EECON
EMBRACO ELECTRONIC CONTROLS

VCC-3 ELECTRONIC INVERTER

(Part of VCC Compressors)

TECHNICAL INFORMATION

TABLE OF CONTENTS

1. SAFETY PRECAUTIONS

1.1. CONVENTIONS

Warning **This situation could cause bodily injury, due to electrical hazard!**

Caution **In this situation, you might do something that could result in equipment damage.**

Note **Contain helpful suggestions or references to material not covered in this document.**

1.2. GENERAL PRECAUTIONS

Warning **Installation and start up must be done only by trained personnel, observing applicable accident prevention procedures.**

Caution **When using GFCI (Ground-Fault Circuit-Interrupters) for protection at the consumer home or on the manufacturer appliance, it must comply with UL 943 January 1 2003 review (immunity to high frequency noise).**

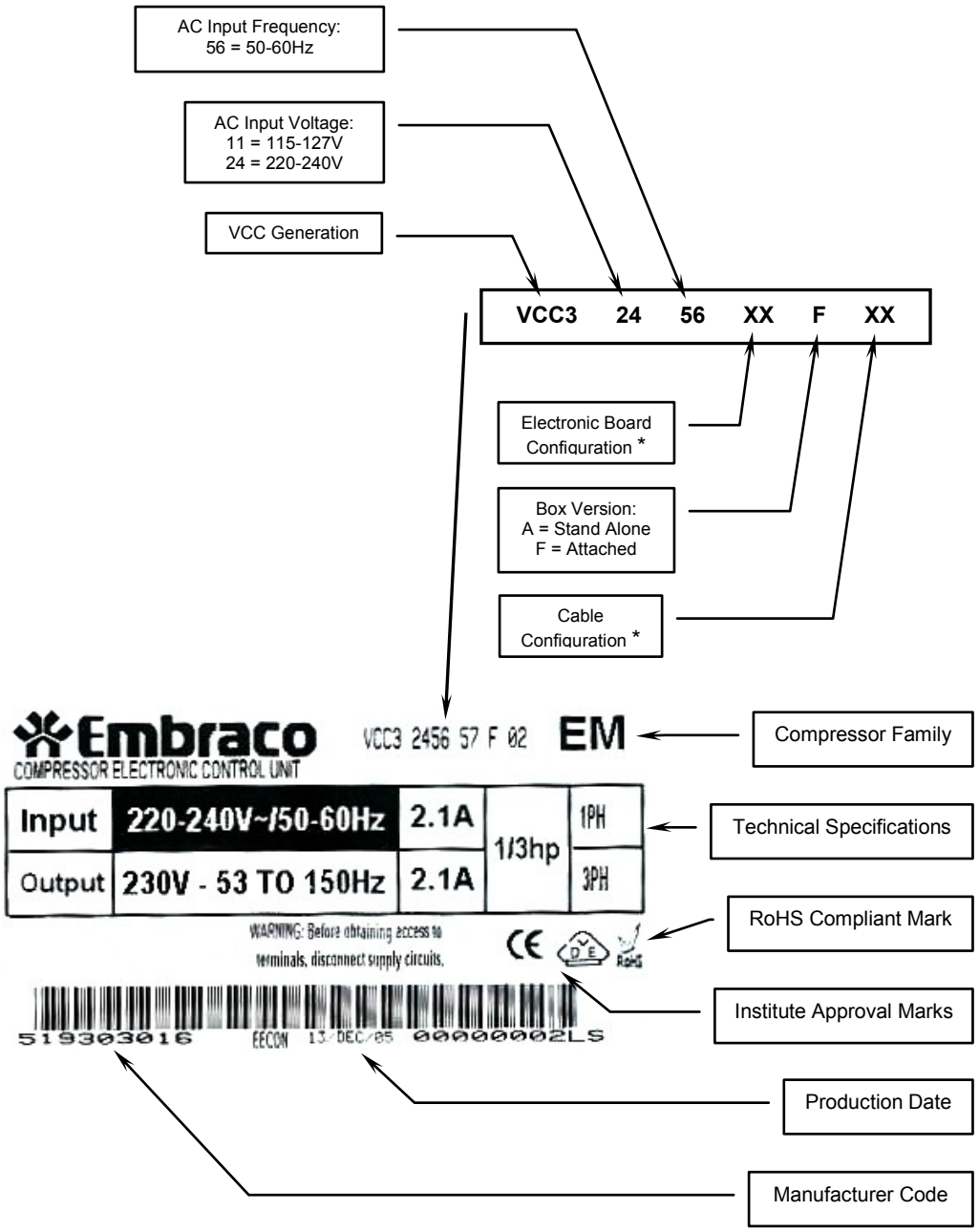
Caution **Read this material carefully before you begin the VCC-3 installation and start up.**

Caution **The VCC-3 Electronic Inverter is made for use only with the Embraco VCC-3 compressors.**

Note **In many occasions, this material will refer to *VCC-3* compressors simply as *compressors*.**

Note **The Drop In Mode allows the VCC-3 to work in any refrigeration system without the need of a control signal coming from an electronic thermostat. Only an ON/OFF thermostat is necessary.**

2. INVERTER INFORMATION TAG



** 00 to 99 = These configuration codes represent the configuration chosen by the customer.*

Figure 1 – Inverter information tag.

3. CERTIFICATIONS

UL (Underwriters Laboratories Inc.)
File: SA9768 - SA5967(Sp)

VDE (Verband Der Elektrotechnik Elektronik Informationstechnik E.V.)
Approval Number: 40006931

CSA (Canadian Standards Association)
File: 047308_C_000

RoHS Directive compliant

4. INVERTER BOX VERSIONS

4.1. ATTACHED VERSION

Integrated Inverter and compressor for easy installation and use.

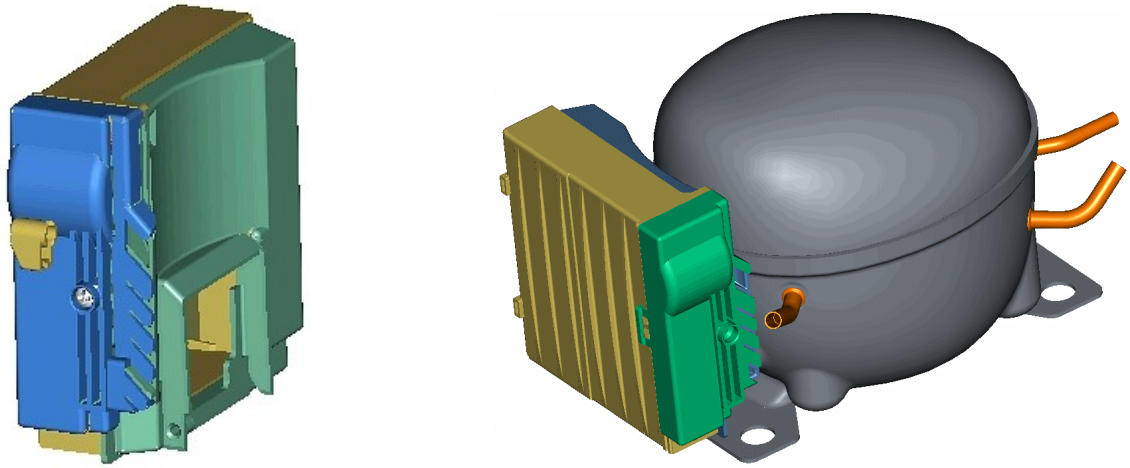
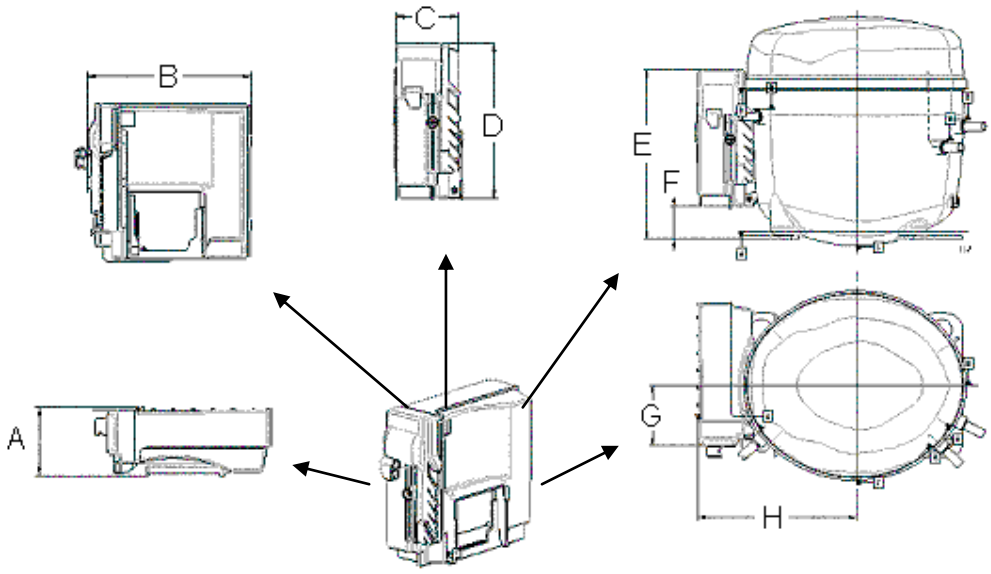
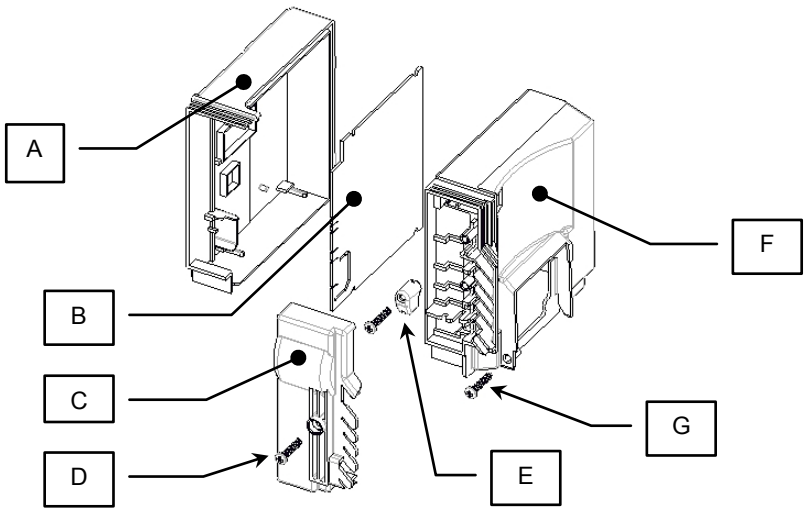


Figure 2 – Inverter and compressor - Attached version



Attached Version	
A	54,70mm
B	131,40mm
C	53,00mm
D	126,10mm
E	153,60mm
F	29,40mm
G	54,60mm
H	145,80mm

Figure 3 - Basic unit dimensions – Attached version.



