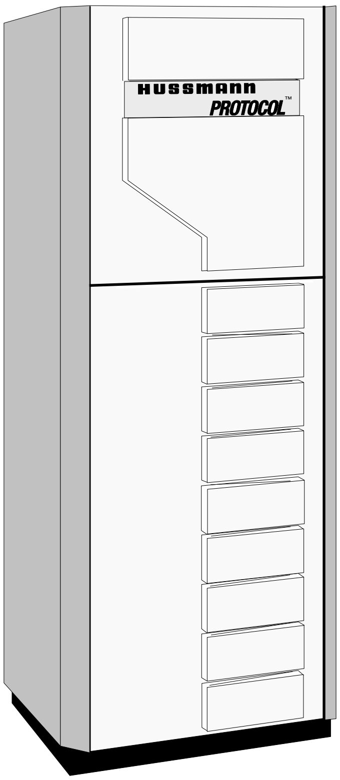
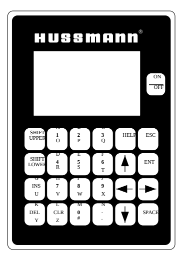
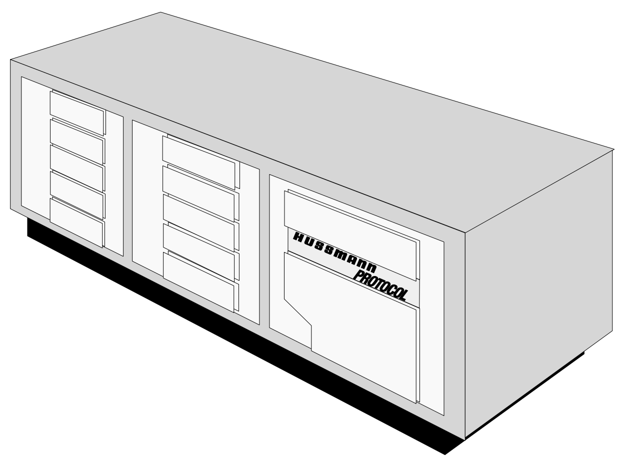
HUSSMANN®

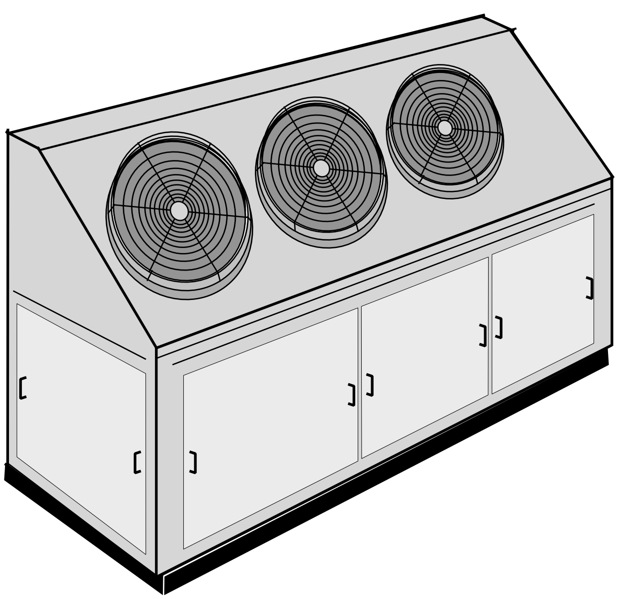
PROTOCOL™
and
PROTO-AIRE™

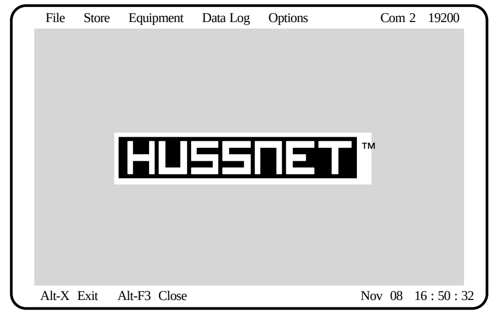
Installation and Service Manual











P/N 385841C
January 15, 1999

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Installation

IMPORTANT
KEEP IN STORE FOR FUTURE REFERENCE
Quality that sets industry standards

Hussmann Refrigeration Systems

12999 St. Charles Rock Road • Bridgeton, MO 63044-2483 USA • (314) 291-2000 • FAX (314) 298-6485

2700 Crestridge Court • Suwanee, GA 30024 USA • (770) 921-9410 • FAX (770) 381-0615

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Field Fabricated Headers are NOT REQUIRED for Protocol™ Installations

Installation

OVERVIEW

This section is limited to the information needed to set the Protocol™ Unit. Auxiliary equipment information is found in the sections devoted to them or in the manuals accompanying them.

Related information is contained in Protocol™ Planning Data; the HUSSNET™ manual; the Hand Held Device manual; and the Pumping Station Planning Data, Service and Installation manual.

SHIPPING DAMAGE

All equipment should be thoroughly examined for shipping damage before and while unloading.

This equipment has been carefully inspected at our factory, and the carrier has assumed responsibility for safe arrival. If damaged, either apparent or concealed, claim must be made to the carrier.

Apparent Loss or Damage

If there is an obvious loss or damage, it must be noted on the freight bill or express receipt and signed by the carrier's agent; otherwise, carrier may refuse claim. The carrier will supply the necessary claim forms.

Concealed Loss or Damage

When loss or damage is not apparent until after equipment is uncrated, a claim for concealed damage is made. Upon discovering damage, make request in writing to carrier for inspection within 15 days and retain all packing. The carrier will supply inspection report and required claim forms.

ON SITE DAMAGE CONTROL

The Protocol™ is shipped on skids with panels installed. Remove panels to access lifting points on frame. Do not attempt to move the unit from the skids without first removing the panels.

DIMENSIONS AND WEIGHTS

Vertical Nomenclature	**L** (in.)	**H** (in.)	**D** (in.)	**Weight** (lb)
17FR	30.5	80	30.5	1600
18FR	43.5	80	30.5	1900

Horizontal Nomenclature	**L** (in.)	**H** (in.)	**D** (in.)	**Weight** (lb)
19FR	83	32	30.5	1600
21FR*	96	32	30.5	1700
20FR	122	32	30.5	1900

*Oversized Control Panel

Proto-Aire™ Nomenclature	**L** (in.)	**H** (in.)	**D** (in.)	**Weight** (lb)
All	128	56.5	42	2800

Receiver capacities are based on 80% liquid fill at 105 deg F.

Vertical	55 lb
Horizontal	72 lb
Proto-Aire™	72 lb

FIELD SUPPLIED AND INSTALLED WATER COMPONENTS

The Protocol™ comes equipped with a flow control/shutoff valve for servicing the plate heat exchanger. All other water loop components must be field supplied and installed. A 16-20 mesh strainer (1 mm) is required immediately upstream of each Protocol™.

ACCESSIBILITY

All Standard Control Panel Doors require 40 inches clearance. Oversized Control Panel Doors require 48 inches clearance. Vertical Protocol™ units must be serviceable from the front and top of the unit. Access to either side is also highly recommended. Horizontal Protocol™ units must be serviceable from the front, the right side as viewed facing the unit, and either the top or the back. A minimum of 40 inches clearance is recommended.

PANEL REMOVAL

Vertical Units

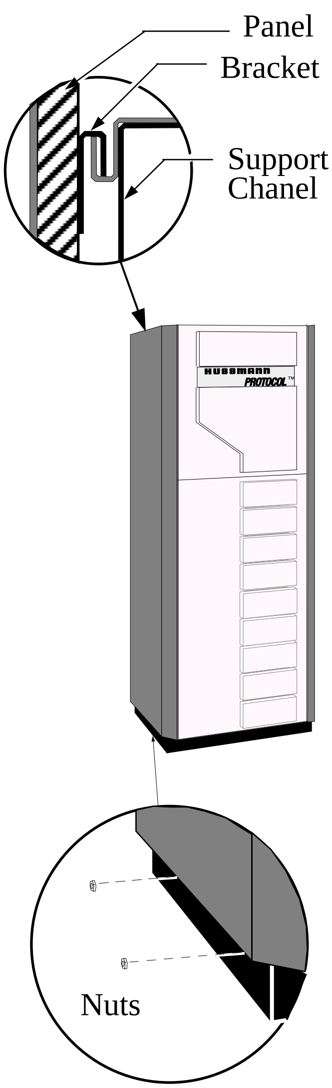
At the top, each panel is supported by a bracket in a channel. At the bottom, each panel is held in place by two studs two nuts.

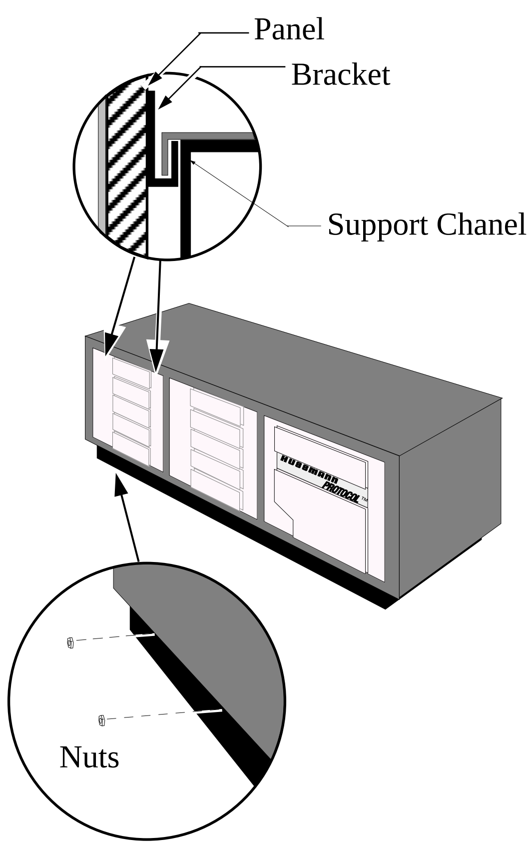
For vertical units, remove the nuts at the bottom of the panel, then lift up and out.

Horizontal Units

At the top, each panel is supported by a bracket in a channel. At the bottom, each panel rests on two studs and is held in place by nuts.

For horizontal units, remove the nuts at the bottom of the panel, then slide the panel out at the bottom and down.

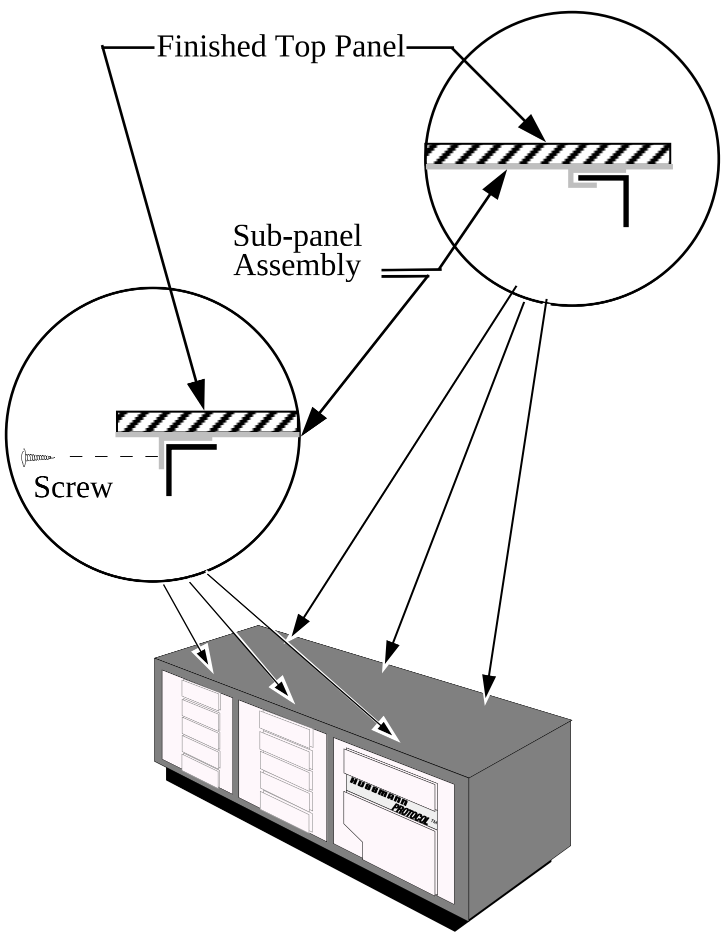




HORIZONTAL UNITS – TOP REMOVAL

To remove the top assembly, first remove the front panels. Then remove the bracket screw at the top center of each panel opening and above the control panel. Slide the top assembly forward until the back clips disengage. Lift the top off. Reverse procedure to install.

For some under-table applications, it may be desirable to remove the finished top panel to reduce the Protocol™ unit's height by 2 inches. To separate the top panel assembly, remove it and take out the screws holding the finished top panel to the sub-panel. The sub-panel **MUST** be installed, even when the finished top is not used.

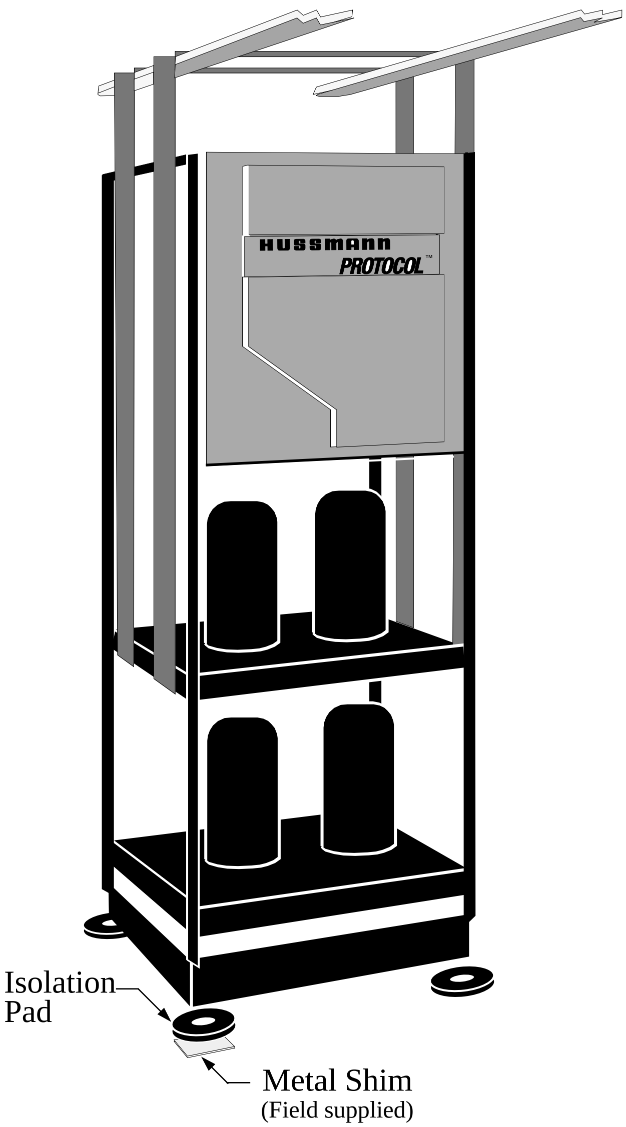


RIGGING AND HOISTING

The installer is responsible for ensuring equipment used to move the units is operated within its limits. Under no circumstances should the top of the unit or the outer panels be used for lifting or moving the unit. For strap rigging, run the straps under the top level of compressor mounting channel.

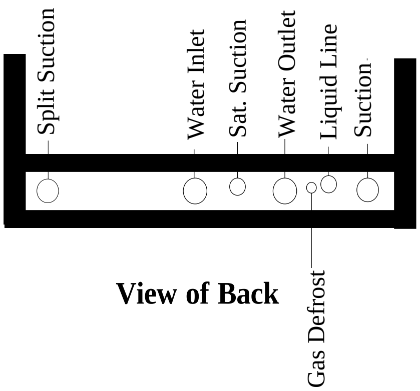
VIBRATION PADS

Vibration Isolation Pads are supplied with each Protocol™ unit. To adjust for slightly uneven floors, place 16 gauge galvanized steel shims between the vibration pads and the floor. (Shims must be field supplied.) One vibration pad is installed under each upright channel. Vertical units use 4 pads. Horizontal units use 8 or 10 pads.



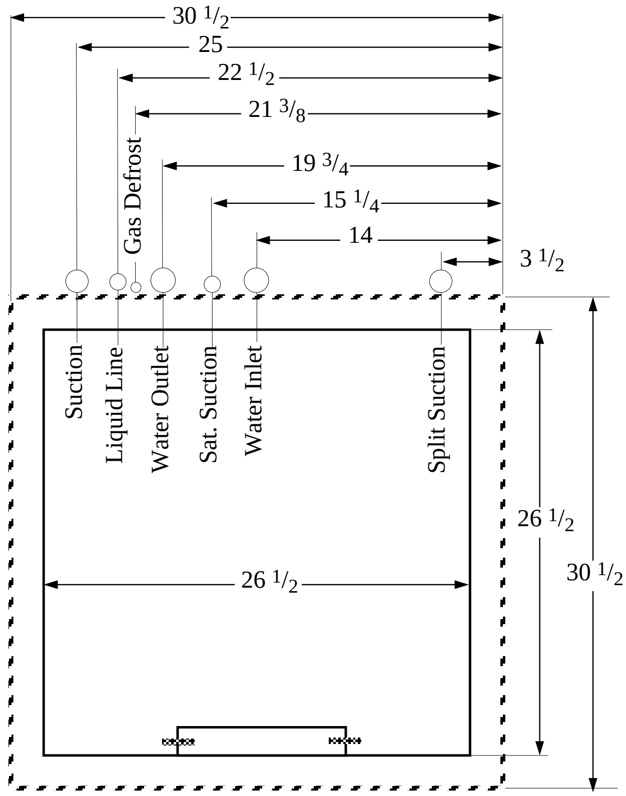
Vertical Protocol™

All Measurements given in Inches

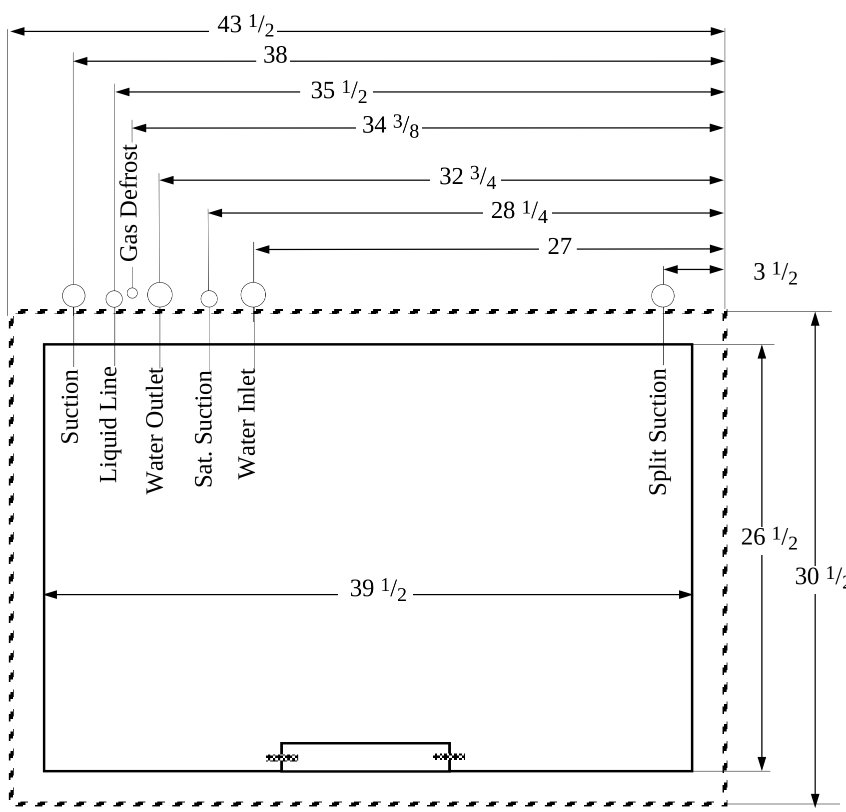


View of Back

Water Lines = 1 $^{1}/_{2}$ ID
Suction Line:
2, 3 or 4 compressors = 1 $^{3}/_{8}$ OD
5 or 6 compressors = 1 $^{5}/_{8}$ OD
Liquid Line = $^{7}/_{8}$ OD
Sat. Suction = $^{7}/_{8}$ OD
Gas Defrost = $^{5}/_{8}$ OD
Split Suction = 1 $^{3}/_{8}$ OD



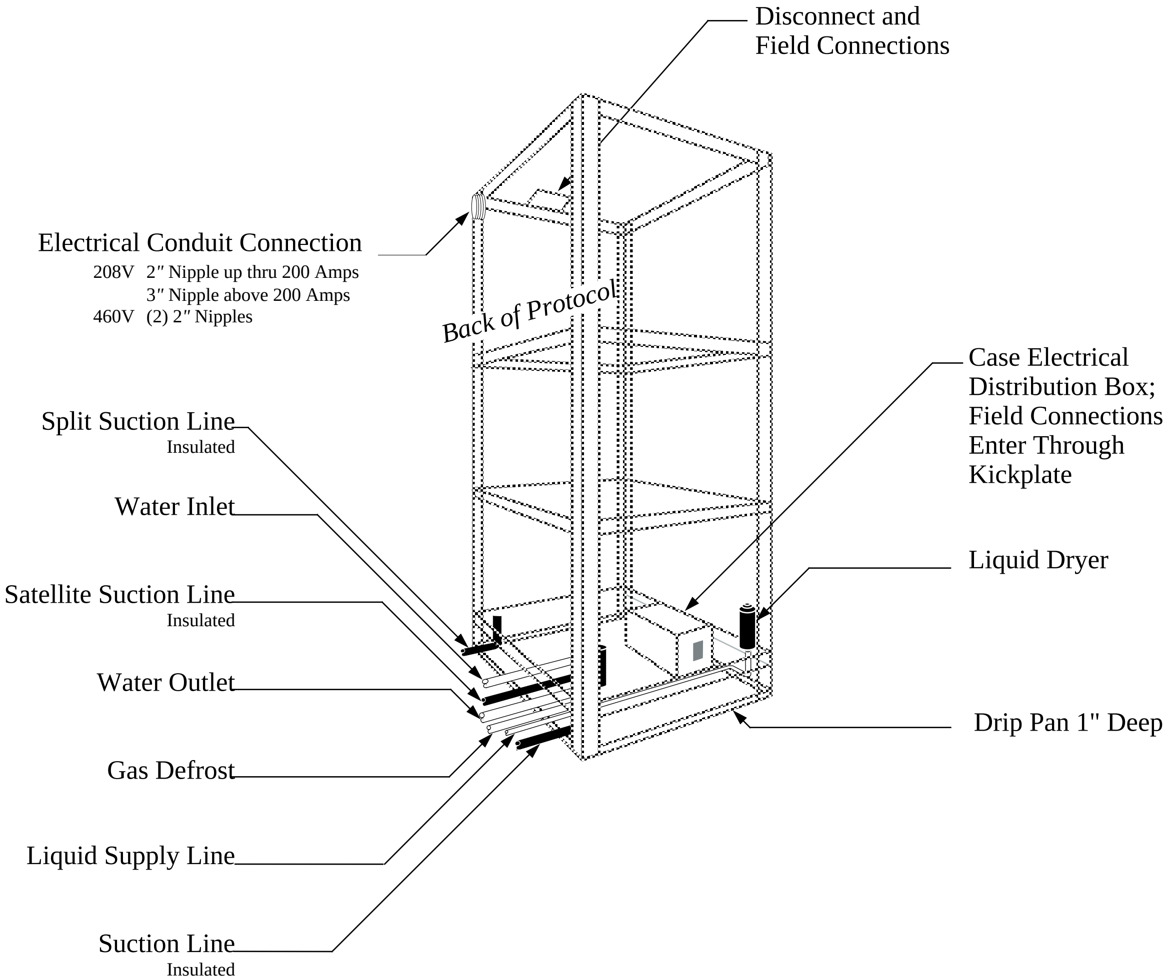
Plan View — 2, 3 or 4 Compressor Unit



Plan View — 5 or 6 Compressor Unit

Vertical Protocol™

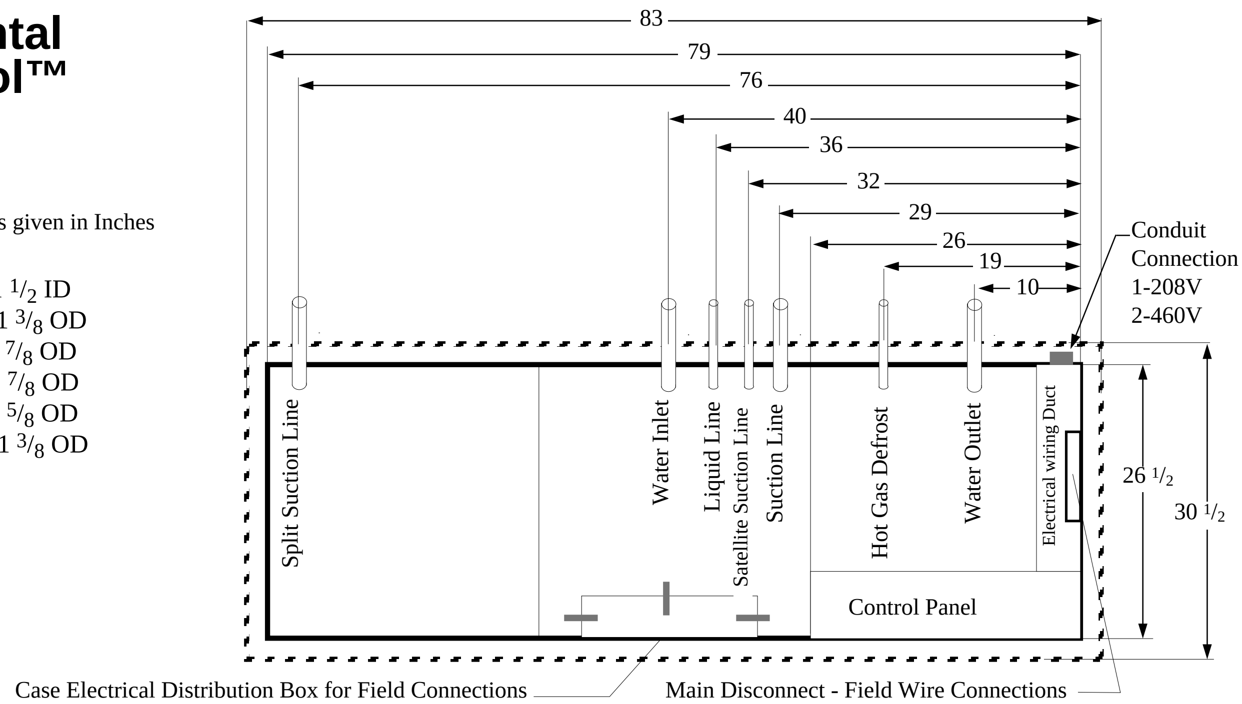
Typical Piping and Electrical Hookup



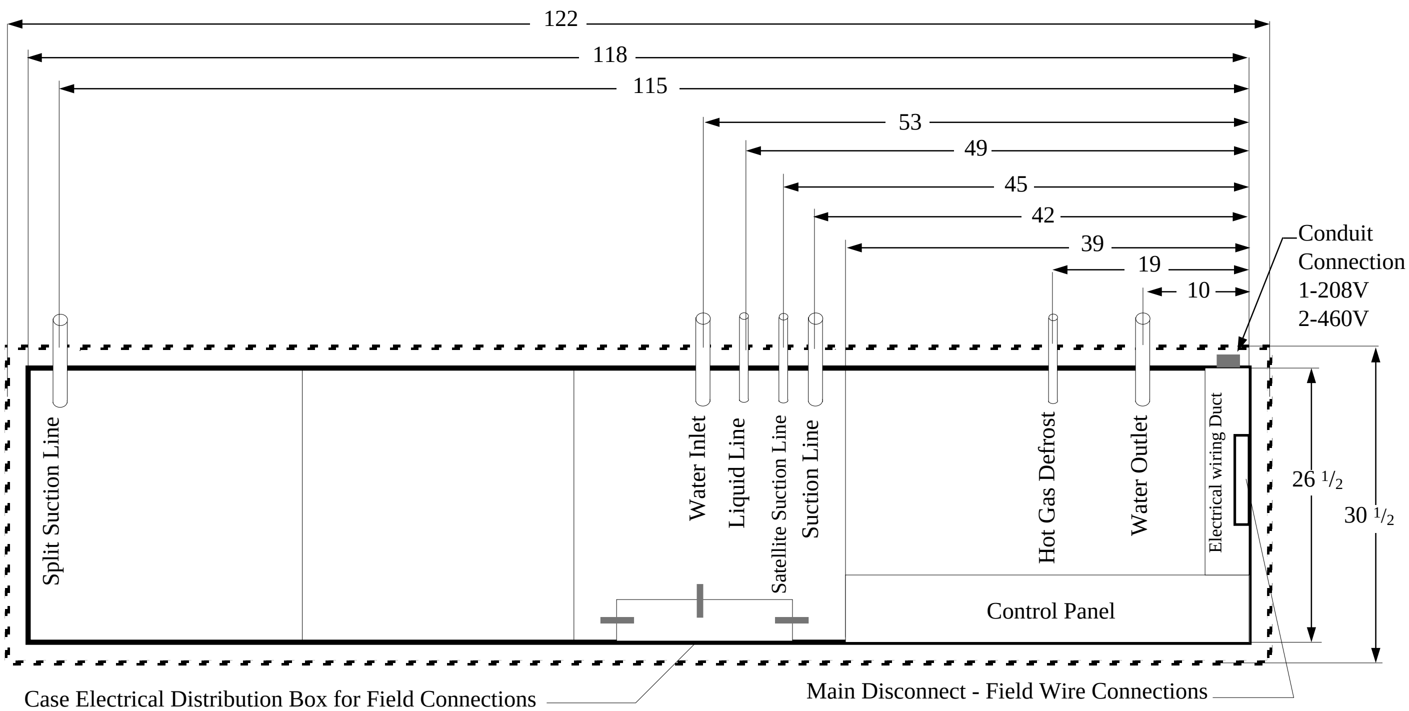
Horizontal Protocol™

Plan View
All Measurements given in Inches

Water Lines = 1 $^{1}/_{2}$ ID
Suction Line = 1 $^{3}/_{8}$ OD
Liquid Line = $^{7}/_{8}$ OD
Sat. Suction = $^{7}/_{8}$ OD
Gas Defrost = $^{5}/_{8}$ OD
Split Suction = 1 $^{3}/_{8}$ OD



