DEWESoft®
measurement innovation

DEWESoft® MicroStrain® MIP AddOn

AddOn-Version:1.1.0

www.dewesoft.com

Table of Contents

1 About this document

This is the user documentation for DEWESoft® MicroStrain® MIP AddOn Version 1.1.0.

The AddOn was developed and tested with a 3DM-GX4-45™ sensor. Also other MicroStrain® sensors that support the MIP protocol should work.

The AddOn supports most of the data-packets and some commands.
Initialisation commands/settings that are not supported by the AddOn can be set in the MicroStrain® MIP monitor software. The DEWESoft® MicroStrain® MIP AddOn will not change those settings.

i.e. you can set up the filters for the IMU in the MicroStrain® MIP monitor and save them as startup settings.

1.1 Terms

GPS Time

Global Positioning System time, is the atomic time scale implemented by the atomic clocks in the GPS ground control stations and the GPS satellites themselves. GPS time was zero at `00:00:00 6-Jan-1980` and since it is not perturbed by leap seconds GPS is now ahead of UTC by 16 seconds.
see also UTC Time, Local time

Local time

The local time is adjusted to different Time Zones and may also include DST (Daylight Savings Time) adjustments.
see also: GPS Time, UTC Time, Local time

UTC Time

Coordinated Universal Time, popularly known as GMT (Greenwich Mean Time), or Zulu time. In comparison to the GPS Time, the UTC Time includes leap second adjustments.

see also: GPS Time, Local time

1.2 Legend

The following symbols and formats will be used throughout the document.

IMPORTANT 	Gives you an important information about a subject. Please read carefully!

HINT 	Gives you a hint or provides additional information about a subject.

EXAMPLE

Gives you an example of a specific subject.

Example	Meaning	Description
Cancel	Button	a button that you can click
File	Menu Item	a menu item, will open a sub menu or a dialogue
`Times New Roman`	List Item	an item in a list (or tree) that you can select
Events	Tab Sheet	a tab sheet that you can select
`D:\DEWESoft\Bin\X3`	File Path and Name	a file name or path
Windows Key	a term	any kind of term (maybe also compound)
`0x0D, 0x21`	MIP field	The first byte (`0x0D` in this example) is the descriptor set byte in hexadecimal representation and the 2nd byte (`0x21` in this example) is the field descriptor byte in hexadecimal representation

Table 1: Layout formats used in the documentation

1.3 Links

- DEWESoft® homepage
  http://www.dewesoft.com
  you can download DEWESoft® AddOns when you go to: *Support* - *Downloads* – *AddOns*
- MicroStrain® Homepage: http://www.microstrain.com/
  - 3DM-GX4-45: http://www.microstrain.com/inertial/3dm-gx4-45

1.4 Platform

Since version DEWESoft® X3 you can choose to install DEWESoft® `32-bit` or `64-bit`. All previous versions (X2, X1, etc.) only supported `32-bit`.

HINT

Note, that the `64-bit` DEWESoft® version also needs `64-bit` versions of the AddOns. At the time of writing this documentation not all AddOns are available as `64-bit` version and some older AddOns may never be converted.

If you are not sure which DEWESoft® version you have installed, you can easily see it in the *About* dialogue:

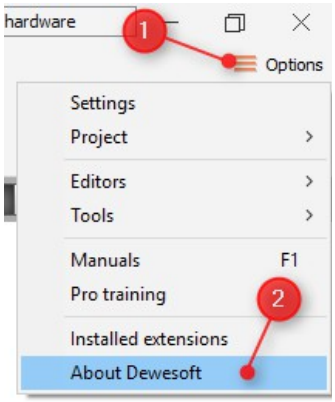


Illustration 1: Open the About dialogue

When the DEWESoft® version ends with (64-bit) then you have the `64-bit` version, otherwise it is the `32-bit` version.

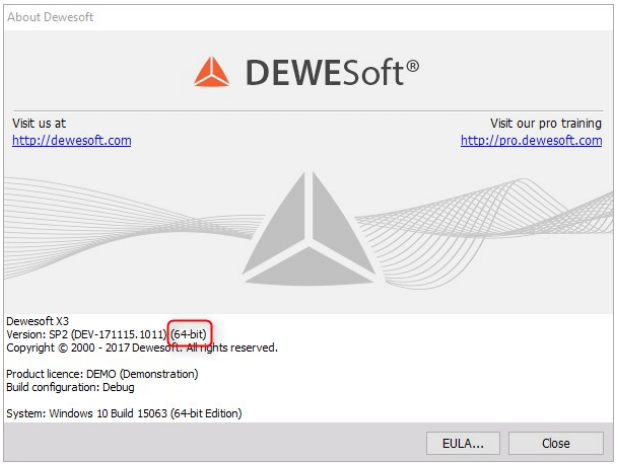


Illustration 2: About dialogue 64-bit

1.5 Compatibility

The AddOn is compatible with DEWESoft® X2 or higher.

The AddOn was developed and tested with a 3DM-GX4-45™ sensor. Also other MicroStrain® sensors that support the MIP protocol should work.

1.6 Files and Directories

The actual location of the directories on your computer may vary dependant on your computer's locale settings and the settings you chose when installing DEWESoft®.

1.6.1 Important DEWESoft® 7 Directories

The following tables show the default paths of your DEWESoft® installation. Note, that the paths may be different, depending on your operating system, DEWESoft® version and language settings.

1.6.1.1 DEWESoft Measurement Unit [recommended]

Name	Explanation	Platform	Default path
`Bin`	Contains `DEWSoftX.exe`	`32-bit`	`D:\DEWESoft\Bin\X3`
		`64-bit`	`D:\DEWESoft\Bin64\X3`
`AddOns`	The files for AddOns (`.dll, mth`) must be copied into this directory	`32-bit`	`D:\DEWESoft\Bin\X3\AddOns`
		`64-bit`	`D:\DEWESoft\Bin64\X3\AddOns64`
`Data`	Folder for the measurement data files		`D:\DEWESoft\Data`
`Setups`	Folder for the setup files		`D:\DEWESoft\Setups`
`System`	Folder for the project files		`D:\DEWESoft\System\X3`
`Log`	Folder for the log files		`D:\DEWESoft\System\X3\Logs`

The paths may be different depending on your DEWESoft® version.

1.6.1.2 Windows Standard

Name	Platform	Default path
Bin	32-bit	C:\Programme\DEWESoft\Bin\X3
	64-bit	C:\Programme\DEWESoft\Bin64\X3
AddOns	32-bit	C:\Programme\DEWESoft\Bin\X3\AddOns
	64-bit	C:\Programme\DEWESoft\Bin64\X3\AddOns64
Data		C:\Dokumente und Einstellungen\All Users\Dokumente\DEWESoft\Data
Setups		C:\Dokumente und Einstellungen\All Users\Dokumente\DEWESoft\Setups
System		C:\Dokumente und Einstellungen\All Users\Dokumente\DEWESoft\System\X3
Log		C:\Dokumente und Einstellungen\All Users\Dokumente\DEWESoft\System\X3\Logs

The paths may be different depending on your DEWESoft® version and the language of your operating system.

2 Installation Procedure

2.1 Install MicroStrain® Software

Before you install the AddOn, you must install the MicroStrain® Windows® drivers. It is also recommended to install the MicroStrain® software (MIP Monitor). The MicroStrain® sensor usually comes with a USB stick that includes all relevant installation files. It may also be a good idea to check their web-site for updates of their software and drivers (see 1.3 Links on page 2).

2.2 AddOn Installation

Make sure to use the correct file for your platform (see 1.4 Platform on page 2):

Platform		AddOn file		Example of *AddOns* Folder
32-bit	Copy the file:	`MicrostrainMip.dll`	to	`D:\DEWESoft\Bin\X3\AddOns`
64-bit		`MicrostrainMip64.dll`	to	`D:\DEWESoft\Bin64\X3\AddOns64`

Then you can start DEWESoft® and register the AddOn (aka. Extension). Click *Options* - *Settings…*, select Extensions and click the plus sign. Then find the *Microstrain MIP* AddOn in the list and activate it (i.e. click the check-box ❶ in Illustration 9) - when the AddOn does not show up in the list, you may need to register it first (see 2.3 Registering the AddOn on page 5)

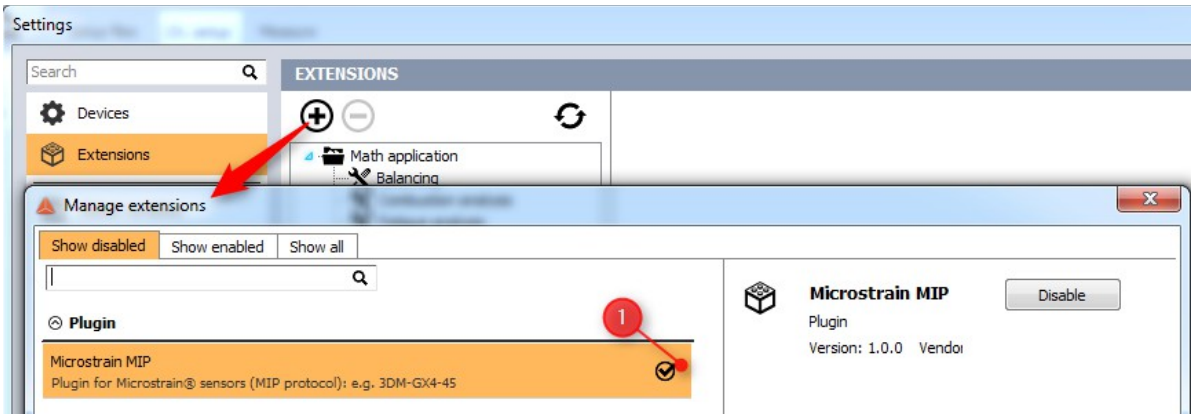


Illustration 3: Enable AddOn

2.3 Registering the AddOn

Before you can use *AddOns* in DEWESoft®, they must be registered once.

When DEWESoft® is started it will try to register all AddOns (`dll` files) that it finds in the `AddOns` folder. But in order to do that, DEWESoft® requires administrator permissions (because it must write to the Windows® registry). When DEWESoft® is not started with administrator permissions, the registration cannot be done automatically.

When the AddOn does not show up in the *Extensions* list, you must press the **Refresh** button (see ❷ in Illustration 4).
Note: you may need to start DEWESoft® as administrator (depending on the UAC settings of your Windows user/installation).
Also make sure that you use the correct `dll` file for your platform (`32-bit` or `64-bit`): see 1.4 Platform on page 2

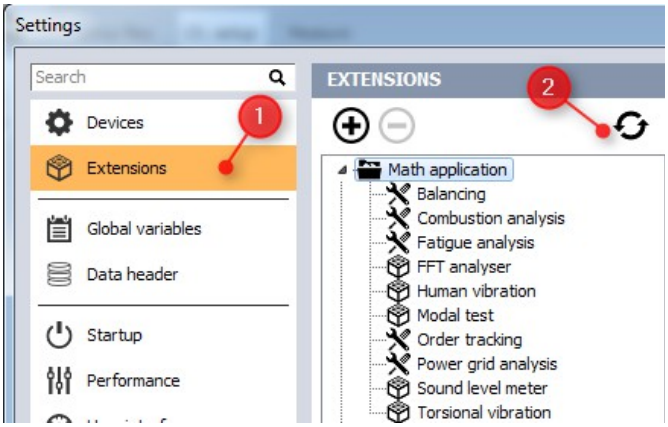


Illustration 4: Extensions: Refresh button

After pressing the **Refresh** button, you will see the registration Window (Illustration 5) for a short time. After that, you must restart DEWESoft®.

