MISSION CRITICAL Air Conditioning Systems

12” In Row

Installation Manual

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IR-IMDOC 2017

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Site Preparation

In order to maximize operating efficiency and performance, the following areas should be observed at the site-planning stage:

- The room should be surrounded with a vapor seal to eliminate moisture migration through the building structure. Windows should be sealed and at least double-glazed to prevent sweating. All door jams should fit tightly and should not have any grilles in them. Polyethylene film type ceiling, vinyl wallpaper or plastic based paint on the walls and slabs are recommended to minimize absorption and transmission of moisture into the room.

- Owing to a generally small population, a typical room should have fresh air kept at only about 5% of the re-circulated air. This provides enough ventilation for personnel and pressurizes the room to prevent dust from entering through leaks. The incoming fresh air must be filtered very closely, and preferably pretreated. Otherwise heating, cooling, humidifying and dehumidifying loads of the incoming fresh air should be taken into account in determining total loading requirements.

- All cables and piping should be carefully routed to lower resistance to the distribution of conditioned air and to avoid the blockage of air-paths to any portion of the room. As a good practice, all cables and piping running under the raised floor should be mounted horizontally and whenever possible, routed to run in parallel with the air-path.

- In order to obtain the most effective air distribution, units should not be located too close together. Attention should be taken to avoid locating the units in an alcove or an extreme end of a long narrow room.

Location Consideration

Positioning of Indoor units

The In Row units are designed to be placed next to or in between server cabinets and racks. The flooring system should be provided with sufficient pedestal supports underneath to support the unit. The unit is provided on casters for easy movement into location and then must be leveled with the 4 leveling bolts and secured on at least one side to a server cabinet or rack.

The room layout should provide 27-1/2” (700mm) service clearance in the front and rear of the unit for the routine service and maintenance. Side access increases serviceability.

Positioning of Outdoor Heat Rejection Devices

The outdoor heat rejection devices such as air-cooled condensers and glycol coolers should be located as close to the indoor unit as possible. From a security and environment standpoint, the outdoor heat rejection devices should be installed away from public access and occupied spaces where low ambient sound level is required.

In order to avoid short circuiting and inter unit re-circulation, outdoor heat rejection devices should be located at least 1.2m (4 ft.) away from any walls or obstructions or 2.4m (8ft), from adjacent units. To ensure maintenance-free operation, outdoor heat rejection devices should be located away from the areas that are continuously exposed to loose dirt and foreign materials that may clog the coil.

The outdoor heat rejection devices should be firmly secured on steel supports or concrete plinths.

Dimensional Details

The following tables summarize the dimensional detail drawing number for In Row unit with standard options. Please refer to Appendix “A” for the dimensional detail drawings.

For units with a special option or configuration, please consult factory for details.

Electrical Installation

Power Feeding

All models are fitted with a 3-pole main isolator, neutral and earth terminal, which are located at the lower right corner of the power panel.

The isolator and terminals will accept cables up to AWG #2 ($35mm^2$) gauge. The power cables should be sized in accordance with local and national codes. Refer to the "Electrical Data" section in the Technical Data Manual for current requirements.

Refrigerant Pipe work Installation

Good practice should always be followed when connecting refrigerant piping in direct expansion systems.

As many of the operational problems encountered in a refrigeration system can be traced back to improper design and installation of refrigerant piping, it is essential that the following guidelines be observed:

- Use clean and dehydrated refrigeration quality tubing with both ends sealed.
- Cut and form tubes carefully to avoid getting dirt or metal particles into the refrigeration lines. Never use a hacksaw to cut the tubing.
- Once the system is open, complete the work as quickly as possible to minimize ingress of moisture and dirt into the system. Always put caps on ends of tubes and parts not being worked on.
- To prevent scaling and oxidation inside the tubing, pass an inert gas such as nitrogen through the line while carrying out brazing, silver soldering or any other welding processes.
- It is recommended that quality refrigeration solder (95% tin, 5% silver) be used for its excellent capillary action.
- Use minimum amount of solder flux to prevent internal contamination of the piping. Use flux with care as it is usually acidic in nature.
- Install a trap at the bottom of the vertical riser of a hot gas line and a trap for every 20 ft. (6m) in elevation to collect refrigerant and lubrication oil during off cycle.
- Insulate liquid lines that may be subjected to high heat gains. Insulate low level discharge lines to avoid burning due to accidental contact.
- Design and arrange refrigerant piping for the remote condenser in such a way so that adequate velocity of refrigerant can be maintained to prevent oil trapping. Recommended pipe sizes are tabulated as follows:

Recommended Pipe Size for Remote Condenser

Eq. length	10'	20'	30'	40'	50'	75'	100'	125'	150'
Hot gas	1/2"	5/8"	5/8"	5/8"	5/8"	3/4"	3/4"	3/4"	3/4"
Liquid	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"

Evacuation

The procedure for leakage testing and evacuation of the system is as follows:

1. Disconnect all line voltage fuses except the fuses for control transformers. Using the test mode, energize fan and all solenoid valves. (See Carel User's Guide) Open liquid line hand valve.

2. Connect a gauge manifold to the compressor suction and discharge ports.

4. Charge the system with dry nitrogen to approximately 150 psig.

5. Leave pressure in system for at least 12 hours. If pressure holds, continue with next step. If the pressure drops detect and seal leak before continuing.

6. Release all pressure.

7. Connect a vacuum pump to the compressor suction and discharge port with refrigerant or high vacuum hoses. Provide an isolating valve and a pressure gauge for pressure checking.

8. Evacuate the system to an absolute pressure not exceeding 1500 microns. Break the vacuum to 2psig with dry nitrogen. Repeat the evacuation process and then re-break the vacuum with dry nitrogen.

9. Evacuate to an absolute pressure not exceeding 500 microns. Let the vacuum pump run without interruption for minimum two hours.

10. Stop the vacuum pump. Break the vacuum and weigh in the system charge. Charge with Liquid state only of R410A (see nameplate for operating gas) through the discharge side of the compressor.

11. Allow the pressure to equalize.

Fan Speed Control System

The fan speed control system maintains not only a constant condensing pressure over a wide range of climatic conditions but also high sensible cooling for the evaporator so that re-humidification is rarely required throughout the year.

A pressure-sensitive fan speed controller is employed in the fan speed control system. It regulates the condenser head pressure at low ambient temperatures by varying the airflow volume through the condenser.

Upon engaging the interlock contact in the indoor unit, the fan speed controller will directly sense the changes in the refrigerant head pressure and vary the output voltage from 15% to 97% of the applied voltage.

Charging

Proper performance of the system depends largely on proper charging. Adhere to the following guidelines for charging:

1. Open the main isolator and insert the fuses for the fans, control transformers and the compressor.

2. Close the main isolator and allow the compressor crankcase heater to operate for at least one hour.

3. Connect the gauge manifold to both discharge and suction rotalock valves, with a common connection to the refrigerant cylinder. Purge the lines and open the refrigerant cylinder vapor valve.

4. Start the compressor using the test mode to energize the main fan and compressor.

5. Open the suction connection on the gauge manifold. Modulate the rate of charging with the gauge manifold valve. Watch the discharge pressure closely during the charging operation to ensure that the system is not overcharged. It is a good practice to weigh the amount of gas added.

6. Charge the system until the sight glass is just clear of bubbles.

7. Compare the temperature of the liquid line leaving the condenser with the saturation temperature equivalent to the condensing pressure. Continue charging until the liquid line temperature is approximately 10-15°F below the condensing temperature.

Head Pressure Control System

For condensers possibly subjected to extremely low ambient temperature, it is recommended that a head pressure control system be installed. This avoids starving the evaporator coil, with the consequence of oil clogging; short cycling on low pressure control, reduction of the system capacity and erratic expansion valve operation.

A drop in the condensing pressure often occurs in air-cooled systems as a result of low ambient conditions encountered during fall-winter-spring operation. Head pressure control renders part of the condenser surface inactive. The reduction of active condensing surface results in a rise in condensing pressure and hence provides a sufficient liquid line pressure for normal system operation. The head pressure control system allows operation at extremely low ambient temperature down to -40°F.

Climateworx uses a two-valve head pressure control with receiver, for factory ordered condensers. The ORI is located in the liquid drain line between the condenser and the receiver, and the ORD is located in a hot gas line bypassing the condenser.

During periods of low ambient temperature, the condensing pressure falls until it approaches the setting of the ORI valve. The ORI then throttles, restricting the flow of liquid from the condenser. This causes refrigerant to back up in the condenser thus reducing the active condenser surface. This raises the condensing pressure. Since it is really the receiver pressure that needs to be maintained, the bypass line with the ORD is required.

