

# Service Tech Manual



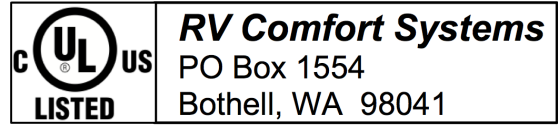
**RVComfortSystems LLC.**

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# Table of Content

|  |     |
|--|-----|
| Introduction .....                                 | 1   |
| Overview .....                                     | 2-3 |
| Specifications .....                               | 4   |
| Hybrid Duct Styles .....                           | 5   |
| All Electric Furnace Duct Styles.....              | 6   |
| Low Voltage Wire Diagram .....                     | 7   |
| High Voltage Wire Diagram (Single Stage Heat)..... | 8   |
| High Voltage Wire Diagram (Two Stage Heat).....    | 9   |
| Hybrid Two Stage Module Wire Layout .....          | 10  |
| All Electric Furnace Wiring (12VDC Blower).....    | 11  |
| All Electric Furnace Wiring ( 230VAC Blower).....  | 12  |
| All Electric Blower Wiring Layout 12V/230V.....    | 13  |
| Shore Power Wiring Layout.....                     | 14  |
| Controller Voltage Test .....                      | 15  |
| Shore Power Voltage test.....                      | 16  |
| Heater Coil Resistance Test .....                  | 17  |
| Suburban SH2542 Wiring for Hybrid System.....      | 18  |

## **CheapHeat™ System Add-on & Stand-A-Lone**



### **Technical Specifications & Charts**

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

This manual is not intended to be use as an installation Manual. It's designed to be used as both a quick reference manual and a source for additional specifications needed when testing and troubleshooting the CheapHeat™ Systems. Prior to using this manual the Technician must read the specific installation & safety manual for the product they are working on or this manual will not be able to provide the helpful information needed for successful installation.

### **IMPORTANT SAFETY INSTRUCTIONS**

- Before starting work on any high voltage (120/240V AC) project, turn off power to affected areas. To accomplish this on an RV, shut down all shore power sources, including generators and inverters.
- All wiring must comply with local and national electrical codes and be installed by a qualified electrician.
- All wiring/cablings that passes through electrical boxes and panels MUST have cable clamps installed to prevent wire chaffing.
- Contact a qualified electrician with any questions about the following instructions.
- Check the available power supply and resolve any wiring problems BEFORE installing or operating this unit.
- The wiring diagrams and specifications with respect to wire size, fuse/breaker size, and grounding requirements must be followed.
- Do not immerse Electric Heater in water this unit is designed for heating air only.
- To provide continued protection against risk of electric shock, connect to properly grounded outlets only.

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## Troubleshooting the CheapHeat™ Hybrid Heating System

### -----CAUTION-----

Only qualified service technicians should perform this test  
BE sure to adhere to all NEC safety precautions when performing these tests  
DO NOT RUN ELECTRIC HEATER WITHOUT FAN RUNNING

The following pages list a number of tests that will help the technician determine what part within the CheapHeat Hybrid has failed, if any and why. When testing the system in the energized mode, be sure the thermostat is at least 10 F degrees above the indoor temperature. When it's off make sure it's 10 F degrees below the indoor temperature.

### TWO MOST COMMON PROBLEMS

#### **(I) Fan Runs but no heat**

1. Improper voltage or tripped breakers:
  - Be sure to turn breakers completely off and then back on to reset breaker.
    - If not a tripped breaker and you just moved to a new RV site it's not uncommon for it to be wired incorrectly (check the voltage exactly as outlined in the attached docs to confirm the correct phasing).
    - Tripped breaker may be caused by loose wire at the breaker, shorted wire, or defective breaker.
  
2. Voltage is present at heater power head:
  - Check to see if you have the correct voltage from the breaker to the controller to the power head (Refer to the attached doc's).
  - If voltage is present check Fuse Link to make sure it is not open (Burned out). If the Fuse link is open in EVERY case it is was caused by a lack of airflow.
    - Torn ductwork, allowing hot air to come back through the return air system causing the high temp switch to short cycle.
    - Blockage in ductwork or not enough duct work
    - Intermittent Blower motor (may work in gas mode because there is NO fail safe fuse link).
    - Blower running too slow (this can happen to a new motor and may be caused by loose wire in motor).
    - Blower overheated and shut down (after it cools it will restart for short periods).

The only solution to a blower motor problem is to replace it, if your system has been running for any period of time (Weeks or Months before the fuse link burned out you can pretty much figure it is a blower motor problem (Duct work doesn't usually go bad for no reason).

**(II) Low or not enough Heat**

*(This assumes the heater is set on the correct heater range)*

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 over all 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 ail 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 caveats. Which reduces the load o 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.

\*Note: Lower blower motor amps can be caused by one of two issues, airflow restriction or bad brushes.

| 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<br>10% loss in current = 15% loss in air flow<br>20% loss in current = 30% loss in air flow |                |               |          |

# 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<br/>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.

| <b>Shore Power</b> | <b>CheapHeat™ Heater Configurations</b> | <b>Ducting</b>  |
|--------------------|---|---|
| 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                     |   |



# Air Flow and Temperatures

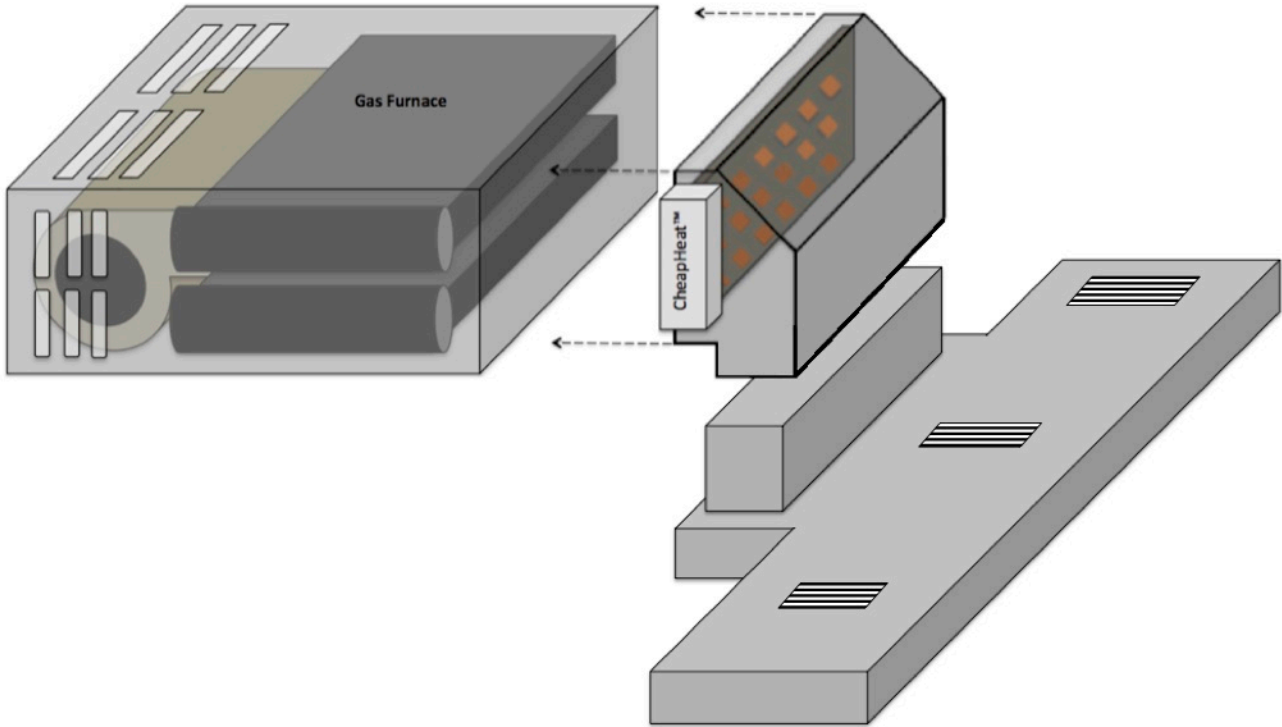
## Plenum System **Minimum** Air Flows

MAX Ducting inside air temperature with in 6 inches of heater coil

| Heater Setting | 2 x10 | 2 x 12 | 2 x 14 | 4 x 8 | 4 x 10 | Cabinet Adapter | Plenum    |
|----------------|-------|--------|--------|-------|--------|-----------------|-----------|
| 1800 Watts     | 3     | 2      | 2      | 2     | 2      | 155 F Deg       | 145 F Deg |
| 3750 Watts     | 5     | 4      | 4      | 5     | 4      | 155 F Deg       | 145 F Deg |
| 5000 Watts     | 6     | 6      | 5      | 6     | 5      | 155 F Deg       | 145 F Deg |

