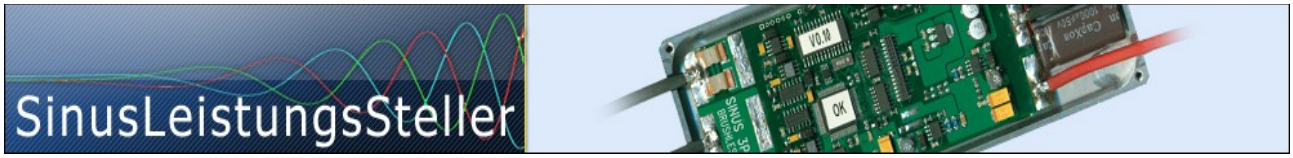


cSLSi
USER MANUAL

cSLSi-24-75-(WK) cSLSi-60-70-(WK)
cSLSi-24-110-(WK) cSLSi-60-100-(WK)

Industrial version potted in AL-heat-sink

variants:
- max 24Vdc with max 75Aac or 110Aac
- max 60Vdc with max 70Aac or 100Aac
- both variants optional with water cooling (option WK)

CE

Ing.-Büro Zimmermann - Industriestraße 7 - D-97297 Waldbüttelbrunn
Tel.: +49 (0) 931/78011030 - www.SinusLeistungsSteller.de - info@SinusLeistungsSteller.de

Contents

1 General Information

The cSLSi is shipped in completely potted form. Silicon cables of adequate cross-section are brought out of the cSLSi potting, on the DC-side (battery) and AC-side (motor) for electric contacting.
The potting has the task to insulate electrically and to protect the sensitive internal parts from moisture, dirt and mechanical influences from outside.

The SLS are *not* "plug&play"!
All SLS 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 SLS, which are suitable for the motor connected.

1.1 Content of Delivery

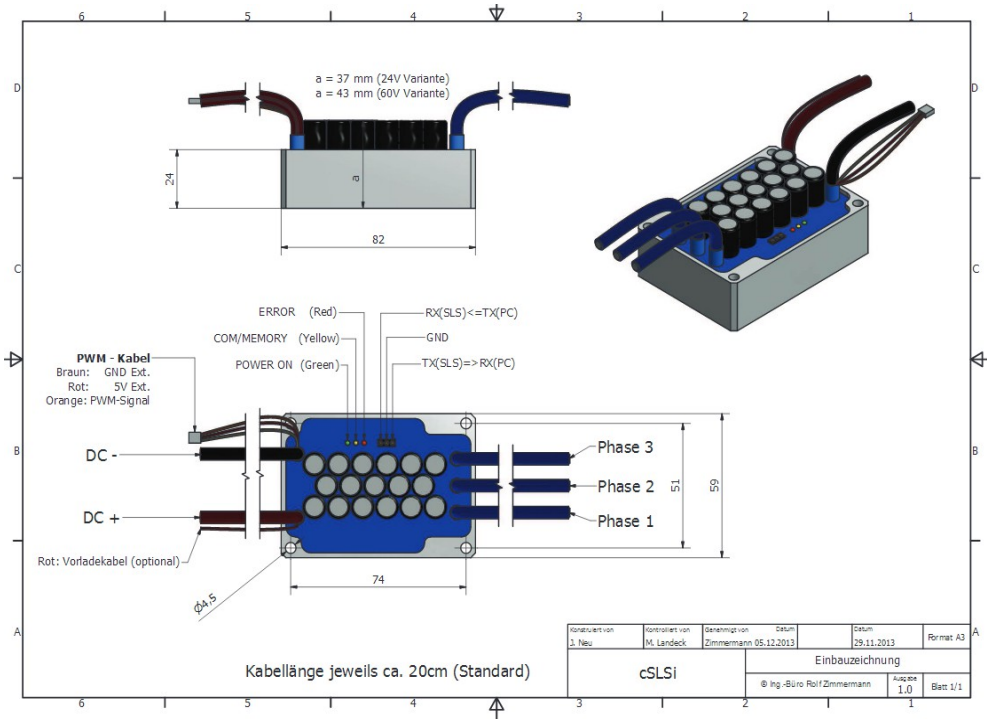
cSLSi:

- cSLSi
- this user manual, download latest version:
  www.SinusLeistungsSteller.de/docu/cSLSi_Manual_en.pdf

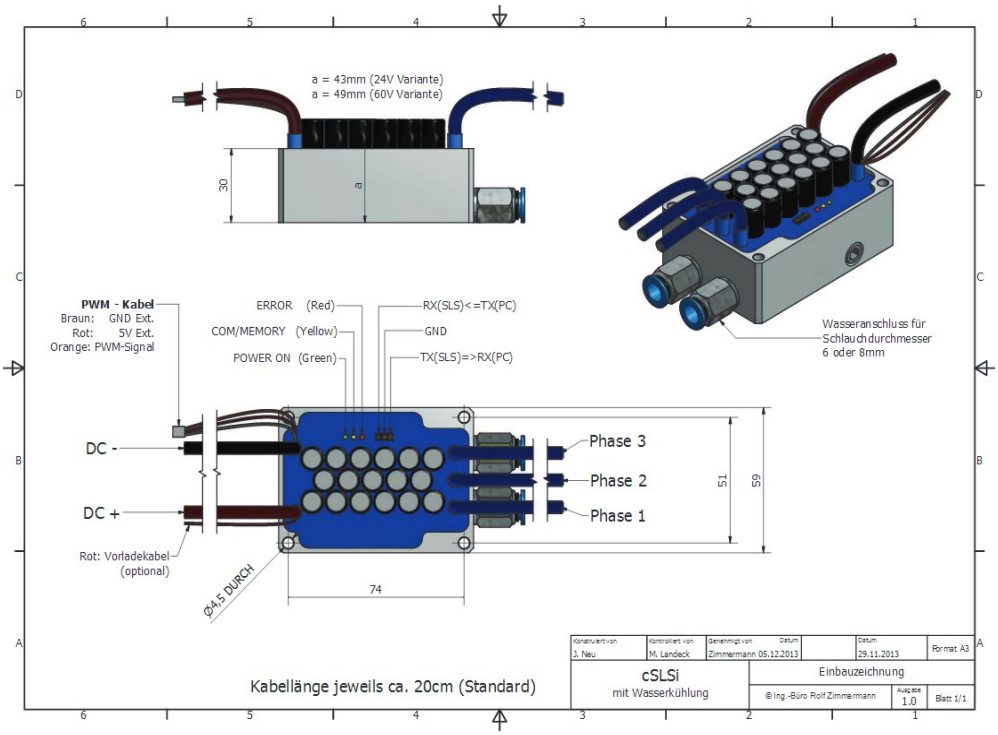
1.2 Dimensions cSLSi

All needed mechanical dimensions of the cSLSi can be found here:

Drawing: cSLSi air cooled.pdf



Drawing: cSLSi with option water cooling (WK).pdf



2 Safety Instructions

Read and understand carrfully 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, 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

Both cSLSi and SLSi are available with a water cooling option. (-WK).
Without water cooling the aluminum potting is used as a heat sink and as a interface for external, larger heat sinks. 4 through-holes can be used for mounting. 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 SLS 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 SLS! The SLS 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 aluminum potting and external heat sink – do not use thermal *compound!* The SLS 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 SLS 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 SLS 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.

4 Electrical Connection

4.1 Motor Connection

Connect the 3 motor phases to the 3 phase connections of the SLS! 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 SLS!

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 cSLSi, 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 SLS with the minus pole of the voltage source. Then precharge the input capacitors of the SLS (with the internal precharging circuit or an external **AVS2**). Only after the steps above are followed connect the positive pole of the source with the positive pole of the SLS. **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 SLS 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 SLS input capacitors (and DC-source) – e.g. at a regenerated current during slow down of a inertia.

