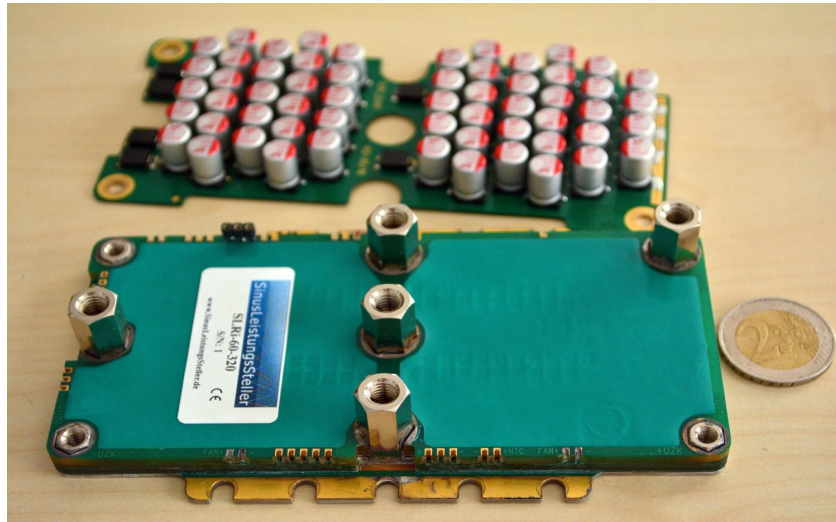


mSLR-60-240 / SLRi-60-240 USER MANUAL



mSLR-60-240 SLRi-60-240 (industrial version with Al-pot)

... variants in preparation:

**mSLR-60-320, SLRi-60-320
mSLR-60-400, SLRi-60-400**

CE

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1 General Information

The mSLR-60-240 is shipped in completely potted form. All power connections are realized by hexagonal terminal-inlays with M6-thru-thread, soldered into the mSLR-60-240. Signal connections are to be soldered at dedicated solder pads around the potting frame.

There is an optional ELKO-bank available, which can be connected externally with M4-screws.

Also an industrial version (SLRi-xx-xxx with/without option -WK) is in preparation. This will come with the ELKO-bank potted into an AL-Pot (known from SLSi-series - same outer-dimensions).

The potting has the task to insulate electrically and to protect the sensitive internal parts from moisture, dirt and mechanical influences from outside.



All mSLR variants are using its PCB as part of its potting case.
At bottom side different potentials are present outside.
Be aware to avoid short cuts, when applying external heat-sinks!
Use some isolating gap pad!



The SLR are *not* "plug&play"!
All SLR must be tuned for the type of motor or drive train on which they will be used. Therefore other motors can not be used until proper parameters are loaded on the SLR, which are suitable for the motor connected.

1.1 Content of Delivery

mSLR-60-240:

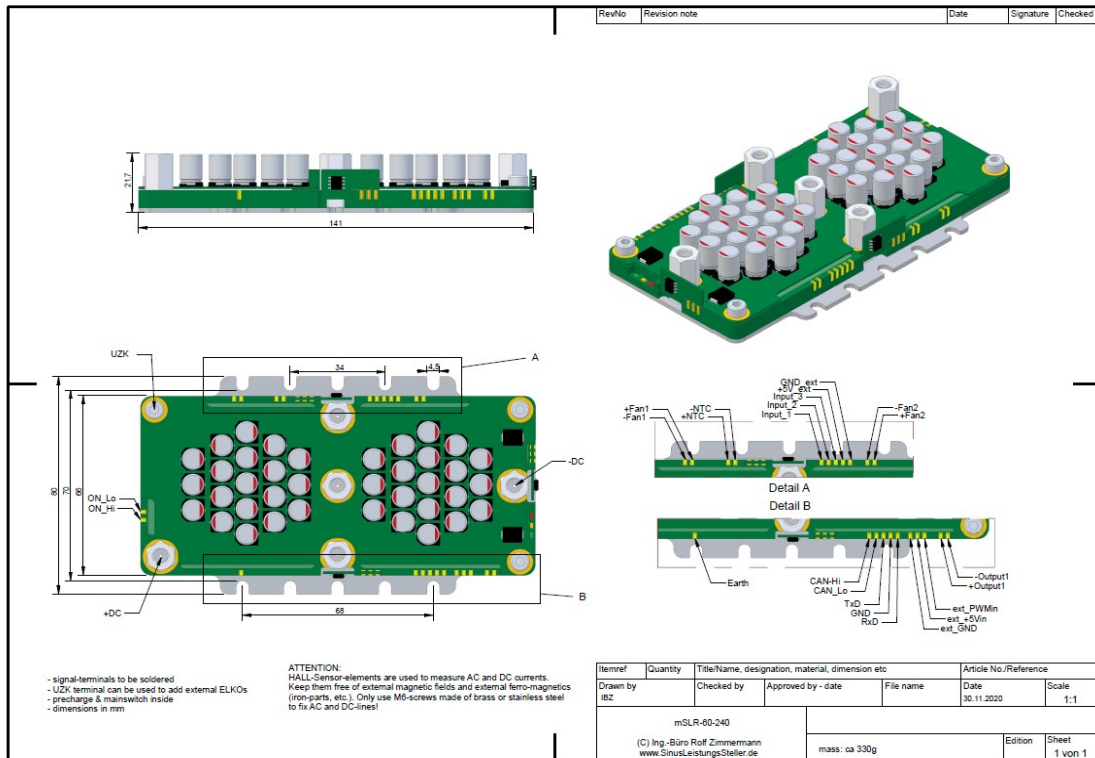
- mSLR-60-240
- optional: ELKO-bank, 2x fan with mounting set
- this user manual, download latest version:

www.SinusLeistungsSteller.de/docu/mSLR-60-240_Manual_en.pdf

1.2 Dimensions mSLR-60-240

All needed mechanical dimensions of the mSLR-60-240 can be found here:

[Drawing: mSLR-60-240.pdf](#)



[Drawing: mSLR-60-240_with_fan.pdf](#)

(drawing to be done, coming soon ...)

[Drawing: SLRi-60-240.pdf](#)

(drawing to be done, coming soon ...)

2 Safety Instructions

Read and understand carefully the following safety instructions!
Don't proceed, if anything is not clear or not ready!



- **All constructional versions/variants of the SinusLeistungsSteller must not be used in the man-carrying area! We hereby explicitly prohibit such use!**
This does not include applications for testing and research purposes, which were reviewed and approved by us (IBZ) in written form.
If the buyer/user performs such application, using one of our controllers without our written consent, this will be at his own risk! We do not accept liability on our part, for damages that might occur directly or indirectly!
- When being installed in machines, the intended operation of the SLS/SLR is forbidden, until it has been ensured that the machine meets the machinery directive and EMC directive.
- During operation the SLS/SLR may have unprotected contacts as well as hot surfaces.
- Assembly and commissioning must be carried out by qualified personnel. Qualified personnel in the sense of the general notes of safety are persons, who are familiar with setting up, assembling, starting up and operating this device or possess the corresponding knowledge within their field of work.
- All SLS/SLR are allowed to operate only with an appropriately sized current fuse for reasons of safety.
- It is necessary to maintain a safe distance from all movable parts when connecting motor and source with the SLS/SLR, because the motor can accidentally start up due to incorrect operation or electric defect. A starting electric motor can cause serious injury. It is important to ensure that no property damage or personal injury occurs when commissioning the controller.
- The controller has to be protected against electrostatic discharges in order to avoid damage.
- A damaged controller (e.g. due to moisture, mechanical or electrical influences) must never be used, otherwise it may result in controller failure.
- The controller is designed for operation with batteries. If operated via a power source, this source must be able to sink eventually generated currents and must have a galvanic insulation to the grid.
- Extending DC- or motor-cables can influence the EMC characteristics and possibly requires an adjustment of controller parameters. Extending or shortening the cables is carried out at your own risk!

3 Cooling and Mounting

All variants of mSLR-60-240 are air-cooled and come without extra heatsink. If further cooling is needed, an external fan or heat-sink can be used. The mSLR-60-240 offers 12V, 100mA for two external fans with settable temperature hysteresis for switching the fan ON/OFF.

You will find the exact dimensions in the respective installation drawings located on our homepage.

During assembly, several points have to be considered:

1. Do not attempt to open the mSLR or apply additional tooling! Electronic components found directly under the protective potting could be damaged. Intruding moisture can damage the electronics, interfere with their function and result in permanent damage.

2. Avoid all forces and bending moments acting from outside the controller! Contacts or heat sinks exposed to external forces or bending moments can lead to cracks at the transition of the potting compound, whereby the intruding of moisture is possible.

3. Fix the DC and AC-lines near the mSLR! The mSLR can not absorb any external forces or vibrations of heavy and long leads. Therefore ensure strain relief is existing on the actual contacts!

