Manual
SLS-Windows-Monitor
(for SLS and SLR)

(Version 1.546)

Contents

1 General Information

The SLS-Windows-Monitor (WMon) is the main tool to interface all versions of both SLS-family and SLR-family devices.

WMon software is free of charge and can be spread free according to it's license agreements.

It's last version can be downloaded here:
http://www.sinusleistungssteller.de/en_SWdownload.html

WMon can be used in OFFLINE-mode (without connected real SLS/SLR-hardware device) to display and/or process Trace-files (*.SLT) or SignalCurve-files (*.SLP). It is clear, not all functions can be available in OFFLINE-mode.

Full functionality is available in ONLINE-mode, when a real SLS/SLR-hardware device is connected and an USB-Serial-Interface http://www.sinusleistungssteller.de/en_USI.html is used for interconnection.

Some SLS/SLR-hardware devices may have optional functions enabled ("chargeable options"). WMon will recognize those options and it´s extended functions automatically.

Identifying of connected hardware-device is done whenever WMon is launched.

The SLS/SLR-hardware devices have a series of internal parameters, which define the operational behavior and enable it´s control. These settings can be managed, changed and optimized via WMon.

WMon software is subject to be changed, developed and adapted to further requirements, e.g. new/future versions of SLS/SLR-hardware or implementation of new firmware-functions. These changes can be done without notice at any time for a quick progress. Documentation´s update may follow with some time-lag.

In this document, all functions of WMon are described for reference and a smooth start working with it.

Keep this manual within reach for your everyday work!
Most of your questions will be answered quickly...

2 Main-Menu

The Main-Menu is displayed as small as possible due to save space on your screen. Normally it is pushed to upper left corner of your screen and so nearly the full screen kept free for other windows.
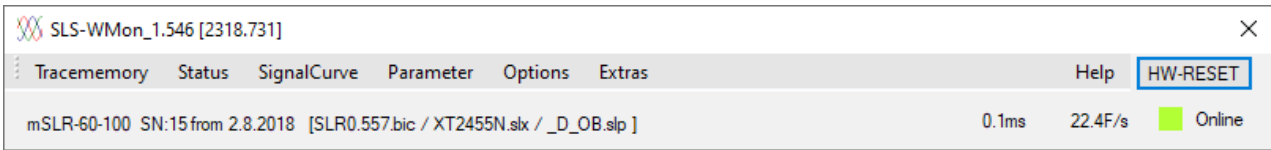
main menu of the SLS-Windows-Monitor

It contains all basic information about your SLS/SLR-hardware device (type, SN, HW-date), it´s configuration (version of firmware, parameter, SignalCurve loaded) and version of WMon itself.

Some extra information might be displayed for WMon-debug purposes. These debug-information is for internal use only (will not be documented) and may change with future versions of WMon.

The main-menu organizes all available functions with pulldown-menus. This supports quick finding of any function and enables easy to implement further extensions of WMon.

3 Trace-Memory

3.1 Menu

The SLS/SLR trace memory can be read or erased in the trace memory menu. Saved *.SLT-files can be viewed. For SLR-devices further configurations are offered.
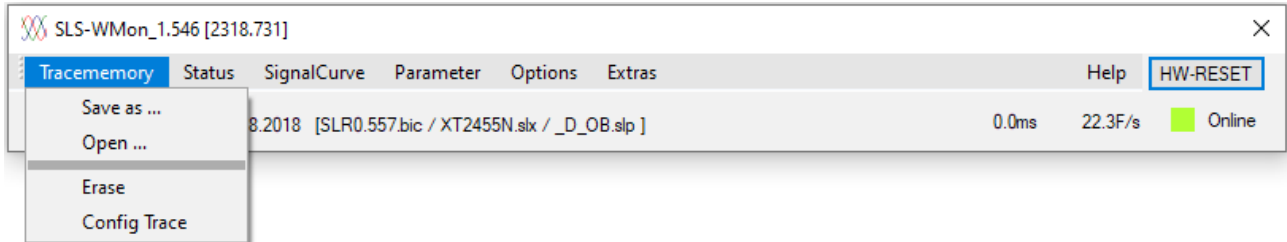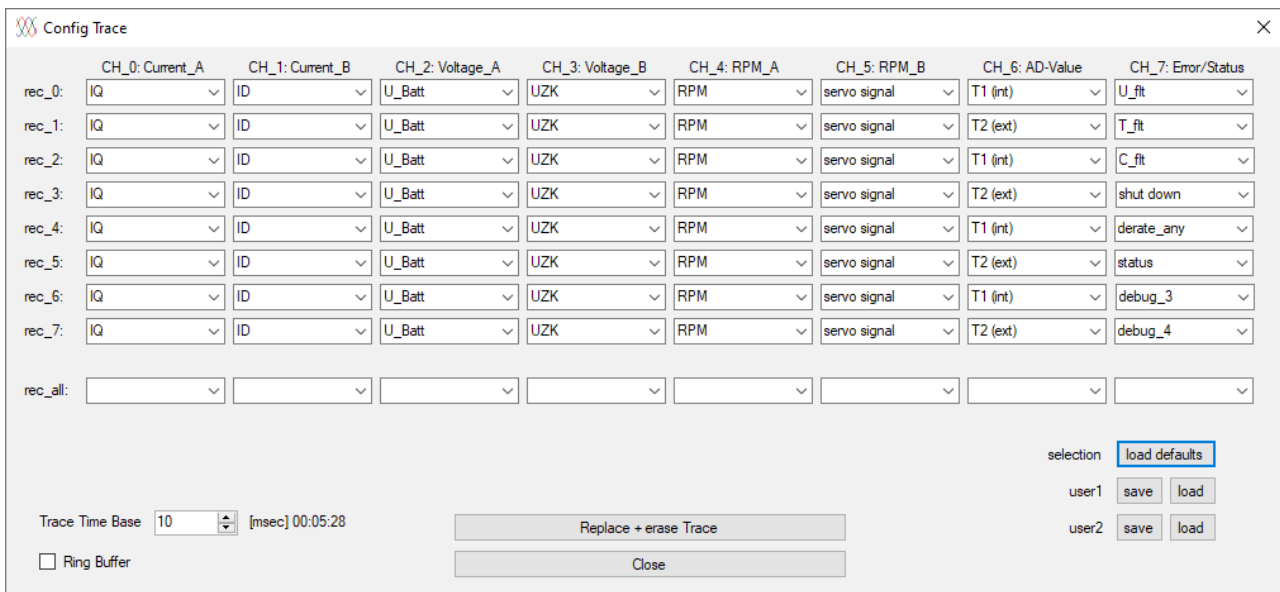
Tracememory window

- **Save as ...**: reads the internal trace memory of the SLS/SLR, displays the content graphically and stores it on the hard disk.
- **Open ...**: a trace file stored on the hard disk (*.SLT) will be opened and displayed.
- **Erase**: erases the trace memory in the SLS/SLR.
- **Config Trace:** schedules signals and tracks to be stored. (only available at SLR-devices)

A trace files (*.SLT) can also be opened directly by double click e.g. from the Windows-Explorer.

3.2 Config Trace (only available at SLR-devices)

Config Trace

	CH_0: Current_A	CH_1: Current_B	CH_2: Voltage_A	CH_3: Voltage_B	CH_4: RPM_A	CH_5: RPM_B	CH_6: AD-Value	CH_7: Error/Status
rec_0:	IQ	ID	U_Batt	UZK	RPM	servo signal	T1 (int)	U_flt
rec_1:	IQ	ID	U_Batt	UZK	RPM	servo signal	T2 (ext)	T_flt
rec_2:	IQ	ID	U_Batt	UZK	RPM	servo signal	T1 (int)	C_flt
rec_3:	IQ	ID	U_Batt	UZK	RPM	servo signal	T2 (ext)	shut down
rec_4:	IQ	ID	U_Batt	UZK	RPM	servo signal	T1 (int)	derate_any
rec_5:	IQ	ID	U_Batt	UZK	RPM	servo signal	T2 (ext)	status
rec_6:	IQ	ID	U_Batt	UZK	RPM	servo signal	T1 (int)	debug_3
rec_7:	IQ	ID	U_Batt	UZK	RPM	servo signal	T2 (ext)	debug_4
rec_all:								

selection — load defaults
user1 — save, load
user2 — save, load

Trace Time Base 10 [msec] 00:05:28
☐ Ring Buffer

Replace + erase Trace
Close

Config Trace

The internal memory has 8 channels (CH_0 .. CH_7). There are different signals available for each channel to choose from. The signals can be time multiplexed from record 0 to record 7.

When selecting a signal in record all, the whole column will be set to that value.

A description of the signals can be found in the following chapter.

- **Trace Time Base [msec]**: This parameter specifies the interval in which the SLR saves data to the trace memory. Values of 1ms up to 10000ms (10s) are possible.

- **Ring Buffer**: The trace memory will be configured as a ring buffer if this box is checked. The maximum number of cycles is restricted to 10 cycles for trace intervals between 1 ms and 99ms, in order to limit write-cycles to trace memory. If box is unchecked, trace-memory will run in sequence-mode and will stop when memory is full.

- **Replace + erase Trace:** The active setup is loaded to the SLR, the trace memory will be cleared. The scheduling-table is stored in SLR and will be used for future data logging until scheduling is modified again.

- **Close:** Closes the menu.

  Selection:
- **load defaults:** default values will be loaded for the trace record.

  User 1 / 2: 2 user settings can be saved and loaded.
- **save:** Saves the actual user settings.

- **load:** Loads the saved user settings.

3.3 Trace-Memory Graphic Display with SLR-devices

While upload from SLR-device or when a trace-file is opened, it´s content is plotted graphically for further processing.
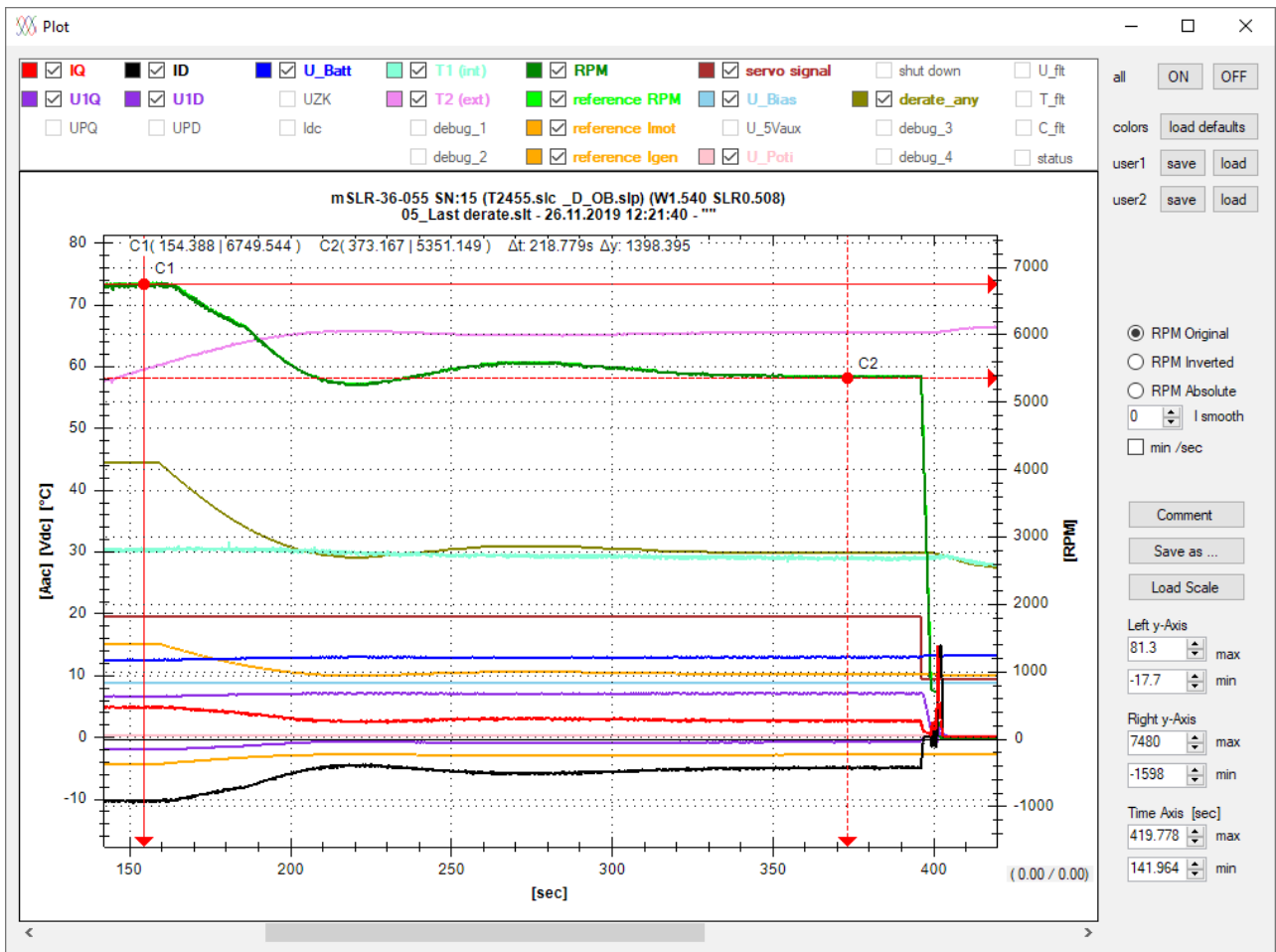
Plot SLR

The time is plotted on the x-axis.
The left y-axis represents the current, the voltage and the temperature.
The right y-axis represents the speed and servo signal.

Detailed information for processing the graphic-display (zoom, save as picture, etc.) are found in chapter "**Right Click Context Menu**" at the end of this manual.

The individual traces can be switched on and off:

- **IQ**: torque generating current in Aac - it is not the dc-current from the source, but the current in the motor phases!
- **U1Q**: represents motor´s terminal-voltage.
- **UPQ**: represents motor´s induced-voltage.

- **ID**: magnetizing current in Aac
- **U1D**: represents motor´s terminal-voltage.
- **UPD**: represents motor´s induced-voltage.

- **U_Batt**: applied DC-voltage in volt
- **UZK**: applied DC-voltage in volt after the mainswitch
- **Idc**: dc-current from the soure (not available on oll SLR-devices)

- **T1 (int)**: temperature of the power module in ° C
- **T2 (ext)**: temperature of the external sensor (available with some SLR) in ° C
- **debug_1**: used for debugging (may vary!)
- **debug_2**: used for debugging (may vary!)

- **RPM**: motor´s speed in RPM
- **reference RPM**: reference-value for speed
- **reference Imot**: reference-value for motor current
- **reference Igen**: reference-value for generator current

- **servo signal**: pulse-width in μs input from servo interface
- **U_Bias**: internal supply voltage
- **U_5Vaux**: supply voltage for external sensors (not available on all SLR-devices)
- **U_Poti**: input voltage of the potentiometer (not available on all SLR-devices)

- **shut down**:
    - value = 15: unknown SLR-Mode
    - value = 14: unknown SLR-Hardware
    - value = 13: free
    - value = 12: free
    - value = 11: AC-OverCurrent L1
    - value = 10: DC-OverCurrent
    - value = 9: DC-OverVoltage
    - value = 8: DC-UnderVoltage
    - value = 7: Stall
    - value = 6: IDLE
    - value = 5: T2-over temperature
    - value = 4: T1-over temperature
    - value = 3: OverSpeed
    - value = 2: Derate to Zero
    - value = 1: ESC
    - value = 0: no shut down dedected

- **derate_any**: 4095 no derating, 0 completely derated
- **debug_3**: used for debugging (may vary!)
- **debug_4**: used for debugging (may vary!)

