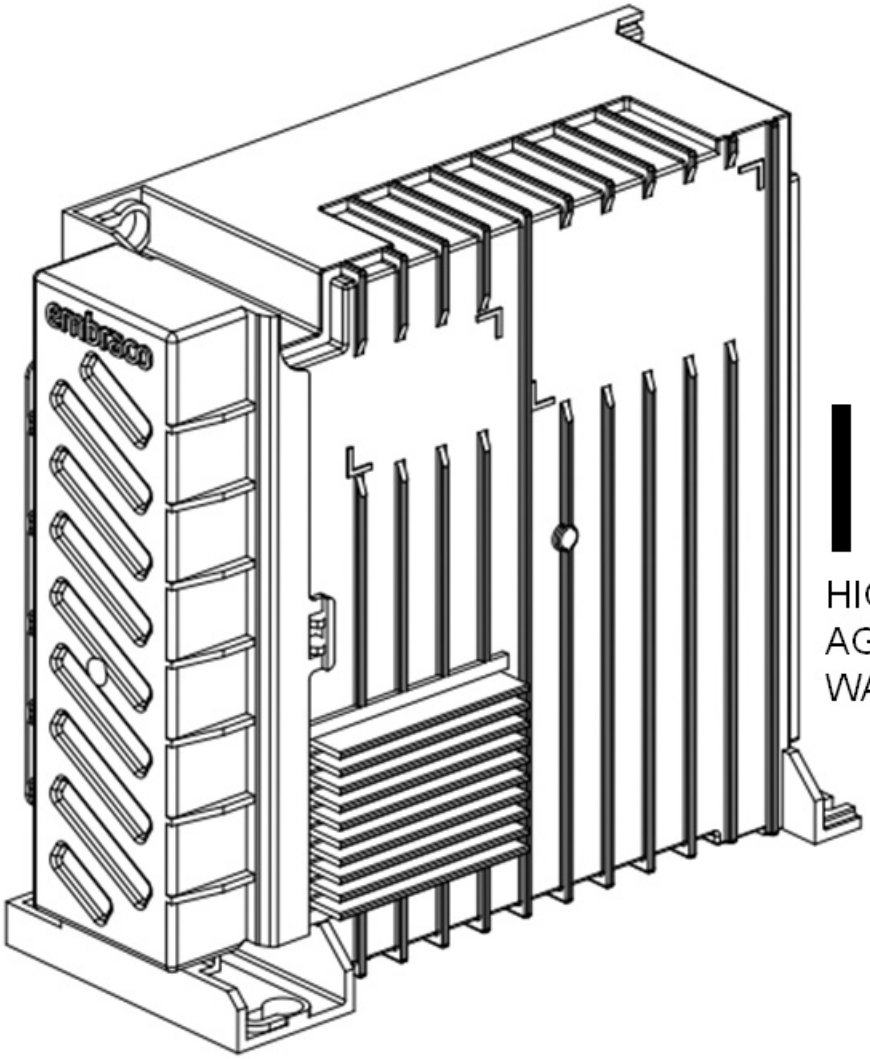
VARIABLE CAPACITY COMPRESSORS
ELECTRONIC INVERTER

PRODUCT MANUAL
CF20A01 INVERTER



IP54

HIGH PROTECTION
AGAINST DUST AND
WATER JETS

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Contents

Chapter 1

INTRODUCTION

This document contains information regarding technical specifications, installation instructions and functionality of CF20A01 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.

Improper operation may lead to bodily injury or death due to electrical hazards.

Improper operation may result in equipment damage.

NOTICE

Include helpful suggestions or references to materials not covered in this document. For access to such resources, please contact your technical support.

Chapter 2

TECHNICAL SPECIFICATIONS

2.1 Nomenclature

Table 1: Naming rules

CF 20 A 01 P 0.0 XX D YY	
CF	Driver Type
20	Family
A	Generation
01	Subversion
P	Power Supply
0.0	Protective Function configuration
XX	Eletronic Configuration
D	Enclosure
YY	Cables and Peripherals

2.2 Product specifications

Table 2: Main features

General Specifications	
Input rated voltage range [i], [ii]	208 - 240 V
Input operating voltage range [iii], [iv]	160 - 264 V
Maximum input voltage [v], [vi]	280 V
Input frequency range	50 - 60 Hz
Input rated current	9.4 A
Input rated power	1850 W
Control mode	Frequency, Serial & SDI
Operating humidity	$\leq$ 85%
Environmental humidity[vii]	10 to 85%
Operating ambient temperature[viii]	-20°C to 60°C / -4°F to 140°F
Storage temperature	-40°C to 85°C / -40°F to 185°F
Air forced ventilation (min) [ix]	2 m/s
Ingress Protection Grade	IP54

[i] Voltage range approved by Agencies.

[ii] Operating below the nominal input voltage may reduce the compressor cooling capacity due to lower link voltage and/or due to Inverter power limitation.

[iii] Minimum voltage without impact on compressor starting performance. The compressor may start with voltages below this limit if starting conditions (suction and discharge pressures) are not extremes.

[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] Inverter shall be stored in an adequate environment to avoid condensation and oxidation of its parts.

[viii] Agency approval temperature.

[ix] Air flow over the inverter heat sink, as shown in Figure 3.15.

- Do not connect the CF20A01 Inverter to a power supply exceeding the declared Maximum Input Voltage.

- This inverter is intended for use exclusively with Embraco VCC compressors.
- Operating the product at voltages outside the declared input operating voltage range may reduce its reliability and significantly impair product performance.
- Ensure the proper match of Inverter SKU and compressor. The use of an incorrect Inverter - VCC may degrade overall product performance.
- To avoid a loss of performance, operate the inverter within the temperature range of 60 °C and with forced ventilation airflow.
- An ambient operational temperature above 60 °C or inappropriate positioning of the inverter concerning forced ventilation airflow may activate inverter thermal protection.

2.2.1 Label information

The Figure 2.1 shows the product label description.

