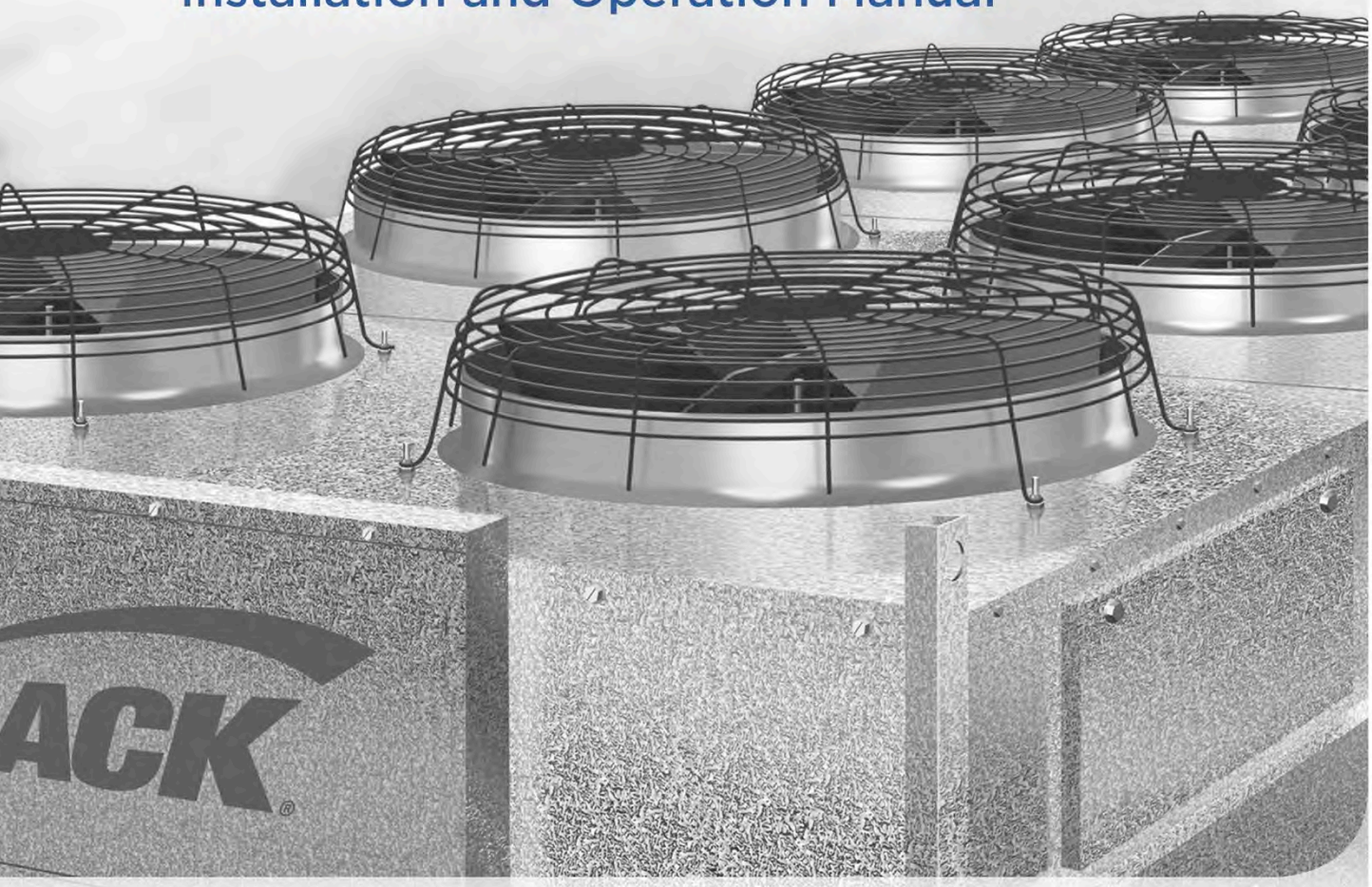
Levitor II

AIR-COOLED CONDENSER
(Available for Fluid Cooler Applications)

Installation and Operation Manual



Part Number: E208035_M

Products that provide lasting solutions.

BEFORE YOU BEGIN

Read the safety information completely and carefully.

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 ANSI 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.

* *

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

PERSONAL PROTECTION EQUIPMENT (PPE)

Only qualified personnel should install and service 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.

⚠ 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, heaters.

⚠ 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.

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.

⚠ 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*

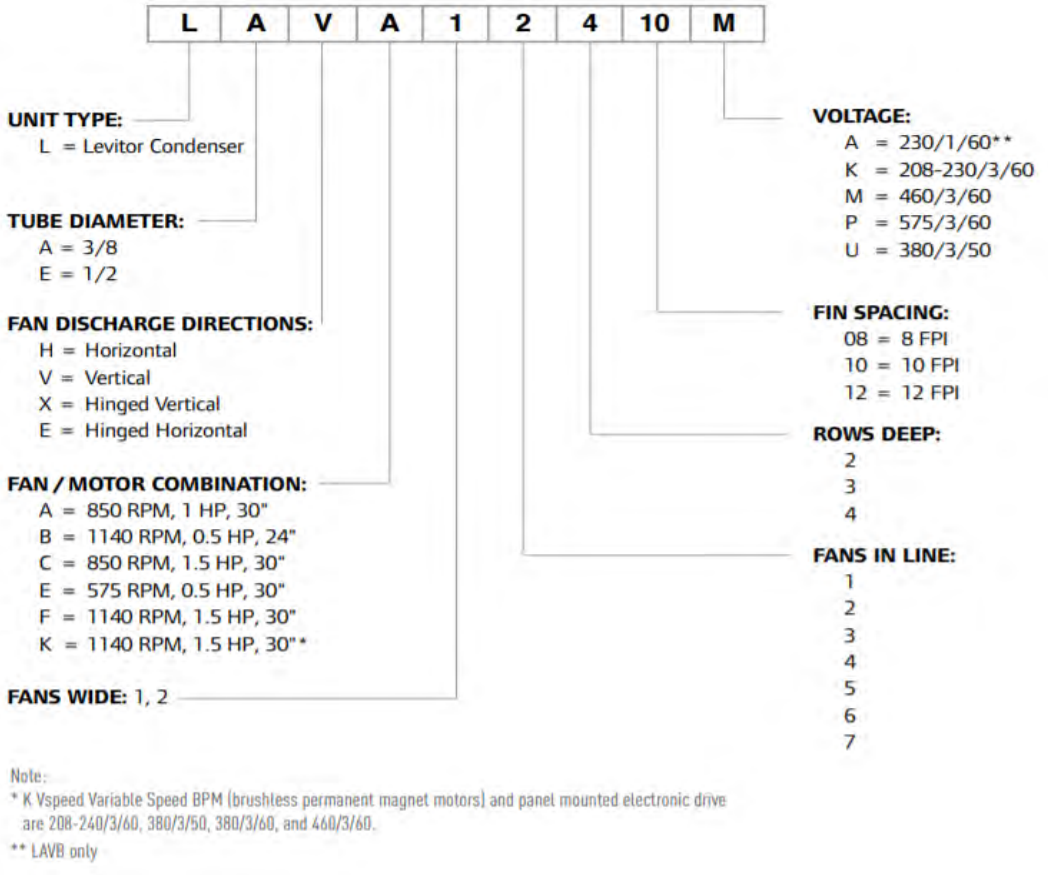
The refrigeration coil section of each Levitor Series II unit is leak tested, evacuated to remove moisture and then shipped with a pressurized nitrogen gas holding charge. Absence of this charge may indicate a leak has developed in transit. The system should not be charged with refrigerant until it is 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 24" and 30" diameter fans and a variety of motor speeds and horsepower. All units are designed for vertical air discharge, with horizontal air discharge as an option. 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



Note:
* K Vspeed Variable Speed BPM (brushless permanent magnet motors) and panel mounted electronic drive are 208-240/3/60, 380/3/50, 380/3/60, and 460/3/60.
** LAVB only

2.2 *30" UNIT DIMENSIONS*

Figure 1 and Table 1 contain the overall dimensions and bolt hole locations for all of the 30" diameter fan units.

Figure 1 30" UNIT DRAWINGS

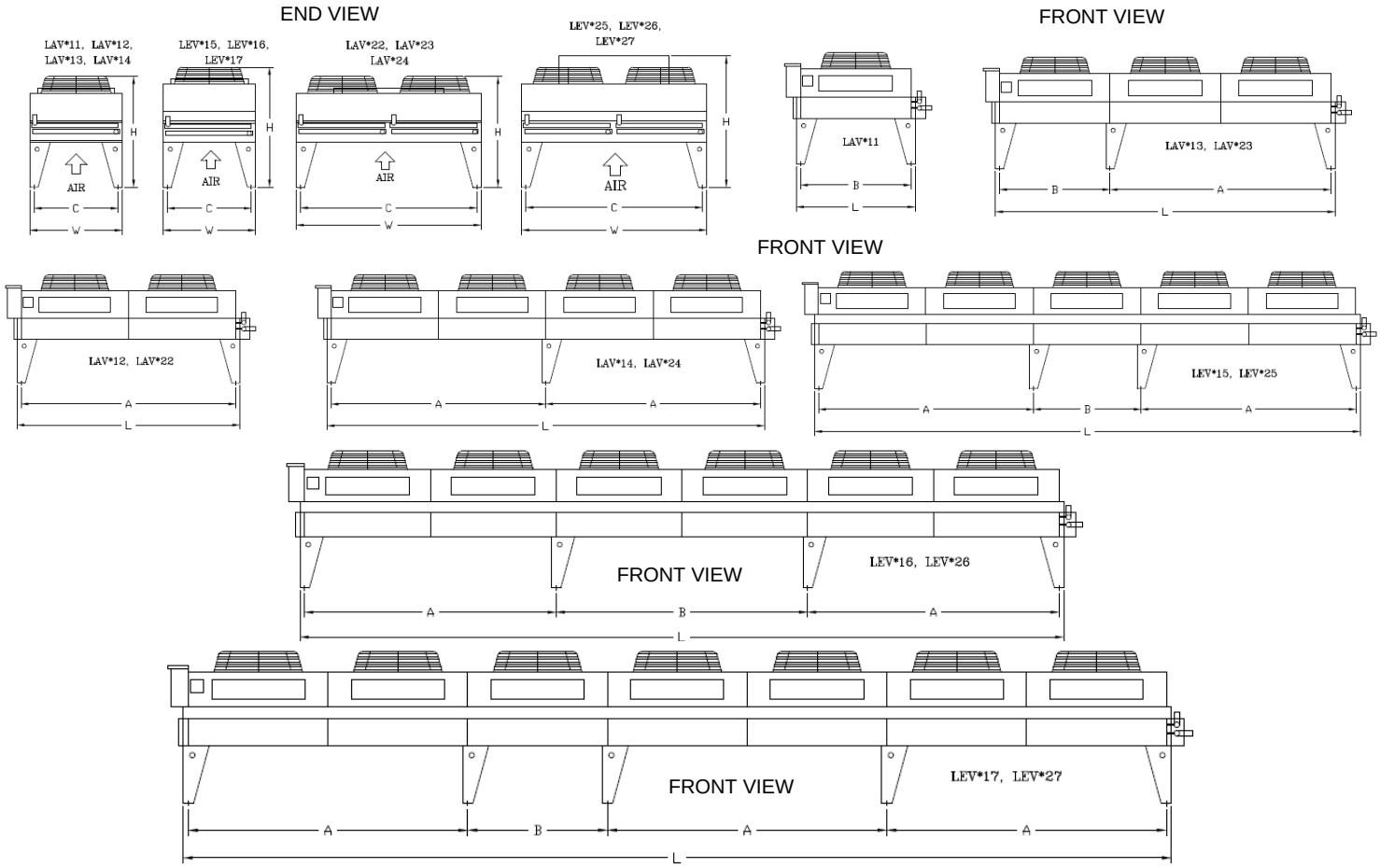


Table 1 30" UNIT DIMENSIONS

	DIMENSIONS (inches)					
MODEL	L	W	H**	A	B	C
LAV_11***	58	45.25	54	-	54	41.25
LAV_12***	112	45.25	54	108	-	41.25
LAV_13***	166	45.25	54	108	54	41.25
LAV_14***	220	45.25	54	108	-	41.25
LAV_15***	274	45.25	58.5	108	54	41.25
LEV_16***	328	45.25	58.5	108	-	41.25
LEV_17***	382	45.25	58.5	108	54	41.25

	DIMENSIONS (inches)					
MODEL	L	W	H**	A	B	C
-	-	-	-	-	-	-
LAV_22***	112	90.5	54	108	-	86.5
LAV_23***	166	90.5	54	108	54	86.5
LAV_24***	220	90.5	54	108	-	86.5
LAV_25***	274	90.5	58.5	108	54	86.5
LEV_26***	328	90.5	58.5	108	-	86.5
LEV_27***	382	90.5	58.5	108	162	86.5

* - Connection size is determined by computerized circuiting program. See drawing shipped with unit.

** - Includes standard 22" legs. Increase height accordingly if 30", 36", 42", 48", or 60" extended legs are used. If the 48" or 60" extended legs are used, every fan section down the length of the unit has a leg and gusset. 60" legs also have cross bracing. Legs, gussets, and bracing require field installation. See unit drawing for details.

*** - Rows & FPI

Figure 2 TWO WIDE UNIT DRAWINGS - K FAN MOTOR MODEL

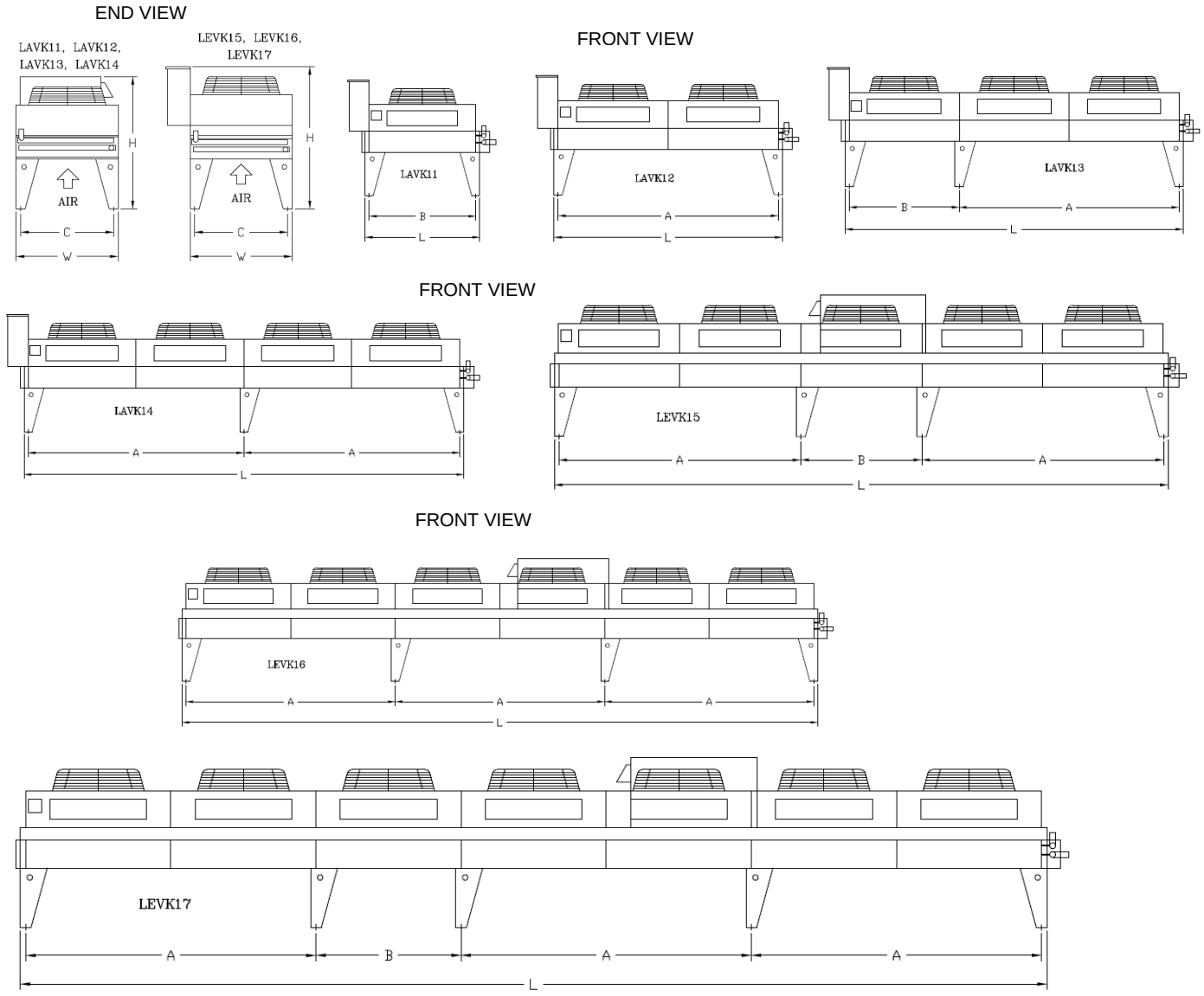


Table 1A 30” TWO WIDE UNIT DIMENSIONS - K FAN MOTOR MODEL

	DIMENSIONS (inches)					
MODEL	L	W	H**	A	B	C
LAVK11***	58	45.25	58.5	-	54	41.25
LAVK12***	112	45.25	58.5	108	-	41.25
LAVK13***	166	45.25	58.5	108	54	41.25
LAVK14***	220	45.25	58.5	108	-	41.25
LAVK15***	274	45.25	63	108	54	41.25
LEVK16***	328	45.25	63	108	-	41.25
LEVK17***	382	45.25	63	108	54	41.25

	DIMENSIONS (inches)					
MODEL	L	W	H**	A	B	C
-	-	-	-	-	-	-
LAVK22***	112	90.5	54	108	-	86.5
LAVK23***	166	90.5	54	108	54	86.5
LAVK24***	220	90.5	54	108	-	86.5
LAVK25***	274	90.5	58.5	108	54	86.5
LEVK26***	328	90.5	58.5	108	-	86.5
LEVK27***	382	90.5	58.5	108	54	86.5

*** - Rows & FPI

Figure 2A ONE WIDE UNIT DRAWINGS - K FAN MOTOR MODEL

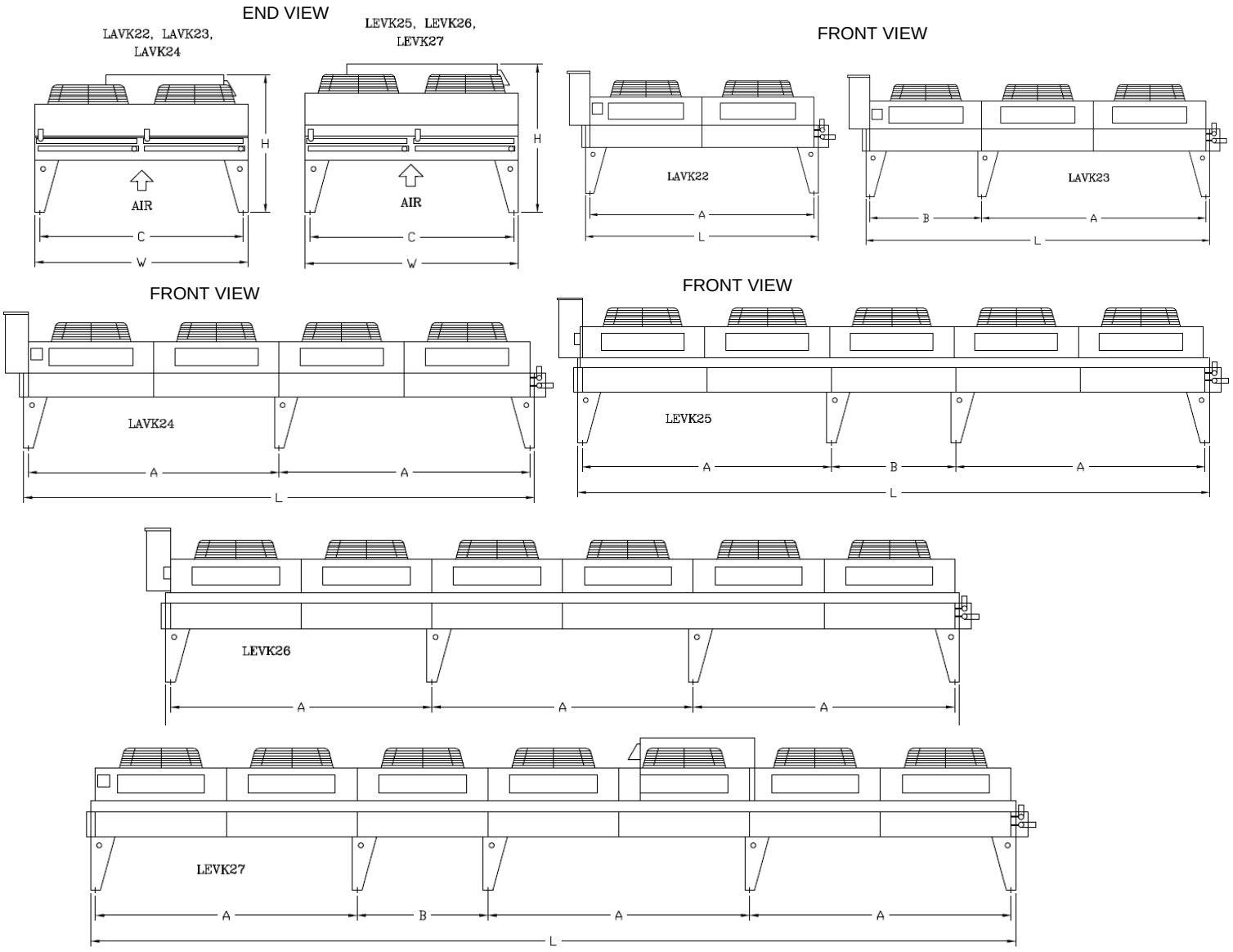


Table 1B 30" ONE WIDE UNIT DIMENSIONS - K FAN MOTOR MODEL

	DIMENSIONS (inches)					
MODEL	L	W	H**	A	B	C
LAVK11***	58	45.25	54	-	54	41.25
LAVK12***	112	45.25	54	108	-	41.25
LAVK13***	166	45.25	54	108	54	41.25
LAVK14***	220	45.25	54	108	-	41.25
LAVK15***	274	45.25	58.5	108	54	41.25
LEVK16***	328	45.25	58.5	108	-	41.25
LEVK17***	382	45.25	58.5	108	54	41.25

	DIMENSIONS (inches)					
MODEL	L	W	H**	A	B	C
-	-	-	-	-	-	-
LAVK22***	112	90.5	54	108	-	86.5
LAVK23***	166	90.5	54	108	54	86.5
LAVK24***	220	90.5	54	108	-	86.5
LAVK25***	274	90.5	58.5	108	54	86.5
LEVK26***	328	90.5	58.5	108	-	86.5
LEVK27***	382	90.5	58.5	108	54	86.5

*** - Rows & FPI

Note: For 50/50 split applications electric panel locations will resemble Figure 2a above.

2.3 *30" UNIT WEIGHTS AND REFRIGERANT CHARGES*

The following table contains approximate unit shipping weights and refrigerant charges for the 30" fan units. 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 2 30" UNIT WEIGHTS AND REFRIGERANT CHARGES

MODEL	Summer Operating Charge R-404A (lbs.)	Winter Flooding Charge* R-404A (lbs.)	Shipping Unit Weight (lbs.)	Shipping Unit Weight w/1 Receiver (lbs.)
ONE FAN WIDE UNITS				
LAV_112*	4	17	444	794
LAV_113*	6	25	478	828
LAV_114*	8	33	508	858
LAV_122*	9	32	729	1169
LAV_123*	13	48	792	1232
LAV_124*	17	64	855	1295
LAV_132*	13	48	1060	1590
LAV_133*	18	72	1153	1683
LAV_134*	24	96	1247	1777
LAV_143*	24	96	1474	2094
LAV_144*	32	127	1599	2219
LAV_153*	32	119	2066	2886
LAV_154*	41	159	2222	3042
LEV_163*	65	266	2610	3520
LEV_164*	84	354	2858	3768
LEV_173*	76	310	3088	4088
LEV_174*	98	413	3366	4366
TWO FAN WIDE UNITS				
LAV_222*	18	64	1336	1856
LAV_223*	26	96	1462	1982
LAV_224*	34	128	1588	2108
LAV_232*	26	96	1912	2532
LAV_233*	36	144	2100	2720
LAV_234*	48	192	2287	2907
LAV_243*	48	192	2700	3420
LAV_244*	64	254	2950	3670
LAV_253*	64	238	3817	4727
LAV_254*	82	318	4129	5039
LEV_263*	130	532	4870	5890
LEV_264*	168	708	5366	6386
LEV_273*	152	620	5826	6938
LEV_274*	196	826	6382	7494

* - Fins per inch.
_ - Motors A, C, E, F

Table 3A 30" UNIT WEIGHTS AND REFRIGERANT CHARGES

MODEL	Summer Operating Charge R-404A (lbs.)	Winter Flooding Charge* R-404A (lbs.)	Shipping Unit Weight (lbs.)	Shipping Unit Weight w/1 Receiver (lbs.)
ONE FAN WIDE UNITS				
LAVK112*	4	17	452	802
LAVK113*	6	25	486	836
LAVK114*	8	33	516	866
LAVK122*	9	32	741	1181
LAVK123*	13	48	804	1244
LAVK124*	17	64	867	1307
LAVK132*	13	48	1076	1606
LAVK133*	18	72	1169	1699
LAVK134*	24	96	1263	1793
LAVK143*	24	96	1494	2114
LAVK144*	32	127	1619	2239
LAVK153*	32	119	2093	2913
LAVK154*	41	159	2249	3069
LEVK163*	65	266	2641	3551
LEVK164*	84	354	2889	3799
LEVK173*	76	310	3123	4123
LEVK174*	98	413	3401	4401
TWO FAN WIDE UNITS				
LAVK222*	18	64	1356	1876
LAVK223*	26	96	1482	2002
LAVK224*	34	128	1608	2128
LAVK232*	26	96	1940	2560
LAVK233*	36	144	2128	2748
LAVK234*	48	192	2315	2935
LAVK243*	48	192	2740	3460
LAVK244*	64	254	2990	3710
LAVK253*	64	238	3865	4775
LAVK254*	82	318	4177	5087
LEVK263*	130	532	4927	5947
LEVK264*	168	708	5423	6443
LEVK273*	152	620	5891	7003
LEVK274*	196	826	6447	7559

* - Fins per inch.

Table 4 CHARGE CORRECTION FACTORS

	Correction Factor From R-404A	
Refrigerant	Summer	Winter
R-134A	1.17	1.11
R-407A	1.10	1.08

	Correction Factor From R-404A	
Refrigerant	Summer	Winter
R-407C	1.09	1.07
R-410A	1.02	1.03

2.4 *24" UNIT DIMENSIONS*

Figure 2 and Tables 4 and 5 contain the overall dimensions, leg bolt hole locations, motor full load amps, and weights for all of the units with 24" diameter fans.

Figure 3 24" UNIT DIMENSIONS

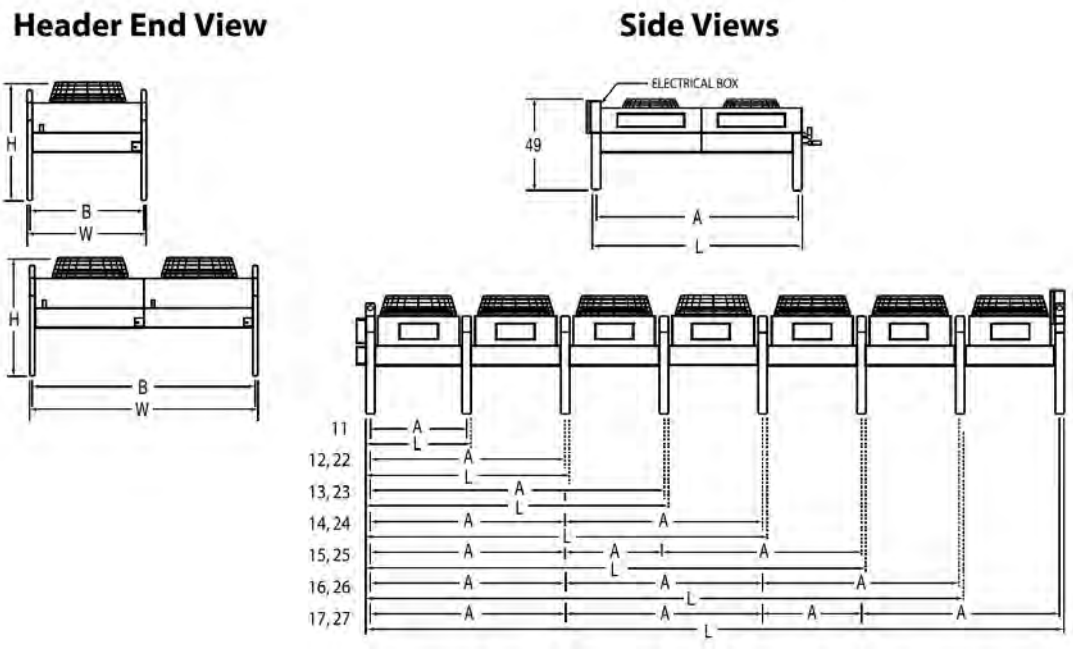


Table 5 24" UNIT DIMENSIONS

	DIMENSIONS (inches)				
MODEL	L	W	H**	A	B
LAV_11***	39	45-1/4	41-1/4	36	43-1/4
LAV_12***	75	45-1/4	41-1/4	72	43-1/4
LAV_13***	111	45-1/4	41-1/4	108	43-1/4
LAV_14***	147	45-1/4	41-1/4	72/72	43-1/4
LAV_15***	183	45-1/4	41-1/4	72/36/72	43-1/4
LAV_16***	219	45-1/4	41-1/4	72/72/72	43-1/4
LAV_17***	262	45-1/4	41-1/4	72/72/36/72	43-1/4

	DIMENSIONS (inches)				
MODEL	L	W	H**	A	B
-	-	-	-	-	-
LAV_22***	75	87-5/8	41-1/4	72	85-5/8
LAV_23***	111	87-5/8	41-1/4	108	85-5/8
LAV_24***	147	87-5/8	41-1/4	72/72	85-5/8
LAV_25***	183	87-5/8	41-1/4	72/36/72	85-5/8
LAV_26***	219	87-5/8	41-1/4	72/72/72	85-5/8
LAV_27***	262	87-5/8	41-1/4	72/72/36/72	85-5/8

Connection size is determined by computerized circuiting program. See drawing shipped with unit.
*** - Rows & FPI

2.5 *24" UNIT WEIGHTS AND REFRIGERANT CHARGES*

Table 6 UNIT WEIGHT AND REFRIGERANT CHARGES

MODEL	Summer Operating Charge R-404A (lbs.)	Winter Flooding Charge* R-404A (lbs.)	Shipping Unit Weight** (lbs.)	Shipping Unit Weight w/1 Receiver*** (lbs.)
ONE FAN WIDE UNITS				
LAVB112*	3	10	184	534
LAVB113*	4	15	190	540
LAVB114*	5	20	207	557
LAVB122*	6	19	358	798
LAVB123*	8	29	382	822
LAVB124*	10	38	413	853
LAVB133*	11	42	574	1104
LAVB134*	14	57	620	1150
LAVB143*	14	56	860	1480
LAVB144*	19	75	927	1547
LAVB153*	18	70	886	1706
LAVB154*	23	94	983	1803
LAVB163*	22	85	1100	2010
LAVB164*	28	113	1190	2100
LAVB173*	25	98	1384	2384
LAVB174*	32	131	1497	2497
TWO FAN WIDE UNITS				
LAVB222*	12	38	666	1186
LAVB223*	16	58	885	1405
LAVB224*	20	76	953	1473
LAVB233*	22	84	1148	1768
LAVB234*	28	114	1265	1885
LAVB243*	28	112	1745	2465
LAVB244*	38	150	1880	2600
LAVB253*	36	140	1772	2682
LAVB254*	46	188	1991	2901
LAVB263*	44	170	2145	3165
LAVB264*	56	226	2305	3325
LAVB273*	50	196	2795	3915
LAVB274*	64	262	3015	4135

* - Fins per inch

Table 7 CHARGE CORRECTION FACTORS

	Correction Factor From R-404A	
Refrigerant	Summer	Winter
R-134A	1.17	1.11
R-407A	1.10	1.08
R-407C	1.09	1.07
R-410A	1.02	1.03

2.6 *30" AND 24" UNIT MOTOR AMPS*

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

Table 8 30" AND 24" UNIT FULL LOAD MOTOR AMPS

ONE FAN WIDE 1 HP 850 RPM					TWO FANS WIDE 1 HP 850 RPM				
MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60	MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60
LAVA11***	4.8	2.3	2.4	1.8	-	-	-	-	-
LAVA12***	9.6	4.6	4.8	3.6	LAVA22***	19.2	9.2	9.6	7.2
LAVA13***	14.4	6.9	7.2	5.4	LAVA23***	28.8	13.8	14.4	10.8
LAVA14***	19.2	9.2	9.6	7.2	LAVA24***	38.4	18.4	19.2	14.4
LAVA15***	24.0	11.5	12.0	9.0	LAVA25***	48.0	23.0	24.0	18.0
LEVA16***	28.8	13.8	14.4	10.8	LEVA26***	57.6	27.6	28.8	21.6
LEVA17***	33.6	16.1	16.8	12.6	LEVA27***	67.2	32.2	33.6	25.2