### Actual Readings

| Temperature Cabinet adapter Discharge | Temperature With-in 6 inch's |                         | Register 1 | Register 2 | Register 3 | Register 4 | Register 5 | Register 6 |
|---------------------------------------|------------------------------|-------------------------|------------|------------|------------|------------|------------|------------|
|                                       |                              | <b>Size of Register</b> |            |            |            |            |            |            |
|                                       |                              | <b>Temperature</b>      |            |            |            |            |            |            |



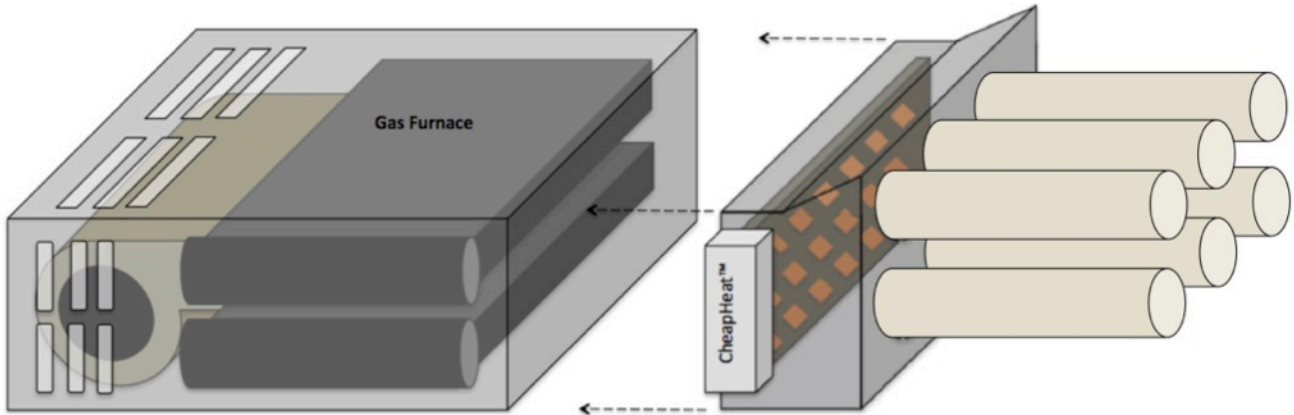
## Ducted System **Minimum** Air Flows

MAX Ducting inside air temperature with in 6 inches of heater coil

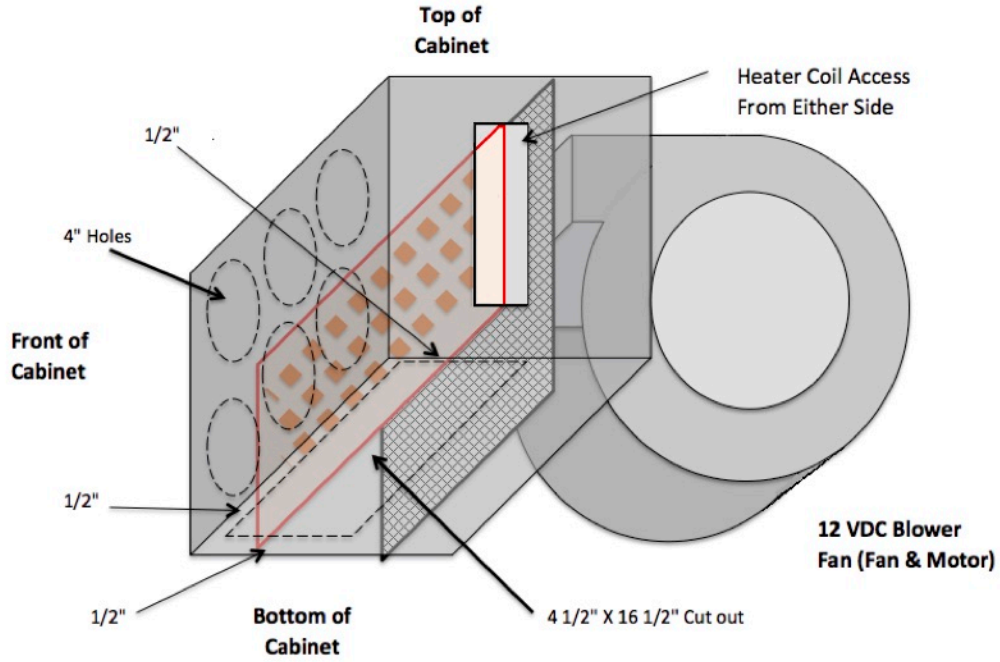
| Heater Setting | 2 x10 or 4" Round | 2 x 12 | 2 x 14 | 4 x 8 | 4 x 10 | Temperature of Air |  |
|----------------|-------------------|--------|--------|-------|--------|--------------------|--|
| 1800 Watts     | 3                 | 2      | 2      | 2     | 2      | 145 F Deg          |  |
| 3750 Watts     | 4                 | 4      | 4      | 5     | 4      | 145 F Deg          |  |
| 5000 Watts     | 6                 | 6      | 5      | 6     | 5      | 145 F Deg          |  |

### Actual Readings

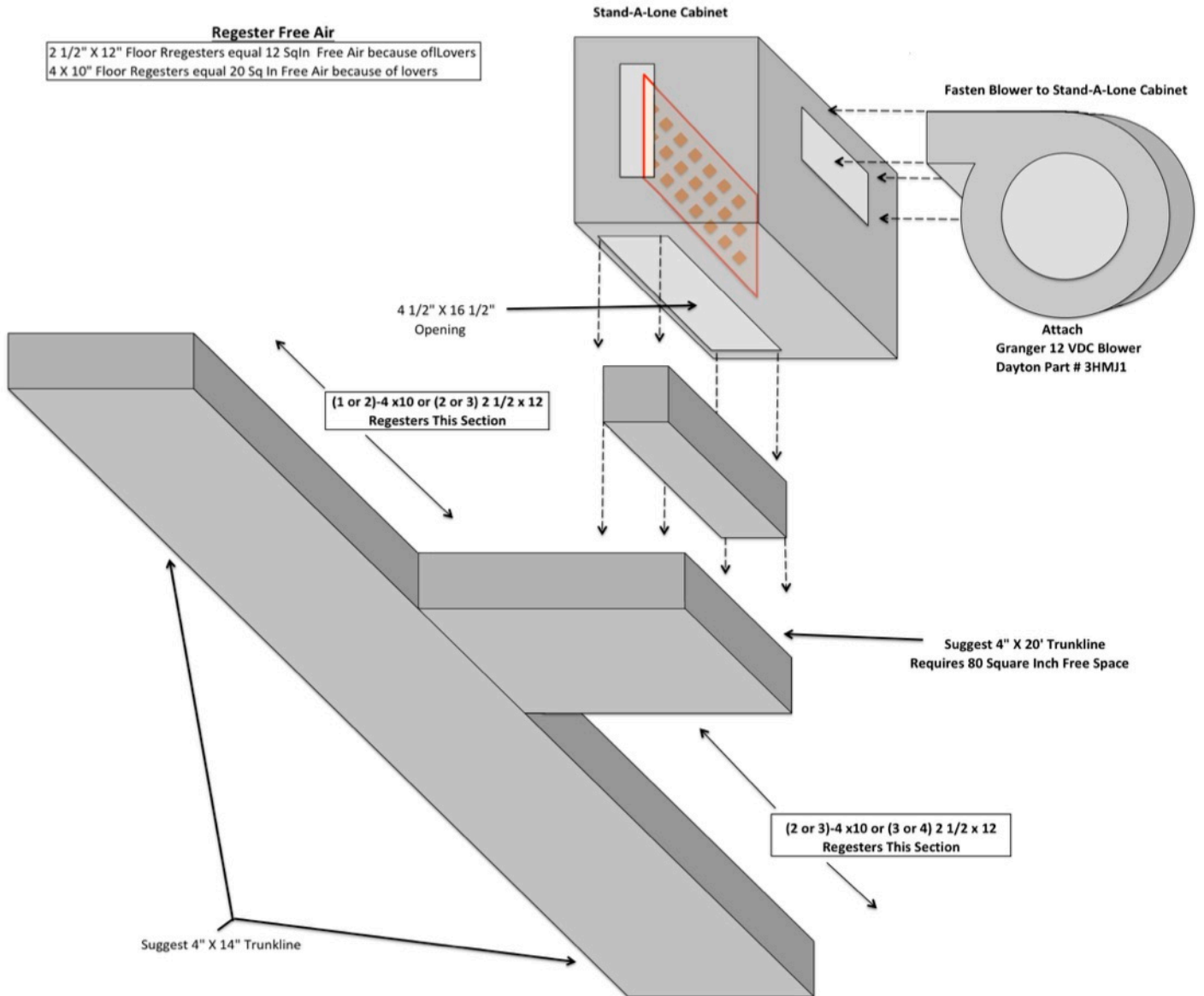
| Temperature with-in 6 " of Cabinet Adapter |                         | Register 1 | Register 2 | Register 3 | Register 4 | Register 5 | Register 6 |
|--|-------------------------|------------|------------|------------|------------|------------|------------|
|  | <b>Size of Register</b> |            |            |            |            |            |            |
|  | <b>Temperature</b>      |            |            |            |            |            |            |



