

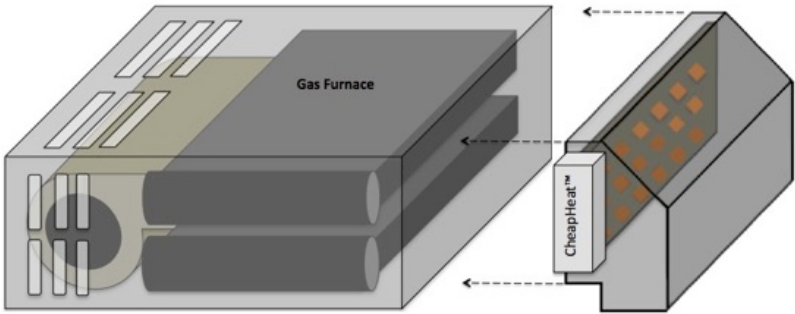


Wiring diagrams are NOT photo's they are 2-Dimensional drawings of a 3-Dimensional world.
Follow the text on the PCB's that matched with the text shown for each individual wire.

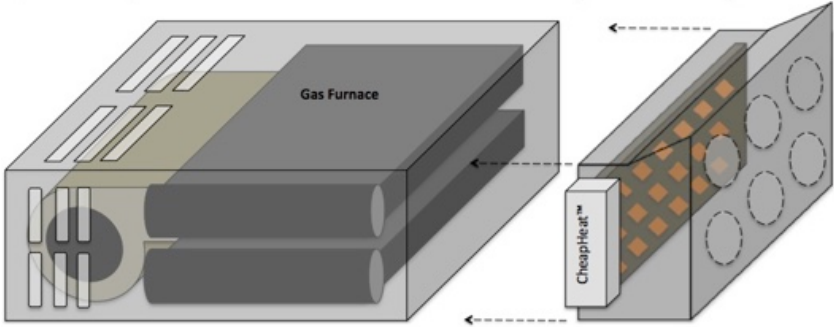
Application Installation Manual

Suburban & Dometic RV Furnaces

Plenum System



Ducted Plenum



RV Comfort Systems

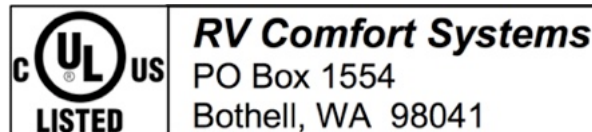
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16/Sept/2022

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CheapHeat™ System

Model# CH-50 & DH18-37-50



Installation and Operation Instructions

READ INSTALLATION INSTRUCTIONS COMPLETELY BEFORE STARTING

Thank you for choosing RV Comfort Systems CheapHeat™ for your heating needs. You can feel confident in your selection of the CheapHeat™ because the same pride in craftsmanship and engineering that goes into other RV Comfort Systems products has been incorporated in the CheapHeat™.

This manual is designed to help with installing, operating and maintaining the unit. It is CRUCIAL that the installation instructions be followed to prevent damage to the CheapHeat™ and existing gas furnace.

Before starting work on any high voltage (120/240V AC) project, turn off power to affected areas. To accomplish this shut down all shore power sources, including generators and inverters. In addition, adhere to all U.S. electrical codes.

It is also important that the compatibility applications chart be followed, especially airflow and shore power requirements. To operate the CheapHeat™ efficiently, the installer needs to read this installation manual completely.

Please retain this manual for future reference and send in the warranty card.

Furnace manufacturer's name/model is to assist our customer in selecting the correct CheapHeat™ kit and does not indicate approval or endorsement by that furnace manufacturer.

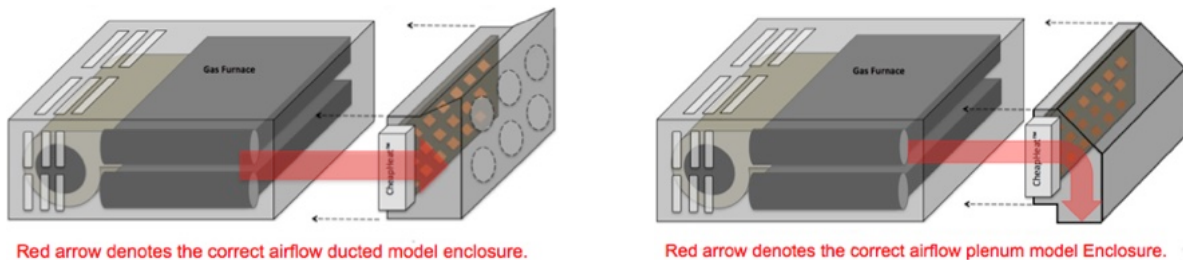
ELECTRICAL DATA

1. All wiring must comply with local and national electrical codes and be installed by a qualified electrician.
2. All wiring/cabling that passes through electrical boxes and panels MUST have cable clamps installed to prevent wire chaffing.
3. Contact a qualified electrician with any questions about the following instructions.
4. Check the available power supply and resolve any wiring problems BEFORE installing or operating this unit.
5. The CheapHeat™ is designed to operate from a 30 amp, 120V AC, 60Hz shore power supply for the 1800 watt configuration and a 50 amp, 240V AC, 60Hz shore power supply for the 3750 watt and 5000 watt configurations.
6. The wiring diagrams and specifications with respect to wire size, fuse/breaker size, and grounding requirements must be followed.
7. Do not immerse in water.
8. To provide continued protection against risk of electric shock, connect to properly grounded outlets only.

INSTALLATION REQUIREMENTS

CAUTION: THIS DUCT HEATER SHOULD BE INSTALLED IN SUCH A MANNER AS TO PERMIT REMOVAL WITHOUT SERIOUS DAMAGE TO THE BUILDING STRUCTURE, SERVICES, OR FINISH OF THE DUCT HEATER ITSELF

1. The CheapHeat™ Duct Heaters plenum is to be placed between the Air Handler/Furnace and the structures duct work.
2. Inlet side of Duct Heater plenum MUST be attached to Furnace.
3. Do not operate Duct Heater without ductwork attached to the discharge side of the duct heater plenum (see Appendix “A” at the end of this manual).
4. Discharge side of Duct Heater plenum MUST not have any single supply air duct run less that 30” or 750 mm in length.
5. Only one Duct Heater is allowed per given heating system. If second Duct Heaters is needed then there must be a second heating system.
6. There can be no more that two Duct Heaters per given structure
7. This Duct Heater is only intended to be use with a warm air HVAC system and a notation on the installation safety manual will point that out.
8. Airflow through plenum shown below with red arrow:



Note: Vertical mounted Duct Heater requires auto temp limit upgrade to 200 F degrees.

SEQUENCE OF OPERATION

The CheapHeat™ is a fairly simple system that is designed to operate with our CH-50 12 VDC controller and a 12 VDC blower motor. The system uses the same thermostat to operate the Duct Heater as does the Gas Furnace. So the only thing the customer needs to become familiar with it the new Gas/Electric changeover switch.

When the thermostat calls for heat, it sends the +12 VDC signal to the center tap on the changeover switch. If the switch is in the “GAS” position, the signal goes directly to the gas furnace and the furnace operates as if the CheapHeat™ system is not even installed. If the switch is in the “ELECT” position the +12 VDC signal is sent directly to TB1-Pin 4 on the CH-50 Controller.

When +12 VDC is applied to TB1-Pin 4, it travels through an interlocked hard wire circuit that energizes both CR-1 (Fan Relay) and CR-2 (control relay for Heater Contactor MC-1) simultaneously. The CR-1 relay then sends +12 VDC directly to the Red wire on the blower motor, which start the Fan. At the same time the CR-2 relay sends power to the MC-1 Contactor which energizes sending the high AC voltage to both TB3-common terminal and the installer selected heater TB-3 terminal (1800 watt 120VAC, 3750 watt 240VAC, or 5000 watt 240VAC). With that the Duct Heater is up and running; then when the thermostat signal is removed everything shuts down immediately.

2- STAGE GAS FURNANCES *(contact RV Comfort Systems for DPDT switch and installation instructions)*

Atwood/Dometic 2-Stage Series

- We ***DO NOT*** support this model of furnace.

Suburban SHD 2542 Series

- This system requires our SHD 2542 adapter, which replaces the current SPST override which with a DPDT override switch and 5 wire Harness.

Duct Heater and Controller Installation Standards

Electrical Specifications

<i>Heat Range Configuration</i>	<i>Voltage</i>	<i>Current</i>	<i>Wattage</i>	<i>Fuse/Breakers</i>	<i>UL Rated, Wire Size Max length 100 ft.</i>
1800	120 VAC	15 Amp	1800	(1) Single 20 Amp	(2) 12 Gauge W/Ground
3750	240 VAC	15.6 Amp	3750	(2) Dual 20 Amp	(2) 12 Gauge W/Ground
5000	240 VAC	20.8 Amp	5000	(2) Dual 30 Amp	(2) 10 Gauge W/Ground

Fan Specifications (Third party Air Handler)

<i>Heat Range Configuration</i>	<i>Max Voltage</i>	<i>Max Current</i>	<i>Minimum CFM</i>	<i>Minimum Velocity</i>	<i>Static Pressure</i>	<i>Max inlet Air Temp Energized</i>	<i>Max Air Temp De-Energized</i>
1800 Watt	15 VDC	12.6 Amps	120	400 fpm	.01-0.5" wc	75 F Degrees	250 F Degrees
3750 Watts	15 VDC	12.6 Amps	180	400 fpm	.01-0.5" wc	75 F Degrees	250 F Degrees
5000 Watts	15 VDC	12.6 Amps	240	400 fpm	.01-0.5" wc	75 F Degrees	250 F Degrees

VERTICAL MOUNTED FURNACES REQUIRE AUTO TEMP LIMIT UPGRADE TO 200°F

(Contact RV Comfort Systems LLC for correct Auto Temp Limit upgrade part)

Air Flow Specifications 4" Round Duct

UL 2158A Rated-Max temp rating 285° F, Max Static 1.0 in

<i>Heat Range Configuration</i>	<i>Min Total CFM</i>	<i>Max Total CFM</i>	<i>Min # Supply Runs</i>	<i>Single 4" Round Duct</i>			<i>Average all 4" Round Ducts Combined</i>		
				<i>Max Length Supply Runs</i>	<i>Max 45° Bends</i>	<i>Max 90° Bends</i>	<i>Max Avg. Length of Runs</i>	<i>Max 45° Bends</i>	<i>Max 90° Bends</i>
1800 Watt	120	300	3	25 Ft	2	1	15 Ft	6	3
3750 Watts	180	400	5	25 ft	2	1	15 Ft	10	5
5000 Watts	240	500	6	25 ft	2	1	15 Ft	12	6

Air Flow Specifications Rectangle Duct

28 Ga. Sheet Metal

<i>Heat Range Configuration</i>	<i>Min Total CFM</i>	<i>Max Total CFM</i>	<i>Min Sq. in Supply Side Trunk line</i>	<i>Min # 4x8 Supply Registers</i>	<i>Min # 4X10 Supply Registers</i>	<i>Min # 2 1/4x10 Supply Registers</i>	<i>Min # 2 1/4x12 Supply Registers</i>
1800 Watts	120	300	40	3	2	3	3
3750 Watts	180	400	60	4	3	5	5
5000 Watts	240	500	80	5	4	6	6

Clearance Around Duct Heater Plenum

<i>Heat Range Configuration</i>	<i>Top</i>	<i>Bottom</i>	<i>Left Side Without Power Head</i>	<i>Left Side With Power Head</i>	<i>Right Side Without Power Head</i>	<i>Right Side With Power Head</i>	<i>Model PL-7 Front</i>	<i>Model SA-7 Front</i>
1800 Watts	1"	0"	1"	2 ½"	1"	2 ½"	1"	N/A
3750 Watts	1"	0"	1"	2 ½"	1"	2 ½"	1"	N/A
5000 Watts	1"	0"	1"	2 ½"	1"	2 ½"	1"	N/A

Multiple Systems

Setting up multiple systems in one coach requires the following configurations and a separate CH-50 controller for each system.