The ORD opens after the ORI has offered enough restriction to cause the differential between condensing pressure and receiver pressure to exceed 20psi. The hot gas flowing through the ORD serves to heat up the cold liquid being passed by the ORI. Thus the liquid reaches the receiver warm and with sufficient pressure to assure proper expansion valve operation. As long as sufficient refrigerant charge is in the system, the two valves modulate the flow automatically to maintain proper receiver pressure regardless of outside ambient.

Charging

When head pressure control is utilized, there must be enough refrigerant to flood the condenser at the lowest expected ambient and still have enough charge in the system for proper operation. After completing the evacuation procedures as in the fan speed control system, follow the following guidelines for charging:

1. Open the main isolator and insert the fuses for the fans, control transformers and the compressor.

2. Close the main power and allow the compressor crankcase heater to operate for at least one hour.

3. Connect the gauge manifold to both discharge and suction service ports, with the common connection to the refrigerant drum. Purge the lines and open the refrigerant drum vapor valve.

4. Start the compressor using the test mode to energize the main fan and compressor.

5. Charge R410A in Liquid state only.

6. Open the suction connection on the gauge manifold. Modulate the rate of charging with the gauge manifold valve do not exceed 15psi differential. Watch the discharge pressure closely during the charging operation to ensure that the system is not overcharged.

7. Charge the system until the sight glass is just clear of bubbles. The system is now correctly charged for operating under head pressure control at the ambient temperature charging is being carried out. It is a good practice to weigh the amount of gas added.

8. If the system is designed to operate at ambient below the ambient that exists during charging, additional charge will have to be added now.

9. Read from the following table the percentage of condenser to be flooded at charging and that at the expected minimum ambient temperature, then calculated the difference:

Ambient Temperature in °F	Percentage of Condenser to be Flooded
70	0
65	0
60	10
55	24
50	33
45	41
40	46
35	52
30	55
25	59
20	62
10	66
0	70
-10	73
-20	76
-30	77
-40	79

10 Read the charge required for flooding the complete condenser to the required minimum ambient temperature from the condenser technical data manual.

11. Multiply the value found in Step 9 by the difference in percentages calculated in Step 8; this gives the additional charge required.

Chilled-water / Water / Glycol Pipework Installation

The Chilled-water / Water / Glycol pipework should be installed in accordance with the following recommendations:

- A manual shut-off valve should be installed at the supply and return pipes of each indoor unit for routine service and emergency isolation of the unit.
- Joints installed inside the room must be kept to a minimum. The system drain discharge point should be installed outside the room.
- Piping inside the building should be insulated to eliminate the possibility of condensation under low ambient conditions.
- Always use the reverse return system when two or more indoor units are served by the same source.
- For condensing water supplied from a cooling tower, adequate filtration and an inhibitor should be added in correct quantities to prevent the formation of scale and corrosion.
- Only ethylene glycol containing a corrosion inhibitor should be used. Automotive anti-freeze is unacceptable and must not be used in the Glycol system.
- Concentration of glycol required depends on the minimum ambient temperature. The following glycol concentration is recommended:

% of ethylene glycol by weight	Minimum operating temperature °C (°F)
10	0 (32)
20	-5 (23)
30	-11.6 (11)
40	-20 (-4)
50	-32.2 (-26)

Piping Connection Size:

Liquid line	-odm	1/2
Hot gas line	-odm	5/8
Cooling coil condensate	-odm	3/4
Chilled water (when req'd)	-odm	1-1/8
Condenser water (when req'd)	-odm	1-1/8

