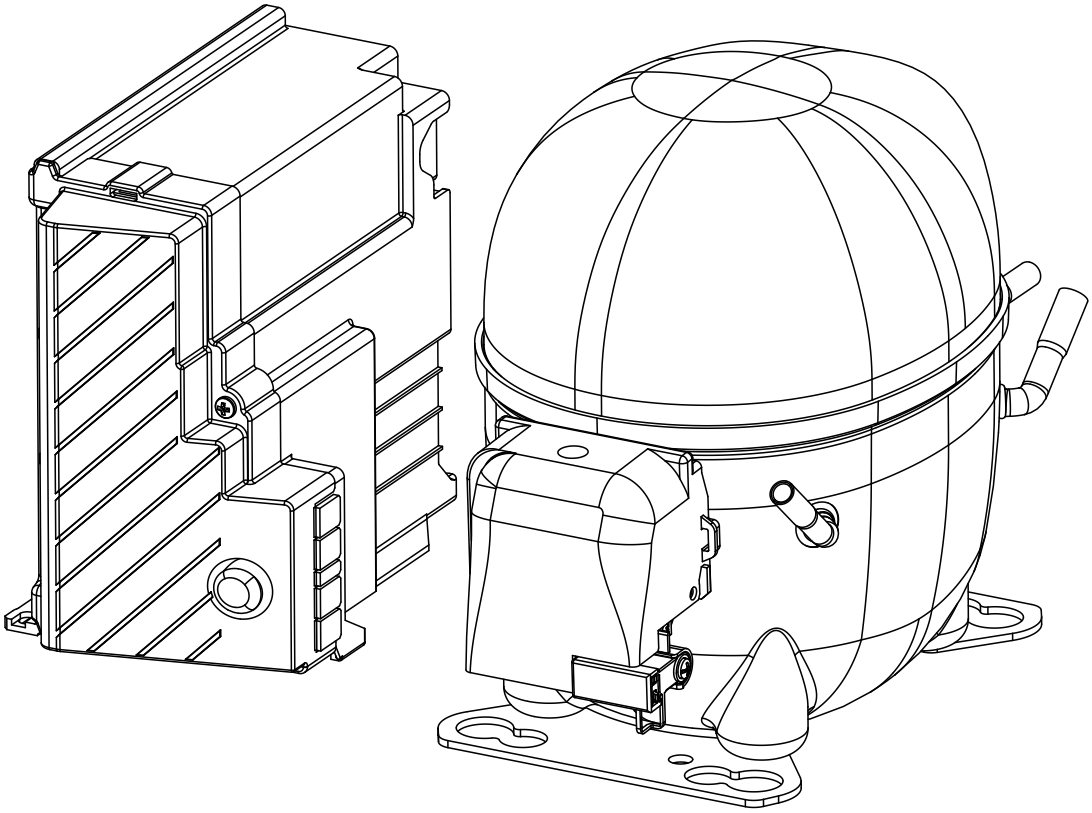
VARIABLE SPEED COMPRESSORS
ELECTRONIC INVERTER

CF10B INVERTER MANUAL



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Contents

Chapter 1

INTRODUCTION

This document contains information regarding technical specifications, installation instructions and functinality of CF10B Inverter family. It is intended to be used during project phase for proper specifications of system configuration and design, in order to ensure the best application and performance available with use of Embraco's Variable Capacity Compressors and avoid undesired issues.

Before you begin the reading of this material, below is presented the convention about some information contained in this document and how such information must be interpreted.

Incorrect operation that could result in bodily injury or death due to electrical hazard.

Incorrect operation that could result in equipment damage.

NOTICE

Contain helpful suggestions or references to material not covered in this document. To obtain access to such materials, please contact your technical support.

Chapter 2

TECHNICAL SPECIFICATIONS

2.1 Nomenclature

CF 10 B 01 N 0.1 YY A ZZ	
CF	Driver Type
10	Family
B	Generation
0X	Subversion
N	Power Supply
0.1	Protective Function configuration
YY	Eletronic Configuration
A	Enclosure
ZZ	Cables and Peripherals

2.2 Product specifications

General Specifications	
Input rated voltage range [i]	120 V or 240 V
Input operating voltage range [ii], [iii], [iv]	70 V-140 V or 160 V-264 V
Maximum input voltage [v], [vi]	176 V or 300 V
Input frequency range	50-60 Hz
Input rated current	15.5 A
Control mode	Frequency, Drop-in and Serial
Operating humidity	< 85%
Operating ambient temperature[vii]	-20 ºC to 55 ºC
Air forced ventilation (min) [viii]	2 m/s

[i] Voltage range approved by Agencies.

[ii] Minimum voltage without impact on compressor starting performance.

[iii] Opearating below the minimum voltage may limit the cooling capacity due to power and compressor speed limitation.

[iv] Maximum voltage without impact on performance and long term reliability.

[v] Maximum voltage without inverter being damaged, but with impact on reliability and performance.

[vi] The inverter may be damaged with voltage above this limit.

[vii] Agency approval temperature.

[viii] Air flow over the inverter heat sink, as shown in Figure 3.4.

WARNING

- Do not connect the CF10B Inverter to a power supply above declared Maximum voltage.

CAUTION

- This inverter is for use only with the Embraco VCC compressors.
- Operating the product at voltages out of declared Input operating voltage range may reduce its reliability and significantly impair product performance.
- Make sure to apply the proper Inverter - VCC match. The use of incorrect Inverter - VCC may degrades product overall performance.
- In order to avoid loss of performance, make sure to operate the inverter inside the temperature range of -20 °C to 50 °C.
- Ambient operation temperature above 50 °C or inappropriate positioning of the inverter related to forced ventilation air flow may activate inverter thermal protection.

NOTICE

- Declared input voltage range represents operating conditions with no impact to product long term reliability.
- Input rated voltage range relates to agency approval.
- Opearating below declared Input rated voltage may limit the cooling capacity due to power and compressor speed limitation. Contact Embraco's technical support to check availability of compressor performance data for the intended input voltage.