4. Use thermal *paste* to achieve a good heat transfer between mSLR and external heat sink – do not use thermal *compound*! Use gap pad to avoid short cuts! The mSLR can be significantly damaged (bending moments!) during a necessary disassembly of the heat sink, when using thermal compound and can lead to permanent damage. Therefore the warranty expires when using thermal compound and attempting disassembly.

When using thermal paste, please make sure to **slowly** tighten the screw to the cooling plate of the mSLR in order to give the paste enough time to spread evenly. Only use the amount of paste that is absolutely necessary! Remove the screw during disassembly and then pull the aluminum potting with a slight turning motion to the side. Never lift off the heat sink (e.g. with a screw driver)!

5. Operate the mSLR only with enough external cooling (heat-sink or fan) up to its limits! Rapid change from "cold" to "warm" or vice versa leads to mechanical stresses and possibly to cracks on the potting transition.

6. When soldering wires to mSLR slots, avoid heatup for longer time and high temperature! Solder one wire by another and give time to cool down between. High temperatures can injure potting resin! Check for shorts after soldering!

7. Don't use mSLR-60-240 (and variants) without external added ELKOs, at high load and/or long DC-wires! ... ask for option "ELKO-bank".

4 Electrical Connection

4.1 Motor Connection

Connect the 3 motor phases to the 3 phase connections of the mSLR! The assignment of the connections initially does not matter. A possibly wrong direction of rotation can be fixed later by interchanging two of the three phases (or by activating the "Change Direction" parameter in the SLS-Windows-Monitor).

4.2 Battery Connection

Connect the power source in the following order with the mSLR!



Make absolutely sure that the voltage is in the permitted range, no reverse polarity exists and nobody is located within the dangerous area of the motor! In any case use the existing precharge function to turn the controller on (internal precharge circuit of the mSLR-60-240 or SLRi, external [AVS2](#) or [EBS](#))!

Especially when the controller is operated near its maximum DC-voltage. Turning the device on via a mechanical switch generates excessively high charging currents in the electrolytic capacitors and in addition produces dangerous over-voltages that may result in permanent controller damage! A in this way damaged controller carries the risk of a battery short-circuit along with the risks of a possible electric arc!

First connect the minus pole of the mSLR with the minus pole of the voltage source. Then precharge the input capacitors of the mSLR (with the internal precharging circuit or an external [AVS2](#)). Only if done the steps above, connect the positive pole of the source with the positive pole of the mSLR. **When using a battery supply the use of a appropriately dimensioned fuse is mandatory – for applications dedicated to safety, we recommend in addition the use of a [EBS](#).** The mSLR is ready as soon as the green LED lights up.

If operated via power source, this source must be able to sink generated currents (alternatively a small battery for buffering, which is connected parallel to the power source can be used). The parameter for the regenerated current must also be adjusted in the SLS-Windows-Monitor to ensure that no dangerous voltage increase occurs at the mSLR input capacitors (and DC-source) – e.g. at a regenerated current during slow down of a inertia.

4.3 PreCharge and Mainswitch

The mSLR-60-240 comes with integrated PreCharge and Mainswitch circuit. More ELKOs can be added externally if a more stable UZK is needed (e.g. high load and/or long battery wires).

See SLS-Windows-Monitor manual for PreCharge and MainSwitch configuration.

4.4 Servo Interface (Reference Signal Specification)

Selecting a reference signal is possible via an externally connected PWM signal. For example a Sollwertgeber ([SG2](#)) is able to produce this signal.

Solder-pins for signals **ext_GND**, **ext_+5Vin** and **ext_PWMIn** can be located with the drawing => [mSLR-60-240.pdf](#)

The +5V must be supplied to the mSLR from the outside, because the internal optocoupler needs also to be supplied.

4.5 NTC, external temperature sensor

An additional NTC temperature sensor can be applied to measure some external temperature (e.g. motor temperature). Be aware to avoid short cuts, when NTC is applied near voltage carrying parts (e.g. motor's windings)!

Refer to SLS-Windows-Monitor manual for NTC configuration.

Solder-pins for signals **+NTC** and **-NTC** can be located with the drawing => [mSLR-60-240.pdf](#)

4.6 Fan

Two external fans can be used for forced cooling the mSLR-60-240.

The fan can be controlled from mSLR's firmware. Refer to SLS-Windows-Monitor manual for fan's on/off-hysteresis configuration. Outputs are limited to 12V and max 120mA each.

