LENNOX®

HEAT PUMP
KITS AND ACCESSORIES

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FUELMASTER 21® CONTROL BOARD

INSTALLATION INSTRUCTIONS FOR FUELMASTER 21® (FM21) CONTROL BOARD

Shipping & Packing List

Package 1 of 1 contains:

- 1 - FM21 board
- 1 - Mounting box with cover
- 1 - Bag assembly containing:
  4 - #8 - 18 x 1/2" screws

Application

The FM21 FuelMaster 21® control board is designed for use with a conventional gas or oil furnace in combination with a heat pump.Optional kits for service light (SLC1) and defrost thermostat probe (DTR1) are available. An outdoor thermostat may be used with the FM21 when low temperature heat pump lockout is desired.

NOTE - A time delay relay (54G5701) is required when an outdoor thermostat is used.

When the outdoor temperature is below the outdoor thermostat setting, the time delay relay (DL10) will provide a two-second delay before the compressor contactor is energized. Refer to figure 3 for field wiring.

Operation

During a call for heat with the FM21, the heat pump will provide first- stage heating. However, if first-stage operation does not satisfy the heating demand, second-stage heat is provided by the furnace as the secondary source of heat. The FM21 automatically terminates heat pump operation and starts the furnace.

The FM21 also controls the indoor blower speed. The indoor blower runs in high speed during first-stage heating (provided by the heat pump). When there is a need for second-stage heating, the FM21 stops the blower, allows the furnace heat exchanger to warm up, and then operates the indoor blower on heating speed. In situations that require the blower to run continuously, the blower speed will change automatically from heat pump (high speed) to furnace (heating speed).

If the optional defrost thermostat probe, DTR1, is used, the indoor blower will run continuously on high speed during both first-stage and second-stage heating without interruption.

Installation

1. Determine an appropriate indoor location close to the furnace to install the FM21 control box. The box may be installed on the furnace to facilitate wiring.

⚠ IMPORTANT

Use caution to avoid damage to furnace when using screws to install control board.

2. Use the provided screws to secure the control box. Refer to figure 1 for dimensions.

   NOTE - Standard 18-gauge thermostat wire is recommended for all wiring.
3. Remove the FM21 control box cover and make the thermostat connections to the FM21 board. Terminals for the thermostat connections are located on the left side of the FM21 board.
4. Make furnace and heat pump connections to terminals on the FM21 board. These terminals are located on the right side of the FM21 board.

   NOTE - If the furnace is equipped with a SureLight® ignition control board, a wire must be connected from the heat pump Y1 terminal on the FM21 board to the Y terminal on the furnace SureLight ignition control board. This will ensure indoor blower operation on cooling speed during heat pump operation.
5. Run wires through the electrical inlets as shown in figure 2.
6. If outdoor thermostat (S26) is being used with FM21, remove jumper JR2 that is located on the upper left side of the FM21 board. The jumper may be stored by placing it on one pin only. Wire the outdoor thermostat (S26) to the outdoor thermostat terminals on the FM21 board. See figure 3 for wiring.

7. If using optional DTR1-1 defrost thermostat board, remove jumper JR1 which is located at the upper right side of the FM21 board. Jumper may be stored by placing it on one pin only. Install DTR1-1 board as outlined in the installation instruction shipped with the kit.

8. If using optional SLC1 service light control, install and adjust as outlined in theinstallation instruction shipped with the kit.

Control Operation Check

Check the operation of the control using the trouble-shooting tables and operation diagrams.

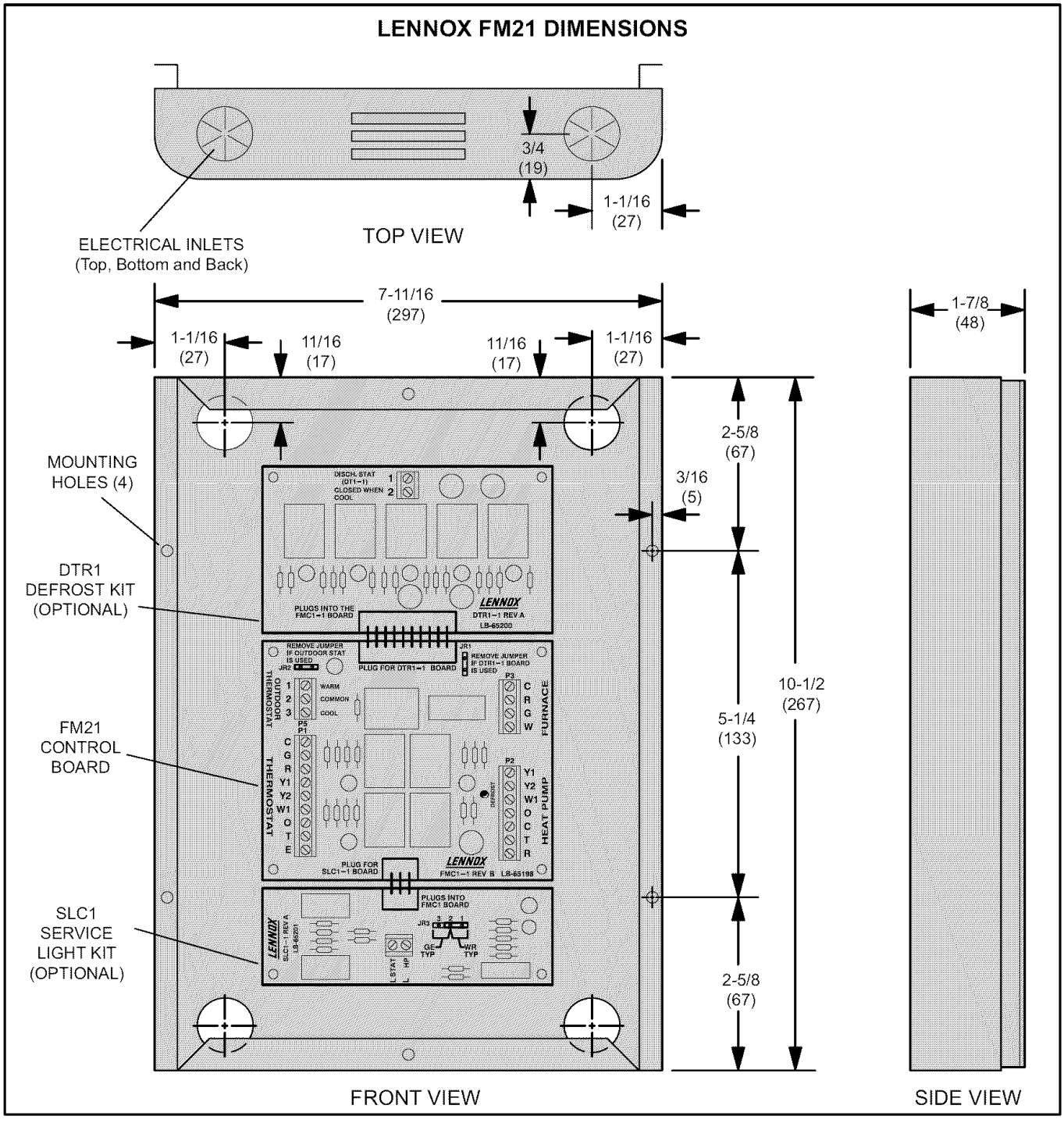


Figure 1

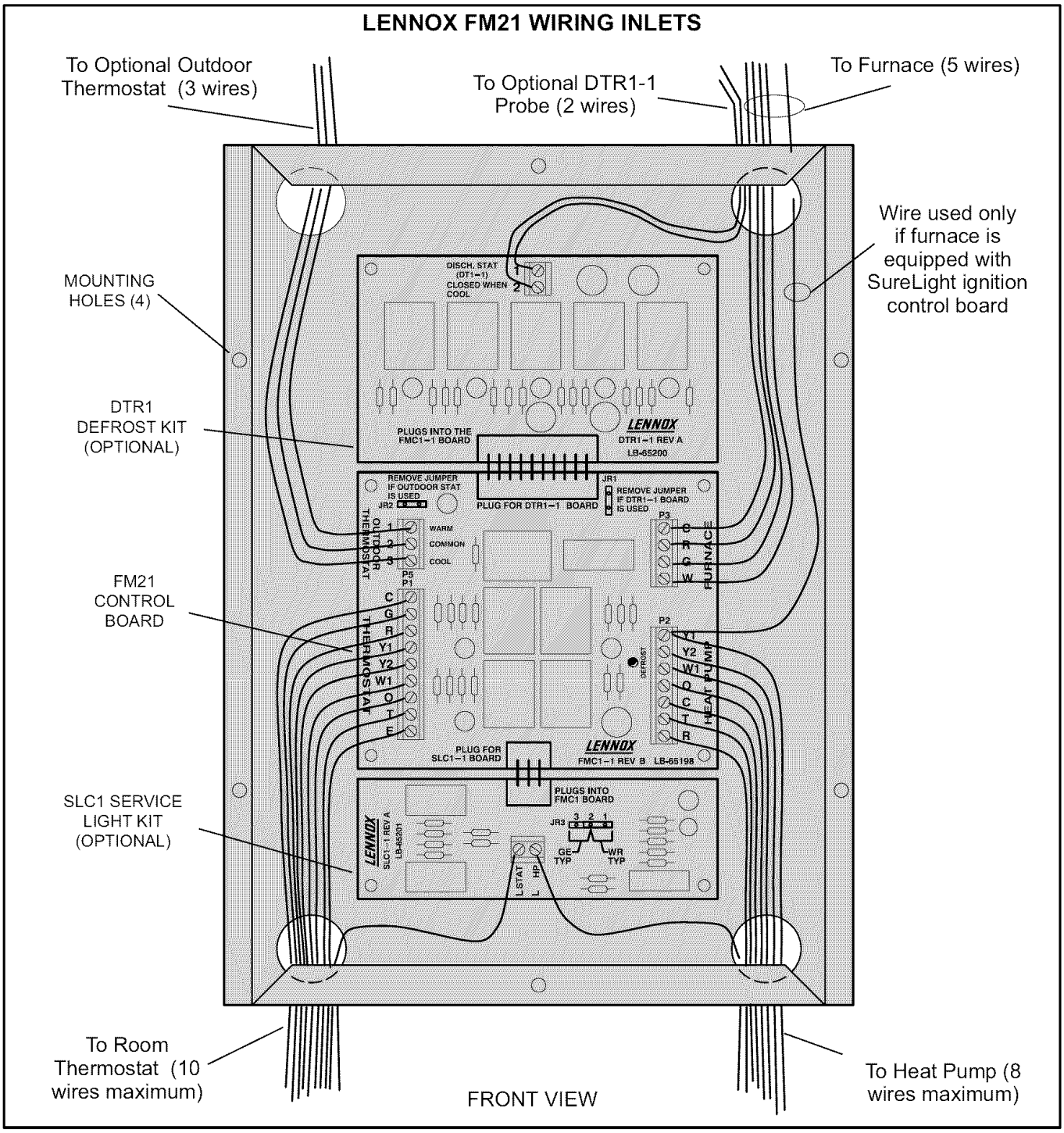
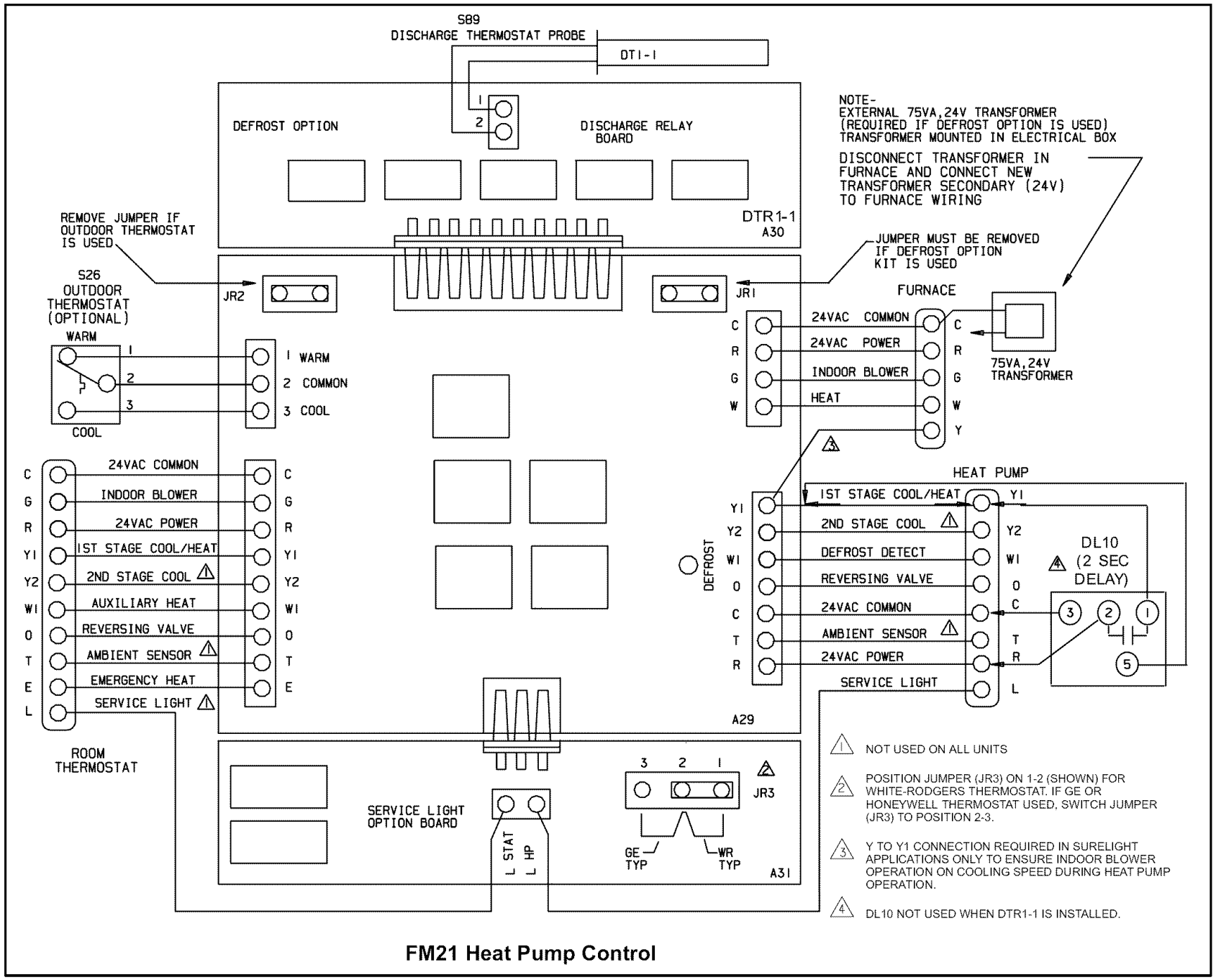