ONE FAN WIDE 1.5 HP 850 RPM					TWO FANS WIDE 1.5 HP 850 RPM				
MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60	MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60
LAVC11***	6.9	2.9	3.3	2.5	-	-	-	-	-
LAVC12***	13.8	5.8	6.6	5.0	LAVC22***	27.6	11.6	13.2	10.0
LAVC13***	20.7	8.7	9.9	7.5	LAVC23***	41.4	17.4	19.8	15.0
LAVC14***	27.6	11.6	13.2	10.0	LAVC24***	55.2	23.2	26.4	20.0
LAVC15***	34.5	14.5	16.5	12.5	LAVC25***	69.0	29.0	33.0	25.0
LEVC16***	41.4	17.4	19.8	15.0	LEVC26***	82.8	34.8	39.6	30.0
LEVC17***	48.3	20.3	23.1	17.5	LEVC27***	96.6	40.6	46.2	35.0

ONE FAN WIDE 1/2 HP 575 RPM					TWO FANS WIDE 1/2 HP 575 RPM				
MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60	MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60
LAVE11***	3.4	1.4	1.6	1.45	-	-	-	-	-
LAVE12***	6.8	2.8	3.2	2.90	LAVE22***	13.6	5.6	6.4	5.8
LAVE13***	10.2	4.2	4.8	4.35	LAVE23***	20.4	8.4	9.6	8.7
LAVE14***	13.6	5.6	6.4	5.80	LAVE24***	27.2	11.2	12.8	11.6
LAVE15***	17.0	7.0	8.0	7.25	LAVE25***	34.0	14.0	16.0	14.5
LEVE16***	20.4	8.4	9.6	8.70	LEVE26***	40.8	16.8	19.2	17.4
LEVE17***	23.8	9.8	11.2	10.2	LEVE27***	47.6	19.6	22.4	20.3

ONE FAN WIDE 1.5 HP 1140 RPM					TWO FANS WIDE 1.5 HP 1140 RPM				
MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60	MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60
LAVF11***	5.4	2.1	2.5	2.2	-	-	-	-	-
LAVF12***	10.8	4.2	5.0	4.4	LAVF22***	21.6	8.4	10.0	8.8
LAVF13***	16.2	6.3	7.5	6.6	LAVF23***	32.4	12.6	15.0	13.2
LAVF14***	21.6	8.4	10.0	8.8	LAVF24***	43.2	16.8	20.0	17.6
LAVF15***	27.0	10.5	12.5	11.0	LAVF25***	54.0	21.0	25.0	22.0
LEVF16***	32.4	12.6	15.0	13.2	LEVF26***	64.8	25.2	30.0	26.4
LEVF17***	37.8	14.7	17.5	15.4	LEVF27***	75.6	29.4	35.0	30.8

ONE FAN WIDE 0.5 HP 1140 RPM					TWO FANS WIDE 0.5 HP 1140 RPM				
MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60	MODEL	208-230/3/60	380/3/50	460/3/60	575/3/60
LAVB11***	4.2	2.5	1.3	0.95	-	-	-	-	-
LAVB12***	8.4	5.0	2.6	1.90	LAVB22***	16.8	10.0	5.2	3.8
LAVB13***	12.6	7.5	3.9	2.85	LAVB23***	25.2	15.0	7.8	5.7
LAVB14***	16.8	10.0	5.2	3.80	LAVB24***	33.6	20.0	10.4	7.6
LAVB15***	21.0	12.5	6.5	4.75	LAVB25***	42.0	25.0	13.0	9.5
LAVB16***	25.2	15.0	7.8	5.70	LAVB26***	50.4	30.0	15.6	11.4
LAVB17***	29.4	17.5	9.1	6.65	LAVB27***	58.8	35.0	18.2	13.3

ONE FAN WIDE 1.5 HP 1140 RPM					TWO FANS WIDE 1.5 HP 1140 RPM				
MODEL	208-230/3/60	380/3/50/60	460/3/60	575/3/60	MODEL	208-230/3/60	380/3/50/60	460/3/60	575/3/60
LAVK11***	5.4	3.8	3.0	NA	-	-	-	-	-
LAVK12***	10.8	7.6	6.0	NA	LAVK22***	21.6	7.6	12	NA
LAVK13***	16.2	11.4	9.0	NA	LAVK23***	32.4	15.2	18	NA
LAVK14***	21.6	15.2	12.0	NA	LAVK24***	43.2	22.8	24	NA
LAVK15***	27	19.0	15.0	NA	LAVK25***	54	30.4	30	NA
LAVK16***	32.4	22.8	18.0	NA	LAVK26***	64.8	38.0	36	NA
LAVK17***	37.8	26.6	21.0	NA	LAVK27***	75.6	45.6	42	NA

*** - Model number shown does not include rows or fins per inch.
For unit Minimum Unit Circuit Amps (MCA) and Maximum Unit Overload Protection (MOP) consult the factory wiring diagram supplied with the unit.

3 UNIT LOCATION

The Levitor Series II 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 taken into account. Note that higher than expected head pressures will result in poor system operation if the following suggested distances are not used.

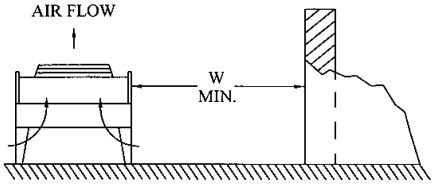
So that the unit performs as predicted, it should be located away from heated air exhausts, steam vents, or corrosive airflow whether it comes from the job site or from another nearby source. A corrosive atmosphere will require an appropriate coil coating or copper fins to protect the coil and extend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

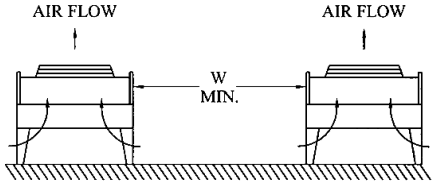
Walls or Barriers

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.



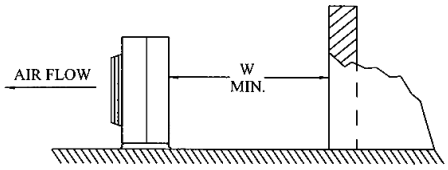
Multiple Units

For units placed side by side, the minimum distance between units is the width of the largest unit. If units are placed end to end, the minimum distance between units is one fan section long.



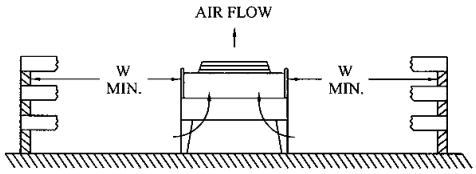
Walls or Barriers for Horizontal Airflow

Units with horizontal airflow should be a minimum of "W" away from any wall or barrier, plus the air discharge should be free flowing away from the unit.



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 Levitor Series II units are designed to be lifted using the leg support channels or the side lifting brackets for larger units. 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 or return bends be used in lifting or moving the unit. See Figures 4, 5, and 6 for the designated lifting points and lift methods for all unit sizes, plus approximate unit weights.

Figure 5 RIGGING FOR 30" FAN UNITS

NOTE: STATIONARY LIFTING POINTS AND LIFTING PLATES ARE 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, ELECTRICAL ENCLOSURE(S) OR RETURN BENDS BE USE FOR LIFTING OR MOVING THE UNITS!

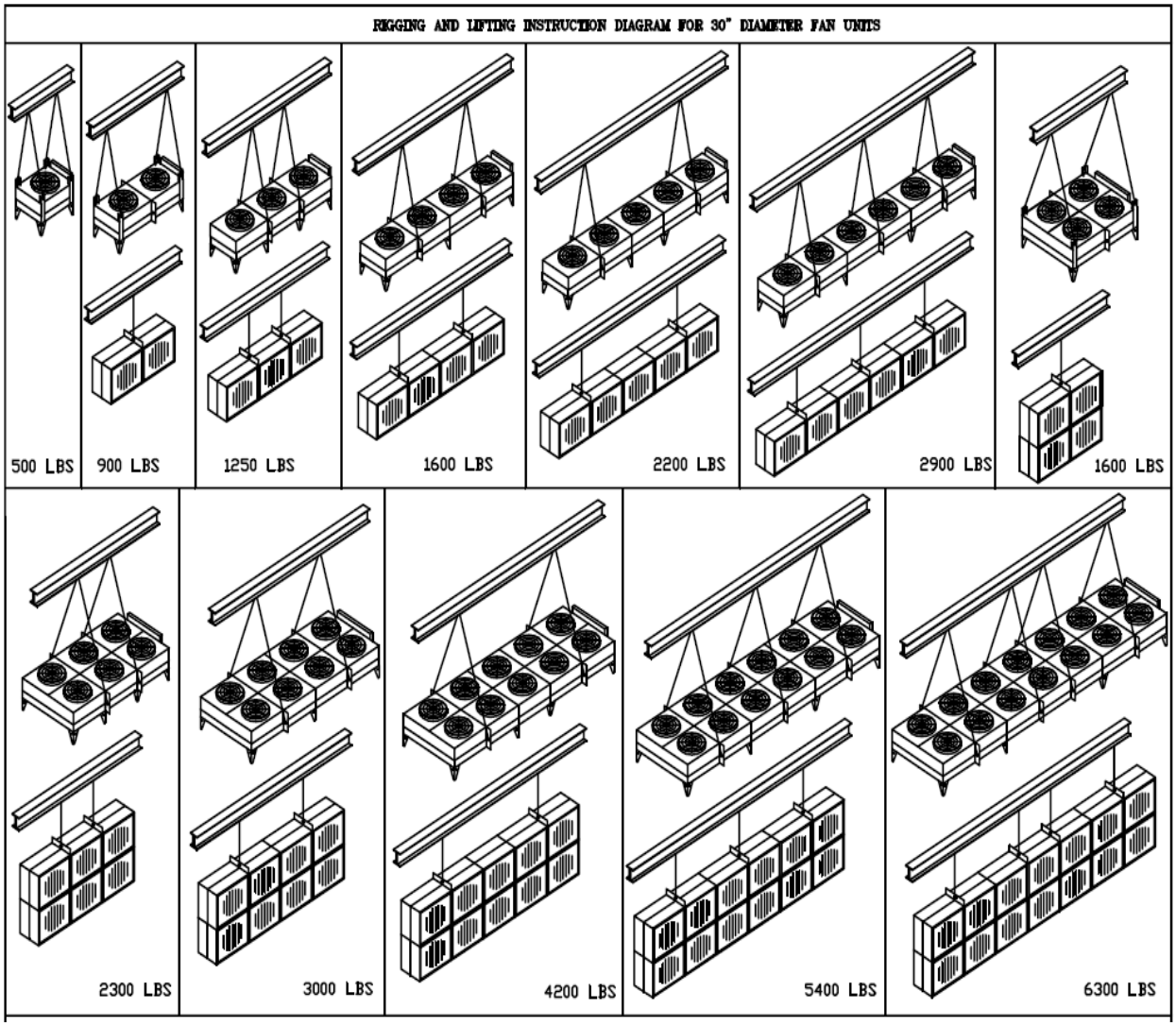


Figure 6 RIGGING FOR 30" FAN UNITS WITH RECEIVERS

NOTE: STATIONARY LIFTING POINTS ARE FACTORY MOUNTED. OUTER SUPPORT LEGS HAVE ADDITIONAL LIFTING HOLES, BUT A SPREADER MUST BE USED TO PREVENT SHEETMETAL DAMAGE. UNDER NO CIRCUMSTANCES SHOULD CONDENSER MANIFOLDS, ELECTRICAL ENCLOSURE(S) OR RETURN BENDS BE USE FOR LIFTING OR MOVING THE UNITS!

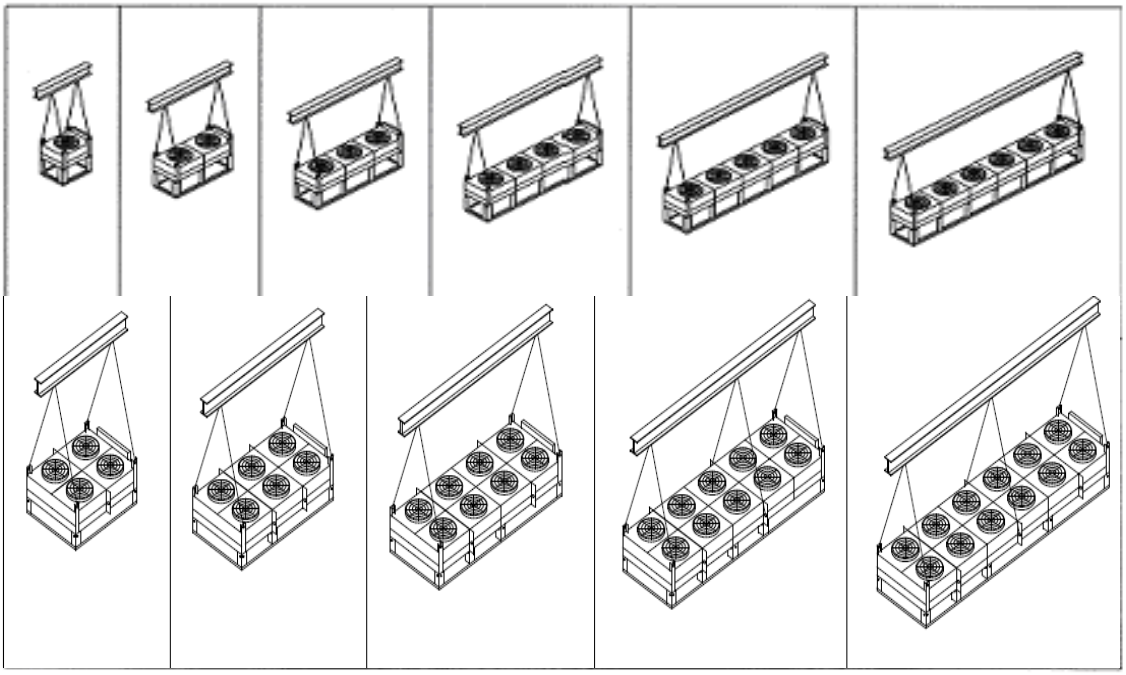
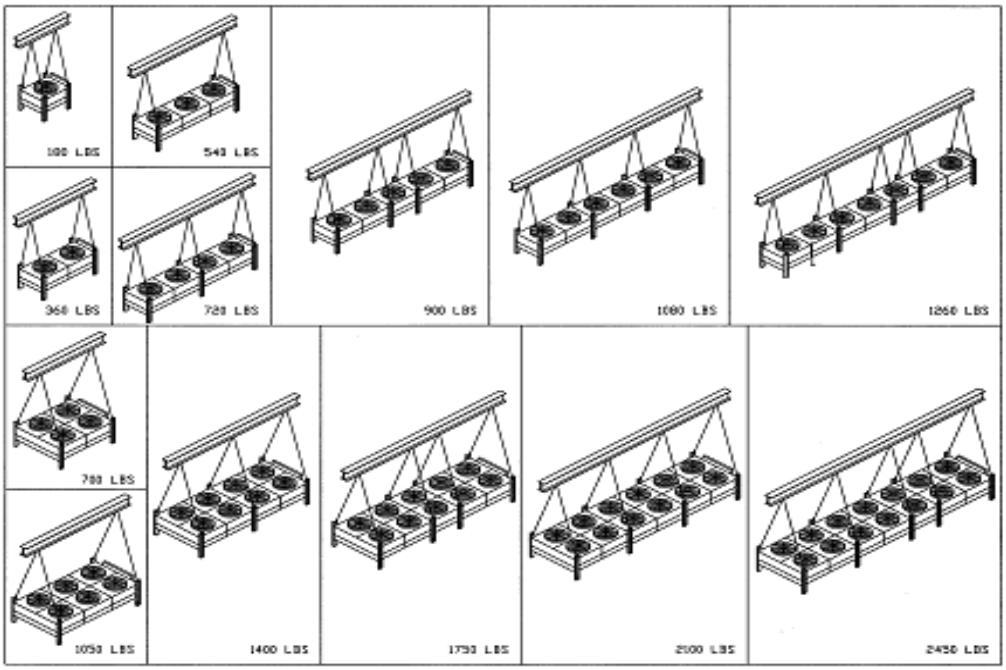


Figure 7 RIGGING FOR 24" FAN UNITS

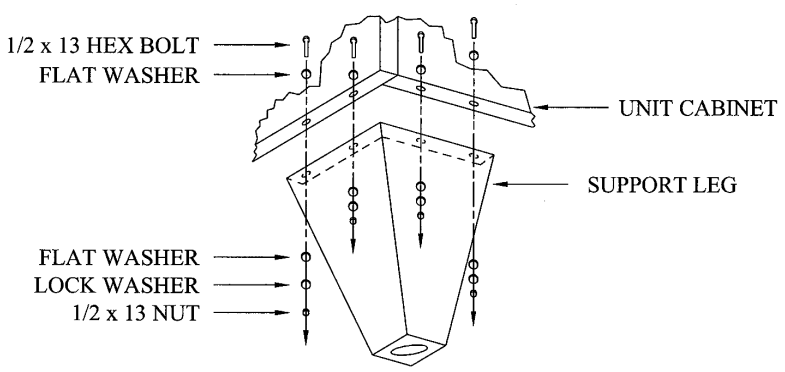


5 UNIT ASSEMBLY

5.1 *LEG ASSEMBLY FOR 30" FAN UNITS*

For Levitor Series II units with 30" diameter 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. Support legs that are 48" or 60" in height will require a leg between every fan section and gusset for stability. 60" legs also require cross bracing, see drawing provided with unit for details.

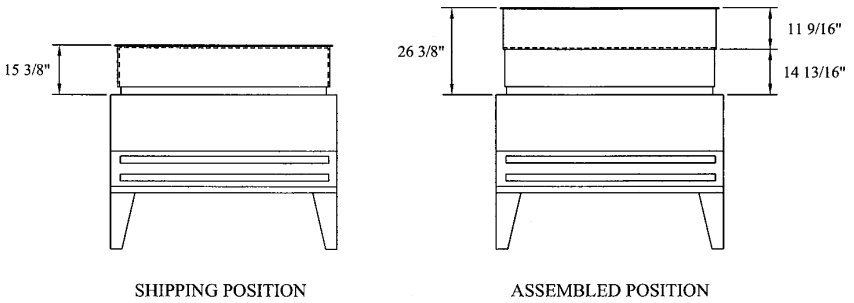
Figure 8 STANDARD 22" & 42" LEG ASSEMBLY



5.2 *OPTIONAL GRAVITY DAMPERS FOR 30" FAN UNITS*

For Levitor Series II units with 30" diameter fans that have been ordered with Gravity Dampers, the dampers are shipped assembled to the unit, but the airflow extensions must be raised from the shipping position. Before working on the outer extensions, remove and discard the small hold down brackets that have secured the damper blades during shipping. The extension for each fan is held onto the gravity damper assembly by (8) #14 hex head screws 1/2" long. Remove the eight screws from each extension, raise the extension so that the screw holes in the bottom of the extension match the bolt holes in the top of the damper assembly, and assemble the screws tightly. See Figure 8 for the extension in both the shipping and raised positions.

Figure 9 GRAVITY DAMPER ASSEMBLY



5.3 *HORIZONAL AIRFLOW BASE SUPPORT*

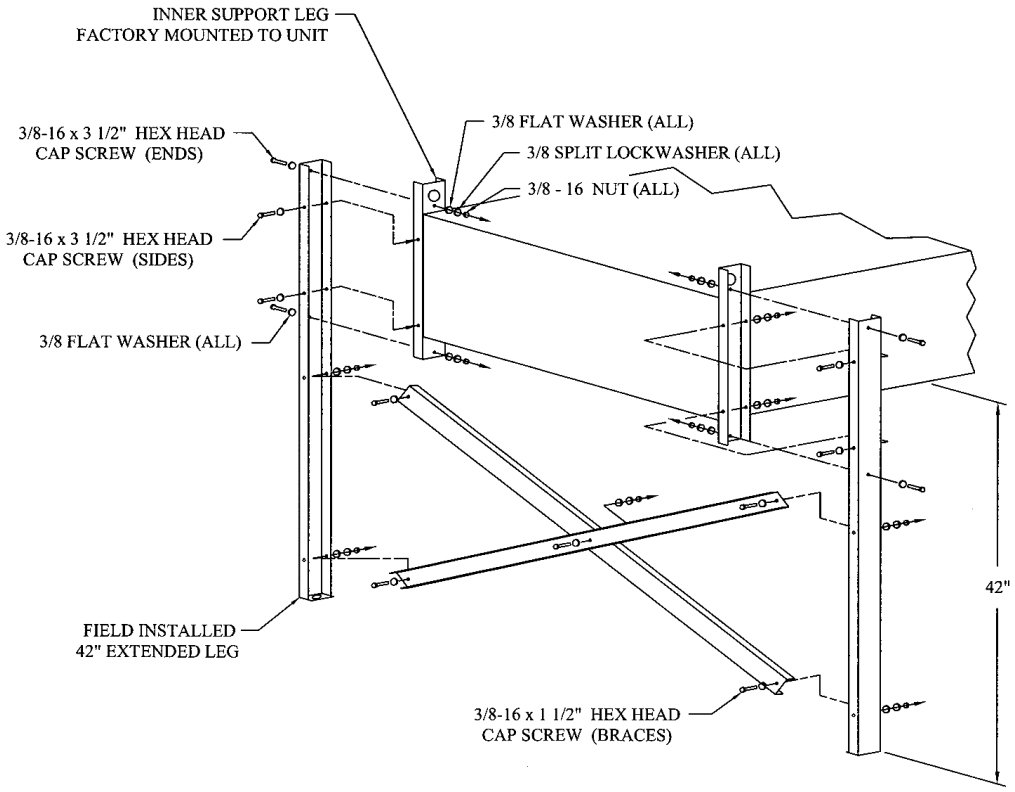
For 30" fan Levitor Series II units ordered with a horizontal airflow the base supports are attached to the unit at the factory. Caution should be taken when raising and moving the unit so that the supports are not bent. Double-wide fan units require field mounting of an angle support brace shipped loose with the unit. See drawing send with the unit for mounting details.

5.4 *LEG ASSEMBLY FOR 24" FAN UNITS*

For Levitor Series II units with 24" diameter fans blowing air in a vertical up direction, the unit is supported by formed, mill galvanized, channel legs that provide a standard 18" of clearance from the bottom of the leg to the bottom of the coil section. The standard 18" legs are factory mounted to the unit. If extended legs are ordered, to provide 42" of clearance, the attachment procedure for the shipped loose legs and the cross bracing is shown in Figure 9 below. Raise the unit off the ground via rigging or other stable support for leg and bracing attachment.

Units that are designed to blow air in the horizontal direction do not require legs and are ready to be rigged into position.

Figure 10 42" LEG & BRACING ASSEMBLY FOR 24" FAN UNITS



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. See Figure 10 for mounting examples.

6.2 *INTERCONNECTING PIPING FOR DOUBLE WIDE UNITS*

Interconnecting refrigerant piping for double wide units should be as short and as direct as possible to the unit header connections. The gas inlet piping should always down-feed into the units' inlet header and be equipped at its highest point with a pressure tap (purge) type valve. Liquid outlet piping is to be directed immediately downwards in a minimum 15" drop leg, making a liquid seal. The drop leg is located before

making any bends or angles connecting it to the remainder of the liquid connection piping run. If the header sheet metal covers were removed for piping, replace the covers for header and return bend protection. See Figure 10 for suggested interconnecting piping support arrangements.

6.3 *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 ANSI 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.

AC&R type copper tubing should be used throughout. Cut tubing with a wheel-type cutter and not a hacksaw. Deburr before assembling the fittings. NOTE: if the field 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 at a later date. 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 so as 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.

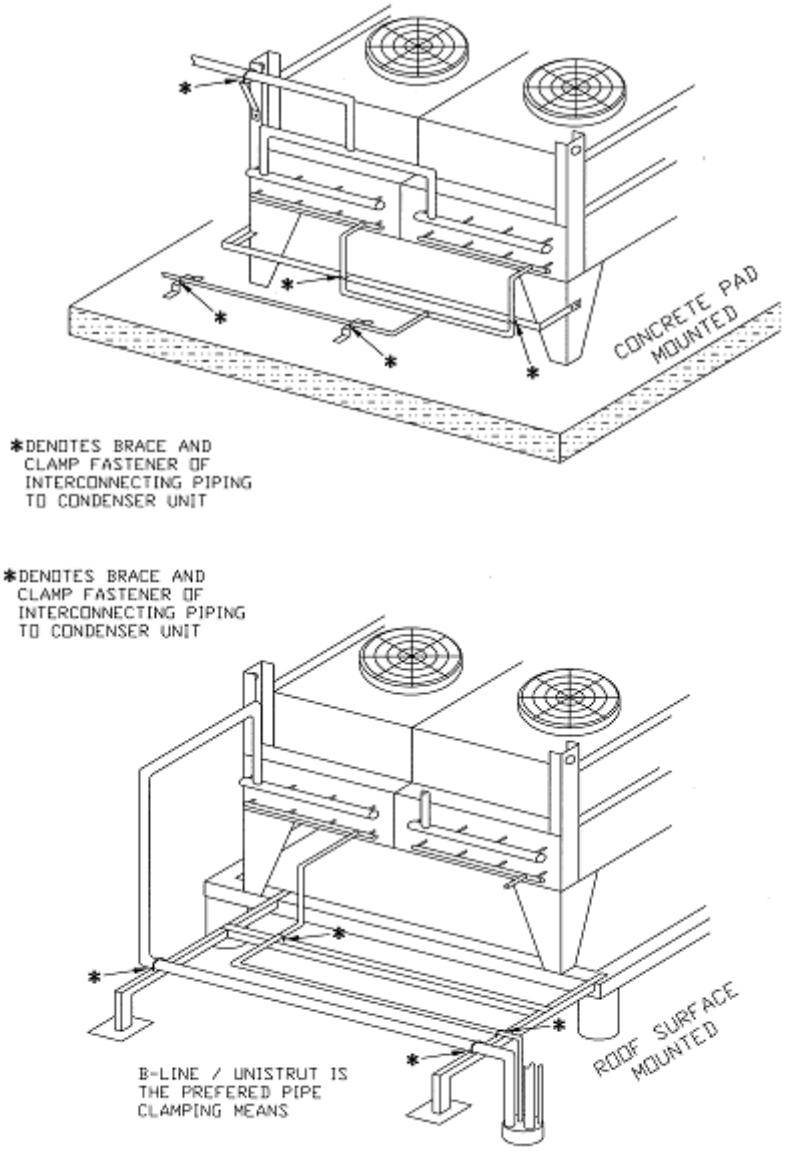
Sizing a discharge line too large will inhibit compressor lube oil circulation. The proper balance is to design discharge lines for approximately 4000 ft/min velocity in vertical risers and can be lowered to 2000 ft/min in sloped horizontal runs. "P" traps should be installed at the base of all vertical 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.

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 run 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. See Figure 10 for suggested arrangements.

Figure 11 UNIT MOUNTING AND PIPING



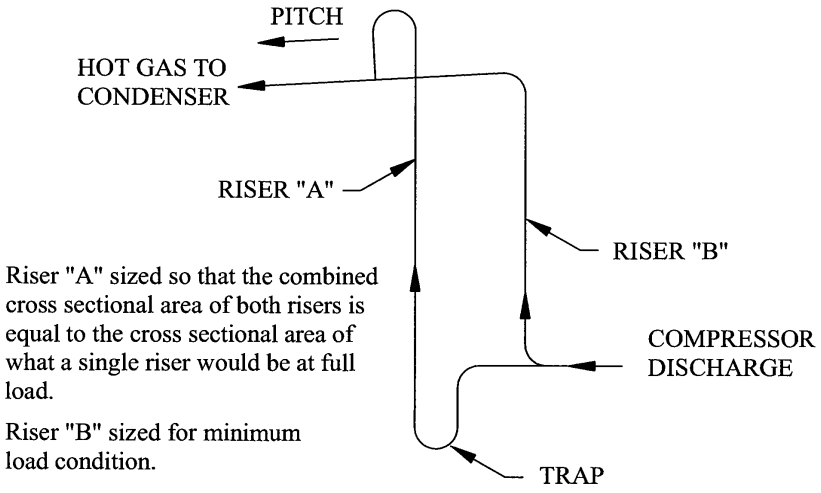
Pressure testing of the piping should be done as soon as the field piping has been completed. The high-side test pressure should not exceed the condenser unit UL nameplated pressure. Nitrogen may be used to increase the trace refrigerant pressure for leak testing. It is recommended that an electronic type leak tester be used. Shipping vibrations can stress joints, thus producing operating leaks which 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 half 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).

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 11. Such arrangement is necessary to facilitate compressor lube oil return to the compressor crankcase.

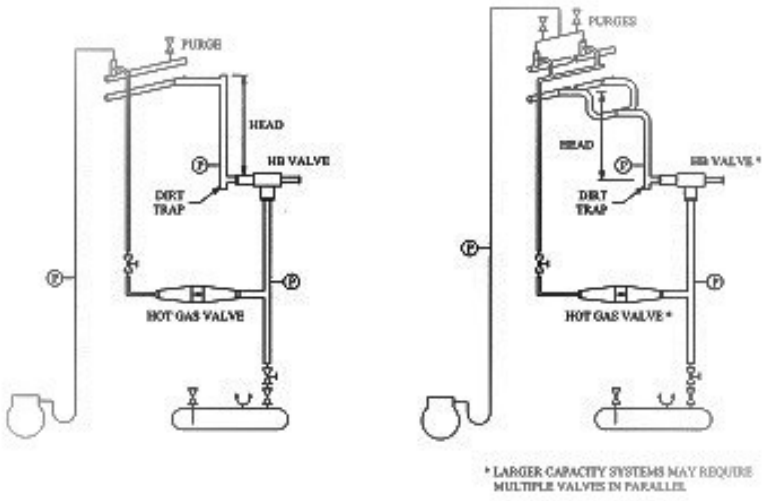
Figure 12 DOUBLE RISER DISCHARGE ARRANGEMENT



6.4 *HOLDBACK FLOODING CONTROL*

Figure 12 shows typical piping drawings for flooding control arrangements of Levitor Series II condensers.

Figure 13 HOLDBACK FLOODING CONTROL ARRANGEMENTS



7 ELECTRICAL

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

If the Levitor Series II 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.

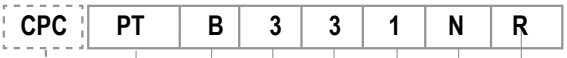
The Levitor Series II unit can be arranged at the factory so that each motor is wired to individual terminal blocks, in which case each motor requires individual power wiring, or the motors can be wired to a fan cycling control panel which requires only one set of power wires. The fan cycling control 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 venturis 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



RELAY BOARD (optional)
A, B, C, E, F Motor
N - None
CPC - 8RO board
CPC1 - Multiflex 88
CPC2 - Multiflex 88AO
AKC - Danfoss 88 w/AKC-SC355/255
AKS - Danfoss 88 w/AKS-SM800
MTH - Microthermo 508
MTH1 - Microthermo 722F and 784A
NOV - Novar
K Motor***
N - None
CPC2 - Multiflex 88AO
HSM - HSM Controller
MTH1 - Microthermo 722F and 784A
DAN - Danfoss

BACKUP CONTROLLER
A, B, C, E, F Motor
NC - No Controls
PT - PressureControls
TF - Temperature Controls
TP - Temp. and Pressure Controls
PV - Pressure Controls w/ Variable Speed*
TV - Temp. Controls w/ Variable Speed*
VN - No Controls w/ Variable Speed*
K Motor***
KB - KB Drive
CD - Copeland Drive

CONTROL VOLTAGE
A, B, C, E, F Motor
A - 208/230 V
B - 115 V
C - No Control Voltage
D - 24 V
E** - 208/230 V w/o Transformer
F** - 115 V w/o Transformer
H** - 24 V w/o Transformer
K Motor***
A - 208/230 V
B - 115 V

RECEIVER OPTION
R - Factory Mounted Receiver (R-Heated or Non-Heated)
S - Standard No Receiver

AMBIENT AIR SENSOR FOR SPLIT
A, B, C, E, F Motor
T - Sensor Provided
N - Sensor Not Required
K Motor***
T - Sensor Provided
N - Sensor Not Required

TYPE OF APPLICATION
A, B, C, E, F Motor
1 - Standard
2 - 50% Winter Reduction (Split Condenser)
3 - 50/50 Split Dual Panel (for Two Independent Slabs)
4 - No Control Operation (Terminal Blocks Only)
K Motor***
1 - Standard
2 - 50% Winter Reduction (Split Condenser)
3 - 50/50 Split Dual Panel (for Two Independent Slabs)

FUSES AND BREAKERS
A, B, C, E, F Motor
1 - Individual Fuses and Contactors
2 - Individual Circuit Breakers and Contactors per Fan 3 - Fuses and Contactors per Pair of Fans
4 - Terminal Blocks Only
5 - Circuit Breaker and Contactor per Pair of Fans
6 - Fuses Only per Motor
8 - High SCCR, Individual Fuses and Contactors
9 - High SCCR, Fuses and Contactors Per Pair of Fans
K Motor***
6 - Fuses Only per Motor

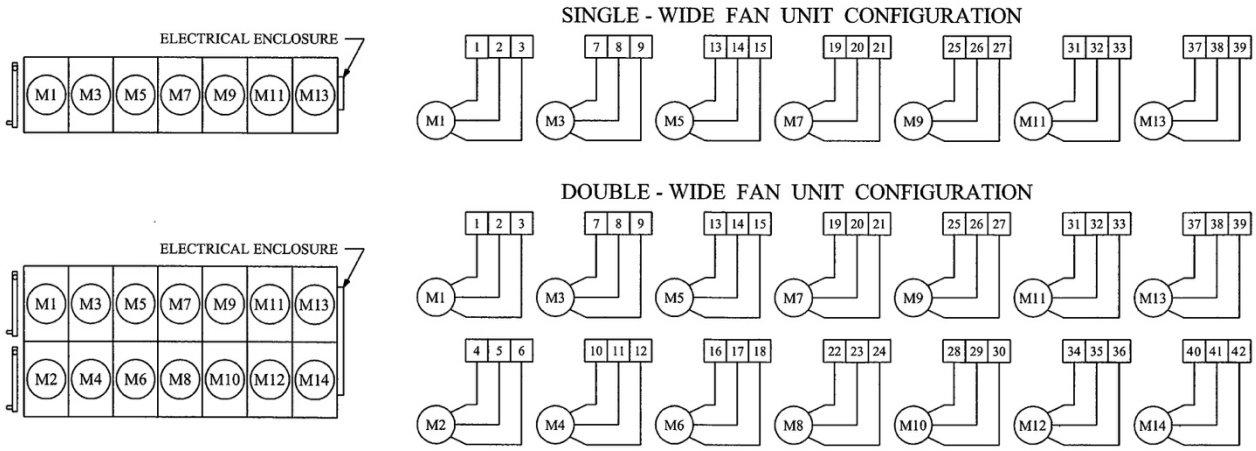
BACKUP CONTROL TYPE
A, B, C, E, F Motor
3 - Johnson Electric
4 - No Controls
K Motor***
4 - No Controls

* Variable Speed - Header End Fans only
** Without Transformer - Control Voltage from source outside of Condenser Control Panel
*** LEVITOR II MODELS LAVK / LEVK (1.5 HP, 1,140 RPM, BPM MOTOR, AND PANEL MOUNTED DRIVE)

7.2 *MOTORS WIRED TO TERMINAL BLOCKS*

Figure 13 shows typical unit wirings to terminal blocks where fan motors are turned on and off by controls outside the unit.