2.2.1 Label information

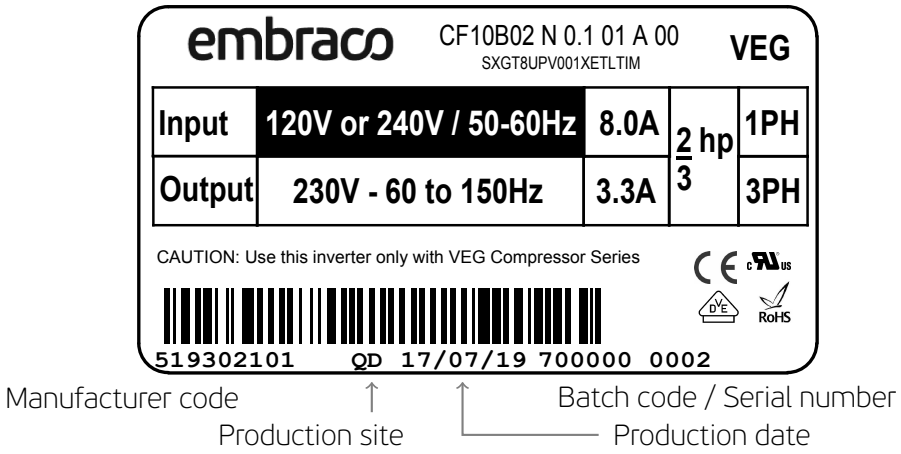


Figure 2.1: Product label example

2.2.2 Institute approval

Compressor Family	VDE	cULus
VEG	X	X
FMF	X	X
VNE	X	X

2.2.3 Product dimensions

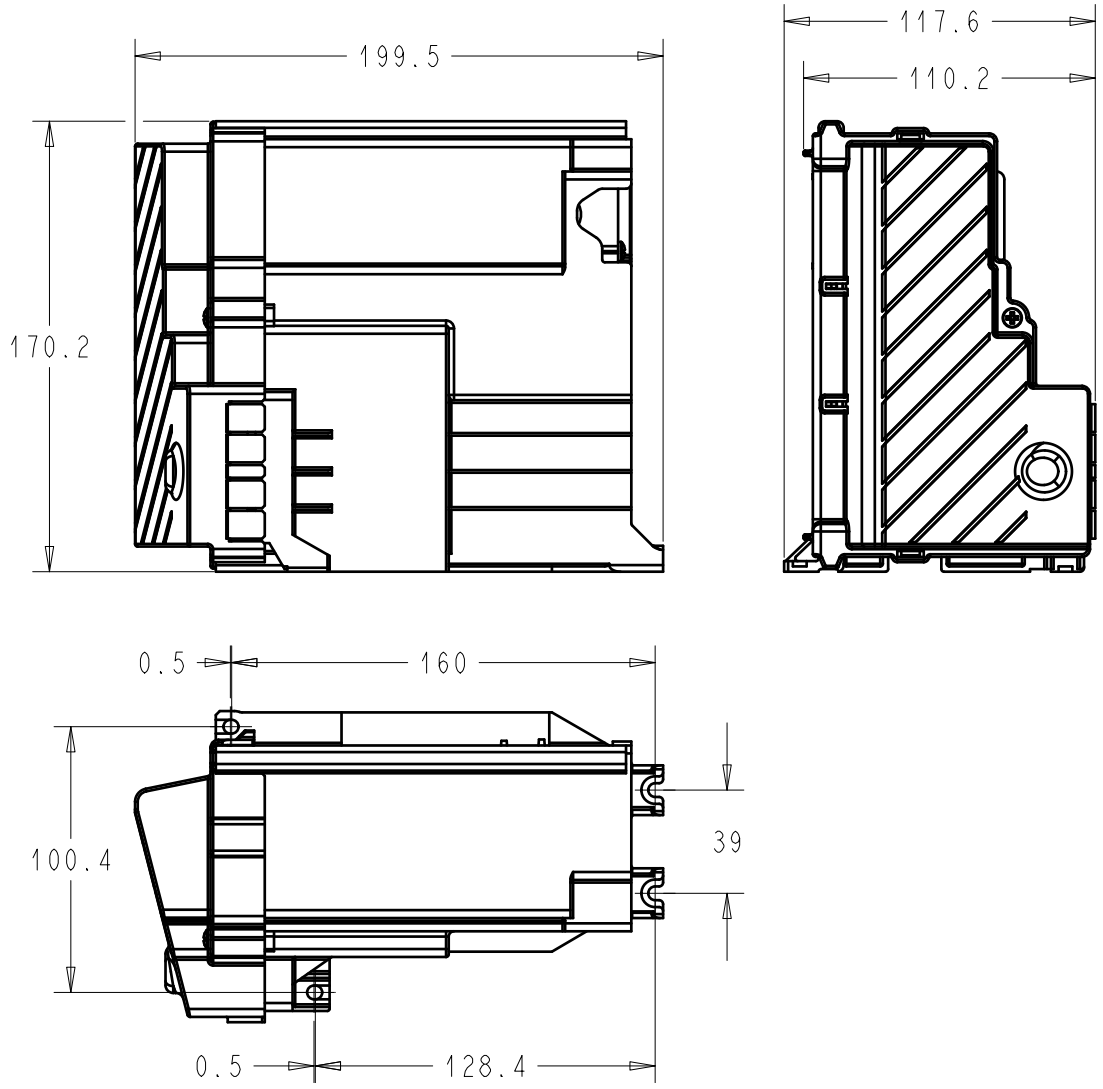


Figure 2.2: Stand alone dimensions

Stand alone dimensions	
Dimensions	170,2 mm x 199,5 mm x 117,6 mm

2.2.4 Connectors

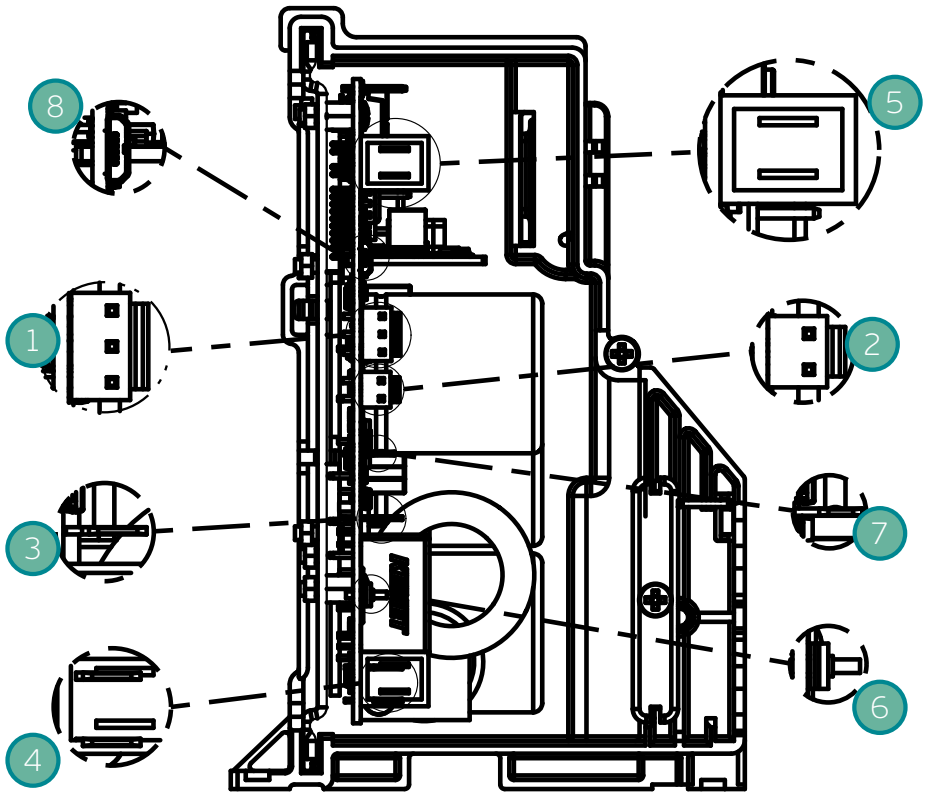


Figure 2.3: Connectors

Connectors part numbers			
Indicator	Description	Part number	Insulation
1	Serial Communication	S3P-VH (LF) (SN)	Reinforced
2	Frequency input	S2P-VH (LF) (SN)	Reinforced
3	Drop in	1217754-1	Functional
4	AC input (L+N)	1217754-1	Functional
5	AC Fan*	MSLO 9402 - 002 - 00A - 960 - 000 - 00	–
6	EMI Earth	Cabble supplied by embraco	
7	Defrost input	1217754-1	Functional
8	"You Control" input	Micro-USB B	–

*Mates with 1/4" faston receptacle. Fan connector assemble is optional.

2.2.5 Cables

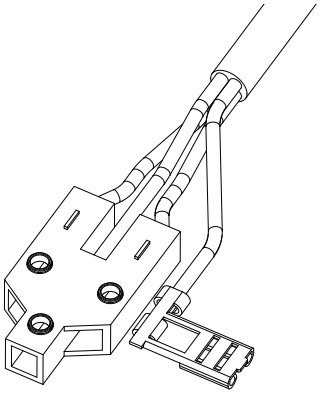


Figure 2.4: Motor cable for VEG and FMF compressor series

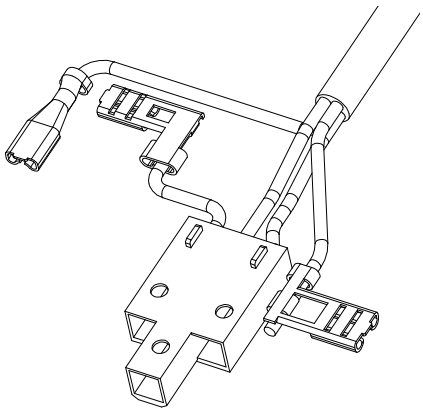


Figure 2.5: Motor cable for VNE compressor series with OLP

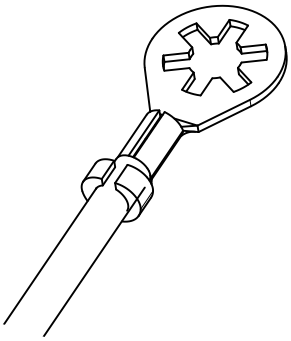


Figure 2.6: EMI Earth and Safety Earth Cable

Cable Specification			
Indicator	Description	Part Specification	Color
Figure 2.4	Standard Motor Cable	UL STYLE 2586 105°C 600 V	Black, Blue and Brown
Figure 2.5	Motor Cable With OLP	UL STYLE 2586 105°C 600 V	Black, Blue and Brown
Figure 2.6	Safety Earth Cable	UL STYLE 1015 105°C 600 V	Green/Yellow
Figure 2.6	EMI Earth Cable	UL STYLE 1015 105°C 600 V	White

- The 'You Control' customization input (micro USB port) does not have electrical insulation. Use the provided communication modules defined by Embraco to guarantee electrical insulation. Check Subsection 4.2.2 for information regarding the indicated communication modules and product customization.

NOTICE

- CF10B inverter series standard configuration is approved to be used only in built in appliances, with not accessible machine compartment. If the intended appliance is an open machine compartment type, please contact Embraco's technical support to ensure the proper configuration of your product.

2.3 Information about input inrush current

Inrush current refers to a transient phenomenon that occurs rarely and only when the power supply cord is connected to the power grid or in the case of power grid shutdown. CF10B inverter series are designed accordingly and can reliably withstand this current along the expected product lifespan. Excessive inrush current events may damage the inverter. Regarding inverter installation, Embraco recommends to have the appliance supply cord directly connected to inverter power input without any disconnection means. Please, contact Embraco Technical Support for any assistance or application assessment needed.

Inrush Specifications		
Voltage Range	120 V	240 V
Allowed inrush events	1 per day	1 per day
Inrush current (cold state)	24 A peak	37 A peak
Inrush current (hot state)	80 A peak	160 A peak
Input fuse melting (i^2t)	631 A^2s	631 A^2s

Chapter 3

INSTALLATION

3.1 Before you begin

- Make sure that CF10B Inverter will not be in direct contact with flames during assembly.
- The location where the Inverter will be installed must be protected against splashed water from all directions.
- Do not open the Inverter enclosure. For installation, remove only the Inverter Cover to make the electrical connections.

- Before you begin your installation observe technical specifications and proper connections.
- To prevent damage to your inverter during and after assembly, avoid contacting with the following substances: Hydrocarbons; Ester based oils (e.g.: compressor oil); Phenols; Amines; Ketenes; Automotive fluids such as grease, except glycol and heavy alcohol.
- Inverter is sensitive to Electrostatic Discharges. The environment must be properly protected against ESD and workers that handle the inverter must be Earthed through adequate ESD wrist strap and wear ESD gloves.

CAUTION

- Take care with product handling until final assembly.
- Do not hold by the wiring.
- Special care must be taken to avoid mechanical impacts on the inverter during assembly process.
- Do not use the inverter if it drops during handling.
- Check if product is properly identified and if it's enclosure is without cracks.

3.1.1 Inverter cables arrangement

The input and communication cables are not provided by Embraco. Therefore, inverter cables must be arranged according to the following instructions.

1. Push/pull repeatedly the cover plastic flap until it detach as much as necessary to pass the cables.
2. Take care to positioning the EMI earth (when applied) and Safety earth cables with the protecting tape beneath the cord relief as shown in Figure 3.1.
3. The cables must pass through the cord relief as shown in Figure 3.2.
4. Assemble the cord relief.

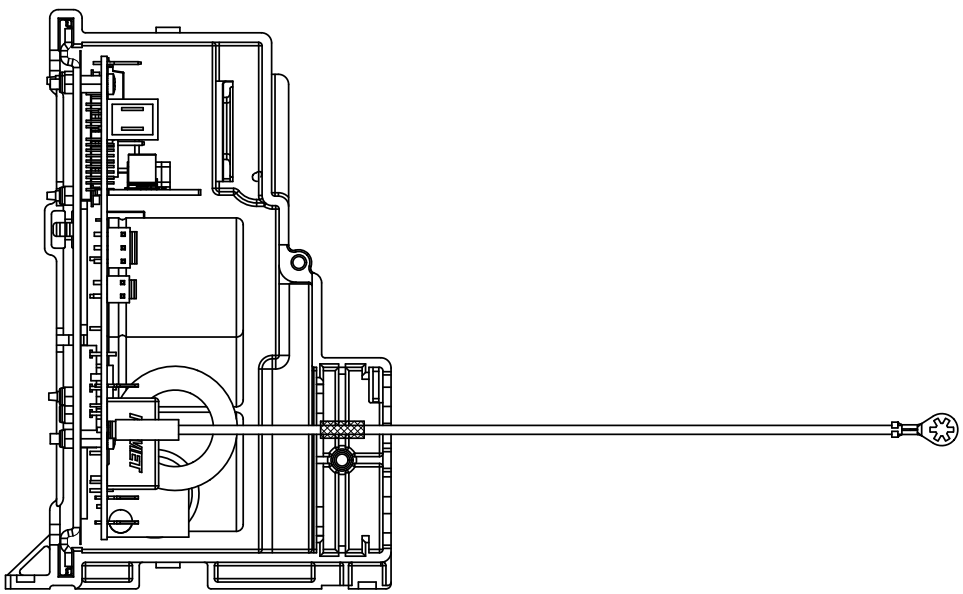


Figure 3.1: Cables arrangement

Routing Description	
Indicator	Description
1	AC Input Cable
2	EMI Earth Cable (optional)
3	Communication Cable
4	FAN Cable
5	Cord Relief
6	Fixing Screw

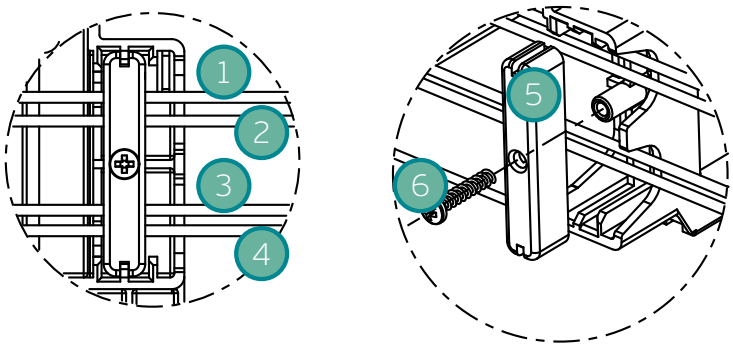


Figure 3.2: Cord relief assembly

CAUTION

- On the mains terminal (L or N) use insulated female FASTON terminals in order to prevent any risk of short-circuit due to terminals bending.
- Avoid routing cables over the cord relief, otherwise the product may damage due to mechanical stress.
- The screw shown in Figure 3.2 must be fixed with a torque within 0.8 - 1.2 Nm.
- After concluded the routing, the plastic cover must be reassembled, fixing the scew with a torque between 0.8 - 1.2 Nm.