LENNOX FM21 WIRING INLETS
To Optional Outdoor Thermostat (3 wires)
To Optional DTR1-1 Probe (2 wires)
To Furnace (5 wires)
Wire used only if furnace is equipped with SureLight ignition control board
MOUNTING HOLES (4)
DTR1 DEFROST KIT (OPTIONAL)
FM21 CONTROL BOARD
SLC1 SERVICE LIGHT KIT (OPTIONAL)
To Room Thermostat (10 wires maximum)
To Heat Pump (8 wires maximum)
FRONT VIEW
DISCH. STAT (DT1-1) CLOSED WHEN COOL
PLUGS INTO THE FMC1-1 BOARD
LENNOX
DTR1-1 REV A
LB-65200
REMOVE JUMPER IF OUTDOOR STAT IS USED
JR2
PLUG FOR DTR1-1 BOARD
JR1
REMOVE JUMPER IF DTR1-1 BOARD IS USED
OUTDOOR THERMOSTAT
WARM
COMMON
COOL
P5
P1
P3
FURNACE
C
R
G
W
THERMOSTAT
C
G
R
Y1
Y2
W1
O
T
E
P2
DEFROST
HEAT PUMP
Y1
Y2
W1
O
C
T
R
PLUG FOR SLC1-1 BOARD
LENNOX
FMC1-1 REV B LB-65198
PLUGS INTO FMC1 BOARD
LENNOX
SLC1-1 REV A
LB-65201
JR3
3 2 1
GE TYP
WR TYP
L STAT
HP

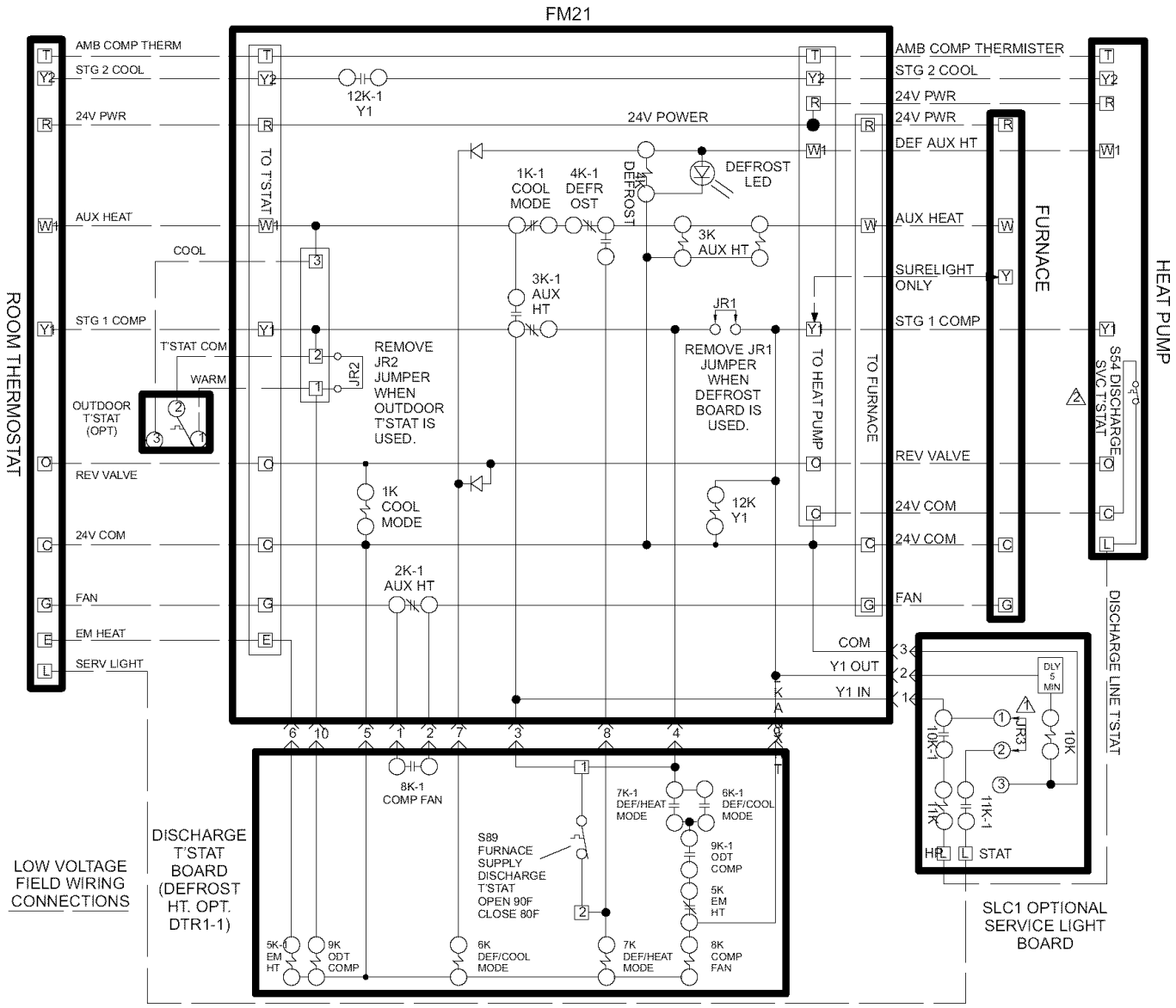
Figure 2



FM21 Heat Pump Control

Figure 3

FM21 SCHEMATIC DIAGRAM



⚠1 POSITION 1-2 SHOWN -- USED FOR WHITE-RODGERS ROOM T'STAT. IF GE OR HONEYWELL T'STAT IS USED, SWITCH JUMPER TO POSITION 2-3.

⚠2 S54 NOT STANDARD ON MERIT HEAT PUMPS. KIT AVAILABLE.

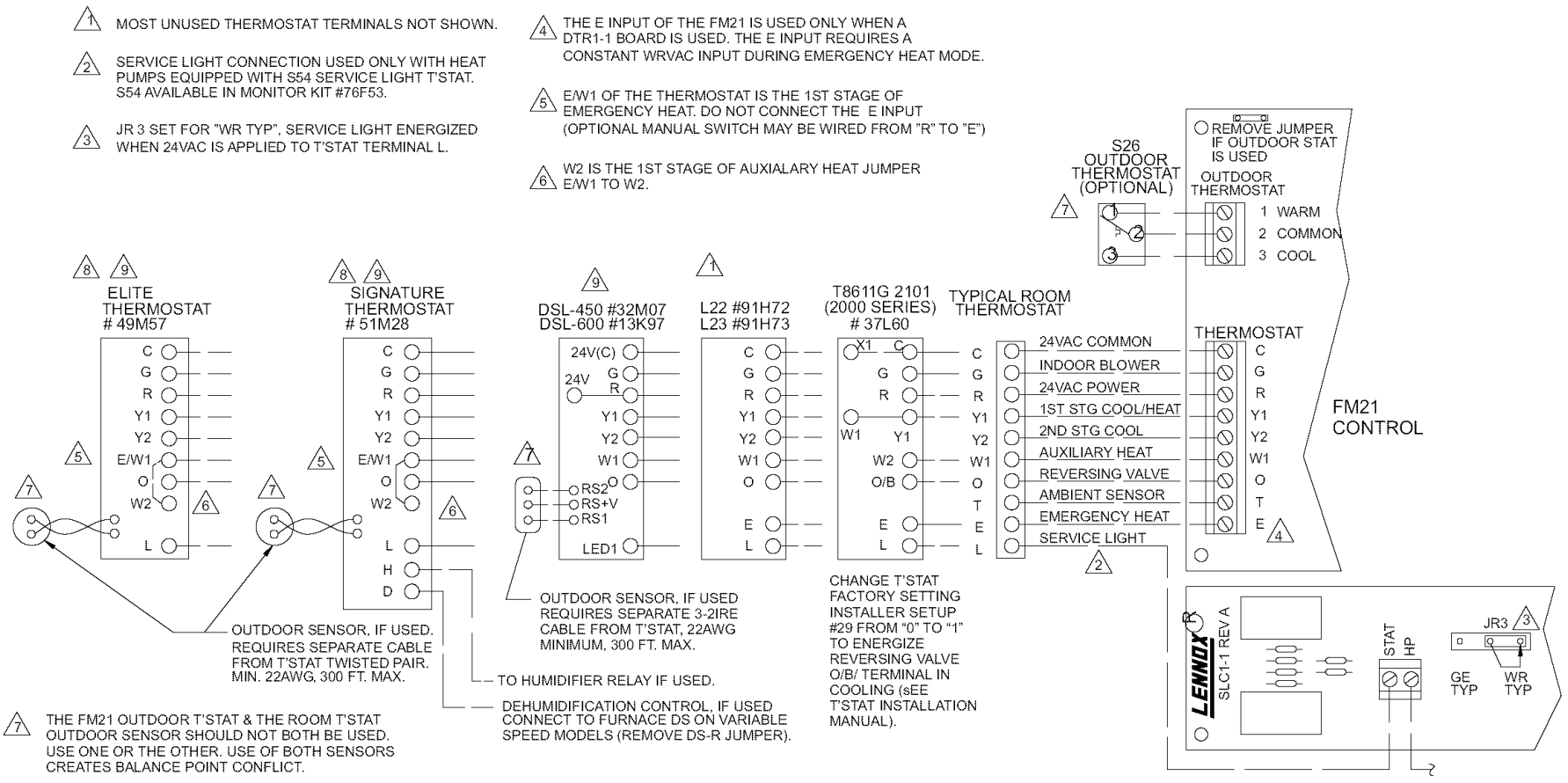
Wiring Connections

This diagram represents the internals of the FM21.

