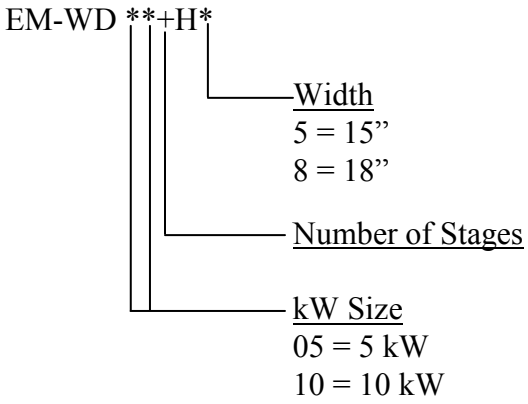
# WARMFLO COMPATIBLE

## Downflow/Horizontal




This is a single package unit, it contains the WarmFlo II controller with a built-in WF-EZ3.

Requires standard 4-wire heat/cool thermostat (not compatible with HP manufacturer’s multi-wire roomstat).

Drawings: **EC001**
**EA104**
**HH329**
**ES721**
**ES722**
**HD320**
**XX017**

ELECTRO INDUSTRIES
Monticello, Minnesota
800.922.4138
www.electromn.com

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# DESCRIPTION

This Electro-Mate series is the supplementary electric element for air source heat pump, add-on or A-coil type. The placement of the electric elements and mechanical design of this Electro-Mate is compatible with zero clearance at the heat pump A-coil top. This does not apply to Air Handler with direct discharge blower, request model EM-WE series.

These models are approved and listed for **downflow** and horizontal applications. At no time can this model be installed in a upflow application. Electro Industries has a similar unit especially designed for upflow applications. The Electro-Mate must be installed on the "warm side" of the HP A-coil.

Generally, a base adapter or raised plenum is required for installation of this DOWNFLOW Electro-Mate. The instructions on page 2 for the field design and fabrication of this base adapter must be followed in detail.

Built-in, permanently connected, and integrated within this single package is the actual WF-EZ3 furnace interface module. All thermostat wiring is at the interface board, mounted on the hinged door. Standard 4-wire heat/cool thermostat is required.

This Electro-Mate unit contains several patented mechanical airflow, and electrical control features. Since these patented features cause this unit to be unique compared to other electric heating products, this installation manual must be studied and followed in detail.

Attached is the product limited warranty statement. Please read and understand conditions associated with proper installation, unauthorized changes, and POWER ON procedures.

For information, this unit is rated at 240VAC. When operating at lower source voltage, the output is reduced.

Example: 10 kW rating
220VAC source - 8.8 kW
208VAC source - 7.5 kW

# INSTALLATION REQUIREMENTS

1. All installation work must be performed by trained, qualified contractors or technicians. Electro Industries, Inc., sponsors installation and service schools to assist the installer. **Visit our web site at electromn.com for upcoming service schools.**
2. All electrical wiring must be in accordance with National Electric Code and local electric codes, ordinances, and regulations.
3. Observe electric polarity and wiring colors. Failure to observe could cause electric shock and/or damage to the equipment.
4. This unit can only be used for its intended design as described in this manual. Any internal wiring changes, modifications to the circuit board, modifications or bypass of any controls, or installation practices not according to the details of this manual will void the product warranty, the ARL certification label, and manufacturer product liability. Electro Industries, Inc., cannot be held responsible for field modifications, incorrect installations, and conditions which may bypass or compromise the built-in safety features and controls.
5. The only approved installation for this Electro-Mate series is downflow and horizontal furnace and on the warm side of the air conditioning or heat pump A-coil. Any other configuration or furnace plenum/ducting installation voids warranty and manufacturers product liability.

# SPECIFICATIONS - TABLE 1

| Model Number | EM-WD051H* | EM-WD102H* |
|---|---|---|
| kW rating | 5 | 10 |
| BTUH | 17000 | 34000 |
| Voltage/Phase | 240/1 | 240/1 |
| Amps, continuous | 21 | 42 |
| Source Feed | 1 | 1 |
| Elements | 2 | 4 |
| Min. CFM | 400 | 700 |
| Max. Temp. Rise | 40°F | 45°F |
| Shipping Weight | 20# | 24# |

# MECHANICAL INSTALLATION

Reference drawing EA104, revision E or above.

FURNACE TYPE - This unit must be installed in as DOWNFLOW application only. Do not turn the Electro-Mate upside down or install this unit in the cold air return.

Since this is probably associated with a heat pump, these instructions and drawing EA104 assume a A-coil where the air is driven backwards through the A-coil. If your installation is a slant coil or a V-coil, positioning of the Electro-Mate is still the same, in the case of the V-coil you can have a much tighter installation.

The 1" minimum spacing of the actual Electro-Mate front enclosure and the bottom of the drip pan is a compromise because typically vertical space is at a premium. If you can allow additional space under the drip pan, do so.

For this type of installation where the air is coming out of the center hole in the drip pan, actually the use of a **15" wide** Electro-Mate is **preferred**. This would be opposite the normal recommendation for a 15" wide unit in large plenums. However, there still should be side and end baffling even though the air is coming out of the drip pan center. In this situation there will definitely be turbulence and unpredictable flow as it comes out of the center hole. Make sure all the air is forced through the Electro-Mate elements.

Verify that all transitions have angles less then 3Ø°F, the Electro-Mate is centered within the plenum, and there are no odd shaped angles or odd shaped transitions within the plenum.

If the width or depth is greater than approximately 1" of the Electro-Mate element pattern, side and back deflectors may be required. Use the same general deflector requirements and techniques normally described in the Electro-Mate upflow manual. If you are not familiar with this, request drawing EH1Ø8.

If the DOWNFLOW furnace is setting directly on the floor, the furnace will have to be raised for insertion of the Electro-Mate unit. This will require a field designed and constructed plenum. This plenum must have sufficient strength to carry the weight of the existing furnace.

The Electro-Mate is designed with a special double plate at the element mounting. Cool air from the blower must blow between these two plates. Therefore, the Elector-Mate must be inserted into the base plenum such that the mounting plate is even with the edge of the hot air outlet hole. Do not necessarily line up the Electro-Mate control box with the furnace cabinet front. The concern is the hole in the bottom of the furnace mating with Electro-Mate elements.

Cutting the correct hole size in the plenum – locate the supplied cutout template marked "UAI012". Once placement of the Electro-Mate is determined, tape all four corners of the template to the plenum. **Make sure that the template is squared off to the plenum before proceeding to the next step.** Using a

utility knife cut out the appropriate dashed line on the template. Then use a marker to trace around the area cut out of the template. Remove the template from the plenum and proceed to cut the hole into the plenum.

Extend the "V" channel to butt against the plenum surface opposite the 8"x18" hole. After Electro-Mate insertion, a sheet metal screw may be installed to attach the back plate of this "V" deflector channel.

Insert the Electro-Mate and properly screw to base plenum. If the base plenum is 18" wide, side supports will be needed on the side for proper attachment to the Electro-Mate.

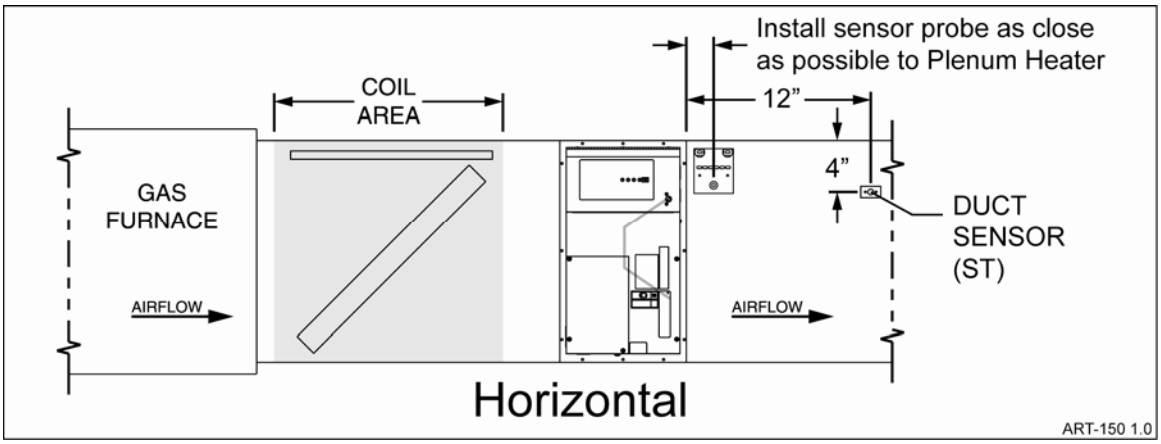
**Horizontal**

With WarmFlo, IT IS permissible (and authorized by the manufacturer) to rotate the Electro-Mate unit 90° for horizontal application. However, you must follow the instructions below relating to temperature sensor positioning, etc.

The reason this practice is acceptable is because the element power and temperature is controllable by the WarmFlo sensor. When placing the sensor at the top of the duct as stated below, heat rise will keep the elements off even without the blower.

**Installation steps**

- Ideally, the WF II Electro-Mate should be inserted on an appropriate duct side so that the 240 power terminal block is at the bottom.
- Locate the WF II Electro-Mate as high as possible in the horizontal duct. At the top, the elements should almost touch the top of the duct.
- If the vertical dimension of the horizontal duct is greater than the WF II Electro-Mate element area, baffle at the bottom.
- If the horizontal duct is deeper than the electric elements, baffling at the back is required.
- Locate and install the WarmFlo duct sensor approximately 4" down from the duct top and 12" away from the Electro-Mate elements.
- Checkout and operation should be identical to standard WarmFlo system.



## Special Hi-Limit Probe Installation

Shipped loose with this unit is a hi-limit probe which must be installed under the electric elements (counterflow). This is shown on drawing EA104. This hi-limit probe must receive direct heated air from the electric elements. It is wired into the red/white hi-limit loop as detailed in the "ELECTRICAL HOOK-UP" section of this manual.

## WarmFlo Supply Sensor Installation

Notice spacing and positioning comments on drawing EA104. Bottom line is this sensor needs to be in a major air stream, about 20 airflow inches away from the actual electric element.

# SYSTEM AIRFLOW

Since the majority of the applications for this Electro-Mate are air source heat pumps, it is assumed the airflow is adequate for the heat pump (400 CFM per ton).

1. SYSTEM TEMPERATURE RISE - The overall temperature rise (both sides of Electro-Mate) must be less than 45°F. If any portion of the plenum top is operating with an air temperature greater than 125°F, element life will be shortened.

   A. CFM CALCULATION, THIS ELECTRO-MATE - By measuring the temperature rise across the Electro-Mate, the actual CFM can be quite accurately determined. The airflow and Electro-Mate unit must be operating in a stable condition for at least 10 minutes. If it is cycling on temperature limit, this calculation will be of no value. The accuracy of this formula will depend upon uniform and average temperature rise plenum thermometer readings and the accuracy of both the clamp-on amp meter and AC voltmeter. NOTE: The volts x amps x 3.4 value is the same as Btuh output.

$$CFM = \frac{\text{Volts x Amps x 3.4}}{\text{Temperature Rise x 1.08}}$$

   B. CALCULATED CFM, OIL/GAS FURNACE - By measuring the temperature rise across the existing furnace, the CFM can be approximated. The accuracy of this formula will depend upon the estimated or determined Btuh output (actual heat energy across the furnace). You cannot use name plate Btuh values. You must use a realistic estimated or measured true OUTPUT Btuh.

$$CFM = \frac{\text{Btuh (output)}}{\text{Temperature Rise x 1.08}}$$

# ELECTRICAL INSTALLATION

**Grounding** – route and install the appropriate size conductor wire between the Electro-Mate lug labeled "ground" and the building service entrance panel ground bus. This must be a conductor wire sized according to the total amp rating of the Electro-Mate. The conduit is not a sufficient ground conductor.

**High Voltage**

The Electro-Mate nameplate lists the continuous amp draw for the model you are installing. Based upon NEC requirements and/or local codes, supply and route an appropriate 240VAC size cable or power wires between the electrical panel source and the Electro-Mate inside circuit breakers, use only **copper** connected to terminal block.

**Low Voltage**

## *WarmFlo II Sensors*

Located within each WarmFlo control are two sensing probes, **OT (outdoor sensing)** and **ST (supply sensing)** necessary for proper operation and installation of the WarmFlo systems. **Without proper installation of these probes the WarmFlo system will not operate correctly.**

**Outdoor Sensor (OT)** is identified by the longer cable and the metal mounting bracket.

1. Determine best location for the OT sensor using the following ground rules.
    a. Locate on the outside of the house to sample outside temperature least affected by sun.
    b. Locate sensor away from other objects that produce a heat or cool effect such as heat pump freon line sets, dryer vents, direct sunlight, steel siding, or other miscellaneous objects that affect the air temperature.
    c. Do not install sensor in an enclosure which may have a "heat build up" or insulation effect.
2. Disconnect OT and ST sensor cable from Warmflo Controller noting the screw locations for future re-hookup.
3. The factory supplied OT cable is approximately 25'. Determine necessary length of cable to route to the predetermined outside location. If the sensor wire cable is too short, you must use the following rules for extending the cable.
    a. Use unshielded (low capacitance, prefer twisted) 3 or 4 wire low voltage cable, **50 foot** maximum.
    b. Do not under any circumstances use leftover wires within the thermostat cable going to the outdoor unit.
4. Mount OT sensor with sensor tip up (cable downward)
5. Drill ¼" hole near the outside sensor location. Routing the cable along the freon tubing often makes the easiest installation.
6. Route wire from outside making sure not to crimp, cut, staple, or damage cable in any way.
7. Keep the sensor cables at least 12" away from any line voltage wiring, Romex, etc. Do not, under any circumstances, use part of existing thermostat cable, leftover wires, for the sensor cable.
8. Do not reconnect sensor wires to the 4-screw terminal block until both sensors are properly installed.