**Stand-A-Lone Cabinet**

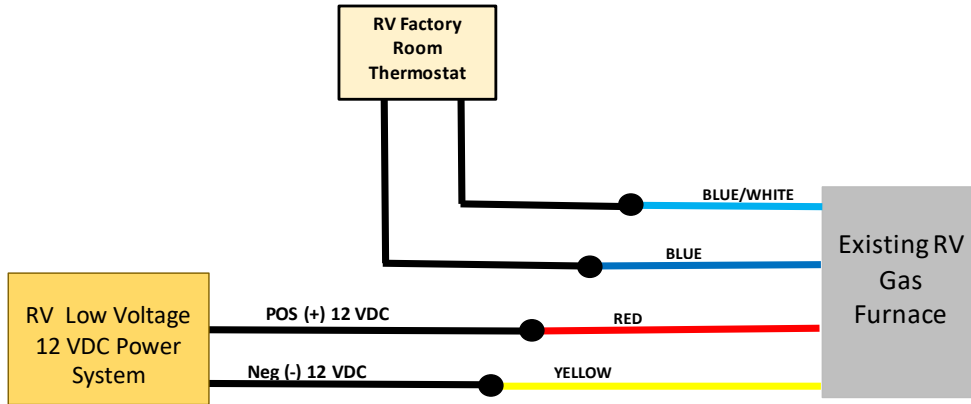


**Register Free Air**  
 2 1/2" X 12" Floor Registers equal 12 SqIn Free Air because of Lovers  
 4 X 10" Floor Registers equal 20 Sq In Free Air because of lovers

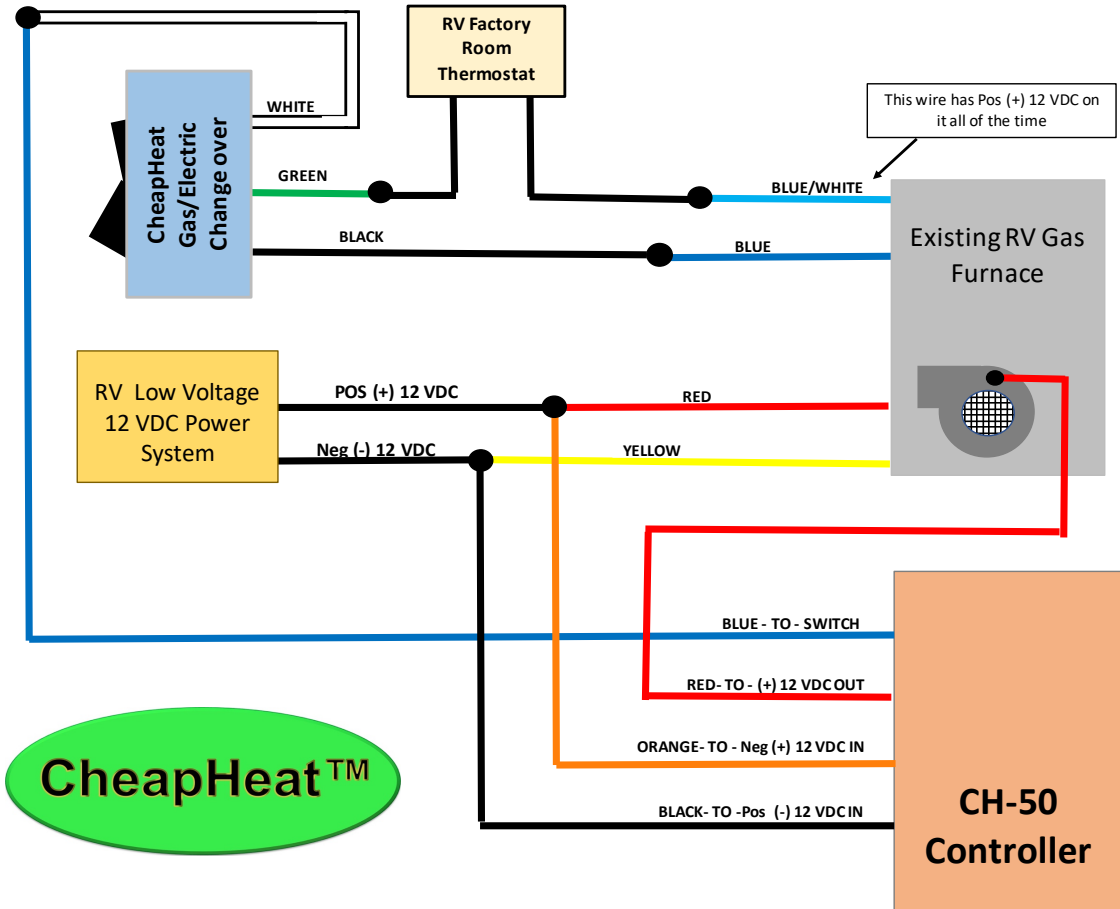




## Low Voltage 12 VDC wiring for Gas Furnace



Picture above shows furnace wiring before CheapHeat system is installed



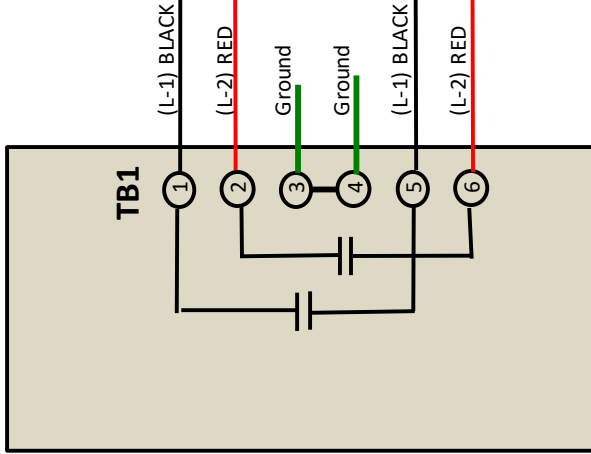
Picture above shows furnace wiring With the CheapHeat system is installed

