

TRAINING BULLETIN

No. 01-03

RANCO DDL DEFROST CONTROL

Purpose

One of the most important and misunderstood components of a heat pump is the defrost control. The defrost control is responsible for both reliable operation of the system in the heating mode and the comfort of the equipment owner.

There have been several generations of the RANCO DDL defrost control used in residential heat pumps. There have been a few changes with each generation. This bulletin outlines the history, and operation of each version. It includes a troubleshooting flowchart at the end.

This training bulletin is for the benefit of servicing contractors in order to help them understand the differences between each RANCO demand defrost control generation. Understanding the various controls and their differences is necessary to accurately service and troubleshoot them.

Defrost Problem Issues

Before replacing any defrost control, be sure the problem is with the control and is not caused by any other factor. There are several causes of defrost cycle problems that are not the fault of the defrost control. The following is a brief list of those problems:

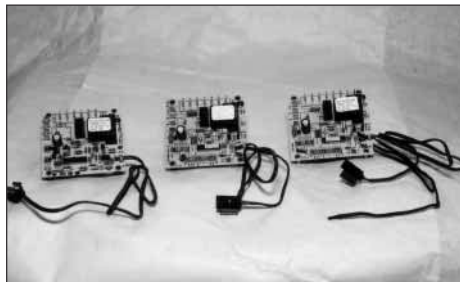
- Low Coil Airflow either Indoor or Outdoor
- Low Charge
- Poorly Attached Defrost Sensor
- 24 volts not present between "R" and "C"

DDL Control

Residential production R-22 heat pumps have had three variations of this RANCO control. The original RANCO DDL defrost control first appeared on units in January 1998.

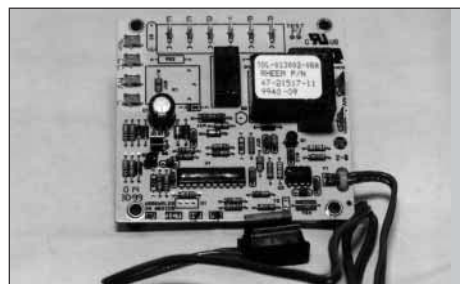
The factory part numbers for these controls are: 47-21517-11, 47-21517-14, and 47-21517-16. The 47-21517-13 is only used on the (-)PML heat pump with R-410A refrigerant and is not addressed in this bulletin.

NOTE: There is another RANCO DDL control with factory part number 47-21517-18. It is used as the universal replacement defrost control provided by *PROSTOCK* in the kit numbered 47-21517-88.



THREE RANCO DDL CONTROLS

The following is the description of the first control. Descriptions of later controls will follow this original control. Those descriptions will only cover the differences in those later controls.



47-21517-11 CONTROL

RANCO Part #: DDL-013002-0RH
Factory Part #: 47-21517-11
Power Input: 24 VAC and 240 VAC

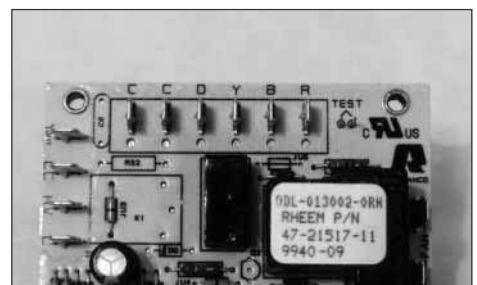
This defrost control was used on the following units:

- (-)PPA, Date Codes 0198 - 1600
- (-)PNJ, Date Codes 0198 - 1600

- (-)PMC, Date Codes 2098 - 1600
- (-)PLA, Date Codes 3998 - 1600
- (-)PKA, Date Codes 3998 - 1600

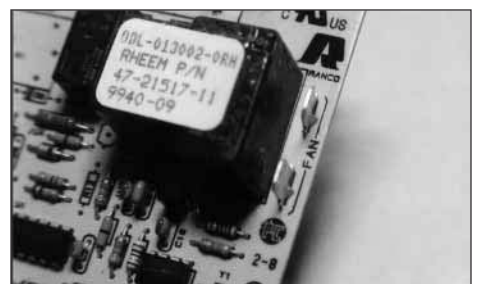
Power Connections

1. 24 VAC is applied between the "R" and "C" terminals.
2. 24 VAC applied to the "Y" terminal calculates compressor run time.
3. 24 VAC thermostat input to the "B" terminal powers the reversing valve (on the onboard defrost relay).



LOW VOLTAGE CONNECTIONS

4. 240 VAC is conducted through the "FAN" terminals on the onboard defrost relay.

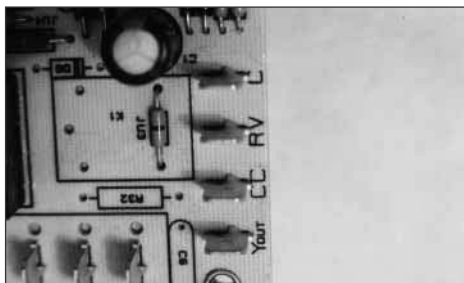


FAN TERMINALS

Power Output: 24 VAC/240 VAC

1. 24 VAC applied to the compressor contactor from terminal "Yout".
2. 24 VAC applied to the reversing valve from terminal "RV".
3. 24 VAC applied to auxiliary heat from terminal "D".

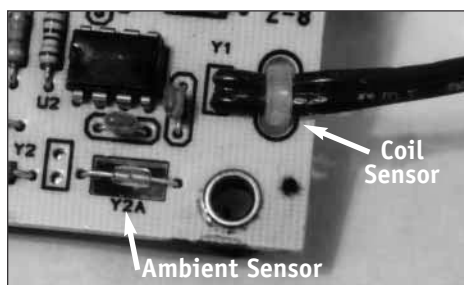
- 240 VAC applied to the outdoor fan through terminals marked "FAN".



OUTPUT TERMINALS

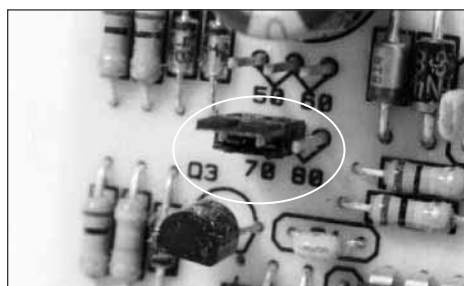
Temperature Measurements

- There are two temperature sensors:
 - The air sensor is mounted on the board (Y2A).
 - The coil sensor (Y1) is mounted to a top copper tube of the outdoor coil.



SENSOR LOCATIONS

- The coil sensor wire length: 24"
- Defrost is initiated by a temperature difference between the air and coil sensors (if the coil is below 35°F, and the 34-minute lock out time has been exceeded).
 - Defrost is terminated by either the coil sensor temperature or time (14 minutes).
 - Defrost termination temperature is field adjustable (50°F, 60°F, 70°F, and 80°F). It is factory set for 70°F.



TERMINATION SETTINGS

System Parameters

- The coil temperature must be below 35°F for defrost to occur.
- Defrost is determined by a temperature difference between the coil and air sensors.
- Defrost is terminated by either temperature **OR** time.
 - Termination by the field selected coil temperature (70°F factory setting).
 - Termination by time if defrost lasts for 14 minutes.
- Defrost lock out period:
 - 34 minutes of run time must elapse before allowing another defrost.
 - Defrost is not allowed during the first two minutes of compressor operation to allow pressures and temperatures to stabilize.

Defrost Function

The control monitors outdoor ambient temperature, outdoor coil temperature, and compressor run-time to determine when to defrost and when to terminate defrost.

- After 34 minutes of compressor run-time in the heat mode following initial power up (or loss of power),** a sacrificial defrost occurs in order to calibrate the control. It checks the time needed to warm up the outdoor coil to termination temperature with what should be a clean, frost-free coil.
- Defrost cannot occur unless the coil sensor is below 35°F.
- The control continually monitors both coil temperature and outdoor air temperature. When the correct temperature difference occurs, it initiates defrost. Correct temperature difference is not fixed as with previous demand controls. The initiate temperature difference changes as the outdoor ambient becomes colder.
- Upon initiation, the control stops the outdoor fan, de-energizes the reversing valve, and sends power

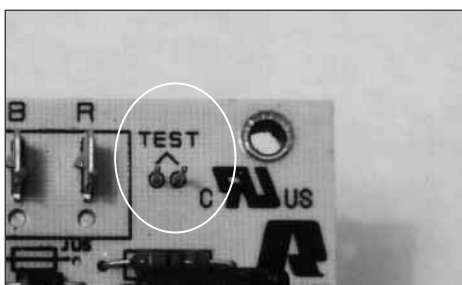
to the air handler to cycle on auxiliary heat.

- During defrost, the control monitors coil temperature and time in defrost.
- Defrost terminates when the coil sensor reaches termination temperature (factory set for 70°F). The control then powers the outdoor fan, powers the reversing valve, and cycles off auxiliary heat.
- OR**, defrost also terminates after 14 minutes in defrost.
- If defrost terminates on sensor temperature, **OR AFTER 14 MINUTES WITH THE COIL TEMPERATURE ABOVE 35°F FOR MORE THAN 4 MINUTES**, the control assumes a frost-free coil.
- The control does not allow another defrost for 34 minutes. This avoids an unnecessary defrost caused by transient system conditions.
- IF** the system terminates after 14 minutes, **AND THE COIL TEMPERATURE DOES NOT EXCEED 35°F FOR MORE THAN 4 MINUTES**, the control assumes defrost was not fully accomplished and, after 34 minutes running in the heat mode, it performs another sacrificial defrost
- After 6 hours of run time with no defrost and the sensor temperature below 35°F, the control conducts a forced defrost. This ensures adequate oil return to the compressor.
- Should the thermostat satisfy during defrost from auxiliary heat, the control immediately (no 34 minute wait) goes into defrost upon the next call for heat.
- If the coil temperature exceeds the termination temperature or if the coil temperature exceeds outdoor ambient air temperature (cooling operation), all defrost operations are suspended.

Testing

There must be a “Y” call for unit operation to perform the “TEST.” 24 volts must be present between “R” and “C”. And the system must be in the heat mode.

1. To test, momentarily jumper the “TEST” pins for **two to eight seconds** with a metal strip. **Remove the jumper after defrost begins.** The initiation temperature is ignored. The unit responds to normal time and temperature controls while in “TEST.”



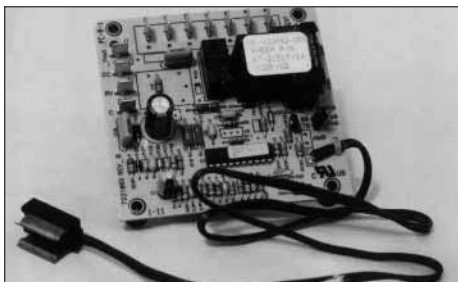
TEST PINS

IMPORTANT: AS LONG AS THE “TEST” PINS REMAIN SHORTED, DEFROST REMAINS ON FOR ONLY 3.5 SECONDS.

2. Remove the “TEST” pin jumper within 3.5 seconds, and monitor the coil temperature at the defrost sensor location. Termination should occur when the coil reaches termination temperature. Be aware that there is a temperature and time lag between the coil reaching termination temperature and when the sensor responds to terminate defrost.
3. Termination should occur when the defrost sensor reaches termination temperature (70°F factory setting).
4. If the control does not perform as previously described, replace it.

NOTE: If the ambient sensor fails, the control initiates defrost every 34 minutes with the coil temperature below 35° F. If the coil sensor fails, no defrost occurs.

This part of the bulletin describes the second control. For the most part this control follows the operation of the original control. These are the differences from the original control.



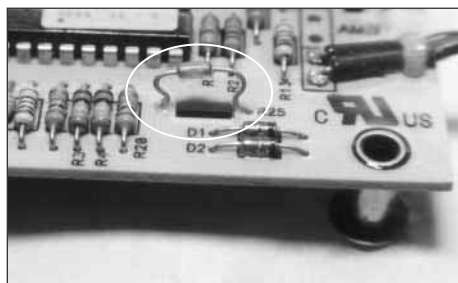
47-21517-14 CONTROL

RANCO Part #: DDL-013002-1RH
 Factory Part #: 47-21517-14
 Power Input: 24 VAC and 240 VAC

This defrost control was used on the following units:

- (-)PPA, Date Codes 1600 - 1602
- (-)PNJ, Date Codes 1600 - 1602
- (-)PMC, Date Codes 1600 - 1602
- (-)PLA, Date Codes 1600 - 1602
- (-)PKA, Date Codes 1600 - 1602

This control still had its ambient air sensor mounted to the control board. However, it was stepped up off the board in an attempt to isolate it from any heat generated by the control.



AMBIENT SENSOR

The major issue with this control concerned its testing. The time requirement to jumper the “TEST” pins was much longer than with the original control.

Testing

There must be a “Y” call for unit operation to perform the “TEST.” 24 volts must be present between “R” and “C”. The unit must be in the heat mode.

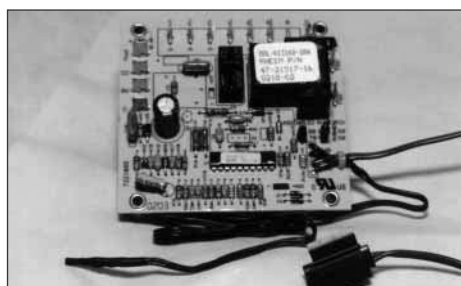
1. To test, jumper the “TEST” pins for **two seconds to three MINUTES** with a metal strip. **Remove the jumper after defrost begins.** The initiation temperature is ignored. The unit responds to normal time and temperature controls while in “TEST.”

IMPORTANT: AS LONG AS THE “TEST” PINS REMAIN SHORTED, DEFROST REMAINS ON FOR ONLY 3.5 SECONDS.

2. Remove the “TEST” pin jumper within 3.5 seconds after defrost starts, and monitor the coil temperature at the defrost sensor location. Termination should occur when the coil reaches termination temperature. Be aware that there is a temperature and time lag between the coil reaching termination temperature and when the sensor responds to terminate defrost.
3. Termination should occur when the defrost sensor reaches termination temperature (70°F factory setting).

Current Control

For the most part the current control follows the original control. This section also only covers the differences from the original control.



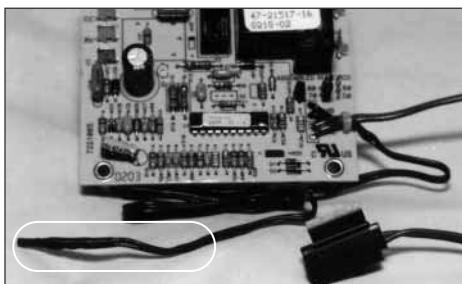
47-21517-16 CONTROL

RANCO Part #: DDL-013102-1RH
 Factory Part #: 47-21517-16
 Power Input: 24 VAC and 240 VAC

This defrost control was used on the following units:

- (-)PPA, Date Codes 1602 to present
- (-)PNJ, Date Codes 1602 to present
- (-)PMC, Date Codes 1602 to present
- (-)PLA, Date Codes 1602 to present
- (-)PKA, Date Codes 1602 to present

The control now has its ambient air sensor mounted at the end of a lead similar to the coil sensor. This was to isolate the ambient sensor not only from any heat generated by the control, but from any heat generated in the control box. **Its "TEST" procedure has changed from the original control.**



AMBIENT SENSOR

Testing

There must be a "Y" call for unit operation to perform the "TEST." 24 volts must be present between "R" and "C". The unit must be in the heat mode.