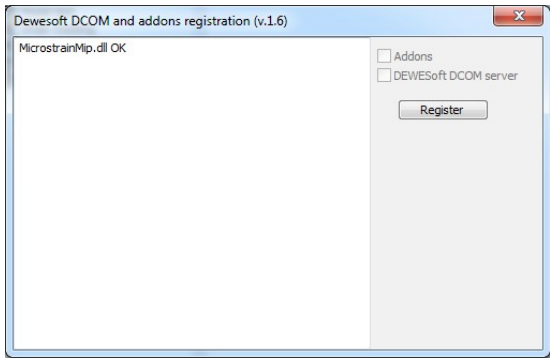


Illustration 5: Registration Window

2.4 Licensing

The AddOn requires a valid DEWESoft® license.
To test the AddOn you can use an *Evaluation license*.

2.4.1.1 Requesting an Evaluation license

You can request an *Evaluation license* from our homepage:
http://www.dewesoft.com/registration

(1) Click on *Evaluation license*
(2) Fill out all the required fields
(3) Click the **Request license** button

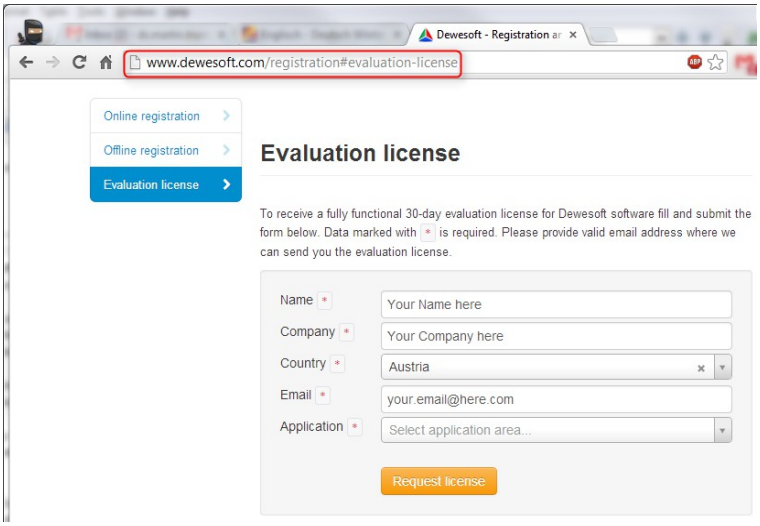


Illustration 6: Request Evaluation License

2.4.1.2 Activating the Evaluation license

When you have received your trial licence key, open DEWESoft®, go to *Settings* - *Settings*, select Licensing ❶ from the list. Click on *Create new license* ❷ and enter the *License number* ❸.

Then click the small arrow ❹ for *ONLINE license registration*.

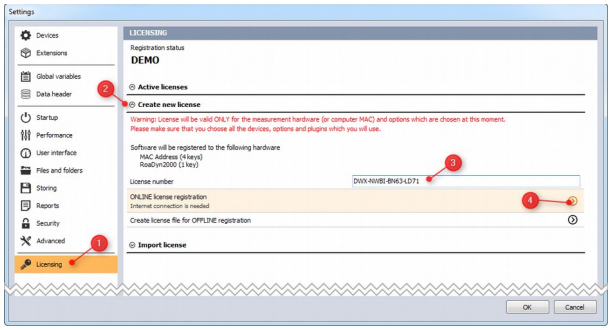


Illustration 7: Enter license key

After your license has been validated by our servers, the new license will show up in the list *of Active licenses*.

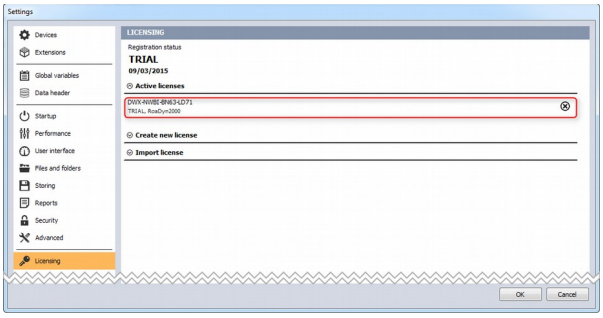


Illustration 8: Valid trial license

2.5 AddOn-Settings

After you have installed the AddOn (see 2 Installation Procedure), *start DEWESoft® and go to* *Options* – *Settings…*:

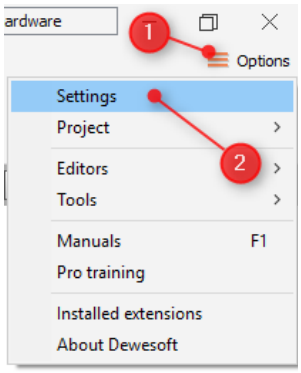


Illustration 9: Settings

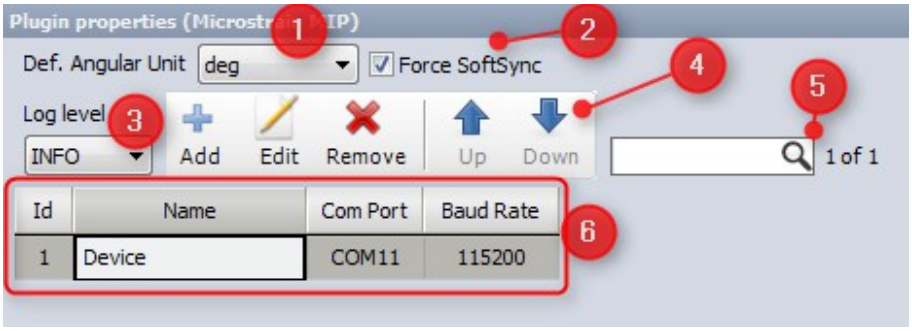


Illustration 10: AddOn Settings

To open the *AddOn Settings* click on *Options* – *Settings…*.

Note: *Options* will be disabled during the measurement.

In the *AddOn-Settings* select *Extensions* and then select *Microstrain MIP* in the *Extensions* tree (if you don't find it, see: 2 Installation Procedure on page 5).

(1) Default angular unit: will be used when you make new Channel Setups

(2) Only deactivate this when you use a UTC masterclock for DEWESoft® (i.e. ADMA): see 6.1 Time synchronisation modes on page 34

(3) General log level: see 2.6.4.1 Log levels on page 10
Note that also each device has it's own log level

(4) Toolbar for the Device grid: 2.6.1 Toolbar on page 8

(5) Grid Filter: filter box for the device grid: 5.4.1 Search-Box & Count-label on page 30

(6) Device grid: Shows a list of all configured devices: see 2.6.2 Hardware Devices Grid on page 8

2.6 Hardware Devices

The AddOn supports multiple devices. You can use the toolbar to manipulate the Devices in the Hardware Devices Grid.

2.6.1 Toolbar

The toolbar-buttons control the Devices in the Hardware Devices Grid.

Add	Will add a new device: see 2.6.3 Add/Edit Devices on page 8
Edit	Will open a dialogue window so that you can edit the currently selected device/s (only active if at least one device is selected): Add/Edit Devices on page 8 Note: you can also double click on a grid-row to edit the device/s. Note: if you have selected multiple devices, then you can press the **Cancel** button in the dialogue to abort the sequence (i.e. the dialogue will not be shown again for the remaining selected devices).
Remove	Will remove all selected devices. The button is only enabled, if you have selected at least one device.
Up	Will move the selected device/s up. The order of devices in the Hardware Devices Grid will also be used in the channel setup. The top device will be the leftmost device in channel setup.
Down	Will move the selected device/s down. The order of devices in the Hardware Devices Grid will also be used in the channel setup. The top device will be the leftmost device in channel setup.

2.6.2 Hardware Devices Grid

The grid shows all defined devices. Use the Toolbar (see 2.6.1 Toolbar on page 8) to manipulate the grid.

See also 5.4 Grid on page 30 for a general overview of the grid-features.

2.6.3 Add/Edit Devices

(1) *Device Name*: the name must be unique and it will be used to find the corresponding channel setup information: see 2.6.3.1 Device Name on page 8

(2) COM Settings: the COM port settings: see 2.6.3.2 COM Settings on page 9

(3) Log Settings: see 2.6.3.3 Log Settings on page 9

(4) Connection Test: see 2.6.3.4 Connection Test on page 9

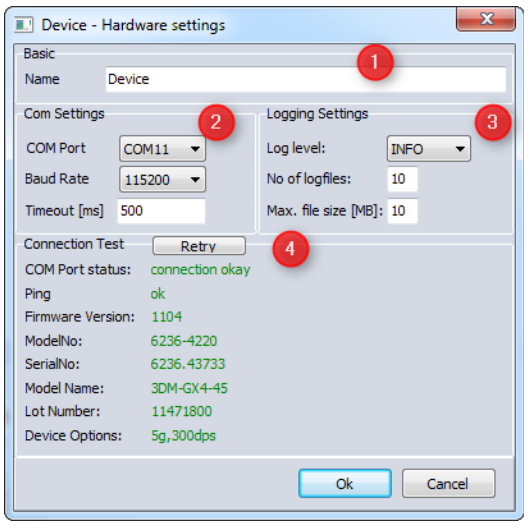


Illustration 11: Add/Edit Device

2.6.3.1 Device Name

The *Device Name* must be unique (i.e. you cannot create two devices with the same name). The *Device Name* is important because, it is used to find the corresponding channel setup information for the device. Thus you should not change the name once it has been set. If you change the device name, your saved channel setup files (`*.d7s`, `*.dxs`) may not work anymore – see 3.1.1 Orphaned Devices on page 9 for details on how to fix this problem.

2.6.3.2 COM Settings

The COM port settings:

- COM Port: the COM Port to which the sensor is connected – the COM Port will also show up in the Windows® Device Manager: see 5.1 Windows® Device Manager on page 29
- Baud Rate: the baud rate of the connected sensor
  Make sure that this is correct, otherwise no communication is possible!
  The default Baud Rate for 4DM-GX4-45™ sensors is *115200*.
- Timeout [ms]: the maximum time that the AddOn will wait for a response of the device when a command is sent.

2.6.3.3 Log Settings

These are the log-settings for the current device.

The log-level defines how much log-information will be written (it is recommended to use the default: *INFO*) – see also: 2.6.4.1 Log levels on page 10.

The log-files have a feature to limit the maximum amount of disk space that will be used. Whenever the logfile grows larger than *Max. file size [MB]*, it will be closed and a new log-file will be created. When the maximum number of log-files (defined by *No of logfiles*) is reached, the oldest file will be deleted.

The name of the log-file will contain the name of the device.

EXAMPLE 1

If your device is called Device A, the log-file name is: `Microstrain MIP_Device_A.log` (note: all non-ASCII characters may be replaced by underscores, to make sure, that it is a valid file-name: i.e. the space character in this example).

2.6.3.4 Connection Test

When you click the **Retry** button, the AddOn will try to

- open the COM Port
- send a ping to the Sensor (`0x01, 0x01`)
- read the device information (`0x01, 0x03`)

When the COM port could be opened successfully, the sensor will start to send the commands and wait for the reply of the sensor. During this time you may see the *in progress* status.

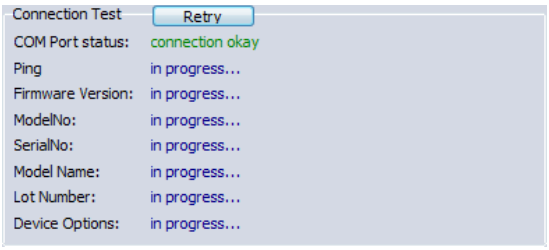


Illustration 12: Connection in progress

When all commands have returned successfully, the status will be okay.