Figure 14 TERMINAL BLOCK ONLY WIRING DIAGRAMS (NC – C444)



7.3 *MOTORS WIRED TO STANDARD FAN CYCLING CONTROL PANEL*

The standard fan cycling control panel for Levitor Series II units contains a series of pressure or temperature controllers. The fans cycle on and off from the signal by the pressure or temperature sensor. If the unit has one row of fans, the fan cycling controls turn the fans on or off individually. If the unit has two rows of fans, either adjoining pairs of fans or individual fans can be cycled depending upon the system requirements. The fan(s) nearest the headers are the first-on, last-off, and are continuously on when the compressor is running. Figures 14 and 15 show typical wiring schematics.

Figure 15 INDIVIDUAL FAN MOTOR WIRING DIAGRAM (-311, -411)

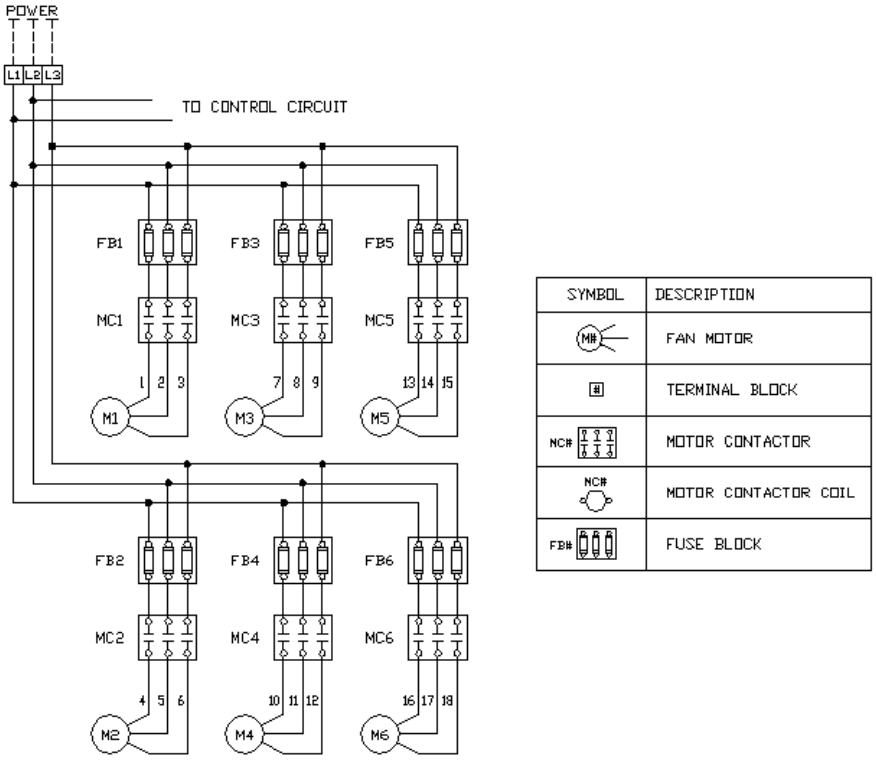


Figure 16 FAN MOTOR WIRING DIAGRAM (-331, -341)

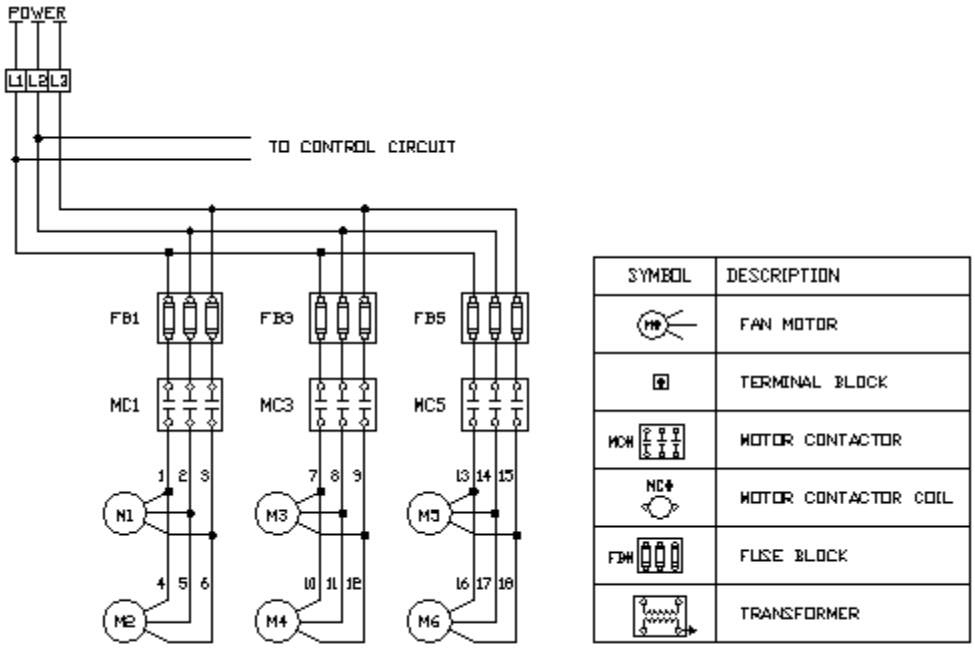
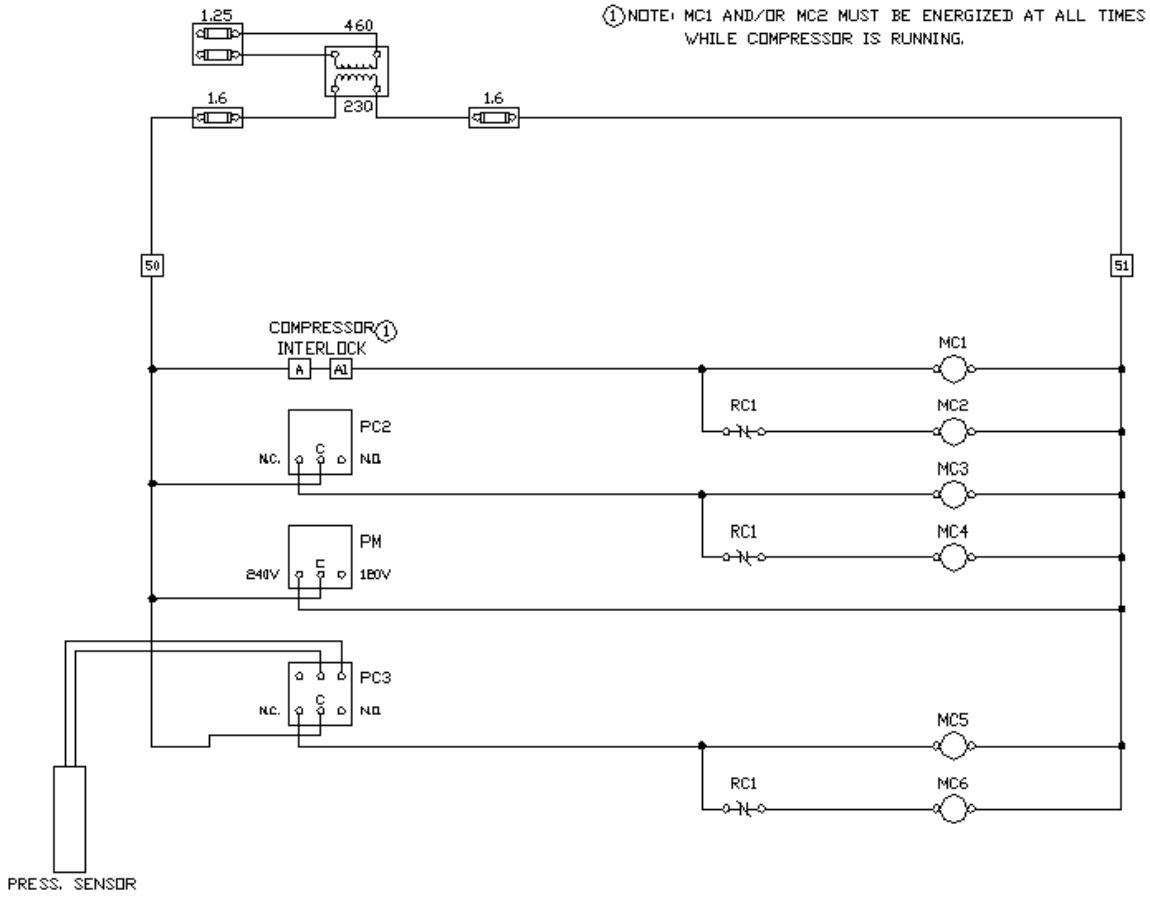


Figure 17 CONTROL CIRCUIT WIRING DIAGRAM (-355)



7.4 *FAN CYCLE OPERATION*

The fan cycle controller employed with the Levitor Series II condenser, should be set up so that the fan or set of fans (if a double wide unit) nearest to the unit headers is/are in continuous operation whenever a system compressor is running.

Not complying with this condition can cause uneven rapid expansion and contraction of the condenser core tubing, contributing to condenser tube failures. Violation of this condition is most often associated with electronic controllers and must be avoided through correct programming. This also means that you should not program the “header end” fans(s) for “equal run time”.

Incorrect fan cycling during cold weather will result in excessive tube stress within the condenser due, to rapid expansion and contraction of the coil caused by needless temperature swings. The header end fan(s) will de-superheat the entering hot gas and allow the remaining condenser surface to condense the refrigerant at internal temperatures that are not a threat to the performance of the equipment.

Due to the Levitor coil support system, all fans may be cycled without increasing the risk of condenser tube failures. To obtain the maximum life from the condenser, as well as meet with warranty stipulations, the following field set-up is required:

1. Always set the header end fan(s) to cycle as first-on, last-off in the fan cycle scheme.
2. Do not set the fans to cycle-on more than 30 times per hour, or lower than a minimum of 40 PSI discharge pressure differential swing. The maximum short cycling is one minute on, one minute off.

7.5 *CONTROL SETTINGS*

Tables 8 & 9 contain the settings to which the control panel components are set for the ordered application. Table 8 contains the settings for pressure sensing controls while Table 9 contains the settings for temperature controls. These are specific to the Johnson 350 series controller, wiring diagrams shipped with the ordered unit(s) will contain specifics for the controller used.

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 *VFD OPERATION*

Variable Frequency Drives (VFDs) are an available, stand-alone option for condensers using the “A”, “C” or “F” fan motors. Also available is a **new** variable speed condenser option that uses **“K”** motor option which come with mini VFDs that are factory mounted, section 8 below discusses this option.
A VFD will vary the speed of all the fan motors together, depending on conditions. Inverter ready motors must be used on all condensers that use a VFD.

The VFD will be shipped loose along with a stand for mounting purposes. After the stand is secured in its proper location, the top cross brace will need to be unbolted and removed. The VFD can then be placed on the frame, and the cross brace can be reattached. The four mounting holes on the VFD will then need to be secured to the appropriate holes on the frame.

The primary power will be brought into the VFD. It will then be run from the VFD to the distribution block inside the condenser electrical enclosure. Reference the wiring schematics located in the condenser enclosure and the VFD. All the electrical wiring will be the responsibility of the installer and shall be carried out as required by the authority having jurisdiction. Basic programming has been done to the VFD, but more field programming is still necessary.

Table 9 CONTROL PANEL SETTINGS – PRESSURE SENSING

		PRESSURE CONTROL PRESSURE SETTINGS (PSIG) (R-404A)							PRESSURE CONTROL PRESSURE SETTINGS (PSIG) (R-410A)						
PRESSURE CONTROL #		- - -	PC2	PC3	PC4	PC5	PC6	PC7	- - -	PC2	PC3	PC4	PC5	PC6	PC7
FAN MOTOR CONTACTOR NUMBER	Single Wide Units	MC1	MC3	MC5	MC7	MC9	MC11	MC13	MC1	MC3	MC5	MC7	MC9	MC11	MC13
	Double Wide Units	MC1 & MC2	MC3 & MC4	MC5 & MC6	MC7 & MC8	MC9 & MC10	MC11 & MC12	MC13 & MC14	MC1 & MC2	MC3 & MC4	MC5 & MC6	MC7 & MC8	MC9 & MC10	MC11 & MC12	MC13 & MC14
SET	FAN(S)	240							330						
OFFSET		- -							- -						
DIFF		40							50						
FAN ON		240							330						
FAN OFF		200							280						
SET	RUN	- -	250						- -	340					
OFFSET		10	- -						10	- -					
DIFF		40	40						50	50					
FAN ON		240	250						330	340					
FAN OFF		200	210						280	290					
SET	WITH	- -	- -	260					- -	- -	350				
OFFSET		20	10	- -					20	10	- -				
DIFF		40	40	40					50	50	50				
FAN ON		240	250	260					330	340	350				
FAN OFF		200	210	220					280	290	300				
SET	ANY	- -	- -	- -	265				- -	- -	- -	360			
OFFSET		25	15	5	- -				30	20	10	- -			
DIFF		40	40	40	40				50	50	50	50			
FAN ON		240	250	260	265				330	340	350	360			
FAN OFF		200	210	220	225				280	290	300	310			
SET	COMPRESSOR	- -	- -	- -	- -	270			- -	- -	- -	- -	370		
OFFSET		30	20	10	5	- -			40	30	20	10	- -		
DIFF		40	40	40	40	40			50	50	50	50	50		
FAN ON		240	250	260	265	270			330	340	350	360	370		
FAN OFF		200	210	220	225	230			280	290	300	310	320		
SET		- -	- -	- -	- -	- -	270		- -	- -	- -	- -	- -	370	
OFFSET		40	30	20	10	5	- -		50	40	30	20	10	- -	
DIFF		40	40	40	40	40	40		50	50	50	50	50	50	
FAN ON		230	240	250	260	265	270		320	330	340	350	360	370	
FAN OFF		190	200	210	220	225	230		270	280	290	300	310	320	

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

Table 10 CONTROL PANEL SETTINGS – TEMPERATURE SENSING

			AMBIENT CONTROL TEMPERATURE SETTINGS (°F)					
TEMPERATURE CONTROL #		- - -	TC2	TC3	TC4	TC5	TC6	TC7
FAN MOTOR CONTACTOR NUMBER	Single Wide Units	MC1	MC3	MC5	MC7	MC9	MC11	MC13
	Double Wide Units	MC1 & MC2	MC3 & MC4	MC5 & MC6	MC7 & MC8	MC9 & MC10	MC11 & MC12	MC13 & MC14
SET			60					
OFFSET			- -					
DIFF			20					
FAN ON		FAN (S)	60					
FAN OFF			40					
SET			- -	65				
OFFSET			10	- -				
DIFF		RUN	10	15				
FAN ON			55	65				
FAN OFF			45	50				
SET			- -	- -	70			
OFFSET			15	10	- -			
DIFF		WITH	10	10	5			
FAN ON			55	60	70			
FAN OFF			45	55	65			
SET			- -	- -	- -	75		
OFFSET			20	15	5	- -		
DIFF		ANY	10	5	5	5		
FAN ON			55	60	70	75		
FAN OFF			45	55	65	70		
SET			- -	- -	- -	- -	80	
OFFSET			25	20	15	10	- -	
DIFF		COMPRESSOR	5	5	5	5	5	
FAN ON			55	60	65	70	80	
FAN OFF			45	55	60	65	75	
SET			- -	- -	- -	- -	- -	80
OFFSET			25	20	15	10	5	- -
DIFF			10	5	5	5	5	5
FAN ON			55	60	65	70	75	80
FAN OFF			45	55	60	65	70	75

NOTE: 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*

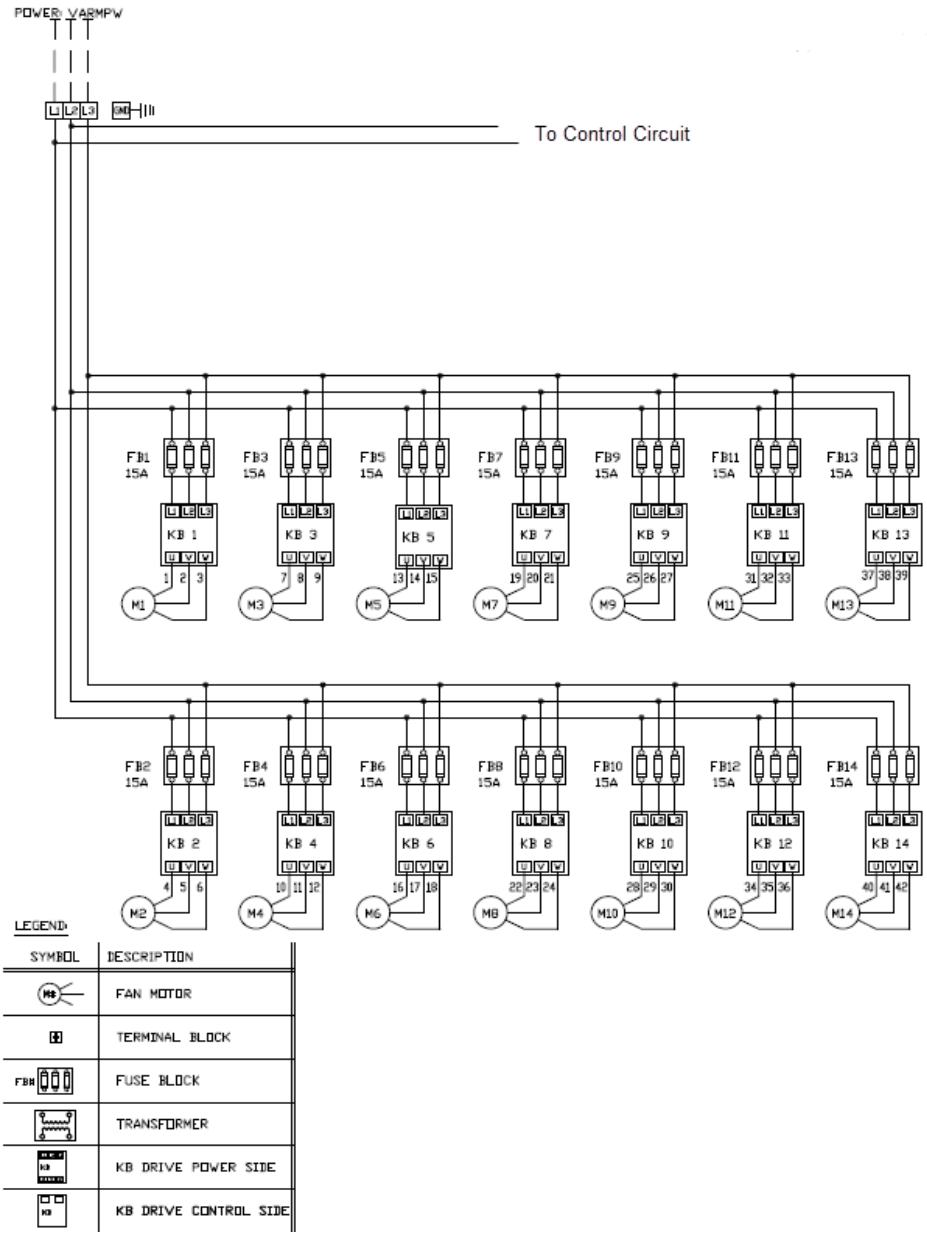
Variable speed condensers use Nidec BPM motors which use KB VFDs. The VFDs come factory mounted in the control panel. Airflow is increased/decreased across the condenser coil surface by modulating variable speed fans to maintain either:

- 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 18 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.

Alarms generated by the application are:

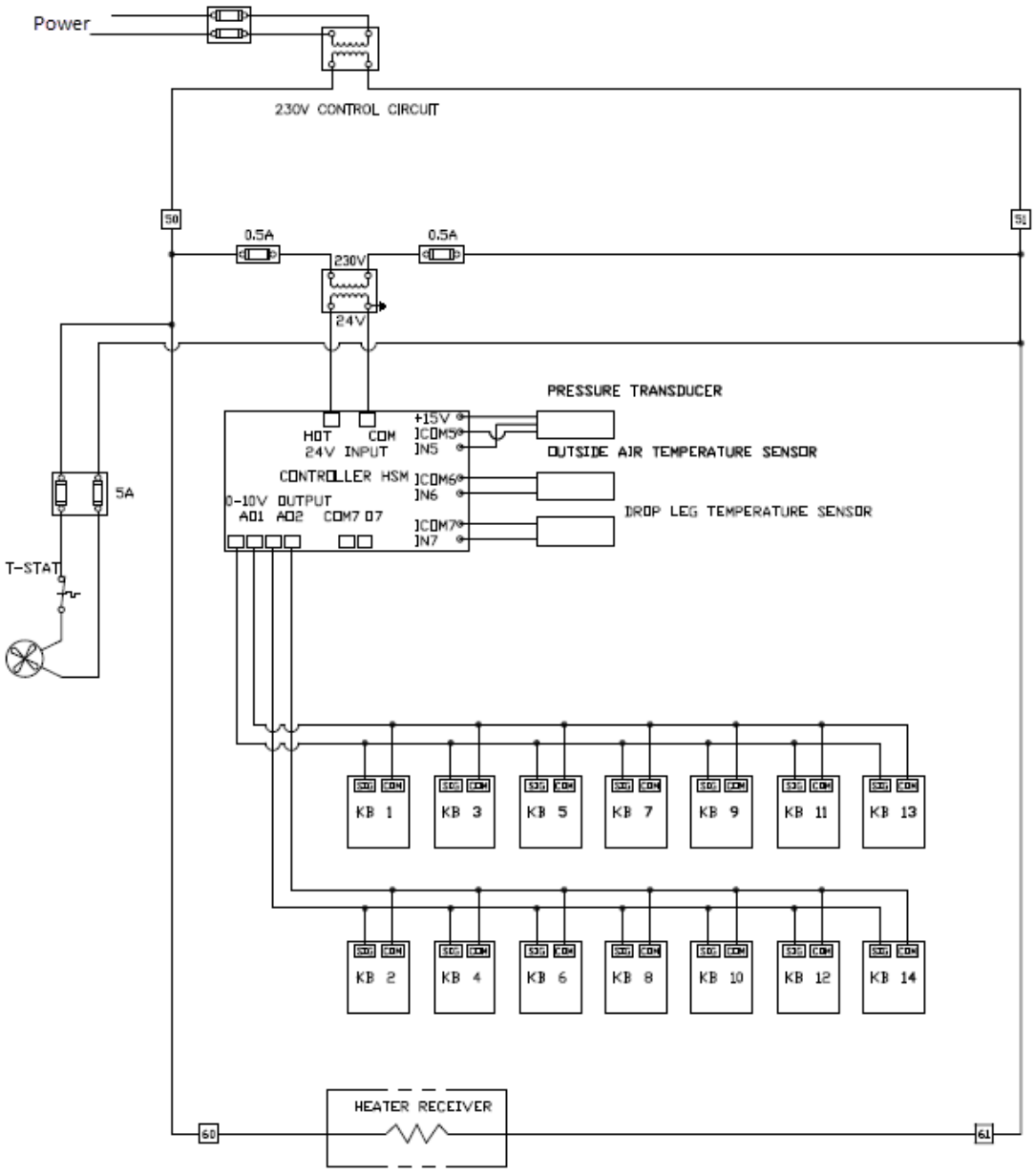
- VFD Fault
- Discharge pressure transducer
- Ambient temperature sensor
- Drop-leg temperature sensor

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, through BACnet or MODBUS interfaces.

Following figure shows the controller wiring schematic.

Figure 19 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 20 HUSSMANN CONTROLLER LOCAL DISPLAY

Following table provides information regarding indicator lights on the controller.

Table 11 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 the Hussmann controller.

- The MAP is physically plugged into the 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.
- It can be 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.

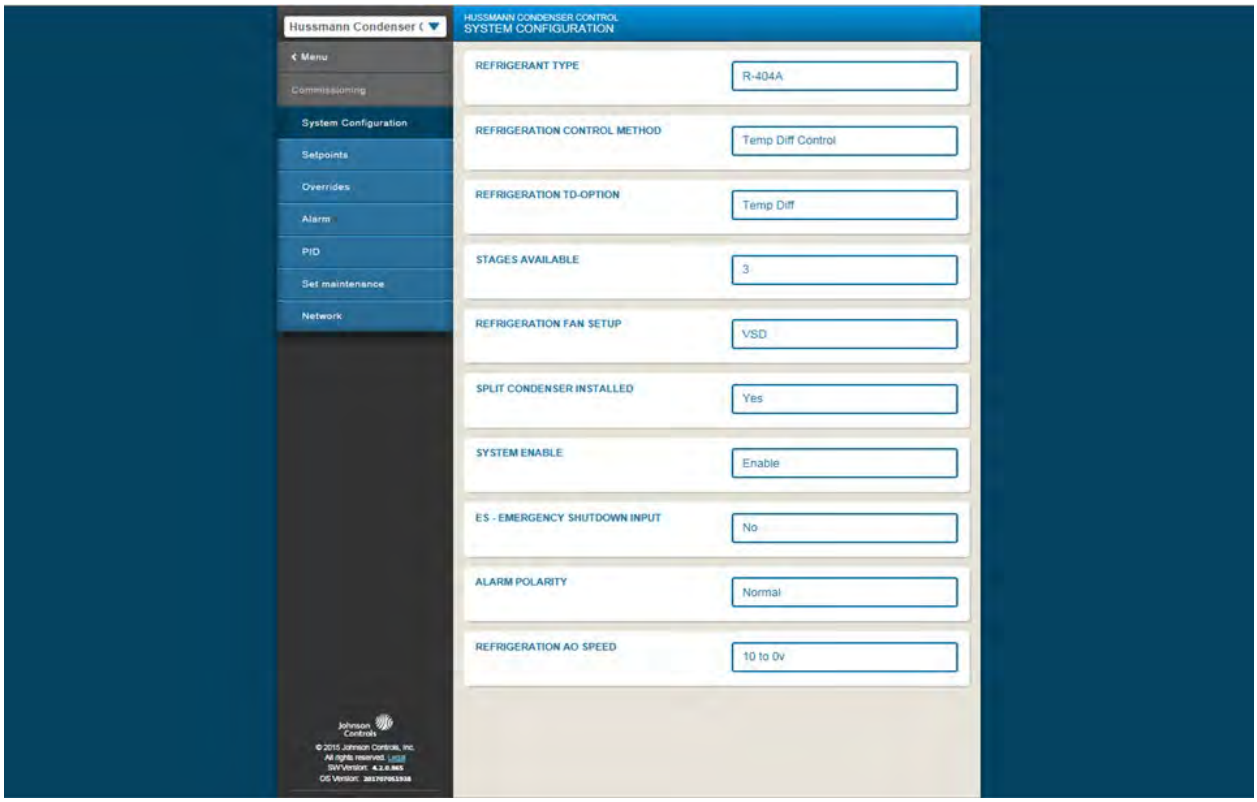
All configuration and setpoint changes can be accessed either through the local display or MAP Gateway. The following sections illustrate how to access the parameters utilizing the MAP 1810 Gateway module.

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 accessed through the MAP Gateway module.

Figure 31 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 12 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 case of outdoor ambient temperature sensor failure, the condenser control application can be configured to operate using on pressure-based controls strategy.

