



# Commercial Refrigeration Basics

## UNI-LINE® PRODUCT KNOWLEDGE

NATE-Recognized



Training Provider

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# Subjects We Will Cover In This Session

- Refrigeration Overview
  - Thermodynamics
  - Refrigeration System
  - Defrost Control
  - Condenser Fan Control
  - Discharge Temp Control
  - Phase Loss Protection
  - Termination Contacts
  - Discharge Pressure Alarms
  - Dripping Time
  - Liquid Line Solenoid Control
  - Reversing Valves
  - Differential, Cut-In and Cut-outs
  - Short Cycle Delay
  - Liquid Vapor Capillary Element
- Existing Product Line & Features
- Troubleshooting
- Where to Find Information
- Q&A

# What Is The Difference Between A/C And Commercial Refrigeration?

- Scientific principals are same, however refrigeration systems:
  - Operation Time 24 / 7
  - Defrost Cycles
  - Load Changes
- Energy Conservation Important on A/C Systems
  - However, more critical on Commercial Refrigeration Applications

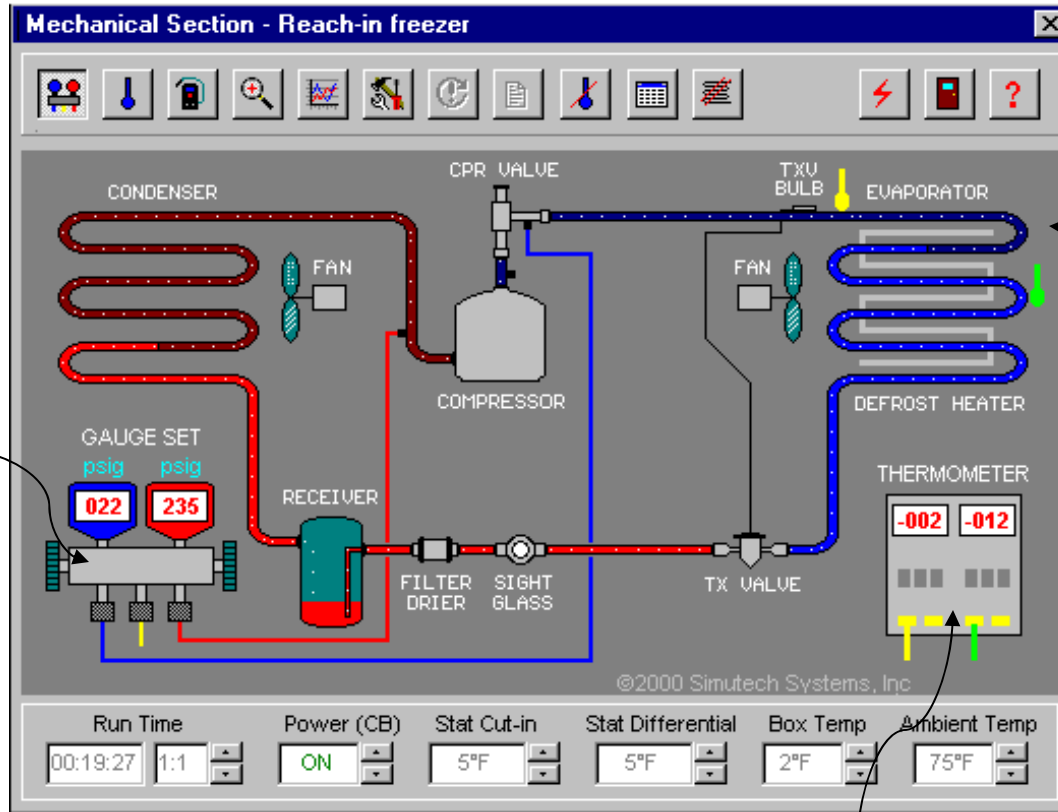
# Technical Terms and Definitions

- PSIG Pounds per Square Inch Gauge
- PSIA Pounds per Square Inch Absolute
- BTU British Thermal Unit
- Conduction Flow of heat with solids
- Convection Flow of heat with fluids (or gas)
- Radiation Flow of heat with air (or space)
- Superheat Heat added to a refrigerant in the evaporator just after it changes from *liquid to gas* up to the compressor
- Sub Cooling The difference in temperature in the condenser just after it changes from *gas to liquid* up to the expansion device
- TXV Thermal Expansion Valve
- Compressor A pump or mechanical device that increases the pressure of gases

# Technical Terms and Concepts

- **Refrigerant Thermodynamics** - The transfer of heat from a place where it's not wanted to a place where it's not objectionable.
- **Hot Gas Defrost System** – Hot refrigerant is pumped directly to the evaporator tubing. Defrost time is usually 5 to 10 minutes.
- **Rules of Heat**
  - Heat always moves from a warmer to a cooler surface
  - Heat always moves in three ways;
    - conduction, convection, or radiation
  - When a refrigerant substance boils, it absorbs heat
  - When a refrigerant substance condenses, it rejects heat

# Refrigeration System



Pressure Control



Defrost Control



Temperature Control



# Defrost Control Concept

- **Defrost Control**
  - Prevents build of frost or ice
  - Heat output is provided by electric or hot gas defrosts
- Defrost can occur manually or automatically
- Defrost include time, temperature, and/or pressure setpoints
- Setpoints control initiation start time and termination end times
- Initiated defrost heats coil while disabling fans until termination setpoint is met
- While in defrost mode, safety interlock prevents compressor and heat output from being energized at the same time



# Condenser Fan Concept

- Each condenser fan has following features:
  - Cut-on and cut-off setpoints
  - Cut-on and cut-off time delays
  - Controlled by discharge pressure or discharge temperature sensor
- Problems occur if head pressure is too low:
  - Frost on evaporator
  - Low flow of refrigerant
  - Short cycling





# Technical Terms and Concepts

- **Defrost Termination Options**

- Time
- Temperature
- Pressure
- Digital

- **Termination Contacts** - When a digital (dry contact) device is used for defrost termination, the user may choose to terminate defrost when the input is closed or open depending on the digital input device used.

- **Discharge Pressure Alarms** - High and low discharge pressure alarms are available with an optional cutoff function for the high alarm to shut off the compressors. The restart function enables the compressor if the discharge pressure drops 50 lbs. below the cut-out target.

# Technical Terms and Concepts

- **Dripping Time** - Allow excess moisture to drip off of evaporator coil after defrost melts ice or frost
- **Liquid Line Solenoid Control** - When two stage compressors are controlled by pressure, the solenoid will be staged ON and OFF along with the first compressor
  - Liquid line closes; compressor, evaporator, and defrost turn OFF
- When the compressors are controlled by temperature, the solenoid will operate based on the pump down settings

# Technical Terms and Concepts

- **Discharge Temperature Control** - When fans are being controlled by discharge temperature, the high discharge pressure cut-out option can be used to shut off the compressors. Each fan may be set up so that the output relay will be energized when the fan is on. Usually set 20% above normal head pressure (R22 : 260 psi).
- **Phase Loss Protection** - Protect 3-phase equipment from being damaged due to loss of one or more phases. In some units phase loss is provided for the condenser fans, along with the compressors, via a Phase Loss input which shuts off the compressors and condenser fans when this input is closed.