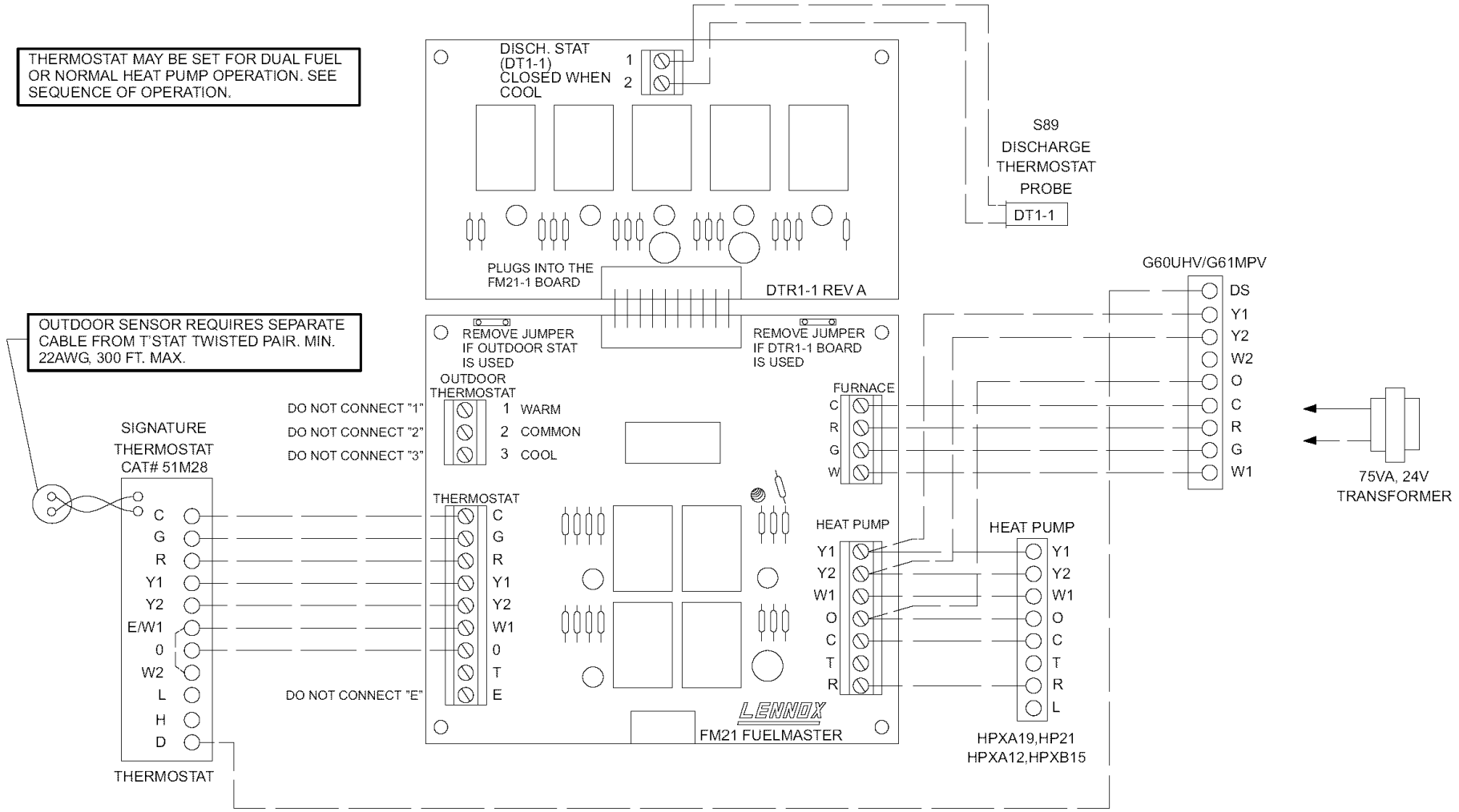
Operating Sequence

The diagrams on the following pages show the sequence of events which take place during normal operation. During most normal operation, an input received from the indoor thermostat will evoke a response in the furnace or heat pump.

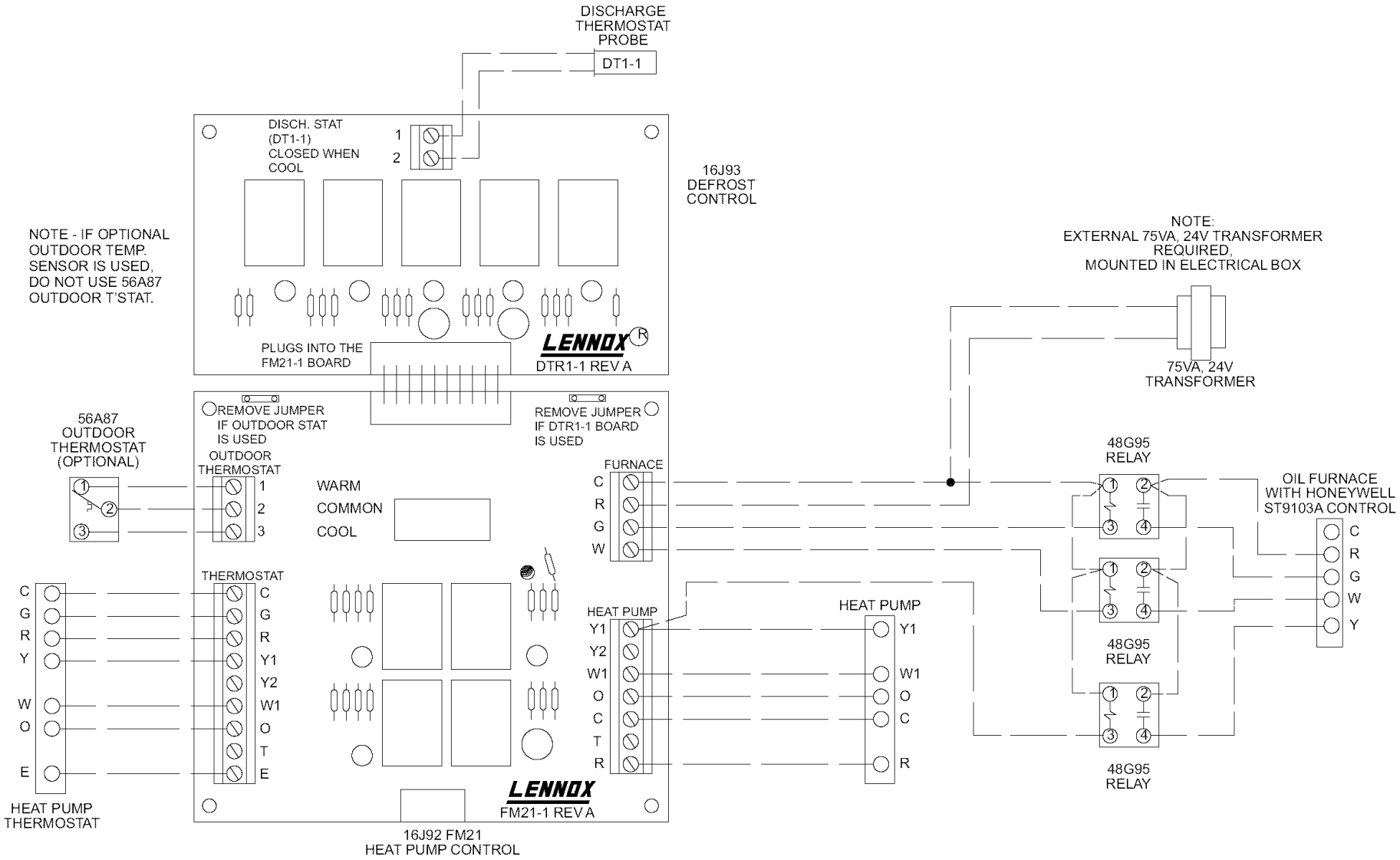
ALTERNATE ROOM THERMOSTAT JUMPERS AND WIRING CONNECTIONS TO FM21 CONTROL



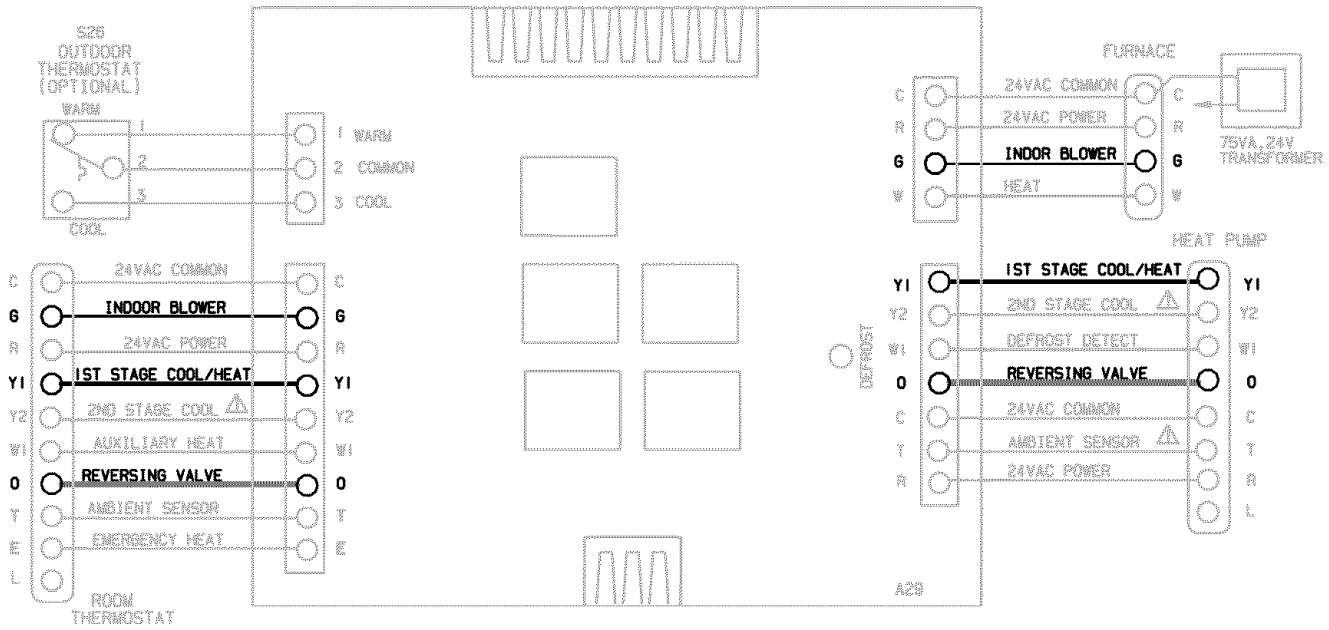
G60UHV/G61MPV WITH FM21, HPXA19 & SIGNATURE THERMOSTAT 51M28



OIL FURNACE WITH FM21, HEAT PUMP AND HEAT PUMP THERMOSTAT



FM21 COOLING SEQUENCE - WITHOUT DEFROST OPTION



Operating Sequence - Cooling:
The diagram above shows the input and output signals in the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