- **U_flt**: voltage fault bits
  - bit15: 0 (free)
  - bit14-12: (not usable)
  - bit11: 0 (free)
  - bit10: 0 (free)
  - bit9: 0 (free)
  - bit8: 0 (free)
  - bit7: shut-off over voltage
  - bit6: cut-off max voltage
  - bit5: limit max voltage
  - bit4: 0 (free)
  - bit3: shut-off under voltage
  - bit2: cut-off under voltage
  - bit1: limit under voltage
  - bit0: 0 (free)

- **T_flt**: temperature fault bits
  - bit15: 0 (free)
  - bit14-12: (not usable)
  - bit11: 0 (free)
  - bit10: 0 (free)
  - bit9: 0 (free)
  - bit8: 0 (free)
  - bit7: shut-off over temperature
  - bit6: cut-off over temperature
  - bit5: limit over temperature
  - bit4: 0 (free)
  - bit3: 0 (free)
  - bit2: 0 (free)
  - bit1: 0 (free)
  - bit0: 0 (free)

- **C_flt**: control fault bits
  - bit15: 0 (free)
  - bit14-12: (not usable)
  - bit11: 0 (free)
  - bit10: 0 (free)
  - bit9: 0 (free)
  - bit8: 0 (free)
  - bit7: PhaseLoss fault
  - bit6: HW-OverCurrent fault
  - bit5: ZeroSpeed fault
  - bit4: I_Offset fault
  - bit3: OverSpeed fault
  - bit2: LoadLess fault
  - bit1: 2 phase pwm active
  - bit0: shut down

- **status**:
                bit15: 0 (free)
                bit14-12: (not usable)
                bit11: Output1
                bit10: Input3
                bit9: Input2
                bit8: Input1
                bit7: T-Brake
                bit6: S-Brake
                bit5: MainSwitchStatus
                bit4: PreChargeStatus
                bit3: torque mode
                bit2: shutdown
                bit1: Fan_on
                bit0: serial OK

all:
- **ON:** All used traces are switched ON.
- **OFF:** All traces are switched OFF.

colors:
- **load defaults:** Loads default colors for the traces.

User 1 / 2: 2 user settings can be saved and loaded.
- **save:** Saves the actual color scheme.
- **load:** Loads the saved color scheme.

The 3 radio buttons can be used to adjust the speed display.

- **RPM Original**: the speed is displayed as it was saved in the file
- **RPM Inverted**: the speed is displayed inverted
- **RPM Absolute**: the amount of speed is displayed (no sign)

I smooth: both currents (IQ, ID) can be smoothed
Higher values will results in more quiet shapes, value=0 will keep currents unchanged.

min/sec: time-base can be scaled in minutes (checked box) or seconds (unchecked box).

With the **Comment** button, a comment can be added to be displayed in displays headline.

Via the button **Save as...** this comment and the actual scaling are stored in a file. Here it is also possible to save the file as a csv file.

Load Scale loads the scaling of another trace into the actual plot window.

Left y-Axis, Right y-Axis, Time-Axis:
The trace memory plots can be re-scaled manually via the input windows of the maximum and minimum values of all 3 axes.

3.4 Trace-Memory Graphic Display with SLS-devices

While upload from SLS-device or when a trace-file is opened, it´s content is plotted graphically for further processing.
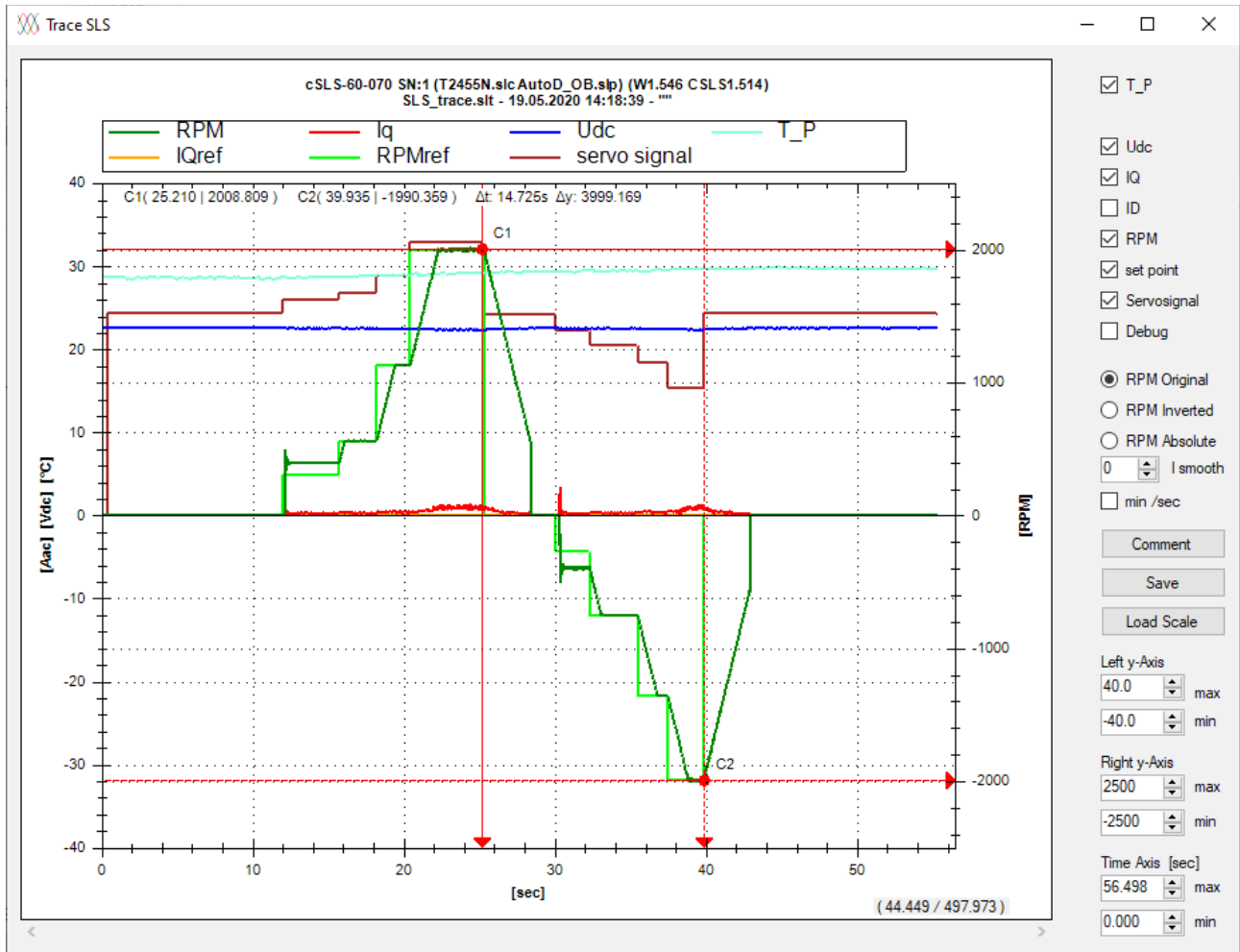
Trace SLS

The time is plotted on the x-axis.
The left y-axis represents the current, the voltage and the temperature.
The right y-axis represents the speed and servo signal.

Detailed information for processing the graphic-display (zoom, save as picture, etc.) are found in chapter "**Right Click Context Menu**" at the end of this manual.

The individual traces can be switched on and off:

- **T_P**: temperature of the power module in ° C
- **T_E**: temperature of the ELKOs (available with some SLS) in ° C
- **Udc**: applied DC-voltage in volt
- **IQ**: torque generating current in Aac - it is not the dc-current from the source, but the current in the motor phases!
- **ID**: magnetizing current in Aac
- **RPM**: motor´s speed in RPM
- **set point**: reference-value for speed or current
- **servo signal**: pulse-width in µs input from servo interface
- **Debug**: used for debugging (may vary!)

The 3 radio buttons can be used to adjust the speed display.

- **RPM Original**: the speed is displayed as it was saved in the file
- **RPM Inverted**: the speed is displayed inverted
- **RPM Absolute**: the amount of speed is displayed (no sign)

I smooth: both currents (IQ, ID) can be smoothed
Higher values will results in more quiet shapes, value=0 will keep currents unchanged.

min/sec: time-base can be scaled in minutes (checked box) or seconds (unchecked box).

With the **Comment** button, a comment can be added to be displayed in displays headline.
Via the 2nd button **Save** this comment and the actual scaling are stored in a file.
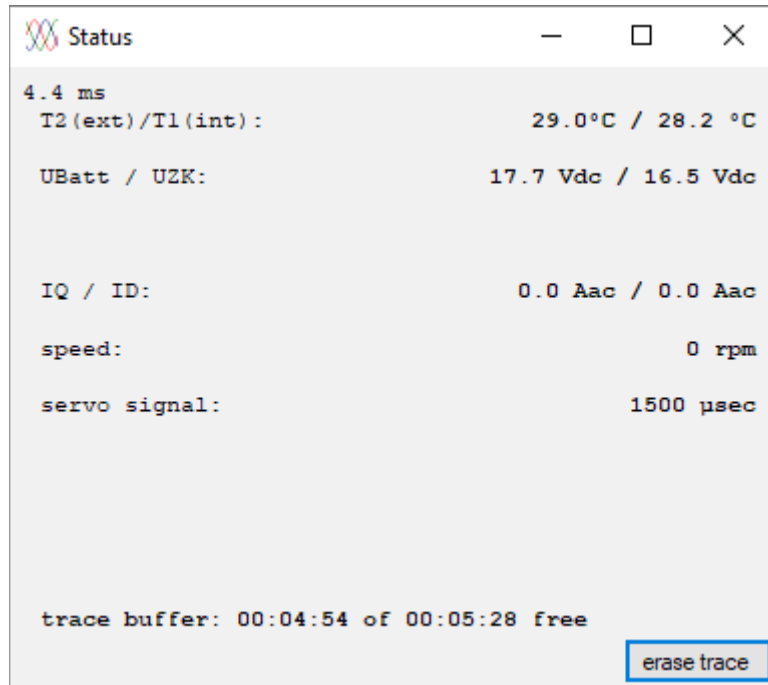**Load Scale** loads the scaling of another trace into the actual plot window.

Left y-Axis, Right y-Axis, Time-Axis:
The trace memory plots can be re-scaled manually via the input windows of the maximum and minimum values of all 3 axes.

4 Status Window

4.1 Displayed values

The status window displays the actual operation values of the SLS/SLR live.

```
XXX Status                        —    □    ✕

4.4 ms
 T2(ext)/T1(int):                29.0°C / 28.2 °C

 UBatt / UZK:                    17.7 Vdc / 16.5 Vdc


 IQ / ID:                        0.0 Aac / 0.0 Aac

 speed:                                     0 rpm

 servo signal:                         1500 µsec




 trace buffer: 00:04:54 of 00:05:28 free
                                   [ erase trace ]
```

Status window

- **T_P:** temperature of the power module in °C
- **T1 (int):** temperature of the power module in °C
- **T_E:** temperature of the capacitors (not for all SLS) in °C
- **T2 (ext):** temperature of the external sensor (not for all SLR) in °C
- **UBatt:** DC-voltage in Volt, measured by the controller
- **UZK:** intermediate circuit voltage in Volt, measured by the controller (not for all SLR)
- **Idc:** DC-current in A_{dc}, measured by the controller (not for all SLR)
- **IQ:** torque current in A_{ac} (It is not the DC-current from the source, but the current in the motor phases!)
- **ID:** magnetizing current in A_{ac}
- **speed:** motor's speed in RPM (revolutions per minute)
- **servo signal:** pulse-width-value, input from servo interface in µs
- **trace buffer:** run-time of the internal trace-memory
  - If the ring buffer is <u>not active</u>, the remaining free trace-memory will be displayed.
  - If the ring buffer is <u>active</u>, the buffer time is displayed.
    For very small trace intervals (< 100ms) a limitation of the buffer cycles is necessary, to prevent excessively writing the FLASH-memory; max. 10 cycles are possible in this case; only complete cycles will be counted.

- **erase trace**: erases the trace memory in the SLS/SLR.

4.2 Displayed Error-Messages

Error messages (if any) are displayed in red color:

- **SwitchOff OverTemp:** The maximum temperature (100°C) has been exceeded. The SLS/SLR stops further operation. The power supply must be disconnected in order to fix the error.

  ⚠️ **Let the SLS/SLR cool down, before restart!**

- **CutOff MaxTemp:** The SLS/SLR has derated the reference to zero (both for speed and current). For resetting the error: set the reference to neutral and give the SLS/SLR enough time to cool down before restart!

- **Limit MaxTemp:** The SLS/SLR is in temperature derating mode. The speed and current are constantly derated with increasing temperature until a thermal balance is achieved. Full power is not available while derating!

- **SwitchOff OverVolt:** The max. allowed voltage on the DC-input of the SLS/SLR was exceeded. Operation is not possible anymore. The error cause must be fixed. To solve the problem, the SLS must be restarted and it must ensured that the error does not occur anymore.

  ⚠️ **Too high voltage can damage the SLS/SLR permanently!**

- **CutOff MaxVolt:** The maximum allowed SLS/SLR operating voltage is reached. The current regeneration is derated to 0%. A further increase in voltage is prevented. With battery operation, the final charge voltage is reached.

- **Limit MaxVolt:** The overvoltage derating is reached, the current regeneration will be reduced until no further voltage increase occurs. The battery is approaching the end charge voltage.

- **Limit MinVolt:** The undervoltage derating started. The motor current and speed are reduced gradually, until no further decrease in voltage occurs. Full power is not available while derating!

- **CutOff MinVolt:** The minimum SLS/SLR operating voltage is reached. The SLS/SLR does not provide additional motor current. The target speed is derated to 0.

- **SwitchOff UnderVolt:** The input voltage is too low for a safe operation or the battery is empty. The SLS/SLR voltage needs to be increased or the battery must be recharged.

... error messages continued:

- **FailSave_Stop - Switch SLS off - on!:** The SLS/SLR disabled itself because of error. Remove the error before restart!

- **LoadLess_Flt:** This error occurs when the load is to low. A min. load can be specified using the option "torque profile". If the min. load is not reached, the SLS/SLR turns off.

- **OvrSpd_Flt:** The rotation speed exceeds the set limit. The device shuts down for safety.

- **I_Offset_Flt:** The SLS/SLR offset-current measured is too high. A restart is required.

- **ZeroSpd_Flt:** The minimum speed was not reached after a start command.

- **Retry_Flt:** Even after several starting attempts no successful start was possible. A completely re-start attempt must be initiated.

- **HW-Overcurrent_Flt:** This error occurs when the current is over the CurrentLimit specified by the hardware. If this limit is reached, the SLR turns immediately OFF. Simultaneously, the **FailSave_Stop** bit is set. Maybe the control loop parameters are not suitable, causing ringing or overshoots.