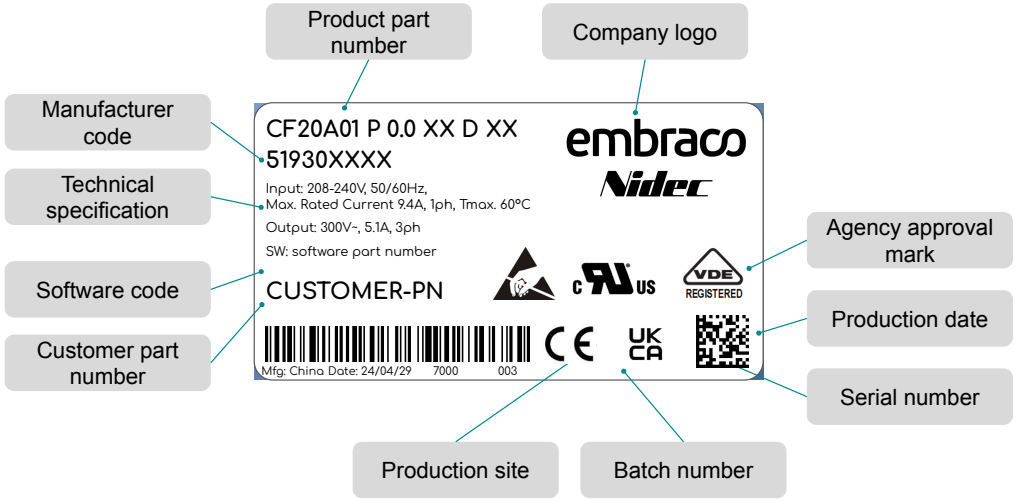


Figure 2.1: Product label example

2.2.2 Agency approval

Table 3: Agency approval marks

Inverter Family	VDE	c UL us
CF20A01	✓	✓

2.2.3 Product dimensions

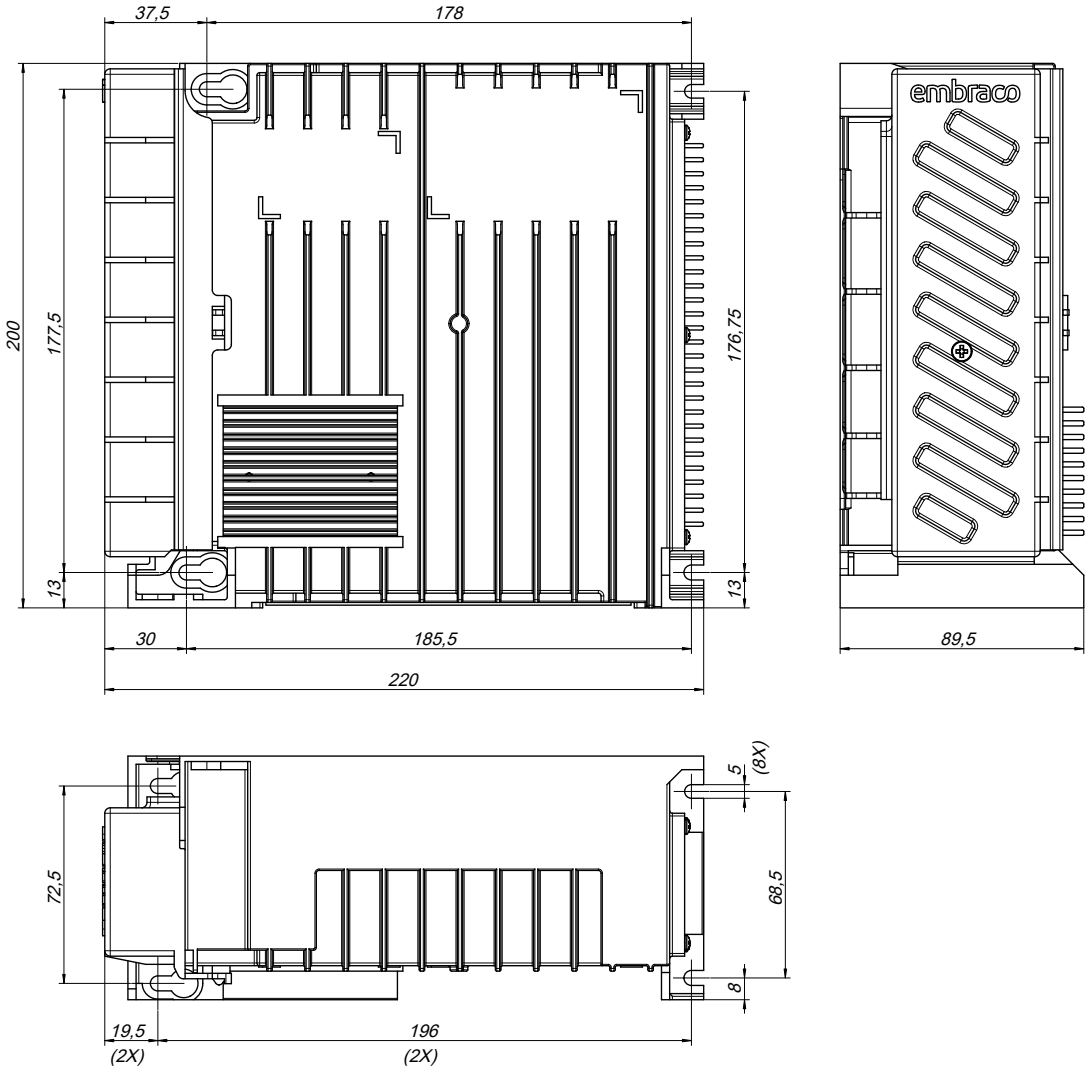


Figure 2.2: Inverter dimensions (mm)

2.2.4 Connectors

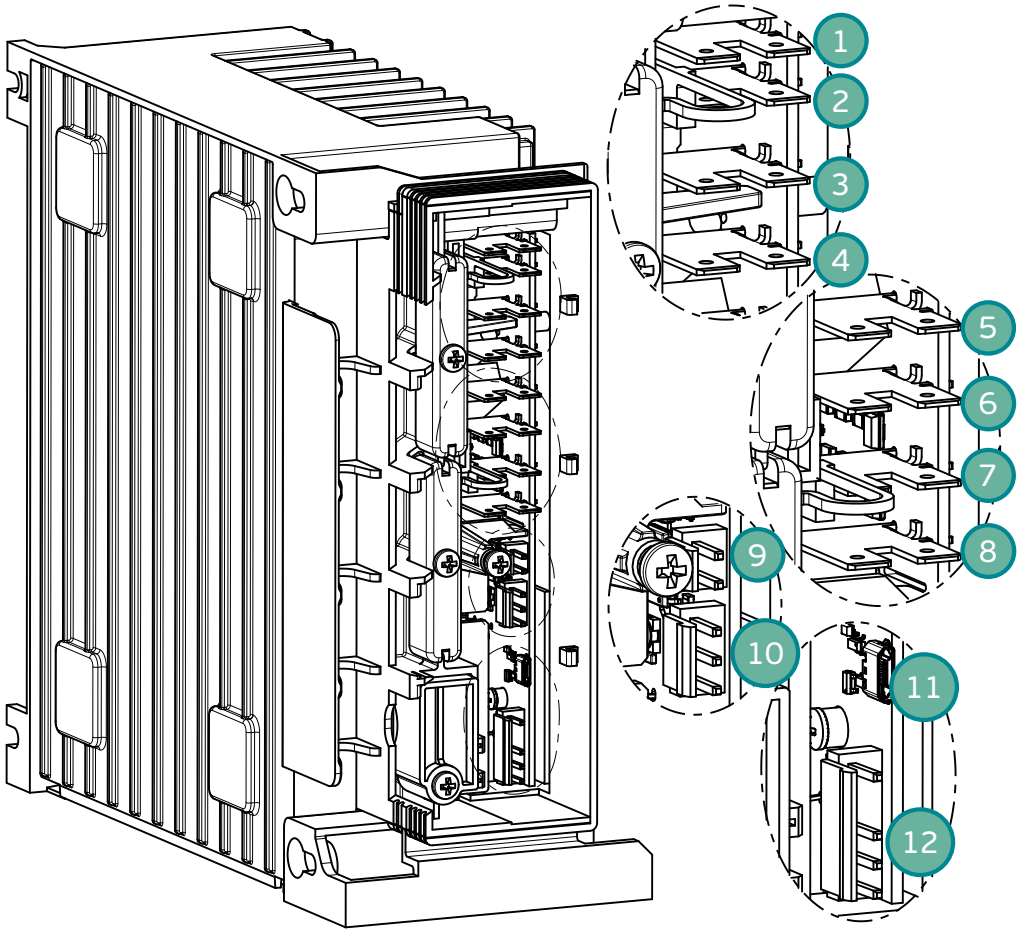


Figure 2.3: Inverter connections

Table 4: Inverter connections

Connectors part numbers			
Indicator	Description	Part number	Insulation
1	Safety earth	2x Fast-on 6.3 mm	–
2	Safety earth	2x Fast-on 6.3 mm	–
3	Neutral or Line 2*	2x Fast-on 6.3mm	–
4	Line 1	2x Fast-on 6.3mm	–
5	Fan Driver Pole 1	2x Fast-on 6.3mm	–
6	Fan Driver Pole 2	2x Fast-on 6.3mm	–
7	Drop in	2x Fast-on 6.3mm	Functional
8	Defrost input	2x Fast-on 6.3mm	Functional
9	Frequency input	S2P-VH (LF) (SN)	Reinforced
10	Serial communication	S3P-VH (LF) (SN)	Reinforced
11	'You Control' input	Micro-USB	–
12	Compressor motor cable already assembled.	–	–

* Line-Line power supply.

2.2.5 Cables

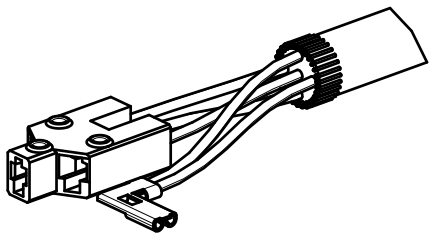


Figure 2.4: Compressor motor cable and earth for VNEX compressor series

Table 5: Cable Specification

Indicator	Description	Part Specification	Color
Figure 2.4	Compressor Motor Cable	UL STYLE 2586 105°C 600 V	Black, Blue and Brown; Green/Yellow

- The 'You Control' customization input (micro USB port) lacks electrical insulation. Utilize the designated communication modules provided by Embraco to ensure electrical insulation. Refer to Subsection 4.2.1 for information regarding the recommended communication modules and product customization.

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 returning after power outages. CF20A01 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.

Table 6: Inrush Specifications

Inrush Specifications	
Voltage Range	240 V
Allowed inrush events	1 per day
Inrush current (cold state)	33 A peak
Inrush current (hot state)	102 A peak
Input fuse melting (i^2t)	175 A^2s

Chapter 3

INSTALLATION

3.1 Before you begin

- Ensure that the CF20A01 Inverter is not in direct contact with flames during assembly.
- The location where the Inverter will be installed must be protected against water jets.
- Do not open the Inverter enclosure. For installation, only remove the Inverter Cover to make electrical connections.
- The communication modules kit cannot be handled with the Inverter turned on.
- Do not handle the Inverter while it is powered. Perform all connections with the Inverter turned off.
- Avoid handling energized cables.
- The 'You Control' customization input (micro USB port of Inverters) lacks electrical insulation. Use the provided communication modules defined by Embraco to ensure electrical insulation.

- Before you begin installation, observe technical specifications and ensure proper connections.
- To prevent damage to your inverter during and after assembly, avoid contact with the following substances: hydrocarbons, ester-based oils (e.g., compressor oil), phenols, amines, ketenes, and automotive fluids such as grease, except glycol and heavy alcohol.
- The inverter is sensitive to Electrostatic Discharges (ESD). The environment must be adequately protected against ESD, and workers handling the inverter must be grounded through an appropriate ESD wrist strap and wear ESD gloves.
- Handle the product with care until final assembly.
- Do not hold onto the wiring.
- Special care must be taken to avoid mechanical impacts on the inverter during the assembly process.
- Do not use the inverter if it falls during handling.
- Check if the product is properly identified, and ensure that its enclosure is without cracks.