**Warm Air Supply Sensor (ST)**

1. Determine best location for ST sensor using the sketches below (horizontal is on previous page).
2. Locate directly below Electro-Mate element, preferably left side. If you do not have the 12" height, locate in the major distribution duct, but as close as possible to the plenum and so there is a direct airflow path from the electric element to the sensor.
3. Drill ½" hole in the hot air distribution duct about 14 to 18 airflow inches away from the Electro-Mate element.
4. Prior to inserting ST white tube verify tip position.

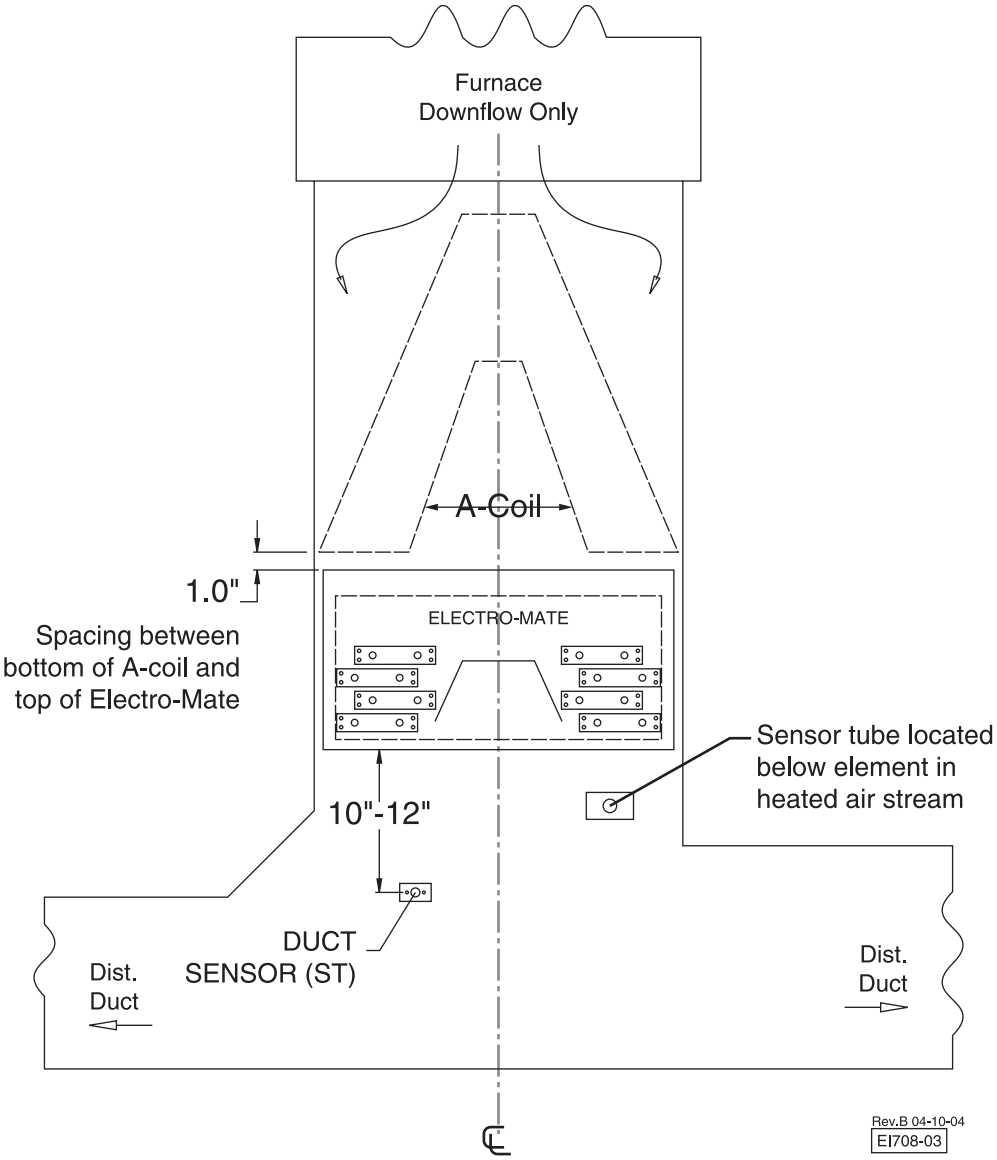
**Note:** The black tip inside of the white tube is the temperature sensor itself. It must be positioned slightly sticking out of the white tube. The only purpose of the white tube is physical protection; once it is installed it is okay to push out the sensor ½"to make it more sensitive and faster responding.

5. Mount ST white tube using two mounting holes.

**OT & ST Sensor Reconnection**

1. A plug-in terminal block is provided for wiring convenience.
2. Both red wires are terminated in the same single screw (+), and both white or green wires are terminated in the single common screw (COM). Each appropriate black wire is terminated in the appropriate OT and ST screw.

**WARNING** - If the black and red sensor wires are crossed or incorrectly installed at the terminal block and power is turned on, burnout damage can result within the sensor probe.



## *WF-EZ3*

Reference Drawing HH329

1. Requirements
    a. Thermostat connection — One 4-wire cable
    b. Fan Center/Gas furnace connection — One 5-wire cable
       40VA or larger transformer
       Blower connection "G" relay
    c. Outdoor Heat Pump — One 4-wire cable
2. **Room Thermostat Connections** - Install room thermostat at the desired room location and route the typical four wires (red, white, green, and yellow) to the WF-EZ3 upper left "stat" terminal block.
   **Note:** When using this WF-EZ3 module, use only a standard single stage heat/cool subbase room thermostat. The heat pump multi-wire stat will not work correctly with an WF-EZ3. If this is a mechanical stat, adjustment of the heat anticipator is required, set the heat anticipator to 0.2.
3. **Fan Center Connections** – Route a 5-wire cable from the WF-EZ3 module, bottom center terminal block "fan center", to furnace fan center, same letter designated connections (R,W,G,C). The 5th wire may be required for variable speed furnace "Y" terminal, see diagram in white section.
4. Within the WF-EZ3 wire harness are two blue wires. Undo these, extend and connect to the **utility load control receiver**. For electric energy operation (off-peak) the two blue wires represent contact closure as shipped. This interrupts both heating and cooling. **Do not apply external voltage or external power to the blue wires**, they are simply looking for a closed contact during off-peak.
    - Optional - Where load management interrupt does not apply, simply leave the blue wires tied together.
    - If load control reverse logic is required, keep the two blue wires shorted and connect load control switch between X1 and R.
5. **HP Outdoor Unit Connections** – Since the WarmFlo controller inherently knows defrost and has its own methods for distinguishing heat or cooling mode, only four basic electrical connections are required to the outdoor unit. The upper right terminal block and reference drawing show basic heat pump terminology for these four wires. Depending upon heat pump manufacturer, the letters or wire colors shown may have slightly different terminology. If additional terminology interpretation is required, consider the following definition.
    - R - 24 volt hot, same as furnace fan center "R" (except for fuse).
    - Y - The HP compressor relay coil, when the Y terminal goes to 24-volt, the compressor and its internal functions should be on.
    - RV - Reversing valve, determines outdoor unit heat or cool mode. See below for logic selection. This may also be called "0".
    - C – 24-volt system common, same as furnace fan center.
6. **Heat Pump Reversing Valve Logic** - Depending upon the heat pump manufacturer, the "RV" may be different logic for heating and cooling. This is selectable on the WF-EZ3 circuit board, top.
    - Heating – RV = 24-volt, high – jumper header between center pin and H.
    - Cooling – RV = 24 volt, high – jumper header between center pin and C.

   Factory set at 24 volt = Cooling

# INSTALLATION NOTICE

Upon installation it is necessary that all the components of the heating system are in place and functional. This controller is designed to operate the complete heating system - heat pump, backup furnace (gas or oil), Electro-Mate, room thermostat, WF outdoor sensor, etc. If one of these components is missing or not initially installed, improper performance of WarmFlo II and the system may be experienced. In other words, if the gas furnace doesn't exist, LP tank not yet installed or filled, and the WarmFlo II is operating on a cold day; do not be disappointed if there is no heat.

# CONTROLLER SETUP OR PROGRAMMING

**Important** - Located on the WF II board is a firmware chip that determines a specific set of defaults (see table below). However, this can be programmed (altered) with optional PC software (ET-SOFT-WF) or a plug-in WarmFlo analyzer (WF-ANZ*). As part of the WF II system this chip represents critical defaults and settings that make your system operate correctly. It is a critical portion of the installation to verify that the chip code sent with your WF II is correct for your intended application. The chip code is located on a white label in the center of the WF II controller.

**MU Time – Standby or Gas Furnace Operation** - Whenever all four stages are full on, and operating at a continuous 100% for a fixed delay (see Chip Code Reference Table, MU Time); the WarmFlo II controller automatically terminates all electric and starts the gas furnace. The gas furnace will be used to complete the heating cycle until room thermostat heat call ends.

During the next heat call, the heat pump and Electro-Mate stages again attempt to produce the WarmFlo II desired temperature. Again, if everything is at 100% plus the MU time, the gas furnace takes over.

**MU Time** – Set at 30 minutes

## *HPDF Chip Code – Electro-Mate Undersized*

**Note:** This is the factory default supplied chip code. Nearly all of the functions are the same, except the MU (see above) is 90 minutes and the ODT is HP only (not EM and HP).

**Application: 4-wire Thermostat, WF II Electro-Mate, Heat Pump, and gas/oil furnace using ODT setting as full electric control –** The WarmFlo II controller with this chip has outside temperature reference for enabling the electric heat staging (except "E" tab). The outside temperature (actual sensor) must be below these values before the stage will come on, independent of supply sensor requirement.

Stage 1 = 5Ø°F  2 = 38°F  3=36ºF  4=34ºF

**WF II Dial Settings**

**Lower right dial switch** – **min. warm air** – The yellow screwdriver adjustment dial sets a "floor" or level minimum operating temperature. The supply temperature will never go below this point independent of outdoor temperature. In other words, this is the flat horizontal line on the warm air versus outdoor temperature curve. Reference manual "heat loss curve graph".

| | | |
|---|---|---|
| 0 = 90 | 4 = 98 | Factory set on #3. |
| 1 = 92 | 5 = 100 | |
| 2 = 94 | 6 = 102 | |
| 3 = 96 | 7 = 104 | |

**Top right dial switch - Built-in ODT or Low Temperature Switch-Over –** The yellow screwdriver adjustment dial can be set to **terminate all electric** (EM and HP) to allow total gas operation below ODT temp. (reference manual WF-ANZ* for special programming).

The temperature settings related to the "ODT dial" are:
Ø = Disabled, no ODT switch-over

| | | |
|---|---|---|
| 1 = -15°F | 5 = 10°F | Factory set on #3. |
| 2 = -10°F | 6 = 20°F | |
| 3 = 0°F | 7 = 30°F | |
| 4 = 5°F | | |

This arrangement provides low temperature interrupt of **both** the heat pump and the Electro-Mate elements. If you desire to interrupt only the heat pump, this is the wrong chip code **or** can be altered with Handheld.

**Temperature (Efficiency Dial)** – Located on the front cover of the WF II Electro-Mate, the red center screwdriver adjustment dial has a selection of A through G. These A through G selections represent a supply temperature point at 0° outdoor. The closer the user or installer selection is to A, the flatter the heat loss curve or the higher the operating efficiency. The closer a selected setting is to G, the steeper the

heat loss curve or the lower overall heat pump system efficiency. If knob is turned to "full" the WF II will automatically put all stages of electric to full capacity. Also see Operational Information section.

**WF-EZ3 adjustments and settings** – only one setting, selection of the reversing valve logic. See page 7, paragraph 6. The normal/standby switch provides the standard user override function (some power companies may request deactivation or deletion of this switch, call factory).

Reference "WarmFlo Handheld Analyzer/Laptop Software" section in this manual for changes to your chip functions.

# OPERATION INDICATORS

**WF-EZ3 Front Monitor LED's**

- **Utility, off-peak** – utility load management receiver is not interrupting.
- **HP or A/C call** – the output "Y" screw terminal is active at 24 volts high. The outdoor unit should be on and running.
- **T-stat call** – the room thermostat W and/or Y is active or 24 volts high.
- **Gas call** – the fan center "W" or terminal block feeding fan center W is 24 volts high.
- **Standby mode** – either override switch, load control receiver (blue wires), or program logic MU timeout have setup an internal relay function for standby operation. The fossil fuel furnace (Gas on LED) is now a function of the T-stat call.
- **Monitor LED Comments** – the "utility, off-peak" LED is a true representation of the load control blue wires. It will not react to the override switch, A1 tab, program MU timeout, etc. The "standby mode" LED represents the internal logic condition directed by the various items requiring fossil fuel furnace or standby action. The actual "gas call" LED is further tied in with the room thermostat function represented by "t-stat call" LED.

**Override Switch** – the front panel slide switch (very similar to standard Electro-Mate DFC) is a direct hardware disabling of any WarmFlo and electric elements functions. The room thermostat heat call wire or function is directly controlling the fossil fuel or gas furnace. This totally resides within the furnace interface module, the WarmFlo II controller could be completely disconnected or completely non-functional but the override switch will still allow fossil fuel furnace operation. This function can also be on a remote switch, see page 13 "SB" tab.

**Blower Operation** – the blower function, via furnace fan center "G", is totally within the EZ3 module and has nothing to do with the main WarmFlo controller. When activated by a thermostat function, there will always be an approximate 10-second turn-on delay and a 1-minute turn-off delay.

- Stat terminal block "G" directly activates this blower on/off delay and relay function to the fan center "G".
- Stat "W" or HP stat "Y" also activates this blower function when in off-peak or non-standby mode. Whenever the system is forced to standby, this blower function will timeout and the blower is controlled by the furnace itself. This puts the gas furnace speed back in the "hands" of the gas furnace and also keeps the blower from falsely operating during load control (for some heat pump stats this may not be the case and may be a load control discomfort situation).

## *WarmFlo II Controller*

**Strip Heat Disable** – To maximize heat pump system energy efficiency and preventing "accidental" unnecessary resistant strip heat when it is not required, this WarmFlo II controller disables or locks out strip heat elements based upon outdoor temperature.

