FAQ (frequently asked questions)

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 afterwards in the SLS parameter-set. One of the most important parameters are the number of pole pairs, the winding resistance and the inductances 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 75,- (+ 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 <u>not</u> 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 <u>sink</u> 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!
<u>In any case</u> use the existing precharge function to turn the controller on (internal precharge circuit of the cSLSi, external <u>AVS2</u> or <u>EBS</u>)! 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! <u>A in this way damaged controller carries the risk of a battery short-circuit along with the risks of a possible electric arc!</u>

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 additonally 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!