Frequency Converter
SpeedControl 1045

PMSM and BLDC

Date: 20/7-2021
Revision: 10
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Product Description

SpeedControl 1045 is a frequency converter for control of EC, PMSM, BLDC and standard asynchronous motors up to 1500W/5.5A or 2000W/6.5A for 3 phase motors with single phase supply. SpeedControl 1045 is enclosed in an IP 54 metal housing for demanding environments. The compact construction offers many mounting options. The construction is not equipped with active cooling, the sound level is very low and the frequency converter is maintenance free.

- Descrete light grey color for reduction of heat absorption.
- Silent and reliable with an advanced self protection feature.
- Provided with a user-friendly interface for quick and easy installation.
- Designed for use in many different applications, including pump, ventilator and compressor applications. Depending on motor profile.
- For special applications, please contact us for further information.

Considerations if used with compressors

For each compressor, the compressor data from the manufacturer datasheet are hard wired into the frequency converter software by LS Control. The specific compressor is selected by means of dip switches. Since the compressor parameters change with changing loads, LS Control must carry out a perform test on each individual compressor to select the best parameters covering the widest range of operating patterns ensuring that the compressor will be able to operate at high loads as well as low loads. The result of the performance test will give a new max. current and new max. RPM for correct operation of the compressor in question.

Rule of thumb! When using a compressor with a frequency converter, make sure that the input power to the compressor is below the maximum power of the frequency converter and that the frequency converter can deliver the required current for the compressor.

Application considerations with 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.

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

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

Technical Specifications

	E1045-1500W-5.5A	E1045-2000W-6.5A
Supply Voltage	Uin = 230VAC ±10% - 50Hz	Uin = 230VAC ±10% - 50Hz
Supply Current	Max. Iin = 10A	Max. Iin = 16A
Supply Power	Max. 1500W	Max. 2000W
Motor Voltage	3 x AC - 0 - Uin	3 x AC - 0 – Uin
Motor Current	Max. 5,5A	Max. 6,5A
Motor Frequency	0 – 300 Hz	0 – 300 Hz
16Vdc output	100mA	100mA
10Vdc output	30mA	30mA
0 – 10V input	0 – 10V, Ri = 7 kOhm.	0 – 10V, Ri = 7 kOhm.
Alarm Relay	Max. 30Vdc/3A & 230VAC/3A	Max. 30Vdc/3A & 230VAC/3A
Operating Temperature	0 – 40°C	0 – 40°C (active cooling over 1650W)
Modbus A	Net plus	Net plus
Modbus B	Net minus	Net minus
Modbus C	Net GND	Net GND

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.

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 frequency converter is taken into use, verify that the frequency converter specifications are compatible with the mains to which it is going to be connected. Furthermore verify that the motor is suitable for frequency converter connection and that it is in compliance with the frequency converter specifications. Check the place of installation for any special requirements and precautions which must be observed during installation, commissioning or operation. The frequency converter must be supplied through a mains switch with at least 3mm breaker space between all conductors according to IEC364. The fuse installed in the electrical switchboard must be 13A or less for E1045-1500 and 16A or less for E1045-2000. The frequency converter must always be connected to yellow/green grounding conductor (PE) in supply. If the frequency converter is connected to an installation with a residual current device as an extra protection, the device must be marked with 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 control unit (connection 1-15) is isolated from the mains potential.

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 control I / O terminals are isolated from the mains potential (clamps 1 – 15). However, dangerous control voltage may be present at the relay output terminals (9, 10 and 11) even when the frequency converter is disconnected from mains.

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.

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 5 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.

Note! 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.

Description of Functions

Supply

The frequency converter is supplied by 230VAC ±10%. However it is possible to lower the voltage, but it must be noted, that the power of the asynchronous motor will be lowered as the main supply voltage decreases. It is not recommended to use a supply less than 200VAC.

Control Voltage

1 – 10 Vdc = min. rpm – max. rpm (6 phase motor => 200rpm – 1000rpm => 10 – 50 Hz). If control voltage gets lower than 1 Vdc the frequency converter will run min. rpm. The control voltage levels can be adjusted via the Modbus-interface. (See chapter on Modbus).

RUN input

If the RUN input is activated (added to GND from internal supply) the frequency converter will start the motor. The RUN input can be disabled through the Modbus-interface. (See chapter on Modbus).