The strip heat may not activate or operate unless the WF outdoor sensor is below the ODT dial setting. Typically for a heat pump, factory settings are:

Stage 1 - 5Ø°F

Stage 2 - 38°F
Stage 3 - 36°F
Stage 4 - 34°

### MONITOR LED'S ON WF II CONTROLLER

**Green LED** - When illuminated the WarmFlo II controller is receiving 24v power. Under all normal operating modes, this should be solid green.

- As a secondary function this green LED provides status of the two remote sensors. If a sensor is inoperative, incorrectly wired, or malfunctioning; this monitor light is in a blinking or pulsing mode. By checking the pulsing pattern, the appropriate sensor can be identified.
- OT sensor - 1ØØ ms blink every second.
- ST sensor - two, 1ØØ ms blinks every second.
- Both bad - ½ second on, ½ second off, alternating.

**Amber LED –** When illuminated the WarmFlo II controller is in the electric heat operating mode.

**Inside Warmflo Board, Red LED's** - The four red LED's next to the output connector, indicate Stage 1, 2, 3, and 4 operation (Stage 1 is on the bottom).

**Triac Relay Module**
This new module now also has its own built-in LED. When the LED is on, the triac switch is closed, elements will be heating. This LED shall operate coincident with Stage 1 on the WarmFlo board.

# MANUAL RESET

Located behind the hinged control board door is a 250° F manual reset. This breaks the circuit for all electric elements. However, connected in the same circuit loop is the automatic reset 170° F hi-limit. Normally the automatic reset should always take care of any overheat condition prior to popping the manual reset. Therefore, you should not experience a manual reset condition unless there has been a true hardware failure.

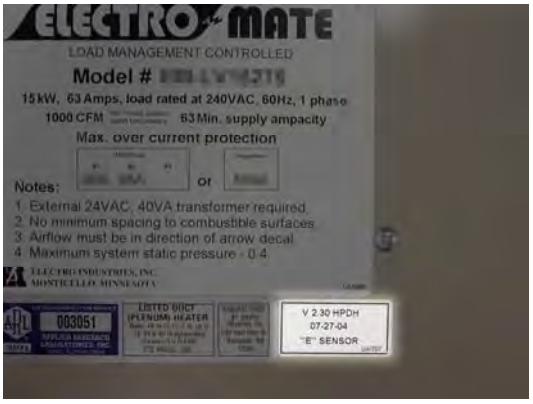
**Two exceptions** – a standby furnace (or wood furnace) having an outlet temperature greater than 250° F or cold startup without blower. Because of the sensitivity of this capillary manual reset, anytime there is a blower failure when the elements come on you can expect a manual reset.

### WARMFLO®
### MICRO CONTROLLER, SOFTWARE AND TEMPERATURE SENSOR VERSION LABEL

**When requesting WarmFlo updates/troubleshooting:**
Locate the nameplate on the unit. Once the nameplate has been located, look for a small rectangle label just below the nameplate, EII part number UAI707. See photo below.

**Note:** Depending upon the age of the product, this label may not be there. Units manufactured after 08-16-04 will have this label.

Next make a note of all of the information on this label. If your unit does not have this label the alternative place to find the chip version is on the chip itself located on the WarmFlo control board.




Example only: Nameplate and exact placement of the chip version label will vary by product.

**When installing a WarmFlo update package:**
Included in the parts package is a chip and temperature sensor version label. This label must be placed as close as possible to the bottom side of the nameplate. See photo above.

# STAT OVERRIDE TIMER (SOT)

This is a field option internal timer which can be field programmed with WF analyzer (from factory it is disabled or set at "0" or disable) to select a roomstat cycle run time. If this downloaded run time (typically 90 minutes) is exceeded before the thermostat is satisfied, the system automatically switches to either full electric elements or standby.

- SOT S – this is the longer set timer which allows transfer to standby if something might have happened to the electric system unmonitored.
- SOT E – this must be shorter time than above, is typically used to overcome morning setback pickup issues. In other words, if you would field download 30 minutes and you program the **setback stat** to begin bringing up the temperature 30 minutes prior to the wakeup time; and the system is not at the new higher temperature at the 30-minute point it will automatically jump to all stages full on (DT flat) in order to more rapidly raise the building temperature. **However**, this also means you will be "short cycling" the HP compressor during **other** heat calls. The maximum run time for the compressor is then about 30 minutes at any time of the day or at any particular heat call.

## HANDHELD ANALYZER/LAPTOP SOFTWARE

This test tool and/or software is available for temperature offset, field altering the program chip parameters and setup, and general assistance for troubleshooting.

See the enclosed "WarmFlo Information" document (HD320) for functional details.

# SPECIAL APPLICATION/INSTALLATION

**For Various Heat Pump, Multi-Speed, Multi-Stage Furnaces, Blower Options, Oil Furnace, etc.**

**Partially Completed Installation**
If during the initial building construction there is a need for Electro-Mate **only** operation for an extended period of time, move the yellow (or heat call wire) from Y to E tab. This conditions the WarmFlo II to all stages on and essentially bypassed all temperature functions.

**Fossil Fuel Furnace Comment**
Furnace interface modules (WF-EZ3, LGR3, EM3, etc.) are designed to interface directly with a furnace fan center containing 24-volt transformer (40VA or larger), blower relay, and a "W" function to operate the fossil fuel furnace. If this installation is for an **oil furnace** with only oil control "T and T" terminals, a fan center will need to be added plus an isolation relay at the "W" terminal so only isolated contacts are

connected to the oil burner master control “T and T”. Another choice is to use a standard fan center and order EE-5053 relay with accompanying HD001 instruction sheet.

**Load Control Interrupt, Blower Function**
Internal to the furnace interface module the control logic applies a "G" function to the furnace fan center whenever there is a call for heat (electric mode only). In the heating mode this is independent of the thermostat “G”. In the cooling mode only the thermostat “G” gets to the fan center “G”.

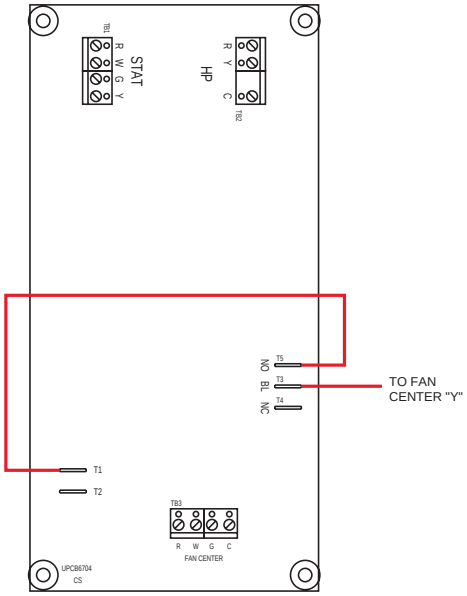
If there is a desire to interrupt the roomstat “G” during load control (gas furnace operates its own blower), route the roomstat green wire through the interface module left tabs COM and EL.

**Optional, gas furnace outlet temperature HP safety** – the interface module 100° gas furnace temperature sensor probe, protects HP compressor, can still be added. Order part EM5713 and follow its instructions (R37 on PC board must be cut).

**2-Stage Gas, 2-Stage Compressor, etc.** – the WF-EZ3 has an extra load control contact which allows the load control interruption of thermostat functions such as W2 or Y2. See breakout bubble on your hookup drawing HH329. Route the additional roomstat wire through the appropriate COM/EL/SB tab relay form C contact. If the single contact mentioned above is not adequate, can add one EE-5053 relay operated by the L tab.

**Optional - Multi-speed/variable-speed blower connection** - Newer “high tech” gas furnaces, special blower speeds, may require energizing fan center “G” and “Y” during WarmFlo II heating cycle. Provisions are included for an extra blower relay contact for appropriate multi-speed wiring.

- Added jumper wires




WF-EZ3 09-10-02 HI320 P4

**Variable speed blower, operate a low speed during low heat requirements –** fall 2002 new feature allows selecting an outdoor temperature to change furnace blower speed. Ideal for newer and 2-stage heat pumps, but requires special connection and special programming. Request description document HD318 with its appropriate hookup and support drawings.

## OPTIONAL ACCESSORIES

**Standby Override** – The front switch provides a very effective override switch to fossil fuel furnace capability. This is a hardware override switch and does not depend upon the WarmFlo board, microprocessor, electronics, etc. Typically this takes the place of dual fuel heat pump thermostat “emergency lever” function.

**Remotely located standby override switch** – on the left side of the I/F board is a “SB” tab. Using an external switch between this “SB” tab and a common tab provides the same function as the front override switch. Whichever switch is in the up or override position takes priority. In other words, they **both** need to be in the down position during **cooling**.

**Note**: All override switches must be in normal or electric position during **cooling**.

**Manual switch or forced gas furnace (stand-by) function** - On the main WarmFlo II board, top center, is tab marked "A1". A switch or jumper from "A1" to "R" will cause a direct gas furnace operation and interrupt or terminate the heat pump. This can be used for a test switch.

**Load Shedding, Electrical Service Entrance Not Adequate** - When using the 10 kW Electro-Mate on a 100-amp service with other major appliances, there are very simple techniques to make sure the 100-amp service is not overloaded. These are based upon inserting one 240 wire from either or both the electric dryer/electric range through a small donut CT. This detection of appliance turn-on immediately drops out a secondary 5 kW load. Both techniques have the necessary input detection delay window to compensate for pulse modulation stove top burners.

- PI-ØA1DYMO – Sensor CT (1 or 2, ½" donut), 4 wire low voltage connection to standard Electro-Mate or WarmFlo II/ Electro-Mate – drops 1 stage or typical 5 kW (reference drawing PH510).
- PI-Ø31DYHO – Sensor CT ( 1 or 2, ½" donut), service panel wiring, drops electric water heater or any 25-amp circuit appliance/electric heater.

# TROUBLESHOOTING

**Comment:** Also see the "WarmFlo Information" document (HD320) included with this manual.

**Sensor Temperature Calibration** - Both remote sensors are digital electronic and factory calibrated. Normally these do not require field calibration or verification. However, if sensor temperature error is determined, there are two field calibration techniques. Proceed with extreme caution.

1. The outdoor sensor can be calibrated with ice (32°F). Notice a small push button next to the sensor terminal block, with the sensor at 32°F, push and hold for approximately ten seconds. When green LED "blinks" at you, release and now the outdoor sensor is set at 32°F.

   **Caution:** This is not a temperature checking situation. If you proceed with this function, the sensor automatically goes to 32°F.

2. Use WarmFlo II Analyzer test set or purchase special PC software disc and PC serial port cable. These plug-in devices allow direct readout of both temperatures, allows a visual determination of WarmFlo II internal temperature settings, and can be used to offset either temperature sensor for troubleshooting and demonstration purposes. This is especially valuable during summer installation. Call factory and order test set device.

**Outdoor Sensor (OT) Location** – direct sunlight has a definite affect on sensor temperature reading. The sensor white tube must be "shadowed" from direct sun rays.

**Troubleshooting/Repair Helps**

1. This WarmFlo II controller contains several interference suppression components, but as an electronic logic product, unpredictable and unusual transients or interferences may sometimes cause strange results. If the WarmFlo II controller is "acting strange", one immediate step would be power down reset. Simply turn off the 24-volt source power (probably furnace or air handler circuit breaker), when the green LED goes out, count to 10, and re-energize power supply.

2. The terminal blocks for control wire hook-up are designed for a wire insertion and screw clamp down. If there is no wire connected and the screw is loose, the screw may not necessarily make a good electrical contact to the inside components. Example – if you are jumpering the thermostat terminals without thermostat wire connection or if you are attempting to measure voltage on the screw head, you may get erroneous or unpredictable results if the screw is not tightened down.

3. Use general heating system logic information and basic understanding of the terminal block wiring functions when measuring voltage to determine proper operation of this module.

4. The outdoor sensor must be located outdoors for this controller to correctly operate. Do not leave the outdoor sensor "hang in conditioned space" and attempt to run this system.

5. Acquiring the WarmFlo II Analyzer test set or the PC software and serial port hook-up cable (see previous page) is a positive tool for understanding and troubleshooting the WarmFlo II controller. Either test set device can display all temperatures, real time evaluation of WarmFlo II functions, provide temperature offsets for assimilating winter conditions, and reprogram the control chip (program stays with the actual controller board).

**Bad sensor, safety** – if the internal logic detects open sensor wire, incorrectly wired sensor, or some bad sensor transmitted value conditions; the green LED reverts to a pulsing mode. Basically the appropriate

sensor is set internally to a 0° value and there will be an attempt to cause the electric heat output to go "DT flat".

- OT sensor – approximately 1/10 second blip every ½ second
- ST sensor – two, 1/10 second blips every ½ second
- Both bad – ½ second on and ½ second off, alternating

**Analyzer readout, sensor temperature constant 32° or 0°** – these two values represent digital bit patterns that are hard to predict an error function. A blinking green light may or may not be experienced. Typically the cable is too long, wrong type of sensor wire, or some electrical interference on the sensor cable.

**WarmFlo Furnace Interface Internal Fuse –** the internal fuse is between the fan center "R" and all other WarmFlo II functions, including the "R" going to the outdoor unit. Use only two amp, fast blow.

**WarmFlo Controller Fuse** – the WarmFlo II board itself does not contain a traditional fuse. At the "R" input terminal is a automatic reset, short current protection device. If there has been a short circuit condition, and the green LED is off, at least 2 to 3 minutes "cool off time" is required for this "fuse" to reset.

# OPERATIONAL INFORMATION

In order for the installer to completely understand the WF II functions and operational sequence it is recommended to thoroughly read and understand the information below. This knowledge can help in determining settings that can be set according to the end customers needs.

**Normal Heating Operation** – Whenever the WarmFlo II Y tab is at 24 volt (with reference to "C"), the WarmFlo II controller begins turning on the Electro-Mate elements (assume outdoor temperature is below disable value) and automatically controls the warm air temperature as sampled by the warm air sensor (ST). However, if added heat is **not** required, no element power is used.