Ref.	Description
A	Inverter Box Base
B	Inverter Board
C	Inverter Box Cover
D	M4x21 Screw – Cover fixing
E	Cord Relief and M4x21 Screw – cables anchorage
F	Inverter Box – Attached version
G	M4x21 Screw – Inverter Box fixing

Figure 4 – Attached version parts – exploded view.

Note **See Annex D for cables dimensions and specification.**

4.2. STAND ALONE VERSION

Separated Inverter box and compressor for customized installation.

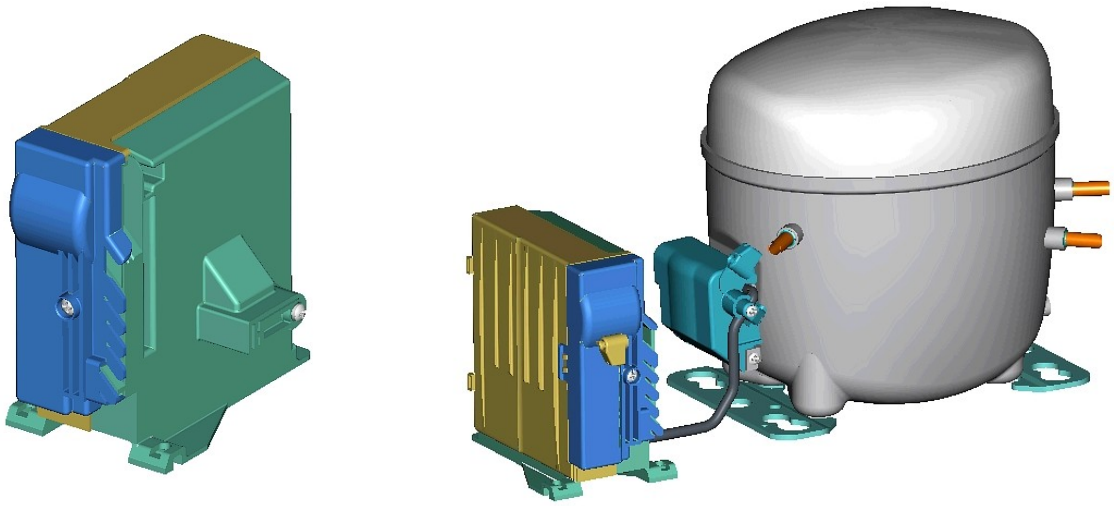
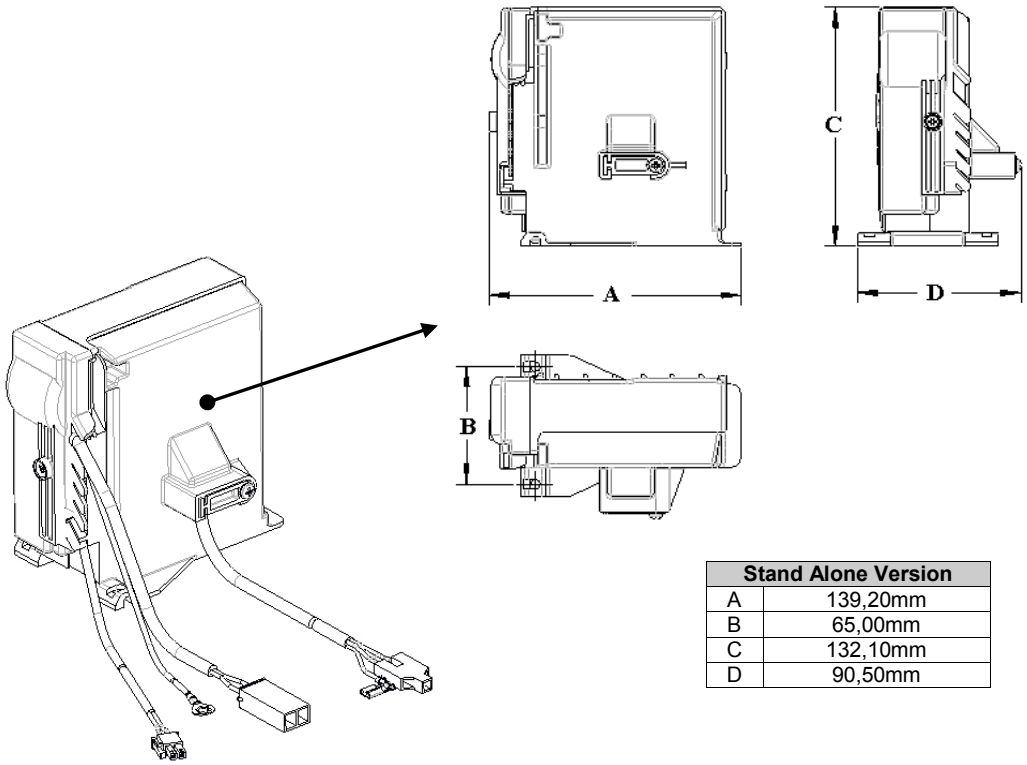
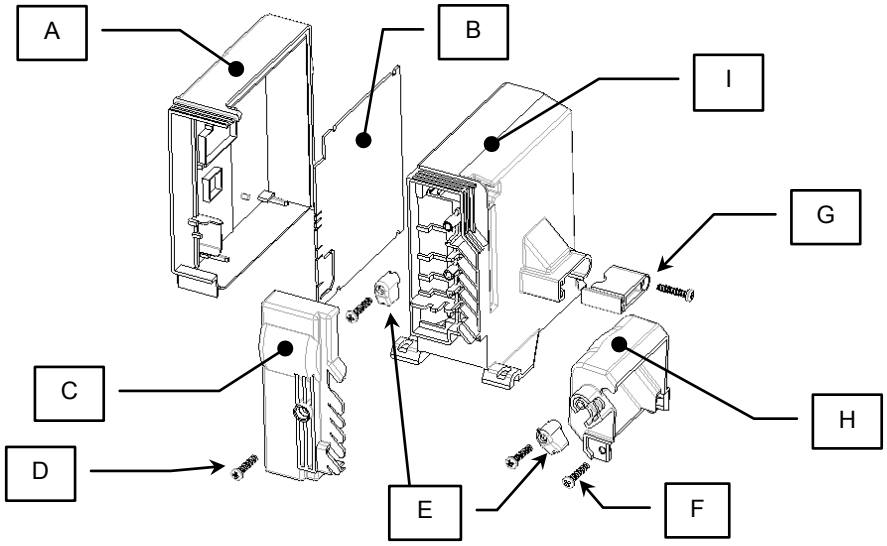


Figure 5 – Inverter and compressor - Stand Alone version.



Stand Alone Version	
A	139,20mm
B	65,00mm
C	132,10mm
D	90,50mm

Figure 6 - Basic unit dimensions – Stand Alone version.



Ref.	Description
A	Inverter Box Base
B	Inverter Board
C	Inverter Box Cover
D	M4x21 Screw – Cover fixing
E	Cord Relief and M4x21 Screw – cables anchorage
F	M4x21Screw – Cover fixing
G	Cord Relief and M4x21 Screw – cable anchorage
H	Hermetic Terminal Cover – attached on the compressor
I	Inverter Box – Stand Alone version

Figure 7 – Stand Alone version parts – exploded view.

Note **See Annex D for cables dimensions and specification.**

5. TECHNICAL SPECIFICATIONS

Nominal AC Input Voltage Range:	**103 to 127VAC (115VAC model)** **198 to 264VAC (220VAC, 240VAC models)**
AC Input Frequency:	**50 and 60Hz**
Maximum AC Input Current:	**3.23A (115VAC model)** **1.68A (220VAC, 240VAC models)**
Maximum AC Input Power:	**200W**
Maximum AC Output Voltage:	**265VAC**
AC Output Frequency Range:	**53.3Hz to 150Hz or 40.1 to 150Hz***
Maximum AC Output Current:	**3.54A @ start up (VEG compressors)** **2.37A @ start up (VEM compressors)**
Maximum AC Output Power:	**195W**
Speed Range:	**1600 to 4500 rpmRPM or 1200 to 4500 rpm***
Maximum Ambient Temperature:	**43°C**
Minimum Ambient Temperature:	**-20°C**
Maximum Storage Temperature:	**85°C**
Minimum Storage Temperature:	**-30°C**
Maximum Storage External Relative Humidity:	**85%**

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Caution Inverter operating out of Nominal AC Input Voltage Range will run at a restricted speed range.

* Note: Allowed speed range depends on compressor family:

1600-4500 rpm for VEM Y and VEMZ, VEGT VEGY and VEGZ.

1200-4500 rpm for VEMA, VEMB and VEMC.

Maximum speed range can be limited according to compressor motor used.
Please consult compressor datasheet for further details.

6. CONNECTIONS AND CABLES

Warning **Before obtain access to connectors, disconnect the power supply.**

6.1. CONNECTIONS

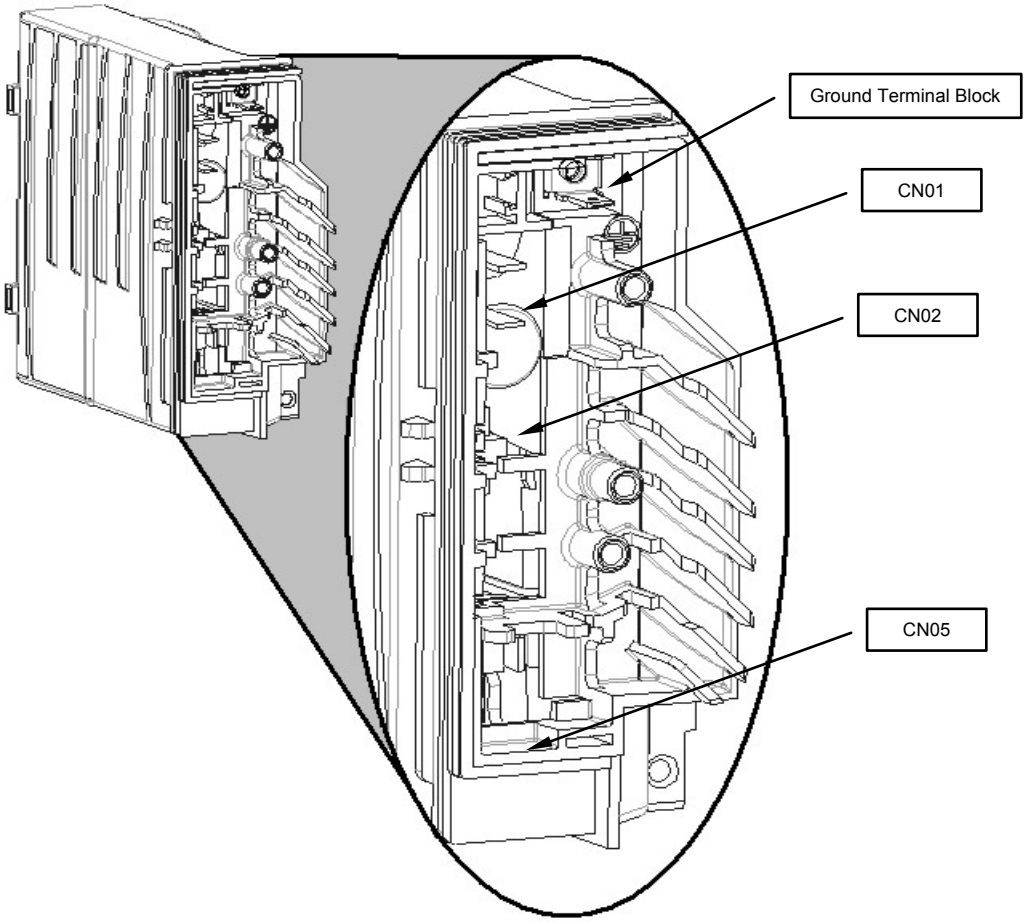

Figure 8 – Connections – box view.