Odm – Outside diameter of copper pipe in inches for brazing/ soldering

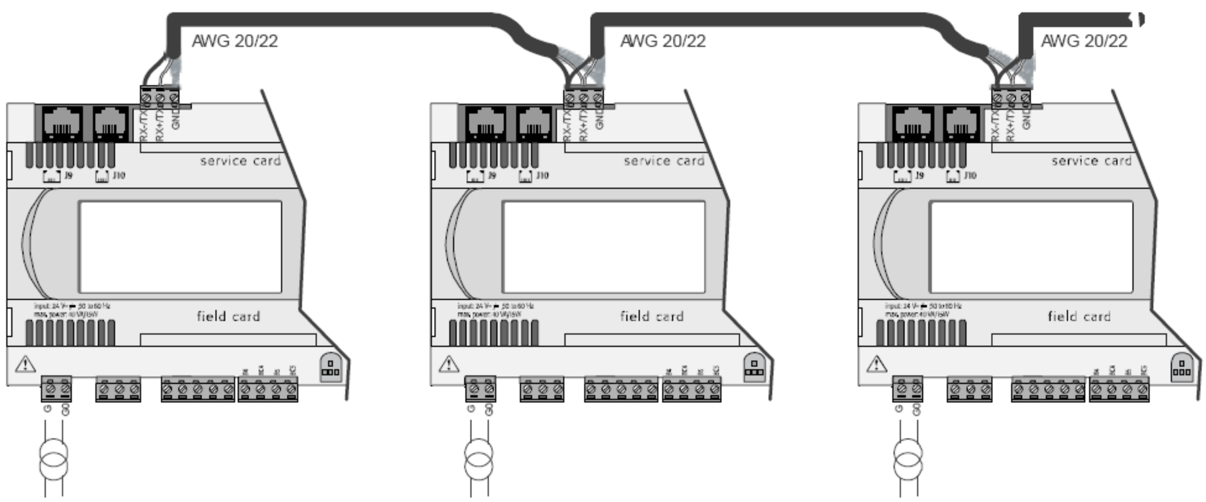
pLAN electrical connections between pCO controllers

The connection of the pCO controllers in the pLAN is carried out using an AWG20/22 shielded cable, twisted pair plus shield, with a capacitance between the wires of less than 90 PF/m.

Maximum pLAN network length: 500 m with AWG22 cable, twisted pair with shield. The boards are connected in parallel with reference to plug-in connection J11.

Important: Observe the network polarity: RX/TX+ on one board must be connected to RX/TX+ on the other boards; the same is true for RX/TX-.

The figure below shows a diagram of a number of boards connected in a pLAN network and powered by different transformers (with G0 not earthed), typical of a number of boards inside different electrical panels.



Important Warnings:

- The earth connection must be made to the same point in the earth line (same earth pole, for all the pCO boards)
- Class 2 safety transformers must be installed with the above configuration
- If the G0 terminals of the pCO controllers are connected together, connect the pLAN cable shield to one pCO only.

Temperature (Rack) Sensor Installation

1. Route the sensor through either the top or the bottom of the equipment

2. Secure the temperature sensor bulb in front of the warmest heat source in the enclosure. Do not secure in front of a blanking panel

3. Secure the temperature sensor cable to the front door of the enclosure at multiple locations using wire clips

   The sensors must be installed where lack of sufficient cooling air is most likely. The optimum position of the rack temperature sensors will vary from installation to installation.

   Servers that will most likely have insufficient or inadequately cooling air due to the recirculation of hot air from the hot aisle include:

   a. Servers positioned at the top of a rack

   b. Servers positioned at any height in the last rack at an open end of a row

   c. Servers positioned behind flow-impairing obstacles such as building elements

   d. Servers positioned in a bank of high-density racks

   e. Servers positioned next to racks with Air Removal Units (ARU)

