



SECTION 1

GENERAL INFORMATION

INTRODUCTION

This Technical Service Manual has been compiled to provide the most recent service information on the Sub-Zero Pro Series (Currently only the model 648PRO). This information will enable the service technician to troubleshoot and diagnose malfunctions, perform necessary repairs, and return a unit to proper operational condition.

The service technician should read the complete instructions contained in this manual before initiating any repairs on a Pro Series Unit.

IMPORTANT SAFETY INFORMATION

Below are Product Safety Labels used in this manual. The "Signal Words" used are **WARNING** or **CAUTION**.

When reviewing this manual, please note these different Product Safety Labels placed at the beginning of certain sections of this manual. You must follow the instructions given in the boxes of the Product Safety Labels in order to avoid personal injury and/or product damage.

The sample Product Safety Labels below illustrate the precautions that should be taken when the signal word is observed.

⚠ WARNING
INDICATES THAT HAZARDOUS OR UNSAFE PRACTICES COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH.

⚠ CAUTION
Indicates that hazardous or unsafe practices could result in minor personal injury, and/or product damage, and/or property damage.

In addition, please pay attention to the signal word **"NOTE"**, which highlights information that is especially important for the topic being covered.

This manual is designed to be used by Authorized Service Personnel only. Sub-Zero Freezer Co., Inc. assumes no responsibility for any repairs made on Sub-Zero refrigeration units by anyone other than Authorized Service Technicians.

TECHNICAL ASSISTANCE

If you should have any questions regarding the 600-2 Series and/or this manual, please contact:

*Sub-Zero Freezer Company, Inc.
ATTN: Service Department
P.O. Box 44988
Madison, WI 53744 - 4988*

*Customer Service & Parts / Warranty Claims
Phone #: (800) 222 - 7820*

*Technical Assistance
Phone #: (800) 919 - 8324*

*Customer Service & Technical Assistance
Facsimile #: (608) 441 - 5887*

*Parts / Warranty Claims
Facsimile #: (608) 441 - 5886*

*Service Department E-Mail Address:
customerservice@subzero.com*

*Office Hours:
7:00 AM to 7:00 PM Central Time
Monday through Friday*

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WARRANTY INFORMATION

This page contains a summary of the 2, 5 & 12 Year Warranty that is supplied with every Model 648PRO unit. This is followed by a summary of the two special warranties: The *Non-Residential Warranty* which applies to units installed in non-residential applications, and the *Display/Model Home Warranty* which applies to distributor or dealer display units and units in model homes, sold three years after date of manufacture. The last entries on this page are details and notes about the warranties.

TWO, FIVE & TWELVE YEAR Warranty Summary

- Two year TOTAL PRODUCT warranty, *parts and labor.
- Five Year SEALED SYSTEM warranty, **parts and labor.
- Sixth through Twelfth year LIMITED SEALED SYSTEM warranty, sealed system **parts only.

ONE & FIVE YEAR Non-Residential Warranty Summary (Example: Office, Yacht, etc.)

- One Year TOTAL PRODUCT warranty, *parts and labor.
- Five year LIMITED SEALED SYSTEM warranty, sealed system **parts only.

ONE & FIVE YEAR Display/Model Home Warranty Summary (Display units sold three years after date of manufacture)

- One Year TOTAL PRODUCT warranty, *parts and labor.
- Five year LIMITED SEALED SYSTEM warranty, sealed system **parts only.

Warranty Details:

- * "Total Product Parts" includes, but is not limited to the following:
Electronic Control System Components, Fan & Light Switches, Fan Motors & Blades, Defrost & Drain Heaters, Defrost Terminator, Drain Pan, Drain Tubes, Wiring, Light sockets & bulbs, Icemaker, Water Valve, Door hinges, Door closers & Cams, Compressor Electricals, etc. . .
- ** "Sealed System Parts" includes the following:
Compressors, Condenser, Evaporators, Filter-Driers, Heat-exchangers, All Tubing that Carries the Freon.

NOTE: Condenser Fan Motors, Freon, Solder and compressor electricals are NOT considered sealed system parts.

Warranty Notes:

- All warranties begin at the time of the unit's initial installation.
- All Warranty and Service information collected by Sub-Zero is arranged and stored under the unit serial number. This information is now also stored under the customer's last name. Sub-Zero requests that you have the model and serial number available whenever contacting the factory or parts distributor.
- The serial number tag on SIDE-BY-SIDE models is located by the top door hinge in the freezer compartment.
- The serial number tag on OVER-AND-UNDER models is located by the top door hinge in the refrigerator compartment.
- The serial number tag on ALL-REFRIGERATOR and ALL-FREEZER models is located by the top door hinge in the refrigeration compartment.

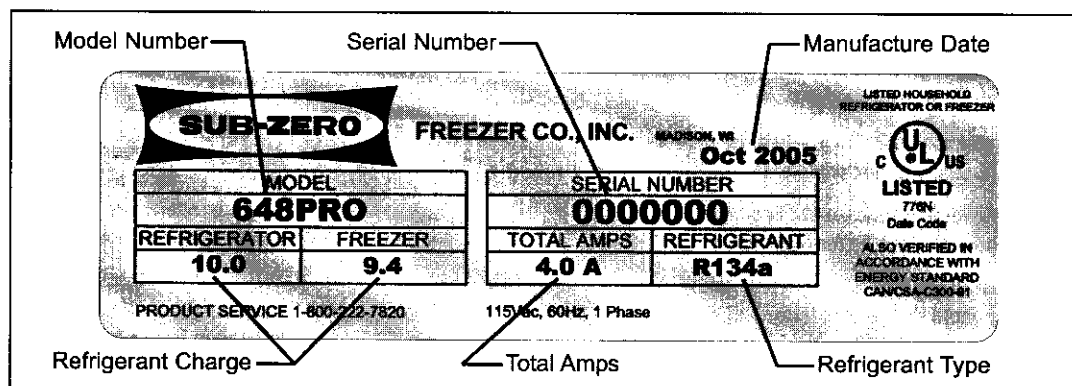
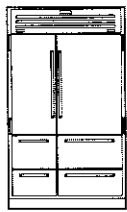
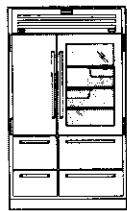


Figure 1-1. Serial Tag Layout (Reference Only, Numbers May Change)

648PRO Side-by-Side Refrigerator / Freezer Model Features



Model 648PRO



Model 648PROG
with Glass Door

Stainless steel
construction

Easy-access grille

Water filter

Alarm

Advanced
lighting

Auto-close
hinge system

Adjustable stainless
steel shelves

Automatic ice
maker

Dual refrigeration
system

Exterior temperature
display

Microprocessor and
interior control panel

Holiday mode

Triple-pane UV resist-
ant glass (648PROG)

Adjustable spill-proof
glass shelves

Slide-out stainless
steel bins

Crisper drawer

Drawers with
dividers

Model 648PROG shown

The Sub-Zero 648PRO side-by-side refrigerator/freezer is available in classic stainless steel and with a glass door on Model 648PROG. The 648PRO can be built-in or, with accessory kit, used in a free-standing application.

FEATURES

- ▶ Dual refrigeration—two compressors and three evaporators keep foods fresher longer and prevent odor transfer
- ▶ Exterior temperature display with easy-to-read digital readouts, accurate within one degree of your preset temperatures
- ▶ Microprocessor and interior control panel with up-front touch controls monitor pattern-sensing defrost and automatic service alerts
- ▶ Holiday mode—power down one or both sides for short or extended periods
- ▶ Slide-out stainless steel bins—two, removable bins that fit neatly under any shelf
- ▶ Crisper drawer is a touch-and-glide crisper with a tight-seal glass lid for high humidity
- ▶ Drawers have adjustable, removable, and interchangeable drawer dividers
- ▶ Automatic ice maker lets you retrieve filtered ice from a stainless steel bucket
- ▶ Shelves are cantilevered and spill-proof, with stainless steel trim (refrigerator); adjustable, removable and 100% stainless steel (freezer)
- ▶ Auto-close system with an advanced hinge design lets doors finish closing automatically
- ▶ Alarm with an audible beep lets you know when doors or drawers are left ajar
- ▶ Water filter is easy to replace and just behind the pop-up grille, for ice as pure as it is fresh
- ▶ Easy access grille pops up to reveal the water filter and condenser for cleaning
- ▶ Stainless steel construction and classic finish (inside and out) for professional strength and beauty
- ▶ Top LED lights bathe upper compartments in a soft glow; on the refrigerator side, channeled sidewall LEDs can even serve as door area night lights (night light option available on Model 648PROG only)
- ▶ Triple-pane UV resistant glass offers convenient visibility while filtering harmful rays and saving energy (Model 648PROG)
- ▶ UL approved for US and Canada
- ▶ Two, five and twelve year residential warranty (exclusions apply), see warranty

SPECIFICATIONS	
Model 648PRO	Side-by-Side Refrigerator/Freezer
Model 648PROG	Side-by-Side Refrigerator/Freezer with Glass Door
Overall Width	48" (1219)
Overall Height	84" (2134)
Depth from behind face frame	23 7/8" (606)
Depth to front of face frame	25 7/8" (657)
Refrigerator Capacity	18.4 cu ft (521 L)
Freezer Capacity	1.7 cu ft (331 L)
Minimum Height (levelers in)	83 1/2" (2121)
Door Swing Clearance	28 3/4" (730)
Electrical Requirements	115 V AC, 60 Hz 15 amp dedicated circuit
Plumbing Requirements	1/4" copper line
Water Supply	35 psi (2.4 bar) to 120 psi (8.3 bar)
Annual Energy Usage (based on 8.29 cents per kilowatt hour)	689 kWh / \$58
Shipping Weight	648PRO 860 lbs (390 kg) 648PROG 875 lbs (397 kg)
<i>Specifications are subject to change without notice.</i>	

General Information

Pro-Series (648PRO)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no text or other markings on the paper.



SECTION 2

INSTALLATION INFORMATION

RECOMMENDED TOOLS AND MATERIALS

Below is a list of tools and materials that should be used during the installation of a Pro Series Unit.

- Phillips screwdriver set
- Slotted screwdriver set
- Copper tubing cutter
- 4' (1219 mm) of 1/4" (6 mm) copper tubing and water line saddle valve.
- Saddle valve for the water line (Part #4200880)
- Level 2' (610 mm) and 4' (1219 mm) are recommended.
- Appliance Dolly - able to support 1,000 lbs (454kg) with proper manpower to handle weight.
- Various sized pliers
- Wrench set
- Allen wrench set
- 1/2" (13 mm) drive socket set, with 10" (254 mm) socket extension.
- Crescent wrenches
- Cordless drill and assorted drill bits
- Masonite, plywood, 1/8" pressed fiberboard or cardboard or some other suitable material for floor protection.
- Moving blankets for protection of product and home.
- 6-Lobe (Torx) drive bits, or 6-Lobe screwdrivers (Sizes: T-10, T-15, T-20, T-25)

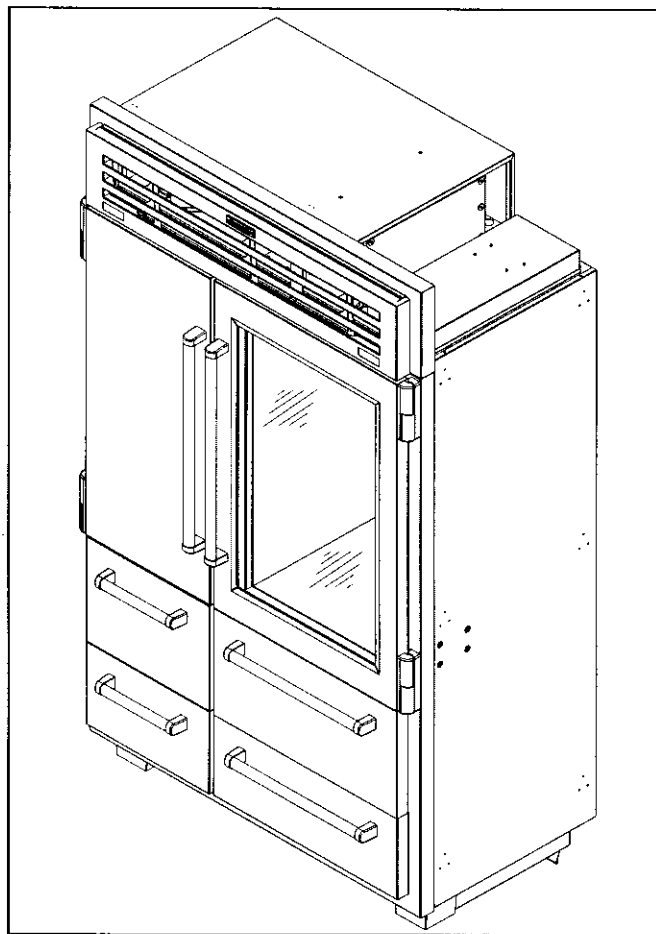


Figure 2-1.



UNIT DIMENSIONAL INFORMATION

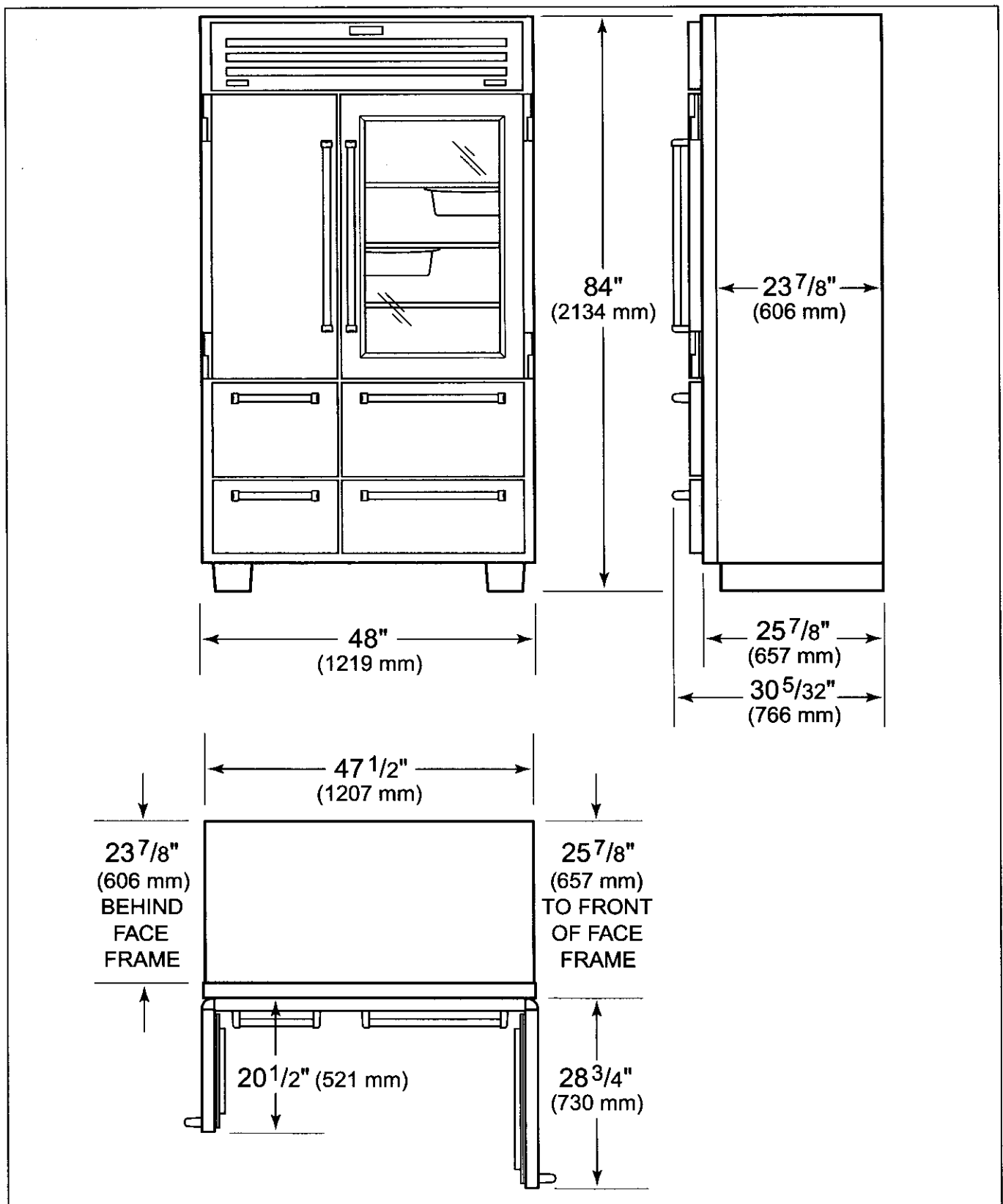


Figure 2-2. Front, Side and Top View

PRE-INSTALLATION SPECIFICATIONS

Preparing the Space

NOTE: Make sure floor under appliance is level with surrounding finished floor. Protect finished floor with masonite, plywood, 1/8" (3 mm) pressed fiberboard, or some other suitable material before moving the appliance across it.

Electrical Requirements

To rough in the electrical outlet following the Pre-Installation Specifications. You will need a 115 Volt, 60 Hertz electrical supply, with a dedicated 15 Amp fuse / circuit breaker. Also be sure to follow any local codes that apply.

The appliance comes with a three-prong grounded plug power supply cord. The appliance must be plugged into a mating three-prong wall receptacle grounded in accordance with the National Electrical Code and local codes.

Plumbing Requirements

The unit has an automatic ice maker with a water filtration system, which operates on water pressure between 35 psi (2.4 bar) and 120 psi (8.3 bar). If the filtration system is bypassed, water pressure must be maintained between 20 psi (1.4 bar) and 120 psi (8.3 bar).

Rough in the water supply using 1/4" OD copper tube. The water line should be routed up through the floor within 1/2" (13 mm) from back wall and no higher than 3" (76 mm) off the floor. If coming through the wall, make sure the water line is no more than 3" (76 mm) from the floor. Regardless of the routing, allow 3' (914 mm) excess copper tubing outside the wall or floor for easy connection to the unit.

Locate water supply line within shaded area indicated in the Pre-Installation Specifications diagram.

Use an easily accessible shut-off valve between the water supply and unit. Do not use self-piercing valves. A saddle valve kit (part #4200880) is available from a Sub-Zero dealer.

It is not recommended that the appliance be connected to a softened water supply. Chemicals, such as salt from a malfunctioning softener, can damage the ice maker and lead to poor ice quality. If a softened water supply cannot be avoided, be sure the softener is well maintained and operating properly.

NOTE: Do not use with water that is microbiologically unsafe or of unknown water quality without adequate disinfection before or after the system.

Systems certified for cyst reduction may be used on disinfected waters that may contain filterable cysts.

NOTE: Installations must meet local plumbing code requirements.

NOTE: A reverse osmosis system can be used, if there is constant water pressure of 20 psi (1.4 bar) to 120 psi (8.3 bar) supplied to the unit at all times. In this application, the integrated water filtration system must be set to bypass mode.

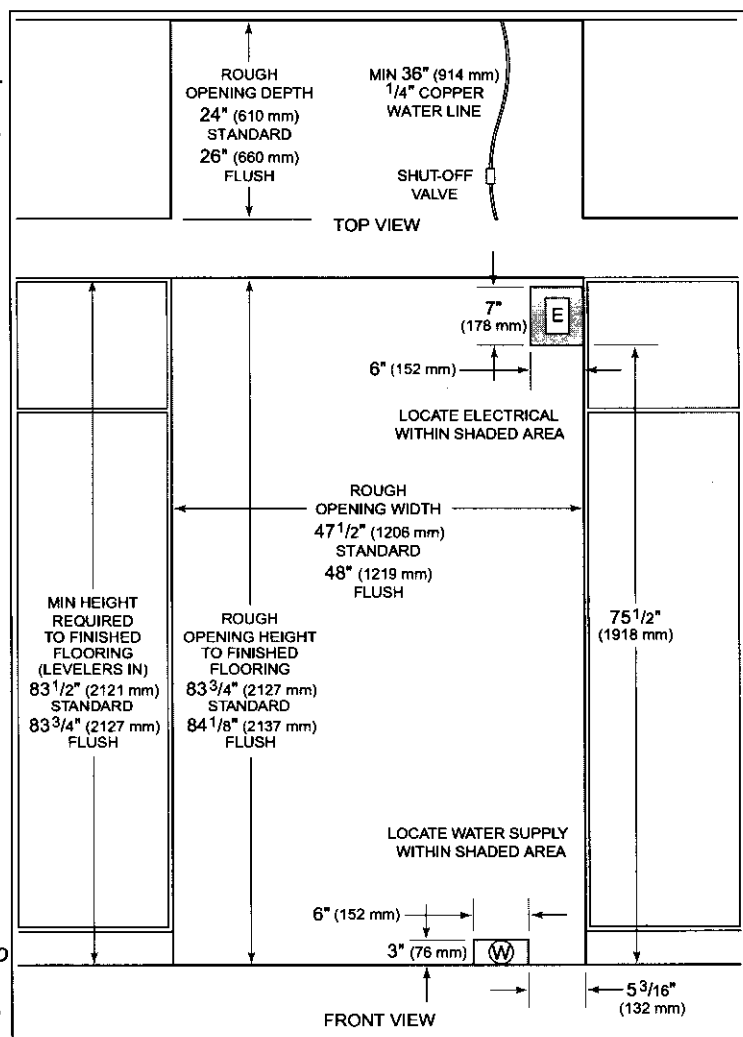


Figure 2-3. Pre-install Specifications

MOVING THE APPLIANCE

After uncrating the unit, do not discard the kickplate that is taped to the side of the refrigerator. Do not discard the Anti-Tip Kit or hardware, you will need them to block the installation.

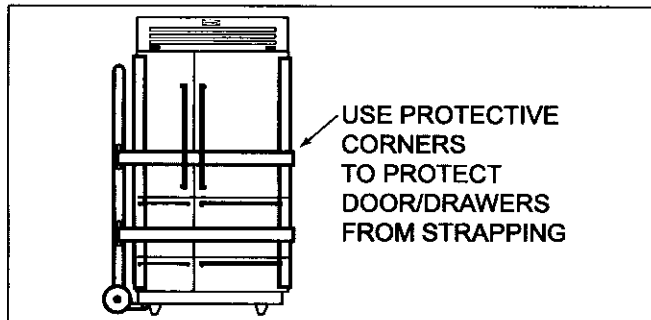
Carefully move the unit from the crate base onto an appliance dolly. Tip to one side removing styrene pads under unit. Tip back onto appliance dolly. Retract leveling legs to their uppermost position for easy movement of the unit while installing. Remember this unit is very heavy (900lbs/408kg) and enough manpower should be used when attempting to move this equipment.

Protect the Flooring

Make sure the floor under the refrigerator is level with the surrounding finished floor. Pushing the unit with front leveling legs down will cause damage to the floor. Make sure the leveling legs are in the uppermost position prior to moving the product. Protect a finished floor with masonite, plywood, 1/8"(3) pressed fiberboard or some other suitable material before moving the refrigerator across it.

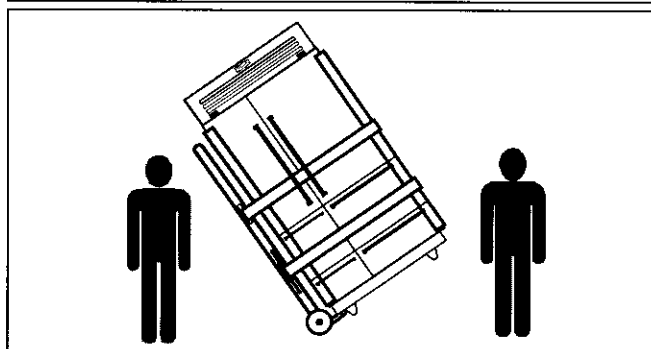
⚠ CAUTION

Protect any finished flooring before moving the unit in place. This Sub-Zero product is equipped with rollers, so it can be easily moved into place. If for any reason the unit has been laid on its back side, you must allow the unit to stand upright for a minimum of 24 hours before connecting power.



⚠ WARNING

Product is very heavy (900 lbs/408kg) keep door(s) and drawer(s) closed while moving unit and use enough manpower to safely move unit.



⚠ CAUTION

When using appliance dolly, make sure the strapping is underneath the door handles and either underneath or over the top of drawer handles. Use enclosed corner protectors to avoid damage to stainless steel. Do not cut corner protectors when unpacking the product.

Removing the Grille

In order to prevent damage to the grille, the top grille assembly should be removed prior to moving the unit.

To remove the grille assembly, pull out on the bottom edge of the grille and tilt the grille frame forward (See Figure 2-4). Disconnect the low-voltage cable which connects the User Displays on the grille to the Technician Display Module, and cut the two white cable ties which attach the network cable to the right grille support. These cables ties should be replaced once the unit is properly installed with the extra cable ties provided. Remove the three 7/16" bolts from base of the grille. Remove the screw from the upper grille area and remove the grille assembly.

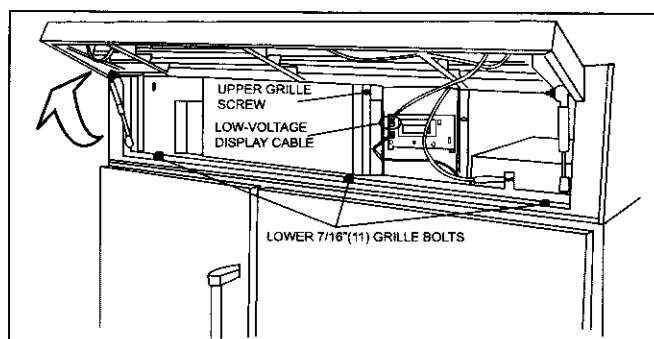


Figure 2-4. Grille Removal

INSTALLATION CONSIDERATIONS

This section covers common installation issues seen by Service Technicians. Improper installation, though not a valid service issue, has the potential to lead to a call for service.

NOTE: If additional information is needed, refer to the complete Installation Guide.

⚠ WARNING

- IF UNIT IS UNDER A SOLID SOFFIT AND CLEARANCE BETWEEN TOP OF UNIT AND SOFFIT IS GREATER THEN 1" (25.4 mm), OR IF SOFFIT IS NOT SOLID, UNIT COULD TIP FORWARD UNDER CERTAIN LOAD CONDITIONS. FAILURE TO INSTALL ANTI-TIP COMPONENTS AND EXTEND LEVELERS TO FLOOR ACCORDING TO INSTALLATION MANUAL COULD RESULT IN SERIOUS INJURY OR DEATH.
- MAKE SURE THERE ARE NO ELECTRICAL WIRES OR PLUMBING THAT THE SCREWS CAN COME INTO CONTACT WITH.

⚠ CAUTION

- Always wear safety glasses and other necessary protective devices or apparel when installing or working with anchors.
- Not recommended for use in light-weight masonry material such as block or brick. Use of core drills not recommended to drill holes for this anchor. Not recommended for use in new concrete which has not had sufficient time to cure.

Anti-Tip Components Installation
(See Figures 2-5, 2-6 and 2-7)

NOTE: The anti-tip bracket is included and fastened to crate base at the front of the unit.

NOTE: Use the center line reference point on the anti-tip bracket to assure proper alignment and engagement of the product to the anti-tip bracket.

1. Install anti-tip bracket exactly 26" (660 mm) from front face frame, centered in the rough opening.

NOTE: The 26" (660 mm) measurement is from the front face frame to the back of the anti-tip bracket.

2. Drill 6 pilot holes 3/16" (5 mm) diameter maximum for mounting anti-tip bracket to the floor.
3. Drill 6 pilot holes 3/16" (5 mm) diameter maximum, for mounting anti-tip bracket to wall a minimum of 3/4" (19 mm) into the wall plate.
4. Install twelve 12 x 2-1/2" (64 mm) wood screws and twelve 1/4" (6 mm) flat washers.

NOTE: If screws do not hit a wall stud in any of the upper holes of anti-tip bracket, use the provided #8 x 1-1/4" (32 mm) wood screw, 1/4" (6.1 mm) flat washer and a nylon zip-it wall anchor.

NOTE: For concrete floors use three 3/8 X 3-3/4" (10 mm x 95 mm) concrete wedge anchors to secure anti-tip bracket to floor. Use six #12 x 2-1/2" (64 mm) wood screws, and six 1/4" (6 mm) flat washers to secure anti-tip bracket to wall.

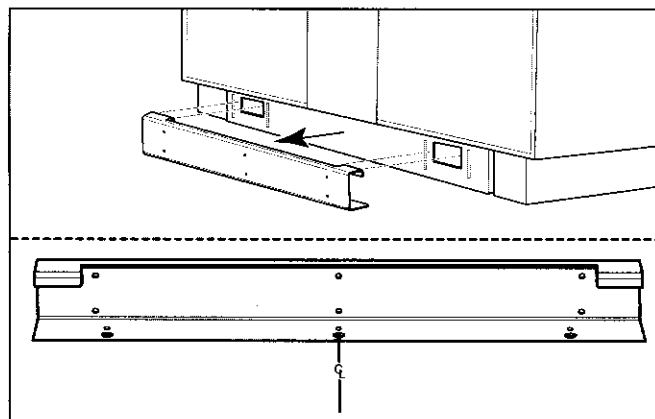


Figure 2-5. Center Line Reference

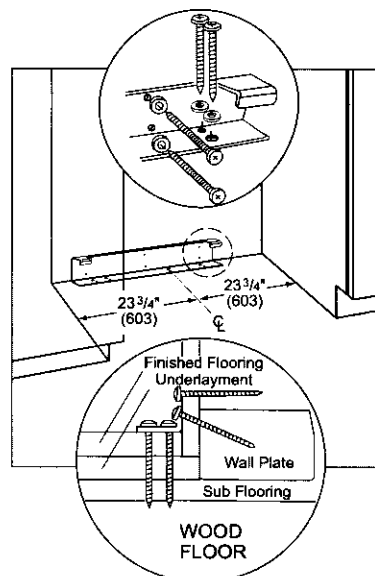


Figure 2-6. Anti-Tip, Wood Floor Mounting

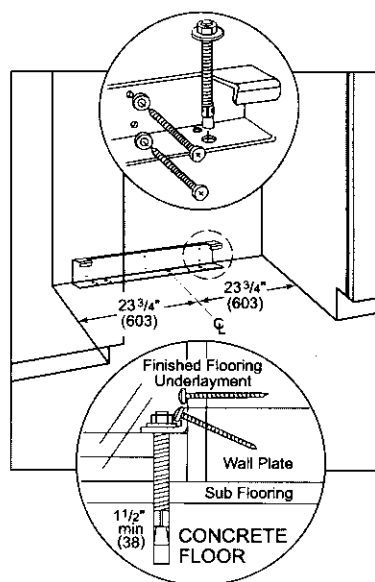


Figure 2-7. Anti-Tip, Concrete Floor Mounting

Unit Leveling (All Models)

NOTE: The rear levelers must be in their lowest position before unit is installed. Unit must be installed before final leveling. If unit is anchored to cabinets, remove anchor screws before leveling, reinstall after leveling.

1. To level unit, first remove kickplate (See Figure 2-8).
2. To raise unit front, turn front leveler legs clockwise to raise, counterclockwise to lower (See Figure 2-9).
3. Rear adjustment can be completed from the front of unit through unit base. To raise unit rear, use 3/8" (10 mm) socket wrench with an extension to turn rear leveling bolt clockwise to raise, counterclockwise to lower (See Figure 2-9).

NOTE: Level is best checked at top & side of main-frame.

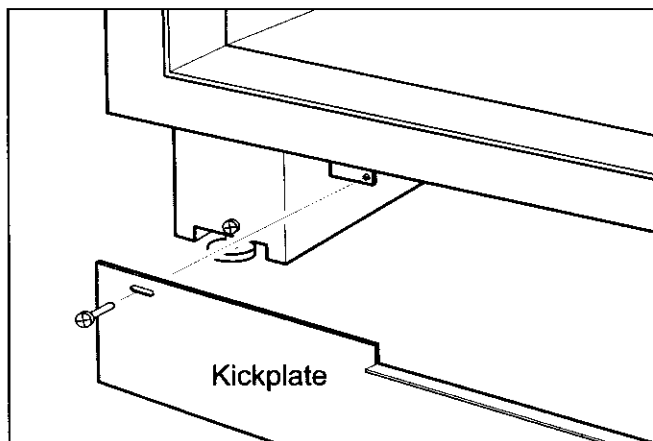


Figure 2-8. Kickplate Removal

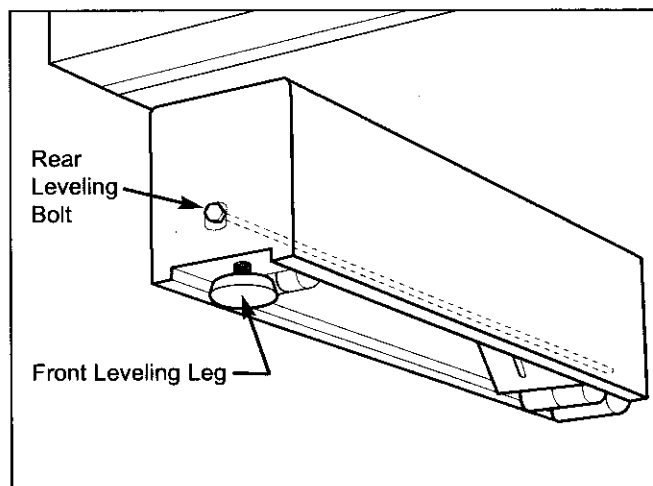


Figure 2-9. Unit Leveling

Door Adjustment

NOTE: Unit must be level before adjusting doors.

⚠ CAUTION

When adjusting hinges it is important to keep hinges parallel to the face of the door and side of the cabinet. Excessive misalignment will result in door switch malfunction. If switch is not activated the fan will not operate and lights will remain on. This will result in elevated cabinet temperatures. After hinge adjustments are made, check for proper functioning of door switch.

If unit is properly installed, blocked and leveled, it may still be necessary to adjust door(s) left to right. Adjustments are performed at top and/or bottom cabinet hinge(s).

1. Open the vent portion of the top grille.
2. Open door to about 90 degrees and lift door off the cabinet hinge assembly (See Figure 2-10).

⚠ CAUTION

Doors are very heavy. Use care and caution when removing them.

3. Remove hinge pins (See Figure 2-12).
4. Loosen the two cabinet hinge screws 1/4 to 1/2 turn (See Figure 2-12).
5. Reinstall hinge pin and door. With door open, use an Allen wrench, and turn adjustment screw to adjust cabinet hinge (See Figure 2-16).
6. Close door to check alignment.

NOTE: If additional adjustment is required repeat steps above.

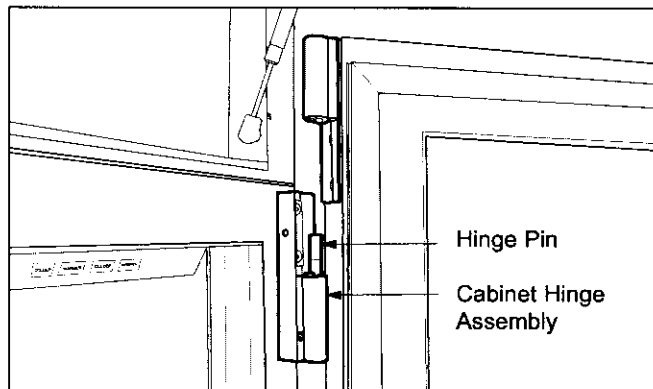


Figure 2-10. Door Removal

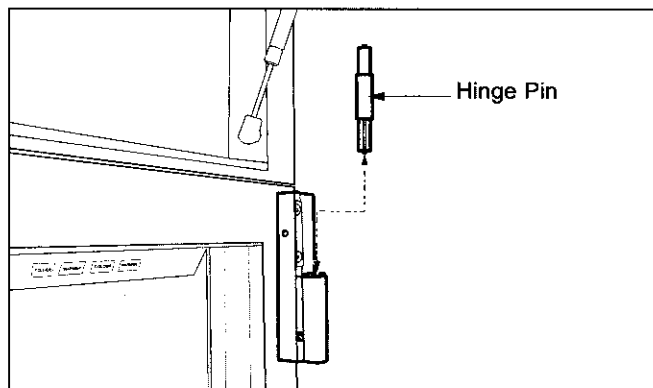


Figure 2-11. Hinge Pin Removal

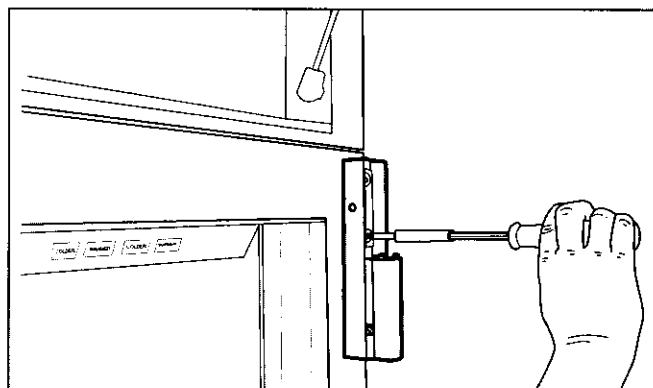


Figure 2-12. Loosen Cabinet Hinge Screws

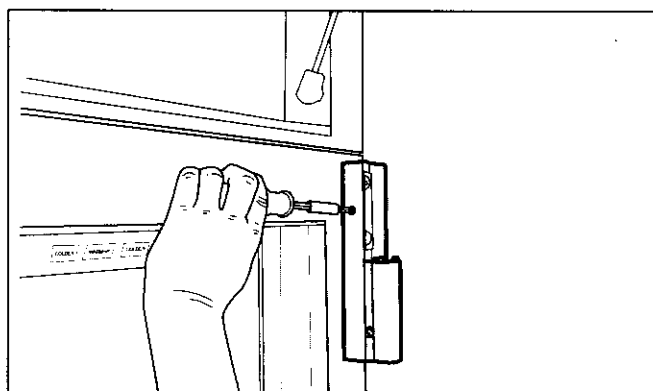


Figure 2-13. Cabinet Hinge Adjustment

Drawer Adjustments

Vertical Drawer Adjustment:

NOTE: Before attempting drawer adjustment, remove drawer assembly. Pull drawer assembly out, then lift at front and pull forward until drawer is free from unit. (See Figure 2-14)

1. Loosen drawer slide mounting screws. (See Figure 2-15)
2. Using a 7/16" (11 mm) open end wrench, turn adjustment screw until proper alignment is obtained. (See Figure 2-15).
3. After adjustment, tighten all screws, reinstall drawer assembly, then check door seal for proper gasket seating.

NOTE: Assure the drawer is fully engaged onto the tracks. Check alignment of the drawer closer. If the closer catch does not align with closer pin adjust the location of drawer closer.

Horizontal Drawer Adjustment:

NOTE: Before attempting drawer adjustment, remove drawer assembly. Pull drawer assembly out, then lift at front and pull forward until drawer is free from unit. (See Figure 2-14)

1. Loosen screws on the front two slide assemblies. (See Figure 2-16)
2. Move adjust blocks to desired location and tighten screws. (See Figure 2-16).
3. Release rear adjust block by disengaging snaps.
4. Move the block forward to shift drawer to the right, and back to move to the left. Each position will move the drawer .030" (.8 mm) (See Figure 2-16).

NOTE: Both sides should be moved in the same direction.

5. Snap the block over the pins located on the rear adjuster. (See Figure 2-16)
6. After adjustment, tighten all screws, reinstall drawer assembly, then check door seal for proper gasket seating.

NOTE: Assure the drawer is fully engaged onto the tracks. Check alignment of the drawer closer. If the closer catch does not align with the closer pin adjust the location of the closer.

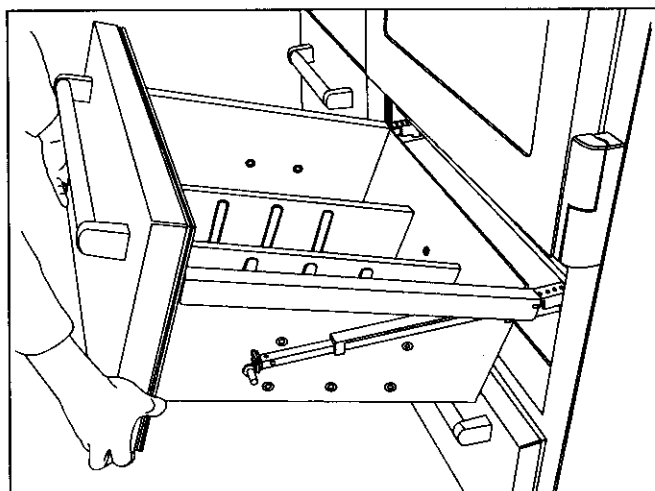


Figure 2-14. Drawer Assembly Removal

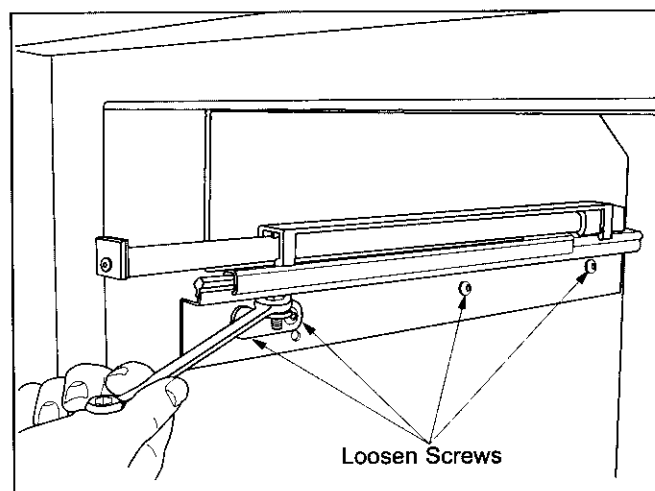


Figure 2-15. Vertical Drawer Adjustment

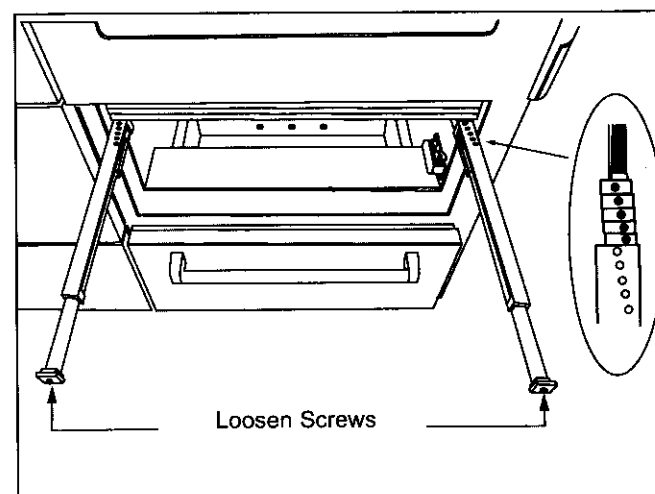


Figure 2-16. Horizontal Drawer Adjustment

Water Filter Bypass

If choosing not to use the water filtration system, the system can be bypassed by removing the water filter cartridge. If done, the water supplied to the ice maker will not be filtered and the electronically controlled water filter monitor will be deactivated.

Lift the grille to access the water filter cartridge by pulling out on the bottom edge of the grille, then tilt the grille frame forward (See Figure 2-17).

Slowly rotate the water filter cartridge 1/4 turn counter-clockwise to disengage. Gently twist until the cartridge is free from the base, DO NOT pull (See Figure 2-18). There will be water in the filter cartridge, so it is normal for a small amount of water to spill out.

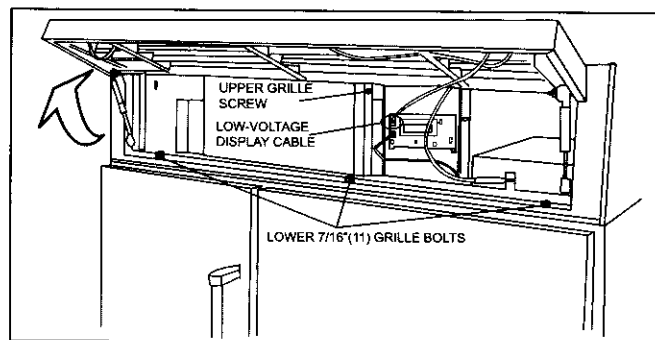


Figure 2-17. Grille Removal

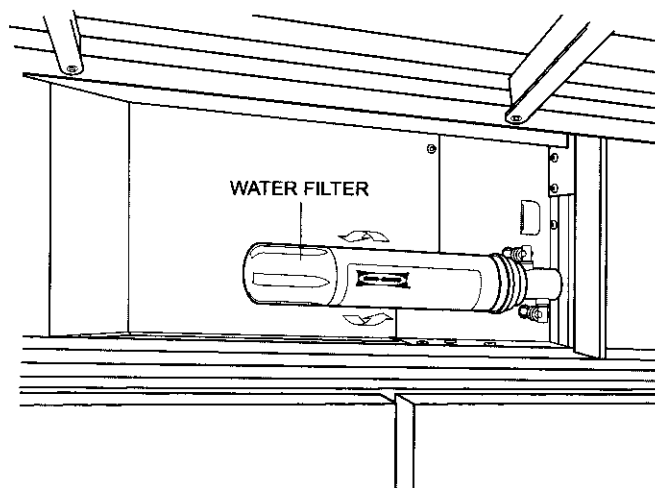


Figure 2-18. Water Filter Removal / Bypass

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SECTION 3

ELECTRONIC CONTROL SYSTEM INFORMATION

ELECTRONIC CONTROL TERMINOLOGY & COMPONENT DESCRIPTIONS

The model 648PRO utilizes an electronic control system which monitors, regulates, controls and displays a variety of functions and operations in the appliance.

The table below defines some of the basic electronic control system terminology.

Term/Component	Definition / Description
Main Control Board	(Also referred to as the Main "Controller" Board), is the printed-circuit board (PC Board) which contains a microprocessor, relays, triacs and electrical connections that monitor and control all functions of the appliance.
Microprocessor	An electrical component on the control board which receives electrical signals from other components, processes the information, then sends electrical signals to relays and triacs on the board to open or close, switching components in the appliance ON or OFF.
Relay	An electrical component on the control board which switches other components in the appliance ON or OFF when instructed to do so by the microprocessor.
Triac	Similar in function to the relay, the triac is a three terminal semiconductor for controlling current in either direction.
Control Panel Assembly	(Also referred to as the Control Keypad Interface), is that part of the electronic control system where all input operations are performed.
Membrane Switch	Part of the control panel assembly, which consists of the function keys.
Keys (Function Keys)	The "buttons" on the Membrane Switch used for input operations: "POWER", "ALARM", "ICE MAKER", "LIGHTS" and 3 sets of "WARMER" & "COLDER"
User Display Module	Those parts of the electronic control system, one at each bottom corner of the grille assembly, which display zone temperatures, mode and some error indicators.
Technician's Display Module	That part of the electronic control system, behind the grille assembly, which displays temperatures, along with mode, error and service text information.
LCD (Liquid Crystal Display)	A semi-liquid substance sandwiched between glass in the User and Technician's Display Modules. The molecules of this semi-liquid substance have no specific orientation. However, when electricity is applied to them, they react predictably, aligning and straightening in such a way as to control light passage.
Indicators	The words, numbers and icons that appear at the User Displays and the Technician's Display through the use of LCD's.
Error Codes	The code numbers that may appear on the Technician's Display when accessing Error Code History during Diagnostic Mode. Error Codes are logged if the unit experienced specific problems related to electrical signals supplied by electrical components. There are ninety-nine possible Error Codes, but only twenty can be stored at a time.
Temperature Units of Measure.....	Temperature observed at the User and Technician Displays may be in Fahrenheit units of measure (°F) or Celsius units of measure (°C). A series of key strokes allows the temperature units of measure to be switched to display as either °F or °C.
Set-Point	The desired zone temperature, established by pressing the COLDER or WARMER keys.
High Offset (Cut-in)	As the zone air temperature cycles up and down, the high offset is the maximum zone temperature that the electronic control system will allow before calling for cooling.
Low Offset (Cut-out).....	As the zone air temperature cycles up and down, the low offset is the minimum zone air temperature that the electronic control system will allow before interrupting cooling.
Thermistor	(Also Referred to as a Temperature Sensor), is a resistor with which resistance changes as the temperature around it changes. For electronic control system purposes, the microprocessor measures the resistance, then displays it as a temperature reading.
Variable Speed Compressor	A compressor that runs at varying speeds depending on the temperature detected in the corresponding zone(s) of the appliance.

