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DATE: January 22, 2015 ST-001-15

TO: All York Branch Service Managers
All York Distribution Service Managers
All Regional Managers

SUBJECT: Residential Package Unit - Defrost Control Operation and Diagnosis

Units: BHQ, BHX, BHZ, BHP, UQ, JP

The purpose of this letter is to provide an explanation of the sequence of operation of the demand defrost, time/temp defrost board and the YorkGuard VI defrost control board as applied in residential package units.

In the heating mode, the heat pump outdoor section operates in "reverse air conditioning mode", and the outdoor coil acts as the evaporator coil and the indoor coil acts as the condenser coil. In the heating mode, depending on the outdoor ambient temperature and relative humidity, there may be ice or frost built up on the outdoor coil. The defrost operating mode is designed to periodically remove the frost and ice from the outdoor coil. The defrost thermostats, sensors, and minimum accumulated run timer determines when defrost is needed. The defrost cycle duration must be long enough to thaw the frost/ice from the coil and short enough to maintain efficiency.

Defrost boards used on residential packaged product may include the YorkGuard VI (dual fuel only), demand defrost, or time/temp models. The function of the YorkGuard VI is similar to the demand defrost board, with additional features including fossil fuel option, low temperature cut out, balance point settings, hot heat pump mode, compressor delay, second stage (Y2 lock), diagnostic LEDs, and fault code history recall. Both control boards use thermistors for the ambient temperature and coil temperature readings. Thermistors and are not to be confused with a defrost thermostat which is a normally open switch. **If the defrost thermostat is used with the demand defrost board, it will create nuisance faults.** All defrost board selections include a 6 hour 4 minute accumulated compressor run time timer, which forces the unit into defrost to circulate refrigerant oil, and a forced defrost TEST terminal that bypasses all sensors and thermostat conditions and forces the defrost cycle. When the defrost test pin jumper is removed, the defrost cycle terminates defrost normally.

The following actions are completed by the demand defrost control board when defrost is initiated:

- De-energizes the outdoor fan
- Energizes the reversing valve
- Energizes W/out (W1/66) output to indoor unit 1st stage heat circuit to temper the circulating airflow, as the unit is operating in the cooling mode while in defrost
- Begins the timer for maximum defrost duration

The following actions are completed by the YorkGuard VI when defrost is initiated:

- De-energizes the outdoor fan
- Energizes the crankcase heater
- Energizes the reversing valve
- Energizes the auxiliary heat outputs to temper the circulating airflow
- Energizes second stage (Y2OUT)
- Begins the timer for maximum defrost duration
- De-energizes the compressor for 30 seconds based on compressor delay selection on the board

The following actions are completed by the time/temperature board when defrost is initiated:

- De-energizes the outdoor fan
- Energizes the reversing valve
- Energizes W/out (W1/66) output to indoor unit's 1st stage heat circuit to temper the circulating airflow
- Begins the timer for maximum defrost duration

The time/temp board looks similar to the demand defrost board, with the distinction of the 30, 60, or 90 minute run time jumper and the defrost thermostat (DFST T-stat) connection. The time/temp defrost cycle is initiated by time selected on the on-board shunt jumper (30, 60, or 90 min) and an open/closed defrost temperature switch. **Do not confuse the defrost thermostat with the thermistor sensor used on the YorkGuard VI and the demand defrost boards**. The time selection is established by the technician during system startup, and selected based on temperature, humidity, and regional conditions. The selectable times represent the length of time the heat pump will run before the board decides to look at the defrost thermostat to determine if defrost is necessary. The defrost switch is a normally "open" switch that closes at 31°F +/- 4°F and opens at 55°F +/- 5°F. The switch will appear "open" when ohmed out, **leading to nuisance faults if installed on the other control boards**. When the time selected (30, 60, or 90 sec.) has been reached, the board will read the DFST T-stat and if it reads it as "open" it will not go into defrost. If the run time selected is met and the switch is "closed" the board will then go into defrost. This control board terminates defrost when the defrost thermostat opens or 10 minutes elapse.