- **Phaseloss_Flt:** The synchronization to the rotating field was lost. A commutation is not possible, the motor must be restarted.

- **SDown:** the SLR has been switched off, the cause of which is explained in more detail. If the shut down IDLE has triggered, a reset of the hardware or power cycle is necessary, otherwise a stop command is sufficient.

    - SDown: ESC
    - SDown: Derate to zero
    - SDown: OverSpeed
    - SDown: T1-Over Temp
    - SDown: T2-Over Temp
    - SDown: IDLE
    - SDown: 7(free)
    - SDown: DC-UnterVoltage
    - SDown: DC-OverVoltage
    - SDown: DC-OverCurrent
    - SDown: AC-OverCurrent L1
    - SDown: AC-OverCurrent L2
    - SDown: AC-OverCurrent L3
    - SDown: unknown SLR-hardware
    - SDown: unknown SLR-mode

5 SignalCurve

The SignalCurve specifies, how to handle the pulse-width signal input from servo-interface. It is stored inside the SLS/SLR and can be modified by user according to his needs.
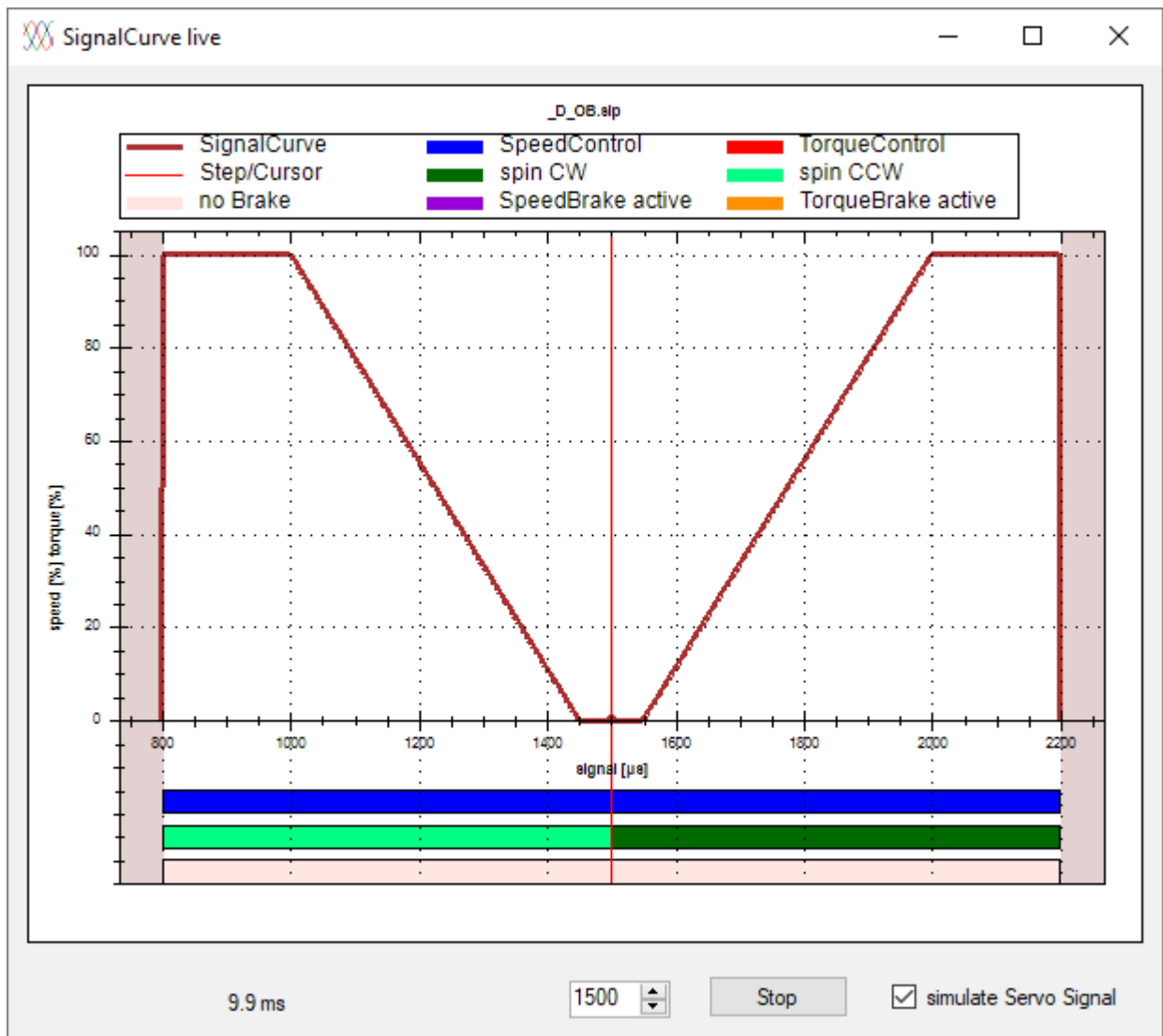
This is a powerful tools which allows many different configurations and optimizing!
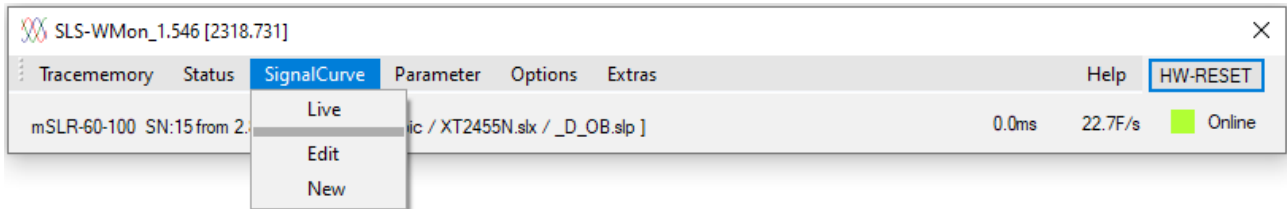
SignalCurve window

– **Live**: Real-time display of SignalCurve vs. applied servo signal [µs].

– **Edit**: Reads back the actual SignalCurve from the SLS/SLR and displays it´s content graphically for modifications.

– **New**: Starts a new (empty) SignalCurve for modifications.

5.1 SignalCurve Live

SignalCurve live

The SignalCurve is read back from SLS/SLR and displayed together with actual input [µs] from servo interface. Actual input [µs] is displayed real-time as a vertical red cursor. This allows to check the signal curve range and correct function.

simulate Servo Signal:
It is also possible to overwrite the external servo signal and to input the ServoSignal directly. Check the box to enable. Click the desired point on the SignalCurve or enter a value [µs] directly into the numeric input field.

Stop:
A Click on this button stops the motor immediately.

No changes/modifications of the SignalCurve are possible in SignalCurveLive.

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5.2 SignalCurve Edit / New

The servo signal [µs] is translated into reference signal via a (configurable and reloadable) characteristic curve. This signal curve represents a powerful tool to adjust the drive to different requirements.
So this SignalCurve can be used to operate the SLS/SLR in **speed- or torque-control**. The **rotational direction** (forward/backward) can be adjusted to the servo input range (e.g. aligning a potentiometer in center position). It can also be determined whether the motor is inhibited (speed-brake), another possibility is a active braking current (torque-brake) or free spinning in the neutral range. With activated **speed brake**, the 3 motor phases are shorted through ground and inhibited by the induced short-circuit currents during rotation. However not completely blocked.

The motor must not be driven mechanically during active parking brake, since the currents will not be limited and this could damage the SLS/SLR hardware in extreme cases!

A new SignalCurve can be configured by the user within the SLS-Windows-Monitor. Complete SignalCurves can be generated according to individual needs using linear connected steps. By inserting a sufficient number of such steps, nonlinear relationships can also be approximated.

A file with the extension *.SLP is generated when saving a new created SignalCurve:
This file contains the actual SignalCurve in binary form. A target value is assigned for each µs-value of the servo signal in accordance with the piecewise linear specification. The SLS/SLR derives it's reference values for internal control during runtime on the basis of the characteristic SignalCurve. The file also contains steps in a kind of vector format. This way, the SignalCurve can be edited and modified later.
The name of this file can be freely chosen by the user. However, it should not exceed 32 characters to avoid confusion, since the SLS/SLR stores only the first 32 characters.

Example of a signal curve:
The **rTQ_vDZ.SLP** SignalCurve is shown on the following page, in order to explain some possible functions of the SLS/SLR.

The SignalCurve specifies torque-control to be activated for the reverse direction („rTQ") and speed control for the forward direction („vDZ" from german: "**v**orwärts **D**reh**Z**ahlregelung").
Servo values from 800µs up to 1450µs are assigned to the "reverse/CCW" direction and servo values from 1550µs up to 2200µs to the "forward/CW" direction. The range in between (1451µs up to 1549µs) is marked as "neutral" by setting all values to 0% (direction and control-mode are not relevant in this area).

Border areas less then 800µs or greater then 2200µs will be interpreted as a missing servo signal and will lead to the immediate shutdown of the motor.

For security, the firmware does not start the motor, if the SLS/SLR is turned ON with a servo position outside the neutral range. To start the motor after a power-cycle (or for reset an error e.g. after a failed start attempt) the servo signal must first be adjusted to the neutral position.

Of course, it is also possible to set the entire range exclusively for one direction or one control-mode. The neutral range would then be in the top or bottom range.

The absolute values for 100% speed or torque are stored together in the SLS/SLR parameter-set and can not be changed within the SignalCurve.
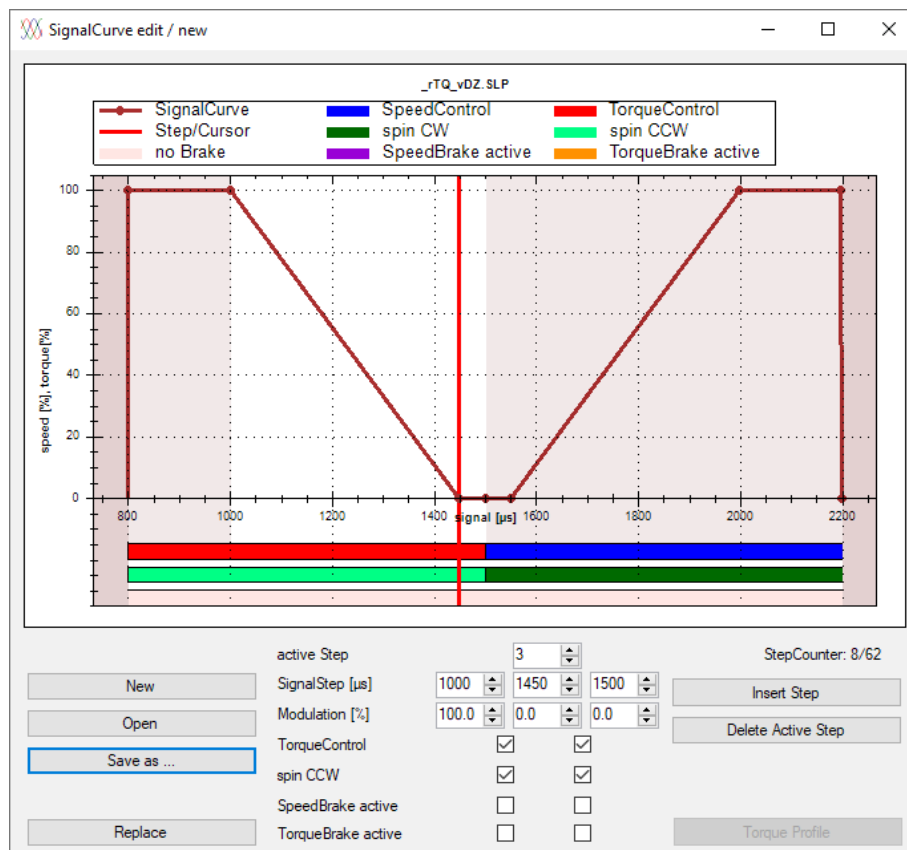
SignalCurve edit / new

- **New**: A new (empty) signal curve is opened.

- **Open**: An existing signal curve can be opened from hard drive.

- **Save as...**: The displayed signal curve will be saved to the hard disk

- **Replace**: The displayed signal curve is transferred to the SLS/SLR.

- **Insert Step**: A new step will be inserted between the active step and the next step.

- **Delete Active Step**: Deletes the selected step.

- **Torque Profile**: With this button you will enter the TorqueProfile window, if this option is enabled for your SLS/SLR-hardware.

All modifications made, will get active on SLS/SLR only after a download was performed with **Replace**! Without **Replace**, the active SignalCurve in SLS/SLR will stay unchanged!

There are two ways, step-points can be modified:

Directly within the upper graphical section:
A first mouse-click to a step point will select it for modification. The selected step is now marked as a vertical red line extending the entire diagram. A second click on this selected step activates it for modification: it is highlighted in green and can now be moved to a new position and then released with another mouse-click. If new step-points are needed, **Insert Step** will add one right of the selected step-point.

Numerical in lower section:
Select a step-point via the top numerical box **Active step**. The active step is marked as a vertical red line extending the entire diagram. The individual steps are numbered from left to right. The settings for the selected step-point are displayed in the middle column, for the previous one in the left column and for the next step in the right column. A step can be moved with the coordinate information (**Signal Step** / **Modulation**) via numerical input (μs / %).

Of course a mix of both methods is possible; e.g. graphical for rough positioning followed by fine-tuning done numerically.

Further settings are for the areas between two neighboring steps - the horizontal bars in lower section of graphic. These are "TorqueControl", "spin CCW", "SpeedBrake active" and "TorqueBrake active". The corresponding check boxes are arranged accordingly in between of two steps-columns.

SignalCurve-files with/without TorqueProfile can be used for SLS- and SLR-devices. The file-format is equal for both hardware-platforms.

