

LSCONTROL

Frequency Converter SpeedControl 1145 PMSM and BLDC



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Manual for SpeedControl 1145

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Product Description

SpeedControl 1145 is a single phased supplied drive for control of PMSM and BLDC and motors up to 3000W / 3x14A. SpeedControl 1145 is enclosed in an IP 20 metal housing for demanding environments. The compact construction with a very low sound level as there is no active fan in the drive and the fact that it is maintenance free makes it suitable for many applications. All parts are integrated in the drive which makes no external capacitors or inductors required. Active cooling is not included.

The SpeedControl 1145 has integrated APFC (Active Power Factor Correction). The APFC prevents the drive from contributing significantly to the harmonic currents on the grid which is a problem for many drives. Harmonic currents impair the reliability of the mains resulting in poor use of the grid and in house electrical installations. This is partly due to the fact that current and voltage are not in phase, but more so due to non-linear components that are used in all electronic products which generate a wide range of harmonic currents at 150Hz, 250Hz, 350Hz etc. etc., which should not be present in installations. These harmonic currents accounts for a considerable loss of efficiency. To protect the grid there are several legislative regulations (EN61000-3-2) which must be observed when releasing a drive. Furthermore, drives used in other type of products, particularly when these are used in domestic housing, drives are subject to strict requirements to ensure high efficiency (ECO design) and efficient exploitation of the building installations. These requirements can be met in various ways depending on the size of the drive. Therefore, we also offer several solutions, including an APFC, which by using an advanced power entry enhances our largest frequency converter, offering a very high performance and a cost-efficient use of the electrical installation.

The SpeedControl 1145 is designed and produced to be in compliance with the IEC 60335-2-40:2016 with respect to the A2L refrigerants. Before considering use with A3 refrigerant LS Control must be contacted to ensure correct use and production as A3 refrigerant requires ATEX classification.

Considerations when selecting compressors

To choose the right compressor for your specific application, it is important to compare the compressor data with the frequency converter data. Make sure that both the frequency converter and the compressor can supply the required power and current for your application.

Compressors must be matched to the drive for optimum performance and energy savings. A number of Motor Profiles are already available, but if the Motor Profile for a specific compressor is not available, there is a new tuning procedure making tuning to new compressor models and motor profiles available at any site, i.e., customer site, manufacturer site etc.

At high loads the frequency converter may become extremely warm. Therefore, if the compressor is operated at high loads and high ambient temperatures, active cooling is necessary. Please refer to chapter Electrical / Mechanical installation.

NB! It is your responsibility to ensure that the installation meets the EMC standards applying for your specific installation and the environment in which it is installed.

Available Models

Models available of SpeedControl 1145	
<p>LHS = Large Heatsink</p> 	<p>28625 - SpeedControl 1145 E 2000W LHS DC/DC</p> <p>28650 - SpeedControl 1145 E 3000W LHS DC/DC</p>
<p>SHS = Small Heatsink</p> 	<p>28620 - SpeedControl 1145 E 2000W SHS DC/DC</p> <p>28680 - SpeedControl 1145 E 3000W SHS DC/DC</p>
<p>CP = Coldplate</p> 	<p>28630 - SpeedControl 1145 E 2000W CP DC/DC</p> <p>28655 - SpeedControl 1145 E 3000W CP DC/DC</p>

Technical Specifications

	SpeedControl 1145 - 2000	SpeedControl 1145 - 3000
Supply Voltage	1 x 200-253 VAC / 50/60Hz	
Supply Current	10A at 230VAC	14A at 230VAC
Output Current	Max 3 x 10A	Max 3 x 14A
Output Power	2000W	3000W
Active PFC, PF	> 0.97	
Working amb temp.	- 10 to 60°C	
Storage temp.	- 20 to 60°C	
IP Class and working humidity	IP 20 and 0-90% RH, no condensation allowed	
Size.	Depending on Heatsink. See models on www.lscontrol.dk	
Inrush Current.	16A	
Leakage Current.	< 3.5 mA (for inverter only)	
HW Stop interface	Open Circuit on input from High Pressure Switch will shut down the inverter. Do not connect to PE.	
Protection	Motor Shorts, PE Shorts, Motor Blocked, Motor Phaseloss.	
Internal temp. Protection.	Will stop at 105°C (Max. 114°C) measured in power module.	
Power and Motor terminals.	Clamp: 0.5 - 2.5mm	
HW stop and control terminals.	Clamp: Max. 1.5mm	
Modbus Interface.	A, B, GND and 24VDC/50mA.	
Cooling.	Prober cooling is mandatory. Place inverter in moving air.	