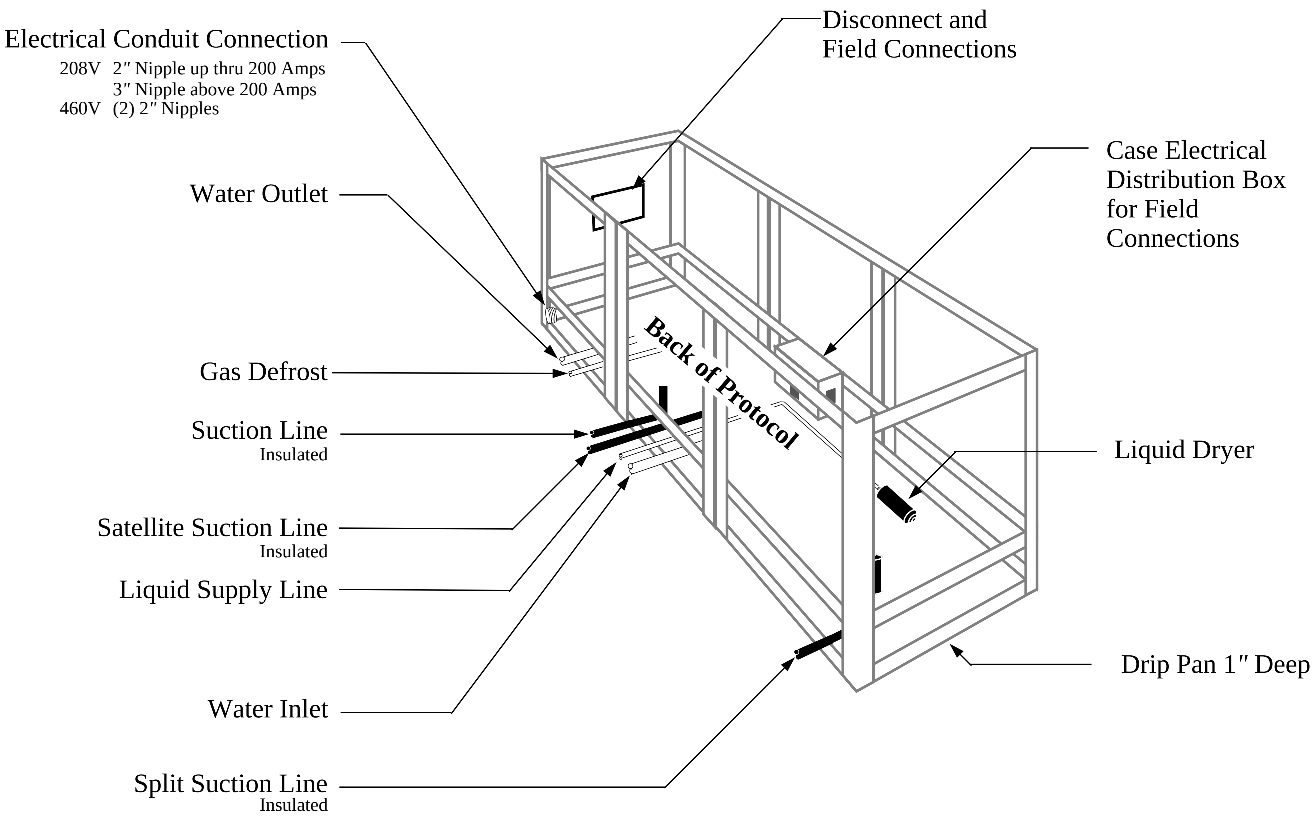
2, 3 & 4 Compressor Units



5 & 6 Compressor Units

Horizontal Protocol™

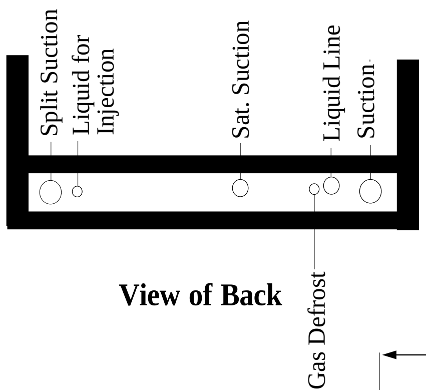
Typical Piping and Electrical Hookup



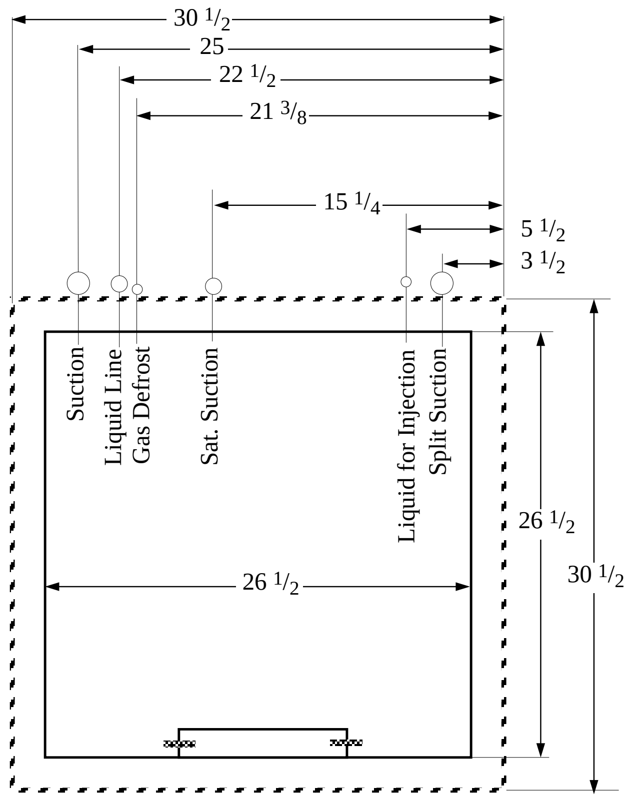
Vertical Air Cooled Protocol™

All Measurements given in Inches

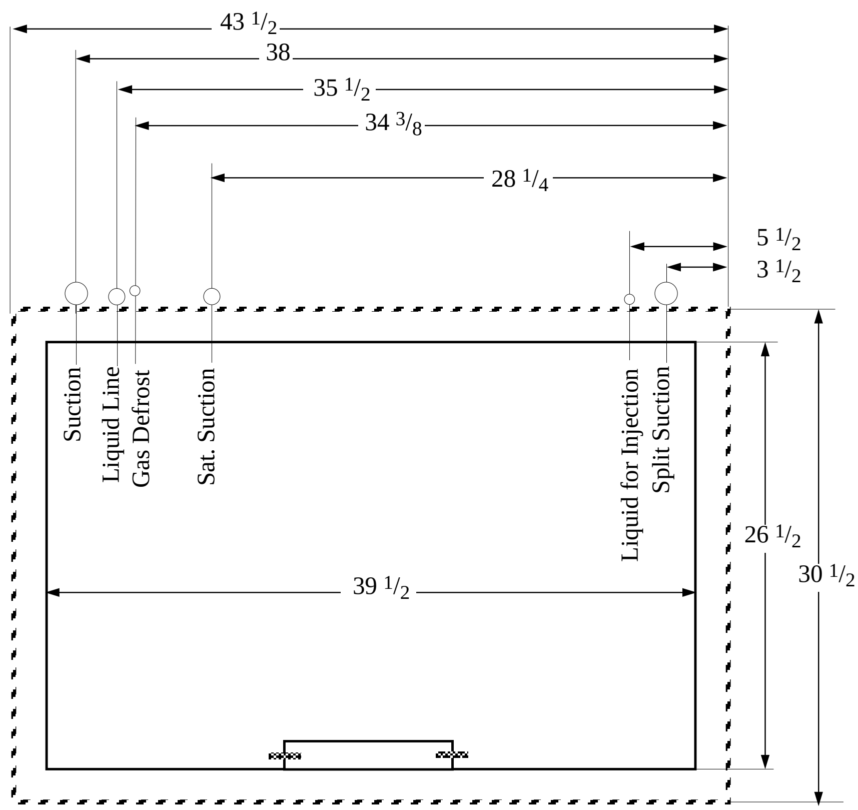
Suction Line:
2, 3 or 4 compressors = 1 $^{3}/_{8}$ OD
5 or 6 compressors = 1 $^{5}/_{8}$ OD
Liquid Line = $^{7}/_{8}$ OD *
Sat. Suction = $^{7}/_{8}$ OD
Gas Defrost = $^{5}/_{8}$ OD
Split Suction = 1 $^{3}/_{8}$ OD
Liquid Injection = $^{3}/_{8}$ OD
Discharge = 1 $^{3}/_{8}$ OD *
* See Notes on Typical Piping and Electrical Hookup drawing



View of Back



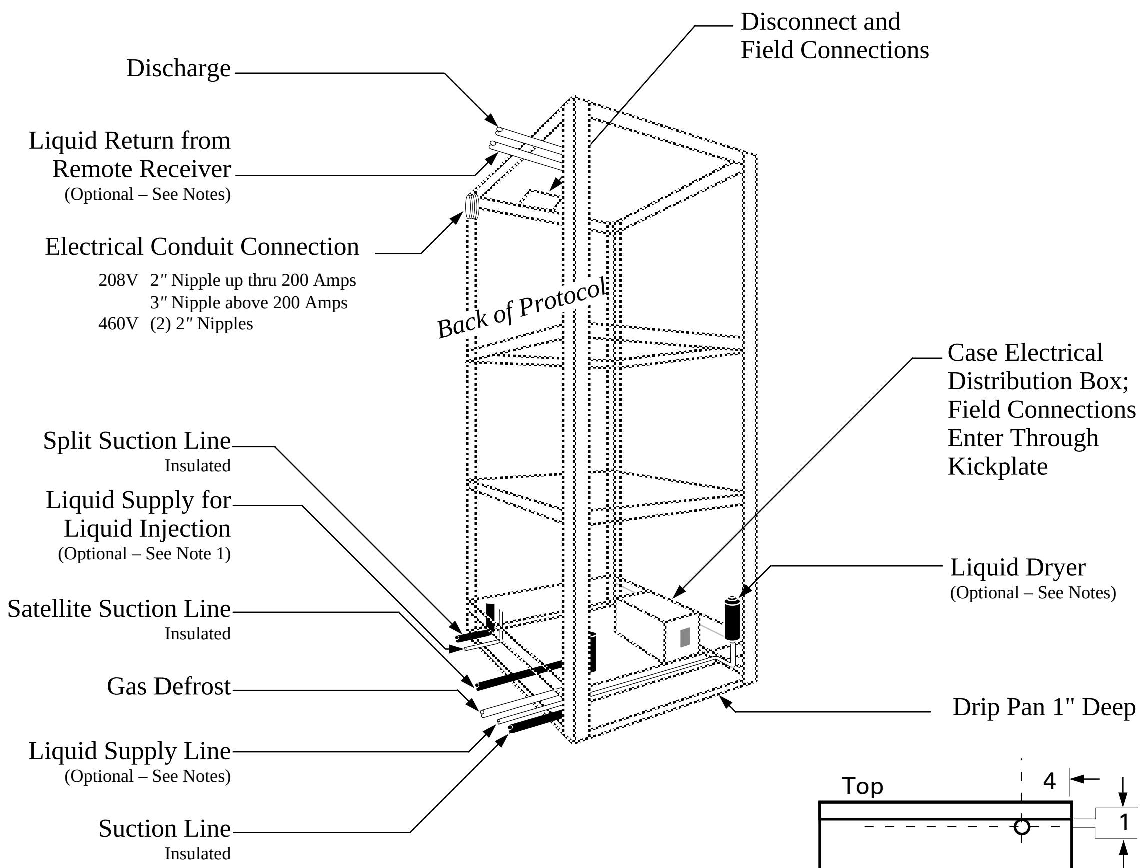
Plan View — 2, 3 or 4 Compressor Unit

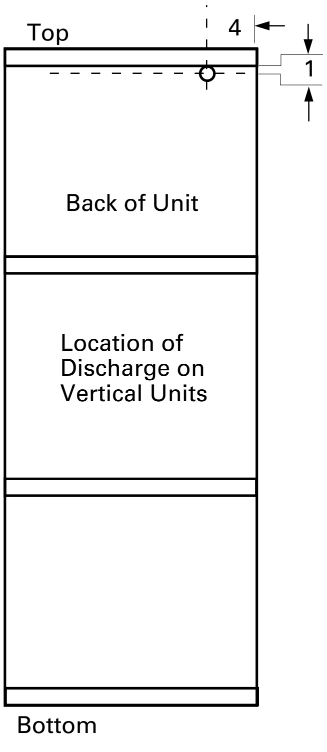


Plan View — 5 or 6 Compressor Unit

Vertical Air-Cooled Protocol™
(Remote Condenser)

Typical Piping and Electrical Hookup



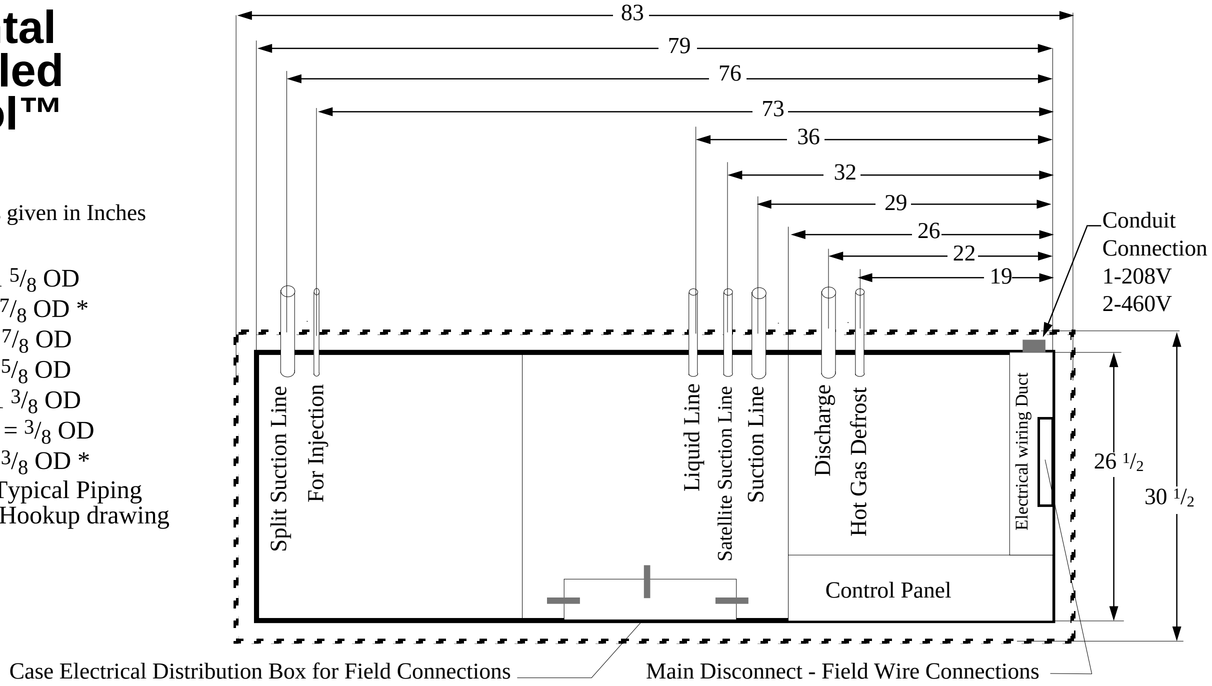


Notes: 1) On units with liquid injection, liquid refrigerant must be piped to this connection.
2) Liquid refrigerant from remote receiver may be piped through the unit as an option. If so, liquid injection piping will be factory installed inside the unit.

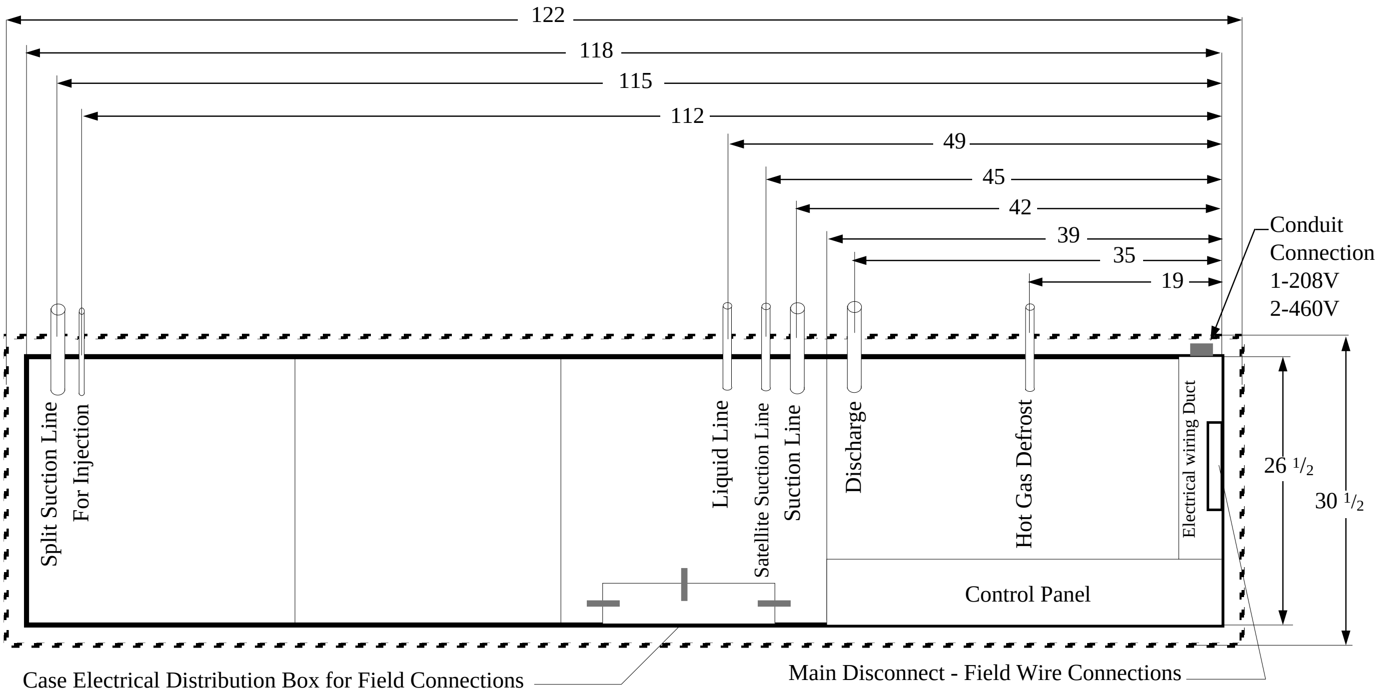
Horizontal Air Cooled Protocol™

Plan View
All Measurements given in Inches

Suction Line = 1 $^{5}/_{8}$ OD
Liquid Line = $^{7}/_{8}$ OD *
Sat. Suction = $^{7}/_{8}$ OD
Gas Defrost = $^{5}/_{8}$ OD
Split Suction = 1 $^{3}/_{8}$ OD
Liquid Injection = $^{3}/_{8}$ OD
Discharge = 1 $^{3}/_{8}$ OD *
* See Notes on Typical Piping and Electrical Hookup drawing



2, 3 & 4 Compressor Units

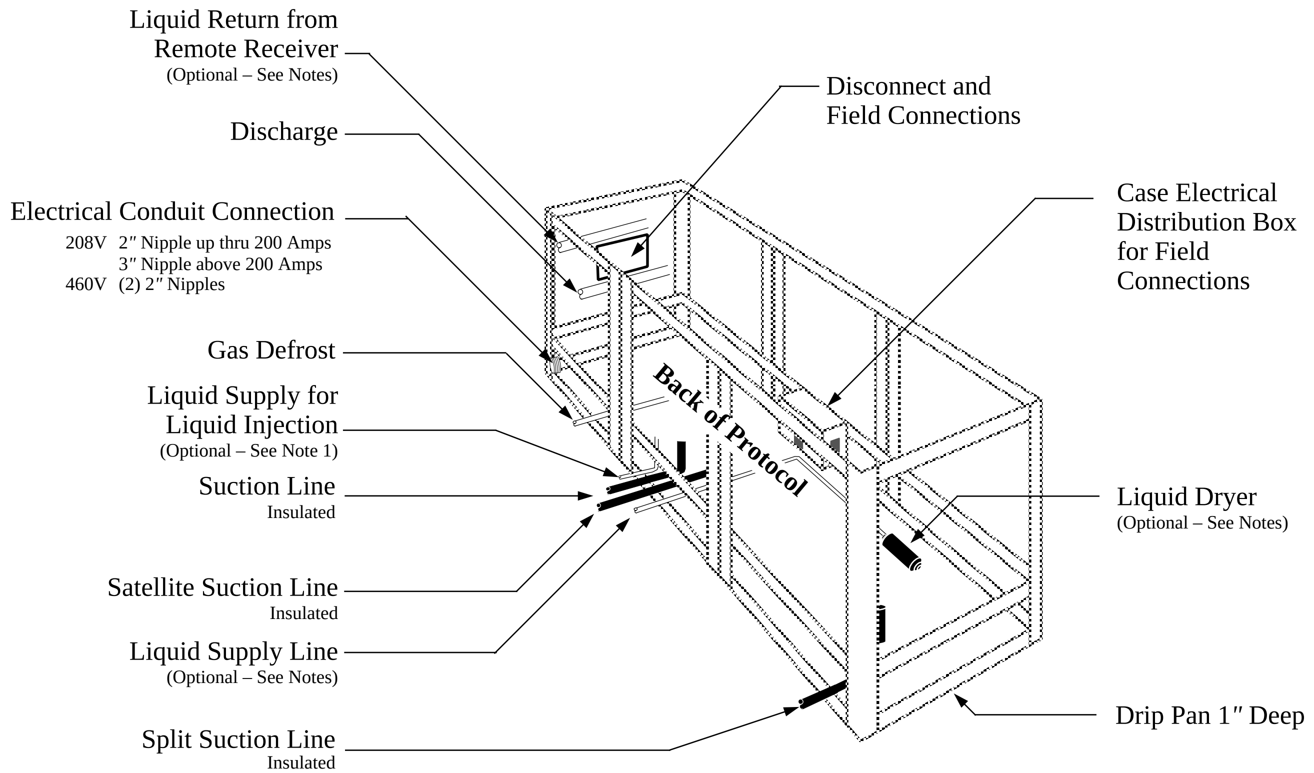


5 & 6 Compressor Units

Horizontal Air Cooled Protocol™

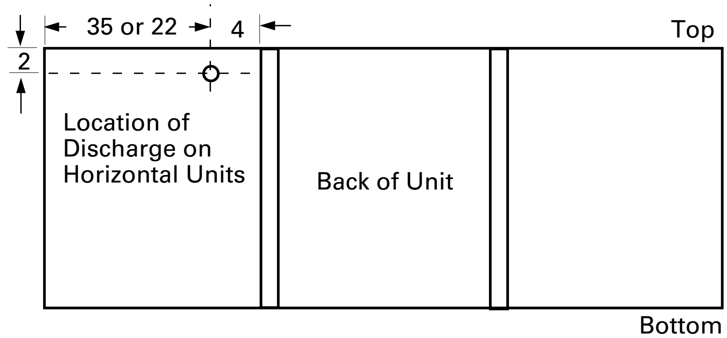
(Remote Condenser)

Typical Piping and Electrical Hookup



Notes: 1) On units with liquid injection, liquid refrigerant must be piped to this connection.

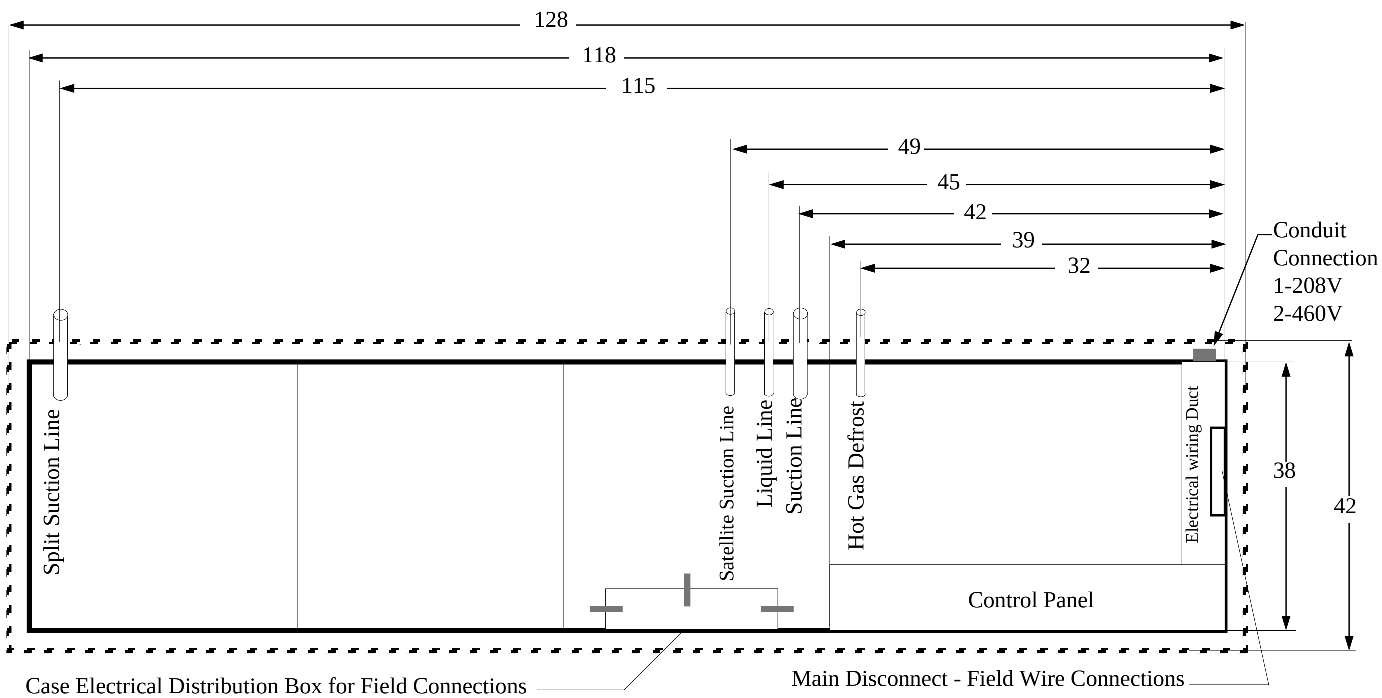
2) Liquid refrigerant from remote receiver may be piped through the unit as an option. If so, liquid injection piping will be factory installed inside the unit.



Proto-Aire™

Plan View
All Measurements given in Inches

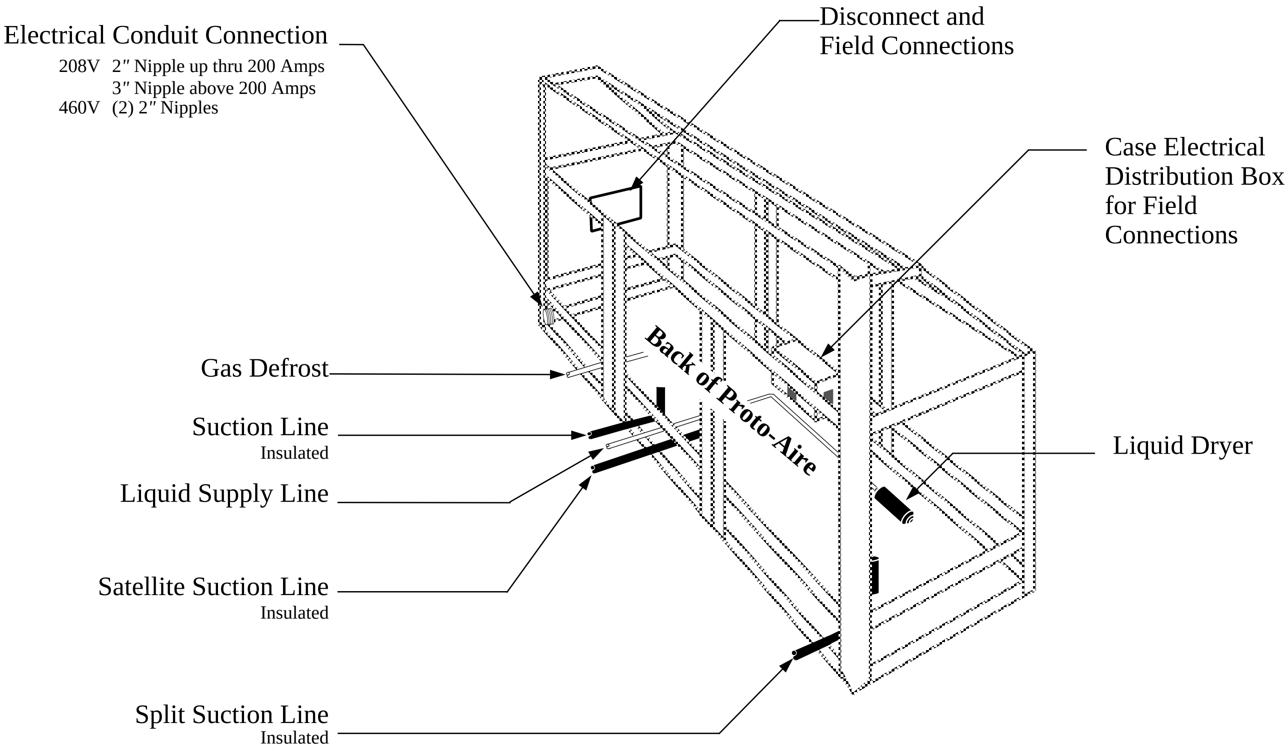
Suction Line = 1 $^5/_8$ OD
Liquid Line = $^7/_8$ OD
Sat. Suction = $^7/_8$ OD
Gas Defrost = $^5/_8$ OD
Split Suction = 1 $^3/_8$ OD



All Units

Proto-Aire™

Typical Piping and Electrical Hookup



Refrigeration Piping

Warning

IMPORTANT: Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor. Refer to Page 2-4.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent lines when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.

The Water Loop should be tested for leaks using pressurized water.
DO NOT exceed 75 psig at the lowest point in the piping.

OVERVIEW

This section details the major refrigeration components and their locations in each piping system.

REFRIGERANT LINE PIPING

Use only clean, dehydrated, sealed refrigeration grade copper tubing. Use dry nitrogen in the tubing during brazing to prevent the formation of copper oxide. All joints should be made with silver alloy brazing material, and use 35% silver solder for dissimilar metals.

Liquid and suction lines must be free to expand and contract independently of each other. Do not clamp or solder them together. Run supports must allow tubing to expand and contract freely. Do not exceed 100 feet without a change of direction or an offset. Plan proper pitching, expansion allowance, and P-traps at the base of all suction risers. Use long radius elbows to reduce flow resistance and breakage. Avoid completely the use of 45˚ elbows. Install service valves at several locations for ease of maintenance and reduction of service costs. These valves must be UL approved for 450 psig minimum working pressure.

All Protocol™ units have a one-inch drip pan at the bottom of the unit. **DO NOT** run piping through the bottom of this pan.

RETURN GAS SUPERHEAT

- Return gas superheat should be 10 to 30°F on all units.

Suction Line

- Pitch in direction of flow. A P-trap is required for all vertical risers.
- Line may be reduced by one size after first third of case load and again after the second third. Do not reduce below evaporator connection size.
- Suction returns from evaporators must enter at the top of the line.

Liquid Line

- Take-offs to evaporators must exit the bottom of the liquid line. Provide an expansion loop for each evaporator take-off (minimum 3-in. diameter).
- Offtime and Electric Defrost may be reduced by one size after one half the case load. Do not reduce below evaporator connection size.
- Reverse Gas Defrost units require one size larger liquid line for proper defrost operation (minimum ⅝ in. OD).

REFRIGERATION CYCLE

Beginning with the COMPRESSORS, vapor is compressed into the DISCHARGE MANIFOLD.

