PRACTEK

USER MANUAL

Integrated Motor Drive

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Contents

1. Introduction

This document describes how to use the IMD Manager. The IMD Manager is used for configuration, monitoring and troubleshooting of PRACTEK's Integrated Motor Driver (IMD). It does not describe how each parameter is configured, but rather the principles of using the IMD Manager.

Read instructions

Read the *IMD 100 Function description*(document no. 4189360013) and the IMD Integration manual (document no. 4189360015) in order to understand the functions and configuration of the IMD.

Read the IMD Manager installation instructions (Document no. 4189360018) for information about how to install the IMD Manager.

Find the IMD documentation here

See revision history for this manual in section 7 on page 66.

1.1 Conventions

The following conventions are used in this document:

Used in document	Description
`Monotype` font	Used when describing a path or text input in a machine human interface
␣ ↵	Used to illustrate a space and Enter characters
	A yellow symbol that illustrates hazard type (this symbol is an example for general hazard). There are different types such as electrical, chemical and so on.
Danger!	A signal word used to indicate an imminently hazardous situation, which if not avoided, will result in death or serious injury. (ISO 3864)
Warning!	A signal word used to indicate an imminently hazardous situation, which if not avoided, could result in death or serious injury. (ISO 3864)
Caution!	A signal word used to indicate a potentially hazardous situation, which if not avoided, could result in minor or moderate injury. (ISO 3864)
	A blue symbol that illustrates a need for mandatory action. In this example read instructions. Other types of blue symbols exist and always indicate mandatory action.
	A symbol used to draw attention to extra information or an action that is not mandatory
Current	When "current" is used it always means electrical current. When a reference to time is made "present" or "ongoing" are used.
IMD	When the IMD is mentioned, it means the IMD 100 series

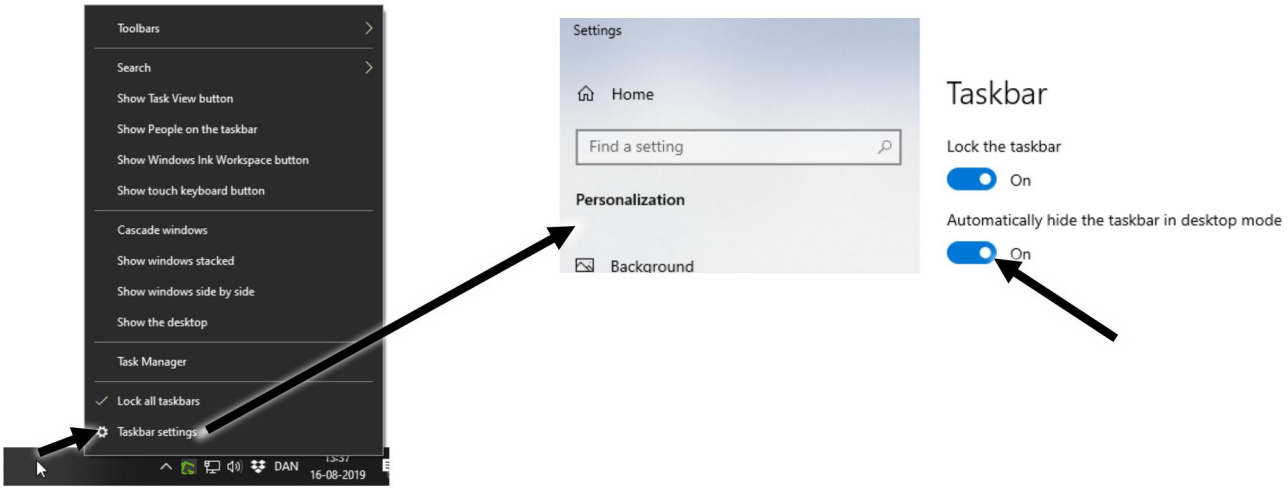
2. Introduction to the IMD Manager

The IMD Manager is the tool used for configuration and monitoring of the IMD. It can only be connected locally to the IMD through a USB connector.

2.1 Platform requirements

Operating system: Windows 7 or higher. The IMD Manager can possibly run on earlier Windows version, however, it was not tested on earlier versions.

Minimum screen resolution: 1200x768. If the height resolution is under 800, and the taskbar is placed at the bottom it is necessary to autohide the taskbar. The following example is from Windows 10:



NOTE Hiding the task bare must be done before starting the IMD manager.

2.2 General screen elements

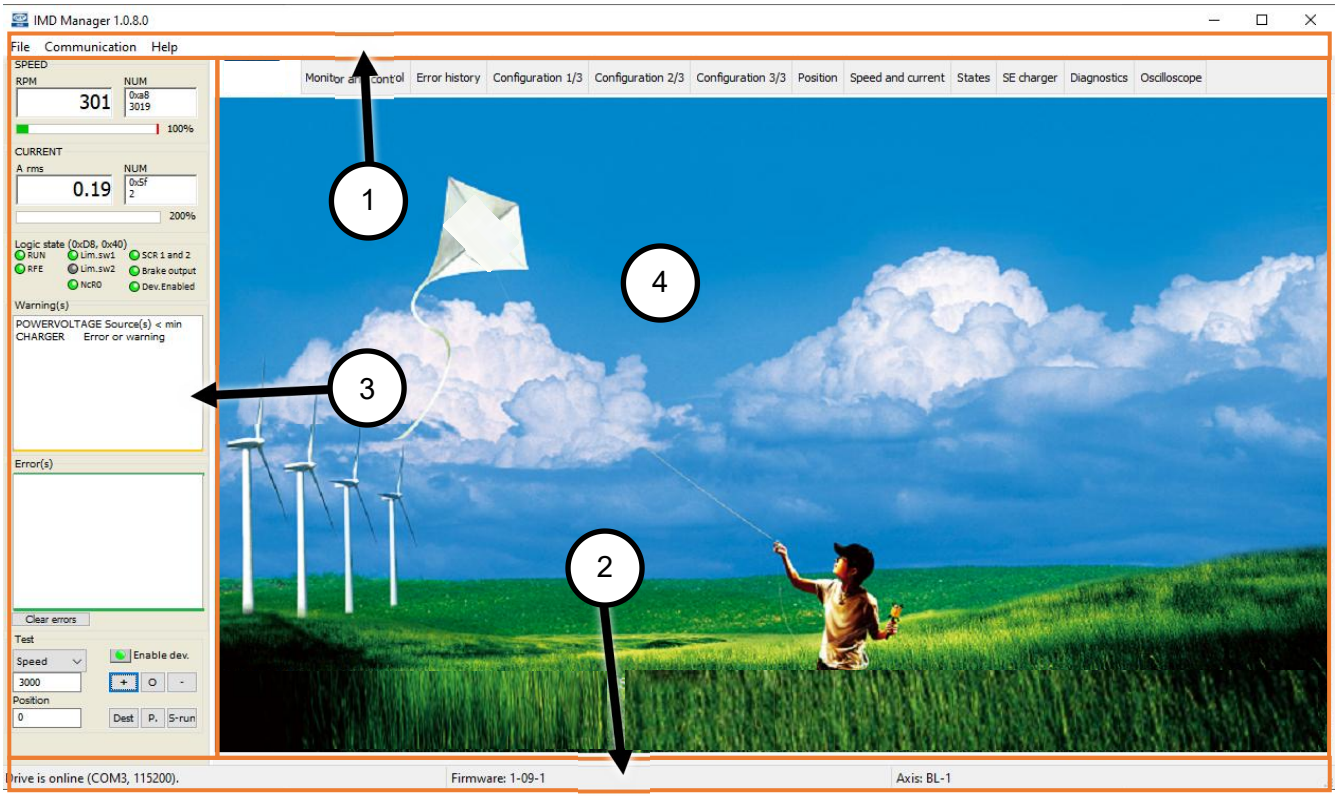
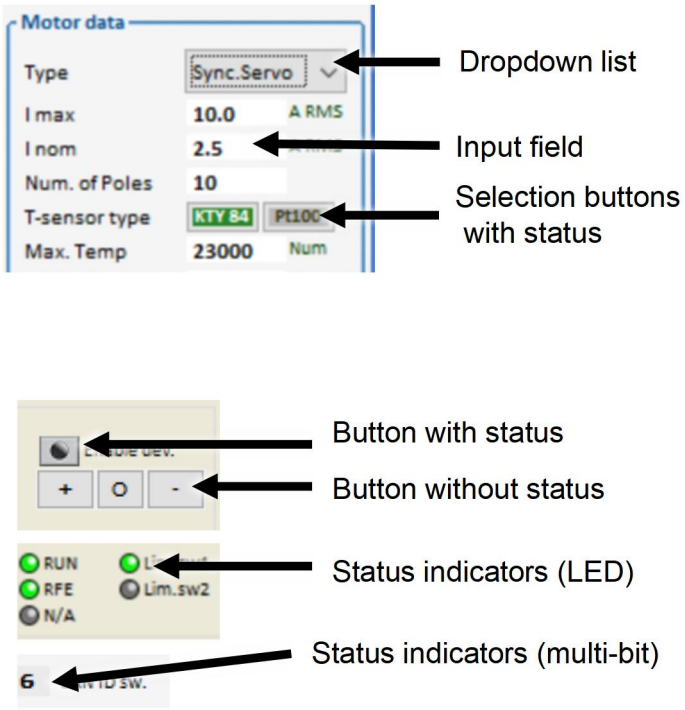


Figure 1 The IMD Manager

The IMD Manager contains four main areas:

1. Menu bar: containing File, communications settings and help
2. Status bar: containing connection status, IMD firmware and axis label
3. Quick access area: containing often used functions and indications
4. Main work area: containing different tabs for different purposes

The IMD Manager uses the following element types:



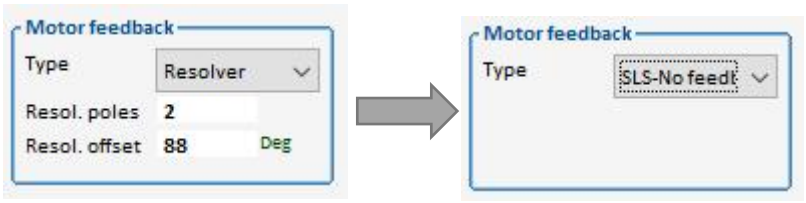
The following colour scheme is used for the LED status indication:

- Green: Active / selected
- Grey: Not active / not selected

Info

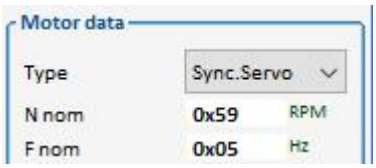
The colours are shown as seen from the IMD. For example, when the “Brake out” is green, it means that the Brake output of the IMD is active (high). It does not show whether the brake itself is active or not due to the output being high.

Some parameters are only visible when an IMD is connected (on-line), or may be visible/invisible depending on Firmware (FW) version, HW type or settings of other parameters.

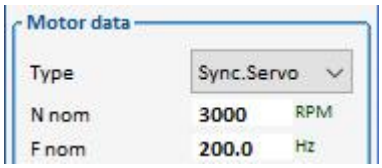


2.3 Entering data

Data can be entered or changed only when the IMD Manager is connected to an IMD or if an offline configuration is loaded to the IMD Manager (Communication→View file). If data cannot be entered, the data in each field shows the register id from which the data will be retrieved. The following figure shows the IMD Manager fields when it is possible and not possible to enter data.



Data cannot be entered



Data can be entered

Attention
The entered data will be lost in the next start-up unless the configuration is saved to the EEPROM.

2.3.1 Entering data in a field

Data can only be entered if the field has a white background: 200.0 Hz.

1. Click in the field
2. Enter the data
3. Press Enter (↵) or click in another field. The entered data is verified and saved in the IMD RAM.

2.3.2 Entering data in a dropdown list

Click anywhere inside the dropdown element Sync.Servo and it will open to show the available options.

Select an option from the list. The data is saved in the IMD RAM upon selection.

2.3.3 Entering data in an option button

Click on the desired option button KTY 84 Pt100 . The data is saved in the IMD RAM when you click.

The green colour shows the selected button.

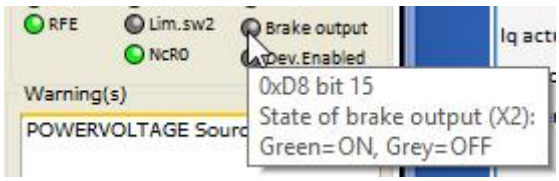
2.4 Getting help

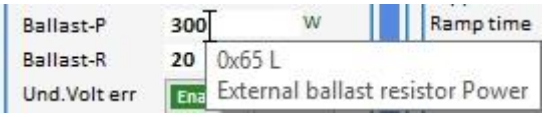
There are several ways to get help when using the IMD manger.

2.4.1 Online help

There are two ways to get online help:

1. This manual. Press “F1” or click “Help→Manual” to open this manual
2. Point the cursor on a field, LED, or button to display a short information on this particular field, as well as the register to which the parameter is related to:





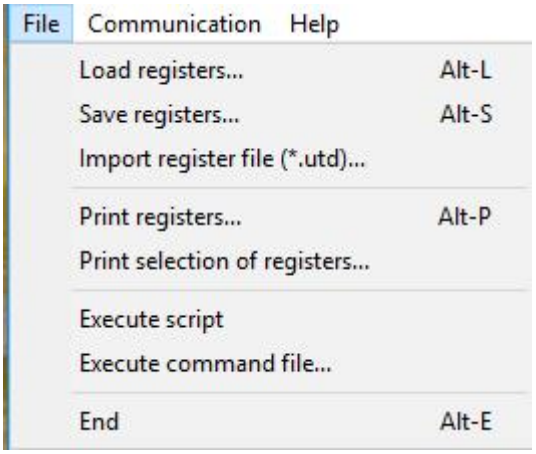
2.4.2 Manuals

Open the appropriate manual from the IMD manuals package related to the task at hand.

3. Menu bar

The menu bar contains three sub-menus: File, Communication and Help.

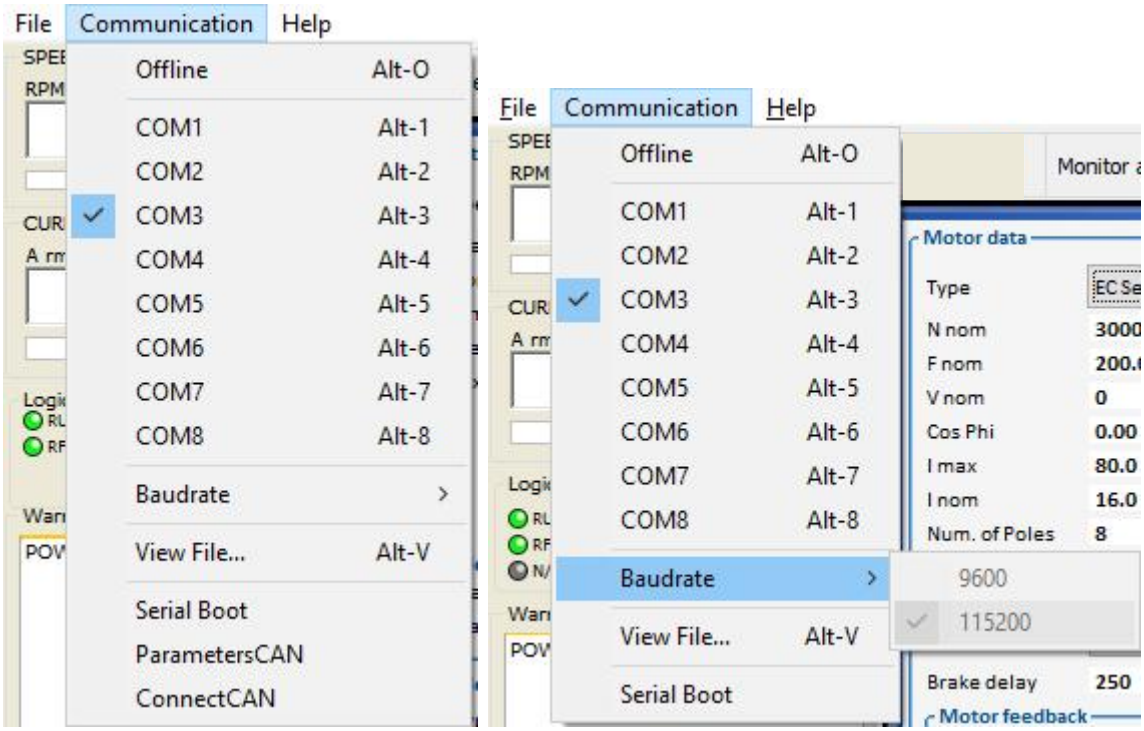
3.1 File Menu



The File menu has the following functions:

Load registers…	Load a configuration file (*.urf) from the PC to the IMD RAM (running configuration). Only enabled with an IMD connected.
Save registers…	Save the configuration in the IMD manager to the PC as a *.urf file. Only enabled with an IMD connected, or when an offline file is loaded.
Import register file (*.utd)…	Load an old format configuration file to the IMD. This option is for compatibility with old products only and should not be used for IMD 100. Only enabled with an IMD connected.
Print registers…	Print all registers content. Only enabled with an IMD connected, or when an offline file is loaded.
Print selection of registers…	Print some registers content (selection cannot be changed). Only enabled with an IMD connected, or when an offline file is loaded.
Execute script	Opens a dialog to execute a script (*usf). For expert's use only. Only enabled with an IMD connected.
Execute command file…	Opens a dialog to execute a command file (*.cmd). For expert's use only. Only enabled with an IMD connected.
End	Exit the IMD manager

3.2 Communication menu

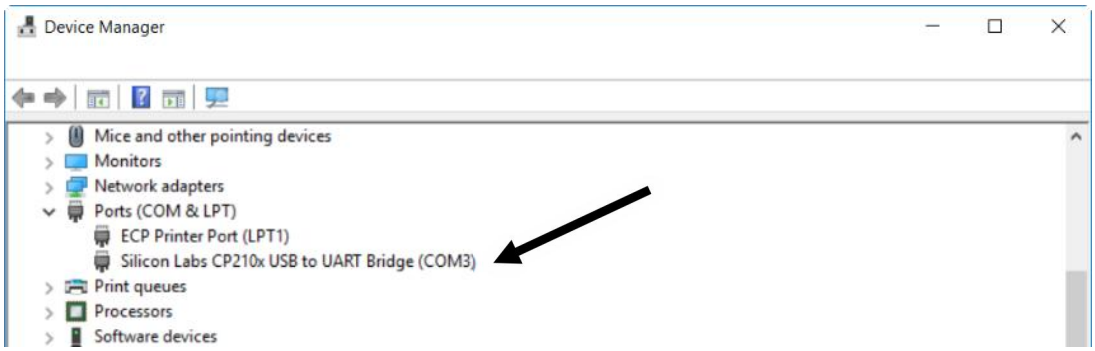


The Communication menu has the following functions:

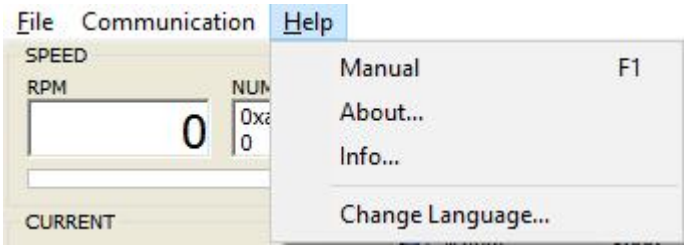
Offline, COM1 to COM8	Set the communication port to the used port (se section 3.2.1 on page 3.2.1). Note that the shortcut to Offline is “Alt”+ “o” and not zero.
Baudrate	Selection between 9600 and 115200. Must always be 115200. If the installation was performed properly, this setting will be set automatically. Otherwise it is only needed to be done once.
View File…	Load an offline configuration file (*.urf) to the IMD Manager. The IMD manager will show all relevant parameters for the FW that was running on the IMD when the configuration file was exported.
Serial Boot	Do not use (compatibility with old products).
ParmetersCAN	For PRACTEK use only.
ConnectCAN	For PRACTEK use only.

3.2.1 Determining used COM port

Open the “Device manager” in the computer’s “Settings” and determine which com port is used for the USB connection (the look of the device manager may differ depending on the operating system):



3.3 Help menu



The Help menu has the following functions:

Manual	Online help (this manual)
About…	Information about the version of the IMD Manager
Info…	Information about firmware version and window size. Not relevant in normal use.
Change Language…	Only English language is supported

4. Status bar

The status bar contains information about:

- Connection state (including COM port and baud rate)
- Firmware
- The Axis label (free text that can be configured in the “Configuration 1/3” tab)

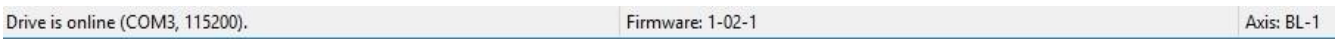


Figure 2 Status bar

5. Quick access area

The quick access area allows to have an overview of selected states of the IMD as well as some control buttons for often used control functions. The quick overview is always visible so it is possible to use it no matter which tab is active in the main area.

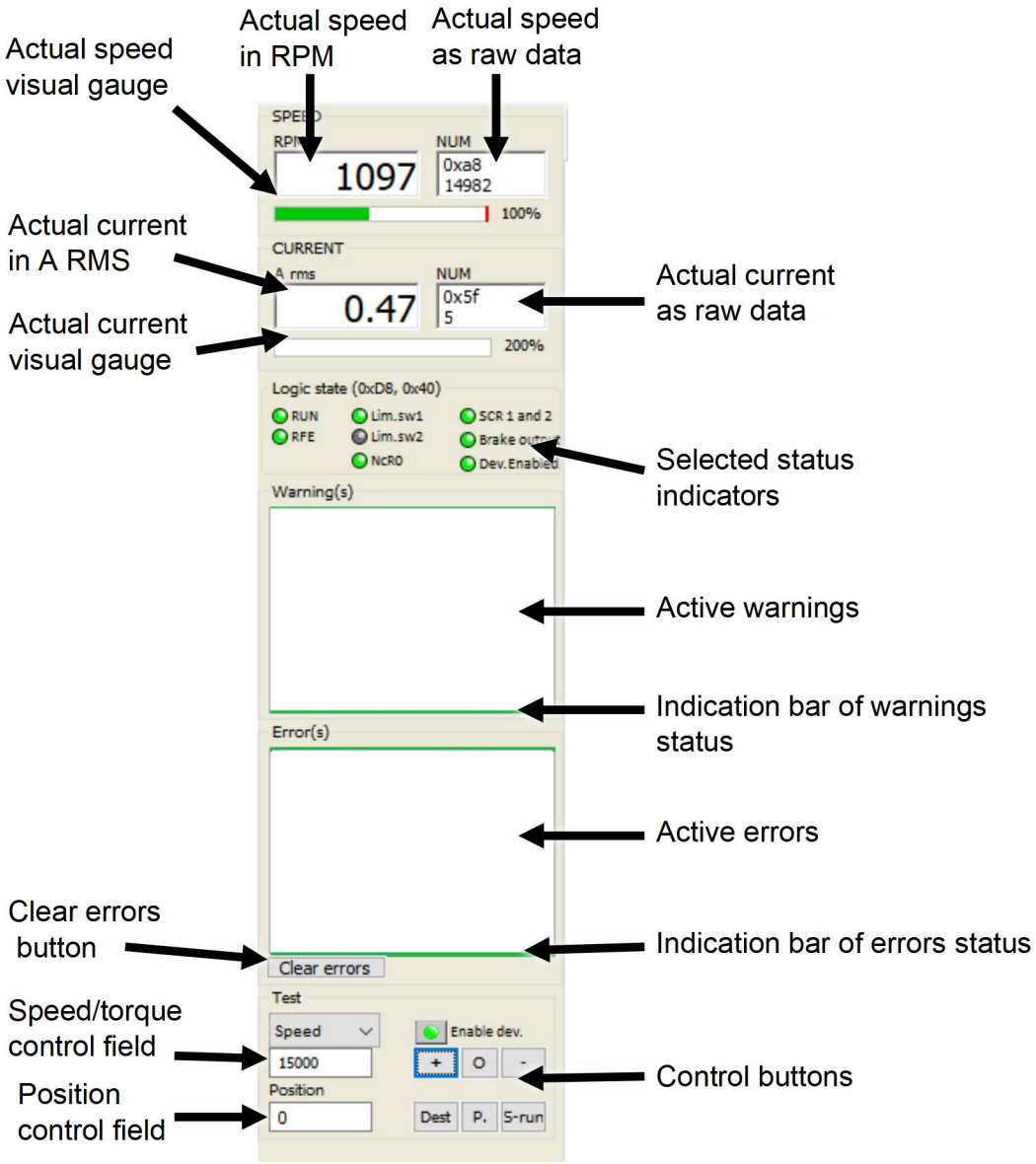


Figure 3 Quick access area

Features in the quick access area include the following:

Actual speed indication	The actual speed is shown in RPM, raw data and a percent gauge (0 to 100 %)
Actual current indication	The actual current is shown in A RMS, raw data and a percent gauge (0 to 200 %)
Selected status indicators	Indicators that show status of the IMD. The selected indicators cannot be changed.
Warnings field	A field that shows the active warnings. Green bars at the top and bottom indicates that there are no active warnings, yellow bars at the top and bottom indicates that there are active warnings
Errors field	A field that shows the active errors. Green bars at the top and bottom indicates that there are no active errors, red bars at the top and bottom indicates that there are active errors
Clear errors button	Clicking on this button will clear the errors if the reason for the error is not active anymore. If there are any errors that are cleared, the safety-chain relays (SCR 1 and 2) will also be cycled.
Test group	The test group contain means to manually control the motor. The IMD must be in state “Normal operation” and the Dev.Enable indicator on, in order to be able to use the manual control buttons.
Enable dev. button	A button that enables the IMD (0x51 bit 2). The button has a status LED that always shows the status of this bit. If for some reason the IMD cannot be enabled (for example if there is an error) the LED will change back to grey when clicking on the button.
Speed/torque control field	This field comprises of a selection list (speed or torque) and a value field. The value in the field will be used as either the N cmd value or as a desired torque value. **NOTE** Torque must never be used without speed limits.
Buttons: | **+** | **O** | **–** |	These buttons control the desired speed or torque parameters depending on the selected mode in the dropdown list • | **+** | sets the desired speed or torque to the value in the speed/torque field (plus direction) • | **–** | sets the desired speed or torque to the value in the speed/torque field (minus direction) • | **O** | sets the desired speed or torque to zero (stops the motor)
Position control field	Value (numeric) for desired position can be entered in this field. Note: The position control must be enabled (Position Kp>0) in order to use the position control.
Buttons: | **Dest** | **P.** | **S-run** |	Buttons for control of the desired position. • Dest: clicking on this button sets the destination position (0x6e) to the value in the position control field • P.: Position preset. Can only be used while in Preset mode (set through special functions). Sets the high 16 bits of the actual position to the value of the 16 high bits in the Position control field. • S-run: Initiate a safety run.

