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</table>
1 Important and general information

1.1 Important information

Please follow these instructions before and during the use and application on any IPETRONIK product!

1.1.1 Safety and Warning instructions

Please follow the instructions and information as contained in the user manual!

1. The user can influence an electronic system by applying the IPETRONIK product. This might cause risk of personal injury or property damages.

2. The use and application of the IPETRONIK product is permitted only to qualified professional staff, as well as, only in appropriate manner and in the designated use.

3. Before using an IPETRONIK measurement system in the vehicle it has to be verified that no function of the vehicle, which is relevant for secure operation, might be influenced:
   - by the installation of the IPETRONIK measurement system in the vehicle,
   - by an potential malfunction of the IPETRONIK system during the test drive.

In order to avoid possible danger or personal injury and property damages, appropriate actions are to be taken; such actions have to bring the entire system into a secured condition (e.g. by using a system for emergency stop, an emergency operation, monitoring of critical values).

Please check the following points to avoid errors:

- Adaption of sensors to components of the electrical system / electronics, brake system, engine and transmission control, chassis, body.

- Tap of one or several bus systems (CAN, LIN, ETHERNET) including the required electrical connection(s) for data acquisition.

- Communication with the vehicle’s control units (ECUs), especially with such of the brake system and/or of the engine and transmission control (power train control system).

- Installation of components for remote data transmission (mobiles, GSM/GPRS modems, WiFi and Bluetooth components).

The products can be operated in extended temperature ranges greater 70 °C and therefore the operator has to take safety measures to avoid any skin burnings on hot surfaces while touching the products.

4. Before directly or indirectly using the data acquired by an IPETRONIK measurement system to calibrate control units, please review the data regarding to plausibility.

5. With regard to the application of IPETRONIK products in vehicles during use on public roads the manufacturer and/or registered user of the vehicle has to ensure that all changes/modifications have no influence concerning the license of the vehicle or its license of operation.

6. User does agree to the instructions and regulations as mentioned above. In case the user does not agree with the instructions and regulations as mentioned above, he has to notify this expressly and immediately in writing to IPETRONIK before confirming the sales contract.
1.2 Terms and conditions

See IPETRONIK website for details: www.ipetronik.com

1.2.1 Legend of used icons

- **Tip**
  This icon indicates a useful tip that facilitates the application of the software.

- **Information**
  This icon indicates additional information for a better understanding.

- **Attention!**
  This icon indicates important information to avoid potential error messages.

1.2.2 Support

Headquarter:

IPETRONIK GmbH & Co. KG
Im Rollfeld 28
76532 Baden-Baden, Germany
Phone +49 7221 9922 0
Fax +49 7221 9922 100
info@ipetronik.com
Website: www.ipetronik.com

Limited commercial partnership with its head office in Baden-Baden, registry court HRA No. 201313
IPETRONIK Verwaltungs-GmbH Baden-Baden is an individually liable society, registry court Mannheim HRB No. 202089
CEOs: A. Wocke, C. Buchholz

**Technical support and product information** e-mail: support@ipetronik.com
2 Introduction to IPEmotion

2.1 YouTube resources

If you like to discover more functions refer to the IPEmotion YouTube channel which has a growing number of video tutorials about the software and many different PlugIns.
IPEmotion YouTube channel: http://www.youtube.com/user/IPEmotion/videos

2.2 The next-generation data acquisition software

IPEmotion software follows a unique approach. Most DAQ software programs are designed to support one vendor-specific data acquisition hardware only. However, IPEmotion was designed in a way that it is an hardware-independent software the use of which is not restricted to one specific data acquisition hardware. In fact, the software is based on open interfaces so that any hardware vendor can interface his hardware to this software. IPETRONIK data acquisition modules and data loggers are integrated to IPEmotion by the same PlugIn interface standard as any other hardware system.

With IPEmotion, you can cover the complete data acquisition process from configuring your data sources / instruments, to show live data on different instruments and mimics, to automate your test bench applications and finally to analyze your stored data and generate a report output.
2.3 The key features of IPEmotion

2.3.1 YouTube resources

What is IPEmotion? http://youtu.be/U0WE5TP-d_E

2.3.2 Vendor independent PlugIn concept

Anybody can interface his hardware to IPEmotion by developing a PlugIn. Documentation, development tools and support are provided by IPETRONIK. Many hardware systems are already supported and the list of supported hardware is growing continuously. The PlugIns are usually developed by the hardware vendors. Currently, there are over 30 PlugIns listed on the IPEmotion website. If the hardware you like to use is not listed on the IPETRONIK website please get in touch with the IPEmotion support team (support@ipetronik.com) to send your enquiry and we will check the availability.

- A PlugIn is an interface between any data acquisition hardware and IPEmotion.
- The PlugIn interface provides two functions. One function is dedicated to device configuration and the other function is dedicated to read measurement data from devices.
- A PlugIn can also be an interface to the manufacturer API (Application Programming Interface) to integrate the devices.
- With the PlugIn designer development tool, the graphical interface is developed to configure the hardware in IPEmotion.
- The PlugIn Designer exports a VisualStudio project with a C#-Framework for configuration and a C++-framework for measurement.

![Diagram of IPEmotion features](image)
2.3.3 Configuration – based GUI

The graphical user interface of IPEmotion is designed in a unique way so that the main task of any test and measurement engineer - which is to measure data- can be accomplished easily. The entire user interface is based on configuration dialogs. There is no need for programming to bring data on the computer screen.

2.3.4 COM interface – open programming interface

However, IPEmotion can also be regarded as development system for all customers who like to solve complex DAQ and test bench applications. The COM and VBS / Python scripting interfaces are a very efficient way to integrate specific functions to the program.

Details about the PlugIn development is available on the IPETRONIK website
https://www.ipetronik.com/

2.3.5 Data API to access IPEmotion IAD data files 32 and 64 bit

An API is available for developers to write import filters for IPEmotion (.IAD) for other programs. This API was originally developed for (.IAD) file import into NI DIAdem software. The data API is posted on IPETRONIK Website in the following link.
https://www.ipetronik.com/

If you require IPEmotion (.IAD) file import for National Instruments software applications see the following link:

2.3.6 OEM and customer-specific setups

Worldwide, IPEmotion is a unique product allowing customers to get their own customer-specific setup. IPEmotion is based on a technology which makes it easy to tailor and customize the software perfectly to client needs. Compared to most off-the-shelf data acquisition software packages, the IPEmotion setup package can be perfectly tailored to corporate standards to increase productivity in test and measurement labs.
3 IPEmotion Quick Start Guide

As an introduction to this manual a high level overview of the main functions is provided.

3.1 YouTube resources
IPEmotion DAQ Software - Functional Overview http://youtu.be/fXpAjCM4aRw

3.2 Installing IPEmotion and PlugIns
The latest version of the IPEmotion software is hosted on www.IPETRONIK.com. After downloading the setup you can run the installation. The software and PlugIns is available as 32 bit and 64 bit setup

- 32-bit: C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3

The x64 bit application is installed parallel to the 32 bit application in its own directory:

- 64-bit C:\Program Files\IPETRONIK\IPEmotion 2019 R3

During the installation process you can chose between different installation options. The main differences are:

3.2.1 Full installation
- All language packages are installed if not deselected.
- PlugIn designer development tool is installed.
- All standard IPETRONIK PlugIns will be installed if not deselected.

3.2.2 Typical installation
- Only the English and local language package related to the computer operating system is installed when supported by IPEmotion.
- PlugIn designer development tool is NOT installed.
- All standard IPETRONIK PlugIns will be installed if not deselected.

3.2.3 User defined installation
- Define your own installation settings.
3.3 Activating PlugIns in the OPTIONS

After installing IPEmotion and the Plugin, start IPEmotion again and activate the Plugin in the Options. You can access the options through the application menu or directly through the ribbon. PlugIns are activated through the check box. Most of the PlugIns include technical documentations explaining the functions supported by the PlugIns. See chapter OPTIONS >PlugIn for more details about the Plugin activation 23.17.
3.4 SIGNALS – Configuring your acquisition system

3.4.1 YouTube resources

Overview of PlugIn configuration videos.

- IPEmotion YOKOGAWA PlugIn – http://youtu.be/YSTu41c1QwU
- IPEmotion DAQmx PlugIn – http://youtu.be/eToyJNv2OZI
- IPEmotion Advantech ADAM PlugIn – http://youtu.be/cQ7Rrti-Wpw
- IPEmotion Serial PlugIn – http://youtu.be/v7XH4CW6d9Q
- IPEmotion Goldammer MultiChoice – http://youtu.be/8tLOCkuqN3g
- IPEmotion Pollin AVR-NET-IO PlugIn – http://youtu.be/-GQH05aw3UU
- IPEmotion ATMEL Processor – http://youtu.be/3EUPfAoKOiu
- IPEmotion SIEMENS PLC PlugIn – http://youtu.be/HZ68JPl0l4A
- IPEmotion SIEMENS SPS PlugIn – http://youtu.be/ytdOCrwB5bE
- IPEmotion Gantner Instruments – http://youtu.be/uj7xduTDswc
- IPEmotion IOtech DAQBook – http://youtu.be/HBjl-f3ByWI
- IPEmotion Velleman K8055 – http://youtu.be/3oU6-5UNBfo
After PlugIn activation, we can move to the SIGNALS work space. This work space is dedicated to the PlugIn configuration. The SIGNALS work space is structured for all PlugIns in three main elements:

- System Tree – list of devices
- Channel List
- Configuration tab sheets / or head up displays for device and channel configuration. The configuration tab sheets are related to the item selected. The available tab sheets can vary a lot from PlugIn to PlugIn. See chapter SIGNALS for more details 12.5.
3.4.2 Hardware detection

The most important button in the SIGNAL work space is the DETECT button. This button runs a scan function and searches all activated Plugins for the devices connected to the computer. This DETECT button with the automatic hardware detection is not supported in all Plugins.

Several Plugins can be activated in the OPTIONS at the same time and you can switch between Plugins by selecting different systems from the drop down list.
3.4.3 Hardware configuration (manually)

When the automatic HW detection is not supported by the PlugIn a manual interface configuration is required. Every device has its own interface settings and parameters. This can be a COM port, an IP address or Serial Number. Details on how to setup communication to the device are included in the vendor PlugIn manual. Some examples for different interface settings are listed below.
3.4 SIGNALS – Configuring your acquisition system

3.4.4 Testing data communication

After setting up the hardware system, the communication can directly be tested by running the display function.

3.4.5 Channel configuration and scaling

Now we need to look into the channel scaling options. This is an important configuration to read your engineering units in IPEmotion. Each channel has the following 3 standard tab sheets.
3.4 SIGNALS – Configuring your acquisition system

- General > for defining channel name & description
- Scaling > for scaling sensor input (MIN / MAX) to engineering units
- Display > decimal places on the display instruments and axis on charts

The default channel grid consists of columns for:

- Active check box
- Units (engineering units: V mA, A, bar, PSI, Ohm, etc.)
- Physical MIN / MAX (engineering units)
- Sensor MIN / MAX (electrical signal to the input)
- Sample rate (measurements per second in Hz)

With the column chooser more channel properties can be added to the channel grid.

The scaling calculator offers a large range of functions. Basic scaling operations to convert analog measurement in engineering units can be performed in the scaling tab sheet. Select the sensor mode from the list box and define the sensor range to the expected electrical signal. In the physical range you can define the engineering unit (bar, rpm, PSI, mm, etc.).

In this example, the ADAM PlugIn supports the analog inputs of the 4017 module VOLT and CURRENT measurement in different predefined ranges. IPEmotion offers a sophisticated scaling interface for each PlugIn. The different scaling options will be explained in the SIGNALS chapter 12.8.
3.5 ACQUISITION – Setting up data storage

Data storage is very important and therefore IPEmotion is very easy to use in this aspect. You just need to add the available channel (left side) to the right window to include them in the storage group.

- **Format:** When you hit the store button data storage is enabled and IPEmotion stores data in the selected file format. An overview of the formats you find in OPTIONS 3.7

- **Prefix:** The prefix is a static name which is put in front of the data file name. After the prefix, an index increments from 0 to n to differentiate the storage files. The number increments by one for each file generated.

- **Marker & marker name** operated with a hotkey: For adding text information to the data file, you can define a marker channel. The marker can then be operated using a keyboard combination (hotkey) defined in the OPTIONS. When you hit the defined hotkey, a pop up window appears and the comment can be added during recording process.
3.5 ACQUISITION – Setting up data storage

3.5.1 Defining storage trigger conditions

Three different storage modes are supported:

- **One file per acquisition:** In the default storage mode, data is recorded when the store button is activated.

- **Cyclical storage:** In this mode, a new data file is automatically generated after a period of time has elapsed. The cycle can be defined in seconds [s], minutes [m] or hours [h].

- **Triggered data storage:** However, in many cases data storage should be started based on trigger events. Triggered data storage with static pre-trigger, post trigger time and the start & stop trigger conditions can be defined through the formula parser which will be explained in chapter ACQUISITION in more detail.
3.6 VIEW – Displaying live data in instruments

There is a large list of instruments available to build your graphical user interface to show live data in different analog and digital instruments. You can also add action buttons and operate switches to trigger functions or to set output channels. You can modify the mimics during display and data storage which is a very comfortable function. There is no need to stop the acquisition process if you like to modify the screen design. The configuration options of each instrument will be explained in detail, later on.

After activating data storage you will see the storage file in the bottom line. You can access this storage file during recording and get access to the already recorded data to perform data analysis functions. This topic will be discussed in the next chapter.
3.7 DATA MANAGER

If you access the raw data file during recording process the software will take you directly to the data manager providing a tabulated overview of the recorded data.

The DATA MANAGER offers many exports and import formats as indicated in the table below.
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</table>

Data export & online display e.g. in Yt graph restricted to the channel count of the Edition:
Basic = 10 / Lite = 64 / Standard = 256 / Professional, Developer, Analysis = no limit
3.8 ANALYSIS – Analyzing recorded data

3.8.1 YouTube resources
IPEmotion - Data Analysis-Processing - Reporting: http://youtu.be/0ELZLvmrxO4
IPEmotion - Althen Graphtec Data Analysis: http://youtu.be/kDKKfy23d5o

If you like to perform data analysis functions you need to navigate the ribbon to the tab sheet ANALYSIS. In the analysis work area you can display recorded data in different instruments like Yt, YX, Maps and Video displays. The main features are applying zoom, stretching and moving functions to the charts. With cursor lines you can add a table with measurement statistics. The mimics you define in the analysis section are converted to a report as you will see in the next chapter.
3.9 REPORTING – Generating a report file

In the REPORTING work space you can launch a layout designer to customize your standard report layout in regard to the header and footer sections. You can add text, tables, pictures and graphical elements directly to report without starting the layout designer. These changes are not saved to the standard template. When you restart the application the manual entries are removed. However, if you add graphical elements using the layout designer and if you save these changes to your default template they will be available any time you open up the report again.

The results of the report can be converted directly to a PDF file, as well. Find more details concerning the Layout Designer in chapter: 21.
3.10 INFO – New feature overview, link to online resources

Starting IPEmotion the first time you will directly be guided to the INFO tab sheet. Here you will see a comprehensive summary of new functions and you will find a couple of web links which take you through additional online resources.

Functions in the ribbon:

► About: Access to IPEmotion license dialog.
► License: Access to myIPE website to see all your IPEmotion licenses (login is required).
► Support: Access to myIPE website to see all your support cases (login is required).
The available links and resources are the following:

- **Documentation**  
  Link to this software manual.
- **Keyboard control**  
  List of all hotkey functions to operate IPEmotion using the keyboard.
- **Hardware**  
  This link takes you to the IPEmotion website and a list of all Plugins.
- **License keys**  
  This link takes you to the IPETRONIK website to access your license keys.
- **Support**  
  This link takes you to the IPETRONIK website to access the support forum.
- **Release Notes**  
  List of all changes and program enhancements for each release.
- **New features**  
  Detailed overview of all new functions includes in this release version.
- **Catalog**  
  Link to the web version of the online product catalog.

### 3.10.1 YouTube videos – Overview of new Features

- **Release 2013.01.x**  
- **Release 2013.02.x**  
  [http://youtu.be/S9cywf8yoT8](http://youtu.be/S9cywf8yoT8)
- **Release 2014 R1.x**  
- **Release 2014 R2.x**  
  [http://youtu.be/qCcTjzdAZzQ](http://youtu.be/qCcTjzdAZzQ)
- **Release 2014 R3.x**  
- **Release 2015 R1.x**  
  [http://youtu.be/r7qP6-F5tQ](http://youtu.be/r7qP6-F5tQ)
- **Release 2015 R2.x**  
- **Release 2015 R3.x**  
  [https://youtu.be/0RohIWQzQiY](https://youtu.be/0RohIWQzQiY)
- **Release 2016 R1.x**  
  [https://youtu.be/dn6KgL5N2qY](https://youtu.be/dn6KgL5N2qY)
- **Release 2016 R2.x**  
  [https://youtu.be/5dWuShbVhSI](https://youtu.be/5dWuShbVhSI)
- **Release 2016 R3.x**  
  no video available
- **Release 2017 R1.x**  
  [https://youtu.be/XitWhXakzQA](https://youtu.be/XitWhXakzQA)
- **Release 2017 R2.x**  
  no video available
- **Release 2017 R3.x**  
  no video available
- **Release 2018 R1.x**  
  [https://youtu.be/WCPM2Rvl7vs](https://youtu.be/WCPM2Rvl7vs)

### 3.11 Conclusion

In this chapter we have covered the complete DAQ process supported by this software. You got an overview of how the program is structured to accomplish your data acquisition tasks quickly. In the next chapters we will have a look at many detailed aspects of the product.
4  IPEmotion RT data logger Quick Start Guide

4.1 Power supply and PC interface

The Quick Start Guide (QSG) covers the basic functions that are required to put your IPEmotion RT logger in operation. The QSG is based on M-LOG V3 and IPElog2 regarding the hardware structure. The logger requires a power supply in the range of 9 to 36 VDC. An Ethernet connection to the PC is also required to configure the logger with IPEmotion RT.UI, as described in section 4.3.

Example M-LOG V3

Example IPElog 2
The logger default IP-address of the PC Gigabit ETH interface is: 192.168.236.1. The logger is operating as a DHCP server. The LAN card setting of the PC should be set to automatic so that logger can assign an IP-address to the PC.

\[\text{Attention!} \quad \text{Because of the DHCP server function, the logger should not be connected to any company network directly. This will cause network errors and IP-address conflicts.}\]

With any browser, you can access the logger status website via 192.168.236.1/state
Access to the status website via browser: 192.168.236.1/state/
4.2 M- and X-Module connection

There are several ways to connect M-Modules and X-Modules to your M-LOG V3.

4.2.1 M-CAN modules

The most common and standard interface is to use one of the two M-CAN connectors next to the power supply input. This M-CAN connector offers an output of up to 50 Watt. The last module of a CAN bus system must have a TERM connector to terminate the bus with a 120 Ohm resistor. If you use the M-CAN connector, CAN 1 is no longer available for other CAN bus measurements. CAN 1 is the only input that supports automatic hardware synchronization, which is explained in the software chapter later.

Example M-LOG V3

![M-LOG V3 diagram]

Example IPElog 2

![IPElog 2 diagram]
4.2 M- and X-Module connection

4.2.2 X-LINK modules

The ETH input (ETH 1) is dedicated to interface and detection of X-Modules. The IP-address of this ETH 1 interface is 192.168.232.1. The X-LINK connector to IPELog2 and M-LOG V3 is supporting 1.3 A power output at 12 Volt. This corresponds to about 15 Watts. It is a limited power supply, to cover only a few modules. Therefore, a special Y-cable was developed for M-LOG V3, which provides power from the M-CAN interface. It is not mandatory to terminate the X-LINK network with a termination plug. However, to protect the input socket from dust and water, it is recommended to add a termination plug.

Example M-LOG V3

Example IPElog 2
4.3 IPEmotion RT.UI software

4.3.1 Logger detection

To configure the data logger, you need to install the IPEmotion RT.UI desktop software. The software is available for download from the IPETRONIK website: https://www.ipetronik.com/ The Ethernet and LAN cable connection between the logger and the computer must be established. In addition, the logger requires a power supply of 9 to 36 V DC to function properly. The green and yellow LEDs next to the power socket must be lit. The LED codes are explained in section 42.1.

TESTdrive customers must also use the new IPEmotion RT.UI desktop icon to configure their RT loggers.

When you have started the software you need to select the SIGNALS workspace in the ribbon. In the SIGNALS workspace the measurement configuration is created.
When you run the Detect and Synchronize function, the software searches for the logger and synchronizes all connected hardware modules on the CAN and ETH interfaces. This is very convenient when you start your logger configuration from scratch.
The detect function also retrieves the serial number of the logger. If you switch to the License dialogue, you get an overview of the licenses and functions activated on the logger and on the PC.
4.3.2 Hardware synchronization

If you have connected M-CAN or X-LINK modules or an USB camera, after you initial hardware detection as described at the beginning of the Quick Start Guide, you must perform the hardware synchronization function. The system will now search for all modules and systems connected to the logger, provided that the components support hardware detection. Hardware detection is e.g. not possible for IP cameras. The synchronization process also detects when modules that were previously connected to the logger are missing, or when new modules have been physically added.
After the hardware synchronization you will see all detected modules.
If you press the play button you can also see online measurements to check the values for plausibility.
4.3.3 Data storage and retrieval

At this configuration stage, the logger is not storing any data. In order to get the storage enabled, you must change the ACQUISITION workspace. Here you must create at least one storage group. The basic licensing package is supporting the configuration of one storage group. Use Drag & Drop to add channels to the storage group. The logger will start with the data storage immediately when the yellow LED above the power connector is active. There is no need for the user to interact with the logger to get the “automatic default” storage process up and running. When you define a triggered data storage the logger will only store data when the trigger condition is true.

After configuring the storage group you need to initialize the logger with the modified configuration. Any online data display in IPEmotion RT.UI software has no impact on the storage process of the logger. Data storage is happening on the logger side. No data files are created on the PC software.
To retrieve data files from the logger, switch back to the SIGNALS workspace and choose the Import or Move Data File function. The function is only enabled if you select the logger in the tree. The Open File dialogue guides you to the standard storage directory.

The default directory is called StorageData.
Finally, you can import the data files into the ANALYSIS workspace and, for example, move the channels into YT charts using drag & drop.
5  Software Editions

5.1  Overview table

IPEmotion is available in different editions. Every edition supports a specific set of functions and you can pick the best edition in terms of cost and functions for your application.

<table>
<thead>
<tr>
<th>Features</th>
<th>Dem/Student</th>
<th>Basic</th>
<th>Lite</th>
<th>Standard</th>
<th>Professional</th>
<th>Developer</th>
<th>Analysis offLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>free</td>
<td>free</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supported Plugins</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of channels for live data</td>
<td>250</td>
<td>64</td>
<td>256</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Number of storage groups (online)</td>
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<td>1</td>
<td>2</td>
<td></td>
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<tr>
<td>Number of display pages for online data</td>
<td>20</td>
<td>5</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of display pages for offline analysis</td>
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<td>5</td>
<td>5</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Number of channels for offline analysis</td>
<td>10</td>
<td>64</td>
<td>256</td>
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<td></td>
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<tr>
<td>Additional online tools</td>
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<tr>
<td>traffic Analyzer, traffic simulator, map</td>
<td></td>
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<tr>
<td>Additional offline tools</td>
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</tr>
<tr>
<td>traffic Analyzer, 3D Model, map</td>
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</tr>
<tr>
<td>Macro recorder - VES &amp; IronPython scripting</td>
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<td>COM interface - external access</td>
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<tr>
<td>Create runtime editions</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Measurement data management (MCM)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional module: control - test sequencing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional module: climate - thermodynamics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional module: acoustic - noise &amp; vibration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.1.1 Demo Edition

This is a 30 days trial edition supporting all features of the Professional edition including the Control module. Anybody can request a Demo Edition license key from the IPETRONIK website. You just need to register an account on the IPETRONIK website and then you can generate your own Demo license key. There is no limitation about the number of Demo keys you can request. However you can activate only one time a Demo key on one computer.
5.1 Overview table

5.1.2 Student Edition
This edition is provided to all enrolled students for free. It covers the functions of the Professional Edition including the Control module and Acoustic Module. This license is valid for 12 months. After that, the Student Edition expires and turns into a Basic Edition. On demand you can also request a Student license supporting the Climate module.

5.1.3 Basic Edition
Free of charge edition to configure all IPETRONIK systems and data loggers. The import of description files like CANdb or A2L is supported. Data can be displayed from several PlugIns at the same time. It is not possible to store data in this edition. The COM programming interfaces for external applications access is blocked. The online data display in instruments is limited to 250 channels on 20 pages which is corresponding to the display capacity of the IPEmotion App. With the Basic Edition the App can be completely configured. The offline data analysis is restricted to 10 channels and 1 display screen.

5.1.4 Lite Edition
The Lite Edition allows data display of 64 channels on up to 5 pages and data storage in 1 storing group. Only one PlugIn of your choice can be activated. The import function for description files like CANdb or A2L is supported. Data export into other formats is limited to the number of channels (64).

5.1.5 Standard Edition
The Standard Edition provides online data display of 256 channels on up to 20 pages and data storage in up to 2 storing groups. Data from several PlugIns can be recorded at the same time. Data export into other formats is limited to the number of channels (256). The offline data analysis pages are restricted to 5 pages.

5.1.6 Professional Edition
No limit on the number of channels, data display pages and storing groups. Data from all PlugIns can be recorded at the same time. Also, the A2L and CANdb (.DBC) files can be imported for measurements on the CAN bus. This edition also includes a module to record and run VBS or Python scripts. The Map, Traffic Analyzer Instrument, Traffic Generator and 3D Instrument are supported in this Edition as well. The Measurement Data Module (MDM) is supporting functions to search in any type of meta data tags in large data file archives. For more details about these instruments see chapters: Map 18.27, Traffic Analyzer 18.25, Message Generator 18.26 and 3D-View 20.18.

5.1.7 Analysis Edition
Suitable for offline data analysis, post processing, import, export in all data file formats and to generate reports. This edition supports the scripting tab sheet for macro recording and COM programming interface to automate the report generation. The Measurement Data Module (MDM) is supporting functions to search in any type of meta data tags in large data file archives. On the instrument tool box the log-ph instrument is only available on request because the REFPROP fluid data base has to be installed and purchased additionally. To perform acoustic analysis function the NVH module needs to be purchased additionally.

5.1.8 Developer Edition
No limit on the number of channels, data display pages and storing groups. Data from all PlugIns can be recorded at the same time. Also, the A2L and CANdb (.DBC) files can be imported for measurements on the CAN bus. This edition also includes a module to record and run VBS or Python scripts and to create an unlimited amount of RUNTIME applications. The Map, Traffic Analyzer, Traffic Generator and 3D Instrument are supported in this edition including the Runtime Editions as well. The Measurement Data Module (MDM) is supporting functions to search in any type of meta data tags in large data file archives. For more details see chapters: Map 18.27, Traffic Analyzer 18.25, Message Generator 18.26 and 3D-View 20.18.

5.1.9 Runtime Edition
The Runtime Edition is a locked application. The Runtime project [IRD] file is created by the Developer Edition only in the Application menu. For more details how to generate a Runtime project see chapter 7.4.
5.2 Software Options

5.2.1 Control Module

The Control module comes with PID controllers, router channels, function generators and test sequencing for test bench automation drive profile applications. This function can be purchased as an option. The functions of the Control module are discussed in chapter 15.

5.2.2 Climate Module

The climate module supports online and offline enthalpy and entropy calculations and can display the data in the log p-h graph. This module only works in combination with the REFPROP data base of the different refrigerants like: R134a, R1234yf, R22, R404a, R410a, R507a, R744, R718, R729, R1234ze, R290, R600a, R717. The directory to the REFPROP data base can be configures in the OPTIONS 23.12. The Climate module can be purchased as an option. The functions of the Climate module are discussed in a separate chapter ACQUISITION 14 in regard to the special formulas and in VIEW in regard to the configuration of the Log p-h diagram 18.23.

Please ensure that you use the latest REFPROP DLL for your climate formulas. In order to determine which REFPROP DLL version you are using right now, enter the file properties of the installer .EXE as indicated in the example below.

- The latest DLL version is: 9.1
5.2.3 Acoustic Module

The acoustic analysis module was developed to support acoustic and vibration data analysis using FFT and Campbell diagrams. The data presentation in the Campbell diagram can be scaled logarithmic or in linear, A and C weighting. Data export for the PAK software in the ATFX format is supported too. This option can be purchased as an add-on for Professional, Developer and Analysis Editions. The Campbell operation is discussed in chapter 19.25 and the instrument is explained in chapter 20.19. The details about the PAK ASAM ATF/XML export are explained in chapter 19.8.3.

5.3 Software upgrades and maintenance

- **Upgrade**

You can upgrade your IPEmotion edition any time. The cost impact is the price difference between the list price of your current edition and the edition you choose.

- **Maintenance**

If you sign a maintenance contract you get free updates at any time you like and you can also benefit from the high priority support service. The maintenance cost are 25% of the software purchasing price. If you like to update an older version to the most reason one you pay for every major release 25% of the list price. Example: If you have IPEmotion major release 2016 Rx and you like to update to IPEmotion 2018 Rx you jump 2 major releases and the update cost is $2 \times 25\% = 50\%$ of the list price.
6 Software Licensing

6.1 Overview

The software only needs ONE license key which includes all features.
License key example: WUW02-RP00A-LE03Z-00000-007A6-00008-00000-00000-00000-00000

The license key includes the following properties:

► Options: Control Module, Climate Modul, Acoustic Modul (are available for Professional and Developer Edition)
► Type of license management: PC, Dongle-Single/Multi, Server Borrow/Floating

Overview of the different software licensing options:
### 6.2 PC license (Single Seat)

<table>
<thead>
<tr>
<th>License Type:</th>
<th>PC-License</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>The license is created on <a href="http://myipe.ipetronik.com/">http://myipe.ipetronik.com/</a>. Customers can create an account on the website and acquire the license key to their account. This license can be activated online with one click in IPEmotion if the PC has an internet connection. A manual activation for standalone PCs is also possible. The license is linked to this specific computer and cannot be transferred to another computer. PC hardware properties are included into the license key.</td>
</tr>
<tr>
<td><strong>Recommended Applications:</strong></td>
<td>This type of license management is useful if:</td>
</tr>
<tr>
<td></td>
<td>- The software is always used on the same computer.</td>
</tr>
<tr>
<td></td>
<td>- The application is static on one computer e.g. on a test bench.</td>
</tr>
<tr>
<td></td>
<td>- Using lab computer for a specific application.</td>
</tr>
<tr>
<td><strong>Pro:</strong></td>
<td>Activation is necessary. Quite easy to activate the SW through the online activation process.</td>
</tr>
<tr>
<td><strong>Con:</strong></td>
<td>License is fixed to one computer. Cannot be moved to other computers.</td>
</tr>
</tbody>
</table>

![PC-License Image](image-url)
### 6.3 Dongle - Single License (Single Seat)

<table>
<thead>
<tr>
<th>License Type:</th>
<th>Dongle-Single License</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>The license is provided by a dongle. One license key is saved on the dongle. Anyone who has the dongle can use the software. The dongle must be connected to the computer with an IPEmotion installation and the software starts with the corresponding IPEmotion edition and options. The license key is invisible for the user. *<strong><strong><strong>-<strong><strong><strong><strong>-</strong></strong></strong></strong>-</strong></strong></strong></td>
</tr>
<tr>
<td>Recommended Applications:</td>
<td>This type of license management is useful if:</td>
</tr>
<tr>
<td>-</td>
<td>- The software is used by different users on different computers.</td>
</tr>
<tr>
<td>Pro:</td>
<td>There is no interaction with the IPETRONIK website or account creation involved. The transfer to different computers is easy – just move the dongle.</td>
</tr>
<tr>
<td>Con:</td>
<td>The dongle is small and can get lost. One USB port is blocked as the dongle must be connected to the computer when the software is in use. Only one product (IPEmotion Edition) can be stored on the dongle. It is difficult to transfer the dongle to people who are not working on the same site.</td>
</tr>
</tbody>
</table>

Dongle-Single License
One license on the Dongle

Dongle must be connected to PC
## 6.4 Dongle - Multi License (Multi Seats)

<table>
<thead>
<tr>
<th>License Type: Dongle-Multi License (Multi Seats)</th>
</tr>
</thead>
</table>
| **Description:** The license keys are provided by a dongle. On the dongle, 1 to n license keys are saved. Anyone who has the dongle can download a license and use the software.  
The dongle has to be connected to the computer only the first time to download the license to the computer.  
A counter is then decrementing the number of licenses stored on the Dongle.  
Users can see how many licenses are still available on the dongle.  
The software every time starts with the corresponding IPEmotion edition and modules included in the license key.  
The license key is invisible for the user.  
| **Recommended Applications:** This type of license management is useful if:  
- Several licenses/users are working with IPEmotion in one department.  
- The license remains most of the time by the users (static).  
| **Pro:** There is no interaction with the IPETRONIK website and no account needs to be created.  
The transfer to different computers is easy, provided you know where the dongle is and where the licenses are installed.  
| **Con:** Dongle can get lost.  
If the PC is lost the license is lost, too.  
It can be difficult to keep track on which computers the licenses are installed.  
Only one product (one type of IPEmotion edition) can be stored on one stick.  
License dongles are usually only handled within one department at the same site/location. |
6.5 Server - Borrow License

<table>
<thead>
<tr>
<th>License Type</th>
<th>Server Borrow License</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>To manage many licenses and to overcome the problems associated with dongles and PC licenses it is recommend to use the license server. IPEmotion can be licensed by using the FlexNet Server of FLEXERA <a href="http://www.flexerasoftware.com/products/flexnet-manager.htm">http://www.flexerasoftware.com/products/flexnet-manager.htm</a> The FlexNet server can host many different IPEmotion editions at the same time and the users can take the licenses they need. You can borrow the license for a certain time period. After this time period the license expires on the computer and is again available on the server.</td>
</tr>
<tr>
<td>Recommended Applications:</td>
<td>This type of license management is useful if: - Different software editions are used in the company - Large number of users need to be managed - Useful for all users which need different editions for different tasks - Users can work in different geographic locations and get licenses from the server.</td>
</tr>
<tr>
<td>Pro:</td>
<td>The license can never get lost. The administration and updating of licenses is done centrally. The license also works if the computer is not connected to the company network.</td>
</tr>
<tr>
<td>Con:</td>
<td>Initial costs and work load to configure FlexNet server. Users need to keep an eye on the expiration date. For server licensing a maintenance contract is required.</td>
</tr>
</tbody>
</table>
### 6.6 Server - Floating Licensing

<table>
<thead>
<tr>
<th>License Type:</th>
<th>Server - Floating License</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>To manage many licenses and to overcome the problems associated with dongles and PC licenses it is recommend to use the license server. IPEmotion can be licensed by using the FlexNet Server of FLEXERA. <a href="http://www.flexerasoftware.de/products/flexnet-manager.asp">http://www.flexerasoftware.de/products/flexnet-manager.asp</a> The FlexNet server can host many different IPEmotion editions at the same time and the users can take the licenses they need. Users are only blocking the license when the IPEmotion software is running. This is ideal to increase software utilization and to save license costs. The floating licensing requires that the computer is connected to the company network while you are working with IPEmotion. The PC communicates with the server in regular intervals (every few minutes) confirming that the license is still in use.</td>
</tr>
</tbody>
</table>
| Recommended Applications: | This type of license management is useful if:  
- Many different editions are used in the company.  
- Large number of users need to be managed  
- Users can work in different geographic location and get licenses from the server.  
- Useful for all users which need different editions for different tasks.  
- They can just download the required edition for the task they have from the server and the license is returned automatically when the software is shut down. |
| Pro: | The license can never get lost.  
The administration and updating of the licenses is done centrally.  
License utilization and costs are optimized.  
Statistics about IPEmotion utilization rates can be generated.  
Users can easily switch between different editions hosted on the license server depending on the task they have to do. |
| Con: | Initial costs and work load to establish FlexNet server.  
Concurrent licenses require that the computer is connected to the company network.  
For server licensing a maintenance contract is required. |
6.7 License activation

6.7.1 PC license activation

In the first step you need to open the ABOUT dialog. You can access this dialog from the application menu or via the main navigation ribbon.
Enter new activation key: SEL01-1S00Y-Y104Z-00000-00TM8-00004-00000-00000-00000-00000

After online registration the software needs to be restarted. Opening the license dialog again, you will see the updated license information.

All activated licenses are stored in the license pull down list which is described in more detail in chapter 6.11.
6.7 License activation

6.7.2 Dongle - single license activation

The activation of the dongle is only required the very first time you use this dongle. When you remove and connect the dongle later to the PC again IPEmotion is automatically recognizing the dongle and starting with the right software edition of the dongle.

In the first step you connect the dongle to your USB port and start the IPEmotion software.

1. Then you open the license dialog and press the button “Read from Dongle”.
2. The license key is updated in the license key field.
3. After that you need to press the “Assign” button to activate the license.

After you press “Assign” a message box informs you that the new license was activated. The license product information is updated as well.
6.7 License activation

After the activation the software requires a restart.

If you start the software without the dongle connected to the PC IPEmotion returns a message that the Basic edition is started due to a missing dongle.

If you connect the dongle and start the software again you have the edition stored on the dongle. As mentioned in the beginning the activation process is only required the very first time to link the dongle license to the PC. Later on, you only connect the dongle and start the software. All activated licenses are stored in the license pull down list which is described in more detail in chapter 6.11.

6.7.3 Dongle - multi license activation

Rather than having the dongle connected all the time to the PC you can select the multi-license dongle option. The difference of this dongle is that 1 or several license can be stored on the dongle and that you can download a license from the dongle to the PC. After the download the number of licenses is decremented and the dongle can be removed. There is no need to connect the dongle again to start IPEmotion. The license activation process is the same as discussed above in chapter 6.7.2.
6.7 License activation

When you download the license from the dongle the license key is invisible and marked with "**********". In the dialog you can also see how many licenses are available for download. In this example 22 of 30 total.

After assigning the license to the PC the number of licenses is incremented by one and the dongle can be removed.

If you like, you can return your license to the dongle. In this case you connect the dongle to the PC, open the license dialog and press the "Give" button. After this process your own license is downgraded to a Basic edition after the restart and the number of licenses on the dongle is incremented by one.

All activated licenses are stored in the license pull down list which is described in more detail in chapter 6.11.

6.7.4 License updating procedure

All licenses are valid for one major release only. Every year in March a new major release is coming to the market. If you like to update your PC, dongle or server license you need to get a new license key from IPETRONIK.

To update a PC license to the new major release is the same process as discussed in chapter 6.7.1. The updating of dongle licenses requires the following steps.

1. The support team of IPETRONIK requires the dongle serial number
2. Based on the dongle serial number a .LUF license file is generated.
3. The .LUF file is send to you.
4. Then you need connect the dongle to the PC and start the dongle update tool: This tool is stored in
   - Win 7: c:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\The update tool is called: IPETRONIK.IPEmotion.DongleTool.exe
5. When you start the Dongle update tool a file open dialog appears and you can link the LUF file to update the dongle.
Information

If you have a multi license dongle you can update this dongle at any time even if the licenses are not returned from the users. The users can return and download the new license separately after the dongle was updated.

6.8 Server License activation

The server licensing procedure has many advantages to dongle or single PC licensing. The main advantage is that the licenses cannot get lost and that the license utilization can be monitored. On the server different license products can be installed.

As discussed the server can host borrow and floating licenses and many different editions like Lite, Standard, Professional including the different Options like Control or Climate. As the graphic indicates the different license files are stored on the server.

The user (client) requires a server activation key which allows him to retrieve a specific license from the server.

Attention!

In order to retrieve a server license the user needs an activation key which is related to a specific server license edition. The activation keys for every license.lic file is provided by IPETRONIK. The user can borrow one license product only. That means when a new product is requested the previous product is automatically returned to the server. The advantage is that only one licenses product (edition) is stored on the PC and not multiple products.
All license keys (activation keys) entered into IPEmotion are stored in the license dialog. After the first activation you can select from the list box which product you like to activate. You do not need to enter the server license again every time if you want to get a license. You just select it from the list. The license list is clearly indicating which products you can select from.
6.8 Server License activation

6.8.1 Server - Borrow license

The license activation key is entered into the license dialog and a new window comes up to define the server name where to fetch the license from. Using the borrow license you can decide for how many days you can keep the license. The maximum duration is defined in the license file. You cannot borrow for a longer period. The system suggests a date with the maximum borrow time.

After the activation from the server the user gets an updated license dialog indicating the activated edition and the included options.
If you try to borrow a license more than 1 year the software is returning an error message. The maximum borrow duration is set to 1 year.

The server is logging all license movements. The screenshot below shows the OUT and IN movement of a borrow license.

6.8.2 Server - Floating licenses

The floating license is working differently than the borrow license. The floating license needs to be activated only one time and every time you start IPEmotion the software is automatically fetching the license from the server.

1. Enter the floating license activation key into the license dialog
2. Press “Assign”
3. The server dialog is opened. When going through the license process the very first time you must define the server name one time. It will be saved into the system settings.
4. Confirm the server / computer name with OK
5. When the new license is activated the server is also showing that it is checked out.

The FlexNet server is also recording all OUT and IN movements of the Floating licenses.
6.9 Overview how to setup up a FlexNet Server

The Server Licensing option is the best solution for corporate installation to provide users many licenses throughout the company and different IPEmotion editions at the same time. IPEmotion is supporting the FlexNet Server of FLEXERA


In order to use the FlexNet licensing technology a FlexNet server needs to be setup together with your IT department. The FlexNet server consists of 4 very small programs. The licensing process does not require any large processing power of the server. From a technical point the server must be reachable by all users working with IPEmotion. These FlexNet programs are provided by IPETRONIK who covers all related licensing costs. You do not need to buy any licenses to use the FlexNet server.

1. The IT department has to define a server which is suitable for the FlexNet application.

2. Create a folder “Flexnet-Server” on the server and copy all programs provided by IPETRONIK to this folder. The following 4 programs are copied to the FlexNet-Server folder:

3. Then the server computer name and the unique Host-ID have to be identified. The licenses will be generated in reference to the unique computer name and Host-ID. This is preventing users from creating duplicated FlexNet servers and running the same license files on multiple servers. The license files have the extension .lic. In order to identify the Host-ID the **Imhostid.exe** needs to be started over a command line.

![Command Prompt with Imhostid.exe output]

The computer name is identified over the Windows System Manager.
6.9 Overview how to setup up a FlexNet Server

In this example the IT depart should provide IPETRONIK the following information:

Computer name: IT02-0293
Host-ID: 028037ec0200 843a4b7ddc70 3c970e7522b0

4. In the next step IPETRONIK will generate license .LIC files for this specific computer and the corresponding Host-ID. Before the licenses can be created the license properties should be discussed. Each license file is made for one specific server, edition and borrow duration/floating property. As an example you can host several license .lic files on the server like:

Professional (20 Qty) – Floating
Professional (10 Qty) – Borrow for 90 days max
Professional (20 Qty) – Borrow for 365 days max

The following table includes the questions which should be answered by the customer.
6.9 Overview how to setup up a FlexNet Server

<table>
<thead>
<tr>
<th>Item</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which Edition</td>
<td>Lite</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>Professional</td>
</tr>
<tr>
<td></td>
<td>Developer</td>
</tr>
<tr>
<td></td>
<td>Analysis</td>
</tr>
<tr>
<td>Which Options</td>
<td>Climate</td>
</tr>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>How many licenses</td>
<td>Number</td>
</tr>
<tr>
<td>License Type</td>
<td>Floating</td>
</tr>
<tr>
<td></td>
<td>Borrow (*)</td>
</tr>
</tbody>
</table>

(*) When Borrow licenses are used the maximum borrow duration needs to be defined in days.

5. The license .lic files have to be copied into the Flexnet-Server folder.

6. Now the FlexNet server needs to be started with the corresponding license files. The `lmgrd.exe` is started over a command line: `lmgrd -z -c FOTProf2014ControlClimate2.lic;FOT Stand2014float.lic`
6.10 PlugIn Licensing

A new business model has evolved where, for example, PlugIns are developed by 3rd party developers. These PlugIns might not be for free. A license key is required to activate these PlugIns. The key can be obtained by IPETRONIK or by the PlugIn developer. PlugIn license keys can be activated through the same process as used for IPEmotion licenses.

A PlugIn is licensed on the same technology as IPEmotion license and available as PC, Dongle or Server licenses. The activation process is the same as described above. When you have activated a PlugIn license you get additional information about the PlugIn and the features in the license dialog.
6.11 Managing different license keys via the license list box

The license dialog is a list box remembering all unlocked licenses you have entered over time. The keys and the corresponding editions with all options are listed. This interface makes it very easy to switch between different licenses. Users can switch just by selecting other licenses from the list of products and after program restart, the functions of the selected license are activated. In the past, users had to organize the unlock keys of different editions in separate lists and copy them into IPEmotion every time.

You can delete activation keys from the licensing dialog. This is convenient for all customers updating to the new major release and who do not need the old license keys any more.

Information

With the latest activation key you can still operate elderly IPEmotion releases. The license keys are compatible to previous IPEmotion releases.
7 Application Menu

7.1 Touch mode for Tablet PC

You can switch between the default mouse and touch mode. In the touch mode the software can be operated more easily from computer screens supporting touch operation.

In the touch mode the GUI row space is increased.

Information

The touch mode is not fully implemented across all configuration dialogs e.g. instrument head up displays.

7.2 Handling IWF files

The first four items in the application menu deal with the handling of IWF project files. The complete IPEmotion configuration is stored in an IWF file. Later, we will see that IPEmotion configurations can be saved in sub configurations with different file extensions. You can create a new empty project file, open an existing IWF file, save the current configuration or save the configuration under a different name.
The new IPEmotion App for Android operating systems gives users the possibility to see online data on smart phone and tablet PCs. The export of the IPEmotion App configuration (.IAW) is organized in two main system setups. One export is dedicated for measurement setup using IPEhub2. The other export is dedicated for setups using M-LOG together with a COMgate V3 to stream the data to the tablet with IPEmotion App.
IPEhub2 is a 2 channel CAN card with LAN and WLAN interface for CAN bus measurements. The internal storage on a removable SD card add a CAN trace data logger functionality to the unit. The diagram below is indicating a measurement setup of IPEhub2 with data transfer to a tablet running the IPEmotion App based on Android.

IPEhub2 is implemented on the following PlugIns as a CAN interface. The minimum release versions are:

- IPETRONIK CAN Plugin V01.13.00
- Protocols Plugin V01.04.02
- X-Plugin V02.00.00
You need to establish a LAN or WLAN connection of IPEhub2 to IPEmotion PC.

After that you run the automatic hardware detection to recognize the device with modules if any connected. Then you can directly export your measurement configuration from the Application menu or from the Plugin as indicated below.

In the export dialog you have to match the configured CAN interface in the different Plugins like IPETRONIK CAN, Protocols Plugin or CAN Acquisition the corresponding CAN interfaces of IPEhub2.
When you have established a WiFi connection from your tablet to the IPEhub2, the IPEmotion App is automatically importing the app configuration file (.IAW) from the non-volatile memory of IPEhub2. You can then directly start with your measurements on the tablet.
7.3.1 DBC measurement

If you like to perform directly a DBC measurement on CAN1 and/or CAN2 you can import the DBC. Just select DBC from the drop down list and the dialog takes you directly to the import directory of IPEmotion.

![Image of DBC measurement process]

**Information**

The IAW App Export is restricted to maximum of 250 channels. The channels are exported by order and the exceeding channels above 250 are not considered in the configuration.

The app can only support up to 250 measurement channels. Often DBC files include a lot more channels. To de select all undesired channels is a time consuming work. Therefore a CSV filter is implemented. With the CSV filter you can remove easily all channels you do not like to consider for the app measurement.
7.3 IPEmotion Android App for TESTdrive

All channels

New channel selection includes only channels from the CSV filter.
7.3.2 IPEmotion App export settings

- **App version**
  The function of the settings is depending on the selected app version. As the screenshot below is indicating if you select app version smaller than 2.12 the settings for file encryption are not supported.

- **File encryption**
  When you enable the file encryption the check box for password is enabled as well. You can then define a password for the IAW file which will be needed to open the App configuration on your tablet.

- **Password**
  Define password for the App configuration.

- **View configuration**
  When you enable this check box you can transfer instrument and display pages to the App. The IPEmotion VIEW configuration should meet the following criteria:
  - Supported Instruments: Alphanumeric, LED, Bar chart, Yt-chart
  - Instruments per page: 4 max
  - Number of channels per instrument: 4 max
  - Number of pages: 20 max
  - Number of channels in the configuration: 250 max

The screenshot shows all 4 supported instruments with a maximum number of channels assigned by each instrument type. If your VIEW configuration contains other instruments or more channels the exceeding channels and the incompatible instruments are not exported to the App IAW file.
**Information**

To import an encrypted IAW configuration you need App version 2.12 or higher.
7.3.3 IPEconnect mode for M-LOG V3

The IPEmotion App can receive data from the M-LOG and M-LOG V3 data logger in combination with the IPEhub2 in the IPEconnect mode. Therefore you need to create a IPEhub2 device on the USB interface.
7.4 Runtime Versions

When you initialize the logger with the measurement configuration the APP display configuration and channel list is automatically transferred to the logger too. The IPEhub2 is then switch to a blue LED which is indicating the IPEconnect mode. The IPEhub2 created automatically an access point with the SSID and PW of the logger serial number. When the tablet is connected to the logger the app display configuration is automatically imported.

7.4 Runtime Versions

If you have activated a Developer Edition of IPEmotion you can export runtime IRC files. This runtime files are automatically stored in the installation directory of the IPEmotion version you have currently started.

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3
With every program start IPEmotion searches this directory for the Runtime.irc file. If this file is available it will always start the Runtime project.

Runtimes are suitable program solutions for applications which require very limited user interaction like starting and stopping data recording or operating static test bench applications with standardized reporting processes. As soon as the application requires any flexibility to modify the signals configuration or the report output the Runtime application is not suitable. You also cannot switch between different Runtime applications. Only one runtime file with the specific name “Runtime.irc” is automatically loaded at program start. If you like to get back to your original IPEmotion Edition you need to remove or rename the IRC file and start the software again.

The runtime project is an executable with very limited functions. The user of a runtime project can only start and stop data acquisition and storage and load data files in predefined analysis and reporting templates. You can also use analysis tools like zoom, stretch, cursors, etc. . . . However, you cannot change the GUI interface of the VIEW work area nor can you modify any channels and instruments in the SIGNALS and ANALYSIS work space. The layout designer for customizing reports is also deactivated. The following screenshots of different ribbons are indicating the very limited functions of runtime projects.
7.4 Runtime Versions

- Application Menu of a runtime project

![Application Menu of a runtime project]

- Signals

![Signals]

- Acquisition

![Acquisition]

- View

![View]
7.4 Runtime Versions

▶ Analysis

▶ Reporting
7.5 Comparing configurations on SIGNALS level

This function compares IWF project files in regard to the signals configuration. Load one configuration and compare it with another IWF project file. The table will show which elements are included (added) in the other configuration or which elements are missing (deleted). In this example Conf 2 is compared to Conf 1. The comparison table is indicating that Conf 1 includes more PlugIns (e.g. Beckhoff, Goldammer, and Serial) than Conf 2. However, both configurations have the DAQlist (Logger Plugin) and the IPETRONIK CAN Plugin in common. The channel list is different, though.

With the merge function you can combine the signals of both configurations to one common configuration.
7.6 Print

The print function is convenient if you like to export the channel list to another file format for comparing or saving the settings. All visible columns in the grid are exported. This export functionality can be applied to any channel grid in the work spaces of PROJECT, SIGNALS and ACQUISITION and DATA MANAGER. In the DATA MANAGER the print function is limited to 1000 lines. If you load a data file with more than 1000 records you cannot created a PDF file because large data files will overload the PC CPU to create the file. In ANALYSIS and REPORTING you can apply the print functions PDF, HTML and Image file which are the print function of reporting.

Within the Print application you can start the layout designer which is the configuration tool for customizing your reports. The detailed functions of the layout designer are discussed in the chapter REPORTING 21.3.2.

7.7 View – message docking windows

With VIEW you can show or hide up to five tab sheets in in the bottom line of the application. This tab sheets (docking windows) are accessible in all work spaces and can indicate valuable information for you.

► Messages

Indicating all types of error, warning and information messages. This tab sheet is the right place to search for all messages which indicate why things are not working. The time stamp is included, as well, which indicates when the message was generated. All messages are stored in a database which is located in:

► C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\Database\LogMessages.db
All messages are continuously stored in the data base. You can delete single messages or all messages from the message window. Within each column you can also apply filters and only delete the filtered messages.
7.7 View – message docking windows

- **Delete messages**
  Here you can delete a single message or all messages stored in the database.

- **Print**
  Here you can select the printer and printing options like number of copies or to print to a file.

  ![Print dialog box](image)

- **Quick print**
  Printing directly to the default printer without a preview.

- **Preview**
  Provides a print review with the options to select a printer, print to the default printer directly or to export the report to a PDF file.
7.7 View – message docking windows

- **Export to CSV**
  Export the data to a CSV file. You can select in the export dialog the encoding, data format (Text, Value), separator. The storage path is the default directory for exports as defined in the OPTIONS >Directory.

- **Status**
  This tab sheet includes only a fraction of all messages displayed in the message window. These messages are related to configuration inconsistencies. The convenient aspect for you here is: You can double-click on a status message and you will directly jump to the section of the program which generated this message.
7.7 View – message docking windows

► Storing

This window is pointing out if the storage is working and in which status each storage group is operating. The status indication of the storage group depends on the storage group configuration.

► Output

This window provides output messages for developers.

► PC

This window shows PC performance parameters like CPU load, number of threads in use and storage utilization. These parameters reveal if the PC is able to provide enough resources to serve the needs of this IPEmotion application.
7.8 Administration

Under ADMINISTRATION you can reset global configuration settings to factory default.

▶ Reset

With the reset functions, many customizing options are set back to factory default. This affects all columns you have added to any type of grid. Customization of the ribbon will be reset, as well. Customizing functions of the ribbon will be explained in chapter 8. The application restarts after the reset.
7.8 Administration

- **Reset templates**
  In the VIEW and ANALYSIS work area you can define templates for instruments. Once you have defined a template, all instruments will be created in this format. For example, if you like to always have a grey background on your Yt-chart you can save this setting as default. For example see chapter VIEW > Yt-chart properties for more details 18.7.

![Reset templates](image)

- **Reset object pool**
  The object pool refers to all items saved to a common repository. Formulas for online and offline calculations and configurations of limit channels can be saved to a pool. You can draw from this pool to build your applications more effectively. Especially when you have complex math operations it is comfortable to save the syntax in a pool. The formulas are saved in the following directory. For more details about the formula pool see chapter 14.2.2.

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\UserSettings\ObjectPool.xml
Reset persistent data

The last value of the formula is stored in a configuration file. However, if you like to reset the persistency value you have to use the reset function in the APPLICATION MENU. The reset function is applied to recursive formulas using the persistency function. For more details about recursive calculations with persistency see 18.28.
Export working environment

This function exports the settings made under OPTIONS. Every user has his own OPTIONS configuration and this has an impact on project files (IWF). In order to ensure that a project file works on another computer just like it did on the original PC, it is recommended to export the settings of the OPTIONS to an .IEF file.

In this example, a BLUE_SKIN configuration is exported to an .IEF file.
7.8 Administration

- Import working environment
  When the .IEF file (BLUE_SKIN) is imported, the settings of the current options (e.g. V2_Skin) of this computer are overwritten. The software requires a restart after import.

- Support file
  The support file is very important for analyzing problems that may occur with your IPEmotion application. When you generate a new support ZIP file you can decide which files are included. The PC system information, PC event log information and data files from the analysis / data manager work space can be excluded. If you reproduce an error message you can directly integrate this screenshot during the support file generation.
7.9 Options

In the OPTIONS, you can configure many important settings which have an impact on your IPEmotion application. For details see chapter 23.

7.10 About

This dialog shows you which version and edition you are currently using. In the ABOUT dialog you can activate new license keys, as well. The license activation for PC, servers or dongles is explained in the chapter Licensing 6.
7.11 Close

CLOSE will exit the application.
8 Customizing your own ribbon

8.1 Customizing icons

To customize the ribbon you can launch a new configuration interface in the ribbon context menu. The main concept is to link commands into any work area where they are most convenient for you. The easiest function is to deactivate tab sheets, rename them or change the order. The 3 main elements for customization will be explained later on.

- **Group:** container to add functions / commands to an existing tab sheet
- **Tab Sheet:** new work area which appears in the ribbon of the main navigation
- **Category:** container to organize tab sheets individually

**Information**

When you change the language of IPEmotion all ribbon customizations are reset back to factory default.
8.1 Customizing icons

8.1.1 Creating a new group

When you create a new group you can link any command into it. Just drag and drop the command. In this example, the Start & Stop data recording command was linked into a new group of the Signals tab sheet. Using drag and drop, you can change the order of groups in the ribbon.
8.1.2 Creating a new tab sheet

New tab sheets can be added to the overall navigation. You can add tab sheets between existing ones or at the end. Every tab sheet also creates a group automatically so that you can directly link the command into the group. In this example, one new tab sheet for USER BUTTONS was created.
8.1.3 Creating a new category

A category is a separate container to organize tab sheets and groups. Categories have their own place in the center part of the ribbon.

8.1.4 Ribbon customizing with user buttons

If you customize a ribbon and integrate a user button, it is very important to manage the UserButtons.xml version number. With the release 2014 R1, a version number was introduced. If you increment the version number and restart IPEmotion the changes on the user button will automatically be integrated to the customized ribbon. In previous versions it was required to reset the customized ribbon in order to update the new user button functions. In this case all customized ribbon settings were lost.
8.2 Integrating your own user buttons to your ribbon

User buttons are a very powerful tool to optimize the efficiency of your application. GUI is improved and very individual functions can be integrated into IPEmotion. You can arrange the buttons on one group and have a drop down list as indicated in the screenshot below.

Another option is to have several user buttons allocated horizontally and to put a list of several sub functions behind each button. The maximal number of buttons in the ribbon is shown in the table below.

The user buttons are configured in an XML file called UserButtons.xml. This file has to be stored in the SCRIPTING directory.

► Win 7 C:\Users\Public\Documents\IPETRONIK\IPEmotion\Scripting
If you design your own user button you should not use the UserButtonsDemo.xml file. This file is exclusively used by IPEmotion for demo applications and it will be overwritten during installation of a new IPEmotion version.

The name space in the UserButtons.xml is slightly different to the work space in IPEmotion. The maximum number of buttons is limited by work space. In vertical direction you can add as many functions as you like.

<table>
<thead>
<tr>
<th>IPEmotion Workspace</th>
<th>UserButtons.xml</th>
<th>Max. number of Buttons in the Ribbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Project</td>
<td>5</td>
</tr>
<tr>
<td>Signals</td>
<td>Device</td>
<td>10</td>
</tr>
<tr>
<td>Acquisition</td>
<td>Acquisition</td>
<td>5</td>
</tr>
<tr>
<td>View</td>
<td>OnlineView</td>
<td>5</td>
</tr>
<tr>
<td>Data Manager</td>
<td>Data</td>
<td>5</td>
</tr>
<tr>
<td>Analysis</td>
<td>Analysis</td>
<td>5</td>
</tr>
<tr>
<td>Reporting</td>
<td>Reporting</td>
<td>5</td>
</tr>
<tr>
<td>Info</td>
<td>Info</td>
<td>5</td>
</tr>
</tbody>
</table>
8.2 Integrating your own user buttons to your ribbon

8.2.1 Base64bit user button Icon converter

In order to convert your ICONS to the appropriate code you need a converter tool. This tool is installed with each release in the TOOLS directory.

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Tools
9 Excel 2010 Add-In

The Add-In in Excel allowing to directly import IPEmotion IAD data files into Excel. The Excel Add-In is a separate installer and works for Excel 2010 and higher. The Add-In is limited to 32 bit Excel, at the moment.

The Excel Add-In can only import IPEmotion IAD data files.
In order to help our customers to update the TEDS sensor information e.g. after calibration we offer a TEDS editor tool (TEDS editor). Several modules from the IPTRONIK support TEDS Class 2 sensors detection function. TEDS is defined as (Transducer Electronic Data Sheet) and includes all information about the sensors scaling definitions. Sensors which include TEDS chips reduce the scaling efforts and scaling errors for the user to a minimum.

TEDS is supported by the following modules with TEDS Class 2:

- Sx-STG
- Mx-STG2 6
- Mx-SENS2 4
- Mx-SENS2 8
- M-SENS2
10.1 Software installation

This TEDS Editor software tool is a separate application and can be operated independently of IPEmotion. The program is installed together with the IPEmotion setup and can be launched from the following directory.

- C:\Programme (x86)\IPETRONIK\IPEmotion 2019 R3\Tools\IPETRONIK.TedsEditor.exe

As explained above, in order to read and write TEDS data to the TEDS chip an external USB dongle hardware is required. The drivers for the USB dongle are included in the setup of IPEmotion and can be installed from the following directory. The drivers are available as 32 and 64 bit versions.

- C:\Programme (x86)\IPETRONIK\IPEmotion 2019 R3\Install

Drivers for the TEDS dongle for 32 or x64 bit operating systems.

10.2 Configuration of the TEDS settings XML

In order to modify TEDS data you need to configure the TEDS settings accordingly. The TEDSEditorSettingsXML file is installed in the following directory together with other important XML setting files.

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\Template

TEDS Editor settings XML
10.3 TEDS Editor GUI

The default setting of the XML file does not allow the user to updated any TEDS data. The settings XML file must be updated in order to make changes through the TEDS editor tool.

With the XML setting you can control the following functions:

- **CalibrationDateEditable** With this setting as True you can define the calibration date and the expire date.
- **StandardCalibrationDuration** Here you define the time span in days for the expire data. That means the defined duration is automatically added to the calibration date.
- **AutoSetCalibrationDateNow** This setting as True defines automatically the date of today as calibration date. The manual input of the calibration data is blocked.
- **PhysicalRangeEditable** With this setting as True you can modify the physical scaling properties.
- **AllEditable** With this setting as True you can modify all sensor properties.

The updated XML file must be copied to the following directory and restart IPEmotion and the TEDS editor tool to put the new XML functions into operation.

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\UserSettings

10.3 TEDS Editor GUI

With the TEDS editor software you can create sensor definitions from scratch, detect and modify sensor configurations and save the TEDS data to binary files. The initial start screen is the following.
When you create a new sensor, you can select from the following templates. The drop-down list of the physical measurement ranges are related to the selected template types below.

- 25 - Accelerometer and Force Transducer
- 30 - High Level Voltage Output Sensor
- 31 - Current Loop Output Sensor
- 33 - Bridge Sensor
- 35 - Strain Gauge Sensor
The following screenshot shows the TEDS editor software with an example of default sensor template.

Example of a default template
The screenshot below shows a new created sensor. IPETRONIK is registered officially as a TEDS sensor manufacturer.

Example of a new created sensor data sheet
When you create a new sensor, detect the data of a sensor, or load a TEDS binary configuration file most of the data fields are editable as indicated below via the red dots. Some field are not editable for all sensor. Some of the fields are not editable depending on the selected template type.
With the write command the sensor gets after a positive confirmation of the pop up message box updated with the new parameters.

Write function: Update TEDS chip of sensor
With the function write to file you can export the TEDS definition of the sensor to a BIN. You can use this exported BIN file later with the read (BIN file import) function to check or modify sensor definition offline without any sensor connected to your TEDS dongle.
11 PROJECT work space

Here you define the project parameters which are saved to the data file.

Example:

![Project parameters interface]

11.1 Ribbon

![Ribbon interface]
### 11.1 Ribbon

- **New**
  Creates an empty project

- **Open**
  Opens file dialog to search for a new IWF configuration

- **Save**
  Saves your configuration

- **Save as**
  Saves the configuration via a file dialog to define location and name of the IWF file

- **Generate**
  Runs an automatic hardware detection and generate an automatic configuration. The function “Generate” is pretty much the same as the function “Frequently Used” in OPTIONS, automatic hardware detection at start

- **Guidance**
  Refers to a wizard to set up a guided hardware configuration as discussed in OPTIONS “Frequently Used” item “Guided Configuration”.

- **Parameter**
  Here you can add new parameter lines to the list.

With the Parameter add function new parameter lines are added to the overall list of parameters. The parameter data can be updated via the IPEmotion ME app over your logger display system too. See chapter xxx for more details.
11.2 Column chooser – KEY field

With the column chooser you can link the field KEY to your parameter list. Add “Key and Source Values” from column chooser

Here you can see the values for the Key field and the source field.

Display “Key and Source Values” in table grid

Information

The field KEY is important because it is the unique identifier if you like to extract parameter values from the data file to your report, later.
11.3 Example: How to configure measurement file prefix

You can use specific project parameters to create your own measurement and log file name pattern. A frequently used function is a combination of logger serial number and the start time of the measurement. The screenshot below shows a modified project parameter page with includes 2 new entries:

- **FilePrefix**: With this parameter key, you can define your individual file name structure. It can be composed of constant values and different parameter key fields included in your parameter list. E.g. Constant – [Key1] – [Key2] – []. The separators can be – or _.

- **TotalStartTime**: This is an example to add date and time information to the data file name. The name pattern can be e.g. composed of: %Y%m%d – %H%M%S (Year, month, date) followed by (Hour, Minute, Seconds). Capital letter will show the year in 4 digits (2020). In small laters it will be 2 digits (20).

- **SerialNumber**: This parameter field is a default value in the factory standard parameter list.
The new file prefix is now visible in the data files stored on the logger as indicated below.

### 11.4 Creating global parameter XML files manually

The default project parameters are loaded automatically as soon as you start the software. However, you can modify the parameter list with new entries, list box elements or even with mandatory fields. A couple of templates are located in the following directory.