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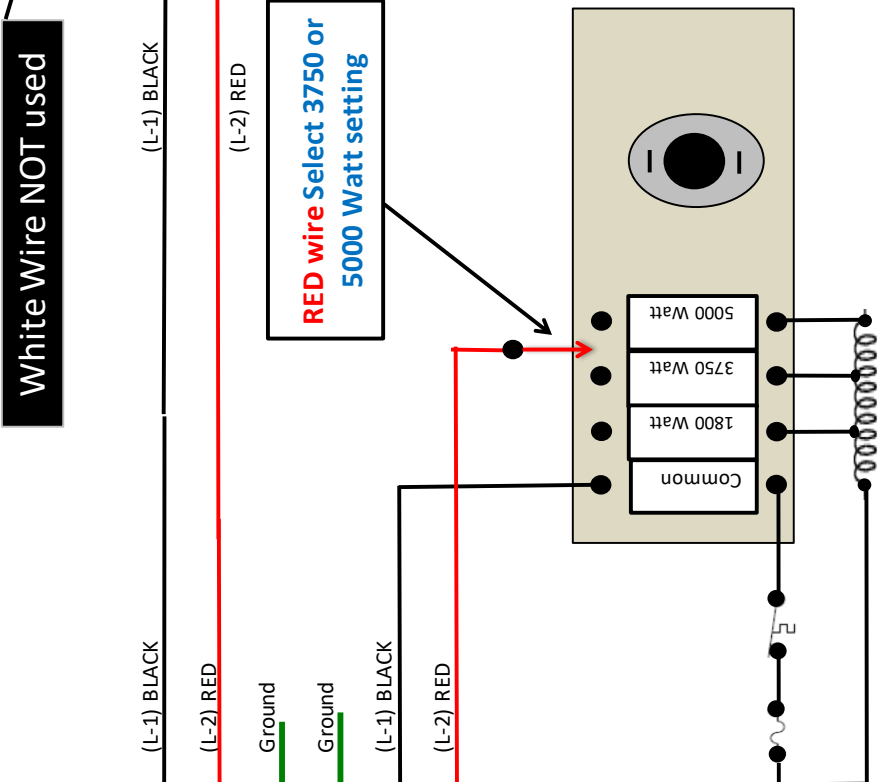
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# High Voltage Wiring For Hi Voltage 3750 or 5000 Watt System

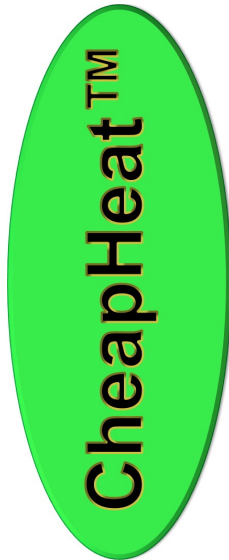
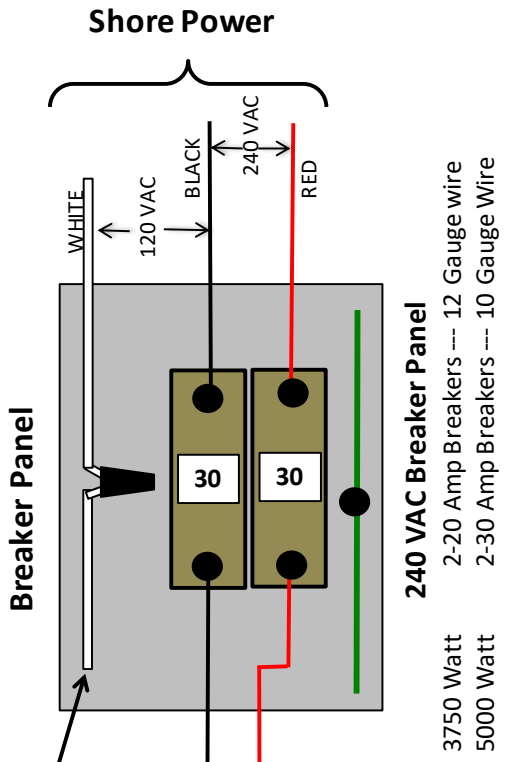
CH50 Controller



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



DH18-37-50 Electric Heater Element

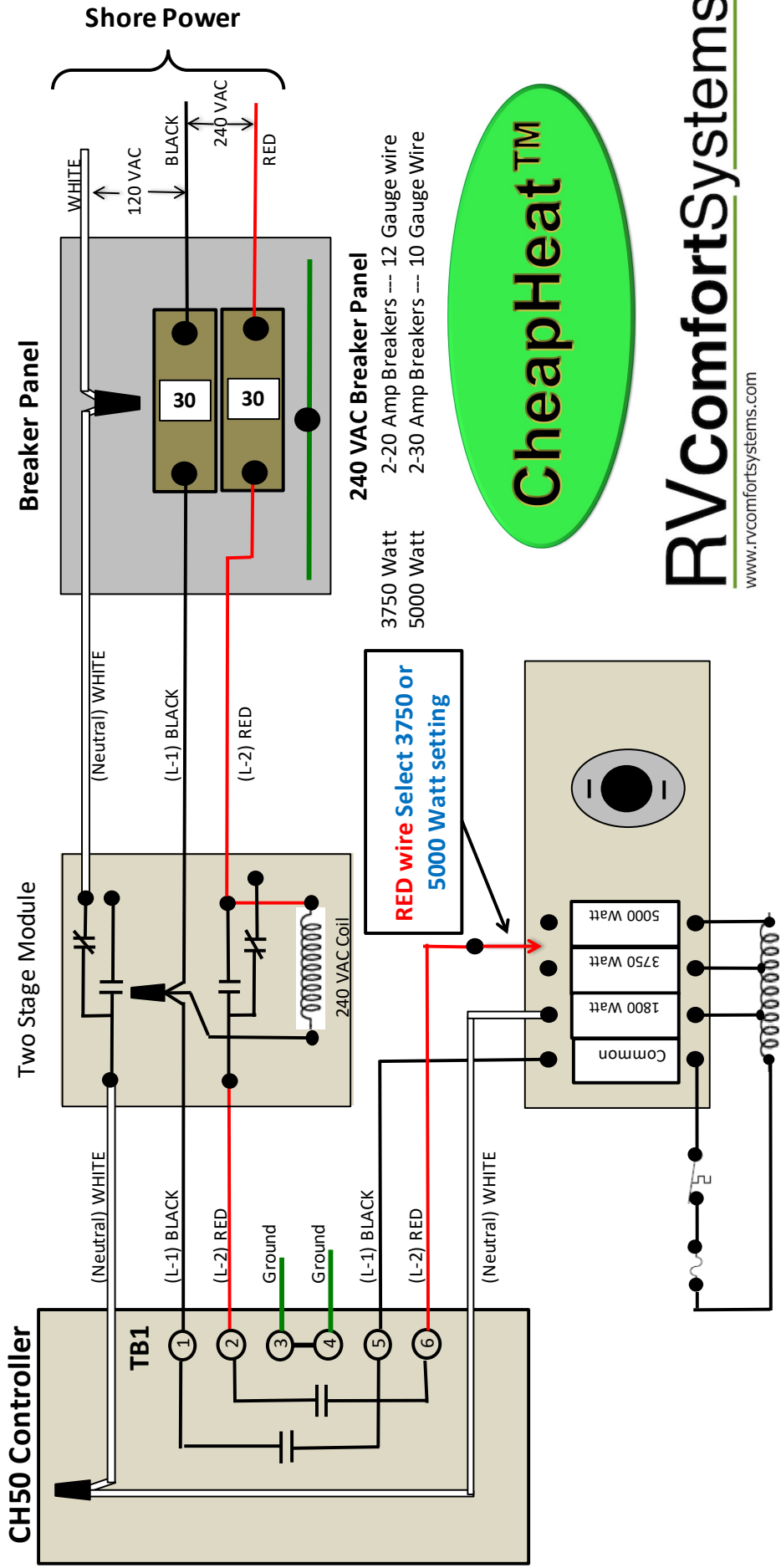


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# High Voltage Wiring for Dual Voltage System