3.1.1 Installation positions

This inverter features three types of installation, which will be indicated below:

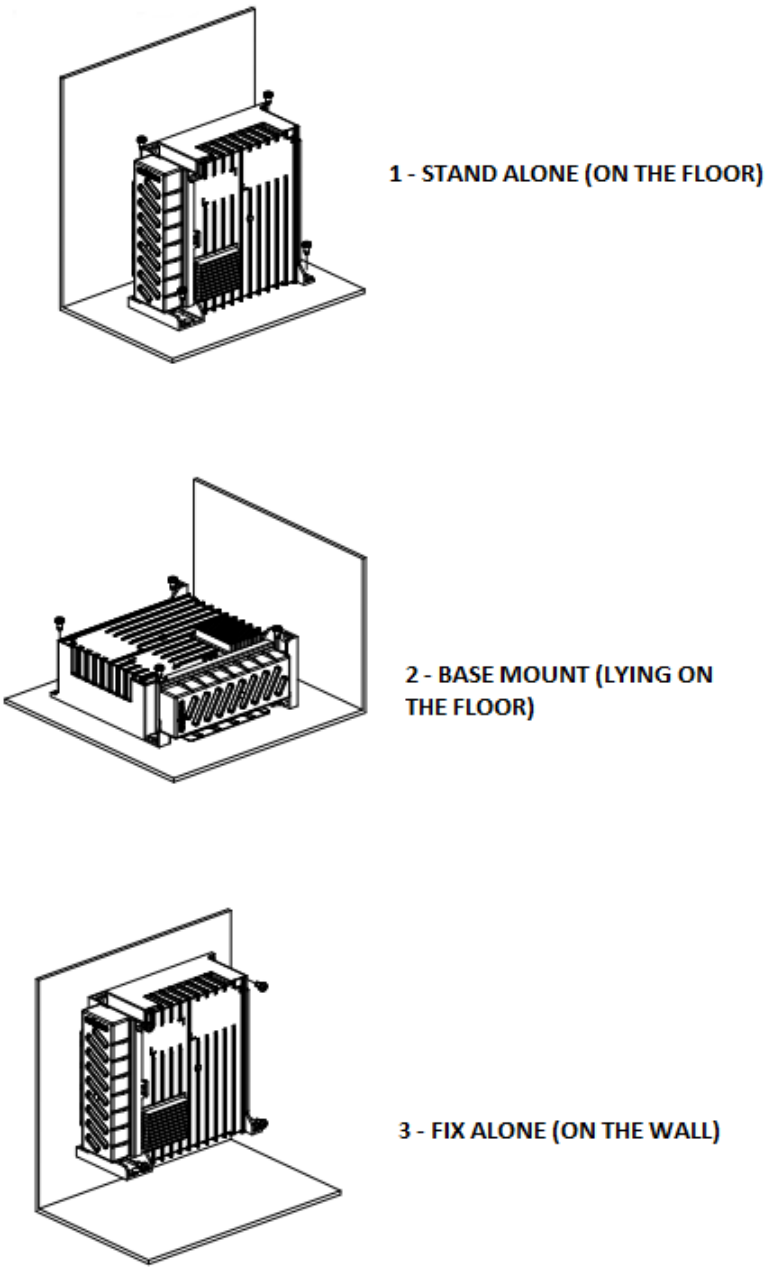


Figure 3.1: Types of mount positions

3.1.2 Inverter cables arrangement

The CF20A01 inverter is supplied only with compressor motor cable, which has your own cord relief. The compressor motor cable is already assembled in the inverter. The input power cord and communication cables are not provided by Embraco. As shown in Figure 3.2, the CF20A01 has 4 cable paths and 2 cord anchorages dedicated to retain the system cables.
Inverter cables must be arranged according to the following instructions.

1. Remove the inverter cover.
2. Make the electrical connections and route the cables trought the cable path (see Figure 3.2).
3. Route all the cables trought the output (see Figure 3.2).

   * To improve EMC, it is recommended to separate the P1 cable into two, the first for [1]EMI/safety earth and the second for [2]Power supply cords.
4. Screw the cord reliefes with torque of 1.0 Nm (± 0.2).
5. Reassemble the plastic cover fixing the screw with torque of 1.0 Nm (± 0.2).

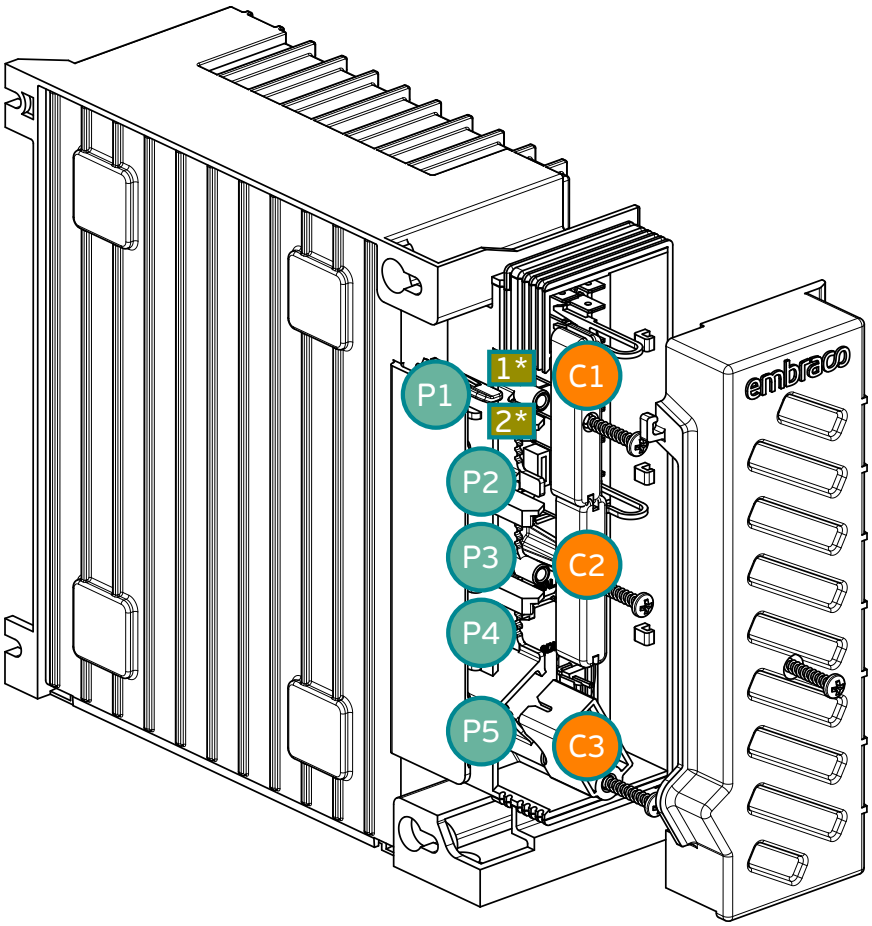


Figure 3.2: Cable paths and cord reliefs

Table 7: Cable paths and cord reliefs

Routing Description			
Cable path	Max cable width [mm]	Cord relief	Purpose
P1	8	C1	[1]EMI/Safety earth [2]Power supply cords
P2	8	C1	Power supply cords /EMI/Safety earth
P3	8	C2	Interconnection cords
P4	8	C2	Interconnection cords
P5	12.5	C3	Compressor motor cable (already assembled)

CAUTION

- It is recommended to use insulated female FASTON terminals to prevent any risk of short-circuit caused by terminal bending.
- Avoid routing cables over the cord anchorage; otherwise, the product may be damaged due to mechanical stress.
- The screws shown in Figure 3.2 must be fixed with torque of 1.0 Nm (±0.2).

NOTICE

- The approval of the input supply cable specifications, certifications, and the interaction of the cord anchorage with the input cables are the customer's responsibility.
- For the appliance supply cord, it is recommended to use cords with Phase and Neutral wires at least 40 mm shorter than the earth cable.

3.2 VNEX compressor series description

1 - Fence cover
2 - Cord anchorage
3 - Cord anchorage Screw
4 - Compressor fence
5 - Fence screw

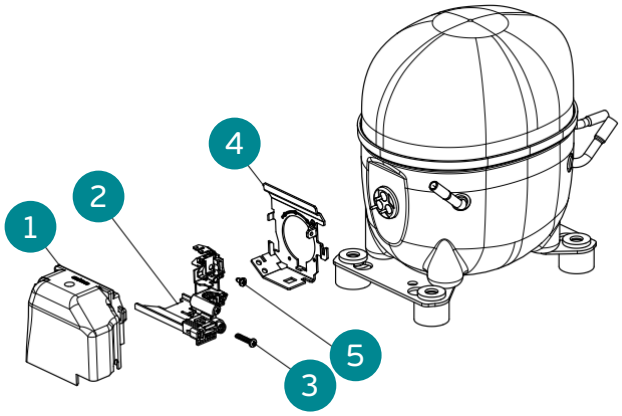


Figure 3.3: VNEX compressor series description

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 the Figures 3.4 to 3.10.

