Microchannel

REMOTE AIR COOLED CONDENSER

Installation and Operation Manual

Products that provide lasting solutions.

The precautions and use of the procedures described herein are intended to use the product correctly and safely. Comply with the precautions described below to protect you and others from possible injuries. Relative to their potential danger, the relevant matters are divided into four parts as defined by ANS Z535.5

ANSI Z535.5 DEFINITIONS

• **DANGER –** Indicate[s] a hazardous situation which, if not avoided, will result in death or serious injury.

• **WARNING –** Indicate[s] a hazardous situation which, if not avoided, could result in death or serious injury.

• **CAUTION –** Indicate[s] a hazardous situation which, if not avoided, could result in minor or moderate injury.

• **NOTICE –** *Not related to personal injury –* Indicates[s] situations, which if not avoided, could result in damage to equipment.

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Environmental Concerns

Hussmann recommends responsible handling of refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those that contain Hydrogen, Chlorine, Fluorine, and Carbon (HCFCs). Only certified technicians may handle these refrigerants. All technicians must be aware and follow the requirements set forth by the Federal Clean Air Act (Section 608) for any service procedure being performed on this equipment that involves refrigerant. Additionally, some states have other requirements that must be adhered to for responsible management of refrigerants.

⚠ WARNING

— LOCK OUT / TAG OUT —

To avoid serious injury or death from electrical shock, always disconnect the electrical power at the main disconnect when servicing or replacing any electrical component. This includes, but is not limited to, such items as controllers, electrical panels, condensers, lights, fans, and heaters. PE) ervice this equipment. Personal Protection Equipment (PPE) is required whenever servicing this equipment. Wear safety glasses, gloves, protective boots or shoes, long pants, and a long-sleeve shirt as required when working with this equipment. Observe all precautions on tags, stickers, labels and literature attached to this equipment.

⚠ CAUTION

Contractors shall strictly adhere to specifications provided by the Engineer of Record (EOR), as well as US Environmental Protection Agency regulations, OSHA regulations, and all other federal, state and local codes. This work should only be done by qualified, licensed contractors. There are numerous hazards, not limited to, but including: burns due to high temperatures, high pressures, toxic substances, electrical arcs and shocks, very heavy equipment with specific lift points and structural constraints, food and product damage or contamination, public safety, noise, and possible environmental damage. Never leave operating compressors unattended during the manual soft-start process. Always power rocker switches off when unattended.

⚠ WARNING

Proper Field Wiring and Grounding Required! Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

FOR CALIFORNIA INSTALLATIONS ONLY:

⚠ WARNING:

Cancer and Reproductive Harm
www.P65Warnings.ca.gov

August 31, 2018   3069575

This warning does not mean that Hussmann products will cause cancer or reproductive harm, or is in violation of any product-safety standards or requirements. As clarified by the California State government, Proposition 65 can be considered more of a 'right to know' law than a pure product safety law. When used as designed, Hussmann believes that our products are not harmful. We provide the Proposition 65 warning to stay in compliance with California State law. It is your responsibility to provide accurate Proposition 65 warning labels to your customers when necessary. For more information on Proposition 65, please visit the California State government website.

⚠ CAUTION

This manual was written in accordance with originally prescribed equipment that is subject to change. Hussmann reserves the right to change all or part of the equipment for future stores such as, but not limited to, controllers, valves and electrical specifications. It is the installers responsibility to reference the refrigeration drawings supplied for each installation, as directed by the Engineer of Record.

⚠ WARNING

This equipment is prohibited from use in California with any refrigerants on the "List of Prohibited Substances" for that specific end-use, per California Code of Regulations, title 17, section 95374.

Use in other locations is limited to refrigerants permitted by country, state, or local laws and is the responsibility of the installer/end-user to ensure only permitted refrigerants are used.

This disclosure statement has been reviewed and approved by Hussmann and Hussmann attests, under penalty of perjury, that these statements are true and accurate.

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1   RECEIPT OF EQUIPMENT

1.1   *INSPECTION*

All equipment should be carefully checked for damage or shortages as soon as it is received. Each shipment should be carefully checked against the bill of lading. If any damage or shortage is evident, a notation must be made on the delivery receipt before it is signed and a claim should then be filed against the freight carrier. **Inspection and claims are the responsibility of the recipient.**

1.2   *LOSS OF GAS HOLDING CHARGE*

The refrigeration coil section of each Microchannel unit is leak tested, evacuated to remove moisture and then shipped with a pressurized nitrogen gas holding charge. Absence of this charge may indicate a leak has developed in transit. The system should not be charged with refrigerant until it is verified that there is no leak, or the source of the leak is located and repaired if necessary.

2   MODELS AND DIMENSIONS

2.1   *UNIT MODELS*

Units are available with 30" diameter fans and a variety of motor speeds and horsepower. All units are designed for vertical air discharge. Each unit is constructed for the refrigerant and internal working pressure that is indicated on the unit nameplate. All units contain the UL, cUL, and CSA labels to indicate the unit was manufactured using acceptable practices by the governing bodies.

MODEL KEY

MX	K	-	10	M

Unit Type

MX - Microchannel

Voltage

K - 208-230/3/60
M - 460/3/60
P - 575/3/60
U - 380/3/50**

Fan/Motor Combination

A - 850 rpm, 1hp, 30"
C - 850 rpm, 1.5 hp, 30"
E - 575 rpm, 0.5 hp, 30"
F - 1140 rpm, 1.5 hp, 30"
K - 1140 rpm 1.5 hp, 30"*

Number of Fans

2	10
4	12
6	14
8	

*Variable speed motor

** 10% capacity derate on all motors except K

2.2 UNIT DIMENSIONS AND MOTOR AMPS

Figure 1 UNIT DIMENSIONS

Table 1 UNIT DIMENSIONS

MODEL	DIMENSIONS (inches)						
	L	W	H*	A	B	C	D
MX*-02	44	95	64	39	-	-	11
MX*-04	88	95	64	83	-	-	55
MX*-06	132	95	64	127	-	-	55
MX*-08	176	95	64	83	-	-	55
MX*-10	220	95	64	83	49	-	55
MX*-12	264	95	64	83	93	-	55
MX*-14	308	95	64	44	83	93	55

* A, C, E, F or K

Microchannel Remote Air Cooled Condensers (PN E660159_K)

Figure 2 UNIT DIMENSIONS – K FAN MOTOR MODEL
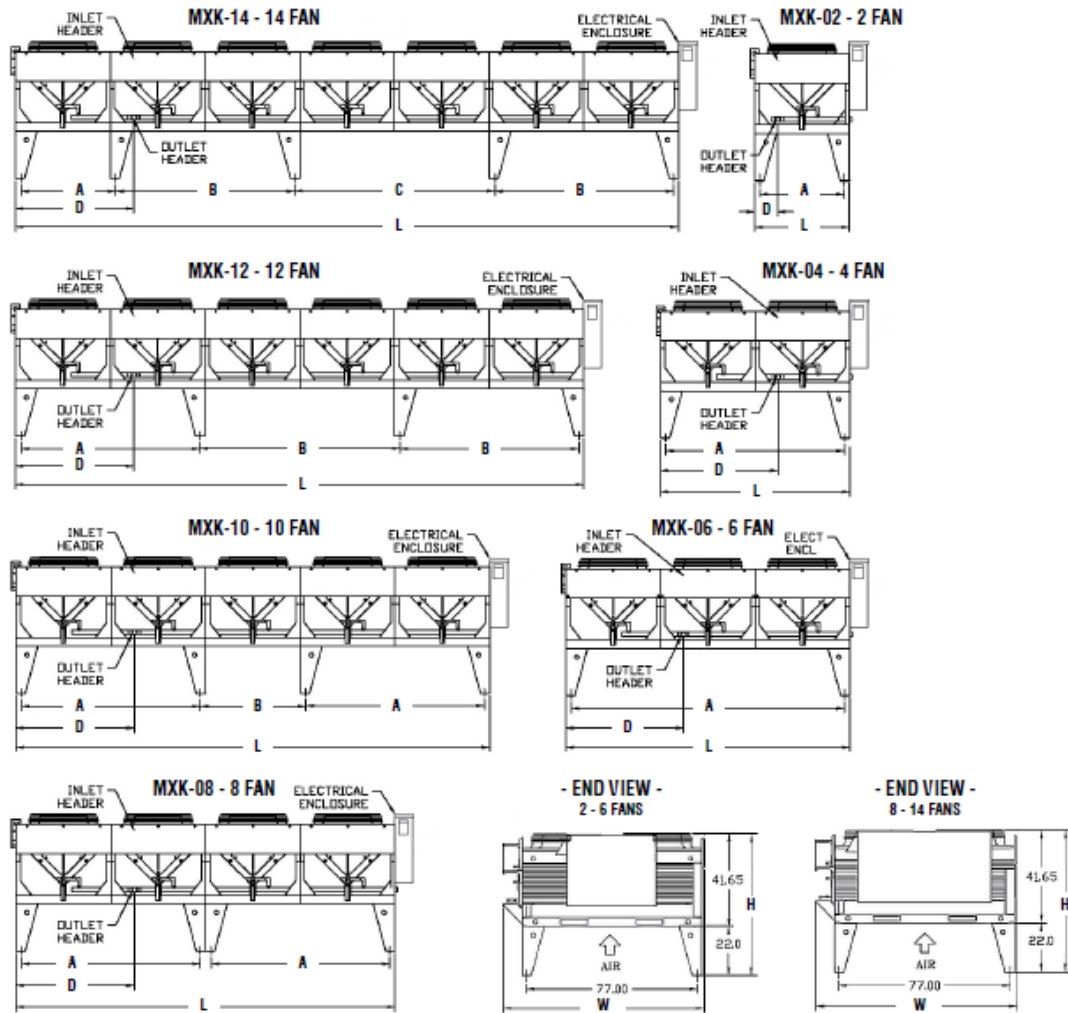
Table 2A UNIT DIMENSIONS

	DIMENSIONS (inches)						
MODEL	L	W	H*	A	B	C	D
MX*-02	44	95	64	39	-	-	11
MX*-04	88	95	64	83	-	-	55
MX*-06	132	95	64	127	-	-	55
MX*-08	176	95	64	83	-	-	55
MX*-10	220	95	64	83	49	-	55
MX*-12	264	95	64	83	93	-	55
MX*-14	308	95	64	44	83	93	55

* A, C, E, F or K

Note: K motor units come with a nonstandard control panel that is 3 inches deeper than the standard panel. All the other dimensions are the same as the ones for the standard units.

Figure 3 UNIT DIMENSTIONS WITH MOUNTED RECEIVER

MOUNTING DIMENSIONS TYPICAL ALL RECEIVER MODELS
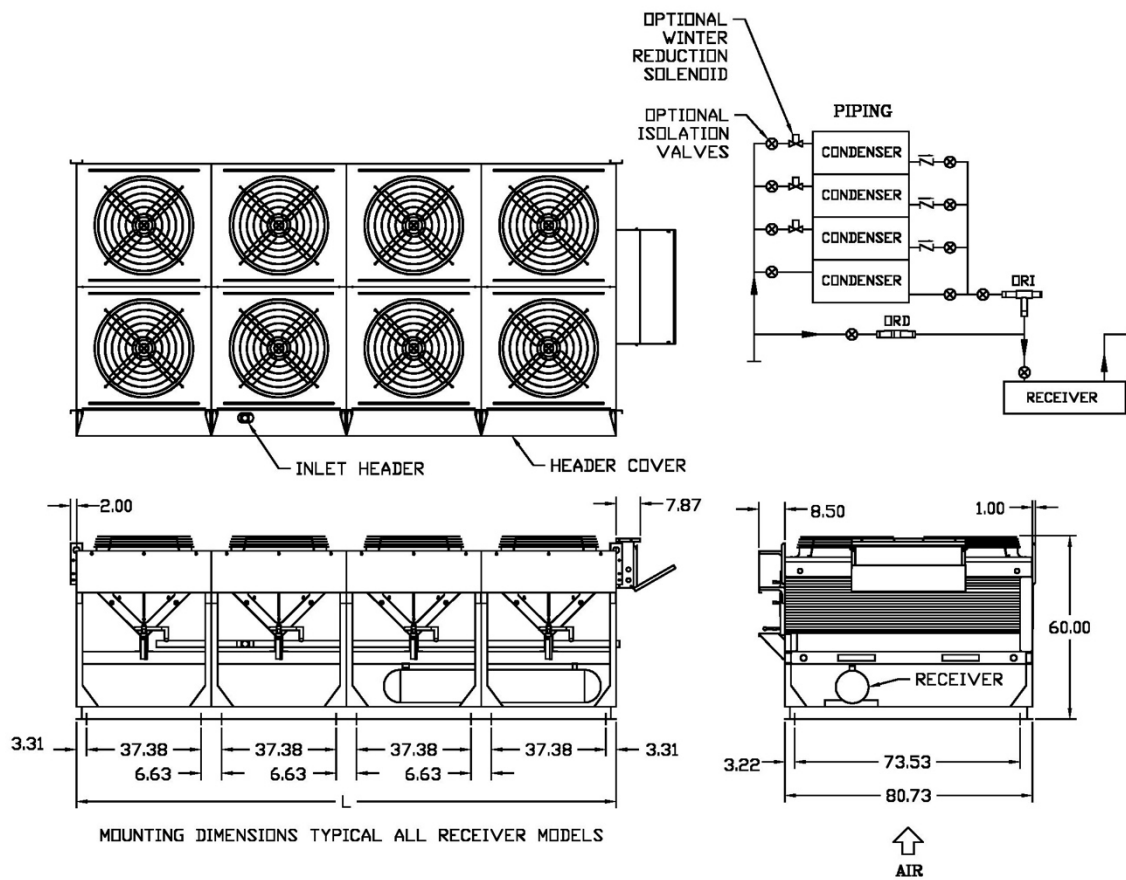
2.3 UNIT MOTOR AMPS

The following table contains the motor amps for the available fan motors.

Table 3 UNIT FULL LOAD MOTOR AMPS

MX MODEL	RPM	HP	FAN MOTORS TOTAL FULL LOAD AMPS			
			208-230/3/60	380/3/50	460/3/60	575/3/60
MXE-02	575	0.5	6.8	2.8	3.2	2.9
MXE-04			13.6	5.6	6.4	5.8
MXE-06			20.4	8.4	9.6	8.7
MXE-08			27.2	11.2	12.8	11.6
MXE-10			34.0	14.0	16.0	14.5
MXE-12			40.8	16.8	19.2	17.4
MXE-14			47.6	19.6	22.4	20.3
MXA-02	850	1	9.6	4.6	4.8	3.6
MXA-04			19.2	9.2	9.6	7.2
MXA-06			28.8	13.8	14.4	10.8
MXA-08			38.4	18.4	19.2	14.4
MXA-10			48.0	23.0	24.0	18.0
MXA-12			57.6	27.6	28.8	21.6
MXA-14			67.2	32.2	33.6	25.2
MXC-02	850	1.5	13.8	5.8	6.6	5.0
MXC-04			27.6	11.6	13.2	10.0
MXC-06			41.4	17.4	19.8	15.0
MXC-08			55.2	23.2	26.4	20.0
MXC-10			69.0	29.0	33.0	25.0
MXC-12			82.8	34.8	39.6	30.0
MXC-14			96.6	40.6	46.2	35.0
MXF-02	1140	1.5	10.8	4.2	5.0	5.0
MXF-04			21.6	8.4	10.0	10.0
MXF-06			32.4	12.6	15.0	15.0
MXF-08			43.2	16.8	20.0	20.0
MXF-10			54.0	21.0	25.0	25.0
MXF-12			64.8	25.2	30.0	30.0
MXF-14			75.6	29.4	35.0	35.0
MXK-02	1140	1.5	10.8	7.6	6.0	N/A
MXK-04			21.6	15.2	12.0	N/A
MXK-06			32.4	22.8	18.0	N/A
MXK-08			43.2	30.4	24.0	N/A
MXK-10			54.0	38.0	30.0	N/A
MXK-12			64.8	45.6	36.0	N/A
MXK-14			75.6	53.2	42.0	N/A

2.4 *UNIT WEIGHTS, SOUND AND REFRIGERANT CHARGES*

The following table contains approximate unit shipping weights and refrigerant charges. The Summer Charge is based on 25% of condenser volume with 86°F liquid. The Winter Charge is based on 90% of condenser volume with –20°F liquid.

Table 4 UNIT WEIGHTS, SOUND AND REFRIGERANT CHARGES

MX MODEL	Sound Pressure dB @ 10 ft	Summer Operating Charge R-404A (lbs.)	Additional Winter Flooding Charge* R-404A (lbs.)	Shipping Unit Weight** (lbs.)	Shipping Unit Weight w/receiver *** (lbs.)
MXE-02	55	4	12	560	N/A
MXE-04	58	15	26	1,170	1,780
MXE-06	59.8	23	40	1,705	2,420
MXE-08	61	40	55	2,280	3,190
MXE-10	62	52	70	2,850	3,860
MXE-12	62.8	80	88	3,385	4,500
MXE-14	63.4	108	119	3,920	5,200
MXA-02	65.9	4	12	560	N/A
MXA-04	68.9	15	26	1,170	1,780
MXA-06	70.7	23	40	1,705	2,420
MXA-08	71.9	40	55	2,280	3,190
MXA-10	72.9	52	70	2,850	3,860
MXA-12	73.7	80	88	3,385	4,500
MXA-14	74.3	108	119	3,920	5,200
MXC-02	67.4	4	12	560	N/A
MXC-04	70.4	15	26	1,170	1,780
MXC-06	72.2	23	40	1,705	2,420
MXC-08	73.4	40	55	2,280	3,190
MXC-10	74.4	52	70	2,850	3,860
MXC-12	75.2	80	88	3,385	4,500
MXC-14	75.8	108	119	3,920	5,200
MXF-02	74.5	4	12	560	N/A
MXF-04	77.5	15	26	1,170	1,780
MXF-06	79.3	23	40	1,705	2,420
MXF-08	80.5	40	55	2,280	3,190
MXF-10	81.5	52	70	2,850	3,860
MXF-12	82.3	80	88	3,385	4,500
MXF-14	80	108	119	3,920	5,200
MXK-02	74.5	4	12	575	N/A
MXK-04	77.5	15	26	1193	1,803
MXK-06	79.3	23	40	1736	2,451
MXK-08	80.5	40	55	2320	3,230
MXK-10	81.5	52	70	2898	3,908
MXK-12	82.3	80	88	3441	4,556
MXK-14	80	108	119	3984	5,264

* Additional Winter Flooding Charge shown is without Module Isolation / Reduction.
** Unit weight includes "Ship Loose" leg weights.
*** Unit weight includes frames, valves and piping.

3   UNIT LOCATION

The Microchannel units require adequate space to allow unrestricted ambient airflow in to and out of the fan section. Figure 4 gives general rules of the location of an air-cooled condenser in different situations. The distances shown in the sketches should be increased whenever possible. The unit position relative to the prevailing winds should be considered. Note that higher than expected head pressures will result in poor system operation if the following suggested distances are not used.

So that the unit performs as predicted, it should be located away from heated air exhausts, steam vents, or corrosive airflow whether it comes from the job site or from another nearby source. A corrosive atmosphere will require an appropriate coil coating or copper fins to protect the coil and extend the life of the unit.

Unit location with regard to noise should also be considered. An air-cooled condensing unit should be located away from noise and vibration sensitive spaces to avoid transmission into workspaces.

Figure 4 LOCATION REQUIREMENTS

Walls or Barriers
For proper airflow and access, all sides of the unit should be a minimum of "W" away from any wall or barrier. Enough space should be allowed for all maintenance work. Overhead obstructions are not allowed.
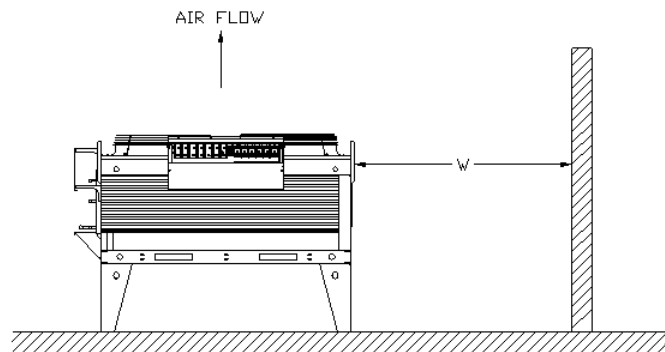
Decorative Fences
Fences must have 50% free area, with 1 foot undercut, a "W" minimum clearance, and must not exceed the top of the unit.
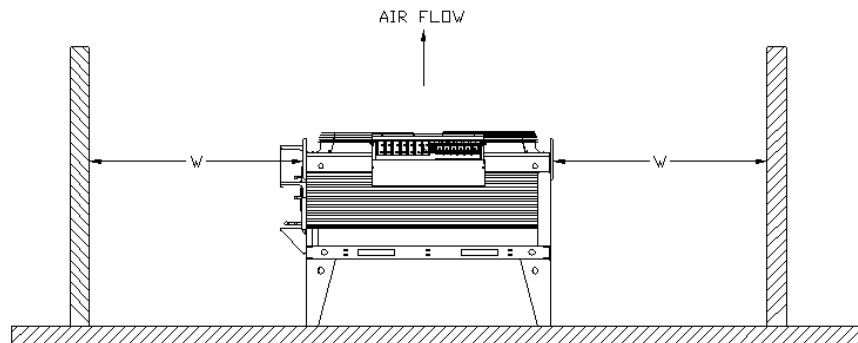
W = Total width of the air-cooled condensing unit.

4   RIGGING

The Microchannel units are designed to be lifted using the leg support channels. The unit mounting leg assemblies are best attached when the unit is in the flat, fans facing up, and supported by the rigging. Take special care not to bump, hit, or otherwise stress the tubing, headers, or connections during the lifting and positioning of the unit. Under no circumstances should the coil headers be used in lifting or moving the unit. See Figure 5 for the designated lifting points and lift methods for all unit sizes. See Table 2 for approximate unit weights.

