



Air Conditioning System

Operation Manual

Arcticsphere

02/2013
P.N. 550302A

To receive the best performance from the air conditioning system, we suggest carefully reading this manual before operating the unit. Keep this manual in the vehicle for future reference.

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INTRODUCTION

At Spheros, we develop our products with the goal of providing a comfortable environment for vehicle passengers. We are always looking for the best air condition concepts that provide the highest performance at the best possible value.

The compact systems are simple to operate and provide high cooling capacities at low noise levels.

This manual was developed with the purpose of presenting critical functional aspects, describing the ease of operation and recommended maintenance necessary to obtain the best performance from the Spheros Air Conditioning system.

To ensure a long, useful and problem free life from the equipment it is essential that the operation and maintenance instructions described in this manual are followed routinely and thoroughly.

All system controls provided by Spheros, are duly illustrated and explained in this manual.

It is important that the operator reads and understands the operation instructions carefully before starting the air conditioning equipment.

Spheros makes every effort to maintain a network of authorized service professionals trained to perform any type of maintenance within the quality standard.

Thank you for choosing Spheros Air Conditioning products. If you have any questions or concerns with our products, please contact us or the nearest authorized service provider.

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SAFETY PRECAUTIONS

GENERAL SAFETY NOTICES

The following safety notices supplement warnings and cautions appearing elsewhere in this manual. The following are recommended precautions that must be understood and applied during operation and maintenance of the equipment. **Failure to adhere to warnings and cautions may result in damage to equipment, fire, personal injury and even death.**

OPERATING PRECAUTIONS

Keep hands, clothing and tools clear of the evaporator and condenser fans.

No work should be performed on the system unless battery power is disconnected.

In case of severe vibration or unusual noise, stop the system and investigate.

MAINTENANCE PRECAUTIONS

Always wear protective eye wear (safety glasses or goggles) and appropriate safety wear.

Never perform any maintenance or service on your equipment before consulting with authorized service personnel. Always unplug unit before attempting any maintenance.

Avoid breathing any refrigerant vapor, lubricant vapor, or mist. Exposure to these, particularly PAG oil mist may irritate your eyes, nose, or throat.

Never use compressed air (shop-air) to leak-test or pressure test a R134A system. Under certain conditions, pressurized mixtures of R134A and air can be combustible. In addition, shop air will inject moisture into the system.

Always use mineral oil to lubricate “O” Rings, hoses, and fittings on R134A systems. PAG oils absorb moisture and become very acidic and corrosive. Mineral oil does not absorb moisture and thus prevents corrosion. Always wear gloves when working with PAG (Polyalkylene Glycol) and Ester (POE or Polyester) lubricants to prevent irritation to your skin. R134A lubricants can damage vehicles paint, plastic parts, engine drive belts and coolant hoses.

Beware of unannounced starting of the evaporator and condenser fans. Do not remove the evaporator/condenser cover without disconnecting the vehicle battery cable. Be sure power is turned off before working on motors, controllers, and electrical control switches. Tag system controls and vehicle battery to prevent accidental energizing of the system.

In case of electrical fire, extinguish with CO₂ (never use water). Disconnect vehicle battery power if possible.

SPECIFIC WARNINGS AND CAUTIONS

WARNING

Be aware of unannounced starting of the evaporator and condenser fans. The unit may cycle the fans and compressor unexpectedly as control requirements dictate.

WARNING

The refrigerant contained in the air conditioning system when in direct contact with skin and eyes can cause frostbite, severe burns or blindness.

WARNING

Be sure to observe warning listed in the safety precautions in the front of this manual before performing maintenance on the air conditioning system.

WARNING

Never use air for leak testing. Pressurized, air-rich mixtures of refrigerants and air are combustible when exposed to ignition source.

SPECIFIC WARNINGS AND CAUTIONS

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Do not use oxygen in or near a refrigeration system as an explosion may occur.

WARNING

The filter-drier may contain liquid refrigerant. Slowly open the fitting nuts and avoid contact with exposed skin or eyes.

CAUTION

Unless there was a catastrophic failure, such as a blown or ruptured refrigerant hose, additional oil may not be needed.

CAUTION

Use only the exact oil specified by the compressor manufacturer. Use of oil other than that specified will void the compressor warranty.

This manual contains **Operation and Preventive Maintenance Schedule** applicable only to the **ARCTICSPHERE** Split System Air Conditioners identified on the title page.

1. AIR CONDITIONING IDENTIFICATION

To clearly identify the air conditioning system components or if service is requested, you will need to know the model number and serial number of the unit. All Spheros Air Conditioning evaporators and condensers have a model/serial number tag located on the assembly (**fig. 1**).