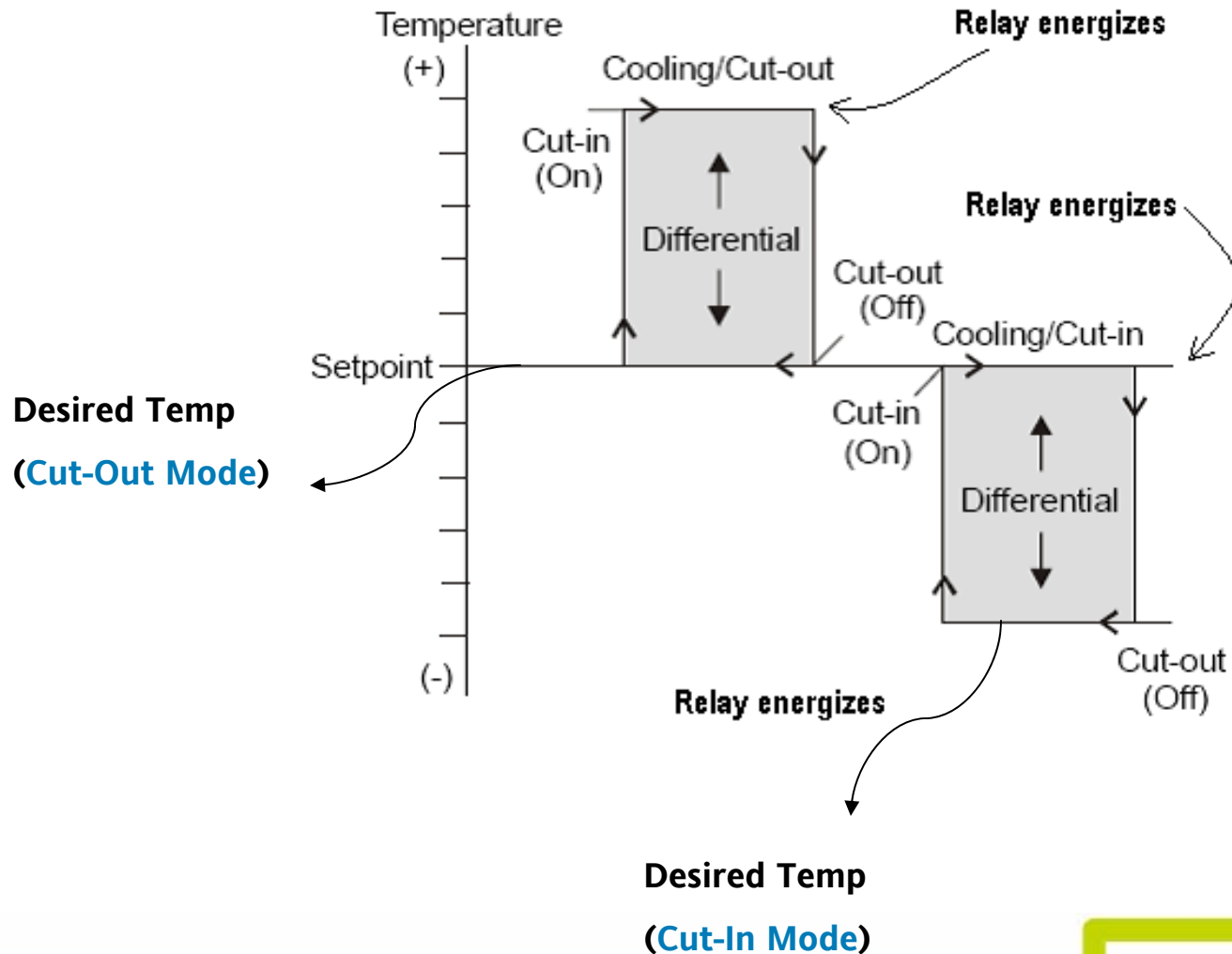
# Differentials

- Narrow Differential (10°F or less)
- When a narrow differential is desired
- Closely maintain within 5 to 6°F
- Wide Differential (10°F or more)
- Required due to swing in evaporator temperature between compressor ON and OFF
- Household refrigerators and room air conditioners
- Differential between 8 to 14°F

# Cut-In And Cut-Out Cooling Applications

- Cut-out mode: Differential is above setpoint
  - Output relay energizes when temperature rises to setpoint *plus* the differential value
  - When temperature drops to setpoint, the relay de-energizes
- Cut-in mode: Differential is below setpoint
  - The output relay energizes when the temperature rises to setpoint
  - When the temperature drops to setpoint *minus* the differential value, the relay de-energizes

# Cut-In And Cut-Cut Cooling Example



# Terms and Concepts Continued

- Two Types of Cold Controls:

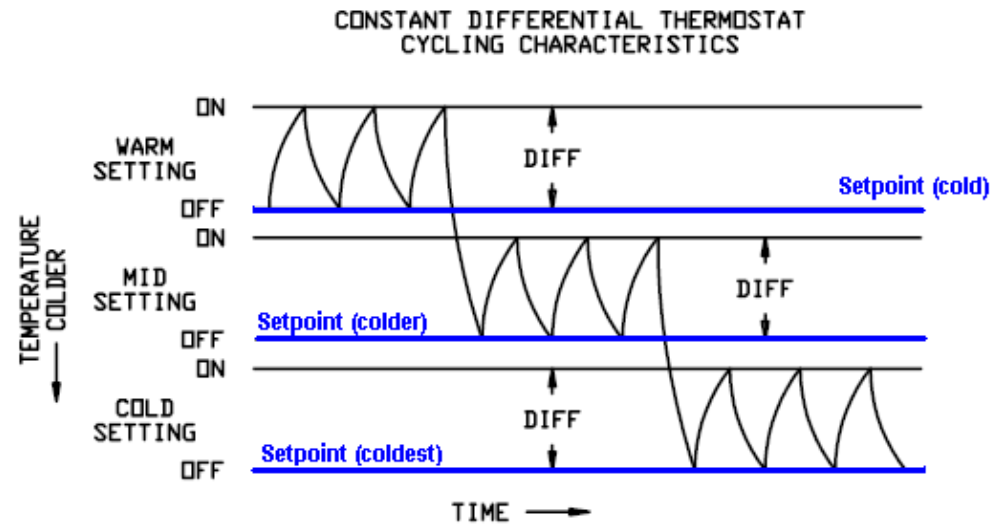
- Constant Differential
- Constant Cut-in

- Applications

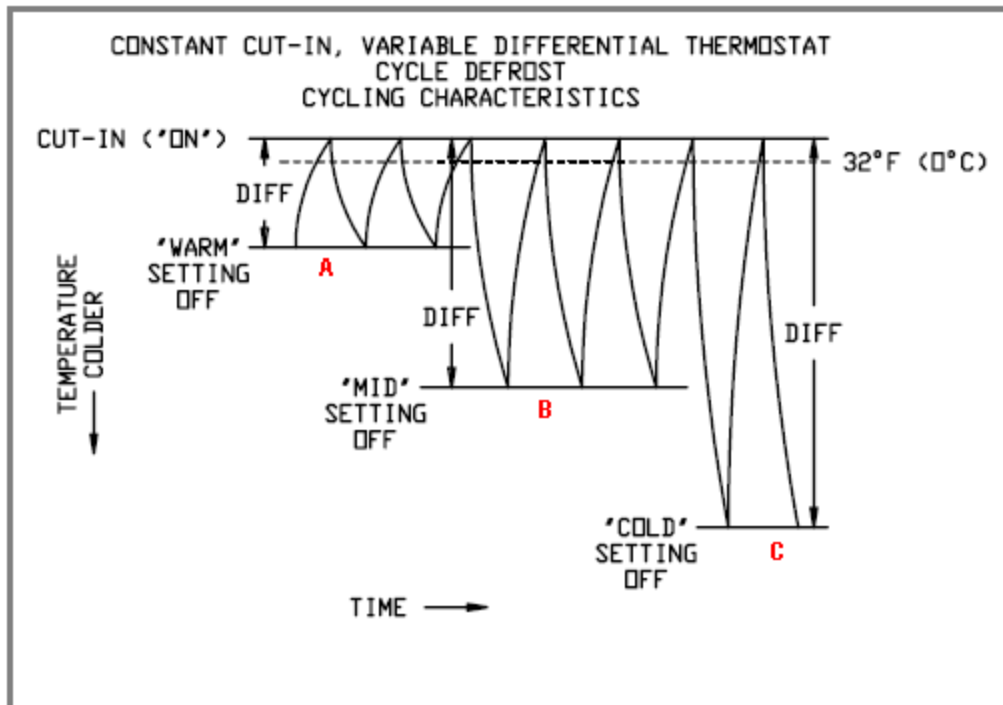
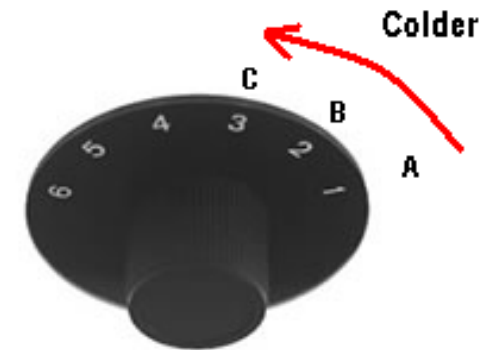
- Water coolers
- Beverage dispensers
- Display cases

- Constant Differential also called “straight range controls”

- Designed for household refrigerators and freezers



# Constant Cut-In With Dial

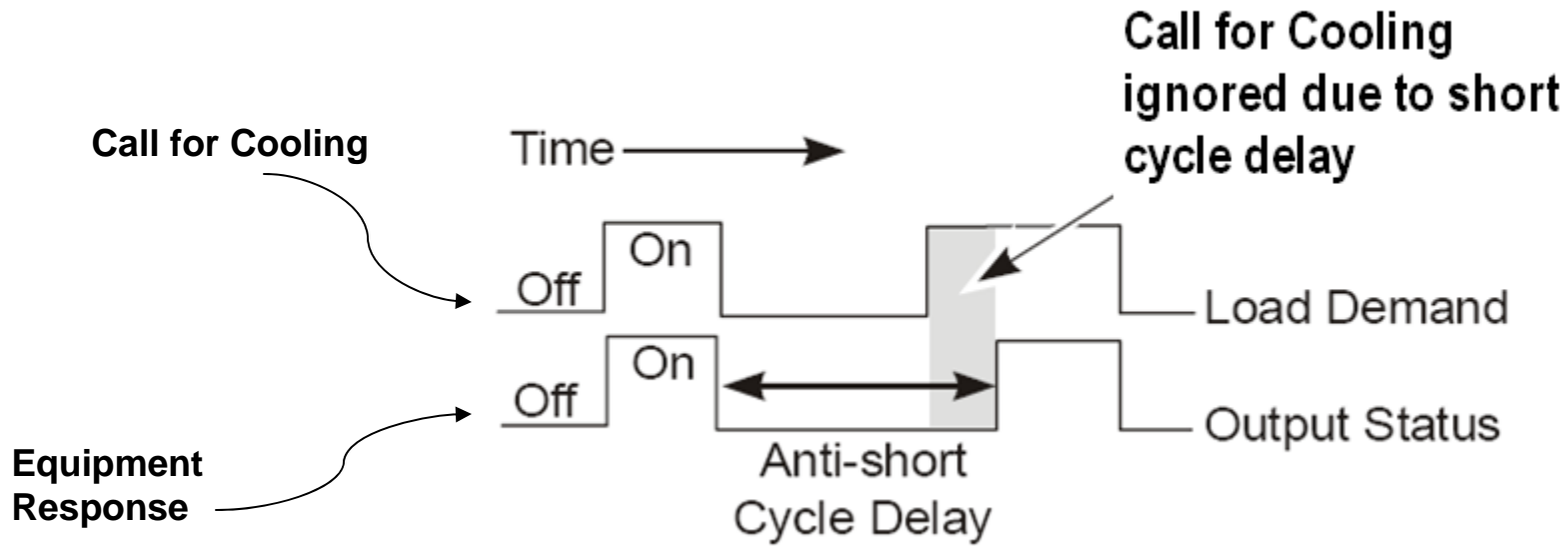




# Terms And Definitions Continued

- Constant Cut-in type controls
  - Designed for frost free refrigerators
  - Used in coolers and display cases
- Operation of Cut-in controls
  - This type of control offers an *adjustable differential*
  - Rotating the dial indicator to the colder position changes the cut-out temperature only and widens the differential
- Capillary tube
  - The gas within the capillary tube reacts to temperature changes
  - Actuates the power element diaphragm to trip the toggle mechanism