   f. Servers positioned very far from the equipment

   g. Servers positioned very close to the equipment

Appendix A: Dimensional Drawings

Drawing Title	Drawing No.
SERIES IR – Dimensional Drawing	IRC-CAB-IBM-BID

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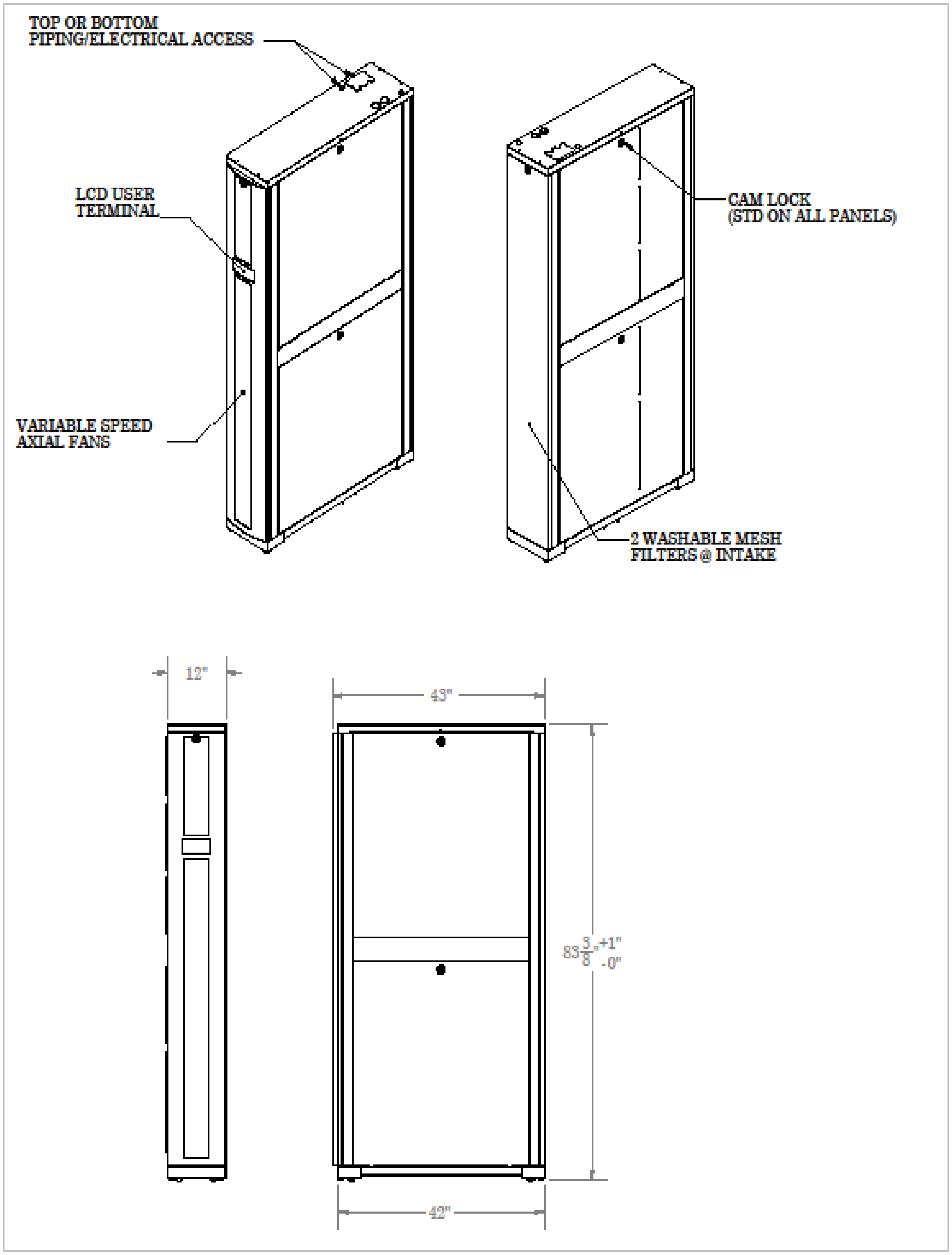
IN-ROW COOLING ASSEMBLY



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Appendix B: Piping Schematic Diagrams

Drawing Title	Drawing No.
SERIES IR – Chilled Water System Schematic	IRDS401
SERIES IR – Air Cooled System Schematic	IRDS101
SERIES IR – Water Cooled System Schematic	IRDS201

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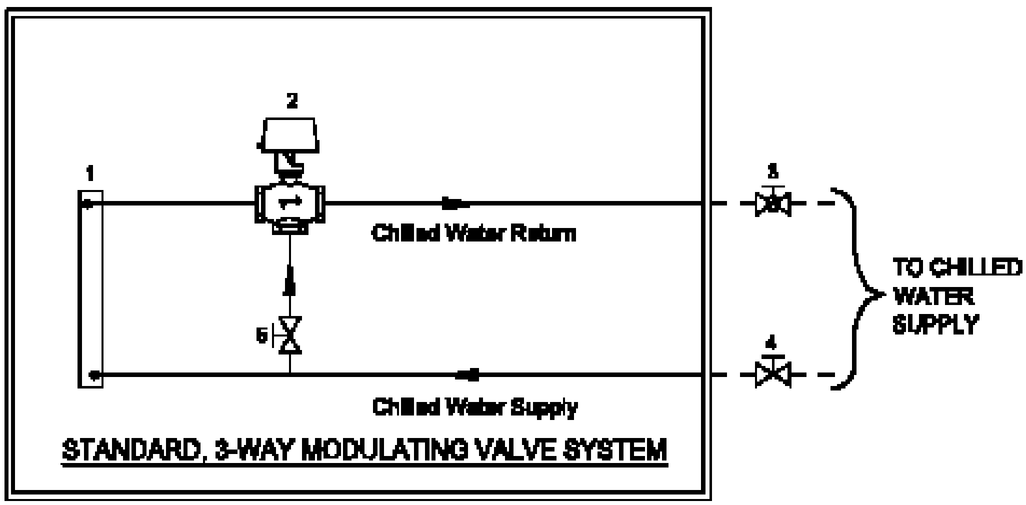
IN ROW - PIPING SCHEMATIC DIAGRAM
CHILLED WATER SYSTEM