<i>Shore Power</i>	<i>CheapHeat™ Heater Configurations</i>	<i>Ducting</i>
50 Amp	1@ 1800W & 1@ 1800W	<i>Each system requires its own ducting with no common connections to the other system.</i>
50 Amp	1@ 1800W & 1@ 3750W	
50 Amp	1@ 3750W & 1@ 3750W	



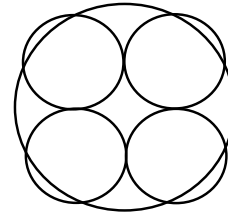
Electrical:

- **2 Pole Breaker Sub Panel**
(Home Depot: Internet #100157760 Model #QO2L30SCP Store SKU #577286)
- **2 Pole 30-amp Breaker**
(Home Depot: Internet #100022140 Model #QO230CP Store SKU #146447)
- **15 Ft 10-3 with ground Romex wire**
(Home Depot: Internet #202525532 Model #63948427 Store SKU #579406)
- **5 Pac ¾” Romex Cable Clamps**
(Home Depot: Internet #100134407 Model #20512 Store SKU #279782)

Misc. Materials:

It takes four 2” Ducts to equal one 4” Duct

- **Metal Tape UL Listed 1.89” x 30 Ft**
(Home Depot: Internet #100048600 Model #1542698 Store SKU #915276)
- **6 - 4” hose clamps**
(Home Depot: Internet #205046887 Model #MCX4HD Store SKU #1000052166)



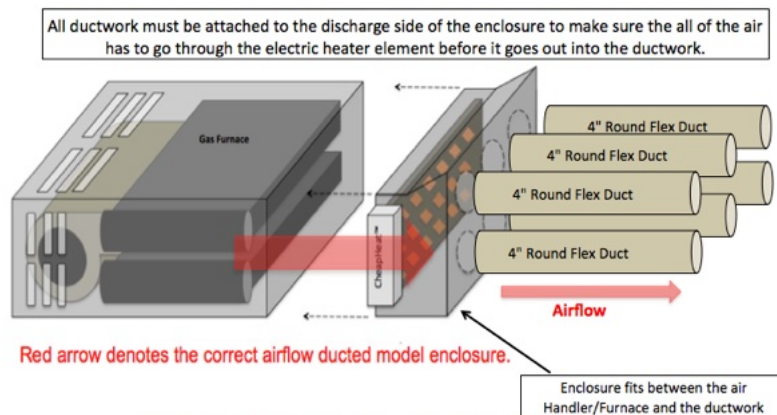
Additional Ducting: (if needed)

Adding only one Duct

- 25 Ft - 4” Flex Duct/Dryer vent hose
(Home Depot: Internet #313386759 Model #TD425PHD Store SKU #1005469188)

Adding second Duct

- 4” Round Wall register
(Amazon: https://www.amazon.com/dp/B07GVS9V71/ref=psdc_13400071_t3_B078TJN7WX)



(SA) Style Ducted Enclosure With Ducting Attached

Any additional questions contact Larry @ RV Comfort Systems Phone: 425-408-3140

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OPERATION INSTRUCTIONS

Operating the CheapHeat™ is very simple since there is only one additional control, a gas/electric changeover switch. The temperature is still controlled by the manufacturer-supplied thermostat, so the only thing the owner needs to decide is whether to run the heating system with gas or electricity.

To maintain the best comfort-level, it is recommended that the owner use the CheapHeat™. Also, to reduce temperature hunting (too hot then too cool), it is suggested that the owner only set the thermostat once for the duration of the heating cycle.

Lastly, to maintain a long system life and a comfortable environment, make sure that:

1. Minimum unrestricted airflows are compliant with the compatibility chart.
2. The system is hooked up to the manufacturer-recommended shore power connections when using the CheapHeat™ without adapters.

CONTROLLER

The CheapHeat™ CH-50 controller has been designed to work with all CheapHeat™ electric elements and plenum. The only time changes need to be made inside the controller are when it is used with the 1800 watt heater coil. When used with the 1800 watt electric coils, move the fan speed jumpers to change the fan speed to match the heating capacity.

The CheapHeat™ controller casing needs to be able to dissipate heat that is generated by its internal components. ***It does not get anywhere close to hot enough to cause a fire hazard.*** DO NOT mount the CheapHeat™ controller on the existing gas furnace, plenum or connecting ductwork. DO NOT mount the controller directly above the gas furnace or associated ductwork.

ELECTRIC HEATER COIL

There are three electric heating capacities and model numbers for the electric heater coil even though there is only one heater coil. This is because the coil was designed in a multi-tap configuration (two voltages and three heating outputs), which helps dealers reduce inventories and control costs. The most important thing to remember when installing the heater is that the heater assembly should be installed so that the FUSIBLE LINK (*looks like a diode*) is physically **located on the bottom of the heater assembly**. In a Vertical configuration the power head must be mounted on the top of the plenum.

PLENUM

Manufacturers install forced-air heating systems in one of two configurations: ducted system with individual duct runs or plenum system with trunk lines and registers in the floor. This means the CheapHeat™ installer needs to choose from a one of two plenums and be mindful that the plenum selected must have enough clearance around the existing gas furnace that match's the compatibility chart for that model furnace and ducting system.

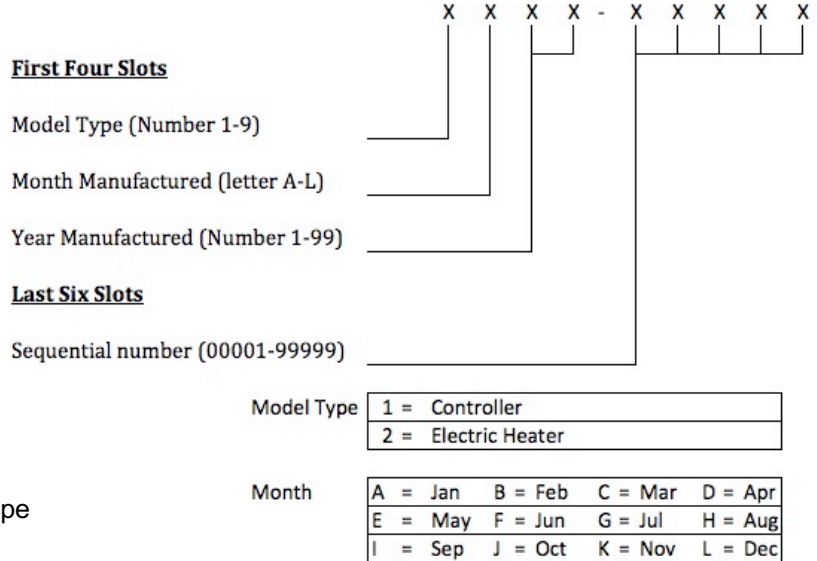
There is one plenum style for the ducted systems and one style for a plenum system, and both have been manufactured so the electric heating element can be installed from either side of the plenum.

The most important thing for the installer to remember is to make sure to plug all unused duct openings on the gas furnace so that all air feeding the living space passes through the new plenum before entering the ductwork or plenum.

Tools Required

- AC/DC Volt-Ohm-Amp Meter
- Wire Cutter/Strippers/Crimpers
- 3/8" Drive Drill Motor
- Sheet Metal Snips
- 1/2" and 3/4" Wood Bit
- 1/4" Drill Bit
- 3/16" Drill Bit
- 1/8" Drill Bit
- 1/4" Nut Driver
- 5/16" Nut Driver
- 1/4" Hex Nut Drive Drill Bit
- #2 Flat / #2 Philips Screwdriver Bits
- 6 1/8" Square Head Screwdriver
- 6" Flat Blade Screwdriver
- 6" Philips Screwdriver
- 13/16" Open End Wrench
- 3/4" Black Electrical Tape
- 2" Wide 3M High Temperature Metal Tape

Serial Number Code



PARTS

Remove controller, electric heater coil, accessories, and plenum from packaging. Verify that all parts are present, in good condition and correct for this installation.

Package #1

- 1 – **CheapHeat™ Controller**
- 1 – 10' 4-Conductor Controller to Furnace wire harness (Not with OEM)
- 1 – Rocker Style SPDT Changeover Switch with Backing Plate
- 1 – 25' 3-Conductor change over switch Wire Harness (Not with OEM)
- 2 – 8 X 1" Phillips Oval head BLACK Screws (For Mounting Switch) (Not with OEM)
- 3 – Orange Wire Nuts (Not with OEM)
- 3 – Red Wire Nuts (Not with OEM)
- 1 – Yellow/Blue Scotch Lock Add-A-Wire Splice for Gas Furnace Fan (16-10 Ga. Wire) (Not with OEM)
- 8 – 6" Nylon Wire Ties (Not with OEM)
- 2 – 8 x 1" Philips Oval Head Taper Point Screws (For Securing Controller to Wall) (Not with OEM)
- 4 – 8 x 3/4" Philips Mounting Screws (For Securing Add-On Cabinet to Furnace) (Not with OEM)
- 4 – 8 x 1/2" Philips Mounting Screws (For Electric Element and Panels) (Not with OEM)
- 2 – 1/2" Romex Cable Clamps (Not with OEM)
- 1 - 3/4" Romex Cable Clamp (Not with OEM)

Electric Element

- 1 – Electric Heater Element (Model DH18-37-50 Works for All Configurations)

Package #2

Option #1 – Ducted Heater Cabinet

- 1 – Plenum for up to individual Ducts
- 1 – Heater Support Blank Plate Cover for Plenum
- 6 – 4" Starter Collars for Flex Ducts (Not with OEM)
- 4 - 4" Blank filler panels

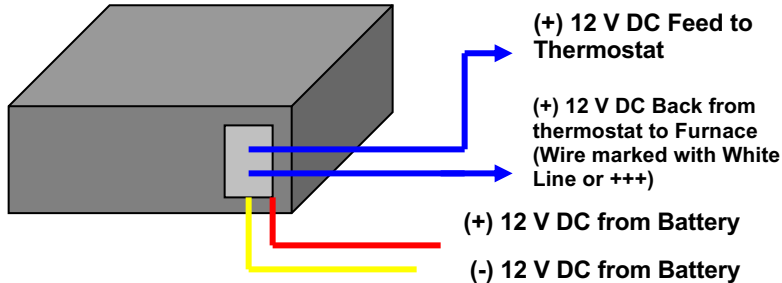
Option #2 – Plenum Heater CABINET

- 1 – Plenum Down Discharge
- 1 – Heater Support Blank Plate Cover for Plenum

INSTALLATION

SITE PREPARATION

- Make sure all high voltage is disconnected.
- Check existing gas furnace installation to see that it meets all clearance requirements necessary to complete CheapHeat™ installation.
- Identify and mark 12 V DC wires connected to existing gas furnace (See below for label recommendations).
- After labeling 12 V DC wiring remove fuse that powers gas furnace.
- Turn off gas supply to gas furnace.



To determine which **blue** wire is the feed wire and return wire.

1. Turn thermostat off or at least 10° F below **inside** temperature.
2. Connect DC volt meter from each wire to ground (negative 12 V DC).
3. The wire that reads 12 V DC is the thermostat feed wire and the wire that reads 0 V DC is the return wire from the thermostat back to the furnace.

Note: Make sure the 12 V DC furnace fuse is installed during this test.

Wire Used For	Suburban	Dometic
(+) 12 V DC	Red	Red
(-) 12 V DC	Yellow	Black
12 V DC Feed to Thermostat	Blue/White	Blue/White
12 V DC Back from Thermostat	Blue	Blue

MOUNTING COMPONENTS

Controller

- Find an accessible location within 10' of the gas furnace and mount controller with 2 – 8 x 1" screws provided. Do not mount controller on the gas furnace or its associated ductwork.