Figure 5 RIGGING
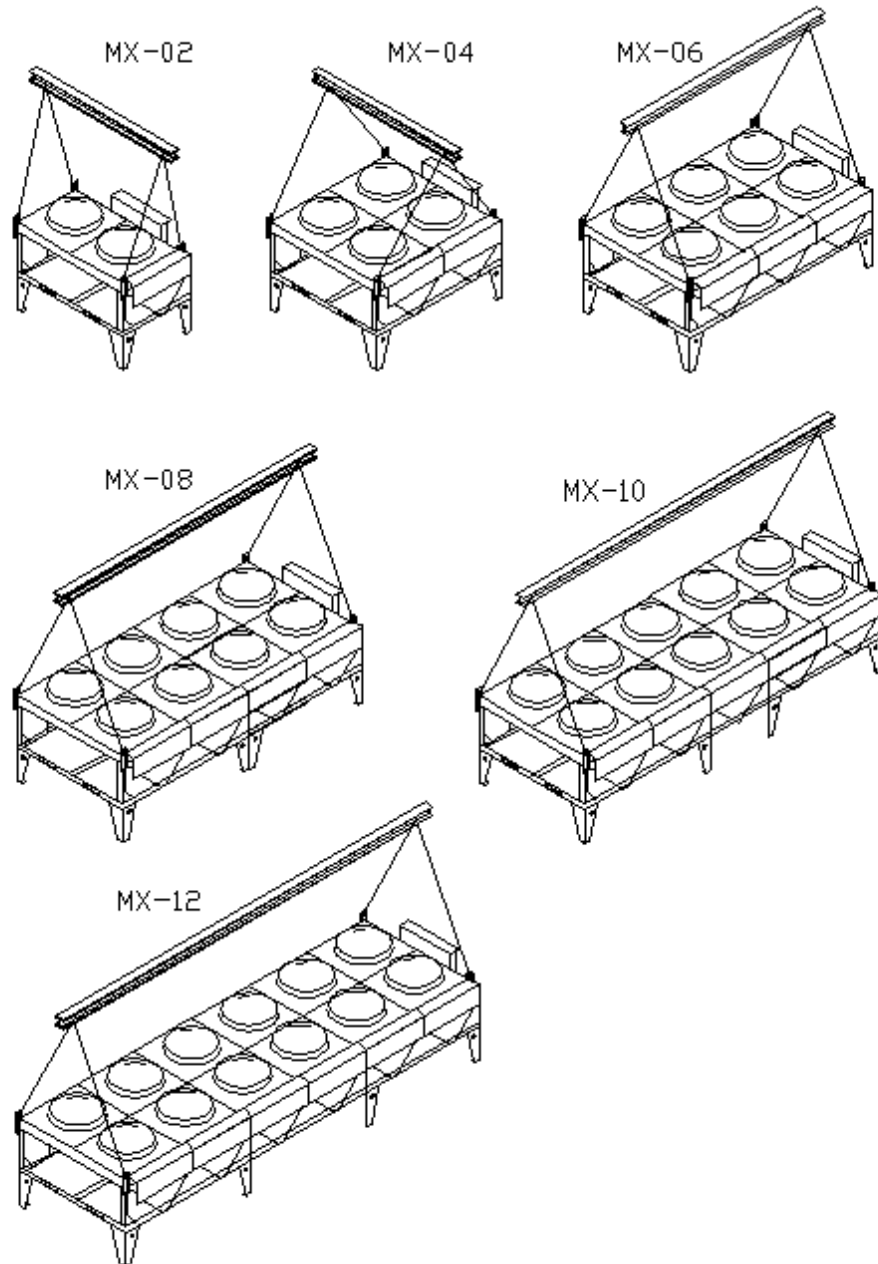
STATIONARY LIFTING POINTS FACTORY MOUNTED. OUTER SUPPORT LEGS (IF REQUIRED) SHIPPED LOOSE FOR FIELD INSTALLATION BY OTHERS WITH NECESSARY BOLTS, WASHERS AND NUTS

INCLUDED (SEE SECTION 5.1 FOR LEG MOUNTING INSTRUCTIONS). UNDER NO CIRCUMSTANCES SHOULD CONDENSER MANIFOLDS OR THE ELECTRICAL ENCLOSURE BE USED FOR LIFTING OR MOVING THE UNITS!

5   UNIT ASSEMBLY

5.1 *LEG ASSEMBLY*

For Microchannel fans that will blow air in a vertical direction, the unit is supported by formed, mill galvanized, channel legs that provide a standard 22" of clearance from the bottom of the leg to the bottom of the coil section. Install the legs on the unit before rigging the unit into place with the hardware provided with the unit. If extended legs are ordered to provide additional clearance, the leg attachment is the same as the standard leg.

Figure 6 STANDARD LEGS ASSEMBLY
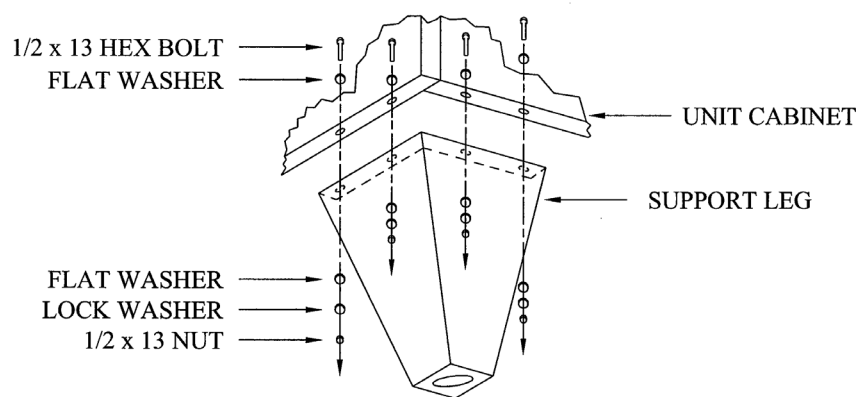
6   INSTALLATION AND PIPING

6.1 *MOUNTING THE UNIT*

The unit must be installed on a firm, level base to assure optimum unit performance. The mounting legs should be securely fastened at their base to the steel or concrete of the supporting base. For roof mounted installations, the steel supporting base holding the unit should be elevated above the roof and fastened to the columns or load bearing walls of the building.

6.2 *REFRIGERATION PIPING*

All jobsite refrigeration piping connecting the condenser to the system should conform to the applicable local and state codes as well as to the latest ASIB B9.1 and B31.5 standards. Use the proper pipe sizes for the installation. Follow good commercial piping practices throughout the installation, which includes properly bracing the lines.

Note: The inlet and outlet manifold headers are not designed to support field piping.

AC&R type copper tubing should be used throughout. Cut tubing with a wheel-type cutter and not a hacksaw. Deburr before assembly in the fittings. NOTE: if the onsite tubing lengths to be used were not capped (i.e., are not perfectly clean) they should be dragged internally with a clean, lint-free rag before fabricating into the system. Soft solders are not to be used. Always clean all pipe and fitting areas that will be brazed with the proper grade emery cloth. Plan to use only oxy-acetylene brazing. A higher content silver brazing rod must be used to avoid excessive use of flux, less it be pushed into the system piping, which will create problems later. Use a silver solder which contains sufficient silver content necessary for joint strength and flexibility yet requires minimum use of flux. For copper-to-copper joints,

use a phos-copper solder with 15% silver content. Some easy-flow types require no flux, and the resultant joints are of maximum strength without brittleness. Nitrogen should be used to purge the air from the connecting tubing during brazing in order to prevent copper oxide formations.

A pressure tap valve should be installed at the highest point in the condenser inlet piping run to facilitate the removal of inadvertently trapped non-condensable gases from the system. The purging process should only be done with the compressor system off and pressures equalized. Do not endeavor to do this unless you are qualified and have the proper reclaim/recovery equipment mandated by the EPA.

Under sizing connecting lines will cause several problems in the refrigeration system. High pressure drop in the discharge line takes away from the system's capacity as well as resulting in excessive power usage.

Sizing a discharge line too large will inhibit compressor lube oil circulation. The proper balance is to design discharge lines for approximately 4000 ft/min velocity in vertical risers and can be lowered to 2000 ft/min in sloped horizontal runs. "P" traps should be installed at the base of all vertical discharge riser lines to facilitate proper oil return to the compressor. This is especially true immediately downstream of the compressor in order to prevent refrigerant liquid and/or oil migrating back into the compressor heads when the compressor is not running.

Figure 7 UNIT MOUNTING AND PIPING
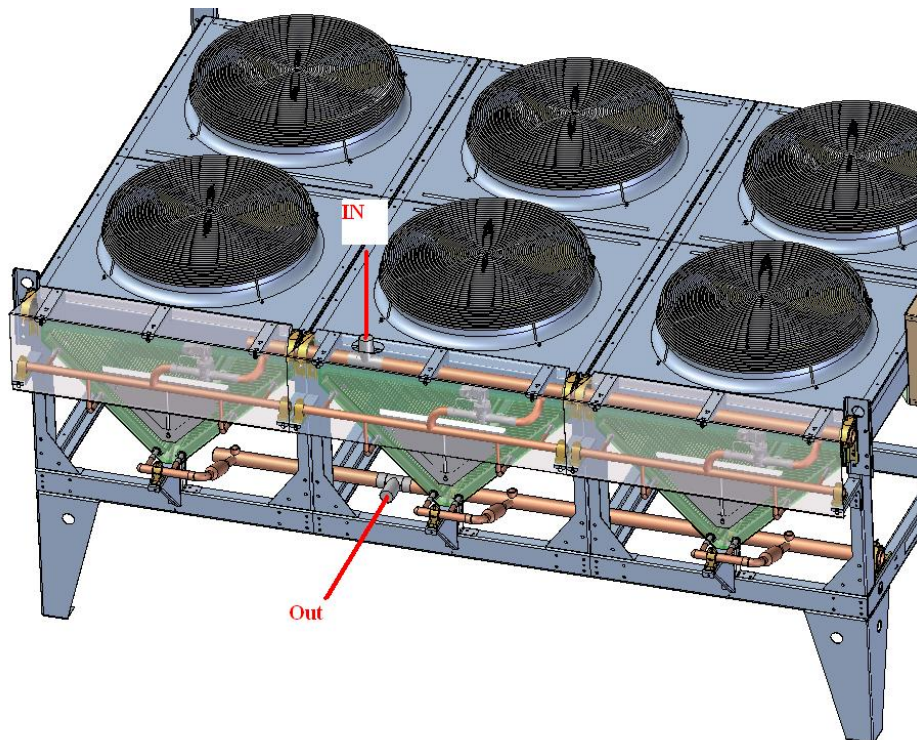
High pressure drop in the liquid line can result in the complete reduction of the liquid sub cooling, thus causing flash gas at the expansion valve. Coil starving and reduced capacity will be the result. Liquid lines can also be misapplied if sized too large. The sizing affects the oil-to-refrigerant mixture ratio as well as necessitating charging the system with an excessive amount of refrigerant. Proper sizing of both the discharge and liquid lines is a necessity for a properly working system. A line sizing guide is available on Hussmann's website to assist with this process.

Generally, horizontal piping runs should grade slightly downwards in the direction of flow. Liquid line piping must be arranged so that it is free draining from the condenser to the receiver. It is best to pipe

liquid lines so that there is an immediate drop of 2 to 3 feet at the condenser outlet before any field headering or horizontal run. The liquid line must be free of any traps or loops and constantly be pitched downhill towards the receiver. Avoid long horizontal lines on roofs. The liquid line is to be sized so the velocity does not exceed 100 feet per minute. Where the ambient temperature can be below the equipment room temperature, a check valve must be installed in the liquid line to prevent liquid migration at the condenser.

Provisions must be made to accommodate expansion and contraction of the lines, especially if the lines have long runs with few elbows or bends. The lines must also be adequately supported at frequent intervals in accordance with good piping practice. It is necessary that field bracing provide adequate support at the condenser connections.

Special precautions must be taken if the refrigeration system is a multiple parallel and/or the condenser is mounted substantially higher than the compressor unit. A double riser discharge line should be used as shown in Figure 8. Such arrangement is necessary to facilitate compressor lube oil return to the compressor crankcase.

Pressure testing of the piping should be done as soon as the field piping has been completed. The high-side test pressure should not exceed the condenser unit UL nameplated pressure. Nitrogen may be used to increase the trace refrigerant pressure for leak testing. It is recommended that an electronic type leak tester be used. Shipping vibrations can stress joints, thus producing operating leaks that would otherwise go undetected from just a low-pressure holding charge. Therefore, check for leaks at all joints, field and factory, before charging the system.

NOTE: If automatic isolating valves are used to shut down modules of the condenser during winter operation, precautions must be employed to eliminate hydraulic shock when the valves are opened for warmer weather operation. This supplementary valving must not be supported from or by the condenser header(s).

Figure 8 DOUBLE RISER DISCHARGE ARRANGEMENT

PITCH

HOT GAS TO CONDENSER

RISER "A"

RISER "B"

Riser "A" sized so that the combined cross sectional area of both risers is equal to the cross sectional area of what a single riser would be at full load.

Riser "B" sized for minimum load condition.

COMPRESSOR DISCHARGE

TRAP
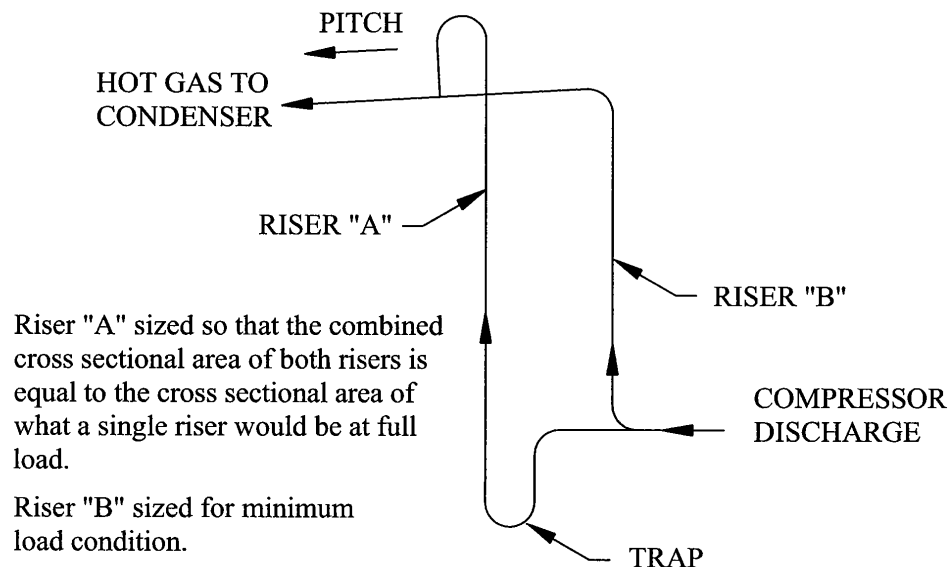
6.3 *HOLDBACK FLOODING CONTROL*

Figure 9 shows typical piping drawings for flooding control arrangements of Microchannel condensers.

Figure 9 HOLDBACK FLOODING CONTROL ARRANGEMENTS

* LARGER CAPACITY SYSTEMS MAY REQUIRE
  MULTIPLE VALVES IN PARALLEL
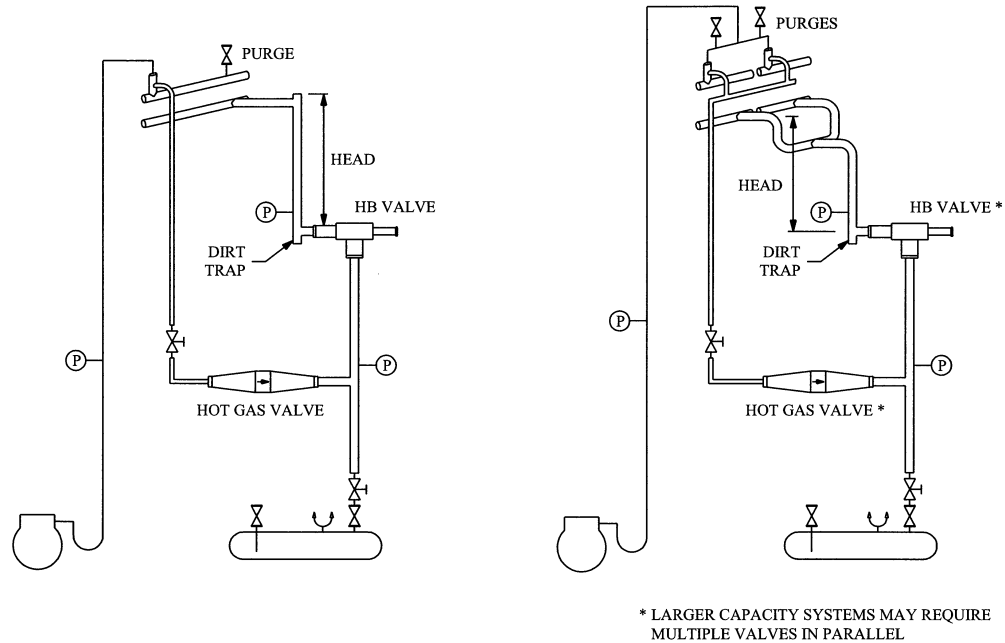
7 ELECTRICAL

⚠️ **WARNING: All power supply to the unit must be shut off before opening any compartments, cleaning or performing maintenance.**

If the Microchannel unit is equipped with an electrical power disconnect switch make sure the switch is in the **"OFF"** position, preferably locked in this position, before any electrical work is performed to the unit.

The Microchannel unit can be arranged at the factory so that each motor is wired to individual terminal blocks, in which case each motor requires individual power wiring, or the motors can be wired to a fan cycling control panel which requires only one set of power wires. The fan cycling control panel can consist of a series of pressure/temperature controllers or a printed circuit board. See the electrical drawing that accompanies the unit for details.

Check fan blade clearances within the ventures' so that each fan is horizontally centered in the venturi. Fan motors operating at higher elevations will draw lower than rated amps, as well as draw a less effective air volume across the coil surface. This is due to the reduced density of the higher altitude air resulting in higher compressor discharge pressure along with reduced unit capacity. Consult factory if you suspect this situation.

7.1 *FIELD WIRING*

Field wiring should comply with NEC and local codes. The power supply voltage, phase, and frequency must match what is shown on the unit data plate. Only qualified electricians should work on the electrical portion of any unit installation.

Control Panel Nomenclature

CPC	PT	B	3	3	1	N	R

**Relay Board
(Optional)**

If supplied with
condenser- specify
Danfoss, CPC, other

K Motor Controllers

Emerson = CPC2

Johnson Controls =JCI

MicroThermo = MTH1

Danfoss = DAN

Controls

NC = No Controls

PT = Pressure Controls

TF = Temperature Controls

TP = Temp. and Press Ctrls

Receiver Option

R = Factory mounted receiver

(R - Heated or Non-heated)

S = Standard no receiver

Ambient Air Sensor for Split

T = Sensor Provided

N = Sensor Not Required

Type of Application

1 = Standard

2 = 50% Winter Reduction (Split Condenser)

4 = No Control Operation (Terminal Blocks Only)

Fuses & Breakers**

1 = Individual Fuses & Contactors

2 = Individual Circuit Breakers & Contactors per Fan

3 = Fuses & Contactors per Pair of Fans

4 = Terminal Blocks Only

5 = Circuit Breaker & Contactor per Pair of Fans

6 = Fuses Only per Motor

Control Type

1 = Johnson Mechanical

3 = Johnson Electronic

4 = No Controls

Control Voltage

A = 208/230V

B = 115V

C = No Control Voltage

D = 24V

*E = 208/230V w/o Transformer

*F = 115V without Transformer

*H = 24V without Transformer

Notes

*Without Transformer - Control voltage from source outside the condenser control panel

**Options 1 -5, #1 Fan will not have contactor. Option 6, Fuses are required with "K" motors to maintain standard or
   higher AIC/SCCR ratings. Breakers are not allowed.

7.2 MOTORS WIRED TO TERMINAL BLOCKS

Figure 10 shows typical unit wirings to terminal blocks. Fan motors are turned on and off by controls outside of the unit.

Figure 10 TERMINAL BLOCK ONLY WIRING DIAGRAMS (NC – C444)

The first motor (M1) must always be energized while the compressor is running.
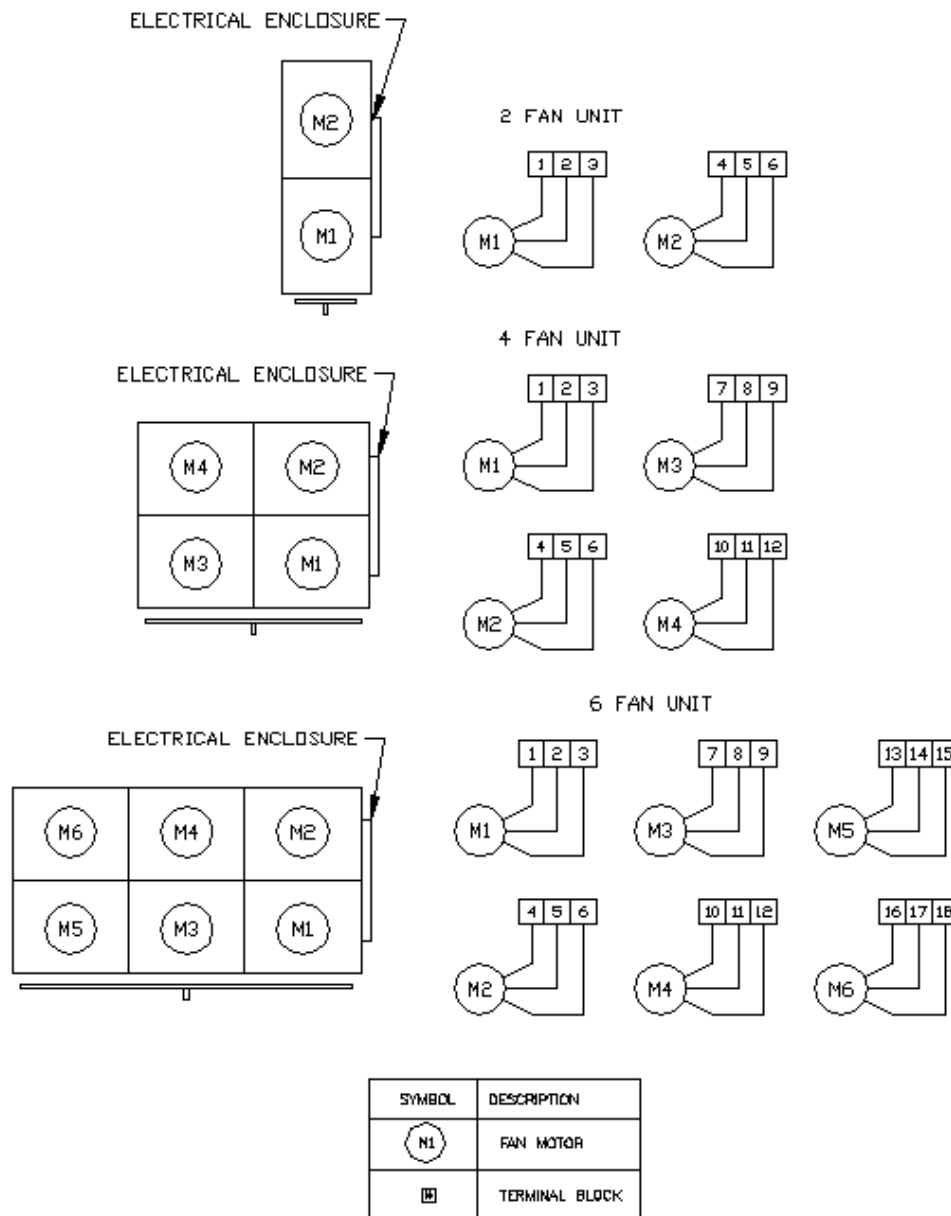
7.3 MOTORS WIRED TO STANDARD FAN CYCLING CONTROL PANEL

The standard fan cycling control panel for Microchannel units contains a series of pressure or temperature controllers. The fans will cycle on and off from the signal by the pressure transducer or temperature sensor. Each module has two rows of fans, therefore, adjoining pairs of fans can be cycled depending upon the system requirements. **The first fan must fan (M1) must always be energized while the compressor is running**. The second fan (M2) nearest the electrical enclosure is the first-on and last-off.