# Concepts – Short Cycle Delay



# Terms And Concepts Continued

- Liquid Vapor Capillary Power Element
  - Liquid is always located at the coldest point in the system, since condensation takes place at the coldest point
  - The thermostat switching gets its signal from the temperature at the liquid vapor interface
  - The temperature at the coldest point of the sensing system controls the thermostat switching
  - The temperature at the point on the capillary to be sensed must always be colder than the remaining parts of the power element system
  - If it is not, then a condition known as a cross ambient condition exists, and the control point of the system will not be at the desired sensing point

# Commercial Refrigeration Categories

- Temperature Controls
- Pressure Controls
- Defrost Controls

# Temperature Controls Applications

- Ice Machines
- Reach-In Refrigerator/Freezers
- Walk-In Refrigerator/Freezers
- Beverage Coolers
- Condensing Units
- Display Cases



# Application For Cold Controls



Ice Maker

- Ice Bin Level Control
- Ice Harvest
- Commercial Refrigeration
- Household
- Water Coolers



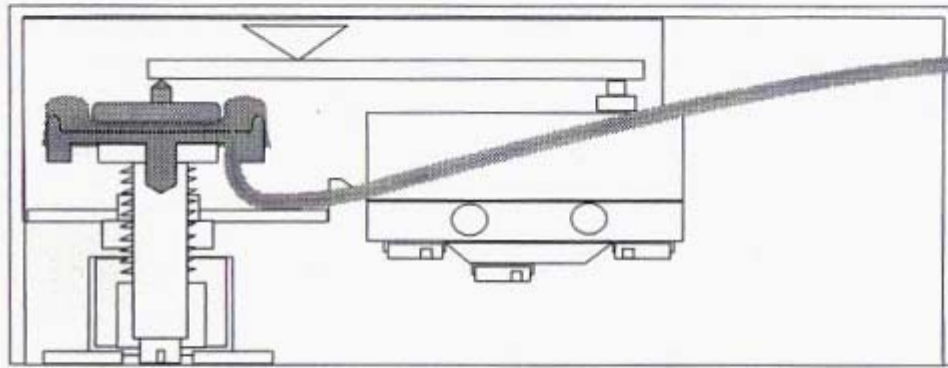
- A and CC Series
- K and RC Series
- 3030 Series are Uni-Kits

# Temperature Controls Continued

- The Capillary-only bellows sense from the coldest exposure point
- The Capillary with bulb senses from the bulb only
- The bulb portion of the A22 & A30 capillaries must be mounted with tip end pointing upward within 65° of vertical
- Sensing elements of A22 & A30 contain saturated vapor liquid refrigerant and are sensitive to barometric pressure changes
- Sensing elements C12 & C17 contain liquid filled bulbs for accurate temperature control
- C12 & C17 bulbs may be oriented in any position

# Capillary Tube Mechanics

## THE SENSOR

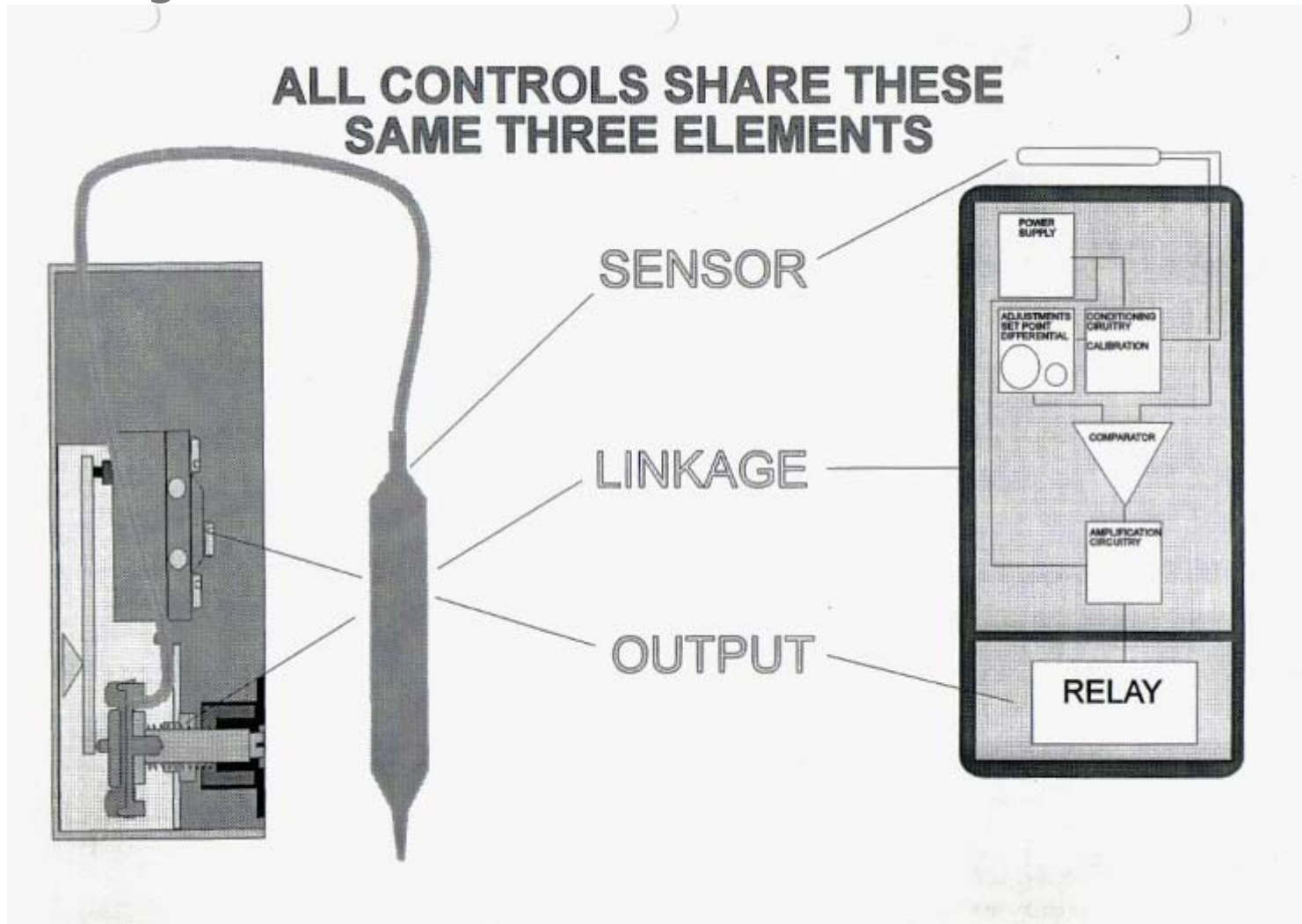


SENSES A CONDITION AND RESPONDS  
WITH SOME PHYSICAL CHANGE.

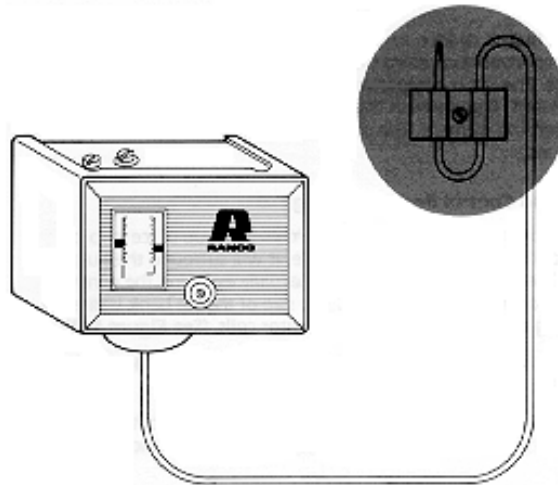




# Capillary Tube Electronics



# Capillary Only Temperature Control



- Limited vapor-fill sensing element
- Sense directly by the capillary
- May be used where the desired sensing is at the coldest point along the capillary (including the control body itself)
- Entire control located where it will sense fixture temperature

# Electronic Temperature Controller (ETC)

- Electronic Accuracy
- Wide Range (-30° to 220°F)
- Wide Differential selection
- Easy Installation
- Temperature Display
- Easy Programming
- No Jumpers
- Contractor Preferred
- Sensor up to 400 Feet
- Averages Multiple Sensors



# ETC Applications

- Retail store display freezers and reach-in coolers
- Supermarket display cases for produce/meats
- Retail store walk-in coolers and freezers
- Boiler operating control (used as a thermostat)
- Condenser fan cycling or staging
- Cooling tower pump and fan control
- Space and return air temperature control
- Bulk milk coolers
- Poultry houses and livestock barns