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EMC

The frequency converter (IP54) complies with the standard of electrical Power Drive Systems. The frequency converter is classified as a Power Drive System (PDS) of "category C2" (EN 61800 – 3).

- EN 61800–3:2005 – Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods.
- EN 61800–3/A1:2012 – Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods.
- EN 61800–5–1:2007 – Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy.
- EN 61800–5–1:2007/A1:2017 – Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy.
- EN 61800–5–1:2007/A11:2021 – Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy.

If a frequency converter is purchased in no enclosure (IP00), LS Control can't ensure that the frequency converter complies with the above standards.

Warnings

Before the drive is taken into use, verify that the specifications of the drive are compatible with the mains to which it is going to be connected. Furthermore, verify that the motor is suitable for drive connection and that it is in compliance with the specifications of the drive. Check the place of installation for any special requirements and precautions which must be observed during installation, commissioning, or operation. The drive must be supplied through a main switch with at least 3mm breaker space between all conductors according to IEC364. The fuse installed in the electrical switchboard must be 16A or less for the SpeedControl 1145. The drive must always be connected to the yellow/green grounding conductor (PE) in supply.

If the drive is connected to an installation with a residual current device as an extra protection, the device must be marked with minimum the following: RCD Type B.



The components of the power unit of the frequency converter are live when it is connected to mains. Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.



The motor terminals U, V and W are live when the frequency converter is connected to mains, even when the motor is not running.



The Modbus control terminals: A, B, GND and Supply, are all isolated from the mains potential (clamps 5–8).



The HW Stop terminals 1-2 and LS terminals 3-4 are **NOT** isolated from the mains potential.



The earth leakage current may exceed 3.5 mA AC when the frequency converter is connected to a motor. According to standard EN61800-5-1 a reinforced protective ground connection must be mounted.

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If the frequency converter is part of a machine solution, the machine manufacturer is responsible for providing the machine with a main switch. (EN60204-1).



If the frequency converter is disconnected from mains while the motor is running, high and dangerous voltage may still be present on the frequency converter power unit. In this case the motor is operating as a generator supplying the frequency converter with power.



After disconnecting the frequency converter from mains, wait a minimum of 30 minutes before handling the frequency converter.



The frequency converter may automatically start the motor after a fault situation or after reconnection of mains. Note that there might be a minimum downtime during which the motor cannot be stopped.



In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.



Intended for use in first environment, that includes domestic premises, it also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purpose.



The frequency converter is only EMC compliant when supplied in IP54 model. If the frequency converter is supplied in IP00 model, the customer will be responsible for EMC compliance.



If the frequency converter is connected to an installation with a residual current device (RCD) protection, the device must be marked with the following: RCD Type B.



The frequency converter is sensitive to ESD (ElectroStatic Discharge). Handle with care. ESD may cause damage to the frequency converter.

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Electrical / Mechanical Installation

Important

A time delay of approx. 3 - 15 sec will occur at start up. If the PCB is dismantled from the metal housing, the warranty will be void. Before handling the frequency converter, it must have been disconnected from supply power for at least 30 min.

Location and temperature

The frequency converter is cooled by passive/active air circulation. To avoid reduced operation or operating stops due to overheating of the frequency converter, the frequency converter must be mounted vertically on a metal plated wall with the glands facing downwards. The frequency converter must be mounted with space around it to ensure sufficient cooling by allowing free circulation of air. Make sure that the mounting surface can withstand the temperature of the surface of the frequency converter.

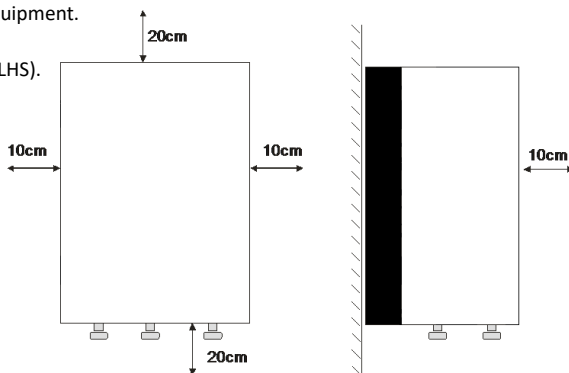
As a basic rule the drive generates up to 8% of the total power as heat dissipation. Meaning if the total output is 1000W the drive generates up to 80W heat, at 3000W it is approx. up to 240W The loss in the drive mainly originates from the rectifier, EMC interference components APCF - middle circuit and amplifier.