6. Main work area

The main work area contains the following tabs:

Tab	Description
PRACTEK	Contains contact information and link (anywhere on the picture) to PRACTEK Wind Power Technology's home page.
Monitor and control	Used for monitoring the IMD functions and controlling outputs and special commands.
Error history	Used for monitoring of the errors occurred in the IMD. The error history show the last 20 errors, some parameters status at the time of the error and total error type distribution.
Configuration 1/3	Used to configure parameters in the IMD, as part of the integration process.
Configuration 2/3	Used to configure parameters in the IMD, as part of the integration process as well as saving and loading configurations.
Configuration 3/3	Expert's tab. Contains extra configuration parameters needed for asynchronous motor, and other special parameters and special configurations.
Position	Used to monitor the position control
Speed and current	Used to monitor speed and current control
States	Used to monitor different operational states of the IMD
SE charger	Used to configure and monitor the built-in safe energy charger (option)
Diagnostics	Expert's tab. Contains possibility for manual direct read/write operations, uninterpreted register read, possibility for tracking specific parameters.
Oscilloscope	Expert's tab. Built in oscilloscope that enables measurements of signals in the IMD.

Info

Parameters in the different tabs might change depending on the SW or HW. Some parameters are only shown if they are relevant for a specific IMD firmware, or specific IMD HW, or to a specific choice done. For example, if Asynchronous motor is selected, Resolver offset parameter will be hidden.

6.1 Monitor and control tab

The monitor and control tab is used for monitoring the functions and state of the IMD as well controlling digital outputs and executing special commands.

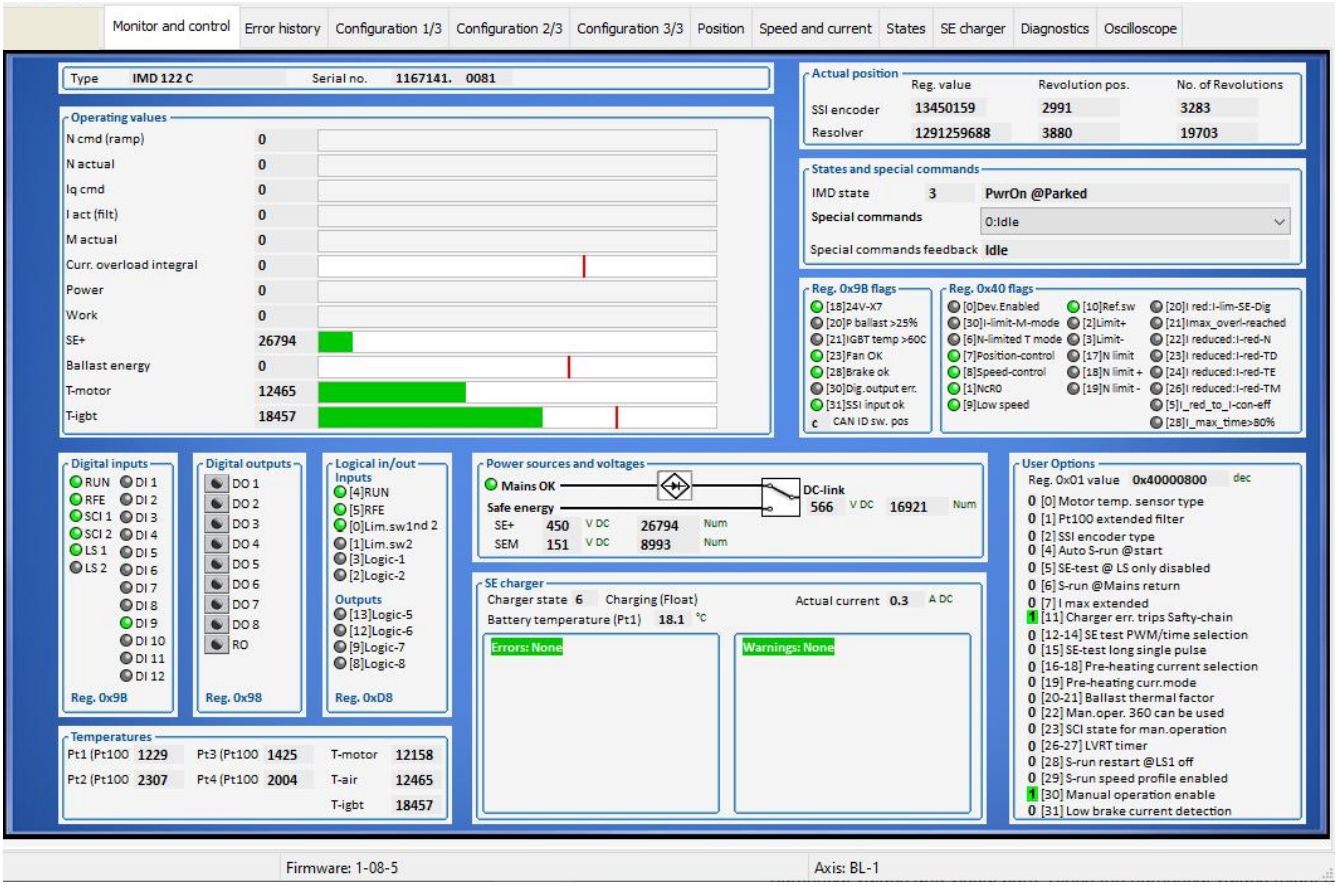
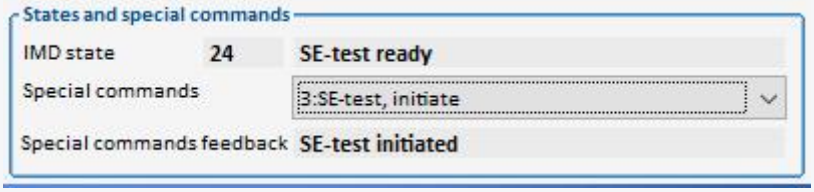


Figure 4 Monitor and control tab (shown from IMD 122C with SE charger)

The monitor and control tab contains the following:

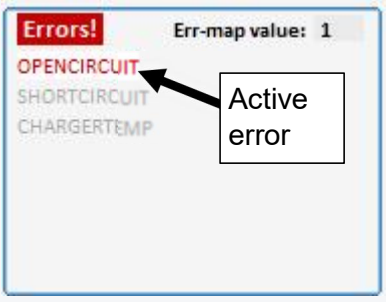
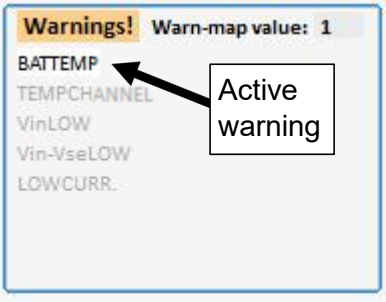
IMD info	Type and serial number of the connected IMD. The format of serial number can vary, depending on the production/shipping time of the specific IMD.
Operating values	Shows different parameter values such as speed, current and temperature as numerical values and visual bars. Since the numerical values might have different scaling even for the same units (such as Volt), numerical values can be shown as larger, even though the value in volt might be smaller. This is for example the case with BAT and DC-link voltages. The following parameters are shown:

Parameter	Description
N cmd (ramp)	Set speed command Value after ramp and speed limits are applied
N actual	Actual speed value
I cmd	Set current command value before ramp and current limits are applied
I act (filt)	Actual output current value after filtering
M actual	Actual numeric torque (out) value

	Curr. overload integral	The accumulated overload current. Current limit will always be applied at the red bar, however, the speed at which it will get there depends on current parameters configuration and actual current.
	I lim inuse	The current limit at any given time. This value is the maximum current that the IMD will be able to deliver.
	VDC-link (dir.)	DC-link level. The red bar indicates where the level is high. There is no action from the IMD at this point.
	Safe energy	Safe energy voltage level.
	Ballast power	Indicates the accumulated power that is delivered to the ballast resistor. A Ballast overload error is generated when it reaches the red bar.
	T-motor	Shows the temperature of the motor. No indication of temperature limit is available.
	T-igbt	Shows the temperature of the IMD's output stage. When the temperature reaches the red bar, a Device temperature too high error will be generated.
User options	The User options shows value and interpretation of register 0x01. The value field is editable in order to be able to enter the whole register value. However, this field is not intended for configuration. Configuration of all the relevant parameters is done from the "Configuration 1/3" tab, using either a selection list or selection buttons.	
Actual position	Shows the values returned from the SSI encoder and resolver. The fields and values of the SSI encoder depends on the selected SSI encoder type in "Configuration 1/3" tab.	
States and special commands	Shows the state of the IMD as both value and interpretation, as well as gives the possibility to execute special commands. A special command is executed by clicking on the dropdown list and selecting a command. The special command feedback field shows the state of the command. If the command cannot be executed for some reason, a dialog box informs that the IMD has changed the command to a different command. The dropdown list and will always show the last selected command (no matter whether it was executed or not): 	

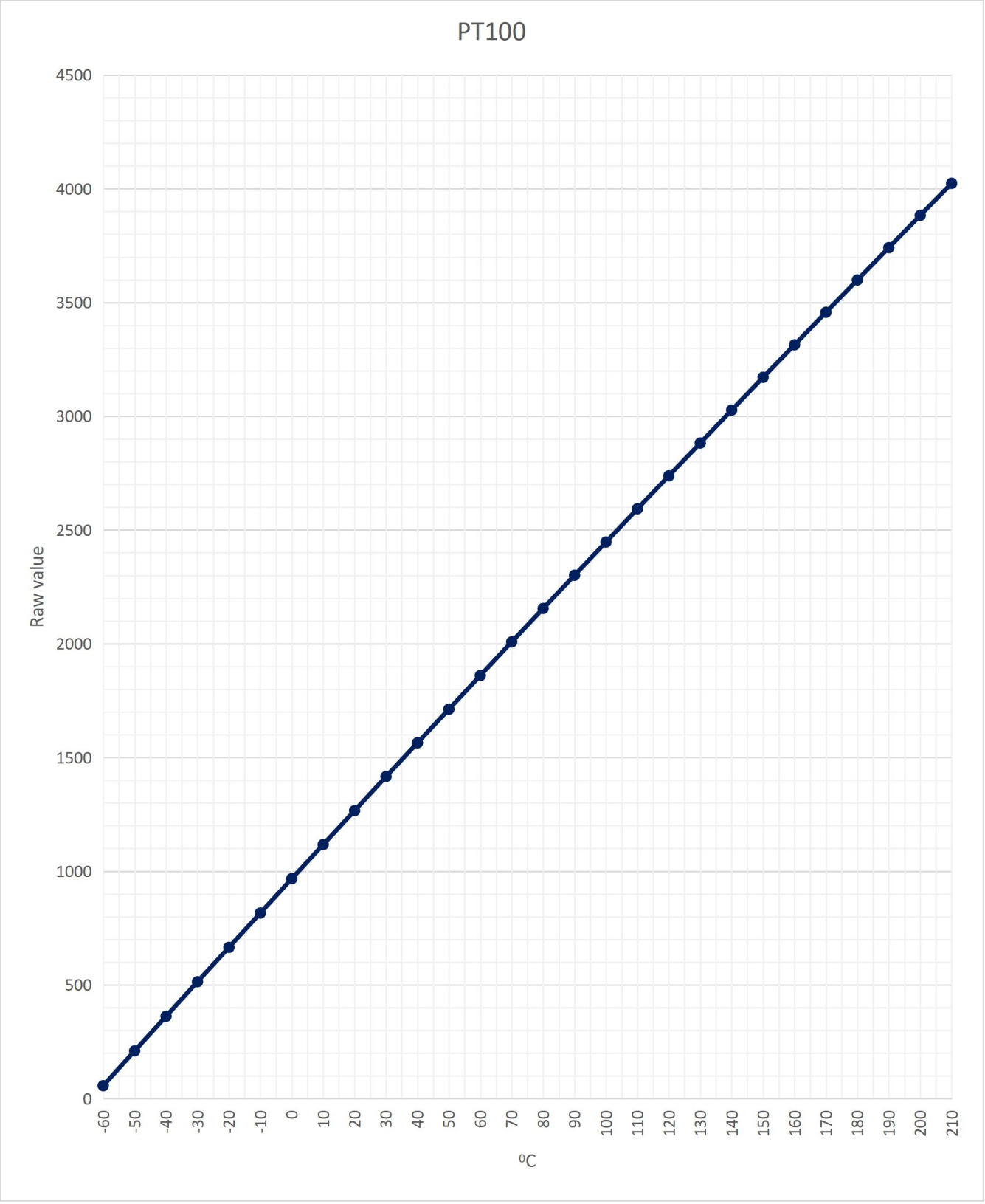
Attention

Consult the Integration manual before initiating Safe energy test (SE-test). Wrong use might overload the ballast resistor.

Digital inputs	The digital inputs show the state of the digital inputs of the IMD, as perceived by the IMD. These are the physical inputs: X8 terminal 1 to 4, and all inputs in X9.
Logical inputs	The logical inputs are internal signals in the IMD. The LED show shows the state (high/low) of the signals. Note that even if a logical input is defined with polarity as active low, the inverted function is the defined function in the configuration tab and not the logical input. For example, if Logic-1 is defined a ref plus active low:  then the logical input will show whether the actual digital input (Di-1) is high or low, while the Ref.sw will depend on the defined polarity. The logic inputs are defined in “Configuration 1/3” tab.
Logical outputs	The logical outputs show the state of logic-5 to logic-8. The logic outputs are defined in “Configuration 1/3” tab.
Digital outputs	The digital outputs show the state of the outputs (as an LED in the centre of the button). Clicking on a button will toggle the output. Note that outputs logic-5 to logic-8 must be defined as Off in the output logic in the configuration tab, otherwise it is not possible to control Do-5 to Do-8 manually through the digital outputs.
Reg. 0x9B flags	Shows the state of different flags in register 0x9B (Logic in block) that are used internally by the IMD SW.
Reg. 0x40 flags	Shows the state of different flags in register 0x40 (Drive status) that are used internally by the IMD SW.
Power sources and Voltages	Power source that shows the state of the X1 Mains input (Reg. 0x63/bit 5) and where the IMD is drawing power from, for the DC-link: AC or safe energy (Reg. 0xD8/bit 14). Voltage and units are shown for the DC-link and Safe energy (SE+). If the hardware of the IMD is equipped with Mid-point voltage (SEM), the SEM value is shown as well.
SE Charger	This group is only visible if a charger is mounted and running. It shows the active state, errors, warnings, and actual charging current. Errors shown can be cleared by clicking on the “Clear errors” button in the quick access area, if the error is not active anymore. If an error is still active, it will be cleared momentarily and then be shown again. Warnings are cleared automatically when they are not active. If Lead acid with temperature compensation is selected in the SE charger configuration, the temperature of the battery is shown. If the temperature of the battery is outside the prefixed limits (BATTEMP warning is shown), the temperature changes between the actual battery temperature and the fixed limit exceeded.  
Temperatures	Shows all the relevant temperature of the IMD. The values are represented as raw data.

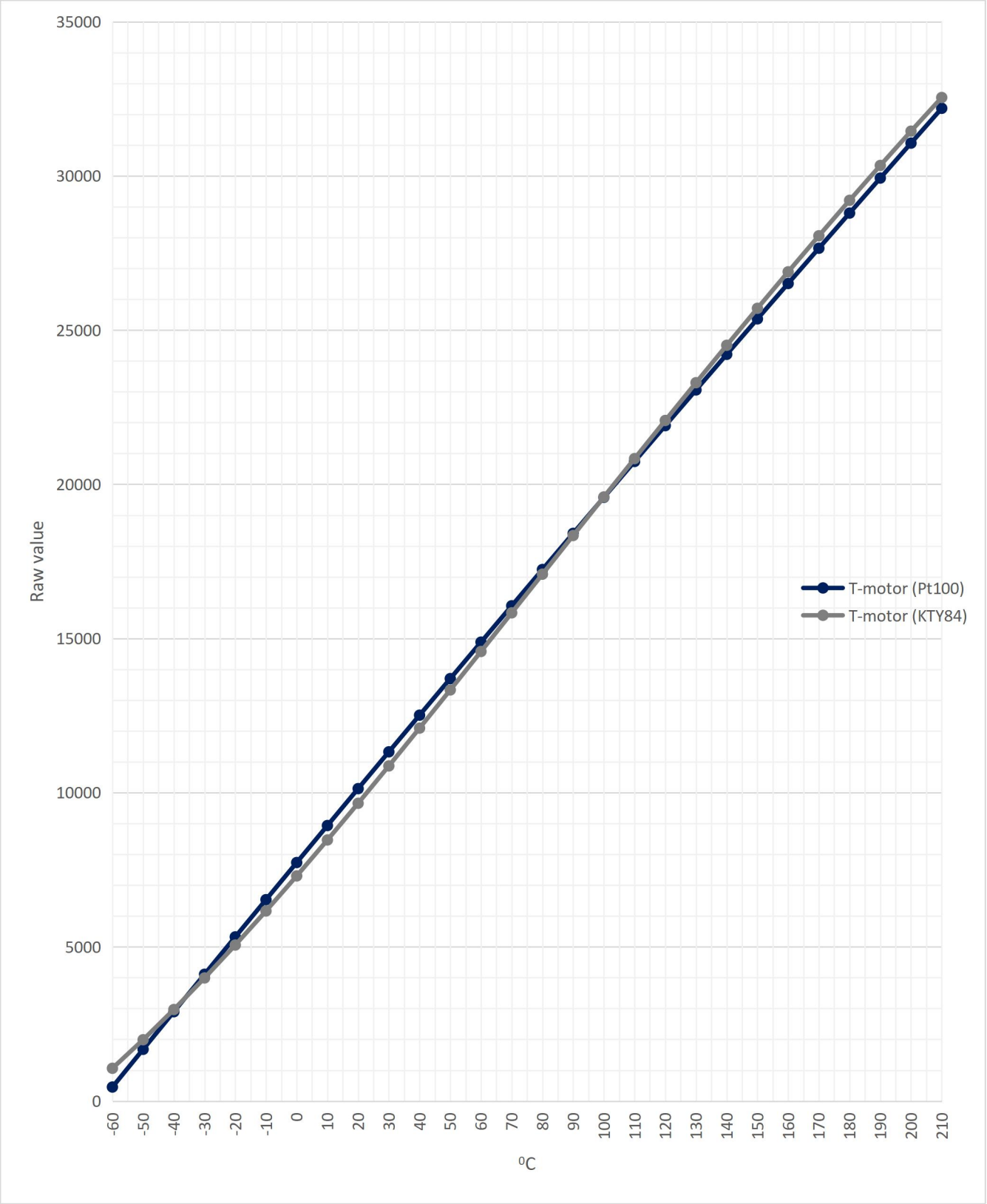
The following charts gives a quick overview of temperature vs. raw values.