NOTICE

- The approval of the input supply cables specifications and certifications as well as the cord relief interaction with the input cables is customer responsability.

3.2 Inverter fixation and installation

The inverter must be fixed in the system by using the screwholes available in the inverter plastic enclosure.

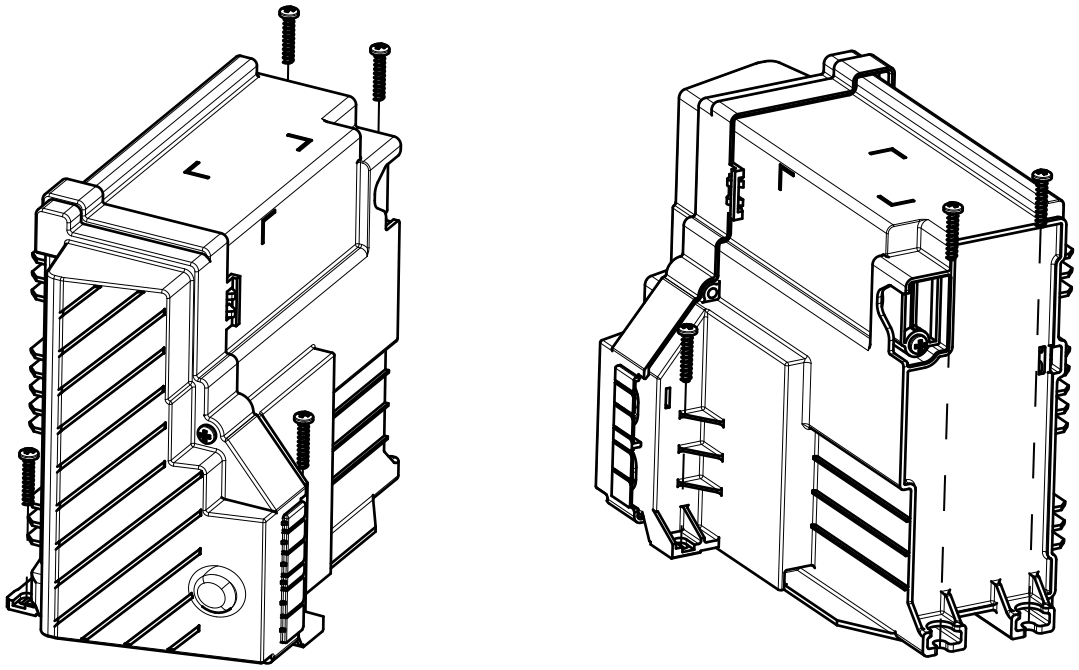


Figure 3.3: Inverter fixation

NOTICE

- The screws presented in Figure 3.3 are only for reference of screwing positions. To fix the inverter in the system the customer shall use a screw or washer with following specification: screw head or washer with minimum diameter of 10 mm; torque range from 1.5 to 2.0 Nm.

The product is approved for forced ventilation application, in which the air flows through the heatsink. Applying the product with restricted ventilation may reduce product performance by activating the thermal protection. The inverter heat sink recomended air flow is shown in Figure 3.4.

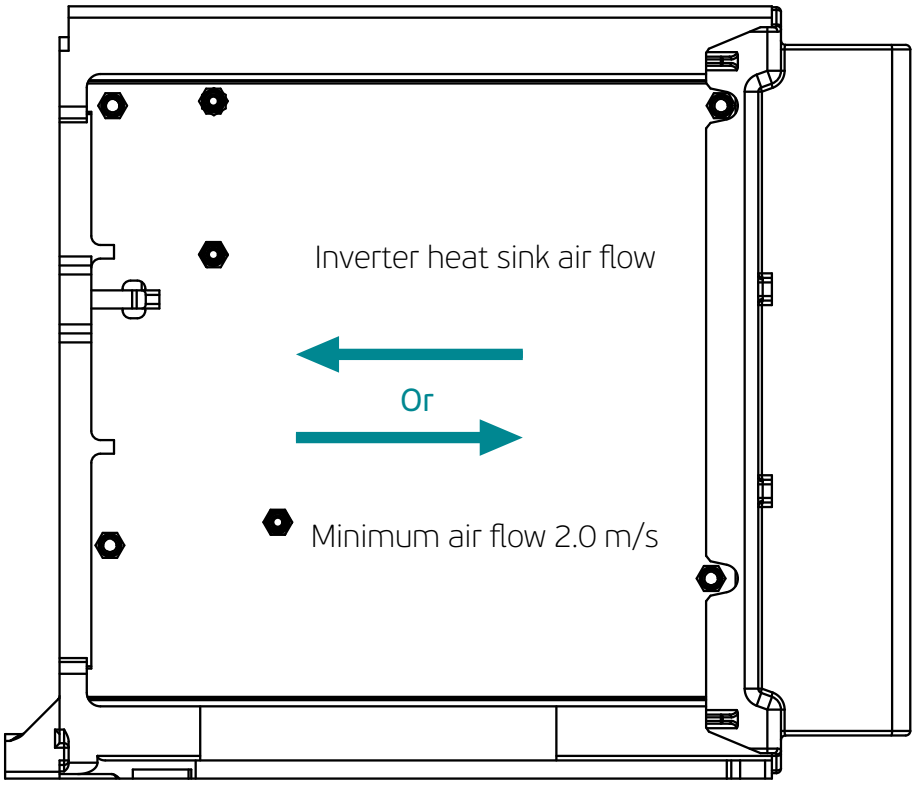


Figure 3.4: Inverter air flow direction

CAUTION

- In order to avoid loss of performance, make sure that the heat sink is not obstructed from the air ventilation.
- Maximum power is only achieved with minimum forced ventilation of 2 m/s over the inverter heat sink and 520 m^3/h air flow over the compressor.
- Distance from fan to compressor shell must be less than 30 cm.

Recommended position of fan + compressor + inverter are shown in the Figure 3.5. All mentioned positions are acceptable. Considering specific aspects as inverter and motor-compressor cooling, the most recomendated are positions 1-4. The last recomendated but still acceptable are positions 5 and 6.

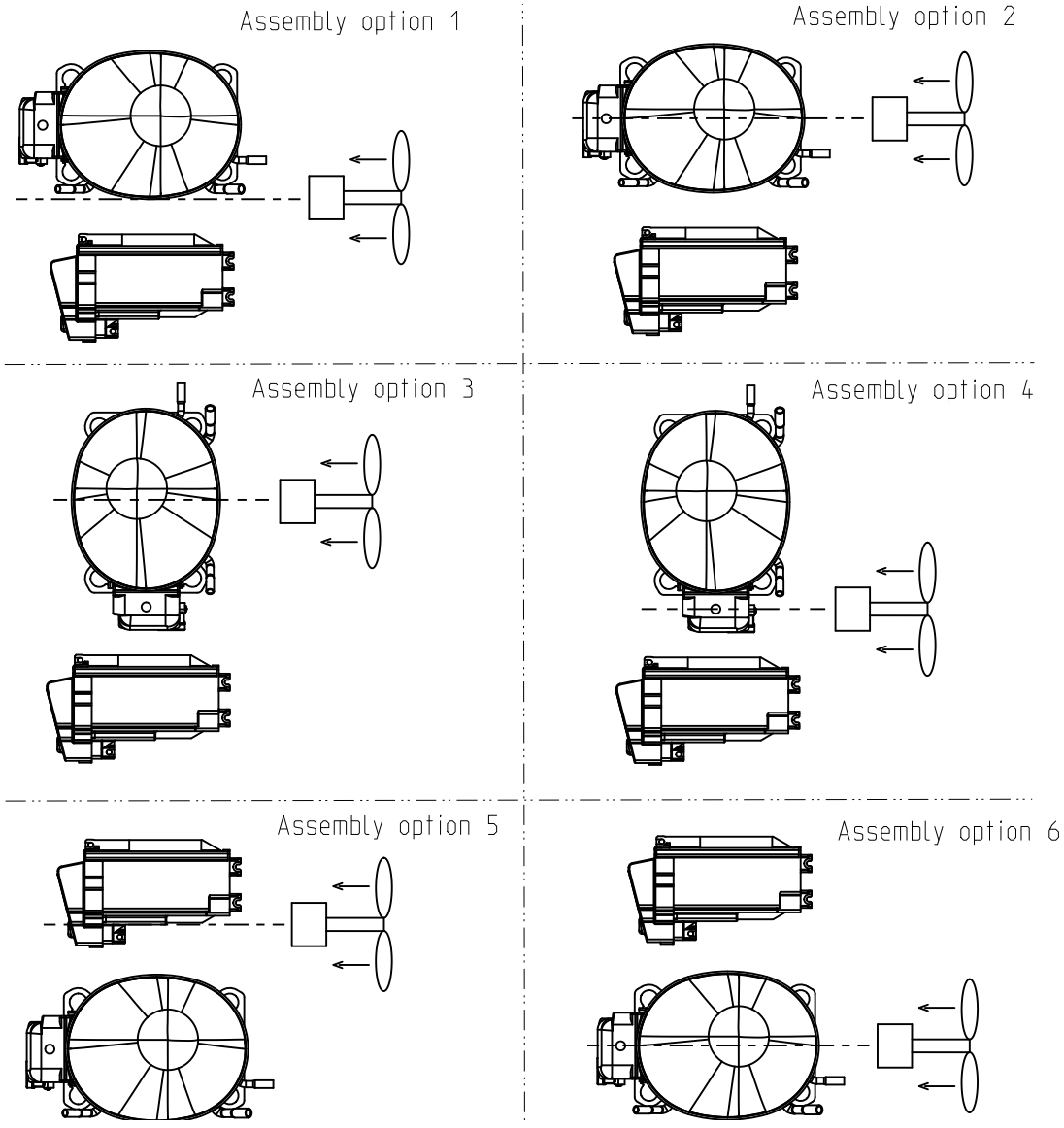


Figure 3.5: Air flow direction[i]

3.2.1 Compressor cable connection

To connect the inverter to the compressor, attach the motor cable on the hermetic compressor terminal, as shown in Figure 3.6.