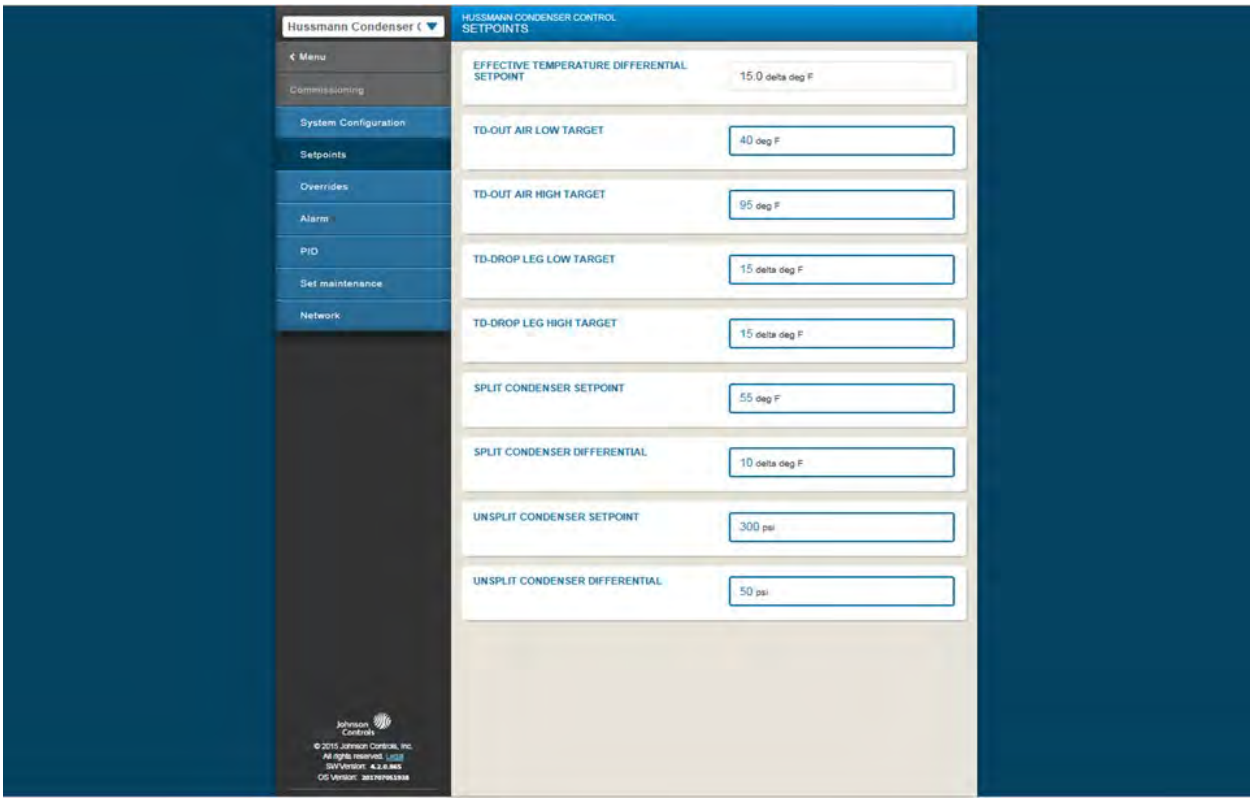
8.2.2.2.2 SETPOINTS

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 22 SETPOINTS SCREENSHOT



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

Table 13 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

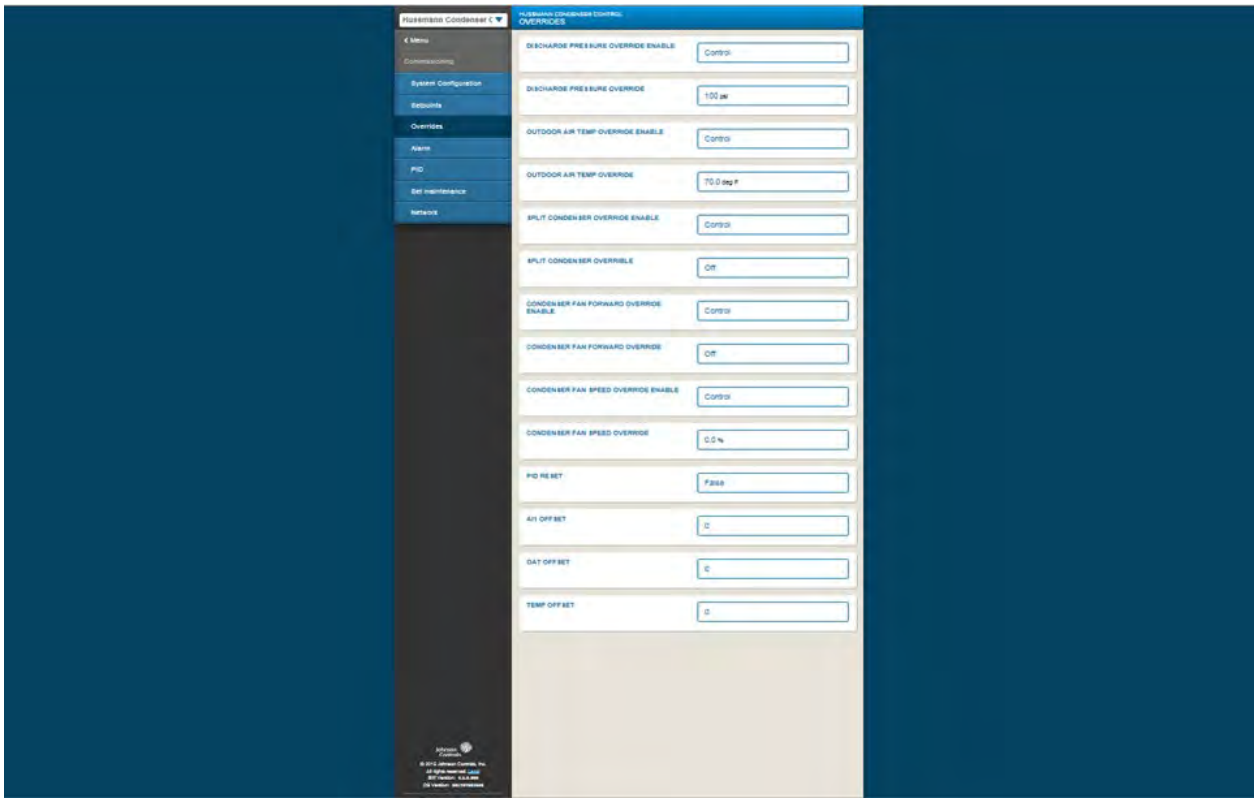
Note: Visible when REFRIGERATION CONTROL METHOD = Temperature Differential.			
CONDENSER FAN MINIMUM SPEED Defines the minimum speed at which the fans shall be staged. *Note: Visible when REFRIGERATION FAN SETUP = Combined.*	0 – 100	0	%
SPLIT CONDENSER SETPOINT Defines the temperature setpoint, the system 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 23 OVERRIDE PARAMETERS SCREENSHOT



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

Table 14 OVERRIDE PARAMETERS DESCRIPTION

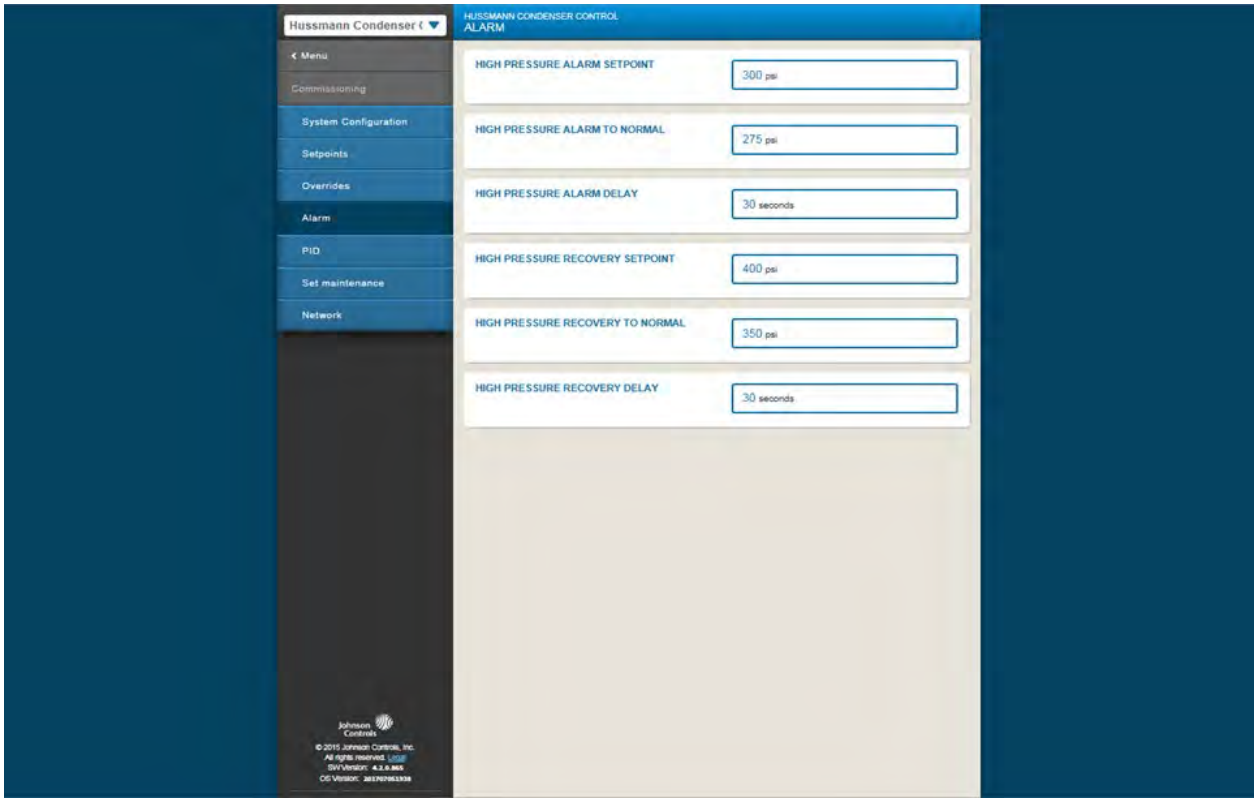
Parameter Name and Description	Range	Default	Units
DISCHARGE PRESSURE OVERRIDE ENABLE Shall be enabled to override discharge pressure input.	Control Override	Control	-
DISCHARGE PRESSURE OVERRIDE Defines the value with which the discharge pressure input would be overridden.	0 – 750	100	PSI
OUTDOOR AIR 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 24 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 15 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 16 HUSSMANN CONTROLLER LED TROUBLESHOOING

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

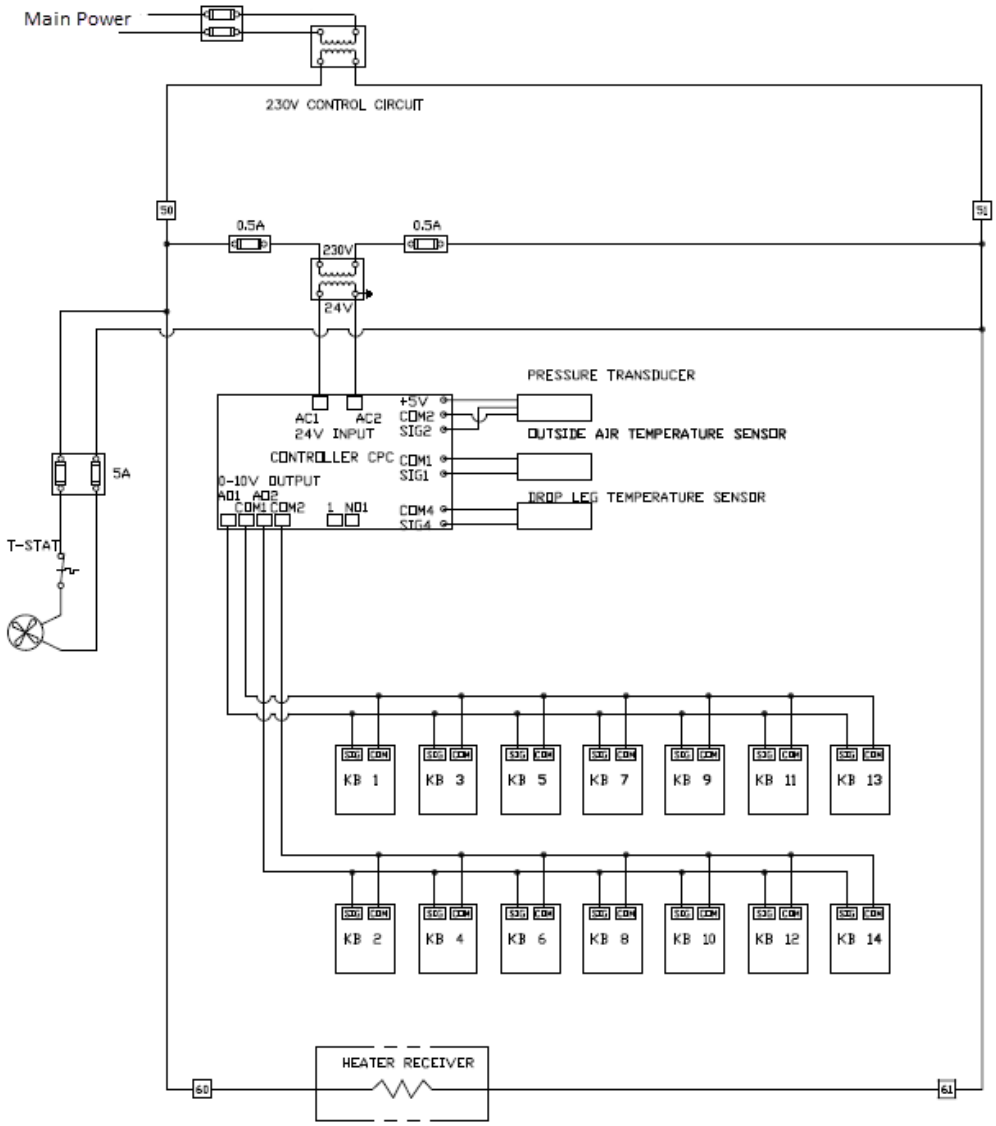
Table 17 HUSSMANN CONTROLLER APPLICATION TROUBLESHOOTING

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 25 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 the 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.

The following figure and table illustrate the inputs setup in the Condenser Control application in the E2.

Figure 26 INPUTS CONFIGURATION SCREENSHOT

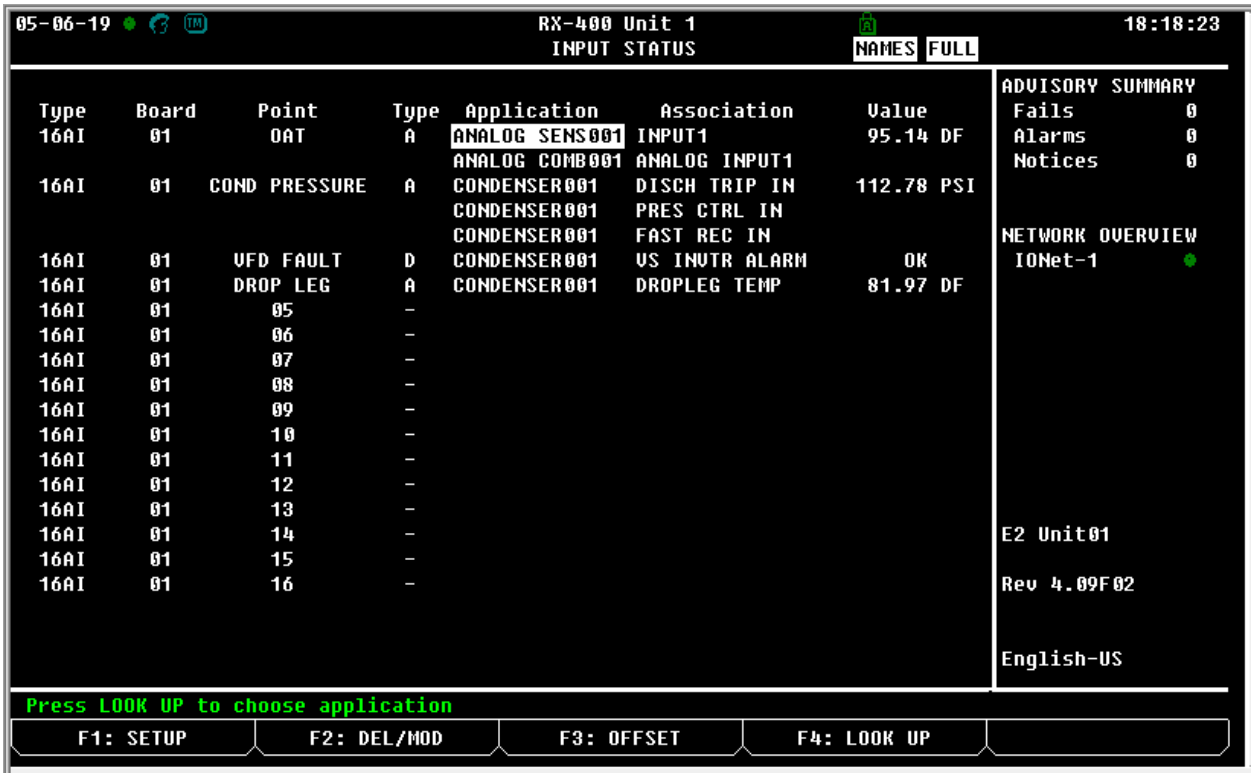


Table 18 INPUTS CONFIGURATION DESCRIPTION

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

The 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 27 OUTPUTS CONFIGURATION SCREENSHOT

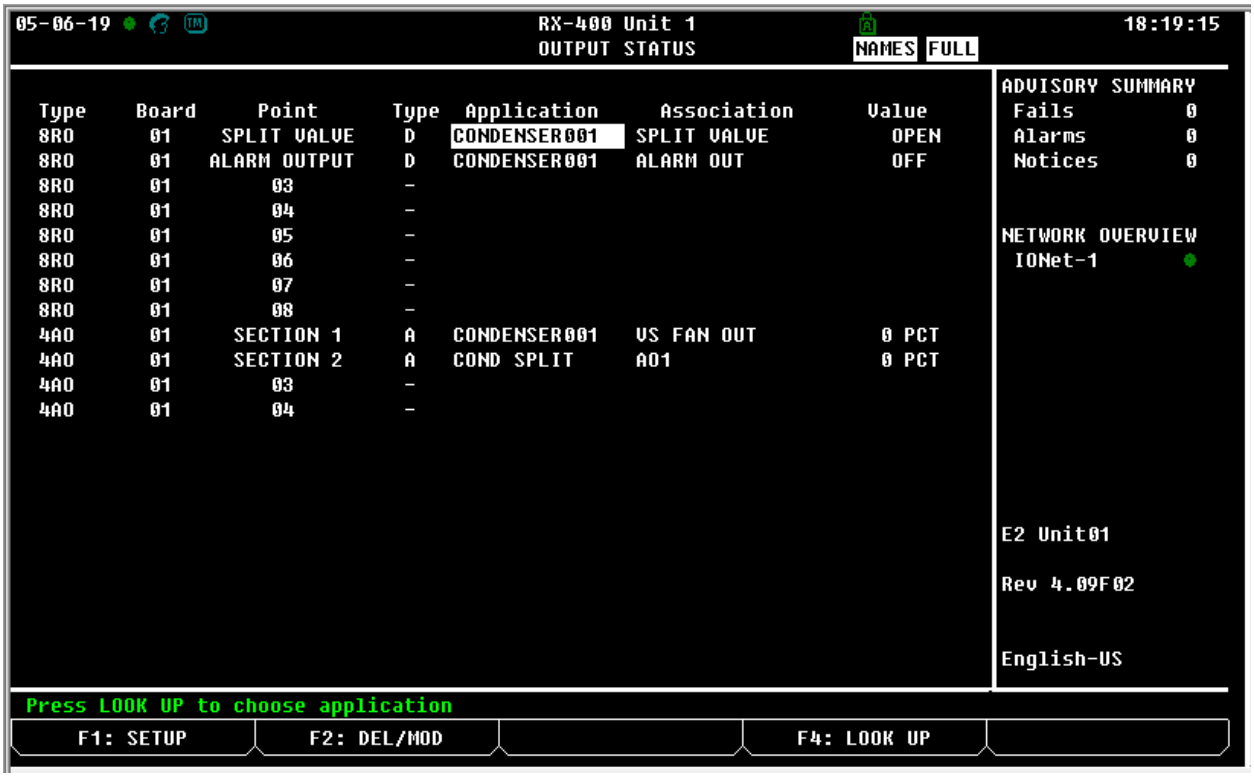


Table 19 OUTPUTS CONFIGURATION DESCRIPTION

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 can also be configured to use air cooled strategy to either maintain a discharge pressure or drop leg temperature.

The general tab parameter is used to define the features available and the operation of the system from a condenser controls application perspective.

FIGURE 28 CONDENSER GENERAL TAB SCREENSHOT

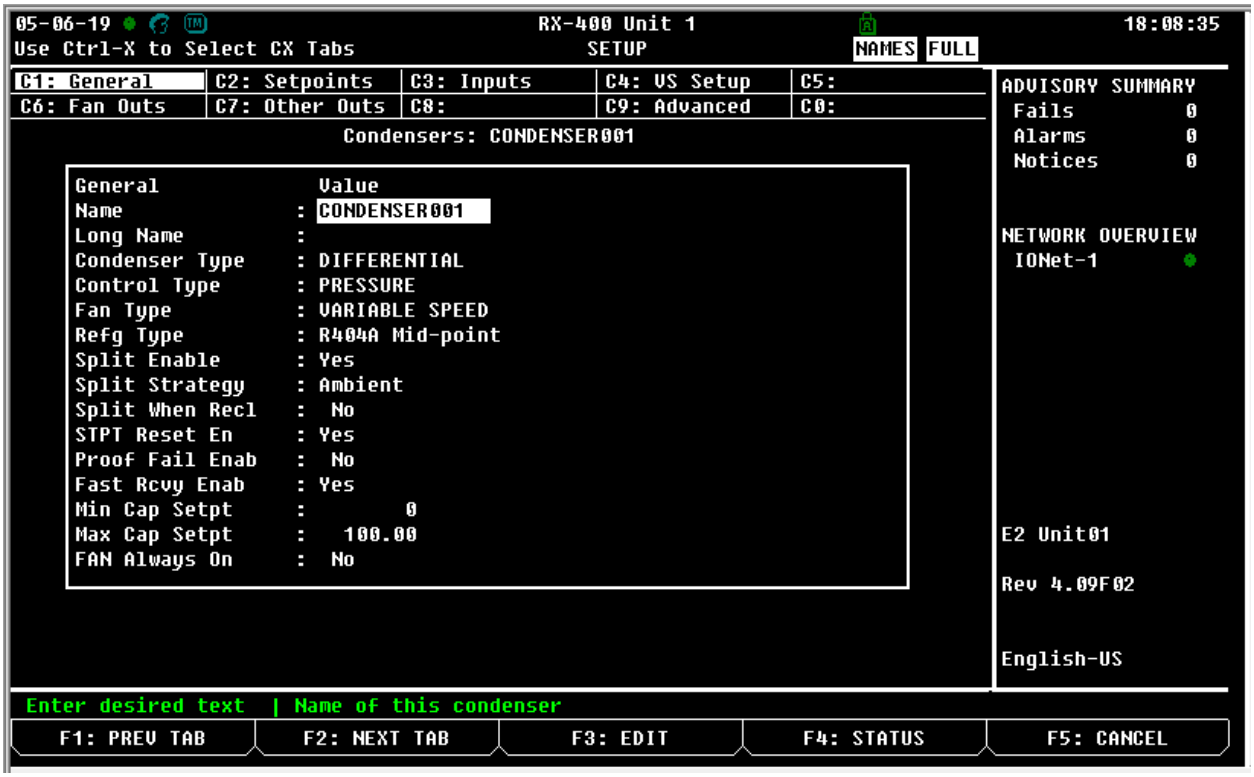


TABLE 20 CONDENSER GENERAL TAB DESCRIPTION

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 4 SETPOINTS TAB 1 SCREENSHOT

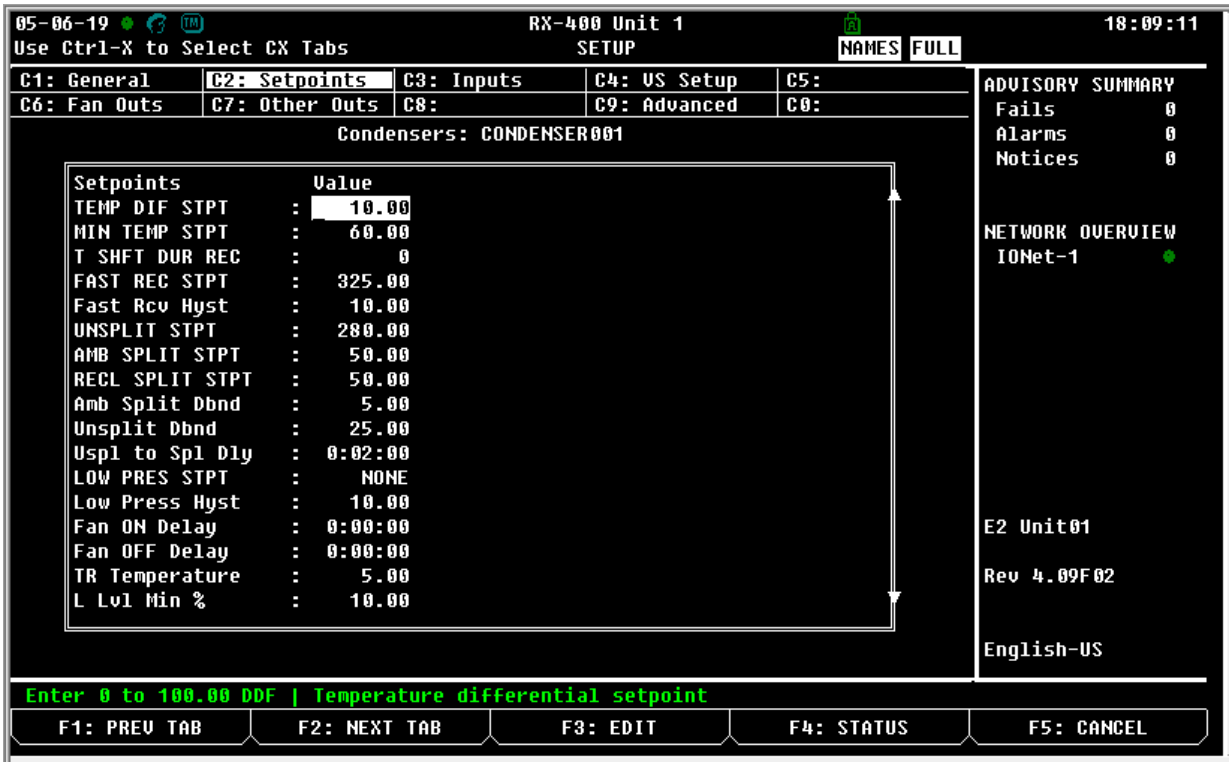


Figure 5 SETPOINTS TAB 2 SCREENSHOT

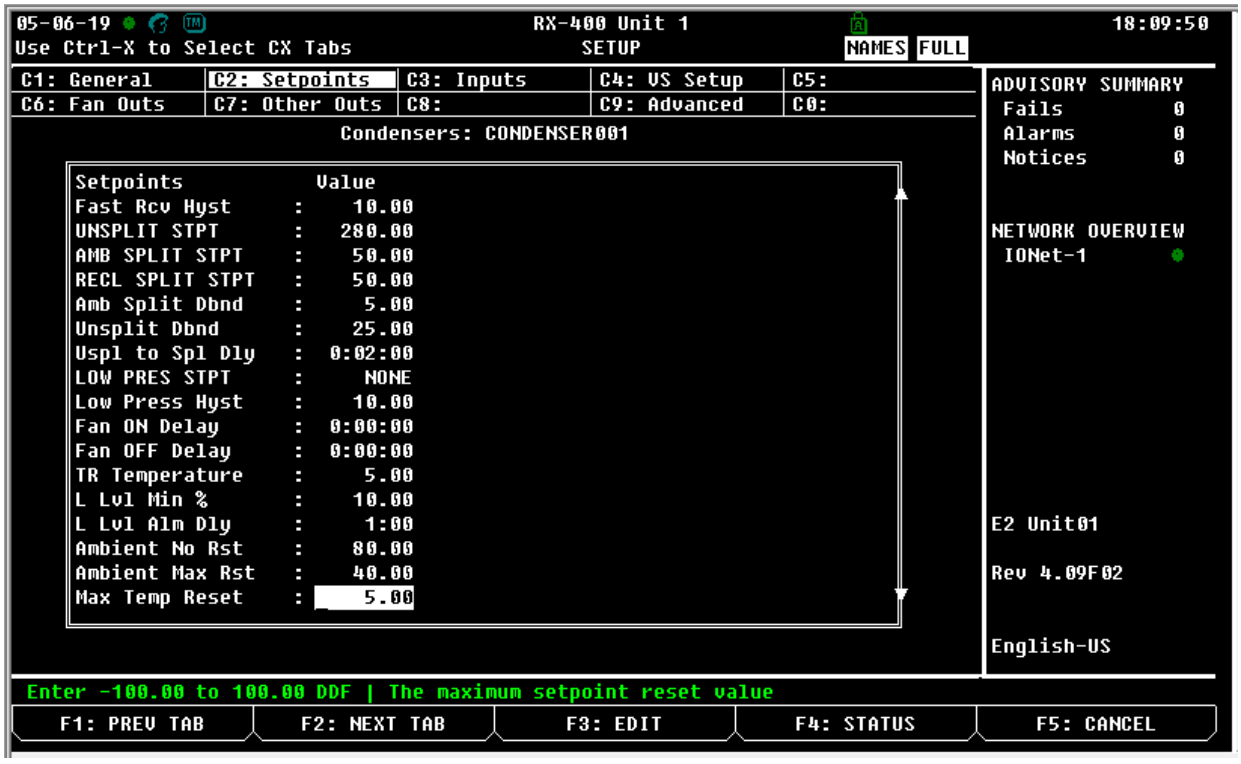


Table 21 SETPOINTS TAB DESCRIPTION

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: $discharge\ pressure > (split\ pressure\ setpoint + (\frac{Unsplit\ deadband\ setpoint}{2}))$ The split mode is available again when: $discharge\ pressure < (split\ pressure\ setpoint - (\frac{Unsplit\ deadband\ setpoint}{2}))$
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 6 INPUTS TAB SCREENSHOT

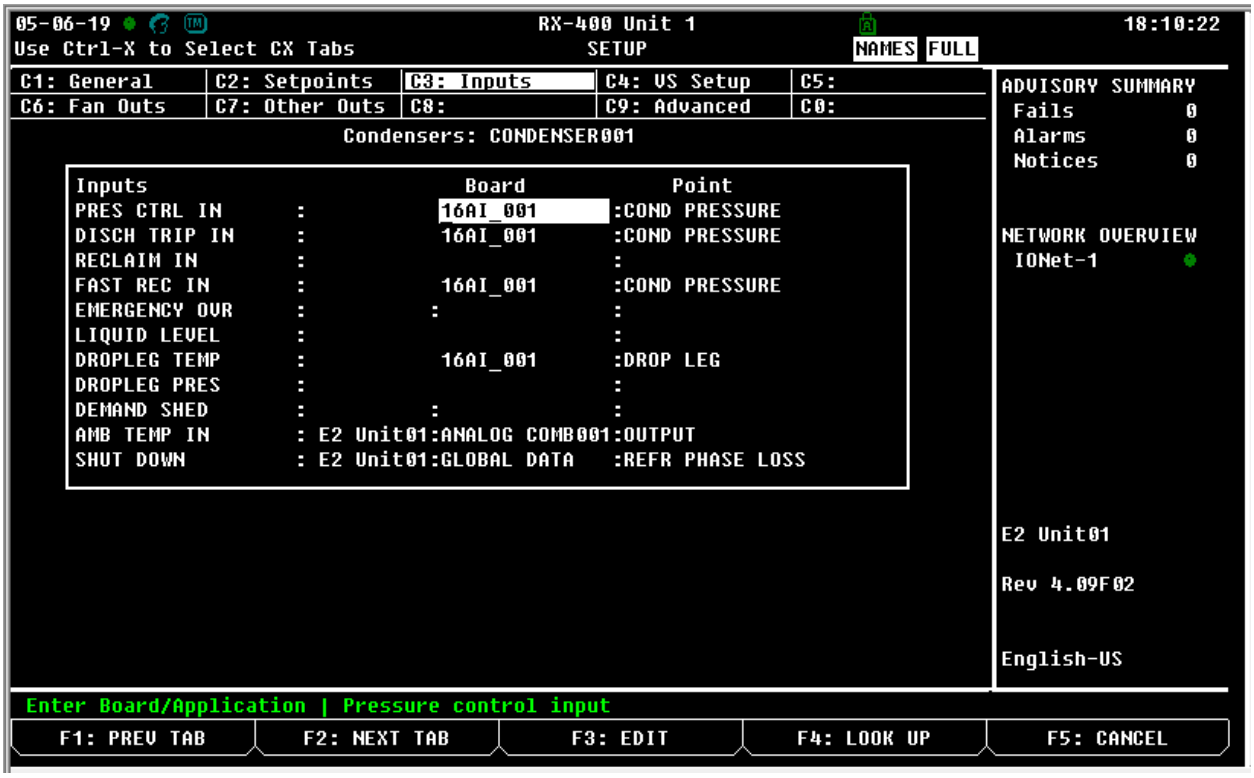


Table 22 INPUTS TAB DESCRIPTION

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 7 VS SETUP TAB SCREENSHOT

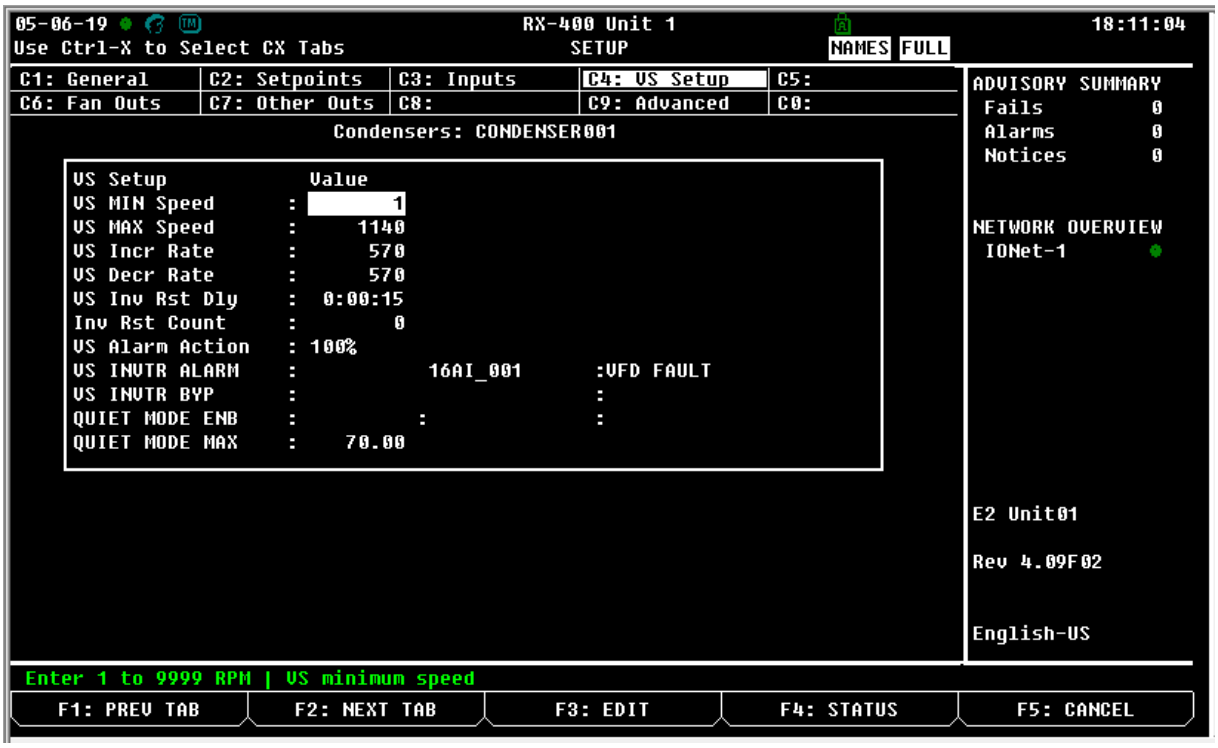


Table 23 VS SETUP TAB DESCRIPTION

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 8 FAN OUTS TAB SCREENSHOT

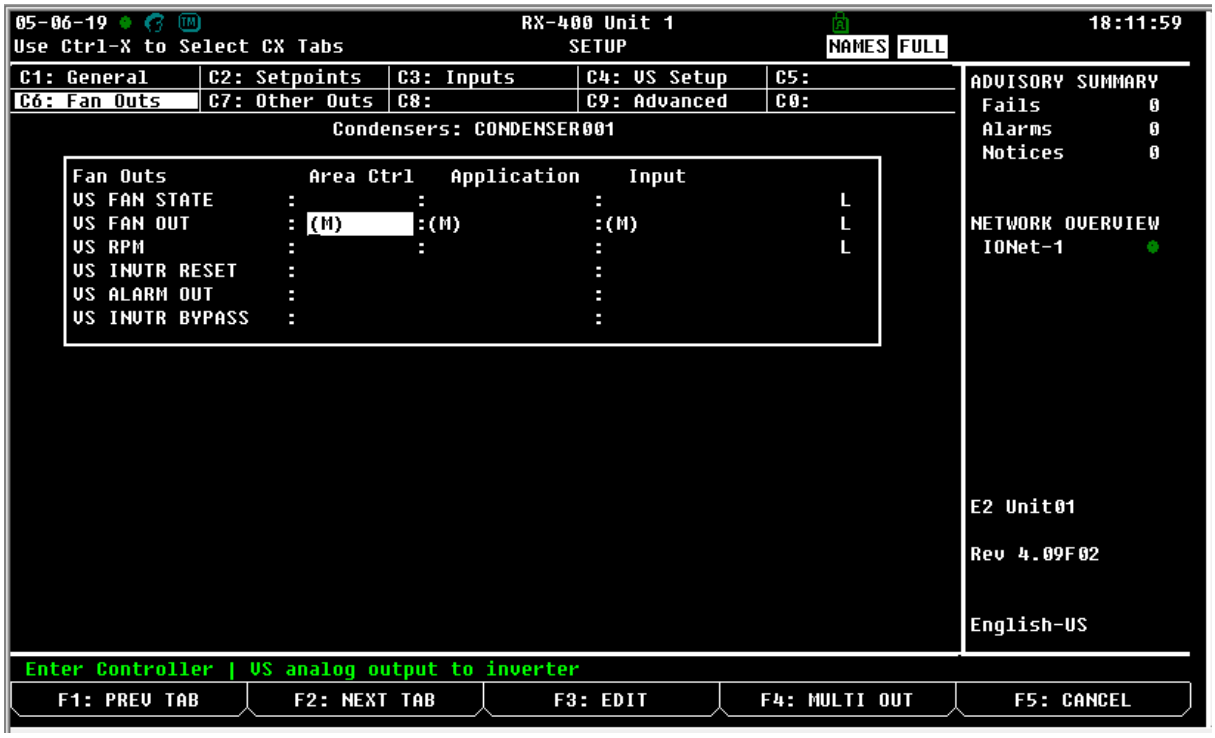


Table 24 FAN OUTS TAB DESCRIPTION

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 9 VS FAN OUT SETUP SCREENSHOT