6.1.1 Temperature conversion chart PT100

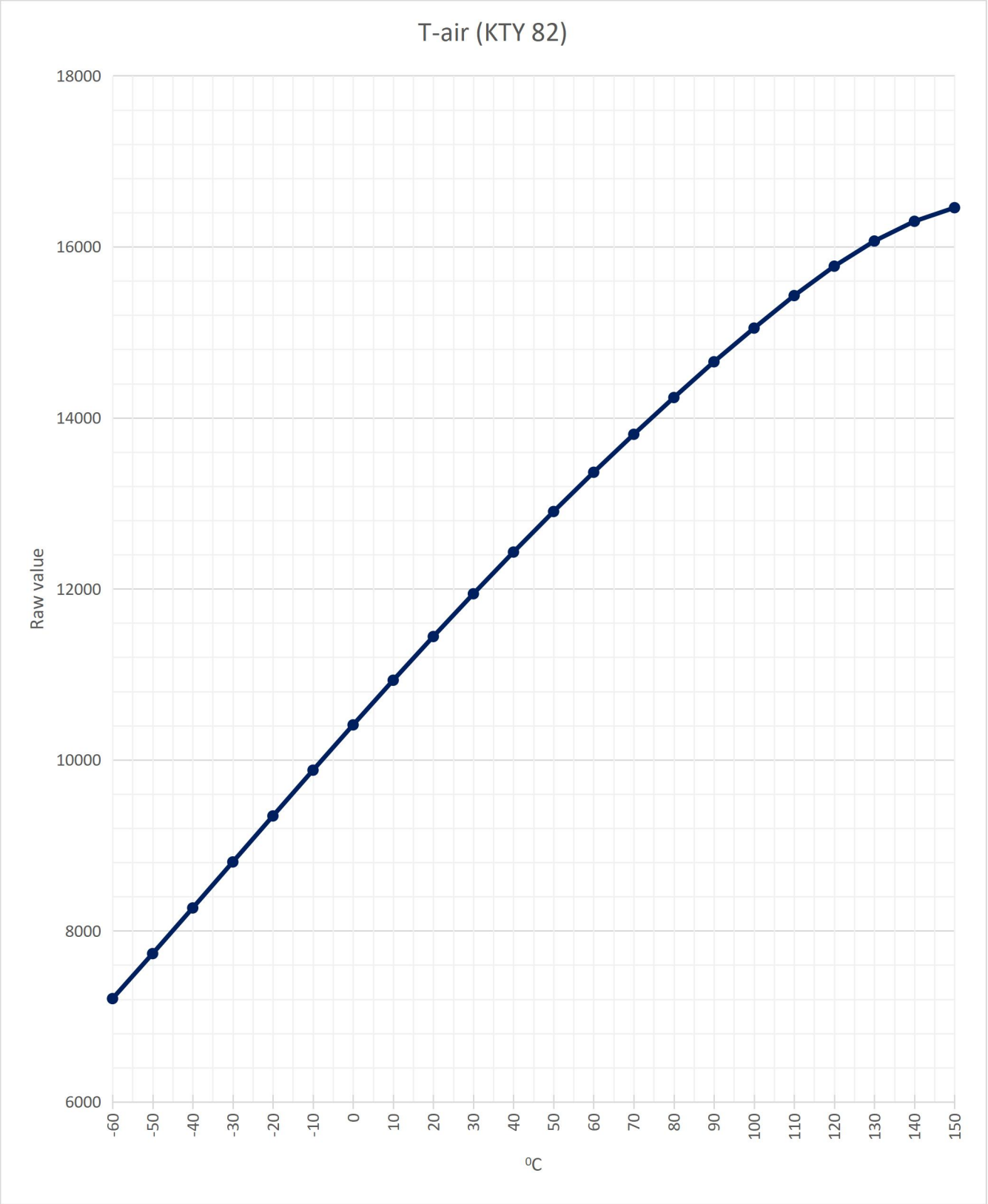


6.1.2 Temperature conversion chart T-motor

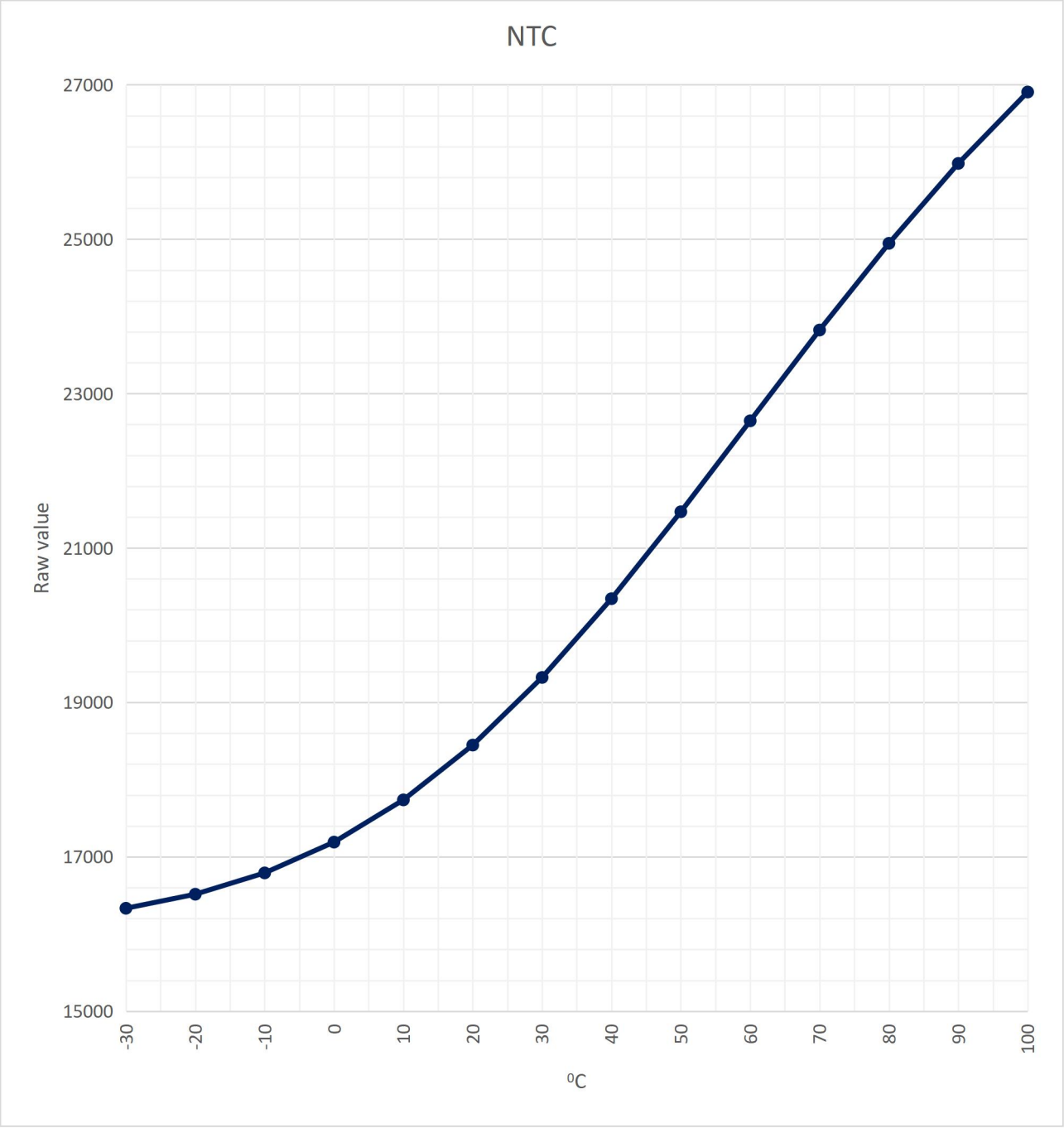
Use the appropriate sensor according to configuration.



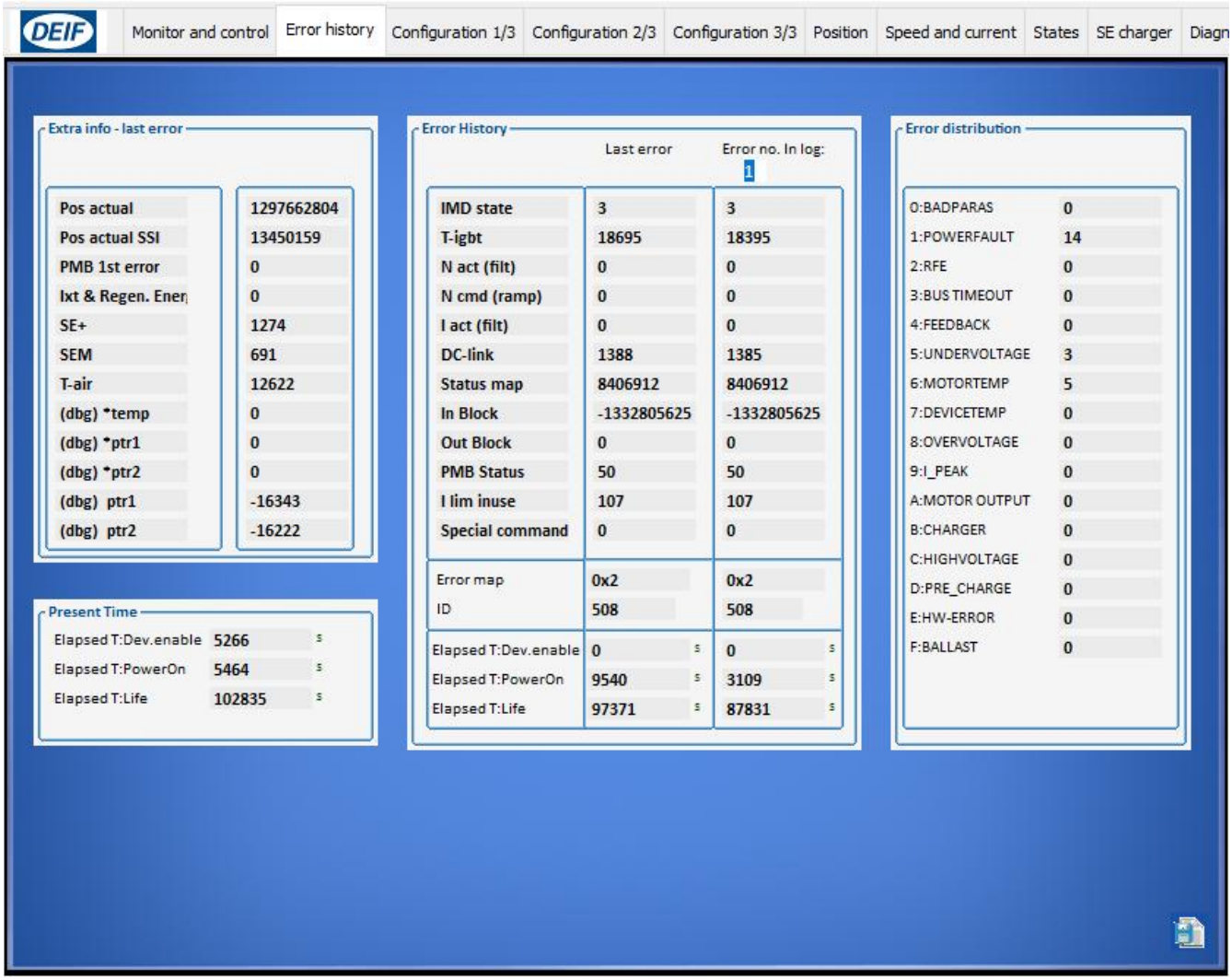
6.1.3 Temperature conversion chart T-air



6.1.4 Temperature conversion chart T-igbt



6.2 Error history tab



The IMD has an error log containing up to 20 entries. The log is a rolling log using “First In First Out” principle, which means that it always contain the latest 20 errors generated by the IMD, with the latest error at the top. The log entries are available in the IMD Manager and through CAN/CANopen. Each entry contains the following parameter values at the time the error occurred (see description of the register in the Integration manual for details):

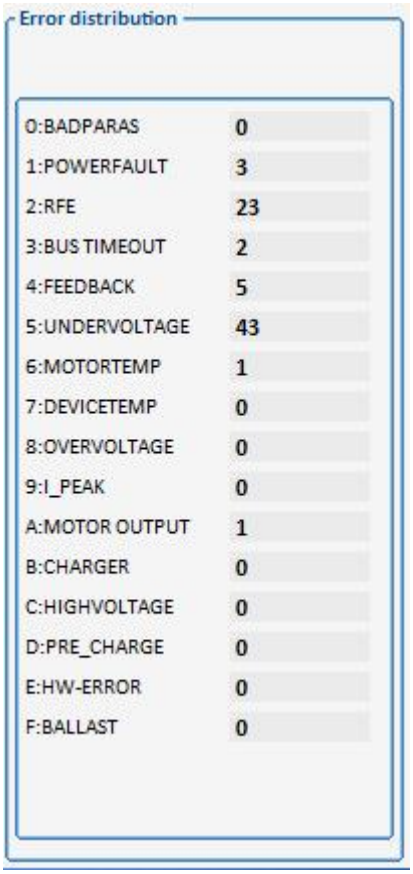
Information	Register	Description
IMD state	0x02	The state of the IMD
T-IGBT	0x4A	The numeric representation of the IGBT temperature
N act (filt)	0xA8	The filtered actual speed value in units
N cmd ramp	0x32	Speed command after ramp in units
I act (filt)	0x5F	Actual filtered current value in units
DC-link voltage	0xEB	The filtered voltage of the DC-link in units
Drive status	0x40	Bit map representation of the state of the internal flags
Logic in block	0x9B	Bit map representation of the state of digital inputs and some internal flags
Out block	0x98	Bit map representation of the state of digital outputs

Information	Register	Description
Power board status	0x63	Status of the power board
Actual current limit	0x48	The current limit used at the time
Special command	0x03	The values of the special commands register. If a command was executed, the register contains the feedback for the command.
Error register value	0x8F	Active errors at the time the error occurred
ID	N/A	Special ID information for the error
Timestamp 1 (Device enabled)	N/A	A relative time stamp (seconds) for the entry indicating the time elapsed since the last time the device enabled flag was set
Timestamp 2 (power)	N/A	A relative time stamp (seconds) for the entry indicating the time elapsed since the last power on of the IMD
Timestamp 3 (life)	N/A	A relative time stamp (seconds) for the entry indicating the time elapsed since the IMD was delivered from the factory, or if the IMD is older, since the first time a firmware supporting error history was installed. This time counter only counts time when the IMD 24 V DC supply (external or internal) is on. For IMDs that were delivered with FW older than 1-08-0 (first FW with error log) the life time stamp is relative to the time when the first FW supporting error log was installed on the IMD.

The last error further contains the following parameter values at the time the error occurred (Extra info):

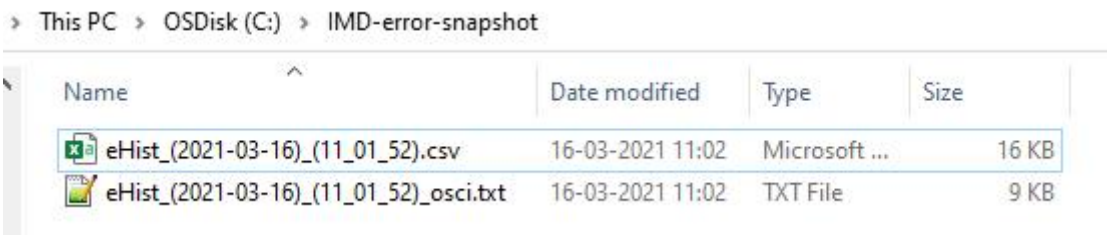
Information	Register	Description
Actual position	0x6D	The actual position based on the resolver and rounds count
Actual position SSI	0x6F	The actual position based on the SSI encoder count
1st error in power board	0x94	First error (code) on power board since last clear error command.
Ballast energy counter (L) and Current overload integral (H)	0x45	Values of Ballast energy counter (low 16 bits), Current overload integral (High16 bits),
SE voltage	0x66	Numeric value of the safe energy voltage
SE mid-point voltage	0x61	Numeric value of the safe energy mid-point voltage
T-air	0x4B	Numeric value of the air temperature inside the IMD
(dbg) *temp	0x9A	Dynamic pointer register used for debug by PRACTEK engineers
(dbg) *ptr1	0xB8	Dynamic pointer register used for debug by PRACTEK engineers
(dbg) *ptr2	0xBA	Dynamic pointer register used for debug by PRACTEK engineers
(dbg) ptr1	0xB7	Dynamic pointer register used for debug by PRACTEK engineers
(dbg) ptr2	0xB9	Dynamic pointer register used for debug by PRACTEK engineers

The error log also contains a distribution representation of all errors occurred during the “Elapsed time:life” (the time elapsed since the first FW supporting error history was installed), showing how many times each error appears in the log:



It is possible to save the error history as well as additional history by clicking on the  icon. The icon changes to  and the “Error no. in log” counts up through all the recorded errors in the error history. This may take some time.

All error history values as well as additional snapshot data saved from the oscilloscope is saved as two files in `C:\IMD-error-snapshot` folder:



6.3 Configuration 1/3 tab

Due to the large number of configuration parameters, the configuration parameters are divided into three tabs: “Configuration 1/3”, “Configuration 2/3”, and “Configuration 3/3”.

“Configuration 1/3” and “Configuration 2/3” tabs contain most of the configuration parameters needed for configuring the IMD. A small number of parameters that are used by experts only are in “Configuration 3/3” tab.

Attention

Changing values in the IMD manager will immediately affect the IMD running configuration. However, the entered data will be lost in the next start up unless the configuration is saved to the EEPROM (see section 6.3.10 on page 37).

The following figure shows the configuration 1/3 tab:

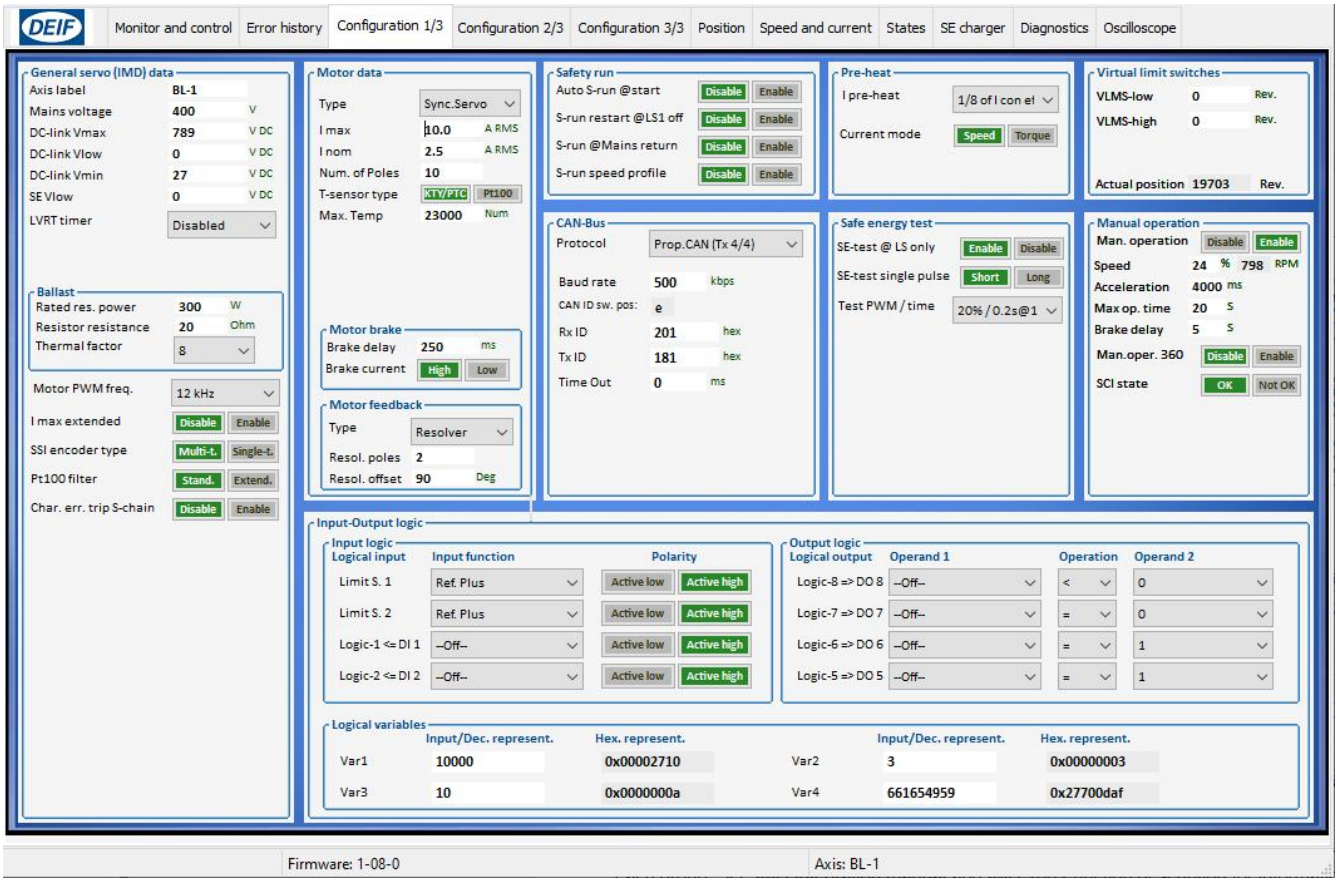
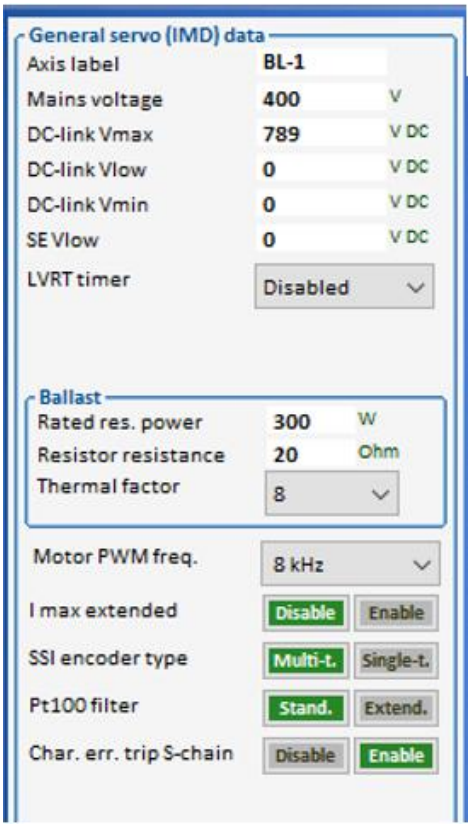


Figure 5 Configuration 1/3 tab

The parameters in the configuration tab are grouped in groups. The following sub-sections describe each group. See IMD Integration manual and IMD 100 Function description for information about specific parameters and their function.

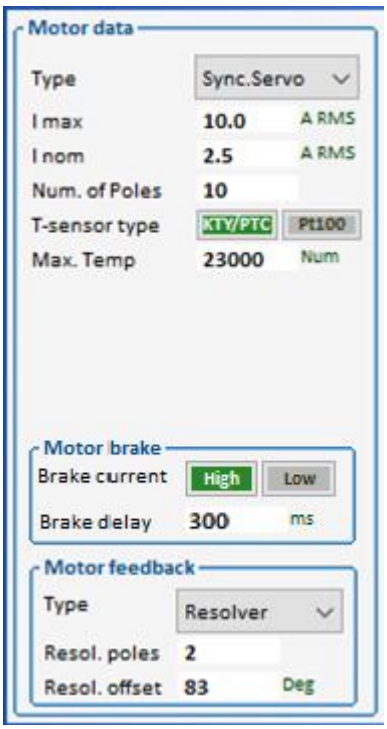
6.3.1 General servo (IMD) data

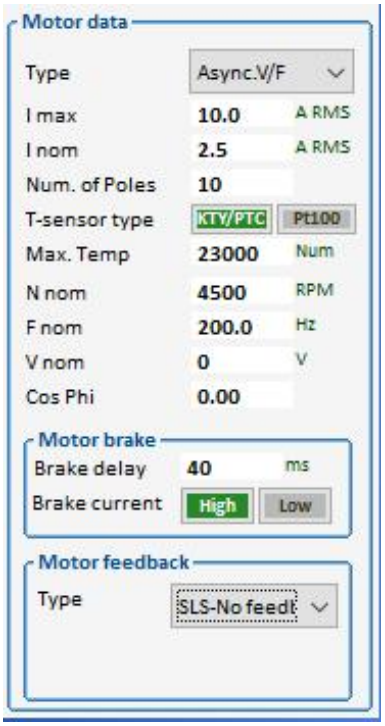
The general servo (IMD) data group contains information and parameters that are related to the general use and configuration of the IMD.

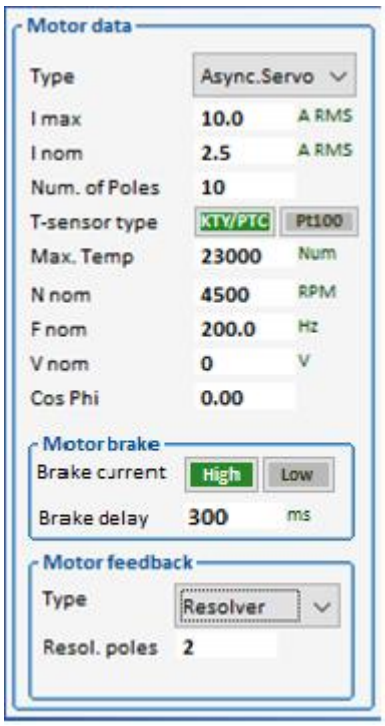


6.3.2 Motor data

The motor data group contains data about the specific motor used. In order to fill in the parameters the motor data sheet is needed. The values entered in this group are used for internal calculations in the motor control. Some of the data (I max for example) is also used as limits. If the I max in the application current definition is higher than the I max in the motor data, the I max value from the motor data will be used. Note that some of the parameters (brake delay and resolver details) are visible only if they are relevant. The following examples show different motor types with their relevant parameters.







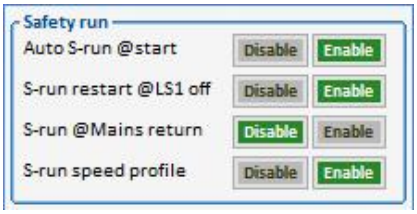
NOTE If the RUN input goes low, A HW delay of approximately 1 s will stop modulation and engage the brake immediately. Depending on the Firmware of the IMD one (used for ON and OFF) or two (one for ON, one for OFF) brake delays can be configured:

FW ≤ 1-08-2

FW > 1-08-2

6.3.3 Safety run

The safety run group contains parameter related to the safety run configuration.