DIR Input

DIR controls which way the motor will run and it can only be updated/changed when the motor is not running. If the DIR input is activated (added to GND from internal supply) the frequency converter will change direction, but only when the motor is at a stand still.

LSC Input

The LSC input can be used with a thermal switch (e.g. a Klixon) or a thermistor. By default it is setup for use with a thermal switch. This can be changed via the ModBus-interface. (See chapter on Modbus).

Thermal switch

If LSC input is used with a thermal switch (e.g. a Klixon), connect thermal switch between connector 1 & 2. When the thermal switch is closed = all is okay. If thermal switch is open for more than 6 seconds a thermal Error is indicated, and motor is stopped. **If thermal switch is not used, connector 1 & 2 must be shortened.**

Thermistor

If the LSC input is used with a thermistor, connect the thermistor between connector 1 and 2. The function of the thermister is setup via the ModBus-interface (see chapter on Modbus). When the thermistor exceeds the setup temperature for more than 6 seconds, a thermal error is indicated, and the motor will stop. The E1045 will try to restart, when the thermistor has fallen below the setup temperature minus the hysterese value for more than 6 seconds. The thermistor function can be setup for a NTC thermistor or a PTC thermistor via ModBus interface. See the ModBus chapter for setup details.

Alarm Relay

The frequency converter is supplied with an alarm relay which is activated when there are no faults. If the frequency converter must stop due to severe error, the relay will be deactivated (it changes position). The alarm relay is deactivated when supply is disconnected. The function of the alarm relay can be changed via the Modbus-interface. (See chapter on Modbus).

HW 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 16 and 17, 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 16 and 17 must be shortend.

Current Limits

Current limits can only be adjusted via the Modbus-interface. (See chapter on Modbus). The current limits are as standard set to the current printed on the motor plate. When the frequency converter registers that the current limit is exceeded, it will automatically reduce the speed of the motor. However, the speed will never be reduced further than minimum speed. In ACIM the down regulation function can be deactivated, and the motor will stop if the current exceeds the current limit. The time delay before the motor stops depends on the current and the overrun time which are integrated into the intelligent protection algorithm in the control.

Temperature

The temperature function is set to ensure that if the frequency converter power unit registers an excess temperature it will reduce the motor speed. However, the speed will never be reduced further than the minimum speed. The motor speed reduction will be slow. Should the temperature continue to increase, despite the speed reduction, the frequency converter will stop and indicate error. The temperature reduction function is part of the intelligent protection algorithm. The temperature setting for where the frequency converter should start to reduce the speed can be lowered by means of the Modbus-interface. (See chapter on Modbus).

Skip areas

It is possible to enter up to 5 skip areas via the ModBus-interface. These skip areas may be used to avoid RPMs where the application generates excessive noise or vibration. These areas are avoided in that the skip frequencies in a given area automatically will be passed by the frequency converter, and in that way avoiding noisy and vibrating operating frequencies. All skip areas is equipped with the same hysteresis value defined by a preset distance from the RPM center. This distance determines how far away the frequency converter needs to adjust the speed from the entered center RPM. See chapter on ModBus for detailed description on how to adjust these skip areas. By default, they are all disabled.

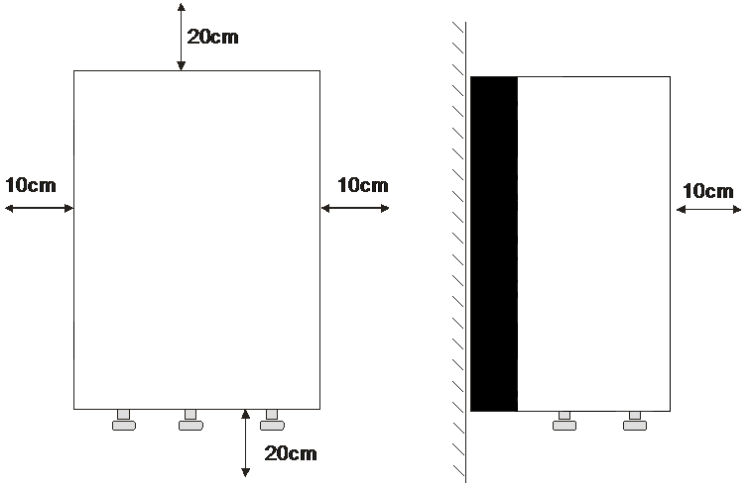
Electrical / Mechanical Installation

Important

A time delay of approx. 3 - 30 sec will occur at start up. If the PCB is dismounted 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 5 min.

