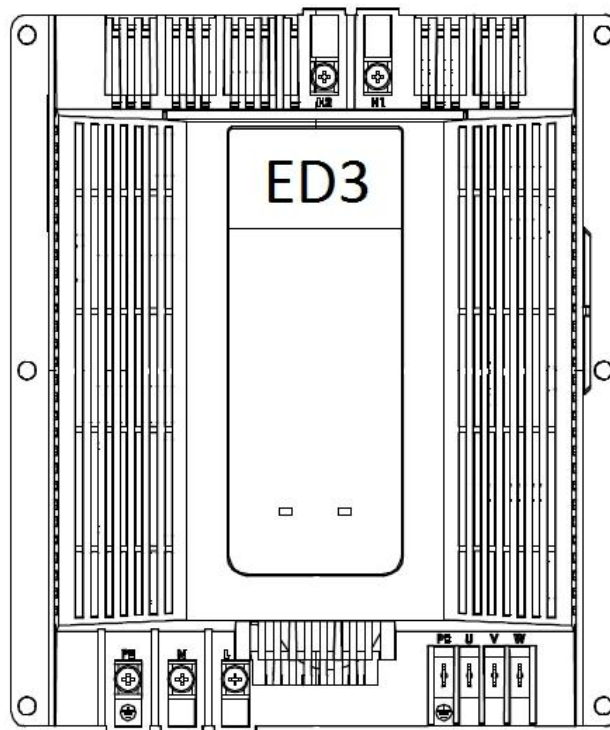


ED3

Variable Speed Drive

Dedicated for Emerson Copeland Branded Scroll Compressors

User Manual



ED3011A(U), ED3015A(U), ED3020A(U)
ED3013B(U), ED3018B(U), ED3022B

Ruking Emerson Climate Technologies (Shanghai) Co., Ltd.

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1 SAFETY INSTRUCTIONS

This product operates at hazardous voltages which can cause severe damage to people and things. Be extremely careful and take necessary precautions when handling the product.

In this publication, the safety warnings are classified into four types based on the risk and nature of damage which can occur if the warnings are neglected.

Explanation of used symbols	
	Possibility of electrical shock. May cause severe injury or death!
	General warning about a possibility of non-electrical damage or injury. Take necessary protections to avoid injury!
	General warning about risk of burning on hot surfaces to avoid injury!
	General warning about risk of explosions to avoid injury!

Safety risks (Read carefully!)	
	After disconnecting power, wait 10 minutes before removing the enclosure. Before operating and maintenance work always check that all voltages at the terminals are zero or at levels which are harmless.
	Always make sure the compressor has stopped completely before removing the drive enclosure. As soon as the drive is connected to the power supply the input terminals will be at line voltage even when the compressor is not rotating.
	Do not measure insulation resistance or dielectric rigidity directly via the input terminals with power supply connected.
	Review relevant safety standards concerning installation of high voltage devices, as well as the regulations for the correct use of the personal protective equipment.
	The drive can only be used for purposes specified by the manufacturer.
	This product can cause beside AC also DC leakage currents. To protect against direct and indirect touching a residual current operated protective device (RCD) must be used on the power supply side. Only AC/DC-sensitive current circuit breakers are usable.










	Do not make any modifications or replace any components as these actions may lead to consequences including but not limited to fire and electric shock and will void the warranty. Product modifications are not allowed. The manufacturer is not responsible for any unauthorized modifications made to the product by the users.
	A proper earth connection of the drive must be ensured to avoid risk of electrical shock.
	The IP20 protection is only given after all terminals are connected with isolated ring and isolated blade terminals!
	In special cases of using the drive without the IP20 enclosure, which is in general forbidden, the protection against direct and indirect touching must be part of the system design to avoid any risk of electrical shock!
	DC-/AC-Chokes must be covered on system side to avoid any risk of electrical shock!
	Use safety shoes to avoid foot injury. Handle the drive carefully.
	Protect the drive from dust. During the installation make sure to clean off the debris arising due to drilling. Remove any conductive debris inside the drive which can cause damage or malfunction.
	Before touching the heat sink or unpowered chokes, make sure that the temperatures are within the safe limits to avoid burn injury.
	In general, the drive cannot be used in an environment where a direct contact with flammable or explosive substances can occur. Furthermore, the usage in a trans critical system isn't allowed. For the usage with flammable refrigerants for dedicated system standards please read the related information's in this chapter of the guideline very carefully.

Table 1: Safety instructions

1.1 Intended use in general

This product is foreseen to use in HVAC/R systems and can only be installed, operated or maintained by an electrically qualified person with additional system related expertise. Please contact the manufacturer for support immediately if the user is uncertain with any safety-related issue.

1.2 Intended use w/ flammable refrigerants



The usage in systems with flammable refrigerants is limited to systems which are based on the IEC 60335-2-40:2018-05 and EN 60335-2-89:2018-10 standards. The Table 2 shows which kind of drive type has to be used based on the system standard and the used refrigerant.

System standard	Refrigerant	Type of drive	
		1-Phase	3-Phase
IEC 60335-2-40 Edition: 2018-05	A1	ED30xxA	ED30xxB
	A2L ¹	ED30xxA	ED30xxB
	A1, A2L, A3	ED30xxAU	ED30xxAU
EN 60335-2-89 Edition: 2018-10	A1	ED30xxA	ED30xxB
	A1, A2L, A3	ED30xxAU	ED30xxBU

Table 2: Type of drives for flammable refrigerants

Systems which are using flammable refrigerants A2L and A3 need to consider following bullet points in order to use ED3 drives:

- The drive mounting area must be in **Zone 2** or outside of any ATEX zone and in line with **“Pollution Degree 2”**
- No airstream guided over the electronics.
- Ensure that the airstream over the heatsink doesn't influence the environment of the drive (Keep pollution degree 2).
- No condensation under normal operation.
- Ensure that the cool plate for flat plate versions doesn't create condensation inside of the drive!
- The IP class of the drive mounting area must be in line with the system standard.

 	<p>ED3 drives are not designed and qualified based on the ATEX directive! The version with the extension U just fulfills the requirements of the mentioned system standards with the usage of flammable refrigerants.</p>
--	--

2 INTRODUCTION

The ED3 inverter drive has been developed specifically for Variable Speed Compressors with permanent magnet synchronous motors. The drive will power the compressor, control the compressor running speed, provide compressor and drive protection and communicate with the master controller. The drive requires cooling and is typically installed in a system near the compressor.

2.1 Drive Highlights

At a glance:

- Control of Emerson Copeland branded variable speed compressors (i.e. XHV, XPV, ZBV) in residential and commercial environments
- Easy selection of pre-matched and tested drive compressor combinations via code
- Special envelope related overload protection
- Compressor crankcase heater functionality
- Operation ambient temperatures -20 to 60°C
- Controllable via RS485 and Modbus® RTU
- Changeable pre-selected Modbus address
- Automatic baud rate detection (9.600/19.200)
- Designed and qualified based on EN 60335-1
- Safety Input to wire a high-pressure limiter
- Discharge line temperature sensor input (DLT)
- Active power factor correction for 1-Phase drives
- Integrated EMI-Filter
- Inrush-Current limitation
- Rated currents @60°C
- Air- and Liquid-Cooling drive versions available
- Enclosure with integrated gasket to mount the heat sink outside the panel
- Speed-Drop Protection Mode for increased system stability
- Ready for the usage with flammable refrigerant for dedicated systems (“U”-version).

¹ Mainly based on Annex JJ of the IEC 60335-2-40

2.2 Models

Drives identified by the additional character “U” are qualified for the usage with flammable refrigerants. The functionality and size are identical.

Table 3, Table 4, Table 5 and Table 6 provide technical information about different available drive models, respective DC- or AC-Chokes and the cooling options for each drive.

2.2.1 Voltage, Current and Power Range

Drive Model	Power supply 50/60Hz	Maximal input current @60°C	Maximal output current @60°C	Power Range "Reference" @230/400V
ED3011A(U)	1~ 200 to 240VAC	13A	11A	2.6kW
ED3015A(U)	1~ 200 to 240VAC	22A	15A	3.8kW
ED3020A(U)	1~ 200 to 240VAC	26A	20A	5.5kW
ED3013B(U)	3~ 360 to 440VAC	9A	13A	4.4kW
ED3018B(U)	3~ 360 to 440VAC	12A	18A	6.0kW
ED3022B	3~ 360 to 440VAC	20A	22A	8.8kW

Table 3: Voltage, current and power range

Attention: The power range in Table 3 is to consider as an indication depended on the system design and the compressor motor. The rated voltage to run Emerson Copeland XHV/XPV Compressors in the full dedicated envelope and to pass EN60335-2-34 testing's is 230VAC for single and 400VAC for three phase drives.

2.2.2 Cooling Versions

Drive Model	Fan cooling	Flat plate	Heat sink Horizontal	Heat sink Vertical
ED3011A	N/A	√	√	N/A
ED3011AU	N/A	√	√	N/A
ED3015A	N/A	√	√	N/A
ED3015AU	N/A	√	√	N/A
ED3020A	N/A	√	√	N/A
ED3020AU	N/A	√	√	N/A
ED3013B	N/A	√	√	N/A
ED3013BU	N/A	√	√	N/A
ED3018B	N/A	√	√	√
ED3018BU	N/A	√	√	√
ED3022B	√	√	√	√

Table 4: Cooling versions

2.2.3 Accessories (DC- / AC-Chokes)

Drive Model	Choke Model	No. of Chokes	Electrical Parameters
ED3011A(U)	R2050RJL	1 x DC	5.2mH ±10%, 20A
ED3015A(U)	R2050RJL	1 x DC	5.2mH ±10%, 20A
ED3020A(U)	R2550RJG	1 x DC	5.0mH ±10%, 25A
ED3013B(U)	LE105-1325	3 x AC	25mH ±10%, 13A
ED3018B(U)	LE105-1325	3 x AC	25mH ±10%, 13A
ED3022B	LE85.8-2502	1 x DC	2.0mH ±10%, 25A
Safety Protection: IP00, Class 0 / Temperature Class: H			

Table 5: DC- / AC Chokes

2.3 Advanced Technical Information

Storage Temperature	-40 to +85°C
Operating Temperature	-20 to +60°C
Humidity	5% to 95% rH non-condensing
Altitude	Max. 2.000m above sea level
Ambient vibration	10~60Hz 0.15mm displacement, 60~150Hz 2g acceleration; No failure;
Pollution degree	2
Drive Enclosure Protection	IP20
DC/AC Choke Protection	IP00
Communication	RS485 Modbus® (RTU) Baud Rate 9.600/19.200 Slave ID: 45
Sensor Input	Discharge Line Temperature DLT / NTC 10kΩ
Safety Torque Off Input	Foreseen to connect a safety high-pressure limiter
Efficiency	1-Phase: up to 94% (PFC ON) 3-Phase: up to 96%
Power Factor	1-Phase: ~0,98 with PFC ON 3-Phase: ~0,90 load dependent

Table 6: Advanced Technical Information

2.4 Conformity to Directives and Standards

ED3 Drives are designed and developed especially for the European residential and commercial market based on applicable European directives. The design is qualified by main safety standard EN 60335-1 (Safety for household and similar electrical appliances).

The drive for the usage with flammable refrigerants and identified with the character “U” like shown in Table 7 is qualified for the usage in system which are in line with the standards shown in Table 2.

To meet the EMC Standards EN 55014-1 and EN 55014-2 external ferrites are needed, especially on the motor cables. Recommended ferrites are shown in the installation part of this guideline.

The drive models from ED3011A to ED3020A with the related DC or AC chokes are complaint with the standard EN 61000-3-2. Whereas the model

ED3022B complies with the standard EN 61000-3-12, with one DC-Choke. Further system related requirements for compliance with the above-mentioned standards are mentioned in the installation part of this guideline.

2.5 Identification

The rating plate on the drive indicates information of the drive, including model, serial number, rated input and output, and certificate approval.



Figure 1: Rating plate

Version legend:

- Ver.: AAA/BBB/CCC
 - AAA: Hardware version
 - BBB: Software version
 - CCC: EEPROM version

It is advised to confirm the rating plate before installing or operating the equipment.

2.6 Nomenclature

Table 7 explains the nomenclature for the drives.
Position 5 differentiates between A1/A2L and A3 drives by the character U.