[i]The figures displayed here are merely illustrative

[i]The figures displayed here are merely illustrative

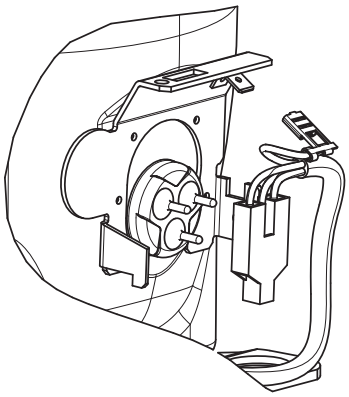


Figure 3.6: Step 1[i]

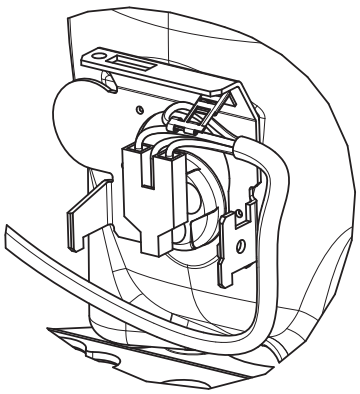


Figure 3.7: Step 2[i]

After performing the connections, assemble the compressor fence cover as shown in the following sequence (Step 3 and 4).

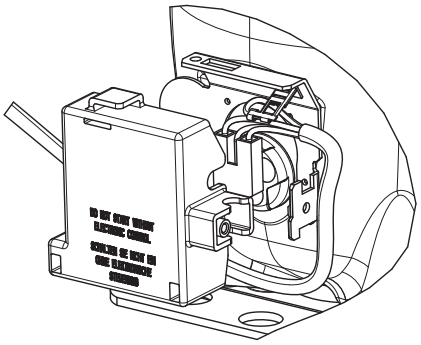


Figure 3.8: Step 3[i]

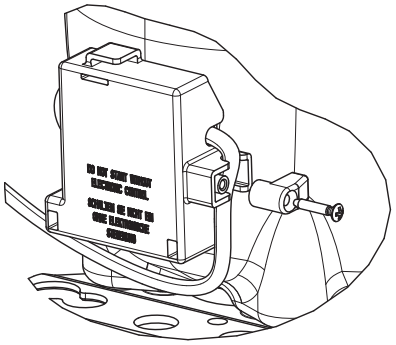
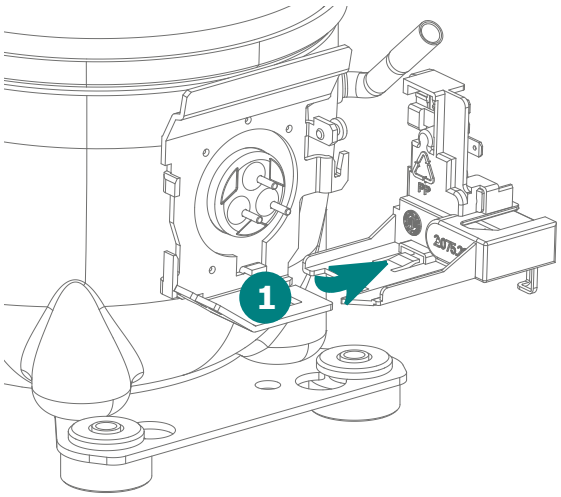


Figure 3.9: Step 4[i]

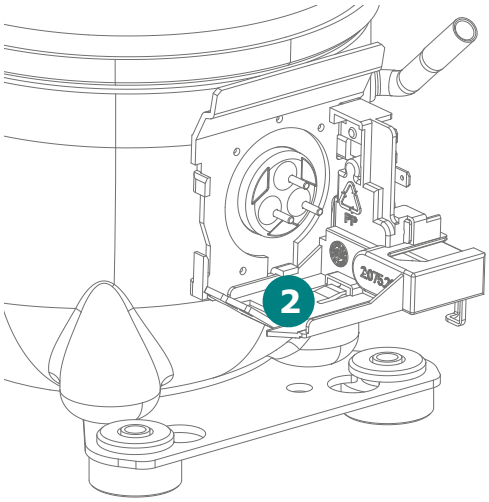
3.2.2 VNE compressor cable connection

To connect the inverter to the compressor, attach the motor cable on the hermetic compressor terminal, as shown in the Figres 3.10 and 3.11.

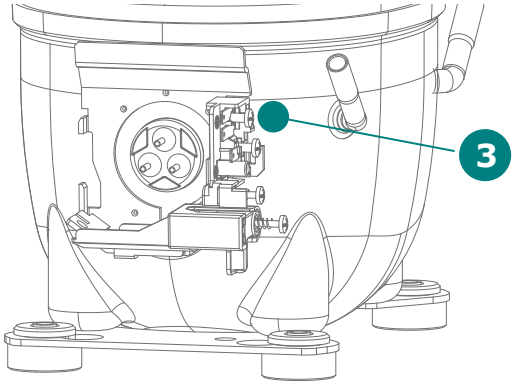
[i]The figures displayed here are merely illustrative



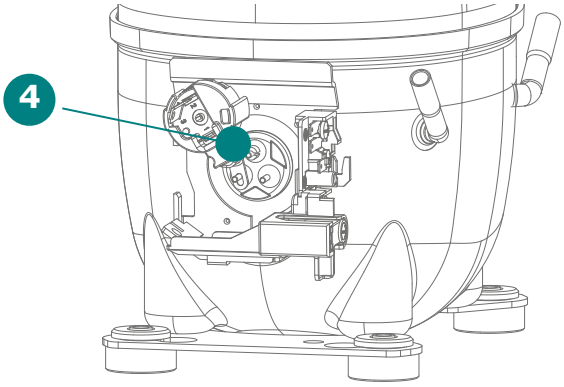
Step 1:
Check the cord anchorage position on the fence support (1).



Step 2:
Slide cord anchorage snap for attachment on fence (2).

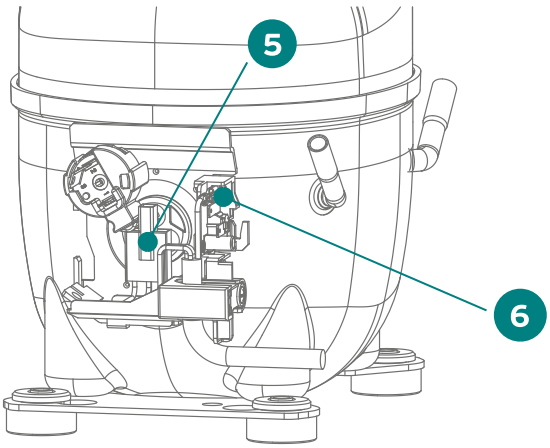


Step 3:
Grounding terminal to fasten the screw in cord anchorage bracket (3) (screw torque 0.1 - 0.6 N.m.).



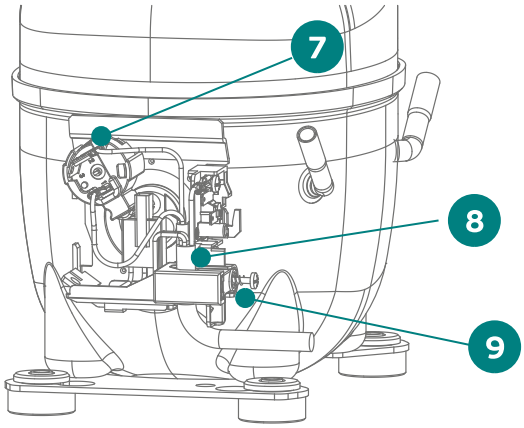
Step 4:
Insert OLP bracket in the hermetic terminal pin (4).

Figure 3.10: Steps for connecting the VNE compressor cable - I[i]



Step 5:
Inverter conector insertion in the compressor hermetic terminal (5).

Step 6:
Insertion of grounding cable



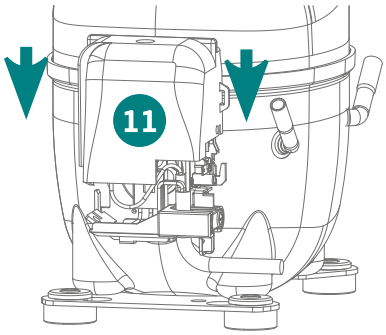
Step 7:
Inverter terminal cables on OLP (7).

Step 8:
Inverter cables positioning on cord anchorage bracket (8).

Step 9:
Insert and screw the cable clip (screw torque 0.7 - 1.2 N.m.).

Step 10:
Complete electrical cables fastening.

Step 11:
Place terminal board cover on fence support top-down (11) until complete fit (12).



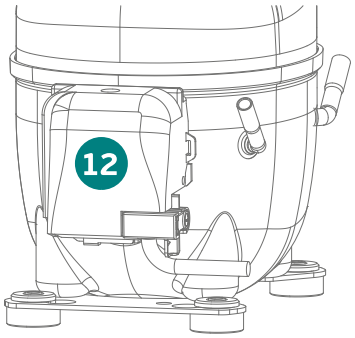
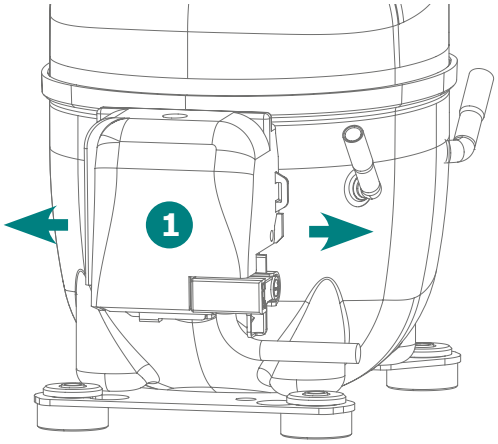


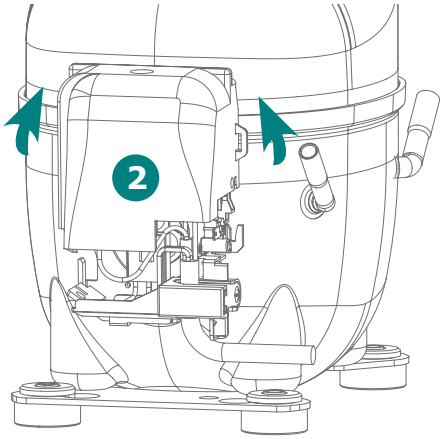
Figure 3.11: Steps for connecting the VNE compressor cable - II[i]

[i]The figures displayed here are merely illustrative

To disassemble the fence cover, the following sequence must be adopted.



Step 1:
Using a screw driver, push the keys in tabs of terminal board cap.



Step 2:
Force the tabs on the opposite direction (13) and then move the cap up (14).

Figure 3.12: Removing the VNE compressor cover[i]

WARNING

- Before obtain access to connectors, disconnect the AC power supply.
- Avoid contact of the Control Input Cable (low voltage) with high voltage or power supply cables, due to electrical hazard and potential equipment damage.

NOTICE

- Please, before emplying the inverter with compressor, refer to compressor technical documentation not covered in the manual. In case of doubt, please, contact Embraco technical support.