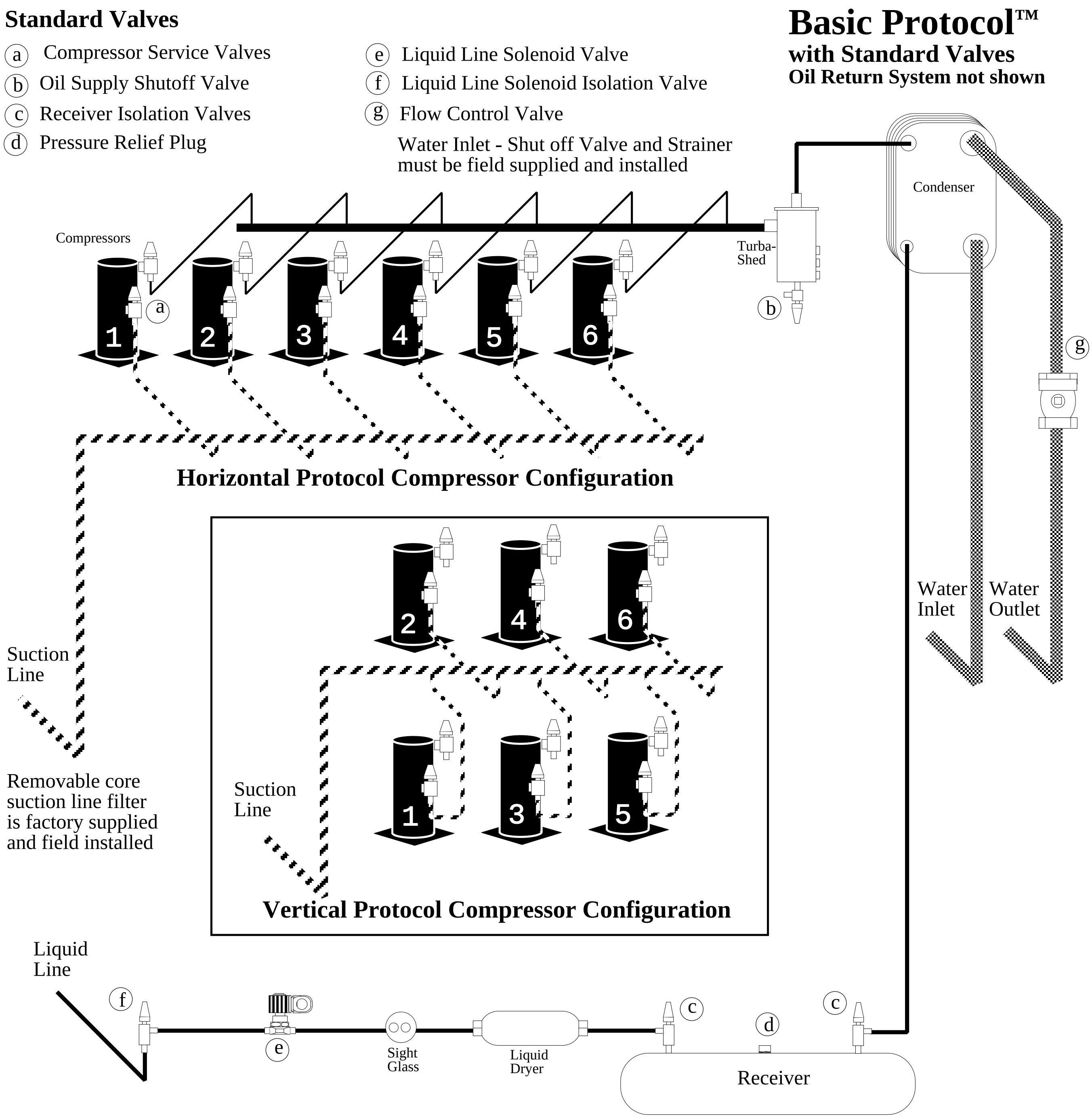
The CONDENSER transfers the unwanted heat from the refrigerant into water/glycol.

The RECEIVER acts as a vapor trap and supplies the Liquid Line with quality liquid refrigerant.

A LIQUID LINE DRIER removes moisture and contaminants from the refrigerant.

The LIQUID LINE SOLENOID VALVE controls refrigerant supply to the evaporator.

A SUCTION FILTER removes system contaminants from return vapor.



Protocol™
with 3-Pipe Gas Defrost
Oil Return System not shown

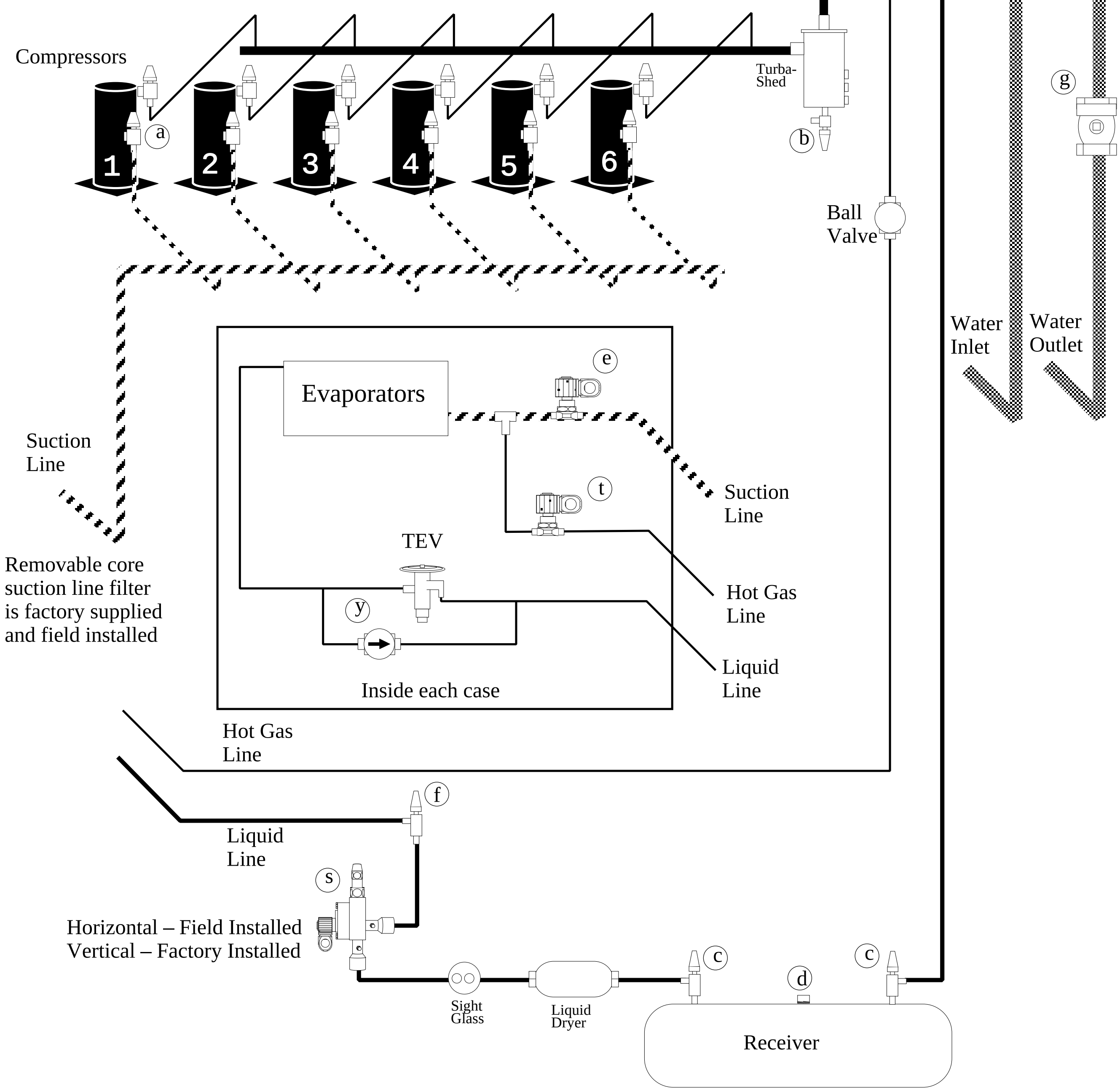
Standard Valves

- (a) Compressor Service Valves
- (b) Oil Supply Shutoff Valve
- (c) Receiver Isolation Valves
- (d) Pressure Relief Plug
- (f) Isolation Valve
- (g) Flow Control Valve

Water Inlet - Shut off Valve and Strainer must be field supplied and installed

Additional Valves for Gas Defrost

- (s) Main Liquid Line Pressure Differential Solenoid Valve
- (t) Hot Defrost Gas Solenoid Valve
- (e) Suction Stop Solenoid Valve
  May be used with case mounted thermostat for temperature control.
- (y) Check Valve

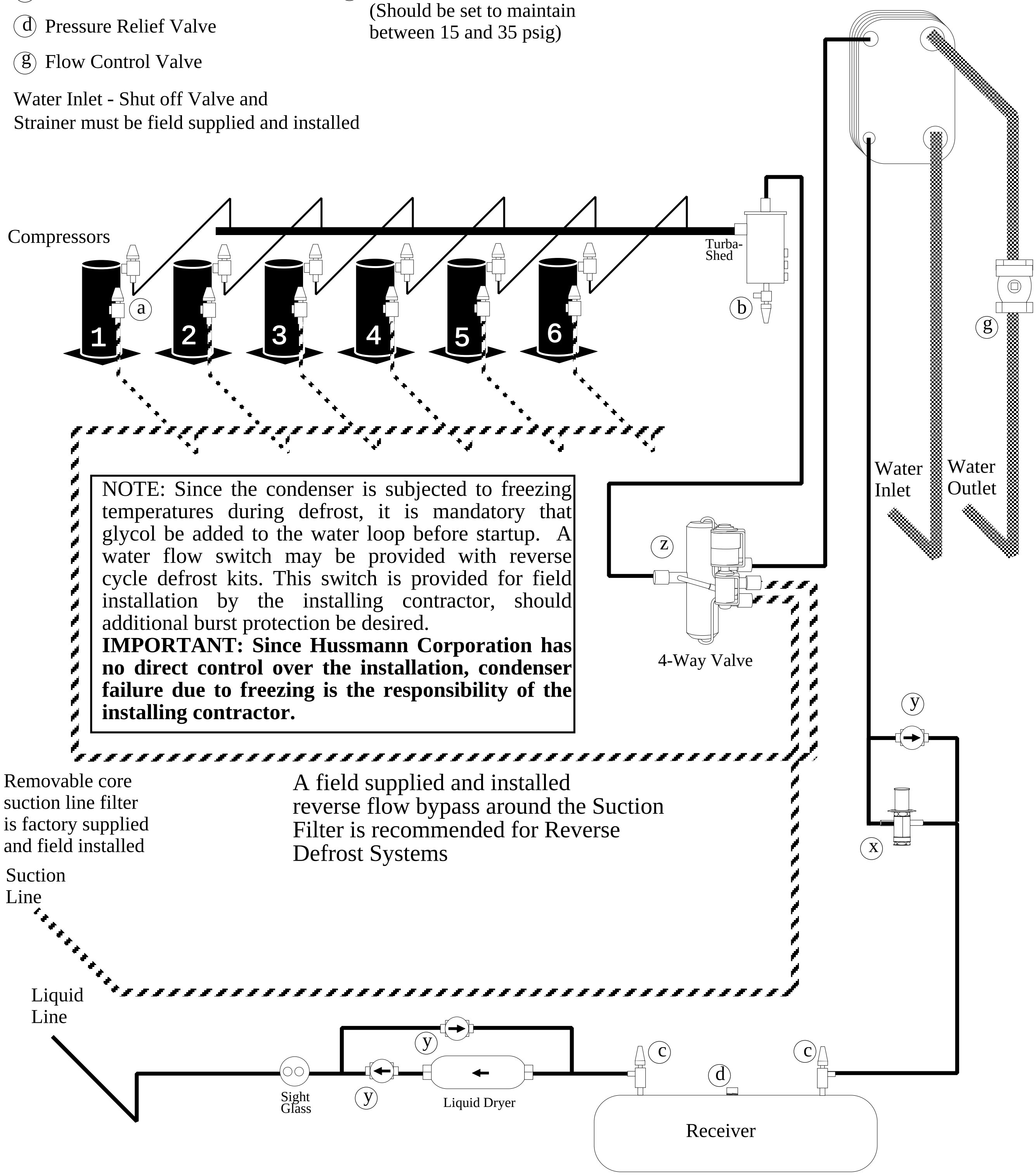


Protocol™
with Reverse Cycle Defrost
Oil Return System not shown

Standard Valves

- (a) Compressor Service Valves
- (b) Oil Supply Shutoff Valve
- (c) Receiver Isolation Valves
- (d) Pressure Relief Valve
- (g) Flow Control Valve
- (z) 4-Way Reversing Valve
- (y) Check Valve
- (x) Down Stream Pressure Regulator (Should be set to maintain between 15 and 35 psig)

Water Inlet - Shut off Valve and Strainer must be field supplied and installed



NOTE: Since the condenser is subjected to freezing temperatures during defrost, it is mandatory that glycol be added to the water loop before startup. A water flow switch may be provided with reverse cycle defrost kits. This switch is provided for field installation by the installing contractor, should additional burst protection be desired.
IMPORTANT: Since Hussmann Corporation has no direct control over the installation, condenser failure due to freezing is the responsibility of the installing contractor.

A field supplied and installed reverse flow bypass around the Suction Filter is recommended for Reverse Defrost Systems

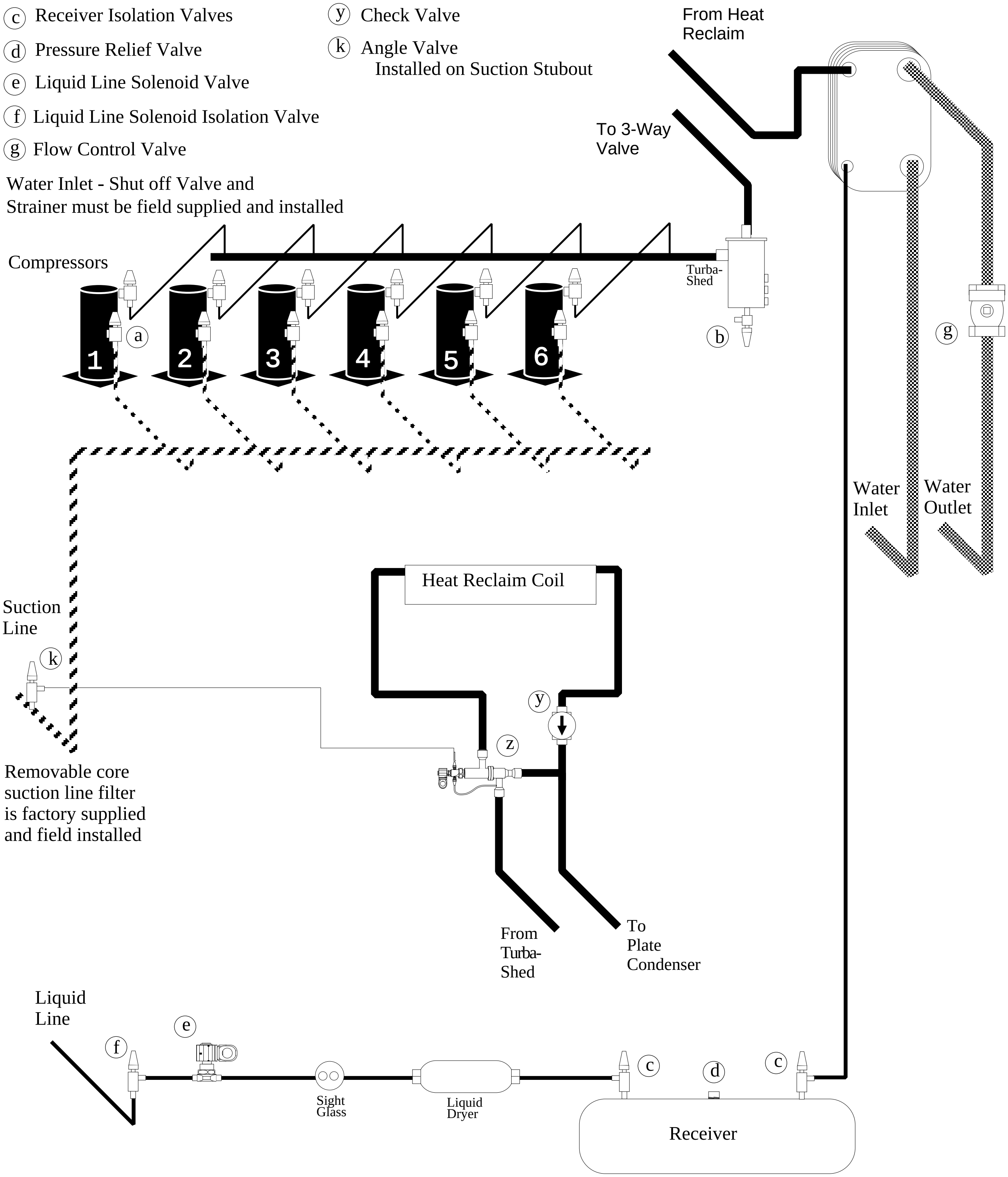
Protocol™
with Heat Reclaim
Oil Return System not shown

Standard Valves
- (a) Compressor Service Valves
- (b) Oil Supply Shutoff Valve
- (c) Receiver Isolation Valves
- (d) Pressure Relief Valve
- (e) Liquid Line Solenoid Valve
- (f) Liquid Line Solenoid Isolation Valve
- (g) Flow Control Valve

Water Inlet - Shut off Valve and
Strainer must be field supplied and installed

Additional Valves for Heat Reclaim
Three valves below are field installed.

- (z) 3-Way Heat Reclaim Valve
- (y) Check Valve
- (k) Angle Valve
  Installed on Suction Stubout

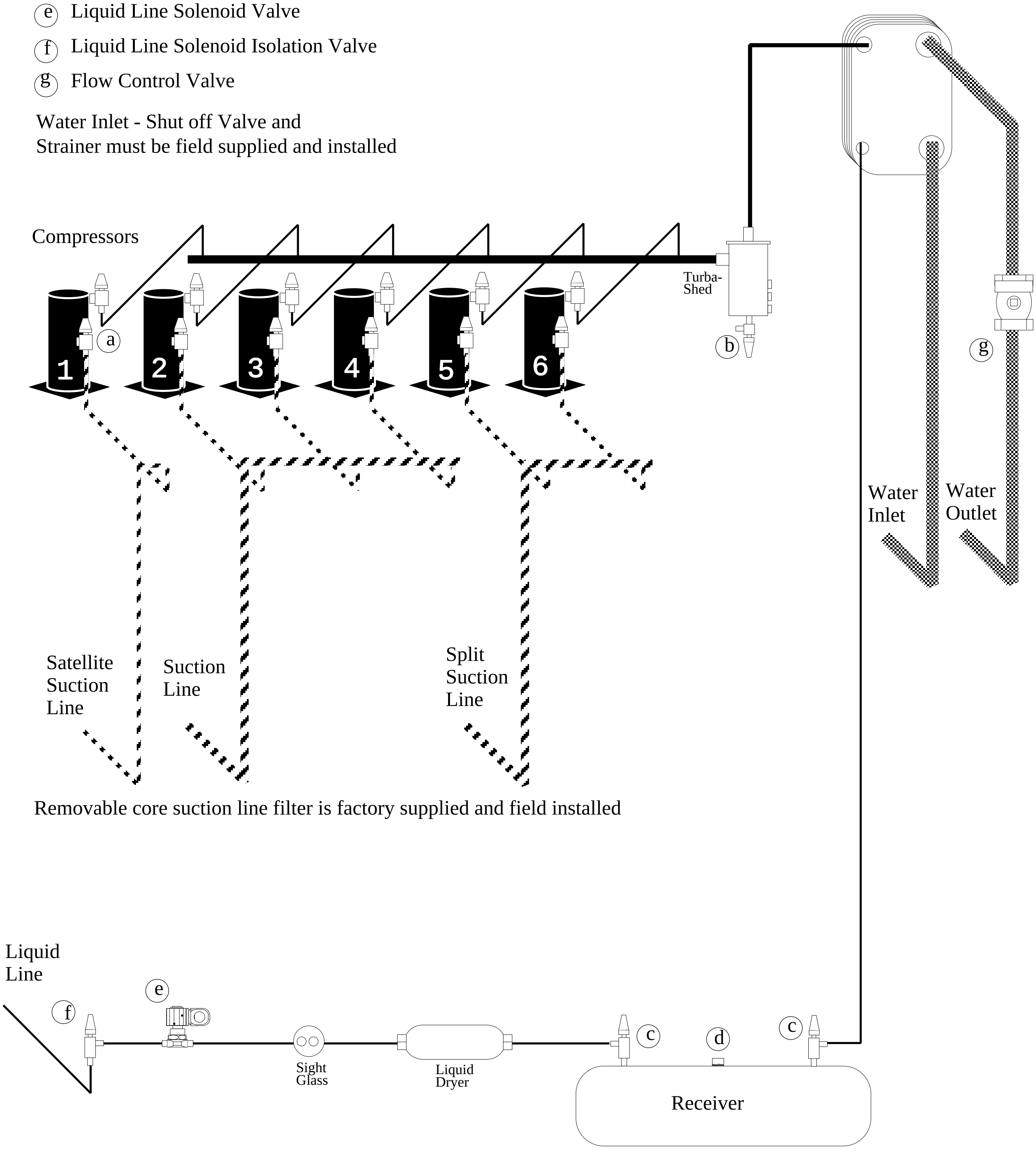


Standard Valves

- (a) Compressor Service Valves
- (b) Oil Supply Shutoff Valve
- (c) Receiver Isolation Valves
- (d) Pressure Relief Plug
- (e) Liquid Line Solenoid Valve
- (f) Liquid Line Solenoid Isolation Valve
- (g) Flow Control Valve

Water Inlet - Shut off Valve and
Strainer must be field supplied and installed

Protocol™
with Satellite or Split Suction
Oil Return System not shown

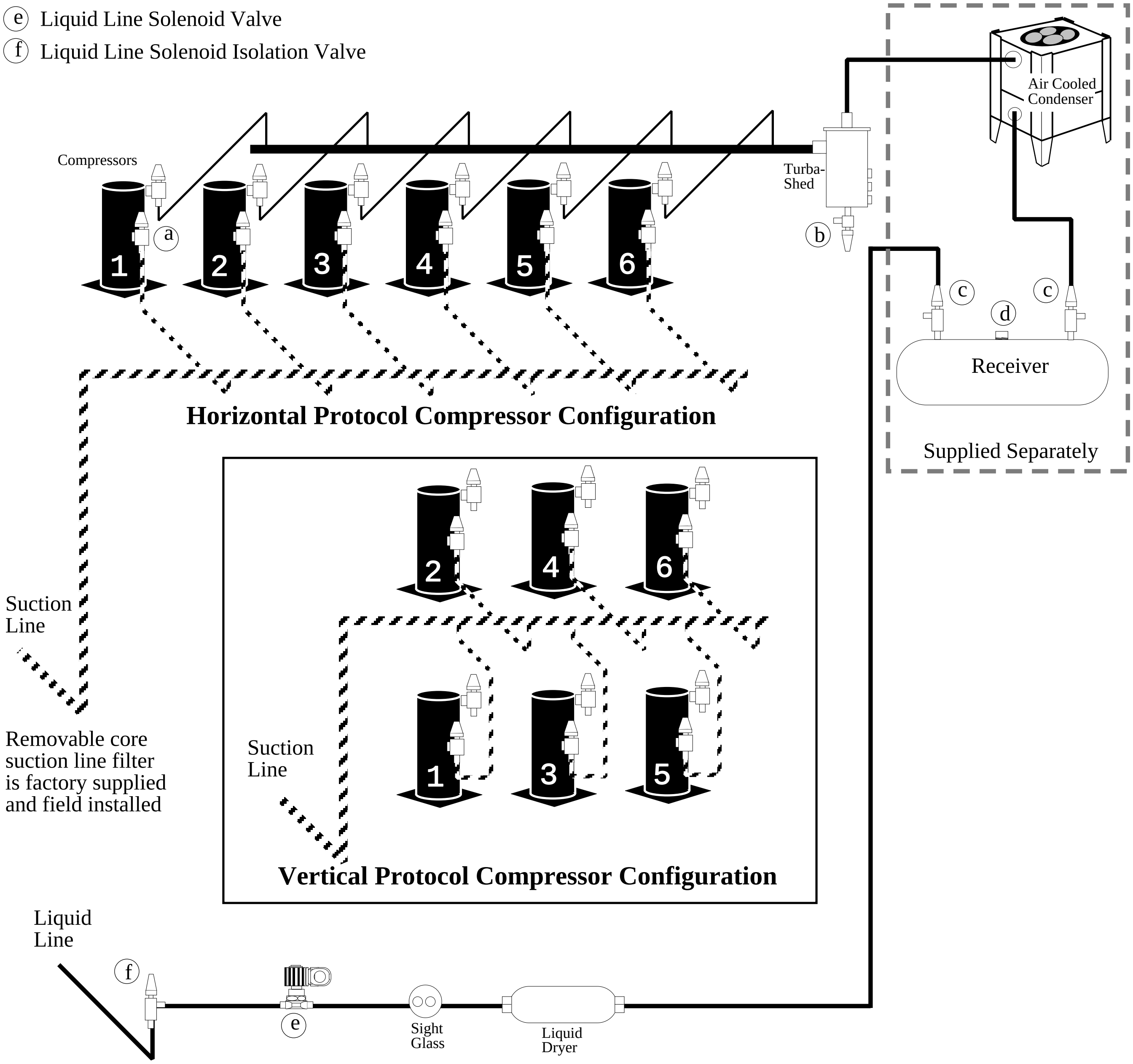


Removable core suction line filter is factory supplied and field installed

Standard Valves

(a) Compressor Service Valves
(b) Oil Supply Shutoff Valve
(c) Receiver Isolation Valves
(d) Pressure Relief Plug
(e) Liquid Line Solenoid Valve
(f) Liquid Line Solenoid Isolation Valve

Basic Protocol™
**with Remote
Air Cooled Condenser
and Standard Valves
Oil Return System not shown**

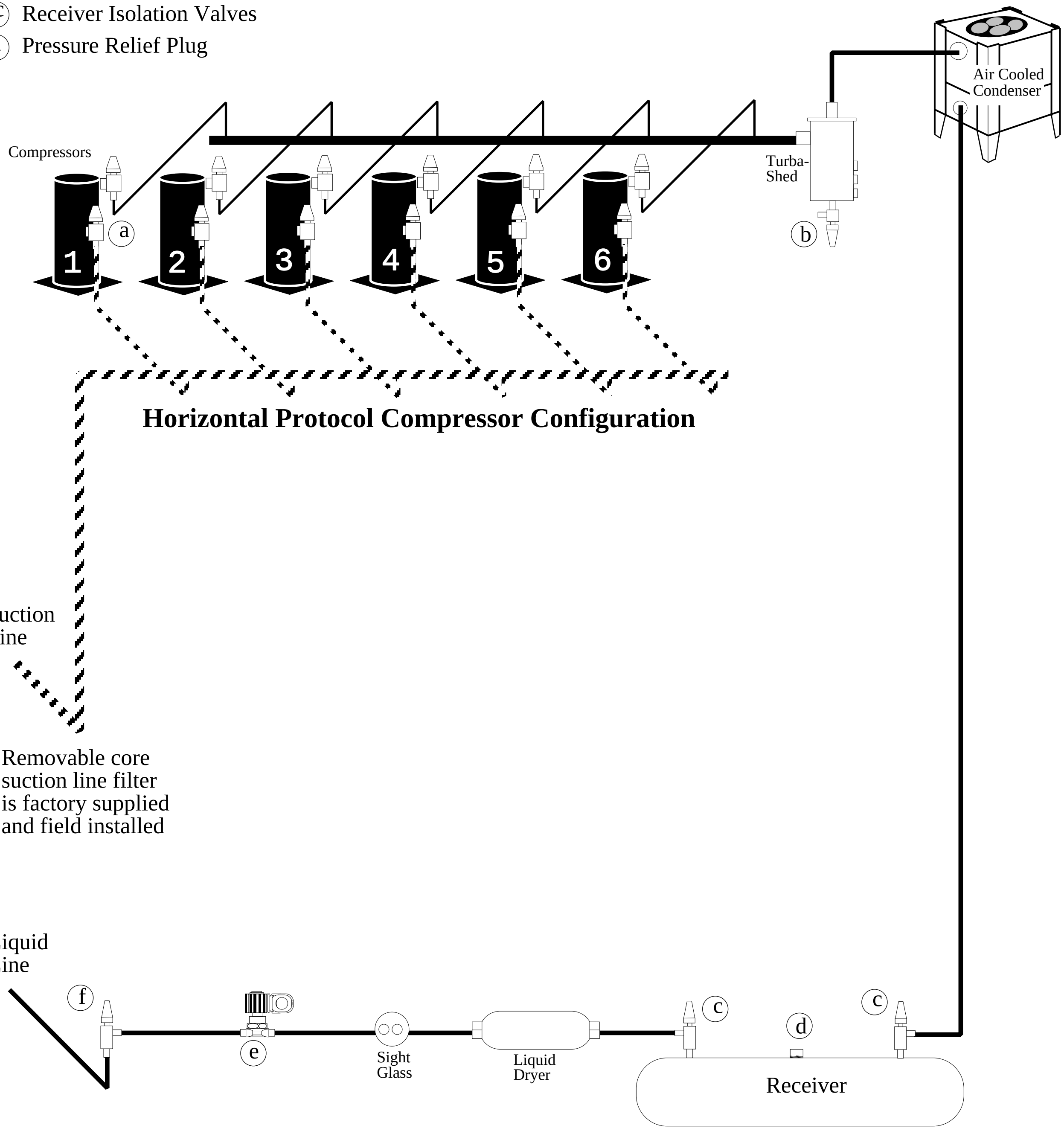


Standard Valves

- (a) Compressor Service Valves
- (b) Oil Supply Shutoff Valve
- (c) Receiver Isolation Valves
- (d) Pressure Relief Plug
- (e) Liquid Line Solenoid Valve
- (f) Liquid Line Solenoid Isolation Valve

Basic Proto-Aire™

with Standard Valves
Oil Return System not shown



Horizontal Protocol Compressor Configuration

OIL CYCLE

Discharge refrigerant carries droplets of oil from the compressor's outlet. The TURBA-SHED separates the oil from the refrigerant. The oil is stored in the Turba-shed until needed. The oil returns to the system through the high pressure line and oil filter.

The oil filter removes impurities from the oil. The high pressure oil is distributed to the electronic oil level control which feeds oil into the compressor through a solenoid valve.

Electronic oil regulators monitor oil levels. The units are powered by a 24V power supply. When the oil level in the compressor drops below ½ sightglass, the fill light comes on, and the oil solenoid is energized. If after 90 seconds the oil level does not rise above ½ sightglass, the unit opens the compressor control circuit. If oil becomes available, the electronic oil level control will automatically re-set and the compressor will resume operation.

Standard Valves

(a) Compressor Service Valves

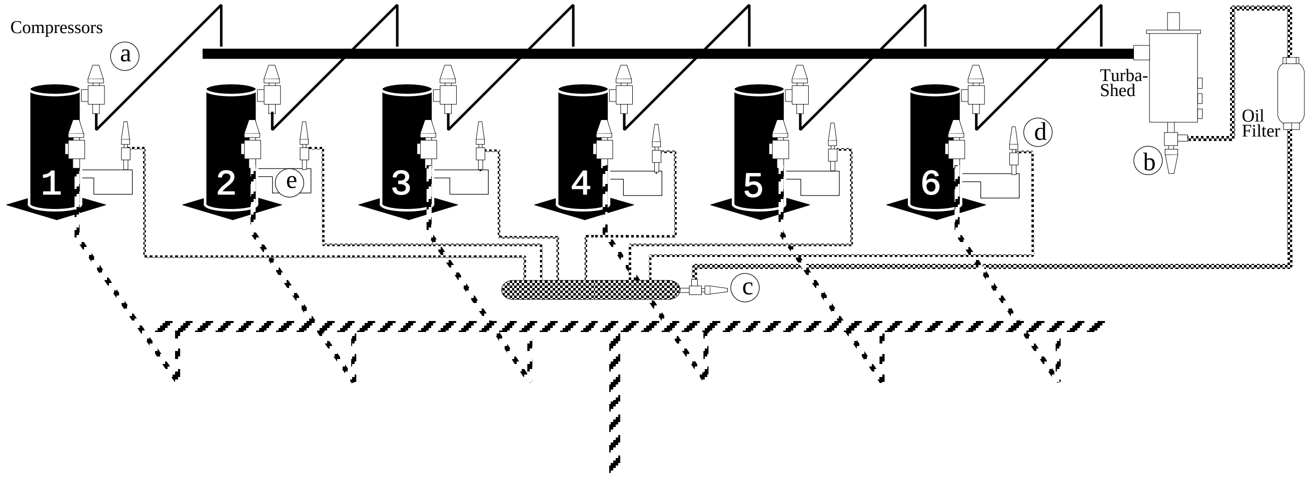
(b) Oil Supply Shutoff Valve

(c) Oil Filter Isolation Valve

(d) Oil Level Regulator Isolation Valve

(e) Electronic Oil Level Control

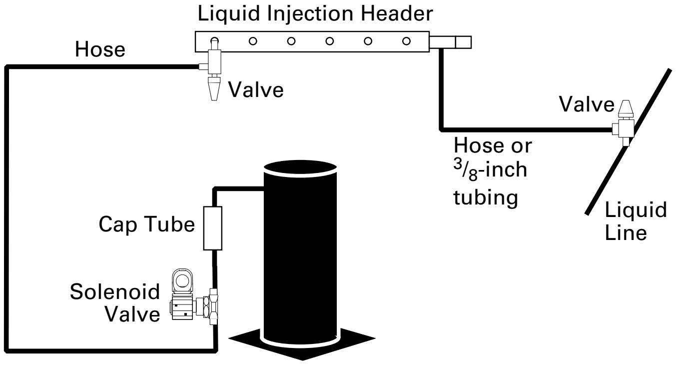
Protocol™
Oil Return System



LIQUID INJECTION

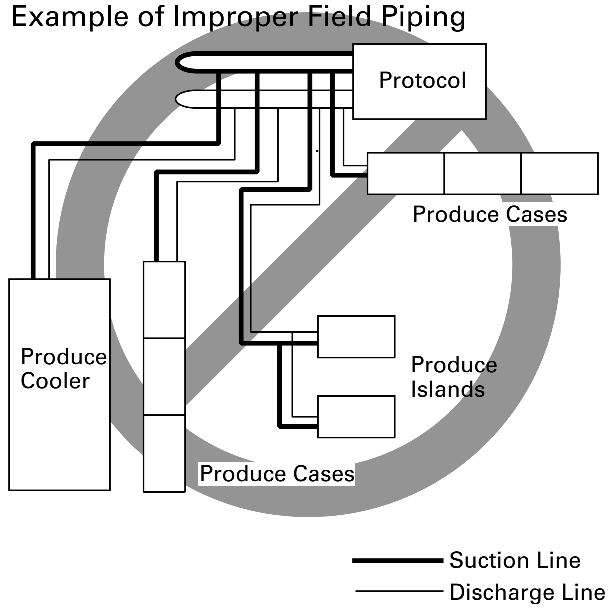
When operating at high compression ratios, injecting liquid part-way through the compression process is Copeland's method of cooling the scroll compressor. Hussmann applies liquid injection on all units below –25 deg F evaporating temperature. Each compressor has its own shutoff valve, injection solenoid valve, and capillary tube. When the compressor is off, the solenoid valve is de-energized via a current sensing relay mounted at the compressor contactor.