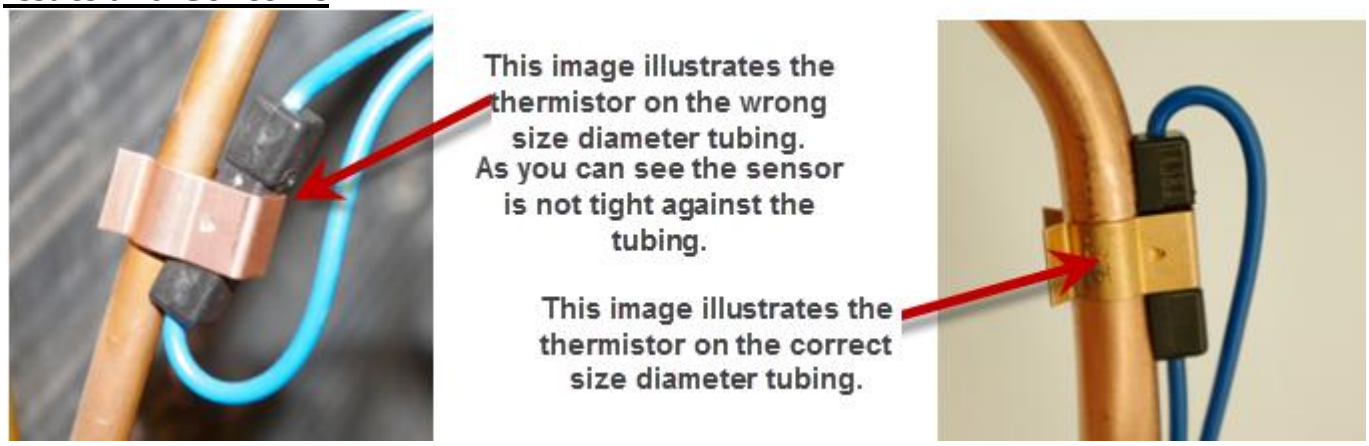
The YorkGuard VI and the demand defrost boards operate differently. These controls enter defrost if the coil sensor (also referred to as the liquid line coil sensor or defrost sensor/thermistor) reads below the initiate point for the measured ambient temperature continually for 4-1/2 minutes. If the control loses the call for heat while in defrost, the defrost cycle will pause. When the call for heating is reapplied, the defrost cycle reinitiates and terminate normally. Defrost also terminates if the unit is in defrost mode and the liquid line coil sensor goes above the "termination curve", or the maximum defrost time. The board will reset the defrost cycle timer at the end of every normal defrost termination.

A number of issues can affect proper defrost operation, including defrost sensors (defrost thermostat or thermistor) positioned in the wrong location. The placement of the defrost coil sensor should be located at lowest distributor tube coming out of the coil. The sensor is mounted on a 3/8" tube, which is just long enough for the proper mounting. The tube then reduces to the normal 1/8" distributor tube size. The sensor should be a tight fit on the 3/8" line. If not, then either the wrong sensor is on the unit, or the sensor is mounted in the wrong location. If the unit was built without the 3/8" stub tube, the sensor will not function properly and result in defrost issues. The sensor should be well insulated regardless if it is factory or field installed.

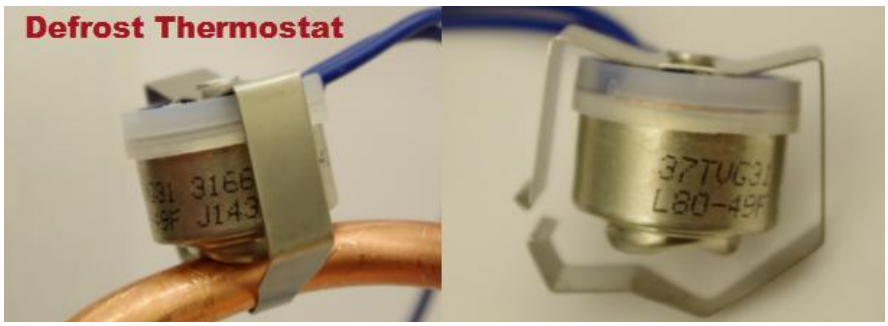
Field issues should be addressed upon discovery. The indoor circulating airflow is critical on all equipment, and especially during the defrost process. A static pressure reading indicates if the airflow across the indoor coil is adequate for proper operation. Refer to the Technical Guide to determine the proper airflow. The majority of York systems are designed to operate between 350 to 450 cfm per ton. Another issue often misunderstood is the formation of frost on the grille of the outdoor coil. This frost may look like "ice", but it is simply frost on the grille that will not affect the function or efficiency of the heat pump. Remember that defrost is initiated based on unit operating characteristics and not on appearance. This will be explained later in this bulletin.

