



CF10C01/02 INVERTER Product Manual



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1 INTRODUCTION

This document contains technical specifications, installation instructions, and operational details for the CF10C01/02 Inverter family. It is intended to be used during the system design phase to ensure proper configuration and optimal performance when using Embraco's Variable Capacity Compressors, thereby preventing potential application errors.

Before reading this manual, please review the conventions below to understand how safety information and technical notes are presented.

1.1 Conventions

	WARNING • Incorrect operation that could result in bodily injury or death due to electrical hazard.
	CAUTION • An 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.

2 TECHNICAL SPECIFICATIONS

2.1 Nomenclature

Table 2-1 – Nomenclature

CF 10 C 0X M 0.X XX A XX		Definitions
CF	Driver Type	Controller for VCC (variable capacity compressors)
10	Family	1000 W Inverter
C	Generation	220V PFC Version
0X	Subversion	01 - High current compressor 02 - Low current compressor
M	Nominal Voltage Range	M - 220-240V, 50/60Hz
0.X	Protective Function	0.0 - No PEC solution 0.1 - With HW PEC solution
XX	Electronic Configuration	Changes according to control mode, diagnosis feature, connections, and non-safety-related features. Any combination of letters and numbers: 00 to ZZ
A	Enclosure / Housing Configuration	A - Stand Alone Version
XX	Cables and Peripherals Configuration	Any combination of letters and numbers: 00 to ZZ

2.2 Product specification

For compressor matching performance information, contact Embraco Technical Support.

Table 2-2: Inverter general specification

Inverter Technical Specification Parameters	
Nominal voltage range ^{i, ii}	220-240 V
Minimum input voltage ⁱⁱⁱ	160 V
Maximum input voltage ^{iv}	264 V
Maximum input overvoltage ^{v, vi}	300 V
Nominal input frequency	50/60 Hz
Maximum input RMS current	5.0 A
Maximum input power ^{vii}	1000 W
Input power factor	> 0.9 (active PFC)
Control mode	Frequency, Smart Drop-in, Serial and Sync Pro
Fan driver maximum current	1 A
Operating conditions ^{viii, ix, x}	-20 °C to 60 °C and < 85% RH
Storage conditions ^x	-40 °C to 85 °C and < 85% RH
Air forced ventilation (min) ^{xi}	2 m/s
Ingress protection grade	IP21
Inverter mounting type	Stand alone

i. Voltage range approved by certification agencies.

ii. Operation below nominal input voltage may reduce compressor cooling capacity due to lower link voltage and/or inverter power limitations.

iii. Minimum inverter operational voltage.

iv. Maximum voltage allowed without affecting the inverter performance or long-term reliability.

v. Maximum voltage without the Inverter being damaged, but with impact on performance and possible impact on product lifespan.

vi. Voltages exceeding this limit may cause permanent product damage.

vii. Maximum input power may be derated based on input voltage, ambient temperature, and compressor maximum current.

viii. Temperature range approved by certification agencies.

ix. Inverter ambient temperature is measured 50 mm away from the heat-sink side of the inverter.

x. Inverter shall be stored and operated in a proper environment to avoid condensation and oxidation of its parts.

xi. Inverter airflow is measured 10 mm from the center of the heatsink.

	WARNING Do not connect the CF10C01/02 Inverter to a power supply exceeding the specified maximum input overvoltage.
	CAUTION - This inverter is designed exclusively for use with Embraco VCC compressors. - Operating the product above the specified maximum input voltage may reduce reliability and significantly impair performance. - Ensure the correct Inverter SKU is paired with the compressor. Using an incompatible inverter/compressor combination may degrade overall performance, cause malfunctions, or impair reliability. - Operate the inverter within the specified temperature and power ranges, ensuring forced minimum airflow. Excessive loads, high ambient temperatures, or insufficient airflow may trigger the inverter's thermal protection. - Improper positioning of the inverter relative to the forced airflow may trigger thermal protection, significantly impair performance, and reduce long-term reliability.

2.2.1 Institute approval

Table 2-3: Institute Approval

Inverter Family		
CF10C01/02	40047706	E222315

2.2.2 Label information

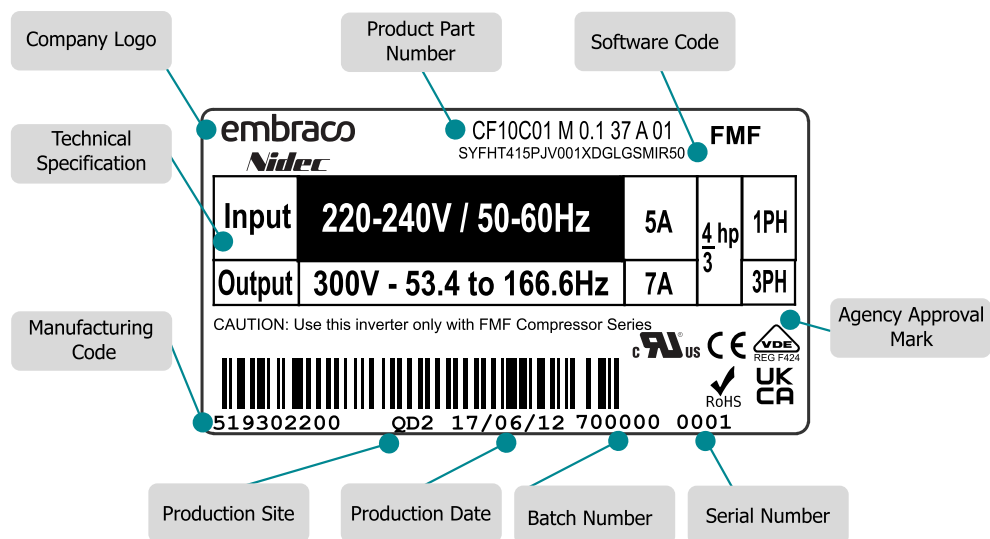


Figure 2-1: Product label example

2.3 Inverter dimensions

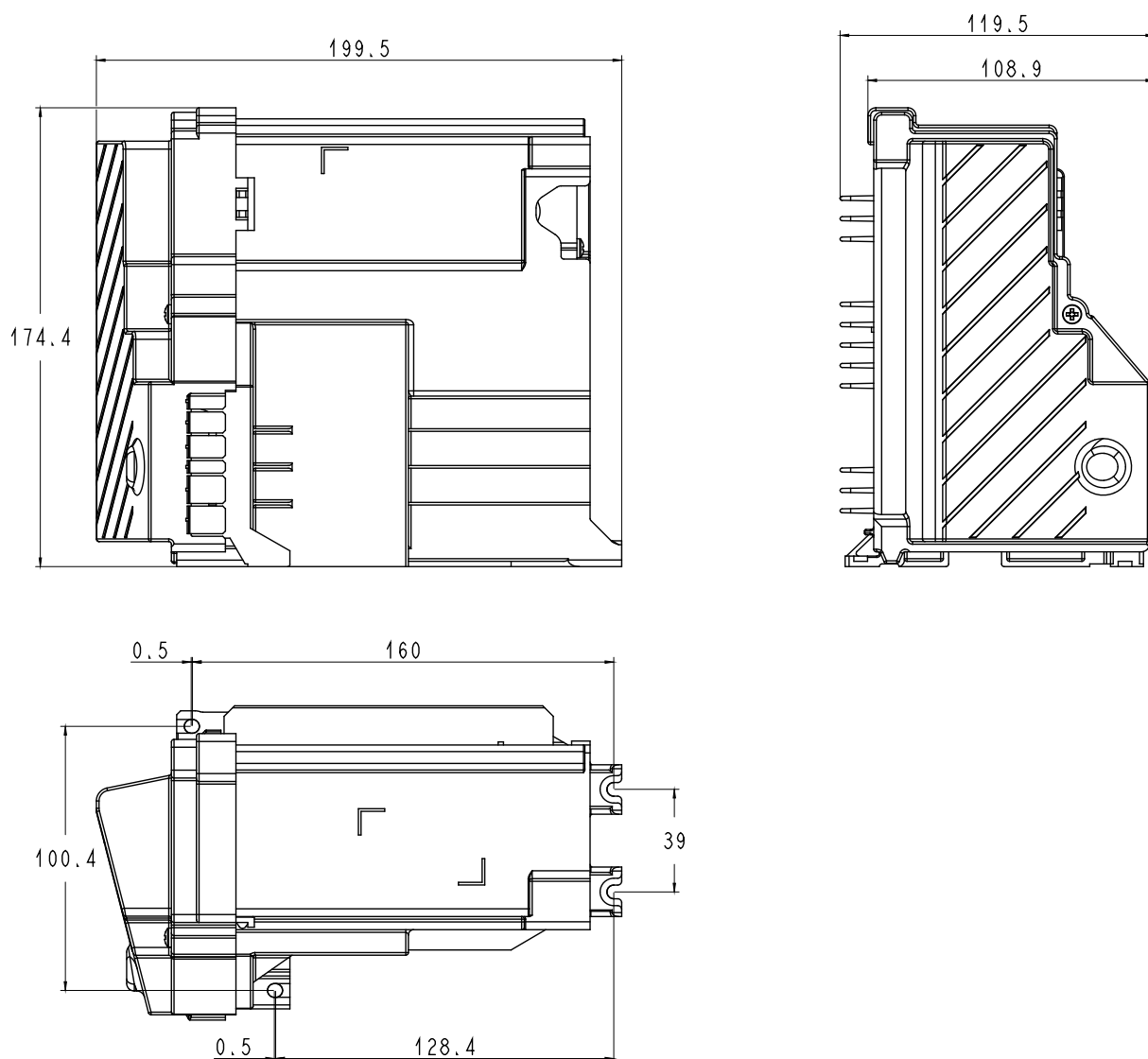


Figure 2-2: Stand-alone dimensions (mm)

2.4 Connectors

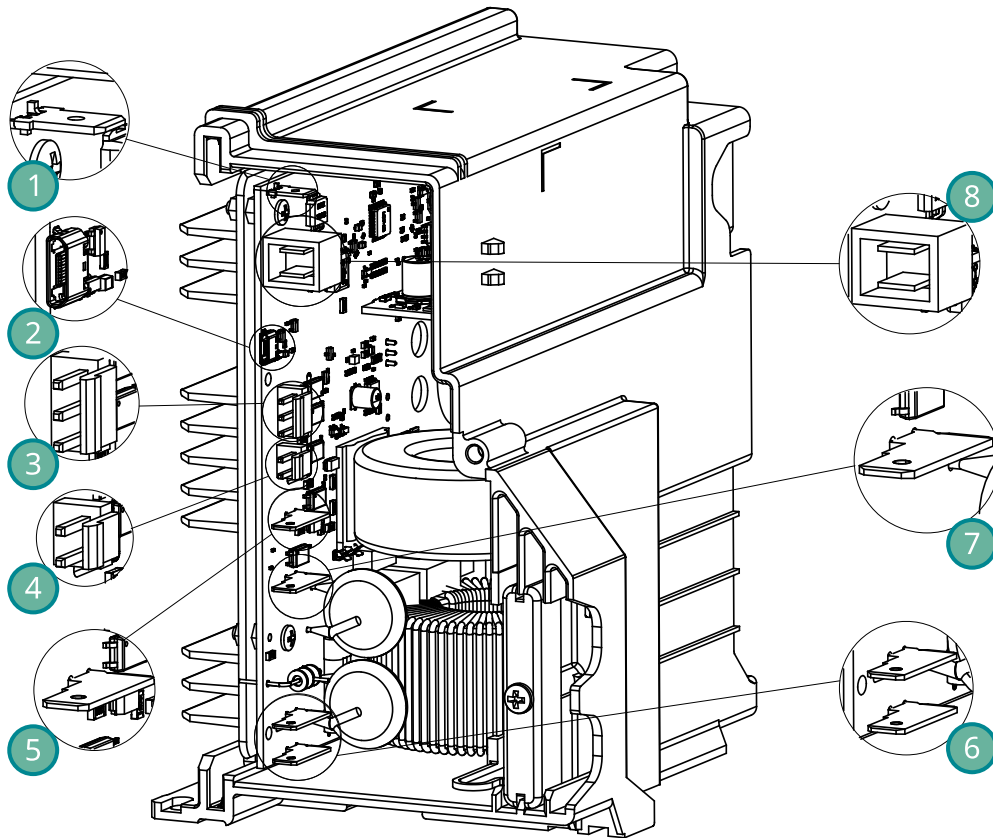


Figure 2-3: Connectors

Table 2-4: Connectors part numbers

Indicator	Description	Manufacturer	Type	Insulation
1	Safety Earth	-	Fast-on 6.3	Protective Earth
2	YouControl input	-	Micro-USB B	Non-insulated
3	Serial Communication	CWB / JST	S3P-VH	Reinforced
4	Frequency input	CWB / JST	S2P-VH	Reinforced
5	Defrost Input	-	Fast-on 6.3	Non-insulated
6	AC input (L+N)	-	Fast-on 6.3	Non-insulated
7	Drop in	-	Fast-on 6.3	Non-insulated
8	AC Fan	-	Fast-on 6.3	Non-insulated