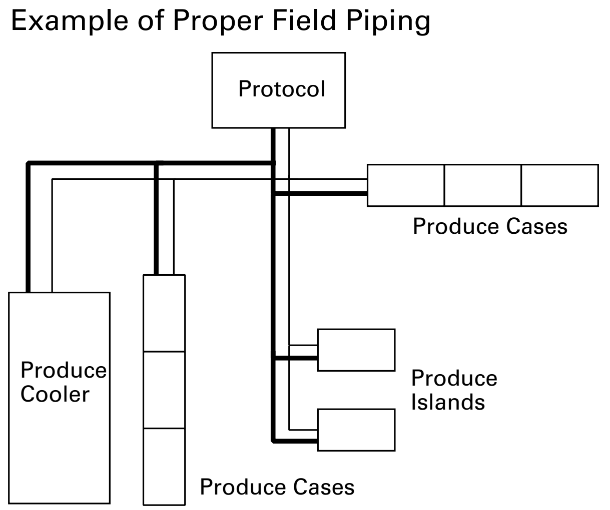
Note: On units with remote air-cooled condensers, liquid refrigerant must be piped to the liquid injection stub-out at the back of the Protocol™ unit.



FIELD PIPING

Field Fabricated Headers are not required for Protocol™ Installations.





Water Loop Piping

Warning

IMPORTANT: Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor. Refer to Page 2-4.

The Water Loop should be tested for leaks using pressurized water.
DO NOT exceed 75 psig.

OVERVIEW

This section details major water loop components, and their locations in the piping system.

WATER LOOP GUIDELINES

Pipe Connections
PVC plastic pipe should be solvent welded (glued) together as described on the glue can.

Pipe and fittings must be clean and dry.

Cut pipe with a *guillotine* type cutter to get a clean, square cut; remove any burrs.

Use Purple Primer on both pipe and fitting before gluing.

Apply glue to both pipe and fitting and join with a twisting motion.

Hold joint together for approximately 30 seconds to allow glue to set.

Allow to dry for 24 hours before putting into service.

Where it is necessary to connect plastic and metal pipe, DO NOT USE A THREADED CONNECTION. A compression type fitting (such as the Ford couplings supplied with each Protocol™) should be used. For larger pipe sizes, a flanged connection may be used.

ISOLATION VALVES
Install isolation valves at inlet and outlet of each Protocol™ unit.

It is good practice to include isolation valves at several locations throughout the piping. For example, valves should be used where branches tie into main supply and return lines.

PVC plastic ball valves may be used.

Strainers
Use a 16 mesh strainer at inlet of each Protocol™ unit. Position isolation valves so that this strainer can be opened for cleaning.

Air Vent Valves
Manual air vent valves are recommended. Air vent valves should be located at piping high points where air will tend to collect. Momentarily open these vents and release trapped air a few times during startup.

Tie-Ins to Supply Headers
Branch supply pipes SHOULD NOT tie into the bottom of main supply pipes. Always tie into the top of a main supply pipe; that is, the "T" fitting should point UP, NOT DOWN.

Pipe Supports
Pipe supports should be provided as follows:

Nominal Pipe Size, in.	Distance Between Supports, ft Schedule 40 Pipe @ 100 Deg F	Distance Between Supports, ft Schedule 80 Pipe @ 120 Deg F
1.0	4.5	3.5
1.5	5.0	3.5
2.0	5.0	4.0
3.0	6.0	4.5
4.0	6.5	5.0
6.0	7.5	6.0

Do not clamp supports tightly—this restricts axial movement of the pipe. Supports should provide a smooth bearing surface that conforms to the bottom of the pipe, and should be a minimum of 2 inches wide.

Exposure to Direct Sunlight
Piping that will be exposed to direct sunlight should be shaded or covered. A thin layer of insulation is adequate for this.

Leak Checking
Leak check the piping before startup by filling with pressurized water at 50 psig.

Cleaning and Flushing
The pipe loop should be cleaned before the system is put into service. Fill the closed loop with a solution of 1% trisodium phosphate and (99%) water, by weight.

Circulate the detergent/water solution for 24 hours.

Drain the loop and refill with fresh water. Circulate for at least 3 hours.

Drain and refill again. Repeat until all phosphate is gone.

Filling
The water loop MUST have adequate corrosion protection. In most situations, corrosion protection can be provided by using fully inhibited, industrial grade ethylene glycol or propylene glycol 30% by volume with water. For most installations, 30% glycol by volume will also provide BURST protection to –20 deg F.

If the store location has particularly hard water, with a total hardness greater than 100 ppm, the water used to fill the loop should be softened or distilled. Local water treatment vendors such as Nu-Calgon can provide information on local water quality.

If any Protocol™ unit has reverse cycle gas defrost, at least 30% glycol by volume MUST be used to prevent condenser freezing.

Use only industrial grade, fully inhibited ethylene or propylene glycol such as Dow Chemical's Dowtherm SR-1 or Dowfrost. Consult local regulations as to which type—ethylene or propylene—to use. Propylene glycol is generally considered non-toxic, while ethylene glycol is somewhat toxic. **DO NOT USE AUTOMOTIVE GRADE GLYCOLS** such as Prestone.

Use a refractometer to check the glycol concentration at least once a year.

The pumping station has a low fluid pressure switch set at roughly 10 to 20 psig which should be tied into an alarm. It is good practice to test the operation of this switch at least once a year.

Balance Valve Adjustment
A flow balancing valve is located inside each Protocol™. These valves should be set at startup using the following procedure.

PRESETTING THE FLOW CONTROL (BALANCING) VALVE
(Bell & Gossett 1½ Inch Circuit Setter)

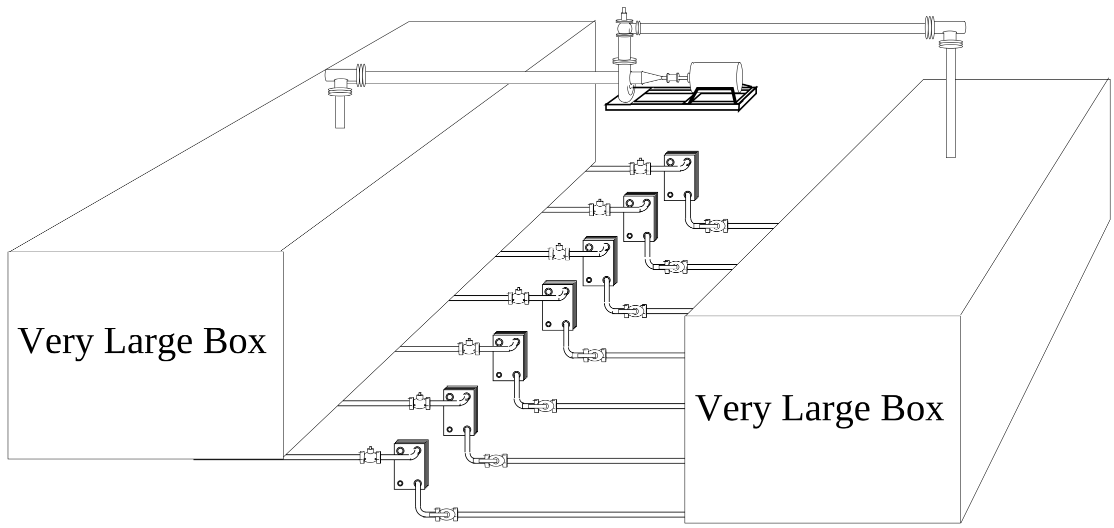
Balancing the Water Loop for Reverse Return Piping
Since this water loop design tends to be self-balancing, open all Circuit Setters completely. All Protocol™ units must be carefully monitored during store startup, and once all Protocol™ units are running, the water loop must be checked and balanced if necessary.

Balancing the Water Loop for Direct Return Piping
Several factors must be accounted for when balancing the water loop of a Protocol™ installation using direct return piping. Two major factors stand out:

1- Balancing to attain the correct water flow for each Protocol™; and
2- Balancing the system for Piping Head Loss.

Since these factors have nearly unlimited combinations, finding the appropriate setting for each combination is unrealistic. However, if these factors are separated, their effect on the system can easily be defined.

Balancing the Water Flow for Each Protocol™
If the store were designed so that each Protocol™ condenser was supplied from and returned to a Very Large Box, and the piping to each condenser was identical; then flow rate (GPM) for each condenser could be set from a simple table. The flow rate (GPM) would be proportional to the Degrees of Closure on each Circuit Setter.



Balancing the System for Piping Head Loss

If the store were designed so that each Protocol™ condenser was identical; then flow rate (GPM) for each condenser could be set from a simple table. Balancing Head Loss for Length of Piping Run could be equated to Degrees of Closure on each Circuit Setter.

By accounting for Head Loss and Flow Rate (GPM) for each Protocol™ in a system, a Preset Value for each Protocol™ unit's Circuit Setter may be established.

Page 5 is a Preset Worksheet which allows the installer to estimate the adjustments required for the Circuit Setters. It is designed to provide a starting place. Since each installation is unique, all Protocol™ units must be carefully monitored during store startup. Once all Protocol™ units are running, the water loop must be checked, and final balancing performed.

Table 1 shows a proportional Closure for the Circuit Setter based on Protocol™ GPM requirements.

Table 2 shows a proportional Closure for the Circuit Setter based on Length of Piping Run.

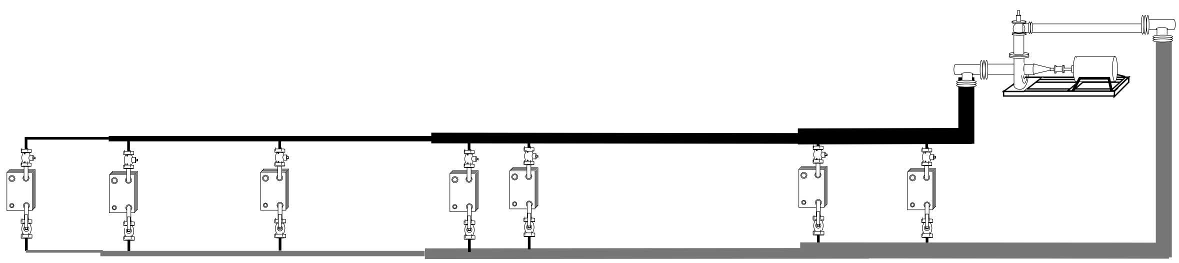


Table 1

GPM	˚Closure	GPM	˚Closure	GPM	˚Closure
58	0	42	8	26	16
57	0	41	8	25	16
56	1	40	9	24	17
55	1	39	9	23	17
54	2	38	10	22	18
53	2	37	10	21	18
52	3	36	11	20	19
51	3	35	11	19	19
50	4	34	12	18	20
49	4	33	12	17	20
48	5	32	13	16	21
47	5	31	13	15	21
46	6	30	14	14	22
45	6	29	14	13	22
44	7	28	15	12	23
43	7	27	15		

Table 2

Length of Run	˚Closure
1000	0
950	1
900	2
850	3
800	4
750	5
700	6
650	7
600	8
550	9
500	10
450	11
400	12
350	13
300	14
250	15
200	16
150	17
100	18
50 and below	19

Table 1

GPM	˚Closure	GPM	˚Closure	GPM	˚Closure
58	0	42	8	26	16
57	0	41	8	25	16
56	1	40	9	24	17
55	1	39	9	23	17
54	2	38	10	22	18
53	2	37	10	21	18
52	3	36	11	20	19
51	3	35	11	19	19
50	4	34	12	18	20
49	4	33	12	17	20
48	5	32	13	16	21
47	5	31	13	15	21
46	6	30	14	14	22
45	6	29	14	13	22
44	7	28	15	12	23
43	7	27	15		

Table 2

Length of Run	˚Closure
1000	0
950	1
900	2
850	3
800	4
750	5
700	6
650	7
600	8
550	9
500	10
450	11
400	12
350	13
300	14
250	15
200	16
150	17
100	18
50 and below	19

Setting the Balancing Valve

Look up flow rate (GPM) for each Protocol™. Find the closest GPM in **Table 1**. Log the listed ˚Closure Value for each Protocol™ in the ***Table 1 Value* row.**

Establish Length of Run for each Protocol™. Find the closest Length of Run in **Table 2**. Log the listed ˚Closure Value for each Protocol™ in the ***Table 2 Value* row.**

Add the two values logged for each Protocol™.

Locate the lowest **Total**. Subtract it from each Protocol™ Unit's **Total**, to get Presetting ˚Closure.

Important Note:
Length of Run includes both the supply and return piping.

Example

Protocol™	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**			
Table 1 Value (+) Table 2 Value	11 9	9 14	14 5	12 8	15 11	7 9	15 10	11 12	8 18			
Total (–) Lowest Total	20 **16**	23 **16**	19 **16**	20 **16**	26 **16**	**16** **16**	25 **16**	23 **16**	26 **16**			
Presetting ˚Closure	4	7	3	4	10	0	9	7	10			

Protocol™												
Table 1 Value (+) Table 2 Value												
Total (–) Lowest Total												
Presetting ˚Closure												

Electrical

FIELD WIRING

Maximum Field Wire Size
Based on the total load Amperes, the largest connectable wire sizes for the terminals on the main disconnect are listed below. (Wire size is based on the serial plate minimum circuit ampacity.)

Total Connected RLA	Largest Connectable Wire
200A (max)	3 / 0 per Ø
320A (max)	2 x (3 / 0) per Ø

(Refer to NEC for temperature derating factors.)

Sizing Wire and Overcurrent Protectors
Check the Legend for Minimum Circuit Ampacity (MCA), Maximum Overcurrent Protective Devices (MOPD), and total RLAs. Follow NEC guidelines.

Note: A Main Disconnect is provided as part of the unit. A Branch Circuit must be built to the unit using information supplied on the unit data plate for Minimum Current Ampacity (MCA) and Maximum Over Current Protective Device (MOPD).

Protocol™ components are wired as completely as possible at the factory with all work completed in accordance with the National Electrical Code (NEC). All deviations required by governing electrical codes will be the responsibility of the installer.

The lugs on the main disconnect in the main disconnect box are sized for copper wire only, with 75 deg C THW insulation. All wiring must be in compliance with governing codes.

For 208-230/3/60 Compressor Units:
To each Protocol™ provide
- one 208-230/3/60 branch circuit
- one 120/1/60 neutral
- one ground wire to earth ground.

For 380-460/3/60-50 Compressor Units with Remote Mounted Transformer:
To each Protocol™ provide
- one 380-460/3/60-50 branch circuit
- one ground wire to earth ground.

To remote mounted transformer
- one 380-460/1 or 3/60-50 branch circuit from Protocol™ Fuse Block
- one ground wire to ground wire connection.

From remote mounted transformer
- one 240/1 or 3/60-50 connection to 240V disconnect in panel
- one derived neutral from transformer.

For 380-460/3/60-50 Compressor Units without Remote Mounted Transformer:
To each Protocol™ provide
- one 380-460/3/60-50 branch circuit
- one ground wire to earth ground
- one 208-240/1 or 3/60-50 branch circuit
- one 120/1/60-50 neutral.

For 575/3/60 Compressor Units without Remote Mounted Transformer:
To each Protocol™ provide
- one 575/3/60 branch circuit
- one ground wire to earth ground
- one 220/1/60 branch circuit
- one ground wire to earth ground.

Consult factory for other voltages.

For Alarm Wiring
Protocol™ provides one NO/NC pilot duty relay for remote alarm.

Temperature Sensors and Defrost Termination Thermostats
Use shielded and grounded Belden Cable #8762 between control panel and case sensors or thermostats.

> **IMPORTANT**
> **Shielded cable must be used. The shield wire must be attached to the panel liner on the control panel door.**

Additional Circuits
Check the store legend for components requiring electrical circuits to the Control Panel and Case Power Distribution Box. The Protocol™ provides power for all case electrical needs, including:
- Fan and Anti-sweat Heater Circuits
- Satellite Control
- Electric Defrost Heaters
- Case mounted refrigeration solenoid
- Case Lighting
- Unit Cooler Fan Power (electric defrost only).

Evaporator Mounted Refrigeration Solenoid
Power for refrigeration solenoids at the evaporator comes from the Protocol™ Case Electrical Distribution Box. If the entire lineup defrosts at one time, a single refrigeration solenoid will be supplied in the Protocol™.

Cooler Door Switch Wiring
Check the store legend for door switch kits (M115 or M116). The switch is mounted to the cooler door frame, and controls the field installed liquid line solenoid and evaporator fans. For Gas Defrost applications, M116 includes a check valve to bypass the liquid line solenoid valve.

PANEL VOLTAGES

The Protocol™ Control Panels contain voltages:

24V	PC Board, POWERLINK™ Control Circuits, Electronic oil level control
220V or 120V	Control Circuits
and 208/230V, 380V, 460V or 575V	Power Supply Circuits.

NOTE: The current draw required by analog meters (Volt-Ohm Meters or VOMs) **can permanently damage electronic equipment.** Never use a VOM to check computer components or computer controlled systems. Use a Digital Multimeter (DMM) to measure voltage, amperage, milliamperes, or ohms. If a range is exceeded, the display will show OL (overload).

ALARM LEDs

One exterior and one interior Alarm LED assist in preliminary troubleshooting.

Alarm Light on Control Board	Alarm Relay Light	Exterior Alarm Light	Condition
ON	**ON**	**OFF**	**Okay**
OFF	ON	OFF	Monitoring Alarm
OFF	**OFF**	**ON**	**Switchback**
ON	ON	ON	Compressor Safeties Failed

LEGEND

Relay Contacts Normally Open

Relay Contacts Normally Closed

Jumper

Splice

Close on Rise
FC = Fan Cycling Control

Close on Rise Pressure Control
LP = Low Pressure

Open on Rise Pressure Control
HP = High Pressure

Oil Control for Trax-Oil™ or Oil-Master

Light, R = Red

Cooling Fan

Terminal Block

Fuse

Thermostat Open on Rise
DT = Discharge Temp Thermostat
TT = Termination Thermostat

Thermostat Close on Rise
RT = Refrigeration Thermostat

Compressor Number

Connector – male to female

Factory Wiring – Power

Factory Wiring – Control

Field Installed Wiring

Wire Color Code:

B = Black	P = Purple
BL = Blue	R = Red
BR = Brown	Y = Yellow
O = Orange	W = White

Ground

120V Receptacle

Ribbon Cable

Contactor

Current Sensing Relay

Compressor

Solenoid
SS = Suction Solenoid
HG = Hot Gas Solenoid
LS = Liquid Solenoid
IS = Injection Solenoid
3W = Heat Reclaim Solenoid
MLΔ = Main Liquid DIfferential
MLS = Main Liquid Solenoid
RG = Reverse Gas Solenoid

Relay or Coil
AR = Alarm Relay
C# = Motor Contactor Coil
DTA = Discharge Temperature Relay
HPA = High Pressure Relay
MCA = Mechanical Alarm Relay
FR = Fan Relay
FC = Fan Contactor