Example of a Nomenclature									
ED	3	018	B	U	-	H	2	-	B
1	2	3	4	5		6	7		8
Pos	Definition								
1	Name of the drive product family								
2	Drive generation								
3	Max. output currents [A] @ 60°C								
4	A: 1-Phase Drive B: 3-Phase Drive								
5	W/o identification: A1 / A2L version U: Version for A3 flammable refrigerants for dedicated standards (See chapter 1.2)								
-									
6	A: Vertical heatsink with integrated fan(s) F: Flat Plate (Liquid Cooled) H: Horizontal heatsink V: Vertical heatsink								
7	0: Without enclosure (IP00) 2: With enclosure (IP20)								
-	X: Sample or Production Pilot - : Released mass production version								
8	Version Index technical updates A: 1st released version B: 2 nd released version • HW: Identical to 1 st released version • SW: Added OneEmerson Modbus Map								

Table 7: Nomenclature

3 INSTALLATIONS

3.1 Handling

- Correct handling and storage of the drive is essential in preventing mechanical damage.
- Box and the protection bag inside the box needs to be carefully opened. Do not use any sharp object to open the protection bag or cut across the drive.
- Once opened don't stack the drives on each other.
- Don't use chemicals, solvents to clean the drive
- Do not drop any mechanical tools on the drive
- Check that the cooling slots and heat sink are free of dust to guarantee a good cooling.

3.2 Terminals and LEDs

Table 8 and additional illustrations explaining the function and location of the drive terminals and LED's.




A	Power input terminals: 1-Phase: L / N / PE  3-Phase: L1 / L2 / L3 / PE 
B	Compressor Terminals: U / V / W / PE 
C	H1 / H2 Terminal <ul style="list-style-type: none"> • ED3011A(U), ED3015A(U), ED3020A(U) & ED3022B: Terminal to connect DC-Choke • ED3013B(U), ED3018B(U) – N/A
D	Control terminal: 1: DLT / Discharge Line Temp. Sensor NTC 10k 2: 5V / 5VDC Powering the DLT Sensor 3: STO / Safety Torque Off (High-Pressure Switch) 4: 5V / 5VDC STO (Powering the High-Pressure Switch) 5: B / Modbus Data Channel B (Physical RS485) 6: A / Modbus Data Channel A (Physical RS485) 7: GND / Modbus Ground (Physical RS485) 8: 5V / 5VDC optional for the RS485 communication 9: 12V / Foreseen to power an external analog board
E	Reserved
F	Service port for updating software with a special tool
G	Power LED (Red)
H	Signal LED (Green)

Table 8: Terminals and LED's

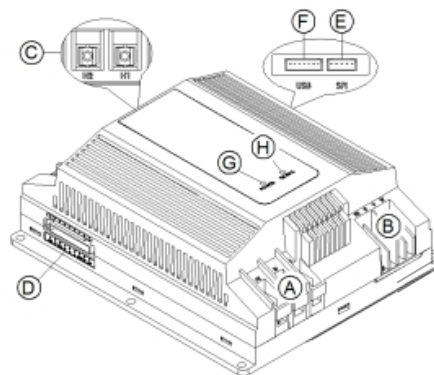


Figure 2: ED3011A(U), ED3015A(U)

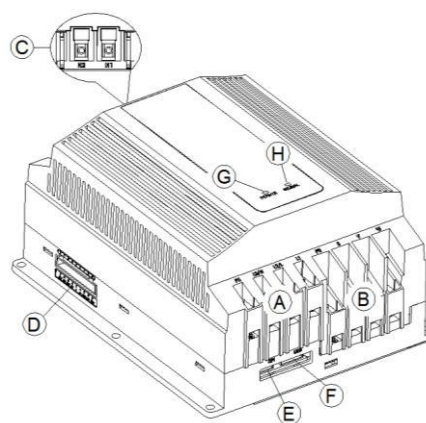


Figure 3: ED3020A(U), ED3013B(U), ED3018B(U)

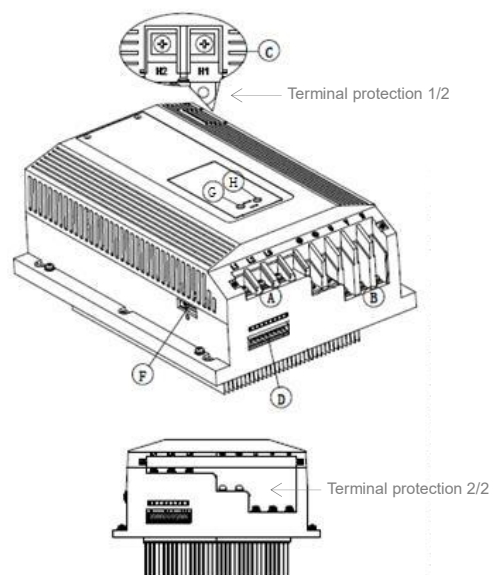


Figure 4: ED3022B

3.3 Mounting

The drive should be located as close to the compressor as possible, preferably within 1 meter of the compressor. To avoid electromagnetic interference please ensure that the motor cables do not cross or attach to any other connecting cables.

Air-cooled drives are supported inside the HVAC system by an extended heatsink plate. The plate mounts, except the model ED3022B-A2 with integrated fans, through an opening in the cabinet sheet metal to expose the heatsink to the condenser or evaporator fan air stream of 3m/s. The flange contains a gasketed surface to prevent water from entering the electronics side of the control box.

Inside the cabinet should be at least a natural air stream around the drive to keep the temperature less than 60°C.

The flat plate option accommodates installation to systems using the mating gas or liquid cooled cold plate heat exchanger. The mating cold plate is designed by OEM to accommodate the system design.

There are holes in the drive mounting flange for mounting purposes. These holes will accommodate a M5 sized screw for mounting (see advanced mounting instructions in the appendix).

The drive should be positioned in a way that the input and output terminals are on the bottom side. Refer to the chapter 9.1 for further information.

Attention: Please take care on the maximum screw torque to avoid any damage on the plastic frame!

- M4 screws: 1.1 Nm
- M5 screws: 2.7 Nm

Figure 5 shows the minimum clearances to other components near the drive. To have a better cooling it is recommended to mount the drive in the lower or middle part of the cabinet. Please insure that the drive is mounted in a way to have a possibility of good natural convection.



Figure 5: Minimum mounting clearances

Recommended minimum clearance on the top, bottom, left and right side		
A [mm]	B [mm]	C [mm]
80	50	60

Table 9: Clearance to other components

3.4 Electrical Installation



Please read carefully the safety instructions in chapter 1 and Table 1!

3.4.1 Earth Leakage Protection

In all inverter devices like the ED3 drives, earth leakage current (DC, AC) may occur. To protect against both kind of leakage currents, a AC/DC-sensitive residual current circuit breaker (RCD) must be installed in front of the ED3 drive.

3.4.2 Grid Supply and Compressor Wiring

Figure 6, Figure 7 and Figure 8 show the general wiring to the power grid and to the compressor. These wiring diagrams do not show any system related components like fuse breaker, RCD and the additional ferrites for EMC. Figure 10 shows how to wire control related components like DLT-Sensor, high-pressure limiter and the RS485 serial communication (Modbus®) to the drive.

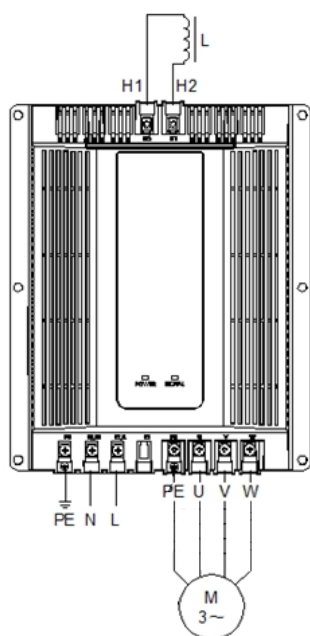


Figure 6: Wiring ED3011A(U), ED3015A(U), ED3020A(U)

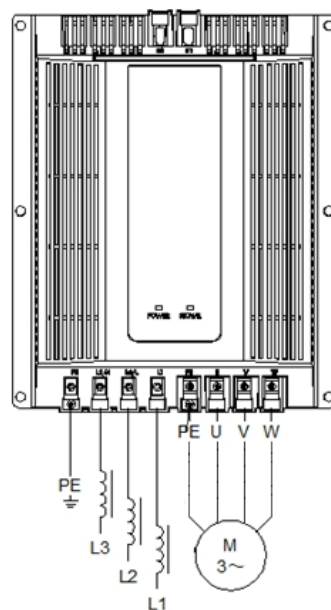


Figure 7: Wiring ED3013B(U), ED3018B(U)

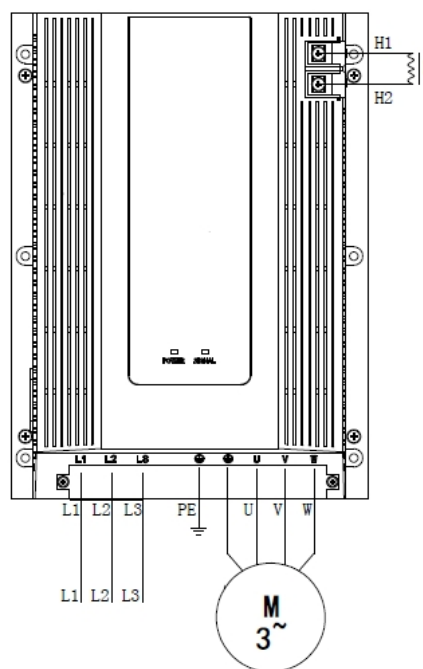


Figure 8: Wiring ED3022B

3.4.3 DC-/AC-Choke Wiring

All the chokes have the protection class of IP00 and temperature class H. To protect against direct touching, they must be covered. The chokes should be installed as close as possible to the drive. The short length of the connecting cables will help in reducing EMI issues. It is recommended to guide an airstream over the chokes for cooling purposes. Each DC-Choke has pre-wired cables with an integrated ferrite. The choke must be connected to the drive terminals H1 and H2 as shown in Figure 6 and Figure 8. One of the mounting holes is provided without varnish. This unvarnished mounting hole serve as the point for system earth connection. The AC-Chokes must be wired in series to the drive input terminals L1, L2 and L3 as shown in Figure 7. Each AC-Chokes has a screw earth terminal for a proper system earth connection.

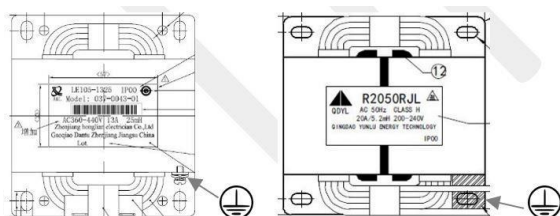


Figure 9: Earthing points of DC-/AC-Chokes

The choke dimensions are shown in the appendix.

3.4.4 Power Grid Connection

Table 10 includes the information to connect the drive to the grid. The max. input current is based on a power factor of approx. 0.98 for 1-phase and approx. 0.9 for the 3-phase models. The ferrites, fuses and cable cross sections should be considered as a recommendation and can be different based on the system design. The connection between the cables and the drive screw terminals should be done with 4mm ring terminals. For the model ED3022B make sure to re-screw the terminal protection after wiring the drive. The terminal protection is required to maintain the IP20 class of the drive.

The usage of isolated ring and isolated blade

terminals is obliged for all terminals to maintain the IP20 class.

Power Grid	1-Phase Grid: 230VAC 50/60Hz (L,N,PE) 3-Phase Grid: 400VAC 50/60Hz (L1,L2,L2,PE)			
Drive-Model / AC-Chokes	Max Input Current [A]	Fuse or circuit breaker @ 30°C ambient	Cable ¹⁾ cross- section @ 60°C Ambient	Usable Ferrite(s) to reduce EMC Noise
ED3011A(U) No AC-Choke	13	16A Type B	2,5mm ²	1 x Würth 74270057 (2 Turns)
ED3015A(U) No AC-Choke	22	25A Type B	4,0mm ²	1 x Würth 74270057 (2 Turns)
ED3020A(U) No AC-Choke	26	32A Type B	6,0mm ²	1 x Würth 74270095 (2 Turns)
ED3013B(U) 3x AC-Chokes 13A/25mH	9	10A Type B	1,5mm ²	N/A
ED3018B(U) 3x AC-Chokes 13A/25mH	12	13A Type B	2,5mm ²	N/A
ED3022B No AC-Chokes	20	32A Type C	4,0mm ²	1 x DMEGC H50x25x20 R7K (3 turns)

Table 10: Connection to the input power grid

¹⁾ Based on: DIN VDE 0298-4 (Conductor temperature 90°C, Laying method E)

For the ED3022B the grid must provide a $R_{SCE} \geq 120\Omega$, together with a system input current of $\geq 16A$ on each phase to be in line with the EN 61000-3-12. All other mentioned drives are in line with the EN 61000-3-2. To connect the ED3013B and ED3018B drive to the grid one AC-Choke must be wired in each line phase.

3.4.5 Compressor Connection

Table 11 shows information on how to connect the drive to the compressor. The selected cables must be foreseen for the usage with drives.