CONNECTION	DESCRIPTION	PIN	DESCRIPTION
CN01	**AC Input Connection** The AC power supply must be connected on this connection.	N P	Neutral Phase
CN02	**Auxiliary AC Connection** It provides an auxiliary AC power connection that supplies energy for other devices, like a lamp or other facilities.	N N P	Neutral Neutral Phase
Ground Terminal Block	**EMI Ground Connection** External Ground Terminal Block.	-	-
Ground Terminal Block	**Safety Ground Connection** External Ground Terminal Block.	-	-
CN05	**Control Input Connection** The Inverter has different types of control signal, depending on the mode. See details on **Chapter 7**.	GND IN OUT	Ground Data In Data Out
-	**Compressor Connection (internal)** It is internal on Inverter Box. It is connected to the compressor using the Compressor Cable. This connection provides the power supply to the compressor.	-	-

Table 1 - Connections.

Warning **The Control Input Connection has reinforced isolation when using Frequency and Serial Control Modes. This isolation is not available when using the Drop In Mode!**

6.2. CABLES

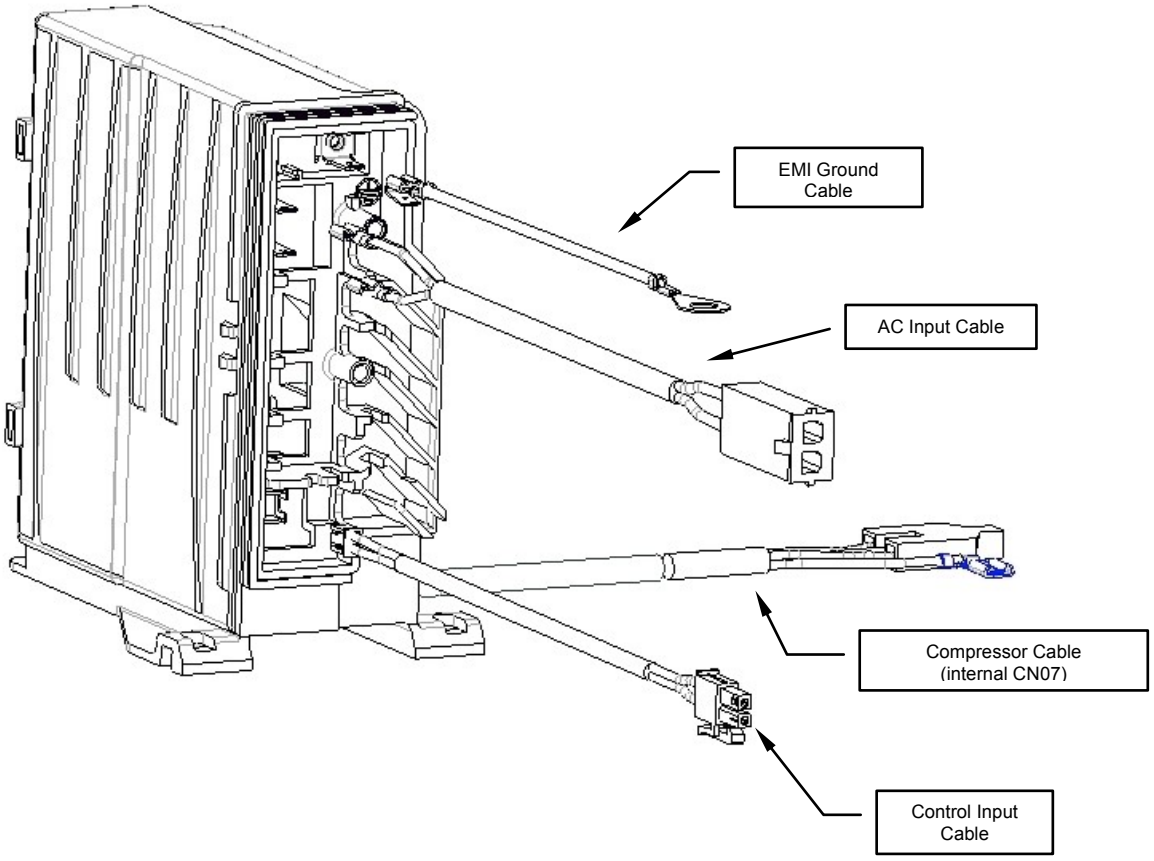

Figure 9 - Inverter Box and respective cables and connections.

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Note **The Auxiliary AC Cable (CN02 connection) and the Safety Ground Cable are not supplied with the Inverter.**

Note **See Annex D for more details about the Inverter cables and connectors type.**

6.2.1. AC Input Cable (CN01 Connection)

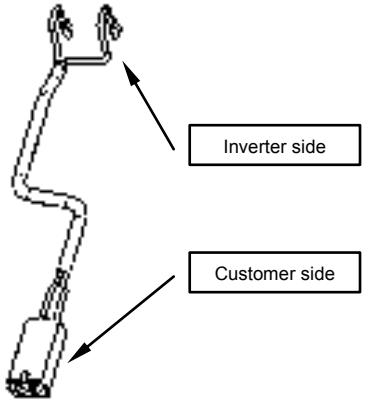


Figure 10 – AC Input Cable.

The Inverter is connected to the AC Power Supply using the AC Input Cable.

For the customer side, the cable is provided with 2 types of connectors (Molex and AMP) as the Figure 10 shows.

The Inverter can be powered through the CN02 connection, using the right connectors: female Edge or Header. If the CN02 will be used, the Auxiliary AC Connection cannot be used.

Warning The Faston connectors of the standard AC Input Connection (CN01) are directly connected to the Auxiliary AC Connection (CN02) and will be energized, as long as the Inverter is powered.

6.2.2. EMI Ground Cable (Ground Terminal Block Connection)

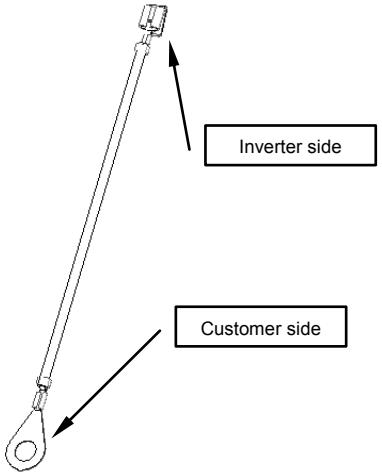
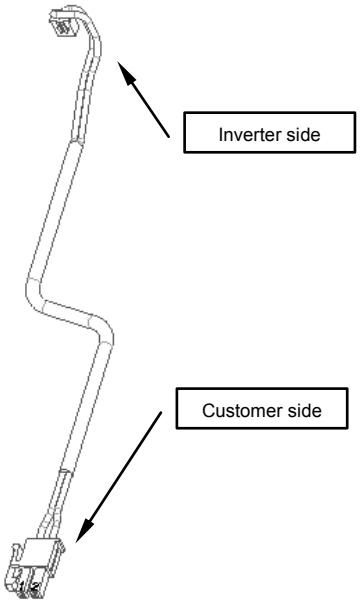


Figure 11 – EMI Ground Cable.

The EMI Ground Cable is connected to the Ground Terminal Block.

For the customer side, the cable must be connected to a suitable grounded conductor (EMI filter).

6.2.3. Control Input Cable (CN05 Connection)



The Control Input Cable is used for the control signal reception, differing in each kind of communication (see Chapter 7 for details). The configuration and description for each cable are shown in Annex D.

The Control Input Cable is connected to the CN05 connection.

For the customer side, the cable must be connected to the Thermostat.

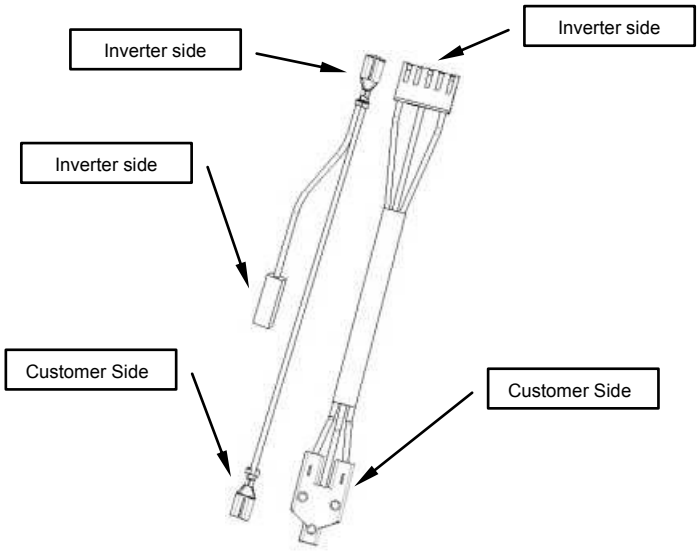
Figure 12 – Control Input Cable.

6.2.4. Compressor Cable (CN07 Connection)

Note **This cable is manufactured and supplied by EECON.**

Caution **The wire positions of the Compressor Cable are critical. Wrong polarity may cause the compressor to run in the opposite direction causing permanent damage!**

6.2.4.1. Attached Version

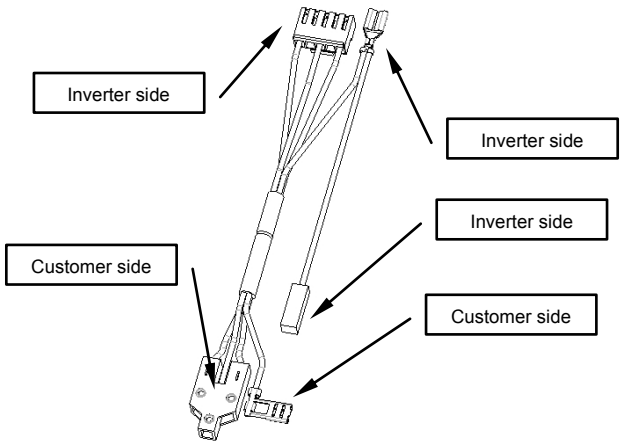


The Compressor Cable is connected to the CN07 connection.

For the customer side (compressor hermetic terminal), a plastic cluster is used. The female Flag Faston terminal must be connected to the compressor male Faston terminal (welded to the compressor fence) in order to provide safety grounding.

Figure 13 – Compressor Cable - Attached version.