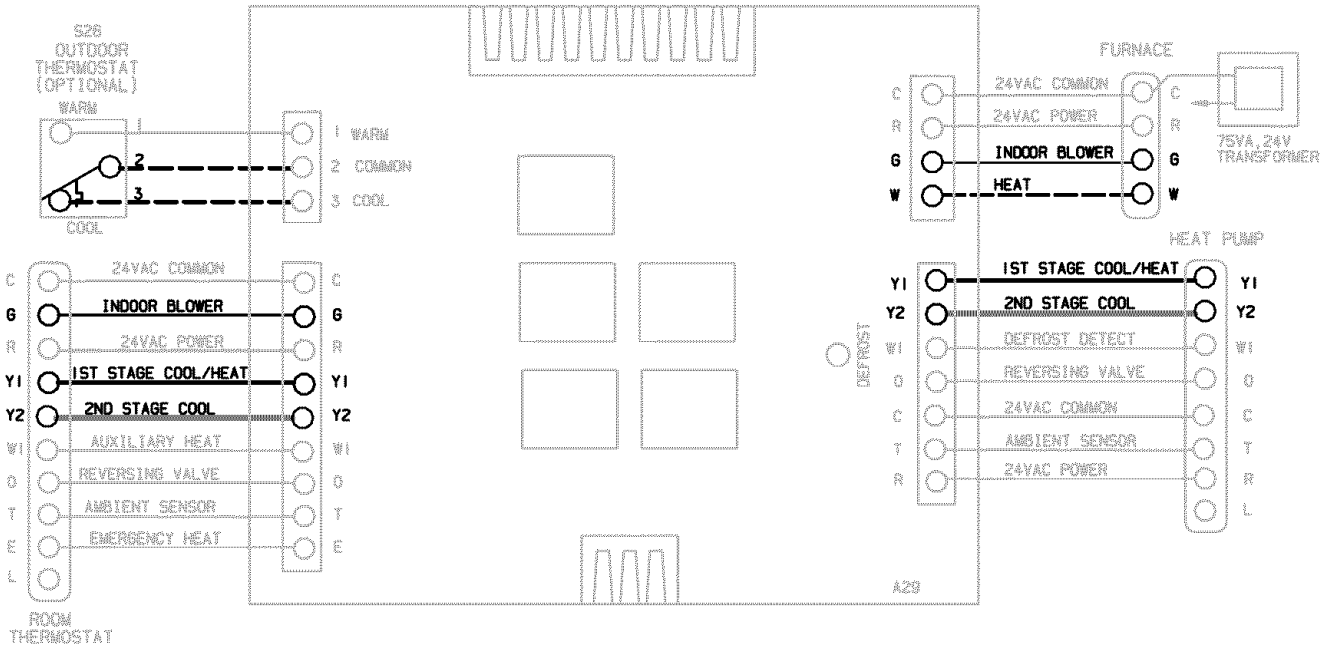
CONDITION:
With or Without Outdoor Thermostat
Constant Fan - Fan Switch "ON"
Blower (G) - Thin Black Line

1 - Blower demand from the thermostat passes directly through the FM21 to energize the furnace blower on high speed.

CONDITION:
Cooling - Fan Switch "ON" or "AUTO"
Compressor (Y1) - Heavy Black Line
Reversing Valve (O) - Heavy Gray Line

1 - Reversing valve (O) is immediately energized when the indoor thermostat is switched to cooling.
2 - On a call for first stage cooling (Y1 & G), indoor blower is energized on high speed and compressor is energized on low speed.
3 - Additional second stage cooling (Y2), compressor is energized on high speed.
4 - Outdoor Thermostat (if used) has no effect on cooling.

FM21 COMPRESSOR HEATING SEQUENCE - WITHOUT DEFROST OPTION



Operating Sequence - Compressor Heating:
The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

CONDITION:
Constant Fan - Fan Switch "ON"
Blower (G) - Thin Black Line

1 - Blower demand from the thermostat passes directly through the FM21 to energize the blower in the furnace on high speed.

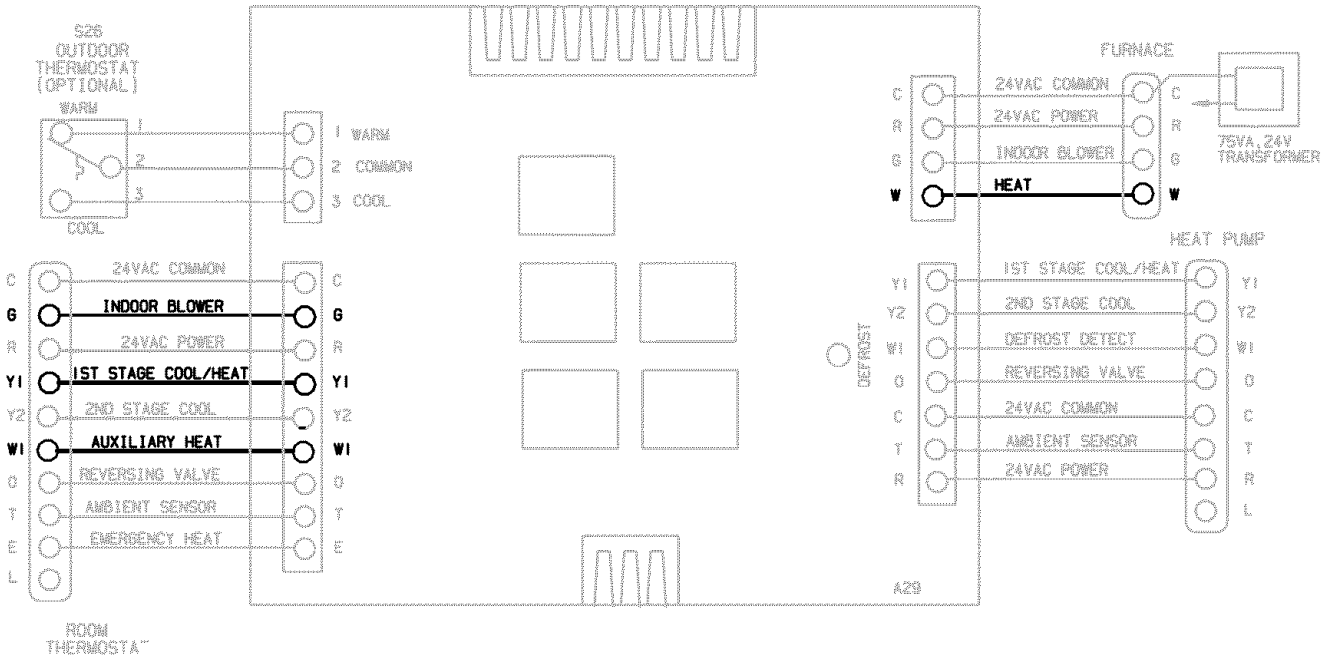
CONDITION:
Heating - Fan Switch "ON" or "AUTO"
Without Outdoor Thermostat or
With Warm Outdoor Thermostat
Compressor (Y1) - Heavy Black Line
Compressor (Y2) - Heavy Gray Line

1 - On a call for first stage heating (Y1 & G), indoor blower is energized on high speed and compressor is energized on low speed.
2 - Additional second stage heating (Y2 - if thermostat has 2nd stage compressor output during heating) energizes the compressor on high speed.
NOTE - Lennox two-speed heat pumps automatically energize high speed when outdoor temperature drops below setpoint of speed control thermostat.

CONDITION:
With Cold Outdoor Thermostat
Furnace (W) - Heavy Black Dashed Line

1 - When outdoor thermostat drops to cold position, compressor (Y1 and Y2) outputs are immediately de-energized. Indoor blower stops operating and furnace output (W) is energized. When heat exchanger warms up, furnace energizes indoor blower on low speed.

FM21 AUXILIARY HEATING SEQUENCE - WITHOUT DEFROST OPTION

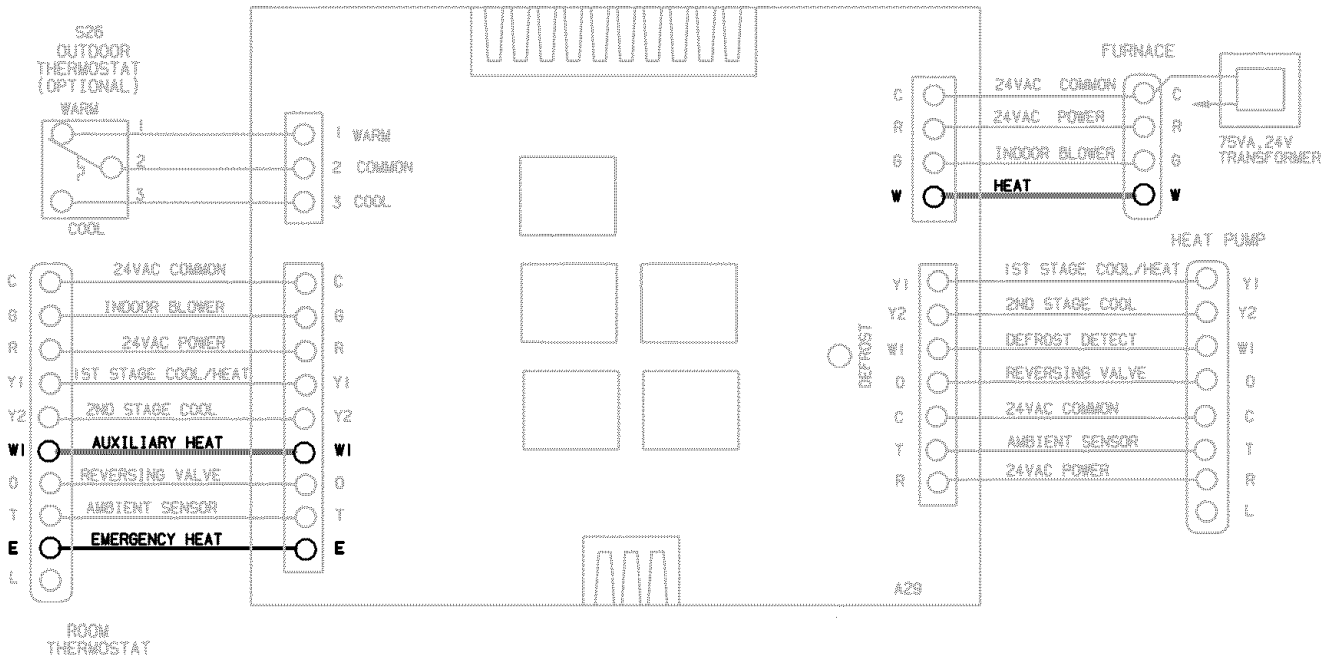


Operating Sequence - 1st Stage Heating:
The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

CONDITION:
Auxiliary Heating
With or Without Outdoor Thermostat
Auxiliary Heat (W1) - Heavy Black Line

1 - On a call for auxiliary heating (Y1, W1 & G inputs), compressor (Y1 and Y2) outputs are immediately de-energized. Indoor blower stops operating and furnace output (W-output) is energized. When heat exchanger warms up, furnace energizes indoor blower on low speed.

FM21 EMERGENCY HEATING SEQUENCE - WITHOUT DEFROST OPTION



Operating Sequence - Compressor Heating:
The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

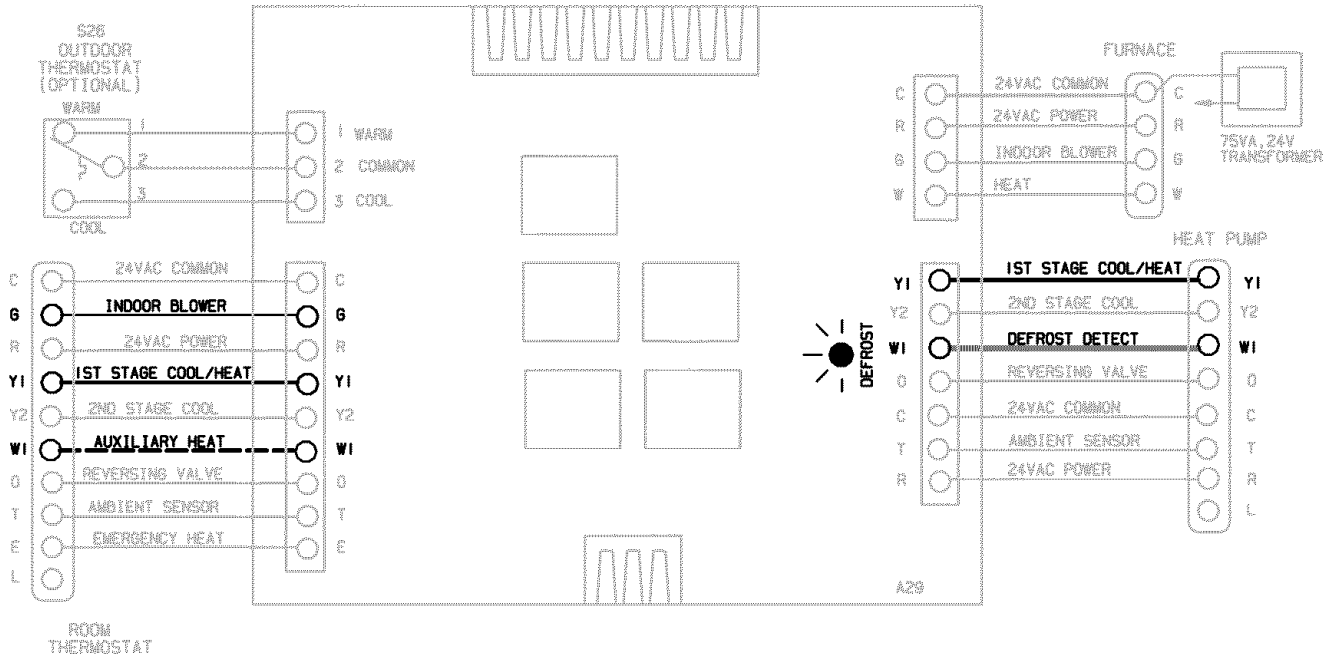
CONDITION:
Emergency Heat Switch "ON" (E) - Heavy Black Line

1 - When the emergency heat switch is turned on, the compressor and indoor blower are immediately de-energized by the room thermostat. The "E" terminal (input) is energized constantly (not swtiched by demand) as long as the Emergency Heat switch is turned on. In this case, without the defrost option, the E terminal has no effect.