- `C:\Users\Public\Documents\IPETRONIK\IPEmotion\ProjectTemplate`

If you like to setup your own parameter entries, you need to define the following XML files in the directory mentioned above. The sample XML files can be used as a reference to build your IPEmotion project parameters or to build a parameter list for IPETRONIK Logger PlugIn applications. The name of the files are used as follows:

- `globalPar.xml` Parameters for IPEmotion / IPEmotionRT.UI
- `globalData.xml` Parameters for IPEmotion IPEmotionRT.UI
- `projectPar.xml` Parameters for the Logger PlugIn (TESTdrive-Loggers)
- `projectData.xml` Parameters for the Logger PlugIn (TESTdrive-Loggers)
The example below shows a project parameter list with a mandatory input field for COMPANY which requires a predefined entry from a list box.

In this case you cannot start measurement without an entry.
You also need to define a KEY for every new entry in the globalPar.XML file. The KEY field is very important later on if you like to extract parameters from the data file (IAD) or the project (IWF) and show them on your report.

11.5 Creating project parameter XML files for the logger

The IPETRONIK TESTdrive data loggers have their own project parameter sheet implemented in the Logger PlugIn. These project parameters are then included in the data files created by the data logger.
12 SIGNALS work space

The SIGNALS work space is dedicated to configure your PlugIns and take measurements.

Example:

12.1 Ribbon

12.1.1 Hardware / PlugIn

Select the hardware / PlugIn you would like to use. The drop down list includes all PlugIns which were activated in OPTIONS >PlugIns. See chapter 23.17.

💡 Tip

Sometimes user experience that they cannot access the list box and make manual configurations. In this case, in OPTIONS > Basic Settings the measurement configuration by MPC data base file was activated. See chapter 23.2.1.
12.1 Ribbon

12.1.2 System

The system is the next level below the selected PlugIn. The system basically is the specific hardware or interface you are using to set up your data acquisition system. Each PlugIn consists at least of one system. Depending on the hardware you may be able to add components or not. This depends on the modularity of the hardware and of how the PlugIn is programmed. If you have a modular DAQ hardware you can add components: Example: IPETRONIK CAN PlugIn.
If you have a system with a fixed IO configuration you cannot add any components. Example: NI PlugIn
12.1.3 PlugIn overview for description file import and export

Whether a PlugIn supports import or export functions also depends on the PlugIn implementation. The import is usually a shortcut to build your configuration. The following list will show you what kind of files can be imported and exported by the PlugIns. The import and export functions depend on the selected interface of the system or module. See also SIGNALS chapter 12.5.4.

<table>
<thead>
<tr>
<th>IPETRONIK Plugins</th>
<th>Interface Level</th>
<th>Configuration Imports</th>
<th>Configuration Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPETRONIK CAN</td>
<td>System</td>
<td></td>
<td>CANdb (DBC)</td>
</tr>
<tr>
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<td></td>
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<td>CANdb XML</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IPEmotion App (IAW)</td>
</tr>
<tr>
<td>IPETRONIK X</td>
<td>System</td>
<td></td>
<td>A2L</td>
</tr>
<tr>
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<td>CANdb XML</td>
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<td></td>
<td>IPEmotion App (IAW)</td>
</tr>
<tr>
<td>FlexRay</td>
<td>Autosar (ARXML)</td>
<td></td>
<td>A2L</td>
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<td></td>
<td>A2L</td>
<td></td>
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<tr>
<td></td>
<td>FlexRay Parameter</td>
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<tr>
<td></td>
<td>FIBEX</td>
<td></td>
<td></td>
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<tr>
<td>IPETRONIK Log</td>
<td>System</td>
<td>TESTdrive measurement files</td>
<td>TESTdrive configuration file (MFC)</td>
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<td></td>
<td></td>
<td>TESTdrive measurement files with ring buffer</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>TESTdrive Log Files</td>
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<td>CAN</td>
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<td></td>
<td>Autosar (ARXML)</td>
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<td>UDS (XML)</td>
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<td></td>
<td>GM-LAN (XML)</td>
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<td>ETH - XCP</td>
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<td>Component</td>
<td>CANdb (DBC / XML)</td>
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<td>Configuration Exports</td>
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<tr>
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</tr>
<tr>
<td>OPC (licensed)</td>
<td>System</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
12.1.4 Configuration check

This function checks the configuration on consistency. However, this function does not work for all Plugins. Messages are only returned if the Plugin supports the checking function. The configuration check function for example considering duplicate channel names across all active Plugins across the SIGNALS and ACQUISITION work space. A comfortable function for message refresh and configuration error searching is implemented in the configuration check function.

Refresh in the message window.

You can directly jump to the channel in the check window for the messages as indicated in the example below of the “Range-1” channel.
You can update the configuration and correct errors while the check window is open. With the refresh button you can update the message list.

12.2 Adjusting functions

12.2.1 Database

This function will automatically update all sensors of the configuration with the latest entries of the sensor database. Details on the sensor database are discussed in chapter 12.9.

If you perform a configuration (IWF) and use sensors from the sensor database and run the Adjust Database function, the software automatically retrieves the latest sensor configuration from the data base. With this process you can automatically update all sensors with the latest calibration data from the data base in one click.
12.2.2 Offset

The offset adjustment is implemented for the IPETRONIK Mx-SENS and Sx-STG modules. You will find more details in the IPETRONIK X-PlugIn documentation.

![Offset adjust](image)

12.2.3 TEDS

The TEDS (Transducer Electronic Data Sheet) adjustment is implemented for the IPETRONIK Sx-STG strain gauge module, Mx-SENS24, Mx-STG2 6, Mx-SENS2 8 and M-SENS2 which supports TEDS sensors. A TEDS sensor data base is supported. If the module detects a TEDS sensor, you can save it to a separate database file called `IPESensorDatabase.xmt`. The main advantage is being able to configure TEDS sensors offline.

![Group name](image)

- C:\Users\Public\Documents\IPETRONIK\IPEmotion\Database\IPESensorDatabase.xmt

When a hardware detection is executed and TEDS sensors are connected to the analog inputs the TEDS symbol is visible provided the symbol column is activated in the channel grid. The following modules support TEDS:

- Sx-STG
- Mx-STG2 6
- Mx-SENS2 4
- Mx-SENS2 8
TEDS sensor detection with automatic unit transformation
When you detect TEDS sensors you can define an automatic unit conversion. This function is needed when the unit defined for the sensor does not meet the unit format required for the measurement application. In order to activate this feature you have to make an additional entry in the Settings.XML file.
In this example the standard sensor was detected with the unit [Pa].

When you add the following code into the settings.XML file the unit are automatically converted to the preferred unit defined in the OPTIONS >Unit settings.

```xml
<CommonSettings>
  <detectWithPreferredUnit>True</detectWithPreferredUnit>
</CommonSettings>
```

The new entry in the XML file should be:
```xml
<CommonSettings>
  <detectWithPreferredUnit>True</detectWithPreferredUnit>
</CommonSettings>
```
The default unit defined in the OPTIONS > Units is [PSI]
The displayed and converted scaling is now automatically changed to [PSI].

TEDS synchronization on channel level

All modules supporting the TEDS (Transducer Electronic Data Sheets) function support in the IPETRONIK X-PlugIn a TEDS synchronization on channel level. Rather than synchronizing your whole configuration with TEDS you can focus on a dedicated channel to integrate the TEDS data from a connected sensor.

When the synchronization is finished the channel is updated with the TEDS data from the sensor.
12.2 Adjusting functions

When a channel is already scaled based on TEDS parameters, you can use from the context menu the TEDS compare function to update the TEDS data e.g. when a new sensor was connected to the input.
12.2.4 Shunt Check

The shunt check function is only implemented for the IPETRONIK strain gauge module Sx-STG. Find more details in the PlugIn manual of the X-Modules.
12.3 Detect

The DETECT function is a very convenient function to identify any hardware connected to IPEmotion. Not every PlugIn supports automatic hardware detection. Usually, USB device interfaces support automatic hardware detection. The device detection via TCP/IP is currently only supported by the IPETRONIK PlugIn LOG and the Gantner PlugIn.

The DETECT function is applied to all active PlugIns. The DETECT function is only required the very first time when you start to set up your measurement configuration. If the hardware configuration is changing by adding or removing modules, you need to execute the SYNCHRONIZE function to update the complete hardware configuration in the device tree. The SYNCHRONIZE function is explained in detail in chapter 12.3.2.

⚠️ Attention!

If you execute the DETECT function the complete configuration of SIGNALS of all connected devices is recreated. Additionally, all the configurations from the ACQUISITION work space are removed.
12.3.1 Mapping

The hardware MAPPING is a very convenient function for merging configuration (IWF) files to the currently connected hardware. If you execute the MAPPING function, the current configuration is compared to the currently connected hardware. IPEmotion is starting the hardware detection to identify all currently connected modules.

![Image of MAPPING function in IPEmotion software](image)

**Information**

The MAPPING function is therefore only supported for those PlugIns which support automatic hardware detection.

In the following you will see an example how to use the mapping function in practice. There are applications in which the same configuration is applied to different hardware setups. For example, each IPETRONIK module has an unique front number and using the mapping function, the actual hardware configuration can be matched to the project configuration (IWF).
12.3 Detect

#1) In the first MAPPING step the M-Thermo module (right) is transferred to the configuration.

# Select the modules you like to map
#2 Press the button [<<-] to execute the mapping
The serial numbers of M-Thermo (right - 1556) is mapped to M-Thermo2 module (left)
#2) In the second MAPPING step the M-SENS module (right) is transferred to the configuration.

The Mapping function can be applied across different modules types. The system is not preventing you from mapping for example a M-RTD (PT100) module to a M-SENS module. The channel names stay the same but the measurement ranges and scaling is changed from VOLT to Temperature PT100.

If you compare the configuration before and after the MAPPING, you will see that the channel definition is unchanged and that the module types and serial numbers are updated in the device tree.
12.3.2 Synchronize

The SYNCHRONIZE function is designed to update an initial configuration (IWF) with an updated hardware setup. This function is the counterpart of the DETECT function. As discussed above the DETECT function is creating your initial module setup. In practice the module setup can change where new modules are added or removed to the configuration. With the SYNCHRONIZE function you update your modules easily to your configuration.

Information

The SYNCHRONIZE function is not changing any configurations defined in the ACQUISITION work space.
The SYNCHRONIZE function can also be applied to identify which modules are missing and cannot get detected.
12.4 Initialize

With the INITIALIZE function you can test the communication between your hardware and IPEmotion. If there are configuration errors or the hardware cannot be reached, messages are returned. Depending on the Plugin version, error, info or warning icons are indicated.

The INITIALIZE function is also updating the hardware with the latest configuration parameters defined in IPEmotion. The configuration is downloaded to the devices. So when you run a hardware detection the latest configuration settings like channel name, scaling etc. are automatically retrieved from the module and displayed in IPEmotion.

However, in many cases the hardware cannot store a configuration. In this case, the configuration is only on the PC side but is not transferred and stored in the hardware.

The IPETRONIK modules store the following configuration settings internally *:

- Channel name
- Physical units
- 2-Point scaling
- Free 2 point scaling
- Factor offset scaling
- Sensor measurement range
- STG mode
- Data type (format)

The following configuration settings are not stored in the IPETRONIK modules internally *:

- Channel description
- No value
- V-TAB (see section 12.8.7)
- V-TAB range (see section 12.8.6)
- Multi point scaling (12.8.4)

(*) Depending on the module there may be other specific settings which can be stored or not be stored in the devices.
12.4 Initialize

12.4.1 Reset

The reset function is relevant for instruments which can store a configuration in the device. After reset, all configurations stored inside the device are set back to factory default.

*Information*

The RESET is applied to all PlugIns which support the reset function. The function is implemented and used for IPETRONIK modules and data loggers as these instruments can store a configuration.
12.4.2 Display

The Display button turns your configuration into measurement mode. Then you will see measurement values for all active channels.

12.4.3 Details

With the Details button in the ribbon you can display or hide all tab sheets for systems, modules and channels configuration.
12.5 Device / System / Module Tree

12.5.1 PlugIn version

If you select a PlugIn from the active hardware list, you will see the currently loaded PlugIn version. For changing the PlugIn version you need to go back to OPTIONS >PlugIn. There you can switch to previous versions. An equal sign (=) behind the PlugIn version indicates that you will always use this version even if a more recent PlugIn version has been installed. For more details see OPTIONS >PlugIn 23.17.3.

12.5.2 Column chooser

In the system tree you can activate a column chooser. In the system tree you can activate a column chooser by right click on the column header. This is a very useful function to add additional properties to your devices and modules. The scope of functions in the column chooser depends on the PlugIn. Some PlugIns support plenty of functions and other PlugIns have limited ranges of functionality.
12.5.3 Device configuration tab sheet

The device configuration tab sheet covers the basic description of any device or system. It is standard for all Plugins. The covered items are:

- **Active**: Checkbox to activate or deactivate a system on top level
- **Name**: Default name - can be changed to any individual description
- **Description**: Default description - can be changed to any individual description
- **Reference**: Is automatically generated and very useful for checking device links. The reference will be discussed in detail in the next section where channels are discussed
- **Sample rate**: Some instruments support a global sample rate and therefore they have an input field to enter the sample rate for all IO modules on device level
There are also plenty of device-specific tab sheets which are individual to certain PlugIns. Detailed descriptions about different settings are part of the PlugIn manuals.
12.5.4 Context menu for system, modules and channels

The context menu offers convenient functions for setting up your application. With right click to the system, module or channel you can access the context menu. The functions provided in the context menu depend on the Plugin. Some Plugins offer plenty of functions and other just provide some basic functions.

- Components

You can add components if the Plugin supports a modular hardware structure. The example shows two different Plugins. If the ribbon does not support any components, the function is deactivated in the context menu.
12.5 Device / System / Module Tree

▶ Change into

This function can convert a component/module to another type. Basically, if you build your configuration offline and you change the type of some modules without rebuilding the complete configuration, you switch modules with the "Change into" function.

▶ Extras

This function covers Plugin-specific functions.
12.5 Device / System / Module Tree

- **Import / Export**
  This function refers to the same function as implemented in the main ribbon. There are plenty of different import and export functions available. It is mainly related to configuration files like A2L, CANdb, Autosar etc. They are discussed in the previous chapter 12.1.3

- **Use as default**
  This function is useful for all users who need to create the same configuration several times. If you save your master configuration as DEFAULT, all systems are created with this order of modules, automatically. The default configuration is saved and can be deleted in the Application menu as discussed in detail in the OPTIONS. You can only define one template for one interface. E.g. you cannot have different module configurations for IPETRONIK CAN 1

- **Cut**
  With the cutting function you can cut out selected modules. After cutting components you can paste them in other sections of the system tree. There is a difference between "Paste" and "Paste behind"

- **Paste**
  Insert one module

- **Paste behind**
  Inserting all modules you have cut out and paste them behind a selected module

- **Copy**
  With the copying function you can replicate modules or a list of selected modules

- **Delete**
  With "Delete" you permanently remove the items from this configuration

- **Clean**
  The "Clean" function only works on an interface or system level. With this function you can remove all modules beneath the interface
12.5 Device / System / Module Tree

- **Copy to file**
  With this function you can save module configurations in a separate file with the extension ITF. This ITF file can be imported, as well.

- **Paste from file**
  Import ITF files. They include all selected modules, channels and configuration elements.
If you select "Properties" from the context menu, another display opens up summarizing the tab sheets for configuration. The properties are context-sensitive. If you select a module, you will get the context for module configuration. If you open the connect menu on channel level, you will see all configuration tab sheets related to the channel.
12.5.5 Module configuration tab sheet

On module level, beside the GENERAL tab sheet some Plugins support module-specific tab sheets to configure the hardware.

- **Active**: Checkbox to activate or deactivate a module
- **Name**: Default name - can be changed to individual names
- **Description**: Default description - can be changed to any individual description
- **Reference**: Is automatically generated and very useful for checking module links. The reference will be discussed in detail in the next section where channels are discussed
- **Sample rate**: Some instruments support a sample rate on module level and therefore they have an input field to enter the sample rate for an IO module on module level

All modules have at least a GENERAL configuration tab sheet. Module specific settings, if available, are implemented in additional tab sheets.
12.6 Channel configuration parameters

12.6.1 Column chooser in the channel grid

In the channel grid head line you can access a context menu to add additional columns to your channel grid. The available columns are depending on the Plugin.

Example of channel grid with 2 additional columns.
You can add your own columns into your channel grid. In order to add individual columns you need to create in the installation directory a new xml file called: **Customize.XML**.

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Customize.xml

With the "readOnly" status (true/false) you define if the field can be edited though the channel grid. XML Code to be included in the **customize.xml** file:

```xml
<Settings Version="1">
<UserDefinedKeyValues>
    <UserDefinedKeyValue>
        <index>1</index>
        <name>testKey1</name>
        <caption>Key1</caption>
        <description>My own key 1</description>
        <readOnly>false</readOnly>
    </UserDefinedKeyValue>
    <UserDefinedKeyValue>
        <index>2</index>
        <name>testKey2</name>
        <caption>Key2</caption>
        <description>My own key 2</description>
        <readOnly>false</readOnly>
    </UserDefinedKeyValue>
    <UserDefinedKeyValue>
        <index>3</index>
        <name>testKey3</name>
        <caption>Key3</caption>
        <description>My own key 3</description>
        <readOnly>true</readOnly>
    </UserDefinedKeyValue>
</UserDefinedKeyValues>
</Settings>
```
12.6 Channel configuration parameters

The following screenshot shows a channel grid which includes 3 individually defined "KEY fields".

The Customize.xml file can be used also to show key-value pairs in the DATA MANAGER tree 19.2.5.
12.6 Channel configuration parameters

12.6.2 General tab sheet

This tab sheet covers general channel settings

- **Active**: Checkbox to activate or deactivate a channel
- **Name**: Default name - can be changed to individual names
- **Description**: Default description - can be changed to any individual description
- **Reference**: Is automatically generated and very useful to check where the channel is linked to

12.6.3 Defining list box entries of channel names

For the channel name you can also define a pull down menu.

Customized fields “Key1...3” in the channel grid.

The entries of the pull down menu are stored in a CSV file with the name (ChannelNames.csv) in the following user settings directory.

- C:\ProgramData\IPETRONIK\SWrelease\UserSettings
12.6.4 Format tab sheet

The FORMAT tab sheet is only visible for users who activate this function in OPTIONS >Expert mode >Ex-
tended tabs in chapter 23.3.1. In the Format tab sheet we can configure a couple of functions which are usually
only relevant for demanding users. The different configuration functions are explained below.

This refers to the data format (resolution) of the measurements. Depending on the module / instrument, sometimes different for-
mats are supported. On most of the instruments, it is not possible
to change the configuration of the data type. They always trans-
mit data in the same format. For IPETRONIK modules the signed
or unsigned format is important. The 8 bit format is still included
because of historic reasons.
12.6 Channel configuration parameters

- **Task**: The task is a very special setting developed for some specific Plugins.

- **Task: GPS Recording**: The settings for a special task are needed for the IPETRONIK IPEspeed GPS receiver. This sensor sends the NMEA protocol in a special format and in order to convert this signal to a standard format which can be used by IPEmotion, the measurement channels need an additional configuration. A reference CANdb file and a IWF project file are included in each IPEmotion installation.

A correct configuration of the task is also required when you would like to save or export data in the GPX format. The coordinates longitude, latitude and altitude are only correctly interpreted in the GPX export when the corresponding task is defined. See also GPX export in chapter DATA MANAGER 19.8.5.
12.6 Channel configuration parameters

**Task: Audio Recording**

When you like to record audio / sound over the PC-Sound Demo PlugIn you should check the setting of the Task which is by default set to "Audio mono" if you have PlugIn version V01.02.00. When you run a previous PlugIn version you need to change the task manually to "Audio mono".

**NoValue**

This configuration is important for all users who would like to see a certain behavior when NO measurements received in IPEmotion. The default configuration is that No Values are recorded in the data file. They are indicated as NoValue in the DATA MANAGER. In the Yt-chart in the ANALYSIS work space you will see missing data points in the graph. The software will always store No VALUE in the data file irrespectively what you select from the drop down box.
In the data file NoValue is stored and in the diagrams you will see missing data points.

Another configuration option is a check box to enable the DefaultValue. With this check box you change the storage and display behavior when no measurements are received. With the check box you can show and store + FullScale, − FullScale or NULL as a numerical value. You can only select NULL if you have a signed (+− measurement range) data format. An unsigned measurement is only covering positive measurements.
The NoValue configuration also has an impact on the data display in the VIEW work area. As the screen shot below indicates. When the check box "Deactivate NoValue and use Default Value" is not activated the instrument will show always NoValue.

However if the check box "Deactivate NoValue and use Default Value" is activated you will enable the list box entries and the instrument will show the selected values for:

- + Full Scale
- - Full Scale
- Null
12.6 Channel configuration parameters

► Default Value Null

The DefaultValue (NULL) is related to the Null value of the binary measurement range. If you select a signed 16bit \(2^{16} = 65536\) measurement range, the temperature signal for the IPETRONIK thermo module is split up between the values -65,536 and +65,536 as the graphic demonstrates below.
The binary NULL value of this measurement range is 655 °C. This value is then indicated to the online instruments and stored in the data file.
Channel type

The channel type indicates the data direction INPUT or OUTPUT. Output channels can be updated through manual entries, through slide controllers or alphanumerical displays in the VIEW work area. Some PlugIns support channels which can be operated as input and output. In digital IOs you will also quite often find the option to change the channel direction input to output or vice a versa through this checkbox.

The basic scaling operations can be defined directly in the scaling tab sheet. The scope of functions depends on Plugin and IO module type. Some inputs, especially analog inputs, support many different functions and ranges and provide more scaling options.
12.7.1 Sensor mode

The sensor mode covers the main measurement type, for example Volt or Current, accelerometers (ICP). You select the sensor mode from your drop-down list. In this example, the analog input module supports many different measurements of thermo element, voltage or current. The supported sensor modes are defined by the PlugIn and you can only select the mode which is supported. Many modules only support one static sensor mode.

12.7.2 Sensor range

The next configuration option is the sensor measurement range. The range is related to the measurement mode. For thermo elements, the measurement range is redefined and cannot be changed. The available voltage and current measurement ranges depend on the functionality of the analog input. In the example below you can select ranges from 15 mV (0,015V) up to 2,5 Volt. The Unit is automatically linked to the selected measurement mode Voltage >V or current >A or temperature >C and cannot be changed manually. It is defined by the PlugIn developer.
12.7.3 Physical range – Engineering units

The physical range is related to your engineering units. Here you define into which unit (mm, bar, etc.) the electrical signal is converted.

12.8 Scaling calculator – for advanced scaling functions

For advanced scaling functions you can use the scaling calculator. This interface provides many different scaling functions which will be discussed later on.

► Sensor mode is related to the type of measurement mode as discussed above
► Sensor range is related to the measurement range as discussed above
► Unit To simplify the conversion between engineering units you can use the change unit editor. Switching between units only works within the same engineering unit family like temperatures, pressures, weight, energy, etc.
The main advantage is that the new engineering unit automatically converts the physical measurement range. As shown in the screenshot, 100 bar are automatically converted to 0.1 kbar. This conversion also works across different metric standards.

Changing for example:

- Pressure: Bar > kbar > mbar > psi > etc.
- Temperature: °C > °K > °F

An overview of all supported engineering units can be found in the OPTIONS chapter 23.13.
12.8.1 2-point scaling

This is a classical scaling configuration using two points, usually the MIN and MAX value of the physical range of the sensor. The scaling information is included in the data sheet / calibration sheet of the sensor.
12.8.2 Free 2-point scaling

This scaling mode offers the possibility to scale the sensor range and the physical range (engineering units) at the same time.
12.8.3 Factor/Offset scaling

This scaling method uses the equation Physical value \( y = m \times x + b \) (\( b = \text{offset} \)) with \( m = \text{slope factor} \). The \( m \)-factor influences the slope \( >1 \) steeper slope / \( <1 \) flatter slope. The offset-\( b \) shifts the physical value by a constant value.
12.8.4 Multipoint scaling

The multipoint scaling is a scaling method that allows to define a nonlinear scaling with as many data points as possible.

⚠️ **Attention!** The multipoint scaling parameters are only stored in IPEmotion. They are not transferred to the instrument unless the instrument is supporting this function. See chapter 12.4.
12.8.5 STG Strain gauge

In this interface, strain gauge bridge types like 1/4; 1/2 or full, etc. can be configured.
12.8.6 VTAB range

This scaling method converts measurements of a specific range into a text message. If the measurement value is in a defined range you can see the corresponding text information on an alphanumerical instrument in the VIEW work area.

![Scaling calculator for VTAB ranges]

**Attention!**

The multipoint scaling parameters are only stored in IPEmotion. They are not transferred to the instrument unless the instrument is supporting this function. See chapter 12.4.
12.8.7 VTAB

In this mode you can relate a specific integer (1, 2, 3, 4, ..) value to a specific text display. You can display this text on the VIEW work area for example in an alphanumerical instrument.

Attention!

The multipoint scaling parameters are only stored in IPEmotion. They are not transferred to the instrument unless the instrument is supporting this function. See chapter 12.4.
12.8 Scaling calculator – for advanced scaling functions

12.8.8 Active Sensors
12.8.9 Passive Sensors

12.8.10 Snapshot – Test Measurement

You can perform a test measurement within the scaling calculator to check your scaling and to see the actual measurements. Three different test measurements are supported:

- Snapshot
- Average over values
- Average over time
12.9 Sensor database in the scaling calculator

The scaling calculator supports a sensor database. In this database, the scaling parameters of many different sensors are included. If you select a sensor from the database, you have directly defined the measurement range and the physical range and, if needed, a sensor excitation.
In this example, you see a shunt for high current measurements. This shunt can measure +10 Amperes and the output of the shunt is +1 Volt. The sensor requires a 10 Volt sensor excitation.

12.9.1 Adding new Sensors - Sensor Database Editor

The sensor database (SDB.exe) is installed with each IPEmotion installation in the following directory:

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Tools

If you like to add your sensor to the existing standard database, it is recommended to import the standard sensor database. The database is installed in the following directory.

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\Database

You can also create your own sensor database XML file from scratch. If you like to use your own database file you have to store it in the right directory and give the file the correct name: IPESensorDatabase.xml

IPEmotion can only work with one database XML file.

You can add new sensor by means of the SensorDB editor. This tool is installed along with IPEmotion and entries can be made through the GUI.
If you save the new sensor and restart IPEmotion, the new sensor will be included in the database and can be selected for channel scaling. Serial numbers and calibration dates can be defined, as well.

However, you can import your own database from Excel using the import function of the SensorDB Editor. The import function is explained in the help manual of the SensorDB Editor.
12.9.2 The database format

The standard Excel template for importing sensors has the following structure:

- sensorName
- sensorTypeId (see next page for details)
- sensorType
- sensorManufacturer
- physicalUnitName
- physicalMin
- physicalMax
- outputUnitName
- outputMin
- outputMax
- sensorSupplyMin
- sensorSupplyMax
- outputProportionalToSupply
- referenceSensorSupply
- sensorSupplySymetric
- sensorSupplyCurrentMax
- propertyName1
- propertyValue1
- propertyName2
- propertyValue2
- propertyName3
- propertyValue3
- serialNumber
- calibrationDate
- calibrationValidMonths
- calibrationValidDays
- physicalMin
- physicalMax
- outputMin
- outputMax
12.9 Sensor database in the scaling calculator

The Sensor type ID

- 0 = UNKNOWN // User-defined sensor
- 1 = DisplacementTransducer // Displacement transducer
- 2 = LoadCell // Load cell
- 3 = Shunt // Shunt
- 4 = CurrentTransformer // Current transformer
- 5 = VoltageTransformer // Voltage transformer
- 6 = ForceTransducer // Force transducer
- 7 = PressureTransmitter // Pressure transmitter
- 8 = AbsolutePressureTransmitter // Absolute pressure transmitter
- 9 = GaugePressureTransmitter // Gauge pressure transmitter
- 10 = DifferentialPressureTransmitter // Differential pressure transmitter
- 11 = FlowRateTurbine // Flow rate turbine
- 12 = PistonFlowmeter // Piston flow meter
- 13 = ScrewFlowmeter // Screw flow meter
- 14 = VortexSheddingDevice // Vortex shedding device
- 15 = Accelerometer // Accelerometer
- 16 = TriAxialAccelerometer // Triaxial accelerometer
- 17 = TorqueMeter // Torque meter
- 18 = Counter // Counter
- 19 = StrainGauge // STG
- 20 = LVDT // LVDT
- 21 = StrainGaugeBridge // STG bridges (Strain)
- 22 = TemperatureSenso // Temperature senso

If none of the predefined types meets your requirements, you can add user-defined types to the sensor database. The "sensorTypeId" value must be set to 0. A short description text should classify the corresponding sensor.

If you want to use sensors of the same type within the sensor database, use the "SpecificSensors" entry. Each one of the sensors must get a unique serial number ("serialNumber"). In addition, each one of these sensors can get a calibration date ("calibrationDate"), as well as a period of validity of the calibration ("CalibrationValidDuration") including the data "calibrationnValidYears", "calibrationValidMonths", and "calibrationValidDays". Furthermore, the values for "physicalMin", "physicalMax", "outputMin", and "outputMax", which can be found in the data sheet, can be overwritten by values, which are read at the calibration.

You can add non-relevant information for the functionality of the sensor data base like the working temperature range under the "UserProperties" entry. These are Key/Value pairs, which are used for displaying the information. Please note that these data are not used in any calculation.

All the sensor data is stored in an XML file with the following structure.
The sensor names ("sensorName") must be unique!

```xml
<Sensor name="Sensor2">
  <sensorName type="String">Sensor2</sensorName>
  <sensorTypeId type="Int32">7</sensorTypeId>
  <sensorManufacturer type="String">IPETRONIK</sensorManufacturer>
  <physicalUnitName type="String">bar</physicalUnitName>
  <physicalMin type="Double">1</physicalMin>
  <physicalMax type="Double">50</physicalMax>
  <outputUnitName type="String">V</outputUnitName>
  <outputMin type="Double">-4</outputMin>
  <outputMax type="Double">4</outputMax>
  <sensorSupplyMin type="Double">-5</sensorSupplyMin>
  <sensorSupplyMax type="Double">5</sensorSupplyMax>
  <sensorSupplyCurrentMax type="Double">0.01</sensorSupplyCurrentMax>
  <PreferredSensorModes>
    <sensorMode />
  </PreferredSensorModes>
  <UserProperties>
    <UserProperty>
      <propertyName type="String">Genauigkeit</propertyName>
      <propertyValue type="String">± 4,7 %</propertyValue>
    </UserProperty>
  </UserProperties>
  <SpecificSensors>
    <SpecificSensor>
      <serialNumber type="String" />
    </SpecificSensor>
    <SpecificSensor>
      <serialNumber type="String">SN01277</serialNumber>
      <calibrationDate type="Date">2012-04-04</calibrationDate>
      <calibrationValidDuration>
        <calibrationValidYears type="Int32">1</calibrationValidYears>
        <calibrationValidMonths type="Int32">6</calibrationValidMonths>
        <calibrationValidDays type="Int32">0</calibrationValidDays>
      </calibrationValidDuration>
      <outputMin type="Double">-3.895</outputMin>
      <outputMax type="Double">4</outputMax>
    </SpecificSensor>
  </SpecificSensors>
</Sensor>
```
12.9.3 Multipoint linearization

The sensor database is supporting sensor linearization functions. You can add for sensors multipoint linearization into sensor database XML file. In the XML file you can add value pairs of “physical reading / sensor output”.

Information

The sensor specific linearization information can only be added through the XML file directly. The Sensor Database Editor and the corresponding CSV/Excel import function is currently not supporting this function.
When you select a sensor with linearization values they are directly indicated in the sensor parameter overview. In this example the scaling is integrated to the “Sensor type properties”.

The linearization values are imported from the sensor database into the multipoint scaling mode with a graphical presentation of the calibration curve.
You can integrate multi point scaling also to the "Sensor specific" properties.
12.9.4 Adding new Sensors – through the Scaling Calculator

The sensor database is a powerful tool to simplify the channels scaling and reduce scaling error. You can now add your own sensor to the database. All the settings defined in the sailing interface are saved to the database. All scaling entry modes are supported to add individual sensors 12.8.

When the sensor parameters are defined you add the sensor header information by accessing the add button.

After you have created the sensor in the database you can search for your sensor. The example below shows the parameters as defined in the scaling calculator.
When a sensor was added to a user define sensor data base file it is saved in:

- C:\Users\Public\Documents\IPETRONIK\IPEmotion\Database\IPESensorDatabase.xmu

- Extension u = user defined sensor data base.

If you like to modify a manually created sensor you need select the sensor from the sensor data base and you can modify settings in the scaling interface. With the function save sensor to data base the modifications are overwritten.

**Information**

*Note: There is no possibility to delete a sensor from the sensor data base. If you need to remove a sensor permanently you need to delete it from the XML files.*
12.10 Display tab sheet

This tab sheet covers display settings for the online VIEW work area. The Display tab sheet is also relevant for formula channels and scaling channels 14.3.3. The main configuration elements are:

- **Display Area**: Covers the initial Y-axis scaling of the Yt-chart.

- **Formatting**: Covers the decimal places. The default setting is Automatic which will show as many decimal places as provided by the Plugin.

- **(Display) Name**: Covers the display name which can differ from the channel name. The display name is only relevant for the VIEW work area. The display name will not be used for formulas and other functions like limit or range monitoring. If you like to see the display name on the instruments, you will have to activate this function in OPTIONS > VIEW 23.5.4.

Additional information:

- The display name is set as "56001556_1.Temp" and the display shows "21.78".
12.10 Display tab sheet

12.10.1 Define standard decimal templates on module level

When detecting modules, the default setting of the decimal places is defined as Automatic. However, if you like to define a default setting for the number of decimal places you like to use you can add to the Settings.XML a new command line in order to use the template as default. The settings XML file is stored on the following directory:

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\Settings.xml

In the settings XML you have to add in the section "Common Settings" the following command line:

<detectWithTemplate>True</detectWithTemplate>

You can disable the function also by setting the command line to "False". <detectWithTemplate>False</detectWithTemplate>

Detect modules and consider the defined template. [SI_95]
With this command line you can save a lot of time because all modules will be detected with the number of decimal places as defined in the template. The template is applied to all channels of the module.

Example: Template with 2 decimal places for the Mx-SENS2 8 is created.
12.11 Output tab sheet for output channel

The output tab sheet is only visible for analog and digital output channels. Its main function is to define a start value. This value will be set to the output when you start the measurement. You can also define an output level. The output level is related to the user administration which is discussed in detail in OPTIONS >User administration 23.15.

12.12 Channel-specific tab sheets

Each Plugin can have channel-specific tab sheets to cover additional configuration functions. There are many individual functions which are discussed in the Plugin manual in more detail. Some examples are shown below.
13 Measurements on CAN, LIN, ETH, FlexRay interfaces

The interface hardware (logger, CAN/LIN interface or Network card) may support several of the following functions. The supported functions are vendor dependent.

- CAN - Free running
- CAN - CCP and XCP (1.4 packed mode)
- CAN - Traffic
- CAN FD - Free running
- CAN FD - XCP (1.4 packed mode)
- CAN FD - Traffic
- LIN - Free running
- LIN - Traffic
- FlexRay - Free running
- FlexRay - Traffic
- FlexRay - XCP
- ETHERNET - Free running (TCP and UDP)
- ETHERNET - SOME/IP
- ETHERNET - Traffic
- ETHERNET - AK Protocol
13.1 Description file import format overview

In order to measure data from your bus networks and ECUs you need to perform a description file import. The available import functions and file formats are depending on the selected interface type. The screenshot below shows as an example import dialog and files for a CAN connector.

![Description file imports](image)
On the CAN interface the following import formats are supported:

- CAN db (.dbc, .xml)
- Autosar (.arxml)
- A2L (.a2l)
- Fibex (.xml)
- UDS (.pdx,.XML)
- GM-LAN (.odx)
- CAN-Send (swichting formats into output direction)

On the LIN interface the following import formats are supported:

- CAN db (.dbc, .xml, .ldf)

On the FlexRay interface the following import formats are supported:

- Autosar (.arxml)
- FlexRay Parameter (.xml)
- Fibex (.xml)

On the ETHERNET interface the following imports are supported:

- Autosar (.arxml)
- A2L (.a2l)
- A2L zipped (.zip)
- Fibex (.xml)
13.2 CAN interface settings

The CAN interface setting can vary in regard to the selected CAN hardware. The CAN hardware can be one of the supported vendors like Vector, KVASA, PEAK, etc., or an IPETRONIK data logger. On the General interface tab sheet you have the following settings.

- **Active**: Activate the interface
- **Name**: Default channel name
- **Description**: Add an additional description to the interface
- **Reference**: Is automatically generated by the system and stored in the data file to back reference the data source.

On the CAN tab sheets the following settings are supported:

- **Baud rate**: Here you can define the baud rate of the CAN bus
- **Send ACK mode**: With an active check box for normal mode the CAN interface is operating in sciience mode. The interface will not send any acknowledgement messages to the bus in order to avoid any disturbances on the bus network.
- **CAN FD**: This check box can only be activated, when the CAN interface supports CAN FD messages which are based on 64 bit message size.
- **Data rate**: This reference to the CAN FD data rate.
- **Sample point**: Is relevant for CAN FD measurements and is usually taken from the description file during the import process.
- **Sync jump with**: Is relevant for CAN FD measurements and is usually taken from the description file during the import process.
On the Extended tab sheet, the Wake on Bus (WoC) function can be activated. This function is only supported by some data loggers.

- **Wake on Bus**: With an activated Wake setting the logger can be automatically started when CAN traffic received on the interface.
- **NML**: No Message Lost. The Logger IPElog2 supports the No Message Lost (NML) functionality. When the logger is in NML mode the Power LED is blinking every 3 seconds. When bus traffic is received on the NML configured interface, the logger is booting up and stores all bus traffic data in the storage group. During the boot phase only CAN traffic is stored. The measurement of protocols or M-CAN / X-LINK measurement modules and other periphery devices like IP- and USB cameras, Satellite interfaces etc. is only stored in the data file, when the logger is completed booted and all systems are properly initialized.
- **Fault-tolerand**: This is related CAN low speed supported e.g. by IPElog2
- **Bus termination**: Activating 120 Ohm bus termination on CAN 1 / M-CAN of IPElog 2

The Option tab sheet provides the following settings.

- **Baud rate initializing**: With this check box setting the baud rate of the CAN controller is updated to the setting defined on the previous CAN tab sheet.
- **Output mode**: Off â¬Å no impact. Configuration â¬Å provides extended output messages in the message window about the ECU communication.

The Bit timing tab sheets is available on all CAN FD supporting interfaces.
CAN FD networks require a detailed timing setting for Tseg 1 and Tseg2, in order to capture the data from the right timing segments of the CAN FD message. For more details see the manuals of the CAN interface vendors or in the internet e.g. www.bittiming.can-wiki.info
The CAN interface in an IPEmotion RT loggers support also a wider range of additional functions which will be discussed below.

- **IPEmotion CAN**
  - On this interface all M-CAN modules can be created. This function is only supported on IPEmotion RT data loggers.

- **IPEspeed**
  - This interface will create all channels of the IPEspeed GPS receiver.

- **IPEout**
  - This interface will create all channels of the analog and digital in/out module from PEAK.

- **Traffic**
  - With this channel you can perform CAN bus traffic measurements.

- **Status**
  - This refers to CAN interface status channels.

- **Manual messages**
  - Here you can create manual CAN messages.

- **WWH-OBD**
  - This refers to world wide harmonized OBD measurements.

- **OBD-2**
  - With this interface a large range of on board diagnostic channel (OBD) are created which are accessible on almost all cars via the OBD connector.

- **OBD-2 mode 21**
  - This covers a special OBD mode.

- **GM-LAN**
  - This covers a special GM diagnostic mode.

- **GM-LAN job-based**
  - This covers a special GM diagnostic mode.
The overview of the CAN status channels is presented below.
13.3 LIN interface settings

On the LIN tab sheets the following settings are supported:

- **Active**
  - Activate the interface

- **Name**
  - Default channel name

- **Description**
  - Add an additional description to the interface

- **Reference**
  - Is automatically generated by the system and stored in the data file to reference the data source.

On the LIN tab sheet the following settings are supported:

- **Baud rate**
  - From the drop down list you can select from 3 different baud rates defined as: 2.4, 9.6, 10.417 kBAud

- **LIN version**
  - The LIN version refers to the standards 1.3, 2.0 and 2.1.

In the Extended tab sheet the Wake on LIN (WoL) function can be activated. The WoL function is only supported by data loggers.

- **Wake on LIN**
  - With an activated WoL setting the logger can be automatically started when LIN traffic is received on the interface.
The LIN interface of IPEmotion RT loggers supports also some additional functions which will be discussed below.

- **Traffic**
  With this channel you can perform LIN bus traffic measurements.

- **Manual messages**
  Here you can create manual LIN messages similar to CAN messages discussed above.
13.4 ETH interface settings

The ETHERNET interfaces on the IPEmotion RT data loggers offers the following configuration functions:

- **Active**: Activate the interface
- **Name**: Default channel name
- **Description**: Add an additional description to the interface
- **Reference**: Is automatically generated by the system and stored in the data file to back reference the data source.

For data loggers the default IP-addresses of the two ETH interfaces 1 and 2 are statically defined. For M-LOG V3 the interfaces are named:

- ETH 1: IP. 192.168.232.1
- ETH 2: IP. 192.168.234.1

For IPElog2 the ETH interfaces are named as below:

- X-LINK/ETH3: IP. 192.168.232.1
- ETH/ETH2: IP. 192.168.234.1

The ETH interfaces on an IPEmotion RT loggers supports also a wider range of additional functions which will be discussed below.
13.4 ETH interface settings

- **IPETRONIK X**
  On this interface all X-Modules and M-CAN in the tunneling mode can be configured. This function is only supported on IPEmotion RT data loggers only.

- **IP camera AXIS**
  Here you can create an IP-camera interface for pre-configured AXIS IP-camera system.

- **IP camera**
  Here you can create a general IP-camera interface system.

- **Traffic**
  With the traffic channel you can record ETH traffic.

- **AK Protocol**
  Interface to get data from MAHA roller benches.

In addition to the function of the ETH interface discussed above, 3 different satellite interfaces are supported:

- **CAN FD Satellite**
  You can add additional CAN FD interfaces to the logger using the CAN FD Satellite.

- **FlexRay Satellite**
  You can add additional FlexRay interfaces to the logger using the FlexRay satellite.

- **LIN Satellite**
  You can add additional LIN interfaces to the logger using the LIN satellite.

Additional interface components (ETH 2 = IP. 192.168.234.1)

For the ETHERNET Traffic measurement, you need to define the name of the LAN card of the PC which is PC dependent. This configuration is not required for data loggers as the ETH interface names are pre-defined by the hardware setup of the system.
13.4 ETH interface settings

IPEmotion PC – ETH Settings of the Protocols PlugIn

Define PC ETHERNET network name
13.5 A2L import - DAQ list with graphical filling level indication

Measurements on ECUs can easily reach the performance limits if many measurements are required. With this graphical import and filling level indication overview you can now clearly identify which signals are measured and which signals are rejected. To activate the DAQ list filling level indication, you have to add the DAQ list from the column chooser to your channel grid as shown below.

Then you will see a new button to open the graphical DAQ filling level indication.

When you open the graphical filling level indication you will see how the signals are allocated to the Data Transfer Objects (DTO). The number of supported DTO’s is defined by the A2L file. In one DTO row you can have several signals. The color is randomly selected and is a visual aid showing how many byte a signal is utilizing from a DTO.
13.5 A2L import - DAQ list with graphical filling level indication

**Diagram Description**

- **9 signals**
  - Drag a column up by that column.
- **100 ms DAQ list**
- **DTO (Data Transfer Objects rows 1...251)**
- **Automatically allocated to 4 DTO's**
- **Fill process**
  - Left to right
  - Row by row
  - Depending on signal size.

---

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13.5.1 DAQ list filling process

The import dialog fills the DAQ list in an optimized way in order to use as much of the available capacity as possible. The maximum capacity for signal measurement of a DTO is 7 byte for CCP measurements and XCPonCAN. The first byte is used for the address header.

Example 1:

In comparison of you take an A2L file and measure XCPonETH on the Ethernet interface of IPETRONIK data loggers like M-LOG have a lot more byte capacity on the DTO. The number of available bytes is defined in the A2L file. In the screenshot below you can see the import dialog and the DTO fill level for an XCPonETH measurement with 60 byte capacity on each DTO.

Example 2:

In the screenshot below you can see that 4 DTOs are used for four 32-bit signals. It is not possible to fill 2 signals of 32-bit signals in one 7 byte DTO.
Example 3:

In the following example, 3 additional 8-bit signals are activated. Now you can see that the IPEmotion software automatically fills up the 3 empty bytes on the first DTO (Data Transfer Object).

The allocation of signals to DTOs is optimized by IPEmotion, internally. It cannot be influenced by users. Some A2L files support the reading of multiple signals from one common DTO address. In this case several signals are allocated to the same DTO address and the mouse over tip text is indicating all channels grouped together in this DTO.
13.5.2 DAQ list overflow – rejected signal export

If you activate more channels than the DAQ list is able to support, you can create a list of rejected channels which can be exported to CSV. With the mouse over function you can read the channel names which are included in the DAQ list.
13.6 Edit A2L dynamic DAQ list ODT values during the import

When you import an A2L file for dynamic DAQ list measurements e.g. for XCPonCAN on your ECU the import dialog considers by default the maximum ODT count = 252. (ODT = Object Descriptor Table). The DAQ list fill level calculation is based on the default assumption that the 252 ODT can be serviced by the ECU.

In practice the user tend to overload the dynamic DAQ list why adding to many ODT. This problem can be solved in the way that the user can define in the import dialog the appropriate values for the MAX ODT and MAX ODT entries to calculate the fill level correctly.

![Diagram showing DAQ list settings and ODT values](image)

If you now like to calculate the DAQ list fill level correctly you must correct the values for MAX ODT and MAX ODT Entries. In order to do this you can take a template file from the following directory:

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\Template\DaqListXcpCan.xml
This file has to be transferred into the following directory:

- C:\ProgramData\IPETRONIK\IPEmotion 2016 R1 RC\UserSettings\DaqListXcpCan.xml

You need to close IPEmotion and edit the XML file and set the values for Max ODT and max ODT Entries for read only into "FALSE".

With this setting in the XML file you are able to modify the ODT setting in the import dialog.
In the example above the MAX ODT count was set to 10 and the fill level calculation is now considering this value.

13.6.1 A2L Import for array signals

The A2L import is supporting array signals. Array signals are basically grouping several measurements together to one channel. In order to import the array signals you need to add in the import dialog from the column chooser the field “Divide array” to the channel grid.

Select “Divide Array” column.
When the array column is included in the channel grid, you can activate the check boxes which include array signals.

Check box activated will provide the complete array list for measurement.

After the import the array signals are all listed and available for measurement.
When the A2L file includes array signals you can import specific signals with a CSV file selection. The standard process is that the complete array is imported. However, if you like to import only specific signals from the array the CSV file selection is only possibility. In the CSV file you define array signal name and the ID in brackets.
13.6.2 A2L import with additional FlexRay parameters import

For FlexRay measurements you need to create a FlexRay interface. For IPEmotion RT and PC based FlexRay measurements a FlexRay Satellite Interface is available.
13.6 Edit A2L dynamic DAQ list ODT values during the import

When you have an A2L description file for a FlexRay protocol measurement and the A2L is not including any FlexRay parameter the import process will open automatically a file open dialog to load the parameter file.

Import dialog to select the FlexRay signals.
13.6 Edit A2L dynamic DAQ list ODT values during the import

Import dialog to select the XCPOnFlexRay signals. Link to the FlexRay parameter XML file for ECU communication.
When the FlexRay parameter file as defined in the A2L is not available a second import dialog will be opened automatically.

New dialog, to select FlexRay parameters.

Select FlexRay parameters for ECU communication.
13.6.3 A2L import from zip files (X-Modules)

When X-Modules are configured on the ETH interface in the of the logger or on the PC with the IPETRONIK Plugin X the export function is creating one ZIP file which includes all A2L files of each X-Module. The dedicated import of A2L ZIP format is then automatically importing all A2L files to create the configuration. On the activated channels are included in the A2L file.

Export of multiple X-Modules in one ZIP file

Import one zip file which contains multiple A2L
13.7 FIBEX import

13.7.1 Import CAN signals from FIBEX files

You can import on all PlugIn supporting CAN interfaces for CANdb measurements a FIBEX file. When the FIBEX file includes CAN messages it is an adequate replacement for the DBC file.

The import dialog is indicating in the protocol header "Free running".
After the import you see you CAN messages and the channel.
13.7.2 Import CAN FD signals from FIBEX files

The FIBEX XML file supports CAN FD protocol imports.
13.7.3 Display of Sender name for FIBEX, DBC, AUTOSAR messages

The import properties of the CAN, FIBEX and AUTOSAR messages include now the sender name when defined in the description file.

Example: DBC import dialog including the „Sender name“. 

![Image of DBC import dialog with highlighted Sender name field]
13.8 Description file import with CSV file for channel reference

The CSV reference file significantly improves the description file import and channel activation. Especially when you are working with large description files with many channels, sometimes you are uncertain if all required channels are included in the description file. It is also time-consuming to search and activate only the relevant channels for your specific measurement manually.

With the CSV reference file you can compare your description file to a CSV channel list. This comparing process covers two functions:

- All matching channel names from the CSV reference list are automatically activated. This saves a lot of time compared to activating channel by channel. The channel selection is not case sensitive. Channels are selected even when the lower and upper cases do not match.

- All the channels which are included in the CSV file but not in the description file are listed in a separate "missing channels" list. Missing channels can be saved in a separate CSV file for later analysis purposes.
Channels are selected even when the lower and upper cases do not match.

Information

A second filter criteria can be added to the CSV file to optimize the import, e.g. to specify sample rate or DAQ list settings in the import process.
### 13.8.1 Multi column CSV selection for description file imports (DBC, A2L)

The CSV filter can support additional columns apart from the channel name to select dedicated channels in your description file import. In the example below you see how a DBC import can be improved by adding the message name as a second selection criteria.

![DBC import with duplicate channel names.](image)

In this example we define only the channel names as selection criteria. In this case duplicate channels across the whole DBC file get selected during the import process.

![CSV filter file with 1 selection column: Channel Name](image)
If you add the message ID to the selection criteria in column 2, you can pick the specific channels of the messages you are interested in.
If you like you can set during the DBC import the sample rate by message ID too.

The sample definition can be located on column 2 also. It is not required that the sample rate definition must be located on column 3 at any time.

When you are using CSV filter for A2L import you can select channels by channel name in the first column and associated to the signal a DAQ list or sample rate during the import too.
13.8 Description file import with CSV file for channel reference

13.8.2 Check duplicate channel names during description file import

When run an import of any description file (DBC, FIBEX, A2L, . . . .) the import process can check for any duplicate channel name and provide a dialog to resolve duplicate channel name conflicts.

In order to activate this feature you have to make an additional entry in the Settings.XML file.

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\Settings.XML

The new entry in the XML file should be:

```
<ImportSettings>
  <checkForDuplicateSignalNames>True</checkForDuplicateSignalNames>
<ImportSettings>
```
13.8 Description file import with CSV file for channel reference

With the new entry in the Settings.XML file the import dialog will guide you to a new dialog highlighting all duplicate channels out of the selected channel list. There are two functions available in the drop down list:

- **Accept duplicates**: With this function you accept the duplicates and confirm them.
- **Rename signals**: When you select the rename function you have to edit the channel names in the grid.
13.8 Description file import with CSV file for channel reference

Apply column chooser to get information about the channel reference.
When all duplicate conflicts are resolved the import can be finalized and all channels are renamed.
13.9 Description file import with INCA LAB file

To support the workflow between INCA and IPEmotion measurements an INCA experiment (LAB-file) import is supported besides the CSV import. You can save part of your INCA experiment in the LAB file format. This LAB file can be used to create easily the same measurement configuration for IPEmotion.
All description file imports on all PlugIns support the CSV and LAB file filter.

After you have imported your complete description file you can use the CSV and LAB reference to select only those channels which are relevant for your measurement application.

Example: Select LAB-file for channel activation
When the LAB file was selected the associated channels from the description file are automatically activated in the import dialog. A message box is also returning all channels which are included in the LAB-file and missing in the description file.
## 13.10 Synchronization of description files

You can use the description file synchronization function to compare your existing measurement configuration against a new description file. The description file synchronization is useful to get a direct view about the differences between a new ECU description file and your current measurement configuration. The following file formats are supported for synchronization:

<table>
<thead>
<tr>
<th>File Format</th>
<th>Objecttype</th>
<th>Protocol</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2L</td>
<td>Signal</td>
<td>CCP, XCP, KWPropCan</td>
<td>DquipType, ListNumber, EventNumber</td>
</tr>
<tr>
<td>A2L</td>
<td>DAQ-Liste</td>
<td>CCP, XCP</td>
<td>Name</td>
</tr>
<tr>
<td>A2L</td>
<td>Characteristic</td>
<td>CCP, XCP, KWPropCan</td>
<td>Name</td>
</tr>
<tr>
<td>AutoSar (ARXML)</td>
<td>Botschaft</td>
<td>FreeRunning</td>
<td>Name, Message</td>
</tr>
<tr>
<td>AutoSar (ARXML)</td>
<td>Frame</td>
<td>FlexRay</td>
<td>Name, Frame</td>
</tr>
<tr>
<td>AutoSar (ARXML)</td>
<td>Signal</td>
<td>FreeRunning</td>
<td>Name, Message</td>
</tr>
<tr>
<td>DBC</td>
<td>Botschaft</td>
<td>FlexRay</td>
<td>Name, Frame</td>
</tr>
<tr>
<td>DBC</td>
<td>Signal</td>
<td>FreeRunning</td>
<td>Name, Message-Sender</td>
</tr>
<tr>
<td>DBC</td>
<td>Signal</td>
<td>J1939</td>
<td>PID</td>
</tr>
<tr>
<td>DBC</td>
<td>Signal</td>
<td>GMLen</td>
<td>Name</td>
</tr>
<tr>
<td>FBEX (XML)</td>
<td>Frame</td>
<td>FlexRay</td>
<td>Name, Frame</td>
</tr>
<tr>
<td>FBEX (XML)</td>
<td>Signal</td>
<td>FlexRay</td>
<td>Name, Frame</td>
</tr>
<tr>
<td>IDF</td>
<td>Job</td>
<td>KWP-, UDS-Diagnose</td>
<td>Name</td>
</tr>
<tr>
<td>LDF</td>
<td>Botschaft</td>
<td>LIN</td>
<td>Name</td>
</tr>
<tr>
<td>LDF</td>
<td>Signal</td>
<td>LIN</td>
<td>Name, Message</td>
</tr>
<tr>
<td>PDX</td>
<td>Job</td>
<td>KWP-, UDS-Diagnose</td>
<td>Name</td>
</tr>
<tr>
<td>UDS-Messn (XML)</td>
<td>Signal</td>
<td>UDS</td>
<td>Name</td>
</tr>
</tbody>
</table>

The default setting of the file synchronization is based on message ID and and message name. In the standard setup the description file is compared on Message ID and channel name. When one of two parameters is different, the synchronization will not take place and you will get a notification in the message window. The standard synchronization behavior can cause an additional workload when e.g. a channel is switched to a different message ID because then the synchronization does not take place and the related links to the VIEW instruments and formulas or storage in the ACQUISITION work space etc. is removed as well. In the following example the default synchronization behaviour is presented by selecting the synchronization function on description file level.
13.10 Synchronization of description files

In the next step you select the description file you like to compare against and the processing treatment operation. Here you can enable a message window to get an overview of the differences detected and how to treat the differences. In this example we will get an message window to see the differences. The treatment selected is: Deactivate the channels which cannot be synchronized.

The message popup window is now indicating that the channel Exhaust1 could not be synchronized and was therefore accordingly to the treatment operation was deactivated.
The configuration is now indicating the deactived channel Exhaust 1.
13.10 Synchronization of description files

13.10.1 Synchronize signals by name
With the EXPERT setting “Synchronize signals by name” the synchronization mechanism is focusing only on the channel name and not any more on the message ID and channel name together. The benefit for the user is that the synchronization will take place and the links to the VIEW instruments etc. remain intact to display online data.

The screenshot below in indicating on the right hand side, that the channel Exhaust 1 was successfully synchronized even so that it is included on a different CAN message ID.

Synchronization: Message ID & Channel Name

Synchronization: Only by Channel Name
14 ACQUISITION workspace

The ACQUISITION work space is dedicated to store data, to run online math and logic functions, monitor on thresholds and analyze data through the classification and the Fast Fourier Transformation (FFT).

Example:

![Functional over view of a Developer edition](image)

**Information**

The screenshot was taken with a Professional Edition not including options like CONTROL or CLIMATE. When you have a license which includes options, more functions and formulas are accessible. See chapter Software Editions > Options for more details 5.2. Note: The Traffic generator is not included in Basic, Lite, or Standard Edition.
14.1 Ribbon

Formula
Here you can create formulas and add formulas to a pool

Number
Number refers to variables in general which consist of Number, Status, Text

Storage Group
Here you can save channels to data files

Limit
Is related to Limit and Range monitoring

FFT
Fast Fourier Transformation for dynamic signal analysis

XCP slave
A2L export function to stream online data to other 3rd party software applications

Router
Is only visible if the control license is activated.
14.2 Calculations

14.2.1 Formula parser

IPEmotion uses the same formula interface in all parts of the application. This refers to online formulas, offline formulas in the analysis or limit and range channels which will be discussed later in this chapter. Also, the trigger conditions of the storage group can be defined through a formula. It is very convenient as you work with the same interface all the time. You can enter the syntax directly into (C) the formula field. You do not need to build your expression by picking operations from the list.

The formula parser is organized in the following 4 sections:

- (A) Here you have a list of all supported operations and math functions.
- (B) List of channels or other formulas you have already created.
- (C) Here you will see your formula / expression which will be calculated based on the syntax of the operation and the related channels.
- (D) The lower part provides some online help instructions of how to use the operation.
14.2 Calculations

Use the column chooser to add additional channel properties to your channel grid. This could be for example the source in order to identify clearly where the channel originates from.

14.2.2 Add formula to formula pool

If you want to keep the syntax for later use you can add the formula to the pool. Select /highlight the formula channels and use the context menu to add them to the pool.
14.2 Calculations

14.2.3 Import / retrieve formulas from the pool

The formula pool is maintained centrally for all parts of the program. Formulas you create for online calculations in ACQUISITION are also available in the ANALYSIS or DATA MANAGER workspace. If you want to see all stored formulas and update or delete entries you need to refer to the APPLICATION menu > Reset Object Pool 7.8.

While importing formulas from the pool, the import dialog is checking formula name and syntax. When the system detects a formula already existing you get a warning message about the duplicate formula name with an option to overwrite the existing formula or to create a duplicate entry.
14.3 Configurations for formula channels

When a formula is created you can edit the formula afterwards in the channel grid or through the context menus below.

14.3.1 General tab sheet

The General tab sheet refers to the general properties of the formula channel.

- **Active**: Activate channel to execute the computations
- **Name**: Default formula / channel name
- **Description**: Add an additional description for the formula
- **Unit**: Symbol to show engineering unit of the channel
- **Sample rate**: Refers to the cycle time of how often a channel executes the calculation. The sample rate can be higher, lower or equal to the sample rate of the operands (source channels). Good results are achieved if the sample rate of the math channel matches the sample rate of the source channel.
14.3.2 Formula tab sheet

In the Formula tab sheet you can edit the formula or retrieve another formula from the formula pool.

Update the formula and / or access the pool.
Recursive formulas can be configured with a start value. Any type of formula which has its own channel as input (recursive) cannot calculate any results as the first input value is missing. With a start value this can be easily solved.
An important impact to the operation is the persistency setting.

- **Non**
  This is the default setting. With every measurement start the recursive formula will start from start value with every measurement.
14.3 Configurations for formula channels

- **Always**

  This setting is designed to use the start value only one time at the beginning. It is a useful function for totalizer operations where you like to keep adding up values from one measurement start to the next like cumulative mileage counting. The last value of the formula is stored in a configuration file. However, if you like to reset the persistency value you have to use the reset function in the APPLICATION MENU 7.8. The reset function is applied to all recursive formulas using the persistency function.

![Diagram of formula configuration]

**Pause periods – no measurement**

**Always persistency**
14.3 Configurations for formula channels

14.3.3 Display tab sheet

In the Display tab sheet you can define settings for data presentation in the VIEW instruments. The same settings were discussed in the SIGNALS chapter 12.10.

- **Display area** Covers the default setting of the Y-axis in the Yt- and XY chart
- **Formatting** Covers the number of decimal places in numerical instruments
- **Mode** With the mode you can influence how the result of the formula channel are displayed and stored
  - **Mode - Factor/Offset** This is the standard default display of the data
  - **Mode - Time Span** This mode is particular useful when you have math functions which count time. Rather than displaying a number e.g. = 120 [seconds] it is presented as HH:MM:SS = 00:02:00
  - **Mode - Absolute Time** This mode is adding the date as well to the time stamp
14.3 Configurations for formula channels

- **(Display) Name**

  With this name you can define a different name compared to the channel name which will be visible on the online VIEW instruments. Provided you have activated the function in the OPTIONS > View 23.5.4. The display name can be added through the column chooser in the VIEW workspace too. See for reference 18.3.2
14.4 Overview of all operations: math and logic functions

Operations and descriptions:

- **Addition**
  
  "Channel 1" + "Channel 2"

- **Subtraction**
  
  "Channel 1" – "Channel 2"

- **Multiplication**
  
  "Channel 1" * "Channel 2"

- **Division**
  
  "Channel 1" / "Channel 2"

- **MOD**
  
  The mod operator calculates the remainder of a division for integer numbers. Integer numbers have no fractional or decimal components.
  
  Syntax: "Operand1" MOD "Operand2"
  
  Examples:
  
  \[
  (11 / 3 = 3 + \text{remainder } 2) \quad 11 = (3*3) +2
  \]
  
  \[11 \text{ MOD } 3 \Rightarrow 2 \quad \text{or} \quad 12 \text{ MOD } 7 \Rightarrow 5\]

- **ABS ()**
  
  The absolute function converts a negative value into a positive one. The terms need to be put into brackets.
  
  Syntax: ABS ("Channel1")
  
  Example:
  
  -33,5 changed to 33,5 or 22,7 remains 22,7

- **SIGN ()**
  
  The SIGN function returns the sign of the numeric term, which is written in brackets. Depending on the read number, the function returns the values as follows:
  
  Syntax: SIGN ("Channel1")
  
  Example:
  
  -33,5 at negative numbers, SIGN returns -1
  26,3 at positive numbers, SIGN returns 1
  0 at zero, SIGN returns 0

- **NEG ()**
  
  The NEG function changes the sign. Negative readings are changed to positive and positive readings are changed to negative.
  
  Syntax: NEG ("Channel1")
  
  Example:
  
  -33,5 changed to 33,5
  26,3 changed to -26,3
  0 remains 0

- **PREV ()**
  
  PREV sends the operands previous value. The result of the first calculation is NoValue if the optional initial value is not defined. If the initial value is sent, it is used as result of the first calculation.
  
  Syntax: PREV(Operand), PREV(Operand; Initial value)
  
  Examples:
  
  PREV ("Channel 1") sends the value of "Channel 1" from the previous calculation cycle, the result of the first calculation is NoValue.
  PREV ("Channel 1"; 10) sends the value of "Channel 1" from the previous calculation cycle, the result of the first calculation is 10.

- **PREVN ()**
  
  PREVN sends the operand's previous value with a settable depth. The result of the first calculations are NoValue if the optional initial value is not defined. If the initial value is sent, it is used as result of the first calculations.
  