Unit tags will list the following:

1. System Model Number
2. Spheros ID Number.
3. Voltage.
4. Refrigerant Type.
5. Serial Number/Date of Production

SPHEROS	
Model	Arcticsphere IW200
Spheros ID	11117105A
Customer ID	
P COOLING / P HEATING	--- / ---
VOLTAGE	12V
REFRIGERANT / OIL TYPE	R134a / ---
COOLENT	---
MAX. PRESSURE / A/C	25 bar
Serial No./Date of Prod.	000000000 / 000000000
<div style="background-color: black; width: 100px; height: 15px; margin-bottom: 5px;"></div> <div style="background-color: black; width: 80px; height: 15px;"></div>	
Year of Initiating	2011 2012 2013

Fig. 1

***Refrigerant amounts vary by unit, application and installation.**

2. OPERATION

2.1 GENERAL INFORMATION

Spheros air conditioner controllers are usually installed on the driver's instrument panel. The controllers enable the driver to select the speed of the blowers and the set point temperature. The set point temperature is the desired temperature inside of the vehicle and regulated by the driver. The internal temperature of the vehicle is detected by a temperature sensor located in the return air (**See Item 3.1**).

CONDENSER OPERATION:

The condenser fan motors, as well as the compressor, will only be activated when the air conditioner is in the "Cooling Mode".

EVAPORATOR OPERATION:

The speed of the evaporator blower is adjusted according to the position selected on the control unit dial.

COMPRESSOR OPERATION:

The compressor operates only in the "Cooling Mode", and will start operation 10 seconds after the condenser is turned on.

For equipment protection the controller delays restarting the compressor up to 30 seconds, every time it is turned off.

PROTECTION SYSTEM:

The air conditioners are equipped with an electrical system that monitors operating pressures. The pressure switches perform this function by monitoring the system for dangerous high and low pressure levels that can lead to system failures.

For safety reasons, the compressor will automatically turn off if the operating pressures rapidly change.

Note: The working pressures are constantly monitored, even when the air conditioner is off.

2.2 AIR CONDITIONER OPERATION – MANUAL AC CONTROL

FUNCTIONS OF THE MANUAL CONTROL PANEL

The air conditioner control panel has two rotary switches, one for the blower speed (E) and one for temperature adjustment (G). It also has an LED indicator (F) to signal activation of the AC compressor drive clutch. **Figure 2** shows the features of the control panel.



Fig. 2: Manual Control Panel

- A: A/C System OFF
- B: Blower Switch, Low Mode
- C: Blower Switch, Medium Mode
- D: Blower Switch, High Mode
- E: Blower Switch
- F: Compressor Operation LED
- G: Temperature Adjust Switch

Temperature Adjustment Switch

The Temperature Adjust Switch (G) is used to set the ideal or desired temperature level for the user. This can be varied between approximately 64°F (18°C) and 78°F (26°C). The system is then automatically regulated and operates until the set value is obtained.

Cooling Compressor LED

The LED indicator (F) lights blue while the AC Compressor Clutch is activated, the condenser fans are running and the cooling system is active. The LED turns off when the cabin temperature falls to the set level.

The Blower Switch

The blower motors have three modes of operation controlled by the Blower Switch (E) – Low, Medium and High speed. The blowers do not run and no cooling occurs at the OFF position (A).

The Low (B) Medium (C) and High (D) switch positions keep the blowers continuously running at low, medium or high fixed speeds respectively, independent of the set or actual temperature values.

2.3 Manual Control AC Regulation

AC Regulation

The A/C regulation is based on the difference between the actual cabin temperature and the set value. This is illustrated in **Figure 3**

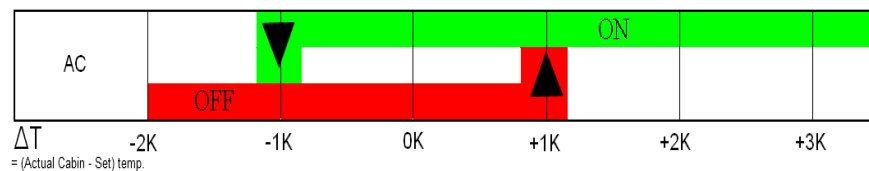


Fig. 3: AC Regulation

Cooling (activated A/C Compressor Clutch and Condenser Fans) starts only after the temperature difference exceeds $1.8^{\circ}\text{F}/1^{\circ}\text{C}$ and stops when the cabin temperature difference is $1.8^{\circ}\text{F}/1^{\circ}\text{C}$ less than the set value.

3. EQUIPMENT DESCRIPTION

3.1 COMPONENT LOCATION

Spheros Arcticsphere Air Conditioning Units consist of an internal equipment split system that uses a custom design for the vehicle. It is composed of a condenser module and an evaporator module connected to a compressor.