[i]The figures displayed here are merely illustrative

CAUTION

- Motor connector must be properly mounted on the 3 pins of compressor hermetic terminal. Bad connection will cause compressor malfunction.
- The screws shown in Figure ?? and Figure 3.9 must be fixed with a torque within 0.8 – 1.2 Nm range.
- The handling of Inverter enclosure must be careful to avoid contact with the internal electronic board, in order to prevent possible electrostatic discharges.
- Make sure all necessary connections are properly done before connecting the Inverter to AC supply line.
- The electronic Inverter must be installed in the vertical position. Refer to Figure 3.5 for recommended assembling positions.
- When using Serial or Frequency communication mode the inverter has reinforced isolation. When using Drop-in mode (energized contact) the inverter has functional insulation.
- In order to avoid ESD discharge to the inverter circuit, insert the earth terminals at first.

3.2.3 Optional AC Fan switch control

CF10B inverter series can be equipped with AC Fan switch control. This switch is ON in case compressor is running and OFF once compressor is stopped. Note, that AC Fan switch control is not powered. It operates like a switch to interrupt the AC supply Line or Neutral of the FAN.

Following connections to be made for switching power of the AC Fan:
- one terminal of AC Fan output to the Phase (or Neutral);
- second terminal of AC Fan output to customer's AC Fan terminal;
- the remaining terminal of customer's AC Fan to the Neutral (or Phase).

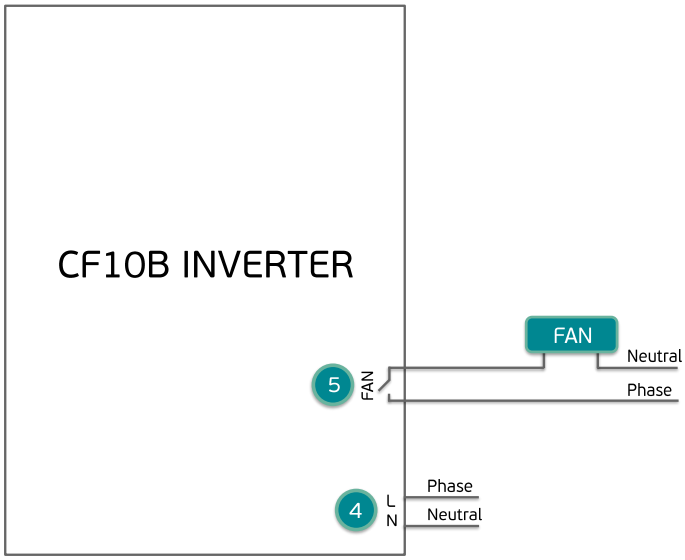


Figure 3.13: Frequency control mode connection

3.3 Safety Recommendations of Electrical Installation

The Inverter shall be powered only in electrical installations with a ground fault circuit interrupter (GFCI) circuit breakers or residual current device (RCD), according to the country technical requirement.
In single-phase installations, the line phase wire shall be protected by a circuit breaker. Furthermore, the line phase wire must be connected to the phase input connector of the inverter and the line neutral to the neutral input connector of the inverter.

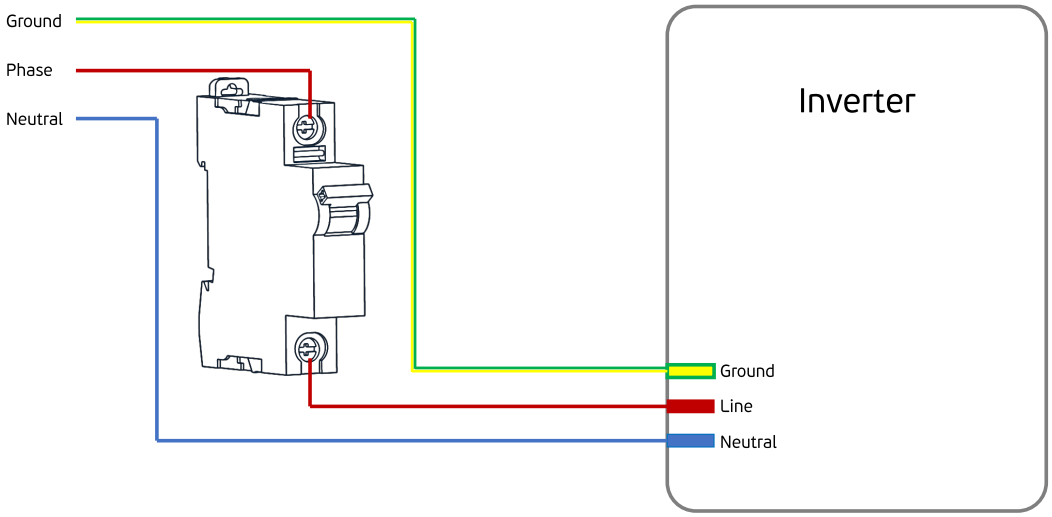


Figure 3.14: Phase-Neutral connection

In the case of two-phase installations, it is recommended to use a 2-pole circuit breaker, because in case of a short circuit both phases of power supply are protected.

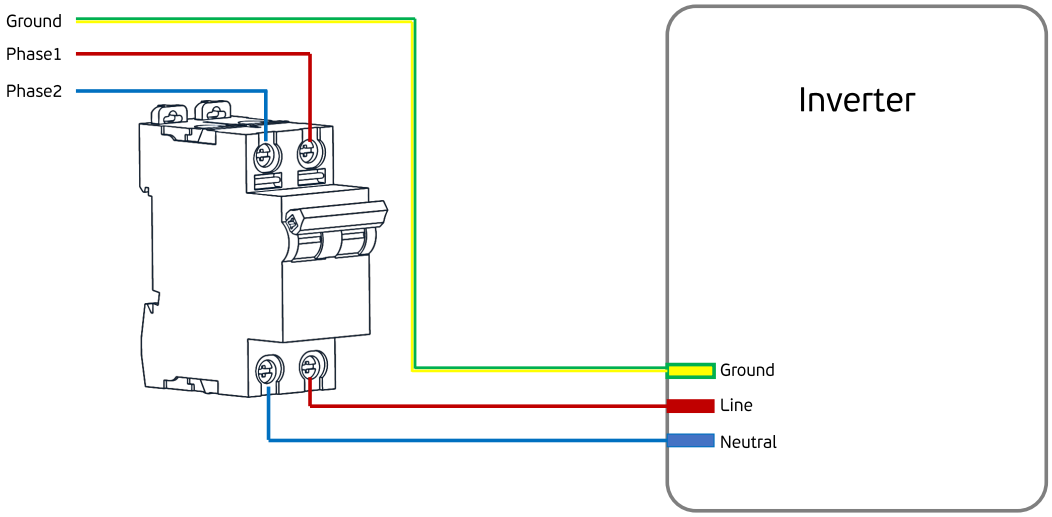


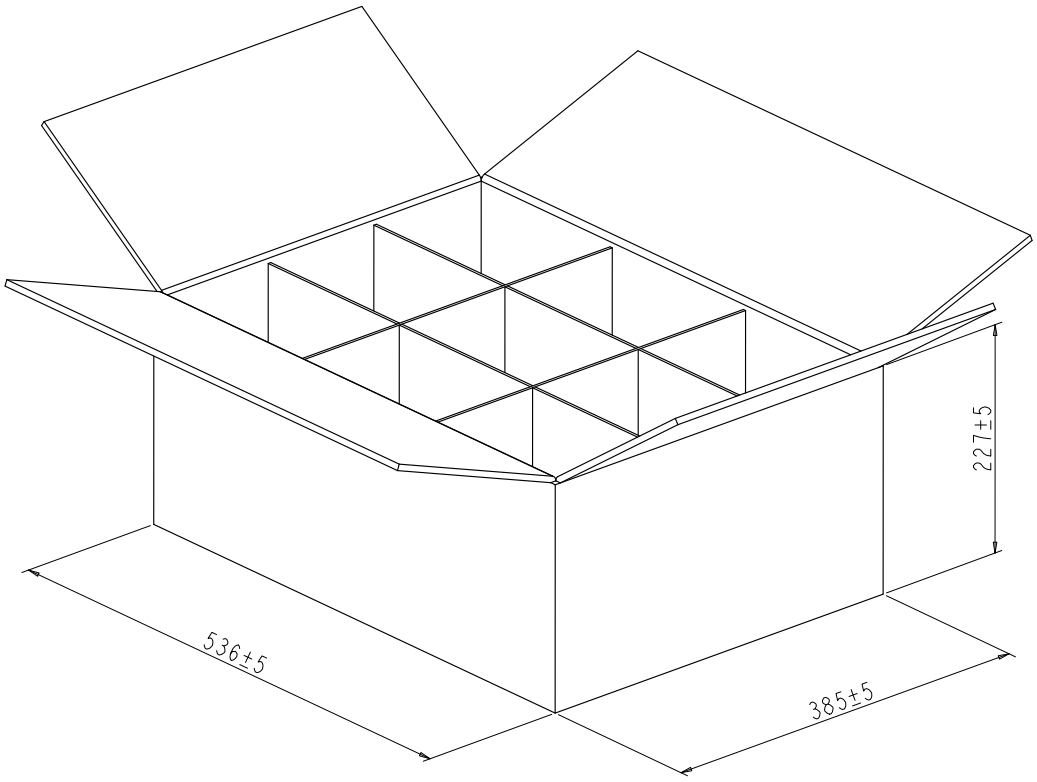
Figure 3.15: Phase-Phase connection

3.4 Package information

The inverters are delivered packed in a carton box. Box dimensions can be changed without previous information.

Storage Conditions	
Storage humidity	< 85%
Storage ambient temperature	-40 ºC to 85 ºC

Configuration	Quantity	Dimensions
Config #1	9	536 x 385 x 227



*Dimensions are in mm.

Figure 3.16: Product package

3.4.1 Product discards

CAUTION

- Do not remove the inverter board from its case.
- Do not incinerate Embraco's inverter. Contact your local authorities, if you need to incinerate this product for disposal.
- Inverters should not be mixed with general waste.

NOTICE

- If you wish to discard this product, please contact your local authorities or dealer for the correct method of disposal, for proper treatment, recovery and recycling.
- The product package and its internal partitions are made of carton and can be disposed as recyclable waste.
- This device is RoHS compliant, nevertheless the correct disposal of this product will help to save valuable resources and prevent any potential negative effects on human health and the environment (e.g.: to avoid ground disperse) which could otherwise arise from inappropriate handling.

Chapter 4

OPERATION

The CF10B Inverter have support for Serial, Frequency and Drop-In communication modes.

NOTICE

- The inverter is assembled with all communication modes and the control mode is chosen automatically by the inverter.
- Output frequency and motor speed may have reduced range based on maximum working conditions of the respective compressor, not following some specific set point conditions. For detailed operating range of the selected compressor, please contact Embraco Technical Support.

4.1 Frequency control mode

In this operation mode the compressor speed is controled through a frequency signal sent to the inverter. Usually this signal is provided by an electronic thermostat.
The frequency signal is a digital square wave and its characteristics are described on Signal specification table and figure below.