2.5 Cables

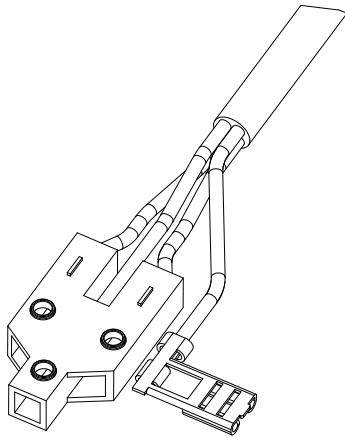


Figure 2-4: Motor cable for FMF and VNEX compressor series

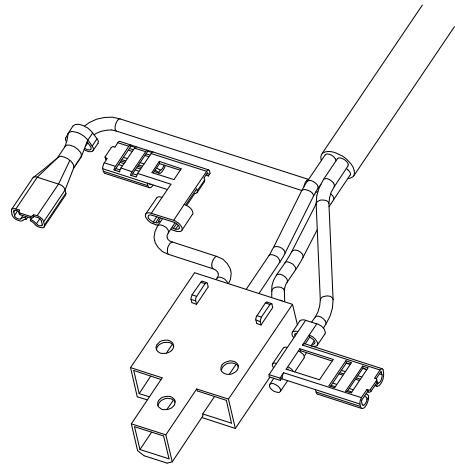


Figure 2-5: Motor cable for VNEK and VNEU compressor series with external OLP

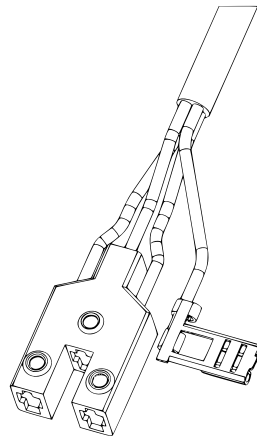


Figure 2-6: Motor cable for VEH compressor series

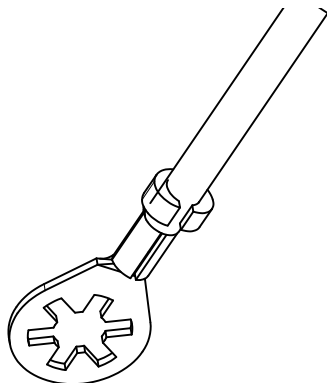


Figure 2-7: Safety Earth Cable

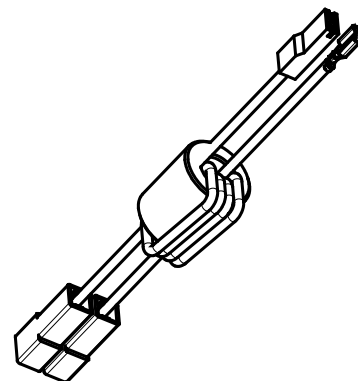


Figure 2-8: Input cable with ferrite filter
(Optional to improve EMI performance)

Table 2-5: Cables 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 Connection	UL STYLE 2586 105°C 600 V	Black, Blue and Brown
Figure 2-6	Standard Motor Cable	UL STYLE 2586 105°C 600 V	Black, Blue and Brown
Figure 2-7	Safety Earth Cable	UL STYLE 1015 105°C 600 V	Green/Yellow
Figure 2-8	EMI Input Cable	UL STYLE 1015 105°C 600 V	Blue and Brown

	WARNING The YouControl customization interface (micro-USB Type B port) is not electrically isolated. Use only the communication modules specified by Nidec to ensure electrical isolation. Refer to Subsection 4.2.1 for details on approved communication modules and product customization.
	NOTICE The standard configuration of the CF10C01/02 inverter series is approved only for use in built-in appliances with non-accessible machine compartments. If the intended application involves an accessible machine compartment, contact Embraco Technical Support to determine the appropriate product configuration.

2.6 Input inrush current characteristics

Inrush current is a transient surge that occurs when the inverter is connected to the power grid or when power is restored after a power outage. The CF10C01/02 series input stage components are dimensioned to tolerate the electrical stresses of these events over the product's specified service life.

The inverter power input must be connected directly to the power grid to ensure continuous operation. Do not use functional switching devices (e.g., thermostats, timers, or relays) in the supply line to interrupt power for cycling the compressor.

Table 2-6: Inrush Characteristics

Inrush Specifications	
Allowed inrush events	1 per day
Inrush current (cold state)	235 A peak
Inrush current (hot state)	357 A peak
Input fuse melting (i^2t)	209 A ² s

2.7 Harmonic current emissions

The CF10C01/02 Inverter is compliant with IEC 61000-3-2.

Using this active PFC technology, the inverter strictly regulates its input current waveform, achieving full compliance with the IEC 61000-3-2 standard for harmonic current emissions.

3 INSTALLATION

3.1 Before you begin

	WARNING • Do not disassemble the main inverter enclosure. Installation requires removing only the external cover to make the necessary electrical connections. • Make sure that CF10C01/02 Inverter will not be in direct contact with flames during assembly. • To prevent damage to the inverter during and after assembly, it must not have contact with the following substances: Hydrocarbons; Ester based oils (e.g.: compressor oil); Phenols; Amines; Ketenes; Automotive fluids such as grease. • The CF10C01/02 Inverter is designed for indoor use. • The location where the Inverter will be installed must be protected against splashed water from all directions. • The product is approved considering its use at altitudes up to 4000 m.
	CAUTION • Read this material carefully before you begin the CF10C01/02 installation and start-up procedures. • The CF10C01/02 Inverter must be applied only with Embraco Variable Capacity Compressors. • Before beginning installation, verify all technical specifications and ensure proper connections are followed. • The inverter is sensitive to Electrostatic Discharge (ESD). Ensure the assembly environment is protected against ESD. Personnel handling the inverter must be grounded using appropriate ESD wrist straps and must wear ESD-protective gloves. • Handle the product with care until final assembly is complete. • Do not hold or carry the inverter by its wiring harness. • Protect the inverter from mechanical impacts. • Inspect the product before installation: ensure it is properly identified and the enclosure is free of cracks. • Discard the inverter if it is dropped during handling, as internal damage may have occurred.

3.1.1 Quick reference table for installation / specification

Table 3-1 provides a quick reference guide with summarized inverter specifications. Please review the full documentation for complete operational details.

Table 3-1: Quick reference table for installation / specification

Characteristic	Specification	For more details
Orientation	Vertical	Section 3.2
Air over inverter	2 m/s	Table 2-2
Air speed distance out from the center of the heatsink	10 mm	Section 3.2
Max ambient air temperature	60 °C	Table 2-2
Ambient measured distance from the heat-sink side of the inverter	50 mm	Section 3.2
Max heatsink temperature	75 °C	Section 3.2
Heatsink measurement location	centered over IPM (glued thermocouple)	Section 3.2

3.1.2 Inverter cables arrangement

Power and communication cables are not supplied by Nidec. In this case, inverter cables must be arranged according to the following instructions.

1. Bend repeatedly the cover's plastic flap back until it detaches to create an opening sufficient for the cables.
2. Carefully position the Safety earth cable within the cable clamp area as shown in Figure 3-1.
3. Pass the remaining cables through the cable clamp guides as shown in Figure 3-1.
4. Assemble and fasten the cable clamp to hold the cables firmly in place as shown in Figure 3-2.
5. Tighten the cable clamp screw shown in Figure 3-2 to a torque of 0.8 – 1.2 Nm.
6. After completing the cable routing, reassemble the plastic cover. Tighten the cover screw to a torque of 0.8 – 1.2 Nm.

Table 3-2: Routing Description

Indicator	Description
1	Safety Earth Cable
2	FAN Cable
3	Communication Cable
4	AC Input Cable
5	Cable Clamp
6	Fixing Screw

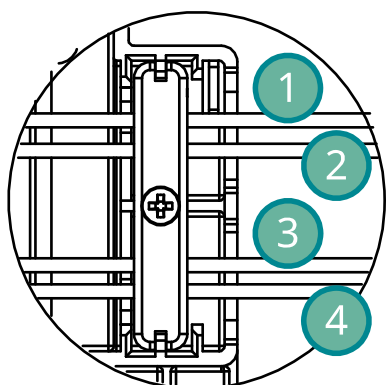


Figure 3-1: Cables arrangement

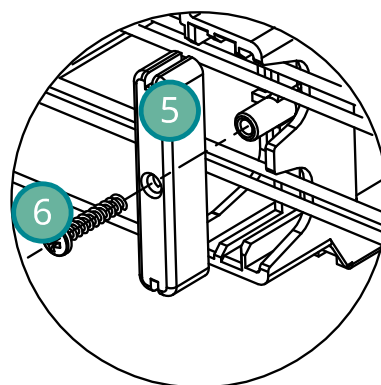


Figure 3-2: Cable clamp assembly

	CAUTION • Use fully insulated female quick-connect (Faston) terminals on the mains connections (L and N). This prevents short circuits caused by accidental bending of the terminals. • Do not route cables over the cable clamp. Improper routing causes mechanical stress that may damage the product.
	NOTICE • The approval of the input supply cables specifications and certifications as well as the cable clamp interaction with the input cables is customer responsibility.

3.2 Inverter fixation and installation

The inverter must be fixed at all the fixation points indicated in the Figure 3-3, using screws to the appliance frame using the dedicated mounting holes located on the inverter's plastic enclosure.

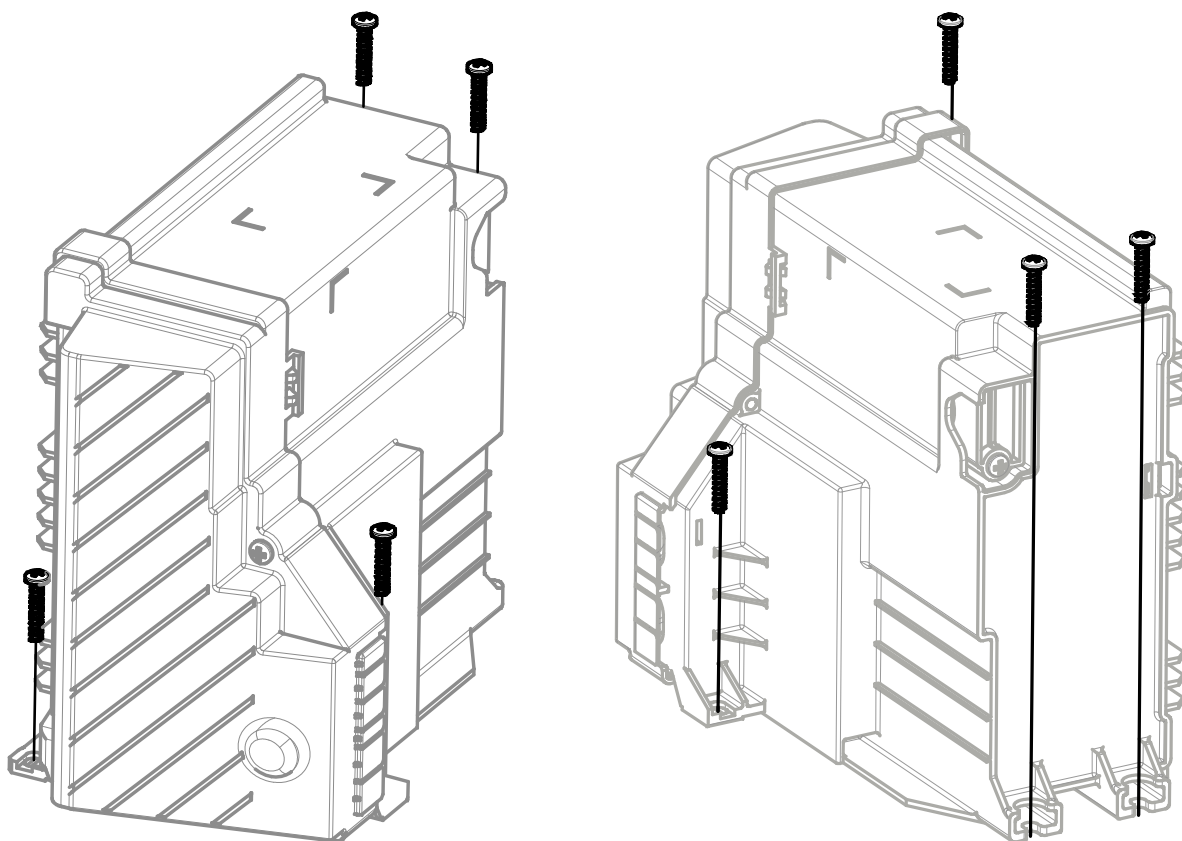


Figure 3-3: Inverter fixation



NOTICE

- The screws shown in Figure 3-3 are for reference only to indicate the fastening positions. Secure the inverter using a screw or washer with a minimum diameter of 10 mm. Tighten to a torque of 1.5 – 2.0 Nm.

The product is designed for forced ventilation applications where airflow is directed through the heatsink. Operating with restricted ventilation may trigger thermal protection and reduce performance and reliability. Refer to Figure 3-4 for the recommended airflow direction.

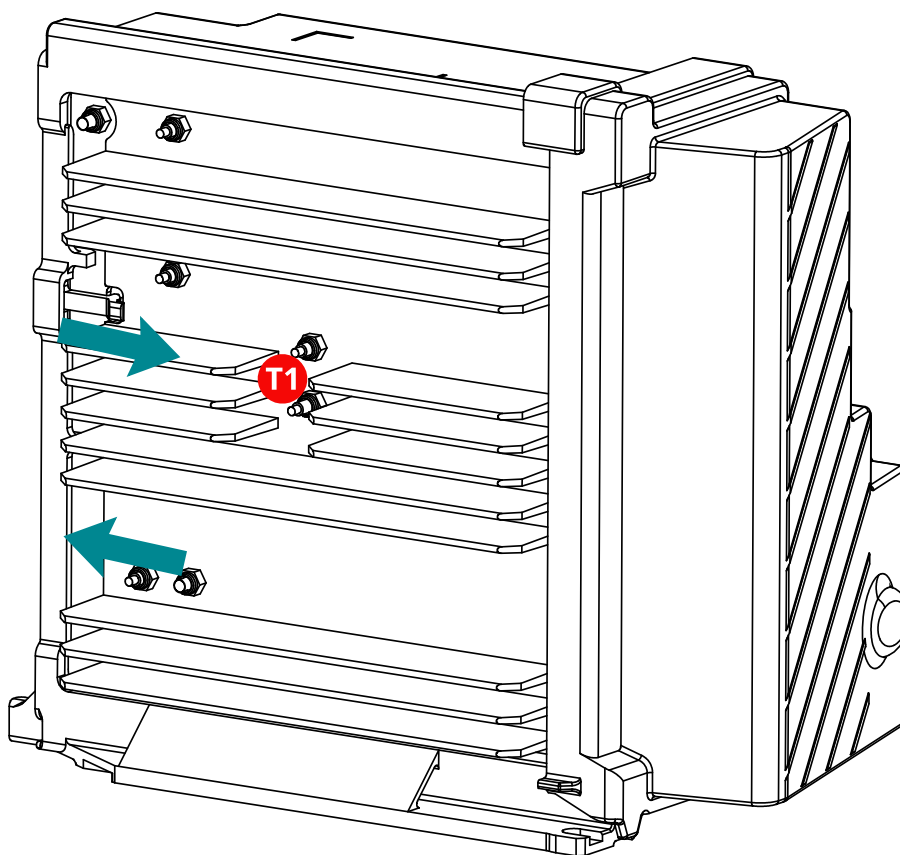


Figure 3-4: Inverter air flow direction

During the development of the refrigeration system, measure temperature T1 on the CF10C01/02 inverter.