5.3 Option Torque Profile (chargeable)

A range of "valid" current [%] versus speed can be set with option TorqueProfile.
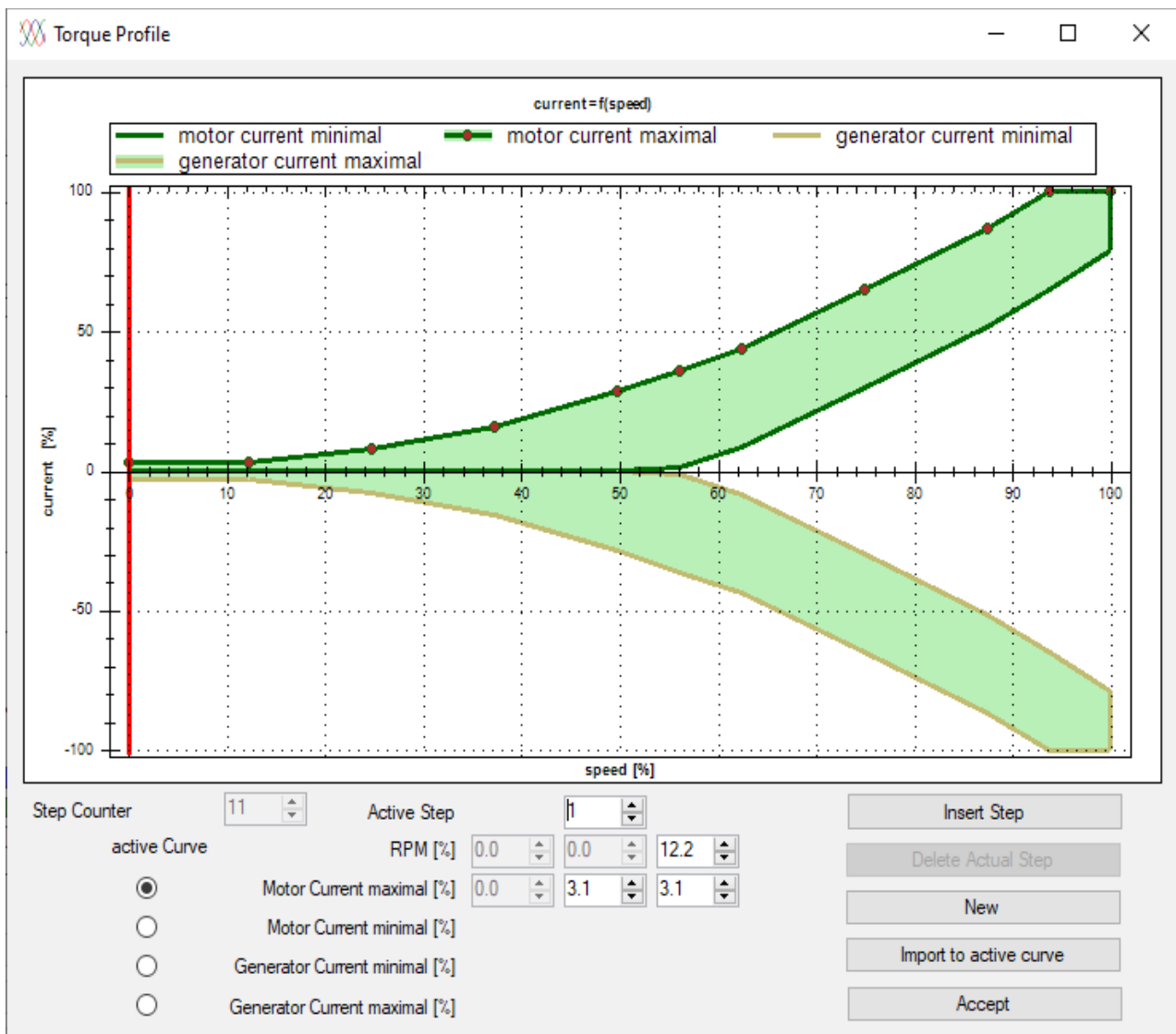
Torque Profile

The motor current is plotted upwards in positive direction, the generated current downwards in negative direction. All numeric entries are absolute values (without sign).

The maximum number of steps is 32. There are different curves possible for motoric and generatoric currents. Both for the maximum as well as the minimum currents.

– **Insert Step**: A new step will be inserted in between the active and the next step.
– **Delete Actual Step**: Deletes the selected step.
– **New**: The TorqueProfile is cleared.
– **Import to active curve**:imports the points of a *.SLK file into the actually selected curve
– **Accept**: The entries are applied, the window is closed. Attention! The TorqueProfile has not been transmitted to the controller yet. Only when clicking **replace** in the signal curve window, the TorqueProfile is transferred (along with the signal curve).

Select the **active Curve** to be modified - via the corresponding radio-button. The existing step-points for this curve will be shown in the graphical display exclusively and can be modified now.

There are two ways, step-points can be modified:

Directly within the upper graphical section:
A first mouse-click to a step point will select it for modification. The selected step is now marked as a vertical red line extending the entire diagram. A second click on this selected step activates it for modification: it is highlighted in green and can now be moved to a new position and then released with another mouse-click. If new step-points are needed, **Insert Step** will add one right of the selected step-point.

Numerical in lower section:
Select a step-point via the top numerical box **Active step**. The active step is marked as a vertical red line extending the entire diagram. The individual steps are numbered from left to right. The settings for the selected step-point are displayed in the middle column, for the previous one in the left column and for the next step in the right column. A step can be moved with the coordinate information (**RPM** / **current**) via numerical input (% / %).

Of course a mix of both methods is possible; e.g. graphical for rough positioning followed by fine-tuning done numerically.

The max. speed (100%) corresponds to the maximum speed, which was stored in the parameter-set for 100%. The motor current and generated current corresponds to the current which has been saved in the parameter-set for 100%.

When the motor current approaches the upper limit, given by the TorqueProfile (motor current maximum), the speed is derated. When the motor current approaches the lower limit, given by the TorqueProfile (motor current minimum), the controller shuts down, with the error message **Loadless_Flt**.

When the generator current approaches the upper limit, given by the TorqueProfile (generator current maximum), the speed increases accordingly! When the generator current approach the lower limit, given by the current profile (generator current maximal), the controller shuts down with the error message **Loadless_Flt**. The motor is released.

… read more explanations of the Torque Profile here: Option_TorqueProfile_en.pdf

6 Parameters

Parameter for SLS and SLR are with similar function but represented in different format.
Further more the SLR needs more parameters than the (older SLS) because of advanced functions.
For that reason it is necessary to describe SLS and SLR parameters in two separate sections.

Parameter setup for SLS are <u>not compatible</u> with SLR-devices and vice versa.

6.1 SLS Parameter Menu

The active SLS parameters can be edited in the parameter menu, complete parameter-sets can also be opened and saved from/to the hard disk in one single file.
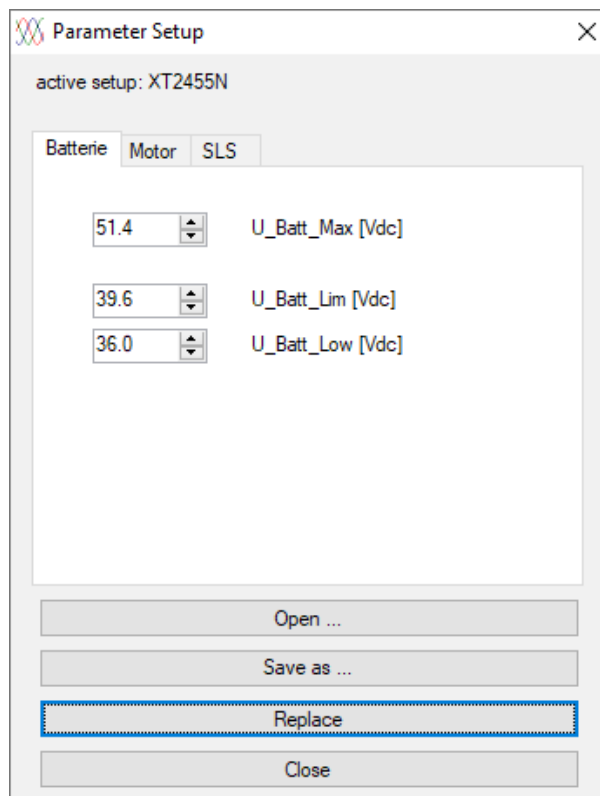
Parameter Setup window / Battery

– **Open ...:** This button is used to load parameter files (*.SLC) from the disk. When a file is loaded the SLS-Windows-Monitor checks if it is compatible with the connected SLS. Finally, the parameters are updated into the SLS by clicking the **Replace** button!
– **Save as ...:** The active parameter set is saved on the hard disk.
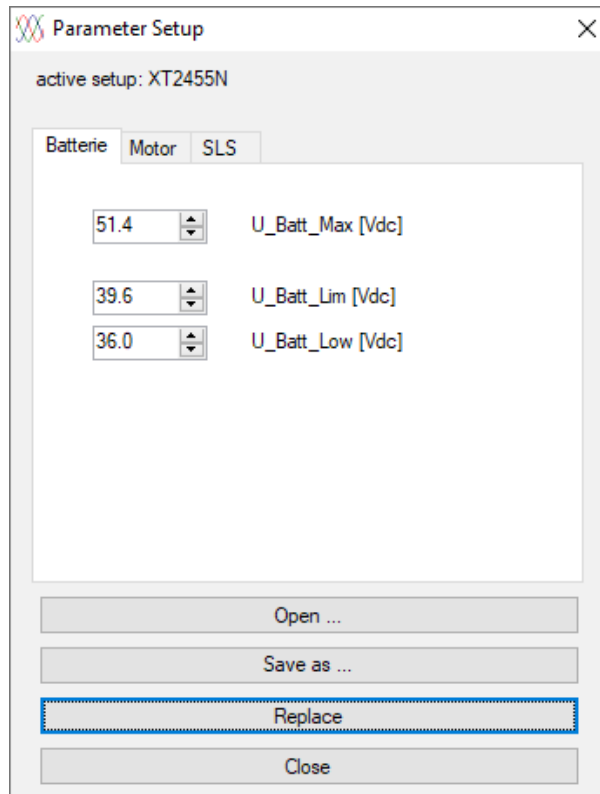– **Replace:** The active parameter set is loaded to the SLS.

⚠️ Replacing the parameters will clear the trace memory!

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– **Close:** Closes the parameter menu.

6.1.1 Battery

Derating voltages can be changed in the **"Battery"** tab:

Parameter Setup window / Battery

– **U_Batt_Max [Vdc]:** Specifies the max. DC-voltage on the SLS. For batteries this voltage corresponds to the final charge voltage. The SLS begins to derate generatoric current 1.5V below this limit. If the specified voltage is reached, this process stops (I_gen = 0).

– **U_Batt_Lim [Vdc]:** Specifies the voltage at which the undervoltage derating begins. The speed and the motor current are reduced gradually down to U_Batt_Low.

– **U_Batt_Low [Vdc]:** At this voltage, rotational speed and motor current are derated to 0. For batteries this voltage corresponds to the final discharge voltage.

6.1.2 Motor

The tab "**Motor**" allows a few changes regarding the motor parameters:
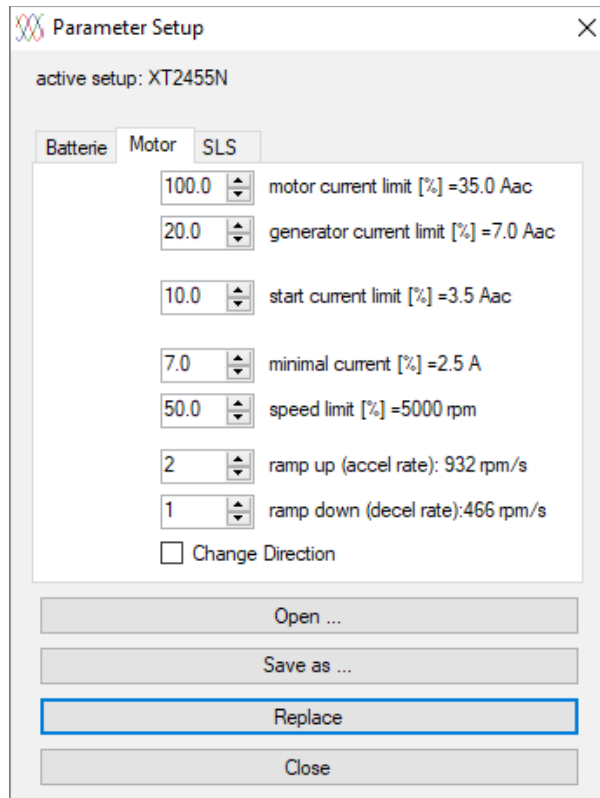
Parameter Setup window / Motor

– **motor current limit [%]:** Indicates the maximum motor current in % The released current is displayed in A_{ac}. 100% corresponds to the current released in the parameter-set.

– **generator current limit [%]:** This feature allows to set the max. generated current.

– **start current limit [%]:** This parameter specifies the current during start-up ("Open Loop"). **Attention!** Please change only after consultation and in small steps.

– **minimal current [%]:** The minimum current is only important in torque mode. This feature allows to set a min. required current for secure operation.

– **speed limit [%]:** The maximum rotation speed can be set via the speed limit. 100% corresponds to the speed released in the data set.

– **ramp up (accel rate):** The acceleration rate is active in the speed mode. Additionally a calculated value of the speed change is displayed in RPM/sec.

– **ramp down (decel rate):** The same as the acceleration rate with the difference that this parameter defines how fast the rotation speed is reduced.

– **Change Direction:** This function allows to reverse the rotational direction – it is the same as interchanging two motor phases.

6.1.3 SLS

Some SLS-related parameter can be set in "**SLS**" tab:
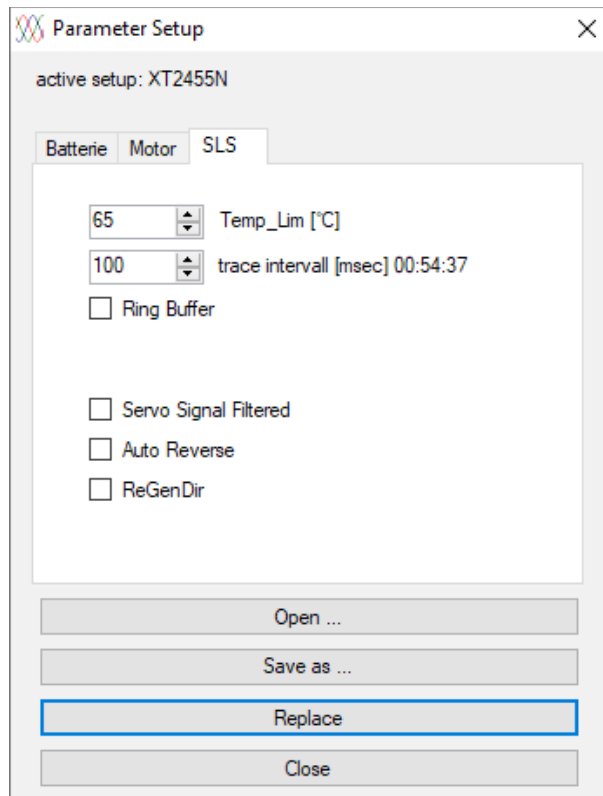
Parameter Setup window / SLS

- **Temp_Lim [°C]:** This parameter specifies the begin temperature derating. Derating will take place above Temp_Lim and will end at 90°C. In practice, this threshold should be between 65°C and 75°C.

- **trace-interval [msec]**: This parameter specifies the interval in which the SLS saves data to the trace memory. Values of 10ms up to 10000ms(10s) are possible.

- **Ring Buffer**: The trace memory will be configured as a ring buffer if this box is checked. The maximum number of cycles is restricted to 10 cycles for trace intervals between 10 and 90ms, in order to limit write-cycles to trace memory.
  If box is unchecked, trace-memory is running in sequence-mode and will stop when memory is full.

- **Servo Signal Filtered:** Setting this checkbox causes the servo signal to be filtered. If filtering is active, this function allows to bridge over possible short interferences in RC-applications. A delay of 1s is added after restart (power-cycle or reset) to allow a save init of external devices (e.g. HALL-sensor poti used as throttle).

⚠️ The trace memory will be erased if the settings are changed by pressing the "Replace" button!

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– **AutoReverse:** Supports direct reversal without the need to set throttle to a neutral position for change direction. This is very helpful to have reverse-thrust in boat-applications.