CONDITION:
Heating - Fan Switch "ON" or "AUTO"
With or Without Outdoor Thermostat
Heat Demand (W1) while E is energized - Heavy Gray Line

1 - On a call for heating (Y1 & G), indoor blower and compressor are locked-out while E is energized.
2 - Additional heating demand (W1 - input) energizes the furnace (W - output).
The indoor blower is energized on low speed by the furnace after the heat exchanger warms up.

FM21 DEFROST SEQUENCE - WITHOUT DEFROST OPTION



Operating Sequence - Defrost:

The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

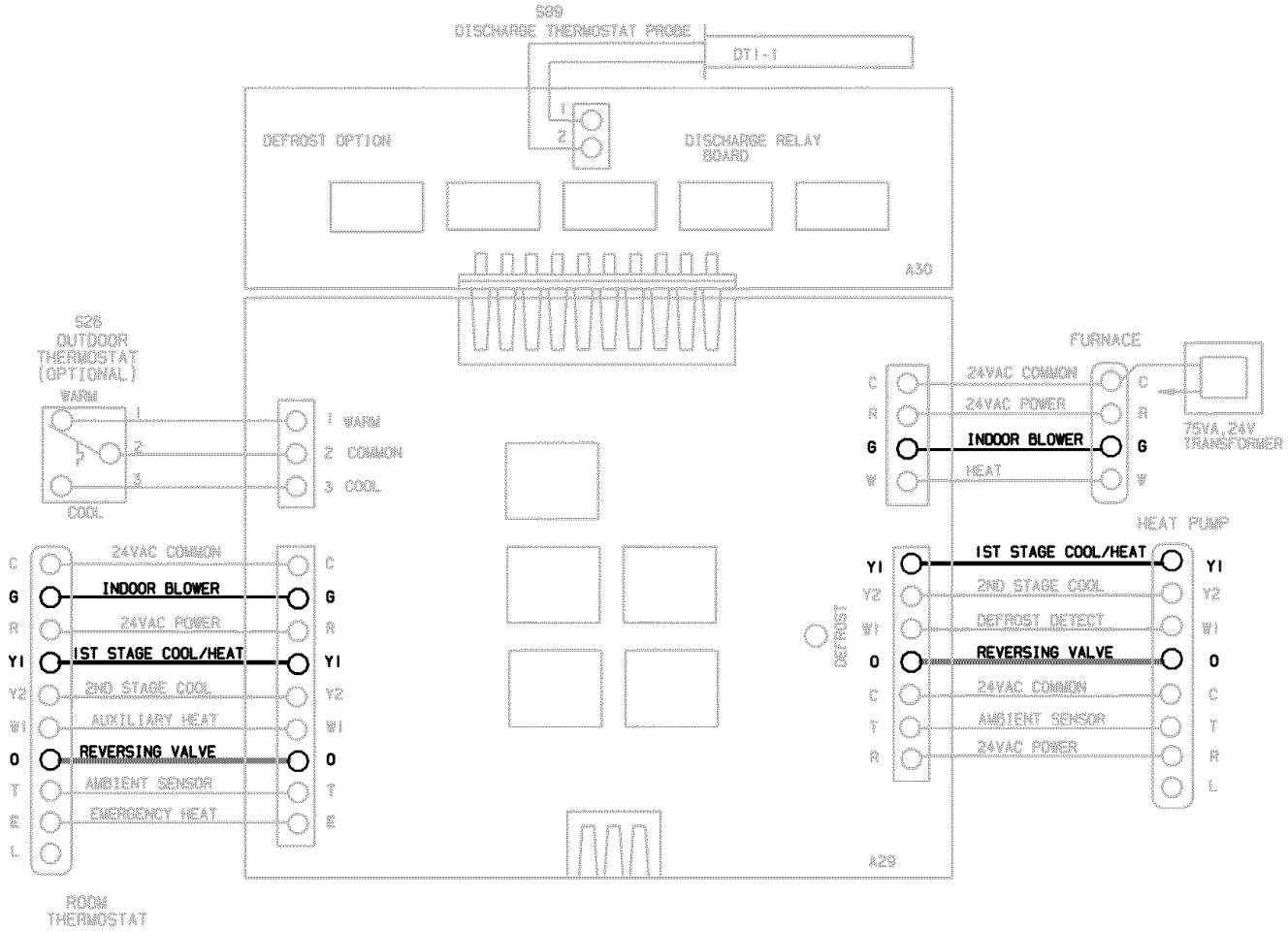
CONDITION:
Defrost Input (W1) From Outdoor Unit - Heavy Gray Line
in conjunction with
Heating Demand (Y1 - input)

1 - When the FM21 senses a defrost cycle the defrost indicator LED is energized.
2 - The compressor continues operating and the furnace is not energized (locked-out in order to prevent overheating the indoor coil). Since the furnace is locked-out and indoor coil is cool, the indoor thermostat may call for auxiliary (W1) heating during defrost.
3 - When defrost is complete, the furnace (W - output) will be energized to satisfy remaining thermostat demand.

CONDITION:
Defrost Input (W1) From Outdoor Unit - Heavy Gray Line
in conjunction with
Auxiliary Heating Demand (Y1 and W1 - input)

1 - Not possible since outdoor unit is de-energized during auxiliary (W1 - input) heating.

FM21 COOLING SEQUENCE - WITH DEFROST OPTION



Operating Sequence - Cooling:
The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

CONDITION:
Constant Fan - Fan Switch "ON"
Blower (G) - Thin Black Line

1 - Blower demand from the thermostat passes directly through the FM21 to energize the blower in the furnace on high speed.

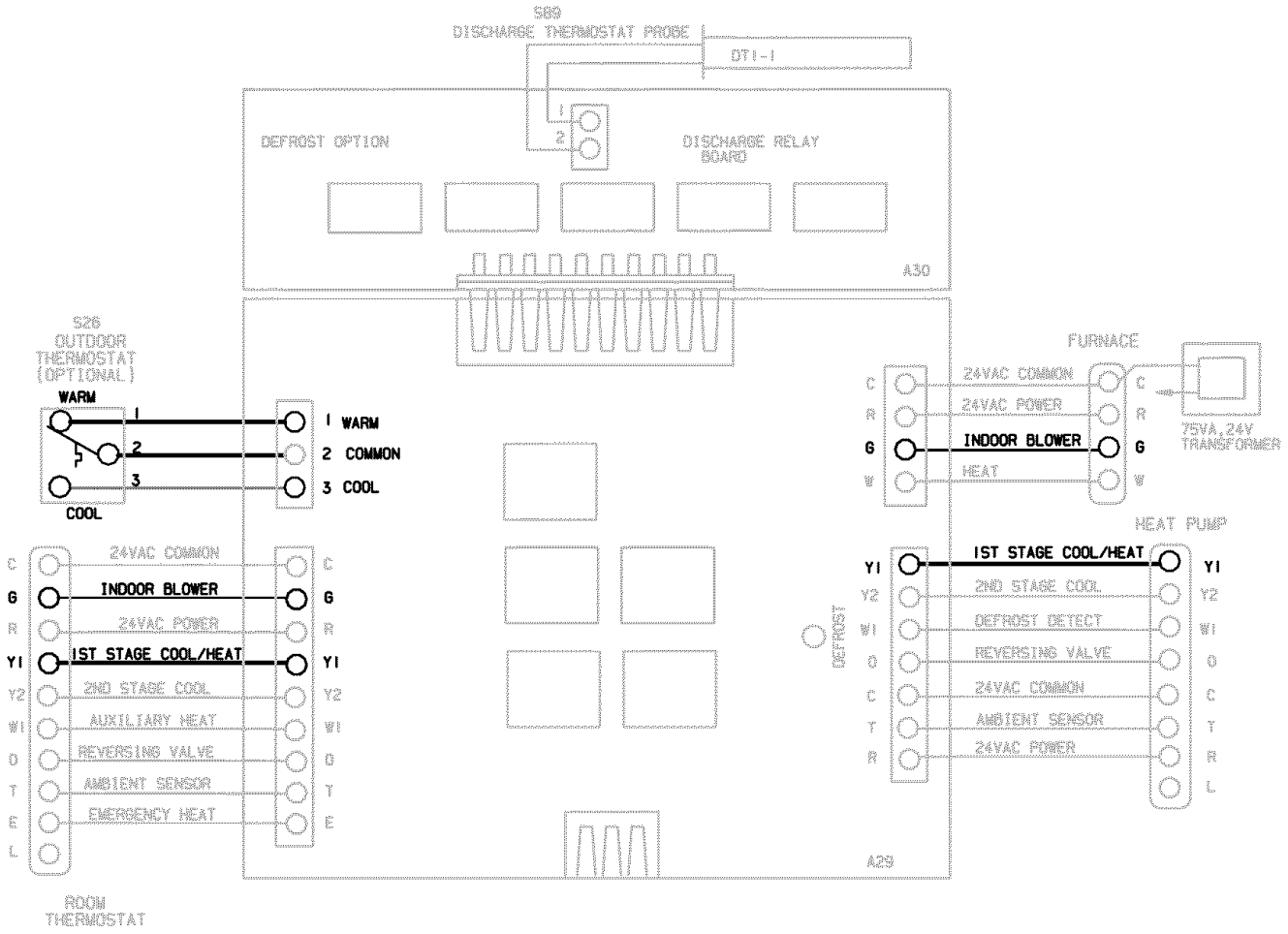
CONDITION:
Cooling - Fan Switch "ON" or "AUTO"
Without Outdoor Thermostat
Compressor (Y1) - Heavy Black Line
Reversing Valve (O) - Heavy Gray Line

1 - Reversing valve (O) is immediately energized when the indoor thermostat is switched to cooling.
2 - On a call for first stage cooling (Y1 & G), indoor blower is energized on high speed and compressor is energized on low speed.
3 - Additional second stage cooling (Y2), compressor is energized on high speed.

CONDITION:
Cooling - Fan Switch "ON" or "AUTO"
With Outdoor Thermostat
Compressor (Y1) - Heavy Black Line
Reversing Valve (O) - Heavy Gray Line

1 - When outdoor thermostat is warm, previous sequence applies.
2 - Outdoor thermostat acts as a low ambient control for the outdoor unit. When outdoor thermostat is cold, compressor (Y1 and Y2 outputs) are de-energized and indoor blower (G output) continues to run on high speed.

FM21 COMPRESSOR HEATING SEQUENCE - WITH DEFROST OPTION



Operating Sequence - Compressor Heating:

The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

CONDITION:
Constant Fan - Fan Switch "ON"
Blower (G) - Thin Black Line

1 - Blower demand from the thermostat passes directly through the FM21 to energize the blower in the furnace on high speed.

