PACCAR

SERVICE MANUAL

Section	**HVAC**
Title	Idle Management System Service Manual
Number	**SM001-300**
Date	Rev. 10 © 6/2019
Model	All w/ Idle Management System
Page	1 of 40

Kenworth Idle Management System

Technical Information and Diagnostic Guide

This guide will assist you in becoming more familiar with the working components of the Kenworth Idle Management System and the proper steps and procedures to completely diagnose the Kenworth Idle Management System unit.

Contents

List of Figures

GENERAL SAFEY INSTRUCTIONS

A number of alerting messages are in this manual. Please read and follow them. They are there for your protection and information. These messages can help you avoid injury to yourself or others and help prevent costly damage to the vehicle.

Warnings, Cautions, and Notes

Key symbols and “signal words” are used to indicate what kind of message is going to follow. Pay special attention to instructions prefaced by symbols and signal words “WARNING”, “CAUTION”, or “NOTE”. Please do not ignore any of these alerts.

WARNING!

When you see this symbol and word, the message that follows is especially vital. This signals something that can cause injury or even death. This message will tell you what the hazard is, what can happen if you don’t heed the warning, and/or how to avoid it.

CAUTION

This symbol and word signals something that could damage your vehicle.

NOTE

This symbol gives you information we believe to be helpful. The information can be a service hint or something to assist with the repairing of the vehicle.

Precautions for Working with HFC134a (R134a) Refrigerant and Polyvinyl Ether (PVE) Refrigerant Oil

WARNING!

- DO NOT breathe A/C refrigerant and oil vapor or mist. Exposure may irritate eyes, nose and throat.
- Additional health and safety information may be obtained from refrigerant and oil manufacturers.
- If accidental system discharge occurs, ventilate work area before resuming service.

CAUTION

- **The air conditioning system uses HFC134a (R134a) refrigerant and polyvinyl ether (PVE) refrigerant oil, which are not compatible with CFC-12 (R12) refrigerant, mineral oil, or PAG oil. If the refrigerants or oils are mixed the compressor may fail.**
- Do not attempt to use R-12 servicing equipment; damage to the air condition system or your servicing equipment will result.
- Use only service equipment that is U.L. listed and is certified to meet the requirements of SAE J2210 to remove HFC134a (R134a) from the air conditioning system.
- Verify the HFC134a (R134a) refrigerant in the vehicle system and the recycling equipment/recovery tank are contaminant free by using a refrigerant identifier.

NOTE

THIS SYSTEM MUST BE SERVICED BY QUALIFIED PERSONNEL ONLY.

R134a service equipment or vehicle air conditioning systems should not be pressure tested or leak tested with compressed air.

- This air conditioning system may contain R134a fluorescent dye for leak detection. Inspect with a high intensity ultraviolet light system.
- A label on the unit will identify systems with fluorescent dye.

NOTE

The Air Conditioning system is designed for use only with the specified polyvinyl ether (PVE) refrigerant oil for HFC134a (R134a) A/C systems and HFC134a (R134a) components. Idemitsu FVC68D PVE oil is the ONLY recommended oil. The PVE oil is very Hygroscopic. Hygroscopic means that it absorbs water. Without proper sealing, oil will become moisture saturated and should not be used.

NOTE

Take care to follow the handling procedures below:

- Only use the specified FVC68D PVE oil from a sealed container.
- Immediately reseal containers of oil.
- To avoid contamination, do not return oil to original container once it is dispensed, and never mix it with other refrigerant oils.
- Do not allow PVE oil to come in contact with Styrofoam parts. Damage may occur.
- Do not allow PVE oil to come in contact with vehicle paint. Damage may occur.
- If any connection in the refrigerant loop is opened it should be closed as soon as possible in order to minimize the amount of moisture that enters the system.
- Any components that are replaced should have dust caps left in place until the component is ready to be installed in the refrigerant loop.
- Any component removed from the refrigerant loop should have dust caps in place as soon as possible in order to minimize moisture intrusion.

Important Safety Notices

WARNING!

Improper practices, carelessness, or ignoring any warnings may cause death, personal injury, equipment or property damage.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that must be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

Work areas should be dry, well lit, ventilated, and be free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.

- Wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do not wear loose-fitting or torn clothing. Remove all jewelry before working.
- Before beginning any repair, disconnect the battery (negative [-] cable) from both battery boxes and discharge any capacitors.
- Disconnect the air starting motor, if equipped, to prevent accidental engine starting.
- Put a "**DO NOT OPERATE**" tag in the operator's compartment or on the controls.
- Allow the engine to cool before beginning any repair.
- Always use blocks or proper stands to support the vehicle or vehicle components before performing any service work. Do not work on anything that is supported only by lifting jacks or a hoist.
- To reduce the possibility of personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Ensure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct load capacity. Make sure any lifting devices are positioned correctly. Always use a spreader bar when necessary. The lifting hooks must not be side-loaded.
- Corrosion inhibitors and lubricating oils may contain alkali. Do not get the substance in eyes and avoid prolonged or repeated contact with skin. Do not swallow. In case of contact, immediately wash skin with soap and water. In case of harmful contact, immediately contact a physician. **Always keep any chemicals OUT OF REACH OF CHILDREN**.
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and must be used with caution. Follow the manufacturer's instructions to ensure safety when using these materials. **Always keep any chemicals OUT OF REACH OF CHILDREN**.
- When working on the vehicle, be alert for hot parts on systems that have just been turned off, exhaust gas flow, and hot fluids in lines, tubes, and compartments. Contact with any hot surface may cause burns.
- Always use tools that are in good condition. Make sure you have the proper understanding of how to use the tools before performing any service work. Use ONLY genuine replacement parts from PACCAR.
- Always use the same fastener part number (or equivalent) when replacing items. Do not use a fastener of lesser quality if replacements are necessary.

- Do not perform any repair when impaired, tired, fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.
- Liquefied petroleum gas is heavier than air and can accumulate near the floor, in sumps, and low-lying areas.
- Close the manual fuel valves prior to performing maintenance and repairs, and when storing the vehicle inside.
- California Proposition 65 Warning – Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.
- **DO NOT** breathe A/C refrigerant and oil vapor or mist. Exposure may irritate eyes, nose and throat.
- Additional health and safety information may be obtained from refrigerant and oil manufacturers.
- If accidental system discharge occurs, ventilate work area before resuming service.

EXTERNAL COMPONENT IDENTIFICATION AND LOCATION

A. Fuses

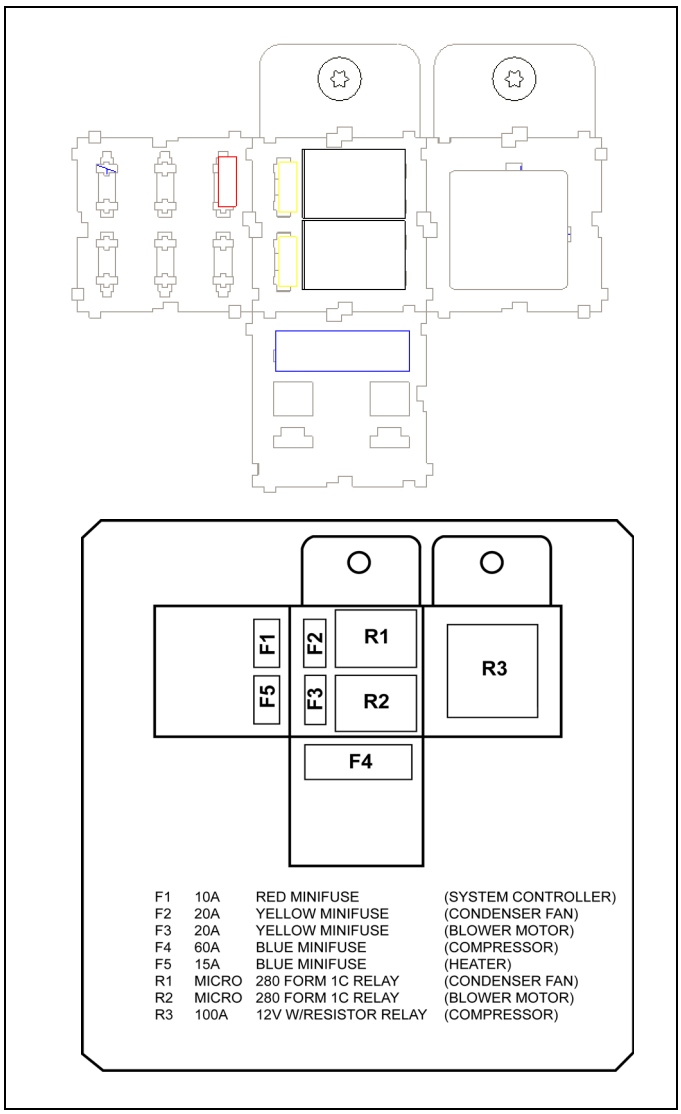


Figure 1. Fuses and Relays

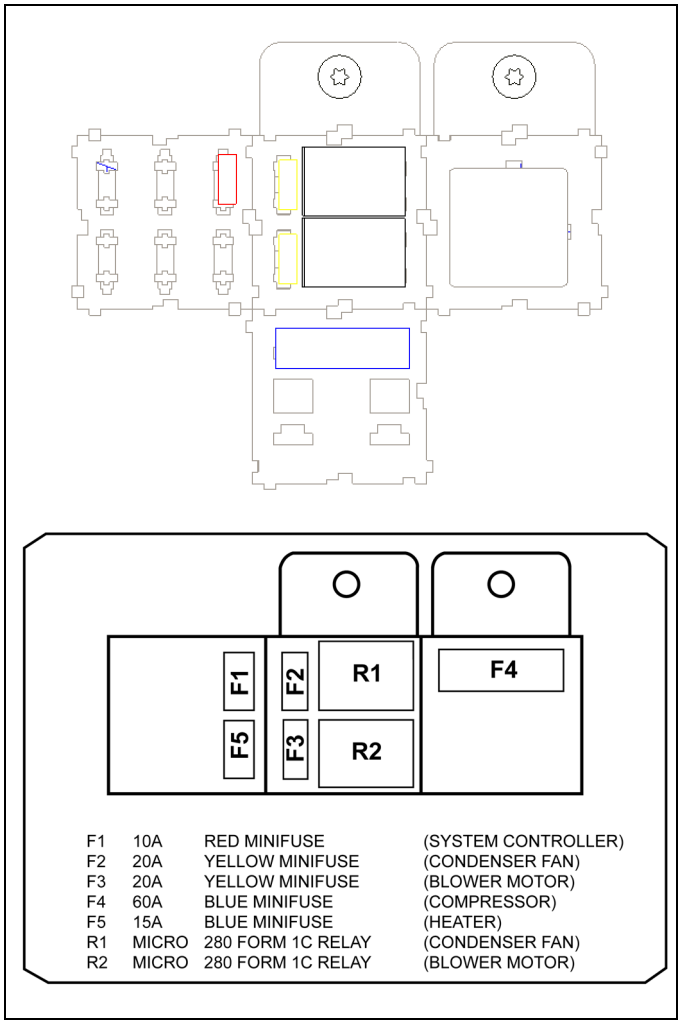


Figure 2. Fuses and Relays (Units built 8/1/2016 to Present)

F1 Fuse 10 Amp (Mini)

This fuse provides short circuit protection for the System control.

NOTE
Removing fuse F1 for 10-15 seconds will reset the system controller to factory default settings.

Location: on the control center.

F2 Fuse 10 Amp (Mini)

This fuse provides short circuit protection for the condenser fan.

Location: on the control center.

F3 Fuse 20 Amp (Mini)

This fuse provides short circuit protection for the evaporator blower.

Location: on the control center.

F4 Fuse 60 Amp (Maxi)

This fuse provides short circuit protection for the compressor.

Location: on the control center.

B. Relays

Location: on the control center.

R1. This relay controls the voltage to the condenser fan.

R2. This relay controls the voltage to the linear power module and evaporator blower.

R3. This relay controls the voltage to the compressor controller.

C. Fan and Temperature Control Display LED Display

Allows for temperature and Blower speed adjustment of the EHVAC (Electrical Heating and Ventilation Air Conditioning) unit when operating in Auto, cool or heat mode. A/C Unit – stops when unit is shut off or batteries are depleted.

Figure 3. Fan and Temperature Control Display

Auxiliary heater will shut down when batteries are depleted but will continue to run through the cool down cycle. Also displays hours of service, battery health and service items.

D. System and Compressor Controller

This device controls the unit and the output voltage to the variable speed compressor. It is located under the large access cover.

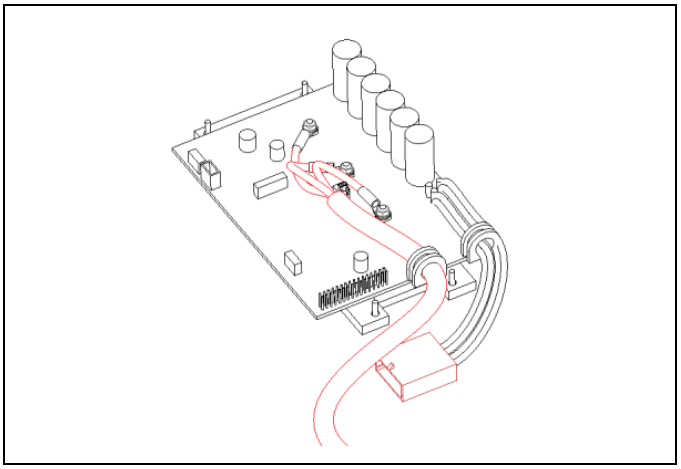


Figure 4. System and Compressor Controller

E. Linear Power Module

This module controls the amount of voltage delivered to the evaporator blower creating variable blower speeds. It is located in the return air in front of the evaporator coil.

