



Technical Manual

VFD / Cabinet Heater Upgrade 110 VAC Heater to 12 VDC Heater



Provided by: _____

Chart Inc.

407 7th Street NW

New Prague, MN 56071 USA

(800) 400-4683



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Revision Log

Revision Level	Date	Description
A	03/21/2016	Original



Preface

Objective

The objective of this technical manual is to described the process of converting the 110 VAC heater system to a 12 VDC heater system.

Terms

Throughout this manual safety precautions will be designated as follows:



Warning! *Description of a condition that can result in personal injury or death.*



Caution! *Description of a condition that can result in equipment or component damage.*



Note: *A statement that contains information that is important enough to emphasize or repeat.*

Acronyms / Abbreviations

The following acronyms / abbreviations are used throughout this manual:

PN	Part Number
VAC	Volts of Alternating Current
VDC	Volts of Direct Current
VFD	Variable Frequency Drive

Instruction

Parts Included

- PN 20977233 Instruction Heater Install
- PN 20960625 Heater Flexible 3" x 5" 12 VDC 50 watt (qty. 4)
- PN 10900408 Thermostat ON @40 OFF @ 55 (qty. 2)
- PN 462052 Wire CU #14 Brown Stranded (qty. 10')
- PN 462058 Wire CU #14 Blue Stranded (qty. 10')
- PN 462057 Wire CU #14 Black Stranded (qty. 2 @ 10')
- PN 462063 Wire CU #14 Purple Stranded (qty. 10')
- PN 462054 Wire CU #12 White Stranded (qty. 2')
- PN 20976959 Din Rail 2 Meters Long (qty. 2)
- PN 20980308 Relay Spring Clip (qty. 1)
- PN 20980309 Relay Spring Clip (qty. 1)
- PN 20970310 End Clamp Din Rail Stop (qty. 4)
- PN 20980577 Diode 1000v 1 Amp (qty. 2)
- PN 20980900 Heat Shrink Tube (qty. 5)
- PN 20988124 Holder Fuse Inline Blade Style (qty. 2)
- PN 20988127 Fuse ATC 10 Amp (qty. 2)
- PN 11910801 Control Panel Relay SPDT (qty. 1)
- PN 11910819 Socket Control Panel Relay (qty. 1)
- PN 20993615 Relay Control Panel 3 Pole (qty. 1)
- PN 20993616 Socket with 2 Metal Clips (qty. 1)
- PN 20993617 Switch Selector 2 Position (qty. 1)
- PN 11912339 Contact PB Mode Selection NO (qty. 1)
- PN 20993618 Terminal Block ZDU 16 Tan (qty. 4)
- PN 20993619 End Blank Terminal Block (qty. 2)
- PN 20993620 Connector Tab Terminal Block (qty. 2)
- PN 20993621 Splice Heat Shrink Insulated (qty. 10)
- PN 20993622 Splice Heat Shrink Multi-Wire (qty. 5)
- PN 20989848 Bracket Aluminum Heater 12 VDC (qty. 1)

Additional Items Needed

Tools Needed:

- Wire Cutters
- Wire Strippers
- Wire Crimping Tool
- Heat Gun or Lighter
- Allen Wrench Set (standard)
- Screw Drivers
 - Flat Head (Precision & Medium Size)
 - Phillips (P2 & P3)
 - Torque (T15 & T20)

Supplies Required:

- Zip Ties (6" black)
- RTV Silicon Adhesive/Sealant
- Hardware
 - Bolts for Din Rail
 - 1/4" Screws (mounting temperature sensor on aluminum pad)
- Wire Connectors (16-14 Ga)
 - Spade or Ring Connectors (Connect to Relays)