If AutoReverse is enabled, the throttle only needs to be switched from forward to backward to stop the boat:
- First, the propeller speed will be slowed down to lower RPM by regenerative braking (according to the generator current setting).
- If RPM falls below MinSpeed the parking brake (shorting the 3 motor-phases) will be enabled to stop the motor. Parking brake will forced to enable, even the parking brake is disabled via the signal curve setting!
- After the motor is stopped, it can start in reverse direction to produce **revers thrust** which will finally stop the boat in short time. Simply hold throttle to backward until stopped. **As soon as the boat stopped moving, it´s time to set throttle to neutral - if not, the boat will accelerate in backward direction!** If that´s not enough, signal curve can be modified to torque control - then brake can work as proportional brake (brake-forces depend on throttle position). If set to speed control, forces are always set by max. motor-/generator currents.

If AutoReverse is disabled, signal curve settings control everything as usual. Parking brake can be disabled if needed (but: boats MUST enable parking brake!). For reverse a short stop at neutral must be done before starting in opposite direction. Brake only works until speed is zero, no auto-start in opposite direction occurs until a short neutral throttle. The system now is more suitable for a traction application like a car on the road.

– **ReGenDir:** Normally, this CheckBox should be unchecked. This function is only needed in very special applications where drive must always start as a generator independent of starting direction.

6.2 SLR Parameters

If a member of SLR-family is connected, the parameter menu is switched to a complete different dialog, reflecting the advanced functionality of the SLR-device.

The active SLR parameters can be edited in the parameter menu, complete parameter-sets can also be opened and saved from/to the hard disk in one single file.

Parameter window / Limits

- **Open ...:** This button is used to load parameter files (*.SLX) from the hard disk. When a file is loaded the SLS-Windows-Monitor checks if it is compatible with the connected SLR. Finally, the parameters are updated into the SLR by clicking the **Replace** button!

- **Save as ...:** The active parameter set is saved on the hard disk.

- **Replace:** The active parameter set is loaded to the SLR.

⚠️   Replacing the parameters will erase the trace memory!

- **Close:** Closes the parameter menu.

- **Mode Selection:** The source of reference-value can be selected. Control via the Servo signal, via CAN-Bus and with a few via Poti are available. The selection idle is for testing, for e.g. the signal curve settings.

- **Servo Signal Filtered:** Setting this checkbox causes the servo signal to be filtered. If filtering is active, this function allows to bridge over possible short interferences in RC-applications.

- **Change Direction:** This function allows to reverse the rotational direction – it is the same as interchanging two motor phases.

- **T Fan ON [°C]:** Some SLRs have the ability to control fans. At this temperature, the fan is turned on.
- **T Fan OFF [°C]:** At this temperature, the fan is switched off.

- **Fader [s]:** Fade-in/-out time for current build-up/down at startup and stop -> softstart.

6.2.1 Limits

The tab **"Limits"** opens the derating matrix, which consists of 5 columns and 4 rows. At the crossing points, derating can be enabled or disabled for this combination. Not all combinations are always available. Inactive pairs can not be activated.

Basic setups are made in head-section of columns and rows:

Column Speed:
 – **CW [%], CCW [%]:** The speed limit for CW and CCW can be set separately. 100% corresponds to the speed specified in the parameter-set.
 – **accel:** The acceleration rate is active in the speed-mode and always in ALS-mode. Higher value will accelerate the motor faster. Additionally a calculated value of the speed change is displayed in RPM/sec.
 – **decel:** Analogous to the acceleration rate, this parameter specifies how fast the speed is reduced.
 – **100% =** : The maximum possible speed can be adjusted.

Column I_Mot:
 – **I_Mot [%]:** Specifies the maximum motor current in % relative to the current released in the data record. In addition, the released current is displayed in Aac. 100% corresponds to the current specified in the parameter-set.
 – **I_FieldWeak [%]:**   This determines the maximum field weakening current. 100% corresponds to the current specified in the parameter-set (=100% of I_Mot).
 – **100% =** : The maximum possible current can be adjusted.

Column I_Gen:
 – **I_Gen [%]:** This allows the maximum generatoric current to be set. 100% corresponds to the current specified in the parameter-set.

Column I_ALS:
 – **I_ALS [%]:** Specifies the maximum ALS-current when ALS-mode is active at low speed

 – **crossover OL/CL:** Speed at which the OpenLoop switches to ClosedLoop. (The exact point of switching is load dependent.)
 – **ramp derate OL:** Within ALS-mode, **accel** and **decel**-ramps are multiplied with this value for additional slow-down near to zero-speed and reversal. Very smooth running near zero-speed is possible!

Column I_Brk:
 – **I_Brk [%]:**   Torque-brake strength. A alternative parking brake with specified holding torque.
 – **HallSensorStop**: The motor stops at a definite angle, marked by a HallSensor.
 – **I_BrkLow**: The current is reduced to this value, when HallSensorStop-position is detected.
 – **lock in speed**: If the motor is commanded to stop and speed falls below this value, final positioning starts.

Row T2 (ext): .... if external temperature sensor is available:

- **upper Lim [°C]:** end of derating (values full folded back to 0)
- **lower Lim [°C]:** begin of derating (values not folded back yet)

Row T1 (int):

- **upper Lim [°C]:** end of derating (values full folded back to 0) ... fixed to 90°C
- **lower Lim [°C]:** begin of derating (values not folded back yet)

Row Udc (max):

- **upper Lim [Vdc]**: end of derating (values full folded back to 0)
  For batteries, this voltage corresponds to the end-of-charge voltage.
- **lower Lim [Vdc]:** begin of derating (values not folded back yet)
  Fixed to be 1.5 volts below **upper limit [Vdc]**

Row Udc (min):

- **upper Lim [Vdc]:** begin of derating (values not folded back yet)
- **lower Lim [Vdc]:** end of derating (values full folded back to 0)
  For batteries, this voltage corresponds to the end-of-discharge voltage.

6.2.2 MotorPar

The Parameter tab **MotorPar** allows to modify the motor values.
For future versions, <u>active tuning</u> and <u>auto tuning</u> capability is planed.

MotorPar is exclusively available with chargeable option EXPERT.

Parameter window / MotorPar

- **R [mOhm]:** the resistance of the motor incl. wiring in mOhm
- **Lq [µH]:** the Lq inductance of the motor in µH
- **Ld [µH]:** the Ld inductance of the motor in µH
- **ke:** back EMF constant in Vs (will be modified, when KV is changed)
- **KV:** the motor speed constant in rpm/Vdc (will be modified, when ke is changed)
- **PolePairs**: PolePairs of the motor
- **F_Switch:** the switching frequency of the controller
- **2-phase mode:** activates the 2 phase mode (less losses in the controller)
- **suppress harmonic**: suppresses the 3rd, 5th or 7th harmonic at PLL-control input
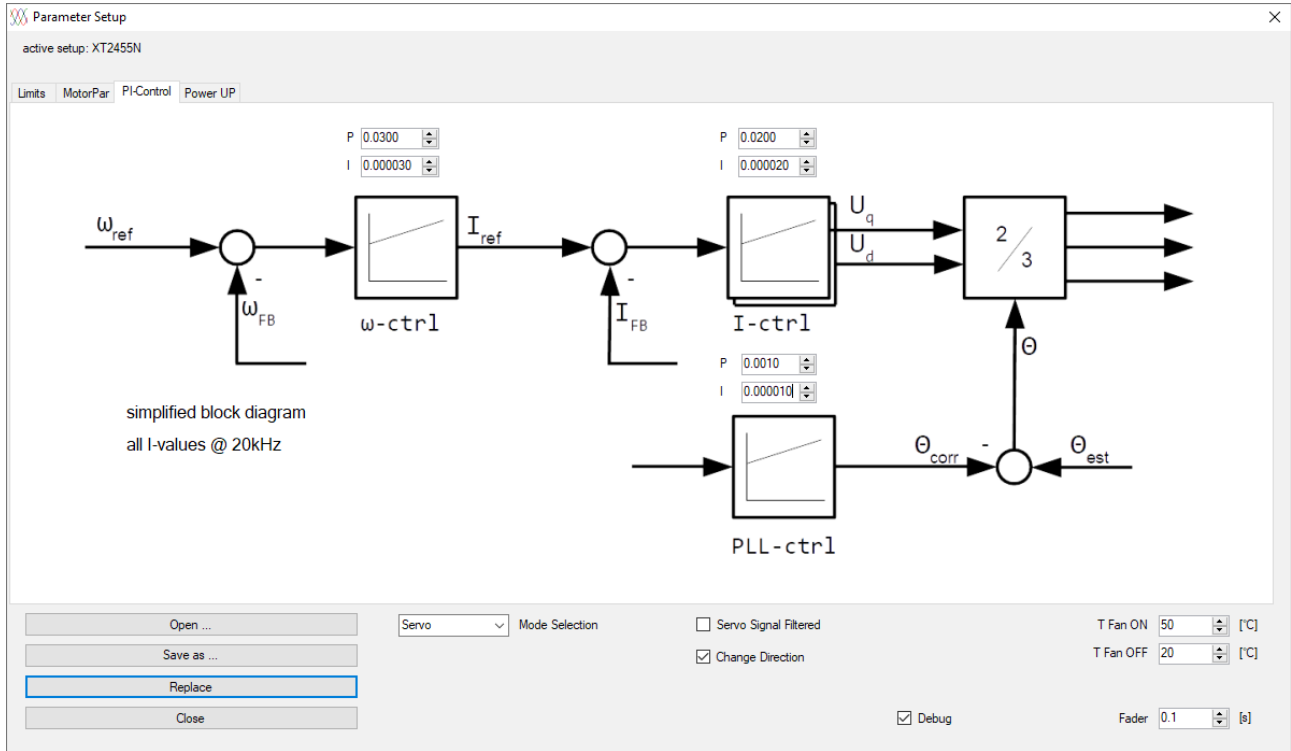
no load losses model:
- **M2:** the square-coefficient of motor losses model
- **M1:** the linear-coefficient of motor losses model

6.2.3 PI-Control

The Parameter tab **PI-control** allows to modify proportional (P) and integral (I) settings of internal PI-control-loop structure.

PI-Control is exclusively available with chargeable option EXPERT.
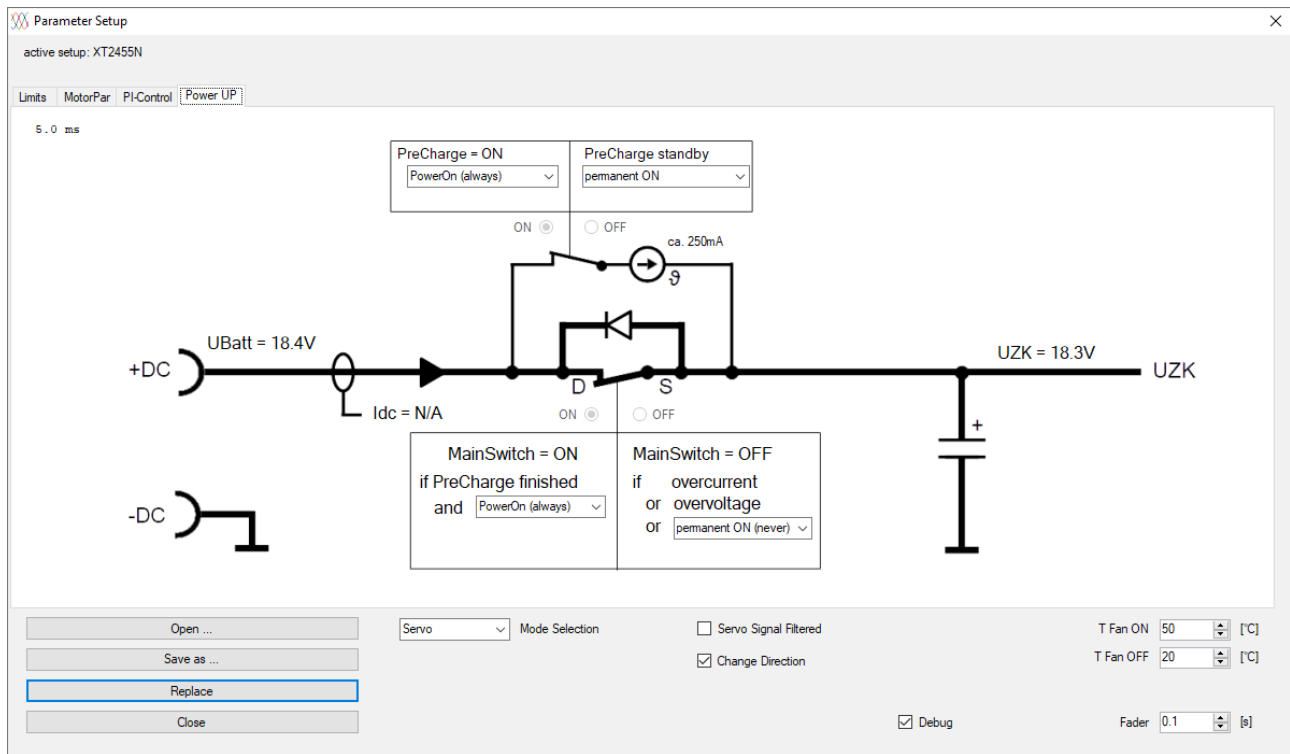

Parameter window / PI-Control

w-ctrl: The P- and I-values for the omega-control-loop can be modified.

I-ctrl: The P- and I-values for the current-control-loops can be modified.

PLL-ctrl: The P- and I-values for the PLL-control-loop can be modified.

6.2.4 Power_up

All SLR with internal PreCharge and MainSwitch offer a **Power_up**-tab due to configure the internal PreCharge/MainSwitch-StateMachine.

Parameter window / Power_up

The display shows the actual state of both switches.
In addition, the battery voltage (UBatt) is displayed on the left, the voltage of the DC link (UZK) on the right side. Some SLR offer DC-current measurement - if available DC-current (Idc) is also displayed.

PreCharge is used to load the ELKOs with a small constant current due to prevent huge inrush-currents and sparking.

- **PreCharge = ON:**
  - **manually**: The PreCharge function is controlled manually via the radio button ON.
  - **motor started (delay)**: The PreCharge function is started as soon as the motor is commanded to start. This mode delays actual start of the motor, because first the DC link must be precharged, then the main switch closes and finally the motor actually starts.
  - **PowerOn (always)**: The PreCharge enables as soon as voltage is applied to the SLR.

- **PreCharge standby:**
  - **manually**: The PreCharge function is controlled manually via the radio buttons OFF.
  - **1s after MainSwitch = OFF**: The PreCharge function will be disabled 1 second after the MainSwitch has been opened.
  - **10s after MainSwitch = OFF**: The PreCharge function will be disabled 10 second after the MainSwitch has been opened.
  - **60s after MainSwitch = OFF**: The PreCharge function will be disabled 60 second after the MainSwitch has been opened.

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– **Permanent ON**: The PreCharge remains active as long voltage is applied to the SLR. MainSwitch can separate SLR power-stage from battery due to limit stored energy in ELKOs to a minimum, when drive is not active for longer time but shall remain connected to battery.

MainSwitch is allowed to close after PreCharge has finished completely (ELKOs are loaded).
MainSwitch may close with delay, when PreCharge is not yet finished.
MainSwitch opens the circuit, if over-current situation was detected on supply line.