Drive-Model	Max Output Current	Cable ¹⁾ cross-section @ 60°C ambient	Usable Ferrite(s) to reduce EMC Noise
ED3011A(U)	11A	1,5mm ²	1 x Würth 74270095 (3 Turns)
ED3015A(U)	15A	2,5mm ²	1 x Würth 74270095 (3 Turns)
ED3020A(U)	20A	4,0mm ²	1 x Würth 74270095 (3 Turns)
ED3013B(U)	13A	2,5mm ²	1 x Würth 74270095 (3 Turns) plus 1 x DMEGC H50X25X20 R7K (5 Turns)
ED3018B(U)	18A	4,0mm ²	1 x Würth 74270095 (3 Turns) plus 1 x DMEGC H50X25X20 R7K (5 Turns)
ED3022B	22A	4,0mm ²	1 x DMEGC H50x25x20 R7K (3 turns)

Table 11: Compressor Connection

¹⁾ Based on: DIN VDE 0298-4 (Conductor temperature 90°C, Laying method E)

The drive output terminals are named as U, V, W. Beside this, there is a PE terminal which must be wired directly to the compressor earth point. The cables should be as short and the ferrites as close as possible to the drive. In any case the motor cables should not cross any other cables to avoid EMI issues. By using a shielded cable, which is in general not foreseen, take care on a proper shielding on both sides to get the best results. The usage of isolated ring and isolated blade terminals is obliged for all terminals to maintain the IP20 class.

3.4.6 Control Terminal

Each drive has a 9-Pin control terminal including the 9-pin plug counterpart (JITE PTB750B-00-1-09-3). The 5V terminals are foreseen to provide voltage supply to the DLT Input, the STO Input (i.e. high-pressure limiter) and if necessary to the RS485 serial communication circuit. The 12V terminal is to power an optional external analog board. No other usage of this 5V and 12V power supplies are allowed.

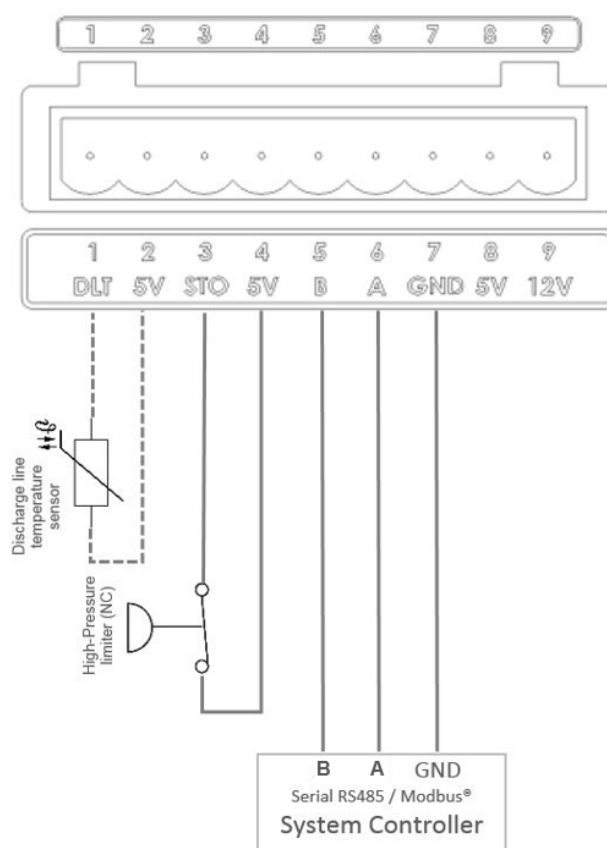


Figure 10: Control terminal

Attention: Consider the total max. output currents:

- Terminal 5V (2, 4, 8) < 150mA
- Terminal 12V (9) < 150mA

3.4.7 DLT Input

To protect the compressor against high discharge temperatures it is possible to connect a discharge line temperature sensor (DLT) between the control terminals 1 and 2. This sensor input is configurable via register [307] and by default enabled.

- Sensor specification:
 - Type: NTC 10kΩ @25°C
 - Accuracy: +-1%
 - Powered by: Internal 5 VDC (Terminal 2)
 - Temp.-Range: -40°C to +155°C
 - Reference: Emerson ECN-G series

The sensor should be mounted on the discharge line approx. 120mm far away from the compressor outlet.

After starting the compressor, the drive observes with a time delay of 2 minutes the temperature from the DLT sensor. The observable temperature range is between 0 to 155°C. The temperatures below 0°C or above 155°C are returned as 0°C and 155°C respectively.

3.4.8 STO Input

Between terminals 3 and 4 a STO Input (**S**afe **T**orque **O**ff) is available to connect a safety high-pressure limiter. The input is designed as a protected electronic circuit (PEC) based on the safety standard EN 60335-1. In case of a high-pressure situation the drive will let the compressor stop immediately. The drive will remain in a safe state until the controller sends a clear fault command to the drive. Due to the 5VDC power supply, a switch with golden plated contacts should be used. It is not allowed to use any other external power supply with a higher voltage rating to avoid damaging the STO Input!

- Specification of a high-pressure limiter:
 - Type: Safety Switch (NC)
NC = Normally closed
Based on latest version of EN 12263!
 - Contacts: Golden plated contacts
 - Powered by: Internal 5 VDC (Terminal 4)
 - Current flow: typically, ~10mA
 - Reference: Emerson PS4 series

Attention: Connect the safety limiter directly to the terminal 3 and 4 without any relays etc. in between. Otherwise the safety is probably not given any longer. The mentioned max. current is an indication to select the right high-pressure limiter without knowing about the resistor of the cable and the limiter them self.

3.4.8.1 Modbus® Communication

The drive acts as a Modbus slave with a pre-selected address 45. The serial communication between drive and any kind of controller or user interface is physically driven via RS485 (Control terminals 5, 6 and 7) and logically via the Modbus® RTU protocol. If a master controller needs to be supplied with 5VDC the control terminal 8 can be used.

During start-up cycle the drive can automatically detect a baud rate of 9.600 or 19.200 as well the combination of “8 data bits + even parity + 1 stop bit” or “8 data bits + none parity + 2 stop bits”. Further information is provided in the Modbus® Map.

Parameter	Value	
Modbus address	45	
Baud rate	9600/19.200 – Auto detection	
Data bits	8	
Parity	Even	None
Stop bits	1	2

Table 12: Modbus Communication Settings

3.4.9 Cooling Options

ED3 drives are available in different cooling options as shown in Table 4:

- Air cooled versions with horizontal and vertical heat sink directions
- Active air cooled version (ED3022B-A2)
- Flat plate versions for other cooling sources (The user is responsible for the cold plate design and that the drive is working at appropriate temperature)

Because of the power electronics used in the drive and the associated heat which is generated, drive cooling is required to keep the drive components in their design temperature range. The allowable temperature range of the drive (the ambient air surrounding the drive) is -20°C to 60°C. The drive temperature should be monitored during system development. Especially the temperature should be monitored at extreme operating conditions for the system. This will ensure that the maximum allowable drive temperature is never exceeded during operation. The highest drive temperature will typically occur during high load conditions and/or during high ambient temperature.

3.4.10 Air Cooled Heat Exchanger

Drives with heat sinks are designed to be in the air flow stream of the condenser, evaporator or any other air source. The air-cooled heat exchanger must be installed so that the heat exchanger fins are parallel to the cooling air flow. The airflow must be at least 3 m/s, measured at the outlet of heatsink in the direction of airflow.

3.4.11 Cold Plate Heat Exchanger

The cold plate design can be used when another cooling source is available – suction gas from the evaporator coil, subcooled liquid refrigerant, glycol solution from a geothermal loop, water from a cooling tower, etc. When refrigerant is used for drive cooling, the heat dissipated by the drive is transferred into the

refrigeration system. This can be a net gain for heating applications and a net loss for cooling applications. Table 13 shows an indication about the dissipation power transferred in the cold plate in order to design the external cooling circuit.

Drive Model	Indication for dissipation power [W]
ED3011A(U)-F	270
ED3015A(U)-F	315
ED3020A(U)-F	370
ED3013B(U)-F	130
ED3018B(U)-F	150
ED3022B(U)-F	190

Table 13: Dissipation Power of Cold Plate Versions

There must be thermal grease between flat plate and cold plate to get a good heat transfer between both. There is no standard for the thickness requirement of thermal grease! A thickness between 0.2mm-0.4mm is a good practice. The entire surface of the flat plate must be covered. Dow Corning 340 silicone heat sink compound or similar product is recommended.

The soldering or brazing that is required to connect the cooling source to the cold plate should be performed before the cold plate is attached to the drive, to prevent overheating drive components with the torch.

3.4.12 Fan Cooling

The drive version ED3022B-A2 has a covered heat sink with 2 integrated fans. It's foreseen to mount inside a control cabinet without any additional air stream. Because the drive dissipation power keeps inside the cabinet the system must take care on the max. ambient temperature of 60°C around the drive.

3.4.13 Control of the Drive-Cooling

The drive provides temperature values from the power modules mounted on the heat sink or flat plate. This values should be used to monitor and control a proper drive cooling from system side.

- 1-Phase drive models dedicated registers
 - [70]: IPM Temperature
 - [22]: IPM Over-Temperature limit
 - [42]: IPM Slow-Drop protection limit
 - [73]: PFC-IGBT Temperature
 - [23]: PFC-IGBT Over-Temperature limit
 - [43]: PFC-IGBT Slow-Drop protec. limit
- 3-Phase drive models dedicated registers
 - [70]: PIM Temperature
 - [22]: PIM Over-Temperature
 - [42]: PIM Slow-Drop protection limit

Exceeding the over-temperature limits the drive will shut down the compressor immediately. By exceeding the slow-drop protection mode the drive will go in the speed-drop protection mode.

For further information about this mode please refer to chapter 7.1.

Advice: By using the slow-drop protection limits as a max. temperature set point on system controller side system oscillations can be minimized.

4 CONFIGURATION AND CONTROL

The configuration and control of the drive can be done via three different options:

- #OneEmerson Modbus Map (Preferred one)
- Optional analog control board
- ED3 Modbus Map (No longer supported)

The #OneEmerson Modbus Map is replacing the ED3 Modbus Map. To be backwards compatible the ED3 Modbus Map is still part of the software and selected by default.

For new projects it's strong recommended only to use the #OneEmerson Modbus map to participate on innovations and easy to move from one to the other Emerson drive generation.

4.1 Modbus® Map

The Modbus Map is provided as a separate document which shows also the status, alarm, configuration and control registers. Furthermore, it provides an advanced register description. This user guideline only refers to the #OneEmerson Modbus Map registers. The link to the related old ED3 ModBus Map registers is given by the mentioned document.

4.2 Drive Configuration

Once the controller is connected to the drive, following configuration steps based on registers [100] ... [233] are required. In step 3 the combination of drive, compressor and related envelope must be selected via a numerical code 1...255. In case of a wrong selection the drive will go in a failure mode and a power cycle is needed.

STEP	ACTION
1	Selection of the #OneEmerson Modbus map [233] <ul style="list-style-type: none"> Write a value 0 (Default value:1 for ED3 Modbus Map)
2	DLT Sensor used? <ul style="list-style-type: none"> Yes: No action needed No: If not configured by writing 0 to register [207] within 2 minutes after a power cycle then it needs a clear fault command.
3	Compressor Selection [205] Selection of a matched Drive Compressor pair! <ul style="list-style-type: none"> I.e.: 6 (ED3018B / XHV0251P-9E9)

Table 14: Configuration steps

Attention: The drive configuration has to be done after each power cycle.

4.3 Drive Operation Modes

There are 2 main operation modes:

- Compressor Run Mode
- Stator Heater Mode

While selecting both control modes at the same time the Compressor Run has the highest priority. While stator heating is already on, sending a compressor run command will not terminate the stator heating mode or start the compressor.

4.3.1 Compressor Run Mode

Following steps needs to start the compressor:

- Check that the drive isn't in a fault mode
 - Register [5] Bit 02 = 0
- Send a clear fault command in case off
 - Register [103] = 1
- Send a speed demand
 - Register [101] = speed (i.e. 3.000)
- Send a start command
 - Register [100] = 1

The drive will accelerate and decelerate by the rates defined in [211] and [212].

4.3.2 Stator Heater Mode

Following steps needs to start the heating:

- Check that the drive isn't in a fault mode
 - Register [5] Bit 02 = 0
- Send a clear fault command in case off
 - Register [103] = 1
- Set the speed command to zero
 - Register [101] = 0
- Set the stator heater demand
 - Register [102] = 0...100 (%)
- Send a start command
 - Register [100] = 1

The max. current in Amps is readable via register [52]. By choosing 100% via register [102] the drive injects the max. current to the stator windings independent of the winding temperature. In this case the compressor motor will produce a heating of approx. 50W @25°C winding temperature.

4.4 Minimum Allowed Speed @ Operation Point

The controller is in charge to write for each compressor envelope operation point the minimum allowed speed @ operation point to register [109]. This is needed to protect the compressor against mechanical damage in case that the drive takes over the speed control during speed drop protection mode (Refer to 7.1).

Alternatively, the controller can write once the minimum allowed speed which is valid for the whole envelope of the compressor. This value will be used as a default value after each drive power cycle.