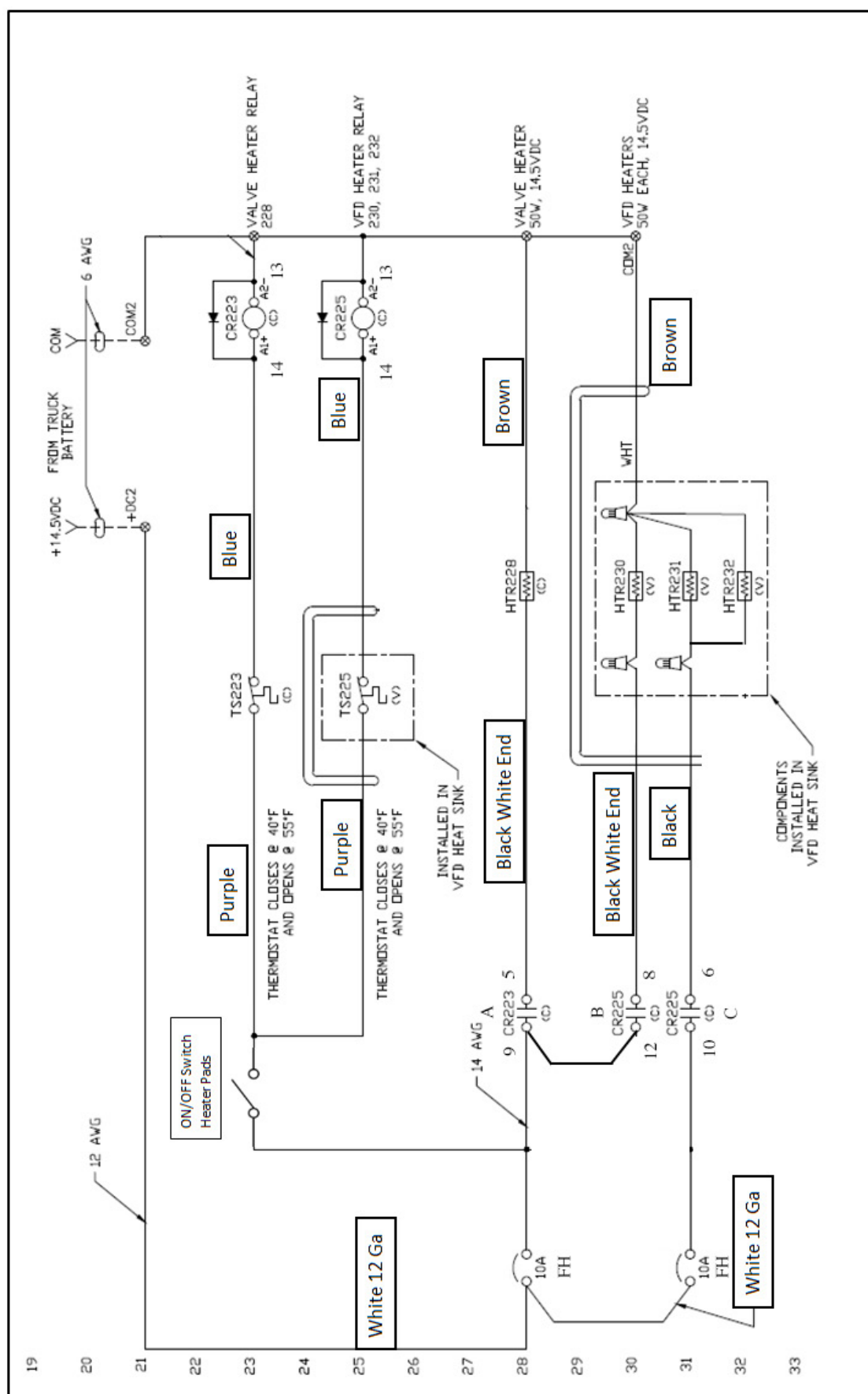


Figure 1 - Wiring Diagram

12V Heater Pad Circuit Schematic



Note: Colors are to be used as a guide only. Be sure to understand the drawing before continuing with the retrofit install. All wires should be labeled and secured. Make note of wiring change in the drawing and add picture of drawing with control panel drawings for future reference.