Illustration 13: Connection okay

When the connection has timed out, check your COM settings (see 2.6.3.2 COM Settings on page 9):

- make sure that you have specified the correct COM port and Baud Rate
- try to increase the Timeout

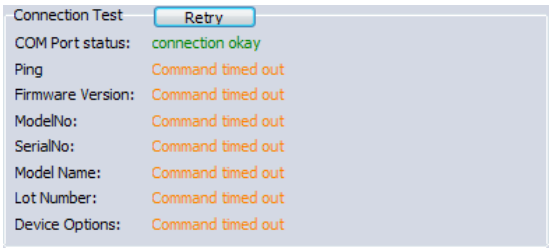


Illustration 14: Connection Timed Out

When the connection has failed:

- make sure that the sensor is connected to the specified COM port
- make sure that the COM port shows up in Windows® Device Manager
- make sure that no other software is currently using the COM port (i.e. close MicroStrain® MIP Monitor)
- try to increase the Timeout

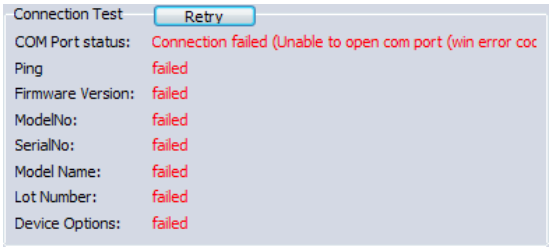


Illustration 15: Connection Failed

2.6.4 Log files

The AddOn will write log files during operation. The amount of log messages is configurable via the *Log level* drop down box in the *AddOn settings*. The name of the logfile is `MicrostrainMip.log`.

When the AddOn is started, it will immediately start to log to the windows temporary directory.

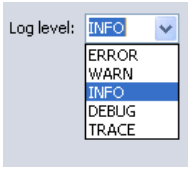
As soon as the DEWESoft® application is available to the AddOn, all subsequent logs will be written to the standard DEWESoft® log directory (e.g. `D:\DEWESoft\System\X3\Logs`).

Note: There is also a log file called `MicrostrainMip.dll.log` in the `AddOns` directory (see 1.6 Files and Directories). This will normally be empty. It will only contain messages when there is a bug very early in the AddOn initialization.

2.6.4.1 Log levels

With the *log level* drop down box you can set the detail level of the logging function.

If you set a high log level (e.g. *TRACE*, *ALL*) a lot of log messages will be written and the logfiles will roll over quite often. This is also dependent on the sample rate – the higher the sample rate is, the more often data will be fetched and thus more log messages will be written.



For production-use the log level *INFO* is recommended.

Log level	Description
Error	Will only log error messages
Warn	Will also log warning messages
Info	Will also log info messages – this is **recommended** for production use
Debug	Will also log debug messages
Trace	Will also log trace messages
All	Will log all messages

Table 2: Log Levels

3 Channel Setup

The *Microstrain MIP* channel setup will show you an overview of all devices and data-packets.

Id	Sensor	Name	Data Rate	Status	Used/Channels	Setup
1	IMU Data	GPS Correlation Timestamp	10Hz	ok	0/7	Setup
2	IMU Data	Scaled Accelerometer Vector	OFF	ok	Off/3	Setup
3	IMU Data	Scaled Gyro Vector	OFF	ok	Off/3	Setup
4	IMU Data	Scaled Magnetometer Vector	OFF	ok	Off/3	Setup
5	IMU Data	Scaled Ambient Pressure	OFF	ok	Off/1	Setup
6	IMU Data	Delta Theta Vector	OFF	ok	Off/3	Setup
7	IMU Data	Delta Velocity Vector	OFF	ok	Off/3	Setup
8	IMU Data	Cf Orientation Matrix	OFF	ok	Off/9	Setup
9	IMU Data	Cf Quaternion	OFF	ok	Off/4	Setup
10	IMU Data	Cf Euler Angles	OFF	ok	Off/4	Setup
11	IMU Data	Cf Stabilized Mag Vector	OFF	ok	Off/3	Setup
12	IMU Data	Cf Stabilized Accel Vector	OFF	ok	Off/3	Setup
13	GPS Data	GPS Time	4Hz	ok	0/6	Setup
14	GPS Data	UTC Time	1Hz	ok	0/10	Setup
15	GPS Data	LLH Position	OFF	ok	Off/11	Setup
16	GPS Data	ECEF Position	OFF	ok	Off/6	Setup

Illustration 16: Channel Setup Overview

(1) *Force SoftSync*: info about the related setting in HW-setup: see 2.5 AddOn-Settings on page 7

(2) Shows the version number of the AddOn

(3) Channel-setup pop-up menu: see 3.3 Channel setup pop-up menu no page 15

(4) Devices-tab sheet: when you have configured multiple devices in AddOn-Settings, then you can switch between the devices

(5) see 3.4 Device status information on page 15

(6) Switch between the Data (see 3.6 Device-Data on page 17) and Settings view (see 3.7 Device-Settings on page 20)

(7) see 3.6.1 Data Packet Setup Grid on page 17

3.1 Connection

In channel setup mode, the AddOn will try to establish a connection to the sensor. The connection status will be shown in the Device status information: see 3.4 Device status information on page 15.

3.1.1 Initialisation state

When the channel setup is loaded, but the sensor information has not been read yet (i.e. because the sensor is not connected to the USB port), the AddOn is in *Initialisation* state:

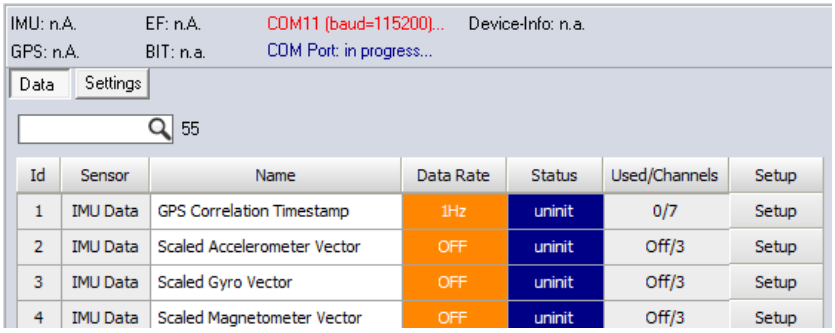


Illustration 17: Initialisation state

In this state, the AddOn will show all implemented data-packets and you can even change the settings (i.e. so that you can prepare the setup offline – without any sensor connected). But since the data is not initialised you should should take care: i.e. since the GPS base rate is not known, you can select all available *Data Rate*s – also *Data Rate*s that may be too high for the sensor: see also 3.5 Data Rate on page 16.

EXAMPLE 2

When no sensor is connected, you can set the data rate for the GPS data-packet '*LLH position*' to 500Hz. When you later connect a sensor where the GPS supports only a base rate of 4Hz (i.e. 3DM-GX4-45™), then the invalid rate will be ignored and the data-rate of the data-packet will be reset to *OFF*.
The same will happen when you connect a sensor that does not have a GPS included (i.e. 3DM-GX4-25™).

3.1.2 Initialisation

When the sensor is connected the AddOn will try to initialise the sensor like this:

- first the COM port will be opened
- `Set To Idle` command (`0x01`, `0x02`) is sent
- `Ping` command (`0x01`, `0x01`) is sent
- `Device Built-In Test (BIT)` command (`0x01`, `0x02`) is sent
- `Get Device Information` command (`0x01`, `0x03`) is sent
- `Get Device Descriptor Sets` command (`0x01`, `0x04`) is sent
- Then the base rates of the available sensor blocks are read:
  - `Get IMU Data Rate Base` command (`0x0C`, `0x06`) is sent
  - [Optional] `Get GPS Data Rate Base` command (`0x0C`, `0x07`) is sent
  - [Optional] `Get Estimation Filter Data Rate Base` command (`0x0C`, `0x0B`) is sent
- Next, the supported init-commands are sent (see also: 3.7.1 Initialisation Settings on page 21)
  - [Optional] `Heading Update Control` command (`0x0D`, `0x18`) is sent
  - [Optional] `Auto-Initialization Control` command (`0x0D`, `0x19`) is sent
  - [Optional] `Vehicle Dynamics Mode` command (`0x0D`, `0x10`) is sent

- Next, the message format for each sensor block (including the data rates) will be set.
  Note: in Channel setup mode all supported data-packets will be set to a data rates of max. 10Hz (i.e. the GPS sensor block may only support up to 4Hz)
  - `IMU Message Format` command (`0x0C`, `0x08`) is sent
  - [Optional] `GPS Message Format` command (`0x0C`, `0x09`) is sent
  - [Optional] `Estimation Filter Message Format` command (`0x0C`, `0x0A`) is sent
- Finally the `Enable/Disable Device Continuous Data Stream` command (`0x0C`, `0x11`) is sent to enable/disable the data-stream for all available sensor-blocks

see also: 3.7.3 Start Measurement Timeout [sec] on page 21

3.1.3 Connected state

Once the *Initialisation* is complete, the AddOn knows the supported sensor boards (i.e. IMU, GPS, EF), the supported data-packets, commands and base rates. The status column in the Data Packet Setup Grid (see 3.6.1 Data Packet Setup Grid on page 17) will turn green and the data-rates will be corrected according to the max. base rate of the sensor board (see also: 3.5 Data Rate on page 16).

In this state, the AddOn will constantly receive all available data from the sensor and add it to the corresponding channels: i.e. you can see the live data in the Data Response Dialogue (see 3.6.2 Data Response Dialogue on page 18), you can use the data in Math channels, or in other AddOns (i.e. Polygon AddOn) and also for Zeroing (see: 3.6.2.3 Zeroing on page 20).

3.1.3.1 Reconnect

Once, the sensor initialisation was okay, the AddOn will monitor the received data-packets. If no packets arrive for more than 1.5 seconds, the AddOn will close the COM port and try to reopen the COM port and also reinitialize the sensor.

When this happens during storing, the AddOn will write a text-events to the DEWESoft® event list:

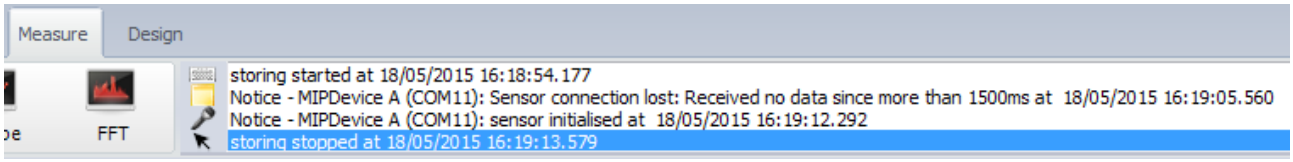


Illustration 18: Reconnect Text-Events

In Illustration 18 above, you can see that the connection loss was detected at `16:19:05` (We disconnected the sensor from the USB port) and that the connection was re-established 7 seconds later at `16:19:12` (When the sensor was reconnected).

3.2 Devices

The device tab sheet will show the names of all devices that are defined in the AddOn-Settings (in the same order as they are defined in the AddOn-Settings) – see also 2.6 Hardware Devices on page 8. If orphaned devices (see 3.2.1 Orphaned Devices on page 14) exist, they will be shown at the and of the list (right side).

Devices which contain errors or warnings will be displayed in red/orange colour.

3.2.1 Orphaned Devices

An orphaned device is a device that exists in channel setup, but does not exist (any more) in the current AddOn-Settings.

Orphaned devices may occur in the following cases:

1. When you go to AddOn-Settings, delete one of the devices (or rename a device) and go back to channel setup
2. When you load a setup which included a device that does not exist in the current AddOn-Settings (i.e. it may have been renamed)

It's best to explain this with a small example. Say we have defined 2 devices in the AddOn-Settings (see Illustration 19), named *Device A* and *Device B*.