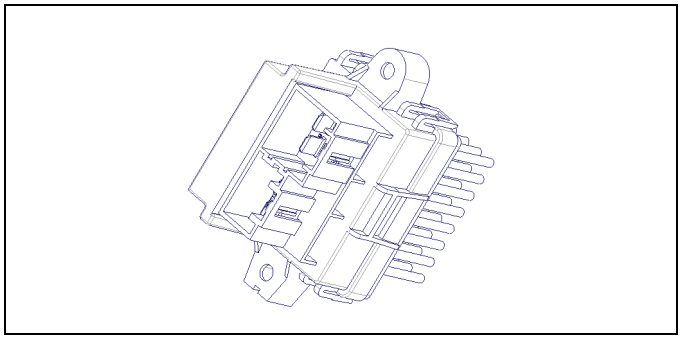


Figure 5. Linear Power Module

F. Discharge Temperature Sensor – Freeze Switch

This sensor monitors the evaporator outlet temperature as it enters the vehicle duct system.

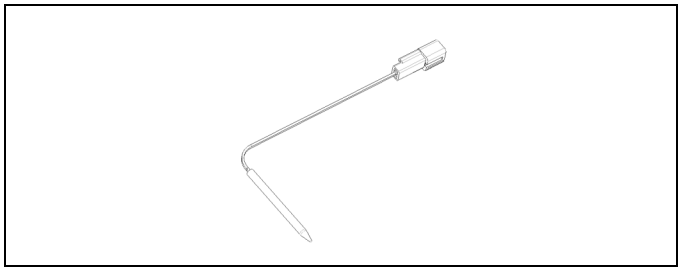


Figure 6. Discharge Temperature Sensor

G. Evaporator Blower

This blower pulls air through the evaporator coil and blows conditioned air into the interior of the sleeper.

H. Condenser Fan

This blower draws air through the condenser coil to cool the refrigerant flowing through the system.

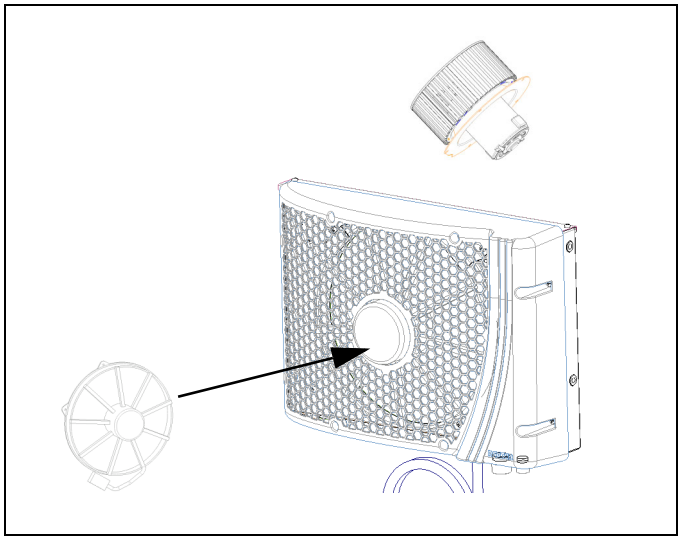


Figure 7. Evaporator Blower and Condenser Fan

I. Battery Management System (BMS)

This device monitors the auxiliary batteries for state of charge, communicates with the EHVAC system and controls the battery separator solenoid. LED light on this device indicates power to the device and does not provide diagnostics. Power inputs to this device are fuse protected.

If one of the BMS fuses blows, the solenoid will disengage.

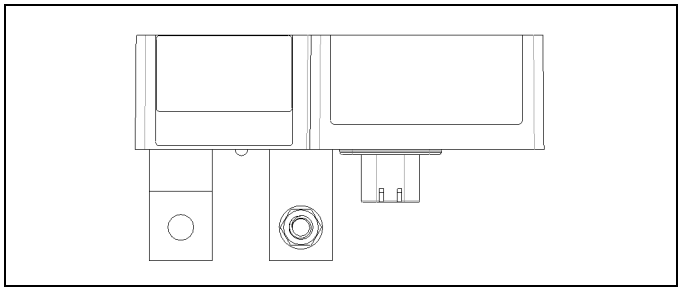


Figure 8. Battery Management System

J. Battery Separator

This device connects the truck batteries to the EHVAC batteries. When the starting batteries are at or above 13.2 volts, the battery management device will engage the solenoid to allow the alternator to charge the auxiliary batteries. When the voltage drops to or below 12.5 volts the battery management system will disengage the solenoid to prevent the truck starting batteries from being discharged below the engine start level.

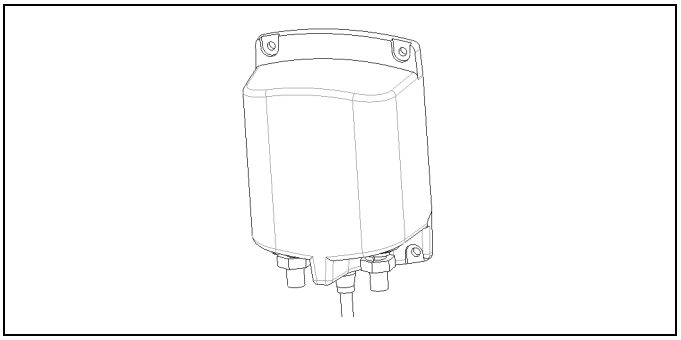


Figure 9. Battery Separator Solenoid, located in the battery box.

Automated Battery Disconnect (Option)

This device disconnects the EHVAC batteries from the EHVAC unit when the cab disconnect switch is set to OFF. The cab disconnect switch must be set to ON for the EHVAC unit to operate.

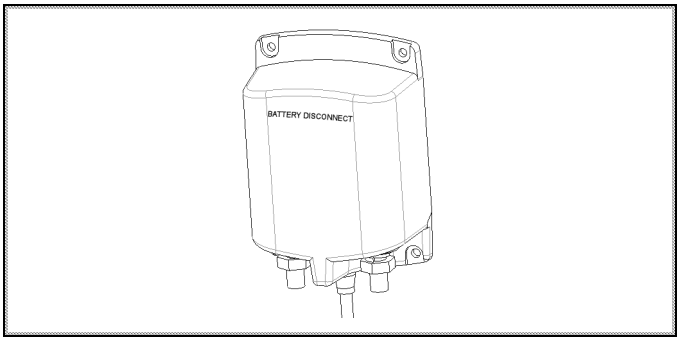


Figure 10. Automated Battery Disconnect Solenoid, located in the battery box.

INTERNAL COMPONENTS

A. High Pressure Switch

This normally closed brazed pressure switch will open and prevent the operation of the compressor due to high internal pressure. It is NOT serviceable.

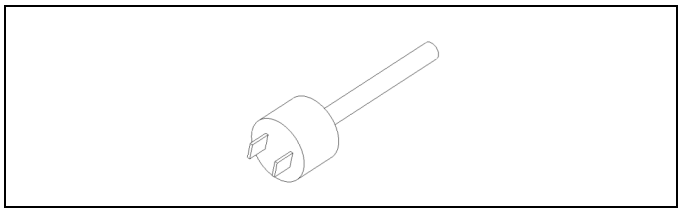


Figure 11. High Pressure Switch

B. Compressor

This unit is part of the hermetically sealed refrigeration system.

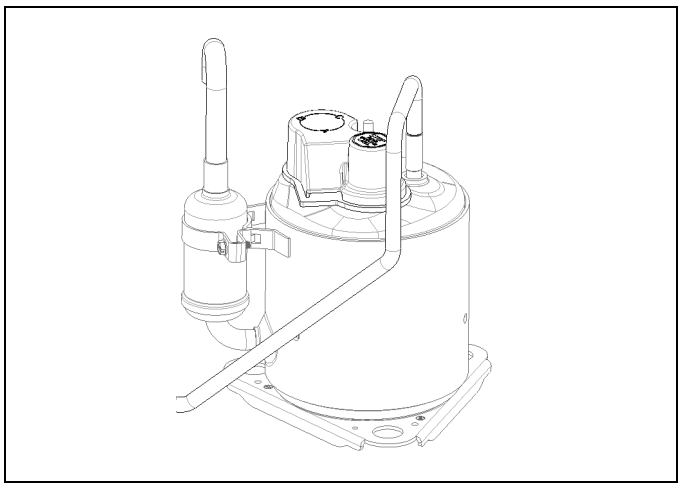


Figure 12. Compressor

C. Thermal Limit Switch on Compressor

This is a normally closed (auto reset) switch to protect the compressor from high temperature.

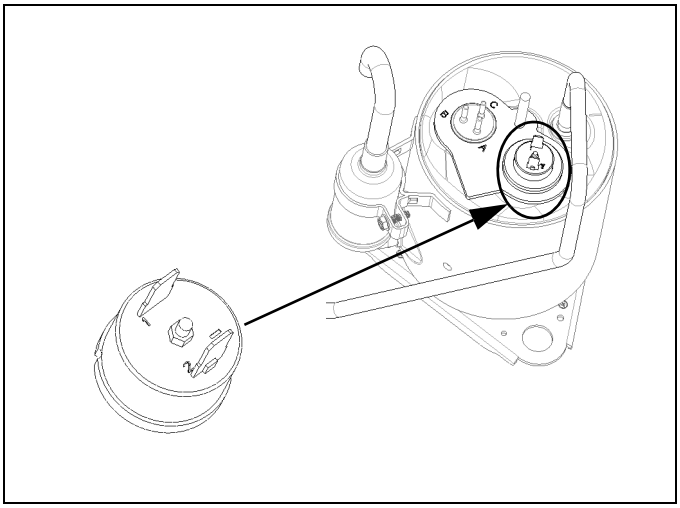


Figure 13. Thermal Limit Switch on Compressor

D. Evaporator Inlet Filter

This filter protects the evaporator coil from dust and debris. It is washable and should be serviced periodically during routine maintenance.

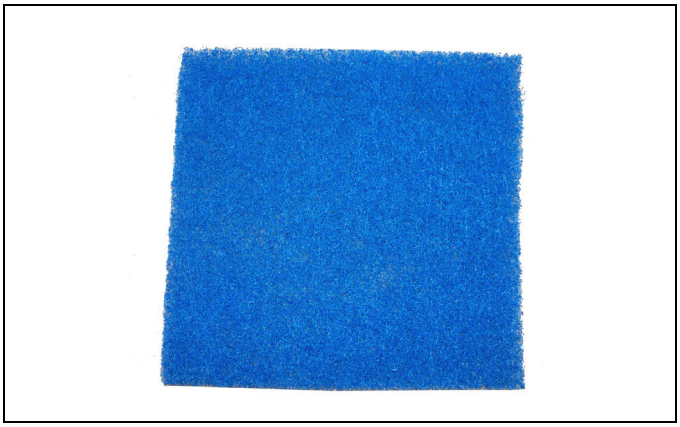


Figure 14. Evaporator Inlet Filter

When necessary, the Check Filter indicator will notify you that the EHVAC filter must be cleaned or changed. To reset “Check Filter” – at screen 1 press and hold enter button for 3 seconds.

A/C System Diagnostic

Check service screens before troubleshooting, see “Operation” on page 37.

NOTE

Removing fuse F1 for 10-15 seconds will reset the system controller to factory default settings.

Table 1. A/C System Diagnostic

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION / “Appendix” on page 18.
Unit will not run or turn on Display comes on for 5 seconds, shows service screen for 3 seconds and then powers off (see #9)	1. Loose connection. 2. No power is available at the unit. 3. Blown fuse or fuses. 4. Check Voltage path to unit and control 5. Defective control panel. 6. A/C system controller defective. 7. Broken wire or defective wire harness. 8. Check for Fault code. 9. Can Buss connection. 10. Ignition switch	1. Confirm all connections are tight, including ground lugs, and terminals crimped on wires and battery cables. 2. Check **All** batteries for Voltage. Check battery management system and separator solenoid. Unit has a low voltage disconnect of 11.2 volts. 3. Check all fuses. See “Figure 18. Internal Wiring Diagram (Before 8/1/2016)” on page 28 and “Figure 19. External Wiring Diagram” on page 29. 4. Check for 12 volt through the 100 amp main fuse and F1 10 amp control fuse to controller pin C1. Also see “H. Main Controller/Compressor Controller” on page 19. 5. Check control. See “B. Fan and Temperature Control Display” on page 18. 6. Test system controller. See “H. Main Controller/Compressor Controller” on page 19. 7. Inspect wiring harness and all ground wires. 8. View faults on the controller. See “ Operation” on page 37. 9. Check can bus harness, resisters and connections. Reset controller. See “M. Can Bus” on page 22, “Figure 18. Internal Wiring Diagram (Before 8/1/2016)” on page 28 and “Figure 19. External Wiring Diagram” on page 29. 10. See “Control Module Pinout with Functional Information” on page 31 (pin D2)
Auxiliary batteries will not recharge	1. Check battery Management System. 2. Check Battery Separator.	1. Check battery management device, harness and separator. See “L. Testing the Battery Management System (BMS)” on page 21. 2. See “H. Main Controller/Compressor Controller” on page 19.