4.5 Clear Faults

Once a fault has occurred it can only be cleared after a delay time of 2 minutes. To do these following steps are needed:

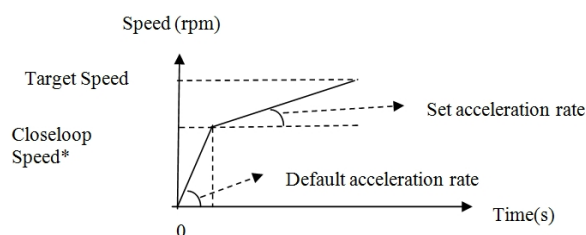
- Wait for 2 minutes after the fault has gone
- Set Compressor Speed Demand [101] = 0
- Set Compressor Control Command [100] = 0
- Set Clear Fault Command [103] = 1

4.6 Compressor Start-Up

The start-up control is divided in two stages:

Stage I: The compressor will run from 0 rpm to close loop speed at a preset acceleration rate.

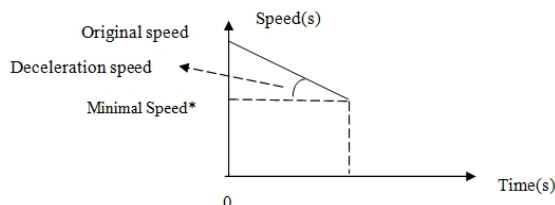
Stage II: The acceleration rate can be changed by giving a value to register [211], it will continue speeding up to the given speed (Default acceleration rate is 60 rpm/s).



The maximum acceleration rate of 600rpm/s is only recommended to use during the start-up cycle for a minimum amount of time. After the compressor has reached the target speed the acceleration rate should not be higher than 180rpm/s to avoid losing control at high load.

4.7 Compressor Shutdown

By setting the compressor run mode [100] = 0 the compressor will stop immediately. By setting the speed demand [101] lower than 600rpm the drive will decelerate [212] to the minimum allowed speed @ operation point [109] before shutting down the compressor.



The default deceleration rate during this shutdown procedure is 180rpm/s, with allowed range from 60 to 600rpm/s.

In case of any fault the drive will shut down the compressor immediately without decelerate to the minimum speed.

Advice: The minimum speed mentioned above is part of the compressor parameters and not related to register [109].

5 Optional Analog Control Board

The analog board is foreseen for customers who don't have the possibility to control the ED3 drive via an RS485 communication and the Modbus® protocol. To control the ED3 drive the analog board needs a digital enable signal and an analog signal to set the speed or heating demand. The drive compressor package must be selected by a 6-Digit DIP-Switch. The 7-Segment Display shows the status, failure codes as well the software version. The board provides also a feedback signal to the system controller whether the drive is ok or tripped. In case a bridge is placed on port "K", the PWM gives up to 5 different operation states of the drive. To protect the compressor a DLT Sensor as shown in Figure 10 must be wired to the drive control terminal. If a DLT protection is already part of the system controller a wired resistance of 10kΩ can be bypass this protection on the drive side. Via the terminal L (CN104) it's possible to select in normal operation between limited and full speed range. Using the full speed range, the main controller must take care that in each sub envelope the speed does not go below the allowed speed. Using the limited speed range, the compressor lowest speed is the one which is valid for the whole envelope and is called MMS (Maximum minimum speed). In this case running at high load the compressor is well protected against too low and too high speeds. In the speed-drop-protection mode (7.1), the drive is only using the limited speed range.

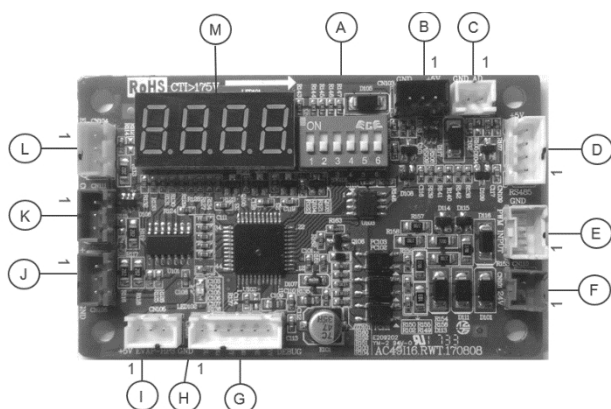


Figure 11: Analog Control Board

5.1 Terminal and LED Description

Table 15 describes in detail the terminals shown in Figure 11 which are supported by the ED3 drive family.

A	DIP-Switch: <ul style="list-style-type: none"> Selection of Drive Compressor Package Code
B	PWM Output Feedback-Signal: <ul style="list-style-type: none"> Pin1: 5VDC > NA Pin2: Signal > Ext. Controller Digital Input Pin3: GND > Ext. Controller GND Duty Cycle [%]: <ul style="list-style-type: none"> 0: Tripped (General fault, miss wiring) 25: Compressor Code Wrong (Power cycle needed) 50: Standby (Waiting for enable and 0...10V signal) 75: SDP-Mode (Speed-Drop-Protection Mode) 100: Running / OK
C	Analog Input: <ul style="list-style-type: none"> Pin1: AD (0...10V) > Ext. Controller Analog Output Pin2: GND > Ext. Controller GND
D	RS485 Communication / Power Supply: <ul style="list-style-type: none"> Pin1: RS485+ (A) > ED3-Drive control terminal: 6 Pin2: RS485- (B) > ED3-Drive control terminal: 5 Pin3: GND > ED3-Drive control terminal: 7 Pin4: 5VDC > ED3-Drive control terminal: 8
E	PWM-Input: <ul style="list-style-type: none"> Not used with ED3-Drives
F	Enable Signal: <ul style="list-style-type: none"> PIN1: (12VDC or 24V DC/AC) <ul style="list-style-type: none"> 12VDC/24V DC/AC > Ext. Controller Enable Signal PIN2: GND > Ext. Controller GND
G	Programming Port: <ul style="list-style-type: none"> Used for software updates via Renesas Emulators together with a special pcb board from Ruking Emerson
H	Status LED (Green): <ul style="list-style-type: none"> Flashing fast: Fault state Flashing slow: Standby Constant on: Compressor running / heating
I	Evaporator Pressure Transducer: <ul style="list-style-type: none"> Not used with ED3-Drives
J	Condenser Pressure Transducer: <ul style="list-style-type: none"> Not used with ED3-Drives
K	Selection of Fault Feedback <ul style="list-style-type: none"> Without bridge between Pin 1 and 3 (default) <ul style="list-style-type: none"> 100% (Running / OK) / 0% (Tripped) Bridge between Pin 1 and 3 <ul style="list-style-type: none"> PWM feedback (0 / 25 / 50 / 75 / 100%)
L	Selection of the Compressor Speed Range: <ul style="list-style-type: none"> Without bridge between Pin 1 and 3 (default) <ul style="list-style-type: none"> Limited speed range in normal operation Bridge between Pin 1 and 3 <ul style="list-style-type: none"> Full speed range in normal operation
M	7-Segment Display: <ul style="list-style-type: none"> Displaying Status, Speed, Error-Code, Software version

Table 15: Terminals and LED's of the Analog Control Board

5.2 Control and Configuration

5.2.1 Selection of Drive Compressor Code

The drive compressor code must be selected by a 6-digit binary coded DIP-Switch which has be done before connecting to the drive. In case of a wrong configuration the 7-Segment Display shows the error code E-30. The PWM output shows a duty cycle of 25%. In this case a power cycle is needed to reset this fault. The DIP-Switch will only be analyzed once after a power cycle. During the start-up cycle the 7-segment display will show the compressor as per the dip-switch configuration. For the dip-switch configuration in figure 12, the compressor code 23 will be displayed as C023.

Example:

- Drive version: ED3022B
- Compressor version: XPV0462E-4E9
- Package Code: 23

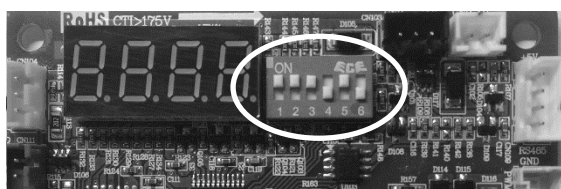


Figure 12: Analog Control Board Code Selection

Binary coding of Package Code 23:

- $2^4 = 16$ > DIP-Switch 5 = ON
- $2^2 = 4$ > DIP-Switch 3 = ON
- $2^1 = 2$ > DIP-Switch 2 = ON
- $2^0 = 1$ > DIP-Switch 1 = ON

5.2.2 Clear Faults

Faults are cleared automatically as long as the cause of the fault is no longer existing. In case of a drive fault the analog board will automatically send the clear fault command to the drive. Once the fault on the drive is gone the fault gets reset after a delay time of approx. 2 minutes the drive will return to normal operation mode.

5.2.3 Control Signals

To control the compressor the analog board needs a enable signal between 12VDC and 24VDC at terminal F. To control the speed and the stator heater demand a 0...10VDC signal is required at terminal C. A PWM feedback signal is available at terminal B.

5.2.4 Stator Heating Control

To control the stator heating of the compressor the analog control board consider the range between 1 to 1.9V (Table 16). The real heating power depends on the type of compressor.

Voltage [V]	Heating Power [%]
≥ 1.0	10
≥ 1.1	20
≥ 1.2	30
≥ 1.3	40
≥ 1.4	50
≥ 1.5	60
≥ 1.6	70
≥ 1.7	80
≥ 1.8	90
≥ 1.9	100

Table 16: Analog Stator Heating Control Mode

5.2.5 Speed Control

To control the compressor speed the analog control board considers the range between 2 and 9V (Table 17) of the analog input signal as the set point.

Voltage [V]	Speed [Hz]	Speed [rpm]
2.0	15	900
3.0	30	1.800
4.0	45	2.700
5.0	60	3.600
6.0	75	4.500
7.0	90	5.400
8.0	105	6.300
9.0	120	7.200
10.0	120	7.200
Speed [Hz] = (Voltage-2) * 15 + 15, [2 ≤ Voltage ≤ 9]		

Table 17: Analog Speed Control Mode

Based on the compressor envelope and the speed range selection (5.2.7) it can happen that low speed demands will be ignored.

5.2.6 Shut down conditions

The drive will stop in heating as well as in the running mode if one of below conditions occurs:

- System or drive fault detected
- Enable signal is gone
- Analog signal gets lower than 0.5V

5.2.7 Compressor Speed Range Selection

With a bridge on terminal L (CN104) the full application envelope speed range is usable during normal operation. In this case the main controller must have a proper envelope control implemented. Without this bridge, the drive will limit the lowest speed to MMS.

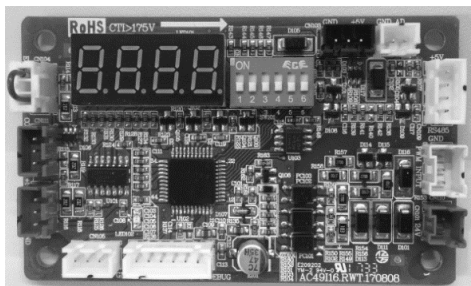


Figure 13: Analog Board Speed Range Selection

During the speed-drop-protection mode (7.1) the drive will only use the limited speed range. In this case the speed will not go below the MMS speed.

5.2.8 Onboard 7-Segment Display

The onboard 7-Segment display shows the main information about the drive compressor status, failure and warning codes which are part of Table 19.

Board State	Description
Power On (5 seconds)	Alternating between selected Drive Compressor Code (i.e. C023) and the software version (i.e. S04.8)
Standby	Alternating between IDLE and software version
Stator heating	Shows the selected power in % between 0 and 100% (H-00, H100)
Speed Control	The display shows the compressor speed in rpm
Speed Drop Protection	Alternating between the compressor speed and the root cause (i.e. Sd06) shown as part of Table 19
Fault State	Displaying the fault code described in Table 19

Table 18: Analog Board Status Display

6 MAINTENANCE



Please read carefully the safety instructions in chapter 1 and Table 1!

- Check frequently that all slots of the drive enclosure are free of dust etc. to guarantee a proper cooling of the electronic components inside.
- Check frequently that the heat sink is free of dust etc. to guarantee a proper drive cooling.
- On the ED3022B-A2 drive check frequently that beside the heat sink also the fans are free of dust and the functionality of the fans is still given.

7 PROTECTIONS and ALERTS

When the drive is in normal operation, the Signal LED will continuously flash at 0.5 Hz. In case the drive is in fault or protection mode the LED will flash at 2 Hz for specific times. The frequency of the LED flashing is linked to one of the alarm codes shown in Table 19.

7.1 Speed-Drop-Protection Mode

To protect the drive in any case of overcurrent or overtemperature the drive will take over the speed control to reduce the component stress by slowing down the speed.

There are three different speed-drop protection levels used and shown in Table 19:

- Fast-Drop protection limit
 - Compressor speed will drop by 180rpm/s
- Slow-Drop protection limit
 - Compressor speed will drop by 60rpm/s
- Recovery limit
 - Undercut this limit the drive will recover and will give back the speed control to the controller.