6.3.4 CAN bus

The CAN group contains configuration for the CAN/CANopen communication. It is only possible to select the communication type that the IMD Firmware allows (there is a different firmware for CAN and CANopen). It also shows the state (position) of the CAN ID switch on the front panel.

Setting the T-Out (bus timeout) to zero, disables the timeout function.

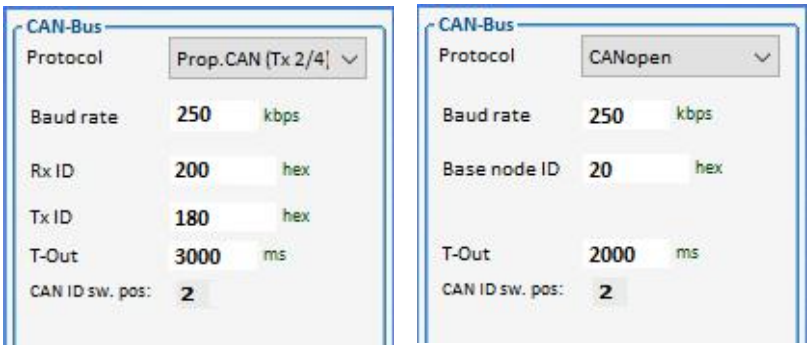


Figure 6 The CAN group with CAN and CAN open firmware

Info
Always restart the IMD after changing any of the CAN settings.

6.3.5 Input logic

In general, digital inputs are passive, and their state can be read in a register. However, four of the inputs are programmable and have or can have special functions, which can be defined in the “Input logic” group.

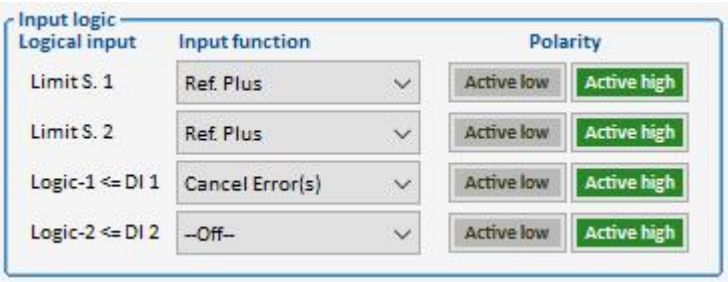


Figure 7 Logical inputs

There are four inputs that can be defined: Limit S.1, Limit S.2, Logic-1, and Logic-2. For each of these inputs it is possible to define a function, and polarity (whether the action will be activated on high or low state of the input). At least one limit switch input is required, since without this function the IMD will consider them just digital inputs with no special action predefined.

In the example in Figure 7 on page 30, Limit1 and Limit2 are defined as reference switches and Logic-1 is defined with “cancel error(s)” function. They are all active high.

Defining Limit1 and Limit2 as Ref. Plus, tells the IMD that these inputs are used as reference switches.

Defining Logic-1 as “Cancel error” function means that when the connection on Digital input 1 goes high, the IMD will cancel errors (the errors will be cancelled if the error causes are not valid anymore).

Attention
Safety run turns the motor until a reference switch is reached. At least one of the limit switches (Limit S.1 or Limit S.2) must be configured to be a reference (Ref.Plus or Ref.

The following actions/definitions can be used for the inputs (some definitions are intentionally omitted, use only the described options):

Table 1 Input definitions and actions

Definition	Description
-Off-	The input does not have any definition attached. It is considered as any digital input.
Ref. & Limit Plus	The input is defined as both limit switch and reference switch. When this is configured, both “Limit+” and “Ref.sw” status bits are active when the input is active. When this switch is activated, it is only possible to continue in the opposite direction from which the switch was reached. That is, if the motor turned in the positive direction and the switch was activated, it is only possible to turn the motor in the negative direction to deactivate the switch. Safety run will stop if the limit switch input (Limit.S 1 or Limit.S 2) is configured as Ref. & Limit Plus. Do not use Ref. & Limit Plus if Virtual Limit Switch (VLMS) is used.
Ref. & Limit Minus	The input is defined as both limit switch and reference switch. When this is configured, both “Limit-” and “Ref.sw” status bits are active when the input is active. When this switch is activated, it is only possible to continue in the opposite direction from which the switch was reached. That is, if the motor turned in the negative direction and the switch was activated, it is only possible to turn the motor in the positive direction to deactivate the switch. Safety run will stop if the limit switch input (Limit.S 1 or Limit.S 2) is configured as Ref. & Limit Minus. Do not use Ref. & Limit Plus if Virtual Limit Switch (VLMS) is used.
Ref. Plus	The input is defined as a reference switch. When this is configured, “Ref.sw” status bit is active when the input is active. It is possible to continue both in both negative and positive direction when this switch is activated. Safety run will stop if the input is configured as Ref. Plus.
Limit Plus	The input is defined as a positive limit switch. When this is configured, “Limit+” status bit is active when the input is active. When this switch is activated, it is only possible to continue in the opposite direction from which the switch was reached. That is, if the motor turned in the negative direction and the switch was activated, it is only possible to turn the motor in the positive direction to deactivate the switch. Safety run will NOT stop if the input is configured as Limit Plus. In IMDs that run on FW later than 1-07-0 the limit plus is always used for VLMS-high.
Limit Minus	The input is defined as a negative limit switch. When this is configured, “Lim-” status bit is active when the input is active. When this switch is activated, it is only possible to continue in the opposite direction from which the switch was reached. That is, if the motor turned in the negative direction and the switch was activated, it is only possible to turn the motor in the positive direction to deactivate the switch. Safety run will NOT stop if the input is configured as Limit Minus. In IMDs that run on FW later than 1-07-0 the limit plus is always used for VLMS-low.
Limit Plus Minus	The input is defined as a positive and negative limit switch. When this is configured, “Lim-” and “Lim+” status bit is active when the input is active. When this switch is activated, it is NOT possible to continue in any direction before the limit switch is deactivated or the input is reconfigured. Safety run will NOT stop if the input is configured as Limit Plus Minus.

Definition	Description
	Do not use Limit Plus Minus if Virtual Limit Switch (VLMS) is used.
Cancel Error(s)	When an input is configured to this, a function is invoked upon activation. This is the same function as the in the CAN/CANopen command (208E) or the cancel error (register 0x8E). This function is invoked every time the input becomes active. If the safety-chain relays are tripped (off) the cancel error will attempt to set them on. The input must be cycled to initiate the action again.
[Start] Ref. Drive	When an input is configured to this, a safety run is initiated upon input activation. The input must be cycled to initiate the action again.
Speed Ramp 0	If an input is configured as Speed Ramp 0, the motor will be stopped and held in position as soon as the input is active. When the input is not active anymore, the motion that was stopped by the input will be resumed.
[Start] Dest = Var1	When an input is configured to this, a motion to the destination saved in Var1 (see section 6.3.6.1 on page 34) is initiated upon input activation. The position control must be enable (Kp > 0) for this function to work.
[Start] Dest = Var2	When an input is configured to this, a motion to the destination saved in Var2 (see section 6.3.6.1 on page 34) is initiated upon input activation. The position control must be enable (Kp > 0) for this function to work.
N cmd Reverse	When an input is configured to this, the active speed value polarity (the motor direction) will be reversed as long as the input is active. This also applies to any speed set points that will be sent to the IMD while the input is active.
I limit (dig)	When an input is configured to this, the I-lim-dig will be imposed as long as the input is active.
N Clip (neg. & Pos.)	When an input is configured to this, speed limiting is activated as long as the input is active.

6.3.6 Output logic

The nine digital outputs (eight DOs and one Safety RO) can be set On and Off by bit mapping in register 0x98. However, four of these outputs (DO 5 to DO 8) can be programmed to do a different function which can be defined in the “Logic” tab in the IMD Manager.

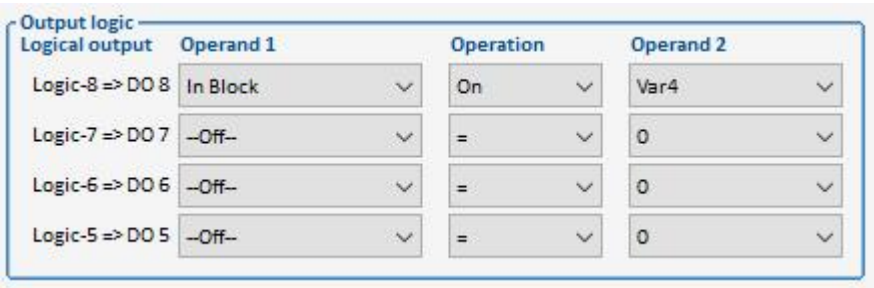


Figure 8 Logical outputputs

The four outputs that can be defined in the Logical outputs group, are mapped to the following digital outputs:

- Logic-8 is mapped to DO 8 (It is recommended to use Logic 8 for fan control)
- Logic-7 is mapped to DO 7
- Logic-6 is mapped to DO 6
- Logic-5 is mapped to DO 5

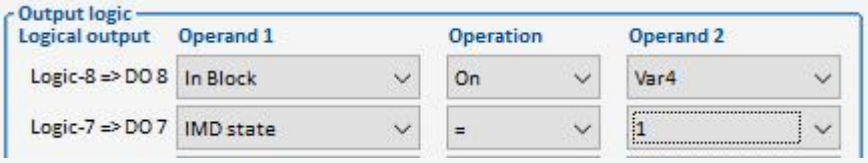
Info

When configuring digital outputs, it is important to distinguish between the terms Logic-x and DO x. DO x is the actual physical output, while Logic-x is the logical mapping of a function to a specific output.

Programming the outputs is done as a Boolean function with two operands (1 and 2) and an operation. If the result of the function is true, the output will be set to High. If the result of the function is false, the output will be set to Low.

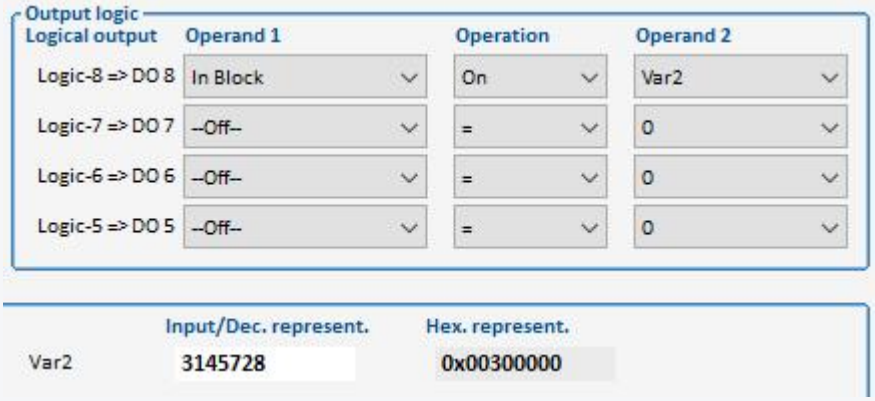
Examples:

Example1:



In example 1 Logic-7 will be true when the IMD state is 1 (normal operation) and false in all other states. Output DO7 will be turned on when the IMD is in normal operation and off when not.

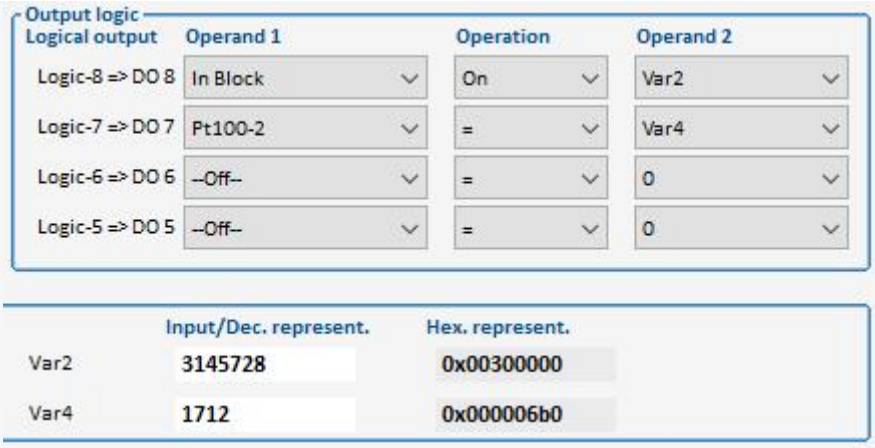
Example2:



In example 2 Logic-8 will be true when the In Block (reg. 9B) value ANDed with the value of Variable 2 (Var2 in this example 0x00300000) is different than zero and false if the result of the AND operation is zero. In this case, it checks bits 20 and 21 in Reg. 9B and if any of them is 1, the result will be true.

Output DO8 will be turned on when the Logic-8 state is true.

Example3:



In example 2 Logic-7 will be true when the PT100-2 value is greater than the value of Variable 4 (Var4 in this example 1712 ≈ 50ºC).

Output DO7 will be turned on when the Logic-7 state is true (when the temperature is above 50 ºC).

6.3.6.1 Operation

The following operations can be used (appears in the dropdown list):

Table 2 Possible operations in digital output programming

Operation	Description
On	This operation has two functions depending on operand 1: • Boolean “AND” operation if one of the following is selected as operand 1: ○ Logic freq. ○ Warning-error map ○ O-Block ○ In block The function result is true if the result of the AND operation is not zero, and false if it is zero. • If any other (than the ones mentioned above) operand is selected as operand 1, the function result will always be true.
Off	This operation has two functions depending on operand 1: • Boolean “OR” operation if one of the following is selected as operand 1: ○ Logic freq. ○ Warning-error map ○ O-Block ○ In block The function result is true if the result of the OR operation is zero, and false if it is not zero. • If any other (than the ones mentioned above) operand is selected as operand 1, the function result will always be false.
1 Hz	A 1 Hz generator. When this operation is used it does not matter how operand 2 is defined. If “-Off-“ is selected as operand 1, only the state of Logic x (5 to 8) will be

Operation	Description
	changed. Selecting anything else as operand 1 will map the 1 Hz generator to the actual output (DO x).
=	True if operand 1 is equal to operand 2
!=	True if operand 1 is not equal to operand 2
>	True if operand 1 is greater than operand 2
<	True if operand 1 is smaller than operand 2
abs>	True if absolute value of operand 1 is greater than absolute value of operand 2
abs<	True if absolute value of operand 1 is smaller than absolute value of operand 2
>=	True if operand 1 is greater or equal to operand 2
<=	True if operand 1 is smaller or equal to operand 2
hyst >=	Operation with Hysteresis (retains state until conditions for change are present). True if absolute value of Operand 1 is greater or equal to absolute value of operand 2. False if absolute value of Operand 1 is smaller than 93.75% of absolute value of operand 2.
hyst <=	Operation with Hysteresis (retains state until conditions for change are present). True if absolute value of Operand 1 is smaller or equal to absolute value of operand 2. False if absolute value of Operand 1 is greater than 106.25% of absolute value of operand 2.
window	True if absolute value of operand 1 is less than 1.25*absolute value of operand 2 AND greater than 0.75* absolute value of operand 2.

6.3.6.2 Operand 1

A large number of values can be used as operand 1 (see dropdown list in the IMD Manager). Most of these values are self-explanatory or can be found in the “Speed” and “Position” tabs in the IMD Manager. The list is also almost identical to the dropdown list in the “Track” fields in the “Diagnostics” tab.

Info
Not all values can be used. If an illegal value is selected, the IMD manager will automatically change the value to the functionally closest value, and the user is notified.

When Operand 1 is set to “-Off-“, the mapping of Logic tx to the digital output is disabled. Note that even though the mapping is set to Off, the Logic x flag in the status might show on or off depending on the operation and operand 2. However, this state is not mapped to the actual digital output.

6.3.6.3 Operand 2

The following can be used as operand 2 (some definitions are intentionally omitted, use only the described options):

Table 3 Possible operand 2

Operand 2	Description
0	Always zero

Operand 2	Description
1	Always one
Var1	Value defined for var1 (see section 6.3.6.1 on page 34)
Var2	Value defined for var2 (see section 6.3.6.1 on page 34)
Var3	Value defined for var3 (see section 6.3.6.1 on page 34)
Var4	Value defined for var4 (see section 6.3.6.1 on page 34)

6.3.7 Logic variables

Variables that can be used as operand 1 or operand 2 can be defined in the “Logic” tab.

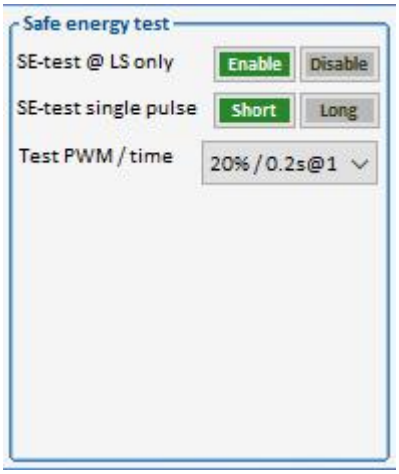
Figure 9 Logical variables

Variables one to four can be define by entering a value in the input field for a variable. The value can be entered as a decimal value or as Hexadecimal value by adding “0x” in front of the value. Once you press the “Enter↵ ” key, the value will be configured and appear in the right side in Hexadecimal format and as decimal in the input field. For example, entering “0xa2” and pressing the “Enter↵ “ key will show 162 in the input field, and 0x000000a2 in the configured value field.

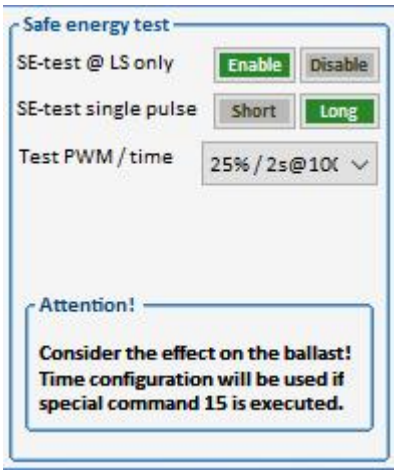
The defined variables are not used for anything else except for comparing them in the logical functions.

6.3.8 Safe energy test

The Safe energy test group defines the parameters related to the Safe energy test.

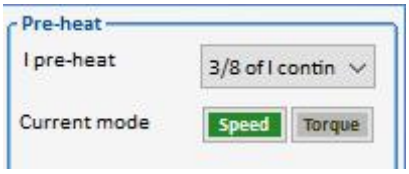


If there is a risk of ballast resistor overload due to single pulse and timing configuration of the IMD, the following warning will be shown:



6.3.9 Pre-heat

The Pre-heat group defines the parameters related to pre-heating the motor in very cold weather, prior to starting the turbine.



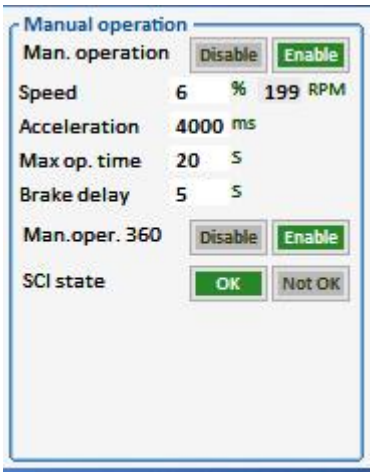
6.3.10 Virtual limit switches

This group defines the revolution values for the two virtual limit switches (VLMS).

Actual position in revolutions is shown for information.

6.3.11 Manual operation

The Manual operation group defines the parameters related to manual operation of the IMD (sometimes referred to as “Jog”).



6.4 Configuration 2/3 tab

Due to the large number of configuration parameters, the configuration parameters are divided into three tabs: “Configuration 1/3”, “Configuration 2/3”, and “Configuration 3/3”.

“Configuration 1/3” and “Configuration 2/3” tabs contain most of the configuration parameters needed for configuring the IMD. A small number of parameters that are used by experts only are in “Configuration 3/3” tab.

Attention

Changing values in the IMD manager will immediately affect the IMD running configuration. However, the entered data will be lost in the next start up unless the configuration is saved to the EEPROM (see section 6.3.10 on page 37).

The following figure shows the configuration 2/3 tab:

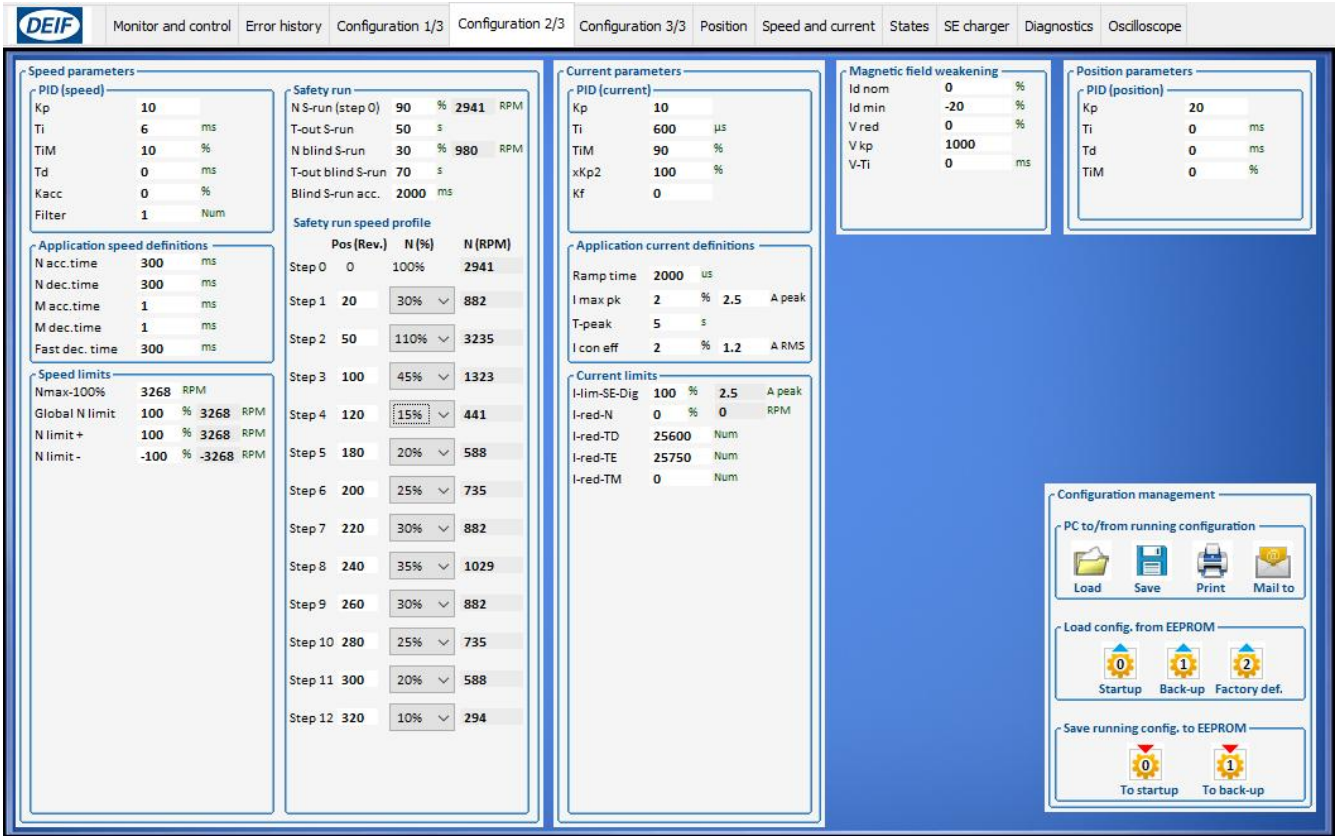


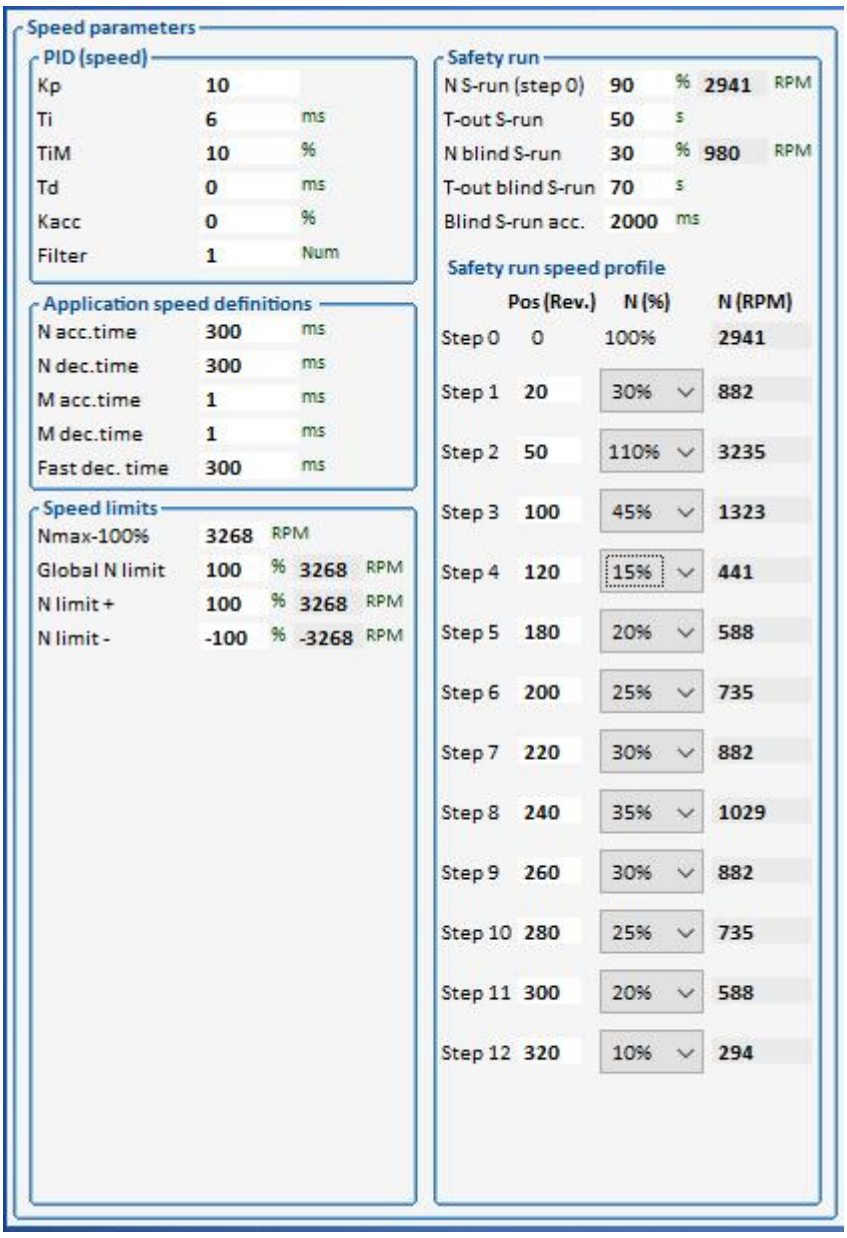
Figure 10 Configuration 2/3 tab

The parameters in the configuration tab are grouped in groups. The following sub-sections describe each group. See IMD Integration manual and IMD 100 Function description for information about specific parameters and their function.