Table 1. A/C System Diagnostic

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION / "Appendix" on page 18.
Unit runs—but does not blow cold air.	1. Airflow blockage. 2. Compressor. 3. Fuse or Relay. 4. System and Compressor controller connections/ defective compressor. 5. Condenser fan and high pressure switch. 6. Evaporator discharge temp sensor/Freeze switch defective. 7. Compressor thermal switch. 8. Evaporator blower/ Linear Power Module. 9. Loss of charge (refrigerant system is serviceable).	1. Clear any blockage from recirculation grill or louvers. Also check condenser inlet and outlet for restriction (outside truck). 2. Check F4 compressor fuse and R3 compressor relay. See "C. Relay Testing" on page 18 and "E. Check Continuity Across Fuse Body" on page 19. 3. Confirm all wire harness plugs are connected. Test system and compressor controller. See "H. Main Controller/Compressor Controller" on page 19. 4. Check high pressure switch and condenser fan. "D. Pressure Switch Testing" on page 18 and "I. Condenser Fan Motor Testing" on page 20. 5. Check sensor. See "F. Discharge Temperature Sensor/Freeze Switch Testing" on page 19. 6. Check normally closed thermal switch. See "G. Compressor Thermal Limit Switch" on page 19. 7. Check evaporator blower and linear power module. See "J. Evaporator Blower Motor and Linear Power Module Testing" on page 20. 8. If all tests check OK, a loss of refrigerant charge may have occurred.
Unit cycles On and Off and doesn't cool	1. Poor electrical connection. 2. Condenser fan inoperative. 3. Air flow blockage causing high pressure or freeze condition.	1. Check all electrical connections. 2. Check condenser fan. See "I. Condenser Fan Motor Testing" on page 20. 3. Check for restricted airflow outside truck at condenser inlet and outlet and at louvers and recirculation grill. Check pressure switch, thermal limit and/or discharge temperature sensor. See "D. Pressure Switch Testing" on page 18, "F. Discharge Temperature Sensor/Freeze Switch Testing" on page 19, and "G. Compressor Thermal Limit Switch" on page 19.
Unit blows cold air—but low airflow	1. Check all duct work connections. 2. Air flow restricted. 3. Evaporator Blower motor inoperative.	1. Make sure all ducts are connected, sealed and secure. 2. Check for airflow at louvers and recirculation grill. 3. Check evaporator blower motor and linear power module. See "J. Evaporator Blower Motor and Linear Power Module Testing" on page 20.

Table 1. A/C System Diagnostic

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION / "Appendix" on page 18.
Unit runs correctly, but less than expected run time.	1. Ground terminal(s). 2. Batteries weak or not charged correctly. 3. High amperage draw. 4. Check battery Management System. 5. Check Battery Separator.	1. Inspect and tighten ALL connections. 2. Check batteries for condition and state of charge. Check service screens in EHVAC control. See "A. Battery Condition and Performance" on page 18. 3. Check amp draw in EHVAC control service screen or use DC ammeter to check amps when running. Excessive amperage could signal compressor or internal component issue. **Amperage ranges 40 to 75 depending on settings and conditions**. 4. Check battery management device, harness and separator. 5. Same as 4.
Unit is noisy or vibrates.	1. Evaporator Blower motor. 2. Condenser fan motor. 3. Compressor mounting. 4. Compressor internal.	1. Check evaporator blower. See "J. Evaporator Blower Motor and Linear Power Module Testing" on page 20. 2. Check condenser fan. See "I. Condenser Fan Motor Testing" on page 20. 3. Check rubber compressor mounts. See "K. Compressor Rubber Mounts" on page 20. 4. If rubber compressor mounts check out acceptable, and compressor vibrates excessively, call your local dealer for support.

ESPAR Heating System Diagnostic Table

Monthly running and periodic maintenance are required for proper heater operation and performance.

Check service screens before troubleshooting, see “Operation” on page 37.

Table 2. ESPAR Heating System Diagnostic Table

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION / “Appendix” on page 18.
Heater is connected to the EHVAC unit and will not operate.	1. Loose connection. 2. No power is available at the unit. 3. Blown fuse or fuses. 4. Check Voltage path to unit and control. 5. Defective EHVAC Control. 6. System controller defective. 7. Broken wire or defective wire harness. 8. Check for Fault code.	1. Confirm all connections are tight, including ground lugs, and terminals crimped on wires and battery cables. 2. Check **Aux.** batteries for Voltage. Check for heater enable signal from EHVAC unit. Heater unit has a low voltage disconnect of 10.6 volts. See “N. Testing the Espar Heater Connected to the EHVAC Digital Controller” on page 22. 3. Check 20 amp main fuse and 5 amp control fuse. See Espar manual. 4. Check harness. 5. Check control. See “N. Testing the Espar Heater Connected to the EHVAC Digital Controller” on page 22 and Espar manual. • Test System Controller. 6. Inspect wiring harness and all ground wires. 7. View faults in the heater controller with Espar’s Edith PC diagnostics or hand held diagnostics tool. See Espars guide.
Heater is not connected to the EHVAC unit and will not operate.	1. Loose connection. 2. No power is available at the unit. 3. Blown fuse or fuses. 4. Check Voltage path to unit and control. 5. Defective Heater Control. 6. System controller defective. 7. Broken wire or defective wire harness. 8. Check for Fault code.	See Espar Manual.

Table 2. ESPAR Heating System Diagnostic Table

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION / “Appendix” on page 18.
Heater blows cold air but no heat.	1. Fuel. 2. Fuel pump. 3. Connections. 4. Glow pin / screen. 5. Sensors.	See Espar Manual.

Appendix

A. Battery Condition and Performance

Battery Voltage is critical for system operation. Special attention should be given to both sets of batteries.

> **NOTE**
>
> Poor quality batteries or a weak alternator will have a negative impact on unit run time. Always maintain the best possible batteries and charging system.

Load test and maintain batteries as required by the manufacturer.

Battery symbol in diagnostics screen indicates battery health. This is created after many cycles. If batteries have been disconnected recently this symbol will reset. Several cycles will be needed to get accurate battery health.

B. Fan and Temperature Control Display

With the control off: check for 12 VOLT at and from F1 10 amp fuse to the connector on rear of control, terminal 1. Terminal 7 is negative. Check for 12 volts at control terminal 6 (wake up) coming from the main/ compressor controller terminal D6. Pushing the control (on) will switch this input from the main controller to ground at the control panel. This signals the main control to start the system. When control is on the wake up signal should be less than 1 volt.

C. Relay Testing

With relay unplugged, confirm there is 12 VOLT on the sockets where 85 and 30 relay terminals are connected.

If you do not have 12 VOLT here check fuses, wiring and battery connections.

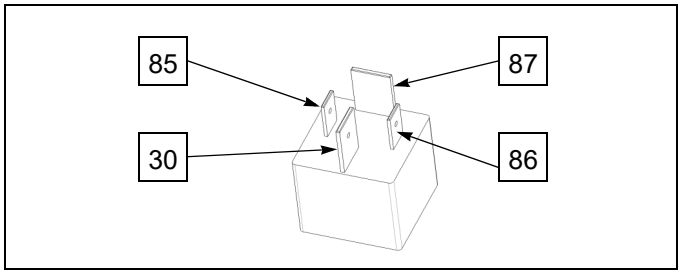


Figure 15. Relay Testing

Now, with relay unplugged, check across terminals 85 and 86 of the relay, using an OHM meter. You should have approximately 90 ohms + or - 10% at 68°F (20°C). This is measuring the resistance through the relay coil. If you do not, replace relay.

Overview

When you turn the EHVAC unit on, if all safety switches are okay, such as the high pressure switch, temperature sensor / freeze switch and the compressor thermal limit switch, the Main / Compressor controller will connect the compressor relay, condenser fan relay and the evaporator blower relay terminals 86 to ground at their respective terminals D10, D11 and D12 at the controller. This will close the contacts 30 and 87 of all 3 relays and allow power to each component.

You should now have 12 VOLT passing through the relays on spade terminals 87. This provides power to fuses F2, F3 and F4, continuing to the Linear Power Module, evaporator blower, condenser fan and the compressor controlling section of the Compressor Controller Assembly.

With relay plugged in: turn the unit on. If you do not have 12 VOLT on terminal 87, check across terminals 85 (+) an 86 (-). You should have 12 VOLT. If you do not, you may have a defective harness or system controller. If you have 12 VOLT here and do not have 12 VOLT on terminal 87 your relay is defective. The internal coil of the relay is energized but the contacts are not closing. Replace the relay.

If you have 12 VOLT on terminal 87 and the compressor, condenser fan or evaporator blower does not run you could have a defective component such as evaporator blower, condenser fan or compressor controller.

See testing “J. Evaporator Blower Motor and Linear Power Module Testing” on page 20, “I. Condenser Fan Motor Testing” on page 20, and “H. Main Controller/Compressor Controller” on page 19.

D. Pressure Switch Testing

You must remove top covers to access the switch.

The brazed “A. High Pressure Switch” on page 12 is not removable. This switch is normally closed. When the unit is off for a few minutes, unplug the System Controller and check between pins D2 and D5, you should always have continuity. If you do not, you may have a broken wire, bad

connection, high pressure situation or defective switch. If the pressure, harness and connections are okay, the EHVAC unit will have to be replaced.

E. Check Continuity Across Fuse Body

Fuse does not look blown.

Remove fuse from fuse holder. Using a meter, check for continuity across the fuse. You can check for voltage at and through the fuse using a DC volt meter, with the fuse installed.

F. Discharge Temperature Sensor/Freeze Switch Testing

Location: Between evaporator coil and intake side of blower.

The freeze switch is a temperature sensor. To verify the condition you will need a Volt/OHM meter.

If a freeze condition occurs, the unit will stop the compressor. If the freeze condition leaves, the compressor will restart and the unit will continue to run.

Check resistance (ohms) value at the system controller with the 32 pin connector disconnected. You should read a resistance across terminals D3 (pos) and D5 (neg) within the range listed on the “Table 4. Discharge Sensor / Freeze Switch Testing Chart” on page 27. If you cannot read the resistance, check at the sensor connection. If you read the resistance here, and it's within the range allowed, you have a defective harness.

If you cannot read the resistance or it is not within the given range, your sensor is defective.

G. Compressor Thermal Limit Switch

You must remove the top cover and the plastic shield on top of the compressor, to access the switch.

This device is a normally closed switch. If the compressor gets too hot, the thermal limit switch will open and the compressor will stop. Checking with a meter you should always have continuity between the two terminals when it is cool.

H. Main Controller/Compressor Controller

See updated information on “Service Instructions for Ring Terminal / Controller and Compressor” on page 33

You must remove the cover.

Do not attempt to test the controller or compressor until you have completely eliminated all other possibilities.

Overview

When you turn the Kenworth EHVAC unit on, if all safeties are okay, such as the high pressure switch, temperature sensor / freeze switch and the compressor thermal limit switch, the Main / Compressor controller will connect the compressor relay, condenser fan relay and the evaporator blower relay terminals 86 to ground at their respective terminals D10, D11 and D12 at the controller. This will close the contacts 30 and 87 of all 3 relays and allow power to each component. The compressor and evaporator blower will begin to operate at a speed determined by the manual control panel. The condenser fan will run at normal operational speed.

Initial start up, the system defaults to Auto Mode, Blower speed 1 and 60°F set point. After the settings are changed for the first time, they will always default to the last setting.

Use the following steps to check the controller:

a. With the control switch off – check for 12 VOLT from F1 10 amp fuse to the back of the control.

b. Now check for 12 volts at switch terminal 6 (wake up) coming from the main/ compressor controller terminal D6. Turning the unit on will switch this 12 volt input from the main controller to ground at the control panel. This signals the main control to start the system.

c. With a correct 12 volt signals to and from the control, now check for (ground) signals to relays on D10, 11 and 12. All relays should be closed and all terminals # 87 should have 12 volts. If you lose any signals from the controller it must be replaced.

d. With relays closed, the main controller will now signal each component to start. The evaporator blower receives its power from the linear power module. Safety controls must be in a normal state for the above signal to operate the unit.

e. If all signals are correct and the safety controls thermal limit on compressor, high pressure switch and temp sensor /freeze switch are okay, the control is calling for cold and the sleeper temperature is above 60 degrees, you should have voltage out on the three wires connected to the compressor terminals: A – Blue, B – Orange and C – Yellow. (ABC – BOY), and the compressor should run.

f. If the compressor does not operate, disconnect the three wires from the compressor. You will have to remove plastic cap from the top of compressor.

- Using a volt meter check each wire, positive on (blue, orange or yellow) negative to battery ground. If you do not have a 6 volt pulse voltage out on each wire, replace the controller. Pulse voltage means the controller will cycle to each colored wire. You should see the voltage appear and disappear continuously.
- If you do have a 6 volt pulse voltage out and the compressor does not run you have a defective compressor. Contact the Kenworth Service line.

I. Condenser Fan Motor Testing

First do a visual inspection of all fan parts.

NOTE

This fan cycles on and off with the compressor! Before testing fan, start the unit, make sure the control is set for full cold and the temperature in the truck will allow the control to attempt to start the compressor and fan.