Figure 2 shows the drawing of the two relays being used. The numbers correspond to actual numbers on the relays. Positions 1, 2 and 4 are normally closed (NC) contacts. Positions 5, 6 and 8 are normally open (NO) contacts. Positions 9, 10 and 12 are power contacts. Positions 13 and 14 are energize contacts and will switch the relay once the circuit is energized.

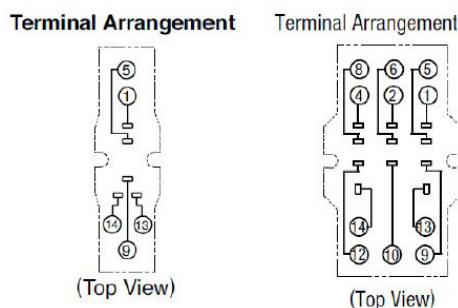


Figure 2 - Relay Configuration

Diodes

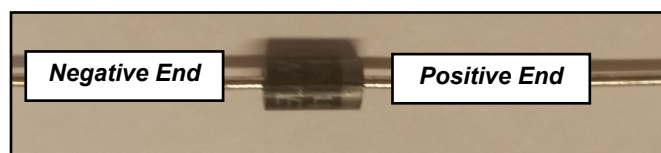


Figure 3 - Diode Explanation

VFD Heater Pad and Thermostat Installation

Turn the 440 VAC breaker switch on the side of the control box off and remove the 440 VAC fuses on the external fuse box next to the alternator.

Removal of Old Heater Pads and Components

- Remove all the wiring, fuses, plugs, inverter, heater pad, and any other 110 VAC heater pad relative items.
- Holes on the side of the control box will be reused.



Figure 4 - Control Panel with 110V Heater System

- The hole left from the male cord end will be used to install the heater pad switch (Figure 5).
- The receptacle end can be saved to plug the hole. Be sure to remove the internal wiring inside the plug to prevent damage. The receptacle would be plugged in by an external wire source.



Figure 5 - Cord End Plug into Control Panel

- Remove current VFD from control panel to access rear heat sink fins.
 - Remove the front access panel and lower sub panel to expose the 440 VAC wires. Remove the 6 - 480 VAC wires and ground. These will need to be reloaded to same location (Figure 6).
 - The contact blocks going into the board of the VFD can be removed.

- 30 HP drives will have a separate wire going into the VFD that cannot be removed without cutting the wires (Figure 7).
- Work will need to be done next to the control panel.



Figure 6 - Front cover removed for access to wiring.

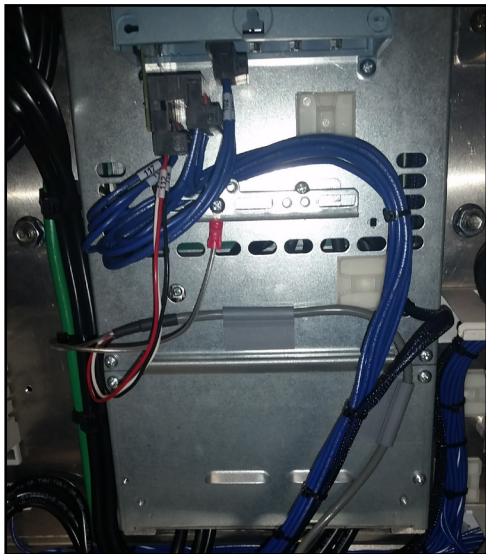


Figure 7 - Wiring going to the VFD

- Place VFD onto work table and remove rear cover.
- Remove the old heater pads and thermostat.

Installation of New Heater Pads and Thermostat

- Evenly install three heater pads (PN 20960625) in fins of VFD and pull wires through the bottom of the fins (Figure 8).