Figure 11 INDIVIDUAL FAN MOTOR WIRING DIAGRAM (-311, -315, -411, -415)

SYMBOL	DESCRIPTION
M#	FAN MOTOR
#	TERMINAL BLOCK
NC#	MOTOR CONTACTOR
NC#	MOTOR CONTACTOR COIL
FB#	FUSE BLOCK
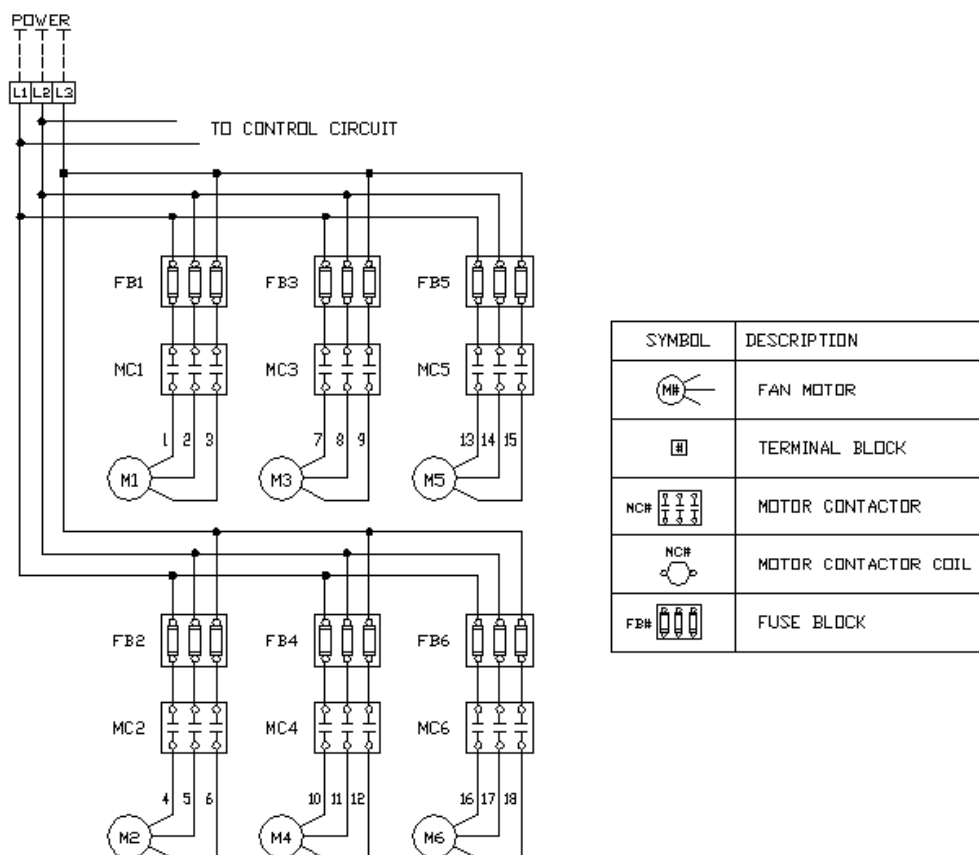
Figure 12 FAN MOTOR CYCLING WITH FUSES AND CONTACTORS IN PAIRS (-331)

SYMBOL	DESCRIPTION
M#	FAN MOTOR
#	TERMINAL BLOCK
MC#	MOTOR CONTACTOR
MC#	MOTOR CONTACTOR COIL
FB#	FUSE BLOCK
	TRANSFORMER

Microchannel Remote Air Cooled Condensers (PN E660159_K)
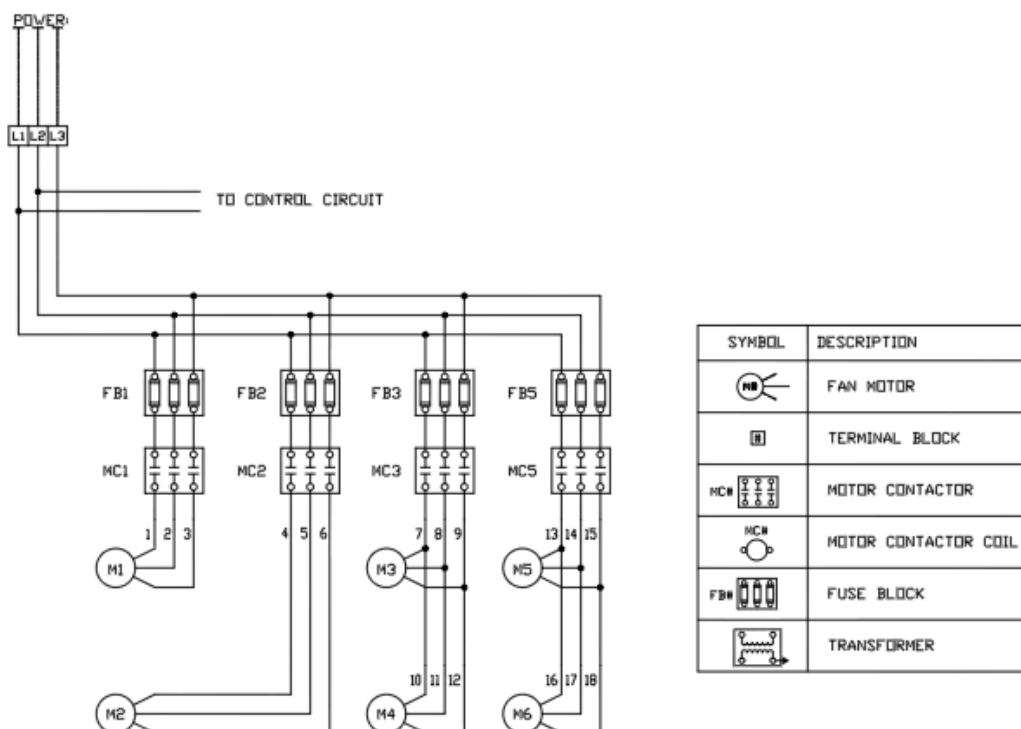
Figure 13 CONTROL CIRCUIT WIRING DIAGRAM (-315)

① NOTE: MC1 MUST BE ENERGIZED AT ALL TIMES WHILE COMPRESSOR IS RUNNING.
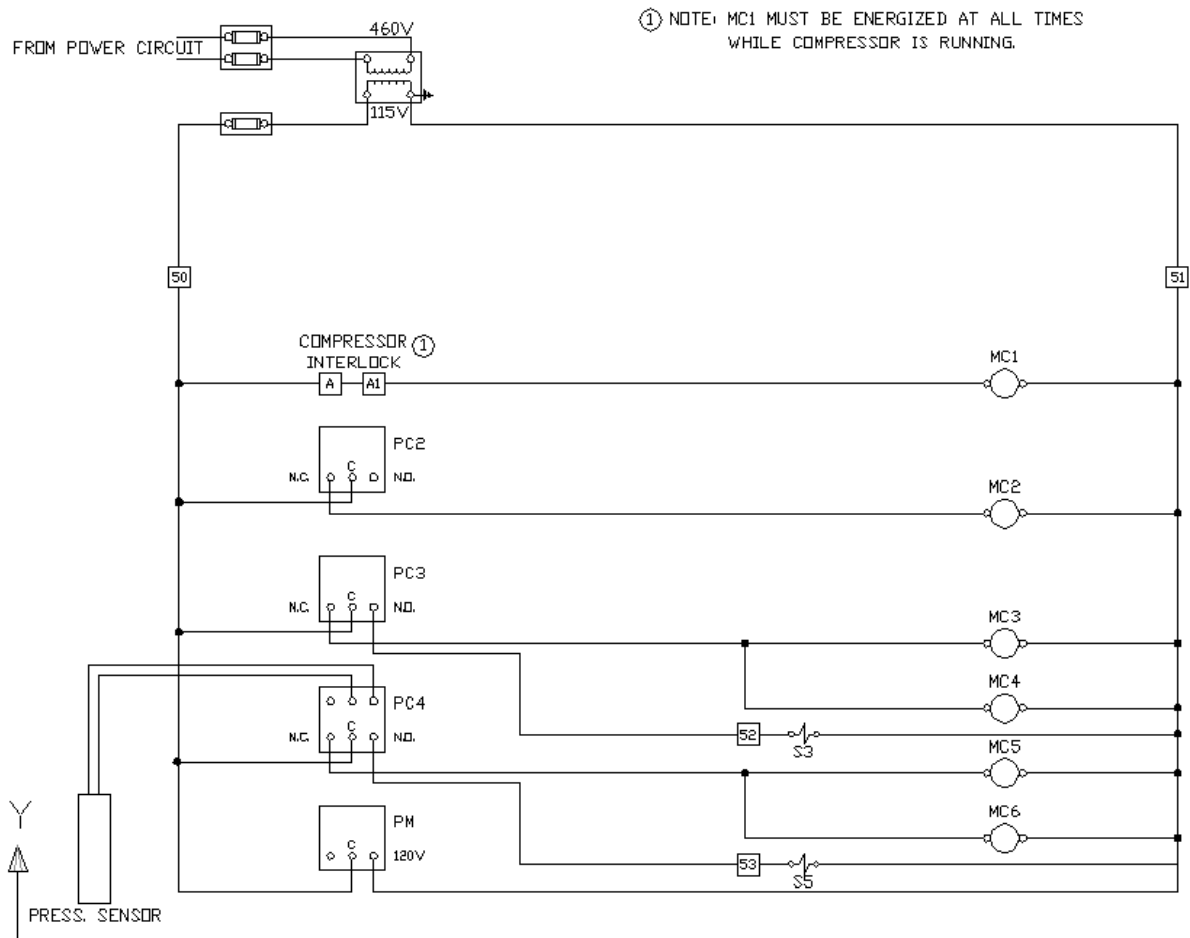
SYMBOL	DESCRIPTION
FUSE BLOCK	FUSE BLOCK
TRANSFORMER	TRANSFORMER
⊞	TERMINAL BLOCK
MC#	MOTOR CONTACTOR COIL
PC# N.C. N.O.	PRESSURE CONTROL MODULE P352AB-1
PC# N.C. N.O.	PRESSURE CONTROL STAGE MODULE S352AA-1
PM E40V 120V	POWER MODULE Y350R-1
SW	OPTIONAL MODULAR WINTER REDUCTION

7.4   FAN CYCLE OPERATION

The standard control scheme is to cycle fans in pairs per module except for the first module whereas each fan is controlled individually with the **number one fan being interlocked to the compressor and must remain on whenever the compressor is running**. The number 2 fan and each module (bank of fans) afterwards will cycle on and off according to either pressure or temperature control, with the fans furthest from the electrical enclosure cycling off first. This cycling is maintained through either factory provided controls or vendor supplied boards.

Care must be used by the engineer or installing contractor to monitor and make adjustments to prevent the fans from cycling too often or to cycle more than one bank of fans at the same time. Short cycling or erratic fan cycling over extended periods of time will cause additional thermal stress to the Microchannel tubes and increase the potential for leaks in the coil.

It is recommended that the units be purchased with the winter isolation solenoid valves. With solenoids the refrigerant flow to that specific module is cut off as the fans power down ensuring proper refrigerant flow.

Note: Do not set fans to cycle-on more than 240 times per day, or lower than a minimum of 40psi discharge pressure differential swing. The maximum short cycling frequency is three minutes on, three minutes off.

7.5   CONTROL SETTINGS

Tables 4 & 5 contain the settings to which the control panel components are set for the ordered application. Table 4 contains the settings for pressure sensing controls and Table 5 contains the settings for temperature setting controls. If a type of control other than the Johnson 350 series controller is used, such as a printed circuit board or variable speed, consult the wiring schematic for the unit ordered. Ensure that the number one fan remains on whenever the compressor is running.

7.6   TEMPERATURE SENSOR

For units that use a temperature sensor as input into the fan controls, the sensor will be factory wired, but shipped inside the control panel to prevent damage during transportation. Once the unit is mounted in the final position open the control panel, unroll the temperature sensor wire and field mount the sensor in the inlet air stream 3+ inches away from the fin pack.

7.7   FIELD INSTALLED VARIABLE FREQUENCY DRIVES - VFD

For field installed variable frequency drives it is recommended that all fans ramp up and down at once. **The motors should not be driven down below 15 HZ and ensure the number one fan remains on when the compressor is running.**

Table 5 CONTROL PANEL SETTINGS – PRESSURE SENSING

	1 MOD	1 MOD	2 MOD	3 MOD	4 MOD	5 MOD	6 MOD	7 MOD
PRES CNTL ONLY - FIRST FAN COMP INTERLOCK								
BASED ON R404A								
MTR	MC1	MC2	MC4 & MC5	MC5 & MC6	MC7 & MC8	MC9 & MC10	MC11 & MC12	MC13 & MC14
CNTL	P1	P2	P3	P4	P5	P6	P7	P8
SET		240						
OFFSET	F	-						
DIFF	A	40						
FAN ON	N	240						
FAN OFF	S	200						
SET		-	250					
OFFSET	R	10	-					
DIFF	U	40	40					
FAN ON	N	240	250					
FAN OFF		200	210					
SET	W	-	-	250				
OFFSET	I	15	10	-				
DIFF	T	40	40	40				
FAN ON	H	235	240	250				
FAN OFF		195	200	210				
SET	C	-	-	-	250			
OFFSET	O	20	15	10	-			
DIFF	M	40	40	40	40			
FAN ON	P	230	235	240	250			
FAN OFF	R	190	195	200	210			
SET	E	-	-	-	-	250		
OFFSET	S	25	20	15	10	-		
DIFF	S	40	40	40	40	40		
FAN ON	O	225	230	235	240	250		
FAN OFF	R	185	190	195	200	210		
SET		-	-	-	-	-	250	
OFFSET		30	25	20	15	10	-	
DIFF		40	40	40	40	40	40	
FAN ON		220	225	230	235	240	250	
FAN OFF		180	185	190	195	200	210	
SET		-	-	-	-	-	-	250
OFFSET		35	30	25	20	15	10	-
DIFF		40	40	40	40	40	40	40
FAN ON		215	220	225	230	235	240	250
FAN OFF		175	180	185	190	195	200	210

NOTES:
MOTOR CONTACTORS WIRED TO "NC" CONTACT OF PRESSURE CONTROL.
PRESSURE CONTROL SET IN "REVERSE" MODE.   SEE WIRING DIAGRAM IN UNIT CONTROL PANEL.

Table 6 CONTROL PANEL SETTINGS – TEMPERATURE SENSING

TEMP CNTL ONLY - FIRST FAN COMPRESSOR INTERLOCK								
	1 MOD	1 MOD	2 MOD	3 MOD	4 MOD	5 MOD	6 MOD	7 MOD
MTR	MC1	MC2	MC4 & MC5	MC5 & MC6	MC7 & MC8	MC9 & MC10	MC11 & MC12	MC13 & MC14
CNTL	T1	T2	T3	T4	T5	T6	T7	T8
SET		60						
OFFSET	F	-						
DIFF	A	20						
FAN ON	N	60						
FAN OFF	S	40						
SET		-	65					
OFFSET	R	10	-					
DIFF	U	10	10					
FAN ON	N	55	65					
FAN OFF		45	55					
SET	W	-	-	65				
OFFSET	I	15	10	-				
DIFF	T	5	5	5				
FAN ON	H	50	55	65				
FAN OFF		45	50	60				
SET	C	-		-	70			
OFFSET	O	20	15	10	-			
DIFF	M	5	5	5	5			
FAN ON	P	50	55	60	70			
FAN OFF	R	45	50	55	65			
SET	E	-	-	-	-	75		
OFFSET	S	25	20	15	10	-		
DIFF	S	5	5	5	5	5		
FAN ON	O	50	55	60	65	75		
FAN OFF	R	45	50	55	60	70		
SET		-	-	-	-	-	80	
OFFSET		30	25	20	15	10	-	
DIFF		5	5	5	5	5	5	
FAN ON		50	55	60	65	70	80	
FAN OFF		45	50	55	60	65	75	
SET		-	-	-	-	-	-	80
OFFSET		30	25	20	15	10	5	-
DIFF		5	5	5	5	5	5	5
FAN ON		50	55	60	65	70	75	80
FAN OFF		45	50	55	60	65	70	75

NOTES:
MOTOR CONTACTORS WIRED TO "NC" CONTACT OF TEMPERATURE CONTROL.
TEMPERATURE CONTROL SET IN "HEATING" MODE.   SEE WIRING DIAGRAM IN UNIT CONTROL PANEL.

8   VARIABLE SPEED CONDENSERS

8.1   *OVERVIEW*

Variable speed condensers use Nidec BPM motors which use KB VFDs. The VFDs come factory mounted in the control panel. Airflow is increased/decreased across the condenser coil surface by modulating variable speed fans to maintain either:

- TD (temperature difference) between condensing temperature / leaving fluid temperature and ambient temperature.
- Fixed discharge pressure.

Split condenser feature, when available in the system, is typically utilized during low ambient conditions to reduce the condenser coil surface area to better maintain the discharge temperature/pressure.

The following figure shows wiring schematics for the drives and motors.

Figure 14 VARIABLE SPEED WIRING DIAGRAM
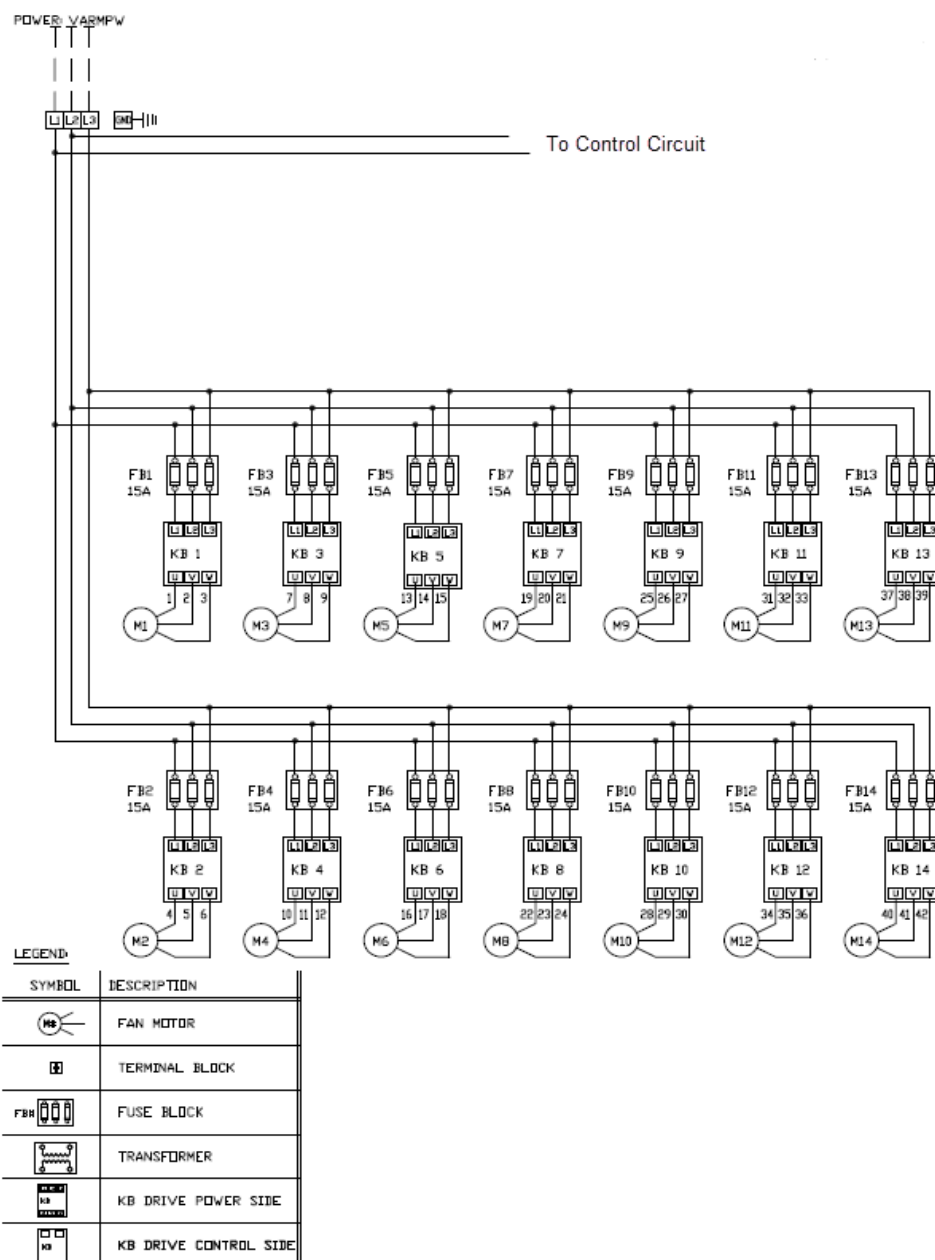
8.2 *CONTROLLERS*

The variable speed condenser is offered with the following controllers:
- Hussmann Controller (JCI PK-OEM1820)
- Emerson Controller (E2 with Multiflex 810-3063 4AO)
- Danfoss Controller (MCX06D)
- Micro Thermo Controller (MT-700 series)

The application on the controllers support following refrigerants selection:
- R-407A
- R-407F
- R-448A (default)
- R-449A
- R-404A
- R-507A
- R-410A

8.2.1 SEQUENCE OF OPERATION

Application utilizes following inputs for the condenser operation:
- Ambient temperature sensor
- Condensing pressure transducer
- Drop-leg temperature sensor
- VFD feedback

Application modulates the variable speed fans using an AO (analog output). During modulation, all fans either ramp up or ramp down simultaneously. The range of AO is defined to be (10 – 0) Vdc, where fans are at:
- Minimum speed when AO is set to 10 Vdc.
- Maximum speed when AO is set to 0 Vdc.

Application allows to either enable or disable the split condenser / winter feature. When available and enabled in the system, the split condenser feature disables half the fans by setting one of the two AOs to 10 Vdc and energizes a split valve using a relay output to alter the flow of the refrigerant through the condenser coil. The remaining half of the fans are still modulated via the selected control strategy.

Following table illustrates the fans and solenoid arrangement on Microchannel system:

Table 7 MICROCHANNEL FANS AND SOLENOID ARRANGEMENT

Number of Fans in MX	AO 1	AO 2	Solenoid
2	2	N/A	N/A
4	2	2	1
6	4	2	1
8	4	4	2
10	6	4	2
12	6	6	3
14	8	6	3

Following guidelines shall assist the field modifications when necessary based on the system performance:
1. Need to move a fan module to split condenser, make modifications at the terminal block to reassign a pair of fans to AO 2 and ignore turning off the refrigerant flow to this module.
2. Need to move a fan module from split condenser, make modifications at the terminal block to reassign a pair of fans to AO 1 and leave the solenoid in de-energized state (Normally Open).

Alarms generated by the application are:

- VFD
- Discharge pressure transducer
- Ambient temperature sensor
- Drop-leg temperature sensor

8.2.2 HUSSMANN CONTROLLER

HS-OEM1820 controller comes factory mounted and can be operated as a standalone application or could be integrated into third party system either through BACnet or MODBUS interfaces.

Following figure shows the controller wiring schematic.

Figure 15 HUSSMANN CONTROLLER WIRING DIAGRAM
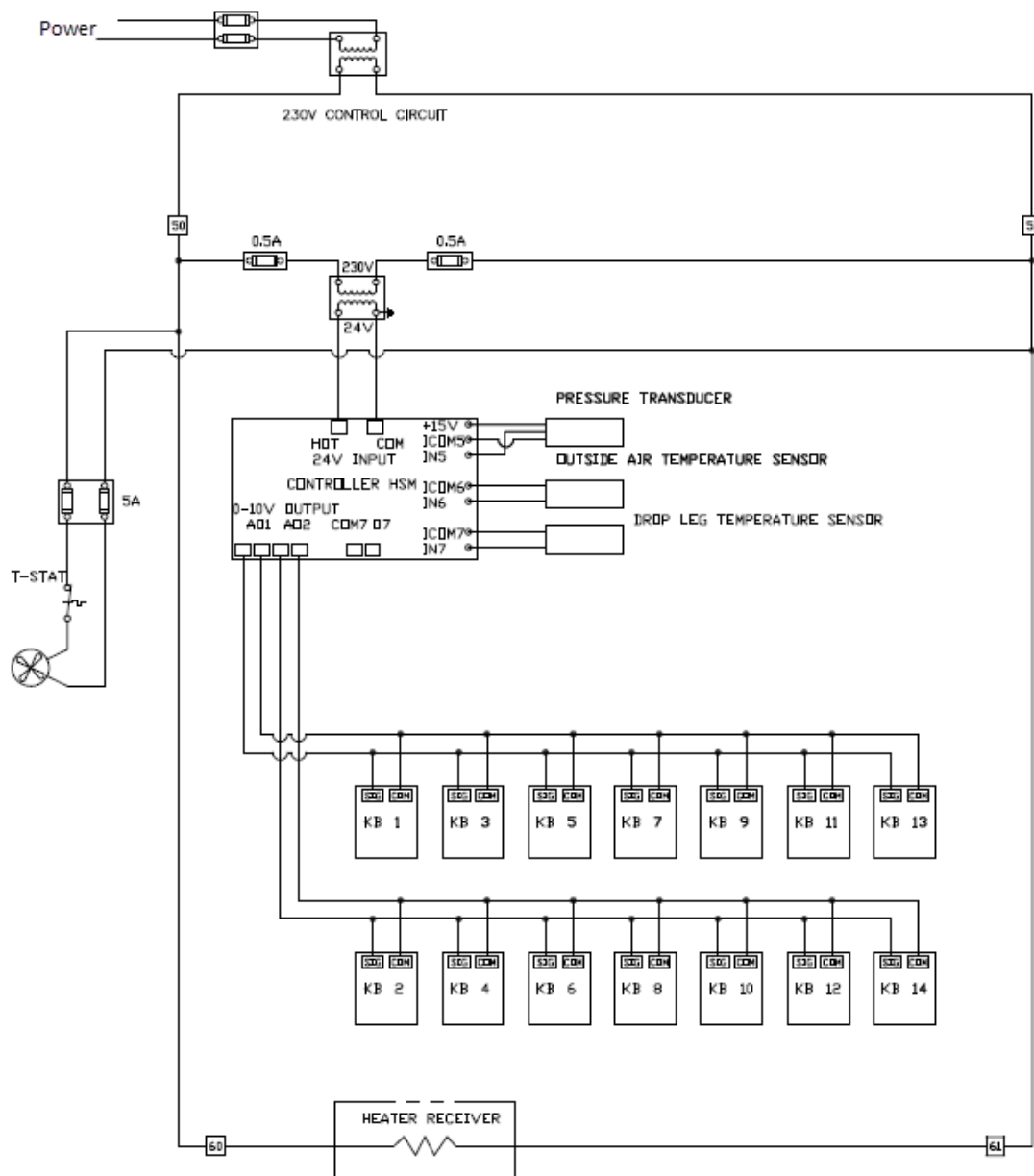
8.2.2.1 CONNECTIVITY

The Hussmann controller can be accessed using the following two methods:
a. Local display on the controller.
b. Johnson Controls MAP 1810 Gateway.