Single Pole Circuit Breaker

2 Pole Circuit Breaker

3 Pole Circuit Breaker

Phase Monitor

Transformer

Earth Ground

Ground Lug

Screw

Bus Bar

POWERLINK™ Symbols

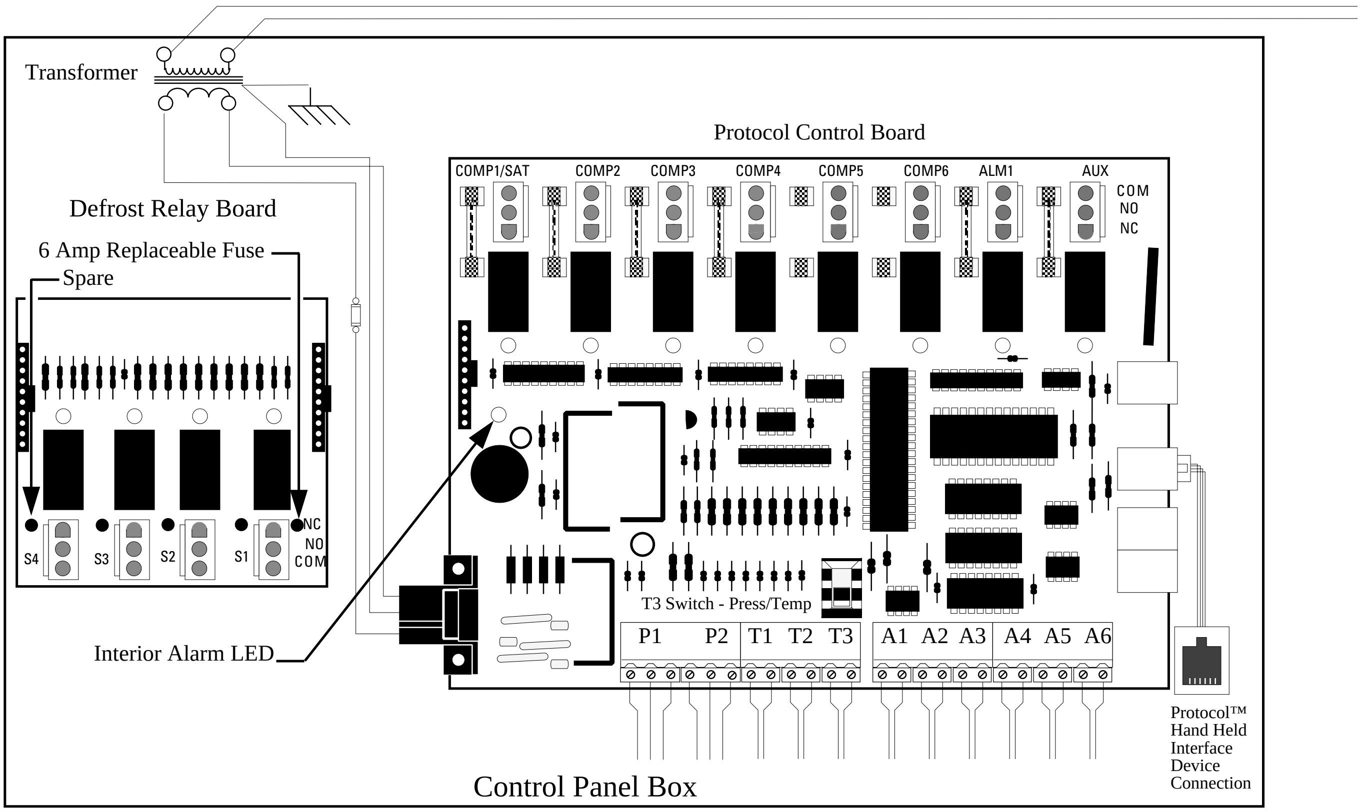
Motor

Power Supply

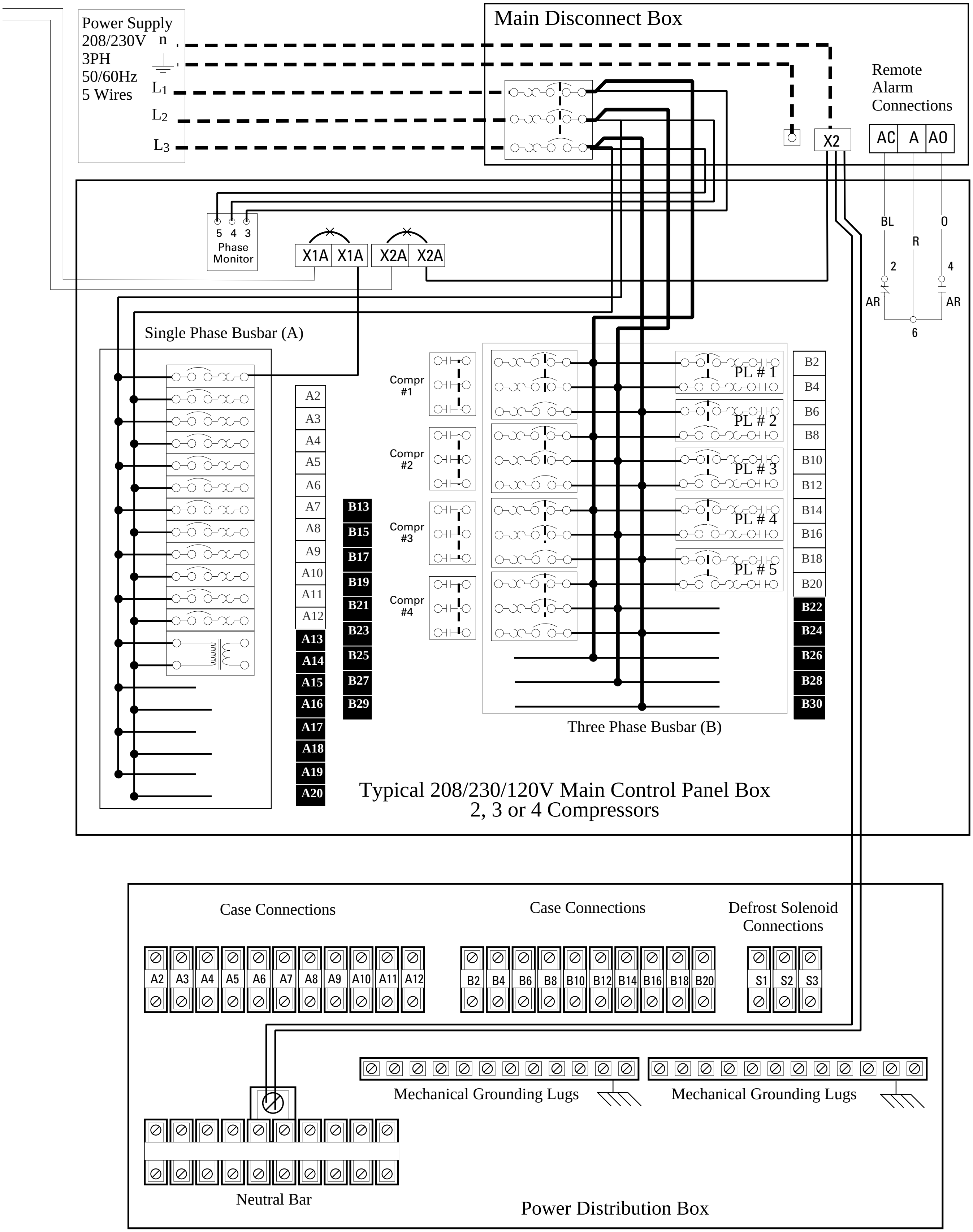
1 Pole

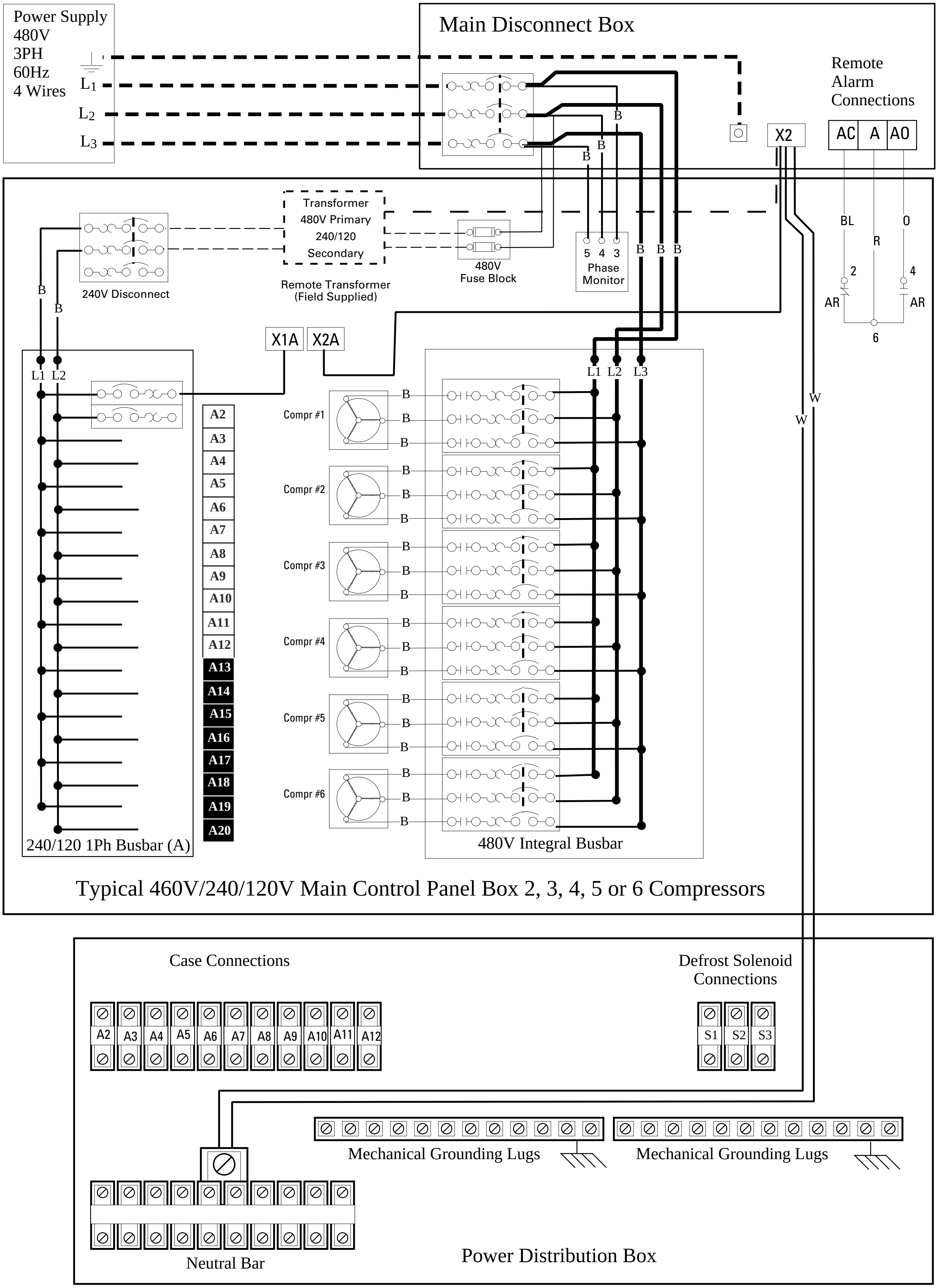
2 Pole

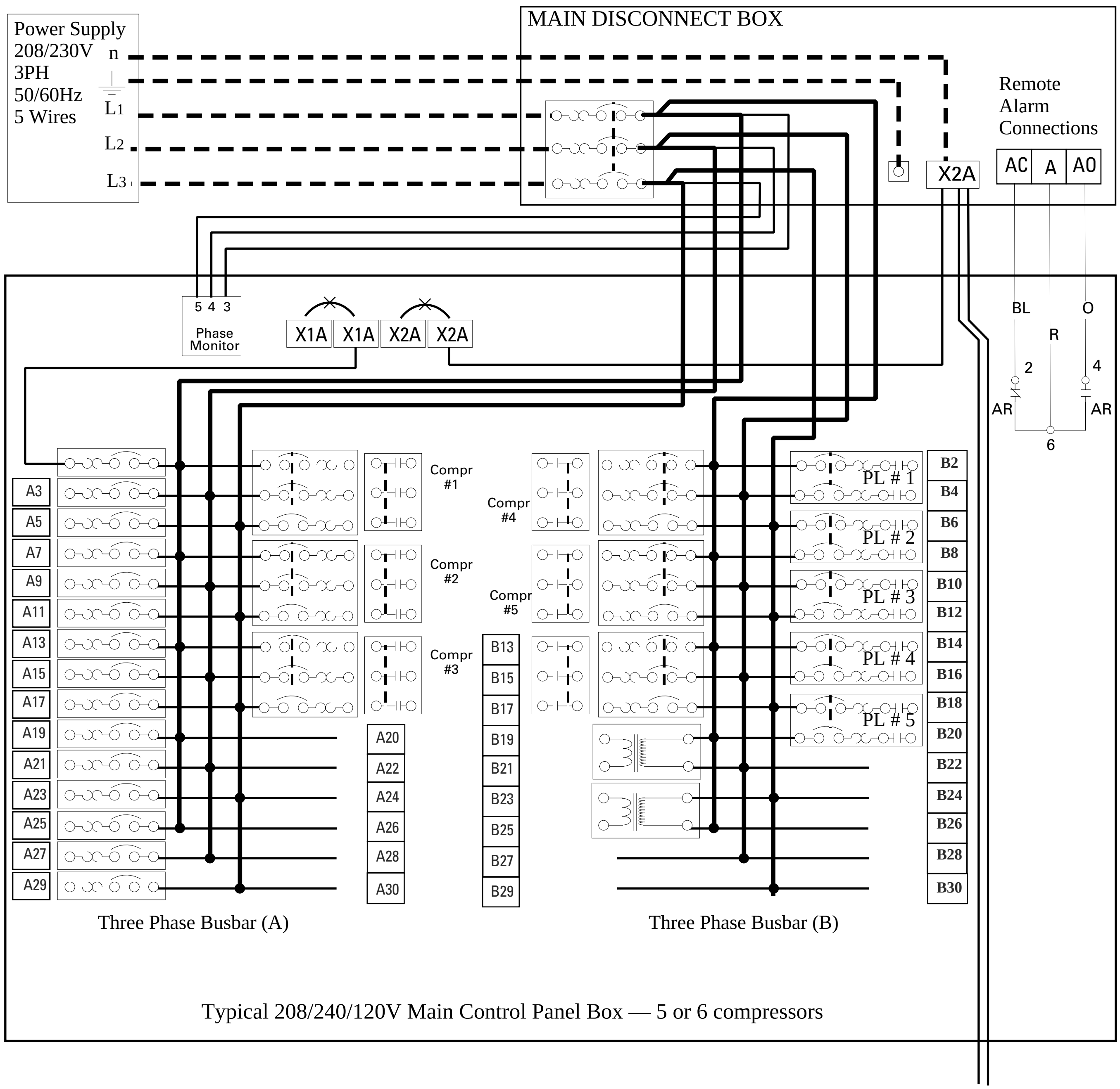
3 Pole



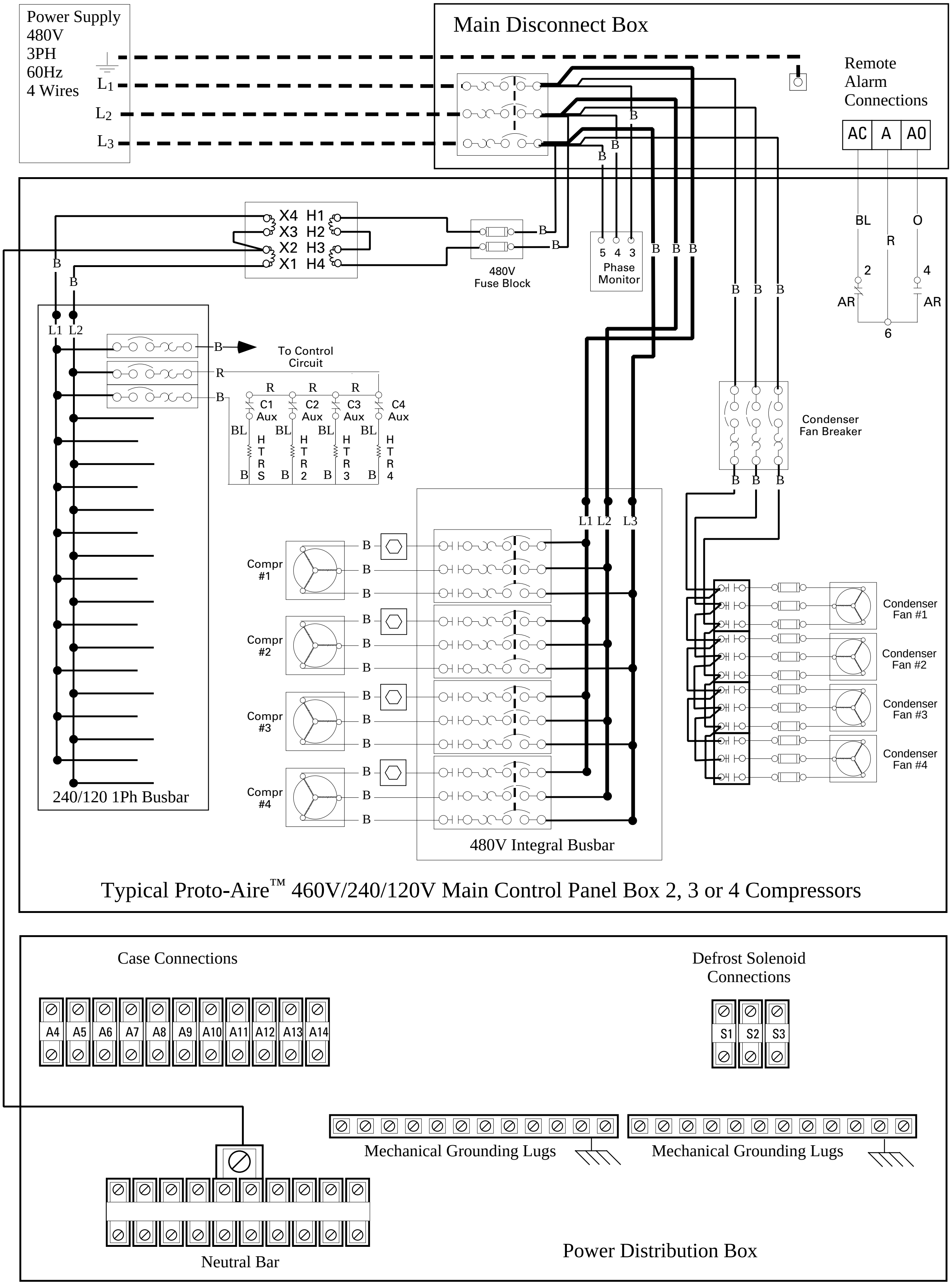
SENSOR DEFINITIONS		RANGE	LOCATION
P1	Suction Pressure Transducer	200 PSI	Mounted on Suction Header
P2	Suction Pressure Transducer	200 PSI	Mounted on 2nd Suction Header of a Split Suction or Satellite Protocol™
	Head Pressure Transducer	500 PSI	Mounted on Discharge Header (Monitoring / Alarming Purposes Only)
T1	Case Temperature Sensor (Suction Pressure Reset)	-40 to 120 F	Mounted in Discharge Air of a Case
T2	Case Temperature Sensor (Satellite Case Temperature)	-40 to 120 F	Mounted in Discharge Air of a Case
T3	Case Temperature Sensor	-40 to 120 F	Mounted in Discharge Air of a Case
	Head Pressure Transducer	500 PSI	Mounted on Discharge header
A1	Case Temperature Sensor	-40 to 120 F	Mounted in Discharge Air of a Case which is part of Defrost Circuit #1
	Defrost termination thermostat	Open/Closed	Mounted near evaporator coil of a Case which is part of Defrost Circuit #1
A2	Case Temperature Sensor	-40 to 120 F	Mounted in Discharge Air of a Case which is part of Defrost Circuit #2
	Defrost termination thermostat	Open/Closed	Mounted near evaporator coil of a Case which is part of Defrost Circuit #2
A3	Case Temperature Sensor	-40 to 120 F	Mounted in Discharge Air of a Case which is part of Defrost Circuit #3
	Defrost termination thermostat	Open/Closed	Mounted near evaporator coil of a Case which is part of Defrost Circuit #3
A4	Case Temperature Sensor	-40 to 120 F	Mounted in Discharge Air of a Case which is part of Defrost Circuit #4
	Defrost termination thermostat	Open/Closed	Mounted near evaporator coil of a Case which is part of Defrost Circuit #4
A5	Case Temperature Sensor	-40 to 120 F	Mounted in Discharge Air of a Case which is part of Defrost Circuit #5
	Defrost termination thermostat	Open/Closed	Mounted near evaporator coil of a Case which is part of Defrost Circuit #5
A6	Case Temperature Sensor	-40 to 120 F	Mounted in Discharge Air of a Case which is part of Defrost Circuit #6
	Defrost termination thermostat	Open/Closed	Mounted near evaporator coil of a Case which is part of Defrost Circuit #6

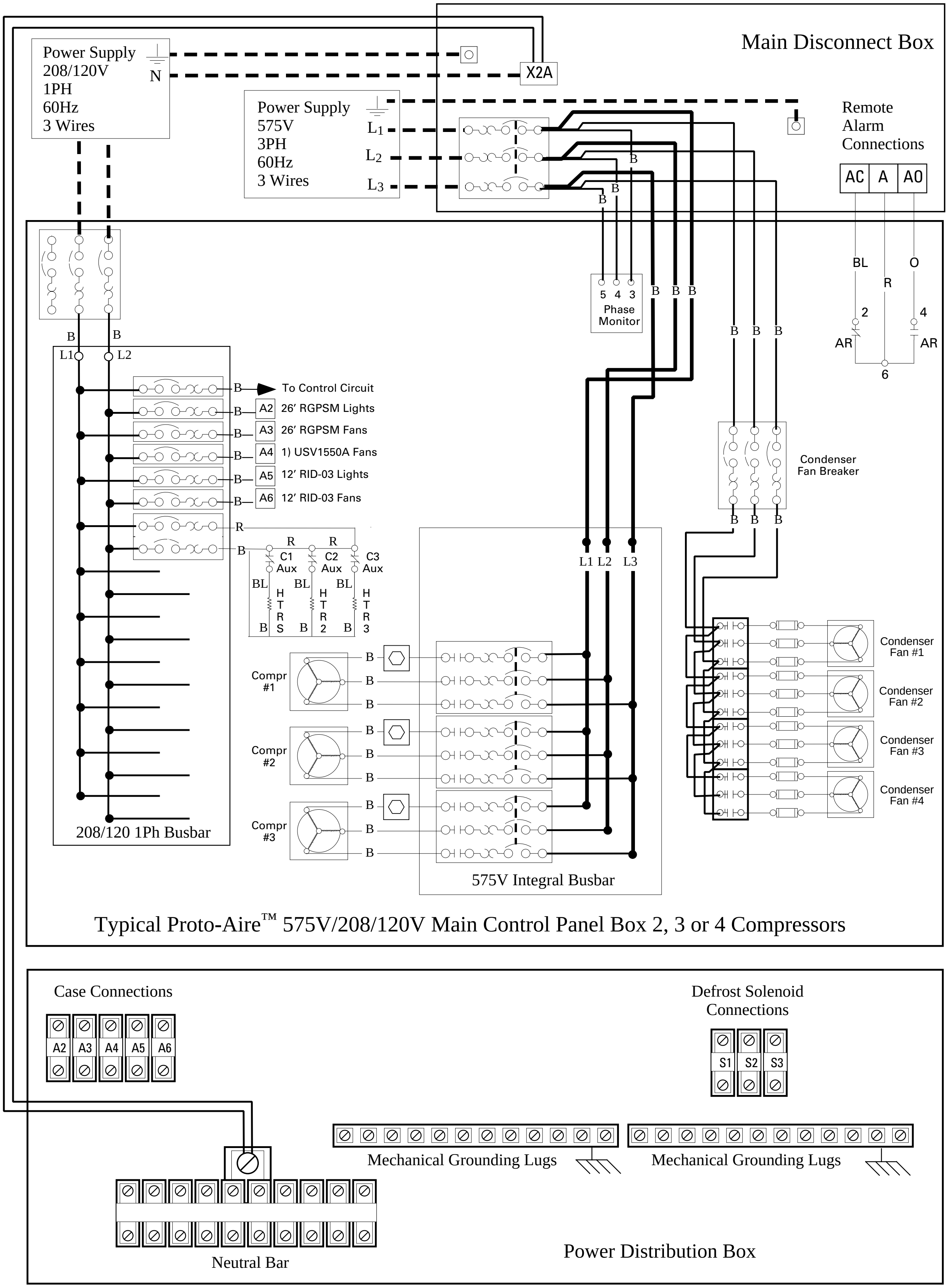

Main Disconnect Box
Power Supply
208/230V
3PH
50/60Hz
5 Wires
n
L1
L2
L3
Remote
Alarm
Connections
AC
A
AO
X2
BL
R
O
2
4
AR
AR
6
5 4 3
Phase
Monitor
X1A
X1A
X2A
X2A
Single Phase Busbar (A)
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
A17
A18
A19
A20
B13
B15
B17
B19
B21
B23
B25
B27
B29
Compr #1
Compr #2
Compr #3
Compr #4
PL # 1
PL # 2
PL # 3
PL # 4
PL # 5
B2
B4
B6
B8
B10
B12
B14
B16
B18
B20
B22
B24
B26
B28
B30
Three Phase Busbar (B)
Typical 208/230/120V Main Control Panel Box
2, 3 or 4 Compressors
Case Connections
A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12
Case Connections
B2 B4 B6 B8 B10 B12 B14 B16 B18 B20
Defrost Solenoid
Connections
S1 S2 S3
Mechanical Grounding Lugs
Mechanical Grounding Lugs
Neutral Bar
Power Distribution Box


Power Supply
480V
3PH
60Hz
4 Wires
L1
L2
L3
Main Disconnect Box
Remote
Alarm
Connections
X2
AC
A
AO
Transformer
480V Primary
240/120
Secondary
Remote Transformer
(Field Supplied)
240V Disconnect
480V
Fuse Block
5 4 3
Phase
Monitor
BL
R
O
2
4
AR
AR
6
X1A
X2A
Compr #1
Compr #2
Compr #3
Compr #4
Compr #5
Compr #6
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
A17
A18
A19
A20
240/120 1Ph Busbar (A)
480V Integral Busbar
Typical 460V/240/120V Main Control Panel Box 2, 3, 4, 5 or 6 Compressors
Case Connections
Defrost Solenoid
Connections
S1
S2
S3
Mechanical Grounding Lugs
Mechanical Grounding Lugs
Neutral Bar
Power Distribution Box



Typical 208/240/120V Main Control Panel Box — 5 or 6 compressors


Power Supply
480V
3PH
60Hz
4 Wires
L1
L2
L3
Main Disconnect Box
Remote
Alarm
Connections
AC
A
AO
BL
R
O
2
4
AR
AR
6
X4 H1
X3 H2
X2 H3
X1 H4
480V
Fuse Block
5 4 3
Phase
Monitor
To Control
Circuit
C1
Aux
C2
Aux
C3
Aux
C4
Aux
HTRS
HTR2
HTR3
HTR4
Condenser
Fan Breaker
240/120 1Ph Busbar
Compr
#1
Compr
#2
Compr
#3
Compr
#4
480V Integral Busbar
Condenser
Fan #1
Condenser
Fan #2
Condenser
Fan #3
Condenser
Fan #4
Typical Proto-Aire™ 460V/240/120V Main Control Panel Box 2, 3 or 4 Compressors
Case Connections
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
Defrost Solenoid
Connections
S1
S2
S3
Mechanical Grounding Lugs
Mechanical Grounding Lugs
Neutral Bar
Power Distribution Box


Main Disconnect Box
Power Supply
208/120V
1PH
60Hz
3 Wires
N
X2A
Power Supply
575V
3PH
60Hz
3 Wires
L1
L2
L3
Remote
Alarm
Connections
AC
A
AO
BL
R
O
2
4
AR
AR
6
Phase
Monitor
5 4 3
L1
L2
To Control Circuit
A2 26' RGPSM Lights
A3 26' RGPSM Fans
A4 1) USV1550A Fans
A5 12' RID-03 Lights
A6 12' RID-03 Fans
C1 Aux
C2 Aux
C3 Aux
HTRS
HTR2
HTR3
Compr #1
Compr #2
Compr #3
Condenser
Fan Breaker
Condenser Fan #1
Condenser Fan #2
Condenser Fan #3
Condenser Fan #4
L1 L2 L3
208/120 1Ph Busbar
575V Integral Busbar
Typical Proto-Aire™ 575V/208/120V Main Control Panel Box 2, 3 or 4 Compressors
Case Connections
A2 A3 A4 A5 A6
Defrost Solenoid
Connections
S1 S2 S3
Mechanical Grounding Lugs
Mechanical Grounding Lugs
Neutral Bar
Power Distribution Box

TERMINAL CONNECTIONS

In the example on page 4-5, the shaded numbered terminal boxes shown in the MAIN CONTROL PANEL BOX do not exist. They are placed on this diagram to show wire number assignments and corresponding terminal number assignments in the POWER DISTRIBUTION BOX.

Protocol™ units carrying 5 and 6 Compressors, or an oversized Control Panel, do not use a single phase busbar. Wire number assignments and corresponding terminal number assignments in the POWER DISTRIBUTION BOX differ from the smaller panel arrangement.

120V CIRCUIT LOGIC

The Protocol™ includes as standard the following 120V components:

- Service Receptacle (5 Amp Max)
- Cabinet Exhaust Fan
- 120V by 24V Transformer
- Compressor Contactor Coils
- Valve Solenoids
- External Alarm Light.

24V CIRCUITS

The printed circuit control boards with attached relay coils are 24V. The POWERLINKS™ are powered by a 24V dc supply (used to control electric defrost heaters). Each POWERLINK™ power supply will drive up to 5 POWERLINKS at once, and require 2 seconds to recharge an internal dc capacitor between operations. If the POWERLINK™ power supply fails, **a transformer will NOT replace it.**

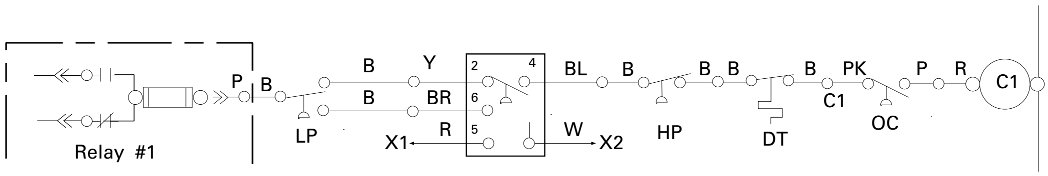
ELECTRONIC OIL LEVEL CONTROL

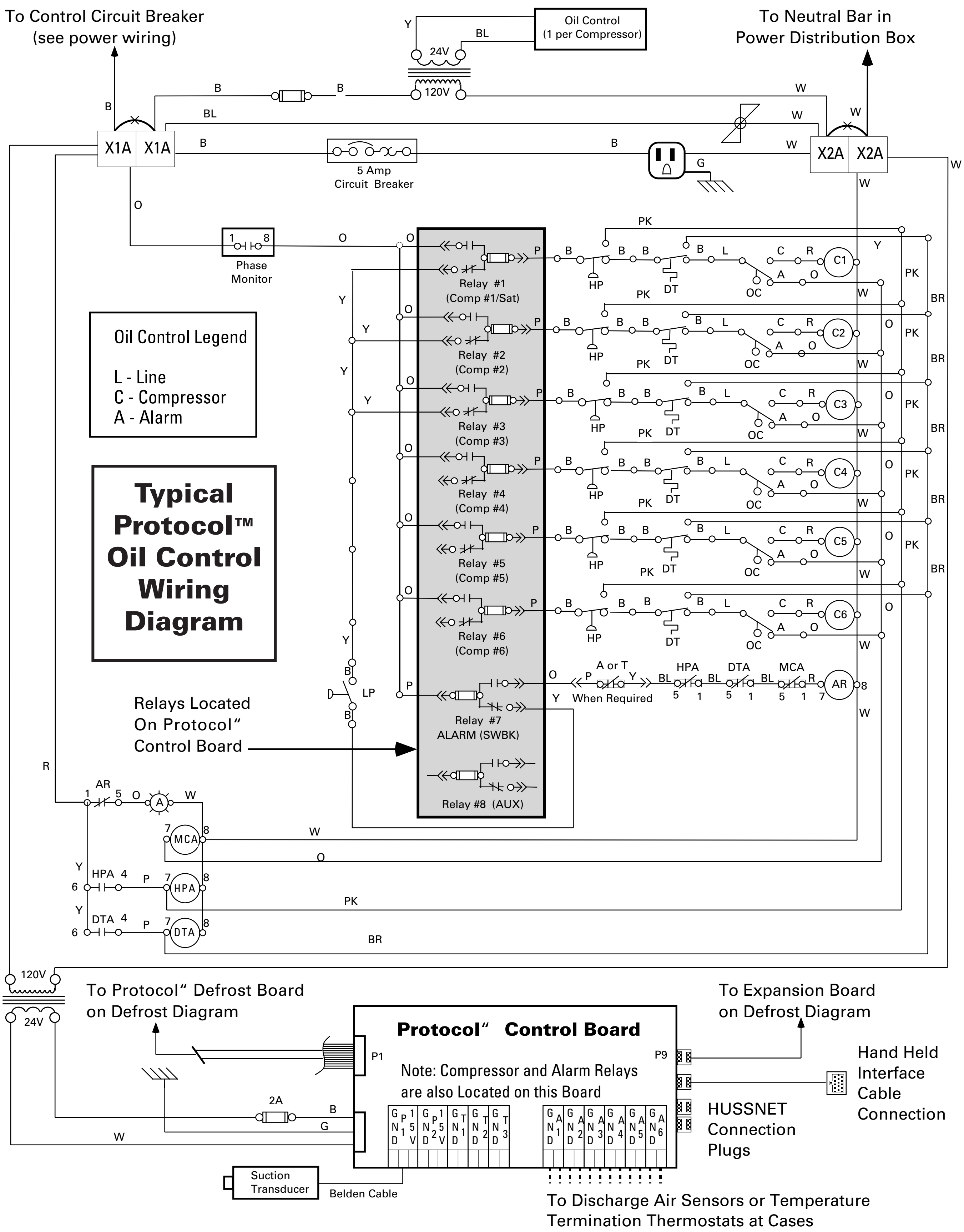
A 24V transformer powers the electronic oil level control. All circuit logic including oil solenoid control is 24 volt. Only the alarm contact is 120V. See next two pages for typical wiring diagrams.

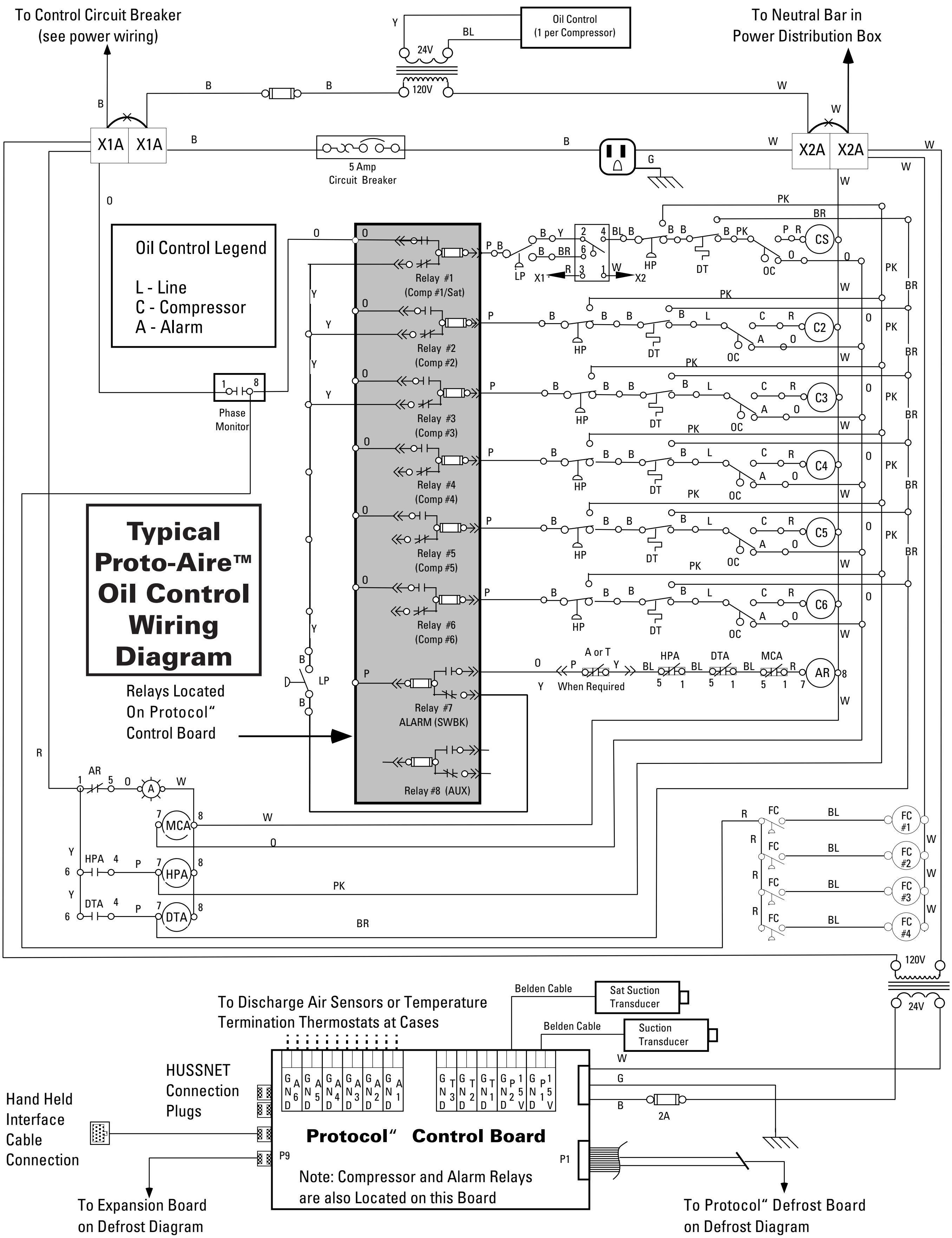
SATELLITE SHORT CYCLE CONTROL RELAY

The satellite short cycle control relay is intended to prevent rapid cycling when the compressor goes into pumpdown mode. It is a single-shot time-delay relay. When the low pressure control opens on a decrease in presure, the short cycle control relay becomes energized and starts timing. After 3 minutes (regardless of the action of the low pressure control) this relay will close, thereby re-engaging the control circuit and allowing the compressor to run again.

Satellite Cycle Control Relay




To Control Circuit Breaker (see power wiring)
Oil Control (1 per Compressor)
24V
120V
To Neutral Bar in Power Distribution Box
X1A X1A
X2A X2A
5 Amp Circuit Breaker
Phase Monitor
Oil Control Legend
L - Line
C - Compressor
A - Alarm
Typical Protocol™ Oil Control Wiring Diagram
Relay #1 (Comp #1/Sat)
Relay #2 (Comp #2)
Relay #3 (Comp #3)
Relay #4 (Comp #4)
Relay #5 (Comp #5)
Relay #6 (Comp #6)
Relay #7 ALARM (SWBK)
Relay #8 (AUX)
Relays Located On Protocol" Control Board
HP
DT
OC
C1
C2
C3
C4
C5
C6
AR
A or T
When Required
HPA
DTA
MCA
LP
To Protocol" Defrost Board on Defrost Diagram
Protocol" Control Board
Note: Compressor and Alarm Relays are also Located on this Board
P1
P9
2A
To Expansion Board on Defrost Diagram
Hand Held Interface Cable Connection
HUSSNET Connection Plugs
Suction Transducer
Belden Cable
To Discharge Air Sensors or Temperature Termination Thermostats at Cases



To Control Circuit Breaker (see power wiring)
Oil Control (1 per Compressor)
To Neutral Bar in Power Distribution Box
24V
120V
X1A X1A
X2A X2A
5 Amp Circuit Breaker
Oil Control Legend
L - Line
C - Compressor
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Phase Monitor
Relay #1 (Comp #1/Sat)
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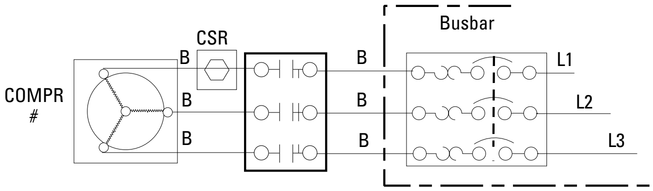
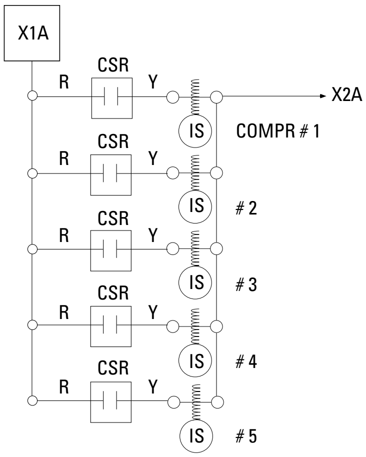
Relay #3 (Comp #3)
Relay #4 (Comp #4)
Relay #5 (Comp #5)
Relay #6 (Comp #6)
Relay #7 ALARM (SWBK)
Relay #8 (AUX)
Typical Proto-Aire™ Oil Control Wiring Diagram
Relays Located On Protocol“ Control Board
A or T
When Required
HPA
DTA
MCA
AR
HP
DT
OC
LP
CS
C2
C3
C4
C5
C6
FC #1
FC #2
FC #3
FC #4
Belden Cable
Sat Suction Transducer
Suction Transducer
To Discharge Air Sensors or Temperature Termination Thermostats at Cases
HUSSNET Connection Plugs
Hand Held Interface Cable Connection
Protocol“ Control Board
Note: Compressor and Alarm Relays are also Located on this Board
2A
P9
P1
To Expansion Board on Defrost Diagram
To Protocol“ Defrost Board on Defrost Diagram

LIQUID INJECTION

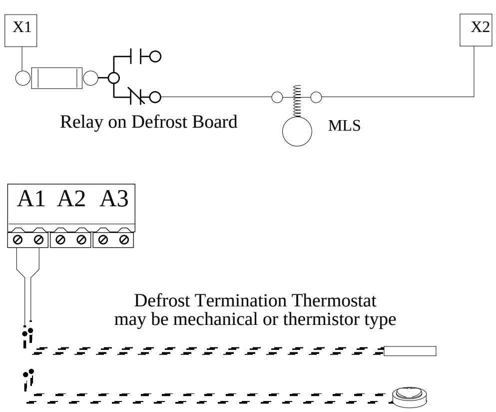




When operating at high compression ratios, injecting liquid part-way through the compression process is Copeland's method of cooling the scroll compressor. Hussmann applies liquid injection on all units below –25 deg F evaporating temperature. Each compressor has its own shutoff valve, injection solenoid valve, and capillary tube. When the compressor is off, the solenoid valve is de-energized via a current sensing relay mounted at the compressor contactor.