Override Switch

- When picking a location for the override switch, remember two things: it needs to be located inside the coach in a place easily accessible by the owner (preferably as close to the thermostat as possible) and the wiring harness that connects it to the controller is 25' long.

Disconnect

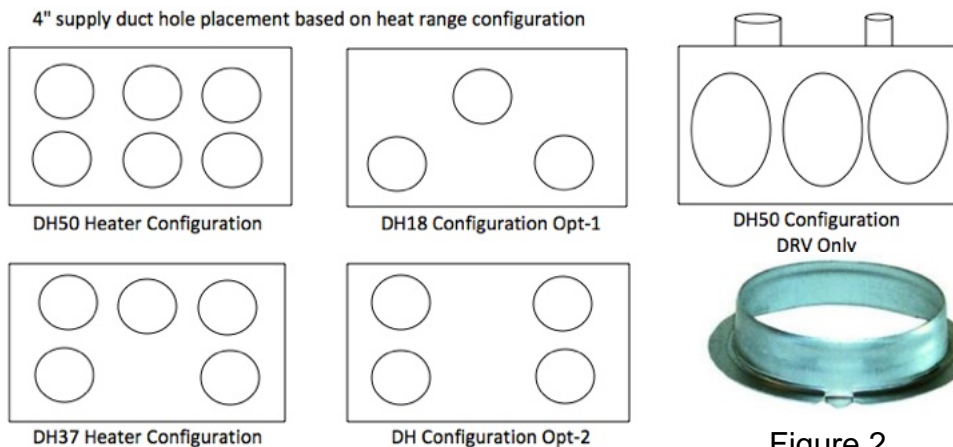
- Find a location within 10' of the transfer switch or shore power input socket and accessible by the owner after installation. Make sure that there is a clear path of no more than 15' between the disconnect and CheapHeat™ controller.

Heater Configuration	Wire Size	Breaker/Fuse Size
1800 watt	12 Ga.	20 Amp Single
3750 watt	12 Ga.	20 Amp Double
5000 watt	10 Ga.	30 Amp Double

Plenum

Ducted System: Prior to installing the new plenum, count the current number of 4" duct runs being supplied by the gas furnace. Then, before installing the electric heater coil, remove the same amount of 4" hole blanks (see figure 1 to determine correct location of holes) and install starter collars (figure 2) in the new plenum as described below.

SPECIAL NOTE: It takes four 2 Inch ducts to equal one 4 inch duct



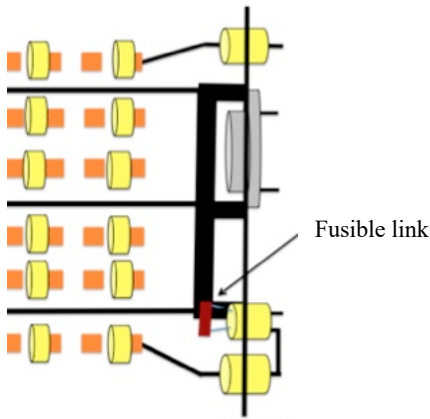


Figure 4

1. For each 4" hole with blank plate removed, insert offset section of flange on starter collar opposite the 3/8" tab on collar.
2. Match up tab on collar with notch in add-on cabinet and spin collar 1/2 turn to lock in place.
3. Slide electric heater element into cabinet (**making sure the FUSIBLE LINK is located at the bottom of the heater coil**) and fasten using 2 – 8 x 1/2" screws (see figure 4). Before installing element into cabinet make sure to pick the side that will allow the easiest access to the electrical connections after the add-on cabinet is connected to the gas furnace. On VERTICALLY mounted furnace power head is on top of plenum.
4. Install blank plate using 2 – 8 x 1/2" screws on the add-on cabinet opposite the opening that the electric element was installed in. Make sure that the electric element support rod fits through the hole in the blank plate.
5. Disconnect all 4" duct runs form gas furnace (save the 4" hose clamps) and block off any 4" openings left open on the sides of the furnace. (This may require some sheet metal patchwork.)

Ducted System:

6. Replace the access door that was just removed with the new plenum (see figure 5) and secure in place with at least 3 of the 6 – 8 x 3/4" sheet metal screws (this may require that the flange on the sides be crushed flat along the sides of the furnace).
7. Reconnect 4" flex duct (with the old 4" hose clamps) to new add-on plenum starter collars, which were previously installed in cabinet.

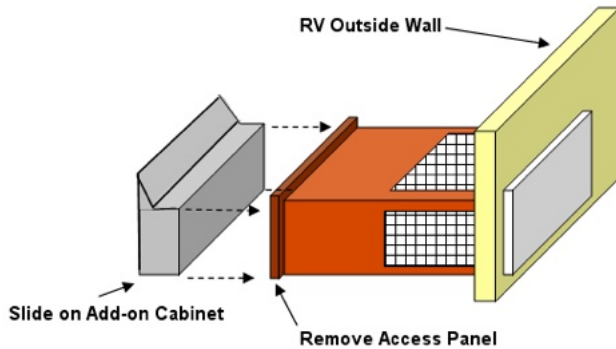


Figure 5

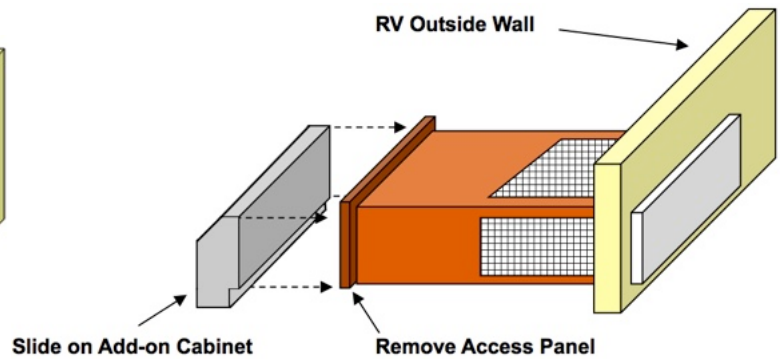
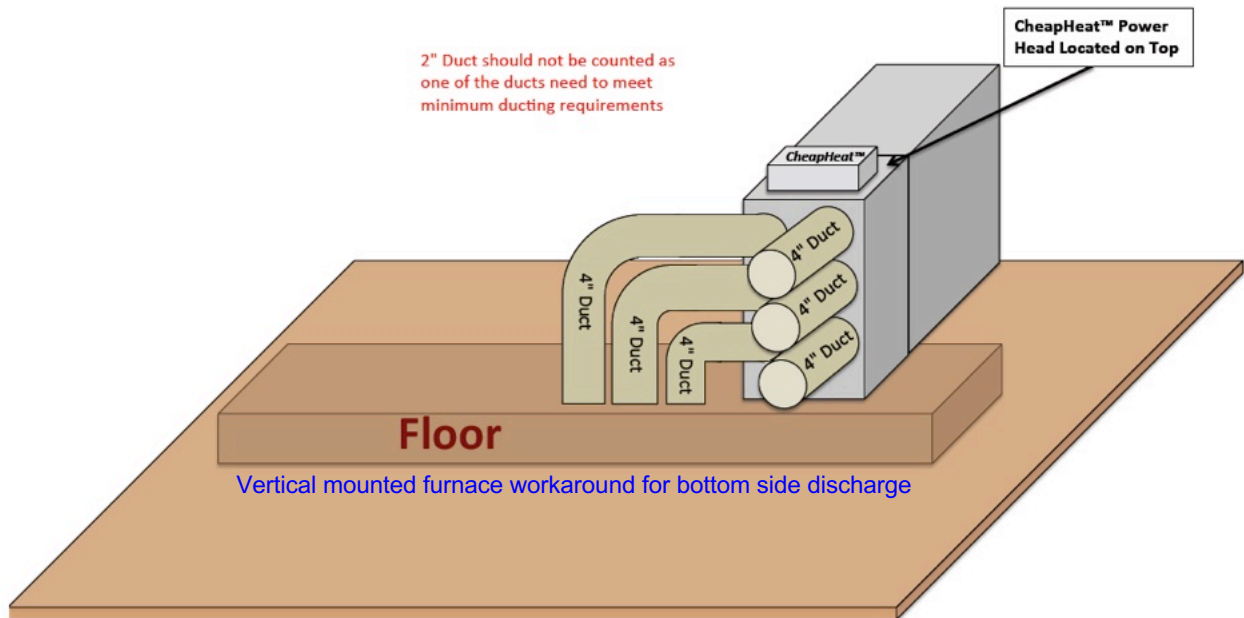


Figure 6



Plenum System: Before starting the installation process for the plenum system configuration, make sure that there is at least **5 3/4" of clear space between the furnace access panel and the wall** of the existing gas furnace. In addition, make sure that there is clear access through the floor to the trunk line under the plywood with no structural cross supports (see figure 6).

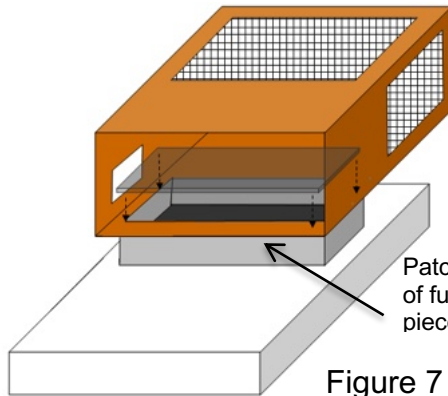


Figure 7

Cut 4 1/4 X 17 3/4 hole in floor to allow PL plenum to blow air into under floor duct.

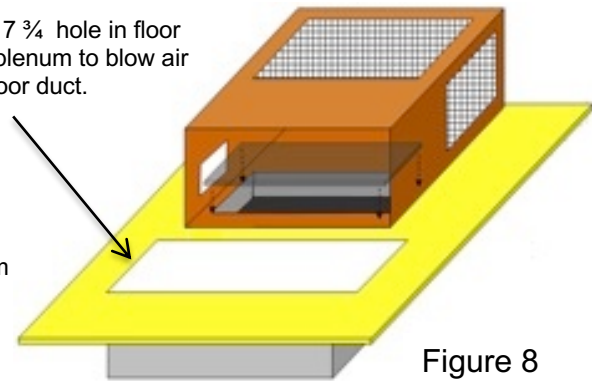


Figure 8

1. Verify that gas supply to furnace has been shut off and disconnect gas line.
2. Verify that fuse that supplies 12 V DC to power the furnace has been removed and disconnect the power wires to the furnace.
3. Remove the furnace firebox and components from its cabinet and then remove cabinet.
4. Plug 4 x 14" or 6 x 14" hole in bottom of furnace with sheet metal blank and seal with high temperature tape (see figure 7).
5. Measure 1 1/2" out from access panel opening and cut 4 1/4" x 17 3/4" hole in floor to access furnace plenum (see figure 8).
6. Cut an opening 1" smaller hole all around in the exposed duct under the floor. Now fold the excess sheet metal back up and tack it to the exposed edges of the plywood left over the previously cut hole in the floor.
7. Install the 4' X 17 1/2" end of new heater plenum then reach down inside Plenum and use the 3M High Temperature Metal Tape to seal the opening from the trunk line to the 4" x 17 1/2" opening on the new plenum.
8. Electric heater element can be slide in from either side of plenum.
9. After installing heater element (see figure 4) be sure to insert support rods in to blank plate on the opposite side of the plenum using the and secure in place with 6 x 3/8" sheet metal screws (be sure to install element so access to electrical connections is possible)
10. Reinstall furnace cabinet and slide backside of furnace into new plenum flange (be sure access door to firebox is removed). **It will be a tight fit and you may have to flatten the flanges on the furnace sides, plus some help from another person, one outside the furnace and one reaching inside, to guide it in place (see figure 6).**
11. Use 3M UL Listed High Temperature Metal Tape to tape all joints and 8 x 3/4" sheet metal screws to fasten the top and sides of the add-on plenum to the furnace.
12. Reinstall the gas furnace firebox and its components back into its furnace cabinet.
13. Reconnect gas line, but leave it turned off.
14. Reconnect wiring.