Id	Name	Com Port	Baud Rate
1	Device A	COM11	115200
2	Device B	COM20	115200

Illustration 19: Hw Setup

Now we load an old setup which includes a device named *Old Device*.
Then the device list in channel setup will look like this:

The devices which are new (or still exist) in AddOn-Settings are listed first (in the same order like in the AddOn-Settings list).
And at the end (right hand-side) you have the orphaned *Old Device* which no longer exists in AddOn-Settings.
When you have an orphaned device in channel setup, you have the following options:

- Open the AddOn-Settings:
  you can add a device to the AddOn-Settings with the name of the orphaned device (or rename a an existing device) – then you can re-use the device.
- Delete the device, if you don't need it any more

3.3 Channel setup pop-up menu

When you click the gear-tooth icon at the right side of the version-label, you will see the channel setup menu.
The only item available is **Reset AddOn configuration**. This will reset the configuration of the AddOn to the defaults: i.e. all channel setup configuration of the Microstrain MIP AddOn will be reset to the defaults.
In contrast to really creating a new setup, all other channel setup settings (i.e. of other AddOns, DEWESoft® analogue channels, Math channels, etc.) will remain unchanged.

3.4 Device status information

This panel will show information about the device (see also: 3.1 Connection on page 12).

Illustration 20: Device status okay

When the BIT - Device Built-In Test `0x01, 0x05` – is not okay, the label will turn orange and you can hoover over it to see the detailed messages in the hint.

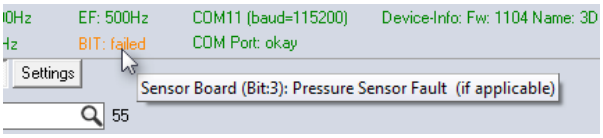


Illustration 21: BIT Warning

When the connection fails, the labels turn red and show the error message/s: see 2.6.3.4 Connection Test on page 9 for more details on possible connection problems.

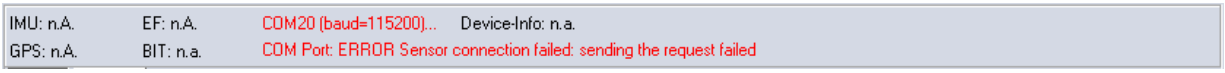


Illustration 22: Device status failed

When you load a channel setup the sensor will try to establish a connection to the sensor. During this time you may see the 'in progress message' – you also see this when the Sensor is currently not connected to the USB port:

Illustration 23: Device status in progress

3.5 Data Rate

The MIP protocol allows to set the data-rate for each data-packet individually. i.e. you can set the *Accelerometer Data* to 100Hz, but the *Ambient Pressure* data to only 1Hz.

Each sensor block (IMU, GPS, EF) has a base rate: this is the maximum possible rate that can be used:
i.e. for the 3DM-GX4-45™, the IMU base rate is 500Hz, the GPS base rate is 4Hz and the EF base rate is also 500Hz

When you set the data rate to *OFF*, the data-packet will be disabled (i.e. it will not be sent to the AddOn and does not consume any bandwidth).

IMPORTANT

When you set high data-rates for many data-packets, it's possible that some packets are lost or that the initialisation sequence does not succeed because of a timeout.
Quote from the MicroStrain® documentation:

> *Because of the large amount and variety of data that is available from the 3DM-GX4-45, it is quite easy to overdrive the bandwidth of the communications channel. This can result in dropped packets. The 3DM-GX4-45 does not do analysis of the bandwidth requirements for any given output data configuration, it will simply drop a packet [...] Often the best way to determine this is empirically by trying different settings and watching for dropped packets.*

3.5.1 Disabled Data Rates

The data-rate of some data-packets is fixed and cannot be changed by the user:

- the UTC Time (`0x81`, `0x08`) will always be set to 1Hz
- the GPS Time (`0x80,0x12` / `0x81,0x09` / `0x82,0x11`), will be set to a value, so that it is included in all data-packets of the corresponding sensor block

EXAMPLE 3

When you set the *IMU Scaled Accelerometer Vector* data rate to *4Hz* and the *IMU Scaled Ambient Pressure* data rate to *5Hz*, the *GPS Correlation Timestamp* will be set to *20Hz*, so that every data-packet also includes the timestamp.

3.5.2 Unsupported data rates

Before the sensor initialisation (see 3.1 Connection on page 12) has completed, the AddOn does not know the max. possible rate for the sensor blocks. Thus it is possible to select all available rates: up to 500Hz.

When you set an unsupported data-rate (i.e. 100Hz for a GPS data-packet, which only supports 4Hz), the data-rate will be reset to OFF once the base rate has been read.

When the base rates have not been read yet, you can select from all available Data Rates:

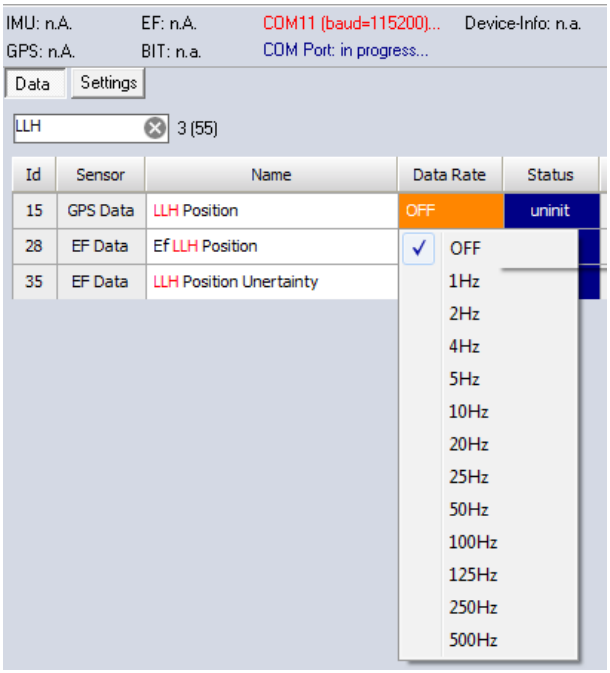


Illustration 24: LLH Data Rate: uninit

After the base rate of the GPS sensor block has been read, unsupported data rates will be reset to OFF and you can see that you now only have the valid rates for GPS in the Data Rate drop-down list:

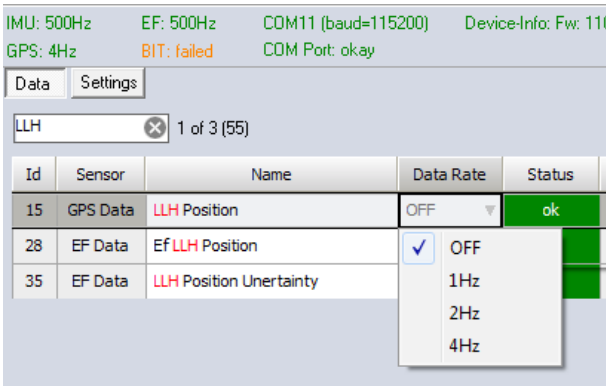


Illustration 25: LLH Data Rate: ok

3.6 Device-Data

The device data tab-sheet shows a list of all data-packets and allows to change the setup. In the Data Response Dialogue you can configure the individual channels and also see live-data from the sensor.

3.6.1 Data Packet Setup Grid

The Data Packet Setup Grid shows information about the data-packets and also let's you change the configuration

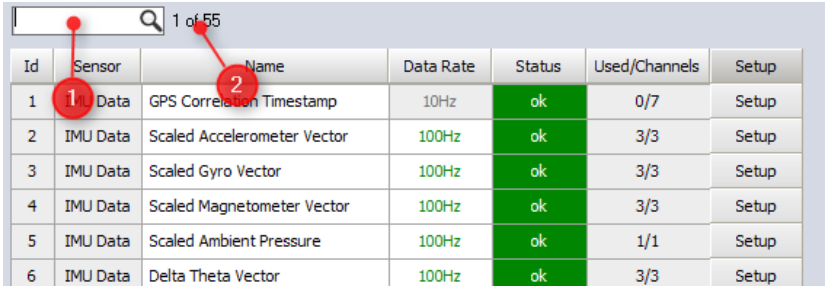


Illustration 26: Data Packet Setup Grid

Column	Information
Id	This is just a unique consecutive number to identify the row/channel of the grid
Sensor	The name of the sensor that the data-packet belongs to: i.e. the 3DM-GX3-45™ sensor has 3 different sensors: IMU, GPS, EF
Name	The name of the data-packet. This can be changed by the user. It will be used as channel group in Measure mode.
Field Name	It is the name of the MIP field, which is also used as default for the *Name* column. This text cannot be changed by the user. This column is hidden per default.
Hex Id	The hexadecimal representation of the data-packet: the 1st byte is the Descriptor Set byte and the 2nd is the Field Descriptor byte. This column is hidden per default.
Data Rate	The data rate for the data-packet: for details see: 3.5 Data Rate on page 16
Status	The status will change depending on the connection status: see 3.1 Connection on page 12 During the initialisation state, the column will show *uninit*. After successfully initialisation the status will change to *ok*. Note: the status can also be *unsupported*, but those rows would be hidden immediately.
Used Channels	Each data-packet can have a different number of channels. You may set individual channels to used/unused in the Data Response Dialogue (see 3.6.2 Data Response Dialogue on page 18). This column shows a summary of the channels: Number of used channels / Number of available channels
Setup	Click this button to open the Data Response Dialogue for the data-packet (see 3.6.2 Data Response Dialogue on page 18)

3.6.2 Data Response Dialogue

The Data Response Dialogue shows all individual channels of the data-packet. You can also change the Name and Sample Rate of the data-packet (same as the columns in the Data Packet Setup Grid - see 3.6.1 Data Packet Setup Grid on page 17):

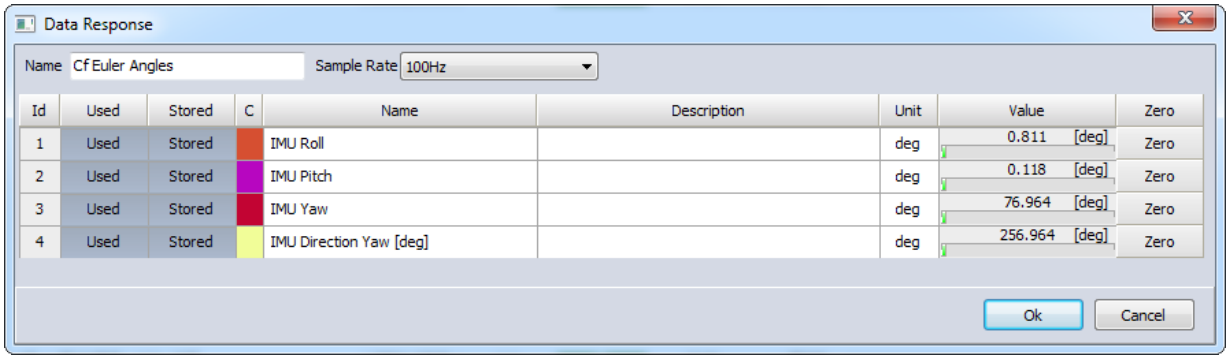


Illustration 27: Data Response Dialogue

3.6.2.1 Channel Setup Grid

Column	Information
Id	This is just a unique consecutive number to identify the row/channel of the grid
Used	You can click on the buttons in this row to toggle the *Used* status from **Used** to **Unused**. Only channels that are set to **Used** will show up in *Measure Mode* and can be stored in DEWESoft® data files. Note: Even when you set all channels to *Unused*, the data-packet will still be sent from the sensor to DEWESoft®. To really deactivate a data-packet, you must set the data-rate to *OFF*.
Stored	This is only useful if the channel is set to **Used** (see description above). For **Used** channels you may want to deactivate the **Store** button. Then you can see and use the values of this channel in *Measure Mode*, but the channel data will not be stored to the DEWESoft® data file. This can be useful if you just want to check the data, but don't need it after the measurement. Another use-case is to use the data of the channel in other *Math* channels (e.g. to do some statistics) and then only store the *Math* channel to the DEWESoft® data file (but not the original data).
C	This colour will be used by the displays in *Measure Mode*. You can click on the colour to change it.
Name	This is the name of the channel as it will show up in the channel list of the Measure mode. Make sure to enter a useful name for the channel (also it makes sense to use unique names to avoid confusion). If you enter a blank name, then you will get a warning.
Description	Detailed description of the channel – is empty per default. You can enter an arbitrary text.
Unit	This is the unit that will be displayed for the channel. See 3.6.2.2 Measurement Units on page 19 for details.
Value	This column will show the online data of the channels. Note: you will not see live-data when the *Sample Rate* is *OFF* or when the channel is set to *Unused*.
Zero	Zeroing is only available for some selected channels: see 3.6.2.3 Zeroing on page 20

3.6.2.2 Measurement Units

There *Unit* column may contain a drop-down menu or it may be a simple text-input.