CONDITION:
Heating - Fan Switch "ON" or "AUTO"
Without Outdoor Thermostat
Compressor (Y1) - Heavy Black Line
Compressor (Y2) - Heavy Gray Line

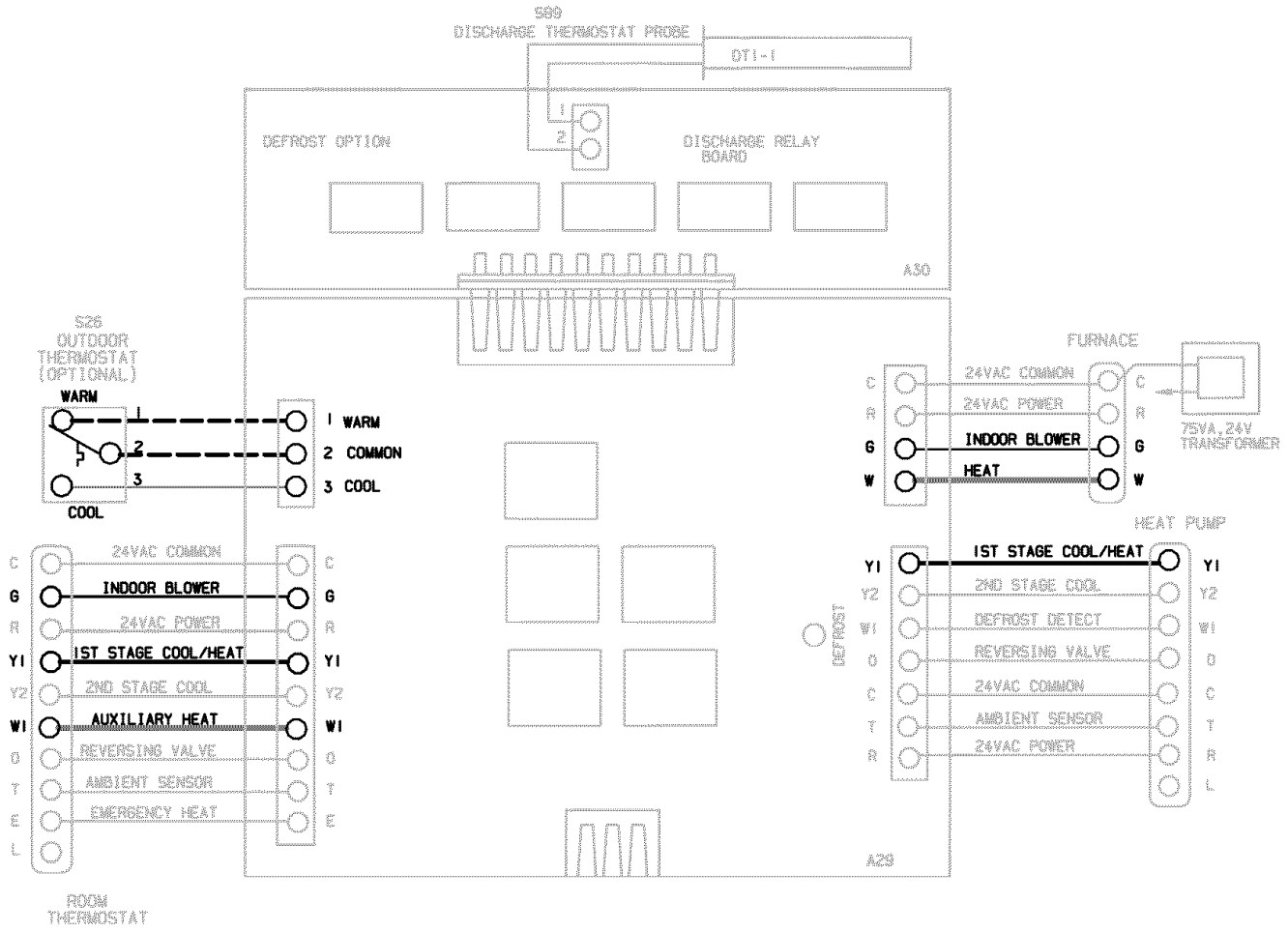
1 - On a call for first stage heating (Y1 & G), indoor blower is energized on high speed and compressor is energized on low speed.

2 - Additional second stage heating (Y2 - if thermostat has 2nd stage compressor output during heating) energizes the compressor on high speed.
NOTE- Lennox two-speed heat pumps automatically energize high speed when outdoor temperature drops below setpoint of speed control thermostat.

CONDITION:
With Outdoor Thermostat

1 - When outdoor thermostat is warm, previous sequence applies.
2 - If outdoor thermostat switches to cold position during compressor heat operation, the compressor and indoor blower (Y1, Y2 and G) outputs are immediately de-energized and the furnace (W-output) is energized. The indoor blower stops and the furnace begins operating.
3 - When the heat exchanger warms, the indoor blower is energized on low speed by the furnace.
4 - If the outdoor thermostat is closed when thermostat demand (Y1 and G input) begins, the compressor and indoor blower (Y1 and G outputs) are locked-out and the furnace (W-output) is energized.

FM21 AUXILIARY HEATING SEQUENCE - WITH DEFROST OPTION



Operating Sequence - Auxiliary Heating:
The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

CONDITION:
Heating - Fan Switch "ON" or "AUTO"
Without Outdoor Thermostat
Compressor and Auxiliary Heat (Y1, W1 inputs) - Heavy Black Line
Compressor (Y2 output) - Heavy Gray Line
Blower (G input) - This Black Line

1 - On a call for auxiliary heating (Y1, Y2, W1 & G inputs), furnace (W-output) is energized along with compressor (Y1 and Y2 output) and high speed blower (G output).

NOTE - Lennox two-speed heat pumps automatically energize high speed when outdoor temperature drops below setpoint of speed control thermostat.

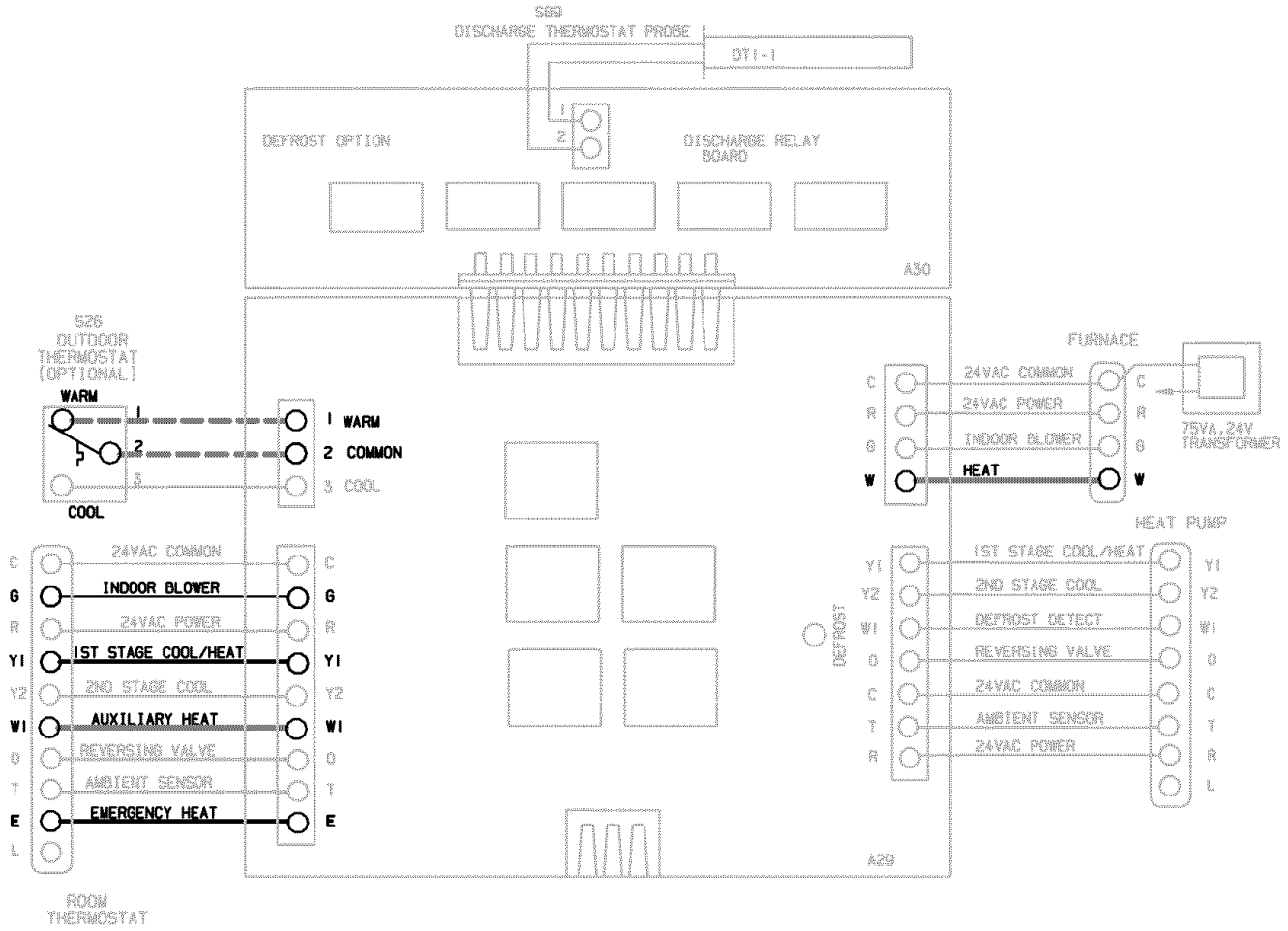
2 - When the furnace warms and the discharge thermostat opens, the compressor and blower (Y1, Y2 and G outputs) are de-energized. The blower returns to low speed and the furnace satisfies remaining thermostat demand.

CONDITION:
With Outdoor Thermostat

1 - When outdoor thermostat is warm, previous sequence applies.

2 - When outdoor thermostat switches to cold position, compressor (Y1 and Y2) outputs are immediately de-energized. Indoor blower stops operating and furnace output (W-output) is energized. When heat exchanger warms up, furnace energizes indoor blower on low speed.

FM21 EMERGENCY HEATING SEQUENCE - WITH DEFROST OPTION



Operating Sequence - Compressor Heating:

The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

CONDITION:

Emergency Heat Switch "ON" (E) - Heavy Black Line

1 - When the emergency heat switch is turned on, the compressor and indoor blower are immediately de-energized. The "E" terminal (input) is energized constantly (not swtiched by demand) as long as the Emergency Heat switch is turned on. With the defrost heat option, the E terminal input energizes a relay in the defrost board to drop the G fan signal to the furnace and the Y1 signal to the compressor if the unit is in a defrost cycle.

CONDITION:

Heating - Fan Switch "ON" or "AUTO"

With or Without Outdoor Thermostat

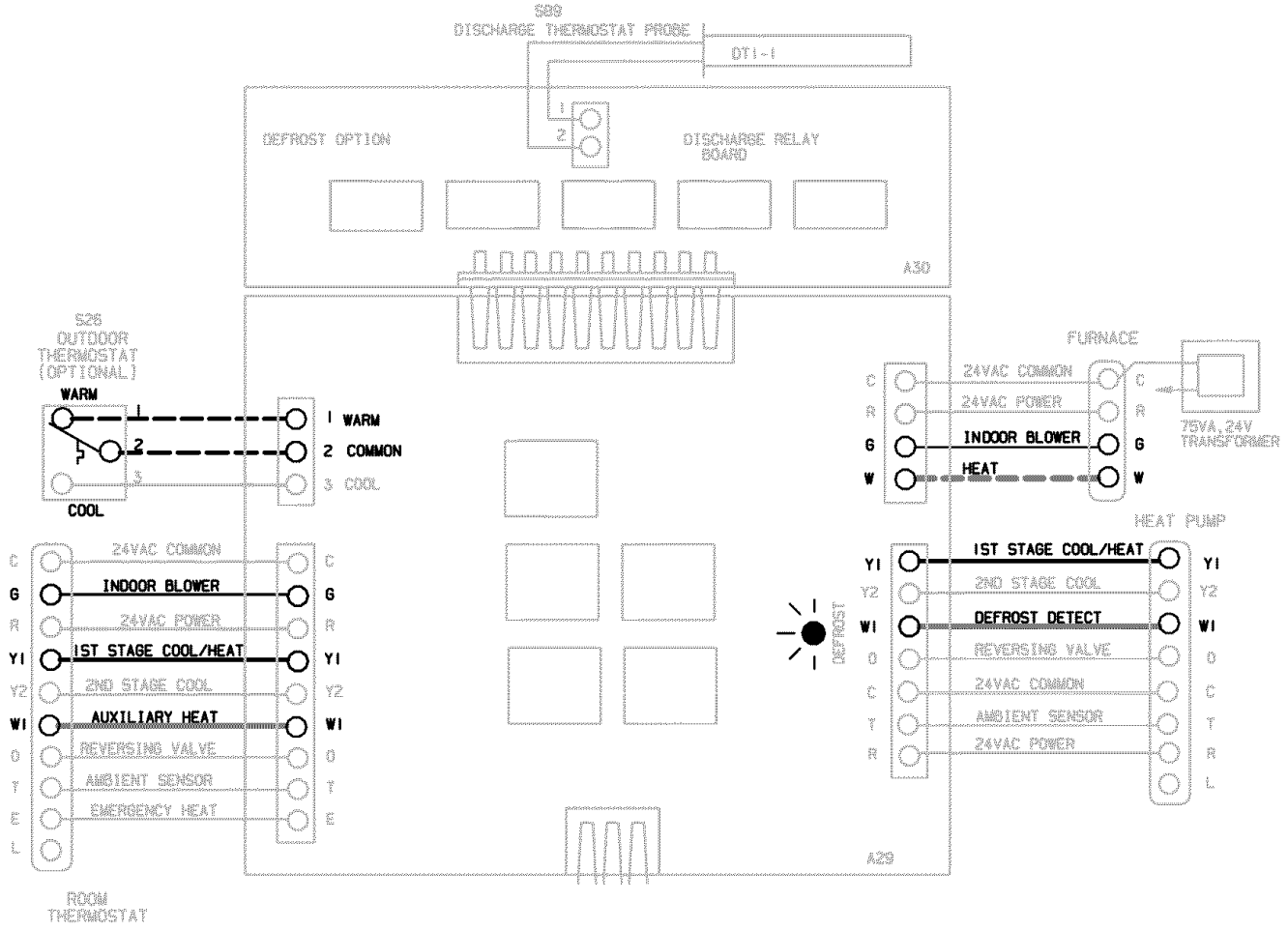
Heat Demand (W1) while E is energized - Heavy Gray Line