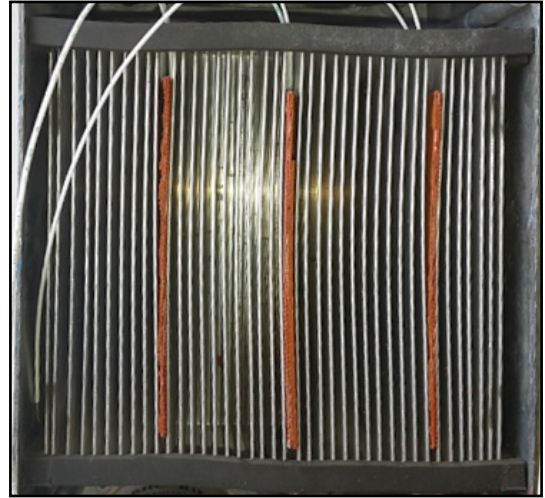


Figure 8 - Heater Pads Installed in VFD Fins.

- Install thermostat (PN 10900408) above the fins or on either the right or left side of the VFD (Figure 9).



Figure 9 - VFD Thermostat Installed

- Mount on top of heat sink fins using two bolts seen in Figure 9 (use old bolts).
- Ensure thermostat will not become dislodged when in use.

VFD Wiring

- Connect and label all wires similar to Figure 10.
 - Since two of the three heater pads are on a different in-line fuse holder be sure to label which black wire is for the single heat pad. Use WHITE TAPE on both ends of wire.

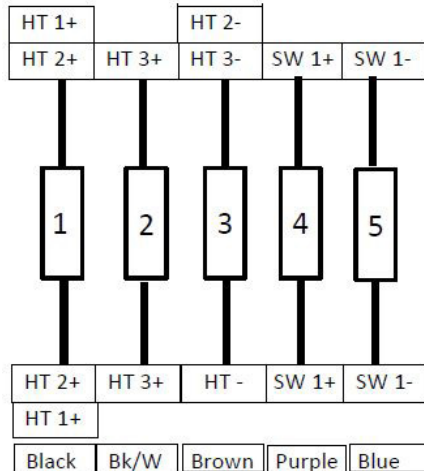


Figure 10 - Wiring Connections Inside VFD

- Run the wires to the control panel box similar to the original wiring.
 - Use the supplied heat shrink tubing whenever wires will be outside of the VFD or control panel. Take note of electrical tape used to prevent the wire from being pulled out of the VFD (Figure 11).



Caution! Be sure not to overheat shrink tube to prevent burning of tubing.



Figure 11 - Wiring Routing in VFD.

- When running into the control panel, be sure to leave enough slack to allow for easy replacement of the VFD.

- Wire slack will then be drawn through the cord grip when VFD is reinstalled. Wire slack needs to be inside the control box during normal operation to prevent damage to wires and shorting out the heater pads.
- Some older control panel models may not have an access hole below the VFD for the heater wires. A new hole may need to be drilled on the right side of the control panel. Be sure to drill hole on the upper side of the panel. Use the cord grip from the heater male end used in the old system to secure the heater wires. A little slack will be needed in wiring in this situation.

Wiring of the Control Panel

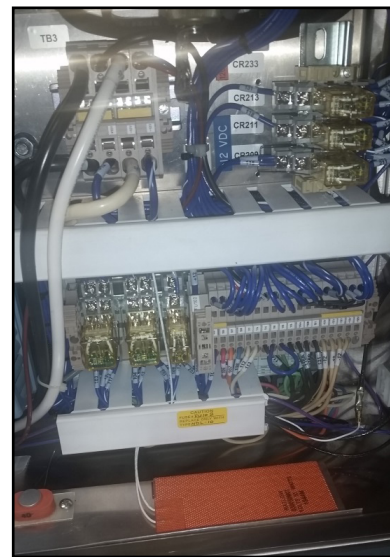


Figure 12 - Control Panel

- Install the VFD
- Install the control panel heater pad and thermostat to the new aluminum bracket. Use 1/4" self-tapping screws to mount thermostat, and RTV caulk to attach heater pad to sheet (Figure 13).
 - Drill holes for bolts in new piece of aluminum.
 - Mount with bolts facing up.