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



3750 Watt  
5000 Watt

RED wire Select 3750 or  
5000 Watt setting

240 VAC Breaker Panel

2-20 Amp Breakers --- 12 Gauge wire  
2-30 Amp Breakers --- 10 Gauge Wire

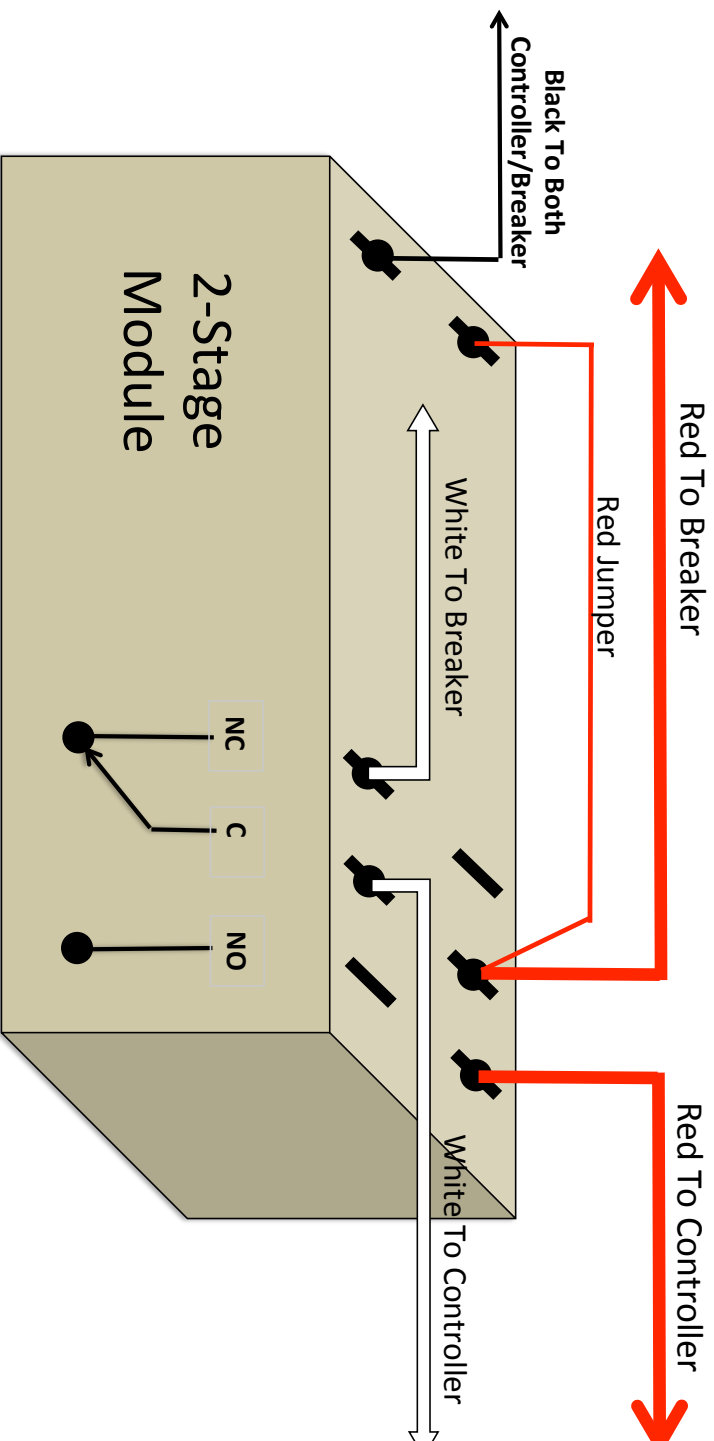


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DH18-37-50 Electric Heater Element

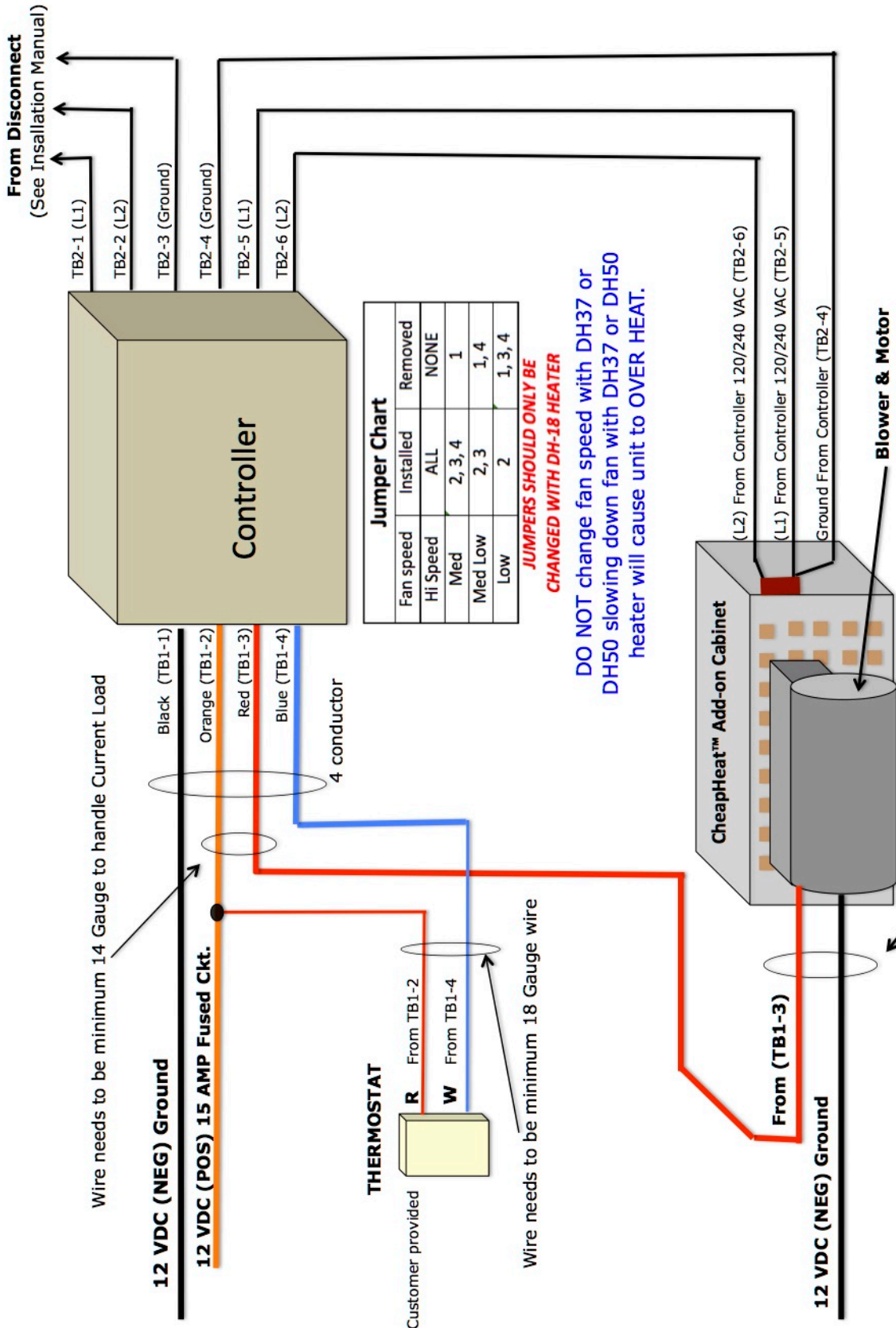
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## 2-Stage Module Layout

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# LOW VOLTAGE WIRE DIAGRAM FOR STAND-A-LONE CHEAPHEAT SYSTEM



Wire needs to be minimum 14 Gauge to handle Current Load

**12 VDC (NEG) Ground**

**12 VDC (POS) 15 AMP Fused Ckt.**

- Black (TB1-1)
- Orange (TB1-2)
- Red (TB1-3)
- Blue (TB1-4)

4 conductor

**THERMOSTAT**

Customer provided

**R** From TB1-2

**W** From TB1-4

Wire needs to be minimum 18 Gauge wire

From (TB1-3)

**12 VDC (NEG) Ground**

CheapHeat™ Add-on Cabinet

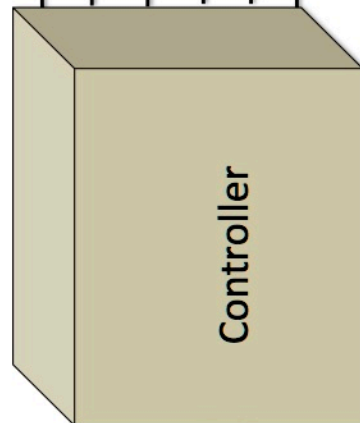
(L2) From Controller 120/240 VAC (TB2-6)

(L1) From Controller 120/240 VAC (TB2-5)

Ground From Controller (TB2-4)

Blower & Motor

Wire needs to be minimum 14 Gauge to handle Current Load



| Fan speed | Installed | Removed |
|-----------|-----------|---------|
| Hi Speed  | ALL       | NONE    |
| Med       | 2, 3, 4   | 1       |
| Med Low   | 2, 3      | 1, 4    |
| Low       | 2         | 1, 3, 4 |

**JUMPERS SHOULD ONLY BE CHANGED WITH DH-18 HEATER**

DO NOT change fan speed with DH37 or DH50 slowing down fan with DH37 or DH50 heater will cause unit to OVER HEAT.