  Syntax: PREVN(Operand; Depth), PREVN(Operand; Depth; Initial value)
  
  Examples:
  
  PREVN("Channel 1"; 2) sends the value of "Channel 1" from the last but one calculation cycle, the result of the first calculation and the second calculation is NoValue.
  PREVN("Channel 1"; 2; 10) sends the value of "Channel 1" from the last but one calculation cycle, the result of the first and the second calculation is 10.
14.4 Overview of all operations: math and logic functions

◮ =
Equal compares Operand1 to Operand2. When the condition is true the formula returns value 1. When the condition is not true it returns the value 0.
Syntax: "Operand1" = "Operand2"

◮ <>
Unequal compares Operand1 to Operand2. If the values do not match, the function returns 1, otherwise when both operands have the same value the function returns 0.
Syntax: Operand1 <> Operand2

◮ <
Less compares Operand1 to Operand2. If the condition is not true the function returns 1, otherwise when Operand1 is greater than Operand2 the function returns 0.
Syntax: Operand1 < Operand2

◮ <=
Less or Equal compares Operand1 to Operand2. If the condition is not true the function returns 1, otherwise when Operand1 is greater than Operand2 the function returns 0.
Syntax: Operand1 <= Operand2

◮ >
Greater compares Operand1 to Operand2. If the condition is true the function returns 1, otherwise when Operand1 is smaller than Operand2 the function returns 0.
Syntax: Operand1 > Operand2

◮ >=
Greater or equal compares Operand1 to Operand2. If the condition is true the function returns 1, otherwise when Operand1 is smaller than Operand2 the function returns 0.
Syntax: Operand1 >= Operand2

◮ AND
Logical AND operator compares two conditions. When both conditions are true value 1 is returned, otherwise 0.
Syntax: (Condition1) AND (Condition2)
Example:
(2.4 > 1.2) AND (21.3 <34.1) => 1
(2.4 <1.2) AND (21.3 <34.1) => 0
(2.4 > 1.2) AND (21.3 = 34.1) => 0
(2.4 <1.2) AND (21.3 = 34.1) => 0

◮ OR
Logical OR operator compares two conditions. When one condition is true the operation returns 1, otherwise 0.
Syntax: (Condition1) OR (Condition2)
(2.4 > 1.2) OR (21.3 <34.1) => 1
(2.4 <1.2) OR (21.3 <34.1) => 1
(2.4 > 1.2) OR (21.3 = 34.1) => 1
(2.4 <1.2) OR (21.3 = 34.1) => 0 (both conditions are not true)

◮ XOR
Refers to the logical Exclusive-Or operator. If exactly one of the partial conditions is true value 1 is returned, otherwise 0.
Syntax: (Condition1) XOR (Condition2)
(2.4 > 1.2) OR (21.3 <34.1) => 0
(2.4 <1.2) OR (21.3 <34.1) => 1
(2.4 > 1.2) OR (21.3 = 34.1) => 1
(2.4 <1.2) OR (21.3 = 34.1) => 0

◮ SHL
Moves Operand1 by the number of bit positions defined by Operand2 to the left. The system is multiplying Operand1 with \(2^\text{Operand2}\).
Syntax: "Operand1" SHL "Operand2"
1 SHL 2 => 4 calculation 1 * 2^2 = 4
12 SHL 1 => 24 calculation 12 * 2^1 = 24

◮ SHR
Moves Operand1 by the number of bit positions defined by Operand2 to the right.
Syntax: "Operand1" SHR "Operand2"
1 SHR 2 => 0 calculation 1 / 2^2 = 0,25 > converted to 0
12 SHR 1 => 6 calculation 12 / 2^1 = 12
14.4 Overview of all operations: math and logic functions

- **SIN** Sine function
- **COS** Cosine function
- **TAN** Tangent function
- **SINH** Hyperbolic sine function
- **COSH** Hyperbolic cosine function
- **TANH** Hyperbolic tangent function
- **ASIN** Arc sine function
- **ACOS** Arc cosine function
- **ATAN** Arc tangent function
- **EXP ()** Natural exponential function \( e^x \). Euler exponential function. Euler's number \( e \) is approximately 2.718.
  Syntax: \( \text{EXP} \left( \text{Operand1} \right) \)
  \( \text{EXP}(1) = 2.72 \) calculation \( 2.718^1 = 2.72 \)
  \( \text{EXP}(2) = 7.39 \) calculation \( 2.718 \times 2.718 = 7.39 \)
  \( \text{EXP}(3) = 20.09 \) calculation \( 2.718 \times 2.718 \times 2.718 = 20.09 \)
- **LOG ()** Common logarithm (log10) is the logarithm to the base 10.
  Syntax: \( \text{LOG} \left( \text{Operand1} \right) \)
  \( \text{LOG}(100) = 2 \) calculation \( 10 \times 10 = 100 \)
  \( \text{LOG}(1000) = 3 \) calculation \( 10 \times 10 \times 10 = 1000 \)
- **LN** Natural logarithm is the logarithm to the base \( e \). Euler's number \( e \) is approximately 2.718. The natural logarithm is the counterpart to the natural exponential function (EXP).
  Syntax: \( \text{LN} \left( \text{Operand1} \right) \)
  \( \text{LN}(2.72) = 1 \)
  \( \text{LN}(7.389) = 2 \)
  \( \text{LN}(20.09) = 3 \)
  \( \text{SQRT()} \) This function calculates the square root of a positive number.
- **IF (;;)** The IF condition compares "Condition1" and returns, if true, the value of "Operand2". If the condition is not true it returns the value of "Operand3".
  Syntax: \( \text{IF} \left( \text{Condition1};\text{Operand2};\text{Operand3} \right) \)
  \( \text{IF} \left( \text{Operand1} > 10;100;-5 \right) \)
- **ANDB** Corresponds to the bitwise And operator. All common bits of Operand1 and Operand2 are returned as a result; all other bits return the value 0.
  Syntax: \( \text{Operand1 ANDB Operand2} \)
  \( 27 \) as binary code: 1 1 0 1 1
  \( 12 \) as binary code: 1 1 0 0
  \( 13 \) as binary code: 1 1 0 1
  \( 4 \) as binary code: 0 1 0 0
  \( 27 \text{ ANDB } 12 \Rightarrow 8 \)
  \( 27 \) as binary code: 1 1 0 1 1
  \( 12 \) as binary code: 1 1 0 0
  calculation \( 27 = 16+8+2+1 \) AND \( 12 = 8+4 \)
  \( 27 \text{ ANDB } 13 \Rightarrow 9 \)
  \( 27 \) as binary code: 1 1 0 1 1
  \( 13 \) as binary code: 1 1 0 1
  calculation \( 27 = 16+8+2+1 \) AND \( 12 = 8+4+1 > (8+1) = 9 \)
  \( 27 \text{ ANDB } 4 \Rightarrow 0 \) no common bit pattern
Decimal Values 0 to 15

<table>
<thead>
<tr>
<th>Dualsystem</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>one</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td>two</td>
<td>0 0 1 0</td>
</tr>
<tr>
<td>three</td>
<td>0 0 1 1</td>
</tr>
<tr>
<td>four</td>
<td>0 1 0 0</td>
</tr>
<tr>
<td>five</td>
<td>0 1 0 1</td>
</tr>
<tr>
<td>six</td>
<td>0 1 1 0</td>
</tr>
<tr>
<td>seven</td>
<td>0 1 1 1</td>
</tr>
<tr>
<td>eight</td>
<td>1 0 0 0</td>
</tr>
<tr>
<td>nine</td>
<td>1 0 0 1</td>
</tr>
<tr>
<td>eleven</td>
<td>1 0 1 1</td>
</tr>
<tr>
<td>twelve</td>
<td>1 1 0 0</td>
</tr>
<tr>
<td>thirteen</td>
<td>1 1 0 1</td>
</tr>
<tr>
<td>fourteen</td>
<td>1 1 1 0</td>
</tr>
<tr>
<td>fifteen</td>
<td>1 1 1 1</td>
</tr>
</tbody>
</table>

orb

- ORB: Corresponds to the bitwise Or operator. All bits, which are set in at least one operand, are also set in the result; all other bits result in 0.

  Syntax: Operand1 ORB Operand2

  Examples:
  
  - 27 as binary code: 1 1 0 1 1
  - 12 as binary code: 1 1 0 0
  - 31 as binary code: 1 1 1 1 1
  
  - 27 ORB 12 => 31
  
  - 27 ORB 13 => 31
  
  - 27 ORB 8 => 27

xor

- XORB: Corresponds to the bitwise Exclusive-Or operator. All bits, which are set in exactly one operand, are also set in the result; all other bits result in 0.

  Syntax: Operand1 XORB Operand2

  Examples:
  
  - 27 as binary code: 1 1 0 1 1
  - 12 as binary code: 1 1 0 0
  - 23 as binary code: 1 0 1 1 1
  
  - 27 XORB 12 => 23
  
  - 27 XORB 13 => 22
  
  - 27 XORB 8 => 19

not

- NOTB: Corresponds to the bitwise Not operator. All bits, which are set in the operand, are not set in the result; all other bits are set in the result.

  Syntax: NOTB(Operand1)

  Examples:
  
  - NOTB(27) => 4294967268 (111111111111111111111111100100)
  - NOTB(12) => 4294967283

test

- TESTBIT (;): The function returns the bit value of the Operand for the position defined.

  Syntax: TESTBIT(Operand;1)

  Example:
  
  - 27 as binary code: 1 1 0 1 1
  - TESTBIT(27;0) = 1
  - TESTBIT(27;1) = 1
  - TESTBIT(27;2) = 0
  - TESTBIT(27;3) = 1
  - TESTBIT(27;4) = 1
14.4 Overview of all operations: math and logic functions

- **TESTMASK ()**
  - Runs a comparison with the fixed bit mask 0xFFFFFFFF.
  - Syntax: TESTMASK(Operand1)
  - Examples:
    - TESTMASK(27) => 1
    - TESTMASK(0) => 0
    - HEX: FFFFFFFF
    - DEC: 4294967295
    - BIN: 11111111111111111111111111111111 (32 bit)
  - The application:
    - If at least one bit is set in Operand1, the result is 1, otherwise 0

- **TESTMASKS (;)**
  - Runs a comparison with a definable bit mask. If at least one bit is set in Operand1, as well as, in Operand2, the result is 1, otherwise it is 0.
  - Syntax: TESTMASKS(Operand1; Operand2)
  - Examples:
    - TESTMASKS(27; 6) => 1
      - 27 = 11011
      - 6 = 110
    - TESTMASKS(27; 4) => 0
      - 27 = 11011
      - 4 = 100 > no common bit

- **TIMER (;)**
  - This function generates a permanent HIGH signal. When Operand1 is changing the value the function returns a LOW (value 0). After the time defined in Operand 2 the function is jumping back to HIGH (value 1).
  - Syntax: TIMER(Operand1;Operand2)
  - Examples:
    - TIMER("Channel1";10)
  - This function works in the opposite direction to the MF (MonoFlop) discussed further below.
14.4 Overview of all operations: math and logic functions

▷ **MIN ()**

Detects the operand’s minimum. The calculation uses all valid values and stores the smallest value.

*Syntax: MIN(Operand)*

*Examples:*

MIN("Channel1")

▷ **MAX ()**

Detects the operand’s maximum. The calculation uses all valid values and stores the biggest value.

*Syntax: MAX(Operand)*

*Examples:*

MAX("Channel1")

▷ **MEAN ()**

This function calculates an average. One average calculation considers all values from the start of recording. If a "certain number of values" is defined the mean calculation considers this amount of values and returns the value. The sample rate of the formula has also an impact on the results.

*Syntax: MEAN(Operand)*

*Syntax: MEAN(Operand;number of values)*

*Examples:*

MEAN("Channel 1")

Calculates the average of Channel 1 over all valid values.

MEAN("Channel1"; 10)

Calculates the average of Channel 1 over the last 10 values.
The Mean calculation below is based on a 200 Hz signal (resolution). The frequency of the sine wave is slow with 0.1 Hz so in 60 seconds 10 periods are recorded.

You can see that the sliding mean calculation is affected by the sample rate of the formula.
14.4 Overview of all operations: math and logic functions

- **MINOR ()**
  - The function returns the smaller value of Operand1 and Operand2.
  - Syntax: MINOR(Operand1; Operand2)
  - Examples:
    - MINOR(6.23; 1.9) => 1.9
    - MINOR(2.41; -4.1) => -4.1

- **MAJOR ()**
  - The function returns the greater value of Operand1 and Operand2.
  - Syntax: MAJOR(Operand1; Operand2)
  - Examples:
    - MAJOR(6.23; 1.9) => 1.9
    - MAJOR(2.41; -4.1) => -4.1

- **VALID ()**
  - This function checks Operand1 for validity (NoValue). If only one operand is used, 1 is sent in case of a valid value and 0 in case of an invalid value. If a second operand is used, the value of Operand2 is sent in case of invalidity of Operand1 (even if it corresponds to NoValue); otherwise the value of Operand1 is sent.
  - Syntax: VALID(Operand1)
  - VALID(Operand1, Operand2)
  - Examples:
    - VALID(1.45) => 1.0
    - VALID(NaN) => 0.0
    - VALID(1.45; 2.31) => 1.45
    - VALID(NaN; 2.31) => 2.31
    - VALID(NaN; NaN) => NaN

When NoValues are recorded the formula returns ZERO.
14.4 Overview of all operations: math and logic functions

◮ **FLOOR ()**

This function rounds a floating point number down to the next smaller integer.

Syntax: FLOOR(Operand)

Examples:

FLOOR(13.53) => 13.0
FLOOR(2.41) => 2.0

◮ **CEIL ()**

This function rounds a floating point number up to the next greater integer.

Syntax: CEIL(Operand)

Examples:

CEIL(13.53) => 14.0
CEIL(2.41) => 3.0

◮ **ROUND ()**

This function rounds a floating point number down to the next smaller integer if the floating point rest is less than 0.5. This function rounds a floating point up to the greater integer if the floating point rest is greater than or equal to 0.5.

Syntax: ROUND(Operand)

Examples:

ROUND(13.53) => 14.0
ROUND(2.41) => 2.0

◮ **INT ()**

The integration calculates the operand's integral with the calculation formula "((Op1(t) + Op1(t-1) / 2) * DeltaT".

Syntax: INT(Operand)

Examples:

INT("Channel 1")

It is calculating the actual area under the actual sample and previous sample. This is then multiplied with deltaT. In this case deltaT of the 100Hz Sawtooth Signal = 0.01s

Example: (5,00+4,99)/2*0.01=0,04995

![Diagram of INT integration and Sawtooth signal]
14.4 Overview of all operations: math and logic functions

- **INT_ADD ()**
  
  This function calculates the operand's integral with the calculation formula 
  \[ \left( \frac{\text{Op1}(t) + \text{Op1}(t-1)}{2} \right) \times \Delta t \] 
  and adds this value to the previous result.

  **Syntax:** INT_ADD(Operand)
  
  **Examples:**
  INT_ADD("Channel1")

The sample rate of the channel has no impact on the calculated result.
INT_UP ()

This function sends the upper integral with the calculation formula "Op1 * DeltaT".
Syntax: INT_UP(Operand)
Examples:
INT_UP("Channel1")
Almost same as "INT" but here no average of actual sample and previous sample, it is made simpler (and faster) here only the "upper" sample = actual sample is used.
Example:
DeltaT of Sine 100Hz=0.01s
5,00*0,01=0,05

![Graphs showing the comparison between Sine and INT_UP functions]
14.4 Overview of all operations: math and logic functions

**DIFF ()**
This function differentiates the operand with the calculation formula \((\text{Op1}(t) - \text{Op1}(t-1)) / \Delta t\).
Syntax: `DIFF(Operand)`
Examples:
`DIFF("Channel1")`

**TIME ()**
This function counts time in seconds. If the condition is true counting starts. If the condition is not true anymore the channel returns ZERO.
Syntax: `TIME(Operand)`
Examples:
`TIME("Channel1" > 5)`
Example: When the channel "Number-1" has a value > 5 the time counter starts to count seconds. When the condition is not true the time counter is set back to ZERO.
14.4 Overview of all operations: math and logic functions

**LIN ()**
This is a linearization function with defined nodes. 2 to 16 nodes can be defined. Entering the input values should result in the function monotonously rising. Enter the nodes in an ascending order and use semicolon as separators. When the value of Operand1 is out of the linearization range the start or end value will be displayed.
Syntax: \( \text{LIN(“Operand1”; x-Node-1;y-Node-1; x-Node-2;y-Node-2; ......; x-Node-16;y-Node-16)} \)
Examples:
\( \text{LIN(“Operand1”;0;1;2;5;5;10;15;20;25;50)} \)

**EDGE_POS ()**
This function returns HIGH (1) if the operand crosses the range [0 to 1] in a rising direction.
Syntax: \( \text{EDGE_POS(Operand)} \)
Examples:
\( \text{EDGE_POS(“Channel1”)} \)
Change 0 > 1 returns HIGH (1)
Change 0,5 > 1,3 stays LOW (0) no impact
Change 3 > 4 stays LOW (0) no impact
Change -5 > 2 returns HIGH (1)
14.4 Overview of all operations: math and logic functions

- **EDGE_NEG ()**
  - This function returns HIGH (1) if the operand crosses the range [0 to 1] in a falling direction.
  - Syntax: `EDGE_POS(Operand)`
  - Examples:
    - `EDGE_POS("Channel1")`
    - Change 3 > 0 returns HIGH (1)
    - Change 2.5 > 0.5 stays LOW (0) no impact
    - Change 3 > -5 returns HIGH (1)

- **TFF ()**
  - This Flip Flop inverts the result of a rising edge of Operand1.
  - Syntax: `TFF(Operand1)`
  - Examples:
    - `TFF("Channel1")`
    - Changes the result from 0 to 1 if "Channel 1" changes from less than 0.5 to greater than or equal to 0.5. The operation of this function needs to be clarified.

- **MF()**
  - MF works as Monoflop. If Operand1 changes from less than 0.5 to greater than or equal to 0.5 the result is HIGH (value 1). The result stays HIGH for the specified "Time" in seconds. When the next positive edge is detected the function returns again a HIGH signal (value 1).
  - Syntax:
    - `MF(Operand1; Time)`
    - `MF(Operand1; Time; Retrigger)`
  - Examples:
    - `MF("Channel1"; 5)`
    - If "Channel1" changes from less than 0.5 to greater than or equal to 0.5. The result is HIGH (1) for 5 seconds and the set back to LOW (0). Retrigger function: If "Channel1" changes from less than 0.5 to greater than or equal to 0.5 within time and retrigger = 1 then time is extended with time seconds (in example 5 new seconds).
14.4 Overview of all operations: math and logic functions

- **COUNT (;)**
  
  This function calculates the number of rising edges of Operand1 and can be reset by a rising edge of Operand2.
  
  Syntax: `COUNT(Operand1 ; Operand2)`
  
  Examples:
  
  `COUNT("Channel1"; "Channel2")`
  
  Increments the result each time when "Channel1" changes from less than 0.5 to greater than or equal to 0.5. If "Channel 2" changes from less than 0.5 to greater than or equal to 0.5 the result is set to zero.

- **TIMEDIFF (;)**

  This function calculates the time difference between a rising edge of Operand 1 and a rising edge of Operand 2.
  
  Syntax: `TIMEDIFF(Operand1 ; Operand2)`
  
  Examples:
  
  `TIMEDIFF("Channel1"; "Channel2")`
  
  Increments the time difference if "Channel 1" changes from less than 0.5 to greater than or equal to 0.5. If "Channel 2" then changes from less than 0.5 to greater than or equal to 0.5 the time difference is set as the result.
14.4 Overview of all operations: math and logic functions

- **SECOND ()**
  This function extracts the seconds from a local PC time.
  Syntax: SECOND(Operand)
  Second(LOCAL TIME)
  Example:
  SECOND(LOCAL TIME) returns the seconds of the PC clock
  SECOND(424366820) => 20 Function needs to be clarified.

- **MINUTE ()**
  This function extracts the minutes from a local PC time.
  Syntax: MINUTE(Operand)
  MINUTE(LOCAL TIME)
  Example:
  MINUTE(LOCAL TIME) returns the minutes of the PC clock
  MINUTE(424366820) = 40 Function needs to be clarified.

- **HOUR ()**
  This function extracts the hours from a local PC time.
  Syntax: HOUR(Operand)
  HOUR(LOCAL TIME)
  Example:
  HOUR(LOCAL TIME) returns the minutes of the PC clock
  HOUR(424366820) = 15 Function needs to be clarified.
14.4 Overview of all operations: math and logic functions

The function of the filters is explained in detail in the DATA MANAGER and ANALYSIS work space.

- **FLT_BW_LP ()**
  Applies a Butterworth low pass filter on a channel at a given frequency (Hz) and filter order (1-8 with 8 being the highest quality).
  Syntax: FLT_BW_LP(Operand; Cut-Off Frequency; Order; Sample rate)
  Examples: FLT_BW_LP("Channel 1";25;8;500) filters "Channel 1". Removes frequencies above 25 Hz. The source channel is sampled at 500 Hz. See chapter 19.29.1.

- **FLT_BW_HP ()**
  Applies a Butterworth high pass filter on a channel at a given frequency (Hz) and filter order (1-8 with 8 being the highest quality).
  Syntax: FLT_BW_HP(Operand; Cut-Off Frequency; Order; Sample rate)
  Examples: FLT_BW_HP("Channel 1";25;8;500) filters "Channel 1". Removes frequencies below 25 Hz. The source channel is sampled at 500 Hz. See chapter 19.29.2.

- **FLT_BW_BP ()**
  Applies a Butterworth band pass filter on a channel at a given frequency range (Hz) and filter order (1-8 with 8 being the highest quality).
  Syntax: FLT_BW_BP(Operand; Lower Boundary; Upper Boundary; Order; Sample rate)
  Examples: FLT_BW_BP("Channel 1";12;25;8;500) filters "Channel 1". Removes frequencies below 12 Hz and above 25 Hz. The source channel is sampled at 500 Hz. See chapter 19.29.3.
14.4 Overview of all operations: math and logic functions

- **FLT_BW_BS ()**
  Applies a Butterworth band stop filter on a channel at a given frequency range (Hz) and filter order (1-8 with 8 being the highest quality).
  Syntax:
  FLT_BW_BS(Operand; Lower Boundary; Upper Boundary; Order; Sample rate)
  Examples:
  FLT_BW_BS("Channel 1";12;25;8;500)
  Filters "Channel 1" and removes frequencies between 12 and 25 Hz. The source channel is sampled at 500 Hz. See chapter 19.29.4.

- **SAMPLERATE ()**
  This function returns the frequency of incoming messages / measurements. When you have 100 incoming messages per second the result is
  Syntax: SAMPLERATE(Operand)
  Example:
  SAMPLERATE(Sine-1) = 100
  The Sine-1 channel of the demo PlugIn has a sample rate of 100Hz.

- **SAMPLETIME ()**
  This function calculates the time difference between two incoming messages / measurements.
  Syntax: SAMPLETIME (Operand)
  Example:
  SAMPLETIME (Sine-1) = 0,010 Sec = 10ms
  The Sine-1 Channel of the demo PlugIn has 100Hz.

- **ANGLE (;)**
  This function calculates the angle from the source channels of your recorded data in the cartesian format. The order of Operand 1 and Operand 2 in the formula has NO impact of the calculated results.
  Syntax: ANGLE (Operand1 ; Operand2)

- **RADIUS (;)**
  This function calculates the radius from the source channels of your recorded data in the cartesian format. The order of Operand 1 and Operand 2 in the formula has an impact of the calculated results.
  Syntax: RADIUS (Operand1 ; Operand2)
  See chapter 20.5.2.
14.5 Add user-defined formulas

IPEmotion offers the functionality to integrate your own formulas. The main benefit for you is that you define complex functions in one DLL file which only needs the operands and returns the values. In many cases the syntax builder is not sufficient to execute complex math functions. Another advantage is that you can hide the internal calculations in the DLL and protect your knowledge. A user-defined formula consists of 3 elements:

- **DLL** covers the internal calculation
- **HTML** covers the help instructions which are displayed in the lower window of the Formula Parser
- **XML** this file links the formula to IPEmotion

The process is the following: You develop your formula as C++ code and generate a DLL file.
Then you define the XML file IPEmotion needs to recognize the formula correctly and to execute the calculations.

The help file is not mandatory. It is an aid to show how to use the formula correctly.

The files need to be installed in the following directories. DLL and the XML file are stored in the UserOperation folder.

- C:\Users\Public\Documents\IPETRONIK\IPEmotion\Custom\UserOperation

The help file needs to be translated and copied to all language folders the help file should be available in.

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Help\en-US
14.6 Scaling for any Channel

Channel scaling is mainly dedicated for input / output channel in the SIGNAL work space. However, with the scaling channel in the ACQUISITION work space you can additionally scale any type of formula or variable channel.

The example below compares the original source signal Sine-1 and the scaled one.
14.7 Variables

Variables are very important channels to store values or to integrate them into formulas in order to dynamically change calculations through updated variables. Usually, the variables are not visible for you. You have to activate the variables in the OPTIONS > Expert Mode > Variable Configuration. See chapter 23.3.4. With the column chooser you can add additional columns to the grid.

For each variable type you can define the following settings:

- **Active**: Active variables are considered in the related functions
- **Name**: Name of variable
- **Description**: Description to add supplementary information to the channel. The description is stored in the store files and also exported to other file formats
- **Unit**: You can enter any unit
- **Set Start Value**: With this checkbox you will activate the start value function. A specific number or text will be displayed at measurement start.
- **Start Value**: The actual value which will be made visible and which will be stored. For some applications it is very important that the measurement is started with a specific first value in order to ensure that all calculations and logic functions are operating correctly.
14.7 Variables

14.7.1 Number Variables
Number variables accept numeric values only.

14.7.2 Status Variables
Status variables only accept 0 or 1 status values.

14.7.3 Text Variables
Text variables accept text and numbers.

The screenshot below indicates the different behavior with activated and defined start values and deactivated start values which display “NoValue” in the instruments.
14.8 Data Saving – Storage Groups

The data storage function is an important function of a data acquisition software. IPEmotion is designed in a way that the data storage functions run in the highest task classes to ensure a safe operation of the data saving process. Other functions which update the GUI to show online data on graphs and diagrams have a lower task priority. The most important highest priority threads are the storage functions and the test sequencing functions if you use the CONTROL module which will be discussed at the end of this chapter.

One store group is automatically created by IPEmotion. On the left side you see all channels and with drag and drop or through selections you can move channels to the right side. All channels on the right side are stored in the data file.

A status channel is related to every store group. When storage is active (saving mode) the status of this channel is HIGH and is recorded with the value 1.
14.8.1 Storage group – prefix data file name configuration

Naming the data files according to a meaningful format is a very useful, in order to group and retrieve data files later on easily. The file name can be individually configured using a large range of standard and individual customizable parameters. The file name is on storage group level defined, so every storage group can have a different prefix.

The Prefix editor is a user-friendly interface to compose your individual file name including your individually defined parameters.
The details of the Prefix editor are explained below.

The editor interface provides the following 5 elements.

(A) In this list you find all parameters and the corresponding input data defined in the PROJEKT work space. The PROJECT parameters can be defined a corresponding globalPar.xml and globalData.xml files, located in the folder:

- C:\Users\Public\Documents\IPETRONIK\IPEmotion\ProjectTemplate\
This area covers 3 default parameters which are independent of the project parameters. Index relates to the increment, when a new file is created. For the Index you can define in the column format placeholders in terms of the number of digits you like to see. This is useful, in order to ensure the same file length to fill up the leading place with zeros. The first data file will always start with number 0. Also, the time and date format can be configured in different formats.

In the editor field you see the defined place holders. With double click to the parameter you add it to the file syntax. You can add free text and many social signs / letters. When the syntax is not correct a warning is visible in the review box. The not allowed characters are listed too.

This field provides a preview of the expected file name structure. In this box help information about the selected parameter is displayed.
14.8.2 Ring buffer storage group (FiFo)

Beside the storage group you can also create a ring buffer storage group. The ring buffer storage group covers only the data of the specified time window. The default time is one minute. When the time window is elapsed, new incoming data is stored, and the oldest data is shifted out like the FIFO principle.
The time window can be specified in seconds [s] and hours [h].

Graphical overview of the ring buffer operation.
14.8.3 Guided measurement for parameter input

With the function guided measurement, the user can trigger a pop-up window to enter and update project parameters.

The popup window can be triggered at the beginning of the storage or at the end when the data file is going to be closed. The pop-up window can only triggered at the beginning of the measurement when one storage group is active. Also no trigger conditions within the storage group configuration are allowed. To generate a pop up window at the beginning of the measurement only one storage group shall be activated. The function is not supported when several storage groups or ring buffer groups are configured.
By default the pop-up window includes all data files and data values as defined in the PROJECT work space.

The green marked cells in black fond can be edited. When the values are updated you will automatically update the default values of the PROJECT work space too.

Data input to the pop-up window will update the default values of the PROJECT work.
14.8 Data Saving – Storage Groups

The standard behavior is that all parameter from the globalPar.xml are used as default for the MeasurementParameterDialogConfig.xml. With modifications in this file you can reduce the list of input fields individually. If you like to modify the selection of list entries in the pop-up window, you need to refer to the following XML file:

- MeasurementParameterDialogConfig.template.xml

This file is located on the following directory:

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\ProjectTemplate\en-US

In order to make the confirmation changes to the XML file effective you need rename the file to: MeasurementParameterDialogConfig.xml

In this example the SerialNumber was deactivated in the XML file. You shall modify the XML file only when IPEmotion application is closed. When you modify the XML and close the software afterwards, all your changes will be overwritten.

Example:
Parameter “Serial Number” is deactivated
The following screenshot compares list items of the PROJECT PARAMETERS on the left side to the modified pop-up window on the right side.

Pop-up window with reduced list of guided measurement parameters.

**Example: Serial number**

Project Parameters (all)  
Guided measurement parameters (selection via XML file) [AC_06_14]
14.8.4 Data storage only enabled when channels are included

The data storage button is only enabled when channels are included in the store group.

⚠️ **Attention!** The button is enabled even if the channels included in the store group are not activated. In this case, the data file will be empty.

14.8.5 Automatic scrolling function at moving channels in the channel list

You can change the order by moving channels up and down. In channel lists with many items this is easy because a scroll bar is available. The channel list is automatically scrolling when you reach the top or bottom end of the channel grid.
The order of the channels in the store group can be manually modified. Just drag and drop the channels to the required position. The order of channels in the store group is also considered in the data manager and in the data export.
14.8.6 Storage rate – reduce data file size

You may want to reduce the data file size by reducing the storage rate. Therefore you can define a storing rate smaller than the sample rate of the inputs. This function is just reducing the number of samples. If you measure 100 Hz and you store at 10 Hz, 90 samples are not stored. When you reduce the storage rate, this has an immediate effect on the final IAD data file size. With the storage rate reduced, the files are also getting smaller.

14.8.7 Storage Group – General tab sheet

In the general tab sheet you define the status active / inactive storage group, the name and an optional additional description.
14.8 Data Saving – Storage Groups

14.8.8 Storage Group – Saving tab sheet

The saving tab sheet is very important as you can configure many saving options.

- **Directory**
  The default directory is defined in the OPTIONS > Directory. For more details see chapter 23.12.

- **Format**
  When you select a data storage format from the dropdown list which is not supported for import you will get a message that an import is not supported.

- **Prefix**
  With the prefix you can define a name for the data file. When you generate several data files they are indexed through an incrementing counter.
In Script you can select from a pull down menu all scripts created in the SCRIPTING work space. The script will be automatically executed when the storage is finished.
Marker channels are important for adding text comments to a data file. You can include a generic Text channel from the variables or a special Marker channel from the storage group options to save text information during data recording.

Marker - HotKey

If you like to operate a marker through a hotkey please see OPTIONS > HotKey chapter 23.14. When you define a HotKey for the Marker channel and you hit this hotkey during recording you will get a pop-up message box to enter your comment.

Marker - Text channel

To add text information (comments) to your data file you can link the text channels to an alphanumerical instrument. Through this instrument you can add text comments to the data file.
When one or more text channels are included in the data file, they can be modified in the ANALYSIS workspace. You can select from the following different transactions.

► To add new text comments for a specific time stamp
► Rename and change the text comment of an existing marker
► Change the position of an existing marker
► Delete a marker from the file

When you have applied all the marker changes the graph gets updated with the new marker information as indicated on the screenshots below. In order to save the updated marker information you need to export the data to a new file.
14.8 Data Saving – Storage Groups

14.8.9 Storage Group – Storage tab sheet

The storage tab sheet is related to the storage trigger functions. The standard storage group operation is to activate / deactivate the data storage through the store button in the ribbon. You can access the storage button in the ACQUISITION and VIEW work space.
Data Saving – Storage Groups

You can activate / deactivated data storage without stopping the overall measurement. The data storage can be operated independently from the overall measurement (display) of online values in instruments.

- **Storage Mode**
  - You can select from 3 different storage modes
  - **One file per acquisition**
    In this storage mode you start and stop data storage through the buttons in the ribbon. The trigger conditions are disabled.

- **Cyclical file generation**
  In this storage mode you can define the Post-trigger time in [s, m, h]. When this mode is selected the software is automatically generating a file after the Post-trigger time has elapsed. You need to activate the storage only one time through the ribbon and then the files are automatically generated in the defined time interval.
Triggered data storage

This storage mode offers you the largest flexibility to define trigger events for the data storage process. You can define Pre- and Post-trigger times. Depending on the selected trigger configuration the graphic is updated to visualize the storage process. With a Pre-trigger you can capture data and events before the trigger condition is true. This function is very practical if you need to analyze signals before the trigger event. With the Post-trigger time you define for how long the storage will remain active even if the trigger condition is not true anymore. When you only define Pre- and post-trigger times you can still operate the data storage through the Store button in the ribbon. However, you are not obliged to.

The Start and Stop Trigger can be defined through the Formula Parser interface. You are free to define any trigger condition taking math and logic functions supported by the Formula parser. In the example above, a limit monitoring function was configured to start and stop the data recording when a digital Input is HIGH (> 0.5) or LOW (<0.5).

Information

Please note that the activation of the measurement (online data is displayed on the screen) never activates the storage process. If you want to activate the data storage you need to hit the store button. This is also needed when you have configured a triggered data storage.

Information

In many cases users think they need to start the measurement and the trigger condition will start the data saving. This is not true. The overall data saving needs to be armed / activated and in the storage status window you will see a status message like Offline or Pre-trigger/Storing and Waiting. The storage status windows were discussed in the application menu in chapter Administration > View 7.6.
Display of online data is not automatically activating data storage.
14.9 Storing duplicate channel names

You can store duplicate channel names in a storage group, in case these channels have different sources. It is mandatory that duplicate channel names have different sources / references. For example, having one measurement module or ECU or a common CAN interface and you define a duplicate channel name, it is still rejected and cannot be stored.

Both channels named “Temp 1” come from two different devices and can be stored in a common storage group. It is recommend that you add the column Reference.
In **DATA MANAGER** you will see a transformed channel name. The duplicate channel names include the sources.

In **ANALYSIS** the Yt- chart indicates where source channels are coming from. The Y-axis cannot be merged.

If you like to use field commands in the reporting, you have to address the new channel name which includes the source running your calculations.
14.9 Storing duplicate channel names

Use full channel name for scripting and field commands.
14.10 Monitoring – Limit and Ranges

14.10.1 Creating Limit channel

Using the Limit channel, you can monitor a signal for a threshold value. If the Limit condition is met, certain events can be executed. The Limit monitoring function is very important for many measurement applications. Limit and range channels have many functions in common. Therefore the Limit will be discussed in detail. The differences to the Range channel will be discussed in the Range chapter 14.10.8.

With the column chooser you can add up to 14 additional data columns to the channel grid. Limit has the following configuration tab sheets.

14.10.2 Limit – General tab sheet

- **Active**: In the general tab sheet you define whether a channel is active or inactive. If the channel is inactive (deactivated) the limit monitoring function is disabled.
- **Name**: Is related to the name of the channel.
- **Description**: A space to add additional text information to the channel.
14.10.3 Limit – Configuration tab sheet

The configuration of a limit consists of two parts. The first one is the definition of the source channel and the threshold condition. The second part is related to the events.

- **Channel**
  Select all input channels, variables (number, status, text), any formula and scaling channel here.

- **Operation**
  Operation covers the type of monitoring function: <smaller> > larger = equal != unequal <= smaller equal >= larger equal

- **Reference value**
  Reference value is the threshold value. It is the value the source channel is permanently compared to. Reference value can be a fixed value like example (4) or a formula or logic operation.

- **Output**
  Output refers to the action associated to the limit. When the limit is met, the defined action is executed. Four actions are supported. Clicking the checkbox, you activate the action.
The Output configuration will be discussed in the Output tab sheet.

### 14.10.4 Limit – Settings tab sheet

In the settings tab sheet you can define level or edge trigger mode.

#### Level trigger

This trigger condition will monitor the source channel on the threshold (reference) value and execute the actions if the condition is true right from the beginning of measurement. Every time the reference value is crossed (condition = right), an action is executed.
Edge trigger

The edge trigger has a different behavior than the level trigger. In this case the limit channel will define the condition true if the signal has crossed the reference value. That means even if at start of measurement the limit condition is true, no action will be executed.
14.10 Monitoring – Limit and Ranges

◮ Hysteresis

With a hysteresis tolerance / range you are able to reduce the number of limit events provided by the signal which is often nearly over and below the reference value. If the signal jumps between above and below the reference value within the tolerance (hysteresis), the limit action only is executed the first time when the limit condition is met. In order to generate another limit action the signal has to leave the hysteresis band and cross the reference value again.

14.10.5 Limit – Output tab sheet

In the output tab sheet you can define the following 3 output events.

◮ Message window

If you like to show a message in the message window you can define the severity Info / Warning / error and a corresponding text here. You can activate the message window in the Application menu as discussed in chapter 7.7.
14.10 Monitoring – Limit and Ranges

- **Output Channel**: If you define an output channel (analog, digital, or variable channels like number or status) the output value will be send to this channel. If you enable reset, the output value will be set back to your defined reset value if the limit condition is not met anymore.

- **Program/Script**: With Program/Script you can execute a Script if the limit condition is met. If you have a Professional license, you have access to the scripting interface and you can manage your VBS and Python scripts as separate functions inside IPEmotion. If you have no scripting tab sheet, you can directly link the Visual basic (VBS) and Python (PY) scripts located on the PC to your event.

- **Popup Window**: You can configure a pop-up window notifying if the limit condition is met. The duration until the window closes, can be configured in options of the Expert mode. The default configuration is 5 seconds. If you configure a duration of 0s, the pop-up window will stay on the screen as long as it gets closed by the user. It will not disappear automatically after the defined time period.
14.10.6 Limit – View tab sheet

In the View tab sheet you can define the appearance of the limit channel.

- **Color**: With color you define how the limit channel is visually presented if the condition is true. You can enable the Limit channel in the Yt-chart and in many other instruments and the color you define will be displayed on the instruments.

- **Blink**: If you enable the blink check box, the LED instrument can show a blinking image if one is defined.

- **Image**: Link an image file you would like to be shown on an LED instrument.

- **Caption**: The caption refers to a text message output on the LED instrument. For more details about the LED configuration see VIEW > LED in chapter 18.18.
14.10 Monitoring – Limit and Ranges

14.10.7 Adding and retrieving limit channels from a pool

Limit channels like formulas can be saved to a pool. You can also retrieve limit channels from the pool.

![Image of limit channel settings]

14.10.8 Range channel

The range channel offers some very convenient functions in order to monitor a source channel to an upper and lower limit. One channel can check whether a signal is leaving or entering a defined range.

- **Color**

  The monitoring operation defines whether the signal is checked to values inside or outside the upper and lower limit reference.

![Image of range channel settings]

Monitor signal inside the range.

Monitor signal outside the range.
14.11 Analysis – FFT

The FFT analysis is made for dynamic signal analysis where you can find harmonic frequencies and corresponding amplitudes. When creating an FFT channel, it will calculate the components of Amplitude, Power and Phase.
14.11 Analysis – FFT

14.11.1 FFT – General tab sheet

- **Active**
  With this checkbox you activate / deactivate the FFT calculation
- **Name**
  Refers to the name of the FFT
- **Description**
  Here you can add an additional description to the FFT

14.11.2 FFT – tab sheet

- **Source channel**
  This is the signal channel which is subjected to the FFT calculation.
- **Resolution**
  The resolution is related to the number of taken samples to calculate the FFT. The resolution range includes 64, 128, 256, 512, 1024, 2048 and 4096 samples.
- **Resulting updating time**
  Is automatically calculated from signal sample rate and the resolution (number of samples). If you take a resolution of 2048 samples and you have a signal with 200 Hz sample rate, the acquisition time takes about 10,24 seconds before the FFT is presented. (2048 / 200 = 10,24 sec)
- **Window function**
  The window function is particularly important if only very few periods of signals are included in the calculation and the trigger point of the signal recording gets an important impact on the computed result. The following window functions are supported: Hanning, Hamming, Backman, Bartlett.
14.11.3 Channel - tab sheet

- Display area MIN / MAX: Defining the Y-axis Min and Max scale
- Unit: Defining unit to be shown on the FFT instrument X-axis

14.11.4 Linking channels to the FFT diagram

You can simply drag and drop all 3 different types (Amplitude, Power, Phase) into the same FFT diagram. The configuration options of the FFT diagram will be discussed in the chapter 18.10.
14.12  Analysis - Classification

Classification is a signal analysis method for to get specific information about the signal. You can choose from eight different classification methods. The computed data is presented in the VIEW work area in a histogram or a table instrument. See chapter VIEW > Histogram for more details on the instrument configuration 18.11.

14.12.1  Sample Count

For a detailed explanation of the classification method see chapter DATA MANAGER > Sample Count 19.23.

14.12.2  Time at Level

For a detailed explanation of the classification method see chapter DATA MANAGER > Time at Level 19.24.

14.12.3  From to count

For a detailed explanation of the classification method see chapter DATA MANAGER > From to Count 19.19.

14.12.4  Level Crossing

For a detailed explanation of the classification method see chapter DATA MANAGER > Level Crossing 19.20.
14.12.5 Transition Matrix

For a detailed explanation of the classification method see chapter DATA MANAGER > Transition Matrix 19.21.

14.12.6 Rainflow

For a detailed explanation of the classification method see chapter DATA MANAGER > Rainflow 19.22.

14.12.7 Sample Count Compound

These classification methods require the input of 2 channels to perform the classification algorithm. The results of the 2D classification are displayed in certain instruments called classification table. The configuration options of the online classification table are discussed in VIEW > Classification table in chapter 18.12. For a detailed explanation of the classification method see chapter DATA MANAGER > Sample count compound classification 19.23.

14.12.8 Time at Level Compound

For a detailed explanation of the classification method see chapter DATA MANAGER > Time at Level Compound Classification 19.19.

14.12.9 Classification – General tab sheet

- **Active**
  - With this checkbox you can activate / deactivate the classification calculation
- **Name**
  - Refers to the name of the classification
- **Description**
  - Here you can add an additional description to the classification
### 14.12.10 Classification – Operating tab sheet

- **Working frequency**
  The calculation frequency of the classification should be related to the sample frequency of the signal. The default value in the drop-down list is the frequency of the signal. However, you can reduce the working frequency by another list box entry.

- **Start trigger**
  This can be a trigger to start the calculation.

- **Stop trigger**
  This can be a trigger to stop the calculation.

- **Hold trigger**
  This can be a trigger to hold the calculation.

### 14.12.11 Classification – Class parameter tab sheet

- **Class count**
  Here you can define in how many classes the lower and upper limit.

- **Lower limit**
  Lower class limit should be split up.

- **Upper limit**
  Upper class limit. The default values are taken from the display range of the source channel.
14.13 XCP slave for gateway operation

With the XCP slave interface you can use IPEmotion as a gateway to send all incoming measurement data to other software platforms using the XCP standard.

In the first step you create a XCP slave interface.
You may create several XCP slaves with different IP-addresses to send data to different applications.

Within this interface you create one or several DAQ lists which include all channels you like to transfer. Within each DAQ list you define sample rate at which the incoming data will be send to the 3rd party application.
14.13 XCP slave for gateway operation

**DAQ list with sample rate setting**

<table>
<thead>
<tr>
<th>Name</th>
<th>Index</th>
<th>Active</th>
<th>Unit</th>
<th>Sampling rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangle 01</td>
<td>0</td>
<td>✓</td>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td>Sine 02</td>
<td>1</td>
<td>✓</td>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td>Sawtooth 03</td>
<td>2</td>
<td>✓</td>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td>Digital input 04</td>
<td>3</td>
<td>✓</td>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td>AnalogOut 01</td>
<td>4</td>
<td>✓</td>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td>DigitalOut 02</td>
<td>5</td>
<td>✓</td>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td>Status-Storagen 1</td>
<td>6</td>
<td>✓</td>
<td>Event controlled</td>
<td></td>
</tr>
<tr>
<td>Status-Ring buffer group 2</td>
<td>7</td>
<td>✓</td>
<td>Event controlled</td>
<td></td>
</tr>
</tbody>
</table>
15 Control Option

15.1 License

To operate the control module you need to buy a license code which includes the control module.

15.2 Configuration of Function Generators (FGN)

With function generators you can create arbitrary wave forms. You can create any function generator from the Ribbon of from the Control module tree.
Every Function Generator is created with 4 channels. Three channels are related to the tuning variables which will be discussed below. The status channel is viewing whether the FGN is operating or not.

Depending on the settings in the Options you may not see the four channels. To show the tuning and status channels refer to OPTIONS section “Basic Settings” item “Expert mode” and then “Variable configuration” in chapter 23.3.4.

- **Status**
  If the status channel shows 1, the FGN is operating. When the status is 0 the FGN is not operating. The status information is convenient e.g. when you use triggers to operate the FGN.

- **Amplitude**
  With Amplitude you can change the magnitude of the amplitude of the waveform during operation as the screenshot shows.

- **Offset**
  With Offset you can shift online the offset of the zero line during operations as the screenshot shows.

- **Frequency**
  With Frequency you can change the frequency of the waveform online as the screenshot shows.
15.2 Configuration of Function Generators (FGN)

15.2.1 FGN – General tab sheet

The general tab sheet covers the Status, Name and Description of the FGN.

- **Active**: With this checkbox you can activate / deactivate the FGN.
- **Name**: Refers to the name of the FGN controller.
- **Description**: Here you can add an additional description to the FGN.
- **Signal from**: Is indicating the basic waveform generated by this FGN.

15.2.2 FGN – Operating tab sheet

In the operating tab sheet you define the triggers for operation and the number of cycles.

- **Start trigger**: This can be a trigger to hold the FGN.
- **Stop trigger**: This can be a trigger to hold the FGN.
- **Hold trigger**: This can be a trigger to hold the FGN. If the hold trigger is released the FGN carries in with the operation until the number of cycles is reached.
- **Cycles**: Here you can define how many cycles the FGN will be operating. When the checkbox is unchecked the FGN is operating in an endless loop.

If you define no trigger condition (of disabled check box), the FGN starts its operation directly when you start the measurement. When the FGN is operating, the status channel is updated from 0 to 1 as discussed above.
The screenshot shows the impact of the Hold trigger to the FGN operation.

15.2.3 FGN – Output tab sheet

In the Output tab sheet you define the receiving channel of the waveform and the end value.
15.2 Configuration of Function Generators (FGN)

- **Output Channel**
  You can search in the channel search dialog for an appropriate output channel. The Output can be generated to an analog, digital, variable channel (Number and Status). Text variables and the scaling channel cannot receive waveform signals from the FGN.

- **Use end value Check box**
  With this check box you activate the end value of the FGN. With the end value you can define which will be last output value of the FGN when it stops the operation. In the example below, the end value after the 10 cycles is -3.

- **End value**
  Define the end value.

*Attention!*

The selected output channel should match or exceed the sample rate (Working frequency) of the waveform generator.

---

15.2.4 FGN – Signal tab sheet

In the signal tab sheet you define the standard parameters of the FGN.

- **Working Frequency**
  This is the resolution of the signal. This frequency defines how many data points are generated to plot the waveform (signal). The working frequency has a close relation to the Signal frequency. The working frequency should be about a factor 10 higher than the signal frequency.

*Example:* The screenshot below shows how the working frequency affects the graphical presentation of the waveform.

*Attention!*

You cannot define a working frequency equal or smaller than the signal frequency.
15.2 Configuration of Function Generators (FGN)

- **Signal Frequency**
  This is the default Frequency of the waveform. It can be changed through the tuning parameters discussed in chapter 15.2 above.

- **Amplitude**
  This is the default Amplitude of the waveform. It can be changed through the tuning parameters discussed in chapter 15.2 above.

- **Offset**
  This is the default Offset of the waveform. It can be changed through the tuning parameters discussed in chapter 15.2 above.
15.2.5 FGN – Signal tab sheet for Arbitrary function generator

The signal tab sheet for the arbitrary function generator has some specific configuration options. You can select an IAD file and a specific channel to generate your individual signal.

The working frequency has a strong impact on how fast the signal is generated as the example below demonstrates.
15.3 FGN – Signal tab sheet for Ramp function generator

The Ramp generator is generating ramps and the configuration options are the start value and the end value.

15.4 FGN – Signal tab sheet for Rectangle function generator

The Rectangle function generator has a special configuration setting which is the Pulse duty factor in %. The pulse duty factor defines for how long the rectangle signal stays high in one period. You can use the Rectangle FGN generator to generate a static PWM signal. There is no possibility to change the Pulse width factor during operation of this FGN.

15.5 FGN – Signal tab sheet for Sine/Sawtooth function generator

The FGN for Sine and Sawtooth functions have the same configuration settings as the Amplitude and the Offset.
15.6 PID Controller

15.6.1 Introduction and system setup

IPEmotion supports a real PID controller functionality with a maximum update rate of 1 kHz which consists of:

- **P** = Proportional control
- **I** = Integral control
- **D** = Derivative Control

Information: It is not possible to test and simulate a PID controller functionality with IPEmotion software alone. You need a real process (Tank, Furnace, Engine, etc.) with an output signal feeding back to the PID calculation.
To demonstrate the PID loop functionality a process simulator specially developed for the IPEmotion PID controller will be used. The process simulator is a small box representing the process and provides an analog output signal from a process and also has an analog input to receive the control value from the PID controller. On a real process the control value e.g. is moving actuators to change the position of a valve to change the flow rate into a tank or to control the throttle position of a motor. The following diagram gives you an overview of the software, the analog measurement system with IO modules and the process and how they are interrelated. You will need normally analog input measurement and analog output signals to control the process.

The objective of a PID controller is to keep a process (Oven temperature, engine RPM, Tank fill level etc.) to a given set point. Also the PID controller should react to disturbances of the process. For example increase the heating of an oven, when temperature drops or increases throttle position of a motor when the load increases.
15.6.2 Create IO channels

As explained above the PID controller requires an analog input signal from the process (Process Variable) and an analog output channel to feed the control value (CO) from the PID back to the process. In this example the Dataforth MAQ20 IO modules are used. The IO channels are connected to the process which is a pocket size simulator.

- VSN: Analog input module (single ended)
- VO: Analog output module
15.6.3 Creating PID controller

You can add the PID controller from the ribbon.

The controller is created and listed in the control module below the PID controller section. Every PID controller is created with 4 channels. Three channels are related to the tuning variable which will be discussed in chapter 15.6.7 below. The status channel is indicating whether the PID controller is operating or not.
Tip

Depending on the settings in the Options you may not see the three tuning parameter channels as the screenshot below is indicating. To activate the variable channels see Options > Basic Settings > Expert mode > Variable configuration in chapter 23.3.4.

Every controller is created with 4 channels:
- 3 x Tuning variable channels (Kr, Tv, Tn)
- 1 x Status channel
15.6.4 PID controller - General tab sheet

The general tab sheet covers the Status, Name and Description of the PID Controller.

- **Active**
  With this checkbox you can activate / deactivate the PID Controller.

- **Name**
  Refers to the name of the PID controller

- **Description**
  Here you can add an additional description to the PID Controller

15.6.5 PID controller - Operating tab sheet

In the operating tab sheet:

- **Start trigger**
  This can be a trigger to start the PID Controller

- **Stop trigger**
  This can be a trigger to stop the PID Controller

- **Hold trigger**
  This can be a trigger to hold the PID Controller

If you define no trigger condition (disabled) the PID Controller starts its operation directly when you start the measurement. When the PID Controller is operating the status channel is updated from 0 to 1. The status one is indicating that the PID Controller is operating.
15.6.6  PID controller - Input/Output tab sheet

The Input and Output tab sheet is the important tab sheet to make the controller work.

- **Control value channel**
  You have to link a channel with the data direction output. The controller is writing the control value (CO) into this channel. This value is then sent to the process through an analog output module. This analog output signal is applied to an actuator of the process which could be e.g. a valve to change the flow rate, motor rpm speed, etc. The control value (CO) must update an actuator which has an impact on the actual value channel (Process Variable PV).

- **Actual value channel**
  The actual value channel (Process Variable PV) is an analog input channel measuring the current process output signal. This measurement channel could be any type of input e.g. (Volt, Temperature, Strain, RPM, etc.). The PID control loop is only effective when the control value (CO) has an impact on the actual value (PV). Example: If you measure the temperature inside a furnace (PV) the control value (CO) should have for example an impact on the valve releasing more or less natural gas to the burner which will then increase or decrease the furnace temperature. The following diagram shows how the PV and CO are interrelated.
Reference value channel (Set Point)

The reference value is also defined as Set Point. The Set Point is a very important point for the process as the PID Controller has to keep the process on this Set Point. The Set Point can be a defined furnace temperature, tank fill level, or engine speed, etc.

The Set Point can be changed by the operator who is adapting the process to his needs. For example the furnace temperature can change depending on the product being processed in the furnace.

Check box: Use limits of control value

This checkbox is activating the control value output range. Control value range

Check box: Use control end value

In this example the value are set from 0 to 10 as the analog output of the hardware can generate 0 - 10 Volt output signal.

End value of control value As end value when the PID Controller is stopped in its operation 0 is defined. You can define any value in the given output range.

15.6.7 PID controller – Parameter tab sheet (Tuning Variables)

In the parameter tab sheet the so called tuning variables like amplification factor (Kr), lead time (Tv), and follow-up time (Tn) are defined. The tuning factors are available as separate channels. If needed you can update the parameters during your acquisition process through manual inputs, sliders or function generators.
15.6 PID Controller

► Working frequency
Here you define the frequency of how fast the PID loop is calculating. The Working frequency should be pretty much in line with the measurement (PV) and output (CO) frequency. There is no point in having the PID loop running at 1 kHz calculation rate when the inputs and outputs are update at 1 Hz rate.

► Kr
Amplification is by default 1. This factor has an impact on the proportional gain.

► Tv
Is a time constant for the derivative gain. The default value is 0. When you increase the Tv >0 the noise is increasing.

► Tn
Is a time constant for the integral gain. The default value is 1. When this factor increases the system reacts slower.

There are different terminologies used for the tuning factors between European and American standards.

<table>
<thead>
<tr>
<th>IPEmotion EU - PID Tuning Parameters</th>
<th>US - PID Tuning Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kr = Amplification</td>
<td>Kp Proportional Gain</td>
</tr>
<tr>
<td></td>
<td>Kr = Kr</td>
</tr>
<tr>
<td>Tv = Lead time</td>
<td>Kd Derivative Gain</td>
</tr>
<tr>
<td></td>
<td>Tv = Kd / Kp (derivative Gain)</td>
</tr>
<tr>
<td></td>
<td>Tv = Kd / Kr = Kd / Ki</td>
</tr>
<tr>
<td>Tn = Reset time</td>
<td>Ki Integral Gain</td>
</tr>
<tr>
<td></td>
<td>Tn = Kp / Ki (Integral Gain)</td>
</tr>
<tr>
<td></td>
<td>Tn = Kr / Ki = Kp / Ki</td>
</tr>
</tbody>
</table>

For more details about the different interpretation of the PID tuning parameters see Wikipedia:
http://de.wikipedia.org/wiki/PID-Regler#PID-Regler
http://en.wikipedia.org/wiki/PID_controller
15.6.8 Examples for the impact of tuning factor settings

Standard tuning factors:

- $Kr = 1 / Tv = 0 / Tn = 1$

Increased tuning factors: Here you can see that $Tv$ is increasing the noise a lot.

- $Kr = 3 / Tv = 3 / Tn = 3$
Decreased tuning factors:

- \( K_r = 0.3 \), \( T_v = 0 \), \( T_n = 0.3 \)
15.7 Router channels

The main function of the router channel is to take a signal (incoming) and return the signal to another channel (output). The router is a turning table for incoming and outgoing data.

15.7.1 Create Routers

You can create several routers. This is particularly useful if you have several Router elements (channels) which will have different trigger and operating conditions.

15.7.2 Router – General tab sheet

The general tab sheet covers the status, name and description of the PID Controller.
15.7 Router channels

**Information**

All router elements related to one router are subjected to the same overall operating trigger conditions and the cycle time parameters.

- **Active**: With this checkbox you can activate / deactivate the router
- **Name**: Refers to the name of the router
- **Description**: Here you can add an additional description to the router

15.7.3 Router – Operating tab sheet

In the operating tab sheet you can define trigger conditions to start, stop and hold the router using the f(x) button.

- **Start trigger**: This can be a trigger to start the Router
- **Stop trigger**: This can be a trigger to stop the Router
- **Hold trigger**: This can be a trigger to hold the Router

15.7.4 Router – Parameter tab sheet

The working frequency can be set to a maximum of 1 kHz. This frequency defines in which interval the router is sending data out.

15.7.5 Router Element

The following screenshot shows a router with one router element (channel).
15.7 Router channels

15.7.6 Router element - General tab sheet

The general tab sheet covers the Status, Name and Description of the router element.

- **Active**: With this checkbox you can activate / deactivate the router
- **Name**: Refers to the name of the router
- **Description**: Here you can add an additional description to the router
15.7 Router channels

15.7.7 Router element – Configuration tab sheet

On router element level you select the source and target channel.

► Source channel The source channel can be any input or output type channel and variable channels (Number, Status, Text) or Scaling channels can serve as input channels and output channels as well.

► Target channel The target channel is receiving the signals from the source channel and converting it to the output format. Using the router channel you can create a bridge and send data between different Plugins. This function works across all signals and supported protocols like: CAN, Ethernet, FlexRay, Profibus, Serial RS232, etc.

► Used end value This is a check box to activate a referred end value. This function becomes effective if you work with trigger conditions to stop the router channel.

► End value Is a defined end value which will be put to the output channel when the trigger condition for Stop is true.

⚠ Attention! Video and audio signals cannot be sending via router elements.
15.7.8 Example Router configuration – Sending over CAN

In the first step you have to check what your source channels and the related scaling is. The target channel should have the same scaling to ensure that the values are correctly transmitted.

The target system in this example is CAN interface (CAN Send PlugIn) and the analog measurements will be transferred as CAN messages. A CAN interface with 2 CAN channels were created.
The Router element is now linking both channels together.

15.8 Sequences Control

The test sequencing is a very powerful part of the overall Control Module to organize and automate tests. This module is particular practical if you like to automate repetitive test cycles. The main purpose of the module is to organize test steps in a chronological (Time) and logical order. Within the sequence you can execute or perform 3 different functions which will be discussed in more detail below. Basically you can combine the 4 main functions in any order to cover your application.

- **Set output**
  This function is to write a numerical or Text value to a variable or output channel. Example: With a numerical output value you can drive analog or digital outputs to operate actuators like engine speed or valve position.

- **Check channel**
  This function is generally used to perform control actions. It is designed to check or monitor if a condition is true. The main idea is that only when the condition is true the next step of the overall sequence is executed. Example: A check condition could be that a certain load is only applied to a motor when a certain engine RPM is reached.

- **Run Script**
  This function is basically a door opener to integrate external applications and more complex programming routines to the test sequence. When you trigger a script from the sequence you have plenty possibilities to perform functions inside the script. Example: A script could generate automatically a specific report.
In larger test applications it is useful to break down a large test sequence in separate smaller blocks. You can then define a master test sequence which is consisting of a combination of different blocks. This approach will give you the following advantages:

1. You program a block only one time and you can use it on several sequences.
2. You can combine different blocks in different orders as appropriate for a specific test cycle.
3. If you need to modify a block you need to do it only one time in one place rather than to make updates on all test sequence individually.

Example: You have different test items (e.g. pumps) and for every model you have different test sequences. However for every pump you have the same start and end testing procedure. In this case it is useful to organize the start and end testing sequence in a separate block. See chapter 15.9 for details about how to configure the blocks.

The following diagram gives an example of a test sequence which is composed of 3 blocks.
15.8 Sequences Control

15.8.1 Creating a Sequence

In the first step we need to create a Sequence.

![Image of the sequence creation process]

Create a Sequence from the ribbon or from the tree on the left side.

15.8.2 Sequence – General tab sheet

The general tab sheet covers the Status, Name and Description of the Sequence.

- **Active**
  - With this checkbox you can activate / deactivate the sequence

- **Name**
  - Refers to the name of the sequence

- **Description**
  - Here you can add an additional description to the sequence
15.8 Sequences Control

15.8.3 Sequence – Operating tab sheet

In the operating tab sheet you can define trigger conditions to start, stop and hold the sequence using the f(x) button.

- **Start trigger**: This can be a trigger to start the sequence.
- **Stop trigger**: This can be a trigger to stop the sequence.
- **Hold trigger**: This can be a trigger to hold the sequence.

15.8.4 Sequence – Parameter tab sheet

In the sequence parameters you define the sample rate and the loop count.

- **Sample rate**: Refers how fast the sequence is executing the different steps.
- **Loop count**: Refers to how often the sequence will be repeated until it will stop automatically.
- **Cancel block**: On Sequence level you can define a Cancel block. This cancel block will be executed when the sequence is cancelled. With Column chooser you add the column "Cancel block" to the grid.
15.8.5 Test bench view

The sequencing operation consists usually of many different steps and operation types. In order to get a clear visibility on the output operations a specific display mode called Test bench view is provided.

The screenshot below shows the test bench view of a small 6 step test operation and compares the presentation with the test bench view below. In the test bench view the output channels names are visible in columns and the output values are presented in the data grid. With this view, you can see immediately which value is set at which point in time by all channels included in the test sequence. In this small example only one output channel called Trigger Storage is used in the operation.

The following screenshots shows the test bench view of a larger output operation of 3 output channels.
15.8.6 Show preview

With the show preview function you can get a graphical overview of the output values along the time axis.
Example: Larger test sequence with multi output channel signal preview

<table>
<thead>
<tr>
<th>Name</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Icmd_Pilot_A - Trigger ZERO Line</td>
<td>Icmd_Pilot_A - Trigger ZERO Line/Status/Variables/</td>
</tr>
<tr>
<td>Icmd_Pilot_A - Trigger Rise Ramp to 1500 TRIGGER</td>
<td>Icmd_Pilot_A - Trigger Rise Ramp to 1500 TRIGGER/Status/Variables/</td>
</tr>
<tr>
<td>Icmd_Pilot_A - Trigger Decline Ramp to 500</td>
<td>Icmd_Pilot_A - Trigger Decline Ramp to 500/Status/Variables/</td>
</tr>
</tbody>
</table>

Sequence preview: PORT-A - Sequence

- Icmd_Pilot_A - Trigger ZERO Line
- Icmd_Pilot_A - Trigger Rise Ramp to 1500 TRIGGER
- Icmd_Pilot_A - Trigger Decline Ramp to 500

[CO_45_6]
15.8.7 Create Steps

The sequence can be created from the following 4 elements:

- **Set output channel**: This refers to variable channels and channels with data direction output. With this function you can write a specific output value for the channel.

- **Check channel**: This function refers to a monitoring function where you can define a threshold condition and when this condition is true the sequence is moving to the next step.

- **Run Script**: With this function you can execute Visual Basic (VBS) and Iron Python (PY) scripts. This function requires that you have a Professional edition where the Scripting tab sheet in the ribbon is visible.

- **Choose Block**: Here you select a block which includes a list of output, check or execute script steps. See chapter 15.9 for details about how to configure the blocks.
Each step consists of the following 5 standard columns:

- **Step name**: Here you can define the name of the step.
- **Type**: Here you will see the type of the step. The type is fixed and related to the function (Check / Set output / Run script).
- **Time**: This is the waiting time from step to step. There are sometime time based sequences. Where the steps are executed strictly according to a defined time pattern.
- **Time out**: This is a very important time setting to define how long a step will wait at maximum before the next step will start. This is particular relevant for check / monitoring steps. In this case you will define how long the check step shall monitor a channel on the threshold condition before it will move on.
- **Break**: If you enable the break check box the whole sequence will be ended when this step is not returning an error or not meeting the check conditions.

With the column chooser you can add more information to the step list.

Below you will see an overview of the step list including all additional channels.
15.8 Sequences Control

Customer Step

With the Customer Step function you can add a grouping hierarchy to the test sequence. With the column chooser you can add the function to the grid. The Customer step is by default activated. In this case every customer step corresponds to a step number in the step sequence list.

15.8.8 Sequence – Display step list overview

You can get an overview of the complete step list. This is particularly convenient to see the full time of the sequence. The steps have a delay time before they start. The time of each step is defined in the column time. In the column Full Time you can see how all the times add up to the overall sequence time.

You can also export the sequence to a CSV file.
CSV Export of the test sequence.
When you disable steps in the **Customer step column** you add a grouping level to the step list as the screenshot below indicates.

**Information**  
*For the overall operation of a test sequence it is **mandatory to enable (activate) the first step as a customer step.***
15.8.9 Example: Configure a Test Sequence

The sequence control function will be explained in a common example for repetitive test measurement where the test item is changing but not the testing process. The test scenario is the following:

1. Operator is starting the measurement and storage. See chapter for reference 15.8.1.
2. New sequence is started automatically when the measurement starts - no additional triggers.
3. Inside the sequence the following actions take place.
   (a) A temperature is measured and compared to a threshold (limit).
   (b) If a certain temperature limit is reached the data recording is started.
   (c) The recording is stopped when the temperature drops below a certain limit.
4. Data file is renamed to the day and time when the test was ended.
5. Test sequence is finished with a message box.

In the following you will see how a sequence can be set up and how the different settings will affect the results.

- 1. Step Check Channel

  The JTC-1 temperature input channel will be monitored on the threshold of input JTC >32°C. Time: Is set to 00:00:00. This implies that the check function will directly start its operation when the sequence is started. There is no delay in the check operation. Timeout: This time is set to 15 seconds. That implies that the check operation (Monitor JTC >32°C) will run for 15 seconds at maximum. If the condition is true before the time of 15s is elapsed, the sequence will move to the second step. If the condition is not reached after 15s, the test sequence will move to step 2 anyway even if the condition is not true.
Graphical presentation of the measurements and the status of the test sequence.

Impact of the Timeout column.

Sequence is jumping from Step 1 to Step 2 when the check condition (JTC > 32) is true.

Temperature stays all the time below 32°C.

Timeout 15s

Sequence is jumping to Step 2 after the Timeout of 15s is elapsed.
2 Step Set Channel

If the temperature condition is true (JTC > 32°C) the next step is executed. In this case a variable channel is set to 1. This will then trigger the storage. Time is configured to 2 seconds. That implies that the set channel function will be executed with a 2 seconds delay.

The Output mode can be switched over a radio button to a fixed output value like the example above or you can build a formula which is calculating an output value from a math or logic function.

Graphical presentation of the measurements and the status of the test sequence.
Example of the configuration for the storage trigger condition.

3. Step Check Channel

The JTC-1 temperature input channel will be monitored on the threshold of input JTC < 30°C. Time: Is set to 00:00:00. This implies that the check function will start its operation directly when step 2 (activate data storage) is executed. Timeout: This time is set to 15 seconds. That implies that the check operation (Monitor JTC < 30°C) will run for 15 seconds at maximum. If the condition is true before the time of 15s is elapsed, the sequence will stop its operation. Break: The break check box is activated. In this case the whole sequence is stopped when the Timeout of 15s is elapsed.
Graphical presentation of the measurements and the status of the test sequence.

Impact of Break check box
You can see here if the break check box is not set, the test sequence is moving after the Timeout duration (15s) to the next steps even if the check channel condition (JTC <30) did not become true. As discussed in Step 1.

Graphical presentation of the measurements and the status of the test sequence.
4_Step Set Channel

If the temperature condition is true \((\text{JTC} < 30^\circ \text{C})\) the next step is executed. In this case, a variable channel (trigger for storage group) is set back to 0. This will stop the data storage. Time: It is configured to 2 seconds. That implies that the set channel function will be executed with a 2s delay.