Signal specifications	
Voltage range	-5 V to +15 V
OFF state	-5 V to +0.7 V
ON state	+4.5 V to +15 V
Maximum duty-cycle	70%
Minimum duty-cycle	30%
Maximum current	15 mA @ 15 V

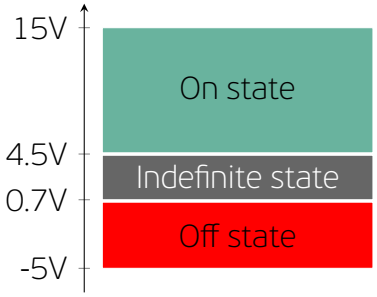
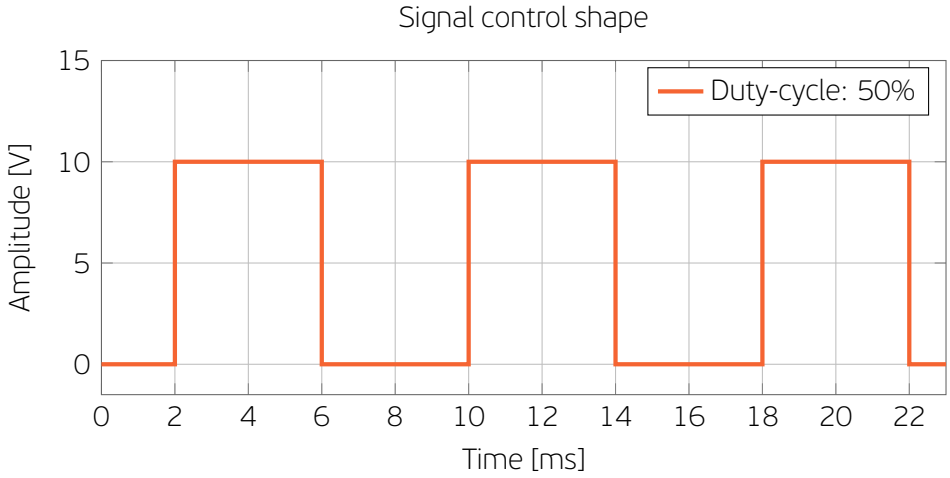


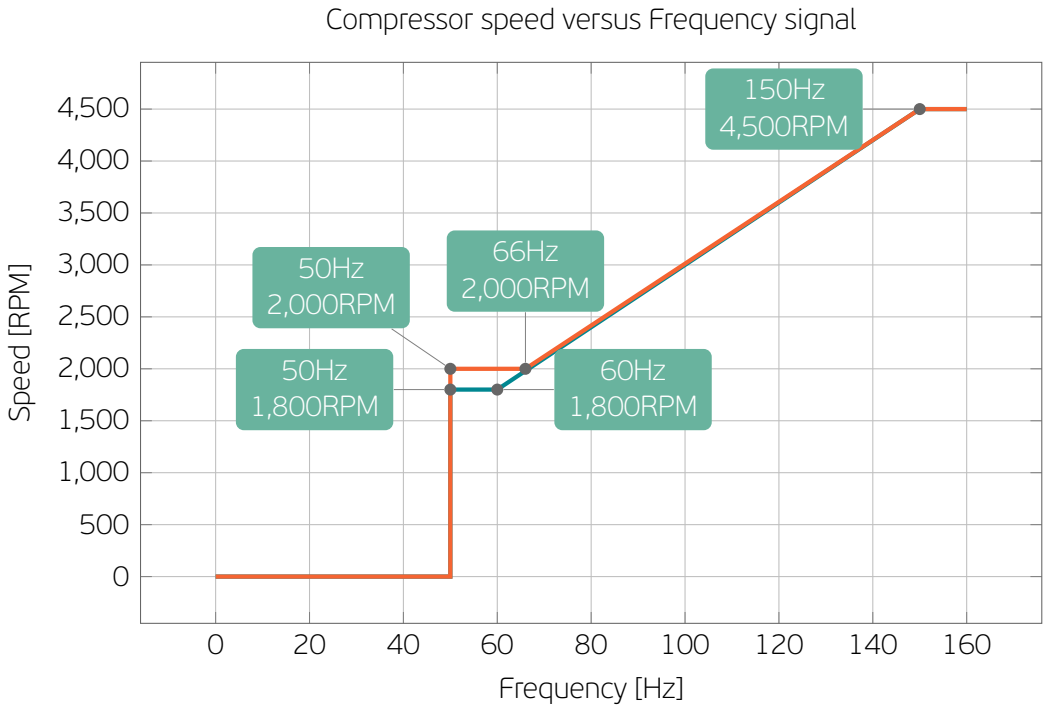
Figure 4.1: Signal levels for frequency control mode

From 0.7 V to 4.5 V the inverter behaviour is indefinite, therefore, it is not recommended to use signals within this range. The following figure presents a graphic example of an input frequency signal of 125 Hz sent to the inverter. The digital signal duty-cycle can vary in the range of 30% to 70%.



The compressor will follow frequency signal sent to the inverter according to the relation described on the following table and illustrated on the graph below.

Input Frequency Signal [Hz]	VNE compressor speed [RPM]	VEG and FMF compressor speed [RPM]
0 to 50	0	0
50 to 60	2000	1800
60 to 66	2000	30 x Hz
66 to 150	30 x Hz	30 x Hz
>150	4500	4500



The Figure 4.2 shows the electrical connections to perform frequency conmmunication between an electronic thermostat and CF10B Inverter Control connector. For Frequency Control Mode, the input resistance is 1.2 kΩ.

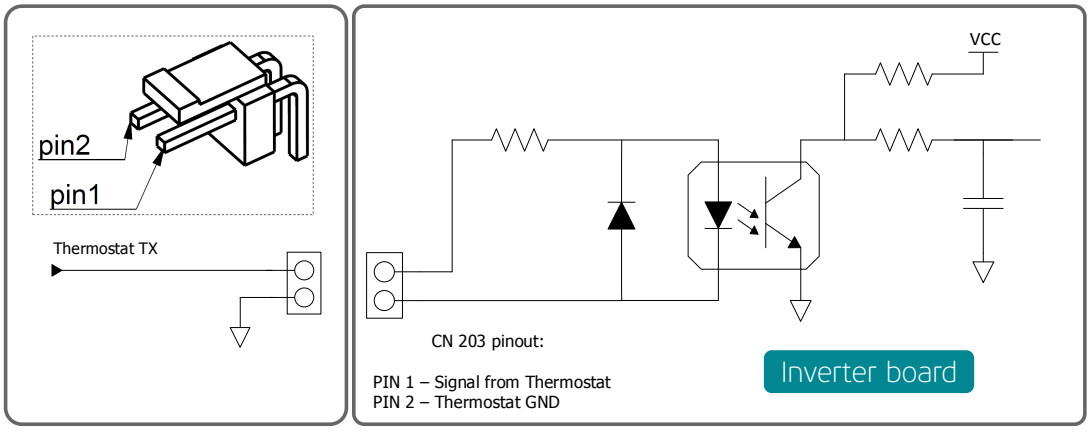


Figure 4.2: Electrical schematic of frequency communication

4.2 Drop-In control mode

The Drop-In mode is a CF10B Inverter control mode, where single thermostat contact is used to set the compressor running conditions. Drop-In mode allows the application to any refrigeration system with a simple ON/OFF thermostat, without needing a rotation control signal through serial or frequency communication. The compressor speed will be adjusted automatically by the Inverter, in accordance to the thermal load variation. This solution has 2 versions, the Default Drop-In and the Smart Drop-In.

4.2.1 Default Drop-In

Not recommended for new designs

This solution was designed with a focus on efficiency, where the control logic is divided in two main parts: when the compressor is energized by the first time (pull-down) and when the compressor is cycling (after the thermostat has switched off the compressor for the first time).

First time Pull-down

After 3 minutes of intermediary speed, the speed is increased to maximum and it is kept at this rotation until the thermostat opens, switching the compressor off.

Normal cycling

Compressor speed increases and decreases proportional to thermal load variation during compressor running time. Optimum speed will be targeted to minimize energy consumption. If thermal load remains constant for a period longer than 20 minutes, the compressor speed is increased.

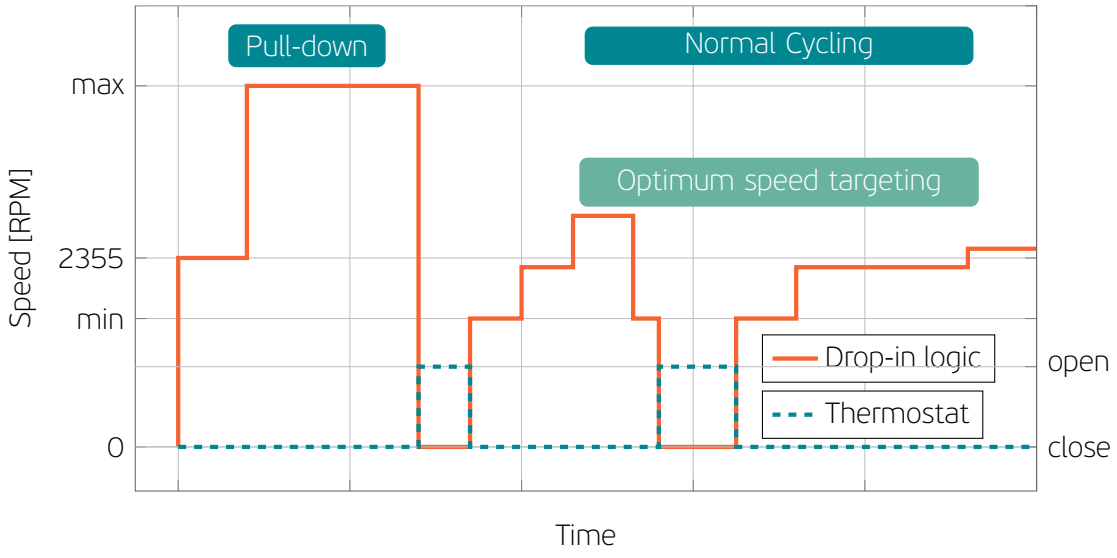


Figure 4.3: Compressor speed versus thermostat behavior Default Drop-in

4.2.2 Smart Drop-In

Recommended for new designs

The Smart Drop-In was designed with focus on cooling capacity, but always considering good system efficiency. This solution provides a customization tool that allows the routine to be parameterized and adjusted for each refrigeration system.
The logic is divided in four mains parts: Pull-down, Stability Routine, Heavy Duty Routine and Defrost Routine. The Stability, Heavy Duty and Defrost Routine begin to run in parallel after Pull-down is completed.

First time Pull-down

Whenever the inverter is powered up, Drop-in is set to the pull-down state, where the compressor runs on the maximum allowed speed, generating more cooling capacity to reduce the pull-down time. This state is kept until thermal load reach stability.

Stability Routine

The stability cycling is the main routine of Smart Drop-in. This routine will select the best speed to run the compressor, in order to achieve the target cycle duration. The target duration is set by the system's manufacturer through the customization tool via computer.