8.2.2.1.1 HUSSMANN CONTROLLER LOCAL DISPLAY INTERFACE

Utilize the controller display (provided with backlight) to view the system status on the home screen as illustrated in the following figure.

Figure 16 HUSSMANN CONTROLLER LOCAL DISPLAY

Following table provides information regarding indicator lights on the controller.

Table 8 INDICATOR LIGHTS

LED Label	LED Color	Description
POWER	Green	Indicates power is being supplied to the controller or not.
FAULT	Red	Indicates fault condition(s) exists or not.
SA BUS	Green	Indicates the SA bus communication status.
FC BUS	Green	Indicates the FC bus communication status.
MODBUS	Green	Indicates the MODBUS communication status.

Navigation using the keypad buttons
- Access the menu by pressing **ent** button.
- Use the **up** and **down** arrow buttons to scroll through the menu.
- Press **ent** button to select menu items.
- Use the **up** and **down** arrow buttons to scroll through the available setpoints and parameters.
- Press **ent** button to view the current setting or status.
- Use the **up** and **down** arrow buttons to change the setpoint.
- Press **ent** button to confirm setpoint change.
- Press **esc** button to revert back one step at a time.

8.2.2.1.2 MOBILE ACCESS PORTAL (MAP) 1810 GATEWAY

The MAP Gateway is a pocket-sized web server that provides a wireless mobile user interface for Hussmann controller.
- The MAP is physically plugged into a SA port or FC port on the controller using a field bus adapter.
- User interface allows users to access device information through any supported web browser.
- Accessed either over Wi-Fi or an existing Ethernet network on site.
  Note: To use the Ethernet port to connect to the MS/TP bus, power must be supplied by an external supply that is not the USB connection or the SA/FC bus connection.

8.2.2.2 COMMISSIONING

The Condenser application increases or decreases the airflow across the condenser coil surface by modulating condenser variable speed fans via analog output(s) based on either a fixed discharge pressure control strategy or condenser temperature differential (TD) strategy.

All configuration and setpoint changes can be accessed either through the local display or MAP Gateway. Following sections illustrates how to access the parameters utilizing the MAP 1810 Gateway module.

8.2.2.2.1 SYSTEM CONFIGURATION

System configuration parameters define the features available and the operation of the system.

The following figure illustrates the system configuration parameters when accesses through the MAP Gateway module.

Figure 17 SYSTEM CONFIGURATION PARAMETERS SCREENSHOT

The following table provides description, range, default value and units (if applicable) for all the system configuration parameters available in the system.

Table 9 SYSTEM CONFIGURATION PARAMETERS DESCRIPTION

Parameter Name and Description	Range	Default	Units
REFRGERANT TYPE Lists the refrigerants supported by the system.	R-407A R-407F R-448A R-449A R-404A R-507A R-410A	R-404A	-
REFRIGERATION CONTROL METHOD Lists the control strategies options available in the system.	Pressure Temperature Differential	Temperature Differential	-
REFRIGERATION TD-OPTION Lists the sensor feedbacks supported by the system.	Drop Leg Temp Temp Diff (Discharge Pressure)	Temp Diff	-
STAGES AVAILABLE Number of fans supported for staging.	1 – 3	3	-
REFRIGERATION FAN SETUP Lists the fan operation options available in the system.	Staged VSD (Variable Speed) Combined (Staged + VSD)	VSD	-
SPLIT CONDENSER INSTALLED Indicates whether split condenser hardware is installed or not in the system.	No Yes	No	-
SYSTEM ENABLE An option to turn off the application.	Shutdown Enable	Enable	-
ES – EMERGENCY SHUTDOWN INPUT Indicates whether a hardware switch, to turn off the application, is installed or not in the system.	No Yes	No	-
ALARM POLARITY Indicates the VFD Fault feedback signal polarity.	Normal Reverse	Normal	
REFRIGERATION AO SPEED Defines the analog output (that signals the KB drives for fan operation) range.	0 to 10 V 10 to 0 V	10 to 0 V	-

Notes:
- *REFRIGERATION TD-OPTION*
  Discharge pressure transducer is the primary input to the controls.
  In the case of discharge pressure transducer failure, the condenser control application can be configured to use Drop leg temperature sensor as the input to the controls.
- *REFRIGERATION CONTROL METHOD*
  Temperature differential is the primary controls strategy.
  In the case of outdoor ambient temperature sensor failure, the condenser control application could be configured to operate on pressure-based controls strategy.

8.2.2.2.2 SETPOINTS

Setpoints will determine how the system behaves:
- Temperature differential controls or Pressure controls operation
- Split condenser operation.

The following figure illustrates the setpoints available when the REFRIGERATION CONTROL METHOD is set to *Temperature Differential* option and accessed through the MAP Gateway module.

Figure 18 SETPOINTS SCREENSHOT

The following table provides description, range, default value and units (if applicable) for all the setpoints available in the system.

Table 10 SETPOINTS DESCRIPTION

Parameter Name and Description	Range	Default	Units
CONDENSER PRESSURE SETPOINT Defines the setpoint at which the condenser discharge pressure needs to be maintained. *Note: Visible when REFRIGERATION CONTROL METHOD = Pressure.*	0 – 750	225	PSI
EFFECTIVE TEMPERATURE DIFFERENTIAL SETPOINT Indicates the TD setpoint determined by the controller application. This is RO status parameter. *Note: Visible when REFRIGERATION CONTROL METHOD = Temperature Differential.*	0 – 100	0	delta °F
TD-OUT AIR LOW TARGET Defines the lowest value for the outside air temperature range in which the controller shall operate with TD strategy. *Note: Visible when REFRIGERATION CONTROL METHOD = Temperature Differential.*	40 – 100	40	°F
TD-OUT AIR HIGH TARGET Defines the highest value for the outside air temperature range in which the controller shall operate with TD strategy. *Note: Visible when REFRIGERATION CONTROL METHOD = Temperature Differential.*	75 – 120	110	°F
TD-DROP LEG LOW TARGET Defines the lowest limit for the TD target, that is determined by the controller. *Note: Visible when REFRIGERATION CONTROL METHOD = Temperature Differential.*	5 - 25	10	°F
TD-DROP LEG HIGH TARGET Defines the highest limit for the TD target, that is determined by the controller.	5 - 25	15	°F

Note: Visible when REFRIGERATION CONTROL METHOD = Temperature Differential.			
CONDENSER FAN MINIMUM SPEED Defines the minimum speed at which the fans shall be staged. *Note: Visible when REFRIGERATION FAN SETUP = Combined.*	0 – 100	0	%
SPLIT CONDENSER SETPOINT Defines the temperature setpoint, the system can enter split condenser feature when the outside air temperature is below the SPLIT CONDENSER SETPOINT. *Note: Visible when SPLIT CONDENSER INSTALLED = Yes.*	0 – 100	55	°F
SPLIT CONDENSER DIFFERENTIAL Defines the temperature differential, the system shall unsplit when the outside air temperature goes above the (SPLIT CONDENSER SETPOINT + SPLIT CONDENSER DIFFERENTIAL) *Note: Visible when SPLIT CONDENSER INSTALLED = Yes.*	0 – 100	10	°F
UNSPLIT CONDENSER SETPOINT Defines the pressure setpoint, the system shall unsplit when the discharge pressure goes above which the UNSPLIT CONDENSER SETPOINT. *Note: Visible when SPLIT CONDENSER INSTALLED = Yes.*	0 – 750	300	PSI
UNSPLIT CONDENSER DIFFERENTIAL Defines the pressure differential, the system can enter split condenser feature when the discharge pressure falls below the (UNSPLIT CONDENSER SETPOINT – UNSPLIT CONDENSER DIFFERENTIAL). *Note: Visible when SPLIT CONDENSER INSTALLED = Yes.*	0 – 200	50	PSI

8.2.2.2.3 OVERRIDES

Override parameters provides a huge benefit to simulate and test the system components during installation and service.

The following figure illustrates the override parameters available when accessed through the MAP Gateway module.

Figure 19 OVERRIDE PARAMETERS SCREENSHOT

Microchannel Remote Air Cooled Condensers (PN E660159_K)

The following table provides description, range, default value and units (if applicable) for all the override parameters available in the system.

Table 11 OVERRIDE PARAMETERS DESCRIPTION

Parameter Name and Description	Range	Default	Units
DISCHARGE PRESSURE OVERRIDE ENABLE Shall be enabled to override discharge pressure input.	Control Override	Control	-
DISCHARGE PRESSURE OVERRIDE Defines the value with which the discharge pressure input would be overridden.	0 – 750	100	PSI
OUTDOOR AIR TEMP OVERRIDE ENABLE Shall be enabled to override outdoor air temperature input.	Control Override	Control	-
OUTDOOR AIR TEMP OVERRIDE Defines the value with which the outdoor air temperature input would be overridden.	0 – 125	0	°F
DROP LEG TEMP OVERRIDE ENABLE Shall be enabled to override drop leg temperature input. *Note: Visible when REFRIGERATION TD-OPTION = Drop Leg Temp.*	Control Override	Control	-
DROP LEG TEMP OVERRIDE Defines the value with which drop leg temperature would be overridden. *Note: Visible when REFRIGERATION TD-OPTION = Drop Leg Temp.*	0 – 100	85	°F
CONDENSER FAN 1 OVERRIDE ENABLE Shall be enabled to override condenser fan 1 operation. *Note: Visible when REFRIGERATION FAN SETUP = VSD.*	Control Override	Control	-
CONDENSER FAN 1 OVERRIDE Allows to either turn on or turn off the condenser fan 1. *Note: Visible when REFRIGERATION FAN SETUP = VSD.*	Off On	Off	-
CONDENSER FAN 2 OVERRIDE ENABLE Shall be enabled to override condenser fan 2 operation. *Note: Visible when REFRIGERATION FAN SETUP = VSD.*	Control Override	Control	-
CONDENSER FAN 2 OVERRIDE COMMAND Allows to either turn on or turn off the condenser fan 2. *Note: Visible when REFRIGERATION FAN SETUP = VSD.*	Off On	Off	-
CONDENSER FAN 3 OVERRIDE ENABLE Shall be enabled to override condenser fan 3 operation. *Note: Visible when REFRIGERATION FAN SETUP = VSD.*	Control Override	Control	-
CONDENSER FAN 3 OVERRIDE COMMAND Allows to either turn on or turn off the condenser fan 3. *Note: Visible when REFRIGERATION FAN SETUP = VSD.*	Off On	Off	-
SPLIT CONDENSER OVERRIDE ENABLE Shall be enabled to override split condenser valve operation. *Note: Visible when SPLIT CONDENSER INSTALLED = Yes.*	Control Override	Control	-
SPLIT CONDENSER OVERRIDE Allows to either turn on or turn off the split condenser valve. *Note: Visible when SPLIT CONDENSER INSTALLED = Yes.*	Off On	Off	-
CONDENSER FAN FORWARD OVERRIDE ENABLE Shall be enabled to override condenser fan direction. *Note: Visible when REFRIGERATION FAN SETUP = VSD or Combined.*	Control Override	Control	-
CONDENSER FAN FORWARD OVERRIDE Allows to either turn the condenser fans forward or reverse. *Note: Visible when REFRIGERATION FAN SETUP = VSD or Combined.*	Off On	Off	-
CONDENSER FAN SPEED OVERRIDE ENABLE Shall be enabled to override condenser fan speed. *Note: Visible when REFRIGERATION FAN SETUP = VSD or Combined.*	Control Override	Control	-
CONDENSER FAN SPEED OVERRIDE Defines the value with which condenser fans speed would be overridden. *Note: Visible when REFRIGERATION FAN SETUP = VSD or Combined.*	0 – 100	0	%

8.2.2.2.4 ALARMS

Alarm setpoints defines when an alarm shall be generated and recovered.

The following figure illustrates the alarm setpoints available when accessed through the MAP Gateway module.

**Figure 20 ALARM SETPOINTS SCREENSHOT**

The following table provides description, range, default value and units (if applicable) for all the alarm setpoints available in the system.

Table 12 ALARM SETPOINTS DESCRIPTION

Parameter Name and Description	Range	Default	Units
HIGH PRESSURE ALARM SETPOINT When the discharge pressure persists above this setpoint for HIGH PRESSURE ALARM DELAY time, the controller shall detect and report HIGH PRESSURE ALARM.	0 – 750	300	PSI
HIGH PRESSURE ALARM TO NORMAL The controller shall recover from HIGH PRESSURE ALARM, when the discharge pressure falls below this setpoint.	0 – 750	275	PSI
HIGH PRESSURE ALARM DELAY Defines the persistence time for which the condition shall prevail for the controller to detect and report HIGH PRESSURE ALARM.	0 – 600	30	Secs
HIGH PRESSURE RECOVERY SETPOINT When the discharge pressure persists above this setpoint for HIGH PRESSURE RECOVERY DELAY time, the controller shall detect and report HIGH PRESSURE RECOERY ALARM. *Note: High pressure controls would be set to 395 PSI.*	0 – 750	375	PSI
HIGH PRESSURE RECOVERY TO NORMAL The controller shall recover from HIGH PRESSURE ALARM, when the discharge pressure falls below this setpoint.	0 – 750	350	PSI
HIGH PRESSURE RECOVERY DELAY Defines the persistence time for which the condition shall prevail for the controller to detect and report HIGH PRESSURE ALARM.	0 – 300	30	Secs

8.2.2.3 TROUBLESHOOTING

Observe the status LEDs on the controller and refer to Table 15 to troubleshoot the controller.

Table 13 HUSSMANN CONTROLLER LED TROUBLESHOOTING

LED Label	Description of LED states	
POWER	**State**	**Description**
	Off Steady	No supply power
	On Steady	Power connected
FAULT	**State**	**Description**
	Off Steady	No faults
	On Steady	Device fault: no application loaded
	Blink – 2 Hz	Download or Startup in progress, not ready for normal operation
SA BUS	**State**	**Description**
	Blink – 2 Hz	Data transmission
	Off Steady	No data transmission
	On Steady	Communication lost, waiting to join
FC BUS	**State**	**Description**
	Blink – 2 Hz	Data transmission
	Off Steady	No data transmission
	On Steady	Communication lost, waiting to join
MODBUS	**State**	**Description**
	Blink – 2 Hz	Data transmission
	Off Steady	No data transmission
	On Steady	Communication lost, waiting to join

Table 14 HUSSMANN CONTROLLER APPLICATION TROUBLESHOOTING

Alarm	Description	Corrective Action
Discharge Pressure Sensor Failure	Discharge pressure transducer failure is shorted, open or detecting the pressure out of range.	▪ Check for any cable issues or connector issues. ▪ Check that the pressure transducer is landing on the appropriate connector on the board. ▪ Check that the pressure transducer cable is fully inserted into the pressure transducer. ▪ Confirm that the proper transducer is being used in the system.
Outdoor Air Temp Sensor Failure	OAT sensor is shorted, open or detecting the temperature out of range.	▪ Check for any cable issues or connector issues. ▪ Check that the temperature sensor is landing on the appropriate connector on the board. ▪ Check that the temperature sensor probe.
Drop Leg Temp Sensor Failure	Drop leg temperature sensor is shorted, open or detecting the temperature out of the range.	
VFD Alarm	VFD reporting fault condition	Please refer to section 8.3
High Pressure Alarm	Discharge pressure raised above the head safety alarm setpoint defined in the application	Auto recovers when the discharge pressure falls below head safety alarm setpoint.

8.2.3 EMERSON CONTROLLER

Condensers are built with Multiflex IO board which needs to be integrated with E2 or Site Supervisor controllers for them to operate.

Figure 21 MULTIFLEX 810-3063 4AO BOARD WIRING DIAGRAM

8.2.3.1 COMMISSIONING

The Condenser Control application in an E2 RX can control either air-cooled or evaporative condensers.

To operate air-cooled condensers, the Condenser Control application supports following two strategies:
- Air-cooled strategy (uses a simple PID control loop that compares a single Control In input to a PID setpoint).
- Temperature differential strategy (attempts to keep a minimum amount of difference between the temperature of the refrigerant and the ambient outside temperature).

8.2.3.1.1 INPUTS CONFIGURATION

This application will need following sensor inputs:
- Discharge pressure transducer
- Drop leg temperature sensor
- Ambient temperature sensor

Notes: Discharge pressure transducer would be our primary input to the controls. In case of discharge pressure transducer failure, the condenser control application can be configured to use Drop leg temperature sensor as the input to the controls.

Following figure and table illustrates the inputs setup in the Condenser Control application in the E2.

Figure 22 INPUTS CONFIGURATION SCREENSHOT

Table 15 INPUTS CONFIGURATION DESCRIPTION

Field	Description
16AI	Associate with the ambient temperature sensor and pass it on to analog combiner application.
16AI	Associate with the discharge pressure sensor input.
16AI	Associate with the VFD fault feedback input.
16AI	Associate with the drop leg temperature sensor input.

8.2.3.1.2 OUTPUTS CONFIGURATION

Our application controls following outputs:

- Fans with two AO's
- Split valve
- Alarm output (VFD fault feedback is monitored to generate an alarm when a VFD reports fault.)

The following figure and table show the outputs setup in the Condenser Control application in the E2.

Figure 23 OUTPUTS CONFIGURATION SCREENSHOT

Table 16 OUTPUTS CONFIGURATION DESCRIPTION

Field	Description
8RO	Associate with the split valve output.
8RO	Associate with the alarm output.
4AO	Associate with the variable speed fan output.
4AO	Associate with the flexible combiner analog output.

8.2.3.1.3 CONDENSER SETUP

The condenser control application in the E2 shall be configured to use temperature differential (T-D) strategy. TD is maintained by operating variable speed fans based on PID control output that corresponds to the amount of total fan power that should be active.

Notes: In the case of ambient sensor failure, the condenser control application on E2 can also be configured to use air cooled strategy to either maintain a discharge pressure or drop leg temperature.

The general tab parameters allow to define the features available and the operation of the system from condenser controls application perspective.

FIGURE 24 CONDENSER GENERAL TAB SCREENSHOT

```
05-06-19 ● ⬡ ™                        RX-400 Unit 1                              18:08:35
Use Ctrl-X to Select CX Tabs              SETUP              NAMES FULL
┌────────────────────────────────────────────────────┬──────────────────────┐
│C1: General  │C2: Setpoints │C3: Inputs │C4: VS Setup│C5:    │ ADVISORY SUMMARY │
│C6: Fan Outs │C7: Other Outs│C8:        │C9: Advanced│C0:    │   Fails        0 │
│             Condensers: CONDENSER001               │   Alarms       0 │
│                                                    │   Notices      0 │
│   General            Value                         │                  │
│   Name            : CONDENSER001                   │                  │
│   Long Name       :                                │ NETWORK OVERVIEW │
│   Condenser Type  : DIFFERENTIAL                   │   IONet-1      ● │
│   Control Type    : PRESSURE                       │                  │
│   Fan Type        : VARIABLE SPEED                 │                  │
│   Refg Type       : R404A Mid-point                │                  │
│   Split Enable    : Yes                            │                  │
│   Split Strategy  : Ambient                        │                  │
│   Split When Recl : No                             │                  │
│   STPT Reset En   : Yes                            │                  │
│   Proof Fail Enab : No                             │                  │
│   Fast Rcvy Enab  : Yes                            │                  │
│   Min Cap Setpt   :        0                       │                  │
│   Max Cap Setpt   :    100.00                      │ E2 Unit01        │
│   FAN Always On   : No                             │                  │
│                                                    │ Rev 4.09F02      │
│                                                    │                  │
│                                                    │                  │
│                                                    │ English-US       │
├────────────────────────────────────────────────────┴──────────────────────┤
│ Enter desired text │ Name of this condenser                                │
│  F1: PREV TAB  │  F2: NEXT TAB  │  F3: EDIT  │  F4: STATUS  │  F5: CANCEL   │
└────────────────────────────────────────────────────────────────────────────┘
```

TABLE 18 CONDENSER GENERAL TAB DESCRIPTION

Field	Description
Name	Specify the name for condenser application
Long Name	Specify further details if needed like functionality, etc.
Condenser Type	Select temperature differential as our control strategy.
Control Type	Select appropriate input, for example discharge pressure for air cooled Levitor and drop leg temperature for fluid coolers.
Fan Type	Select variable speed fans type.
Refrigerant Type	Refrigerant selected based on application.
Split Enable	Application based, you can either enable or disable split condenser feature. By default, split condenser shall be disabled.
Split Strategy	Split condenser when enabled, shall be entered or exited based on the ambient temperature.
Split When Recl	Disable split condenser based on reclaim input.
STPT Reset En	Enable active control setpoint.
Proof Fail Enab	Disable the condenser control application's ability to generate and automatically clear proof failures.
Fast Rcvy Enab	Enable fast recovery mode.
Min Cap Setpt	Defines the lowest possible % of total condenser cooling capacity that will be allowed to be active.
Max Cap Setpt	Defines the highest possible % of total condenser cooling capacity that will be allowed to be active.
FAN Always On	Fans are not always on.

Setpoints tab parameters define the behavior of the system.