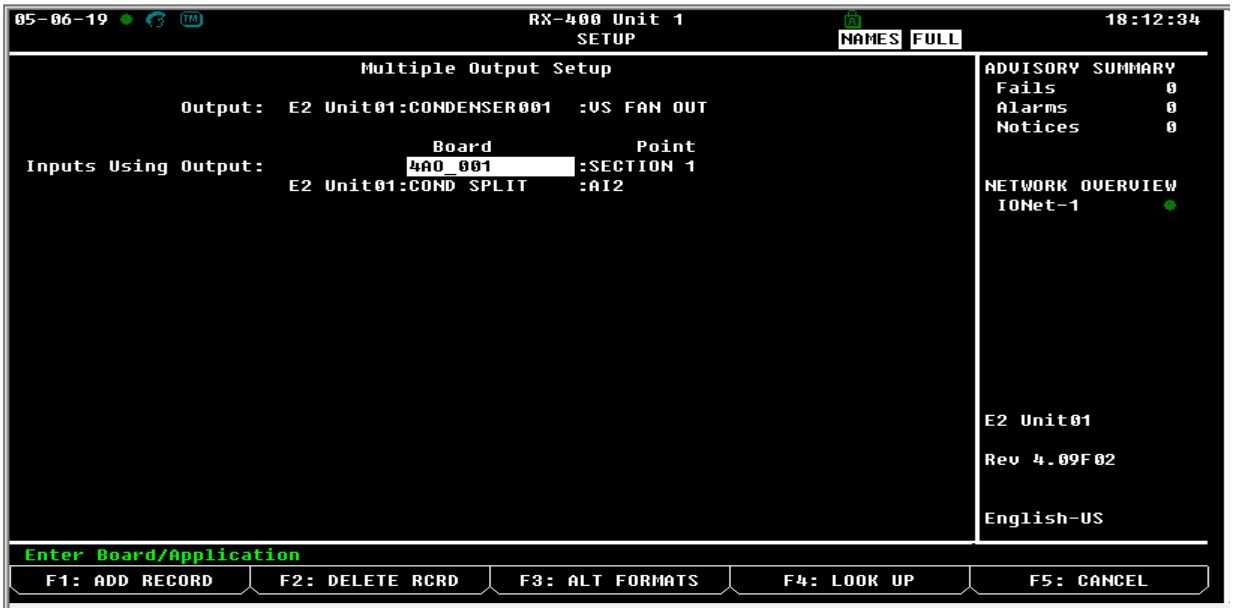


Figure 10 OTHER OUTS TAB SCREENSHOT

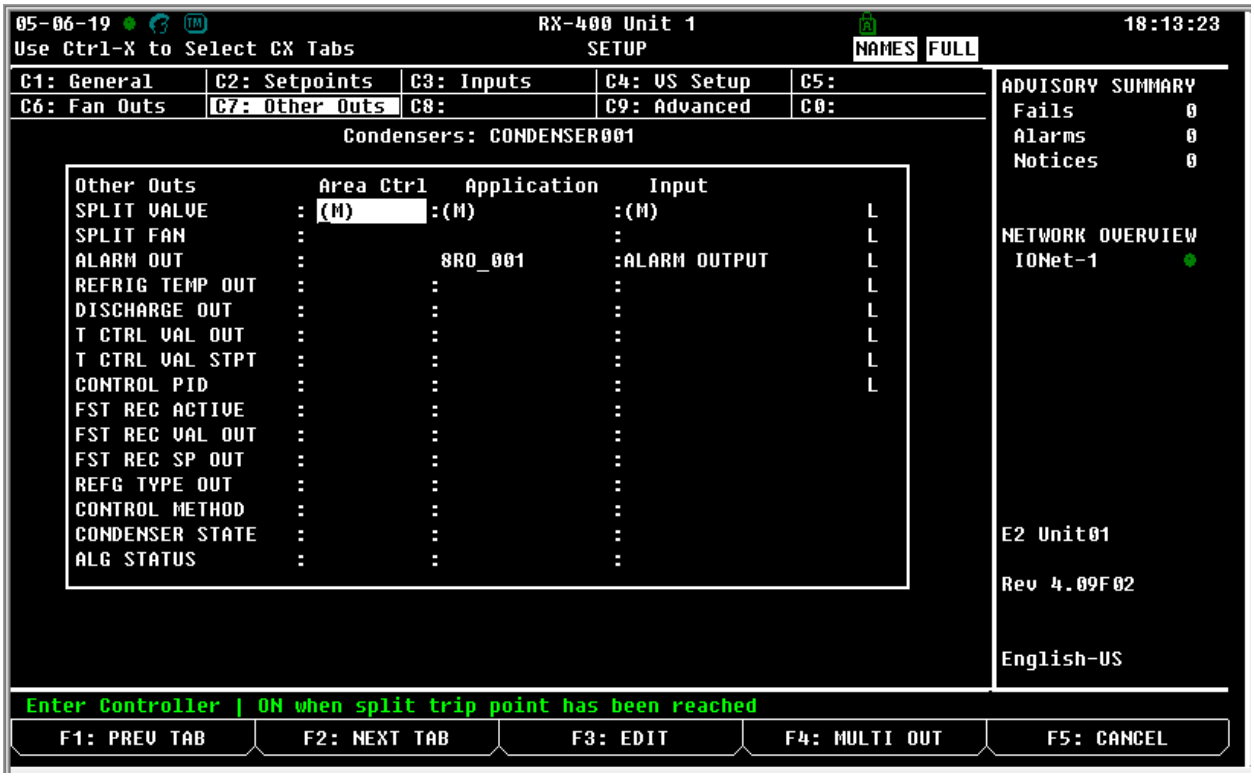


Table 25 OTHER OUTS TAB DESCRIPTION

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 11 SPLIT VALVE SETUP SCREEN SHOT