Location

The frequency converter is cooled by passive 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.



Operating temperature

The frequency converter must be installed in a well ventilated enviroment. The surrounding temperature must not exceed 40°C and the frequency converter must never be mounted in a location where it is exposed to direct sun light.

The E1045-1500 will be able to run at maximum supply power without additional cooling at 40°C ambient temperature.

The E1045-2000 will be able to run up to 1650W supply power without additional cooling at 40°C ambient temperature. When running at more than 1650W power supply the E1045-2000 will need additional cooling. This should be done by making sure that there is a sufficient airflow through the cooling fins of the heat sink.

The frequency converter will reduce performance of the motor, if a too high temperature is measured. By default, this temperature is set at maximum, but it can be adjusted down through the ModBus – interface.

Supply

The frequency converter is supplied by mains (230VAC ±10%) with minimum 3 x 1.5 mm2 cable. The distance between supply cable and motor cable must be as long as possible (> 30 cm). If it is neccessary to cross the power cable and the motor cable, this must be done at an angle of 90°. The PE-conducter from the motor, which is screwed into the terminal block, must be longer than L and N. The fuse installed in the electrical switchboard must be 13A or less for E1045-1500 and 16A or less for E1045-2000.

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 conducter should be as short as possible to avoid high frequency radiation.

Supply Connection

PE	Protective grounding (supply)
N	Neutral (supply)
L	Live (230VAC) (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 be mounted correctly in the metal gland or to the PCB with a cabel clamp 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
U	Motor Conductor U
V	Motor Conductor V
W	Motor Conductor W
Shield	Grounding from gland

Signal Cables

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.

Signals

1	GND
2	LSC – Thermo switch/thermistor
3	DIR
4	RUN
5	GND
6	0 - 10V in
7	10Vdc out
8	16 to 16,5Vdc out

Alarm

9	NO
10	Common
11	NC

HW Stop Switch

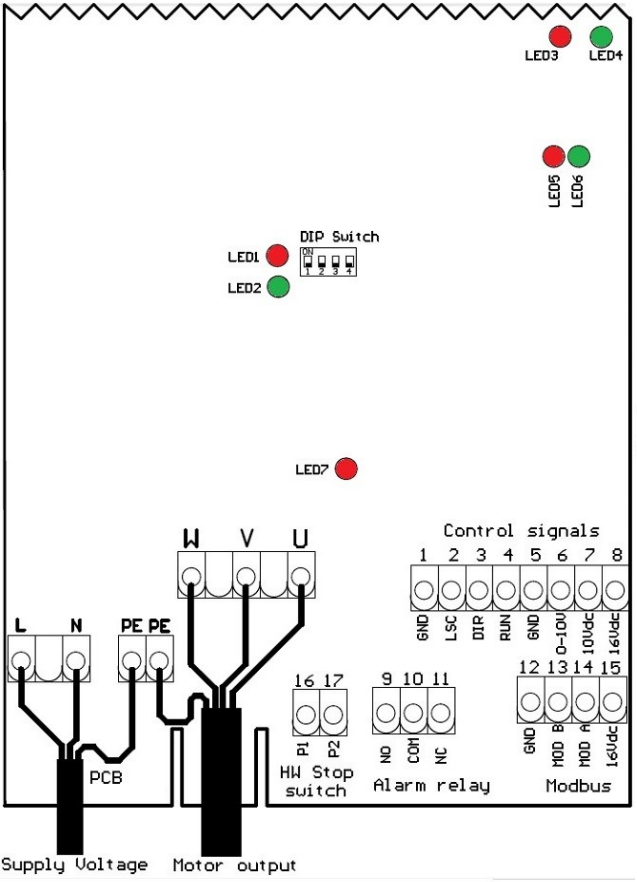
16	Switch
17	Switch

Modbus

12	GND
13	Modbus B
14	Modbus A
15	16,5Vdc out

Mounting

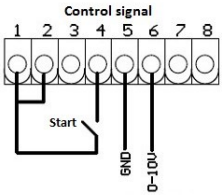
Mounting instruction for ES1045D PCB



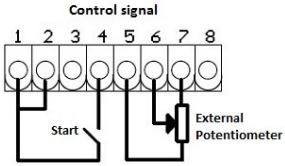
Note:
If thermal switch is not used shorten connector 1 & 2.