Both fans will switch ON/OFF simultaneously.

For control of more powerful fans, this outputs can also be used to drive a relay to switch the higher current and/or voltage of such fan supply. Don't forget a free wheeling diode over the relay coil!

Mechanical mounting interface is available optional for two fans 80x80mm. Please ask for it!

Solder-pins for signals **+Fan1**, **-Fan1** and **+Fan2**, **-Fan2** can be located with the drawing => [mSLR-60-240.pdf](#)

4.7 Serial Interfaces RS232

The SLS-Windows-Monitor can access the controller through the serial RS232 interface. This makes it possible e.g. to change limit values and store them non-volatile in the mSLR, exchange complete parameter sets or display the mSLR status "live". This way internally recorded trace data can be read out and displayed graphically.

The connection between the PC and mSLR should be as short as possible – specifically the USB-cable. If you need to extend the interface cable, the RS232-side of the USB-Serial-Interface (USI) must be extended. The risk of ground-loops is prevented by the realized galvanic insulation through the USB-Serial-Interface (**USI**). **Therefore do not use other interfaces that does not have the necessary galvanic insulation!**

The software-protocol is identical for all mSLR.

Basically, the response message is seen after sending a command. Only after receiving the response, a new command can be send. The communication can only be initiated by the host. The settings of the serial interface are 115kBd, 1 start bit, 8 data bits, 1 stop bit, no parity.

Documentation of the serial-protocol can be found here: [SLR-serial-protocol.pdf](#)

The mSLR-60-240 has a serial connection implemented via solder pads in a 2,54mm grid. The pin marked on the cable, points towards the center of mSLR-60-240.

Solder-pins for signals **TxD**, **GND** and **RxD** can be located with the drawing
=> [mSLR-60-240.pdf](#)

4.8 CAN-Bus

All mSLR are prepared for CAN-Bus.

Also a low-level CAN-Bus protocol is already implemented in SLR-firmware.

Documentation of the CAN-Bus-protocol can be found here: [SLR-CAN-Bus-protocol.pdf](#)

CAN-Bus connections are to be soldered (see picture above: CAN_H, CAN_L).

If CAN-Bus termination is needed, it has to be applied externally (no termination network inside!).

See SLS-Windows-Monitor manual for CAN-Bus configuration.

Solder-pins for signals **CAN-Hi** and **CAN-Lo** can be located with the drawing
=> [mSLR-60-240.pdf](#)

4.9 Digital Inputs

The mSLR-60-240 offers 3 digital inputs, referenced to main ground (DC-). No galvanic isolation!

Solder-pins for signals **Input_1**, **Input_2**, **Input_3**, **GND_ext** and **+5V_ext** can be located with the drawing => [mSLR-60-240.pdf](#)

GND_ext and **+5V_ext** can be used to supply external sensor circuits (e.g. HALL-sensors). Current is limited to a max of about 50mA.

4.10 Digital Output

The mSLR-60-240 offers one digital output. This output is galvanic isolated by an internal optocoupler and works as open collector with current limited to about 40mA.

Solder-pins for signals **+Output1** and **-Output2** can be located with the drawing => [mSLR-60-240.pdf](#)

5 Signaling via LEDs

The mSLR indicates its status via 3 LEDs:

- **LED green:**
 - continuously ON: Internal powerup-self-test completed successfully. mSLR is ready.
 - flashing: Loss of EEPROM-information (reload the *.SLC parameter file)

- **LED yellow:**
 - Data logger is active (short pulses, when data is being saved)
 - Communication via the serial interface is active (short pulses)

- **LED red:**
 - continuously ON: mSLR in failsafe (under-/overvoltage, overtemperature shutdown, no valid reference signal applied)
 - pulses: mSLR operates in derating (undervoltage, overvoltage, overtemperature)



The "failsafe" state protects the mSLR-hardware and battery. This state can only be reset via power cycle (separating the mSLR from battery for at least 30 seconds).

6 Configuration and Control via SLS-Windows-Monitor

The mSLR have a series of parameters, characterizing the motor connected and define the operational behavior. All these settings and controls are managed via SLS-Windows-Monitor.