A properly charged system will ensure the proper operation of the refrigeration circuit and rated efficiencies and also allow for a proper defrost cycle. The technician must ensure the unit has a clean indoor and outdoor coil and that the unit is not overcharged or undercharged. The system must be charged according to the rating plate. Both overcharged and undercharged systems may result in an incomplete defrost cycle. A system low on charge will result in premature frost and will not result in a completely defrosted coil at the end of the defrost cycle. An overcharged system may trip on high head pressure during defrost and may cause a pressure switch lockout prior to defrost termination.

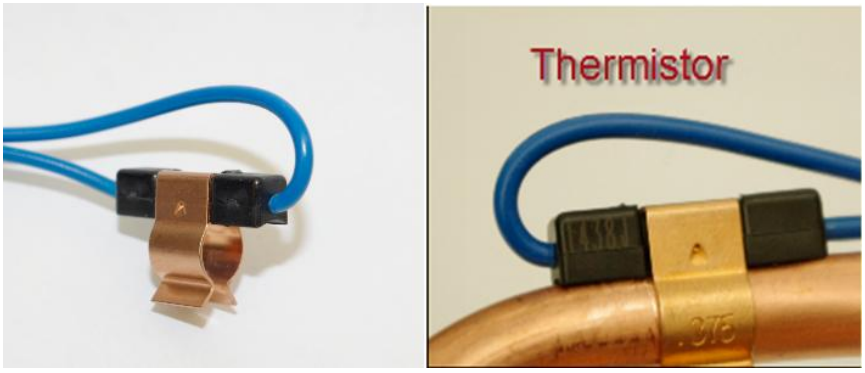
Issues and Concerns



When replacing any part, it is best to order the part using the serial number of the unit. The most common sensor used is a 10k ohm negative coefficient thermistor type sensor, used on both the demand defrost board and the YorkGuard VI. The open/closed switch is used on the time/temp board. There is a physical difference between the two types of switches. The open/closed switch is round and silver in color, and the thermistor is narrow and black in color. The thermistor can be tested using a resistance vs. temperature chart that is found on UPGNet or through your local distributor.