Depending upon Electro-Mate model, the heating section may have one, two, three, or four stages. Stage one is pulse modulated (approximate 10-second cycle) based upon the WarmFlo II controller automatic requirement. Stages 2, 3, and 4 are turned on and off with a relay. However, Stage 2 is only used when needed by the WarmFlo II supply air temperature calculations. When the warm air sensor is calling for more than the heat pump and Stage 1 100% output, Stage 2 turns on. Stage 1 may not necessarily remain at 100%, but is modulated downward to meet the requirements of the warm air sensor.
Also on the next call for heat, the WarmFlo II controller remembers what stages were on and starts at that point. A clamp-on amp meter at the service input can be used to "visualize" the Stage 1 modulation and/or Stages 2, 3, and 4 functions.

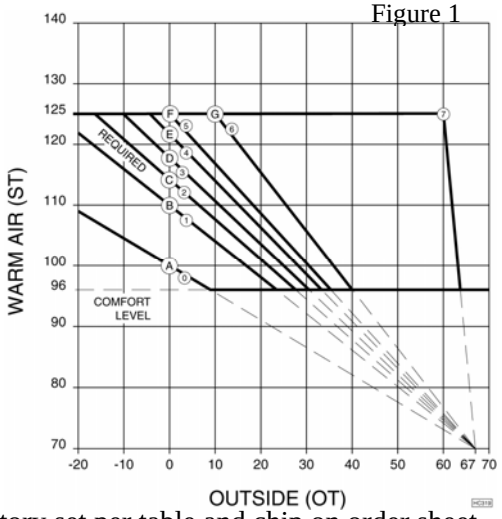
**Efficiency*** – the characteristic of a heat pump dual heat system is the heat pump's ability to deliver warm air at efficiencies greater than 100%. Gas and oil systems are always less than 100% (60% through 90%), resistance electric (Electro-Mate) is always exactly 100%, but the heat pump is always at least 100% (-20°F) or greater, up to about 200% for air source.

The user needs to realize it is to his advantage to run the heat pump either continuously or at the longest possible thermostat call cycles. This is contrary to the basic understanding of most users. However, realizing again the heat pump is a device that delivers greater than 100%, this system can only deliver greater than 100% if it's running, let it run. Because of WarmFlo's design concept and its internal "brain" the heat loss curve (diagonal lines, below) allows the compressor to operate with a minimal amount of electric resistance supplement or temperature boost.

**Where should I set the efficiency dial?** – As you can visualize from the curves below, the lower the setting, the flatter the curve, the less electric resistance is added to the heat pump compressor warm air. Therefore, the efficiency knob setting is based upon comfort and efficiency. The lower the setting the higher the overall operating annual efficiency, the higher the setting the warmer the air at the register.

**Heat loss curve*** – within the "brain" of the WarmFlo controller is a relationship of supply temperature (ST) to outdoor temperature (OT) measurement. As it gets colder outside, the higher the supply temperature in order to properly overcome the heat loss within the structure. This is the diagonal line between 67° outdoor and maximum Btuh (heat loss) at the coldest outdoor temperature. The slope of this line or the exact warm air position at the coldest temperature is established by the "efficiency" adjustment knob or dial.

Figure 1





Factory set per table and chip on order sheet.

**Temperature (Efficiency Dial)*** – the red center screwdriver adjustment dial has a selection of A through G. These A through G selections represent a supply temperature point at 0° outdoor. The closer the user or installer selection is to A, the flatter the heat loss curve or the higher the operating efficiency. The closer a selected setting is to G, the steeper the heat loss curve or the lower overall heat pump system efficiency. If dial is turned to "full electric" the WF II will automatically put all stages of electric to full capacity.

**Outdoor sensor reference or heating requirement level*** – the outdoor digital sensor "tells" the WarmFlo "brain" its desired (DT) value or decision making capability. This is for desired or required supply temperatures greater than the "min. warm air" horizontal line setting. At each internal calculation cycle a DT is determined by reading the outdoor temperature (OT) and then finding the appropriate warm air point on the appropriate or selected diagonal line. See Figure 1 for the various diagonal lines associated with the A through G "temperature" selection knob.

> **Example** – if the temperature knob is set on Position C, at 20° outside the DT or the supply delivery temperature is 100°. The WarmFlo controller now automatically adjusts and maintains electric element power to keep the supply temperature at 100°. Likewise if it -10° outside the DT or supply delivery temperature is 120°. The elements are re-adjusted to provide a constant 120° temperature.

**Chip code/field programming** – your unit was ordered and supplied with a "coded" program chip. With WarmFlo II a number of field re-programming possibilities and options exist using either PC software or the WarmFlo analyzer, reference "WarmFlo Handheld Analyzer/Laptop Software" section. Chip code is located on the WarmFlo II controller board white label.

> **Note:** There are certain things such as SOT's, MU time, etc. which are only field programmable. If the item is not shown in the chip code table, that feature or item is default set as disable.

**Delay, transfer from standby to electric** – if the unit was operating in SB for more than 1 minute, the follow-up transfer back to electric engages a 4-minute delay before the HP compressor relay is activated

and any of the electric stages are activated. The blower will react to the call for heat, but the elements will stay off for 4 minutes in order for the blower to cool down the furnace heat exchanger.

**SB (Gas) 5-Minute Safety** – when in the standby mode (see previous section) there is now a 5-minute timer which begins at each heat call. If after the 5 minutes the ST sensor is less than 85°, the logic board itself goes into an automatic reset and restart. This simply means it attempts to begin the heat cycle using electric in case the furnace did not ignite or "out of gas". However, if it is in the SB mode because of Load Control it will still remain SB and try the gas furnace again. The system will never go back to electric if you have a Load Control on-peak or A1 tab high. **Note:** Handheld can disable (must have latest firmware chips).

**Blower operation** – the air handler or fossil fuel furnace blower is operated from its own fan center (G screw). The activation of this "G" input is either directly from a heat pump (total electric system) roomstat "G" screw or in the case of dual heat from the furnace interface module (WF-EZ3, LGR3, EM3, etc.). The interface module and its wiring or association with the room thermostat completely controls the blower. There is nothing on or within the WarmFlo control board itself which has anything to do with the blower function.

- Delay on/delay off – within all interface modules there is an approximate 10 to 15 second blower on delay and a 1-minute blower off delay. In the case of a heat pump stat, this can be bypassed by taking the stat "G" screw directly to the interface module tab "G1" (multi-wire stat only).
- Multi-speed blower – see page 11 and associated hookup instructions.
- Using E tab with HP stat emergency output – see previous "E-tab" section for blower operation caution.

# DUCT SIZING TABLE

| DUCT CAP. CFM | DUCT DIAM IN. | Equivalent Friction Rectangular Ducts (In.) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 80 | 5.3 | 5x5 | 6x4 | 9x3 | | | | | | |
| 100 | 5.8 | 6x5 | 7x4 | 10x3 | | | | | | |
| 125 | 6.3 | 6x6 | 7x5 | 9x4 | 12x3 | | | | | |
| 150 | 6.8 | 7x6 | 8x5 | 10x4 | 15x3 | | | | | |
| 175 | 7.2 | 7x6 | 9x5 | 11x4 | 17x3 | | | | | |
| 200 | 7.5 | 7x7 | 8x6 | 10x5 | 13x4 | 19x3 | | | | |
| 225 | 7.9 | 8x7 | 9x6 | 11x5 | 14x4 | 21x3 | | | | |
| 250 | 8.2 | 8x7 | 10x6 | 12x5 | 16x4 | 23x3 | | | | |
| 275 | 8.5 | 8x8 | 9x7 | 10x6 | 13x6 | 17x4 | 25x3 | | | |
| 300 | 8.8 | 8x8 | 9x7 | 11x6 | 14x5 | 18x4 | 27x3 | | | |
| 350 | 9.3 | 9x8 | 11x7 | 13x6 | 16x5 | 21x4 | 32x3 | | | |
| 400 | 9.8 | 9x9 | 10x8 | 12x7 | 14x6 | 18x5 | 24x4 | 36x3 | | |
| 450 | 10.2 | 10x9 | 11x8 | 13x7 | 15x6 | 19x5 | 26x4 | 40x3 | | |
| 500 | 10.7 | 10x10 | 11x9 | 12x8 | 14x7 | 17x6 | 21x5 | 28x4 | 44x3 | |
| 550 | 11.0 | 10x10 | 11x9 | 13x8 | 15x7 | 18x6 | 23x5 | 32x4 | 48x3 | |
| 600 | 11.4 | 11x10 | 12x9 | 14x8 | 16x7 | 20x6 | 25x5 | 35x4 | 52x3 | |
| 650 | 11.8 | 11x11 | 12x10 | 13x9 | 15x8 | 17x7 | 21x6 | 27x5 | 37x4 | |
| 700 | 12.1 | 11x11 | 12x10 | 14x9 | 16x8 | 18x7 | 22x6 | 29x5 | 40x4 | |
| 750 | 12.3 | 12x11 | 13x10 | 15x9 | 17x8 | 20x7 | 24x6 | 30x5 | 42x4 | |
| 800 | 12.7 | 12x11 | 14x10 | 15x9 | 18x8 | 21x7 | 25x6 | 32x5 | 45x4 | |
| 850 | 13.0 | 12x12 | 13x11 | 14x10 | 16x9 | 18x8 | 21x7 | 26x6 | 35x5 | |
| 900 | 13.2 | 12x12 | 14x11 | 15x10 | 17x9 | 19x8 | 23x7 | 28x6 | 36x5 | |
| 950 | 13.6 | 13x12 | 14x11 | 16x10 | 18x9 | 20x8 | 24x7 | 30x6 | 38x5 | |
| 1000 | 13.9 | 13x12 | 15x11 | 16x10 | 18x9 | 21x8 | 25x7 | 31x6 | 40x5 | |
| 1100 | 14.3 | 13x13 | 14x12 | 16x11 | 18x10 | 20x9 | 23x8 | 27x7 | 33x6 | 43x5 |
| 1200 | 14.8 | 14x13 | 15x12 | 17x11 | 19x10 | 21x9 | 25x8 | 29x7 | 36x6 | 47x5 |
| 1300 | 15.2 | 14x14 | 15x13 | 16x12 | 18x11 | 20x10 | 23x9 | 26x8 | 31x7 | 39x6 |
| 1400 | 15.7 | 15x14 | 16x13 | 17x12 | 19x11 | 21x10 | 24x9 | 28x8 | 34x7 | 41x6 |

NOTE:

If sizing is in question, always go to the larger duct for CFM in question.

Grilles and registers shall be sized according to manufacturers performance data capable of handling the CFM of the duct at a throw based on room dimensions. Return air registers should be selected to provide for 450 FPM face velocity.

The above capacities assume individual duct static pressures of less than about 0.1. If the static pressure is higher, assume considerably reduced CFM.

## EVALUATING AND SIZING DUCT WORK SYSTEMS

### Quickie Method

- The trunkline duct work off of the plenum should have 70 square inches per ton for the supply side
- The return air plenum should have 80 square inches per ton

### Standards Used

- Heat pumps require 400 CFM to 450 CFM per ton to operate
- Use a friction per 100 ft. of duct of .08 when sizing or evaluating supply duct work
- Use a friction per 100 ft. of duct of .06 when sizing or evaluating return air duct work
- Duct work is manufactured in 8 ft. lengths
- Rectangular duct work is normally 8 inches tall
- Return air grills are normally 8 inches high and the width of one or two joist spaces
- 7 inch round pipe will handle approximately 150 CFM
- 6 inch round pipe will handle approximately 100 CFM

### Tips

- Never go larger than a 3 to 1 ratio on rectangular duct work width to height when figuring a duct work system
- Common branch duct round pipe is either 6 inch or 7 inch
- Never use branch duct piping smaller than 6 inch round pipe when using a heat pump system
- Normal practice when sizing new duct work is to use a friction per 100 ft. of duct of .08 for the supply line duct work and .06 for the return line duct work
- When doing a retrofit job you will more likely have problems with the distribution of air to the rooms than the size of the duct work

### Evaluating Existing Duct Work

1. Perform a heat loss/gain calculation on the structure and obtain the size system needed and the CFM needed per room.

2. Figure the total CFM needed for the system room by room or: 400 CFM minimum to 450 CFM maximum x heat pump system tonnage.

3. Figure the CFM that can be supplied with each trunkline leaving the plenum using the duct calculator with a friction per 100 ft. of duct of .08.