Caution! Do not mount on bottom of control panel. Heat pad will not be used effectively.

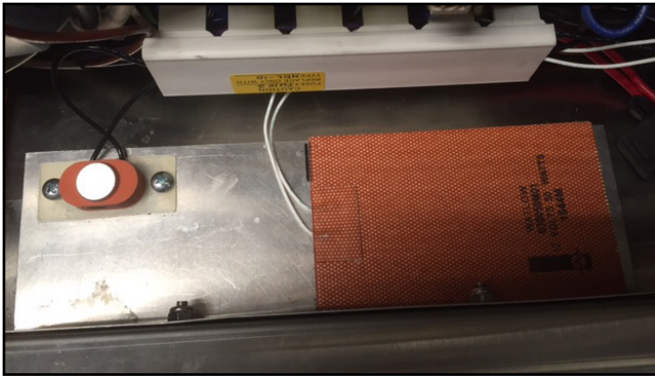


Figure 13 - New Control Panel Heater Pad and Thermostat.

- Install the new relays and circuit breakers. If there is not enough space to mount on the current DIN rail, install the supplied DIN rail to an open spot in the control box. The bolts from the old fuse holder can be used to mount the DIN rail.
 - Install spring clips to the Relay before installing to DIN Rail (Figure 14).

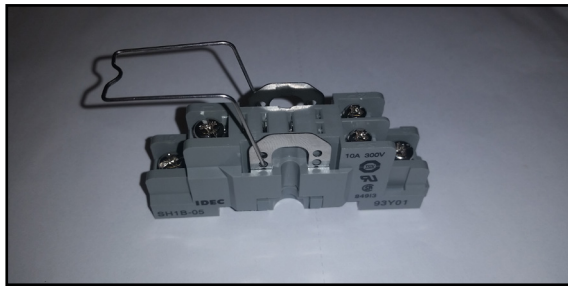


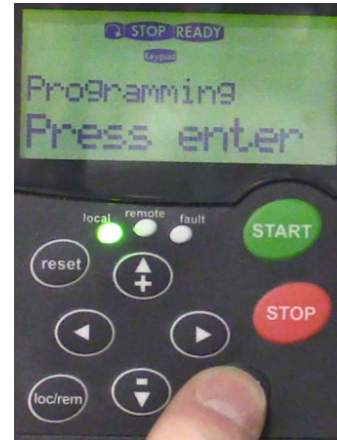
Figure 14 - Spring Clip Installed on Relay.

- Install the on/off switch to the side of the control panel using the hole left of the male plug cord end. Use a square file to make a small notch on the control panel for the switch to fit in and prevent switch from spinning.
- Wire the control panel following the wiring diagram (see Figure 1).
 - Use the 12 gauge white wire to go from +12 volt supply into butt splice. Next butt splice both 10 amp fuse holders together.
 - The first fuse holder will power the control panel heater and a single heater in the VFD and power to the switches.
 - The second will power two of the three heater pads in the VFD.
 - From the first breaker output run two wires. One will run to the heater system on/off switch. The other wire will run to the 3PDT relay on just one of the input power leads (9, 10, and 12).
 - Run a jumper from the lead used in the above relay to the 1PDT relay input (9).
 - On the 3PDT relay find the switched power lead (5 for 9; 6 for 10; and 8 for 12) and connect the black white end wire from the VFD heater.
 - 1PDT relay
 - Find the switched power lead (5) connect this with a control box heater pad wire. May not need to be spliced in some cases.
 - On the control panel thermostat connect one of the wires to signal leads on the 1 PDT relay (14).
 - Take one of the diodes and connect it to the signal leads. The positive end connects to the 14 terminal and negative on the 13 lead.
 - 3PDT relay
 - The single heater pad is wired on one of the relay circuits from a previous step.
 - From the second breaker run a wire from the output lead to the relay's input lead similar to the wiring of the other heater.
 - The black wire for the double heater pad from the VFD is to be wired to the switched lead (5 for 9; 6 for 10; and 8 for 12).
 - For units with a 30 HP VFD fan cut out relay. See original electrical drawing to find the relay number.
 - We will connect the power and switched lead to the 3PDT relay on the third pole. Connect the power lead to the last power lead on the 3PDT relay (9, 10, 12). The next lead will be connected to the NC lead on the relay (1 for 9; 2 for 10; and 4 for 12). The leads on 13 and 14 of the old relay will no longer be needed.
 - Run the blue thermostat wire from the VFD to the signal lead on the relay (14).
 - Take the final diode and attach it similar to the diode used in the 1PDT relay.
 - Power to thermostats.
 - The purple wire and a wire from the control panel thermostat will be spliced with another wire going to the on/off switch.