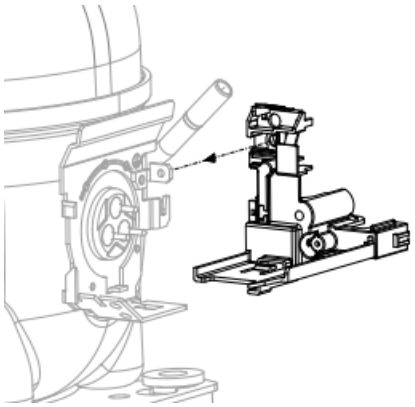


Figure 3.4: Step 1 - Check the cord anchorage position on the fence support

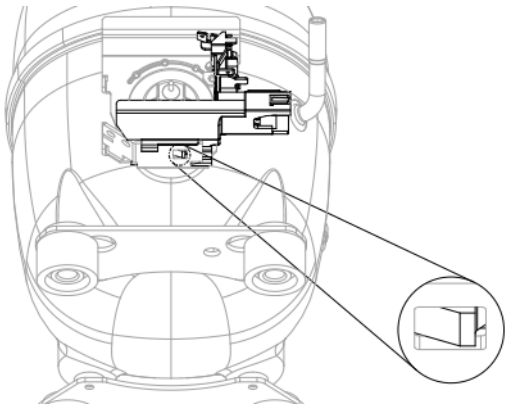


Figure 3.5: Step 2 - Slide cord anchorage snap for attachment on fence

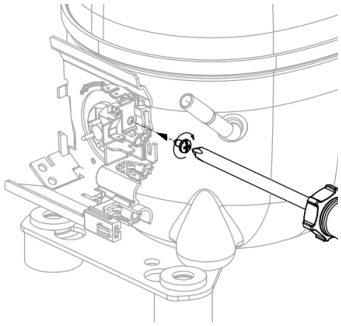


Figure 3.6: Step 3 - Screw the grounding terminal in cord anchorage bracket

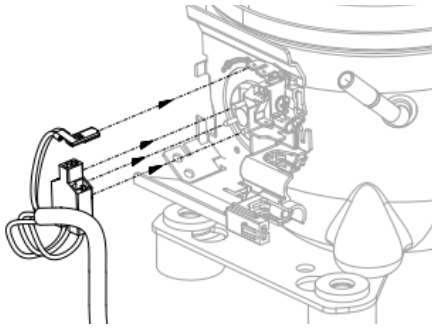


Figure 3.7: Step 4 - Connect the compressor motor cable

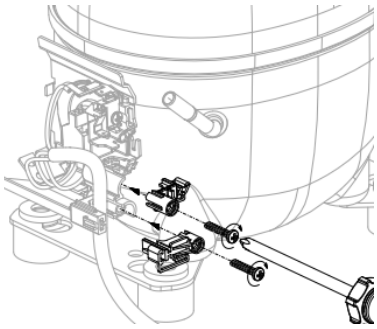


Figure 3.8: Step 5 - Insert and screw the cable clip and complete electrical cables fastening

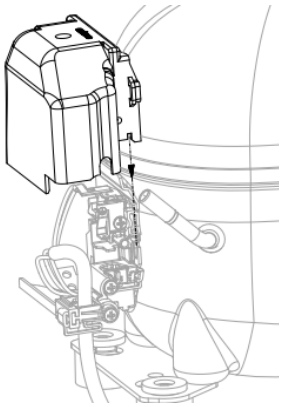


Figure 3.9: Step 6 - Place terminal board cover on fence support top-down

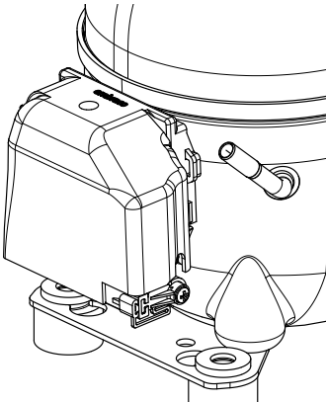
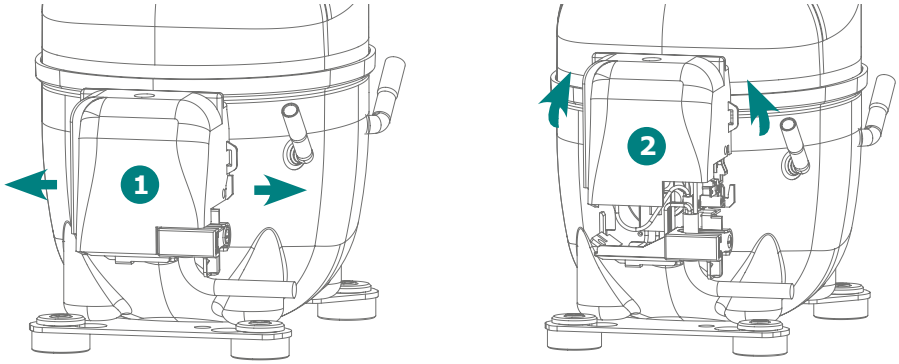


Figure 3.10: Step 7 - Finish fitting the cover to the fence

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 3.11: Removing the VNEX compressor cover

WARNING

- Before obtaining access to connectors, disconnect the AC power supply.
- Avoid contact between the Control Input Cable (low voltage) and high voltage or power supply cables to prevent electrical hazards and potential equipment damage.

NOTICE

- Before using the inverter with the compressor, consult the compressor's technical documentation, which may not be covered in the inverter manual. In case of any uncertainty, please contact Embraco technical support.

CAUTION

- Ensure that the motor connector is correctly mounted on the 3 pins of the compressor hermetic terminal, as a poor connection may lead to compressor malfunction.
- Secure the screws depicted in Figure 3.6 with a torque of 0.1 - 0.6 Nm (±0.2).
- Fasten the screws shown in Figure 3.8 with a torque of 0.7 - 1.2 Nm (±0.2).
- Handle the Inverter enclosure with care to avoid contact with the internal electronic board, preventing potential electrostatic discharges.
- Ensure that all necessary connections are properly established before connecting the Inverter to the AC supply line.
- Install the electronic Inverter in the vertical position. Refer to Figures 3.12 through 3.14 for recommended assembly positions.
- When using Serial or Frequency communication modes, the inverter provides reinforced isolation. In Drop-in mode, the inverter features functional insulation.
- To prevent ESD discharge to the inverter circuit, insert the earth terminals first.

3.3 Forced ventilation

Acceptable positions of fan + compressor + inverter are shown in the Figures 3.12 to 3.14.

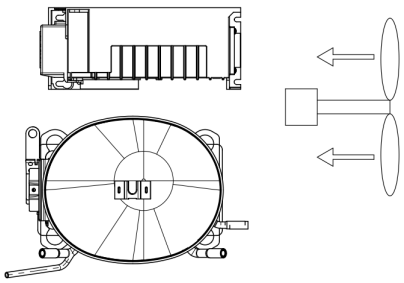


Figure 3.12: Option 1

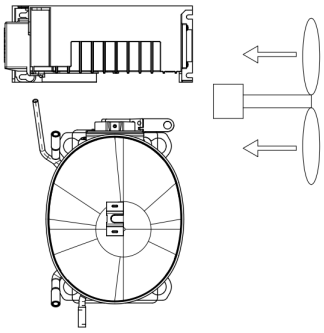


Figure 3.13: Option 2

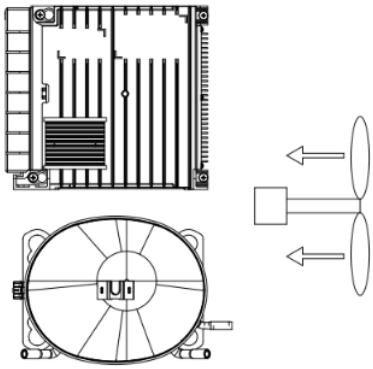


Figure 3.14: Option 3

All mentioned positions are acceptable. Considering specific aspects as inverter and motor-compressor cooling, the most recommended are Options 1-2.

The acceptable air flow directions in the Inverter heat sink are shown in Figure 3.15.