ELECTRONIC CONTROL SYSTEM OVERVIEW

Below is the wiring schematic for the model 648PRO, illustrating the components of the electronic control system.

- Manual input operations are performed at the Control Panel (Keypad).
- Monitoring, regulating and controlling functions take place at the Main Control Board.
- Temperatures, mode activation icons and possibly error indicators are displayed on the left and right User Displays (Left and Right Display Boards) and the Technician Display (Tech Display).

The entire electronic control system is described in greater detail on the following pages.

NOTE: For more detailed electrical diagrams refer to the wiring diagram and schematic supplied with the unit.

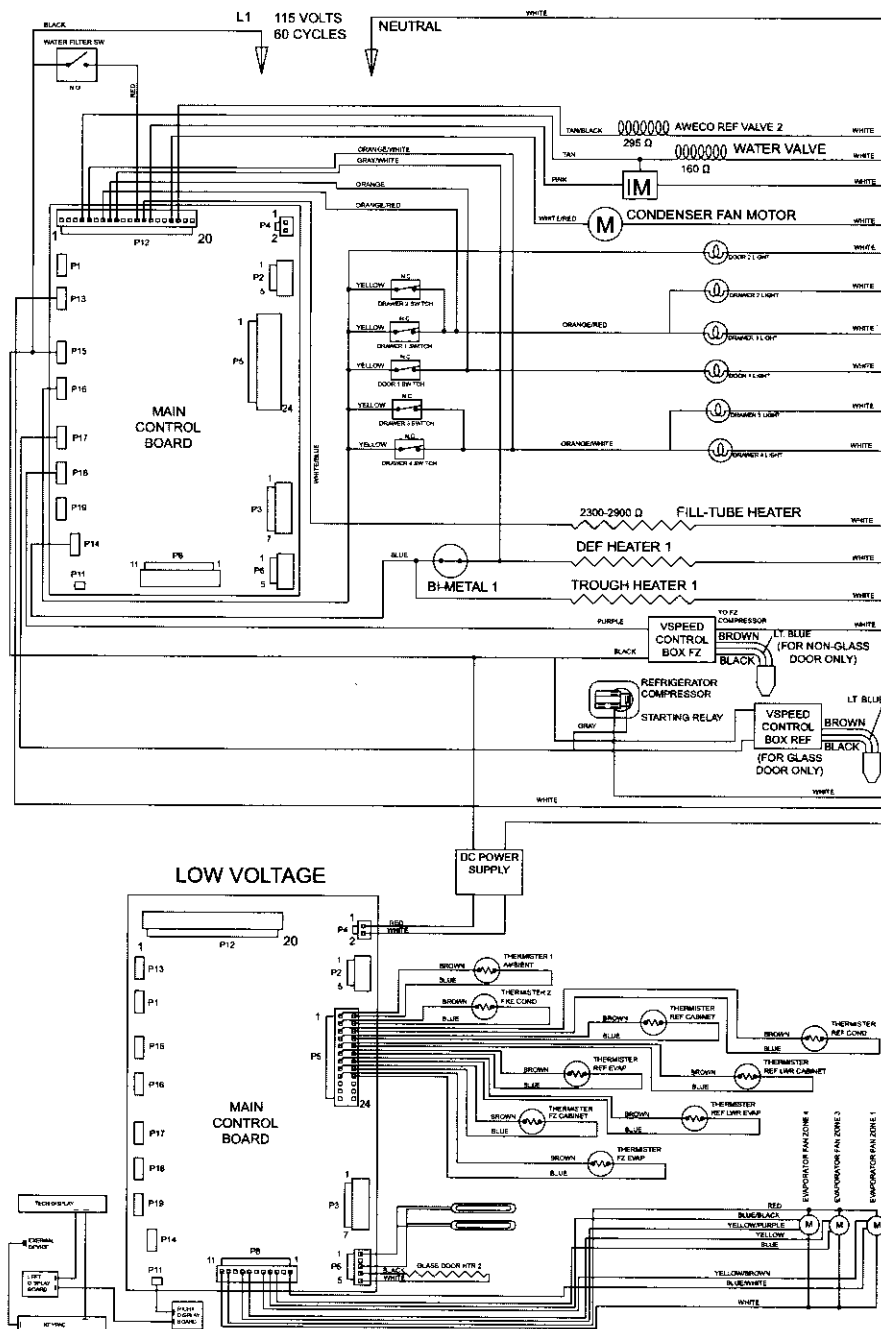


Figure 3-1. Wiring Schematic

CONTROL BOARD LAYOUT AND SUMMARY TABLE

The electrical connection points on the main control board are labeled alphanumerically. These labels correspond with the alphanumeric control board summary table, located on wiring diagrams. By referencing the summary table, it is possible to identify which components are connected at which connection points on the main control board. Below is a layout diagram of the control board and a copy of a summary table (See Figures 3-2 & 3-3).

NOTE: All components on control board are non-replaceable. If problems with control board are identified, the complete control board must be replaced.

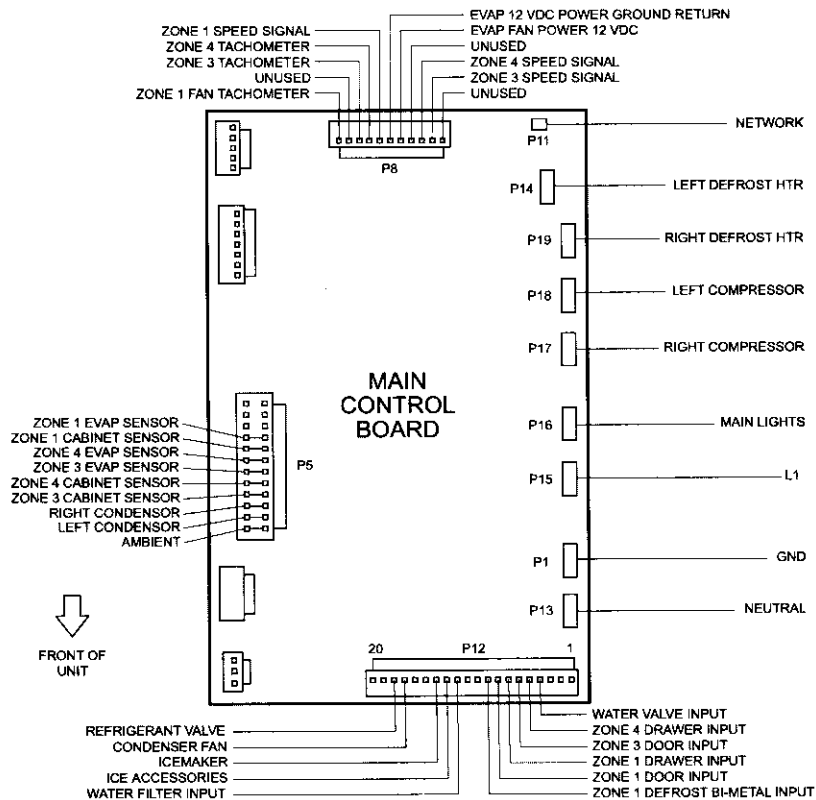


Figure 3-2. Control Board Layout

CIRCUIT	DESCRIPTION	FUNCTION	COLOR
P13	120 VOLT CIRCUITS	NEUTRAL INTO BOARD	WHITE
P14	DEFROST HEATER 1	POWERS DEF HTR 1	BLUE
P15	POWER IN	POWER INTO BOARD	BLACK
P16	MAIN LIGHTS	POWERS MAIN LIGHTS	YELLOW
P17	COMPRESSOR REF	POWERS REF COMPRESSOR	GRAY
P18	COMPRESSOR FREEZER	POWERS COMPRESSOR FRZ	PURPLE
P19	UNUSED	UNUSED	UNUSED
P12-1	UNUSED	UNUSED	UNUSED
P12-2	UNUSED	UNUSED	UNUSED
P12-3	UNUSED	UNUSED	UNUSED
P12-4	WATER VALVE INPUT	SENSES WATER VALVE ACTIVATION	TAN
P12-5	ZONE 4 DRAWER INPUT	SENSES IF ZONE 4 DRAWERS ARE OPEN	UNUSED
P12-6	ZONE 3 DOOR INPUT	SENSES IF ZONE 3 DOOR OPEN	UNUSED
P12-7	ZONE 1 DRAWER	UNUSED	UNUSED
P12-8	ZONE 1 DOOR	UNUSED	UNUSED
P12-9	DEF BI-METAL 1	SENSES WHEN HEATER 1 SHUTS OFF	GRAY/WHITE
P12-10	UNUSED	UNUSED	UNUSED
P12-11	UNUSED	UNUSED	UNUSED
P12-12	WATER FILTER INPUT	SENSE WATER FILTER	RED
P12-13	ICE ACCESSORIES	POWERS FILL TUBE AND ACCESSORIES	WHITE/BLUE
P12-14	ICE MAKER	POWERS ICE-MAKER	UNUSED
P12-15	UNUSED	UNUSED	UNUSED
P12-16	UNUSED	UNUSED	UNUSED
P12-17	CONDENSER FAN	CONDENSER FAN	WHITE/RED
P12-18	AWECO VALVE 2	POWERS AWECO VALVE 2	TAN/WHITE
P12-19	UNUSED	UNUSED	UNUSED
P12-20	UNUSED	UNUSED	UNUSED
P2-1	LOW VOLTAGE CIRCUITS	UNUSED	UNUSED
P2-2	UNUSED	UNUSED	UNUSED
P2-3	UNUSED	UNUSED	UNUSED
P2-4	UNUSED	UNUSED	UNUSED
P2-5	UNUSED	UNUSED	UNUSED
P4-1	LOW VOLTAGE CIRCUITS CONTINUED	12 VDC POWER	RED
P4-2	12 VDC RETURN	12 VDC RETURN	WHITE
P6-1	VERTICAL LED (REF)	12 V TO LED	BLACK/WHITE
P6-2	UNUSED	UNUSED	UNUSED
P6-3	VERTICAL LED (REF) COMMON	VERTICAL LED RETURN	WHITE
P6-4	GLASS DOOR HTR 2	12 V TO HTR 2	BLACK
P6-5	GLASS DOOR HTR 2 COMMON	HTR 2 RETURN	WHITE
P8-1	EVAPORATOR FAN ZONE 1	TACHOMETER INPUT	BLUE/WHITE
P8-2	UNUSED	UNUSED	UNUSED
P8-3	EVAPORATOR FAN ZONE 3	TACHOMETER INPUT	BLUE
P8-4	EVAPORATOR FAN ZONE 4	TACHOMETER INPUT	BLUE/BLACK
P8-5	EVAPORATOR FAN ZONE 1	PWM DRIVE OUTPUT	YELLOW/BROWN
P8-6	UNUSED	UNUSED	UNUSED
P8-7	EVAPORATOR FAN ZONE 3	PWM DRIVE OUTPUT	UNUSED
P8-8	EVAPORATOR FAN ZONE 4	PWM DRIVE OUTPUT	YELLOW/PURPLE
P8-9	UNUSED	UNUSED	UNUSED
P8-10	EVAPORATOR FAN 12 VDC POWER	ZONE FAN POWER	RED
P8-11	EVAPORATOR FAN GROUND RETURN	ZONE FAN RETURN	WHITE
P5-1	THERMISTOR CIRCUITS	SENSES TEMPERATURE	BROWN
P5-2	AMBIENT	SENSES TEMPERATURE	BLUE
P5-3	CONDENSOR LT SYSTEM	SENSES TEMPERATURE	BROWN
P5-4	CONDENSOR LT SYSTEM	SENSES TEMPERATURE	BLUE
P5-5	CONDENSOR RT SYSTEM	SENSES TEMPERATURE	BROWN
P5-6	CONDENSOR RT SYSTEM	SENSES TEMPERATURE	BLUE
P5-7	REF UPPER CABINET (ZONE 3)	SENSES TEMPERATURE	BROWN
P5-8	REF UPPER CABINET (ZONE 3)	SENSES TEMPERATURE	BLUE
P5-9	REF LOWER CABINET (ZONE 4)	SENSES TEMPERATURE	BROWN
P5-10	REF LOWER CABINET (ZONE 4)	SENSES TEMPERATURE	BLUE
P5-11	REF UPPER EVAP (ZONE 3)	SENSES TEMPERATURE	BROWN
P5-12	REF UPPER EVAP (ZONE 3)	SENSES TEMPERATURE	BLUE
P5-13	REF LOWER EVAP (ZONE 4)	SENSES TEMPERATURE	BROWN
P5-14	REF LOWER EVAP (ZONE 4)	SENSES TEMPERATURE	BLUE
P5-15	FRE CABINET (ZONE 1)	SENSES TEMPERATURE	BROWN
P5-16	FRE CABINET (ZONE 1)	SENSES TEMPERATURE	BLUE
P5-17	FRE EVAP (ZONE 1)	SENSES TEMPERATURE	BROWN
P5-18	FRE EVAP (ZONE 1)	SENSES TEMPERATURE	BLUE
P5-19	UNUSED	UNUSED	UNUSED
P5-20	UNUSED	UNUSED	UNUSED
P5-21	UNUSED	UNUSED	UNUSED
P5-22	UNUSED	UNUSED	UNUSED
P5-23	UNUSED	UNUSED	UNUSED
P5-24	UNUSED	UNUSED	UNUSED

648PRO CONTROL BOARD SUMMARY

Figure 3-3. Control Board Summary Table

CONTROL PANEL AND USER DISPLAYS LAYOUT

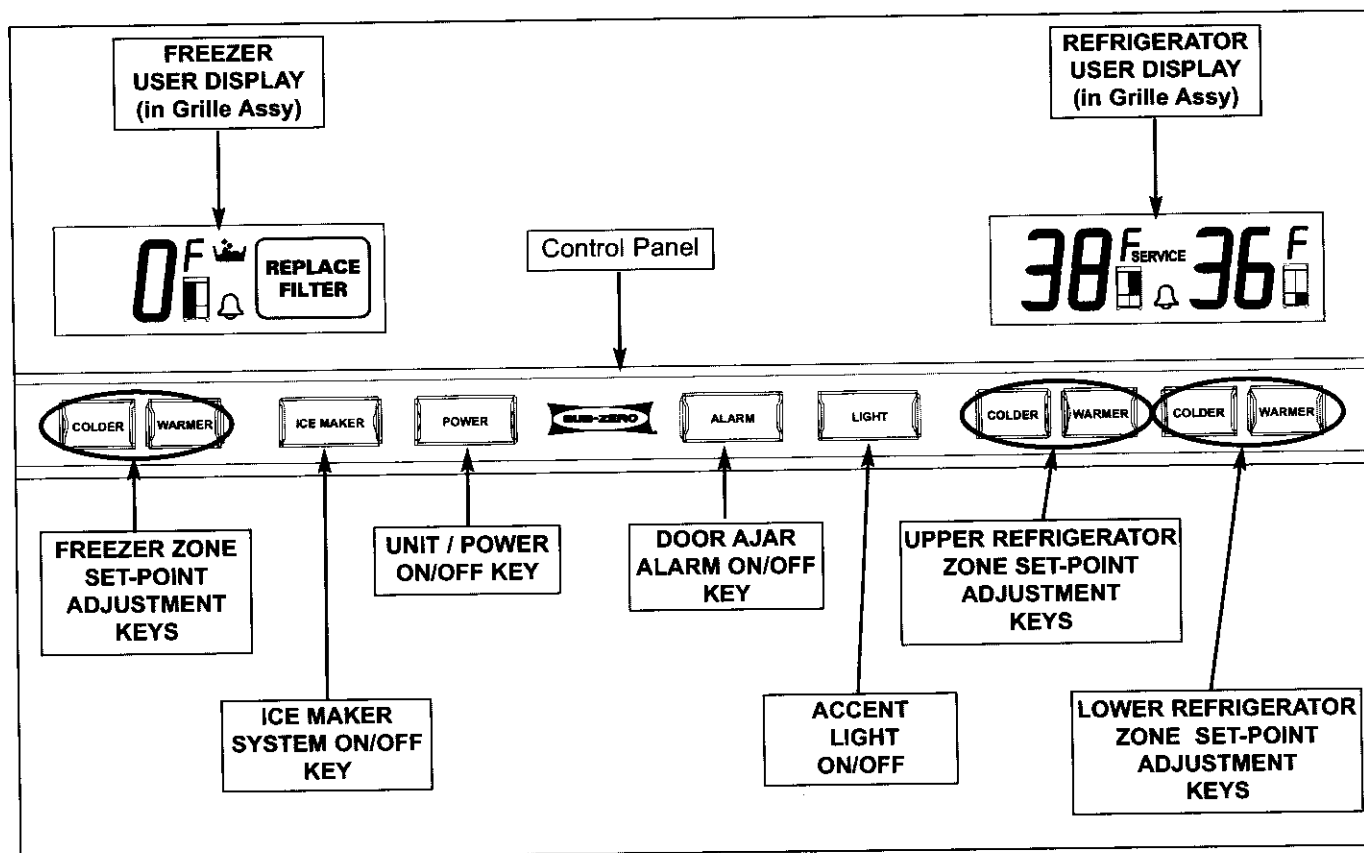


Figure 3-4. 648PROG Series Control Panel Layout

NOTE: Figure 3-4 represents the 648PROG (with glass door). The control panel for the 648PROS (with solid door) does not have the LIGHTS on/off key.

BASIC ELECTRONIC CONTROL INPUT OPERATIONS

The following pages describe the basic input operations performed at the control panel (switching unit ON and OFF; adjusting set-point (temperature adjustment); switching ice maker system ON and OFF; enabling and disabling door ajar alarm feature; and in models with glass doors only, accent lighting system ON and OFF). Please note that though possible to display temperatures in Fahrenheit or Celsius, in most cases Fahrenheit readings are shown.

Unit ON/OFF

All units are shipped in the OFF Mode. When power is supplied to the unit the word "OFF" is visible in the right User Display. By pressing the POWER key (See Figure 3-5), power is allowed past the main control board to the rest of the unit, indicated by the appliance running through a self test, in which the lights and all the LCD's in the User Displays energize, then the User Displays show temperatures.

NOTE: If the unit is switched OFF using the POWER key, the word "OFF" will be visible on the right User Display.

⚠ WARNING

WHEN IN "OFF" MODE, AC LINE VOLTAGE IS STILL PRESENT AT THE MAIN CONTROL BOARD AND DC POWER SUPPLY! AND, LOW DC VOLTAGE IS PRESENT IN THE LOW VOLTAGE ELECTRICAL SYSTEM.

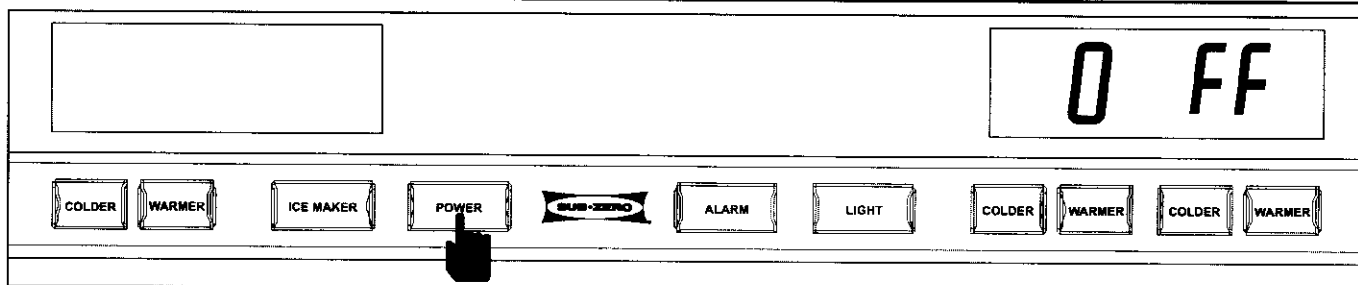


Figure 3-5. Switching Unit ON or OFF - Press POWER Key

Adjusting Set-Point (Temperature Adjustment)

To adjust set-points, press the appropriate WARMER or COLDER key on control panel in multiple key strokes until desired set-point is achieved (See Figure 3-6). One key stroke equals one degree change.

NOTES:

- To the right of each temperature reading is an icon representing the appliance. The darkened portion of the appliance icon indicates which zone is associated with the temperatures to its left.
- The temperature range in a freezer zone is -5°F (-20°C) to $+5^{\circ}\text{F}$ (-15°C). The temperature range in a refrigerator zone is $+34^{\circ}\text{F}$ ($+1^{\circ}\text{C}$) to $+45^{\circ}\text{F}$ ($+7^{\circ}\text{C}$).
- The initial stroke of the WARMER or COLDER key will change the previous set-point by one degree.
- The set-point will be displayed on the User Display for ten (10) seconds after the last key stroke, then the zone temperature will be displayed. As the zone temperature changes, the temperature displayed will change by no more than one degree per minute.

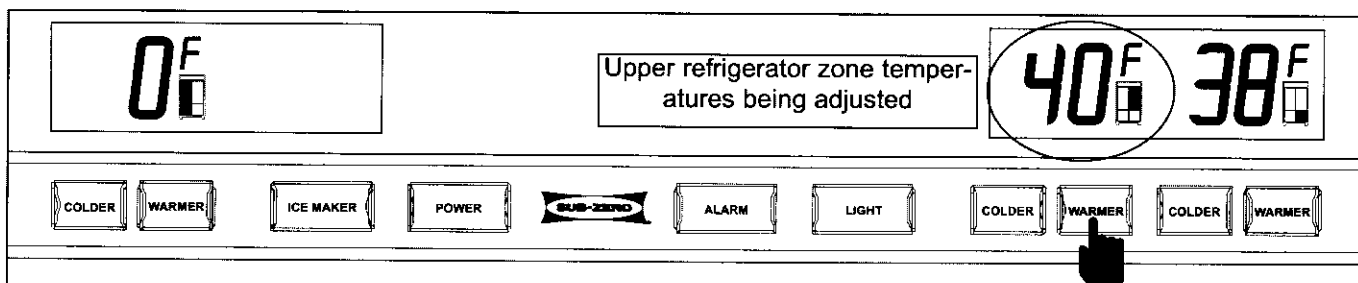


Figure 3-6. Adjusting Set-Point - Press Appropriate WARMER or COLDER Key In Multiple Key Strokes

Icemaker System ON/OFF

All units are shipped with the icemaker system is OFF. By pressing the ICE MAKER key on the control panel, power is allowed to the icemaker system and the ice making icon appears in the left User Display (See Figure 3-7). To switch the ice maker system OFF, press the ICE MAKER key again and the ice making icon disappears.

NOTES:

- When in "Sabbath Mode," the icemaker system is deactivated. Sabbath Mode will be explained later.
- To allow ice to freeze fully and reduce effects of low water pressure, power to the icemaker system is interrupted for forty-five (45) minutes after each ice harvest. This can be bypassed for service purposes by switching the ice-maker system OFF, then back ON with the ICE MAKER key.

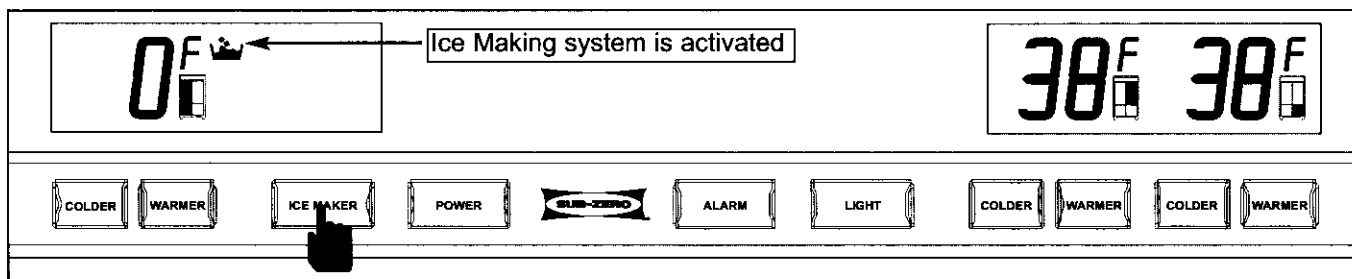


Figure 3-7. Switching Icemaker System ON or OFF - Press ICE MAKER Key

Door Ajar Alarm Feature

All units are equipped with a door ajar alarm feature. To enable the door ajar alarm, press the ALARM key on the control panel (See Figure 3-8). The bell icon appears in both User Displays indicating the alarm is enabled. With the alarm enabled, the bell icon will flash and an audible alarm will beep whenever a door or drawer is left open for more than thirty (30) seconds. To disable the door ajar alarm, press the ALARM key again and the bell icon disappears from the displays.

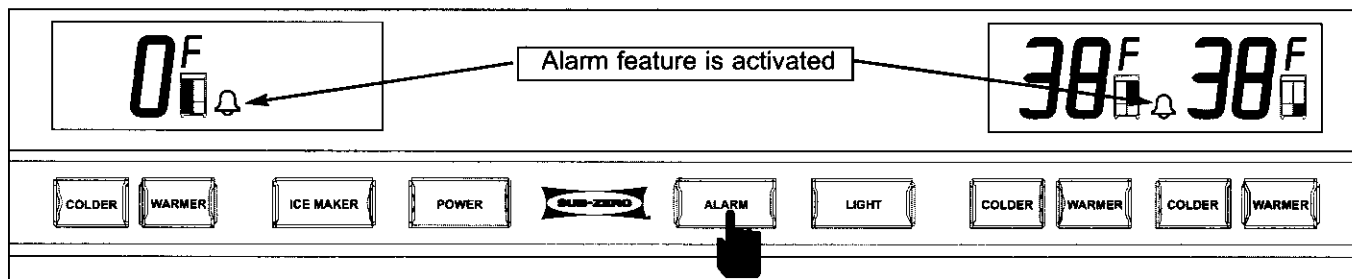


Figure 3-8. Switching Door Ajar Alarm ON or OFF - Press the ALARM Key

Accent Lighting System ON/OFF (Model 648PROG)

Models produced with glass doors possess an accent lighting system, which allows the lights on each side of the upper refrigerator zone to stay ON when the door is closed. To make this happen, press the LIGHT key (See Figure 3-9). To switch back to normal operation, so that the lights on each side of the upper refrigerator zone switch ON and OFF with light switch activation, press the LIGHT key again.

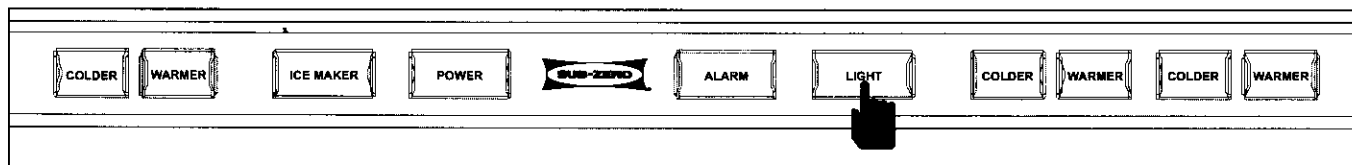


Figure 3-9. 648PROG Accent Lighting System ON or OFF - Press the LIGHT Key

UNIQUE ELECTRONIC CONTROL INPUT OPERATIONS

The following pages illustrate unique customer input operations performed at the control panel. The input operations described are: Temperature Unit Selection Mode, Sabbath Mode, Showroom Mode, Manual Zone Disable Mode and Manual Freezer Evaporator Defrost.

Temperature Units Selection Mode (Selecting Degrees Fahrenheit or Degrees Celsius Display)

The appliance is initially set to display temperatures in Fahrenheit temperature units of measure, indicated by the "F" on the User Displays above the appliance icons. This can be changed so Celsius units of measure are displayed by initiating Temperature Units Selection Mode.

NOTE: Temperature Units Selection Mode must be initiated within the first (1) minute after switching the unit ON.

To convert Fahrenheit (°F) temperature units of measure to Celsius (°C), press and hold the ALARM key and the POWER key simultaneously for five (5) seconds, then release the keys (See Figure 3-10). A "c" will appear on the User Displays above the appliance icons, indicating that temperatures will now be displayed in Celsius units of measure. Please note that changing from Celsius temperature units of measure to Fahrenheit is the same procedure (See Figure 3-11).

NOTES:

- Temperature Units Selection Mode will end ten (10) seconds after the last key stroke.
- Do not press and hold the POWER key first, that will simply switch the unit OFF.

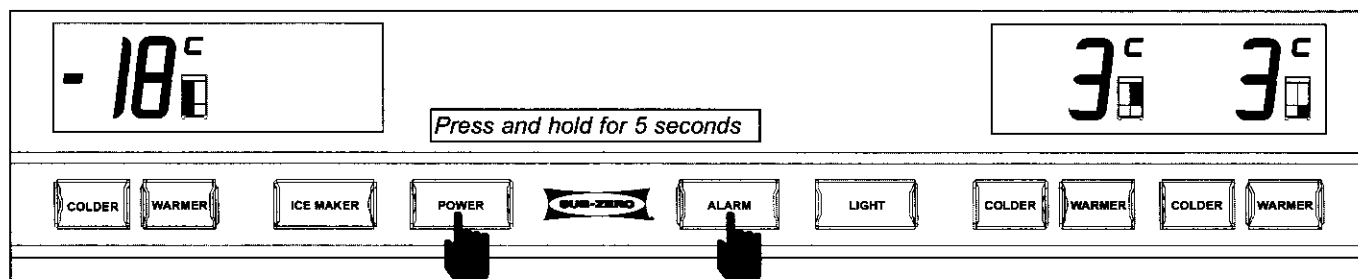


Figure 3-10. Converting Temperature Units of Measure to °C (within first minute after switching unit ON) - Press and Hold ALARM Key and POWER Key for five (5) seconds

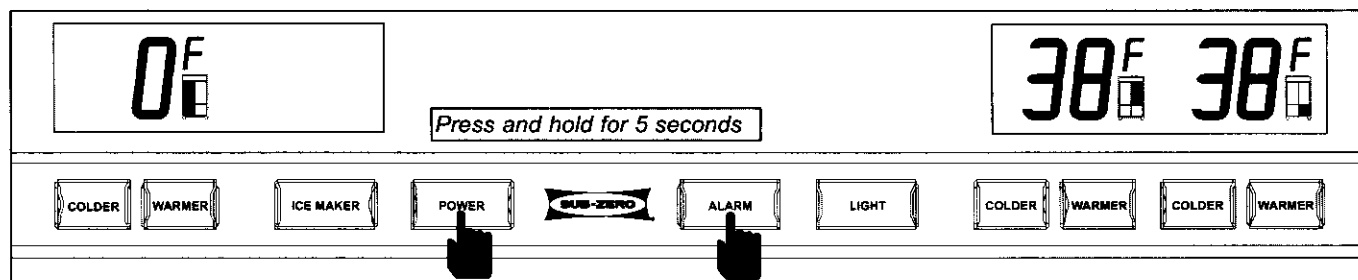


Figure 3-11. Converting Temperature Units of Measure to °F (within first minute after switching unit ON) - Press and Hold ALARM Key and POWER Key for five (5) seconds



Showroom Mode

Showroom Mode was incorporated into the electronic control system so that these appliances could be displayed in a showroom setting. When in Showroom Mode, all cooling, defrosting, and ice making functions are disabled, but the lighting system, displays and door ajar alarm are operational.. Set-points will appear on the User Displays, and "Showroom Mode" will appear on the Technician Display.

To initiate Showroom Mode, the unit must first be switched OFF using the POWER key (See Figure 3-12), then press and hold any pair of WARMER and COLDER keys, then the POWER key, then release all three keys (See Figure 3-13). To return the unit to normal operation, repeat the steps above.

NOTES:

- Always check set-points after returning unit to normal operation.
- One unique operation that is possible when in Showroom Mode is to force the "REPLACE FILTER" icon to appear. Do this by pressing and holding the ICE MAKER key for five seconds, but only if the filter is in place. And, to deactivate the "REPLACE FILTER" icon, the filter must be removed, then replaced.

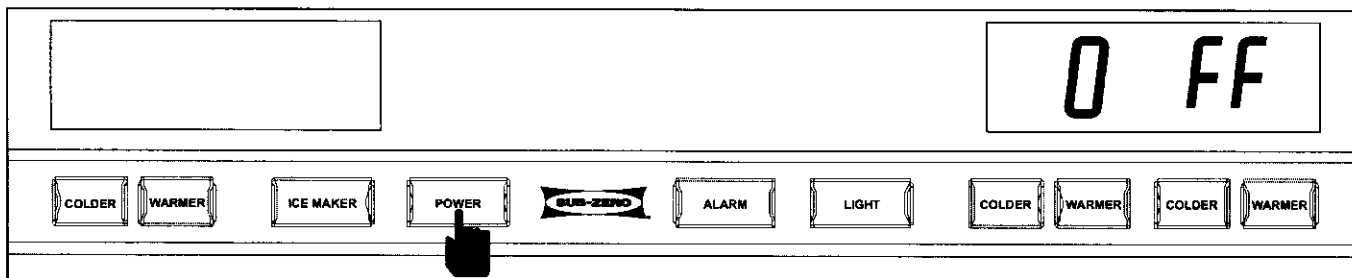


Figure 3-12. To Enter (or Exit) Showroom Mode, Switch Unit OFF First

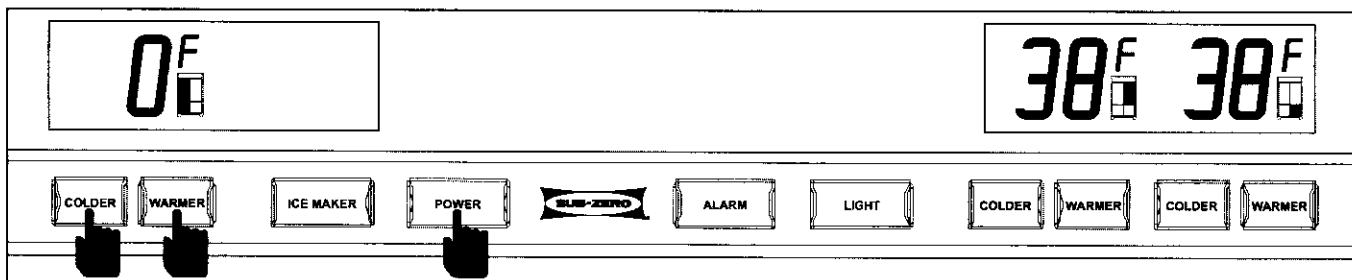


Figure 3-13. Then Press and Hold Any Pair of WARMER and COLDER Keys, Then the POWER Key

Sabbath Mode

Sabbath Mode was incorporated into the electronic control system for the observance of certain religious days. Initiating Sabbath Mode disables the lighting systems, ice making system, alarm system and the User Displays, and "Sabbath Mode" will appear on the Technician Display.

To initiate Sabbath Mode, the unit must first be switched OFF using the POWER key (See Figure 3-14), then press and hold the POWER key until the User Displays and lights switch OFF, the alarm emits a quick series of beeps, and "Sabbath Mode" appears on the Technician Display (See Figure 3-15). This will take approximately ten (10) seconds. To return to normal operation, switch the unit OFF, then back ON.

NOTE: During Sabbath Mode, set-points cannot be changed and manual defrost cannot be initiated.

NOTE: When in Sabbath Mode, the following holds true in accordance with Star-K requirements:

- Freezer defrosting functions will convert to a fixed time base sequence instead of adaptive defrosting, which is usage based.
- The zone thermistors will still detect high off-set, which is the determining factor to start the cooling process, but there will be a random 15 to 25 second delay before cooling begins.

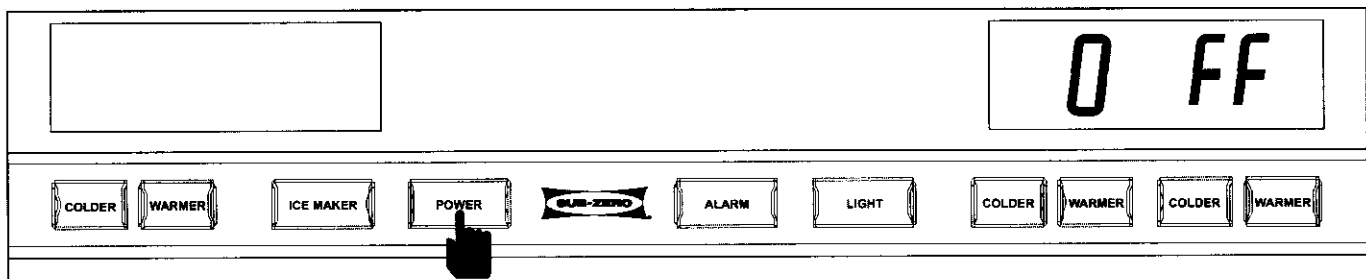


Figure 3-14. To Enter Sabbath Mode, Switch Unit OFF First

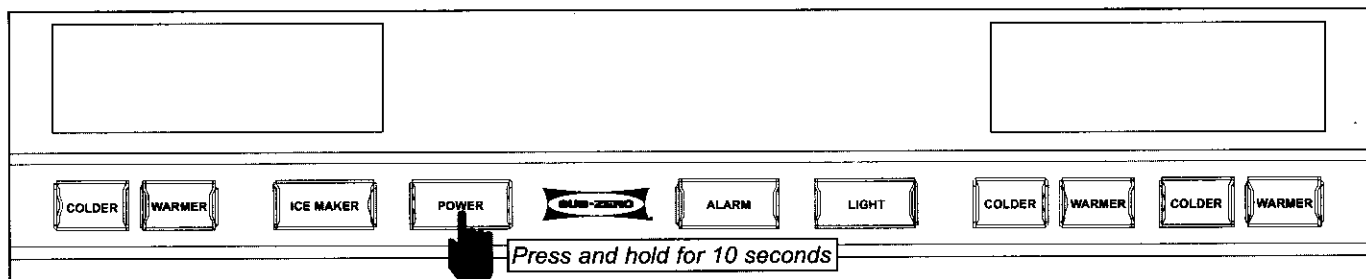


Figure 3-15. Then Press and Hold POWER Key for ten (10) seconds

Manual Zone Disable Mode

Manual Zone Disable Mode allows a customer or Service Technician to switch one zone, or "compartment" OFF for interior cleaning, defrosting, or diagnostic purposes, while allowing the other zones to continue cooling.

To initiate Manual Zone Disable Mode, the unit must be ON. With the unit ON, press and hold the WARMER key for the zone being disabled, then press the POWER key, then release both keys (See Figure 3-16). When a zone is disabled, "--" (double dashes) will appear on the User Display in place of zone temperatures, indicating all cooling functions for that zone are disabled.

There are two ways to exit Manual Zone Disable Mode and return the unit to normal operation. Repeating the WARMER and POWER key strokes is one way. The other way is to switch the unit OFF, then back ON.

NOTE: Always check set-points after returning unit to normal operation.

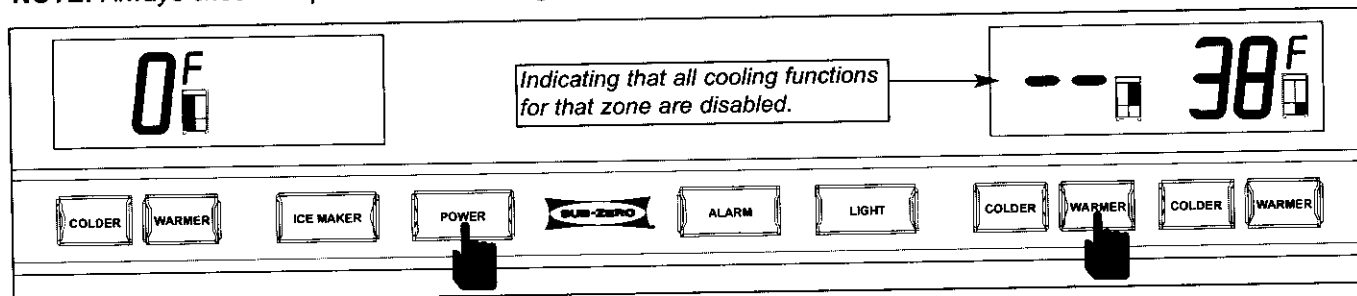


Figure 3-16. To Enter (or Exit) Manual Zone Disable Mode, Press and Hold WARMER Key for Zone Being Disabled, Then Press POWER Key.

Manual Freezer Evaporator Defrost

Manual Freezer Evaporator Defrost was incorporated into the electronic control to assist in servicing and diagnostics.

To initiate manual freezer evaporator defrost, press and hold the ICE MAKER key for five (5) seconds (See Figure 3-17).

NOTE: Manual Freezer Evaporator Defrost will not operate if unit is in Sabbath Mode.

NOTE: The defrost terminator opens at fifty-five (55°F/13°C) degrees and closes at thirty (30°F/-1°C) degrees, so it will not allow power to the defrost heater if the evaporator is above thirty degrees.

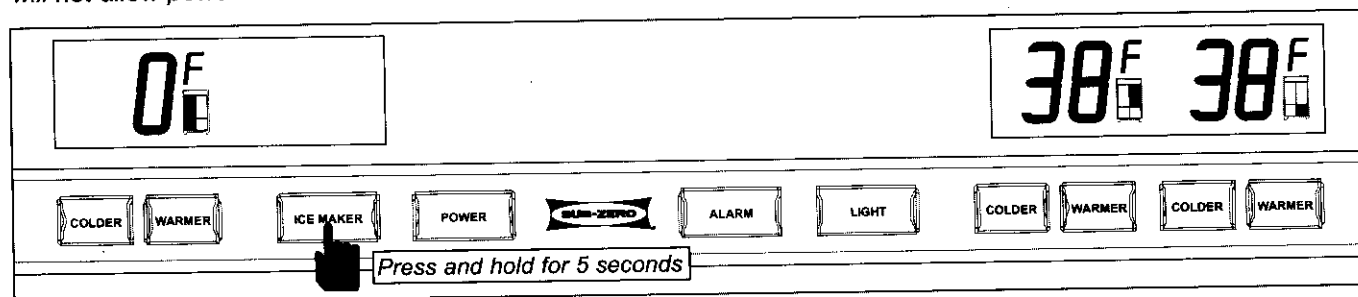


Figure 3-17. Initiate Manual Freezer Evaporator Defrost - Press and Hold ICE MAKER Key for 5 Seconds

FUNCTIONS OF THE ELECTRONIC CONTROL SYSTEM

The following pages explain monitoring, regulating and controlling functions of the electronic control system. Signal traces on a model 648PRO wiring schematic are used to show current flow for functions being explained.

Supply Power to the Lighting System

Power is supplied to the lighting system through the control board when the unit is switched ON by pressing the POWER key. With a door or drawer open, light switches allows power to the lights (See Figure 3-18).

NOTES:

- Power to the upper refrigerator lights is monitored by the microprocessor to control switching ON and OFF of the accent lights. This information is ignored if the accent lighting system has been switched to 100% ON.
- Power to all lights is monitored by the microprocessor to control the door ajar alarm feature.
- If in Sabbath Mode, the lighting system is disabled. Sabbath Mode will be covered later.

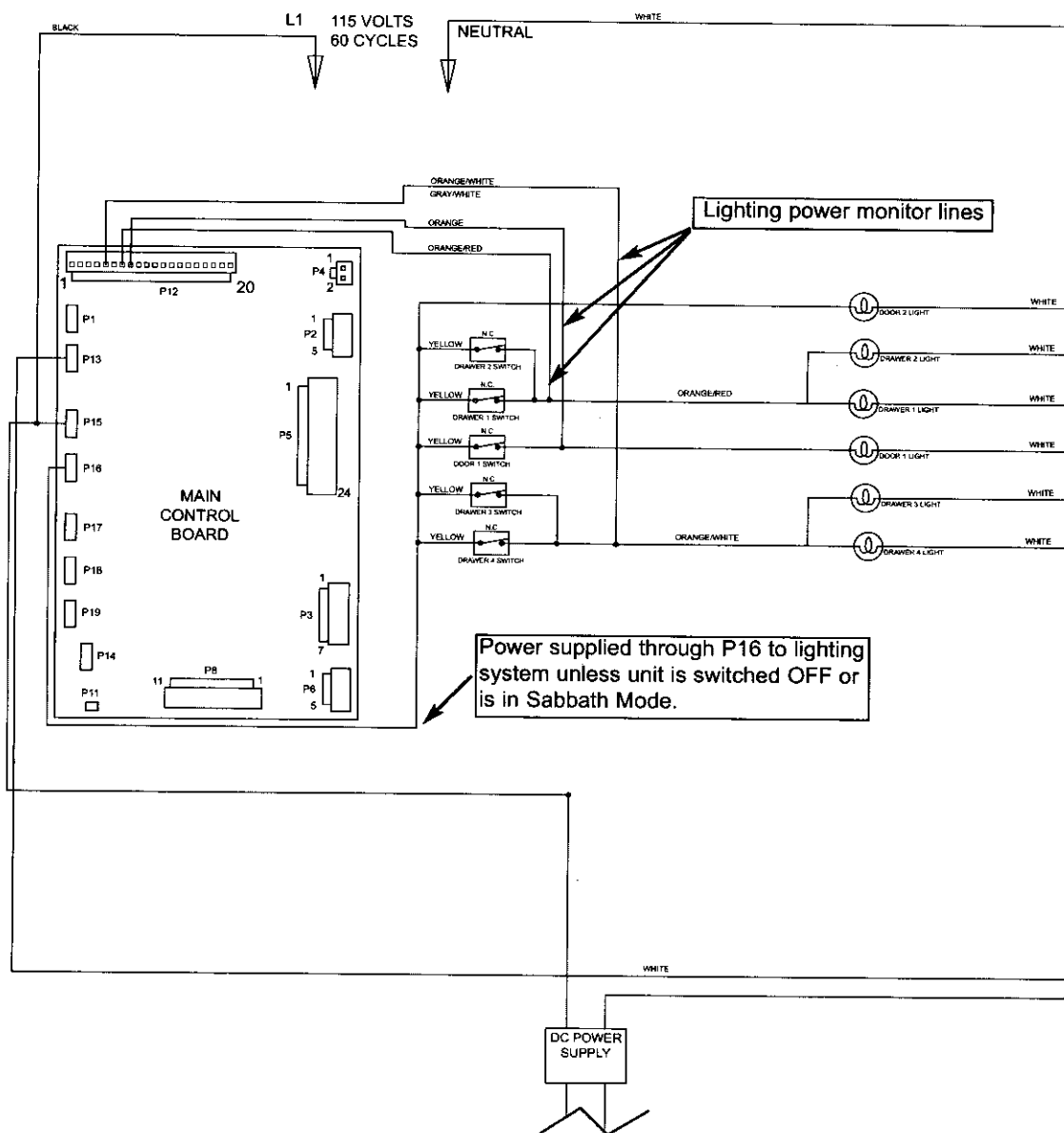


Figure 3-18. Signal Trace Schematic of Lighting System

Monitor, Display and Regulate Zone Temperatures

Temperature signals from thermistors in each zone are monitored and displayed on the User Displays. When a zone temperature reaches high offset (calling for cooling), the compressor and evaporator fan are switched ON, and if a refrigerator zone, the refrigerant valve is switched to the appropriate side. (See Figure 3-19). When a zone reaches low offset (cut-out) temperature, the compressor and evaporator fan are switched OFF. Though zone air temperature fluctuates from off and on cycles, the “average” temperature is displayed.