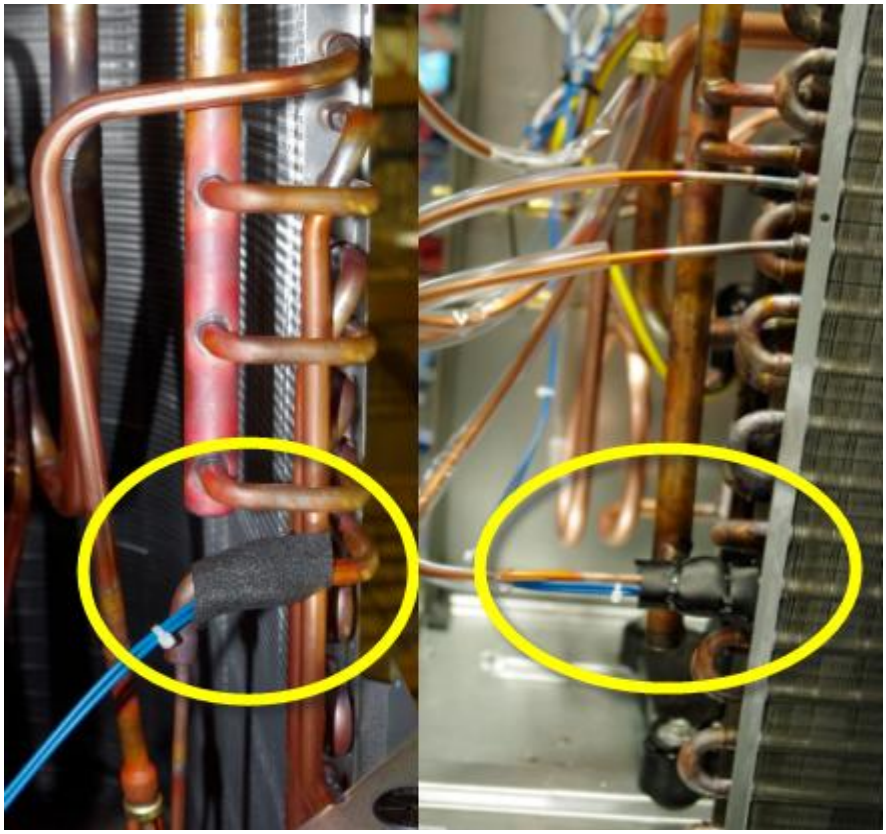


The Defrost Thermostat is Used with the Time/Temperature defrost board.



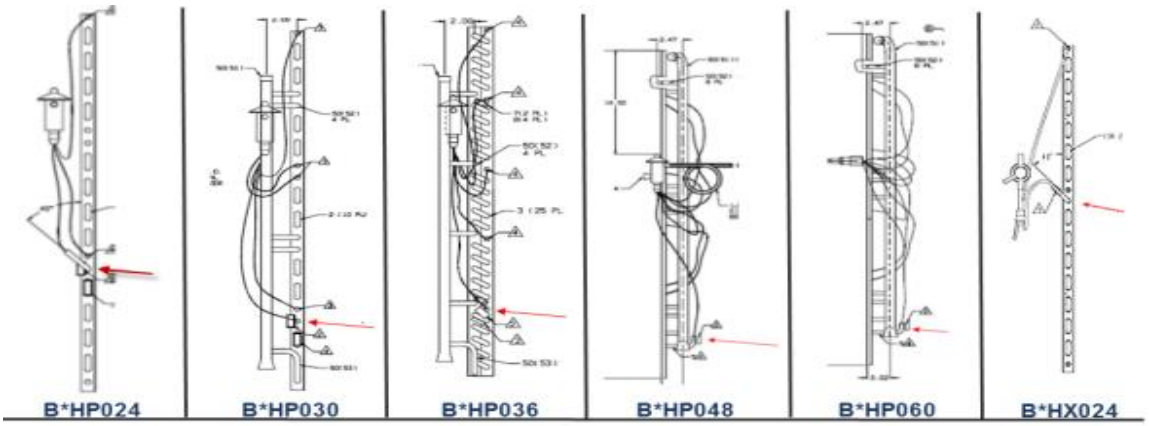
The Thermistor is Used on the YorkGuard VI and Demand Defrost boards.

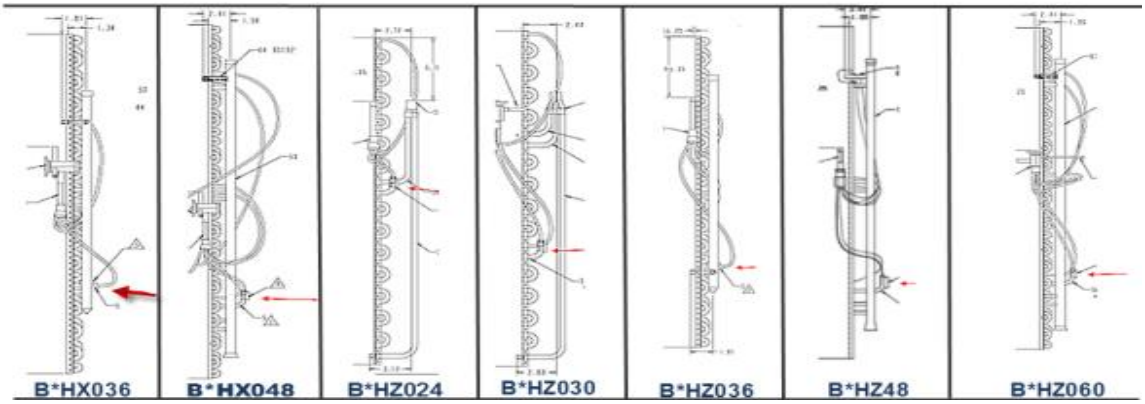
Note: The defrost thermostat and thermistor are not interchangeable. You must use the correct type of sensor for the defrost control board application.