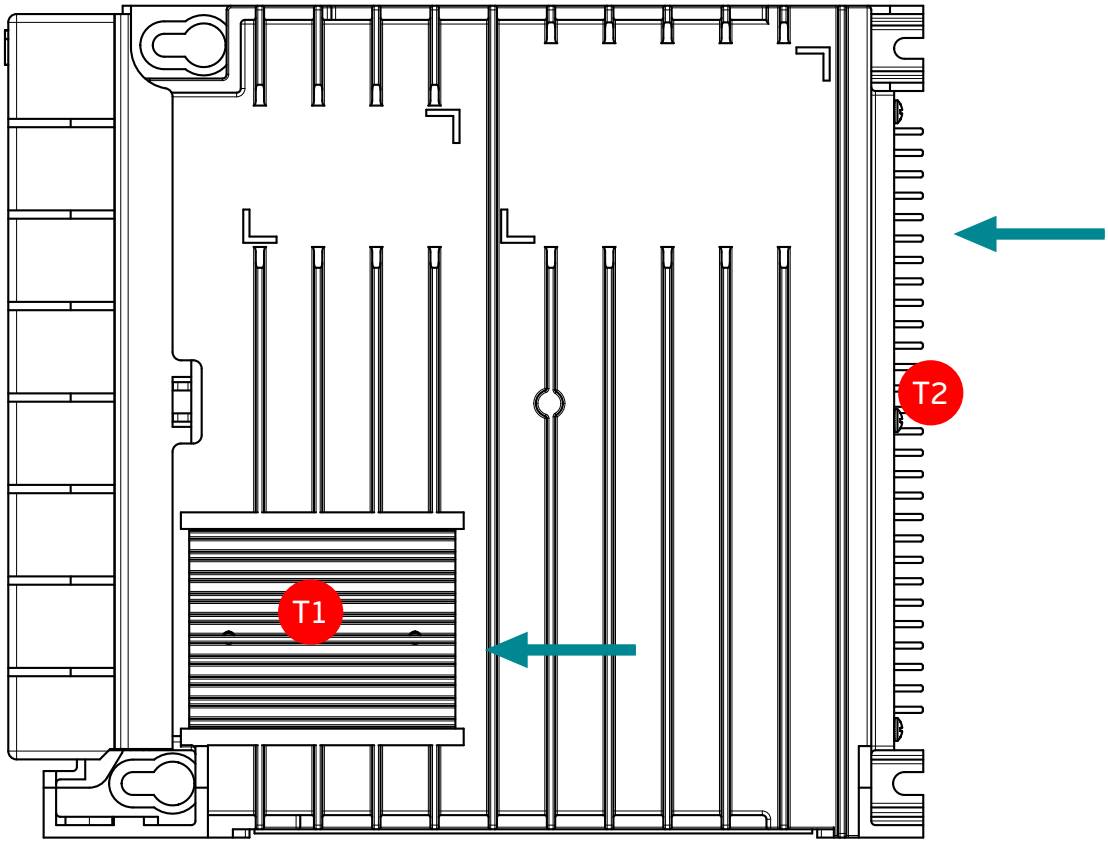


Figure 3.15: Inverter air flow direction

During the refrigeration system's development that will apply the CF20A01 inverter, it is recommended to measure the temperature T1 and T2.The temperature should never be higher than 85 °C for T1 and 95 °C for T2, even when the inverter is working with high power and it is subjected to high ambient temperatures.

CAUTION

- To prevent a loss of performance, ensure that the heat sink is not obstructed from air ventilation.
- Maximum power is achieved only with a minimum forced ventilation of 2 m/s over the inverter heat sink and an air flow of 520 m^3/h over the compressor.
- The distance from the fan to the compressor shell must be less than 30 cm.

3.4 Safety Recommendations of Electrical Installation

In single-phase installations, the line phase wire must 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.

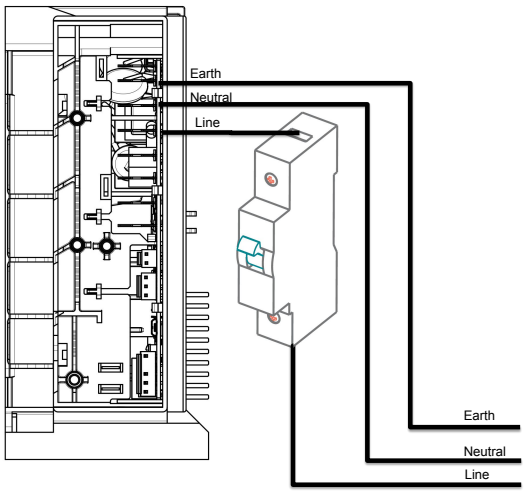


Figure 3.16: Phase-Neutral connection

In the case of two-phase installations, it must be used a 2-pole circuit breaker, because in case of a short circuit both phases of power supply are protected.

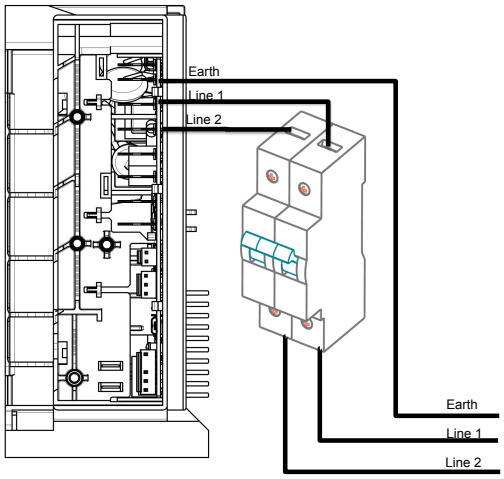


Figure 3.17: Phase-Phase connection

3.5 AC Fan switch control

CF20A01 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 Phase (or Neutral) - CN106;
- other terminal of AC Fan output to customer's AC Fan terminal - CN105;
- the remaining terminal of customer's AC Fan to the Neutral (or Phase).

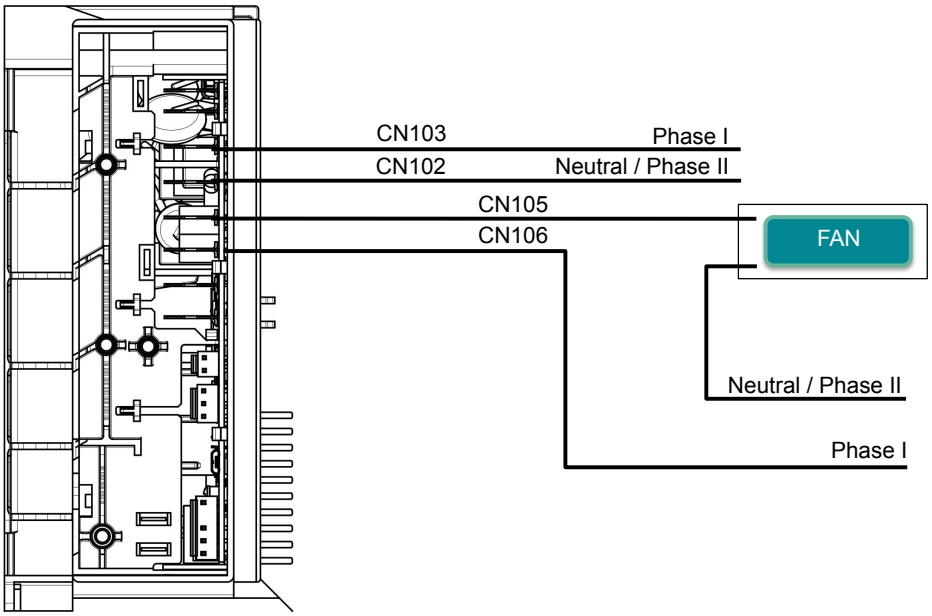


Figure 3.18: Fan connection

3.6 Package information

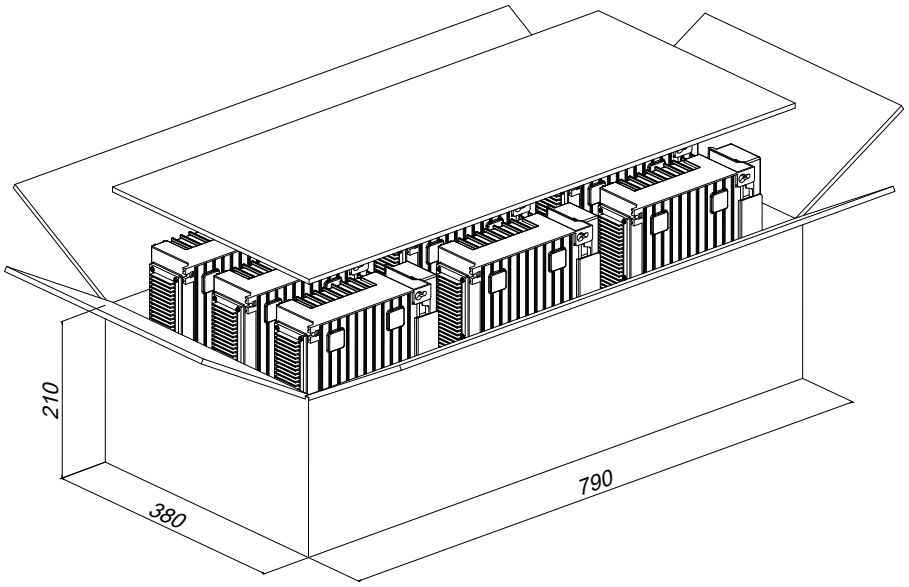
The inverters are delivered packed in a carton box. Box dimensions can be changed without previous information.

Table 8: Storage Conditions

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

Table 9: Package Configuration

Configuration	Quantity	Dimensions (mm)
Config #1	9	790 x 380 x 210



*Dimensions are in mm.

Figure 3.19: Product package

3.6.1 Product discards

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

NOTICE

- If you wish to discard this product, please contact your local authorities or dealer for guidance on the correct disposal method, ensuring proper treatment, recovery, and recycling.
- The product package and its internal partitions are made of cardboard and can be disposed of as recyclable waste.
- While the inverter is RoHS compliant, appropriate disposal of this product will contribute to saving valuable resources and preventing potential negative effects on human health and the environment (e.g., ground dispersion) that could arise from improper handling.

Chapter 4

OPERATION

The CF20A01 Inverter have support for Drop-in, Frequency and Serial communication modes.

WARNING

- Do not handle the inverter while it is powered. Perform all connections with the inverter turned off.

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 a reduced range based on the maximum working conditions of the respective compressor, not following specific setpoint conditions. For a detailed operating range of the selected compressor, please contact Embraco Technical Support.