It is up to the customer to make sure that there is a sufficient airflow through the cooling fins of the heatsink. The frequency converter will reduce performance of the motor, if a too high temperature is measured. By default, this temperature is set at 105°C measured inside the Power Module, but it can be adjusted down or up through the ModBus – interface. See modbus document at www.lsccontrol.dk under SpeedControl 1145.

Note: If the SpeedControl 1145 is cooled by mounting on a heat exchanger it must be ensured that the surface of the heat exchanger is large enough to ensure sufficient cooling. If the SpeedControl 1145 is mounted for use of air cooling it is important to ensure sufficient air speed passes through the heat sink. It is recommended that the air speed is at least 2 - 3 m/sec. at full load.

NOTE: The drive turns itself down if it gets to hot. Giving that if sufficient cooling is not ensured you will experience reduced function of the equipment.

E.x. of mounting with Large Heatsink (LHS).



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Main Supply

The frequency converter is supplied by 200-253VAC 50/60HZ. It is However possible to go to a lower voltage, but it must be noted, that there is no garanti of stability when running the motor. It is not recommended to use a supply less than 200VAC. Use a Cablesize of minimum 1.5mm².

The distance between supply cable and motor cable must be as long as possible (> 30 cm). If it is necessary to cross the power cable and the motor cable, this must be done at an angle of 90°. The PE-conductor from the motor, which is screwed into the terminal block, must be longer than L and N.

Due to relatively high leakage currents in the frequency converter and the motor, the frequency converter and the motor must always be properly grounded in accordance with national and local regulations. The ground conductor should be as short as possible to avoid high frequency radiation.

Main Supply Connection

N	Neutral (supply)
L	Live (230VAC) (supply)
PE	Protective grounding (supply)

Motor

The motor is connected to the frequency converter by minimum 4 x 1.5 mm² shielded cable. The total cable length must not exceed 20 m, **keep it as short as possible**. Long cables may cause function failure. The motor cable must be shielded and made especially for the use with frequency converters. Mount the shielding correctly in the cabel clamp mounted on the front of the cabinet to minimize electrical noise from the motor. PE conductors must be longer than U, V and W.

Motor Connection

PE	Protective Earthing conductor for motor
W	Motor Conductor W
V	Motor Conductor V
U	Motor Conductor U

Hardware Stop switch

The frequency converter is supplied with a Hardware (HW) Stop switch function. This HW Stop Function can be used with a switch (e.g., a pressure switch or a thermal switch). The Switch must be connected between connector 1 and 2, and it must be closed for the frequency converter to run the motor. If the switch is open, the frequency converter is stopped, and it will not be able to restart, until the supply voltage has been disconnected long enough for the frequency converter to come to a complete stand still.

If not used, connector 1 and 2 must be shortend.

Hardware Stop Connection

1 = HW1 – Hardware Stop 1	3 = LSC1 – Do not use
2 = HW2 – Hardware Stop 2	4 = LSC2 – Do not use

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Modbus interface

The distance between the signal cable and the motor cable and supply cable must be as long as possible (> 30 cm). If the signal cable crosses the motor cable, it must be done at an angle of 90°. The cable must be shielded to GND. For detailed description of ModBus communication see modbus document on www.lscntrl.dk under SpeedControl 1145.