If any current or temperature is between the slow-drop protection and recovery limit the following control method is used in case that the related value is coming from top down (undercut the slow-drop protection limit):

- Compressor will run at the reduced speed
- The controller gets back the control partially (Only allowed to decrease the speed in this area)
- The controller should adjust system parameters to come below the recovery limit!
- Once the recovery limit is undercut or the compressor runs at this stage for longer than 30sec the system controller will get back the full speed control.

Advice: Here is the risk that system oscillation can occur. How to avoid this is described below.

The drive will inform the controller by updating Modbus register [5] and [51]. This will allow the system controller to respond and mitigate the system conditions causing this situation. During this Speed-Drop-Protection mode the system controller is in charge to update the minimum allowed speed @ operation point in register [109] frequently. Otherwise the risk is given to damage the compressor in heavy load and low speed conditions.

Reasons to move in this speed-drop protection mode:

- Overtemperature of the Output Power Modul
- Overtemperature of the PFC IGBT
- Overtemperature in the discharge line
- Operating in field weakening range
- Output overcurrent
- Input overcurrent

The controller can avoid to move in this speed-drop protection mode by using the registers [40], [41], [42], [43] and [110] for control purposes (Slow-Drop Protection Limits).

7.2 Discharge Line Temperature Protection

If a discharge line temperature sensor is wired and selected via register [207] the drive will control this temperature via the sensor input value [77] under consideration of a lower changeable slow-drop limit [110] and an upper maximum threshold [27].

Once the drive goes into speed-drop protection mode the functionality is the same as describes in chapter 7.1. The drive computes the fast-drop and recovery limit based on the slow-drop limit [110].

Control, shut down and recovery limits:

- Immediate stop: Register [27]
- Fast-Drop limit: Register [110] + 5°C
- Slow-Drop limit: Register [110]
- Recovery limit: Register [110] - 5°C

Advice: The discharge line temperature speed drop protection can be disabled by setting the register [101] equal to register [27]. In this case the drive will shut down the compressor immediately by exceeding the upper limit.

7.3 Overload Protection

Based on the compressor operation envelope, which is transferred in a speed-current curve, the drive will compute and adjust frequently the output current threshold. Once the output current exceeds this calculated threshold the drive will go in the speed-drop protection mode. It's a power limitation to protect the drive and the stator windings against overload.

Advice: This is independent of the envelope control managed by the system controller!

The system controller is responsible, based on the envelope operating point, to provide for each operating point a valid speed demand [101] and a minimum allowed speed @ operation point [109] to the drive to avoid reliability issues on the compressor.

7.4 Protection Limits, LED and Analog Board Codes

During any case of failure, the alarm code is visible at the signal led. The number of blinks are equal to the alarm code.

No	Alert and fault message	Static, dynamic and recovery limits	Protection Action	Analog Board	Alarm Code	ED3 Modbus® Register.Bit	#OneEmerson Register.Bit
1	Compressor Hardware Overcurrent	Dependent on the system	Compressor/ PFC Trip	E-44	1	197.0	84.11
2	Compressor U Phase Overcurrent	Read from EEPROM	Compressor/ PFC Trip	E-41	2	197.1	84.8
3	Compressor V Phase Overcurrent	Read from EEPROM	Compressor/ PFC Trip	E-42	3	197.2	84.9
4	Compressor W Phase Overcurrent	Read from EEPROM	Compressor/ PFC Trip	E-43	4	197.3	84.10
5	Compressor Loss of Phase	0.25 A	Compressor/ PFC Trip	E-10	5	197.4	80.9
6	Compressor Loss of Rotor	N/A	Compressor/ PFC Trip	E-11	6	197.5	80.10
7	Compressor Startup Failure	24s	Compressor/ PFC Trip	E-14	7	197.6	80.13
8	Compressor Phase Current Imbalanced	N/A	Compressor/ PFC Trip	E-33	8	197.7	84.0
9	Compressor Overload	N/A	Compressor/ PFC Trip	E-48	9	197.8	84.15

No	Alert and fault message	Static, dynamic and recovery limits	Protection Action	Analog Board	Alarm Code	ED3 Modbus® Register.Bit	#OneEmerson Register.Bit
10	Compressor DLT Over-Temperature	Read from EEPROM	Compressor/ PFC Trip	E-25	10	197.9	81.8
11	IPM Desat Protection	N/A	Compressor/ PFC Trip	E-44	12	197.11	84.11
12	Compressor Loss of Rotor 2	N/A	Compressor Trip	E-10	13	197.12	80.10
13	Compressor Loss of Rotor 3	N/A	Compressor Trip	E-10	14	197.13	80.10
14	PFC Hardware Overcurrent	ED3011A, ED3015A, ED3020A: 32A	Compressor/ PFC Trip	E-57	17	198.0	85.8
15	PFC Software Overcurrent	ED3011A, ED3015A: 55A Peak / Recovery: 40 A ED3020A: 70 A Peak / 50A Peak	Compressor/ PFC Trip	E-58	18	198.1	85.9
16	PFC Overvoltage	ED3011A, ED3015A, ED3020A: 430V / Recovery: 400V	Compressor/ PFC Trip	E-59	19	198.2	85.10
17	Communication Fault	30 s	Compressor/ PFC Trip	E-24	33	196.0	81.7
18	EEPROM Fault	N/A	Compressor/ PFC Trip	E-37	34	196.1	84.4
19	AC Input Overcurrent	ED3011A: 15A RMS / Recovery: 12A RMS ED3015A: 24A RMS / Recovery: 20A RMS ED3020A: 30A RMS / Recovery: 24A RMS ED3013B: 11A RMS / Recovery: 8A RMS ED3018B: 14A RMS / Recovery: 10A RMS ED3022B: 22A RMS / Recovery: 18A RMS	Compressor/ PFC Trip	E-02	35	196.2	80.1

No	Alert and fault message	Static, dynamic and recovery limits	Protection Action	Analog Board	Alarm Code	ED3 Modbus® Register.Bit	#OneEmerson Register.Bit
20	AC Over Voltage	ED3011A, ED3015A, ED3020A: 270V / Recovery: 250V	Compressor/ PFC Trip	E-05	36	196.3	80.4
21	AC Under Voltage	ED3011A, ED3015A, ED3020A: 165 V / Recovery: 185V	Compressor/ PFC Trip	E-06	37	196.4	80.5
22	DC Over Voltage	ED3011A, ED3015A, ED3020A: 430V / Recovery: 380V ED3013B, ED3018B, ED3022B: 740V / Recovery: 700V	Compressor/ PFC Trip	E-03	38	196.5	80.2
23	DC Under Voltage	ED3011A, ED3015A, ED3020A: 170V / Recovery: 190V ED3013B, ED3018B, ED3022B: 300V / Recovery: 340V	Compressor/ PFC Trip	E-04	39	196.6	80.3
24	High Pressure	N/A	Compressor/ PFC Trip	E-09	40	196.7	80.8
25	Input Loss of Phase	ED3013B, ED3018B, ED3022B: N/A	Compressor/ PFC Trip	E-07	41	196.8	80.6
26	IPM / PIM Overheating	ED3011A, ED3015A, ED3020A: 100°C / Recovery: 85°C ED3013B, ED3018B: 110°C / Recovery: 95°C ED3022B: 118°C / Recovery: 103°C	Compressor/ PFC Trip	E-12	42	196.9	80.11
27	PFC-IGBT Overheating	ED3011A, ED3015A, ED3020A: 105°C / Recovery: 90°C	Compressor/ PFC Trip	E-13	43	196.10	80.12
28	Compressor Code Fault	N/A	Compressor/ PFC Trip	E-39	44	196.11	84.6
29	Micro Electronic Fault (ADC)	N/A	Compressor/ PFC Trip	E-35	N/A	199.6	84.2

No	Alert and fault message	Static, dynamic and recovery limits	Protection Action	ANALOG	ALARM	MODBUS	#OneEmerson Register.Bit
				Board	Code	ED3 Modbus® Register.Bit	
30	Micro Electronic Fault (Wrong addressing)	N/A	Compressor/ PFC Trip	E-35	N/A	199.10	84.2
31	Input Current Speed-Drop Protection (Fold back)	Fast-Drop limit / Slow-Drop limit / Recovery value ED3011A: 14A / 13A / 12A ED3015A: 23A / 22A / 20A ED3020A: 28A / 26A / 24A ED3013B: 10A / 9A / 8A ED3018B: 13A / 12A / 10A ED3022B: 21A / 20A / 18A	Compressor Speed Drop	Sd04	N/A	200.0	51.3
32	Output Current Speed-Drop-Protection (Fold back)	Fast-Drop limit / Slow-Drop limit / Recovery value <ul style="list-style-type: none">Fast-Drop limit calculated based on speed current curveSlow-Drop limit: Fast-Drop limit minus 1ARecovery value: Fast-Drop limit minus 2A	Compressor Speed Drop	Sd05	N/A	200.1	51.4
33	Field Weakening Angle Speed-Drop-Protection (Fold back)	N/A	Compressor Speed Drop	Sd08	N/A	200.3	51.7
34	IPM / PIM Temperature Speed-Drop-Protection (Fold back)	Fast-Drop limit / Slow-Drop limit / Recovery value ED3011A, ED3015A, ED3020A: 98°C / 95°C / 85°C ED3013B, ED3018B: 108°C / 105°C / 95°C ED3022B: 115°C / 113°C / 103°C	Compressor Speed Drop	Sd06	N/A	200.4	51.5
35	PFC Temperature Speed-Drop-Protection (Fold back)	Fast-Drop limit / Slow-Drop limit / Recovery value ED3011A, ED3015A, ED3020A: 103°C / 100°C / 90°C	Compressor Speed Drop	Sd03	N/A	200.5	51.2
36	DLT Temperature Speed-Drop-Protection (Fold back)	Fast-Drop limit / Slow-Drop limit / Recovery value [308] + 5°C / [308] / [308] – 5°C	Compressor Speed Drop	Sd07	N/A	200.6	51.6
37	Compressor U Phase Current Sensor Fault	0.25V Recovery:0.2V	Compressor/ PFC Trip	E-41	49	195.0	84.8
38	Compressor V Phase Current Sensor Fault	0.25V Recovery:0.2V	Compressor/ PFC Trip	E-42	50	195.1	84.9

No	Alert and fault message	Static, dynamic and recovery limits	Protection Action	Analog Board	Alarm Code	ED3 Modbus® Register.Bit	#OneEmerson Register.Bit
39	Compressor W Phase Current Sensor Fault	0.25V Recovery:0.2V	Compressor/ PFC Trip	E-43	51	195.2	84.10
40	PFC / Input Current Sensor Fault	0.25V Recovery:0.2V	Compressor/ PFC Trip	E-45	52	195.3	84.12
41	IPM / PIM Temperature Sensor Fault	<i>Shown values are AD Values (Analog Digital Converter)</i> ED3011A, ED3015A: 115 / Recovery: 166 ED3020A: 360 / Recovery: 500 ED3013B, ED3018B, ED3022B: 135 / Recovery: 140	Compressor/ PFC Trip	E-54	53	195.4	85.5
42	PFC Temperature Sensor Fault	<i>Shown values are AD Values (Analog Digital Converter)</i> ED3011A, ED3015A, ED3020A: 115 / Recovery: 166	Compressor/ PFC Trip	E-55	54	195.5	85.6
43	DLT Sensor Fault	Read from EEPROM	Compressor/ PFC Trip	E-51	55	195.6	85.2

Table 19: Protection limits, LED and Analog Board Codes

8 FREQUENTLY ASKED QUESTIONS (FAQ)

Table 20 provides answers to frequently asked questions. Please check here first in case of problems with the installation and assembly. In case further assistance is needed please call Emerson application engineering department.