# Installation for ETC Control

- Mount unit to wall or flat surface
- Review typical line voltage wiring diagram
- Determine location of sensor
- Program 4 simple steps

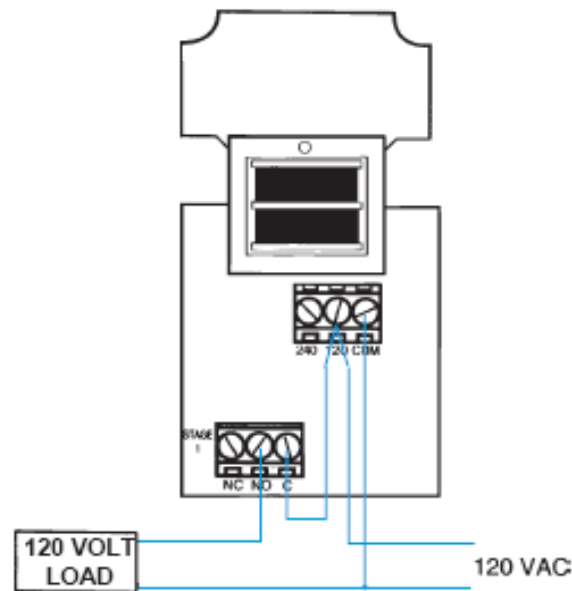
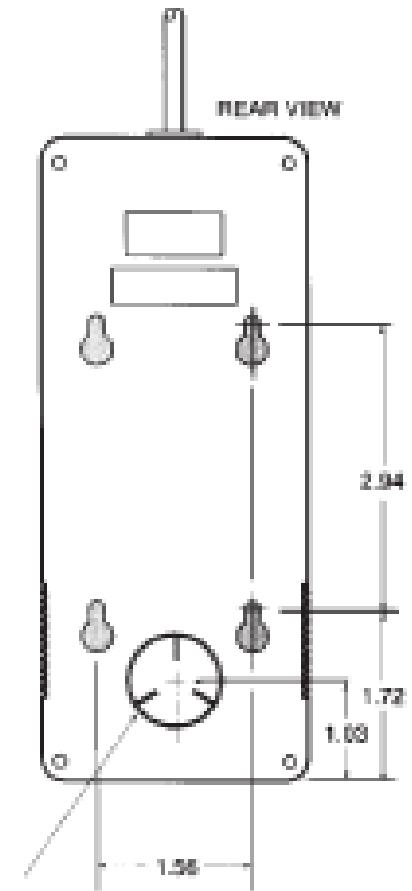


Figure 4: Typical Line Voltage Wiring Diagram.



# Troubleshooting Error Messages



- E1 Appears when up or down keys are pressed
  - To correct: If the E1 message appears when no keys are being pressed, replace the control
- E2 Appears if the control settings are not properly stored in memory
  - To correct: Check all settings and correct if necessary
- EP Appears when the probe is open, shorted or sensing a temperature that is out of range
  - To correct: Check if the sensed temp is out of range. If not, check for probe damage by comparing it to a known ambient temp between -30° F and 220° F. Replace the probe if necessary.
- EE Appears if the EEPROM data has been corrupted
  - To correct: This condition cannot be field repaired. Replace control
- CL Appears if calibration mode has been entered.
  - To correct: Remove power to the control for at least five seconds. Reapply power. If CL message still appears, replace control

# Temperature Control Manufacturers

- Johnson Controls – Penn
- White-Rodgers
- Saganomia (Danfoss)
- G.E. - Art series
- Asian knock-offs
- Sunne Peco
- Ranco®

# Poll Question #1

What is the temperature range of the Ranco® Electronic Temperature Controls (ETC)?

- 50 to 0° F**
- 30 to 220° F**
- 30 to 220° C**

What voltages are available within the ETC family of products?

- 120 VAC**
- 240 VAC**
- 24 VAC**
- All of the above**



# Commercial Refrigeration Product Categories

Temperature Controls

Pressure Controls

Defrost Controls

# Pressure Controls

- "O" series
- "G" series
- "P" series for Oil Pressure
- 3321 Series Oil Protection
- Additional Controls
- Accessories



# Pressure Controls – O Series

- Over 36 Million “O” controls have been produced since 1936
- Multiple pressure ranges for most refrigerant types
- Unique Lexan cover and captive set screw
- Offers super cap for vibration protection
- Ranco® O Series can also be temperature controls
  - Be careful to not confuse the following
    - O10-1402 (Pressure)
    - O10-1409 (Temperature)

# Single Pressure Controls Replacements

SKU #	Description	Reset	Range PSI	Differential PSI	Switch	Pressure Connection	Cap. Length	Replaces
<b>010-1401</b>	Low Pressure Controls	Auto	12" to 50	5 to 35	SPST-Opens Low	1/4" SAE male flare		Honeywell: L414A, Johnson: P70AN-8, P70AA-157, P70AN-9, P70AA-64
<b>010-1402</b>	Low Pressure Controls	Auto	12" to 50	5 to 35	SPST-Opens Low	1/4" SAE flare nut	36"	Honeywell: P420B, Johnson: 970AB-29, P70AA-123, P70AC-9, P70AB-12, P70AB-40, P70AA-47, P70AB-44

# Commercial Refrigeration Super Cap

- Super Cap Capillary Protection System
- Provides 10 times more vibration protection
- Uses unique vibration-dampening cone
- Light weight copper alloy tubing
- Available on all single and dual "O" pressure controls



# Dual Pressure controls

- Combines high and low pressure limit control into one unit
- Low pressure cycles compressor depends on suction pressure
- High pressure controls high pressure shutdown



# Dual Pressure Parts

- Common parts include **012-1549** and **012-4834**

SKU #	Description	Low Press. (Open Low) Reset	Low Press. (Open Low) Cut-In PSI	Low Press. (Open Low) Diff. PSI	High Press. (Open High) Reset	High Press. (Open High) Cut-Out PSI	High Press. (Open High) Diff. PSI	Capillary Length	Replaces
<b>012-1505</b>	O12 Series-SPST Switch	Auto	12" to 50	5 to 35	Auto	100 to 250	50 Fixed	Has 1/4" SAE male flare.	Honeywell: L413A
<b>012-1506</b>	O12 Series-SPST Switch	Auto	12" to 50	5 to 35	Auto	100 to 250	50 Fixed	36" Has 1/4" SAE flare nut.	Honeywell: P421B, Johnson: P70LA-88
<b>012-1502</b>	O12 Series-SPST Switch	Auto	12" to 50	5 to 35	Auto	150 to 450	70 Fixed	36" Has 1/4" SAE flare nut.	JOHNSON: P70LA-87, P70LA-96
<b>012-4842</b>	O12 Series-SPST Switch	Auto	12" to 50	5 to 35	Convertible	150 to 450	70 Fixed	Has 1/4" SAE male flare.	

# G Series for Refrigeration Compressors

- **Applications (Pressure and Temperature Control)**

- G20 used to protect against loss of charge
  - Evaporator freeze-up
  - Low pressure
- G23 provides high head pressure protection
  - High pressure



- **To Determine Part:**

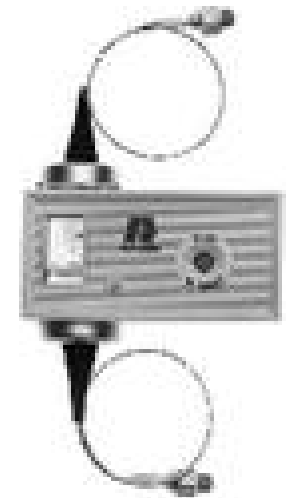
- Determine Current and Voltage settings
- Determine Pounds Per Square Inch (PSI) Pressure settings
- Determine Auto or Manual
- Determine Temperature Setpoints



# P30 Series for Lube Oil Protection

- Guards pressure-lubricated refrigeration compressors

SKU #	Pressure Range P.S.I.D.	Time Delay (SEC)	Repl. Module	Press Connection
<b>P30-5826</b>	9	120	S30-1302	36" Cap W/Nut
<b>P30-5827</b>		120	S30-1302	Male Flare
<b>P30-5629</b>	5	60	S30-1307	36" Cap W/Nut
<b>P30-3801</b>	8 to 60 Adjustable	120	S30-1302	36" Cap W/Nut
<b>P30-3701</b>	8 to 60 Adjustable	90	S30-1200	36" Cap W/Nut
<b>P30-3803H</b>	8 to 60 Adjustable	120	S30-1302	Male Flare w/24" Refrigeration Hose
<b>P30-5827H</b>	9	120	S30-1302	Male Flare w/24" Refrigeration Hose
<b>P30-5628H</b>	5	60	S30-1307	Male Flare w/24" Refrigeration Hose



# Additional Controls and Accessories

- Solid State Lube Oil Protector **3321**
- Lube Oil Protection for 2<sup>nd</sup> Compressor **3311**
  - Time Delays include 45, 60, 90 or 120



- Refrigerant Hose **1290132-A18** Straight 18"
- Available with 90° Elbow & multiple lengths



# Manufacturers of Pressure Controls

- Johnson Controls – Penn
- Danfoss
- Ranco®
- Robertshaw®
  
- Ranco Advantages Include:
  - Lexan Cover
  - Super Cap
  - Application Specific

# Commercial Refrigeration Categories

- Temperature Controls
- Pressure Controls
- Defrost Controls

# How To Get Rid of Frost and Ice?

- Manual Defrost
- Off Cycle Defrost
- Timed Off Cycle Defrost
- Heat Defrost
  - Electrical
  - Hot Gas



