



ALL-ELECTRIC ROOFTOP AIR CONDITIONING UNIT FOR ELECTRIC AND HYBRID BUSES

CC355-E

Owner's Manual
Warranty Certificate

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Code: 036-00351-002

SPHEROS

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OBSERVATION: to get the best air conditioner performance we recommend that you read this manual carefully before starting operation.
Keep this manual with your vehicle for reference.

SPHEROS DO BRASIL - S/A offers a full line of equipment for bus air conditioning systems for vans, micro and midi buses, commuter, articulated, coaches and double-deckers.

Air conditioning system that is modern and high quality, the products of SPHEROS DO BRASIL - S/A have been developed looking for comfort and tranquility to passengers that uses the public transport.

However, you need to take care to assure a good use and operation of the air conditioning system, and then you can obtain a better performance of its technology resources.

It is mandatory to do the preventive and corrective maintenance procedures, they must be accomplished by experts or dully technicians. Looking for improving and updating the refrigeration technical teams, this manual describes the fundamentals of our air conditioning system based on the most important thermodynamic formulas.

You can find operation instructions of SPHEROS DO BRASIL - S/A air conditioning too, besides it advises you to follow technical procedures of adequate preventive maintenance obeying environmental and safety rules.

Frequent training for technical team make them able to get right diagnosis from equipment (appliances) to accomplish the servicing.

correctly with quality and responsibility, assuring to the whole fleet a perfect operation of SPHEROS DO BRASIL - S/A equipment.



During operation these equipments have energized parts, so any irregularity in the system, please contact a Spheros authorized dealer.



WARNING!

The use of the equipment at altitudes above 3,000 meters is prohibited. Risk of electric shock.

Warranty Terms

SPHEROS DO BRASIL - S/A warrants its products for two-years period in accordance with the terms listed below:

- 1- The warranty will be valid for the period above specified, counting from the date when the equipment is installed in keeping with the warrant certificate, even after the property there of has ben transferred.
- 2- Should the equipment be installed by a third part, SPHEROS DO BRASIL - S/A warrant only the product and not its instalations.
- 3- During the stipulated period, the warranty completely covers the workmanship and spare parts used to repair defects duly identified as being:
premature failure of material and components defects used on its manufacture.
- 4- Only a technician from the SPHEROS DO BRASIL - S/A authorized network of services is qualified to repair the defects coverd under the warranty.
- 5- The warranty approval is subject to the technical analysis of the defects shown in the components and operational conditions to which the equipment has been subjected.
- 6- No claims will be accepted if the vehicle is still in use after the defect is found, even if there is lack of pieces, delay in transportation or any other such incident.

7 - The Warranty Loses its Validity

- a) If the installation or use of the product is not in accordance with the SPHEROS DO BRASIL - S/A technical recommendations.
- b) If the product suffers any damage caused by improper use, neglect, accident, failures caused by external agents and even lack of maintenance (see owner's manual) or services performed by unqualified person.
- c) If the warranty certificate and/or the serial number of the product are adulterated, overwritten or damaged.
- d) If defects or unsatisfactory performance are caused by the use of non original spare parts and in disagreement with the technical specifications from SPHEROS DO BRASIL - S/A.

8- The Warranty Does Not Cover

- a) Displacement of the bus for repairing of the equipment. In case the customer requests to be attended in the same place where products is operating, the collection or not of the visitation charge will be the criterion of the authorized service provider.
- b) The attending to the consumer, free or paid, in cities that do not have authorized services providers. So the expenses with displacement are the sole responsibility of the owner.
- c) Lack of proper preventive maintenance, as described in the preventive maintenance item in this manual.
- d) Loss or loss of profits caused by the stoppage of the vehicle due to non-operation of the equipment.

Electrical System

Electrical System Care

When performing preventive maintenance procedures, always pay attention to safety in the use of PPE's and other factors that may compromise human integrity.

 **RISK OF ELECTRIC SHOCK**
VOLTAGE 450 - 850 Vdc

Equipment works in two voltage ranges:

Voltage range 1- 850 Vdc to 450 Vdc

The components operating in this voltage range are identified by the symbol above.

These components **MUST NOT** be opened and cables **MUST NOT** be handled. If any of these covers are open or the cable is damaged, discontinue use and seek Authorized Service immediately.

Voltage range 2- 24Vdc

In this voltage range, the control and signaling components operate.

Distribution box

Component where the electrical connection is made to the supply in the Spheros air conditioner.



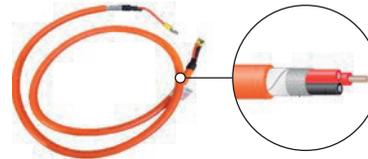
Perform a visual assessment of the cover that must be closed, by tightening the screws and cable connectors as preventive maintenance.

Electrical Conductors

Visually inspect the condition of the cables, with no signs of damage to the covers, tightening of the connections, as described in the preventive maintenance routine.

Orange Conductor

Vcc POWER CABLE



Green Conductor - Yellow

GROUNDING



Frequency inverter

Converts the voltage range of up to 850 Vdc to 380 Vd three-phase that controls the compressor. It may have a 24 Vdc output.

Perform a visual assessment of the covers, which must be closed and with the tightening of the screws and cable connectors that must be mounted.

Assess the presence of dirt in the air passages and dissipators. In case of excessive dirt, clean.



WARNING!

The use of the equipment at altitudes above 3,000 meters is prohibited. Risk of electric shock.

Compressor

Hermetic compressor mounted next to the ceiling unit, controlled by the frequency inverter. Check if the cable is mounted and without damage marks on the cover.

Check that the cover of the electrical connection is closed and the screws are tightened. Check that the pipe connections are tight.

In the air conditioning model CC355E, refrigerant gas R134a is used.



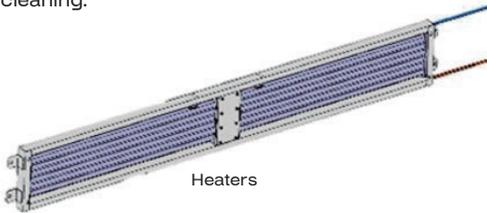
Caution! Extremely hot surface.