Heavy Duty Routine

The heavy duty is a routine running on the background, that keeps checking the compressor's load to identify disturbances and exceptional cases of the system. Based on inverter electrical parameters variation, which represents the thermal load curve, it takes decisions of change or not the speed.

Defrost Routine

This routine is used for greater accuracy in detecting defrost, reducing the time of defrost (e.g. Hot-Gas) and accelerating the recovery in the post-defrosting (e.g. Hot-Gas and Heater).

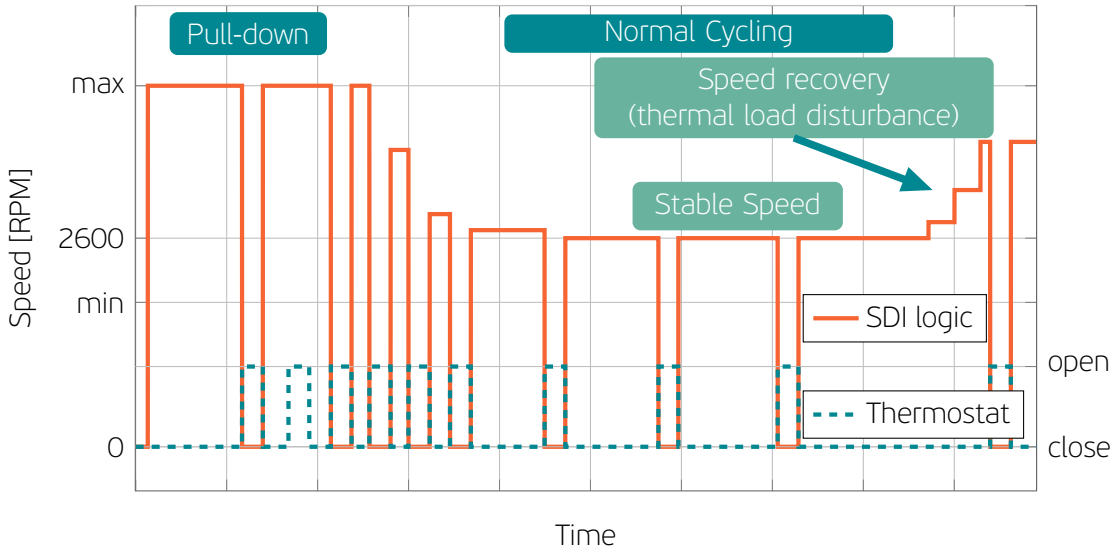


Figure 4.4: Compressor speed versus thermostat behavior Smart Drop-in

For more information, such as 'Quick start guide', Smart Drop-In manual, application notes and tutorial videos, please access our website Embraco Smart Drop-In.

4.2.3 Defrost input (optional)

The Defrost input is an additional control signal for Drop-in logic, which allows the Inverter to improve the product performance by detecting when a defrost happened. For the Default Drop-in, the Defrost input sets the compressor at maximum capacity and keeps it for two cycles. The Drop-in input still defines the compressor state, i.e. on/off operation.
For the Smart Drop-in, the Defrost input will be compared to the Drop-in input to detect if appliance is operating with a Heater (resistance) or Hot-gas defrost, acting differently in each case. The logic sets the compressor at maximum capacity during a Hot-gas defrosts. In both cases, the post-defrost cycle is performed with higher speed, in order to recover the appliance temperatures. More information can be found on our website Embraco Smart Drop-In.

NOTICE

- The Drop-in input still defines the compressor state, i.e. on/off operation.

4.2.4 Connection

The Drop-In mode connection shall be wired according to Figure 4.5. The connection is an Energized Contact and must be used when the thermostat control signal is energized directly from the AC phase. This signal is usually called Thermostat Return Signal.

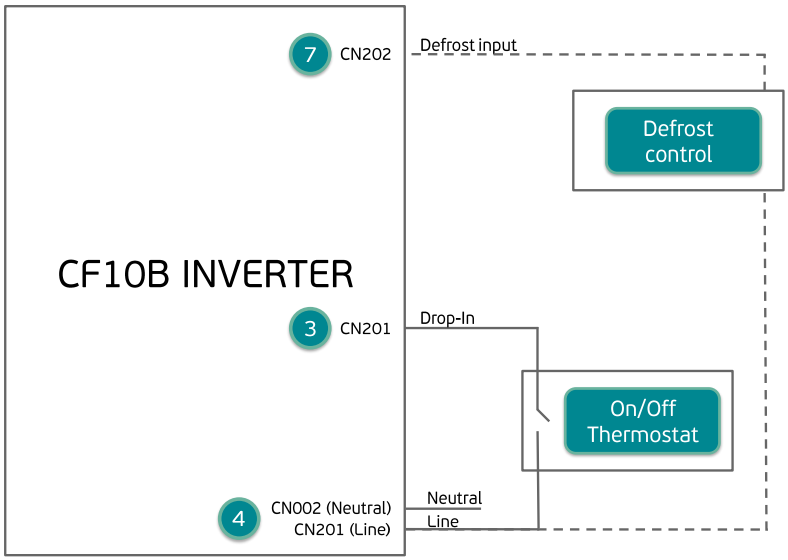


Figure 4.5: Energized Contact Drop-In connection

CAUTION

- When opened, the thermostat and defrost control impedance must be higher than 380 kΩ. Otherwise the compressor can run continuously, without ever turning off.

NOTICE

- All main parameters, such as minimum and maximum speed are described at compressor datasheet.

4.3 Serial control mode

This option is used when an electronic thermostat controls the CF10B Inverter uses a serial communication protocol. Based on Embraco protocol it is possible to define the compressor speed and check other parameters.

NOTICE

- Avoid the use of serial communication with inverter while using the 'You Control' interface.

4.3.1 Serial specifications and Internal Circuit

The Serial Control mode has an isolated input stage provided by the usage of optocouplers. The circuit on Figure 4.6 shows the electrical connections to perform serial communication between an electronic thermostat and CF10B Inverter serial connector (CN204).
The input resistance for serial communication, shown in Figure 4.6, is 1.2 kΩ.

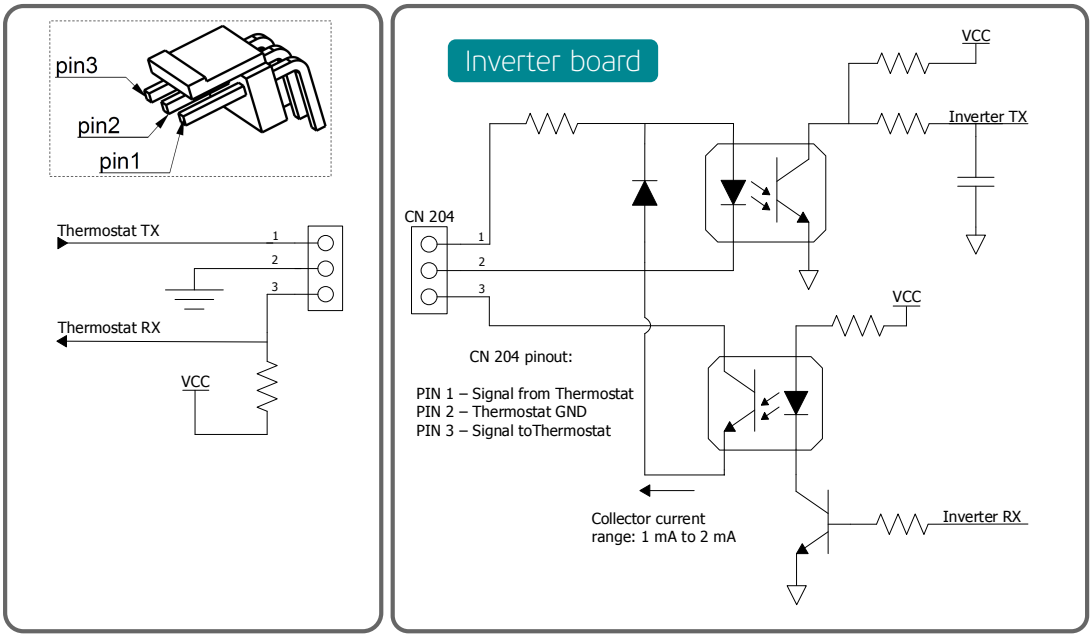


Figure 4.6: Electrical schematic of serial communication

To guarantee the correct functionality of serial communication, the signal to be sent to the inverter must be according to the following values.

Signal specifications	
Voltage range	-5 V to +15 V
TRUE state	-5 V to +0.7 V
FALSE state	+4.5 V to +15 V
Maximum current	2 mA @ 15 V

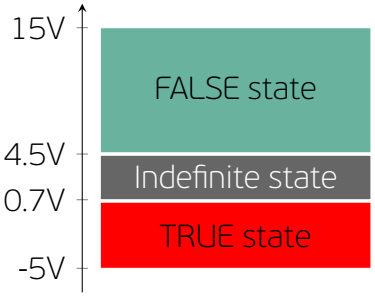
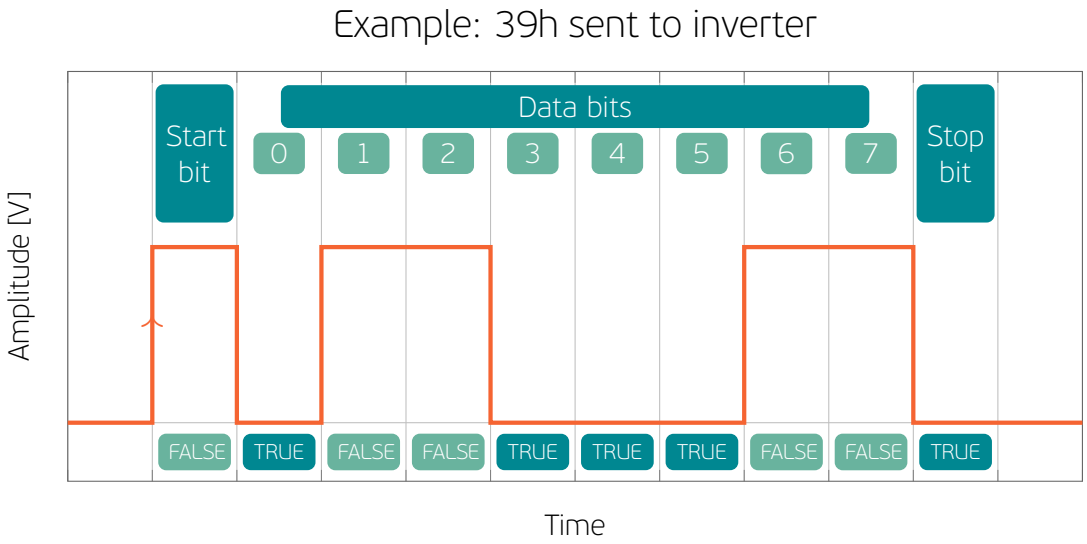


Figure 4.7: Signal levels for serial communication



The identification byte (1st byte), is used for command synchronization. After inverter identifies a valid A5h, it starts to read the next 4 bytes. After reading, a response will be sent as indicated on "Receive commands structure" table. No response will be sent until the inverter recognizes a byte A5h. There is a time out of 2 seconds to receive the entire command after inverter identifies one A5h. After this time out, a new synchronization will start.