WIRING SYSTEM: All high voltage wiring should be 300 V NEMA rated and meet all national, state and local electrical codes. All wiring/cabling that passes through electrical boxes and panels **MUST** have cable clamps installed to prevent wire chaffing.

Disconnect Wiring

NEC (National Electrical Code) "10 foot rule"

In accordance with the NEC (National Electric Code) it is acceptable to have the same gauge (size) of wire FEEDING a fused Disconnect as the wire LEAVING the Disconnect as long as (See Wire Size Chart Below):

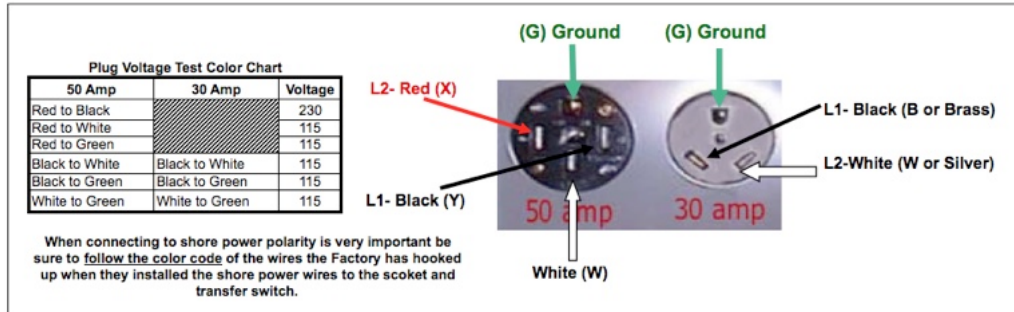
1. That wire is large enough to handle the size of the circuit ampacity protection inside that disconnect.
2. The feed in wire is **NO LONGER** than **10 feet**.
3. As long as the fused rating of the disconnect is in excess if 10% of the total feeder ampacity line it is attaching to.

FOR ANY ADDITIONAL QUESTIONS SEE THE ATTACHED EXCERPT (last pages of installation manual) FROM THE NATIONAL ELECTRICAL CODE BOOK Section 240.21 (B)(1)

High Voltage Wire Size Chart

Elect Heater Configuration	Disconnect to Shore Power Wire (10 ft rule)	Disconnect to Controller	Controller to Heater Element
1800 Watt	12 Ga.	12 Ga.	12 Ga.
3750 watt	12 Ga.	12 Ga.	12 Ga.
5000 watt	10 Ga.	10 Ga.	10 Ga.

Shore Power Socket Guide



Disconnect Switch Wiring:

1. When running wire from disconnect switch to shore power, the shore power connection can be made at the receptacle where the power feeds inside, where the power connects to the transfer switch, or the backside of the 50-amp breakers. Make sure to follow the color code for both the 50 and 30 amp services.
2. Run wire from Shore Power Source to the input side of Breaker for the Electric Heater, making sure that the wire is not impinged or supported in a way that would allow insulation to chaff. Make sure to follow the color code for both the 50 and 30 amp services.
3. Run wire between Electric Heaters Breaker and Controller, and connect wires to the apperated high voltage terminals (see figure 10). Make sure to follow the color code for both the 50 Amp service and 30 amp service).
4. **When wiring 1800-Watt configuration** eliminate the RED's wire breaker and wire. Replace the RED wire with a WHITE wire wired directly back to the shore power source
5. Double check all connections to make sure there tight and connected correctly Disconnect L1 to Controller TB2-L1, Disconnect L2 to Controller TB2-L2 and Disconnect ground to TB2-Controller ground.

Electric Heater Element Wiring:

(see high voltage wire size chart)

There are three different heater elements ratings and only one physical coil. That being said, it is the heater element heat rating that determines the wire size.

1. Run Romex wire between controller and electric heater element **(Make sure to install cable clamp in to 1/2" knock out hole on heater panel to prevent wire from chaffing)** located in add-on cabinet (see figure 11).
2. Connect wires from controller TB2 terminal 4 to element ground (**NOT NETURAL**), TB2 terminal 5 to element L1 (**COMMON**), and TB2 terminal 6 to element L2 (see *Electric Heater Diagram*).
3. Double check all connections for tightness and proper support to prevent chaffing.

Controller Wiring:

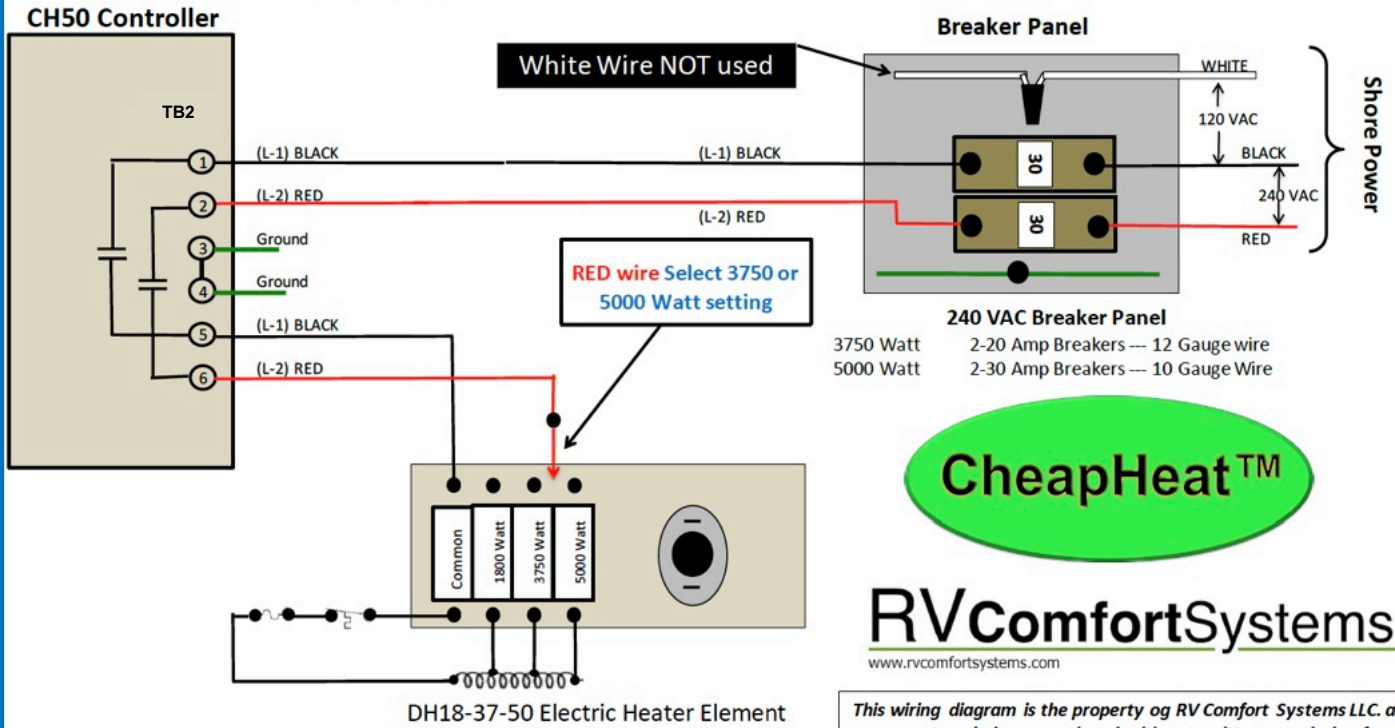
The controller has both low (12 VDC) and high voltage (120/240 VAC) running inside its cabinet, so make sure that all power is turned off before starting working on the controller. The high voltage terminal block is marked TB2, and the low voltage terminal block is marked TB1. Ensure that the correct wires are connected to the correct terminal blocks (see figure 11).

Controller Wiring Chart

Wire Connected <i>Low Voltage</i>	TB1 Term #	Wire connected <i>High Voltage</i>	TB2 Term #
NEG (-) 12 V DC from furnace (Black)	1	(L1) input from Disconnect	1
POS (+) 12 V DC from furnace (Orange)	2	(L2) input from Disconnect	2
POS (+) 12 V DC to fan motor (Red)	3	(Ground) feed from Disconnect	3
POS(+) 12 V DC from changeover switch (Blue)	4	(Ground) output to Electric Element	4
		(L1) output to Electric Element	5
		(L2) output to Electric Element	6

High Voltage Wiring For Hi Voltage 3750 or 5000 Watt System

Wire color codes and wiring to terminals must be followed EXACTLY as shown.



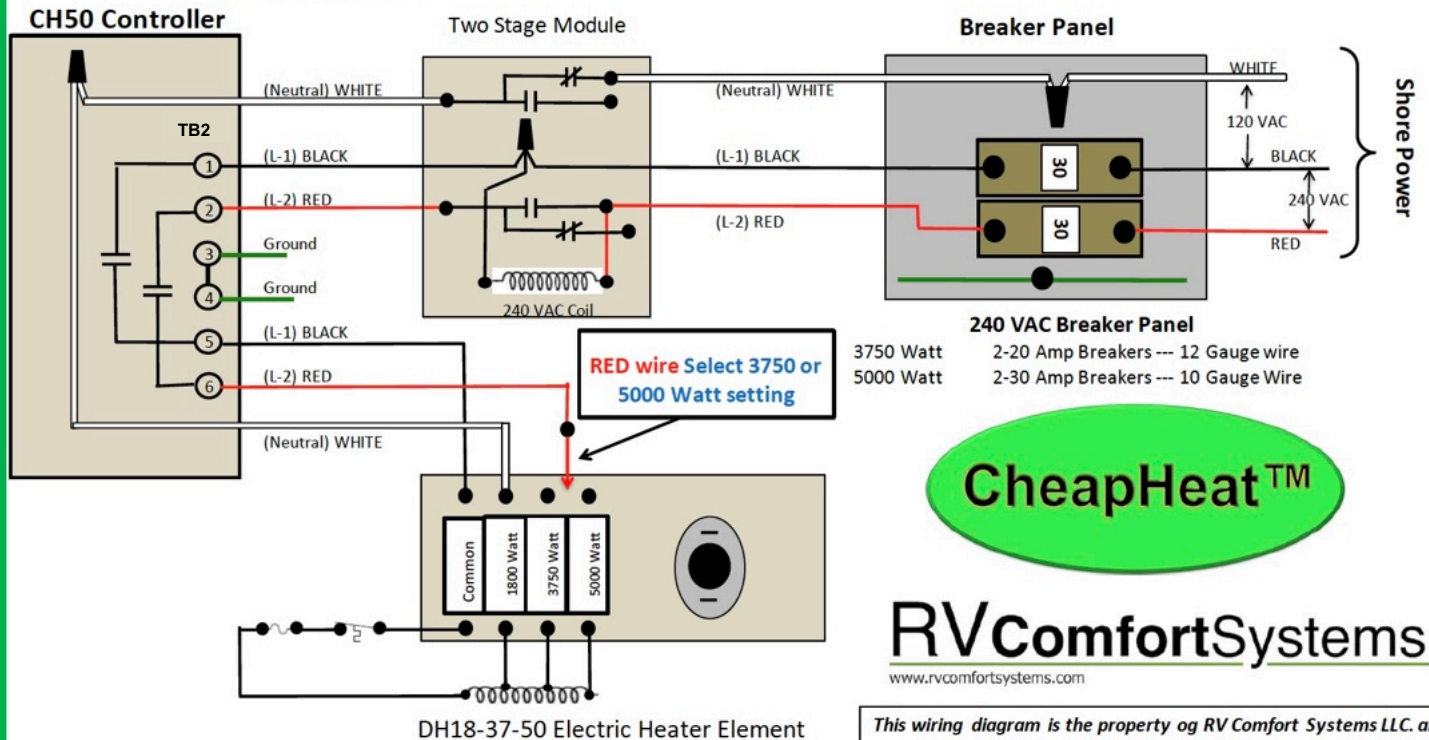
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High Voltage Wiring for Dual Voltage System

Wire color codes and wiring to terminals must be followed EXACTLY as shown.