4.3 Servo Interface (Reference Signal Specification)

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

The cSLSi 3-pin connector is assigned as follows:

brown	GND
red	+5V
orange	signal

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

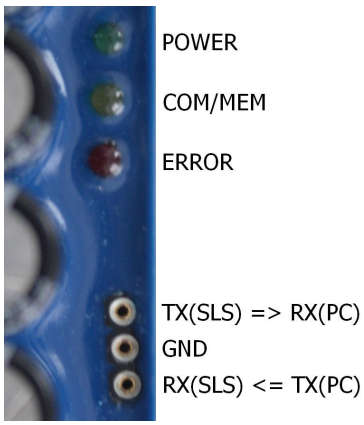
4.4 Serial Interface

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

Documentation of the serial-protocol can be found here: **SLS-serial-protocol.pdf**

The software-protocol is identical for all SLS.
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.

The cSLSi has a serial connection implemented via a female connector, in a 2,54mm grid with round 0,5mm pins. The pin marked on the cable, points towards the LEDs.



picture 4.1: cSLSi serial / LED

5 Signaling via LEDs

The cSLSi indicates its status via 3 LEDs:

- **LED green:**
  continuously ON: Internal powerup-self-test completed successfully. SLS 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: SLS in failsafe (under-/overvoltage or overtemperature shutdown)
  pulses: SLS operates in derating (undervoltage, overvoltage, overtemperature)

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

6 Configuration and Control via SLS-Windows-Monitor

The SLS 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 SLS 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 cSLSi firmware can be updated.
Latest version of the firmware can be found in download area of our homepage:
http://www.sinusleistungssteller.de/en_SWdownload.html
(For the cSLSi the correct variant must be chosen: **c**SLSxxxx.BIC)

Some special firmware functions are not needed on each SLS 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, therefore we need the number and information about the exact type of the SLS. The current price list can be found on the SLS website:
http://www.sinusleistungssteller.de/en_preise.html

Available options for the cSLSi are:

7.1 Operating Point live

Live visualization of all possible operating points … I=f(rpm)... based on the active setup.
… read more: **Option_OperationPointLive_en.pdf**

7.2 U/I-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**

8 Technical Data

8.1 cSLSi-24-xxx

	cSLSi-24-**xxx**		
	min	typical	max
Input voltage	8Vdc		26Vdc (max. 6S LiPo)
Output current (Note 1)	$0A_{ac}$		cSLSi-24-75: $75A_{ac}$ cSLSi-24-110: $110A_{ac}$
switching-frequency (Note 2, 3)	8kHz		60kHz
+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
Environmental temperature during operation	0°C		50°C
Storage temperature	0°C		70°C
Dimensions		82 x 59 x 37 mm 102 x 59 x 43 mm (with option -WK)	
Weight with 20cm cable (6 mm²)		370g 470g (with option -WK)	

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.

8.2 cSLSi-60-xxx

	cSLSi-60-**xxx**		
	min	typical	max
Input voltage	16Vdc		60Vdc (max. 14S LiPo)
Output current (Note 1)	$0A_{ac}$		cSLSi-60-70: $70A_{ac}$ cSLSi-60-100: $100A_{ac}$
switching-frequency (Note 2, 3)	8kHz		60kHz
+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
Environmental temperature during operation	0°C		50°C
Storage temperature	0°C		70°C
Dimensions		82 x 59 x 43 mm 102 x 59 x 49 mm (with option -WK)	
Weight with 20cm cable (6 mm²)		370g 470g (with option -WK)	

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.

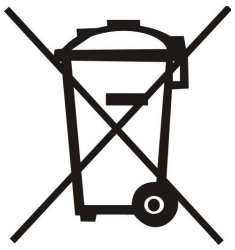
9 Recycling

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 cSLSi/SLSi back to the manufacturer for disposal.

10 Warranty, Returning the Product

Warranty is governed by our terms and conditions, which are viewed here:
www.sinusleistungssteller.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 cSLSi-24-75

EU Konformitätserklärung
EU Declaration of Conformity

1. **Gerätetyp/Produkt** — SinusLeistungsSteller
   Apparatus model/Product

2. **Name und Anschrift des Herstellers** — Ing.-Büro Rolf Zimmermann, Industriestr. 7, D-97297 Waldbüttelbrunn
   Name and address of the manufacturer

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** — cSLS-24-75, cSLSi-24-75
   Object of the declaration