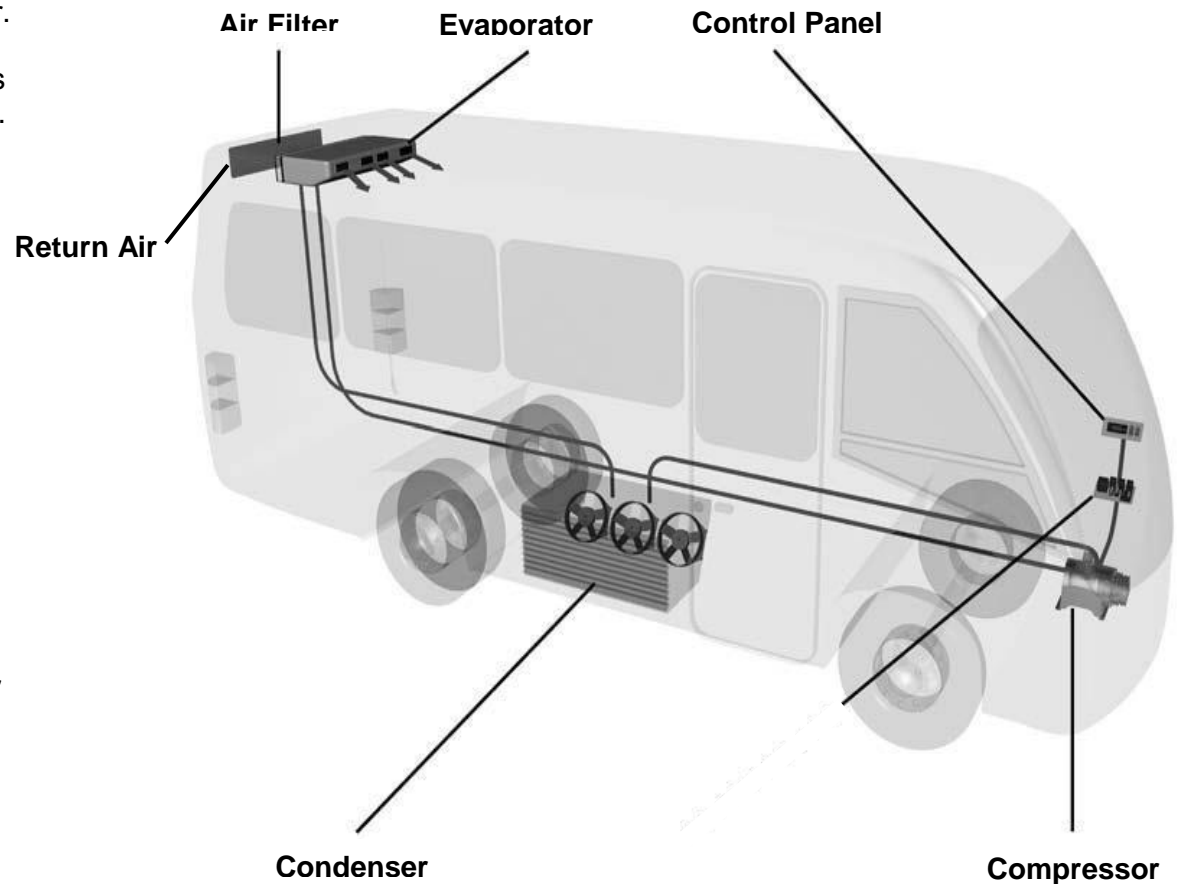
The compressor is located next to the vehicle's engine and driven by way of an accessory belt. These products are designed for use with R134A refrigerant, according to environmental protection standards.

The electrical system is composed of a relay board, which is regulated by the electronic controller positioned in the driver's instrument panel.

The controller receives signals from the temperature sensor, situated on the air return. These devices work together to regulate and control the desired temperature inside the vehicle (Fig. 3).

Note: The electrical system is interconnected with the vehicle's alternator and batteries.

Fig. 4 Component Location



3.2 TECHNICAL SPECIFICATIONS FOR ARCTICSPHERE

ARCTICSPHERE TECHNICAL DATA SHEET				
AIR CONDITIONING	MODEL CAPACITY	CE-100 SC-120 40,000	CE-200 SC-220 IW200, IW210, IW220 55,000	CE-200 SC-230 IW200, IW210, IW220 60,000BTUH
REFRIGERANT	TYPE	R-134A	R-134A	R-134A
EVAPORATOR SECTION	BLOWER TYPE BLOWER QUANTITY	RADIAL 2	RADIAL 2	RADIAL 2
CONDENSER SECTION	AXIAL 2	AXIAL 2	AXIAL 2	AXIAL 2
COMPRESSOR	MODEL (ALTERNATIVE) MAXIMUM RPM LUBRICATING OIL	TM16/QP16 6,000 RPM PAG	TM21/QP21 6,000 RPM PAG	TM21/QP21 6,000 RPM PAG
CLUTCH	TYPE VOLTAGE	ELECTROMAGNETIC 12VDC	ELECTROMAGNETIC 12VDC	ELECTROMAGNETIC 12VDC

The amount of refrigerant can vary according to the application and installation.