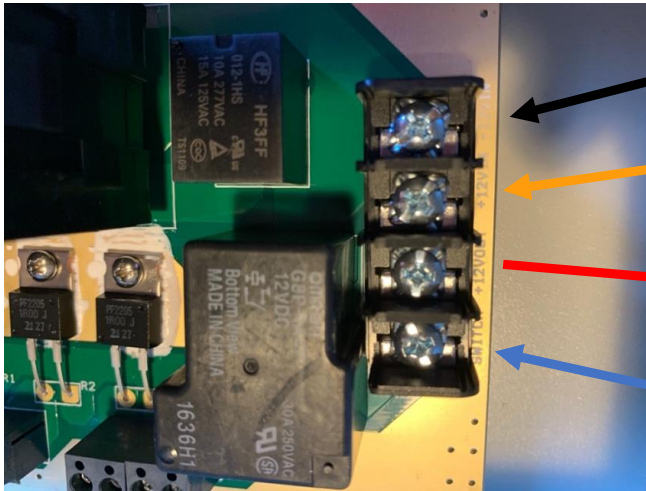


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READ THE **TEXT ON THE CONTROLLER PCB & HEATER BEFORE YOU WIRE SYSTEM**

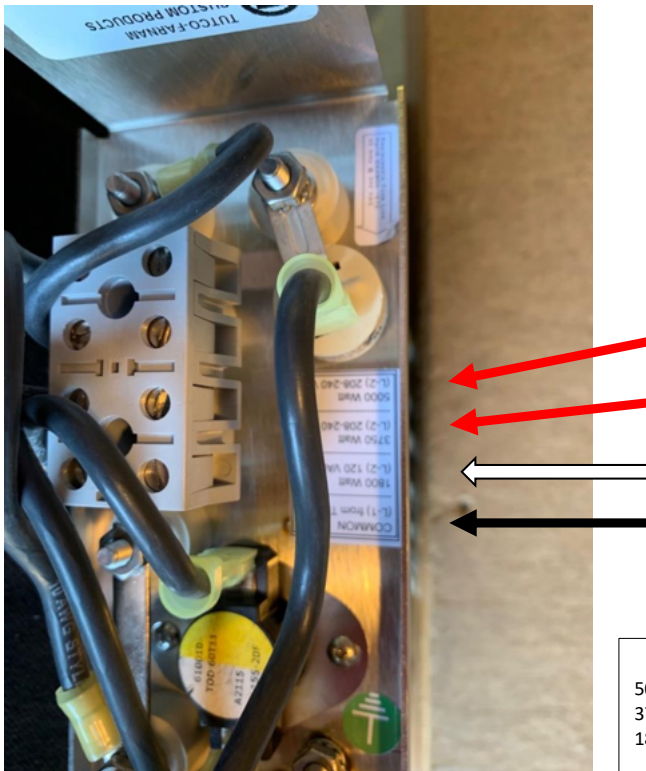


BLACK	Neg (-) 12 VDC from RV
ORANGE	Pos (+) 12 VDC from RV **For Stand-A-Lone All Electric only Additional feeder wire from this (+) 12 VDC Pos terminal to the input to the thermostat.
RED	RED wire directly to RED wire of 12 VDC blower motor at Blower motor (Hybrid System ONLY). *** Not used on Stand-a-lone System.
BLUE	Switch Leg from Override Switch WHITE wire (Hybrid System). ***From thermostat directly on (Stand-a lone System).



Black L-1 Out	to Common terminal on Heater (all heater ranges). <u>THIS IS NOT A WHITE NEUTRAL WIRE EVER.</u>
RED L-2 Out	to 3750 or 5000 Watt terminal on Heater. Not used with the 1800 Watt setting
Green	Ground out to Heater
Green	Ground from Breaker Panel
Black L-1 IN	from Breaker (all heater ranges).
RED L-2 IN	from Breaker when setting for 3750 or 5000 Watts. ** When 1800 watt heater range use WHITE wire just passes through Controller and does not connect to anything in controller. With the 1800 W setting the RED is not used

*****SPECIAL NOTES FAN*****
Stand-A-Lone ONLY All Electric furnace 120 VAC fan has two BLACK wires. One connects to the BLACK out on the controller and the other BLACK connects to the WHITE coming from the Breaker Panel

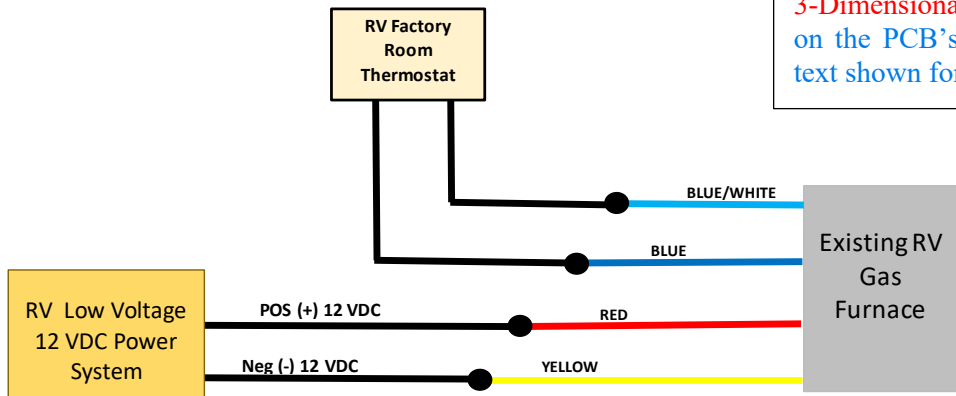


RED L-2 IN	from Controller AC-Out terminal when 5000 Watt range used..
RED L-2 IN	from Controller AC-Out terminal when 3750 Watt range used..
WHITE	from Controller Neutral wire when using the 1800 Watt range only.
Black L-1 IN	from Controller AC-Out Terminal (all heater ranges) <u>NEVER WHITE WIRE</u>

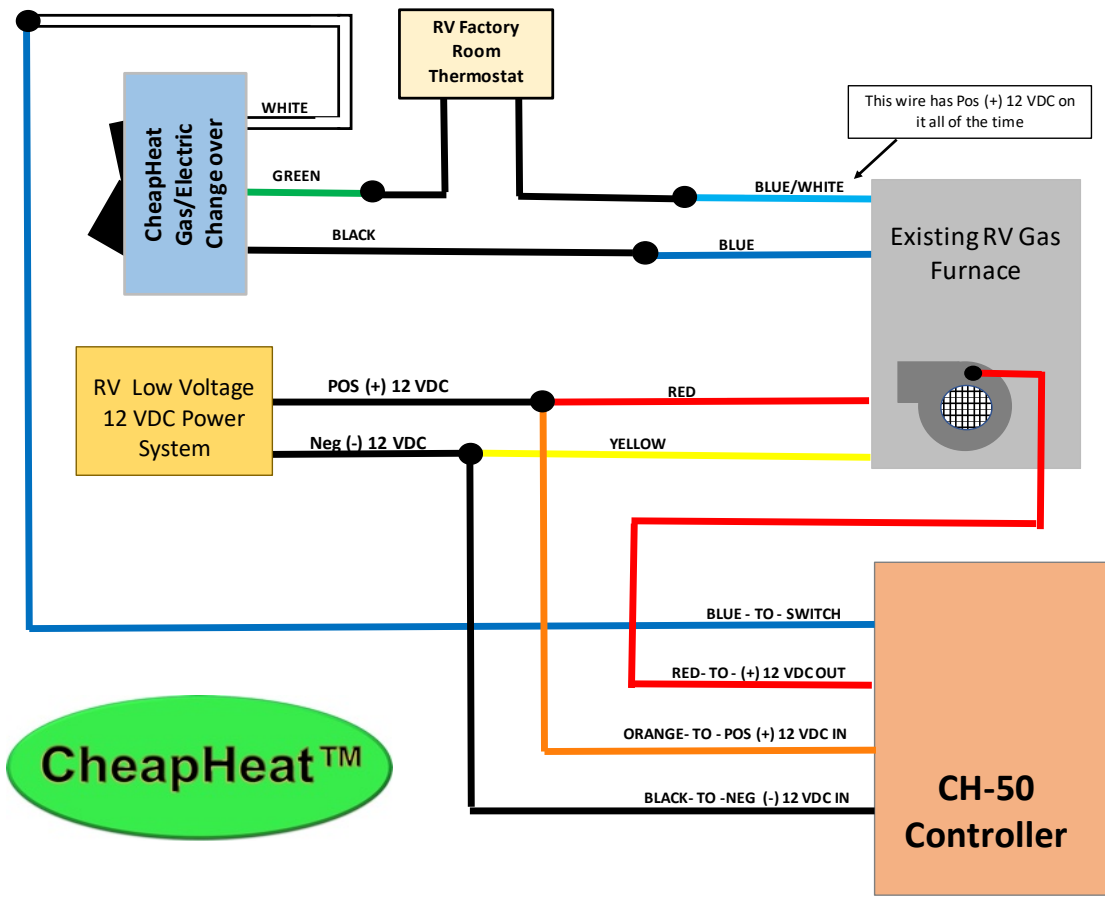
*****SPECIAL NOTES BREAKERS*****
5000 Watts requires 10 Ga. wire with two 30 amp breakers
3750 Watts requires 12 Ga. wire with two 20 amp breakers
1800 Watts requires 12 Ga. wire with one 20 amp breaker

Low Voltage 12 VDC wiring for Gas Furnace

Wiring diagrams are NOT photo's they are 2-Dimensional drawings of a 3-Dimensional world. Follow the text on the PCB's that matched with the text shown for each individual wire.



Picture above shows furnace wiring before CheapHeat system is installed



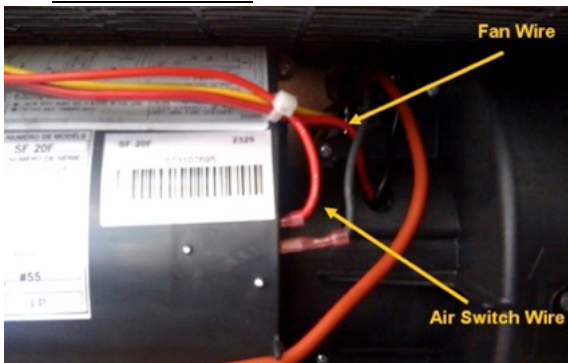
Picture above shows furnace wiring With the CheapHeat system is installed

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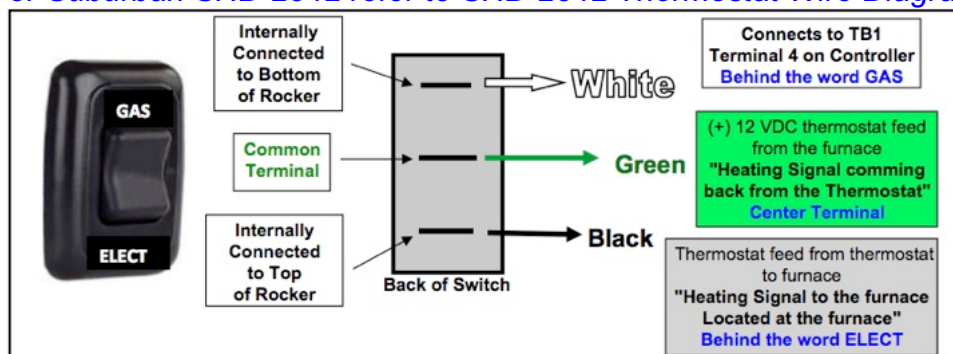
By this time in the installation, the high voltage wires should have already been run, so take a minute to confirm that the correct high voltage wires are connected to the correct terminal block (TB2) and the correct terminals as shown in the controller wiring chart above. Then, follow the steps below to connect the low voltage wiring.