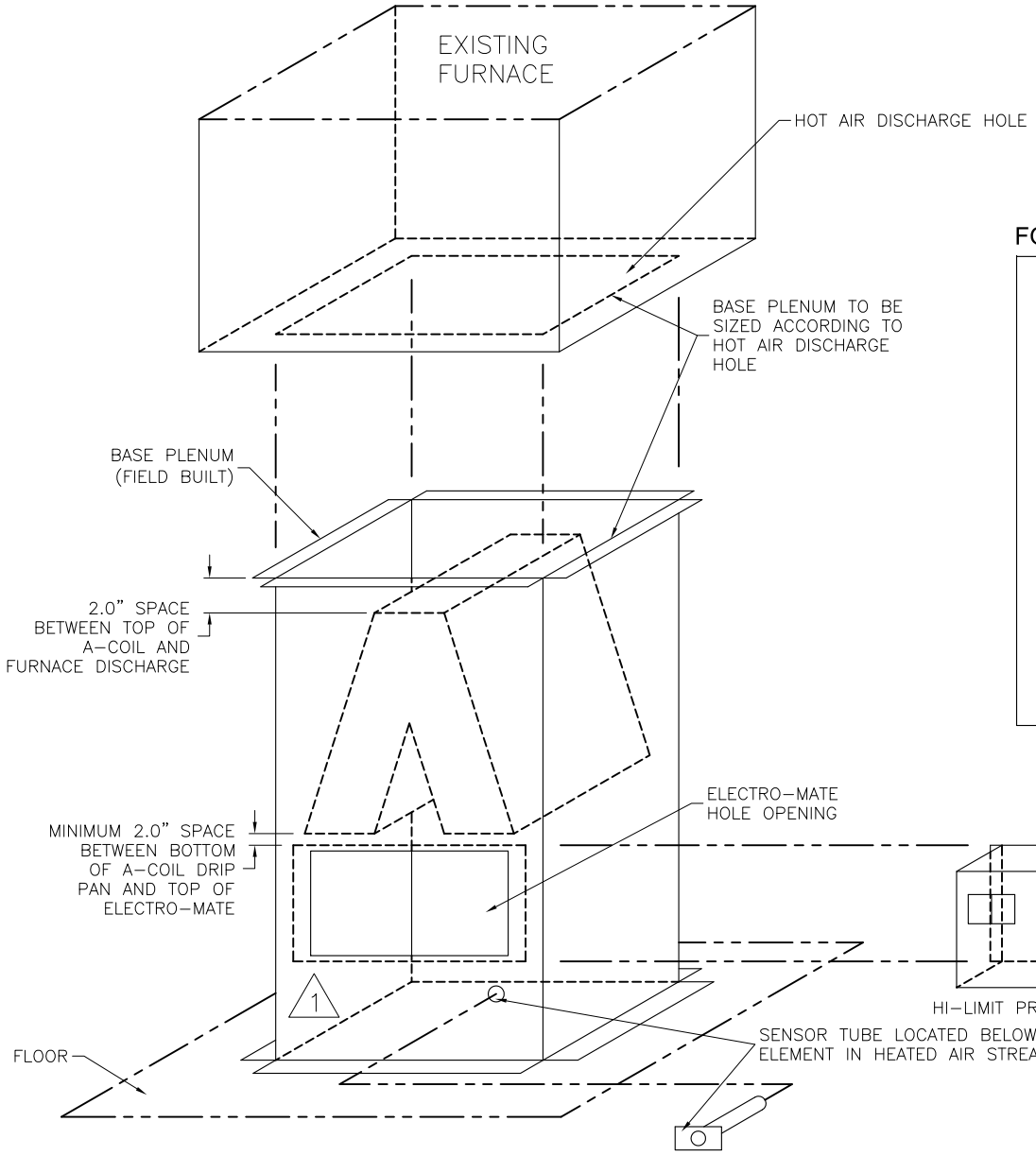
4. The total CFM that the trunkline(s) can handle must equal or exceed the CFM required by the heat pump system. If it is not, the duct work will have to be replaced or changed.

5. If the trunkline is large enough, subtract the heat loss/gain CFM (whichever is larger) needed per room, fed by the first section of trunkline from the total provided. Then figure the size of the next piece of trunkline for the remaining CFM.

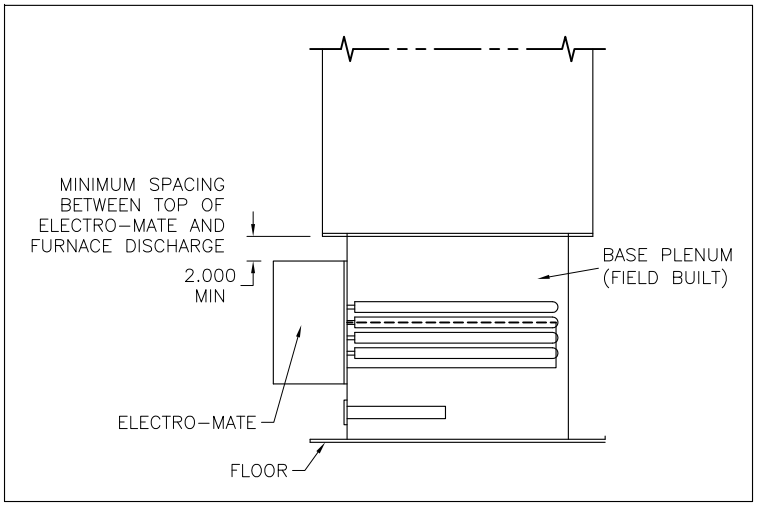
6. The return air duct work must handle the CFM put out by the supply side of the system. Using the duct calculator, figure the amount of air that can be handled by the existing system. Use a friction per 100 ft. of duct of .06. Figure the trunklines first, then branch ducts.

ELECTRO INDUSTRIES, INC.
2150 WEST RIVER STREET, P.O. BOX 538
MONTICELLO, MN 55362
( 763) 295-4138

# ELECTRO-MATE DOWNFLOW INSTALLATION (HEAT PUMP)




FOR NON-A/C OR HEAT PUMP APPLICATIONS



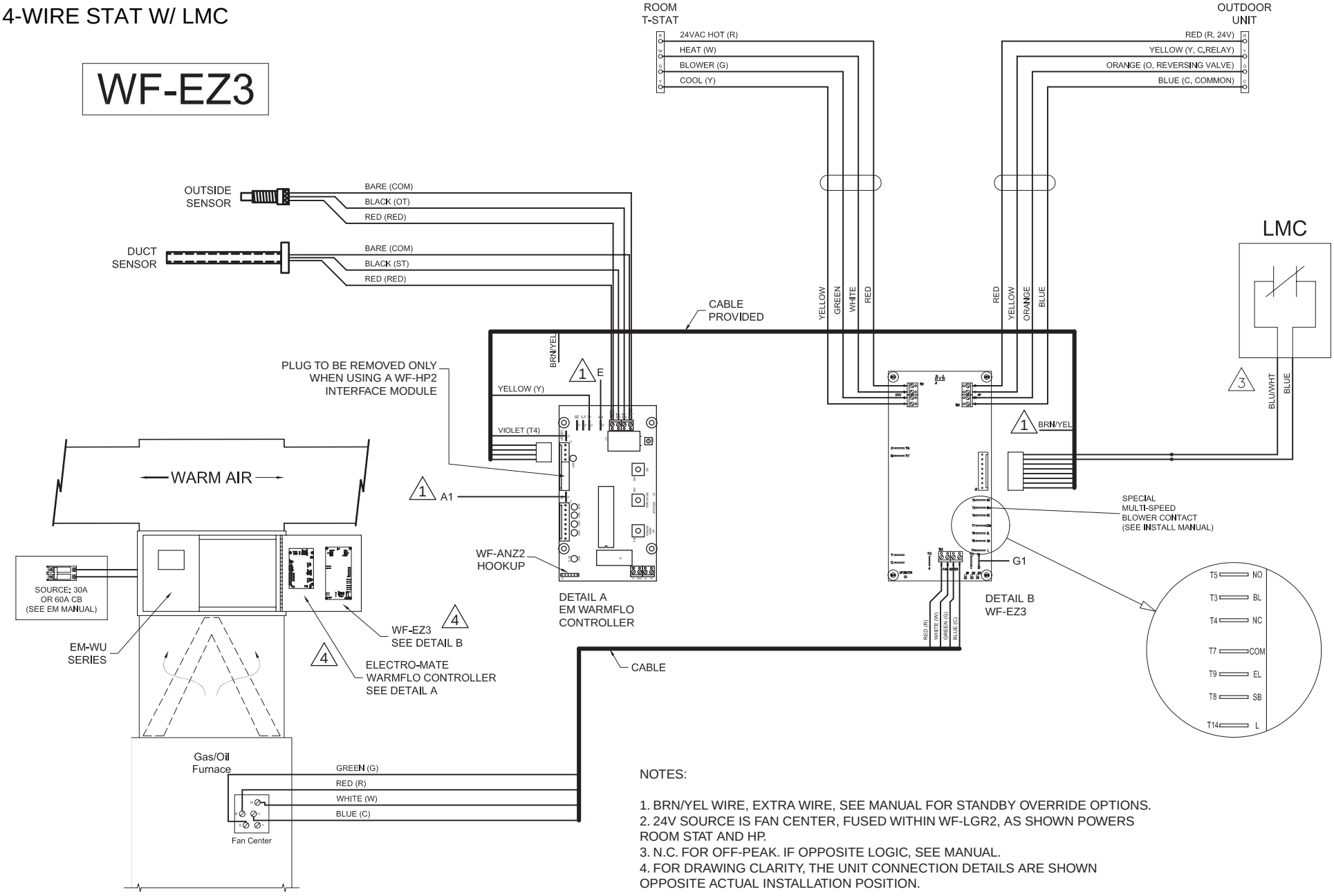

NOTES:

1. WARMFLO REQUIRES SUPPLY SENSOR (ST) INSTALLATION. 18 TO 24 AIRFLOW INCHES FROM THE ELECTRO-MATE ELEMENT, SEE MANUAL TEXT FOR SUGGESTIONS.

ELECTRO INDUSTRIES, INC.
MONTICELLO, MN 55362

# ELECTRO-MATE / WARMFLO SIMPLE PACKAGE
# 4-WIRE STAT W/ LMC

## WF-EZ3




NOTES:

1. BRN/YEL WIRE, EXTRA WIRE, SEE MANUAL FOR STANDBY OVERRIDE OPTIONS.
2. 24V SOURCE IS FAN CENTER, FUSED WITHIN WF-LGR2, AS SHOWN POWERS ROOM STAT AND HP.
3. N.C. FOR OFF-PEAK. IF OPPOSITE LOGIC, SEE MANUAL.
4. FOR DRAWING CLARITY, THE UNIT CONNECTION DETAILS ARE SHOWN OPPOSITE ACTUAL INSTALLATION POSITION.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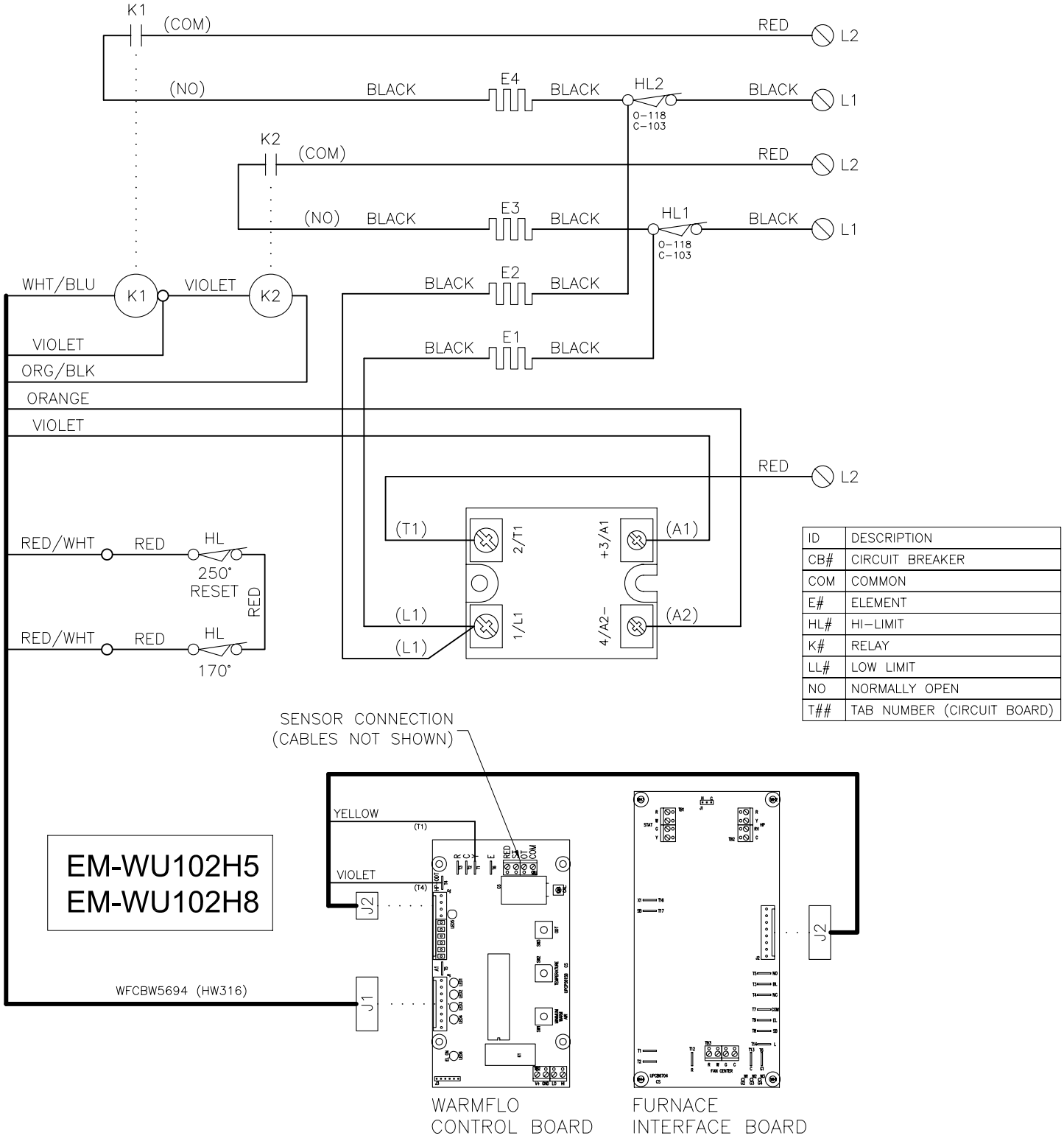
MONTICELLO, MN 55362



Rev.A 08-19-04
HH329




| ID | DESCRIPTION |
|---|---|
| CB# | CIRCUIT BREAKER |
| COM | COMMON |
| E# | ELEMENT |
| HL# | HI–LIMIT |
| K# | RELAY |
| LL# | LOW LIMIT |
| NO | NORMALLY OPEN |
| T## | TAB NUMBER (CIRCUIT BOARD) |

Rev.B 10–19–05: Updated hi–limit temperature values.