⚠️ Due to it's semiconductor nature, the MainSwitch is **not allowed** to be used as a fuse in a classical sense! An additional, external and suitable fuse/protection is **mandatory** whenever huge and dangerous currents can occur e.g. when a battery can be shorted.

– **MainSwitch = ON**:
  – **manually**: The MainSwitch function is controlled manually via the radio button ON.
  – **motor started** : The MainSwitch is started as soon as the motor is commanded to start.
  – **PowerOn (always)**: The MainSwitch will close as soon as the DC link (UZK) has been precharged and voltage is applied to the SLR.

– **MainSwitch = OFF**:
  – **manually**: The MainSwitch function is controlled manually via the radio button OFF.
  – **motor stopped** : The MainSwitch will open as soon as the motor stopped.
  – **permanent ON (never)**: The MainSwitch will stay closed as long voltage is applied to the SLR.

7 Options

This menu summarizes the chargeable options. Not activated functions are displayed grayed.
If necessary, options can be activated later by requesting an activation key. See point 8..
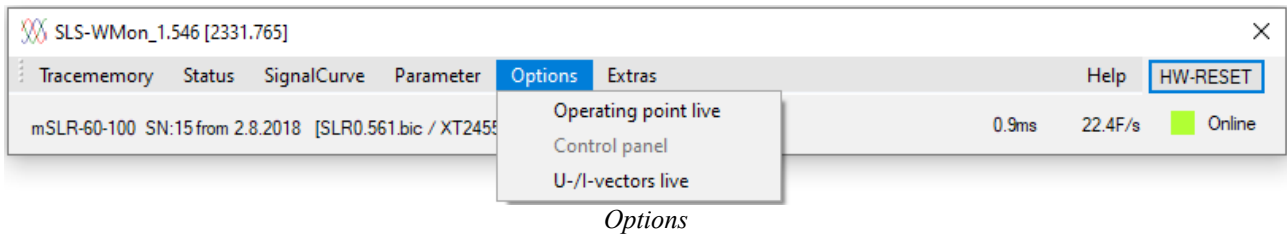

Options

7.1 Option Operation Point Live (chargeable)

The SLS/SLR in combination with the SLS-Windows-Monitor offers the function to display the **motor characteristic $I_{ac}=f(n)$** in real-time together with the actual operating point (displayed as a red dot).

The limits set for AC motor current, AC generator current and speed are displayed simultaneously including the hardware related maximum currents. The limitations are shown dynamically and in real-time: e.g. the motor limit changes with the DC-voltage applied.

Derating limits will also be displayed, if the controller operates in derating mode. This may be the case with overvoltage, undervoltage or overtemperature.

The motor characteristic shown is calculated at a DC-voltage of 26Vdc. On the motoric side max. +35A_{ac} are enabled, on the generatoric side max. -7A_{ac}. The user however, can enable up to +/- 35A_{ac}. The default setting for the speed limit is 50% of 10.000rpm (=5.000rpm).
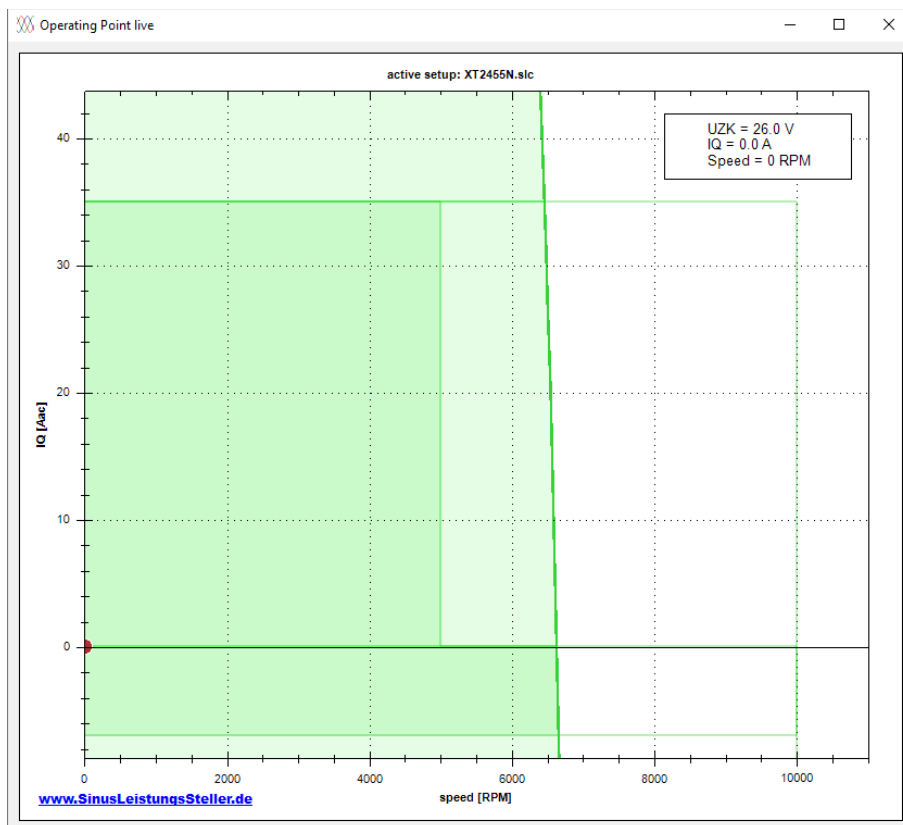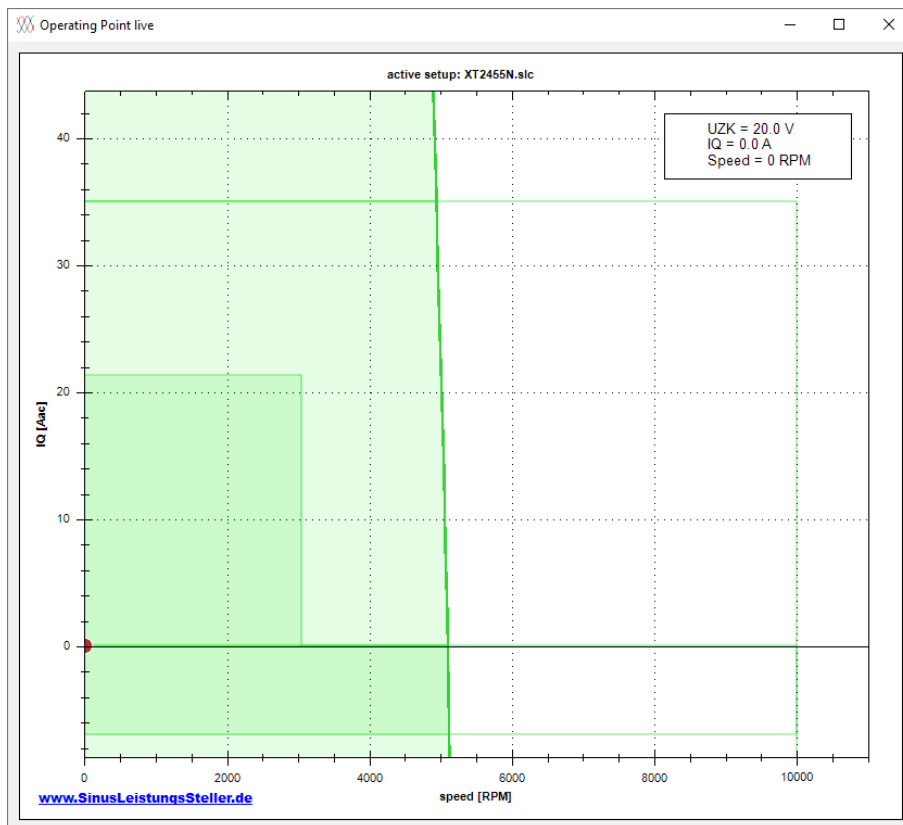

Operating Point live at 26Vdc

The activated area is displayed in darker green color. The possible area (but not yet activated) is displayed in light green color. Only the two right quadrants are displayed. The two left quadrants are symmetric to the origin and can be mapped in the area of the right quadrants.

The curved boundary towards high speeds originates from the motor constants and the DC link-voltage. It represents the given limit without field weakening (Id=0). Exceeding this limit in motor mode ($I_{ac} > 0$) is not possible.

In the generator mode ($I_{ac} < 0$) however, this limitation can be exceeded by over-speed. Since uncontrollable high currents can flow from the SLS/SLR due to diode commutation, an operation outside these limit must be avoided!

The following picture shows the same motor with reduced input voltage (20Vdc). In this case the input voltage is in the derating area between **U_Batt_Lim** and **U_Batt_Low**. The input power is thereby reduced to avoid a too deep battery discharge. The limitations of the activated (motoric) operational area will be further derated and the actual operating point adjusted downwards. The generator area on the other hand is not restricted.

Operating Point live derated

Detailed information for processing the graphic-display (zoom, save as picture, etc.) are found in chapter "**Right Click Context Menu**" at the end of this manual.

… read more explanations of the Operation Point Live here: Option_OperationPointLive_en.pdf

7.2 Option ETA_Live (chargeable)

For all SLR an option ETA_Live is available, with advanced functionality compared to option OperationPointLive.

Purchase of Option ETA_live includes option OperationPointLive.
ETA_Live is not an upgrade to OperationPointLive.

Option ETA_Live offers a powerful tool to calculate efficiency/losses of motor/ECU/system and also power on input(DC) and output(shaft). User can switch between these layers at any time.

All calculations are done for the whole 2D-plot-range, in real-time and in color.

All calculations are performed on a model based on measured motor-parameters. A second model ("manually") can be calculated in parallel with modified model-parameters to figure out differences and effects of single model-parameters.

7.2.1 Layers

Following layers can be displayed:

- **Standard:** corresponds to the classic OperatingPointLive; numeric info added

- **ETA_Motor:** the motor efficiency
- **ETA_ECU:** the electronic control unit efficiency
- **ETA_System:** the efficiency of the whole system (= ETA_Motor * ETA_ECU)

- **P_Mech(shaft):** the mechanical power on the shaft
- **P_ac:** the power at the input of the motor (= P_Mech / ETA_Motor)
- **P_dc:** the power at the input of the controller (= P_ac / ETA_ECU)

- **PV_Motor:** the losses in the motor (= P_ac - P_Mech)
- **PV_ECU:** the losses in the controller (= P_dc -P_ac)
- **PV_System:** the losses of the whole system (= Pdc - P_Mech)

7.2.2 Numeric Model Information and Control
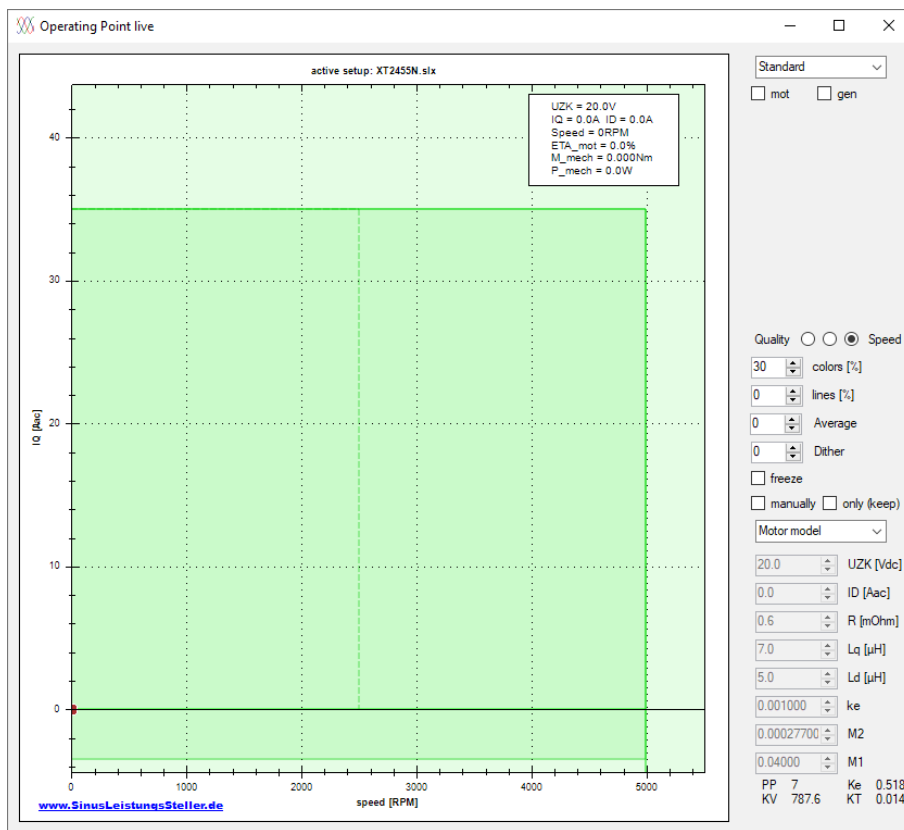
Operating Point live Standard

Quality .. Speed: the accuracy of the calculated graphs can be adjusted here.
Quality: high quality picture, more computing-intensive and therefore slower
Speed: lower quality picture, but faster on the PC (recommended for older/slow PCs)

colors[%]: intensity of the background colors (outside limits)
lines[%]: intensity of shell curves displayed (no shell curves: value = 0%)
Average: the display can be calmed with a filter; no filter applied with value=0
Dither: the display can be blurred for faster computing; no blurring applied with value=0
Freeze: freezes the actual display
manually: a second motor-model with manual parameters is calculated an displayed
only(keep): displays only the manual motor-model

- **motor model:** model-parameters (can be modified in manual mode)
- **UZK[Vdc]:** applied DC-voltage
- **ID[Aac]:** ID-current
- **R [mOhm]:** the resistance of the motor incl. cable and ECU in mOhm
- **Lq [µH]:** the Lq value of the motor in µH
- **Ld [µH]:** the Ld value of the motor in µH
- **ke:** back EMF constant in Vs
- **M2:** the square-coefficient of motor losses model
- **M1:** the linear-coefficient of motor losses model
- **PP:** PolePairs of the motor (as info only)
- **Ke:** back EMF constant in V/kRPM (as info only)
- **KV:** the motor speed constant in RPM/Vdc (as info only)
- **KT:** the motor torque constant in Nm/Aac (as info only)

- **ECU model:** model-parameters (can be modified in manual mode)
  - **E2:** the square-coefficient of the ECU losses model
  - **E1:** the linear-coefficient of the ECU losses model
 - **E0:** the constant-coefficient of the ECU losses model (self-consumption of the ECU)

- **Test:** some internal values for info, testing, debugging
  (may change in future versions of WMon)

Detailed information for processing the graphic-display (zoom, save as picture, etc.) are found in chapter "**Right Click Context Menu**" at the end of this manual.