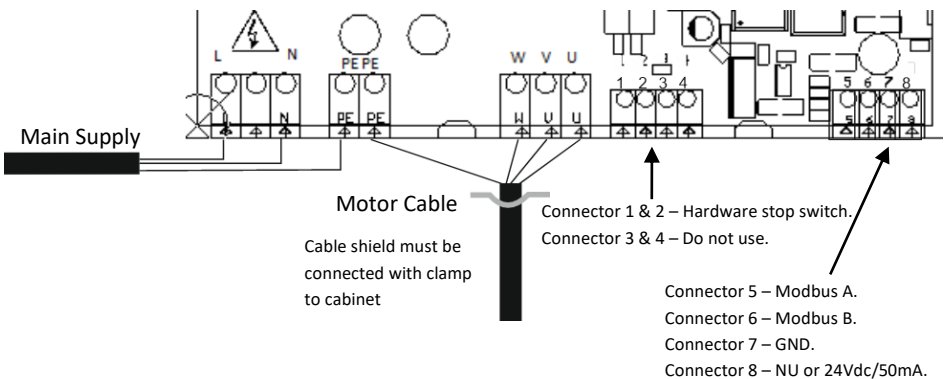
Modbus interface connection

- 5 = Modbus A
- 6 = Modbus B
- 7 = GND
- 8 = +24Vdc

Default modbus setup

- Baudrate = 19200
- Data bits = 8
- Stop bits = 1
- Parity = Even
- Mode = RTU
- Time Between polls = 100ms

Overview

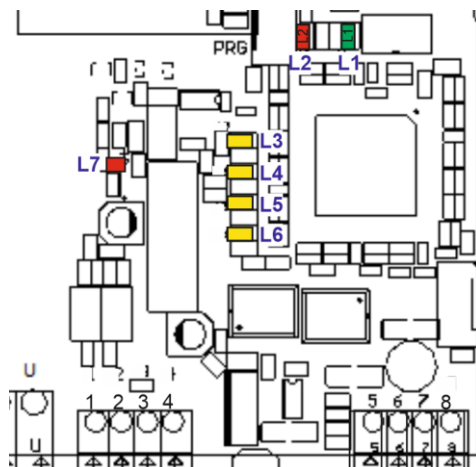


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Indicator Lights

The LED lights inside the inverter is for trouble shooting only when 0-10V Addon PCB is used. Otherwise the Modbus will give sufficient information regard running status, Errors etc.

Overview



L1 = Green run LED	- Flashes when OK
L2 = Red Fault LED	- ON when Fault
L3 = Yellow Fault Type LED	- Flashes error number.
L4 = Yellow ModBus Communication LED	- Flashes fast with communication speed
L5 = Yellow LED	- Reserved for future use
L6 = Yellow LED	- Reserved for future use
L7 = Red hardware stop LED	- Flashing = OK, ON or OFF = Fault.

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Error and Hardware stop LEDs

Hardware Stop LED

L7 (red) is controlled by the HW Stop function. When it flashes it is indicating that the switch is closed and the HW Stop Function is not blocking the Frequency Converter.

If L7 (red) is on constantly, it is indicating that the Frequency Converter has been blocked by the HW Stop Function, and that it will not be able to continue until the Supply Voltage has been removed long enough for the Frequency Converter to completely turn off and on again.

Error LED

If an error is detected, the circuit will indicate the error by turning on L2 and stop flashing with L1.

L3 will start to flash a number of times with a pause at the end, indicating a error number. See table below for error description.

At the same time the modbus registers 5, 9 and 10 will be set to a value corresponding value to indicate the error. Modbus input register 11 will be set if the frequency converter is unable to restart and resume operation. The following errors will be indicated by LED3 and the modbus input registers 5, 9 and 10:

MCE Error Input Reg 5 [L3 flasches & Value]	ErrorCode Input Reg 9 [Value]	ErrorCode2 Input Reg 10 [Value]	Error type Description
1	4096	0	EEPROM initializing error
2	256	0	System Fault Error
3	1024	0	Position lost
4	0	1	Temperature max shutdown
5	0	0	Reserved.
6	0	16384	Modbus Heartbeat alarm
7	0	32768	HW-stop Fault detected
8	4096	0	15V out of range fault.
9	4096	0	365V Low fault
10	4096	0	365V High fault
11	4096	0	EEPROM error mode 1 (no valid active motor).
12	4096	0	EEPROM error mode 2 (no valid motor and no valid motor defaults)
13	4096	0	EEPROM error mode 4 (no valid motor defaults)
14	0	0	This error will not be indicated by inverter, but only by addon PCB.
15	256	0	System fault error – output disabling request has been input to the POE0 pin.
16	256	0	System fault error – Outputs have simultaneously become active level.
17	256	0	System fault error – P70 is low.
18	0	0	Special Motor resistor selection error

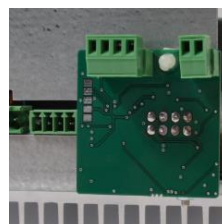
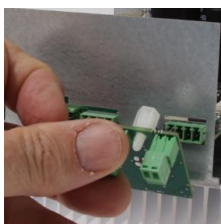
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0-10V Addon PCB

Item number 28615 - SpeedControl 1145 0 - 10V Addon PCB

As already described the SpeedControl 1145 is configured and controlled by ModBus as standard. However, an addon PCB is available which enables the SpeedControl 1145 to be configured with any known motor profile by using the dip-switches and furthermore the drive may then be controlled by a 0-10V signal.