When the cell has the focus you can see the small grey down-arrow. When you click the cell, the drop-down list will appear. When you change the unit, the value will automatically be converted: i.e. the scale of the channel will automatically be changed.
See also: 3.7.2 Change Angular Units on page 21

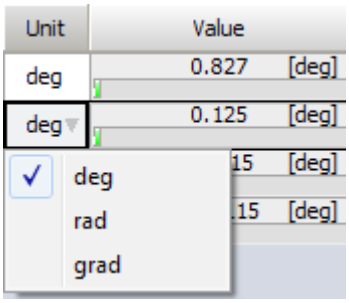


Illustration 28: Unit drop-down

When the cell is a simple text-input, you can click into the cell and change the text
Note: Changing the unit will NOT trigger any conversion! Thus, changing the unit is not recommended.

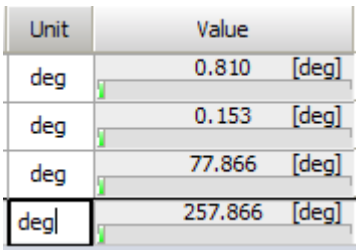


Illustration 29: Unit Text-Input

3.6.2.3 Zeroing

Some channel support zeroing: i.e. the Euler Angle channels Roll, Pitch and Yaw. Press the Zero button (also repeatedly) to do the zeroing. To clear the zeroing, you can right-click the (pressed) **Zero** button.

In the Illustration 30 you can see that the value of the channel is about 0.17 deg. When you press the zero button, the current value will be used as offset for the channel and thus..	...the value after pressing the **Zero** button will be 0 (see Illustration 31)[1].

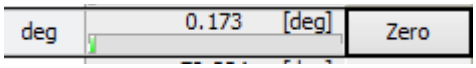
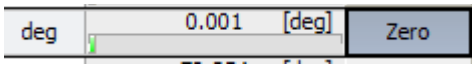

	

Illustration 30: Pre Zeroing	*Illustration 31: Zeroed*

HINT

You can also use the multi-select feature (see 5.4.3 Multi-select on page 32) to select multiple rows and then do the zeroing for multiple channels at the same time.

You can also do the zeroing in Measure mode: see 4.2 Zeroing on page 27

IMPORTANT

Note, that zeroing simply changes the offset of the channel.
For example; when you have a channel where the sensor sends data from 0 to 360 deg, and you do zeroing at 5 deg, then the offset of the channel will be set to those 5 deg.
Thus when the sensor sends the value of 360 deg, DEWESoft® will show 365 deg (which may not make sense for certain calculations).

3.7 Device-Settings

This chapter describes the Device Settings tab-sheet:

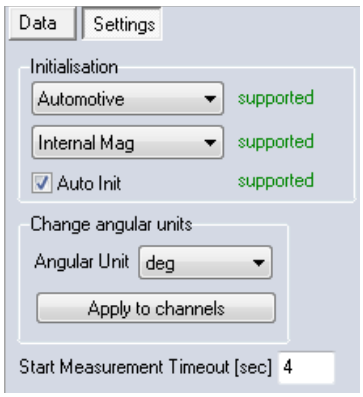


Illustration 32: Device Settings

1 In this example the value of the IMU Pitch channel was used which is not very stable. Thus the value already changed again a little bit after zeroing to 0.001 deg.

3.7.1 Initialisation Settings

This box contains some settings that will be used during the Initialisation of the sensor (see also: 3.1.2 Initialisation on page 13). The label at the right side will show the supported status (i.e. supported in Illustration 32): Other sensor types may not support those command: i.e. the 3DM-GX4-25™ sensor does not support `Vehicle Dynamics Mode`.

- `Vehicle Dynamics Mode` (command `0x0D`, `0x10`): default *Automotive*.
- `Heading Update Control` command (`0x0D`, `0x18`): default: *Internal Mag*
- `Auto-Initialization Control` command (`0x0D`, `0x19`): default *enabled*

3.7.2 Change Angular Units

When you click the **Apply to channels** button, the angular unit of all channels that support the angular unit (i.e. Euler Angle: Pitch, Roll, Yaw) will be changed immediately to the currently selected angular unit. See also 3.6.2.2 Measurement Units on page 19.

3.7.3 Start Measurement Timeout [sec]

When you start the measurement in DEWESoft®, the AddOn will start it's initialisation sequence (see 3.1.2 Initialisation on page 13). When the initialisation fails, or does not complete in the specified number of seconds, the AddOn will show an error-message and the measurement will not start.

3.8 Special Notes

Most data-packets and channels are straight-forward - just check the user documentation of your MicroStrain® sensor. This chapter covers data-packets and channels that have some special features.

3.8.1 GPS Time

The data rate of the GPS Time data-packets cannot be changed by the user and the related channels are deactivated per default. Note that the GPS Time channels will always contain the data from the sensor (even if the time is marked as invalid – because it is always used for synchronisation (see also: 6.1 Time synchronisation modes on page 34) – either *SoftSync* or *UTC Sync*):

- IMU: GPS Correlation Timestamp (`0x80, 0x12`)
- GPS: GPS Time (`0x81, 0x09`)
- EF: GPS Timestamp (`0x82, 0x11`)

In addition to the data that is sent from the sensor, there are 2 additional channels that represent the same information in a different format to make the time information easier to read in the digital display controls. These channels will only contain data when the GPS time is valid:

- Abs. GPS time: this channel is marked as *Absolute time* channel
- Rel. GPS time: this channel is marked as *Relative time* channel

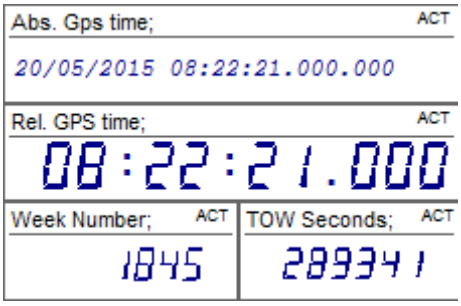


Illustration 33: GPS Time channels

3.8.2 UTC Time

The data rate of the UTC time data-packet (of the GPS sensor block) cannot be changed by the user and the related channels are deactivated per default. A valid UTC Time is required, when you want to use UTC Sync (see also 6.2.1 UTC Time on page 35).
In addition to the data that is sent from the sensor, there is an additional channel '*Abs. UTC time*' which is marked as *Absolute time* channel: This channel is easier to read and use in visual controls, as the individual channels (i.e. Year, Month, etc.). Note: this channel will only contain data when the valid flags are asserted.

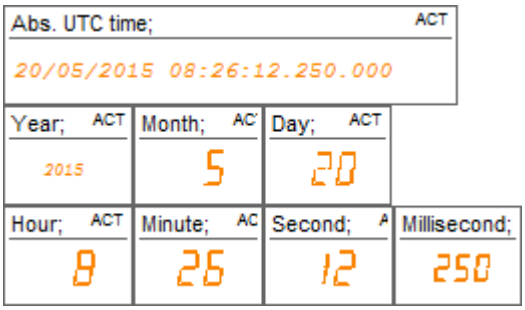


Illustration 34: UTC Time channels

3.8.3 GPS data channels

Some channels are marked as GPS data channels, so that you can use them in the DEWESoft® GPS visual control:

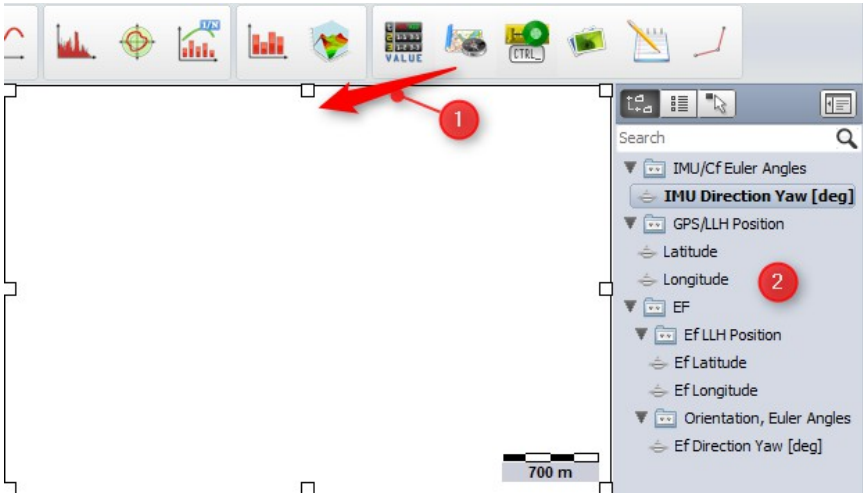


Illustration 35: GPS visual control

Notes:

- The GPS visual control will only be available when at least one of the GPS data channels is set to used
- When the GPS visual control has the focus, only GPS data channels will show up in the channel selection list (see ❷ in Illustration 35)

3.8.4 Angular channels

Angular channels have support zeroing (see 4.2 Zeroing on page 27) and Measurement Unit conversion (see 3.6.2.2 Measurement Units on page 19 for details):

- IMU Roll, IMU Pitch, IMU Yaw
- EF Roll, EF Pitch, EF Yaw
- GPS Heading, EF Heading
- see also Direction below

3.8.5 Direction

The following channels represent a direction and are angular channels (see Angular channels above):

- IMU Yaw
- GPS Heading
- EF Yaw
- EF Heading

For each of these channels, there is an additional *direction* channel, which has the unit fixed to the unit *deg* and an offset of 180°, so that it's range is from 0° to 360°. These channels are marked as GPS direction channels, so that they can be used by the DEWESoft® GPS visual controls.