4.1 Inverter connections

The inverter general mode connection shall be wired according to Figure 4.1.

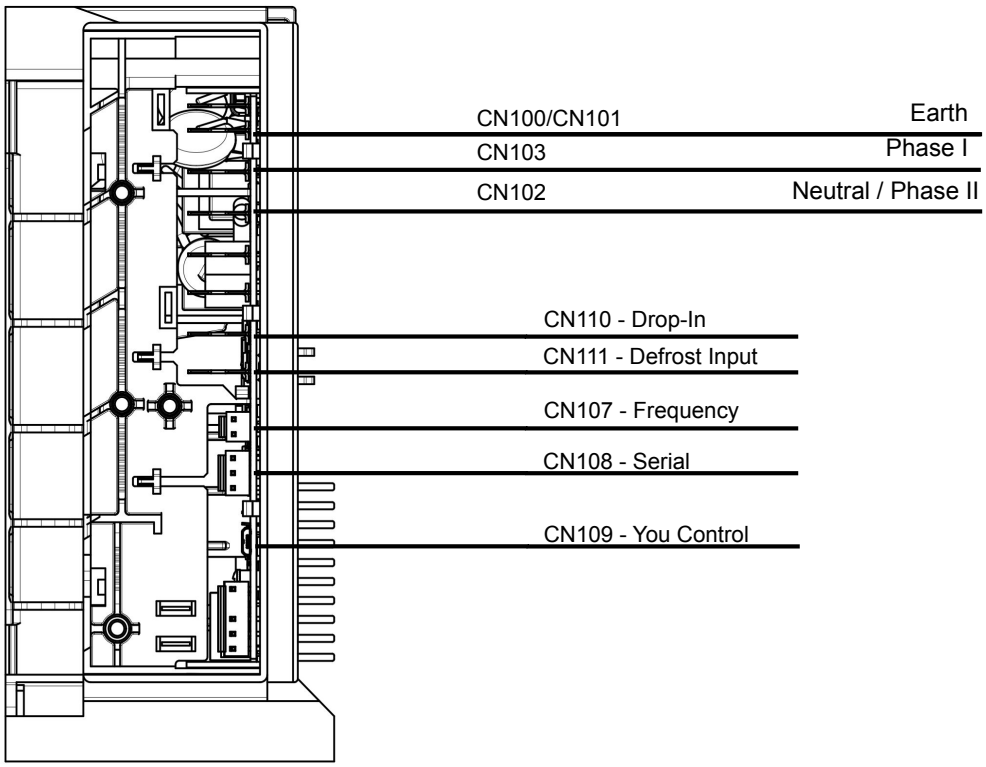


Figure 4.1: Inverter connections

4.2 Drop-In control mode

The Drop-In mode is a CF20A01 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 the need of 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.

4.2.1 Smart Drop-In

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, Smart 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 YouControl 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).

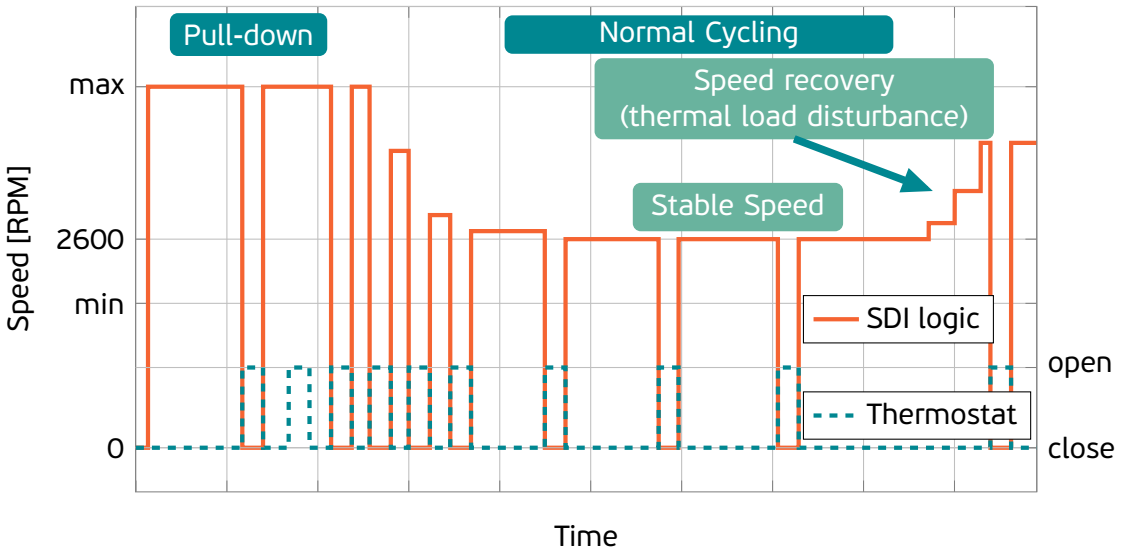


Figure 4.2: Compressor speed versus thermostat behavior Smart Drop-in

For more information, please access our website Embraco Smart Drop-in or contact our Application Engineer.

4.2.2 Defrost input

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 requested from our Application Engineer.

NOTICE

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

4.2.3 Drop-in connection

The Drop-In mode connection shall be wired according to Figure 4.3. This signal is usually called Thermostat Return Signal.

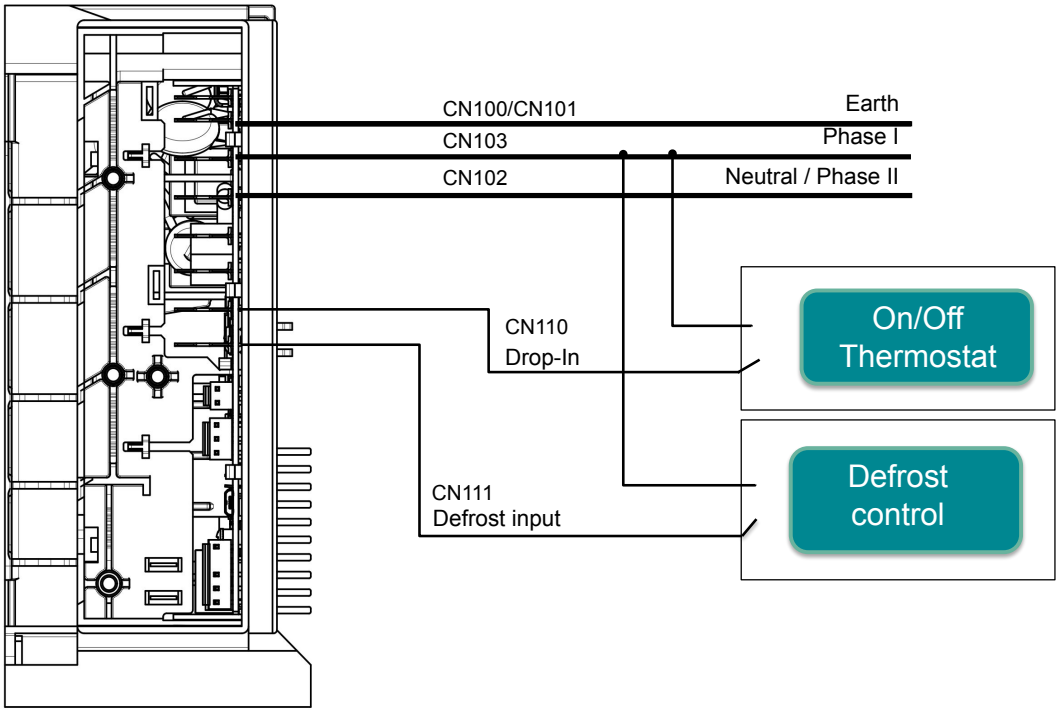


Figure 4.3: Drop-In connection

CAUTION

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

NOTICE

- All main parameters, including minimum and maximum speed, are described in the compressor datasheet.

4.3 Frequency control mode

In this operation mode the compressor speed is controlled 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.