1. Remove the 10' 4 conductor (2 – 12 ga., 2 – 18 ga.) wire from the shipping carton.
2. Run the 4 conductor wire harness between controller and gas furnace terminating the 3" ends at the controller and 12" ends at the gas furnace.
3. Remove outside access door to gas furnace.
4. Take the loose 12" **RED** wire from the wire harness and feed it through the opening in the gas furnace, where the existing wires pass through the furnace cabinet.
5. Locate **red** wire that feeds directly to the fan motor from the gas furnace PC board. **DO NOT** confuse this wire with the **red** wire that connects to the blower wheel air switch, the fan wire is usually a darker **red** (see figure 12).
6. Using the yellow scotch-loc splice connector provided with wiring harness, attach the **RED** 14 ga. wire in the 4 conductor wiring harness to the **red** fan wire (see figure 13). Controller TB1 Terminal 3



7. Fasten loose wires with nylon ties so they do not get sucked into fan or chaff on cabinet, and reinstall gas furnace outside access panel.
8. Connect (wire nut) the other 12 ga. wire (**ORANGE**) coming out of the 4 conductor wire harness to the (+) 12 V DC wire that feeds the furnace power from the 12 V DC power system. After this connection, there should now be three wires connected together with a red wire nut: one **ORANGE** wire from the controller, one **red** wire from the furnace and one wire from (+) 12 V DC power supplied from the fuse block. Controller TB1 Terminal 2
9. Connect (wire nut) the black 18 ga. wire coming out of the 4 conductor wire harness to the (-) 12 V DC wire that feeds the furnace power from the 12 V DC power system. After this, there should now be three wires connected together with a red wire nut. One black wire from the controller, one yellow (Atwood is black) from the furnace and one wire from the (-) 12 V DC power supplied from the fuse block ground system. Controller TB1 Terminal 1
10. Connect (wire nut) the blue 18 ga. coming out of the 4 conductor wire harness to the **WHITE** wire in the three conductor wire harness coming from the changeover switch (see figure 14). (Controller TB1 Terminal 4)

(For Suburban SHD 2542 refer to SHD 2542 Thermostat Wire Diagram)



Changeover Switch Wiring: *(For Suburban SHD 2542 refer to SHD 2542 Thermostat Wire Diagram)*

This switch should have already been mounted at the beginning of this installation process. That being said, find the three conductor wire harness that came with the controller *(should already have its green wire hooked up to one of the controller wires at the gas furnace)*. This wire should have three quick connectors already attached to one end of the wire, and this is the end that should be run from the furnace back to the switch and connected as follows:

1. As shown in *figure 14*, connect the green, white and black wires to the appropriate terminals on the switch.
2. Before connecting the other wires at the furnace, test the switch to make sure that the correct wires are connected to the correct terminals on the switch as shown in the wire diagram. ***Make sure that the Green wire is on the center terminal.***
 - Put the rocker on the switch to the ELECT position, and measure the resistance between the green and white wires. The resistance should be (0) ZERO.
 - With the switch still in the ELECT position, measure the resistances between the black and white wires. The resistance should be infinity.
 - Put the rocker on the switch to the GAS position, and measure the resistance between the Black and Green wires. The resistance should be (0) ZERO.
 - With the switch still in the GAS position, measure the resistance between the Black and White wires. The resistance should be infinity.

If the readings specified above were not obtained, exchange the black and green wires and do the test again. If there is still a problem, make sure that the wires on the other end of the wire harness by the furnace are not touching each other or anything else.

3. After completing the test process, go to the furnace and find the blue wire that feeds back from the thermostat to the gas furnace (see SITE PREPARATION section to determine the proper wire).
4. Remove the wire nut that connects the thermostat wire to the furnace wire.
5. Now that the wire nut has been removed, take the wire that physically comes back from the thermostat and connect it to the Green wire on the three conductor wire harness.
6. Now take the other disconnected wire (coming from the gas furnace) and connect it to the black wire in the three conductor wire harness.

Run Test

Before starting the run test, make sure that the shore power is turned off and proceed with the following checks.

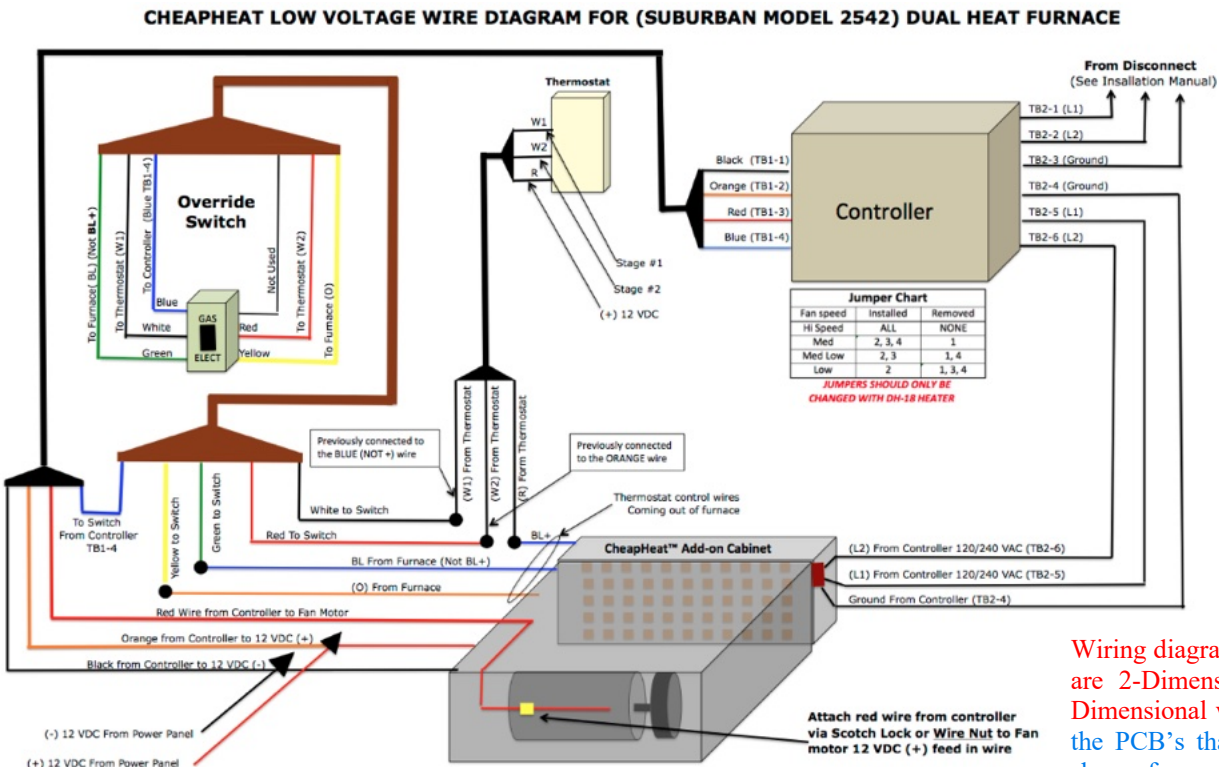
1. Make sure that the 3/8" gas line has been reattached and that the flare nut is tight.
2. Leave the gas off.
3. Turn the thermostat to at least 10° F below the inside temperature.
4. Replace the 12 V DC fuse for the gas furnace.
5. With a volt meter, check for 12 V DC at the gas furnace.
6. Place the changeover switch in the Elect position.
7. Turn the thermostat up to 10° F above the inside Temperature (the fan should start immediately).
 - If the fan does not start immediately, check the connection of the three conductor wire harness at the gas furnace.
8. Turn the thermostat back down 10° F below inside temperature (the fan should stop immediately).
 - If the fan does not shut off immediately, reverse the black and green wires on the changeover switch.
9. Put the rocker switch in the gas position.
10. Turn the thermostat up to 10° F above the inside temperature (the fan should start immediately).
11. Turn the thermostat back down 10° F below inside temperature (the fan should continue to run for one to two minutes).

- If the fan does not continue to run after the thermostat is turned down for one to two minutes, check for correct wiring, where the three conductor wire harness connects at the gas furnace.
12. Make sure that the thermostat is set 10° F below inside temperature, turn on the shore power and disconnect the breaker to the CheapHeat™ system.
 13. Remove the access panel to the controller, and check the voltage on TB2 at terminals 1 & 2.
 - If hooked to a 30 amp shore power system, the reading should be 115-120 VAC.
 - If hooked to a 50 amp shore power system, the reading should be 230-240 VAC.
 If these readings are not correct, fix the problem before continuing.
 14. Remove the access panel for the electric heating element.
 15. Attach amp probe meter around one of the wires hooked to the heater.
 16. Turn thermostat up 10° F above indoor temperature and read amp reading at electric heater (see chart below for correct readings).
 17. Verify that there is heat coming out of all of the registers.
 18. Let system run for at least 20 minutes to make sure that there are no problems.
 19. Turn thermostat back down to 10° F below indoor temperature.
 20. Remove amp probe and reinstall electric heater access panel.
 21. Turn gas line on to furnace, and check for leaks.
 22. Turn changeover to GAS.
 23. Turn thermostat up to 10° F above indoor temperature (fan should start immediately and heat should start with in three to four minutes).
 - If heat does not come out of registers after three to four minutes, check to make sure that the propane tanks are turned on and full.
 24. Turn thermostat off, replace all panels and inspect wiring.
 25. YOUR DONE. GOOD JOB!

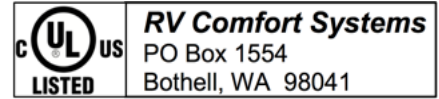
Troubleshooting

This system is pretty straightforward. If you have any problems, redoing the RUN TEST section should help resolve any problems except for burnt up parts. The schematic shown below should help you resolve any diagnostic problems.

(For Suburban SHD 2542 refer to SHD 25423 Thermostat Wire Diagram)



Wiring diagrams are NOT photo's they are 2-Dimensional drawings of a 3-Dimensional world. Follow the text on the PCB's that matched with the text shown for each individual wire.



20 Minute Test For

Low Heat Output/Short Cycling

This assumes the heater is set on the correct heater range

Short Cycle Test

This is a simple test that verifies if your ducting system has adequate air flow to prevent your Heater Coil from short cycling, ultimately causing a reduced heat output (*Fan will continue to run even if the heater coil is cycling on over temp*).

- Turn your thermostat up to 82 F degrees and clamp your **Amp Meter around only one** of the high voltage wires coming out of the breakers, that feed the CheapHeat Controller.
- Note current reading, reading should be as follows:
 - 1800 Watt setting = 14.5 to 15 amps @ 120 VAC
 - 3750 Watt setting = 14.5 to 15 amps @ 240 VAC
 - 5000 Watts setting = 19.5 to 20 amps @ 240 VAC
- During this test you need to watch the amp meter for a full 20 minutes to make sure that the current reading stays constant (*you may need to open the windows and door to keep the thermostat from shutting off during this test*).
- If at any time during this test while the thermostat is calling for heat the meter reading drops out. That is an indication that you have an airflow related problem causing the system to short cycle, which will result in substantial loss in heating capacity.

Note:

1. Make sure all of the outside storage compartment doors are closed. This is to make sure the furnace is NOT sucking in outside air, which will through off the test.
2. Be sure you have the correct voltage coming out of the breakers that feed the controller. If you have 120 VAC Test Black to White, if you have 240 VAC. Test Red to Black (*Testing one lead to ground will not give you the correct reading*).