3.2 TECHNICAL SPECIFICATIONS FOR ARCTICSPHERE

ARCTICSPHERE TECHNICAL DATA SHEET			
AIR CONDITIONING	MODEL CAPACITY	CE-300 SC-230 RC-320 65,000 BTUH	CE-300 SC-230 RC-320 75,000 BTUH
REFRIGERANT	TYPE	R-134A	R-134A
EVAPORATOR SECTION	BLOWER TYPE BLOWER QUANTITY	RADIAL 2	RADIAL 2
CONDENSER SECTION	FAN TYPE FAN QUANTITY	AXIAL 2	AXIAL 2
COMPRESSOR	MODEL (ALTERNATIVE) MAXIMUM RPM LUBRICATING OIL	TM21/QP21 4,500 RPM PAG	TM31/QP31 4,500 RPM PAG
CLUTCH	TYPE	ELECTROMAGNETIC 12VDC	ELECTROMAGNETIC 12VDC

The amount of refrigerant can vary according to the application and installation.

4 PREVENTATIVE MAINTENANCE ACTIVITIES

4.1 GENERAL

An air conditioning system is subjected to constant mechanical strain and stress. To ensure trouble-free operation of the system and avoid any damage to its parts, it is important to perform all required service activities on the air conditioning system by trained and qualified personnel who are knowledgeable in the field of refrigeration.

The proper handling of the system including proof of the service activities record is a prerequisite for acceptance of any warranty claims in the event of damage to parts subject to maintenance.

Warranty replacement parts and out of warranty replacement parts must be supplied by Spheros Climate System, LLC to assure the quality and reliability of the product.

Regardless of the maintenance intervals, specified in the maintenance and service schedule, all attachments of the unit and the connections of refrigerant lines must be checked for tightness within the first four weeks following the initial start-up of the air conditioning system or the vehicle.

Even if the air conditioning system is not in operation, wear caused by normal aging or the strain and stress occurring during the driving operation of the bus may occur on individual components. All checks listed in the maintenance and service schedule need to be independent of the operation hours of the system.

Loss of refrigerant is possible even if the refrigerant connections are tight due to the structure of the material of the refrigerant lines and ambient temperatures. In the event of a relatively high refrigerant loss within short intervals, leaks in the system can be assumed and should be located and repaired.

During long periods of non-use, the air conditioning system should be operated for about 15 minutes at least twice a month in order to prevent the shaft seals of the refrigerant compressor from hardening.

The drive pulley of the electromagnetic clutch is continuously rotating when the vehicle engine is in operation. Bearing wear or possible damage to the clutch may occur and should be inspected independently of maintenance intervals based on the operating time of the air conditioning system. It is imperative that the clutch be checked for correct lubrication, belt tension etc.

CAUTION

- The refrigerant receiver is subject to the Pressure Equipment Directive. Check the receiver every 6 months for cracks, mechanical damage or corrosion. The receiver must be replaced if any defects are found.
- The maintenance intervals indicated in the maintenance and service schedule are based on the operation hours of the vehicle, with the exception of the compressor assembly, which are based on the air-conditioning unit's hours of operation.
- These time intervals are empirical values that may vary widely depending on the type of system and type of bus concerned.

4.2 Preventive Maintenance Schedule

All preventive maintenance described below is based on typical operating conditions. The frequency outlined below is for normal operating conditions and should increase if used under more severe conditions.

COOLING CIRCUIT	MONTHLY	QUARTERLY	ANNUALLY
Measure and record the refrigerant pressures and temperatures of the suction line		X	
Measure and record the refrigerant pressures and temperatures of the liquid line		X	
Visually inspect for signs of oil or refrigerant leaks	X		
After 15 minutes of operation check refrigerant level using the sight glass	X		
Visually inspect all components, tubes and hoses for signs of wear and deterioration	X		
Change the filter drier once a year or each time the system is opened			X
Check the opening and closing pressures of the high and low pressure switches			X

COMPRESSOR / CLUTCH	MONTHLY	QUARTERLY	ANNUALLY
Visually inspect the clutch plate		X	
Visually inspect the condition, tension and alignment of the compressor belts	X		
Clean the compressor and clutch with steam or hot water			X
Measure the resistance and the voltage on the clutch coil			X
Check the compressor oil level after 15 minutes of operation	X		

STRUCTURE	MONTHLY	QUARTERLY	ANNUALLY
Visually inspect for loose parts, damaged or broken wires	X		
Clean or replace the return air filters	X		
Clean the condenser and evaporator drains			X
Clean the fins the evaporator and condenser coils with coil cleaner or soap and water	X		
Retighten all bolts on the compressor support and the unit using recommended torque			

ELECTRICAL SYSTEM	MONTHLY	QUARTERLY	ANNUALLY
Check control panel operation, clean panel and thermostat sensor with air			X
Check the alternator for corrosion and inspect electrical connections			X
Visually check the alternator belt tension, check for mis-alignment and wear			X
Check the power cable at the relay plate, re-torque if necessary	X		
Inspect all wires and terminals for damage and corrosion			X
Check the ventilation of the condenser and evaporator motors	X		

Note: We recommend using this table to develop a plan for routine maintenance to you A/C System

IMPORTANT: The return air filter and the condenser coil must be checked and cleaned weekly. As a rule, the air ducts must be cleaned every 3 months and more frequently depending on operating times of the system, the number of passengers and the severity of the environmental conditions.