B 10–19–05 – REVISED

| | | | | |
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| APPROVED | DRAWING STATUS: RELEASED | DOCUMENT DATE: 09–29–03 | SHEET: 1/2 | DOCUMENT NUMBER: ES721 |

| ID | DESCRIPTION |
|---|---|
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| COM | COMMON |
| E# | ELEMENT |
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| K# | RELAY |
| LL# | LOW LIMIT |
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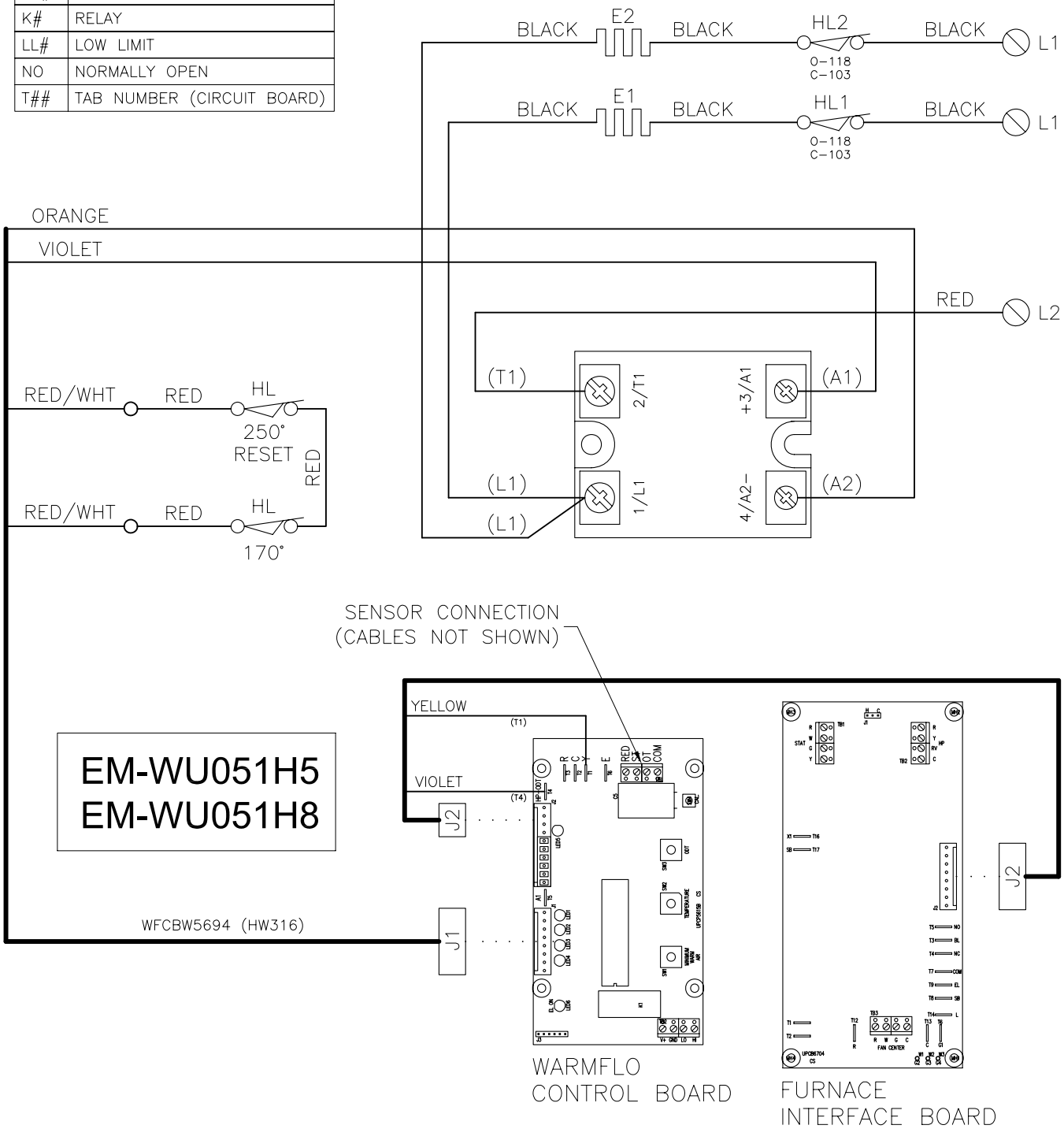
| T## | TAB NUMBER (CIRCUIT BOARD) |




Rev.B 10–19–05: Updated hi–limit temperature values.

| | | | | | |
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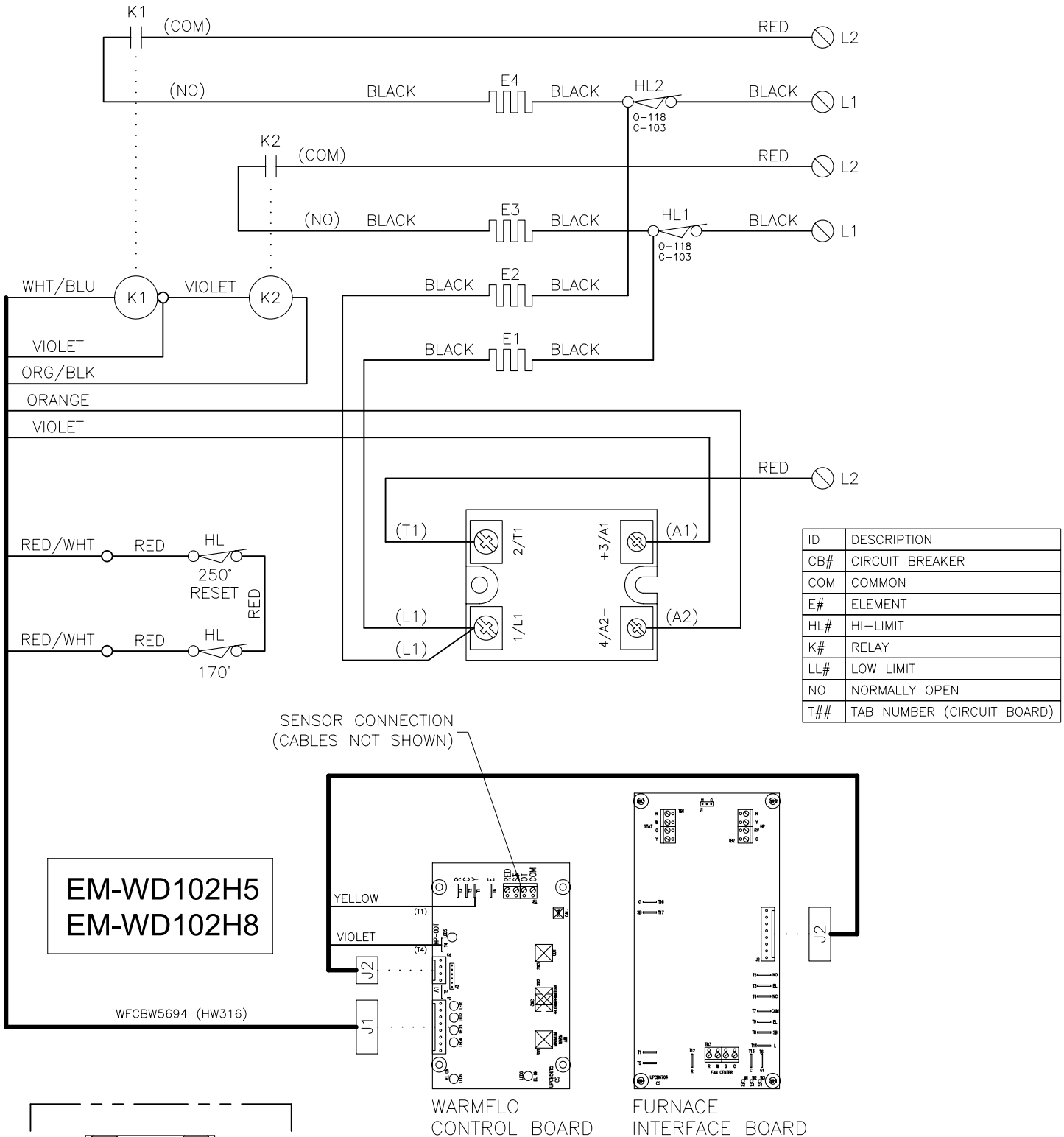


| ID | DESCRIPTION |
|---|---|
| CB# | CIRCUIT BREAKER |
| COM | COMMON |
| E# | ELEMENT |
| HL# | HI–LIMIT |
| K# | RELAY |
| LL# | LOW LIMIT |
| NO | NORMALLY OPEN |
| T## | TAB NUMBER (CIRCUIT BOARD) |

Rev.A 10–19–05: Updated hi–limit temperature values.

| | | | | | |
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| ID | DESCRIPTION |
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| LL# | LOW LIMIT |
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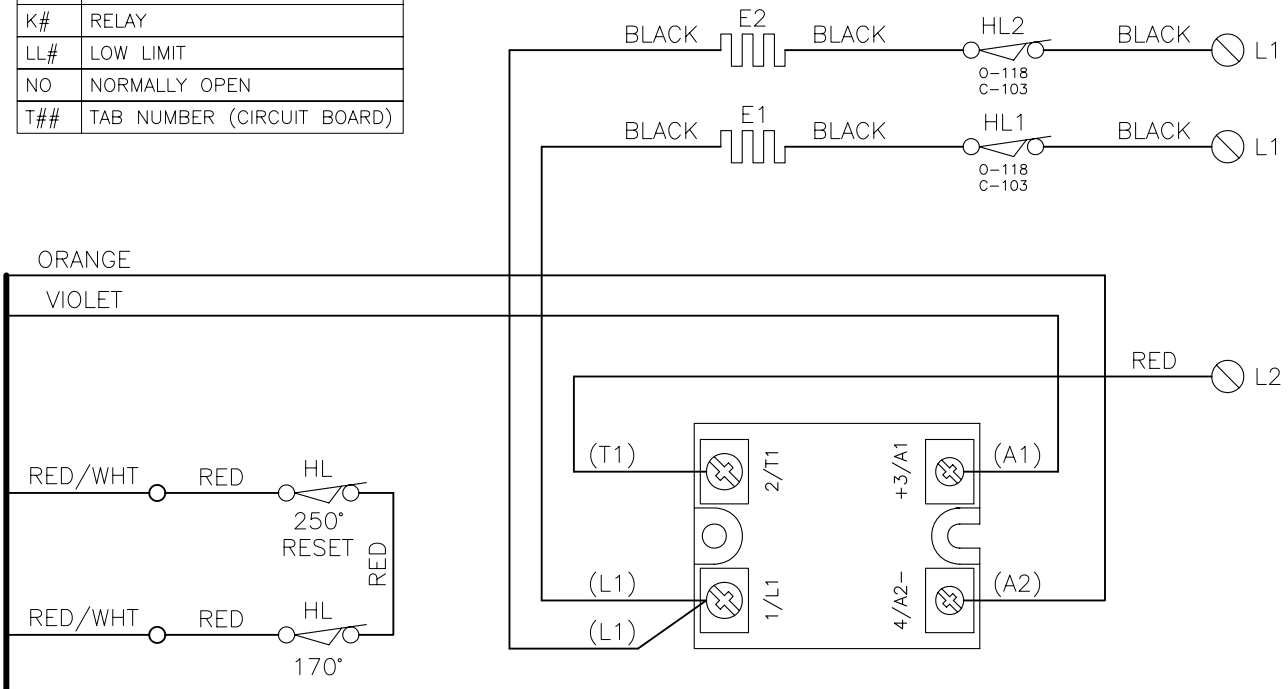
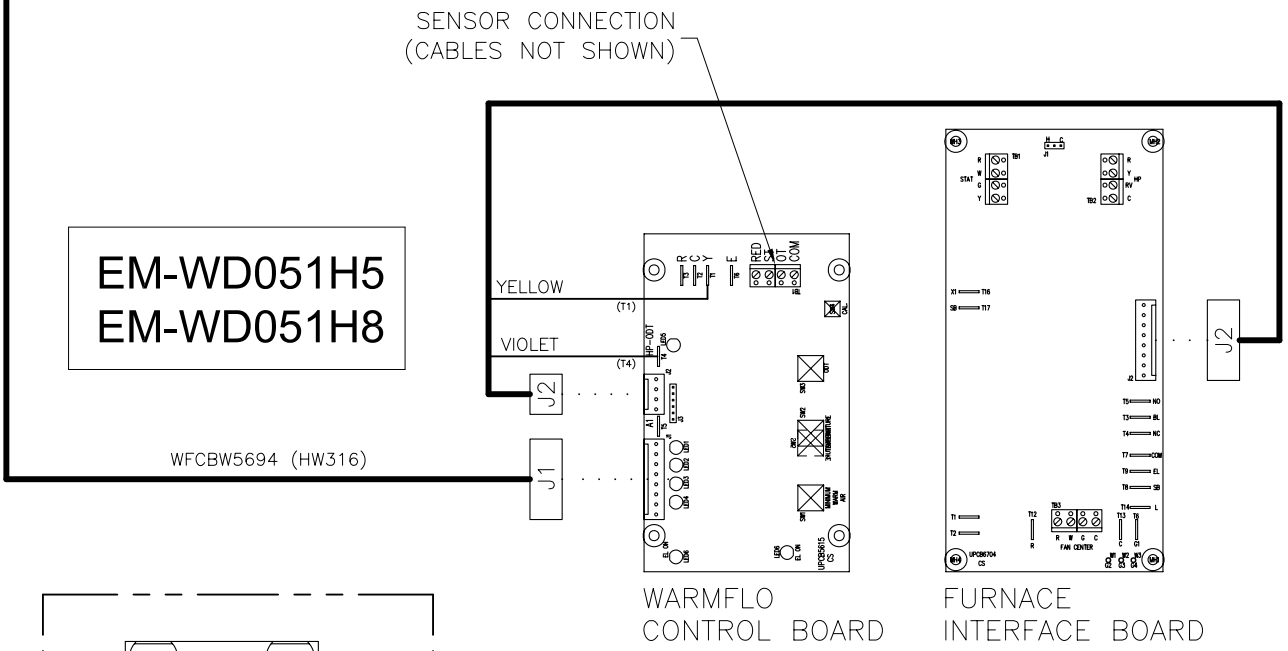
| T## | TAB NUMBER (CIRCUIT BOARD) |

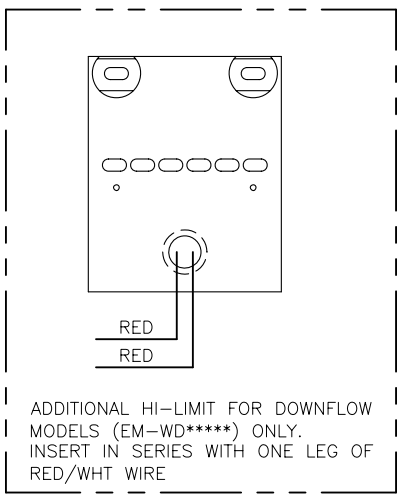



**EM-WD051H5**
**EM-WD051H8**

WARMFLO CONTROL BOARD

FURNACE INTERFACE BOARD




Rev.A 10–19–05: Updated hi–limit temperature values.

| | | | | | |
|---|---|---|---|---|---|
| A 10–19–05 – REVISED | ELECTRO INDUSTRIES, INC. MONTICELLO, MN 55362 | | DESCRIPTION: EM–WD(051, 102)H(5,8) WIRING SCHEMATIC | | |
| | DRAWN: MEF | REFERENCE DOCUMENT: ES721 | | | |
| | CHECKED | VIEW/DRAWING TYPE: WIRING SCHEMATIC | | SCALE: NTS | PART/ASSY/MODEL NUMBER: EM–WD***H* |
| | APPROVED | DRAWING STATUS: RELEASED | DOCUMENT DATE: 09–30–03 | SHEET: 2/2 | DOCUMENT NUMBER: ES722 |

# *Electro-HELPS IV*

## 2016 Update

In the spring of 2016, an update was made to the main WarmFlo II controller to encompass all chip codes into one single control module. There is now a dial labeled “MODE” (SW6) which allows the selection of the various chip codes.