Heating system

It operates with resistive elements attached to the cooling coils and is controlled by an electronic control panel.

Check if the resistive elements are clogged or excessively dirty and if necessary, conduct a cleaning.

Heater Controller



Heaters

The heater controller has a panel with an LED display that shows the following activation diagnosis:

- 24 Volts of power
- Enables
- Heater 1 ON
- 2 ON heater



WARNING!
Check the display diagnostics only. Do not access the inside of the controller.

Refrigerant Gas R407C

This appliance uses the R407C refrigerant. The use of gas with different characteristics, low quality or doubtful origin will cause low cooling performance and will also damage components of the air conditioning equipment.



WARNING!
under no circumstances should refrigerants be discharged into the atmosphere.

Drying Filter

We recommend the preventive replacement of the drying filter every 3 years. If the complete loss of the gas charge occurs, we recommend replacing the filter drier to eliminate impurities that may be lodged within the system.

Ducts

The cleaning of the air ducts should be performed on a quarterly basis, and this time can be reduced, depending on the use of the air conditioning system, the number of people transported and the aggressiveness of the environment where the vehicle travels. This cleaning is the exclusive responsibility of the vehicle owner, he will bear all the burden of poor air quality offered to his passengers.

NOTE: ducts are components of the body.

DO NOT USE RECONDITIONED PARTS!

The use of reconditioned parts will decrease the efficiency of the air conditioning, overload the electrical system and may cause component damage and even cause a fire.

Preventive Maintenance Frequency Check List

| | |
|-------------------|---|
| WEEKLY | 1 - Clean or change the return air filter. |
| MONTHLY | 1 - Accomplish the weekly check list. |
| | 2 - Clean the condenser capillary tube coil (Apply only water and neutral non-aggressive soap to copper and aluminum). See note (*) |
| | 3 - Check if the evaporator hatches are closed to avoid air intake into the equipment. |
| | 4 - Test the equipment operation functions: cool / fan (high and low speed) / heat / dry (air renewing) modes. |
| TRIMESTRAL | 1 - Accomplish the monthly check list. |
| | 2 - Activate the heating system, if any. |
| | 3 - Measure the exhaust suction pressure, temperature and suction line condition. |
| | 4 - Measure the condenser and evaporator fan flow consumption (check their air outflow). |
| SEMESTER | 1 - Accomplish the trimestral check list. |
| | 2 - Clean the evaporator capillary tube coil. (Apply only water and neutral non-aggressive soap to copper and aluminum). See note (*) |
| | 3 - Clean the heating system heaters, if any. (Apply only water and neutral non-aggressive soap to copper and aluminum). See note (*) |
| | 4 - Clean the evaporator drain. |
| | 5 - Look carefully, if there is any leakage at coupling spots: oil leakage, refrigerant leakage. |
| | 6 - Check if there are any loose, free, damaged, broken, worn parts, rusty, melting, cracked or bad fractioning to the bus body. |
| YEARLY | 1 - Accomplish the semester check list. |
| | 2 - Check the opening and closing pressures of high and low pressure switches. |
| | 3 - Clean the air conditioning body getting rid of any dust/scrap at components. See note (*) |

IMPORTANT: If you do not accomplish the preventive maintenance check list as above, it implies to total or partial loss of warranty coverage. The actions of preventive maintenance written in this manual have been based on normal conditions. Just in case of environment contaminated and bad conditions, then you must do the maintenance more frequent.

NOTE (*) : when cleaning using water, protect electrical and electronic components to prevent damage.

IMPORTANT: the vehicle owner must do preventive maintenance actions.

If you do not do the preventive maintenance as described in this chapter, it implies you lose partially or full warranty coverage.

ATTENTION: Just in case a problem happens in the refrigeration system, then it must be repaired in an authorized shop or qualified professional. If a third party installs the equipment, SPHEROS DO BRASIL - S/A, guarantees only the product, not the installation of it.

The following items are in charge of the OEM Plant (Bus Body Builder).

• Driver´s evaporator:

Problems with any driver´s air conditioning component, leakage, bad working or operation.

IMPORTANT: Iclean the return filter of the driver´s air conditioning, at least, once a week.

• Tubes, hoses, drains and wiring harness:

Bad attachment. Leakage at connections and welding points. Damages due to frictioning / chassis and components frictioning or bad installed.

• Gas Charge Process:

Leakage test procedure. Vacuum process and refrigerant gas charge.

Note: in case the installation is bad, SPHEROS Agent Authorized Service Net will have to call the OEM Plant first, then get an authorization to do the service, print and issue the invoice of repairs.

Identification Tag

It is very important, when you need to ask for spare parts or after sales parts, and similar ones, customer must identify the model of the air conditioning, telling the series number, model and manufacturing date.

This information can be found in the Air Conditioning Warranty Certificate and ID tag.