3.8.6 Valid Flags

Many data-packets include valid flags for the data. The AddOn will only add the received data to the channels when the corresponding valid flags are asserted.
For example, let's take a look at the *ECEF Velocity* data-packet:

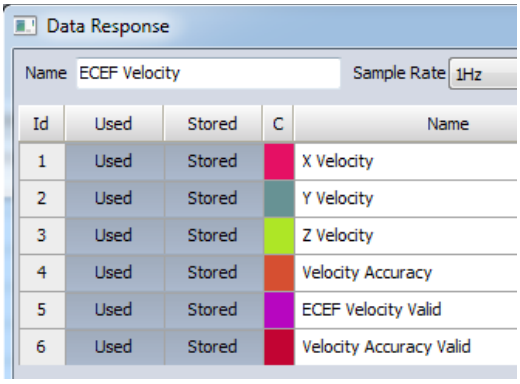


Illustration 36: Valid Flags

It includes 2 valid flags:

- *ECEF Velocity Valid*: corresponds to the channels *X Velocity*, *Y Velocity*, *Z Velocity*
- *Velocity Accuracy Valid*: corresponds to the channels *Velocity Accuracy*

Note: the valid channels will only include sample points when their status changes (not at the full sample rate):

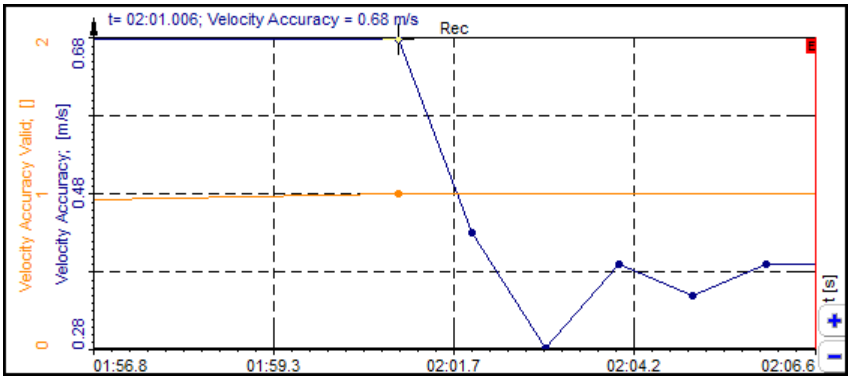


Illustration 37: Recorder Valid Flag

In Illustration 37 you can see that the *Velocity Accuracy* data is sampled at the specified sample rate: i.e. one sample point every second (because the data-rate was set to 1Hz). The *Velocity Accuracy Valid* channel has only one data-point. Actually the sensor does also send this information to DEWESoft® every second, but the AddOn will discard the data when it does not change[2]. This is a very nice feature, because it means that you can just store all valid flags channels in the DEWESoft® data-file without worrying about the file-size.

2 Actually the data will also be written to the channel every 10 seconds when it did not change. Otherwise the displays in the analyse mode would show "No Data" when there is no data in the channel for a long period of time.

3.8.6.1 Valid Flags and Indicator Lamp

You must take some care when you assign *Valid Flags* to Indicator Lamps because the default colour settings of the Indicator Lamp visual control may be confusing.
For example, let's add an Incidator Lamp visual control to our measurement screen and assign a Valid Flags channel (e.g. *Velocity Accuracy Valid*) to it:

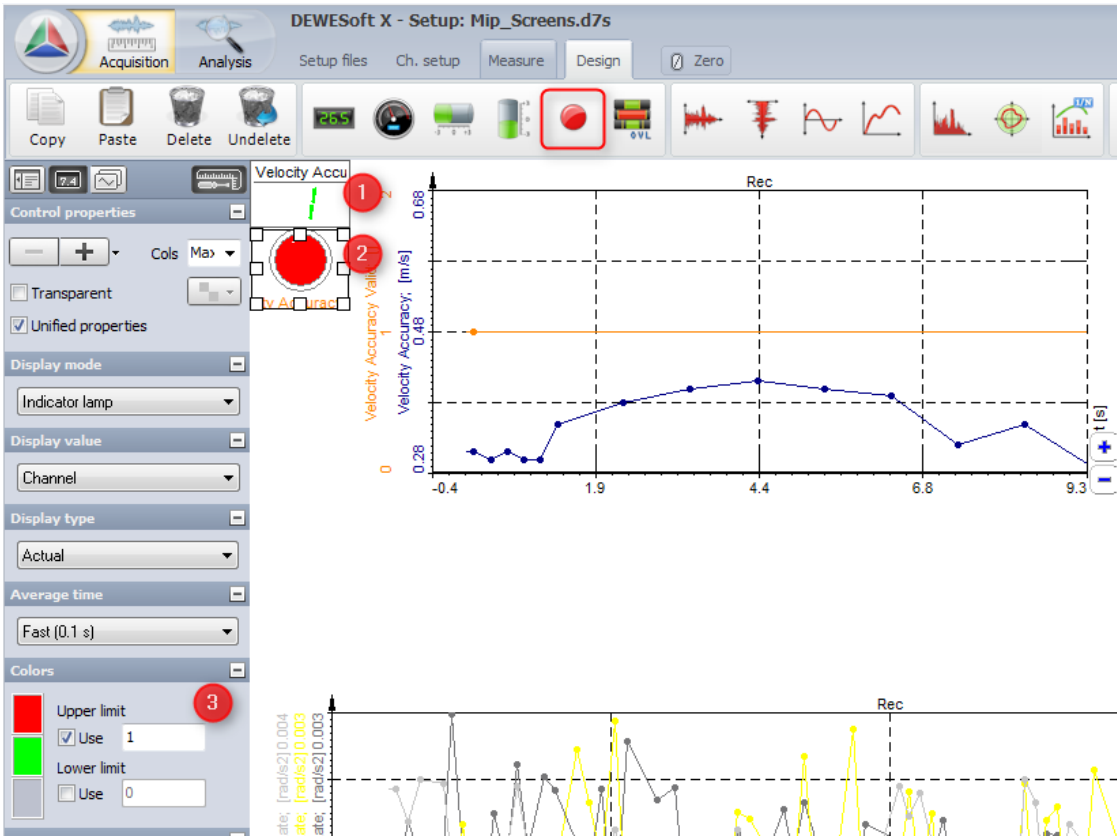


Illustration 38: Valid Flags: Indicator Lamp Default

You can see that the value of the channel is 1 (in the digital control ❶), which means, that the corresponding data is valid. But the Indicator Lamp ❷ is red, which is usually associated with the meaning of something being invalid.

To remedy the problem, we can simple swap the default colours of the Indicator Lamp visual control ❸:

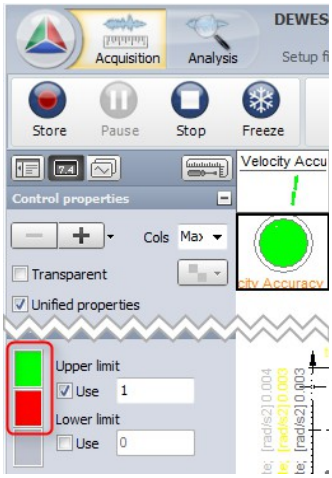


Illustration 39: Valid Flags: Indicator Lamp Swapped Colours

Now that the colours are swapped, the Indicator Lamp will be green when the valid flag channel is 1 and red when it is 0. Unfortunately there is currently no way for the AddOn to change this automatically.

3.8.7 Sync Mode

Each sensor has a Sync Mode channel that displays the currently used sync mode (SoftSync or UTC – for details see 6.1 Time synchronisation modes on page 34).When the *Force SoftSync* checkbox in AddOn-Settings (see 2.5 AddOn-Settings on page 7) is enabled, the Sync Mode channels will of course always be *SoftSync*. Otherwise it may also be *UTC*. The AddOn only writes data to these channels, when their value changes.

3.8.8 Status Channel

The status channel will contain status messages when you use Control Channels: see 4.2.1 Control Channels on page 27.

4 Measurement

4.1 Start of measurement

When the measurement is started the AddOn will try to initialise all configured sensors (see 3.1 Connection on page 12). If the initialisation fails or does not complete in the specified timeout (see 3.7.3 Start Measurement Timeout [sec] on page 21), the AddOn will show an error message and abort the measurement.

4.2 Zeroing

When you have activated any channels that support zeroing (see also 3.6.2.3 Zeroing on page 20), you will also see the Zero button in Measure mode. When you click this button, ALL channels that support zeroing will be zeroed.

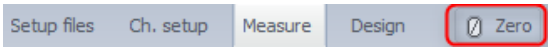


Illustration 40: Measure Mode: Zero button

4.2.1 Control Channels

The AddOn also supports some control channels that can be used during measurement to send commands to the MicroStrain® sensor:

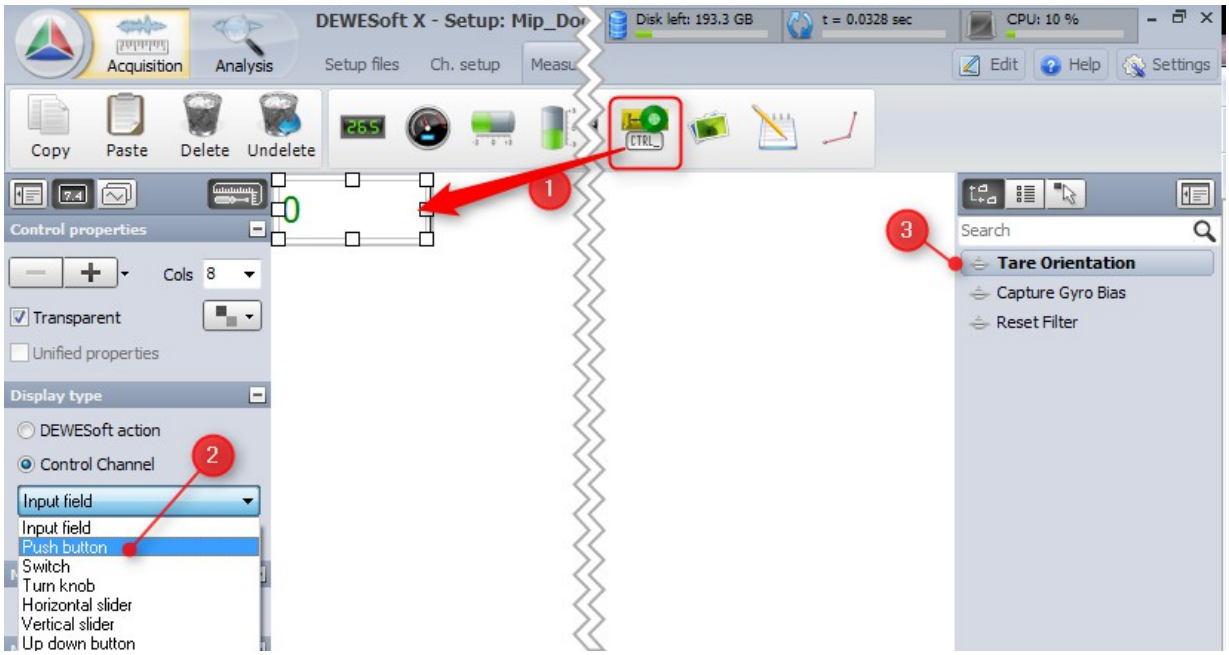


Illustration 41: Add Control Channel

To add a control channel, go to *Design Mode* and add an *Input Control display* to the measurement screen ❶. Switch the *Control Channel type* to *Push button* ❷. Note: when the *Input Control display* is focused, the channel list ❸ will only show control channels. Then the *Input Control display* should look like ❶ in Illustration 42.