A cost effective preventive maintenance program can prevent costly down time and repairs and avoid cancellation of warranty due to negligence.

4.3 VERIFICATION OF CORRECT AMOUNT OF REFRIGERANT IN THE SYSTEM

After the air condition system has been operating for approximately 45 minutes, with the magnetic clutch engaged and the vehicle's motor working at a minimum rotation of 1500 RPM, the refrigerant must flow through the liquid sight glass without any bubbles.

Note: The refrigerant should be disposed of properly and according to the environmental laws and regulations in Section 608 of the Clean Air Act.

4.4 OFF SEASON MAINTENANCE (WINTER CARE)

To prevent against leakage on the compressor's mechanical seal, operate the air conditioner for 15 minutes. This operation must be performed twice a month at temperatures above 46°F (8°C). The lines, fittings and other components of the air conditioning system must also be inspected.

During the maintenance activities, special attention must be given to detecting signs of corrosion or and mechanical damage. All components which are not in suitable condition must be replaced for safety and reliability reasons.

4.5 CHANGE OF OIL AND FILTER / DRIER

To ensure optimal air conditioner operation, the oil and the Filter / Drier must be inspected periodically. We recommend changing the oil every **(3)** years or **(1200)** working hours, or whichever occurs first. The quality of the compressor oil can be determined by its color. If the oil shows any change in color, it must be replaced.

- a) Yellow – Normal Oil
- b) Black – Carbonized Oil
- c) Brown – Copper Corrosion, due to moisture in system
- d) Metallic Gray – Suspended Metallic Particles

The filter / drier must be changed every time sealed system maintenance is performed or when the sealed system is exposed to contamination.

ATTENTION:

If any problems in the cooling circuit occur, the repair must be performed by qualified personnel or by an authorized service provider.

5 Failure Diagnosis Table

As a troubleshooting aide, the table in **Fig. 5** lists possible failure symptoms, possible causes and solutions to assist in correcting the problem.

Symptoms	Possible Cause	Solution
Compressor does not work	Fuse or relay defective	Replace fuse or relay
	Magnetic clutch burned	Replace clutch
	Compressor locked	Replace compressor
	Low pressure switch open	Low on refrigerant or defective pressure switch
HP switch opens	Overcharge of refrigerant	Adjust refrigerant charge
	Condenser coil dirty	Clean condenser coil
	Condenser motor(s) not working	Replace motors(s)
	Faulty HP switch	Replace HP switch
LP switch opens	Loss of refrigerant	Check for possible leak, adjust charge
	Plugged or defective expansion valve	Replace the expansion valve
	Dirty evaporator coil	Clean the evaporator coil
	Dirty air filter	Clean or replace air filter
	Evaporator blower(s) not working	Replace fan motor(s)
	Faulty low pressure switch	Replace low pressure switch
Condenser motor not working	Electrical wiring connection bad	Locate and repair connection
	Burned fuse or defective control relay	Replace fuse and/or relay
	Open winding in motor	Replace motor
Evaporator motor not working	Electrical wiring connection bad	Locate and repair connection
	Burned fuse or defective control relay	Replace fuse and/or relay
	Open winding in motor	Replace motor