NOTES:

- NOTES:**
- Freezer zone temperature range is: -5°F (-21°C) to +5°F (-15°C); Refrigerator zone temperature range is: +34°F (+1°C) to +45°F (+7°C).
 - If average zone temperature changes, the display will change by only one degree per minute.
 - If a freezer zone thermistor is faulty, the compressor defaults to 20 minutes ON, 20 minutes OFF cycling, the evaporator fan will cycle with the compressor at medium fan speed, EE appears in appropriate User Display, SERVICE flashes and the Error Code is logged.
 - If a freezer evaporator thermistor is faulty, the freezer compressor and evaporator fan will not energize until zone air temperature exceeds high offset by 5°F (3°C). SERVICE flashes and the Error Code is logged.
 - If a refrigerator zone thermistor is faulty, the compressor defaults to 10 minutes ON, 10 minutes OFF cycling, the evaporator fan will cycle with the compressor and/or the refrigerant valve at medium fan speed, EE appears in appropriate area of User Display, SERVICE flashes and the Error Code is logged.
 - If a refrigerator evaporator thermistor is faulty, the refrigerator compressor and evaporator fan will not energize and/or the refrigerant valve will not switch sides until zone air temperature exceeds high offset by 5°F (3°C). SERVICE flashes and the Error Code is logged.
 - If in Sabbath Mode, the zone thermistors still control compressor operation, except that when high offset is reached, there is a random 15 to 25 second delay before a compressors is energized.
-
- The diagram illustrates the electrical architecture of a dual-zone cooling system. At the top, power enters via L1 (115V, 60 cycles) and Neutral (White). The MAIN CONTROL BOARD (P1-P19) is connected to a LOW VOLTAGE board (P1-P15), which in turn connects to a DC POWER SUPPLY. Key components include the REFRIGERATOR COMPRESSOR, STARTING RELAY, VSPEED CONTROL BOX FZ, VSPEED CONTROL BOX REF, and various solenoid valves (AWECO REF VALVE 2, 295 Ω). Thermistors are shown for the REFR. CABINET, REFR. EVAP., and REFR. LOW CABINET. Callout boxes indicate specific operational states: '5. Refrigerator refrigerant solenoid valve opens to appropriate side' and '4. Compressor(s) energized'. A box labeled '2. Zone(s) calling for cooling (Temp above high offset)' points to the low voltage board's input section.

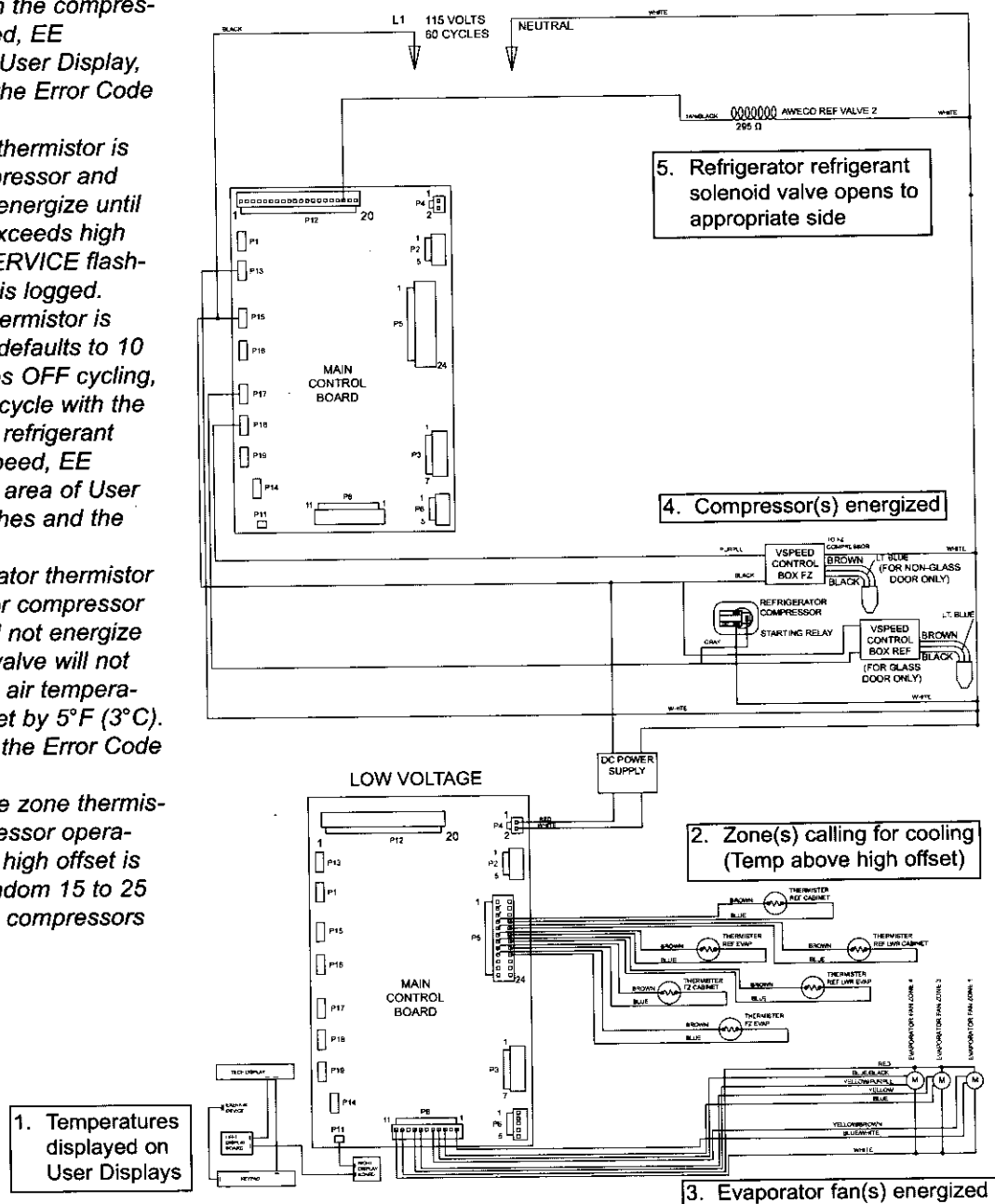


Figure 3-19. Signal Trace Regulating Temperatures

Assist in Control of Variable Speed Compressors

As mentioned on the previous page, temperature signals from the thermistors in the zones/compartments are monitored by the microprocessor and then displayed on the User displays.

When a zone reaches high-offset (calling for cooling), a start command is sent to the inverter, which is supplied with AC power at all times. The inverter then provide high DC voltage (3-phase, 50 - 150 Hz), outputs to the compressor. The inverter in turn senses the compressor load. If the the compressor load is high, the speed command from the inverter will be for high speed compressor operation; if medium compressor load, speed command from the inverter will be for medium speed; if low compressor load, speed command from the inverter will be for low speed. If/when a zone reaches low-offset, a stop command signal is sent to the inverter, which then cuts DC power to the compressor.

NOTE:

- *Variable speed compressors, evaporator fans and the condenser fan will run a great majority of the time. This is normal. These components will only cycle off during defrost and may also cycle off for short periods of time if the ambient temperature is low enough.*
- *Initial speed command from an inverter to a compressor are always for High speed.*
- *The refrigerator compressor will not be variable speed on solid door units.*
- *The refrigerator service replacement compressor is non-variable speed, regardless of the unit configuration (glass door or solid door).*

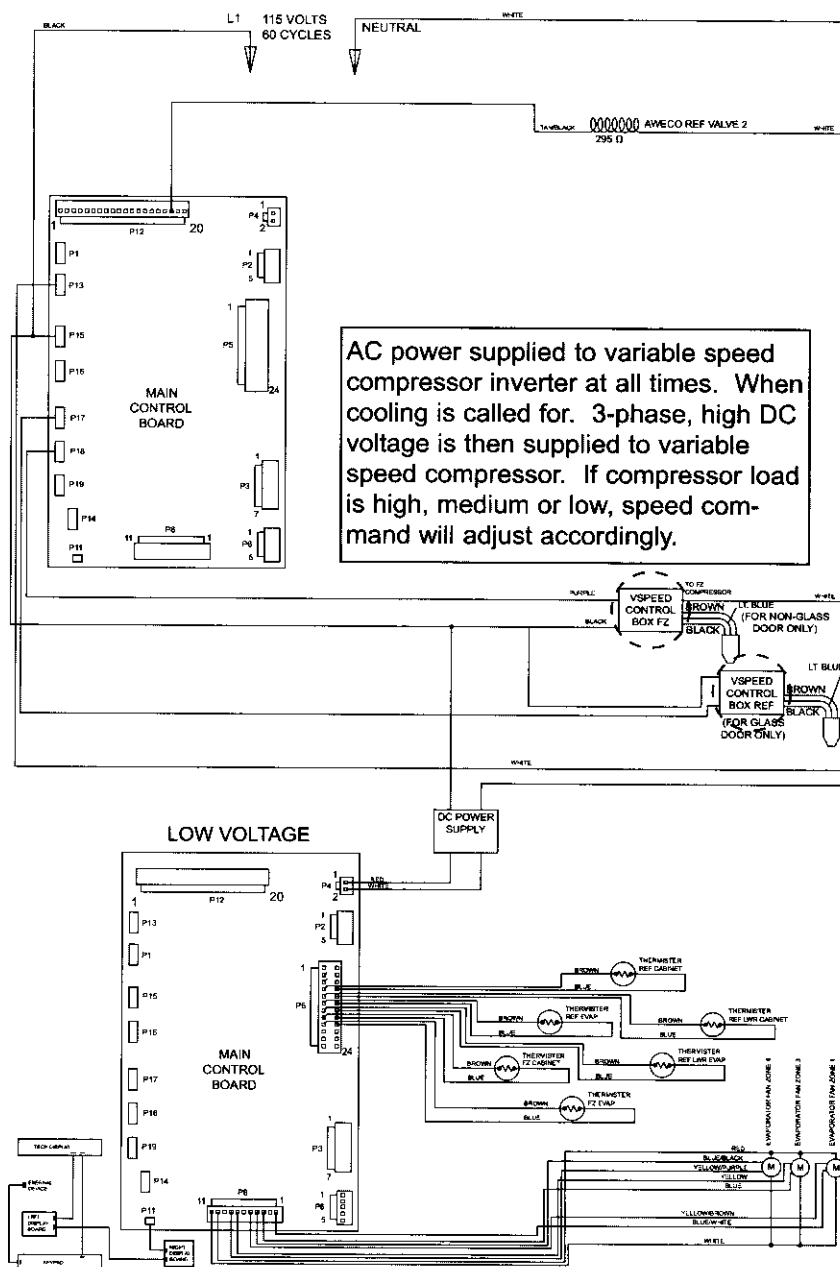


Figure 3-20. Signal Trace Variable Speed Compressor Control

Control Refrigerator Dual Refrigerant Solenoid Valve

The electronic control senses refrigerator zone temperatures via thermistors, one in each of two refrigerator zones (Zones 3 and 4). If either zone reaches high-offset (calling for cooling), then two parallel circuits on the control board (1 relay per circuit, with 1 common triac) are used to control the dual refrigerant valve. Depending on which zone is calling for cooling, its corresponding relay supplies power to the triac, a positive (+) polarity, or a negative (-) polarity pulse signal (500ms / 30 pulses per 1/2 second) is delivered to the dual refrigerant valve, forcing the bead inside the valves T-connection to one side or the other. If the pulse signal is positive (+), the upper evaporator is supplied with refrigerant; If the pulse signal is negative (-), the lower evaporator is supplied with refrigerant. (See Figure 3-21).

NOTES:

- On initial pull-down, the refrigerant valve will receive a (+) pulse signal, then switch back and forth between (+) and (-) on thirty (30) minute intervals until a zone achieves set-point.
- If neither compartment is calling for cooling, the compressor and evaporator fans are switched off.
- Refrigerator evaporator fans cycle with the refrigerant valve.

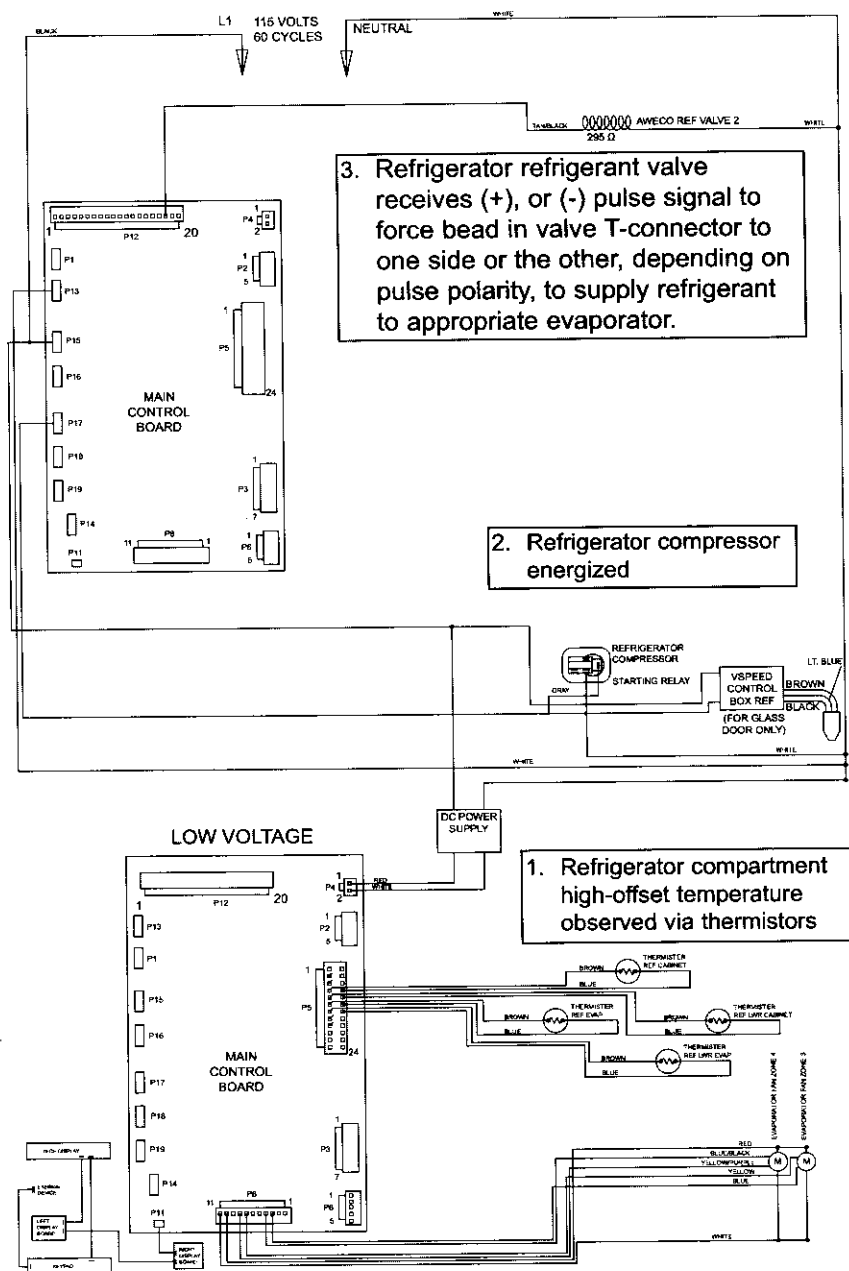


Figure 3-21. Signal Trace Refrigerant Valve Activation

Control Condenser Fan Operation

The microprocessor observes the condenser outlet temperatures of both systems. If either compressor is running and a condenser outlet temperature is $\geq 90^{\circ}\text{F}$ (32°C), a signal is sent to the condenser fan relay on the control board to close, supplying power to the condenser fan (See Figure 3-22). If both compressors are off, the condenser fan will be off.

NOTES:

- If both condenser outlet temperatures are $< 90^{\circ}\text{F}$ (32°C), no power is supplied to the condenser fan motor, regardless of compressor operational state.
- Currently, the condenser fan operates at 1350 RPM, whenever it is energized. In the near future, the condenser fan will operate at a variable speed as follows:
 1. Compressor running and condenser outlet temperature $\geq 90^{\circ}\text{F}$ (32°C), condenser fan speed will be Low = 1100 RPM.
 2. Compressor running and condenser outlet temperature $\geq 95^{\circ}\text{F}$ (35°C), condenser fan speed will be High = 1350 RPM.
- If a condenser outlet thermistor is defective, the condenser fan will run at high speed whenever a compressor is energized.

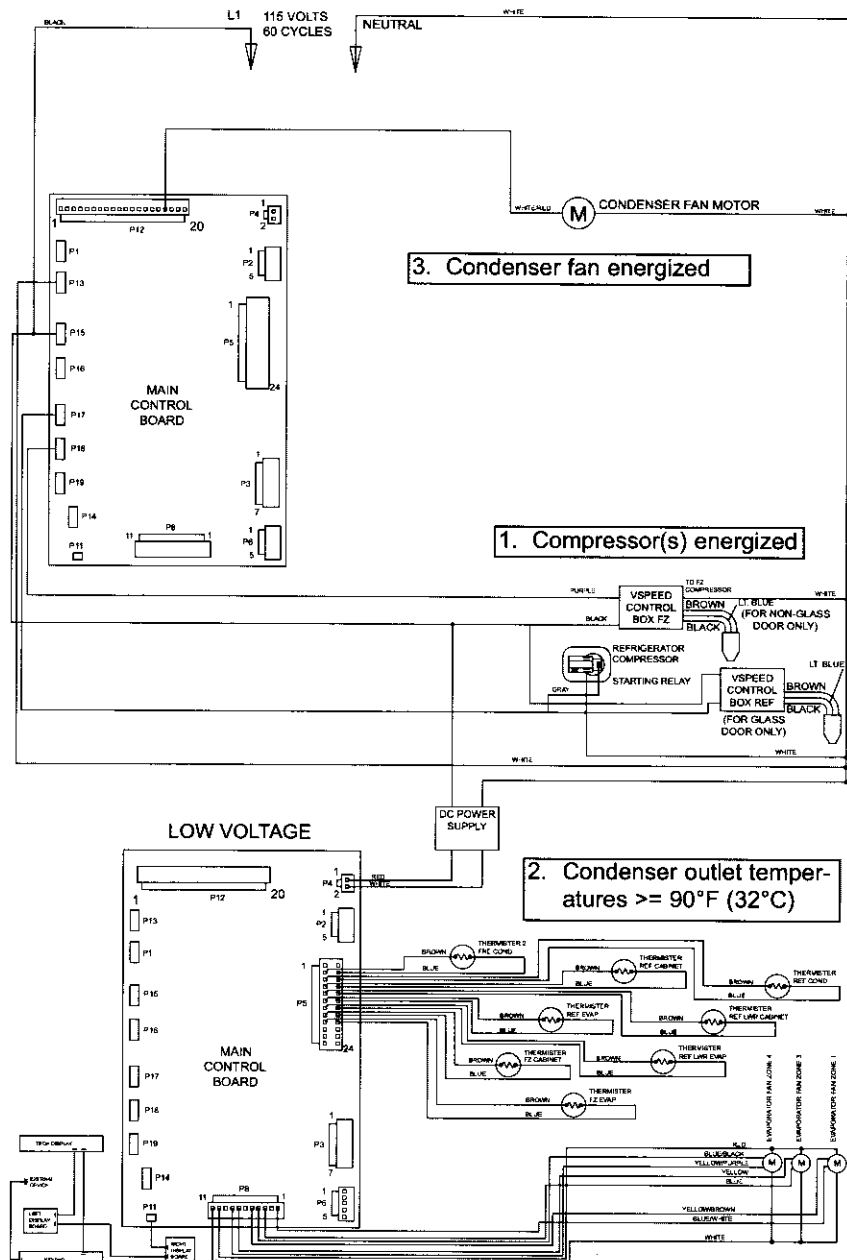


Figure 3-22. Signal Trace Schematic of Condenser Fan Operation

Minimize Condensation on Refrigerator Door Glass

On units produced with glass doors, the microprocessor detects when the refrigerator door is opened, via the light switch, so when the door closes, the evaporator fan is energized for five (5) minutes, regardless of compressor operational status. This draws any warmer moist air away from the door glass. (See Figure 3-23). To further assist in minimizing condensation on the glass, the door is equipped with a braided wire heater around the glass perimeter.

NOTES:

- Refrigerator evaporator fans also cycle with the refrigerant valve.
- This door heater on glass door models is powered off of the condenser fan circuit relay.

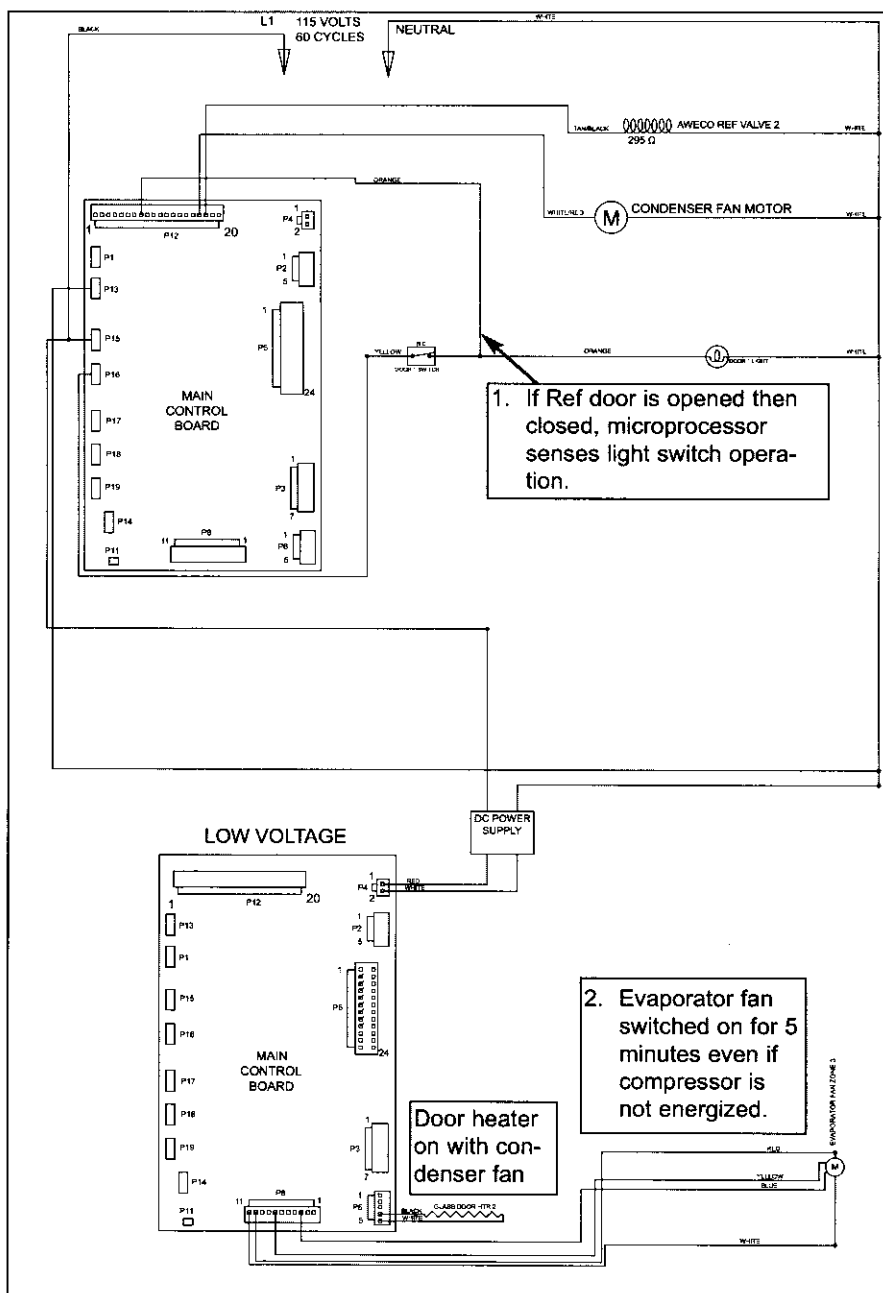


Figure 3-23. Signal Trace Schematic of Refrigerator Evaporator Fan Operation & Door Heater

Monitor and Control Refrigerator Fan-Assisted, Off-Cycle Defrost

Temperature signals from refrigerator evaporator's thermistor's are observed by the microprocessor. During off cycle defrost, if a refrigerator zone temperature reaches high offset (calling for cooling) before evaporator temperature rises to 38°F (3°C), no power will be supplied the the compressor, and/or no (+) or (-) pulse signal will be supplied to the refrigerant valve. But, the the zone evaporator fan will switch ON at low speed. Once the evaporator temperature reaches 38°F (3°C), normal cooling functions begin. (See Figure 3-24).

NOTES:

- If a refrigerator zone thermistor is faulty, the refrigerator compressor defaults to 10 minutes ON, 10 minutes OFF cycling, the evaporator fan will cycle with the compressor at medium fan speed, EE appears in appropriate area of User Display, SERVICE flashes and the Error Code is logged.
- If a refrigerator evaporator thermistor is faulty, the refrigerator compressor will not energize and/or the refrigerant valve will not switch sides until zone air temperature exceeds high offset by 5°F (3°C). SERVICE flashes and the Error Code is logged.

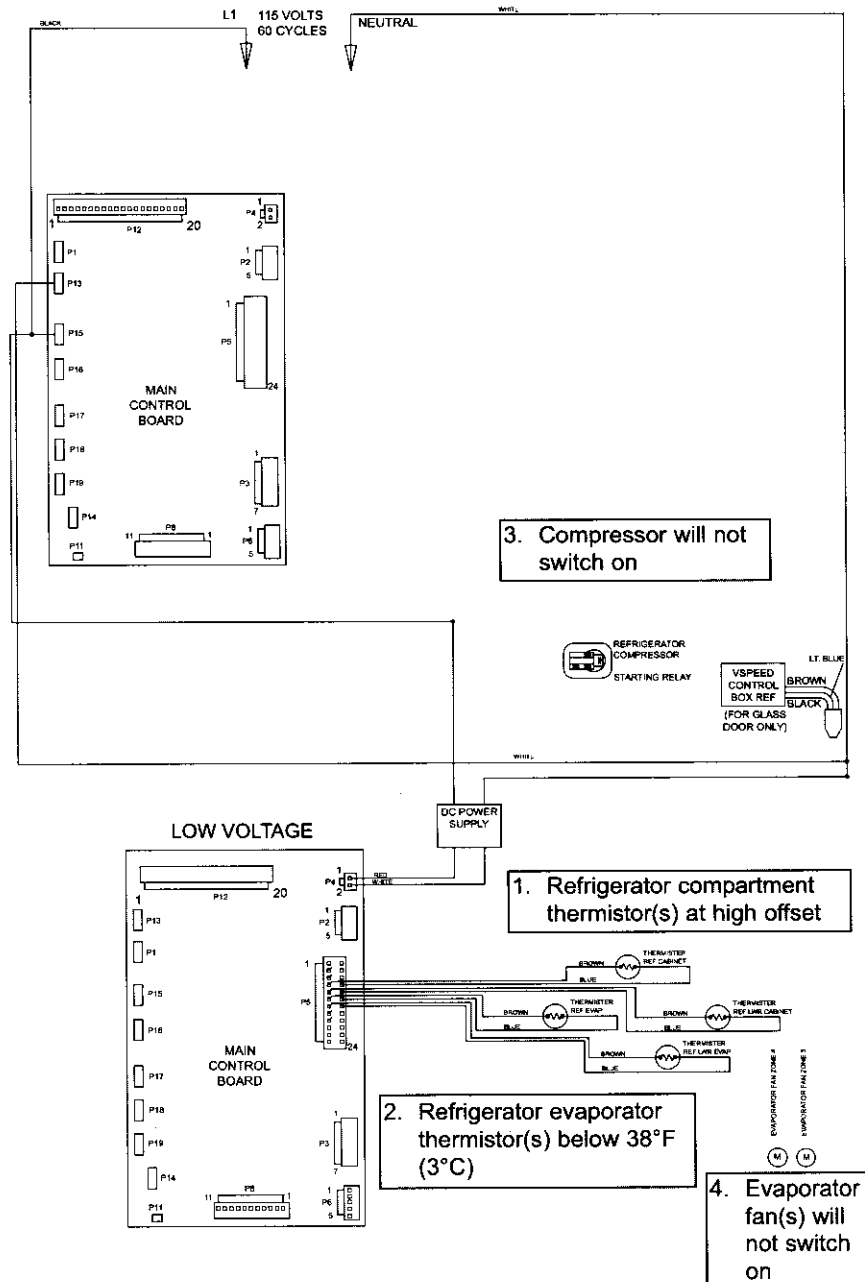


Figure 3-24. Signal Trace Schematic of Refrigerator Off-Cycle Defrost

Monitor and Control "Adaptive Defrost" of Freezer Evaporator

Initially, the freezer compressor cycle-runs 12 hours. The control board defrost relay is then closed, supplying power to the defrost and drain trough heaters. The compressor and evaporator fan are switched OFF.

With "Adaptive Defrost", the length of time the defrost heater stays on to open the defrost terminator bimetal (55°F/13°C), is observed by the microprocessor via the grey w/white stripe wire to P12-9. This length of time is used to calculate the number of hours before the next defrost (defrost interval). If the heater then stays on for a shorter time period, the microprocessor increases the next defrost interval. If the heater stays on for a longer time period, the microprocessor decreases the defrost interval. (See Figure 3-25) This is an ongoing process whereby the defrost time and the defrost interval will vary by unit use.

NOTES:

- A five (5) minute time delay/dwell follows all defrosts, during which the drain trough and fill tube heaters remain energized. At the end of the dwell, the compressor and evaporator fan are energized, and the drain trough heater switches OFF.
- If the freezer is at high offset (calling for cooling) after the five (5) minute time delay/dwell, the compressor will switch ON, but the evaporator fan will remain OFF until the evaporator has fallen below 20°F (-7°C).
- Minimum defrost interval = 6 hours of compressor run time; Maximum defrost interval = 80 hours of compressor run time; Maximum defrost duration = 30 minutes, plus 5 minute dwell.
- If the defrost sensing line is open, defrost operation defaults to 30 minute defrost time / 6 hour build time, and an Error Code is logged. If the evaporator thermistor detects an under-heat or overheat situation at the same time, another Error Codes is logged.
- During defrost, the displayed temperature is locked.

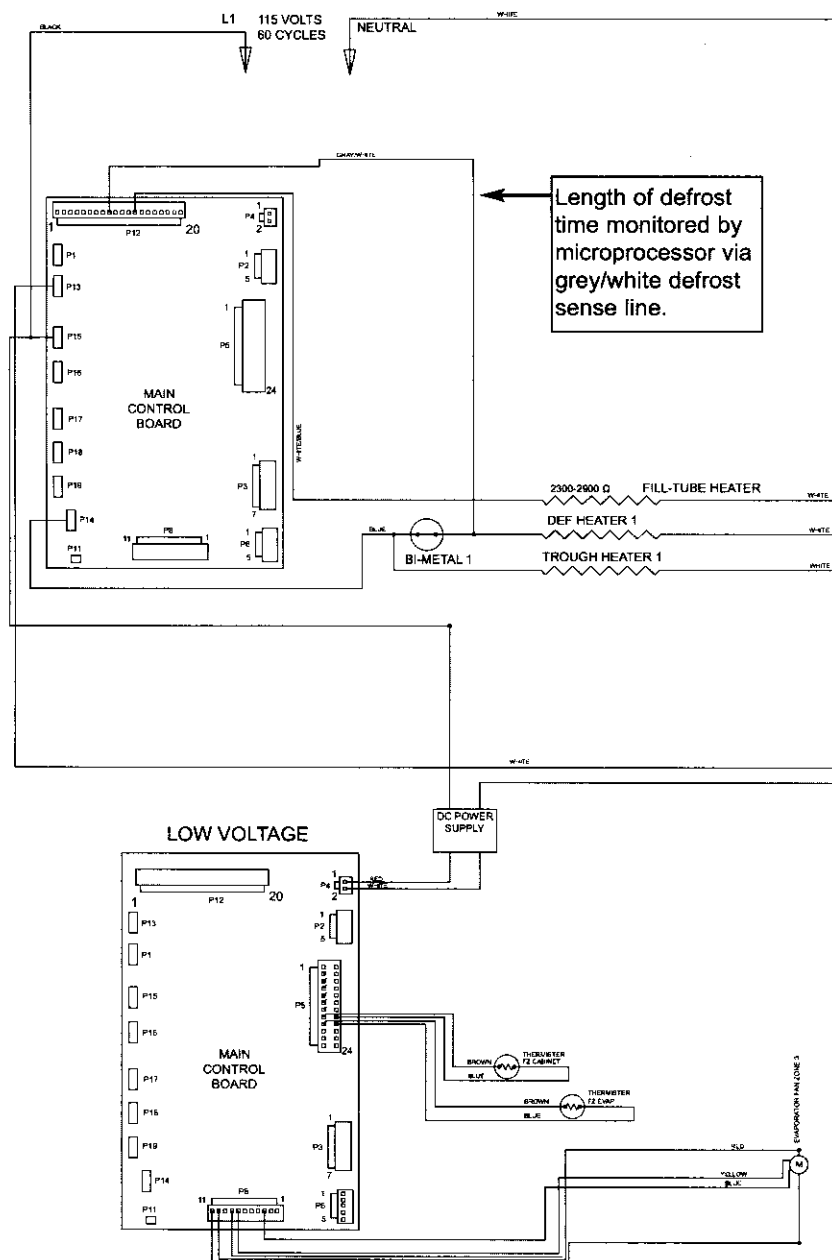


Figure 3-25. Signal Trace Schematic of Freezer Adaptive Defrost

Pro-Series (648PRO) SUB-ZERO

NOTE: To clear a flashing SERVICE, the problem must be corrected, the Error Code must be cleared from memory while in Service Mode, and the unit must be switched OFF, then back ON.



3-20



Monitor Icemaker System and Display If Service is Needed

The microprocessor observes the voltage supplied to the icemaker water valve solenoid. If the solenoid is energized for more than fifteen (15) seconds, power to the icemaker system is disabled for 12 hours (See Figure 3-28), and an error code is logged. If this happens five consecutive times, ice making icons in both User Displays and the SERVICE icon in the right User Display will flash, indicating the ice making system is now disabled (See Figure 3-29).

NOTES:

- To clear this error indicator from the User Displays and reactivate the ice making system, the problem must be corrected, the Error Code must be cleared from memory while in Service Mode, and the unit must be switched OFF, then back ON.
- To allow ice to freeze fully and reduce effects of low water pressure, power to the ice making system is interrupted for forty-five (45) minutes after each ice harvest. This can be bypassed for service diagnostic purposes by switching the icemaker system OFF, then back ON using the ICE MAKER key.
- When in Sabbath Mode, the ice making system is disabled. Sabbath Mode will be covered later.

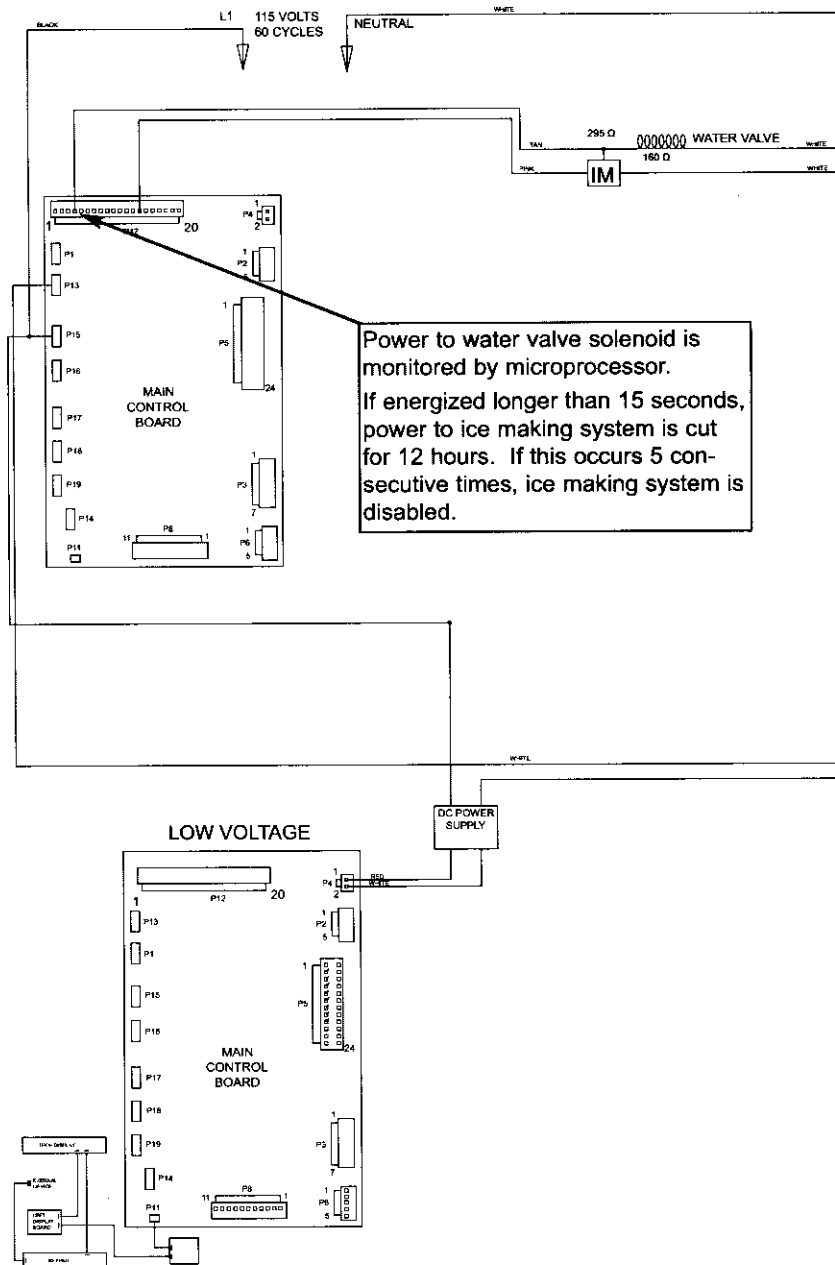


Figure 3-28. Signal Trace Schematic of Icemaker Electrical System

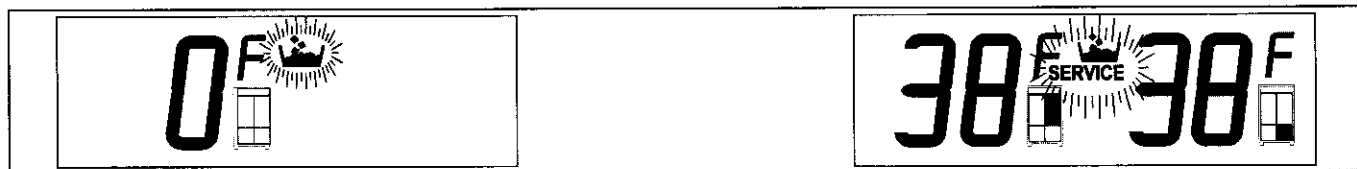


Figure 3-29. ICE & SERVICE Flashing = Solenoid Energized 15 sec., every 12 hrs., 5 Consecutive Times

Monitor Water Filter Time in Use and Display When it's Time to Replace it

The microprocessor observes the switch behind the water filter. When the filter is installed, the switch behind the filter is depressed/closed, telling the microprocessor to start the filter timer countdown (see Figure 30). After approximately one (1) year of use, the REPLACE FILTER icon on the left User Display will appear (See Figure 3-31). Removing the filter will open the switch and replacing the filter with a new one will re-close the switch. When this is done, the REPLACE FILTER icon will disappear and the countdown will start over.

NOTES:

- If removing the filter for service purposes, it is possible to avoid restarting the filter timer by depressing the filter switch five (5) times within five (5) seconds before replacing the filter. If this is done, the timer will resume counting from when the filter was removed.
- One unique operation that is possible when in Showroom Mode is to force the "REPLACE FILTER" icon to appear. Do this by pressing and holding the ICE MAKER key for five seconds, but only if the filter is in place. And, to deactivate the "REPLACE FILTER" icon, the filter must be removed, then replaced.

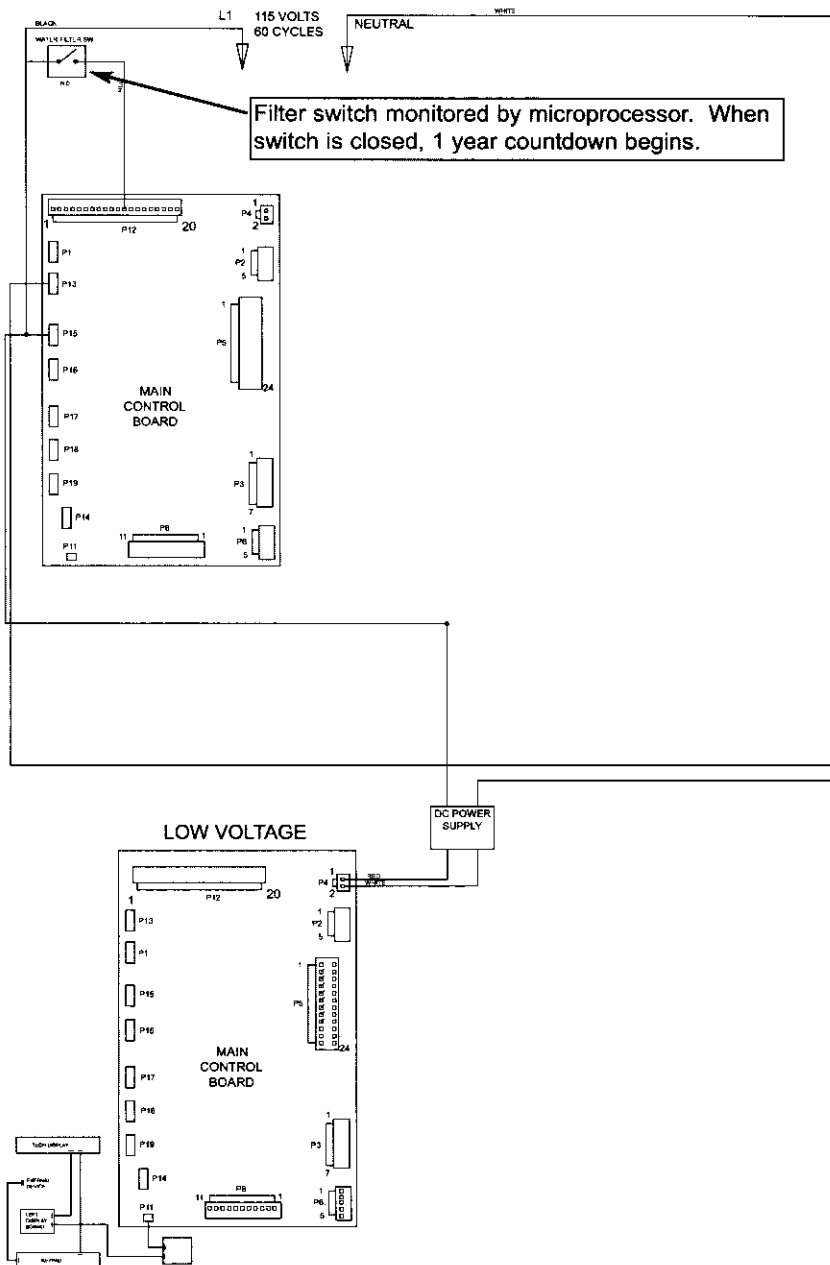


Figure 3-30. Signal Trace Schematic of Icemaker Electrical System

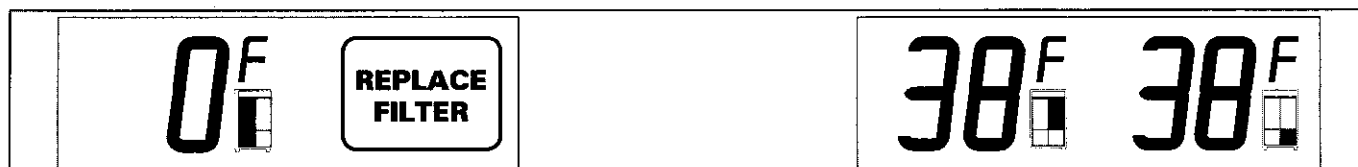


Figure 3-31. REPLACE FILTER Icon Appears after approximately one (1) Year of Filter Use

Self Diagnostics of the Electronic Control System

The electronic control system automatically runs through self diagnostics at predetermined time intervals and in the event of an excessive run condition. During this self test, the control cycles the loads and checks the inputs for failures. The following components are energized for a few seconds during the self diagnostic program:

- Thermistors
- Glass Door Heater
- Evaporator Fans
- RS485 Transceiver
- Aweco (Refrigerant) Valve
- Condenser Fan
- Accent Lights
- Power Relays and triacs
- Digital AC Inputs

If there is a problem with the electronic control system or an electrical component, the appropriate Error Code will be logged. If the problem causes the inability of the appliance to maintain temperature, SERVICE will flash on the right User Display (See Figure 3-33).

NOTES:

- It is possible to force the appliance to run self diagnostics when in Service mode. Service Mode is explained later in this section.
- A Service Technician should always initiate Service Mode and view Error Code History when the SERVICE icon is flashing. Service Mode is explained later in this section.

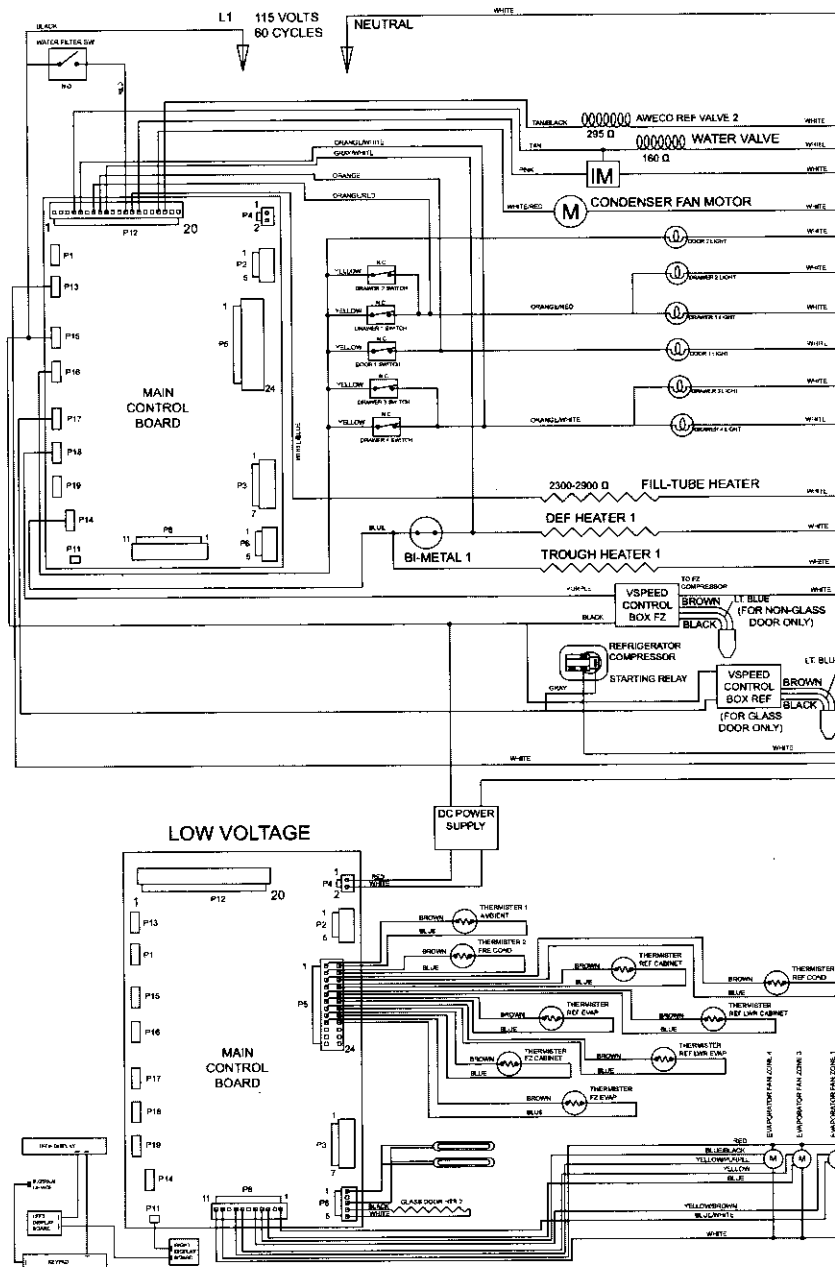


Figure 3-32. Signal Trace Schematic E-Control System Components



Figure 3-33. “SERVICE” Flashing = Multiple Possibilities; See Error Code History

POSSIBLE ERROR INDICATORS

This page contains diagrams illustrating what a customer may see on the User Displays, alerting them that there is a problem with the appliance.

NOTE: A Service Technician should always initiate Service Mode and view Error Code History when error indicators are observed.

NOTE: For thermistor errors described below, thermistors can be tested by submersing them in a glass of ice water for two (2) to five (5) minutes, and checked for 30,000 to 33,000 ohms.