If the thermistor is needed connect to connector 1 & 2 and setup through ModBus for thermistor use.

If HW Stop Switch not needed shorten connector 16 & 17.



External input signal



Indicator Lights

The PCB is equipped with LED lights. LED1 to LED7.

Modbus LED lights

LED5 (red) and LED6 (green) are modbus LED lights. See page ”10” for LED locations.
LED6 flashes fast when communicating.
LED5 has no function.

Motor LED lights

LED1 (red) and LED2 (green) are controlled by the circuit regulating the motor.
See page ”10” for LED locations.

Start

When the frequency converter is connected to mains, the following pattern is shown:

1. LED1 is turned off and LED2 is lit constantly => processor initialization
2. After 5 – 10 seconds LED1 flashes a number of times to indicate the motor selected by the DIP switches. This also indicates that the motor in questions has been initialized in the processor.
3. At last LED1 turns off and LED2 starts flashing.

Operation

When there are no errors LED2 will be flashing. LED2 flashes when the motor is running and when it is stopped. This indicates that everything is running normally.

Errors

If an error is detected, the frequency converter will stop the motor, turn on LED1 and turn off LED2.

HW Stop Function LED lights

LED7 (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 LED7 (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.

Controller LED's

LED3 (red) and LED4 (green) are controlled by the interface circuit controlling the I/O's.
See page "10" for LED locations.

Start

When the frequency converter is connected to mains, the following pattern is shown:

1. LED3 turns on and LED4 flashes fast.
2. After 5 – 30 seconds (when the power electronics has been initialized and indicated the motor choice), LED3 will turn off and LED4 will flash slowly.

Operation

When there are no errors LED4 flashes slowly and LED3 is turned off. This pattern is shown both when the motor is stopped or running. It indicates that everything is running normally.

Restart

When an error is detected, and the frequency converter is waiting to restart, LED3 and LED4 will be flashing at the same frequency. When restart is activated, a new start is initialized.

Errors

If an error is detected, the circuit will indicate the error by flashing LED3 and turn off LED4. At the same time the modbus registers 03x0009 and 03x0010 will be set to a value corresponding to the error. Modbus-register 03x0011 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 registers 03x0009 and 03x0010:

Flash LED3	03x0009 Error code	03x0010 Error code2	Error type Description
1	0	1	Maximum Temperature error. Have not been able to adjust motor, to prevent over temperature.
2	0	2	Motor Start Error. Have not been able to start motor.
3	0	4	Motor current error 1. Current limit exceeded for more than 4 minutes.
4	0	8	Motor current error 2. Current limit x 1,25 exceeded for more than 2 minutes.
5	0	16	Motor current error 3. Current limit x 1,50 exceeded for more than 1 minutes.
6	0	32	Motor current error 4. Current limit x 2,00 exceeded for more than 10 seconds.
7	256	0	Motor gate kill error. High current peak detected.
8	1024	0	Motor phase loss error.
9	2048	0	Motor zero speed error.
10	4096	0	MCE error. This includes: over voltage, undervoltage, regulating error, etc.
11	32768	0	Thermal error. Thermal switch is open or thermister is indicating too high a temperature.
12	16384	0	Modbus Heartbeat Error
13	8192	0	Motor Selection Error
14			
15			
16			
17			
18			
19			
20			

FAQ

No LEDs are on and the motor will not start.	1.) Check if the frequency converter is connected to mains 2.) Check if fuse is blown.
The motor will not start and LED7 is on	If hardware stop switch is not in use, terminals 16 and 17 must be shortened.
The motor will not start and LED3 flashes (11 times)	If LSC input is detecting an error. By default, LSC input is setup for connection of a thermal switch, and if it is not used, terminals 1 and 2 must be shortened.

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 wheelie bin logo. This logo symbolizes that electrical and electronic equipment must not be disposed of 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.