To obtain an accurate reading, the measurement must be performed using a thermocouple securely glued directly to the heatsink's flat surface, positioned inside the heatsink fins.

The T1 temperature must not exceed 75°C. This strict limit applies under all operating scenarios, including maximum power loads and high ambient temperature conditions.



CAUTION

- To prevent performance loss, ensure the heatsink is free from any obstructions that block airflow.
- Maximum output power is only achievable with a minimum forced air velocity of 2 m/s. It must be measured at a distance of 10 mm from the center of the heatsink.

The recommended fan, compressor and inverter position is shown in Figure 3-5.

To meet the forced ventilation requirements, we recommend tilting the inverter or installing air deflectors to direct airflow through the heatsink.

Measure the inverter airflow 10 mm from the center of the heatsink, Z axis of Figure 3-5, with a hot wire anemometer, the minimum forced air velocity is 2 m/s.

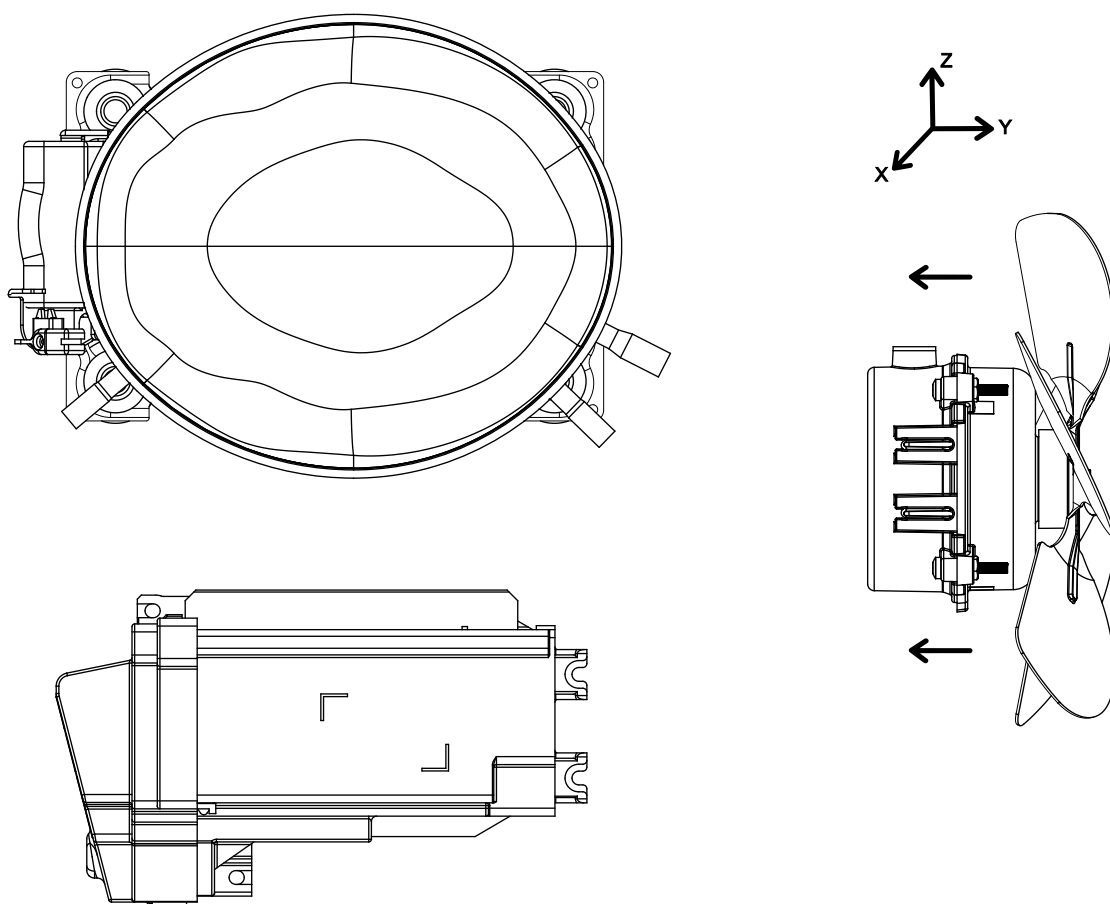


Figure 3-5: Recommended fan, compressor, and inverter position

3.3 Compressor cable and fence cover assembling

	WARNING • Disconnect the AC power supply before accessing the connectors. • Keep the Control Input Cable (low voltage) physically separated from high-voltage power cables. Contact between these cables may result in electrical hazards or damage to the equipment.
	CAUTION • Ensure the motor connector is properly connected to the 3 pins of the compressor's hermetic terminal. Improper connection may cause compressor malfunction. • The inverter must be installed in a vertical position. Refer to Figure 3-5 for the recommended mounting orientations. • To protect the inverter circuit from Electrostatic Discharge (ESD), connect the earth (ground) terminals first before making any other connections. • Handle the inverter enclosure with care. Avoid contact with the internal electronic board to prevent ESD damage. • The Serial and Frequency communication modes provide Reinforced Isolation. • The Drop-in and Defrost Inputs (Energized Contact) provide Functional Insulation. • Verify that all connections are secure before connecting the inverter to the AC supply line. Remove any cables connected to the YouControl input prior to final assembly. The YouControl input is not isolated.
	NOTICE • Please refer to the compressor's technical specifications for data not included in this inverter manual. Contact Embraco Technical Support for any inquiries regarding system integration.

All figures at sections 3.3.1, 3.3.2, 3.3.3 and 3.3.4 are for reference only.

3.3.1 VEH compressor cable connection

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

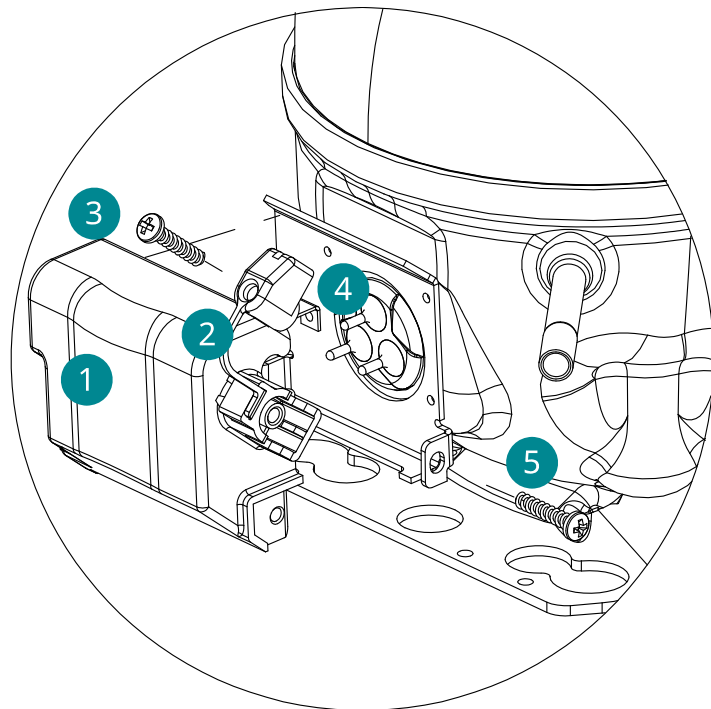


Figure 3-6: VEH compressor series description

Tighten the screws shown in Figure 3-11 and Figure 3-12 to a torque range of 0.8 – 1.2 Nm.

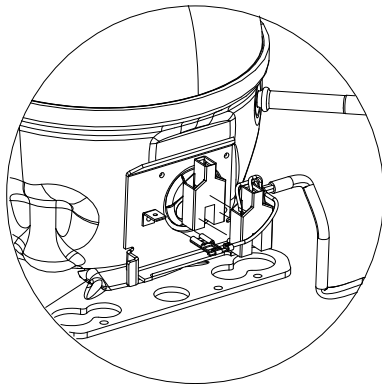


Figure 3-7: Step 1 - Connect the ground cable

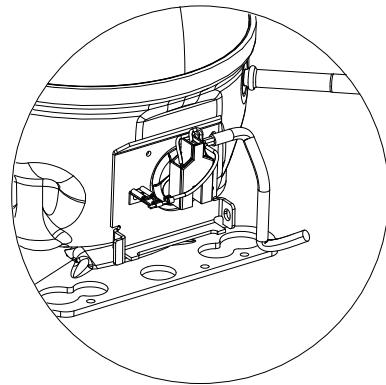


Figure 3-8: Step 2 - Connect the compressor motor cable

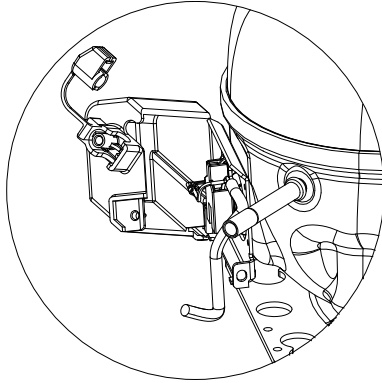


Figure 3-9: Step 3 - Connect the back corner of the cover

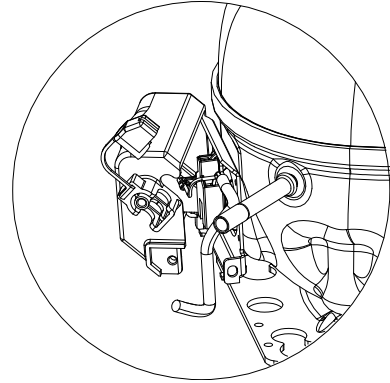


Figure 3-10: Step 4 - Assemble the fence cover

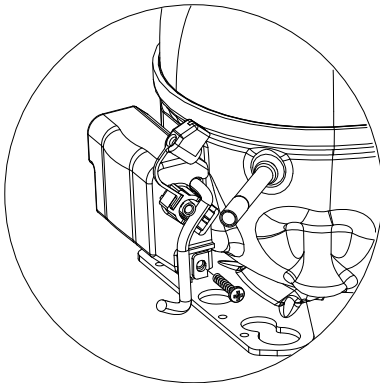


Figure 3-11: Step 5 - Screw the fence cover

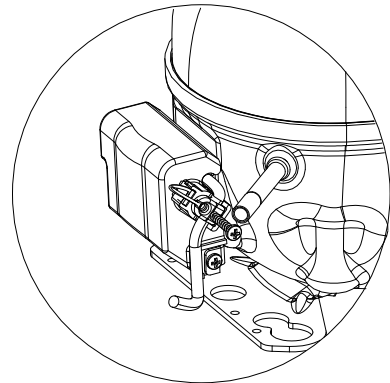


Figure 3-12: Step 6 - Screw the cord anchorage

3.3.2 FMF compressor cable connection

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

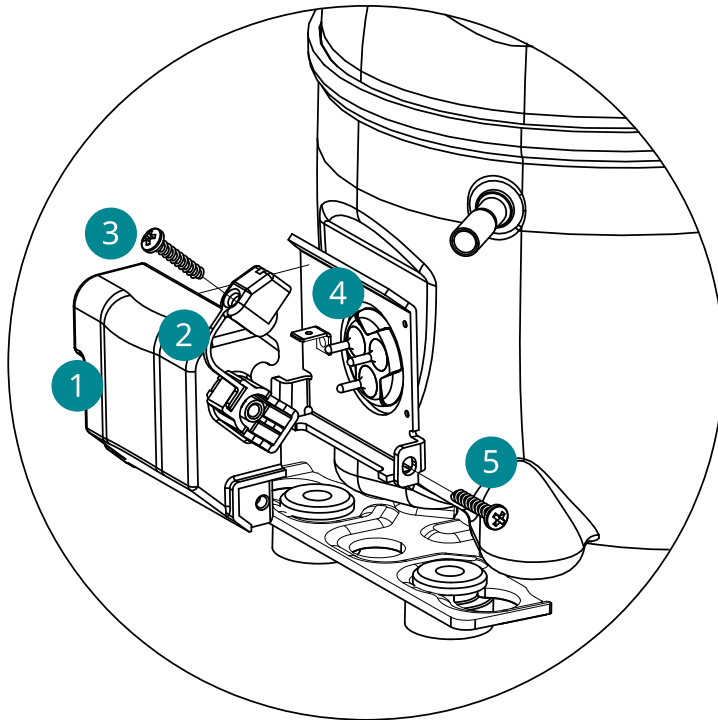


Figure 3-13: VEG and FMF compressor series description

Tighten the screws shown in Figure 3-18 and Figure 3-19 to a torque range of 0.8 – 1.2 Nm.