6.4.1 Speed parameters

The speed parameters group contains all parameters related to speed control. The group is divided to four sub-groups:

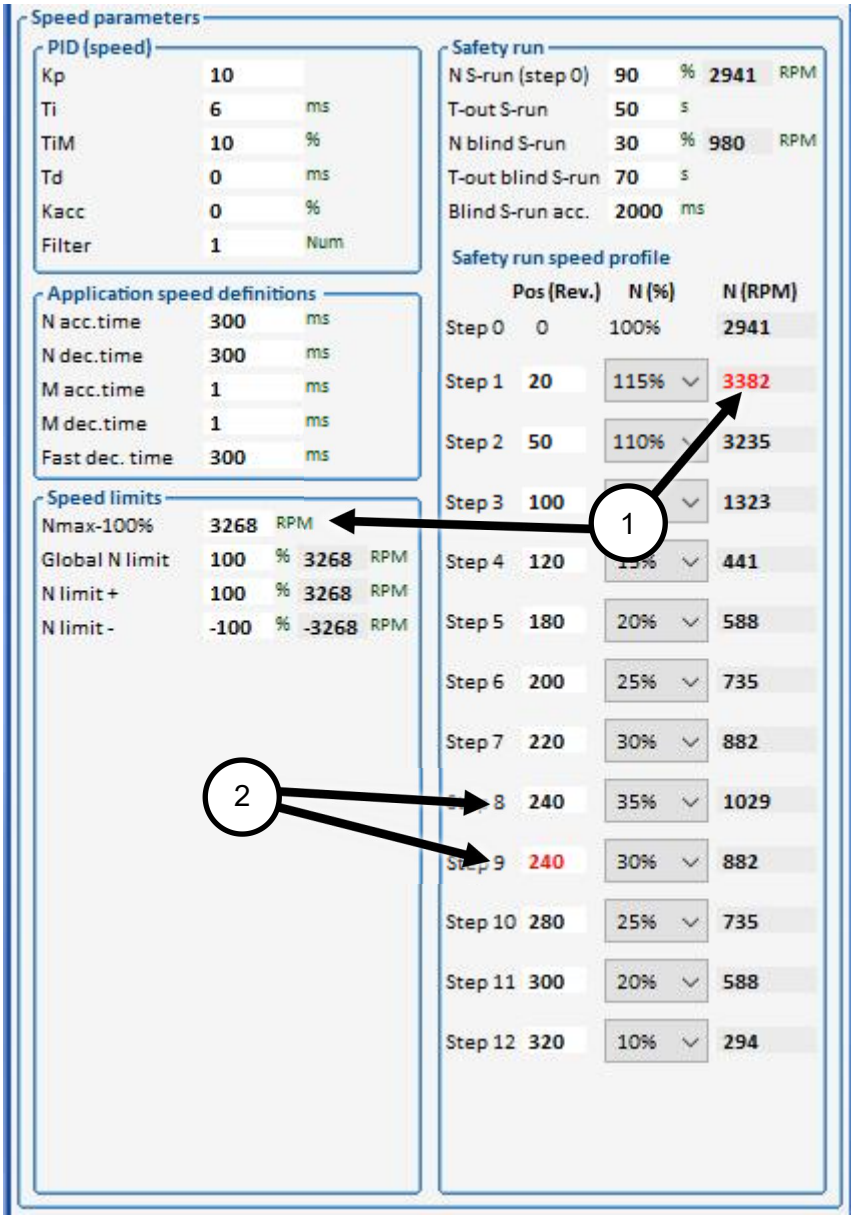
- PID (speed): This sub group contains the PID control parameters for the speed control loop.
- Application speed definitions: This sub group contains definitions for acceleration and deceleration times
- Speed limits: This sub group contains definition of speed limits. Nmax-100% is defined in RPM and is the main speed definitions. All other speed definitions are made in percent related to this speed.
- Safety run: This sub group contains speed and timeout definitions for safety run and blind safety run (safety run with no sensors), as well as safety run speed profile definition.



Safety run speed profile:

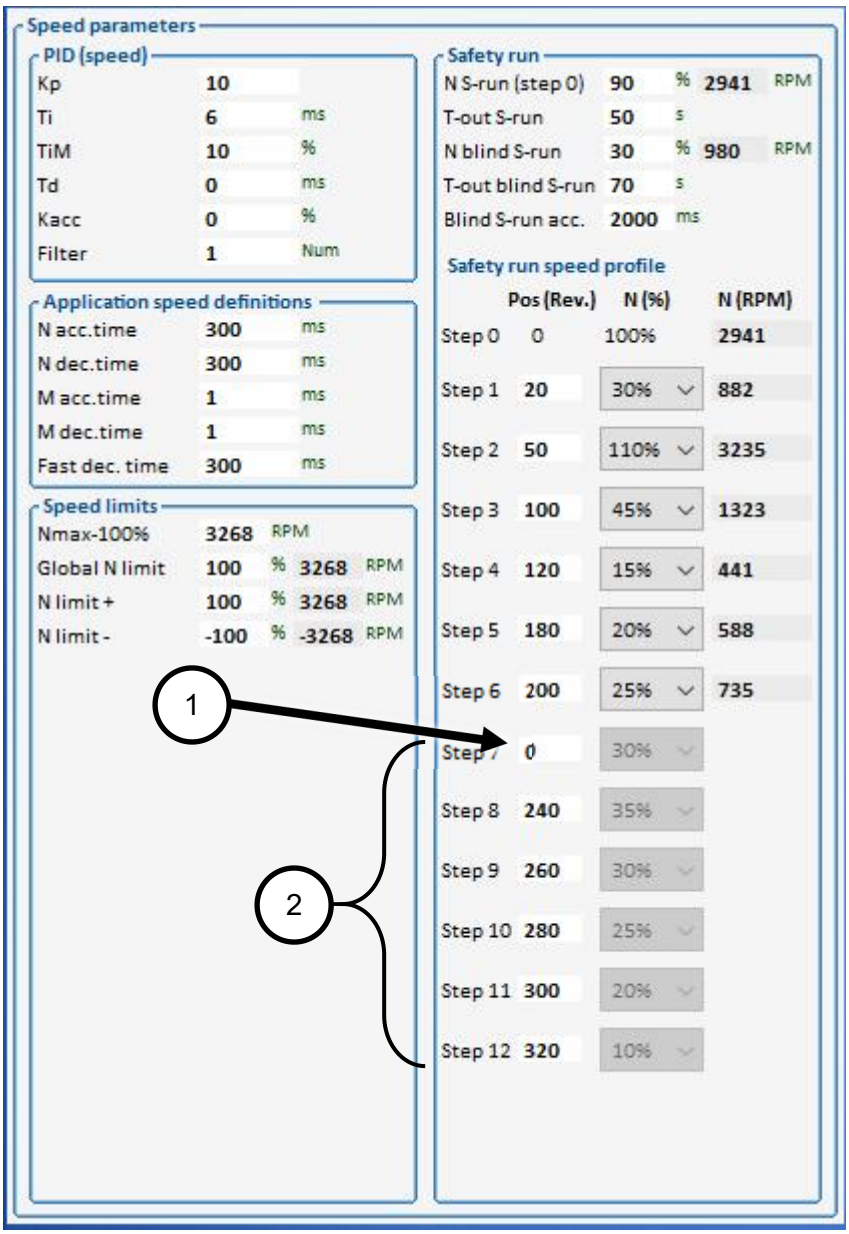
It is possible to define 13 steps in the speed profile, including step 0.

If the resulting speed of a step is higher than Nmax-100% (1), or the Pos (Rev.) value in a step is equal or smaller than the previous step (2), the wrong configuration is shown in red.



If the profile does not need all steps, set the “Pos(Rev.)” to zero (1). This step and all following steps are ignored (2), and the IMD uses the speed from the last step before the zero position until the limit switch is reached. The IMD manager shows the ignored steps by disabling the speed selection and removing the “N(RPM)” value. If the zero is changed, the ignored steps will be enabled again.

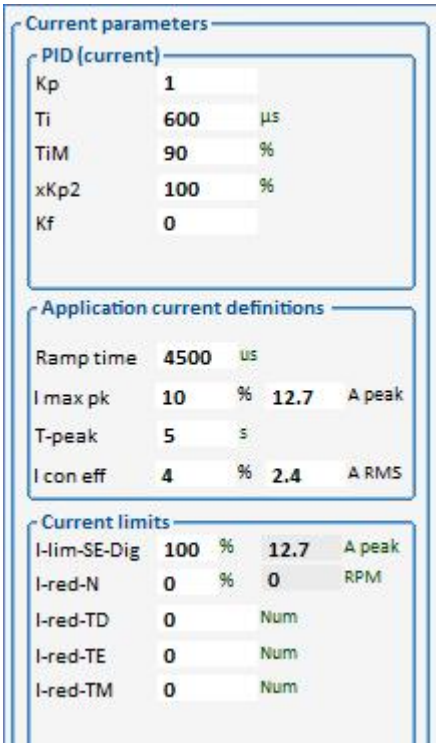
In the following example step 6 is the last step that is executed:



6.4.2 Current parameters

The current parameters group is divided to three groups: PID (current), Application current definitions and current limits.

- PID (current): This sub group contains the PID control parameters for the current control loop.
- Application current definitions: This sub group contains definitions for acceleration/deceleration (ramp) as well as current definitions.
- Current limits: This sub group contains definition of current limits. Various limits can be defined.

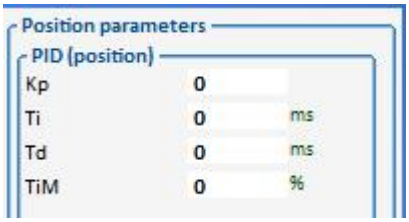


6.4.3 Magnetic field weakening

The parameters in this group are used to enable higher speed even when the voltage of the DC-link is lower than needed in order to maintain a specific speed. This is used for example, when a safety run is performed on safe energy and the voltage level decreases during the safety run.

6.4.4 Position parameters

The position parameters group contains the PID control parameters for the position control. Setting the “Kp” parameter to 0 (zero), disables the position control in the IMD.



6.4.5 Configuration management - Loading and saving configurations

The IMD has multiple areas in its non-volatile memory (EEPROM) in which it is possible to store configurations. As illustrated in the following figure, all configuration management are performed through the IMD RAM memory, which holds the running configuration. Configurations 0 and 2 contain both drive and charger parameters. Configuration 1 contains only drive parameters.

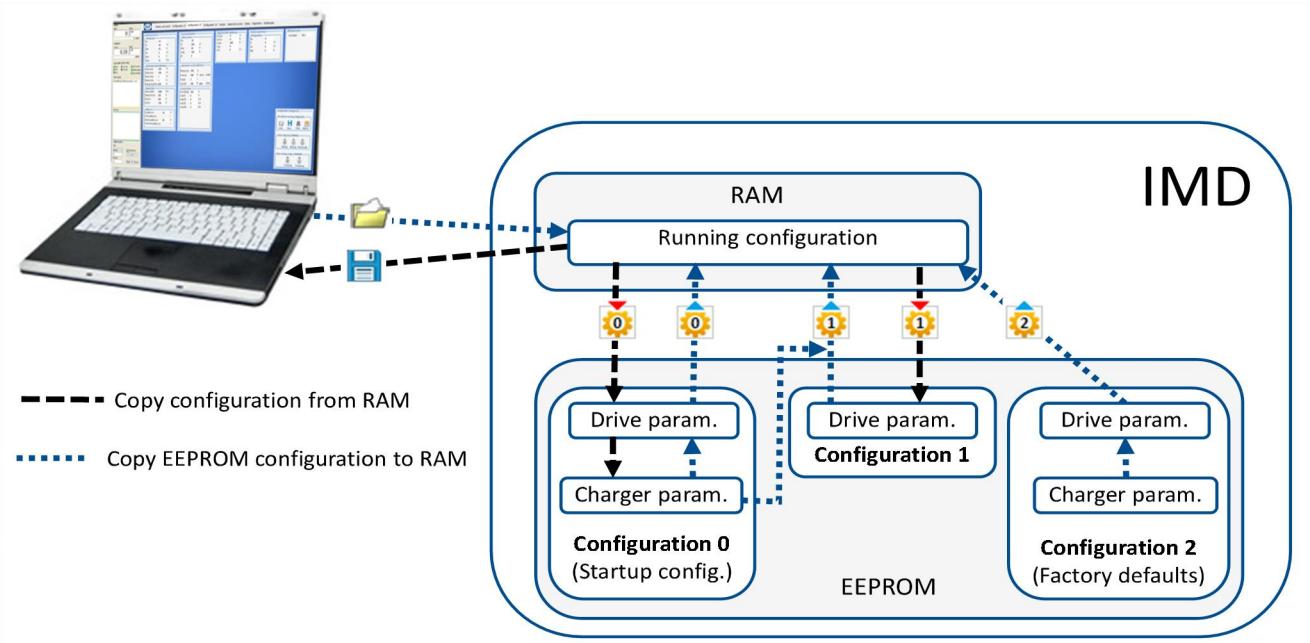


Figure 11 Configuration management

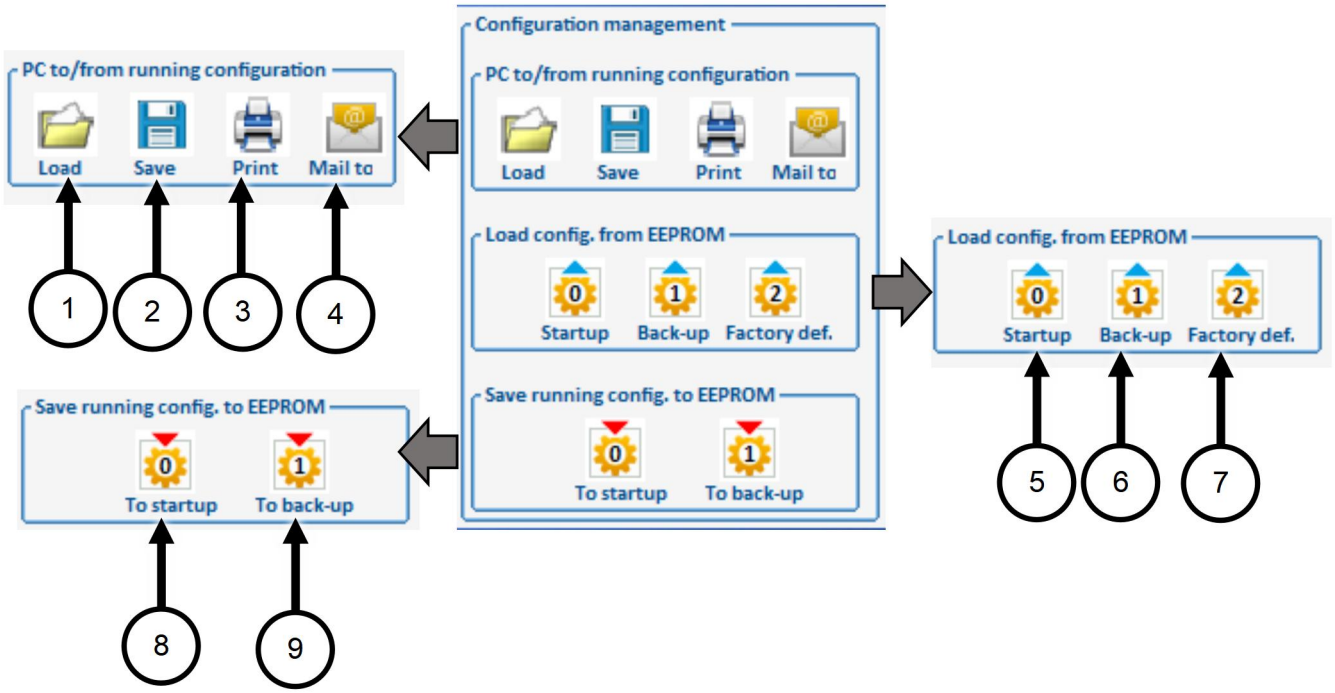
There are three configurations that can be saved in the EEPROM:

- Configuration 0 is the default configuration that the IMD loads to the RAM upon start. This configuration is used as the running configuration. Configuration 0 also contains charger configuration, if a charger is mounted.
- configuration 1 can be used to save a “known good configuration” if you are trying changes in the IMD configuration. This way it is always easy to load a working configuration again if things go wrong. Configuration 1 does not contain charger configuration. Charger configuration from configuration 0 is loaded together with configuration 1.
- Configuration 2 is reserved for factory defaults configuration, which is the reason that it is not possible to save a configuration as configuration 2. Note that the factory defaults contain the default values from the factory, and not any customized default configuration that was used in the customer’s production.

It is possible to load another configuration using the IMD Manager. This configuration can be any of the configurations stored in the EEPROM of the IMD, or another configuration stored on the PC or anywhere else the PC can reach.

When parameters are changed (either from the IMD Manager or using the CAN interface), they are changed in the running configuration. The running configuration must be saved for the changes to be used the next time the IMD starts, or be retrievable from a saved configuration.

All configuration management actions are performed from the “Configuration management” group (see description in the following table):

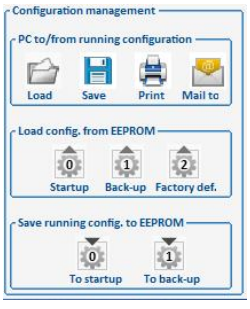


Position	Button description
1	Load a configuration file from the PC to the RAM (including charger configuration if applicable).
2	Save the running configuration from the RAM to a file (including charger configuration if applicable).
3	Print a selection of the running configuration (a printer is required). It is not possible to change the selection (the same selection as in section 6.10.6 on page 55).
4	Send the running configuration as an attachment to an e-mail.
5	Load configuration 0 from the EEPROM to the RAM (including charger configuration if applicable).
6	Load configuration 1 from the EEPROM to the RAM (including charger configuration 0 if applicable).
7	Load configuration 2 from the EEPROM to the RAM. Charger parameters (if applicable) are all set to zero.
8	Save the running configuration from the RAM in the EEPROM as configuration 0 (including charger configuration if applicable).
9	Save the running configuration from the RAM in the EEPROM as configuration 1. Charger parameters are not saved.

Info

If the IMD is enabled (Dev. Enabled is green) only Save, Print, and Mail to are enabled. In order to use any of the other buttons the device must be disabled either by setting the RUN low or clicking on the “Enable dev.” button.

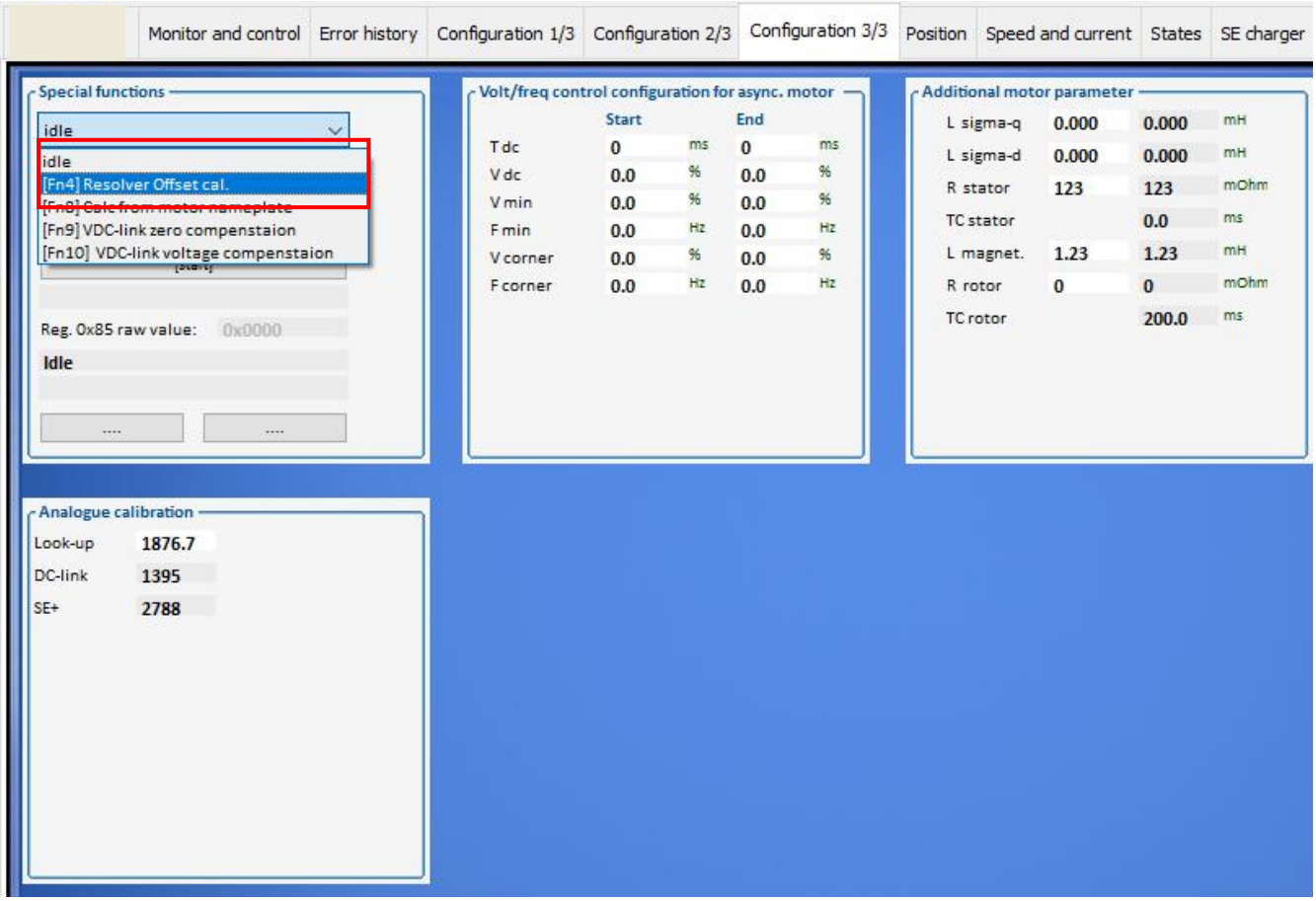
Load from file / Load from EEPROM /Save to EEPROM: The charger (if mounted) will stop charging while the operation is ongoing, and resume the charge automatically with the loaded configuration.



6.5 Configuration 3/3 tab

Due to the large number of configuration parameters, the configuration parameters are divided into three tabs: “Configuration 1/3”, “Configuration 2/3”, and “Configuration 3/3”.

Apart from resolver calibration and name plate calculation described in the IMD Integration manual, “Configuration 3/3” tab is intended for experts/PRACTEK use only.

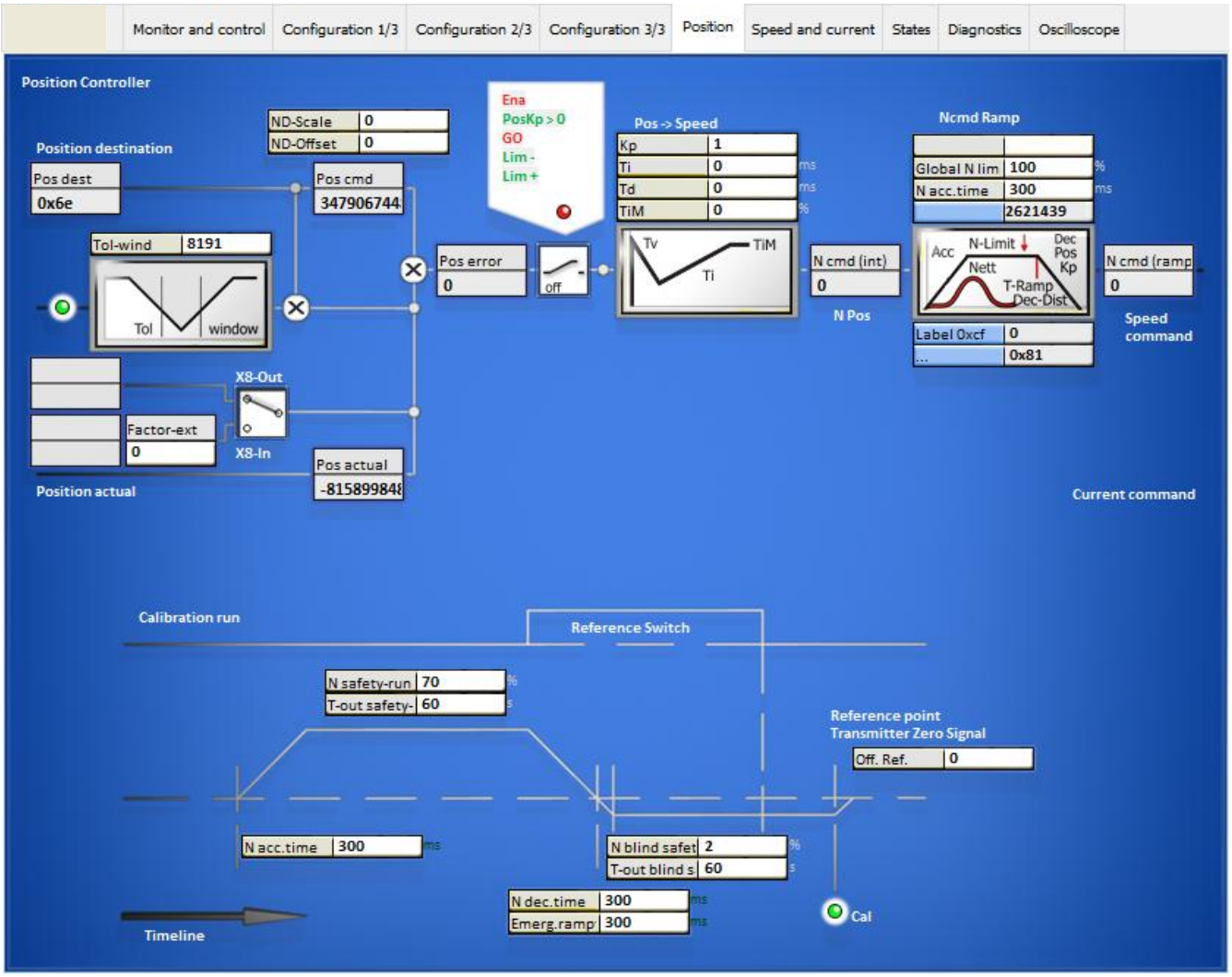


Info

In the additional motor parameter group, the editing fields are not updated automatically. They are only updated when a field is edited and when the IMD manager is connected to the IMD (updated once). To update the editable fields, disconnect and reconnect the IMD manager to the IMD.

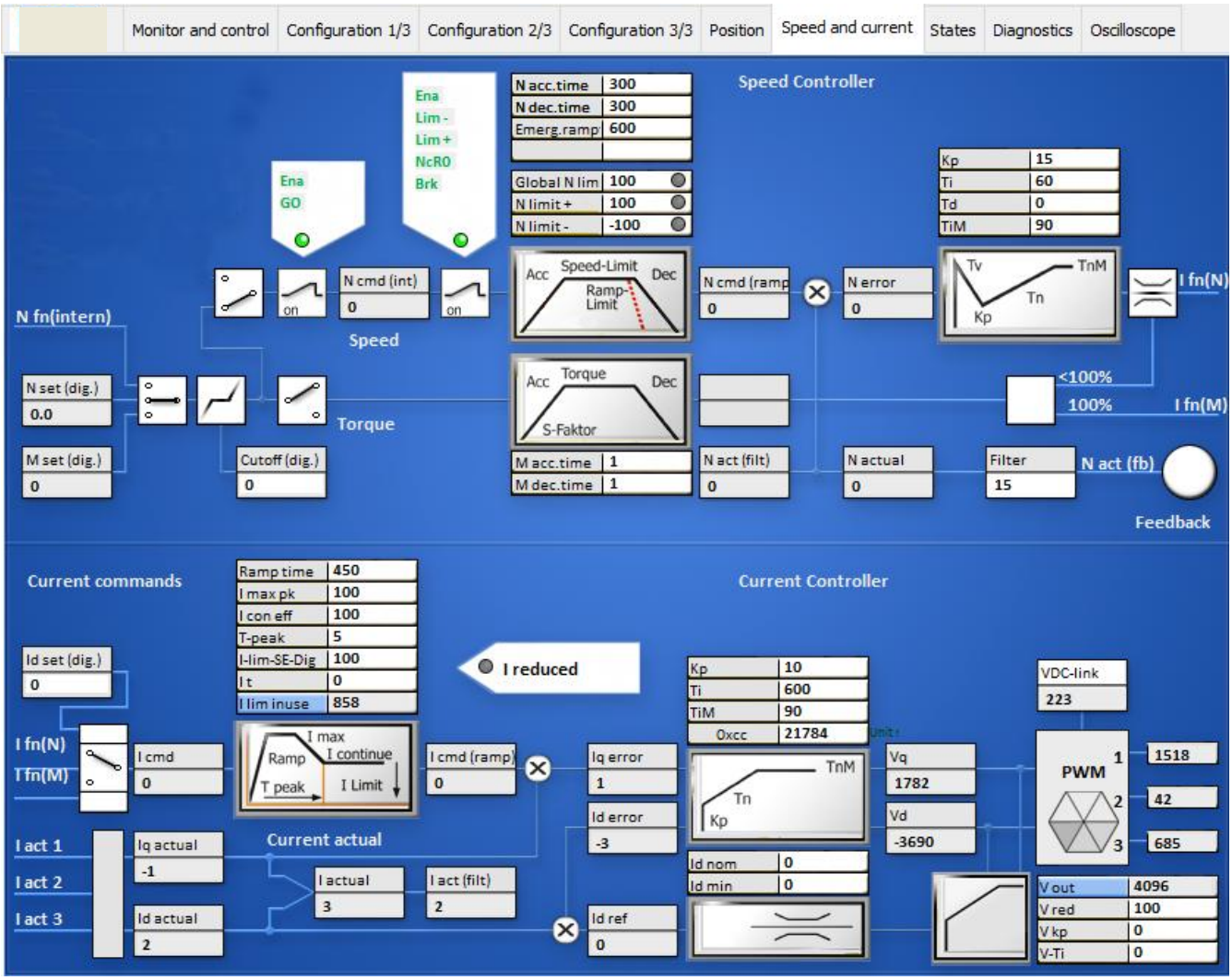
6.6 Position tab

The “Position” tab shows a flow chart of the position control loop with the related parameters and flags. This tab is intended for expert’s use.



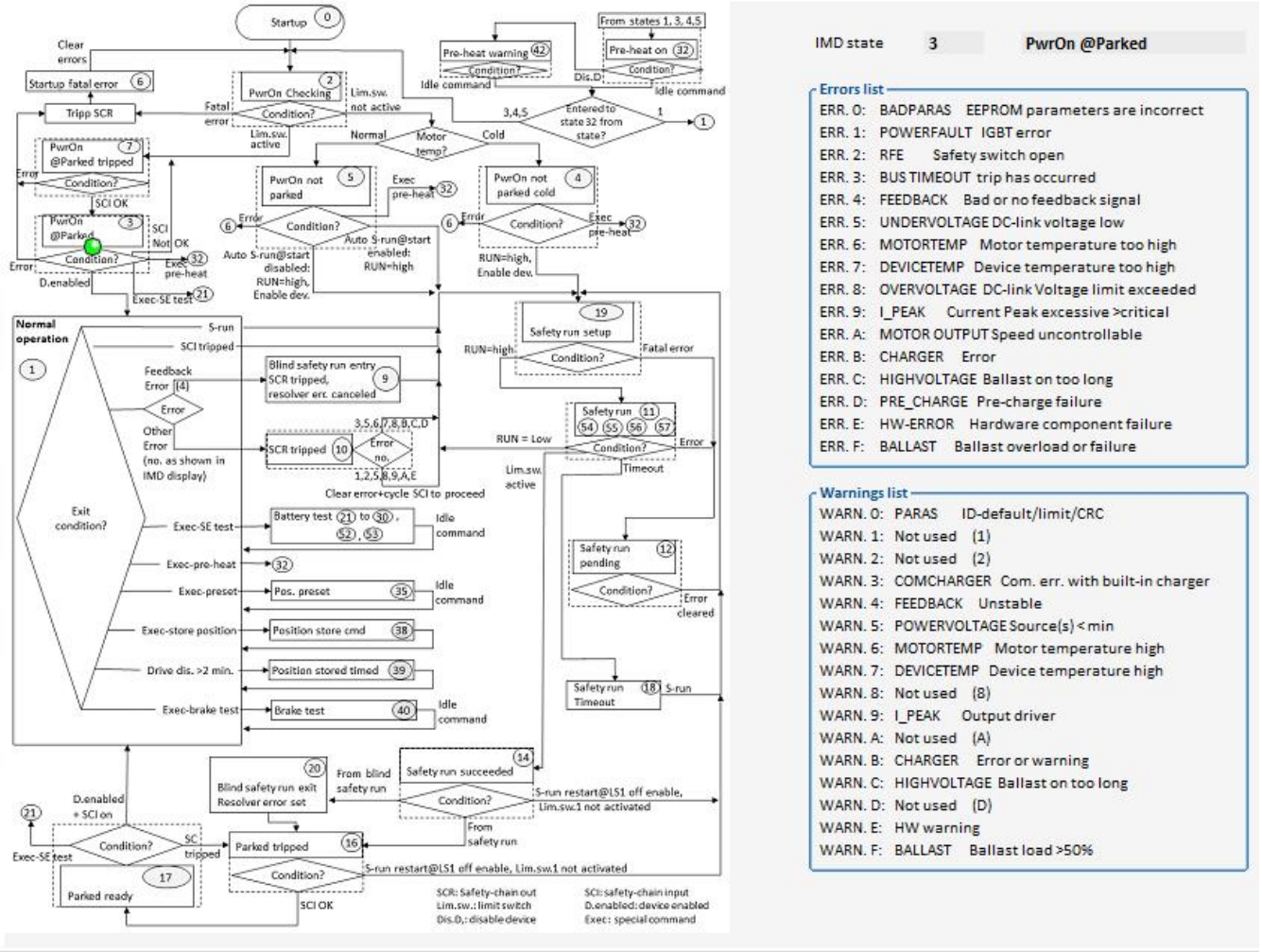
6.7 Speed and current tab

The “Speed and current” tab shows a flow chart of the speed and current control loops with the related parameters and flags. This tab is intended for expert’s use.



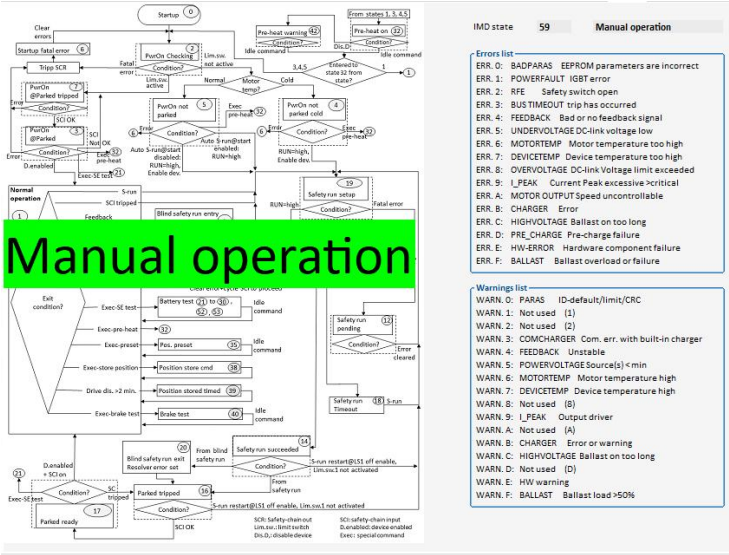
6.8 States tab

The “States” tab shows a flow chart of the IMD states and lists of errors and warnings. It does not contain all possible states. States that are only traverses without stopping and therefore will never be visible to the user are not depicted. A green LED indicates the present state of the IMD.



NOTE The state chart varies depending on the Firmwear.

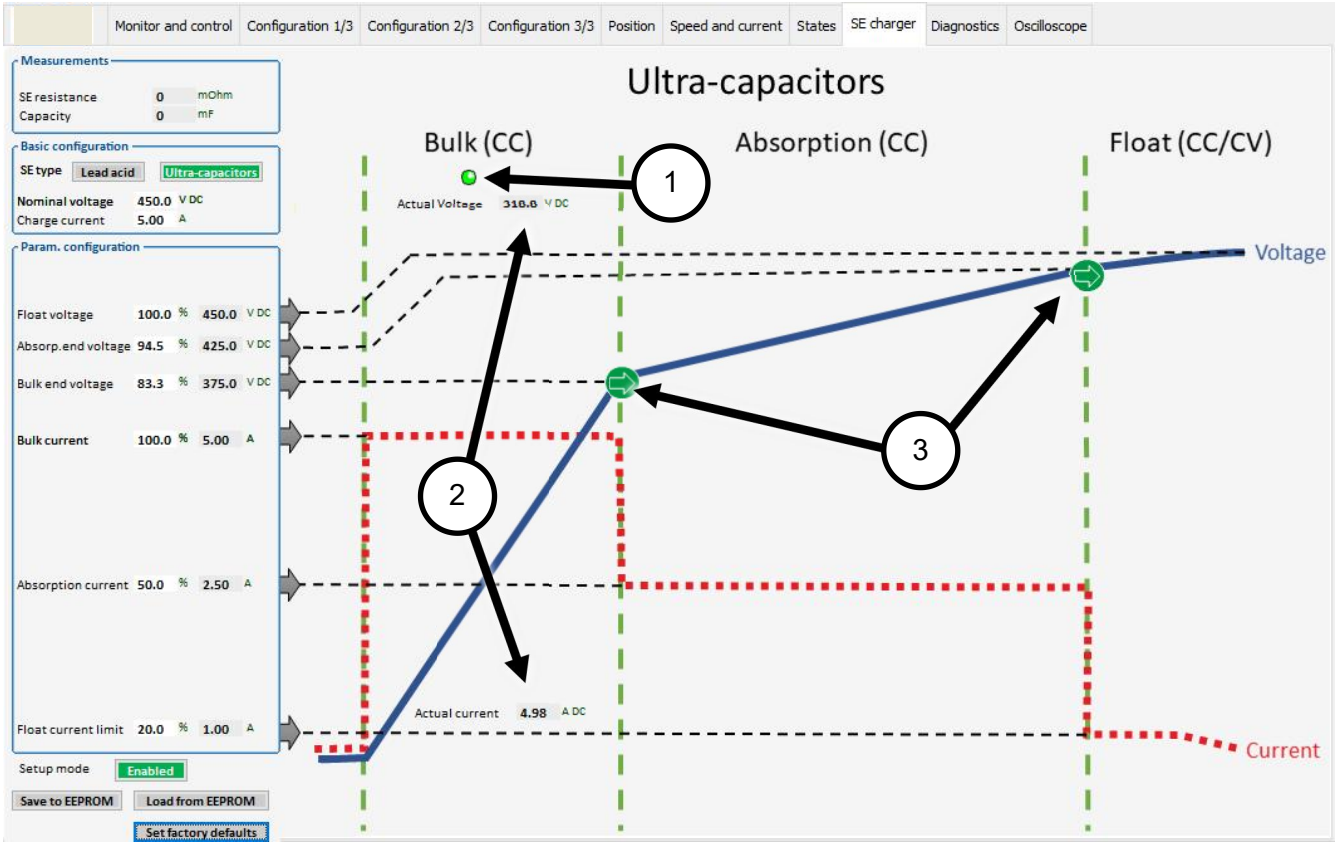
Following screen show the States tab when manual operation is active:



6.9 SE Charger tab

The “SE charger” tab is used to configure and monitor the charger.

Following is an example of an Ultra-capacitor configuration.



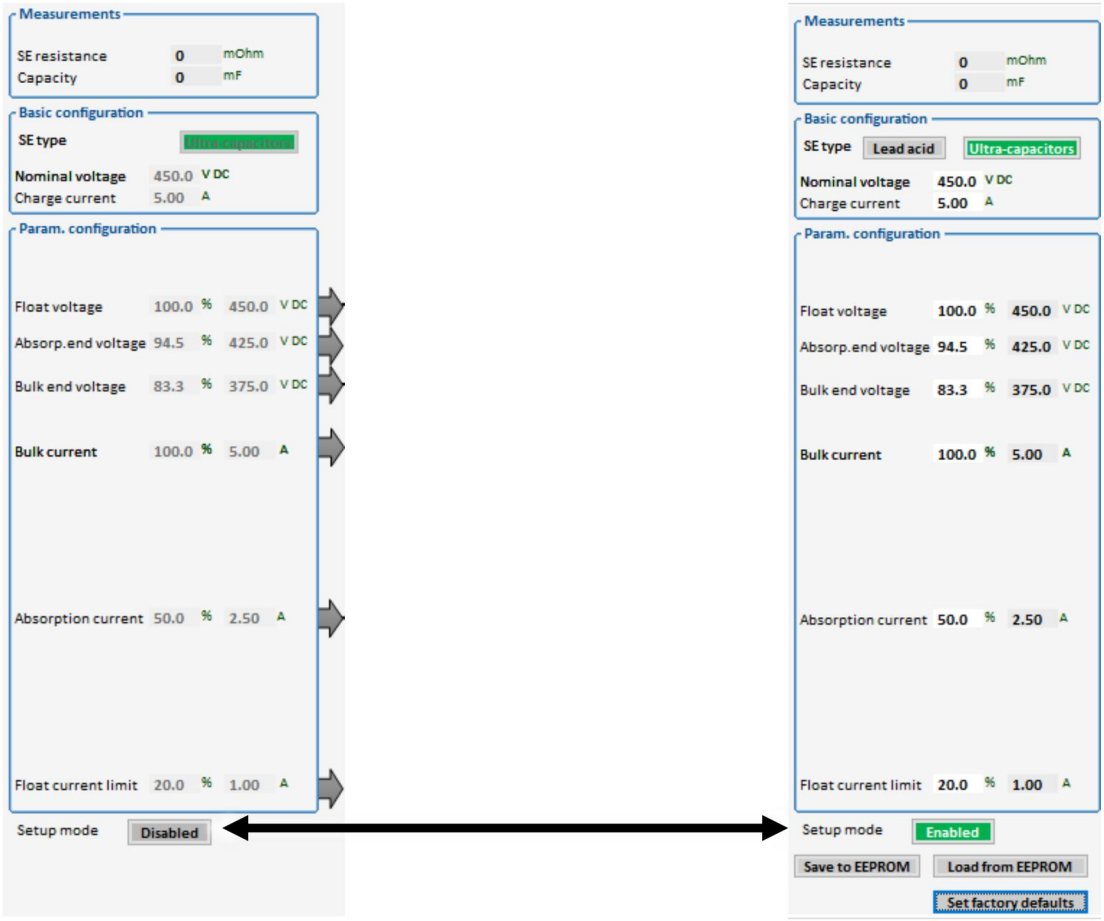
The illustration on the right shows the charging process used for the selected SE type. The LED (1) shows which state is active. When the charger is charging, the actual voltage and charge current are shown in the active state (2).

The green arrow icons (3) show the limits that causes the charger to change to the next state (either voltage or current). The dashed line from each parameter show how the parameter affects the charging process.

There are three groups in this tab:

Measurements	Contains relevant measurements for the selected SE type
Basic configuration	Contains the SE type selection and the voltage and current of the SE source. It is not possible to configure any parameter before the SE type is selected. When the SE type is changed, the other basic parameters are always set to zero. Clicking on a selected button deselects the type (nothing selected).
Param. configuration	Contains parameters that defines the charging properties. All parameters in this group are given in percentage of the voltage and current defined in the Basic configuration. The actual parameters shown changes according to the selected SE type.

It is only possible to change configuration when the charger “Setup mode” is enabled. All configuration fields are greyed out if Set mode is disabled. The charger stops charging when Setup mode is enabled. Click on the button to toggle between disabled and enabled:



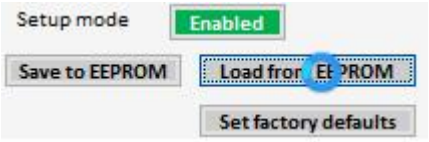
Parameters that are used in more than one SE type (for example “absorption voltage”) will keep their value even if the SE type is changed, unless factory defaults are applied.

6.9.1 Saving charger configuration to EEPROM

Click on “Save to EEPROM” button to save a running configuration to the EEPROM:

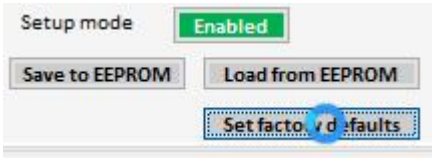
6.9.2 Loading charger configuration from EEPROM

Click on “Load from EEPROM” button to load the configuration from the EEPROM.