# Why Paragon® Defrost Timers?

- Paragon Electrical Products are high quality time switches with sealed synchronous motors and metal gears
- Commercial Refrigerators store valuable products
- Refrigeration failures are costly in terms of lost product and business
- Paragon Defrost Timers are UL certified as refrigeration controls, not as time switches



# 8000 Series Timers (D80)

- 40 Amps
- Time Initiated, Time Terminated
- All are 60 Hz, some 50 Hz units available

<b>Part Number</b>	<b>Volts / 60 Hz</b>	<b>Contact 2-4</b>	<b>Contact 3-N</b>	<b>Application</b>
8041-00	120	Closed	Closed	Electric Heat Defrosting
8041-20	208-240	Closed	Closed	Electric Heat Defrosting
8045-00	120	Closed	None	Electric, Hot Gas, Compressor
8045-20	208-240	Closed	None	Electric, Hot Gas, Compressor
8047-00	120	Open	Closed	Electric Heat Defrosting
8047-20	208-240	Open	Closed	Electric Heat Defrosting

# 8100 Series (D81)

- 40 Amp switches
- Time Initiated, Temperature or Pressure Terminated
- Provides three defrost cycles with mechanical timer
- Pump-down, defrost, and fan delay



Part Number	Volts / 60 Hz	Contact 3-N	Contact 1-3	Contact 2-4
8141-00	120	Closed	Open	Closed
8141-20	208-240	Closed	Open	Closed
8143-00	120	Open	Closed	Open
8143-20	208-240	Open	Closed	Open
8145-00	120	None	Open	Closed
8145-20	208-240	None	Open	Closed



# Paragon<sup>®</sup> Mechanical Defrost Timers

1. 8145-20
2. 8141-00
3. 8145-00
4. 8045-20
5. 8045-00



Model Number		Time Initiated, Time Terminated	Time Initiated, Temperature or Pressure Terminated
120V AC	208/240V AC		
8041-00	8041-20	•	
8045-00	8045-20	•	
8047-00	8047-20	•	
8141-00	8141-20		•
8143-00	8143-20		•
8145-00	8145-20		•

# The Latest Paragon® Defrost Timer

- Universal Defrost Timers (UDT)
- Works with multiple voltages
- Removes built up of ice and frost
- Easy to install
- Simple to program
- Part 9145-00 temp terminated
- Part 9045-00 time terminated
- Available as mechanism only without case
  - Add “M” to end of part number

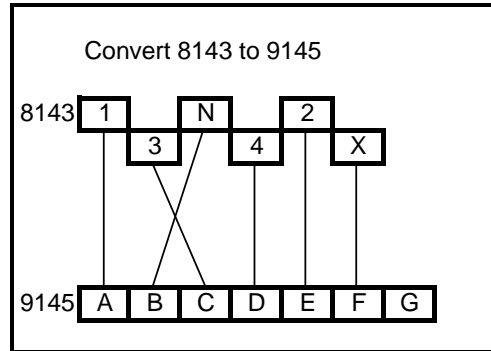
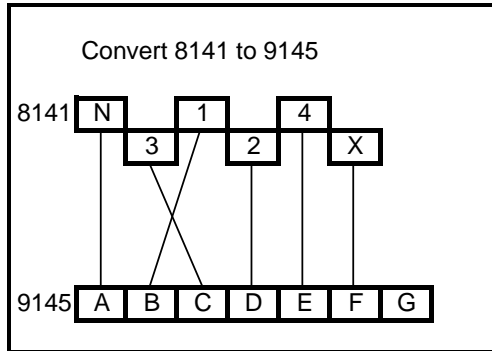


# Universal Defrost Timer (UDT) Features

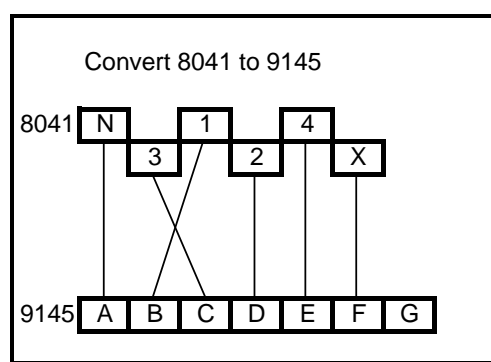
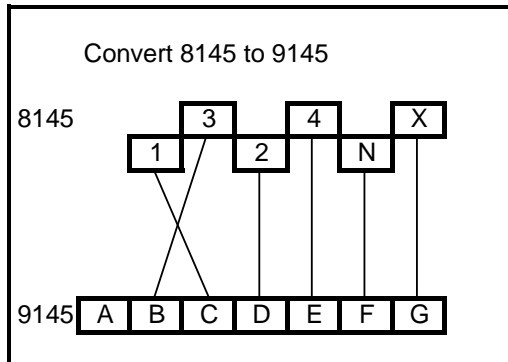
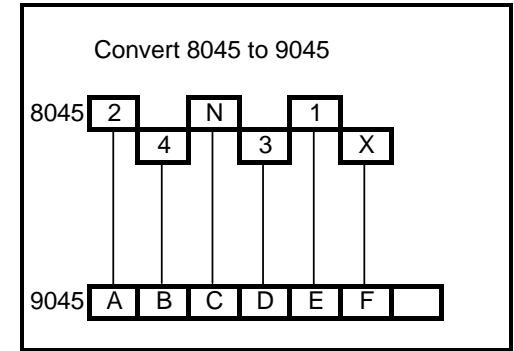
- Simple Programming
- Certified to UL873
- Switches rated at 30,000 cycles
- Last 16 years longer (4 defrost/day)
- Initiate 15 minute manual defrost
- Lighted display
- 100 hours of power loss protection
- Easy Installation
- Designed to fit in Paragon® enclosures
- Withstands most rigorous applications
- Wires to 120V AC, 208V AC or 230V AC
- Display has defrost time and duration
- System status indicators
- Real-time clock

# Universal Defrost Timer – Wiring

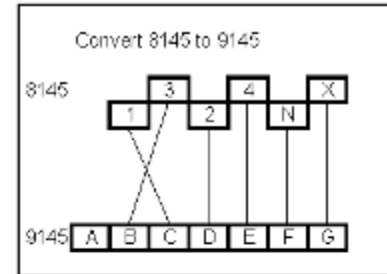
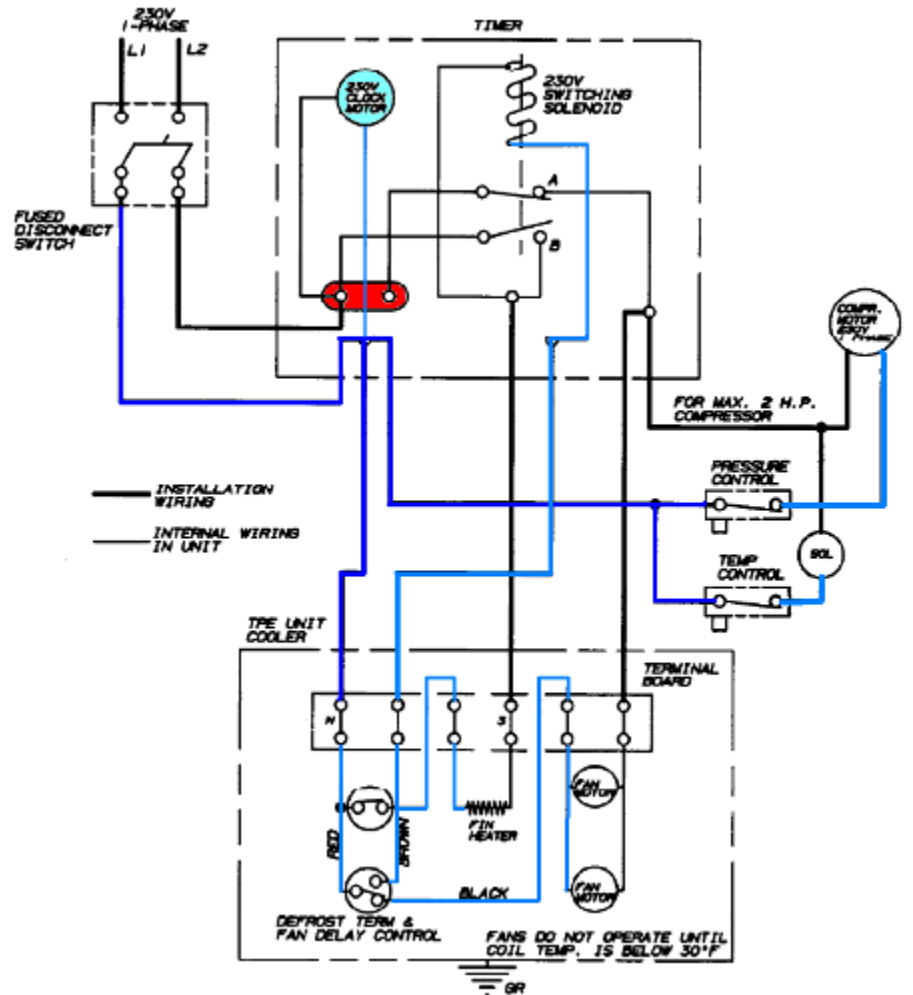
## Convert to 9145