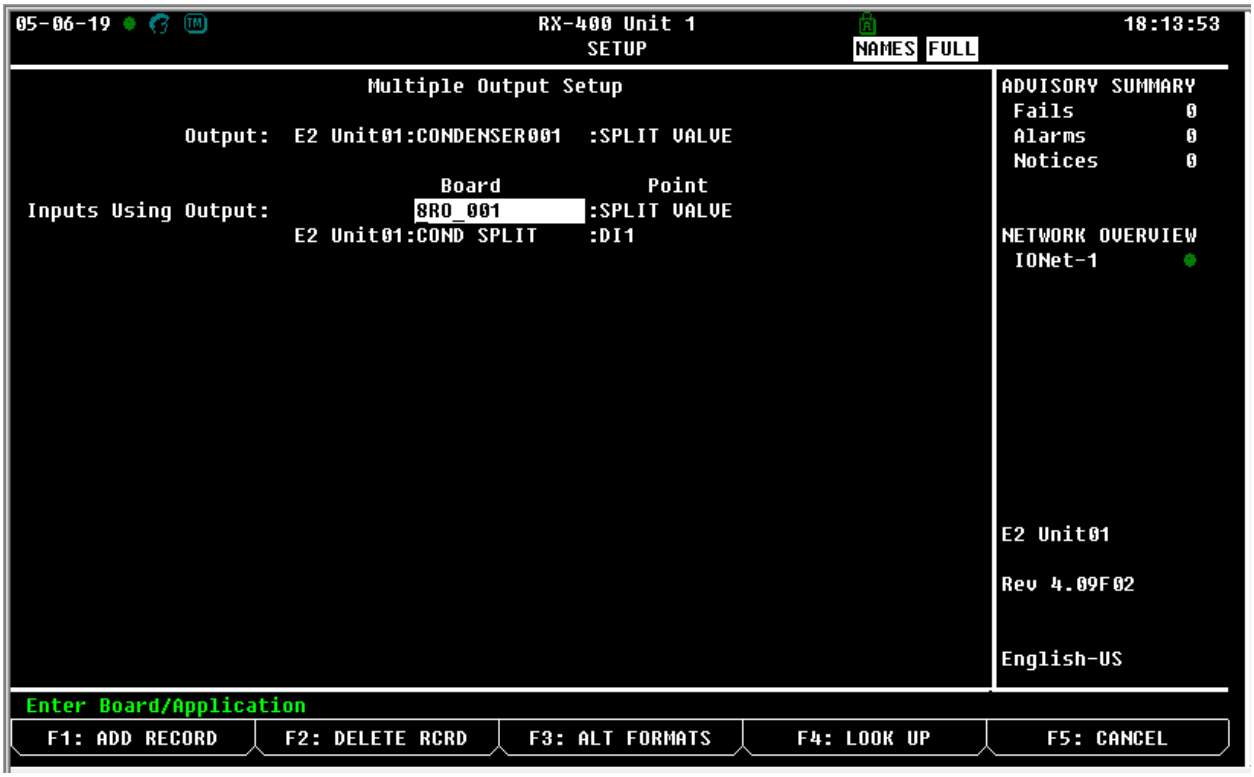


Figure 12 ADVANCED TAB SCREENSHOT

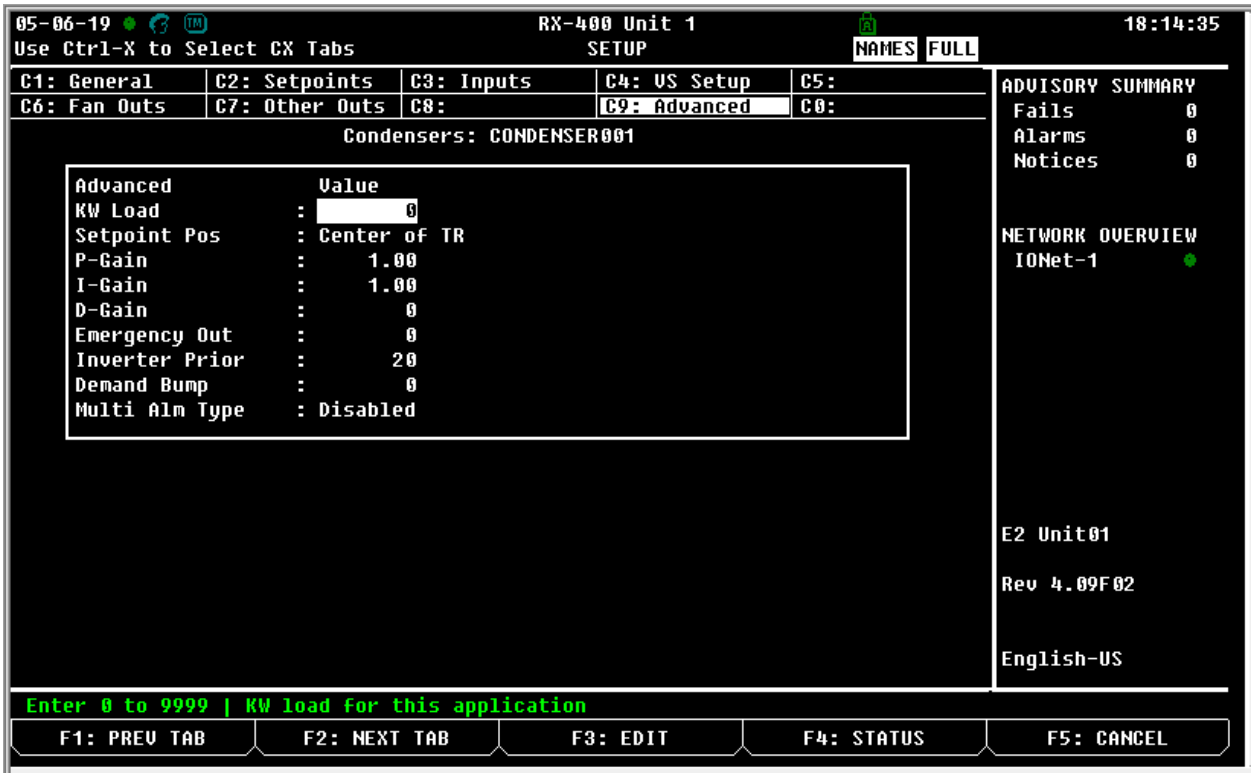


Table 26 ADVANCED TAB DESCRIPTION

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 13 GENERAL TAB SCREENSHOT

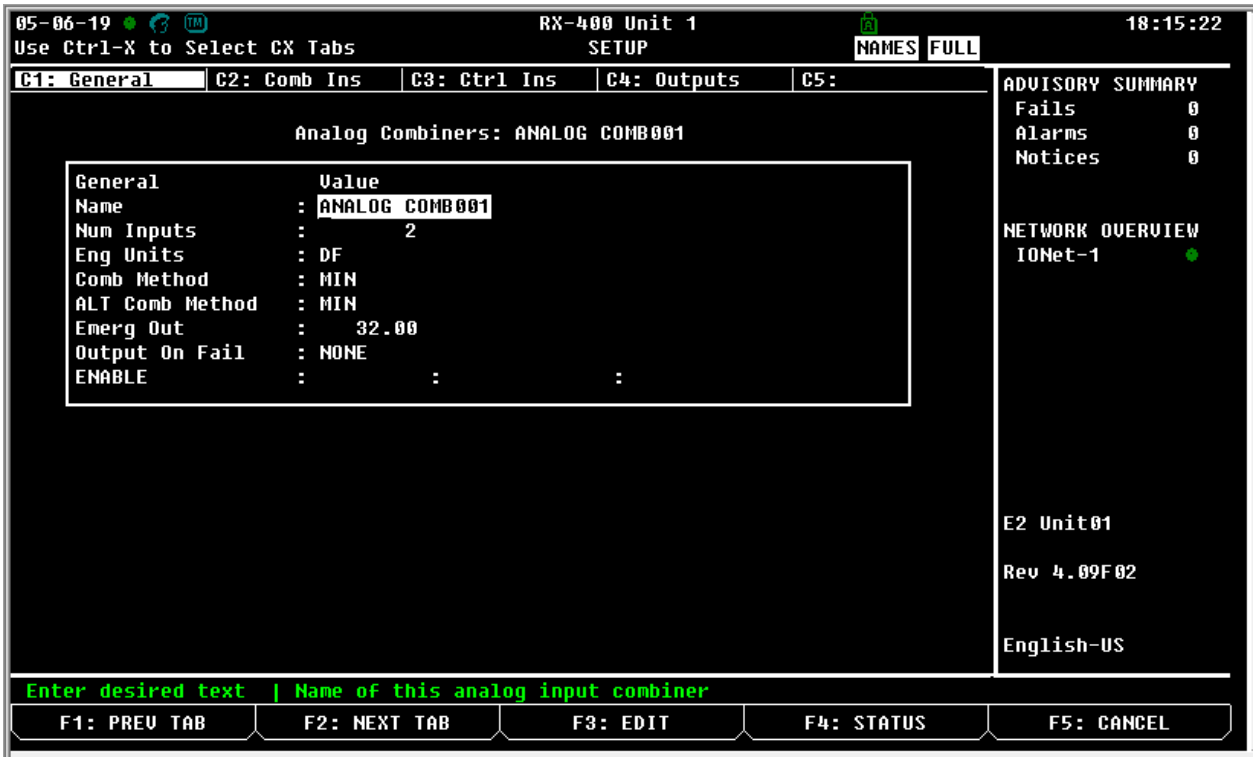


Table 27 GENERAL TAB DESCRIPTION

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 14 COMB INS TAB SCREENSHOT

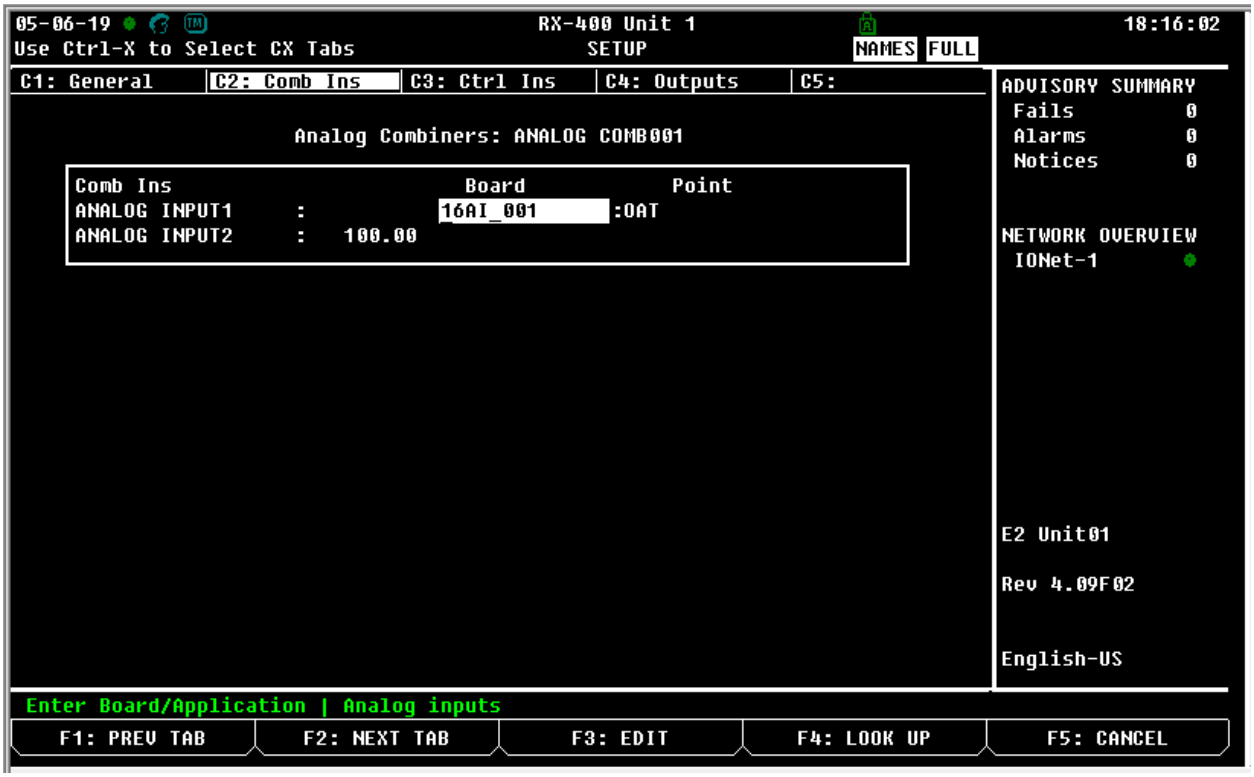


Table 28 COMB INS TAB DESCRIPTION

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 15 CTRL INS TAB SCREENSHOT

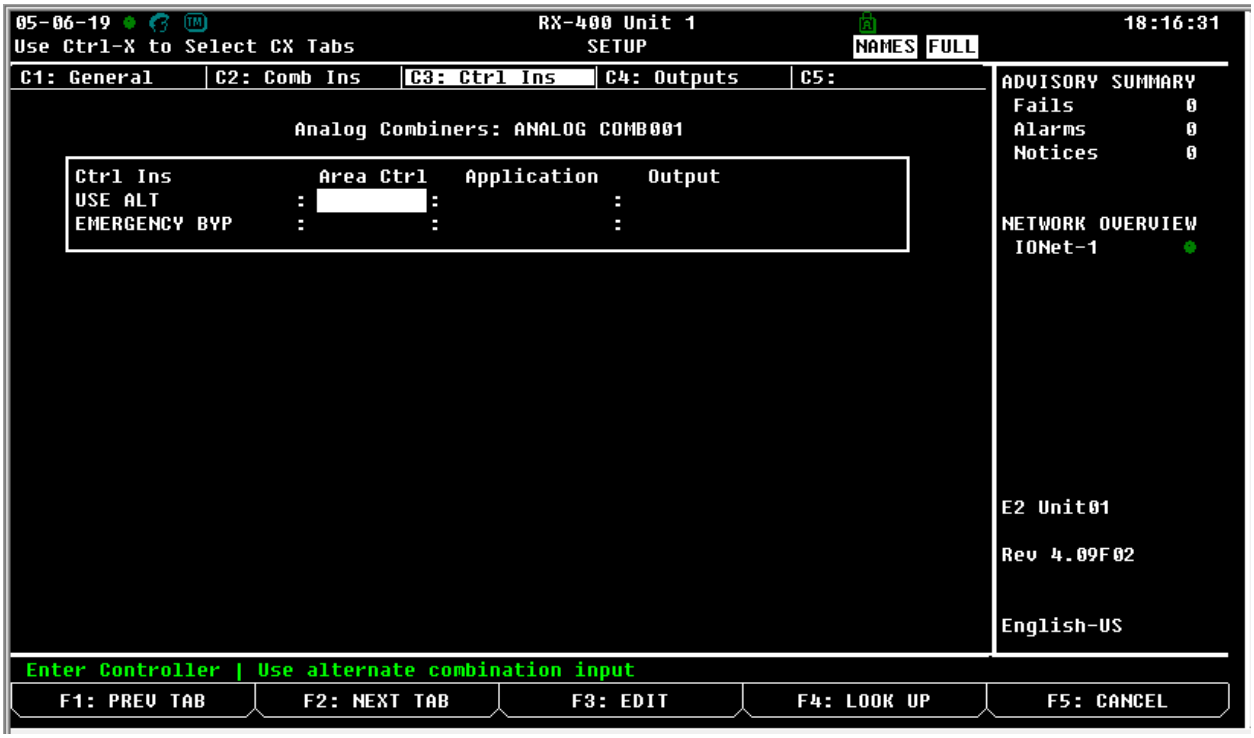


Table 29 CTRL INS TAB DESCRIPTION

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 16 OUTPUTS TAB SCREENSHOT

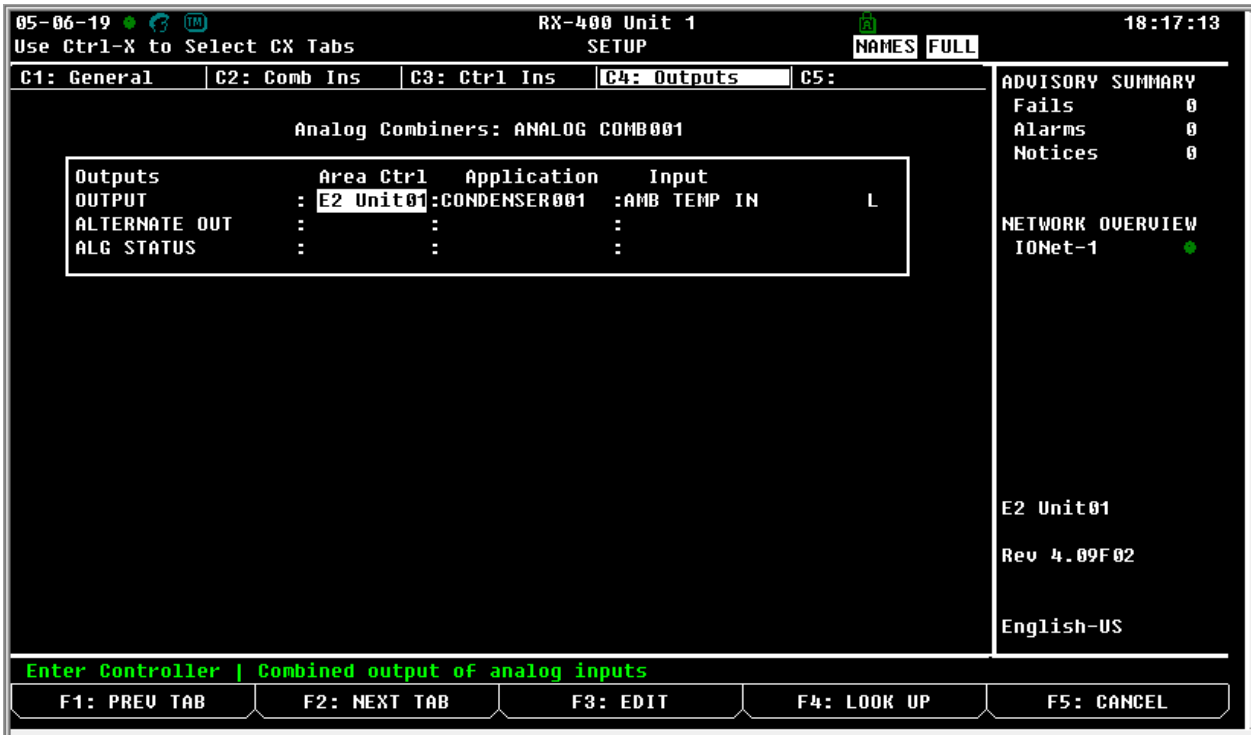


Table 30 OUTPUTS TAB DESCRIPTION

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 17 GENERAL TAB SCREEN SHOT

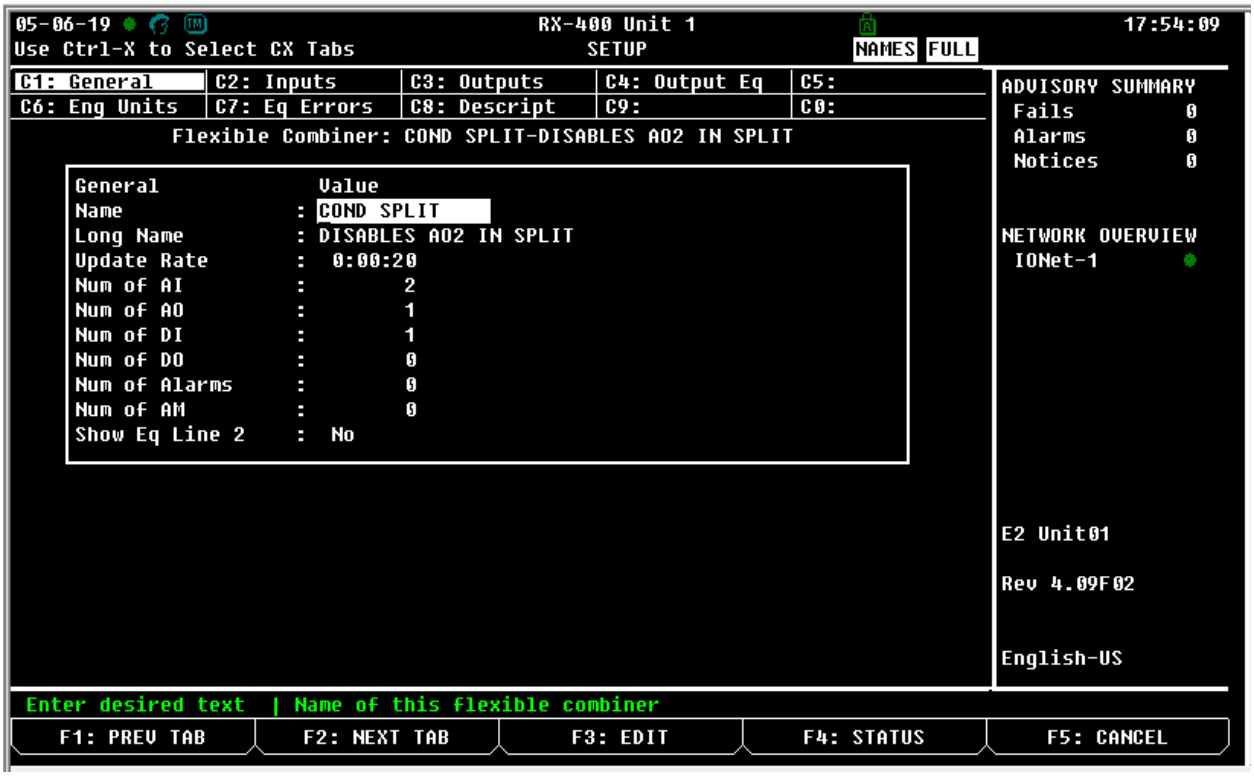


Table 31 GENERAL TAB DESCRIPTION

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 18 INPUTS TAB SCREENSHOT

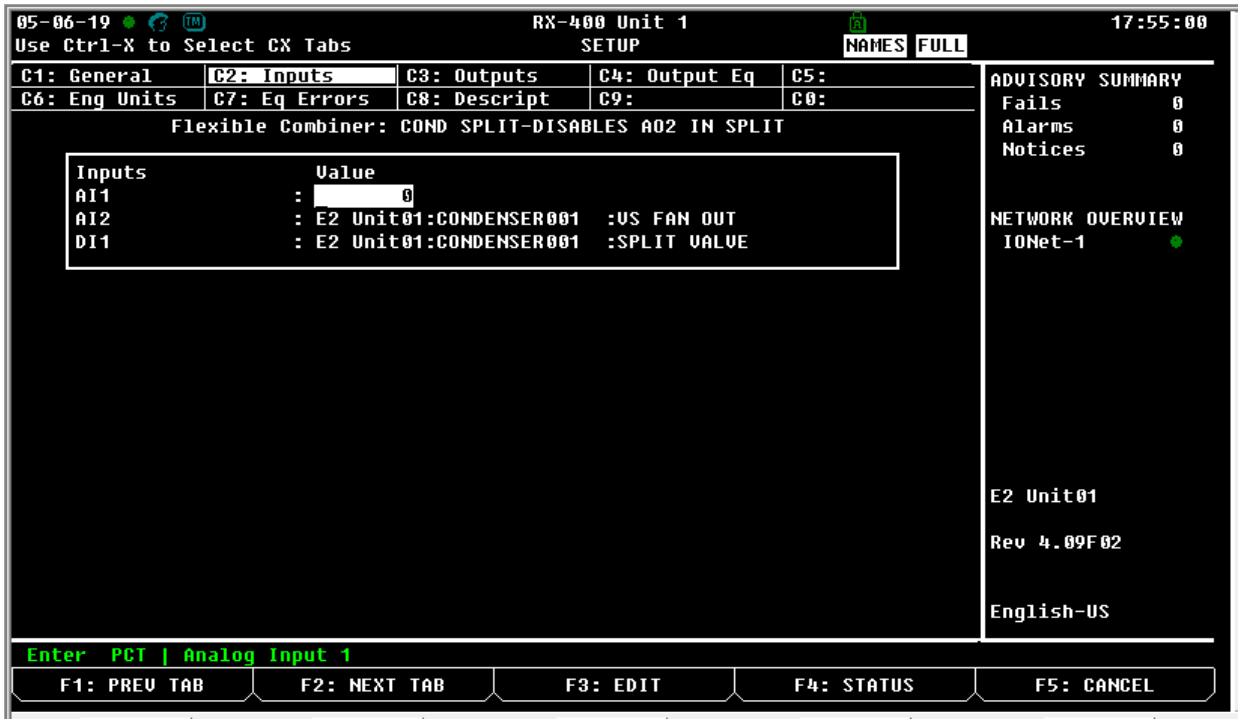


Table 32 INPUTS TAB DESCRIPTION

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 19 OUTPUTS TAB SCREENSHOT

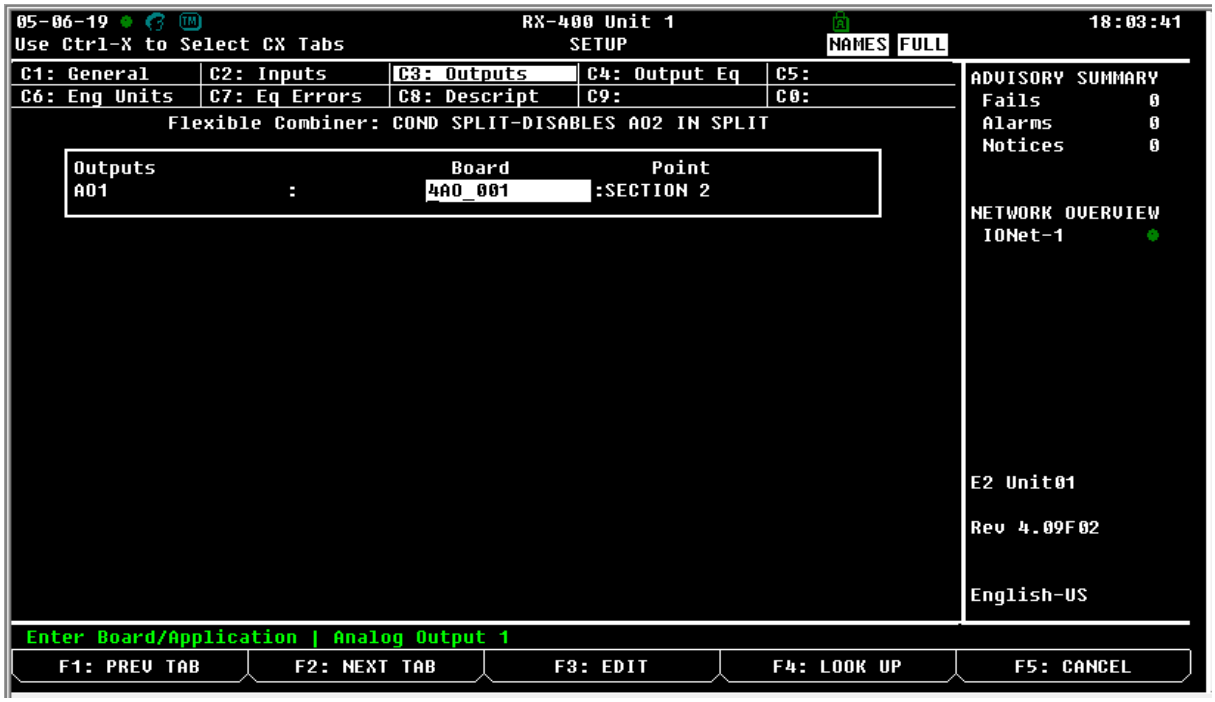


Table 33 OUTPUTS TAB DESCRIPITION

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

Figure 20 OUTPUT EQ TAB SCREENSHOT

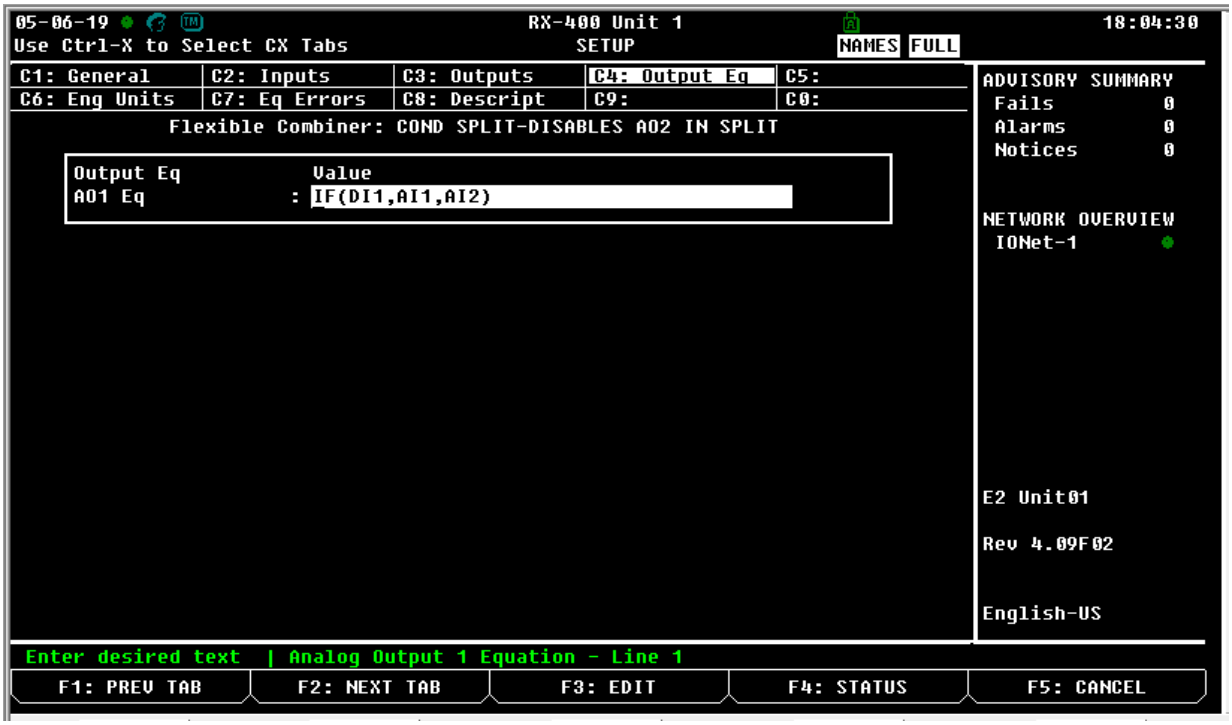


Table 34 OUTPUT EQ TAB DESCRIPTION

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 21 ENG UNIT TAB SCREENSHOT

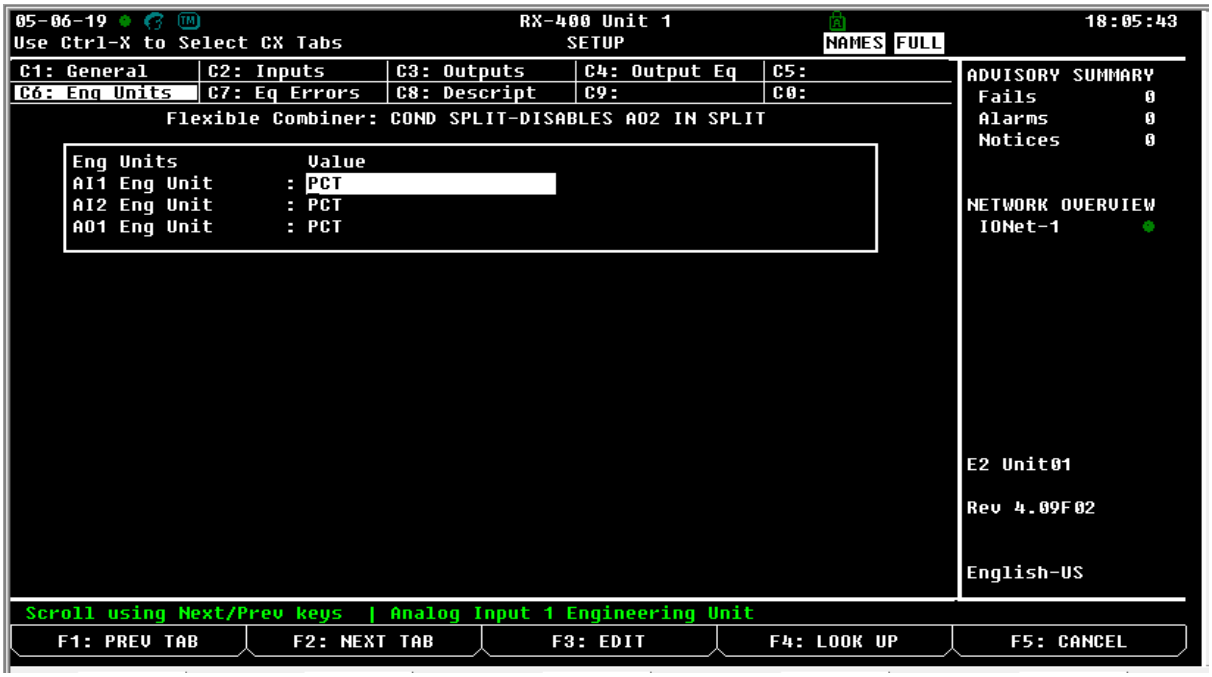


Table 35 ENG UNITS TAB DESCRIPTION

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 22 DESCRIPT TAB SCREENSHOT

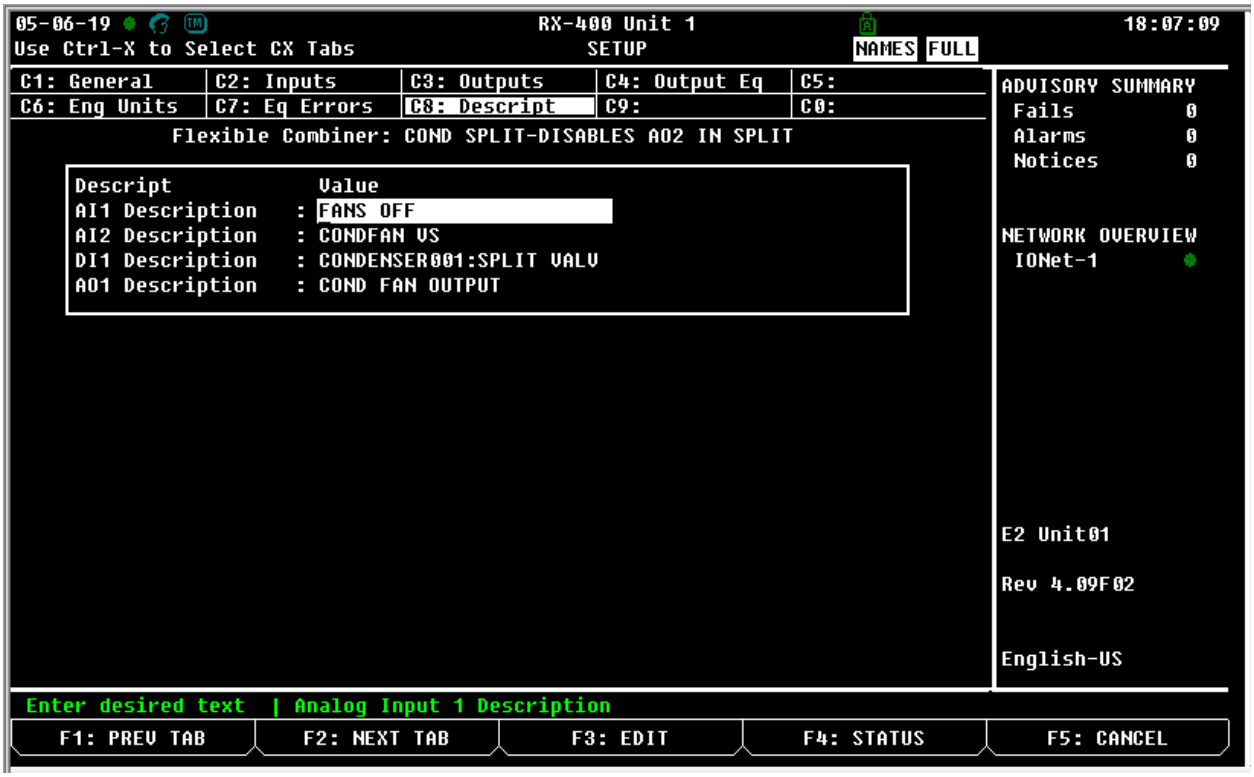


Table 36 DESCRIPT TAB DESCRIPTION

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 37 E2 MULTIFLEX TROUBLESHOOTING

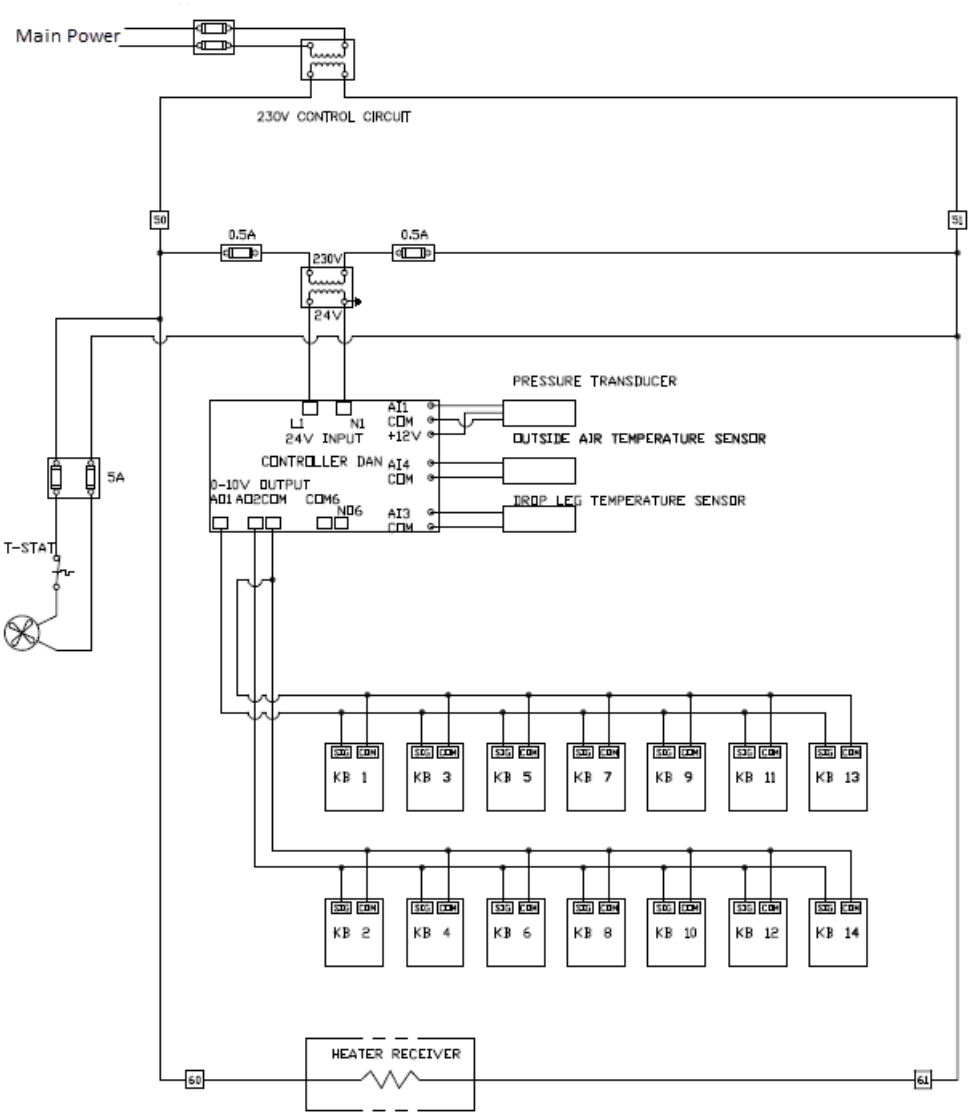
SYMPTOM	POSSIBLE PROBLEM	SOLUTION
I/O Network Problems	I/O board not getting power.	Check I/O board power--is the green STATUS light on? If not, check power wiring connections, and use a multimeter to verify the board is getting 24VAC. Reset power to board.
	I/O board not communicating or won't come 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 23 DANFOSS MCX06D CONTROLLER WIRING DIAGRAM



8.2.4.1 CONNECTIVITY

Following are the two methods in which the Danfoss MCX06D controller can be accessed:

c. Local display on the controller.
d. 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 24 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 38 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 25 MMIMYK CONNECTION DIAGRAM

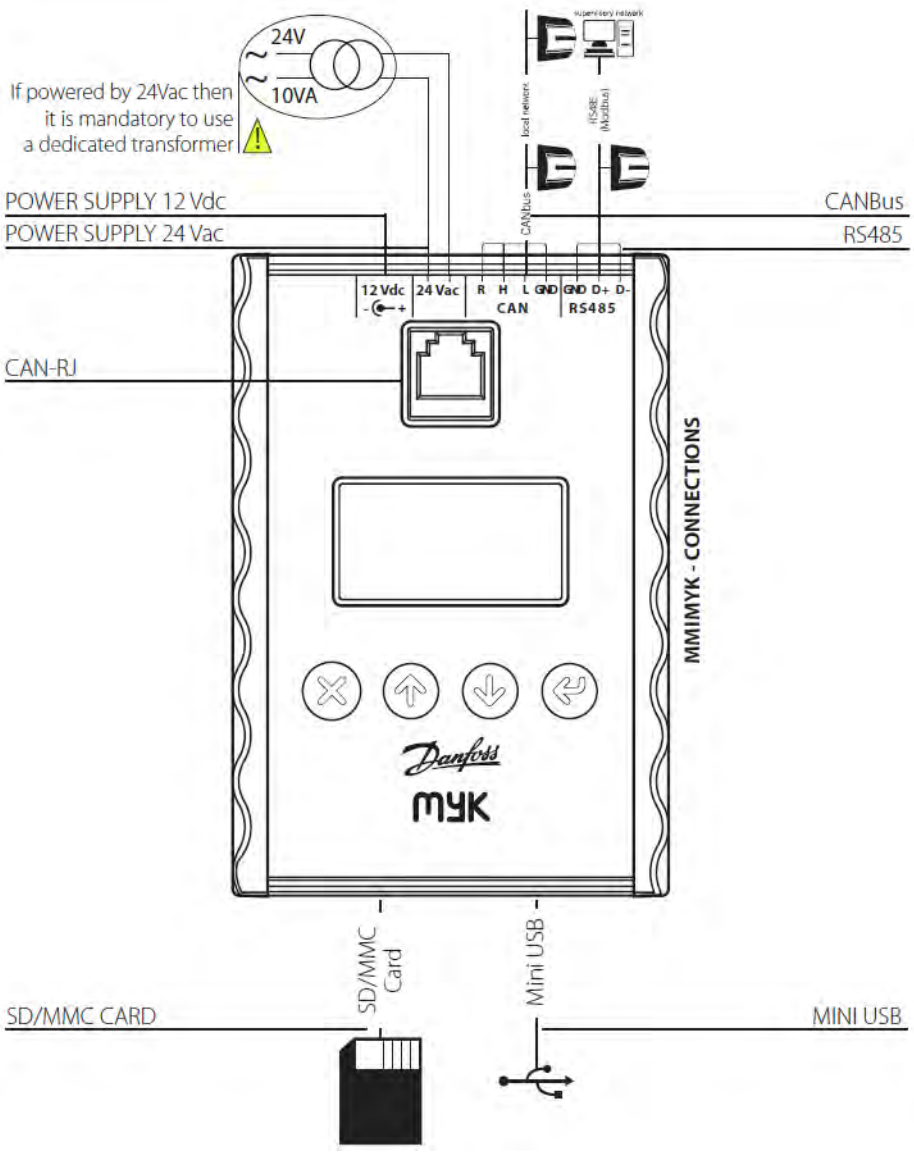
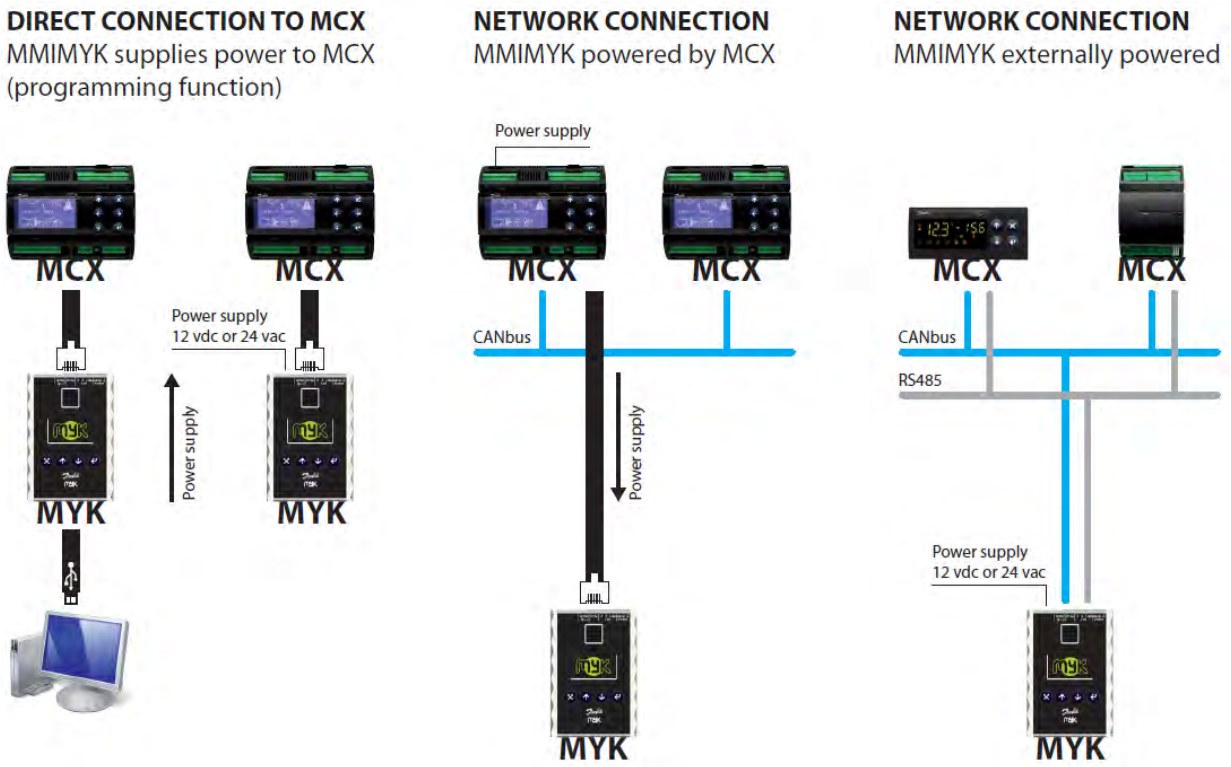


Figure 26 MMIMYK NETWORK DIAGRAM



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 27 MMIMYK CONNECTIONS - CANBUS TO MCX06D

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:

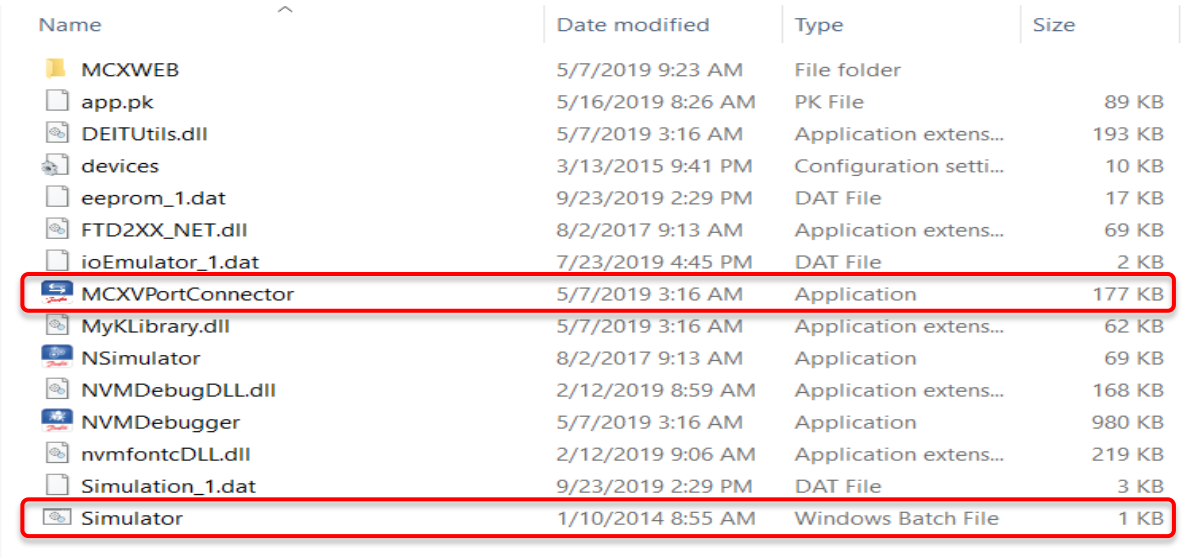
- Select PROGRAM and press ENTER button.
- Select DOWNLOAD and press ENTER button.
- Using DOWN button select 1:/ folder and press ENTER button.
- Using DOWN button select /cond and press ENTER button.
- Select ALL and press ENTER button.
- MMIMYK would start downloading.
- MMIMYK displays FINISHED when 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.

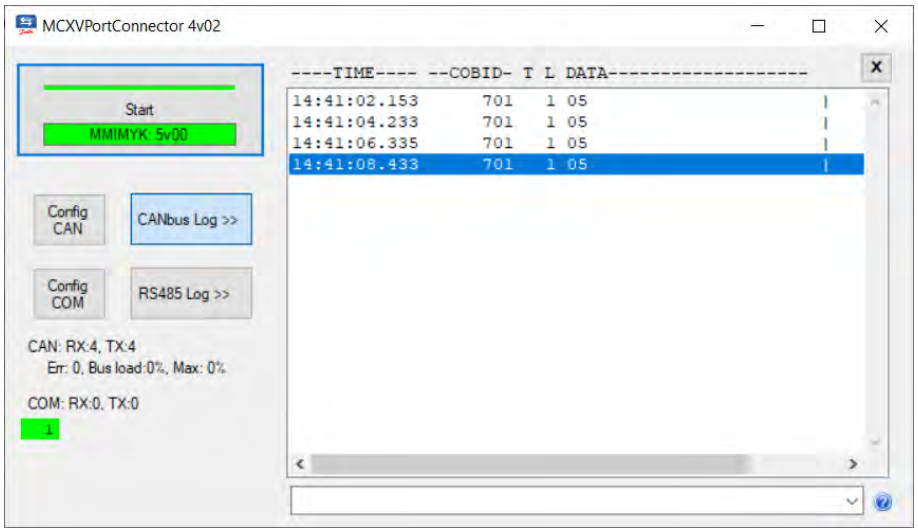
Figure 28 SIMULATOR FOLDER



Name	Date modified	Type	Size
MCXWEB	5/7/2019 9:23 AM	File folder	
app.pk	5/16/2019 8:26 AM	PK File	89 KB
DEITUtils.dll	5/7/2019 3:16 AM	Application extens...	193 KB
devices	3/13/2015 9:41 PM	Configuration setti...	10 KB
eeprom_1.dat	9/23/2019 2:29 PM	DAT File	17 KB
FTD2XX_NET.dll	8/2/2017 9:13 AM	Application extens...	69 KB
ioEmulator_1.dat	7/23/2019 4:45 PM	DAT File	2 KB
MCXVPortConnector	5/7/2019 3:16 AM	Application	177 KB
MyKLibrary.dll	5/7/2019 3:16 AM	Application extens...	62 KB
NSimulator	8/2/2017 9:13 AM	Application	69 KB
NVMDebugDLL.dll	2/12/2019 8:59 AM	Application extens...	168 KB
NVMDebugger	5/7/2019 3:16 AM	Application	980 KB
nvmfontcDLL.dll	2/12/2019 9:06 AM	Application extens...	219 KB
Simulation_1.dat	9/23/2019 2:29 PM	DAT File	3 KB
Simulator	1/10/2014 8:55 AM	Windows Batch File	1 KB

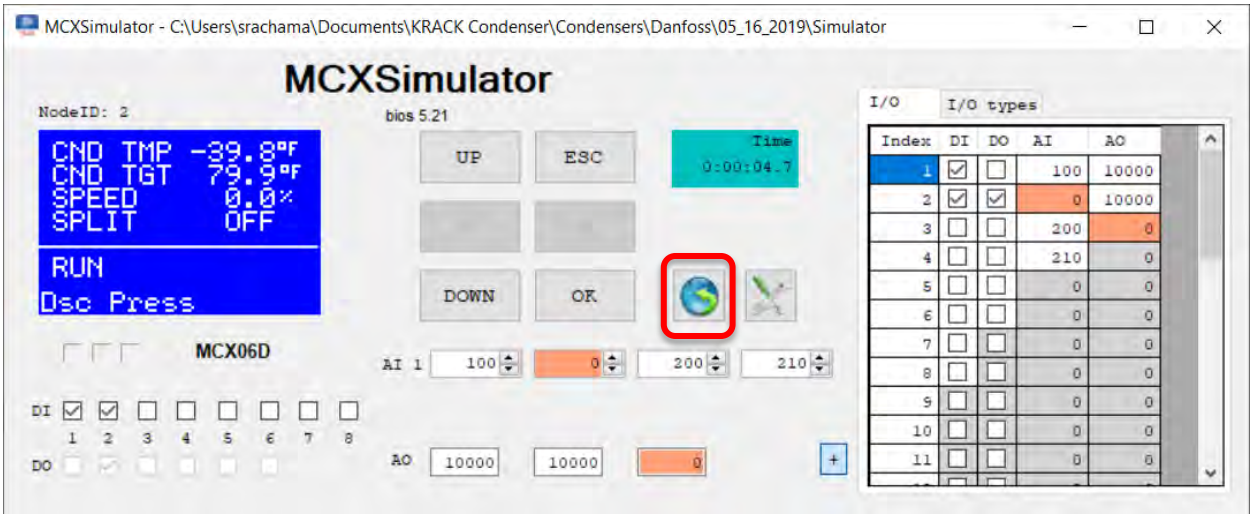
- Run MCXVPortConnector application as highlighted in Figure 47. Select Start and the datalogger should be running.

Figure 29 MCXVPortConnector DATALOGGER



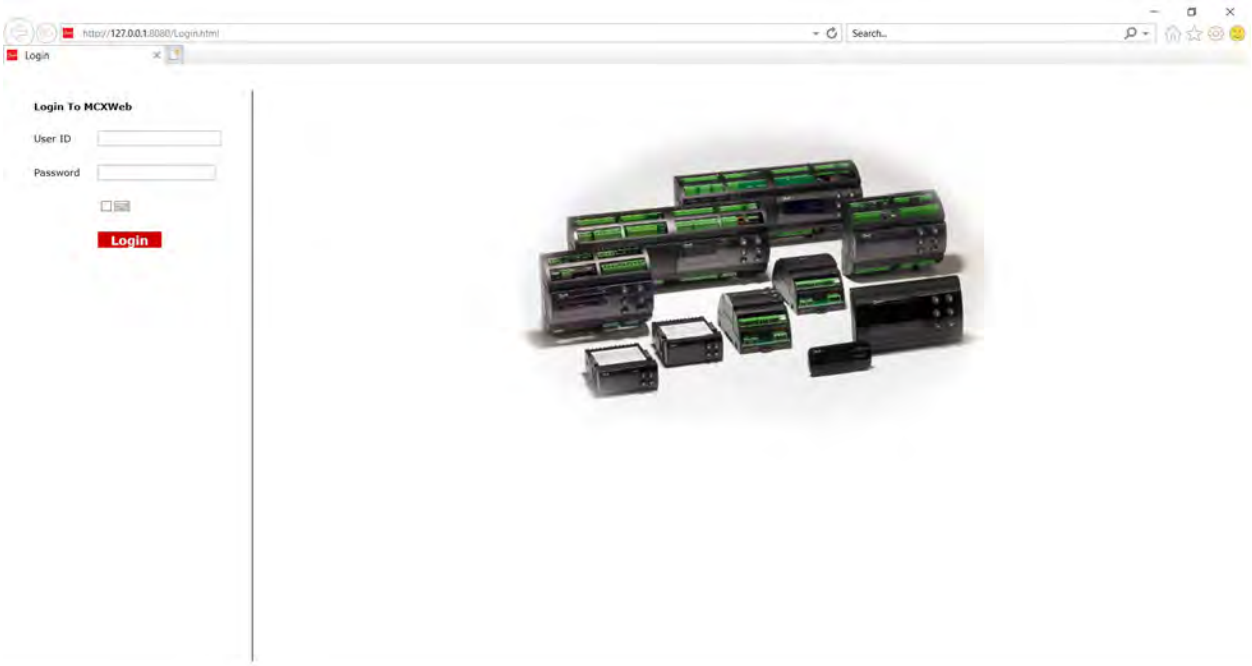
- Select the Simulator batch file as illustrated in Figure 47 and let it run.

Figure 30 MCXSimulator



- Select the Globe icon as illustrated in Figure 49 a web browser will pop as illustrated below:

Figure 31 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 a few of the screens available in the web interface.