Turn the unit on, you should have 12 volts across terminals 1 and 2 at the condenser fan connector. If you do not have 12 volt at the fan, check fuse F2 And relay R1. If condenser fan 12 volt power is okay, check condenser speed signal from C7 on main controller. This voltage will vary depending on requested speed: approximately 1.6 for low, 2.6 for high. If all voltages are correct, and the fan does not run, it is defective, and needs to be replaced.

Using a DC ammeter you can check the amperage draw of the blower. Normal amps approximately 5–10 depending on speed requests.

CAUTION

If attempting to connect blower to an outside power source, internal electronic components are sensitive to arcing or reverse polarity! Damage will occur.

J. Evaporator Blower Motor and Linear Power Module Testing

First do a visual inspection of all blower parts. The evaporator blower speed is controlled by the LPM. See “E. Linear Power Module” on page 10.

Turn the unit on, you should have 12 volt at the LPM pins 6 (pos) and pin 5 (neg), if you do not, check fuse F3 and relay R2. If you have 12 VOLT main power, check for the speed signal voltage on the LPM at pin 3 coming from the system controller pin C13. You should have approximately 5.6V for speed 1, 4.9V for speed 2 and 3.1V for speed 3. If all of these voltages are correct, check the output voltage from the LPM pins 1 and 2 going to the blower. You should have approximately 6.6V out for speed 1, 8.1V out for speed 2 and 10V out for speed 3 to the blower.

If fan does not run, it is defective, and needs to be replaced.

Using a DC ammeter you can check the amperage draw of the blower. Normal amps will range from 4 to 10 amps.

CAUTION

If attempting to connect blower to an outside power source, internal electronic components are sensitive to arcing or reverse polarity! Damage will occur!

K. Compressor Rubber Mounts

Visual inspection of the compressor rubber mounts may be necessary if excessive vibration is present. Check for loose mounting nuts. If mounting nuts and captive studs are okay, vibration could be from the internal part of the compressor.

L. Testing the Battery Management System (BMS)

Overview

The BMS monitors the auxiliary batteries for state of charge, communicates with the EHVAC system and controls the battery separator solenoid. LED light on the BMS indicates power to the device and does not provide diagnostics. Power inputs to the BMS are fuse protected.

When the truck starting battery voltage is above 13.2 volts for at least 15 seconds, the BMS will send an engage signal to the separator. The separator will close and allow charging of the aux batteries. When the truck starting battery voltage falls below 12.5 volts for 15 seconds, the BMS will disengage the separator. The separator will open and stop the charge of the aux batteries, and prevent the truck starting batteries from being discharged.

Testing

Before testing the BMS or separator, unplug the BMS for at least 1 minute to reset the system then reconnect and attempt to operate the system. If the system does not operate continue with the following tests.

BMS tab with hole must be connected to the negative battery terminal on the aux batteries. First, check the aux battery voltage. Voltage must be above 6 volts for the device to work. Batteries should be tested and fully charged before they are installed in the truck for best results. If not, it can take a considerable amount of time for the battery state of health indicator to be correct.

Check the LED light on the BMS, it should be flashing indicating the device has power.

If the aux battery voltage is okay, and the LED is not flashing, check the connection and 5 amp fuse in the aux battery sense wire near the BMS.

With aux voltage okay and LED flashing, check for 12 volts from the truck starting batteries. This voltage passes through a 5 amp fuse in the start battery box and connects at pin 8 (pos) and 1 (neg) in the 8 pin connector on the BMS. This voltage, from the truck batteries, is displayed on the LED controller (service) screen. It also powers the output for the engage signal to the separator. If you do not have 12 volts across pins 8 (pos) and 1 (neg), check the 5 amp fuse and the wiring harness.

With aux voltage okay, LED flashing and 12 volts across pins 8 and 1, start the truck or connect the start batteries to a battery charger and bring the voltage above 13.2 for at least 15 seconds. You should hear a click when the solenoid pulls in. This would indicate that the BMS has sent the engage signal from pin 5 (orange wire) of the BMS to pin 2 on the Terra Power separator, pin 1 is ground on both devices. This is a 12 volt signal. When the separator closes, you should see an increase in voltage on the aux side of the separator and at the aux batteries. The voltage across both sides of the solenoid will slowly become the same value, which indicates that the tractor batteries and auxiliary batteries are tied together in parallel. If the separator did not close by the BMS, check the separator. (See below) If the separator checks okay, recheck the BMS. If the separator closed and does not allow charge to the aux batteries, the internal contacts of the switch could be defective. Replace the separator.

If the separator closes and allows charge to the aux batteries, that part of the BMS is working. Now shut off the truck engine or battery charger and put a load on the tractor batteries. Examples of a load include the headlights and radio. Allow the voltage of the truck batteries to drop below 12.5 volts for 15 seconds. You should hear a click when the solenoid disengages. This would indicate that the BMS has disengaged the signal from pin 5 of the BMS to pin 2 on the separator. The voltage of the tractor batteries and the auxiliary batteries should now start to be different. Turn off the headlights or other loads that were placed on the batteries. When the separator opens, it prevents the starting batteries from being drained. If the separator clicks and does not disengage the internal contacts, the contacts could be welded together. Replace the separator.

Separator Switch Testing:

NOTE
Power must be present on separator posts to check separator operation.

Disconnect the Deutsch connector of the Terra Power separator. Connecting 12 volts to terminals 2 (pos) and 1 (neg) will engage the separator and close the contacts connecting the start and aux batteries. Disconnecting the 12 volts to terminals 2 (pos) and 1 (neg) will disengage the separator and open the contacts connecting the start and aux batteries.

If the separator switch tests okay, reconnect the separator wires, unplug the BMS for at least 15 seconds, reconnect BMS and repeat BMS test. If the BMS will not operate the separator, replace the BMS.

M. Can Bus

NOTE

Before checking Can Bus, if control lights for a few seconds and goes out, disconnect the controller harness at the controller unit. Reconnect to reset. If unit does not run, continue with Can Bus tests.

Also, before checking can bus, disconnect BMS and retry system for operation.

POWER TO BOTH DEVICES (EHVAC AND BATTERY MANAGEMENT SYSTEM) MUST BE DISCONNECTED TO PERFORM THESE TESTS.

The communication from the BMS to the EHVAC unit travels through the controller harness and the BMS harness. These harnesses have a twisted pair of wires, yellow (Can H) and green (Can L). These harnesses should be loomed and routed away from any components in the truck that could cause interference, such as florescent lights, etc.

First, determine what part of the can is affected. If you lose the Can Bus to the BMS, the EHVAC unit will operate normally. You will not see volts and amps displayed on the service screens and the battery symbol will indicate full as a default.

If the digital controller does not communicate to the EHVAC unit, the unit will not operate. If the unit is operating and loses communication for more than 5 seconds it will shut down.

The Idle Management System has the CAN BUS 120 ohm resistors built internally in the digital control panel and Battery Management System (BMS). To test the CAN BUS, remove digital control and disconnect the harness. Check across pins 3 and 4 on the control. You should measure 120 ohms. Back probe the harness. You should again measure 120 ohms with harness connected to the unit and BMS.

If not, check at BMS. Disconnect harness at BMS. Check pins 6 and 7 on the BMS. You should measure 120 ohms. Reconnect the harness to the digital control. With harness still connected to control and unit, back probe harness. You should measure 120 ohms.

Reconnect the harness to the BMS. With all harnesses connected you should measure 60 ohms.

N. Testing the Espar Heater Connected to the EHVAC Digital Controller

The Espar heater control harness connects to the EHVAC unit using a 6 pin connector. Pin 1 is heater option. This is a 12 volt input from the Espar heater to the main controller pin C3, signaling that the Espar heater is connected to the system. Pin 2 is heater enable. This 12 volt output from the unit to the Espar heater enables the heater to turn on. Pin 3 is ground. Pin 4 is heat level. This wire transmits the temperature signal from the EHVAC temperature sensor to the heater ECM. The Espar heater will regulate heat according to this temperature and the set point of the control. When checking resistance on the temperature circuit, always use the brown/white for reference.

Selecting HEAT mode will turn the ENABLE signal on. The heat level will be controlled through the EHVAC (gray/red) wire coming from the unit on pin 4. This is a variable resistance signal from the EHVAC digital controller. Resistance ranges from approx. 1.8k ohms for low heat and 2.2k ohms for high heat.

First, set the EHVAC digital controller to HEAT mode, set the temperature to full heat 85 degrees. When testing the heater, the ambient temperature in the sleeper must be below 85 degrees.

Check for the heat enable signal between the yellow (positive) and brown/white (negative) wires. You should have 12 volts. If the digital controller shows the temperature set point and heat mode and you do not have 12 volts, check the EHVAC internal system controller output from pin C15. If you have 12 volts on pin C15 but not outside the unit, you have a bad connection or the harness is defective. If you do not have 12 volts on pin C15, you have a defective system controller.

With 12 volts on the heat enable, check the heat level signal on the EHVAC (gray/red) wire using the brown/white as ground. This variable resistance signal will range from approx. 1.8k ohms to 2.2k ohms. If this resistance is within range, the heater should operate. If it

does not operate, the problem is internal in the heater. See Espar's Airtronic Installation, Troubleshooting, and Parts Manual for complete heater diagnostics.

If the resistance level is not present or correct, check across pins 5 and 7 on the back of the digital controller. If you have the correct resistance here but not outside the Idle Management System unit, you have a bad connection or a defective harness. If you do not have the correct resistance here, your digital controller is defective.

O. Connecting the System

O-Ring/Line Service Only

NOTE

Refrigerant lines are shipped after being vacuumed. To service the o-rings and/or lines on the EHVAC system you must (1) recover the systems refrigerant charge, (2) replace the o-rings / lines, (3) evacuate / leak test system and (4) recharge the system with the recommended charge from "Charge Capacity" on page 26.

Servicing the Evaporator and / or Condenser Unit

NOTE

Evaporator and condenser units are shipped with a holding charge only. For proper system operation all replacement units must be recovered and EHVAC system recharged with the recommended charge from "Charge Capacity" on page 26.

Proper service procedure: (1) recover system refrigerant charge, (2) replace unit, (3) recover holding charge, (4) evacuate / leak test, (5) recharge proper refrigerant level.

WARNING!

Before doing any of the work below, be aware of the dangers involved. Working with refrigerant could lead to serious personal injury.

CAUTION

The Kenworth EHVAC uses PVE lubricant in the refrigerant system. PVE oils absorb atmospheric moisture very quickly. Never leave PVE oil exposed to air for a prolonged time. Tightly reseal the system after each charge or service.

CAUTION

Do not add oil. Kenworth EHVAC uses special PVE oil which is different than standard PAG oil in most AC systems. Addition of PAG oil to the system will greatly reduce performance and void Kenworth EHVAC warranty.

NOTE

Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is similar. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

Typical Equipment Hookup for Servicing the Kenworth EHVAC System

1. Remove the protection cap from service port. The Kenworth EHVAC system uses smaller lines than conventional AC systems. In order to simplify the installation and charging only one service port has been given for the system.

1 – Low Pressure Hose (Blue)

2 – High Pressure Hose (Red)

3 – Recovery/ Recycling/ Charging Station

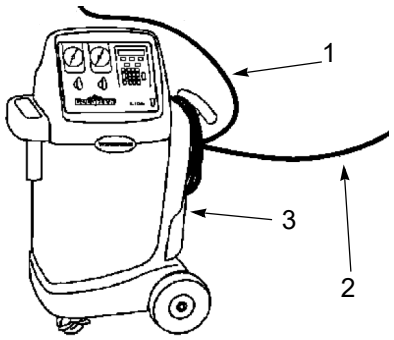


Figure 16. Service Equipment

On the recovery station and hose fittings, verify that all valves are closed. The valves at the recovery station must be set to the CLOSED position. The valves at the quick-disconnect fittings must be set fully counterclockwise (CCW).

2. Connect the recovery station to the system as follows:
   a. Connect the blue hose to service port located on the compressor-to-condenser line of the sleeper outdoor unit.
   b. Open (turn CW) the valves on the quick-disconnect fittings connected to the service ports on the units.
3. Work may now begin on the air conditioning system.

P. Evacuating the System

Evacuating the Kenworth EHVAC System Service Procedures for R-134a

When any part of the refrigeration system has been replaced or requires service, the system must be recovered and evacuated. The system must be completely evacuated of air and moisture before being charged. After evacuation, the system vacuum should measure between 750 and 1000 microns.

1. On the recovery station and hose fittings, verify that all valves are closed. The valves at the recovery station must be set to the CLOSED position. The valves at the quick-disconnect fittings must be set fully counterclockwise (CCW).
2. Connect the electronic vacuum gauge to the recovery station, at the vacuum manifold, using a valve and 'T' fittings.
3. Connect the recovery stations blue hose to the service port located on the Kenworth EHVAC system.
4. On the blue hose, open the valves on the quick-disconnect fittings (turn the knobs fully CW).
5. On the recovery station, set both hand valves to the RECOVERY/VACUUM position.
6. On the recovery station, turn on main power switch and press the VACUUM button.
7. After the low pressure gauge on the station shows that vacuum is being established in the system, continue to operate the vacuum pump for fifteen minutes.
8. After 15 minutes, set both valves on the recovery station to the CLOSED position, and observe low side gauge for one minute. The gauge should not indicate a rise of more than 2 inches-Hg. If the gauge rises more than 2 inches-Hg in one minute, the system has a leak, which must be repaired.
   - The valve for the electronic vacuum gauge must be in the closed position until instructed to open. If the valve is open during system charging, excess pressure may damage the electronic vacuum gauge.
9. If there are no leaks:
   a. Set both hand valves on the recovery station to the RECOVERY/VACUUM position and press the VACUUM button.
   b. Open the valve connecting the electronic vacuum gauge to the recovery station low side line.