7.2.3 Numeric Context Information and Control

Some layers offer additional information and controls (may change with selected layer)
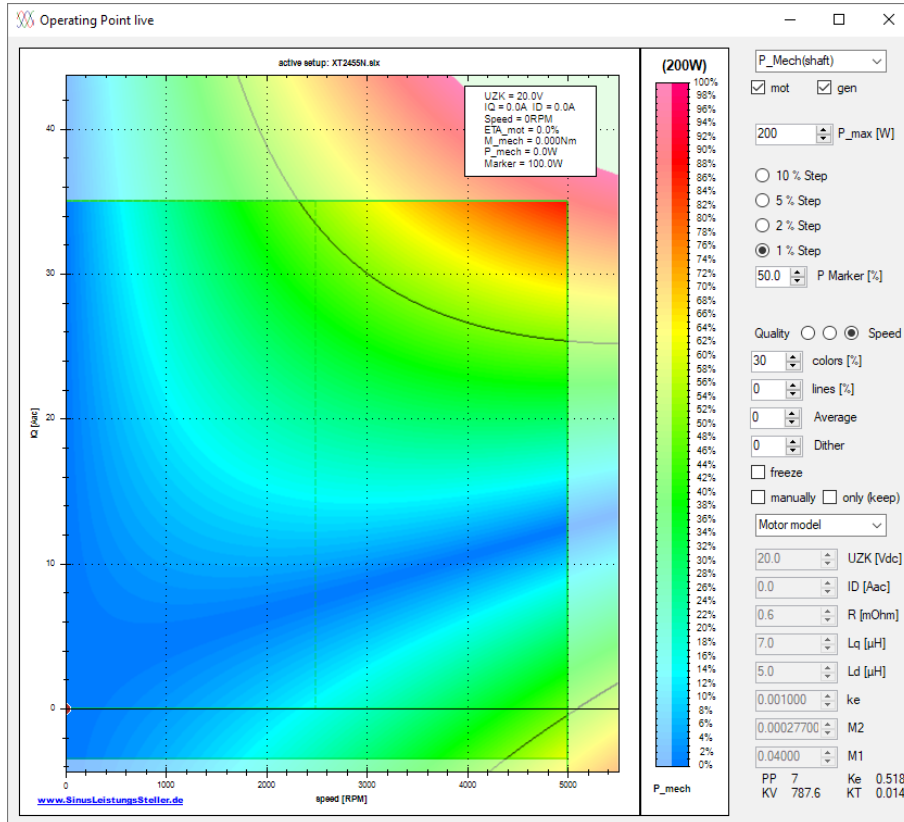
ETA_Motor:
ETA_ECU:
ETA_System:
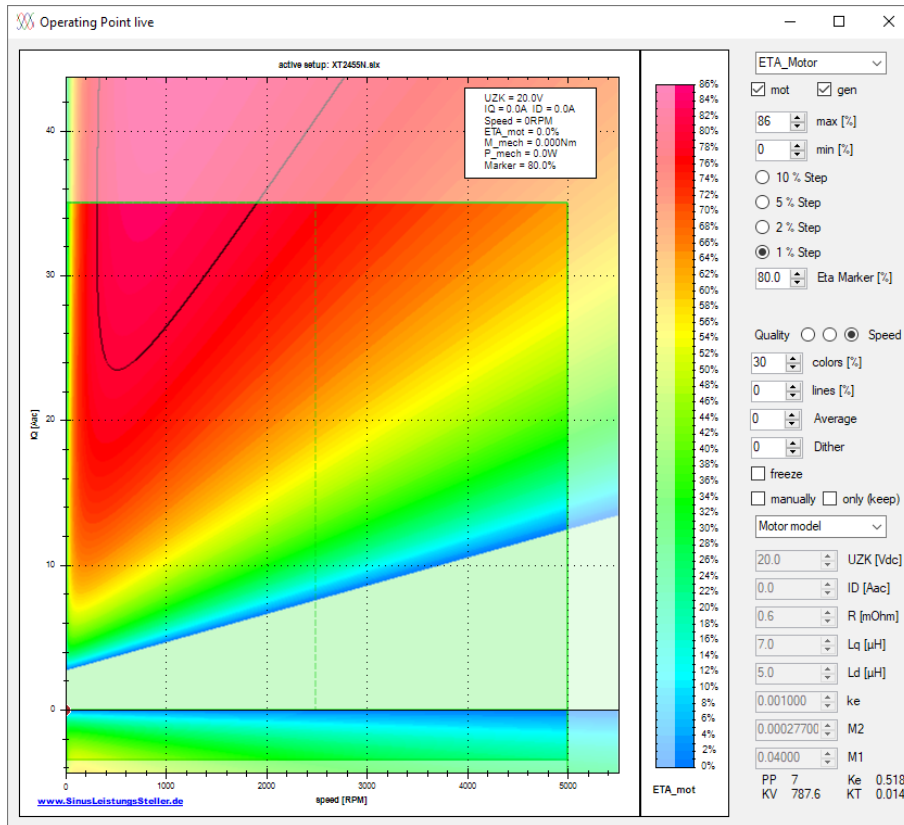
Operating Point live ETA_Motor

- – **mot:** ETA will be calculated and displayed for the motoric quadrant
- – **gen:** ETA will be calculated and displayed for the generatoric quadrant
- – max[%]: the max displayed efficiency (due to spread color scale)
- – **min[%]:** the min displayed efficiency (due to spread color scale)
- – **x Step:** the increment between shell curves displayed
- – **Eta Marker[%]:** a shell curve with specific efficiency will be highlighted (black)

P_Mech:
P_ac:
P_dc_
PV_Motor:
PV_ECU:
PV_System:


Operating Point live P_Mech

- **mot:** power will be calculated and displayed for the motoric quadrant
- **gen:** power will be calculated and displayed for the generatoric quadrant
- **P_max[W]:** the max displayed power (due to spread color scale)
- **x Step:** the increment between shell curves in percent of P_max
- **P Marker[%]:** an power line is highlighted

… read more explanations of the ETA_Live here: Option_ETA_Live_en.pdf

7.3 Option Control Panel (chargeable)

The control panel is used to visualization and control of the SLS via the serial interface on base of currents, speed and limits.
The Option Control Panel is currently only available with the SLS!
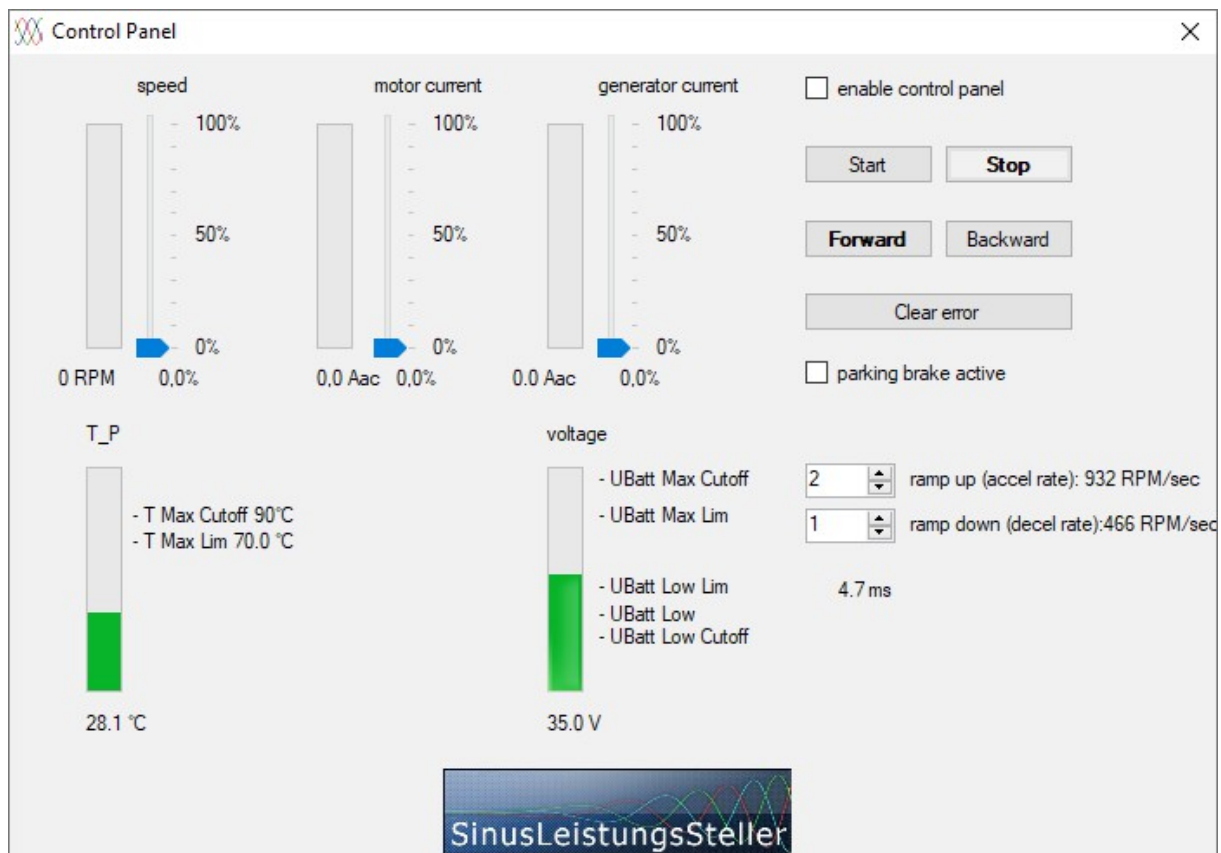
Control Panel

ControlPanel offers 3 sliders. They can specify reference-values for speed and currents.
Enough current to reach target speed must be released in advance via the corresponding motor current-slider. If the preset current is high enough, the SLS will be in speed controlled mode and the speed-slider is command-device. Otherwise the controller operates in torque controlled mode and current-slider is command-device (if enough headroom in speed is preset).

The position of the slider represents the reference value, the bar on the left shows the actual value. Reference and actual value are displayed with the corresponding numerical value: the reference value in percent, the actual value in real units.

The control panel is enabled by checking the box **enable control panel**. The buttons **Start** and **Stop**, starts or stops the motor. **Forward** and **Backward** select the rotational direction. Direct reversal is not possible at this moment - motor must stopped before running in opposite direction.

The **Clear error** button resets all errors displayed in the status window (failsafe-error still needs a power-cycle to be reset!)

If **parking brake active** checked, the motor is blocked during standstill (by shorting the 3 motor phases to ground/GND).

The remaining bars in the lower half of the window, display the actual values for temperature and DC-voltage with the corresponding limits set in parameters.

T_P stands for the power module temperature.

The SLSi displays in addition the capacitor temperature T_E also with its limits.
(Some SLR displays the temperature of an external sensor T_Ext.)

It is also possible to overwrite the deceleration and acceleration rate. After disabling the ControlPanel, these values remain stored on the SLS.

… read more explanations of the Control Panel here: Option_ControlPanel_en.pdf

7.4 Option U-/I-Vector Live (chargeable)

The Option U-/I-Vectors is only available with the SLR!
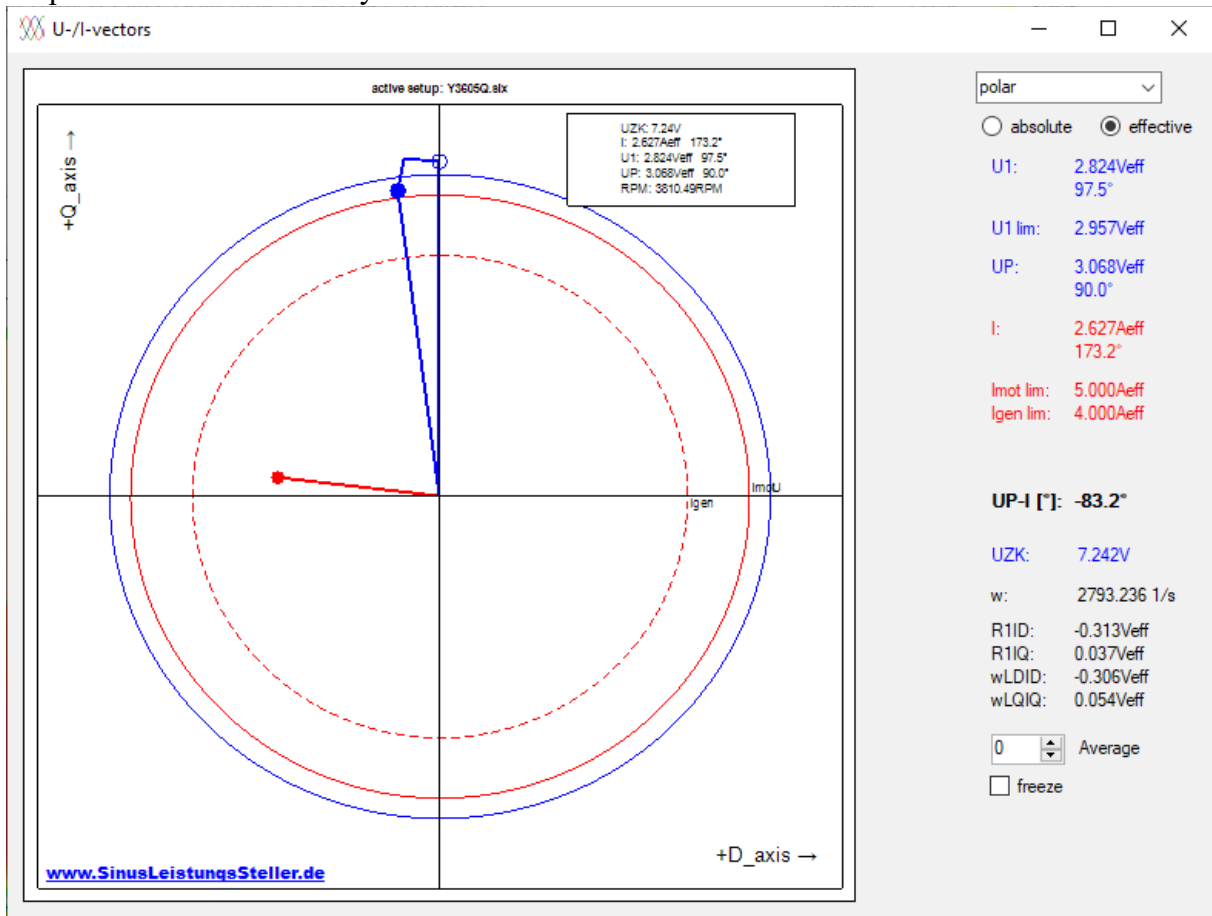
U-/I-vectors

Select layer for numeric display:

    – **cartesian:** all numeric display of vectors will be split-up in it´s D and Q-components
    – **polar:** all numeric display of vectors will be split-up in it´s length and angle
    – **test:** internal values for info, testing, debugging (may change in future version of WMon)

Select domain of displayed vectors:

    – **absolute:** absolute length of the vectors displayed
    – **effective:** rms-value of the pointer is displayed

Displayed numeric values:

- **U1**: motor´s terminal-voltage (=ECU´s output-voltage); ends with a solid blue handle

- **U1 lim**: ECU´s max. output-voltage; displayed with a blue circle around origin

- **UP**: motor´s induced voltage; ends with a non-solid blue handle

- **I**: motor´s phase current; ends with a solid red handle

- **Imot lim**: max. motoric current; displayed as a red circle around origin
  If the motor runs motoric mode, the circle is solid, otherwise it´s dotted.

- **Igen lim**: max. generatoric current; displayed as a red circle around origin
  If the motor is in generatoric mode, the circle is solid, otherwise it´s dotted.