It is also recommended to add a *Tabular values display* for the *Status channel*. First add the *Tabular values display* ❷ to the measurement screen and then assign the *Status Channel* from the channel list ❸:

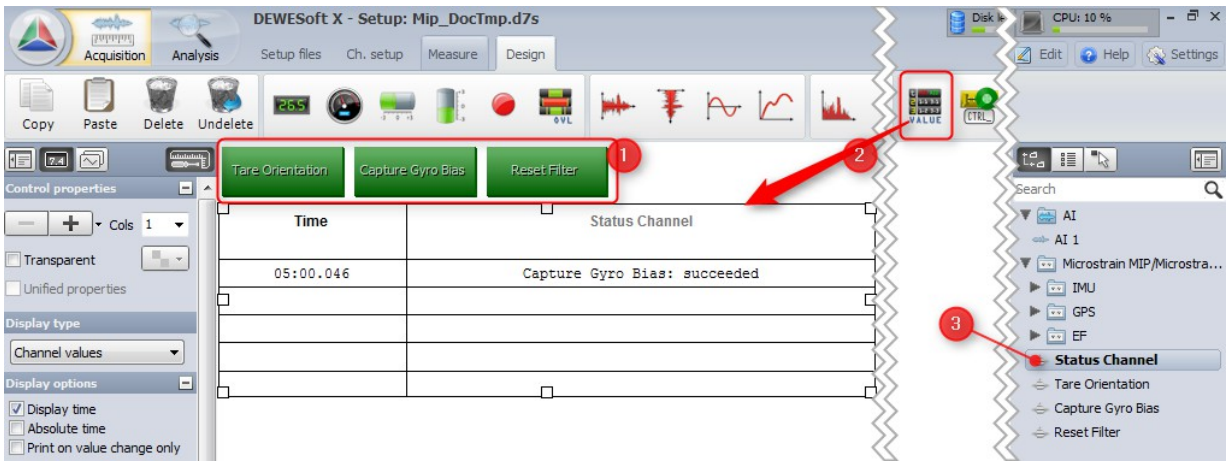


Illustration 42: Add Status Channel

Whenever you press the button for any control channel, the corresponding command will be sent to the sensor and when the response is received (or an error or timeout occurs), a message will be written to the status channel: i.e. in Illustration 42 you can see the status message after the *Capture Gyro Bias* command was successfully executed.

Only control channels that are supported by the sensor will show up: i.e. the `Set Initial Attitude with Magnetometer` command is not supported by the 3DM-GX4-45™ and does not show up in the channel list (❸ in Illustration 42).

4.2.1.1 Tare Orientation

Will send the `Tare Orientation` command (`0x0D, 0x21`) for all 3 axis to the sensor.

4.2.1.2 Capture Gyro Bias

Will send the `Capture Gyro Bias` command (`0x0C, 0x39`) for 1 second to the sensor.

Note: the 1 second time is fixed and cannot be changed (since the sensor does not send any data during this time, the AddOn would reconnect after 1.5 seconds! See 3.3 Channel setup pop-up menu on page 15).

4.2.1.3 Reset Filter

Will send the `Reset Filter` command (`0x0D, 0x01`) to the sensor.

4.2.1.4 Set Initial Attitude with Magnetometer

Will send the `Set Initial Attitude with Magnetometer` command (`0x0D, 0x04`) to the sensor.

Note: this command is supported by the 3DM-GX4-25™ sensor (but not by 3DM-GX4-45™).

5 General

5.1 Windows® Device Manager

You can open the Windows® Device Manger to check if the COM port for the MicroStrain® sensor shows up as expected.

When the MicroStrain® sensor is connected via USB, then it should show up under the *Ports (COM & LPT)* node as *STMicroelectronics Virtual COM Port*. You must use this port number (COM11 in this example) in the AddOn-Settings of your device: see 2.6.3.2 COM Settings on page 9.

When the COM port does not show up in the Windows® Device Manager, make sure that you have installed the MicroStrain® drivers correctly: please consult the MicroStrain® user documentation.

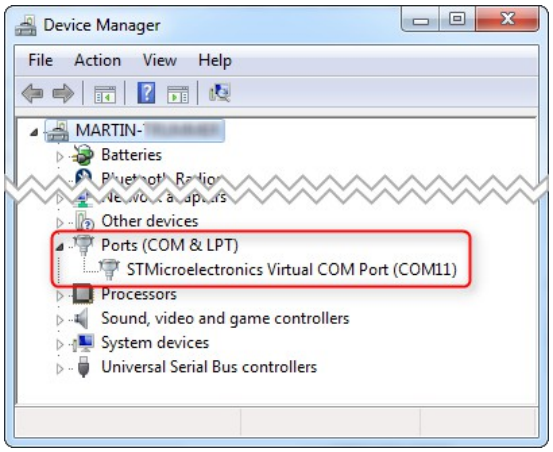
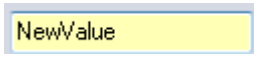


Illustration 43: Windows® Device Manager

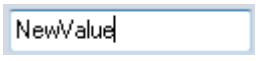
5.2 Input Fields

5.2.1 Input Confirmation

When you change the value of an input field, the background colour of the input field will turn yellow to indicate that you have changed something and that this change has not been confirmed yet.
Your input will automatically be confirmed when you set the focus to another input filed (i.e. by clicking with the mouse or by pressing the Tab key).
You can also press Return to manually confirm your change.



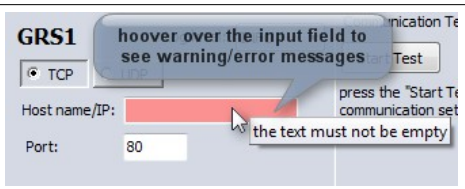
After the input has been confirmed the background colour of the input field will be white again (or red/orange, when there are errors/warnings).



5.2.2 Input Warnings/Errors

An invalid input may cause a warning and error.

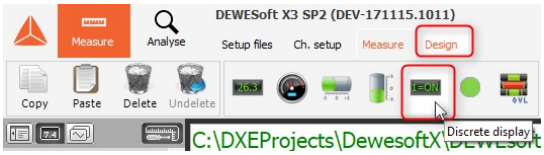
Warnings will be highlighted in orange, errors in red. When you hover over the input field you will see a hint with a detailed description of what is wrong:



5.3 Discrete Items

Some channels have discrete values assigned – this is best displayed with the *Discrete display* visual control:

1. click on the *Discrete display* visual control
2. move the *Discrete display* visual control to the screen
3. and finally assign a channel that has a discrete items list assigned



5.4 Grid

This chapter describes some general features of the grid.

5.4.1 Search-Box & Count-label

The search box can be used to easily filter the Grid, so that it only shows rows that contain the search text. The count-label on the right side of the search box shows information about the rows in the grid. It can show the total number of rows, the number of filtered rows and the number of currently selected rows (you can hover over the label to see a hint).

This is best explained with a simple example: see Illustration 44.

We have 55 rows in the grid, the filter box is empty and no rows are selected. In this case the count-label shows the total number of rows in the grid: in this example `55`.

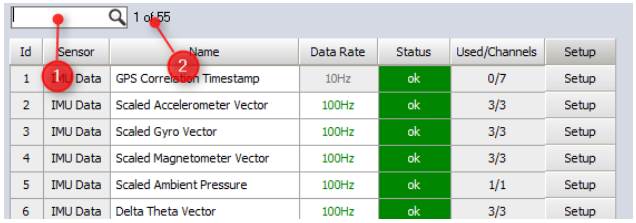


Illustration 44: Grid: 55 rows

When you now select 2 rows in the grid (see 5.4.3 Multi-select), you can see that the label shows `2 of 55` (2 rows of the total 55 rows are selected).

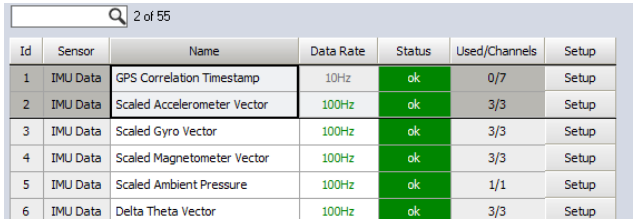


Illustration 45: Grid: 55 rows, 2 selected

Now let's enter the text *LLH* into the search box. You can see that the grid is immediately filtered and only the rows that match our input text are shown (the matching part of the text will be highlighted in red).

The count label changed and now shows `3 (55)` to indicate that only `3` of the total `55` rows are visible because we have filtered the grid.

To clear the filter, you can:

- simple delete the text in the search-box
- press the X-icon on the right side
- press the Esc button (while the focus is on the search-box)

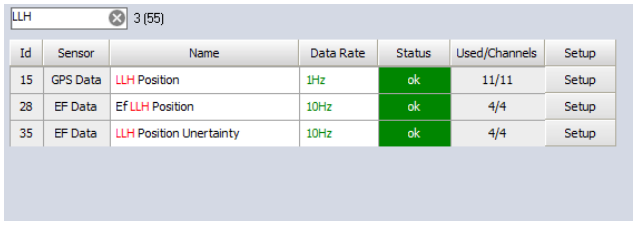


Illustration 46: Filtered Grid: shows 3 rows (of 55)

When you now select one of the 3 filtered rows the count label will change again to: `1 of 3 (55)` to indicate that one row of the `3` filtered rows is selected – and that there are `55` rows in total.

Illustration 47 also shows the hint that will appear when you hoover the mouse over the count label.

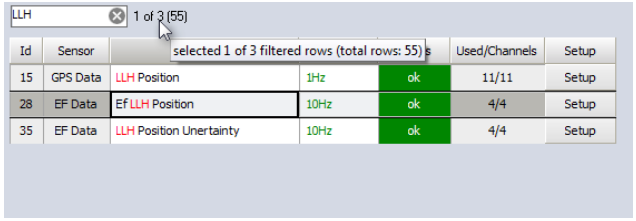


Illustration 47: Filtered Grid – one row selected

5.4.2 Header pop-up

When you right-click on the header row of the grid, you can specify which columns you want to see (i.e. show/hide columns) and you can also sort/unsort the grid by certain columns.

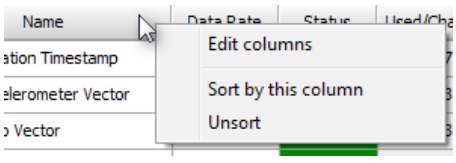


Illustration 48: Grid: Header Popup

5.4.2.1 Edit columns

When you click *Edit columns* from the pop-up, you will see the *Choose columns* dialogue (see Illustration 49). In this dialogue you can:

- change the order of the columns (**Move up** and **Move down** buttons)
- change the visibility of the columns (**Show** and **Hide** buttons)
- change the column width (edit field at the bottom)
- reset everything to default (button **Default**)

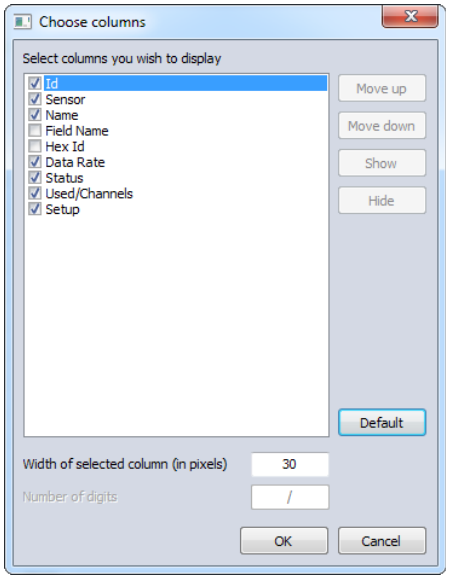


Illustration 49: Choose columns

5.4.2.2 Grid Sorting

When you select *Sort by this Column* from the header pop-up menu (see Illustration 48), the grid rows will be sorted by the values of the selected column: i.e. in Illustration 50 the grid is sorted by the *Name* column in ascending order. The small arrow at the bottom of the column reader (see red rectangle in Illustration 50) represents the sort order which is now ascending.
Select *Sort by this Column* again, to change the sort order to descending.
Also note that the values of the *Id* columns have also changed accordingly: i.e. the *Id* it is not a row-number relative to the grid, but it is a unique number, that identifies the row.
When you select *Unsort* from the header pop-up menu (see Illustration 48), the rows will be in the default order (ordered by *Id*) again.
Note that some Grids allow to move their elements Up/Down. This is of course only possible if the grid is *Unsorted*.