**NOTE:** Upon changing of this dial, a power down reset is required.

All information detailed in this document is still accurate regarding control board functionality (various timers, sensor operation, stage disables, etc.), but now there is a dial which allows the selection of your desired chip code (no longer need to order a new chip when reconfiguring). WarmFlo Analyzer and PC software are still usable with this new, updated module.

The chart below details the new module as it pertains to the various chip codes.

| Various Chip Codes | Mode dial (SW6) |
|---|---|
| HPDH | 0 |
| HPDF | 1 |
| HPEL | 2 |
| AH | 2 |
| EMA | 3 |
| EMW | 4 |
| EBA | 5 |
| EBW | 6 |
| AHS | 7 |
| A | 7 |
| B | 7 |
| C | 7 |
| D | 7 |
| E | 7 |
| H | 7 |
| WFMU | 7 |

**NOTE:** If mode #7 is the required setting for your application, there is a temperature range option to allow for up to 16 temperature selections (space heating and make up air). See below:

| MIN WARM AIR SETTING | TEMP RANGE SELECTION | |
|---|---|---|
| | HI °F | LO °F |
| 0 | 70 | 20 |
| 1 | 80 | 30 |
| 2 | 90 | 35 |
| 3 | 100 | 40 |
| 4 | 110 | 50 |
| 5 | 115 | 55 |
| 6 | 120 | 60 |
| 7 | 125 | 65 |

# WarmFlo Terminology, Key Terms

**ST** – supply temperature sensor. This is the warm air or duct sensor (boiler – supply outlet water).

**OT** – outdoor temperature sensor. Provides the WarmFlo board with outdoor temperature information.

**DT** – desired temperature to overcome building heat loss, the diagonal line on heat loss curve. The front panel efficiency knob selects one of 8 curves to determine DT at specific real time OT.

**DT Flat** – this is an internal reference point, as WarmFlo establishes this mode it in essence sets the operating point at 125° F. (Analyzer or software may have any value from 123 to 125). Electric element modulation and staging are still in effect. The staging will be based upon the ST sensor detecting and operating around the 125° point.

> **Note**: All four stages do not automatically go to full on.

**HL** – actually this is the same as "DT Flat". This perceived hi-limit temperature value (130°) within the control logic, measured by the ST. This is over and above the 155° probe or 170° mechanical hi-limits.

**Full electric (or Full EL)** – this setting causes the modulation and staging to operate at "DT Flat". When first selected or turned on, the WarmFlo logic may first go through a process of building up to the "DT Flat" value. Do not expect the outlet temperature to immediately jump up to this highest value. However, on consecutive thermostat calls it will immediately step to the "DT Flat" temperature value.

> **Note**: This is essentially the same as DT Flat and again all four stages do not automatically go to full on.

**Staging Disable Temperature –** in all OT active sensor applications (DT cal) there is a setup program temperature to "hold off" each stage for warmer heating conditions. In other words, the OT sensor must be reporting a temperature below these values before the stage is allowed to come on. In WarmFlo Analyzer or PC software terminology this is called – STG1 DIS, etc.

The stage-up situation relating to all of the above "DT Flat" operation is controlled by these stage enable temperature set points. This statement must be carefully related to all of the above.

- In other words, if the OT is reading 42° and the front panel is set to "full electric" the ST is looking to operate at 125°, but only stage 1 will be on.

If for heat pump applications Stg 1 is set at 50°, there will be no electric element or standby furnace above 50° OT.

> **Note**: For HP roomstat multi-wire thermostat application, the OT temp. set point must be below normal desired cooling.

**E tab (board top center)** – in most WarmFlo products and TS Series boiler products there is a troubleshooting tab marked "E". When applying 24-volt (or jumpered to "W" tab) this input function immediately forces all four stages on and bypasses all temperature sensing or element modulation sequences. If used verify blower also functions properly.

- A potential convenience or secondary usage for this upgraded E tab function is to provide an easy manual means for rapidly bringing up the building or room temperature if the system has been set for non-occupancy. By installing a pushbutton between W and E tab,

the homeowner can easily activate all stages on to the end of the thermostat cycle. **Warning:** This is all stages on, no temperature monitor. This should only be used in this manner when it is a very cold building from non-occupancy, the outdoor temperature is quite low with low temperature rise coming from the heat pump.

**Stat override timer (SOT)** – this is an option WarmFlo internal timer which can be programmed with WF analyzer to select a roomstat run time. If this downloaded run time (typically 90 minutes) is exceeded before the thermostat is satisfied, the system automatically switches to either full electric elements or standby.

- SOT S – this is the longer set timer which allows **transfer to standby** if something might have happened to the electric system.
- SOT E – this must be shorter time, is typically used to overcome morning setback pickup issues. In other words, if you would field download 30 minutes and you program the **setback stat** to begin bringing up the temperature 30 minutes prior to the wakeup time; and the system is not at the new higher temperature at the 30-minute point it will automatically jump to DT Flat in order to more rapidly raise the building temperature. **However**, this also means you will be "short cycling" the HP compressor during **other** heat calls. The maximum run time for the compressor is then about 30 minutes at any time of the day or at any particular heat call.

  **Note:** Beginning approximately 7-04 the SOT S has been factory default at 90 minutes for all dual heat chip codes.

**MU –** this is an internal timeout function which begins when **all stages** are on at 100%. Anytime the electric section is operating with all stages on at 100% for a continuous operating time greater than the programmed MU (3 initial minutes), the system automatically switches to standby. MU = 00 is a disable setting. The amber LED on the main WarmFlo board will correctly follow electric or standby. On the Interface module (EZ3, etc.) the "gas call" LED also will be on, but the "utility off-peak" LED remains on.

**Electro-Mate or strip heat undersizing** – there are provisions within WarmFlo and within Electro's various heating products to add partial resistance heating section to heat pumps. To provide optimum operation and comfort, the setup functions need to be activated accordingly. Default program code chip "HPDF" has been designed for this application. As a field setup, you probably want MU to be relatively short (30 minutes), the ODT mode will be "EL to SB" with an ODT dial switch temperature selection at about the combination heat pump and Electro-Mate output energy (probably 0°) or position #3.

**Electro-Mate only, no heat pump** – there are two default chip codes, EMW or EMA.

- EMW – all normal WarmFlo functions and modulation, front dial, etc.
  - Must be auto standby, no wood furnace.
- EMA – does not use an OT sensor, at each thermostat call outlet temperature goes to a preset value (commonly called electronic aquastat). This value is the "min. warm air" adjustment (inside main board).
  - The decal table shows the outlet temperature at the various "temperature" settings.
  - The plug-in Analyzer OT Function must be "disable" (no OT sensor).

**Note:** With an Electro-Mate it is assumed there is always standby or gas furnace. For non-automatic or wood, suggest using EMA and select the desired outlet temperature.

**ODT dial switch mode** – within the program chip default and Analyzer/software programming this function defines the use of the dial switch on the circuit board labeled "ODT". The dial switch selects the temperature, the setup function selects what the temperature does.

- EL to SB – interrupts all electric elements **and** the heat pump

- HP – interrupts only the outdoor compressor unit, electric energy continues without an OT temperature shut down reference

**Note**: "0" position does not disable outdoor sensor. This only disables the built-in heat pump ODT function. With the dial switch "0" position the heat pump becomes a direct function of the room thermostat and/or standby mode.

**Standby (SB)** – the WarmFlo control system has transferred the thermostat or heat active function to the standby furnace via the appropriate Furnace Interface module (WF-EZ3, etc.). These actions cause SB.

- SOT-S timeout – thermostat continuous run time.
- MU timeout.
- ODT dial switch value – EL to SB mode.
- A1 tab at 24 volts – any switching device which raises A1 tab to 24VAC.

In addition the Furnace Interface module (EZ3, EM3, etc.) sends a signal via J2-4 (blue, high DC)

- Load Control interrupt (open blues)
- Front panel switch
- Added remote switch, "SB" tab to common

**Note**: ***Electro-Helps V*** has additional troubleshooting conditions that will help evaluate standby.

**SB (Gas) 5-Minute Safety** – when in the standby mode (see previous section) there is a 5-minute timer which begins at each heat call. If after the 5 minutes the ST sensor is less than 80°, the logic board itself goes into an automatic reset and restart. This simply means it attempts to begin the heat cycle using electric in case the furnace did not ignite or "out of gas". However, if it is in the SB mode because of Load Control it will still remain SB and try the gas furnace again. The system will never go back to electric if Load Control is set for on-peak or A1 tab high.

- Typically this is disabled for boiler control applications.
- Analyzer or PC software can disable this function.
- As an added non-freeze safety feature, the program counts these 5-minute resets. If the count reaches 40 (200 minutes) and each time the ST is still less than 80°, the system will revert back to electric to bring up the temperature of the building, one thermostat cycle only.

**Delay, transfer from electric to standby** – because there are a multitude of gas furnaces which turn off the blower during their internal heat exchanger warm-up, there is a 1-minute delay before the gas furnace receives the W input. During this 1-minute the gas furnace G function remains high allowing the blower to purge out the heat on the Electro-Mate elements. After the 1-minute the G function drops and the gas furnace W function goes high.

**Delay, transfer from standby to electric** – if the unit was operating in SB for more than 1 minute, the follow-up transfer back to electric engages a 2-minute delay before the HP compressor relay is activated and any of the electric stages are activated. The blower will react to the call for heat, but the elements will stay off for 2 minutes in order for the blower to cool down the furnace heat exchanger. In addition the WarmFlo logic stages up from stage 1 through the various temperature/delay staging sequences.

**Blower operation** – the air handler or fossil fuel furnace blower is operated from its own fan center (G screw). The activation of this "G" input is either directly from a heat pump (total electric system) roomstat "G" screw or in the case of dual heat from the Furnace Interface module (WF-EZ3, LGR4, EM3, etc.). The Interface module and its wiring or association with the room thermostat completely controls the blower. There is nothing on or within the WarmFlo control board itself which has anything to do with the blower function.

- Delay on/delay off – within all Interface modules there is an approximate 10 to 15 second blower on delay and a 1-minute blower off delay. In the case of a heat pump stat, this can be bypassed by taking the stat "G" screw directly to the interface module tab "G1" (multi-wire stat only).
- Multi-speed blower – newer furnaces having multi-speed blower functions can be stepped up to the proper high speed with an appropriate (special relay contact) jumper between the furnace fan center "G" and "Y". See the installation manual sketch and paragraph for adding the necessary wiring jumpers associated with the Interface module special terminals (BL, NO, NC). Also ***Electro-Helps VIII*** provides details on all the various wiring arrangements for ECM variable speed blower.
- Using E tab with HP stat emergency output – see previous "E-tab" section for blower operation caution.

**Bad sensor, safety** – if the internal logic detects open sensor wire, incorrectly wired sensor, or some bad sensor transmitted value conditions; the green LED reverts to a pulsing mode. Basically the appropriate sensor is set internally to a default value and there will be an attempt to cause the electric heat output to go "DT Flat".

- OT sensor – approximately 1/10 second blip every ½ second
- ST sensor – two, 1/10 second blips every ½ second
- Both bad – ½ second on and ½ second off, alternating

**Bad sensor default heating** – when above condition is detected electric unit has limited staging output.

**WarmFlo Analyzer or Software Bad Sensor Indicators**

- 255 or NA - OT function is disabled, EMA/EBA type operation
- 254 or BAD - controller cannot read a value from the temperature sensor
- 31° (assuming it is not 31°) - new software (2.3* and up chip) with previous sensor, "D" ring (DS2434)
- 0° (assuming it is not 0° F) - previous software (2.2* chip) with new sensor, "E" ring (DS18B20), green LED should also blink

**Cal. pushbutton, on board upper right** – function is unchanged, holding for 10 seconds forces the OT sensor to 32° value.

**Power-Down Reset –** there are some data entry or setup modes which require power-down reset - WF+ board configuration selection, cancelling pulsing bad sensor green LED, etc. If in doubt do a complete 24-volt system power-down reset after WarmFlo Analyzer save operations. Reset always verifies the proper handling of a software modification.

# HANDHELD ANALYZER/LAPTOP SOFTWARE

**PC software (ET-SOFT-WF) or Handheld (WF-ANZ*)** – has provisions for the following setup or reprogramming functions. Caution – do not attempt to reprogram a forced air (Electro-Mate) chip for boiler application.

- Select proper product application – dial switch on the back
- MU time, or disable
- SB RESET – disable/enable
- SOT S time, or disable – switches to standby
- SOT E time, or disable – all stages on
- Stage disable temperature – 1, 2, 3, 4
- OT sensor function
    - DT cal.
    - Flat DT or HL (suggest not using)
    - Disable
- ODT dial switch mode
    - EL to SB – interrupt all electric energy (Electro-Mate and HP)
    - HP – Outdoor compressor interrupt only
- OT SPD A/B and ST SPD A/B – special temperature sensing speed settings, relates only to variable speed motor interface arrangements (WF-ANZ5 and up)
- WF-ANZ7 adds a EB-WO or EB-MO function for establishing the baseline or beginning point for modulation temperature ramp-on

**Warning, field reprogramming –** within WarmFlo II internal logic and non-volatile memory, it can detect whether it is operating from a pre-programmed chip (see table, following pages) or if it has been modified (reprogrammed) with PC software or Handheld. Once the user or field technician has downloaded (save), the WarmFlo II physical control board is no longer governed by the chip code written on the plug-in chip, etc. In other words, power up/power down or reset does not affect any altered reprogrammed functions. It is smart enough to know it is no longer the original chip and that **specific physical** board, from this time forward, must be under the control of the PC software/Handheld.