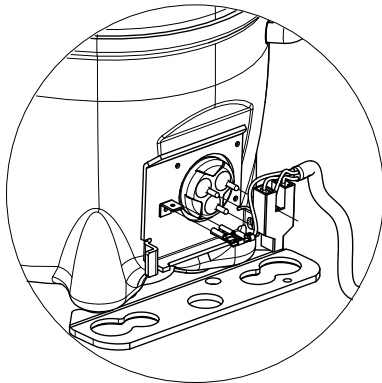


Figure 3-14: Step 1 - Connect the earth cable

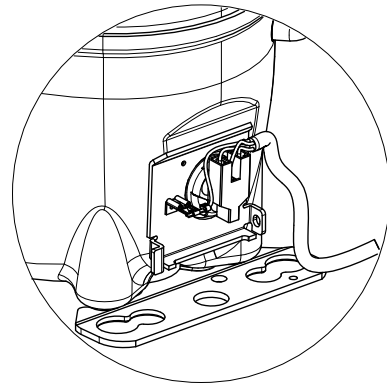


Figure 3-15: Step 2 - Connect the compressor motor cable

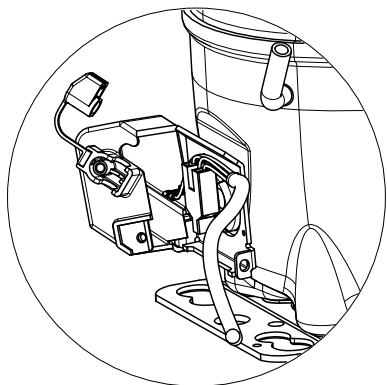


Figure 3-16: Step 3 - Connect the back corner of the cover

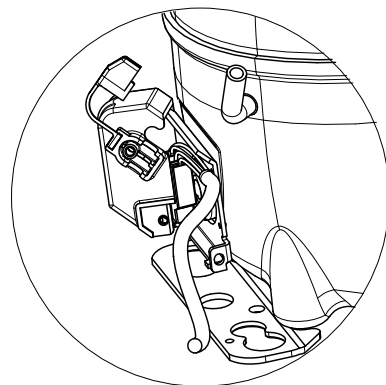


Figure 3-17: Step 4 - Assembly the fence cover

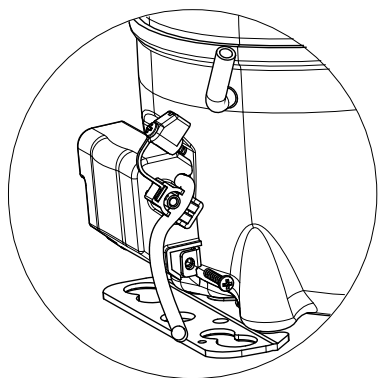


Figure 3-18: Step 5 - Screw the fence cover

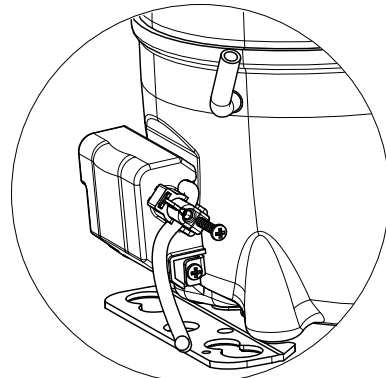


Figure 3-19: Step 6 - Screw the cord anchorage

To disassemble the fence cover, first remove the cord anchorage screw and then remove the fence cover screw.

3.3.3 VNEK/VNEU compressor cable connection

Tighten the screws shown in Figure 3-22 to a torque range of 0.1 – 0.6 Nm.

Tighten the screws shown in Figure 3-25 (Step 9) to a torque range of 0.8 – 1.2 Nm.

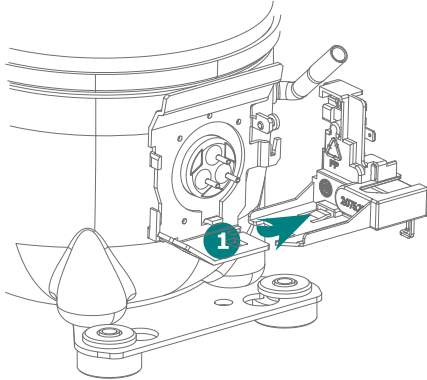


Figure 3-20: Step 1 - Check the cord anchorage position on the fence support

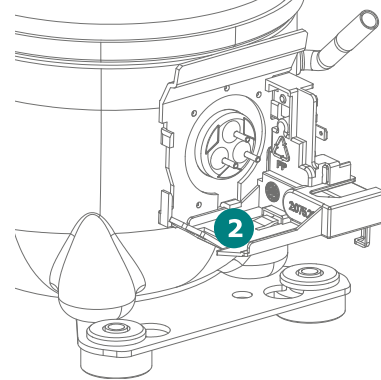


Figure 3-21: Step 2 - Slide cord anchorage snap for attachment on fence

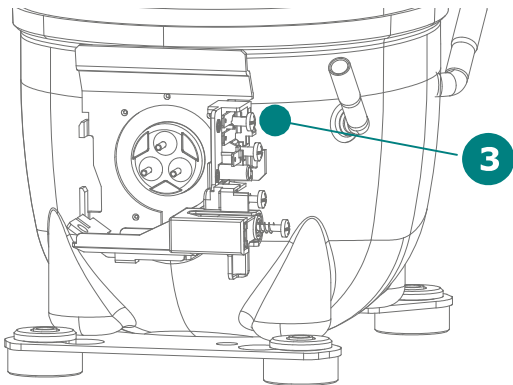


Figure 3-22: Step 3 - Grounding terminal to fasten the screw in cord anchorage bracket

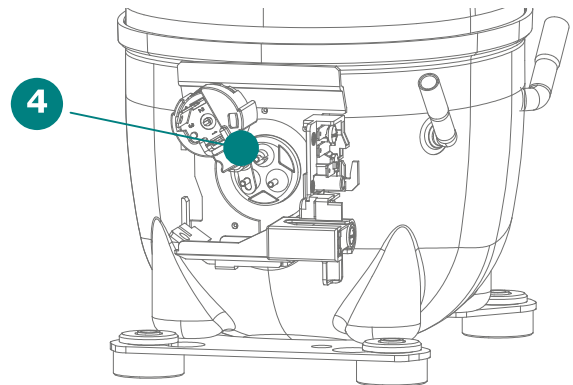


Figure 3-23: Step 4 - Insert OLP bracket in the hermetic terminal pin

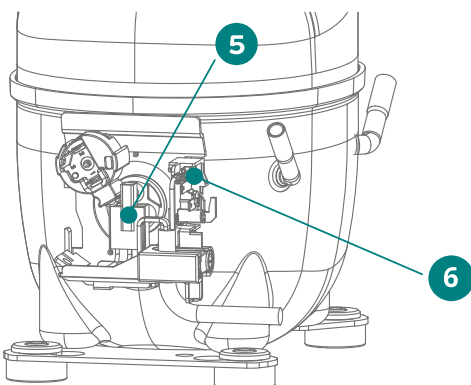


Figure 3-24: Step 5 - Inverter connector insertion in the compressor hermetic terminal.
Step 6 - Insertion of grounding cable

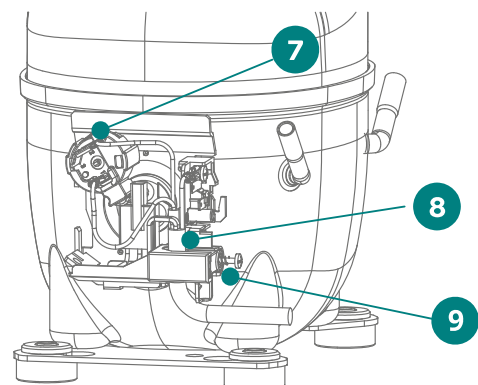


Figure 3-25: Step 7 - Inverter terminal cables on OLP. Step 8 - Inverter cables positioning on cord anchorage bracket. Step 9 - Insert and screw the cable clip.

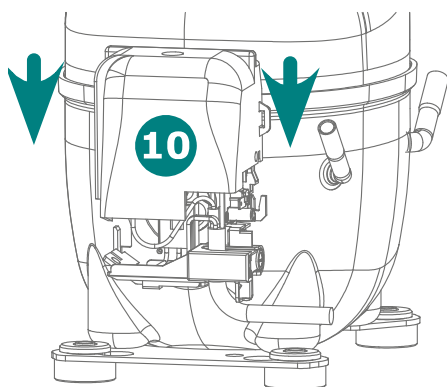


Figure 3-26: Step 10: Place terminal board cover on fence support top-down until complete fit

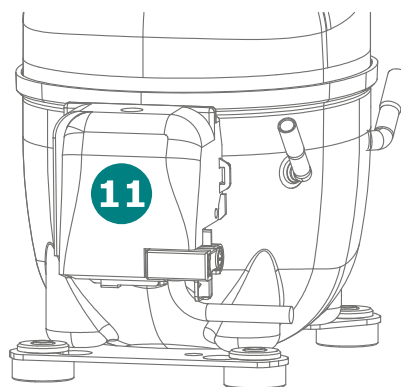


Figure 3-27: Step 11: Complete the assembly

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

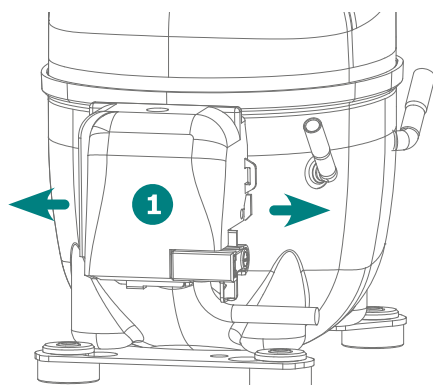


Figure 3-28: Step 1 - Using a screwdriver, push the keys in tabs of terminal board cap

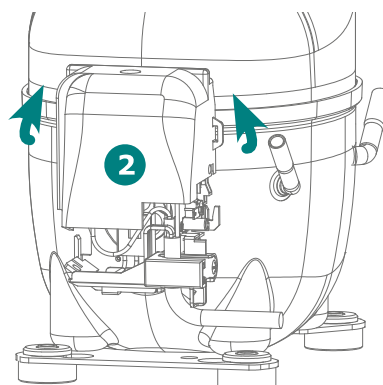


Figure 3-29: Step 2 - Force the tabs in the opposite direction and then move the cap up

3.3.4 VNEX compressor cable connection

To connect the inverter to the compressor, attach the motor cable on the hermetic compressor terminal, as shown from Figure 3-30 to Figure 3-36.

Tighten the screws shown in Figure 3-32 and Figure 3-34 to a torque range of 0.8 – 1.2 Nm.

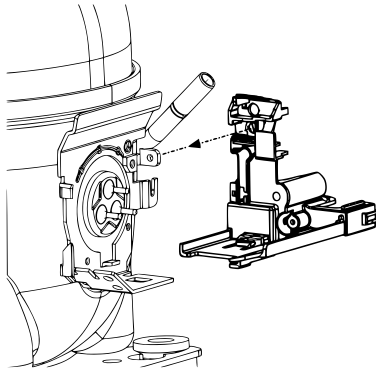


Figure 3-30: Step 1 - Check the cord anchorage position on the fence support

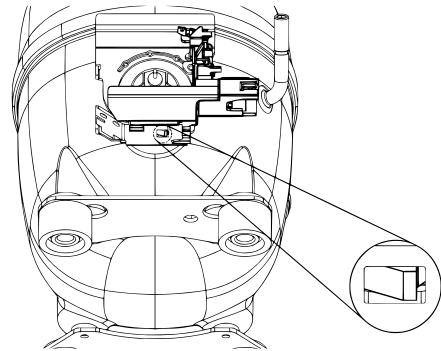


Figure 3-31: Step 2 - Slide cord anchorage snap for attachment on fence

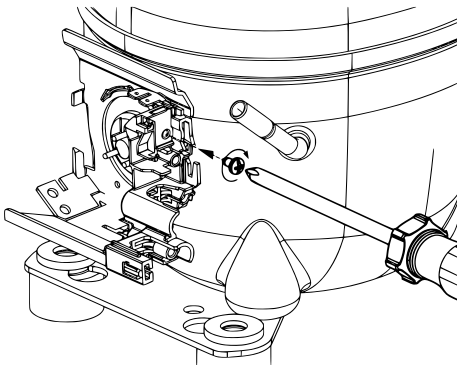


Figure 3-32: Step 3 - Screw the grounding terminal in cord anchorage bracket

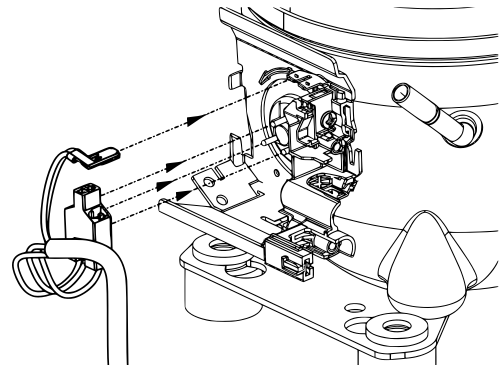


Figure 3-33: Step 4 - Connect the compressor motor cable

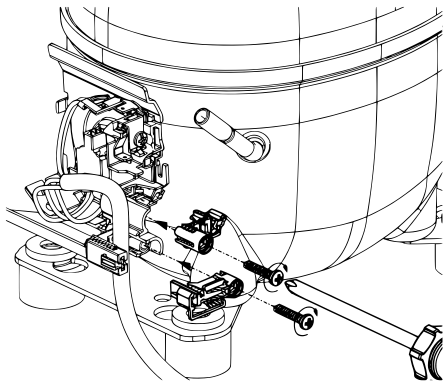


Figure 3-34: Step 5 - Insert and screw the cable clip and complete electrical cables fastening