6.2.4.2. Stand Alone Version



The Compressor Cable is connected to the CN07 connection.

For the customer side (compressor hermetic terminal), a plastic cluster is used. The female Flag Faston terminal must be connected to the compressor male Faston terminal (welded to the compressor fence) in order to provide safety grounding.

Figure 14 – Compressor Cable - Stand Alone version.

7. VCC-3 CONTROL MODES

Caution The Control Mode chosen by the customer is configured in the production line.

7.1. FREQUENCY MODE

This option is used when the application uses an electronic thermostat, that controls the compressor speed through a frequency signal sent to the Inverter.

The frequency signal is a digital square wave, with 0 to +5V voltage amplitude and defined range as described ahead. The duty cycle must be from 30% to 70%

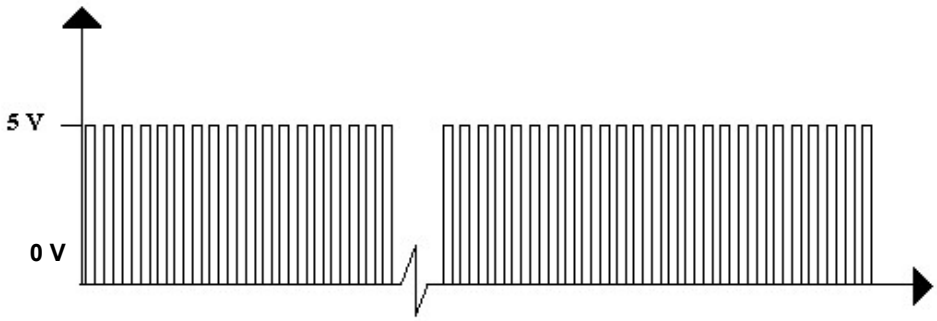


Figure 15 - Frequency signal.

Note See Annex A for control signal electrical specifications.

Compressor speed will follow the frequency signal, according to the relation described below:

Compressor Speed (rpm) ≈ Frequency Signal (Hz) x 30

Hz	rpm
0 to 50	0
50.1 to 53.3	1,600
53.4 to 150	**30 x Hz**
105 to 111	hysteresis
130 to 132	hysteresis
136.6 to 138.6	hysteresis
> 150	4,500

Table 2 - Relation between Inverter frequency and compressor rotation for speed range 1600 to 4500 rpm.

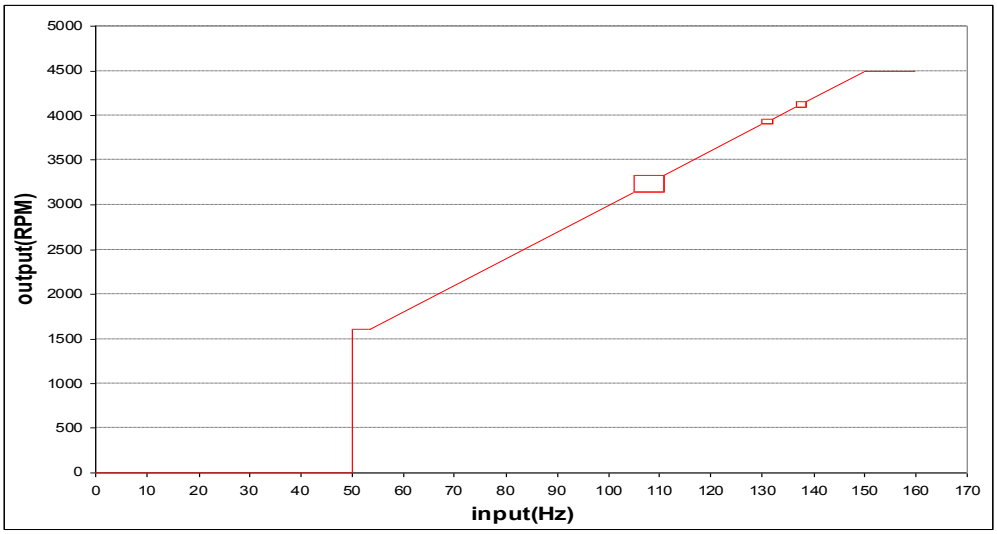


Figure 16 – Example : Relation between Inverter frequency and compressor rotation for speed range 1600 to 4500 rpm.

Connections

The thermostat is connected to the Inverter through the Control Input Connection, using the Control Input Cable. Frequency signal to the IN pin and the 0V to the GND pin (see the Figure 17).

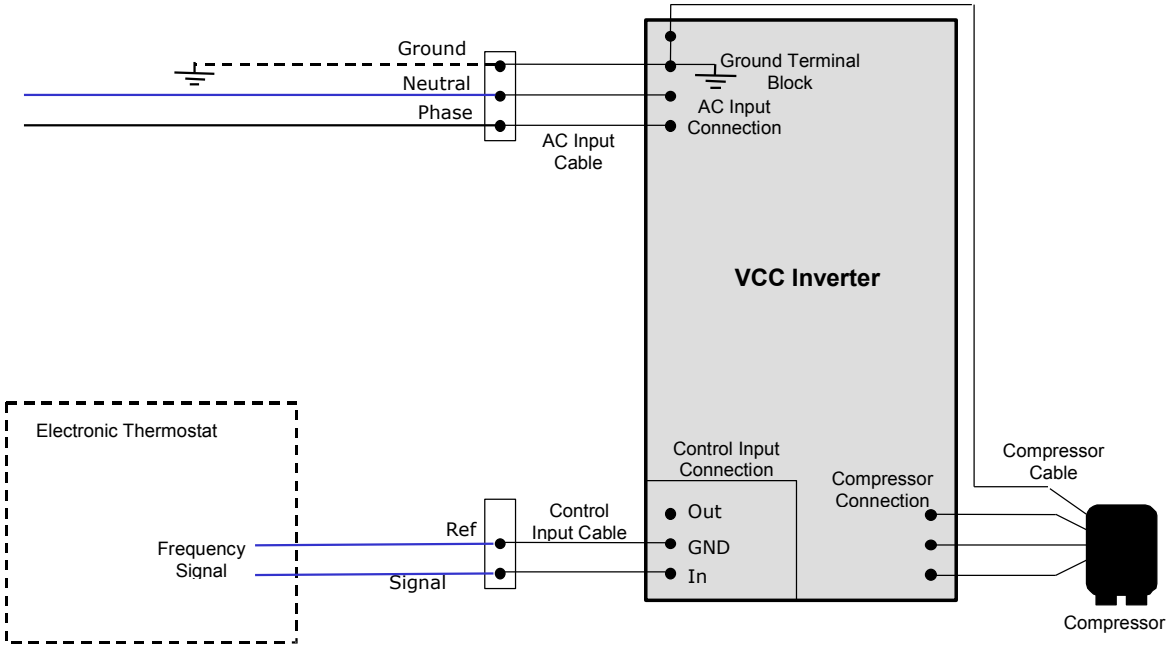


Figure 17 - Frequency Mode connections

Warning **Avoid contact of the Control Input Cable (low voltage) with high voltage or power supply cables, due to electrical hazard and potential equipment damage!**

7.2. SERIAL MODE

This option is used when the electronic thermostat controls the VCC-3 using a serial communication protocol.

Caution **The serial communication protocol is based on RS-232 parameters, but the electrical specifications of interface are different from this standard. See Annex A and Annex B for further and technical specifications.**

Connections

The thermostat is connected to the Inverter through the CN05 connection, using the Control Input Cable. Use the IN pin for the Thermostat Tx signal, the GND for the Ground signal and the OUT pin for the Thermostat Rx signal (see Figure 18).

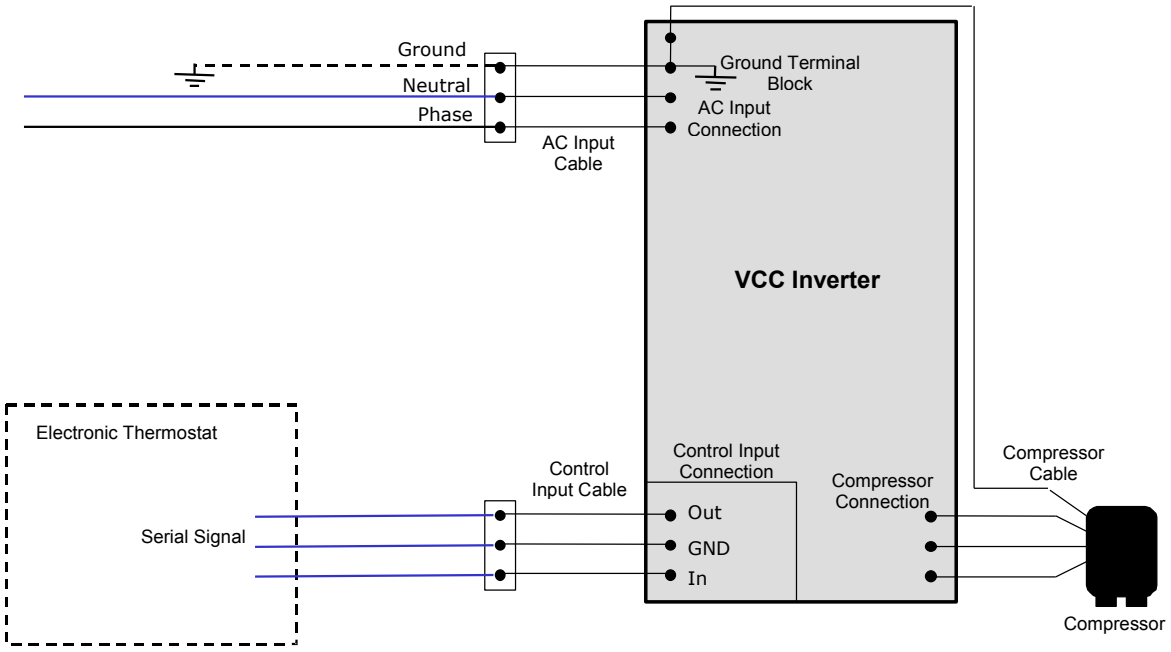


Figure 18 - Serial Mode connections.

Warning **Avoid contact of the Control Input Cable (low voltage) with high voltage or power supply cables, due to electrical hazard and potential equipment damage!**

7.3. DROP IN MODE

The ***Drop In Mode*** is a VCC-3 control mode using the same ON/OFF thermostat of standard compressors. The Drop In allows the application to any refrigeration system without the need of a digital control signal coming from an electronic thermostat.

The compressor speed will be adjusted automatically by the Inverter, in accordance to the thermal load variation. As the thermal load changes inside the appliance, pressures will change and the Inverter will sense this variation, changing the compressor speed proportionally, without the need of a temperature sensor.

For the Drop In Mode, the first time that the VCC-3 is energized, the system sets the Pull Down routine. The Drop In Mode steps are described on the Table 3.