CANATAL VERTICAL FLOOR MOUNT UNIT



COMPONENTS:

1 Cooling coil
2 3-way modulating valve
3 Globe valve (Supplied by others)
4 Gate valve (Supplied by others)
5 Ball valve

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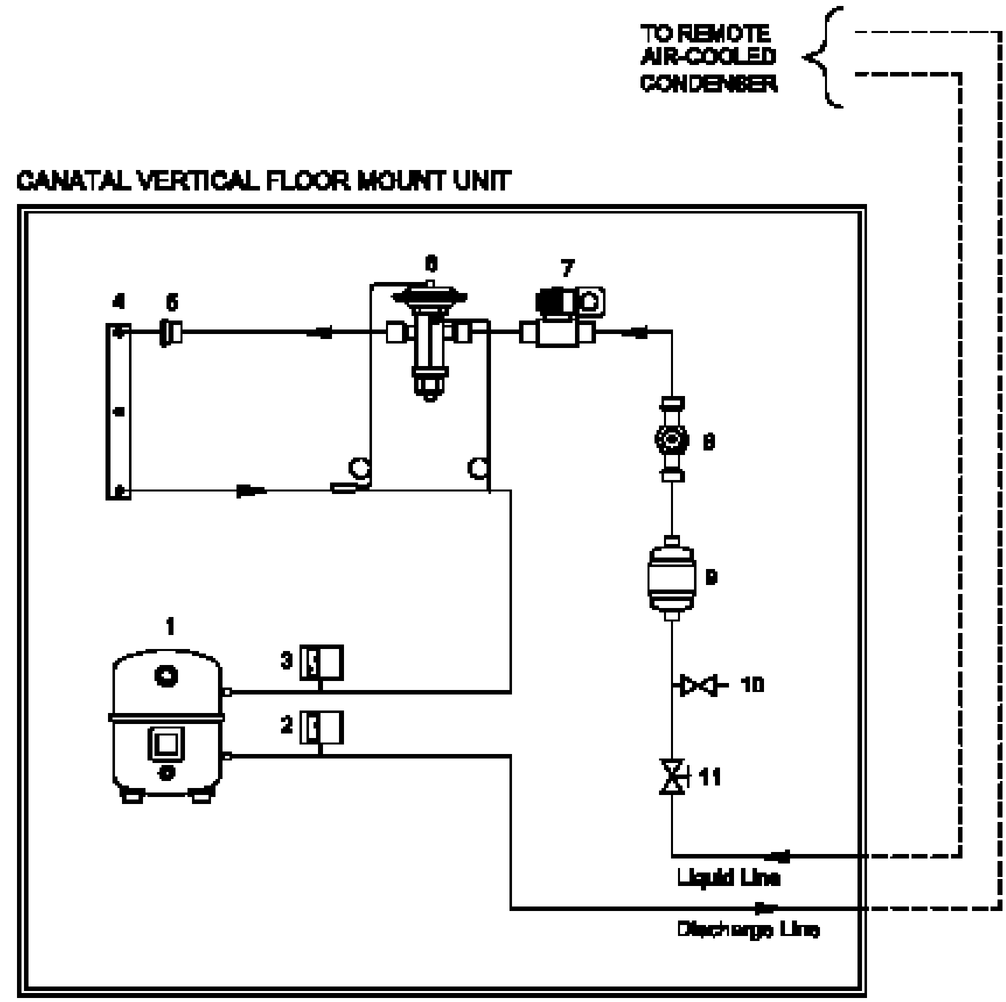
IN ROW - PIPING SCHEMATIC DIAGRAM
AIR-COOLED SYSTEM