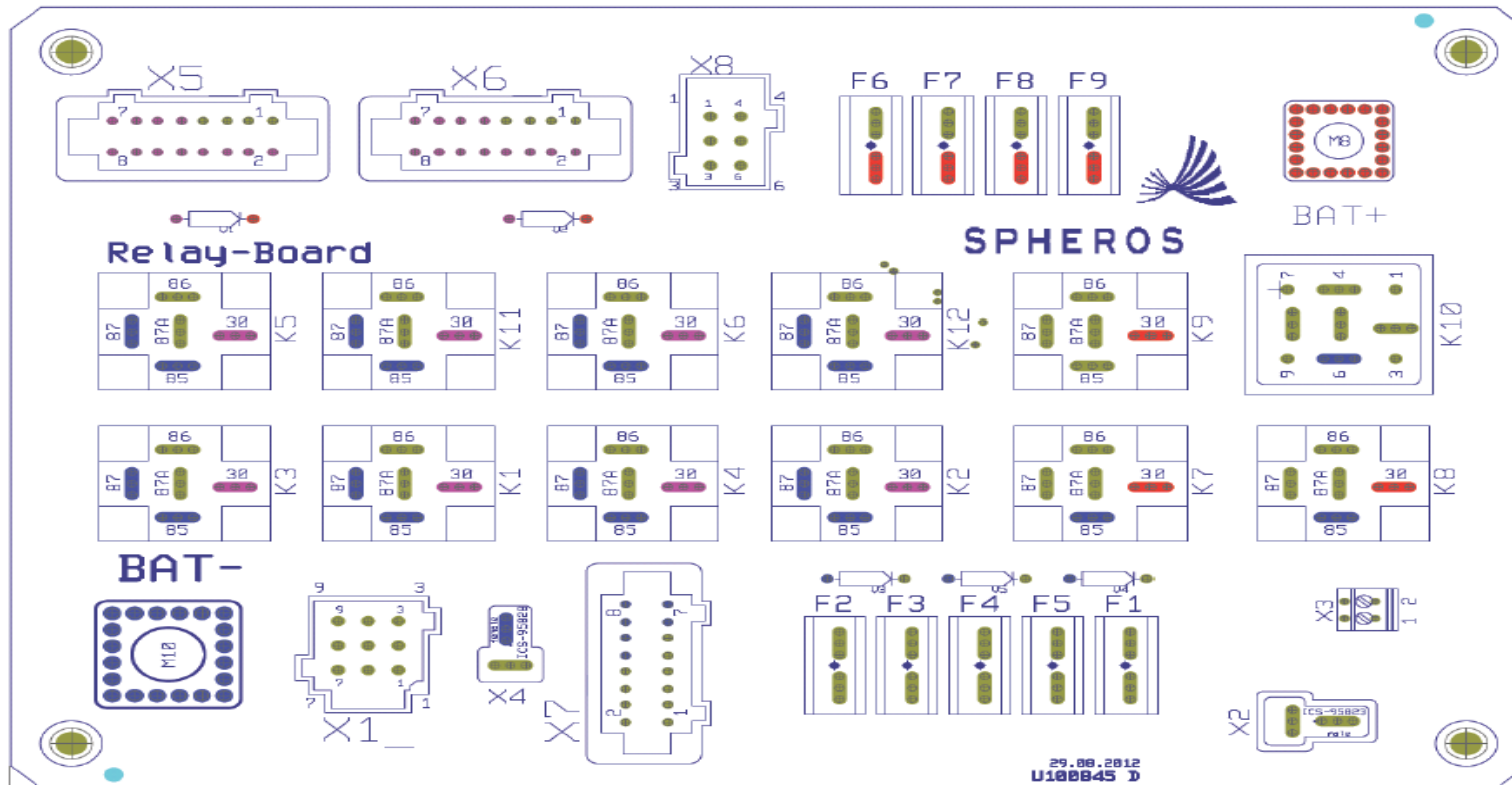
Fig. 5 Failure Diagnosis Table

Symptoms	Possible Cause	Solution
AC does not cool and Compressor remains on	Low on refrigerant charge	Check for leaks, adjust charge
	Non-Condensables in system	Evacuate the unit to 1000 microns or less and adjust charge to correct amount
	Plugged or defective expansion valve	Replace the expansion valve
	Dirty evaporator coil	Clean the coil
	Dirty air filters	Clean or replace air filters
AC cools down too much and Compressor continues to run	Incorrect temperature set point selection	Adjust desired set point temperature on control panel
	Temperature sensor location	Check and relocate temperature sensor
High discharge pressure	Overcharge of refrigerant in system	Adjust charge to correct amount
	Restriction in sealed system	Locate and remove restriction, compressor valve partially closed, expansion valve partially closed, filter drier plugged
	Condenser motor not working	Refer to symptom "Condenser motor not Working"
	Dirty condenser coil	Clean condenser coil
Low suction pressure	Low system charge	Check for leak, adjust charge
	Return air temperature too low	Relocate temperature sensor
	Plugged or defective expansion valve	Replace the expansion valve
	Evaporator motor not working	Refer to symptom "Evaporator motor not Working"
	Restriction in sealed system	Locate and remove restriction
	Dirty air filters	Clean or replace air filters
	Dirty evaporator coils	Clean evaporator coils

Fig. 5 Failure Diagnosis Table

6. ELECTRICAL SCHEMATIC OF RELAY BOARD FOR MANUAL CONTROL PANEL

6.1 12V Relay and Fuse Locations



RELAY	FUNCTION	TYPE
K1	Blower Fan 1 – High Speed	40A
K2	Blower Fan 3 – High Speed	40A
K3	Blower Fan 2 – High Speed	40A
K4	Blower Fan 4 – High Speed	40A
K5	Blower Fans 1 & 2 – Med. Speed	40A
K6	Blower Fans 3 & 4 – Med. Speed	40A
K7	Condenser Fan 1 & Clutch Switch	40A
K8	Condenser Fan 2	40A
K9	Condenser Fan 3	40A
K10	Control relay	11115103A
K11	Blower Fans 1 & 2 Low Speed	40A
K12	Blower Fans 3 & 4 Low Speed	40A