Beside this, the SLS-Windows-Monitor offers more useful functionality:

- management and display of trace-memory (also offline)
- configuring/editing of signalcurve (lookuptable for reference value)
- changing complete setups/parameter to different motors/drivetrains
- monitoring status information
- live visualization of internal processes
- loading updates of SLR firmware
- loading enable-keys for firmware-options

The SLS-Windows-Monitor can be downloaded for free from our homepage:

http://www.sinusleistungssteller.de/en_SWdownload.html

The User-Manual for the SLS-Windows-Monitor can be found here:

[Manual_WMon_en.pdf](#)

7 Firmware and Options (chargeable options)

If required, the SLR firmware can be updated.

Latest version of the firmware can be found in download area of our homepage:

http://www.sinusleistungsteller.de/en_SWdownload.html

(For the SLR the correct variant must be chosen: **SLR**xxxx.BIC)

Some special firmware functions are not needed on each SLR device in field, but are very useful for tuning, optimization, development, education or just to get an insight and understanding whats going on inside.

Keys for one or more options can be ordered via email: info@SinusLeistungsSteller.de. The options are bound to the controller hardware by the serial number (S/N), therefore we need the S/N-number and information about the exact type of the SLR. The current price list can be found on the SLR website: http://www.sinusleistungsteller.de/en_preise.html

Available options for the mSLR are:

7.1 Operating Point live

Live visualization of all possible operating points ... $I=f(\text{rpm})$... based on the active setup.

... read more: [Option_OperationPointLive_en.pdf](#)

7.2 UI-Vectors live

Live visualization of FOC's voltage- and current-vectors based on the active setup.
(for cSLSi and SLSi it is BETA and discontinued)

... read more: [Option_UI-VectorsLive_en.pdf](#)

7.3 Control Panel

Live control/visualization via speed and current reference values.

... read more: [Option_ControlPanel_en.pdf](#)

7.4 Torque Profile

Enables to set limits for phase current as a function of actual speed.

... read more: [Option_TorqueProfile_en.pdf](#)

7.5 Fieldweakening

Enables the mSLR to be driven in fieldweakening and control of fieldweakening current.

... read more: [Option_Fieldweakening_en.pdf](#)

... SLR's options continued:

7.6 ETA-Plots

Enables the mSLR to calculate several ETA-plots based on the active setup.

... read more: [Option_ETL_Live_en.pdf](#)

7.7 Expert-Mode

This mode enables the user a nearly full access to all internal parameters. Only user with suitable knowledge should use this option – SLR could get permanent damaged due to incorrect settings!

... read more: [Option_Expert_en.pdf](#)

7.8 Calibration

SLR comes with calibrated current- and voltage measurement paths.

... read more: [Option_Calibrate_en.pdf](#)

8 Technical Data

8.1 mSLR-60-240

| | mSLR-60-240 | | |
|---|------------------|------------------------------|---|
| | min | typical | max |
| Input voltage | 16Vdc | | 60Vdc (max. 14S LiPo) |
| Output current (Note 1) | 0A _{ac} | | mSLR-60-240: 240Aac mSLR-60-320: 320Aac mSLR-60-400: 400Aac |
| switching-frequency (Note 2, 3) | 8kHz | | 40kHz |
| +5V at the servo input | 3,3V | 5,0V | 7,0V |
| Voltage at the PWM-input low-level | | | 1,0V |
| Voltage at the PWM-input high-level | 3,3V | 5,0V | 7,0V |
| PWM High time | 800μs | | 2200μs |
| PWM Low time | 100μs | 20ms | 50ms |
| Timeout if no reference => motor stops | | 0,3s | 0,5s |
| Fan-supply output | | | 12V, 120mA |
| Environmental temperature during operation | 0°C | | 50°C |
| Storage temperature | 0°C | | 70°C |
| Dimensions | | 141 x 80 x 22 mm (Note 4) | 141 x 80 x 22 mm (Note 5) |
| Weight (potted) | | 270g (Note 4) | ca. 350g (Note 5) |

Note 1: Continuous operation at high currents might require additional external cooling.

Note 2: The PWM-frequency is set and fixed during tuning.

Note 3: Small motor-inductances require a higher PWM-frequency. By this, more switching losses occur and this may result in a reduction of possible motor current.

Note 4: dimensions and weight without external ELKOs, fan and without wiring.

Note 5: dimensions and weight with external ELKOs (option "ELKO-bank"), without fan and without wiring.

9 Recycling

Electric components must not be disposed with household waste but have to be disposed according to local environmental regulations!

National and local disposal regulations have to be respected.

You can also send the SLR back to the manufacturer for disposal.