Basic specification	
Communication type	UART (Half-Duplex)
Baud rate	600 baud
Parity	None
Flow control	None
Unit size	5 Bytes
Electronic thermostat	Host
Inverter	Slave

To perform serial communication between a computer (RS-232) and the CF10B Inverter serial connection, please contact Embraco Technical Support to receive instructions.

4.3.2 Commands

Command structure				
1st Byte	2nd Byte	3rd Byte	4th Byte	5th Byte
Identification (ID)	Command (CMD)	LSB*	MSB**	Checksum*** (CK)

*Least significant Byte (LSB) of Data. Example: Data=ABCDh, thus Data low=CDh.

**Most significant Byte (MSB) of Data. Example: Data=ABCDh, thus Data high=ABh.

***Checksum=100h - (S14h AND 0FFh), where S14h is the addition of Bytes 1 to 4.

Transmit commands structure					
Command	ID	CMD	LSB	MSB	CK
Set speed	A5h	C3h	Speed [RPM]		CK
Read set speed	A5h	3Ch	80h	39h	CK
Read operation status	A5h	3Ch	83h	39h	CK
Read power	A5h	3Ch	82h	39h	CK
Read starting trials	A5h	3Ch	81h	39h	CK
Read bus voltage	A5h	3Ch	84h	39h	CK
Read temperature	A5h	3Ch	88h	39h	CK
Read power limitation	A5h	3Ch	8Ah	39h	CK
Serial set speed overwrite	A5h	69h	[Note]	93h	CK

Receive commands structure					
Response to:	ID	CMD	LSB	MSB	CK
Set speed	5Ah	83h	Status*		CK
Read set speed	5Ah	80h	Speed [RPM]		CK
Read operation status	5Ah	83h	Status*		CK
Read power	5Ah	82h	Power [W]		CK
Read starting trials	5Ah	81h	Number of trials		CK
Read bus voltage	5Ah	84h	Voltage [V]		CK
Read temperature	5Ah	88h	Temperature [ºC x 10]		CK
Read power limitation	5Ah	8Ah	Power limitation [W]		CK
Serial set speed overwrite	A5h	C3h	[Note]	00h	CK
Communication error	5Ah	Code**	FFh	FFh	CK

*See Status Data table.

**See Error Code table

[Note]: Serial set speed overwrite status/command:
00h – Serial set speed does not overwrite the thermostat set point
01h – Serial set speed overwrites the thermostat set point
Remark: if there is no serial communication for more than 4 h then the overwrite command is resetted.

Status Data			
H Bit	LSB	MSB	Description
-	-	00h	Compressor running
-	-	FFh	Compressor stopped (waiting for a valid start speed)
0	01h	FFh	Start failure
1	02h	-	Overload protection (Note 1)
1	02h	FFh	Overload (Note 3)
2	04h	FFh	Under speed (1550 rpm or lower)
3	08h	FFh	Wrong rotor position
4	10h	FFh	Short circuit
5	20h	FFh	Over temperature failure (Note 6)
7	80h	-	Set speed data out of specification (Note 2)
7	80h	FFh	Set speed data out of specification (Note 4)

Note 1 : This response occurs when compressor is running with a high load. If the Data High byte is 00h, compressor is still running.
Note 2 : Response to the out-of-spec set speed data received while the comp is running.
Note 3 : This response occurs when compressor is stopped due to high load.
Note 4 : Response to the out-of-spec set speed data received while the comp is stopped.
Note 5 : When one or more errors occur, the corresponding bits "H" are set to 1.
Example: Overload and Under speed: 0xFF06
Note 6 : The over temperature failure refers to when the inverter turns off due to the temperature overcoming 105°C, not to the temperature protection actuating.

Error Code	
Code	Error
F0h	Error in 4th Byte
F2h	Checksum error
F4h	Command error
F8h	Error in the 3rd Byte

If compressor is stopped due to a failure (see Data Status table), it is possible to reset that failure sending a speed command to turn inverter off (0 rpm set speed). However, if nothing is done, the failure reset will occur after 8 minutes and then the compressor will try to restart. The following example shows a situation where the compressor speed is set at 2000 RPM.

Example: Set compressor at 2000 RPM
Step 1: select proper command
Command for selecting a speed is **Set speed**
ID →A5h
CMD →C3h
Step 2: transform speed from decimal into hexadecimal base
2000d →07D0h
Step 3: split lower and higher Bytes
LSB →D0h
MSB →07h
Step 4: calculate sum of first 4 Bytes
S14h=A5h+C3h+D0h+07h
S14h→23Fh
Step 5: boolean logic to maintain sum as 8-bit
L14h=0FFh AND S14h
L14h →3Fh
Step 6: calculate checksum
CK=100h-(0FFh AND S14h)=100h-3Fh
CK= →C1h
Command: A5h C3h D0h 07h C1h

NOTICE

- To avoid noise increasing and damages to the compressor due to mechanical resonance, some operating speeds are forbidden by software for all control modes.
- When one or more errors occur, the corresponding "H" bits are set to 1. Example: Overload and Under speed LSB →06h.
- The Frequency and Drop-In modes can have serial communication only for monitoring purpose. This functionality can be used for product diagnostic.

Chapter 5

DIAGNOSTICS

The CF10B Inverter has two diagnostics methods, by visual light emission using a LED indication, or by serial communication protocol.

5.1 LED indication

The LED diagnostics function helps services technicians to diagnose possible fault components by blinking a LED inside the box in different patterns. Basically, it indicates if there is a problem with Compressor, CF10B Inverter or Thermostat. The table below describes the failure modes.

LED Status	Period	Color	Description
1 Flash	30 seconds	Green	Normal operation
2 Flashes	5 seconds	Green	Communication problem
3 Flashes	5 seconds	Red	Inverter problem
4 Flashes	5 seconds	Orange	Compressor problem
No Flash	–	–	No input power / Damaged inverter

5.2 Troubleshooting

The following tables shows some possible problems and the best action to deal with them.

Compressor does not start	
Problem	Action
Compressor disconnected from the inverter.	·Verify compressor cable connection.
No AC power supply; or wrong voltage/terminals connected.	·Verify AC input cable connection and measure AC input voltage.
No control signal input or bad connection.	·Verify control input cable connection and measure the signal from the thermostat.
Blown fuse (due to previous major failure).	·Return the unit to manufacturer, replacing it by new one.
Open compressor motor winding.	·Measure winding for open circuit between all pair of pins on the hermetic terminal. If any winding is open, return compressor to manufacturer.
Compressor with locked rotor (due to mechanical damage).	·Replace compressor by new one and test for confirmation. Return damaged unit to manufacturer.
Dropped, damaged, burnt inverter.	·Replace by new one and test for confirmation. Return damaged unit to manufacturer.
Inverter on waiting time after failed start.	·Wait the necessary time or reset the inverter disconnecting it from the AC power supply. The reset time is about 50s.
Demagnetized rotor (only if compressor was previously connected directly to the AC power supply).	·Replace compressor by a new one and test for confirmation. Return damaged unit to manufacturer.
Unequaled pressures between discharge and suction pressures in the refrigerating system.	·Allow the Inverter to equalize pressure between suction and discharge sides.
Low input voltage supplied to the inverter.	·Measure AC voltage to confirm.

Compressor does not run at the selected speed	
Problem	Action
High compression load, with compressor being subjected to a stall condition.	·Review system design,refrigerant gas load or compressor capacity is not suitable for the application. If system is apropriated designed, speed will reach set value when load condition is stabilized.
Compressor always on pulldown cycle for Drop-In Mode.	·In Drop-In mode, check if the inverter AC input is connected to thermostat output. Inverter AC input should be directly connected to AC power supply (see Drop-In mode schematic).
No or incorrect control signal.	·Check if the appropriate control signal is being correctly applied to the Control Input Connection.

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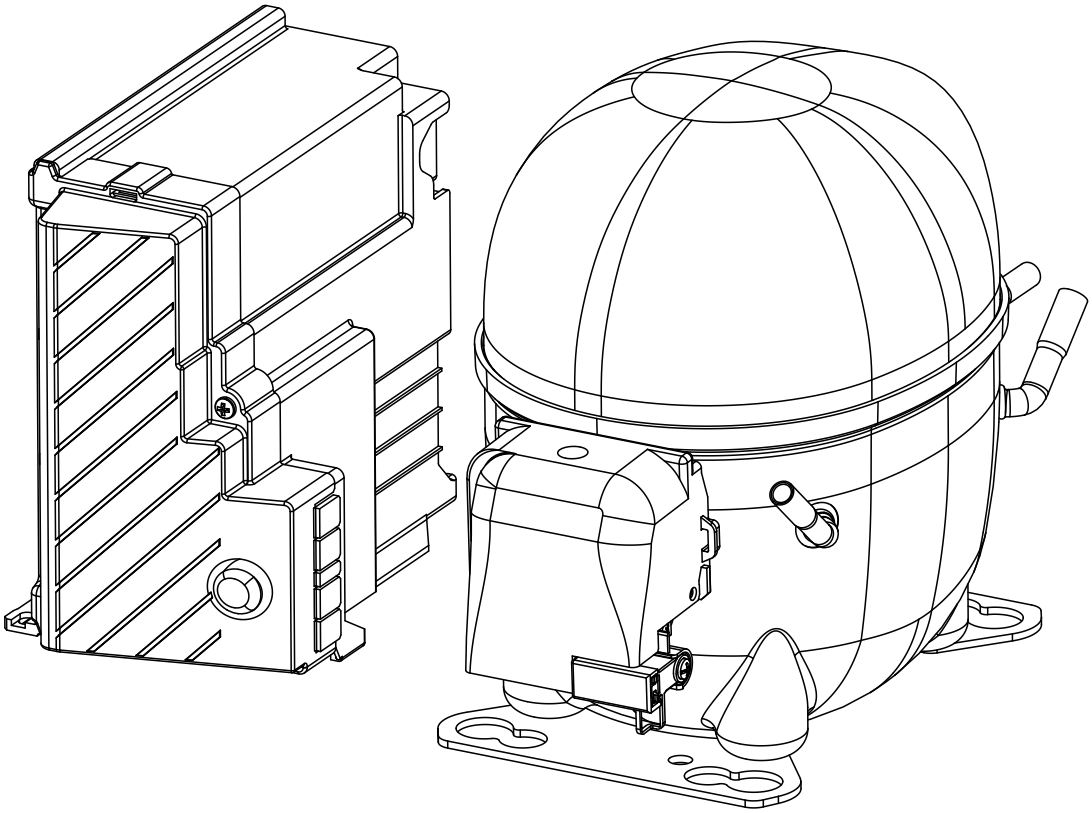

CONTACT

If after these instructions you still have doubts, please do not hesitate to contact our Technical Support.
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