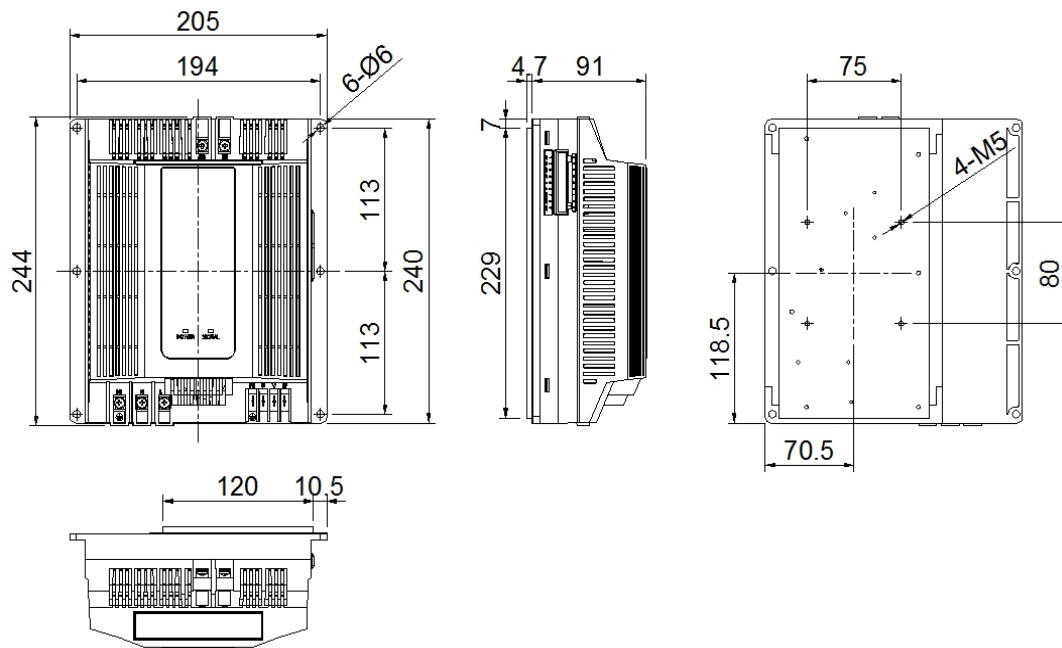
No.	Question / Drive behavior	Advice / Corrective action
1	Drive is connected to the grid but seems to be not powered.	Check if the DC-Choke is wired!
2	Compressor trips with a delay time after it has started! • Failure message: DLT Sensor Fault	If the DLT Sensor isn't physically connected to terminal 1 and 2 it needs to be disabled via Modbus for continued operation
3	Can't reconfigure / reselect a compressor code • Failure message: Compressor Code Fault!	Once a wrong compressor code has configured a power cycle is needed to clear this fault!
4	Drive ignores the speed command from the controller • Alert message: Input Current SDP , Compressor ...	Drive is in running in the Speed-Drop-Protection Mode. In this mode, the drive takes over the speed control.
5	Unable to clear a fault message via "Clear Fault" command	<ul style="list-style-type: none"> The root cause of the fault is still there! The compressor speed demand as well the compressor ON/OFF command must be set to 0 before sending a "Clear Fault" command to the drive Fault messages can only be cleared by a minimum delay of 2 minutes after the failure disappeared
6	Signal LED is always ON	Drive is not working. A power cycle is needed. If this does not solve the issue a drive software update may help.
7	Drive doesn't provide the expected power! • Alert message: Input Current SDP , Compressor ...	Drive is most likely running in the Speed-Drop-Protection Mode <ul style="list-style-type: none"> Check the root cause of SDP in register [200] Check the system and drive ambient temperatures Check the drive cooling
8	Drive reports non-existing high pressure condition • Failure Message: High Pressure Fault	<ul style="list-style-type: none"> Check if the high-pressure limiter is directly connected to the terminals 3/4 without any relays etc. in between. By using standard high-pressure limiters with silver contacts the voltage drop can get higher with the time and cause malfunctions.
9	Which kind of plug-in is the counterpart of the control terminal?	JITE Technologies (www.jite.com) <ul style="list-style-type: none"> Type of connector: PTB750B-00-1-09-3
10	What happen in case of a communication lost between drive and controller?	After 30sec the drive will let the compressor trip. The protection will remain for 2min before the failure can be cleared by a clear faults command.

Table 20: Frequently asked questions (FAQ's)

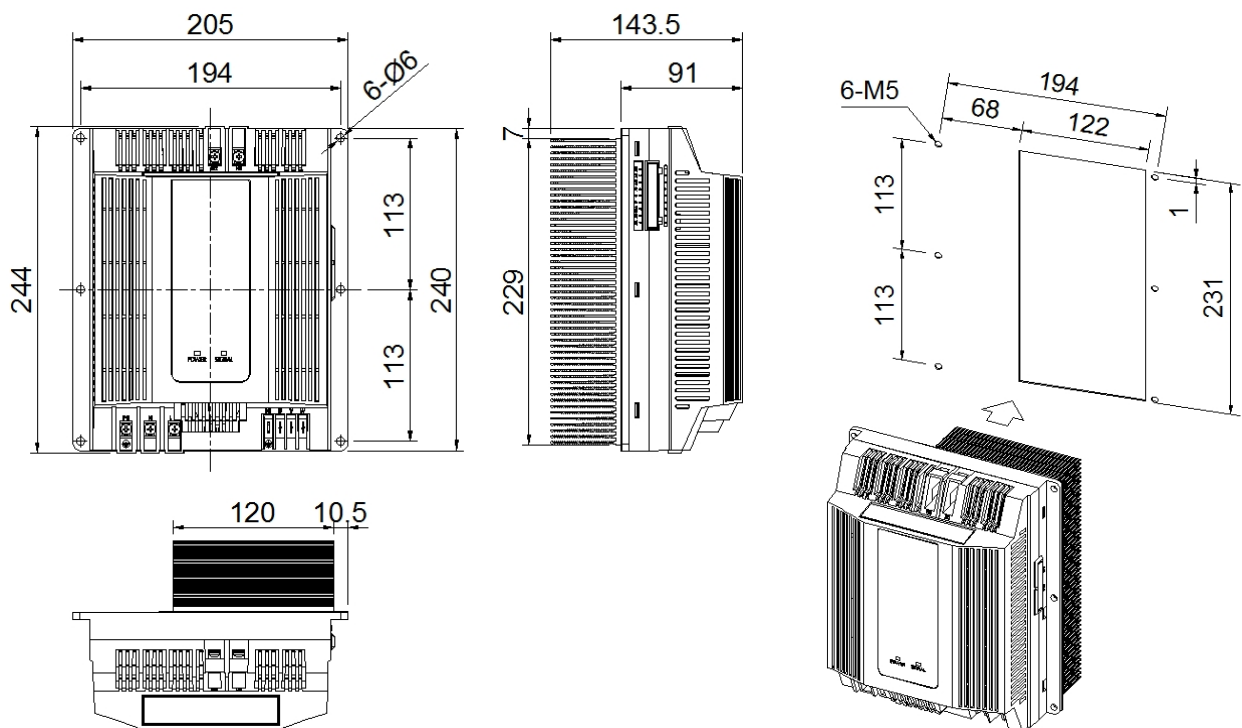
9 APPENDIX

9.1 Drive Dimensions and Mounting Instructions

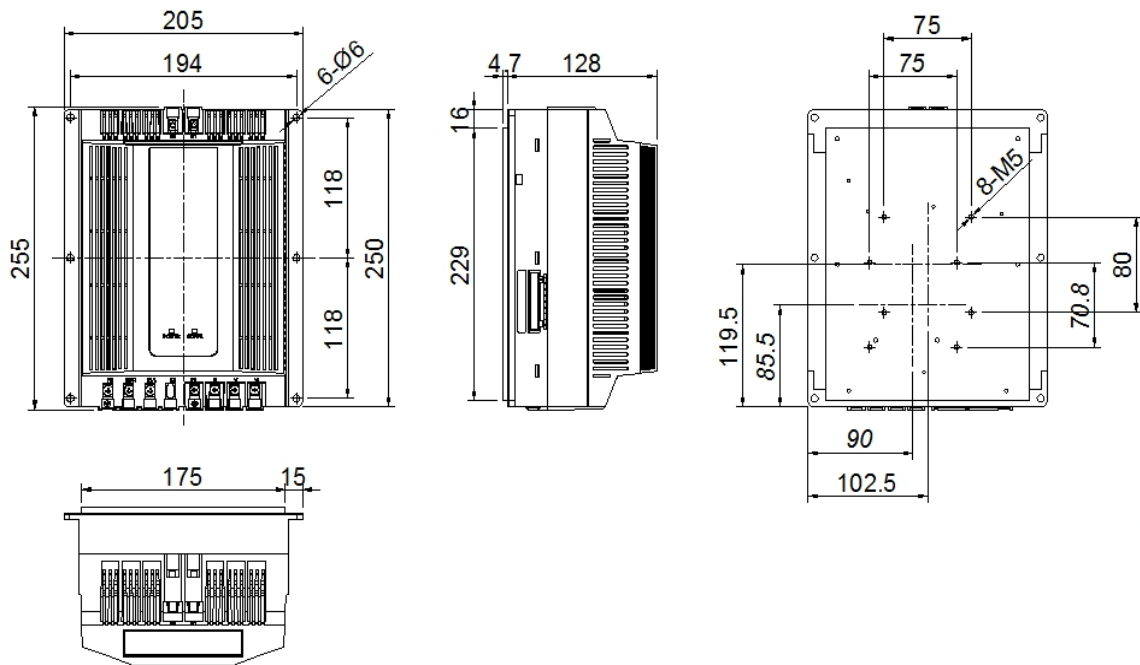
9.1.1 ED3011A(U)-F2-X / ED3015A(U)-F2-X (Flat plate)



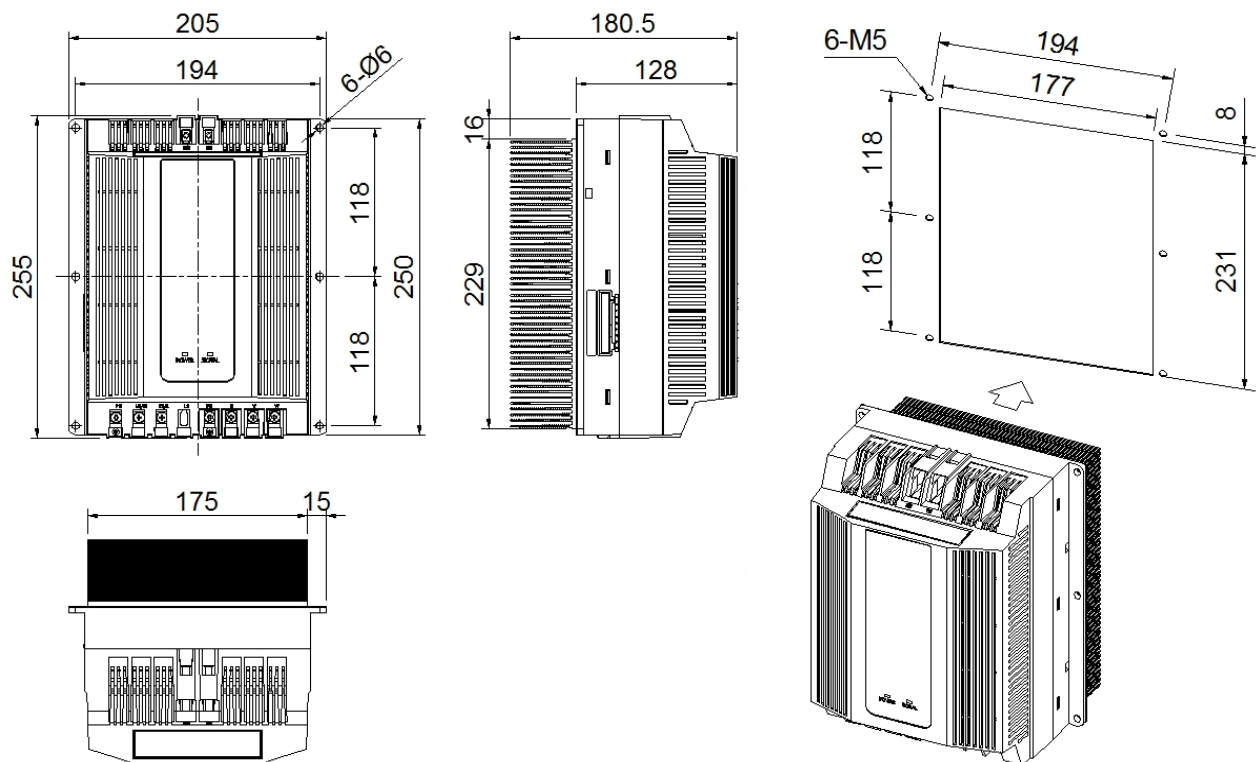
9.1.2 ED3011A(U)-H2-X / ED3015A(U)-H2-X (Heat sink horizontal)