- **UP-I[°]**: angel between UP and I

- **UZK**: applied DC-voltage

- **w**: the actual angular-speed in rad

- **R1ID**: the D-component of the R1*ID-vector (vector length only)

- **R1IQ**: the Q-component of the R1*IQ-vector (vector length only)

- **wLDID**: the D-component of the w*LD*ID vector (vector length only)

- **wLQIQ**: the Q-component of the w*LQ*IQ-vector (vector length only)

- **Average**: the display can be calmed with a filter; no filter applied with value=0

- **freeze**: freezes the actual display

Detailed information for processing the graphic-display (zoom, save as picture, etc.) are found in chapter "**Right Click Context Menu**" at the end of this manual.

… read more explanations of the U-/I-Vector Live here: Option_UI-VectorsLive_en.pdf

8 Extras

Rarely needed settings and functions are summarized in Extra-menu.
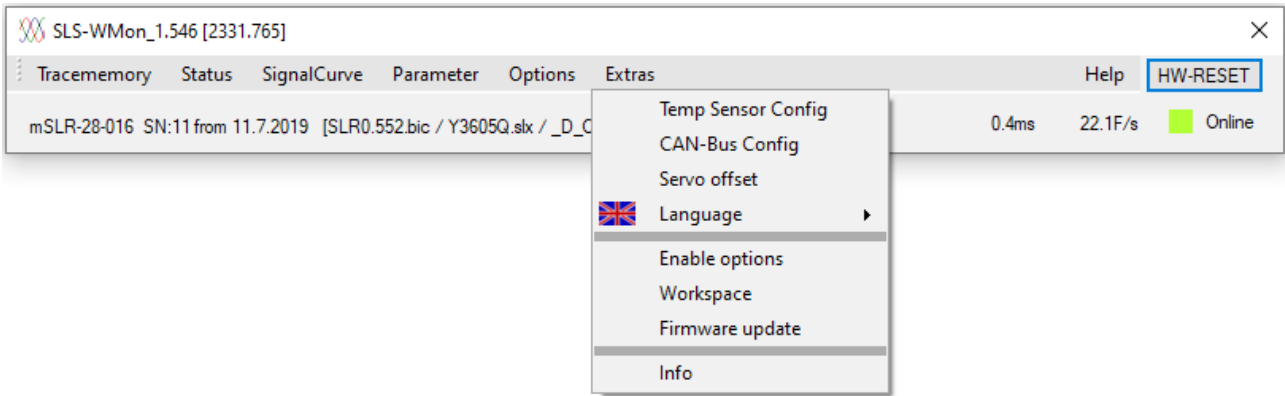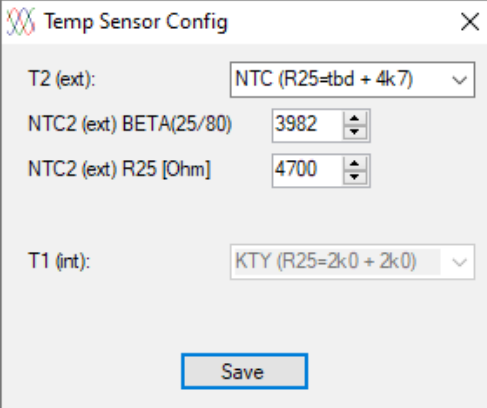

Extras

8.1 Temp Sensor Config

Some SLRs offer a second, external temperature sensor: T2 (ext).
Different NTC-characteristics can be configured or the KTY sensor can be choosen.
All needed values like BETA(25/80) or R25 can be derived from the NTC´s datasheet.

For best resolution with NTC, choose R25=4700 Ohm if possible!

Temp Sensor Config

- **T2 (ext):** Selection of the installed temperature sensor
  - **none:** no external temperature sensor is installed
  - **NTC (R25=tbd + 4K7):** A NTC-senor is installed, the internal pullup resister is 4,7kOhm
  - **KTY (R25 = 2k0 + 4k7):** A 2kOhm KTY-senor is installed, the internal pullup resister is 4,7kOhm

- **NTC2/ext BETA(25/80):** BETA-value of the NTC for the temperature range 25/80

- **NTC2/ext R25 [Ohm]:** resistance of the NTC at 25 ° C

- **T1 (int):** Information about the installed internal temperature sensor

- **Save:** Saves the settings permanently in the SLR.

8.2 CAN-Bus Node

All SLRs have a CAN-Bus interface. A unique CAN-Bus-node must be applied for each member of a CAN_Bus segment.
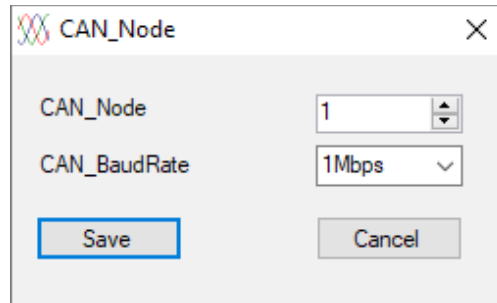
CAN_Node

- **CAN_Node:** SLR´s CAN_node; range is [1 ..127]; default: 1
- **CAN_BaudRate:** SLR´s BaudRate; possible values are:
    - 1Mbps (default)
    - 500kbps
    - 250kbps
    - 125kbps
    - 100kbps
    - 50kbps
    - 20kbps

- **Save:** setting is saved permanently in the SLR

8.3 Servo Offset

The servo input has a galvanic insulation realized by optocoupler. Slight differences can occur in the evaluation of the pulse-width due to manufacturing tolerances. This is e.g. not desirable in the synchronous operation of several controllers.
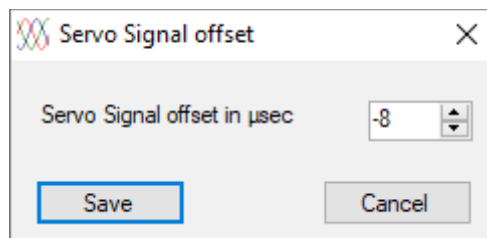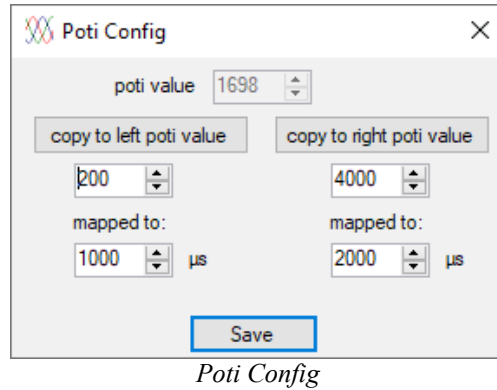

Servo Signal offset

Servo signal offset can be adjusted in the range of +127 - 127μsec.

**Save** will update the SLS/SLR with the new offset value

8.4 Poti Config

With some SLR it is possible to connect a potentiometer directly. The mapping can be teached-in with this window.

Poti Config

- **poti value:** the actual read in AD value from the Poti (range: 0 .. 4095)
- **copy to left poti value:** takes the actual poti value as the left poti rail
- **copy to right poti value:** takes the actual poti value as the right poti rail
- **mapped to:** the µs values left and right, associated with the AD values
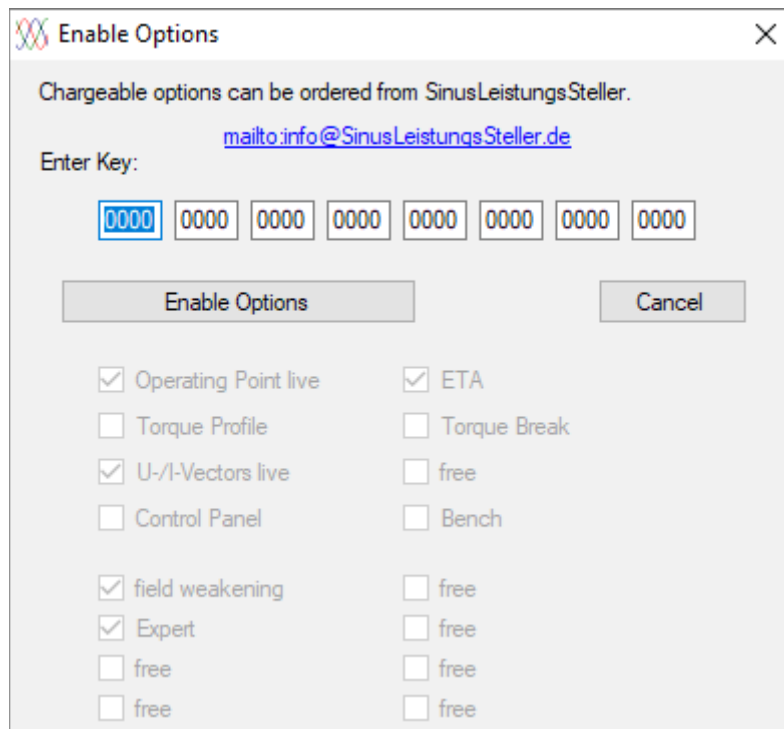
- **Save:** will update the SLR with the mapping values

8.5 Language

The SLS Windows Monitor is available in two languages, German and English.
If the language is changed, the monitor must be restarted.

Extras Language

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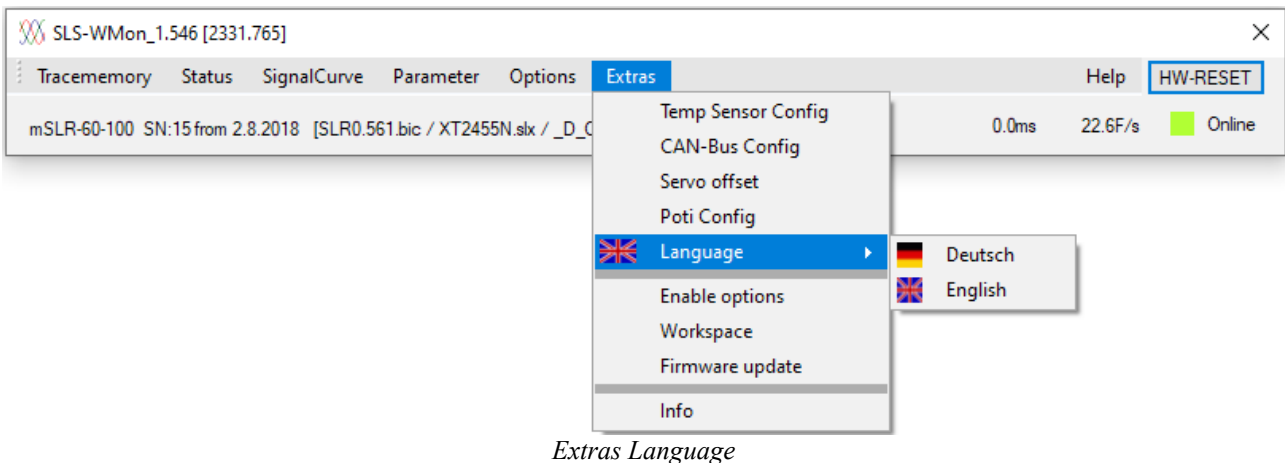
8.6 Enable Options

All available options can be ordered after purchase. Enable-Keys can be entered here:

Enable Options

Enabled options are marked with a check.

Keys for one or more options can be ordered here info@SinusLeistungsSteller.de. The options are bound to the SLS/SLR-hardware-device by the serial number, therefore we need the S/N and exact type of the SLS/SLR.

8.7 Workspace

A working directory for the Windows monitor can be preselected.
With the exception of the firmware update function, the system always uses this specified directory for load and save files.

8.8 Firmware Update

If required, the SLS/SLR can be updated via the option **firmware update**.

There are three different versions at this moment:

- – cSLS and cSLSi require the variant **cSLS**xxxx.BIC
- – SLSi require the variant **SLS**xxxx.BIC
- – all SLR require the variant **SLR**xxxx.BIC

Based on the connected hardware, the SLS-Windows-Monitor automatically detects which firmware version can be loaded.

Always make sure that the latest firmware is in use!
We provide updates for download on our homepage, check frequently for updates:
www.SinusLeistungsSteller.de/SWdownload.html

8.9 Info

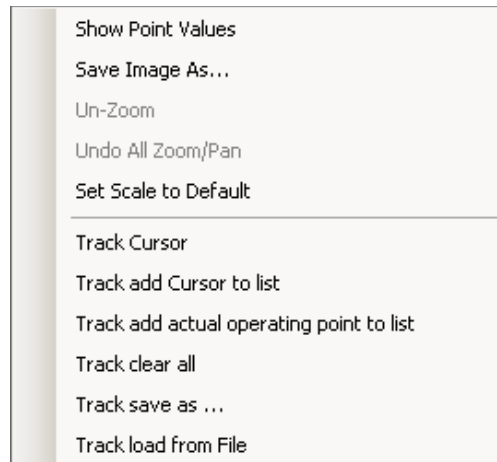Direct link to SLS homepage is found in **Info**.

Info

9 Right Click Context Menu

Right-click with the mouse to a graphical window (Plot, SignalCurveLive, SignalCurve Edit/New, TorqueProfile, OperationPointLive, U-/I-Vectors, Trace-Plot) to open the Right Click Context Menu. Not all features are always available.

This is the menu of the OperationPointLive:

*Right Click Context Menu / Operation Point live*

Common features:

- **Show Point Values:** value of the nearest point is displayed
- **Save Image As...:** an image of the graphic-display can be saved
- **Un-Zoom:** last zoom action is re-done
- **Undo All Zoom/Pan:** all zoom previous zoom/pan actions are re-done
- **Set Scale to Default:** the graphic-display will be set to its default values

Special features for OperationPointLive:

- **Track Cursor:** cursor-position and its value will be marked by space-bar; position remains fixed if layer switched; but values will be switched

- **Track add Cursor to list:** cursor-position will be added to a list by the space-bar

- **Track add actual operating point to list:** actual operation point will be added to a list with the space-bar

- **Track clear all:** all points listed before will be cleared

- **Track save as...:** all points listed before will be saved in a *.SLK-file

- **Track load from File:** already stored *.SLK-file will be imported

This is the menu of the Trace-Plot with some different features:
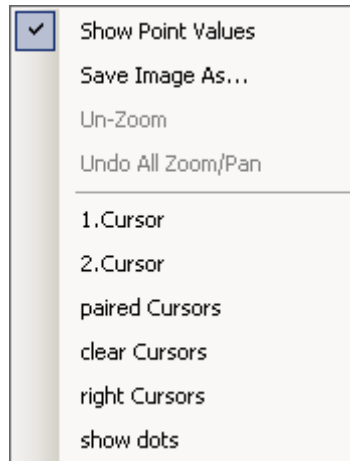
Right Click Context Menu / Plot

Special features for Trace-Plot:

–   **1.Cursor:** The 1. cursor is activated. To place at any point with the left mouse button. Moving a set cursor is only possible when cursor is picked-up again.

–   **2.Cursor:** The 2. cursor is activated. To place at any point with the left mouse button. Moving a set cursor is only possible when cursor is picked-up again.

–   **paired Cursors:** The two cursor can be moved together. For this one of the two must be selected.

–   **clear Cursors:** The cursor will be cleared.

–   **right Cursors:** The cursors refer to the right (speed) axis, otherwise they refer to left axis

–   **show dots:** All points stored in the actual loaded trace-file are visually displayed in the plot window by non-solid handles due to ease selection.

Cursors can be used for measurements distance between two points (like done on an oscilloscope). Position and differences are displayed according to which axis (left/right) is selected.