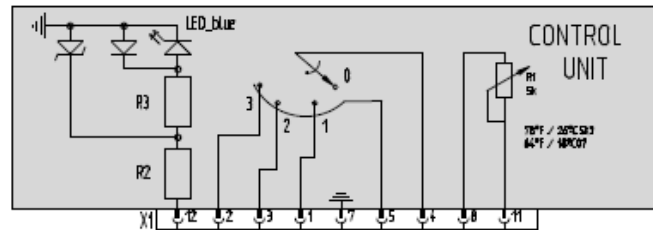
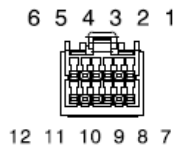
FUSE	FUNCTION	TYPE
F1	Relay Coils	ISO8820 – 5A
F2	Condenser Clutch	ISO8820 – 10A
F3	Condenser Fan 1	ISO8820 – 25A
F4	Condenser Fan 2	ISO8820 – 25A
F5	Condenser Fan 3	ISO8820 – 25A
F6	Blower Fan 1	ISO8820 – 25A
F7	Blower Fan 2	ISO8820 – 25A
F8	Blower Fan 3	ISO8820 – 25A
F9	Blower Fan 4	ISO8820 – 25A

6.2 Relay Board Schematic for Manual Control Panel

Relay Board X1 Connector
(Pin Side)