From Disconnect (See Installation Manual)

TB2-1 (L1)

TB2-2 (L2)

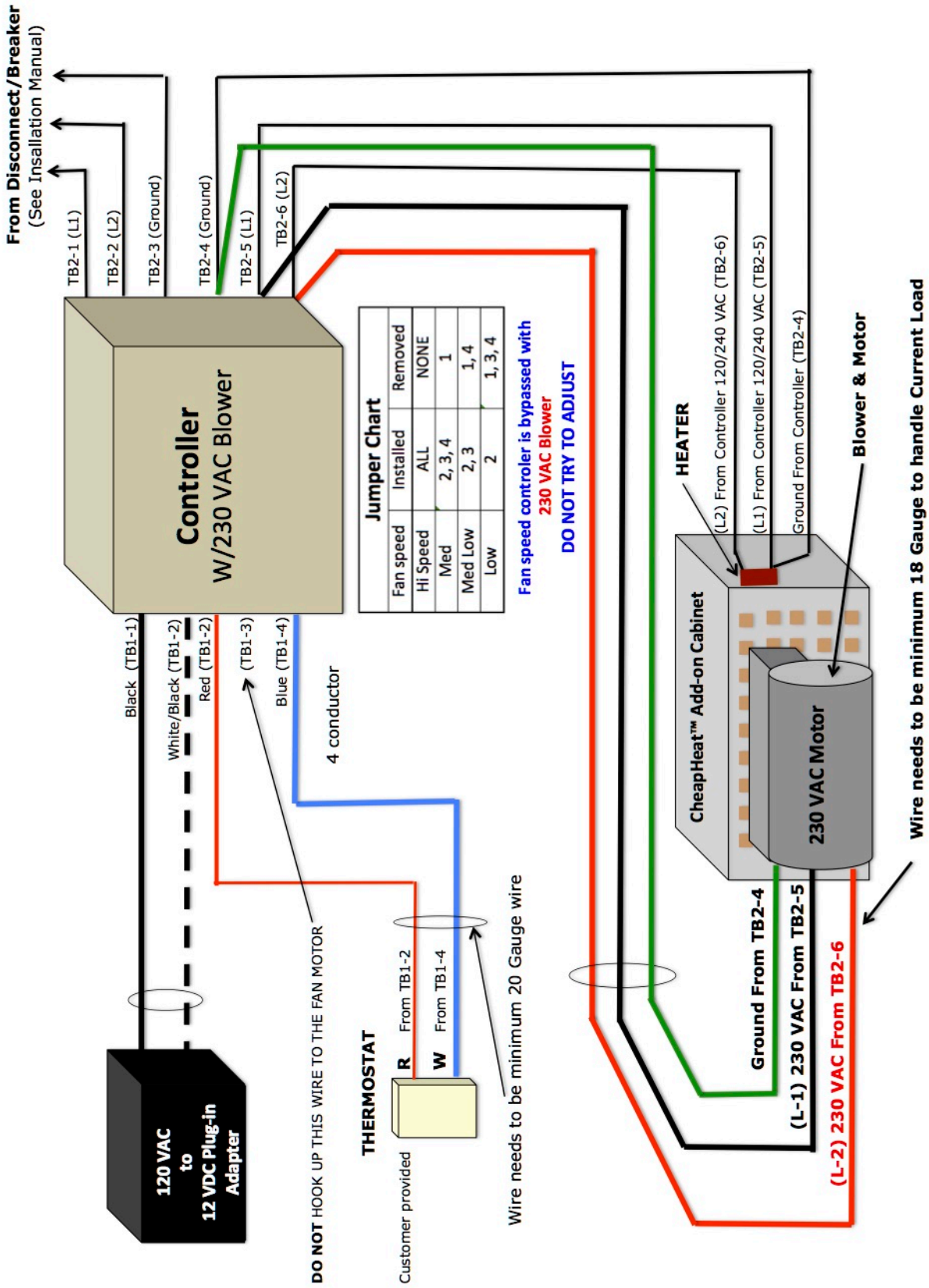
TB2-3 (Ground)

TB2-4 (Ground)

TB2-5 (L1)

TB2-6 (L2)

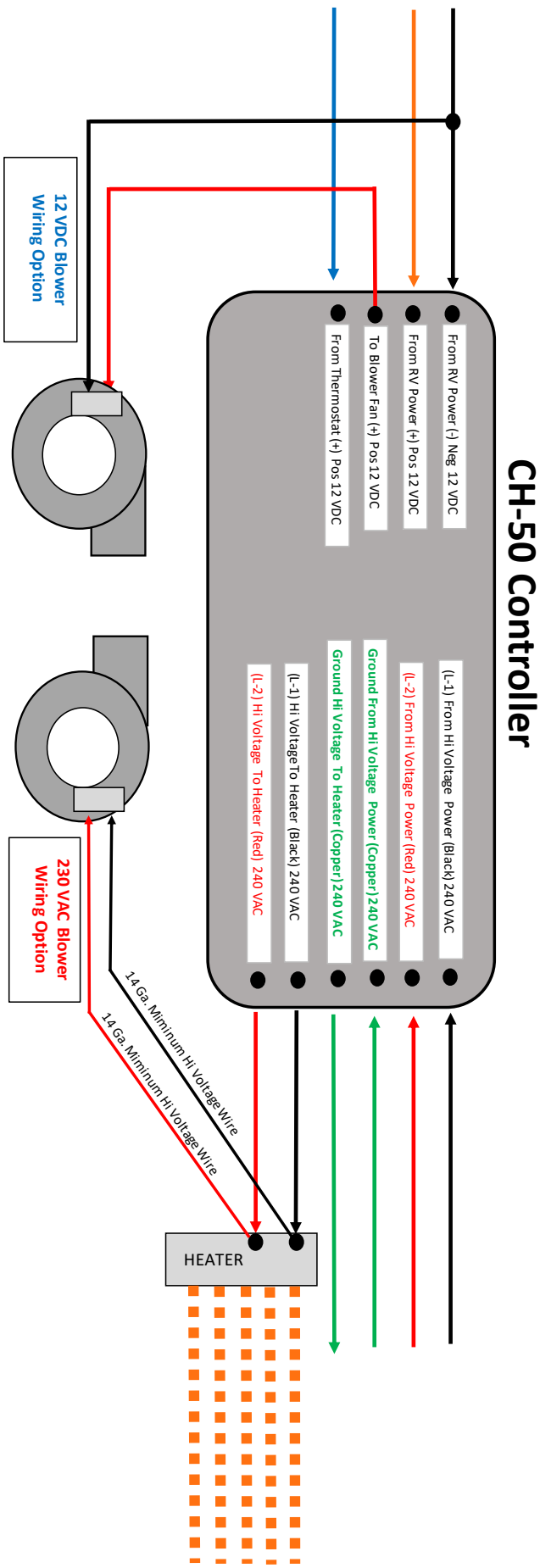
## 230 VAC Blower WIRE DIAGRAM FOR STAND-A-LONE 230 VAC Blower