Note: On units with remote air-cooled condensers, liquid refrigerant must be piped to the liquid injection header inside the Protocol™ unit.

SINGLE DEFROST SCHEDULE



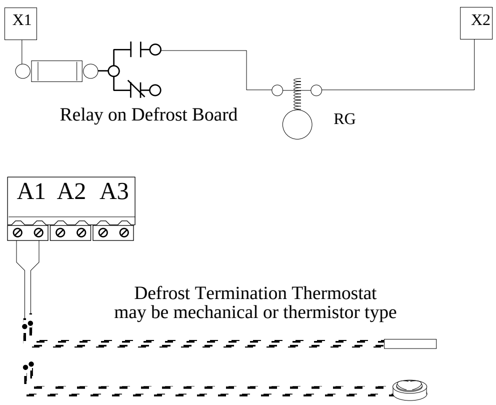
Offtime Sequence of Operation

- Control Board energizes the Defrost Board Relay Coil, which opens the Main Liquid Line Solenoid circuit.

- Main Liquid Line Valve closes. As evaporators empty, the compressors cycle off on Low Pressure.

- Defrost may be time or temperature terminated.

SINGLE DEFROST SCHEDULES (Cont'd)



Reverse Gas Sequence of Operation

- The control will turn off all compressors and wait 1 minute to allow the suction and discharge pressures to equalize.

- The four-way valve will switch to the reverse flow position and the suction pressure will be set to 10 psig by the controller. The compressors will cycle based on this 10 psig setpoint. The four-way valve is controlled by the Aux. relay on the control board. The Aux relay light should be on during defrost.

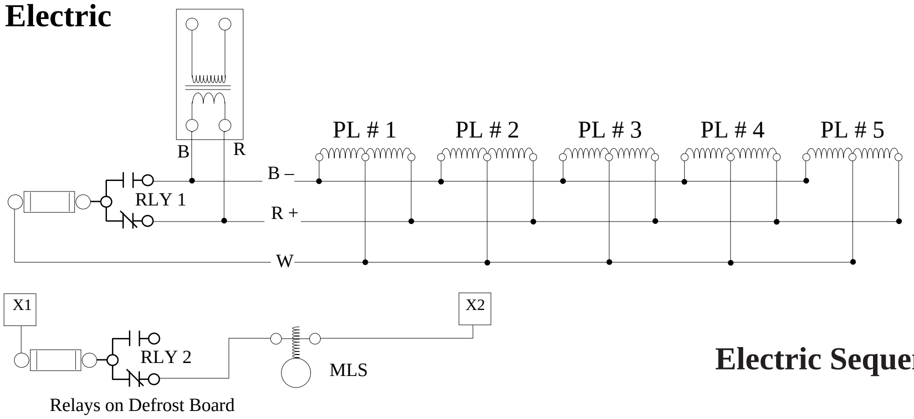
- The defrost will proceed for the time allowed or until temperature termination.

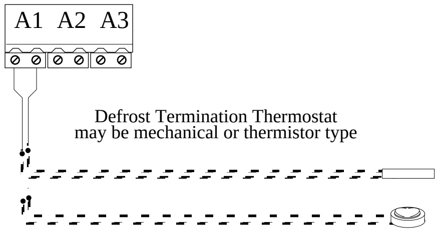
- After defrost termination, all compressors turn off, the valve shifts and a preset drip cycle for 1 to 2 minutes will allow the suction and discharge pressures to equalize and the condensate to clear the case.

- After this drip cycle, the compressors will resume cycling based on the original suction setpoint.

SINGLE DEFROST SCHEDULES (Cont'd)

Electric





Electric Sequence of Operation

- Control Board locks out compressors with defrost interlock enabled.

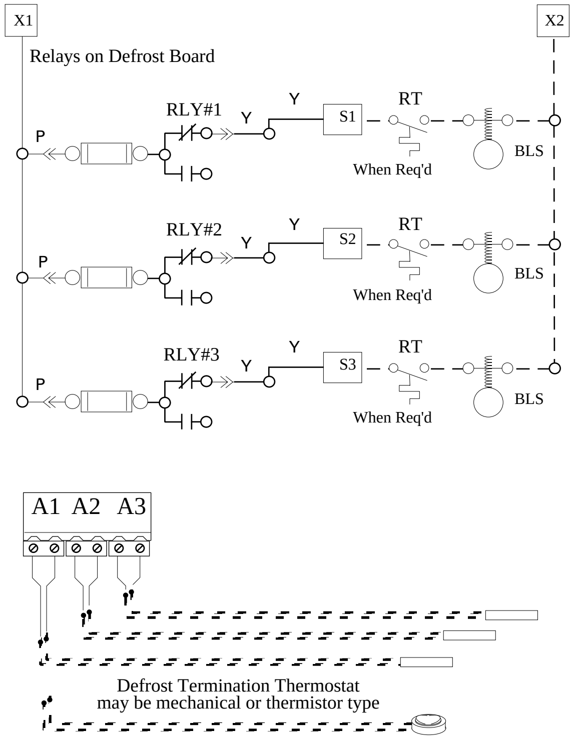
- Control Board energizes two Defrost Board Relay Coils:
1) The first closes the POWERLINK™ circuit.
2) The second opens the Main Liquid Line Solenoid circuit.

- Electric Heaters are energized. Main Liquid Line Valve closes.

- Defrost is temperature terminated.

MULTIPLE DEFROST SCHEDULES

Offtime using Liquid Solenoids



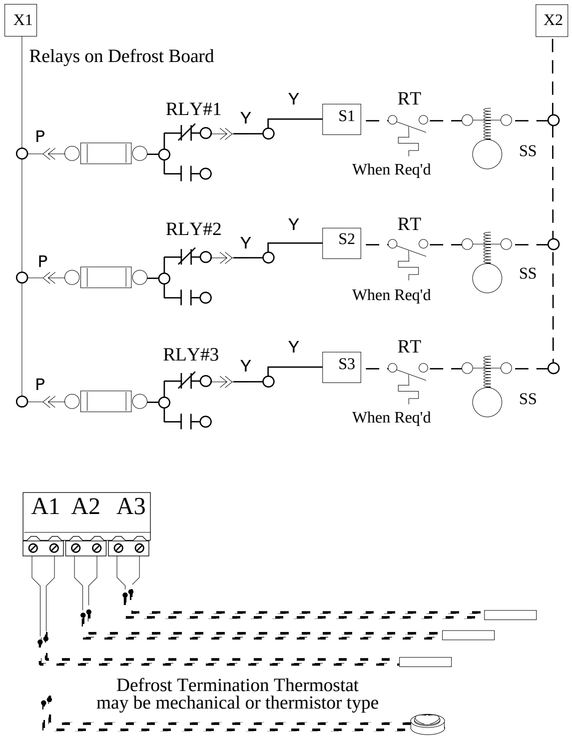
Offtime Sequence of Operation Using Liquid Solenoids

- Control Board energizes one or more Defrost Relay Coil, which opens the Branch Liquid Line Solenoid circuit.

- Branch Liquid Line Valve closes. As evaporators empty, some compressors may cycle off on Low Pressure.

- Defrost may be time or temperature terminated.

Offtime using Suction Solenoids



Offtime Sequence of Operation Using Suction Solenoids

- Control Board energizes one or more Defrost Relay Coil, which opens the Branch Suction Line Solenoid circuit.

- Branch Suction Line Valve closes. As evaporators empty, some compressors may cycle off on Low Pressure.

- Defrost may be time or temperature terminated.

MULTIPLE DEFROST SCHEDULES
(cont'd)

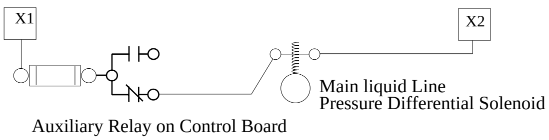
Gas, 3-Pipe Sequence of Operation

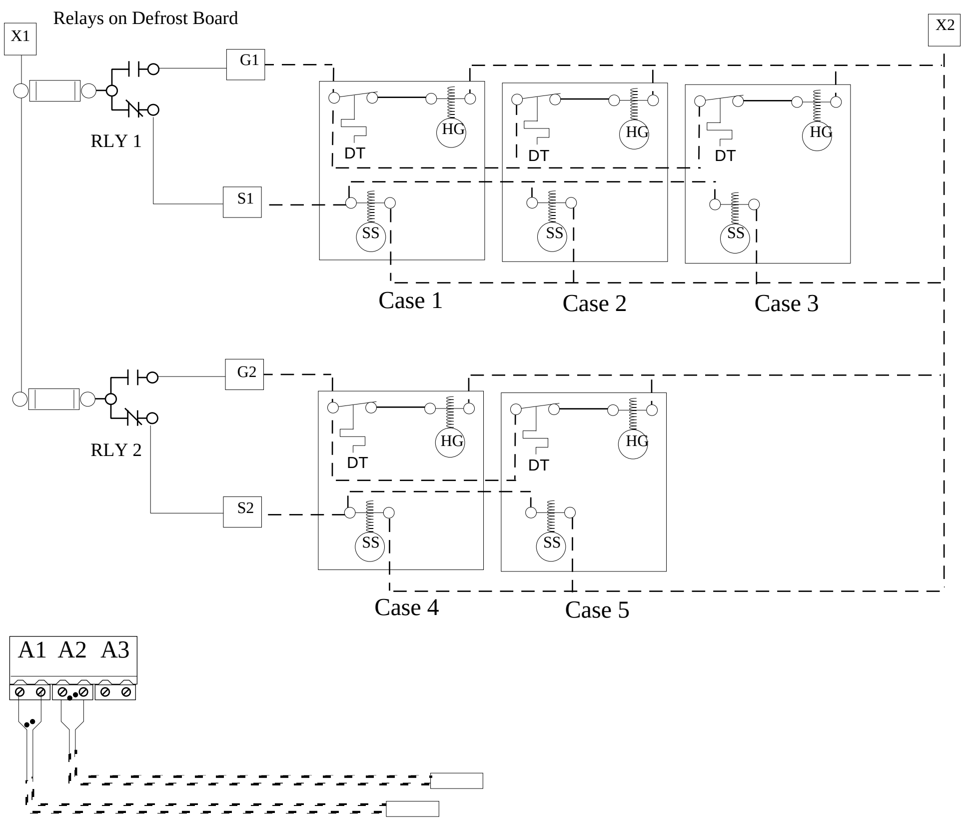
- Control Board energizes the Aux Relay Coil, which de-energizes the Main Liquid Line Pressure Differential Solenoid. The valve reduces liquid supply line pressure.

- Control Board also energizes the Defrost Relay coil, which opens Hot Gas Solenoid valves and closes the Suction Solenoid valves. Each case terminates defrost through individual defrost termination thermostats, and goes into drip cycle until the branch is timed off by the Control Board.

Note: Only two or three cases may be defrosted at once because of the necessity to keep a refrigeration load on the compressors to provide gas for defrost.

Gas, 3-Pipe





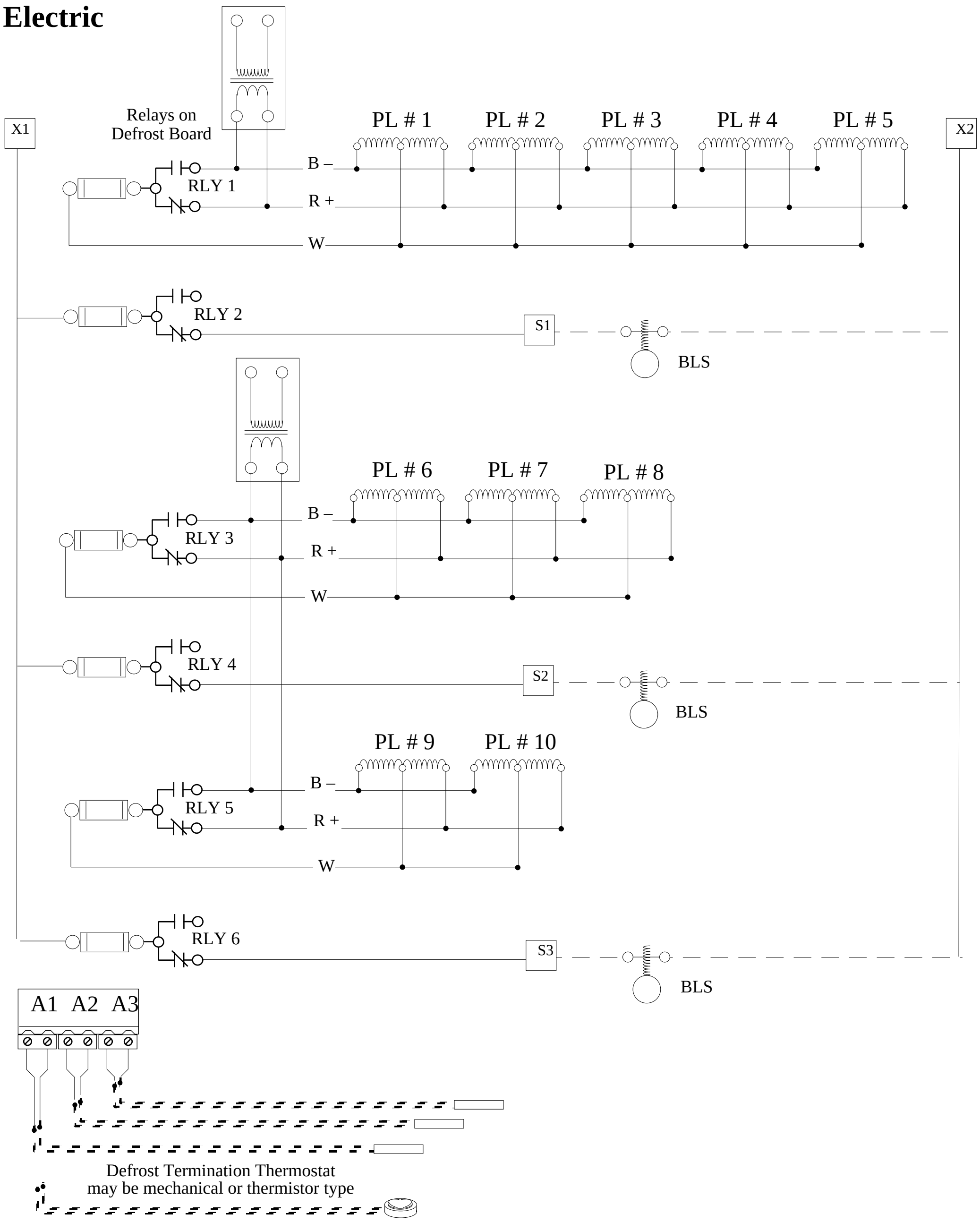
MULTIPLE DEFROST SCHEDULES USING LIQUID SOLENOIDS

Electric
- Control Board locks out certain compressors to cover heater Amp draw.
- Control Board energizes two Defrost Board Relay Coils for each Defrost Circuit:
1) The first closes the POWERLINK™ circuit.
2) The second opens the Branch Liquid Line Solenoid circuit.

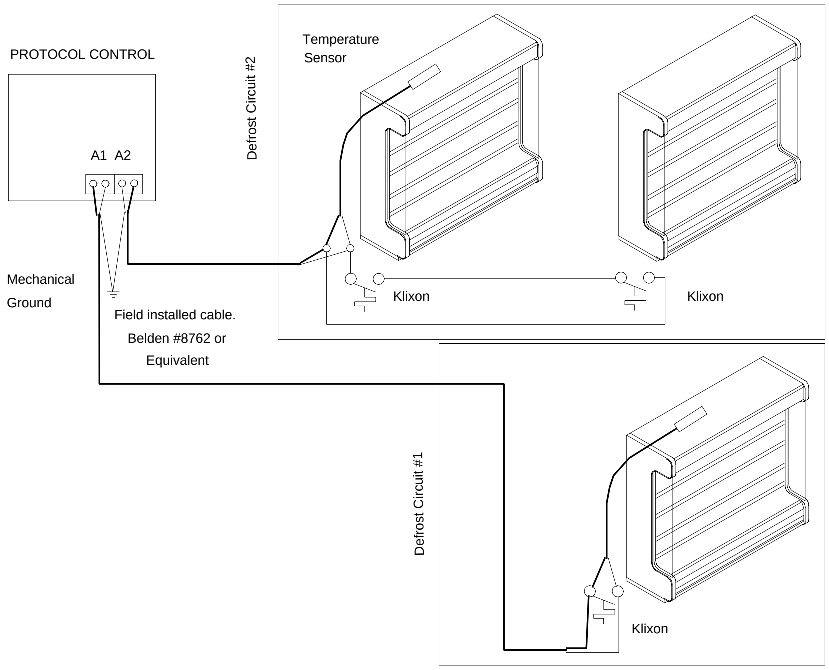
Electric Heaters are energized. Branch Liquid Line Valve closes. Compressors not locked out maintain case refrigeration for units not defrosting.

Defrost is temperature terminated.

Electric



The following wiring diagram shows how two defrost circuits might be connected to the Protocol™ Control. Defrost Circuit #2 shows two cases with each case containing a defrost termination thermostat used to terminate defrost on high temperature. The Klixons are field connected in series so that both devices must satisfy in order to terminate the defrost. A single temperature sensor is wired across the series combination of Klixons which will allow for monitoring and alarming purposes for this circuit. A single cable is used to connect the sensors and defrost termination thermostat devices back to the Protocol™ Control at input A2.



The Defrost Circuit #1 consists of a single case where the defrost termination thermostat and temperature sensor are wired in parallel. A single cable is then used to connect the sensor and defrost termination thermostat device back to the Protocol™ Control at input A1.

NOTE: The auxiliary sensor number (A1…A6) always corresponds to the same defrost circuit number (1…6). That is, there is a one to one relationship between the defrost circuit and the auxiliary input.

As in both examples, the conductors used to connect the sensors back to the Protocol™ units are shielded cables. The shields are connected to the panel liner which is in effect, mechanical ground. The following information would be programmed into the Protocol™ control via the Hand held Device or HUSSNET™ for proper operation.

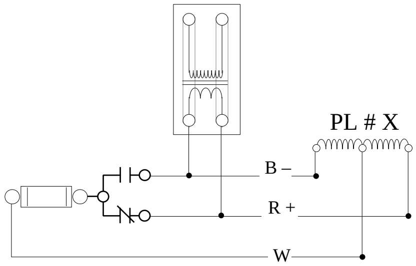
Defrost Menu	**Circuit #1**	**Circuit #2**
Temperature Termination	Enabled	Enabled

Auxiliary Sensor	**Circuit #1**	**Circuit #1**
Aux. Sensor Mode	Analog	Analog
Termination Setpoint	60 deg F (*)	60 deg F (*)
High Alarm Setpoint	Choice of Customer (Case dependent)	Choice of Customer (Case dependent)

(*) Note that the temperature level is still determined by the defrost termination thermostat at the case. When the defrost termination thermostat satisfies, the sensor will be shorted out and the control will interpret this as a very high temperature. Older versions (Rev. E and below) of the Protocol™ control have a 60 deg F maximum reading for temperature. Newer versions, those produced after mid 1995 (Rev. F and up), have a 120 deg F maximum.

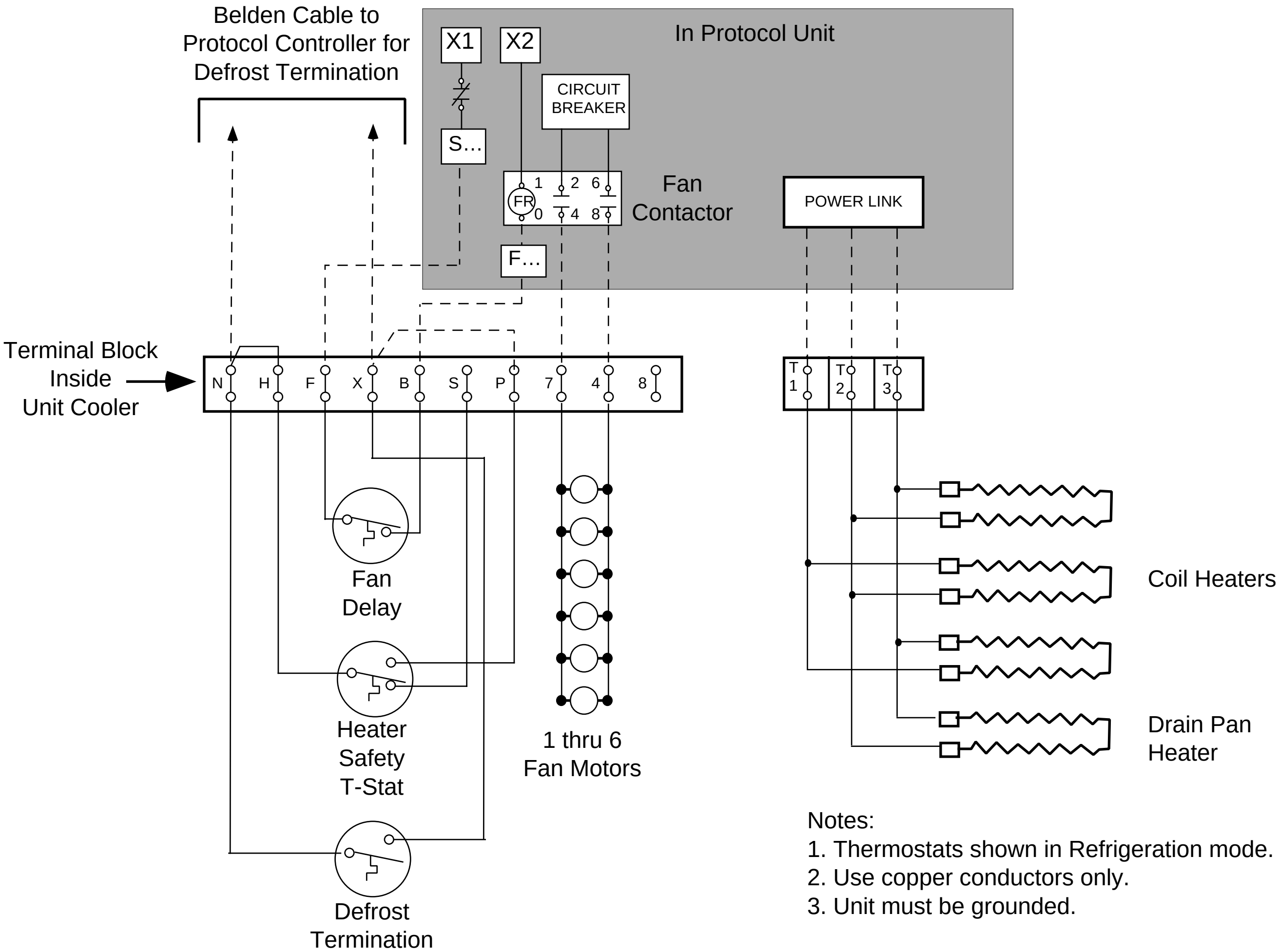
LIGHTING CONTROL

- Control board energizes one output relay for each lighting circuit (each control can have up to two lighting circuits.)
- Each lighting circuit has a schedule which determines when the output is turned on and when the output turns off.



Where X is the number of the PowerLink™

UNIT COOLER FAN WIRING



Notes:
1. Thermostats shown in Refrigeration mode.
2. Use copper conductors only.
3. Unit must be grounded.

* T-Block Designation will be labeled per customized diagram in unit.

POWERLINK™ OPERATION

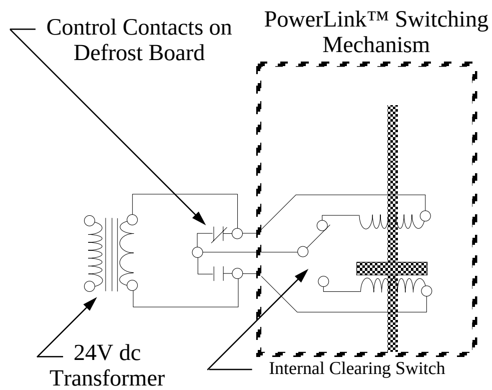
The POWERLINK™ circuit breaker operates like a standard circuit breaker. The contactor portion of the control does not operate like a standard contactor. In a standard contactor an electric coil is energized producing a magnetic field which pulls the contacts closed. When the coil is de-energized a spring forces the contacts open. This arrangement produces an immediate response to control demands.

In contrast, the POWERLINK™ coil, or motor, receives a momentary charge from a capacitor in its power supply. The energized motor moves a push/pull rod like might be found in a manual switch. A slight delay between control circuit demand and the POWERLINK™ response will be noticed.

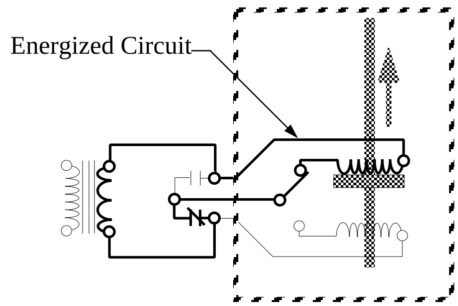
The four schematics show a complete cycle of POWERLINK™ operation. A single pole double throw (SPDT) control circuit switch and an internal clearing switch are used to produce the switching movement. This design requires only the momentary energizing of the POWER-LINK™ motor, but a two second delay between operations is required to recharge the power supply capacitor.

Begin with Defrost ***OFF.*** When the Defrost Board Relay calls for defrost, the NC contact opens and the NO contact closes energizing the POWERLINK™ coil. The push/pull rod closes the defrost circuit. When defrost is terminated, the output relay returns to refrigeration mode. The push/pull rod opens the defrost circuit.

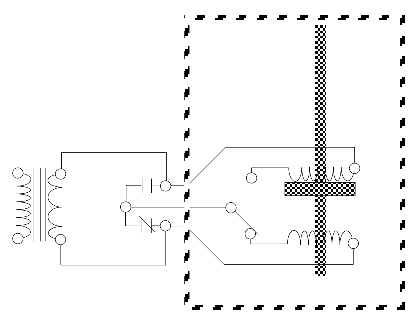
POWERLINK™ is a registered trademark of Square D Company.

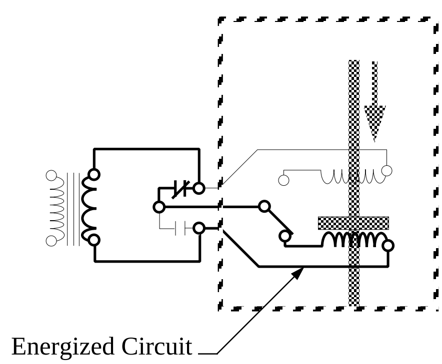


Defrost “OFF”, PowerLink™ Contacts Open
Internal Clearing Switch Opens 24V Circuit



Defrost “ON”, PowerLink™ Contacts Closed


Defrost “ON”, PowerLink™ Contacts Closed
Internal Clearing Switch Opens 24V Circuit



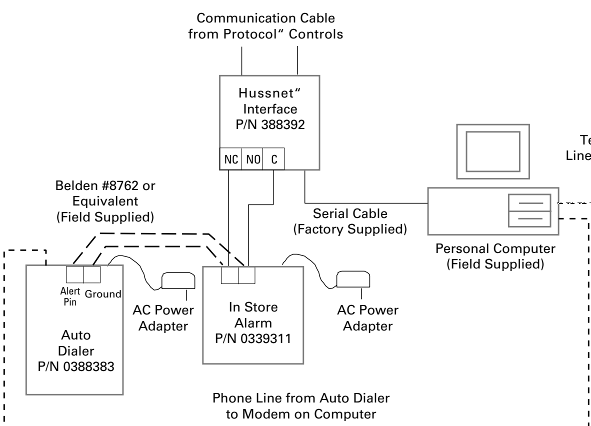
Defrost “OFF”, PowerLink™ Contacts Opened

WIRING OPTIONAL AUTO DIALER AND IN-STORE ALARM

With HUSSNET™
(used on kit 56FP only)

Under this application, all Protocol™ controls can be networked together into a centralized personal computer for data logging and alarm scanning. The communication cable should be shielded twisted pair such as Belden #9502. See the Hussmann® Protocol™ Planning Data for more information.

Wiring Connections
Auto Dialer and In-Store Alarm
With Hussnet“



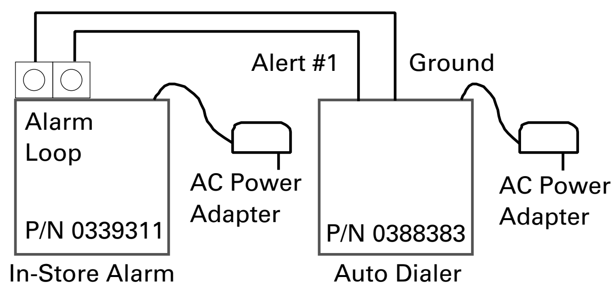
All Protocol™ alarm relays are powered closed when an alarm is **NOT** present. Any alarm relay which de-energizes and opens the alarm loop circuit will cause the in-store alarm and/or auto-dialer to operate.

Without HUSSNET™
(used on kits 57FP only)

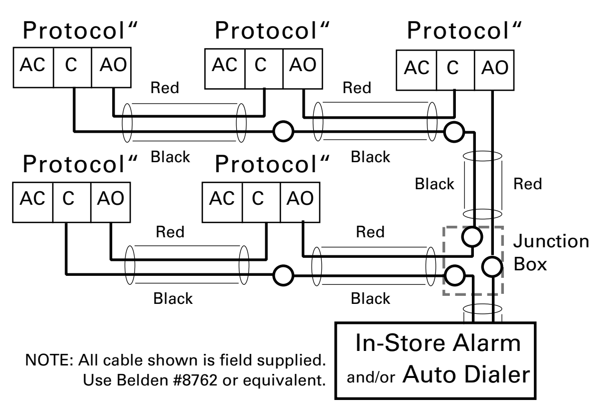
When the In-Store Alarm box and the Auto Dialer are used together, the correct method for wiring the alarm signals from each Protocol™ is a continuous current loop fed around the store. You will need to connect to the "COMMON" and "NORMALLY OPEN" alarm terminals located in the disconnect box of each Protocol™ unit. See wiring diagram for proper connection methods.

IMPORTANT: The Paralleled connection between the In-Store Alarm box and the Auto Dialer is polarity sensitive. Follow the wiring connections shown.

Wiring Method
Auto Dialer and In-Store Alarm
Without Hussnet“



Wiring Method to
Connect Alarm Loop



Startup

Warning

IMPORTANT: **Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor. Refer to Page 2-4.**

Know whether or not a circuit is open at the power supply. Remove all power before opening control panels. NOTE: SOME EQUIPMENT HAS MORE THAN ONE POWER SUPPLY.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent lines when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.

The Water Loop should be tested for leaks using pressurized water.
DO NOT exceed 75 psig.

STARTUP

The closed loop system and evaporative fluid cooler must be running before starting up any Protocol™ units.

Charging the Closed Loop

The closed loop may be filled through a large ball valve at the highest point in the system. Use a funnel when pouring or pumping the glycol into the loop. Water may bes added with a hose. The funnel provides an air break, and ensures no glycol contamination of the water supply. Where the high point is not accessible, glycol must be pumped into the system. Water charging from a utility supply line will require anti-backflow equipment. (A simple check valve in the supply line is not sufficient.)

Vent trapped air. Place a towel around the vent valve to catch any liquid. Any valve and hose assembly used in venting should not be used for anything else.

If the loop employs reverse return piping, open each circuit setter completely. For direct return piping, adjust the circuit setters proportionally for piping head loss and GPM requirements.

Start pumps individually just long enough to check for proper rotation. If pumps are running backwards, have the field connections corrected.

Periodically vent trapped air during startup.

Charging the Refrigeration Side

Leak Testing
Visually inspect all lines and joints for proper piping practices.

Open Power Supply
Compressors–Open circuit breakers to all compressors.

Isolate
Compressors – Frontseat service valves on suction and discharge.

Pressure Transducers — Close angle valves.

Open
Valves–to condenser, heat reclaim, receiver.

Liquid Line Solenoid Valve(s) – Solenoid should be energized.