Graphical presentation of the measurements and the status of the test sequence.
After the storage is finished a script is executed. In this example the script will rename the data file to a given IAD file name of:

Date & Time

Time: The Script which is renaming the data file is executed 5s after the storage is finished. A delay time of a few seconds is considered to ensure that the data file is ready for the renaming procedure. Timeout: is defined for 5s. That gives the script 5 seconds to finalize the operation before the next step starts. Some scripts can perform considerable math functions which can take some seconds to finish. Therefore it is important to define an appropriate timeout for the script functions.

Graphical presentation of the measurements and the status of the test sequence.
6_Run Script

The last step is to execute a script to show an end message box that the test was finished successfully.
Message box with scripting code example below.

```plaintext
* ACQUISITION_End_Message Box
* Description:
* This script brings up a message box.
* ........................
* (C) 2018 IPETRONIK GmbH & Co.KG

MsgBox "Test successfully finished. Data file was renamed."
```
15.9 Sequence Blocks

If you start to setup larger test sequencing applications with dedicated test phases like the example below, it will be practical to organize each sequence in a separate block.

- Initialize System
- Test Sequence 1
- Test Sequence x
- Safety Sequence
- End Sequence

The blocks are created like a sequence with the same functions (Set output, Check Channel, Run Script) but all the steps are in a logical unit called “Sequence Block”. 
15.10 Profile Generator

You can then arrange and link different blocks together in the sequence steps as discussed in the example above 15.8.9.

15.10 Profile Generator

The profile generator is a specific function generator to generate output signals either user defined step based or file based through importing a data file. The output profiles can be graphically displayed online in the VIEW workspace in the Profile Diagram. The configuration of the Diagram instrument is discussed in chapter 18.28.
15.10.1 Profile Generator – General tab sheet

The STEP based and FILE based Profile generator can be configured through 4 tab sheets. In the General tab sheet you define the status, name and description of the Profile generator channel.

- **Active**: With this checkbox you can activate / deactivate the Profile generator.
- **Name**: Refers to the name of the Profile generator.
- **Description**: Here you can add an additional description to the Profile generator.

15.10.2 Profile generator – Operating tab sheet

- **Start trigger**: This can be a trigger to start the Profile generator.
- **Stop trigger**: This can be a trigger to stop the Profile generator.
- **Hold trigger**: This can be a trigger to hold and pause the Profile generator.

15.10.3 Profile generator – Configuration tab sheet

The settings in the configuration tab sheet have mainly an impact to the Profile diagram appearance.

- **Source channel**: Here you define a source channel which will be visible in the Profile diagram. This channel is presenting the actual online measurements in the Profile diagram 18.28.4.
- **Loop count (drop edit)**: Here you define how many time the profile is repeated. The drop edit list is providing default entries: Endless, 1, 10, 100, 1000 or user defined numeric inputs. When you select Endless the profile start from the beginning again.
15.10 Profile Generator

- **Tolerance mode**
  
  With this radio button define whether you use absolute or percent tolerance calculation. When you select absolute tolerance the unit of the source channel is displayed. The upper and lower tolerance lines can be presented in the Profile Diagram.

- **Lower / upper tolerance**

  Here you enter the individual values for tolerance band width if needed.

15.10.4 Profile generator – Display tab sheet

The display tab sheet is related to the reference channel display range in the Profile diagram 18.28.4.
15.10.5 Add step

The profile Generator is supporting four different step types.

- **Reference value**
  The reference value is designed to create a graphical reference line presentation in the Profile diagram. With this type of steps you can create a graphical profile which serves the driver as a reference profile for his vehicle speed.

- **Set output channel**
  The output channel has a different function. With this type of channel you can send output values (numeric or text) to drive actuators or to provide text information messages to the driver. The output channel values are not displayed in the Profile diagram.

- **Check channel**
  The check channel operation is designed to perform controls and continue the test sequence when the check operation returns a positive value.

- **Run script**
  The script operation is executing scripts which are linked to your application in the SCRIPTING workspace.
15.10.6 Application Example: Time based reference profile

In this simple example 4 reference value steps are defined to create a graphical reference profile in the Profile instrument for the driver.

The reference value steps consist of the following properties allocated to 3 different tab sheets:

- **Step name**
  - Refers to an individual name

- **Active check box**
  - To enable or disable a step

- **Type**
  - Refers to the step type: Reference Value or Output channel

- **Time (relative)**
  - This time base is relative and associated to this specific step

- **Value**
  - Is the display and output value which is related to this time base

This diagram shows a associated graphical reference profile of the steps defined above. Only the Profile Generator channel can be linked to the instrument. The other associated status channels can be linked to other instruments to display other useful information to the driver.
The configuration of the Profile diagram and the related status channels will be explained in detail in chapter VIEW 18. The status channels of the Profile generator are visible when the EXPERT mode is activated in the OPTIONS. For more details see chapter 23.3.
15.10.7 Application Example: Time based reference profile with outputs

The reference profile can include output channels. With output channel you can provide text information to the driver or control physical output channels to communicate with the test bench PLC or other 3rd party hardware. In this example a variable text channel was created to provide text information to the driver.

This output channel "Driver info text" can be included in the profile generator as indicated below. For the display value you either define static text, numbers or output the result of a formula.

Text message provided to the driver
When you start creating additional channel they are appearing at the end of the sequence. With the right-click on the step you have access to the context menu to cut a step.

With the past behind function you insert this step behind the selected step.
Updated order of the test sequence, after inserting an output channel.

<table>
<thead>
<tr>
<th>Step name</th>
<th>Active</th>
<th>Type</th>
<th>Time</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step reference value-1</td>
<td></td>
<td>Reference value</td>
<td>00:00:00</td>
<td>0,00</td>
</tr>
<tr>
<td>Step set output channel-6</td>
<td></td>
<td>Set channel</td>
<td>00:00:10</td>
<td>50,00</td>
</tr>
<tr>
<td>Step reference value-2</td>
<td></td>
<td>Reference value</td>
<td>00:00:03</td>
<td>50,00</td>
</tr>
<tr>
<td>Step reference value-3</td>
<td></td>
<td>Reference value</td>
<td>00:00:07</td>
<td>23,00</td>
</tr>
<tr>
<td>Step set output channel-5</td>
<td></td>
<td>Set channel</td>
<td>00:00:00</td>
<td>Shift to 3rd gear</td>
</tr>
</tbody>
</table>

The following test sequence includes 2 output channels e.g. to set the output channel to control the wind speed “CWT –Wind”.

<table>
<thead>
<tr>
<th>Step name</th>
<th>Active</th>
<th>Type</th>
<th>Time</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step reference value-1</td>
<td></td>
<td>Reference value</td>
<td>00:00:00</td>
<td>0,00</td>
</tr>
<tr>
<td>CWT - Wind</td>
<td></td>
<td>Set channel</td>
<td>00:00:05</td>
<td>33,00</td>
</tr>
<tr>
<td>CWT - Wind</td>
<td></td>
<td>Set channel</td>
<td>00:00:00</td>
<td>44,00</td>
</tr>
</tbody>
</table>

„Set channel“ steps are included in the overall profile.
The output channel are executed along the time base and set the defined value as indicated in the screenshot below.

The timing operation of the output channels is added to the overall timing to the reference value channels. On this example the output value of 44 is directly set when the reference value step 3 is finished and the slope down profile is starting at 20 seconds elapsed time and will take 7 sec to reach the 25 km/h.

However if you add a time to the set output channel e.g. 10 sec as indicated below, the output channel is operated at 10 sec delay from the previous operation. This time of 10 sec is added to the next reference value step which is in this case a ramp down to 25 km/h. That means the overall ramp down step is (10 sec + 7 sec = 17 sec).

„Set channel“ operation is executed 10 sec after the previous step.
The following screenshot is indicating how the 10 sec additional time of the "CWT - Set output channel" is affecting the overall profile presentation. In this case the output channel is set to 44 after 30 seconds total time elapsed and the ramp town to 25km/h is taking a total time of 17 sec.

15.10.8 Application Example: Load Different Profiles

Over Com and Scripting interface you can load different Profiles into the Profile diagram. This function is useful if you have a configuration of different profiles and you like to change your test setup within one click. In this example 2 different profiles are created.
With the following scripting commands you can switch between the profiles through an action button.

**Script: Profile 2**

```vbscript
'Call AcquisitionWorkspace.StopAcquisition()
'Call AcquisitionWorkspace.StartAcquisition(2)
GraphicalUserInterface.VisibleView = 3
```

**Script: Profile 1**

```vbscript
'Call AcquisitionWorkspace.StopAcquisition()
'Call AcquisitionWorkspace.StartAcquisition(2)
```

The only difference on the scripting commands is the yellow highlighted section where the profile index is different:

- **Index = 0** => Profile 1
- **Index = 1** => Profile 2

The Action button is configured as following. See for more details chapter VIEW 18.21.
Configuration of Action button.

Link the script
15.10.9  Application Example: Trigger functions in a sequence operation

In the following you will get an example how to use the trigger function to control your Profile generator through 3 Status variables.

![Image of Profile generator interface showing trigger functions]

**Trigger definition - using status variable channels.**

These 3 variables are included in the operating tab sheet of the Profile generator.
The 3 status variable channels are linked to the Switch instrument in the VIEW work space to give the user the ability to control with one button click the operation of the profile. For more details about the Switch instrument refer to chapter VIEW 18.19.
15.10.10 File based profile generator

The profile generator is mainly used to indicate drive profiles to the test driver. Rather than setting up a step-by-step list manually, a pre-recorded data file can be imported to display the required drive profile. The main benefit of a file based profile creation is time saving and you have the ability to match a real recorded test drive profile from an on-road test to a test drive on the roller test bench.

Supported file formats for the import are:

- IPEmotion .IAD
- CSV .CSV, .TXT
- DIAdem .DAT, .TDM
- MDF .MDF4
An example of file based reference profile generation is indicated blow.
16 Climate Option

16.1 Introduction

With the climate option you can calculate thermodynamic cycles using different refrigerants. Thermodynamic cycles basically consist of four main elements as the below graphic shows.

- **Compressor**: The compressor is compressing the low pressure gas refrigerant to high pressure gas. The compression process is increasing the temperature of the gas. The refrigerant is getting hot.
- **Condenser**: The condenser is cooling the hot high pressure gas to a cold liquid fluid.
- **Evaporator**: The cold low pressure liquid fluid is going through the evaporator and the coolant (refrigerant) is changing from liquid to gas phase.
- **Expansion valve**: When the liquid is passing through the expansion valve, the pressure is released and it can turn into gas phase. When the liquid changes to the gas phase it causes a heat drift in the evaporator. The evaporator gets cold and extracts the energy from the incoming hot air and cools it down.
16.2 Climate License

With the climate license you get the special Log p-h instrument in the VIEW and ANALYSIS work space and a set of special enthalpy, entropy and humidity formulas.

16.3 REFPROP database (NIST)

For the climate module you need to install the REFPROP database which includes the thermodynamic properties of different refrigerants. See VIEW >Log p-h instrument for more details in chapter 18.24.1. The REFPROP data base is not included in the IPEmotion standard setup. It is usually purchased together with the Climate module and delivered as a separate setup file. The link to the REFPROP data base can be defined in the OPTIONS 23.12.
16.4 Climate Formulas

The formulas for enthalpy calculations need a corresponding refrigerant. The refrigerants are included in the REFPROP database with their thermodynamic properties indicated.

- Formula Index 1: R134a
- Formula Index 2: R1234yf
- Formula Index 3: R22
- Formula Index 4: R404a
- Formula Index 5: R410a
- Formula Index 6: R507a
- Formula Index 7: R744 (CO2)
- Formula Index 8: R718 (H2O)
- Formula Index 9: R729 (N2+O2+Ar)
- Formula Index 10: R123ze
- Formula Index 11: R290 (Propane)
- Formula Index 12: R600a (Isobutene)
- Formula Index 13: R717 (Ammonia)

The display ranges of the log p-h diagramm for the different refrigerants are listed below.

<table>
<thead>
<tr>
<th>ID</th>
<th>Display Name</th>
<th>Refrigerant</th>
<th>Enthalpy [kJ/kg] Values for 2017</th>
<th>Pressure [bar] Values for 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R134a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>R1234yf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>R22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>R404a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>R410a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>R507a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>R744 (CO2)</td>
<td></td>
<td>110</td>
<td>620</td>
</tr>
<tr>
<td>8</td>
<td>R718 (H2O)</td>
<td></td>
<td>20</td>
<td>3200</td>
</tr>
<tr>
<td>9</td>
<td>R729 (N2 + O2 + Ar)</td>
<td></td>
<td>0</td>
<td>350</td>
</tr>
<tr>
<td>10</td>
<td>R1234ze (HFO-1234ze)</td>
<td></td>
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</tr>
<tr>
<td>11</td>
<td>R290 (Propane)</td>
<td></td>
<td>70</td>
<td>900</td>
</tr>
<tr>
<td>12</td>
<td>R600a (Butane)</td>
<td></td>
<td>140</td>
<td>900</td>
</tr>
<tr>
<td>13</td>
<td>R717 (Ammonia)</td>
<td></td>
<td>120</td>
<td>2000</td>
</tr>
</tbody>
</table>
16.4 Climate Formulas

◮ **h_std**

*h_std* calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

Syntax: *h_std*(temperature-operand; pressure-operand; index of fluid)

Examples: *h_std*("ChannelTemperature"; "ChannelPressure"; 1) calculates the specific enthalpy using a temperature channel and a pressure channel for the fluid R134a. *h_std*(20; 2; 2) calculates the specific enthalpy using fixed values for the pressure and temperature of fluid R1234yf.

◮ **h_vap**

*h_vap* calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. This calculation is only suitable for measure points that are in the vapor area. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

Syntax: *h_vap*(temperature-operand; pressure-operand; index of fluid)

Examples: *h_vap*("ChannelTemperature"; "ChannelPressure"; 1) calculates the specific enthalpy using a temperature channel and a pressure channel for the fluid R134a. *h_vap*(20; 2; 2) calculates the specific enthalpy using fixed values for the pressure and temperature of fluid R1234yf.

◮ **h_liq**

*h_liq* calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. This calculation is only suitable for measure points within the liquid area. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

Syntax: *h_liq*(temperature-operand; pressure-operand; index of fluid)

Examples: *h_liq*("ChannelTemperature"; "ChannelPressure"; 1) calculates the specific enthalpy using a temperature channel and a pressure channel for the fluid R134a. *h_liq*(20; 2; 2) calculates the specific enthalpy using fixed values for the pressure and temperature of fluid R1234yf.
16.4 Climate Formulas

- **h_ps**
  h_ps calculates the specific enthalpy (unit: kJ/kg) as a function of pressure (unit: bar), entropy (unit: kJ/(kg*K)), and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  Syntax: h_ps(pressure-operand; entropy-operand; index of fluid)
  Examples:
  h_ps("ChannelPressure"; "ChannelEntropy"; 1) calculates the specific enthalpy using a pressure channel and an entropy channel for the fluid R134a. h_ps(20; 2; 2) calculates the specific enthalpy using fixed values for pressure and entropy of fluid.

- **h_liq_p**
  h_liq_p calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °F), pressure (unit: bar), and a fluid on the boiling line. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  Syntax: h_liq_p(pressure-operand; index of fluid)
  Examples:
  h_liq_p("ChannelPressure"; 1) calculates the specific enthalpy using a pressure channel for the fluid R134a. h_liq_p(2; 2) calculates the specific enthalpy using a fixed value for the pressure of the fluid R1234yf.

- **h_vap_p**
  h_vap_p calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °F), pressure (unit: bar), and a fluid on the dewing line. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  Syntax: h_vap_p(pressure-operand; index of fluid)
  Examples:
  h_vap_p("ChannelPressure"; 1) calculates the specific enthalpy using a pressure channel for the fluid R134a. h_vap_p(20; 2; 2) calculates the specific enthalpy using a fixed value for the pressure of the fluid R1234yf.

- **h_liq_t**
  h_liq_t calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °F), pressure (unit: bar), and a fluid on the boiling line. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  Syntax: h_liq_t(temperature-operand; index of fluid)
  Examples:
  h_liq_t("ChannelTemperature"; 1) calculates the specific enthalpy using a temperature channel for the fluid R134a. h_liq_t(2; 2) calculates the specific enthalpy using a fixed value for the temperature of the fluid R1234yf.

- **h_vap_t**
  h_vap_t calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °F), pressure (unit: bar), and a fluid on the dewing line. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  Syntax: h_vap_t(temperature-operand; index of fluid)
  Examples:
  h_vap_t("ChannelTemperature"; 1) calculates the specific enthalpy using a temperature channel for the fluid R134a. h_vap_t(20; 2) calculates the specific enthalpy using a fixed value for the temperature of the fluid R1234yf.
16.4 Climate Formulas

- **h_liqvap_pq**

  h_liqvap_pq calculates the specific enthalpy (unit: kJ/kg) as a function of pressure (unit: bar), mixing quality, and a fluid. The mixing quality equals 0 for pure liquids, 1 for vapors, and values in-between for mixes, e.g. 0.25 for 25% liquid and 75% vapor content. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

  Syntax: `h_liqvap_pq(pressure_operand; quality_operand; index_of_fluid)`

  Examples:
  
  - `h_liqvap_pq("ChannelPressure"; "ChannelQuality"; 1)` calculates the specific enthalpy using a temperature channel or a pressure channel for the fluid R134a.
  - `h_liqvap_pq(1.5; 0.75; 2)` calculates the specific enthalpy using fixed values for the pressure and mixing quality of the fluid R1234yf.

- **h_liqvap_tq**

  h_liqvap_tq calculates the specific enthalpy (unit: kJ/kg) as a function of temperature (unit: °C), mixing quality, and a fluid. The mixing quality equals 0 for pure liquids, 1 for vapors, and values in-between for mixes, e.g. 0.25 for 25% liquid and 75% vapor content. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

  Syntax: `h_liqvap_tq(temperature_operand; quality_operand; index_of_fluid)`

  Examples:
  
  - `h_liqvap_tq("ChannelTemperature"; "ChannelQuality"; 1)` calculates the specific enthalpy using a temperature channel or a pressure channel for the fluid R134a.
  - `h_liqvap_tq(20; 0.25; 2)` calculates the specific enthalpy using fixed values for the temperature and mixing quality of the fluid R1234yf.

- **u_std**

  u_std calculates the specific internal energy (unit: kJ/kg) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

  Syntax: `u_std(temperature_operand; pressure_operand; index_of_fluid)`

  Examples:
  
  - `u_std("ChannelTemperature"; "ChannelPressure"; 1)` calculates the specific internal energy using a temperature channel and a pressure channel for the fluid R134a.
  - `u_std(20; 2; 2)` calculates the specific internal energy using fixed values for the pressure and temperature of fluid R1234yf.

- **s_std**

  s_std calculates the specific entropy (unit: kJ/kg) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

  Syntax: `s_std(temperature_operand; pressure_operand; index_of_fluid)`

  Examples:
  
  - `s_std("ChannelTemperature"; "ChannelPressure"; 1)` calculates the specific entropy using a temperature channel and a pressure channel for the fluid R134a.
  - `s_std(20; 2; 2)` calculates the specific entropy using fixed values for the pressure and temperature of fluid R1234yf.
16.4 Climate Formulas

**rho_std**

rho_std calculates the density (unit: kg/m³) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air)

Syntax: rho_std(temperature-operand; pressure-operand; index of fluid)

Examples:
rho_std("ChannelTemperature"; "ChannelPressure"; 1) calculates the density using a temperature channel and a pressure channel for the fluid R134a. rho_std(20; 2; 2) calculates the density using fixed values for the pressure and temperature of fluid R1234yf.

**V_spec**

V_spec calculates the specific volume (unit: m³/kg) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air)

Syntax: V_spec(temperature-operand; pressure-operand; index of fluid)

Examples:
V_spec("ChannelTemperature"; "ChannelPressure"; 1) calculates the specific volume using a temperature channel and a pressure channel for the fluid R134a. V_spec(20; 2; 2) calculates the specific volume using fixed values for the pressure and temperature of fluid R1234yf.

**c_sound**

c_sound calculates the speed of sound (unit: m/s) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air)

Syntax: c_sound(temperature-operand; pressure-operand; index of fluid)

Examples:
c_sound("ChannelTemperature"; "ChannelPressure"; 1) calculates the speed of sound using a temperature channel and a pressure channel for the fluid R134a. c_sound(20; 2; 2) calculates the speed of sound using fixed values for the pressure and temperature of fluid R1234yf.

**c_vol**

c_vol calculates the isochoric heat capacity (unit: kJ/kgK) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air)

Syntax: c_vol(temperature-operand; pressure-operand; index of fluid)

Examples:
c_vol("ChannelTemperature"; "ChannelPressure"; 1) calculates the isochoric heat capacity using a temperature channel and a pressure channel for the fluid R134a. c_vol(20; 2; 2) calculates the isochoric heat capacity using fixed values for the pressure and temperature of fluid R1234yf.
16.4 Climate Formulas

- **c_pres**
  
c_pres calculates the isobaric heat capacity (unit: kJ/kgK) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  
  **Syntax:** c_pres(temperature-operand; pressure-operand; index of fluid)
  
  **Examples:**
  
c_pres("ChannelTemperature"; "ChannelPressure"; 1) calculates the isobaric heat capacity using a temperature channel and a pressure channel for the fluid R134a. c_pres(20; 2; 2) calculates the isobaric heat capacity using fixed values for the pressure and temperature of fluid R1234yf.

- **T_sat_liq**
  
  T_sat_liq calculates the saturation temperature of the boiling line (unit: °C) as a function of pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  
  **Syntax:** T_sat_liq(pressure-operand; index of fluid)
  
  **Examples:**
  
  T_sat_liq("ChannelPressure"; 1) calculates the saturation temperature of the boiling line using a pressure channel for the fluid R134a. T_sat_liq(1; 2) calculates the saturation temperature of the boiling line using a fixed value for the pressure of fluid R1234yf.

- **T_sat_vap**
  
  T_sat_vap calculates the saturation temperature of the dew line (unit: °C) as a function of pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  
  **Syntax:** T_sat_vap(pressure-operand; index of fluid)
  
  **Examples:**
  
  T_sat_vap("ChannelPressure"; 1) calculates the saturation temperature of the dew line using a pressure channel for the fluid R134a. T_sat_vap(1; 2) calculates the saturation temperature of the dew line using a fixed value for the pressure of fluid R1234yf.

- **superheating**
  
  superheating calculates the superheating (unit: °C) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The superheating results from the temperature difference between the measuring point and the saturation temperature of the dew line at the same pressure level. Positive values indicate a superheated state. If the fluid is not in a superheated state, the values can also be negative. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).
  
  **Syntax:** superheating(temperature-operand; pressure-operand; index of fluid)
  
  **Examples:**
  
  superheating("ChannelTemperature"; "ChannelPressure"; 1) calculates the superheating using a temperature channel and a pressure channel for the fluid R134a. superheating(20; 2; 2) calculates the superheating using fixed values for the pressure and temperature of fluid R1234yf.
16.4 Climate Formulas

**subcooling**

Subcooling calculates the subcooling (unit: °C) as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The subcooling results from the temperature difference between the measuring point and the saturation temperature of the boiling line at the same pressure level. Positive values indicate a subcooled state. If the fluid is not in a subcooled state, the values can also be negative. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

Syntax: subcooling(temperature-operand; pressure-operand; index of fluid)

Examples:

- subcooling("ChannelTemperature"; "ChannelPressure"; 1) calculates the subcooling using a temperature channel and a pressure channel for the fluid R134a.
- subcooling(20; 10; 2) calculates the subcooling using fixed values for the pressure and temperature of fluid R1234yf.

**enthalpy_dif_liq**

Enthalpy difference liquid calculates the enthalpy difference (unit: kJ/kg) between the enthalpy of measuring point and boiling line at the same pressure level as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

Syntax: enthalpy_dif_liq(temperature-operand; pressure-operand; index of fluid)

Examples:

- enthalpy_dif_liq("ChannelTemperature"; "ChannelPressure"; 1) calculates the enthalpy difference liquid using a temperature channel and a pressure channel for the fluid R134a.
- enthalpy_dif_liq(20; 10; 2) calculates the enthalpy difference liquid using fixed values for the pressure and temperature of fluid R1234yf.

**enthalpy_dif_vap**

Enthalpy difference vapor calculates the enthalpy difference (unit: kJ/kg) between the enthalpy of measuring point and dew line at the same pressure level as a function of temperature (unit: °C), pressure (unit: bar) and a fluid. The fluid is defined by an index referring to the following list of supported fluids: R134a, R1234yf, R22, R404a, R410a, R507a, R744 (carbon dioxide), R718 (water), R729 (dry air).

Syntax: enthalpy_dif_vap(temperature-operand; pressure-operand; index of fluid)

Examples:

- enthalpy_dif_vap("ChannelTemperature"; "ChannelPressure"; 1) calculates the enthalpy difference vapor using a temperature channel and a pressure channel for the fluid R134a.
- enthalpy_dif_vap(20; 2; 2) calculates the enthalpy difference vapor using fixed values for the pressure and temperature of fluid R1234yf.

**ha_P_sat_vap**

Ha_P_sat_vap calculates the saturation vapor pressure of water in humid air (unit: bar) as a function of temperature (unit: °C) and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperatures are below 0 °C).

Syntax: ha_P_sat_vap(temperature-operand; state-flag)

Examples:

- ha_P_sat_vap("T1"; 1) calculates the saturation vapor pressure over ice using a temperature channel named "T1".
- ha_P_sat_vap(8; 0) calculates the saturation vapor pressure at a temperature of 8 °C.
16.4 Climate Formulas

- **ha_P_vap**
  ha_P_vap calculates the vapor pressure of water in humid air (unit: bar) as a function of temperature (unit: °C), relative humidity (unit: %), and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperatures are below 0 °C).
  Syntax: `ha_P_vap(temperature-operand; relative-humidity-operand; state-flag)`
  Examples:
  `ha_P_vap("T1"; "RH1"; 0)` calculates the vapor pressure over water using a temperature channel named "T1" and a relative humidity channel named "RH1". `ha_P_vap(-10; 45; 1)` calculates the vapor pressure over ice at a temperature of -10 °C and a relative humidity of 45%.

- **ha_rh**
  ha_rh calculates the relative humidity of humid air (unit: %) as a function of temperature (unit: °C), dew point temperature (unit: °C), and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperatures are below 0 °C).
  Syntax: `ha_rh(temperature-operand; dew-point-temperature-operand; state-flag)`
  Examples:
  `ha_rh("T1"; "TD1"; 1)` calculates the relative humidity over ice using a temperature channel named "T1" and a dew point temperature channel named "TD1". `ha_rh(42; 30; 0)` calculates the relative humidity at a temperature of 42 °C and a dew point temperature of 30 °C.

- **ha_ah_1**
  ha_ah_1 calculates the density of water vapor in humid air (unit: g/m³) as a function of temperature (unit: °C), relative humidity (unit: %), and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperature is below 0 °C).
  Syntax: `ha_ah_1(temperature-operand; relative-humidity-operand; state-flag)`
  Examples:
  `ha_ah_1("T1"; 60; 0)` calculates the absolute humidity over water using a temperature channel named "T1" at a constant relative humidity of 60%. `ha_ah_1(-2; "RH1"; 1)` calculates the absolute humidity over ice using a relative humidity channel named "RH1" at a constant temperature of -2 °C.

- **ha_ah_2**
  ha_ah_2 calculates the density of water vapor in humid air (unit: g/m³) as a function of temperature (unit: °C), dew point temperature (unit: °C), and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperature is below 0 °C).
  Syntax: `ha_ah_2(temperature-operand; dew-point-temperature-operand; state-flag)`
  Examples:
  `ha_ah_2("T1"; "TD1"; 1)` calculates the absolute humidity over ice using a temperature channel named "T1" and a dew point temperature channel named "TD1". `ha_ah_2(15; 5; 0)` calculates the absolute humidity at a temperature of 15 °C and a dew point temperature of 5 °C.
16.4 Climate Formulas

ha_ah_3 calculates the mass ratio between water vapor and dry air in humid air (unit: g/kg) as a function of temperature (unit: °C), barometric pressure (unit: bar), relative humidity (unit: %), and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperature is below 0 °C).

Syntax: ha_ah_3(temperature-operand; pressure-operand; relative-humidity-operand; state-flag)

Examples:
ha_ah_3(42; 1.013; 85; 0) calculates the absolute humidity at a temperature of 42 °C, a barometric reading of 1.013 bar, and a relative humidity of 85%. ha_ah_3("T2"; "P2"; "RH2"; 1) calculates the absolute humidity over ice using a temperature channel named "T2", a pressure channel named "P2", and a relative humidity channel named "RH2".

ha_T_dew_pt_1 calculates the dew point temperature of water in humid air (unit: °C) as a function of temperature (unit: °C), relative humidity (unit: %), and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperature is below 0 °C).

Syntax: ha_T_dew_pt_1(temperature-operand; relative-humidity-operand; state-flag)

Examples:
ha_T_dew_pt_1("T1"; "RH1"; 0) calculates the dew point temperature over water using a temperature channel named "T1" and a relative humidity channel named "RH1". ha_T_dew_pt_1(-20; 33; 1) calculates the dew point temperature over ice at a temperature of -20 °C and a relative humidity of 33%.

ha_T_de_pt_2 calculates the dew point temperature of water in humid air (unit: °C) as a function of absolute humidity (unit: g/kg) and barometric pressure (unit: bar). This calculation is only suitable for temperatures >0.01 °C.

Syntax: ha_T_de_pt_2(temperature-operand; pressure-operand)

Examples:
ha_T_de_pt_2(20; 1.013) calculates the dew point temperature at an absolute humidity of 20 g water per kg dry air and a barometric reading of 1.013 bar. ha_T_de_pt_2("AH0"; "P0") calculates the dew point temperature using an absolute humidity channel named "AH0" and a pressure channel named "P0".

ha_h calculates the enthalpy of humid air (unit: kJ/kg) as a function of temperature (unit: °C), barometric pressure (unit: bar), relative humidity (unit: %), and a flag indicating the aggregation state of the non-gaseous mass fraction (0 = over water, 1 = over ice; only relevant if temperature is below 0 °C).

Syntax: ha_h(temperature-operand; pressure-operand; relative-humidity-operand; state-flag)

Examples:
ha_h(20; 1.013; 100; 0) calculates the enthalpy at a temperature of 20 °C, a barometric reading of 1.013 bar, and a relative humidity of 100%. ha_h("T2"; "P2"; "RH2"; 1) calculates the enthalpy over ice using a temperature channel named "T2", a pressure channel named "P2", and a relative humidity channel named "RH2".
16.5 Log p-h Diagram

Details on how to configure the Log p-h diagram are explained in the VIEW work area. See chapter 18.24.2. If you like to use the log p-h diagram for data analysis see chapter ANALYSIS 20.16.

16.5.1 Application Example

The climate calculation formulas pressure, temperature together which the refrigerant index is the input parameter. For the pressure measurement IPETRONIK offers a very accurate product called “CAN pressure”. This transducer is available as relative and absolute pressure measurement device in the range of 1 – 250bar.

For the log p-h calculations you have to use absolute pressure transducers. With absolute pressure transducers you achieve the same measurement results independently where your test bench is located e.g. close to the sea level or in the mountains.
17 CAN bus traffic generator

This function is only available if you are the owner of a Professional or Developer Edition. See chapter Editions 5.1.6. When you have a CAN Traffic .ASC file which includes CAN bus traffic messages you can output these message over this traffic generator. If you would like to measure and generate CAN traffic signals you need a traffic channel. It is recommended to use the new Protocols Plugin V01.03.00 or higher which includes Traffic measurement and Traffic Send functions at the same time on the same CAN interface.

Information

The CAN traffic analyzer instrument and the Traffic generator are only included in the Professional and Developer Edition.
When you have a Traffic “output” channel in your configuration you can directly configure the Traffic channel correctly. When you create a Traffic generator the dialog is proposing a list of all suitable traffic output channels.

When a Traffic generator channel is created you can use the column chooser to add more parameters into the grid overview. The parameters will be discussed below.
17.1 Traffic Generator – General tab sheet

The CAN Traffic generator can be configured through 4 tab sheets. In the General tab sheet you define the status, name and description of the traffic generator channel.

- **Active**
  With this checkbox you can activate / deactivate the Traffic generator

- **Name**
  Refers to the name of the Traffic generator

- **Description**
  Here you can add an additional description to the Traffic generator

17.2 Traffic Generator – Operating tab sheet

In the operating tab sheet you can define Start, Stop and Hold Trigger conditions to control the traffic signal generation. With the (fx) button you can open the formula interface to configure your trigger condition.

- **Start trigger**
  This can be a trigger to start the Traffic generator.

- **Stop trigger**
  This can be a trigger to stop the Traffic generator.

- **Hold trigger**
  This can be a trigger to hold the Traffic generator.
17.3 Traffic Generator – Output tab sheet

In the Output tab sheet you can define the channel which is receiving the CAN traffic messages. This channel must be defined as Output channel suitable for CAN messages.

17.4 Traffic Generator – Parameter tab sheet

In the parameter tab sheet you find the ASCII traffic file which includes the signals you would like to generate as an output signal.

► File

Here you can browse with the file open dialog to search for your ASCII file (Traffic ASCII). See next section how to get a Traffic ASCII file from IPEmotion. You can load CAN and FlexRay traffic ASCII files.

► Loop count

With Loop count you define the number of repeating output loops. When all signals are generated from the data file the signal generation will start as many times as defined in Loop count. Endless will repeat the output generation until you stop the measurement mode of the software.

► Interface ID

Here you can define which of the recorded CAN interface will be considered for signal generation. When you open the ASCII file with an Editor you can see the related CAN interface ID of the traffic signals.
### 17.4 Traffic Generator – Parameter tab sheet

<table>
<thead>
<tr>
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<th>Time</th>
<th>Description</th>
</tr>
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</tr>
</tbody>
</table>

**CAN interface ID**

```
Configuration application:=V04.01.00 RC Build 37409
ConfigurationFile:=-:\Users\Public\Documents\IPETRONIK\IPEmotion\ConfigurationFile.txt
ConfigurationFile creation:=05.09.2014 06:34:43
```

<table>
<thead>
<tr>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
<th>Value 5</th>
<th>Value 6</th>
<th>Value 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.004993</td>
<td>1</td>
<td>B</td>
<td>Rx</td>
<td>d 8</td>
<td>91</td>
<td>8E</td>
</tr>
</tbody>
</table>
18  VIEW work space

This work space shows live measurement data in a display instrument. You can build your individual graphical interface to operate your test and measurement application.

Example of a VIEW screen consisting of several instruments:

- Map
- Action Button
- LED
- Bar chart
- Table
- Alphanumerical
- Traffic Analyzer

A very convenient feature of IPEmotion is that the instruments and GUI can be created and modified during measurement / data recording process. There is no need to stop the measurement process in order to make changes to the instrument settings.
18.1 Transfer instruments from VIEW to ANALYSIS

You have the ability to easily copy pages and instruments including the properties from the VIEW work space directly to the ANALYSIS work space. This function is supported by all instruments included in the ANALYSIS work space 20.2.

- Yt-chart
- XY-chart
- Alphanumerical
- Map instrument
- Log p-h diagram
- Video instrument
- Action button

When the copy and paste function is not working to transfer an instrument from VIEW to ANALYSIS an information message is provided. See example: “LED is not supported”
Paste the instrument including the settings from VIEW to ANALYSIS. When you transfer instruments a page must be created in the ANALYSIS work space.

The copy and paste function is not only working for individual instruments but also for complete pages. You can select several pages and past them with all settings into ANALYSIS.
18.2 Ribbon

18.2.1 Display

With the Display button, you activate the data display. The measurement is initialized and online data from the devices / instrument are retrieved.

**Information**

*If you activate the data display, you are not automatically activating data storage. Data storage needs to be activated by a separate button.*

18.2.2 Store

The data store button can only be operated if channels are associated to the store group. An empty storage group returns a grey, disabled store button. See chapter ACQUISITION 14.8 for how to link channels to the store group.

18.2.3 Pause

The Pause button is only active if measurement has been started. With this button you can freeze the screen and stop the plotting of graphs and updating of instruments. If you pause the display, the recording is not affected.
18.2.4 New

With the New button you can add pages to fill your GUI (Graphical user Interface) with instruments.

---

**Information**

The number of display pages is restricted by the different editions. See the overview table of chapter Software Editions 5.1 for more details. If you exceed the number of permitted pages you will get a warning message.

You can also group pages to one logical unit. This is particular interesting for users who have many pages and who need to structure the pages in a suitable way.
The detailed configuration functions will be discussed in the section Tree below.
18.2.5 Overview page – switching between pages

The Page icon navigates between different screen pages even if the Tree on the left hand side is not visible. The detailed configuration functions of the Tree are discussed in chapter 18.3. As you can see, all pages and groups are listed in a drop-down list and can be selected to switch to this page.

The Overview page is a default page which lists all channels and measurement signals. The channel list includes measurement channels from SIGNALS work space but also all variables (number, text and status channels), formulas, scaling and status channels from FFTs, function generators, storage groups.
18.2.6 Master page layout for VIEW and ANALYSIS pages

With the master page layout function, you can define template pages with dedicated instruments you would like to share across several display pages. This function is very useful for e.g. test bench application where you would like to see the overall bench status on every page and to operate an emergency stop also from every page too. Rather than copying all dedicated display elements from page to page you need only to link the master layout to all pages in concern to get the instruments displayed. Another advantage is when it comes to changes, by adding, removing or rearranging master instruments. Rather than doing these modifications on every page individually you do it one time on the master page and it is updated automatically across all associated pages.

Only in the free edit mode (undo grid) you can arrange the instruments individually. In this mode you define the instruments you like to share across several display pages later.

In this example Page 1 is defined as "Master layout". However, you can define several master layouts for different applications.
Then you have defined other display pages you need the page context menu to associate the master layout to these pages. The master layout can only be assigned to the new page, when the automatic grid alignment (undo grid) is deactivated.

The final result is, that in this example, Page-2 has the same instrument footer as defined in the master layout of Page-1. Any modification which is made to the master layout will be automatically transferred to the pages related to this layout.
18.2.7 Fix / Undo fixing

The Fixing function is related to the modification of the page and instrument grid. You can change the size of the instrument grid horizontally and vertically.

If you activate the Fixing function, the handles are removed and the size of the instruments cannot be changed. In both options the instrument keeps the proportional size if you change the overall screen size of the application window.
18.2.8 Undo grid

The instruments are arranged automatically on the page by the software, considering the order of creation. If you resolve (undo) the grid you can allocate and position the instruments at any place. With the snap to grid setting in the OPTIONS - Appearance you can define the grid resolution. More details are in section 23.4.7.

Information When the screen page is still in the fixed mode the undo grid function is ineffective.

When the grid is resolved the instrument containers can be positioned on any place of the page. If you activate the grid again, the software is switching back to the automatic arranging function.
18.2.9 Area

With the Area function you can split the view page in a basic structure of the instrument containers before you start adding instruments. Each area is considered as a container for one instrument type. The same function is available in the ANALYSIS workspace in chapter 20.2.3.

For each container you can open the context menu to divide the instrument container vertically and horizontally.
18.2.10 Instrument Overview

The software is currently supporting 21 different instruments. You can add instruments directly from the ribbon to the view page.
18.2 Ribbon

Note:
Traffic Analyzer, Message Generator, Map are only included in the Professional and Developer Edition.
Log-pH diagram is part of the Climate Module.
Profile diagram is part of the Control Module.
The following 16 instruments are supported by all IPEmotion editions, regardless of which license you have activated.

<table>
<thead>
<tr>
<th>Instrument name</th>
<th>Change-to function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yt-chart</td>
<td>Yes</td>
</tr>
<tr>
<td>XY-chart</td>
<td>No</td>
</tr>
<tr>
<td>Oscilloscope</td>
<td>Yes</td>
</tr>
<tr>
<td>Spectrum</td>
<td>No</td>
</tr>
<tr>
<td>Histogram</td>
<td>No</td>
</tr>
<tr>
<td>Classification table</td>
<td>No</td>
</tr>
<tr>
<td>Alphanumerical</td>
<td>Yes</td>
</tr>
<tr>
<td>Bar graph</td>
<td>Yes</td>
</tr>
<tr>
<td>Tachometer</td>
<td>Yes</td>
</tr>
<tr>
<td>Analog display</td>
<td>Yes</td>
</tr>
<tr>
<td>Slide control</td>
<td>Yes</td>
</tr>
<tr>
<td>LED</td>
<td>Yes</td>
</tr>
<tr>
<td>Switch</td>
<td>Yes</td>
</tr>
<tr>
<td>Table</td>
<td>No</td>
</tr>
<tr>
<td>Video</td>
<td>No</td>
</tr>
<tr>
<td>Action</td>
<td>No</td>
</tr>
</tbody>
</table>

The change-to function refers to the context menu of the instruments where you can change an instrument from e.g. a Yt-chart into an alphanumerical display. See chapter 18.6 to find more details about the context menu.

Each instrument will be discussed in detail below.
18.2.11 Dragging channels to the instrument

There are different possibilities of how to get a channel associated to an instrument. One way is to select channels from the channel tab sheet from the Tree box and to drag and drop channels to the instrument. The software automatically takes the instrument which is selected in the ribbon. In this example, a Yt-chart is created for the selected channels.
18.3 Tree window - for pages, channels, display instruments

With the tree function you can show or hide the tree of pages, channels and instruments. You can build your application without using the tree function. You can create pages, add instruments and link channels through the context menus. If the tree is removed, you gain more screen page space for the instrument display.
18.3.1 Tree – Page tab sheet

The tree provides direct access to three tab sheets. The page tab sheet configures the page. It was discussed in section 18.2.5 - how to create a page group and how to link a page to a group.

If you like to add a background picture for the complete screen page, you have to resolve / undo the grid. Then you can search for a picture file. The default directory for pictures is:

- C:\Users\Public\Documents\IPETRONIK\IPEmotion\Custom\Pictures
You can change the default directory for all custom files (Map database, UserOperations and Pictures) in the options. See chapter OPTIONS >Directories 23.12.
You can place instruments on the background picture wherever you like. The instruments are not transparent. They are hiding / overlaying parts of the background picture.

Background pictures can be integrated to the IWF project file. This function can be activated in OPTIONS >Frequently used, as discussed in chapter 23.1.2.
The Tree tab sheet also has a search field to search for and filter specific page names.
18.3.2 Tree – Channels tab sheet

Another useful function of the tree element is the channel tab sheet that is used to select, drag and drop the channels into the instruments as discussed in section 18.2.11.

With the column chooser you can drag additional channels into the channel grid. The description and source field are particularly useful if you need this field to clearly identify which channel is the right one.

Using the search field below the Name column to filter for your channels.
Within the context menu of the channel tab sheet you can show the line numbers.

Additional functions in the context menu:

- sorting in ascending and descending order
- ability to build filter expressions
18.3.3 Tree - Display tab sheet

The display tab sheet is destined for working, searching and customizing display instruments. One function is to directly spot on which pages the instruments are located.

In the search box you can search across instrument names and channel names.
With the context menu of the instrument you can easily search on which page and on what page section the instrument is located. This function is useful if you maintain large applications with many channels, instruments and view pages.

The instrument context menu and the configuration head-up displays will be discussed in the chapter of the detailed instrument overview below.
18.4 Showing VIEW pages in full screen mode

With the icon at the lower bottom right hand corner you can hide the complete ribbon to show the instrument page in full screen mode. In this mode, you need to define your own action buttons to navigate between screen view pages.

18.5 Displaying VIEW page on a second computer screen

If the computer is configured for two display screens, you can define one VIEW page to be shown on the second computer screen. The external display option is only available if two screens are supported by the computer. A green icon shows that this view page is presented on a second computer screen.
18.6 Standard context menu all instruments share

All instruments have the same common context menu. Some instruments support special features like map download which will be discussed in detail on instrument level.

- **Change visual element**: This function gives you the ability to exchange one instrument with another instrument directly, no need to delete the instrument used before.
18.6 Standard context menu all instruments share

- **Delete visual element**
  Using the deleting function you remove an instrument from the instrument container. Each instrument maintains a container for the instrument. Only if you delete the instrument and the container, the page layout is changed.

- **Add channel**
  This function opens a channel search dialog to add channels to the instrument. In the first row you can add filter criteria for each column.

This is an intelligent channel search dialog. If you open it in the context of an FFT instrument or in the context of a Histogram / Classification instrument, only the channels supported by the instrument are provided for selection. This prevents from linking misleading channels to an instrument.
18.6 Standard context menu all instruments share

- **Delete channel**
  This function removes channels from the instrument. Select the checkboxes to delete the channels.

- **Divide area horizontally**
  Was discussed above in chapter Area 18.2.9

- **Divide area vertically**
  see above

- **Delete area**
  This function is only active if an area / instrument container is selected on the VIEW page.

- **Use as default**
  The customizing settings of the instrument can be saved to a default configuration. If you hit the Use as default button you save the instrument configuration to a data base file and all instruments you create are shown in the same format. The instruments are configured in the properties dialog discussed below for example for the Yt-chart 18.7. If you like to see a list of all instruments with a default configuration see chapter Application Menu >Administration >Reset templates 7.8

- **Cut/Paste**
  Using cut (Ctrl+x) you remove the instrument from this instrument container and you can insert it to another instrument container. You can use this function e.g. to rearrange the order of your instruments on your screen area or to replicate an instrument with all properties and related channels for any times.
18.6 Standard context menu all instruments share

- **Copy / Paste**
  This function will copy and paste the channels of one instrument to another instrument. The copy and paste function works on channel level and on instrument container level. In the example below, all the channels of the Yt-chart are copied over to an empty alphanumerical instrument.

- **Paste to overwrite**
  You can select only one channel from one instrument and paste it over another channel of another instrument if a specific channel was selected.

- **Paste to add channel**
  Another functionality is to copy a channel from one instrument and to insert this channel to another instrument. That function works only if you select the complete container of the target instrument.

- **Delete**
  With the delete function you can remove channels from instruments. Below, you see an empty alphanumerical instrument.
18.6 Standard context menu all instruments share

Empty instrument – no channels linked.
If the last channel is removed, you will delete the instrument itself in the next step. The screenshot below shows an empty instrument container.

Finally, the container is deleted and more space is gained for other instruments.

Using the copy function, you will copy the selected channel, instrument or complete instrument container into your clipboard. You can paste the image to other Microsoft Office applications.
18.6 Standard context menu all instruments share

- **Clean**
  The instruments in VIEW do not support any Clean function. The Clean function is implemented in the SIGNALS workspace.

- **Copy to file**
  With this function you can save the container/instrument configuration to a ITF file. This file can be retrieved and pasted over other instruments.

- **Paste from file**
  Using the paste function you can load an ITF file and create an instrument in an empty instrument container.
18.7 Yt-chart

18.7.1 Chart analysis - zoom and stretch functions

The Yt-chart in the online view supports chart analysis functions during live data plotting. It is possible to squeeze & stretch along the X- and Y-axis. The buffer size settings are defined in the OPTIONS >History Buffer chapter 23.5.1. The zooming functionality does not require any active data storage. The data is stored independently from the normal data storage function discussed in the ACQUISITION >Storage chapter 14.8. For users it is very convenient that they can use these zoom and stretch functions along all axes to optimize the data presentation of the online view. The easiest way to zoom and stretch the graphs and axes is to use the CONTROL key and the left mouse button.
Zoom, compress, stretch and move during live data plotting.
After zooming into the graph a small icon appears to reset the zoom.

After reset the diagram axis are are changed back to the standard settings.
After reset diagrams set back to standard x- and y-axis scaling.
18.7 Yt-chart

18.7.2 Yt-chart head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channel is linked to the instrument.

18.7.3 Use as default

As discussed above, you can save all configurations of an instrument by hitting the default button. In this case, the software creates a template file and every new instrument you create will comply with this template. The templates are managed under Application Menu > Administration. For more details see chapter 7.8.
18.7.4 General

- Use Caption
  Checkbox to show the name defined in caption
- Caption
  Refers to the name of the instrument container

- Background color
  The background color can be selected from three different color systems and is directly applied to the instrument even before the dialog is closed.
18.7 Yt-chart

- **Grid**
  The checkbox activates the grid

- **Grid color**
  Here you can select from three different color systems to define your grid color

18.7.5 Time axis

- **Time period**
  Refers to the default time axis of the diagram defined in hours. You can define the time period you will use to show the plotted diagram. This setting has an immediate effect on the displaying/scrolling behavior. If you select a large time axis it will take accordingly longer until the scroll mechanism will start its operation. If appropriate for the application, you can define hours and days as time period.

- **Display behavior**
  Here you define how the time (x-axis) is updated. There are different scrolling and scaling modes available which are discussed below.

- **Scroll continuously**
  You will see a complete graph in the chart if the time window is filled with data. The axis is then scrolling through.
Scroll 50 %

Here the graph is covering only 50% of the time window. If 100% are filled with data, the graph jumps forward by 50% which is the empty part, then. If the empty part is filled up with data, it again jumps 50% forward.

Scroll 100 %

In this configuration the graph jumps the full time axis (100%) forward if the diagram is full of data.
- **Scale continuously**
  In this scaling mode, if the measurement started, a fixed starting point is defined in the diagram and all incoming data is squeezed into the diagram.

- **Scale 50%**
  The graph has a fixed starting point. If the diagram is full of data the time axis of the recorded data is squeezed together by 50% so that there is space for new incoming data.

- **Scale 100%**
  The difference between 50% and 100% scaling needs to be clarified.

- **Wiper**
  This is a special display mode where a horizontal bar moves along the time axis. The wiper is the dividing line between online data and historic data. The wiper overwrites the historic data in the chart.
18.7 Yt-chart

18.7.6 Y-axis

- **Adjustment**
  
  Covers the properties of the y-axis

- **Separate axis**
  
  In this configuration, each channel has its own y-axis
Separate coordinate systems

The diagram will be split into separate coordinate systems for each channel.

Join axis

The join function is merging all y-axes together. The common y-axis scale is determined by the channel with the MAX positive scale and the channel with the MIN negative scale. Two separate channels can define the upper and lower end of the scale. In the example below, one channel alone is defining MAX and MIN end of the y-axis scale.
Merge equal axes

Using the merge function you can consolidate the number of y-axes and group all channels that use the same MIN / MAX scale. You can only merge y-axes, provided the channels have the same display MIN / MAX scaling defined e.g. in the SIGNALS workspace. See also chapter 12.8.1.
Position

With position you can define the location of the y-axes (left, right, alternating or both sides) for the Yt-chart. The screenshot below shows the display of the Y-axis' location on both sides of the diagram.
The display behavior of the y-axis can be configured similar to the display properties of the x-axis (time axis) discussed above.

- **Display behavior**
  - Scroll continually refer to x-axis
  - Scroll 50 % refer to x-axis
  - Scroll 100 % refer to x-axis
  - Scale continuously refer to x-axis
  - Scale 50 % refer to x-axis
  - Scale 100 % refer to x-axis
  - Scale fixed

The Y-axis is set fixed to the MIN / MAX display values as defined on channel level in the SIGNALS work space or as defined for variables or formulas in the ACQUISITION work space. Even if the signal goes beyond the MIN / MAX display range, the axes are not updated.
The Yt chart is supporting a mouse wheel scroll function for X- and Y-axis. You need to click on the axis to select the axis and then you can use the mouse wheel to change the axis display range.

18.7.7 Channel view

- Channel

In this drop-down list you can select the channel subjected to the different configurations which will be discussed below.
Define a label/description for the y-axis. If each channel has its own y-axis you can have a separate label on each axis. You can show the y-axes’ labels if you change the display mode to separate coordinate systems, as well.

This checkbox relates the y-axis MIN / MAX scaling either to the channel display scaling discussed above or to a specific scaling individually defined in this specific diagram. If you disable the check box you can define the MIN / MAX scaling for the channel selected in the list box. In the screenshot below, the channel SINE-2 was individually scaled from -20 to 10. The diagram is directly updated to the new scaling values.
Scaling

Logarithmic scaling can only be configured if the signal display range is within the MIN value in the positive number range. The scaling mode Linear / logarithmic can be defined on channel level.

Line color / width

For each channel, an individual line color and width can be defined. The settings are directly visible on the diagram.
18.7 Yt-chart

- **Show limit value**
  
  If a limit channel is associated to the channel in the graph, you can show the limit / threshold line in the diagram. This is applied to the limit channel and the range channel. To see how to configure limit and range channels refer to ACQUISITION >Monitoring in chapter 14.10.

18.7.8 Legend

- **Show**
  
  With this checkbox you enable / disable the visibility of the legend.
- **Position**
  With position you define the location of the legend: below, above, left, right.

- **Unit**
  Units defined in SIGNALS on channel level or in ACQUISITION for calculation channels, variables or scaling channels can be integrated to the legend.
18.8 x-y chart

For details see chapter 18.6.

18.8.1 Context menu - Redraw

With the redraw function you can clean up the diagram and remove all lines.
18.8.2 x-y chart head-up display

This diagram requires a pair of channels. You need to drag and drop the channels into the diagram in the required order (X > Y). If you like to show force above displacement, you need to drag force (x-channel) and displacement (y-channel) into this order to the diagram.

The first channel is related to the x-axis and the second channel to the y-axis.

You can add several pair (x/y) channel combinations to the diagram.
18.8.3 General

- Background picture
  You can relate a background picture to the instrument. Background pictures can be included in the IWF configuration file when activated. See chapter OPTIONS >Frequently used 23.1.2.

18.8.4 Axes

- X-axis
  With the radio button X / Y you can decide which axis is configured. The radio button has an impact on all axes-related settings in this group.

The join axis function is applied only to the Y-axis.
18.8.5 Graph displaying

- **Axis selection**

  With radio button you define the configuration properties of this instrument concerning axis marking, scaling, and the MIN / MAX display. In the screenshot below, the axis marking (name) is demonstrated.
18.8.6 Legend
See chapter VIEW >Yt-chart [16.7.8]

18.8.7 Deletion interval
Over time, plotting Y-X charts leads to graphically overloaded graphs where it is nearly impossible to see the incoming signal. Therefore, a time buffer (deletion interval) can be specified for the period of time in which the data should be displayed. As the screenshot below shows, the lower Y-X chart only shows 1 minute of the latest incoming data. The diagram operates in the LIFO mode where basically the latest incoming data is plotted and at the same time the oldest data is removed. In essence, only one minute of data is displayed in the diagram.
18.9 Oscilloscope

Information

Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details, see chapter 18.6.

18.9.1 Oscilloscope chart head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.
18.9 Oscilloscope

18.9.2 Trigger

If you activate the trigger function, you start the recording of the chart, in case the trigger condition is true. If the trigger is inactive, the diagram is retriggering itself automatically, based on the time axis setting discussed below.

18.9.3 Time axis

- Time base

The time base defines the size of the x-axis. The time base has impact on the update refreshing rate. If no trigger condition is defined, the diagram is refreshed according to the time base. In conclusion, large time bases will slow down the update rate because the time has to elapse before the graph can be plotted.
With the block factor setting it is possible to show continuously dynamic signals in the Oscilloscope diagram. Any block factor setting smaller than 100% increases the update rate of the Oscilloscope. For example, if you select a block factor of 10% the oscilloscope will be refreshed 10 times. For example, if the time axis unit is 1 second, every 100 ms a new set of data is loaded into the diagram and the oldest data block is removed.
18.10 Spectrum

Information

Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details, see chapter 18.6.

18.10.1 Spectrum head-up display

Exit and save the settings of the dialog by closing on the X.
18.10 Spectrum

18.10.2 FFT Source signal

The signal for the FFT is calculated in the ACQUISITION work space. Details about the FFT configuration are discussed in chapter 14.11. You can link several spectrum channels from the same FFT components like (Amplitude, Phase, or Power) to one FFT diagram.

18.10.3 Frequency axis

- Automatic / manual

If this checkbox is disabled, you can define manual frequency ranges for the x-axis.
18.11 Histogram

Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.11.1 Histogram head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.
18.11.2 Histogram source signal

The source signal for the classification is calculated in ACQUISITION > Analysis - Classification in chapter 14.12. You can only link one classification channel to one diagram.

18.11.3 Graph displaying

- **Show value**
  
  If you activate this checkbox, the actual values of each class are displayed.

- **Color**
  
  Here you can define the color of the bars.
18.12 Classification table

18.12.1 1D-Classification

18.12.2 2D-Classification

Information Only functions differing from the functions of the Yt- chart and the standard context menu, which all instruments share, are explained. For details, see chapter 18.6.
18.12.3 Classification table head-up display

18.12.4 Classification table source signal

The source signal for the classification table is calculated in ACQUISITION >Analysis - Classification in chapter 14.12. You can only link one classification channel to one diagram. The table instrument is relevant for 2D classification methods where the classification is applied to channels. 2D classification results cannot be displayed in a Histogram instrument.

18.13 Alphanumerical

Information

Only functions differing from the functions of the Yt- chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.
18.13.1 Alphanumeric head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.
18.13.2 Layout

- **Adjustment Horizontal**  Arranging instruments in a horizontal order. With the number of columns you can influence the vertical column arrangement of the horizontal row arrangement

- **Vertical**  Arranging instruments in a vertical order.

- **Automatic**  Automatic arranging of the instruments
Channel name

If you deactivate this checkbox, the channel name is removed.

Font size mode Automatic

In the automatic mode, the font size is adjusted to the available place of the instrument container. When the instrument container is getting very small, the channel name and the spin buttons to set output channels will be suppressed. If the instrument container is larger, all fonts will be increased. All channels will have the same font size. Note that the channel name font size cannot be configured.
Font size mode Per channel

In the per-channel mode the font size of each channel will be individually set to the available space in the instrument container. The setting is considering the number of decimal places configured in the display tab sheet in the SIGNALS workspace. Text channels are considered in the size calculation with the decimal format "Automatic". All channels with automatic decimal place configuration will get the same font sizes.

Font size mode Fixed

In the fixed mode all channels get a defend font size. When you change the size of the instrument container it will not affect the size of the font. If the instrument container is smaller than scroll bars will appear.
18.13.3 Channel view

- **Background color**
  You can define an individual background color for each channel.

- **Font color**
  You can define an individual font color for each channel.

If you link an output channel or a variable channel to the alphanumerical instrument, spin buttons will appear. For output channels, three configuration options are available: No input (blocked) / free entry / use spin buttons for up / down setting. You can see the data direction Input / Output in the SIGNALS work space >Channel >Format tab sheet in chapter 12.6.4.
18.14 Bar graph

Information

Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.14.1 Bar graph head-up display

Exit and save the settings of the dialog by closing on the X.

With alignment, you can change the orientation of the bars from horizontal to vertical.

18.14.2 Layout
- **Joint**: The joint checkbox is related to the axis and becomes effective as soon as the show axis checkbox is activated.

- **Show axis**: This checkbox will show the display MIN / MAX range defined on channel level in the SIGNALS work space and to formula channels or variables channels.

Each bar has its own axis.

Axis are joint together.
18.14 Bar graph

- **Show channel name**  
  With this checkbox you can remove the channel name as discussed in the chapter about the alphanumerical instrument 18.13.2.

- **Digital displays**  
  With this checkbox you can activate digital displays in the instrument for each bar.

![Digital displays](image)

18.14.3 Channel view

- **Axis marking**  
  Refers to the name of the axis. A name can be defined for each bar.

- **Background color**  
  Refers to the background color. A background color can be defined for each bar.

- **Bar graph color**  
  Refers to the bar color which can be defined on bar / channel level.

![Channel view](image)
18.15 Tachometer

Information Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.15.1 Tachometer head-up display

18.15.2 Layout
See alphanumerical instrument 18.13.2.

18.15.3 Channel view
Has already been discussed.
Only functions differing from the functions of the Yt- chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.16.1 Analog head-up display

Limited properties for configuration when no channels are linked to the instrument.

18.16.2 Layout

See tachometer instrument 18.15.

18.16.3 Channel view

Has already been discussed.
18.17 Slide Controller

Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.17.1 Slide controller head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.

18.17.2 Layout
See bar graph instrument 18.14.2.

18.17.3 Channel view
See bar graph instrument 18.14.2.
18.18 LED

Information

Only functions differing from the functions of the Yt chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.18.1 LED head-up display
18.18 LED

18.18.2 Layout

See bar alphanumerical instrument 18.13.2, for example.

18.18.3 Channel View

The LED instrument is also related to configuration settings defined on the limit channels discussed in ACQUISITION >Monitoring >Limit >View tab sheet in chapter 14.10.6.

- **Show limit values** If you relate a channel to the LED which has a limit channel defined, an output text can be made visible on the LED if the condition is true. The LED is also changing the color according to the defined color on the limit channel.

- **Status** The status refers to the status of the signal coming into the LED. The status can be ON, OFF or Invalid. Each status can be associated with a color and a caption (text display inside the instrument).
- **Caption**
  Is shown on the LED instrument

- **Color**
  Can be defined for each status individually.

- **Image**
  Here you can link an individual picture to each status. Alternatively, you can show an image which is defined on the limit channel. If you link an image on LED level, the picture of the LIMIT channel for the Status ON, OFF will be overruled and will not be displayed if the condition is true. The stats pictures can be included in the IWF configuration file when activated. See chapter OPTIONS >Frequently used 23.1.2.

- **Blink**
  The instrument background picture is blinking if the limit condition of the source channel is true.
Only functions differing from the functions of the Y-t chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.19.1 Switch head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.

18.19.2 Layout
See for example LED instrument 18.18.2

18.19.3 Channel View
See for example LED instrument 18.18.3
18.20 Table

Information

Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.

18.20.1 Table head-up display

Exit and save the settings of the dialog by closing on the X.
18.20.2 Table View

- **Font Size**
  Defining font size. Default is 12pt. The Entry can range from 1 up to the size of a Single (32 bit) number format.

- **Column chooser**
  With the column chooser function you can add the source to the table grid.

Drag Source channel from column chooser to your channel grid.
18.20 Table

- Column headings
  Activate / deactivate the column headline

### 18.20.3 Channel View

- Background color
  Defining individual background colors for all channels. See example above

- Limit channel
  If a limit channel is associated to a channel included in the table instrument, the color of the limit channel is visible in the instrument if the limit condition is true. See ACQUISITION > Limit Monitoring in chapter 14.10.6.
18.21 Action button

- **Spin buttons**
  When output channels included in the table instrument you can enter output values to the instrument or use the spin buttons.

<table>
<thead>
<tr>
<th>Name</th>
<th>Current value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_4_HV_Therm_Eng_Oil</td>
<td>20.91 °C</td>
</tr>
<tr>
<td>DigitalOut 02</td>
<td>1</td>
</tr>
<tr>
<td>AnalogOut 01</td>
<td>4.23</td>
</tr>
</tbody>
</table>

18.21.1 Action button head-up display

**Information**

Only functions differing from the functions of the Yt-chart and the standard context menu, which all instruments share, are explained. For details see chapter 18.6.
The action button does not have channel relations. Only VBS (Visual Basic), PY (Iron Python) scripts or program executables (.EXE) can be linked to the action button.

18.21.2 Action Settings

► Caption

Using the Caption function, you can define a text visible on the action button.

► Background color

Defining individual background colors for the button.
Jean Background picture

Defining individual background picture. Default directory is defined in OPTIONS.

- Execute

With the Execute radio button, you can define where you like to start a program (.EXE) file or if you like to run a script (VBA or PYTHON). The script can be an internal script managed in the SCRIPTING work space or can be a script file located from somewhere on the PC.

Information

The Action button is fully operational even if you have no Professional license which supports the SCRIPTING tab sheet.
18.22 Video

18.22.1 Required PlugIn

The video instrument requires the video PlugIn. USB Webcams (computer integrated or external) based on the WDM driver are supported by the Video PlugIn. The latest version of the Video PlugIn (V01.02.00) is supporting ethernet IP cameras based on the Realtime Streaming Protocol (RTSP). For more details see the manual of the Video PlugIn.
18.22.2 Video instrument head-up display

The video instrument has no channel related configuration options.

18.23 Instruments for Professional, Developer, Analysis Edition

18.24 Log p-h

The Log p-h diagram is included in the Climate Module 5.2.2.

In order to use the Log p-h diagram, you need to install the REFPROP (National Institute of Standards and Technology, see http://www.nist.gov/srd/nist23.cfm) on your computer. The database is provided by NIST (National Institute of Standards and Technology). If you start IPEmotion with a climate license, you need to link the REFPROP dll to the application, initially. The default installation directory of the REFPROP database is:

C:\Program Files (x86)\REFPROP\refprop.dll
18.24.2 Log p-h head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.
In the context menu of the log p-h instruments you can add, select and delete several circuits.

18.24.3 General

► Refrigerant

Here you can select the coolant used in your thermodynamic system. The type of coolant has an impact on the layout of the log p-h diagram. It is important that the Enthalpy calculations defined in the ACQUISITION use the same coolant as defined for the log p-h diagram. See chapter 16.4 for the formulas and the supported refrigerants.
The selected refrigerant has a strong impact on the Pressure [p] / enthalpy [h] scaling of the Log p-h diagram.
18.24 Axes

- **x-axis Enthalpy**
  
  With the radio button you can switch between the different axes, just as discussed with the y-x chart. The x-axis is defined for enthalpy [kJ/kg] which is linear-scaled by default.

- **y-axis Pressure**
  
  The y-axis is defined for the pressure [p] scale which is logarithmic-scaled by default.
18.24.5 Circuit

- **Circuit 1**
  
  You can show one thermodynamic cycle in the log p-h instrument.

- **Measure points**
  
  You need to link the enthalpy / pressure channels of the corresponding measurement point to the diagram as pairs. The pressure measurement and the enthalpy calculation are related to one measurement point of your thermodynamic circuit. First, drag the enthalpy channel and then the pressure channel of the measurement point to the diagram. You need at least four measurement points to get a reasonable circuit diagram.
**Circuit 1 - Reference**

The reference circuit is a simulated circuit based on the main circuit where you can define a reference cycle with its own constant pressure and enthalpy.