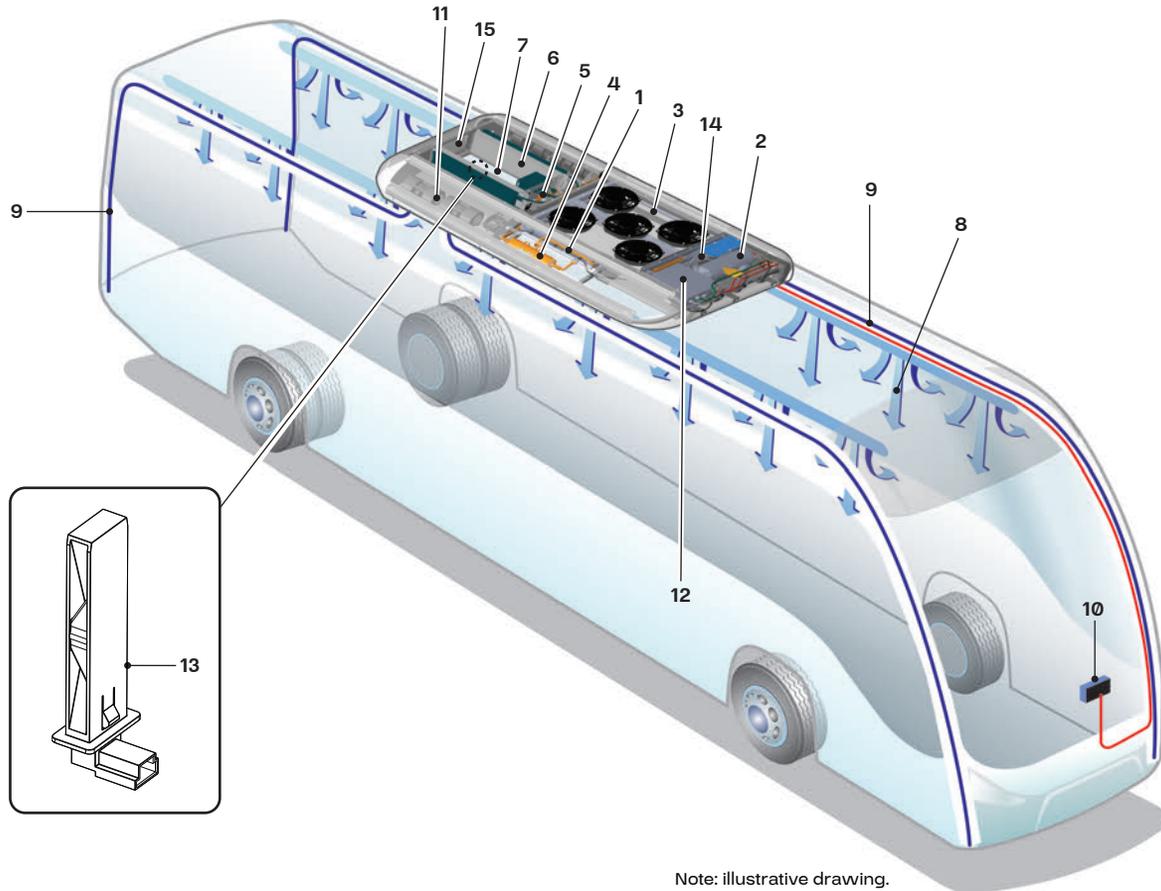
Application information regarding to: series and bus body model, series and chassis model are very important to identify which parts the equipment carries.

In order to identify the bus body and chassis, you need to check the bus body builder manual.



The refrigerant gas amount can vary according to application.

Operating the Air Conditioner



Note: illustrative drawing.

| | | |
|-----------------|---------------------------------------|--|
| MECHANIC SYSTEM | 1 Refrigerant Fluid | It is inside the air conditioning equipment, inside the system. It works absorbing the heat from the interior / room of the vehicle, at the evaporator, and then it goes to the condenser where the heat is thrown to the outside. SPHEROS DO BRASIL - S/A, products apply refrigerant R134a, according to the Protection Environmental Law. |
| | 2 Compressor | When it is working, the compressor sucks the refrigerant fluid from evaporator at gaseous state and under low pressure, compressing it, so temperature and pressure increase, then the compressor puts it into the condenser. |
| | 3 Condenser | Its main goal is dissipate the heat out, which was absorbed by the refrigerant fluid along the refrigeration system. At the condenser, the overheat refrigerant fluid is sent to outside losing its force, changing from gaseous state to liquid state. |
| | 4 Drier Filter | Its purpose is to retain impurities and / or moisture that may be in the system preventing them from reaching the expansion valve. |
| | 5 Expansion Thermostatic Valve | Valve hinders the refrigerant inlet that comes from de condenser at high pressure and its goal is adjust the refrigerant gas flow that passed by the evaporator looking for making the pressure steady and temperature at the capillary tubes output. |

| | | |
|-----------------|--------------------------|---|
| MECHANIC SYSTEM | 6 Evaporators | Now at evaporators, the refrigerant fluid, at low pressure, turns from liquid to gaseous state, absorbing the interior heat of the vehicle in this process. |
| | 7 Air Filter | Air return filter retains impurities from air avoiding any block of dirt at evaporator capillary tubes and coil. |
| | 8 Air Circulation | Air being cooled by the evaporator, then it follows to the bus interior through fans. |
| | 9 Drain | It is a way to get the condensed moisture from evaporator tubes from the condensed tray to putting out. |
| ELECTRIC SYSTEM | 10 Controller | It is installed in the instrument panel, it offers to the driver to set-point of temperature, to see by display the interior temperature, offering full climatic control inside de bus. <u>Set-point</u> : it is the temperature the driver wishes to set inside the vehicle for passengers. |
| | 11 Electronic Fan | Electronic fans differ from conventional fans because their speed varies according to the compressor rotation, thus allowing a better temperature adjustment. |

| | | |
|-----------------|------------------------------|--|
| ELECTRIC SYSTEM | 12 Frequency Inverter | The frequency inverter has the purpose of transforming DC voltage into 380VAC three-phase, thus varying the frequency of rotation of the compressor. |
| | 13 Temperature Sensor | The interior temperature is measured by the temperature sensor placed at the air return spot. |
| | 14 Pressure Switches | Pressure sensors are devices that read pressure and convert it into an electrical signal. |
| | 15 Air Refrechment | This permits the entry of the external in order to expel unwanted odors and impurities from the vehicle. |

1.1- SC2000 Controller Operation

This product aims to control the temperature of SD (Single Deck) vehicles. The intelligence of the system and charge activation is done by Smart ECU in conjunction with the relay board, while the panel is used for user interface only.

The following ECU configurations are available:

- SC2000 - HVAC SD
- SC2000 - VAC SD

1.2- Description of the Control Panel

Below is a description of each of the keys with their respective functions.