Table 10: Signal specifications

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

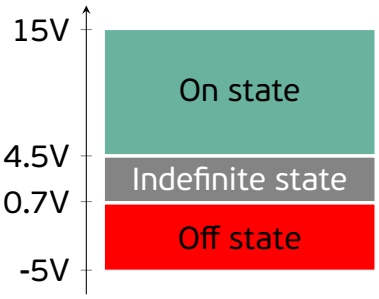
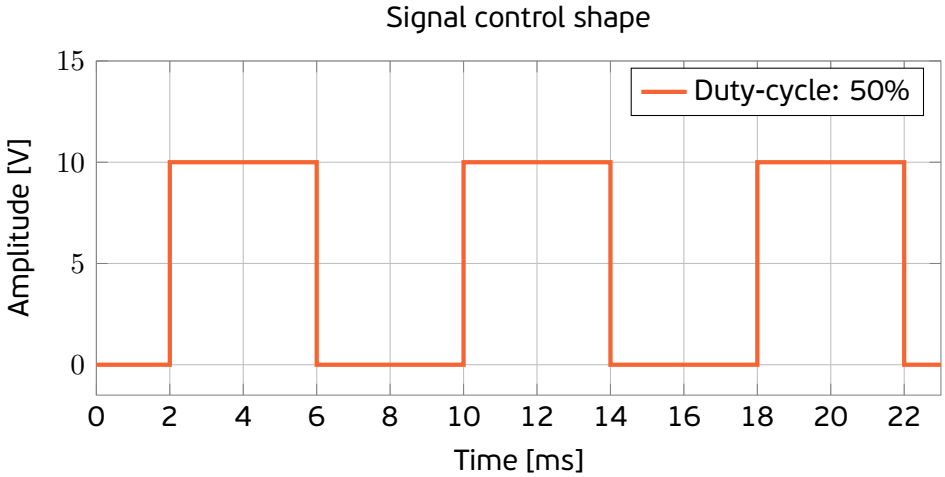


Figure 4.4: Signal levels for frequency control mode

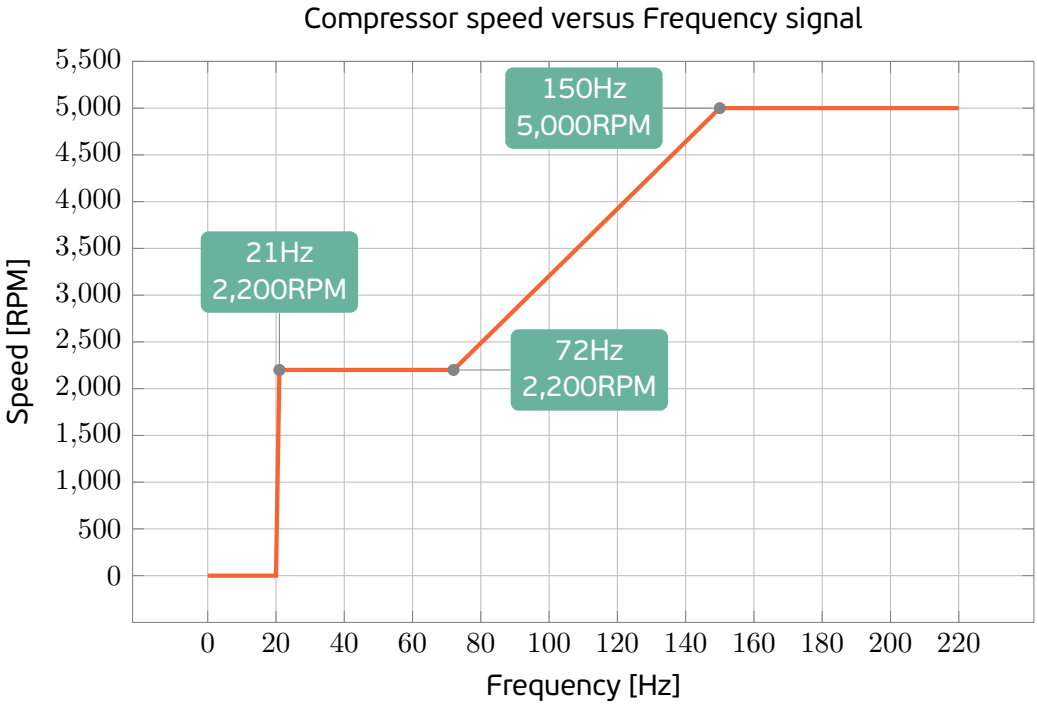
From 0.7 V to 4.5 V the inverter behaviour is indefinite, therefore, it is not recommended to use signals within this range. The following figure presents a graphic example of an input frequency signal of 125 Hz sent to the inverter. The digital signal duty-cycle can vary in the range of 30% to 70%.



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.

Table 11: Frequency Signal

Input Frequency Signal [Hz]	VNEX compressor - motor speed [RPM]]
0 - 20	0
21 - 72	2200
73 - 150	(36 x Hz) - 400
>150	5000



The Figure 4.5 shows the electrical connections to perform frequency communication between an electronic thermostat and CF20A01 Inverter Control connector. For Frequency Control Mode, the input resistance is 1.2 kΩ.

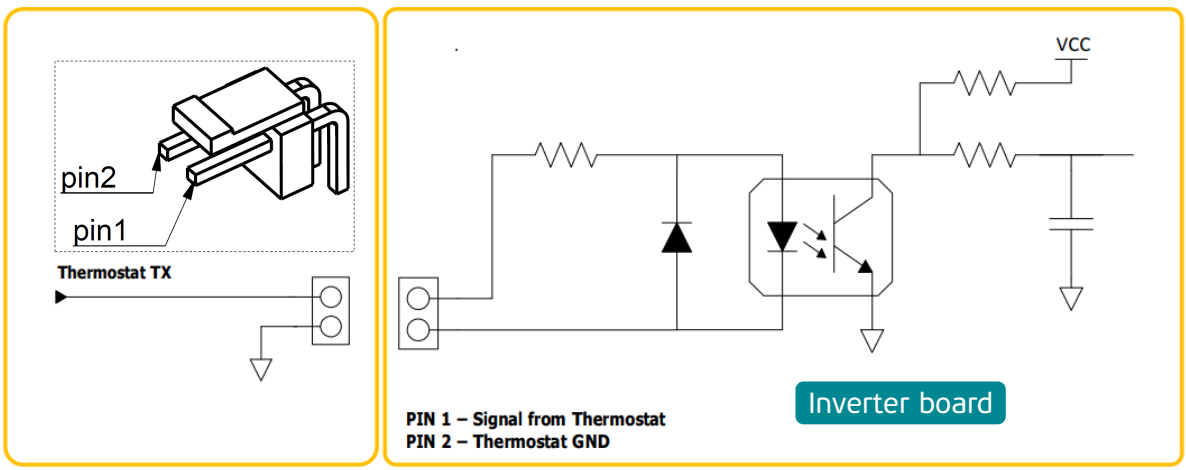


Figure 4.5: Electrical schematic of frequency communication

4.3.1 Frequency connection

The frequency mode connection shall be wired according to Figure 4.6.

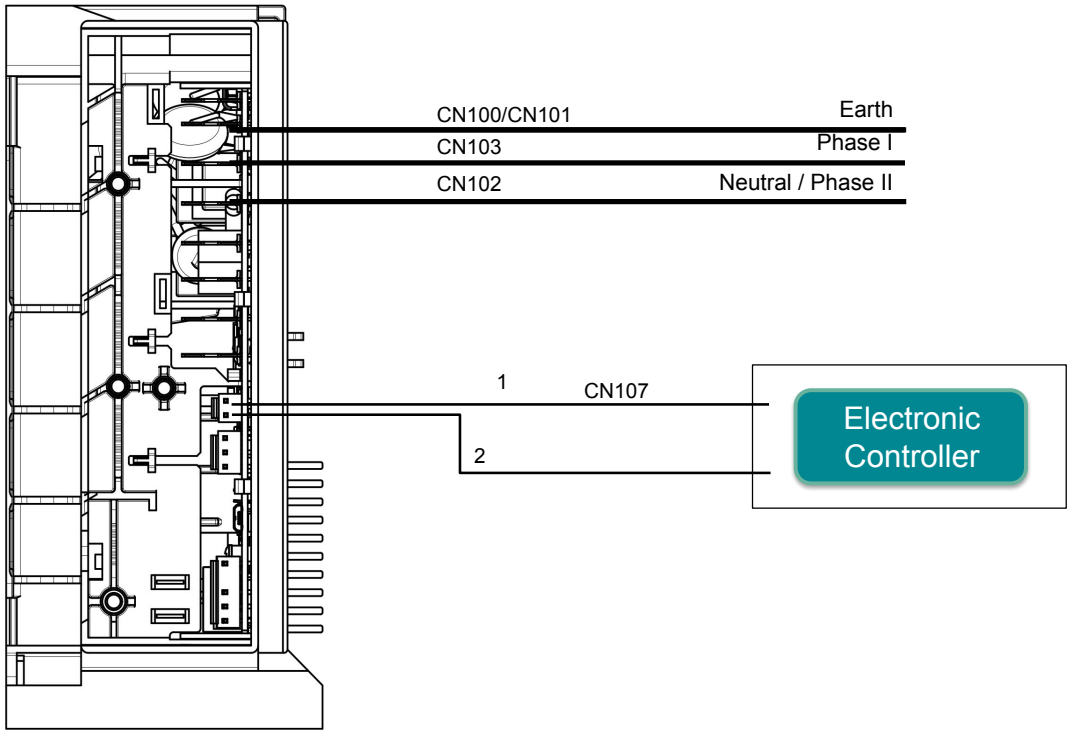


Figure 4.6: Frequency connection

4.4 Serial control mode

This option is used when an electronic thermostat controls the CF20A01 Inverter uses a serial communication protocol. Based on Embraco protocol it is possible to define the compressor speed and check other parameters.

NOTICE

- Do not use the inverter serial communication while using the 'You Control' interface.

4.4.1 Serial specifications and Internal Circuit

The Serial Control mode has an isolated input stage provided by the usage of optocouplers. The circuit on Figure 4.7 shows the electrical connections to perform serial communication between an electronic thermostat and CF20A01 Inverter serial connector (CN108).
The input resistance for serial communication, shown in Figure 4.7, is 1.2kΩ.