**Caption (measure point)**

The default caption is created from the name of the enthalpy calculation channel and the pressure measurement channel. However, you can define your own specific name for each measurement point.
18.24.6 Graph display

- Circuit 1
- Circuit - Reference
- Steam Content
- Temperature
- Entropy
- Boiling Line
- Dew Line

Define individual line color and thickness.
18.25 Traffic analyzer

18.25.1 Plugin for traffic measurement

With the Protocols Plugin you can perform traffic measurements Rx and you can send Tx traffic signals.
Data display in the instrument depends on the functions selected on the traffic channel. The following frames are supported:

- **Data frames**: Includes signal data received from a CAN interface / device.

- **Status frames**: This frame is not measured on the CAN bus. Rather it is generated by the IPEmotion CAN server integrated to CAN interface of the PlugIns. The status frames include an error counter for received Rx and transmitted Tx frames and can report the following status changes when a certain limit is crossed:
  - CAN_SERVER_STATE_BUS_ACTIVE > changed to status active
  - CAN_SERVER_STATE_BUS_WARNING > changed to status warning
  - CAN_SERVER_STATE_BUS_PASSIVE > changed to status passive
  - CAN_SERVER_STATE_BUS_OFFLINE > changed to status offline
  - CAN_SERVER_STATE_HARDWARE_BUFFER_OVERFLOW
  - CAN_SERVER_STATESOFTWARE_BUFFER_OVERFLOW
  - CAN_SERVER_STATE_BUFFER_OVERFLOW

- **Remote frames**: This is a request telegram to ask a passive CAN device to provide data.

- **Error frames**: A CAN device is sending an error message.

- **Statistic frames**: This frame is not a frame measured on the CAN bus. Rather it is a software switch to display the static information in the traffic analyzer instrument 18.25.

- **Transmit frames**: This are frames sent from the PlugIn and the installed CAN card.

**Information**: You can store CAN traffic messages and analyze them with a suitable DBC file in the data manager. See chapter DATA MANAGER 19.12.2.
18.25.2 Traffic analyzer head-up display

Exit and save the settings of the dialog by closing on the X.

The Traffic analyzer instrument has no channel related configuration options.
18.25.3 Column filter functions

You can filter in the following columns:

- **DLC** Data length byte (activated over column chooser) 18.25.14
- **ID** CAN ID
- **Name** Name of message when DBC is linked
- **Type** Rx – received frames or Tx – transmit frames
- **Data length** Message length in byte. Since CAN FD implementation length can reach up to 64 byte.
- **Data type** Is indicating standard 8 byte CAN traffic from up to 64 byte CAN FD, traffic and FlexRay traffic.

The online traffic analyzer instrument is supporting an extended filter function. You can define filters for individual and multiple CAN IDs and CAN ID ranges. The CAN IDs defined in the filter are those ID which pass and will be presented in the instrument. Filtering of FlexRay traffic is not jet supported.
In the example blow the CAN IDs are defined by entering directly the Start and End ID range. The filter of displayed CAN ID is updated accordingly. You can see that the ID B and E are suppressed.

If you do not know the CAN IDs you like to filter you can import a DBC description file to create your filter definition. As indicated below you select the channels you like to see in the traffic analyzer and the corresponding CAN IDs from the selected channels are automatically integrated to the traffic filter.
When you confirm the selection dialog the CAN ID filter settings are displayed. You can see that only 3 filter definitions for CAN ID A, C, D included. Even though 6 channels were selected in the DBC channel list.

The reason for this behavior is that only one channel is considered as relevant to identify which CAN ID has to be integrated in the filter definition. In other words you need only to select one channel which is part of the CAN ID you like to filter.
18.25.4 Instrument button for play/pause

With the display / Pause button you can switch the instrument from measurement mode with updated readings to a freezing mode where the values stay constant which gives the ability to filter and analyze the data.

![Pause mode – no new values are received and updated in the instrument.](image)

![Display mode – display red LED is blinking and new measurement are updated in the table.](image)
18.25.5 Instrument button to redraw table data

With the redraw function you can delete all entries from the table.

![Image of redraw table function]

Redraw table and delete all entries.

18.25.6 Instrument button to switch between Hex and Dec data

With this button you switch ID and data presentation between hexadecimal and decimal presentation.

![Image of switch between hex and dec data]

Switch between Decimal and Hexadecimal data and ID presentation.
18.25.7 Instrument button to switch between Log and Trace mode

In the Log mode you see all incoming messages with the most recent messages at the end of the table.

You can set the Log display mode from the head-up display or from the instrument button directly.
In the display trace view you get a static presentation of the message IDs and only the time stamp and the data column is updated.
18.25.8 Link description files to trace display mode

When you link a corresponding description file (DBC, Fibex, AUTOSAR) file to your traffic the instrument can directly convert the data frames received directly in signal names together with actual physical measurements.

The description files linked to the traffic analyzer instrument are not included in the .IWF file when you activate in the OPTIONS > Frequently used > the function include External files. This is a safety measure to ensure that confidential description files are not transferred between users through the exchange of IPEmotion .IWF measurement configuration files. 23.1.2.
18.25.9 Expand statistic frames

To display the statistic frame in the traffic analyzer instrument you have to activate the static channel in the corresponding Protocols PlugIn in the traffic channel level. For more information about the different static channels see 18.25.1.
18.25.10 Highlight changed byte data

The instrument supports a visual aid to spot changing bytes directly. By default the highlighting function is enabled. When bytes are changing the related background color of this byte is changing the color. The traffic instrument has an online update rate for the readings and the color changes of 10 Hz.

The background color coding is defined as following:

► Dark Blue
  When a byte is changing the value in a time period of every 5 seconds or slower, it is indicated with blue background color. When no new value is received within the next 5 seconds the blue is fading away.

► Dark Grey
  Dark grey is indicating frequently updated data bytes. When a byte is changing the value every 5 seconds or at shorter time periods the background color is dark grey.

► White
  When a byte is static and not changing at all the background color turns to white color.

The sample rate has only a limited impact on the color code. When you apply a high measurement rate but the byte value is not changing the background color is not affected. The background color is affect by updated / new values. However is the sample rate slow e.g. every 10 seconds or 1 reading per minute, every new reading is considered as new data and the instrument will show all bytes with blue background color. In this constellation the instrument will never be able to show grey background color as the measurement rate is slower than needed for grey background color.
18.25.11 Message Count
Here you define how many messages are stored in the instrument. The maximum number of messages which can be displayed in the instrument is 2000.

18.25.12 Legend
With this checkbox you can show or hide the “Traffic Channel” in the lower left corner of the instrument.
18.25.13  Context menu – ASCII export

The data recorded in the Traffic Analyzer instrument can be exported from the context menu to ASCII (:ASC) files. These ASCII files can be used for traffic generation as discussed in chapter ??.

**Information**

The ASCII data file export is always in hexadecimal format even if the display in the instrument is configured to decimal format. The ASCII export will include only the most recent values stored in the instrument.

The number of exported message to ASCII file is corresponding to the defined number of max message displayed in the instrument. When you define and display 10 messages in the instrument these 10 messages are exported to ASCII file.
18.25.14 Instrument grid columns and column chooser

With the Column chooser you can add additional columns to the instrument grid.

The following columns are available in the instrument:

- **Time**
  Relative time in seconds. Starting with zero seconds if you press the acquisition button.

- **Time diff.**
  Shows the time difference between the incoming messages. In the screen below, in the ID trace view the time difference between the incoming messages is 1 second.

If you switch into LOG view the time difference is calculated between the previous incoming messages.

The time difference is calculated from the previous 2 rows.
18.25 Traffic analyzer

- **Count**
  Counting the number of messages from the display starting point.

- **ID**
  ID of the message.

- **Name**
  Name of the message when description file is linked.

- **Data type**
  Is differentiating CAN, CAN FD or FlexRay traffic.

- **Data length**
  Is corresponding to the byte length of the message.

- **DLC (Data Length Count)**
  Is indicating the byte length of the messages received. DLC is ranging from CAN: 0 – 8, CAN FD: 0 – 15 and FlexRay: 0 – 254. In the range count 0 – 8 the DLC is corresponding to the byte length of the message indicated in the column Data length. In the range 9 – 15 the DLC number needs to be converted into the byte length. The conversion is defined in the following table.

<table>
<thead>
<tr>
<th>DLC</th>
<th>Byte Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>12 Byte Data</td>
</tr>
<tr>
<td>10</td>
<td>16 Byte Data</td>
</tr>
<tr>
<td>11</td>
<td>20 Byte Data</td>
</tr>
<tr>
<td>12</td>
<td>24 Byte Data</td>
</tr>
<tr>
<td>13</td>
<td>32 Byte Data</td>
</tr>
<tr>
<td>14</td>
<td>48 Byte Data</td>
</tr>
<tr>
<td>15</td>
<td>64 Byte Data</td>
</tr>
</tbody>
</table>

- **Type**
  Type of message, Rx - receive, Tx - transmit, Error, Statistic. The available message types are depending on the functions selected in the Protocols PlugIn discussed above 18.25.1.

- **Data**
  Data of the message display hexadecimal or decimal.

- **Description**
  This field is only filled with a value if you have a channel / message description included in the DBC or Fibex XML file.

**18.25.15 FlexRay traffic analysis**

The traffic analyzer instrument is supporting FlexRay traffic also. When a FlexRay traffic channel is linked to the instrument the instrument columns are adapted to the FlexRay format.

- **Slot ID**
  Message ID

- **Cycle**
  Transfer cycle
18.26 Message Generator

18.26.1 YouTube resources

IPEmotion - Online Instrument - Message Generator: http://youtu.be/Hi8LyfnKCu0

With the message generator you can edit output values and send messages from a reference DBC file. When you have loaded a DBC file you see that the instrument is divided in 2 main sections. In the upper part you see the CAN IDs and the related message data properties like CAN or CAN FD type, message length etc.

[Message generator figure]

In the lower part of the instrument you see the channels / labels included in the message. When you select a message ID from the top you see the related channels included in this specific ID below.

[Display of signals included in the message]

You have to start the measurement mode of IPEmotion in order to send the messages over the CAN interface. The instrument configuration and data values are always updated inside the instrument but they are only effectively transferred, when you are in the measurement mode.
18.26 Message Generator

18.26.2 Required Plugin for traffic output generation

To operate the message generator you need a corresponding Plugin supporting traffic sending functions. In this example Protocols Plugin is used. Select a CAN interface and create on the CAN interface a traffic channel. The default configuration is traffic input measurement. If you like to send CAN messages you need to change the data direction in the Format tab sheet to output.

If you cannot see the format tab sheet activate in OPTION >Basic settings >Expert mode the check box extended tabs sheets. For more details see 23.3.1. When the traffic channel is set to output can send and measure traffic on the same CAN interface at the same time.
18.26.3 Message generator head-up display

In the head up displays you can load the CANdb to select the message you like to send. Also you can change the data format from hexadecimal to decimal. The functions are also available through the instrument buttons which will be discussed below.

18.26.4 Link traffic output channel to instrument

In order to put the instrument into operation you need to link an traffic output channel which is configured in the SIGNALS workspace to the instrument.

You can only link one traffic output channel by instrument.
18.26.5 Import CANdb and select CAN messages for output generation

To put the instrument into operation you can either enter individual message IDs or you load a DBC reference file. To enter messages manually you access the ID column and type the values in the HEX value range 0 - FF.

The message name cannot be edited.
The other possibility is to load a DBC file and select from the DBC file the messages manually.

Information

You can load only one DBC file to select messages. However if you like to have messages from several DBC files in the message generator, load one DBC after another and select the channels needed from the channel name column.
After loading the DBC file you can select the messages in the column message name from the pull down list. In the pulldown list all messages included in the DBC are available.

When you highlight and select one message the signals included in the message are displayed in the lower part of the instrument. The same message from the DBC can be selected multiple times too.
With a right click in the very first column you can access a context menu to change the order of message IDs by using the cut, copy, past and past behind or delete function.

**18.26.6 Instrument grid and columns**

- **Message name**
  The message name is selected from the drop down list from the loaded DBC file. When you enter message IDs manually the name is equal to the ID. The message name cannot be edited.

- **ID**
  ID is predefined by the selected messages when a DBC file is loaded. When you enter messages manually you can define any ID in the valid HEX input range of 0-FF.

- **Data type**
  In the column data type you select between CAN and CAN FD. The data type CAN FD is only available when the selected CAN card in the SIGNALS work space is supporting CAN FD or when you have no Traffic channel linked to the instrument. When CAN FD is selected the 64 bit messages can be configured.
**Data length**

The data length is related to the CAN data type. CAN is supporting up to 8 bit and CAN FD up to 64 bit. When you load a DBC file the length of each message ID is defined and the data byte grid is reflecting the length in the byte grid.

**Send**

This is static information as the default function is send mode.

**Cyclic**

This checkbox is activating the cyclical output generation.

**Cycle time**

Cycle time defines the frequency for the transfer. The slowest transfer rate is 10,000 ms = 10 sec.

**Data bytes**

In the byte grid you can directly enter the values you like to send. The byte values are directly converted into physical values on signal level in the lower part of the instrument.

You can enter alternatively data byte values on signal level. The physical values are updated automatically.
Another possibility is to enter physical values directly in signal level.

Finally you can add physical values also through the spin buttons by an individual defined step value. With every hit on the button the output value is changing by the defined value for the physical step.
18.26.7 Instrument button to delete selected messages

With the instrument delete button only the selected messages (lines) are deleted. You do not delete all messages.

18.26.8 Instrument button to switch between Hex and Dec data

With this button you switch ID and data byte presentation between hexadecimal and decimal presentation.
18.26.9 Instrument button to send all selected messages manually

The data is sent only in the measurement mode of IPEmotion. When you activate the cyclical transfer the data values entered are transferred in this interval. However, if you like to send specific messages manually at a user-defined time point you can select the messages, enter the value, and hint the transfer button. The manual transfer can be executed inside the cyclical transfer too.

18.27 Map
18.27.1 Required Plugin

For the Map instrument you need a GPS signal with Latitude and Longitude channels. Both channels combined show the location of your vehicle on the map. The GPS signal can be retrieved from different sources.
Here you can take any standard GPS receiver using an USB or serial interface which supports the standard NMEA protocol together with the GPS Plugin.
IPEspeed

IPETRONIK’s self-developed high speed GPS receiver. This receiver can be directly interfaced to the Laptop using a CAN card and the CAN Acquisition Plugin. In order to get the signals in the right format from the IPEspeed GPS receiver, you should load the demo configuration IPEspeedDemo.IWF. In this configuration, the complete sensor setup is predefined. For the right format of the Latitude and Longitude the channels in the red box should be linked to the Map instrument. As indicated in the format tab sheet some special tasks are defined to ensure that the data format of the IPEspeed GPS receiver is processed correctly in IPEmotion.

M-LOG V3 / FLEETLog / IPElog

You can also receive a GPS signal from IPETRONIK data loggers which have an interface to any GPS sensor. In this setup the GPS sensor is configured in the IPETRONIK LOG Plugin and the GPS signals are sent to the PC over XCP service. For more details on how to configure the XCP service function have a look at the OPTIONS >Basic Settings >Automatic Service Administration in chapter 23.2.4.
18.27 Map context menu

If you download map tiles through the map instrument in the VIEW or ANALYSIS work space, you define a corresponding data file.

Once the download is finished, the file is fixed and cannot be changed, any more. Adding more tiles or other geographic areas later to this data file is not possible.

- **Region**
  The coordinates refer to the visible geographic area covered in the instrument.

- **Level of detail**
  The drop-down list offers predefined entries for different resolutions. The highest resolution is 25 m. If you select a large territory and a high resolution, the system automatically computes the amount of data you are downloading and the required time at a standard download rate of 1 Mbit/s. For large territories it is not possible to download all tiles to the highest resolution of 25 m.

- **Duration**
  The duration is the time you need to download all tiles, provided you have a 1 Mbit download rate.

- **Name**
  Name of the data file. The tiles are stored in a file called name-xyz.db located in the following directory.

  - Win 7: C:/Users/Public/Documents/IPETRONIK/IPEmotion/Custom/Map

- **Description**
  Description of the data file.
All downloaded map files are listed in the OPTIONS under ‘Maps’. You can only activate one database of your choice. For more information of the different data base settings see chapter 23.11.

**Information**

The selected data base in the OPTIONS is a global setting. This means it applies to all map instruments in VIEW and ANALYSIS. If you like to change the “default” map data base file you need to delete and reinser the map instruments.

18.27.3 Map instrument head-up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.
18.27.4 Channel view

- **Channel**
  The channel is always a pair of Longitude & Latitude. It is important that you first link Longitude and then Latitude. If you link the channels the other way round, your GPS position will be wrong. You can link several pairs of these channels into the instrument. The map instrument accepts any channel, as the screenshot below shows.

- **Dot color**
  With the dot color you can define in which color your current position is indicated on the map. The dot is only visible during measurement if a valid GPS signal for longitude/latitude is received.

- **Dot size**
  The dot size can be defined in Small, Medium, Large.
18.27.5 Display behavior

- Scroll continuously
  The map is moving continuously and follows the GPS position.
- Scroll 50 %
  The map is moving 50% forward in the direction of movement.
- Fixed
  The map remains in the predefined section even if the GPS signal is outside the visible territory.

18.27.6 Navigation aids

- Guidance track
  You can load a reference track data file to compare your current position (dot) to a reference position. The use case is that drivers can load a reference track to the map instrument and can then track their online position and see if it matches the reference position. The guidance track can only be imported as a GPX file. The details about the GPX export will be discussed in DATA MANAGER chapter 19.8.5. The GPX data file can be included in the IWF configuration when this function is activated in the OPTIONS >Frequently used as discussed in chapter 23.1.2.

- Line color
  Here you can define the color of the guidance track line.
- Line thickness
  Here you can define the thickness of the guidance track line.
The profile diagram can be used for any application on the road or test benches e.g. in climatic wind tunnels (CWT) where the driver has to perform specific test according to speed or break tests. The instrument is a graphical display to graphically indicate to the driver the actions he should take.

**Information**

The Profile diagram is only available in your instrument tool box if you purchase the Control module license 5.2.1.

Refer to the ACQUISITION work space in chapter 15.10 to see the configuration details of the Profile generator.
18.28.1 Profile diagram head-up display

Exit and save the settings of the dialog by clicking on the X.

Limited properties for configuration when no channel is linked to the instrument.

18.28.2 General

See bar graph instrument 18.14.2.
18.28.3 Time axis

- **Alignment**
  Here you define over the radio button the scroll direction of the instrument. You can have a horizontal or a vertical scroll behavior. In many wind tunnel test benches the vertical scroll direction is preferred by the drivers.

- **Axis marking**
  Adding a text label to the time axis.

- **Lead & Follow up time**
  This refers to the time axis display for the driver. With the lead time you define in seconds \([s]\) how much of the future profile is visible to the driver. It is important for the driver to see the future profile in order to adapt his driving pattern accordingly to meet in the best possible way the target or reference speed profile line. The follow up time defined how much of the past profile is visible to the driver.
18.28.4 Channel view

- **Axis marking**
  Add a text label to the reference/actual source channel.

- **Min / max scaling**
  The min and max display is by default taken from the settings of the Profile generator as defined in the display tab sheet 15.10.4.

- **Line color**
  Refers to the color of the actual source channel. The source channel is linked to the Profile generator in the configuration tab sheet 15.10.3.

- **Dot width**
  The source channel is highlighted by a dot with configurable dot size.
18.28.5 Profile line

- **Line color**: Define the color of the reference profile.
- **Line width**: You can define the width of the reference profile.

18.28.6 Tolerance lines

- **Show**: With the checkbox you enable the visibility of the tolerance lines. The tolerance lines are defined in absolute or relative terms in the Profile generator in the configuration tab sheet 15.10.3.
- **Color**: You can define individual color for the tolerance lines.
- **Line width**: You can define line width if the tolerance lines.
18.28.7 Status channels

As mentioned in chapter 15.10.6 the Profile generator is supporting a set of status channels when you enable in the OPTIONS the Expert mode 23.3.1. The status channels provide very useful information for the test driver and the reporting. These are internal channels computed during profile generation. These channels can be used as inputs for other math, logic and formula operations.
- **Loop**  
  Is counting the number of loops the profile has been generated. The loop count is configured in the Profile generator configuration tab sheet 15.10.3.

- **Time**  
  This status channel is indicating how much time is elapsed since the start of the profile. Time is displayed in seconds. You can create a formula to convert the seconds into the standard time format of HH:MM:SS. See chapter 14.4, or search for this expression "HH:MM:SS".

- **Lower tolerance**  
  This channel is displaying the actual reading of the tolerance.

- **Upper tolerance**  
  This channel is displaying the actual reading of the tolerance.

- **Violation time**  
  This channel is displaying (integrating) the time in seconds for how long the source channel is outside of the tolerance bands. This is reflecting the time outside the lower and upper tolerance line.

- **Violation count**  
  The counter channel is counting the incidents how often the source channel has left the tolerance band.
19 DATA MANAGER work space

19.1 Ribbon

[Image of the ribbon with highlighted Data manager]

19.2 Load (Import)

[Image of the file open dialog]

If you hit the Load button, the file open dialog will come up. The supported import formats are found in the list box. The import formats are discussed in more detail in OPTIONS > Import in chapter 23.8. You can select and load several data files at once. If you already run the IPEmotion program and you like to load another data file, you can simply double-click on any IAD data file in your explorer and it will automatically be opened in your running IPEmotion program.
The DATA MANAGER is organized in three main areas.

- **First area**
  The main area is the tabulated data overview. Time stamps and measurement data are listed in columns for each channel.

- **Second area**
  Is related to the data groups and the related channels. In this area you can also enable or disable channels and data groups.

- **Third area**
  Shows properties of the data group or the channels.
19.2.1 Edit data group properties

In the properties window you can see details of the data group. General properties are the name, channel count and time of the first recording and the last recording. These properties cannot be modified. In the section of the user-defined parameters, you will see all properties saved to the data file which are originating from the project properties. In the PROJECT work space you can enter and define your user-defined parameters. If the data file is saved, these parameters are included to the data file displayed in the section of the window. You will find more information about the PROJECT parameters in chapter 11. However, if you like you can modify the project parameters in the data manager. The modifications are only effective when you export the file to a new data file.
If you select a channel, you will see its properties. The General and Value-component properties are defined in the SIGNALS work space. The Time-component is related to the time channel and is automatically defined by IPEmotion.
19.2.2 Editing data records

You can modify and update data records in the DATAManager grid.

The changes become effective when you export the data file.
19.2.3 Channel properties

The channel properties can be edited as well. These parameters are defined in SIGNALS on channel level. You can modify them after recording is needed. The changes become effective when you export the data file. You can modify the following parameters.

- **Description**: Change channel description
- **Unit**: Change unit
- **Display MIN / Max**: Change display scaling Yt- and XY-diagrams
- **Decimal places**: Change the number of decimal places
Example: When you change the Display Min/Max properties they become effective in the Yt- or XY-diagram when you disable the automatic scaling function.
19.2.4 Time channel format – relative / absolute

When you import a data the time channel format in the data grid, is influenced by the settings in the OPTIONS >Appearance 23.4.7. When the time channel is set to absolute time the full date and time is displayed in the time column for each channel. When in the settings in the option is defined for relative the time channel is starting from Zero and incrementing the numerical value by the sample rate.
19.2.5 Working in the data file tree

- **Hide / show channel tree**
  In the data file tree you have different configuration options. You can show or hide the channels of each data file.

- **Enable / disable channels**
  You can activate or deactivate all channels if you select or deselect the checkbox on data file level.

- **Delete data files**
  You can delete individual files from the pool of all loaded files. With Ctrl+A you can select several files and delete them as well. This function is different from the REMOVE function that will be discussed below.
19.2 Load (Import)

- **Deactivate channels**
  You can deactivate each channel individually by deselecting the checkbox. The channel grid is updated and the deselected channels are invisible.

- **Delete channels**
  The channel checkbox discussed above has only an impact on the data grid. If you like to remove a channel for the export, you need to select and delete the channel first.
Merge Time channels

Every channel has a corresponding time channel. By default the data grid shows a time channel for every measurement channel. You can merge the time channels with a setting in OPTIONS > Data Manager in chapter 23.6.1.

Information

When you activate the function "Merge Time channels" in the options the order of the channels in the data grid can change. Normally the channels have the same order as listed in the channel tree. However when the time channels are merged all channels in the data file with the same acquisition rate are grouped together.
19.2 Load (Import)

- **Column chooser**

  With the column chooser in the data file tree you can add valuable information to the channel list. By default you can add the channel description and the channel reference to the grid.

  ![Image of column chooser in data file tree]

  **Default customizing KEY VALUE pairs.**

  With the **Customize.XML** file you are able to add individual key-value parameters to the channel grid of the DATA MANAGER tree. The customize.XML file has to be installed in the installation directory of IPEmotion.

  - C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Customize.xml

  **Information**

  The **Customize.XML** file can be used to add individual key-value pairs to the SIGANL channel grid too. See chapter 12.6.1.
With the definition of Customize.XML new columns are added to the channel grid of the DATA MANAGER. The benefit is that you can add additional channel specific properties to the grid.

The customized key-value pairs are included in the detailed export column chooser too.
19.2.6 Adding key-value pairs to channel properties

IPEmotion - Key-Value pairs and MDF4: https://youtu.be/T87XygAgAs58

With the key-value pair function users can add additional metadata to their channel to describe very precisely the origin of data. In the screenshot below you can see how the standard information of measurement channel can be enriched with additional information. You can add metadata of any Plugin to your channels.

The main idea is to add information tags (meta data) on channel level so that from a data traceability point of view the user can easily identify along the whole hierarchy of the data acquisition system, where the data is originating from. The following diagram shows an example of the hierarchy is reflected in the XML schema.
The key-value definition XML file is stored for TEStdrive data loggers in the following directory:

- C:\Program Files (x86)\IPETRONIK\IPEmotion PlugIn IPETRONIK LOG V03.xx.xx\Data\KeyValueDefinition.XML

The key-value definition XML file is stored for IPEmotionRT data loggers in the following directory:

- 32 Bit C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\KeyValueDefinition.XML
- 64 Bit C:\ProgramData\IPETRONIK\IPEmotion 2019 R3 (x64)\KeyValueDefinition.XML

As indicated below this XML file includes parameters which the user would like to store in addition to the general channel properties.

KVP can be defined for any PlugIn. As default the following KVP are included for any PlugIn:

- Index
- Source type
- Bus type
- Type name
- Interface
- System

The default KVP can be extended via the KeyValueDefinition.xml. As indicated in the example below the XML file includes parameters specific to the M-SENS2 module of the IPTRONK PlugIn X.
In this example the XML file was extended by the following parameters which are stored additionally to the channels:

- Physical Min/Max scaling
- Sensor supply voltage
- Hardware filter
- Device Name
- Firmware version
- Data type
- Sample rate

The types of parameters which can be made available for storage are depending on the PlugIn and the nature of the channel. Only IPETRONIK developers have access to the exact parameter names in order to define them in the XML file. The types of parameters which can be made available for storage are depending on the PlugIn and the nature of the channel. Most of the additional technical parameters users are interested in depending on the channel type (temperature, strain, voltage, etc.)

**Information**

*Only IPETRONIK developers have access to the exact parameter names in order to define them in the XML file.*

With the Customize.XML file the additional channel parameter stored in the data file can be made accessible and visible to the channel grid of the DATA MANAGER 19.2.5.
19.2.7 Remove

With the remove function you can remove all data files. However if you made any modification to the data file, group properties, channel properties, delete channels are update data records you get a warning that these changes are not saved. Only when you export the file the changes are effective.
19.3 Data export

IPEmotion – Data Post-Processing – Data Formats: http://youtu.be/2R3VCndYYHg

19.3.1 Export channel count is limited by the different Edition

You can load any data files and any supported format with every IPEmotion Edition. However, the export is limited to the same number of channels as defined for data storage. See chapter Editions 5.1 for more details on export restrictions. The supported export formats are discussed in more detail in OPTIONS >Export in chapter 23.9.

19.3.2 Different export behavior – deactivated vs. deleted channels

For data export it is important to consider that the software is behaving differently. In the normal export only the deleted channels are excluded and removed from the exported file. However if you use the detailed export all deselected channels from the export window are excluded from the export.

Information At any case if you delete a channel from a data file, this deletion will become effective after the export process. The original data file remains unchanged and keeps all data and all channels.
19.3.3 Detailed export

The data export offer special export settings which will be discussed in turn.

The settings can be defined in the following interface.
19.3 Data export

Through the channel grid you can add 5 additional columns.

- **Count**  
  Indicating the number of sample in the data file.

- **Data type**  
  Indicating the data format when stored. The data format you can see on channel level in SIGNALS in the tab sheet "Format".

- **Reference**  
  Channel standard reference to determine the source of the data.

- **Special task**  
  The special task is also defined in SIGNALS in the tab sheet "Format" 12.6.4.

- **Unit**  
  Units of the channel.

- **Customized KEY-VALUE**  
  All customized Key-value pairs defined in the Customize.XML file are included in the column chooser of the detailed export 19.2.5.
Detailed export including Customize.XML Key-value pairs too.

19.3.4 Start and end time

With start and end time you define which part of the data file should be exported or processed. In the OPTIONS you can define the time axis between relative and absolute. This time setting is reflected on the export time range.
19.3.5 File size calculation for IPEmotion .iad format

Depending on the sample rate selected you get an approximation of the file size after the export. This approximation is only an estimate for IPEmotion (.iad) files. The size of other formats can be different.

19.3.6 Storage rate and processing type – Sample

In these drop down lists you can define the sample rate you would like to apply to the processing rate. When you select sample and a corresponding sample rate all selected channels will be resampled.
The graph below indicates how the original signals either reduced in sample rate (Sine-1) or are increased with additional values (Sawtooth-2). Finally all channels will have the same number of samples (sample rate) in the data file.

19.3.7 Storage rate and processing type – MEAN

When you select the processing type MEAN the export function will calculate the mean value of all samples in the selected sample rate (time range).
19.3 Data export

When the sample rate is 10 Hz it is equivalent to 100ms. The MEAN formula is then taking all sample from the original source channel (Sine-1) and is returning the MEAN value every 100ms. In this example the Sine-1 channel has a resolution of 200 Hz. In this case the software takes 20 samples to calculate the mean value as indicated in the diagram below.

**Information**

When you apply MEAN, MIN or MAX calculations the resulting graph has inevitably a phase shift. This is caused by the fact that depending on the sample rate of the source channel and the output channel a time shift takes place.
19.3.8 Storage rate and processing type – MAXIMUM

With MAXIMUM function you calculate the maximum out of the source channel. All sample of the source channel are included in the calculation. In this example 20 values of the 100 Hz Sine-1 channel are considered in computing the maximum.
19.3.9 Storage rate and processing type – MINIMUM

With MINIMUM function you calculate the minimum out of the source channel.
19.4 Impact of increased sample rates

In the processing settings you can define computations (Sample, MIN, MAX, MEAN) with higher sample rates than the source channels. In this case the result is that additional samples are plotted and integrated to the resulting output signal. The diagram below indicates how a 200 Hz (5 ms between each measurement) signal is represented when the overall applied sample rate of 1 kHz (1 ms between each sample) is applied.

![Diagram showing mean calculation result](image)

**Information**
The software is not "inventing" or computing any intermediate data points. When the sample rate is smaller than data points are excluded (removed from the output signal). If the sample rate is higher than the source channel data points of the same values are added (filled) up to the output signal.

19.5 File name and storage path

Here you can define the file name and the location where to export the new data file. The default directory is the one you have defined in the OPTIONS >Directory 23.12.

19.6 File type – data export formats

Here you can define in which formats you like to export the data.
The following table provides an overview of all import and export formats.

<table>
<thead>
<tr>
<th>Format</th>
<th>File Type</th>
<th>Storage</th>
<th>Data Export</th>
<th>Data Import</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPEmotion</td>
<td>.iad &amp; .ird</td>
<td>yes (iad)</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>IPEmotionRT</td>
<td>.ziprt</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CSV</td>
<td>.csv &amp; .txt &amp; .asc</td>
<td>yes (csv)</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>DIadem</td>
<td>.dat &amp; .tdm &amp; .tdms</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Drupal Metadata</td>
<td>.XML</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Excel 2003 XML</td>
<td>.xls &amp; .xml</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Excel 2013 XLSX</td>
<td>.xlsx</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>ASAM ATF/XML</td>
<td>.atfx</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>PAK ASAM ATF/XML</td>
<td>.atfx</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>FAMOS</td>
<td>.dat</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>MATLAB</td>
<td>.mat</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>MDF 3</td>
<td>.mdf &amp; .dat</td>
<td>yes (mdf)</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>MDF 4</td>
<td>.mdf</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>PD5</td>
<td>.pd5</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>RPCIII</td>
<td>.rep</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Video</td>
<td>.avi</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>AUDIO</td>
<td>.wav</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GPX</td>
<td>.gpx</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>G.I.N. audio</td>
<td>.wav</td>
<td></td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Graphtec</td>
<td>.gbd</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>KML</td>
<td>.kml</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>TRAFFIC ASCII</td>
<td>.asc</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRAFFIC BLF</td>
<td>.blf</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRAFFIC MDF</td>
<td>.log &amp; .mdf</td>
<td></td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>TRAFFIC ETH</td>
<td>.pcap</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>TESTdrive AUDIO</td>
<td>.dat &amp; .wav</td>
<td>yes (atfx)</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>TESTdrive Data Format</td>
<td>.zip</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>TESTdrive Video Format</td>
<td>.dat</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>TESTdrive Traffic</td>
<td>.bin</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
</tbody>
</table>

Data export & online display e.g. in Yt graph: restricted to the channel count of the Edition:
Basic = 10 / Lite = 64 / Standard = 256 / Professional, Developer, Analysis = no limit
19.7 File Conversion

With the file conversion dialog, a couple of features known from IPEconverter are integrated to IPEmotion. The conversion operation is only available from the DATA MANAGER work space.

In the first step you define your export format. Several formats can be exported at the same time as indicated in the screenshot below - CSV and DIADEM DAT file will be generated.
19.7 File Conversion

- **Target directory**
  For the target directory it is recommended to select a different directory from the source files. This will give you a better overview of the input data files and the converted output files.

- **Grouping**
  There are 2 grouping modes supported. By measurement file and by group name. It is recommended to use the grouping my measurement file for data files which do contain only one group. However, for data files from data loggers which contain several data groups (storage groups) can be integrated in one data file (MEA-ZIP, ZIP.RT). Therefor the grouping by group name is useful for data files with several data groups.

- **Merge operation**
  With the merge operation data files are bound together in a chronological order. This function is operating like in the OPTIONS settings “Merge at loading”

- **Split operation**
  The file split operation is acting on trigger events. The trigger events are usually generated by data loggers where a triggered data storage is configured. Every trigger event will generate a separate data chunk in the overall MEA.ZIP or ZIP.RT file. The split operation will then generate from every trigger event a separate file.

- **Overwrite file**
  With this checkbox you can overwrite previous exports. Otherwise the conversion will fail.
The results of the conversion process are presented below.
19.8 Exports requiring particular attention

19.8.1 Audio Export [.WAV]

If your IAD data file includes an AUDIO channel, recorded e.g. from the SOUND PlugIn or through your M-LOG IPEaudio measurement system, you can run an AUDIO export. In this case, for every audio channel a separate WAV file is created. The new WAV file includes the starting time stamp of when the export was executed. There is no synchrony between the originally recorded file and the WAV file after the export.

19.8.2 Video Export

For every VIDEO channel, a separate AVI file is created. At video export, you can choose between different compression methods (CODEC). They are specified in OPTIONS >Export >VIDEO in chapter 23.9.22. The export of the video channel is the same as with the audio channel export. The new video files have a starting time stamp showing when the export was executed. There is no synchrony between the originally recorded file and the WAV file after the export.

19.8.3 PAK ASAM ATF/XML Export

This is an export for audio and sound analysis for the Müller BBM PAK software package. This export requires special attention in the settings in OPTIONS. Here you can define a damping factor which depends on the gain factor of the IPEaudio signal conditioner and the selected microphone. For more details see OPTIONS >Export >PAK ASAM ATF/XML in chapter 23.9.16. This export is licenses together with the Acoustic Module 5.2.3.
19.8.4 GIN Audio Export

Audio signals recorded from G.I.N microphones based on the CAN traffic format can be exported to WAV format to play back the audio recordings. The audio recording must be stored with an IPETRONIK data logger in the traffic file format and storage group. The audio (WAV) export is automatically considering all traffic messages starting with ID \texttt{0x1BFF0008} as audio recordings. See option 23.9.11.

19.8.5 GPX export

The GPX files contain GPS position coordinate data which is required for the Map instrument to load a reference track (see chapter VIEW >Map instrument 18.27.6). The GPX export is only possible if the data file includes Longitude, Latitude and Altitude channels in the right format. To ensure that the channels have the right format you need to define a special task in the SIGNALS >Format tab sheet. For more details see chapter 12.6.4.

19.8.6 Excel export

The ribbon supports a direct Excel 2010 (XLSX) export. If you execute an Excel export, the Video and Audio data records cannot be interpreted and exported by Excel.

19.9 Merging channels and data files

Merging data files is an important function. Generally, every data file is treated as a separate entity in the DATA MANAGER. However, if you have data files with common channels, merging the files can be useful. The benefit is that you only have one data group including all channels. This has a particular impact on the graphical display in the Yt-charts and on other post-processing functions. See more details in OPTIONS >DATA MANAGER in chapter 23.6.3.
19.10 Enable / disable Tree

With the tree button you can hide or show the data file / channel tree.
19.11 Filter functions - CSV file

In the DATA MANAGER workspace in the measurement file tab sheet a filter function is implemented. The filter is supporting also CSV reference files in order to select specific channels from large data files with many channels easily.

The CSV file has to include the exact channel names you like to filter. When the file is loaded all other channels are invisible.
19.12 Traffic measurement

With the Protocols PlugIn you can measure CAN, CAN FD, LIN and FlexRay bus traffic. This traffic channel can be stored in the storage group. See chapter VIEW >Traffic Analyzer instrument 18.25.1 for more details how to activate the Traffic channel and to show online traffic measurements in the Traffic Analyzer instrument.

19.12.1 Loading traffic data file

Then you load your Traffic data file into the DATA MANAGER.
19.12.2 Convert traffic back to signals

The CAN, CAN FD, LIN and FlexRay traffic recordings can be converted into signals with the following description file formats:

- `dbc` (DBC file format)
- `xml` (DBC file format)
- `ldf` (DBC file format)
- `arxml` (Autosar file format)
- `xml` (Fibex file format)

Here you can see how the DBC / LDF file is converting the CAN message to measurement channels (names) and shows the numerical values of the measurement.
19.13 Sequences for post processing

IPEmotion - Data Post-Processing - Sequences and Operations: http://youtu.be/lSwMrUPyoA4

The offline data processing is supporting operation sequences. Within the operation sequence, you can define different operations to be applied to the channels of the original data file or to intermediate calculation results. The concept of the sequence is to process a source channel in consecutive order as defined in the sequence. You can create several sequences with different processing steps.

You can add the operations to a sequence from the ribbon or from the sequence context menu. You can create the following post processing functions which will be explained in detail below:

- **Formulas**
  - This includes all online math functions and operations.

- **Formula from Pool**
  - Retrieve formulas from the pool.

- **FFT**
  - Fast Fourier Transformation.

- **Classification**
  - Refers to offline classification methods.
19.13 Sequences for post processing

- **Acoustics**
  This operation is only available if you have the Acoustic Module [4.2.3]. It is a special operation to calculate the Campbell diagram, Order Analysis or Overall Level 20.19.

- **Filter**
  Low pass filter: Passes only frequencies below cut-off frequency.
  High pass filter: Passes only frequencies over cut-off frequency.
  Band pass filter: Passes only frequencies within the lower and upper cut-off frequency.
  Band stop filter: Passes only frequencies below the lower and over the upper cut-off frequency.
  Inverted band pass filter.

- **Segment**
  This operation allows you to select a specific section of graph.

- **Find conditions**
  This function can search for specific data points or time points.

- **Script**
  This operation will give you the ability to perform specific functions which are beyond the standard tool box.

- **Statistic**
  This function is calculating standard statistic functions like MIN, MAX, MEAN etc. from a selected channel.

### 19.13.1 Create a Sequence – General tab sheet

In order to execute any of the post processing function you have to create a post processing sequence.
19.13 Sequences for post processing

- **Active**
  
  Activating the sequence. This indicated in the tree list.

- **Name**
  
  Define a name for the sequence

- **Description**
  
  Add a more detailed description to the sequence

- **Automatic**
  
  With the automatic check box you control the execution of the sequence. By default the sequence has an automatic execute. When you load a data file or you create a new processing function it is directly executed.
19.13 Sequences for post processing

- Execute manually

When you deactivate the Automatic check box, you can execute the sequence manually from the context menu. A dedicated icon is indicating when a sequence is in the manual operation mode.

19.13.2 Impact of the order of operations

Another important aspect is the right order within one sequence. The operations inside a sequence are processed in the same order as they are listed. In this example first operation Script 1 then operation Script 2 and finally the segment operation is executed.
19.13 Sequences for post processing

**Information**

If you would like to use the result of one operation as an input to another operation, you need to accommodate both functions in the same sequence. You cannot jump between sequences and use operation a of sequence A as an input for operation in sequence B.

19.13.3 Operation results for analysis and data export

If you create operations, they will be visible and displayed at the end of the channel tree.
All operation result channels can be linked to diagrams in the ANALYSIS work space.

All operation result channels are available as inputs for other operations or to display in instruments in ANALYSIS.
All operation results represented as channels in the data pool can be exported into a new data file. When you export the calculations into a new data file the results are saved.
19.14 Formula

IPEmotion - Data Post-Processing – Formula:http://youtu.be/2Eu0fyE-pls The offline formulas can be applied to the data file for post processing calculations.

19.14.1 General – tab sheet
19.14 Formula

- **Active**
  With this check box you can enable the formula and run the calculation.

- **Name**
  The default name after creating is "Formula-X" having an incrementing index.

- **Description**
  To define a supplementary description of the formula.

### 19.14.2 Formula – tab sheet

In this tab sheet you define the syntax of the formula operation.

![Formula tab sheet](image)

### 19.14.3 Display – tab sheet

- **Display area**
  Covers the default setting of the Y-axis in the Yt- and XY-chart.

- **Formatting**
  Covers the number of decimal places in numerical instruments.

Add the offline formula to the overall formula pool to save the formula for future use.
Add formula to pool.
19.14.4 Formula from pool

You can use online formulas from the ACQUISITION work space and offline formulas you created in DATA MANAGER. See chapter for online formulas 14.2.2.

19.15 FFT

IPEmotion - Data Post-Processing - FFT Analysis: http://youtube/5Xv47A-gv-U The FFT (Fast Fourier Transformation) can be calculated online and in the post processing operations.
19.15 FFT

19.15.1 General – tab sheet

- Active
  - With this checkbox you activate / deactivate the FFT calculation.

- Name
  - Refers to the name of the FFT.

- Description
  - Here you can add an additional description to the FFT.

19.15.2 FFT – tab sheet

In this tab sheet you define the FFT calculation parameters for the source channel.
Source channel This is the signal channel which is subjected to the FFT calculation.

Sample rate Indicating the sample rate of the selected source channel.

Resolution The resolution is related to the number of taken samples to calculate the FFT. The resolution or number of samples subjected to an FFT calculation is a drop down list. Based on the selected resolution the corresponding frequency and block duration is calculated:

\[
\text{Block duration} = \frac{\text{Resolution}}{\text{Sample Rate}}
\]

\[
\text{Frequency} = \frac{\text{Sample rate}}{2} \div \text{Resolution}
\]

Window function The window function is particularly important if only very few periods of signals are included in the calculation and the trigger point of the signal recording gets an important impact on the computed result. The following window functions are supported: Rectangle, Hanning, Hamming, Backman, Bartlett. The different window function correction factors are:

<table>
<thead>
<tr>
<th>Window function</th>
<th>Peak correction factor</th>
<th>Power correction factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hanning</td>
<td>2</td>
<td>1.63299</td>
</tr>
<tr>
<td>Hamming</td>
<td>1.85185</td>
<td>1.58630</td>
</tr>
<tr>
<td>Bartlett</td>
<td>2</td>
<td>1.732</td>
</tr>
<tr>
<td>Blackmann</td>
<td>2.381</td>
<td>1.8119</td>
</tr>
<tr>
<td>Bartlett-Hann</td>
<td>2</td>
<td>1.658</td>
</tr>
</tbody>
</table>

Short time mode Single: the FFT is only calculated from the first block of data. The following screenshot is an example for a 1024 point resolution FFT. Average: In this case the resulting FFTs is an arithmetic average from all FFTs calculated over the complete data file. For the average FFT calculation the overlap factor is an important setting too.

Overlap factor If this check box is activated, the FFT is calculated from all data included in the data file. With factor (%) you can define the overlap of the FFT calculation. 0% = no overlap.
Example: Short time mode: Single

Information

All other data points of the measurement file are not included in the FFT calculation.
**Example: Short time mode: Average: 0% overlap**
Using this setting, the FFT is calculated from data blocks in the size of the resolution with no overlap. In this example, the block size is 1024 samples.
**Example: Short time mode: Average: 50% overlap**

With this setting the FFT is calculated from data blocks in the size of the resolution with 50% overlap. Every FFT is including 50% of the data points from the previous data block.
19.16 Introduction to classification

In the post processing sequence you can also include classifications. Eight different classification methods are supported.

The classification is calculating different statistical values from the source signal by grouping the data (samples) according to the criteria. Each classification method will be explained with an example using the same source signal as indicated below.

The results of the classification calculation can be presented in a histogram instrument 20.6 in the ANALYSIS workspace. The result of 2D classifications is presented in the classification table 20.7 or in the classification grid 20.8.
19.17 Sample count classification

The sample count classification is counting the number of samples (measurements) of each class.

IPEmotion – Post-Processing – Sample Count Classification: http://youtu.be/6y0z9jX2Ct8

19.17.1 General – tab sheet

- **Active**: This checkbox activates / deactivates the classification calculation.
- **Name**: Refers to the name of the classification.
- **Description**: Here you can add an additional description to the classification.

19.17.2 Class parameter – tab sheet

In this tab sheet you define the setting for the classification calculation.

- **Source channel**: Select the source channel to calculate the classification.
- **Class count**: Class count defines in how many classes you will divide the range of your lower and upper limit. The classes are divided in equidistant sizes.
- **Lower limit**: Is the starting point of your classification considering the smallest measurements you like to include in your classification.
- **Upper limit**: Refers to the highest measurements you like to include for the calculation.
- **Open boundary**: Here you can define how to deal with the data outside the lower and upper limits. If the checkbox is activated the data is included in the adjacent upper and lower classes.
- **Relative result**: The relative result is converting the class count samples in percent.
Example: Sample Count Classification (standard settings)
The source channel “Vehicle_Speed” is ranging from 0 to 100 km/h and all measurements (samples) are included in the calculation of the sample count classification as the upper and lower limit ranging from 0 to 100 km/h.
Example: Sample Count Classification (impact of upper and lower limit)
In this example you will see how the upper and lower limit have an impact on the classification calculation. If you narrow down the measurement range e.g. from 20 – 80 km/h sample outside, the limits are not included in the statistic calculation as the screenshot below is indicating.
Example: Sample Count Classification (impact of open boundary checkbox)
In this example you will see the impact of the open boundary check box. If you activate the open boundary checkbox, the measurements outside the lower and upper limit will be included in the classes next to the lower and upper boundary class. In the example below the calculations are:

- Lower limit including open boundary: $455 + 155 = 610$
- Upper limit including open boundary: $153 + 436 = 589$
Example: Sample Count Classification (relative result)
The sample count and sample count compound classification can display the results also in percent based on all samples counted. In the case that some samples are outside your defined boundaries the calculated percentage will not add up to 100.

19.17.3 Display – tab sheet

- Display area: Defines the default range for Y axis scaling when channel is added to an instrument like Yt, XY, or histogram.
- Formatting: Defines the number of decimal places when value measurements are indicated.
- Unit: Refers to the unit of the classification. Note: The unit cannot be displayed in the instrument nor in the calculation grid.
19.18 Time at level classification

This classification statistic is counting the time in seconds [s] for how long a signal stays in a given class.

19.18.1 General – tab sheet

See section sample count classification 19.17.1.

19.18.2 Class parameter – tab sheet

See section sample count classification 19.17.2.

Example: Time at Level Classification

In the example below, we have 5 speed classes with the size of 20km/h. As indicated the signal is only for a short time period in the 80 -100 km/h class. If you use the measurement cursors, you can see the time difference is 7.7 sec in the measurement statistic window. The classification is calculating the same value.
19.19 From to count classification

This classification statistic is calculating how often a signal is crossing adjacent classes.

19.19.1 General – tab sheet

See section sample count classification 19.18.1.

19.19.2 Class parameter – tab sheet

See section sample count classification 19.18.2.

See section sample count classification Example: From to count classification (from class 4 to adjacent classes)

The following example it will be explained how the classification result is calculated. The following signal is classified.
The result in the matrix table is the following:

<table>
<thead>
<tr>
<th></th>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
<th>Class 4</th>
<th>Class 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C2</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C3</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>C4</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>C5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

The algorithm is counting how many times the signal from a given class is changing to the next class below or above. In the example the classification result in the table is showing that the signal starting from reference class 4 was crossing twice to class 3 (40 – 60) and two times to the higher class 5 (80-100).
19.20  Level crossing classification

This classification statistic is calculating the number of times a signal is crossing a class. This method is calculating the positive class crossings but also considering negative class passes depending on the reference line. The reference line has an impact on how positive or negative class crossing will be counted.

19.20.1  General – tab sheet

See section sample count classification 19.17.1.

19.20.2  Class parameter – tab sheet

See section sample count classification 19.17.2.

- **Source channel**  
  Select the source channel to calculate the classification.

- **Class count**  
  Class count defines in how many classes you will divide the range of your lower and upper limit. The classes are divided in equidistant sizes.

- **Lower limit**  
  Is the starting point of your classification considering the smallest measurements, you like to include in your classification.

- **Upper limit**  
  Refers to the highest measurements, you like to include for the calculation.

- **Hysteresis**  
  The hysteresis is adding a tolerance to the calculation if a signal is oscillating on the border of a class.

- **Reference line**  
  The reference line is considered as a starting point for positive counting. However, when the reference line is greater than the start samples the algorithm is counting falling signals below the reference line, too.
Example: Level crossing Classification (reference line = 0)
The following example shows how the reference signal “Vehicle_Speed” is processed in the level crossing classification. Every time the signal is crossing a class in the positive direction the counter is incremented. In this example the reference line is starting at 0 km/h. The speed signal is starting at 0 km/h. There is no positive level crossing counted of the first speed class ranging from 0 – 20km/h because the signal is already starting in this class.
Example: Level crossing classification (Range 10 – 40 km/h, reference line = 10)
The following example will show the impact of the upper and lower limit of the level crossing classification. The considered part of the signal is in the range of 10 - 40 km/h. The reference line is defined to 10 km/h which is on the lower limit of the first class.
Example: Level crossing classification (Range 10 – 40 km/h, reference line = 30)
In this example you can see the impact of the reference line shifted to a value e.g. 32 km/h. In this case all positive crossings above 32 are considered for the level crossing calculations. There is only one positive level crossing the selected range of 10 - 40km/h. However, the level crossing classification is also considering all negative classes crossing on the descending signals. In this case, the signal is crossing the negative direction of class 2 and class 1.

19.20.3 Display – tab sheet
See section sample count classification 19.17.3.
19.21 Transition matrix classification

This classification statistic is calculating is counting all events where a signal is reaching from a maxima or a minima from a given class to another class.

19.21.1 General – tab sheet

See section sample count classification 19.17.1.

19.21.2 Class parameter – tab sheet

See section sample count classification 19.17.2.

- Source channel Select the source channel to calculate the classification.
- Class count Class count defines in how many classes you will divide the range of your lower and upper limit. The classes are divided in equidistant sizes.
- Lower limit Is the starting point of your classification considering the smallest measurements, you like to include in your classification.
- Upper limit Refers to the highest measurements, you like to include for the calculation.
- Hysteresis The hysteresis is adding a tolerance to the calculation if a signal is oscillating on the border of a class.

Example: Transition matrix (From class 3)

In this example we will explain the counting results from the start class 3.

The results of the 2D classification can be presented graphically in the classification grid 20.8.
The counting results shows, that the signal is changing 2 times from class class3 into class 2 and one time from class 3 into class 5.
19.22 Rainflow classification

This classification statistic is very popular for fatigue test and load monitoring applications on mechanical structures.

19.22.1 General – tab sheet

See section sample count classification 19.17.1.

19.22.2 Class parameter – tab sheet

See section sample count classification 19.17.2.

The result of a Rain flow classification will be applied to the signal below.
To understand the counting result it is recommended to rotate the signal by $90^\circ$ to get a better graphical understanding of the rain flow.

Only 2 events are counted and presented in the matrix.

The results of the 2D classification can be presented graphically in the classification grid 20.8.
19.23 Sample count compound classification

This classification statistic is closely related to the sample count classification 19.17. This classification method is considering 2 channels and counts only the values (data points) where both channels are overlapping in the class.

19.23.1 General – tab sheet

See section sample count classification 19.17.1.

19.23.2 Class parameter – tab sheet

Class parameters for first channel

Class parameters for second channel

- **Source channel**: Select the source channel to calculate the classification.
- **Class count**: Class count defines in how many classes you will divide the range of your lower and upper limit. The classes are divided in equidistant sizes.
- **Lower limit**: Is the starting point of your classification considering the smallest measurements, you like to include in your classification.
- **Upper limit**: Refers to the highest measurements, you like to include for the calculation.
- **Open boundary classes**: This setting includes all samples outside of the first and last calls and adds it to the adjacent classes. See example in section 19.17.2.
The results are presented in the analysis work space in the classification table instrument.
The following chart is graphically indicating 5 classes which were defined for the following two channels:

- Vehicle speed range from 0 – 100
- Sine-1 range from -5 - +5

The class ranges are reflected in the classification table. For channel one the 5 classes are ranging from -5 to 5 and for the second channel the class parameters are ranging from 5 to 100.
The results of the 2D classification can be presented graphically in the classification grid 20.8.

**Example 1: Sample count compound classification (Class 1 / Class 1)**
The classification method is only counting the samples of the channel with the higher sample rate, which is in this example, the Sine-1 channel. Only those samples get counted where both signals are included / overlap in the defined class range. In this example the Sine-1 channel and the “Vehicle_Speed” channel overlap in the indicated white areas.

**Example 2: Sample count compound classification (Class 5 / Class 2)**
In this example we show how the result (528 samples) for the following class 5 / class 2 is computed.
The following diagram is indicating 2 white areas where both channels Sine-1 (class 5) and Vehicle_Speed (class 2) are overlapping.
19.24 Time at Level Compound

This classification statistic is very closely related to the Time at level classification. In this case the time is counted, how long a single is staying in a giving class. As a compound classification method the same principle as in sample count compound classification is applied in order to identify the relevant sections of the chart.

19.24.1 General – tab sheet

See section sample count classification 19.17.1.

19.24.2 Class parameter – tab sheet

See section sample count compound classification 19.23.

Example 1: Time at level compound classification (Class 5 / Class 1)

In this example below we will show how the result for the following class 5 / class 1 (5.9 seconds) is computed.

The results of the 2D classification can be presented graphically in the classification grid 20.8. The white areas indicate those sections of channel 1 (Sine in class 5) with is overlapping with channel 2 (Vehicle_Speed in class 1). When we use the cursor tool and count the time of all segments of channel 1 we arrive at the computed result of 5.9 seconds.
19.25 Campbell

IPEmotion – Post-Processing – Campbell: https://youtu.be/RqMltapsBcs
The Campbell operation is based on the FFT operation by adding additional filter weighting function to present data in the Campbell instrument in the ANALYSIS workspace 20.19.

19.25.1 General – tab sheet
See section sample count classification 19.17.1.
19.25.2 FFT – tab sheet

The FFT tab sheet offers the most detailed configuration options how the FFT for the Campbell diagram is calculated.

- **Source channel**
  This is the signal channel which is subjected to the FFT calculation.

- **Sample rate**
  Indicating the sample rate of the selected source channel.

- **Resolution**
  The resolution is related to the number of taken samples to calculate the FFT. The resolution or number of samples subjected to an FFT calculation is a drop down list. Based on the selected resolution the corresponding frequency and block duration is calculated:
  \[
  \text{Block duration} = \frac{\text{Resolution}}{\text{Sample Rate}}
  \]
  \[
  \text{Frequency Resolution} = \frac{\text{Sample Rate}}{\text{Resolution}}
  \]
  When you increase the FFT resolution you increase the accuracy of the sequence but you lose accuracy in regard to the time base.

- **Reference variable**
  In the standard configuration all FFTs are calculated in regard to the time base. However in many cases it is reasonable to plot FFTs not against time but against another channel which is correlating to the measurement sound and vibration frequencies. A popular channel is the engine RPM when you are investigating acoustic effects in a car.
**Reference monotony**

This setting is related to an increasing or decreasing reference signal e.g. RPM. For the FFT calculation it is important that only FFTs included to the Campbell diagram which are originating from an monotony increasing or decreasing signal.

![Graph showing monotony increasing signal](image)

**Window function**

The window function is particularly important if only very few periods of signals are included in the calculation and the trigger point of the signal recording gets an important impact on the computed result. The following window functions are supported: Rectangle, Hanning, Hamming, Backman, Bartlett. Based on the selected window function you can select a peak or power correction factors which are listed in this section 19.15.2

**Step definition**

Overlap: The overlap function is the same behavior as explained in the FFT analysis. With the overlap you specify how much data of the previous data block is included in the FFT calculation.

Absolute: With this setting you can define the absolute step width for the FFT calculation. The default value is calculated by the following formula: \((\text{Max value} - \text{Min value}) / 500\)

The user can change the step definition to other values depending on the desired results in the Campbell diagram. In the example below the default step definition:

\[(4021 \text{ rpm} - 644 \text{ rpm}) / 500 = 6.75 \text{ rpm}\]
19.25.3 Pre-filter – tab sheet

The pre-filter tab sheet supports the filter functions as discussed in section 19.29. With the filter operation, specific signal frequency can be damped.

The Campbell diagram with the pre-filter is showing values above the 500 Hz line. The filter damping is of course not perfect, there are some frequencies still crossing the 500 border line.

If you like, you can also operate the pre-filter operation before the Campbell operation and use the result of the pre-filter as an input to the Campbell operation.
19.25.4 Weighting – tab sheet

The weighting function is a very important setting for the Campbell operation. The weighting function parameters have to be configured to present the data in a normative format.

The following scaling modes and recommended reference values are defined:

- Linear Scaling has no impact to the calculated results.
- dB unweighted
- dB A weighted
- dB B weighted
- dB C weighted
- dB D weighted

With the weighting function it is possible to compensate different sound pressure levels accordingly to human hears. The correct reference values are depending on the application. For the Campbell operation a drop down and edit field makes the selection of the weighting factors more user friendly. You can only select or add new weighting factors which match to the unit of the source channel.
Attention! When the source channel has no unit defined the weighting factor shall have not unit too.
The weighing types are defined as:

- RMS (Root Mean Square)
- Peak value
- Peak to Peak value

19.26 Display - tabs heet

The display range for the y-axis (frequency) can be defined in the display tab sheet of the Campbell operation.
19.26.1 Impact of different Campbell operation settings

In this example you will see how the different Campbell operation settings impact the results and the data presentation of the Campbell diagram. The configuration settings of the diagram itself are explained in section 20.19.

Example Resolution (number of samples considered for FFT calculation)

In order to calculate the FFT of 50 kHz raw signal, a defined number of samples (resolution) have to be taken into the calculation. In the example below a low resolution (1024 samples) is compared by a high resolution (16384 samples). As you can see along the Y-axis the resolution is about 50 Hz (very low) caused by the small number of samples (1024) and in contrast you see 3 Hz high frequency resolution Campbell diagram as a result of a high number (16394) of samples included in the FFT calculation.

If you need to investigate high frequency resolution you should consider a high number of samples to calculate the Campbell diagram.
**Example: Impacts of using a reference channel (non-time based Campbell)**

Another configuration option is to use another reference channel than the time base. In this example the engine RPM is used to calculate the Campbell diagram.

When we use a reference channel which is correlating with the vibrations and acoustic effects like the engine RPM on vehicles we see a different presentation of the Campbell diagram. The harmonic frequency bands starting from the same point and allow better analysis to identify at which engine RPM level which frequencies which high amplitudes occurred. High amplitudes are indicated in red color and indicated higher noise levels. The Campbell diagram is supporting cursors to display the order information in the measurement window. The order is available when a reference channel based on RPM is included to the Campbell operation.

The order is calculated by the following formula: 

$$\text{Order} = \frac{\text{Frequency [Hz]}}{\text{Reference Channel [RPM]}} \times 60 > 17 = \frac{1.000 \text{ [Hz]}}{4.500 \text{ [RPM]}} \times 60$$
When you use a separate reference channel you have to consider the setting for the step definition in absolute value. The step definition has a big impact on the result of the Campbell diagram.
When you consider a large step size only a few FFT are calculated and therefore the resolution of the Campbell diagram is going down. The following sketch is indicating how the step size is impacting how many FFT are calculated along the RPM profile.

A large step size and block size have an impact on how many FFT are calculated. In the example below you see how different reference profiles have impact to the FFT calculation. When the reference channel has a high gradient (strong rise) the data block for FFT reach still a good overlap when with a small block size (resolution). However when the reference signal is rising very slowly and you define a large step size you need to increase the block length (number of samples) to gain a reasonable overlap.
Example: Impacts of the Window function and the overlap
The window functions are very important to ensure a clean FFT calculation without too many artefacts originating from the start and end section of the raw signal. The window function is smoothing the start and end section of data block before the FFT is calculated. Each window function has a different weighting and smoothing function which has a positive impact on the frequency resolution (Hamming window) or on the amplitude accuracy.

With the window function in intake and outlet section of the raw signal are smoothed.

This is now the hamming weighted raw signal (time domain signal).
A window function is very important to smooth the intake and outlet time domain signal. Otherwise the FFT is calculating because of the mathematical model unwanted (artefact) frequencies and associated amplitudes.

The weighing function is smoothing the borders of the raw signal before the FFT calculation.

The example below shows the same time domain signal but the window snapshot is varying and therefore the FFT calculation results from the same signal is different just because of the different waveform from the start and end section.

In theory: Perfect window snapshot where intake and outlet section at the zero line.

In reality: Undesired window snapshot where intake and outlet signal is anywhere from the zero line.
19.27 Overall Level

The Overall Level operation has the same settings as the Campbell operation. With the Overall Level operation it is possible to identify which frequency ranges contribute mostly to the sound level to investigate the source of origin. The result of the operation is presented in a XY-chart. In the example below 3 overall level calculations are performed.

- Red line - Includes all frequencies from the raw signal (always highest signal)
- Black line - Includes only frequencies in the range of 500 to 600 Hz
- Green line - Includes only frequencies below 100 Hz

The main use case of this operation is to identify in which frequency ranges have the main impact to the overall sound level. The black line indicates strong impacts in the 500 to 600Hz range at 3 different RPM ranges. In this example the 2000 rpm, 2750 rpm and 3400 rpm have the highest contribution. It becomes also apparent that the low frequency range in the area of 100 Hz and smaller has only a very limited impact to the overall sound level.
19.28 Order Filter

The Order Filter operation is supporting almost the same configuration settings as the Campbell operation. The main difference is that the Order filter is not supporting any overlap configuration.

- Order: Here you define which order you like to analyse. To identify the orders the order cursor of the Campbell diagram can be used 19.29.5.
- Order band width: defines how narrow or widely you include FFT lines in the calculation.

This operation is useful to calculate the amplitudes for a specific order across the time or RPM range. The Order filter is particularly useful in cooperation with the order cursor of the Campbell diagram. With the order cursor you can identify the order number which is of interest.
In the example above a Campbell diagram is compared with the result of the Order Filter. With the order cursor the two orders with high amplitudes are identified. This are the orders of 15.3 and the 9.2. The Order Filter operation is now returning exactly the amplitude level across the full RPM range. You can identify that the 15.3 order has the highest values in the RPM range 1,600 to 2,200. The 9.2 order has the highest amplitudes in the range of 2,700 to 3,500 RPM. The results between the Campbell diagram and the Order Filter operation match exactly.
19.29 Digital filters – Butterworth

Creating digital filters for online calculations are discussed in chapter ACQUISITION 14.4. For post processing operations, the digital filters can be applied, too. Using the Butterworth filters, you can filter certain frequencies from your signal in order to avoid e.g. anti-aliasing effects.

![Digital Filter Operation in IPEmotion](image-url)
19.29 Digital filters – Butterworth

Example: FFT from an unfiltered signal
The function of different filters and the impact of filter orders will be explained by using FFTs from a noisy source signal e.g. with 3 main defined frequencies of 10 Hz, 50 Hz and 70 Hz.

19.29.1 Low pass filter
With the low pass filter you will only keep frequencies below cut-off frequency.

- **Source channel**: Select the source channel which should be filtered.
- **Filter order**: Filter order can be defined between 1 and 8 poles. Higher filter orders will increase the strength of the filter as demonstrated in chapter 19.29.5.
- **Filter type**: Fixed defined as Butterworth.
- **Cut-off frequency**: In this case defined as low pass frequency.
- **Channel**: Here you can define a variable channel as parameter for the operation. See example 19.33.
Example: Low pass filter
If you e.g. set the cut-off frequency to 20 Hz, all signals below 20 Hz can pass the filter and all higher frequencies are blocked as indicated below.
19.29.2 High pass filter

The high pass filter will allow all frequency to pass which are above the cut-off frequency.

► Source channel  
Select the source channel which should be filtered.

► Filter order  
Filter order can be defined between 1 and 8 poles. Higher filter orders will increase the strength of the filter as demonstrated in chapter 19.29.5.

► Filter type  
Fixed defined as Butterworth.

► Cut-off frequency  
In this case defined as low pass frequency.

► Channel  
Here you can define a variable channel as parameter for the operation. See example 19.33.

Example: High pass filter >60 Hz
If you e.g. set the cut-off frequency to 60 Hz, all signals over 60Hz can pass the filter and all smaller frequencies are blocked as indicated below.