Figure 24 SETPOINTS TAB 1 SCREENSHOT

```
05-06-19 ● ⓒ 🆃🅼                    RX-400 Unit 1            🔒          18:09:11
Use Ctrl-X to Select CX Tabs          SETUP              NAMES FULL
┌──────────────────────────────────────────────────────────┐ ┌────────────────────┐
│ C1: General    │C2: Setpoints│ C3: Inputs  │ C4: VS Setup │ C5:     │ ADVISORY SUMMARY
│ C6: Fan Outs   │ C7: Other Outs│ C8:       │ C9: Advanced │ C0:     │  Fails         0
│              Condensers: CONDENSER001                       │  Alarms        0
│                                                             │  Notices       0
│  ┌────────────────────────────────────────────────┐        │
│  │ Setpoints        Value                          │▲       │
│  │ TEMP DIF STPT   :    10.00                       ││      │ NETWORK OVERVIEW
│  │ MIN TEMP STPT   :    60.00                       ││      │  IONet-1        ●
│  │ T SHFT DUR REC  :        0                       ││      │
│  │ FAST REC STPT   :   325.00                       ││      │
│  │ Fast Rcv Hyst   :    10.00                       ││      │
│  │ UNSPLIT STPT    :   280.00                       ││      │
│  │ AMB SPLIT STPT  :    50.00                       ││      │
│  │ RECL SPLIT STPT :    50.00                       ││      │
│  │ Amb Split Dbnd  :     5.00                       ││      │
│  │ Unsplit Dbnd    :    25.00                       ││      │
│  │ Uspl to Spl Dly : 0:02:00                        ││      │
│  │ LOW PRES STPT   :     NONE                       ││      │
│  │ Low Press Hyst  :    10.00                       ││      │ E2 Unit01
│  │ Fan ON Delay    : 0:00:00                        ││      │
│  │ Fan OFF Delay   : 0:00:00                        ││      │ Rev 4.09F02
│  │ TR Temperature  :     5.00                       ││      │
│  │ L Lvl Min %     :    10.00                       │▼      │
│  └────────────────────────────────────────────────┘        │ English-US
│                                                             │
├─────────────────────────────────────────────────────────────┤
│ Enter 0 to 100.00 DDF | Temperature differential setpoint
├──────────────┬──────────────┬──────────────┬──────────────┬──────────────┤
│ F1: PREV TAB │ F2: NEXT TAB │ F3: EDIT     │ F4: STATUS   │ F5: CANCEL   │
└──────────────┴──────────────┴──────────────┴──────────────┴──────────────┘
```

Figure 25 SETPOINTS TAB 2 SCREENSHOT

```
05-06-19 ● ⓒ 🆃🅼                    RX-400 Unit 1            🔒          18:09:50
Use Ctrl-X to Select CX Tabs          SETUP              NAMES FULL
┌──────────────────────────────────────────────────────────┐ ┌────────────────────┐
│ C1: General    │C2: Setpoints│ C3: Inputs  │ C4: VS Setup │ C5:     │ ADVISORY SUMMARY
│ C6: Fan Outs   │ C7: Other Outs│ C8:       │ C9: Advanced │ C0:     │  Fails         0
│              Condensers: CONDENSER001                       │  Alarms        0
│                                                             │  Notices       0
│  ┌────────────────────────────────────────────────┐        │
│  │ Setpoints        Value                          │▲       │
│  │ Fast Rcv Hyst   :    10.00                       ││      │ NETWORK OVERVIEW
│  │ UNSPLIT STPT    :   280.00                       ││      │  IONet-1        ●
│  │ AMB SPLIT STPT  :    50.00                       ││      │
│  │ RECL SPLIT STPT :    50.00                       ││      │
│  │ Amb Split Dbnd  :     5.00                       ││      │
│  │ Unsplit Dbnd    :    25.00                       ││      │
│  │ Uspl to Spl Dly : 0:02:00                        ││      │
│  │ LOW PRES STPT   :     NONE                       ││      │
│  │ Low Press Hyst  :    10.00                       ││      │
│  │ Fan ON Delay    : 0:00:00                        ││      │
│  │ Fan OFF Delay   : 0:00:00                        ││      │
│  │ TR Temperature  :     5.00                       ││      │
│  │ L Lvl Min %     :    10.00                       ││      │
│  │ L Lvl Alm Dly   :     1:00                       ││      │ E2 Unit01
│  │ Ambient No Rst  :    80.00                       ││      │
│  │ Ambient Max Rst :    40.00                       ││      │ Rev 4.09F02
│  │ Max Temp Reset  :     5.00                       │▼      │
│  └────────────────────────────────────────────────┘        │ English-US
│                                                             │
├─────────────────────────────────────────────────────────────┤
│ Enter -100.00 to 100.00 DDF | The maximum setpoint reset value
├──────────────┬──────────────┬──────────────┬──────────────┬──────────────┤
│ F1: PREV TAB │ F2: NEXT TAB │ F3: EDIT     │ F4: STATUS   │ F5: CANCEL   │
└──────────────┴──────────────┴──────────────┴──────────────┴──────────────┘
```

Table 17 SETPOINTS TAB DESCRIPTION

| Field	Description
TEMP DIF STPT	Defines the TD setpoint that is compared to the difference between the refrigerant temperature and the ambient temperature to yield the PID percentage that drives the condenser fans.
MIN TEMP STPT	Defines the lowest possible condensing setpoint (ambient temperature + TEMP DIF STPT) allowable in a TD condenser.
T SHFT DUR REC	Defines the amount the condenser control setpoint will be shifted when the refrigeration system is using a heat reclaim.
FAST REC STPT	Defines the setpoint that would initiate fast recovery.
Fast Rcv Hyst	Defines the hysteresis to avoid condenser from short-cycling between normal and fast recovery mode.
UNSPLIT STPT	Defines the fail-safe pressure setpoint above which the condenser comes out of split mode.
AMB SPLIT STPT	Defines the temperature setpoint above which the condenser split mode is locked out. *Notes: Shall appear only if the condenser has single-speed fans and the condenser split feature is enabled.*
RECL SPLIT STPT	Defines the temperature setpoint above which the condenser split mode is locked out and the reclaim is active. *Notes: Shall appear only if the condenser has single-speed fans and the condenser split feature is enabled.*
Amb Split Dbnd	Defines a dead band around the ambient split setpoint. The condenser will go into split mode, when: $$ambient\ temperature < (ambient\ split\ setpoint - \frac{ambient\ split\ deadband}{2})$$ The condenser will unsplit, when: $$ambient\ temperature > (ambient\ split\ setpoint + \frac{ambient\ split\ deadband}{2})$$
Unsplit Dbnd	Defines a dead band around the split pressure setpoint. If the condenser is in split mode, it will unsplit when: $$discharge\ pressure > (split\ pressure\ setpoint + \left(\frac{Unsplit\ deadband\ setpoint}{2}\right))$$ The split mode is available again when: $$discharge\ pressure < (split\ pressure\ setpoint - \left(\frac{Unsplit\ deadband\ setpoint}{2}\right))$$
Uspl to Spl Dly	Specifies a period after the condenser unsplit, for which the split mode activation is disabled.
LOW PRES STPT	Defines a fail-safe pressure setpoint below which all the fans will be turned OFF.
Low Press Hyst	Defines the hysteresis to avoid condenser from short-cycling between normal and low pressure cut off mode.
Fan ON Delay	Defines a period between when a fan is called by the E2 to be ON and when the fan turns on.
Fan OFF Delay	Defines a period between when a fan is called by the E2 to be OFF and when the fan turns off.
TR Temperature	The Temperature Throttling Range is a range of temperature around the control temperature setpoint that determines the PID percentage called for by the P mode.
L Lvl Min %	Specifies the liquid level % at which the low liquid level alarm will be generated.
L Lvl Alm Dly	Specifies the amount of time for which the liquid level input must be below the **Liquid Level Minimum %** setpoint for an alarm to be generated.
Ambient No Rst	Specifies the ambient temperature at which no adjustment to the active control setpoint will take place. $$(\ (ambient\ temperature > Ambient\ No\ Reset\ setpoint)\ \&\&$$

	$(Ambient\ No\ Reset\ setpoint > Ambient\ Max\ Reset\ setpoint))$ $\|$ $((ambient\ temperature < Ambient\ No\ Reset\ setpoint)\ \&\&$ $(Ambient\ No\ Reset\ setpoint < Ambient\ Max\ Reset\ setpoint))$
Ambient Max Rst	Specifies the ambient temperature at which adjustment to the active control setpoint will take place by either the **Max Temp Reset** or **Max Press Reset** setpoint. $((ambient\ temperature < Ambient\ Max\ Reset\ setpoint)\ \&\&$ $(Ambient\ Max\ Reset\ setpoint < Ambient\ No\ Reset\ setpoint))$ $\|$ $((ambient\ temperature > Ambient\ Max\ Reset\ setpoint)\ \&\&$ $(Ambient\ Max\ Reset\ setpoint > Ambient\ No\ Reset\ setpoint))$
Max Temp Reset	Specifies the maximum temperature setpoint reset value that would be added to the control setpoint when the ambient temperature reaches the **Ambient Max Reset** value.

Figure 26 INPUTS TAB SCREENSHOT

Table 18 INPUTS TAB DESCRIPTION

Field	Description
PRES CTRL IN	Pressure transducer input that is compared to the PID setpoint and used to operate the condenser fans.
DISCH TRIP IN	Pressure transducer input that is utilized by the condenser split feature to bring the condenser out of split when the discharge temperature or pressure is too high.
RECLAIM IN	Not used
FAST REC IN	Pressure transducer input that is utilized by the condenser fast recovery feature.
LIQUID LEVEL	Not used
DROPLEG TEMP	Temperature input that indicates the refrigeration temperature being supplied.

DROPLEG PRES	Not used
AMB TEMP IN	Temperature input that captures the ambient temperature.
SHUT DOWN	Used for emergency shutdown of a condenser.

Figure 27 VS SETUP TAB SCREENSHOT

Table 19 VS SETUP TAB DESCRIPTION

Field	Description
VS MIN Speed	Defines the lowest possible fan speed (in RPM) at which the variable-speed fan will operate.
VS MAX Speed	Defines the highest possible fan speed (in RPM) at which the variable-speed fan will operate.
VS Incr Rate	Determines how fast the speed of a variable-speed fan may increase.
VS Decr Rate	Determines how fast the speed of a variable-speed fan may decrease.
VS Inv Rst Dly	Defines the amount of time between inverter clearing attempts.
VS Rst Count	Defines number of attempts the application will make to clear the inverter failure.
VS Alarm Action	Defines the bypass value at which the fans shall operate when inverter goes into alarm status.
VS INVTR ALARM	Input that shall connected to a contact on the inverter that closes whenever an alarm occurs.
VS INVTR BYP	During bypass mode: a. If the PID % > 50%, the VS fan will operate at 100% speed. b. If the PID % < 50%, the VS fan will operate at 0% speed.
QUIET MODE ENB	Enables or disables the quiet mode feature. It is highly recommended to use Fast recovery when quiet mode is being used to handle the high discharge pressure scenarios.
QUIET MODE MAX	Defines the maximum variable-speed fan % when operating in quiet mode.

Figure 28 FAN OUTS TAB SCREENSHOT

```
05-06-19  ◆ ☾ ™                        RX-400 Unit 1                  ⓐ                    18:11:59
Use Ctrl-X to Select CX Tabs              SETUP              NAMES FULL

C1: General    C2: Setpoints  C3: Inputs    C4: VS Setup   C5:         ADVISORY SUMMARY
C6: Fan Outs   C7: Other Outs C8:           C9: Advanced   C0:         Fails        0
                    Condensers: CONDENSER001                           Alarms       0
                                                                       Notices      0
     ┌─────────────────────────────────────────────────────────┐
     │ Fan Outs          Area Ctrl   Application     Input       │
     │ VS FAN STATE      :           :               :        L  │      NETWORK OVERVIEW
     │ VS FAN OUT        :(M)       :(M)            :(M)       L  │        IONet-1       ◆
     │ VS RPM            :           :               :        L  │
     │ VS INVTR RESET    :                           :           │
     │ VS ALARM OUT      :                           :           │
     │ VS INVTR BYPASS   :                           :           │
     └─────────────────────────────────────────────────────────┘




                                                                       E2 Unit01

                                                                       Rev 4.09F02


                                                                       English-US

 Enter Controller | VS analog output to inverter
   F1: PREV TAB      F2: NEXT TAB      F3: EDIT      F4: MULTI OUT      F5: CANCEL
```

Table 20 FAN OUTS TAB DESCRIPTION

Field	Description
VS FAN STATE	Not used
VS FAN OUT	Output to which the inverter must be connected.
VS RPM	Not used
VS INVTR RESET	Not used
VS ALARM OUT	Not used
VS INVTR BYPASS	Not used

Figure 29 VS FAN OUT SETUP SCREENSHOT

```
05-06-19  ◆ ☾ ™                        RX-400 Unit 1                  ⓐ                    18:12:34
                                          SETUP              NAMES FULL
                       Multiple Output Setup                            ADVISORY SUMMARY
                                                                       Fails        0
        Output:  E2 Unit01:CONDENSER001   :VS FAN OUT                  Alarms       0
                                                                       Notices      0
                             Board          Point
Inputs Using Output:         4AO_001       :SECTION 1
                 E2 Unit01:COND SPLIT      :AI2                        NETWORK OVERVIEW
                                                                         IONet-1       ◆




                                                                       E2 Unit01

                                                                       Rev 4.09F02


                                                                       English-US

 Enter Board/Application
   F1: ADD RECORD     F2: DELETE RCRD    F3: ALT FORMATS    F4: LOOK UP      F5: CANCEL
```

Figure 30 OTHER OUTS TAB SCREENSHOT

```
05-06-19  ● ⟳ TM                        RX-400 Unit 1              🔒            18:13:23
Use Ctrl-X to Select CX Tabs              SETUP              NAMES FULL

C1: General    │ C2: Setpoints │ C3: Inputs  │ C4: VS Setup │ C5:        │ ADVISORY SUMMARY
C6: Fan Outs   │ C7: Other Outs│ C8:         │ C9: Advanced │ C0:        │   Fails        0
                    Condensers: CONDENSER001                              │   Alarms       0
                                                                         │   Notices      0
    Other Outs          Area Ctrl   Application   Input
    SPLIT VALVE     : (M)        :(M)          :(M)            L
    SPLIT FAN       :           :             :               L          NETWORK OVERVIEW
    ALARM OUT       :            8RO_001      :ALARM OUTPUT    L            IONet-1        ●
    REFRIG TEMP OUT :           :             :               L
    DISCHARGE OUT   :           :             :               L
    T CTRL VAL OUT  :           :             :               L
    T CTRL VAL STPT :           :             :               L
    CONTROL PID     :           :             :               L
    FST REC ACTIVE  :           :             :
    FST REC VAL OUT :           :             :
    FST REC SP OUT  :           :             :
    REFG TYPE OUT   :           :             :
    CONTROL METHOD  :           :             :
    CONDENSER STATE :           :             :               E2 Unit01
    ALG STATUS      :           :             :
                                                               Rev 4.09F02

                                                               English-US

    Enter Controller │ ON when split trip point has been reached
    F1: PREV TAB   │  F2: NEXT TAB  │  F3: EDIT  │  F4: MULTI OUT  │  F5: CANCEL
```

Table 21 OTHER OUTS TAB DESCRIPTION

| Field	Description
SPLIT VALVE	Split valve is ON when split feature is active and OFF when split is inactive.
SPLIT FAN	Output is ON when split feature is active and OFF when split is inactive.
ALARM OUT	Output turns ON when certain fatal system condition (input device supplying the control value fails) is detected.
REFRIG TEMP OUT	For TD condensers, this output is equal to refrigerant temperature as converted from pressure.
DISCHARGE OUT	Output equal to current discharge pressure (either measure from transducer or as converted from discharge temperature).
T CTRL VAL OUT	Output equal to the temperature control value being used by the PID algorithm.
T CTRL VAL STPT	Output equal to the control input value (discharge temperature including any adjustments that may be made) being used by PID algorithm.
CONTROL PID	Real-time PID output %.
FST REC ACTIVE	Output that reflects the current state of fast recovery mode.
FST REC VAL OUT	Output equal to the current fast recovery control value.
RST REC SP OUT	Output value is equal to the currently active fast recovery setpoint.
REFG TYPE OUT	Output displays the refrigerant being used in the system.
CONTROL METHOD	Output shows whether the control input is either discharge temperature or discharge pressure.
CONDENSER STATE	Output that reflects the current state of the condenser.
ALG STATUS	Output that indicates the algorithm status.

Figure 31 SPLIT VALVE SETUP SCREEN SHOT

```
05-06-19 ● 🔧 ™                    RX-400 Unit 1              🔒              18:13:53
                                      SETUP              NAMES FULL

                 Multiple Output Setup                          ADVISORY SUMMARY
                                                                  Fails        0
        Output:  E2 Unit01:CONDENSER001  :SPLIT VALVE            Alarms       0
                                                                  Notices      0
                             Board          Point
  Inputs Using Output:      8RO_001       :SPLIT VALVE           NETWORK OVERVIEW
                 E2 Unit01:COND SPLIT     :DI1                    IONet-1         ●




                                                                  E2 Unit01

                                                                  Rev 4.09F02

                                                                  English-US

  Enter Board/Application
  ┌─────────────┬──────────────┬──────────────┬──────────────┬──────────────┐
  │F1: ADD RECORD│F2: DELETE RCRD│F3: ALT FORMATS│F4: LOOK UP  │F5: CANCEL   │
  └─────────────┴──────────────┴──────────────┴──────────────┴──────────────┘
```

Figure 32 ADVANCED TAB SCREENSHOT

```
05-06-19 ● 🔧 ™                    RX-400 Unit 1              🔒              18:14:35
  Use Ctrl-X to Select CX Tabs        SETUP              NAMES FULL

  C1: General   │C2: Setpoints │C3: Inputs │C4: VS Setup │C5:              ADVISORY SUMMARY
  C6: Fan Outs  │C7: Other Outs│C8:        │C9: Advanced │C0:                Fails        0
                 Condensers: CONDENSER001                                    Alarms       0
                                                                             Notices      0
   ┌────────────────────────────────────────┐
   │Advanced          Value                  │                             NETWORK OVERVIEW
   │KW Load        :          0              │                              IONet-1         ●
   │Setpoint Pos   : Center of TR            │
   │P-Gain         :       1.00              │
   │I-Gain         :       1.00              │
   │D-Gain         :          0              │
   │Emergency Out  :          0              │
   │Inverter Prior :         20              │
   │Demand Bump    :          0              │
   │Multi Alm Type : Disabled                │
   └────────────────────────────────────────┘
                                                                             E2 Unit01

                                                                             Rev 4.09F02

                                                                             English-US

  Enter 0 to 9999 | KW load for this application
  ┌─────────────┬──────────────┬──────────────┬──────────────┬──────────────┐
  │F1: PREV TAB │F2: NEXT TAB  │F3: EDIT      │F4: STATUS    │F5: CANCEL   │
  └─────────────┴──────────────┴──────────────┴──────────────┴──────────────┘
```

Table 22 ADVANCED TAB DESCRIPTION

Field	Description
KW Load	A reference for power monitoring system regarding total amount of KW used by the condenser system (including fans, pumps, etc).
Setpoint Pos	Refers to where the setpoint lies within the Throttling Range.
P-Gain	Determines how large the P mode of the PID will be.
I-Gain	Determines how large the I mode of the PID will be.
D-Gain	Determines how large the D mode of the PID will be.
Emergency Out	Indicates the % of fan capacity at which the condenser will operate when the emergency override input is low.
Inverter Prior	Defines the priority level of the alarm generated when the variable-speed fan inverter fails.
Demand Bump	The amount that will be added to the control setpoint when the demand shed input is ON.
Multi Alm Type	Displays the multiple alarm advisory types of the Enhanced Suction Group application.

8.2.3.1.4 ANALOG COMBINER

Analog combiner application reads data values from multiple inputs (up to sixteen), combines them using a user-defined combination strategy and sends the combined value to the desired application input.

We are utilizing the analog combiner application to monitor and limit the maximum ambient temperature input to the condenser control application.

Figure 33 GENERAL TAB SCREENSHOT

Table 23 GENERAL TAB DESCRIPTION

Field	Description
Name	Specify the name of the analog combiner application.
Num Inputs	Number of inputs that would be combined by the analog combiner.
Eng Units	Units for both the analog input and output values.
Comb Method	Selects MIN as the input combination strategy, which uses the lowest input value as the output.
ALT Comb Method	Strategy used when the use alt input is ON.
Emerg Out	Output will be overridden to this value whenever the EMERGENCY BYP input is low.
Output on Fail	Not used
ENABLE	Not used.

Figure 34 COMB INS TAB SCREENSHOT

Table 24 COMB INS TAB DESCRIPTION

Field	Description
ANALOG INPUT1	Associated with the Outside Air Temperature (OAT) input.
ANALOG INPUT2	Specified to be a constant 100.00 as we needed to limit the analog input to a maximum allowed value.

Figure 35 CTRL INS TAB SCREENSHOT

```
05-06-19 ●          RX-400 Unit 1                              18:16:31
Use Ctrl-X to Select CX Tabs          SETUP          NAMES FULL
C1: General  | C2: Comb Ins  | C3: Ctrl Ins | C4: Outputs | C5:    | ADVISORY SUMMARY
                                                                     Fails        0
                 Analog Combiners: ANALOG COMB001                    Alarms       0
                                                                     Notices      0
       Ctrl Ins           Area Ctrl   Application    Output
       USE ALT         :              :             :                NETWORK OVERVIEW
       EMERGENCY BYP   :              :             :                 IONet-1        ●




                                                                     E2 Unit01

                                                                     Rev 4.09F02

                                                                     English-US

   Enter Controller | Use alternate combination input
   F1: PREV TAB    | F2: NEXT TAB  | F3: EDIT | F4: LOOK UP | F5: CANCEL
```

Table 25 CTRL INS TAB DESCRIPTION

Field	Description
USE ALT	Input tells the analog combiner application whether to use the primary combination method (OFF) or the alternate combination method (ON).
EMERGENCY BYP	Input allows the user to override the analog combiner application's output to the value specified in the Emerg Out field.

Figure 36 OUTPUTS TAB SCREENSHOT

```
05-06-19 ●          RX-400 Unit 1                              18:17:13
Use Ctrl-X to Select CX Tabs          SETUP          NAMES FULL
C1: General  | C2: Comb Ins  | C3: Ctrl Ins | C4: Outputs | C5:    | ADVISORY SUMMARY
                                                                     Fails        0
                 Analog Combiners: ANALOG COMB001                    Alarms       0
                                                                     Notices      0
       Outputs            Area Ctrl   Application    Input
       OUTPUT          : E2 Unit01 :CONDENSER001 :AMB TEMP IN    L
       ALTERNATE OUT   :           :             :                  NETWORK OVERVIEW
       ALG STATUS      :           :             :                   IONet-1        ●




                                                                     E2 Unit01

                                                                     Rev 4.09F02

                                                                     English-US

   Enter Controller | Combined output of analog inputs
   F1: PREV TAB    | F2: NEXT TAB  | F3: EDIT | F4: LOOK UP | F5: CANCEL
```

Table 26 OUTPUTS TAB DESCRIPTION

Field	Description
OUTPUT	Result of the combination of Analog Input 1 through Analog Input 16 using the primary method of combination (Comb Method) is sent to the output.
ALTERNATE OUT	Not used
ALG STATUS	Not used

8.2.3.1.5 FLEXIBLE COMBINER

Flexible combiner application combines up to eight analog and up to eight digital input values using programmed equations to provide up to provide up to eight analog outputs and four digital outputs.

We are utilizing the flexible combiner application to disable the second AO in split condenser mode.

Figure 37 GENERAL TAB SCREEN SHOT

Table 27 GENERAL TAB DESCRIPTION

Field	Description
Name	Specify the name for flexible combiner application
Long Name	Specify further details if needed like functionality, etc.
Update Rate	Determines how fast this flexible combiner application within the E2 controller operates.
Num of AI	Define to use two analog inputs.
Num of AO	Define to provide one analog output.
Num of DI	Define to use one digital input.
Num of DO	Not used.
Num of Alarms	Not used.
Num of AM	Not used.
Show Eq Line 2	Not used.