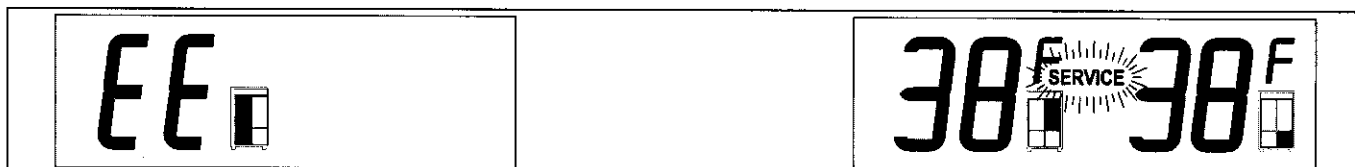


Figure 3-34. "EE" in Left User Display, SERVICE Flashing in Right = Freezer Zone Thermistor Fault



Figure 3-35. "EE" at Left of Right User Display & "SERVICE" Flashing = Upper Ref. Zone Thermistor Fault



Fig. 3-36. "EE" at Right of Right User Display & "SERVICE" Flashing = Lower Ref. Zone Thermistor Fault



Fig. 3-37. Ice Making Icon & "SERVICE" Flashing = Water Valve Powered 15 Sec.; Icemaker System Disabled



Figure 3-38. "SERVICE" alone Flashing = Multiple Possibilities; See Error Code History



Figure 3-39. "--" Double Dashes Displayed = Zone Manually Disabled

SERVICE MODE (Troubleshooting Input Operations)

The service features in this electronic control system allow the technician to perform a series of key strokes at the control panel in order to verify, configure, query and troubleshoot the appliance and its electronic control system. These service features are activated while in the four sub-modes of the Service Mode.

The four sub-modes of the Service Mode are:

- 1) Diagnostics Mode
- 2) Operational Status Mode
- 3) Model Information Mode
- 4) Version Information Mode.

The technicians display, located behind the top grille assembly, utilizes a two (2) line X sixteen (16) character LCD. While in Service Mode, this display will indicate which sub-mode is active, the data being searched for, and what other data can be accessed. When not in the Service mode, the Technician's display will indicate system information as defined for each particular operational mode.

Basic instructions for working through the Service Mode menu can be found on the Technician's Display cover (See Figure 3-40). These basic instructions (the Key Symbol and Arrows), correspond with keys on the control panel, thus directing the technician as to what keys need be pressed in order to move in the direction indicated by the arrow closest to each key symbol.

NOTES:

- A complete Service Mode Menu can be found on the back of the wiring diagram and on the next page of this manual.
- Since it is possible to initiate, bypass, an/or step back through the four different sub-modes while in Service Mode, initiating Service Mode will always be the first step when explaining how to work through the Service Mode menu for the sub-modes.

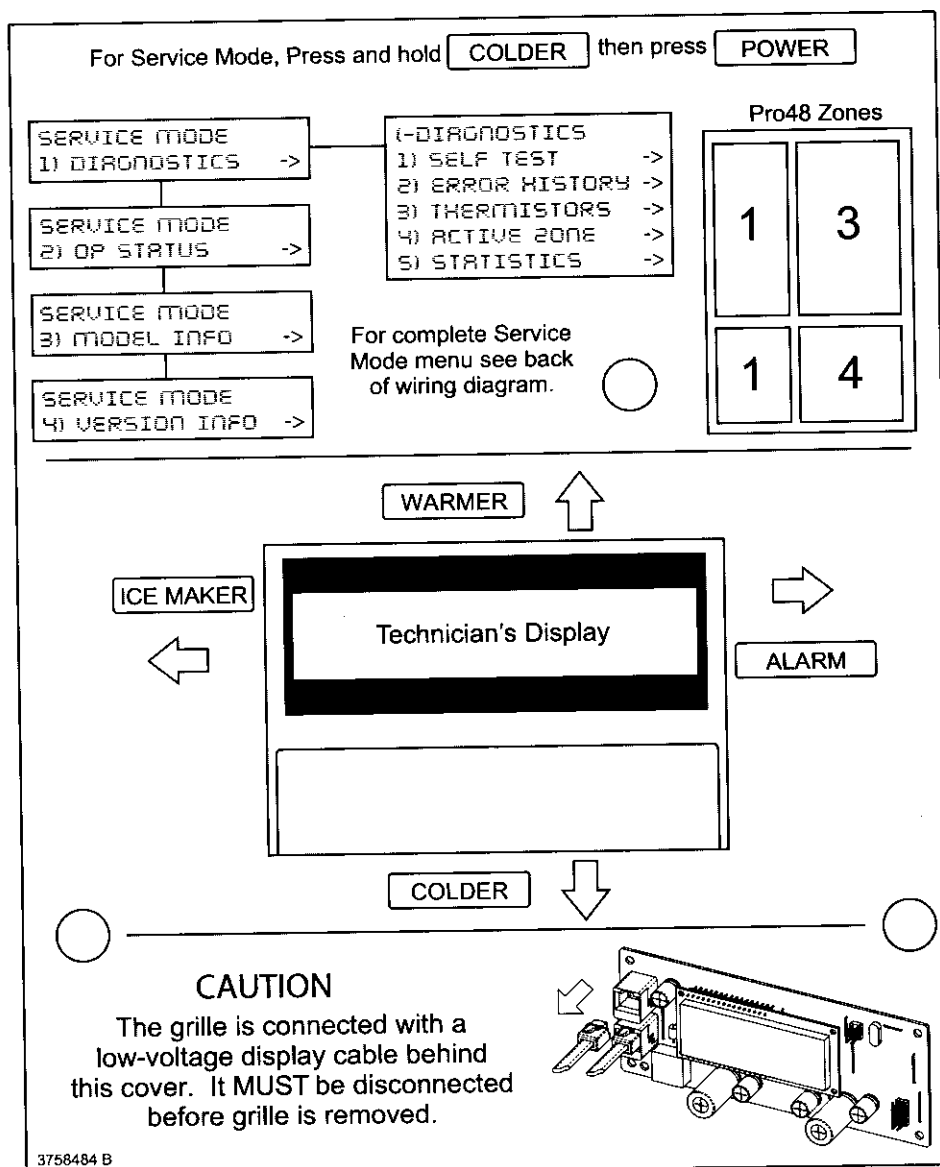
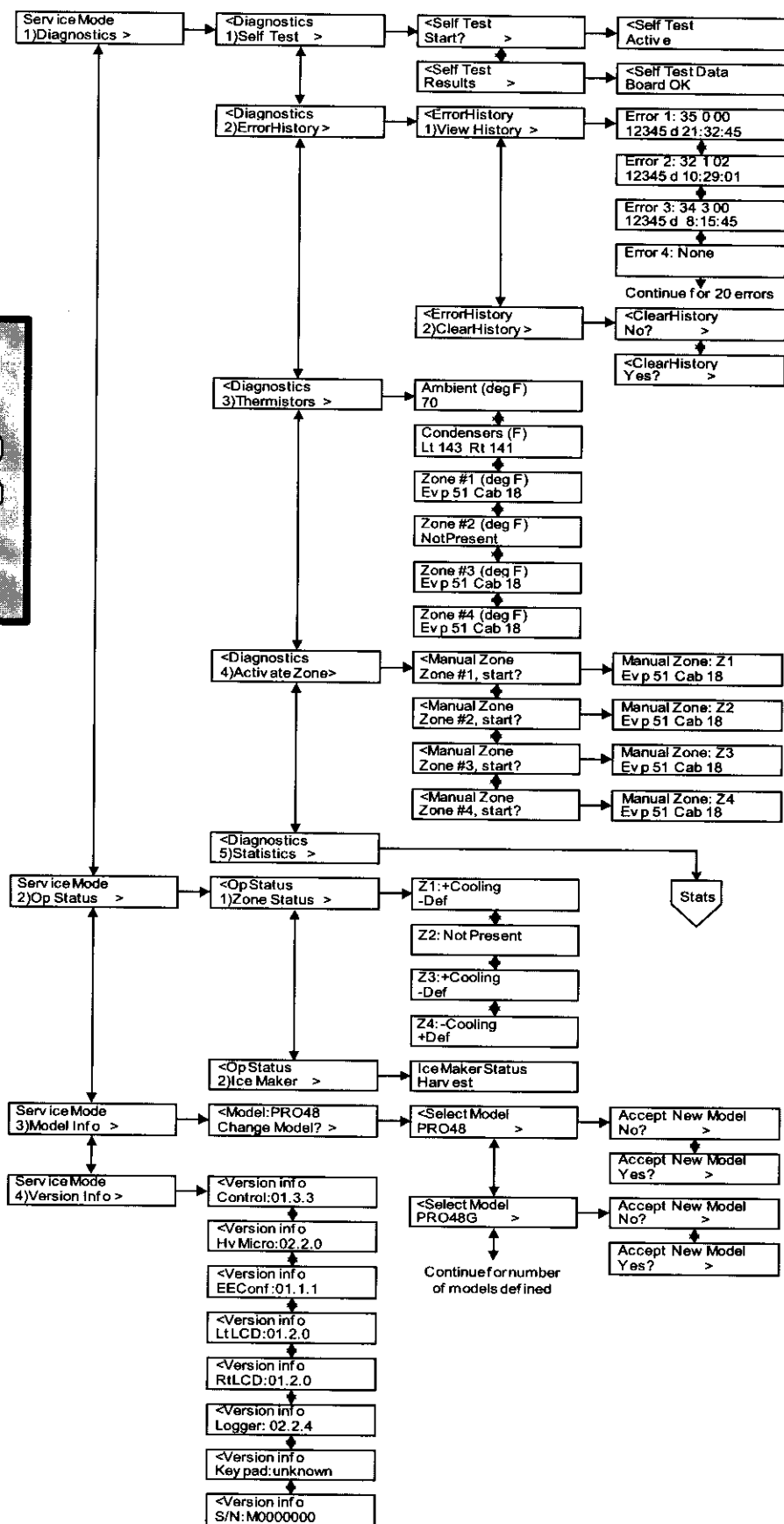
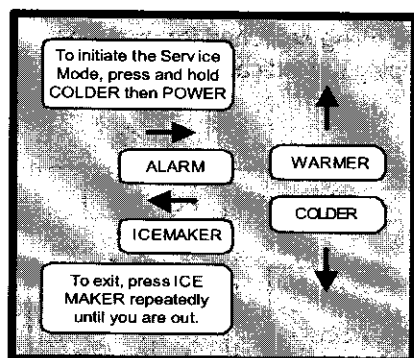


Figure 3-40. Technician's Display with Service Mode Menu

Service Mode Menu





Non-Service Mode Display Information

Prior to initiating Service Mode, the following information will appear on the Technician's Display, depending on operational mode.

Operational Mode	LCD Line #1	LCD Line #2
Power Up	Scrolling Messages (every 2s) 1) Model ID # 2) Main Software Version # 3) Left Display Version # 4) Keyboard Version #	Scrolling Messages (every 2s) 1) Unit ID # 2) E2 Version # 3) Right Display Version # 4) Tech Display Version #
Off		
Showroom	Sub Zero	Showroom mode
Sabbath	Sub Zero	Sabbath mode
Normal	Scrolling Messages (every 2s) 1) Model Name 2) Zone #1 Status 3) Zone #2 Status 4) Zone #3 Status 5) Zone #4 Status	Scrolling Messages (every 2s) 1) S/N: XXXXX 2) Status 3) Status 4) Status 5) Status

Initiating Service Mode

To initiate Service Mode, press and hold any COLDER key, then press the POWER key, then release both keys (See Figure 3-41). "Service Mode, 1) Diagnostics" is the first sub-mode to appear in the Technician's Display, with a small arrow in the bottom right corner pointing right.

NOTES:

- By following the basic directions on the Technicians Display cover and the prompts that appear in the Technician's Display, a Service Technician will be able to work through the Service Mode menu, to the desired verification point, configuration portion, and troubleshooting section of the menu.
- For sake of space, the directions that follow will not explain or show what is seen in the display after each key stroke. Only the final, and/or desired result will be explained and illustrated.
- There are three (3) ways to exit Service Mode:
 - To exit the Service Mode at any time, press the ICE MAKER key repeatedly until completely out of Service Mode menu.
 - Pressing the POWER key will switch the unit OFF and exit Service Mode.
 - If no keys are pressed for five (5) minutes after initiating Service Mode, the electronic control will automatically exit the mode.

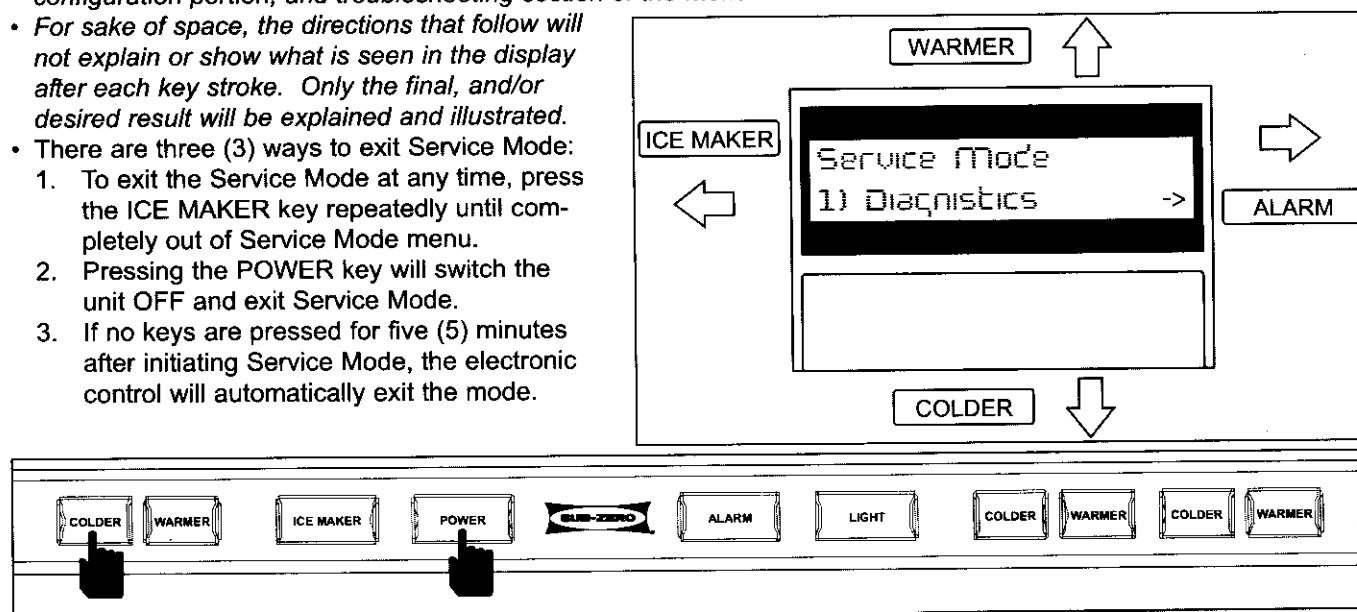


Figure 3-41. Key Strokes and Tech Display - Initiate Service Mode

Service Mode, 1) Diagnostics (Sub) Mode

There are five levels under Diagnostics Mode, they are:

- 1) Self Test
- 2) Error Code History
- 3) Thermistor Read
- 4) Activate Zone
- 5) Statistics

The next few pages explain the steps for working through the five levels of Diagnostics Mode. For sake of space, the directions that follow will not explain or show what is seen in the display after each key stroke. Only the final, and/or desired result will be explained and illustrated.

Diagnostics 1) Self Test - As mentioned, when Service mode is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display, with a small arrow in the bottom right corner pointing right. That is the prompt to enter Diagnostics Mode. Follow the steps below to work through Diagnostics Mode 1) Self Test:

1. After initiating Service Mode, press ALARM key three (3) consecutive times; "Self Test, Active" appears on display (See Figure 3-42).

During Self Test, which lasts approximately ninety (90) seconds, the main controller board cycles through all relays and triacs, switching components ON and OFF, and checking for correct feedback information from various electrical components. For example: each evaporator fan will be energized for a few seconds, regardless of the door being opened or closed. Then, if a relay or triac fails to function properly, or incorrect feedback is received, a message will appear on the Technician's Display, headed by the words "Self Test Data", with words indicating where the problem exists.

2. To see if multiple problems were detected, press the COLDER key to toggle down through the Self Test Data.

If there are no problems, the display will read "Self Test Data, Board OK"

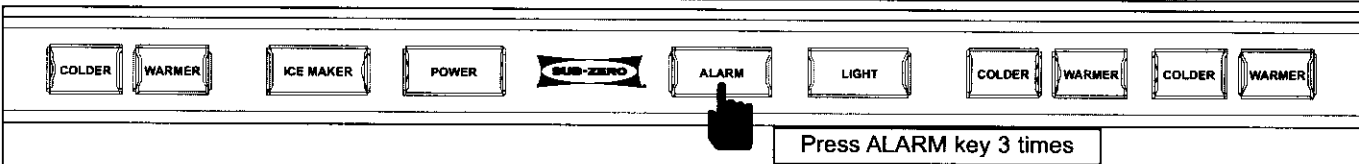
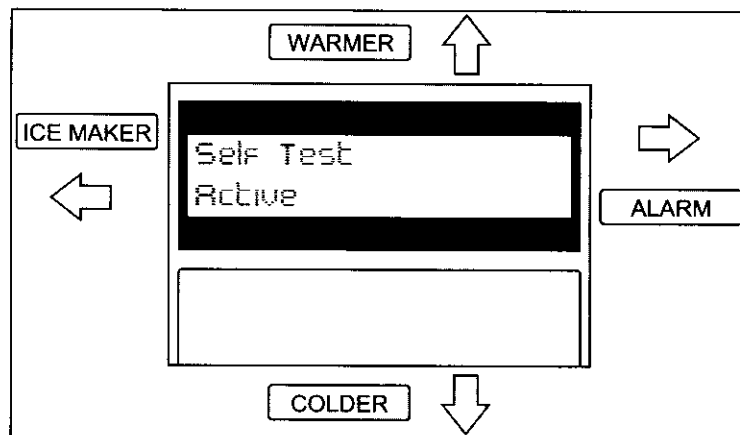


Figure 3-42. Key Strokes and Tech Display - Self Test

Diagnostics 2) Error History - As mentioned, when Service mode, is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display, with a small arrow in the bottom right corner pointing right. That is the prompt to enter Diagnostics Mode. Follow the steps below to work through Diagnostics Mode 2) Error History:

1. After initiating Service Mode, press ALARM key once.
2. Press the COLDER key once.
3. Press the ALARM key two (2) times. Now, if error codes are present, the most recent will be displayed (See Figure 3-43). Below the Error Code will be the number of days, hours and minutes since the error was logged.

NOTE: Though there are ninety-nine possible Error Codes, twenty is the most that can be stored. If over twenty occur, the newest error code over-writes the oldest.

4. To see if multiple error codes are logged, press the COLDER key to toggle down through the Error History.

NOTE: See following page for Error Code Table. See directions below to clearing Error Codes.

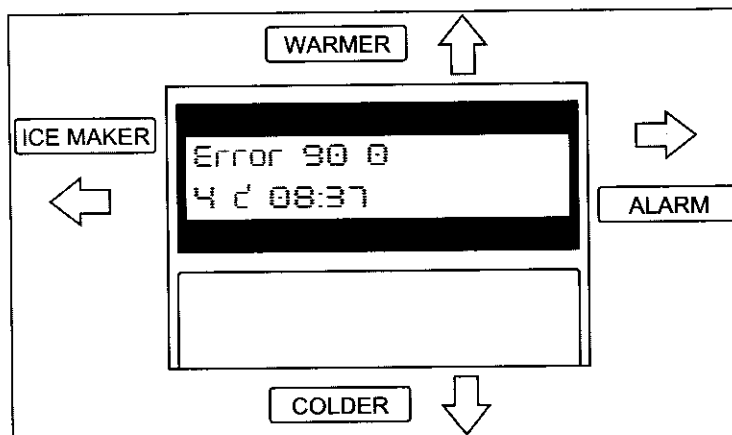


Figure 3-43. Key Strokes and Tech Display - Error History

Before attempting to clear Error History, the cause must first be corrected. If this is not done, the Error Codes will be re-logged. After repairs, follow the steps below to clear Error History:

1. After initiating Service Mode, press ALARM key once.
2. Press the COLDER key once.
3. Press ALARM key once.
4. Press the COLDER key once.
5. Press ALARM key once.
6. Press the COLDER key once, and "Clear Error History, Yes? ->" appears (See Figure 3-44).
7. Press ALARM key now and all Error Codes will be cleared from memory.

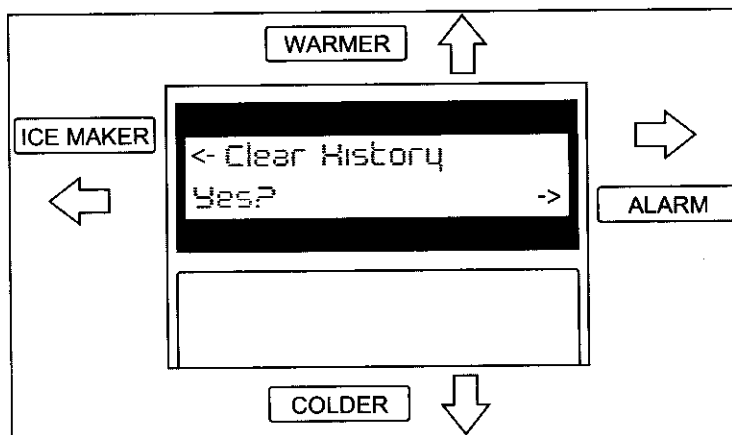


Figure 3-44. Key Strokes and Tech Display - Clearing Error History

Error Code Table		
CODE	ZONE	SERVICE INSTRUCTION
01	X	Zone "X" Cabinet Thermistor Failure (Device or Wiring)
02	X	Zone "X" Evaporator Thermistor Failure (Device or Wiring)
03	X	Zone "X" Condenser Thermistor Failure (Device or Wiring)
04	0	Ambient Thermistor Failure (Device or Wiring)
20	X	Check Zone "X" Defrost Bi-metal for Proper Operation
21	X	Check Zone "X" Defrost Bi-metal for Proper Operation
22	X	Check Zone "X" Defrost Wiring
23	X	Check Zone "X" Defrost Wiring
24	X	Check Zone "X" Defrost Heater Ohms
30	0	Check for Stuck Icemaker or Water Valve Failure
35	X	Check Zone "X" Fan, Fan Speed Error
40	X	Zone "X" Excessive Run
41	X	Check Zone "X" Compressor and Wiring
42	0	Check Condenser Fan and/or Wiring
43	X	Check Left Refrigerant Valve and Wiring
44	X	Check Zone "X" Glass Door Heater and Wiring
45	X	Errors Detectable with Red Door Switches-Disabled Now. Check Overhead Lighting
46	0	Check Ice Accessory Wiring for Open Circuit
47	3	Check Accent Lighting Wiring for Short Circuit
80	X	Check Power to Compressor Controller for Zone "X", Troubleshoot with Manual Activation Mode
83	X	Replace Zone "X" VS Compressor and Filter-Drier
84	X	Check Zone "X" VS Compressor Wiring
85	X	Zone "X" VS Compressor Control Overheat
86	X	Check Communication Wiring, Replace Zone "X" VS Controller
87	X	Check for Broken Wiring or Open Defrost Heater
89	X	Check Icemaker Solenoid Valve and Wiring
90	X	Change Main Control Board
92	0	Check Keypad Wiring
93	0	Replace Keypad
94	1	Check Wiring / Replace User Display #1
94	3	Check Wiring / Replace User Display #2
96	0	Datalogger Malfunction
97	0	Check Communications Cables / Connectors
98	0	Brownout Check Input Power Supply

Explanation of zone error codes

If "X" = 0, Failure was with a common component.

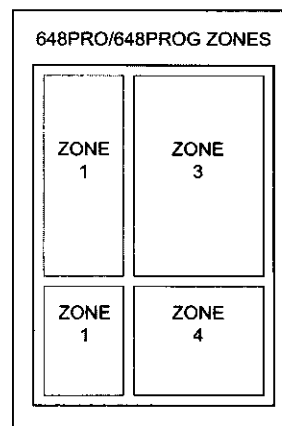
If "X" = 1, Failure occurred in Zone 1 or left system.

If "X" = 2, Failure occurred in Zone 2.

If "X" = 3, Failure occurred in Zone 3 or right system.

If "X" = 4, Failure occurred in Zone 4.

Note: Zone 2 and zone 4 may or may not be present depending on model.



Diagnostics 3) Thermistors - As mentioned, when Service mode, is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display, with a small arrow in the bottom right corner pointing right. That is the prompt to enter Diagnostics Mode. Follow the steps below to work through Diagnostics Mode 3) Thermistor Read:

1. After initiating Service Mode, press ALARM.
2. Press COLDER two (2) times.
3. Press ALARM now, and the ambient thermistor is the first to be read (See Figure 3-45).
4. Press the COLDER key to toggle down through the other thermistor readings.

These readings are real time temperatures, with no temperature averaging as seen on the User Displays.

Note: Zones 2 and 4 may or may not be present depending on model. If not present, "Zone #X (°F), Not Present" will appear in display.

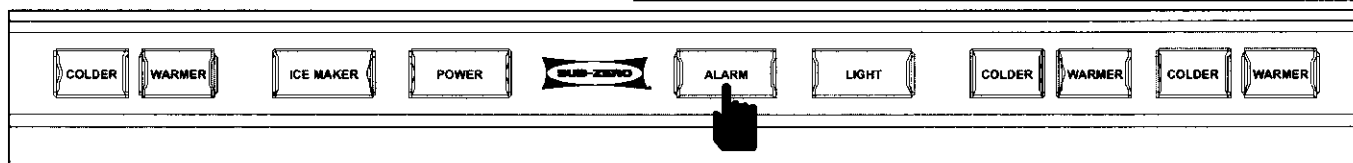
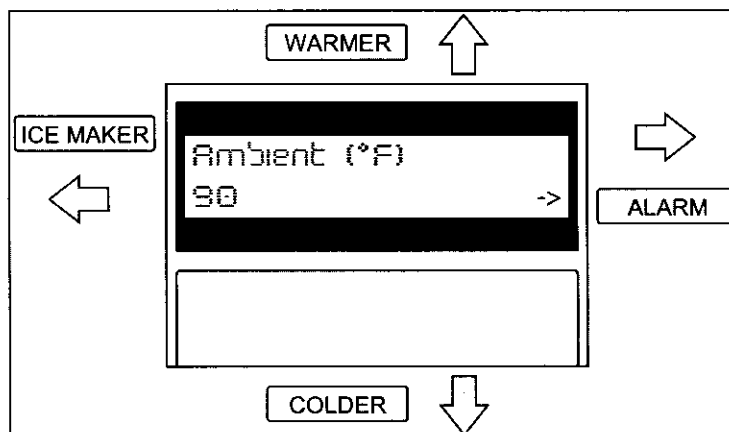


Figure 3-45. Key Strokes and Tech Display - Thermistor Read

Diagnostics 4) Activate Zone - As mentioned, when Service mode, is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display, with a small arrow in the bottom right corner pointing right. That is the prompt to enter Diagnostics Mode. Follow the steps below to work through Diagnostics Mode 4) Activate Zone:

1. After initiating Service Mode, press ALARM.
2. Press COLDER three (3) times.
3. Press ALARM now, and "Manual Zone, Zone #1, Start ? ->" appears on the display (See Figure 3-46).
4. If Zone #1 is the desired zone to activate, press ALARM. If Zone #1 is NOT the desired zone to activate, press COLDER until desired zone appears, then press ALARM.

When a zone is activated, the compressor will run at high speed and the compartment's evaporator fan will energize for five minutes. During this five minute run, the activated zone's evaporator and cabinet real time temperatures will be displayed on the Technician's Display.

Note: Zones 2 and 4 may or may not be present depending on model. If not present, "Manual Zone, Not Present" will appear in display.

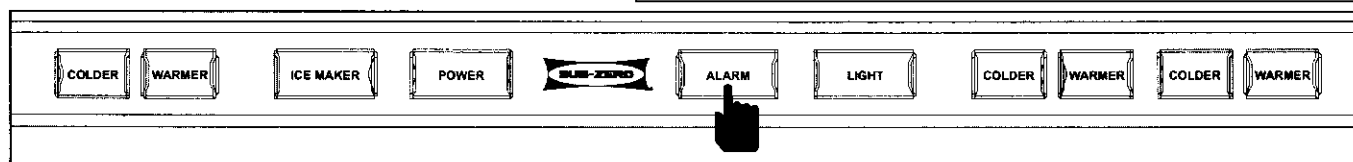
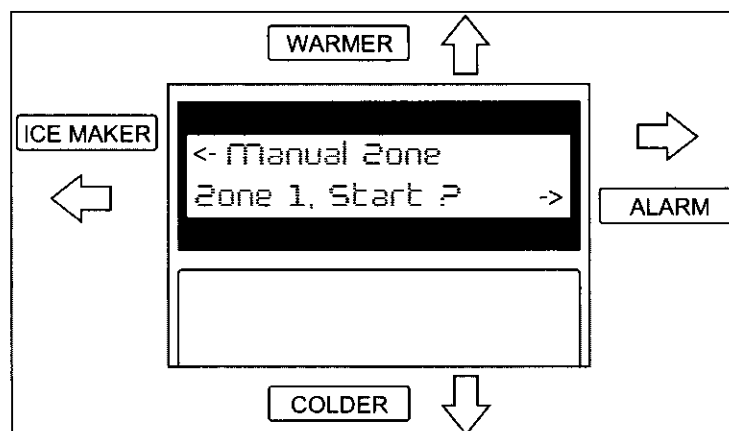


Figure 3-46. Key Strokes and Tech Display - Thermistor Read

Diagnostics 5) Statistics - As mentioned, when Service mode, is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display, with a small arrow in the bottom right corner pointing right. That is the prompt to enter Diagnostics Mode. Follow the steps below to work through Diagnostics Mode 5) Statistics:

1. After initiating Service Mode, press ALARM.
2. Press COLDER four (4) times.
3. Press ALARM now (See Figure 3-47), and it is possible to work through the following ten (10) levels:
 - 1) "Running Time ->" = Total days, hours and minutes unit has been operating.
 - 2) "Power Cycles ->" = Total number of power cycles unit has performed.
 - 3) "% Run Btwn Def ->" = % of freezer compressor run time between freezer defrosts(four possible zones).
 - 4) "% Run 50 Cycles ->" = % of each of four possible zone's run time, based on 50 cycles (% and duration).
 - 5) "Comp Cycles ->" = Total number of compressor cycles for left and right compressor.
 - 6) "Defrost ->" = Last defrost interval in hours and minutes; Last defrost duration in minutes.
 - 7) "Average Temps ->" = Average temperature of: Ambient, left/right condenser, 4 cabinet & evaporators.
 - 8) "Door Open Tim ->" = Greatest non-cumulative duration of light switch open readings (four possible zones).
 - 9) "Ice Maker ->" = Number of ice harvests in 14 days; Number of minutes ON in 14 days.
 - 10) "Self Test ->" = Amount of time since last self test was implemented,

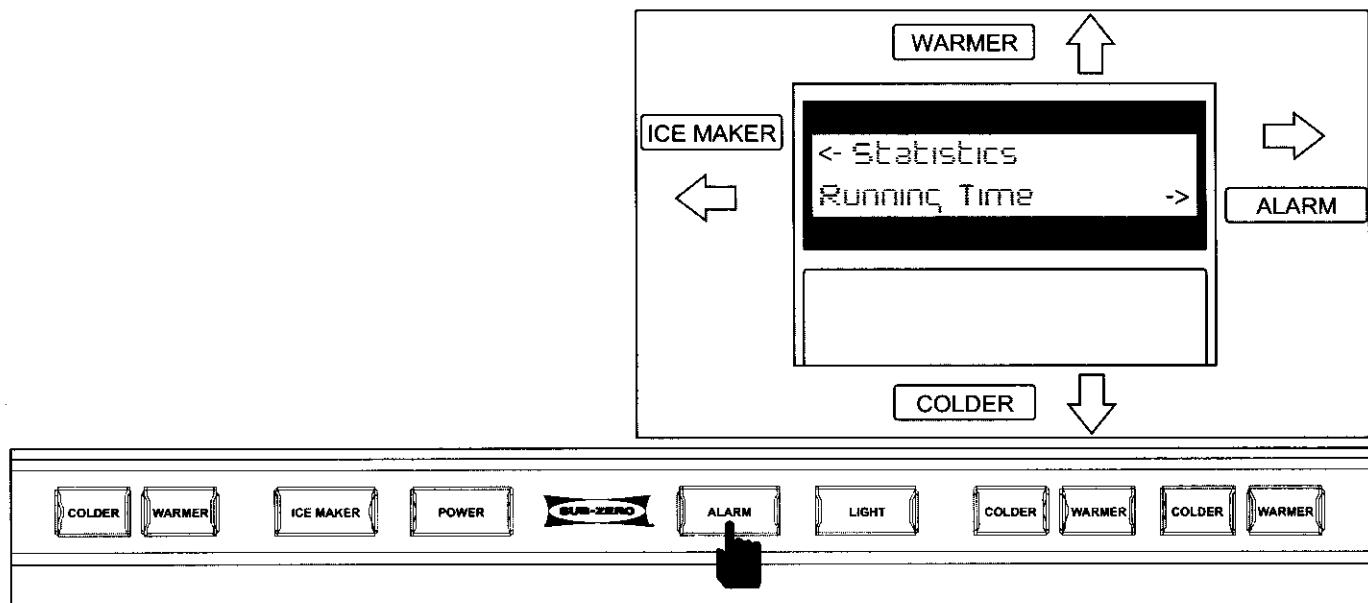


Figure 3-47. Key Strokes and Tech Display - Statistics

Service Mode, 2) Operational Status (Sub) Mode

There are two levels under Op (Operational) Status Mode, they are:

- 1) Zone Status - Accessing Operational Status, Zone Status will show a zone's cooling and defrost status.
- 2) Ice Maker - Accessing Operational Status, Ice Maker shows ice maker status as Harvest or Production.

The next few pages explain the steps for working through the two levels of Op Status Mode. For sake of space, the directions that follow will not explain or show what is seen in the display after each key stroke. Only the final, and/or desired result will be explained and illustrated.

Op Status 1) Zone Status - As mentioned, when Service mode is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display. Follow the steps below to work to and through Op Status Mode 1) Zone Status:

1. After initiating Service Mode, press COLDER key one (1) time; "Service Mode, 2) Op Status" appears on display.
2. Press ALARM key two (2) times (See Figure 3-48), and it is now possible to work through the following four (4) levels:
 - 1) "Z1 +/- Cooling; +/- Def" = Zone 1 is cooling, or defrosting.
 - 2) "Z2 Not Present" = Zone 2 is currently not present in this appliance.
 - 3) "Z3 +/- Cooling; +/- Def" = Zone 3 is cooling, or defrosting.
 - 4) "Z4 +/- Cooling; +/- Def" = Zone 4 is cooling, or defrosting.

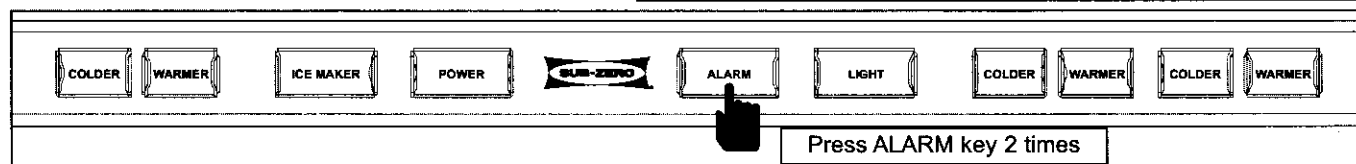
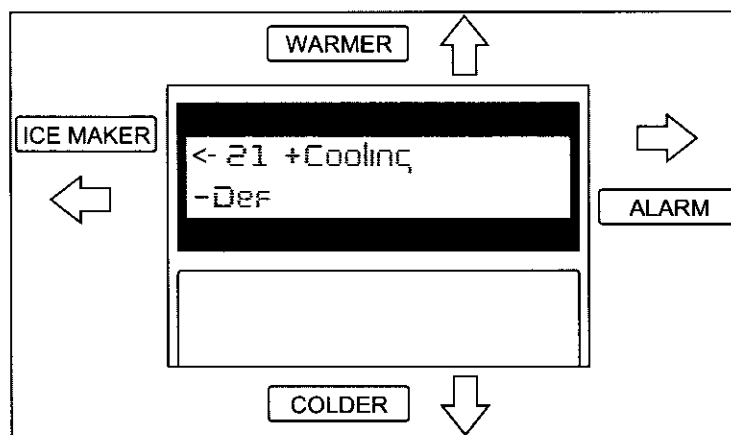


Figure 3-48. Key Strokes and Tech Display - Operational Status, Zone Status

Op Status 2) Ice Maker - As mentioned, when Service mode is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display. Follow the steps below to work to Op Status Mode 2) Ice Maker:

1. After initiating Service Mode, press the COLDER key one (1) time; "Op Status, 1) Zone Status" appears on display.
2. Press COLDER key one (1) time.
3. Press the ALARM key one (1) time (See Figure 3-49); "Ice Maker Status, Harvest (or Production)" appears on display.

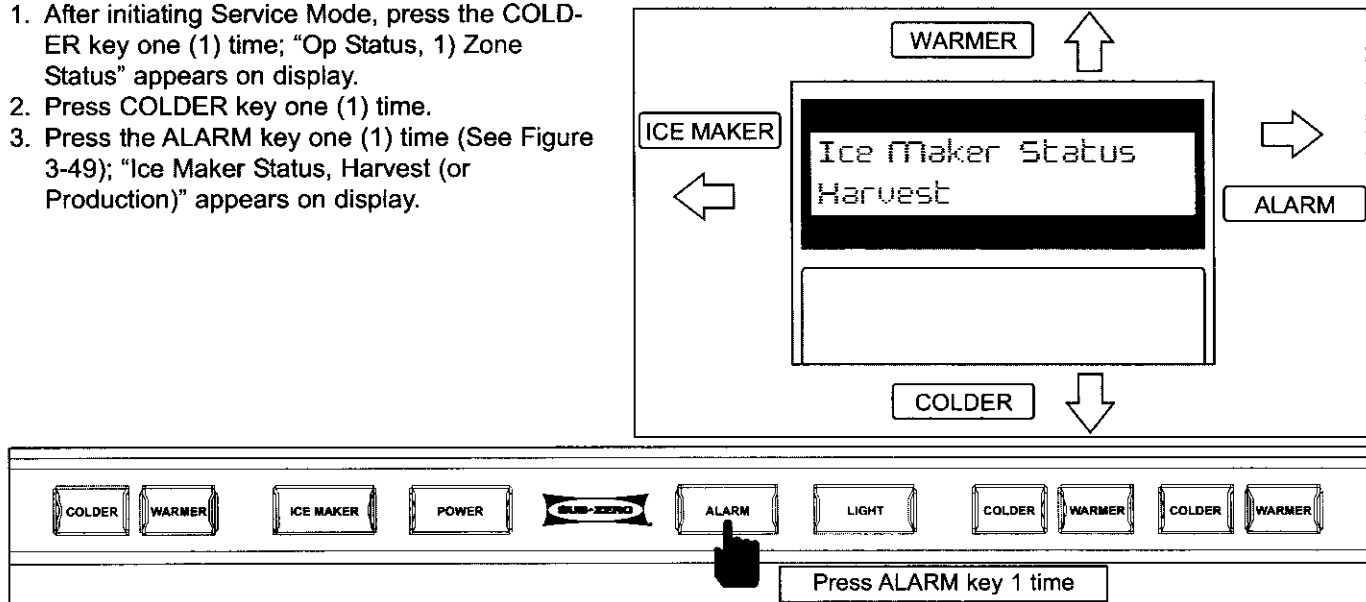


Figure 3-49. Key Strokes and Tech Display - Operational Status, Ice Maker

Service Mode, 3) Model Information (Sub) Mode

Accessing Model Information allows the Service Technician to verify, or change model configuration.

This page explains the steps for working through Model Information Mode. For sake of space, the directions that follow will not explain or show what is seen in the display after each key stroke. Only the final, and/or desired result will be explained and illustrated.

As mentioned, when Service mode is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display. Follow the steps below to work to and through **Service Mode, 3) Model Information (Sub) Mode**:

1. After initiating Service Mode, press the COLDER key two (2) times; "Service Mode, 3) Model Info" appears on display.
2. Press ALARM key two (2) times (See Figure 3-50), and it is now possible to select, change, or verify model configuration.

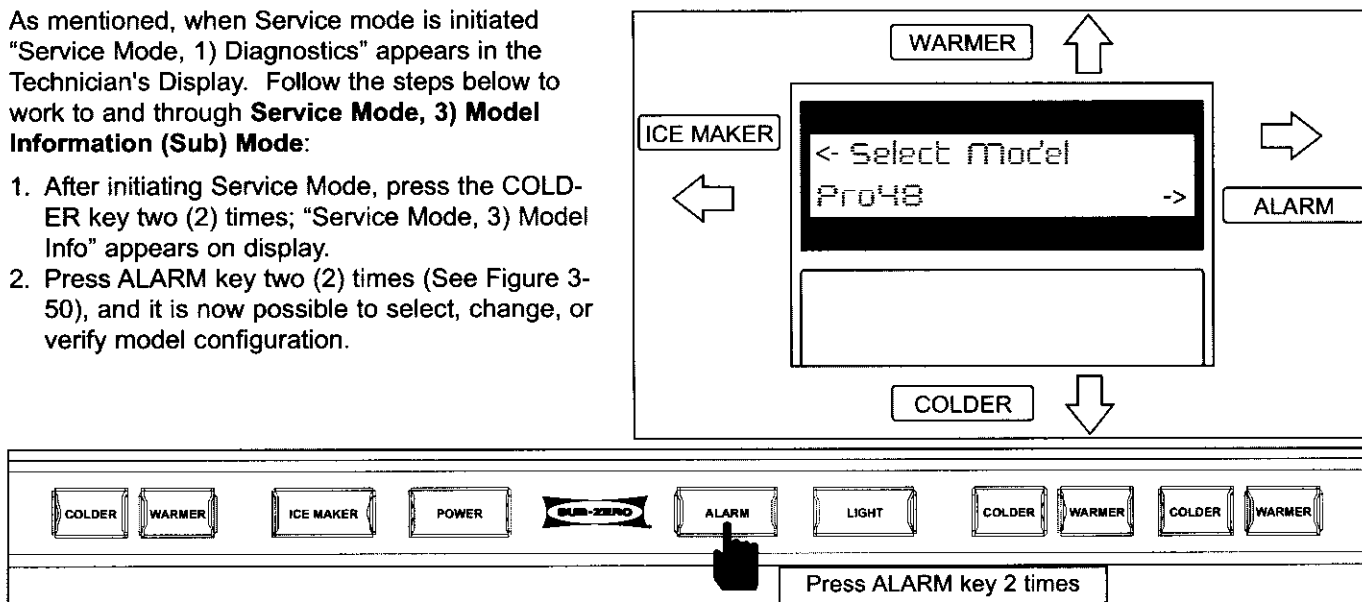


Figure 3-50. Key Strokes and Tech Display - Model Information

Service Mode, 4) Version Information (Sub) Mode

Accessing Version Information allows the Service Technician to recall all the electronic control modules software versions and the E2 version of the main control board.

This page explains the steps for working through Version Information Mode. For sake of space, the directions that follow will not explain or show what is seen in the display after each key stroke. Only the final, and/or desired result will be explained and illustrated.

As mentioned, when Service mode is initiated "Service Mode, 1) Diagnostics" appears in the Technician's Display. Follow the steps below to work to and through **Service Mode, 4) Version Information (Sub) Mode**:

1. After initiating Service Mode, press the COLDER key three (3) times; "Service Mode, 4) Version Info" appears on display.
2. Press ALARM key one (1) time (See Figure 3-51), and it is now possible to toggle down through the software version information.

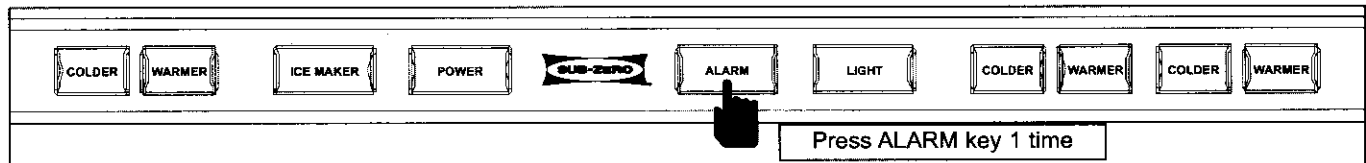
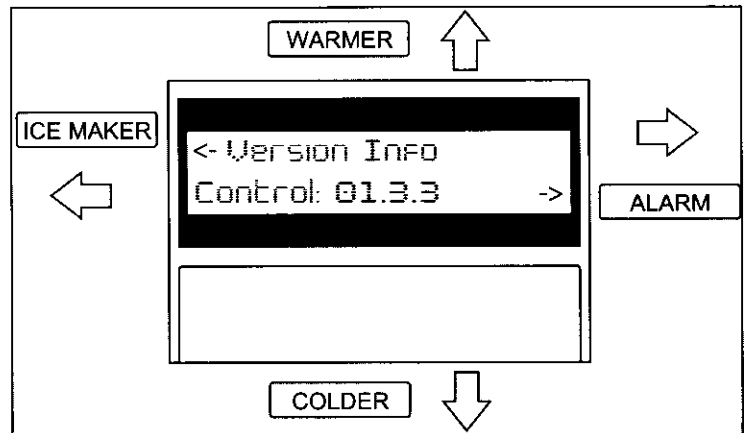


Figure 3-51. Key Strokes and Tech Display - Version Information

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



SECTION 4

SEALED SYSTEM INFORMATION

HFC-134a REFRIGERANT SERVICE INFORMATION

The Pro Series sealed systems contain HFC-134a refrigerant. This section provides general rules for working with 134a, and procedures to be followed while servicing the sealed system. This is followed by diagrams illustrating sealed system operation, then model-specific refrigerant flow diagrams.

⚠ CAUTION

134a refrigerant requires Synthetic Ester oil in the compressor, and does not tolerate contamination from other refrigerants, moisture, petroleum-based lubricants, silicone lubricants, cleaning compounds, rust inhibitors, leak detection dyes, or any other type of additive.

General Rules for Working with 134a Refrigerant

- Use equipment dedicated to 134a sealed system service only.
- Use only 134a refrigerant for back-flushing and sweep charging.
- Always replace the filter-drier when servicing the sealed system.
- The filter-drier must be cut from the sealed system. Never un-braze the drier as the heat will drive moisture back into the sealed system.
- Do not leave sealed system nor replacement compressor open to the atmosphere for more than 10 minutes.
- When the rubber plugs are pulled from the service compressor, a release of pressure should be heard. If no release of pressure is heard, do not use the compressor.
- Use **ONLY** virgin 134a refrigerant when recharging the sealed system.