## Convert to 9045



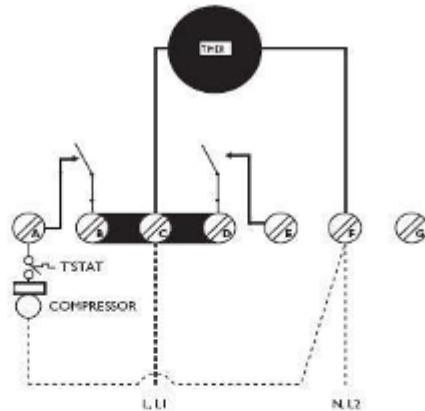
# Conversion exercise - Converting 8145 to 9145



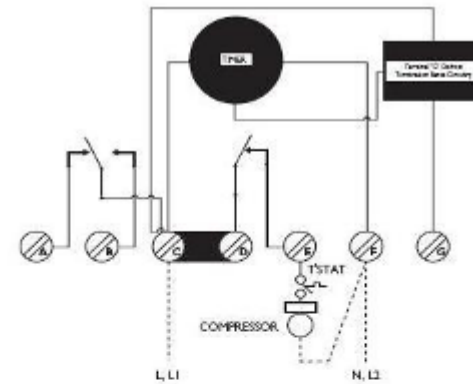
# Air vs. Electric Defrost Terminations

- Time or Temperature Terminated in Electric Defrost

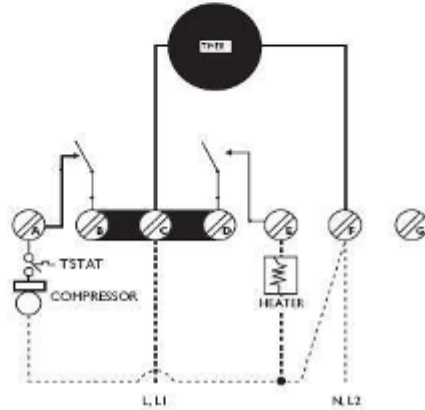
**9045**  
**AIR**  
**DEFROST**  
Time Initiated  
Time Terminated



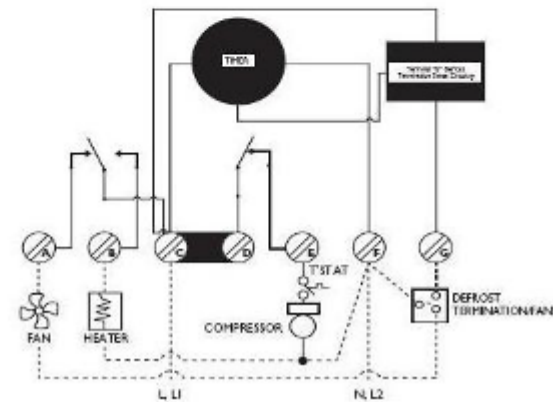
**9145**  
**AIR**  
**DEFROST**  
Time Initiated  
Time Terminated



**9045**  
**ELECTRIC**  
**DEFROST**  
Time Initiated  
Time Terminated



**9145**  
**ELECTRIC**  
**DEFROST**  
Time Initiated  
Temperature  
Terminated



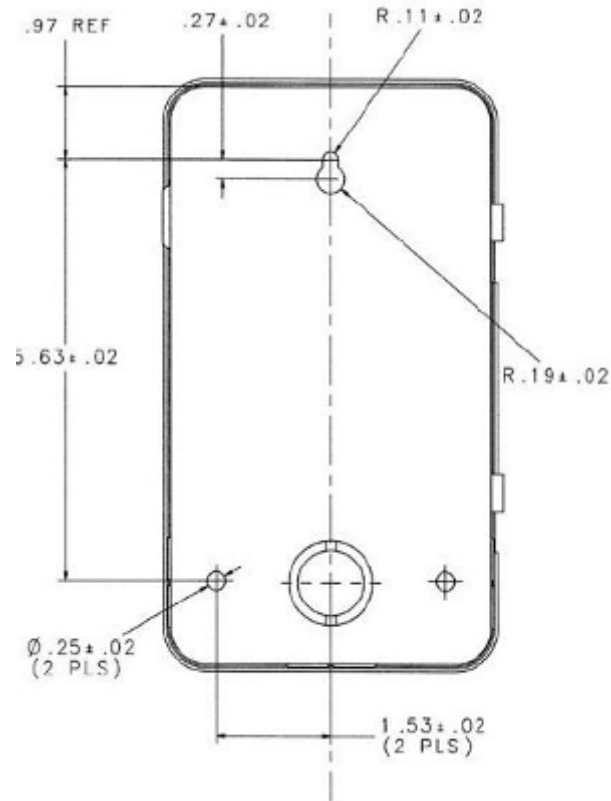
# Installation Steps for 9045 Defrost

1. Turn off AC power
2. Open metal case to access control connectors
3. Connect wires from compressor to terminal A
4. Connect heater or hot gas solenoid to Terminal E
5. Connect wire to Terminal C from
  - ▶ L1 – 120 VAC or 208-240 VAC line
6. Jumper Terminal C to Terminals B and D
7. Connect wire from L2/N to Terminal F



# Installation of Enclosure

- Universal Defrost Timer mounts in previous legacy boxes
- Perfect for aftermarket applications





# Easy As 1-2-3 Programming

## As Easy As 1 - 2 - 3

### 1. Set Time

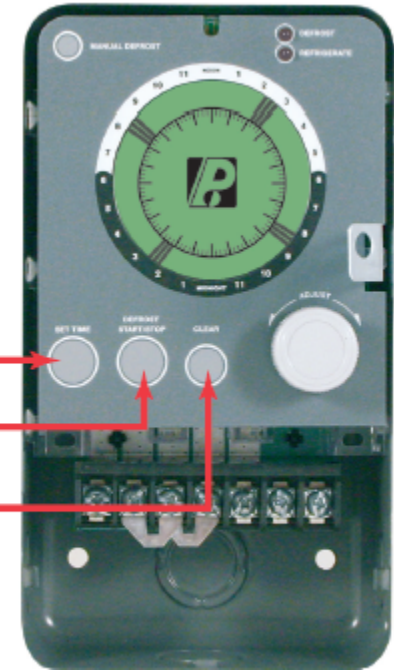
Scroll cursor to desired time.  
Select SET TIME button.

### 2. Set Defrost

Scroll cursor to desired defrost times.  
Select DEFROST START/STOP button.

### 3. Clear Defrost

Rotate cursor to the first segment in the defrost screen.  
Select CLEAR button.



No pins, jumpers or switches to mess with!

Automatically detects input voltage

# Universal Defrost Timer – Operation Training

Flashes at 12:00 Noon

Refrigerate LED is on



# The Easy Part: Set Defrost



1. Scroll cursor to desired defrost start time



2. Press "Defrost Start/Stop" once

# Still Easy Part: Clear Defrost



1. Rotate cursor to the first segment in the defrost




2. Press "Clear"

# Reset Program, your CTRL-ALT-DEL!



Press, hold and release all four buttons to clear the program.  
The Defrost Timer will return to its original power up state

# Troubleshooting UDT Defrost Timer

<p>Backlight is not on.</p>	<p>The display backlight will turn on when the ADJUST knob is turned and will remain on for 10 seconds after the last activity.</p>
<p>The display segments and backlight are not on.</p>	<ol style="list-style-type: none"><li>1. Verify proper voltage is applied to the correct terminals.</li><li>2. Perform PROGRAM RESET.</li><li>3. Replace timer.</li></ol>
<p>All the display segments and LEDs are flashing.</p>	<p>The control has detected a catastrophic or programming failure. If possible the UDT will return to refrigerate.</p> <ol style="list-style-type: none"><li>1. Verify proper voltage is applied to the correct terminals.</li><li>2. Verify wiring of the device.</li><li>3. Perform PROGRAM RESET.</li><li>4. If problem clears, reprogram the device.</li><li>5. If indication remains, replace the timer.</li></ol>
<p>The display is flashing a G during normal operation.</p> 	<p>Indicates a shorted defrost termination switch on Terminal G. The control will default to its timed termination point.</p> <ol style="list-style-type: none"><li>1. Verify wiring of defrost termination switch.</li><li>2. Verify switch operation, and replace defrost termination switch if necessary.</li><li>3. Once the defrost termination switch is operating normally, the flashing G will reset automatically. (This may take one defrost cycle to reset.)</li></ol>

# Defrost Control Manufacturers

- Defrost Manufacturers
  - Paragon®
  - Intermatic / Grasslin (DTMV)
  - Supco
  - Precision



**Precision Timer Co, Inc.**

# Manufacturer Analysis



Feature	Paragon Universal Defrost Timer	Grasslin DTMV40
Multi-Voltage (120/208-240V AC)	Yes – Direct wire to terminals	Yes – Requires setting switches
UL 873 Listed as refrigeration controller	Yes – Listed as a refrigeration controller. Requires life test to 30,000 cycles at temperature extremes.	No – Listed as an electrical controller. UL917 clock operated switch. Requires life test to 6,000 cycles at room temperature.
Easy Programing	Yes	Yes
System Status Indicators	Yes	Yes
Lighted Display	Yes	No
Real Time Clock	Yes – electronic	No
Power Loss Protection	Yes – Clock maintained by capacitor for 100 hours of lost power. Schedule stored in flash memory.	Optional – Can order battery backup which requires replacement.
Manual Defrost Initiation	Yes	No
Intuitive Display	Yes – Time and defrost schedule easy to understand.	No – Defrost duration is counter-clockwise.
Switch Ratings	Compressor – 1 HP @ 120V, 2 HP @ 240V Defrost Heater – 30 Amps resistive Fan – 1/4 HP @ 120V, 1/2 HP @ 240V, 15 Amps resistive	Compressor – 1 HP @ 120V, 2 HP @ 240V Defrost Heater – 40 Amps resistive Fan – 1 HP @ 120V, 2 HP @ 240V, 30 Amps resistive
Warning of Timer Failure	Yes	No
Informative Color Packaging	Yes	No