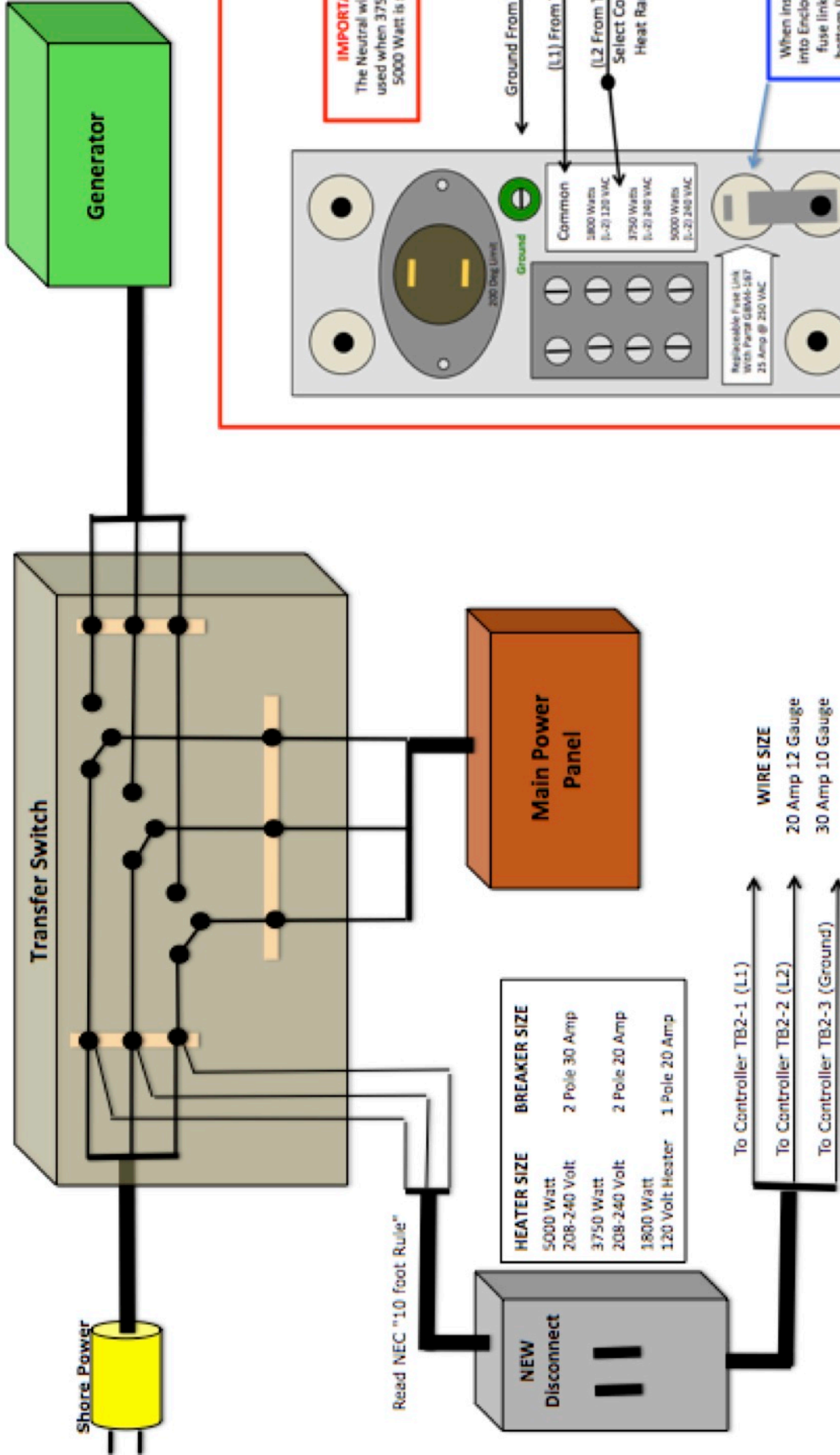


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CheapHeat™ Stand-A-Lone All Electric Furnace Blower motor wiring options.

# HIGH VOLTAGE WIRE DIAGRAM FOR CHEAPHEAT SYSTEM

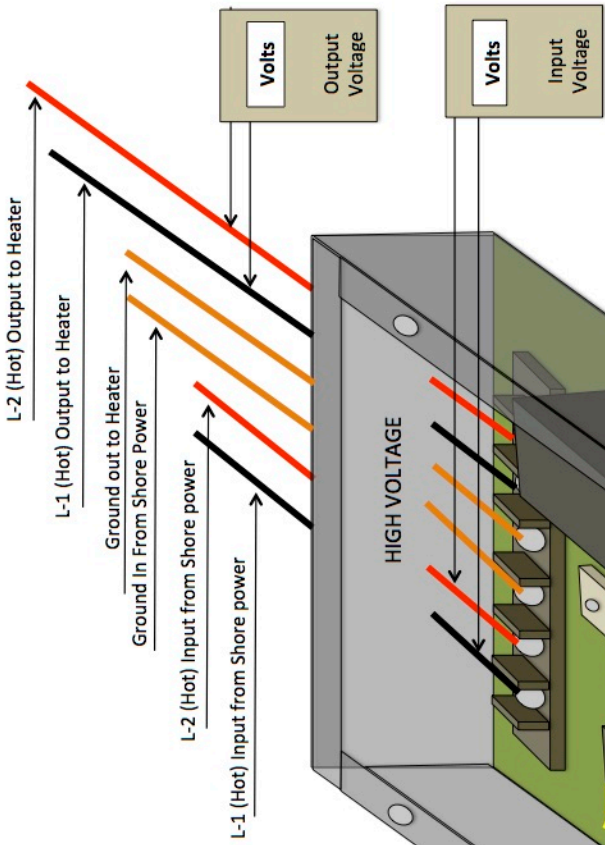


All Grounds must be connected and Neutral can **NOT** be substituted for ground, also Ground can **NOT** be used as Neutral. The Neutral leg is only used in the 120 VAC configuration.

## IMPORTANT SAFETY INSTRUCTIONS READ THESE INSTRUCTIONS

1. To provide continued protection against risk of electric shock, connect to properly grounded outlets only.
2. All wiring must comply with local and national electrical codes and be installed by a qualified electrician.
3. Check the available power supply and resolve any wiring problems **BEFORE** installing or operating this unit.
4. Contact a qualified electrician with any questions about the following instructions.
5. Do not immerse in water.
6. Make sure to install cable clamp in to ½" knock out hole on heater panel to prevent wire from chaffing

**SAVE THESE INSTRUCTIONS**



**LOW VOLTAGE**

**\*\*Heat Calling (ON)\*\***  
 Black to Orange ..... 12 VDC  
 Black to Red ..... 12 VDC  
 Black to Blue ..... 12 VDC

**\*\* Heat Not Calling (OFF)\*\***  
 Black to Orange ..... 12 VDC  
 Black to Red ..... Zero VDC  
 Black to Blue ..... Zero VDC

Actual Volts (ON)

Black to Orange ..... VDC  
 Black to Red ..... VDC  
 Black to Blue ..... VDC

**System on Readings Voltage Testing**

When testing voltage all test should be made L-1 to L-2 Hot to Hot, NOT Hot to ground.