Figure 38 INPUTS TAB SCREENSHOT

```
05-06-19 ●  ⟳  TM                        RX-400 Unit 1                        17:55:00
Use Ctrl-X to Select CX Tabs                SETUP            NAMES FULL
C1: General    │ C2: Inputs  │ C3: Outputs   │ C4: Output Eq │ C5:        │   ADVISORY SUMMARY
C6: Eng Units  │ C7: Eq Errors│ C8: Descript │ C9:           │ C0:        │   Fails         0
         Flexible Combiner: COND SPLIT-DISABLES AO2 IN SPLIT               │   Alarms        0
                                                                          │   Notices       0
    ┌──────────────────────────────────────────────────────────┐
    │ Inputs            Value                                    │            NETWORK OVERVIEW
    │ AI1          :    ▢          0                             │              IONet-1        ●
    │ AI2          :    E2 Unit01:CONDENSER001  :VS FAN OUT      │
    │ DI1          :    E2 Unit01:CONDENSER001  :SPLIT VALVE     │
    └──────────────────────────────────────────────────────────┘




                                                                              E2 Unit01

                                                                              Rev 4.09F02


                                                                              English-US

 Enter   PCT │ Analog Input 1
┌──────────────┬──────────────┬──────────────┬──────────────┬──────────────┐
│ F1: PREV TAB │ F2: NEXT TAB │  F3: EDIT    │ F4: STATUS   │ F5: CANCEL   │
```

Table 28 INPUTS TAB DESCRIPTION

Field	Description
AI1	Specified to be a constant 0 as we need to turn of the analog output.
AI2	Associated with an analog output generated to control section 1 in the condenser application.
DI1	Associated with a digital output generated to control split valve in the condenser application.

Figure 39 OUTPUTS TAB SCREENSHOT

```
05-06-19 ●  ⟳  TM                        RX-400 Unit 1                        18:03:41
Use Ctrl-X to Select CX Tabs                SETUP            NAMES FULL
C1: General    │ C2: Inputs  │ C3: Outputs   │ C4: Output Eq │ C5:        │   ADVISORY SUMMARY
C6: Eng Units  │ C7: Eq Errors│ C8: Descript │ C9:           │ C0:        │   Fails         0
         Flexible Combiner: COND SPLIT-DISABLES AO2 IN SPLIT               │   Alarms        0
                                                                          │   Notices       0
    ┌──────────────────────────────────────────────────────────┐
    │ Outputs                     Board          Point          │
    │ AO1               :         4AO_001        :SECTION 2      │            NETWORK OVERVIEW
    └──────────────────────────────────────────────────────────┘              IONet-1        ●






                                                                              E2 Unit01

                                                                              Rev 4.09F02


                                                                              English-US

 Enter  Board/Application │ Analog Output 1
┌──────────────┬──────────────┬──────────────┬──────────────┬──────────────┐
│ F1: PREV TAB │ F2: NEXT TAB │  F3: EDIT    │ F4: LOOK UP  │ F5: CANCEL   │
```

Table 29 OUTPUTS TAB DESCRIPTION

Field	Description
AO1	For our application this is associated to control the section 2 fans.

Figure 40 OUTPUT EQ TAB SCREENSHOT

Table 30 OUTPUT EQ TAB DESCRIPTION

Field	Description
AO1 Eq	When the digital input 1 is ON, AO1 is set to AI1. When the digital input 1 is OFF, AO1 is set to AI2.

Figure 41 ENG UNIT TAB SCREENSHOT

Table 31 ENG UNITS TAB DESCRIPTION

Field	Description
AI1 Eng Unit	Specifies the analog input 1 engineering units for flexible combiner. *Notes: For our application this is specified to be percentage.*
AI2 Eng Unit	Specifies the analog input 2 engineering units for flexible combiner. *Notes: For our application this is specified to be percentage.*
DI1 Eng Unit	Specifies the digital input 1 engineering units for flexible combiner. *Notes: For our application this is specified to be percentage.*

Figure 42 DESCRIPT TAB SCREENSHOT

Table 32 DESCRIPT TAB DESCRIPTION

Field	Description
AI1 Description	Used to provide additional analog input 1 description for flexible combiner.
AI2 Description	Used to provide additional analog input 2 description for flexible combiner.
DI1 Description	Used to provide additional digital input 1 description for flexible combiner.
AO1 Description	Used to provide additional analog output 1 description for flexible combiner.

8.2.3.2 TROUBLESHOOTING

Table 33 E2 MULTIFLEX TROUBLESHOOTING

SYMPTOM	POSSIBLE PROBLEM	SOLUTION
I/O Network Problems	I/O board not getting power.	Check I/O board power--is the green STATUS light on? If not, check power wiring connections, and use a multimeter to verify the board is getting 24VAC. Reset power to board.
	I/O board not communicating or won't come online.	Check I/O network connections: 1. Check wire polarity (positive to positive/negative to negative) 2. Check for broken or loose wires.
	Dip switches are set incorrectly.	Check I/O board network dip switches. Verify network ID number is not a duplicate and that baud rate switches are set to 9600. (If switches are wrong, make changes and then reset the controller.)
	Terminating resistance jumpers are set incorrectly.	Check for proper setting of terminating resistance jumpers. Network segment should be terminated on the two endpoints of the daisy chain and unterminated everywhere else.
	Boards are not powered.	Check Network/Power voltages.
Problems with Condenser	Condenser will not operate.	Verify that E2 is programmed with proper number of fans. 1. Highlight the General tab (C1) in the Condenser Setup screen. 2. Is the correct number of fans in the **Number of Fans** field?
	Incorrect board and point settings.	Confirm proper board and point settings: Go to the Inputs tab (C3) in the Condenser Setup screen to check PRES CRTL IN and DISCH TRIP IN.
	Fail-Safe wiring on 8RO is incorrect.	Verify proper fail-safe switch positions on the 8RO board. The fail-safe dip switches are labeled S2 on the 8RO and S3 on the 8ROe and 8IO. Set the rocker UP (ON) to close the relay and turn the output ON during network failure. Set the switch DOWN (OFF) to open the relay and turn the output OFF during network failure.
	Condenser will not split.	Enable the condenser to split.

		Go to General tab (C1) in the Condensers Setup screen and set the Split Enable field to **Yes**.
	Unsplit setpoint is set too low.	Unsplit setpoint value is compared with discharge pressure value instead of temperature. Enter the value in terms of discharge pressure. Go to Setpoints tab (C2) in the Condensers Setup screen and check that the UNSPLIT STPT field value has been entered as a pressure value.
	Half of the fans are not running.	Check the split fan relay output: 1. Go to the Other Outs tab (C7) in the Condensers Setup screen and check that SPLIT FAN has a board and point assignment. 2. Verify Split is enabled: Go to General tab (C1) in the Condensers Setup screen and set the Split Enable filed to **Yes**. 3. Verify output is ON.
Problems with Temp Sensor or Pressure Transducer Displaying Proper Value	16AI input dip switches are set improperly	The 16 dip switched on the 16AI board correspond to each of the inputs: Dip Switches Up = Temperature sensor Dip Switches Down = Pressure Transducer
	Incorrect board and point address	Set Proper board and point setting for both input and output: Go to the Inputs tab in the application's Setup screen and check Board and Point
	Incorrect sensor type	1. Verify that the sensor type in E2 is the same as the sensor installed. 2. From the Main Menu, select System Configuration (7) and Input Definitions (1). 3. Highlight the desired input and press F1 (SETUP) to check Sensor Type.

8.2.4 DANFOSS CONTROLLER

Condensers are built with MCX06D programmable controller fitted with LCD display.

Figure 43 DANFOSS MCX06D CONTROLLER WIRING DIAGRAM
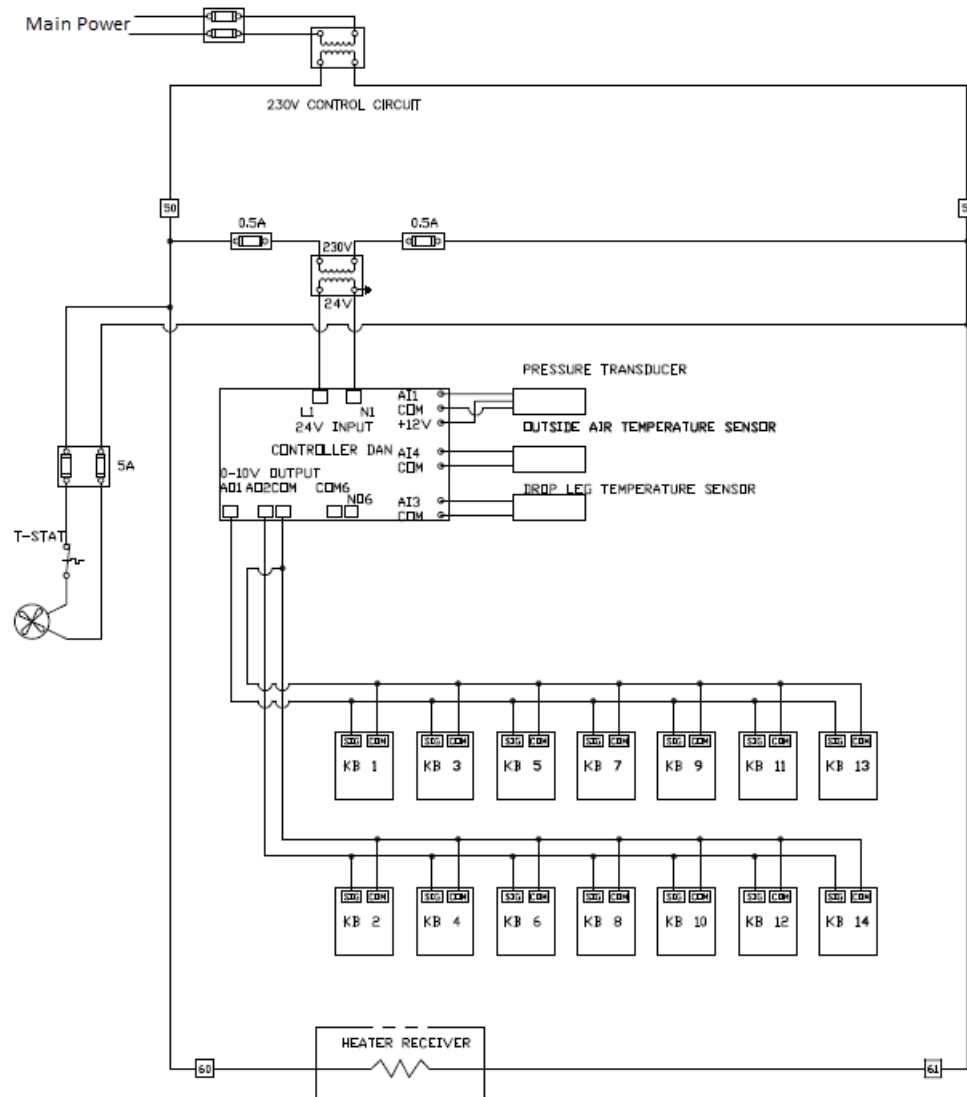
8.2.4.1 CONNECTIVITY

Following are the two methods in which the Danfoss MCX06D controller can be accessed:
a. Local display on the controller.
b. Programmable controller MMIMYK.

8.2.4.1.1 MCX06D LOCAL DISPLAY INTERFACE

Utilize the controller display (provided with backlight) to view the system status on the home screen as illustrated in the following figure.

Figure 44 MCX06D CONTROLLER LOCAL DISPLAY

Home screen displays following information:
1. Condensing temperature
2. Condensing target temperature
3. Fan speed (%)
4. Split condenser status (ON/OFF)
5. Application status
6. Control input (Discharge pressure/Drop leg temperature)

Following table provides information regarding 4 keys functionality from home screen:

Table 34 KEYS FUNCTIONALITY IN HOME SCREEN

KEY Label	Description
CANCEL	1. In home screen, when selected navigates to alarm status screen. 2. In any other screen, when selected navigates back to previous screen.
UP	1. In home screen, not programmed. 2. In appropriate screens, utilized to increase the value.
DOWN	1. In home screen, when selected navigates to inputs status screen. 2. In appropriate screens, utilized to decrease the value.
ENTER	1. In home screen, when selected navigates to main menu screen. 2. In appropriate screens, utilized to update the modified parameter.

8.2.4.1.2 PROGRAMMABLE CONTROLLER MMIMYK

MMIMYK controller performs the following functions:
- Programming module
- Gateway
- Data logger

MMIMYK also supports the following interfaces:
- CANbus interface to connect to MCX controllers.
- SD/MMC card slot to support software upload and datalogging.
- Modbus RS485 serial interface

Figure 45 MMIMYK CONNECTION DIAGRAM
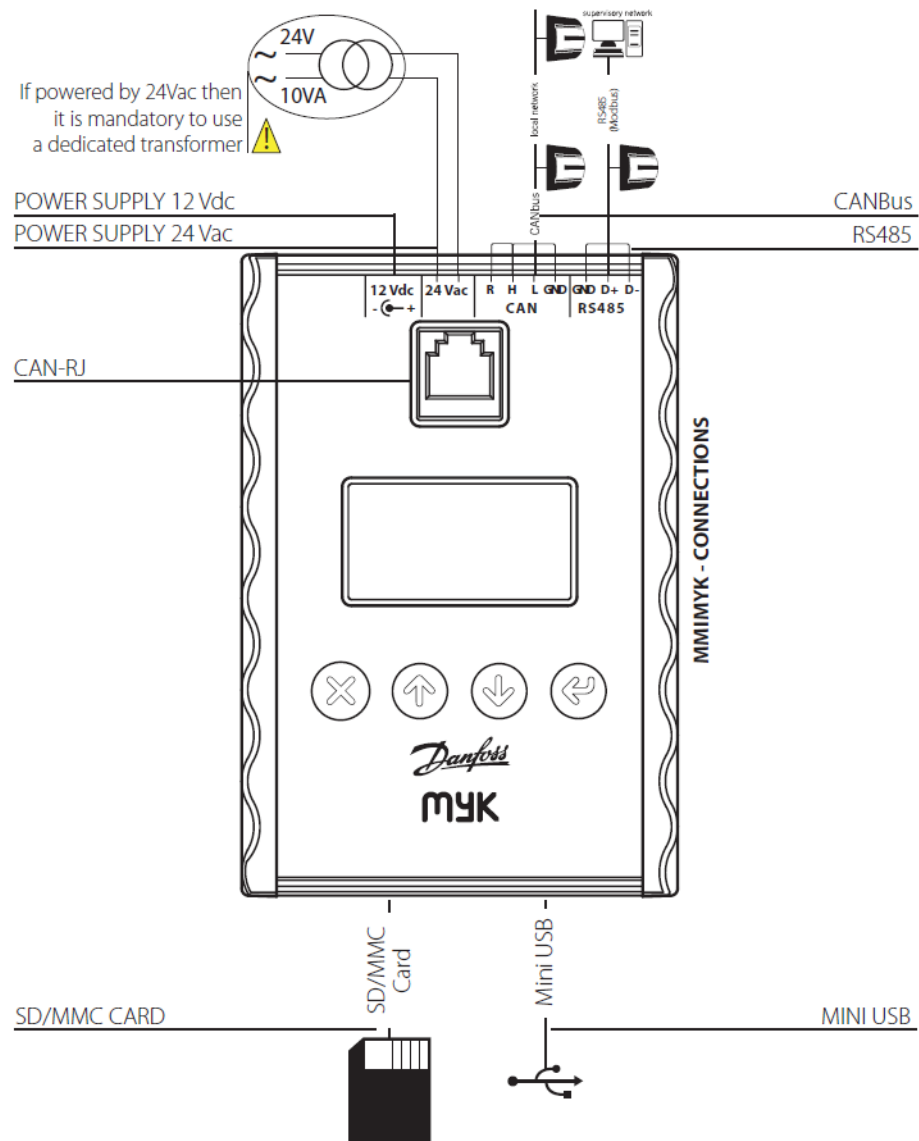
Figure 46 MMIMYK NETWORK DIAGRAM
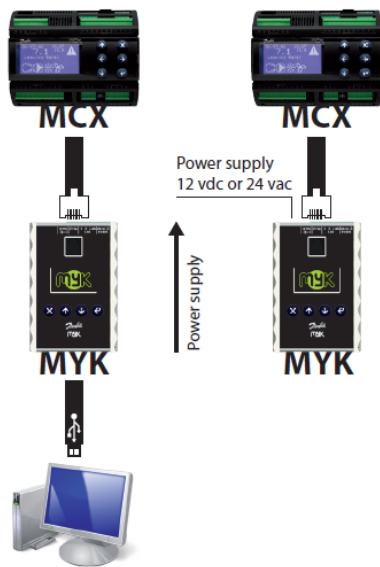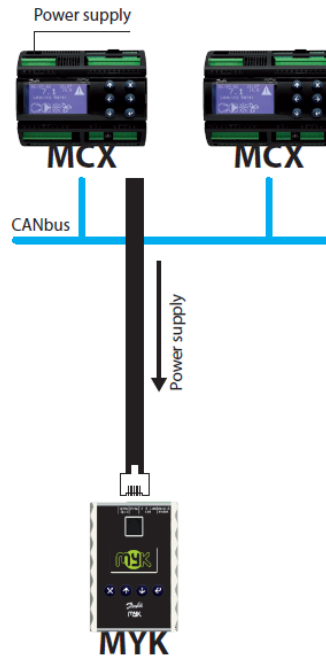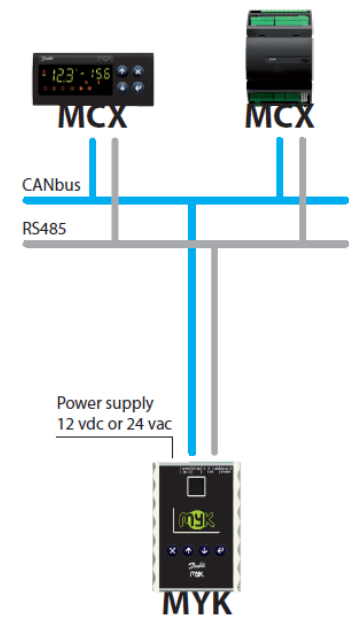
8.2.4.1.2.1 APPLICATION SOFTWARE UPDATE

Following figure illustrates MMIMYK connection to MCX06D controller through CANbus network. The MMIMYK can be powered either through USB to PC connection or external power supply.

Figure 47 MMIMYK CONNECTIONS - CANBUS TO MCX06D

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To upload the latest application to MCX06D controller, both the latest app.pk and mmimyk.cfg files must be loaded into an SD-Card and insert upside down into MMIMYK. Navigate the menu as follows:

- Select PROGRAM and press ENTER button.
- Select DOWNLOAD and press ENTER button.
- Using DOWN button select 1:/ folder and press ENTER button.
- Using DOWN button select /cond and press ENTER button.
- Select ALL and press ENTER button.
- MMIMYK would start downloading.
- MMIMYK displays FINISHED when transfer is complete.
- Press EXIT button until we get back to the main screen.

8.2.4.1.2.2 WEBSERVER ACCESS

Following steps illustrate how to access MCX06D webserver:
- If not installed, please install MyKManager on our PC.
- Have the Simulator folder downloaded onto your PC.

Figure 48 SIMULATOR FOLDER

- Run MCXVPortConnector application as highlighted in Figure 47. Select Start and the datalogger shall be running.

Figure 49 MCXVPortConnector DATALOGGER

Microchannel Remote Air Cooled Condensers (PN E660159_K)
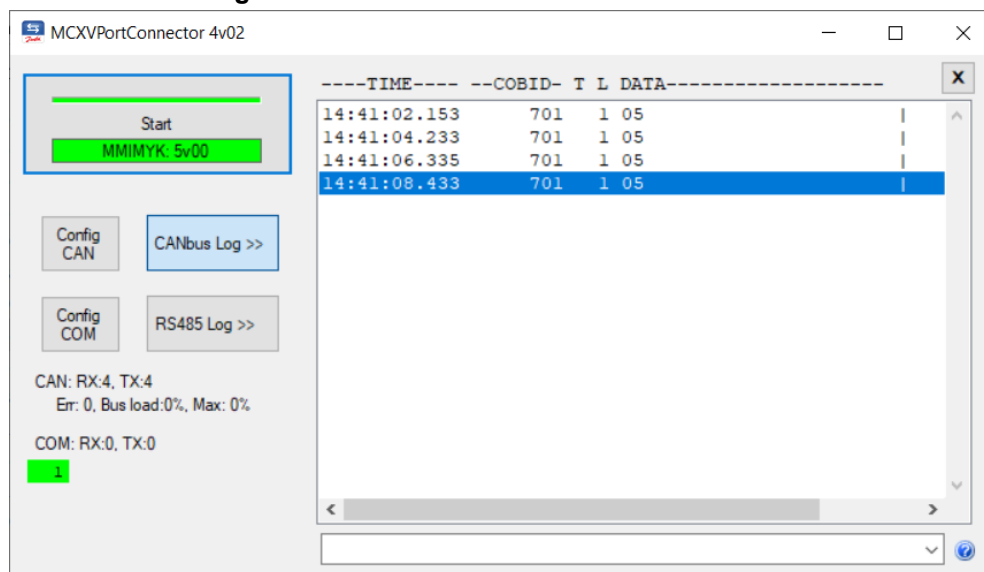
- Select the Simulator batch file as illustrated in Figure 47 and let it run.