6.9.3 Setting factory defaults

Click on the “Set factory defaults” button to set all parameters (in percent) in the “Param. Configuration” group to factory defaults for the selected SE type. It is still possible to manually change any parameter after this is done.



6.10 Diagnostics tab

The “Diagnostics” tab in the IMD Manager is used for easily accessing some parameter values as well it enables direct read and write operations to registers. Clicking on the buttons on the left side, open the respective windows, that enables different operations.

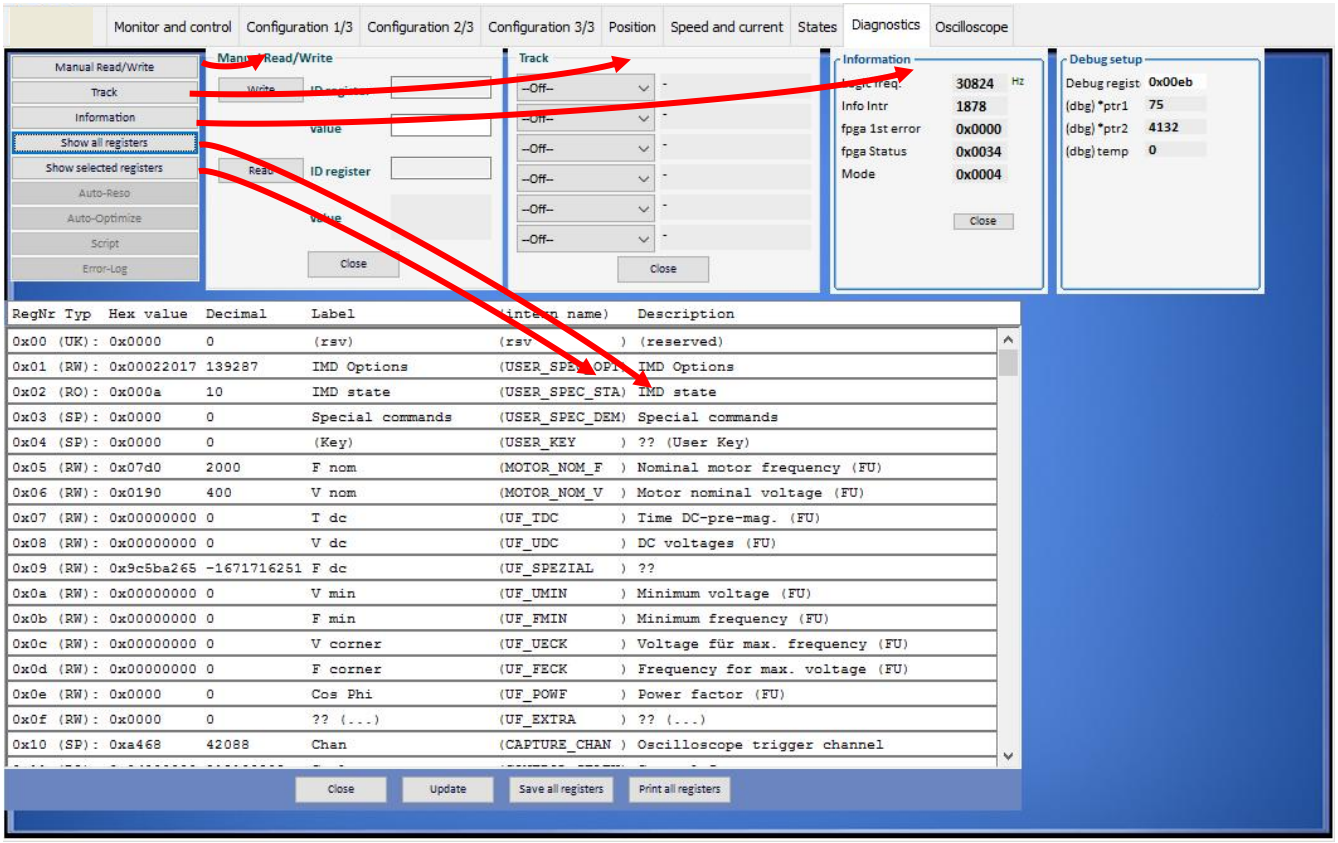


Figure 12 Diagnostics tab

6.10.1 Manual Read/write

The manual Read/Write enables direct read or write to a specific register. It is mainly used for writing to registers that are otherwise not available. The ID register is entered in either Hexadecimal by writing “0x” in front of the ID no. or decimal by omitting the “0x”.

In the following example the motor temperature sensor is changed from KTY84 to Pt100. This is done in the User options register by changing bit 0 from zero to one (note that this is an alternative way to do it – there is a button in “Configuration 1/3” that has this function). In order not to change other settings in the User options, the present value is read first.

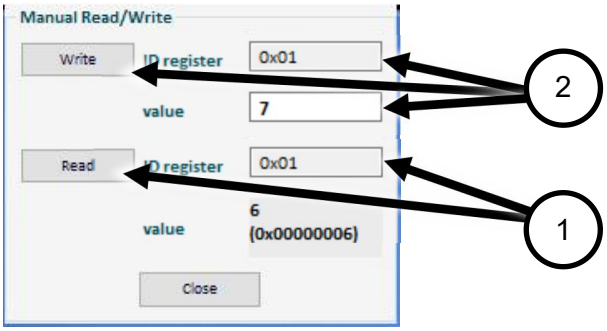


Figure 13 Manual Read/Write

In the example above register 0x01 (User options) is read for the present value by writing "0x01" in the bottom "ID register" field and clicking on the "Read" button (pos. 1).

The result "6" is shown in the "Value" field: Bit 1 (extended PT100 filter) and bit 2 (SSI type) are set. The new value needs to be "7" (bit 0, bit 1, and bit 2 are set). Enter "0x01" in the top "ID register" field, enter "7" in the value field and click on the "Write" button (pos. 2). The value in the register is now changed.

6.10.2 Track

Track can be used for continuously monitoring specific parameters while the IMD Manager is connected to the IMD. Up to 6 parameters can be monitored simultaneously. Select the parameter from the dropdown list and the value will be shown in decimal and hexadecimal (in parentheses).

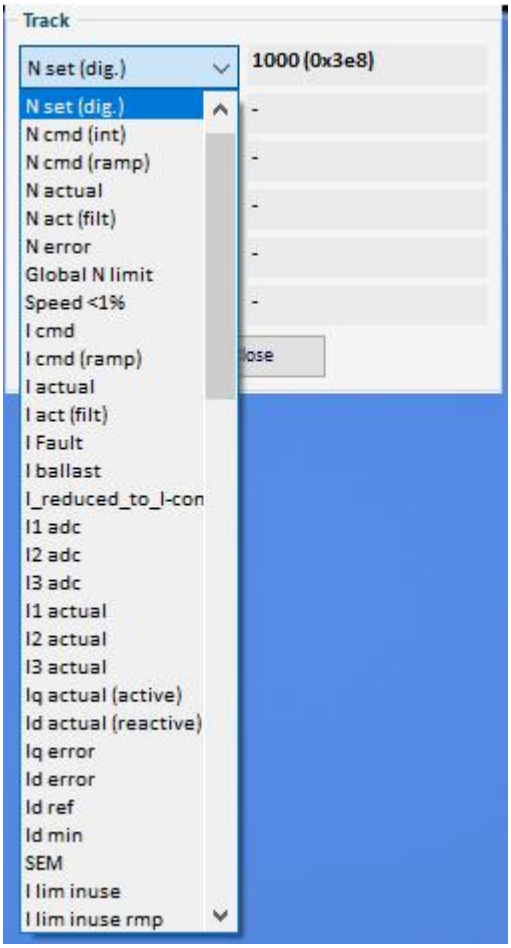
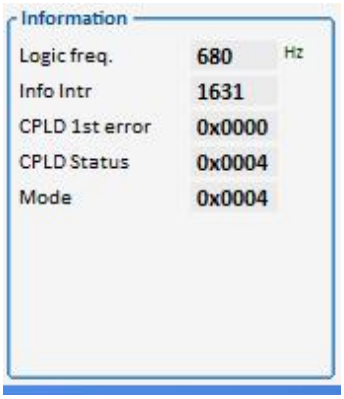


Figure 14 Track

See available options description in the dropdown list in Table 4 on page 59.

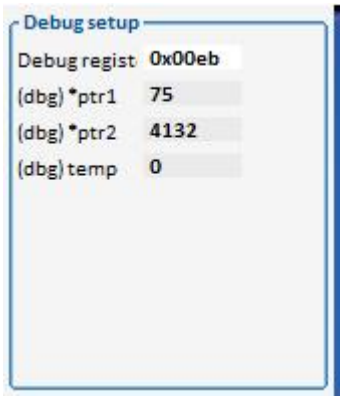
6.10.3 Information

The information window shows internal error codes and status, and is used for factory debugging purposes.



6.10.4 Debug setup

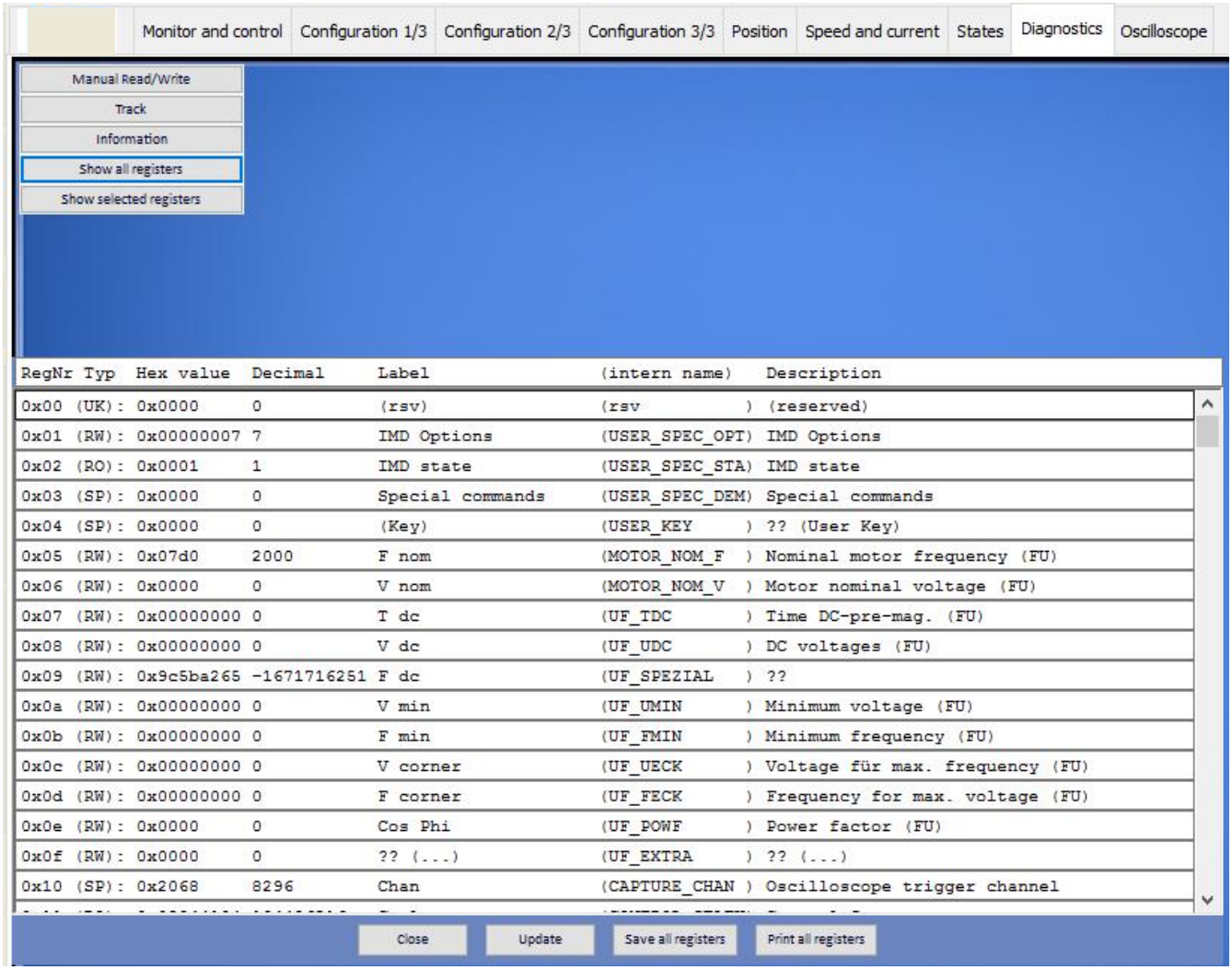
This group is intended for PRACTEK use only.



6.10.5 Show all registers

The “show registers” shows all registers with their properties and values. The values are not updated automatically. Click on the “Update” button to update the contents.

Clicking on the “Save all registers” button opens a dialog that enables saving all registers values in a *.urf file format (same function as File→Save registers… menu).



Be aware that many of the registers are used for intermediate results in calculations. Some of the registers and descriptions will not make sense to normal users.

6.10.6 Show selected registers

The “show selected registers” shows the registers used in the IMD manager only (though not all parameters used in the “Position” and “Speed and current” tabs). It is not possible to modify which registers are shown. The values are not updated automatically. Click on the “Update” button to update the contents.

Clicking on the “Save selected registers” button opens a dialog that enables saving the shown registers values in a *.urf file format.

6.11 Oscilloscope

The built-in oscilloscope enables direct measurements on the IMD. It is possible to record and trig on many register's values, as well as use the built in step generator to create a specific situation.

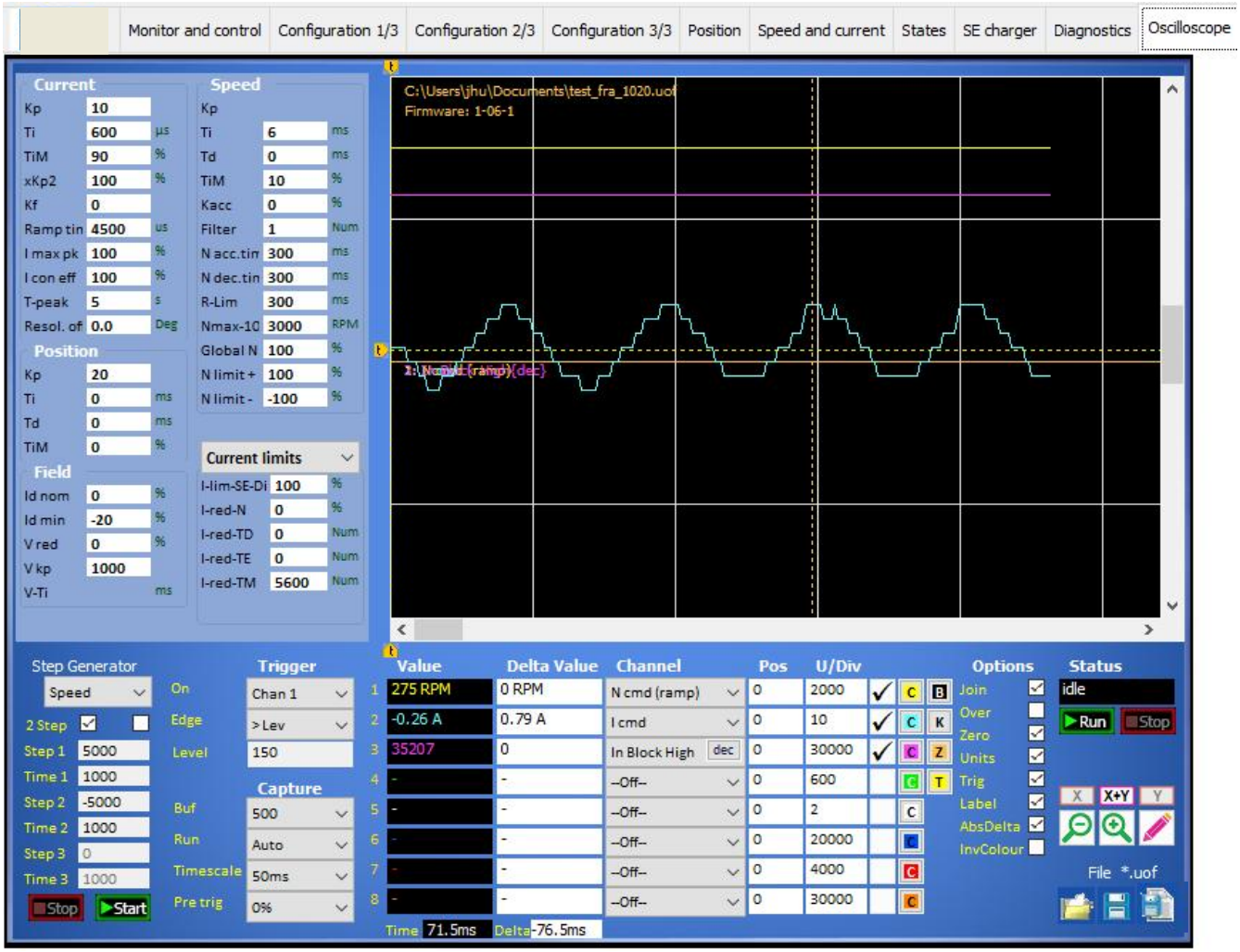


Figure 15 The built-in oscilloscope

6.11.1 Screen functions

Screen colours:	
B	Oscilloscope background
K	Oscilloscope grid
Z	Oscilloscope zero line
T	Oscilloscope trigger line
Option	
Join	Pixels connected
Over	Old measurements remain on the screen and new measurements are added
Zero	Zero line visible
Units	Display measured values as ”num” or real values
Trig	Trigger line visible
Label	Channel designation visible
AbsDelta	The delta values are shown as absolute values (always positive)
InvColour	Invert oscilloscope screen colours
X	Select zoom function: X axe only
X+Y	Select zoom function: both X and Y axes
Y	Select zoom function: Y axe only
	The screen content is enlarged according to the selected zoom function
	The screen content is reduced according to the selected zoom function
	Change the thickness of the measured lines
File *.uof	
	Load an oscilloscope file from the pc
	Save the oscilloscope content as *.uof file on the pc
	Save the oscilloscope content as a spread sheet file
Status	
	

State	Colour	Description
Waiting (0)	Red	Display of the last recording and waiting for a new triggering
Waiting (xx)	Green	Triggered, data are saved
Reading	Blue	Reading of the data from the drive to the pc
Drawing		Display of the data on the oscilloscope screen
Idle	White	Frozen data after “Stop capture”

Run/Stop	
	The oscilloscope recording is focused via the key field “run capture”. The recording is started at the next triggering signal.
	The recording is stopped through “stop capture” and the display is frozen

6.11.2 Channel selection

In the channel selection, it is possible to select what the different channels measure.

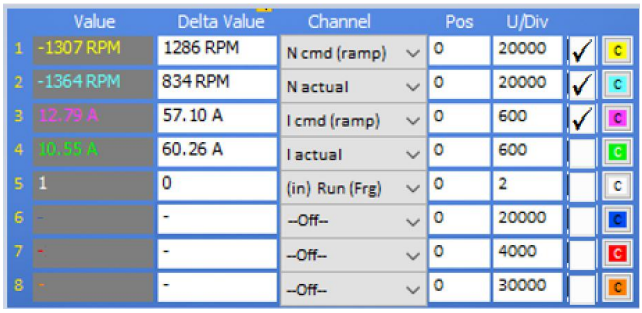


Figure 16 The channel selection

Field	Function
Value	Value at the cursor line (numerical or real)
Time	Time from the trigger line to the first cursor line
Delta Value	Difference values from the first to the second cursor
Delta (Time)	Difference time from the first to the second cursor
Channel	Select what to monitor with the channel from the dropdown list (see description in Table 4 on page 59. The channel is switched off at ‘off‘. **Channels which are not used must always be switched off! (Off)**
Pos	The value of 100 corresponds to a horizontal grid line. For example: At value 50 the zero line of the selected channel is shifted upwards by half a square.
U/Div	Units for a horizontal grid line. For example: U/Div = 32768 at N cmd Ramp. (N max parameter = 3000 rpm) The numerical value (32768) of the speed command value corresponds to a horizontal line at 3000 rpm. At cursor request a horizontal line equals 100. Thus, the cursor value 100 corresponds to a speed of 3000.
Channel checkbox	The display of the channel is switched on and off. The switched-off channel remains in the background and is also saved.
Channel colour	A colour selection window is opened by clicking the colour key C. Select the new channel colour and accept it by clicking ‘ok’.

When a bit mapped register is selected, it is possible to select farther what to monitor in the register:

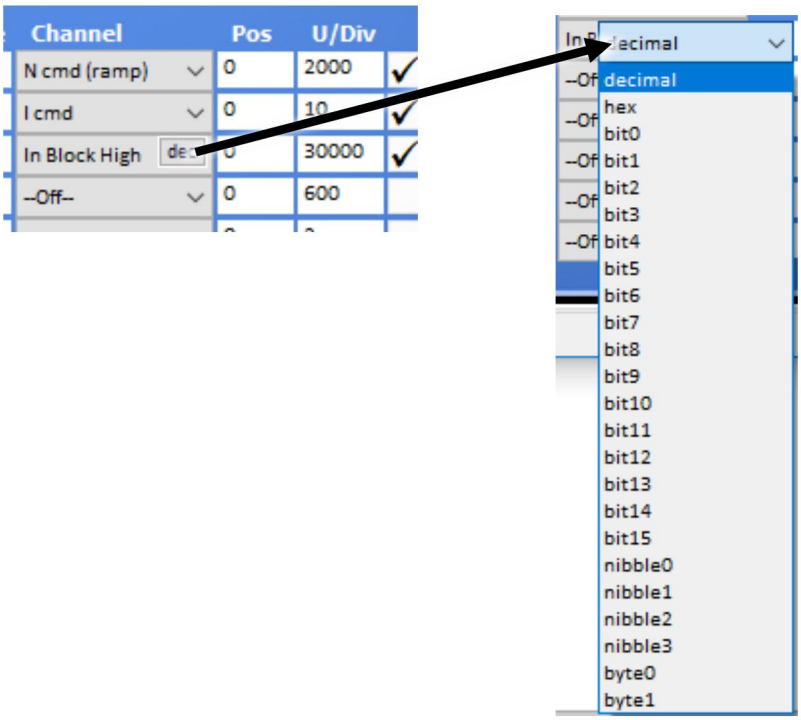


Table 4 Dropdown selection options

Text	Register	Description
N set (dig.)	0x31	Digital Speed Set Point
N cmd (int)	0x5d	Speed command value before ramp
N cmd (ramp)	0x32	Speed command value after Ramp
N actual	0x30	Speed actual value
N act (filt)	0xA8	Actual speed value (filtered)
N error	0x33	Speed setpoint minus actual speed in numeric
Global N limit	0x34	Global speed limit
Speed <1%	0xf5	Speed is almost zero
I cmd	0x26	Current Command value
I cmd (ramp)	0x22	Current (I) command value
I actual	0x20	Actual current value
I act (filt)	0x5f	Filtered, actual current value for display in IMD Manager
I Fault	0xe9	Status of the power section (OK/Error)
I ballast	0xea	Status (On/Off) of the ballast resistor
I_reduced_to_I-con-eff	0xf3	Current reduced to configured continuous current
I1 adc	0xa1	Current phase 1
I2 adc	0xaa	Current phase 2
I3 adc	0xa9	Current phase 3
I1 actual	0x54	Actual current value phase 1
I2 actual	0x55	Actual current value phase 2
I3 actual	0x56	Actual current value phase 3