**Correct Readings**  
 Low Heat (1800 Watts) = 120 VAC  
 Med Heat (3750 Watt) = 240 VAC  
 High Heat (5000 Watts = 240 VAC

Actual Input ..... VAC  
 Actual Output ..... VAC

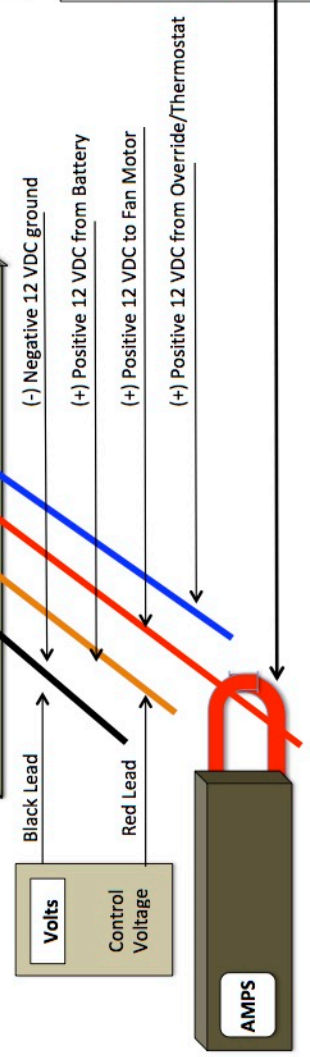
**Blower Motor Test**

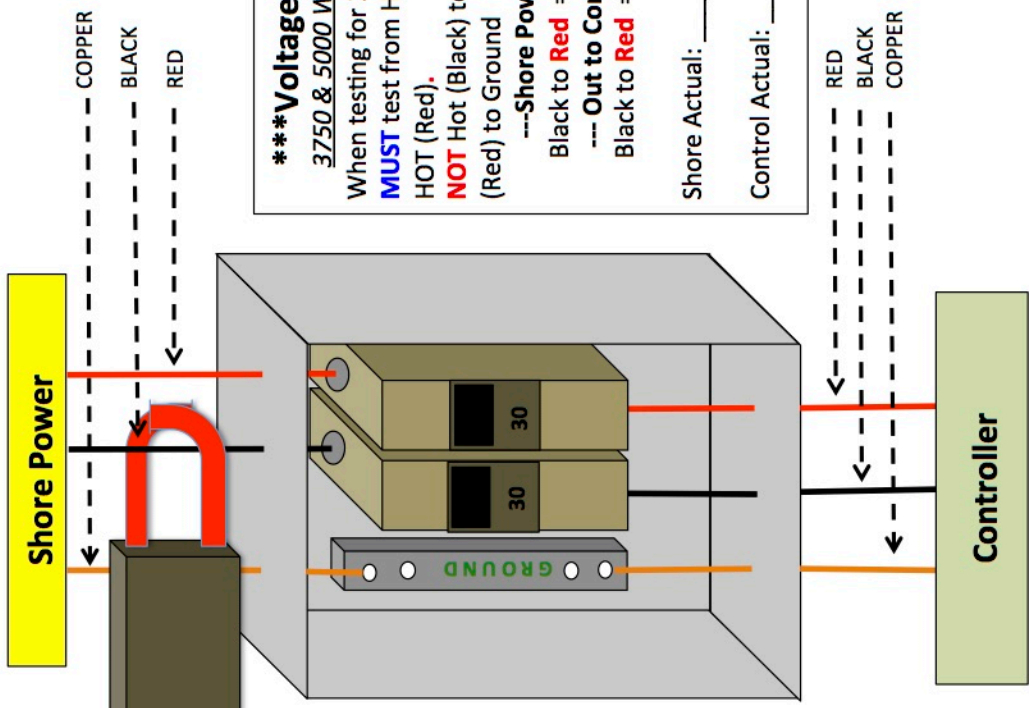
Voltage Red to Black ..... 13.5 to 14.1 VDC  
 Actual Black to Red ..... VDC

**Current Check**

If rating is not with-in 10% of factory rating you have:  
 Low Voltage, or Supply ducting blockage, or Defective motor.

Furnace Manufacture Rating ..... Amps  
 Actual Current Reading ..... Amps





**\*\*\*Current Test\*\*\***  
 When testing for Current you **MUST** only clamp your meter around **ONE** hot wire at a time. It doesn't matter which side of the breaker your on  
 ---5000 Watts---  
 Black or Red = 21 Amps  
 --- 3750 Watts---  
 Black or Red = 16 Amps  
 --- 1800 Watts---  
 Black or White = 16 Amps  
 Amps Actual: \_\_\_\_\_ Amps  
**\*\* Note: ONLY ONE BREAKER USED ON 1800 WATT 120 VAC SYSTEM**

**\*\*\*Voltage Test\*\*\***  
3750 & 5000 Watt System  
 When testing for 240 VAC you **MUST** test from HOT (Black) to HOT (Red).  
**NOT** Hot (Black) to Ground, Hot (Red) to Ground  
 ---Shore Power In---  
 Black to Red = 240 VAC  
 --- Out to Controller---  
 Black to Red = 240 VAC  
 Shore Actual: \_\_\_\_\_ VAC  
 Control Actual: \_\_\_\_\_ VAC

**\*\*\*Voltage Test\*\*\***  
1800 Watt System  
 When testing for 120 VAC you **MUST** test from HOT (Black) to Neutral (White).  
**NOT** Hot (Black) to Ground, Neutral (White) to Ground  
 ---Shore Power In---  
 Black to White = 120 VAC  
 --- Out to Controller---  
 Black to White = 120 VAC  
 Shore Actual: \_\_\_\_\_ VAC  
 Control Actual: \_\_\_\_\_ VAC



**\*\*\*WHEN TESTING RESISTANCE MAKE SURE ALL POWER IS TURNED OFF\*\*\***

**Resistance Testing**

Common to 1800 = 8 Ohms (+ or - 1)  
 Common to 3750 = 14 Ohms (+ or - 1)  
 Common to 5000 = 12 Ohms (+ or - 1)

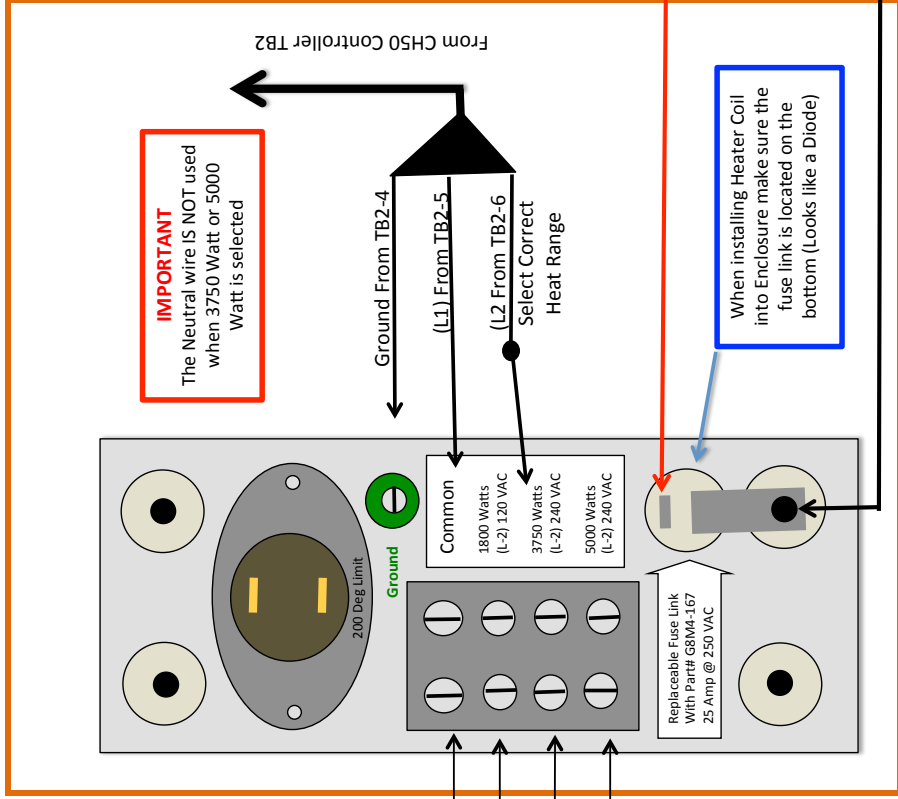
**Fusible Link**

Red to Black probe points = 0 Ohms

**Actual Test**

Common to 1800 \_\_\_\_\_ Ohms  
 Common to 3750 \_\_\_\_\_ Ohms  
 Common to 5000 \_\_\_\_\_ Ohms  
 Fusible Link \_\_\_\_\_ Ohms

*In EVERY case if the Fuse link is open (Burned out) it was caused by a lack of air flow from restricted supply duct or a intermitment/bad blower motor.*



**Ohm's**

Red Wire Test Probe

Black wire Test Prob

Black L-1 All Heat Ranges Common

White Neutral L-2 to 1800 Watts

Red Hot L-2 to 3750 Watts

Red Hot L-2 to 5000 Watts

**Ohm's**

# CHEAPEAT LOW VOLTAGE WIRE DIAGRAM FOR (SUBURBAN MODEL 2542) DUAL HEAT FURNACE