Figure 32 MCXWeb - DEVICE LIST

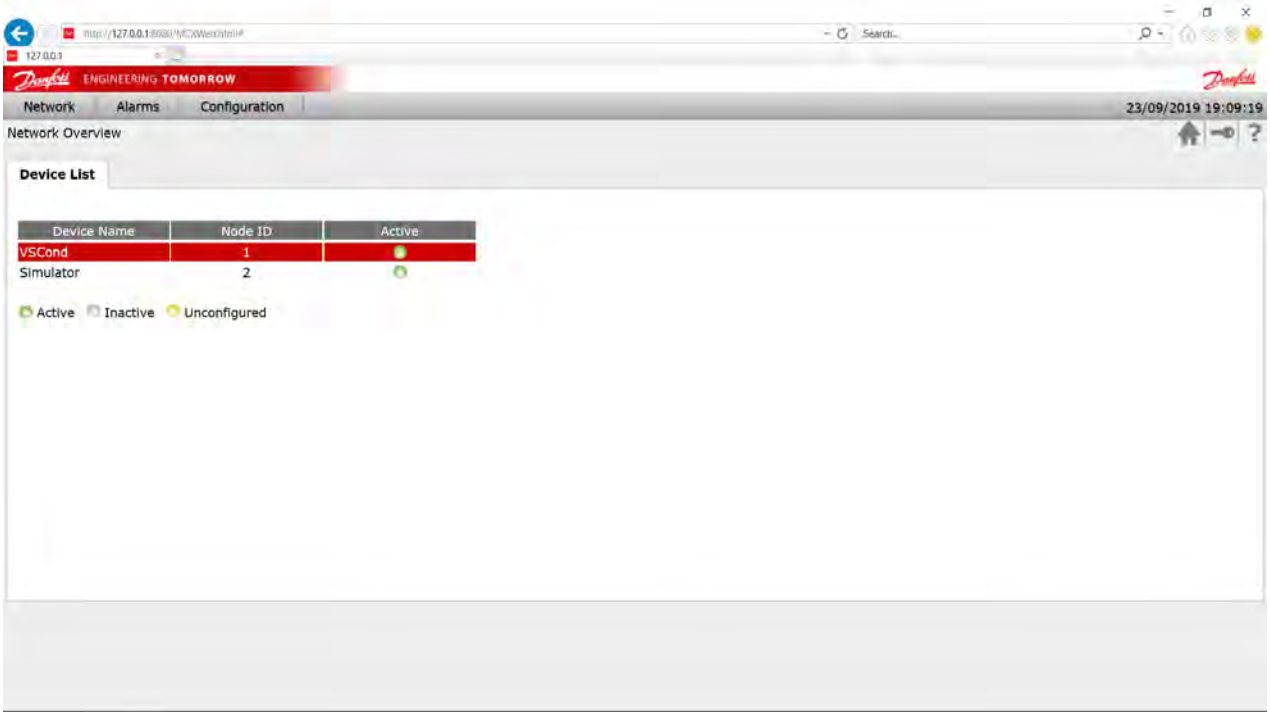


Figure 33 MCXWeb - OVERVIEW TAB

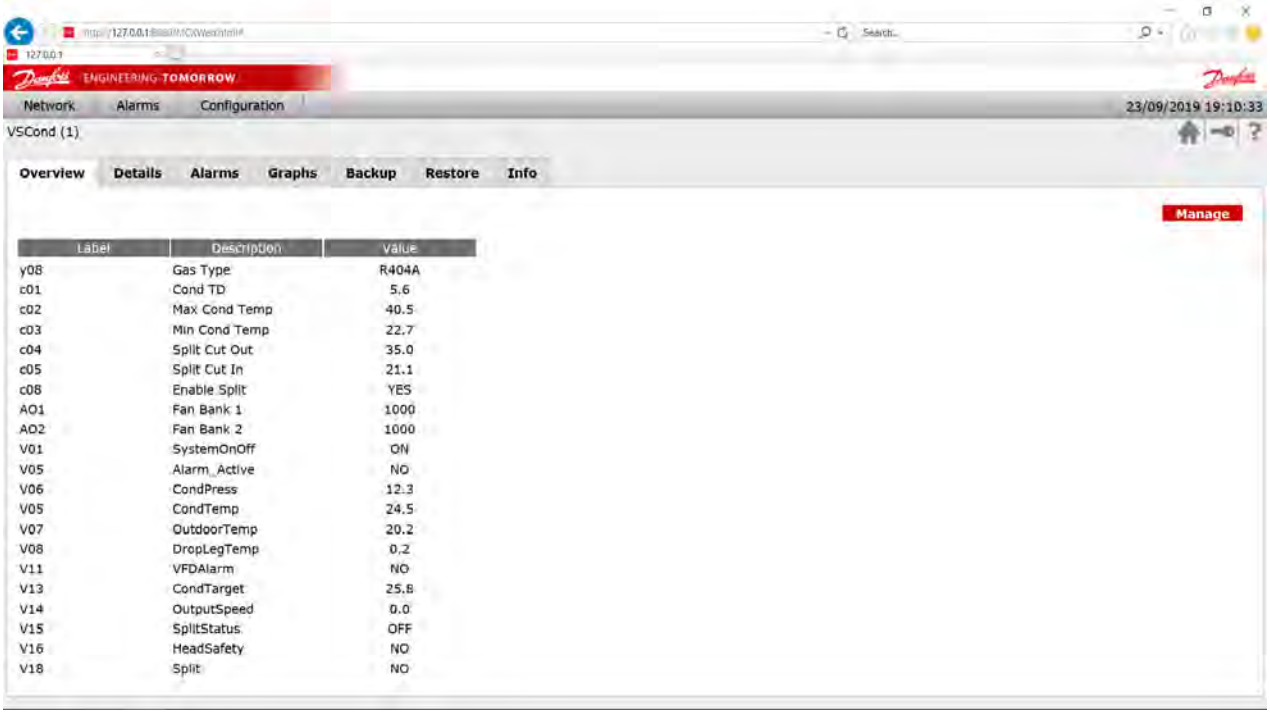


Figure 34 MCXWeb - DETAILS TAB

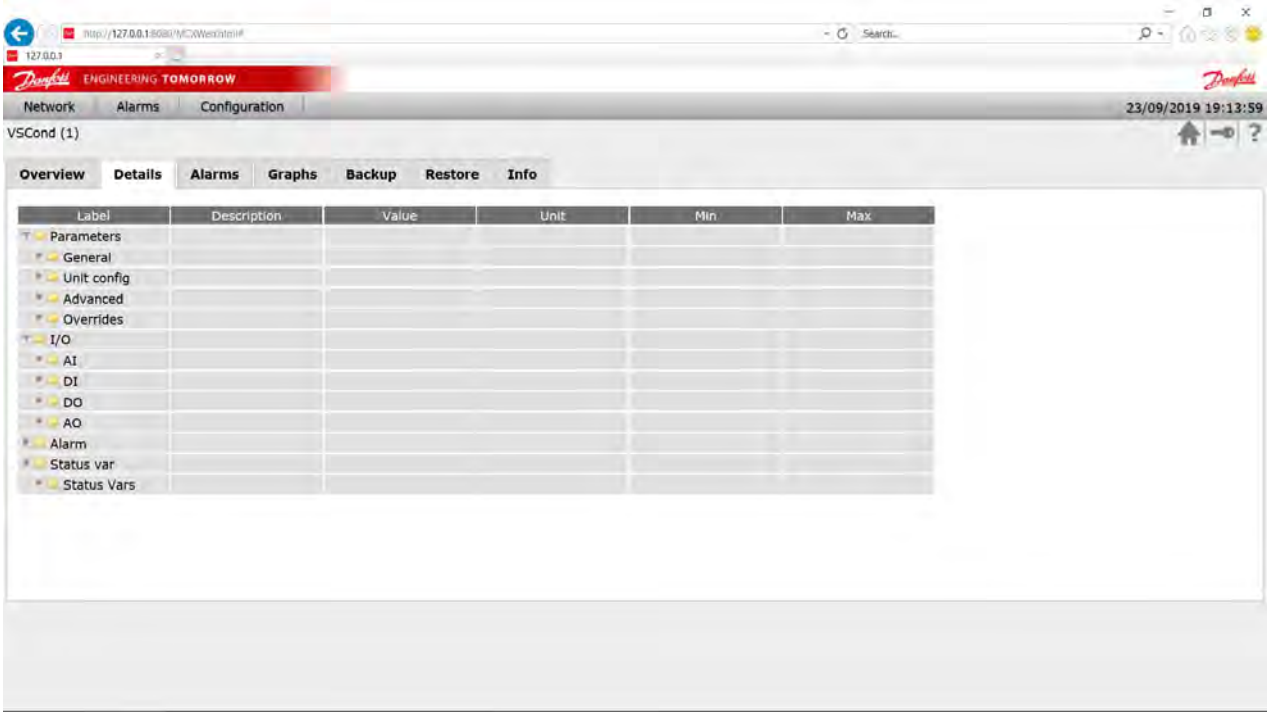
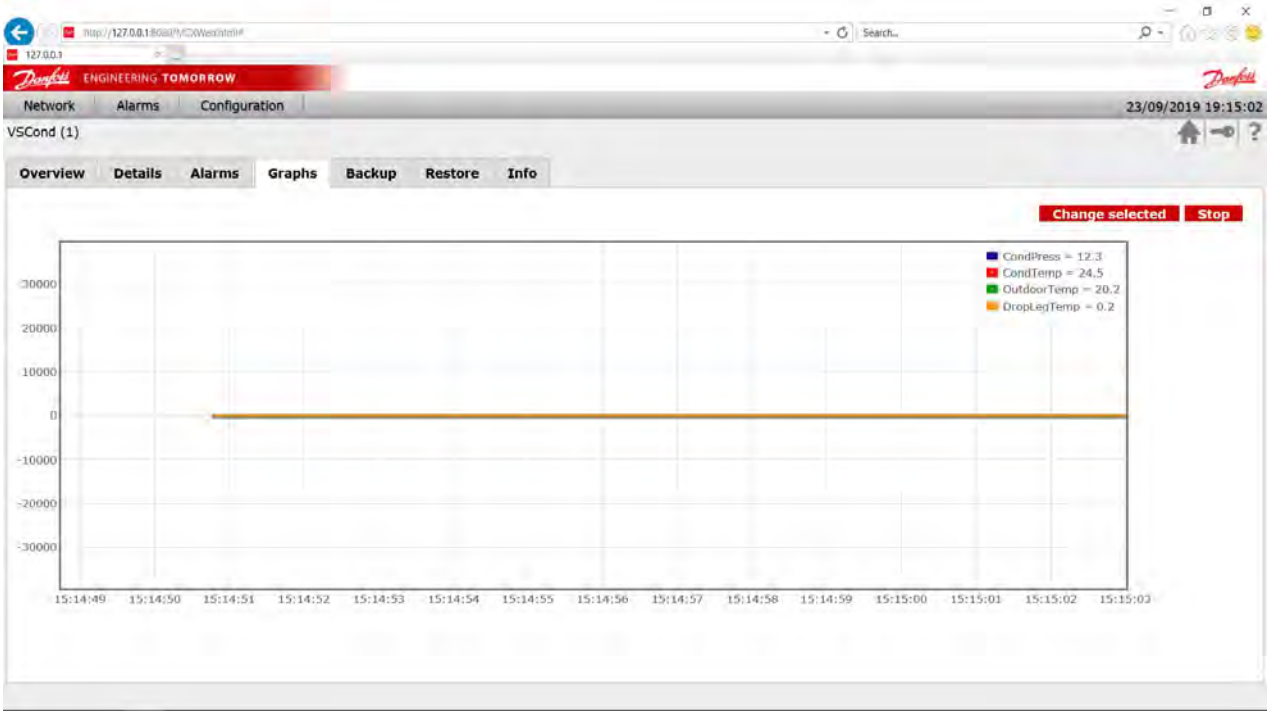


Figure 35 MCXWeb - GRAPHS TAB



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

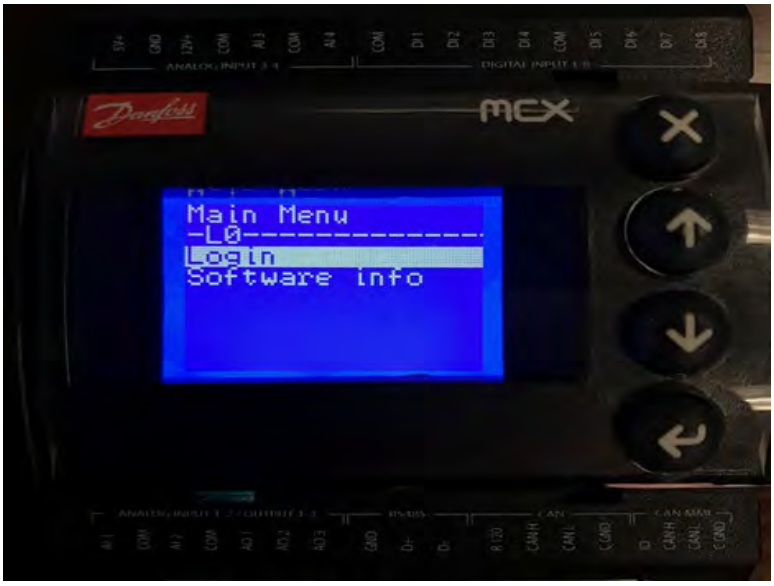
.

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 36 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 37 LEVEL 3 PASSWORD

Following figure illustrates the Main Menu at Level 3.

Figure 38 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 39 I/O CONFIG SELECTION

The application provides following options under I/O Config Menu:

Table 2 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 40 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 41 ANALOG INPUT SETUP SCREEN

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

The following are the settings available for each analog input:

Table 40 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 42 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 43 ANALOG OUTPUT SETUP SCREEN

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 41 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 44 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 45 PARAMETERS SELECTION

The application provides following options under Parameters Menu:

Table 42 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 46 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 47 GENERAL SCREEN

General screen provides following options for further selection:

Table 43 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 44 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 45 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 46 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 47 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	Enable or disable the 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 48 UNIT CONFIG SELECTION

Unit config menu provides following options for further selection:

Table 48 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 49 OVERRIDES SELECTION

Overrides menu provides the following options for further selection:

Table 49 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 50 ALARMS SELECTION

The application provides the following options under Parameters Menu:

Table 50 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 51 ALARMS SCREEN

8.2.4.3 TROUBLESHOOTING

Table 51 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 modules are used in this application:

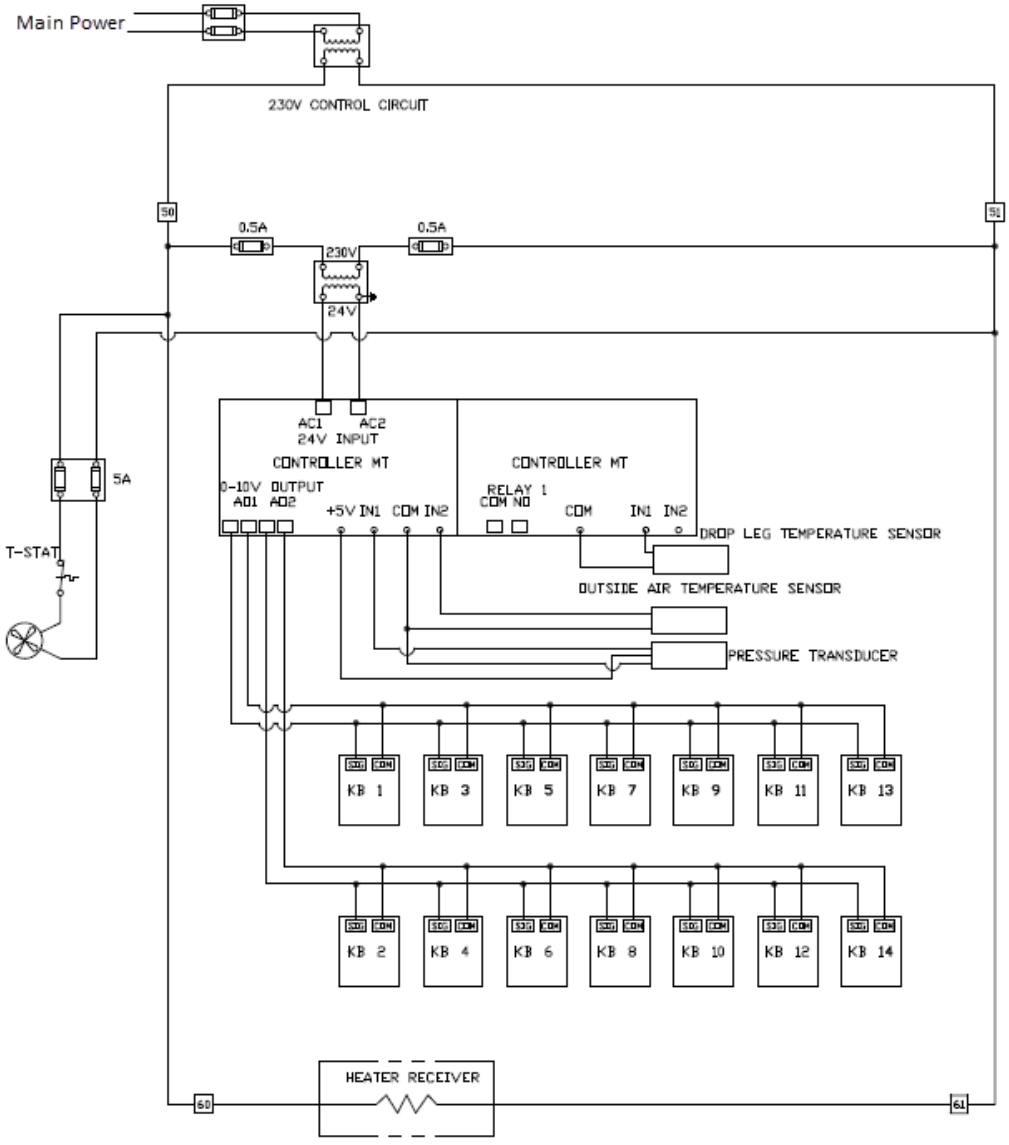
- MT-722F is the main brain module.
- MT-784A is the expansion module that provides 8 universal inputs and 4 relay outputs.

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 52 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.

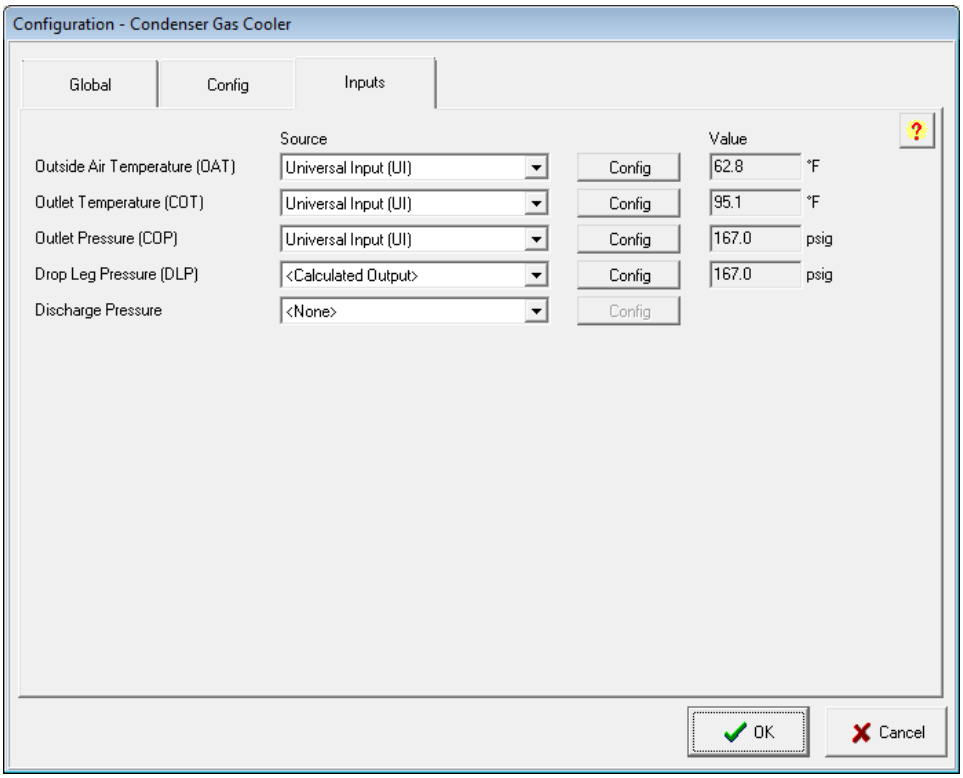
8.2.5.1.1 INPUT SETTINGS

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 53 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 note that the values shown may not represent your application settings.

.

Figure 54 OAT SENSOR CONFIGURATION SCREENSHOT

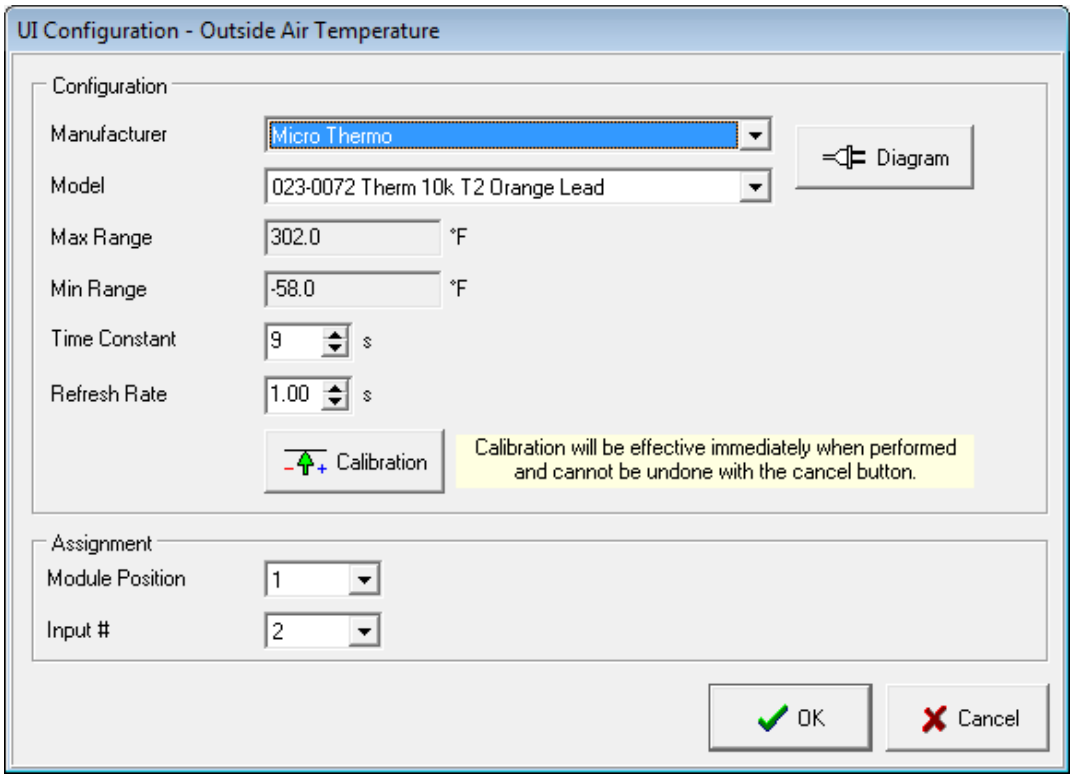


Figure 55 DROPLEG SENSOR CONFIGURATION SCREENSHOT

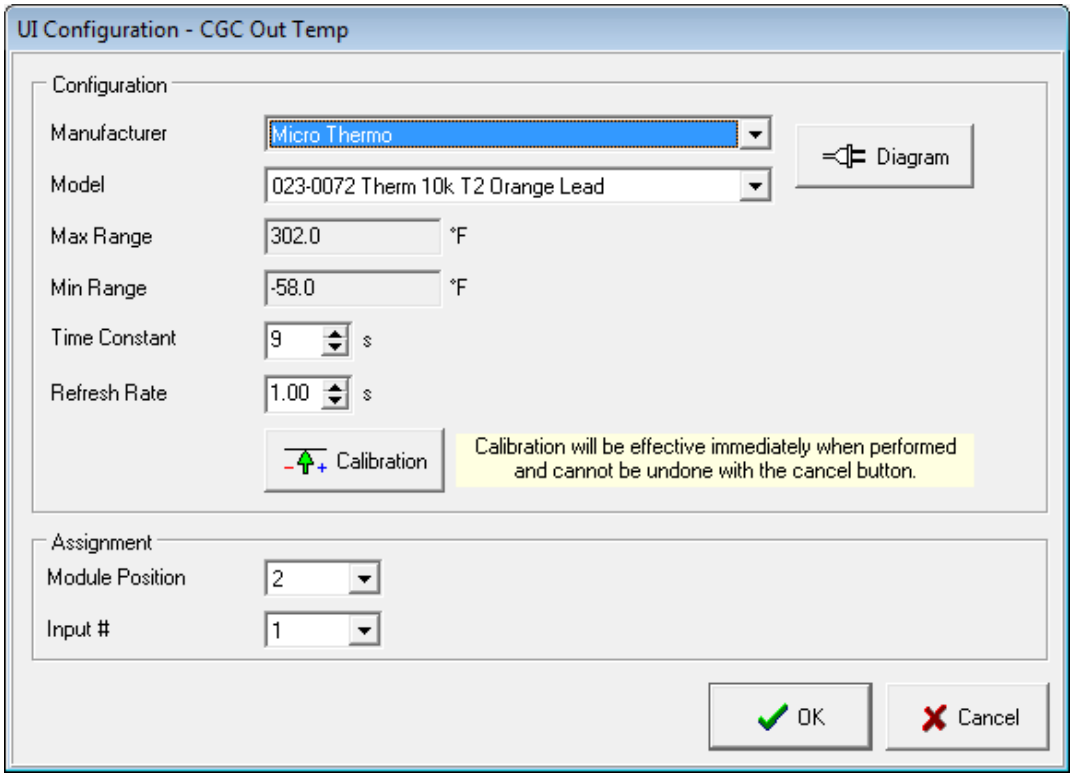
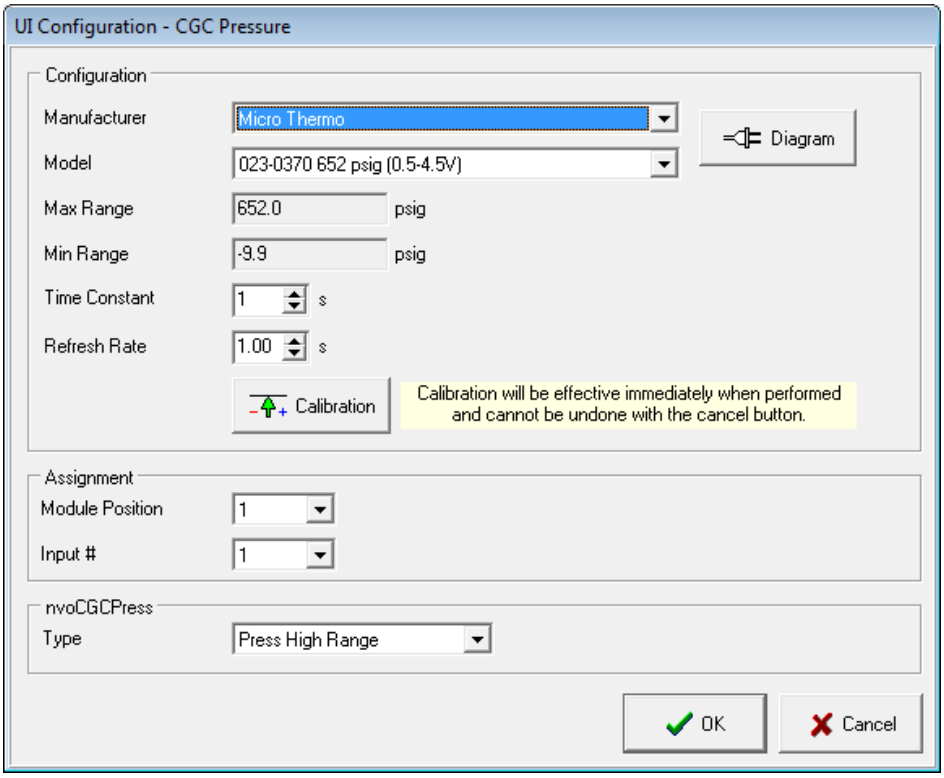
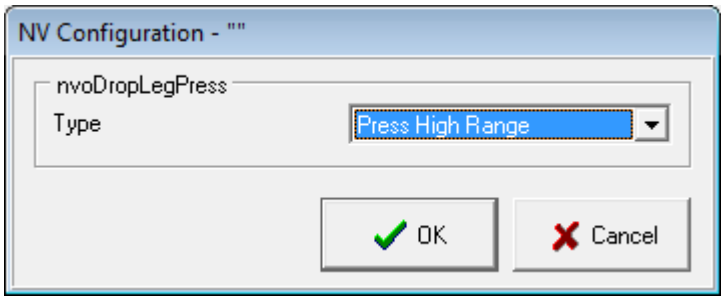


Figure 56 DISCHARGE PRESSURE TRANSDUCER CONFIGURATION SCREENSHOT



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 57 DROP LEG PRESSURE CONFIGURATION SCREENSHOT

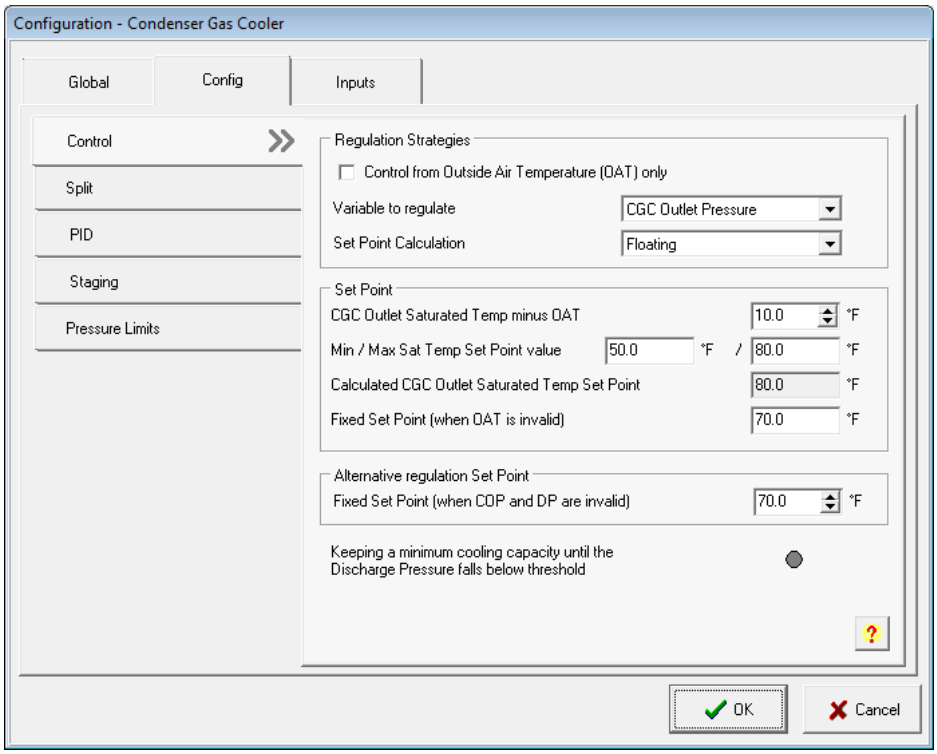


8.2.5.1.2 CONFIGURATION

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) is not available, the CGC application uses the outlet temperature (drop leg) with reference to "Fixed Set Point (when COP and DP are invalid)".