10 Warranty, Returning the Product

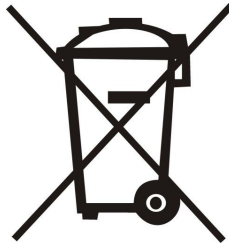
Warranty is governed by our terms and conditions, which are viewed here:

www.sinusleistungsteller.de/AGB_IBZ.pdf

Returning the product to us (for whatever reason) requires our prior consent.

To accept warranty the **original invoice** is required, with information visible for date of purchase and dealer.

Further we need a written error description with precise indication of the error itself and the circumstances in which the error occurred.



11 EU-Declaration of Conformity

11.1 mSLR-60-240

EU Konformitätserklärung EU Declaration of Conformity

1. **Gerätetyp/Produkt**
Apparatus model/Product SinusLeistungsSteller
2. **Name und Anschrift des Herstellers**
Name and address of the manufacturer Ing.-Büro Rolf Zimmermann
Industriestr. 7
D-97297 Waldbüttelbrunn
3. **Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.**
This declaration of conformity is issued under the sole responsibility of the manufacturer.
4. **Gegenstand der Erklärung**
Object of the declaration mSLR-60-240
5. **Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsrechtsvorschriften der Union.**
The object of the declaration described above is in conformity with the relevant Union harmonisation legislation.

RICHTLINIE 2014/30/EU DES EUROPÄISCHEN PARLAMENTS UND DES RATES vom 26. Februar 2014 zur Harmonisierung der Rechtsvorschriften der Mitgliedstaaten über die elektromagnetische Verträglichkeit

DIRECTIVE 2014/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
6. **Angabe der einschlägigen harmonisierten Normen, die zugrunde gelegt wurden, einschließlich des Datums der Norm, oder Angabe anderer technischer Spezifikationen, für die die Konformität erklärt wird, einschließlich des Datums der Spezifikation:**
References to the relevant harmonised standards used, including the date of the standard, or references to the other technical specifications, including the date of the specification, in relation to which conformity is declared:

DIN EN 61000-6-2, VDE 0839-6-2:2006-03 Elektromagnetische Verträglichkeit (EMV)
Teil 6-2: Fachgrundnormen – Störfestigkeit für Industriebereiche (IEC 61000-6-2:2005);
EN 61000-6-2:2005

DIN EN 61000-6-4, VDE 0839-6-4:2011-09 Elektromagnetische Verträglichkeit (EMV)
Teil 6-4: Fachgrundnormen – Störaussendung für Industriebereiche
(IEC 61000-6-4:2006 + A1:2010); EN 61000-6-4:2007 + A1:2011
7. **Nicht zutreffend.**
No applicable.
8. **Zusatzangaben**
Additional information --

Unterzeichnet für und im Namen von:
Signed for and on behalf of: Ing.-Büro Rolf Zimmermann
Industriestr. 7
D-97297 Waldbüttelbrunn

Ort und Datum der Ausstellung:
place and date of issue Waldbüttelbrunn, 30.08.2019

Name und Funktion
name, function

Rolf Zimmermann Dipl.-Ing.(FH), Inhaber

12 FAQ (frequently asked questions)

Our FAQs are updated frequently. The latest version can be found here:

www.sinusleistungsteller.de/en_SLR_FAQ.pdf .

Question: *Why must a SLR be tuned on a motor?*

Answer: All SLR operate according to the principle of field-oriented control. The basic idea of the field-oriented control is to achieve an ideal orientation of the current and voltage vectors, which will result in best efficiency. For this, the controller simulates a model of the real motor or drive. For this simulated model, motor parameters are necessary, which have to be measured first and saved afterwards in the SLR parameter-set. One of the most important parameters are the number of pole pairs, the winding resistance and the inductance of the motor phases.

Question: *What happens, if the SLR parameters are not suitable for the motor?*

Answer: Of course, the SLR must be able to compensate some deviations in motor parameters, which may occur due to unavoidable temperature rise of the motor windings or manufacturing tolerances. On larger deviations, the efficiency drops, the motor might start badly or not at all (all SLR operate sensorless!). If wrong parameters (the simulated model does not fit), the control-loops for current and speed could become unstable, which may lead to permanent damage of the controller in extreme cases. Always make sure that the loaded parameterset matches on the motor in use!