Note: Filters are not perfect and cannot shut of the undesired frequencies completely. There are still around the cut-off frequency >60Hz some undesired signal components as indicated at 50Hz.
19.29.3 Band pass filter

The Band pass filter will only accept and pass frequencies which are in between the lower and upper band.

- **Source channel** Select the source channel which should be filtered.
- **Filter order** Filter order can be defined between 1 and 8 poles. Higher filter orders will increase the strength of the filter as demonstrated in chapter 19.29.5.
- **Filter type** Fixed defined as Butterworth.
- **Lower cut-off frequency** In this case defined as lower pass frequency.
- **Upper cut-off frequency** In this case defined as highest frequency to pass.
- **Channel** Here you can define a variable channel as parameter for the operation. See example 19.33.

**Example: Band pass filter in the range of 30 – 60 Hz**
If you e.g. set. the cut-off frequency in the range of 30 - 60 Hz, all frequency signals below 30 Hz and over 60 Hz are filtered out.
19.29.4 Band stop filter

This filter will stop and depress all frequency components which are lying with the lower and upper cut-off frequency. It is principally an inverted band filter.

- **Source channel** Select the source channel which should be filtered.
- **Filter order** Filter order can be defined between 1 and 8 poles. Higher filter orders will increase the strength of the filter as demonstrated in chapter 19.29.5.
- **Filter type** Fixed defined as Butterworth.
- **Lower cut-off frequency** In this case defined as lower pass frequency.
- **Upper cut-off frequency** In this case defined as highest frequency to pass.
- **Channel** Here you can define a variable channel as parameter for the operation. See example 19.33.

**Example: The band stop filter in the range between 30 – 60 Hz**

If you e.g. set the cut-off frequency in the range of 30 - 60 Hz, all frequency signals within 30 Hz and up to 60 Hz are filtered out.
19.29.5 Impact of the filter order

The filter order is ranging from 1 to 8. A higher order number is increasing the filter strength and the damping of the unwanted frequencies is increasing.
19.30  Segment

With the segment operation you can cut out a defined section of a source channel.

Segment operation

IPEmotion – Post-Processing – Segment Operation:http://youtu.be/cAfT8ILXyA

19.30.1  General – tab sheet

- **Active**
  - This checkbox activates / deactivates the segment operation.

- **Name**
  - Refers to the name of the segment.

- **Description**
  - Here you can add an additional description for the segment.
19.30.2 Segment by INDEX – tab sheet

In this tab sheet you define the source channel and the start and stop data point.

- **Source channel**
  Here you select any channel from the loaded data files. The segment operation cannot access any post calculated channels.

- **Start index**
  Here you define the first sample to start with. Default value is "First".

- **Resulting start time**
  The software is converting the start index into a start time point.

- **End index**
  Here you define the last sample you like to stop. Default value is "Last".

- **Resulting end time**
  The software is converting the end index into an end time point.

- **Channel**
  Here you can define a variable channel as parameter for the operation.

Example: Fixed start Index
19.30.3 Segment by TIME – tab sheet

Another segment configuration option is to define the start and endpoint by time in [s].

- **Start time**
  - Here you define the start time point. Default value is First.
- **End time**
  - Here you define the end time point. Default value is Last.
- **Channel**
  - Here you can define a variable channel as parameter for the operation. See example 19.33.
19.31 Find conditions

IPEmotion – Post-Processing – Find Conditions: http://youtu.be/8VK8jYINEZ4
With the find condition operation you can search for specific index or time point.

Find conditions

19.31.1 General – tab sheet

- **Active**: This checkbox activates / deactivates the script operation.
- **Name**: Refers to the name of the script operation.
- **Description**: Here you can add an additional description for the script.
19.31.2 Find condition by index / time – tab sheet

When you select the find condition by index or time the search result will be either a specific index or a time point. The output of this index can be considered as input for the segment operation.

- **Formula** Define your math or logic operation to search for a specific event. For more information how to use the formula interface see section 19.14.

- **Start Index** In the fixed radio button you can select from the drop down list if you like to start from the beginning with the first measurement, or if you like to start searching from the end. This drop down list is a drop / edit field and you can define your individual start index or time point.

This setting First or Last as to be selected in relation with the search direction.

- **Channel** Here you can define a variable channel as parameter for the operation. See example 19.33.

- **Search** Define the search direction. Forward is searching from the beginning of the data recording. Backward is searching for the end time point.
Example 1:
Start index and search direction have to be defined logically correct to get the desired results. This configuration is able to generate search results.

![Graphs showing vehicle speed with different search directions](image)

When the search start point and direction are configured like this you will not identify any reasonable result.
Example 2:
The following analysis screen shows the different results (index or time) of the same find conditions.
Example 3:
Search direction with different output results for the same condition depending on the search direction.
19.32 Script

The post processing functions are supporting scripting operations, too. In the sequence of operations you can add scripts to perform any function you like to apply to channels and the data file. The script gives you a lot of flexibility to perform individual calculations which are not available through the point and click GUI interface.

19.32.1 General – tab sheet

- **Active**: This checkbox activates / deactivates the script operation.
- **Name**: Refers to the name of the script operation.
- **Description**: Here you can add an additional description for the script.
19.32.2 Script – tab sheet

In the script tab sheet you configure the following parameters.

- **Name**
  
  Here you select the script you like to use for the data processing from a drop down list. In order to be able to select a script, you need to define the script in the SCRIPTING work space. The SCRIPTING work space is only available in the Demo, Student, Professional, Developer and Analysis Edition.

- **Function**
  
  Here you define within the script the function you like to execute. The function is defined in the script.

- **Channels**
  
  Here you can select the relevant channels you like to consider for the script from the list of all channels of the data file.
Finally, you need to create the result channels to show and store the result of the script calculations.
There are 3 different result channels available. The type of result channel should be matching to the result of the script.

- **Numeric channel**
  This channel type can accommodate many calculation results. This is a suitable format if you like to process a complete signal with your script.

- **Single value**
  This channel type can accommodate only one final result coming out from the scripting calculation. This is the required channel type if you like to link variable cut-off frequencies or on variable segment operations.

- **Single text**
  This channel is dedicated to show text messages only.
Script result channels are linked to an instrument.

19.33 Example: Use script operations for variable parameters

As discussed above the Segment operation, Filter operation, Find index operation can link a channel as variable input function. Most frequently a scripting operation is selected to calculate variable parameter for these operations. In this example we will define the segment not statically but calculated the segment start and endpoint dynamically based on a script operation.
The following screenshot shows a configuration of a scripting operation to determine the first index. A similar scripting operation to determine the end index is created too.

These two scripting results channels are linked to the segment.

The output of the scripting operation must be defined as a “Single value”. This number can be used as a variable input parameter for the operations like filter, segment or index. An important aspect is the right order of operations inside the sequence as discussed in the introduction 19.13.2. The single value outputs of the two scripts can be used as variable input parameter for e.g. segment operation.
The analysis screenshot shows graphically the result of the segment operation.
19.34 Statistic

The statistic operation is a dedicated post processing function to calculate several statistic indicators for a source channel in one operation.

The output channels of the statistic operation are listed below. For details about the different calculations refer to chapter 14.4.

- Minimum
- Maximum
- Mean
- Root mean square
- Variance
- Standard deviation
19.34.1 General – tab sheet

- **Active**: This checkbox activates / deactivates the script operation.
- **Name**: Refers to the name of the script operation.
- **Description**: Here you can add an additional description for the script.

19.34.2 Statistic – tab sheet

- **Source channel**: Select one channel which is the basis to calculate the statistic values. If you have other operations already included in the sequence these channels can be selected too. For more details refer to 19.13.2.
The result of the static operation is presented in 6 channels. By default the Minimum and Maximum is activated. If you like to get the statistic results of the other channels activate them manually.

Results of the statistic calculation presented in a table instrument in the ANALYSIS work space.
19.35 Measurement Data Management (MDM)

With the MDM module you can index data file archives and search for many different measurement file parameters. All meta data properties of the data file and the channels can be searched for. The module is available as a separate module for the Standard and Analysis edition. The functionality is included in the Professional, Developer and Analysis Edition. The search technology is based on a background database which is indexing all incoming files to a relational database. The queries are running though the database and return a list of matching data files. The database is activated in the OPTIONS.

- The MDM data file search function is only available in the Professional, Developer and Analysis Edition.

Extended search module
The search interface offers different filter criteria which will be explained below.

- (A) The user will get a default list of all data files included in the indexing directories. The search function is considering the file formats of: .IAD, .TDM, .MDF4, .ZIPRT,

- (B) This file is dedicated to full text search. You can enter any keyword and all files including this key word or parts of the key word are returned.
(C) Here you can define a timespan which should be considered for searching.

(D) This button is dedicated to execute the search function and to generate the list with all file results. The execution of this button is mandatory to run the database requires.

(E) Here you can define a search condition. This condition is searching for events in one selected data file only. See section ?? for more details.

In this example the time range was set from 03.2016 to 03.2018. However, the returned data files include start and end dates from 2009 to 2016. The reason for this result is that the start and end date in the table show the dates of the first and last time stamp of any channel included in the file. It is not related to the date when the file itself was created.
### Measurement Data Management (MDM)

![Data mining search screen](image)

**Save Advanced search filter profiles with +**
In the data file grid presenting the results from your search condition you can add additional columns.

![Add data file properties to the grid](image)

![Additional columns added](image)
19.35.1 Condition based event search

With the condition-based search operation you can identify specific events from a selected data file. It is mandatory to load one data file first before the condition analysis can be defined.
When the file is loaded, all channels from the data file are available as input operands. To apply the condition to the data file, you need to execute the search button.
When the condition operation was executed you can expand the hit list. This is an overview of all events where the condition is true. In the case of large data files or complex conditions the progress bar shows the status of the operation. With the abort button you can terminate the calculation at any time.
In the ANALYSIS work space, you can graphically display the hits in a diagram. In this example the channel was presented in an Yt-chart. The Yt-chart and the related channel must be created manually to use this function.
When you select on dedicated hit from the hit list, the Yt-chart will directly zoom to this area as indicated below.

20 ANALYSIS Work Space

20.1 Ribbon

In the ANALYSIS work space you can perform graphical data analysis.

Example of a Yt-chart:
20.1.1 Load (Import)

With load you will access the file open dialog to browse for your data files. As discussed in the DATA MANAGER 19.2.

20.1.2 Remove

With remove all loaded data files are removed from the ANALYSIS and DATA MANAGER work space.
20.1.3 New

In New you can add pages to build your analysis instruments.

Information
The number of display pages is restricted by different editions. See the overview table of chapter Software Editions 5 for more details. If you exceed the number of permitted pages you will get a warning message.

20.1.4 Page

Here you can navigate between pages directly from the ribbon.
20.1.5 Instruments

In Instruments you can select from 13 different instruments. Each instrument will be discussed in detail.

The Map, Traffic Analyzer, 3D view, log p-h and Campbell instruments are only available if you have a suitable license. For the Map and Traffic Analyzer and 3D view instrument you need a Professional, Developer or Analysis edition. For the log p-h instrument you need the Climate module additionally. See chapter Software Edition for more details. For the Campbell diagram you need the Acoustic module.
20.2 Transfer view pages and instruments from VIEW to ANALYSIS

As discussed in VIEW 18.1 you can transfer an instrument configuration through the context menu from VIEW to ANALYSIS.

20.2.1 Layout – Fix / Undo fixing

With the Fix / Undo fixing function you can either change the size of the instrument containers or freeze the position. The layout function is the same as discussed in VIEW in chapter 18.2.7.
20.2.2 Layout – Undo grid

The instruments are arranged automatically on the page by the software, considering the order of creation. If you resolve (undo) the grid you can allocate and position the instruments at any place. The layout function is the same as discussed in VIEW in chapter 18.2.8.

Information

When the screen page is still in fixed mode the undo grid function is ineffective.
20.2.3 Layout – Area

With the area function you can split the view page in a basic structure of the instrument containers before you start adding instruments. Each area is considered as a container for one instrument type. If you like, you can subdivide each container through the context menu. The layout function is the same as discussed in VIEW in chapter 18.2.9.
20.2 Transfer view pages and instruments from VIEW to ANALYSIS

20.2.4 Move / Stretch / Select

These are 3 operations to perform chart analysis functions.

- Move graph in X- and Y- direction
- Compress and stretch in X- and Y- direction
- Select – ZOOM in the graph

20.2.5 Back

With the back button you undo all Stretch, Move, Select commands performed in the Yt-diagram and XY-diagram. If you delete the diagrams or remove the data file, the back commands are deleted from the internal memory of diagram as well.

**Information**

The other instruments like Map, log-ph and Video do not support any Move, Stretch, Select, Back or Sync functions.
20.2.6 Sync

The Sync function is effecting the time Yt-chart, XY-chart and the Campbell diagram. It is supporting 3 different settings which will be explained in turn.

- **No Sync**  With the no sync setting all Yt-diagrams have individual time axis settings.
Time Sync

When you hit the Sync button all diagrams (Yt, XK and Campbell diagram) on all pages are updated with the time axis settings of the diagram which was most recently configured. The Sync function is only applied to the time axis (x-axis).
20.2 Transfer view pages and instruments from VIEW to ANALYSIS

- **Multi Sync**
  With the Multi Sync function all time axis of diagrams (Yt, XY, Campbell) and the Y-axis and color axis scaling of the Campbell diagram are automatically synchronized to all other Campbell diagrams. With this function it is very easy to configure several Campbell diagrams with the same settings.

![Multi Sync setting selected. Any change on the time axis and in the Campbell diagram is updated.](image)
20.2.7 Optimal X-Y Zoom

On the Yt- and YX-chart you can now apply zoom function for the x-range and y-range.

20.2.8 Original

If you hit the Original button you perform a complete rezoom along the time axis (X-axis) and Y-axis of the Yt- and XY-diagram.
20.2.9  1 Cursor

If you select one cursor you can read the value (X and Y) of the data point selected in the measurement statistic window.

20.2.10  2 Cursors

If you activate 2 cursors the measurement window will indicate the time difference between the cursor lines. If you hit the $f(x)$ button the measurement statistics between the two cursor lines will be calculated. The statistics in the cursor window covers:

- Count of samples
- Index 1
- Index 2
- Minimum value
- Maximum value
- Average
- Unit
- Standard deviation
20.2 Transfer view pages and instruments from VIEW to ANALYSIS
If you move the cursor, the statistical values need to be recalculated by hitting on the $f(x)$ button again.

If you move cursor 2 in front of cursor 1 the delta X (time) is calculated with a negative result.
20.2.11 Free cursor

The standard behavior of the cursor is that the lines snap to the data points of the selected / highlighted channel. With the free cursor function, the cursor lines can be positioned between data points.

Information

The cursor statistics are calculated on the basis of the data points in between the cursor lines and not based on the exact cursor position.
20.2.12 Copying data from the measurement window to other programs

Using the cursor, you can now copy the data from the measurement statistics to other MS office applications like Excel, Word, PowerPoint etc. The measurement window is only available if you select to use the extended measurement window in the Options (Analysis).
20.2.13 Channel highlighting through cursor statistics and legend

You can highlight a channel in the graph either by selecting the channel through the measurement window or just by selecting the channel through the legend in the diagram.

![Channel highlighting through cursor statistics and legend](image)

20.2.14 Start

If you hit the start button one cursor line is generated and the cursor line is moving chronologically along the visible section of the graph. The start, pause and stop button are particularly useful when you have video signals as well.

20.2.15 Pause

When you hit the pause button the cursor stops at this position. When you hit the start button again the cursor keeps moving on.

20.2.16 Stop

When you hit the stop button the cursor stops and resets back to the beginning of the graph.
20.2.17 Tree

With the tree button you can enable or disable the tree on the left hand side. In the tree you can switch between 3 different work spaces.

- **Page**
  On the page tab sheet you get an overview of all analysis pages you have created as discussed in this chapter in section 20.1.3.

- **Loaded measurement files**
  In this area you will see all loaded data files as discussed in section 20.1.1.

- **Display**
  In this tab sheet you have an overview of all instruments created and the related channels to the instrument.
In the tree you can search for instrument, page or channel names.

Within the display tab sheet you can perform a bulk update of all selected instruments across all pages like in the VIEW work area discussed. This is convenient if you have many diagrams and the basic setup of all diagrams should look the same. You just need to select the diagrams and open the instrument properties headup display.
20.3 Yt-chart
20.3 Yt- chart

20.3.1 Yt- chart head up display

As discussed above, you can save all configurations of an instrument by hitting the default button. In this case, the software creates a template file and every new instrument you create will comply with this template. The templates are managed under Application Menu > Administration. For more details see chapter 7.8.

20.3.2 Use as default

As discussed above, you can save all configurations of an instrument by hitting the default button. In this case, the software creates a template file and every new instrument you create will comply with this template. The templates are managed under Application Menu > Administration. For more details see chapter 7.8.

20.3.3 General

► See configuration options in chapter VIEW > Yt- chart 18.7.4.
20.3.4 Time Axis

**Adjustment**

If you select the mode "Separated axes", the Yt-diagram shows a separate time line for each channel included in the diagram. You can move, stretch and compress the time line for each channel individually as the screenshot below indicates.

**Adjustment**

If you need to compare channels of different data files, you can use the mode "Merge equal files". In this configuration, all channels of the same data file are aligned to a common timeline. If you move, stretch or compress the time line, this is applied to all channels of the related data file.
20.3  Yt- chart

- **Automatic Scaling**
  The time span in the Yt- chart can be defined. To activate this function, the automatic time axis scaling needs to be deactivated. After defining the start and end time, the Yt- chart is setting the time axis to the defined position. This function can also be used through the scripting / COM interface. This gives you the ability to zoom and cut out a specific time span of the data file to perform your analysis.

20.3.5  Y-axis

- **Adjustment**
  See configuration options in chapter VIEW >Yt- chart 18.7.4.

- **Position**
  See configuration options in chapter VIEW >Yt- chart 18.7.4.
20.3.6 Channel view

- See configuration options in chapter VIEW > Yt-chart 18.7.7.

- **Line Style**  
  The line style is a specific function which is not supported in the online VIEW. Here you can define 5 different line types. The default line style is Solid also used in VIEW. The other analysis specific line styles are: Dot, Dash, DashDot, DasDotDot.
In this line style mode the default behaviour is reflected. When you zoom into the data, at a certain high zoom level the data points appear and the data points are connected in a step line type.

In this mode the graph will show on all high and low zoom levels only a line and no data points.
20.3 Yt- chart

- **Graph Style Step**
  In this mode you get at all zoom levels a step type line presentation between the data points.

20.3.7 **Legend**

- See configuration options in chapter VIEW >Yt- chart 18.7.8.
20.4 x-y chart / FFT display

20.4.1 x-y chart head up display

Exit and save the settings of the dialog by closing on the X.
20.4.2 General

▶ See configuration options in chapter VIEW >Yt- chart 18.8.

20.4.3 Axis

▶ See configuration options in chapter VIEW >Yt- chart 18.8.4.

▶ Position

In the configuration display of the Yt- chart you can decide about the location (left, right, alternating or both sides) for the Yt- chart. The screenshot below shows the display of the Y-axis location on the right side of the diagram.

20.4.4 Graph displaying

▶ See configuration options in chapter VIEW >x-y chart 18.8.5.

▶ Line Style

Refer to Yt-chart discussed above 20.4.4.

20.4.5 Legend

▶ See configuration options in chapter VIEW >Yt- chart 18.7.8.
20.5 Polar diagram

20.5.1 Polar diagram head up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.
20.5.2 Polar coordinate input channels

The polar diagram requires 2 input channels in polar coordinates. One channel must represent the radius and the other channel the angle. Both channels together generate the graph. If you do not have recorded the data in polar coordinates you can generate polar coordinates in the post processing using the following formulas:

![Image of source channels in Cartesian format]

Radius & Angle formula to convert Cartesian coordinates into Polar coordinates.

20.5.3 General

► See configuration options in chapter VIEW >Yt-chart 18.8.

20.5.4 Angular Axis

► Direction  Define the angle orientation clockwise or counterclockwise direction.
20.5 Polar diagram

- **Orientation**
  With the input of the orientation angle the instrument is rotated. The instrument can be rotated manually with left mouse click inside the labeling of the angles.

20.5.5 Amplitude Axis

- **Adjustment**
  Here you can define whether all signals scaled along the same axis of along separate axes. The function is grouping all axis with the same min max scaling range together.
20.5.6 Graph displaying

- See configuration options in chapter VIEW >x-y chart 18.8.5.
- Line Style: Refer to Yt-chart discussed above 20.4.4.

20.5.7 Legend

- See configuration options in chapter VIEW >Yt-chart 18.7.8.

20.6 Histogram

The histogram can present data in columns. Currently, the results of the classifications are presented in this diagram type. The configuration of an offline classification is discussed in chapter 19.16. The configuration of the online classification is explained in chapter 14.12.

20.6.1 Histogram head up display

Exit and save the settings of the dialog by closing on the X.
20.7 Classification table

20.6.2 General

► See configuration options in chapter VIEW >Yt-chart 18.8.

20.6.3 Graph displaying

► See configuration options in chapter VIEW >x-y chart 18.8.5.

► Line Style
Refer to Yt-chart discussed above 20.4.4.

20.6.4 X-Axis

► Axis marking

20.6.5 Y-axis

► Axis marking
Here you can define a name for the Y axis.

► Position
Here you define the position of the axis. See example in chapter 20.4.3.

20.6.6 Legend

► See configuration options in chapter VIEW >Yt-chart 18.7.8.

20.7 Classification table

20.7.1 Classification table head up display

The result of the 2D classification operations explained in the DATA MANAGER 19.16 can be presented in this instrument.

The results of the 2D classifications can be presented graphically in the classification grid 20.8.
20.8 Classification grid

The classification grid is a complementary display instrument to show the results of 2D classification methods graphically.

- From to Count
- Rainflow
- Transition Matrix
- Sample count Compound
- Tim at Level Compound

20.8.1 Classification grid head up display

The configuration properties are related to the Campbell diagram as discussed in section 20.19.

Exit and save the settings of the dialog by closing on the X.
Example: Present results of the classification table in the classification grid
20.9 Alphanumerical

You can read values in the alphanumerical instrument when you hit the play button and the cursor is scrolling though the data or when you move the cursor manually. When you activate 2 cursors the values if cursor 2 will be displayed in the instrument.
20.9.1 Alphanumerical head up display

![Configuration Alphanumerical display]

20.9.2 General

- **Use caption**
  
  With this check box you can activate and display an individual instrument name. See chapter 20.11.2.

20.9.3 Layout

For configuration see chapter VIEW >Alphanumerical instrument 18.13.2.

20.9.4 Channel view

For configuration see chapter VIEW >Alphanumerical instrument 18.13.3.
### 20.10 Table

<table>
<thead>
<tr>
<th>Name</th>
<th>Current value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sine-1</td>
<td>1.46</td>
</tr>
<tr>
<td>Rectangle-4</td>
<td>5.00</td>
</tr>
<tr>
<td>Sawtooth-2</td>
<td>-18.00</td>
</tr>
<tr>
<td>Sawtooth-1</td>
<td>1.53</td>
</tr>
<tr>
<td>Vehicle_Speed</td>
<td>65,769,436,179,1409 km/h</td>
</tr>
</tbody>
</table>

#### 20.10.1 Show readings

With drag and drop you add channels to the instrument. In order to get readings in the table instrument, you need to hit the play button or use cursors to update the data in the instrument. If you have more than one cursor, the values of cursor 1 will be presented in the instrument.
20.10.2 Table configuration

The table instrument is supporting the following configuration functions. You can filter by channel name.

With the column chooser you can add one supplementary column with information of the channel reference to the channel grid.
20.10.3 Table head up display

Exit and save the settings of the dialog by closing on the X.

- **Use caption**
  
  With this check box you can activate and display an individual instrument name. See chapter 20.11.2.

20.10.4 General

- **Use caption**

20.10.5 Layout

For configuration see chapter VIEW >Alphanumerical instrument 18.13.2.

20.10.6 Channel view

For configuration see chapter VIEW >Alphanumerical instrument 18.13.3.
20.11 Video display

20.11.1 Video head up display

Exit and save the settings of the dialog by closing on the X.

This instrument shows with and without a related Video channel the same properties.

20.11.2 General

Use caption

With this check box you can activate and display an individual instrument name. See chapter 20.11.2.
20.11 Video display

20.11.3 Layout

- **Show channel name**: With this check box you activate and display the video channel name in the top line of the instrument.

- **Show video time**: With this check box you activate the first and last recording time stamp beside the slide controller.

- **Replay**: With the replay + / - button you can adjust the speed how fast the video should be replayed when you hit the play button. You can increase the replay speed with “plus” or you can turn it to slow motion with “minus”. The default speed setting is 1 which is equal to the recording speed. The replay speed settings are: x2 / x4 / x8 / x16 / x32 / x64
  The replay slow motion settings: x1/2 / x1/4 / x1/8 / x1/16 / x1/32 / x1/64

![Configuration Video display](image1)

![Replay speed / slowmotion settings.](image2)
20.11.4 Video offline synchronization

Video signals can be offline synchronized with other measurements signals. The context menu of the video instrument supports a function called "Synchronization".

In the following example you will see a video signal which shows a 1,5 seconds time shift between the recorded digital LED status channel (high / low) and the corresponding video signal (LED red / off).
With the synchronization function the video signal can be manually aligned and shifted to your defined reference signal position. In the first step you move the video slider to the right picture. After that you move the cursor in the diagram with your reference channel to the right position. When you execute the "Apply" function the offset is applied to the video channel time stamps.

The original time stamps of the video file is now shifted and aligned to the reference channel time stamp.
The impact of the time shift can be seen in the data manager too.

To save the time shift changes permanently you need to export the data file. As indicated below you can compare that the synchronized digital channel has shifted his time channel by 1,5 seconds to match the first digital high signal to the right position of the movie showing correspondingly first time a red status LED light.
20.12 Action Button

The configuration properties of the Action button in VIEW and ANALYSIS are exactly the same. The chapter VIEW for details 18.21.
20.13 Play back sound / voice over speakers

If you import data files IAD or WAV or MEA.ZIP etc., which include an audio channel, you can listen to the sound / voice recording. In order to play back the sound, you need to activate one cursor and select the sound channel through the Yt-chart instrument legend or the measurement statistics window. When you record Audio data through the PC you should take the latest PC-Sound Card Demo Plugin. If you cannot listen to your audio recordings refer to chapter SIGANLS >Format tab sheet 12.6.4 to check the task settings.
20.15 Map

20.15.1 Standard context menu

In the standard context menu you can download the map tiles into a defined data base. The data bases are managed in the OPTIONS >Map. More details are in chapter 23.11. The area you download is the visible part in the map instrument. Depending on the zoom level you can select different levels of detail. The software is than calculating how many tile in Mega Byte you are downloading at your defined level of detail.
20.15.2 Map head up display

See configuration options in chapter VIEW > Yt- chart 20.8

20.15.3 General

- See configuration options in chapter VIEW > Yt- chart 20.8

20.15.4 Channel view

- **Channel**
  
  Here you select the channel pair. The first channel you drag and drop to the diagram is always related to the x-axis. The second channel is related to the y-axis.

- **Line color**
  
  Refers to the line color of the channel pair.

- **Line thickness**
  
  Refers to the line thickness of the channel pair.

- **Color source channel**
  
  You can relate a third channel to the Map instrument indicated through a color coding along the track. The 3rd channel is adding a 3rd dimension to the GPS position. Apart from plotting the track from the coordinates (longitude & latitude) for each measurement point, you can now relate a color code from another channel e.g. a speed along the track. You can select any channel from the data file.
You can define any individual color for your spectrum. There are only 2 different types of the presentation: The gradient mode is gradually shifting to the next color. The fixed color mode defines one color only for each intersection.

The color spectrum / scale can be individually defined. You can manually add entries to the table and define your individual color for the measurement ranges for the selected channel.
The default range settings are taken automatically from the settings of the **Displaying area**.
Note: The Log p-h instrument is only availed when your license includes the climate module. See chapter Editions and modules for more details 5.2.2.
20.16.1 Log p-h head up display

Exit and save the settings of the dialog by closing on the X.

Limited properties for configuration when no channels are linked to the instrument.
20.16.2 Link channels to the diagram

In order to get the log p-h diagram plotted you need to link your pressure and enthalpy channels from the data file to the diagram. It is important that the channels are linked as pairs to the diagram.

With the Start button you can replay the recording.
20.16.3 General

- Refrigerant

Here you can select the refrigerant from the list box. The same refrigerant (Formula index) of the online enthalpy calculation should be used for the log p-h diagram in order to get a correct presentation of the data. The refrigerants are included in the REFPROP database and the selected type has a strong impact on the presentation of the log p-h diagram. The supported refrigerants are listed in section 16.4.

20.16.4 Axis

- See configuration options in chapter VIEW >Yt-chart 18.8.4.

20.16.5 Graph displaying

- Graph

Here you can configure the graphical presentation of the log p-h diagram. This covers the areas of the thermal circuit, reference circuit, steam content, temperature, entropy, boiling line and dew line. The configuration of a reference circuit is discussed below. The impact of the setting to the diagram is demonstrated on 3 examples: Circuit-1, Steam content and Temperature.
20.16.6 Circuit

You can also define a reference circuit for each measurement point. In order to define the reference measure points you select the measurement point and enter manually the reference enthalpy and reference pressure. The black graph is indicating a reference thermodynamic cycle.

20.16.7 Legend

See configuration options in chapter VIEW >Yt-chart 18.7.8.
20.17 Traffic Analyzer

20.17.1 Supported traffic file import formats

You can import traffic data recordings from the following formats only.

- .IAD     IPEmotion data files
- .ZIPRT   IPEmotionRT data files from LINUX loggers
- TESTdrive TRAFFIC Traffic recordings from IPETRONIK RTOS loggers
- .HRD     Traffic data files stored by IPEhub2 CAN card
- .BLF     BLF files for CAN, CAN FD and FlexRay
- .ASC     ASCII traffic files including CAN or FlexRay traffic

20.17.2 Traffic Analyzer head up display

Exit and save the settings of the dialog by closing on the X.
20.17.3 Traffic analyzer configuration for CAN messages

You can search for a specific time point or by ID, Name, Type. Alternatively, you can navigate between pages or scroll within one page.

The search function is only searching for data within one page. One page has a maximum of 10,000 records. In conclusion the search operation is not searching through the whole data file.

For more information about the column Data length and DLC see chapter VIEW 18.25.14.

With a button next to the page navigation bar you can change the data presentation from decimal numbers to hexadecimal.

20.17.4 Traffic analyzer configuration for FlexRay messages

The traffic analyzer instrument can present FlexRay traffic. You can also link a corresponding XML file to convert FlexRay traffic into signals.
Traffic analyzer with FlexRay traffic.

In the screen shot below all available columns from the column chooser are added to the instrument.

All additional columns linked to the instrument.
20.17.5 Synchronized Analysis: Signals – Traffic – Video measurements

The data analysis function is supporting with active cursors a synchronized display of data originating from different measurement input types:

- Signals
- Video channels
- Traffic channels

You can use the cursor and search in any of the display elements and the updated cursors position or the selected CAN traffic value will updated the other instruments accordingly. Using the slide controller of the video instrument will update the cursors in the chart and the traffic readings.
20.18 3D view instrument

20.18.1 Youtube resources

IPEmotion - Analysis Toolbox - 3D view: http://youtu.be/Au6RHiXyvgc

The 3D view instrument shows STL files. STL files are generated from CAD programs and display the surface of objects. Within the 3D view instrument you can display graphical indicators in the 3D object. There are many applications for this instrument possible. Some examples are:

- Display strength of forces of 3-axis strain gauge sensors.
- Display vibrations measured von 3-axis accelerometers.
- Display steering wheel angle.
- Display accelerations.

20.18.2 3D view instrument configuration

20.18.3 Set camera view

In instrument level you can select the camera view. With this view you can position the object in a define angle.
Another tool in order to align the model is the cube object. The cube is presenting the 6 different view angles. With a single klick to one of the surfaces of the cube the model is changing its orientation.

- **F** = Front
- **L** = Left
- **B** = Back/Rear
- **R** = Right
- **U** = Up
- **D** = Down

### 20.18.4 Manual object rotation

You can rotate the object to any individual view position. The object can be rotated using the CONTROL Key and left mouse button to drag the object to the required position. You can also zoom to the instrument and move it inside the instrument container. With the function key "Pos1" you jump back to the original orientation of the STL model.
20.18.5 Add / remove indicators

Indicators are the general objects which can be graphically presented in the instrument.

20.18.6 3D view instrument head up display

20.18.7 General

▶ See configuration options in chapter VIEW > Yt- chart 18.7.4.

20.18.8 Model

In models you define the properties if the model.

▶ File name

Select a STL from your local drives. The STL file part of the IWF configuration. When you transfer an IWF file to another computer the related 3D model is transferred to and will be installed on the new computer in the directory: 
C:/Users/Public/Documents/IPETRONIK/IPEmotion/Custom/3DModels

The model is only transferred and included in the configuration when in the OPTIONS > Frequently used the function include external files is activated 23.1.2.

▶ STL color

Define the color of the 3D object.
STL transparency

You can define the object transparency from 0% to 99%. Transparency is required if you like to see the indicators located inside the object. See example in section 20.18.13.

Clipping

With the clipping function the graphical elements of the indicators outside the 3D cube of the object are removed. Sections outside the bounding circle are invisible when clipping is active.
20.18.9 Indicators

For the indicator configuration you have to consider many details in order to get the desired results. In the following each setting will be explained in general. A detailed example will follow here after 20.18.11.

- **Indicator**
  The indicator itself hat to be created from the context menu as explained in section 20.18.12. The initially created indicator has default name called “Indicator â˘A ¸ Sn”.

- **Name**
  In this field you can change the default name to a meaningful name.

- **Visible**
  With the visible check box you show or hid the indicator in the 3D view instrument.

- **Mode**
  The indicator can have different display modes. Currently arrow and line mode is supported.

- **Color**
  Here you define the color of the indicator.

- **Start point X**
  Here you define the start point X-coordinate.

- **Start point Y**
  Here you define the start point Y-coordinate.

- **Start point Z**
  Here you define the start point Z-coordinate.

- **End point X**
  Here you define the end point X-coordinate.

- **End point Y**
  Here you define the end point Y-coordinate.

- **End point Z**
  Here you define the end point Z-coordinate.

- **Length multiplier**
  The length multiplier is a factor which is computed in reference to the overall scaling. See details in the example below.

- **Diameter**
  Configure the diameter of the arrow or line.

20.18.10 Legend

Hide or show the legend with the indicator names.
20.18.11  Example of a 3D view instrument setup

The configuration of a 3D instrument requires some knowledge which will be discussed below.

20.18.12  Creating indicators

When you setup the 3D view instrument you need to decide how many indicators you like to show in the model. You need to create indicators first in order to proceed with the detailed configuration. Apart from the default arrows you can change the indicators to infinite lines too.
20.18.13  Defining start point coordinates in reference to the STL model

The default start points for the indicators is the center of the coordinate system which is (0;0;0). You can move the start point of the indicators as presented below. In this example indicator 2 (black) is just shifted by one distance unit to the left.

When you like to place the starting point of your indicators to a specific location of the STL model you have to know the coordinates of the STL model. These coordinates you get from the CAD program where the original model is created. In the example below you can see that the STL model is located quite close to the center coordinates (0;0;0).
However if you like to place the starting point of the indicators (arrows, or line) somewhere inside the STL model you have to ask the CAD file developer for the detailed coordinates. Alternatively you move them manually through try an error to the desired position. In this example the center is located inside the door.
If the model is configured for transparency the indicators originating from inside the model are invisible.

**Attention!**

In some cases you import your STL file and you cannot see anything. In this case it is most likely that the STL coordinates are very far away from the center coordinates. The instrument is zooming to a high macro level which is then reducing the resolution so that you cannot see model or your indicators. Help: To establish visibility you may increase significantly indicator line thickness or switch to infinite line to see the indicators relative to the STL model. Finally you have to find the right (X,Y,Z) starting points to place the indicators at the right location to the instrument.
20.18.14 Updating vectors though scripting operations

So far you have seen how to configure and locate the indicators and how to load STL files. Finally you would like to show graphically the magnitude and direction of the indicators to understand more about the circumstances you are investigating. In order to update indicator direction and magnitude you need to use scripting function. With the scripting function you can execute the updates. In the example below the measurement of acceleration in X, Y, and Z direction is graphically update in reference to the cursor position.

Scripting example:
20.19 Campbell

20.19.1 You tube resources

IPEmotion – Acoustic analysis with Campbell instrument: https://youtu.be/uPVTp6tpFe4

The configuration settings of the Campbell operation are explained in this chapter 19.25.

20.19.2 Instrument configuration functions

- **Y-axis (frequency)** On the y-axis you define the frequency range. With the shift + mouse wheel you can increase or reduce the frequency axis. With a click on the Y-axis and an up/down movement you can shift the complete Y-axis.

- **X-axis (time / ref channel)** On the x-axis you can display either the time or a reference channel. The type of axis presented on the x-axis is depending on the Campbell operation settings 19.25.2. With the shift + mouse wheel you can increase or reduce the frequency axis. With a click on the x-axis and a left/right movement you can shift the complete X-axis.
Color bar scaling

The most important function are the move and scaling function in the color bar and the numerical range. With this configuration functions you can achieve the desired contrast for the spectrums and amplitudes.

In the example below the upper Campbell diagram shows all areas with amplitude around ZERO (0 db) in dark blue. However in the lower diagram the display color range was changed /shifted where the color blue is indicating all signals with amplitude -100 db. All red signals have amplitude of around ZERO. Because of the shifted color min / max range the FFT amplitude spectrum can better identified in the lower Campbell diagram.
Another configuration function is to change the display range. When you left click into the numerical axis of the color scale you can stretch and compress the numerical Min / Max display range.

In the following example you will see how the selected range on the graphical presentation of the amplitudes and the level of detail. In this example a very good range von 30 db (10 = blue to 40 = red) was selected and there is a good resolution between the red and yellow/green amplitude areas visible.
In the example below the range was set to 20 db (10 = blue to 30 = red). In this case all signals above 30 are indicated in red color. The result is that this scaling in the range from 10 – 20 db is not well suited as all amplitudes above 20 db cannot be differentiated clearly. They are all grouped together in the red color range.

20.19.3 Campbell diagram head up display

Exit and save the settings of the dialog by closing on the X.
20.19.4 General

The general settings are only visible when no Campbell operation is linked to the diagram or when the diagram is moved and other empty areas appear. For more details see configuration options in chapter VIEW >Yt- chart 18.7.4.

![General settings configuration](image1)

**Area with general settings.**

20.19.5 X-axis

- **Axis marking**
  
  Refers to a name displayed along the x-axis.

- **Automatic scaling**
  
  Takes the time values from the data file into the diagram. You can deactivate the checkbox and define your own time span for the display range in the diagram. When you configure the Campbell operation with a reference channel then the Min max scaling of the x-axis from the reference channel is considered.
20.19.6 Y-axis

- **Axis marking**: Refers to a name displayed along the Y-axis which is related to the frequency.

- **Scaling**: The frequency can be scaled in linear and logarithmic mode. In the screenshot below logarithmic scaling was selected.

- **Automatic scaling**: This included the frequency range which is based on the calculation: sample rate of source channel divided by 2. In this example the source channel was sampled at 50 kHz and the frequency display range is up to 25 kHz. If you are searching for data in a lower frequency range you should lower the display range.
20.19.7 Graph displaying

- **Color style**
  Three default color styles can be selected. Rainbow, Fire, Grey.

- **Automatic Scaling**
  The default setting is automatic scaling. In this case, the Min and Max values are taken from the actual FFT amplitudes calculations the complete color range is spread across the Min and Max values.

- **Color min / max**
  Refers to the upper and lower ends of the color scale. Examples are explained in section 20.19.2.
20.19.8 Legend

- **Show**
  - Display or hide the legend.

- **Show unit**
  - This display option includes information about the sample rate in Hz.
20.19.9 Audio play back

The Campbell diagram is supporting an audio play back function. This function is particularly useful in order to perform an acoustic validation of the recorded data before to start more detailed post processing tasks. The output of audio data is currently only possible when the Campbell operation is time based.
21 REPORTING work space

21.1 Automatically generated

The basic report layout is automatically generated when you change to the Reporting work space. The layout you define in the analysis is automatically converted into the report template.
21.1.1 Generic Report structure

When the report is generated the following structure is automatically available to you.

- Report cover sheet
  
  The cover sheet is the first page of the report. You can edit this pages with the tools discussed below.

- Project Parameters
  
  This page shows all project parameters of all loaded data files. This can cover many pages when you load many data files which have plenty of parameters stored inside.

- Pages
  
  The pages are automatically generated from the ANALYSIS work space. All pages from the ANALYSIS are transferred to the report.

21.2 Report Ribbon

The report ribbon covers basic functions to modify the report and add graphical elements or text fields. However, the layout designer is a powerful editor to add valuable information to the report.
21.2.1 Print

- **Review**
  
  If you hit the preview button all selected report pages are converted to a preview document.

- **Print**
  
  Using print the printer selection dialog opens up.

- **Quick Print**
  
  Is directly printing to the default printer.
21.2.2 PDF / Image / HTML

Export selected report pages into pdf, image or HTML files.

You can add specific text and drawing elements to every report page. If you select a text element you can define font and size as well. This graphical modifications are saved to the IWF project file. Whenever you create a new report with this project file the graphical elements show up.
21.2.4 Page copy & paste operation

On the report pages you can copy and paste the report page individual layout modifications to other pages.

Copy page 1 layout and paste to page 4.
Graphic element are transferred.

Apart from the copy and paste function you can save the report layout in the ITF file format.
21.3 Report Layout configuration

21.3.1 Introduction

Converting the layout of the analysis into a report is easy. However, if you like to build a customized report which shows individual cover sheets, header or footer sections you need to switch to the layout designer. With the layout designer you can define your own report template (IRL) file which includes all individually defined settings.

On many reports the following information is included:

- Time when report is created
- Name of the data file
- Start or stop of measurement
- Information about the project parameters saved to the data file
- Project parameters of the current IWF file
- Statistic functions like min, max average of a channel displayed in a table
- and many more

21.3.2 Layout designer

With the layout designer you can create your own report templates with your specific layout. The difference to the drawing elements mentioned above 21.2.3 is that the changes are saved in a separate IRL report file.

Attention!

When you share a IWF project file with your colleague, the IPEmotion Report template (IRL) file is not included. In this case, you have to include the IRL file manually to the project and install it in the default directory. Report templates are stored in: C:/Users/Public/Documents/IPETRONIK/IPEmotion/Reports

21.3.3 Ribbon of the layout designer:
21.3.4 Change Report Logo

You can replace the IPEmotion logo permanently by another logo if you have started the layout designer. Select the logo and open the properties of the logo. The default search directory of the logo is:

\[
\text{C:\Users\Public\Documents\IPETRONIK\IPEmotion\Custom\Pictures}\]

![Image of the layout designer with the logo and its properties open.](image-url)
21.3.5 Individual report templates for each page

You can define individual report templates for each page of the report. In the first step you start the layout designer and create your individual page layout.

Open report layout templates and modify according to your needs.

Your preferred layout will be saved with a specific name.
This individual layout can be linked to a specific page.

An example of the different report templates is shown below.
21.4 Field command editor

With the field command editor you can define the syntax to show individual information on the report. The editor gives you access to several field function categories which will be discussed in turn.

21.4.1 Field command DATETIME

Using the function DATETIME, you can add different time formats to the report to indicate when the report was created.
21.4.2 Field command GROUPPROPERTY

You have access to the header information of a data group with the field command GROUPPROPERTY. You can see all data group properties in the DATA MANAGER when you select the IAD data file.
21.4 Field command EDITOR

21.4.3 Field command DATAPROPERTY

With the field command DATAPROPERTY you have access to all user defined parameters saved to the data file when the recording is finished. These project parameters are also visible on the specified parameter sheet of the report. You will find more information about the data file and user defined properties in chapter DATA MANAGER 19.2.1.
21.4.4  Field command PROJECTPARAM

With the field command PROJECTPARAM you can display user-defined project parameters of this project file (IWF) on the report. The user-defined project parameters are not necessarily the same as the ones included in the IAD data file. However, if you save a data file, it saves the user-defined project parameters by default. In chapter PROJECT you can get more information how to modify the project parameters.
21.4.5 Field command SCRIPTINVOKE

This field function is useful to run scripts inside the report. In order to invoke the script, you need to define the scripts in the SCRIPTING work space of IPEmotion. The Scripting workspace is only supported in the Professional Edition. See chapter EDITIONS for more information 5.1.

In this example, the script is calculating a MIN, MAX and AVERAGE value of the selected channel. The script needs to be programmed in a suitable structure so that the result can be integrated to the report. You will have at least 3 elements in the functions:

- Name of the Script which has to be integrated to the Project through the SCRIPTING work space.
- Name of the math calculation function.
- Name of the channel included in the data file which is subjected to the calculation.
21.4.6 Field command **MEAWINDPROPERTY**

Use this field function to show all data from the measurement window on the report. You need to activate at least one cursor in the **ANALYSIS** work space in order to bring up the measurement window. In this example the number of samples between the cursor lines of channel “Sine-1” is displayed on the report.
21.4.7 Field command SINGLEVALUE

Use this field function to access single values post processing results. When you have a post processing operation with a single value result these results can be integrated to the report.

Single value output operations are:

- Statistic operation
- Find condition by Time & Index
21.5 Report font and line size for Yt and XY diagrams

You can increase on the report for Yt-, XY diagram the sickness of lines in the graph, legend and axis. You need to update the Settings.XML file. The file is located in Program Data directory.

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3

The new entry in the file should be:

```xml
<ReportingSettings>
  <ReportingVisualOffset>4</ReportingVisualOffset>
</ReportingSettings>
```

Close IPEmotion before you modify the Setting.XML file. If you edit the file and close IPEmotion afterwards your changes will not be saved and overwritten by the IPEmotion settings.

The Visual Offset should be in the Range:

- 0 = default
- 4 = larger
- 10 = large
- Not recommended: You can add also very large numbers. There is no control in the Settings.XML.
The SCRIPTING interface is only available in the Professional, Developer and Analysis Edition. For more details see chapter EDITIONS 5.1.

22.1 COM interface

With the COM interface of IPEmotion you can run scripts inside the application but you can also access IPEmotion from other 3rd party programs.

The documentation of the COM interface (IPEmotionCOM.chm & PDF) is available in:

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Help
22.2 Ribbon

- **New**
  
  Here you can program Visual Basic (VBS) and Python (PY) scripts. The default directory for the storage of the scripts is: Win7: C:/Users/Public/Documents/IPETRONIK/IPEmotion/Scripting/
  
  You can program scripts directly in IPEmotion and the script is part of the IWF project file. However, the software provides no syntax help or debugging functions which makes the programming more difficult.

- **Import / Export**
  
  Here you can import and export scripts from your directory.

- **Run**
  
  When you hit the run button the script is executed.

- **Start/Stop Macro recording**
  
  With the Start/Stop Button you can activate a macro recording function. When you activate the Start recording function all steps you perform are recorded. This is a very useful way to identify the work spaces and commands to develop your own scripts. See the COM interface manual to get an overview of the available functions.
22.3 Details

Autostart

Here you can define the Autostart script. The pull down list gives you access to all scripts defined in this project file. The Autostart script is like all other scripts part of the IWF project file. When you configure IPEmotion in the OPTIONS and start with the last configuration you will automatically invoke the project file with IPEmotion and then the related autostart script will be executed. See chapter OPTIONS for more details how to set up the automatic start of the last project file 23.1.1.

Name

Here you can define a specific name for your script.

Directory

Here you will see where the script is located.

Description

Here you can define a complementary description for the script.

Script language

As discussed above you can link Visual Basic (VBS) and Python (PY) scripts to your application. The syntax of both scripting languages is different. It is likely when you change a VBS script to a PY script or vice a versa it will not be functioning correctly.

Link to file

When you activate this check box the script is integrated to the IWF project as a separate scripting file. When you share a project with your colleagues the scripts are transferred as separate (PY or VBS) files as well. They are installed on the receiving computer in the default directory. For information of the included files functions see chapter OPTIONS 23.1.2.

Information

Take care that the scripting language fits to the syntax used in the programming and do not change the language during exports.
22.4 Demo Scripting examples of the Setup

The following demo scripts are included in the standard setup of this IPEmotion release. The scripting PDF includes a detailed description of the demo scripts.
23 APPENDIX: Options

OPTIONS are a very important part of the program because many settings can be defined in this part of the program which has various impacts on the IPEmotion application and the projects. Most of the setting with its impacts is discussed below.

23.1 Frequently used

23.1.1 Start with the latest IWF configuration

This checkbox will automatically load the last IWF file you worked with. This function is automatically starting the last project file (IWF). This can be useful if you like to give a quick demo and like to start IPEmotion directly with the last project file.

23.1.2 Include external files in the IWF configuration

This check box makes the transfer of project files (IWF) easier. Activating this check box, all page and instrument picture and GPX guidance track and MAP tiles from the VIEW are included. Data files IAD and ASCII linked to function and traffic generators from ACQUISITION are included in the IWF too. Also STL files for the 3D view instrument in ANALYSIS are included in the IWF configuration. Description files of the Traffic Analyzer 18.25.8 are not included due to security reasons. The included files are located in:

- **Folder Custom**
  - C:/Users/Public/Documents/IPETRONIK/IPEmotion/Custom/3DModels
  - C:/Users/Public/Documents/IPETRONIK/IPEmotion/Custom/Map
  - C:/Users/Public/Documents/IPETRONIK/IPEmotion/Custom/Pictures

- **Folder StorageData**
  - Data files (IAD) linked to random function generators or GPX files linked to a Map instrument for the guidance track.

- **Folder Scripting**
  - VBS and PYTHON scripts are only linked when separately activated in the Scripting tab sheet which is only available for Professional and Developer Editions.
To find out which files are included you can rename the .IWF and change it to .ZIP. Then you can extract the zip file and see all included external files. When opening an IWF file on another computer all external files are copied on the new computer into the default installation directories. The screenshot below shows how to extract the content of an IWF file by converting to ZIP and extracting it.

You can include VBS and Python scripts in the IWF project file to transfer them to another computer. In this case you need to activate the check box “linked to file” in the SCRIPTING tab sheet. See chapter SCRIPTING for more details 22.3.
23.1 Frequently used

**Attention!**
It is important to know that the external scripting files are only transferred to the Scripting folder on the new computer provided that the scripts are not existing there yet. If a script file with the same name is already on this computer it will not be overwritten nor the user will get a notification that the files are not transferred. What to do when the include function is not possible and the check box is marked with a red cross. In this case you need to execute the script export operation so that a separate script file is created in the scripting directory. After that the scripting file can be linked to the IWF project.

**Information**
The SCRIPTING tab sheet is only visible in the Professional and Developer and Analysis Edition.

### 23.1.3 Include some OPTIONS settings in the configuration

This checkbox will affect IPEmotion configurations (IWF) files and PlugIn configurations which are stored in IPEmotion System Files (ISF). The ISF files can currently only be generated for the IPETRONIK Logger PlugIn.

The use case for this check box is that configuration files (IWF or ISF) which are shared with other users are enriched with some important settings from OPTIONS. OPTIONS are configured individually on each computer. Due to the different option configurations from PC to PC the same IWF or ISF file could look differently. With an active check box you will ensure that the key configuration functions look the same on each computer.

With the check box the following 4 settings are included in the configuration file. The functions of these settings are discussed in the next sections.

- **Automatic Service Administration** (from the Basic Settings)
- **Ignore Verbal Tables** (from the Expert Mode)
- **Max Polling List** (from the Expert Mode)
- **Use Characteristics** (from the Expert Mode)

When you load an IWF file which includes different OPTION settings compared to the settings on your computer you will get an information message. "The options settings have been adjusted..."
23.1 Frequently used

23.1.4 Automatic hardware detection at start

This function is related to the OneClick acquisition feature of IPEmotion. When this check box is activated the IPEmotion software is automatically executing hardware detection for all active PlugIns and tries to establish a connection to the devices. The hardware detection works well for USB devices and Ethernet devices provided the PlugIn supports an automatic IP-address scan function. For serial devices the hardware detection is usually not working as the serial interface parameters are not known by IPEmotion. After hardware detection a dialog comes up indicating which devices were detected and you have several choices. Apart from the automatic configuration you can use the guided configuration or carry out a manual configuration.

![Automatic hardware detection](image)

23.1.5 Standard command after successful detection

When the hardware detection was successful you can specify which action will be the next one. As indicated in the screenshot above you can choose from 3 actions.

- **Guided configuration**  The guided configuration takes you like a wizard in several steps systematically through a complete configuration procedure.
23.1 Frequently used

- **Automatic configuration**
  The automatic configuration is creating screen pages in the VIEW work area automatically and creating up to 3 Yt-charts per page. On each Yt-chart are at most 4 channels linked to. All channels are also linked to a store group so that you can directly activate the data storage.

- **Manual configuration**
  The manual configuration is the best solution for you if you like to create your individual application from scratch.
23.2  Basic Settings

23.2.1  Preferred configuration type

- **Hardware configuration**  
  The hardware configuration refers to the SIGNALS work spaces where you can manually define systems and create your measurement application. This is the most flexible configuration approach as you can decide which systems to configure, which modules to create and how to scale the IO channels.
Manual configuration of instruments.
23.2 Basic Settings

Signals configuration

The signals configuration is based entirely on the signal import function of an MPC (Measurement Point Catalog) data file. You only need to select which signals should be measured. The MPC file is an XML file which is created through specific software packages by each customer individually. IPETRONIK does not offer any software tool to create MPC files.

Overview of the XML structure of an MPC data file.
23.2 Basic Settings

Measurement configuration:
Systems and components can be created manually.
IO modules are listed.

Signal configuration from MPC file:
Signal list – no IO modules are visible.
23.2 Basic Settings

23.2.2 Grouped by interface type

In the Basic settings you can activate a function to group all interfaces by type like CAN, LIN, ETH, FlexRay etc.

The interface grouping is a function to reduce the interface list which is particularly useful, when you have data logger systems with a large list of interfaces to increase the readability.
23.2 Basic Settings

23.2.3 Accurate acquisition chain required

The accurate acquisition change is a setting which will require that all modules and PlugIns specified in the SIGNALS work area are working correctly and well connected to the application. If one system of the configuration is not connected the whole measurement will not start.

23.2.4 Automatic service administration

The automatic service administration is a function dedicated to IPETRONIK data loggers. The automatic service administration only is working in cooperation with an active Expert mode and activated check box for "view Protocols". The function of the automatic service administration is that the signals of IPETRONIK data loggers are automatically included on XCP DAQ list which is streaming the data to the PC. With this function you can see the measurement signals of the logger in IPEmotion provided you have a TCP/IP LAN or WLAN connection between your computer and the data logger.
Channels are automatically added to the DAQ list for XCP transfer to the PC.
23.3 Expert mode

23.3.1 Impact of the Export mode check box

When this check box itself is enabled it will show additional channels in in the SIGANAL, ACQUISITION and VIEW workspaces. The screenshot below is an example how the additional channels become visible.
23.3 Expert mode

- Status channels of Function Generators
- Status channels of PID Controller
- Status channels of Router
- Status channels of Sequence Control
- Status channels of Profile generator
- Status channels of Classification Operations
- Display of DAQ lists from A2L file imports in the SIGNALS work space

With this check box you can also activate the tab sheet "Format" in the SIGNALS work areas. In this tab sheet you can see the data direction INPUT / OUTPUT and you can define the no VALUE output and some other expert settings which are discussed in the SIGNALS chapter 12.6.4.
23.3.2 Additional warnings

The additional warnings refer to a message window which is indicating that the configuration IWF file you are loading was created with a previous IPEmotion release and may also contain previous versions of Plugins if included. This message should make you aware that any modifications saved to this IWF file has irreversible effects and that you cannot open this project file with previous IPEmotion releases and PlugIn releases.

Example:

- Basis configuration: New IPEmotion Software release
- IPEmotion V02.00.06: IPEmotion 2015 R3
- Logger PlugIn V03.50.01: Logger PlugIn V03.52.00
- Beckhoff PlugIn V01.00.00: Beckhoff PlugIn V01.04.00

23.3.3 Name pattern for post processing operations

When you create post processing operations you can define how the channels names are generated. The names patterns can be composed of the following 4 elements:

- Type: Type of operation (Statics, Filter, Classification,...)
- Source: Name of source channel
- Description: Description of the operation
- Index: Index or number count of the operation
- Free Text: Add any default text descriptions
The default name pattern is: "Type" – "Source" – "Index"

When you modify the name pattern entry in the options the post processing operation names are created accordingly as indicated in the example below. The benefit is that you can define how the operation names and the output channel names are created. In the example below the operation name and channel names are modified.
23.3 Expert mode

*Source* xx "Type" yy "Index" zz "Description" FreeText

Customized Name Pattern:
changed order / different separators / operation description / free text entry
23.3 Expert mode

Information
The name patter function is not applied to formula channels.

23.3.4 Variable configuration

In the acquisition work space you can define 3 types of variables:

- Number (Float 32 bit)
- Status (Bool 0 or 1)
- Text (text, comment input e.g. for marker channels)

With this check box you influence whether the variables are visible or not. However, if you hide the variables and you load an IWF configuration which includes variables in the configuration, they are made visible. If you like to find out more about variables refer to chapter ACQUISITION 14.7.
23.3.5 Allow new versions

The compatibility between IPEmotion configuration files (IWF) created from different IPEmotion releases and PlugIn releases is improved. Working in teams and sharing measurement configuration files is common practice. The recipient of configuration might not have the same IPEmotion Software and PlugIn version installed compared to the PC here the configuration was created. In this cases the software used to block the import and loading process of the IWF file. In the Expert settings in the OPTIONS the check box Allow newer versions is by default activated.

With IPEmotion 2018 R1 the compatibility to elderly IPEmotion releases is significantly improved. Newer configurations (higher than 2018 R1) can be accessed and opened by elderly software installations (but not before 2018 R1). However, the user will see a notification in the GUI where configurations components are included which are not supported in the previous software versions.
23.3.6 Maximum size of acquisition file

Here you can define the maximum size of the data file in MB (Mega Byte). When you record data, IPEmotion will split the files when the file size is reached. The maximum file size is 1000 MB (1 GB). If you have several files from the recording you can specify in OPTIONS > Data manager to connect all the files to one common file during the loading process into the ANALYSIS work area. See chapter ANALYSIS for more details. There is also a setting in the OPTIONS > Data Manager called "Merge data at loading" 23.6.3. The file split size is specified only for the IAD IPEmotion format. If your final output file is CSV the size could be much larger than the IPEmotion IAD format.

23.3.7 No value time out

IPEmotion is recording NO VALUE data in the data file when the Plugin is sending no data. That can cause problems on graph plotting and mathematical calculations. In order to overcome this problem you can activate the NO VALUE TIME OUT function. This function avoids that missing data points are recorded with "NO Value". Instead the last valid measurement is stored. The maximum time frame you can configure is 5 seconds. The default configuration is 0 seconds. In this case the tolerance is zero and NO VALUEs are recorded immediately.
23.3.8 Limit message duration

For limit channels you can configure a pop-up window notifying when the limit condition is true. The duration for how long this window will stay on the screen can be configured in OPTIONS of the Expert mode. The default configuration is 5 seconds. After 5 seconds the message window will disappear automatically. If you set the time to 0 Sec the window will stay on the screen until it gets acknowledged by the user.

23.3.9 View protocols

Certain Plugins like the CAN Protocols Plugin or the IPETRONIK Logger Plugin support the measurement of XCP, CCP and other protocols. The protocols can take measurements from ECUs which are organized in different tabs.
23.3.10 Editing protocol scaling

The protocol scaling check box refers to any description files (DBC or A2L etc..) which will either give the user access to the scaling calculator or will be blocked.
23.3.11 View diagnostic jobs

Diagnostic measurement based (.idf) description files can be triggered. Without this setting (active check box) the diagnostic channels are not visible in the interface tree of the IPETRONIK LOG Plugin V03.54.00 or higher, and cannot be configured.
23.3.12 Ignoring verbal tables - during import

Verbal tables (V-TAB) is a special input scaling mode. With Verbal Tables you can scale numerical values into text expressions. This is very useful when a numeric value should be translated into meaningful text messages. When this check box is activated, verbal tables from description files like A2L, DBC will not be imported.
23.3.13 Use short verbal table text

The Autosar ARXML import supports in the OPTION > Basic Settings > Expert Mode an new setting to change the length of verbal tables. When the check box is activates the V-TAB text shows a reduced length.
23.3.14 Max Polling List

In the Expert mode two important configuration functions were added. First of all you can define up to 4 DAQ polling lists. During the A2L import you can allocate the signals to different polling groups. The main benefit is that each polling list can be triggered individually and that the polling load is balanced. A2L imports for ECU measurement are supported by the IPETRONIK LOG Plugin and the CAN Protocols Plugin. See chapter SIGANLS description files import for more information 12.1.3.

The screenshot below shows the A2L import dialog where you can assign to each signal a polling group. Polling groups can be currently defined for the following XCP and CAN interfaces:

- XCPonUDP / XCPonCAN / XCPonTCP / XCPonFlexRay
- CCPonCAN

23.3.15 Use characteristics (for ECU calibration)

There have been increasing requests to change parameters on the ECU. Provided the A2L file includes characteristics, it is possible to address these characteristics in IPEmotion to change the parameters.
23.3 Expert mode

- For calibration: In the calibration mode you can initialize calibration command to the ECU and change ECU parameters.
- As measurement: This is the normal measurement mode which supports no calibration functions, only measurements. However, some A2L files also use calibration for measurement and therefore this mode was implemented.
- No characteristics: In this setting the calibration functionality is disabled.

23.3.16 Support J1939

If the check box is enabled you will see a J1939 processing channel after the import and you can change DM01 messages conversion methods.
23.3.17 Synchronize signals by name

The function of this check box to enable a description file synchronization one channel name only. The default behavior is that description files are only synchronized with the configuration when message ID and channel name are matching. However in the case that that a channel is allocated to a different message ID the synchronization is not working, which leads to the effect that the channel is not any more stored, linked to formulas of VIEW instruments. With an activated check box in the OPTIONS it is now possible to synchronize only on channel name level. For more details see section 13.10.1.

23.3.18 Logging import

The standard import messages are displayed in the Message window which was discussed in the APPLICATION MENU >View in chapter 7.7. When you active the import logging function a spate data base file is created which stores all import messages. The file is called: **ImportLog.Log** and located in:

► All PlugIn using import functions (DBC, A2L, S7P, etc...) store the import protocol with all messages in this common file when the check box is enabled.
23.4 Appearance

23.4.1 Language Selection

You can select the following languages:

▸ English
▸ German
▸ Italian
▸ Korean
▸ Chinese simplified
▸ Japanese

The first major release only includes German and English language. The other languages are translated after that and will be included in the corresponding hotfix. You can switch to any language after restart of the software.

When you switch the language the some customizing settings are set back to default. This is impacting individually selected columns, docking windows like message windows or measurement cursor windows.
23.4 Appearance

23.4.2 Skin Selection

IPEmotion offers 6 different Skins. You can directly switch between the skins without restarting the software.

- IPEmotion V2
- Light Blue
- Dark Blue
- Blue
- Grey
- Black

Customizing in EN language before reset with individual column settings.

After reset to e.g. German language columns are set back to default.
23.4 Appearance

23.4.3 Display tool tips
Many labels and buttons in IPEmotion support tool tip information with some additional explanation about the function.

23.4.4 Font size of visual elements
The font size range of the event messages and display objects is extended to 4 size levels: S, M, L, XL. With the font size you influence the following graphical elements:

- Channel names in charts
- Name of instruments and alphanumerical instruments in the analog displays (e.g. Tachometer)
- Y-axis
- All entries in Message, Status, Storage, Output and PC tab sheets
23.4.5 Transparency of configuration dialogs

The transparency can go from 0% (no transparency) up to 30% where parts of the background elements are shining through.
23.4.6 Use Windows standard dialogs

On all file open and file export dialogs you can either choose the familiar windows dialogs or the IPEmotion dialogs.
23.4.7 Time channel format (relative vs. absolute)

This time channel format affects the analysis and the graphical presentation of the time axis in the Yt-chart plotting online data in the VIEW work space and in the ANALYSIS work space. You can switch the time axis during the recording and live data display.

- **Absolute**
  
  This refers to a time axis where the time of recording is indicated.

- **Relative**
  
  This refers to a time axis where all graphs are starting with the first time stamp at ZERO seconds.

- **VIEW**
  
  Relative and absolute as impact on the x-axis format as indicated below.

- **DATA MANAGER**

  Depending on the setting relative and absolute the time format in the data manger is affected too 19.2.4.

- **ANALYSIS**

  In the ANALYSIS the Yt-chart offers different graphical presentations depending on the time scale setting. In relative time all charts of all data files are starting at a common point ZERO seconds. When you have the total setting e the graphs are presented in a chronological order.
In the VIEW and ANALYSIS workspace the instruments can be aligned to a grid. The grid resolution can be configured in the range of 10, 20, 50 and 100 units. The default behavior is defined for "Disabled".

The smoothest grid resolution is obtained with the setting 100. The largest grid resolution is obtained with the setting to 10.

Examples for grid size settings
23.5 View

23.5.1 History buffer depth factor

The history buffer for the Yt-chart in the VIEW work area gives you the ability to scroll back in time to perform some chart analysis functions. The depth factor can be set up to 50. That enables users to scroll back on the configured time axis of the Yt-chart 50 times. If the time axis is set to 1 minute, the user can scroll back up to 50 minutes. The zoom function is explained in the VIEW work space Yt-diagram 18.7.1.

23.5.2 History buffer resolution

The resolution can be set to a maximum factor of 10. This defines how deep users can zoom into the graph. The zoom function is explained in the VIEW work space Yt-diagram 18.7.1.

23.5.3 Initialization of VIEW pages at first visibility

This new setting was introduced to improve and reduce the loading time of large applications with many VIEW pages and instruments. With this check box activated, the VIEW pages are initialized only when they are access for the first time.
23.5.4 Use of display names

For input channels in the SIGNALS 12, formulas and scaling channels in ACQUISITION 14.3.2 you can display different channels name on the VIEW instruments. When the check box is activated the display name will be shown on the instrument. The display name has no impact on the storage. The channel is stored with the channel name and not the display name.