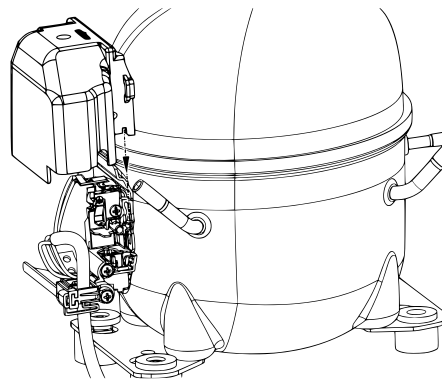


Figure 3-35: Step 6 - Place terminal board cover on fence support top-down

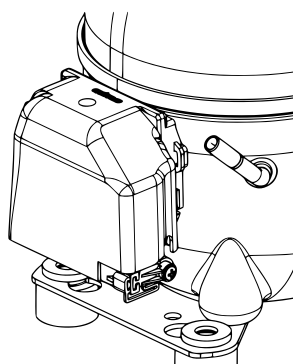


Figure 3-36: Step 7 - Finish fitting the cover to the fence

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

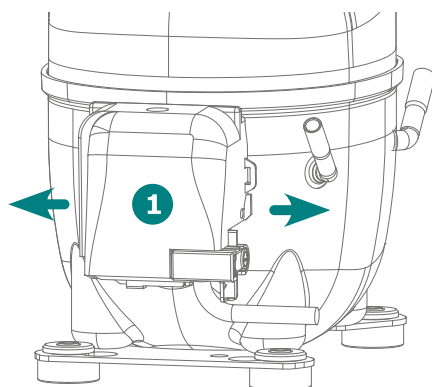


Figure 3-37: Step 1 - Using a screwdriver, push the keys in tabs of terminal board cap

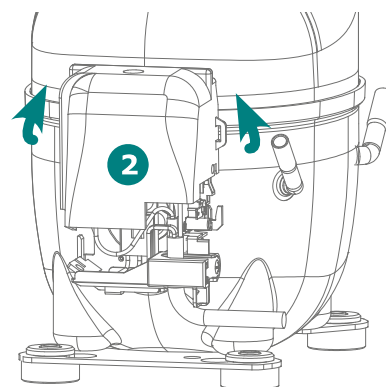


Figure 3-38: Step 2 - Force the tabs in the opposite direction and then move the cap up

3.4 Optional AC fan output function

The CF10C01/02 series features an optional AC Fan control switch. This is a dry contact (potential-free) switch that synchronizes with the compressor: it closes (ON) when the compressor is running and opens (OFF) when the compressor stops.

The switch is designed to be connected in series with the fan power supply. Connect the circuit as follows:

- Connect one terminal of the Inverter Fan Output to the AC power source (Phase or Line).
- Connect the second terminal of the Inverter Fan Output to one of the Fan terminals.
- Connect the remaining Fan terminal to the return path of the AC power source (Neutral).

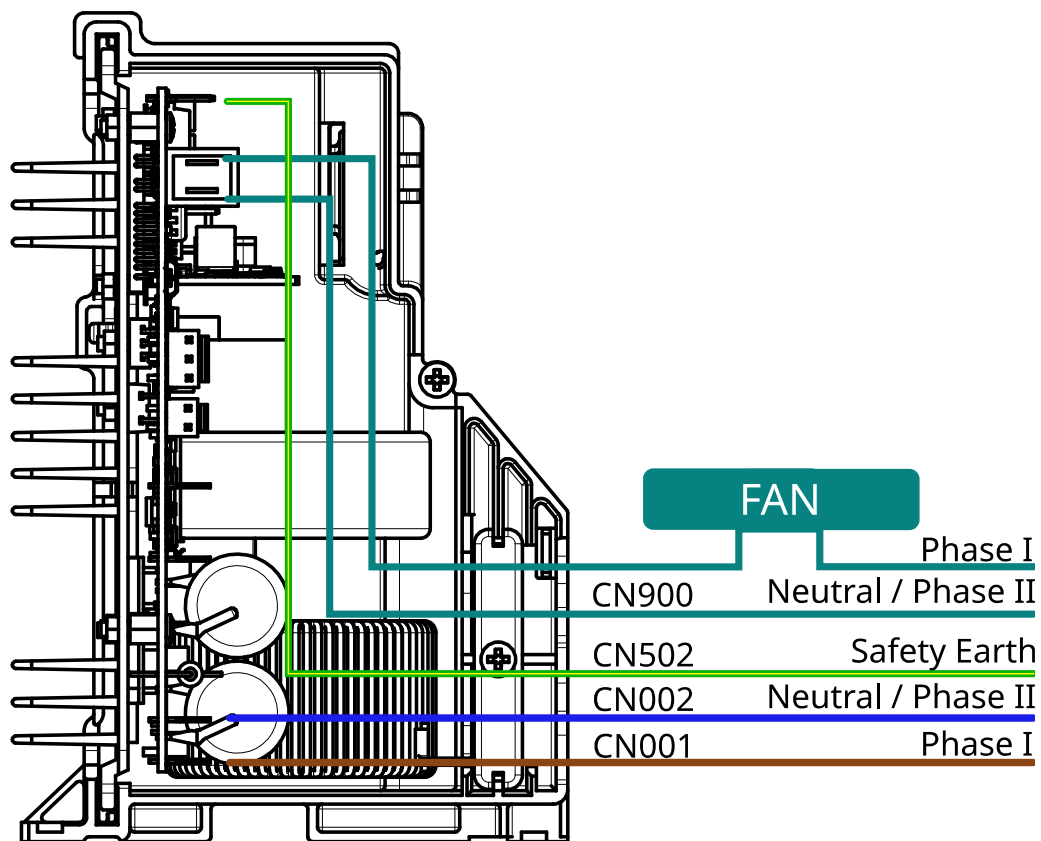


Figure 3-39: Fan connection

3.5 Safety recommendations for electrical installation

	WARNING • Only qualified and trained personnel must perform diagnostic and maintenance procedures. • Always ensure the product is completely disconnected from the AC power supply before starting any maintenance or diagnostics. • After disconnecting the AC power supply, wait for the inverter to cool down. Only perform maintenance or diagnostic procedures once the inverter is cold (below 30°C). • Proper grounding of the inverter is mandatory to prevent electrical shock and ensure safe operation. • For single-phase installations, the phase wire must be protected by a circuit breaker. Ensure correct polarity. Connect the Phase wire to the Inverter Line (L) input and the Neutral wire to the Inverter Neutral (N) input. • For two-phase installations, a 2-pole circuit breaker is mandatory. • The inverter shall be connected to a power supply protected with a Ground Fault Circuit Interrupter (GFCI) or Residual Current Device (RCD), in accordance with local regulations.
	NOTICE • Be aware that high-frequency leakage currents naturally generated by inverter operation may cause nuisance tripping in standard Class A GFCIs. To prevent this, the use of a High-Frequency (HF) type GFCI, compliant with UL 943, is highly recommended.

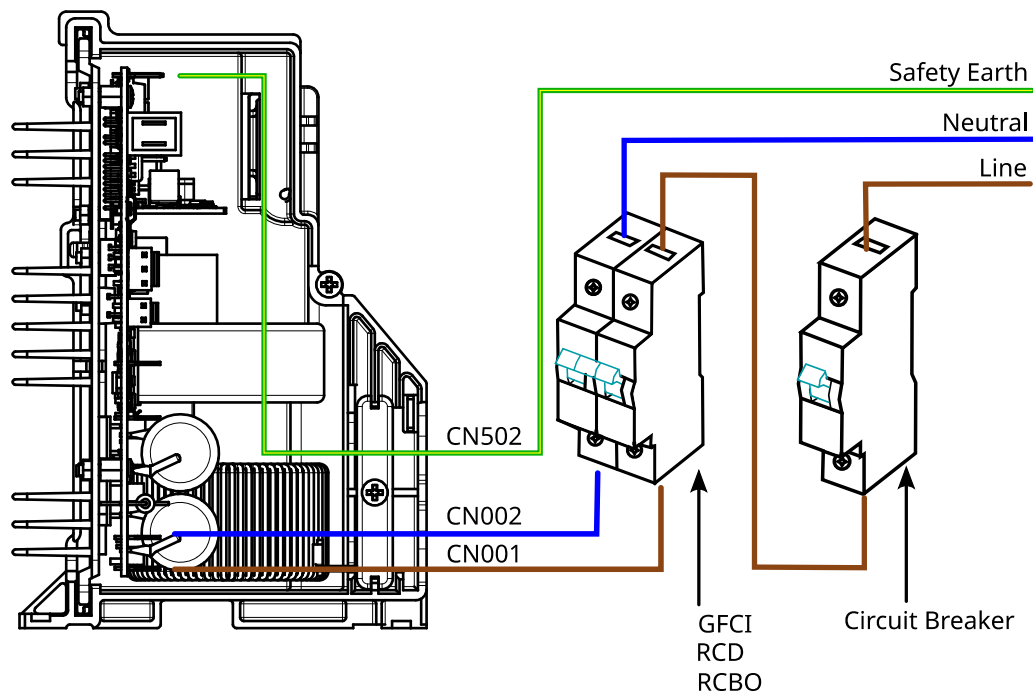


Figure 3-40: Phase-Neutral connection

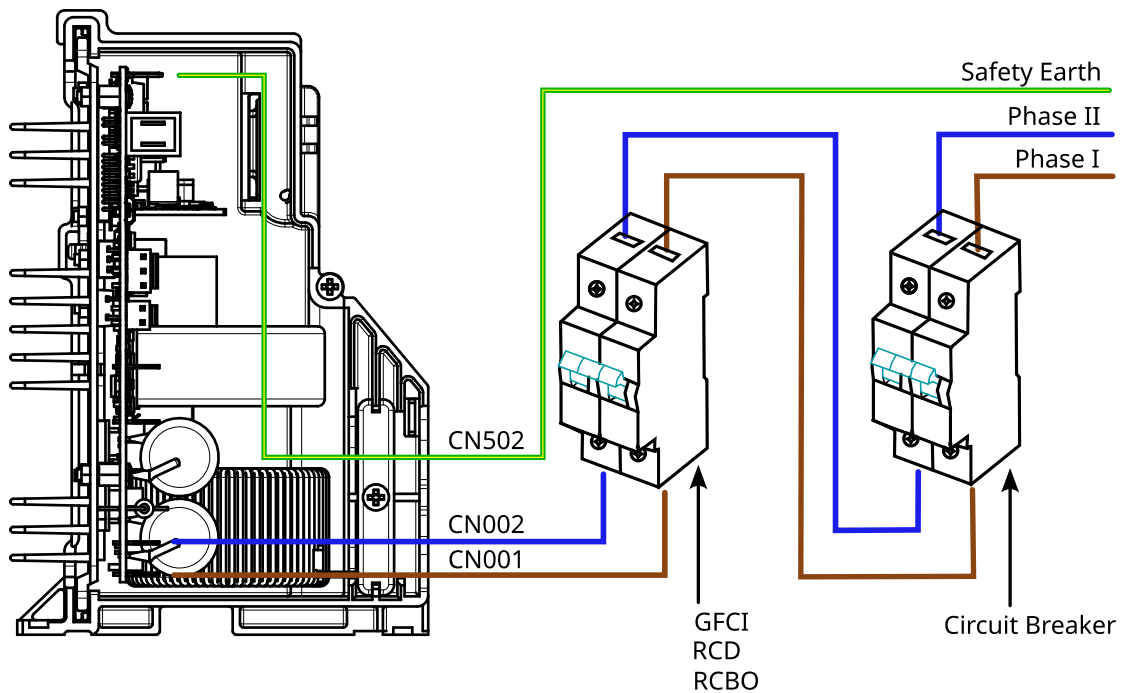


Figure 3-41: Phase-Phase connection

GFCI – Ground fault circuit interrupter

RCD – Residual current device

RCBO – Residual current circuit breaker with overcurrent protection

3.6 Package information

The inverters are supplied in cardboard packaging. Box dimensions may change without prior notice.

Table 3-3: Storage Conditions

Storage Conditions	
Storage humidity	< 85%
Storage ambient temperature	-20 °C to 85 °C

Table 3-4: Configuration

Configuration	Quantity	Dimensions (mm)
Config #1	9	536 x 385 x 227

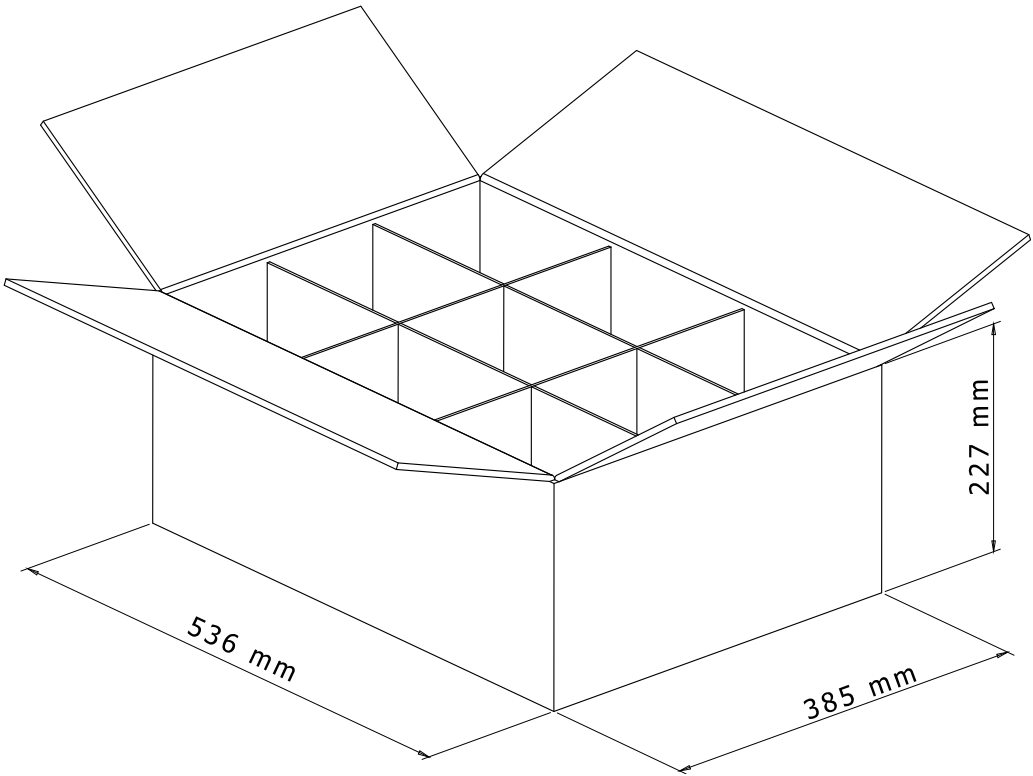


Figure 3-42: Product cardboard package dimensions

3.6.1 Product disposal

	WARNING • Keep the inverter board inside its case. • Do not place the inverter in fire; contact authorities if incineration is necessary.
	CAUTION • Do not throw the inverter in regular trash bins; use specific e-waste channels. • For proper treatment, recovery, and recycling, please contact your local authorities or the equipment dealer to determine the correct method of disposal for this product. • In accordance with the Waste Electrical and Electronic Equipment (WEEE) Directive, the CF10C01/02 Inverter must not be disposed of with general waste. Please use designated collection facilities according to your own country's regulations.
	NOTICE • The product packaging and internal partitions are constructed from carton material and should be disposed of as recyclable waste. • This device is RoHS compliant. Proper disposal is essential to conserve valuable resources and contribute to environmental preservation.