PRO SERIES SEALED SYSTEM REPAIR PROCEDURES

Problem	Service Procedures
Non-Operating, Inefficient, Noisy Compressor <i>(NOTE: To check for a non-operating compressor, a hard start kit can be used)</i>	a. Capture refrigerant b. Replace Compressor c. Replace filter-drier d. Evacuate or sweep charge system <i>NOTE: If evacuating refrigerator sealed system, unit must be evacuated from the low & high sides due to refrigerant valve. If sweep charging refrigerator sealed system, refrigerant valve must be energized during procedure. (See Diagnostics 4) Activate Zone in Section 3)</i> e. Recharge system with Virgin 134a refrigerant
High Side leak	a. Capture refrigerant b. Repair leak c. Replace filter-drier d. Evacuate or sweep charge system <i>NOTE: If evacuating refrigerator sealed system, unit must be evacuated from the low & high sides due to refrigerant valve. If sweep charging refrigerator sealed system, refrigerant valve must be energized during procedure. (See Diagnostics 4) Activate Zone in Section 3)</i> e. Recharge system with Virgin 134a refrigerant
Low Side Leak	a. Capture refrigerant b. Repair leak (if at solder joint) or replace part c. Back flush high side of sealed system d. If all refrigerant has escaped and system is in a vacuum, replace compressor e. Replace filter-drier f. Evacuate or sweep charge system <i>NOTE: If evacuating refrigerator sealed system, unit must be evacuated from the low & high sides due to refrigerant valve. If sweep charging refrigerator sealed system, refrigerant valve must be energized during procedure. (See Diagnostics 4) Activate Zone in Section 3)</i> g. Recharge system with Virgin 134a refrigerant
Contaminated Sealed System <i>Examples:</i> > Burned out compressor > Excessive moisture from leak in condensate loop or in low side > Plugged capillary tube	a. Capture refrigerant b. Repair leak (if at solder joint) or replace part c. Back flush high side of sealed system d. Replace compressor e. Replace filter-drier f. Replace heat exchanger if cap tube is clogged g. Install a low side drier on suction tube h. Evacuate or sweep charge sealed system <i>NOTE: If evacuating refrigerator sealed system, unit must be evacuated from the low & high sides due to refrigerant valve. If sweep charging refrigerator sealed system, refrigerant valve must be energized during procedure. (See Diagnostics 4) Activate Zone in Section 3)</i> i. Recharge with Virgin 134a refrigerant
Restriction <i>(NOTE: If restriction is due to sealed system being contaminated, see Contaminated Sealed System above.)</i>	a. Capture refrigerant b. Locate and remove restriction or locate and replace part c. Back flush high side of sealed system d. Replace filter-drier e. Evacuate or sweep charge system <i>NOTE: If evacuating refrigerator sealed system, unit must be evacuated from the low & high sides due to refrigerant valve. If sweep charging refrigerator sealed system, refrigerant valve must be energized during procedure. (See Diagnostics 4) Activate Zone in Section 3)</i> f. Recharge system with Virgin 134a refrigerant.
Overcharge	a. Capture refrigerant b. Replace filter-drier c. Evacuate or sweep charge system <i>NOTE: If evacuating refrigerator sealed system, unit must be evacuated from the low & high sides due to refrigerant valve. If sweep charging refrigerator sealed system, refrigerant valve must be energized during procedure. (See Diagnostics 4) Activate Zone in Section 3)</i> d. Recharge system with Virgin 134a refrigerant

FREEZER SEALED SYSTEM OPERATION

The following six diagrams illustrate a 648PRO freezer sealed system. The components are listed in order of refrigerant flow, with an explanation of their fundamental role as part of a sealed system.

(1) - Compressor (Figure 4-1)

The compressor creates a high side and low side pressure difference in the sealed system by compressing the refrigerant gas, thus raising the pressure and temperature. The compressor pushes this high-pressure/high-heat gas through the discharge tube to the condenser.

(2) - Condenser (Figure 4-2)

The high-pressure/high-heat gas travels through the condenser, where the heat is dissipated by cooler air being drawn over the condenser tubing by the condenser fan. This changes the gas into a high-pressure/warm liquid that is then routed through the door gasket seat heater loop to prevent sweating, and through the drain pan heater loop to help evaporate water in the drain pan. The high-pressure/high-heat gas then enters the high-side filter-drier.

(3) - High-Side Filter-Drier (Figure 4-3)

The high-pressure/warm liquid travels through the high-side filter-drier, which removes moisture from the refrigerant before it enters the capillary tube.

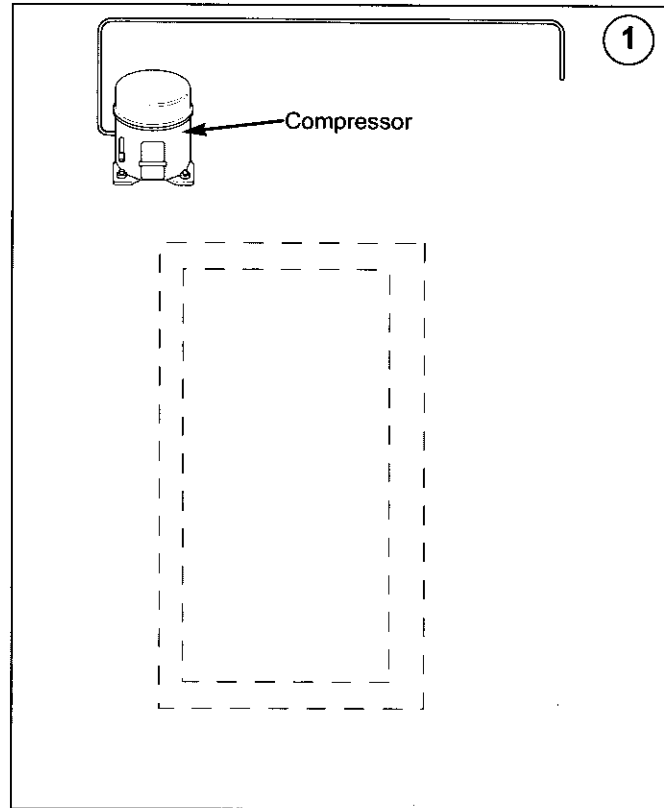


Figure 4-1. Compressor

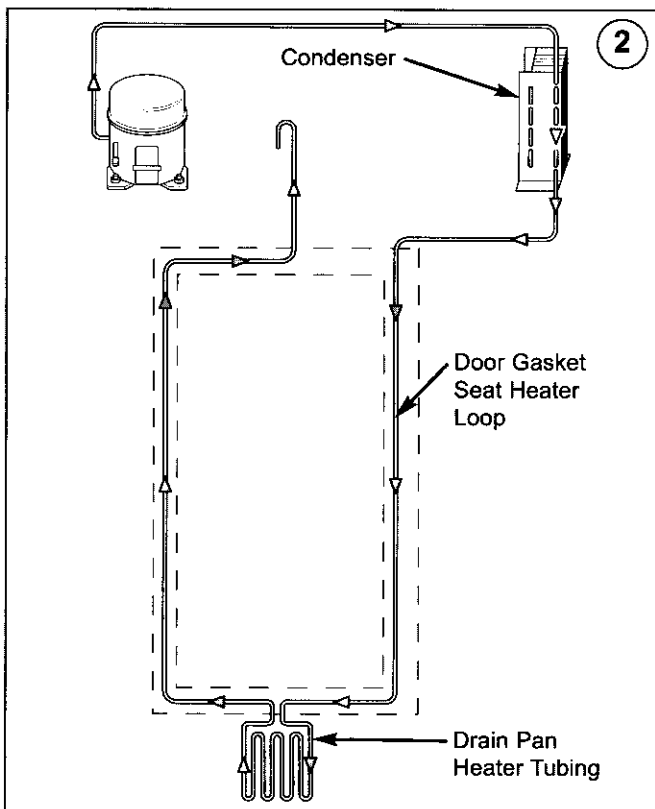


Figure 4-2. Condenser

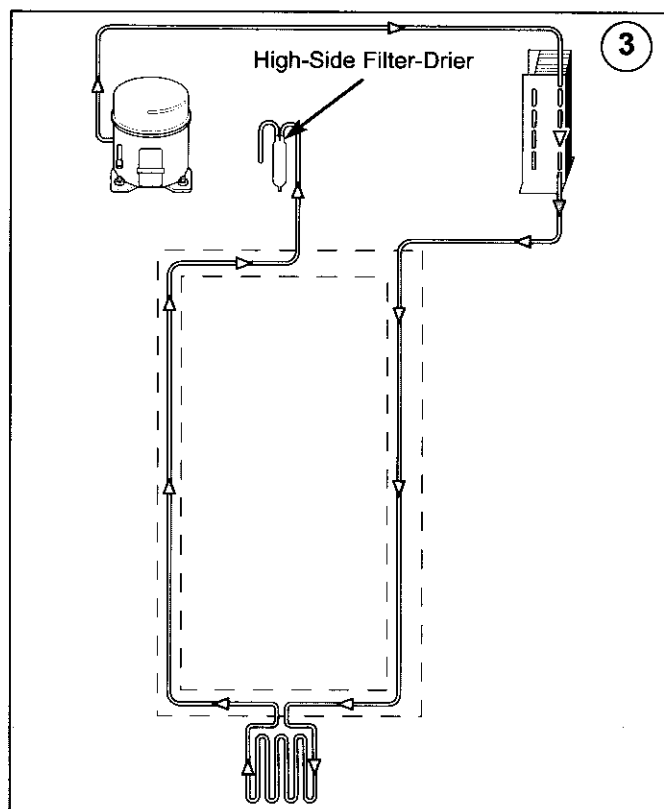


Figure 4-3. High-Side Filter-Drier

(4) - Capillary Tube (Part of Heat Exchanger) (Fig. 4-4)

The high-pressure/warm liquid refrigerant travels through the long skinny capillary tube which is attached to the suction tube (these two tubes soldered together create the heat exchanger). As the high-pressure/warm liquid refrigerant travels through the capillary tube it gives up heat to the cool refrigerant gas traveling through the suction tube and the pressure drops, so it is a low-pressure/cool liquid before it enters the evaporator.

(5) - Evaporator (Figure 4-5)

As the low-pressure/cool liquid refrigerant enters the evaporator, it vaporizes. This is caused by a dramatic pressure change which occurs when the refrigerant enters the larger diameter evaporator tubing from the smaller diameter capillary tubing. This vapor travels through the evaporator absorbing heat from the compartment, gradually converting the vapor to a cool gas. This cool gas then enters the suction tube.

(6) - Suction Tube (& Heat Exchanger) (Figure 4-6)

The cool gas travels through the suction tube which is attached to the capillary tube (as mentioned earlier, these two tubes soldered together create the heat exchanger). As this cool refrigerant gas travels through the suction tube it absorbs heat from the warm liquid refrigerant traveling through the capillary tube, making it a luke warm gas. The lukewarm refrigerant gas returns to the compressor where the process begins again.

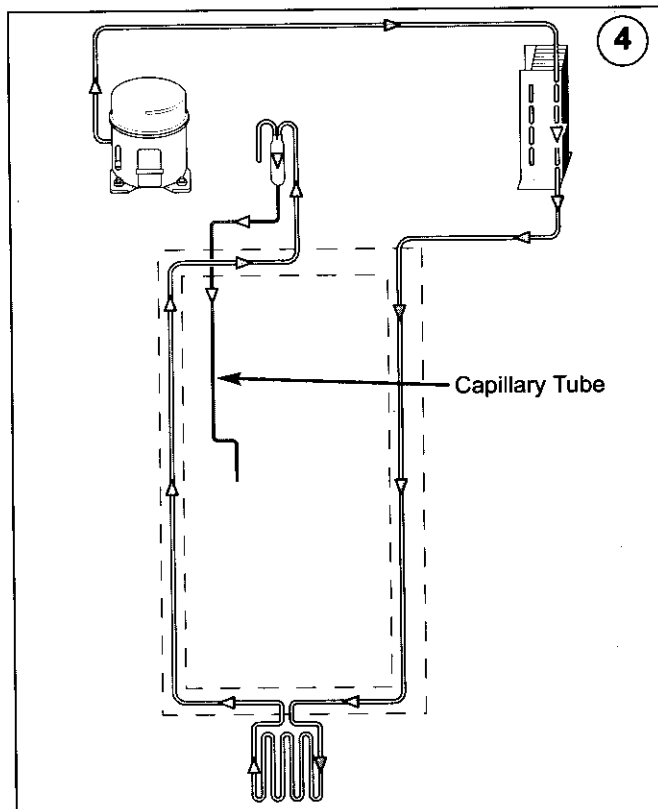


Figure 4-4. Capillary Tube (Part of Heat Exchanger)

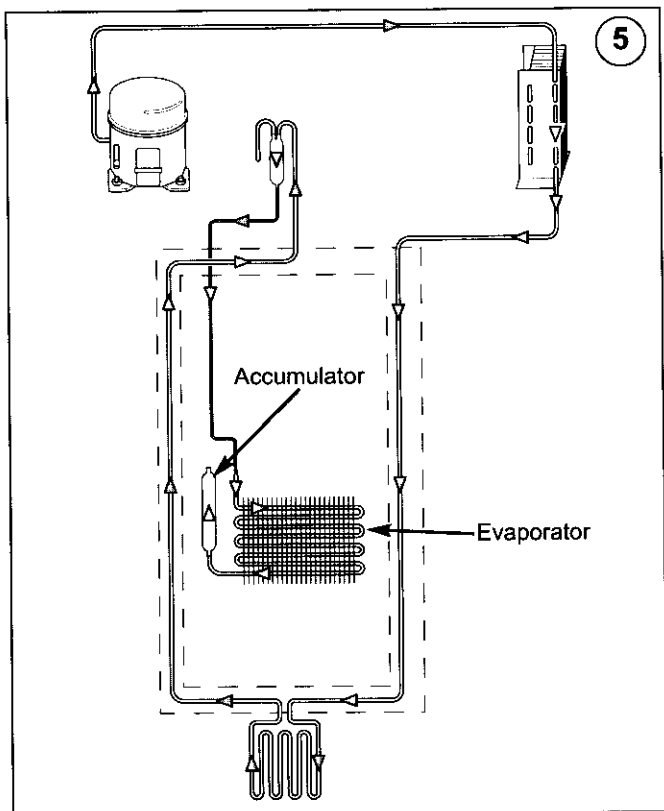


Figure 4-5. Evaporator

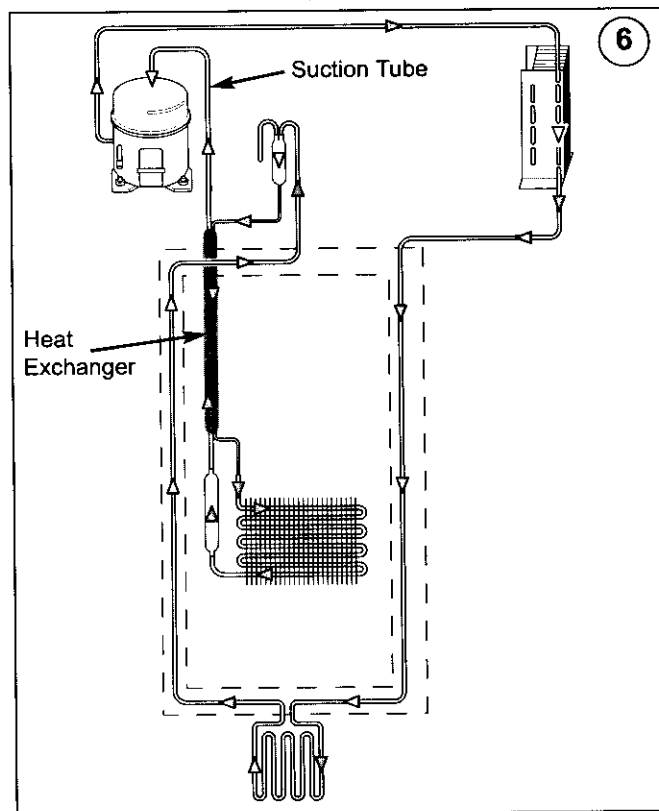


Figure 4-6. Suction Tube (Part of Heat Exchanger)

REFRIGERATOR SEALED SYSTEM OPERATION

The following six diagrams illustrate a 648PRO refrigerator sealed system. The components are listed in order of refrigerant flow, with an explanation of their fundamental role as part of a sealed system.

(1) - Compressor (Figure 4-7)

The compressor creates a high and low side pressure difference in the sealed system by compressing the refrigerant gas, raising its pressure and temperature. The compressor pushes the high-pressure/high-heat gas through the heater loop in the mullion to prevent sweat, then to the condenser.

(2A) - Condenser (Figure 4-8)

The high-pressure/high-heat gas travels through the condenser, where the heat is dissipated by cooler air being drawn over the condenser tubing by the condenser fan. This changes the gas into a high-pressure/warm liquid that then enters the high-side filter-drier.

(2B) - Filter-Drier (Figure 4-8)

The high-pressure/warm liquid travels through the high-side filter-drier, which removes moisture from the refrigerant before it enters the dual refrigerant valve.

(3) - Dual Refrigerant Valve (Figure 4-9)

A Tubing T-connection that is part of the dual refrigerant valve has a bead inside. This bead is forced to one side or the other of the T-connection, depending on the electrical signal from the control board to the valve solenoid. When the bead is to one side of the T-connection, that side is closed, the other side is open. The open side allows the high-pressure warm liquid to the appropriate capillary tube.

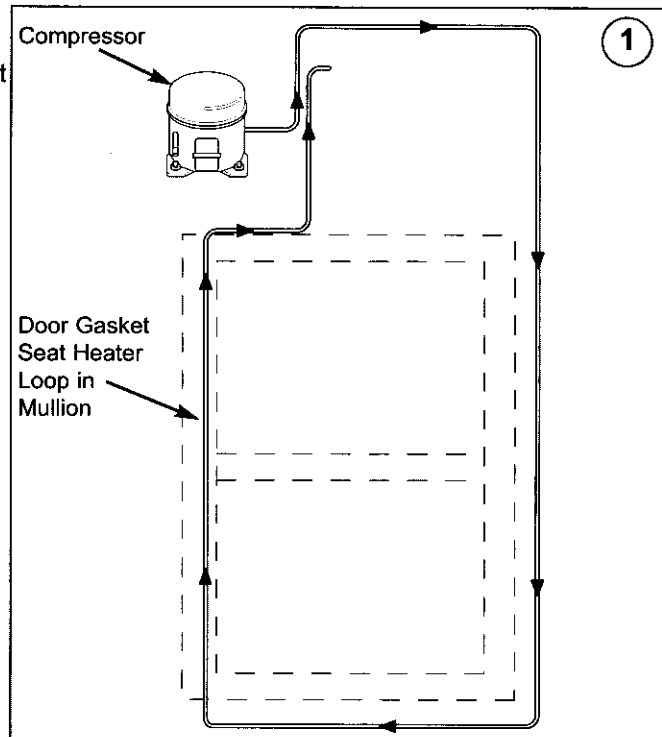


Figure 4-7. Compressor

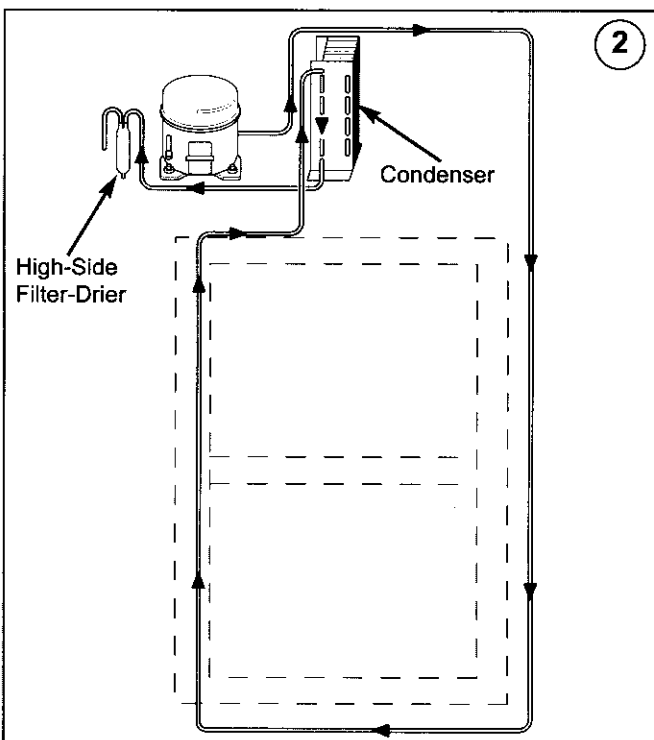


Figure 4-8. Condenser & Filter-Drier

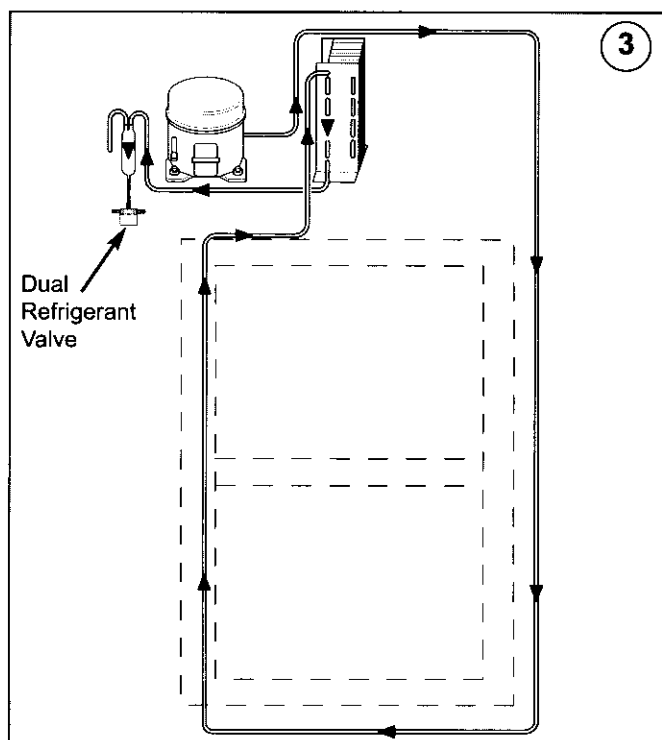


Figure 4-9. Dual Refrigerant Valve

(4) - Capillary Tube(s) (Figure 4-10)

The high-pressure/warm liquid refrigerant travels through the long skinny capillary tube which is attached to the suction tube (these two tubes soldered together create the heat exchanger). As the high-pressure/warm liquid refrigerant travels through the capillary tube it gives up heat to the cool refrigerant gas traveling through the suction tube and the pressure drops, so it is a low-pressure/cool liquid before it enters the evaporator.

(5) - Evaporator(s) (Figure 4-11)

As the low-pressure/cool liquid refrigerant enters the evaporator, it vaporizes. This is caused by a dramatic pressure change which occurs when the refrigerant enters the larger diameter evaporator tubing from the smaller diameter capillary tubing. This vapor travels through the evaporator absorbing heat from the compartment, gradually converting the vapor to a cool gas. This cool gas then enters the suction tube.

(6) - Suction Tube(s) & Heat Exchanger(s) (Figure 4-12)

The cool gas travels through the suction tube which is soldered to the capillary tube (as mentioned earlier, these two tubes soldered together create the heat exchanger). As this cool refrigerant gas travels through the suction tube it absorbs heat from the warm liquid refrigerant traveling through the capillary tube, making it a luke warm gas. (There is a suction tube "T" connection that diverts the two separate suction tubes from the evaporators to one suction tube that enters the compressor.) The lukewarm refrigerant gas is pulled back to the compressor (via vacuum force), where the process begins again.

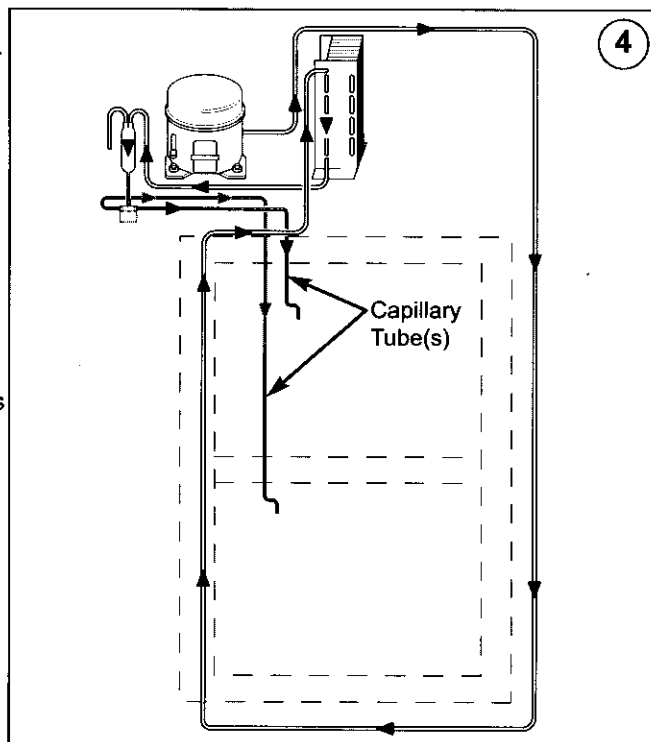


Fig. 4-10. Capillary Tube(s)-Part of Heat Exchangers

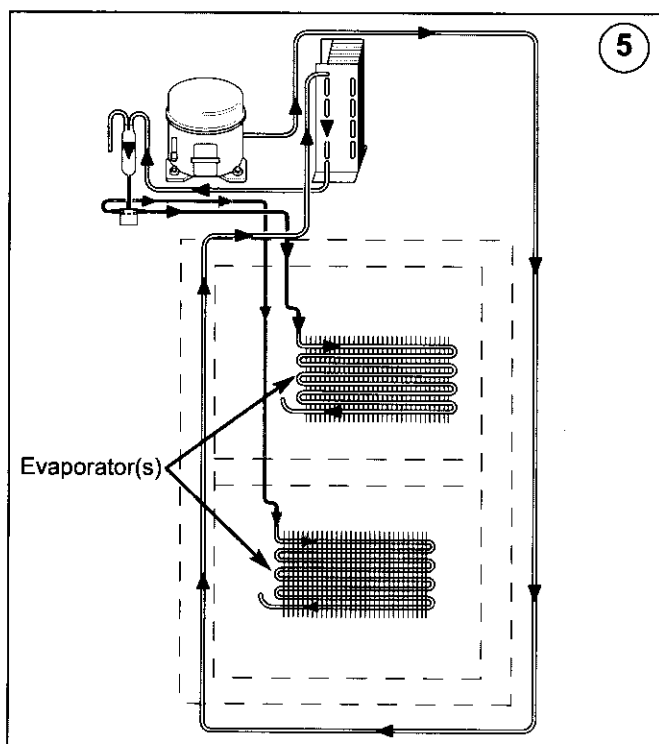


Figure 4-11. Evaporator(s)

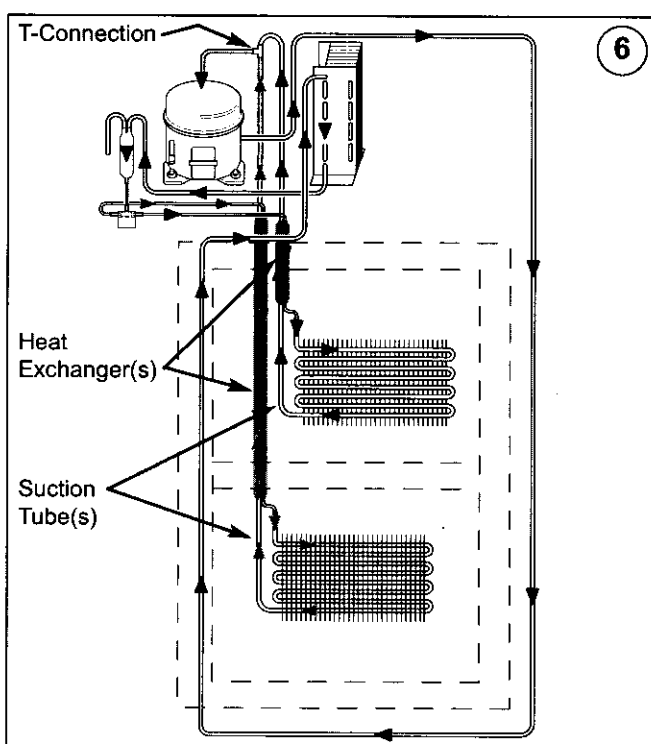


Figure 4-12. Suction Tube(s) & Heat Exchanger(s)

REFRIGERANT FLOW DIAGRAMS

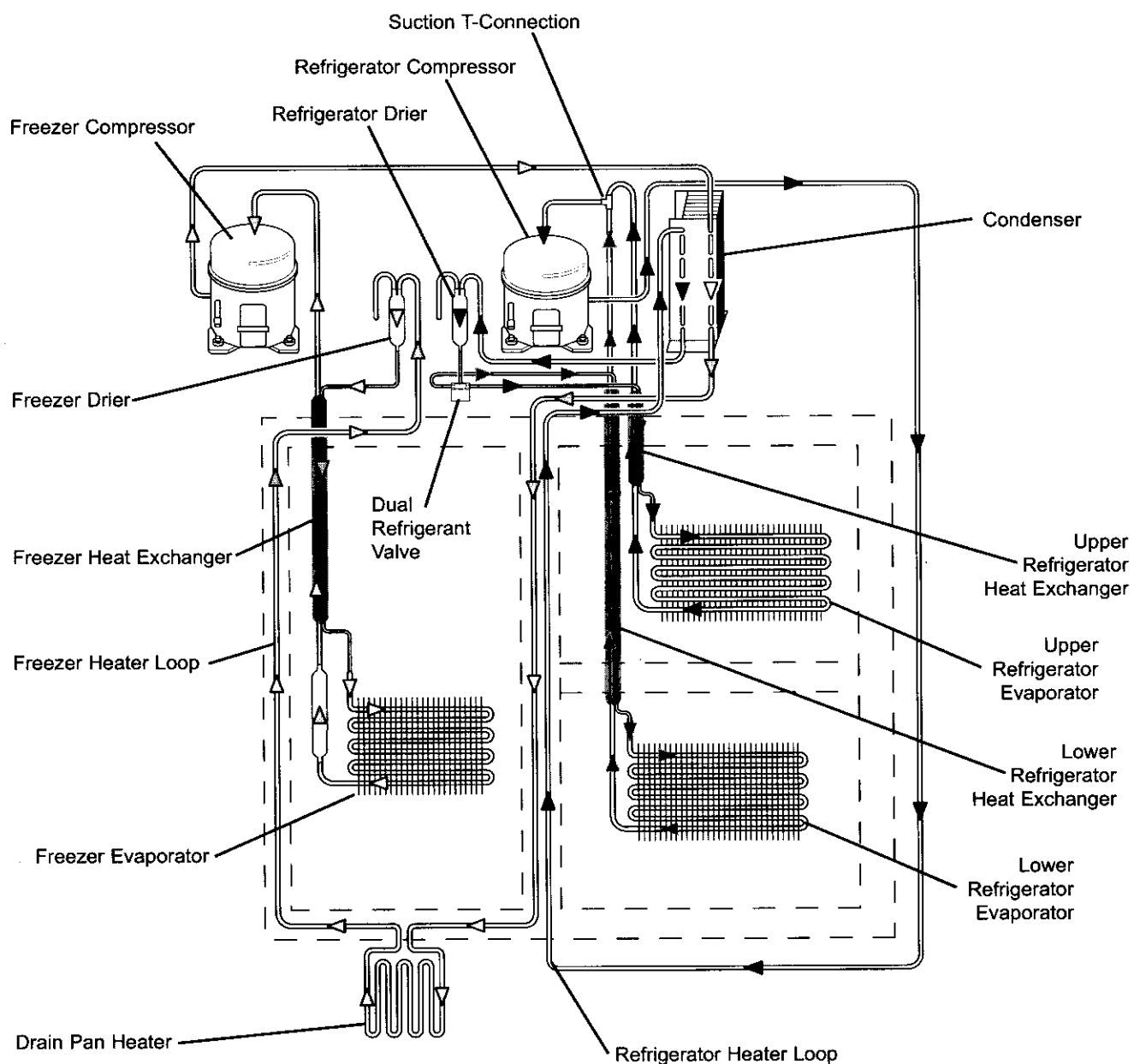


Figure 4-13. Models 648PRO Refrigerant Flow



SECTION 5

AIRFLOW AND FAN BLADE SPACING

AIRFLOW DIAGRAMS

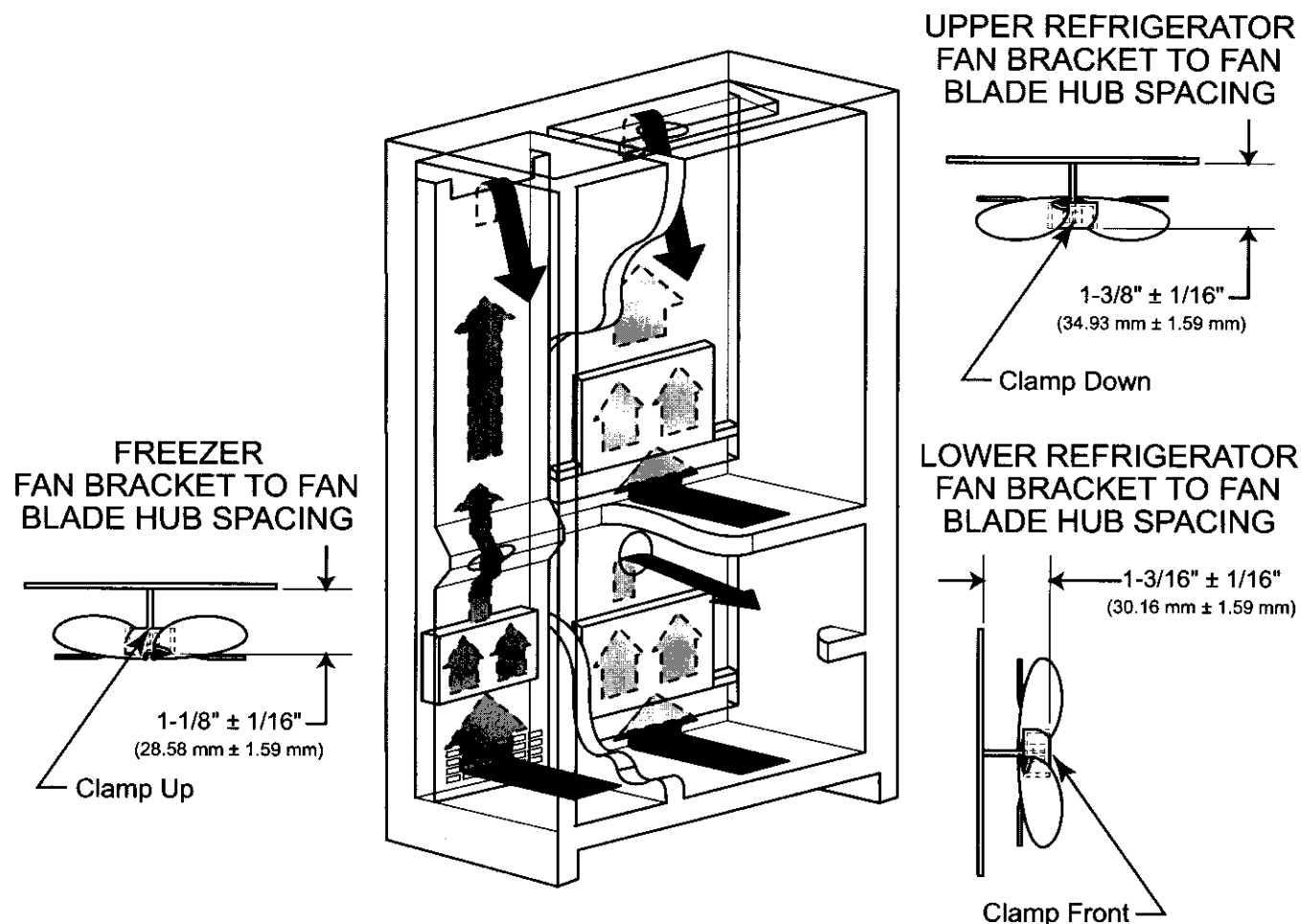


Figure 5-1. Air Flow and Fan Blade Spacing, Model 648PRO



SECTION 6

ICEMAKER INFORMATION

ICEMAKER SYSTEM INFORMATION

The model 648PRO utilizes a MidSouth® icemaker, or a Japan-Servo® icemaker, for which the operating characteristics of each are similar.

Icemaker operation is not complex, but icemaker components and operation cycles should be understood by a Service Technician in order to make proper diagnosis.

⚠ WARNING

TO AVOID ELECTRIC SHOCK, ALWAYS DISCONNECT ELECTRICAL POWER TO UNIT WHEN SERVICING ICEMAKER.

NOTE: The ICE MAKER key at the control panel activates the icemaker system. If the ice making icon is not displayed on the LCD, the icemaker system is OFF.

NOTE: To allow ice to freeze fully and reduce effects of low water pressure, the electronic control disables the icemaker system for 45 minutes after each ice harvest.

ICEMAKER COMPONENTS

Following are descriptions that explain the function of each icemaker component. The components are diagrammed in Figure 6-1 on the next page.

Support - The support is the housing around the electrical components and wire connections. The support is attached to the ice mold.

Mounting Plate - The drive motor, holding switch, water valve solenoid switch, timing gear, timing cam and water fill adjusting screw are attached to the metal mounting plate. The mounting plate is then attached to the support.

Drive Motor - AC power supplied to the drive motor causes the motor to operate. The motor has a single output shaft with a small gear. The motor gear drives/spins the timing gear.

Timing Gear - The timing gear is driven/spun by the drive motor gear and is attached to the timing cam.

Timing Cam - The timing cam is attached to the timing gear, and the ice ejector is inserted into the center of the timing cam. As the timing cam rotates, high and low spots on the cam operate the water valve solenoid switch and the holding switch. The timing cam also moves the lever arm side to side and rotates the ice ejector.

Ice Mold - The ice mold is where the eight crescent shaped ice cubes are formed.

Mold Heater - The mold heater uses 175 watts to thaw the ice free from the mold.

Ice Ejector - The drive end of the ice ejector is "D" shaped to fit into the "D" shaped hole in the timing cam. It has eight blades which rotate and sweep the ice from the mold cavities during the ejection phase of the cycle.

Ice Stripper - The stripper is attached to the dumping side of the mold, serving as a decorative side cover and it also prevents ice from falling back into the mold.

Bearing / Inlet - The bearing / inlet is attached to the ice mold, opposite the support. Water enters the bearing / inlet and is directed to the ice mold. The bearing/inlet also supports the ice ejector at the end opposite the timing cam.

Thermostat - The thermostat is a single-pole, single-throw, bi-metal switch. At 15°F (-9°C) ± 3° it closes, starting the ice ejection phase.

Thermal-Mastic - A substance similar in appearance to grease that is applied between the thermostat and the ice mold. Its purpose is to increase thermal conductivity between the mold and the thermostat.

Lever Arm and Shut-off Arm - The lever arm is moved side to side by two revolutions of the timing cam. As it moves, it raises and lowers the shut-off arm and operates the shut-off switch to control quantity of ice production. If shut-off arm comes to rest on top of the ice in the storage bin during either revolution, the shut-off switch will remain open, stopping ice production at the end of that revolution.

Water Valve Solenoid Switch - A single-pole, double-throw type switch that allows electricity to the water valve solenoid, opening the valve, during the fill cycle.

Holding Switch - A single-pole, double-throw type switch that assures completion of a revolution once the icemaker has been energized.

Shut-off Switch - A single-pole, double-throw type switch that stops ice production when the ice bin is full.

TCO (Thermal Cut Out) - The TCO is thermal protection device in the wire harness that would open in the event of mechanical failure, thus protecting against over heating. (The TCO is not shown in diagram.)

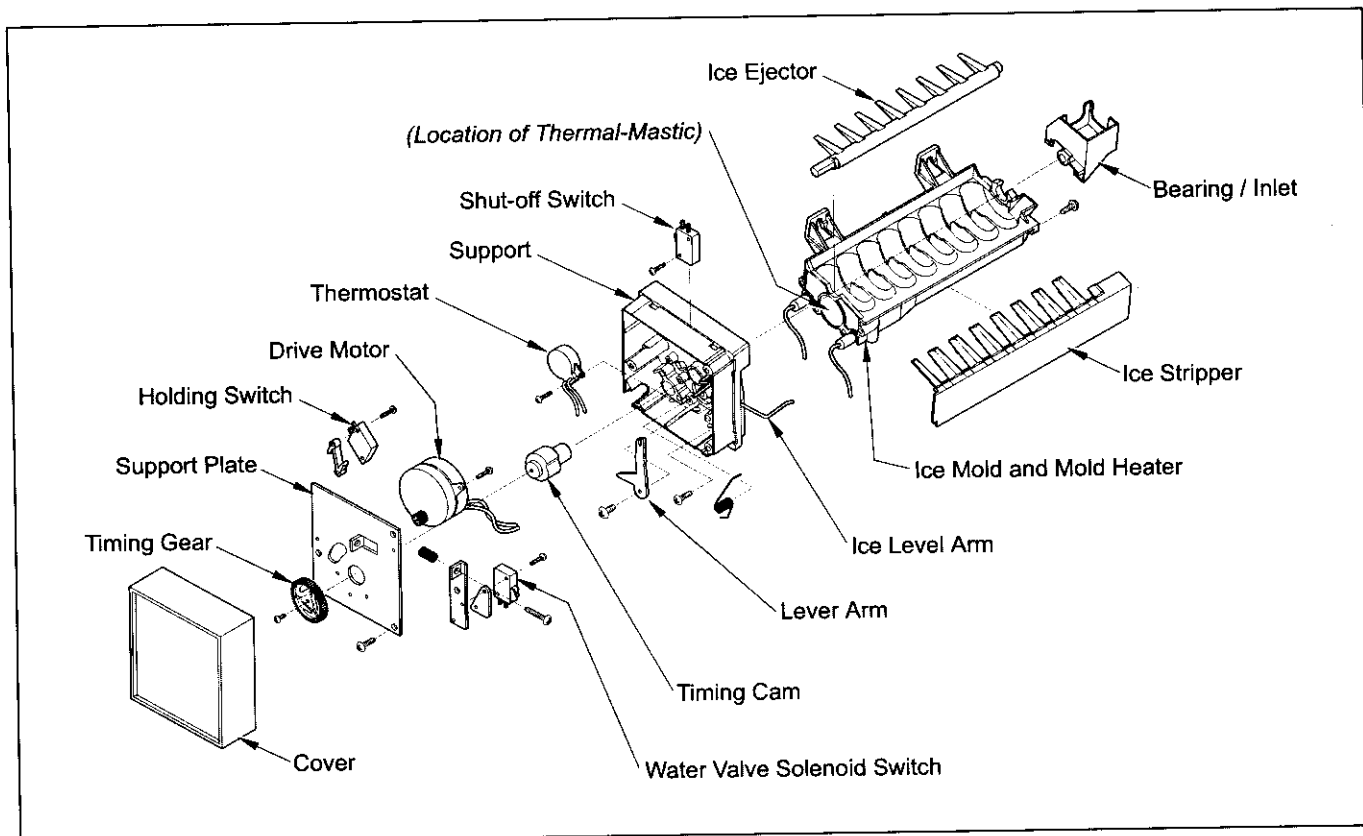


Figure 6-1. Diagram of Icemaker Components

ICEMAKER OPERATION

The following series of electrical schematics illustrate a typical icemaker cycle of operation. Below each schematic is a diagram indicating the approximate location of the ice ejector and ice level arm during the phase the schematic indicates.

Freeze Phase of Ice Making Cycle (See Figure 6-2)

- The ice mold is filled with water.
- The thermostat is open.
- No icemaker components are energized.

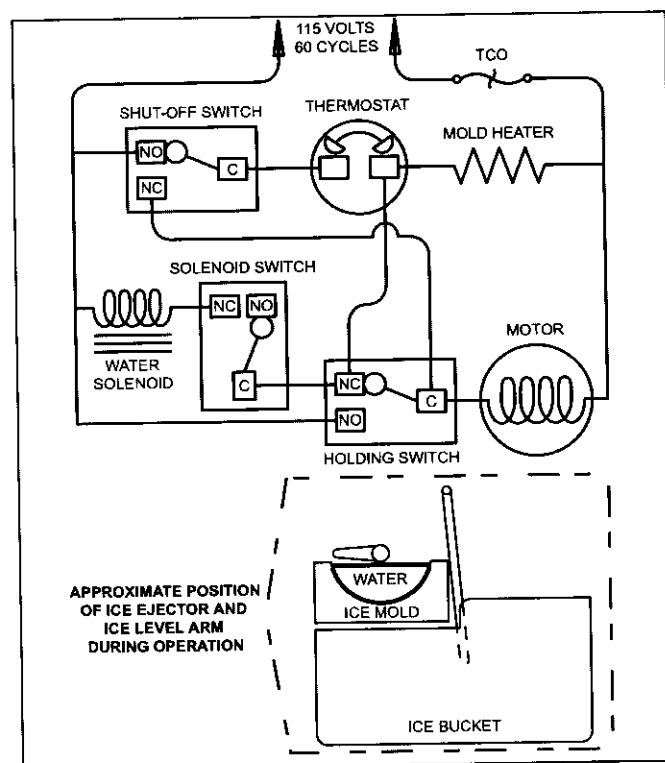


Figure 6-2. The Freeze Phase

Start of the First Revolution (See Figure 6-3)

- The water in the ice mold has turned to ice.
- At 15°F (-9°C) $\pm 3^{\circ}$ the thermostat closes.
- Mold heater is energized through the thermostat.
- The drive motor is started through the thermostat and "normally closed" terminal of the holding switch.
- The ice ejector begins to turn and the shut-off arm begins to rise.

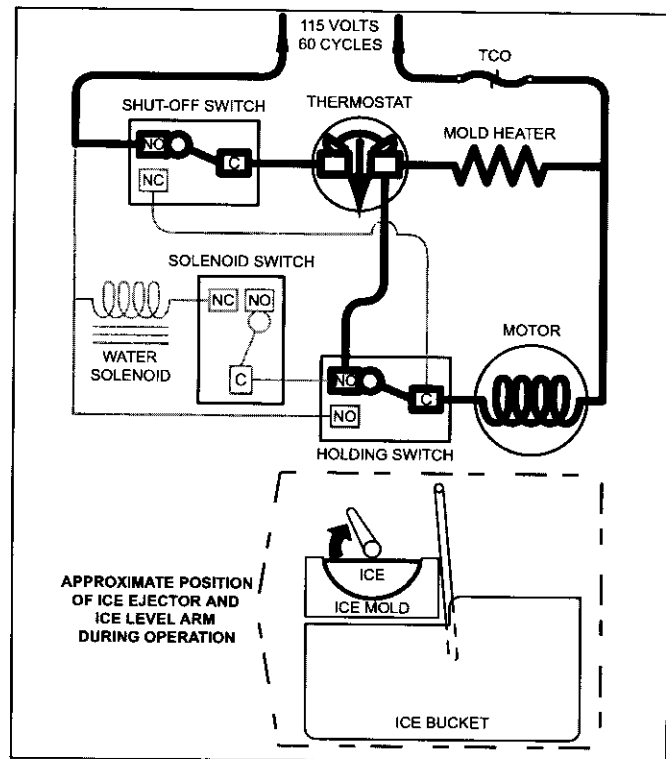


Figure 6-3. Start of First Revolution

First Revolution Continued (See Figure 6-4)

- The holding switch is tripped by the timing cam to "normally open" thus holding power to the motor.
- The mold heater remains energized through the thermostat.
- The shut-off arm begins to rise.