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 – Störausssendung 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: — Ing.-Büro Rolf Zimmermann, Industriestr. 7, D-97297 Waldbüttelbrunn
Signed for and on behalf of:

Ort und Datum der Ausstellung: — Waldbüttelbrunn, 21.08.2014
place and date of issue

Name und Funktion
name, function

Ingenieurbüro
Rolf Zimmermann
Industriestraße 7
D-97297 Waldbüttelbrunn
Tel. 0931/7801103-0 Fax -8

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

11.2 cSLSi-60-xxx

EU Konformitätserklärung
EU Declaration of Conformity

1. **Gerätetyp/Produkt** — SinusLeistungsSteller
   Apparatus model/Product

2. **Name und Anschrift des Herstellers** — Ing.-Büro Rolf Zimmermann, Industriestr. 7, D-97297 Waldbüttelbrunn
   Name and address of the manufacturer

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** — cSLS-60-70, cSLSi-60-70; cSLS-60-100, cSLSi-60-100; cSLS-60-140, cSLSi-60-140
   Object of the declaration

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 – Störausssendung 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: — Ing.-Büro Rolf Zimmermann, Industriestr. 7, D-97297 Waldbüttelbrunn
Signed for and on behalf of:

Ort und Datum der Ausstellung: — Waldbüttelbrunn, 21.08.2014
place and date of issue

Name und Funktion
name, function

Ingenieurbüro
Rolf Zimmermann
Industriestraße 7
D-97297 Waldbüttelbrunn
Tel. 0931/7801103-0 Fax -8
Rolf Zimmermann Dipl.-Ing.(FH), Inhaber

12 FAQ (frequently asked questions)

Our FAQs are updated frequently. The latest version can be found here:
www.sinusleistungssteller.de/en_SLS_FAQ.pdf .

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

Answer: All cSLS/SLS 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 afterward in the SLS 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 SLS parameters are not suitable for the motor?*

Answer: Of course, the SLS 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 SLS 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 parameter-set 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 pair: so that we can 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 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 SLS only be used with the motor it was matched for?*

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

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: it should not exceed a maximum of 1.000Hz (= 60.000rpm 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 cSLS/SLS at this moment.

Question: *Are the cSLS/SLS 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 cSLS/SLS has less losses in partial load than in full load, for which the cSLS/SLS is designed. Primarily the AC-currents are responsible for the losses of the cSLS/SLS – 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 SLS also suitable for traction drives in vehicles?*

Answer: Yes, however with certain restrictions. The cSLS/SLS operates sensorless at this moment and does not support any hall-sensors, which are used for starts with full torque.
However at sensorless operation, full torque is 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 cSLS/SLS 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 the cSLS/SLS.

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 cSLS/SLS 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 cSLS/SLS 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 , cSLS/SLS 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 cSLS/SLS is not exceeded. Some chargers produce very high voltage pulses (e.g. desulfation of lead-acid-batteries), which could damage the cSLS/SLS. 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!
Disconnect the cSLS/SLS from the battery during recharge to keep the cSLS/SLS safe!
In any case use the existing precharge function to turn the controller on (internal precharge circuit of the cSLSi, 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 SLS for our application?*

Answer: We will gladly help you in choosing the right cSLS/SLS. 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 SLS 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 payed for their services. By request we will gladly provide a contact for you!

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

Answer: We distribute the cSLS/SLS exclusively ourselves. The cSLS/SLS 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 cSLSi/SLSi 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 cSLS/SLS 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: *I loaded an update from the download area into my SLS. Now the red LED is permanently ON after turning the device ON...*

Answer: No need to worry! Starting from firmware version 1.480, the red LED additionally indicates an invalid servo input signal. “Invalid” here means: out of range (800µs..2200µs, no Sollwertgeber connected) or immediately after turning ON: not in the neutral position of the signal curve stored in the cSLS/SLS (protection against unintentional start up after switching ON). Once you connect a valid reference signal (e.g. from SG2) and it is in neutral range, the red LED should turn OFF.

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 SLS 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 SLS ("thin red wire"), an external AVS2 or our EBS. We will not grant warranty for damages caused by turning ON without precharging!