- 1- ON/OFF _____ Turns the product ON /OFF.
- 2- AC _____ Indicates that the compressor is ready for operation.
- 3- Increment of the set-point _____ Defines the desired temperature in the room.
- 4- Decrease of the set-point _____ Defines the desired temperature in the room.
- 5- Auto _____ Activates the automatic fan speed and air renewal mode.
- 6- VENT _____ Manual speed control of the evaporator fans.
- 7- Re-Heat _____ Turns on / off the passenger window defroster.
- 8- Air recirculation _____ Turns on / off air recirculation on the bus.

SC2000 Controller

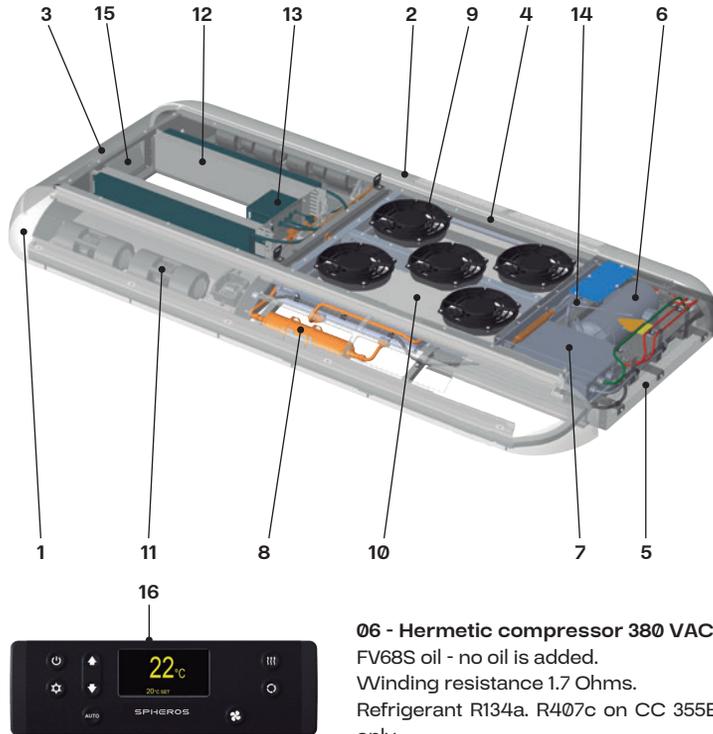


2- Technical Data Sheet

| Component | Characteristics | Cooling | | Cooling + Heating PTC | |
|--|------------------------------------|----------------------------------|---------------------------|----------------------------------|---------------------------|
| AIR CONDITIONING | Cooling Capacity | 110.000 BTU/h (32kW) | | 110.000 BTU/h (32kW) | |
| | Heating Capacity | - | | 41.000 BTU/h (12 kW) | |
| | Air Renewal | 25% | | 25% | |
| | Evaporator Air flow (free blowing) | 6.600 m ³ /h | | 6.600 m ³ /h | |
| | Condenser Air flow (free blowing) | 13.500 m ³ /h | | 13.500 m ³ /h | |
| | Cut-off Temperature | > 55° C | | > 55° C | |
| DIMENSIONS | L x W x H (mm) | 3500 x 1695 x 278 | | 3500 x 1695 x 278 | |
| | Weight | 235 Kg | | 260 Kg | |
| | Ceiling Radius (mm) | 5.500 - 10.000 | | 5.500 - 10.000 | |
| ELECTRIC | Current Consumption @ 600 Vdc | Nominal - 17,0 A | | Nominal - 21,0 A | |
| | Integrated Converter | Included 24V / 380 VDC | Without 380 VDC | Included 24V / 380 VDC | Without 380 VDC |
| CURRENT CONSUMPTION 600 MAXIMUM ROTATION (100%) | Cooling | 13A | 7A | 13A | 7A |
| | Heating PTC | - | - | 15A | 13A |
| COMPRESSOR | Refrigerant Gas | R407C | | R407C | |
| | Tension | 380 VAC Three Phase | | 380 VAC Three Phase | |
| | - | - | | - | |

3- Equipment Components

NOTE: visit www.spheros.com/br to consult the complet parts catalog.



06 - Hermetic compressor 380 VAC:
FV68S oil - no oil is added.
Winding resistance 1.7 Ohms.
Refrigerant R134a. R407c on CC 355E only.

| Item | Code | Description |
|------|----------|---|
| 01 | See NOTE | Right Side Cover |
| 02 | See NOTE | Left Side Cover |
| 03 | See NOTE | Evaporator Cover |
| 04 | See NOTE | Condenser Cover |
| 05 | See NOTE | Compressor Cover |
| 06 | See NOTE | Electric Compressor |
| 07 | See NOTE | Frequency Converter |
| 08 | See NOTE | Drier Filter / Liquid Sight / Liquid Tank |
| 09 | See NOTE | Condenser Fan |
| 10 | See NOTE | Condenser Coil |
| 11 | See NOTE | Evaporator Blowers |
| 12 | See NOTE | Evaporator Coil |
| 13 | See NOTE | Inversor |
| 14 | See NOTE | Pressure Sensors |
| 15 | See NOTE | 24V Air Fresh Set |
| 16 | See NOTE | SC2000 Controller |

07 - DC / DC - 24VDC converter:

Do not invert the output phases for the UVW motor.

13 - Inverter IP65: : does not need preventive maintenance.
Maximum altitude: 3,000 meters.

16 - SC2000 controller:

PTC heating controller.
Controls the power of PTCs
Input: 450 to 850 VDC 30A
Two 15A outputs: PTC1 and PTC2
DC 355E 5kw of power.

4- Definitions and Main Information

**High Voltage - 450 to 900 VDC**

ATTENTION: before any maintenance, disconnect the High Voltage and wait 20 minutes for electrical discharge.