Id	Sensor	Name	Data Rate
34	EF Data	Accel Bias	10Hz
48	EF Data	Accel Scale Factor	10Hz
50	EF Data	Accel Scale Factor Uncertainty	10Hz
39	EF Data	Accelleration Bias Uncertainty	10Hz
54	EF Data	Antenna Offset Correction	10Hz
55	EF Data	Antenna Offset Correction Un...	10Hz
37	EF Data	Attitude Uncertainty Euler An	10Hz

Illustration 50: Sorted Grid

5.4.3 Multi-select

You can select and edit multiple rows/cells at once.

The selected cells will be surrounded by a black rectangle. When you click into the selected region, you can apply actions to all selected rows at once (e.g. clicking a button, selecting from a drop-down menu or entering text)..

Note: some text-columns have an auto-enumeration feature: i.e. when you start to write text into the *Name* column for a range-selection (as shown in Illustration 52) and enter e.g. IMU, then the 3 selected channels will be named IMU 1, IMU 2, IMU 3.

Range selection (see Illustration 51):

1. left-click a cell and hold the mouse button
2. move the mouse (while still holding down the mouse button) to the target cell and then release the mouse button
3. now the *Name* column of 3 rows is selected

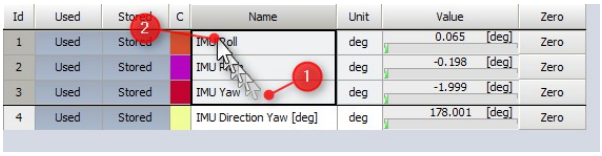


Illustration 51: Range selection

Arbitrary selection (see Illustration 52):

1. click the *Name* column of row 2, to select row 2
2. hold down the Ctrl key and click into the *Name* column of row 4, to add row 4 to the selection. Now rows 2 and 4 are selected but row 3 is not.

Release the Ctrl key when you are done selecting channels

Illustration 52: Arbitrary Selection

6 Advanced

6.1 Time synchronisation modes

The AddOn can use SoftSync (based on GPS correlation timestamps) or the UTC time. In most cases you want to use SoftSync (which is also the default).

6.1.1 General

The AddOn will make sure that each response that is received will also contain the sensor GPS timestamp (by setting the GPS timestamp data-rate accordingly) as the first field. Moreover each field that was received in the same data-packet will have the same tick count.

Note: one exception to this rule is when the response is too long to fit into a single MIP data-packet (i.e. when you activate all EF data-packets). In this case the sensor will split the response into 2 parts – then only the first data-packet will start with the GPS timestamp information. The second data-packet will reuse this very same information for time-stamping.

6.1.2 SoftSync

In *SoftSync* mode, the AddOn will use the GPS timestamp information (these are available in all sensor blocks) as reference for the SoftSync algorithm. The GPS (correlation) timestamp will be used for permanent slightly adjustments to the DEWESoft® time of the AddOn: so even, when the measurement is running for days, the sensor time and the DEWESoft® time will not drift apart.

Notes:

- Always make sure, that the CPU load is not too high. The *SoftSync* algorithm will not work well, when the CPU load is too high (i.e. <80 % CPU load worked fine in the tests).
- The AddOn will automatically handle big jumps in the GPS time:
  i.e. when you connect the sensor (and it does not have any GPS signal yet), then the GPS time will start from 0 and increase every second – based on the sensor-internal clock).
  When the GPS signal becomes available, the GPS time will jump to the current time (e.g. from 20 sec to 1200 sec).

6.2 Time synchronisation

Note: this chapter is very detailed and only relevant to understand the internal implementation. It is more dedicated to developers than to users.

The MicroStrain® sensors may have multiple internal sensor blocks: e.g. the 3DM-GX4-45™ has 3 sensor blocks:

- GPS: a GPS sensor block, that can receive GPS data, including accurate GPS time, UTC time
- IMU: Inertial Measurement Unit
- EF: Extended Kalman Filter

Each sensor block has an internal clock. When the GPS signal is available, then the 3 internal clocks will be kept in sync – otherwise they become free running and will drift apart (in the long run).

The AddOn will configure the sensor to send the GPS time (of each sensor block) in each data-packet. And the UTC time (if available) – every second (i.e. at a data-rate of 1Hz).
Note: for the GPS sensor block, this means, that the UTC time and the GPS time are received in the same data-packet and are thus in sync. The GPS times of the other sensor blocks (IMU, EF), will be internally adjusted by the sensor, so that they match the GPS time of the GPS sensor block.

6.2.1 UTC Time

To use UTC Time sync:

- You must deactivate the *Force SoftSync* checkbox in AddOn-Settings: see 2.5 AddOn-Settings on page 7
- The sensor must support UTC Time (i.e. it must have a GPS sensor block)
- DEWESoft® must also use a UTC time source as master clock (e.g. ADMA, GPS, etc.)
- Both time sources (the DEWESoft® Masterclock and the MicroStrain® sensor) must have a valid UTC time)
  Note: it take up to several minutes depending on the GPS system and the number of satellites in sight until the UTC time is available

Notes:

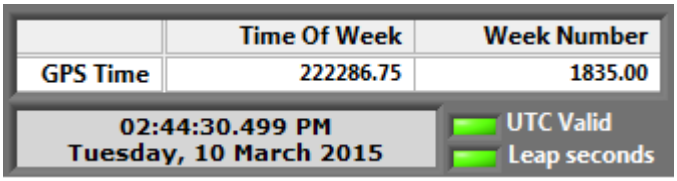
- You should wait until DEWESoft® and the MicroStrain® sensor have a valid GPS signal before you start storing.
  When you start storing before the MicroStrain® sensor has a valid UTC time, it will start in *SoftSync* mode and later (when a valid UTC time is available) it will switch to UTC time sync.
- When the MicroStrain® sensor has once found a valid UTC time, it will always continue to report that the UTC time is valid (even when the GPS signal is lost).
  The AddOn will constantly check the UTC time. And when no new UTC time is received for more than 10 minutes, the AddOn will switch back to *SoftSync*.

6.2.2 UTC Timing Example

This chapter will explain in detail what happens when the UTC time is available for DEWESoft® and for the MicroStrain® sensor.

Notes to GPS and UTC time:

- The AddOn will set the data-rate of the UTC time to 1Hz, so that we receive the UTC time once a second. The GPS time of the GPS sensor block is set to a data-rate, so that it is included in every data-packet.
  Thus, we get the UTC time and the GPS time of the sensor block in the same data-packet every second: we call this information: `UTCInfo`
- Of course the UTC time may be invalid (i.e. because not enough satellites may be in sight): then we must discard the info and wait a little longer or switch to SoftSync.
- Unfortunately the GPS time and the UTC time that we receive from the MicroStrain® sensor GPS block (in the same data-packet) are not fully synchronized. Here is an example from the MicroStrain® MIP Monitor application:



  you can see that the milliseconds of the GPS time do not match the milliseconds of the UTC time: `750` vs `499`!

  - According to the MicroStrain® support the “UTC time can trail the GPS anywhere up to `750` milliseconds”.
    In other words the UTC time may be up to `750` ms older than the GPS time (even though they are in the same data-packet).

- Thus the AddOn must adjust this mismatch: i.e. it will correct the milliseconds of the UTC time to match the GPS time:
  for the example above it means that the real UTC time is: `02:44:30.750`
  since this correction is done right when we receive the `UTCInfo`, we need not consider this in the following discussion: i.e. whenever we talk about the UTC time or `UTCInfo` we refer to the real UTC time (corrected milliseconds)

Now that we have the correct `UTCInfo` from the GPS we can take a look at the timing synchronization for the other sensor blocks (IMU, EF):

- Whenever a data-packet from the sensor is received, it will be inserted into an internal buffer (note, that every data-packet contains a GPS correlation timestamp)
- `TsdiDrGpsUTCTime.Add()`: The GPS sensor block will always remember the most recent valid UTC time. The UTC time is considered valid, when the valid flags are asserted, and when the difference between the Sensor UTC time and the current DEWESoft® UTC time is not too high (max. 1.5 seconds).
- When `TDevice.EvOnGetData()` is called, the AddOn will check if a valid UTC time is already available
  - When we do NOT have a valid UTC time yet, the AddOn will wait for about 1 second (the data will remain in the buffer) – When we did not receive a valid UTC time after about 1 second, the AddOn will switch to *SoftSync* mode.
    Note: when the UTC time becomes valid at a later time, the AddOn will switch back to *UTC Sync*.
  - When a valid UTC time is available we make sure that it is not too old (i.e. when the most currently received UTC time info is older than 10 minutes it is considered invalid and we will switch back to *SoftSync*), it will be used for synchronisation:
    → this is the case that we will consider here
- So now we have a valid `UTCInfo` (UTC time and the related GPS time from the GPS sensor block). These 2 times are in sync (i.e. they have been received in the same data-packet and the milliseconds have been corrected, as explained above).
  Example: `UTCTimeOfLastValidUTCInfo = 10, March 2015 02:44:30.750 PM`
  → related GPS time: `GPSTimeOfLastValidUTCInfo = WeekNo=1835, TOW=222286.75`
- What we really need for adding the data to the DEWESoft® channels, is the elapsed time in seconds since the start of the measurement: i.e. for the `IChannel.AddAsync*Sample()` functions
  So the first step is to calculate this for the last valid `UTCInfo`:
  `LastValidUTCInfo_ElapsedTimeInSec=(UTCTimeOfLastValidUTCInfo) - (IData.StartStoreTimeUTC)`
  Example: when we assume that the `IData.StartStoreTimeUTC` is `10, March 2015 02:44:25.00 PM`
  Then we have the following 3 different time-representations for the last valid `UTCInfo`:
  ```
  UTCTimeOfLastValidUTCInfo =  10, March 2015 02:44:30.750 PM
  GPSTimeOfLastValidUTCInfo = WeekNo=1835, TOW=222286.75
  LastValidUTCInfo_ElapsedTimeInSec = 5.750 sec
  ```
- Since each arrived data-packet also includes the GPS time, the adjustment for each data-packet is easy:
  we can just add the time difference between the data-packets GPS time to the UTC reference GPS time (`GPSTimeOfLastValidUTCInfo`) (which is equivalent to `LastValidUTCInfo_ElapsedTimeInSec`).
  Example: let's assume a data-packet that has a GPS timestamp of:
  `SampleGPSTime= WeekNo=1835, TOW=222286.35`
  then the difference to the reference GPS time is:
  `GPSDelta = GPSTimeOfLastValidUTCInfo - SampleGPSTime = -0.4sec`
  now add this to the `LastValidUTCInfo_ElapsedTimeInSec`:
  `LastValidUTCInfo_ElapsedTimeInSec + GPSDelta`
  and we have the DEWESoft® time of the sample point: `5.35sec`

6.3 Debug Channels

In the debug version, there are some more channels available. So this chapter is also only for developers, not users.

6.3.1 SoftSyncTime

Each sensor block has a channel *SoftSyncTime*. Whenever `OnGetData()` is called, the currently soft-sync time (in sec) will be added to this channel. The timestamp of the channel is the current Dewesoft time when `OnGetData` was called.

6.3.2 OnGetDataTime

Helper channel for performance checks. Can be setup to measure the time it takes to execute the `OnGetData` function or parts of it.

7 Version History

Revision number: 153
Last modified: Wed 14 Feb 2018, 16:32

Doc-Version	Date [dd.mm.yyyy]	Notes
1.0.0	02.06.2015	initial revision for AddOn version 1.0.0
1.0.1	02.07.2015	3DM-GX4-25 is now also supported: 1kHz Data-Rate, only the supported descriptors are used in the Message Format command
1.0.2	25.04.2016	Stability improvements when loading the setup (some users reported out-of-memory conditions when used with DEWESoft® X2 beta versions)
1.1.0	14.02.2018	Support for 64-bit DEWESoft® X3