4 OPERATION

The CF10C01/02 Inverter is designed to support multiple communication modes:

- Drop-In Control Mode (with optional Defrost Input)
- Frequency Control Mode
- Serial Control Mode
- Sync Pro Control Mode

	WARNING • Do not handle the inverter while it is powered. • Ensure the inverter is completely disconnected and de-energized before making or modifying any connections.
	NOTICE • The inverter is assembled with multiple communication capabilities; the specific control mode is chosen automatically by the inverter based on the active signal. • Serial Control Mode and Sync Pro Control Mode are mutually exclusive configurations. The inverter is equipped with one or the other, never both simultaneously. • Output frequency and motor speed range may be automatically reduced based on the maximum working conditions of the compressor, potentially overriding specific set point instructions. • For the detailed operating range of your specific compressor, please contact Embraco Technical Support.

4.1 Drop-in control mode

This mode allows the inverter to be applied to any refrigeration system using a simple ON/OFF thermostat, eliminating the need for electronic controllers.

The compressor speed is adjusted automatically by the inverter in accordance with thermal load variations.

4.1.1 Smart drop-in

Smart Drop-In was designed with focus on cooling capacity, while also considering the 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 into four main parts: Pull-down, Stability Routine, Heavy Duty Routine and Defrost Routine. The Stability, Heavy Duty and Defrost Routines start 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 at the maximum allowed speed, generating more cooling capacity to reduce the pull-down time. This state is kept until thermal load reaches 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 routine runs continuously in the background to monitor the system and detect any disturbances. It observes the inverter's electrical parameter variations—which directly correlate to the thermal load curve—to identify exceptional load conditions. Based on this continuous data feed, the routine decides whether it is necessary to alter the compressor speed to handle these heavy loads.

Defrost Routine

Designed for high accuracy in defrost detection and management, this routine optimizes the entire defrosting process. It provides significant operational benefits by minimizing the time required for active defrost cycles (such as Hot-Gas) and accelerating the temperature recovery during the post-defrosting phase for both Hot-Gas and Heater defrost systems.

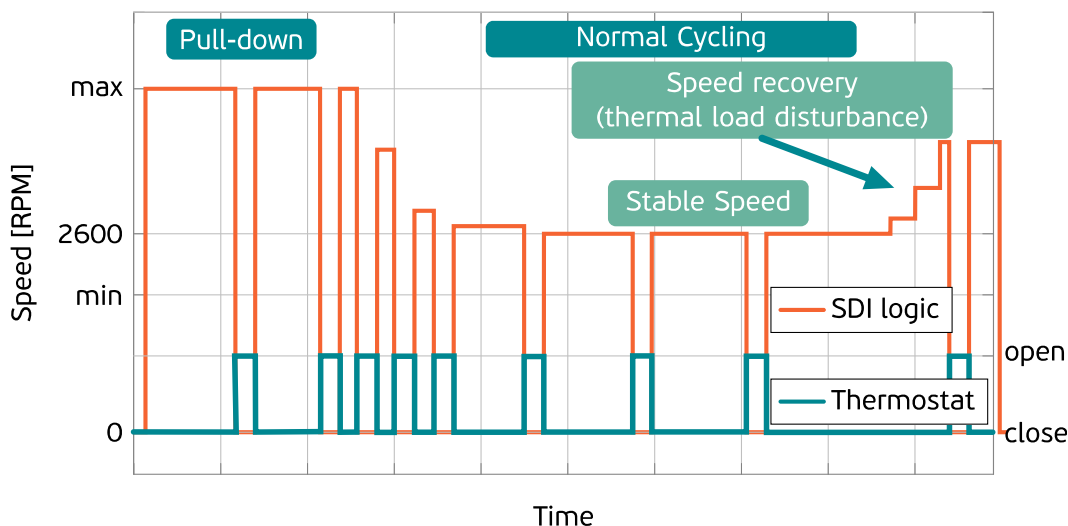


Figure 4-1: Compressor speed versus thermostat behavior Smart Drop-in

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](#).



4.1.2 Defrost input

The Defrost input serves as an additional control signal within the Smart Drop-In logic, designed to enhance overall product performance by accurately detecting when a defrost cycle occurs. It is important to note that the primary Drop-In input still defines the core compressor ON/OFF state.

The inverter determines the specific type of defrost by monitoring the combined states of the Defrost input and the main Drop-In input:

Hot-Gas Defrost: If the Defrost signal is ON and the Drop-In signal is also ON, the system identifies a Hot-Gas defrost. To facilitate this, the logic overrides the standard speed and forces the compressor to run at maximum capacity.

Heater Defrost: If the Defrost signal is ON but the Drop-In signal is OFF, the system identifies an electrical Heater defrost. Since the Drop-In signal is off, the compressor remains completely OFF during the heating cycle.

Regardless of the defrost method detected (Hot-Gas or Heater), the system ensures that the immediate post-defrost cycle is always performed at a higher speed to rapidly recover the internal appliance temperatures.



NOTICE

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

4.1.3 Drop-in connection

The Drop-In mode connection must be wired according to Figure 4-2. This connection utilizes an energized contact and must be used when the thermostat control signal is energized directly from the AC phase. In standard applications, this specific signal configuration is commonly referred to as the Thermostat Return Signal.

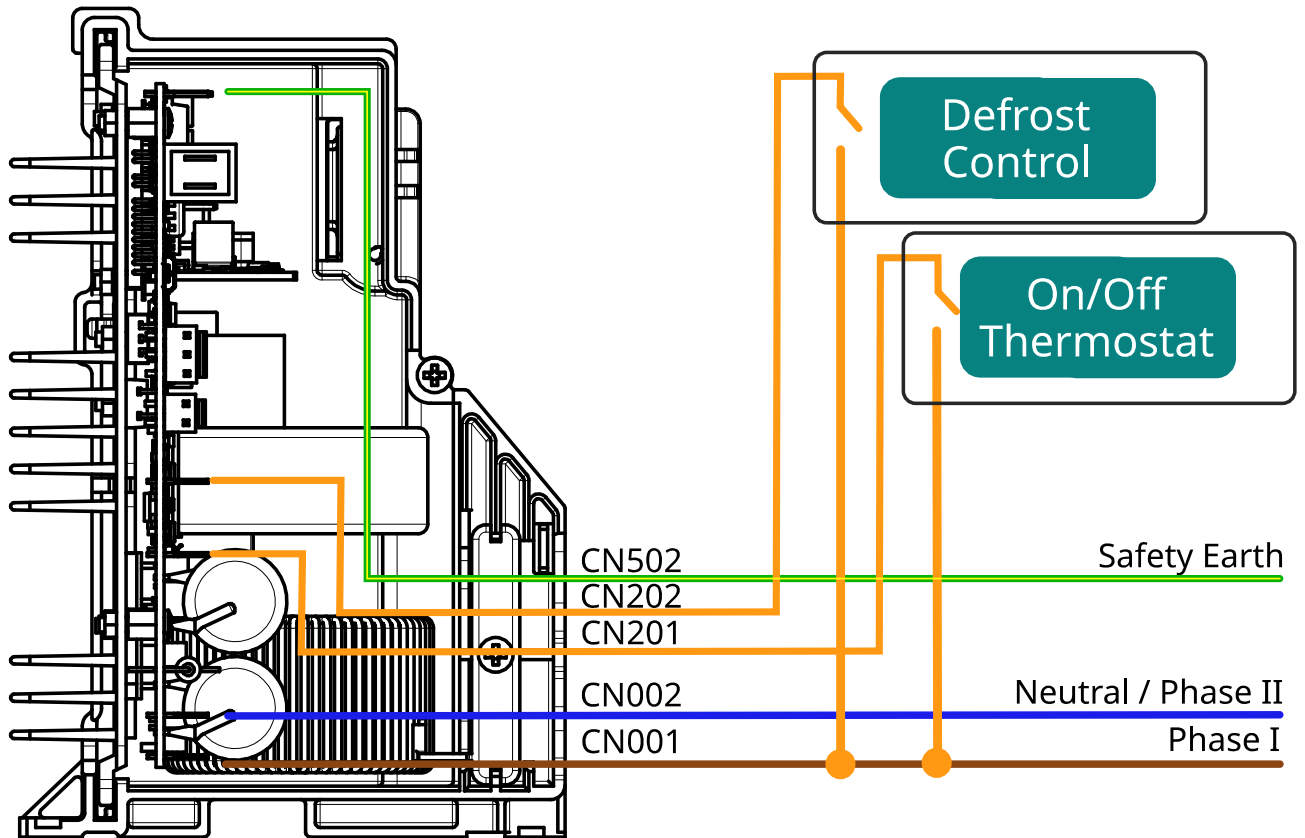


Figure 4-2: Energized Contact Drop-In connection

	CAUTION The impedance across the open contacts of the thermostat and defrost controls must be greater than 380 kΩ. If the isolation impedance falls below this threshold, the inverter may falsely detect a closed circuit, causing the compressor to run continuously without shutting off.
	NOTICE All primary operational parameters, including minimum and maximum speeds, are specified in the respective compressor datasheet.

4.2 Frequency control mode

In this operation mode, the compressor speed is directly controlled by a frequency signal sent to the inverter. This signal is typically provided by an external electronic thermostat.

The input is a digital square wave. For precise electrical parameters and timing details, please refer to the Signal Specification Table 4-1 and Figure 4-3. Figure 4-6 illustrates the required electrical connections to establish frequency communication between an external electronic controller and the CF10C01/02 Inverter's serial connector (CN203).

Table 4-1: 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 ⁱ	7 mA
Minimum current ⁱⁱ	2 mA
Maximum frequency signal	200 Hz

i. Currents above this value may reduce the life span of the optocoupler.

ii. Currents below this value may cause a loss of inverter communication.

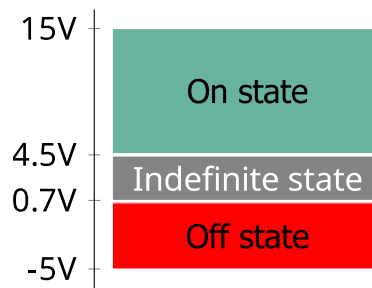


Figure 4-3: Signal levels for frequency control mode

The inverter behavior is indefinite for signal voltages between 0.7 V and 4.5 V. It is strictly not recommended to use signals within this range to ensure reliable operation.

The digital signal duty cycle must remain within the range of 30% to 70%.

The Figure 4-4 below illustrates a graphical example of a standard input frequency signal at 125 Hz, adhering to the valid voltage and duty cycle parameters.

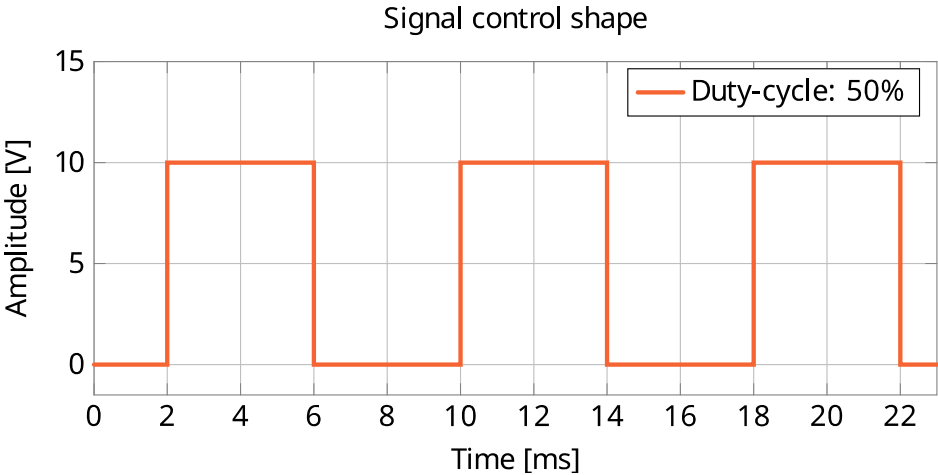


Figure 4-4: Signal control shape

The compressor speed is determined by the input frequency signal according to a pre-defined transfer function. The Table 4-2 and Table 4-3 demonstrate the relationship using two specific compressor models as examples: VNEU217U and FMFT411U.