Possible cause of Short cycling

1. Duct work related problem:
 - Check ductwork for holes, leaks, blockages or tears.
 - Torn or leaking ductwork will allow hot air to short cycle back through the return air causing the high temp safety switch to short cycle reducing the output temperature.
 - Blockage in duct work or not enough duct work will cause a reduced air flow across the heater coil causing in a high temperature short cycle by the high temp safety switch, resulting in a lower output temperature of the overall system.
2. Not enough ductwork:
 - Ductwork minimums specs must be follow as shown in the installation manual (**Spec's shown below**).
 - The CheapHeat system is a UL listed device we are have safeties in place that will not allow any part of our ductwork to exceed very specific surface

temperatures. Because of that if the ducting minimums are not followed the system will short cycle on high temperature lock out reducing output temperatures.

3. Fan Motor Problem:

- Furnace blower motor running slow or below full load amp draw (**verify blower amps on motor sticker**), this can happen for one of three reasons.
 - The first reason of a restriction in airflow, contrary to popular belief closing off registers will NOT increase airflow to the other registers. The fan will only move so much air as you restrict the air flow all that happens is the fan blade cavates. Which reduces the load on the motor ultimately reducing the current draw (amp load).
 - The second reason is slow blower motor this is usually an internal problem with the motor, on 12 volt direct current motors this is defective brushed, **not uncommon on new motors** (results in low current).
 - The third reason is dried out bearings, this usually happens on a blower that is 1 year or older and will ultimately result in a failed blower motor.

Important Note:

1. Since Gas Furnaces are **not** UL Listed, they are not held to the same high temperature reset standard. In fact, most gas furnaces operated at as much as a 100 F degree higher reset temperature. Because of this when blower motors start to fail due to bad bearings, the problem doesn't show its self as soon as it does on a UL Listed product. There higher reset point can also cover up overheating caused by leaking or restricted duct work.
2. Low blower motor amps are caused by one of two issues, airflow restriction or bad brushes.
3. Do not include 2" ducts in minimum ducting requirements (*it takes 4-2' ducts to equal the air flow of one 4" duct*).

VERTICAL MOUNTED FURNACES REQUIRE AUTO TEMP LIMIT UPGRADE TO 200°F

(Contact RV Comfort Systems LLC for correct Auto Temp Limit upgrade part)

Air Flow Specifications 4" Round Duct

Max Air Temperature 155° F, Max Static 1.0 in.

Heat Range Configuration	Min Total CFM	Max Total CFM	Min # Supply Runs	Single 4" Round Duct			Average all 4" Round Ducts Combined		
				Max Length Supply Runs	Max 45° Bends	Max 90° Bends	Max Avg. Length of Runs	Max 45° Bends	Max 90° Bends
1800 Watt	120	300	3	25 Ft	2	1	15 Ft	6	3
3750 Watts	180	400	5	25 ft	2	1	15 Ft	10	5
5000 Watts	240	500	6	25 ft	2	1	15 Ft	12	6

Air Flow Specifications Rectangle Duct

28 Ga. Sheet Metal

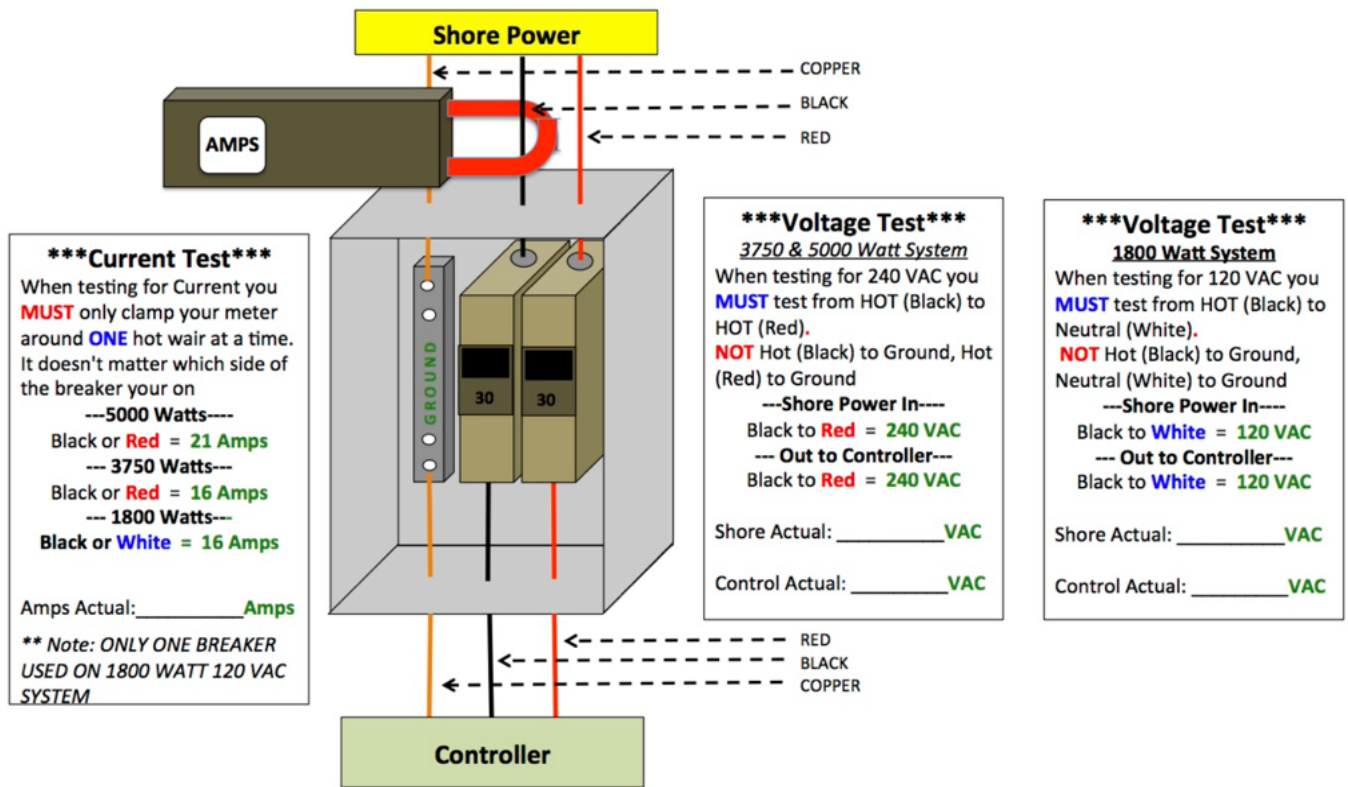
Heat Range Configuration	Min Total CFM	Max Total CFM	Min Sq. in Supply Side Trunk line	Min # 4x8 Supply Registers	Min # 4X10 Supply Registers	Min # 2 1/4x10 Supply Registers	Min # 2 1/4x12 Supply Registers
1800 Watts	120	300	40	3	2	3	3
3750 Watts	180	400	60	4	3	5	5
5000 Watts	240	500	80	5	4	6	6

**Gas Furnace motors are Direct Current motors and require a special meter designed to test DC current to make these amperage test on the blower motor.

Atwood/Dometic			
Model	Motor Watts	Current	Voltage
8516	55	4.6 amps	12.5 VDC
8520	55	4.6 amps	12.5 VDC
8525	91	7.6 amps	12.5 VDC
8531	91	7.6 amps	12.5 VDC
8535	118	9.8 amps	12.5 VDC
8935	132	11.0 amps	12.5 VDC
8940	132	11.0 amps	12.5 VDC
8900-2450	86/202	7.2/16.8 amps	12.5 VDC
AFMD/DFMD-16	50	4.2 amps	12.5 VDC
AFMD/DFMD-20	50	4.2 amps	12.5 VDC
AFMD/DFMD-25	90	7.5 amps	12.5 VDC
AFMD/DFMD-30	90	7.5 amps	12.5 VDC
AFMD/DFMD-35	132	11.1 amps	12.5 VDC
AFLD/DFLD-35	150	12.5 amps	12.5 VDC
AFLD/DFLD-40	150	12.5 amps	12.5 VDC

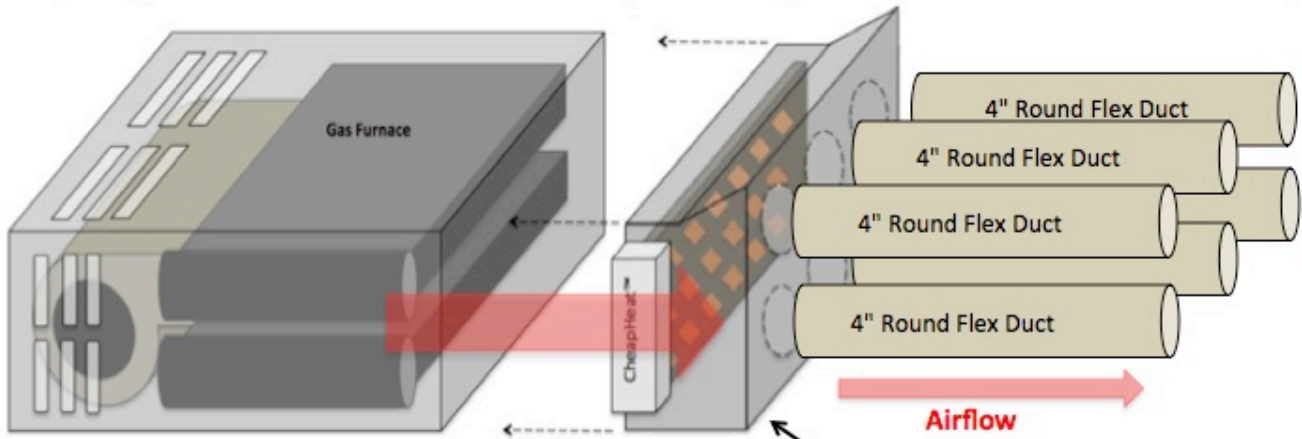
Suburban			
Model	Motor diameter	Current	Voltage
SF Series - 20 Mbtu	2.5"	6.5 amps	12.5 VDC
SF Series - 20 Mbtu	3.0"	8.5 amps	12.5 VDC
SF Series - 25 Mbtu	2.5"	6.5 amps	12.5 VDC
SF Series - 25 Mbtu	3.0"	8.5 amps	12.5 VDC
SF Series - 30 Mbtu	2.5"	6.5 amps	12.5 VDC
SF Series - 30 Mbtu	3.0"	6.5 amps	12.5 VDC
SF Series - 35 Mbtu	2.5"	8.5 amps	12.5 VDC
SF Series - 35 Mbtu	3.0"	9.4 amps	12.5 VDC
SF Series - 42 Mbtu	3.0"	11.5 amps	12.5 VDC
SH Series - 35 Mbtu	3.0"	8.2 amps	12.5 VDC
SH Series - 42 Mbtu	3.0"	10.6 amps	12.5 VDC
SHD Series - 25/42 Mbtu	3.0"	8.8/12.0 amps	12.5 VDC

Current draw should be within 5% of factory spec's
 10% loss in current = 15% loss in air flow
 20% loss in current = 30% loss in air flow



Appendix-A

All ductwork must be attached to the discharge side of the enclosure to make sure the all of the air has to go through the electric heater element before it goes out into the ductwork.