Verify
Refrigerant requirements for system, compressors, and TEV's in merchandisers and coolers.

Electrical supply and component requirements.

Test Charge
Using properly regulated dry nitrogen and refrigerant mixture, pressurize the system with vapor only. Bring the system pressure up to 150 psig. Use an electronic leak detector to inspect all connections. If a leak is found, isolate, repair, and retest. Be sure system is at 150 psig and all valves closed to repair the leak are re-opened. After the last leak is repaired and retested, the system must stand unaltered for at least 12 hours with no pressure drop from 150 psig.

Evacuation
Nitrogen and moisture will remain in the system unless proper evacuation procedures are followed. Nitrogen left in the system may cause excessive head pressure. Moisture causes TEV ice blockage, wax build up, acid oil, and sludge formation.

Do not simply purge the system—this procedure is not legal, expensive, harmful to the environment, and may leave moisture and nitrogen behind.

Do not run the compressor to evacuate—this procedure introduces moisture into the compressor's crankcase oil and does not produce adequate vacuum to remove moisture from the rest of the system at normal temperatures.

Setup
Using an 8 CFM or larger vacuum pump, connect to the access port on both the suction and discharge headers of the Protocol™ unit. Connect one micron vacuum gauge at the pump, and one at the furthest point in the system from the compressor. Plan procedures so breaking the vacuum with refrigerant will not introduce contaminates into the system. The vacuum pump must be in good condition and filled with fresh oil to achieve desired results.

Procedure - Triple Evacuation
Pull a vacuum to 1500 microns. If the vacuum fails to hold, determine the cause and correct. Begin again and pull a vacuum to 1500 microns.

Break the vacuum with refrigerant vapor to a pressure of about 2 psig. Do not exceed the micron gauge transducer's maximum pressure limit. Liquid refrigerant may cause damage to components through thermal shock or a pressure surge to the transducer of the micron gauge.

Pull a second vacuum to 1500 microns.

Break the vacuum with refrigerant vapor to a pressure of about 2 psig.

Pull a third vacuum to 500 microns. Close vacuum header valves and allow system to stand for a minimum of 12 hours. If the 500 micron vacuum holds, charging may begin. If not, the cause must be determined and corrected. Repeated the entire evacuation procedure from the first step.

Pre-charge Check List
During any of the pull downs, check:

Merchandisers
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting.

Walk-in coolers and freezers
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting.

Water Loop
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper pump operation
- Proper fan operation
- Thermostat or pressure settings
- Damper operation, if equipped
- Protocol™ Water valves set properly.

Heat Reclaim and other systems
- Electrical requirements and power supply
- Electrical connections tight and clean
- Component operation.

Refrigerant Charging
Remember: the condenser in the Protocol™ holds only a small amount of refrigerant. It is therefore very easy to overcharge the Protocol™ unless care is taken during the charging process.

Charging until the liquid sight glass is clear of bubbles will often overcharge the system causing head pressure alarms.

Because the HFC refrigerants are less dense than the refrigerants they replace, they will tend to "flash" or bubble more easily, even when the correct charge is in the system. Therefore, charge only until the *sight glass on the receiver* is covered with refrigerant when the system is operating in a balanced refrigeration mode. Protocol™ units with gas defrost should also be monitored during defrost to ensure that the receiver does not completely empty. Add enough refrigerant, if necessary, to maintain a liquid seal on the receiver outlet if the receiver empties during defrost.

Oil Charge

Charge the Turba-Shed with oil.

Use only Mobil EAL Arctic 22 CC, ICI Emkarate RL 32 CF or Copeland Ultra 22 CC.

Turba-Shed is shipped without oil charge.

Oil Levels
Compressor top half of the sight glass

Turba-Shed between two sight glasses.

Important Notice to Installer

The compressors and the Turba-Shed must be closely monitored during startup because POE oil does not return from the evaporators as quickly as mineral oil.

Compressor Motor Rotation
To check compressor rotation, use the following procedure:

1. Install gauges on suction and discharge headers. Be aware of Satellite and Split-Suction Protocol™ units when making hookup. A momentary compressor run should cause a drop in suction pressure and a rise in discharge pressure.

2. With main disconnect ***OFF***, switch ***OFF*** all breakers in the control panel **EXCEPT** the control circuit breaker.

3. Turn ***ON*** main disconnect.

4. Look for the green light on the single phase protector. If the light is red, turn ***OFF*** the main disconnect. All Protocol™ 3-Phase wiring is connected L_1 to T_1, L_2 to T_2, and L_3 to T_3. Have the field connections corrected so the phase protector indicates phase alignment. (The light is green.)

5. Turn ***ON*** main disconnect.

6. Using Hussmann's Hand Held Device, force all compressors ***ON.***

7. Momentarily turn ***ON*** compressor breaker #1 and verify correct pumping direction. Check all compressors before switching any wires. If all compressors are rotating backwards, change two Legs at the field side of the main disconnect. For individual compressors, change the Legs on the load side of the compressor contactor.

8. Using Hussmann's Hand Held Device, **CLEAR FORCE FLAGS** to remove forced conditions.

Final Checks

RETURN GAS SUPERHEAT
• Return Gas Superheat should be 10 to 30°F on all units

Once the system is up and running, it is the responsibility of the installer to see that all the final adjustments are made so the Protocol™ delivers maximum temperature performance and efficiency for the customer. These include:

TEV superheat adjustment
EPR settings
Defrost scheduling and timing
Condenser flow balance
High and low pressure controls
Thermostat settings
Adjustments to electronic controls
Electronic oil level controls.

Thoroughly inspect all field piping while the equipment is running and add supports where line vibration occurs. Be sure additional supports do not conflict with pipe expansion and contraction.

When merchandisers are completely stocked, check the operation of the system again.

At 90 days recheck the entire system, including all field wiring.

Caution:
Never run the compressors in a vacuum as this may quickly damage the compressors.

Control Settings

• High Pressure Safety – 395 psig.

• Discharge Temperature Sensor – 240°F.

• Low pressure control should be set in the field.

ELECTRONIC OIL LEVEL CONTROL

Electronic oil regulators monitor oil levels. The units are powered by a 24V power supply. When the oil level in the compressor drops below 1/2 sightglass, the fill light comes on and the oil solenoid is energized. If after 90 seconds the oil level does not rise above 1/2 sightglass, the unit opens the compressor control circuit. If oil becomes available, the control will re-set and the compressor will resume operation.

AUXILIARY SENSORS

These form of sensor inputs can be programmed for analog operation (case temperature sensor) or digital operation (such as Klixon). The auxiliary sensors are typically used to provide information to the control regarding a particular defrost circuit. The auxiliary sensors can also be used to provide monitoring inputs from some external device; i.e., glycol temperature, computer room thermostat, pump station alarm relay closure.

It is important to remember that the auxiliary sensors, when used to provide information regarding a particular defrost circuit, must be located in the correct defrost circuit lineup of cases. Sensor A1 can only be used on Defrost Circuit #1. Sensor A2 can only be used on Defrost Circuit #2. The same attachment of sensors to defrost circuits can be repeated for A3 through A6.

NOTE: In the following examples, the #() refers to a defrost circuit and /or Aux sensor # between 1 and 6. The same screens apply for all circuit and sensor attachments.

Temperature Termination (Digital Mode)

When the Auxiliary Sensor is used to connect a defrost termination thermostat (Klixon*) device to the control in order to terminate defrost on high temperature, the following information is required for proper operation.

Parameter	Location (Hand Held Device)	Location (Hussnet)
Temp. Termination (Set to Enabled)	DEFROST MENU View/Set Items Circuit (#)	DEFROST MENU
Input Mode (Set to Digital)	CONFIG MENU SENSOR MENU AUX SENSORS AUX SENSOR (#)	SENSOR MENU

NOTE: When temperature termination is Enabled, the control will automatically alarm on a non-defrost mode contact closure from the defrost termination thermostat device. It is assumed that while in refrigeration, the defrost termination thermostat (which is a close on rise device) should be open.

***No case temperature sensor present.**

Temperature Termination (Analog Mode)

In some applications of the Protocol™, there are not enough inputs to provide all of the information to the control for terminating defrost, alarming and monitoring purposes. When this is the case, a temperature sensor and a defrost termination thermostat can be wired in parallel at the case and then one cable run back to the Protocol™ control and connected to the Auxiliary input. Under this application, the temperature sensor is used to provide alarming and monitoring of discharge air while the defrost termination thermostat provides the termination input. For this type of setup, the following information is required for proper operation.

Parameter	Location (Hand Held Device)	Location (Hussnet)
Temp. Termination (Set to Enabled)	DEFROST MENU View/Set Items Circuit (#)	DEFROST MENU
Termination Setpoint (Set to 100°F)	CONFIG MENU SENSOR MENU AUX SENSORS AUX SENSOR (#)	SENSOR MENU
Input Mode (Set to Analog)		
High Alarm		
Low Alarm		
Alarm Activation (Enabled / Disabled)		

REVERSE CYCLE GAS DEFROST

Application

Reverse cycle gas defrost operates like a heat pump. During refrigeration, the 4-way valve is de-energized, directing the discharge gas to the condenser and the suction gas to the compressor. When defrost is initiated, the valve is energized and shifts, diverting the discharge gas to the evaporator. The condenser becomes the evaporator at this time with the water loop providing a constant heat load. **Caution: This requires a minimum 30% by volume glycol in the water loop. The expansion device used for the condenser is a discharge bypass valve (closes on rise of downstream pressure), and should be set between 15 and 35 psig while in defrost.**

All evaporators attached to a Protocol™ with reverse gas defrost must defrost at the same time. This may cause some modification of defrost schedules of different type cases. All required valves for defrost are located within the Protocol™. Isolation ball valves for each case lineup are recommended for ease of servicing.

Defrost Operation

1. The control will turn off all compressors and wait 1 minute to allow the suction and discharge pressures to equalize.

2. After 1 minute, the four-way valve will switch to the reverse flow position and the suction pressure will be set to 10 psig by the controller. The compressors will cycle based on this 10 psig setpoint. The four-way valve is controlled by the Aux. relay on the control board. The Aux relay light should be on during defrost.

3. The defrost will proceed for the time allowed or until temperature termination.

4. After defrost termination, all compressors turn off, the valve shifts and a user set drip cycle for 1 minute will allow the suction and discharge pressures to equalize and the condensate to clear the case.

5. After this drip cycle, the compressors will resume cycling based on the original suction setpoint.

Software Setup

1. On the HHD, enter the main Protocol™ menu and select the CONFIG menu. Then enter the Protocol™ SETUP menu and then the DEFR SETUP menu. This menu should show **1 circuit** with INTERLOCK **ENABLED**.

2. Temperature termination is highly recommended for reverse cycle gas defrost. If defrost termination is done with a temperature activated switch wired back to A1 on the control board, then while in the CONFIG menu, you must enter the SENSOR SETUP menu. Arrow down to the AUX. SENSOR menu and press 'enter.' At AUX. SENSOR 1 enter and set the mode for DIGITAL if only a temperature activated switch is connected. If both temperature sensor and temperature activated switch are connected, then set the mode to **ANALOG** and follow the instructions on the Sensor Application Sheet. If temperature alarms are desired, the high and low cutouts should be entered and the alarm enabled.

3. After step 2, return to the MAIN MENU and enter the DEFROST MENU. Enter the VIEW/SET ITEMS menu and at CIRCUIT 1 press 'enter.'This will take you to the screen showing the specifics about circuit 1. In this screen, enter the information for defrost. The name should be some description of the lineup being defrosted but has no importance other than that. Enter the defrost type as **gas,** then enter the number of defrosts per day, the length, and the starting time of the first defrost. If there are multiple defrosts for this circuit, the controller will automatically calculate the remaining defrost times.

3-PIPE GAS DEFROST

Application

3-pipe gas defrost is designed to operate with different defrost schedules and durations.

Only one lineup or no more than 20 percent of the load should go into defrost at one time. As a lineup goes into defrost, the other cases will be fed liquid from the Protocol™ and from the lineup in defrost. For longer lineups, or cases with large evaporator coils, partitions may be required to split these lineups into smaller sections. All the valves, gas solenoid and suction solenoid, are located in the cases and are controlled by the Protocol™. The main liquid differential valve is located in the Protocol™ on vertical units, and field installed on horizontal units. Isolation ball valves for each lineup branch are recommended for ease of servicing.

Defrost Operation

1. When a system goes into defrost, the liquid differential valve, located in the Protocol™ on vertical units and outside the Protocol™ for horizontal units, is de-energized allowing the valve to modulate at the desired setting of 15-20 lb. (Note: higher settings may be required if the Protocol™ unit is located above the evaporators). The valve is controlled by the Aux relay on the control board. The Aux relay light should be on.

2. The control board will simultaneously switch the appropriate output relay for the defrosting circuit which will de-energize the

suction solenoid and energize the hot gas solenoid allowing discharge gas to flow through the coil and return through the liquid line.

3. The defrost can be either temperature terminated using a thermostat or time terminated. No drip cycle has been built in.

Software Setup

1. Enter the HHD main Protocol™ menu and select the CONFIG menu. Then enter the Protocol™ SETUP menu, arrow down to the DEFR SETUP menu and press 'enter.' This menu shows the number of defrost circuits required for the unit, and the interlock feature should be **disabled**.

2. If defrost termination is used and a temperature activated switch has been wired back to A1-A6 on the control board, then while in the CONFIG menu, you must enter the SENSOR SETUP menu. Arrow down to the AUX. SENSOR menu and press 'enter.' At AUX. SENSOR 1, enter and set the mode for digital if only an activated switch is connected. If both a temperature sensor and an activated switch are connected, then set the mode for analog and follow the instructions on the Sensor Application Sheet. If temperature alarms are desired, the high and low cutouts should be entered and the alarm enabled. **A specific circuit number be must be wired to the corresponding A_ input** (i.e., circuit 3 termination thermostat should be wired to A3).

3. After step 2, back out to the MAIN MENU by pressing 'esc' and enter the DEFROST MENU. Enter the VIEW/SET ITEMS menu and at CIRCUIT 1 press 'enter.' This will take you to a screen showing the specifics about circuit 1. In this screen, enter the information for defrost. The name area should be some description of the lineup being defrosted but has no importance other than that. Enter the defrost type as **GAS** then enter the number of defrosts per day, the length, and the starting time of the first defrost. If there are multiple defrosts for this circuit, the controller will automatically calculate the remaining defrost times. Defrost termination should be enabled only if Step 2 is used.

4. Enter all defrost circuit information as in step 3 for the remaining circuits.

5. The remaining step is to program the output assignments. In the DEFROST MENU go to the ASSIGN OUTPUTS menu and enter the specific circuit to its specific output. For gas defrost this should typically be output 1 assigned to circuit 1 and so forth.

ELECTRIC DEFROST

Application

Electric defrost is the same with Protocol™ as with any other system. The only exception is that a POWERLINK™ type circuit breaker is used for the defrost loads. This breaker will provide overload protection, and also be the contactor that switches the defrost heaters on and off. Liquid solenoids should be used to control temperature and defrost for each circuit. This prevents a possible pump down problem. The defrost solenoid and POWERLINK™ breakers are controlled by independent output relays on the defrost board, but will be assigned (programmed) to the same defrost circuit so that they will be energized simultaneously (see step 5 under Software Setup). The amp draw for each circuit must be entered into the controller so that a defrost shedding of compressors can occur reducing the overall amp draw of the unit. Isolation ball valves for each case lineup are recommended for ease of servicing.

Defrost Operation

1. The control board will de-energize the solenoid (suction or liquid) when a defrost occurs while simultaneously energizing the relay controlling the defrost breakers.

2. When the defrost relay is energized the POWERLINK™ breakers will receive a momentary charge or pulse from a capacitor in its POWERLINK™ Power Supply (PPS). The energized motor moves a push/pull rod similar to what might be found in a manual switch. A slight delay between the control circuit demand and the POWERLINK™ response will be noticed. This pulse switches the POWERLINK™ such that the heaters are now energized. At the termination of defrost, the PPS will receive another pulse, causing the POWERLINK™ to switch off.

Software Setup

1. Enter the HHD main Protocol™menu and then the CONFIG menu. Then enter the Protocol™ SETUP menu, arrow down to the DEFR SETUP menu, and press ‘enter.’ This menu should show the number of defrost circuits required for this unit. The interlock feature should be either enabled or disabled depending on whether one or multiple circuits are used. If only one circuit is on a Protocol™ unit, then a main liquid solenoid can be installed at the Protocol™. If this is done, the interlock enabled feature will shut off the compressors during defrost. If multiple circuits are on a unit, the interlock feature should be disabled.

2. If defrost termination is used and a temperature activated switch has been wired back to A1-A6 on the control board, then while in the CONFIG menu, enter the SENSOR SETUP menu. Arrow down to the AUX. SENSOR menu and press ‘enter.’ At AUX. SENSOR 1, enter and set the mode for digital if only an activated switch is connected. If both a temperature sensor and activated switch are connected, then set the mode for analog and follow the instructions on the Sensor Application Sheet. If temperature alarms are desired, the high and low cutouts should be entered and the alarm enabled. **A specific circuit must number be wired to the corresponding A_ input** (i.e., circuit 3 termination t-stat should be wired to A3).

3. After step 2, back out to the MAIN MENU and enter the DEFROST MENU. Enter the VIEW/ SET ITEMS menu and at CIRCUIT 1 press ‘enter.’ This will take you to a screen showing the specifics about circuit 1. In this screen, enter the information for defrost. The name should be some description of the lineup being defrosted, but has no importance other than this. Enter the type of defrost as **electric**, then enter the number of defrosts per day, the length, and the starting time of the first defrost. If there are multiple defrosts for a circuit, the controller will automatically calculate the remaining defrost times. Defrost termination should be enabled only if Step 2 is used. (The defrost amps required for this circuit should be entered here. On older hand-held devices—Version 1-10 and earlier—the defrost amps are input under the ASSIGN OUTPUTS menu.)

4. Enter all defrost circuit information as in step 3 for the remaining circuits.

5. Since electric defrost requires two output relays, one for the POWERLINK™ and one for the defrost solenoid valve, the control board needs to be told which relays are controlled together. This is done in the DEFROST MENU under ASSIGN OUTPUTS. In this menu, for example, circuit 1 would be set to control outputs 1 and 2. Output 1 would control the solenoid and output 2 would control the POWERLINK™. This means that only two defrost circuits can be used for each defrost board which only has four relays.

OFFTIME DEFROST

Application

Offtime defrost is the simplest defrost type. A relay is used to de-energize a solenoid valve at specific times. Suction stop solenoid valves should be used to control temperature on long lineups due to the limited receiver capacity. Isolation ball valves for each case lineup are recommended for ease of servicing.

Defrost Operation

1. To initiate a defrost, the control board will de-energize the specific circuit solenoid.

2. After the preset time for defrost has elapsed, the unit will energize the solenoid allowing normal refrigeration.

Software Setup

1. Enter the HHD main Protocol™ menu and enter the CONFIG menu. Then enter the Protocol™ SETUP menu, arrow down to the DEFR SETUP menu, and press ‘enter.’ This menu should show the number of defrost circuits required for this unit. The interlock feature should be either enabled or disabled depending on whether one or multiple circuits are used. If only one defrost circuit is on a Protocol™ unit, then a main liquid solenoid can be installed at the Protocol™. If this is done, the interlock enabled feature will shut off the compressors during defrost. If multiple circuits are on a unit, then the interlock should be disabled.

2. If defrost termination is used and a temperature activated switch has been wired back to A1-A6 on the control board, then while in the CONFIG menu, you must enter the SENSOR SETUP menu. Arrow down to the AUX. SENSOR menu and press ‘enter.’ At AUX. SENSOR 1, enter and set the mode for digital if only an activated switch is connected. If both a temperature sensor and an activated switch are connected, then set the mode for analog and follow the instructions on the Sensor Application Sheet. If temperature alarms are desired, the high and low cutouts should be entered and the alarm enabled. **A specific circuit number must be wired to the corresponding A_ input** (i.e., circuit 3 termination t-stat should be wired to A3).

3. After step 1, back out to the MAIN MENU and enter the DEFROST MENU. Enter the VIEW/SET ITEMS menu and at CIRCUIT 1 press ‘enter.’ This will take you to a screen showing the specifics about circuit 1. In this screen, enter the information for defrost. The name should be some description of the lineup being defrosted, but has no importance other than this. Enter the type of defrost as offtime, then enter the number of defrosts per day, the length, and the starting time of the first defrost. If there are multiple defrosts for a circuit, the controller will automatically calculate the remaining defrost times.

3. The remaining step is to program the output assignments. In the DEFROST MENU, go the ASSIGN OUTPUTS menu and set up the specific circuit to its specific output. For offtime defrost, this should typically be output 1 assigned to circuit 1 and so forth.

SENSOR APPLICATIONS

P1
This suction pressure input provides the electronic controller the necessary information to cycle the compressors on and off to maintain an overall setpoint. You will need to program the following:

SUCTION PRESSURE SETUP

Parameter	Location (Hand Held Device)	Location (Hussnet)
Setpoint	CONFIG MENU REFR SETUP PROTOCOL™ SETUP	SYSTEM MENU
High Alarm	CONFIG MENU SENSOR SETUP PRESSURE #1	SENSOR MENU
Low Alarm		
Range		

The high and low alarm settings provide a window of safe operation that the Protocol™ should operate within. If the suction pressure moves outside this margin of operation for more than 30 minutes, the control will default to switchback operation and control of the compressors will be passed to a low pressure mechanical switch mounted inside the Protocol™ cabinet.

P2
This suction pressure input has a dual function. It can provide the electronic controller the necessary information to cycle the compressors on and off under a split suction configuration, or it can be used to monitor discharge pressure. If the input is used to monitor discharge pressure, you will need to program the following:

HEAD PRESSURE MONITORING

Parameter	Location (Hand Held Device)	Location (Hussnet)
High Alarm	CONFIG MENU SENSOR SETUP PRESSURE #2	SENSOR SETUP
Low Alarm		
Range (Typically 500 PSI)		

Under split suction configuration, this input provides the electronic controller pressure signal used to cycle compressors on and off. The split suction configuration may contain multiple compressors (2 or more) or a single compressor (low or high end satellite). When two or more compressors are attached to the second suction header, you will need to program the following:

SPLIT SUCTION SETUP

Parameter	Location (Hand Held Device)	Location (Hussnet)
Split Suction Operation (Enabled / Disabled)	CONFIG MENU PROTOCOL™ SETUP REFR SETUP	SYSTEM MENU
Number of Compressor		
Split Suction Setpoint		
High Alarm	CONFIG MENU SENSOR MENU PRESSURE #2	SENSOR MENU
Low Alarm		
Range		

If only a single compressor is used (Satellite configuration), you will need to program the following:

SATELLITE SETUP

Parameter	Location (Hand Held Device)	Location (Hussnet)
Satellite Operation (Enabled / Disabled)	CONFIG MENU PROTOCOL™ SETUP REFR SETUP	SYSTEM MENU
Satellite Setpoint		
Satellite Differential		
High Alarm	CONFIG MENU SENSOR MENU PRESSURE #2	SENSOR MENU
Low Alarm		
Range		

T1

This temperature input has a dual function operation: 1) temperature input for Suction Pressure Reset feature or 2) alarming and monitoring of temperature for a display case. The Suction Pressure Reset (SPR) function allows the suction pressure setpoint to float upward to reduce comprssor energy consumption. The temperature sensor used with the SPR function allows a setpoint to be entered for a specific display case, normally the case containing the evaporator with the lowest suction temperature. When the temperaturein this case is satisfied, the suction pressure setpoint will increase by 1 psi. The following information should be programmed into the control:

SUCTION PRESSURE RESET

Parameter	Location (Hand Held Device)	Location (Hussnet)
Suction Pressure Reset (Enabled / Disabled)	CONFIG MENU PROTOCOL™ SETUP REFR SETUP	SYSTEM MENU
SPR Setpoint		
T1 High Alarm	CONFIG MENU SENSOR MENU TEMP #1	SENSOR MENU
T1 Low Alarm		

When this temperature input is used to monitor and alarm on temperature of a given display case, the following information should be used:

TEMPERATURE MONITORING SETUP

Parameter	Location (Hand Held Device)	Location (Hussnet)
High Alarm	CONFIG MENU SENSOR MENU TEMP #1	SENSOR MENU
Low Alarm		
Alarm Activation (Enabled / Disabled)		
Alarm Delay		
Circuit Attachment		

T2
This temperature input has a dual function operation: 1) temperature input for a Satellite Compressor or 2) alarming and monitoring of temperature for a display case. The Satellite function as described earlier can be a high or low temperature compressor operating a small evaporator load. To ensure proper operation for Satellite control **by temperature**, the following information should be programmed into the control:

SATELLITE CONTROL

Parameter	Location (Hand Held Device)	Location (Hussnet)
Satellite Operation (Enabled / Disabled)	CONFIG MENU PROTOCOL™ SETUP REFR SETUP	SYSTEM MENU
Satellite Setpoint		
Satellite Differential		
High Alarm	CONFIG MENU SENSOR MENU TEMP #2	SENSOR MENU
Low Alarm		

When this temperature input is used to monitor and alarm on temperature of a given display case, the following information should be used:

TEMPERATURE MONITORING SETUP

Parameter	Location (Hand Held Device)	Location (Hussnet)
High Alarm	CONFIG MENU SENSOR MENU TEMP #1	SENSOR MENU
Low Alarm		
Alarm Activation (Enabled / Disabled)		
Alarm Delay		
Circuit Attachment		

T3 / P3
This temperature input has a dual function operation: 1) pressure input for monitoring discharge pressure or 2) alarming and monitoring of temperature for a display case. Since this input can operate as a temperature or pressure, you will need to configure both the hardware (input circuitry) and software (memory settings) for proper operation. Note that the hardware switch is located on the printed circuit board directly above the T3 input and is marked with the proper 'PRESS' or 'TEMP' position. When operating as a pressure input, the following should be programmed:

OPTIONAL 3RD PRESSURE INPUT

Parameter	Location (Hand Held Device)	Location (Hussnet)
Input Mode (Set to Pressure)	CONFIG MENU SENSOR MENU TEMP #3	SENSOR MENU
High Alarm		
Low Alarm		
Alarm Activation (Enabled / Disabled)		

When operating as a temperature input , the following information should be programmed:

TEMPERATURE MONITORING SETUP

Parameter	Location (Hand Held Device)	Location (Hussnet)
Input Mode (Set to Temperature)	CONFIG MENU SENSOR MENU TEMP #3	SENSOR MENU
High Alarm		
Low Alarm		
Alarm Activation (Enabled / Disabled)		
Alarm Delay		
Circuit Attachment		

PROGRAMMING THE *OPTIONAL* IN-STORE ALARM AND AUTO DIALER

All alarm wiring (refer to Electrical section) must be complete before beginning the programming of the alarm dialer. The Protocol™ units and any other equipment connected on the alarm connection must not be in alarm. This normal operating state is used to allow the auto dialer to preset the non-alarm condition present on the alert inputs.

IMPORTANT: Make sure that the six D cell batteries required for the auto dialer are inserted before beginning programming. The batteries are needed to retain the programming information within the auto dialer's memory.

1. Program the ID# for the Auto Dialer. This ID# will be used to indicate which store is in alarm. If the customer wishes the auto dialer to be muted during the verbal alarm message, the MUTE key must be pressed first and then the store ID# will follow (see page 21 and 22 in the Owners Manual).

2. Next, program one or all of the four available phone numbers that will be dialed during an alarm condition. You will need to know if the store telephone system uses 'TONE' or 'PULSE' dialing (see page 15 and 16 in the Owners Manual). You will also need to include any prefix numbers when required, for gaining access externally through the telephone system (i.e., 9,555,1212).

3. Preview the above programming information by pressing the 'WHAT IS' key and then the item you wish to preview.

Recommended Phone Number Programming

In many cases, it is advantageous to program the store as the first phone number dialed. This helps to avoid nuisance alarms and allows the store manager to take appropriate action during normal store hours. The second and subsequent phone numbers should be programmed to dial a phone answering service, personnel home number or answering machine, or pager. The choice and decision of phone numbers is at the customer's discretion.

NOTICE: During an alarm condition, the auto dialer will continue calling the programmed phone numbers until the confirmation code has been pressed. The confirmation code for the auto is '555'. Thus, when the auto dialer dials your phone number, it will begin giving the alarm message. At the end of its message, it will prompt you for the confirmation code. You will have 5 seconds in which to enter '555' by pressing the '5' key on your phone, three times.

Troubleshooting Guide

This section is to aid in the troubleshooting of electrical and electronic considerations of the Protocol Refrigeration System. The manual assumes that the reader has a working knowledge of the Hand-Held Device (HHD) and/or HUSSNET, the communications platform used in networking the Protocol Electronic controls. References in the following pages will be made to certain areas of the *HHD* and *HUSSNET Operating Manuals*. Thus it will be necessary to have a copy of these manuals on hand to facilitate the troubleshooting process.

The structure of this troubleshooting guide is based upon a Question/Answer format. In most cases, the HHD and/or HUSSNET will be used to determine whether the problem lies within the electronic control, or external to the control — most likely contained in the control panel. You will need to follow the instructions carefully to ensure a quick method of solving the problem or question.

Please familiarize yourself with the picture on Page 4-4 as references will be made to the control inputs and outputs.

IMPORTANT:
The current draw required by analog meters (Volt-Ohm Meters or VOMs) **can permanently damage electronic equipment.**

Never use a VOM to check computer components or computer controlled systems. Use a Digital Multimeter (DMM) to measure voltage, amperage, milliamperes, or ohms. If a range is exceeded, the display will show OL (overload).

ELECTRICAL QUESTIONS

Problem A: The compressor will not turn ***ON*** or will not run.

STEP A1 Visually observe if the Alarm Relay LED (Output #7) on the control board is ***ON***. If LED is ***ON***, go to Step A2. If LED is ***OFF***, go to Step A9.

STEP A2 Using the HHD, access the Protocol™ *Maintenance Menu* and enter the *Force Comp On* submenu. Enter the compressor number you wish to turn ***ON*** and press enter. Visually observe if the correct compressor relay output LED on the control board, turns ***ON***. If LED turns ***ON***, go to Step A3. If LED does not turn ***ON***, go to Step A7.

STEP A3 If the compressor contactor is energized, verify that the compressor turned ***ON*** by cycling the compressor circuit breaker (the compressor should turn ***ON*** and ***OFF*** with the circuit breaker) or use an amp probe and measure all three phase wires between the contactor and the compressor. If the compressor contactor did not energize, go to Step A6.

STEP A4 If the compressor contactor energized, but the compressor cannot be cycled with the circuit breaker, you will need to open up the compressor terminal box located on the side of the compressor, and ensure that the power wires are tightened down**. Important: you should turn the compressor circuit breaker off before implementing this check.**

STEP A5 If the compressor wires are tight within the terminal box, the compressor may be damaged internally and may need to be replaced.

STEP A6 Problem appears to be located in the control circuit wiring, most likely in one of the safeties. Referring to the supplied customized wiring diagram, use a digital voltmeter and determine where the circuit is being broken. The control circuit originates from the phase monitor, passes through the control board relay and fuse, through the high pressure safety switch, the discharge line thermostat, and finally through the electronic oil level control safety.

STEP A7 If you cannot force the compressor ***ON*** with the HHD, check the following parameters with the HHD:

1. No electric defrost is currently engaged. Electric defrosts implement a compressor shedding routine which may be keeping the particular compressor you want to energize off-line.
2. The correct number of compressors are installed.
3. Check that the suction pressure reading in the STATUS menu is not below 2 PSI. Pressures below 2 PSI activate the vacuum prevention routine which will not allow compressors to turn ***ON***.

STEP A8 If the preceding parameters check out, you may need to replace the electronic control board.

STEP A9 At this point, it is assumed that the electronic control board is in switchback (see page 6-6 for details describing switchback). If the compressor you are trying to turn ***ON*** is not wired to the switchback control circuit (refer to the supplied customized wiring diagram), you will need to investigate the cause of this switchback condition and correct the existing problem.