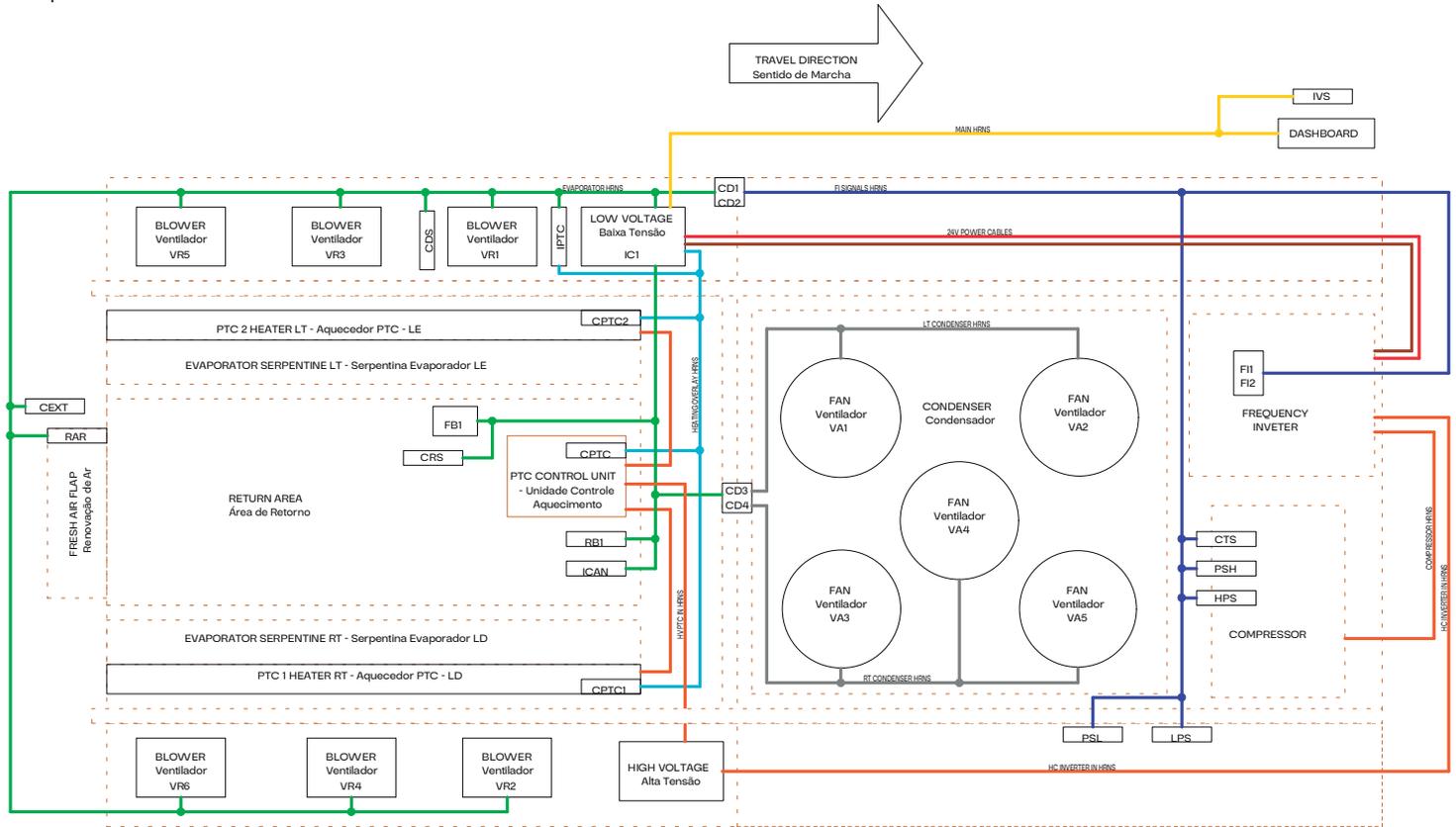
- High Voltage fuses under the responsibility of the chassis/body.
- High Voltage input cable in the ceiling device under the responsibility of the chassis/body.
- Do not invert the phases in the connection between the Inverter and the Compressor.
- Minimum section for the Protective Conductor of 25mm².
- Grounding Points CPE1 to CPE4 must be directly connected to the body structure to ensure electromagnetic compatibility.

| Wire colors according to IEC 60757 | | |
|------------------------------------|------------------|-----------------|
| ABREV. | English | Español |
| BN | BROWN | Marrón |
| RD | RED | Rojo |
| BU | BLUE | Azul |
| OG | ORANGE | Naranja |
| BK | BLACK | Negro |
| YE | YELLOW | Amarillo |
| GN | GREEN | Verde |
| VT | VIOLETT | Violeta |
| GY | GRAY | Gris |
| WH | WHITE | Blanco |
| PK | PINK | Rosa |
| TQ | TURQUOISE | Turquesa |

| Definitions | |
|-------------|---------------------------------------|
| ICN | Connector Controller Interface |
| ISV | Vehicle Interface Connector |
| IC | Connector Body Interface |
| B10M | 24V - M10 Positive Terminal |
| B8M | 24V - M8 Negative Terminal |
| RB | Relay Base |
| IPTC | Connector Heating System Interface |
| STD | Duct Temperature Sensor |
| STE | External Temperature Sensor |
| STR | Return Temperature Sensor |
| RAR | Air Renewal |
| FB | Fuse Base |
| VR | Radial Fan |
| CD | Condenser Interface Connector |
| CAN | Communication with Frequency Inverter |
| VA | Axis Fans |
| HPS | High Pressure Sensor |
| LPS | Low Pressure Sensor |
| PSL | Low Pressure Switch |
| PSH | High Pressure Switch |
| CTS | Compressor Temperature Sensor |
| FI | Frequency Inverter Connectors |
| CPTC | PTC Connector |
| CPE | Protective Conductor Connection |