# Promotional Materials

**inven.sys**  
Controls

Thermostat, Heating, and Refrigeration Controls

Part Number 150-2228

**PARAGON**  
9000 Series MECHANICAL DEFROST TIMER

**Features and Benefits**

- Designed for control of mechanical defrost systems, Paragon Mechanical Defrost Timers have been designed to provide accurate defrost timing and control for up to 10 years longer than competitive offerings.
- Three minute manual defrost, as pressure or low temperature indicator available.
- 15 minute manual defrost, 45 and 90 minutes.
- Flashes at low time until Auto Reverse Cycle Defrost Control (ARC) stops the manual defrost at termination.
- Setpoint or Manual 15 Minute stops the manual defrost and resumes cooling or heating operation as programmed.
- Heavy duty construction with stainless steel and brass components.
- Flashes at low time until Auto Reverse Cycle Defrost Control (ARC) stops the manual defrost at termination.
- Also available in 15, 45 and 90 minute defrost times.
- 150 hours of power loss protection for both time and defrost schedule.
- Mechanism-only versions designed to fit in the standard Paragon enclosure.
- Wireless direct to 120V AC, 208V AC or 230V AC power sources without jampers or switches.
- Easy programming, easy set-up, set time, set defrost start and defrost end.
- Display shows defrost start time and duration.

**As Easy As 1-2-3**

1. Light Clock
2. Set Defrost
3. Set Time

**As Easy As 1-2-3**

1. Light Clock
2. Set Defrost
3. Set Time

Part No. 9000-1-0000 Series Converter  
1 Year Warranty

Part Number 150-2230

**PARAGON**  
9145 / 9045 Series UNIVERSAL DEFROST TIMERS

**Features and Benefits**

- The Paragon 9045-00 and 9145-00 Universal Defrost Timers are the only multi-voltage defrost timers engineered to meet global standards. At four defrosts per day, the Paragon Universal Defrost Timer switches last 10 years longer than competitive offerings.
- Complies to UL273 Standard for Temperature-Indicating and Regulating Equipment, as Refrigeration Controls.
- Wires directly to 120V AC, 208V AC or 230V AC power sources without jampers or switches.
- Includes 15 minute manual defrost.
- Easy programming, easy set-up, set time, set defrost start and defrost end.
- 100 hours of power loss protection for both time and defrost schedule.
- Display shows defrost start time and duration.
- Lighted display.
- Customer status indicators.
- Mechanism-only versions designed to fit in the standard Paragon enclosure.

**As Easy As 1-2-3**

1. Light Clock
2. Set Defrost
3. Set Time

**As Easy As 1-2-3**

1. Light Clock
2. Set Defrost
3. Set Time

Part No. 9045-1-0000 Series Converter  
1 Year Warranty

Part Number 150-1893

**PARAGON** Universal Defrost Timers

The Paragon 9045-00 and 9145-00 Universal Defrost Timers are the only multi-voltage defrost timers engineered to meet global standards. At four defrosts per day, the Paragon Universal Defrost Timer switches last 10 years longer than competitive offerings.

**Features**

- Real time clock
- Includes 15 minute manual defrost
- System status indicators
- Lighted display
- 100 hours of power loss protection for both time and defrost schedule
- Mechanism-only versions designed to fit in the standard Paragon enclosure
- Certified to UL273 Standard for Temperature-Indicating and Regulating Equipment, as Refrigeration Controls
- Wires directly to 120V AC, 208V AC or 230V AC power sources without jampers or switches
- Easy programming, easy set-up, set time, set defrost start and defrost end
- Display shows defrost start time and duration

**Conversion Diagrams for Paragon Mechanical Controls**

Ordering Information:

- 9145-00 Time Initiate/Temperature, Pressure Terminate Defrost Timer with Metal Enclosure
- 9145-00M Time Initiate/Temperature, Pressure Terminate Defrost Timer - Mechanism Only
- 9045-00 Time Initiate/Time Terminate Defrost Timer with Metal Enclosure
- 9045-00M Time Initiate/Time Terminate Defrost Timer - Mechanism Only

Prody made in the USA.

Part Number 150-2147

# Poll Question #2

What is the difference in part numbers ending in 00 vs. 20?

- Frequency**
- Voltage**
- Contact state**

The UL standard used for temperature regulating (refrigeration) equipment is UL873.

- True**
- False**

The Paragon 9145-00 defrost control will terminate a defrost cycle based on which of these inputs?

- Pressure**
- Temperature**
- Time**
- All of the above**

What input voltage will not power a Paragon electronic UDT?

- 24 VAC**
- 120 VAC**
- 208 VAC**
- 240 VAC**

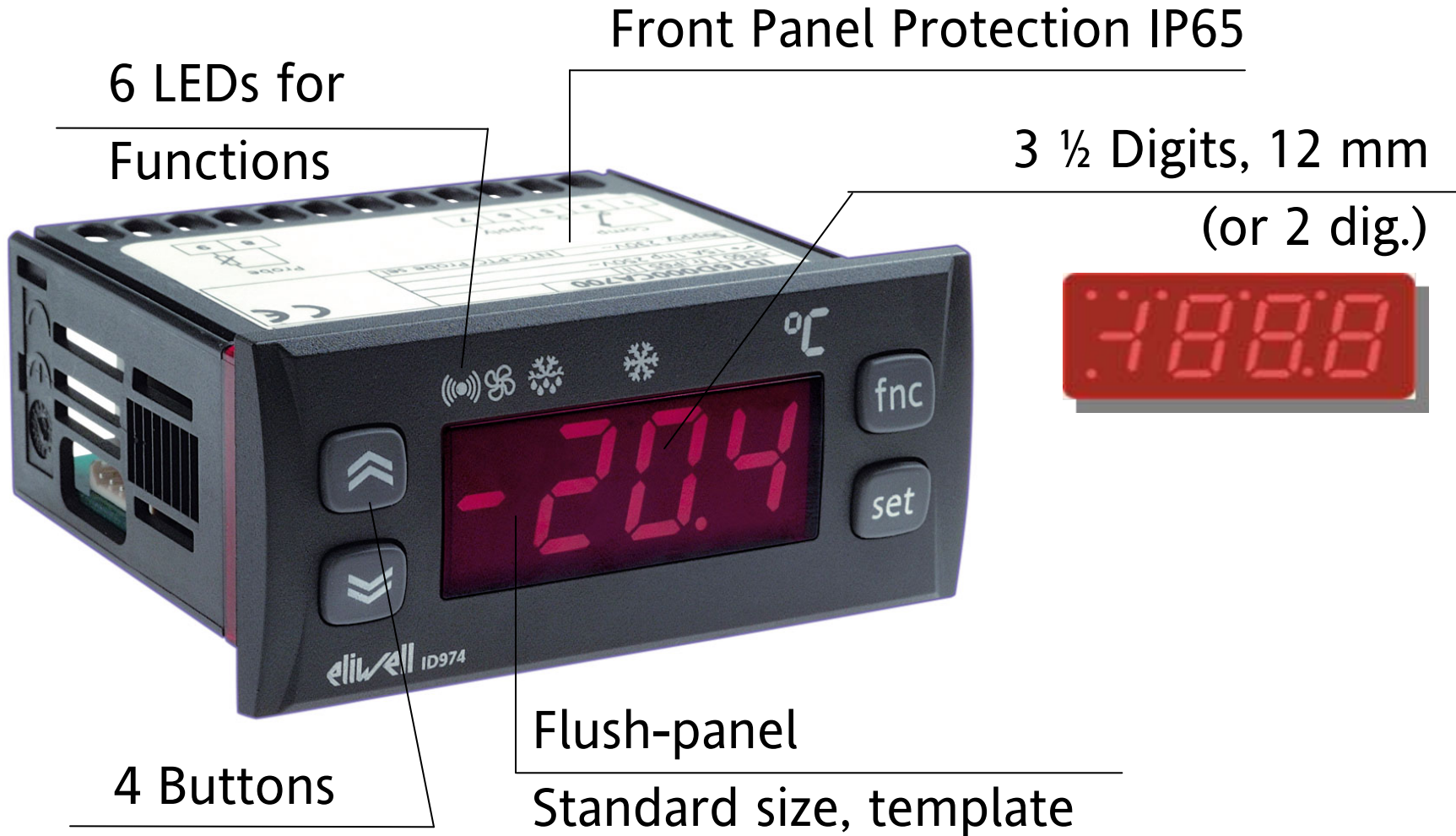
# Digital Controllers



- Digital refrigeration and defrost controllers
- Self-contained refrigerated cases
- Low or med temperature applications



# Eliwell™ Digital Controllers



# Applications

- Refrigeration Temperature Control
  - Compressor or solenoid valve control
- Thermostat functionality
- Defrost Control
- Optional Evaporator Fan Control
- Optional Alarm Relay Output
- Optional Evaporator Temperature Sensor for Defrost Termination and Fan Control
- Optional third Temperature Sensor
- Optional configurable Digital Input(s)

# Eliwell™ Features

- Easy installation and configuration
- 12V AC/DC, 24V AC/DC, 120V AC or 230V AC power supply versions
- Copy Card accessory – Copies configuration from one controller to another
- Configurable PTC/NTC temperature sensor input
- Front protection rate IP65 (NEMA5 to NEMA6)
- Versions for direct drive of compressor, up to 2HP
- Remote communication capability – Optional through Televis System, HACCP management

# Manufacturers of Digital Controllers

- Eliwell™
- Dixell
- Carel
- Danfoss - EKC series
- Technologic
- Love Controls
- Full Gauge Controls
- LAE
- Alreha

# Troubleshooting Defrost Timers

## Purpose of the Timer

- Shut off the refrigerator's compressor and evaporator fan motor
- Turn on the defrost system at regular intervals to rid the evaporator of frost.