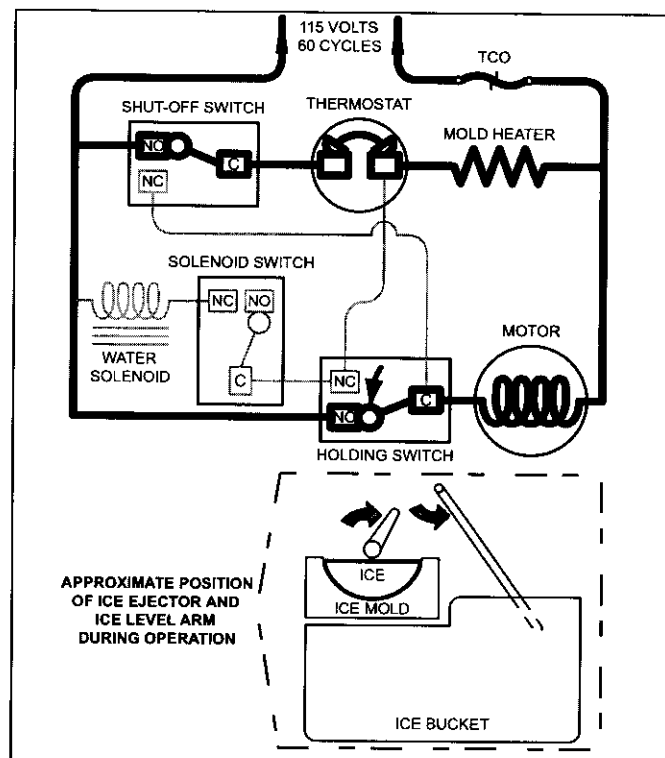
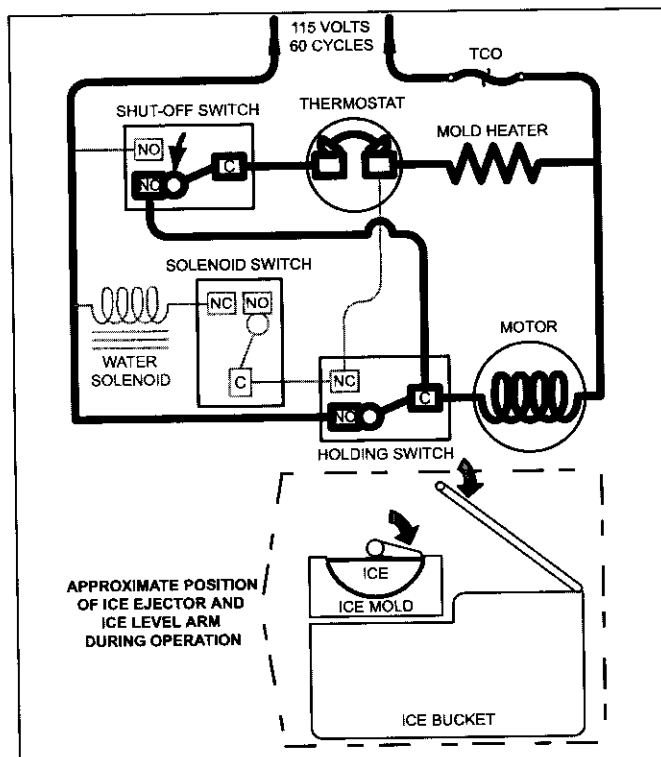


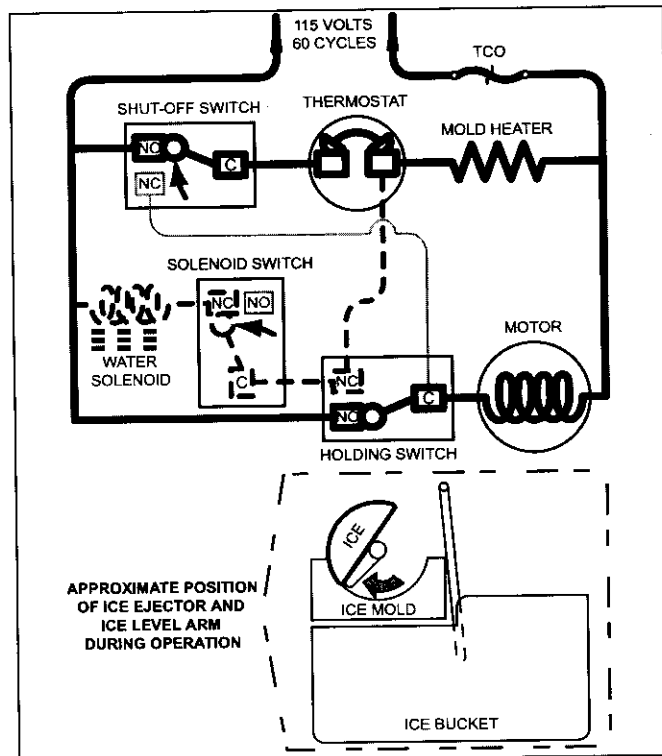
Figure 6-4. First Revolution Continued

First Revolution Continued (See Figure 6-5)

- The ice ejector reaches the ice in the mold.
- The ice releases from the mold as the ejector blades begin to rotate the cubes out.
- The drive motor remains energized through the holding switch.
- The mold heater remains energized through the thermostat.
- As the shut-off arm rises, the shut off switch is tripped to "normally closed", and then the shut-off arm begins to lower.


Figure 6-5. First Revolution Continued
First Revolution Continued (See Figure 6-6)

- The ice has released from the mold.
- The motor remains energized through the holding switch.
- The shut-off arm is lowered and the shut off switch is tripped to "normally open".
- The water valve solenoid switch is tripped by the timing cam, but the solenoid is not energized, because the thermostat is still closed and is energizing the mold heater. (Electric current follows the path of least resistance.)


Figure 6-6. First Revolution Continued

End of First Revolution (See Figure 6-7)

- The water valve solenoid switch is tripped by the timing cam back to "normally open."
- The timing cam trips the holding switch to "normally close," which ends the first revolution, but the thermostat is still closed, so the motor is again started.
- The mold heater remains energized through the thermostat.

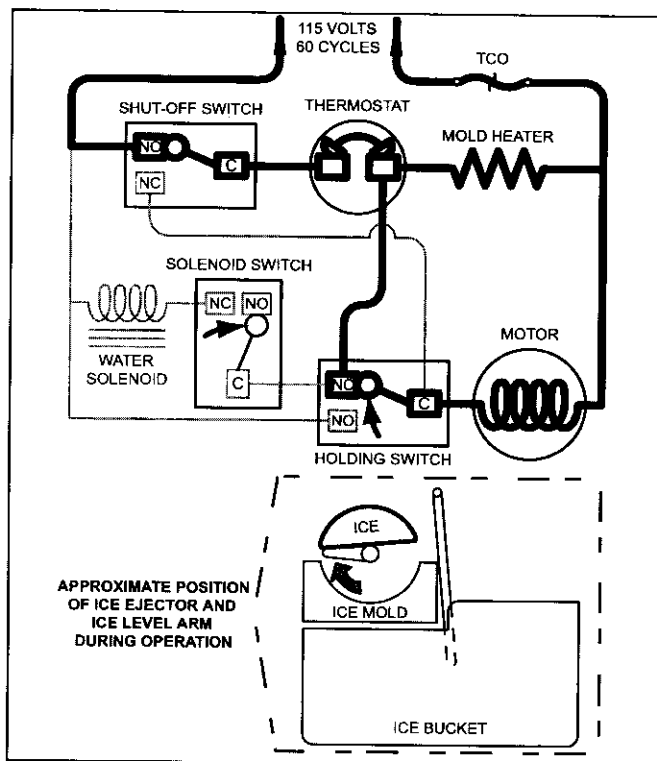


Figure 6-7. End of First Revolution

Start of Second Revolution:(See Figure 6-8)

- The water valve solenoid switch is tripped by the timing cam back to "normally open."
- The timing cam trips the holding switch to "normally close," which ends the first revolution, but the thermostat is still closed, so the motor is again started.
- The mold heater remains energized through the thermostat.

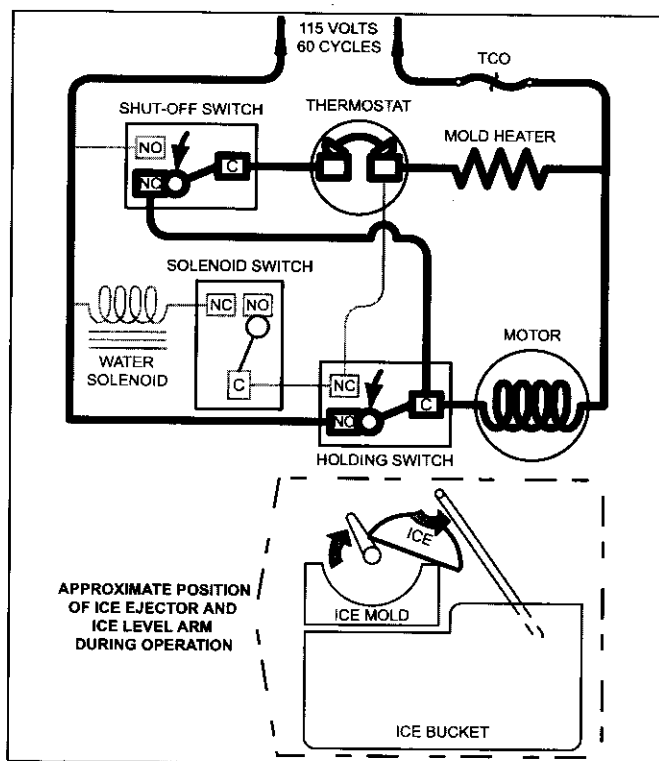
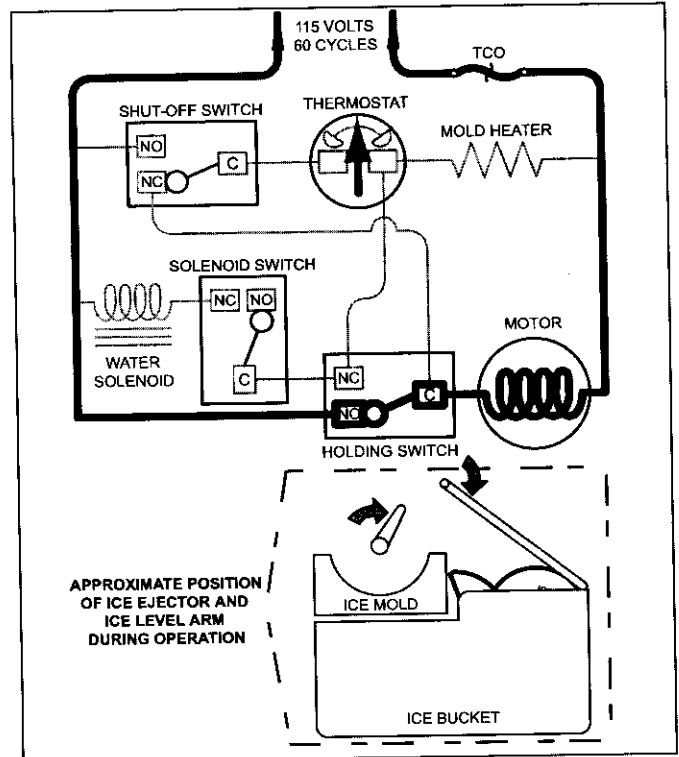


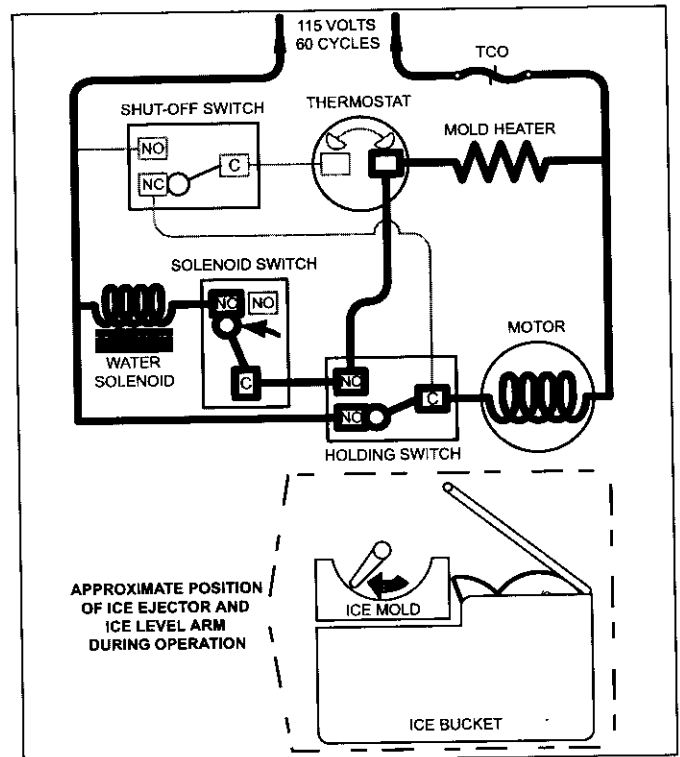
Figure 6-8. Start of Second Revolution

Second Revolution Continued (See Figure 6-9)

- The mold heater has warmed the thermostat, so the thermostat opens, and the mold heater is de-energized.
- If the shut-off arm comes to rest on top of the ice in the storage bin (as illustrated), the shut-off switch will remain in the "normally closed" position.
- The motor remains energized through the holding switch.


Figure 6-9. Second Revolution Continued
Second Revolution Continued (See Figure 6-10)

- The water valve solenoid switch is tripped by the timing cam. This time the solenoid is energized because the thermostat is open. The water solenoid is open for approximately seven seconds, filling the ice mold with water.
- The mold heater is energized through the solenoid switch and holding switch.


Figure 6-10. Second Revolution Continued

End of Ice making Cycle (See Figure 6-11)

- The water valve solenoid switch is tripped by the timing cam back to "normally open" ending the water fill.
- The timing cam trips the holding switch to "normally close," which ends the second revolution.
- The thermostat is still open, so it does not start the drive motor.
- If the shut-off arm has come to rest on top of the ice in storage bin (as illustrated), the shut-off switch remains in the "normally closed" position. This interrupts power from reaching the thermostat, until sufficient ice has been removed from the storage bin allowing the shut-off arm to lower.

NOTE: To allow ice to freeze fully and reduce effects of low water pressure, the electronic control system disables the icemaker system for 45 minutes after each ice harvest.

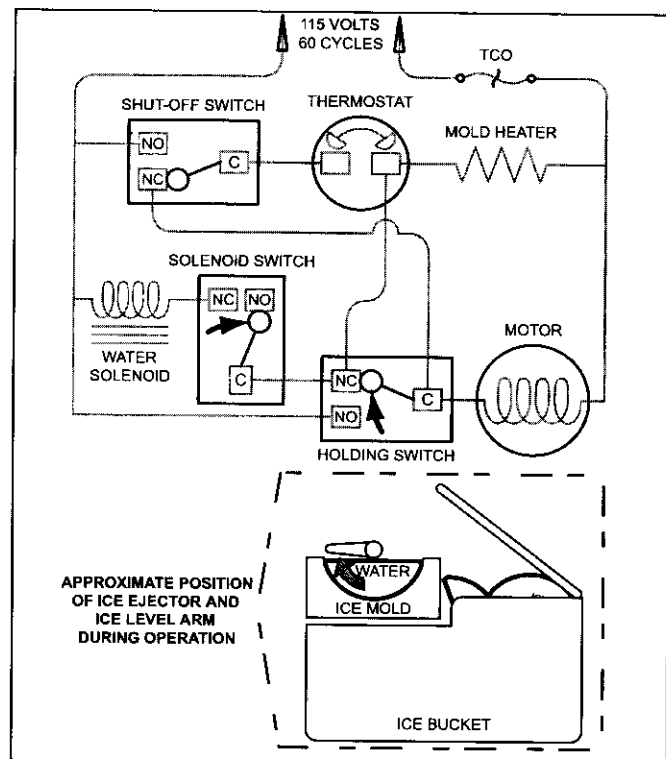


Figure 6-11. End of Ice Making Cycle

MANUALLY STOPPING ICE PRODUCTION

Ice production can be manually stopped by pressing the ICE MAKER key on the control panel so that the ice making icon is not displayed on the left User Display.

NOTES:

- If the ice level arm sticks in the "up" position, ice production will stop (See Figure 6-12).
- Removing the ice bucket will NOT stop ice production, as there is no ice maker rocker-switch used in this series.

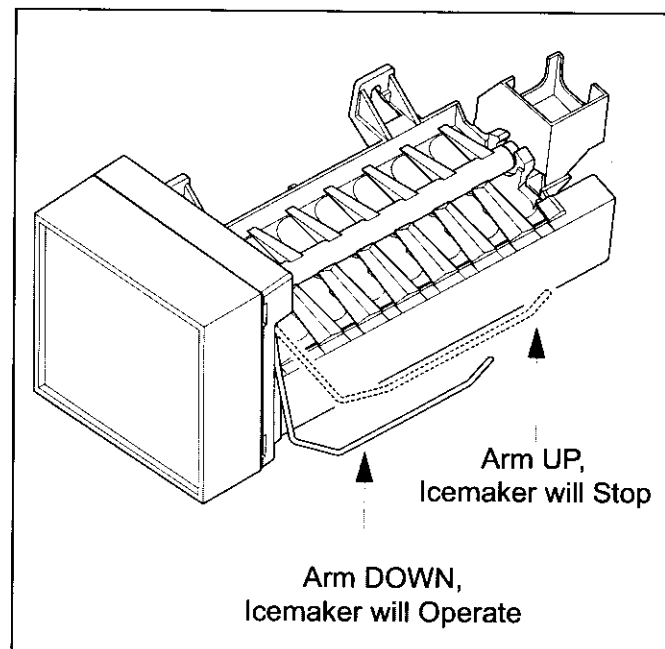


Figure 6-12. Stopping Icemaker

MANUALLY STARTING THE ICEMAKER

NOTE: To allow ice to freeze fully and reduce effects of low water pressure, the electronic control disables the icemaker system for 45 minutes after each ice harvest. To bypass this 45 minute dwell for service purposes, press the ICE key at the control panel.

Manual Start Procedure:

1. Pry the icemaker front cover from the support using a flat-blade screwdriver or coin.
2. With a flat-blade screwdriver, turn the drive gear counterclockwise until the holding switch is activated, completing the circuit to the drive motor (this will be about a 1/8 turn). (See Figure 6-13) The icemaker will then complete its cycle automatically.

NOTE: If after 1/4 turn the icemaker is not running on its own, it may be in the 45 minute dwell period or there is an electrical or mechanical problem.

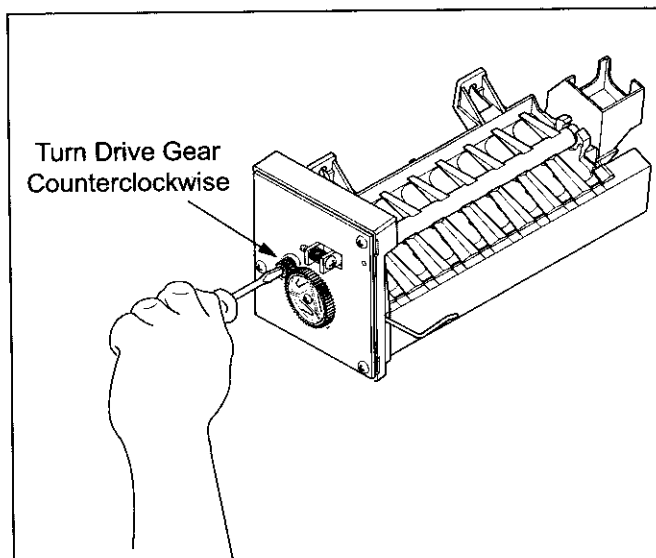


Figure 6-13. Manually Start Icemaker

ADJUSTING WATER FILL LEVEL

Proper water fill level for a MidSouth icemaker is 100 - 110 cc's (3.5 - 3.75 oz). If the fill level is checked and needs to be adjusted, turn the water fill adjusting screw clockwise to reduce fill level, or counterclockwise to increase fill level. One full turn of the screw equals 15 cc's. (See Figure 6-14)

NOTE: Always check fill level before making any adjustments of the water fill adjusting screw.

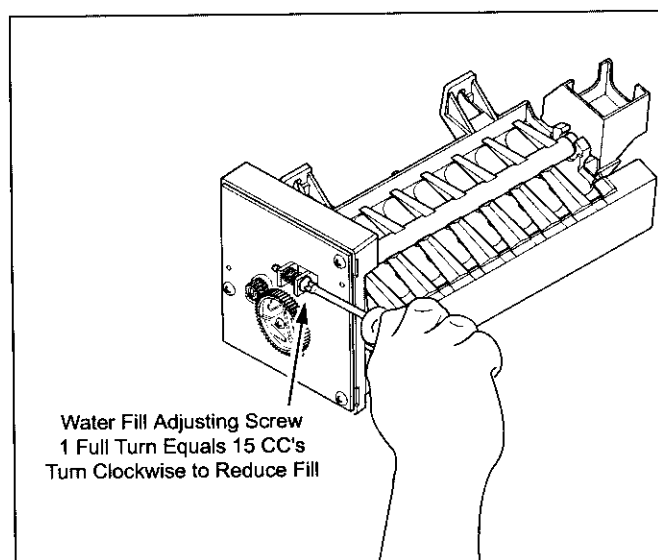


Figure 6-14. Adjust Water Fill Level

ICEMAKER FAULT TESTING

Bypass 45-minute dwell by pressing ICE ON/OFF key to OFF then ON. Then depress icemaker switch & manually start icemaker by turning driver gear counter-clockwise with screw-driver.

1 If icemaker starts & finishes cycle:

(NOTE: If $>15^{\circ}\text{F}$ (-9°C), icemaker will only complete 1 revolution.)

- Visually inspect electrical connections at icemaker & valve. Repair if necessary.
- Check valve operation with test cord, if doesn't open, replace.
- Check thermostat. Open: 48° (9°C) $\pm 6^{\circ}$, Close: 15° (-9°C) $\pm 3^{\circ}$. Replace icemaker if defective.
- With icemaker in park position, check solenoid switch terminals "C" & "NO" for continuity. With ejector between 8:00 & 10:00 position, check solenoid switch terminals "C" & "NC" for continuity. If no continuity for either terminal check, replace icemaker.

2. If icemaker starts but does not finish cycle:

- With icemaker in park position check holding switch terminals "C" & "NC" for continuity. Then with icemaker ejector between 10:00 & 12:00, check holding switch terminals "C" & "NO" for continuity. If no continuity for either terminal check, replace icemaker. (Refer to enclosed wiring diagram)
- With icemaker in park position check shut-off switch terminals "C" & "NO" for continuity. With ejector between 12:00 & 2:00 check shut-off switch terminals "C" & "NC" for continuity. If no continuity for either terminal check, replace icemaker.
- Check mold heater for 75-85 Ω . If outside range, replace icemaker.

3 If icemaker motor does NOT start:

- Lower shutoff arm
- Check motor operation with test cord. If motor doesn't run, replace icemaker.
- Check power to & from icemaker switch. Reconnect or repair connection or replace icemaker as necessary.
- Check for 115V AC from control board. If power is present check & repair connection. If no power, replace control board.

QUICK REFERENCE

- Water Fill Time - 6.3 \pm 2 seconds
- Fill Tube Heater Ohm - 2850-3890 Ω
- Mold Heater Ohm - 75-85 Ω
- Water Valve Ohm - 160-165 Ω
- Thermostat - Open: 48° (9°C) $\pm 6^{\circ}$, Close: 15° (-9°C) $\pm 3^{\circ}$.
- Water Pressure Needed - 20-100 psi constant

Possible Problems

No / Slow Ice Production

- Ice maker system switched OFF. Switch ice system ON.
- Shut off arm in up/OFF position. Move to ON position.
- Freezer too warm. Check temp's & see troubleshooting guide in service manual.
- Poor airflow over icemaker. Remove obstructions.
- Ice cube jam. Remove ice & check water fill setting.
 - Water fill setting too low (< 6.5 sec's). Adjust setting.
 - Water fill setting too high (> 7 sec's). Adjust setting.
- Water froze in inlet tube. Remove ice from tube. Check for 115VAC from control board; Fill tube heater = 2850-3890 Ω .
- Water supply not constant 20-100 psi. Instruct customer.
- Water line to unit pinched/kinked. Repair water line.
- Saddle valve not installed correctly to supply line. Reposition.
- Saddle valve not fully open. Open valve fully.
- Icemaker wire/connections loose/broken. Repair wiring.
- Water valve wire/connections loose/broken. Repair wiring.
- Defective water valve. Check valve (160-165 Ω), Replace valve.
- Thermostat wire/connections loose/broken. Repair wiring.
- TCO overheat or short. Replace icemaker.
- See Icemaker Fault Testing.

No Water Fill

- Water supply switched OFF. Switch supply water line ON.
- Water line to unit pinched/kinked. Repair water line.
- Saddle valve not installed correctly to supply line. Reposition.
- Water froze in inlet tube. Remove ice from tube. Check for 115VAC from control board; Fill tube heater = 2850-3890 Ω .
- Water valve wire/connections loose/broken. Repair wiring.
- Defective water valve. Check valve (160-165 Ω), Replace valve.

Overflows / Ice Block Forms in Bucket / Oversized Cubes

- Icemaker not level. Level icemaker.
- Unit not level. Level unit
- Water supply not constant 20-100 psi. Instruct customer.
- Water fill setting too high (> 7 sec's). Adjust setting.
- Water fill setting too low (< 6.5 sec's). Adjust setting.
- Defective water valve. Check valve (160-165 Ω), Replace valve.

Ice Cubes Hollow or Small

- Icemaker not level. Level icemaker.
- Unit not level. Level unit
- Water supply not constant 20-100 psi. Instruct customer.
- Water fill setting too low (< 6.5 sec's). Adjust setting.
- Too little thermalmastic on thermostat. Add thermalmastic.
- Defective thermostat (Open: 48° (9°C) $\pm 6^{\circ}$, Close: 15° (-9°C) $\pm 3^{\circ}$. Replace icemaker if defective.

Too much Ice

- Shut off arm/linkage bent/broken. Repair or replace arm/linkage.
- If ejector blades rotate with arm in up/OFF position - Icemaker faulty. Replace icemaker.



SECTION 7

COMPONENT ACCESS AND REMOVAL

COMPONENT ACCESS AND REMOVAL

This section explains how to adjust, access and/or remove components.

<i>This section is arranged as follows:</i>	<i>Page:</i>
• Exterior Cosmetic / Mechanical Components	7-3
• Refrigerator Interior Cosmetic / Mechanical Components	7-8
• Freezer Interior Cosmetic / Mechanical Components	7-15
• Compressor Area Mechanical Components	7-20
• Sealed System Components.....	7-21

An attempt has been made to arrange these procedures in such a way as to simulate which components would need to be removed first in order to gain access to other components. When following a component removal procedure, it may be necessary to reference another component removal procedure earlier in this section.

NOTE: Before continuing, please take note of the **WARNINGS** and **CAUTIONS** below.

⚠ WARNING

- IF IT IS NECESSARY TO REMOVE A UNIT FROM ITS INSTALLATION, REMEMBER THAT THE UNIT COULD TIP WHEN PULLED FORWARD BEYOND THE ANTI-TIP COMPONENTS, RESULTING IN SERIOUS INJURY OR DEATH. PULLING A UNIT FROM ITS INSTALLATION SHOULD ONLY BE PERFORMED BY AN AUTHORIZED SERVICE TECHNICIAN OR INSTALLER.
- TO AVOID ELECTRIC SHOCK, POWER TO THE UNIT MUST BE DISCONNECTED WHENEVER ACCESSING AND/OR REMOVING COMPONENTS POWERED BY ELECTRICITY OR COMPONENTS NEAR OTHER ELECTRICAL COMPONENTS. IF THE UNIT IS PLUGGED IN, BUT HAS NOT BEEN SWITCHED ON BY PRESSING THE UNIT ON/OFF KEY, AC VOLTAGE IS STILL PRESENT AT THE CONTROL BOARD.
- IF REMOVING A DOOR OR DRAWER, REMEMBER THAT DOORS AND DRAWERS ARE HEAVY. IF THEY WERE TO FALL, THEY COULD CAUSE SERIOUS PERSONAL INJURY.

⚠ CAUTION

- If working in the compressor area, remember that compressors and tubing may be hot.
- If working on or around an evaporator or condenser, remember that evaporator and condenser fins are sharp.

Exterior Cosmetic and Mechanical Components

Kickplate Removal

The kickplate is located on the bottom of unit, between the base assemblies.

To remove the kickplate, extract screws from left and right corners of kickplate, then pull kickplate forward (See Figure 7-1).

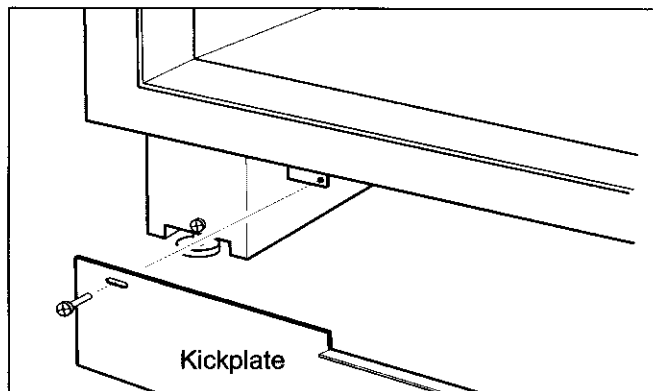


Figure 7-1. Kickplate Removal

Drain Pan Removal

The drain pan slides in from the front of unit on two side brackets, coming to rest on a rear bracket. A locking feature was formed into the drain pan, that drops into notches at the front of the side brackets.

To remove the drain pan (See Figure 7-2):

1. Remove kickplate.
2. Push front of drain pan up slightly and pull forward.

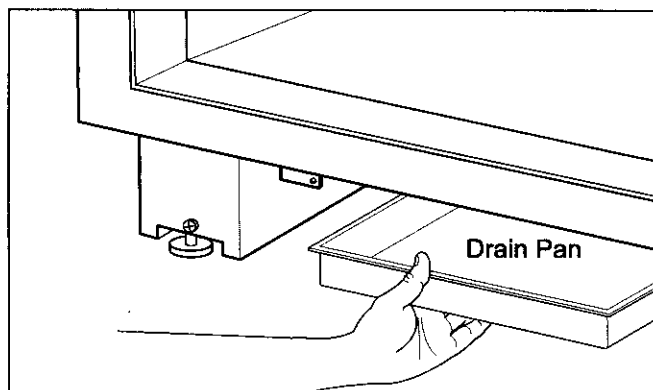


Figure 7-2. Drain Pan Removal

Door/Drawer Handle Assembly Removal

A screw through the handle standoff into the handle secures the handle to the standoff. The standoff then slides over a threaded stud that is attached to the door shell. A socket head set-screw inserted through the standoff secures the standoff to the stud.

To remove a handle assembly (See Figure 7-3):

1. Use a 3/32" Allen-wrench to loosen the set-screw in each handle standoff.
2. Pull handle assembly off of the threaded studs.

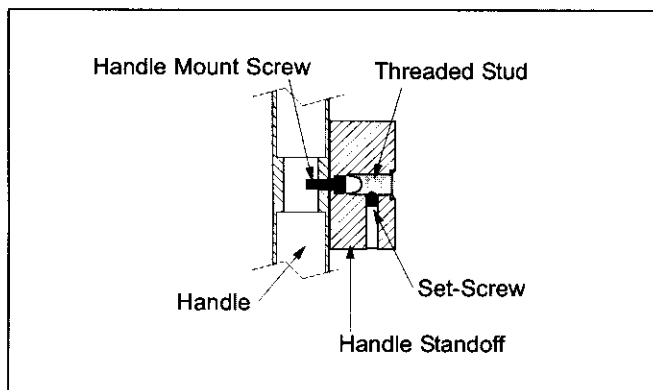


Figure 7-3. Handle and Standoff Cut-Away View

Door Removal

To remove a door (See Figure 7-4):

NOTE: See **WARNING** at beginning of this section.

1. Open door to ninety (90) degrees.
3. Lift door up off of hinge pins.

NOTE: Hinge pins sit loosely in hinge assemblies. Take care to not drop the hinge pins during this procedure.

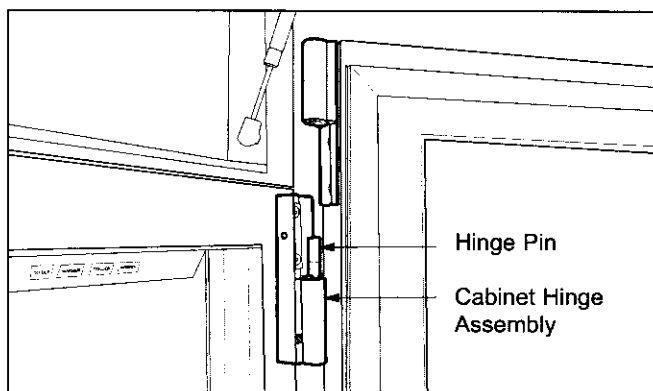


Figure 7-4. Door Removal

Drawer Assembly Removal

To remove a drawer assembly (See Figure 7-5):

1. Open drawer until the slides are fully extended.
2. Lift front of drawer up, then continue pulling drawer forward, off of slides.

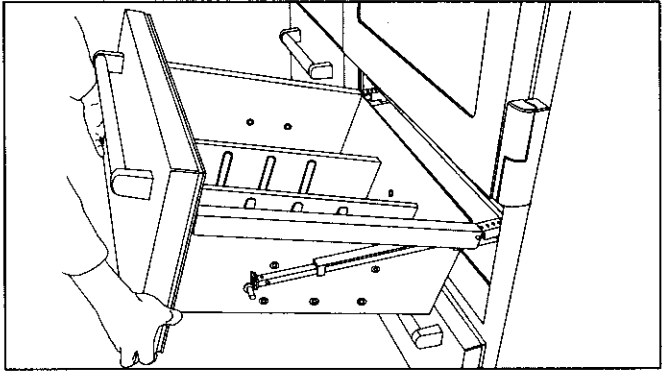


Figure 7-5. Drawer Assembly Removal

Door and Drawer Gasket Removal

A dart at the back of the door and drawer gaskets fit into channels built into the door and drawer liners.

NOTE: To remove a drawer gasket, the drawer must be removed from the unit.

To remove a door, or drawer gasket, pull the gasket dart from the channel in the door, or drawer (See Figure 7-6).

NOTE: On older models, silicone may have been used at the corners of the gasket to help hold it in place.

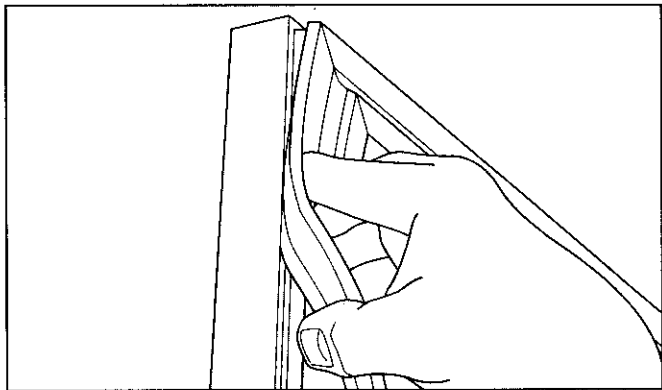


Figure 7-6. Door/Drawer Gasket Removal

Cabinet Hinge Assembly Removal

Cabinet hinge assemblies are mounted to the exterior of the appliance. The upper hinge assemblies house the door light switches.

To remove a cabinet hinge assembly:

1. Remove door.
2. Extract hinge mounting screws (See Figure 7-7).
3. Disconnect wire leads from unit (See Figure 7-8).

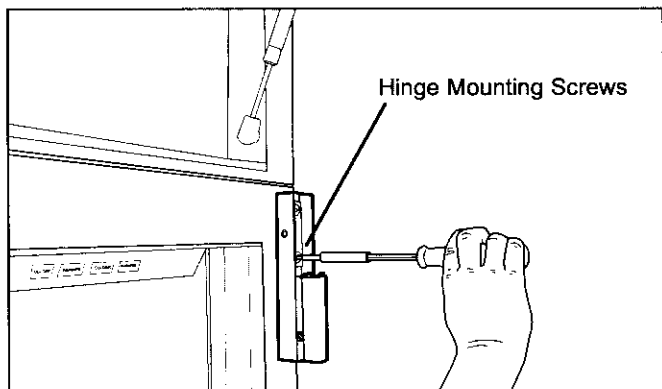


Figure 7-7. Cabinet Hinge Assembly Removal

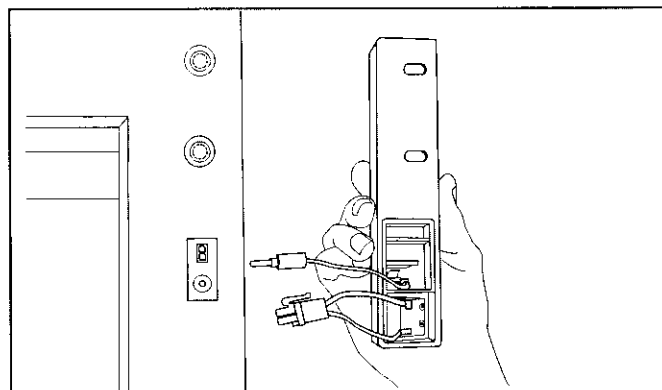


Figure 7-8. Disconnect Wire Leads

Water Filter Removal

The water filter is located behind the grille assembly.

To remove the water filter:

1. Lift Louvered section of grille assembly up (See Figure 7-9).
2. Rotate filter counterclockwise to remove it (See Figure 7-10); clockwise to install it.

NOTE: The water filter timer will reset to a one year countdown when the filter is replaced. If the water filter was removed only to service other components, press the filter switch five times within five seconds to allow the filter timer to continue the original countdown. A beep will be emitted indicating the original countdown has been resumed.

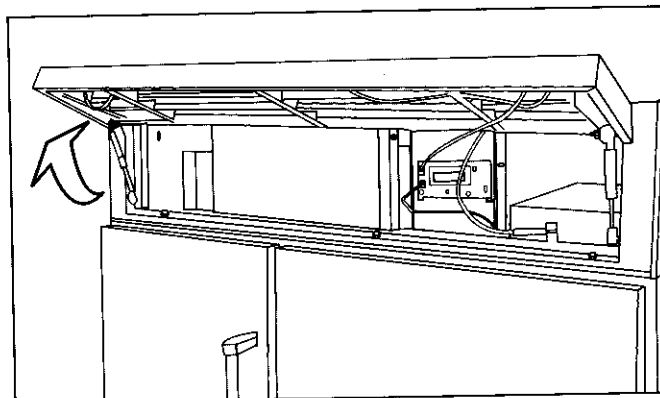


Figure 7-9. Lift Grille Louvers

Water Valve Removal

The water valve is attached to the back side of the water valve bracket, located behind the grille assembly.

NOTE: Before continuing, disconnect or switch off water supply.

To remove the water valve (See Figure 7-11):

1. Lift Louvered section of grille assembly up.
2. Rotate water filter counterclockwise to remove it.
3. Extract mounting screws from mounting bracket.
4. Disconnect wire leads from valve.
5. Disconnect water lines from valve.
6. Extract mounting screws from valve mounting bracket.

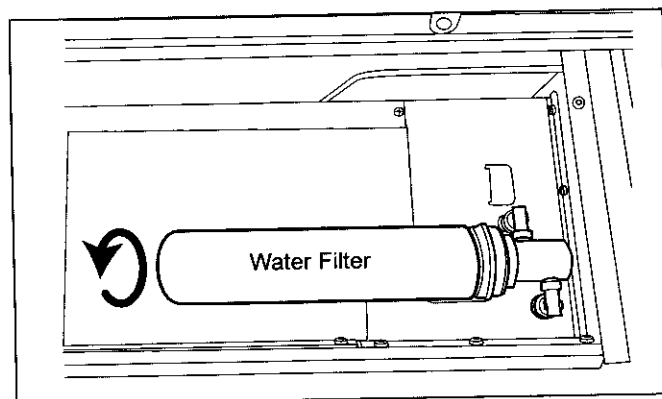


Figure 7-10. Water Filter Removal

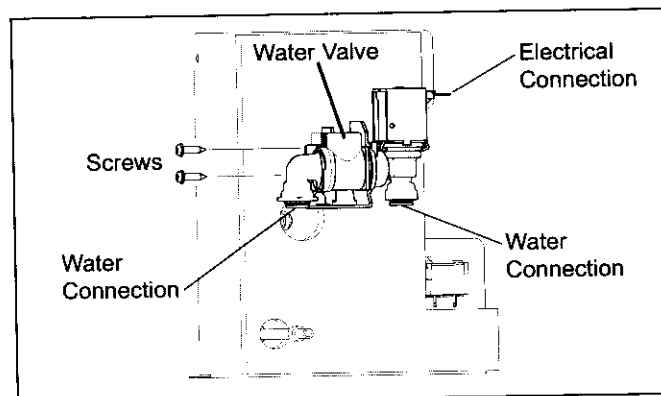


Figure 7-11. Water Valve Removal (Rear View)

Grille Assembly Removal

The grille assembly is located at top front of the unit. The grille Louvers can be lifted up to provide access to the technician display and sealed system components.

To remove the grille assembly (See Figure 7-12):

1. Lift Louvered section of grille assembly up.
2. Disconnect communication cable from behind the Technician display cover, and remove any cable tie-downs.
3. Extract the bolts holding the grille assembly to the top of the refrigerator.
4. Extract the mounting screw to right of center, then lift the assembly from the top of the appliance.

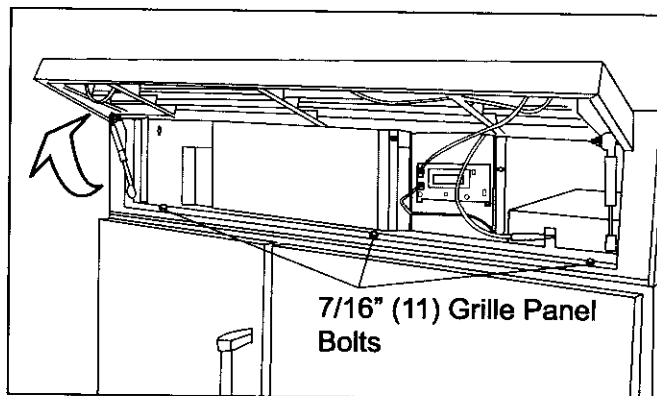


Figure 7-12. Grille Assembly Removal

Gas Grille Spring Cylinder Valve Removal

To remove a gas grille spring cylinder valve (See Figure 7-13):

1. With small flat bladed screwdriver, expand the retaining clips at each end of the gas grille spring away from the stud mounts.
2. Then, pull each end from the mounts.

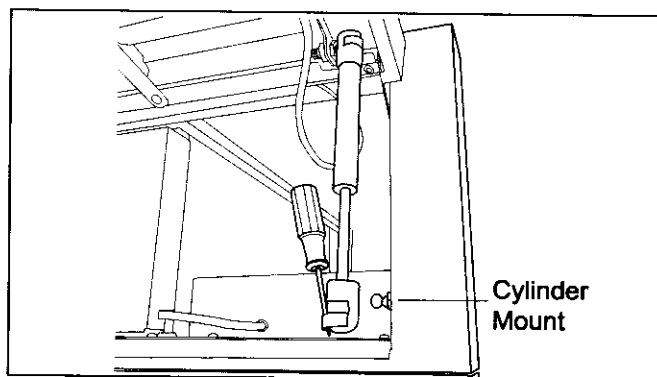


Figure 7-13. Cylinder Valve Removal

User Display Removal

The two User Displays are mounted in the grille assembly. The left User Display is for the freezer zone and the right User Display is for the two refrigerator zones.

To remove a User Display (See Figure 7-14):

1. Remove the grille assembly.
2. Disconnect the communication cables from display being removed.
3. Extract mounting screws securing the displays to the grille assembly.

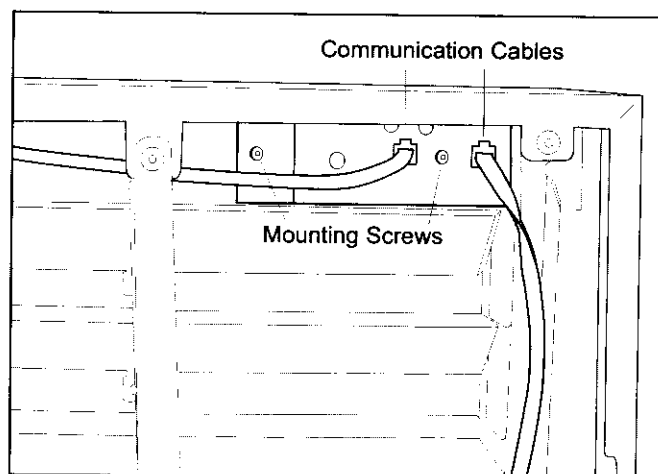


Figure 7-14. User Display Removal (Rear View)

Main Controller Board Removal

NOTE: Electrical shock hazard. Refer to **WARNING** at beginning of section.

The main control board is located on top of the unit, behind the grille assembly, to the right of the condenser, and is covered by a control cover.

To remove the main controller board (See Figure 7-15):

1. Extract screws along front flange of cover.
2. Work wire leads and grommets down and out through key-hole slots in sides of cover, while lifting front of cover up.
3. Disconnect wire leads from DC power supply located inside the control cover. Control cover is now free to be removed.
4. Disconnect all wire leads from main controller board.
5. Extract mounting screws securing control board to unit top, then lift board out.

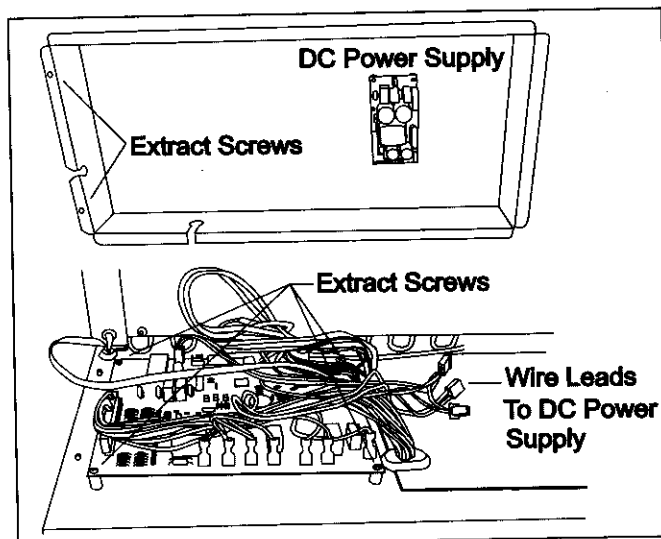


Figure 7-15. Control Board (Right Side View)

Unit Shroud Removal

The unit shroud houses the sealed system and technician display.

To remove the unit shroud (See Figure 7-16):

1. Remove the grille assembly.
2. Extract screws along left side and rear flange of unit shroud.
3. Extract screws from top of unit shroud, above condenser.
4. Lift shroud from top of unit.

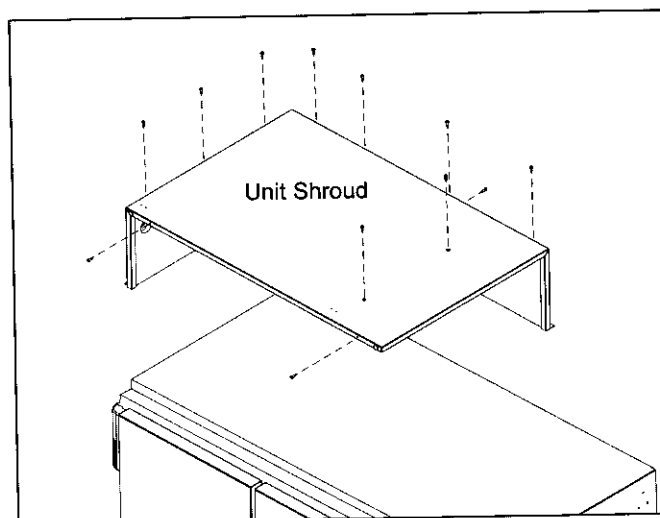


Figure 7-16. Top Cover Removal

Refrigerator Interior Cosmetic and Mechanical Components

Refrigerator Slide Bin Removal

Slide bins fit into guideways under either side of any of the refrigerator shelves.

To remove a slide bin, pull it forward, out of the guideways (See Figure 7-17).

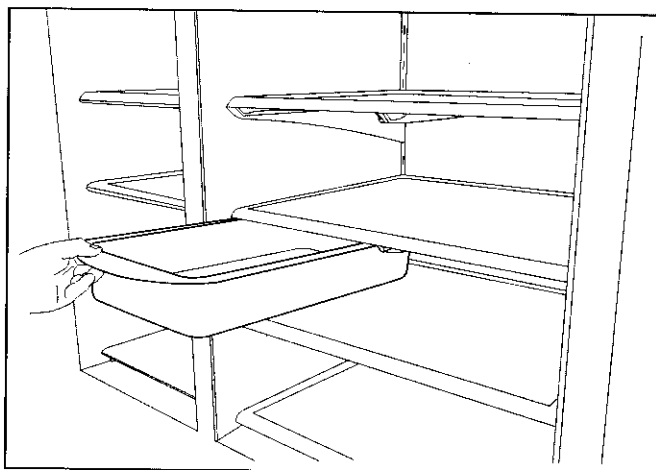


Figure 7-17. Slide Bin Removal

Refrigerator Shelf Adjustment and/or Removal

To adjust and/or remove a refrigerator shelf, lift up at front slightly, then lift back up and out of shelf ladders (See Figure 7-18).

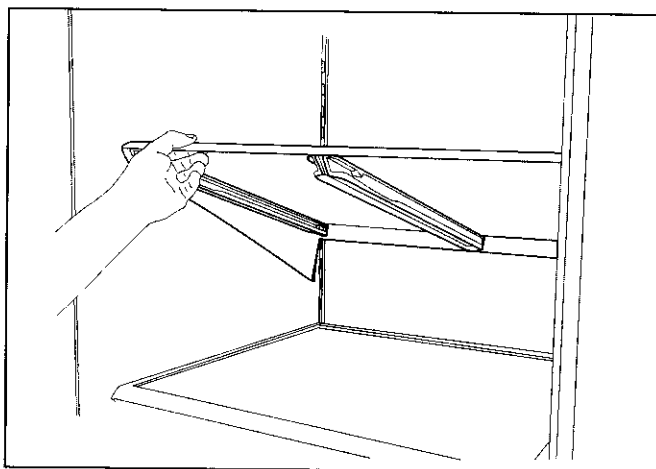


Figure 7-18. Refrigerator Shelf

Upper Refrigerator Light Diffuser Removal

The refrigerator light diffuser is located at the top of the compartment. The light diffuser is held in place by C-shaped clamps fitting over pegs protruding from the side walls (See Figure 7-19).