The motor profile for the drive must be selected at the dip-switch before the 0-10V add-on print is mounted in the drive. When the print is mounted there will be access to the clamps shown on the drawing below



Motor Profile	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON

A Small orange LED will flash slowly when there is no error.

If there is an error, the orange LED will flash fast to indicate an error. The number of fast flashing can be counted and translated into an Error. (See chapter “Error and Hardware stop LEDs”)

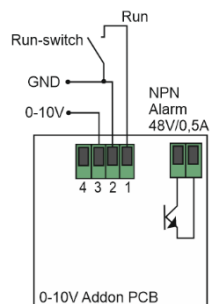
To run motor with 0 – 10V input, the RUN terminal (1) must be shortened to GND (2), otherwise motor will not run. If the shorting between RUN and GND is removed while motor is running, then motor will stop.

0 – 10V input (Vinut):

- For motor to start, 0 – 10V input must be greater than 1,0V.
- 0,0 – 0,5V – Motor will Stop.
- 0,5 – 1,0V – Motor will RUN at minimum RPM (RPMmin).
- 1,0 – 10,0V – Motor will run from Minimum to maximum RPM (RPMmax).

Formula for RPMsig = ((RPMmax – RPMmin) / 9V) x (Vinut – 1V) + RPMmin.
RPMmin and RPMMax is the min and max RPM for the selected Motor Profile.

Alarm output signal is an “NPN - Open collector”.



For more detailed information on 0-10V Addon PCB, see documentation on www.lscntrl.dk under SpeedControl 1145.

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Selecting Motor Profile

For the SpeedControl 1145 to operate smoothly and effectively the compressors data of the specific compressor must be entered correctly into the Frequency Converter. To ease this task, a number of motor profiles are already, ready for use and can be selected by ModBus setting or via a small 0-10V addon PCB, which enable motor selection to be done by dip-switch setting and also enable the drive to run using a 0-10V signal. See chapter on “0-10V Addon PCB”. For already supported compressors and motor profiles, see list in spreadsheet at www.lscntrl.dk under SpeedControl 1145.

First part of spreadsheet lists the already known and tested compressor with by manufacture and modelnumber. In this list it can be possible to find your compressor and use the indicated Motor Profile.

Motor List Page 1/1

Manufacturer	Compressor	Motor Profile	Dip - Switch	Classification	DB Ver.	Profile date	From Software	Te
Hitachi Highly	WHP04000ARKQA6JT6	0	0000 0000	A	1	0418	3,25	
Hitachi Highly	WHP04200ARKQA6JT6	0	0000 0000		1	0418	3,25	
Hitachi Highly	ASD102RKQA6JT6B	0	0000 0000	A	1	0418	3,25	
Hitachi Highly	WHP04200VRKQA7JT6	0	0000 0000	A	1	0418	3,25	
Hitachi Highly	WHP03700PRKQA6JT6	0	0000 0000		1	0418	3,25	
Hitachi Highly	BSA8045D-A3BUA	1	0000 0001	A	1	0418	3,25	

Second part of the spreadsheet lists the motor profiles and the parameters that they are created by. If your compressor is not listed in first part, then look in this part and see if there is a profile, where the parameters correspond with your compressor.

Motor Profiles Page 1/2

Value	Unit	Profile 0	Profile 1	Profile 2	Pr
From database Ver.	Version	1	1	1	
Profile Date	WEEKYEAR	1018	1018	1018	1
From Software version *1	Version	3,25	3,25	3,25	3
Tested on	1002/1145/both	1145	1145	1145	1
DIP - switch	0 = OFF, 1 = ON	0000 0000	0000 0001	0000 0010	000
Pol Pairs	[pol pairs]	3	2	2	
Max. Start Current	[Arms]	4	3	4	
Max. Run Current	[Arms]	8	5	8	
Stator resistance	[Ohm] pr. winding	0,934	1,36	1,02	
Inductance (Lq) (Lq <= 2xLd)	[mH]	12,2 @6A	9,93 @5A	20,6 @5A	5,0
Flux	[Wb]	0,128	0,106	0,749	
Min. Speed	[rpm]	1000	2400	900	
Max. Speed	[rpm]	7200	7200	6000	
Acceleration Speed	[rpm/s]	300	300	300	
Decelerate Speed	[rpm/s]	300	300	300	