Question: *What does the tuning procedure look like? What is required? How long does it take? What are the costs?*

Answer: The tuning has to be performed in our laboratory and is basically divided into two steps:
1. Determination of the motor parameters and tuning in loadless mode (basic-setup). In the simplest case we need only the motor. You have to send us the motor for the duration of the tuning process. The operation under load must then be tested by the customer by gradually increasing the load itself.

2. Tuning the motor with load (load-optimized-setup). For this, two identical motors would be ideal to build a motor generator couple: it allows to set and measure any operating point. Only one motor with the later intended load (e.g. propeller) would also be possible – the tuning optimization then refers only to this operating point.

The determination of the parameter-set needs about 4-8 hours of work, the hourly fee amounts to EUR 80,- (+ VAT.). We also offer additional tuning tasks (e.g. creating a optimal signal curve or creating a current profile optimized for your system etc.)

Question: *Does each motor (same type) require to be tuned individually ?*

Answer: No. Every motor type needs to be tuned, not every motor device. The tuning must be done only once, as long it is the same type of motor (identical model and the same winding scheme!). The additional costs will be charged only once. You can use this parameter-setup to any number of identical drives.

Question: *Why is there no way for the user to tune a new motor himself?*

Answer: Determining the motor parameters requires special measurement devices, theoretical background and experience. Because these requirements are not met by all customers (with regard to possible damages caused by mismatching), we generally reserve the right to determine the setup of new motors. The measured motor-specific parameters (R, L, Kv, etc.) and the settings for current and speed control loops remain covered in the background and can not be changed by the user. Based on this basic-setup (or load-optimized-setup), the user can change numerous parameters (e.g. current-, voltage- and temperature-limits) and adjust them to his needs.

Question: *Can a SLR only be used with the motor it was tuned for?*

Answer: The parameter-set must **always** match on the motor connected to the SLR! But the user can switch the parameter-set to another parameter-set and operate the SLR with another suitable motor. All parameter-sets can be read entirely from the SLR and saved on the PC in form of ONE file.

You will need our [USB-Seriell-Interface \(USI\)](#) to change/replace parameter-sets and a installation of the SLS-Windows-Monitor. The [USI](#) is also required to read trace data or load firmware-updates and is in most cases already available or a worthwhile investment. The SLS-Window-Monitor can be downloaded for free from the [Download-Area](#) on our homepage.

Question: *Which types of motors can be operated with the SLR?*

Answer: All 3-phase motors that match the basic concept of a permanent-magnet synchronous motor (PMSM, BLDC). It makes no difference whether it is an inrunner or outrunner. Ideal (but not mandatory) is a sine induced voltage - if the voltage differs from pure sine, efficiency slightly drops. Due to the sine-commutation, there are restrictions on the maximum field frequency: for the SLR, it should not exceed a maximum of 2.000Hz (= 120.000rpm field).

For motors with very small winding inductance, the PWM-frequency must be increased in order to keep the current ripple small. As a result, additional losses occur (increased switch-losses!), this leads further to a derating of the max. allowed AC-current of the controller. Further, separately excited synchronous motors and induction motors can not be operated with the SLR at this moment.

Question: *Are the SLR really safe at partial load?*

Answer: Yes, absolutely! The full AC-current, indicated on the name-plate can be used in all partial load situations. Exceeding this maximum current is practically impossible, since the real AC-currents are measured and limited – this way overload is impossible. The SLR has less losses in partial load than in full load, for which the SLR is designed. Primarily the AC-currents are responsible for the losses of the SLR – not the speed nor the converted power! A derating of the max. allowed AC-current may be necessary for motors with small inductance, but applies in this case for all load situations.

Question: *Is the SLR also suitable for traction drives in vehicles?*

Answer: Yes, however with certain restrictions. The SLR operates sensorless at this moment and does not support any hall-sensors, which are used for starts with full torque. **SLR improved this situation (compared with the SLS) by “ALS” (advanced low speed = OpenLoopControl). ALS allows certain amount of torque even at zero speed inclusive reversion! Main penalty is much less efficiency while running in ALS.**

However at sensorless operation, full torque is still available only above a certain minimum speed. This restriction can be overcome by using a centrifugal clutch, which enables the torque-free motor start. Thus the SLR with all its advantages is also suitable for traction drives.

Question: *Why is the AC-current specified on the name-plate and not the DC-current?*

Answer: The AC-current is the specification used in the industry. This is, because the AC-current can be translated directly into the torque if the motor constant is known. The DC-current together with the DC-voltage indicates only the input power – which is still dependent on the speed and does not provide any information about the actual operating point (speed, torque).