Figure 50 MCXSimulator
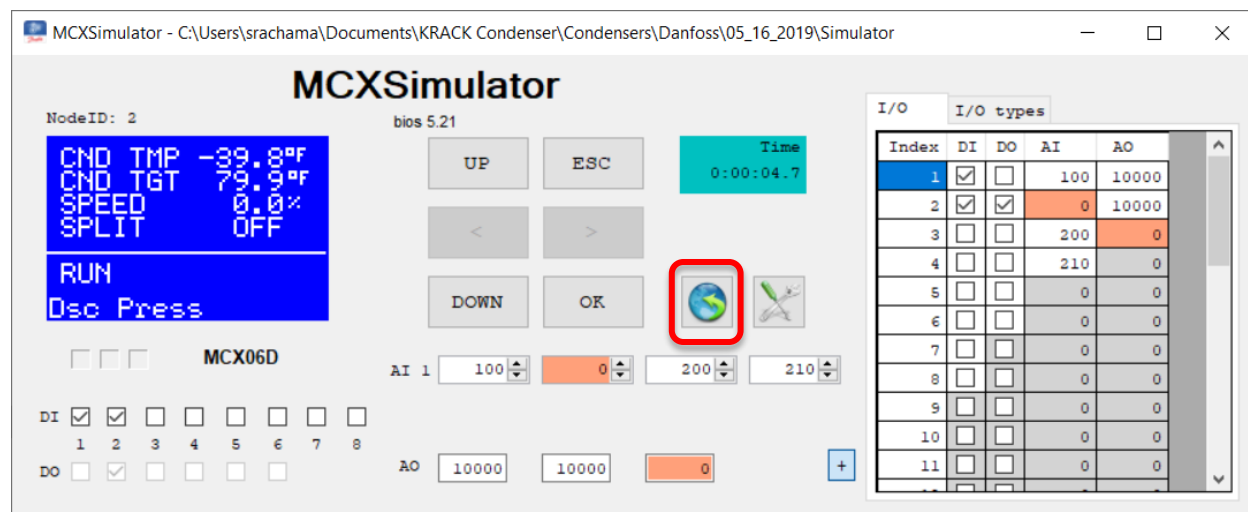
- Select the Globe icon as illustrated in Figure 49 and a web browser will pop as illustrated below:
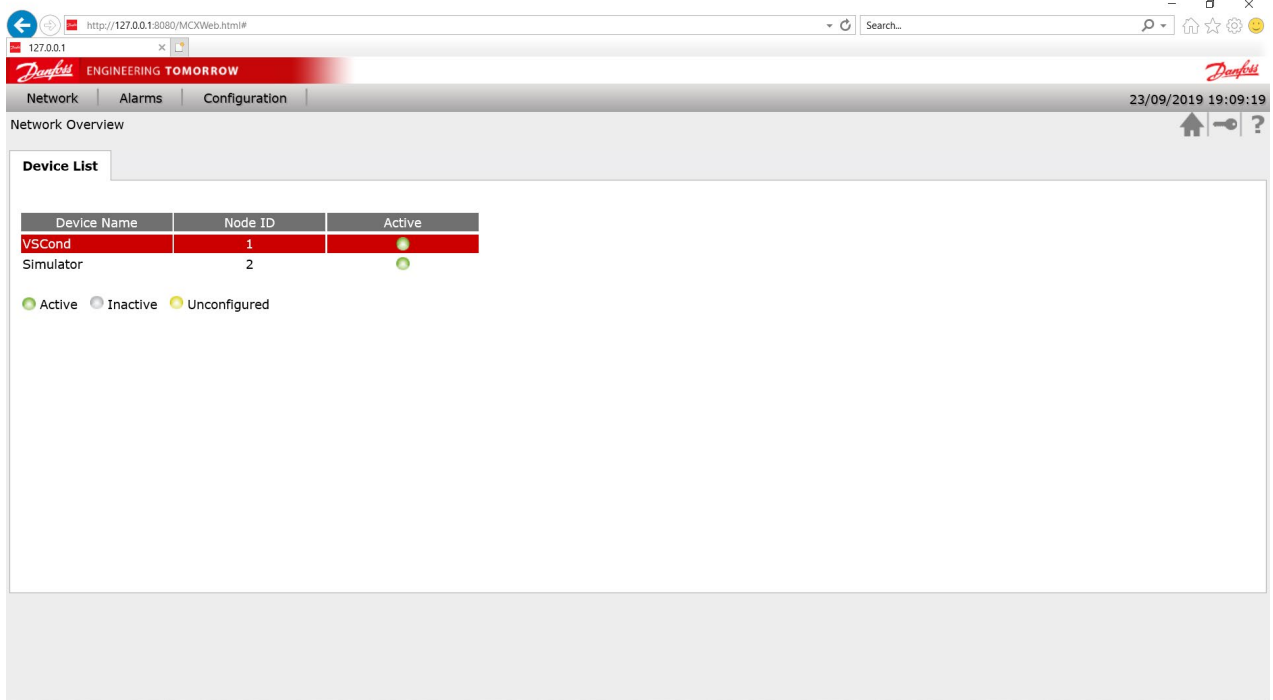
Figure 51 MCXWeb INTERFACE
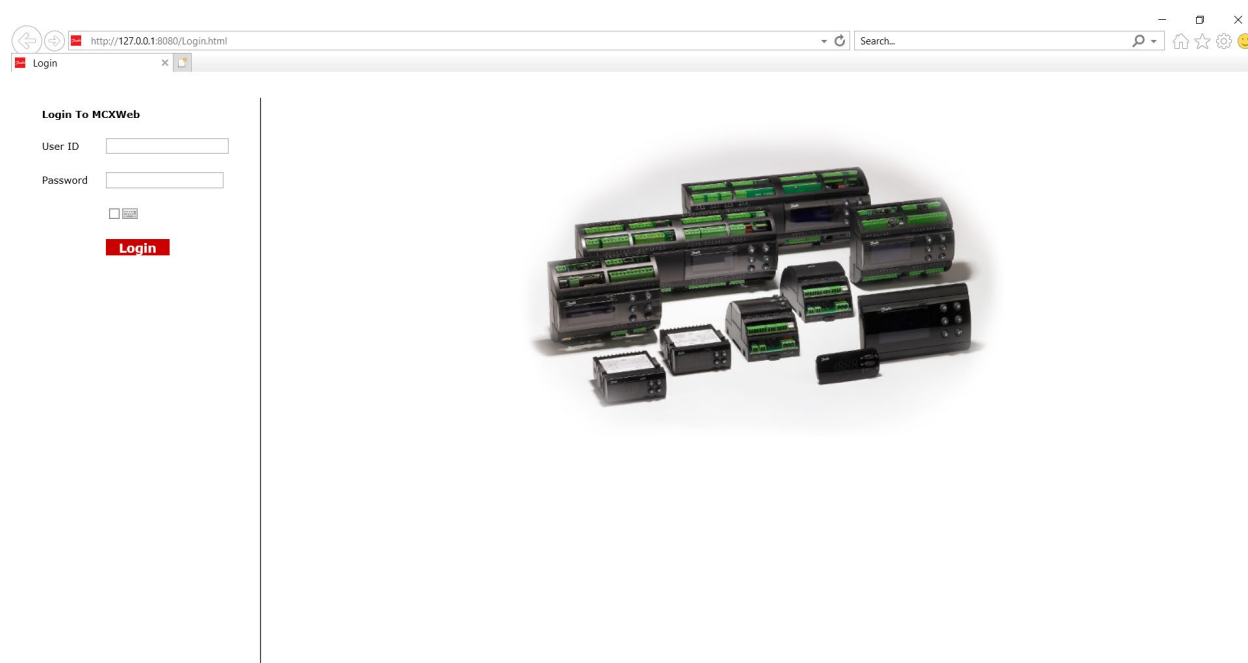
- Use following credentials to login to the controller.
  User ID: admin
  Password: PASS
- Wait until the page refreshes and displays the devices available.
  Select VSCond device to view the application status, update parameters, view any existing alarms in the system, graph the parameters over time, etc.

  Following figures show few of the screens available in the web interface.

Figure 52 MCXWeb - DEVICE LIST
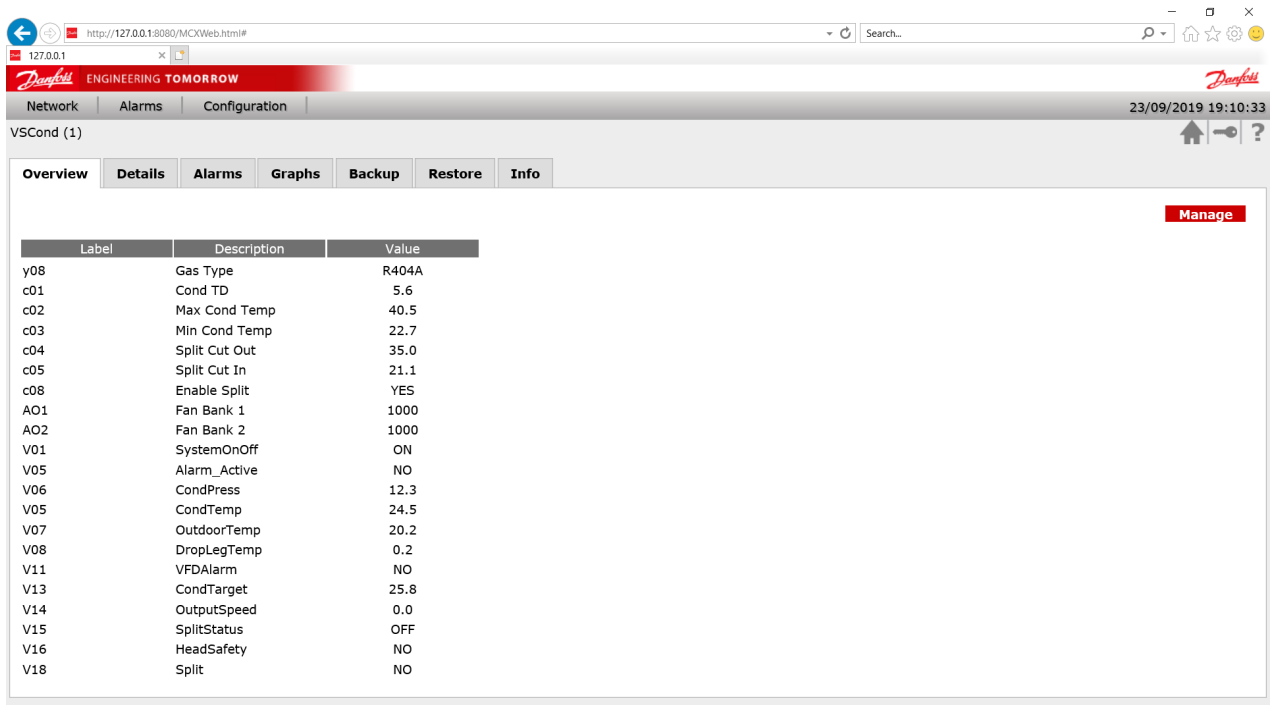
Figure 53 MCXWeb - OVERVIEW TAB

Figure 54 MCXWeb - DETAILS TAB
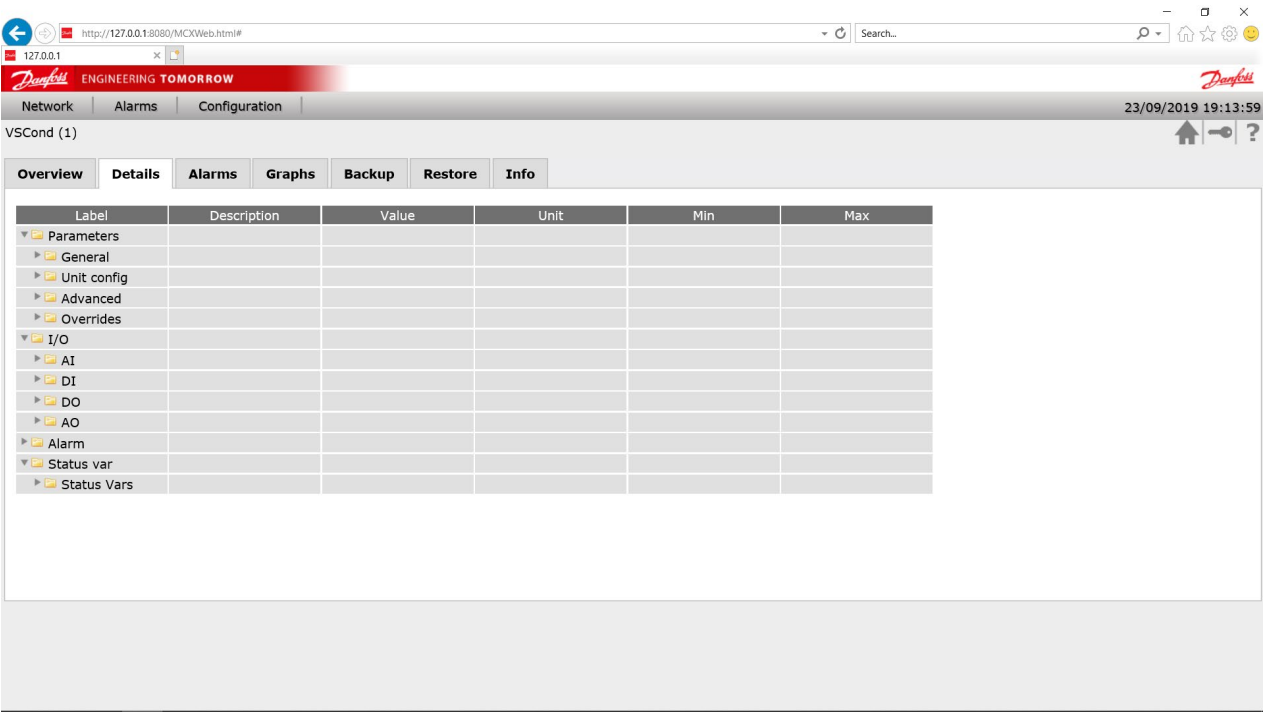
Figure 55 MCXWeb - GRAPHS TAB
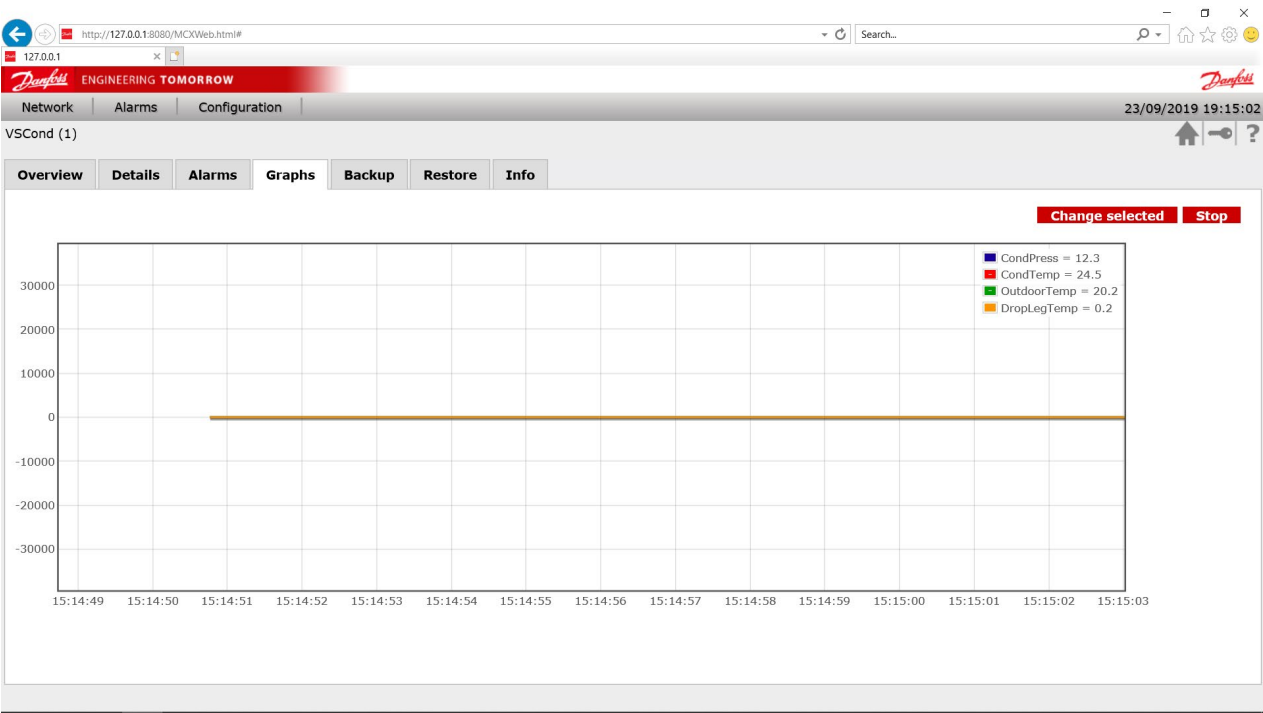
8.2.4.2 COMMISSIONING

The Condenser Control application increases or decreases the airflow across the condenser coil surface by modulating condenser variable speed fans via analog output(s) to maintain a minimum amount of difference between either condensing temperature (calculated from discharge pressure) or drop leg temperature and the outside ambient temperature.

8.2.4.2.1 MAIN MENU ACCESS

By default, the application allows the user to access Main Menu at Level 0. To view the extended version of Main Menu, the user needs to enter login credentials
.
The controller supports three levels of accessibility:
- a. L1 – password (100)
- b. L2 – password (200)
- c. L3 – password (300)

Navigate to Main Menu at Level 0 by pressing the ENTER button on home screen.

Figure 56 MAIN MENU L0

Navigate to Password screen by selecting "Login" and pressing ENTER button.
Utilize UP and DOWN buttons to enter 300 as password and press ENTER button.

Figure 57 LEVEL 3 PASSWORD

Following figure illustrates the Main Menu at Level 3.

Figure 58 MAIN MENU L3

8.2.4.2.2 I/O CONFIG

Scroll to select "I/O Config" option on the Main Menu at Level 3 and press ENTER button for the application to navigate to I/O Config screen.

Figure 59 I/O CONFIG SELECTION
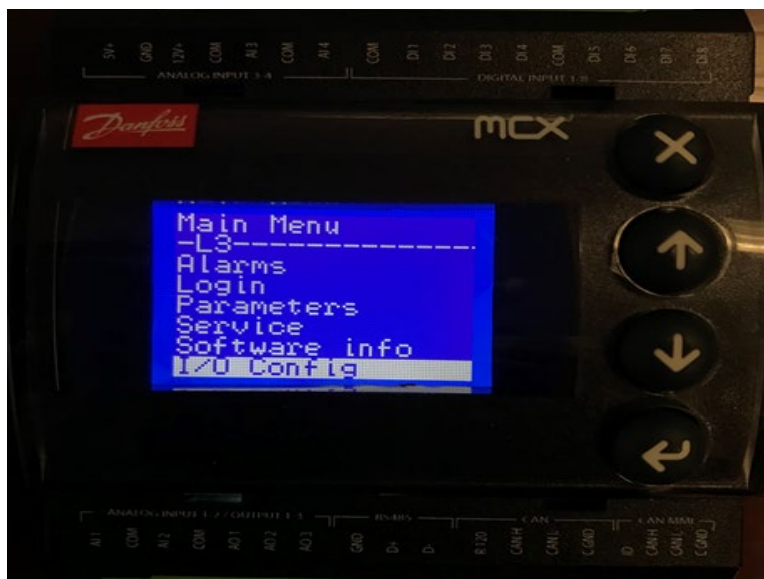
The application provides following options under I/O Config Menu:

Table 35 I/O CONFIG MENU

S. No.	Option	Description
1	Analog Input	Allows the user to configure analog inputs for the application.
2	Analog Output	Allows the user to configure analog outputs for this application.

Figure 60 I/O CONFIG SCREEN

Select "Analog Input" option on I/O Config screen and press ENTER button for the application to navigate to Analog Input Setup screen.

Following are the analog inputs necessary for the Condenser Control application:
- Discharge pressure transducer
- Drop leg temperature sensor
- Outdoor ambient temperature sensor

Figure 61 ANALOG INPUT SETUP SCREEN

Select an analog input and press ENTER button for the application to navigate to the corresponding analog input screen.

Following are the settings available for each analog input:

Table 36 ANALOG INPUT MENU

S.No.	Option	Description
1.	FUN	Allows to select one of the inputs defined in the application.
2.	TYPE	Allows to select the input type from the defined options.
3.	CAL	Allows to define the calibration offset.
4.	MIN	Defines the minimum valid value.
5.	MAX	Defines the maximum valid value.
6.	DEL	Defines the delay time for error detection.
7.	ERR	Enables or disables error detection.

Figure 62 ANALOG INPUT SCREEN

Select "Analog Output" option on I/O Config screen and press ENTER button for the application to navigate to the Analog Output Setup screen.

Following are the analog outputs being controlled by the Condenser Control application:
- Fan bank 1
- Fan bank 2

Figure 63 ANALOG OUTPUT SETUP SCREEN

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Select an analog output and press ENTER button for the application to navigate to the corresponding analog output screen.

The following are the settings available for each analog input:

Table 37 ANALOG OUTPUT MENU

S.No.	Option	Description
1.	FUN	Allows to select one of the outputs defined in the application.
2.	TYPE	Allows to select the output type from the defined options.

Figure 64 ANALOG OUTPUT SCREEN

8.2.4.2.3 PARAMETERS

Scroll to select "Parameters" option on the Main Menu at Level 3 and press ENTER button for the application to navigate to Parameters screen.

Figure 65 PARAMETERS SELECTION

The application provides following options under Parameters Menu:

Table 38 PARAMETERS MENU

S. No.	Option	Description
1.	General	Allows to update controller settings.
2.	Unit Config	Allows to update application settings.
3.	Advanced	Allows to update advanced application settings.
4.	Overrides	Allows to override inputs and outputs.

Figure 66 PARAMETERS SCREEN

8.2.4.2.3.1 GENERAL

Scroll to select "General" option on the Parameters screen and press ENTER button for the application to navigate to General screen.

Figure 67 GENERAL SCREEN

General screen provides following options for further selection:

Table 39 GENERAL MENU

S. No.	Option	Description
1.	Configuration	Configure buzzer and alarm related parameters.
2.	Serial settings	Configure serial communication settings.
3.	Password	Configure passwords for 3 levels of access.
4.	Setup	Configure system related parameters.
5.	Reset VFD	Reset VFD (Sets AO to 10VDC for 2 seconds and auto clears).

The following table lists the parameters available under Configuration:

Table 40 GENERAL – CONFIGURATION PARAMETERS

Label	Parameters	Description	Min	Max	Default	Unit
BUZ	Buzzer activation time	Defines the on time for which the buzzer will be active	0	15	1	Min
AdL	Alarm relay activation delay	Defines the delay from the point of alarm generation after which the alarm relay would be active	0	999	0	Sec
AOF	Alarm relay active if unit in OFF	Defines whether alarm relay would be active or not when the application is turned OFF	0	1	1 – YES	Enum 1

The following table lists the parameters available under Serial Settings:

Table 41 GENERAL – SERIAL SETTINGS PARAMETERS

Label	Parameters	Description	Min	Max	Default	Unit
SEr	Serial address	Defines the device address for both MODBUS and CANbus networks	1	100	1	
bAU	Serial baudrate	Defines the serial communication baud rate for MODBUS network	0	8	8 – 384	Enum 2
COM	Serial settings	Defines the serial communication settings for MODBUS Network	0	2	1 – 8E1	Enum 1

The following table lists the parameters available under Password:

Table 42 GENERAL – PASSWORD PARAMETERS

Label	Parameters	Description	Min	Max	Default	Unit
L01	Password level 1	Defines the password for level 1 access	0	999	100	
L02	Password level 2	Defines the password for level 2 access	0	999	200	
L03	Password level 3	Defines the password for level 2 access	0	999	300	

The following table lists the parameters available under Setup:

Table 43 GENERAL – SETUP PARAMETERS

Label	Parameters	Description	Min	Max	Default	Unit
y01	ON/OFF	Enable or disable the condenser control application	0	1	1 - ON	Enum 5

y05	Temp Units	Defines the temperature units	0	1	1 – F	Enum 4
y07	Restore default parameters	When selected restores the parameters to default values	0	1	0 – NO	Enum 1
y08	Gas Type	Select the appropriate refrigerant	0	41	39 – R448A	Enum 6
y09	Advanced Menu		0	1	0 – NO	Enum 1

8.2.4.2.3.2 UNIT CONFIG

Scroll to select "Unit Config" option on the Parameters screen and press ENTER button for the application to navigate to Unit Config screen.

Figure 68 UNIT CONFIG SELECTION

Unit config menu provides following options for further selection:

Table 44 UNIT CONFIG PARAMETERS

Label	Parameters	Description	Min	Max	Default	Unit
c01	Cond TD	Defines the temperature differential setpoint	0	50	10.1	°F
c02	Max Cond Temp	Defines the maximum condensing temperature for operation	0	100	104.9	°F
c03	Min Cond Temp	Defines the minimum condensing temperature for operation	0	0	72.9	°F
c04	Split Cut Out	Defines the OAT setpoint above which the application exits the split condenser mode.	0	100	95	°F
c05	Split Cut In	Defines the OAT setpoint below which the application enters the split condenser mode	0	0	70	°F
c06	Head Safety Alrm	Defines the discharge pressure setpoint above which the alarm would be generated	0	100	345.1	PSI

c07	Select Input	Selects the input for control logic to be either Discharge pressure or Drop leg temperature					
c08	Enable Split	Enable or disable the split condenser feature in the system	0	1	0 – NO	Enum 1

8.2.4.2.3.3 OVERRIDES

Scroll to select "Overrides" option on the Parameters screen and press ENTER button for the application to navigate to Overrides screen.

Figure 69 OVERRIDES SELECTION

Overrides menu provides the following options for further selection:

Table 45 OVERRIDES PARAMETERS

Label	Parameters	Description	Min	Max	Default	Unit
Oe1	Disc Press	Enables or disables discharge pressure input override feature	0	1	0 = NO	Enum 1
Ov1	Disc Press	Defines the override value for discharge pressure input	-50.0	200.0	0.0	Bar
Oe2	Drop Leg	Enables or disables drop leg temperature input override feature	0	1	0 = NO	Enum 1
Ov2	Drop Leg	Defines the override value for drop leg temperature input	-50.0	500.0	0.0	°C
Oe3	Outdoor temp	Enables or disables outdoor temperature input override feature	0	1	0 = NO	Enum 1
Ov3	Outdoor temp	Defines the override value for outdoor temperature input	-50.0	500.0	0.0	°C
Oe4	Fan 1	Enables or disables fan 1 output override feature	0	1	0 = NO	Enum 1
Ov4	Fan 1	Defines the override value for fan 1 output	0.0	100.0	0.0	%

Oe5	Fan 2	Enables or disables fan 2 output override feature	0	1	0 = NO	Enum 1
Ov5	Fan 2	Defines the override value for fan 2 output	0.0	100.0	0.0	%
Ov6	Split	Forces split ON/OFF	0	1	0 = AUTO	

8.2.4.2.4 ALARMS

Scroll to select "Alarms" option on the Main Menu at Level 3 and press ENTER button for the application to navigate to Alarms screen.