COMPONENTS:

1 Compressor
2 High pressure switch
3 Low pressure switch
4 Evaporator
5 Refrigerant distributor
6 Thermostatic expansion valve
7 Liquid line solenoid valve
8 Sight glass
9 Filter- drier
10 Access valve
11 Shut off valve

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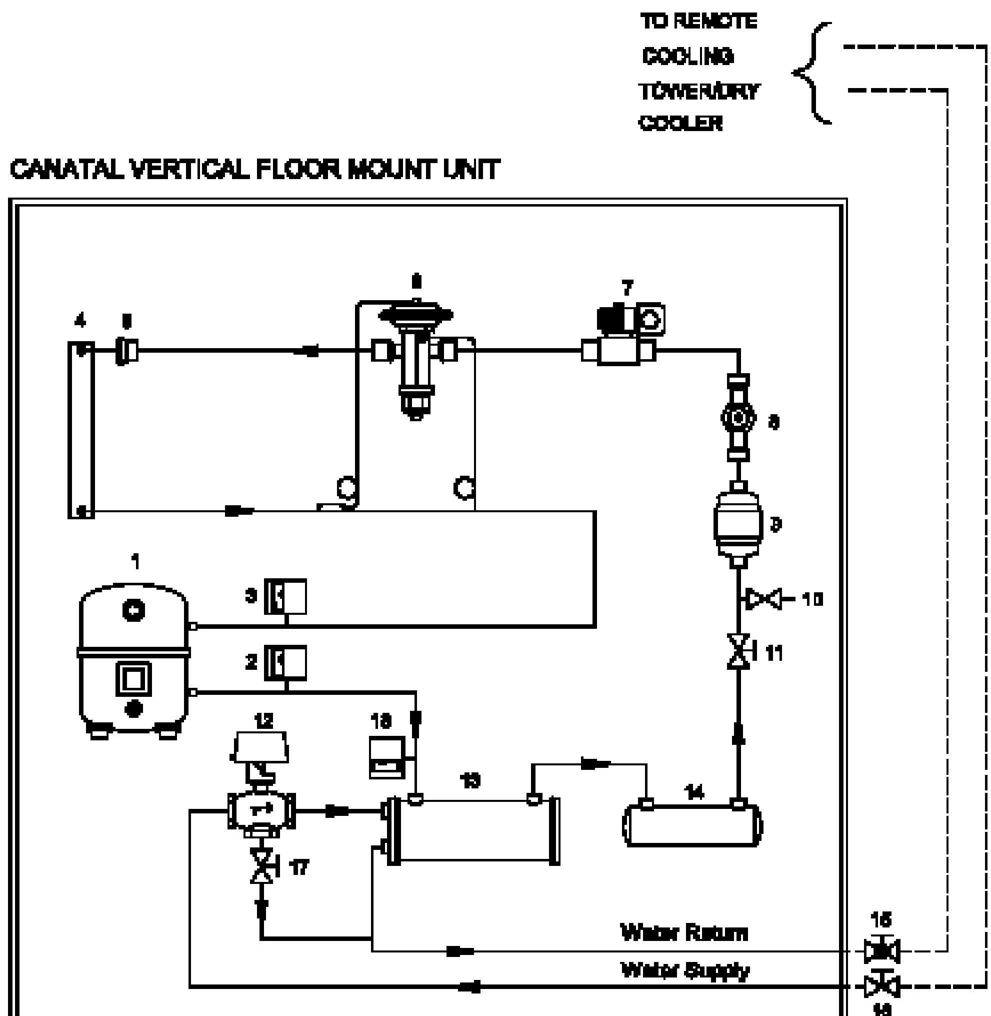
IN ROW - PIPING SCHEMATIC DIAGRAM
WATER COOLED SYSTEM (3-WAY VALVE)



COMPONENTS:

1	Compressor	10	Access valve
2	High pressure switch	11	Shut off valve
3	Low pressure switch	12	Water regulating valve (Standard 2-way)
4	Evaporator	13	Water cooled condenser
5	Refrigerant distributor	14	Receiver
6	Thermostatic expansion valve	15	Globe valve (supplied by others)
7	Liquid line solenoid valve	16	Gate valve (supplied by others)
8	Sight glass	17	Ball valve
9	Filter- drier	18	Pressure Transducer