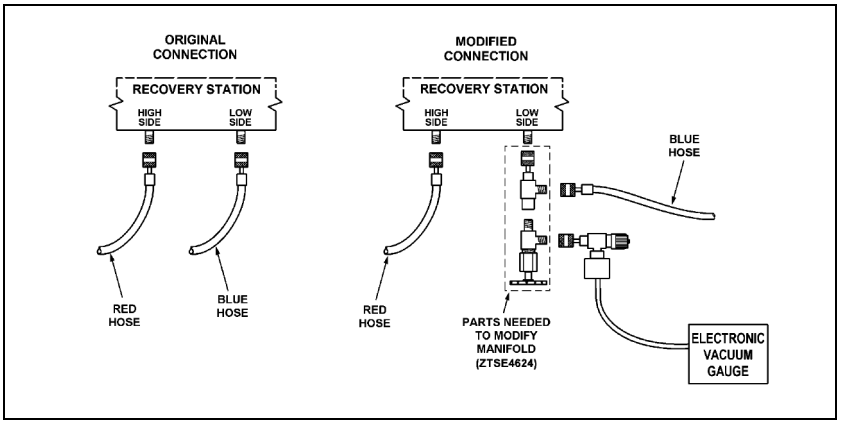


Figure 17. Service Recovery Connections

c. Continue to operate the recovery station vacuum pump until the system has pulled a vacuum of 750 – 1000 microns as measured by the electronic vacuum gauge (15 minutes minimum).

d. Close both hand valves on the recovery station, and the valve connecting the electronic vacuum gauge to the recovery station low side line.

10. The A/C system is ready to be charged.

NOTE

The full amount of refrigerant oil has already been added to the system, DO NOT ADD OIL when charging the Kenworth EHVAC system.

NOTE

DO NOT disconnect the recovery/recycling/charging station from the A/C system before charging the system.

Q. Charging the Kenworth EHVAC System

WARNING!

Before doing any of the work below, be aware of the dangers involved. Working with refrigerant could lead to serious personal injury.

CAUTION

Use only new or clean recycled R-134a refrigerant; not any of the so called “direct replacement” refrigerants. Use of equipment dedicated for R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns.

CAUTION

When charging the A/C system, the refrigerant tank must be kept upright. If the tank is not in the upright position, liquid refrigerant may enter the system and cause compressor damage.

NOTE

Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

NOTE

If recycled refrigerant is to be used, follow the instructions supplied with the recycling equipment to purge the air from the refrigerant before charging the system.

Perform the charging procedure, using new or recycled refrigerant, only after the following actions have been completed:

- System components completely installed
- System completely evacuated

CAUTION

If the equipment being used adds system refrigerant oil during the evacuation/charging procedure, you must first DISABLE this feature. Follow the instructions furnished with the recovery station, or refrigerant oil injector tool, to disable this feature.

DO NOT ADD OIL TO THE EHVAC SYSTEM

The recovery station blue (suction) hose should still be connected as it was during the evacuation operation.

CAUTION

Due to the density of R-134a, the amount of refrigerant required to charge a typical air conditioning system has been reduced. Overcharging the system will result in excessively high head pressures during operation and may damage the compressor.

1. Determine the model of truck to charge the A/C system.

Table 3. Charge Capacity

Model	Size
T680, w/ 76 inch Sleeper	21.00 oz. (1.31 lbs.)

Above shows tested charge level for current Kenworth models. Following the instructions provided with the recovery station, set the recovery station to charge the system with the specified amount of refrigerant.

2. On the recovery station, set the high side valve to CLOSED, and the low side valve to CHARGE.
3. Press the CHARGE button to start the charge procedure. When the system is fully charged, the recovery station will turn off.
4. Complete the charging procedure by setting both hand valves on the recovery station to the CLOSED position.
5. Close valve on hose at condenser, then disconnect the blue hose quick-disconnect fitting from the Kenworth EHVAC service port.
6. Install the protective cap on the Kenworth EHVAC service port fitting.

Table 4. Discharge Sensor / Freeze Switch Testing Chart

TEMP (°C)	R (min)	R (cent)	R (max)	R (min)	R (max)
-30	84.45	86.75	89.11	-2.7%	2.7%
-29	79.39	81.51	83.68	-2.6%	2.7%
-28	74.68	76.62	78.61	-2.5%	2.6%
-27	70.28	72.06	73.89	-2.5%	2.5%
-26	66.16	67.80	69.48	-2.4%	2.5%
-25	62.32	63.82	65.36	-2.4%	2.4%
-24	58.72	60.10	61.51	-2.3%	2.3%
-23	55.35	56.62	57.92	-2.2%	2.3%
-22	52.20	53.37	54.55	-2.2%	2.2%
-21	49.25	50.32	51.41	-2.1%	2.2%
-20	46.49	47.47	48.47	-2.1%	2.1%
-19	43.89	44.80	45.71	-2.0%	2.0%
-18	41.46	42.29	43.13	-2.0%	2.0%
-17	39.18	39.94	40.71	-1.9%	1.9%
-16	37.04	37.74	38.44	-1.8%	1.9%
-15	35.03	35.67	36.32	-1.8%	1.8%
-14	33.14	33.73	34.32	-1.7%	1.8%
-13	31.37	31.90	32.45	-1.7%	1.7%
-12	29.70	30.19	30.69	-1.6%	1.6%
-11	28.13	28.58	29.03	-1.6%	1.6%
-10	26.65	27.06	27.48	-1.5%	1.5%
-9	25.26	25.64	26.02	-1.5%	1.5%
-8	23.95	24.30	24.64	-1.4%	1.4%
-7	22.72	23.03	23.35	-1.4%	1.4%
-6	21.56	21.84	22.13	-1.3%	1.3%
-5	20.46	20.72	20.98	-1.3%	1.3%
-4	19.43	19.66	19.90	-1.2%	1.2%
-3	18.45	18.67	18.88	-1.2%	1.2%
-2	17.53	17.73	17.92	-1.1%	1.1%
-1	16.66	16.84	17.01	-1.1%	1.1%
0	15.84	16.00	16.16	-1.0%	1.0%
1	15.05	15.21	15.37	-1.1%	1.1%
2	14.30	14.46	14.62	-1.1%	1.1%
3	13.60	13.75	13.91	-1.1%	1.2%
4	12.93	13.09	13.24	-1.2%	1.2%
5	12.30	12.46	12.61	-1.2%	1.3%
6	11.70	11.86	12.01	-1.3%	1.3%
7	11.14	11.29	11.45	-1.3%	1.4%
8	10.61	10.76	10.91	-1.4%	1.4%
9	10.10	10.25	10.40	-1.4%	1.5%
10	9.626	9.771	9.918	-1.5%	1.5%
11	9.174	9.316	9.461	-1.5%	1.5%
12	8.745	8.885	9.027	-1.6%	1.6%
13	8.339	8.477	8.616	-1.6%	1.6%
14	7.954	8.089	8.226	-1.7%	1.7%
15	7.589	7.722	7.856	-1.7%	1.7%
16	7.243	7.373	7.504	-1.8%	1.8%
17	6.914	7.041	7.170	-1.8%	1.8%
18	6.602	6.727	6.853	-1.9%	1.9%
19	6.306	6.428	6.552	-1.9%	1.9%
20	6.025	6.144	6.265	-1.9%	2.0%
21	5.758	5.875	5.993	-2.0%	2.0%
22	5.504	5.618	5.734	-2.0%	2.1%
23	5.263	5.374	5.488	-2.1%	2.1%
24	5.034	5.142	5.253	-2.1%	2.2%
25	4.816	4.922	5.030	-2.2%	2.2%
26	4.608	4.712	4.818	-2.2%	2.2%
27	4.411	4.512	4.615	-2.2%	2.3%

TEMP (°C)	R (min)	R (cent)	R (max)	R (min)	R (max)
28	4.223	4.322	4.422	-2.3%	2.3%
29	4.044	4.140	4.239	-2.3%	2.4%
30	3.874	3.968	4.064	-2.4%	2.4%
31	3.711	3.803	3.897	-2.4%	2.5%
32	3.557	3.646	3.738	-2.5%	2.5%
33	3.410	3.497	3.586	-2.5%	2.5%
34	3.269	3.354	3.441	-2.5%	2.6%
35	3.135	3.218	3.303	-2.6%	2.6%
36	3.007	3.088	3.171	-2.6%	2.7%
37	2.886	2.964	3.045	-2.7%	2.7%
38	2.769	2.846	2.925	-2.7%	2.8%
39	2.658	2.733	2.810	-2.7%	2.8%
40	2.553	2.625	2.700	-2.8%	2.8%
41	2.451	2.522	2.595	-2.8%	2.9%
42	2.355	2.424	2.495	-2.9%	2.9%
43	2.262	2.330	2.399	-2.9%	3.0%
44	2.174	2.240	2.307	-2.9%	3.0%
45	2.090	2.154	2.219	-3.0%	3.0%
46	2.009	2.072	2.136	-3.0%	3.1%
47	1.932	1.993	2.055	-3.0%	3.1%
48	1.859	1.918	1.978	-3.1%	3.2%
49	1.788	1.846	1.905	-3.1%	3.2%
50	1.721	1.777	1.834	-3.2%	3.2%
51	1.656	1.711	1.767	-3.2%	3.3%
52	1.594	1.647	1.702	-3.2%	3.3%
53	1.535	1.587	1.640	-3.3%	3.4%
54	1.478	1.529	1.581	-3.3%	3.4%
55	1.424	1.473	1.524	-3.3%	3.4%
56	1.372	1.420	1.469	-3.4%	3.5%
57	1.322	1.369	1.417	-3.4%	3.5%
58	1.274	1.320	1.367	-3.4%	3.6%
59	1.228	1.273	1.318	-3.5%	3.6%
60	1.185	1.228	1.272	-3.5%	3.6%
61	1.142	1.184	1.228	-3.5%	3.7%
62	1.102	1.143	1.185	-3.6%	3.7%
63	1.063	1.103	1.144	-3.6%	3.7%
64	1.026	1.065	1.105	-3.6%	3.8%
65	0.9902	1.028	1.067	-3.7%	3.8%
66	0.9559	0.993	1.031	-3.7%	3.8%
67	0.9229	0.9589	0.9960	-3.7%	3.9%
68	0.8913	0.9263	0.9630	-3.8%	3.9%
69	0.8609	0.8950	0.9304	-3.8%	4.0%
70	0.8317	0.8649	0.8994	-3.8%	4.0%
71	0.8036	0.8360	0.8697	-3.9%	4.0%
72	0.7766	0.8082	0.8410	-3.9%	4.1%
73	0.7506	0.7815	0.8135	-3.9%	4.1%
74	0.7257	0.7558	0.7870	-4.0%	4.1%
75	0.7017	0.7310	0.7615	-4.0%	4.2%
76	0.6786	0.7072	0.7369	-4.0%	4.2%
77	0.6564	0.6843	0.7133	-4.1%	4.2%
78	0.6351	0.6622	0.6905	-4.1%	4.3%
79	0.6145	0.6410	0.6686	-4.1%	4.3%
80	0.5947	0.6206	0.6475	-4.2%	4.3%
81	0.5756	0.6009	0.6271	-4.2%	4.4%
82	0.5573	0.5819	0.6075	-4.2%	4.4%
83	0.5396	0.5636	0.5886	-4.3%	4.4%
84	0.5226	0.5460	0.5704	-4.3%	4.5%
85	0.5062	0.5290	0.5528	-4.3%	4.5%