Text	Register	Description
Iq actual (active)	0x27	Q-current (active) actual
Id actual (reactive)	0x28	D-current (reactive) actual
Iq error	0x38	Q-current error feedback (active current)
Id error	0x39	D-current error feedback (reactive current)
Id ref	0x23	D-current (reactive) reference
Id min	0xb5	Minimum magnetising current
SEM	0x61	Battery mid-point voltage (“SEM” terminal)
I lim inuse	0x48	Actual used current limit
I lim inuse rmp	0x57	-
Power	0xf6	Calculated power in use
Work	0xf7	Calculated work (accumulated power over time)
Pos dest	0x6e	Position target command
Pos cmd	0x91	Position Command value (int.)
Pos actual	0x6d	Actual position (from resolver)
Pos error	0x70	Position actual error
Pos act in tol	0xf4	Position is within tolerance window
Pos actual SSI	0x6f	Actual position from SSI encoder
MotorPos mech	0x42	Actual rotor position
MotorPos elec	0x43	Actual rotor position within one electrical phase
M set (dig.)	0x90	Torque Set Point (based on the current)
M actual	0xa0	Torque actual (based on the current)
In Block	0x9b L	Digital inputs status (bits 0 – 15)
In Block	0x9b H	Digital inputs status (bits 16 – 31)
Resol. LosOfSignal	0xec	Resolver signal missing or faulty (2 bits)
Go	0xe3	Status of the “GO” flag
Brake output	0xf2	Brake delay time is active (1 while the delay is on)
Out Block	0x98	Digital outputs staus
Rotor	0x5c	Rotor signal
VDC-link (filt.)	0xeb L	Filtered DC-link voltage
VDC-link (dir.)	0xeb H	Not filtered DC-link voltage
Safe energy (filt.)	0x66 L	Filtered battery voltage (“SE+” terminal)
Safe energy (dir.)	0x66 H	Not filtered battery voltage (“SE+” terminal)
Vq	0x29	Q-Output voltage
Vd	0x2a	D-Output voltage
V out	0x8a	Relative output voltage
V red	0x8b	Begin of field weakening in percentage of VOUT
V kp	0x8c	Proportional amplification field reduction
V-Ti	0x8d	Integral amplification field reduction
pwm1 (5/6)	0xac	Pulse width modulation phase 1

Text	Register	Description
pwm2 (3/4)	0xad	Pulse width modulation phase 2
pwm3 (1/2)	0xae	Pulse width modulation phase 3
T-motor	0x49	Motor temperature (from the configured M-temp sensor)
T-igbt	0x4a	Output power module (IGBT) temperature
T-air	0x4b	Air (inside the IMD) temperature
Pt1 (Pt100)	0x9c	Pt 100 1 value
Pt2 (Pt100)	0x9d	Pt 100 2 value
Pt3 (Pt100)	0x9e	Pt 100 3 value
Pt4 (Pt100)	0x9f	Pt 100 4 value
Ballast energy	0x45 L	Ballast energy counter (bits 0- 15 of 0x45)
(dbg) temp	0x9a	Value from debug temp register
(dbg) *ptr1	0xb8	Value from debug *ptr1 register
(dbg) *ptr2	0xba	Value from debug *ptr2 register
Logic freq.	0xab	Intern logic frequency
PMB Status	0x63	Power board status
Warning-Error map	0x8f	Error bits (0 - 15), and Warning bits (16 - 31)
L Error map	0x8f L	Error bits (0 - 15)
H Warning map	0x8f H	Warning bits (16 - 31)
L Status map low	0x40	State Bits (0 – 15)
H Status map high	0x40	State Bits (16 – 31)
IMD state	0x02	Present IMD state
incr_delta	0x41	PRACTEK use only
Mode	0x51	Device mode (application commands)
Ctrl status	0x11	Intern commands status (PRACTEK use only)
Ctrl (high)	0x11 H	Intern commands status (PRACTEK use only)
Logic map intern	0xD8	Logic in/out state

6.11.3 Trigger and capture functions

On	Selection of the channel or register for the trigger function. Select either one of the

	channels (1 – 8) or one of the registers from the dropdown list. If a register that is not selected in one of the channels is used, the oscilloscope will trig on this signal, but it will not be seen on the oscilloscope. Use the direct selection only if all eight channels are used to monitor other signals. See description of the available direct options in Table 4 on page 59.
Edge	Selection of the trigger function with regards to the level (such as rise, fall, equal).
level	Trigger level (numerical value).
Buf	Buffer size, horizontal pixels for all switched-on channels.
Run	Selection trigger switching function.
Timescale	Time unit per gridline. The oscilloscope makes 50 measurements per timescale. Events in-between measurements are not recorded.
Pre trig	Horizontal shifting of the trigger line. Measured value display before the trigger line.

To calculate the total recorded time of a measurement:

Total measurement time (s) = buffer size / no. of measured channels * timescale (s) / 50

Example with the shown settings (and screen in Figure 16 on page 58):

Total measurement recorded time = 2000 / 5 * 0.5 s / 50 = 4 s.

6.11.4 Display of measurements

The recording of the measured values is displayed with the selected colours.

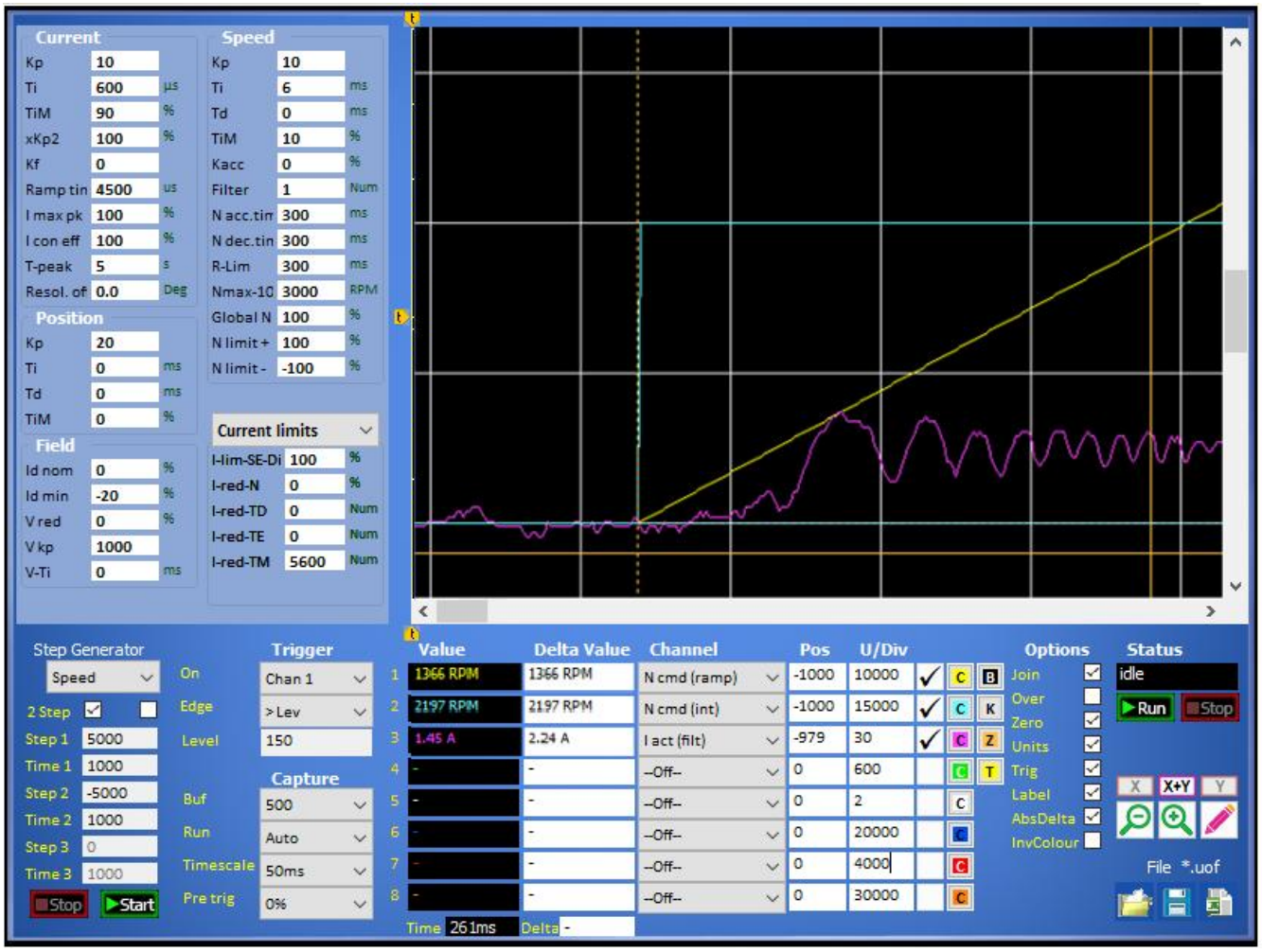
The first vertical trigger line is tagged with an arrow symbol at the upper and lower edge of the screen.

The second vertical line is the first cursor line.

The active second cursor is displayed as horizontal and vertical crossline.

The measured values at the first vertical cursor line are displayed at value and saved. The measured values at the second cursor (crossline) are displayed in the fields “Delta value” as delta values from the values at the first cursor. The time from trigger line to the first cursor line is displayed in the “Time” field. The time between the first cursor line and the second cursor line is displayed the “Delta” field.

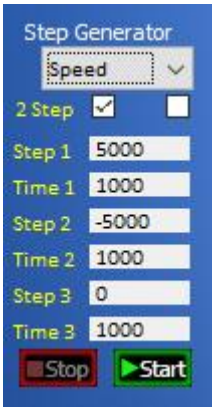
If the “Units” box in the “Options” is ticked the displayed values are transformed from numerical to real values.



6.11.5 Step generator

The oscilloscope has a built-in command executer (step generator) that can execute two or three steps in a loop. It is possible to set a parameter value for either speed, current, torque or position, as well as the duration (time) for each step. Enter a value for a step and select the control for the step (speed, current, torque or position). Except for the parameters configured in the steps of the step generator, all other configured parameters will be used (such as limits, ramp time and so on).

Once the step generator is started with the start button, it will loop through the steps until the stop button is pressed.



Step generator	Select what the value in a step will be executed as: speed, current, torque or

selection	position
2 step check boxes	Select sequence length: Two steps:  Three steps: 
Step 1	Value for step 1. Value type depends on the selected function in the Step generator selection (speed, current, torque or position)
Time 1	Time duration for step 1 in ms. Range: 0 – 32767.
Step 2	Value for step 2. Value type depends on the selected function in the Step generator selection (speed, current, torque or position)
Time 2	Time duration for step 2 in ms, If the sequence is two steps, it will stop after time 2 elapsed. Range: 0 – 32767.
Step 3	Value for step 3 (disabled if two step is selected). Value type depends on the selected function in the Step generator selection (speed, current, torque or position)
Time 3	Time duration for step 3 in ms (disabled if two step is selected). The sequence will stop after time 3 elapsed. Range: 0 – 32767.

Value ranges according to type:

Current	± 330
Torque	± 32767
Speed	± 32767
Position	± 2147483647

Using the step generator:

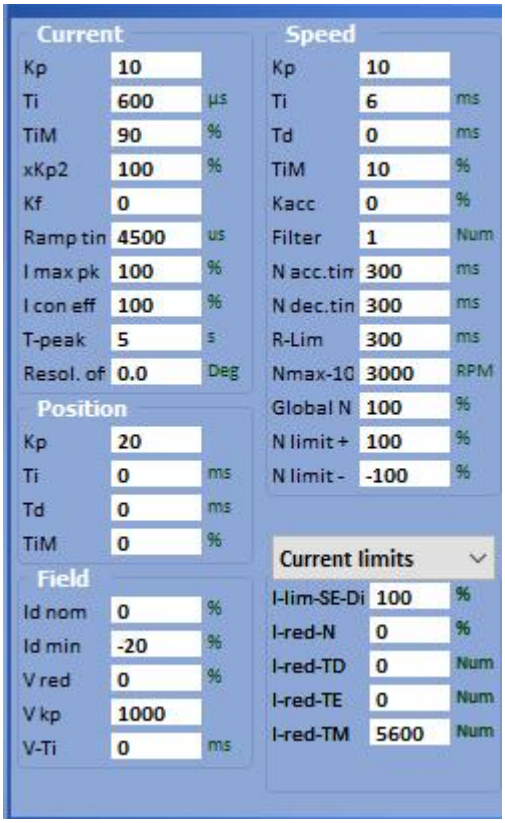
1. Configure the steps in the step generator
2. Enable the drive (the Dev.Enabled LED must be on)
3. Start the step sequence by clicking on the start button () of the step generator:
4. The steps will now be executed in a continuous loop
5. The execution can be stopped by clicking on the stop button () of the step generator.

Attention
When using “current”, “torque” or “position”, the motor might rotate at max speed if no other limit is set. Consider any travel limits before starting the step execution.

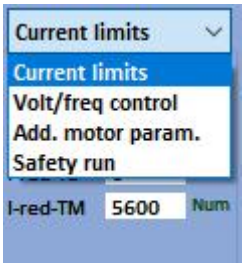
6.11.6 Parameters in the oscilloscope tab

The parameters of the Oscilloscope tab can be changed during the test function. The modifications are transferred immediately to the running parameter set (tabs Configuration 2/3, and 3/3).

The result is immediately displayed on the oscilloscope screen after the next triggering.



It is possible to change the displayed parameters on the bottom left by selecting a different list:



7. Revision history

Apart from editorial changes the following changes have been made in this revision:

Date	Revision	Changes
2021-03-16	M	• Updated for version 1.0.8.0 • “Configuration 2/3” updated • “Error history tab” updated
2020-09-28	L	• Updated for version 1.0.7.0 • “Monitor and control tab” updated • “States tab” updated • “Communication menu” in the “Menu bar” updated
2020-07-02	K	• Updated for version 1.0.6.0 • “Motor data” in “Configuration 1/3” updated
2020-06-03	J	• Updated for version 1.0.5.0 • “SE charger” description in “Monitor and control” updated • “Configuration 1/3” figure updated • “Speed parameters” figure updated • “SE Charger tab updated”
2020-04-23	H	• Updated for version 1.0.4.0 • “Error history tab” added • “Monitor and control tab” and “Configuration 1/3” sections updated • “General servo (IMD) data” in “Configuration 1/3” updated • “Manual operation” in “Configuration 1/3” updated • “Virtual limit switches” added to “Configuration 1/3” • “Track” section updated • List of available options added to “Channel selection” • “Trigger and capture functions” section updated
2020-01-08	G	• Updated for version 1.0.3.1 • “SE charger” tab section updated
2019-09-05	F	• Updated for version 1.0.3.0 • “States” tab updated • Screen dumps and information for “Monitor and control” and “configuration 1/3” tabs updated • Manual operation group added to “configuration 1/3” section • “Oscilloscope” section updated

		• File menu updated • “Configuration management” updated with charger configuration • “Show selected registers” section added to “Diagnostics” tab • “Platform requirements” section added to “Introduction to the IMD Manager”
2018-07-04	E	Updated to reflect changes in the IMD Manager: • “Monitor” tab screen dump and description updated • “Configuration 1/3” motor data and General servo (IMD) data groups updated • “States” screen dump updated
2018-02-15	D	Updated to reflect changes in the IMD Manager: • Introduction to the IMD manager and entering data updated • “Monitor” tab screen dump and description updated • “Configuration 1/3” tab screen dump and description updated (general, motor data, general servo, safety run, CAN bus, safe energy test). • “Configuration 2/3” tab screen dump and description updated (speed parameters, current parameters) • “States” tab screen dump updated • Revision history moved to the end of the document
2017-10-18	C	Updated to reflect changes in the IMD Manager: • “Monitor” tab screen dump and description updated • “CAN bus” group in “Configuration 1/3” completely updated • New screen dump of “States” tab (states chart updated, WAR. Changed to WARN. in list) • Screen dump for “Configuration 1/3” updated • “Battery test” and “General servo…” group in “Configuration 1/3” updated • Quick access area updated with NcR0
2017-02-28	B	Updated to reflect changes in the IMD Manager: • Resolver and SSI encoder readings added to “Monitor” tab • State flow chart updated • Description of Operating values in the “Monitor” tab updated • Description of output logic improved • Errors and warnings lists added to screen in the States tab
2016-12-21	A	This is the first version of the document.

8. Product user documentation

The IMD product has an extensive user documentation, targeted towards different audience and product use stages.

The following documents are part of the user documentation:

Table 5 IMD user documentation

Document	Target audience	Content
IMD 100 datasheet Document no.: 4921260015	Buyers and technicians of customers	Describes relevant specifications and give an overview of the IMD functions
IMD 100 function description Document no.: 4189360013	Mainly technicians and engineers of customers.	Describes the functions of the IMD. Gives the reader an understanding of the purpose of the IMD in a system, and which functions can be utilised in a pitch system. The functions are described so that the reader can understand what each function is used for.
IMD 100 integration manual Document no.: 4189360015	Engineers at customer R&D department	Describes how to integrate the IMD in a pitch system. Gives extensive knowledge about: IMD SW (parameters and how to achieve specific functionality) How to create customized parameter file for use in production Requirements for external interfaces/components
IMD Manager installation instructions Document no.: 4189360018	Engineers at customer R&D department, as well as commissioners and service personnel	Describes how to install the IMD Manager. The IMD Manager is an application used to configure and control the IMD using the Service USB connector.
IMD Manager user manual Document no.: 4189360019	Engineers at customer R&D department, as well as commissioners and service personnel	Describes how to use the IMD Manager. The IMD Manager is an application used to configure and control the IMD using the Service USB connector.
IMD 100 installation instructions Document no.: 4189360005	Technicians at production site where the IMD is mounted in the cabinet/hub	Describes how to mount, connect and perform initial start, test, and configuration (using a configuration file) of the IMD at production.
IMD 100 initial configuration and verification manual Document no.: 4189360016	Commissioners or other personnel with similar qualifications, as well as service personnel (for SW upgrade)	Describes how to upgrade the IMD SW, how to load configuration file, and how to verify the IMD installation to the possible extent.
IMD 100 service and maintenance manual Document no.: 4189360017	Service and warehouse personnel	Describes preventive (scheduled) and corrective maintenance of the IMD, as well as storage requirements.

Document	Target audience	Content
IMD 100 installation checklist Document no.: 4189360021	Technicians at production site where the IMD is mounted in the cabinet/hub	Installation tasks with check boxes to document the tasks done during installation
IMD 100 configuration and verification checklist Document no.: 4189360022	Commissioners or other personnel with similar qualifications, as well as service personnel (for SW upgrade)	configuration and verification tasks with check boxes to document the tasks done during configuration and verification
Addendum to installation manual Document no.: 4189360023	Integration and installation personnel	Describes the how to replace a pitch drive when the IMD is equipped with Retrofit wiring harness var.1

The IMD 100 documentation is written anticipating an OEM (original equipment manufacturer) product use-cycle in a wind turbine. The envisioned cycle is described in the following figure. The description also explains the tasks, who is expected to execute the task, the location where the execution takes place and the supporting PRACTEK documentation for the task. Many details in these tasks depends on the actual implementation, which is why the IMD documentation will never stand alone.

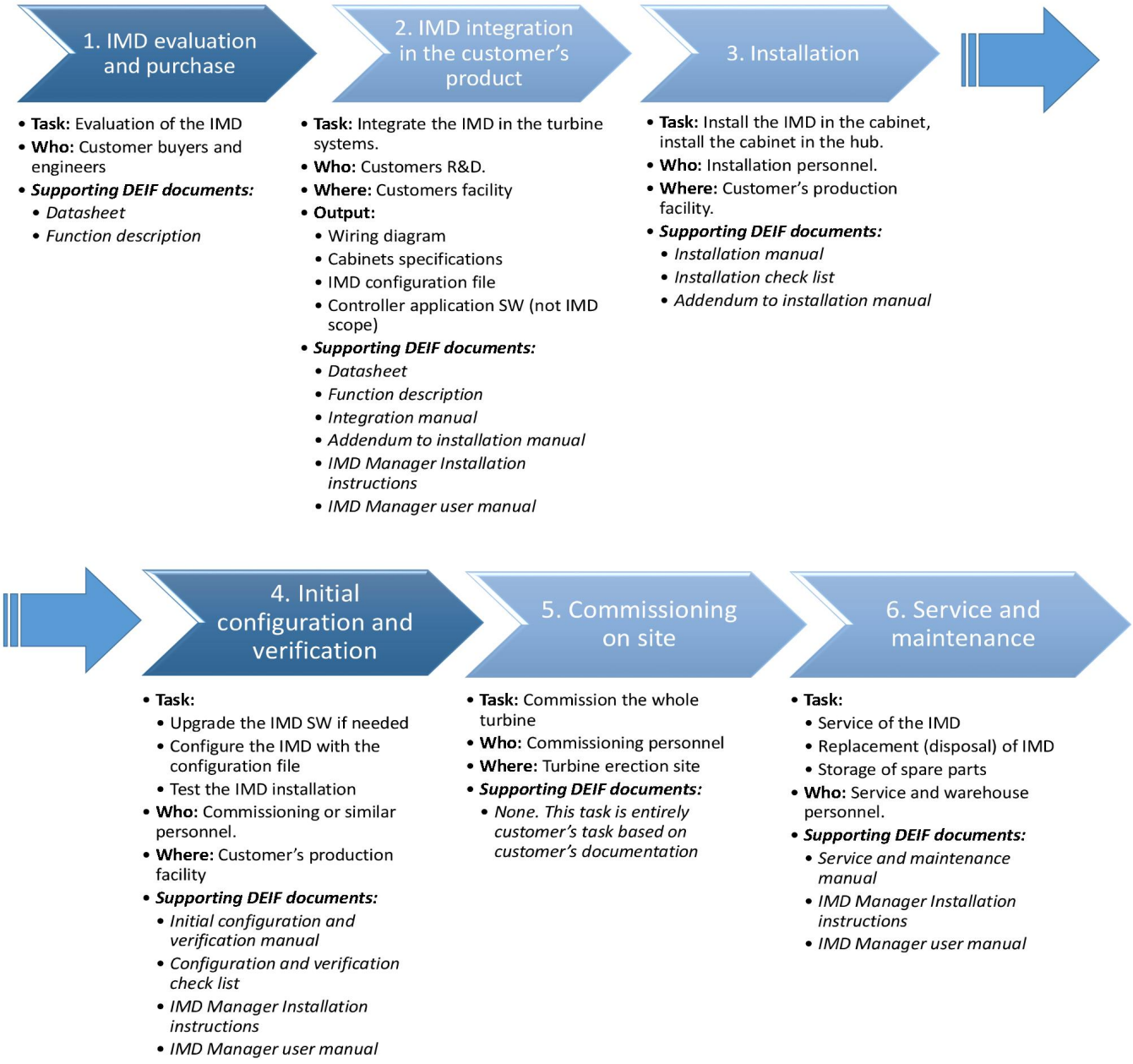


Figure 17 Tasks and documentation overview

The described product use-cycle might not apply as is for all customers, but the tasks are universal and can therefore be adapted. For example, if the SW upgrade, configuration and verification is done during the turbine commissioning, the applicable documentation can be used at this stage instead of a separate stage at the end of production.

9. Glossary

9.1 Terms and abbreviations

Baudrate	Transmission speed
IMD	Integrated Motor Drive
N/A	Not applicable
PID	Proportional Integral Derivative (controller)
PMC	Pitch Motion Controller
RMS	Root Mean Square
RPM	Revolutions Per Minute
SCI	Safety-Chain Input
SCR	Safety-Chain Relay
SE	Safe Energy
VLMS	Virtual Limit Switch

9.2 Units

Unit	Unit Name	Quantity name	US unit	US name	Conversion	Alternative units
A	ampere	Current				
ºC	degrees Celsius	Temperature	ºF	Fahrenheit	$T[ºC] = \frac{(T[ºF] - 32\,º) \times 5}{9}$	
Hz	hertz	Frequency (cycles per second)				
bps	Bits per second	Data transmission speed				
m	metre	length	ft	foot (or feet)	1 m = 3.28 ft	
mA	milliampere	Current				
ms	millisecond	Time				
Nm	Newton metre	Torque	Lb-in	pound-force inch	1 Nm = 8.85 lb-in	
RPM	revolutions per minute	Frequency of rotation (rotational speed)				
s	second	Time				
V	volt	Voltage				
V AC	volt	Voltage				

Unit	Unit Name	Quantity name	US unit	US name	Conversion	Alternative units
	(alternating current)	(alternating current)				
V DC	volt (direct current)	Voltage (direct current)				
W	watt	Power				
Ω	ohm	Resistance				