- The following will need to connect to -12 supply:
 - Relays: Run a -12 wire (common) to either relay's negative signal lead (13). Use a jumper to connect the other relay's negative signal lead (13).
 - Heater Pads: Run the brown wire from the VFD heater pads to the -12 volt supply. Connect the control panel heater pad wire that has not been used to the -12 supply.
 - These wires may need to all be spliced together due to not enough contact space. Be sure to use a 12 gauge wire for this application. Some control panels may allow enough contact space to connect the wires to the -12 volt supply without having to splice the wires together.
 - TB3 in Figure 12 is not in all control panels, however all of the components are in the kit to add if necessary.
 - Secure all wires with zip ties and make sure wires run neatly through the panel so wires will not inhibit future maintenance and repairs (Figure 12).

- Test 12V heat system.
 - Use ice cube on thermostat.
 - Verify heaters are on (less than two min to heat up).
- Operate pump system and controls to ensure unit operates correctly.

2. Press the 'Enter' button.



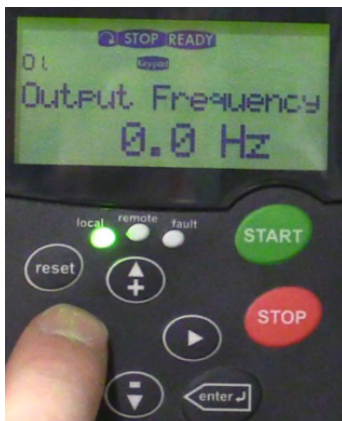
3. Use the ▲ or ▼ arrow buttons until "System Menu" is displayed on the screen, then press the ► arrow button.



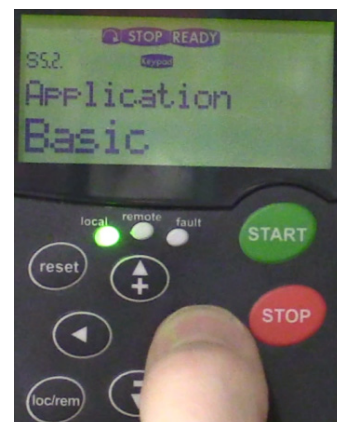
VFD Cold Weather Programming

Change application from Basic to Standard

1. Press the ► arrow button until the screen shows "Programming".



4. Press the ▲ arrow button until "Application" is displayed on the screen, then press the ► arrow button.



- Press the ▲ arrow button until "Standard" is displayed on the screen, then press 'Enter'.



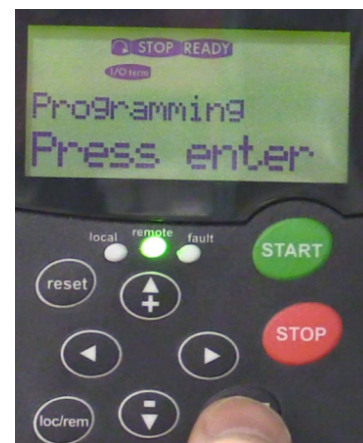
- See "Basic Parameters" for settings.



- The VFD unit will power off and then back on.