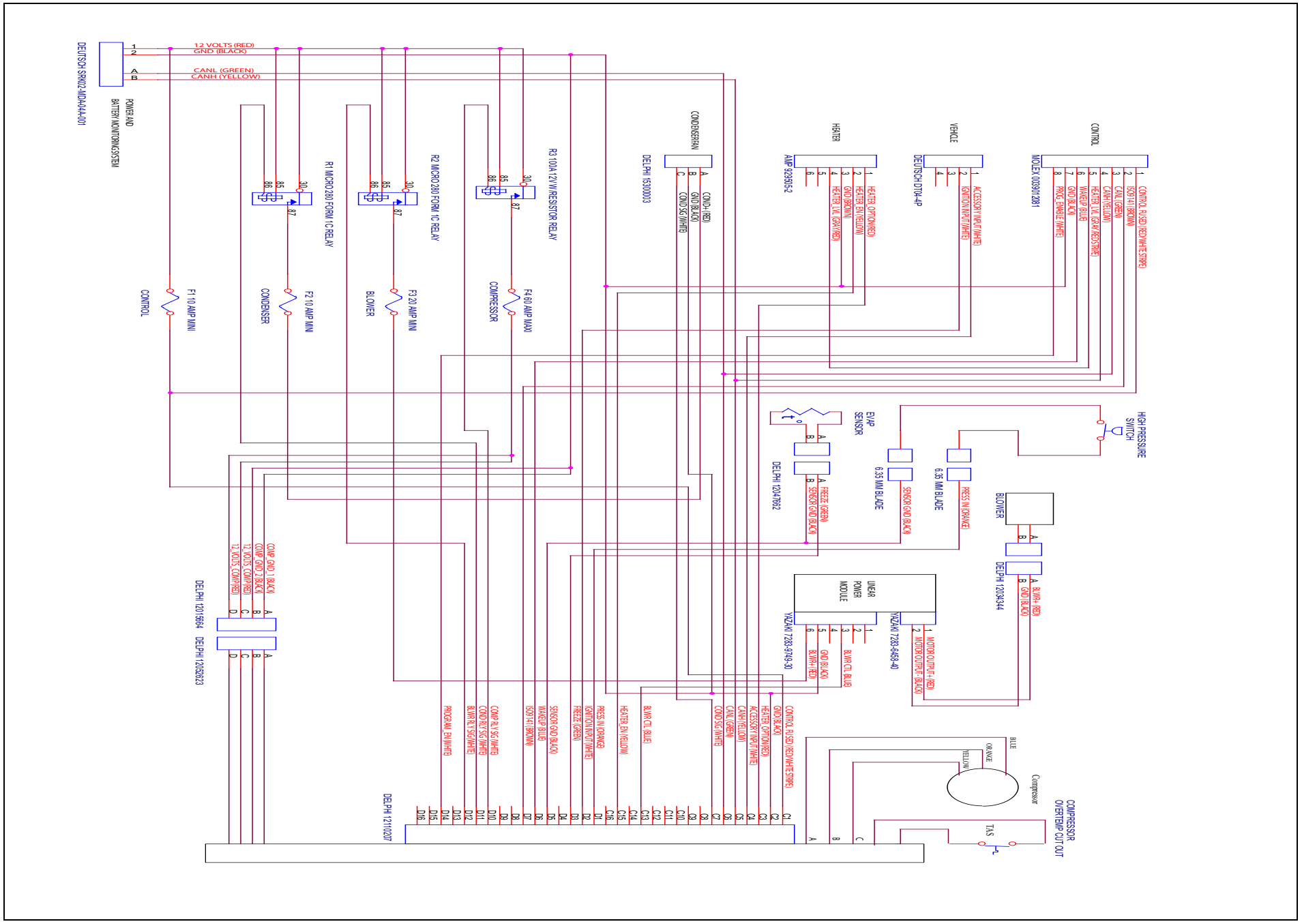
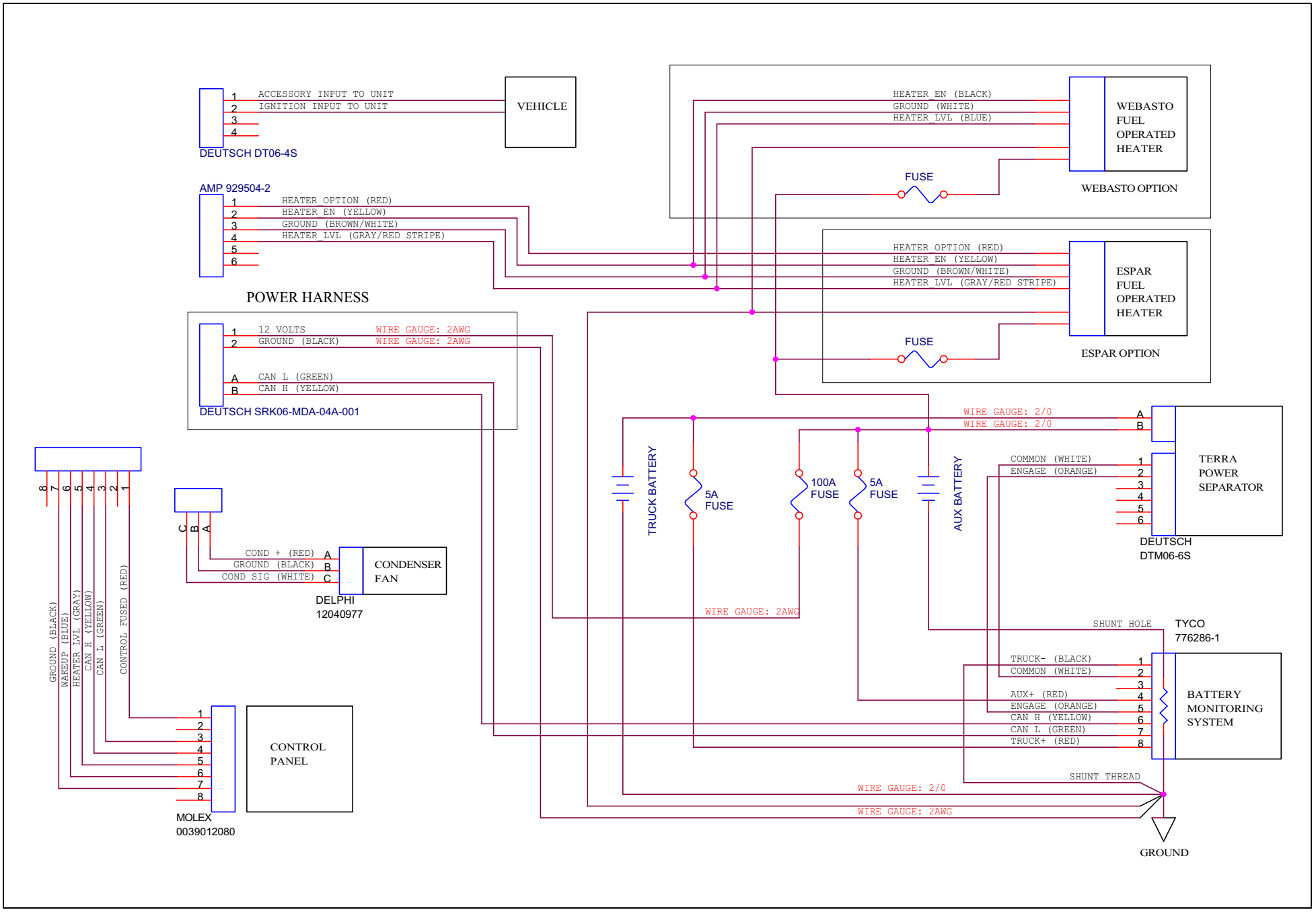


Figure 18. Internal Wiring Diagram (Before 8/1/2016)

HVAC: Idle Management System

Figure 19. External Wiring Diagram



HVAC: Idle Management System

Figure 20. Wiring Diagram (8/1/2016 to Present)

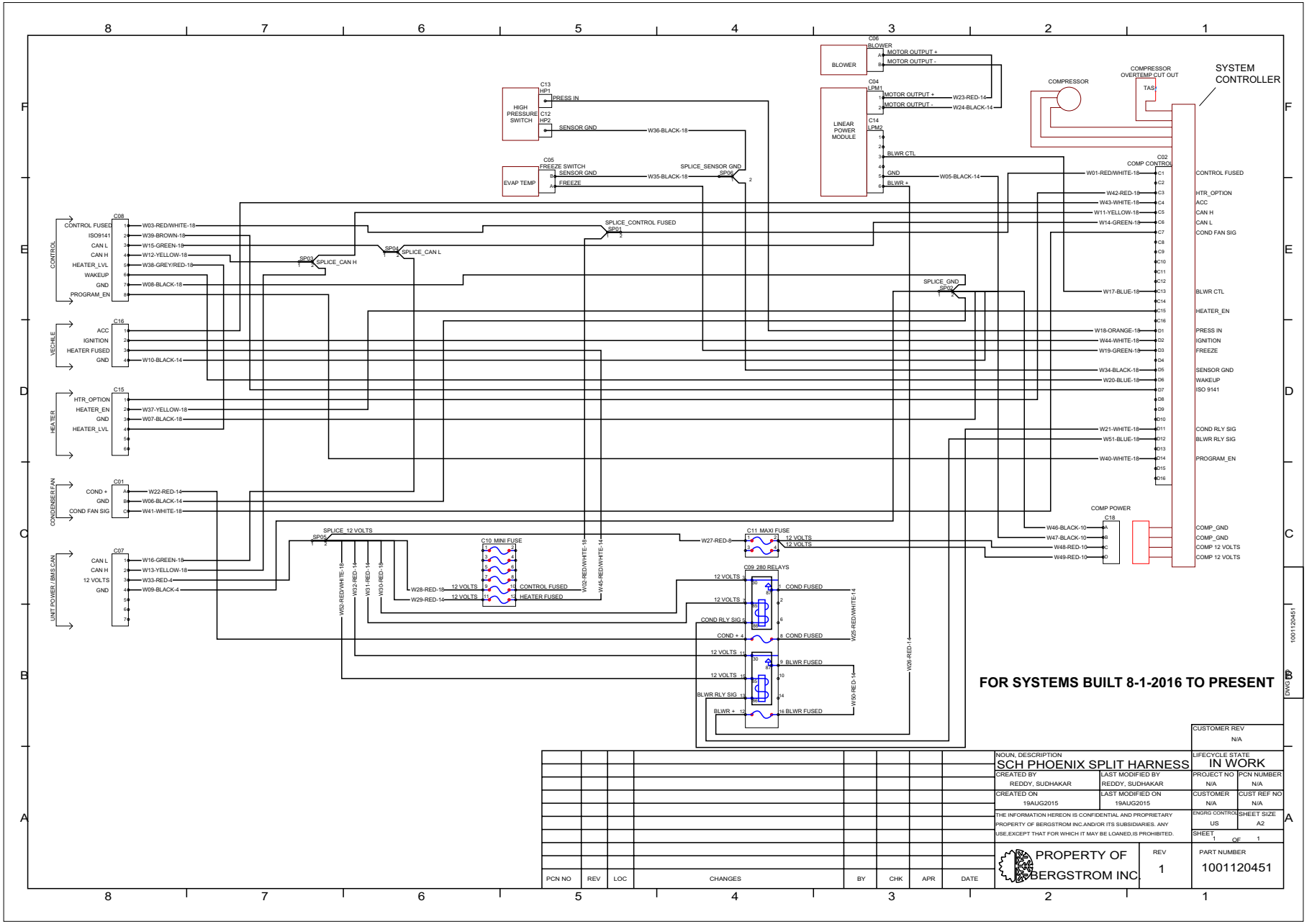


Table 5. Control Module Pinout with Functional Information

Pin	Circuit ID	Wire Color	Function	Typical Voltage	Other End of Circuit
C1	CONTROL_FUSED	Red/White	12V power from F1 - 10Amp fuse	12-14V	Control fuse F1 and control pin 1
C2	GND	Black	Ground for controls	0V	Black harness connector / various internal grounds
C3	HTR_OPTION	Red	Indicates if Espar FOH is connected	12V if Espar FOH connected, 0V otherwise	Fuel Operated Heater
C4	ACC	White	Possible future feature	Not used	
C5	CANH	Yellow	J1939 Can bus HI	2.5V bus with "pulsing"	Yellow wire (pin 4) in connector on back of control
C6	CANL	Green	J1939 Can bus LO	2.5V bus with "pulsing"	Green wire (pin 3) in connector on back of control
C7	COND_FAN_SIG	White	PWM ground switched output to control condenser fan speed	0V fan off, 1.6-2.6V cooling mode	Condenser fan (3 way connector)
C8					
C9					
C10					
C11					
C12					
C13	BLWR_CTL	Blue	PWM ground switched output to control blower speed	5.6V speed 1, 4.9V speed 2, 3.1V speed 3	Linear Power Module
C14					
C15	HEATER_EN	Yellow	12V output to enable FOH operation	11-14V in heat mode and parking brake engaged	Fuel Operated Heater
C16					
D1	PRESS_IN	Orange	Pressure switch input	11-14V if open and unit on, <1V if switch closed or unit off	High pressure switch
D2	IGNITION	White	Prevent or Allow unit operation (12V = unit off)	12V if key is in ignition position, 0V otherwise	Vehicle's Key Ignition circuit
D3	EVAP_TEMP	Green	0-5V input from evaporator temperature sensor	5V with sensor open or unplugged, 1V-2.5V with sensor plugged in	Evaporator temperature sensor - inside unit
D4					
D5	SENSOR_GND	Black	Ground from control module for sensors, pressure switch	Ground	Temperature sensor, high pressure switch

Table 5. Control Module Pinout with Functional Information

Pin	Circuit ID	Wire Color	Function	Typical Voltage	Other End of Circuit
D6	WAKEUP	Blue	Switch to Ground input from ACU - turns on Parked unit	9-14V with control off, <1V when unit on	Blue wire (pin 6) in connector on back of control
D7	ISO 9141	Brown	Reprogramming	Used for software upgrades - no normal function	
D8					
D9					
D10	COMP_RLY _SIG	White	Switch to Ground output to relay 3 - Compressor power from AUX Batteries	<0.5V if on, otherwise 11-14V	Relay in electrical center
D11	COND_RLY _SIG	White	Switch to Ground output to relay 1 - Condenser fan power from AUX Batteries	<0.5V if on, otherwise 11-14V	Relay in electrical center
D12	BLWR_RLY _SIG	White	Switch to Ground output to relay 2 - Evap blower power from AUX Batteries	<0.5V if on, otherwise 11-14V	Relay in electrical center
D13					
D14	PROGRAM _EN	White	Ground input to go into reprogramming mode	Not normally used	White wire (pin 8) in connector on back of control
D15					
D16					

Service Instructions for Ring Terminal / Controller and Compressor

⚠ WARNING: To avoid potential property damage or personal injury, Read Important Safety Warnings and ALL instructions before attempting to install or service product.

CAUTION: Care must always be taken to install the control cover without bending the connector pins identified in **FIGURE 1**.

After the controller with phase harness has been removed from the unit, follow the below instructions to replace the phase harness.

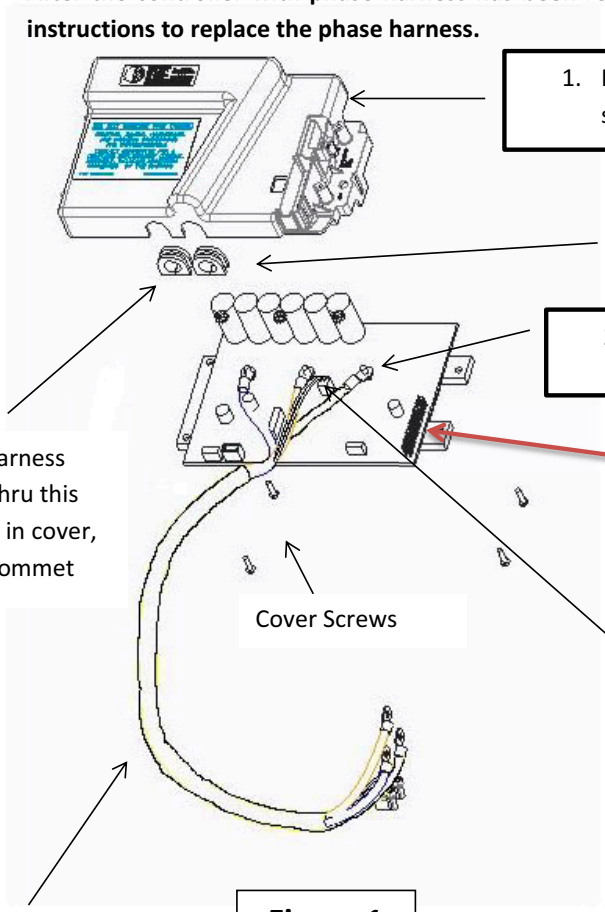


Figure 1

⚠ WARNING: To avoid potential property damage or personal injury, Read Important Safety Warnings and ALL instructions before attempting to install or service product.

CAUTION: Care must always be taken to install the control cover without bending the connector pins identified in **FIGURE 1**.

4. Slide (3) ring terminals of new harness over threaded posts of PCB and route wires as shown

⚠ Align each colored wire to specific threaded post identified only.

5. Secure wire terminals with (3) nuts. Torque to 12 to 14 in-lbs

⚠ Use the torque value specified.

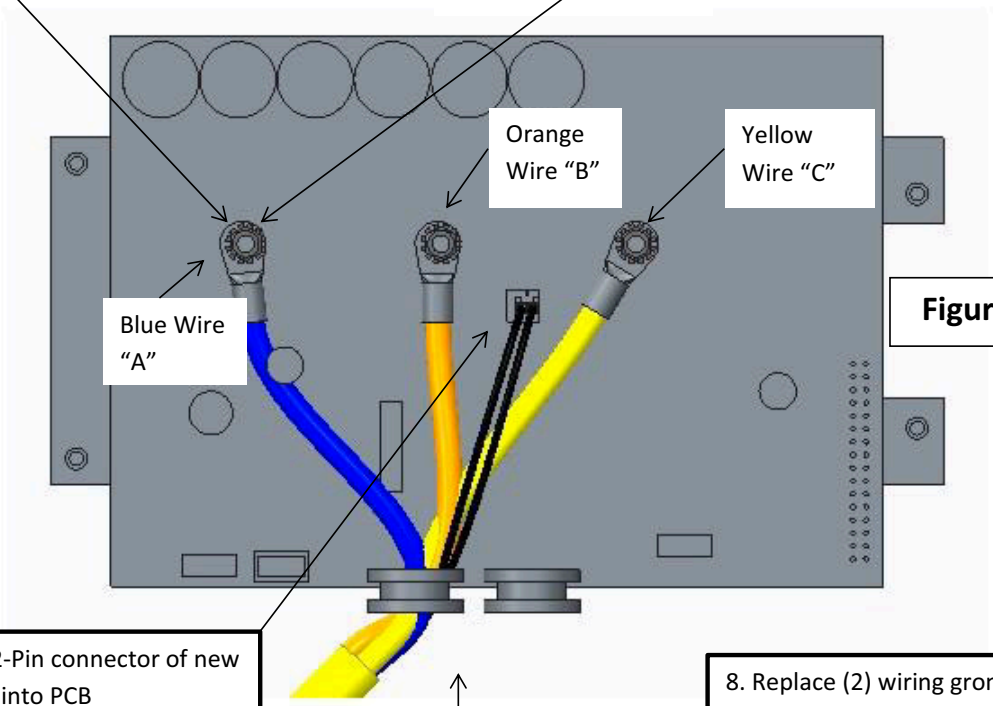


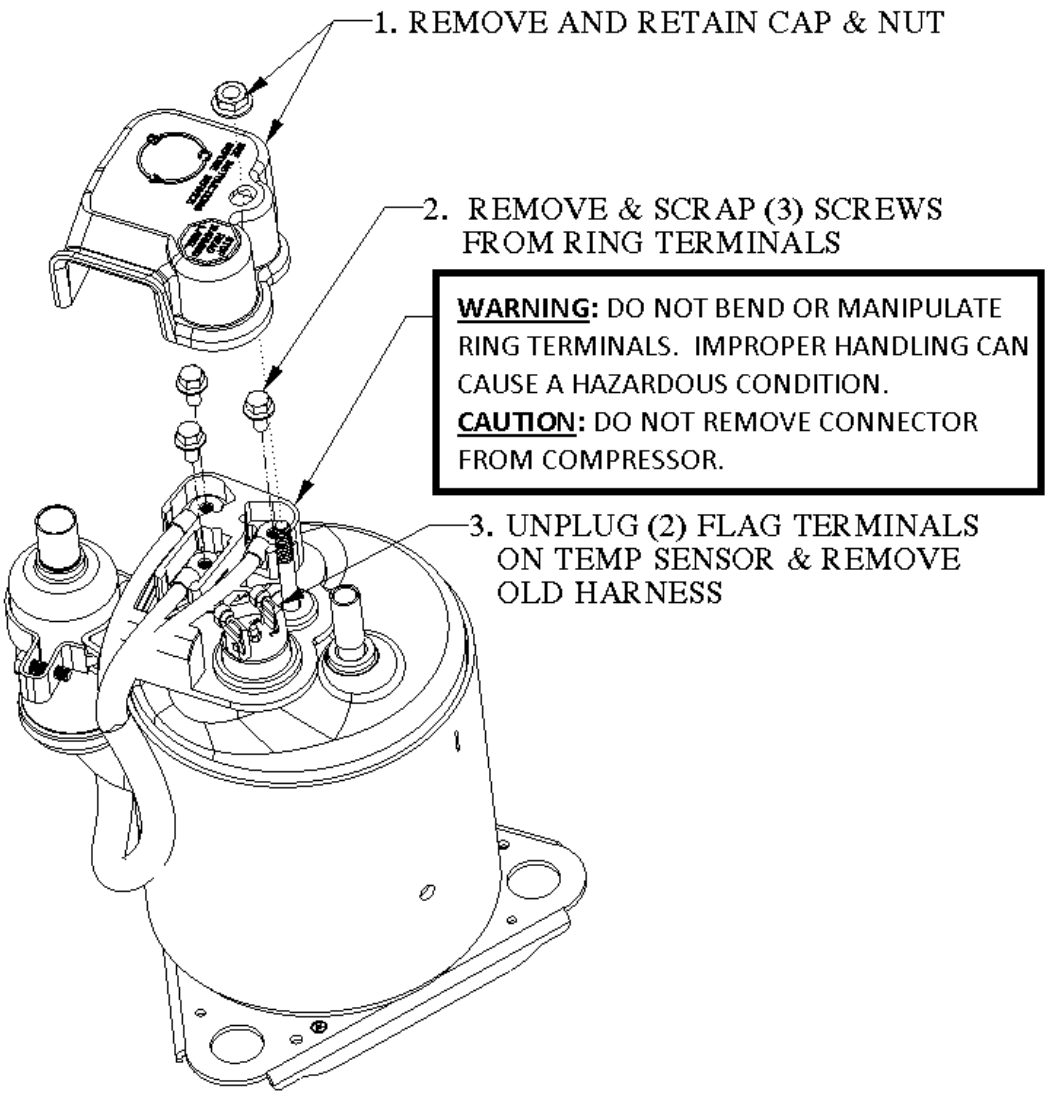
Figure 2

6. Plug 2-Pin connector of new harness into PCB

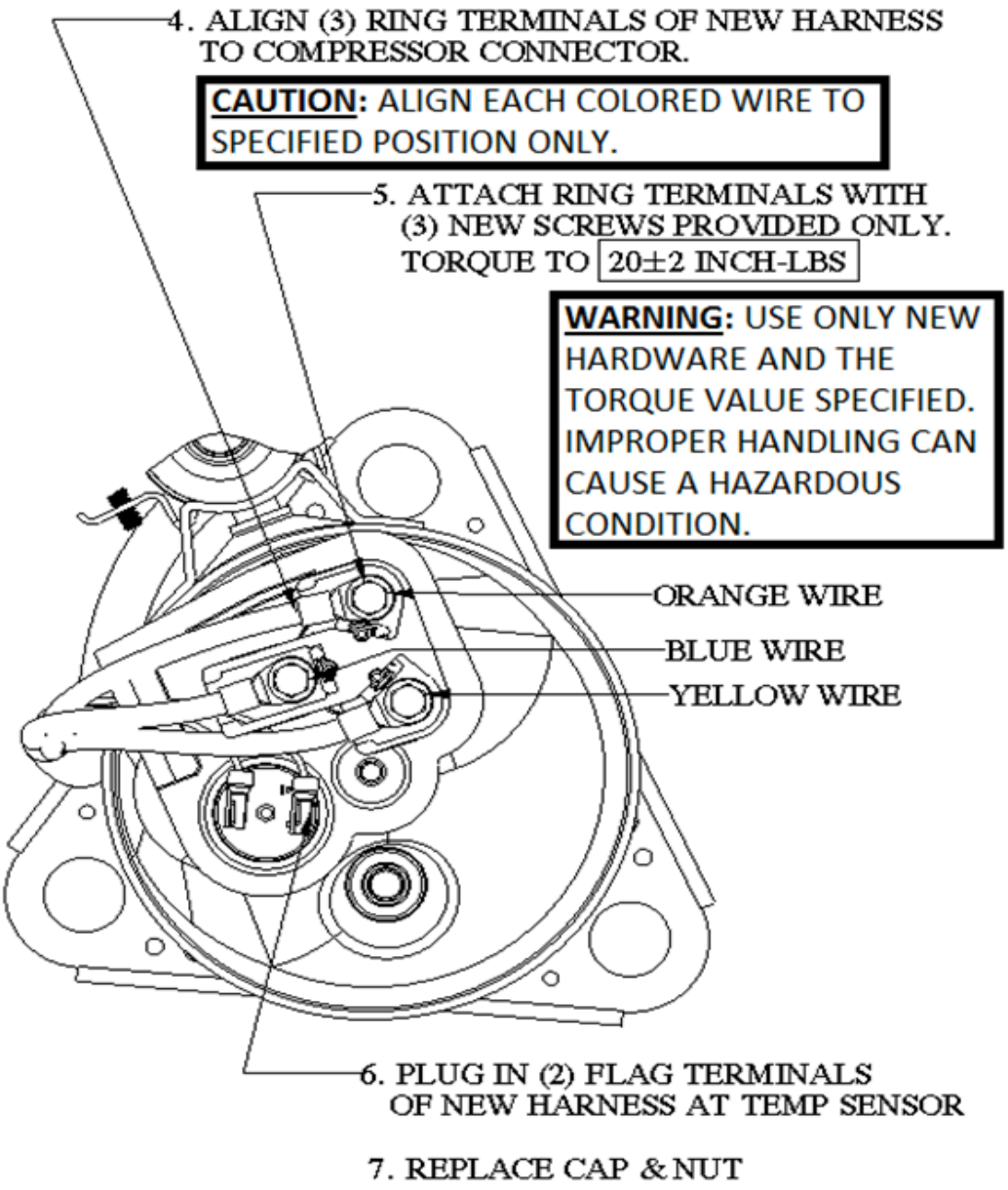
8. Replace (2) wiring grommets, cover, and (4) cover screws

7. Orient ring terminals and route wiring harness out of cover as shown

WARNING: To avoid potential property damage or personal injury, Read Important Safety Warnings and ALL instructions before attempting to install or service product.



WARNING: To avoid potential property damage or personal injury, Read Important Safety Warnings and ALL instructions before attempting to install or service product.



Operation

To start the system push ON/OFF button. Display will show current mode/ temperature setting / battery level. See Figure 21.

Initial default setting is blower speed 1/ AUTO- MODE /60 °F.

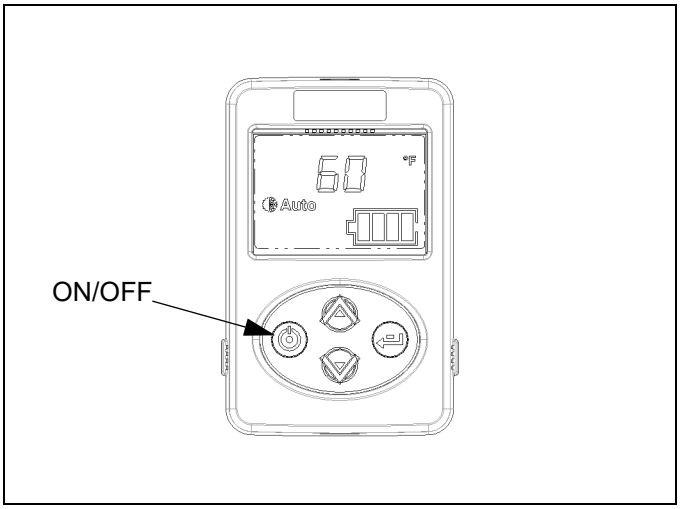


Figure 21. On/Off Button

Changing MODE – press ENTER, while mode is displayed use up or down arrows to select AUTO / COOL / HEAT. After 5 seconds selection will be set. See Figure 22.

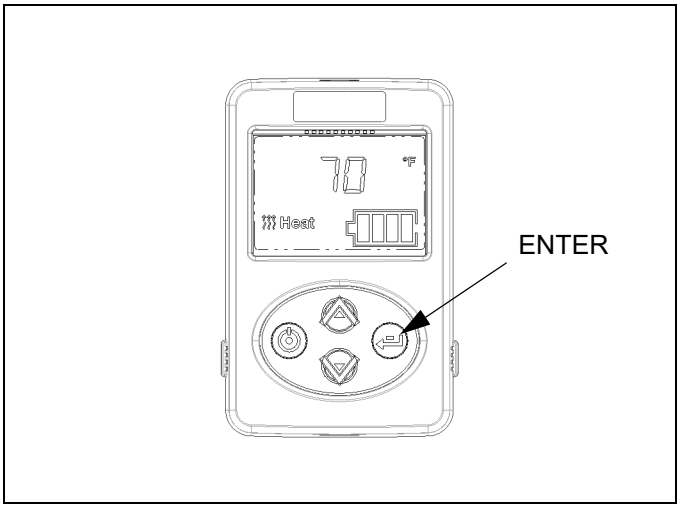


Figure 22. Changing Mode

Changing BLOWER SPEED – press ENTER until display shows FAN and SPEED. Press up or down arrows to select 1 - 2 - 3 speed. After 5 seconds selection will be set. See Figure 23.

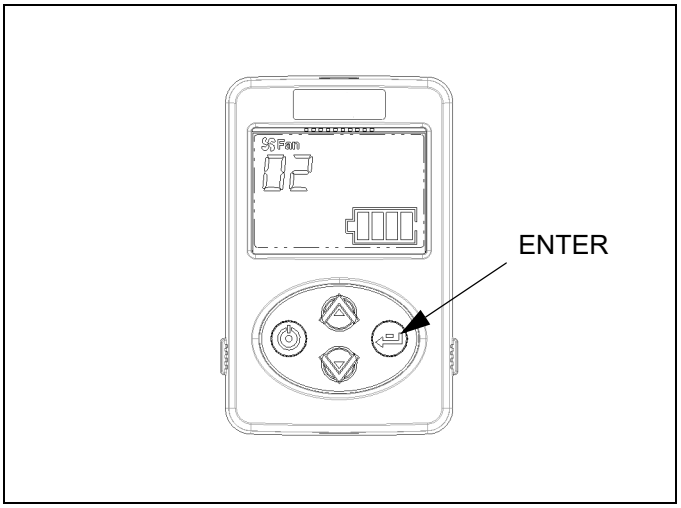


Figure 23. Changing Blower Speeds

Changing TEMPERATURE set point. Anytime the temperature set point is displayed on the screen, push the up or down arrows to change. Temperature range is from 60 °F (coolest) to 85 °F (warmest). See Figure 24.

i	NOTE
Control will always default to the last setting when the unit is turned on.	

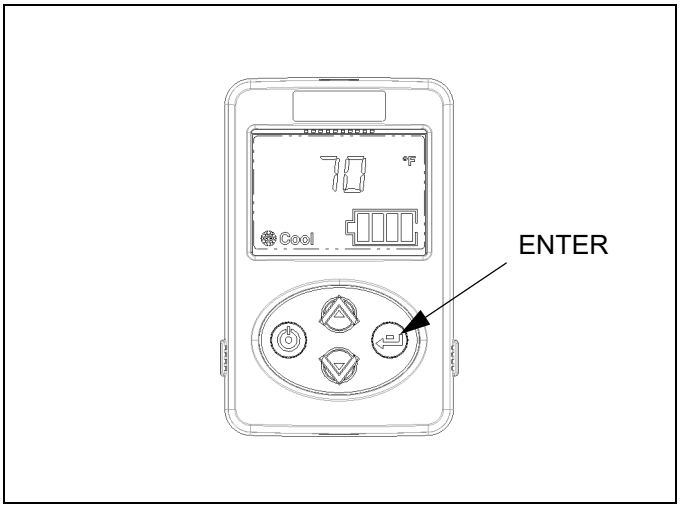


Figure 24. Changing Temperature

To view system runtime/hours – press ENTER until "Hrs" show on display. When hours are displayed, pressing ENTER for 7 seconds will reset the hours to zero. See Figure 25.

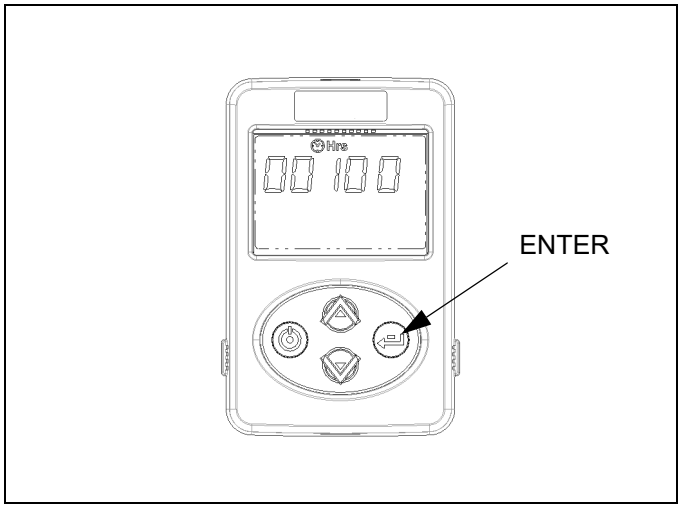


Figure 25. View System Runtime/Hours

To change from °F to °C press ENTER until temperature symbol only shows – push the up or down arrow to change. After 5 seconds selection will be locked. See Figure 26.

Anytime the control is idle for 5 seconds the screen will return to the temperature set point screen.

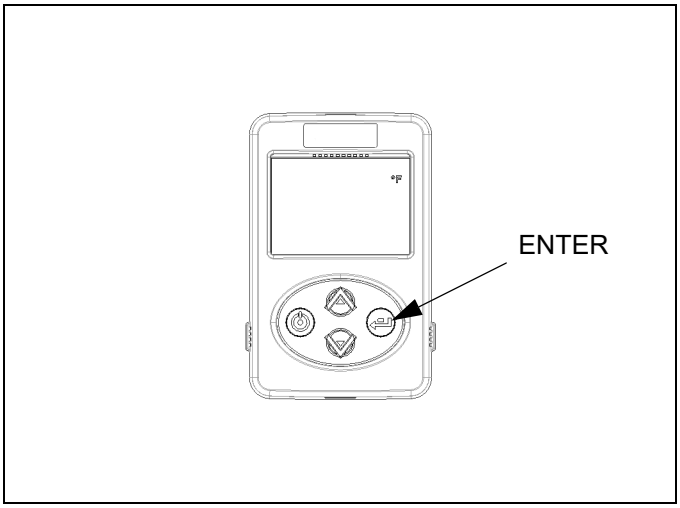


Figure 26. Change from °F to °C

To enter SERVICE MODE: Push both the ON/OFF and ENTER button simultaneously at any time. See Figure 27.

Display will show service indicator and a code 00 unless a fault has occurred. If there is an active fault the display will show it as 01, 02, etc. Use up and down arrows to scroll through the Fault Codes. See fault code chart for definitions.

Table 6. Fault Code List

Code	Failure	Description	Solution
O1	Evaporator Sensor	Shorted high or missing (received through CAN)	See “Discharge Temperature Sensor/Freeze Switch Testing” on page 19.
O2	Evaporator Sensor	Shorted low (received through CAN)	See “Discharge Temperature Sensor/Freeze Switch Testing” on page 19.
O3	High Pressure Switch	(received through CAN)	See “Pressure Switch Testing” on page 18.
O9	Filter Clean or Change	Active after 500 hrs	See technical guide.
10	HVAC unit Communication Error	Loss of communication or error - controller / panel	See “Can Bus” on page 22.
11	BMS Communication Error	Error 11 active on user interface controllers using software 2:09 or prior	See “Testing the Battery Management System (BMS)” on page 21.

Table 6. Fault Code List

Code	Failure	Description	Solution
13	HMI Temperature Sensor Error	BLUETOOTH Controller only / System defaults to 72F	

1. Evaporator sensor open or shorted high
2. Evaporator sensor shorted low
3. High pressure switch open or shorted high

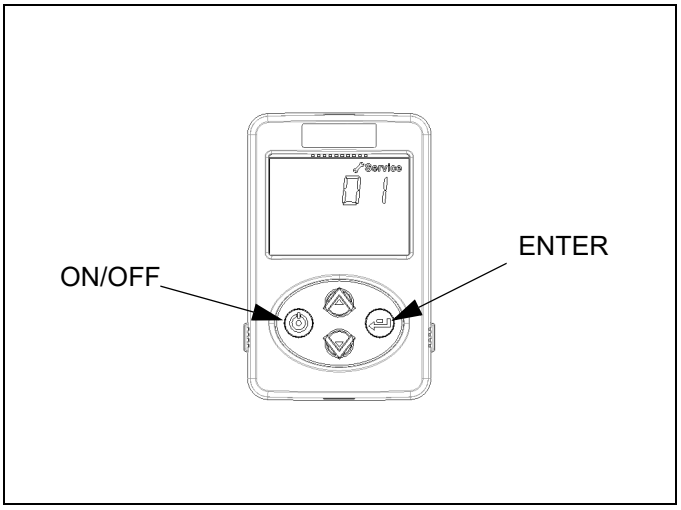


Figure 27. Enter Service Mode

Press the ENTER button to proceed through the available service screens. See Figure 28.

1. SV = Starting batteries Voltage
2. AV = Auxiliary batteries Voltage
3. AA = Unit Amperage draw

Pressing ENTER arrow after viewing service screen will return you to the fault code screen.

Pressing the ON/OFF button will return you to the Temperature Display screen.

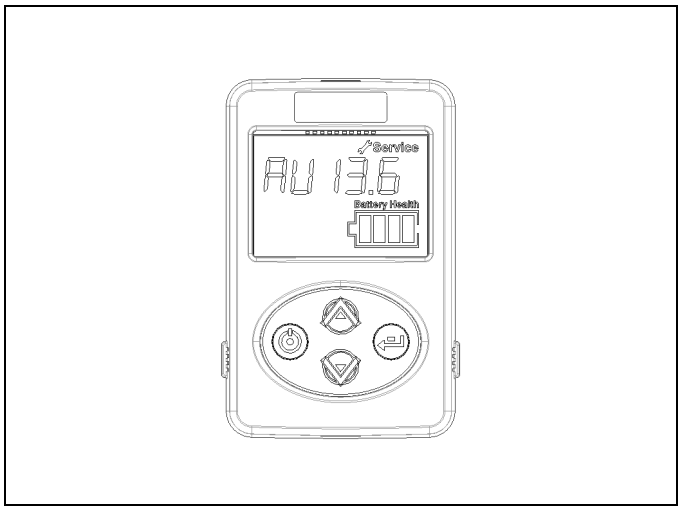


Figure 28. Service Screens

When necessary, Check Filter light will notify you that the EHVAC filter must be cleaned or changed. To reset filter: at screen 1 press and hold enter button for 3 seconds. See Figure 29.

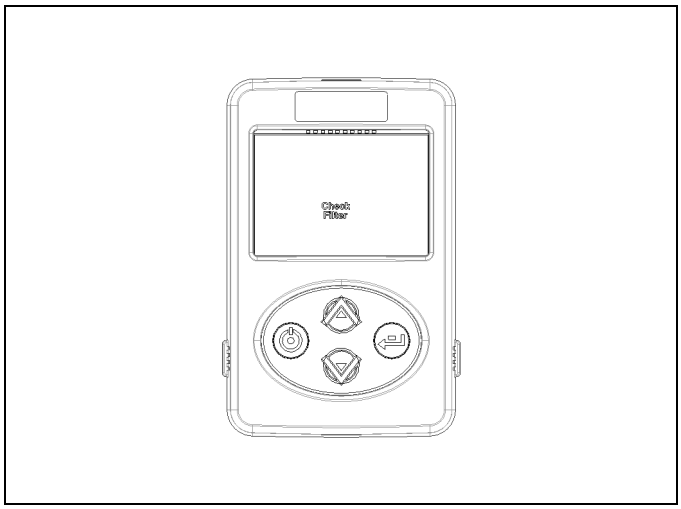


Figure 29. EHVAC Filter