Figure 70 ALARMS SELECTION

The application provides the following options under Parameters Menu:

Table 46 ALARMS MENU

S. No.	Option	Description
1.	Active Alarms	Displays active alarms.
2.	Reset Alarms	Displays alarms that were reset.
3.	Log History	Displays the log of alarms.
4.	Clear Log History	Commands to clear the log history.

Figure 71 ALARMS SCREEN

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8.2.4.3 TROUBLESHOOTING

Table 47 DANFOSS CONTROLLER APPLICATION TROUBLESHOOTING

Alarm	Description	Corrective Action
Discharge Pressure Fault	Discharge pressure transducer failure is shorted, open or detecting the pressure out of range.	- Check for any cable issues or connector issues. - Check that the pressure transducer is landing on the appropriate connector on the board. - Check that the pressure transducer cable is fully inserted into the pressure transducer. - Confirm that the proper transducer is being used in the system.
Outdoor Temp Fault	OAT sensor is shorted, open or detecting the temperature out of range.	- Check for any cable issues or connector issues. - Check that the temperature sensor is landing on the appropriate connector on the board. - Check that the temperature sensor probe.
Drop Leg Temp Fault	Drop leg temperature sensor is shorted, open or detecting the temperature out of the range.	
VFD Alarm	VFD reporting fault condition	Please refer to section 8.3
High Pressure Alarm	Discharge pressure raised above the head safety alarm setpoint defined in the application	Auto recovers when the discharge pressure falls below head safety alarm setpoint.

8.2.5 MICROTHERMO

Condensers are built with MT-700 series modular hardware platform which needs to be integrated with the Data Logger for access. The following module are used in this application"
- MT-722F is the main brain module.
- MT-784A is the expansion module that provides 8 universal inputs and 4 relay outputs.

The function of the main controller is determined by the Condenser / Gas Cooler application that is loaded by the MT Alliance software.

Notes:
- *Main module supports a maximum of 10 expansion modules.*
- *Physical order of modules in a train does not matter.*

Figure 72 MICROTHERMO MT-722F MT-784A CONTROLLER WIRING DIAGRAM
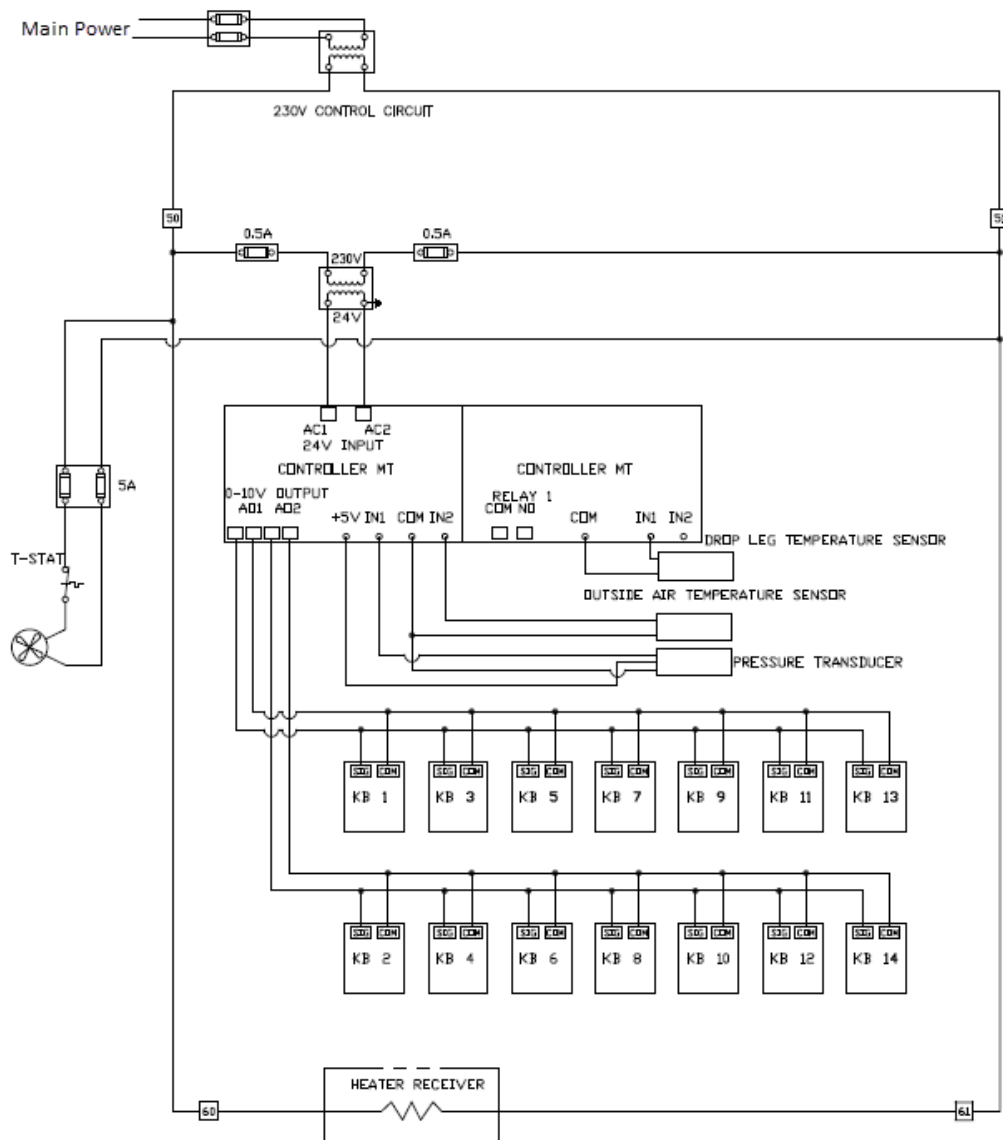
8.2.5.1 COMMISSIONING

Condenser Gas Cooler (CGC) application is a complete high-side control application. Following sections illustrate how to setup this application through MT Alliance Software on the Data Logger.

8.2.5.1.1 INPUT SETTINGS

Following inputs are necessary for this application:
- Ambient temperature
- Drop leg temperature
- Discharge pressure
- VFD fault

The following figure shows the inputs selection please note that the values shown may not represent your application settings.

Figure 73 INPUT SETTINGS SCREENSHOT

The "Config" button allows each input to be configured either to select a sensor model and assigned to the hardware or to the network variable. It also allows to configure a low-pass filter:
- When the "Time Constant" is set to 0 secs, the filter would be disabled yielding the fastest response.
- A high value provides a more precise measurement, by averaging fluctuations caused by electrical noise, at the expense of a more sluggish response.

Following figures illustrate the controller configuration please not that the values shown may not represent your application settings.

Figure 74 OAT SENSOR CONFIGURATION SCREENSHOT
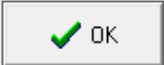
Figure 75 DROPLEG SENSOR CONFIGURATION SCREENSHOT
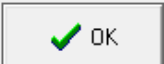
Figure 76 DISCHARGE PRESSURE TRANSDUCER CONFIGURATION SCREENSHOT

Notes: In the MT-700 platform, the physical pressure sensor and the type of output network variable are choosen independently. Plan is to standardize type to be "Press High Range" for all pressures, large or small.

Figure 77 DROP LEG PRESSURE CONFIGURATION SCREENSHOT

8.2.5.1.2 CONFIGURATION

The CGC application supports regulation strategies either to control outlet temperature or outlet pressure (discharge pressure converted to saturated temperature). For the application shown condenser outlet pressure controlled by maintaining a fixed difference, between outside ambient temperature and the condenser saturated temperature. Also, a floating setpoint rather than the fixed setpoint, which is limited by "Min / Max Sat Temp Set Point value". When the OAT is not available, a "Fixed set point" is the fall back.

When the outlet pressure (discharge pressure) isn't available, the CGC application uses the outlet temperature (drop leg) with reference to "Fixed Set Point (when COP and DP are invalid)"

Figure 78 CGC CONTROL SETTINGS SCREENSHOT

For split condenser system, the section B is shut down when OAT drops below the threshold minus half of the dead band and resumes operation when OAT rises above the threshold plus half of the dead band. The split condenser is disabled when discharge pressure rises above the "Threshold to start maximum refrigeration".

Figure 79 CGC SPLIT SETTINGS SCREENSHOT

Figure 80 CGC PID SETTINGS SCREENSHOT

Variable speed fans are operated through VFDs therefore one AO is used per section and no fan relay. The minimum and maximum relative capacity are set to 0% and 100%.

Figure 81 CGC STAGING SETTINGS SCREENSHOT

Figure 82 CGC PRESSURE LIMITS SETTINGS SCREENSHOT

8.2.5.1.3 GLOBAL SETTINGS

Select the condenser type and measure either Drop Leg Pressure or CGC Outlet Pressure using the differential pressure created by the weight of the column of liquid refrigerant. The static differential pressure is considered +ve, if the CGC is at a higher level than the receiver.

Figure 83 CGC GLOBAL SETTINGS SCREENSHOT

8.2.5.1.4 SECTION A

The following screen shots illustrate Section A settings regarding the AO and VFD.

Figure 84 CGC SECTION A – OUTPUTS CONFIGURATION SCREENSHOT

Figure 85 CGC SECTION A – AO CONFIGURATION SCREENSHOT

Notes: AO is specified to be 10 – 0V, so that the fans run at maximum speed when the node is powered off.

Reset and bypass VFD settings, they shall be configured as remote/network variables as we do not need them for the VFDs utilized in our system. Following screenshots illustrate the appropriate settings.

Figure 86 CGC SECTION A – RESET VFD CONFIGURATION SCREENSHOT

Figure 87 CGC SECTION A – BYPASS VFD CONFIGURATION SCREENSHOT

Following screenshots illustrates the VFD Fault input selection and settings.

Figure 88 CGC SECTION A – VFD FAULT SELECTION SCREENSHOT

Figure 89 CGC SECTION A – VFD FAULT CONFIGURATION SCREENSHOT

8.2.5.1.5 SECTION B

Following screen shots illustrate Section B settings regarding the Split, AO and VFD.

Figure 90 CGC SECTION B – OUTPUTS CONFIGURATION SCREENSHOT

Figure 91 CGC SECTION B – SPLIT VALVE RELAY CONFIGURATION SCREENSHOT

Figure 92 CGC SECTION B – AO CONFIGURATION SCREENSHOT

Figure 93 CGC SECTION B – RESET VFD CONFIGURATION SCREENSHOT

**Figure 94 CGD SECTION B – BYPASS VFD CONFIGURATION SCREENSHOT**

Figure 95 CGC SECTION B – VFD FAULT SELECTION SCREENSHOT

Figure 96 CGC SECTION B – VFD FAULT CONFIGURATION SCREENSHOT

8.2.5.2 TROUBLESHOOTING

Table 48 MICROTHERMO CONTROLLER APPLICATION TROUBLESHOOTING

Alarm	Description	Corrective Action
CGC Outlet Pressure Failure	Discharge pressure transducer failure is shorted, open or detecting the pressure out of range.	▪ Check for any cable issues or connector issues. ▪ Check that the pressure transducer is landing on the appropriate connector on the board. ▪ Check that the pressure transducer cable is fully inserted into the pressure transducer. ▪ Confirm that the proper transducer is being used in the system.
Outside Air Temperature Sensor Failure	OAT sensor is shorted, open or detecting the temperature out of range.	▪ Check for any cable issues or connector issues. ▪ Check that the temperature sensor is landing on the appropriate connector on the board. ▪ Check that the temperature sensor probe.
CGC Outlet Temperature Sensor Failure	Drop leg temperature sensor is shorted, open or detecting the temperature out of the range.	
Section A Drive Fault Section B Drive Fault	VFD reporting fault condition	Please refer to section 8.3

8.3 KB DRIVE TROUBLESHOOTING - LED STATUS, FAULTS AND RECOVERY

LED	Drive Status	Color and Flash sequence	Flash Rate	Color and sequence after recovered fault	Description	Fault State J3 (A/M) on	Fault State J3 (A/M) off	Recovery J3 (A/M) on	Recovery J3 (A/M) off
Status (ST)	Normal Operation	Green	1 Sec. On/off	-	Run Mode	-		-	-
	Overload 120% Full load	Red	On Continuously	Green	Motor Current greater than 120%	Motor speed reduced to maintain the CL		-	-
	Overload trip	Red	0.25 Sec On/Off	-	Drive/motor in Overload for greater than 6 seconds	Drive shutdown (PWMs off)		Set speed to zero or toggle F-S or R-S connection	
	Short Circuit	Red	1 Sec. On/Off	-	Output Phase to Phase Short			Toggle F-S or R-S connection	Toggle J3 (A/M)
	Undervoltage	Red Yellow	0.25 Sec. On/Off	Red/Yellow/Green	Line voltage less than 151Vac			Automatic recovery when the line voltage is greater than 174Vac	Toggle J3 (A/M) State when the line voltage is greater than 174Vac
	Overvoltage	Red/Yellow	1 Sec. On/Off	Red/Yellow/Green	Line voltage greater than 283Vac			Automatic recovery when the line voltage is less than 265Vac	Toggle J3 (A/M) State when the line voltage is less than 265Vac
	Stop	Yellow	On Continuously	-	Stop Mode	-		-	-
	Phase Loss Detection	Yellow	0.04 Sec. On/0.06 Sec. Off	-	Input Phase missing. (3 Phase input drives only)	Drive shutdown (PWMs off) after 60 seconds		Check Input connections, Cycle AC line power	Check Input connections, Toggle J3 (A/M) State
	Communications Error	Green/Red	1 Sec. On/Off	-	Modbus communications error	Drive shutdown (PWMs off)		Automatic recovery when the error is fixed. Check connections	Automatic recovery when the error is fixed. Check connections
	Overtemperature	Red	1 Sec On, 1 Sec. Off, 0.25 Sec. On, 0.25 Sec. Off	Red/Green	IPM Temperature greater than 108C			Automatic recovery when the IPM	Toggle J3 (A/M) State when the IPM temperature is less than 90C

							temperature is less than 90C	
	EEPROM error	Red	0.25 Sec. On, 0.25 Sec. Off, 0.25 Sec On. 2 Sec. Off	-	EEPROM data corrupt		Cycle AC line power	Toggle J3 (A/M) State
PWR (Power)	Bus and Logic Power supply on	Green	On Continuously	-	Power supply is ok	-	-	-

9 INSPECTION

If Microchannel unit is equipped with an electrical power disconnect switch make sure the switch is in the "OFF" position, preferably locked in this position, before any electrical work is performed on the unit. Without a disconnect switch on the unit, make sure all power to the unit is off from the source.

Electrical connections should be inspected periodically and tightened if required. Loose electric connections can cause severe electrical damage as well as nuisance trip out and burnouts.

During the unit startup phase check the fans for the correct rotation. While the fans are rotating the airflow should pass through the coil surface first, flow through the fan and away from the unit. If the fans are pushing the air into the coil surface the fans are rotating in the wrong direction and the motor wiring needs to be corrected.

10 CLEANING

For maximum efficiency, air-cooled condensers should be cleaned of lint and dust every 4 to 6 months so that airflow is not restricted. More frequent cleaning may be necessary under severe conditions.

Warning: No chemical cleaners should be used at any time on the coil as severe damage may occur.

General Safety
- Improper service and maintenance may cause personal and/or property damage.
- Contact qualified installer, servicer or distributor for information or assistance
- Always wear gloves, protective clothing and safety glasses.
- Employ dust mask as required.
- Have quenching cloth and fire extinguisher available
- Follow all Local and National building and electrical codes

Electrical
- Make sure refrigeration system is properly secured following the OEM manufacturer's recommendation before shutting the condenser down for cleaning.
- Before servicing or maintaining unit, turn off power supply at disconnect/breaker and install Lock-Out tag
- Test for voltage with multi-meter prior to performing service

Primary Cleaning – Remove Gross Debris – Dry Coil
1) Remove any large debris manually making sure all proper safety equipment is used.
2) Utilize a 10" Corn broom (reference ASTM F2367-04a (2010) to remove dust and dirt from the outside of the coil. Gently sweep in vertical direction from the top to the bottom of the coil. This will remove the majority of the dust and entrained debris.
3) Turn the condenser fans back on.
4) Utilize a 10" Corn broom to remove dust and dirt from the outside of the coil. Gently sweep in vertical direction from the top to the bottom of the coil. Any remaining dirt will be sucked through clearing the coil.
5) In the majority of circumstances this will be sufficient to properly clean the coil.
6) If additional cleaning is required go to Alternate Cleaning -1.

Alternate Cleaning – 1 Low Pressure Coil Rinse
Having completed Primary Cleaning Procedure if it is deemed that additional cleaning is required, follow the recommended steps:

1) Remove the access panel from each end of the condenser V bank.

2) Note that the coil should only be rinsed with potable water. No chemical cleaners should be used as this may damage the coil.
3) Use a garden hose with an adjustable spray nozzle and water pressure of 50-100 psi, access the coil through the end access ports. Rinse the V-bank on each side from top to bottom taking care not to directly spray the condenser motor or electrical connections and wiring.
4) Reinstall the access panel's torqueing the fasteners to 20-25 in-lbs.
5) Turn the condenser fan circuit back on.

For more detailed instructions visit the Krack website to view our Microchannel Cleaning Video
http://www.krack.com/en/Video%20Library/MicroChCondenserCleaning.mp4

# 11 REPLACEMENT PARTS LISTS

Figure 97 TYPICAL REPLACEMENT PART NUMBERS
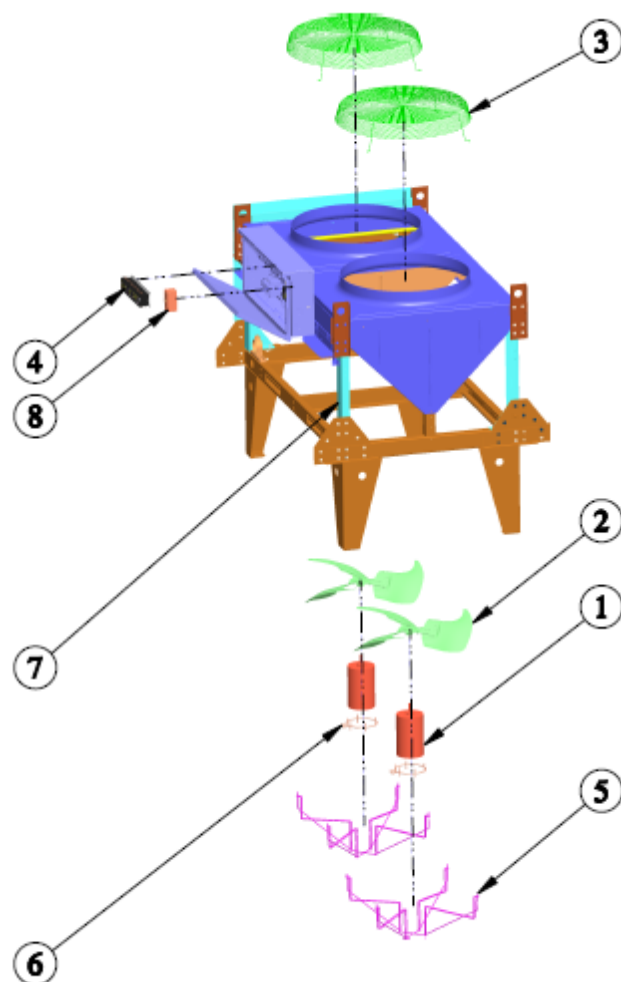
Table 49 TYPICAL REPLACEMENT PART NUMBERS

Item	General Description	Options Description	Krack BOM Part Number
1	MOTOR	0.5 HP 208-230/460/60/3 575 RPM	E206880IN
		0.5 HP 575/60/3 575 RPM	E318680IN
		1 HP 208-230/460/60/3 850 RPM	11503IN
		1 HP 575/60/3 850 RPM	E205307IN
		1.5 HP 230/460/3/600 850 RPM	E151976IN
		1.5 HP 575/60/3 850 RPM	E151976AIN
		1.5 HP 230/460/60/3 1140RPM	E205492IN
		1.5 HP 575/60/3 1140 RPM	E206689IN
		0.75 HP 208-230/460/1/60 FOR VARIABLE SPEED	E208162IN
		1.5HP 240V 50-60HZ 3P 120-1200RPM "K" MOTOR	3055269
		1.5HP 460V 50-60HZ 3P 120-1200RPM "K" MOTOR	3080452
2	VFD "K" MOTOR OPTION	KBVF-27 208/230V	3059065
		KBVF-45 400/460V	3080453
3	CONTROL WIRE "K" MOTOR	CABLE BELDEN 22GA 2C 8761	0427376
4	FAN	FAN 30" DIA FOR E205492IN, E206689IN	E208056
		FAN 30" DIA FOR 11503IN, E205307IN	E208057
		FAN 30" DIA FOR E151976IN, E151976AIN	E208058
5	FAN GUARD 30"	FAN GUARD 30"	E280792
6	MOTOR CONTACTOR	24V	E209971004
		110V	E209971002
		230V	E209971003
7	MOTOR MTG BRACKET FAN UNIT (2 PER MOTOR)	MOTOR MTG BRACKET FAN UNIT (2 PER MOTOR)	E208055
8	MOTOR MTG RING FAN UNIT (1 PER MOTOR)	MOTOR MTG RING FAN UNIT (1 PER MOTOR)	80034
9	SUPPORT LEG	STD 22" RT SUPPORT LEG	E660033
		STD 22" LT SUPPORT LEG	E660034
		STD 30" RT LEG MOUNTED RECEIVER	E660150
		STD 30" LT MOUNTED RECEIVER	E660151
10	CONTROLS	P352AB-3C PRESSURE CONTROLLER	E207051
		S352AA-2C ADDER MODULE (PRESSURE)	E207052
		P399BAC-1C PRESSURE TRANSDUCER	E207053
		A350AB-1 TEMPERATURE CONTROLLER	E205533
		Y350 R-1 POWER MODULE	E205534
		A99BC-300 TEMPERATURE SENSOR (9.75 FEET)	E205564
	VARIABLE SPEED CONTROLLERS FOR "K" MOTOR OPTION JCI/HUSSMANN	PEAK 1820 HS-OEM1820-0	3075128
		TRANSDUCER JOHNSON P499ACP-105 (4-20 mA)	E211081001
		P499RCP-105C PRESSURE TRANSDUCER (.5-4.5vdc)	E207053
		WHA-P399-200C WIRE HARNESS	E207054
		A99BC-300 TEMP SENSOR (set189a) 9.75FT LEAD	E205564
	EMERSON CPC	CPC MULTIFLEX 810-3063 88AO	E210857001

		CPC TRANSDUCER 0-500PSI #800-2500 (0.5-4.5 vdc)	E152353
		SNSR TEMP LOW PIPE HLC5011125	0706186
	DANFOSS	DANFOSS MCX06D 24V	3087943
		AKS 32 PRESSURE TRANSDUCER 0-500 PSIG METER WIRE 060G3991	E208130
		084N002900 AKS-11 TEMP PROBE	E208131
	MICRO-THERMO	MT-784A 8UI-4RO	3095039
		CONTROLLER MT-722F	3094789
		23-0073 AMBIENT TEMP SENSOSR	E207161
		952-0002 500PSI TRANSDUCER	E208140
11	CONTROL PANEL VENTILATION ACCESSORIES FOR "K" MOTOR OPTION	VENT FAN-SQUARE AXIAL 6-15/16" 335 CFM	3089686
		CONTROL-THERMOSTAT GRAINGER 1ZHC5	3082140
		INTAKE FILTER 2H05583/A-FLTR ASSM SC162-P15/60	2H05583001
		FAN STEEL GUARD 6-15/16	3074993

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