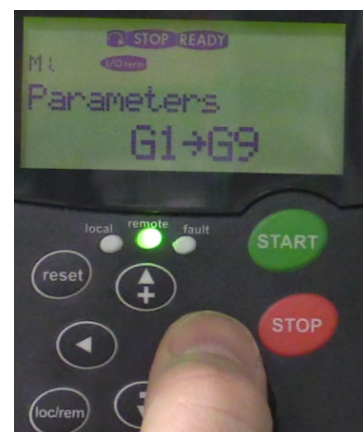
- Press the ◀ arrow button until "Programming" is displayed on the screen, then press 'Enter' (if not already in programming from fan setting).



- The VFD unit auto-powered on, press 'Enter'.



- Use the ▲ or ▼ arrow buttons until "Parameters" is displayed on the screen then press the ▶ arrow button.



3. Use the ▲ or ▼ arrow buttons until "Cold Weather" is displayed on the screen then press the ► arrow button.



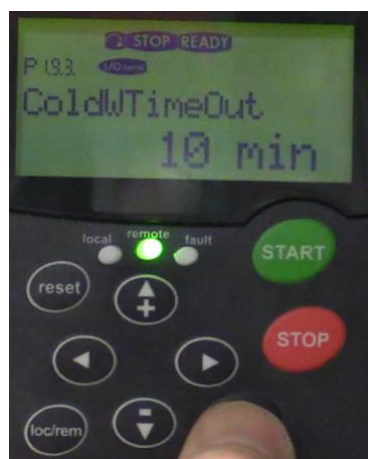
6. Press the ▼ arrow button until "ColdWTimeOut" is displayed on the screen, then press the ► arrow button.



4. Press the ► arrow button again.



7. Set the time to "10 min" and press 'Enter'.



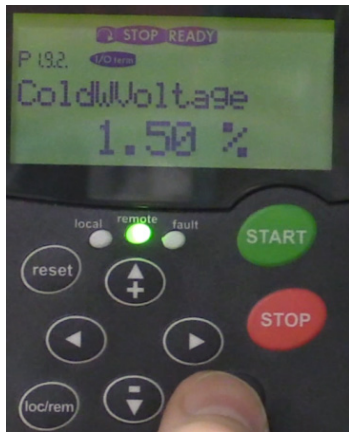
5. Press the ▲ arrow button to "Enabled" then press 'Enter'.



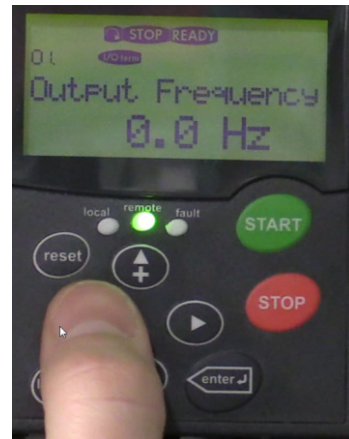
8. Press the ▼ arrow button until "ColdWVoltage" is displayed on the screen, then press the ► arrow button.



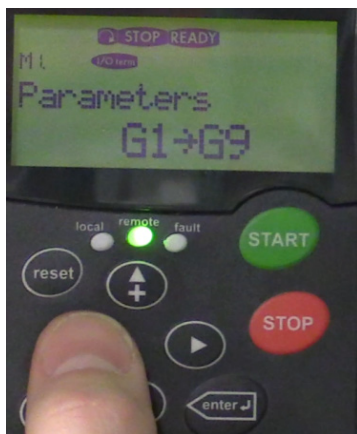
9. Set the percentage to "1.50%", then press 'Enter'.



12. Enabling cold weather steps are complete.



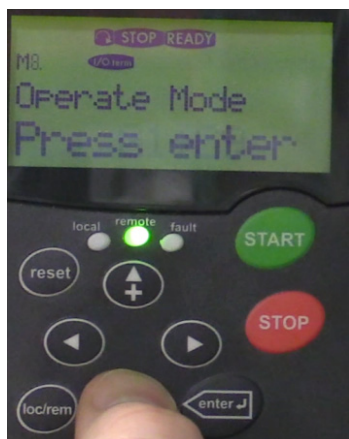
10. Press the ◀ arrow button until "Parameters" is displayed on the screen.