The images above illustrate the sensor at the bottom distributor line with a 3/8” stub for sensor mounting.

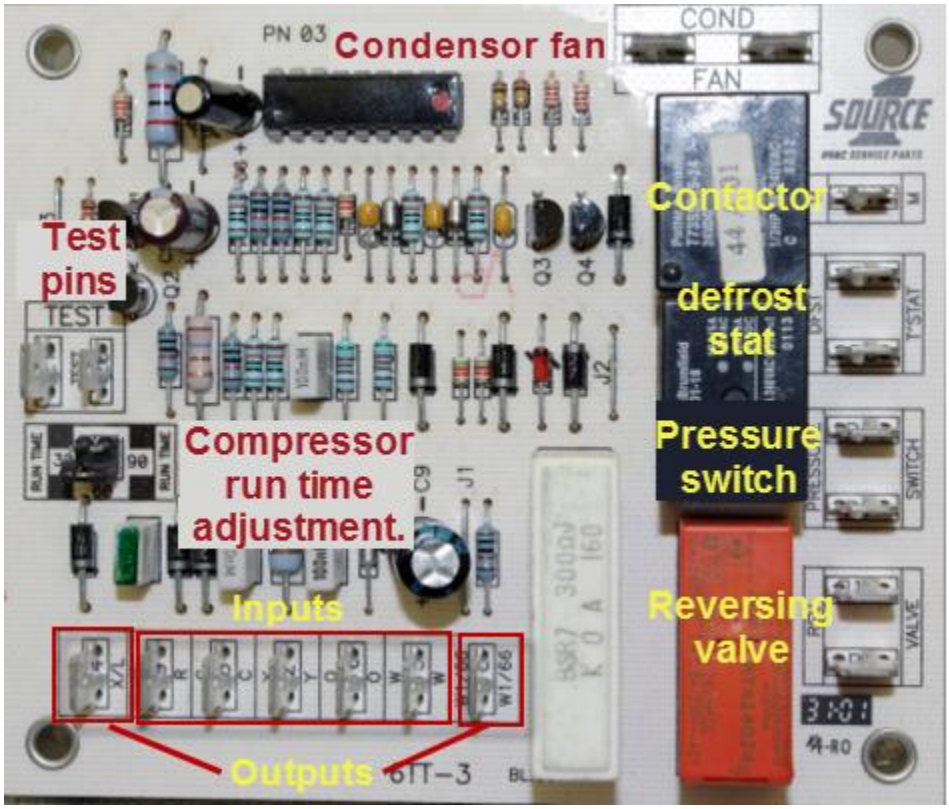
The following drawings show the locations of the coil sensors for our packaged products.