See Holding register 106, 107 & 108, in the documentation for Modbus Communication at www.lscntrl.dk under SpeedControl 1145, for how to select a Motor Profile. It is always the responsibility of the customer to perform a full test at site to ensure that SpeedControl 1145 works well under any anticipated conditions in the specific application. If there isn't a Motor Profile that matches the compressor then a new Motor Profile must be tuned to a fit the new compressor. The SpeedControl 1145 may be tuned in the field at site by a technician in cooperation with LS Control support department.

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Tuning a new motor profile

It is important to contact LS Control in case the SpeedControl 1145 is to be used with a compressor type which is not on the spread sheet. In conjunction it is decided on how to proceed. This tuning can be done online in connection with customers setup or done at LS Control.

Tuning at LS Control

When a tuning must be done at LS Controls facilities, the customer must ship the compressor to LS Control. Upon arrival at LS Control, the compressor will be mounted in one of LS Controls Test-setups. Then a tuning of the new Motor Profile will be done. The new Motor Profile will be added to the software of the SpeedControl 1145. Atlast a SpeedControl 1145 with the new Motor Profile will be shipped to customer.

There will be a fee for this tuning. Contact LS Control for information on fee.

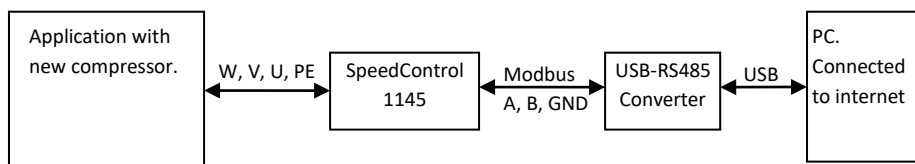
Tuning online

An online tuning will be done by a employees of LS Controls support department and a small fee will be charged for this task.

Customer must have a PC with internet connection at site. When there is a PC with internet connection at site, LS Control can ship a USB-RS485 converter to site (credited upon returned to LS Control after tuning).

Customer preperations.

Connect the SpeedControl 1145 to the compressor in the application. Make sure not to connect the power supply, the 0-10V Signal print or any other parts must not in any way be connected to the ModBus interface no matter if it should be part of the final application. Then connect the PC to the SpeedControl 1145 using the USB-RS485 converter.



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Call the LS Control Support.

LS Control will take over the PC and run a test procedure via the 'TeamViewer'. A customer technician must be available at site during the tuning to turn on the power supply and to increase and decrease the load on the drive. When the USB-RS485 converter is received and the 'TeamViewer' program has been downloaded and installed to the PC to be used, an appointment between the Technician at site and the LS Control Support department is made.

A "Teamviewer" support program can be downloaded from LS Controls homepage.

Link : www.lscontrol.dk/en/about-us/support/

Click on the Teamviewer picture (LS Control support) to the right in the page and install it.



When the test procedure is completed successfully the drive has been tuned to this specific compressor model. The Customer is now able to continue their own testing of the entire product / application using either ModBus or connect the 0-10V Addon PCB and test using a 0-10V signal.

In the meantime, at LS Control, the compressor model and motor will be given a profile number within the software for all future produced SpeedControl 1145s to include this profile, making it able to run with this specific compressor model, only by selecting the profile number in the Modbus register or setting the dip-switch on the 0-10V Addon PCB to the profile number of the specific compressor model.

Please note. Any stock of the SpeedControl 1145 delivered prior to the tuning must be returned to LS Control for software update before including the new compressor model or it may be updated manually by an employee of LS Control support department over a teamviewer session, like the tuning process. A fee will be charged for updating existing SpeedControl 1145.

Declaration

The product complies with the requirements of the EMC directive 2014/30/EU, the Low Voltage Directive 214/35/EU and the RoHS Directive 2011/65/EU and carries the CE-marking:



WEEE

Electrical and electronic equipment contains material which may be hazardous to human health and environment if it is not handled correctly at disposal.

Electrical and electronic equipment is marked with a crossed/out bin logo. This logo symbolizes that electrical and electronic equipment must not be disposed together with normal household waste but must be collected separately.



Contact your local authorities for further information on disposal of equipment under the WEEE directive.