## How They Fail

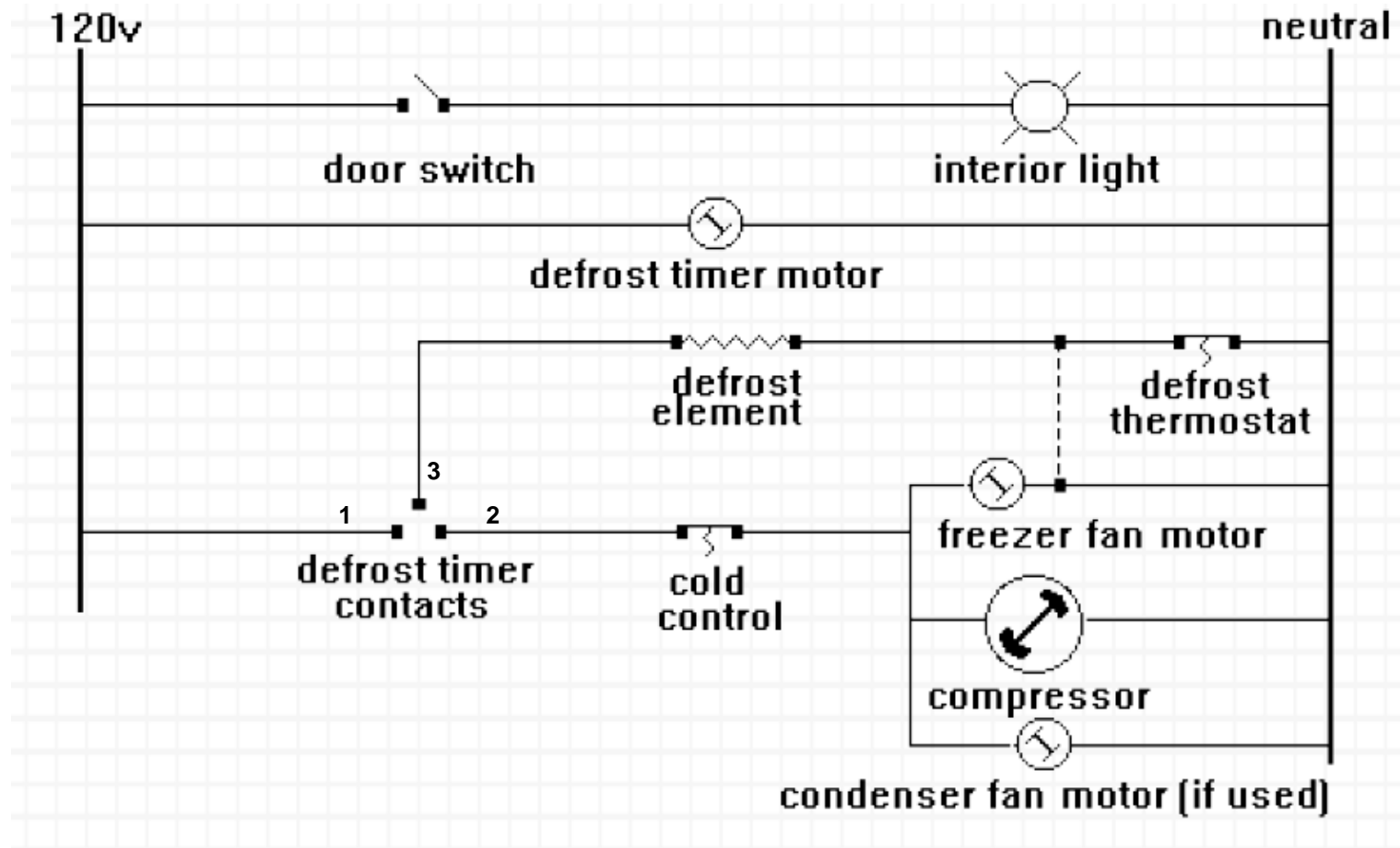
- Timer motor, motor bearing, or reduction gears wear out
- Occasional or constant noise comes from the part
- Runs sometimes but not others, causes occasional frost to build up gears jam or bearing piles up, timer stops rotating
- Motor coil burns out and becomes an open circuit, timer stops rotating
- Burnt out contacts stick together causing: run and defrost



# Troubleshooting Defrost Timer

- If timer stops in run cycle
  - Refrigerator fails to automatically defrost
  - Evaporator builds up with frost
  - Restricts air flow
- If timer stops in defrost part of the cycle
  - Food in the freezer thaws
  - Refrigerator components do not operate

# Troubleshooting Exercise - Electrical



# Unit Cooler Troubleshooting Tips

- Observe unit cooler conditions and collect current operation information.
- Correct unrestricted airflow is mandatory with all evaporators.
- Suction pressure at the evaporator is necessary in order to correctly calculate superheat at the Thermostatic Expansion Value (TXV).
- Check feeding supplied to the evaporator by the TXV and distributor assembly.
- The ability of the evaporator to efficiently exchange heat is totally dependent on having a fully active coil as near to saturated suction temperature of the refrigerant as possible.
- Remember superheat can be correct with incorrect refrigerant distribution.

# Unit Cooler Troubleshooting Tips

- Check electrical compartment for proper operation.
- Ice accumulations inside the compartment resulting in moisture to flow into the compartment condensing on all cold components.
- This can result in large ice or frost accumulation inside the compartment or conduit.
- This condition can affect defrost termination and fan control operations, which can leave defrost heaters operating longer than needed, resulting in heaters creeping or coming out of heater slots.
- Defrost heaters can suffer damage resulting from ice or frost which can damage electrical wiring.

# Troubleshooting Tips Continued

- Suction pressure, suction line temperature, liquid line pressure, liquid line temperature, and correct operating charge at the condensing unit are necessary to properly make a complete system diagnosis.
- Correct superheat range at the compressor is the only crucial superheat that really matters in refrigeration.
- Superheat at discussed compressor should be between 15° and 35° F in order to protect the compressor from flooding or possibly more importantly overheating.
- Superheat for scroll compressors should be between 10° to 20° F.
- Serious compressor damage can result from operating outside the above conditions.
- Frost at the compressor does not necessarily mean low superheat, and no frost at the compressor certainly does not mean there is sufficient superheat.

# Find Refrigeration Products on Website

## Sub Categories for: Refrigeration

[ID-Digifrost Controllers](#)  
[IS Split Controllers](#)  
[IC-Universal Controllers](#)  
[Controller Accessories](#)  
[Televis Communication Software for ID, IS and Commercial Refrigeration Defrost Controls](#)  
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[Cold Controls](#)  
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[Cold Controls Canadian Models](#)  
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[Pressure Temperature Controls](#)  
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Go to [www.Uni-Line.com](http://www.Uni-Line.com)

Click on [Refrigeration](#)

# Website Tools: [www.Uni-Line.com](http://www.Uni-Line.com)

The screenshot shows the Uni-Line website interface. At the top, the 'UNI-LINE' logo is on the left, and 'About Us', 'Careers', and 'Contact Us' are on the right. Below the logo is a navigation bar with 'Uni-Line Home', 'Products', 'Customer Support', and 'Online Services'. On the left side, there is a 'Search Options' section with a search box labeled 'By Part # or Keyword', a 'Categories' dropdown menu set to 'Thermostats', and an 'Advance Search' button. An arrow points from the text 'Enter part numbers' to the search box. The main content area features a 'Welcome to the Uni-Line Catalog' message, followed by a paragraph about product data access and links to literature, cross-reference guides, and an FAQ Knowledge Database. To the right of this text is a 'PARAGON' advertisement for universal controls, with a 'Click for details' button. Below the welcome message is a three-column menu structure:

Product Categories	Customer Support	Online Services
Thermostats	Customer Service	Customer Toolbox
Zoning	Technical Service	Product Cross Reference
Indoor Air Quality	Dealer Price Information	Distributor Locator
Alarms and Detectors		Publication Zone
Heating		Contractor ID
Refrigeration		
Cooking		
Laundry		
Time and Energy Controls		

An arrow points from the text 'Click here for more information' to the 'Refrigeration' link in the Product Categories column. Another arrow points from the text 'Cross reference' to the 'Product Cross Reference' link in the Online Services column.

Enter part numbers

Click here for more information

Cross reference

# When You Have Uni-Line® Questions

## Telephone:

Technical Service	1-800-445-8299
Technical Service Fax	1-630-260-7294
Customer Service	1-800-304-6563
Customer Service Fax	1-800-426-0804

## Websites:

Uni-Line® Catalog: [www.Uni-Line.com](http://www.Uni-Line.com)

Cross Reference: [www.uni-line.com/modules/xref/xrefsearch.aspx](http://www.uni-line.com/modules/xref/xrefsearch.aspx)

### General Information for:

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