Control Panel
Male Connector

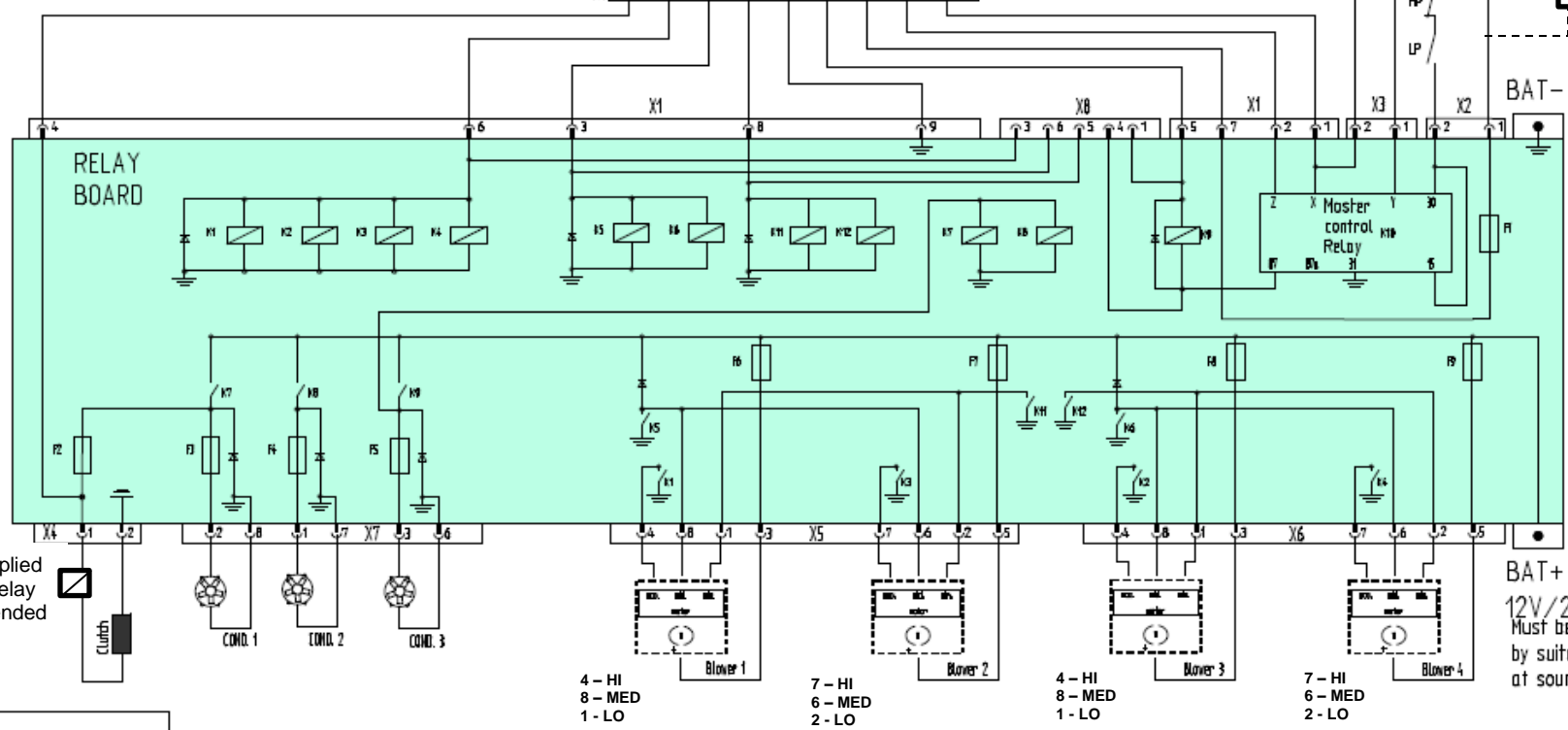


D+ = Alternator
15 = Ignition
30 = Battery

room temp. sensor

D+ D+/15/30

Optional
Noise
Suppression
Switch



Field Supplied
Clutch Relay
Recommended

BAT+
12V/24V
Must be protected
by suitable fuse
at source

4 - HI
8 - MED
1 - LO

7 - HI
6 - MED
2 - LO

4 - HI
8 - MED
1 - LO

7 - HI
6 - MED
2 - LO

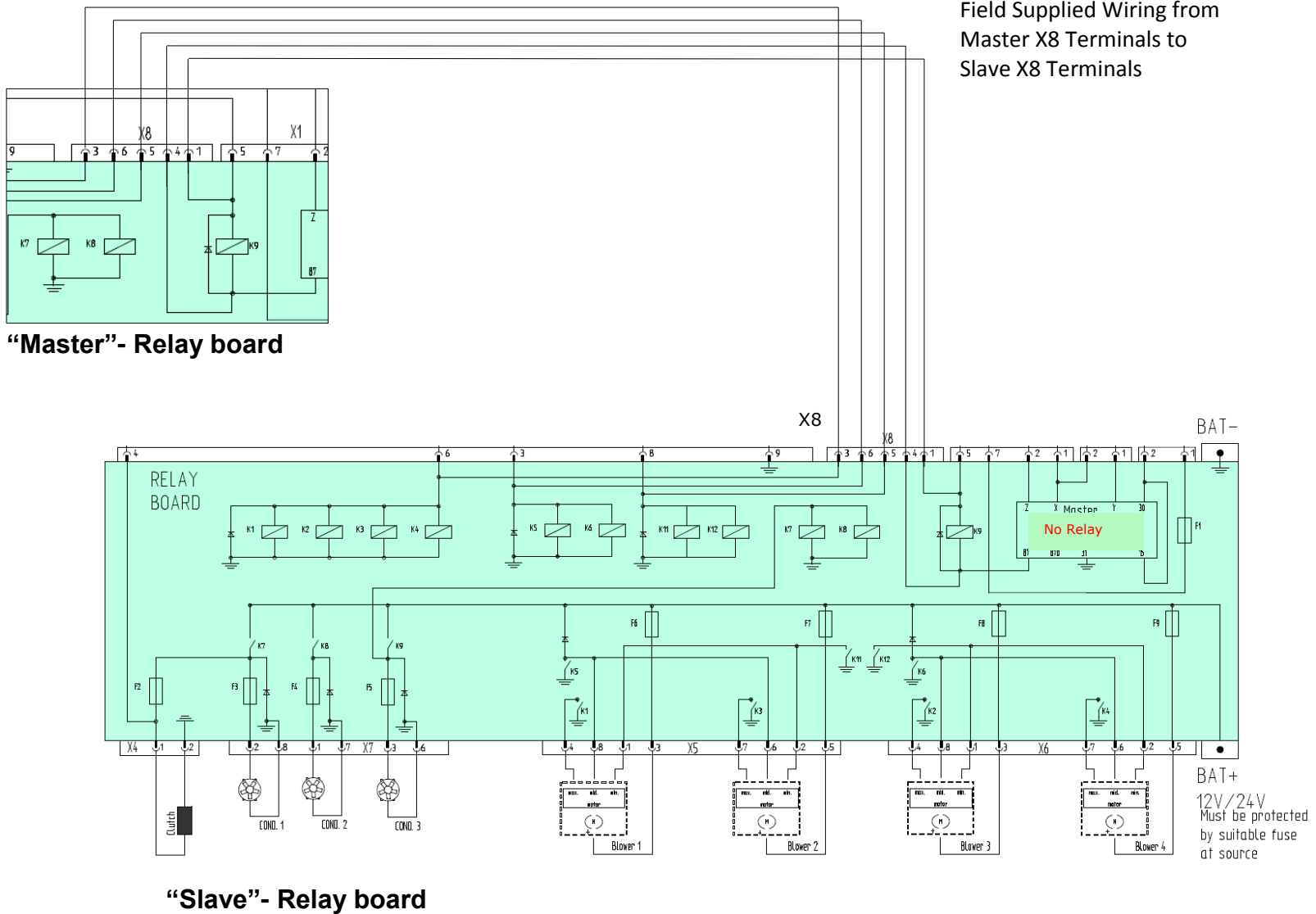
noting connectors

X1 (9 pin) Tyco 1-967621-→
X2 Tyco 180907 series
X4 Tyco 180908 series
X5 - X7 G+H 8 pin
LEAR DFK 1 + DFK 2 series (old No: 16184)
Pueplichhulsen-No: 70148645626210
X8 (6 pin) PT Tyco 1-965640-→

Signal Availability			X2 pin 1 input connected to		
D+ (Clamp 61)	Ignition stage 1 (Clamp 15)	Battery + (Clamp 30)	D+ (Clamp 61)	Ignition stage 1 (Clamp 15)	Battery + (Clamp 30)
OFF	OFF	ON	no function	no function	no AC only ventilation
OFF	ON	ON	no function	no AC only ventilation	no AC only ventilation
ON	ON	ON	AC	AC	AC

Fuses	12V	24V
F1	5A	5A
F2	10A	10A
F3, F9	25A	15A

6.3 Master / Slave Relay Board Interface for Single Control Dual Loop System



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