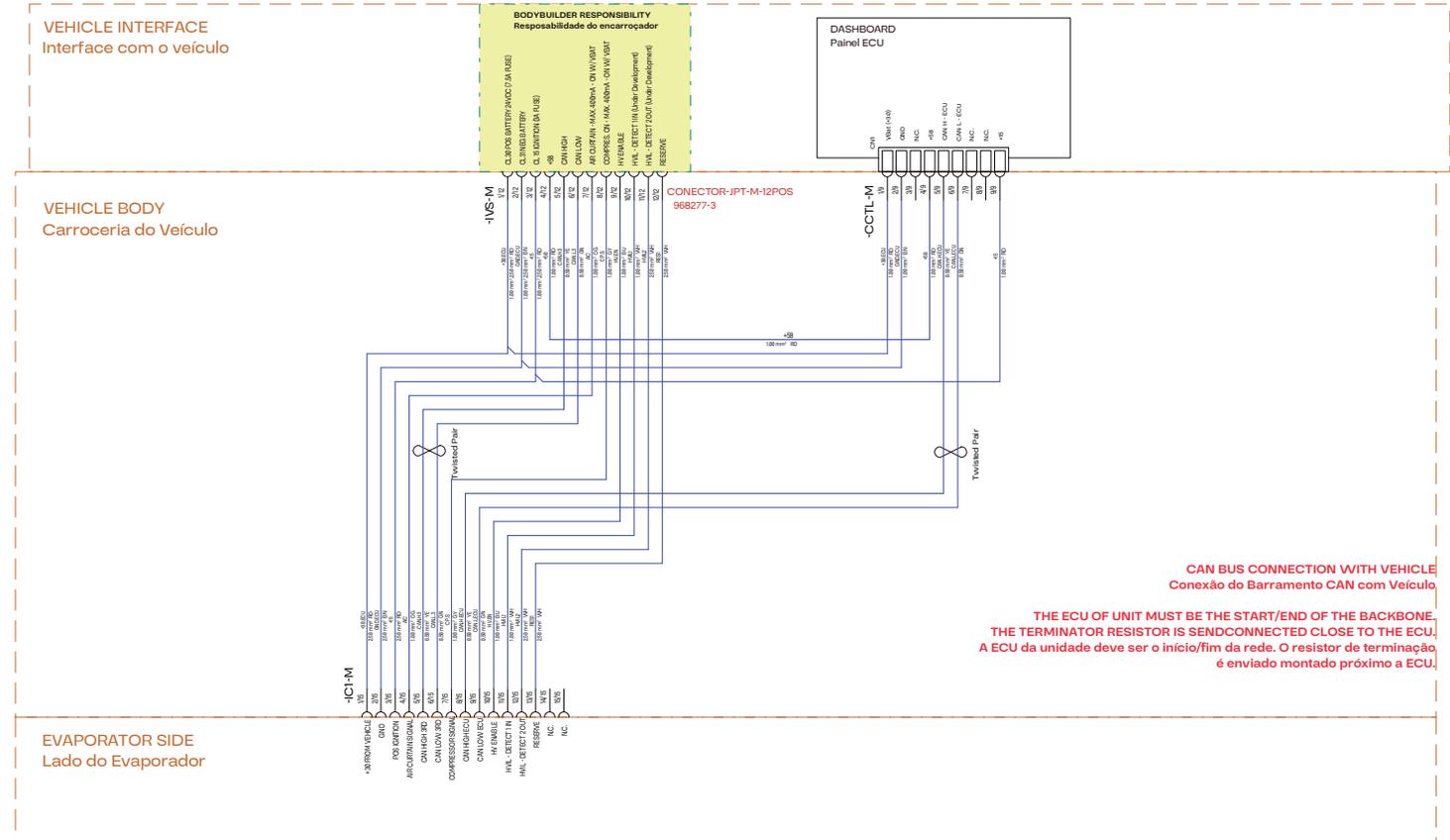
4.1- Configuration of CC 355E Harnesses

Floor plan code: 036-00313-001



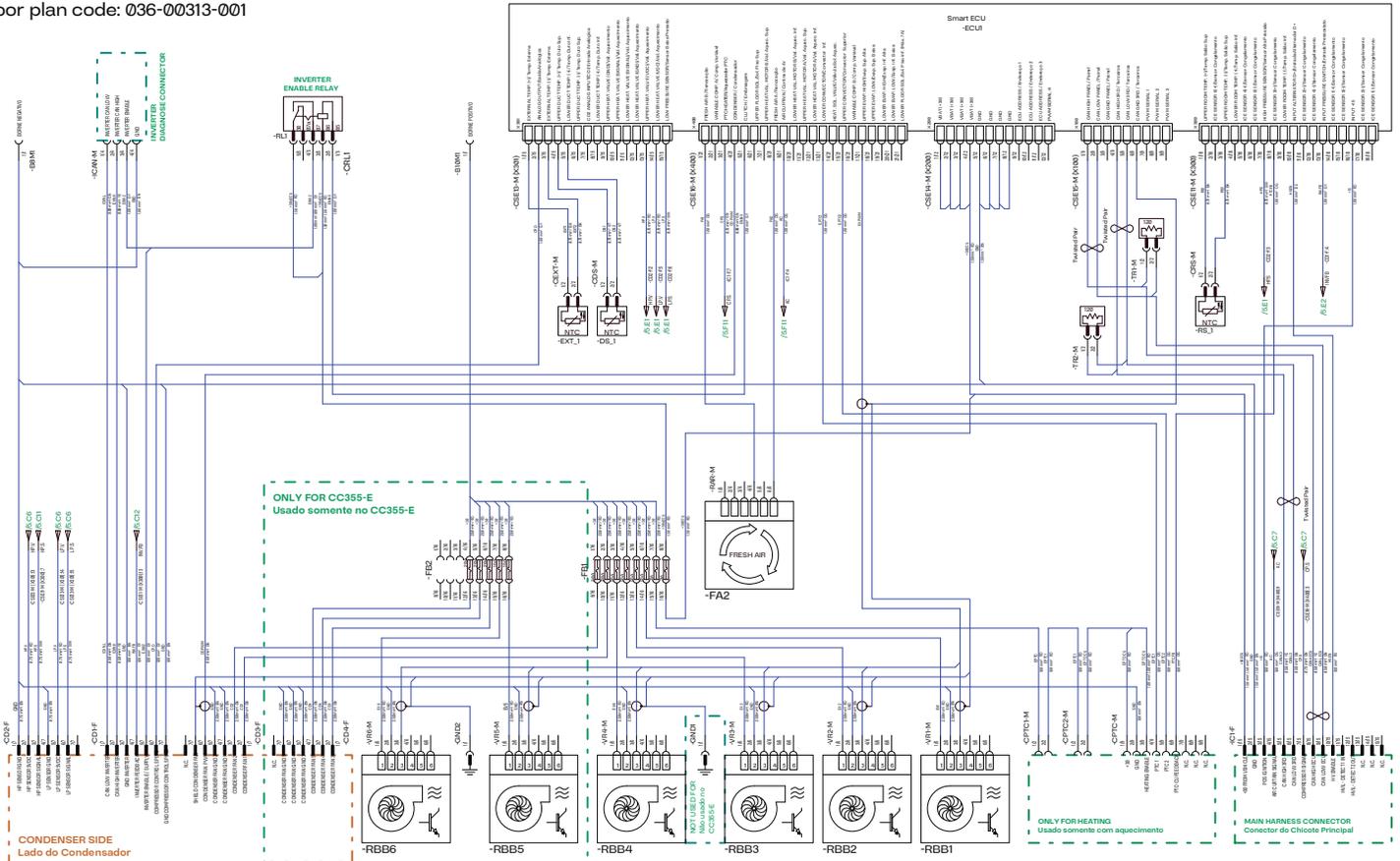
4.2- Main Switch - Ceiling Unit Controller