1 - On a call for heating (Y1 & G), indoor blower and compressor are locked-out while E is energized.

2 - Additional heating demand (W1 - input) energizes the furnace (W - output).

The indoor blower is energized on low speed by the furnace after the heat exchanger warms up.

FM21 DEFROST SEQUENCE - WITH DEFROST OPTION



Operating Sequence - Defrost:

The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

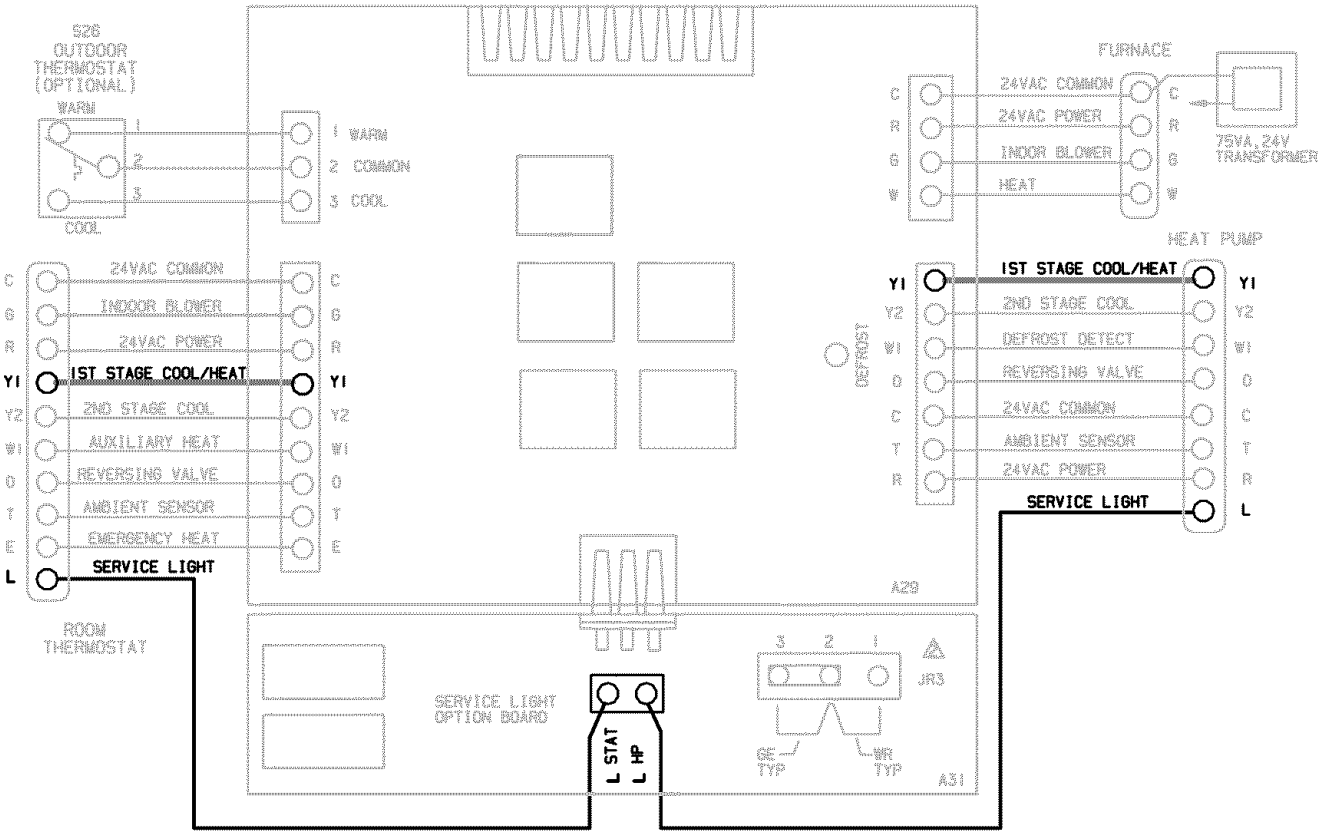
CONDITION:
Defrost Input (W1) From Outdoor Unit - Heavy Gray Line in conjunction with
Heating Demand (Y1 - input)

1 - When the FM21 senses a defrost cycle the defrost indicator LED is energized.
2 - The compressor continues operating and the furnace (W output is energized. The furnace operates during defrost.
NOTE- Lennox two-speed heat pumps automatically energize high speed when outdoor temperature drops below setpoint of speed control thermostat..
3 - During defrost, the furnace is cycled on and off by the discharge thermostat in order to control discharge air temperature.
4 - When defrost is complete, heating demand will be satisfied by either the furnace or heat pump based on whether the furnace is on or off at the time the defrost terminals.
If the furnace is ON when the defrost terminates (S89 closed), the furnace will satisfy the Y1 demand.
If the furnace is OFF when the defrost terminates (S89 open) both the heat pump and furnace will remain off until S89 cools and closes. When S89 closes, the heat pump will satisfy the Y1 demand.

CONDITION:
Defrost Input (W1) From Outdoor Unit - Heavy Gray Line in conjunction with
Auxiliary Heating Demand (Y1 and W1 - input)

1 - Not possible since outdoor unit is de-energized during auxiliary (W1 - input) heating.

FM21 SERVICE LIGHT SEQUENCE - WITH OR WITHOUT DEFROST OPTION



Operating Sequence - Service Light:
The diagram above shows the inputs and outputs of the FM21. The following operating sequence steps through the inputs (left side of diagram) and the resulting outputs (right side of diagram).

CONDITION:
Compressor Input (Y1) From Indoor Thermostat - Heavy Gray Line in conjunction with
Service Light (L - input from outdoor unit) and
Auxiliary Heat (W1 - Input from Indoor Thermostat)

1 - When the FM21 senses a closed defrost thermostat during a heating cycle, the SLC1 will begin a 5-1/2 minute (330 sec.) time delay.
2 - If auxiliary heat demand is received after the time delay, the SLC1 energizes the "L" terminal (output to indoor thermostat) and the service light is energized.

TABLE 1
FM21 OPERATION and TROUBLESHOOTING (FM21 Basic Unit)

Unit Mode	Input						Response					
	Room Thermostat						Heat Pump				Furnace	
	G	Y1	Y2	W1	O	E	Y1	Y2	W1*	O	W	G
Cooling	ON	ON	OFF	OFF	ON	OFF	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	ON	ON	OFF	ON	OFF	ON
Primary Heating	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON
	ON	ON	ON†	OFF	OFF	OFF	ON	ON**	OFF	OFF	OFF	ON
Auxiliary Heating	ON	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	ON†	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON***	OFF
Emergency Heating	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF
Defrost During Primary Heat	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	OFF	OFF	OFF	ON	ON**	ON	OFF‡	OFF	ON
Defrost During Auxiliary Heat	ON	ON	OFF	ON	OFF	OFF	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	ON	OFF	OFF	ON	ON**	ON	OFF‡	OFF	ON

*Actually an input used to detect defrost. "On" indicates defrost is being sensed.
**Even though FM21 provides Y2 output, high speed heating is controlled by heat pump in Lennox two speed units.
***Latched in state until Y1 goes off.
†Most heat pump thermostats do not provide Y2 (high speed compressor) output during heating.
‡FM21 output is off but voltage from outdoor unit may be measured in some Lennox units.

TABLE 2
FM21 OPERATION and TROUBLESHOOTING (FM21 with Outdoor Thermostat Option)

Unit Mode	Input								Response					
	Room Thermostat						Outdoor Thermostat		Heat Pump				Furnace	
	G	Y1	Y2	W1	O	E	Terminal 2-3 (Closed When Cold)	Terminal 1-2 (Closed When Warm)	Y1	Y2	W1*	O	W	G
Cooling	ON	ON	OFF	OFF	ON	OFF	CLOSED	OPEN	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	CLOSED	OPEN	ON	ON	OFF	ON	OFF	ON
	ON	ON	OFF	OFF	ON	OFF	OPEN	CLOSED	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	OPEN	CLOSED	ON	ON	OFF	ON	OFF	ON
Primary Heating	ON	ON	OFF	OFF	OFF	OFF	OPEN	CLOSED	ON	OFF	OFF	OFF	OFF	ON
	ON	ON	ON†	OFF	OFF	OFF	OPEN	CLOSED	ON	ON**	OFF	OFF	OFF	ON
	ON	ON	OFF	OFF	OFF	OFF	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON	OFF
	ON	ON	ON†	OFF	OFF	OFF	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON	OFF
Auxiliary Heating	ON	ON	OFF	ON	OFF	OFF	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	ON†	ON	OFF	OFF	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	OFF	ON	OFF	OFF	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	ON†	ON	OFF	OFF	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
Emergency Heating	OFF	OFF	OFF	ON	OFF	ON	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON	OFF
	OFF	OFF	OFF	ON	OFF	ON	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON	OFF
Defrost During Primary Heat	ON	ON	OFF	OFF	OFF	OFF	OPEN††	CLOSED	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	OFF	OFF	OFF	OPEN††	CLOSED	ON	ON**	ON	OFF‡	OFF	ON
Defrost During Auxiliary Heat	ON	ON	OFF	ON	OFF	OFF	OPEN††	CLOSED	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	ON	OFF	OFF	OPEN††	CLOSED	ON	ON**	ON	OFF‡	OFF	ON

*Actually an input used to detect defrost. "On" indicates defrost is being sensed.
**Even though FM21 provides Y2 output, high speed heating is controlled By heat pump in Lennox two speed units.
***Latched in state until Y1 goes off.
†Most heat pump thermostats do not provide Y2 (high speed compressor) output during heating.
‡FM21 output is off but voltage from outdoor unit may be measured in some Lennox units.
††Heat pump cannot go into defrost when outdoor temp. is cold since heat pump unit is de-energized. However, if outdoor thermostat switches to cold position during a defrost cycle, compressor is de-energized and the furnace completes the heating cycle.