Table 4-2: Input Frequency Signal Compressor VNEU217U

Input Frequency Signal [Hz]	VNEU217U compressor speed [RPM]
0 to 50	0
50 to 66	2000
66 to 150	30 x Hz
>150	4500

Table 4-3: Input Frequency Signal Compressor FMFT411U

Input Frequency Signal [Hz]	FMFT411U compressor speed [RPM]
0 to 50	0
50 to 60	1800
60 to 150	30 x Hz
>150	4500

For detailed speed versus input frequency signal information for each specific compressor, please contact Embraco Technical Support.

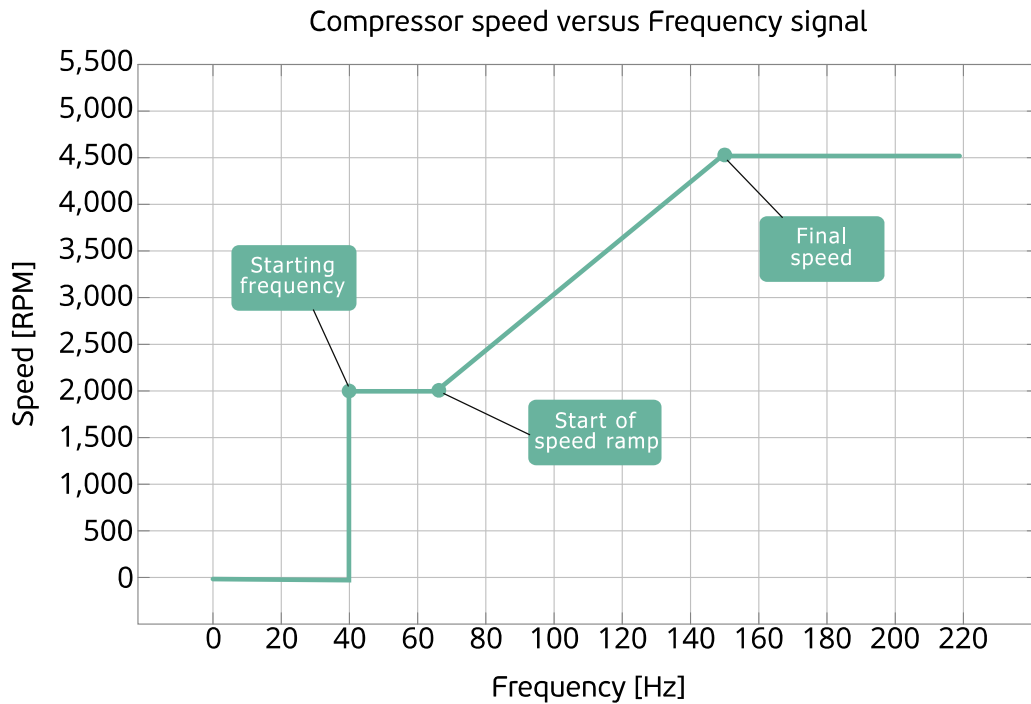


Figure 4-5: Example of a typical signal control frequency vs compressor speed

The Figure 4-7 illustrates the required electrical connections to establish frequency communication between an electronic thermostat and the CF10C01/02 Inverter Control connector.

The Frequency Control mode features a reinforced isolation circuit provided by the use of an optocoupler.

The input resistance for frequency communication is 1.2 k Ω .

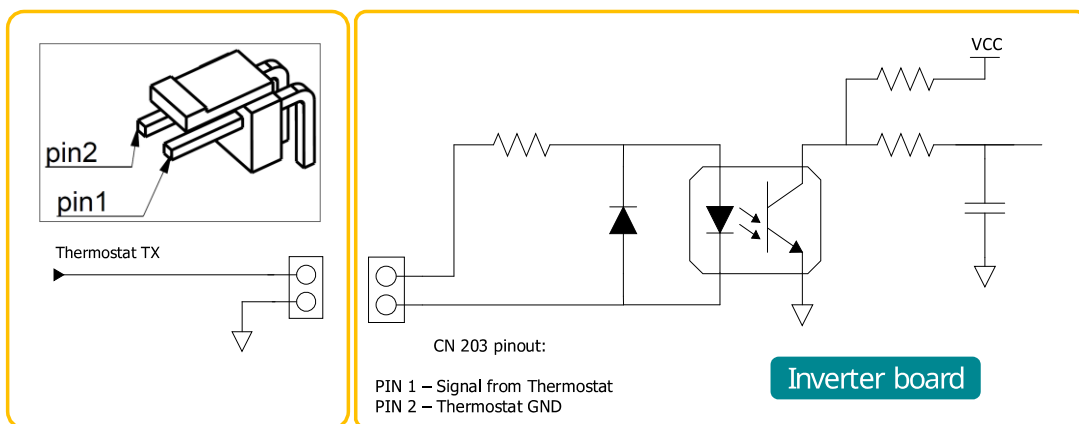


Figure 4-6: Electrical schematic of frequency communication

4.2.1 Frequency connection

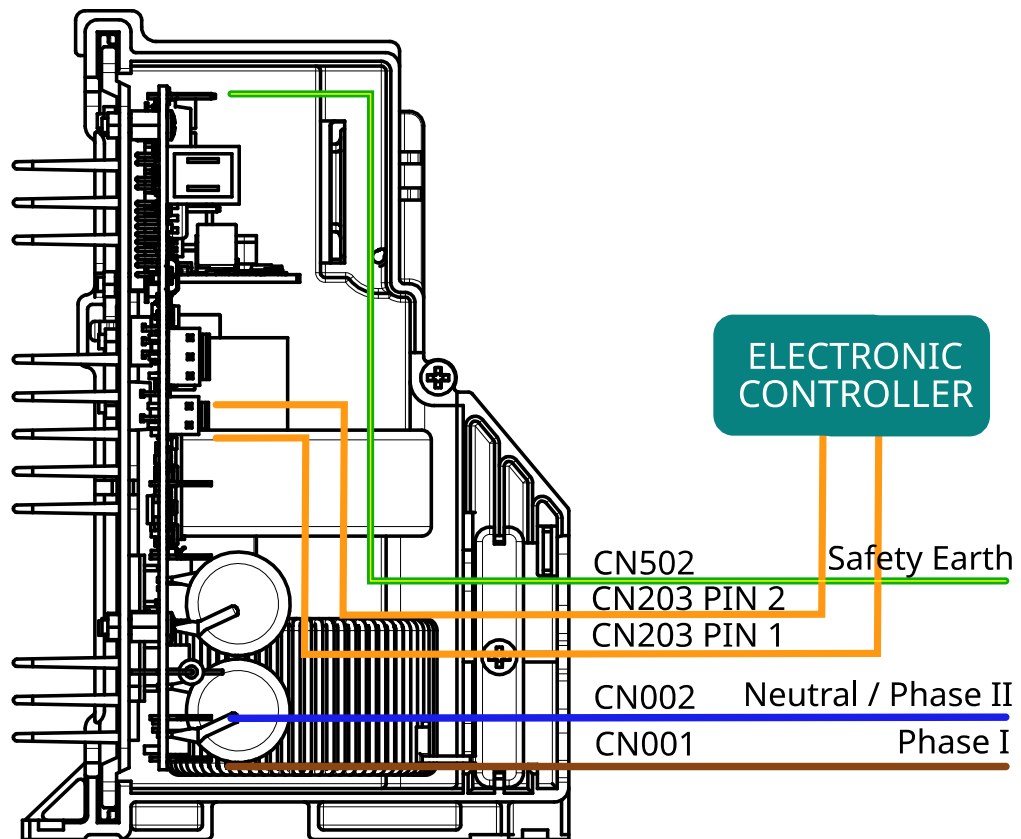


Figure 4-7: Frequency connection

4.3 Serial control mode

This control mode is applied when an electronic thermostat manages the CF10C01/02 Inverter using a serial communication interface. By implementing the proprietary Embraco serial protocol, the controller can precisely dictate the compressor's running speed and continuously monitor other key operational parameters.



NOTICE

- Do not use the serial communication link and the YouControl interface simultaneously. Concurrent use will generate direct communication conflicts and disrupt inverter operation.

4.3.1 Serial specifications and internal circuit

The Serial Control mode features a reinforced isolation circuit provided by the use of optocouplers. Figure 4-10 illustrates the required electrical connections to establish serial communication between an external electronic controller and the CF10C01/02 Inverter's serial connector (CN204).

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

Table 4-4: 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
Optocoupler Diode Maximum current ⁱ	7 mA
Optocoupler Diode Minimum current ⁱⁱ	2 mA
Optocoupler collector maximum current ⁱⁱⁱ	2 mA
Optocoupler collector minimum current ⁱⁱ	1 mA

i. Currents above this value may reduce optocoupler life span.

ii. Currents below this value may cause loss of inverter communication.

iii. Currents above this value may cause loss of inverter communication.

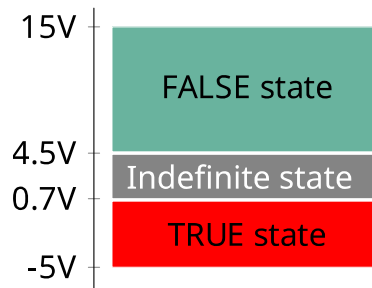


Figure 4-8: Signal levels for serial communication

Example: 39h sent to inverter

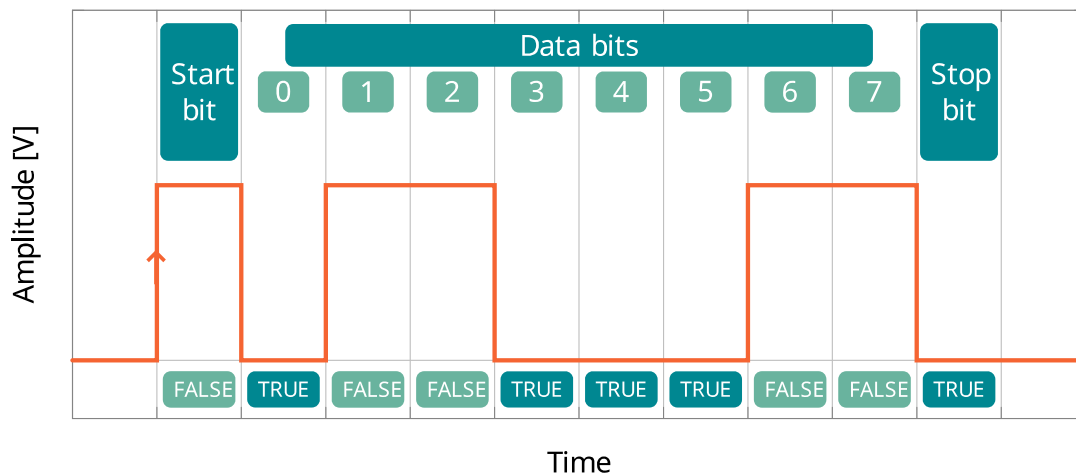


Figure 4-9: Signal control shape

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 4-8. 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.

The input resistance for serial communication varies from 1 k Ω to 1.2 k Ω .