STEP A10 If the compressor you are trying to turn ***ON*** is wired into the switchback control circuit, use a digital voltmeter and determine where the circuit is being broken. The switchback control circuit originates from the phase monitor, passes through the switchback relay (Output #7) on the control board, through the low pressure mechanical backup switch, then back through the control board relay and fuse, through the high pressure safety switch, the discharge line thermostat and finally through the electronic oil level control safety.

PROBLEM B: Evaporator is not defrosting.

STEP B1 Visually observe if the Alarm Relay LED (Output #7) on the control board is ***ON***. If LED is ***ON***, go to Step B2. If LED is ***OFF***, refer to the *Troubleshooting Alarms* section of this document.

STEP B2 Using the HHD, verify that the Clock contained in the Protocol is keeping time. Access the *CONFIG MENU* and select the *Set the Clock* submenu. If the clock is running, go to Step B3. If clock is not running, try changing the time to the correct setting. You may want to consult the section on *Electrical Noise* contained within this manual.

STEP B3 Using the HHD, access the *Maintenance Menu* and enter the *Force Defrost On* submenu. Enter the defrost circuit number you wish to turn ***ON*** and press enter. Now exit the *Maintenance Menu* and go to the *Defrost Menu*. Observe in the *View/Set Item*s section the status of the circuit you forced into defrost. If the status indicates defrost, DEFR, proceed to Step B4. If the status does not indicate defrost, go to Step B7.

STEP B4 Visually observe which defrost relay located on the defrost board is energized. The corresponding indicator light on the defrost board should be ***ON***. If the indicator light is ***ON***, proceed to Step B5. If the indicator light is ***OFF***, proceed to Step B10.

Step B5 At this point, we have assumed that the control is responding correctly and the problem lies within the control panel. Use a digital voltmeter to check that voltage is present at the correct terminal blocks in the power distribution box. You will need to refer to the supplied customized wiring diagram to determine which terminal blocks are providing power for the particular case load you are defrosting. If voltage is present at the terminal blocks, verify that the case is in defrost by visual inspection and then return to Step B6. If voltage is not present at the terminal blocks, go to Step B11.

Step B6 At this point, we have verified the electrical wiring is correct and the control is programmed properly for defrost. If HUSSNET has been installed, you will want to access the historical data that has been logged for this case to determine if defrosts have been occurring. This can be accomplished by entering the *Graph* menu and selecting data points such as suction pressure (P1) and any temperatures (Auxiliary Inputs) if installed, for this particular Protocol. You may need to refer to the *HUSSNET Operating Manual* for details on Graphing. If HUSSNET is not available, go to Step B7.

If the historical graphing indicates that defrosts have been occurring, consult the appropriate department manager on performance concerns he might have with the case. If the historical graphing indicates that defrosts have not been occurring, verify the programming of the suspect defrost circuit as outlined in Step B7.

Step B7 If the status of this defrost circuit indicates it is deactivated, DATV, reactivate the circuit by moving the cursor to the corresponding circuit number and press the left or right arrow key on the Hand-Held Device. Now press the enter key (ENT) and verify the programming of this circuit as outlined in Step B8. If the status of this defrost circuit indicates that it is not installed, N/A, go to the Protocol configuration menu and access the *PROTOCOL SETUP* submenu. Enter the *DEFR SETUP* and program the control with the correct number of defrost circuits. Verify that the circuit is activated by repeating this step.

Step B8 Verifying the defrost circuit configuration. Check the number of defrosts per day, the defrost length and defrost start times to ensure proper configuration. If HUSSNET is available, access the *Custom Defrost Menu* for this Protocol which reveals the defrost periods (highlighted blocks) in graphical form. Go to Step B9.

Step B9 Verifying the Defrost Output Assignments. Enter the Protocol *Defrost Menu* and select the *Assign Output* submenu. Verify that the correct output(s) have been assigned to the appropriate defrost circuit. Now that all programming information has been verified, return to Step B3 to force the defrost on.

Step B10 Verify the Defrost Output Assignments. Enter the Protocol *Defrost Menu* and select the *Assign Output* submenu. Verify that the correct output(s) have been assigned to the appropriate defrost circuit. If the correct outputs have been assigned, and the status reveals the circuit is in defrost, DEFR, check the ribbon cable between the control board and defrost board. Try replacing the ribbon cable with one from another Protocol to verify the cable is good or bad. If the cable is good, replace the control board. The defrost output drive chip has possibly been damaged. If the correct outputs have not been assigned, enter the correct programming information and repeat this step.

STEP B11 Electrical Wiring Check. Use a digital voltmeter to verify where the circuit is being broken. Power for defrost solenoids originates from the 'X1' terminal block, passes through the fuse and relay located on the defrost board, and ends at the terminal block located in the power distribution block. If the fuse on the defrost board has blown, try replacing it with another fuse and repeat the voltage checks.

For electric defrosts, a minimum of two defrost outputs will be used for defrost: one for the solenoid and one for the defrost heaters. The power for the solenoid can be checked as described previously in this step. To verify the defrost heater wiring, go to Step B12.

STEP B12 PowerLink™ Wiring. You may want to first familiarize yourself with information on PowerLink™ Operation as detailed in the *Protocol Installation and Service Manual*. Visually inspect that the circuit breaker handles of the PowerLink(s), located on the bus bars within the control panel, are in the ***ON*** position. If the handle is in the ***ON*** position, use a digital meter and check for voltage at the terminals of the PowerLink™ device and again at the terminal blocks in the power distribution panel. If voltage is not present at these two points, go to Step B13.

STEP B13 PowerLink™ Power Supply Check. Using a digital meter, inspect the PowerLink™ Power supply, which provides power for the PowerLink™ device. Set your digital meter for DC voltage. There should be 24 VDC across the terminals of the PowerLink™ Power Supply. If 24 VDC is not present, replace the PowerLink™ Power Supply. If 24 VDC is present, go to Step B14.

STEP B14 Check fuse on defrost relay board. Replace fuse if it is blown. If fuse is good, measure the voltage present at the white connector on the defrost relay board. Place the positive test lead of your meter (typically the red wire) on the normally open (N.O.) contact of the defrost relay board connector. Place the negative test lead of your meter (typically the black wire) on the common (COM) contact of the defrost relay board connector. Your digital meter should read +24 volts DC. If +24 volts DC is present, the PowerLink™ Device must be replaced. If +24 volts DC is not present, verify that wiring is correct as compared with the supplied customized wiring diagram.

PROBLEM C: Pressure transducer is not reading properly.

The pressure transducers used on Protocol consist of a three wire interface to the Protocol control board. These three wires consist of an excitation voltage, signal voltage and ground. **The transducer cable is shielded and should not have the bare drain wire attached to door panel liner. The mechanical ground connection is achieved through the threaded fitting on the suction and/or discharge header**.

STEP C1 Use a service gauge to verify the actual pressure reading. If the pressure reading of the gauge and the reading of the Hand-Held Device is more than 2 psi, check the pressure transducer offset which is available on those electronic controls shipped after November, 1996. The transducer offset is located in the *CONFIG MENU* under the *SENSOR SETUP* section. Choose the appropriate pressure menu, P1 or P2, and verify the offset setting. (Note: the offset pressure has a range of +/- 5 psi). Go to Step C2.

STEP C2 Verify that the transducer range is set properly. If using the Hand-Held Device, enter the *Config Menu* and access the *Sensor Setup* submenu. Select the pressure input you are currently having problems with and observe the 'XDCR' range. Suction transducers should be selected for a 200 psi range while discharge transducers require a 500 psi range. If the range is not set properly, make the programming change and reevaluate the transducer. If the range is set properly, go to Step C3.

STEP C3 Use a digital volt meter with the scale set for DC volts to measure the excitation voltage and signal voltage of the transducer.

P1 and P2 Voltages	
Excitation	12 to 18
Signal	1 to 6

STEP C4 If the excitation voltage is not within the limits, go to Step C6. If the excitation voltage is within the limits, apply the following formula to determine the output voltage capability of the transducer.

For 200 psi transducers: Pressure Reading =
{ (Signal Voltage) - One volt} x 40

For 500 psi transducers: Pressure Reading =
{ (Signal Voltage) - One volt} x 100

For example: If a 200 psi transducer yields a signal voltage of 2.154 volts. Actual pressure from the transducer, which should match the Hand-Held Device reading, is 46 psig.

STEP C5 If the pressure reading, as indicated by the above formula matches the reading of the Hand-Held Device, replace the transducer. If the pressure reading, as indicated by the above formula does not match the reading of the Hand-Held Device, replace the control board.

STEP C6 Use a digital voltmeter to measure the control transformer secondary voltage. With the scale of your meter set for AC volts, remove the power plug connected to the Protocol control and place your test leads of the meter to the two outside pins. The voltage present at these two pins should be between 20 and 27 VAC. If the secondary voltage is within limits, replace the control board. If the secondary voltage is out of limits, investigate supply voltage to the control transformer.

PROBLEM D: Temperature Sensor is not reading properly.

The temperature sensor used on Protocol is typically used to sense discharge air temperatures at the evaporator load. The sensor contains a NTC (Negative Temperature Coefficient) thermistor which will increase resistance as temperature falls and decreases resistance as temperature rises. The following table gives various points to compare temperatures versus resistance of the probe.

Temperature - Resistance Chart

degrees Fahrenheit	Ohms
-20	119700
-10	88610
-5	76580
0	66870
5	59310
10	51650
20	39450
30	30460
40	23840
50	18800
60	14890
70	11890
80	9585
90	7772

TROUBLESHOOTING ALARMS

The following section gives information on diagnosing specific alarms. The first step in analyzing alarms is to determine when the alarm occurred. The alarms will appear in the Alarm Table of the Protocol control and can be accessed by the Hand-Held Device or Hussnet. The cause, time and date of the alarm will be shown.

There are two types of alarms: switchback and non-switchback. A switchback alarm is normally the result of some external failure as seen or interpreted by the electronic control. When a switchback alarm occurs, the electronic control removes itself from control of the compressors by de-energizing the #7 relay on the control board. Operation and cycling of the compressors will be controlled by a low pressure mechanical switch, located inside the Protocol system, which will cycle one half of the compressors. The indication of alarm will be dependent upon which alarm device has been installed: autodialer, in-store alarm or HUSSNET computer system. Note that under a switchback alarm no defrosts will occur. There are three types of switchback alarms: (1) High Suction Pressure, (2) Low Suction Pressure or (3) All compressors off for more than 60 minutes.

All other types of alarms fall under the 'non-switchback' category, such as high discharge temperatures. The control will continue to cycle compressors and manage defrosts under this category of alarms. For these types of alarms, it is necessary for the HUSSNET computer system to be installed to facilitate alarm indication.

Alarm: High Suction Pressure

This alarm is one of the three 'switchback' alarms. The time delay for this condition is 30 minutes. High suction pressures are ignored during defrosts.

POSSIBLE CAUSES:
- One or more compressors are not operational
- High alarm limit is not set properly

STEP 1 If a HUSSNET computer is installed on site, proceed to Step 2. If a HUSSNET computer is not installed on site, proceed to Step 5.

STEP 2 Enter the *Graph* menu. Press the *Select Data Points* button to enter the *Data Point Selection* screen. Press the *Clear All* button to remove previously selected data points. Highlight the specific Protocol from which the alarm occurred. Choose the *Pressure #1* data point and click the OK button. Now select the *Time and Date* of the graph to correspond with when the alarm occurred (the alarm will have a time stamp associated with it in the alarm table of the control). You may want to start the graph several hours prior to the actual alarm. Now graph the data.

The alarm condition should present itself in the graph. You may need to adjust the times and scale the data point limits (Max and Min values in the *Data Graphing Setup* screen) in order to display the beginning of the alarm condition.

STEP 3 Once you have identified the alarm condition in the graph, you will need to determine the cause of the problem:

- Did the alarm occur after a defrost?
  This could indicate an excessive load condition at the evaporator

• Did the graph display discrete steps or jumps in suction pressure?

These steps may indicate compressors are going off line.

• Did suction pressure rise over a period of time?

A gradual increase could also indicate that compressors have gone off line

STEP 4 Now go to the *Equipment List* and select the Protocol in Alarm. Access the alarm table and press the *Clear Current Alarm* button. This will remove the current alarm condition. Go to Step 6

STEP 5 Enter the *Alarm Table* menu as listed in the *Protocol Main Menu* of the Hand-Held Device. Observe the time and date of the alarm. Press the *ESC* key to exit the alarm table. You will be prompted as to whether or not you want to clear the current alarm. Press the *DEL* key to remove the current alarm condition.

STEP 6 Proceed to the *Status Menu* for this Protocol. Observe the operation of compressors turning ***ON,*** as indicated by 'X's and watch for suction pressure to come down. If the suction pressure does not come down when a compressor comes on, it is an indication that some external device is keeping the compressors off line (high pressure safety, oil safety, phase monitor, etc.) You will need to go to this Protocol and investigate whether or not compressors are running.

Alarm: Low Suction Pressure

This alarm is one of the three 'switchback' alarms (See the paragraph describing switchback). The time delay for this condition is 30 minutes. Low suction pressures are ignored during defrost.

POSSIBLE CAUSES:
• Low refrigerant charge
• Low alarm limit is not set properly

STEP 1 If a HUSSNET computer is installed on site, proceed to Step 2. If a HUSSNET computer is not installed on site, proceed to Step 5.

STEP 2 Enter the *Graph* menu. Press the *Select Data Points* button to enter the *Data Point Selection* screen. Press the *Clear All* button to remove previously selected data points. Highlight the specific Protocol from which the alarm occurred. Choose the *Pressure #1* data point and click the OK button. Now select the *Time and Date* of the graph to correspond with when the alarm occurred (the alarm will have a time stamp associated with it in the alarm table of the control). You may want to start the graph several hours prior to the actual alarm. Now graph the data.

The alarm condition should present itself in the graph. You may need to adjust your times and scale the data point limits (Max and Min values in the *Data Graphing Setup* screen) in order to display the beginning of the alarm condition.

STEP 3 Once you have identified the alarm condition in the graph, you will need to determine the cause of the problem:

• Did the alarm occur after a defrost?

This could indicate a stuck solenoid valve

• Did suction pressure fall over a period of time?

A gradual decrease could be an indication of loss of refrigerant charge

STEP 4 Now go to the *Equipment List* and select the Protocol in Alarm. Access the alarm table and press the *Clear Current Alarm* button. This will remove the current alarm condition. Go to Step 6.

STEP 5 Enter the *Alarm Table* menu as listed in the *Protocol Main Menu* of the Hand-Held Device. Observe the time and date of the alarm. Press the *ESC* key to exit the alarm table. You will be prompted as to whether or not you want to clear the current alarm. Press the *DEL* key to remove the current alarm.

STEP 6 Proceed to the *Status Menu* for this Protocol. Observe the operation of compressors turning ***ON***, as indicated by 'X's. The Protocol control should begin to operate the compressors and suction pressure should be maintained. If this does not occur, you will need to further investigate the Protocol operation.

Alarm: All Compressors Off

This alarm is one of the three 'switchback' alarms (See the paragraph describing switch-back). The time delay for this condition is 60 minutes. When the electronic control has not turned on a compressor for one hour, this alarm will be triggered. This condition exists when the suction pressure, as read by the electronic control is above the low alarm limit and below the suction pressure setpoint.

Possible Causes:
• An external influence has turned ***ON*** one of more compressors
• Faulty reading from the pressure transducer

STEP 1 If a HUSSNET computer is installed on site, proceed to Step 2. If a HUSSNET computer is not installed on site, proceed to Step 4.

STEP 2 Enter the *Graph* menu. Press the *Select Data Points* button to enter the *Data Point Selection* screen. Press the *Clear All* button to remove previously selected data points. Highlight the specific Protocol from which the alarm occurred. Choose the *Pressure #1* data point and click the OK button. Now select the *Time and Date* of the graph to correspond with when the alarm occurred (the alarm will have a time stamp associated with it in the alarm table of the control). You may want to start the graph several hours prior to the actual alarm. Now graph the data.

The alarm condition should present itself in the graph. You may need to adjust your times and scale the data point limits (Max and Min values in the *Data Graphing Setup* screen) in order to display the beginning of the alarm condition.

STEP 3 Now go to the *Equipment List* and select the Protocol in Alarm. Access the alarm table and press the *Clear Current Alarm* button. This will remove the current alarm condition. Go to Step 5.

STEP 4 Enter the *Alarm Table* menu as listed in the *Protocol Main Menu* of the Hand-Held Device. Observe the time and date of the alarm. Press the *ESC* key to exit the alarm table. You will be prompted as to whether or not you want to clear the current alarm. Press the *DEL* key to remove the current alarm condition.

STEP 5 Proceed to the *Status Menu* for this Protocol. Observe the operation of compressors turning ***ON,*** as indicated by 'X's. The Protocol control should begin to operate the compressors and suction pressure should be maintained. If this does not occur, you will need to further investigate the Protocol operation.

Alarm: High Limit on Ax
Low Limit on Ax
where x is a number between 1 and 8

The *Ax* as indicated in the alarm message refers to one of the *Auxiliary Inputs* (A1 through A8). Auxiliary Inputs are normally used to provide information to the electronic control for defrosting and alarming purposes. When the Auxiliary Input is used to provide information to the control for a connected defrost load, there must be a one to one relationship between Input and Defrost circuit. For example, Auxiliary 1 must be associated with defrost circuit #1, Auxiliary 2 must be associated with defrost circuit #2 and so on.

Auxiliary Inputs contain a fixed 30 minute time delay. If the Auxiliary Input has been attached to a defrost circuit, high temperature conditions are ignored during defrost and suppressed for 45 minutes during pull down after the termination of the defrost. After the pull down period following a defrost, the 30 minute time delay will begin to count down to zero.

POSSIBLE CAUSES:

• Evaporator Coil contains frost or may not be defrosting
• Evaporator fixture has been over-loaded with product or doors have been left open
• High and Low alarm limits not set properly
• Auxiliary input has not been programmed properly

STEP 1 If a HUSSNET computer is installed on site, proceed to Step 2. If a HUSSNET computer is not installed on site, proceed to Step 4.

STEP 2 Enter the *Graph* menu. Press the *Select Data Points* button to enter the *Data Point Selection* screen. Press the *Clear All* button to remove previously selected data points. Highlight the specific Protocol from which the alarm occurred. Choose the auxiliary input that is in alarm and click the OK button. Now select the *Time and Date* of the graph to correspond with when the alarm occurred (the alarm will have a time stamp associated with it in the alarm table of the control). You may want to start the graph several hours prior to the actual alarm. Now graph the data.

The alarm condition should present itself in the graph. You may need to adjust your times and scale the data point limits (Max and Min values in the *Data Graphing Setup* screen) in order to display the beginning of the alarm condition.

STEP 3 Once you have identified the alarm condition in the graph you will need to determine the cause of the problem:

• Did the alarm occur after a defrost?
This could indicate a stuck solenoid valve
• Did the alarm occur during stocking or loading of the case?
This would be an indication of warm product being placed in the case

STEP 4 Enter the *Status* Menu as listed in the *Protocol Main Menu* of the Hand-Held Device and inspect the current condition of the input. If the auxiliary input is still above its high or low limit, go to the evaporator in which the temperature sensor is installed. Inspect the coil (for frost buildup) and the position of the product (for interference with air curtains). If the auxiliary input is within its high or low alarm limits, this is an indication that the alarm might have been a nuisance trip.

STEP 5 The next step is to confirm the existence of proper programming. First, check the high and low alarm limits for proper levels. If using the Hussnet computer, access the *Aux Input Menu* for the Protocol in alarm. If using the Hand-Held Device, access the *Sensor Setup* submenu under the *Config Menu* title.

STEP 6 Now verify that the auxiliary input has been properly assigned to its defrost circuit. If using the Hussnet computer, access the *Defrost Menu*. If using the Hand-Held Device, enter the *View/Set Items* within the *Defrost Menu*. The proper assignment of an Auxiliary Input to a defrost circuit is to have Temperature

Termination enabled. This informs the electronic control that the attached auxiliary input has been installed in this particular defrost circuit.

Important: You must maintain a one to one compatibility between auxiliary input and defrost circuit. For example: auxiliary #1 must be associated with defrost circuit #1, auxiliary #2 must be associated with defrost circuit #2, and so on.

If you do not want temperature termination to end your defrost, set the termination setpoint in the *Sensor Menu* to a very high level; i.e., 120 degrees Fahrenheit.

STEP 7 If the programming has been verified and the evaporator coil is functioning properly, refer to the Temperature Sensor checkout procedure mentioned above to determine if the sensor is reading properly.

Hussmann Corporation
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Bridgeton, MO. 63044-2483

PROTOCOL TECHNICAL FACTS BULLETIN

DATE	**October 9, 1997**

SUBJECT	1. **AUX Input Alarms** 2. **T3 Temp Alarms when configured as Pressure Input**

1. When any Aux input is selected as defrost termination input, the alarm function is automatically and irreversibly enabled. Viewing the Aux inputs in the 'Aux Input' menu will show the alarm function disabled; however this is false information. We have received several calls regarding false Lo temp alarms on Aux inputs. This has been found to be the cause in all cases. There is no 'fix' for this other than to be aware of the possibility and set appropriate Hi and Lo alarm values for all Aux inputs that are serving as defrost termination inputs.

2. When using T3 as a pressure input to monitor and alarm on discharge pressure, always use the HandHeld Device to program the parameters into the controller. If HUSSNET is used to program alarm values greater than 128 psi (which is the case for discharge pressure) erroneous data is entered into the controller that can only be cleared by clearing all memory in the controller. All other parameters can be programmed using HUSSNET. If you need to set up T3, enter it separately via the HandHeld after all other parameters have been downloaded with HUSSNET.

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PROTOCOL TECHNICAL FACTS BULLETIN

DATE	**October 28, 1997**

SUBJECT	**1) HUSSNET 3.00 Bug** **2) SMARTDRV.EXE for HUSSNET 3.00** **3) ULG Connectors for network wiring**

1. Configuration' feature from working. As of this date the corrupted file has been fixed. All future distributed copies will function properly. If you have an installation that requires a patch, download the file 'MEM_MAP.006' from the bulletin board and copy it into the *HNET* directory and the *STOREXXX* directories on the target system.

2. HUSSNET version 3.00 makes intense use of the hard disk as it swaps portions of the program in and out of RAM. To improve system performance, add the following line to the *AUTOEXEC.BAT* file:

   C:\DOS\SMARTDRV.EXE 4096 4096 /B 2048 /V

   (The above line assumes DOS is installed in the directory named DOS and that the PC has at least 4 megabytes of RAM installed.)

3. The use of ULG splices (typical telephone line crimp terminals) is not recommended when splicing stranded cable of the type recommended by HUSSMANN for HUSSNET network wiring. These splices are intended for use with solid conductor wire and do not make proper connection when applied to stranded wire. Use of these will result in a non-functional network that will be difficult to troubleshoot due to the hit or miss splices located throughout the network.

Service and Maintenance

Warning

IMPORTANT: Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor. Refer to Page 2-4.

Know whether or not a circuit is open at the power supply. Remove all power before opening control panels. NOTE: SOME EQUIPMENT HAS MORE THAN ONE POWER SUPPLY.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent lines when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.

The Water Loop should be tested for leaks using pressurized water.
DO NOT exceed 75 psig.

SERVICE

COMPRESSOR REPLACEMENT

Before beginning removal of old compressor prepare replacement compressor as folows:

Verify

Replacement compressor

- Electrical requirements
- Refrigerant application
- Capacity
- Piping hookup location and design
- Suction and discharge gaskets
- Mounting requirements

Have compressor in an easily accessible position, uncrated and unbolted from shipping pallet.

Disconnect Electrical Supply

Turn off motor and control panel power supplies to the Unit.

Turn off control circuit and open all compressor circuit breakers.

Tag and remove electrical wires from the compressor.

Isolate Compressor

Frontseat Suction and Discharge Service Valves.

Bleed compressor pressure through both discharge and suction access ports into an **approved recovery vessel.**

Remove externally mounted components which will be re-used on the replacement compressor.

Remove suction and discharge rotolocks.

Remove mounting bolts.

Plug holes per compressor manufacturer's specifications.

Install the new compressor in reverse order of removal. Do not open the new compressor to the system until the system has been leak tested and triple evacuated.

Replacing Drier

Shut down the system. Isolate the Drier to be replaced and bleed off pressure into an **approved recovery vessel.** Replace. Pressurize, leak test and bring back on line.

MAINTENANCE

Hussmann recommends the following maintenance for Protocol™ systems:

Twice a Month

1. Review store operating data on HUSSNET.

   a) Graph the various temperatures and pressures for each unit; look for unusual trends.

   b) Look through the alarm menu of each unit.

Every Six Months

1. Check water strainers at each unit. Clean as necessary.

2. Go through Protocol Checklist. See sample on next page. You should duplicate the blank checklist for your use. File the completed checklists for future reference.

3. Check and keep a record of pumping station inlet and outlet pressures.

4. Review maintenance logs. ALL service must be logged.

Every Year

1. Check freezing point of glycol in closed loop; add water or glycol as required.

2. Replace Liquid, Oil, and Suction Filters.

3. Check the Alarm functions on the pumping station. The low fluid pressure, high fluid temperature, and automatic pump switching functions should be checked.

4. If equipped with air cooled condenser, inspect and clean as necessary.

Every Two Years

Sample the closed loop fluid and have it analyzed. If this fluid contains a Dow product (Dowtherm or Dowfrost), Dow can perform the analysis. Call Dow at 1-800-447-4369 and ask for a fluid sampling kit.

Use only Mobil EAL Arctic 22 CC, ICI Emkarate RL 32CF OR Copeland Ultra 22 CC.

Turba-Shed is shipped without oil charge.

Oil Levels

Compressor top half of the sight glass

Turba-Shed between two sight glasses.

Store: Joe's Market	Location: Anytown, USA
Date: 6/7/76	Time:

Unit	K
Model Number	PH06PK-MEMEMEMEMEMF
Serial Number	
Factory Order Number	06542
Manufacture Date	08/31/93

Defrost								
Circuit NO.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Type	off	off	off	off	off	off		
No./Day	4	3	3	2	1	3		
Length	40m	45m	45m	45m	60m	45m		

Superheat	42°
Suction Set Point	52 psig
Suction Pressure	52.0 psig / 17°F Saturated
Suction Temperature	59°F
Split/Satellite Superheat	
Suction Set Point	
Suction Pressure	
Suction Temperature	
Oil	POE
Turba-shed	Between glasses
Pressure Differential	
Condenser	
Head Pressure	214.9 psig
Water Temperature In	OK
Water Temperature Out	OK
Refrigerant	404a
Receiver Level	
Liquid Sight Glass	Foamy

Protocol Checklist Example

Compressor No.	**1**	**2**	**3**	**4**	**5**	**6**
Model No.	ZF13K4	ZH13K2	ZH13K2	ZH13K2	ZF13K4	ZF15K4
Discharge Temperature	173	166	166	165	162	165
Amp Draw	10.2	10.7	10.8	11.2	10.2	12.5
Shell Temp at Oil Connect	hot	hot	warm	warm	warm	warm
Float or Oil Control Level	3/4	full	7/8	3/4	1/2	full
Oil Control Magnet Cond.						

Controller	
Alarms	
Time & Date Displayed	

NOTES:
- L.L. filter changed
- All valves were adjusted. 4 PEXH4s, 2 C-store Reach-Ins, 1 ND5 would not adjust.
- Removed T-stats from PEXH4s, ND5s, and DM.
- Raised the suct. S.P. from 48 psig to 52 psig
- All PEXH4s were cleaned. 1-2 inches of slime grew in these

Store:	Location:
Date:	Time:

Unit								
Model Number								
Serial Number								
Factory Order Number								
Manufacture Date								
Defrost								
Circuit NO.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Type								
No./Day								
Length								
Superheat								
Suction Set Point								
Suction Pressure								
Suction Temperature								
Split/Satellite Superheat								
Suction Set Point								
Suction Pressure								
Suction Temperature								
Oil								
Turba-shed								
Pressure Differential								
Condenser								
Head Pressure								
Water Temperature In								
Water Temperature Out								
Refrigerant								
Receiver Level								
Liquid Sight Glass								

Compressor No.	**1**	**2**	**3**	**4**	**5**	**6**
Model No.						
Discharge Temperature						
Amp Draw						
Shell Temp at Oil Connect						
Float or Oil Control Level						
Oil Control Magnet Cond.						

Controller	
Alarms	
Time & Date Displayed	

NOTES:

HUSSMANN®

Limited Warranty

This warranty is made to the original user at the original installation site and is not transferable.

Hussmann merchandisers are warranted to be free from defect in material and workmanship under normal use and service for a period of one (1) year from the date of original installation (not to exceed fifteen (15) months from the date of shipment from the factory). **Hussmann Impact *Modular Coils* are warranted for a total of five (5) years based upon the above criteria.** Hussmann's obligation under this warranty shall be limited to repairing or exchanging any part or parts, without charge F.O.B. factory or nearest authorized parts depot within said period and which is proven to the satisfaction of the original manufacturing plant warranty group to be thus defective.

Hussmann covers the entire case or refrigeration product and all its components (except for lamps, driers, fuses, and other maintenance type replacement parts) for the one (1) year warranty period.

Additionally, Hussmann warrants for a total period of three (3) years all sealed, multi-glass assemblies except those used in sliding doors on closed meat display cases. If within three (3) years from the date of installation (not to exceed thirty-nine (39) months from the date of shipment from factory), it shall be proven to the satisfaction of the originating factory warranty group that there is impaired visibility through the multi-glass assemblies thereof caused by moisture between the glasses, the multi-glass assembly will be replaced free of charge, F.O.B. factory. This additional warranty excludes accident, misuse, or glass breakage.

On Hussmann-Gloversville manufactured self-contained display cases, Hussmann agrees to repair or exchange, at its option, the original motor/compressor unit only with a motor/compressor of like or of similar design and capacity if it is shown to the satisfaction of Hussmann that the motor/compressor is inoperative due to defects in factory workmanship or material under normal use and service as outlined in Hussmann's "Installation Instructions" which are shipped inside new Hussmann equipment. Hussmann's sole obligation under this warranty shall be limited to a period not to exceed five years from date of factory shipment.

On Hussmann refrigeration systems (Atlanta, Bridgeton, Brantford, Chino) and self-contained display cases (Bridgeton, Brantford, Chino, Denver), an additional (4) year extended warranty for the motor/compressor assembly is available, but must be purchased prior to shipment to be in effect. Hussmann reserves the right to inspect the job site, installation and reason for failure.

The motor/compressor warranties listed above do not include replacement or repair of controls, relays, capacitors, overload protectors, valve plates, oil pumps, gaskets or any external part on the motor/compressor replaceable in the field, or any other part of the refrigeration system or self-contained display case.

THE WARRANTIES TO REPAIR OR REPLACE ABOVE RECITED ARE THE ONLY WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, MADE BY HUSSMANN WITH RESPECT TO THE ABOVE MENTIONED EQUIPMENT, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS, AND HUSSMANN NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT, ANY OTHER OBLIGATION OR LIABILITY IN CONNECTION WITH THE SALE OF SAID EQUIPMENT OR ANY PART THEREOF.

***THIS WARRANTY SHALL NOT APPLY TO LOSS OF FOOD OR CONTENTS OF THE EQUIPMENT DUE TO FAILURE FOR ANY REASON*. HUSSMANN SHALL NOT BE LIABLE:**

- For payment of labor for any removal or installation of warranted parts;
- For any repair or replacements made without the written consent of Hussmann, or when the equipment is installed or operated in a manner contrary to the printed instructions covering installation and service which accompanied such equipment;
- For any damages, delays, or losses, direct or consequential which may arise in connection with such equipment or part thereof;
- For damages caused by fire, flood, strikes, acts of God or circumstances beyond its control;
- When the equipment is subject to negligence, abuse, misuse or when the serial number of the equipment has been removed, defaced, or altered;
- When the equipment is operated on low or improper voltages
- When the equipment is put to a use other than normally recommended by Hussmann (i.e. deli case used for fresh meat);
- When operation of this equipment is impaired due to improper drain installation;
- For payment of refrigerant loss for any reason;
- For costs related to shipping or handling of replacement parts.