STEP	ACTION
1 - Pull Down	Compressor remains at low speed (~2,250rpm) for 7 minutes and then increases to maximum (~4,500rpm) till thermostat opens.
2 - Normal Cycles	Compressor speed increases and decreases proportional to thermal load variation during compressor running time. Minimum speed will be targeted to minimize energy consumption.
3 – Stability Sub Routine	If thermal load remains constant for a period longer than 20 minutes, the compressor speed is increased.

Table 3 - Drop in steps.

7.3.1. Energized Contact

This option must be used when the thermostat control signal is energized directly from the AC phase. This signal is usually called *Thermostat Return Signal*.

Connections

The thermostat is connected to the Inverter through the Control Input Connection, using the Control Input Cable. Use the GND pin to connect the Thermostat with the AC power supply phase (see Figure 19).

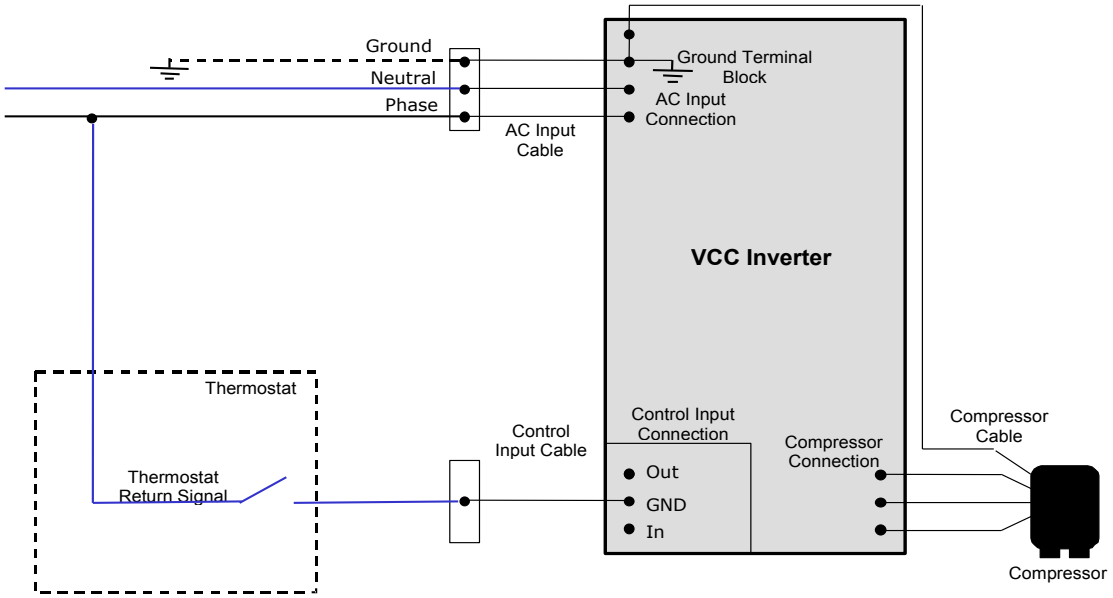


Figure 19 – Drop In Energized Contact Mode connections.

7.3.2. Dry Contact or Isolated Mode

This option must be used when the thermostat control signal passes through a "d*ry contact"*. It means the thermostat has just a switch, without any kind of energy supply, connected directly to the Control Input Connection.

Connections

The thermostat is connected to the Inverter through the Control Input Connection, using the Control Input Cable. Use the IN and GND pins to connect the Thermostat (see Figure 20).

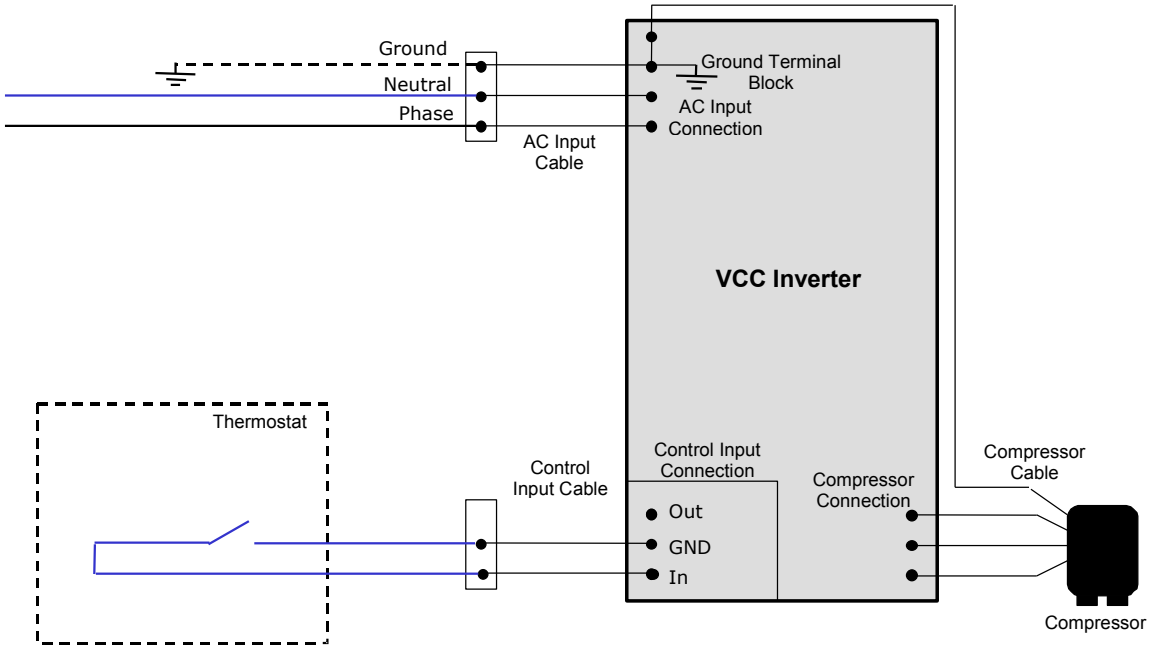


Figure 20 – Drop In Dry Contact Mode connections.

8. FUNCTIONAL DESCRIPTION

8.1. OPERATION PROCEDURES

Once the electrical connections are made and the compressor is properly assembled in the refrigeration system, it will start up if the AC power is supplied to the Inverter. The following steps take part during the operation.

8.1.1. Compressor Start Up

After the connection to AC supply line it will be necessary also a command to start the compressor. This command depends on the inverter control mode:

- In the case of Frequency Mode, the command to start is a frequency signal greater or equal to compressor speed – 40.1 or 53.3 Hz (see section 7.1)
- In the case of Serial mode, the command is to set a speed greater or equal to minimum compressor speed to the inverter. (see section 7.2)
- In the case of Drop In mode, the command to start the compressor is the thermostat switch on. (see section 7.3)

After the start command, the Control takes about 2 seconds to start up. If any anomality occurs during the start up, control will wait for compressor to stop, in order to establish a new trial. The maximum number of consecutive start up trials is 12.

The current applied during start up is limited in accordance to the motor type connected to the Control, which is also the same limit used for normal compressor operation. Due to this reason, the total current at power line, as well as power consumption during compressor start up, is very low if compared to standard single phase induction motors, not causing motor temperature increase for Locked Rotor condition.

8.1.2. Locked Rotor Condition

In case the compressor rotor is locked during the starting trial, the current output to the compressor is interrupted. When it occurs, a limit of 12 consecutive trials will be made until the Inverter takes over the Waiting Time. After the Waiting Time, another 12 trials will be enabled.

8.1.3. Pull Down Procedure for Drop In Mode

For the Drop In Mode first time, after the compressor starting, it will run at 2,250rpm, and this speed set up is kept for 7 minutes to avoid a high overload during the starting procedure. After this period, speed is set at its maximum value and this condition will remain until first thermostat switches OFF.

8.1.4. Inverter Shut Down

When the Inverter receives a stop command or when any protection occurs, the power applied to the motor is disconnected and the motor stops.

9. INSTALLATION PROCEDURES

Warning **The Faston connectors of the standard AC Input Connection (CN01) are directly connected to the Auxiliary AC Connection (CN02) and will be energized, as long as the Inverter is powered.**

Caution **The handling of Inverter box must be careful to avoid contact with the internal electronic board, in order to prevent possible electrostatic discharges!**

Caution **The electronic Inverter is developed for indoor use only, and must be installed in the vertical position. The location where the Inverter will be installed must be protected against splashed water from all directions.**

Caution **Make sure all necessary connections are properly done before connecting the Inverter to AC supply line.**

Note **It is necessary to read the Embraco compressor documents that contain technical information about the VCC-3 compressors, not covered in this material.**

9.1. COMPRESSOR CABLE CONNECTION

The figures illustrate the connections between the compressor and the Inverter in both versions (Stand Alone and Attached).

The Compressor Cable is already connected to the Inverter Box. The other end must be connected to the compressor hermetic terminal .

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Caution Permanent damage will occur if the Compressor is directly connected to the AC supply line!

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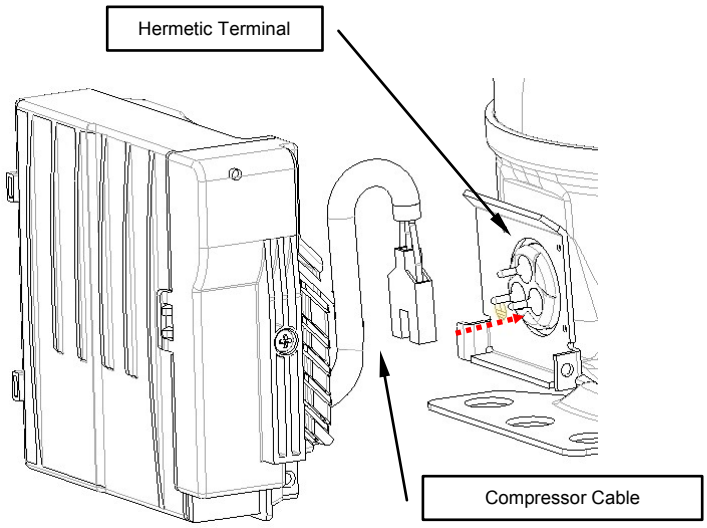
Caution The wire positions of the Compressor Cable are critical. Wrong polarity may cause the compressor to run in the opposite direction causing permanent damage!

9.1.1. Attached Version

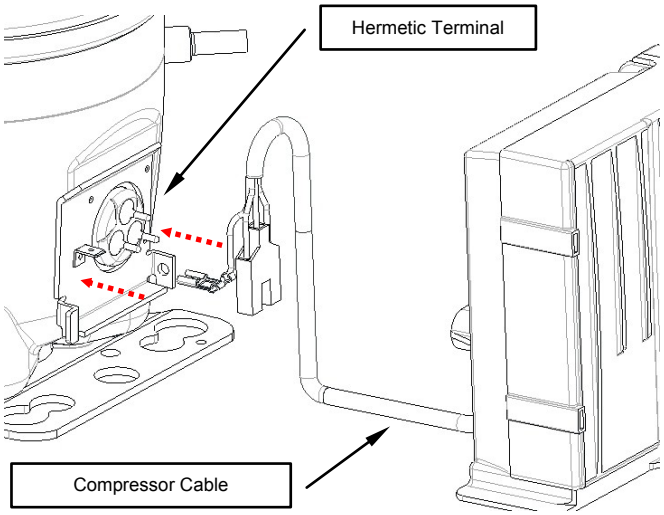


1. Connect the Compressor Cable on the hermetic terminal and the Ground Cable on the compressor ground terminal. The plastic cluster must be connected with the conductors exit upwards in order to allow the assembly of the Hermetic Terminal Cover (see Figure 21).

