eAPU® Reference Guide
System Component Information

#68004 REV A

Table of Contents

Battery Separator – 101.0 RF

Component Description & Application

Battery Separator
IFS Part # 35004

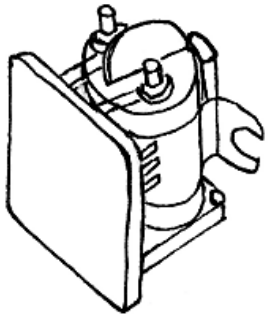
Component Location
APU, exterior
Top Level, front
Above outside battery

Description & Application
The battery separator is used to separate the truck's battery bank from the Idle Free AGM battery bank.
The battery separator is rated at 200 DC Amps and is controlled by its attached circuit board.
The battery separator connects the truck battery bank to the APU battery bank when it determines the truck's battery bank has reached and exceeded 13.2 VDC.
When the battery separator closes, the truck's alternator charges the combined battery banks, the truck starter batteries and the Idle Free batteries.
If the alternator fails to keep the combined battery voltage above 12.8 VDC, the battery separator will open (separate the battery banks).

The battery separator will combine both battery banks together when either battery bank reaches and exceeds 13.2 VDC.
The Idle Free AC to DC power converter (RF104) is connected to the AGM battery side of the battery separator via the UBB, (under bed box, RF110). This means whenever the Idle Free AC to DC power converter is plugged into shore power, the AC to DC power inverter supplies DC power to the AGM batteries. When the DC power from the AC to DC power converter raises, and exceeds 13.2 VDC on the Idle Free battery bank, the battery separator will close and send the AC to DC power to the truck's battery bank via the battery separator.
If the combined battery bank voltage drops below 12.8 VDC, the battery separator will open the connection between the two battery banks.

Common Issues
The battery separator is trouble free.
The life expediency of the battery separator is dependent on:

- Size of the alternator
- Condition of the batteries connected to it
- Battery cable connection quality.

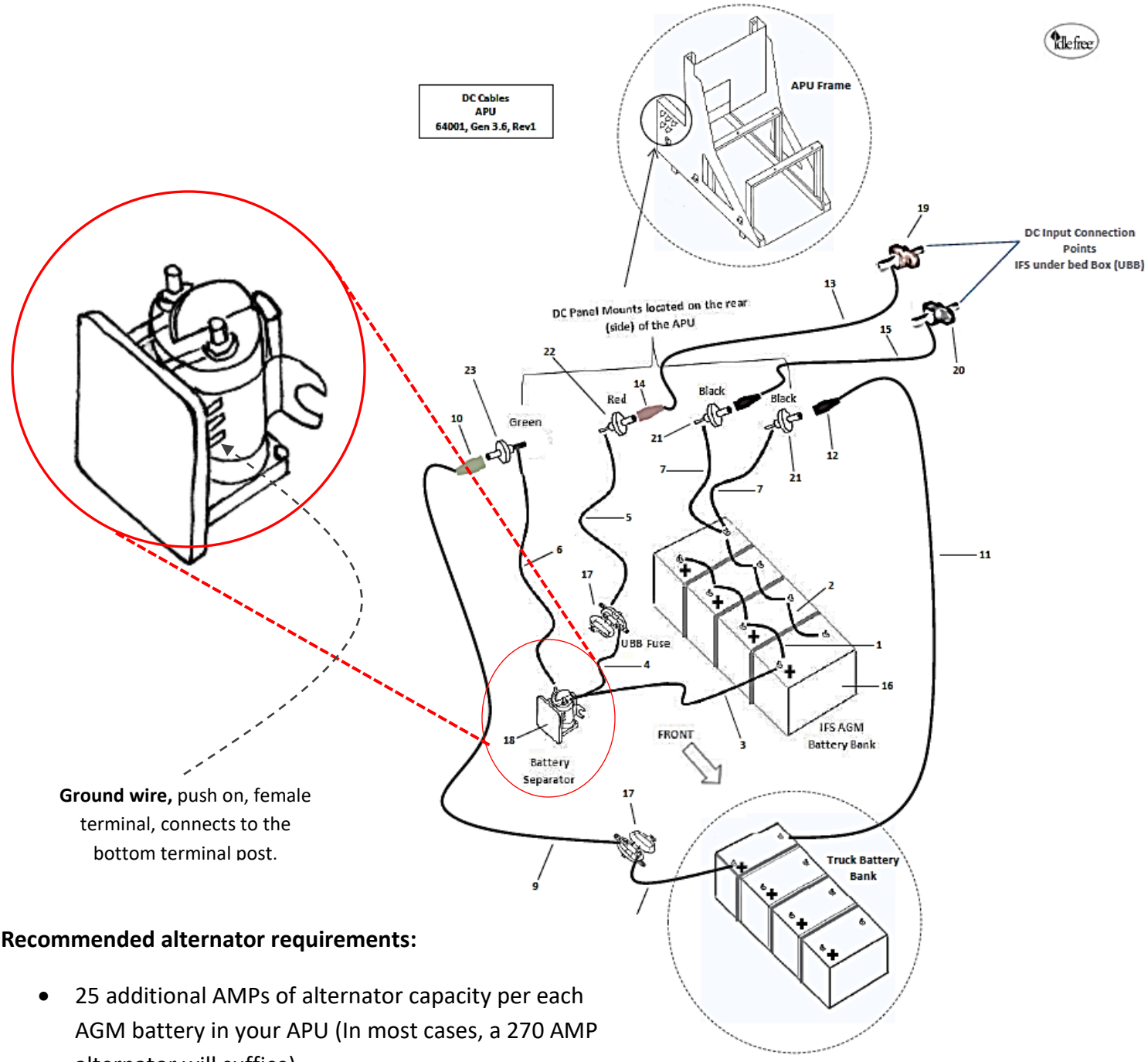


Service

1. Clean battery cables connections
2. Tighten battery cable connections
3. Protect battery cable connections with battery corrosion protection spray
4. Clean, tighten and protect circuit board ground wire (bottom terminal)

Battery Separator – 101.0 RF

Component Description & Application



Recommended alternator requirements:

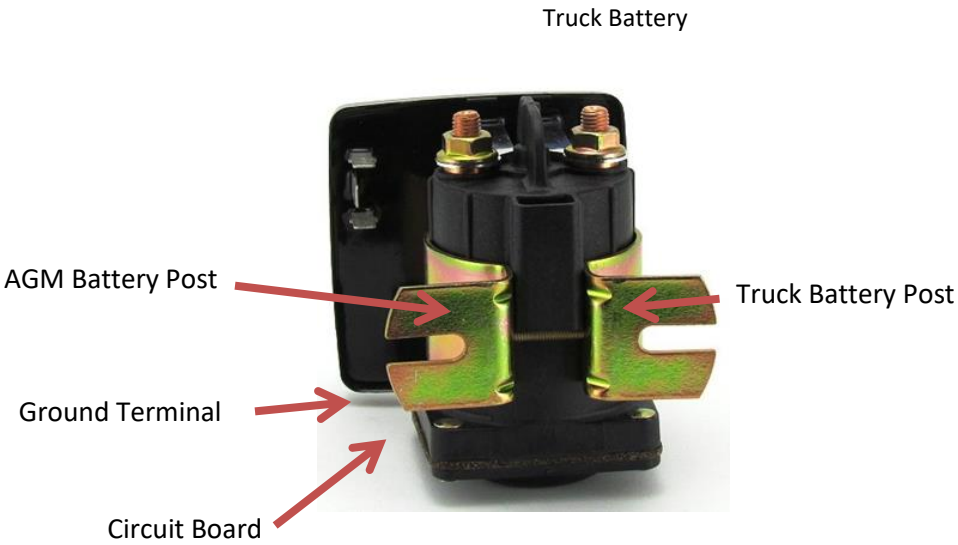
- 25 additional AMPs of alternator capacity per each AGM battery in your APU (In most cases, a 270 AMP alternator will suffice)
- The alternator has remote voltage reading capability

Battery Separator – 101.0 RF

Component Description & Application

Battery Separator
IFS Part # 35004

Component Location
APU, exterior
Top Level, front
Above outside battery



Tools Needed
DC Clamp AMP Meter
DC Volt Meter

Component Check Procedure
Check for DC voltage on the truck battery post on the top of the battery separator. Use the ground terminal on the battery separator for the meter's ground lead. This voltage is the truck's starter battery voltage.
If the truck's engine is running this voltage should be alternator output voltage, >12.7VDC.
If no voltage is present, check for DC voltage on the GREEN male connector on the DC input side of the APU, (previous page).
If alternator voltage is present (>12.7 VDC), clamp the AMP meter around the cable connecting to the truck battery post. The DC AMPs should be proportional the DC voltage, high AMPs = low volts.
If no amperage is read on the meter, the battery separator is not closed or is not connected to the AGM battery bank.
The truck's voltage must be higher than 13.2 VDC to activate the circuit board that will close the battery separator when the truck's battery voltage rises to 13.2 VDC or higher.
If the battery separator is working:

1. The voltage on both top posts will be the same
2. The amperage read on the clamp meter will be the same on the truck battery cables as the amperage reading on the AGM battery cable
3. The voltage and amperage will be proportional to each other; an amperage reading of 100 AMPS DC will mean a low alternator DC voltage, 13.0 VDC.

The battery separator will operate (close) based on a voltage rise from either the truck's battery bank or the AGM battery bank. The Idle Free AC to DC power converter (shore power, RF104) is connected to the AGM battery side of the battery separator. When shore power is being used, the AGM side of the battery separator will control the closing of the battery separator.

This document pertains to systems that have serial numbers that begin with 36 or 37.

Battery Separator – 101.0 RF

Component Description & Application

Component Check Procedure (continued)

If the battery separator is not functioning when either of the top posts has >13.2VDC, remove the ground wire from the ground terminal (battery separator terminal) and place the negative probe from your volt meter into this terminal end of the ground wire. Check for DC voltage on either battery post to confirm that a ground is present on the ground terminal harness. This test will ensure the wire is bringing a ground to the battery separator's circuit board. If a ground is present on the ground terminal wire, suspect a bad battery separator.

Proper diagnostic work needs to be done prior to replacing the battery separator.
The battery separator may be working if the battery voltage is below 13.2 VDC but above 12.8 VDC.
The battery separator will close its contacts when either of its battery posts rises above 13.2 VDC. The battery separator will remain closed until the contacts drop to 12.8 VDC.

12.7VDC	12.8	12.9	13.0	13.1	13.2	13.3	>13.3
Not	*Connected*	←	—	—	*Connected*	←	→
	Connected	←	—	—	—	—	→

The top line blocks represent the initial DC voltage when the battery separator was open (not connected) and the filled in blocks show the battery separator connected.
The second line shows what the DC voltage can look like once the separator closes, both battery banks will remain connected together until the DC voltage drops to 12.8 VDC.

Component Check Procedure

If the battery separator is connected for only a few seconds and then disconnects, a problem exists in the truck's charge circuit. When the battery separator continues to close and then open, the battery separator is closing at 13.2 VDC however the combined battery voltage (both battery banks) drops to below 12.8 VDC and the separator opens.
This condition can be caused by:

1. Bad starter battery
2. Loose cable connections
3. Alternator too small
4. Either battery bank deeply discharged

If one of the battery banks has a DC voltage of 11.5 VDC or less, it is recommended to test the batteries in this bank individually.
It is common to find the truck's battery bank contains a bad starter battery.
A bad truck starter battery will not allow the Idle Free AGM batteries to properly charge.
Replace defective truck starter batteries.
Loose or un-connected battery cables will not enable AGM battery charging.

DC Voltage Display – 102.0 RF

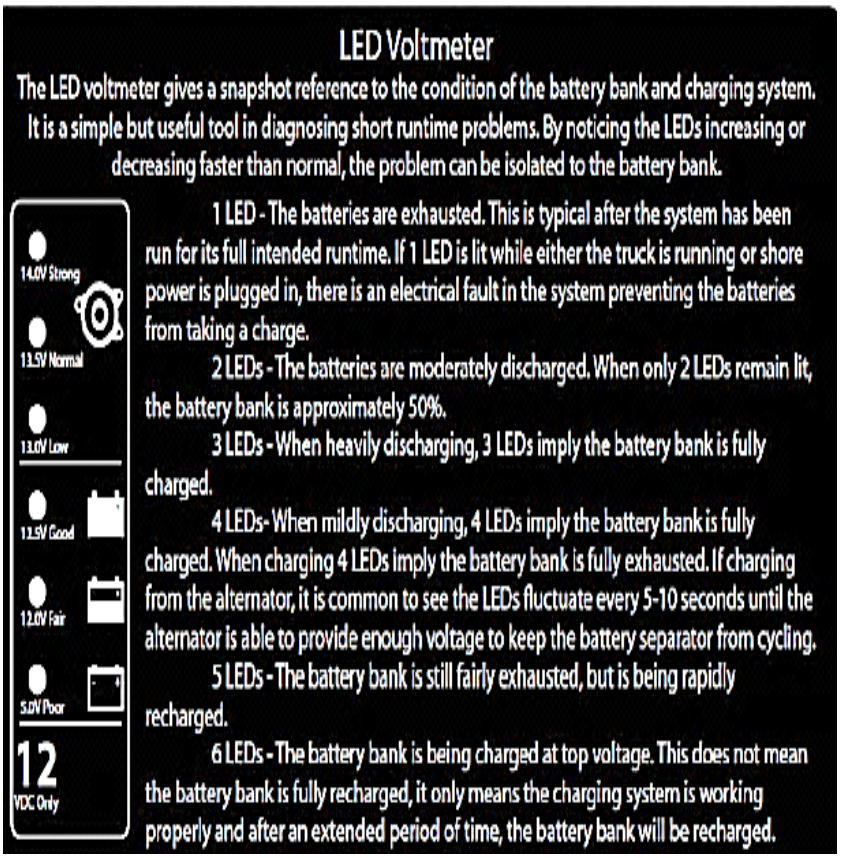
Current DC Voltage Level of AGM Battery Bank

DC Volt Meter
IFS Part # 32026

Component Location
Truck Interior
Bunk Area
Connected to the back side of
the UBB

Description & Application
The DC volt meter is used as an Idle Free AGM battery fuel gauge.
The DC volt meter is connected to the under bed module (RF110).
The flat magnet is located on the back side of the DC volt meter.
The DC volt meter has a six-foot cord used to enable the use of the volt meter in the driver's living area.

Overview
The volt meter is divided into top and bottom halves.
The bottom half represents the battery voltage when the truck's engine is not running.
The top half of the volt meter displays the voltage when the truck's engine is running or when the truck is plugged into Shore Power.
If the truck's engine is running, at least one of the top three lights should be lit.
The longer the truck engine runs, the more lights will be lit.
The voltage reading of this volt meter should be the same as the truck's battery voltage when the truck's engine is running.
If the battery voltage on the truck's dash is higher than the voltage reading on this volt



Common Issues
The volt meter has no history of issues.

Service
The volt meter does not require any service.

Thermostat – 103.0 RF

Thermostat
IFS Part # 37060

Component Location
Bunk, above bed, side wall or closet

Description & Application
The Idle Free thermostat contains a LCD display and two slide switches.
The IFS thermostat uses two AA batteries to power the display and to send switch signals to the Idle Free relay group (RF106).
The left slide switch is used to turn on the air conditioner or turn on the heat. The center position of the left slide switch turns the system off.
The right slide switch has two positions marked AUTO and ON.
The AUTO position is used if the system user wishes to have the air conditioner's evaporator fan turn on and off with the air conditioning compressor circuit. Leaving this switch in the ON position will continuously run the evaporator fan regardless of the compressor's current mode.
The driver should place the fan switch in the ON position for best system performance. Placing the thermostat fan switch in the ON position will eliminate 10 percent of the inverter start up power needs.
The IFS thermostat has two soft push buttons located near the LCD display.
The center soft button is used to display the current room temperature and turn on the display's backlight.
The top soft switch increases the temperature setting of the thermostat and the bottom soft button decreases the temperature of the room setting.
A low voltage battery indicator icon is shown on the display when the AA batteries need to be changed.

Thermostat – 103.0 RF

Technical Information

The Idle Free thermostat can be separated from its mounting base.
The mounting base contains terminals for the wiring harness that runs between the thermostat and the UBB.
The thermostat is used to operate the relay group located in the UBB (RF106).
The thermostat is supplied with 12 VDC power from the 2AMP fuse located on the front of the UBB (RF108).
The 12 VDC power enters the thermostat base on the red wire, R terminal (jumped) to a second R marked terminal.
The thermostat switch positions determine where, how and when 12 VDC power is sent to the UBB relay group.

- G Terminal - Green wire; 12 VDC to the evaporator relay
- Y Terminal - Yellow wire; 12 VDC to the compressor relay
- B terminal – Blue wire; 12 VDC to the heat relay

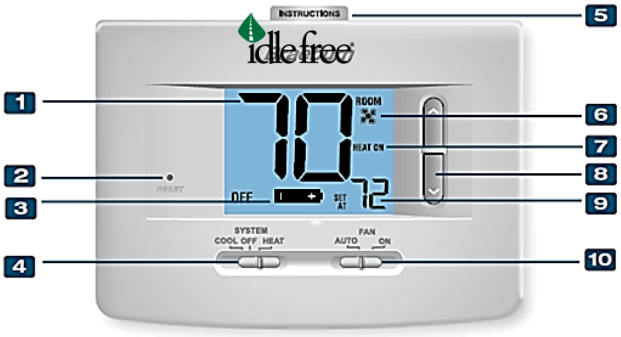
The back side of the thermostat includes three DIP switches that need to be in the proper position for the thermostat to function properly.

1. CONV/HP = **CONV**
2. F/C = **F**
3. HE/HG = **HG**

Common Failure Issues

User fails to understand that the left mode switch in A/C mode has a five-minute delay between ON then OFF then ON. This is dealt with by instructing the driver to place the right switch in the auto position to see if the thermostat is in the five-minute delay window. If the evaporator fan is not running when the mode switch is in COOL mode, the thermostat is in the five-minute delay mode.

Thermostat – 103.0 RF



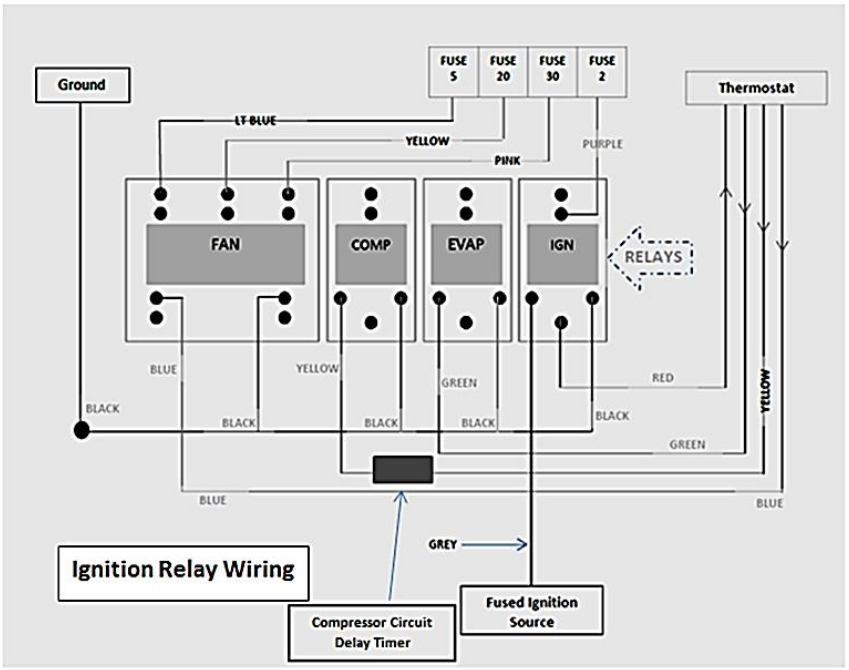
1 Room Temperature.....Displays the current room temperature
2 Reset Button.....Resets thermostat back to factory defaults
3 Low Battery Indicator .....Indicates when the batteries need to be replaced
4 System Switch.....Selects system preference
5 Quick Reference Instructions .....Stored in slot at top of thermostat
6 Fan Indicator .....Indicates when the system fan is running
7 System Status Indicator...Displays information about the status of the system
8 Arrow Buttons .....Used to increase or decrease settings
9 Set Temperature.....Displays the current set point temperature
10 Fan Switch.....Selects the system fan mode
Battery Compartment.....Located in the back of the thermostat

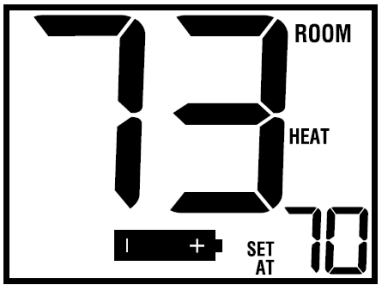
Wiring Terminations

Terminal	
Rc	Red Wire, 12VDC IN from Thermostat harness (Jumped)
Rh	
O	Not Used
B	Blue wire, Heater ON
Y1	Yellow wire, Compressor ON
G	Green wire, Evaporator ON
W1	Not Used
C	Not Used

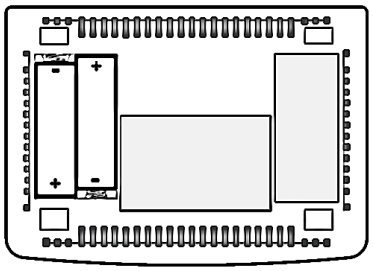
Switch	Factory Default
CONV / HP	CONV
F / C	F
HE / HG	HG

Thermostat DIP Switch Settings





A battery symbol will appear on the Thermostat display when it is time to replace the AA batteries.



Back view of the thermostat. Batteries are located on the left side.

Power Converter – 104.0 RF

Shore Power – Description

Power Converter, 120 VAC to 12 VDC
Shore Power
IFS Part # 35003

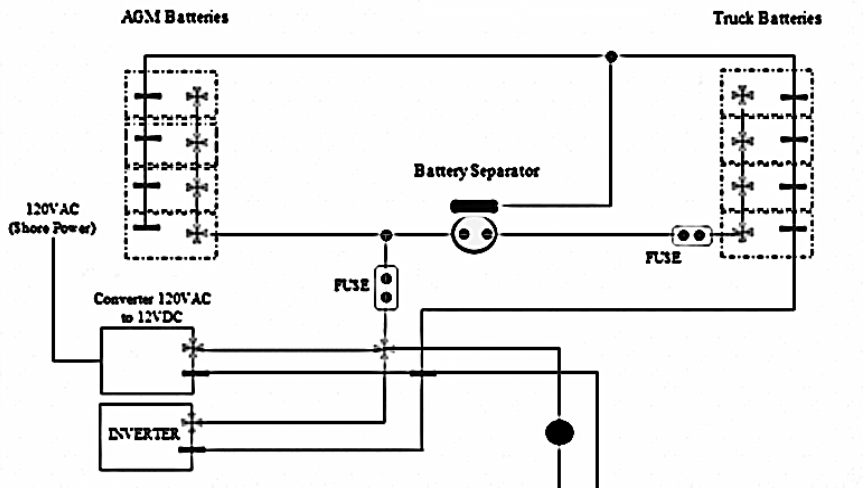
Component Location
UBB, Under Bed Module, Upper level

Description & Application

The Idle Free power converter converts incoming 120 VAC power (shore power) to 12 VDC power. When shore power is available, the converter maintains the Idle Free AGM battery voltage.
The power converter has a rated amperage output of 55 AMPS DC. The Idle Free air conditioner uses less than 50 AMPs DC and when using the power converter (shore power), the AGM battery voltage level maintains 12.6 VDC or higher.
Whenever the power converter's DC voltage rises past 13.2 VDC, the Idle Free battery separator closes and connects the Idle Free battery bank to the truck's battery bank (battery separator RF101). If the combined voltage of both battery banks remains above 12.8 VDC, both battery banks will remain connected and both battery banks will receive a charge from the Idle Free power converter.
The power converter's 120 VAC circuit begins on the truck's exterior with a covered receptacle (male) that is used to receive the female end of an extension cord.
The power converter's DC circuit begins at the bulkhead DC connection posts on the lower back corner of the UBB (UBB RF108).

Potential Issues

1. Installer connects a ground power supply cable to the wrong (+ or -) battery post. This action causes the power converter's DC fuses to fail. The two 30 AMP fuses are located on the rear side of the power converter.
2. Shore power (plugging in) is perceived to be a direct use of 120 VAC power that directly powers the 120 VAC Idle Free air conditioning circuit. Shore power is only used to convert AC to DC. The inverter is always the 120 VAC power provider for the Idle Free air conditioner.



Hotel Loads – 144.0 RF

Overview

Hotel loads include any use of 120-volt electrical energy from the Idle Free inverter
The Idle Free system includes a 1500-watt inverter. This inverter is used to operate the air conditioner's compressor and evaporator fan.

When the system operator/driver uses the inverter for hotel loads, the air conditioner is affected.

Hotel loads may also contribute to GFCI tripping

Microwave

The energy required to start a microwave is three times the rated microwave rating. The maximum wattage that can be used with the Idle Free inverter is 700 watts rated during running.
Do not attempt to operate a microwave if the air conditioner is running. Using both a microwave and the air conditioner at the same time will result in an overloaded inverter or cause the inverter to shut down. If the inverter does shut down due to an overload, turn the inverter's switch from the "ON" position to the "OFF" position and then back to the "ON" position. This will reset the inverter.

Hot Plates

Do not use hot plates with the Idle Free inverter. The wattage needs of a hot plate may exceed the output of the Idle Free inverter.

Phone Chargers, Shavers and Other Small Devices

These items can be used with the Idle Free inverter; however, some of these have been known to trip the GFCI outlet (located on the face of the inverter).

Inverter – 105.0 RF

Inverter, 12 VDC to 120 VAC
IFS Part # 35002
1500 Watt, Sine Wave

Component Location
UBB, Under Bed Module, Lower

Description
The Idle Free inverter provides 120 VAC sine wave power for the air conditioner's compressor and evaporator blower fan.
The inverter is rated at 1500 watts continuous with a 3000-watt surge capacity.
The inverter has a GFCI outlet that is used to protect against electrical shock hazards.
The inverter is located in the UBB module (RF110), lower level.
The inverter is installed with stand-by mode activated. Stand-by mode is used as an automatic ON/OFF feature (shuts off automatically, ON with load > 20 watts).
A 120 VAC power strip is included with the Idle Free system. The power strip can be used to power driver needs. Some small wattage 120 VAC convenience devices can be powered with the inverter (if managed properly).

Application
120 VAC inverter power is sent from the inverter through two relays to activate the 120 VAC compressor circuit and the 120 VAC evaporator circuit. Both relays are controlled with a 12 VDC signal from the Idle Free thermostat (RF103).
The compressor relay sends it 120 VAC to the exterior located APU.
The exterior APU module's compressor 120 VAC circuit contains a pressure switch, condenser fan relay, run capacitor, start capacitor and a compressor.
The evaporator relay sends its power to the evaporator module to power the single speed 120 VAC blower fan typically located in a bunk closet.

Inverter 105.0 RF

Component Issues

1. GFCI will trip occasionally when the Idle Free system is turned off suddenly by starting the truck. The user manual instructs the driver to turn OFF the air conditioner with the thermostat only.
2. The inverter may over load (red light condition) if the start capacitor is not properly connected to the run capacitor. The connection quality is a factor especially after a year of operation. Service is required for the electrical APU harness, clean, tight and corrosion application for all APU electrical connections.
3. Inverter may shut down if 1500 watts is exceeded or 3000 watts' surge is exceeded. The inverter's maximum output is exceeded when the air conditioner is turned off for a few seconds and then back ON by turning the ignition key ON and then OFF.
   This action forces the air conditioner to attempt to start however the pressure present on the high side Freon circuit may be too high for the inverter (output) to overcome. The correct user procedure is to turn the air conditioner off using the slide switch on the face of the thermostat.
4. The inverter may overload if a microwave is used that exceeds the maximum output rating of the inverter. This tends to be the case on any microwave rated at >700watts. The microwave rating is based on run watt, not the watts needed to start the microwave. Idle Free cannot control what is plugged into the inverter and the user needs to understand the inverter parameters.
5. Drivers need to understand the "do's and don'ts" when using the Idle Free air conditioner. The inverter will display LED lights that will show the reason for the inverter shut down. Learning to properly react to these indicators will eliminate most inverter issues.
6. A permanent label/sticker is affixed to the underside of the UBB cover. This information label contains helpful information for troubleshooting the inverter.

Inverter – 105.0 RF

3-3. Protections Features:

Model	DC Input (VDC)				
	Over Voltage		Under Voltage Alarm	Under Voltage	
	Shut-down	Restart		Shut-down	Restart
12 V	15.3	14.2	11.0	10.5	12.5

3-1-6. Status：Display Power & Fault Status

Green LED	LED Signal	Status
Solid	———	Power OK
Blink (Slow)	– – – –	Power Saving
Red LED	**LED Signal**	**Status**
Blink (Fast)	– – – – – – – – –	OVP
Blink (Slow)	– – – –	UVP
Blink (Intermittently)	-- -- --	OTP
Solid	———	OLP

3-1-3. Input Level：Display Input Voltages

LED Status	DC 12V	DC 24V	DC 48V
RED Blink (slow)	10.5~10.9	21.0~21.8	42.0~43.6
RED	10.9~11.3	21.8~22.6	43.6~45.2
ORANGE	11.3~12.0	22.6~24.0	45.2~48.0
GREEN	12.0~14.0	24.0~28.0	48.0~56.0
ORANGE Blink	14.0~14.7	28.0~29.4	56.0~58.8
OVER RED BLINK	14.7↑	29.4↑	58.8↑

3-1-4. Load Level：Display AC Loads (Watts)

LED status	DARK	GREEN	ORANGE	RED	RED BLINK
SK1500	0 ~ 75W	75 ~ 495W	495 ~ 1125W	1125 ~ 1450W	Over 1450W

Troubleshooting guide：

WARNING!
Do not open or disassemble the Inverter.
Attempting to service the unit yourself may result in a risk of electrical shock or fire.

Problems and Symptoms	Possible Cause	Solutions
"No AC Power Output"		
STATUS illuminates the red LED		
a. Blinking fast	Over input voltage. (OVP)	Check input voltage. Reduce input voltage.
b. Blinking slow.	Low input voltage. (UVP)	Recharge battery. Check connections and cable.
c. Blinking Intermittently.	Thermal shutdown. (OTP)	Improve ventilation. Make sure ventilation openings in inverter are not obstructed. Reduce ambient temperature.
d. Solid ON.	Short circuit or Wiring error. Overload.(OLP)	Check AC wiring for short circuit. Reduce load.

The **STATUS** light is the bottom light on the face of the inverter, to the right of the GFCI, 120 VAC outlet.

Inverter – 105.0 RF

NO AC POWER OUTPUT
STATUS illuminates the RED LED

Problems and Symptoms	Possible Cause	Solutions
No AC Power Output Status illuminates the Red Led		
Blinking Fast	Over input voltage (OVP)	• Check input voltage • Reduce input voltage
Blinking Slow	Low input voltage (UVP)	• Recharge battery • Check connections and cable
Blinking Intermittently	Thermal shutdown (OTP)	• Improve ventilation • Make sure ventilation openings in inverter are not obstructed • Reduce ambient temperature
Solid ON	Short circuit or wiring error Overload (OLP)	• Check A/C wiring for short circuit • Reduce load

TOP LIGHT
DC input voltage light

Inverter – 105.0 RF

CENTER LIGHT INVERTER LOAD LEVEL					
LED STATUS	DARK	GREEN	ORANGE	RED	RED BLINK
SK1500	0 – 120W	120 – 495W	495 – 1125W	1125 – 1450W	OVER 1450W

CENTER LIGHT
Inverter Load Level

er light will not be lit when the inverter is in stand-by mode
the inverter is turned off or if the GFCI outlet is tripped.

3-1-6 STATUS: DISPLAY POWER & FAULT STATUS		
GREEN LED	LED SIGNAL	STATUS
Solid (normal)	———	Power OK
Slow Blink (power saving mode)	— · — · — · — ·	Power Saving
RED LED	LED SIGNAL	STATUS
Fast Blink (plugged into shore power or reefer, running okay)	- - - - - - - - -	OVP
Slow Blink (out of battery power)	— · — · — · — ·	UVP
Intermittent Blink (ventilation overheated)	- - - - - -	OTP
Solid (inverter was overloaded)	———	OLP

BOTTOM LIGHT
Status Light
This light is key to what is happening to the inverter.

This document pertains to systems that have serial numbers that begin with 36 or 37.

Inverter – 105.0 RF

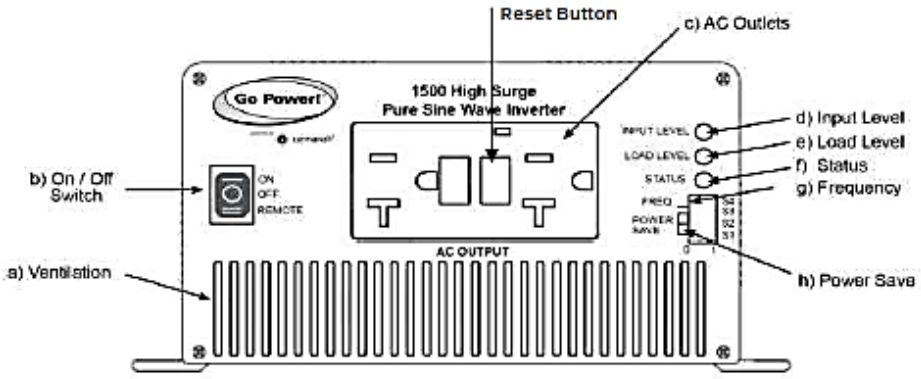
A permanent label/sticker is affixed to the UBB Cover. This information label contains helpful information.

GFCI Reset Procedures

1. Locate the GFCI Outlet, found on the end of the inverter.
2. Turn the inverter OFF using the black switch, located to the left of the white 120VAC outlet.
3. Turn the inverter ON using the black switch, located to the left of the white 120VAC outlet.
4. Push the Reset Button in within 5 seconds of turning the inverter switch to the ON position.

OR

1. Locate the GFCI Outlet found on the end of the inverter.
2. **Push and Hold** the Reset Button "IN".
3. Turn the inverter Switch to the OFF position.
4. Turn the inverter Switch to the ON position.



Letter Identifier	Component Name	Main Function
a)	Ventilation Ports	Do not obstruct, allow at least one inch for airflow
b)	ON/OFF Switch	Leave ON/OFF switch in the OFF position during installation. Leave in REMOTE position when using optional remote.
c)	AC Outlet	Ground Fault Protected (GFCI) Outlet sockets available (North America)
d)	Input Level	Displays input voltage. Green indicates normal battery level, yellow indicates mid to low battery level and red indicates under/over voltage.
e)	Load Level	Displays AC load watts. Green indicates normal operation; yellow indicates mid to high operation and red indicates overload levels.
f)	Status Level	The LED display indicates the power status of the inverter Solid Green: AC Power Okay Flashing Green: Power Saving Active Fast Red Blink: Over Voltage Protection (OVP) Slow Red Blink: Under Voltage Protection (UVP) Intermittent Red Blink: Over temperature Protection (OTP) Solid Red: Overload Protection (OLP)
g)	Frequency	Typical North American setting is 60 Hz. Set dip switch S4 to "0" for 50 Hz and "1" for 60 Hz.
h)	Power Save	Puts inverter to sleep until a load is present. Adjustable by the dip switches: S1, S2 and S3 on the front panel.

Inverter – 105.0 RF

Inverter Diagnostics

The Idle Free inverter has all the indicators in place to determine why it is or is not working.
The top indicator light is the input DC voltage.
The bottom indicator light is green or flashing green when the inverter is ON or in stand-by mode.
The center indicator light is only lit when an inverter load is present (green = okay, red = too high).
The GFCI has its own indicator light that replicates the bottom light (status) green or flashing green.
If the bottom light is RED the GFCI indicator light will not be lit because the inverter is shut down when the status light is RED.

The inverter is fused with non-replaceable fuses. The inverter fuse power from the AGM battery bank is located in the APU exterior frame mounted unit above the battery separator.

The inverter can be used as a diagnostic tool.

- The top light for battery voltage level input
- The center light as a load light (green = okay, red = too high)
- Bottom light for why the inverter shut down (red light = overload, flashing red = battery voltage too low)
- Bottom light gives current state of the inverter (green = okay, flashing green = stand-by)

Inverter Load Test – RF 146.0

Inverter Load Testing

This test is intended to determine if the inverter is capable of providing 100% of its rated capacity.
This test will involve testing the inverter at two power levels, one of the power levels will be at or close to 1500 watts.

The best device for testing the inverter is a heat gun. The best heat gun to use will have two power levels. The low setting of the heat gun will put out about 750 watts and the high setting will put out about 1500 watts.

Test Procedure

1. Remove the plug from the inverter outlet
2. Ensure that the inverter is turned on, switch is in the ON position
3. Ensure that the top inverter indicator light is Green
4. Prior to plugging the heat gun into the inverter, place the heat gun power switch in the OFF position.
5. Plug in the heat gun and turn the switch to LOW.
   The inverter's indicator lights should now look like this (RF105):
   Top light = green or yellow
   Middle light = green
   Bottom light = green

6. Turn the heat gun's power switch to HI.
   The inverter's indicator lights should now look like this (RF105):
   Top light = green or yellow
   Middle light = green
   Bottom light = green
   If the top light is now red, plug the system into shore power (RF148) and run the test again (HI).
   If the top light is now GREEN, the inverter issue is probably related to a battery or battery connection issue.

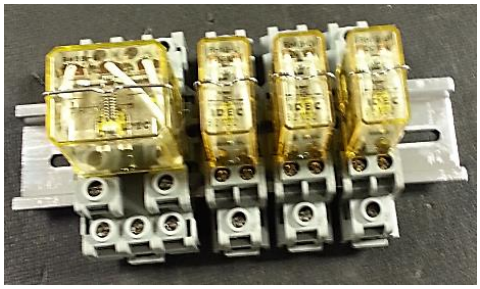
   If the inverter shuts down when the heat gun is operated in the HI mode, check the color of the inverter's bottom light (RF105). The color or condition of the inverter light will inform the user the reason for the inverter shut down.

   Contact Idle Free systems prior to changing out any inverters.
   Call customer tech support - 920 206 6900
   Email – tech support@idlefreesystems.com

Relay Group– 106.0 RF

Power Relays, explanation

Component Location:
Truck Interior
Bunk Area
UBB, upper level
UBB (REF Sheet, RF110)



Description & Application

The relay group is made up of four ice cube relays.
The relays are mounted on a DIN rail, in the upper portion of the UBB.
The relays are used to power the thermostat, evaporator fan, compressor circuit and heat circuit.
The relays use a 12 VDC coil.
The heat relay is a single pole, triple throw relay (SPTT).
The compressor relay, the evaporator relay and the ignition relay are single pole; single throw relays (SPST).
The ignition relay controls 12 VDC (2 AMP fuse) power used to power the thermostat.
The ignition relay is wired to use the normally closed contacts within the relay. When the truck's ignition is turned on, 12 VDC power is sent to the ignition relay and the normally closed contacts are opened. Opening the ignition relay circuit (truck ignition ON) disables the thermostat functions (heat and air conditioning) (RF103).
The evaporator relay controls 120 VAC power that is used to run the evaporator blower fan.
The evaporator relay is wired to use the normally open contacts within the relay. When the thermostat is set to turn on the evaporator fan, the 12 VDC coil is activated and the 120 VAC is sent through the relay to the evaporator fan.
The compressor relay controls 120 VAC power that is used to run the compressor circuit.
The compressor relay is wired to use the normally open contacts within the relay. When the thermostat is set to turn on the compressor circuit, the 12 VDC coil is activated and the 120 VAC is sent through the relay to the APU (exterior), compressor circuit (RF112).
The heat relay controls 12 DC power that is used to run the truck's blower fan circuit.
The truck's blower fan circuit is switched to Idle Free battery power whenever the heat relay is activated.
The heat relay is activated by moving the thermostat mode switch to HEAT.
The heat relay is wired to use the normally closed contacts and the normally open contacts, within the relay. When the thermostat is set to the HEAT mode, the 12 VDC coil is activated and 12 VDC fused power from the Idle Free battery bank is sent through the relay, to the truck fan motor and fan control circuits (1 -3).
When the relay is not activated (heat switch is OFF or ignition switch is ON), the normally closed circuit passes through the truck's blower fan power needs with 12 VDC "truck battery power."
The three circuits in this relay are not all used for every truck.
Instructions are included in the installation manual regarding the circuits needed for each truck brand installation application.

Relay Group– 106.0 RF

Power Relays, explanation

Overview

The relay group is controlled by the thermostat.
The thermostat (RF103) sends 12 VDC signals to the individual relays in the relay group.
The relay group contains *ice cube relays.*
Ice Cube (type) relays enable the use of both AC and DC voltages through the relay contacts.

Service

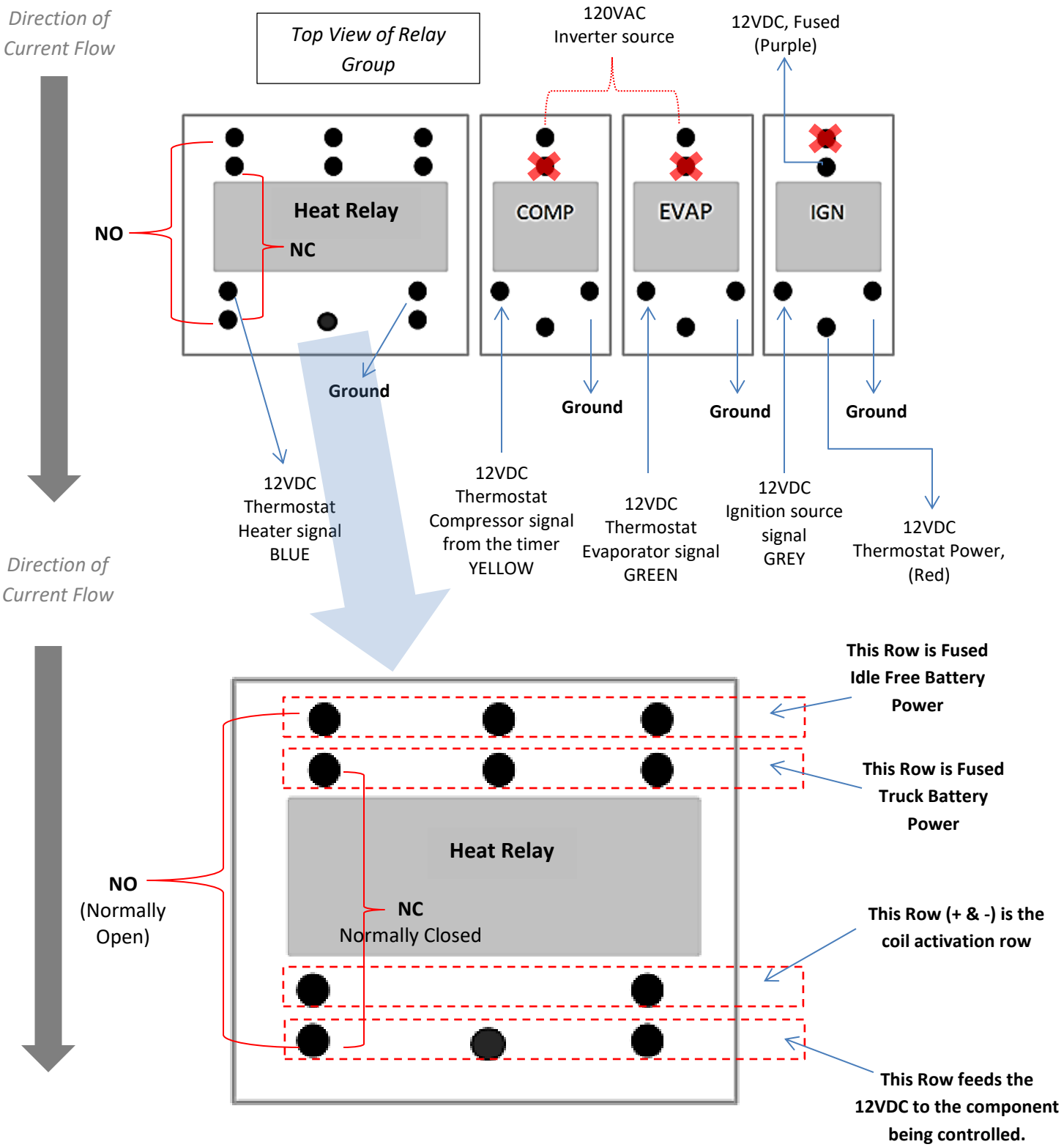
The relay group does not require any service.

Common Issues

The relay group has no history of issues.

Relay Group– 106.0 RF

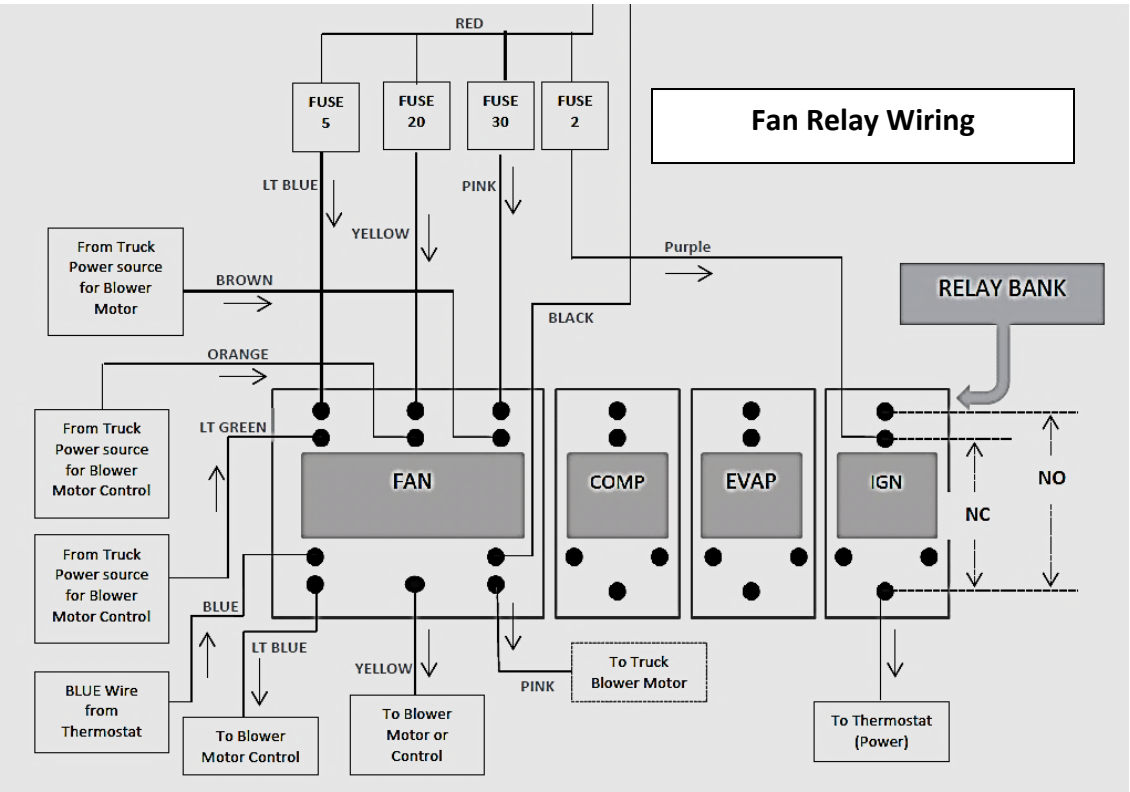
Not Used

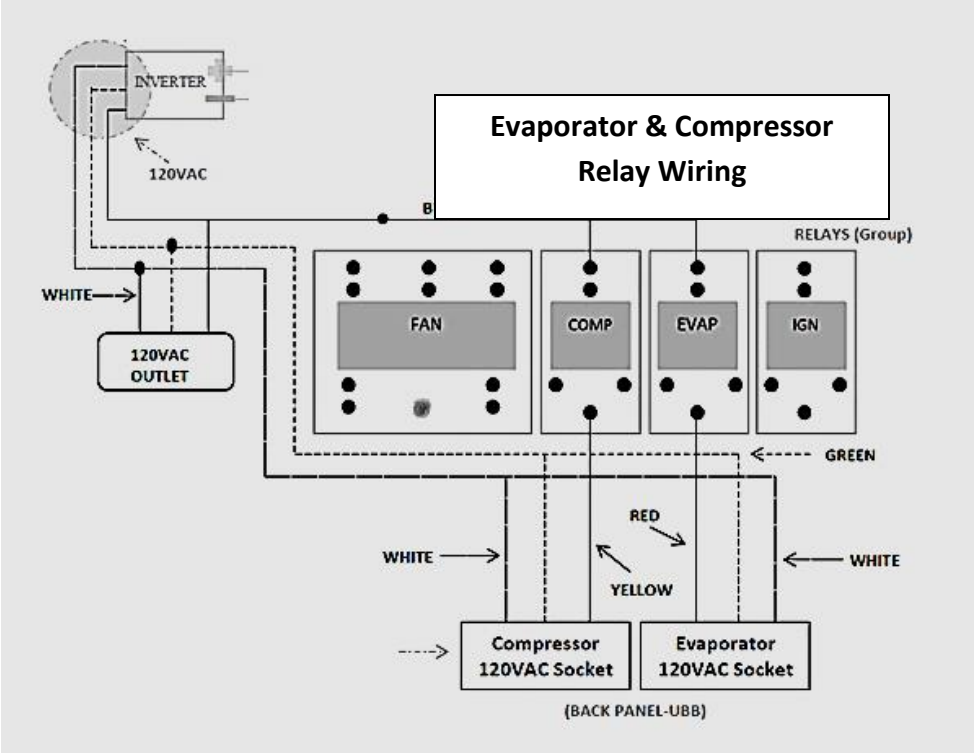


idle free

Relay Group– 106.0 RF

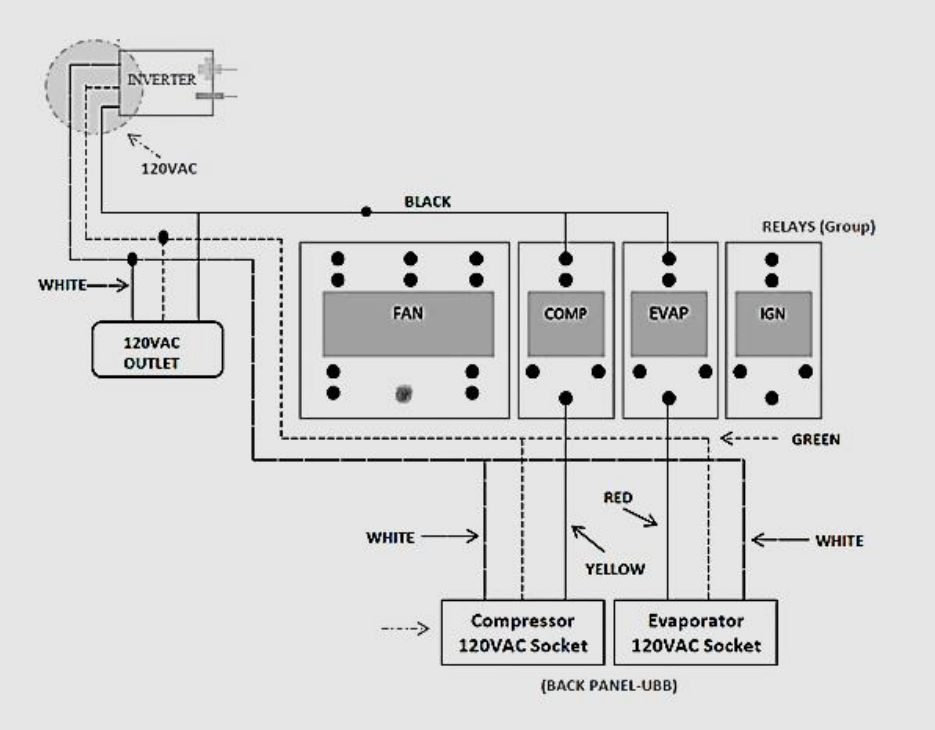
Power Relays, explanation





Relay Group– 106.0 RF

Power Relays, explanation



Troubleshooting:

Use the relay black 18 gauge wires for ground service connections.
Ignition relay must be OFF (not activated) for any of the other relays to receive 12 VDC power.
The evaporator relay and the compressor relay pass through 120 VAC when activated by the thermostat.
The inverter must be turned on with a green or flashing green light located on the GFCI outlet. (RF105).
To check each relay for coil activation, place your volt meter on DC and place probes into the relay coil terminals (page 13). Use the ground for the relay being checked.
The relay 12 VDC+ wires are from the thermostat or the ignition source, colors for 12 VDC coil operation are:

- Grey = ignition relay
- Green = evaporator relay
- Yellow = compressor timer and compressor relay
- Blue = heat relay, (triple relay)

Relay coils are activated with 12 VDC from thermostat switches.
Thermostat switch position determines 12 VDC to relays.
Ignition relay passes through fused 12 VDC power when truck ignition is turned OFF.
Evaporator relay passes through 120 VAC when thermostat is in COOL mode or fan switch is in ON mode.
Compressor relay passes through 120 VAC when thermostat is in COOL mode and temperature setting is calling for COOL. Compressor relay is delayed eight seconds using a timer relay.
Heat relay passes through 12 VDC when thermostat is in heat mode. Not all heat circuits are used for all trucks. Fuse panel fuses all three heat circuits (RF108).

Relay Group– 106.0 RF

Power Relays, explanation

Timer for the compressor circuit

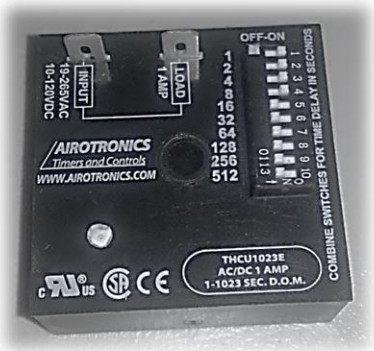
The compressor circuit includes a timer that delays the start of the compressor circuit eight seconds.

The compressor circuit will start eight seconds after the thermostat calls for COOL.

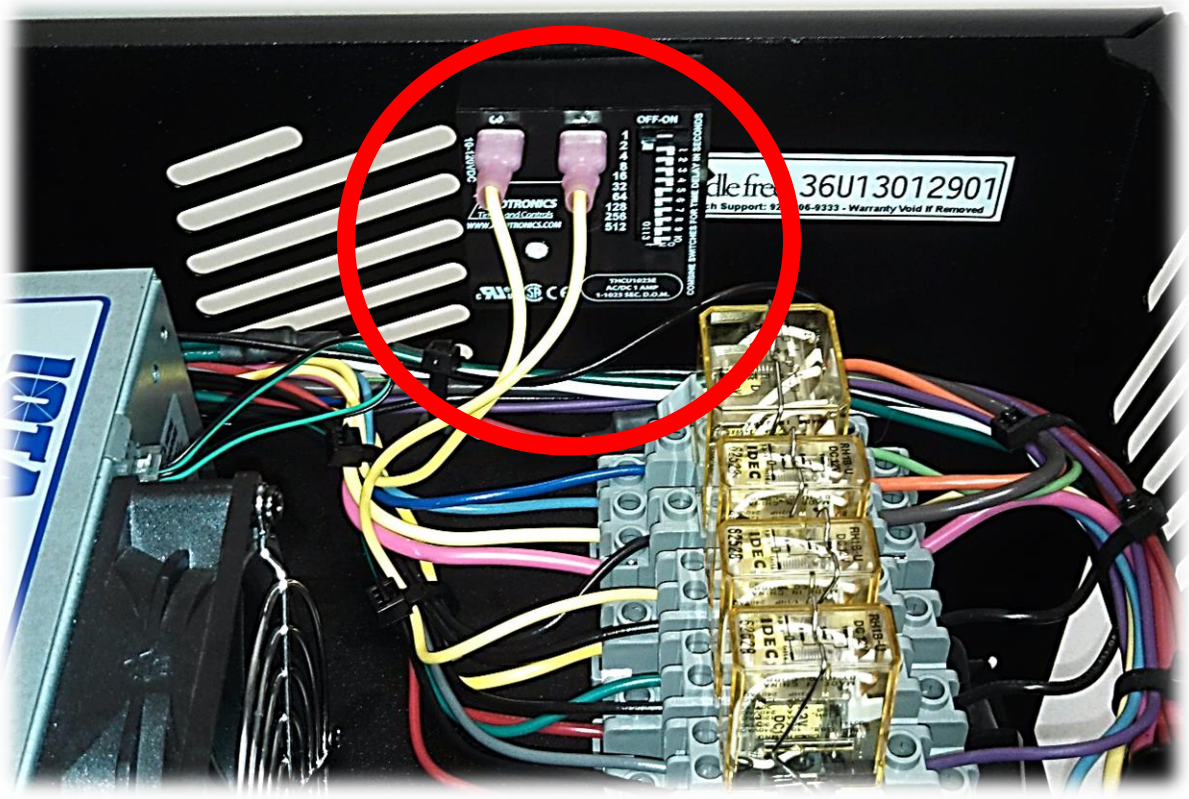
During the eight second delay the evaporator fan will come on and be up to full speed.

The compressor delay circuit is used to eliminate the added surge power needed to start the evaporator blower fan.

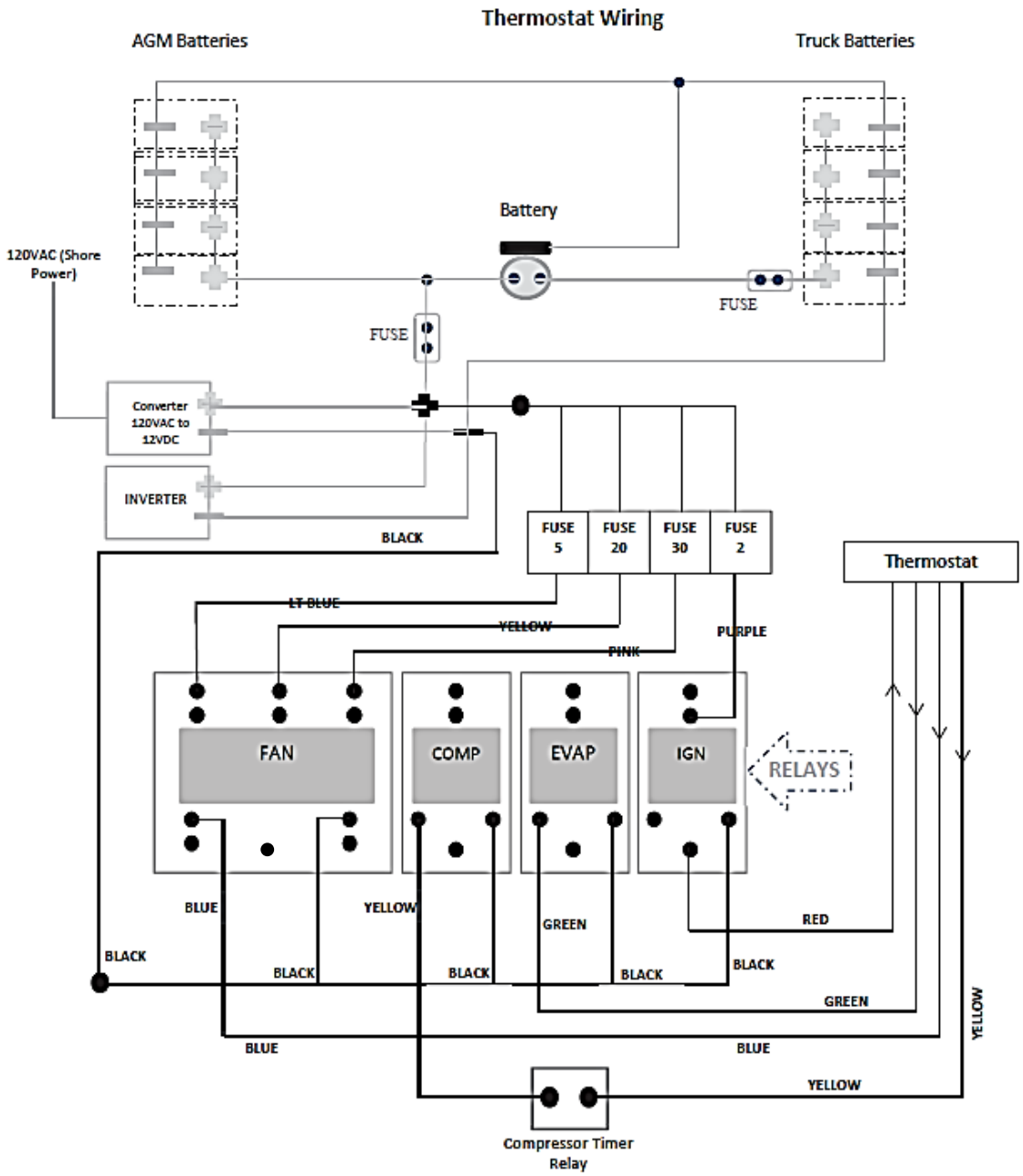
The thermostat sends its 12 VDC signal to the time delay relay prior to the compressor relay.



Under Bed Box (UBB)



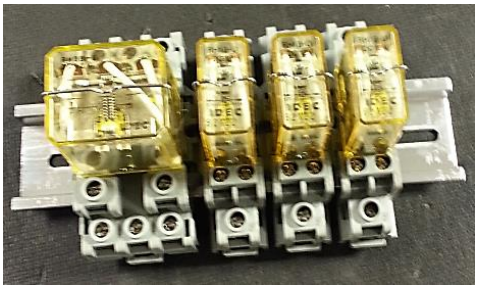
Relay Group– 106.0 RF



Relay Group– 106.1 RF

Power Relays, explanation

Component Location:
Truck Interior
Bunk Area
UBB, upper level
UBB (REF Sheet, RF110)



Description & Application

The relay group is made up of four ice cube relays.
The relays are mounted on a DIN Rail, in the upper portion of the UBB.
The relays are used to power the thermostat, evaporator fan, compressor circuit and heat circuit.
The relays use a 12 VDC coil.
The heat relay is a single pole, triple throw relay (SPTT).
The compressor relay, the evaporator relay and the ignition relay are single pole; single throw relays (SPST).
The ignition relay controls 12 VDC (2 AMP fuse) power used to power the thermostat.
The ignition relay is wired to use the normally closed contacts within the relay. When the truck's ignition is turned on, 12 VDC power is sent to the ignition relay and the normally closed contacts are opened.
Opening the ignition relay circuit (truck ignition ON) disables the thermostat functions (heat and air conditioning) (RF103).
The evaporator relay controls 120 VAC power that is used to run the evaporator blower fan.
The evaporator relay is wired to use the normally open contacts within the relay. When the thermostat is set to turn on the evaporator fan, the 12 VDC coil is activated and the 120 VAC is sent through the relay to the evaporator fan.

Relay Group– 106.1 RF

Power Relays, explanation

Description & Application (continued)

The compressor relay controls 120 VAC power used to run the compressor circuit. The compressor relay receives its ground from the low pressure switch located in the exterior condensing unit. If the condensing unit loses its refrigerant, the ground goes away and opens the compressor circuit.

The compressor relay is wired to use the normally open contacts within the relay. When the thermostat is set to turn on the compressor circuit, the 12 VDC coil is activated and the 120 VAC is sent through the relay to the APU (exterior), compressor circuit (RF112).
The heat relay controls 12 DC power used to run the truck's blower fan circuit.
The truck's blower fan circuit is switched to Idle Free battery power whenever the heat relay is activated.
The heat relay is activated by moving the thermostat mode switch to HEAT.
The heat relay is wired to use the normally closed contacts and the normally open contacts, within the relay. When the thermostat is set to the HEAT mode, the 12 VDC coil is activated and 12 VDC fused power from the Idle Free battery bank is sent through the relay, to the truck fan motor and fan control circuits (1 -3).
When the relay is not activated (heat switch is OFF or ignition switch is ON), the normally closed circuit passes through the truck's blower fan power needs with 12 VDC "truck battery power."
The three circuits in this relay are not all used for every truck.
Instructions are included in the installation manual regarding the circuits needed for each truck brand installation application.

Overview

The relay group is controlled by the thermostat.
The thermostat (RF103) sends 12 VDC signals to the individual relays in the relay group.
The relay group contains *ice cube relays.*
Ice cube (type) relays enable the use of both AC and DC voltages through the relay contacts.

Common Issues

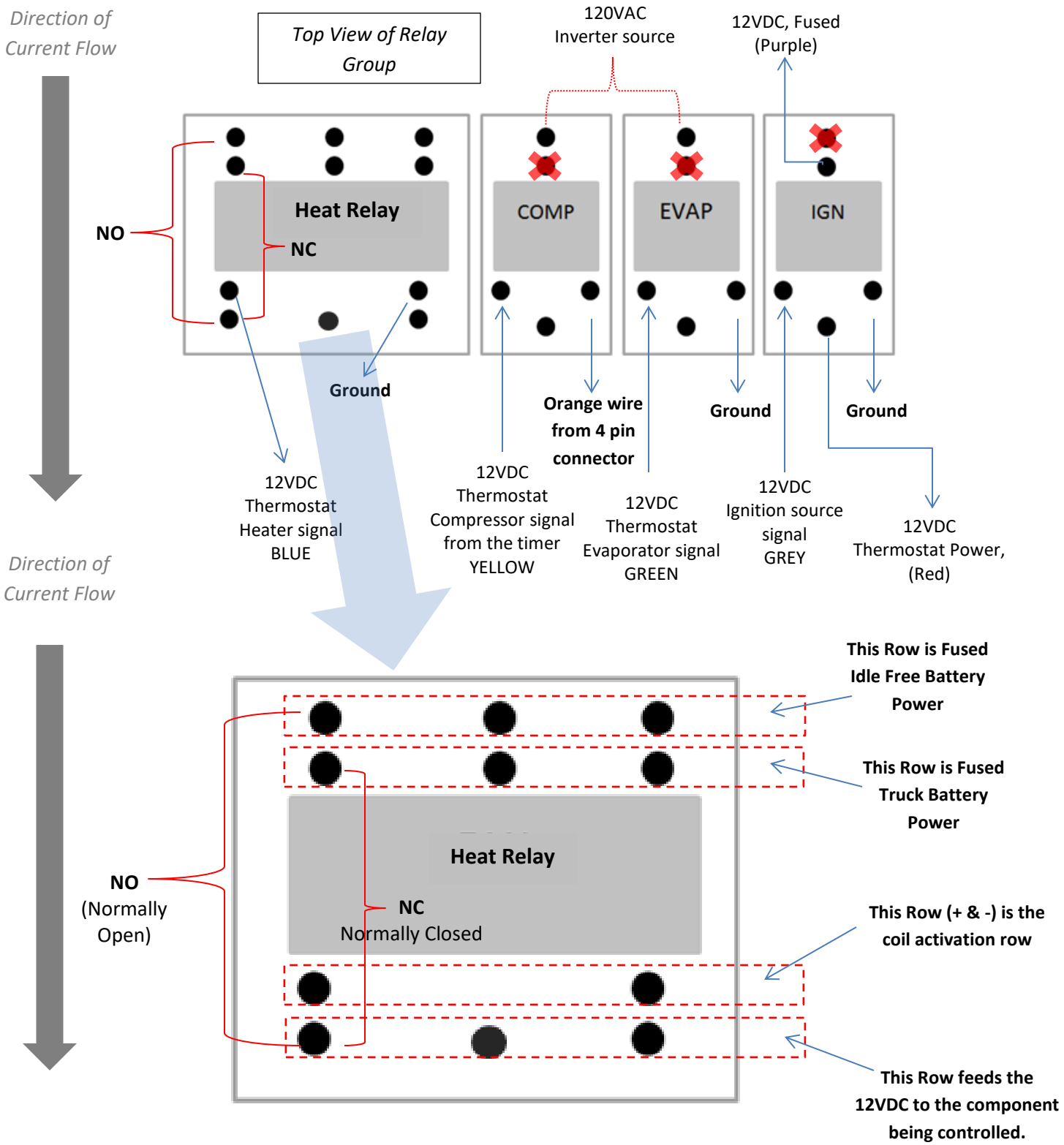
The relay group has no history of issues.

Service

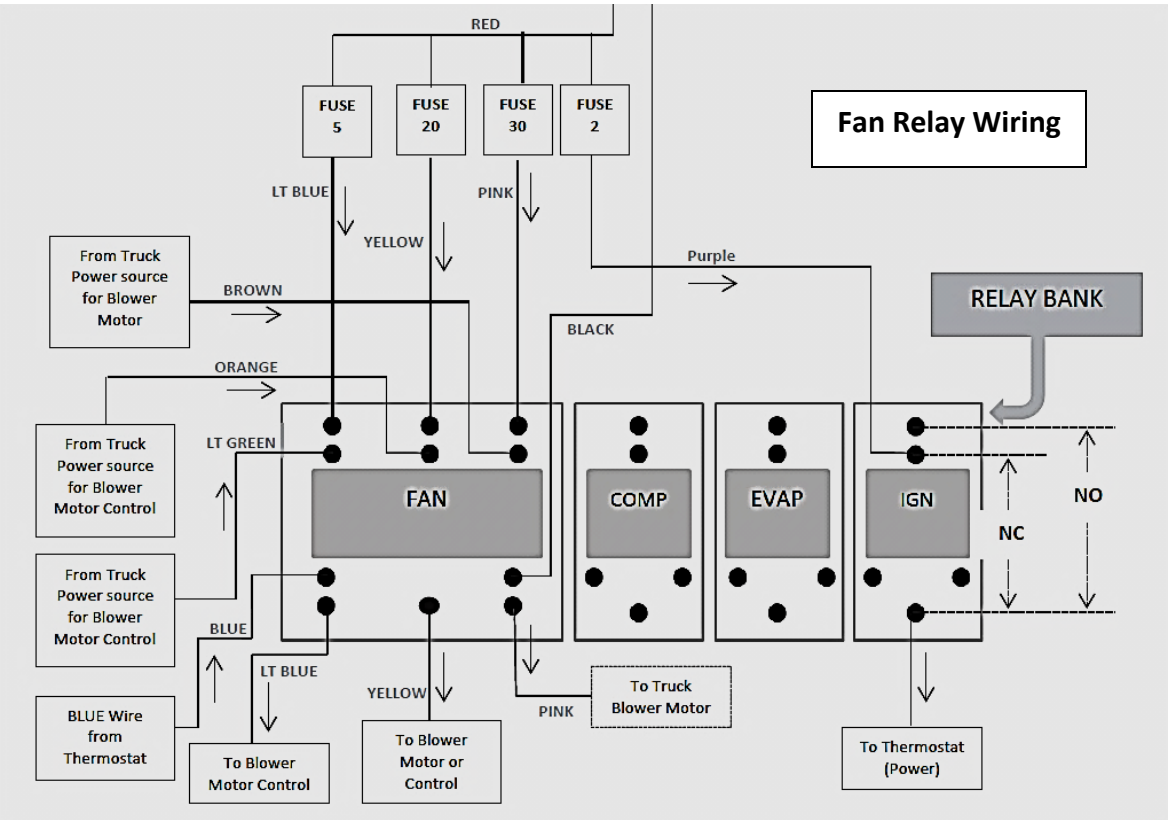
The relay group does not require any service

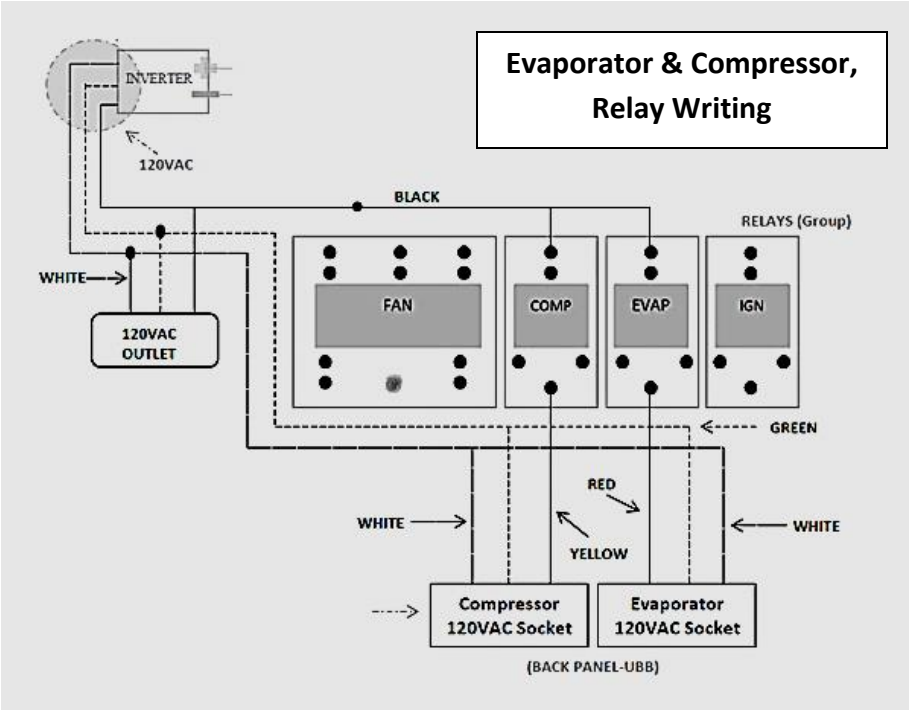
Relay Group– 106.1 RF

✖ = Not Used

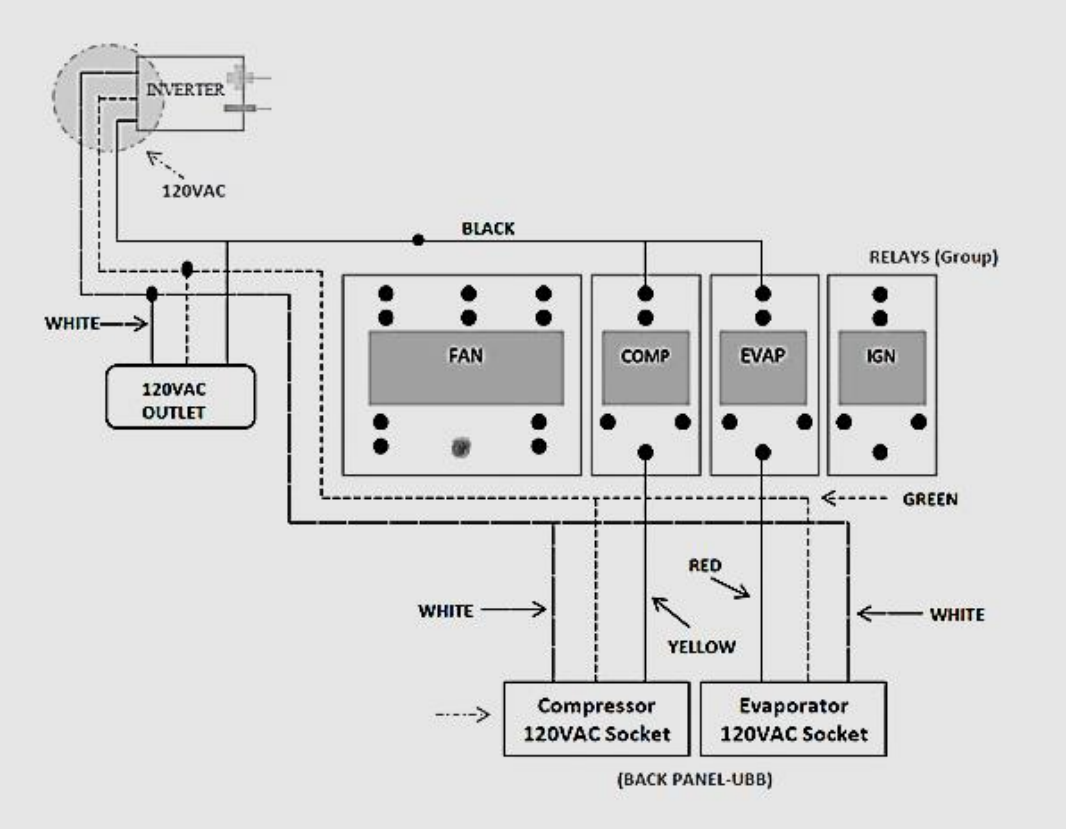


Relay Group– 106.1 RF





Relay Group– 106.1 RF



Troubleshooting:

Use the relay black 18 gauge wires for ground service connections.
Ignition relay must be OFF (not activated) for any of the other relays to receive 12 VDC power.
The evaporator relay and the compressor relay pass through 120 VAC when activated by the thermostat.
The inverter must be turned on with a green or flashing green light located on the GFCI outlet. (RF105).
To check each relay for coil activation, place your volt meter on DC and place probes into the relay coil terminals (page 13). Use the ground for the relay being checked.
The relay 12 VDC+ wires are from the thermostat or the ignition source, colors for 12 VDC coil operation are:

- Grey = ignition relay
- Green = evaporator relay
- Yellow = compressor timer and compressor relay
- Blue = heat relay, (triple relay)

From Thermostat

Relay coils are activated with 12 VDC from thermostat switches.
Thermostat switch position determines 12 VDC to relays.
Ignition relay passes through fused 12 VDC power when truck ignition is turned OFF.
Evaporator relay passes through 120 VAC when thermostat is in COOL mode or fan switch is in ON mode.
Compressor relay passes through 120 VAC when thermostat is in COOL mode and temperature setting is calling for COOL. Compressor relay is delayed eight seconds using a timer relay.
Heat relay passes through 12 VDC when thermostat is in heat mode. Not all heat circuits are used for all trucks.
Fuse panel fuses all three heat circuits (RF108).

Relay Group– 106.1 RF

Power Relays, explanation

Timer for the compressor circuit

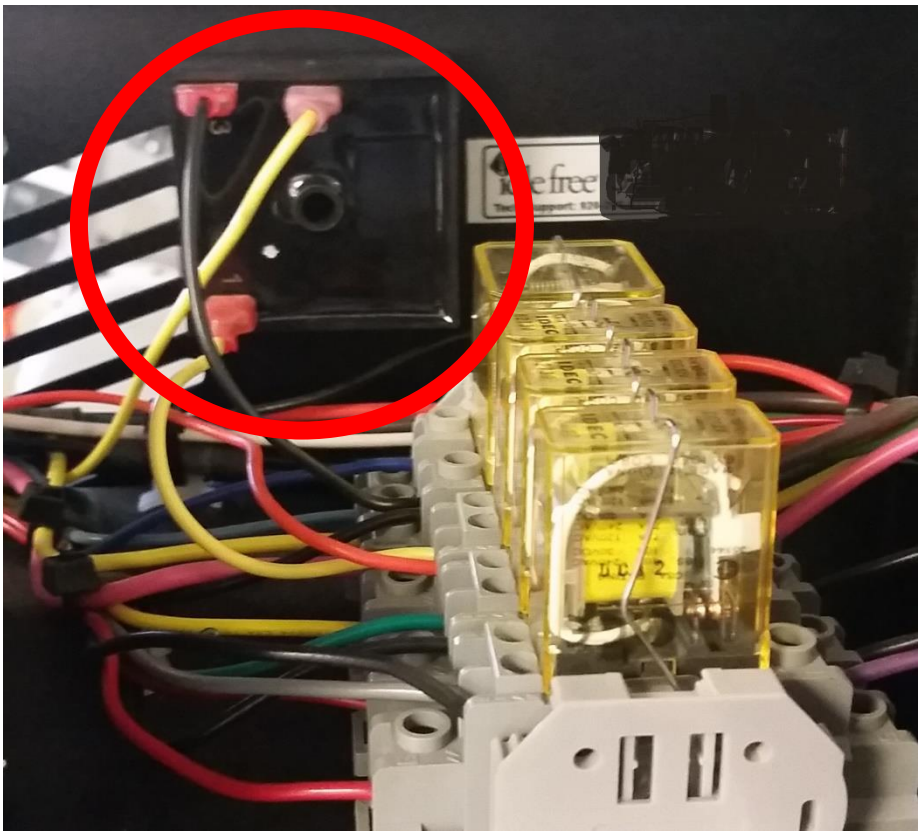
The compressor circuit includes a timer that delays the start of the compressor circuit eight seconds.

The compressor circuit will start eight seconds after the thermostat calls for COOL. During the eight second delay the evaporator fan will come on and be up to full speed.

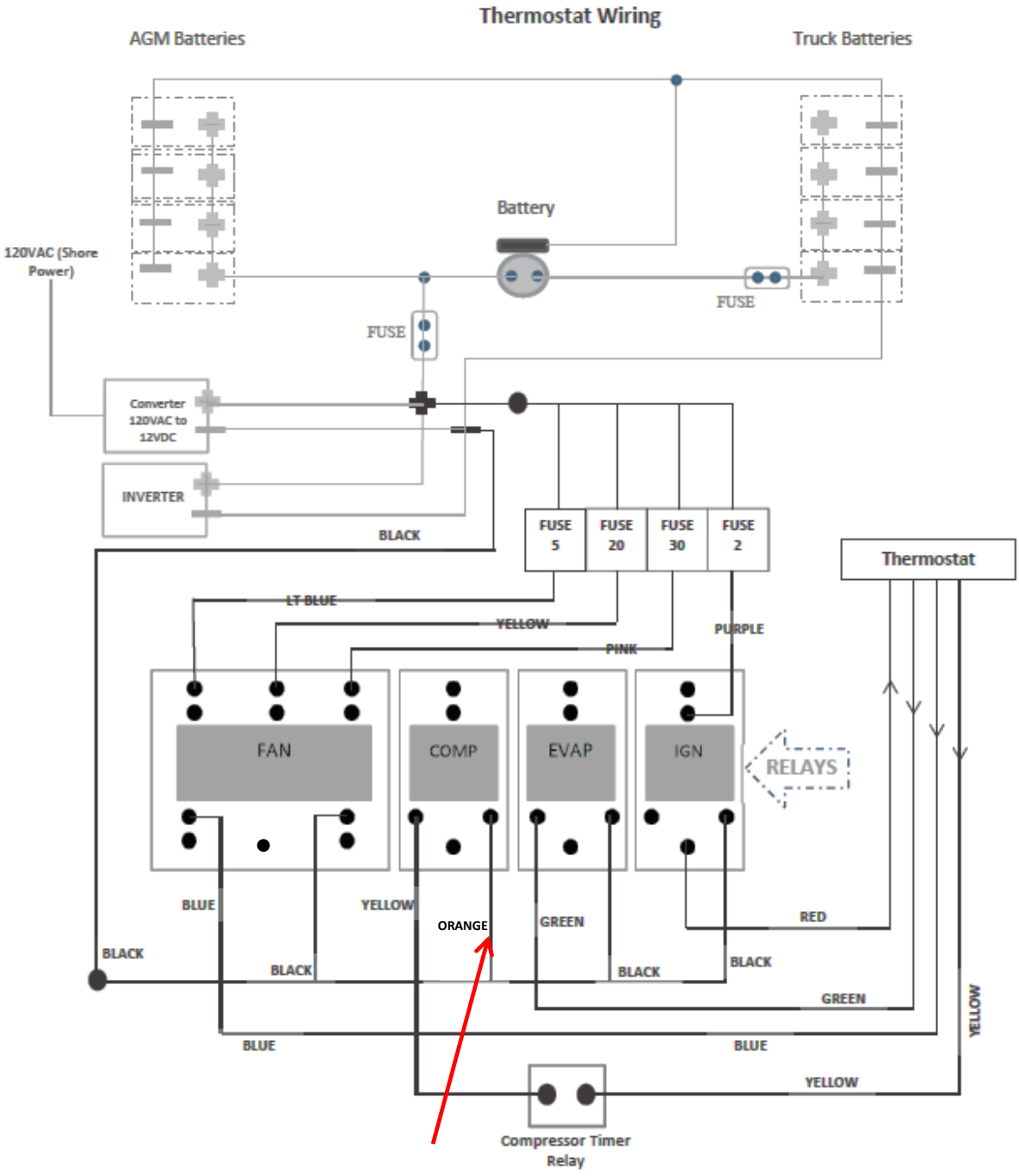
The compressor delay circuit is used to eliminate the added surge power needed to start the evaporator blower fan.

The thermostat sends its 12 VDC signal to the time delay relay prior to the compressor relay.

Under Bed Box (UBB)



Relay Group– 106.1 RF



This wire is orange on 3.7 systems and originates on the exterior located, low pressure switch. This is a ground wire.

Ignition Cut-Out Circuit – 107.0 RF

Ignition Cut-Out Circuit

Component Location

Bunk area
Connected to the back side of the UBB (RF110)
Starts at a truck specific ignition source and powers the UBB ignition relay

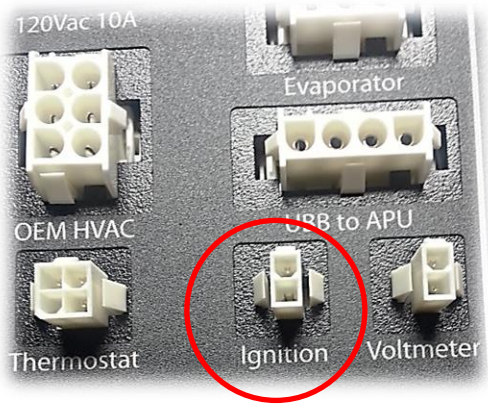
1st relay is ignition

Description & Application

The DC ignition cut-out circuit is used to disable the Idle Free System when the truck's engine is running.
The ignition cut-out circuit sends fused 12 VDC power from the ignition source to the UBB.
The ignition cut-out circuit cuts the 12 VDC power to the thermostat when the truck's engine is running.

Common Issues

1. The ignition cut-out circuit has been installed incorrectly on rare occasions. When the installation instructions are not followed, the ignition cut-out circuit is connected to the accessory circuit instead of an *ignition only* circuit. This causes the Idle Free air conditioner or heater to shut off whenever the truck's ignition key is moved to the accessory position. When the user wants to listen to the radio, the Idle Free System shuts down.
2. The Idle Free System user turns the ignition key to the ON position without turning the air conditioner to the OFF position (thermostat). When the user turns the ignition key back to OFF, the Idle Free air conditioner is forced to start without a five-minute delay (delay is built into the thermostat). The Idle Free air conditioner start attempt (forced) under these conditions may overload the inverter (RF105).



Ignition harness plugs into the back of the UBB

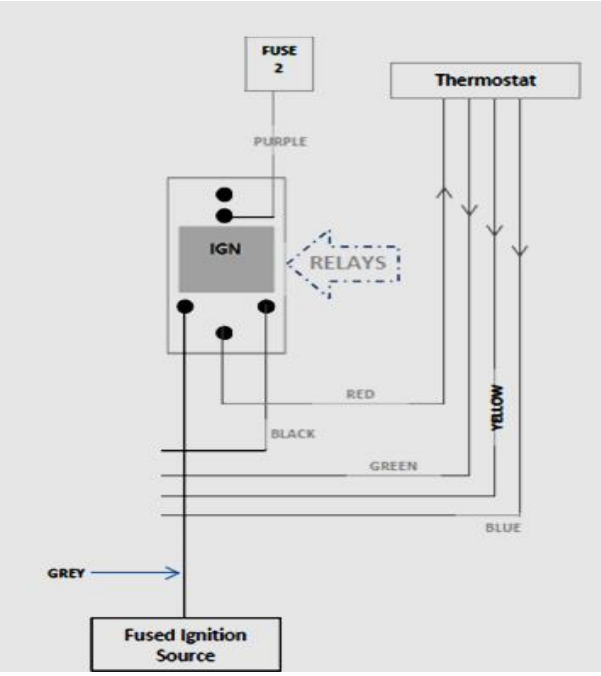
Ignition Cut-Out Circuit – 107.0 RF

Service

The ignition circuit does not require service.
The ignition cut-out fuse location varies by truck application.
The ignition cut-out fuse is located within 12 inches of the ignition connection point.
Freightliner and international trucks begin the ignition cut out circuit at the ignition key.
The Mack ignition cut out circuit begins at the dash panel (passenger side, top).
The Kenworth ignition circuit begins in the fuse panel, on the floor behind the brake pedal.

Do not use the truck's ignition to turn off the air conditioner.

Always use the thermostat mode switch to control air conditioning and heat functions.



DC Fuse Holder – 108.0 RF
DC Fuse Holder - UBB

DC Fuse Holder
IFS Part # 36003

Component Location
Truck Interior
Bunk Area
Connected to the inside, top

Description & Application
The DC fuse holder contains four openings for fuses.
The top fuse is always a 2 AMP fuse that powers the volt meter (RF102) and the thermostat (RF103).
The second fuse from the top powers the bunk blower fan when the Idle Free coolant heater is a part of the system. This fuse is a 30 AMP fuse. *(For Mack and Kenworth trucks the remaining fuse positions are not used.)*
The third and fourth fuses from the top are only used in some (truck specific) applications where bunk heater control is a part of more than one circuit. International, Freightliner and Volvo require fuses place in positions 3 and 4.
When an Idle Free heater is a part of the system, truck specific instructions are included along with the OEM fan harness kit (IFS Part# 91801). Kit 91801 includes the fan harness, installation instructions and fuse placement instructions.

DC Fuse Holder – 108.0 RF

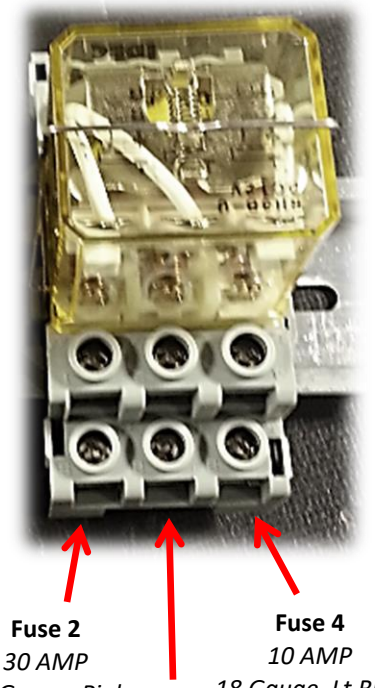
DC Fuse Holder - UBB

Overview

The DC fuse holder may contain up to four fuses.
The top fuse is used in all applications (see above paragraph).
Fuse #2 is used in all heater applications and contains a 30 AMP fuse used to provide power for the bunk blower fan. This fuse supplies fan power whenever the Idle Free heater is activated by turning the thermostat mode switch to heat (RF103).
Fuses 2, 3 and 4 (positions from top) are connected to the bottom row of the heat relay.

Fuse 2 uses a 12-gauge wire.
Fuse 3 uses a 14-gauge wire.
Fuse 4 uses an 18-gauge wire.

Heat Relay
(see RF 106)



Fuse 2
30 AMP
12 Gauge, Pink

Fuse 4
10 AMP
18 Gauge, Lt Blue

Fuse 3
20 AMP
14 Gauge, Yellow

History

The DC fuse holder can be fused incorrectly during installation. Fuse placement instructions are included with every heater harness installation kit.

Reefer Link Connection – RF109

Reefer Link Connection
IFS Part # 91901

Component Location
APU & Reefer Unit

Description & Application
The Idle Free Reefer Link Technology is patented and should not be used to power other battery based APUs.

The reefer unit must have an alternator rating of 65 AMPS or greater.

The Idle Free Reefer Link connection kit should be used to supplement the Idle Free APU system.
The Reefer Link connection kit consists of four parts:

1. APU DC connection cables, internal and panel mount receptacles (fused)
2. Truck connection connector, body and cover
3. Trailer connection connector, body and cover (fused)
4. Truck to trailer interconnects cable set

The Reefer Link connection provides the 12 VDC power available when the refer unit is running to be used to maintain the Idle Free APU battery bank voltage and the truck's 12 VDC battery voltage levels.
Refrigerated trailers have systems in place that start their reefer units when contents of the trailer require temperature management.
Refrigerated trailers have systems in place that start their reefer units when their starter battery requires charging.
Typical refer units will start their engines when the starter battery requires charging. A starter battery voltage of <12.1 VDC will engage the start circuit of the reefer unit. If the Idle Free Reefer Link connection is in place the reefer unit will engage its start circuit whenever the reefer's battery and the Idle Free battery bank drop to <12.1 VDC. The reefer unit will continue to operate until the alternator output amperage drops to <8 AMPS.

Reefer Link Connection – RF109

Description & Application (continued)

When the reefer unit is running with the Idle Free Reefer Link connection in place, the following will take place:

1. Reefer battery and Idle Free battery bank will see alternator output voltage and amperage.
2. Reefer output amperage will be based on:
    a. APU mode (air conditioning or heat)
    b. Battery voltage level of Idle Free battery bank, reefer starter battery, truck starter battery bank.
3. Reefer alternator will close the Idle Free battery separator when the Idle Free battery bank rises to 13.2 VDC.

The truck and trailer can be connected (Reefer Link connection), when the truck is moving, in the event that:

a. Truck's alternator fails
b. Reefer's alternator fails

The truck's alternator can be used to keep the reefer units 12 VDC systems operating by using the Reefer Link connection.
The reefer unit's alternator can be used to keep the truck's 12 VDC systems operating by using the Reefer Link connection.
The reefer unit must have an alternator rating of 65 AMPS or greater.
The reefer connection kit (reefer portion) includes a 250 AMP in line fuse.
The reefer connection kit (reefer portion) DC connections must be made in this way; connect the negative cable to the reefer battery negative post and connect the positive reefer connect positive battery cable to the positive output post on the alternator.
The alternator must be rated at 65 AMPS or greater.
The positive connection must be made at the reefer alternator positive output post.

Overview

The Idle Free Reefer Link system is a controlled DC connection between the truck and the reefer unit.
The Reefer Link connection provides battery charging for the Idle Free APU.
The controlled DC connection between the truck and the trailer allows the truck or the reefer unit to supply power to each other.
In the event a truck alternator or a reefer alternator fail, the Reefer Link connection is used to connect the 12 VDC connections (truck and reefer trailer) together.

Reefer Link Connection – RF109

Overview (continued)

The Idle Free Reefer Link system will allow the reefer unit to start from the Idle Free APU batteries directly by connecting the reefer trailer to the truck using the Reefer Link interconnect cable set.
Using the Reefer Link connection to power the APU has the benefit of using nontaxed fuel for non-road use.

Reefer Link connection kit consists of four parts:

1. *APU DC connection cables, internal and panel mount receptacles (fused).*
   The APU has internal cables added along with DC panel mount receptacles. The added panel mount receptacles added to the side of the APU provide a quick connect point for the truck side of the Reefer Link connection kit. The APU DC connections are fused with a 250 AMP fuse to protect the truck and trailer.
2. *Truck connection connector, body and cover.*
   The truck connection portion is mounted near the connection point on the back of the bunk where the air hoses and electrical cord are housed for the standard truck to trailer connections.
3. *Trailer connection connector, body and cover (fused).*
   The trailer connection kit includes a 250 AMP fuse used to protect the truck and reefer unit from short circuits. The trailer portion of the Reefer Link connection uses a permanent mount for the Anderson connector. This mount is typically mounted near the electrical plug-in and the air-line connection point.
4. *Truck to trailer interconnect cable set.*
   The truck to trailer interconnect cable set is typically kept in the driver's side box. This connection can be made anytime however it is best practice to only mate the truck and trailer together when the need arises or when the truck is stationary.

Service

The Reefer Link connections require regular service. This service includes:

1. Checking for tight connections
2. Checking for clean connections
3. Adding battery terminal protection spray to exposed DC connection points

Reefer Link Connection – RF109

Reefer Link, explanation

Troubleshooting

The Reefer Link connections can be checked using a DC volt meter.

1. Check the reefer side connector for DC voltage by placing the volt meter probes onto the lugs located inside the connector body. The connector body has + or – indicator markings on the connector body near the terminal connection points.
2. If DC voltage is not present, check the 250 AMP fuse, alternator connection and the reefer's battery connections.
3. The truck side Reefer Link connector should always show APU DC battery voltage. Check the connector located on the back side of the bunk for 12 VDC power. If 12 VDC power is not present, check the APU panel-mount connectors (exterior of APU). Remove the panel mount connectors (counter clockwise to remove, clockwise to tighten).
4. You should always have 12 VDC at the APU panel-mount connectors. If no DC is present, remove the back cover from the APU and check for loose or missing cables.

Common Issues

The Reefer Link issues include:

1. Cables between the truck and trailer un-secured during driving periods resulting in lost or broken cables.
2. Wrong DC + connection point (battery + instead of alternator +) resulting in the reefer's control display showing a fault code.

UBB– RF110

UBB, Under Bed Box or
Under Bed Module

Component Location
Truck Interior
Bunk Area
Under Bed, Floor mounted

Description & Application
The UBB (under bed box) is the connection module for the Idle Free System
The UBB contains the following components:

1. Inverter (RF105)
2. AC to DC power supply (shore power) (RF104)
3. Relay group (RF106)
4. DC fuse holder (RF108)
5. Timer relay, compressor circuit (RF106)

The back side of the UBB box contains connection hubs for the following components:

1. DC cables (from APU) (RF113)
2. Ignition harness (RF107)
3. Volt meter (RF102)
4. Thermostat (RF103)
5. Evaporator fan (RF111)
6. Shore power, harness connection point from power inlet plug.
7. Compressor circuit, includes coolant heater signal wire (blue)
8. 120 VAC (10 AMP) connection socket
9. OEM HVAC (fan harness connections for truck bunk blower fan)(RF106)

UBB– RF110

Overview
All components contained in the UBB and all components that plug into the UBB have their own reference sheets (RF).
The underside of the UBB cover includes a troubleshooting guide.

The UBB is used for diagnostic entry into the Idle Free System.
The relay group is tested to see if the DC voltage from the thermostat is reaching the relays.
The inverter GFCI reset is located on the end of the inverter, located in the lower level of the UBB (RF105).

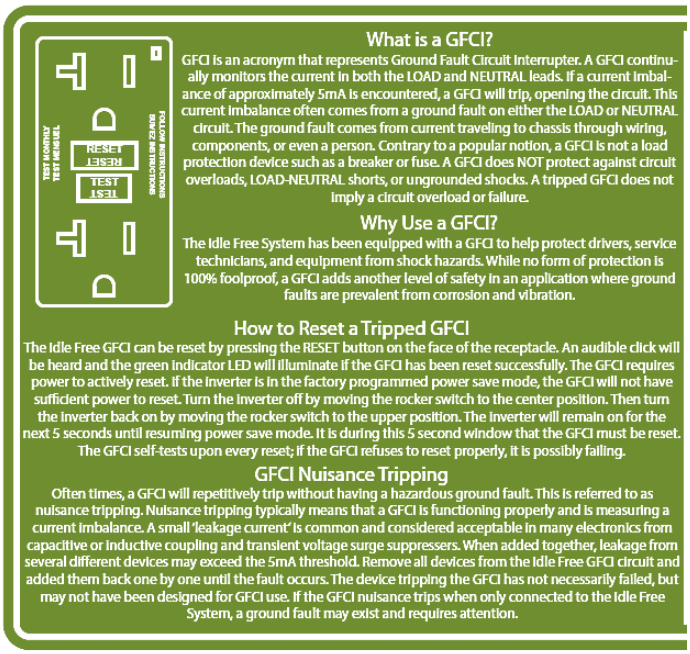
Common Issues
The UBB has a history of involving GFCI tripping of the inverter or red light conditions on the inverter. These issues go away after the driver better understands how to properly use the system (RF105).

Service
The UBB does not require any service however connection quality needs to be maintained and proper ventilation needs to be present around the UBB to allow for air flow to the inverter and the AC to DC power converter.

This document pertains to systems that have serial numbers that begin with 36.

UBB– RF 110

Under Bed Box, Explained



What is a GFCI?

GFCI is an acronym that represents Ground Fault Circuit Interrupter. A GFCI continually monitors the current in both the LOAD and NEUTRAL leads. If a current imbalance of approximately 5mA is encountered, a GFCI will trip, opening the circuit. This current imbalance often comes from a ground fault on either the LOAD or NEUTRAL circuit. The ground fault comes from current traveling to chassis through wiring, components, or even a person. Contrary to a popular notion, a GFCI is not a load protection device such as a breaker or fuse. A GFCI does NOT protect against circuit overloads, LOAD-NEUTRAL shorts, or ungrounded shocks. A tripped GFCI does not imply a circuit overload or failure.

Why Use a GFCI?

The Idle Free System has been equipped with a GFCI to help protect drivers, service technicians, and equipment from shock hazards. While no form of protection is 100% foolproof, a GFCI adds another level of safety in an application where ground faults are prevalent from corrosion and vibration.

How to Reset a Tripped GFCI

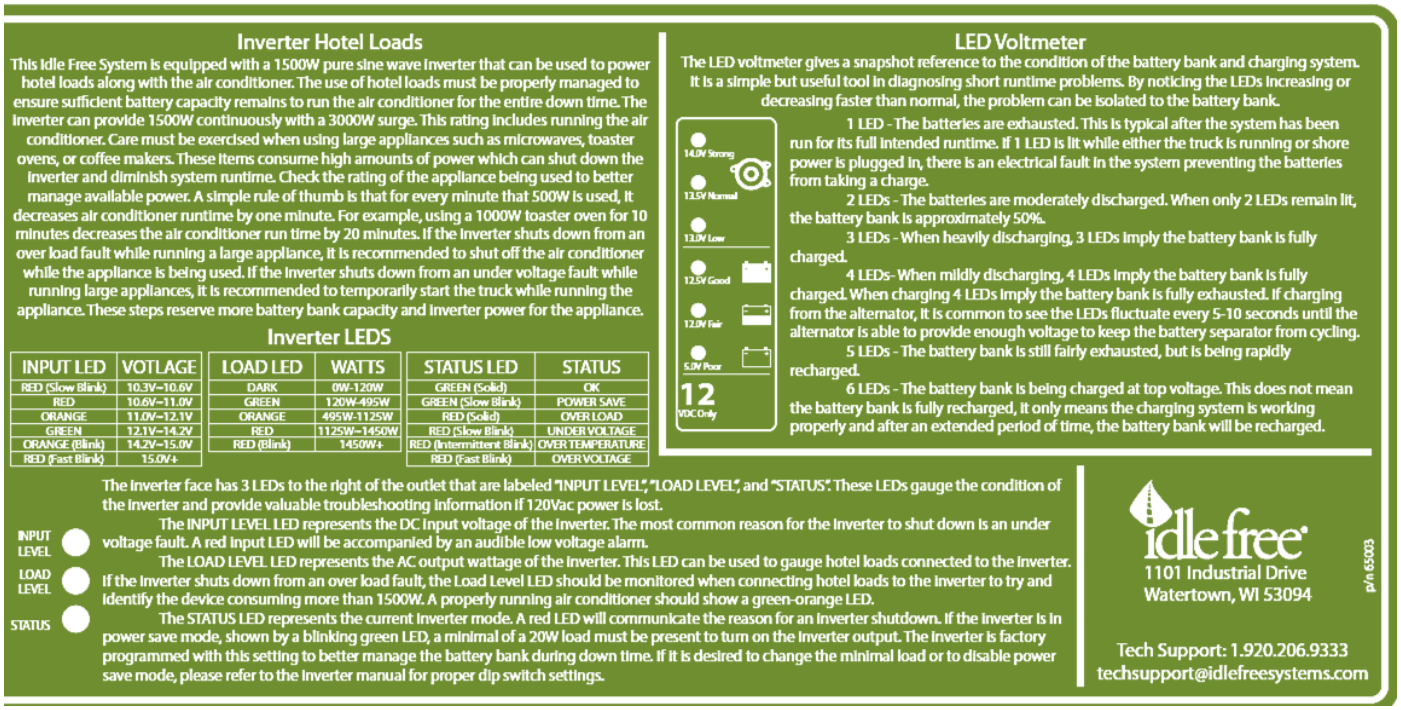
The Idle Free GFCI can be reset by pressing the RESET button on the face of the receptacle. An audible click will be heard and the green indicator LED will illuminate if the GFCI has been reset successfully. The GFCI requires power to actively reset. If the inverter is in the factory programmed power save mode, the GFCI will not have sufficient power to reset. Turn the inverter off by moving the rocker switch to the center position. Then turn the inverter back on by moving the rocker switch to the upper position. The inverter will remain on for the next 5 seconds until resuming power save mode. It is during this 5 second window that the GFCI must be reset. The GFCI self-tests upon every reset; if the GFCI refuses to reset properly, it is possibly failing.

GFCI Nuisance Tripping

Often times, a GFCI will repetitively trip without having a hazardous ground fault. This is referred to as nuisance tripping. Nuisance tripping typically means that a GFCI is functioning properly and is measuring a current imbalance. A small 'leakage current' is common and considered acceptable in many electronics from capacitive or inductive coupling and transient voltage surge suppressers. When added together, leakage from several different devices may exceed the 5mA threshold. Remove all devices from the Idle Free GFCI circuit and added them back one by one until the fault occurs. The device tripping the GFCI has not necessarily failed, but may not have been designed for GFCI use. If the GFCI nuisance trips when only connected to the Idle Free System, a ground fault may exist and requires attention.

1/3 of the label under the UBB Cover

2/3 of the label under the UBB Cover



Inverter Hotel Loads

This Idle Free System is equipped with a 1500W pure sine wave inverter that can be used to power hotel loads along with the air conditioner. The use of hotel loads must be properly managed to ensure sufficient battery capacity remains to run the air conditioner for the entire down time. The inverter can provide 1500W continuously with a 3000W surge. This rating includes running the air conditioner. Care must be exercised when using large appliances such as microwaves, toaster ovens, or coffee makers. These items consume high amounts of power which can shut down the inverter and diminish system runtime. Check the rating of the appliance being used to better manage available power. A simple rule of thumb is that for every minute that 500W is used, it decreases air conditioner runtime by one minute. For example, using a 1000W toaster oven for 10 minutes decreases the air conditioner run time by 20 minutes. If the inverter shuts down from an over load fault while running a large appliance, it is recommended to shut off the air conditioner while the appliance is being used. If the inverter shuts down from an under voltage fault while running large appliances, it is recommended to temporarily start the truck while running the appliance. These steps reserve more battery bank capacity and inverter power for the appliance.

Inverter LEDS

INPUT LED	VOTLAGE
RED (Slow Blink)	10.3V–10.6V
RED	10.6V–11.0V
ORANGE	11.0V–12.1V
GREEN	12.1V–14.2V
ORANGE (Blink)	14.2V–15.0V
RED (Fast Blink)	15.0V+

LOAD LED	WATTS
DARK	0W-120W
GREEN	120W-495W
ORANGE	495W-1125W
RED	1125W–1450W
RED (Blink)	1450W+

STATUS LED	STATUS
GREEN (Solid)	OK
GREEN (Slow Blink)	POWER SAVE
RED (Solid)	OVER LOAD
RED (Slow Blink)	UNDER VOLTAGE
RED (Intermittent Blink)	OVER TEMPERATURE
RED (Fast Blink)	OVER VOLTAGE

LED Voltmeter

The LED voltmeter gives a snapshot reference to the condition of the battery bank and charging system. It is a simple but useful tool in diagnosing short runtime problems. By noticing the LEDs increasing or decreasing faster than normal, the problem can be isolated to the battery bank.

14.0V Strong
13.5V Normal
13.0V Low
12.5V Good
12.0V Fair
5.0V Poor
12 VDC Only

1 LED - The batteries are exhausted. This is typical after the system has been run for its full intended runtime. If 1 LED is lit while either the truck is running or shore power is plugged in, there is an electrical fault in the system preventing the batteries from taking a charge.

2 LEDs - The batteries are moderately discharged. When only 2 LEDs remain lit, the battery bank is approximately 50%.

3 LEDs - When heavily discharging, 3 LEDs imply the battery bank is fully charged.

4 LEDs- When mildly discharging, 4 LEDs imply the battery bank is fully charged. When charging 4 LEDs imply the battery bank is fully exhausted. If charging from the alternator, it is common to see the LEDs fluctuate every 5-10 seconds until the alternator is able to provide enough voltage to keep the battery separator from cycling.

5 LEDs - The battery bank is still fairly exhausted, but is being rapidly recharged.

6 LEDs - The battery bank is being charged at top voltage. This does not mean the battery bank is fully recharged, it only means the charging system is working properly and after an extended period of time, the battery bank will be recharged.

INPUT LEVEL
LOAD LEVEL
STATUS

The inverter face has 3 LEDs to the right of the outlet that are labeled "INPUT LEVEL", "LOAD LEVEL", and "STATUS". These LEDs gauge the condition of the inverter and provide valuable troubleshooting information if 120Vac power is lost.

The INPUT LEVEL LED represents the DC input voltage of the inverter. The most common reason for the inverter to shut down is an under voltage fault. A red input LED will be accompanied by an audible low voltage alarm.

The LOAD LEVEL LED represents the AC output wattage of the inverter. This LED can be used to gauge hotel loads connected to the inverter. If the inverter shuts down from an over load fault, the Load Level LED should be monitored when connecting hotel loads to the inverter to try and identify the device consuming more than 1500W. A properly running air conditioner should show a green-orange LED.

The STATUS LED represents the current inverter mode. A red LED will communicate the reason for an inverter shutdown. If the inverter is in power save mode, shown by a blinking green LED, a minimal of a 20W load must be present to turn on the inverter output. The inverter is factory programmed with this setting to better manage the battery bank during down time. If it is desired to change the minimal load or to disable power save mode, please refer to the inverter manual for proper dip switch settings.

idle free
1101 Industrial Drive
Watertown, WI 53094

Tech Support: 1.920.206.9333
techsupport@idlefreesystems.com

p/n 65003

UBB– RF110

10 AMP, 120 VAC power outlet

Shore power plug = ground – center, neutral and hot 120 VAC outside terminals

Evaporator = Ground – center, neutral and hot 120 VAC outside terminals, on when thermostat is in cool mode or thermostat fan switch turned ON.

OEM Fan Harness:
Top terminals, 12 GA, 30 AMP
Middle terminals, 14 GA, 20 AMP
Bottom terminals, 18 GA, 10 AMP

UBB to APU = Ground –2 from right, neutral and hot 120 VAC outside of ground terminal, far terminal is heater on signal, blue 18 gauge wire. 120 VAC on when thermostat calls for COOL.

Thermostat, 4 WIRE, **RED** = 12 VDC, to thermostat
GREEN = Evaporator relay, 12 VDC, from thermostat
YELLOW = Compressor relay, 12 VDC, from thermostat to timer delay relay
BLUE = Heater relay, 12 VDC, from thermostat

Volt meter, on when 2 AMP fuse is in holder

Ignition, single grey wire from truck ignition source, fused input from source

250 AMP fused power from AGM batteries trough RED DC connector on rear side of APU (IFS#32043)

Ground cable from AGM battery power, through black DC connector on rear side of APU (IFS#32045)

UBB– RF110.1

UBB, Under Bed Box or
Under Bed Module

Component Location
Truck Interior
Bunk Area

Description & Application
The UBB (Under Bed Box) is the connection module for the Idle Free System
The UBB contains the following components:

1. Inverter (RF105)
2. AC to DC power supply (shore power) (RF104)
3. Relay group (RF106)
4. DC fuse holder (RF108)
5. Timer relay, compressor circuit (RF106)

The back side of the UBB box contains connection hubs for the following components:

1. DC cables (from APU) (RF113)
2. Ignition harness (RF107)
3. Volt meter (RF102)
4. Thermostat (RF103)
5. Evaporator fan (RF111)
6. Shore power, harness connection point from power inlet plug.
7. Compressor circuit, includes coolant heater signal wire (blue)
8. 120 VAC (10 AMP) connection socket
9. OEM HVAC (fan harness connections for truck bunk blower fan) (RF106)

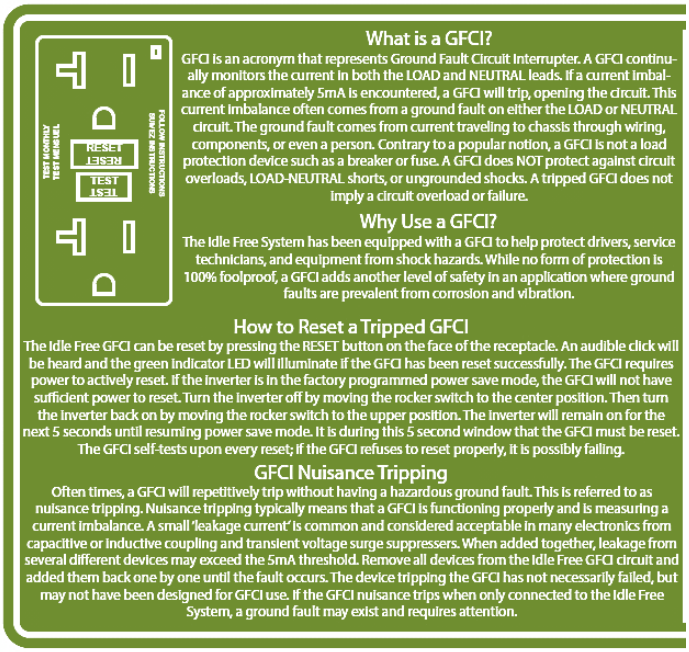
Overview
All components contained in the UBB and all components that plug into the UBB have their own reference sheets (RF).
The underside of the UBB cover includes a troubleshooting guide.

The UBB is used for diagnostic entry into the Idle Free System. The relay group is tested to see if DC voltage from the thermostat is reaching the relays. The inverter GFCI reset is located on the end of the inverter, located in the lower level of the UBB (RF105).

Common Issues
The UBB has a history involving GFCI tripping of the inverter or red light conditions on the inverter. These issues go away after the driver better understands how to properly use the system (RF105).

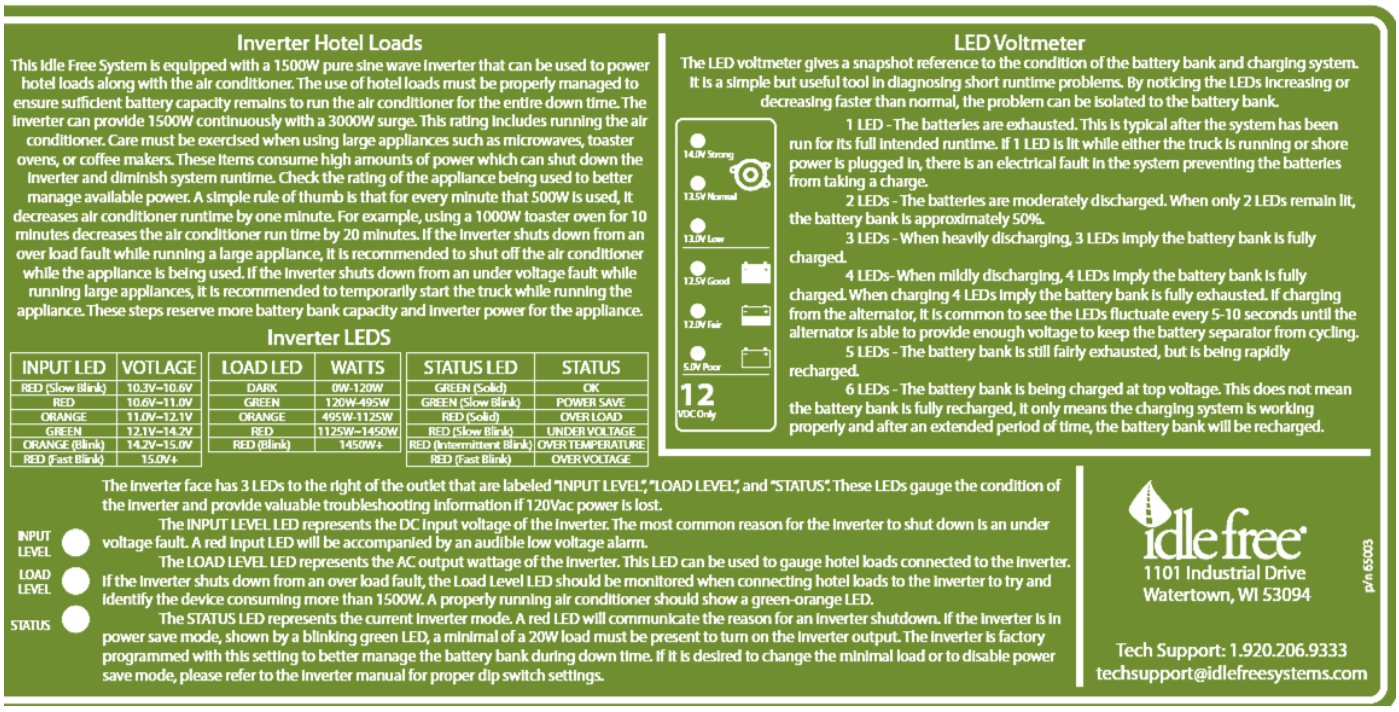
Service
The UBB does not require any service however connection quality needs to be maintained and proper ventilation needs to be present around the UBB to allow for air flow to the inverter and the AC to DC power converter.

UBB– RF110.1



1/3 of the label under the UBB Cover

2/3 of the label under the UBB Cover



UBB– RF110.1

10 AMP, 120 VAC power outlet

Shore power plug = Ground – center, neutral and hot 120 VAC outside terminals

Evaporator = Ground – center, neutral and hot 120 VAC outside terminals, on when thermostat is in cool mode or thermostat fan switch turned ON.

OEM Fan Harness:
Top Terminals, 12 GA, 30 AMP
Middle Terminals, 14 GA, 20 AMP
Bottom Terminals, 18 GA, 10 AMP

UBB to APU = Ground for compressor relay, neutral and hot 120 VAC outside of ground terminal, far terminal is heater on signal, blue 18 gauge wire. 120 VAC on when thermostat calls for COOL.

Thermostat, 4 WIRE, **RED** = 12VDC, to thermostat
GREEN = Evaporator relay, 12 VDC, from thermostat
YELLOW = Compressor relay, 12VDC, from thermostat to timer delay relay
Blue = Heater relay, 12 VDC, from thermostat

Volt meter, on when 2 AMP fuse is in holder

Ignition, single grey wire from truck ignition source, fused input from source

250 AMP fused power from AGM batteries trough RED DC connector on rear side of APU (IFS#32043)

Ground cable from AGM battery power, through black DC connector on rear side of APU (IFS#32045)

Condenser Fan – 142.0 RF

Condenser Fan
IFS Part # 34004i

Component Location
Truck exterior – frame rail unit

Description
The condenser fan is located on the cover of the frame rail unit
The condenser fan utilizes 12V power
The condenser fan's fuse (20 AMP) is located in an inline fuse holder near the battery separator

Overview
Operation of the condenser fan is controlled by the compressor circuit
The condenser fan is turned on once the air conditioner's high-side pressure reaches 155 pounds
The condenser fan will continue to operate as long as the air conditioner's compressor is running
The condenser fan will operate for 5 to 15 minutes after the air conditioner's compressor shuts down. This aids in lowering the high-side refrigerant pressure

Common Issues
The condenser fan must be unplugged prior to removing the cover of the frame rail unit
The condenser fan must be plugged in whenever the frame rail unit cover is in place

Service

The condenser fan should be washed with a hose or pressure washer every three months

Condenser Fan Switch – RF133

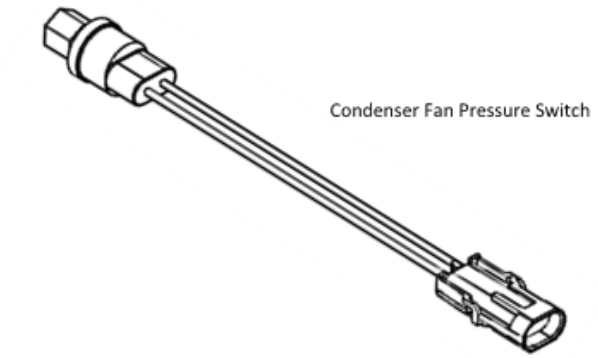
Condenser Fan Pressure Switch
IFS Part #37028

Component Location
Truck Exterior
APU, Top Level

Description & Application
The condenser fan pressure switch is connected to a 90-degree Schrader fitting which connects to the drier
The switch controls the condenser fan by closing at 150 pounds and opening at about 100 pounds
This switch is used to cycle “ON and OFF” the condenser fan

Condenser Fan pressure switch – Service
The condenser fan pressure switch does not require service

90 Degree Schrader Fitting



Evaporator Module – RF111

Evaporator Module
IFS #91301
Component Location
Truck Interior
Bunk Area
Located in the closet, on the closet, on a bunk side wall

Description & Application
The evaporator module contains an evaporator coil, an electric blower fan and an expansion valve.
The evaporator's blower fan is a single speed, 120 VAC fan, controlled by the thermostat switch settings (RF103) and the relay group (RF106).
The evaporator coil and expansion valve control 134A refrigerant.
The evaporator module has two refrigerant hoses, a drain hose and a power cord exiting out the bottom of the module.
The refrigerant and drain hoses leave the bunk area through a 2" hole drilled into the base of the closet.

Overview
The Idle Free evaporator module is installed into the living area of the bunk.

Evaporator Module – RF111

Service

The Idle Free evaporator has a removable aluminum filter that must be cleaned (water) in order to maximize performance.

Common Issues

The evaporator must be maintained in a way that allows air to reach the rear side filter.

Keep driver's personal belongings away from the evaporator's air intake (coil and filter)

During installation ensure the screws used to secure the evaporator are not driven through the refrigerant core or the blower motor.

Suggestion; have user place the right thermostat switch (RF103) into the ON position, not the AUTO position. Leaving the thermostat in the ON position when in air conditioning mode will keep the room in a consistent temperature range.

Troubleshooting

The evaporator fan receives its 120 VAC power from the inverter. The inverter must have a green status light or a flashing green status light to enable the evaporator fan.

The thermostat must have its fan switch in the ON position to activate this fan motor OR the thermostat must be in the COOL mode with a temperature set to below the current bunk temperature.

The thermostat sends 12 VDC to the evaporator relay.

The evaporator relay (UBB, ice cube relay) passes through 120 VAC when the relay coil receives 12 VDC power (green wire) from the thermostat.

The connection point for the evaporator is the UBB back side, three pin connector, second from the top, marked EVAPORATOR.

The outside pins are used to test for 120 VAC power, red and white wires.

Compressor Circuit, APU– RF112

Compressor Circuit

Component Location

Truck Exterior

APU Frame Mount

Top Level, Harness

Description & Application

The compressor circuit connects the following components together:

1. Compressor
2. Overload switch (compressor top)
3. Run capacitor
4. Start capacitor
5. Pressure switch (drier top)
6. In-line neutral connection

All components listed above use 120 VAC.

Overview

1. The 120 VAC circuit begins in the APU with two black wires connected to the pressure switch located on top of the d ryer top. These connectors require a tight fit.
2. The next connection in the compressor circuit connects two in-line connectors together, blue wire into a white wire, using a male and a female connector, push together type. These connectors require a tight fit.
3. The next connection point is the run capacitor. The run capacitor has five connections divided into two connection points. (See Figure #2). These connectors require a tight fit.
4. The next component is the start capacitor. The start capacitor is connected to the run capacitor using the two black wires, see Figure #2.
5. The next connection is the compressor top connections. Four connectors are located under the plastic cover. The heat overload switch receives the black wire from the dryer top. The short wire that leaves the overload switch connects to the **C** terminal on the compressor top. The red wire from the run capacitor connects to the top of the compressor onto the **S** terminal. The remaining compressor top terminal is the **R** terminal and this terminal receives the blue wire from the run capacitor. These connections require a tight fit.

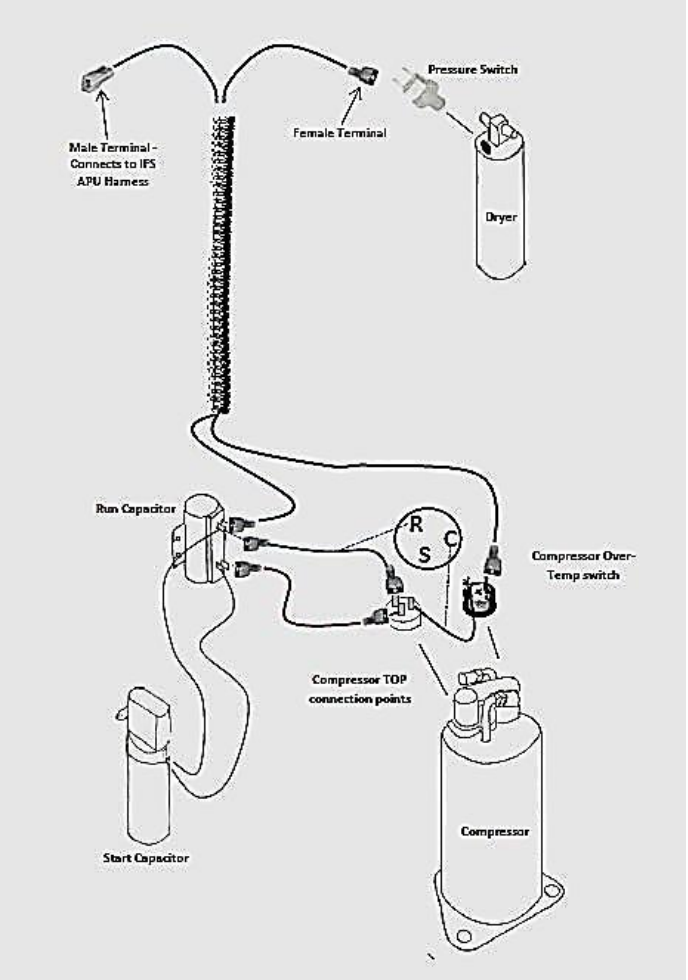


Figure 1

Run Capacitor Top

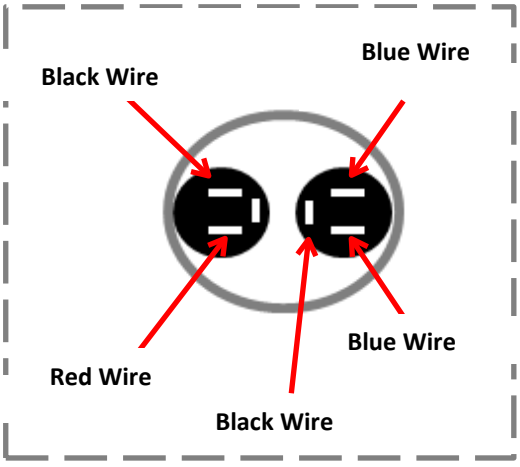


Figure 2

Compressor Circuit, APU– RF112

Common Issues

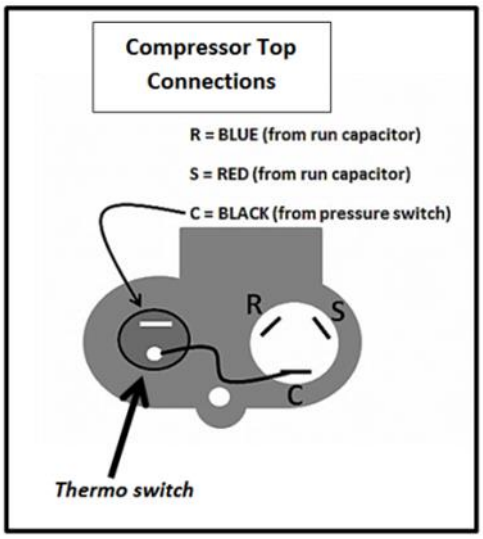
The compressor circuit has two areas to focus in on; start capacitor and pressure switch (drier top connections). These connections are the focal point when the compressor fails to start.

Service

The compressor circuit needs to be maintained with tight connections. All components and connections need to be inspected for cleanliness, tightness and corrosion treatment (prevention).

Compressor Circuit, APU– RF112.1

Compressor, 3.7 systems
IFS part number: 59014



Component Location
Truck Exterior
APU frame rail unit
Top right side

Description
The compressor circuit connects the following components together.

1. Compressor
2. Overload switch (compressor, top location)
3. Run Capacitor
4. Start capacitor

All components operate using 120 VAC
The compressor top includes an electrical connection hub (3 wires) and an overload thermal switch. These connections are located under the black plastic cover.

Service (Annual)
Check the compressor connection tightness of the top connectors

Compressor Troubleshooting
The compressor requires the following to operate:

1. Inverter in the “ON” position (or Stand-By Mode)
2. UBB power cord plugged into the inverter’s 120 volt GFCI outlet
3. GFCI outlet, not tripped
4. Ignition key switch in the “OFF” or “accessory” position
5. 12VDC power leaving the ignition relay (RF107, RF106) feeding the thermostat
6. Thermostat mode switch set to “COOL” (not in the 5 minute shut down “MODE” RF103)
7. 12VDC coil power (18-gauge yellow wire) at compressor relay (RF106)
8. 120VAC power (14 gauge) leaving the compressor relay (RF106)
9. 120VAC power at the compressor connection, rear of the UBB (RF110)

Compressor Circuit, APU– RF112.1

Compressor Troubleshooting (Continued)

10. 120VAC power on the compressor top, thermo-overload switch (RF120).
11. Run capacitor must be connected to the compressor (RF122)
12. Start Capacitor must be connected to the run capacitor(RF122)

Common Issues

The compressor circuit is not operating because:

- The ignition key has been cycled (on/off) and this action has activated the 5-minute delay circuit (RF128).
- The inverter's GFCI outlet has tripped (RF11)
- The start capacitor has failed (RF122)
- The inverter has been overloaded (RF11).
- The compressor's internal circuit protection has been activated and time to cool down is needed prior to the compressor operating.

8 Second + 5 Minute Delay Circuit – RF128

Description & Application

8 second + 5-minute Compressor Delay Circuit

Component Location

UBB, Top Shelf, Back Wall

8 second + 5-minute delay circuit is factory installed starting 12/05/2014

Idle Free serial numbers >36U14120512

The relay delay timer (37022) will delay the compressor activation eight seconds and will include a five-minute delay circuit that will prevent the compressor from starting for five minutes, anytime power is cut to the compressor circuit.

Delay timer relay (37022) eliminates compressor hard starts caused by the truck's ignition being turned on for less than five minutes.

Delay timer relay #37022 uses three terminals instead of two terminals used on delay timer relay #37020 (previous delay method used prior to this one).

Delay timer relay #37022 is wired:

1. To the compressor relay +, yellow, 18-gauge wire
2. From the thermostat +, yellow, 18-gauge wire
3. To the heat relay ground connection point, black, 18-gauge wire

37022 Delay Timer, UBB, 5 min

Diagnostics

Question: Has the truck's ignition key been moved to the ON position in the last five minutes?

The delay timer relay (#37022) only affects the compressor circuit. *If the thermostat is in COOL and AUTO modes, the evaporator fan is running will confirm the delay timer is in its five minute shut down period.*

Confirm that the driver is shutting down the air conditioner with the ignition key instead of the thermostat.

Remind the system operator to always shut down the air conditioner with the thermostat!

Remember the inverter will show a solid red light if the compressor did not start.

This document pertains to systems that have serial numbers that begin with 36. Serial numbers starting with 37 do not require service on these connections.

120 Volt Connections – RF152

Service Procedures

The Idle Free air conditioning 120 volt harness requires service to ensure proper system operation and performance.

When the Idle Free APU connections are dirty or loose, the Idle Free inverter's GFCI may trip or the inverter may overload and shutdown.

An overloaded inverter (shown with a red status light, face of the inverter) may be caused by the start capacitor not engaging (needed to start the compressor) because the start capacitor connectors are dirty or loose.

The Idle Free inverter's GFCI outlet may trip due to dirty connections leaking voltage back to the inverter.

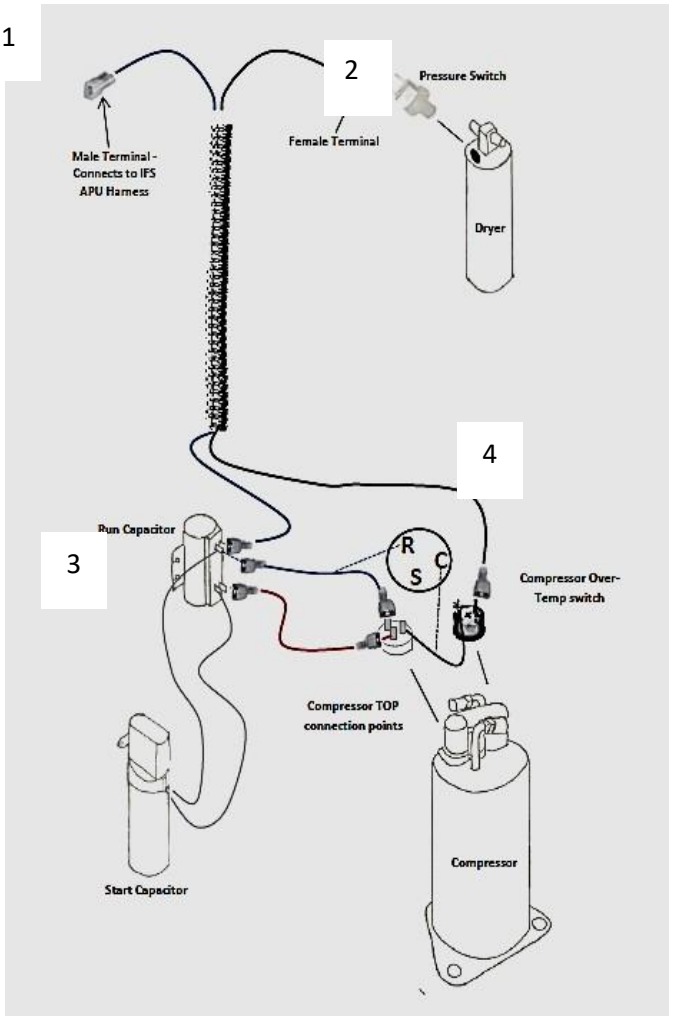
Warning: Before any maintenance or repair can be conducted ensure that all capacitors are discharged safely in the system. Failure to do so can lead to death or serious injury.

Service

APU, 120-volt air conditioner harness connections

Service needs: _

Clean, tighten and protect all 120 volt APU connection terminals.



Connection Terminals – (13 total)

1. Harness input, (white to blue, neutral)
2. Harness input pressure switch (drier), 2 connections (black, hot)
3. Run capacitor, five connections
4. Compressor top, four connections

Tools Needed

- Needle nosed pliers
- Side cutters
- Tie-straps, 8 inch, narrow

Procedure Overview

1. The tie straps currently securing the 120 volt, APU air conditioning harness need to be removed to allow all connections to be serviced.
2. All connections need to be removed, cleaned and tightened to ensure a tight fit onto the appropriate connection point.
3. All connections (cleaned and properly tightened need to be treated with an appropriate preventative terminal protection spray.

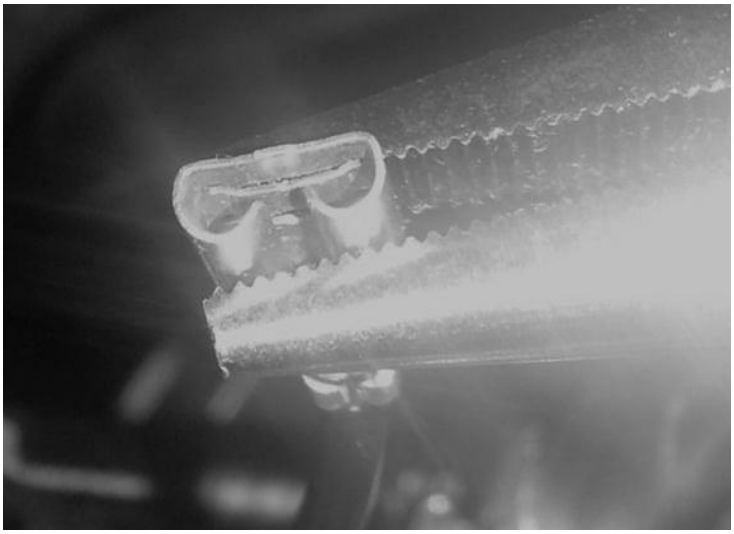
120 Volt Connections – RF152

Service Procedures

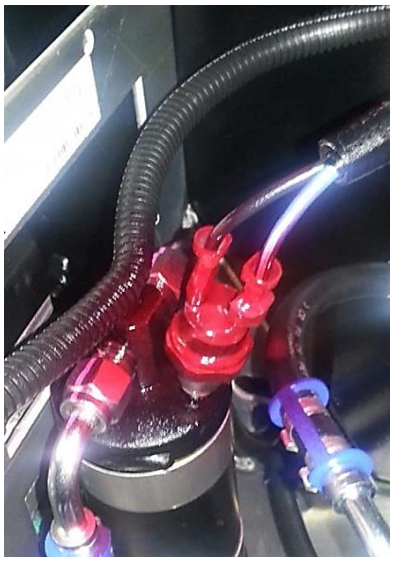
Thermostat must be in the OFF position!

Pressure Switch Connections (2, female push-on, black wire)

1. Remove pressure switch (drier) connectors.
2. Clean pressure switch terminals.
3. Tighten crimped female push-on terminals using needle nosed pliers, tighten to near closed.
4. Return crimped and tightened terminals to the pressure switch terminals.
5. Spray pressure switch connection points with the battery terminal protection spray.



Pressure switch should look like this after the terminals are removed, cleaned, tightened, replaced and treated with the battery terminal protection spray.

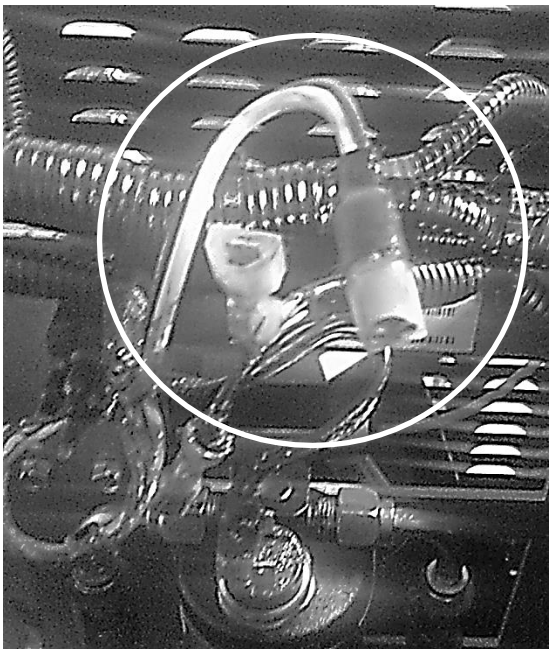


=

This document pertains to systems that have serial numbers that begin with 36. Serial numbers starting with 37 do not require service on these connections.

120 Volt Connections -RF152

Service Procedures



Thermostat must be in the OFF position!

Harness input, (white to blue, neutral)

1. Locate the neutral white on the IFS 120-volt air conditioning harness. The neutral wires are connected in line above the drier, white wire connected to a blue wire, male pushed into a female.
2. Clean both connectors (terminals).
3. Tighten female terminal using needle nosed pliers, tighten to near closed.
4. Connect crimped and tightened terminals together.
5. Spray pressure switch connection points with the battery terminal protection spray.

=

This document pertains to systems that have serial numbers that begin with 36. Serial numbers starting with 37 do not require service on these connections.

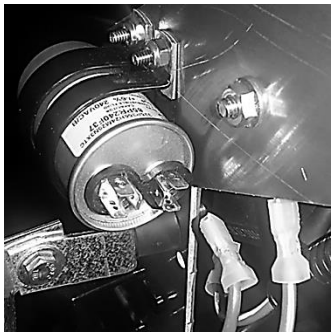
120 Volt Connections – RF152

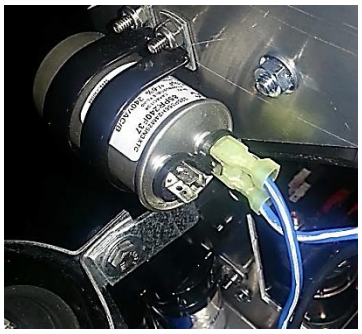
Service Procedures

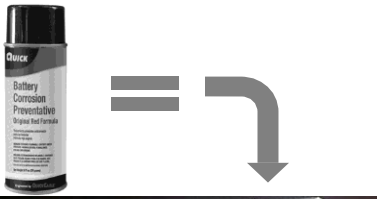
Thermostat must be in the OFF position!

Run Capacitor, five connections

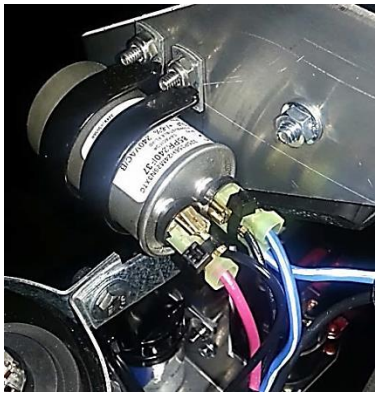
1. Remove all five connectors from the run capacitor.
2. Clean all terminals.
3. Tighten the two blue wires, female terminals, using a needle nosed pliers, tighten to near closed.
4. Push both female, blue terminals back onto the (aluminum frame side) run capacitor, top and bottom posts.
5. Locate one of the black, 18 gauge wires from the start capacitor (mounted below the run capacitor).
6. Tighten the female connector end using the needle nosed pliers. **(This step is critical and has been found to be a recurring problem)**
7. Push on the female start capacitor terminal to the open post on the same side along with the two blue wires.
8. Place a tie strap around these three connections and tighten.
9. Locate the removed red wire and the remaining black wire (start capacitor).
10. Tighten both terminal ends using the needle nosed pliers, red and black wires.
11. Install the tightened red and black capacitor wires onto the open side of the start capacitor. Place the red wire onto the lower post and the black wire onto the supper post. The side post will not receive a terminal.
12. Place a tie strap around the red and black wire and tighten.
13. Spray the run capacitor connection points with the battery terminal protection spray.



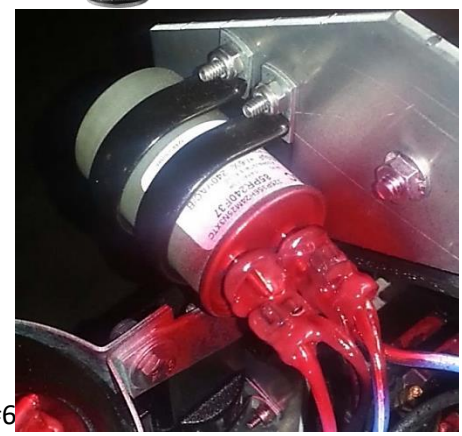




Tie strap in place on first set of run capacitor terminals, contains two blue wires and a back wire from the start capacitor.



Run capacitor with all terminals in place. Two the straps are used; each set of terminals is tied separately.



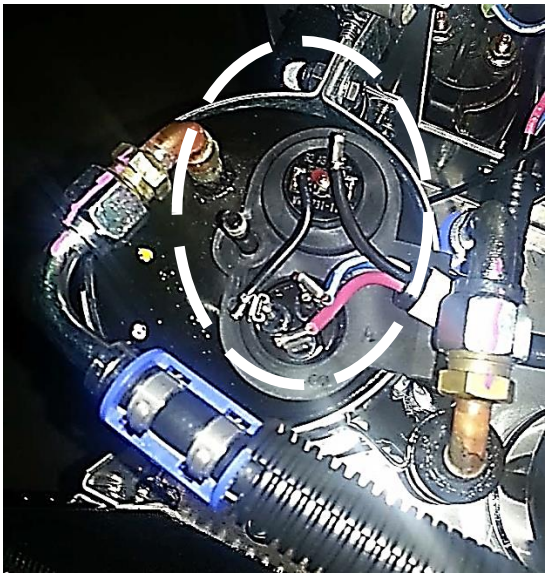
#6

120 Volt Connections – RF152

Service Procedures

Compressor Top, four connections

1. Remove the screwed-on cover from the compressor top.
2. Check the tightness and cleanliness of the connections.
3. If the four connectors are clean and tight, do not remove them from their connection point.
4. If anyone of the connections is loose, remove it and use the needle nosed pliers to tighten the connector, place the tightened connector (s) back on to the appropriate terminal post.
    a. Black = C
    b. Red = S
    c. Blue = R
5. Spray all compressor terminals with battery corrosion spray.
6. Install cover, do not over tighten. If the cover is cracked, replace the cover.
7. Secure all loose wires with tie straps.
8. End of procedure.



DC Wiring, APU – RF113.0

Coolant Heater and Condenser Fan Wiring

Component location

APU, Exterior, Top Level
Fuse Holder to Component

Condenser Fan Relay
(120 VAC Coil)

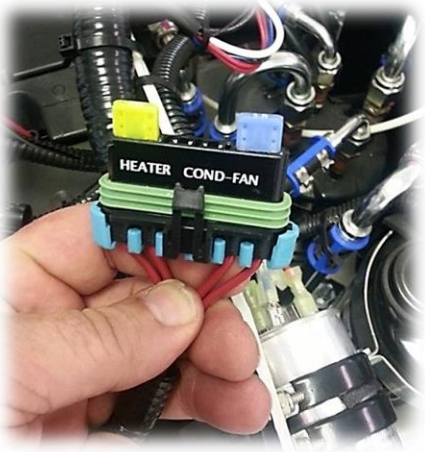
Description & Application

The APU DC circuit consists of:

1. Fuse holder with two circuits
    a. Coolant heater (20 AMP)
    b. Condenser fan (15 AMP)
2. Coolant heater power circuit
3. Condenser fan relay

Overview

12 VDC Idle Free battery power feeds a two-place fuse holder located near the battery separator in the upper level of the APU (exterior).
The fuse holder contains two fuses, 20 AMP fuse for the coolant heater and a 15 AMP fuse for the condenser fan.
The coolant heater fuse feeds 12 VDC power to the coolant heater power plug located on the top of the coolant heater (oval plug).
The condenser fan fuse feeds 12 VDC power to the condenser fan relay located above the dryer on the aluminum wall, in the top level of the APU (exterior).
The 12 VDC power from the condenser fan fuse is sent to the condenser fan when the 120 VAC compressor circuit is energized (RF 112).
The condenser fan relay has a 120 VAC coil.



Coolant Heater and
Condenser Fan Relay Fuse

DC Wiring, APU – RF113.0

Coolant Heater and Condenser Fan Wiring

Common Issues

The DC wiring, APU has no history of issues.
The condenser fan circuit must be fused with a 15 AMP fuse; a 10 AMP fuse will not support the start needs of the condenser fan.

Service

The APU DC circuit requires basic service to ensure that the fuse terminals, the relay terminals and the power connectors are clean and tight.
Make sure that the connector gasket on the coolant heater top power connector is in place (green in color).
Note; the coolant heater power plug connector into the top of the coolant can be used to reset the coolant heater in the event that the coolant heater has stored faults codes (5) and needs to be reset (RF 114).

Coolant Heater Power Plug

Condenser Fan Power Plug

DC Wiring, APU – 113.1 RF

Coolant Heater and Condenser Fan Wiring

DC Wiring, Series 1000, 2000, 3000, 4000

Component Location

APU, exterior, top level

Battery to components

Description & Application

The APU DC circuit consists of:

Battery connection with fuse

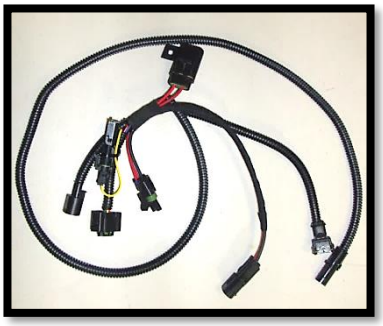
Coolant heater power circuit

Condenser fan pressure switch

Condenser fan

Low pressure switch

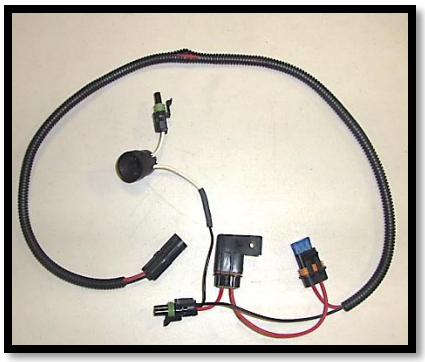
32068 – Coolant heater harness



Overview

The 12-volt circuit begins with a red and black harness originating at the AGM battery power source. A 20 AMP fuse is used for circuit protection. The 12-volt circuit provides power for the coolant heater and the condenser fan.

The condenser fan is controlled using a pressure switch located on the refrigerant dryer.



The 12-volt circuit provides a ground wire to the battery separator and a ground wire to the low pressure switch. The low pressure switch is located on or near the dryer. The ground used on the low pressure switch supplies ground to the compressor relay, located in the under bed box, under the bunk bed.

The 12-volt supply point location is based on the system configuration. The Series 1000 receives its 12-volt power from the front AGM battery. The Series 2000, Series 3000 and Series 4000 receive their 12-volt power from a secondary battery box.

History

This circuit will only be seen on systems that have serial numbers beginning with 37. Systems that have serial numbers beginning with 36 should use 113.0 RF (reference sheet).

Service

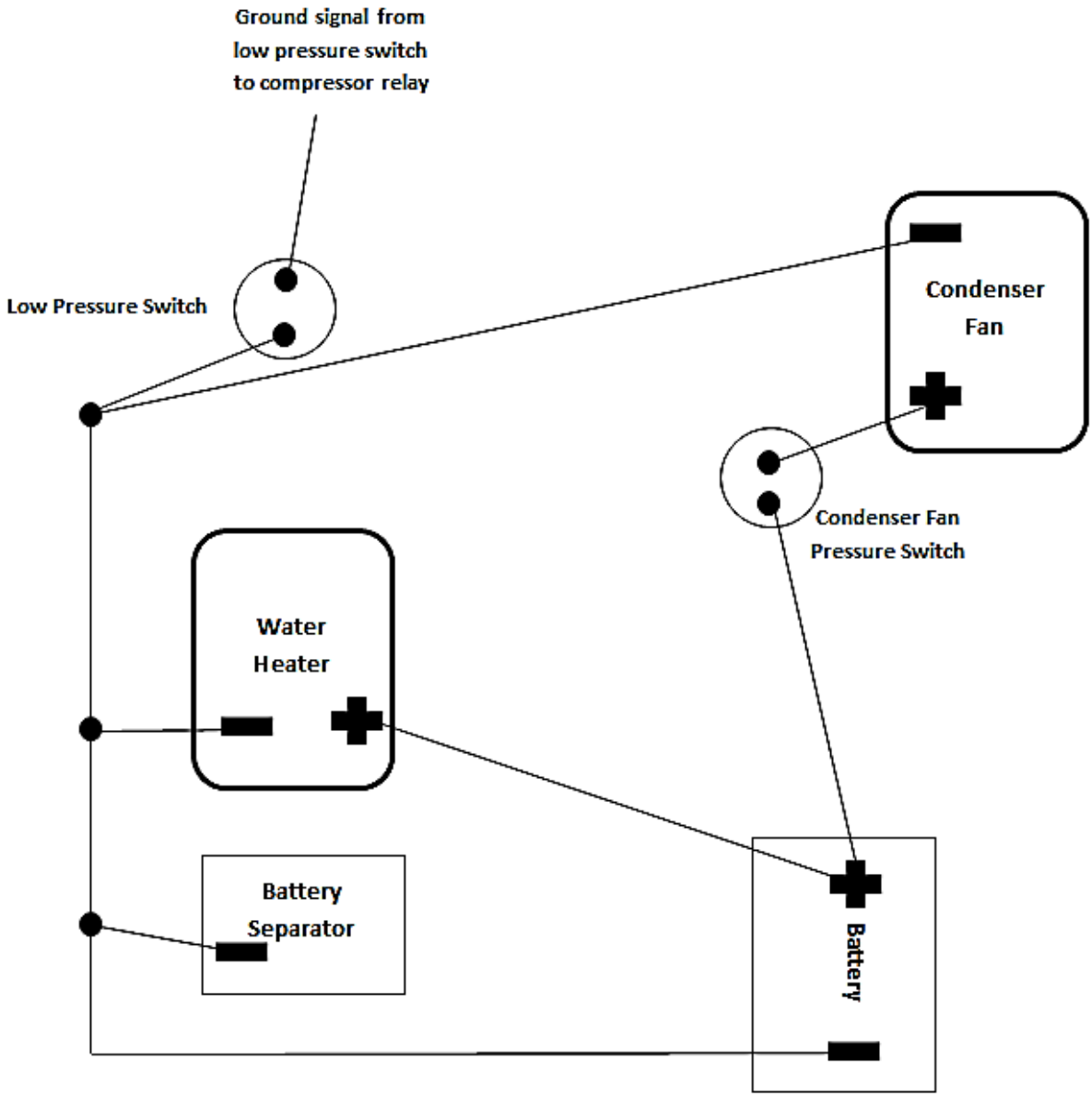
Check the battery connections to make sure that they are clean and tight.

Coolant Heater Power Plug

Condenser Fan Power Plug

DC Wiring, APU – 113.1 RF

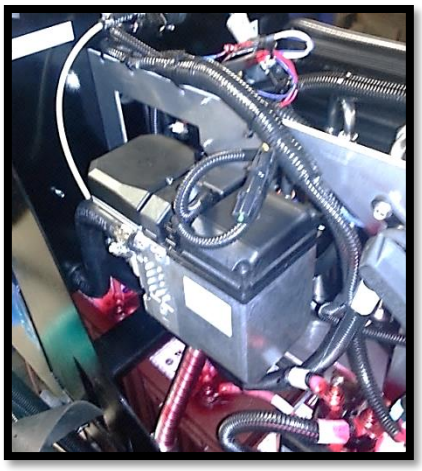
Coolant Heater and Condenser Fan Wiring



Coolant Heater Module – RF114

Coolant Heater Module
IFS Part # 42001

Component Location
Truck Exterior
APU
Top Level, left side



Description & Application
The Idle Free coolant heater is located in the APU (exterior).
The coolant heater consists of:

1. Webasto TSL17 coolant heater
2. Dosing pump (fuel pump)
3. Fuel filter and fuel circuit
4. Coolant circuit

The Webasto TSL17 is a 17,000 BTU coolant heater that is connected to the engine's coolant circuit. When the truck's engine is running, the engine's coolant is circulated through the engine block, cab heater core, Idle Free coolant heater and bunk heater core.
When the truck's engine is shut off and the Idle Free heater module is turned ON, the engine's coolant continues to flow through the engine block, and both heater cores (cab and bunk), by means of the 12 VDC circulating pump, attached to the Webasto TSL17 coolant heater.
The coolant heater monitors the coolant's temperature, as the coolant flows through the truck's coolant circuit.
Once the truck's coolant temperature drops to 138 degree (F), the coolant heater begins its "start-up cycle."
The truck's engine thermostat will close when the engine's coolant temperature drops below 180 degrees. When the engine block thermostat is closed, the size of the coolant system is decreased.
When the Idle Free heater module is activated, the truck's bunk blower fan is powered by the Idle Free battery bank (RF106).
The coolant heater module's coolant pump is running 100% of the time that the thermostat mode switch is in the HEAT position.

Dosing Pump
The Idle Free dosing pump (fuel pump) is mounted on the rear wall of the APU.
The electrical connection is made using two wires. The dosing pump has two speeds. The speed of the dosing pump determines the output of the heater. The temperature requirements for the coolant heater determine the speed of the dosing pump/ heater output.

Fuel Filter and Fuel Circuit
The in-line fuel filter is attached to the input side of the Idle Free dosing pump.
The fuel line feeding the fuel filter begins at the fuel pick-up tube on one of the truck's fuel tanks.

Coolant Circuit
The Idle Free heater module is plumbed in series with the truck's bunk heater core coolant circuit. The truck is plumbed so the coolant heater's coolant inlet circuit begins at the rear of the truck's engine. The engine's coolant runs through the Idle Free coolant heater, the bunk's heater core, and returns to the engine block.

Coolant Heater Module – RF114

Common Issues

The coolant heater module is trouble free however issues exist that prevent the heater from starting after a period of non-use.

The fuel filter needs to be checked to make sure fuel is present. If the tank fuel pick-up tube is not properly located in the fuel tank or if the truck was run out of fuel, the fuel filter may be void of fuel.

The fuel filter will need to be primed if the fuel filter does not have fuel present.

The coolant heater module will shut down if the coolant heater over-heats. Overheating will take place if the coolant circuit has its coolant supply cut off (closed valves).

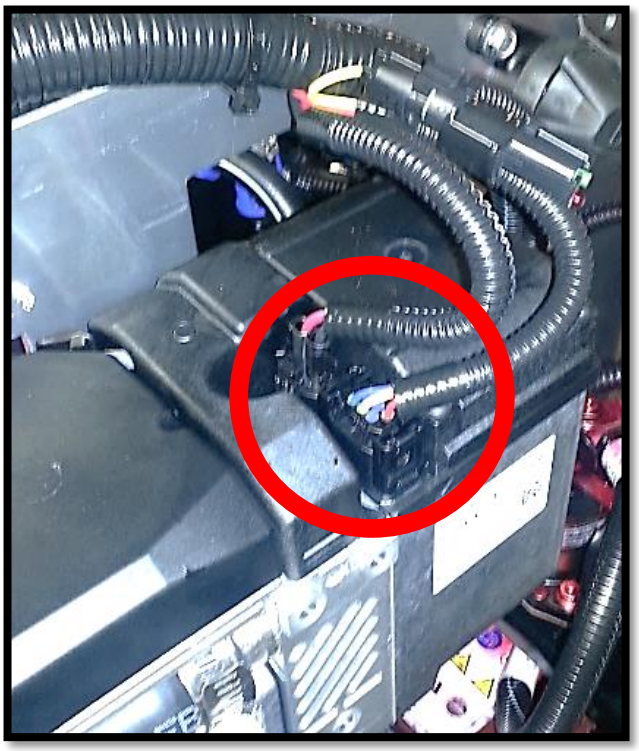
If the coolant heater shuts down five times, the heater will not attempt to re-start unless the 12 VDC power plug is removed and re- installed into the socket (heater reset procedure).

Service

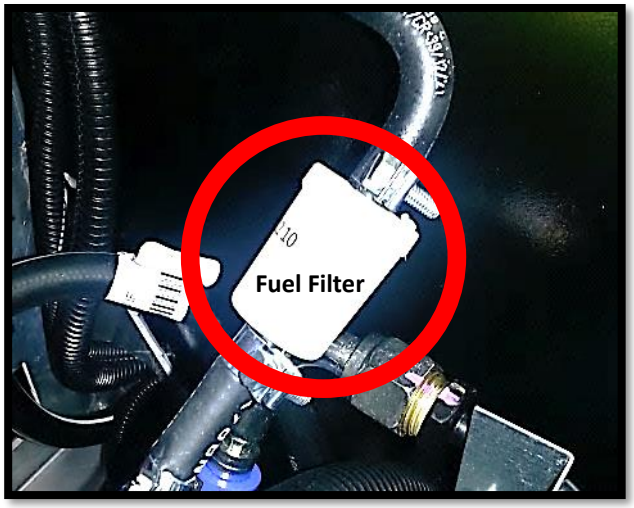
The coolant heater module requires a fuel filter replacement at the beginning of each winter season, part #42002.

The coolant heater exhaust needs to be checked for restrictions and obstructions.

The coolant heater combustion air intake needs to be checked for restrictions and obstructions.



Top of coolant heater
(Oval connector is power connector, left)



AGM – RF116

AGM Battery Bank

AGM Batteries
IFS Part # 35001

Component Location
1. APU exterior, lower level or
2. BTF battery box

Recommended alternator requirements:

- 25 additional AMPs of alternator capacity per AGM battery in your APU. (In most cases, a 270 AMP alternator will suffice)
- The alternator has remote voltage reading capability

Description & Application
The Idle Free System uses four AGM batteries, connected in series.
The battery family is group 31 and each battery contains 105 AMPS (useable).
The four AGM batteries are connected with red cables (+) and black (-).
The positive battery bank feed is from the front of the battery bank and the negative battery bank feed is from the opposite end (back or rear).
The battery bank is fuse protected with a 250 AMP fuse located above the battery separator (RF101).
The four AGM batteries are held in place with a battery hold-down bar.

Overview
The AGM battery bank is dependent on the charge from the truck's alternator whenever the truck's engine is running.
The Idle Free AGM batteries are dependent on the quality of the truck's starter battery condition and connections.
Service is required on the Idle Free AGM batteries. The battery service includes the battery connections in the truck's starter battery box.
The AGM batteries are charged by the truck's alternator when the truck's engine is running. The Idle Free battery separator (RF101) connects the truck's battery bank to the AGM battery bank when the truck's batteries >13.2 VDC.
The AGM batteries are charged when connected to a shore power connection (RF104).
The AGM batteries are charged using the Reefer Link connection (RF109) if/when the truck is connected to a reefer unit.

This document pertains to systems that have serial numbers that begin with 36 or 37.

AGM – RF116

AGM Battery Bank

Common Issues

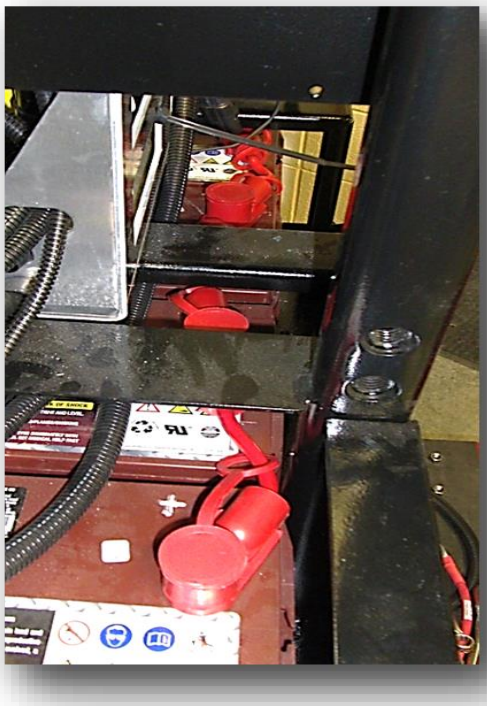
The Idle Free system includes shore power.
Shore power (when used) keeps the batteries conditioned and extends AGM battery life.
The Idle Free system uses an inverter to power the Idle Free air conditioner. The use of the inverter forces the unit to shut down when the AGM batteries reach 11.0 VDC.
Battery terminals will become corroded if they not treated with battery protection spray.

Service

The AGM battery bank requires regular service to maintain connection quality.
The service required is specified on the following pages.

Clean cables
Tight cables
Treated cables

For Serial Numbers Starting with 36



For Serial Numbers Starting with 37

AGM – RF116

AGM Battery Bank

The Idle Free DC circuit, APU, exterior, requires service to ensure proper system operation and performance.
When the Idle Free APU DC connections are dirty or loose, the Idle Free inverter's GFCI may trip or the inverter may overload and shutdown.
A poor, dirty or weak DC connection will prevent the Idle Free batteries from charging and will limit the energy available for adequate air conditioner starting.
An overloaded inverter (shown with a red status light, face of the inverter) may be caused by a loose or dirty DC cable. A loose DC connection will reduce the available energy needed to start the air conditioner.
The Idle Free inverter's GFCI outlet may trip due to dirty connections leaking voltage back to the inverter.

Service

APU, DC connections

Service needs:

Clean, tighten and protect all DC APU connection points

Connection points

1. Battery to battery cables (6)
2. Bulkhead connectors (4)
3. Battery separator (2)
4. Fuse (2)

Tools needed

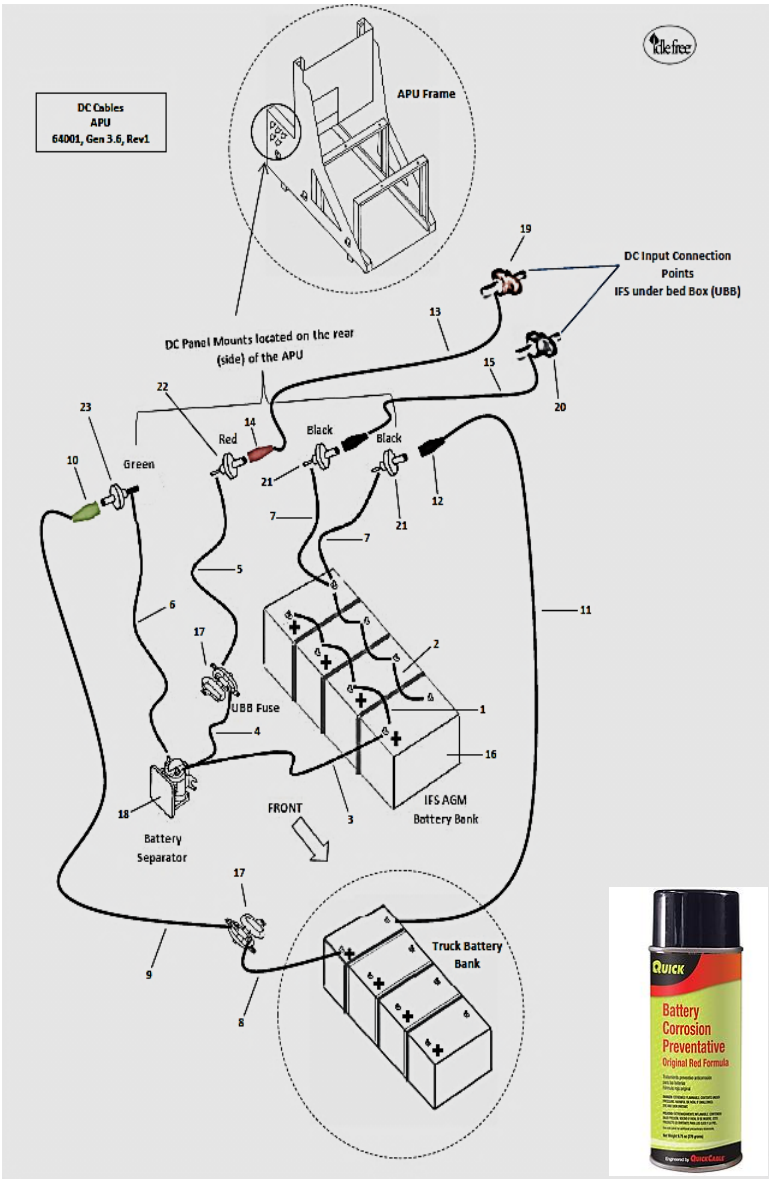
- 9/16 wrench or socket
- ½ wrench or socket
- Side cutters

Parts needed

- Tie-straps, 8 inch, narrow
- Battery protection connection spray

Procedure overview

- Remove cover from APU and examine all DC cable connection points. Ensure all are clean, tight and treated for corrosion protection.
- Use a flashlight to check the battery post connections that are located under the upper level. The positive battery connections are subject to contamination as well as the cable crimps (under the heat shrink), cable ends.
- Replace severely corroded battery cable ends or battery to battery cables.
- Use battery protection corrosion spray on all DC cable connection points.



AGM – RF116

AGM Battery Bank

Thermostat must be in the OFF position!

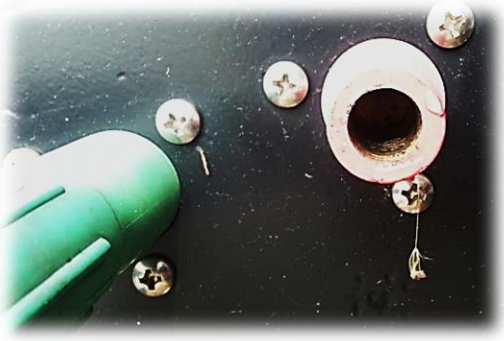
The Idle Free AGM batteries will be in one of two locations; under the air conditioner and coolant heater or in a between the frame battery box. The service procedure for either type is the same.

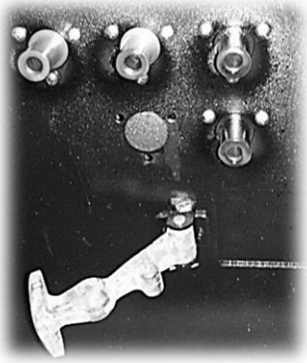
Battery to battery cables and connection points

1. Inspect all battery to battery cables looking for signs of corrosion or dirt. If corrosion or dirt is present, remove the battery nut and clean the lug and battery terminal. If the battery connection looks clean, check the battery nut to make sure that the battery cable does not move.

Bulkhead connectors

1. Remove the rear cover of the APU to reveal the DC bulkhead connectors located on the rear side of the APU. Disconnect all exterior rubber connectors by twisting them counter-clockwise and pulling them out.
2. Inspect the panel mount connection points to ensure cleanliness and no signs of corrosion. Repeat this procedure with the male plug-in connectors.
3. The black bulkhead connector is ground, the green is the truck battery bank fused power and the red connector feeds the under-bed module with fused DC power for the Idle Free inverter and other DC needs.
4. Use dielectric grease (into the bulkhead connectors) prior to re-connecting the color matched male connectors into the bulk head connectors.
5. The bulkhead connectors will only allow the male plug to go in if the proper alignment is achieved. Place a negative twist (counterclockwise) unto the cable connector prior to inserting it to ensure that the connector remains tight. Twist each connector clockwise to lock them in place.





AGM – RF116

AGM Battery Bank

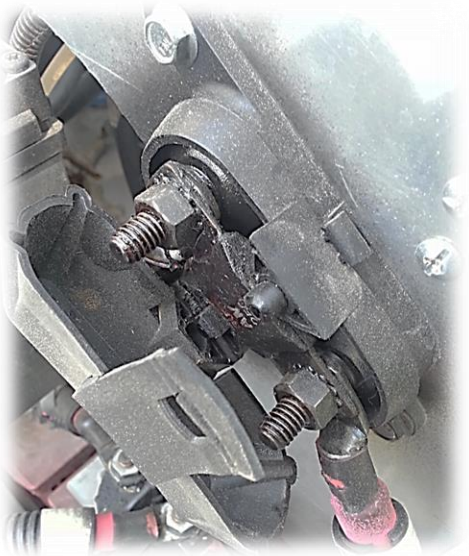
Thermostat must be in the OFF position!

Battery Separator

1. Inspect both terminals on top of the battery separator for cleanliness, tightness and protection treatment. The far post on top of the battery separator has a single cable and the closest post has two battery cables connected to it.
2. Remove the single cable from the far post first; clean the cable end and the battery separator post.
3. Replace cleaned cable end to the far post and tighten securely.
4. Repeat the procedure (3) on the closest battery separator post (two cables).
5. Treat the cleaned and tightened battery separator posts with battery corrosion protection spray.

Fuse

1. Remove the rubber fuse cover and remove the fuse.
2. Clean the fuse ends, fuse receiver terminals and the cables ends that connect to the fuse.
3. Return the fuse to the fuse holder and tighten to ensure no cable movement.
4. Treat the cleaned and tightened fuse posts with battery corrosion protection spray.



AGM – RF116

AGM Battery Bank

Treated DC Connections, APU

Image gallery

Rear Battery,
Negative Post

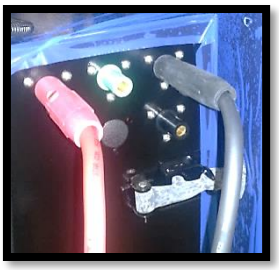
Fuse
Connections

Battery
Separator

Bulkhead
Connectors

DC Cam Lock Connectors – RF117

Current DC Voltage Level of IFS AGM Battery Bank



Cam Lock Connectors

Component Location

APU Exterior, DC Connection Points

Part #s

Red Plug = 33017 Red Socket = 33014

Black Plug = 33018 Black Socket = 33015

Green Plug 33016 Green Socket = 33013

Description & Application

The DC cam lock connectors are connection points between the APU, truck's battery bank and the UBB.

Cam locks are used so the critical DC connections are controlled by Idle Free manufacturing, enabling testing of completed units.

Overview

The DC cam locks form a sealed DC connection point between the truck's battery box, the APU and the UBB.

The cam lock connectors use a locking cam (male connector) that locks into the female, panel mount receiver.

Three colors are used in the Idle Free system:

1. Red = APU fused power from APU AGM battery bank to UBB
2. Green = truck alternator/starter batteries to APU
3. Black = ground from truck battery bank to APU and ground to UBB from APU.

The cam lock panel mount connectors can be moved from one side of the APU to the opposite side.

Plastic plug inserts can be removed to allow the re-location of the panel mount cam lock connectors.

DC Cam Lock Connectors – RF117

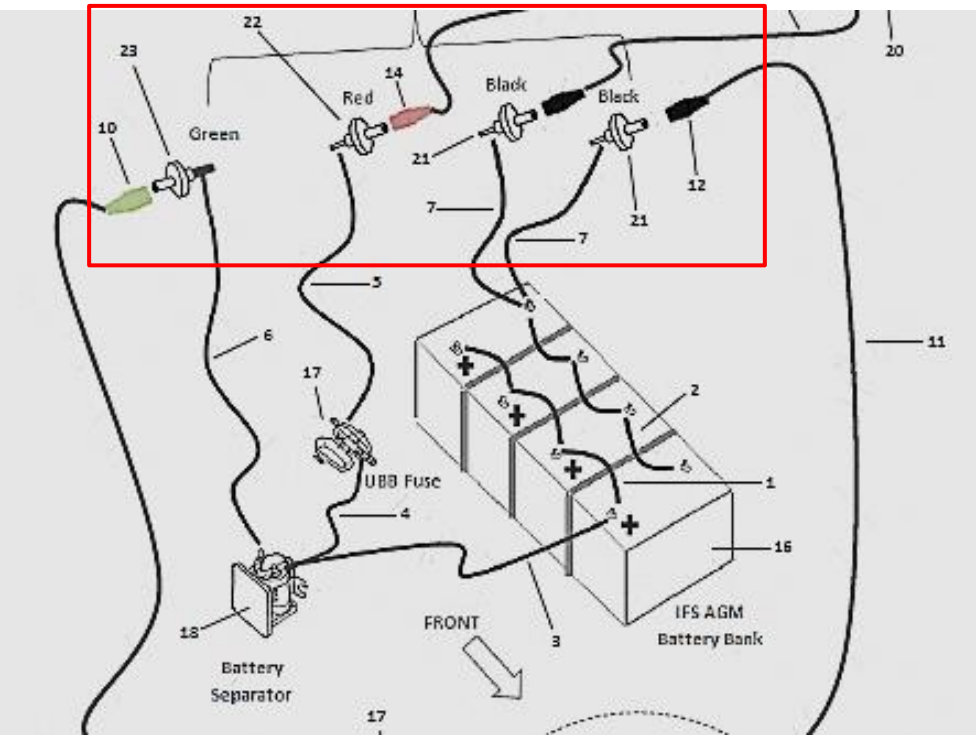
Current DC Voltage Level of IFS AGM Battery Bank

Common Issues

The cam locks need to be locked in place to ensure proper energy transfer. The cam locks need to be inserted and twisted to the right to lock them in place.

Service

The cam locks need to be serviced to ensure clean connections, tight connections and treated connections. Use an anti-oxidant dielectric grease to prevent connection deterioration.



Refrigerant Quick-Connects – RF118

Description & Application

Refrigerant Quick Connects

Component Location
APU Exterior, behind APU
Part #s
Male #6 =54207
Female #6 = 54201
Male #8 = 54208
Female #8 = 54202

Description & Application
The refrigerant quick connects enables the air conditioner's evaporator and compressor units to be separated without having to remove the 134A refrigerant from the completed system.
The refrigerant quick connects enable the correct amount of refrigerant to be placed into the air conditioning system at the time of manufacture.

Overview
The refrigerant quick connects includes the R134 refrigerant service ports that are located within 12 inches of the rear of the APU.
The refrigerant connections between the evaporator refrigerant circuits use a male to female threaded valve connection that opens the refrigerant circuit between both components, when the two are threaded together.
The service ports used are standard 134A refrigerant service ports.
The amount of 134A used in each system is one of two levels:

- 2.8 pounds
- 2.0 pounds

The exact Freon level is posted on the APU rear wall under the cover.
The rule of thumb is:

- 6-inch accumulator = 2.0 pounds, 134A
- 12-inch accumulator = 2.8 pounds, 134A

Common Issues
The refrigerant quick connects need to be properly connected during the installation process.
Refrigerant oil needs to be added to the connector seals, prior to joining the two connectors together.
Partially connecting the two quick connect parts together results in fittings leaking refrigerant or a high compressor head pressure reading.

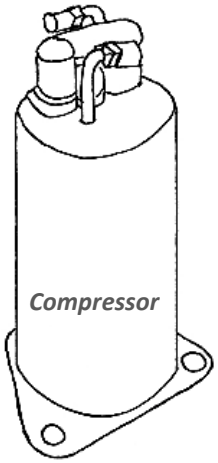
Compressor, A/C – RF120

A/C Compressor, Tecumseh

Compressor
IFS Part #59014

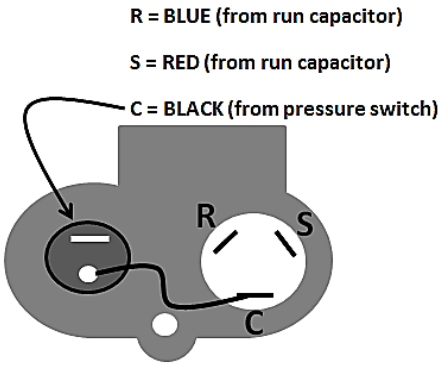
Component Location
Truck Exterior
Frame rail unit, top level

Description & Application
The IFS A/C compressor operates using 120 VAC power from the IFS inverter (RF105).
The IFS A/C compressor uses 134A refrigerant.
The IFS A/C compressor has a thermal overload switch located on the compressor top, under the plastic cover.



Service
The compressor does require a small amount of service just to make sure that the connector terminal ends are tight (secure) on the connection points under the plastic cover, compressor top. Also, the compressor mount bolts should be checked to ensure that they are properly torqued.

Compressor Top Wiring



Compressor Troubleshooting
The compressor requires the following (operate):

1. Inverter ON (or stand-by mode)
2. UBB power plug into the inverter outlet
3. GFCI outlet, not tripped
4. Ignition key in OFF or accessory position
5. 12 VDC power leaving the ignition relay (RF107, RF106)
6. Thermostat on COOL (not in five minute shut down MODE) (RF103)
7. 12 VDC coil power at compressor relay (RF106)
8. 120 VAC power leaving the compressor relay (RF106)
9. 120 VAC power at the compressor connection, rear of the UBB (RF110)
10. 120 VAC power on the pressure switch, both terminals (APU, receiver/drier top).
11. 120 VAC power on the compressor top, thermo-overload switch (RF120).
12. Run capacitor must have five wires connected to it (RF122).
13. Start capacitor must have its two wires connected to the run capacitor (RF122).

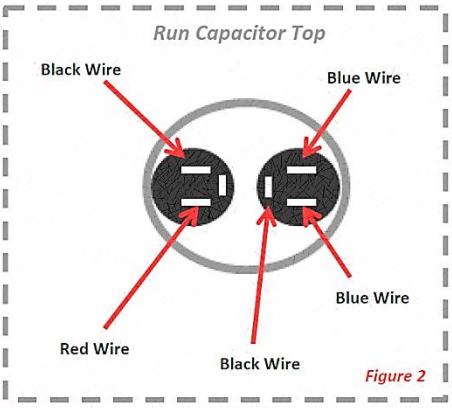


Figure 2

Compressor Test – RF140

Compressor Location

Truck exterior

Frame rail unit, top level

Compressor Test Procedure

The system (air conditioning mode) can be tested using shore power or battery power only. Testing using battery power only will aide in finding alternative possible reasons for non-operation.

An extension cord and a 120-volt external power source will be needed to check for proper compressor operation.

1. Set the thermostat's MODE switch to the COOL position (RF103).
2. Set the Thermostat's FAN switch to ON (RF103).
3. Confirm that the closet located evaporator fan is running (RF111).
4. If the evaporator fan is not running, confirm proper inverter operation (RF105).

Shore Power/Cab Power – RF148

Shore Power

All Idle Free systems include shore power.
Shore power requires the use of an extension cord and plugging the cord's female end, into the Idle Free male inlet plug, located on the driver's side of the truck, above the fuel tank. The male end of the extension cord is plugged into a 120-volt power supply (minimum of 15 amps).

Shore power is used (with the Idle Free System) to provide 120-volt power to a 55 amp (DC) converter (RF104). The converter is directly connected to the AGM battery bank. This shore power connection is used as an AGM battery charger. When using the Idle Free shore power connection, 55 DC amps are available to operate the Idle Free inverter or anything connected to the AGM battery bank.

The shore power connection is also used to charge the truck's battery bank. The truck's battery bank is connected to the AGM battery bank through the battery separator. The battery separator will connect the two battery banks together when the AGM battery voltage rises to 13.2 VDC (RF101).

Cab Power®

Cab Power is a shore power system that may be a part of the Idle Free system. All Idle Free systems include shore power and some of the Idle Free systems use Cab Power® components as part of their shore power circuit.
A system with Cab Power® will include components as seen below.

Cab Power Plus®

A truck that includes the Cab Power® components may also include a factory installed inverter. This Cab Power® system is called the Cab Power Plus®.

Idle Free AC to DC converter

Idle Free AC to DC converter

Cab Power® components

Cab Power Plus® inverter

Drier/Pressure Switch – RF121

Receiver/Dryer
IFS Part #53301

Pressure Switch
IFS Part #37015

Component Location
Truck Exterior
APU, Top Level

Receiver/Dryer

Pressure Switch

Description & Application

The IFS pressure switch is located on top of the dryer.
It is a binary switch that opens its contacts when no zero pressure is present or opens its contacts when high pressure is reached.
The contacting terminals on the pressure switch need to be checked to make sure that they are tight, clean and protected from potential corrosion.
The use of battery protection spray is important on the pressure switch because the contacts, when contaminated, potentially can leak.

Pressure Switch: Common Issues
The pressure switch should be replaced if the contacts are tested and continuity is not present when refrigerant is seen in the sight glass below the pressure switch.

Pressure Switch: Service
The contacts on the pressure switch need to be checked to make sure that they are tight, clean and protected.
The use of battery protection spray is important on the pressure switch because of the contacts, when contaminated, potentially can leak.

Dryer: Common Issues and Service
The dryer does not have history of issues and does not require service.

Drier/Low- Pressure Switch – RF131

Receiver/Drier
IFS Part #53301

Low Pressure Switch
IFS Part #37029

Component Location
Truck Exterior

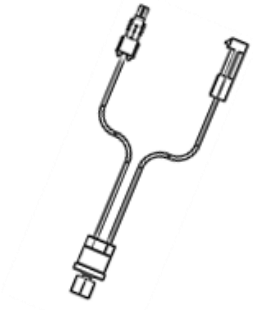
Low pressure switch - Description & Application
The low-pressure refrigerant switch is located on top of the drier.
The low-pressure switch opens its contacts when < 10#'s of refrigerant pressure is present.
The low-pressure switch uses two Weather Pak connectors to send a ground signal to the UBB's compressor relay.
If refrigerant pressure is lost, the compressor will shut down due to the compressor relay shutting off (no coil ground signal).

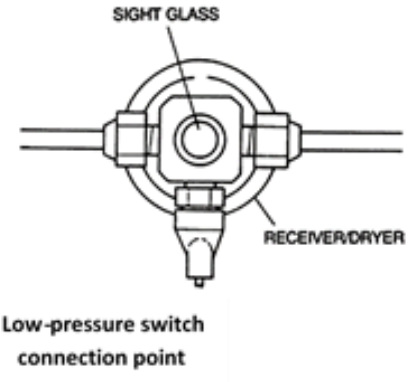
Low pressure switch – Service
No service is required.

Receiver/Drier – Description and Application
The receiver/drier is used to pull moisture and contaminates from the air conditioning system.
The receiver/dryer includes a top mounted sight glass.

Receiver/Drier Service
The receiver drier should be replaced any time the refrigerant is exposed to the atmosphere.

Low-pressure switch is located on the top of the receiver drier. It has two connection points and sends a ground signal to the UBB, compressor relay.





Start Capacitor – RF122

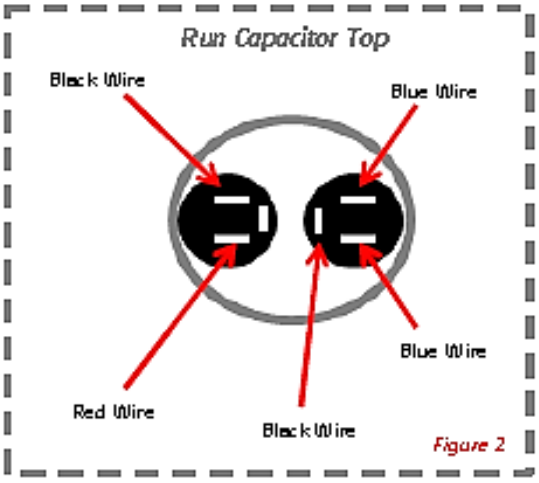
Start Capacitor
IFS Part # 34009

Component Location
Truck Exterior
APU
Top Level, left side of compressor

Description & Application
The start capacitor is used to assist in starting the compressor during hot or heavy use conditions.
The start capacitor engages when the inverter voltage drops to 100 VAC.
The start capacitor raises the compressor start voltage to potentially 170 VAC.

Overview
The start capacitor uses a circuit board to control mechanical contacts.
The circuit board is attached to the capacitor with female push on terminals.
The circuit board controls a timer that sends the stored capacity, (during compressor start up) over a two second period, whenever the inverter voltage drops to <100 VAC.
The start capacitor has two wires exiting the side of the removable black plastic cover.
Both of the start capacitor wires connect to the run capacitor located above the start capacitor (see Figure #2).

Common Issues
The start capacitor's contacts sometimes close and remain closed when they are supposed to be in an open condition. This causes the inverter to overload and shut down.
Turning the inverter off and then on resets the inverter and starts the compressor ***only if the start capacitor contacts open***.
If the inverter continues to overload and shut down, after turning it on and then off, the start capacitor may need to be replaced.
The start capacitor can be checked by removing the start capacitor terminals from the run capacitor.
If the compressor starts, the start capacitor is bad and needs to be replaced.



Service
The start capacitor requires minimal service.
The start capacitor connections points must be maintained by keeping the connections clean, tight and treated to prevent contamination.
Please use RF112 for service procedures.

Start Capacitor – RF132

Start Capacitor
IFS Part # 34009

Component Location
Truck Exterior
APU top Level, left side of compressor

Description & Application
The start capacitor is used to assist in starting the compressor during heavy use conditions
The start capacitor engages when the inverter voltage drops to 100VAC
The start capacitor raises the compressor start voltage to potentially 170VAC

Overview
The start capacitor uses a circuit board to control mechanical contacts
The circuit board is attached to the capacitor with female push-on terminals
The circuit board controls a timer that sends the stored capacity, (during compressor start up) over a 2 second period, whenever the inverter voltage drops to <100VAC.

The start capacitor is connected to the 120VAC harness via a weather proof connector

Common Issues
The start capacitor's contacts sometimes close and remain closed when they are supposed to be in an open condition. This causes the inverter to overload and shut down.
Turning the inverter OFF & then ON resets the inverter and starts the compressor ***only if the start capacitor contacts open***.
If the inverter continues to overload and shut down, (after turning it on and then off) the start capacitor may need to be replaced
The start capacitor can be checked by unplugging the connector from the 120 VAC harness (compressor must be room temperature)
If the compressor starts, the start capacitor is not functioning correctly and needs to be replaced

Service
The start capacitor requires no service

This document pertains to systems that have serial numbers that begin with 36 or 37.

Battery Test Procedure – RF123

AGM Batteries

AGM Battery Testing

Proper AGM battery testing is required in order to file a warranty claim. Proper system diagnostics are needed to properly determine that the APU AGM batteries should be removed and tested. Less than two percent of IFS AGM batteries fail in a two-year period.

Midtronics EXP1000
Kit, link to instruction manual

The truck's charge system should be checked for problems prior to pulling and testing AGM batteries. (See reference sheet RF124)

If a truck is driven into a service center and the AGM battery voltage is taken shortly after the truck's arrival, the APU AGM battery voltage should be at least 12.7 VDC.

If a voltage reading is taken that shows less than 12.7 DC volts, the problem is probably the truck's charge system not the AGM battery bank.

The AGM battery bank's present voltage may be a result of an inadequate truck charge circuit, not necessarily a result of a bad battery(s) that need(s) to be replaced.

It is common to have a dealership diagnose that an AGM battery bank has failed, replace the battery bank, return the AGM batteries to Idle Free, Idle Free analyzes the AGM batteries and determines that the batteries are undercharged, not bad or in a replaceable condition.

This document pertains to systems that have serial numbers that begin with 36 or 37.

Battery Test Procedure – RF123

AGM Batteries

Determine why the AGM batteries are underperforming.
Do not remove the AGM batteries without first determining if the problem is the truck's charge circuit.

Tools needed:

- DC AMP meter
- Volt meter
- Battery analyzer

1. Start the truck and take the alternator output voltage at the truck's alternator. Since the truck probably just drove in, the voltage output should be 14.0+ VDC.
2. If the alternator output voltage is lower than 13.8 VDC, use a DC clamp AMP meter and determine the DC AMPs running through the alternator's positive cable. Since the truck probably had driven to the service location, the truck's batteries and the AGM batteries shown have already been charged by the alternator. This would mean the amperage seen at this point should be only the DC components (truck) currently turned ON; blower fan, lights, radio.
3. The DC amperage put out by the alternator should be less than 40 amps (all truck accessories OFF) after the truck has been started and after a period of three to five minutes.
4. Amperage readings higher than 40 amps (all truck accessories OFF) should be researched further to determine if the alternator output amperage is being sent to a bad battery with a bad cell.
5. With the truck's engine still running; remove the APU cover and take the DC voltage on the first battery. Voltage should be the same as the voltage read at the alternator. If the voltage is more than .3 volts lower than the alternator voltage, suspect poor connections; loose cabling or other factors that are contributing to the voltage difference.

Test the truck batteries first. History has shown poor truck batteries result in poor APU battery charging.

1. Turn the truck's engine off and remove the surface charge from the truck's starter battery bank by running the truck's headlights for at least 10 minutes. *Do not test any batteries that have just been charged by the engine running or a battery charger.*
2. Remove the battery cables from the truck's starter battery bank.
3. Use the Midtronics battery analyzer to determine the quality of each battery.
4. Replace any battery that lacks the correct capacity.
5. Check cable ends for cleanliness prior to putting all back onto the correct battery posts.

Battery Test Procedure – RF123

AGM Batteries

Test the Truck Charging Circuit

1. Remove the cover from the APU.
2. Locate the battery separator *(use the link to the reference guide if needed).*
3. Check the voltage on the single cable connection point on the top of the battery separator.
    a. The voltage reading is the truck's battery voltage and should be the same reading as voltage taken directly on one of the truck's starter batteries.
4. If the voltage is different (lower) check the DC connection points between the truck's battery bank and the APU battery separator. The connection points include:
        i. Green panel mount connector on the side of the APU or battery box
        ii. Green cam lock connector plugged into the green panel mount connector
        iii. Fuse holder (Bussman), located in the truck's battery box
        iv. Positive cable connector located in the truck's battery box
        v. Ground cable # 32044, truck's battery box or on the frame behind the truck's batteries
        vi. Ground cable (black connector), connected to the black panel mount connector, side of the APU
5. If the voltage is the same start the truck and take the voltage reading again on the single cable connection point on the top of the battery separator. The voltage reading should show alternator voltage of greater than 13.0 volts.
6. When or if the voltage reading is above 13.2 VDC, the battery separator should close and the APU batteries will be connected to the truck's batteries.
7. Check the voltage on the double cable connection point (two cables on this post), on the top of the battery separator.
    a. The voltage on both battery separator top posts should display the same voltage when the battery separator is closed.
    b. The voltage displayed if both banks are connected will be >12.8 VDC.
8. The actual DC voltage will be based on the charge condition of the AGM battery bank. This will be the case because the truck's battery bank has already been checked.
    a. If the battery separator DC voltage shows to be near 14 VDC, the battery charge circuit (from the truck) is working properly. The remaining factors that determine if the APU batteries need attention are the cable connections between the APU batteries.
9. Turn off the truck's engine.
10. Plug the truck into shore power. The Idle Free battery charger should now be ON.

Battery Test Procedure– RF123

AGM Batteries

11. Check the voltage on the double cable connection point (two cables on this post), on the top of the battery separator.
    a. The voltage on both battery separator top posts should display the same voltage when the battery separator is closed.
    b. The voltage displayed if both banks are connected should be >12.8 VDC.
    c. If the Idle Free battery charging is working, the voltage should be at least 12.8 VDC.
    d. A voltage reading >13.5 VDC means
        i. Battery charger is working
        ii. APU AGM battery bank is nearly full
        iii. Battery separator should be closed
12. Unplug the battery charger, (shore power).
13. If the purpose of this diagnostics was to address a run time complaint:
    a. Turn on the Idle Free air conditioner.
    b. Use the AMP meter and clamp the red cable between the battery separator and the Bussman fuse located above the battery separator.
    c. The DC amperage should be between 35 and 45 AMPS DC.
    d. The amperage could be much higher if the air conditioner has been running more than one minute without the condenser fan running (APU cover is off).
14. Turn off the air conditioner as soon as you have taken the amperage reading to prevent compressor damage.
15. If the testing so far has resulted in a change in the truck's battery bank or the results of the testing has revealed a good battery charge system from the truck:
    a. Check the underside of the APU and check to confirm five battery bolts are present that run down the middle of the box. These are used to hold down the batteries via the battery hold-down bar.
    b. If any bolts are missing, the batteries need to be removed to ensure that battery movement has not resulted in loose or broken battery to battery cables.
16. If all battery hold-down bolts are present, remove the cables from the first battery.
17. Test the battery using the Midtronics battery tester.
18. If the first battery shows BAD, remove all batteries and test each one.
19. If the first battery shows GOOD:
    a. Put the battery to battery cables back onto the front APU AGM battery, leaving the cable that runs to the battery separator removed.
    b. Remove the rear APU cover.
    c. Connect the ground cable of the Midtronics battery analyzer to the ground post of the rear battery.
    d. Connect the positive connector lead of the Midtronics battery analyzer to the positive battery post on the front APU AGM battery.
    e. Test the group of batteries using the CCA function set at 2920 CCA.

Battery Test Procedure– RF123

AGM Batteries

20. If the test shows good, inspect the connections on the batteries for contamination.
21. Clean the battery connections + the battery separator cable connection points and the fuse connection points.
22. If the battery test shows *GOOD BATTERIES CHARGE & RETEST*, charge the batteries by plugging into shore power.
23. Continue the charge (shore power) until the amperage going into the battery bank is less than 10 AMPS DC.
24. If the Midtronic's battery analyzer showed that the batteries have low capacity, remove the AGM batteries and test them individually using a CCA rating of 730 CCA.
25. Replace batteries that say REPLACE BATTERY (Midtronics battery tester)
26. Clean cables before placing them back into service.
27. Ensure all connections are tight.
28. Use battery protection spray to protect the new battery connection points.
29. Be sure to connect the positive cable between the battery separator and the first AGM battery prior to putting the APU covers back in place.
30. Be sure to connect the condenser fan harness after the front APU cover is put in place.

10 reasons your APU AGM Batteries are not Fully Charged- RF124.0

Read before you change any APU AGM batteries.

*Check out the charge circuit of the truck **BEFORE** you pull the APU batteries.*

1. **Truck battery bank has a bad battery.**
    a. A failed truck battery will prevent the APU batteries from being charged.
    b. A truck starter battery is subject to fail faster than an APU AGM battery because:
        i. Truck battery has the job of starting the truck
        ii. Spends too much time at a voltage level below its minimum voltage level (11.8 VDC)
        iii. Lead plates in a starter battery are thinner than the lead plates in AGM batteries
        iv. Lead plates in starter batteries are surrounded by liquid and AGM batteries are surrounded by poly-fiber matting
        v. The amperage leaving an APU AGM battery is a fraction of the amperage leaving the truck's starter battery bank during engine start
2. **Truck and/or DC cables are not connected to the correct connection point.**
    a. Trucks that use fusible links suffer when additional batteries are added to the truck because a voltage drop occurs across the fusible link. This voltage drop prevents the additional batteries from being fully charged.
3. **DC cables are the wrong size (gauge).**
    a. When alternators are upgraded because additional batteries were added to a truck, the size of the DC cables (ground and positive) need to be sized to allow current flow between the alternator, the truck's battery bank and the additional battery bank.
4. **DC cables are too long.**
    a. The length of the cables used between the truck's battery bank and the APU battery bank needs to be as short as possible to prevent or eliminate any voltage drops that will prevent the AGM batteries from being fully charged.
5. **Battery connection points are contaminated.**
    a. Battery posts on the truck's batteries as well as the battery posts on the APU batteries need to be serviced in order to maintain battery connection quality. Battery connections need to be clean, tight and protected.
6. **Alternator was replaced with the wrong alternator (too small).**
    a. The alternator needs to be >160Amps, bigger is okay, >270 is dangerous.
7. **A starter battery was replaced and the cables were left off or placed on the wrong connection point.**

a. When a second battery bank is added to a truck, a battery separator is used to control the connection between the two battery banks. If work is done in the truck's battery bank, ensure all cables are properly connected to the battery posts.

8. **APU battery connections in the truck's battery bank are:**
    a. Connected at the wrong connection point
    b. APU ground cable is connected to a truck starter battery that has a fusible link between the alternator ground and the truck starter battery (Volvo or Mack)
    c. APU truck battery connection points are separated onto different battery pairs (Peterbilt uses two sets of two batteries in the truck's start battery bank. One of these pairs is used to start the truck and the second pair provides non-starter circuit DC power needs.)
9. **The APU battery truck battery connection points are stacked onto insulated, OEM, battery to battery cable lugs.**
    a. Kenworth (at times) will use "battery to battery" cables that include plastic coverings that encase the battery lugs. The plastic on these lugs needs to be removed when an APU battery cable is to be sharing the same battery terminal. Failure to remove this material will aide in preventing the AGM batteries from becoming fully charged.
10. **Battery cables are loose.**
    a. All DC battery connections points need to be tight. A loose battery connection results in no battery connection.
    b. Loose battery connections prevent batteries from charging resulting in batteries with no capacity.

Driver Orientation – RF125

Discuss with new driver:

1. **Ignition switch**
    - **a.** ON and accessory position
    - **b.** Confirm the ignition cut-out circuit works
    - **c.** Turn off air conditioner prior to turning key to on position or starting truck
2. **Volt meter**
    - **a.** Explain lights are added (lit) when the truck's engine is running
    - **b.** Explain the volt meter is a fuel gauge
    - **c.** Have volt meter in a location the driver can see
3. **Thermostat**
    - **a.** Controls air conditioning only (temperature)
    - **b.** Heat switch turns only turns on the coolant heater, factory bunk controls regulate bunk heat temperature (coolant heater installed)
    - **c.** Turn the thermostat fan switch on when using air conditioning
    - **d.** Explain the five-minute delay when moving the left switch from COOL to OFF to COOL
    - **e.** ***Hold*** arrows (up or down) to adjust temperature
    - **f.** Temperature setting needs to be below current room temperature
    - **g.** Minimum temperature is 68 degrees
    - **h.** Use fan switch to turn on the inverter (get the inverter out of stand-by mode)
    - **i.** Show them our phone number on the thermostat (920-206-9333)
4. **120 Volt power strip**
    - **a.** Flashing light on the power strip means that the inverter is in standby mode, turn thermostat fan switch ON to start the inverter (make the power strip light solid)
    - **b.** Use the microwave with truck engine running to conserve APU battery power
5. **Lift up the bunk and remove the cover from the under bunk box**
    - **a.** Show the driver the sticker and help them to understand that much of what they do or control is discussed on this sticker
    - **b.** Show them the battery charger (top level) and make sure that understand that they should use shore power when available (the battery charger is shore power)
    - **c.** Show them the two-amp thermostat fuse and explain it belongs in the top fuse location only and the lower three fuse positions are only used when the Idle Free system includes the coolant heater

Driver Orientation (continued)

6. **Inverter**
    - **a.** Located in the lower level of the under bed box (blue)
    - **b.** The 120-volt inverter outlet is on the right side of the inverter
    - **c.** Inverter status lights on the right, next to the 120-volt outlet
    - **d.** Inverter GFCI rest is in the center of the 120-volt outlet (white)
    - **e.** GFCI trips are typically driver controlled (ignition key turned to ON or what you plug in)
    - **f.** Reset for inverter is the ON/OFF switch, black on right, right side of the white 120-volt outlet
    - **g.** Inverter overloads are driver controlled (ignition key turned to ON, use the thermostat to turn the air conditioner off, not the ignition key)
7. **Shore power plug (outside of the truck)**
    - **a.** Show them where to plug in shore power
    - **b.** Tell them that shore power charges the AGM batteries and the truck's starter batteries

Driver Orientation – RF126

Reefer Link Connection

The Reefer Link connection needs to be used (connected) before the Idle Free System is turned on. This ensures the Idle Free batteries remained charged during system operation.

The reefer unit must have an alternator rating of 65 AMPS or greater.

- The Reefer Link connection needs to be used before the Idle Free System is turned on. This ensures that the Idle Free batteries remained charged during system operation. DO NOT run the APU batteries down and then connect to the reefer unit. This will not harm the reefer but may result in the Idle Free batteries not being charged, short run time.
- DO NOT connect the reefer link connector while you are driving unless you have a failed alternator on the truck or trailer. Connecting if both alternators are working will not allow you to know if one of the alternators has failed because the opposite alternator will run both 12 VDC systems.
- The Idle Free Reefer Link System is a controlled DC connection between the truck and the reefer unit.
- The Reefer Link connection provides battery charging for the Idle Free APU.
- The Reefer Link connection allows the truck or the reefer unit to supply power to each other.
- In the event that a truck alternator or a reefer alternator fail, the Reefer Link connection is used to literally connect the 12 VDC connections (truck and reefer trailer) together.

Using the Idle Free Reefer Link Connection:

1. Make sure that the reefer unit is turned ON, AUTO start or continuous run.
2. Remove the Idle Free interconnect cable set from the driver's side box.
3. Connect the interconnect cable to the truck side of the Reefer Link connector.
4. Connect the interconnect cable to the trailer side of the Reefer Link connector.
5. Turn on the Idle Free APU (air conditioner or heat).

Driver Orientation – RF126

Reefer Link Connection

The Reefer Link System Operation Guide

(Reefer unit is running)

- Reefer alternator should display >13.1 VDC.
- Idle Free volt meter should show four lights (or more).

(Reefer is not running)

- Reefer battery voltage should display between 12.1 VDC and 12.6 VDC.
- Reefer unit should automatically start when DC volts drop to 12.1 or 12.0.

When to use the Reefer Link connection:

1. When the bunk requires air conditioning or heat
2. When/if the reefer alternator fails
3. When/if the truck alternator fails

Reefer alternator failure

1. Connect the interconnect cable set to the truck and trailer and route the set with the air lines or electrical trailer harness from the truck to the trailer.
2. Keep both connectors in place, as you drive, until the reefer's alternator can be replaced.
3. Secure the Reefer Link cable set to ensure that it does not rub on the step deck.
4. Make sure the replacement alternator is at least 65 AMPS.

Truck alternator failure

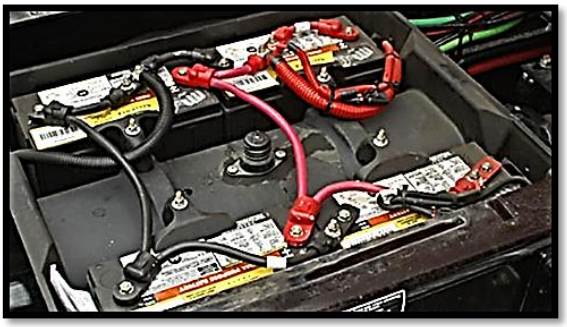
1. Connect the interconnect cables and route them with the air lines or electrical trailer harness.
2. Keep the connector in place as you drive, until the truck's alternator can be replaced.
3. Secure the Reefer Link cable set to ensure that it does not rub on the step deck.
4. Make sure that the replacement alternator is at least 160 AMPS.

Service Requirements

The APU system requires basic service performed at seasonal intervals (fall and spring).

The components that require service include:

- Frame rail unit
- Truck battery connections
- Evaporator
- Thermostat
- Coolant heater filter



Service Requirements

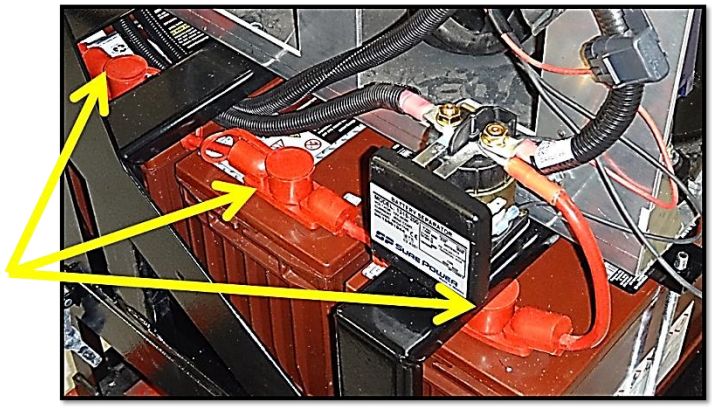
Service Intervals: Fall & Spring

Positive battery post connections:

- Remove covers from four posts
- Check for signs of corrosion
- Clean, tighten, apply Battery Corrosion Protective spray and ensure cover is secure

Part number: 73100

Positive Battery Posts

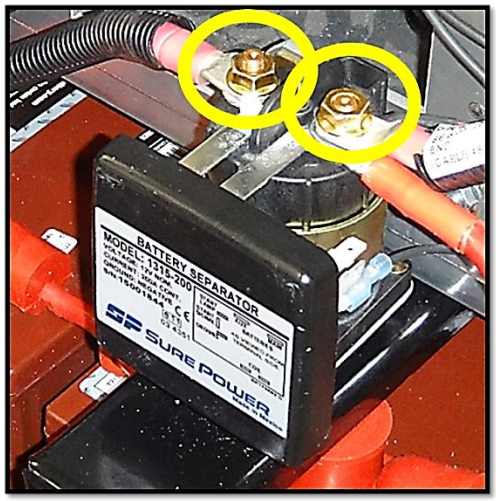


Battery separator connections:

- Check for signs of corrosion
- Clean, tighten and apply Battery Corrosion Protection spray

Battery hold down bracket:

- Check to ensure that the bolts on the hold down bracket are torqued to 50 inch pounds, plus a ½ turn

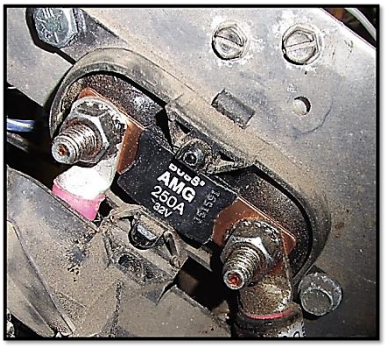


THREADED ROD SHOULD NOT BE USED TO REPLACE MISSING BATTERY HOLD DOWN BOLTS. THE REPLACEMENT BOLTS MUST BE GRADE 5 BOLTS. TORQUE SPECIFICATION IS 50 INCH POUNDS, PLUS A HALF TURN. START ON CENTER BOLT AND WORK TO END BOLTS.

Service Requirements

Battery Fuse Connections:

- Check the cables attached to the battery 250 AMP fuse
- Check for signs of corrosion
- Clean, tighten and apply Battery Corrosion Protection spray



Negative Battery Connections:

- Check for signs of corrosion
- Clean, tighten and apply Battery Corrosion Protection spray

Marinco Connectors:

- Clean and tighten the connectors

The APU has four Marinco connectors located on the rear side of the frame rail unit.
The Marinco connectors are red, green and black, four in total.
The male connector is a twist to lock/unlock, connector type.

Service Requirements

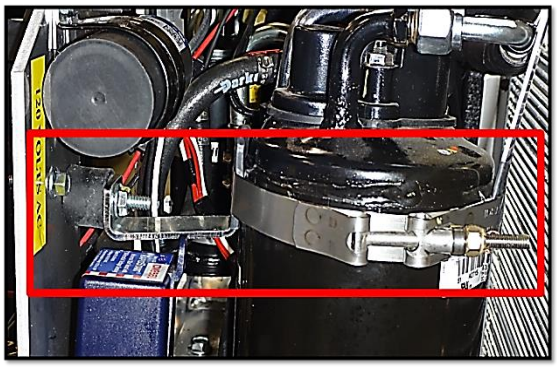
Condenser Coil Service:

- Clean
- Straighten the cooling fins

Compressor Service:

- Check the rubber compressor feet bushings for tightness
- Check the compressor top bracket for tightness

Compressor Feet



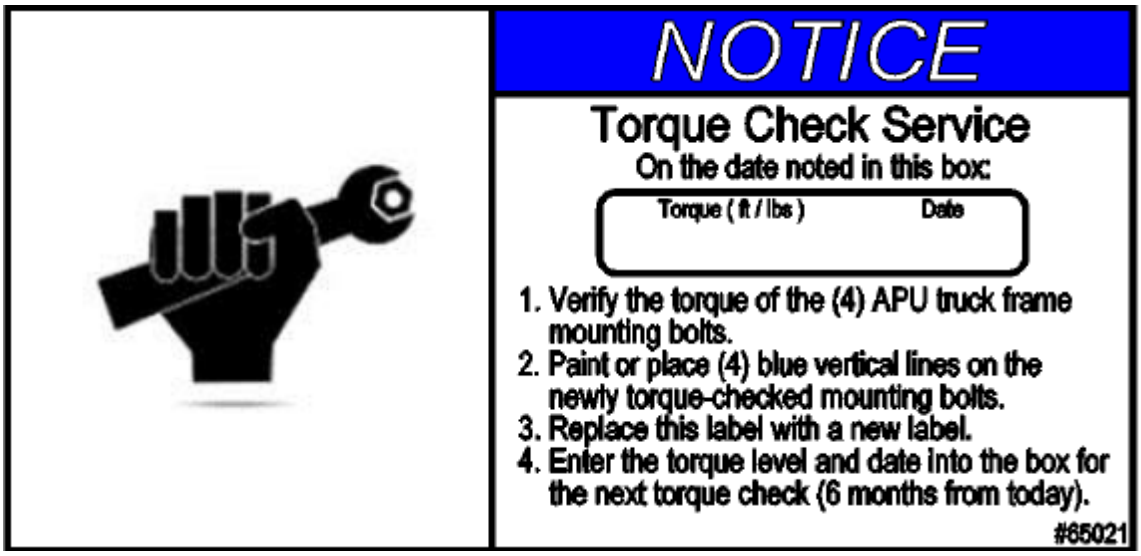
Compressor Top Bracket

Frame Mounting Torque Check:

- Check the four mounting bolts to ensure that all are secure and torqued to 212 DRY foot pounds.

WARNING	**Warning: Torque must be measured as a dry torque without use of lubrication or anti-seize product. Improper torque of the mounting bolts can lead to loss of clamp force or bolt failure.**

- Mark the torque label with the correct date (6 months from the day serviced).



Service Requirements

Truck Battery Box Service: (For systems with a separate battery box)

- Locate the APU cable connection points (red and black cables)
- Check the positive and negative cables attached to the truck's batteries
    - Clean the cable lugs
    - Tighten the battery lugs
    - Protect the battery lugs with a protection additive
- Locate the 250 AMP fuse connected to the red APU cable
    - Clean the cable lugs
    - Tighten the battery lugs
    - Protect the battery lugs with a protection additive

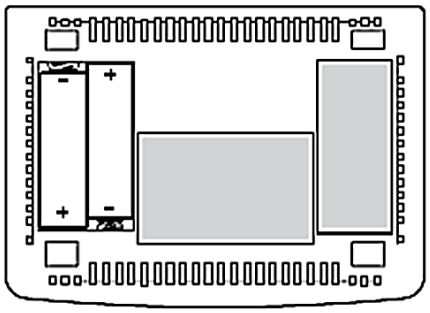
Evaporator Filter Service:

- Remove the filter and wash with water to remove dirt
- Check the exposed coil for cleanliness
- Check the drain pan for water and drain if needed
- Replace the filter in the filter housing

Service Requirements

Thermostat Battery Service: When the thermostat display cannot be seen, replace two AA batteries which are located on the back side of the thermostat

1. Remove thermostat body by gently pulling it from base.
2. Remove old batteries and replace with new batteries.
3. Make sure to correctly position the (+) and (-) symbols.
4. Gently push thermostat body back onto base.



NOTE: We recommend replacing the thermostat batteries annually or if the thermostat will be unattended for an extended period of time.

Coolant Heater Filter: Remove and replace the fuel filter