To remove the light diffuser, push diffuser toward rear of unit to disengage C-shaped clamps from the pegs in the side wall, then lower the diffuser down and pull from the compartment.

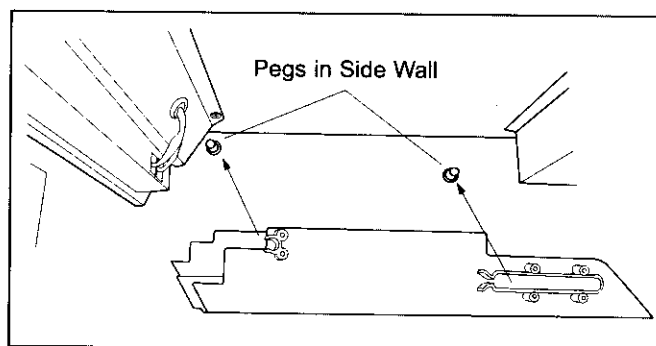


Figure 7-19. Light Diffuser Removal

LED Accent Lighting (Side Lights) Removal

To access and remove the accent lights:

1. Use a small flat bladed screwdriver to pry accent light diffuser out of the breaker strip, taking care not to damage the edges of diffuser or the breaker strip (See Figure 7-20).

NOTE: On earlier models the side light diffusers were glued in place. In this case, the glue must be broken loose in order to remove the diffuser.

2. Bow the diffuser out, then extract both ends from the top and bottom of the breaker strip.
3. With the diffuser removed, use a needle-nose pliers, starting at bottom of light strip, to depress the plastic tabs securing light strip to pocket in breaker strip.
4. Now, pull the light strip past the tabs (See Figure 7-21).

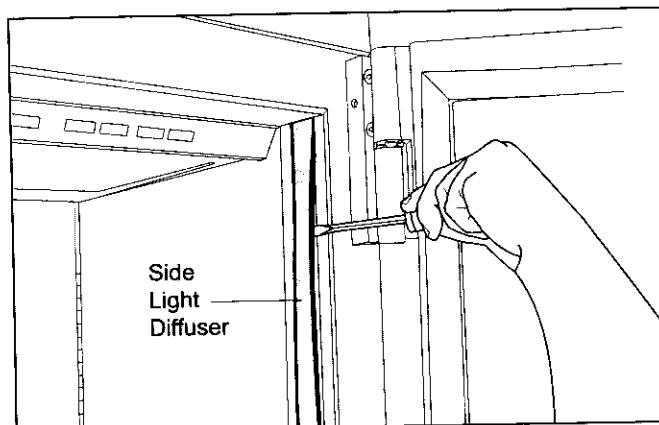


Figure 7-20. Side Light Diffuser Removal

Control Keypad Interface (Control Panel) Removal

The Control Keypad Interface (AKA Control Panel) is located on the top front of the refrigerator compartment.

To remove the control panel:

1. Remove the top light diffuser.
2. Disconnect the communication cables from **the left rear side of the control panel**. (See Figure 7-22)
3. Extract screws from the top rear of the control panel and pull the assembly down and out..

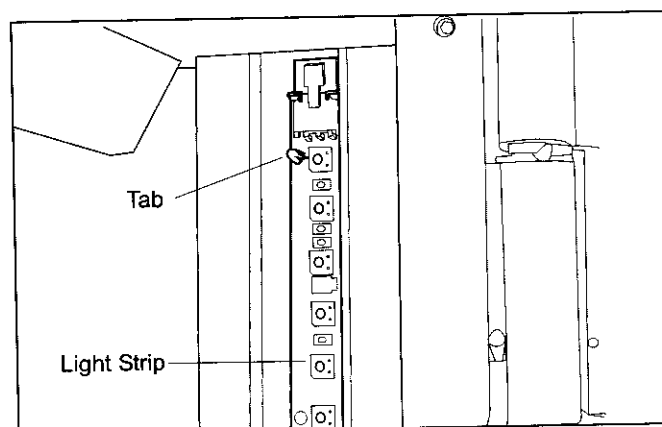


Figure 7-21. LED Light Strip Removal

Upper Refrigerator (Zone 3) Light Assembly Removal

To remove the upper refrigerator light assembly, the control panel must first be removed, then:

(Not Illustrated)

1. Extract the screws at each end of the assembly.
2. Lower the light assembly down, and disconnect the wire leads behind the right side.
3. Now, push the communication cable grommet from the hole at the left end and remove the communication cables from the hole.

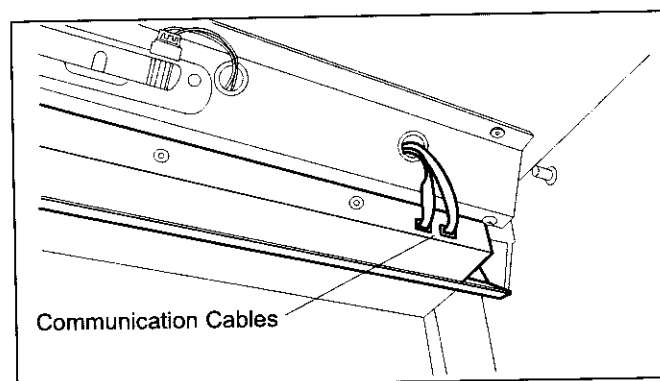


Figure 7-22. Control Panel Removal

Upper Refrigerator (Zone 3) Evaporator Cover Removal

The bottom of the evaporator cover is secured by slots in the side flanges that fit over pegs at the bottom of each shelf ladder. The top is secured by screws holding it to the evaporator fan shroud.

To remove an evaporator cover, the light diffuser must be removed first, then (See Figure 7-23):

1. Extract screws from top of evaporator cover.
2. Tilt cover forward and lift off of locating pegs.

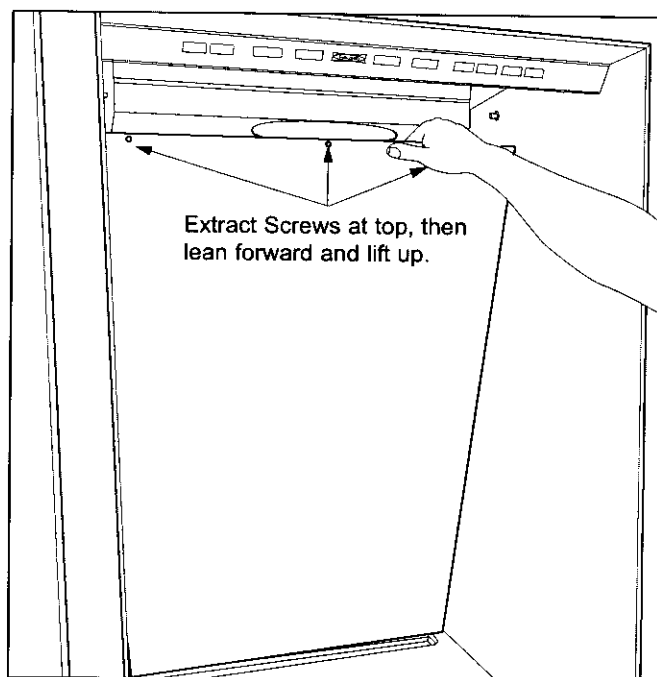


Figure 7-23. Zone 3 Evaporator Cover Removal

Upper Refrigerator (Zone 3) Evaporator Fan Shroud Assembly Removal

The evaporator fan shroud assembly is secured to the ceiling with screws.

To remove an evaporator fan shroud assembly, the light diffuser and evaporator cover must be removed first, then (See Figure 7-24):

1. Extract mounting screws along front flange and middle sides of shroud.
2. Lower assembly and disconnect wire harness.

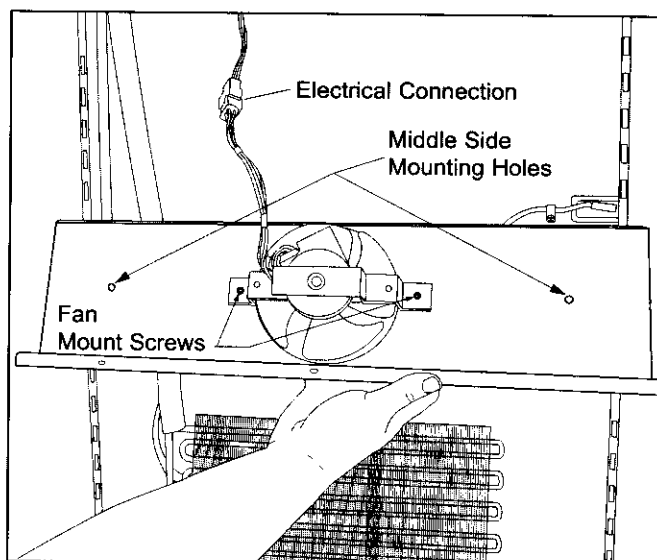


Figure 7-24. Zone 3 Fan Shroud Removal

Upper Refrigerator (Zone 3) Evaporator Fan Assembly Removal

The fan assembly is secured to the shroud with screws.

To remove an evaporator fan assembly, the light diffuser, evaporator cover and fan shroud must be removed first, then extract the fan assembly mounting screws from the shroud and pull the fan assembly from the shroud (See Figure 7-24):

Upper Refrigerator (Zone 3) Compartment Thermistor

The upper refrigerator compartment thermistor is located behind the evaporator cover, and attached to the rear wall with a screw.

To remove the compartment thermistor, the light diffuser and evaporator cover must be removed first, then (See Figure 7-25):

1. Extract thermistor mounting screw.
2. Cut thermistor's wire leads six (6) to twelve (12) inches from the back wall, then pull thermistor from compartment.

Upper Refrigerator (Zone 3) Evaporator Thermistor

The upper refrigerator evaporator thermistor is inserted into the third opening from the top in the evaporator fins left side, and extending approximately to the center of the evaporator.

To remove the evaporator thermistor, the light diffuser and evaporator cover must be removed first, then (See Figure 7-25):

1. Pull thermistor from evaporator fins.
2. Cut thermistor's wire leads six (6) to twelve (12) inches from the back wall, then pull thermistor from compartment.

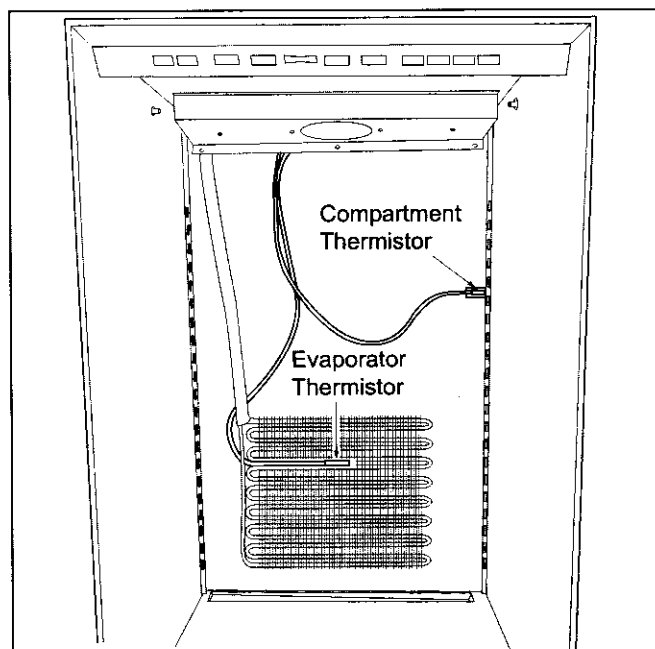


Figure 7-25. Zone 3 Thermistors

Refrigerator Crisper Lid Assembly Removal

To remove the crisper lid assembly (See Figure 7-26):

1. Open top drawer until the slides are fully extended.
2. Pull glass crisper lid forward.
3. Lift front of crisper lid up and out.

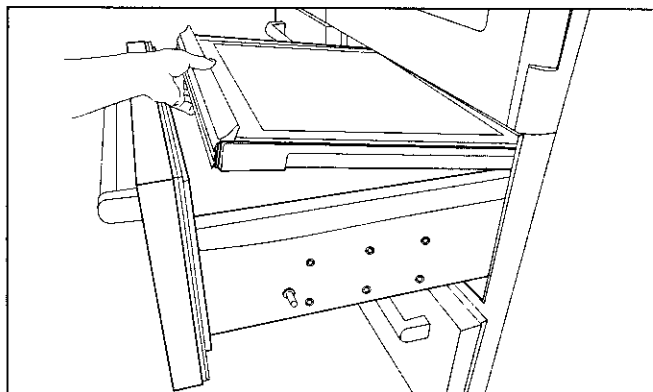


Figure 7-26. Crisper Lid Assembly

Drawer Light and Socket Removal

The drawer lights are located at the top front of each drawer compartment.

To remove the drawer light or replace the light socket, the drawer assembly must first be removed, then (See Figure 7-27):

1. Remove light bulb from socket by turning the light bulb counterclockwise.
2. Extract screws from light socket mounting bracket.
3. Disconnect wire leads from light socket.
4. The light socket is held in place with retaining clips. Depress the retaining clips and extract socket from mounting bracket.

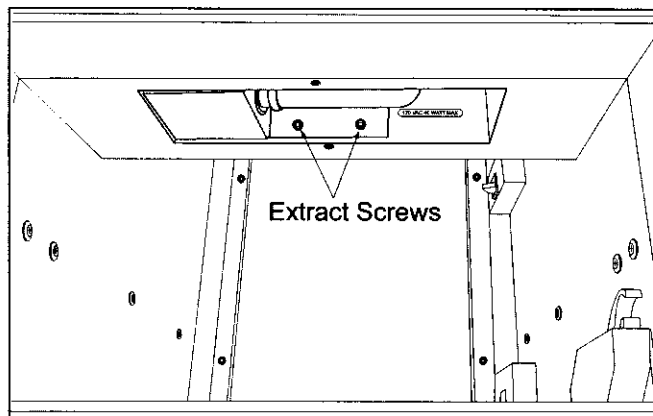


Figure 7-27. Drawer Light Socket Removal

Drawer Closer Removal

Drawer closer assemblies are located at the front right side wall of the drawer compartments. Screws secure each drawer closer to the wall.

To removal a drawer closer assembly (See Figure 7-28):

1. Remove appropriate drawer assembly.
2. Extract screws that secure the drawer closer to side wall.

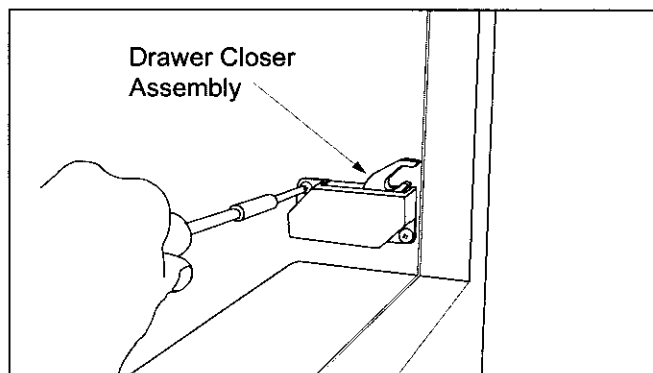


Figure 7-28. Drawer Closer Removal

Drawer Slide Assembly Removal

To remove a drawer slide assembly (See Figure 7-29):

1. Extract drawer slide assembly mounting screws.
2. Pull assembly from side wall.

NOTE: When removing drawer slides and their associated components, it is important to keep track of their original location. Failure to do so may lead to misaligned drawers when reinstalled.

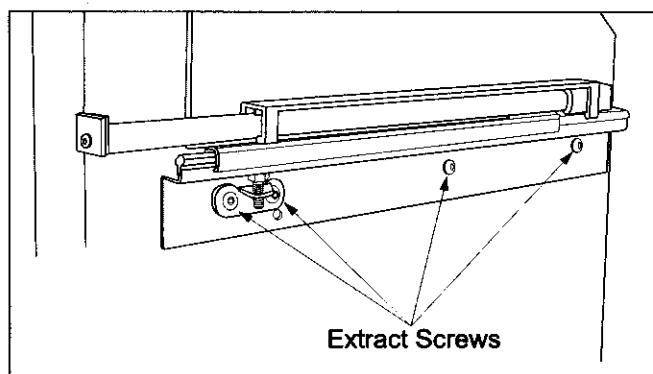


Figure 7-29. Carriage Assembly

Lower Refrigerator (Zone 4) Evaporator Fan Shroud

The lower refrigerator evaporator fan shroud is secured to the evaporator cover assembly with screws.

To remove the lower evaporator fan shroud, extract its mounting screws and pull it from the compartment (See Figure 7-30).

Lower Refrigerator (Zone 4) Evaporator Cover Assembly

The lower refrigerator evaporator cover assembly includes the evaporator fan assembly, and is attached to the back wall with screws.

To remove the evaporator cover assembly, the left drawer slide assemblies and fan shroud must be removed first, then (See Figure 7-30):

1. Extract evaporator cover mounting screws.
2. Work the compartment thermistor wires through the key-hole slot in the left side of the evaporator cover.
3. Lean evaporator cover assembly forward and disconnect evaporator fan wire leads, then pull assembly from the compartment.

Lower Refrigerator (Zone 4) Evaporator Fan Assembly

The lower refrigerator evaporator fan assembly is attached to the evaporator cover with screws.

To remove the evaporator fan assembly, the left drawer slide assemblies, fan shroud and evaporator cover assembly must be removed first, then extract evaporator fan assembly mounting screws and pull fan assembly from evaporator cover (See Figure 7-30):

Lower Refrigerator (Zone 4) Light Switch Removal

The light switches for the lower refrigerator zone are located in the right rear switch enclosure. The enclosure is held to the back wall with screws.

To remove a light switch, the right drawer slide assemblies, fan shroud and evaporator cover assembly must be removed first. Then, (See Figure 7-30):

1. Extract switch enclosure mounting screw.
2. Pull enclosure forward and disconnect switch electrical leads.
3. Depress tabs at back side of switch and push switch from switch enclosure.

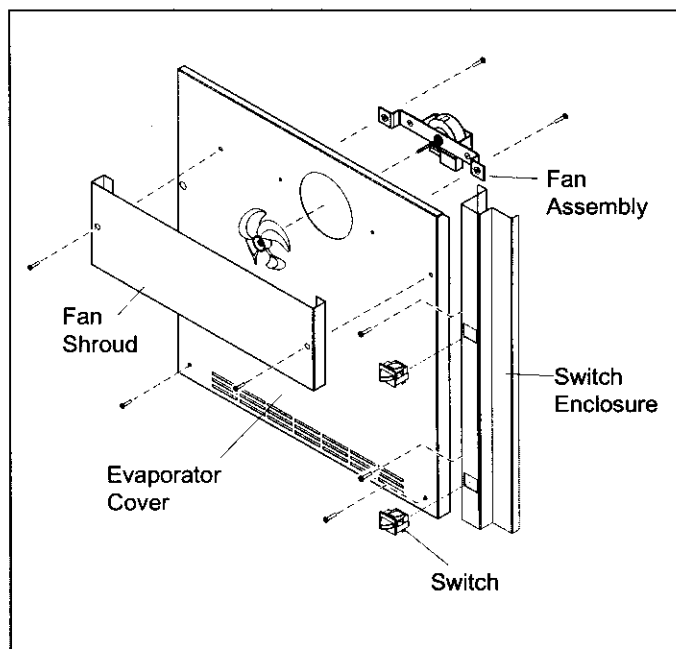


Figure 7-30.
Zone 4 Fan Shroud, Evaporator Cover Assembly and Light Switch Assembly

Lower Refrigerator (Zone 4) Compartment Thermistor

The lower refrigerator compartment thermistor is attached to the left side wall with screws and tube clamps.

To remove the compartment thermistor, the left drawer slide assemblies, fan shroud and evaporator cover assembly must be removed first, then (See Figure 7-31):

1. Extract screws and clamps holding thermistor to left side wall.
2. Cut thermistor's wire leads six (6) to twelve (12) inches from the back wall, then pull thermistor from compartment.

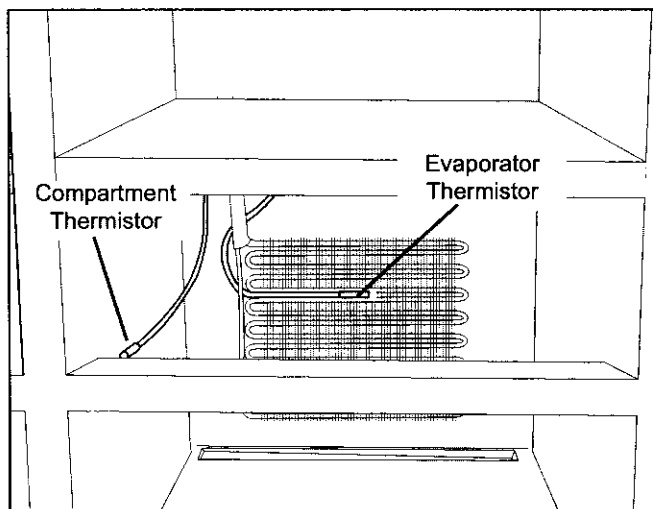


Figure 7-31. Zone 4 Thermistors

Lower Refrigerator (Zone 4) Evaporator Thermistor

The lower refrigerator evaporator thermistor is inserted into the third opening from the top in the evaporator fins left side, and extending approximately to the center of the evaporator.

To remove a evaporator thermistor, the left drawer slide assemblies, fan shroud and evaporator cover assembly must be removed first, then (See Figure 7-31):

1. Pull thermistor from evaporator fins.
2. Cut thermistor's wire leads six (6) to twelve (12) inches from the back wall, then pull thermistor from compartment.

Freezer Interior Cosmetic and Mechanical Components

Freezer Shelf Adjustment and/or Removal

To adjust and/or remove a freezer shelf, lift up at front slightly, then lift back up and out of shelf ladders (See Figure 7-32).

Light Diffuser Removal

The freezer light diffuser is located at the top of the compartment. The light diffuser is held in place by C-shaped clamps fitting over pegs protruding from the side walls (See Figure 7-33).

To remove the light diffuser, push diffuser toward rear of unit to disengage C-shaped clamps from the pegs in the side wall, then lower the diffuser down and pull from the compartment.

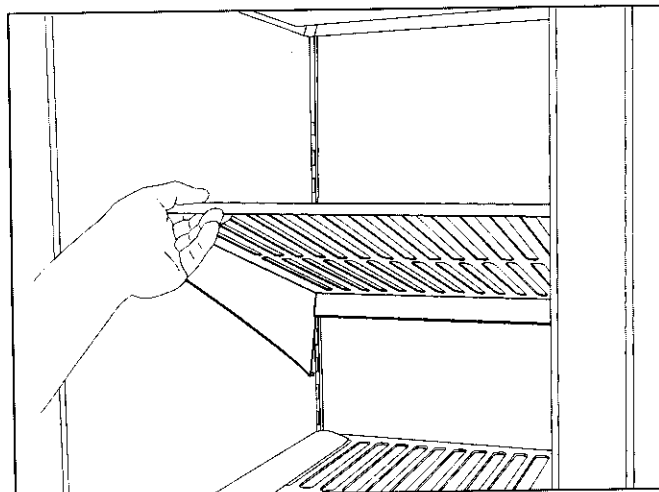


Figure 7-32. Freezer Shelf

Upper Freezer Light Assembly Removal

To remove the upper freezer light assembly (*Not Illustrated*):

1. Extract the screws at each end of the assembly.
2. Lower the light assembly down, and disconnect the wire leads.
3. Now, push the communication cable grommet from the hole at the left end and remove the communication cables from the hole.

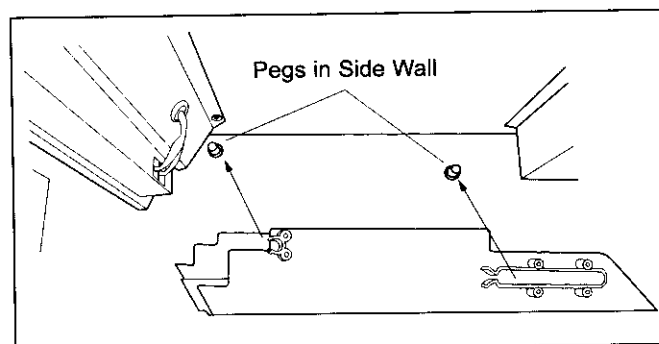


Figure 7-33. Light Diffuser Removal

Upper Freezer Evaporator Duct/Cover

The bottom of the upper freezer duct/cover is secured by slots in the side flanges that fit over pegs at the bottom of each shelf ladder. The top is secured by screws holding it to the back wall.

To remove the upper freezer duct/cover, the light diffuser must be removed first, then (See Figure 7-34):

1. Extract screws from top of duct/cover.
2. Tilt duct/cover forward and lift off of locating pegs.

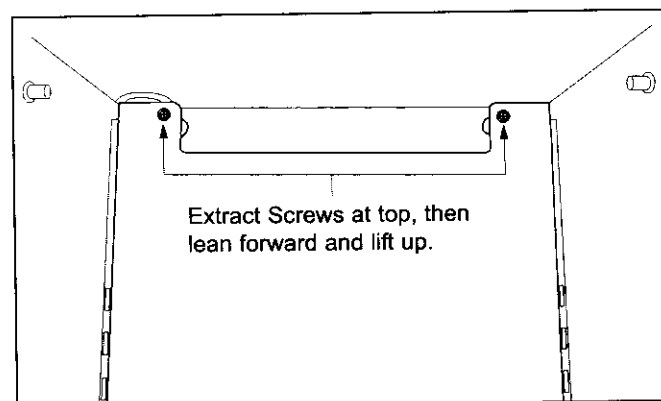


Figure 7-34. Upper Freezer Duct/Cover Removal

Freezer Bottom Shelf Assembly Removal

At the bottom of the upper freezer compartment is a shelf separating the top compartment from the drawer compartments.

To remove the shelf, lift the front up, then lift the back off of the locating pegs in the rear side walls of the compartment. (See Figure 7-35)

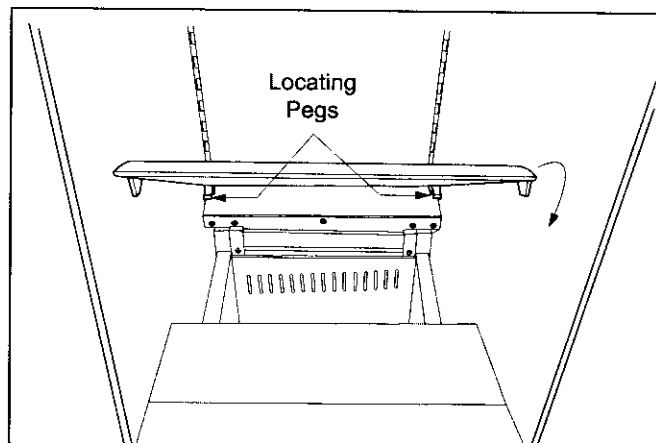


Figure 7-35. Freezer Bottom Shelf Removal

Freezer (Zone 1) Compartment Thermistor Removal

The freezer thermistor is located behind the upper duct/cover and attached to the back wall with a screw and tube clamp.

To remove the freezer thermistor, the light diffuser and upper duct/cover must be removed, then (See Figure 7-36):

1. Extract screw and clamp holding thermistor to back wall.
2. Cut thermistor's wire leads six (6) to twelve (12) inches from the back wall, then pull thermistor from compartment.

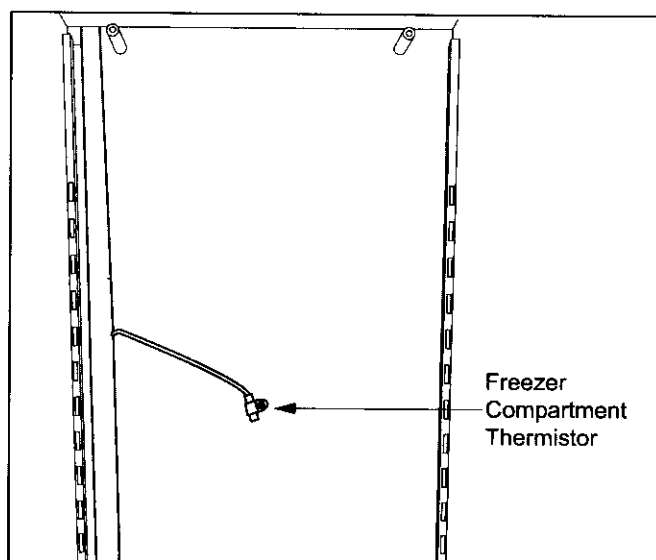


Figure 7-36. Freezer Compartment Thermistor

Ice Bucket Removal

The ice bucket sits in the bottom freezer drawer.

To remove the ice bucket, open bottom freezer drawer and lift bucket out of drawer. (See Figure 7-37)

NOTE: When reinstalling the ice bucket, make sure its rear flange is not sitting up on the back edge of the drawer. If this happens, the ice level arm will be held in the up position, stopping ice production.

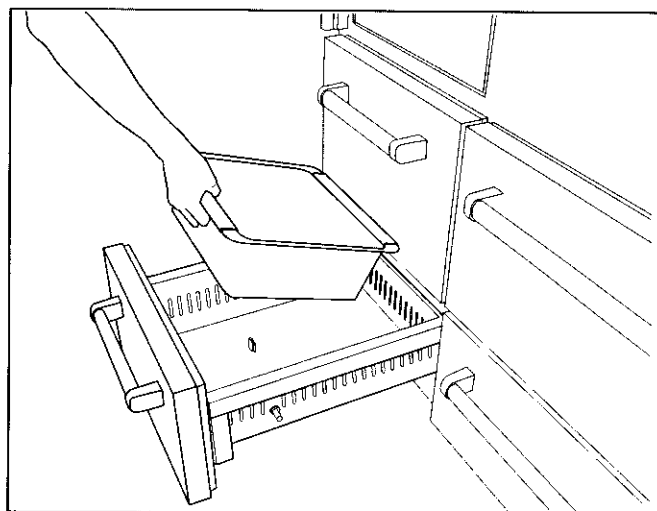


Figure 7-37. Ice Bucket Removal

Drawer Light and Socket Removal

The drawer lights are located at the top front of each drawer compartment.

To remove the drawer light or replace the light socket, the drawer assembly must first be removed, then (See Figure 7-38):

1. Remove light bulb from socket by turning the light bulb counterclockwise.
2. Extract screws from light socket mounting bracket.
3. Disconnect wire leads from light socket.
4. The light socket is held in place with retaining clips. Depress the retaining clips and extract socket from mounting bracket.

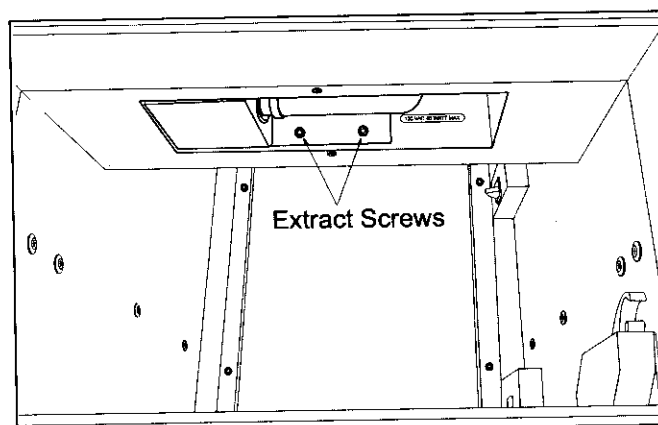


Figure 7-38. Drawer Light Socket Removal

Upper Freezer Evaporator Fan Shroud Removal

The upper freezer evaporator fan shroud is located under the freezer bottom shelf and is mounted over the top of the evaporator fan assembly with screws.

To remove the upper freezer evaporator fan shroud, the freezer bottom shelf must be removed first, then (See Figure 7-43):

1. Extract screws securing shroud to fan assembly.
2. Lift fan shroud out of unit.

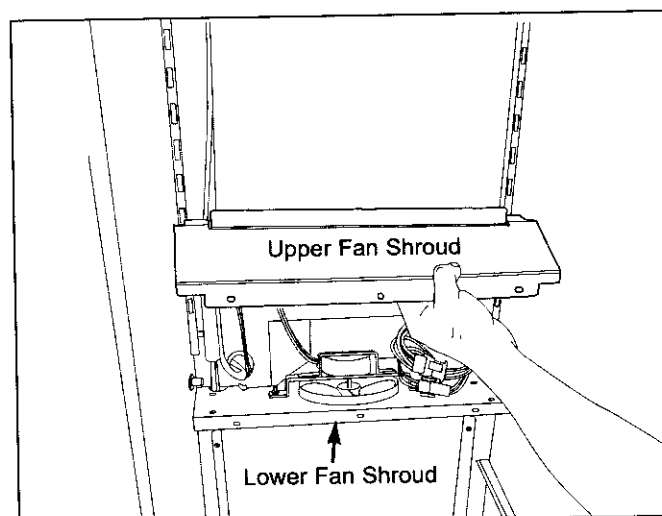


Figure 7-43. Freezer Evaporator Fan Shrouds

Lower Freezer Evaporator Fan Shroud Removal

The lower freezer evaporator fan shroud is located under the freezer bottom shelf, and is mounted in front of the evaporator fan assembly with screws.

To remove the lower freezer evaporator fan shroud, the freezer bottom shelf must be removed first, then (See Figure 7-43):

1. Extract screws securing shroud to fan assembly.
2. Tilt top of shroud down, then lift shroud out of unit.

Freezer Evaporator Fan Assembly Removal

The freezer evaporator fan assembly is located behind the freezer evaporator fan shrouds.

To remove the freezer evaporator fan assembly, the freezer bottom shelf and both fan shrouds must be removed first, then (See Figure 7-44):

1. Disconnect wire leads from fan assembly.
2. Extract fan assembly mounting screws.
3. Lift assembly from the compartment.

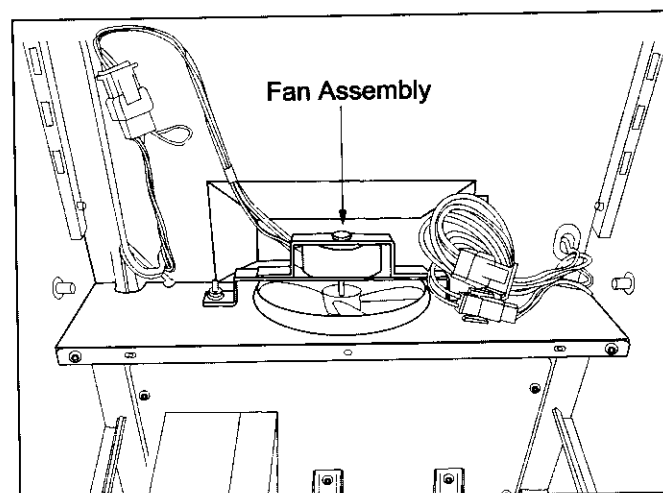


Figure 7-44. Freezer Evaporator Fan Assembly

Icemaker Assembly Removal

The icemaker is located behind the bottom freezer drawer, mounted on a plate that is attached to the back wall.

To remove ice maker the freezer drawers must be removed first, then (See Figure 7-45):

1. Extract icemaker mounting screws from below and above ice maker.
2. Pull ice maker forward and disconnect icemaker electrical leads.
3. Pull icemaker forward, out of the compartment.

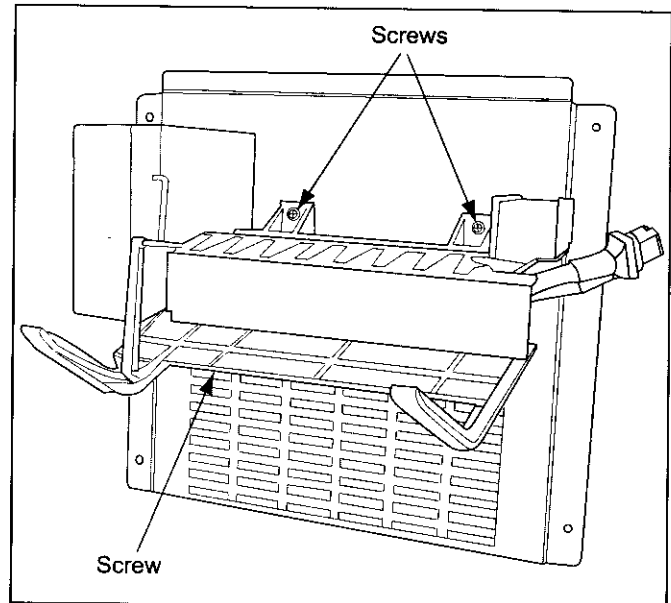


Figure 7-45. Icemaker Removal

Freezer Evaporator Cover Removal

The freezer evaporator cover is located behind the top freezer drawer compartment.

To remove the freezer evaporator cover, the freezer bottom shelf needs to be removed first, then (See Figure 7-46):

1. Extract evaporator cover mounting screws.
2. Pull cover forward and out of compartment.



Figure 7-46. Evaporator Cover Removal

Freezer Evaporator Thermistor Removal

The freezer evaporator thermistor is inserted into the third opening from the top in the evaporator fins left side, and extending approximately to the center of the evaporator.

To remove the evaporator thermistor (See Figure 7-47):

1. Pull thermistor from evaporator fins.
2. Cut thermistor's wire leads six (6) to twelve (12) inches from the back wall, then pull thermistor from compartment.

Freezer Defrost Terminator Removal

The freezer defrost terminator sits on the tubing at the upper left hand side of the evaporator.

To remove the defrost terminator (See Figure 7-47):

1. Disconnect the terminator clip from the evaporator tubing.
2. Cut the cable ties at the back wall.
3. Disconnect terminator electrical leads, then pull the terminator from the freezer compartment.

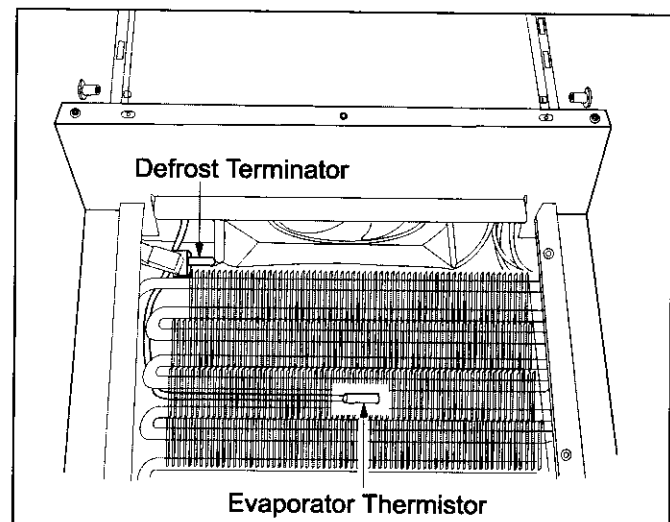


Figure 7-47. Freezer Evaporator Thermistor & Defrost Terminator

Freezer Defrost Heater Removal

The freezer defrost heater is located under the freezer evaporator, and is held in place by a heater bracket that is screwed to the back wall.

To remove the freezer defrost heater (See Figure 7-48):

1. Cut heater electrical leads at wiring junction points.
2. Extract heater bracket mounting screws.
3. Lift defrost heater from freezer compartment.

Freezer Drain Trough Heater Removal

The drain trough heater is located at the bottom rear of the freezer compartment, behind the lower freezer evaporator cover assembly.

To remove the drain trough heater, access the drain trough heater the freezer drawers and the icemaker assembly must be removed first, then (See Figure 7-49):

1. Cut heater wire leads at their junction points
2. Extract heater bracket mounting screws.
3. Lift drain trough heater from the freezer compartment.

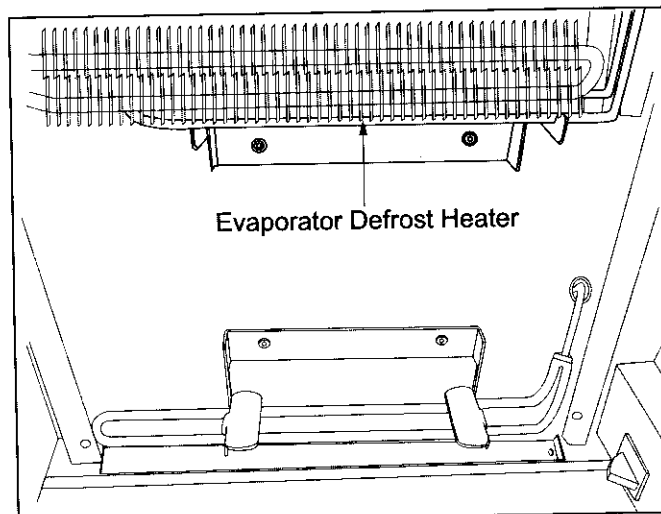


Figure 7-48. Freezer Defrost Heater Removal

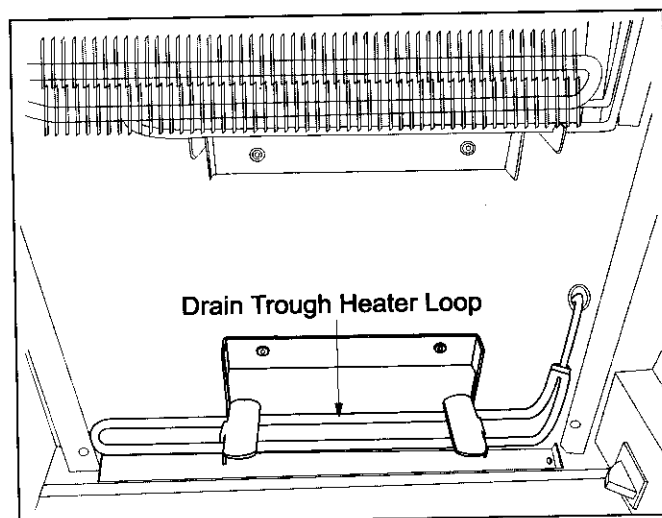


Figure 7-49. Drain Trough Heater

Compressor Area Mechanical Components

Water Filter Removal

The water filter is located behind the grille assembly.

To remove the water filter:

1. Lift Louvered section of grille assembly up
2. Rotate filter counterclockwise to remove it (See Figure 7-50); clockwise to install it.

NOTE: The water filter timer will reset to a one year countdown when the filter is replaced. If the water filter was removed only to service other components, press the filter switch five times within five seconds to allow the filter timer to continue the original countdown. A beep will be emitted indicating the original countdown has been resumed.

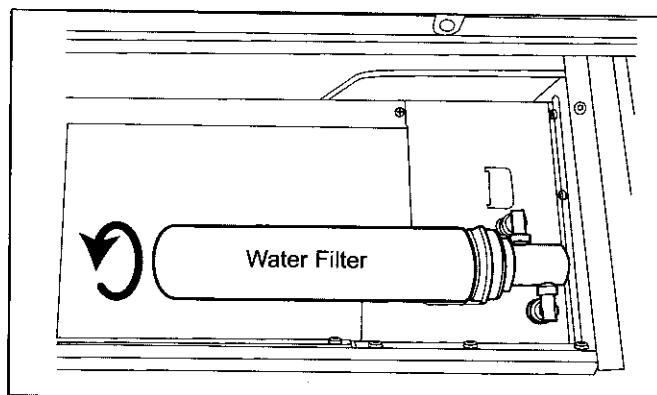


Figure 7-50. Water Filter Removal

Water Valve Removal

The water valve is attached to the back side of the water valve bracket, located behind the grille assembly.

NOTE: Before continuing, disconnect or switch off water supply.

To remove the water valve (See Figure 7-51):

1. Lift Louvered section of grille assembly up.
2. Rotate water filter counterclockwise to remove it
3. Extract mounting screws from mounting bracket.
4. Disconnect wire leads from valve.
5. Disconnect water lines from valve.
6. Extract mounting screws from valve mounting bracket.

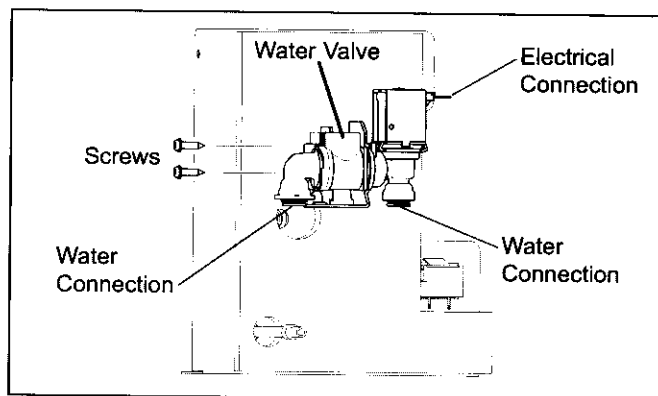


Figure 7-51. Water Valve Removal (Rear View)

Condenser Fan Removal

The condenser fan is mounted to the condenser fan shroud with three (3) fan brackets that hook into grommets in the fan shroud. Screws passing through these brackets secure the fan motor to the brackets.

To remove the condenser fan (See Figure 7-52):

1. Disconnect electrical leads from fan motor.
2. Extract screws securing motor to brackets.

NOTE: Brackets will unhook from grommets in condenser fan shroud after screws are removed.

3. To remove fan blade from fan motor:
 - a. Grab blade and motor while turning nut counterclockwise.
 - b. Pull blade from the motor shaft.

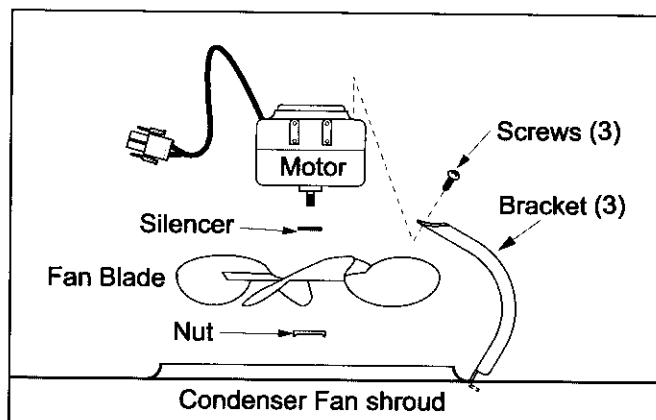


Figure 7-52. Condenser Fan Removal (Top View)

Sealed System Components

NOTE: When entering the sealed system, always use solder-on process valves. Do **NOT** use bolt-on process valves as they are prone to leak.

NOTE: Whenever servicing the sealed system, the high-side filter-drier must be replaced.

Freezer High-Side Filter-Drier Removal

To remove the freezer high-side filter-drier, first capturing the refrigerant from sealed system, then (See Figure 7-53):

1. With a file, score a line around capillary tube 1" or less from drier outlet, then fatigue capillary tube at this line until it separates.
2. With a tube-cutter, cut inlet tube 1" or less from drier inlet.

NOTE: It is not recommended to sweat tubing apart. Doing so will induce moisture into the sealed system.

NOTE: After capillary tube separates, check tubing for internal burrs. If burrs exist, repeat step 1 above.

NOTE: When installing replacement filter-drier, insert capillary tube until it touches screen inside drier, then pull capillary tube away from screen approximately 3/8" before brazing. (See Figure 7-54).

NOTE: Filter-drier outlet must be facing downward in order to function properly.

Refrigerator High-Side Filter-Drier/Refrigerant Valve Assembly Removal

To remove the refrigerator drier/valve assembly, first capturing the refrigerant from sealed system, then (See Figure 7-55):

1. With a file, score a line around capillary tubes 1" or less from drier/valve outlet tubes, then fatigue capillary tubes at these lines until they separate.
2. With a tube-cutter, cut inlet tube 1" or less from drier inlet.

NOTE: It is not recommended to sweat tubing apart. Doing so will induce moisture into the sealed system.

NOTE: After capillary tube separates, check tubing for internal burrs. If burrs exist, repeat step 1 above.