2. Attach the Inverter Box on the compressor fence and fix it correctly with the Screw. Note the Compressor Cable positioning before the attachment.

Figure 21 – Inverter-compressor connection - Attached version.

9.1.2. Stand Alone Version

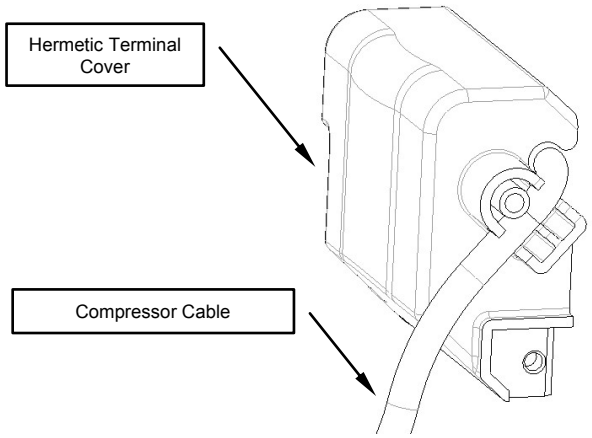


1. Connect the Compressor Cable on the hermetic terminal and the Ground Cable on the compressor ground terminal. The plastic cluster must be connected with the conductors exit upwards in order to allow the assembly of the

Hermetic Terminal Cover (see Figure 22).

Figure 22 - Inverter-compressor connection - Stand Alone version.

9.2. COMPRESSOR CABLE POSITIONING FOR STAND ALONE VERSION



1. Provide the correct cable positioning on the Hermetic Terminal Cover as indicated by the Figure 23.

Figure 23 – Compressor Cable positioning.

9.3. HERMETIC TERMINAL COVER FIXING FOR STAND ALONE VERSION

1. Put the Hermetic Terminal Cover on the compressor fence as indicated by the arrow on the Figure 24.

2. Fix the Screw with the Cord Relief to the Compressor Cable anchorage.

3. Fix the Hermetic Terminal Cover to the compressor using the second Screw as indicated.

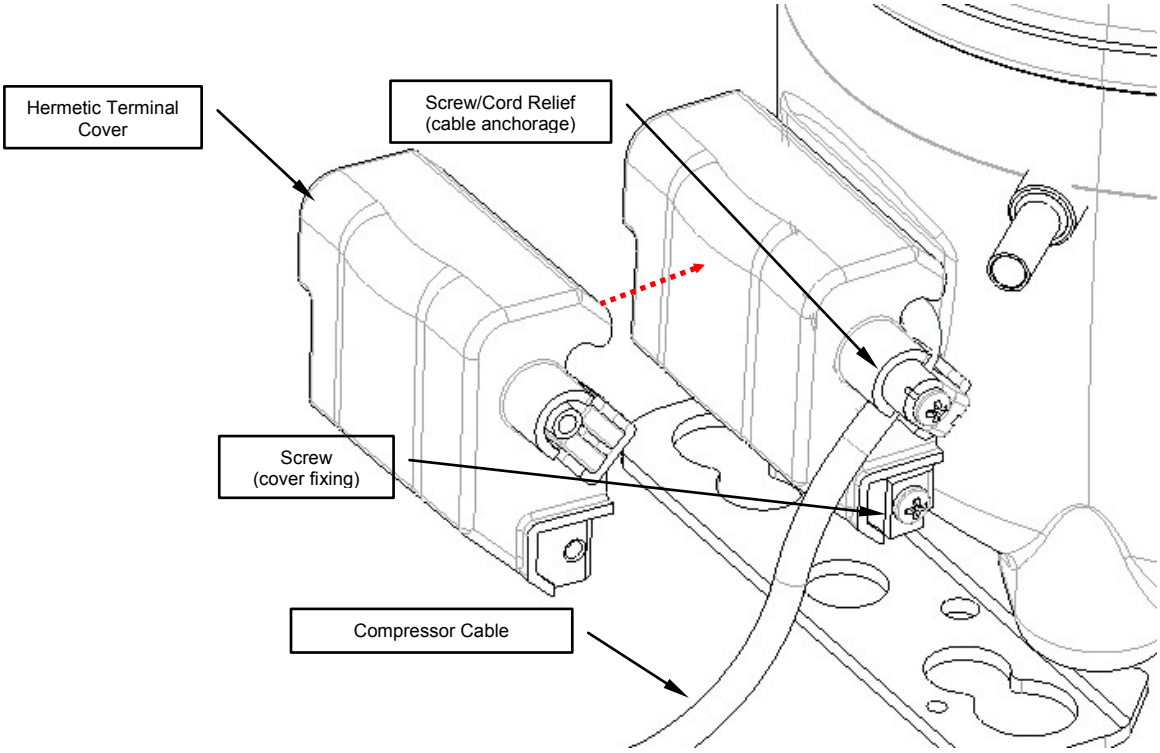


Figure 24 - Hermetic Terminal Cover fixing.

9.4. MOUNTING POSITION

9.4.1. Attached Version

Inverter is already fixed on the compressor. There is no need to fix on the appliance.

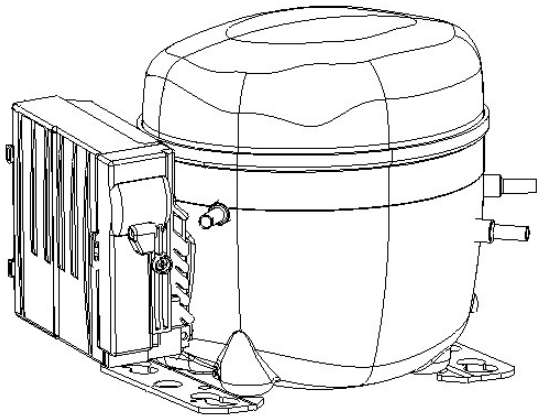


Figure 25 – Inverter attached on the compressor.

9.4.2. Stand Alone Version

Inverter is fixed on the appliance, separated from the compressor. Note the Compressor Cable connected on the hermetic terminal. The Inverter is provided with fixing points.

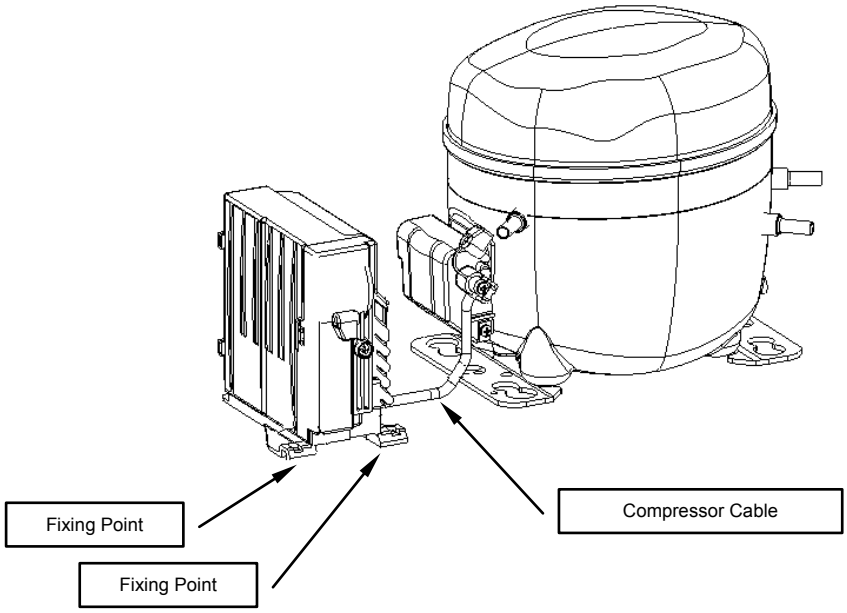


Figure 26 - Inverter separated from the compressor.

9.5. INVERTER CABLE CONNECTIONS

Follow the steps bellow, according with the Figure 9 in the Chapter 6.2:

1. Connect the Safety Ground Cable to the Inverter (Ground Terminal Block connector).

2. Connect the EMI Ground Cable to the Inverter (Ground Terminal Block connector).

3. Connect the AC Input Cable to the Inverter (CN01 connector).

4. Connect the Control Input Cable to the Inverter (CN05 connector).

9.6. CABLES POSITIONING AND FIXING

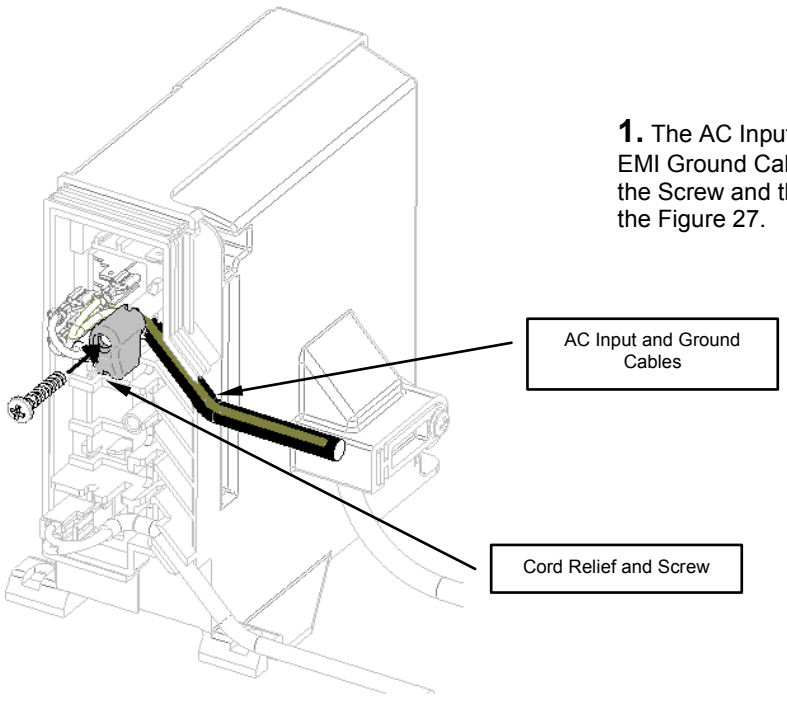
After the electrical connections have been done, the cables must be positioned, before the Inverter Box Cover fixing.

⚠

Caution The Cord Relief pressure on the cables must be done only over the areas with external insulation!

⚠

Caution Optional connections using other cables must be positioned in the appropriate location before the Inverter Cover fixing!



1. The AC Input Cable, Safety Ground Cable and EMI Ground Cable are positioned and fixed using the Screw and the Cord Relief, as indicated by the Figure 27.