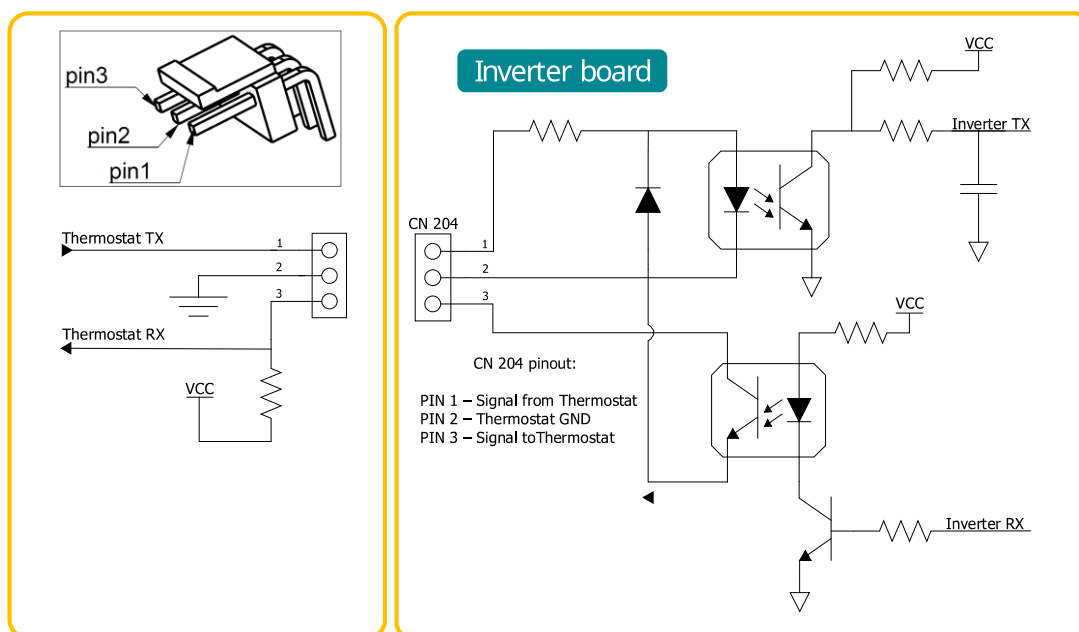


Figure 4-10: Electrical schematic of serial communication

4.3.2 Serial connection

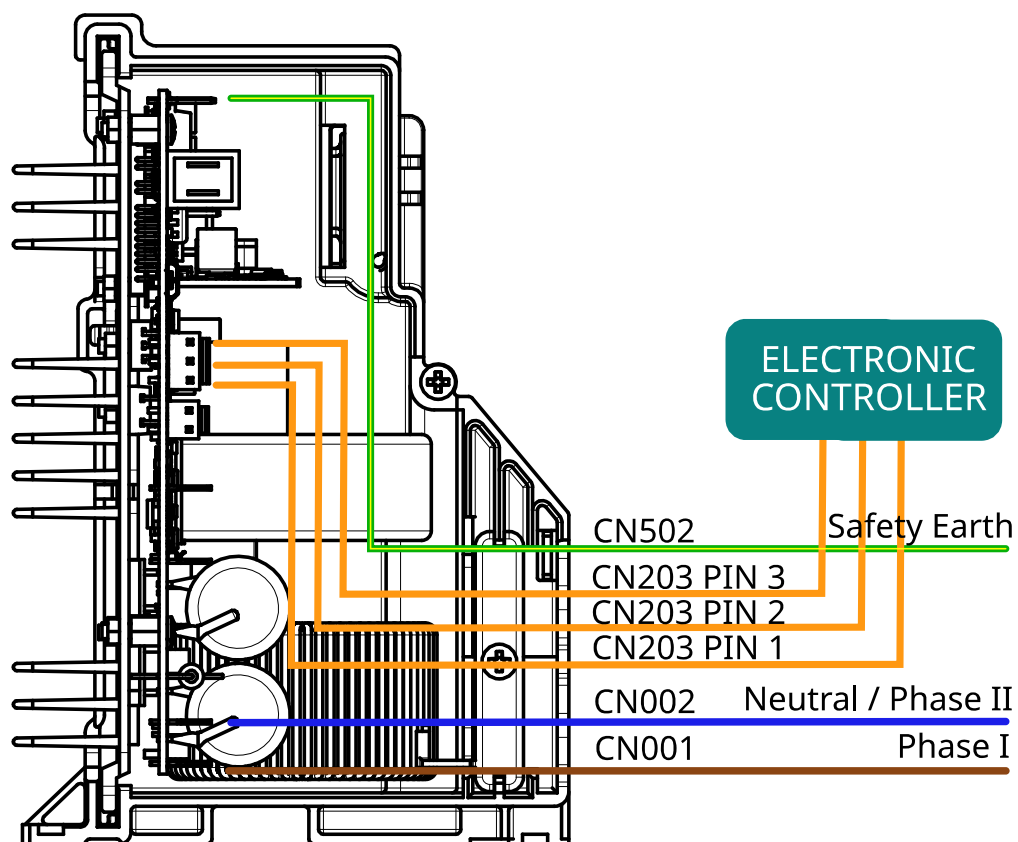


Figure 4-11: Serial connections

4.3.3 Serial commands

To perform serial communication between a computer (RS-232) and the CF10C01/02 Inverter serial connection, please contact Embraco Technical Support to receive instructions.

Table 4-5: Basic specification

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

Table 4-6: Command structure

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

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

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

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

Table 4-7: 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	5Ah	69h	[Note]	93h	CK

Table 4-8: Receive commands structure

Response to:	ID	CMD	LSB	MSB	CK
Set speed	5Ah	83h	Status ⁱ		CK
Read set speed	5Ah	80h	Speed [RPM]		CK
Read operation status	5Ah	83h	Status ⁱ		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 [°C x 10]		CK
Read power limitation	5Ah	8Ah	Power limitation [W]		CK
Communication error	5Ah	Code ⁱⁱ	FFh	FFh	CK

i. See Status Data Table 4-9.

ii. See Error Code Table 4-10

Table 4-9: 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 ⁱ
1	02h	FFh	Overload ⁱⁱ
2	04h	FFh	Under speed (below minimum allowed limit)
3	08h	FFh	Wrong rotor position
4	10h	FFh	Overvoltage Failure
5	20h	FFh	Over temperature failure ⁱⁱⁱ
7	80h	-	Set speed data out of specification ^{iv}
7	80h	FFh	Set speed data out of specification ^v

i. This response occurs when compressor is running with a high load. If the Data High byte is 00h, compressor is still running.

ii. This response occurs when compressor is stopped due to high load.

iii. The over temperature failure refers to when the inverter turns off due to the temperature overcoming 105°C. It is a reliability feature and can not be taken as a temperature protection feature for compliance.

iv. Response to the out-of-spec set speed data received while the comp is running.

v. Response to the out-of-spec set speed data received while the comp is stopped.

Table 4-10: Error code

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

If the compressor stops due to a failure (refer to the Status Data Table 4-9), the error can be handled in two ways:

- The failure can be reset immediately by sending a speed command of 0 RPM, which turns the inverter off.
- If no manual command is received, the inverter will automatically perform a failure reset after an 8-minute and attempt to restart the compressor.

The following example demonstrates a serial command sequence where the target compressor speed is set to 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 prevent noise and compressor damage from mechanical resonance, the inverter software automatically forbids certain operating speeds across all control modes.
- Active errors set their corresponding "H" bits to 1. For example, simultaneous Overload and Under Speed errors will set the Least Significant Byte (LSB) to 06h.
- In Frequency and Drop-In modes, serial communication is active but restricted exclusively to monitoring and product diagnostics.

4.4 Sync Pro control mode

The Embraco Sync PRO Control Mode uses a proprietary communication protocol between the Inverter and the Embraco Sync Controller to optimize energy consumption with the highest cooling capacity, while simplifying cable management. The connection between the Controller and the devices is made via a Daisy Chain connection.

- **Connection Cable:**
 - The cable required to connect the inverter to the Daisy Chain is SKU 19308845.
 - This cable is 0.2m long and connects to the 3-pin connector of the inverter's serial interface showed in Figure 4-12.
 - For other cables, please contact Embraco Technical Support.

4.4.1 Emergency mode with Sync Pro control

To prevent malfunction of the device, the communication line is monitored by the inverter. If the cable is broken or any other condition interrupts communication, after 300 seconds (adjustable), the inverter will enter Emergency Mode and follow the defined parameters.

- **LED Indication:** The LED will flash indicating a "Communication Problem" and the active Emergency Mode (See "LED indication" in Section 5 Table 5-1).

4.4.2 Programming setup - YouControl

To program and configure some of the system's information correctly, a programming setup is necessary.

- **Setup:** This setup consists of the YouControl software and the Programming Key. For more information, please contact Embraco Technical Support.

4.4.3 Sync Pro connection

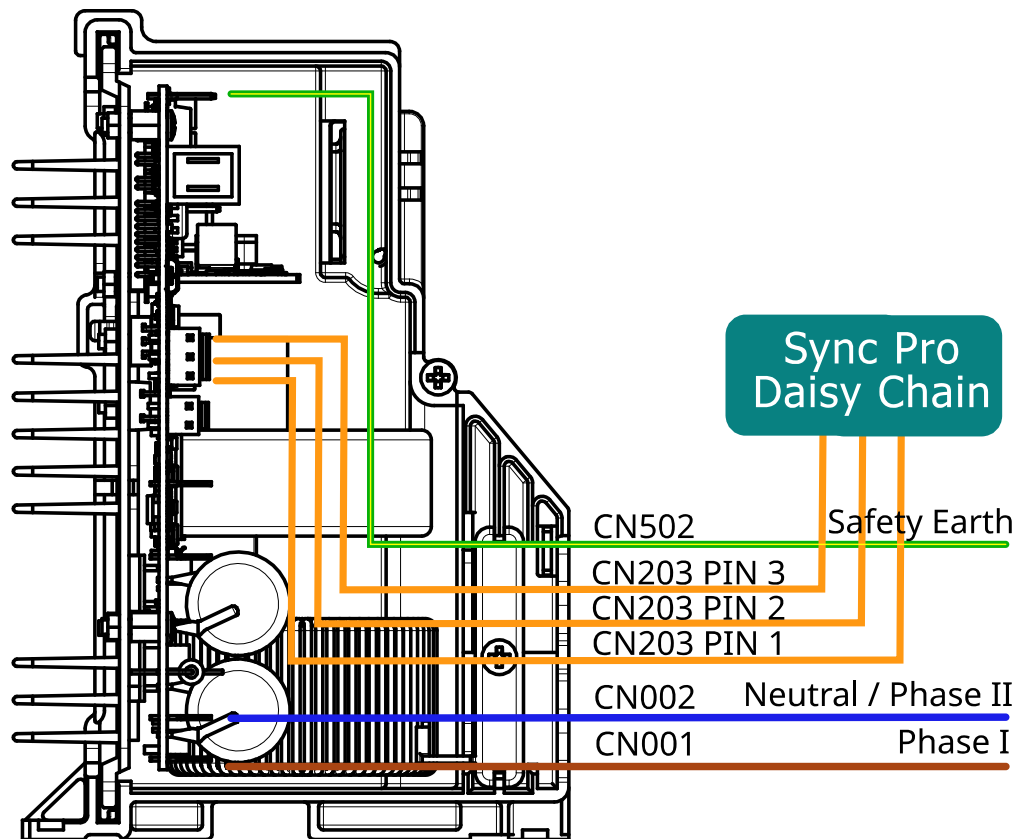


Figure 4-12: Sync Pro connections

5 DIAGNOSTICS

The CF10C01/02 Inverter offers two diagnostics methods: LED status indicators and serial communication protocol.

The LED diagnostic function assists service technicians in rapidly identifying potentially faulty components, specifically isolating issues between the compressor, the inverter, or the external controller/thermostat. This is achieved through specific blinking patterns emitted by an LED located inside the inverter housing.

The Table 5-1 details the specific failure modes and their corresponding LED flash sequences and colors:

Table 5-1: LED Status

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

6 TROUBLESHOOTING

The following tables show some potential problems and the best action to deal with them.

Table 6-1: Compressor does not start

Problem	Action
Compressor disconnected from the inverter.	Verify compressor cable connection to the inverter.
No AC power supply, or wrong voltage/terminals connected.	Verify the AC input cable connection and measure the AC input voltage.
Low input voltage supplied to the inverter.	Measure the AC input voltage to confirm it is within the acceptable operating range.
No control signal input or bad connection.	Verify the control input cable connection and measure the signal coming from the thermostat.
Inverter on waiting time after a failed start.	Wait the necessary time or reset the inverter by disconnecting it from the AC power supply for approximately 50 seconds.
Unequal discharge and suction pressures in the refrigerating system.	Allow the system sufficient time to equalize the pressure between the suction and discharge.
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 (mechanical damage).	Replace compressor with a new one and test for confirmation. Return damaged unit to manufacturer.
Demagnetized rotor (Occurs if compressor was previously connected directly to the AC power supply).	Replace the compressor with a new one and test to confirm operation. Return the damaged unit to the manufacturer.
Blown fuse (usually due to previous major failure).	Return the unit to manufacturer and replace it with a new one.
Dropped, damaged, burnt inverter.	Replace the compressor with a new one and test to confirm operation. Return the damaged unit to the manufacturer.

Table 6-2: Compressor does not run at the selected speed

Problem	Action
High compression load resulting in a compressor stall.	Review the system design; the refrigerant gas charge or compressor capacity may not be suitable for the application. If the system is correctly designed, the speed will reach the set target once the load condition stabilizes.
Compressor remains continuously in the pull-down cycle (Drop-In Mode).	Check if the inverter's AC input is mistakenly connected to the thermostat output. The inverter's AC input must be connected directly to the AC power supply.
Missing or incorrect control signal.	Verify that the appropriate control signal is being correctly applied to the designated Control Input Connection.

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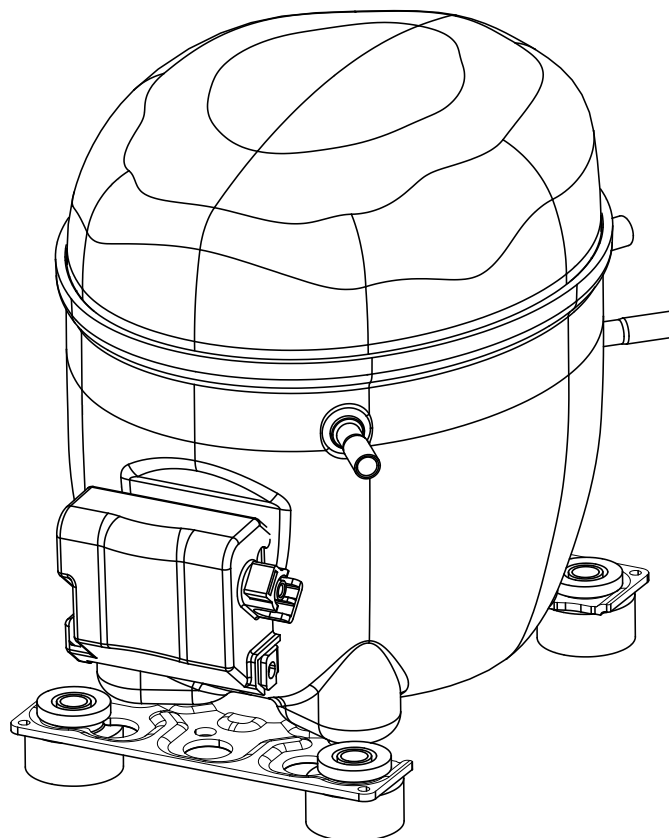
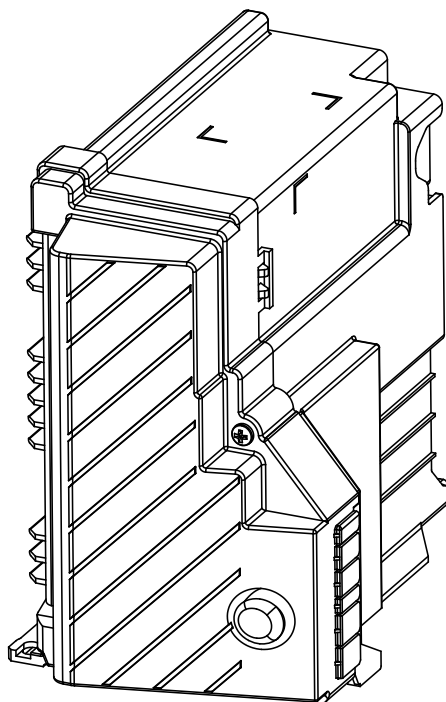
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CONTACT

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