13. The VFD temp can be checked by pressing the ◀ arrow button.

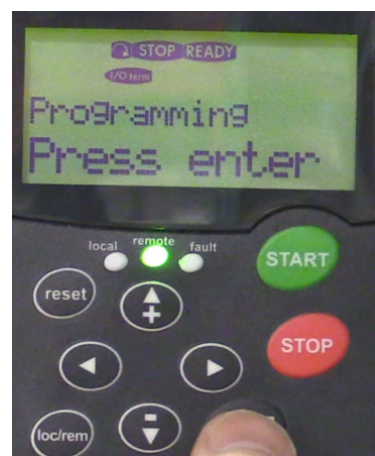


11. Press the ▼ arrow button to select "Operate Mode".

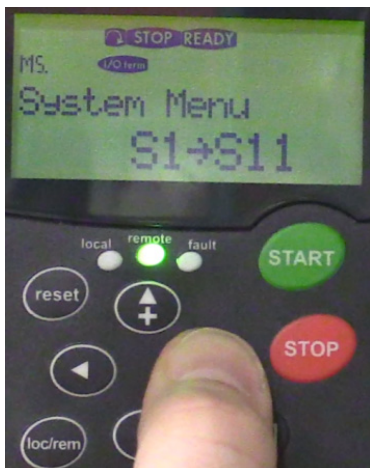


Change Fan to Calculated Temperature

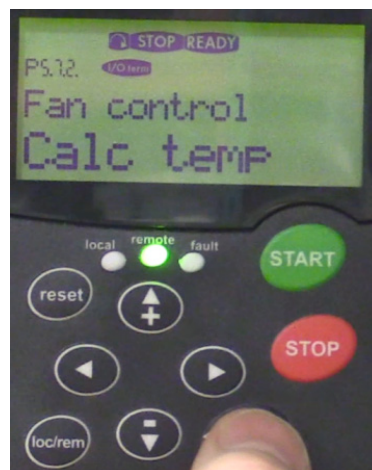
1. Press the ▶ arrow button until "Programming" is displayed on the screen then press 'Enter'.



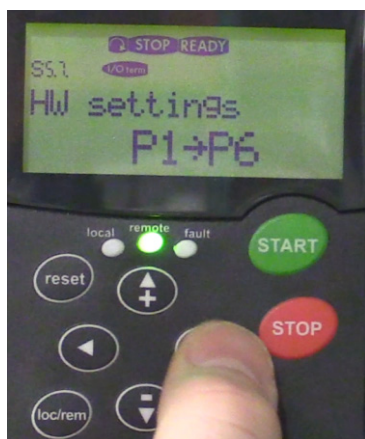
2. Use the ▲ or ▼ arrow buttons until "System Menu" is displayed on the screen, then press 'Enter'.



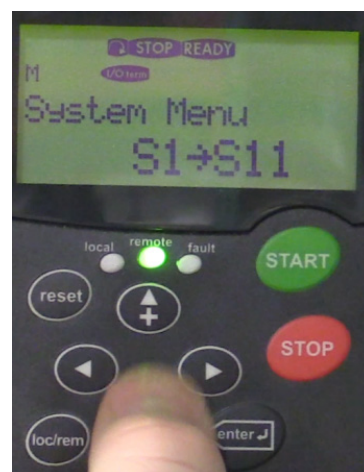
5. Press the ▲ arrow button until "Calc temp" is displayed on the screen, then press 'Enter'. (The fan turns off now if the temperature is < 86°F).



3. Use the ▲ or ▼ arrow buttons until "HW settings" is displayed on the screen, then press the ► arrow button.



6. Press the ◀ arrow button until the screen displays "System Menu" at the main menu tree.



4. Press the ▲ arrow button until "Fan Control" is displayed on the screen, then press the ► arrow button.