Figure 27 – AC Input Cable and Ground Cables positioning and fixing.

2. Put the Control Input Cable in the appropriate location on the Inverter as indicated by the Figure 28.

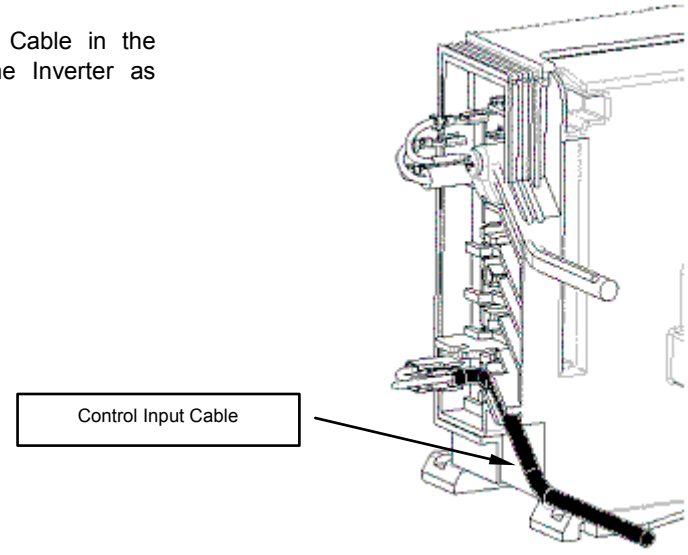


Figure 28 – Control Input Cable positioning.

9.7. INVERTER BOX COVER FIXING

1. Put all the cables in the appropriate position, close de Inverter Box Cover and fix it using the Screw, as indicated by the Figure 29. The plastic holder must be over the Control Input Cable.

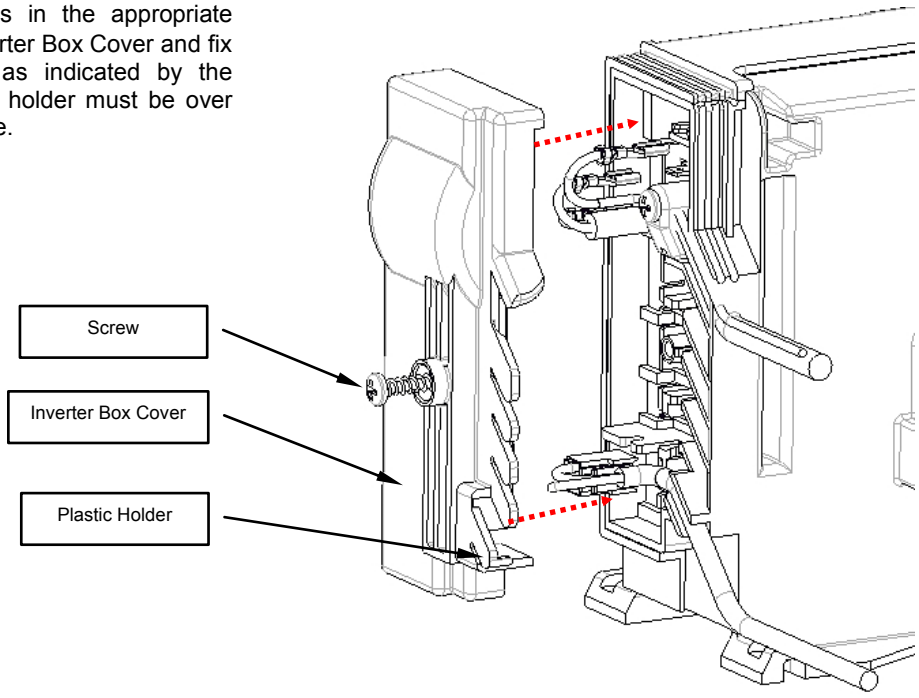


Figure 29 - Inverter Box Cover Fixing.

Warning **The Screw fixing must be done by trained personal, in order to prevent contact with the cables on the internal side, what can cause signal interruption and electric discharge!**

10. TROUBLESHOOTING

10.1. NO START

PROBLEM	ACTION
NO COMPRESSOR TRIAL	
Compressor disconnected from the Inverter.	Verify the Compressor Cable connection.
No AC power supply; or wrong voltage/wrong terminals connected to the Inverter.	Verify the AC Input Cable connection and measure the AC Input voltage.
No control signal input or bad connection.	Verify the 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 a new one.
Open compressor motor winding.	Measure winding for open circuit between all pair of pins on the hermetic terminal. If one winding is open, return defective unit to manufacturer, replacing it by a new one.
Compressor with locked rotor (due to mechanical damage).	Replace compressor by a new one and test for confirmation; return defective unit to manufacturer.
Dropped, damaged, burnt Inverter.	Replace by a new one and test for confirmation; return defective 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 15s.
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 defective unit to manufacturer.
COMPRESSOR POSITIONS ROTOR, BUT FAILS TO START	
Unequaled pressures between discharge and suction pressures in the refrigerating system.	Allow the Inverter to equalize pressure between suction and discharge sides.
Open compressor motor winding.	Measure winding for open circuit between all pair of pins on the hermetic terminal. If one winding is open, return defective unit to manufacturer, replacing it by a new one.
Too low AC voltage supplied to the Inverter.	Measure AC voltage to confirm; correct the voltage or change the Inverter to the correct voltage range (115V or 220V model).
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 defective unit to manufacturer.

Table 4 - Troubleshooting - no start.

10.2. MALFUNCTION DURING OPERATION

PROBLEM	ACTION
Compressor does not run at the selected speed.	Too high compression load, with compressor being subjected to a stall condition (lower suction and/or discharge pressures for correction).
	Too low AC voltage. Check the AC voltage supplied to the Inverter and set it to the required level or change the Inverter to the correct voltage range (115V or 220V model).
	In Drop In mode, check if the defrost heater is in parallel with the thermostat. If it is, change to the correct connections.
	In Drop In mode, check if the thermostat is in series with the AC Power supply. If it is, change to the correct connections.
	No or incorrect control signal (check if the correct control signal is arriving at the Control Input Connection).
Unexpected stops during the run cycle.	Protection circuits are actuating.

Table 5 - Troubleshooting - malfunction.

11. APPENDIX

ANNEX A - ELECTRICAL SPECIFICATIONS FOR FREQUENCY AND SERIAL CONTROL SIGNALS

Parameter	Symbol	Value
Maximum negative voltage	V_{NEG_MAX}	-5V
Maximum positive voltage	V_{POS_MAX}	+15V
Maximum voltage to guarantee OFF state (optocoupler internal transistor cut-off)	V_{OFF_MAX}	+0.7V
Minimum voltage to guarantee ON state (optocoupler internal transistor saturation)	V_{ON_MIN}	+4V

The polarities were defined considering the VCC-3 pinout: pin 1 = input, pin 2 = reference (0 V).

Table 6 - Control signal electrical specifications.

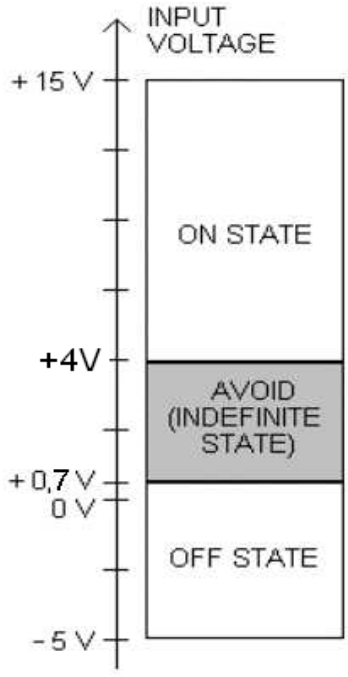


Figure 30 - Control signal electrical specifications.

ANNEX B - SERIAL MODE COMMUNICATION PARAMETERS

1. Basic Specifications

Communication Type	Asynchronous (start-stop)
Baud Rate	75 baud
Start Bits	1
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None
Unit Size	5 Bytes

Table 7 - Serial communication - basic specifications.

2. Communication Protocol

Unit Board	Host
Inverter Board	Sub
Start Bit	1 → 0 (logic level)
Data bits	Inverted logic (0 V -> 1 and 5 V -> 0)
Stop Bit	0 → 1 (logic level)

Table 8 - Serial communication - protocol.

3. Electrical Specifications

The circuit below shows the electrical connections to perform serial communication in the VCC-3 Serial Mode. As could be seen, both input and output are opto-coupled.

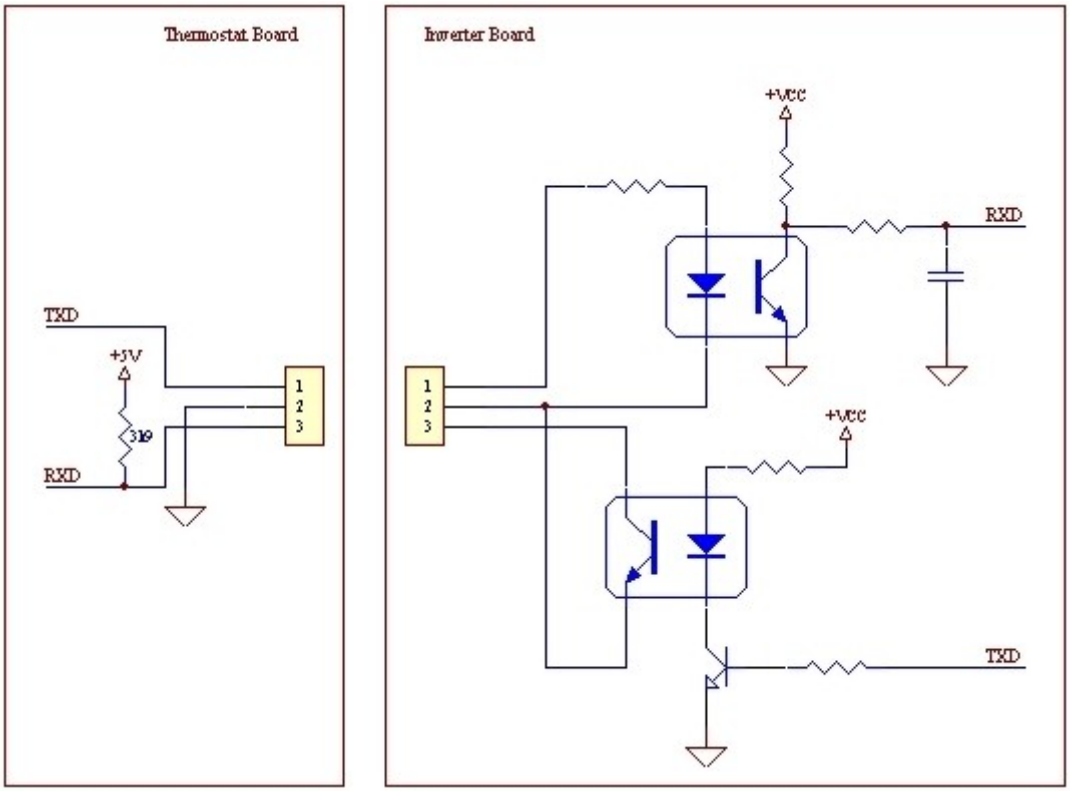


Figure 31 - Recommended circuit for serial communication.