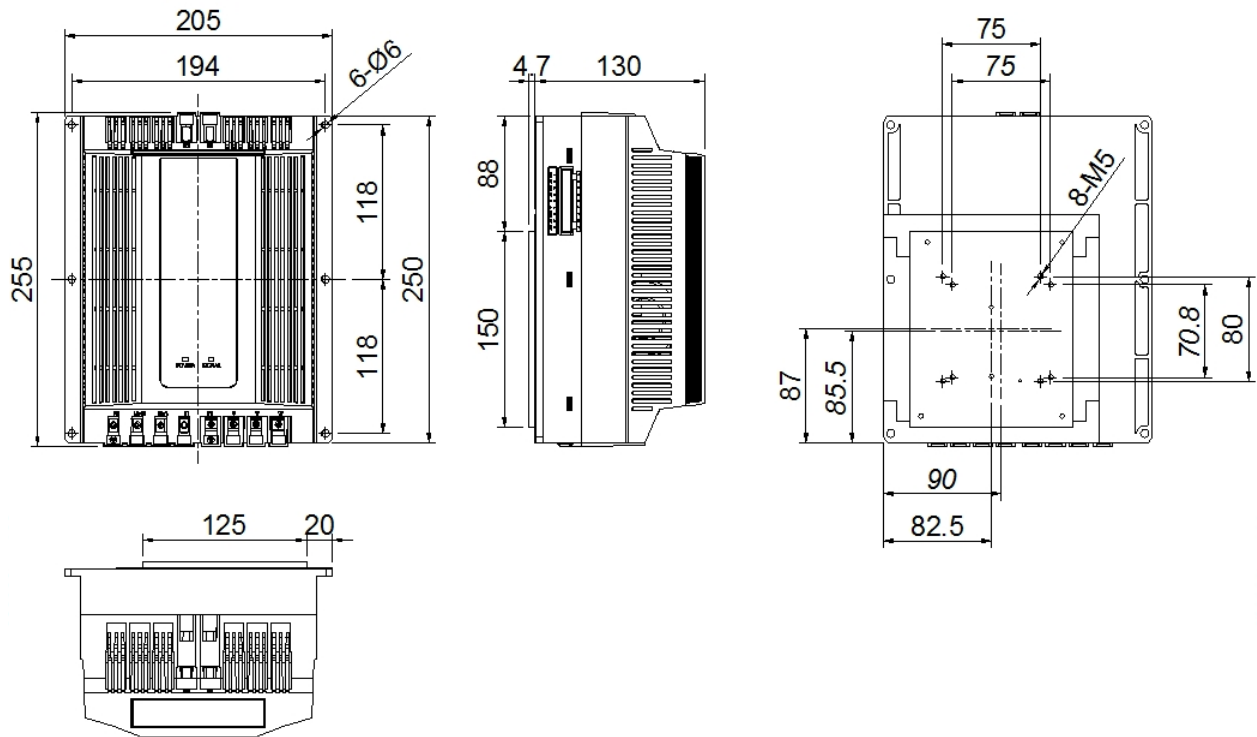
9.1.3 ED3020A(U)-F2-X (Flat plate)



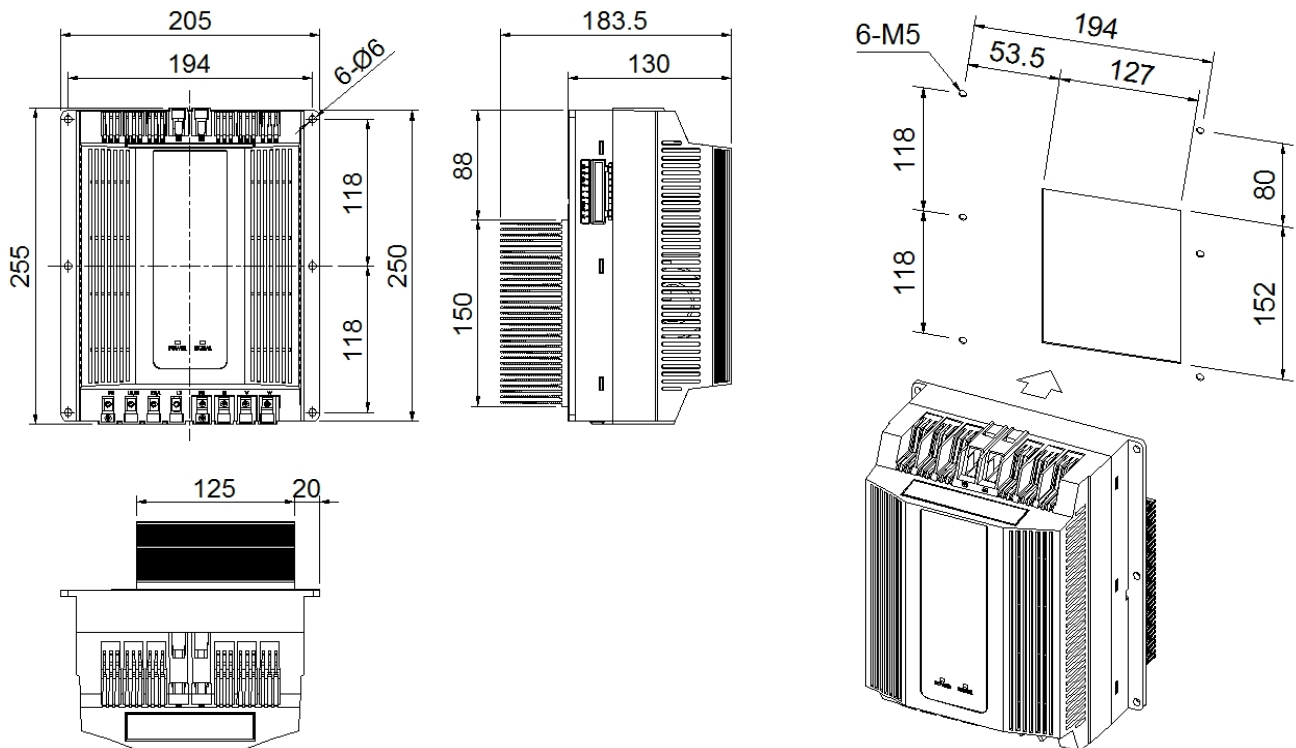
9.1.4 ED3020A(U)-H2-X (Heat sink horizontal)



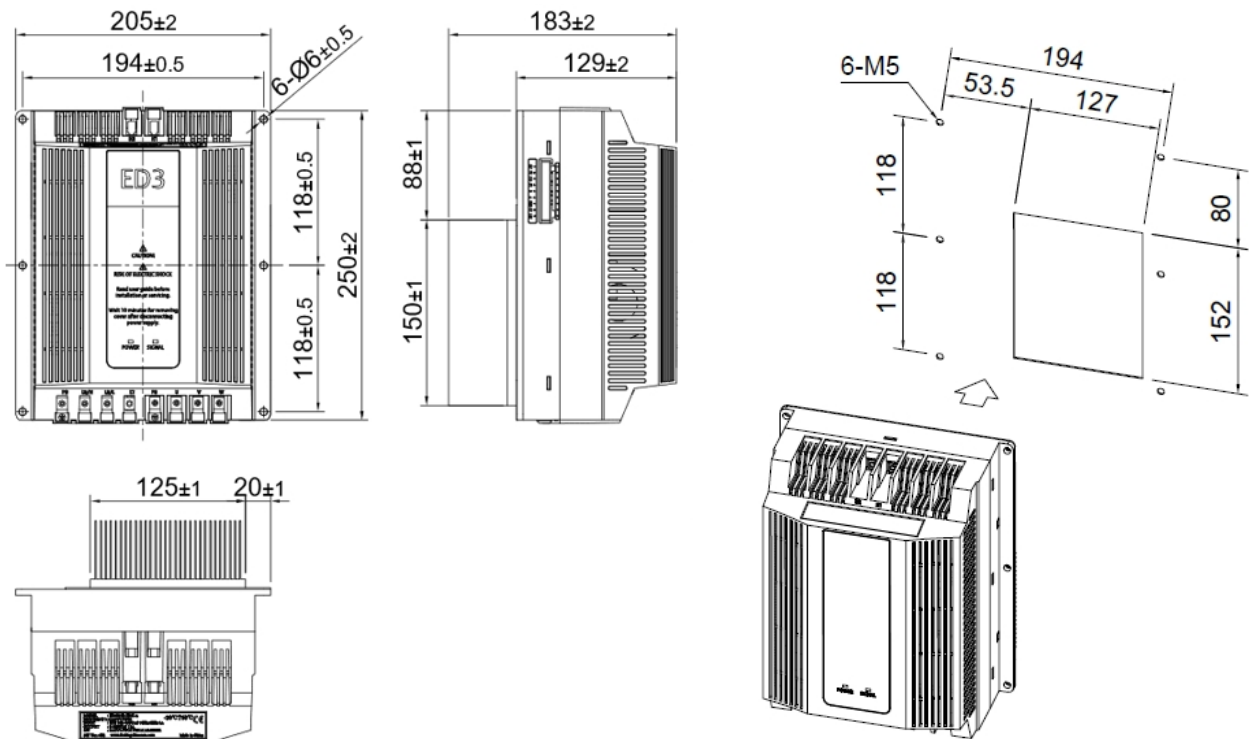
9.1.5 ED3013B(U)-F2-X / ED3018B(U)-F2-X (Flat plate)



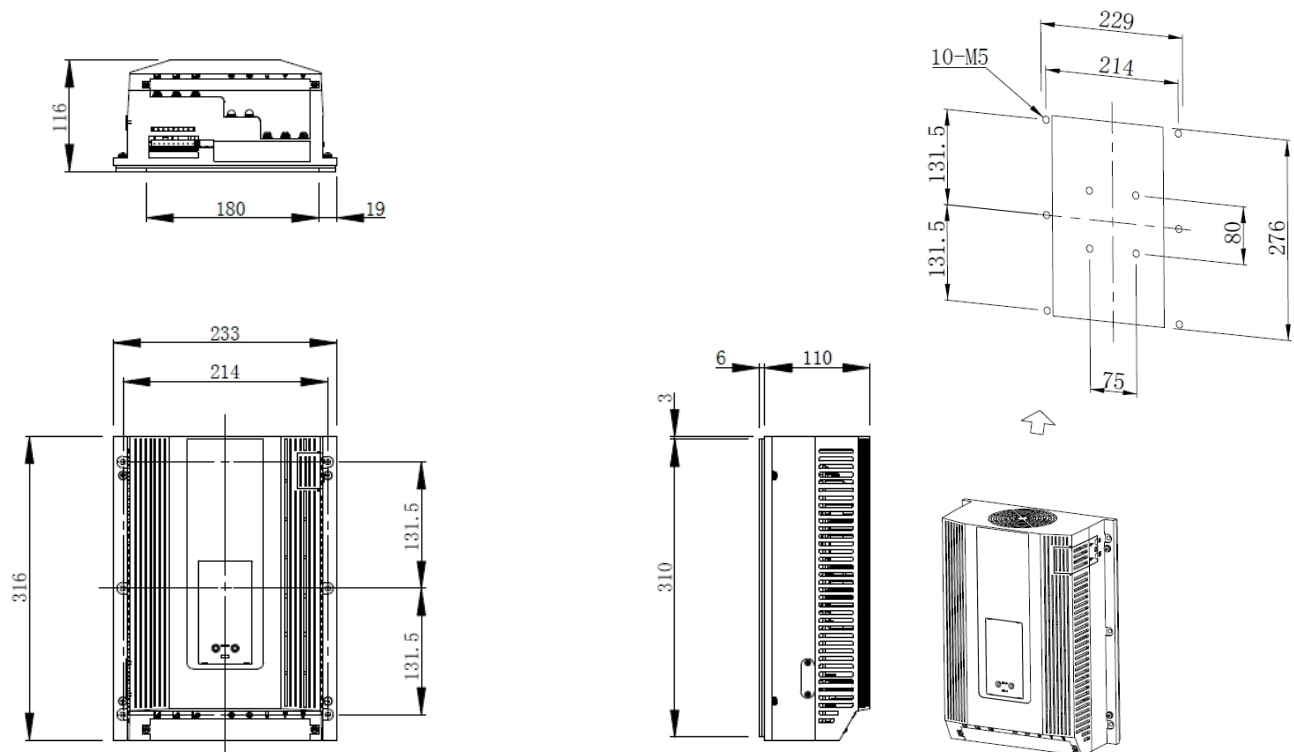
9.1.6 ED3013B(U)-H2-X / ED3018B(U)-H2-X (Heat sink horizontal)