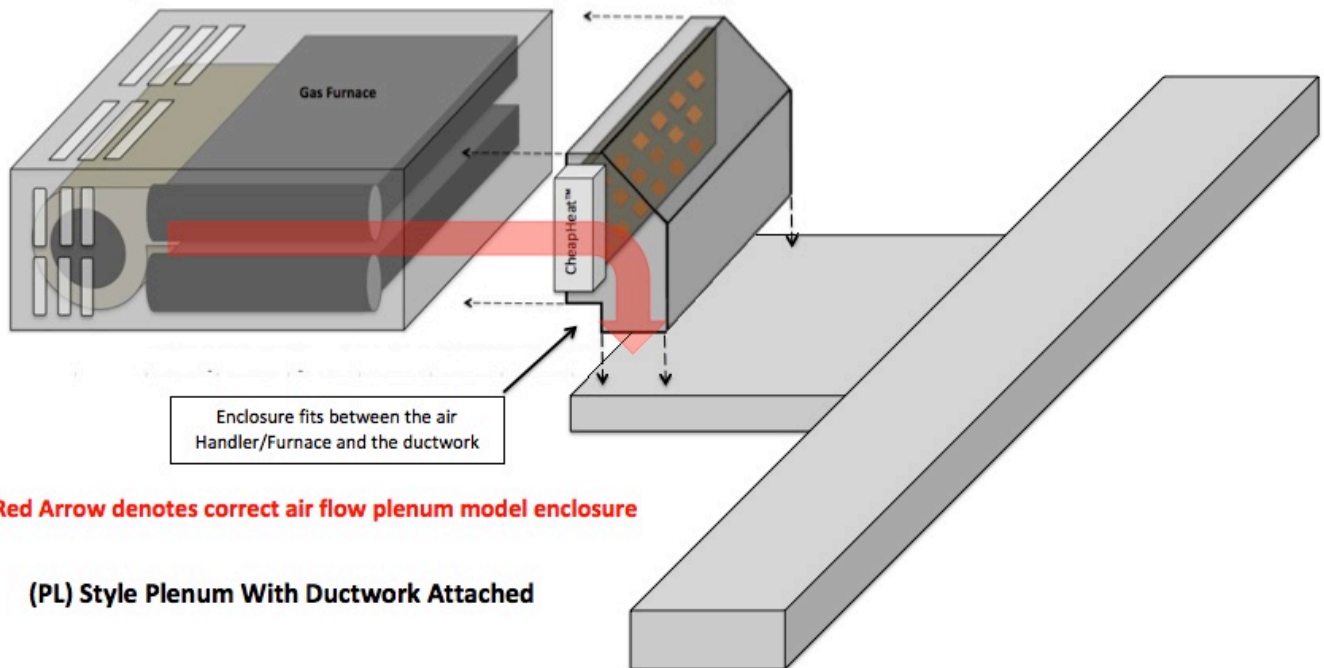


Red arrow denotes the correct airflow ducted model enclosure.

Enclosure fits between the air Handler/Furnace and the ductwork

(SA) Style Ducted Enclosure With Ducting Attached

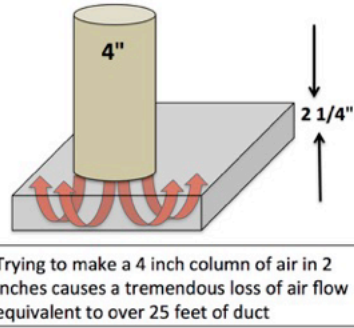
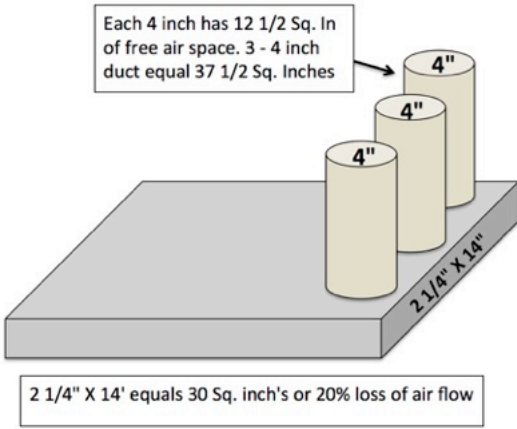
All ductwork must be attached to the discharge side of the enclosure to make sure the all of the air has to go through the electric heater element before it goes out into the ductwork.



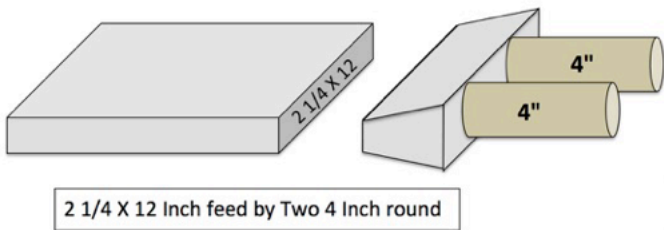
Enclosure fits between the air Handler/Furnace and the ductwork

Red Arrow denotes correct air flow plenum model enclosure

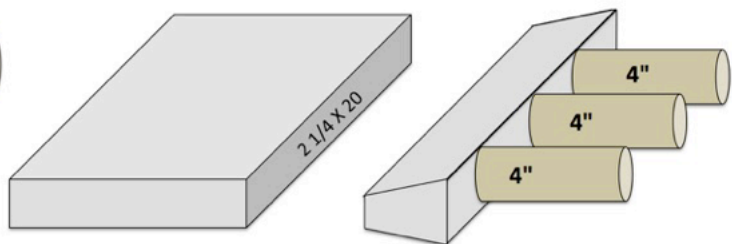
(PL) Style Plenum With Ductwork Attached



The examples above is the wrong way to connect 4 inch round duct to rectangular duct



2 1/4 X 12 Inch feed by Two 4 Inch round



2 1/4 X 20 Inch feed by Three 4 Inch round

The examples above is the Correct way to connect 4 inch round duct to rectangular duct

Furnace Brand

Ducted System Cabinet Adapters

ATWOOD	8500 Series	8900 Series	8900 (2-Stage)	AFMD Series	AFLD Series
Horizontal Adapter	Discontinued	SAH89	Discontinued	SAH7	SAH9
Vertical Adapter	Discontinued	N/A	Discontinued	SAV7	SAV9
DOMETIC			DFLD (2-Stage)	DFMD Series	DFLD Series
Horizontal Adapter	N/A	N/A	Discontinued	SAH7	SAH9
Vertical Adapter	N/A	N/A	Discontinued	SAV7	SAV9
SUBURBAN	SF Series	SH Series	SH 25/42	Ductless Only NT-12, NT-16, NT-20	NT-20 & Larger Ducted
Horizontal Adapter	SFH7	SHH9	SHH9	NT-DH19	N/A
Vertical Adapter	SFV7	SHV9	SHV9	N/A	N/A

Plenum System Cabinet Adapters

ATWOOD	8500 Series	8900 Series	8900 (2-Stage)	AFMD Series	AFLD Series
Horizontal Adapter	Discontinued	PAH89	Discontinued	PAH7	PAH9
Vertical Adapter	Discontinued	N/A	Discontinued	N/A	N/A
DOMETIC			DFLD (2-Stage)	DFMD Series	DFLD Series
Horizontal Adapter	N/A	N/A	Discontinued	PAH7	PAH9
Vertical Adapter	N/A	N/A	Discontinued	N/A	N/A
SUBURBAN	SF Series	SH Series	SH 25/42	Ductless Only NT-12, NT-16, NT-20	NT-20 & Larger Ducted
Horizontal Adapter	PFH7	PHH9	PHH9	N/A	N/A
Vertical Adapter	N/a	N/A	N/A	N/A	N/A

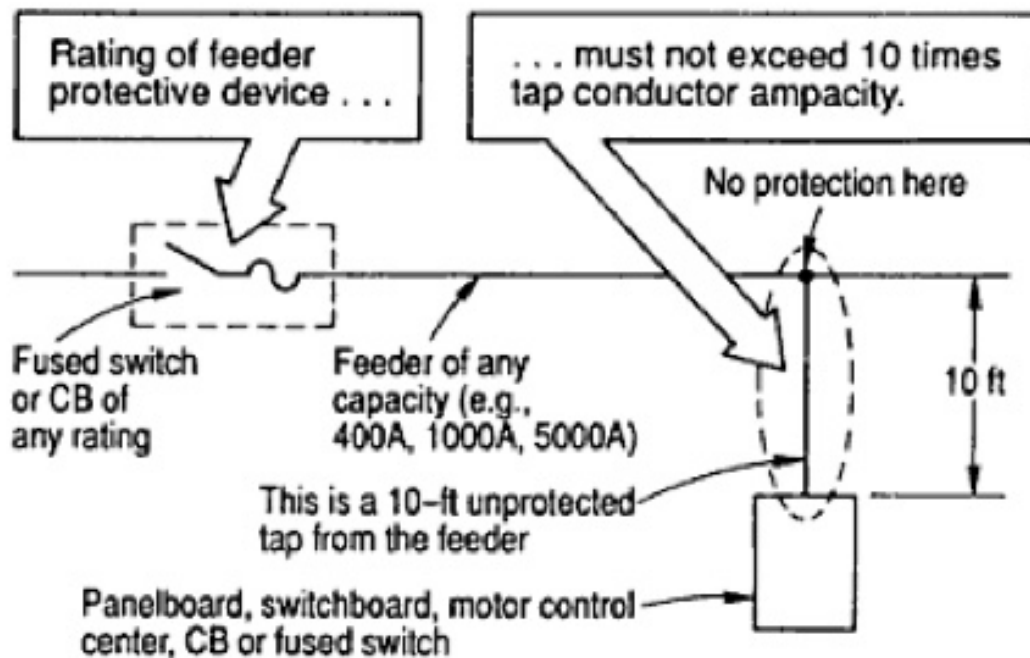
Although basic Code requirements dictate the use of an overcurrent device at the point at which a conductor received its supply, subparts (A) through (H) effectively present exceptions to this rule in the case of taps to feeders. That is, to meet the practical demands of field application, certain lengths of unprotected conductors may be used to tap energy from protected feeder conductors.

These “exceptions” to the rule for protecting conductors at their points of supply are made in the case of 10-, 25-, and 100-ft (3.0-, 7.5-, and 30.0-m) taps from a feeder, as described in 240.21, parts (B)(1), (B)(2), and (B)(4). Application of the tap rules should be made carefully to effectively minimize any sacrifice in safety. The taps are permitted without overcurrent protective devices at the point of supply.

240.21(B)(1) says that unprotected taps not over 10 ft (3.0 m) long (Fig. 240-15) may be made from feeders, provided:

1. The smaller conductors have a current rating that is not less than the combined computed loads of the circuits supplied by the tap conductors and must have ampacity of—

Not less than the rating of the “device” supplied by the tap conductors, (which formerly included the bus structure of a main lug only panelboard but given changes in 408.36, an overcurrent device is now generally required) or



240.21(B)(1)



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	Patent Pending and Trademark Protected

Product Warranty
Model# CH-50 & DH18-37-50

CheapHeat™

RV Comfort Systems products offer no warranty directly to the end user. The warranty for the CheapHeat™ product is through the installing dealer or OEM manufacture. This warranty is subject to proper installation and operation and only covers the product workmanship with regards to component operation as rated for a period of 1 year on aftermarket installations and 2 years on OEM installations, from the date of the installation.

Gas Furnace

OEM Coach Manufacturers

For 2 years RV Comfort Systems will reimburse the OEM coach manufacturer for the cost of any failed part not covered by the furnace manufacture to which the CheapHeat™ System is attached.

After Market installation

For 1 year RV Comfort Systems will reimburse the installing Dealer for the cost of any failed part in the furnace caused by the addition of the CheapHeat™ System.

IN NO EVENT, REGARDLESS OF CAUSE, SHALL RV COMFORT SYSTEMS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES OF ANY KIND.

The form below must be filled out and mailed to RV Comfort Systems with in 30 days of the installation (OEM with in 30 days of the RV being sold, leased, or rented to its first customer) for this warranty to be honored.

To initiate warranty cut on black line and mail to address shown at the bottom

Date Installed _____ OEM Date Sold _____

Customer Name _____ Address _____

City _____ State _____ Zip _____ Ph _____ email _____

Furnace Brand _____ Mod # _____ Serial # _____

For Ducted System: Number of Duct Runs _____ Size _____

For Plenum System: Number of Registers _____ Size _____

Controller Serial # _____ Shore Power _30 amp _50 amp

Heater Serial # _____ Setting (KW) _____

Dealer/OEM: _____ Ph _____ Fax _____

Street Address _____ Mail _____

City _____ State _____ Zip _____ email _____

Tech (Print) _____ (Signature) _____

Mail to: RV Comfort Systems PO Box 1554 Bothell, Washington 98041