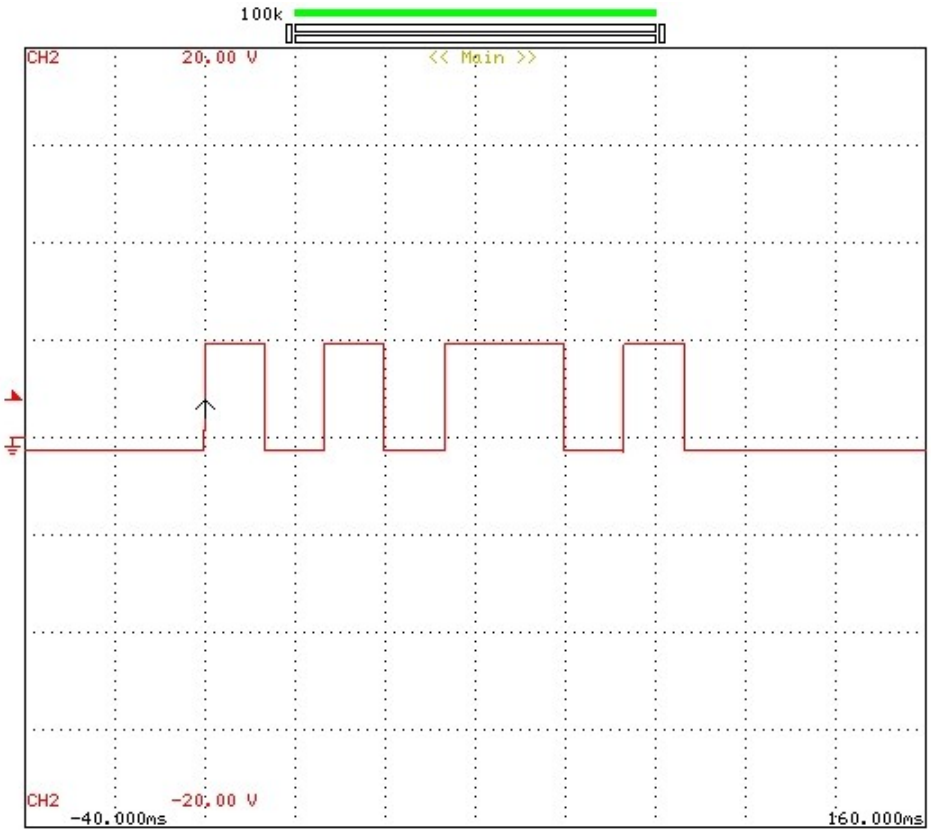


Figure 32 - Signal example of an A5h sent to Inverter.

4. Command Structure

Transmit command structure	1st byte Identification	2nd byte Command	3rd byte Data low	4th byte Data high	5th byte Checksum
A. Transmit set speed	A5h	C3h	1)	2)	3)
B. Read set speed	A5h	3Ch	80h	39h	3)
C. Read operation status	A5h	3Ch	83h	39h	3)

Table 9 - Serial communication - transmit command structure.

Receive command structure	1st byte Identification	2nd byte Command	3rd byte Data low	4th byte Data high	5th byte Checksum
Response to A	5Ah	83h	4)	5)	3)
Response to B	5Ah	80h	1)	2)	3)
Response to C	5Ah	83h	4)	5)	3)
Communication error	5Ah	6)	FFh	FFh	3)

Table 10 - Serial communication - receive command structure.

1) Set speed data low byte
2) Set speed data high byte
3) Checksum

   Addition of hex value of 1-4 bytes = S14h

   Checksum = 100h - (S14h AND 0FFh)
4) Status data low byte

   Note 1 – Status data Table 11
5) Status data high byte

   Note 1 – Status data Table 11
6) Code:

   F0 - Error in the 4th byte for commands B and C

   F2 - Checksum (5th byte) error

   F4 - Command code (2nd byte) error

   F8 - Error in the 3rd byte for commands B and C

Status data	Bit "H"	Description	Remarks
0 x 0000	-	Normal operation.	Typically this data is returned. 4)= 00, 5)= 00
0 x 0002	1	Overload protection (Note 1).	4)= 02, 5)= 00
0 x 0080	7	Set speed data out of spec (Note 2).	4)= 80, 5)= 00
0 x FF00	-	Compressor stopped (waiting for a valid start speed).	4)= 00, 5)= FF
0 x FF01	0	Start fail.	4)= 01, 5)= FF
0 x FF02	1	Overload condition (Note 3).	4)= 02, 5)= FF
0 x FF04	2	Under speed (1550 rpm or lower).	4)= 04, 5)= FF
0 x FF10	4	Short circuit.	4)= 10, 5)= FF
0 x FF80	7	Set speed data out of spec. (Note 4).	4)= 80, 5)= FF

Table 11 - Serial communication - status data.

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

5. Remarks

The valid speed range is shown on the Table 12:

Speed Sent	Compressor Speed	Data Low (response)
0-1550RPM	0RPM	00h
1551-1600RPM	1600RPM	00h
1600-4507RPM	Same as sent	00h
>4508RPM	4507RPM	80h

Table 12 – Example: Serial communication - valid speed range for speed range 1600 to 4500 rpm

Any speed higher than 1551rpm turn the compressor on (if there is no fail).

Data High byte, as a status response, always indicates the compressor status:

Compressor Running: 00h

Compressor Stopped: FFh

The identification byte (1st byte), is used for command synchronization.

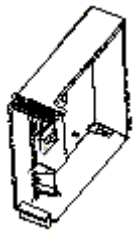
After inverter identifies a valid A5h, it starts to read the next 4 bytes. After reading, a response will be sent as indicated above. No response will be sent until the inverter recognizes a byte A5h.

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.

If compressor is stopped due to a fail (Table 11), it is possible to reset that fail sending a speed to turn inverter off (lower than 1,550rpm). After receive this command, compressor could be restarted sending a speed higher than 1,551rpm. However, if a speed command to turn compressor on is continuing been sent, a fail reset will occur after 8 minutes (compressor will try to restart).

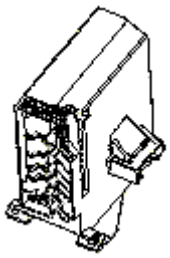
ANNEX C - INVERTER BOX MATERIALS

1. Inverter Housing



Description	Material	Color
Inverter Housing	PX9406 J 780 (V0)	Gray
Inverter Housing	N300 V0	Black

2. Inverter Box



Description	Material	Color
Inverter Box – Stand Alone	PX9406 J 780 (V0)	Gray
Inverter Box – Stand Alone	PA66A205F V2	Black
Inverter Box - Attached	PX9406 J 780 (V0)	Gray
Inverter Box - Attached	PA66A205F V2	Black

3. Inverter Cover

Description	Material	Color
Inverter Cover	PX9406 J 780 (V0)	Gray
Inverter Cover	PA66A205F V2	Black

4. Hermetic Terminal Cover (only for Stand Alone Version)

Description	Material	Color
Hermetic Terminal Cover	PA 66 A205F(V2)	Black
Hermetic Terminal Cover	SE1 701 (V1)	Black

ANNEX D - INVERTER CABLES SPECIFICATIONS

1. AC Input Cable

Voltage	Voltage Rating	Length	Nominal Section of Conductors	Conductors Temperature Rating	Sheath Temperature Rating	Customer Side Connector	Inverter Side Connector
115V	600V	200mm	18AWG	105°C	105°C	Molex 43680-2002	JST SPS-51T-187-8

2. EMI Ground Cable

Version	Voltage	Voltage Rating	Length	Nominal Section of Conductors	Conductors Temperature Rating	Customer Side Connector	Inverter Side Connector
Attached	115V	600V	180mm	18AWG	105°C	AMP 626034-1	JST SPS-51T-187-8
Stand Alone	115V	600V	360mm	18AWG	105°C	AMP 61795-1	Faston 4,8mm 881623-1

3. Control Input Cable

Control Mode	Voltage Rating	Length	Nominal Section of Conductors	Conductors Temperature Rating	Sheath Temperature Rating	PVC Insulation Temperature Rating	Customer Side Connector	Inverter Side Connector
Frequency	115V/220V	260mm	24AWG	105°C	105°C	105°C	Molex 39-01-2020	JST VHR-2N
Serial	115V/220V	260mm	24AWG	105°C	105°C	-	Molex 39-01-2020 ---------- Molex 39-01-3023	JST VHR-3N
Drop In	115V	210mm	20AWG	105°C	105°C	-	Molex 35151-0110	JST VHR-2N
Drop In	220V	260mm	24AWG	105°C	105°C	105°C	Molex 39-01-2025	JST VHR-2N

4. Compressor Cable

Compressor Model	Version	Voltage	Voltage Rating	Length	Nominal Section of Conductors	Conductors Temperature Rating	Sheath Temperature Rating	Compressor Side Connector *(Compressor power)*	Inverter Side Connector *(Compressor power)*	Compressor Side Connector *(Ground connection)*	Inverter Side Connector *(Ground connection)*
VEM	Attached	115V	600V	125mm	20AWG	105°C	105°C	AMP 880631-5	JST VHR-5N	Flag Faston 280050-1	JST SIP-SLV ---------- JST SPS-61T-250
VEM	Attached	220V	300V	125mm	0.5mm^2	105°C	90°C	AMP 880631-5	JST VHR-5N	Flag Faston 280050-1	JST SIP-SLV ---------- JST SPS-61T-250
VEM	Stand Alone	115V	600V	370mm	20AWG	105°C	105°C	AMP 880631-5	JST VHR-5N	Flag Faston 280050-1	JST SIP-SLV ---------- JST SPS-61T-250
VEM	Stand Alone	220V	300V	370mm	0.5mm^2	105°C	90°C	AMP 880631-5	JST VHR-5N	Flag Faston 280050-1	JST SIP-SLV ---------- JST SPS-61T-250
VEG	Attached	115V	600V	125mm	20AWG	105°C	105°C	AMP 880631-5	JST VHR-5N	Flag Faston 280050-1	JST SIP-SLV ---------- JST SPS-61T-250
VEG	Attached	220V	300V	125mm	0.5mm^2	105°C	90°C	AMP 1380145-1	JST VHR-5N	Flag Faston 280050-1	JST SIP-SLV ---------- JST SPS-61T-250
VEG	Stand Alone	115V	600V	550mm	20AWG	105°C	105°C	AMP 8-1380145-2	JST VHR-5N	Flag Faston 280050-1	JST SIP-SLV ---------- JST SPS-61T-250
VEG	Stand Alone	220V	300V	370mm	0.5mm^2	105°C	90°C	AMP 8-1380145-2	JST VHR-5N	Flag Faston 280050-2	JST SIP-SLV ---------- JST SPS-61T-251

12. MORE INFORMATION

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