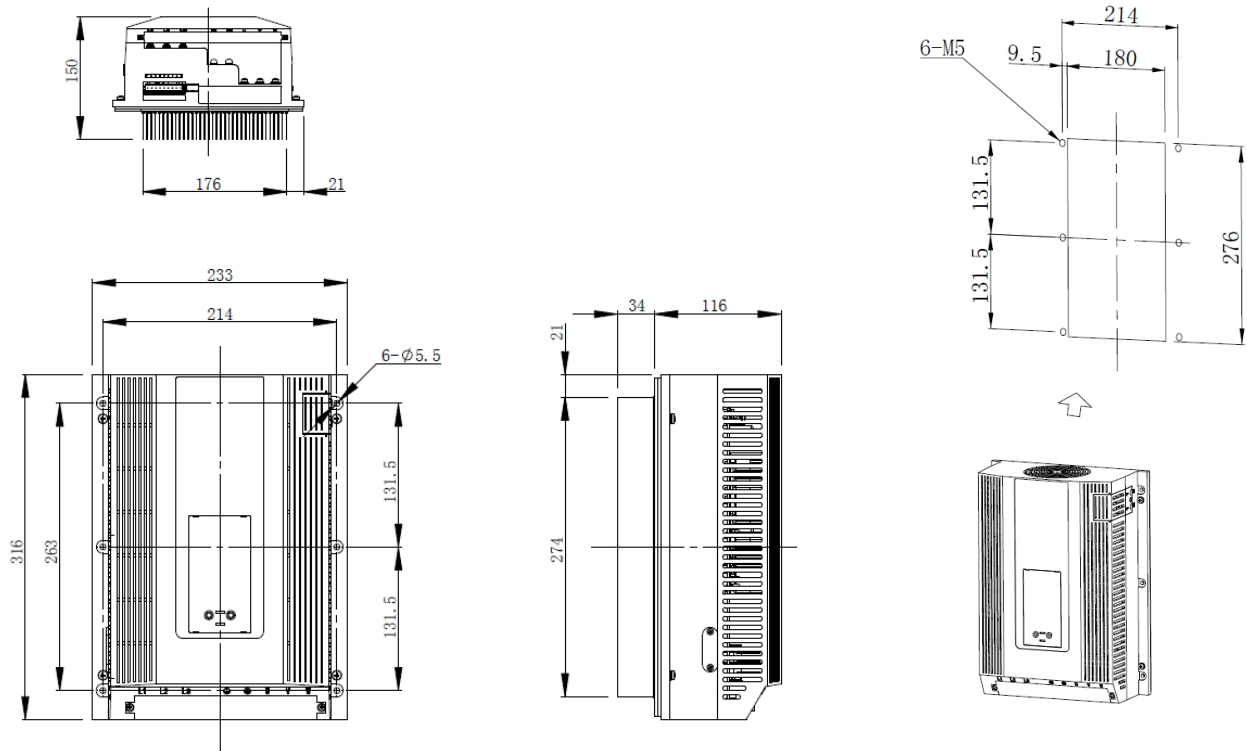
9.1.7 ED3018B(U)-V2-X (Heat sink vertical)



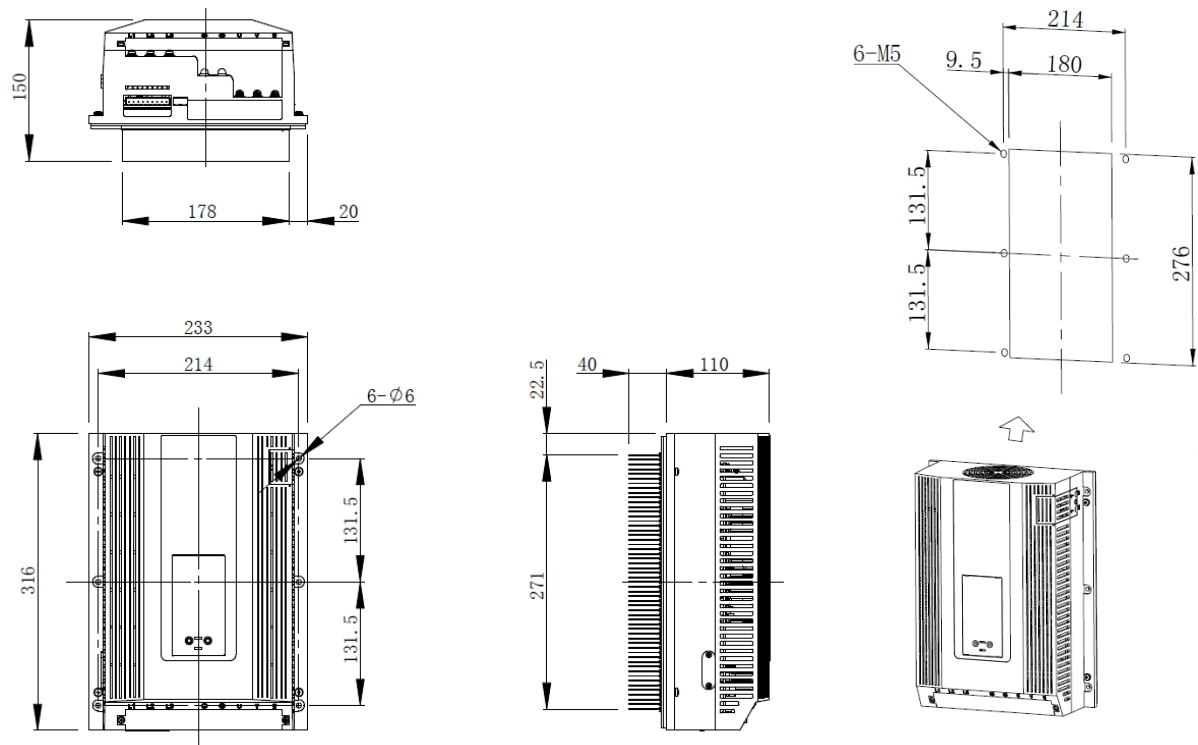
9.1.8 ED3022B-F2-X (Flat plate)



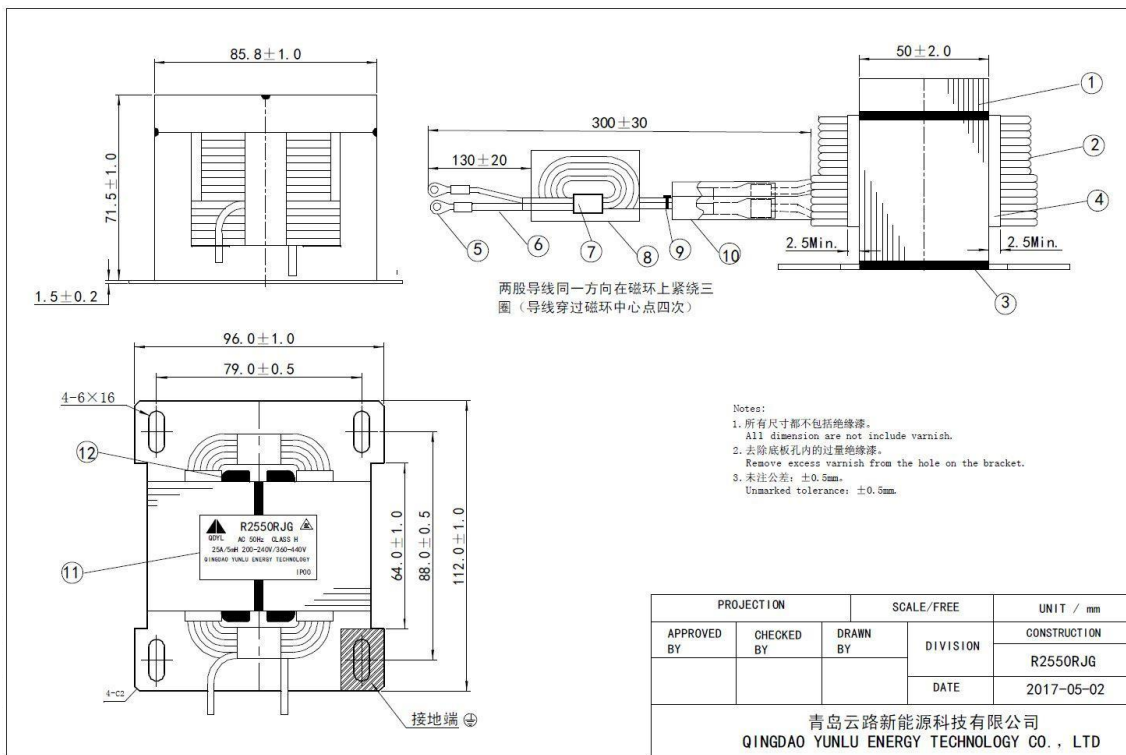
9.1.9 ED3022B-V2-X (Heat sink vertical)



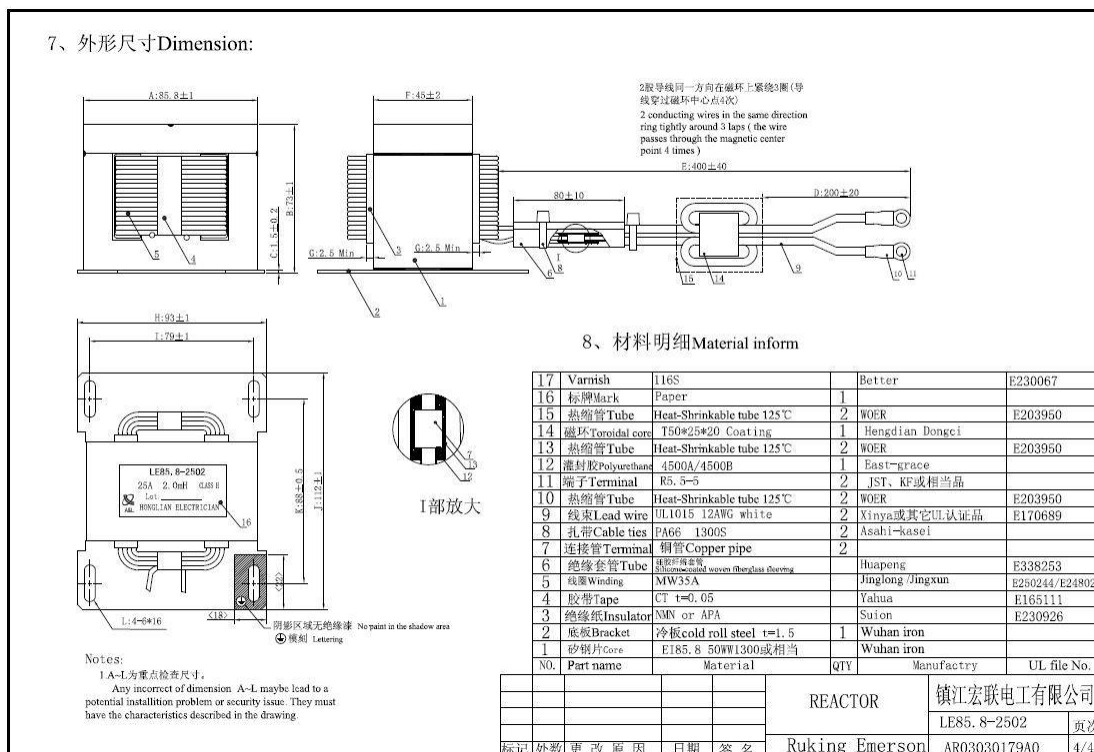
9.1.10 ED3022B-H2-X (Heat sink horizontal)



9.2.2 DC-Choke 25A, 5mH for ED3020A



9.2.3 DC-Choke 25A, 2mH for ED3022B



UNCONTROLLED - DO NOT MODIFY

9.4 Software Update Tool

There is a Software Update Tool available in case that you need to update the main software of the drive (DSP Software) or the compressor configuration file (EEPROM File).

Please ask the Application Engineering Team in order to get the latest version of this tool.

9.5 Annex ED3 Modbus® Map

There is a separate detailed Modbus® map document available with complementary information.

9.6 Annex #OneEmerson Modbus® Map

There is a separate detailed Modbus® map document available with complementary information and an addition with a link to the ED3 Modbus Map registers.

9.7 Annex Drive-Compressor-Envelope Overview

A separate Drive Compressor Package Overview document is available. It contains all the released and pre-tested drive compressor combinations.

9.8 EU Declaration of Conformity

EU Declaration of Conformity

According to the EU Low Voltage Directive 2014/35/EU set out in Annex IV from February 26, 2014

We hereby declare that the designated products below their conception and construction and in the version marketed by us conform to the essential health and safety requirements of the EU Directive Low Voltage. In a not approved by us changing the Product this declaration loses its validity.

Manufacturer:

Ruking Emerson Climate Technologies (Shanghai) Co., Ltd.
12th Floor, Building B5, Bay Valley, 1688 North Guoquan Road
Yangpu District, Shanghai, P.R. China, 200438

Description of the electrical equipment:

- Function: Control of Variable Speed Compressors dedicated for HVAC/R systems
- Model: ED3011A, ED3015A, ED3020A, ED3013B, ED3018B and ED3022B
- Model: ED3011AU, ED3015AU, ED3020AU, ED3013BU and ED3018BU
- Build Year: 2019

There is compliance with other, also apply to the product guidelines / rules explained:

- EMC Directive (2014/30/EU)
- RoHS Directive (2011/65/EU)

Applied harmonized standards in particular:

- EN 60335-1:2012/A11:2014
- EN 60335-2-34:2014-10
- IEC 60335-2-40:2018-05 (Regarding flammable refrigerants)
- EN 60335-2-89:2018-10 (Regarding flammable refrigerants)
- EN 60079-15:2011-02 (Regarding flammable refrigerants)
- EN 60079-18:2015-10 (Regarding flammable refrigerants)
- EN 55014-1:2018-08
- EN 55014-2:2016-01
- EN 61000-3-2:2017-03
- EN 61000-3-12:2012-06

Year of CE mark allocation:

- 2019

Place and date:

- Shanghai / China

Identity of the person of the signatory:

- Hailing Qiu, General Manager & Executive Vice President.

Signature:



