NewAvionics CORPORATION

Ice*Meister™ Model 9734-REFR

OPTICAL DEMAND-DEFROST CONTROLLER

FOR COMMERCIAL REFRIGERATORS

Technical Data Sheet

Figure 1 -- Model 9734-REFR demand defrost controller for commercial walk-in refrigerators and reach-in refrigerated display cases in supermarkets, restaurants, convenience stores.

9734 reacts to a light dusting of frost, virtually eliminating frost from evaporator coils. Relay contacts close immediately as frost appears on evaporator tube, defrost cycle starts . Blue indicator LED and relay contacts remain activated until defrost cycle is complete, then LED goes dark and contacts open when frost is gone, terminating defrost cycle. Self-indicating sensor probe glows frosty blue throughout defrost cycle.

GENERAL DESCRIPTION

Ice*Meister™ Model 9734-REFR is a demand-defrost controller that monitors the optical profile of refrigerator evaporator coils, senses frost and ice on the coils, and controls the refrigerator's defrost cycle in response to the physical presence or absence of frost and ice. Initiates defrost cycles when required, suppresses defrost cycles when not required, holds defrost duration to an absolute minimum. Keeps food colder, minimizes operating cost.

9734 is completely self-contained. Robust, solid, no exposed electronics. Simple 4-wire interface. No moving parts. Rugged four-conductor cable exits downwind side of housing for interface to host refrigerator. Color-coded wires are conveniently stripped and tinned for universal use.

Power input is any clean voltage between 6 VDC and 35 VDC. Control output is a pair of normally-open, single-pole, single-throw relay contacts that control the defrost cycle. A blue indicator LED is displayed inside the clear plastic probe to indicate the presence of offending frost and the defrost cycle is ON.

No external components other than a power relay is needed to switch power between the host refrigerator's compressor and defrost heater.

9734 replaces primitive defrost timers. It provides sensitive real time defrost control in response to the physical presence or absence of offending frost for commercial walk-in and reach-in refrigerators and all other self-defrosting chiller systems, large and small.

When the evaporator tube is frost-free, 9734's output relay contacts remain open and the probe's indicator LED remains dark. Immediately as the tube begins to accumulate offending frost, 9734 senses that frost, closes its output relay contacts, and illuminates the blue indicator LED. This signals the host power contactor to switch the compressor OFF and the heater ON, initiating a defrost cycle.

As soon as the defrost heater has melted the offending frost and the evaporator tube is frost-free, the defrost cycle terminates. 9734 output relay contacts re-open, and the blue indicator LED goes dark again. No needless heat is introduced into the chiller box at any time, keeping food colder, saving energy.

9734 controls any refrigerator's defrost cycle in real time, sweeping back-and-forth across the frost-formation threshold, reducing defrost energy to an absolute minimum, reducing operating cost, and paying for itself in saved electricity.

The amount of offending frost required to initiate and terminate a defrost cycle is set at installation time by moving the 9734 housing either up or down, so the evaporator tube's tangent line rides either higher or lower in the air gap.

GENERAL DESCRIPTION, cont.

9734 installs on any evaporator coil or refrigerator at the factory, or is retrofitted in the field as an aftermarket product. It eliminates all moving parts, reduces parts count, improves reliability, and pays for itself with saved energy.

9734-REFR reduces energy consumption, it ...

- eliminates defrost cycles when there is no frost to be defrosted.
- initiates defrost cycles immediately as insulating frost appears on evaporator coils.
- terminates defrost cycles immediately as insulating frost is gone.
- minimizes defrost heat inside the refrigerator, so the compressor works less.
- keeps food colder, minimizes defrost heat inside the chiller box, improves efficiency.

√ defrost cycles are shorter, more precise.
√ food temperature excursions during defrost cycles are more modest.

Figure 2 -- 9734 installs directly on evaporator coil assemblies

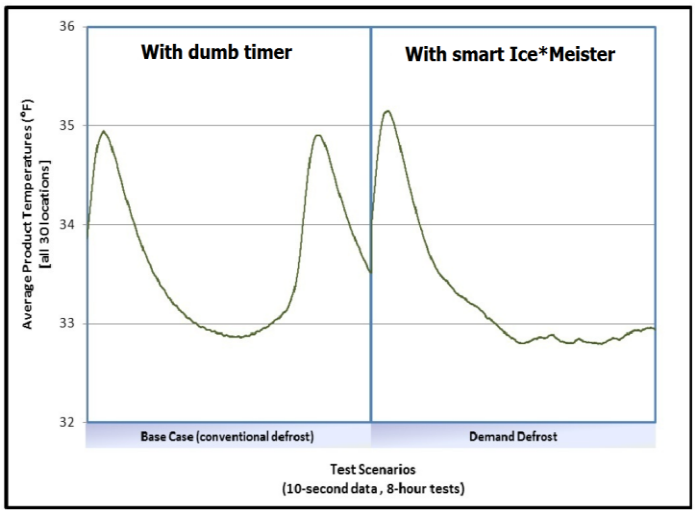


Figure 3 -- 9734 suppresses wasteful defrost cycles, keeps food colder

SPECIFICATIONS

SENSITIVITY TO FROST ACCUMULATION:

Better than 0.1 inch of rime frost or clear ice.

ORIENTATION:

Air gap must enclose the monitored evaporator coil, and face into the oncoming air flow.

OPERATING / STORAGE TEMPERATURE:

-40 deg C to + 50 deg C.

ELECTRICAL INPUT:

Any clean DC source between 6 VDC and 35 VDC

Current draw: 100 mA max @ 24 VDC.

red wire + 24 volts DC

black wire - 24 volts DC, instrumentation ground

ELECTRICAL OUTPUT:

1 pair of single pole, single throw, normally open relay contacts,
output for buffered control of compressor motor or evaporator-coil bypass valve

Capacity 1 Amp, 50 volts non-inductive (see relay data sheet, below)
Close when frost is present,
Open when frost is absent.
green and white wires = output relay contacts

VISUAL OUTPUT:

Probe glows **BLUE** to indicate defrost cycle is ON and relay contacts are closed.

CONNECTING CABLE :

0.1 inch diam lightweight four-conductor shielded cable, stripped and tinned

Red, black wires:	± 24 VDC in
Green, white wires:	Relay contacts out
Length:	6 feet

DIMENSIONS:

Height: 2½ inches
Width: 1¼ inches
Depth: 1 inch
Probe extension from housing: 1 inch

WEIGHT:

4 ounces

ELECTRICAL CONNECTIONS

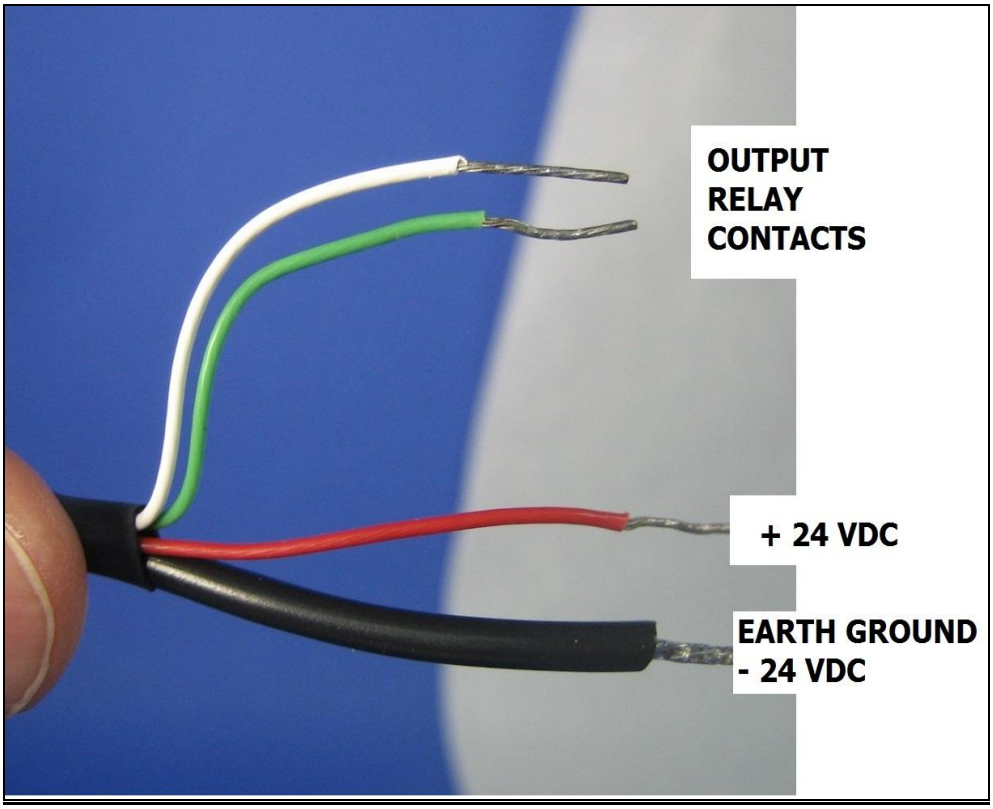


Figure 4 -- Cable connections. For best results, be sure to properly secure earth ground connection.

SERIAL NUMBER LOCATION

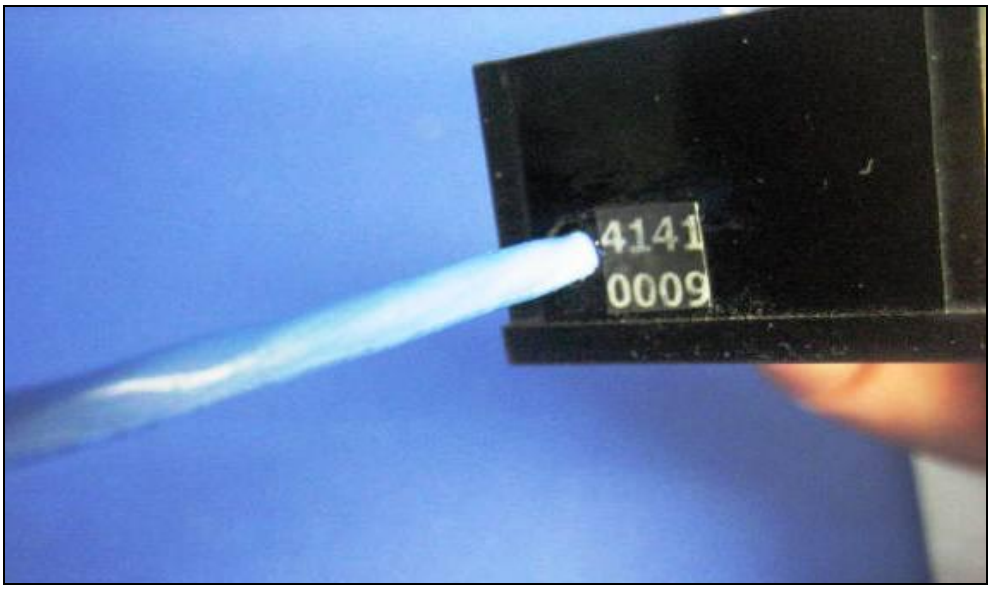


Figure 5 -- Serial number is located on the downwind face, next to the cable exit point.

TESTING I (desktop FROST test)

Convenient, simple, first-thing-out-of-the-box desktop FROST test with supplied 9-volt battery and foam dunnage chip:

Connect 9734's red wire to the 9-volt battery's positive **(+)** terminal, and the black wire to the battery's negative **(−)** terminal.

Insert foam dunnage into 9734's air gap.

Observe blue indicator LED glows, indicating the foam has simulated FROST threshold.

Listen for relay activation *click* inside the solid 9734 housing.

Using a suitable continuity checker, confirm output relay contacts close between white and green wires.

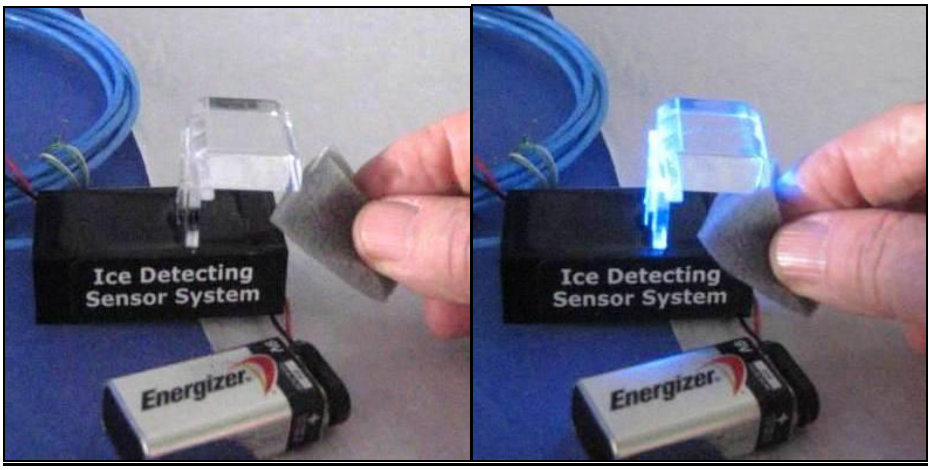


Figure 6 -- Desktop FROST test with supplied 9-volt battery and opaque charcoal test foam.

Figure 7-- Opaque charcoal test foam is readily available from office supply stores. A 9-volt battery and foam sample are each supplied with 9734.

STANDARD TEST CONDITIONS for testing in a laboratory		
ambient temperature	energize unit, soak at ambient temp ½ hour	25 deg C (normal office temp)
ambient lighting	fluorescent illumination (from ceiling)	500 lux (normal office lighting)
	white LED illumination	no limit
	sunlight	0.0
	incandescent lamp	0.0
mechanical	probe body orientation	probe air gap encompasses evaporator coil
	sensor air-gap orientation	faces into air stream
testing I	desktop field test with 9-volt battery and foam dunnage chip	convenient out-of-the-box test
testing II	desktop CLEAR ICE test with a transparent tumbler of tap water.	differentiates clear ice from frost
testing III	9734 can be tested for actual frost with commercial component cooler cold spray.	simulates actual defrost cycle
testing IV	evaluation data logging after physical installation in host refrigerator coil.	monitor power factor for indication of defrost cycle

TESTING II (water CLEAR ICE test)

Simple, CLEAR ICE test with a clear glass tumbler of clean tap water.

With 9734 still connected to the battery or a suitable DC power supply, submerge the probe into a tumbler of clean tap water. The tumbler must be transparent glass, as shown below.

Observe the blue LED illuminates, the relay *clicks* closed, and continuity tester confirms the relay contacts are closed, as Testing I, above.

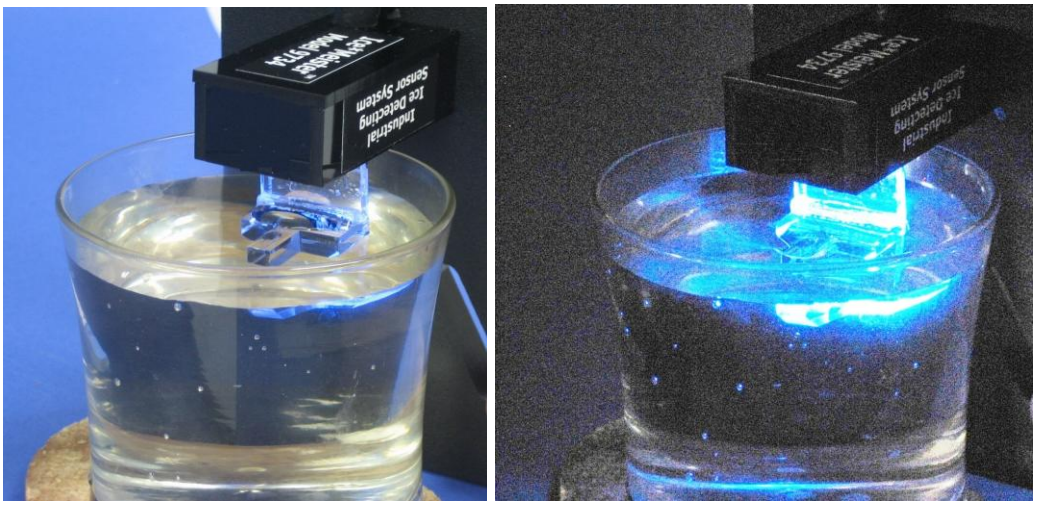


Figure 8 -- CLEAR ICE test with 9-volt battery and clear glass tumbler of clean tap water.

INSTALLATION

Install 9734 so the evaporator coil is securely positioned against the housing, and the coil's tangent aligns with the edge of the air gap.

Slide 9734 up and down on the coil to determine the defrost-threshold position. The closer to the edge of the air gap, the more sensitivity; the deeper into the air gap, the less sensitivity.

Set 9734 at a point where it is just short of the defrost threshold. Fix it in place to the adjacent fin with adhesive tape.

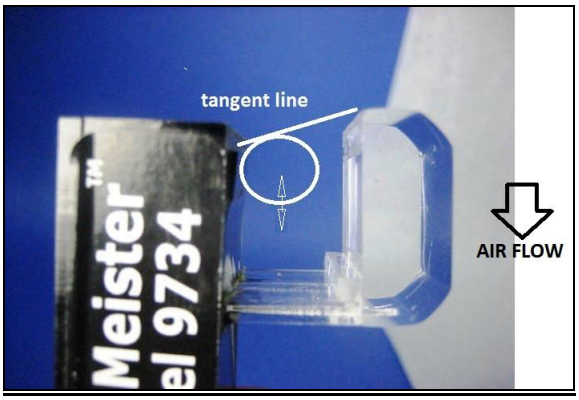


Figure 9 -- Fix 9734 in place so that the evaporator tube's tangent line is at the entrance of the air gap.

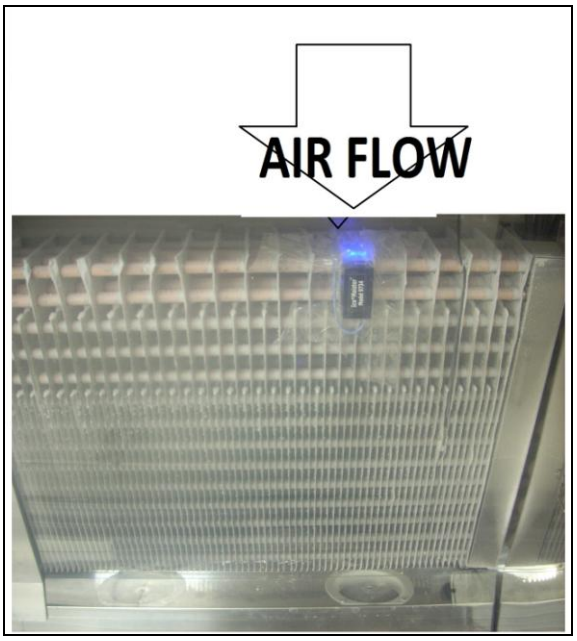


Figure 10 -- 9734 air gap faces towards the fan, into the air flow.

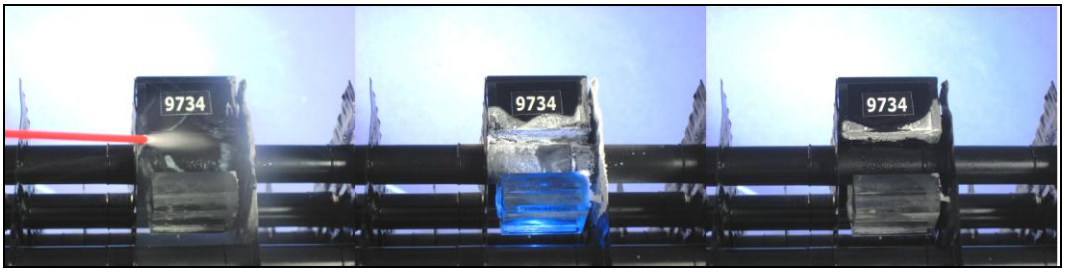
TESTING III (cold spray FROST test)

After installation, 9734 can be tested for actual frost with Radio Shack brand component cooler p/n 64-4321 cold spray.

Be certain to use only TETRAFLUOROETHANE COMPONENT COOLER to avoid damaging the acrylic optical components in the air gap.

Figure 11 -- Commercial component cooler spray simulates detectable FROST on the evaporator coil.

Connect 9734's red and black wires to host system DC-voltage power supply. Direct cold spray into air gap for 10-15 seconds, monitor blue indicator LED and output relay contact closure via green and white wires.



SPRAY COLD AIR | BLUE LED DEFROST ON | FROST GONE END DEFROST

Figure 12 -- Spray test freezes moisture out of the ambient air to produce FROST in 9734 air gap. Visually monitor blue indicator LED to observe defrost cycle.

TESTING IV

Evaluation data logging after installation in host refrigerator.

Capture and record all pertinent operating data. Note and record periods of operation while power factor equals unity **(pf = 1)** to identify short defrost cycles. (See note 1).

Time	Freezer	Chiller	voltage	current	power	pf	wh	Freq	
8:03:38	-12.3	6.4	229.23	0.68	108.8	0.698	337.8	50.009	
8:05:22	-13.7	6.3	229.22	0.677	107.8	0.695	340.93	50.009	
8:07:06	-15	6.1	229.22	0.674	107.1	0.693	344.03	50.009	
8:08:51	-16.1	5.9	229.23	0.671	106.2	0.69	347.17	50.009	
8:10:36	-17.1	5.7	229.24	0.67	105.5	0.687	350.17	50.009	
8:12:20	-17.9	5.5	229.24	0.667	104.5	0.683	353.26	50.009	
8:14:04	-18	5.4	229.26	0.491	112.6	1	356.49	50.007	
8:15:49	-17.7	5.3	229.23	0.489	112.1	1	359.73	50.009	
8:17:34	-17.1	5.3	229.22	0.488	112	1	362.97	50.009	
8:19:18	-16.2	5.4	229.26	0.489	112	1	366.26	50.009	**DEFROST**
8:21:03	-14.8	5.4	229.27	0.489	112	1	369.5	50.009	**CYCLE**
8:22:48	-13.2	5.5	229.27	0.489	112	1	372.8	50.007	
8:24:31	-11.5	5.7	229.28	0.489	112	1	376.03	50.009	**PF = 1**
8:26:15	-9.6	5.8	229.27	0.489	112	1	379.21	50.007	
8:27:59	-7.6	6	229.31	0.489	112	1	382.44	50.007	
8:29:43	-5.3	6.2	229.28	0.488	112	1	385.68	50.009	
8:31:27	-2.9	6.4	229.27	0.488	112	1	388.85	50.009	
8:33:11	0	6.6	229.41	0	0.4	Inf	391.96	50.009	
8:34:55	2.5	6.8	229.39	0	0.4	Inf	391.97	50.009	

Figure 13 -- Sample data set for refrigerator with 9734 demand-defrost controller. Observe how short the defrost cycles are vs. mechanical timer, how food temperature excursions are minimized vs mechanical timer.

Note 1:

POWER FACTOR is the tangent of the alternating-current phase displacement between voltage and current in an electrical load. Because a compressor motor's inductive copper windings present a *reactive* load when energized, the current through the motor is out of phase from the applied voltage (pf < 1).

But during defrost cycle, the motor is off and its load is replaced by a purely *resistive* defrost heater load, or no heater at all. This causes the power factor of the refrigerator's electrical load to become unity (pf = 1).

POWER FACTOR is a convenient way to identify and log defrost cycles.

Note 2:

CUSTOMER EXAMPLE of a full 36-hour data set documenting only two defrost cycles over 36 hours is available upon request from the factory.

DISCLAIMERS

1. Specifications and other contents are subject to change at any time without notice.

2. This document is not contractual. Nothing in it constitutes or implies a warranty or guaranty of any kind, explicit or implicit. Warranty information is given only in separate printed "warranty" statement.

3. Plastic optical probe is made of Polymethylmethacrylate, also called PMMA, acrylic, or Plexiglas®. It should be protected from mechanical abuse, abrasion and harsh chemicals. Damage to the probe voids the warranty.

4. No warranty is given as to the suitability of this product for any particular application.

5. Initial thermal shocking of the sensor may cause condensation to form on the optics and register as "frost".

6. This unit is not a measuring instrument, and provides no specific calibration.

7. For best results, allow unit to soak at ambient temperature before evaluating

8. Test under low-level fluorescent or energy-saving LED lighting; see STANDARD TEST CONDITIONS for testing in a laboratory

NOTES

1. Ice*Meister™ is a trademark of New Avionics Corporation.

2. Ice*Meister™ is protected under one or both US Patents #ooooooo and ooooooo.

Ice*Meister™ Model 9734-REFR
Optical Demand-Defrost Controller
for Commercial Refrigerators
Technical Data Sheet

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