TESTING WITH THE OUTDOOR AMBIENT ABOVE 35°F

1. To test, jumper the "TEST" pins with a metal strip. The unit should go into defrost within two to eight seconds. The initiation temperature is ignored. The unit responds to normal time controls while in "TEST." If a sensor failure is detected, no defrost occurs.
2. Remove the "TEST" pin jumper and the unit terminates defrost.

Testing the control above 35°F only allows the technician to check that unit components actually shift into and out of defrost.

IMPORTANT: AS LONG AS THE "TEST" PINS REMAIN SHORTED, THE UNIT REMAINS IN DEFROST FOR A MAXIMUM OF 14 MINUTES.

CAUTION: DO NOT ALLOW THE UNIT TO OPERATE IN DEFROST LONGER THAN NECESSARY. IN WARM AMBIENT CONDITIONS, DANGEROUSLY HIGH PRESSURES COULD DEVELOP. THIS COULD RESULT IN EQUIPMENT DAMAGE.

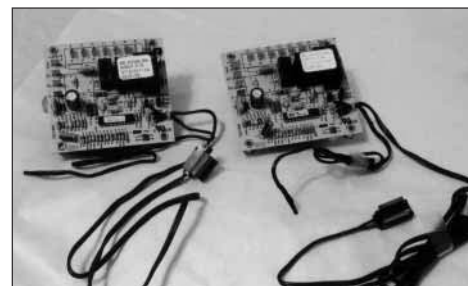
TESTING WITH THE OUTDOOR AMBIENT BELOW 35°F

1. To test, jumper the "TEST" pins for with a metal strip. The unit should go into defrost within two to eight seconds. The initiation temperature is ignored. The unit responds to normal time and temperature controls while in "TEST." If a sensor failure is detected, no defrost occurs.

IMPORTANT: AS LONG AS THE "TEST" PINS REMAIN SHORTED, THE UNIT REMAINS IN DEFROST FOR A MAXIMUM OF 14 MINUTES.

2. Remove the "TEST" pin jumper and monitor the coil temperature at the defrost sensor location.
3. Termination should occur when the defrost sensor reaches termination temperature (70°F factory setting). Be aware that there is a temperature and time lag between the coil reaching termination temperature and when the sensor responds to terminate defrost.

NOTE: There is another control that is sent as a replacement part for all DDL controls either residential or commercial. It carries the factory part number of 47-21517-18. Functionally, it is the same as the 47-21517-16 control. The only difference is the length of the sensor leads. They are longer to accommodate the extra distance required for commercial equipment.



CURRENT AND REPLACEMENT CONTROLS

When replacing a DDL control in the field, follow these instructions for proper placement of the sensors.

Coil Sensor

Place the coil sensor at the same location on the top copper tube of the outdoor coil as the sensor was before. Tie up any slack in the coil sensor wiring to prevent it from coming in contact with any object.

Ambient Air Sensor

Route the ambient air sensor lead through one of the openings in the control box. Locate and secure the sensor one to two inches below the bottom of the control box. Ensure that it does not come in contact with any object. Especially be certain that the ambient sensor is clear of any object with a temperature different than the ambient air.

IMPORTANT: NEVER CUT AND SPLICE ANY SENSOR LEAD. THE CONTROL IS FACTORY CALIBRATED WITH THE SENSORS AND SENSOR LEADS IN PLACE. ANY CONTROL RETURNED UNDER WARRANTY WITH THE SENSOR LEADS CUT, OR CUT AND SPLICED, WILL BE DENIED CREDIT.

Summary

This bulletin describes the various generations of RANCO DDL defrost control. It outlines the operation of the control. It describes the differences between the controls and the differences in the "TEST" procedures.