23.5.5 Hide inactive channels

If you activate the check box, all inactive channels from SIGNALS and ACQUISITION will not be visible in VIEW work space.

This checkbox has impact on the ACQUISITION and will hide inactive formulas, scaling, variable channels (number, status, text) FFT and classification as well. The check box has no impact on the Control module (function generators, controllers, and test sequencing).
23.5.6 Reset relative time on each start of storage

In the VIEW section of the options dialog you can configure an automatic reset of the relative time axis in an Yt-chart. In the default behavior you start your data display and execute the storage operation some time later. In this case the yt-chart keeps plotting the relative time and it is not visible to the user when the data storage was executed.
When you activate the function in the VIEW options, the display behavior in the case of a storage event will change. In this case if you run the display of data for some time and you then, hit the storage button, the diagrams sets the relative time axis for the storage event to zero.
23.6 Data manager
23.6.1 Merging time channels with equal acquisition rates

Every measurement channel in the data file has its own time channel. This is related to the storage concept where you can store every channel at an individual storage rate. However, many time channels will make it more difficult to read data presentation in the DATA MANAGER and in the exports to Excel or CSV. Therefore you can merge all time channels with the same sample rate.
23.6.2 Merge data at loading

This function is important for the ANALYSIS and DATA MANAGER work space. If you have several data files and you like to merge them, this function is the right approach. You can merge data files which include the same channels or data files that have no channels in common. This function is most effective if you need to merge data files which contain the same measurement channels because the graph is plotted for one channel in one common color. See more details in chapter DATA MANAGER 19.2.
23.6.3 Continuous time signal for connecting channels

In the setting of the data manager a new check box "continuous time signal for connecting channels" is available which is working only in combination with the checkbox "merge data at loading" discussed above. When you merge your data file at loading the absolute time offset between the different data file is presented in the diagrams as indicated low.

With the new check box you have now the ability cut out the absolute time difference between the different recording events as indicated below.
23.6.4 Displaying absolute time in zones

With the new time zone setting it is easier to analyze data files which were recorded in different time zones. For the time line you can select different settings. You can show the data with the time of your analysis system (time of the PC), or you can show the data with the time of recording. Or you can relate the time to the UTC (Universal Time Coordinate). The example below shows how a data file is related to UTC+1 or UTC time.

23.6.5 Tree display style

In the OPTIONS of IPEmotion you can change the tree structure of the data file and channel presentation. "Group / Signal" is the traditional default setting of IPEmotion. Every storage group is represented as a separate grouping level, based on the storage group name.
With the setting of "File / Group / Signal" you can add an overall file note based on the file name only to the tree with includes all storage groups together. This setting will make it easier to navigate between different data file (including one or several groups) originating from different measurement setups.
The “File / Signal” setting will remove all storage groups and provide only a list of all channels listed below the file name.
23.7 Data service

With the MDM module you can index data file archives and search for many different measurement file parameters. All meta data properties of the data file and the channels can be searched for. The module is available as a separate module for the Standard and Analysis edition. The functionality is included in the Professional, Developer and Analysis Edition. The search technology is based on a background data base which is indexing all incoming files to a relational database. The queries are running though the database and return a list of matching data files. The database is activated as indicated below.

It is also possible to include network drives in your Data Service search and indexing process.
### Data service

**Database browser**

<table>
<thead>
<tr>
<th>Name</th>
<th>Start</th>
<th>End</th>
<th>Size</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>222-3:08_150701_1534...</td>
<td>01.07.2015 11:31:49</td>
<td>01.07.2015 13:54:21</td>
<td>222,1 KB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen652_150701_1534...</td>
</tr>
<tr>
<td>222-3:08_150701_1444...</td>
<td>01.07.2015 11:44:44</td>
<td>01.07.2015 13:51:15</td>
<td>679,4 KB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen655_150701_1444...</td>
</tr>
<tr>
<td>MEA_0002.ZIP</td>
<td>01.07.2015 11:49:09</td>
<td>01.07.2015 13:57:14</td>
<td>981,1 KB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen652_150701_1534...</td>
</tr>
<tr>
<td>MEA_0008.ZIP</td>
<td>01.07.2015 11:43:55</td>
<td>01.07.2015 13:46:14</td>
<td>1,4 MB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen652_150701_1534...</td>
</tr>
<tr>
<td>MEA_0009.ZIP</td>
<td>01.07.2015 11:39:19</td>
<td>01.07.2015 13:44:56</td>
<td>1,2 MB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen652_150701_1534...</td>
</tr>
<tr>
<td>MEA_0010.ZIP</td>
<td>01.07.2015 11:38:12</td>
<td>01.07.2015 13:42:27</td>
<td>1,4 MB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen652_150701_1534...</td>
</tr>
<tr>
<td>MEA_0001.ZIP</td>
<td>01.07.2015 11:37:30</td>
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</tr>
<tr>
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<td>01.07.2015 13:38:21</td>
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</tr>
<tr>
<td>MEA_0006.ZIP</td>
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<td>01.07.2015 13:37:20</td>
<td>231,4 KB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen652_150701_1534...</td>
</tr>
<tr>
<td>MEA_0005.ZIP</td>
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<td>01.07.2015 13:17:11</td>
<td>785,1 KB</td>
<td>C:/Users/IPETRONIK/IPemotion/StorageData/GO_T1/sen652_150701_1534...</td>
</tr>
</tbody>
</table>

**Indexing network drives**
23.8 Import

23.8.1 IPEmotion

IPEmotion imports refer to the proprietary format of the IPEmotion software. All data is originally recorded in the raw data format (IRD). After recording is finished the data is converted into the defined data format. The IAD format is the standard file format.

23.8.2 IPEmotion RT

IPEmotionRT refers to the data file format of IPEmotionRT data logger software based on LINUX operating system.

23.8.3 IPEmotion raw data

When you activate data storage all data is initially saved in the raw data format (IRD) files. When the storage process is finished the data is converted to its final format as defined in the file format options of the ACQUISITION work space >Storage groups 14.8.8. The IRD files are saved to the RawDataBackup directory located in:

```
C:\Users\Public\Documents\IPETRONIK\IPEmotion\RawDataBackup
```

When you save data in a non IPEmotion (.IAD) format e.g. MDF4, TDM, etc... the original raw data file stays in the RawDataBackup directory in case the conversion was not successfully executed. The raw data directory is monitored automatically to ensure that not too many old IRD files remain undeleted. The folder has a active monitoring according to the parameters as defined in chapter 23.12. The checkbox "Use Channel relative time original" has the following impact during data import. When the check box is activated and you import only a section from your total recording the imported segment will start at the time point of the cursor setting of the export.
Exported segment starts at the same time point as recorded from the original data file below.
However of you deactivate the check box and you reimport the same segment you will see that the segment will start at Zero and ignore the time stamps of the cursor position when the export was made.
23.8.4 IPEhub2

IPEhub2 is a 2-CAN channel LAN and WLAN interface with internal CAN traffic storage capabilities. The data files are stored in .hrd (Hub Raw Data) format on a removable SD card. These .hrd files can be imported from the CAN card interface through the Protocols PlugIn. For more information about IPEhub2 see chapter 7.3.

23.8.5 TESTdrive

TESTdrive import refers to data files stored on IPETRONIK data loggers. On the logger you will find different file formats and they can be loaded directly to IPEmotion. The overall encompassing data file is TESTdrive Data.

The TESTdrive data files are ZIP files which include a bunch for data files. You can deselect the import if you like exclude some file types.
23.8.6 Audio

The Audio import refers to .WAV files. There are no import settings available.

23.8.7 CSV

For a CSV import you need to define the file structure. The import settings for each individual CSV file are saved as separate individually named templates.

Defining File Structure:

- **Character Encoding**
  Here users can define the supported data format: UNICODE / UTF-8 / ASCII

- **Classifying rows**
  Channel / Channel Description / Data / Units / Ignore
This is an important setting to specify relevant channels which should be considered for the import. It can be specified in which row the channel names or units etc. are included and in what sequence the measurement data display is carried out. Rows which should not be imported can be classified with the ignore status.

In the data tab sheet, specific settings to the data sets can be configured.

- **Column separator**
  Users specify how the columns are to be separated: Tabulator; Semicolon; Comma; Space

- **Decimal separator**
  This is important to different EN and non-EN Windows operating systems since comma and dot are used differently. 1,000.00 >EN format; 1.000,00 >non-EN format

- **Channel Grid**
  In the channel grid you can define for each column whether it is data or time or it should be ignored during the import.
All CSV specific import templates you have created are listed in the ANALYSIS or DATA MANAGER import dialogs.
When you import CSV files which include channels with different sample rates the data column length is different for each channel. The empty cells which do not include any time stamps and measurement values are displayed as empty cells.

23.8.8 DIAdem DAT

This import refers to the import to data files created with the DIAdem software. No import settings are defined.

23.8.9 DIAdem TDM

This import refers to the import to data files created with the DIAdem software. No import settings are defined.

23.8.10 GPX

The GPX import refers to files which include GPS data (Longitude, Latitude, Speed, Time and Altitude)

23.8.11 Graphtec data

Graphtec import refers to binary data files (.gbd) from Graphtec loggers GL820-, GL 900-, GL7000-Series.

23.8.12 MDF4

The IPETRONIK data loggers support with TESTdrive V03.54.00 event based measurements. The event measurements are stored in the TESTdrive MEA.ZIP file in the MDF4 format and can now be analyzed in IPEmotion.

The MDF import supports MDF 4.1 format as well.

The import setting for MDF4 support a check box for a dedicated NoValue treatment. MDF4 can support different NoValue entries. The new checkbox "ignore no value status“ has to impacts.

- Importing MDF4 files with one NoValue definition the NoValue data is converted to ZERO (screens below)
- Importing MDF4 files with multiple NoValue definitions will ignore all NoValues and mark them as VALID data.
The example below is indicating how one no value definition "NoValue" can be converted to ZERO.
23.8.13 Traffic ASCII

Refers to CAN and FlexRay traffic ASCII files. The ASCII traffic files can be used in the traffic generator and in the traffic analyzer instrument in the ANALYSIS work space. 20.17.1.

23.8.14 Video

Refers to AVI video files.
23.9 Export

23.9.1 IPEmotion

Any file loaded into IPEmotion can be exported to the IPEmotion IAD format.

23.9.2 ASAM / ATFX

Configuration options:

- **No value handling**: Select: Proprietary or Flags
- **Grouping mode**: Select: Proprietary or AoMeasurement or AoSubmatrix
- **Convert to FLOAT 64**: When this check box is deactivated the values are exported in the native format.
23.9.3 Audio

No configuration options. See chapter SIGNALS for additional information about the task settings in the Format tab sheet for Audio recording 12.6.4.

23.9.4 CSV

Configuration options

▶ Use tabulator channel conversion

When this check box is activated the CSV Export includes the V-TAB scaling from the scaling calculator.
Use rounded floating values

This checkbox is by default activated. When the checkbox is activated a rounded value is exported. You can define the decimal places in SIGNALS on the Display tab sheet. In ACQUISITION you can define on Formulas, Scaling channels and Number and Status variables the decimal place format.

DATA MANAGER and the CSV Export show the same number of decimal places.
23.9.5 DIAdem DAT

Configuration options

The DIAdem DAT Export supports now the following data formats when the check box is deactivated:

- UInt8, UInt16, UInt32, UInt64
- Int8, Int16, Int32, Int64
- Float
- Other DAT native data formats will be exported as Double.

When you activate the check box "Convert channel to FLOA T64" all channels will be exported with this format.

23.9.6 DIAdem TDM

Configuration options

The DIAdem TDM Export supports now the following data formats when the check box is deactivated:

- UInt8, UInt16, UInt32, UInt64
- Int8, Int16, Int32, Int64
- Float
- Other TDM native data formats will be exported as Double.

When you activate the check box "Convert channel to FLOAT 64" all channels will be exported with this format.

23.9.7 Drupal Metadata

No configuration options. This is a specific XML export for the IPETRONIK website.
23.9.8 Excel 2003 XML and XLS

Configuration options

The Export is supporting two additional configuration options.

- Use rounded floating values  See chapter CSV Export 23.9.4.
- Use tabular channel conversion  See chapter CSV Export 23.9.4.

23.9.9 Excel 2010 XLSX

Configuration options

- Use tabular channel conversion  See chapter CSV Export 23.9.4.

23.9.10 FAMOS

Configuration options

23.9.11 GIN Audio

No configuration options.
The GIN Audio export considers only TESTdrive audio recording based on CAN traffic. For more details see 19.8.4.

23.9.12 GPX

No configuration options. See chapter SIGNALS for additional information about the task settings in the Format tab sheet when GPX (GPS position) data is recorded 12.6.4.

23.9.13 Matlab

Configuration options:
23.9.14 MDF 3

Configuration options:

<table>
<thead>
<tr>
<th>Export options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclude NoValues By TimeChannel</td>
</tr>
<tr>
<td>Use tabular channel conversions</td>
</tr>
<tr>
<td>Use event blocks</td>
</tr>
<tr>
<td>Write data as zipped block</td>
</tr>
<tr>
<td>Minimum block size to zip data</td>
</tr>
<tr>
<td>Uncompressed data block size</td>
</tr>
<tr>
<td>Compression level</td>
</tr>
<tr>
<td>Write source reduction block</td>
</tr>
<tr>
<td>Factor to the minimum sample interval's length</td>
</tr>
<tr>
<td>First source reduction block’s samples</td>
</tr>
<tr>
<td>Second source reduction block’s samples</td>
</tr>
</tbody>
</table>

[OP_68]

23.9.15 MDF 4

Configuration options:

The MDF4 export is supporting text channels too. With a specific Mdf4MetadataConfigurationFile.XML file you can define how the data is converted into the MDF format. The XML file has to be stored in the following directory:

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\DataPluginSettings\Mdf4MetadataConfigurationFile.xml

[OP_67]
23.9 Export

The MDF4 validator software shows how one parameter "Bus Name" of the XML file are integrated into the MDF4 data file structure.

23.9.16 PAK ASAM ATF/XML (license in Acoustic Module)

Configuration options

This storage format especially supports data post processing in the Mueller BBM PAK acoustic software package. The PAK ATFX export was developed to export data in the file format of the PAK acoustic software system from Mueller BBM. The export considers all measurement signals in the data file with a sample rate below or equal to 1 kHz sample rate as a reference signal for the Campbell instrument in the PAK software. With a reference signal the Campbell diagram can display the results along other measurement parameters than time for example along engine RPM. This export is licensed together with the Acoustic module 5.2.3.

23.9.17 RPCIII

Configuration options.

23.9.18 TRAFFIC ASCII

No configuration options.

23.9.19 TRAFFIC BLF

No configuration options.

23.9.20 TRAFFIC MDF

No configuration options.
23.9.21 TRAFFIC PCAP

No configuration options.
23.9.22 VIDEO

Configuration options

For the AVI export it can be specified in the options if the data is compressed in the MJPEG (Motion JPEG) format or the h264 format. See more details chapter DATA MANAGER 19.8.2.
23.10 Analysis

23.10.1 Slide controller - data display in charts

With the slide controller you influence the speed and resolution of imported data files. When importing large data files of several GB, data loading can take some time. If you move the slider to the left side (Speed) the data files are loaded considerably faster. However, the software will not load all data points. They will be loaded in a post processing step when you start to move and zoom into the graph.
23.10.2 Using the extended measurement window

The extended measurement window shows the cursor statistics on the Yt-chart and xy-chart in a separate window in the ANALYSIS work space.
23.10.3  Highlighting of cursor

You can define how a graph is displayed in a chart in the ANALYSIS work area when a channel is selected in the extended measurement window.

23.10.4  Absolute time axis format

On the OPTIONS you can define default display for the time axis of the Yt-chart. There are 3 radio buttons which have an impact on the datum display on the time-axis. The setting of the radio button is only effective when you have selected the absolute time format as defined in OPTIONS > Appearance > time channel format. The first radio button represents the default behavior. With the second button you can add the day and month to the axis. With the 3rd button you add the year of recording too.
When you download tiles through the Map instrument in the VIEW or ANALYSIS workspace, you can define a dedicated data file. When you download tiles into one file and the download is finished, the file is fixed and cannot be changed in that sense that you may add some more tiles / geographic areas later on. This is not possible.
The tiles are stored in a file called **name-xyz.db** located in the following directory.

- `C:\Users\Public\Documents\IPETRONIK\IPEmotion\Custom\Map`

All downloaded map files are listed. You can only activate one database of your choice.

---

**Information**

The selected database is a global setting. That means it applies to all map instruments in VIEW and ANALYSIS. If you like to change the MAP data base file you need to delete and reinsert the all map instrument after changing to a new "default" map database file.
23.11 Map

23.11.1 Map provider

The default map provider is Geofabrik (https://www.geofabrik.de/en/index.html). However IPEmotion is supporting custom map providers to. To implement a custom map provider get in touch with the support team.

23.11.2 Web server

This check enables or disables the download of map tiles to your computer. When this check box is not active you cannot download any map tiles. When you activate this check box you always retrieve map tiles from the internet. You are not taking any data from your local data base.

23.11.3 Local data base + Web server

This check box is a good compromise if you like to combine already downloaded tiles together with the option to reload new tiles provided you have internet access.

23.11.4 Local data base only

This check box is retrieving the data from the data base file only. This is a useful setting to check which area exactly is stored in the data file.

Information

The tab sheet Map is only visible in the OPTIONS dialog when you have a Professional or Developer license. See chapter EDITIONS for more details about the functions of each edition 5.1.
23.12 Directories

Here you can define where all types of files are to be stored and loaded by default.
The directory is referring to the following file types:

- **Configuration**
  - IWF project files
- **Project data**
  - GlobalPar and GlobalData to manage project parameters of IPEmotion. For the IPETRONIK LOG PlugIn (ProjectPar and ProjectData) are relative.
- **Import**
  - Refers to all file imports supported by any PlugIn: DBC, A2L, Autosar, etc.
- **Export**
  - Covers all exports supported by PlugIns.
- **Storage**
  - Is the location of the data files created by the storage group.
- **Temporary data**
  - Location of IRD raw data measurement files from the storage process. In the raw data directory a copy of the original data file is maintained before export conversion is executed. The folder is automatically monitored and is keeping files according to the following criteria. See also chapter 14.8.8:
    - Maximum single file size: 10 GB
    - Minimum free disk space of the partition: 20 GB
    - Oldest measurement file: 6 weeks
    - Maximum number of measurement files: 1000
- **Specific data**
  - This covers specific files like pictures, map tiles, etc. See 23.1.2
- **Layouts**
  - Refers to individual report templates.
- **Database**
  - Covers the sensor data base of the scaling calculator.
- **REFPROP library**
  - Link to REFPROP data base for your climate formulas. This data base is needed when you use the climate module 5.2.2.

### 23.13 Units

List of engineering units.
Here you see all supported engineering units also supported by the Scaling calculator if you like to change engineering units. For this function see chapter SIGNALS 12.8.
You cannot enter new units by your own. If you require a new unit please contact support@ipetronik.com.
23.14 Hotkey

You can operate IPEmotion through hot keys. This is practical for reoccurring operations in situations where manual navigation with a mouse is too difficult. In the list box Command you select the a specific function from a work space. Then you define the key combination to execute this command. Valid hot key combinations are those which do not create any characters (letters, numbers or special signs).
Example: You can only operate the marker channel of the storage group through a hotkey function. The operation of the marker is explained in the ACQUISITION work space in chapter 14.8.8.
23.15 User Administration

An activated user administration requires a login before you can start IPEmotion. The user can be allocated to different levels (1, 2, 3) (1 = low / 2 = middle / 3 = high). A higher level means more access rights. With the user administration you can basically limit two aspects of the software:

- **Channel configuration**
  Refers to the operation of any type of output channels.

- **View configuration**
  Refers to a profile for configuration the functions in VIEW and ACQUISITION workspace only, except to start a measurement.

- **Status modification**
  Refers to the status of IPEmotion in regard to data display and storage and user buttons visibility. The configuration of user buttons is explained in 8.2.
23.15.1 Defining the Administrator password

In the first step you define the password for the administrator. It is not mandatory to set a password for the administrator login.

After that you need to activate the administrator. After password activation, every software start requires a login.
All active users are available from a drop down list.

23.15.2 Channel configuration profile

This profile mainly serves to build configurations. Using this profile, channels can be configured, hardware detection can be run, etc., and the GUI can be modified in the VIEW work area but neither measurement nor data storage can be started. These icons are deactivated. Furthermore, IPEmotion applications cannot be closed using this profile.
To change the user you need to navigate to the logout button. With “login” you can access the application with a new user.
23.15.3 Status modification profile

User level 1 for status configuration

This user is meant to operate a configuration but not to change it. This user can start and stop the data display and storage but he cannot make changes to the channel configuration nor can he modify the GUI in the VIEW work area. He can also not load any new configurations but he can close the software.
User level 2 for status configuration

With status level 2, users can operate output channels with the output status 1 and 2.

User level 3 for status configuration

With status level 3, users can operate output channels with the output status 1, 2 and 3.
With status modification profile you can also control the visibility of the user buttons. To use this function you have to activate the user administration as indicated below.

- **Level**

  With level in the range of (1, 2, 3) you define which user buttons will be made available.

To enable the control of the visibility you have to add the user level definition into the user button XML file.
Depending on the login the following user buttons will be visible

![User Administration](image)

### 23.15.4 View configuration profile

With the view configuration profile you can control the configuration access rights in the VIEW work space.
23.16 Cloud

In the options of IPEmotion you can define the parameters for connections to FTP servers. IPETRONIK data loggers e.g. can support an automatic FTP file transfer to collect data files in certain intervals from the loggers, automatically. The data files are transferred to an IPETRONIK FTP server of the fleet management system. The FTP access works with any FTP server. In order to easily access the data files on the FTP server you need to define:

- Name of connection
- Check box to activate FTP connection
- FTP Link (Server Address)
- User name
- Password
- Name (Letter) of the network drive

When the FTP connection is activated, IPEmotion is mapping the FTP server as an additional network drive to the windows Explorer overview. You can directly load the data from the FTP server to your data analysis or data manager work spaces of IPEmotion for reporting and analysis purposes.
23.17 Plugins

As discussed in chapter 3.3, a PlugIn is a program supporting the communication between IPEmotion and a specific hardware or network protocol. A PlugIn only works in combination with IPEmotion. In this list you will see all PlugIns installed on your computer.

23.17.1 PlugIn Activation

With the check box active, you are loading the PlugIn and it can be used in the SIGNALS work space.
23.17.2 PlugIn Configuration

Some PlugIns offer substantial additional configuration settings. Below, you can see the example of the IPETRONIK CAN PlugIn. Details of how these settings work are explained in the PlugIn's Help file. Not all PlugIns have additional configuration options.

23.17.3 PlugIn Versions

In the column "Version" you will see the selected PlugIn version. If desired, you can switch to previous PlugIn versions in the drop down box. If you select a PlugIn with an equal sign (=) you define this PlugIn as your standard PlugIn and newer PlugIn versions will be ignored. If you use a PlugIn without an Equal sign and you install a more recent version, it will automatically load to the SIGNALS work space 12.5.1.
23.17.4 Plugin Help Manual

Many Plugin include a HELP file. You can access the help file from here.
23.18 User displays

The PlugIn concept for measurement instruments is supported for online VIEW and offline ANALYSIS display instruments too. This PlugIn interface allows the development of customer specific instruments. To get access to the documentation you have to select SDK during the installation process. Similar to measurement PlugIns the developer has to apply for a manufacturer code before the development can start. The technical documentation is providing all information relevant to integrated our own instruments.

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\VEP

![Activation of visual elements Plugins (VEP).]
The following screenshot is demonstrating the integration of demo instruments in the VIEW and ANALYSIS work space.
23.19 User operations

The PlugIn concept for measurement instruments is supported for online VIEW and offline ANALYSIS display instruments too. This PlugIn interface allows the development of customer specific instruments. The technical documentation is providing all information relevant to integrate our own instruments. To get access to the documentation you have to select SDK during the installation process. Similar to measurement PlugIns the developer has to apply for a manufacturer code before the development can start.

▶ C:\Program Files (x86)\PETRONIK\IPEmotion 2019 R3\UOP
The following screenshot is demonstrating the integration of a demo user operation in the DATA MANAGER work space.
24 IPEmotion RT data logger software

24.1 Introduction

IPEmotionRT is the latest generation of IPETRONIK data logger software. The new logger software is based on the well-known IPEmotion PC (Windows) data acquisition software and is running on a 64-bit embedded Linux operating system. RT is the acronym for Real Time data logging software.

As indicated in the diagram below, IPEmotion software is the common source code platform for the Linux operating system environment for the data loggers and the Windows operating system. The main benefits for the customer are that the same functionality is available on the Windows and Linux side. The development of features is on both platforms accelerated and functionally synchronized. Also, all operations and math functions etc. generated by the logger are identical to data files generated from test benches operating on Windows PCs. The bottom line is that the data collected from road testing applications can be directly compared to data derived from test bench application based on Windows. There is a direct exchangeability between road2rig and vice versa.

The following data loggers are available with IPEmotion RT software.

- M-LOG V3 + COMgate V3
- IPElog2
- MuCros SL

The data logger software is supporting the following Linux operating systems:

- 64 bit

The data logger configuration software IPEmotion RT.UI for Windows desktop is supporting the following Windows operating systems:

- 32 bit
- 64 bit
In order to use IPEmotion RT loggers, you need to install the desktop software. The desktop software is available for download from the IPETRONIK website: https://www.ipetronik.com/ However, if you have already used the IPEmotion for data logger configuration with IPETRONIK LOG Plugin for TESTdrive loggers in the past, you will discover a new desktop icon labeled with RT.UI. for the configuration of your new IPEmotion RT Linux loggers. IPEmotion RT loggers with a Linux operating system are clearly marked with a sticker.

24.2 Common PlugIn architecture for Linux logger and Windows PC

The following schematic diagram presents the modular architecture. The different software modules compose the overall IPEmotion RT software package. The well-established plugin concept of IPEmotion (PC) is now also available for IPEmotion RT.
See the release notes of IPEmotion RT to see which PlugIn versions are included in the IPEmotion RT standard setup.

- IPETRONIK Plugin X
- Protocols Plugin
- Video Plugin
- Status Plugin
- GPS Plugin
- IPESensors Plugin
- Demo Plugin
- Logger IO (RT only)
- IPEmotion ME

However, it is also possible to provide OEM setups which included customer specific plugins and IPEmotion settings. With IPEmotion RT, the same OEM setup concept is available as for IPEmotion PC software. If you require custom plugins contact our support.

24.3 IPEmotion RT.UI desktop editions

To make the licensing and the management of your license keys for the well-known IPEmotion and the new IPEmotion RT desktop software as easy as possible, a license sharing function was developed, allowing our customers to use their existing IPEmotion licenses for RT desktop and thus avoid additional costs when switching to RT.UI.
To configure the IPEmotion RT data loggers, an IPEmotion RT.UI desktop software is needed. It will be available in the well-known IPEmotion editions (Basic, Standard, Professional). With the free basic edition, all of our Linux loggers can be configured. However, similar to the IPEmotion basic edition, there are some limitations, such as max. 20 display pages for web server display, max. 250 measurement channels for online display of measurement data in instruments like Yt-chart, and max. 1 display page with up to 10 channels for the offline data analysis.

<table>
<thead>
<tr>
<th>Functions</th>
<th>Basic</th>
<th>Standard</th>
<th>Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>free of charge</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Number of channels for online display</td>
<td>250</td>
<td>256</td>
<td>■</td>
</tr>
<tr>
<td>Number of screens for PC online charts</td>
<td>20</td>
<td>20</td>
<td>■</td>
</tr>
<tr>
<td>Number of webservers/app display pages</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Number of screens for offline data analysis</td>
<td>1</td>
<td>5</td>
<td>■</td>
</tr>
<tr>
<td>Number of channels for offline display (analysis)</td>
<td>10</td>
<td>256</td>
<td>■</td>
</tr>
<tr>
<td>Additional online tools: traffic analysis, traffic simulator, maps</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Additional offline tools: traffic analysis, 3D model, maps</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Macro recorder: VBS and Python scripting</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>COM interface: external program access</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Module Acoustic: noise, vibration, harshness</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Software maintenance contract</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
</tbody>
</table>
24.4 IPEmotion RT logger licensing

The data logger licensing is based on the same technology as IPEmotion desktop licensing: The required functions are activated by a license code. The logger license is created for a specific logger serial number. Therefore, the license code is only valid for this hardware serial number that must match to the sticker on the logger.

The license is activated on the logger before shipment, according to the purchase order. However, if the customer later purchases a new license, it can be directly activated in IPEmotion RT.UI. No internet connection is need for a license activation process. The advantage of licensing with a license key is that licenses can easily be activated. If required, they can be created very quickly by the support team e.g. to add missing functions during field testing. Also, a RESCUE license key is supported to make all functions temporarily available to a logger in case of urgency. The functions of the logger software and the hardware are managed via the license key.
For every logger a basic functional package was defined that is listed below. The basic package considers the hardware limitations. The annual software maintenance of 25 percent is applied to the cost of the basic package.

### Functions included in the basic package

<table>
<thead>
<tr>
<th>Package</th>
<th>Functions</th>
<th>IPELOG 2</th>
<th>M-LOG V3</th>
<th>µCROS SL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Basic package*</td>
<td>Number of bus interfaces (CAN, CAN FD, LIN, ETH, FlexRay)</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>Number of storage groups</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>Traffic (CAN, LIN, ETH, FlexRay)</td>
<td>yes</td>
<td>yes</td>
<td>CAN</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>CAN signal measurement DBC Import</td>
<td>yes</td>
<td>yes</td>
<td>CAN</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>X-LINK &amp; M-CAN</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>Gateway: CAN Send, XCL Slave für INCA, CANape, DIAdem</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>OBD, GPS</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>Wake on CAN/LIN</td>
<td>yes</td>
<td>WoC</td>
<td>yes</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>NML/Quickstart</td>
<td>yes</td>
<td>yes</td>
<td>Quicksart</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>Webserver visualization</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>RF Basic package*</td>
<td>Software Maintenance</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

In addition to the basic package, customers may purchase additional packages as listed below. There is no change in the annual maintenance fee for the additionally purchased packages.

### Additional packages – can be purchased on top of the basic package

<table>
<thead>
<tr>
<th>Package</th>
<th>Functions</th>
<th>IPELOG 2</th>
<th>M-LOG V3</th>
<th>µCROS SL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optional extensions*</td>
<td>Data storage for signals, traffic, video, etc.</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Storage groups unlimited</td>
<td>CAN, CAN FD, LIN, ETH, FlexRay</td>
<td>twofold</td>
<td>twofold</td>
<td>twofold</td>
</tr>
<tr>
<td>Bus Interface extension</td>
<td>CAN, CAN FD, LIN, ETH, FlexRay</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Protocols</td>
<td>CCP, XCP, J1939, ...</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Communication</td>
<td>Modern, WIFI, IoT connection:*</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Multimedia</td>
<td>Audio and Video</td>
<td>yes</td>
<td>yes</td>
<td>Audio</td>
</tr>
<tr>
<td>Comfort display</td>
<td>App for Android and IOS Including WiFi</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
Short description of the different licensing packages.

- **Basic package:** This package defines the standard functionality of the logger. The package includes many functions to get standard logging application up and running. The new licensing based on general interfaces gives you more flexibility. You can flexibly use any of the available interfaces for CAN, LIN, FlexRay or ETH inputs. Any type of CAN, LIN, ETH, FlexRay traffic and DBC imports for signal-based CAN-bus measurements is supported too. Diagnostic information can be accessed using the OBD protocol. With the XCP-Slave Gateway mode you can generate an A2L configuration file to transfer the data from your logger to third-party software programs. GPS positioning is also included in the basic package. With the supplied webserver, you can use a browser to obtain online data. The browser based instruments are configured via RT.UI in the MOBILE VIEW tab sheet.

- **Storage Groups** The Basic package includes one storage group to store all type of measured data. However, if you like to organize the data storage in different logical functional units e.g. traffic data in one group and video data in another, an upgrade to unlimited storage groups is recommended.

- **Bus interfaces** If the default number of bus interfaces is sufficient, you can add more interfaces as multiples of 2, so you can upgrade e.g. from $4 + 2 + 2 + 2 + 2$ to a total of 12 interfaces.

- **Protocols** This package provides access to protocol services for accessing data from ECUs via CAN, LIN, ETHERNET interfaces. The supported protocols are growing constantly. An overview of the supported protocols is presented in chapter 13.

- **Communication** This package supports Modem and WiFi data transfer. It is mandatory if you want to send measurements files to IPEcloud via modem and WiFi networks with FTP or SFTP protocols. However, this package is not required for the wireless display support described above.

- **Multimedia** This option allows access to video recording via USB and IP-cameras and and Audio recording via the iMIC or standard microphones.

- **Comfort Display** This option supports WiFi access to your display system. With this addon you can use your mobile device (Tablet, Cellphone) or your PC via the WiFi interface to get live data from the instruments. Another functionality is that you can adapt the display instruments locally to your needs. Several devices can be connected in parallel to the logger.

- **Control** With the control module PID-loops, function generators and test sequencing operations are available on the logger.
24.5 Software maintenance - updates

The well-proven IPEmotion major release versioning will be established for IPEmotion RT too. Every year in March, a new major release is offered for IPEmotion and IPEmotion RT. Customers with a maintenance contract for the IPEmotion RT Basic package can update their loggers to the latest version. A new license key is provided by inside sales and must be activated on the logger before the logger Linux and RT image update can be performed. Customers without a maintenance contract will nevertheless profit from a two-year support period within which bug fixes will be made available for the major release. However, new functions will only be implemented in a new major release version.
24.6 Cross-platform driver display systems (IPEmotion ME)

In addition to the IPEmotion RT development, the visualization of data logger online measurement data is based on the latest functional and technological architecture. For the first time, three different display platforms are available. The measurement data can be visualized via internet browser or via Android or iOS app. With this new HTML5-based display technology, the measurement data can be visualized on any end device, meeting all display requirements. In addition to that, the functions have been extended and its usability and design have been improved too.

24.7 Remote access via IoT technology

The IPEmotion RT data logger software will also support IoT technology. This enables our customers to access the status of the logger system online and exchange commands bidirectionally with the data logger at any time. With this type of connection, it is possible to execute functions on the logger, such as transferring data files to the IPEcloud MDM, executing diagnostic jobs on the ECUs, or loading new measurement configurations. The fleet manager has permanent access to the system state of the loggers and can communicate bidirectionally from remote. This functionality is useful for stationary applications such as monitoring gas generator power stations. Analog or digital outputs can be set, and CAN messages can be sent from the control room in order to avoid equipment damage. For mobile fleet management applications, the online access provides information about the current vehicle GPS position and the productivity of the data recording. In addition, RAM usage, CPU usage and logger status messages can be monitored. The implemented IoT technology facilitates the administration of access parameters. Several users may access the logger at the same time to retrieve online data and status information. Control and output permissions can be managed via the IPEcloud administration settings and broker server configuration.
25 IPElog2 hardware setup

In order to use your logger hardware, a suitable cabling is required. In this section we will review the different input cables to interface your bus networks, ECUs and the CAN and X-LINK based modules, antennas, USB and IP-cameras and satellite modules such as CAN FD and FlexRay satellite, to the logger. For detailed pin assignment see APPENDIX chapter 42.1.

25.1 Power supply and PC interface (LAN/WiFi) detect

The logger requires a power supply of 9 ... 36 VDC. An Ethernet connection to the PC is also required to configure the logger with IPEmotion RT.UI.

The default logger IP-address of the PC Gigabit ETH interface is: 192.168.236.1. The LAN card setting of the PC should be set to automatic.
25.1 Power supply and PC interface (LAN/WiFi) detect

The WiFi access point for IPElog2 and M-LOG V3 with COMgate V3 is by design automatically activated and configured as indicated below. The default SSID and password is the "Logger SerialNumber".

The WiFi access point for IPElog2 and M-LOG V3 with COMgate V3 is by design automatically activated and configured as indicated below. The default SSID and password is the "Logger SerialNumber".

When you have established a WiFi connection between PC and logger access point, you can detect the logger, stream online data (gateway operation) to the PC and configure the logger. Also, you can copy measurement data from the logger over WiFi to the PC.
Connect IPElog2 / M-LOG V3 + COMgate WiFi access point to PC
25.2 Module connection

25.2.1 M-CAN modules

The following M-CAN modules can be used for IPEmotion RT data logging applications.

![CAN M-Modules for IPEmotion RT](image-url)
There are several ways to connect M-Modules to your IPElog2. The most common and standardized interface is to use the M-CAN connector above the power supply input. This M-CAN connector offers an output of up to 50 Watt. The last module of a CAN bus system must have a TERM connector to terminate the bus with a 120 Ohm resistor. Therefore, when you use the M-CAN Lemo connector, the CAN1 is not any more available for other CAN bus measurements. The CAN1 Â¬ M-CAN Lemo connector has an inbuild software switchable 120 Ohm CAN bus terminating resistor. This terminating resistor must be activated via the software.

If the power provided by the logger is not sufficient, you can use the 620-561 cable to add an additional power supply from the end of your M-CAN module chain.
Another way to extend the power supply of your M module chain is to use the M-CAN switch. The advantage of the M-CAN switch is that you can use it to feed-in power in-between the module chain. This is sometimes necessary when large M-CAN chains are in operation and the modules have a high-power demand due to activated sensor supply. If needed, you can also use several M-CAN switches to supply power to the module chain in different positions. However, if the setup requires also additional power you can remove the last M-CAN TERM connector and add a power supply here as well.
Alternatively, the M-Module can be interfaced to the logger via the SUB-D 9-pole connector too. In this case, you have to supply the modules with additional power. The SUB-D 9-pole connectors do not provide any power at all.
25.2.2 X-LINK modules

The following X-Modules can be interfaces to the IPEmotion RT data loggers. X-Modules are operating on a 100 Mbit Ethernet network based on the XCP protocol.

The X-LINK connector on the IPELog supports an output power of 1.3 A at 12 Volts. This corresponds to about 15 Watts. It is a limited power supply, to cover only a few modules. In contrast to the M-CAN modules, it is not mandatory to terminate the X-LINK network with a termination plug. However, to protect the input socket from dust, it is recommended to add a termination plug.
If you operate a larger X-LINK module chain as shown in the drawing below, you can power your system from the last module. You can use any of the SUB-D 9-pole connectors and any CAN input for this configuration.
25.2.3 X- and M-CAN modules in one chain (tunneling)

A common setup combines X-Modules with Ethernet interface together with M-CAN modules based on CAN bus. This setup is the X-LINK tunneling, and the CAN messages are included as separate data packages in the entire XCP on Ethernet data stream. The colors symbolize the different physical segments of the network. The blue color represents the Ethernet network and the red network represents the CAN Bus network.

If more power is required, you can use the standard M-CAN power supply cable at the end of the M-Module chain. However, the M-CAN switches described above, can also be used in the M-CAN chain at any time.
Finally, another option is to use a Y-cable to combine the X-LINK power injection only. The Y-cable only supports the power supply to the X-Modules. In this case, the M-CAN modules also require a separate power supply.
25.3 Antenna connection

25.3.1 3-fold Modem, WiFi, GPS antenna

For IPElog 2, the following combined Modem, WiFi, GPS is available. The modem connector is based on the FMA (For Mobile Application) port. The WiFi signal is interfaced to a RP SMA (Reverse Polarity Sub-Miniature-A) connector. Finally, the GPS signal is connected to the SMA input. If no WiFi is used, connect a WiFi signal termination plug to the RP SMA connector.

25.3.2 GPS antenna

To receive only the GPS/GLONASS signal, the following antenna is available (IPE-ANT-003). This antenna can be used for the IPESPEED GPS receiver too.
25.3 Antenna connection

25.3.3 WiFi antenna

You can choose from two different WiFi antennas to interface your logger to your company WiFi network for data transfer or to connect your IPEmotion Mobile Edition (ME) cross platform app system. The model (IPE-ANT-004) is designed for in-vehicle applications suitable for your display system. This antenna covers the frequency bandwidth of 2.4 and 5.0 GHz. It can also be connected to COMgate V3.

![WiFi antenna diagram](image)

25.3.4 Modem antenna

If you only need a modem antenna, the IPE-ANT-006 with FMA plug is suitable. This antenna supports up to 4G(LTE) networks. The antenna can be used for COMgate V3 too.

![Modem antenna diagram](image)
25.4 Bus network interfaces

It is recommended to interface the satellites to ETH 2 of the IPElog2. The ETH 2 interface has the IP-address 192.168.234.1 on both logger product lines and operates as a DHCP server. It automatically assigns an IP-address to the satellite. The default IP for the satellite starts with 192.168.234.10.

25.4.1 FlexRay

With the FlexRay Satellite you can access FlexRay networks. The Satellite supports FlexRay traffic, signal and XCPonFlexRay protocol measurement. The software configuration is explained in chapter [X].

25.4.2 CAN FD

With the CAN FD Satellite you can access CAN FD networks. The satellite supports CAN FD traffic, signal, and CAN FD protocol measurement. The software configuration is explained in chapter [X].
25.4.3 CAN and LIN

You can also interface the logger to your CAN and LIN networks with a special Y-cable.
25.5 Camera connection

25.5.1 IP-/ Ethernet camera

At both Ethernet input (ETH and X-LINK) you can operate one or more IP cameras. All cameras that support the RTSP (Real Time Streaming Protocol) can be connected to the logger. The software configuration is explained in chapter 39.4.

![Diagram of IP-camera connection]

25.5.2 USB camera

If you prefer to use only one USB camera, you can choose any model from the consumer market, provided a WDM video class one driver is supported. The camera can be connected directly to the USB port of the logger. The Software configuration is explained in chapter 39.2.

![Diagram of USB-camera connection]

If you want to use multiple USB cameras, it is recommended that you use the Summit USB 3.0 (USB-III-HUB) 4x USB hub. This hub requires a separate power supply provided by the logger.

![Diagram of USB-hub connection]
25.6 Microphone

25.6.1 Trigger button, microphone and buzzer (iMIC)

With the iMIC, you have a device that provides a microphone for audio recording and a digital input for controlling trigger events. The iMIC has also a bus which can be triggered from digital output of the logger.

25.6.2 General Microphone input

If you don’t need the full functionality set of the iMIC with LEDs and digital trigger functions, you can use the standard microphone input directly.
26 M-LOG V3 hardware setup

In order to use your logger hardware, a suitable cabling is required. In this section we will look at the different input cables for connecting your bus networks, ECUs and CAN and X-LINK based modules, antennas, USB- and IP-cameras and satellite modules, such as CAN FD and FlexRay satellite, to the logger. M-LOG V3 is available with 3 different port replicators. The port replicators influence the available CAN, LN, ETH interfaces. In the following documentation, all interface types are covered, and the limitations of the different port replicators are explained. For detailed pin assignment see APPENDIX chapter 42.3.

26.1 Power supply and PC interface

The logger requires a power supply of 9 ... 36 VDC. An Ethernet connection to the PC is also required to configure the logger with IPEmotion RT.UI. Later we will explain how to configure the logger via the USB drive.

If you have a M-LOG V3 with a COMgate V3, the interface cable to the PC is different.
Instead of a COMgate V3 which supports WiFi and modem communication at the same time, you could use an IPEwifi V3, to establish a WiFi interface for data file transfer and mobile display system. The device provides an access point for tablets to connect, so that you can use it for a wireless data logger display with (IPEmotion ME â˘Ã® Android and iOS app). However, the IPEwifi V3 is connected to the PC interface of M-LOG V3. In this setup it is not possible to see online data with your IPEmotion RT.Ui desktop software over the LAN interface.
The default logger IP-address of the PC Gigabit ETH interface is: 192.168.236.1. The LAN card setting of the PC should be set to automatic.

PC LAN interface for automatic IP-address assignment
26.2 Module connection

26.2.1 M-CAN modules

The following M-CAN modules can be used for IPEmotion RT data logging applications.
There are several ways to connect M-Modules to your IPElog2. The most common and standardized interface is to use the M-CAN connector above the power supply input. This M-CAN connector offers an output of up to 50 Watt. The last module of a CAN bus system must have a TERM connector to terminate the bus with a 120 Ohm resistor. Therefore, when you use the M-CAN Lemo connector, the CAN1 is not any more available for other CAN bus measurements. CAN 1 is the only input that supports automatic hardware synchronization, which is explained in the software chapter later on.

If the power provided by the logger is not sufficient, you can use the 620-561 cable to add an additional power supply from the end of your M-CAN module chain.
Another way to extend the power of your M-Module chain is to use the M-CAN switch. The advantage of the M-CAN switch is that you can use it to feed power in-between the module chain. This is sometimes necessary when large M-CAN chains are in use and the modules have a high-power demand due to activated sensor supply. If needed, you can also use several M-CAN switches to supply power to the module chain at different positions. However, if the setup requires additional power, you can remove the last M-CAN TERM plug and add a power supply here as well.
Alternatively, the M-Module can be interfaced to the logger via the SUB-D 9-pole connector too. In this case, you have to supply the modules with additional power. The SUB-D 9-pole connectors do not provide any power at all. In this setup it is not absolutely necessary to add an M-CAN termination plug to the logger. The cable 620-502 already contains a CAN bus termination.
26.2.2 X-LINK modules

The following X-Modules can be interfaces to the IPEmotion RT data loggers. X-Modules are operating in a 100 Mbit Ethernet network based on the XCP protocol.

The ETH input (ETH 1) is used for interface and detection of X-Modules. The IP-address of this ETH 1 interface is 192.168.232.1. The X-LINK connector to the IPElog supports an output power of 1.3 A at 12 Volts. This corresponds to about 15 Watts. It is a limited power supply, to cover only a few modules. In contrast to the M-CAN modules, it is not mandatory to terminate the X-LINK network with a termination plug. However, to protect the input socket from dust, it is recommended to add a termination plug.
If you operate a larger X-LINK module chain as shown in the drawing below, you can power your system from the last module.
26.2.3 X- and M-CAN modules in one chain (tunneling)

A common setup combines X-Modules with Ethernet interface together with M-CAN modules based on CAN bus. This setup is the X-LINK tunneling, and the CAN messages are included as separate data packages in the entire XCP on Ethernet data stream. The colors symbolize the different physical segments of the network. The blue color represents the Ethernet network and the red network represents the CAN Bus network.
26.3 Antenna connection

26.3.1 GPS antenna

To receive the GPS, you must connect the antenna with code GPS-REC-SER-18 to the COM 2 serial interface of the logger. This GPS receiver provides the NMEA protocol.

![GPS connection diagram]

26.3.2 M-LOG V3 + COMgate V3 - Modem, WiFi

For modem and WiFi signals, the 3-way combi-antenna is the recommended solution. The GPS signal from this antenna cannot be used by COMgate V3 or M-LOG V3.

![3-way combi-antenna diagram]

An alternative to the combined 3-way antenna mentioned above is a single WiFi antenna and a single 4G modem antenna as shown below.

![Single WiFi and 4G modem antenna diagram]
26.3 Antenna connection

![Antenna Connection Diagram]

- M-LOG V3
- LOG ETH Cable COMgate V3
- COMgate V3
- Modem
- WiFi
- FME (Modem)
- IPE-ANT-006
- IPE-ANT-004
26.4 Bus network interfaces

It is recommended to interface the satellites to ETH 2 of the IPElog2. The ETH 2 interface has the IP-address 192.168.234.1 on both logger product lines and operates as a DHCP server. It automatically assigns an IP-address to the satellite. The default IP for the satellite starts with 192.168.234.10.

26.4.1 FlexRay

With the FlexRay Satellite you can access FlexRay networks. The Satellite supports FlexRay traffic, signal and XCPonFlexRay protocol measurement. The software configuration is explained in chapter [X].

26.4.2 CAN FD

With the CAN FD Satellite you can access CAN FD networks. The satellite supports CAN FD traffic, signal, and CAN FD protocol measurement. The software configuration is explained in chapter [X].
26.4.3 CAN and LIN

You can also interface the logger to your CAN and LIN networks with a special Y-cable.
26.5 Camera connection

26.5.1 IP-/ Ethernet camera
At both Ethernet input (ETH and X-LINK) you can operate one or more IP cameras. All cameras that support the RTSP (Real Time Streaming Protocol) can be connected to the logger. The software configuration is explained in chapter 39.4.

26.5.2 USB camera
If you prefer to use only one USB camera, you can choose any model from the consumer market, provided a WDM video class one driver is supported. The software configuration is explained in chapter 39.2. If you want to use multiple USB cameras, it is recommended that you use the Summit USB 3.0 (USB-III-HUB) 4x USB hub. This hub requires a separate power supply provided by the logger.
26.6 Microphone

26.6.1 Trigger button, microphone and buzzer (iMIC)

With the iMIC, you have a device that provides a microphone for audio recording and a digital input for controlling trigger events. The iMIC has also a bus which can be triggered from digital output of the logger.
27 External Connection Examples

27.1 Remote Power connection

Always switch on and off the logger using the REM (ignition line 15) connector, never by switching the PWR+ line. Never disconnect the PWR- (GND) line while the logger is running, because this will damage electronic circuits. Switching-on/off the logger via PWR- (GND) is not allowed. The logger has internal buffer capacitors to avoid a data loss due to sudden voltage losses. The regular shut-down is executed via remote and not by switching-off the excitation. The activating via a remote impulse (impulse length > 20 ms) is also supported. But the continuous remote signal must be received within 60 s, otherwise the logger is shut down by the watchdog.

Example: Start of measuring system with opening the vehicle door. The continuous remote signal is received at motor start and the system continues measuring. If the continuous signal is not received (no motor start), the logger shuts down after 60 s.

27.2 Digital input connection

The digital inputs are electrically isolated but the respective DIN-GNDs are all connected to one PIN of the Sub D socket! This PIN has a direct connection to PWR-IN GND with the PR03, PR04, PR05, PR06 port replicators. The inputs are protected by an internal 5 mA current limitation. Required minimum values at the input for a clean functionality: Umin = 3 V bzw. Imin = 2 mA
27.3 Digital output connection

The digital outputs are electrically isolated and can operate bipolarely but the respective COM ports are all connected to one PIN of the Sub D socket.

![Digital output connection](image)

27.4 External Status LED connection

![External status LED connection](image)
27.5 CAN Bus connection

Due to the galvanic isolation, the transceiver of the LIN measurement input must be power supplied by an external source. This can be:

- Connection of the vehicle bus power supply (VBsupply)
- Connection of the logger power supply (bridge from PIN 5 to PIN 1)
- IPElog 2 requires a bridge between pin 3 (CAN ground) and 6 (LIN ground)

27.6 LIN Bus connection

We have two variant to connect the LIN bus to the Logger.

LIN Bus connection
28 mCROS SL hardware setup

In order to use your logger hardware, a suitable cabling is required. In this section we will look at the different input cables for connecting your bus networks, ECUs and CAN modules, antennas, USB- cameras. For detailed pin assignment see APPENDIX chapter ??.

28.1 Power supply and PC interface

The logger requires a power supply of 9 ... 36 VDC. An Ethernet connection to the PC is also required to configure the logger with IPEmotion RT.UI. For the Ethernet connection a standard LAN cable is sufficient between you RJ45 connector of your laptop and the logger. The logger operates as DHCP server and therefore you need not to change any IP-address settings of your computer. For the power supply a multi connector is required which covers, supply, CAN 1 ... 4, Digital IOs and Analog inputs.
28.2 Antenna connection

The logger is supplied with a multipurpose antenna which covers 2 WiFi inputs, GPS, and modem in one unit. The antenna cables are labeled accordingly to the inputs of the logger. It does not matter on which WiFi antenna input of the logger, antenna cable WiFi 1 and WiFi 2 is connected.

28.3 USB camera

There are 2 USB ports provide by miCROS SL. You can use the USB port to attached one or 2 USB cameras. The cameras must support a standard web cam driver.
29 SIGNAL workspace

This chapter covers configuration functions in the SIGNAL workspace. This are functions like listed below.

- Module detection of M- and X-modules
- ECU and bus network for CAN, CAN FD, LIN, ETH, FlexRay,
- ECU protocol configuration
- Overall system and status monitoring
- USB and IP-cameras
- Additional Plugins - Demo PlugIn
- IPEmotion Mobile Edition - remote IoT access with cross-platform display

29.1 Start the software, detect logger and modules

Please refer to the quick start guide in chapter 4.3 to get an overview.
29.2 Configure data storage on the logger

In order to store data with your logger you need to create a storage group in the ACQUISITION work space. You cannot store any data on the IPEmotion RT UI desktop software.

When the configuration is created on the PC side you need to initialize the logger so that the changes become effective.
The measurement status is also reflected on the status LEDs.

29.3 Update logger configuration via PC initialization

You can use the Play button from the SIGNALS and VIEW workspace too to perform a test measurement with online data readings. The display of measurement data is also initializing the logger with the new configuration.
Another possibility to update the logger configuration is to use a USB drive. The USB drive must be named STICK in capital letters so that it can be recognized by the logger. The capital letter naming is a Windows default behavior. You need to select the logger in the system tree first and then the export functional is available from the context menu, or you use the export button in the ribbon directly. The file you are exporting is an (.irf) file. You can export the (.irf) file to the root directory of the STICK or in a subfolder named with the logger serial number. When you export the .irf to the root directory, the logger will perform a configuration updated but the configuration file will not be deleted as a proof of a successful configuration update. The behaviour is different when you export the configuration to a subfolder with the logger serial number as explained below.

It recommended to create on the USB STICK a subfolder with logger serial number and to export the configuration to this subfolder.
When the configuration is exported, you connect the USB stick to the USB port of the logger. The LED 2 will change the operation during the update process. If the logger is already in measurement operation (LED 1 = green and LED 2 = orange) the logger will stop its measurement (LED 2 = off) and import the new configuration. Also all measurement (.ziprt) and log files (.zip) are transferred to the USB stick. During the transfer the LED 2 is blinking. When the configuration update is finished the files are transfer and LED 2 will stay off. Then you can remove the USB drive from the logger. The logger will switch automatically into the measurement mode which is indicated with (LED 2 = orange.

When you connect the USB STICK back to the PC you will get an overview of all files copied to the USB STICK. You will see that the measurement configuration (.irf) file is removed. This is a proof that the configuration was successfully imported by the logger and put into operation.
29.5 Retrieve data files from the logger

29.5.1 Import storage data via IPEmotion RT.UI

There are several possibilities to get access to the storage data files and log files of the logger. An easy way is to import data files via the import function of ribbon of the RT.UI desktop software. You can select from two import methods. With the standard import you copy the data and the data files stay still on the logger. When you select the move import function, the logger has no data files any more. See also the section in the Quick Start Guide 4.3.3.
29.5.2 Retrieve storage data, log files, etc. via USB drive

Another possibility is to retrieve logger data and log files, etc via an USB stick. Here you need to rename a USB stick to STICK. When you insert this STICK to the logger USB port it will automatically move all data and logfiles to the STICK. The logger is empty after this operation. See also the section how to update the configuration via USB stick 29.4.

![Empty USB STICK](image1)

![Automatic transfer of data and log files to the USB STICK](image2)

29.5.3 Retrieve storage data, log files, etc. via network drive

With Linux operating system the WebDAV technology is supported. So you can directly create a network mapping to the data a logger to copy and move data from the logger. You need to activate the network mapping function in the OPTIONS > IPEcloud.
29.5 Retrieve data files from the logger

 Activate network drive to access logger data files
29.5 Retrieve data files from the logger

The raw data is stored on the Linux portion of the storage medium. The converted MEA rtzip files are stored on the windows partition. When being connected to the logger in IPEmotion RT.UI the MEA partition is mapped to the PC as WEBDAV drive.

Note that on Windows 7 and 8 it is a known Microsoft issue that cached WebDAV data might not be deleted.
30  IPEmotion ME: live data over the internet (IoT)

30.1 Overview of IPEmotion Mobile Edition

The logger is supporting remote access based on the latest IoT technology which can stream data over the mobile cell phone network to multiple clients like PCs with browser or to mobile devices (smartphones, tablets). Several devices can access the data stream at the same time (multi-client support). The technology offers a bi-directional real time communication where you can get online measurement data displayed and you can execute commands like triggering scripts and other events at the same time. The visualization is based on IPEmotion mobile edition (ME) which uses cross-platform-technology for Android, iOS app or browsers. The diagram below shows the functional overview.

The visualization instruments (charts, tables, tachometer, etc..) can be configured with IPEmotion RT.UI. The clients like PC, tablet, or cellphone are fetching the UI (User Interface) configuration to provide these instruments to the client device. However, the users are also able to modify the UI instruments locally to their individual needs. For the moment the local UI modification is stored locally and not saved back to the data logger. This is a planned evolution for the future. Users can also create the complete UI configuration from scratch on the client (PC, tablet, smartphone).

The employed IoT technology requires an intermediate MQTT broker who handles the logins from the client (logger and user) and the security certificates.
30.2 Example configuration of MQTT broker

The central element for the real time remote read and write access to the logger is the MQTT broker. IPETRONIK is using the Rabbit MQ broker to manage the internet connectivity. More details on www.rabbitmq.com

The broker can be installed on any internet connected Linux server such as Amazon Web Services (AWS), Microsoft AZURE or a standard computer with Linux operating system. Customers are not obliged to use the broker installation from IPETRONIK. There is a free choice where to install the broker and which broker to use. If there is already broker available within the company, the existing infrastructure can be used. A new Rabbit MQ broker installation from scratch is supported from IPETRONIK support. There is a separate technical documentation available when the broker installation is purchased. The following documentation will now be based on the Rabbit MQ broker. The Rabbit MQ broker was selected as it provides a web-based user configuration interface. As a starting point you need to login to the broker with administrator rights.
30.2 Example configuration of MQTT broker

Than you should create one dedicated virtual host on your broker. This virtual host is grouping all user and logger logins to one logical unit. All users and loggers which need to connect to each other must be grouped to the same virtual host. Dedicated virtual hosts give you a lot of flexibility to manage access rights later on to organize your user groups. It also offers higher security levels to ensure that data access is restricted to certain virtual hosts.

The following screenshot shows the created virtual host. However, no users are assigned to this host, in the beginning, apart from the administrator who created it.
When the virtual host is created you need to create the user and logger logins too. It is recommended to have dedicated logins for the loggers and for the users to enable separate rights management in the future.
Finally, the users and loggers are assigned to a common host. When they are grouped to the same host it is possible that users can connect later on to all loggers who are included to the host, provide they know the logger ID which is configured in IPEmotion RT.UI. It is also possible to assign several virtual hosts to a logger and a user to enable connections across virtual hosts. The virtual host is part of the login parameters which are explained further below.
The screenshot below shows a tabulated overview of both logins (user and logger) assigned to the same virtual host customer_demo.

Overview table: User logins names and virtual host are linked
30.3 Configure logger to connect to a MQTT broker

When all the logins for users and loggers are created on the MQTT broker the IPEmotion RT.UI specific logger internet configuration can be done. Therefore, you need to select the logger in the SIGNALS tab in the system tree. Then you have access to the internet communication tab sheet as indicated below. Most of the parameters are already known from the MQTT server configuration and explained below.

- **Active**
  Here you can activate or deactivate the internet connection on a global level.

- **Broker name**
  Here you enter the IP-address or the DNS name resolution of the MQTT broker. The broker name is provided by the IT department who created the broker and DNS name.

- **Port**
  With the port number the TLS certificates are controlled. The port number is defined by the IT department. For Rabbit MQ port 1883 is without TLS encryption and port 8883 is use for TLS encryption. The settings on the client (browser, app) have to be configured accordingly.

- **IoT ID**
  This is a very important ID. With this ID definition you create a unique identification of the logger. This ID could be e.g. the number plate or functional identification of the vehicle / logger. This ID will be later used on the client side (app, browser) to establish the connection.
30.3 Configure logger to connect to a MQTT broker

- **Username**
  This is the login name created on the MQTT broker for a specific virtual host by the broker system administrator. It is useful to know that several loggers can login with the same username and password to the same virtual host. This reduces the configuration workload in regard to the logins. The username includes the name of the virtual host.

- **Password**
  This is password defined on the MQTT broker for this specific user.

- **Update interval**
  This refers to the data update. The highest frequency is an update of 10 milliseconds. However, if you like to reduce the data stream and the associated data volume costs on your SIM card, you can switch to slower update intervals.

- **TLS**
  With this check box you activate the TLS encryption. The detailed function of the TLS encryption is explained further below.

- **Schema**
  Besides to the connection parameters of a standard MQTT broker like the Rabbit MQ an interface to larger IoT cores like the Google IoT core is supported. When the logger is interfaced to IoT core the data is streamed into this platform and the remote access with the IPEmotion ME app is not any more supported.

The IoT core configuration is provider specific. These parameters are related to the Google IoT core requirements:

- **Project ID**
  Google IoT project ID.

- **Location**
  Location of the IoT core server.

- **Registry**
  ID of the googleIoT core registry.

- **Default topic**
  Path to the default telemetry topic.
30.4 Configure logger modem

You need to activate the modem with a SIM card so that logger can connect to the internet. For M-LOG V3 you need the COMgate V3 which is configured in the COMMUNICATION tab sheet.
When the COMgate is created as an interface you create a modem connection you enter the cellphone provider of your SIM card, your regional access point and the PIN number of your SIM card. The SIM card must be physically installed on the COMgate V3 behind the removable cover on the front. See COMgate V3 hardware description.

If you have an IPElog2 data logger you can create directly a modem interface and enter the telecom provider and SIM pin details.
When the modem configuration is finalized you just need to initialize the logger with the new modem configuration. The logger will directly connect to the MQTT broker as indicated below.

Verify successful login of the logger with TLS encryption

### 30.5 Install IPEmotion ME app on mobile devices

The IPEmotion Mobile Edition is a cross-platform displays software which supports browser, Android and Apple apps. The software functionality for the user is exactly the same for all 3 platforms. However the IOs GUI designs follows Apple guidelines and the Android and browser GUI design is based on Google material design approach. You can install the IOs app from the Apple app store. The Android version is installed from the Google play store or from the IPETRONIK website.

30.6 Configure IPEmotion ME app to connect for MQTT broker

When the logger has successfully connected to the MQTT broker, you need to install the App on your smart device as explained above. When you start the app you have to access the Logger connection work space. Here you create a new internet connection with the following parameters.

- **Connect**
  With this button you trigger the connection to the MQTT broker. The connection has 3 colors, Red: no login to broker, Yellow: Login to broker is working but the logger cannot be reached, Green: successful connection to logger with data streaming to client device.

- **Name**
  Here you define your individual name of the connection. This could be for example the IoT ID of the logger. Within the IPEmotion ME application you can easily switch between different loggers to get live data.

- **Broker URL**
  This is the IP-address or DNS name of the MQTT broker. It is the same name as it is used for the logger configuration.
30.6 Configure IPEmotion ME app to connect for MQTT broker

- **Port**: This is the part used by the client to login to the broker. For the IPETRONIK broker installation the port is by default 15675.

- **TLS**: This refers to the activation of the TLS encryption. If the IT has installed security certificates the TLS encryption shall be activated on the logger and client side.

- **Username**: This is the login name for the user. It is created on the MQTT broker for a specific virtual host by the broker system administrator. The complete username includes also as a prefix for the virtual host. The structure is: [virtual host:username].

- **Password**: This is the password of the user to login to the broker and the specific virtual host. The password is only exchanged with the broker, wenn a trusted relation is established to the MQTT broker. The password is transferred in encrypted format.

- **IoT ID**: This refers to the unique ID which was assigned to the logger to reach the device via MQTT from any client. The user can define an individual IoT ID for the logger. This is the key information so that the client with the IPEMotion ME software can reach the logger to receive online data. The IoT ID can be any logical name which describes the device under test like name of a machine, or vehicle number palate.

- **Load layout automatically**: The IPEmotion ME edition is also included in the IPEmotion RT.UI software in the ribbon MOBILE VIEW. With the RT.UI desktop software you can create user displays and controls for your mobile clients. When a client configuration was created you can load this config automatically from the logger. In the case you switch between different loggers you always load the new configuration from the connected logger and all local changes are deleted.
30.7 Security based on TLS encryption

The TLS encryption (transport layer security) is based on the former Secure Sockets Layer (SSL) encryption. The MQTT broker has a certificate from an official certification authority (CA) installed. The clients with IPEmotion ME on tablet / smartphone have a private key installed, which works only together with the public key on the MQTT server. The login of clients (loggers / users) is based on username and password. The login data is only exchanged in encrypted format after the client (loggers / users) has established a trusted relation to the MQTT broker.
31 IPEmotion ME: live data over the WiFi interface

The IPEmotion ME app is supporting live data streaming and remote control functions of the WiFi interface of the logger. The logger is creating automatically an access point via the internal WiFi module of IPElog 2. If you have M-LOG V3 you need the COMgate V3 or the IPEwifi module to create an access point. For a WiFi live data transfer an appropriate “Comfort display” license is required. See section 24.4 about the different license options.

31.1 Define SSID and password

The default SSID is based on the logger serial number which is also the default password. However, as indicated below you can define your individual access point name and your individual password. The password must consist of 8 characters minimum.

Define WiFi SSID and password

The WiFi access point can be deactivated with a script command. This applies to IPElog2, COMgateV3, IPEwifiV3 devices. Command line which has to be executed in the SCRIPTING workspace of RT:UI. This command does not work in the LOGGER SCRIPTING work space.

  - true = deactivate
  - false = activated
31.2 Connect mobile device to logger

When the logger was initialized with your SSID and password you can connect our mobile device to the logger access point.

As indicated below you have now established connection between both systems.