However, a new totally different coded chip with the same or different revision date will automatically wipe out any of the previous setups and can restart the same physical board based on the defaults within this newly added or different coded chip. After power-up reset the internal program reads the chip code and the version number. If either changes it begins new with the defaults and revision code of the specific replaced chip.

# OPERATIONAL INFORMATION

In order for the installer to completely understand the WarmFlo II functions and operational sequence it is recommended to thoroughly read and understand the information below. This knowledge can help in determining settings that can be set according to the end customers needs.

**Normal Heating Operation** – Whenever the WarmFlo II Y tab is at 24 volt (with reference to "C"), the WarmFlo II controller begins turning on the Electro-Mate elements (assume outdoor temperature is below disable value) and automatically controls the warm air temperature as sampled by the warm air sensor (ST). However, if added heat is **not** required, no element power is used.

Depending upon Electro-Mate model, the heating section may have one, two, three, or four stages. Stage one is pulse modulated (approximate 10-second cycle) based upon the WarmFlo II controller automatic requirement. Stages 2, 3, and 4 are turned on and off with a relay. However, Stage 2, etc. is only used when needed by the WarmFlo II supply air temperature calculations.

When the warm air sensor is calling for more than the heat pump and Stage 1 100% output, Stage 2, etc. turns on. Stage 1 may not necessarily remain at 100%, but can be modulated downward to meet the requirements of the warm air sensor.

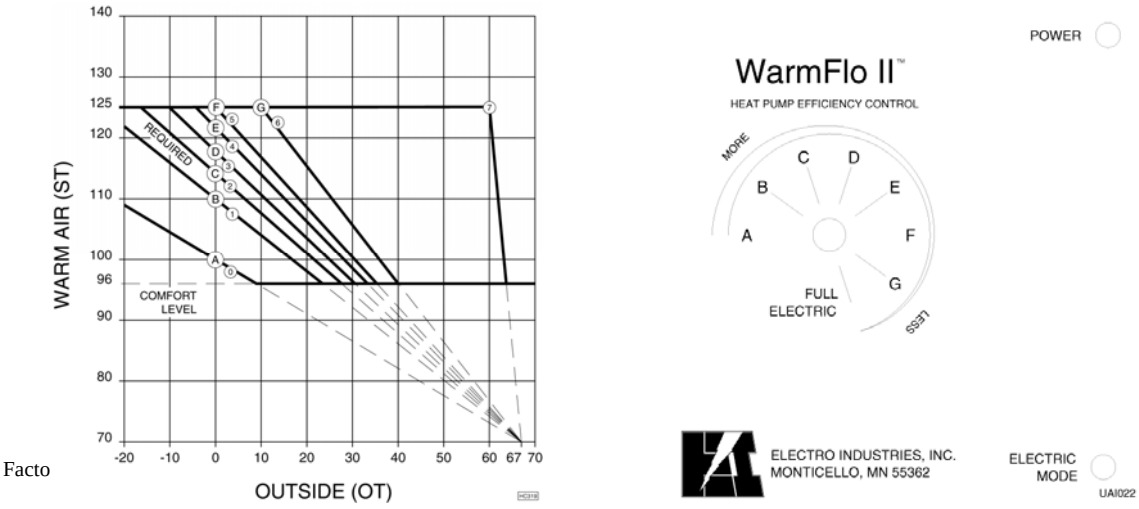
Also on the next call for heat, the WarmFlo II controller remembers what stages were on and starts at that point. A clamp-on amp meter at the service input can be used to "visualize" the Stage 1 modulation and/or Stages 2, 3, and 4 functions.

Note: Power-up reset or return from standby (SB) resets all staging memory and temperature cycling begins new.

**Efficiency*** – the characteristic of a heat pump dual heat system is the heat pump's ability to deliver warm air at efficiencies greater than 100%. Gas and oil systems are always less than 100% (60% through 90%), resistance electric (Electro-Mate) is always exactly 100%, but the heat pump is always at least 100% (-20°F) or greater, up to about 200% for air source.

The user needs to realize it is to his advantage to run the heat pump either continuously or at the longest possible thermostat call cycles. This is contrary to the basic understanding of most users. However, realizing again the heat pump is a device that delivers greater than 100%, this system can only deliver greater than 100% if it's running, let it run. Because of the WarmFlo design concept and its internal "brain" the heat loss curve (diagonal lines, below) allows the compressor to operate with a minimal amount of electric resistance supplement or temperature boost.

**Heat loss curve*** – within the "brain" of the WarmFlo controller is a relationship of supply temperature (ST) to outdoor temperature (OT) measurement. As it gets colder outside, the higher needed the supply temperature in order to properly overcome the heat loss within the structure. This is the diagonal line between 67° outdoor and maximum Btu/h (heat loss) at the coldest outdoor temperature. The slope of this line or the exact warm air position at the coldest temperature is established by the "efficiency" adjustment knob or dial.




Facto

**Temperature (Efficiency Dial)*** – the red center screwdriver adjustment dial has a selection of A through G. These A through G selections represent a supply temperature point at 0° outdoor. The closer the user or installer selection is to A, the flatter the heat loss curve or the higher the operating efficiency. The closer a selected setting is to G, the steeper the heat loss curve or the lower overall heat pump system efficiency. If dial is turned to "full electric" the WF II will automatically put all stages of electric to full capacity.

***Does not apply to chip codes such as EMA and EBA.**

**Outdoor sensor reference or heating requirement level*** – the outdoor digital sensor "tells" the WarmFlo "brain" its desired (DT) value or decision making capability. This is for desired or required supply temperatures greater than the "min. warm air" horizontal line setting. At each internal calculation cycle a DT is determined by reading the outdoor temperature (OT) and then finding the appropriate warm air point on the appropriate or selected diagonal line. See Figure 1 for the various diagonal lines associated with the A through G "temperature" selection knob.

> **Example** – if the temperature knob is set on Position C, at 20° outside the DT or the supply delivery temperature is 100°. The WarmFlo controller now automatically adjusts and maintains electric element power to keep the supply temperature at 100°. Likewise if it -10° outside the DT or supply delivery temperature is 120°. The elements are re-adjusted to provide a constant 120° temperature.

**Where should I set the efficiency dial?** – As you can visualize from the curves above, the lower the setting, the flatter the curve, the less electric resistance is added to the heat pump compressor warm air. Therefore, the efficiency knob setting is based upon comfort and efficiency. The lower the setting the higher the overall operating annual efficiency, the higher the setting the warmer the air at the register.

**Chip code/field programming** – your unit was ordered and supplied with a "coded" program chip, one of the selections shown in each Chip Code Reference Table for your application (within the various colored page sections). These tables show the various defaults associated with that particular code. With WarmFlo II a number of field re-programming possibilities and options exist using either PC software or WarmFlo analyzer, reference "WarmFlo Handheld Analyzer/Laptop Software" section. Chip code is located on the WarmFlo II controller board white label.

> **Note:** There are certain things such as SOT's, MU time, etc. which are only field programmable. If the item is not shown in the chip code table, that feature or item is default set as disable.

## WarmFlo Select, WarmFlo+, EZ-Mate, WF II

| Selection Dial | Code | Stg. Enable | MU Time | ODT Mode | OT Function | SOT-S |
|---|---|---|---|---|---|---|
| Dual | HPDH[2] | 50°, 38°, 36°, 34° | 90 | HP | DT Cal. | 90 |
| ANZ-set | HPDF[2] | 50°, 38°, 36°, 34° | 30 | EL to SB | DT Cal. | 90 |
| No Gas | HPEL | 50°, 38°, 36°, 34° | 00 | HP | DT Cal. | 00 |
| ST & OT | EMW | 90°, 50°, 36°, 34° | 60 | EL to SB[1] | DT Cal. | 90 |
| ST | EMA | - | 00 | EL to SB[1] | Disable | 90 |
| - | HPFU | 50°, 38°, 36°, 34° | 30 | HP | DT Cal. | 90 |

[1]ODT dial switch must be set on 0 = disable.
[2]EZ-Mate – dual is HPDF, not HPDH.

Other defaults, all Forced Air models.

| | |
|---|---|
| SB RESET – enabled | ST SPD A – N/A |
| SOT-E – 000 (disabled) | ST SPD B – 105° |
| OT SPD A – N/A | CT STG DISABLE – all 0, except EZ-Mate = 3 |
| OT SPD B – 30° | CT STG DISABLE – all 0, except EZ-Mate = 4 |

ELECTRO INDUSTRIES
Monticello, Minnesota
800.922.4138
www.electromn.com

# Electro Industries, Inc. Residential Limited Product Warranty

**Effective November 1, 2009**

Electro Industries, Inc. warrants to the original owner, at the original installation site, for a period of two (2) years from date of original purchase, that the product and product parts manufactured by Electro Industries, Inc. are free from manufacturing defects in materials and workmanship, when used under normal conditions and when such product has not been modified or changed in any manner after leaving the plant of Electro Industries, Inc. If any product or product parts manufactured by Electro Industries, Inc. are found to have manufacturing defects in materials or workmanship, such will be repaired or replaced by Electro Industries, Inc. Electro Industries, Inc., shall have the opportunity to directly, or through its authorized representative, examine and inspect the alleged defective product or product parts. Electro Industries, Inc. may request that the materials be returned to Electro Industries, Inc. at owner's expense for factory inspection. The determination as to whether product or product parts shall be repaired, or in the alternative, replaced, shall be made by Electro Industries, Inc. or its authorized representative.

Electro Industries, Inc. will cover labor costs according to the Repair / Replacement Labor Allowance Schedule for a period of ninety (90) days from the date of original purchase, to the original owner, at the original installation site. The Repair / Replacement Labor Allowance is designed to reduce the cost of repairs. This Repair / Replacement Labor Allowance may not cover the entire labor fee charged by your dealer / contractor.

**TWENTY YEAR (20) LIMITED WARRANTY ON BOILER ELEMENTS AND VESSELS**

Electro Industries, Inc. warrants that the boiler elements and vessels of its products are free from defects in materials and workmanship through the twentieth year following date of original purchase. If any boiler elements or vessels are found to have a manufacturing defect in materials or workmanship, Electro Industries, Inc. will replace them.

**TWENTY YEAR (20) LIMITED WARRANTY ON SPIN FIN ELEMENTS**

Electro Industries, Inc. warrants that the spin fin elements of its products are free from defects in materials and workmanship through the twentieth year following date of original purchase. If any spin fin elements are found to have a manufacturing defect in materials or workmanship, Electro Industries, Inc. will replace them.

**FIVE YEAR (5) LIMITED WARRANTY ON OPEN WIRE ELEMENTS**

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## THESE WARRANTIES DO NOT COVER:

1. Costs for labor for removal and reinstallation of an alleged defective product or product parts, transportation to Electro Industries, and any other materials necessary to perform the exchange, except as stated in this warranty. Replacement material will be invoiced to the distributor in the usual manner and will be subject to adjustment upon verification of defect.
2. Any product that has been damaged as a result of being improperly serviced or operated, including, but not limited to, the following: operated with insufficient water or airflow, allowed to freeze, subjected to flood conditions, subjected to improper voltages or power supplies, operated with airflow or water conditions and/or fuels or additives which cause unusual deposits or corrosion in or on the product, chemical or galvanic erosion, improper maintenance or subject to any other abuse or negligence.
3. Any product that has been damaged as a result of natural disasters, including, but not limited to, the following: lightning, fire, earthquake, hurricanes, tornadoes or floods.
4. Any product that has been damaged as a result of shipment or handling by the freight carrier. It is the receiver's responsibility to claim and process freight damage with the carrier.
5. Any product that has been defaced, abused, or suffered unusual wear and tear as determined by Electro Industries or its authorized representative.
6. Workmanship of any installer of the product. This warranty does not assume any liability of any nature for unsatisfactory performance caused by improper installation.
7. Transportation charges for any replacement part or component, service calls, normal maintenance; replacement of fuses, filters, refrigerant, etc.

## CONDITIONS AND LIMITATIONS:

1. If at the time of a request for service the original owner cannot provide an original sales receipt or a warranty card registration then the warranty period for the product will have deemed to begin thirty (30) days after the date of manufacture and **NOT** the date of installation.
2. The product must have been sold and installed by a licensed electrical contractor, a licensed plumbing contractor, or a licensed heating contractor.
3. The application and installation of the product must be in compliance with Electro Industries' specifications as stated in the installation and instruction manual, and all state and federal codes and statutes. If not, the warranty will be null and void.
4. The purchaser shall have maintained the product in accordance with the manual that accompanies the unit. Annually, a qualified and licensed contractor must inspect the product to assure it is in proper working condition.
5. All related heating components must be maintained in good operating condition.
6. All lines must be checked to confirm that all condensation drains properly from the unit.
7. Replacement of a product or product part under this limited warranty does not extend the warranty term or period.
8. Replacement product parts are warranted to be free from defects in material and workmanship for ninety (90) days from the date of installation. All exclusions, conditions, and limitations expressed in this warranty apply.
9. Before warranty claims will be honored, Electro Industries shall have the opportunity to directly, or through its authorized representative, examine and inspect the alleged defective product or product parts. Remedies under this warranty are limited to repairing or replacing alleged defective product or product parts. The decision whether to repair or, in the alternative replace, products or product parts shall be made by Electro Industries or its authorized representative.

**THESE WARRANTIES DO NOT EXTEND TO ANYONE EXCEPT THE ORIGINAL PURCHASER AT RETAIL AND ONLY WHEN THE PRODUCT IS IN THE ORIGINAL INSTALLATION SITE. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE.**

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