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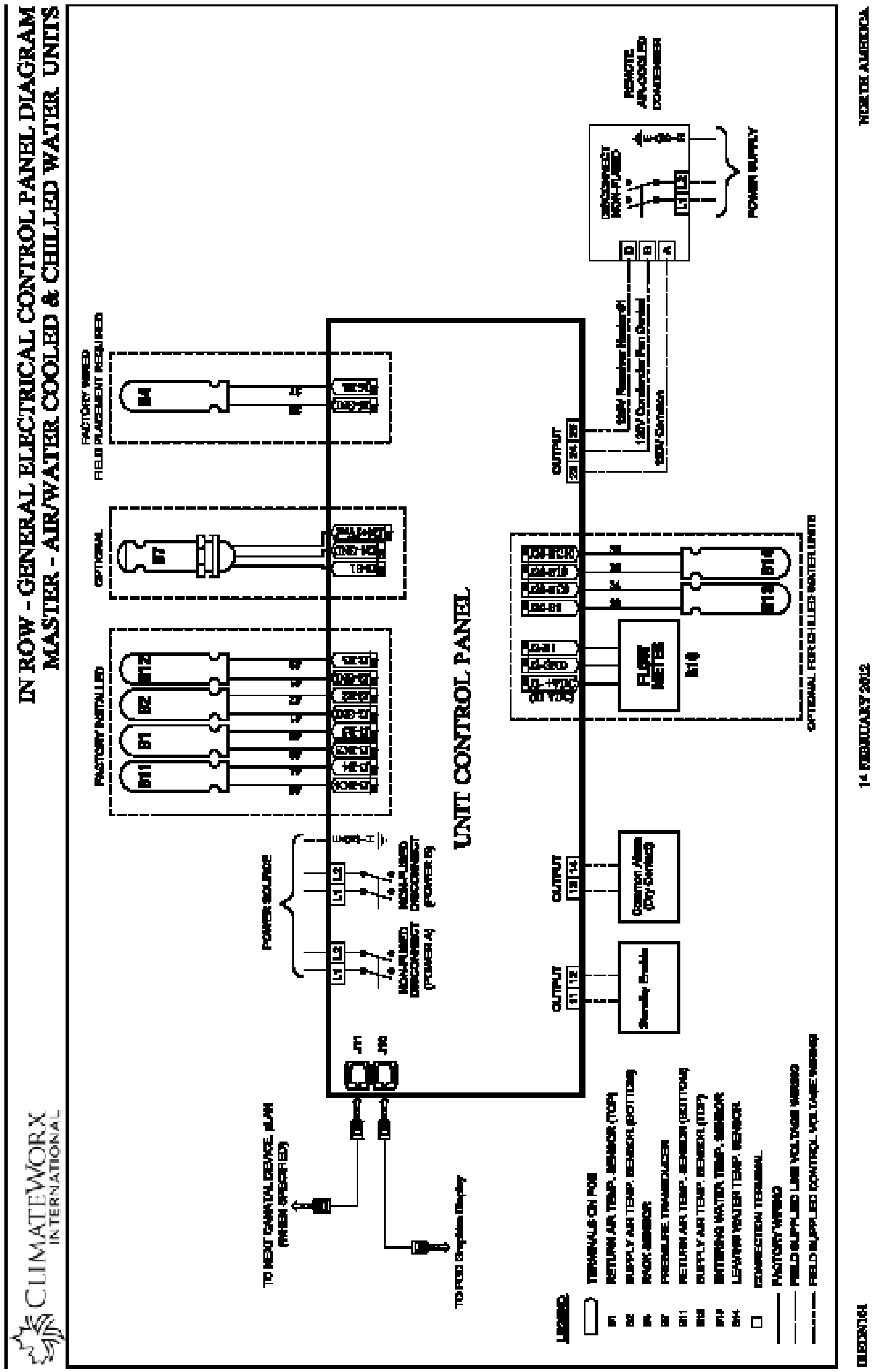
Appendix C: Electrical Schematic Diagrams

Drawing Title	Drawing No.
SERIES IN ROW – Master Air Cooled Unit Control Panel (North America)	IREDN101


IN ROW - GENERAL ELECTRICAL CONTROL PANEL DIAGRAM
MASTER - AIR/WATER COOLED & CHILLED WATER UNITS
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UNIT CONTROL PANEL
14 FEBRUARY 2012
NORTH AMERICA