Floor plan code: 036-00313-001



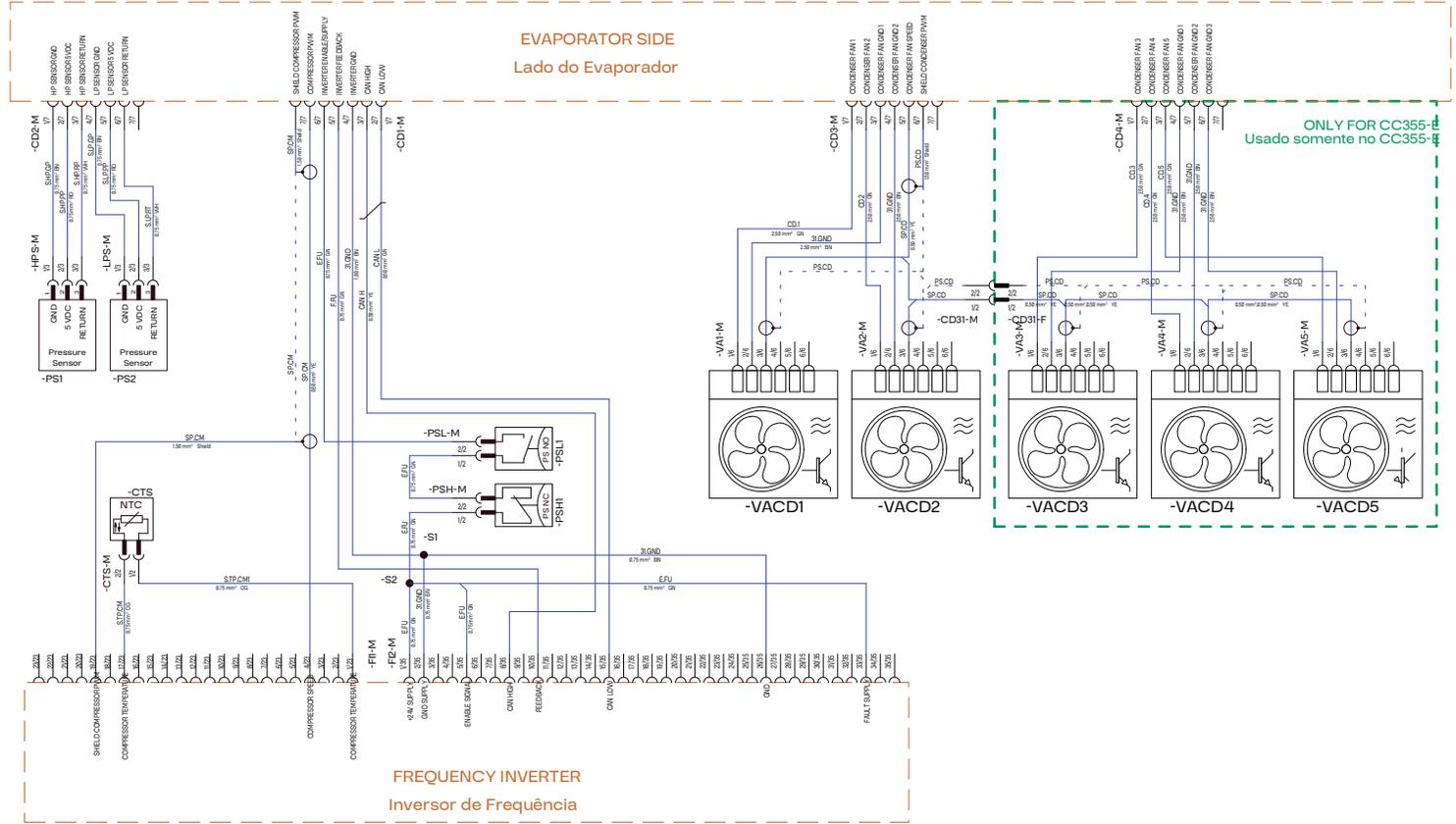
4.3- Evaporator Harness

Floor plan code: 036-00313-001



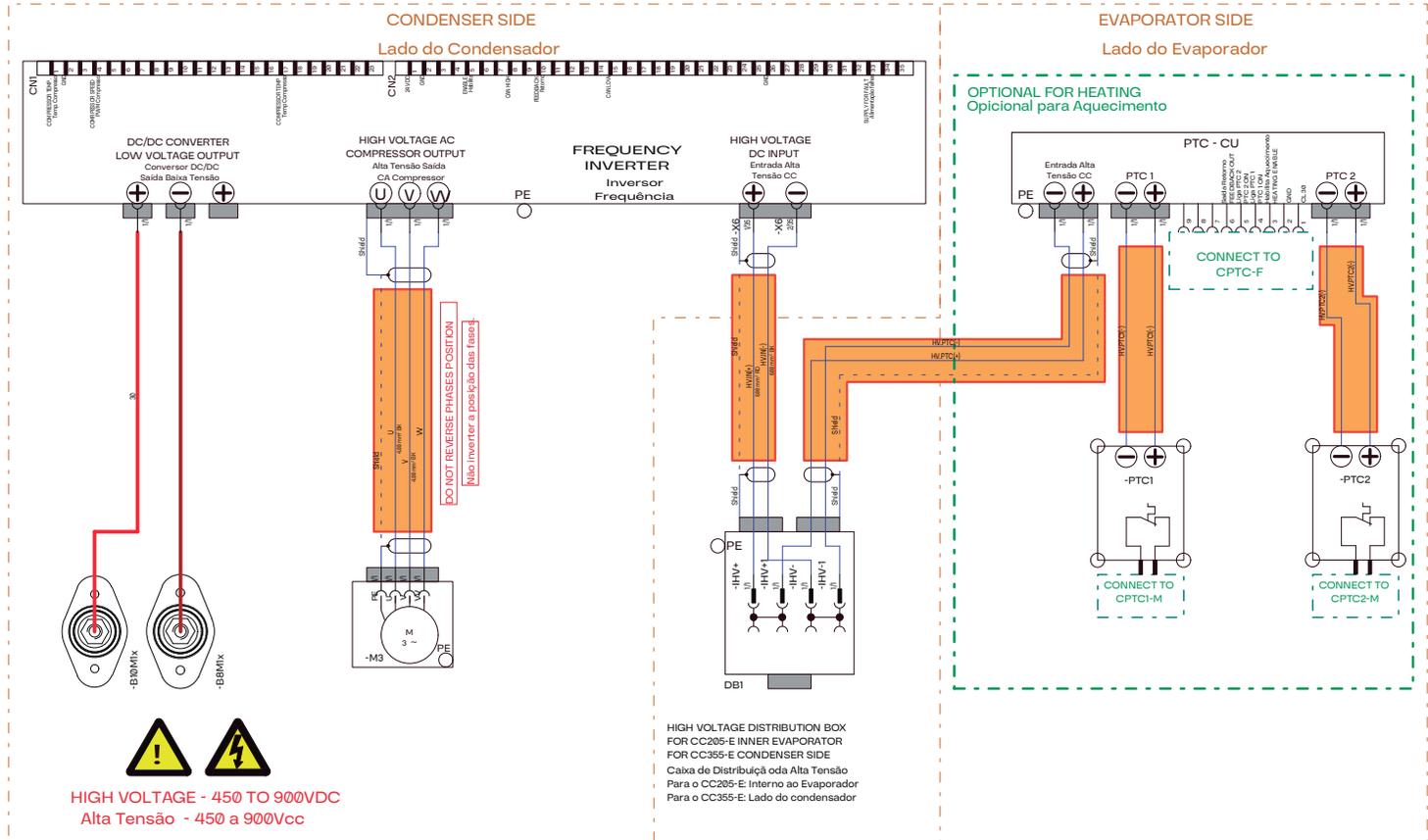
4.4- Condenser Harness and Frequency Inverter Signals

Floor plan code: 036-00313-001



4.5- Frequency Inverter and High Voltage

Floor plan code: 036-00313-001



5- Safety Precaution

**1- Personal Protection:**

Air conditioning systems offers chemic, mechanic and electric risks.

It is mandatory to wear IPE (Individual Protection Equipment), picture 1 to protect yourself from refrigerant gas, refrigerant oil, battery acid, waste launched, engine high temperature and noise.

2- High Pressure:

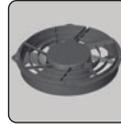
The refrigerant in liquid state and high pressure causes a potential risk. When the refrigerant is sprayed to natural air, it can cause serious injuries to eyes and skin.

3- Hoses:

Check if manometer hoses are in good conditions, when holding them; stay far from belts, pulleys and hot surfaces.

4- Hot Surface:

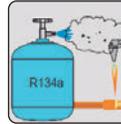
The compressor discharges, exhaust pipes and other engine components can be extremely hot.

**5- Rotation Components:**

The fans, pulleys and belts are not visible under certain conditions. Special care must be taken when putting your hands near them.

**6- Welding:**

Welding must be done carefully; it causes burns and spray toxic gases out. Provide ventilated places to do it.

**7- Toxic Gases:**

The refrigerant gas along with flame becomes into toxic gases and can cause very serious breathing illness. Take special care in closed places, if gases scape somehow (leakage) and then it can cause no toxygen in the air.

Other Care:

- When handling and going up and down stairs, ladders and platforms, you can slide or they can break.
- Wear a seat belt always when working over 1.5m high.
- Never apply heat in recipients or pressured lines.
- Never operate the equipment if discharge service valve is closed.
- The refrigeration oil can cause irritation to your skin and eyes.
- Check if every screw are long enough and right tight.
- **Components that are not in good conditions must be replaced by new ones due to safety reasons.**

6- Product Discard

Concerned about sustainability at SPHEROS DO BRASIL - S/A guides its customers and its authorized service network to discard products in an environmentally sound and safe manner.

Proper disposal of the product or components at the end of their useful life will contribute with the preservation and pollution reduction of the environment, creating economic growth through the Reverse Logistics Program.

According to Law 12,305 / 2010, the environmentally adequate destination of components (parts, oil, refrigerant) is required.

It is the responsibility of all to ensure that products and components are sent to appropriate treatment to companies approved by the environmental agencies.

For more information about our Reverse Logistics Program, please see our website: www.spheros.com/br





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