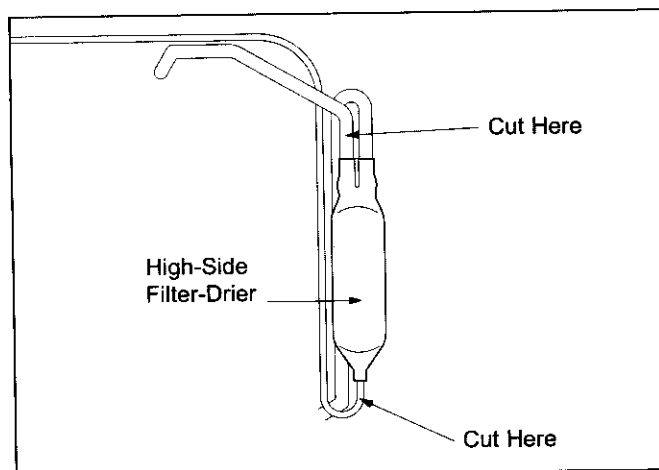


Figure 7-53. Freezer Filter-Drier Removal

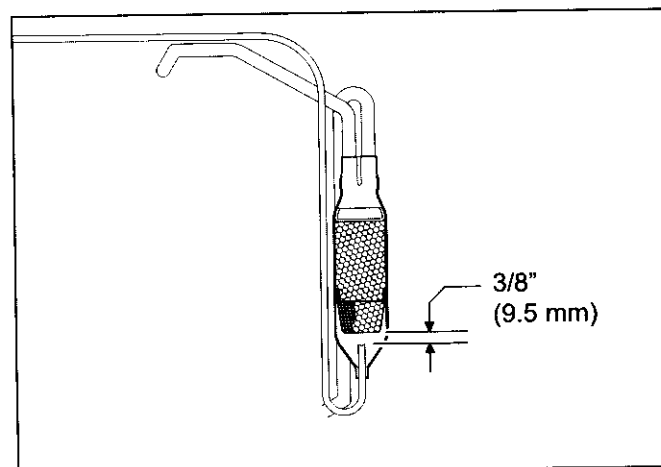


Figure 7-54. Capillary Tube Insertion Note

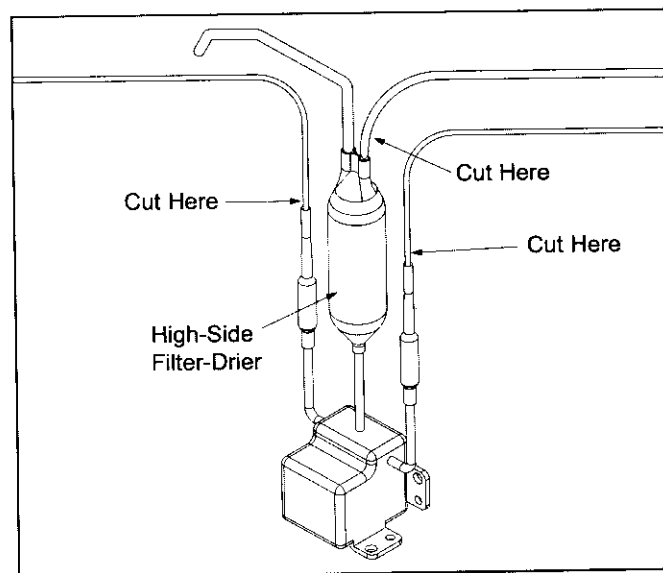


Figure 7-55. Refrigerator Drier / Valve Assembly

Compressor Removal

Compressors are secured to the top of the unit with nuts over stud-bolts. The left compressor is the freezer compressor, the right compressor is the refrigerator compressor.

NOTE: When replacing a compressor, the high-side filter-drier must also be replaced.

After capturing the refrigerant from sealed system, (See Figure 7-56):

1. Disconnect electricals from compressor.
2. Extract nuts from stud-bolts at each corner of compressor base.
3. Lift compressor up and pull forward to gain access to suction and discharge lines.
4. Using a tube cutter, cut suction and discharge lines approximately 1" from compressor.

NOTE: It is not recommended to sweat tubing apart. Doing so will induce moisture into the sealed system.

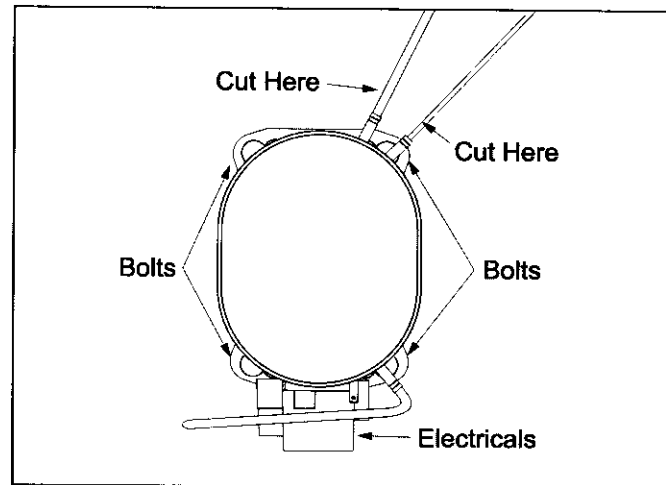


Figure 7-56. Compressor Top View

Condenser Removal

NOTE: When replacing the condenser, both high-side filter-driers must also be replaced.

To remove the condenser the unit shroud will need to be removed first, then after capturing the refrigerant from sealed system, (See Figure 7-57):

1. From control board side of condenser, extract screws which hold condenser side brackets to condenser.
2. Cut cable-ties holding thermistors to condenser outlet tubes.
3. Using a tube cutter, cut condenser inlet and outlet tubes.

NOTE: It is not recommended to sweat tubing apart. Doing so will induce moisture into the sealed system.

4. Lift condenser off of unit.

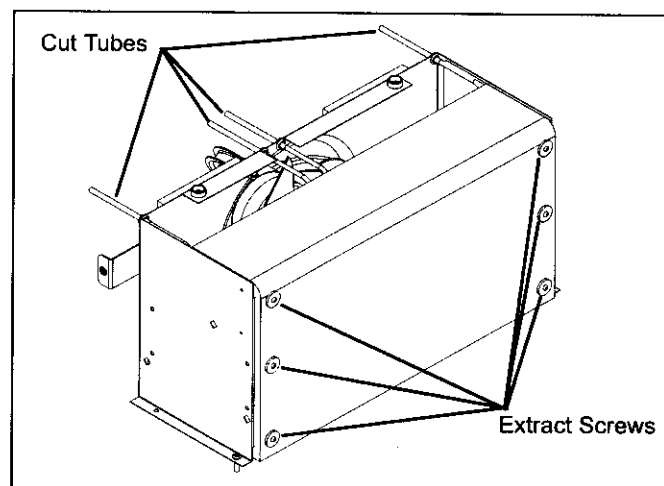


Figure 7-57. Condenser Removal

Evaporator Removal

Evaporators are attached to rear walls of the compartments with screws, behind evaporator covers which must be removed first.

NOTE: When replacing an evaporator, the high-side filter-drier must also be replaced.

NOTE: When removing a freezer evaporator, the evaporator thermistor, defrost terminator and defrost heater must also be removed and reused on new evaporator.

After capturing the refrigerant from the sealed system (See Figure 7-58):

1. Extract screws which hold evaporator to rear wall of compartment.
2. Pull and rotate evaporator so heat exchanger is accessible.
3. With a file, score a line around capillary tube, 1" or less from evaporator inlet, then fatigue capillary tube at this line until it separates.
4. With a tube-cutter, cut evaporator outlet 1" or less from accumulator (if applicable), or 1" or less from suction line connection point.

NOTE: It is not recommended to sweat tubing apart. Doing so will induce moisture into the sealed system.

NOTE: After capillary tube is fatigued until it separates, check tubing for internal burrs. If burrs exist, repeat step 3 above.

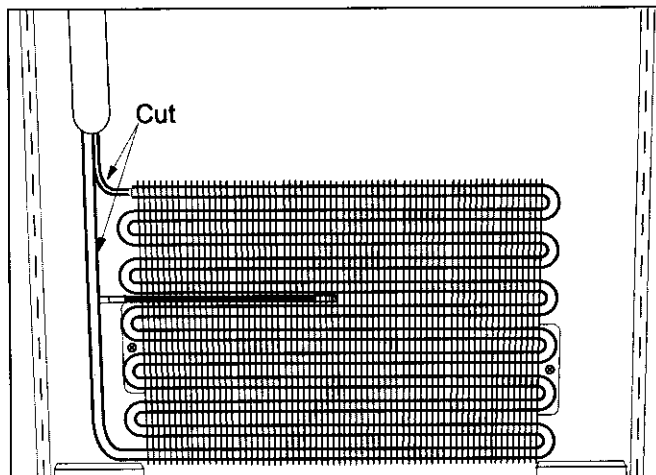


Figure 7-58. Refrigerator Evaporator

NOTE: Freezer evaporator removal not illustrated.

Heat Exchanger

NOTE: When replacing a heat exchanger, the high-side filter-drier must also be replaced.

To remove the heat exchanger the top cover and evaporator cover must be removed, then after capturing the refrigerant from the sealed system (See Figures 7-59):

1. Extract screws which hold evaporator.
2. Remove insulation from heat exchanger.
3. With a file, score a line around capillary tube, 1" or less from evaporator inlet, then fatigue capillary tube at this line until it separates.
4. With a tube-cutter, cut evaporator outlet 1" or less from accumulator (if applicable), or 1" or less from suction line connection point.
5. With a tin snips, or similar tool, cut heat exchanger in compartment as close as possible to wall or ceiling where heat exchanger passes through.
6. In upper compressor area, use a tube-cutter to cut drier from condenser.
7. Extract nuts from stud-bolts at each corner of compressor base.
8. Lift compressor up and pull forward to gain access to suction line.
8. Using a tube cutter, cut suction line approximately 1" from compressor.
9. Pull remaining heat exchanger from unit.

NOTE: It is not recommended to sweat tubing apart. Doing so will induce moisture into the sealed system.

NOTE: When replacing the heat exchanger, it is recommended to attach it at the evaporator end first, then feed the heat exchanger through hole, up to compressor area.

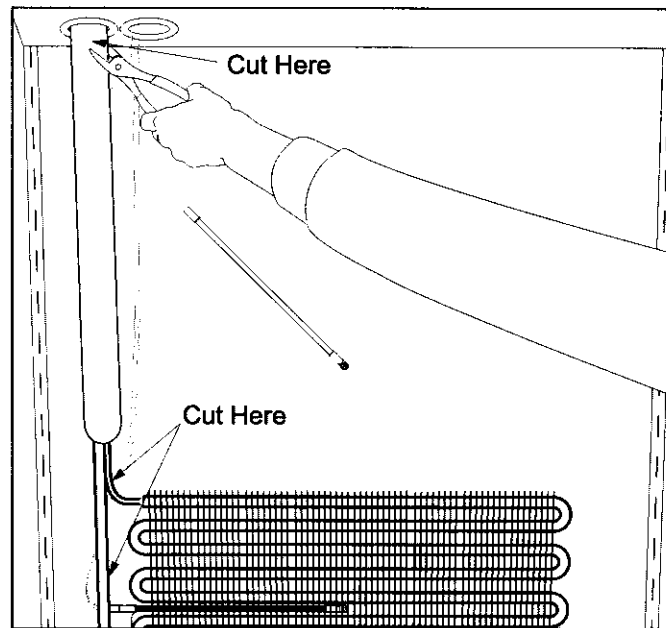


Figure 7-59. Heat Exchanger



Drain Pan Heater Loop Removal

The drain pan heater loop is located on the underside of the bottom panel of unit and above the drain pan.

NOTE: When replacing a condensate heater loop, the filter-drier must also be replaced.

NOTE: It is recommended that a suction line drier be added to the sealed system when replacing the condensate heater loop.

To remove the drain pan heater loop, the drain pan must be removed first, then after capturing the refrigerant from sealed system, (See Figure 7-60):

1. Using a tube cutter, cut condensate loop inlet and outlet.

NOTE: It is not recommended to sweat tubing apart. Doing so will induce moisture into the sealed system.

2. Extract tubing from heater loop brackets.

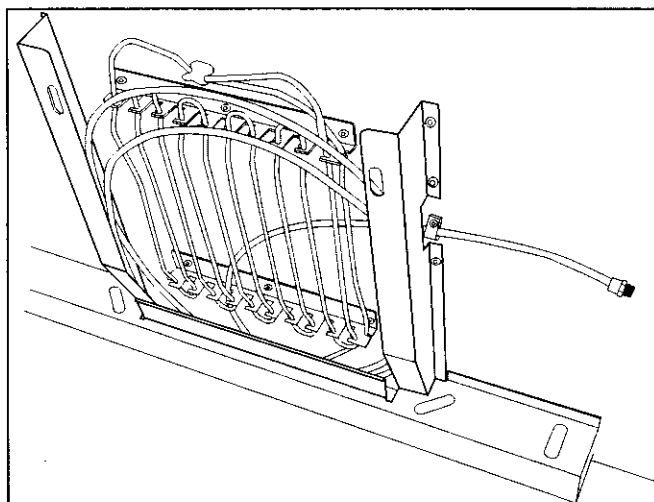


Figure 7-59. Drain Pan Heater Loop Removal

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SECTION 8

TROUBLESHOOTING

GUIDES

SERVICE MODE (Troubleshooting Input Operations)

The service features in this electronic control system allow the technician to perform a series of key strokes at the control panel in order to verify, configure, query and troubleshoot the appliance and its electronic control system. These service features are activated while in the four sub-modes of the Service Mode.

The four sub-modes of the Service Mode are:

- 1) Diagnostics Mode
- 2) Operational Status Mode
- 3) Model Information Mode
- 4) Version Information Mode.

The technicians display, located behind the top grille assembly, utilizes a two (2) line X sixteen (16) character LCD. While in Service Mode, this display will indicate which sub-mode is active, the data being searched for, and what other data can be accessed. When not in the Service mode, the Technician's display will indicate system information as defined for each particular operational mode.

Basic instructions for working through the Service Mode menu can be found on the Technician's Display cover (See Figure 8-1). These basic instructions (the Key Symbol and Arrows), correspond with keys on the control panel, thus directing the technician as to what keys need be pressed in order to move in the direction indicated by the arrow closest to each key symbol.

NOTES:

- A complete Service Mode Menu can be found on the back of the wiring diagram and on the next page of this manual.
- Since it is possible to initiate, bypass, an/or step back through the four different sub-modes while in Service Mode, initiating Service Mode will always be the first step when explaining how to work through the Service Mode menu for the sub-modes.

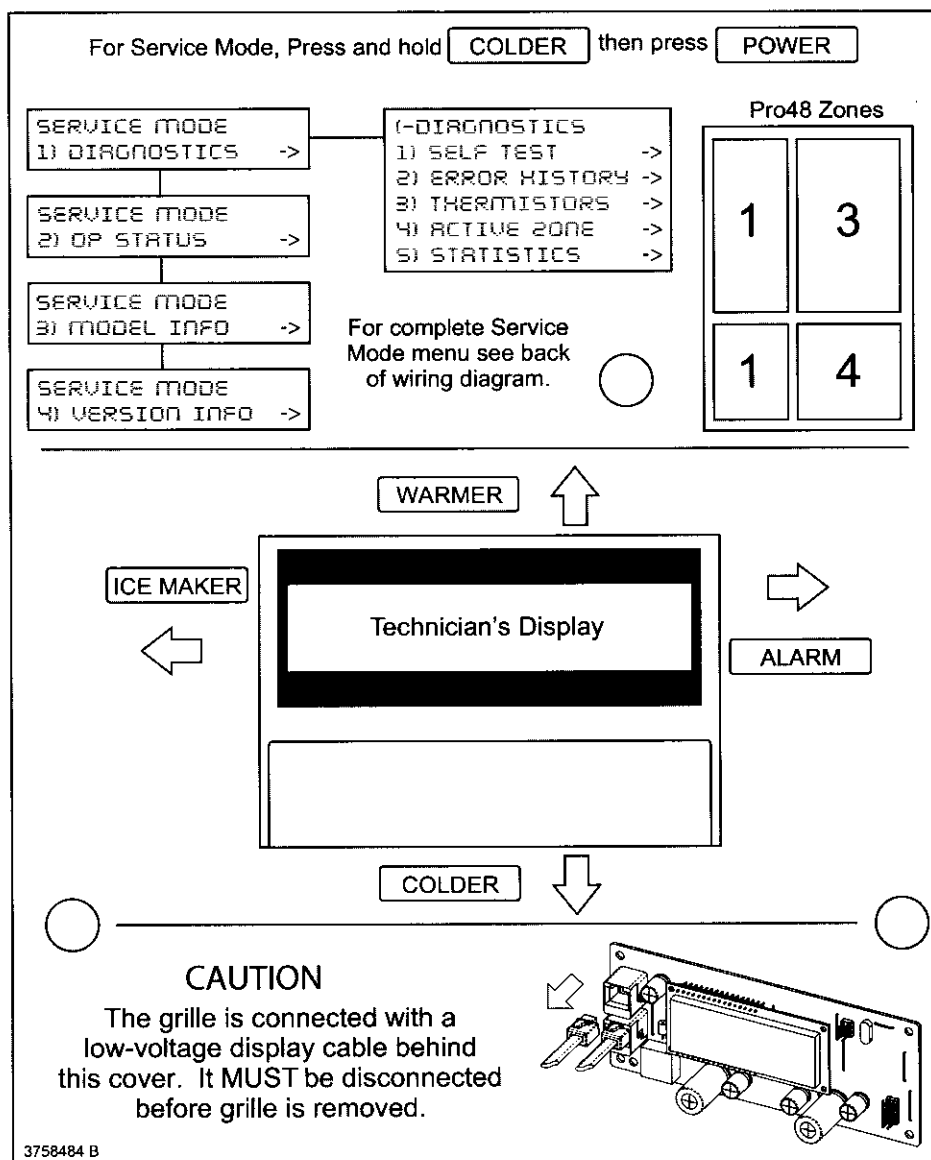


Figure 8-1. Technician's Display with Service Mode Menu

Non-Service Mode Display Information

Prior to initiating Service Mode, the following information will appear on the Technician's Display, depending on operational mode.

Operational Mode	LCD Line #1	LCD Line #2
Power Up	Scrolling Messages (every 2s) 1) Model ID # 2) Main Software Version # 3) Left Display Version # 4) Keyboard Version #	Scrolling Messages (every 2s) 1) Unit ID # 2) E2 Version # 3) Right Display Version # 4) Tech Display Version #
Off		
Showroom	Sub Zero	Showroom mode
Sabbath	Sub Zero	Sabbath mode
Normal	Scrolling Messages (every 2s) 1) Model Name 2) Zone #1 Status 3) Zone #2 Status 4) Zone #3 Status 5) Zone #4 Status	Scrolling Messages (every 2s) 1) S/N: XXXXX 2) Status 3) Status 4) Status 5) Status

Initiating Service Mode

To initiate Service Mode, press and hold any COLDER key, then press the POWER key, then release both keys (See Figure 8-2). "Service Mode, 1) Diagnostics" is the first sub-mode to appear in the Technician's Display, with a small arrow in the bottom right corner pointing right.

NOTES:

- By following the basic directions on the Technicians Display cover and the prompts that appear in the Technician's Display, a Service Technician will be able to work through the Service Mode menu, to the desired verification point, configuration portion, and troubleshooting section of the menu.
- For sake of space, the directions that follow will not explain or show what is seen in the display after each key stroke. Only the final, and/or desired result will be explained and illustrated.
- There are three (3) ways to exit Service Mode:
 - To exit the Service Mode at any time, press the ICE MAKER key repeatedly until completely out of Service Mode menu.
 - Pressing the POWER key will switch the unit OFF and exit Service Mode.
 - If no keys are pressed for five (5) minutes after initiating Service Mode, the electronic control will automatically exit the mode.

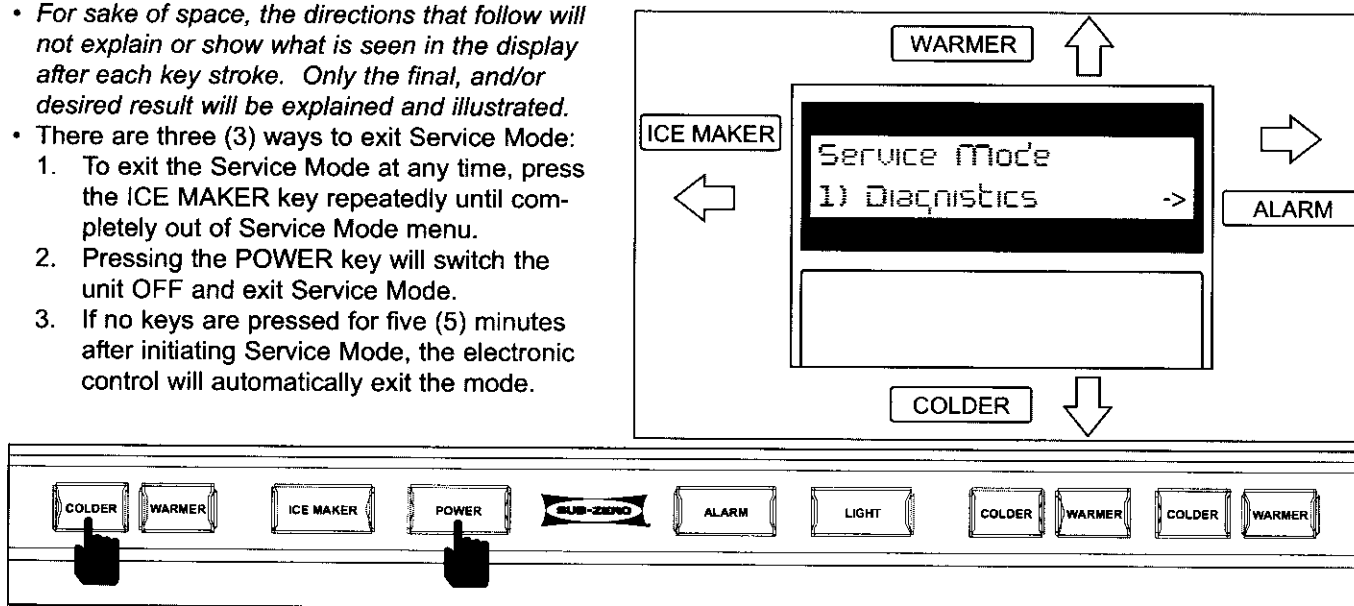
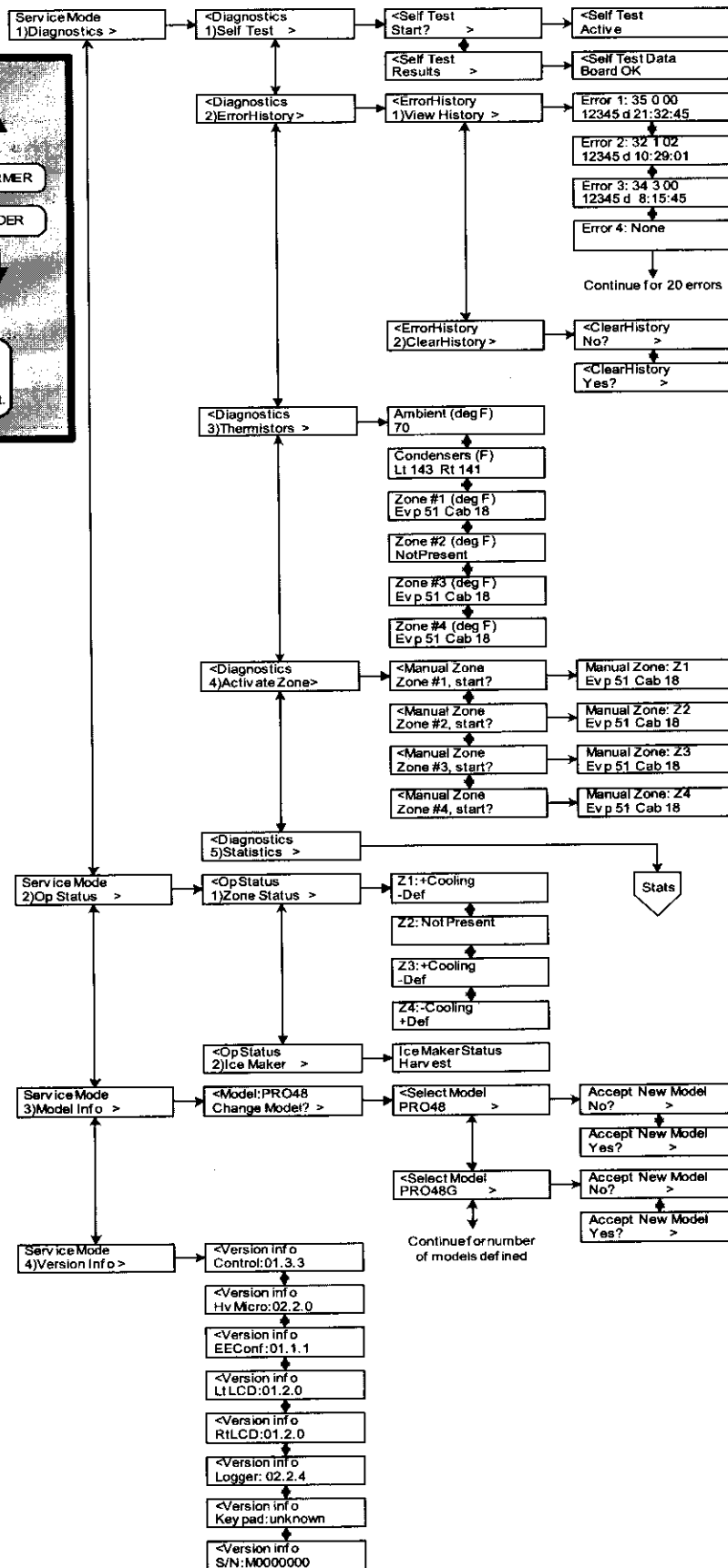
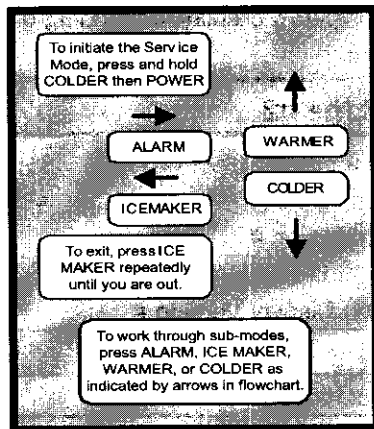


Figure 8-2. Key Strokes and Tech Display - Initiate Service Mode

Service Mode Menu





Error Code Table		
CODE	ZONE	SERVICE INSTRUCTION
01	X	Zone "X" Cabinet Thermistor Failure (Device or Wiring)
02	X	Zone "X" Evaporator Thermistor Failure (Device or Wiring)
03	X	Zone "X" Condenser Thermistor Failure (Device or Wiring)
04	0	Ambient Thermistor Failure (Device or Wiring)
20	X	Check Zone "X" Defrost Bi-metal for Proper Operation
21	X	Check Zone "X" Defrost Bi-metal for Proper Operation
22	X	Check Zone "X" Defrost Wiring
23	X	Check Zone "X" Defrost Wiring
24	X	Check Zone "X" Defrost Heater Ohms
30	0	Check for Stuck Icemaker or Water Valve Failure
35	X	Check Zone "X" Fan, Fan Speed Error
40	X	Zone "X" Excessive Run
41	X	Check Zone "X" Compressor and Wiring
42	0	Check Condenser Fan and/or Wiring
43	X	Check Left Refrigerant Valve and Wiring
44	X	Check Zone "X" Glass Door Heater and Wiring
45	X	Errors Detectable with Red Door Switches-Disabled Now. Check Overhead Lighting
46	0	Check Ice Accessory Wiring for Open Circuit
47	3	Check Accent Lighting Wiring for Short Circuit
80	X	Check Power to Compressor Controller for Zone "X", Troubleshoot with Manual Activation Mode
83	X	Replace Zone "X" VS Compressor and Filter-Drier
84	X	Check Zone "X" VS Compressor Wiring
85	X	Zone "X" VS Compressor Control Overheat
86	X	Check Communication Wiring, Replace Zone "X" VS Controller
87	X	Check for Broken Wiring or Open Defrost Heater
89	X	Check Icemaker Solenoid Valve and Wiring
90	X	Change Main Control Board
92	0	Check Keypad Wiring
93	0	Replace Keypad
94	1	Check Wiring / Replace User Display #1
94	3	Check Wiring / Replace User Display #2
96	0	Datalogger Malfunction
97	0	Check Communications Cables / Connectors
98	0	Brownout Check Input Power Supply

SEALED SYSTEM DIAGNOSTICS TABLES

NORMAL OPERATING PRESSURES TABLE NOTES:

- Only enter the sealed system to check pressures if the cause of the temperature problem could not identified with the appliance in Service Mode.
- Always use solder-on process valves when entering the sealed system. Do NOT use bolt-on process valves as they are prone to leak.
- Whenever servicing the sealed system, the high-side filter-drier MUST be replaced.
- Pressures listed below are not indicative of initial pull down, but rather of a steadily running and properly functioning appliance.
- Pressures listed are for reference only, as actual pressure readings may vary because of one or more of the following reasons:
 1. Ambient temperatures (Pressures are based on a 70°F (21°C) Ambient).
 2. Temperature set-points (Pressures listed below are based on set-points of 0°F (-18°C) in freezers and 38°F (3°C) in refrigerators)
 3. Food load quantity and temperature.
 4. Condenser cleanliness.
 5. Whether or not one or both refrigeration systems are operating.
 6. Gauge calibration.

NORMAL OPERATING PRESSURES			
Model		Normal Low-Side Pressures	Normal High-Side Pressures
648PRO	Refrigerator	0 - 12 psi to 30 - 42 psi	75 psi to 110 psi
	Freezer	5" Vac - 1 psi to 6 - 12 psi	75 psi to 120 psi

PRESSURE INDICATIONS		
If low-side pressure is	& high-side pressure is	possible problem is
NORMAL	NORMAL	MECHANICAL (see General Troubleshooting Guide)
LOW	LOW	LEAK
LOW	HIGH	RESTRICTION
HIGH	LOW	INEFFICIENT COMPRESSOR
HIGH	HIGH	OVER CHARGE

**EVAPORATOR TEMPERATURE / SEALED SYSTEM LOW-SIDE PRESSURE CORRELATION**

NOTE: The temperature/pressure table at right is for reference only. A unit's temperature/pressure correlation may differ from those listed due to: variations in evaporator thermistor location, set-points, where the sealed system is in the refrigeration cycle, ambient temperature, etc.

If a unit is experiencing temperature problems, it is recommended that you initiate Service Mode and interpret the information therein before accessing the sealed system. After all mechanical and electrical components have been ruled out, sealed system pressures can be checked by applying solder-on process valves and referencing the preceding page. Do NOT use bolt-on process valves as they are prone to leak.

This table should only be used as a last quick check before entering the sealed system.

Temperature	Pressure
-30°F (-34°C)	10" Vac
-25°F (-32°C)	7" Vac
-20°F (-29°C)	4" Vac
-15°F (-26°C)	0" Vac
-10°F (-23°C)	2 Psi
-5°F (-21°C)	4 Psi
0°F (-18°C)	7 Psi
5°F (-15°C)	9 Psi
10°F (-12°C)	12 Psi
15°F (-9°C)	15 Psi
20°F (-7°C)	18 Psi
25°F (-4°C)	22 Psi
30°F (-1°C)	26 Psi
35°F (2°C)	30 Psi
40°F (4°C)	35 Psi
45°F (7°C)	40 Psi
50°F (10°C)	45 Psi
55°F (13°C)	51 Psi
60°F (16°C)	57 Psi
65°F (18°C)	64 Psi
70°F (21°C)	71 Psi
75°F (24°C)	78 Psi

Troubleshooting

Pro-Series (648PRO)

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SECTION 9

TECHNICAL DATA

Model 648PRO

		REFRIGERATOR	FREEZER
CHARGE (R-134a Refrigerant) <i>NOTE: Always check serial tag for exact charge</i>		4.0 oz.	6.0 oz.
NORMAL OPERATING PRESSURES	Low Side High Side	0 - 12 psi to 30 - 42 psi 75 psi to 110 psi	5" Vac-1 psi to 6-12 psi 75 psi to 120 psi
COMPRESSOR <i>NOTE: Always check parts price list for possible substitutions.</i>	Service Part No. Manufacturer Mfg. Part No. Original Compressor / Service Compressor Amps Original Compressor / Service Compressor BTU's	4201880 Embraco EMI30HER 2.1(V), 0.8 (non-V) / 1.1 864(V), 345(non-V) / 280	4204741 Embraco VEGY 2.6 / 2.6 1070 / 1070
DEFROST METHOD		"Fan Assisted Off Cycle Defrost" Evap > 38°F before Compressor ON.	"Adaptive Defrost" Intervals and duration varies. Followed by 5 min. compressor delay.
DEFROST TERMINATOR	Cut-In Temp. Cut-Out Temp.	--- ---	30°F / -1°C 55°F / 13°C
DEFROST HEATER	Watts Amps Ohms	--- --- ---	450 3.75 ~ 32
DRAIN TROUGH HEATER	Watts Amps Ohms	--- --- ---	80 .66 ~ 180
FILL TUBE HEATER	Watts Amps Ohms	--- --- ---	4.2 .04 3000 - 3500
WATER VALVE	Watts Amps Ohms (Inductive)	--- --- ---	50 .4 ~ 288
THERMISTORS (Evap & Compartment)	Ohms at 32°F / 0°C	30000 - 33000	30000 - 33000
GLASS REFRIGERATOR DOOR HEATER	Watts Amps Ohms	5 @ 12VDC .4 ~ 29	--- --- ---



SECTION 10

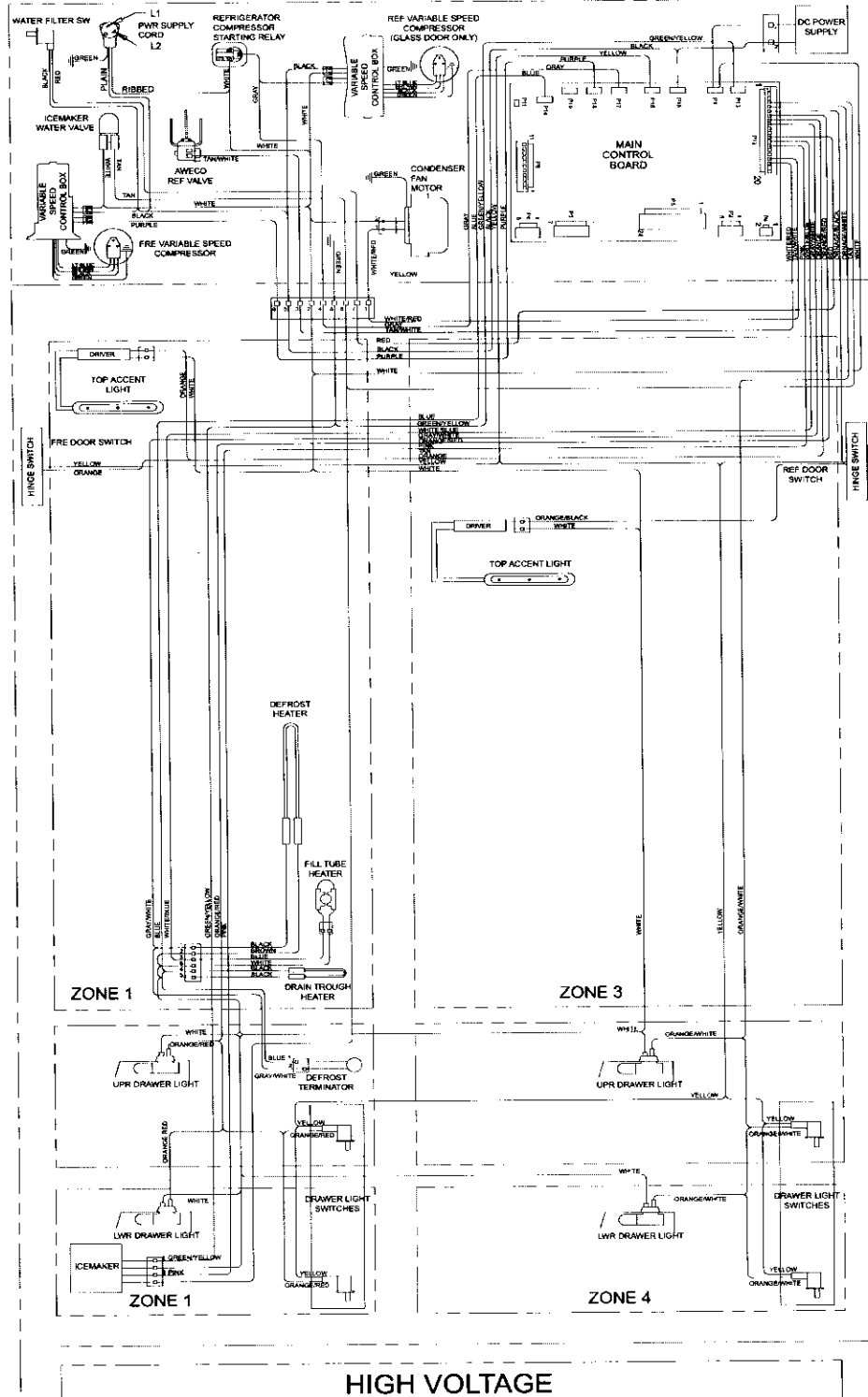
WIRING DIAGRAMS AND SCHEMATICS

WIRING DIAGRAM MODELS: PRO48 (HIGH VOLTAGE)

WARNING

-This wiring information is provided for use by qualified service personnel only.
-Disconnect appliance from electrical supply before beginning service.
-Be sure all grounding devices are connected when service is complete.
-Failure to observe the above warnings may result in severe electrical shock.

PART NUMBER 3758388 REVISION C



WIRING DIAGRAM MODELS: PRO48 (LOW VOLTAGE)

WARNING

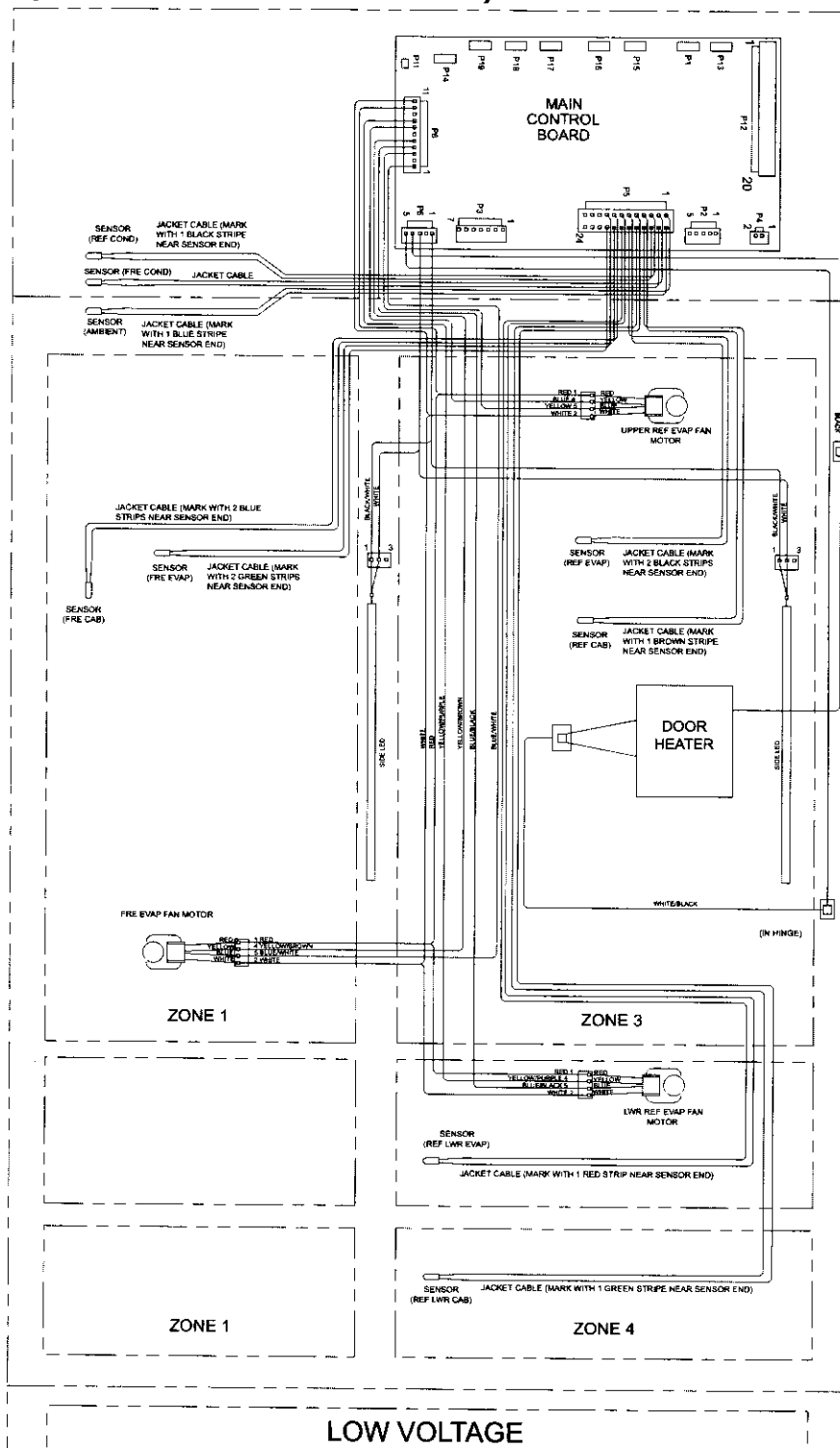
- This wiring information is provided for use by qualified service personnel only.

- Disconnect appliance from electrical supply before beginning service.

- Be sure all grounding devices are connected when service is complete.

- Failure to observe the above warnings may result in severe electrical shock.

PART NUMBER 3758388 REVISION C

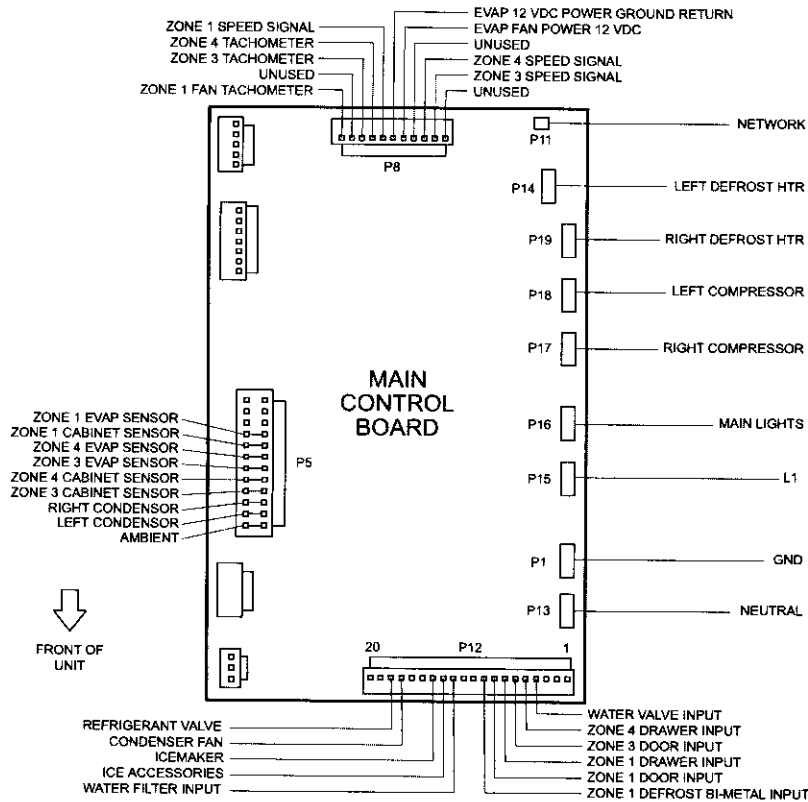


WARNING

- This wiring information is provided for use by qualified service personnel only.
- Disconnect appliance from electrical supply before beginning service.
- Be sure all grounding devices are connected when service is complete.
- Failure to observe the above warnings may result in severe electrical shock.



MODEL 648PRO CONTROL BOARD LAYOUT



MODEL 648PRO CONTROL BOARD SUMMARY TABLE

CIRCUIT	DESCRIPTION	FUNCTION	COLOR	CIRCUIT	DESCRIPTION	FUNCTION	COLOR
P13	120 VOLT CIRCUITS	NEUTRAL INTO BOARD	WHITE	P4-1	12 VDC POWER	12 VDC POWER	RED
P14	DEFROST HEATER 1	POWERS DEF HTR 1	BLUE	P4-2	12 VDC RETURN	12 VDC RETURN	WHITE
P15	POWER IN	POWER INTO BOARD	BLACK	P6-1	VERTICAL LED (REF)	12 V TO LED	BLACK/WHITE
P16	MAIN LIGHTS	POWERS MAIN LIGHTS	YELLOW	P6-2	UNUSED	UNUSED	UNUSED
P17	COMPRESSOR REF	POWERS REF COMPRESSOR	GRAY	P6-3	VERTICAL LED (REF) COMMON	VERTICAL LED RETURN	WHITE
P18	COMPRESSOR FREEZER	POWERS COMPRESSOR FRZ	PURPLE	P6-4	GLASS DOOR HTR 2	12 V TO HTR 2	BLACK
P19	UNUSED	UNUSED	UNUSED	P6-5	GLASS DOOR HTR 2 COMMON	HTR 2 RETURN	WHITE
P12-1	UNUSED	UNUSED	UNUSED	P8-1	EVAPORATOR FAN ZONE 1	TACHOMETER INPUT	BLUE/WHITE
P12-2	UNUSED	UNUSED	UNUSED	P8-2	UNUSED	UNUSED	UNUSED
P12-3	UNUSED	UNUSED	UNUSED	P8-3	EVAPORATOR FAN ZONE 3	TACHOMETER INPUT	BLUE
P12-4	WATER VALVE INPUT	SENSES WATER VALVE ACTIVATION	TAN	P8-4	EVAPORATOR FAN ZONE 4	TACHOMETER INPUT	BLUE/BLACK
P12-5	ZONE 4 DRAWER INPUT	SENSES IF ZONE 4 DRAWERS ARE OPEN	UNUSED	P8-5	EVAPORATOR FAN ZONE 1	PWM DRIVE OUTPUT	YELLOW/BROWN
P12-6	ZONE 3 DOOR INPUT	SENSES IF ZONE 3 DOOR OPEN	UNUSED	P8-6	UNUSED	UNUSED	UNUSED
P12-7	ZONE 1 DRAWER INPUT	UNUSED	UNUSED	P8-7	EVAPORATOR FAN ZONE 3	PWM DRIVE OUTPUT	YELLOW
P12-8	ZONE 1 DOOR	UNUSED	UNUSED	P8-8	EVAPORATOR FAN ZONE 4	PWM DRIVE OUTPUT	YELLOW/PURPLE
P12-9	DEF BI-METAL 1	SENSES WHEN HEATER 1 SHUTS OFF	GRAY/WHITE	P8-9	UNUSED	UNUSED	UNUSED
P12-10	UNUSED	UNUSED	UNUSED	P8-10	EVAPORATOR FAN 12 VDC POWER	ZONE FAN POWER	RED
P12-11	UNUSED	SENSE WATER FILTER	RED	P8-11	EVAPORATOR FAN GROUND RETURN	ZONE FAN RETURN	WHITE
P12-12	WATER FILTER INPUT	POWERS FILL TUBE AND ACCESSORIES	WHITE/BLUE				
P12-13	ICE ACCESSORIES	POWERS ICE-MAKER	UNUSED				
P12-14	ICE MAKER	UNUSED	UNUSED				
P12-15	UNUSED	CONDENSER FAN	WHITE/RED				
P12-16	CONDENSER FAN	POWERS AWECO VALVE 2	TAN/WHITE				
P12-17	AWECO VALVE 2	UNUSED	UNUSED				
P12-18	UNUSED	UNUSED	UNUSED				
P12-19	UNUSED	UNUSED	UNUSED				
P12-20	UNUSED	UNUSED	UNUSED				
P2-1	LOW VOLTAGE CIRCUITS	UNUSED	UNUSED				
P2-2	UNUSED	UNUSED	UNUSED				
P2-3	UNUSED	UNUSED	UNUSED				
P2-4	UNUSED	UNUSED	UNUSED				
P2-5	UNUSED	UNUSED	UNUSED				

648PRO CONTROL BOARD SUMMARY



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