TABLE 3
FM21 OPERATION and TROUBLESHOOTING (FM21 with Defrost Option)

Unit Mode	Input							Response					
	Room Thermostat						Discharge Thermostat	Heat Pump				Furnace	
	G	Y1	Y2	W1	O	E	Terminal 1-2 (Closed When Cold)	Y1	Y2	W1*	O	W	G
Cooling	ON	ON	OFF	OFF	ON	OFF	CLOSED	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	CLOSED	ON	ON	OFF	ON	OFF	ON
	ON	ON	OFF	OFF	ON	OFF	OPEN	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	OPEN	ON	ON	OFF	ON	OFF	ON
Primary Heating	ON	ON	OFF	OFF	OFF	OFF	CLOSED	ON	OFF	OFF	OFF	OFF	ON
	ON	ON	ON†	OFF	OFF	OFF	CLOSED	ON	ON**	OFF	OFF	OFF	ON
	ON	ON	OFF	OFF	OFF	OFF	OPEN	OFF	OFF	OFF	OFF	OFF	ON
	ON	ON	ON†	OFF	OFF	OFF	OPEN	OFF	OFF	OFF	OFF	OFF	ON
Auxiliary Heating	ON	ON	OFF	ON	OFF	OFF	CLOSED	ON	OFF	OFF	OFF	ON***	ON
	ON	ON	ON†	ON	OFF	OFF	CLOSED	ON	ON**	OFF	OFF	ON***	ON
	ON	ON	OFF	ON	OFF	OFF	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	ON†	ON	OFF	OFF	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
Emergency Heating	OFF	OFF	OFF	ON	OFF	ON	CLOSED	OFF	OFF	OFF	OFF	ON	OFF
	OFF	OFF	OFF	ON	OFF	ON	OPEN	OFF	OFF	OFF	OFF	ON	OFF
Defrost During Primary Heat	ON	ON	OFF	OFF	OFF‡	OFF	CLOSED	ON	OFF	ON	OFF‡	ON	ON
	ON	ON	ON†	OFF	OFF‡	OFF	CLOSED	ON	ON**	ON	OFF‡	ON	ON
	ON	ON	OFF	OFF	OFF‡	OFF	OPEN	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	OFF	OFF‡	OFF	OPEN	ON	ON**	ON	OFF‡	OFF	ON
Defrost During Auxiliary Heat☆	ON	ON	OFF	ON	OFF‡	OFF	CLOSED	ON	OFF	ON	OFF‡	ON	ON
	ON	ON	ON†	ON	OFF‡	OFF	CLOSED	ON	ON**	ON	OFF‡	ON	ON
	ON	ON	OFF	ON	OFF‡	OFF	OPEN	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	ON	OFF‡	OFF	OPEN	ON	ON**	ON	OFF‡	OFF	ON

*Actually an input used to detect defrost. "On" indicates defrost is being sensed.
**Even though FM21 provides Y2 output, high speed heating is controlled By heat pump in Lennox two-speed units.
***Latched in state until Y1 goes off.
†Most heat pump thermostats do not provide Y2 (high speed compressor) output during heating.
‡FM21 output is off but voltage from outdoor unit may be measured in some Lennox units.
☆When defrost is complete, heating demand will be satisfied by either the furnace or heat pump based on whether the furnace is on or off at the time the defrost terminals.
If the furnace is ON when the defrost terminates (S89 closed), the furnace will satisfy the Y1 demand.
If the furnace is OFF when the defrost terminates (S89 open) both the heat pump and furnace will remain off until S89 cools and closes. When S89 closes, the heat pump will satisfy the Y1 demand.

TABLE 4
FM21 OPERATION and TROUBLESHOOTING (FM21 with Defrost Option and 51M28 or 49M57 Thermostat)

Unit Mode	Input							Response					
	Room Thermostat						Discharge Thermostat	Heat Pump				Furnace	
	G	Y1	Y2	W1	O	E NA	Terminal 1-2 (Closed When Cold)	Y1	Y2	W1*	O	W	G
Cooling	ON	ON	OFF	OFF	ON	OFF	CLOSED	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	CLOSED	ON	ON	OFF	ON	OFF	ON
	ON	ON	OFF	OFF	ON	OFF	OPEN	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	OPEN	ON	ON	OFF	ON	OFF	ON
Primary Heating	ON	ON	OFF	OFF	OFF	OFF	CLOSED	ON	OFF	OFF	OFF	OFF	ON
	ON	ON	OFF	OFF	OFF	OFF	OPEN	OFF	OFF	OFF	OFF	OFF	ON
Auxiliary Heating	ON	ON◇	OFF	ON◇	OFF	OFF	CLOSED	ON	OFF	OFF	OFF	ON***	ON
	ON	ON◇	OFF	ON◇	OFF	OFF	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
Emergency Heating	Emergency heat is function of the thermostat.												
Defrost During Primary Heat	ON	ON	OFF	OFF	OFF‡	OFF	CLOSED	ON	OFF	ON	OFF‡	ON	ON
	ON	ON	ON†	OFF	OFF‡	OFF	CLOSED	ON	ON**	ON	OFF‡	ON	ON
	ON	ON	OFF	OFF	OFF‡	OFF	OPEN	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	OFF	OFF‡	OFF	OPEN	ON	ON**	ON	OFF‡	OFF	ON
Defrost During Auxiliary Heat☆	ON	ON	OFF	ON	OFF‡	OFF	CLOSED	ON	OFF	ON	OFF‡	ON	ON
	ON	ON	ON†	ON	OFF‡	OFF	CLOSED	ON	ON**	ON	OFF‡	ON	ON
	ON	ON	OFF	ON	OFF‡	OFF	OPEN	ON	OFF	ON	OFF‡	OFF	ON
	ON	ON	ON†	ON	OFF‡	OFF	OPEN	ON	ON**	ON	OFF‡	OFF	ON

*Actually an input used to detect defrost. "On" indicates defrost is being sensed.
**Even though FM21 provides Y2 output, high speed heating is controlled By heat pump in Lennox two-speed units.
***Latched in state until Y1 goes off.
†Most heat pump thermostats do not provide Y2 (high speed compressor) output during heating.
‡FM21 output is off but voltage from outdoor unit may be measured in some Lennox units.
◇Simultaneous Y and W demand will not occur if thermostat is set to add-on dual fuel.
☆When defrost is complete, heating demand will be satisfied by either the furnace or heat pump based on whether the furnace is on or off at the time the defrost terminals.
If the furnace is ON when the defrost terminates (S89 closed), the furnace will satisfy the Y1 demand.
If the furnace is OFF when the defrost terminates (S89 open) both the heat pump and furnace will remain off until S89 cools and closes. When S89 closes, the heat pump will satisfy the Y1 demand.

TABLE 5
FM21 OPERATION and TROUBLESHOOTING (FM21 with Outdoor Thermostat and Defrost Options)

Unit Mode	Input									Response					
	Room Thermostat						Outdoor Thermostat		Discharge Thermostat	Heat Pump				Furnace	
	G	Y1	Y2	W1	O	E	Terminal 2-3 (Closed When Cold)	Terminal 1-2 (Closed When Warm)	Terminal 1-2 (Closed When Cold)	Y1	Y2	W1*	O	W	G
Cooling	ON	ON	OFF	OFF	ON	OFF	CLOSED	OPEN	CLOSED	OFF	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	CLOSED	OPEN	CLOSED	OFF	OFF	OFF	ON	OFF	ON
	ON	ON	OFF	OFF	ON	OFF	OPEN	CLOSED	CLOSED	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	OPEN	CLOSED	CLOSED	ON	ON	OFF	ON	OFF	ON
	ON	ON	OFF	OFF	ON	OFF	OPEN	CLOSED	OPEN	ON	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	OPEN	CLOSED	OPEN	ON	ON	OFF	ON	OFF	ON
	ON	ON	OFF	OFF	ON	OFF	CLOSED	OPEN	OPEN	OFF	OFF	OFF	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	CLOSED	OPEN	OPEN	OFF	OFF	OFF	ON	OFF	ON
Primary Heating	ON	ON	OFF	OFF	OFF	OFF	CLOSED	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON	OFF
	ON	ON	ON	OFF	OFF	OFF	CLOSED	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON	OFF
	ON	ON	OFF	OFF	OFF	OFF	OPEN	CLOSED	CLOSED	ON	OFF	OFF	OFF	OFF	ON
	ON	ON	ON	OFF	OFF	OFF	OPEN	CLOSED	CLOSED	ON	ON**	OFF	OFF	OFF	ON
	ON	ON	OFF	OFF	OFF	OFF	OPEN	CLOSED	OPEN	OFF	OFF	OFF	OFF	OFF	ON
	ON	ON	ON	OFF	OFF	OFF	OPEN	CLOSED	OPEN	OFF	OFF	OFF	OFF	OFF	ON
	ON	ON	OFF	OFF	OFF	OFF	CLOSED	OPEN	OPEN	OFF	OFF	OFF	OFF	ON	OFF
	ON	ON	ON	OFF	OFF	OFF	CLOSED	OPEN	OPEN	OFF	OFF	OFF	OFF	ON	OFF
Auxiliary Heating	ON	ON	OFF	ON	OFF	OFF	CLOSED	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	ON	ON	OFF	OFF	CLOSED	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	OFF	ON	OFF	OFF	OPEN	CLOSED	CLOSED	ON	OFF	OFF	OFF	ON***	ON
	ON	ON	ON	ON	OFF	OFF	OPEN	CLOSED	CLOSED	ON	ON**	OFF	OFF	ON***	ON
	ON	ON	OFF	ON	OFF	OFF	OPEN	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	ON	ON	OFF	OFF	OPEN	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	OFF	ON	OFF	OFF	CLOSED	OPEN	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
	ON	ON	ON	ON	OFF	OFF	CLOSED	OPEN	OPEN	OFF	OFF	OFF	OFF	ON***	OFF
Emergency Heating	OFF	OFF	OFF	ON	OFF	ON	CLOSED	OPEN	CLOSED	OFF	OFF	OFF	OFF	ON	OFF
	OFF	OFF	OFF	ON	OFF	ON	OPEN	CLOSED	CLOSED	OFF	OFF	OFF	OFF	ON	OFF
	OFF	OFF	OFF	ON	OFF	ON	OPEN	CLOSED	OPEN	OFF	OFF	OFF	OFF	ON	OFF
	OFF	OFF	OFF	ON	OFF	ON	CLOSED	OPEN	OPEN	OFF	OFF	OFF	OFF	ON	OFF
Defrost During Primary Heat	ON	ON	OFF	OFF	ON	OFF	OPEN††	CLOSED	CLOSED	ON	OFF	ON	ON	ON	ON
	ON	ON	ON	OFF	ON	OFF	OPEN††	CLOSED	CLOSED	ON	ON**	ON	ON	ON	ON
	ON	ON	OFF	OFF	ON	OFF	OPEN††	CLOSED	OPEN	ON	OFF	ON	ON	OFF	ON
	ON	ON	ON	OFF	ON	OFF	OPEN††	CLOSED	OPEN	ON	ON**	ON	ON	OFF	ON
Defrost During Auxiliary Heat☆	ON	ON	OFF	ON	ON	OFF	OPEN††	CLOSED	CLOSED	ON	OFF	ON	ON	ON	ON
	ON	ON	ON	ON	ON	OFF	OPEN††	CLOSED	CLOSED	ON	ON**	ON	ON	ON	ON
	ON	ON	OFF	ON	ON	OFF	OPEN††	CLOSED	OPEN	ON	OFF	ON	ON	OFF	ON
	ON	ON	ON	ON	ON	OFF	OPEN††	CLOSED	OPEN	ON	ON**	ON	ON	OFF	ON

*Actually an input used to detect defrost. "On" indicates defrost is being sensed.
**Even though FM21 provides Y2 output, high speed heating is controlled By heat pump in Lennox two speed units.
***Latched in state until Y1 goes off.
†Most heat pump thermostats do not provide Y2 (high speed compressor) output during heating.
‡FM21 output is off but voltage from outdoor unit may be measured in some Lennox units.
††Heat pump cannot go into defrost when outdoor temp. is cold since heat pump unit is de-energized. However, if outdoor thermostat switches to cold position during a defrost cycle, compressor is de-energized.
☆When defrost is complete, heating demand will be satisfied by either the furnace or heat pump based on whether the furnace is on or off at the time the defrost terminals.
If the furnace is ON when the defrost terminates (S89 closed), the furnace will satisfy the Y1 demand.
If the furnace is OFF when the defrost terminates (S89 open) both the heat pump and furnace will remain off until S89 cools and closes. When S89 closes, the heat pump will satisfy the Y1 demand.