Since the AC-currents are needed for the field-oriented control (i.e. they must be measured), the indication of the AC-current is obvious. The DC-current is not measured by most SLR.

Question: *What are the advantages of sine-commutation towards block-commutation?*

Answer: The sine-commutation causes a absolutely uniform torque, a "smooth running" of the motor. ... one might demonstrate the difference by comparing round and hexagonal wheels - which would you like to have on your car? ;-)

Without torque ripple also the input power from the DC-power supply (battery or AC adapter) is uniform - thereby there is no length limitation of the DC-supply cables. The efficiency of the overall system is higher (especially in partial load) and there is no reactive power drawn from the supply. Finally an almost noise-free operation is possible with sine-commutation - the high-frequency "squeaking and squealing" of block-commutation is completely eliminated.

Question: *Is the operation via power supply(or battery with connected charger) possible?*

Answer: Principally: YES – because the SLR does not “see” whether it draws its current from a power source or battery ;-)

If supplied by power supply it must be ensured that the SLR does not regenerate current back (e.g. rapid braking of a inertia) or the power supply must be able to source and sink currents. By using a not suitable power supply, SLR and/or power supply can be damaged by over-voltage. During battery operation with a connected charger, always make sure that the max. voltage of the cSLR is not exceeded. Some chargers produce very high voltage pulses (e.g. desulfation of lead-acid-batteries), which could damage the SLR. Especially when the battery-pack consists of multiple, serial-connected 12V lead-acid batteries, which are recharged each with a separate 12V charger - this is where the pulses of the individual chargers can add-up to dangerous voltages! Always disconnect the SLR from the battery during recharge to keep the SLR safe!

In any case use the existing precharge function to turn the controller on (internal precharge circuit of the SLR, external [AVS2](#) or [EBS](#))! Especially when the controller is operated near its maximum DC voltage. Turning the device on via a mechanical switch generates excessively high charging currents in the electrolytic capacitors and in addition produces dangerous over-voltages that may result in permanent controller damage! A in this way damaged controller carries the risk of a battery short-circuit along with the risks of a possible electric arc!

Question: *What information is required to send an offer, and find the best SLR for my application?*

Answer: We will gladly help you in choosing the right SLR. In order to evaluate your application, we need further information (best case via eMail: info@SinusLeistungsSteller.de):

- A brief, general description of your application.
- Have you already selected a motor? If so, what type of motor?
- How is the motor supplied with energy? (by battery, AC-adapter, hybrid, fuel cell, etc.)
- Level of the DC-voltage (min, nom, max)
- Level of the maximum speed.
- Level power (nom, max, maximum time for Pmax)
- What kind of cooling (air-cooling, water-cooling)
- Is it a private or commercial application (estimated quantity p.a.)?
- Your residence and delivery address

Question: *Why do you deliver only within Europe? How can I get a SLR if I live outside of Europe?*

Answer: We do not want to deal with the enormous amount of "paperwork" that would arise for exporting products abroad. The EU-internal market makes it easier for us to deliver beyond the border of Germany to the neighboring EU countries. Everything beyond that, is done by a Germany-based import/export company. Unfortunately, this company does not work for free – so they need to be paid for their services. By request we will gladly provide a contact for you!

Question: *I did not found a dealer for SLR ...*

Answer: We distribute the SLR exclusively ourselves. The SLR is not "plug&play" and needs to be tuned on the motor (see above). This is very hard to accomplish by merchants.

Question: *Can the offered water cooling for SLR be used with sea/salt water?*

Answer: No. A sea water resistant design would require a different aluminum alloy, but this would also mean a significantly worse thermal conductivity – the SLR water cooling would therefore be too bad. We recommend a dual-circuit cooling system for applications permanently operating in seawater. The internal cooling circuit can operate with normal water (possibly with suitable antifreeze) and the heat can be dissipated via the outer cooling circuit (with sea water) to the sea.

Question: *Is it really necessary to precharge the electrolytic capacitors, when turning ON the controller (before connecting the controller to the battery)?*

Answer: Hard switching can damage the SLR by over-current and over-voltage! In some cases, controllers failed, when they were connected to the battery without precharging the capacitors. We examined the occurring problem in detail (see [P03.pdf](#)) and conclude, that the use of the existing precharge options is mandatory.

You can use the precharge circuit integrated in the SLR, an external [AVS2](#) or our [EBS](#). We will not grant warranty for damages caused by turning ON without precharging!