WiFi connection of mobile device to logger SSID

WiFi connection of mobile device to logger SSID
31.3  Configure WiFi connection IPEmotion ME app

When the WiFi connection is established you need to start the IPEmotion ME app on your smart device and select the logger icon. Then you select the WiFi connection and press the connect button. The App will then automatically load the logger channel list and display configuration into the app.
Over the WiFi interface you have also access to a logger status page which was also discussed in section 4.1. On the status page you get information about logger serial number, activated license code, the measurement status like running or waiting and the status of the storage groups and the first 4 channels.
32 Support FAQ

32.1 How to check RT logger image vs RT.UI and perform image update

The software versions between IPEmotion RT (Logger) and the desktop software IPEmotion RT.UI should be synchronized in order to minimize configuration and update problems. There is an upward compatibility available where you can have a more resent RT logger configurations which can be loaded by older RT.UI desktop software versions. When the software releases are inconstant, warning messages are provided after hardware detection. However, it is recommended that logger RT logger version should match to RT.UI desktop version. You can check both versions as indicated below.

32.2 How to update logger image via IPEmotion RT.UI

If you have an inconsistency you can easily update the logger to the same version as the RT.UI software. Therefore, a simple image update function is provided. However, you can as easily downgrade the image as you can upgrade the image. With the image update all corresponding firmware modules of the different hardware modules are updated automatically. This includes components like:

- Linux OS distribution package
- IPEmotion RT operating program
- FPGA firmware
- PIC firmware
- Modem firmware
- GPS module firmware
- WiFi module firmware
- etc...
Image update via RT.Ui desktop

Firmware modules are updated in a sequential order

The image update was successful. The logger will restart.
32.3 How to update the logger firmware via USB drive

If no LAN connection between PC and data logger possible you can use a USB stick to update the logger image. The USB stick must be named as STICK so that it gets recognized by the logger. See also configuration update via USB STICK [1]. You need have to select the logger in the system tree and then you can use the Export function from the SIGNALS ribbon. Here you select image file .fwc. When the .fwc file is on the USB STICK you can attach this to the USB port of the logger.

The logger LEDs are beaving during the image update as following. See also LED codes as discussed in section 29.2.

1. Attach the USB STICK with image file to a running logger.
2. Measurement is stopped and LED 2 (orange = off). LED 1 is still in operation (green = on).
3. All LEDs are activated (green, orange, red) during the importing process of the image file.
4. All LEDs are off due to automatic reboot of logger.
5. Wait: It can take several minutes until all firmware packages deployed to the different modules.
6. When update is successful all LEDs are on again.
7. Another reboot is performed when PIC update is included in the image file.
8. Finally logger is back in measurement mode with his current measurement configuration LED 1 (green = on and LED 2 (orange = on).
32.4 How to synchronize logger clock with local PC time

The logger has an internal RTC (Real Time Clock) installed. However this clock can drift over time. You can use the local PC time to update the clock of the logger. This is a one-shot update process. The new time has no impact on the actual data saving and storage process. The new time will be applied when a new measurement file is started after robot. You can use also use the Restart acquisition function. Which his command the actual data file is closed and a new data file is created with the new time setting. The disadvantage of this type of time synchronization is that over time the clock of the logger could shift over time.

32.5 How to synchronize logger clock permanently with an internet time server

A permanent time synchronization is supported with the SNTP protocol. You can configure a SNTP server in the DATA COMMUNICATION tab sheet. The synchronization requires an internet connection via WiFi or modem network.
32.6 How to reset the logger to factory settings

The is an easy way to bring the logger back to its factory settings. You can detect the logger and use the Reset function from the ribbon. When you reset the logger the complete configuration is deleted.

![Reset logger to factory settings](image)

If you like to reset the COMgate V3 you need to initialize the logger with an empty COMgate V3 configuration as a work around, which includes only one empty dummy channel. If you like to reset the X- and M-Modules you need to use the IPETRONIK X-PlugIn together with the standard IPEmotion software.

32.7 How to update M- and X-Module firmware

The M-CAN und X-LINK modules can be updated over the data logger. When the modules are detected on the CAN and ETH connector a firmware updated function is provided. The latest released module firmware is included in the setup of the IPEmotion RT.UI software.

![Update module firmware](image)
32.8 How to resolve logger error state - red LED

When the red LED on the power supply socket is active the logger is not doing any measurement task any more. There are a couple of recommendations you can try out which might resolve the error status.

- **Full disc space**
  
  When data is recorded continuously the logger will reach at some point in time his maximum storage capacity on the FAT32 partition. When this drive is full of data file the post processing cannot convert NTFS raw data files into .ZIPRT files. The blocking point is indicated with a red error led. You can use a USB drive to download data from the logger when the detection over Ethernet is not working any more.

- **Corrupt configuration**
  
  It can happen that the configuration is corrupted. In this case it is recommended you create a dry configuration which consist only if an empty logger configuration and the corresponding front number. This configuration is exported to a USB drive and transferred to the logger. The logger will load this empty config from the USB drive and should be starting again.

- **License to config mismatch**
  
  When the configuration does not match to the activated license the system is blocked. In this case you can check in the web interface, if a licenses error is indicated. To resolve license error, you need to bring license and configuration to alignment.
32.9 How to convert a TESTdrive configuration to IPEmotionRT

A converter tool is provided to convert IPETRONIK-LOG PlugIn configurations for TESTdrive into IPEmotion RT configurations. The convert is installed together with IPEmotion release 2018 R2.2 in the folder SCRIPTING. You can also access the converter tool from the context menu of the IPETRONIK LOG PlugIn 3.65.

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Tools

Together with IPELoggerConverter a logger type XML file is provided. In this XML file users can add individually additional loggers to be considered by the converter tool. Information about the different logger types are provide by the support team. At this stage of the implementation the following types are supported:

- IPElog 2 (16 CAN / 2 ETH)
- IPElog 2 (10 CAN / 2 ETH / 6 LIN)
- IPElog 2 (16 CAN FD / 2 ETH)
- M-LOG V3 (12 CAN)
- M-LOG V3 (8 CAN / 2 ETH)
- M-LOG V3 (8 CAN / 4 LIN)
- M-LOG V3 (6 CAN / 2 ETH / 4 LIN)
- M-LOG V3 (4 CAN / 2 ETH / 1 DIG I/O)

The conversion process is using the COM interface of the IPEmotion software. Therefore, users need a license which includes the COM interface. You can check the availability of the COM interface in the license dialog. Remember that IPEmotion and IPEmotion RT.UI share the same license.
How to convert a TESTdrive configuration to IPEmotionRT

LoggerConverter requires: COM / Automation license
The IPEloggerConverter can only operate when both software packages of IPEmotion and IPEmotion RT.Ui are installed on the PC as indicated below. It does not matter which releases of IPEmotion are installed. Any version will be supported by the converter.

The supported functions of the converter are listed below:

- Name of the configuration file
- Project parameters of ProjectPar.xml
- CAN interfaces
- LIN interfaces
- Digital IN / Out channels
- GPS interface of IPElog2
- Storage groups
- Formulas

You have to operate the conversion process manually in the following order.

1. Start IPEmotion and activate IPETRONIK-LOG PlugIn
2. Load IWF configuration which should be converted from .IWF to .RTF format
3. Launch IPEloggerConverter (follow toast messages for status update).
4. Launch IPEmotion RT.UI software and open default directory
   - C:\ Users \Public\Documents\IPETRONIK\ IPEmotionRT\Configuration

Toast message window disappears when the process is finalized. Open IPEmotion RT.UI to load converted .RTF file.
32.9 How to convert a TESTdrive configuration to IPEmotionRT

The following components are not included in the conversion process:

- Logger Project Parameters
- FlexRay Extender
- CAN Extender
- LIN Extender
- ETH interface
- CAN FD, FlexRay Satellites
- VIDEO Extender
- M-VIEWgraph / M-VIEWfleet
- USB camera
- IPEwifi / IPEwifi V3 access point
- IPEconnect (IPEhub2) for Android App
- Data transfer settings: Modem, WiFi, Send Categories, FTP, e-mail, SMS
- Wake on CAN / NML
- Audio

The functionality of the IPEloggerConverter will be extended to increase the degree of conversion. The converter provides no pop messages to be confirmed by the user to use the tool for bulk configuration conversion via scripting commands. The converter can converted a large number of .IWF configurations automatically to .RTF.
33 Subconfigurations

The measurement configuration of IPEmotion or IPEmotion RT.UI can be split in separate elements so called “Subconfiguration”. The main benefit of this functionality is, that several teams can work together on one global measurement configuration and update and manage their measurement scopes individually.

Subconfigurations can be applied to the following workspace and elements:

- **SIGNALS**
  All nodes with exception (Audio, GPS, Internal Status).

- **ACQUISITION**
  Formula channels, Storage groups

In the following section the workflow, how to create and use Subconfiguration files, will be explained. It is important to know, that Subconfigurations are updated on the logger via USB drive or of the WiFi / Modem interface using IPEcloud and the FTP connection.

The Subconfiguration (.isz) file cannot be initialized to the logger from the RT.Ui desktop software. The Subconfiguration (.isz) file a related to one specific logger type. You cannot use a Subconfiguration created from IPElog2-01 on M-LOG V3 (8 CAN, 2 ETH).
33.1 How to generate a Subconfiguration

You can select your node and use the context menu to save this node to an (.isz) file.

Add node to Subconfiguration

The icons are updated to visually indicate, that this node is saved to a Subconfiguration file (.isz).

Standard configuration (.irf)                      Node in Subconfiguration included (.isz)

Icons are updated to indicate Subconfigurations
The saving function of the Subconfiguration is not activated by default. The reason for this default setting is, to avoid that Subconfigurations get overwritten without any notice to the owner of the Subconfigurations.

In the OPTIONS > BASIC SETTINGS you can enable the automatic storage functionality.

When you have stored your Subconfiguration you can get an overview of all Subconfigurations (.isz) files linked to this workspace file (.irf).
The Subconfiguration administration dialog supports the following functions.

- **Add**: Here you can load additional Subconfigurations and link them to the overall measurement configuration.
- **Unlink**: Here you can remove the Subconfiguration from the overall configuration and it will clean the corresponding nodes on the SIGNAL and ACQUISITION workspace.
- **Move**: With the move function you can change the list order.

### 33.2 How to initialize logger with a Subconfiguration

As mentioned above Subconfigurations are not automatically initialized to the logger over the RT.Ui desktop software. When you start measurement, all channels included in the Subconfigurations show now data as they are not known by the data logger.
33.2 How to initialize logger with a Subconfiguration

The logger can be initialized with Subconfiguration via a USB STICK or wireless via IPEcloud and an FTP connection. In this example the Subconfigurations files of both CAN nodes are transferred to a USB drive called STICK. The logger recognizes only USB drives with the name STICK.

The stick is then connected to the USB port of the logger. When the yellow LED is off, the configuration is transferred, and the STICK can be removed from the logger. The yellow LED is on again and the logger operates with the new Subconfigurations. When you start measurement in RT.UI desktop software, you will see online data also on the Subconfiguration nodes.
33.3 How to exclude Subconfigurations from current logger configuration

If you like to remove a Subconfiguration from the logger you need to use the Unlink function. After that the logger can be initialized with a new (.irf) file via LAN, USB STICK or via remote FTP connection and the Subconfiguration in concern is removed.

Unlink a Subconfiguration
33.4 How to modify and extend an existing Subconfiguration

So far, we have created and managed one Subconfiguration of one CAN node. However, a Subconfiguration can include Formulas and Storage Groups also. In a practical use case engineers need a consistent Subconfiguration which includes not only the signals but also formulas and the corresponding data storage groups. You can add Subconfiguration from a Formula or Storage group to an existing Subconfiguration as indicated in the screenshot below.

You can only merge new elements to an existing Subconfiguration, when the target Subconfiguration is linked to configuration file. Otherwise an error message will be reported.
33.5 How to load and modify a single Subconfigurations

The concept of Subconfiguration is based on the idea, that several stake holders are using a logger for their individual purposes and that every team can change their local configuration independently without needing to touch the overall configuration file. This architecture provides a huge flexibility to modify configuration in decentralized approach. In a practical use case TEAM 1 and TEAM 2 will work independently on their configuration. Therefore, each team can load and modify the (.isz) file independently too.

Open a single Subconfiguration (.isz) file
The modifications of the Subconfiguration can be saved to the existing or new (.isz) file.
34  IPEmotion ME: Display configuration on RT.UI desktop software

34.1 Standard page configuration

The MOBILE DISPLAY (ME) is a dedicated workspace to configure display instruments for the logger web server of the Android or iOS app. These instruments use the cross-platform technology and the results are available within IPEmotion RT UI desktop, on a browser or an Android or iOS app. In order to display within the app or to modify the display configuration with the app a dedicated license Comfort Display is required. In this chapter the configuration of the web instruments within IPEmotion RT.UI software is described. However, you can also create your instruments on your smart phone or tablet device. In this case the configuration is not stored on the logger and can therefore not stored in the long run. Therefore, the web instrument configuration should be done on the IPEmotion RT.UI side.
When you access the MOBILE DISPLAY work space the following functions are provided:

In the Play and Pause button you can start and hold the display of online data. The function of the button is linked to other buttons in the workspaces like SIGNALS or VIEW. When data display is started in the VIEW work pace it affects the MOBILE DISPLAY and vice versa. The SD card icon will indicate how much disk space of the logger is already utilized. Next to the SD card icon the type of interface LAN, WiFi or Internet is indicated. Within IPEmotion RT.UI the LAN connection is only available. However if you use the browser only also WiFi or an Internet connection is supported which will be explained in other sections.
34.1 Standard page configuration

In the device drop down list box you can select your target display device. This setting will help you, to define good visible instrument pages which fit to the size of the display you will use together with the data logger. You can also define a custom device size by entering the pixels. The idea is to avoid that the user is creating too many instruments on a large desktop screen which do not fit well on a small smartphone display used by the test driver.

![Select device / screen size of your display](image1)

With the rotation function you can define a landscape format as indicated below.

![Rotate: to landscape](image2)
34.1 Standard page configuration

With the rotation function you can also rotate to portrait.

When you have defined your display size you need to add a display page.
34.1 Standard page configuration

On the header of the display page a customer logo can be integrated. You select the logo from your file pick dialog.

In this example an IPEmotion Logo was added. With the dustbin icon the logo can be removed.
With the swipe left function you can delete or rename or copy (duplicate) or delete the page.

With the swipe right function you can rename the page.
In order to configure a page, you need to switch in the bottom tool bar from OVERVIEW to PAGE. Then the pencil icon becomes visible.

In the page edit mode 4 main tool for page instrumentation are provided.
In order to add a new instruments, you select the Add instrument function is select. You can choose from 12 different instruments. In this example a Yt-chart will be selected.

After the instrument is created you need to add signals to the instrument. There are 2 workflow support for this task. The more advanced add signals dialog is provided by the signals icon in the instrument container.
The advanced add signals container allows in one dialoge to add multiple channels at the same time or to deselect easily multiple channels from the instrument.

However, the alternative dialog provides a flyout on the left side where you can also search but only drag and drop single channels one by one to the instrument. This dialog supports also no deselection of channels.
With left/right arrow tools the selected channels can be moved into the chart. This function works also to
deselect multiple channels from the instrument at the same time. With the close icon you can leave the dialog.

When you return to the instrument you see all channels added to the instrument legend. You can then carry
on with the configuration by using the pencil icon on the bottom right corner with the instrument or you save
the setting with the Ok check icon in the grey bottom bar.

The default order of the channels in the instrument is based on the sequence how channels are dragged into
the instrument. In many cases users like to change the display order in the instrument later, when the
configuration is growing, to arrange channels in logical orders. In the example above we have the default
order 1 Æ 4. In order to change the channel order in the instrument, you have to access the channels
search dialog and use the move icon.
When you confirm the dialog, the channels are arranged in the order as defined in the dialog above.
34.1 Standard page configuration

Access to instrument specific configurations

Save and close configuration menu

Signals are added to chart
In order to get online data, you need to press the display button. This button will initialize the logger with the configuration and show online data.

Finally, you get the online readings in your instrument.
### 34.2 Instrument specific configuration functions

The IPEmotion ME display instruments support different configuration functions. The table below summarizes the different settings for all instruments.

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<th>Yt-chart</th>
<th>Tacho</th>
<th>Analog</th>
<th>Slider</th>
<th>Bargraph</th>
<th>Table</th>
<th>All signals / table</th>
<th>LED</th>
<th>Switch</th>
<th>Text</th>
<th>Video</th>
<th>Syslog</th>
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34.2 Instrument specific configuration functions

34.2.1 Yt-chart

The axis and coordinate systems and scaling can be defined very similar to IPEmotion Yt-chart.

![Yt-chart settings](image)

34.2.2 Tachometer

Settings of the Tachometer

![Tachometer settings](image)
34.2 Instrument specific configuration functions

34.2.3 Slider

The slider is used to operate outputs and write data to variable channels like status and number and analog and digital output. However, analog and digital inputs are supported too but cannot be used to control any values.

34.2.4 Bar graph

The bar graph settings are very similar to the slider settings.
34.2 Instrument specific configuration functions

34.2.5 Table
Settings of the table instrument.

34.2.6 All Signals
Settings of the all signals table instrument
34.2.7 LED

Settings of the LED instrument.

The LED instrument supports the configuration of a custom threshold. The default behavior of the LED instrument is to change the display color based on a binary value 0, 1. However, in some cases, users may like to use other numerical values to change the state of the LED. This can be configured with numerical custom thresholds.
34.2 Instrument specific configuration functions

34.2.8 Switch

The switch instrument is supporting 2 different modes. In the SWITCH mode the switch ON value is send to the output only for the time you press the switch. When you release the switch is jumps back to the OFF mode. The BUTTON mode is operating differently. The button keeps the defined status (ON or OFF) statically. You need to press the button every time you want to change the status. For both modes you can define which numerical value is sent to the output channel.
34.2.9 Text

The text instrument can be used to display data from numerical and text channels. When you link an output or variable channel to the text instrument channel spin buttons appear to operate output values.

34.2.10 Video

Settings of the Video instrument. Note: The video data streaming is only supported over the LAN and WiFi interface. Not over an IoT and internet connection.
34.2.11 Analog

Settings of the Analog instrument.

34.2.12 SysLog

With the SysLog instrument all public internal log messages (Log file) are transferred to the instrument. When the instrument is created the transfer is automatically activated. The internal process of the logger are pushing all new message to instrument. With the SysLog message the use gets real time information about the internal logger operation which is very practical for the operation.
The syslog instrument works for the LAN interface for IPEmotion RT:UI desktop software, and the web browser application which is accessible over the IP 192.168.236.1. Also, the SysLog instrument can receive all message over a WiFi connection on the tablet (IPEmotion Mobile Edition app). Over the WiFi and LAN interface all buffered messages from the boot process are send to instrument also. The SysLog message can also be retrieved over the internet via MQTT protocol. In this communication architecture, only fresh message generated from an established internet connection are transferred. In order to save bandwidth, the historical messages e.g. from the boot process are not transferred over MQTT.
34.2.13 KPI Dashboard

The intention of the KPI dashboard is to give the user an instant overview of key indicators of the data logging system. The dashboard needs no configuration or activation. It is automatically available and accessible via IPEmotion ME app through a Bar Graph Icon in the bottom left corner. The dashboard provides the following information.

- Name of the configuration Test.rwf
- Actual MEA (measurement) number: 123
- CPU Load > 80 % LED red / < 80% = green
- RAM Usage > 80 % LED red / < 80% = green
- Free Diskspace Default < 15 % LED red / > 15% = green
- Free Diskspace Raw < 15 % LED red / > 15% = green
- Supply Voltage < 9 Volt LED red / > 9V = green
- Bus Activity LED: These LEDs show the status of the bus activity.

When data is received on the interfaces it is indicated in green colour. When no bus activity is active the status colour is grey. The list of bus interfaces is statically defined to 16. There is no difference if it is a CAN and LIN interface. The activity is reported on both types. Bus activity does not jet implemented for ETH interfaces.
34.2.14 Audio Notes Recording

The user can record via the ME app audio notes over the WiFi and LAN interface only. The audio recording is generating a WAV file. Audio Recording must be activated in the settings of the App. After activation an Audio Icon appears in the top right corner of the pages of the app.

When the audio icon is activated a microphone icon shows up, and the user can record up to 30 seconds of data. When the audio data recording is started the app is fetching from the logger the actual MEA number and the actual logger time stamp. This information important to synchronize the audio data to the right MEA number and to other measurement data files of the logger for the post processing.
The WAV audio files are stored locally on the tablet first and asap transferred to the actual measurement number MEA. A status is indicating the successful transfer to the logger. After 10 minutes the audio files are deleted automatically from the mobile device. You can playback the audio recordings on the mobile device as along as the files visible in the audio notes inventory list.

In the case the MEA number is already closed before the audio file transfer to the logger cloud be executed, the audio file cannot be integrated and will stay on the mobile device. All audio files not uploaded to the logger are indicated with a warning message must be deleted manually.
34.2.15  Update Project Parameters

With the IPEmotion ME app users can update the project parameters during the measurement of the data logger. The default parameters are defined in the IPEmotion PROJECT workspace.

IPEmotion RT.UI default parameter
There parameters are also available on IPEmotion RT.UI desktop software, app, and browser application over the LAN and WiFi connection. Parameters cannot be updated over the internet MQTT connection.

From the Overview workspace you can access the parameter dialog. This functionality is supported from the IPEMotion ME app and from the IPEmotion RT.UI desktop software.
The updates and entries made to this dialog are stored to the running storage data file as well to all new measurements. The last entries made to the dialog are stored before the measurement is stopped. Example: When the storage process is operating and the driver adds comment A, this commend A is stored when the measurement is stopped. When the data post processing operation is running on the logger, the parameters are updated to the data file. However, if is the user updates during the storage process sometime later the value A to B, the latest entry B, will be included in the data file. When a new storage process is triggered the last entry in the parameter dialog, in this case B, will be stored in the new data file. In conclusion the user can overwrite his entries many times, when the storage process is running. When the storage process is stopped the very last entry is included in the file. When the logger gets a new configuration with new definitions in the project workspace these values are automatically updated in the app dialog and considered for storage in the header section.
34.2.16 Change page trigger events

The display pages of the app can be changed via a dedicated trigger channel. In some applications the driver cannot use swiping gesture to navigate within the app pages e.g. when he is driving very fast or the display is too far away to reach. With the internal trigger channel, it is possible to change the display page based on events.

When the “Display page switch” event channel is created and activated the app will switch to this page accordingly to the numerical value sent to this channel.

The Display page switch channel should be configured with start value = 0.

The page count starts from Zero for Page 1, 1 = Page 2, 2 = Page 3, etc."
The configuration below is a basic example how to use 2 digital inputs to trigger a page change event. When the user is actuating Digital Input 1 the page is scrolling forward (incrementing) and when he is actuating Digital input 2 the page is scrolling back (decrementing). Many other configurations are possible. The page change event can be executed via Limit channels too, where a specific page is loaded when the limit condition is true.

Example: Software channels to configure page change events

When a formula channel is created with determines your change page logic, you need to create a router element to send the data to the dedicated status channel “Display page switch”.

Example: Router channel to send page number from formula to “Display page switch” channel.

The formula should transmit a numerical value, which is indicating the page number you like to switch too. When the page number transmitted this page is loaded. However, if you send a page number which is not existing on the Mobile Display configuration the current page stays active.
35  IPEmotion RT ACQUISITION workspace

In this work space the IPEmotion RT specific acquisition configurations are explained.

35.1  Calculations

For calculation functions refer to section 14.2

35.2  Variables

For formulas functions refer to section 14.7
35.3 Storage

The general saving process of the logger can be configured on the saving node in the ACQUISITION workspace.

- **File compression**
  This checkbox activates the file compression and the logger will create a MEA.ZIPRT file which includes the data. When the check box is deactivated all following settings are disabled and all files are stored separately on the logger.

- **File split**
  Here you define when the logger will split a continuous measurement. If no split size is defined, the logger will split automatically the file when 4 GB are reached. The maximum file size is 4GB.

- **File split size**
  Here you define the split size when a new data file is created. The file size can be in the range between 1 MB and 4 GB.

- **Data encryption**
  Here you can activate the file encryption based on the blowfish algorithm.

- **Encryption key**
  Here you can activate the file encryption based on the blowfish algorithm. The encrypted data can be opened only with the IpeCrypt.exe.

- **Include log file**
  Here you include or exclude the log files to the MEA.ZIPRT container.

- **Include configuration file**
  Here you include or exclude the configuration file to the MEA.ZIPRT container.

Encrypted data files can be decrypted with the IpeCrypt.exe. The tool is installed in the following directory.

- C:\Program Files (x86)\IPETRONIK\IPEmotion 2019 R3\Tool\IpeCrypt.exe
35.4 CAN Send

With the CAN send functionality incoming data can be send out. This functionality is required for different use cases. One use case is to send data from the logger to another test bench software. Another use case is to send data to another data acquisition software which supports CAN inputs only. Also, the CAN send functionality can be used to stimulate CAN based sensors to initiate measurement values.

Create CAN message sender and select source channel
The source channel needs a target channel where to send the data to. The target channel needs to be a traffic channel which can be created on any CAN interface. The channel type must be data output. If you do not see the Format table sheet you need to activate the OPTIONS > Expert settings.

Create CAN traffic output channel
Then you link to the CAN Send node a CAN traffic output channel.

Select CAN traffic output channel
The default CAN Send channel settings are defined below.

The settings of the source channel displayed below. However, with the column chooser you can add more properties to the channel grid.
36 COMMUNICATION workspace

36.1 Introduction

The COMMUNICATION workspace is designed to deal with all configuration parameters for data transfer from and to the logger. This covers the different media (WiFi, LAN, modem) and the different protocols for time synchronization, data transfer and e-mails.
36.2 Transfer categories

With the data transfer categories you can control, if data is at all transferred and by which medium (WiFi, Modem, LAN). You need to link a storage group to a category.

In the COMMUNICATION workspace in section Relation, you define the medium and the transfer protocols for each category you like to use.
In the example below, all protocols for data transfer, e-mail and time sync are permitted for the WiFi and Modem medium.
37 LOGGER SCRIPTING workspace

37.1 Scripting activation

In the SCRIPTING workspace you can integrate PYTHON scripts to your logger operation. It is a function for experts which is by default not visible.

The logger scripting function is considered as an expert setting and is by default not activated. The corresponding settings XML file is installed in this directory:

- C:\ProgramData\IPETRONIK\IPEmotion 2019 R3\SettingsRT.UI.xml

When the SettingsRT.UI.xml is activated as indicated above you can then use the customize ribbon function to show the LOGGER SCRIPTING work space. the scripting workspace over the ribbon customize button.
37.1 Scripting activation

Customize ribbon
37.1 Scripting activation

Activate the Logger Scripting Workspace

Activate: Logger scripting

Finally, you can integrate scripts. The scripts can be triggered from logger events like limits.

Activated LOGGER SCRIPTING workspace
37.2 Scripting commands

- BaseHTTPServer: bisect, inspect, select
- Bastion: bz2, io, sets
- CDROM: cPickle, ipaddress, setuptools
- CGIHTTPServer: cProfile, itertools, sgmllib
- ConfigParser: cStringIO, json, sha
38 Logger status monitoring

The Status functions are available as Windows Plugin too.

The Status node is very useful to monitor the overall health status of your logger. Critical process and overall CPU and RAM usage can be effectively monitored. When you use these channels for limit monitoring or trigger events for notification e.g. over the IoT communication to your mobile display and IPEcloud - fleet management system. The following 3 channels are available by default.

- **CPU load** Refers to the overall CPU load of the computer.
- **Memory usage** Refers to the overall memory usage of all running applications.
- **Free disc space** Refers to free disc space on the drive where IPEmotion is installed.
38.1 Global monitoring

The 3 global monitoring channels are automatically created when a system is created.

System level

- **Active**: Checkbox to active the system
- **Name**: Define an individual name
- **Description**: Define an individual system description
- **Reference**: is automatically created by the system and is included in the storage data

On the Global monitoring parameters you have the following settings in the General tab sheet.

3 default global monitoring parameter.
38.2 Process channels

Below the Status node you can add process monitoring channels. With the process channel to parameters can be monitored.

- **Active**  
  Checkbox to active Global monitoring channels

- **Name**  
  Define an individual name of the Global system

- **Description**  
  Define an individual Global description

- **Reference**  
  Is automatically created by the system and is included in the storage data

- **Sample rate**  
  The sample rate is configured in the channel grid and is ranging from 1/h up to 1 Hz

- **Process CPU load**  
  Display the CPU load caused by this process.

- **Process Memory**  
  Display memory usage by the process.
When a Process monitoring is created you have to define the Settings tab sheet the process name. For IPEmotion RT the following 3 process can be monitored. On Process level you get automatically also information about the memory (RAM) usage of the process.

- **ipetrld** This is the control deamon who is operating the logger event handling
- **IPEwatch** This is a monitoring process over all processes
- **IPEmotionRT** This is the overall RT data logger operation process
39 Video camera configuration

With IPEmotion RT you can use multiple USB and multiple IP-/Ethernet cameras.

39.1 USB camera configuration

The USB cameras support the hardware synchronization function. The you use after logger detection and physical connection to the USB input the SYNCHRONIZE function to detect the USB cameras.

---

LED colors:
1 = green  => running
2 = orange => measuring (storage)
3 = red    => error
39.2 USB channel settings

On video channel level you can select from the following 3 data formats. Additional information about the data processing mechanism are provided in the last chapter.
In the video settings tab sheet you have additional configuration functions to define the resolution of the stored pictures. 4 different modes with defined quality settings are provided. Depending on the selected quality rate an estimated data transfer rate is calculated. With the USB interface and the WDM driver it is possible to update the camera settings from the PlugIn.
39.3 IP camera configuration

The IP-Camera interfaces can be created on any of the supported ETH inputs of the logger. The cameras must support the RTSP (Real Time Streaming Protocol).

On the interface level you can add several streams. It is needed when you have an IP-Camera which supports multiple camera inputs. Every stream has to be configured with its own streaming parameters.
39.4 PC network card settings

In order to establish a data communication connection to the camera, you need to define a static IP address on the LAN interface of your computer, which is connected to your network camera. The network IP and subnet mask should be in the same range to that of the IP-camera. The network address of the IP-camera is mentioned in the manual. In this example the address of the camera is this: 192.168.234.102. This IP-address was selected in order to make configuration compatible to ETH 2 input of IPElog2 or M-LOG V3. For the PC LAN network setting the IP-address 192.168.234.200 was selected.

Define static IP for PC LAN IPv4 network settings

With a web browser you can access the configuration interface. The link to the web browser is part of the manual. In this example you enter the static IP-address to the browser to the live picture:

http://192.168.234.102/

http://192.168.234.102/view/viewer_index.shtml?id=6

Data live view in browser
39.5  IP camera settings

From the web interface you can access the settings area. The default user name and password for this product is root.

In the configuration menu you need to create an administrative user who is later used by IPEmotion to retrieve the data from the camera. In the example below the user is called ipe with the corresponding password ipe.
In the TCP/IP setup you may change the IP-address. However, in this example the default fixed IP is used. The fixed IP-address is an important setting to retrieve the video data in IPEmotion.

- **IP-address**: Here you define the fixed IP-address to reach the camera from your browser. This IP-address will also be used to configure the connection parameters for measurements with IPEmotion. If you would like to use the camera on the IPEmotion RT data logger you should select the address suitable for the address range of the ETH input of the logger which should be in the range of ETH 2 of 192.168.234.xxx.

- **Subnet mask**: Here you can use the default setting 255.255.255.0.

- **Default router**: Here you define the IP-address which will be used by the IPEmotion ME (Mobile Edition) app to receive the video stream on your app. The router IP address must be in the same network range as the ETH input of the logger.

For streaming into IPEmotion ME
Another important configuration part are the image settings. Here you can define the image size in pix and the compression. The compression is ranging in percent from $0 = \text{no compression}$ to $100 = \text{maximum compression}$. In this example we will use 50 percent compression as an initial recommendation. As standard frame rate 15 Hz is selected. The frame rate has to be considered for the settings in the Plugin too. The impact of the different settings will be explained at the end of the manual.
This camera is providing a h264 video stream. For the h264 codec you can define a GOV length. GOV is a setting for the Group of Pictures. This factor has a considerable impact on the amount of data you store. The factor is determining how many differential frames are transferred together with a full picture. Large GOV factor will group many different frames together with one full frame. If configure the GOV factor to one ever frame transferred is a full frame including all data which will cause high data storage volumes. In our example we will use a GOV factor of 16. The GOV factor will be configured in IPEmotion too.
Finally, we need to enable the RTSP stream and define the port number. This are important settings so that data is retrieved by the IPEmotion. The Port number will be used for the connection parameters in IPEmotion too.

In order to send the video stream to the IPEmotion Mobile Edition (app) it is required to define an alternative HTTP port: 8081. This port is considered in the App connection string.
In the General tab sheet you define interface name and description.

In the Connection tab sheet you define the fixed IP-address of the camera, the user and the password, which was defined in the web interface of the camera. See section 39.5
In the Streaming tab sheet you have a check box to activate a function called

► Automatic sample rate

When this check box is activated the PlugIn will check during an initialization process the actual sample rate setting of the camera.

Information

It is recommended to deactivate this check box because it is extending the initialization time for each measurement. You can only identify the defined frame rate of the camera when all connection parameters which are discussed below are defined.

Information

When you make any updates in the web interface of the camera like frame rate, compression, GOP factor, resolution, etc you have to execute the initialize function in IPEmotion to make the changes in the web interface also affective to the PlugIn.
39.6 Stream configuration - single and multiple

On Stream level you have to define the stream configuration setting. When you use e.g. AXIS F44 camera you have 4 cameras in one IP interface system. In this case you need to add 3 more streams to your configuration as discussed above. In the General tab sheet you define stream name and description.

In the Connection tab sheet the stream specific parameters are defined.

When the settings are all defined you can use the initialize function to test the communication to the camera. When the automatic sample rate check box is still active, the Plugin retrieves the sample rate / frame rate setting of the camera. Which match quite close to the setting in the web interface.
39.6 Stream configuration - single and multiple

- **Access name**
  The access name cannot be directly obtained from the web interface of the AXIS camera. To identify the correct access name, you must consult the camera vendor's user manual. In this example, the stream is defined as: `axis-media/media.amp`.

- **Port number**
  The port number was defined in the advanced settings of the web interface of the AXIS camera 39.5.

- **Transport protocol**
  The transport protocol can be selected UDP or TCP. The default setting for RTSP protocols is the UDP protocol. However, the correct setting of the transport protocol is dependent on the camera vendor. In some cases, both TCP or UDP work alike.

- **App connection**
  This tab sheet is required to stream the data to IPEmotion ME (app) application. See explanation below.

The App connection tab sheet is only visible for IPEmotion RT loggers. Here you define the streaming parameters to display the video image in the IPEmotion ME app. The connection string consists of the mandatory port number (8081) as defined in the web interface of the advanced network settings and the resolution and frame rate (fps) which were also defined in the web interface of the camera.

IPEmotion RT supports also multiple IP-camera streams. The configuration on the web interfaces of the cameras side follows the same principle for one stream or for multiple streams or the combined quad stream.
However, you need to identify the different streams correctly. The first stream has no index. The second up to the forth stream has the index camera=2, camera=3, camera=4. For the quad stream the index is camera=quad is defined as indicated in the screenshot below.
39.7 Video channel data formats settings

Similar to the USB cameras you can define on channel level the data format. For IP cameras the following 3 data formats are supported.

- Motion
- Motion with live picture
- Image

The default setting is the Motion format. With the Motion (Motion with live picture) format the h264 stream is stored in the data file considers the GOP factor. The GOP factor (Group of Picture) was defined in the web interface of the camera and should match with the PlugIn settings. In this example the GOP factor was set 16. See chapter: 39.5
When you select the Image format for the channel, you have in the video settings tab sheet a configuration function of the JPEG quality. The quality factor is ranging between 0 and 100 percent. High quality settings will lead to higher stored data volumes and better pictures in the video instrument. However, the picture quality can be influenced with the compression setting in the web interface of the camera too. Some test data file are presented in section 39.8.5

The Image data format is not supporting a GOP factor setting. The Image format requires more processing CPU resources because h264 stream from the IP camera in this case is transformed into MJPEG picture data stream for storage.
39.8 Video stream processing examples

Depending on the camera interface (USB / Ethernet) and the related drivers (WDM / Direct X) for USB cameras or protocols like RTSP (Real Time Streaming) for IP cameras different processing mechanisms can be applied. Not all drivers and data formats are compatible from all camera vendors. Therefor it is recommended to test the camera together with the video PlugIn before to purchase the product.

39.8.1 Image format

The Image format is taking incoming data streams and converting them to JPEG pictures. However, this format is consuming plenty of storage space.
39.8.2 Motion format

The Motion format is basically routing the incoming data stream in the same format to the data storage. That means incoming h264 data streams are also stored in the format. An incoming MJPEG stream will be stored in the MJPEG format. However, the driver of the camera hardware and the PlugIn must be compatible. Not all cameras support the Motion format.
39.8.3 Motion with live picture format

This format is a derivate from the Motion format. The main difference is that the Plugin is processing the incoming data stream to an additional MJPEG picture in order to have a good update rate of the online picture for the user. The Motion format supports for h264 streams the GOP factor. The GOP factor is a good setting to save storage capacity, but it is causing on the downside a delay in the online picture screen update.
39.8.4 GOP factor

In the example below a data file was recorded for 30 seconds with the resolution of 800x600 pixels. As you can see an increased GOP/GOV (Group of Picture) factor leads to smaller data files. However, when the GOP factor is getting larger than for example 32 the impact on the storage volume is not much lower compared to the factor 16.

39.8.5 Quality factor

Another setting is the quality when you store the data in the Image (MJPEG format). In this case the h264 stream is converted to MJPEG pictures by the Plugin and you can change the storage and online display quality. The data was stored again from a 800 x 600 pixel picture for 30 seconds duration. As you can see the quality has a significant impact on the storage volume.
Install additional Plugins: Example Demo Signals

It was discussed in the introduction 24.2 that IPEmotion RT is supporting the Plugin concept. With additional Plugins customers can get OEM specific custom setups for their specific data logging application. The two main benefits are that RT Plugins can be used firstly to protect customer specific know how from the general IPEmotion RT user and secondly the Plugins can be developed by any party outside of the IPETRONIK development team to speed up the implementation. For a RT Plugin development, a dedicated manufacturer Code for the Plugin is required. The standard IPEmotion RT setup is using the Demo Signal Plugin which can be optionally installed on the RT logger.

When the Plugin is installed you can add on logger system level the Demo Plugin. With the demo Plugin you can configure many different waveforms, and traffic signals.
Install additional Plugins: Example Demo Signals

Activate Demo Plugin in system tree
40.1 Demo Plugin – Periodic signals configuration

The periodic signals can be created when you select the periodic signal interfaces. The different signals

- Rectangle
- Sine
- Sawtooth
- Digital output

When you change the sample rate in the channel grid it has an impact in how many samples are taken to generate the waveform. It can also impact the frequency of the when they respond to ticks like it is the case for a rectangle signal.
40.1 Dem PlugIn – Periodic signals configuration

40.1.1 Rectangle

This signal supports thee configuration function for amplitude and the distribution / ratio of the UP (high) and DOWN (low) ticks. The high / low duration is depending on the number of defined in the column sample rate.

Example:

- 100 Hz sample rate and 100 ticks high = 1 s high
- 10 Hz sample rate and 100 ticks high = 10 s high

40.1.2 Sine

In the Sine signal you can configure only the amplitude. However with the channel scaling for the Physical min and max you can modify the amplitude and the offset as well. The frequency of the Sine signal cannot be changed.
40.1.3 Sawtooth

This signal generator has 3 configuration parameters for start value, increment and end value. With every tick the slope will rise by the defined increment. The sample rate has an impact how fast the end value is reached. The increment has an impact how large the steps are. Large increments will lead to stair case types of diagrams with a higher signal frequency. Small increments with high sample rates will lead to very smooth and slow rising graphs.

![Sawtooth](image)

40.1.4 Digital output

This signal can be configured like the rectangle waveform. The amplitude is statically defined to 1 and the ratio between high and low values is defined in ticks.

![Digital input](image)
40.2 Output channels

The characteristic of the output channels is that you can write data to this type of channels. There are two types supported. An analog output and a digital output.

In the tab sheet format you can see the data direction is indicated as output. The impact of data direction output is also that alphanumerical instruments in the VIEW workspace show spin buttons to enter values. Also the slide controller and switch can write data the output channels.
The configuration of the analog output covers a start value and the settings of the output level. The output level is related to the user administration. Here you can control which user profile can operate outputs at all. The configuration of the user administration is in detailed explained in the IPEmotion manual.

![Outputs settings](image)

The Digital channel has no separate configuration tab sheet.

### 40.3 Traffic simulator

The Demo PlugIn is also providing a traffic simulation function for CAN and FlexRay. With this demo traffic stream you can test the functions of the Traffic Analyzer instrument in the VIEW work space.

![Create traffic simulators](image)
40.3.1 CAN traffic simulator

For CAN traffic you can activate a couple of additional traffic messages which are part for a real traffic scream from bus networks.

CAN traffic settings for frames
You can visualize the traffic stream in the VIEW workspace with the Traffic Analyzer instrument. You need a Demo Edition or Professional Edition to get access to this instrument. The functions of the Traffic Analyzer Instrument are explained in the IPEmotion manual.

When you import the IPEmotionDemo.dbc file you can convert the traffic stream into signals too.
40.3 Traffic simulator

Conversion to signals with DBC file
40.3.2 FlexRay traffic simulator

For the FlexRay traffic simulation no additional configuration functions are provided.
Similar to the CAN traffic you can convert the FleRay traffic stream into signals when you import the IPEmotionDemo Fibex.xml file.

Author: FOT
41 OPTIONS - IPEmotion RT

41.1 Logger

For IPEmotion RT some settings of the OPTIONS are different compared to IPEmotion. Plugins are not included in the IPEmotion RT OPTIONS, but a separate section called Logger is available to configure some interface settings. On the ETHERNET interface you define the IP-address to detect IPETRONIK X-modules.

![Logger OPTIONS of IPEmotion RT](image)

On the CAN interface you define on which CAN input and on which baud rate M-Modules can be detected.

![CAN interface settings](image)
On the Options settings you can deactivate the alias free measurement settings and other module specific settings.
42 Hardware information

42.1 IPElog2 pin assignment

In the following 2 diagrams you get an overview of the different pin assignments of the versions IPELog2-01 and IPElog2-02.

42.1.1 IPELog2-01
42.1.2 IPELog2-02

IPElog2 (10 CAN + 6 LIN + 2 ETH) IPElog2-02
42.1.3 IPELog2-03

IPElog2 (16 CAN FD + 2 ETH) IPELog2-03
42.1.4 IPELog2-04

IPELog2 (10 CAN FD + 6 LIN + 2 ETH) IPELog2-04
42.2 IPElog2 LED description
42.2 IPElog2 LED description

- **L1 Power supply**: This LED is indicating in green color when supply voltage in the range of 9 to 36 V is available.

- **L2 Measurement status**: This LED is indicating in yellow color when the logger is in measurement mode. When you apply supply voltage to the logger it will take about 30 seconds until the yellow LED is indicating the measurement mode. Measurement mode defines that the configuration is running correctly and data is received. This LED is blinking when data is transferred to a USB drive or when the logger is operating in the post processing mode when data is compressed and transferred.

- **L3 Error status**: This LED is indicating in red color when the logger is in an error status. In this case the measurement is not working and there a different reasons, why the logger is in error state. Errors can be caused because of full storage media, wrong license activated compared to the configuration applied, corrupted configuration file, etc. See section 32.8 to find how to resolve the error status.

- **L4 M-CAN termination**: This LED is indicating in yellow color when the M-CAN termination of 120 Ohm is activated. This is a software setting which is currently not implemented In order to use M-CAN modules you need to take a M-CAN system cable with an inbuilt termination 620-429

- **L5 ETH input**: This LED is indicating in yellow when Ethernet data on ETH 2 from e.g. a satellite interface, IP-camera or an X-LINK system is received.

- **L6 PC**: This LED is indicating in green color when Ethernet data on ETH 1 is received. The PC LED of the logger can be off, when the communication to the PC is not working e.g. because of a fixed IP-address setting on the PC network card or no physical connection between logger and PC.

- **L7 X-LINK input**: This LED is indicating in yellow color when Ethernet data on ETH 3 from X-LINK modules is received.

- **L8 external modem**: Modem status - not yet functional.

- **L9 external modem**: Modem signal strength - not yet functional.

- **L10 modem status**: Yellow on: Modem is configured in the software settings.

- **L11 modem signal strength**: 3 color status LED: Red/textless 50 %, Yellow 50 ... 75%. Green >75%. The LED is on when a connection to the phone network was established

- **L12 WiFi status**: Yellow on: WiFi access point is activated on the software settings. LED off: WiFi is not configured from the software side.

- **L13 WiFi signal strength**: 3 color status LED: Red <50%, Yellow 50 ... 75%. Green >75%

- **L14 CAN, LIN inputs**: When bus traffic is received the CAN and LIN inputs are blinking.

- **WPS button**: Not yet functional. It is planned for the future to use this button to establish easily a WiFi access point connection to a tablet or smartphone to exchange the SSID.
42.3 M-LOG V3 pin assignment

In the following 3 diagrams you get an overview of the different pin assignments of M-LOG V3.

42.3.1 M-LOG V3 PR05
42.3.2 M-LOG V3 PR08

![Diagram of M-LOG V3 PR08](image-url)
42.3.3 M-LOG V3 PR13

![Diagram of M-LOG V3 pin assignment]

M-LOG V3 (6 CAN + 2 LIN + 2 ETH) PR05
42.4 COMgate V3 LED description

- **L1 Power supply**  
  Behind this cover you can install the SIM card 2FF form factor to enable the modem communication. The modem needs to be configured in the COMMUNICATION tab sheet of the IPEmotion RT.UI software. There is also a slot for a micro SD card for a manual firmware updates. The firmware update process is also explained in the service use cases in chapter.

- **L1 SIM / SD slot**  
  Behind this cover you can install the SIM card 2FF form factor to enable the modem communication. The modem needs to be configured in the COMMUNICATION tab sheet of the IPEmotion RT.UI software. There is also a slot for a micro SD card for a manual firmware updates. The firmware update process is also explained in the service use cases in chapter.

- **L2 WPS button**  
  Not functional. It is planned for the future to use this button to establish easily a WiFi access point connection to a tablet or smartphone to exchange the SSID.

- **L3 WiFi status**  
  Yellow on: WiFi access point is activated on the software settings. LED off: WiFi is not configured from the software side.

- **L4 WiFi signal strength**  
  3 color status LED: Red <50%, Yellow 50 ... 75%. Green >75%

- **L5 modem status**  
  Yellow on: Modem is configured in the software settings.

- **L6 modem signal strength**  
  3 color status LED: Red /textless 50 %, Yellow 50 ... 75%. Green >75%. The LED is on when a connection to the phone network was established

- **L7 ext. modem signal strength**  
  Not functional.

- **L8 ext. modem status**  
  Not functional.

- **L9 Logger**  
  Green on: communication to the logger is working.

- **L10 PC**  
  Green on: Communication to the PC is established.

- **L11 COMgate status**  
  Green on: Power supply to the COMgate is available and functional. Red: error indicating e.g. SIM card is missing or SIM PIN is wrong.
42.5 FlexRay Satellite LED description

- **L1 Link**
  - Yellow blinking: Internal data communication established.

- **L2 FlexRay 1 - 2**
  - Yellow on: FlexRay channel is activated in the software settings.
  - Green on: indicating data reception for a FlexRAy channel. Yellow blinking: configured as WakeonFlexRay (WoF).

- **L3 Link IN**
  - Yellow blinking: 10 or 100 Bit data communication established to logger or PC.

- **L4 GbE IN**
  - Green on: 1 Gigabit Ethernet connection is established to logger or PC.

- **L5 Link OUT**
  - Green LED is indicating a successful communication with another satellite interface.

- **L6 GbE OUT**
  - Green on: 1 Gigabit Ethernet connection is established to logger or PC.
42.6 CAN FD Satellite LED description

- **L1 Link**
  - Yellow blinking: Internal data communication established.

- **L2 CAN 1 - 4**
  - Yellow on: CAN channel is activated in the software settings.
  - Green on: indicating data reception for a CAN channel. Yellow blinking: configured as WakeonCAN (WoC).

- **L3 Link IN**
  - Yellow blinking: 10 or 100 Bit data communication established to logger or PC.

- **L4 GbE IN**
  - Green on: 1 Gigabit Ethernet connection is established to logger or PC.

- **L5 Link OUT**
  - Green LED is indicating a successful communication with another satellite interface.

- **L6 GbE OUT**
  - Green on: 1 Gigabit Ethernet connection is established to logger or PC.
42.7 License information about pcixcanxli

For the pcixcanxlin and am335xcan interfaces of IPETRONIK data loggers with Linux operation system, IPETRONIK uses own kernel mode drivers. The source code of the pcixcanxlin and/or am335xcan driver can be requested at IPETRONIK by contacting support@ipetronik.com.

43 Keyboard handling

This page offers an overview about the keyboard navigation within the View and Analysis tabs.

43.1 View

General

► Page Up/Page Down: Change between the first and last entries from a list
► Tab: Focus the next element
► Tab+Shift: Focus the previous element
► Ctrl+C: Copy the focused element
► Ctrl+V: Paste the focused element
► Ctrl+X: Cut the focused element
► Delete: Delete the focused element

Content tree

► Ctrl →/←: Show/hide subnodes
► ↑/↓: Select previous/next node
► Shift ↑/↓: Add previous/next node to selection
► Ctrl+A: Select all
► Ctrl+move node with mouse: Cut node and add to destination node
► Shift+move node with mouse: Cut node and add above destination node
► Alt Gr+move node with mouse: Cut node and add below destination node
► Page Up/Page Down: Select first/last node

List of channels

► ↑/↓: Select previous/next node
► Shift ↑/↓: Add previous/next node to selection
► Ctrl+A: Select all
► Page Up/Page Down: Select first/last node

List of pages

► ↑/↓: Select previous/next node
► Shift ↑/↓: Add previous/next node to selection
► Ctrl+A: Select all
► Page Up/Page Down: Select first/last node
43.1 View

**yt-chart**
- +/-: Zoom in/zoom out the x-axis
- **Shift**: Mode “Select”
- **Shift +/-**: Zoom in/zoom out all y-axes
- **Shift ←/→**: Move the x-axis by one axis scaling to the right/left
- **Ctrl ←/→**: Move the x-axis by the total length to the right/left
- **Shift ↑/↓**: Move all y-axes by one axis scaling up/down
- **Ctrl**: Mode “Stretch/Compress”

**Alphanumerical**
- **Enter**: Open the input field only if the measuring is running
- **Enter (input field open)**: Set value and close input field
- **Esc (input field open)**: Close input field and do not set value
- +/- (spin buttons active): Increase/decrease the value
- ↑/↓ (spin buttons active): Increase/decrease the value

**Slide control**
- +/-: Increase/decrease the value
- ←/→: Increase/decrease the value of a horizontal slider
- ↑/↓: Increase/decrease the value of a vertical slider

**Switch**
- **Space bar**: Change between the status “On” and “Off” of the output

**Traffic Analyzer**
- ↑/↓: Select previous/next row
- ←/→: Focus next/previous column to the right/left
- **Ctrl +/-**: Show/hide signals of a message, if possible
- **Page Up/Page Down**: Switch to first/last row from the current page
- **Home/End**: The first/last column “Time”/“Description” is focused
- **Delete**: The marked value is deleted
- **Statistic Frame**: +/- [NumBlock]: Drop down list is open/closed
- **Statistic Frame**: Ctrl +/-: Drop down list is open/closed

**Message generator**
- ↑/↓: Select previous/next message
- ←/→: Select next/previous slot
43.2 Analysis

Table

- ↑/↓: Select previous/next line
- →←: Select next/previous slot

Map

- +/-: Zoom in/zoom out the map
- ↑↓: Move the map up/down
- →←: Move the map to the right/left

Action

- Enter: Execute program/script

43.2 Analysis

General

- Page Up/Page Down: Change between the first and last entries from a list
- Tab: Focus the next element
- Tab+Shift: Focus the previous element
- Ctrl+C: Copy the focused element
- Ctrl+V: Paste the focused element
- Ctrl+X: Cut the focused element
- Delete: Delete the focused element

Content tree

- Ctrl →←: Show/hide subnodes
- ↑/↓: Select previous/next node
- Shift ↑/↓: Add previous/next node to selection
- Ctrl+A: Select all
- Ctrl+move node with mouse: Cut node and add to destination node
- Shift+move node with mouse: Cut node and add above destination node
- Alt Gr+move node with mouse: Cut node and add below destination node
- Page Up/Page Down: Select first/last node

List of loaded measurement files

- ↑/↓: Select previous/next node
- Shift ↑/↓: Add previous/next node to selection
- Ctrl+A: Select all
- Page Up/Page Down: Select first/last node

List of pages

- ↑/↓: Select previous/next node
- Shift ↑/↓: Add previous/next node to selection
- Ctrl+A: Select all
- Page Up/Page Down: Select first/last node
Extended measurement window

- ↑↓: Select previous/next node

**yt-chart**

- Space bar: Change the active measuring cursor
- →←: Move the measuring cursor on the active graph by exactly one value
- ↑↓: Move the active measuring cursor by 0.5 % of the x-axis range to the right/left
- Home/End: Move the active measuring cursor to the point, which is the closest to the upper/lower limit of the x-axis range
- +/-: Zoom in/zoom out the x-axis
- Shift: Mode “Select”
- Shift +/-: Zoom in/zoom out all y-axes
- Ctrl +/-: Zoom in/zoom out the active y-axis
- Shift →←: Move the x-axis by one axis scaling to the right/left
- Ctrl →←: Move the x-axis by the total length to the right/left
- Shift ↑↓: Move all y-axes by one axis scaling up/down
- Ctrl ↑↓: Move the active y-axis by one axis scaling up/down
- Ctrl/Alt: Mode “Stretch/Compress”

**xy-chart**

- Space bar: Change the active measuring cursor
- →←: Move the measuring cursor on the active graph by exactly one value
- ↑↓: Move the active measuring cursor by 0.5% of the time channel range back/forth
- Home/End: Move the active measuring cursor to the first/last point
- +/-: Zoom in/zoom out the x-axis
- Alt +/-: Zoom in/zoom out the active x-axis
- Shift: Mode “Select”
- Shift +/-: Zoom in/zoom out all y-axis
- Ctrl +/-: Zoom in/zoom out the active y-axis
- Shift →←: Move the x-axis by one axis scaling to the right/left
- Ctrl →←: Move the x-axis by one axis scaling to the right/left
- Shift ↑↓: Move all y-axes by one axis scaling up/down
- Ctrl ↑↓: Move the active y-axis by one axis scaling up/down
- Ctrl/Alt: Mode “Stretch/Compress”
43.2 Analysis

Polar diagram

- **Space bar**: Change the active measuring cursor
- **→/←**: Move the measuring cursor on the active graph by exactly one value
- **Page Up/Page Down**: Move the measuring cursor on the active graph by 60 steps
- **Home/End**: Move the active measuring cursor to the point which is the closest to the upper/lower limit of the angle range
- **+/−**: Both graphs are zooming in/zooming out
- **Ctrl+/−**: Only the selected graph is zooming in/zooming out
- **Alt+/−**: Zoom in/out the current curve by one tenth of the currently displayed scale
- **Shift →/←**: The whole polar diagram is rotating clockwise/counterclockwise
- **Ctrl →/←**: The whole polar diagram is rotating clockwise/counterclockwise
- **Shift ↑/↓**: The range of amplitude axises from both graphs decreased/increased
- **Ctrl ↑/↓**: The selected graph is zooming in/zooming out

Campell diagram

- **Delete**: Delete the instrument
- **Tab**: Switch to next panel
- **→/←**: Move the measuring cursor to the right/left
- **↑/↓**: Move the measuring cursor up/down
- **Page Up/Page Down**: Move measuring cursor for many steps
- **Home/End**: Move the measuring cursor to the first/last point
- **Space**: Switch between cursor 1 and 2
- **Shift →/←**: Panning
- **Ctrl →/←**: Panning, active curve
- **Shift ↑/↓**: Turn the diagram
- **+/−**: Zoom in/zoom out
- **Ctrl+/−**: Zoom in/zoom out the active curve

Classification grid

- **Delete**: Delete the instrument
- **Tab**: Switch to next panel
- **→/←**: Move the measuring cursor to the right/left
- **↑/↓**: Move the measuring cursor up/down
- **Page Up/Page Down**: Move measuring cursor for many steps
- **Home/End**: Move the measuring cursor to the first/last point
- **Space**: Switch between cursor 1 and 2
- **Shift →/←**: Panning
- **Ctrl →/←**: Panning, active curve
- **Shift ↑/↓**: Turn the diagram
43.2 Analysis

- +/-: Zoom in/zoom out
- Ctrl +/-: Zoom in/zoom out the active curve

Log p-h diagram
- →/←: Move the slider to the next/previous position
- Home/End: Move the slider to the start/end position

Traffic Analyzer
- ‹/›: Select previous/next row
- →/←: Focus next/previous column to the right/left
- Ctrl +/-: Show/hide signals of a message, if possible
- Page Up/Page Down: Switch to first/last row from the current page
- Home/End: The first/last column "Time"/"Description" is focused
- Delete: The marked value is deleted
- Statistic Frame: +/- [NumBlock]: Drop down list is open/closed
- Statistic Frame: Ctrl +/-: Drop down list is open/closed

Table
- ‹/›: Select previous/next line
- →/←: Select next/previous slot

Map
- +/-: Zoom in/zoom out the map
- ‹/›: Move the map up/down
- →/←: Move the map to the right/left

Video
- →/←: Move the slider to the next/previous position
- Home/End: Move the slider to the start/end position

3D-View
- ‹/›/→/←: Rotate the camera
- Page Up/Page Down: Zoom in/zoom out the camera
- Shift ‹/›: The 3D model is moving up/down
- Shift →/←: The 3D model is moving right/left
- Home: The 3D model is moved back to the central position
- W/S: Move the camera in/out
- A/D: Move the camera to the left/right

Action
- Enter: Execute program/script

Author: FOT
## 44 Terms and abbreviations

### 44.1 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAQ</td>
<td>Data acquisition</td>
</tr>
<tr>
<td>ICP</td>
<td>Integrated circuit supply (used for accelerometer sensors)</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical user interface</td>
</tr>
<tr>
<td>PID</td>
<td>Proportional, integral derivative controller. See chapter PID Control 15.6.1</td>
</tr>
<tr>
<td>CAN</td>
<td>Controller are network</td>
</tr>
<tr>
<td>Sensor</td>
<td>Is a probe to measure pressure, temperatures, digital signals like pulse etc...</td>
</tr>
<tr>
<td>PWM</td>
<td>Pulse width modulation. See chapter function generators 15.4</td>
</tr>
<tr>
<td>PlugIn</td>
<td>Software program to enable a communication with 3rd party vendor hardware</td>
</tr>
<tr>
<td>TESTdrive</td>
<td>Operating system of IPETRONIK data loggers</td>
</tr>
<tr>
<td>DBC</td>
<td>CAN bus description file</td>
</tr>
<tr>
<td>LDF</td>
<td>LIN bus description file</td>
</tr>
<tr>
<td>A2L</td>
<td>Description files for ECU’s</td>
</tr>
<tr>
<td>ECU</td>
<td>Electronic control unit operating electronic components like engine in a vehicle</td>
</tr>
<tr>
<td>XCP</td>
<td>Universal calibration Protocol</td>
</tr>
<tr>
<td>CCP</td>
<td>CAN calibration Protocol</td>
</tr>
<tr>
<td>J1939</td>
<td>CAN bus protocol applied for diesel engines (Truck, Ship, Construction Machines, ...)</td>
</tr>
<tr>
<td>UDS</td>
<td>Unified Diagnostic Services</td>
</tr>
<tr>
<td>GM-LAN</td>
<td>GM specific protocol</td>
</tr>
<tr>
<td>KWP</td>
<td>Key word protocol - Diagnostic protocol</td>
</tr>
<tr>
<td>OBD</td>
<td>Also called OBD2 - Diagnostic protocol</td>
</tr>
<tr>
<td>ODT</td>
<td>Object Descriptor Table</td>
</tr>
<tr>
<td>DTO</td>
<td>Data Transfer Objects</td>
</tr>
<tr>
<td>CWT</td>
<td>Climatic Wind Channel</td>
</tr>
<tr>
<td>TEDS</td>
<td>Transducer Electronic Data Sheet 12.2.3</td>
</tr>
<tr>
<td>RPM</td>
<td>Revolutions per Minute 19.25.2</td>
</tr>
<tr>
<td>ZIPRT</td>
<td>Data files from IPEmotion RT data logger software</td>
</tr>
<tr>
<td>PCAP</td>
<td>Data format for Ethernet traffic</td>
</tr>
</tbody>
</table>
44.2 IPEmotion specific file formats

.iwf  IPEmotion Workspace File, refer to: 7.2
.irf  IPEmotion RT Configuration file
.ipc  IPEmotion Project Configuration
.iac  IPEmotion Acquisition Configuration
.ioc  IPEmotion Online-View Configuration
.icc  IPEmotion Analysis Operation Configuration
.inc  IPEmotion Analysis View Configuration
.isc  IPEmotion Script Configuration
.idf  IPETRONIK Diagnostic File
.isf  IPEmotion System File
 irc  IPEmotion Runtime Configuration, refer to: 5.1.9
.mpc  Measure Point Catalog, refer to: 23.2.1
.iru  IPEmotion Raw Data
.iad  IPEmotion Acquisition Data
.lic  License File for server license management, refer to: 6.8
.irl  IPEmotion Reporting Layout
.iec  IPEmotion Reporting Configuration
.imd  IPEmotion MAL Definition
.imt  IPEmotion MAL Template
.iaw  IPEmotion App Workspace, refer to: 7.3
.itf  IPEmotion Template File
.ief  IPEmotion Environment File
.luf  License Update File, refer to: 6.7.4
.hrd  IPEhub2 raw data file to store CAN traffic trace files on SD card, refer to: 7.3 and refer to: 23.8.4
.idf  IPEmotion diagnostic file used for diagnostic measurements
.pdx  Diagnostic file for UDS measurement
.odx  Diagnostic file
.isz  Subconfiguration file, refer to: 33
.ziprt  IPEmotion RT data file
45 Commandline installation

45.1 IPEmotion installation

The IPEmotion setup offers several parameters to configure the installation via the command line. With the parameters:

- `/install`
- `/uninstall`
- `/modify`
- `/repair`

You can select between installation, uninstallation, modification (modification requires an existing installation) or reparation. If you select none of these values, it will be an installation. The installation, uninstallation or modification can run in silent mode by using `/s` or `/silent`.

The root directories for the installation can be defined by:

- `MANUFACTURERBINFOLDER`
- `USERDATAFOLDER`
- `APPLICATIONDATAFOLDER`

`MANUFACTURERBINFOLDER` defines the root for the program files of IPETRONIK products

- `C:\Program Files (x86)\IPETRONIK`

`USERDATAFOLDER` defines the root for the user data

- `C:\Users\Public\Documents\IPETRONIK\IPEmotion`

`APPLICATIONDATAFOLDER` defines the root for the application data

- `C:\ProgramData\IPETRONIK\IPEmotion 2019 R3`

You only have to define root directories which differ from the default value. Quotes are required if a directory contains spaces.

`INSTALLSCOPE` defines if all users use the same application data or if each user has his own application data.

- `INSTALLSCOPE=perMachine`
- `INSTALLSCOPE=perUser`

The type of installation can be defined by the `INSTALLTYPE`

- `INSTALLTYPE=Full`
- `INSTALLTYPE=Typical`
- `INSTALLTYPE=Custom`

Full installs all features which are contained in the setup. Typical installs only features which are defined as typical (Quickstarter;PlugIns;PC language). If the `INSTALLTYPE` is not defined, the typical features will be installed.

If additional features are needed or features are to be unselected you can use:

- `SELECT_FEATURE = IPEmotion;IPEmotionPC;de-DE`
- `UNSELECT_FEATURE`.
- `SELECT_FEATURE=SemicolonSeparatedList`
- `UNSELECT_FEATURE=SemicolonSeparatedList`
- If more than one feature is affected, the features have to be separated by semicolon (e.g. `UNSELECT=Quickstarter;it-IT`)
The following features are available:

- IPEmotionPC: Installs IPEmotion standard (since IPEmotion 2019 R1)
- IPEmotionRT: Installs IPEmotion RT.UI and RT plugin component (since IPEmotion 2019 R1)
- QuickStarter
- Dongle
- PluginDesigner
- PluginIpetronikCan
- PluginIpetronikLogger
- PluginIpetronikX
- PluginCAN
- PluginCanProtocols
- PluginCanSend
- IPEmotionPluginRTDemo
- de-DE
- fr-FR
- it-IT
- ja-JP
- ko-KR
- zh-CHS
- zh-CHT

45.2 Plugin installation

The plugins require a complete setup. The available language packs can differ from version to version. From IPEmotion 2019 R1 hotfixes uninstall the belonging versions automatically by default (e.g. 2019 R1.1 uninstalls 2019 R1 or 2019 R1.1). This behaviour can be switched of by using:

- HOTFIX=NO

Logging of the installation can be activated by using \log followed by the file name for the logging.

Pending Reboots \ Restarts By default, the bootstrapper blocks the execution of a setup, in case the system indicates a pending restart due to an earlier installation process. This behaviour can be changed by the new command line parameter

- IGNORE_REBOOT_STATUS=VALUE

If the assigned value is equal to "YES" (case independent), the bootstrapper does not blocked the installation due to pending reboot \ restart. Alternatively one can provide the command line switch "IGNORE_REBOOT_STATUS" without assignment. In this case, the installation is processed as if its value had been set to "YES".

ATTENTION: The command line parameter does only affect the behaviour of the bootstrapper. It is out of reach and thus out of the bootstrappers responsibility, if any packet contained in a bundle interrupts the installation, lets it fail or automatically reboots the computer!

Detection of pending reboots:

- Check HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Component Based Servicing\ if a subkey named "RebootRequired" is present.
- Check HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\WindowsUpdate\Auto Update\ if a subkey named "RebootRequired" is present.
- Check HKLM\SYSTEM\CurrentControlSet\Control\Session Manager\ if a value "PendingFileRenameOperations" if present. If any of these conditions are met, a reboot is required.