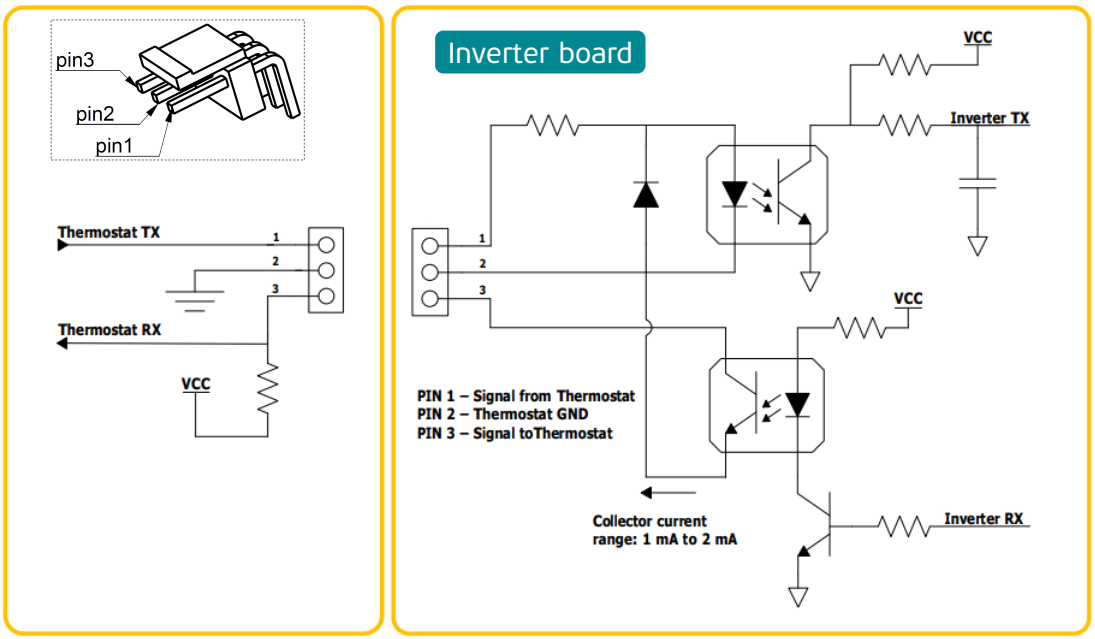


Figure 4.7: Electrical schematic of serial communication

To guarantee the correct functionality of serial communication, the signal to be sent to the inverter must be according to Figure 4.7.

Table 12: Signal specifications

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

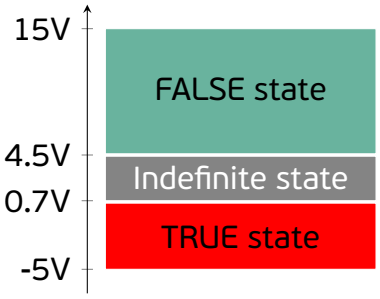
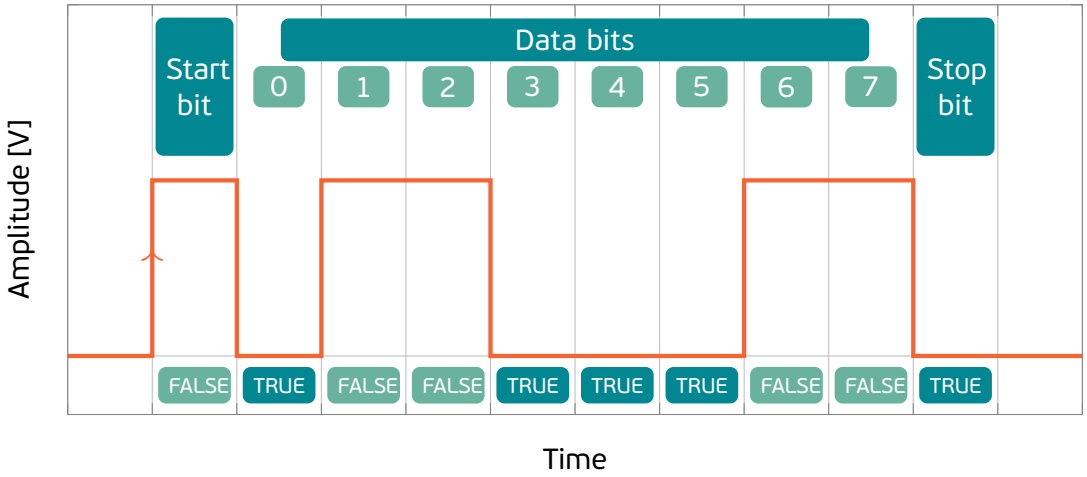


Figure 4.8: Signal levels for serial communication

Example: 39h sent to inverter



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.

Table 13: Basic Specification - Serial Control

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 CF20A01 Inverter serial connection, please contact Embraco Technical Support to receive instructions.

4.4.2 Serial connection

The serial mode connection shall be wired according to Figure 4.9.

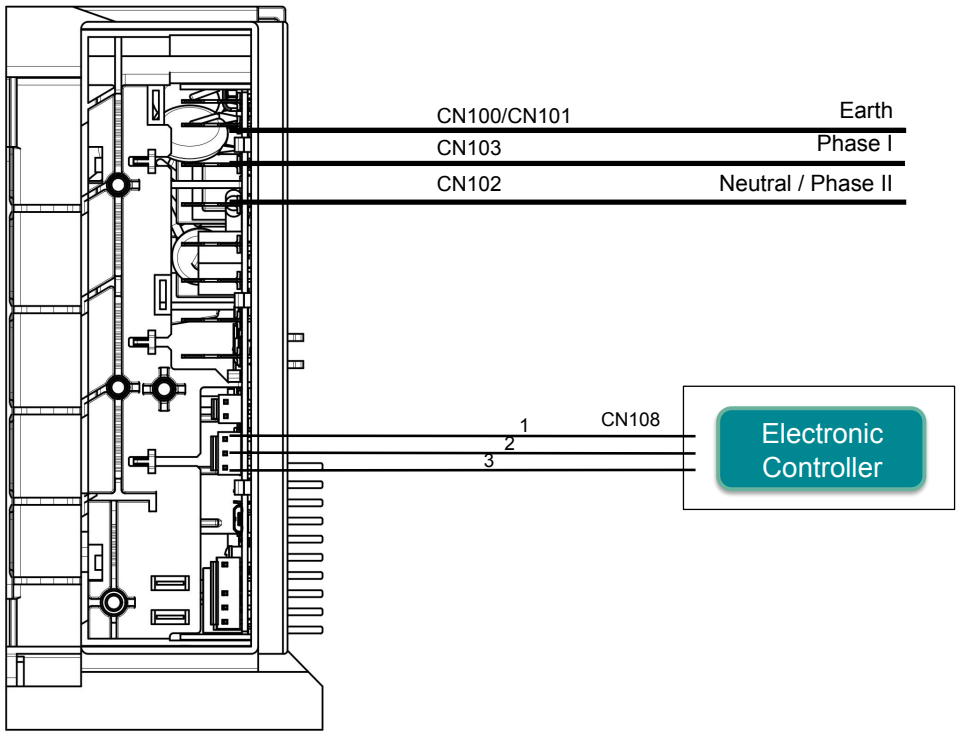


Figure 4.9: Serial connection

4.4.3 Commands

Table 14: Commands structure

Command structure				
1st Byte	2nd Byte	3rd Byte	4th Byte	5th Byte
Identification (ID)	Command (CMD)	LSB*	MSB**	Check-sum*** (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.

Table 15: 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

Table 16: 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
Communication error	5Ah	Code**	FFh	FFh	CK

*See Status Data table.

**See Error Code table

Table 17: 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

Table 18: 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 3000 RPM
Step 1: select proper command
Command for selecting a speed is **Set speed**
ID $\rightarrow A5h$
CMD $\rightarrow C3h$
Step 2: transform speed from decimal into hexadecimal base
3000d $\rightarrow 0BB8h$
Step 3: split lower and higher Bytes
LSB $\rightarrow B8h$
MSB $\rightarrow 0Bh$
Step 4: calculate sum of first 4 Bytes
S14h = A5h + C3h + B8h + 0Bh
S14h$\rightarrow 22Bh$
Step 5: boolean logic to maintain sum as 8-bit
L14h=0FFh AND S14h
L14h $\rightarrow 2Bh$
Step 6: calculate checksum
CK=100h-(0FFh AND S14h)=100h-3Fh
CK= $\rightarrow D5h$
Command: A5h C3h 22Bh 2Bh D5h

NOTICE

- To prevent an increase in noise and potential damage to the compressor due to mechanical resonance, certain operating speeds are restricted by the software for all control modes.
- When one or more errors occur, the corresponding 'H' bits are set to 1. For example, Overload and Underspeed **LSB** $\rightarrow$ **06h**.
- The Frequency and Drop-In modes support serial communication only for monitoring purposes. This functionality can be used for product diagnostics.

Chapter 5

DIAGNOSTICS

The CF20A01 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, CF20A01 Inverter or Thermostat. The table below describes the failure modes.

Table 21: 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	Red	Compressor problem
No Flash	–	–	No input power / Damaged inverter

5.2 Troubleshooting

Table 22: 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

Table 23: 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

Chapter 6

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Chapter 7

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