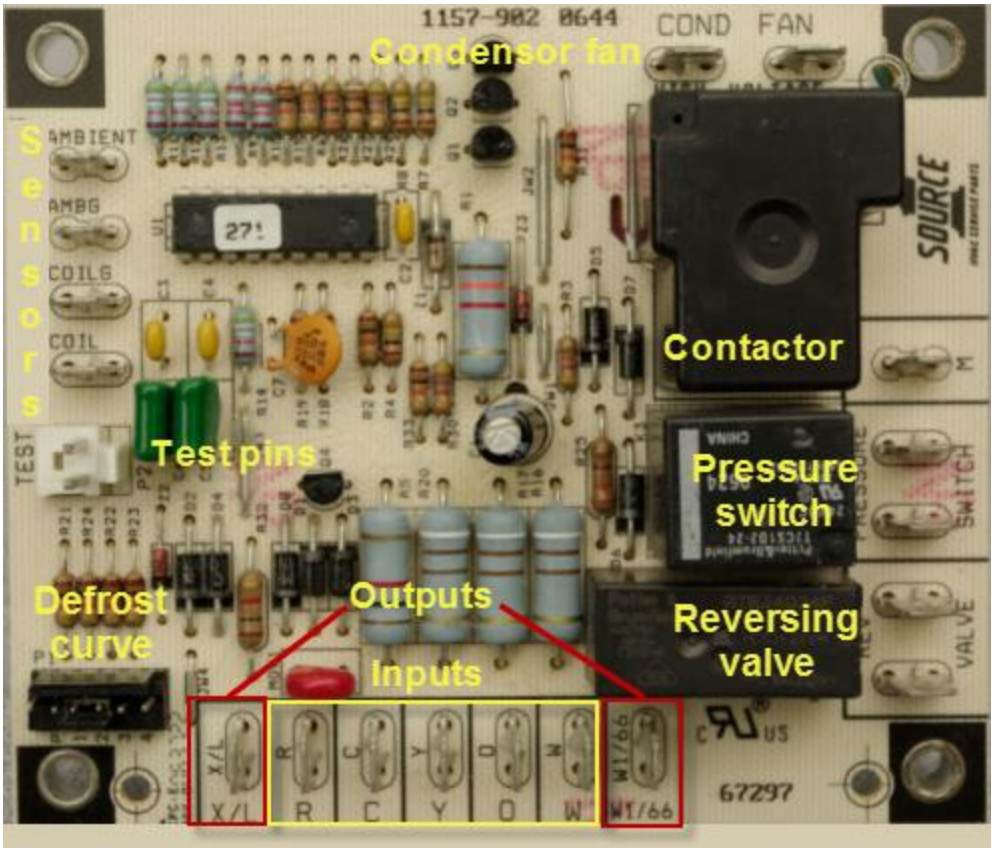


Defrost Control Board Exemplar Photos

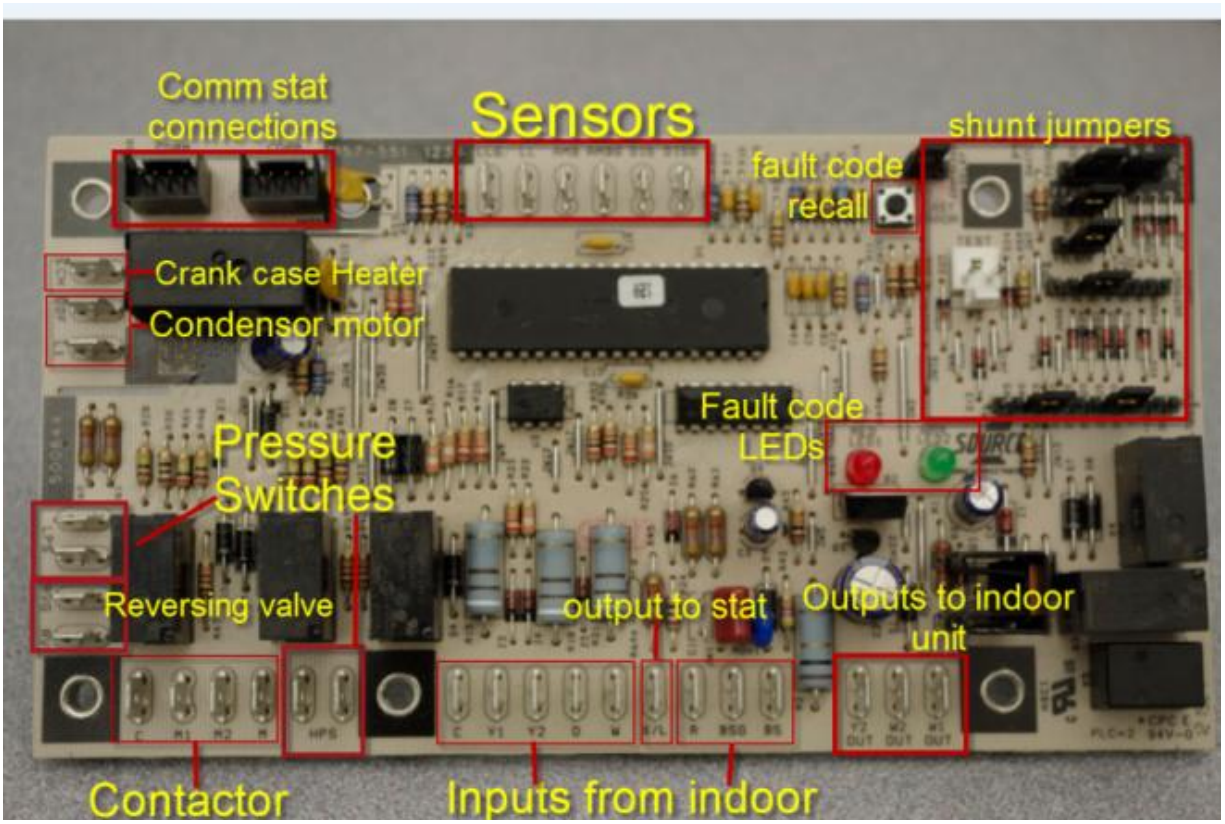
Time/Temp Defrost Control Board



Demand Defrost Control Board



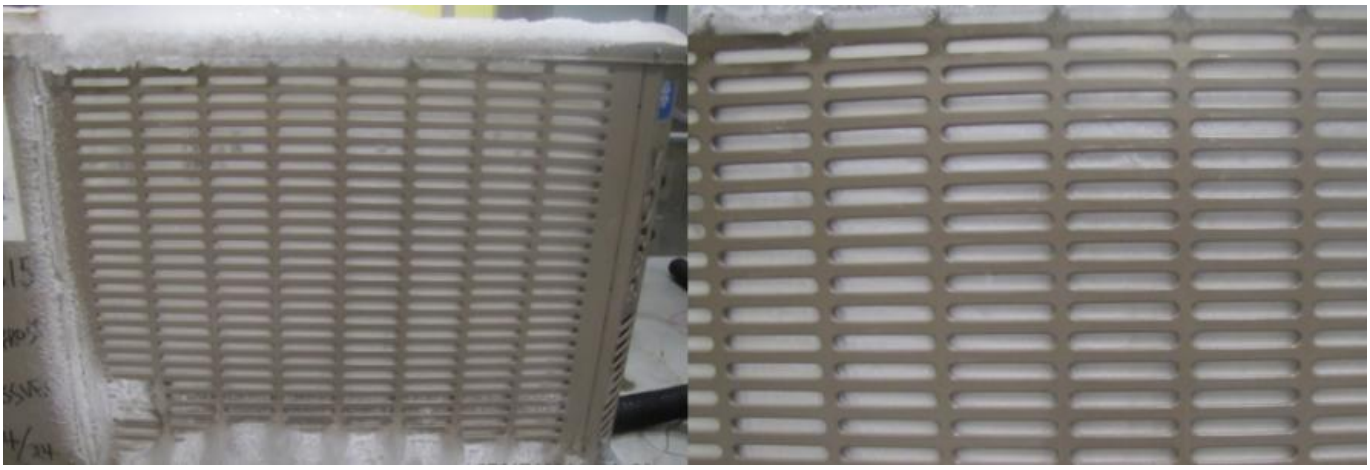
YorkGuard VI Control Board



The following images are of packaged product in various states of operation. Remember the defrost mode is initiated by the defrost control based on unit operating conditions and control board operating parameters. The appearance of frost or ice on the coil or coil guard (as shown below) are not indicative of a unit needing a defrost cycle. The pictures shown below are of units operating in our Highly Accelerated Lifecycle Testing (HALT) chamber.

The images above are of frost that has built on the grille of the unit. While it appears that the unit needs a defrost cycle, the performance of the unit was minimally effected. Although the grille is frosted, the coil itself is 100% clear.

The images above are of the beginning of the heat pump coil frosting. You can see behind the grill, the circuits are slowly building up frost. During extreme weather conditions, ice and frost can build on the coil and grille surface without affecting the unit's performance and efficiency.



The images above are of coils frosted due to normal running conditions. Once the conditions meet the design parameters of the defrost control board, the defrost cycle will begin.

Feel free to contact UPG Technical Services at 877-874-7378 if you have any questions.

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