Figure 58 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 59 CGC SPLIT SETTINGS SCREENSHOT

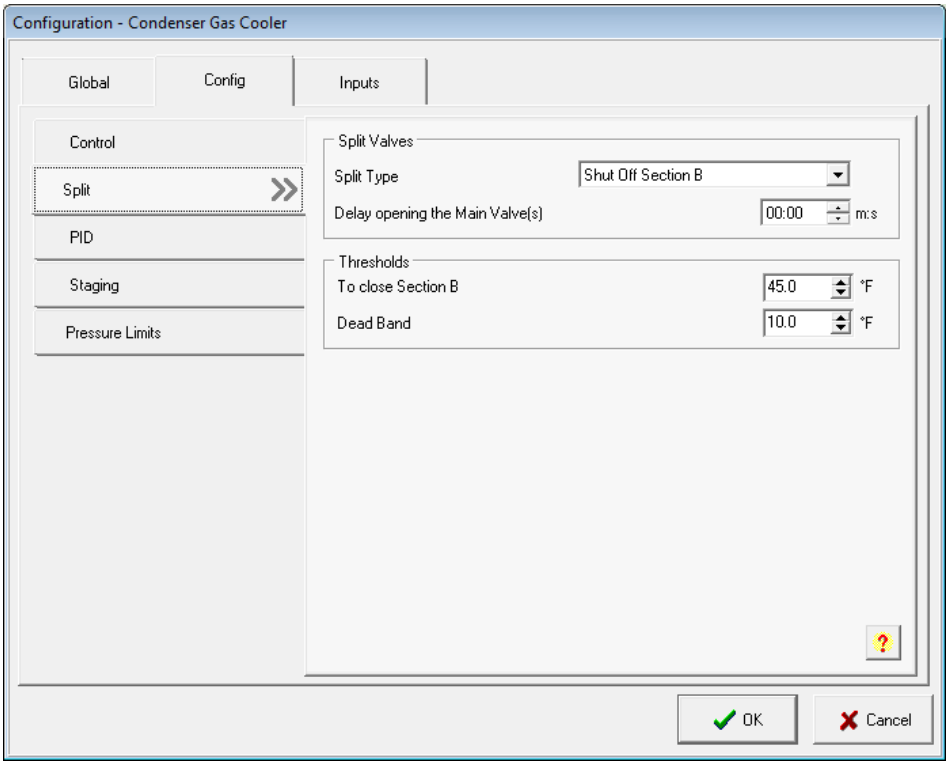
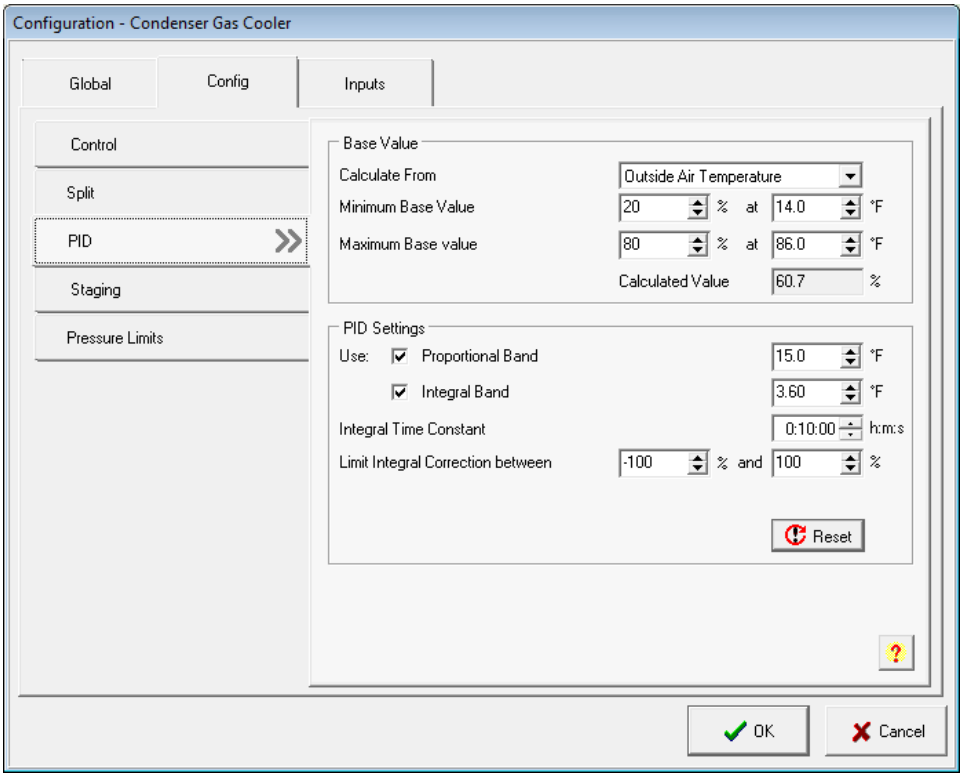


Figure 60 CGC PID SETTINGS SCREENSHOT



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 61 CGC STAGING SETTINGS SCREENSHOT

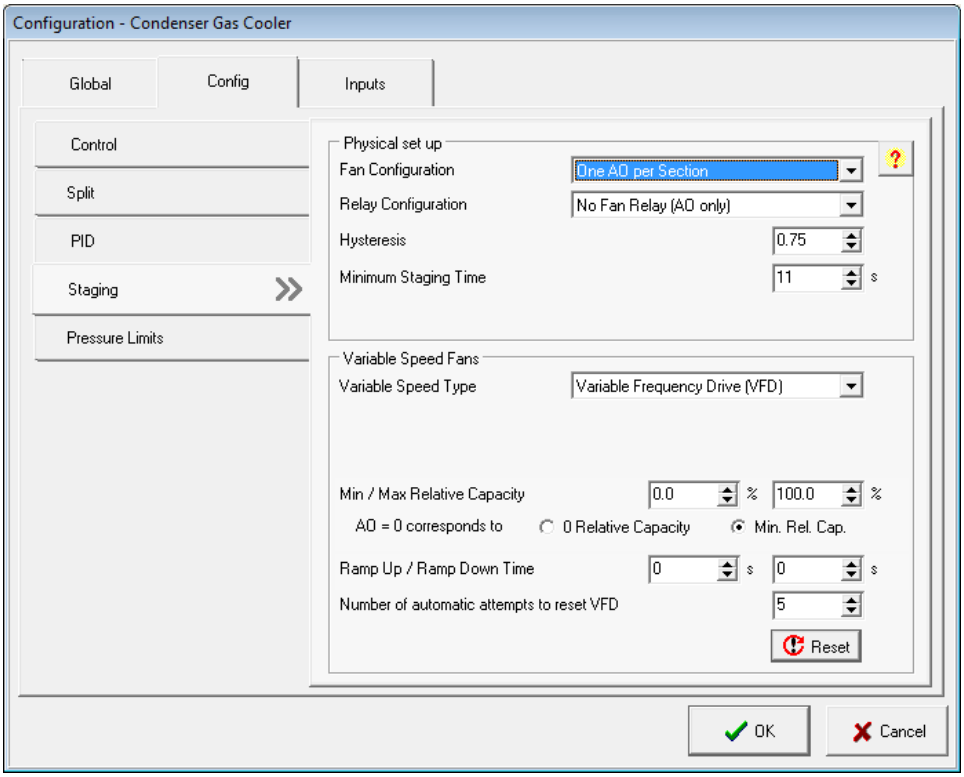
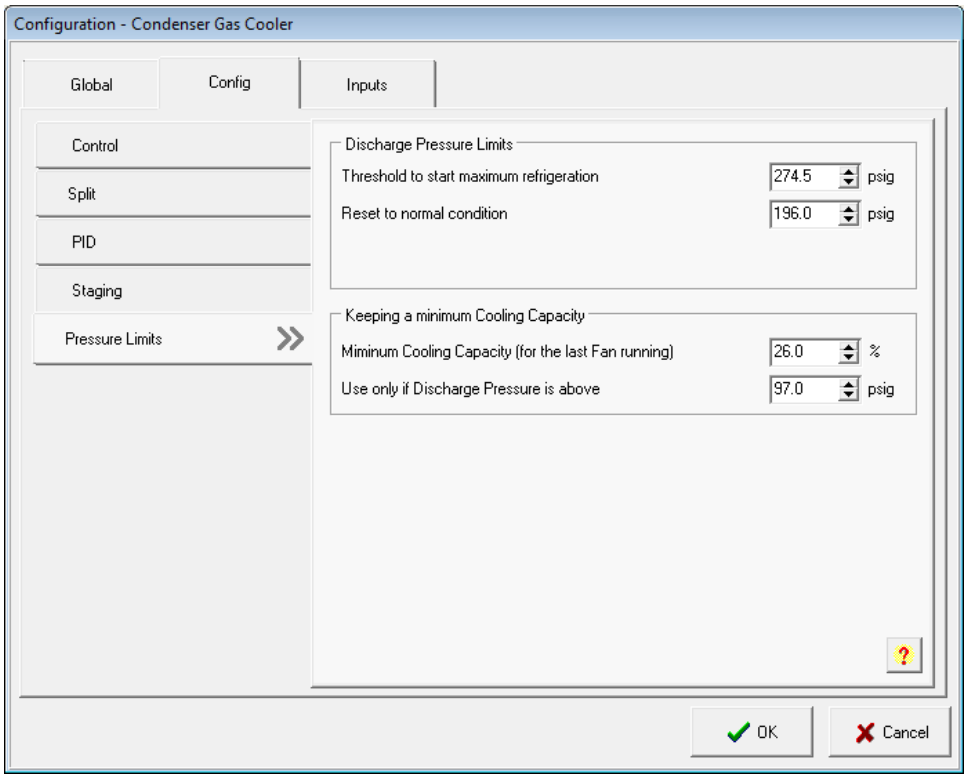


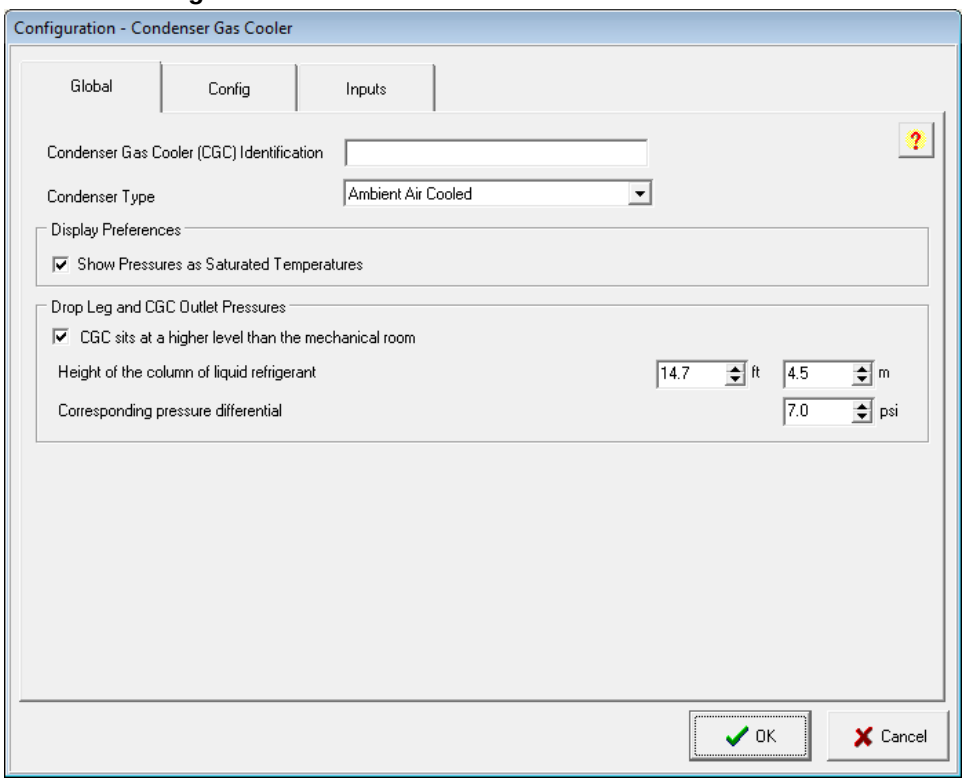
Figure 62 CGC PRESSURE LIMITS SETTINGS SCREENSHOT



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 63 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 64 CGC SECTION A – OUTPUTS CONFIGURATION SCREENSHOT

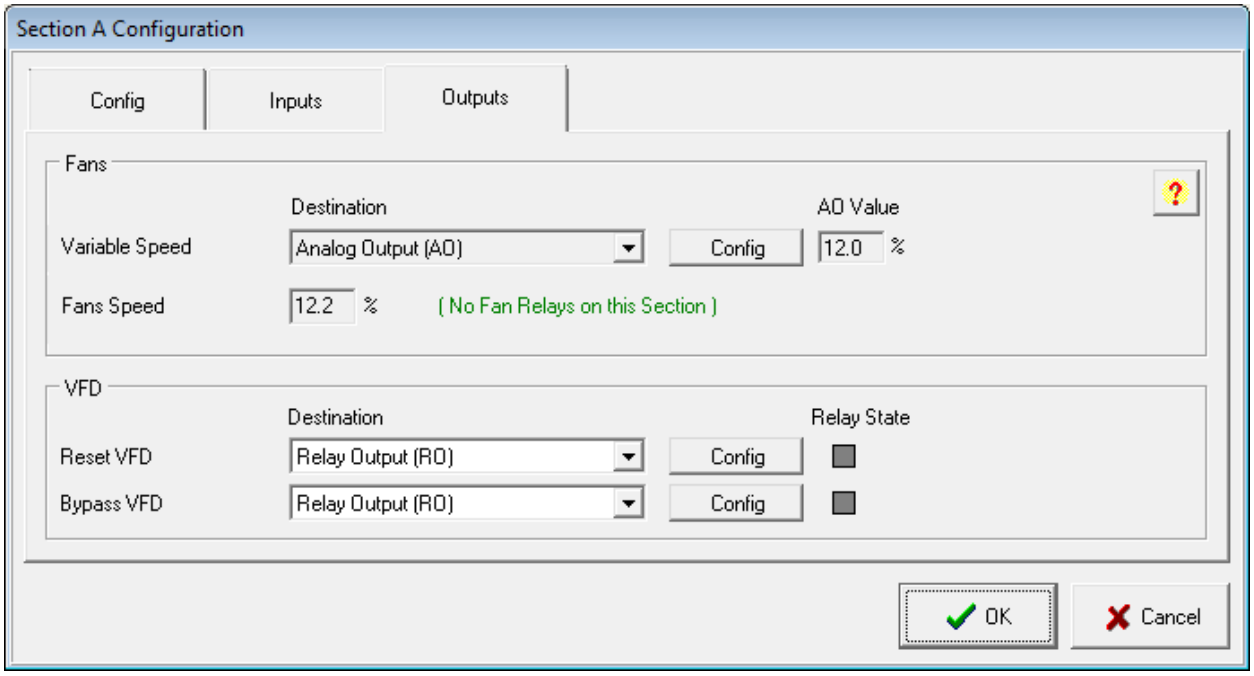
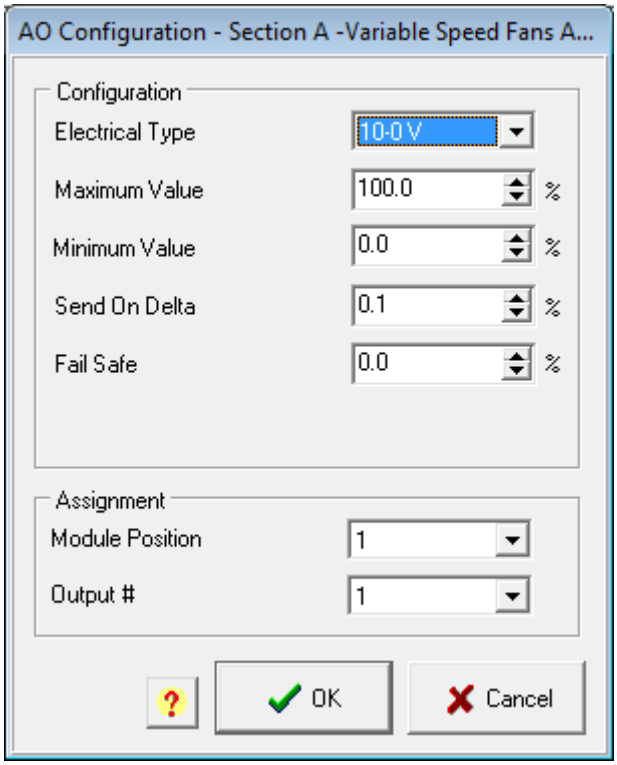


Figure 65 CGC SECTION A – AO CONFIGURATION SCREENSHOT



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, 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 66 CGC SECTION A – RESET VFD CONFIGURATION SCREENSHOT

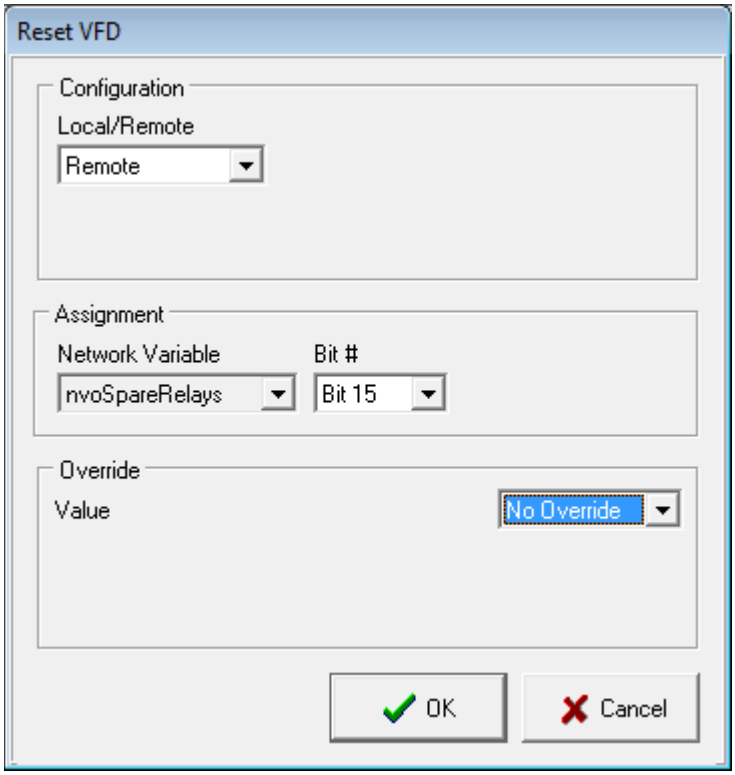
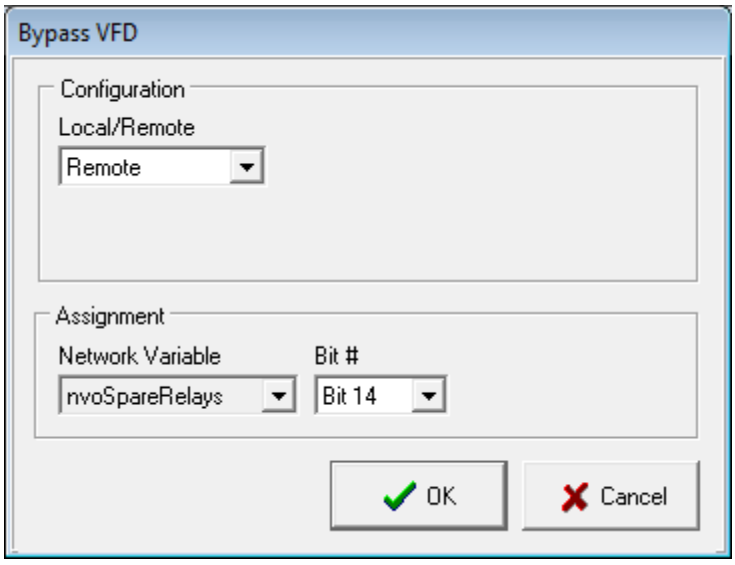


Figure 67 CGC SECTION A – BYPASS VFD CONFIGURATION SCREENSHOT



Following screenshots illustrates the VFD Fault input selection and settings.

Figure 68 CGC SECTION A – VFD FAULT SELECTION SCREENSHOT

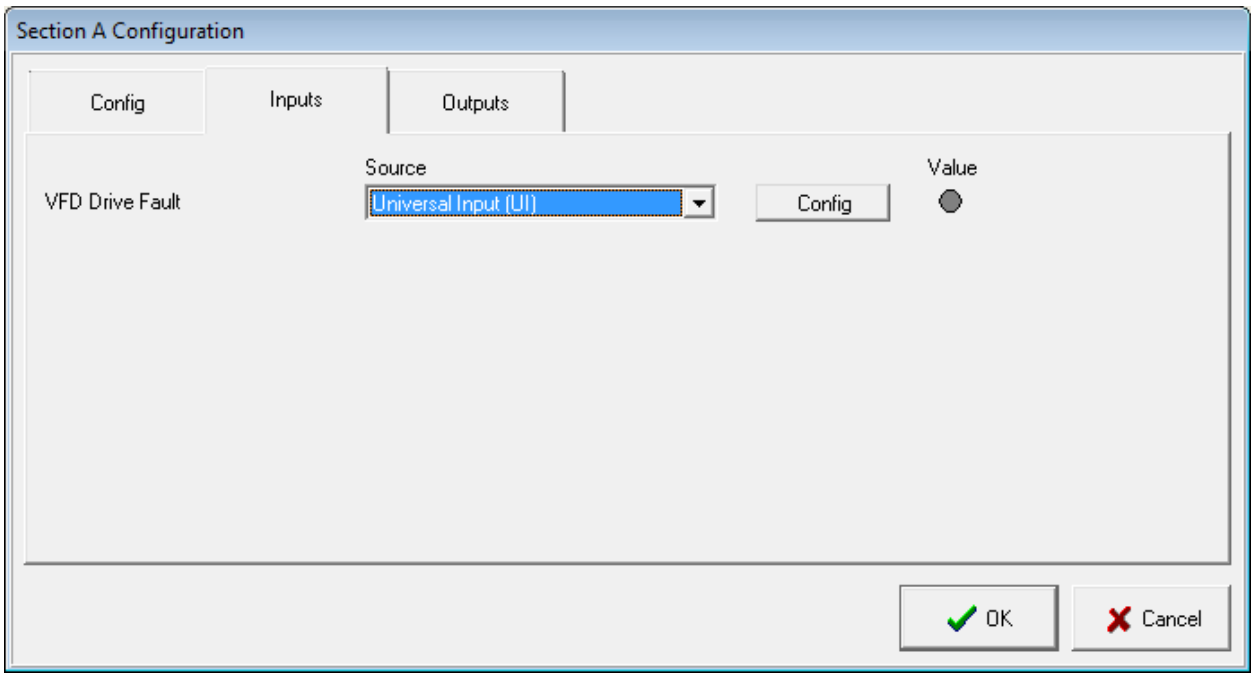
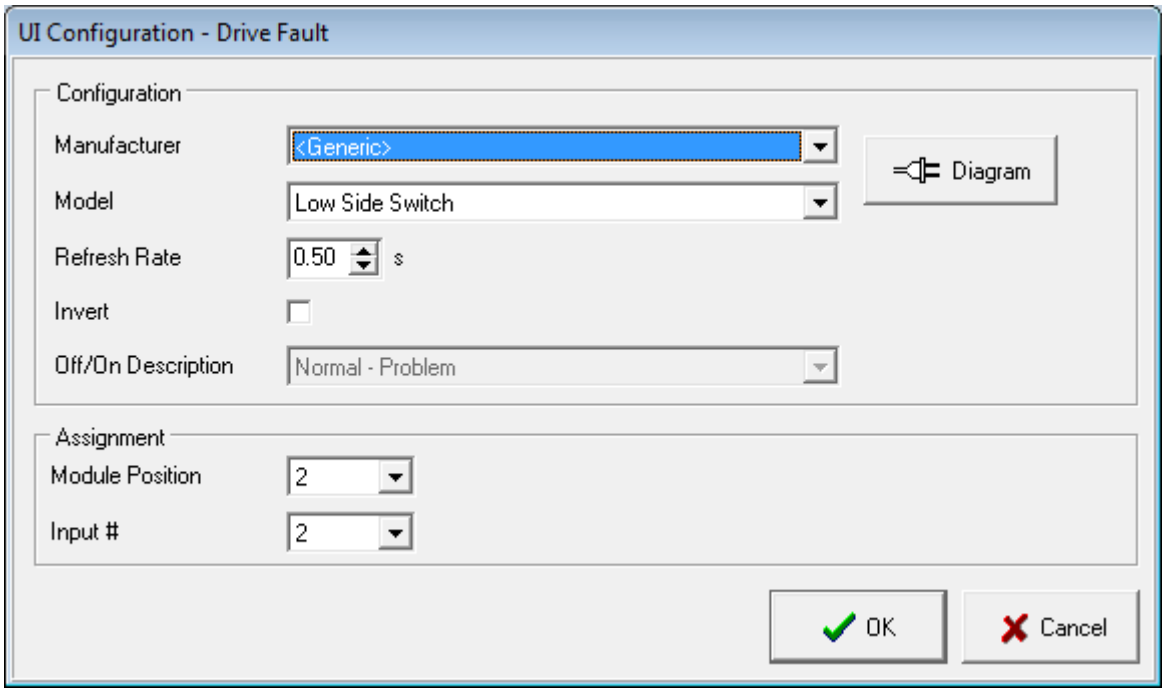


Figure 69 CGC SECTION A – VFD FAULT CONFIGURATION SCREENSHOT



8.2.5.1.5 SECTION B

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

Figure 70 CGC SECTION B – OUTPUTS CONFIGURATION SCREENSHOT

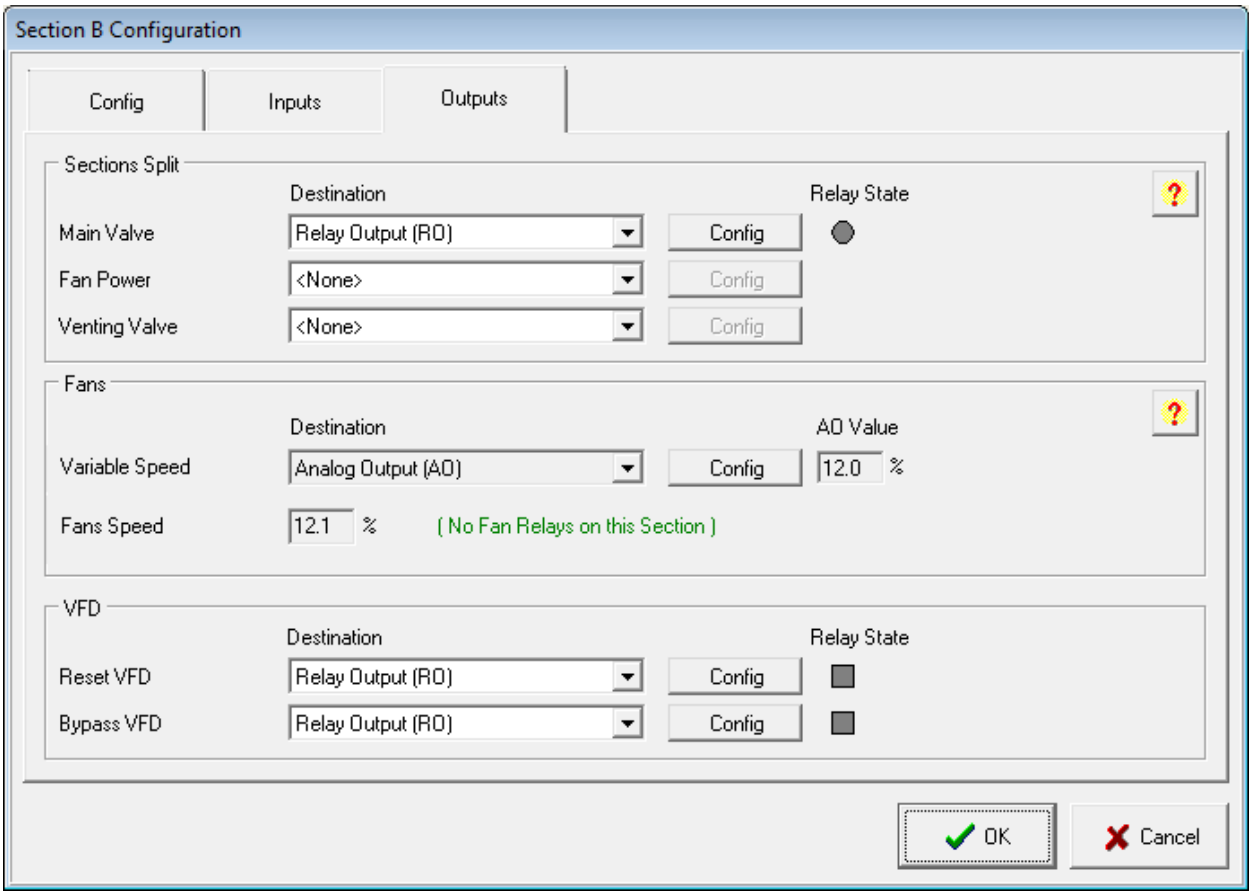


Figure 71 CGC SECTION B – SPLIT VALVE RELAY CONFIGURATION SCREENSHOT

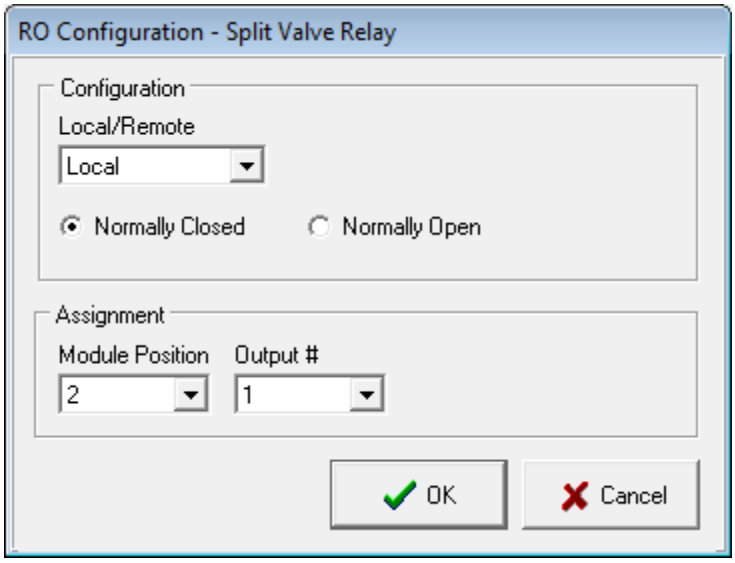


Figure 72 CGC SECTION B – AO CONFIGURATION SCREENSHOT

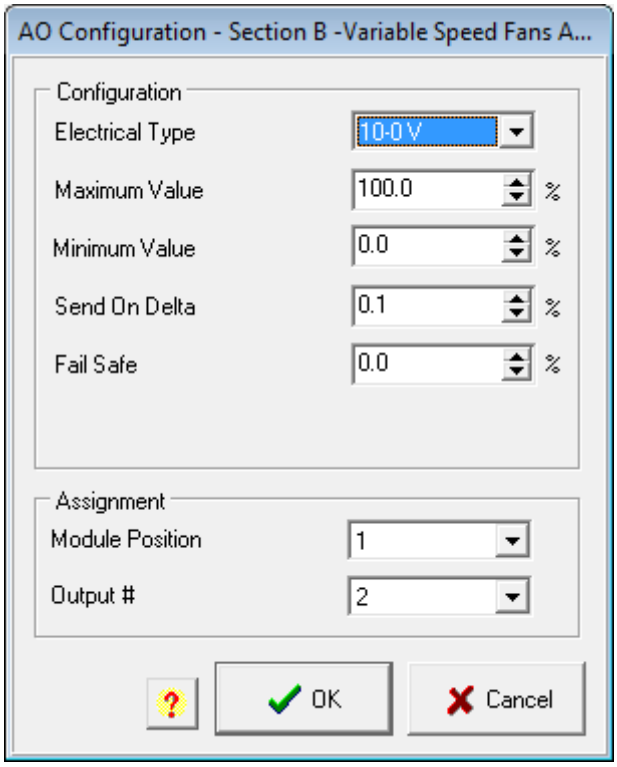


Figure 73 CGC SECTION B – RESET VFD CONFIGURATION SCREENSHOT

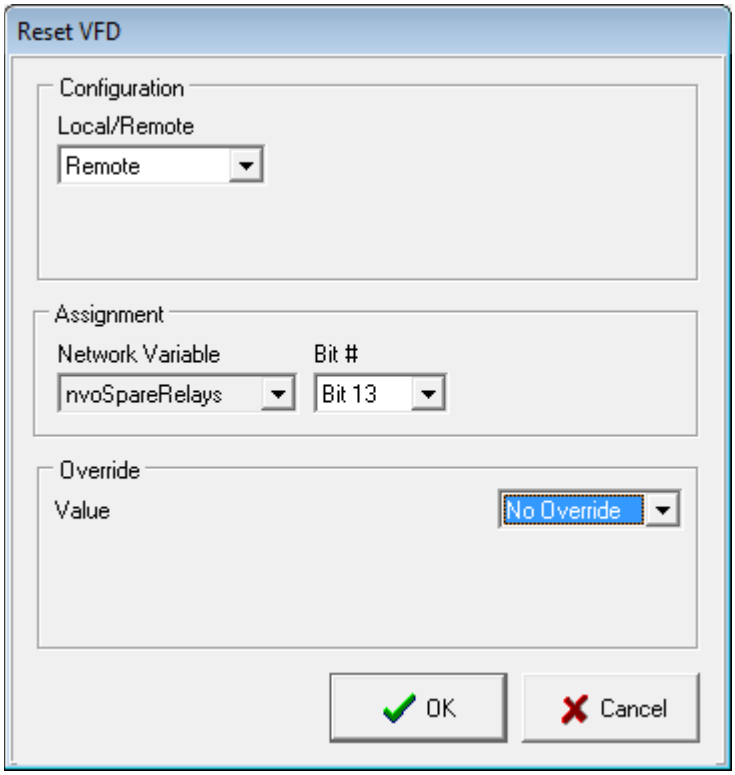


Figure 74 CGD SECTION B – BYPASS VFD CONFIGURATION SCREENSHOT

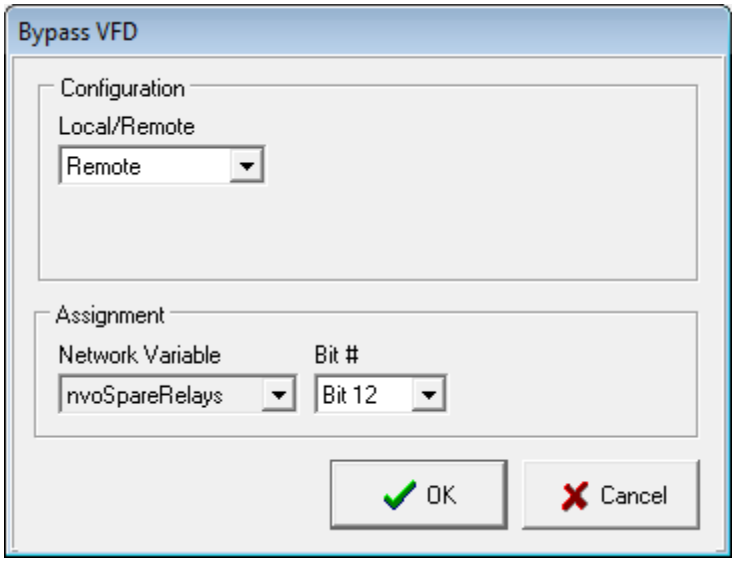


Figure 75 CGC SECTION B – VFD FAULT SELECTION SCREENSHOT

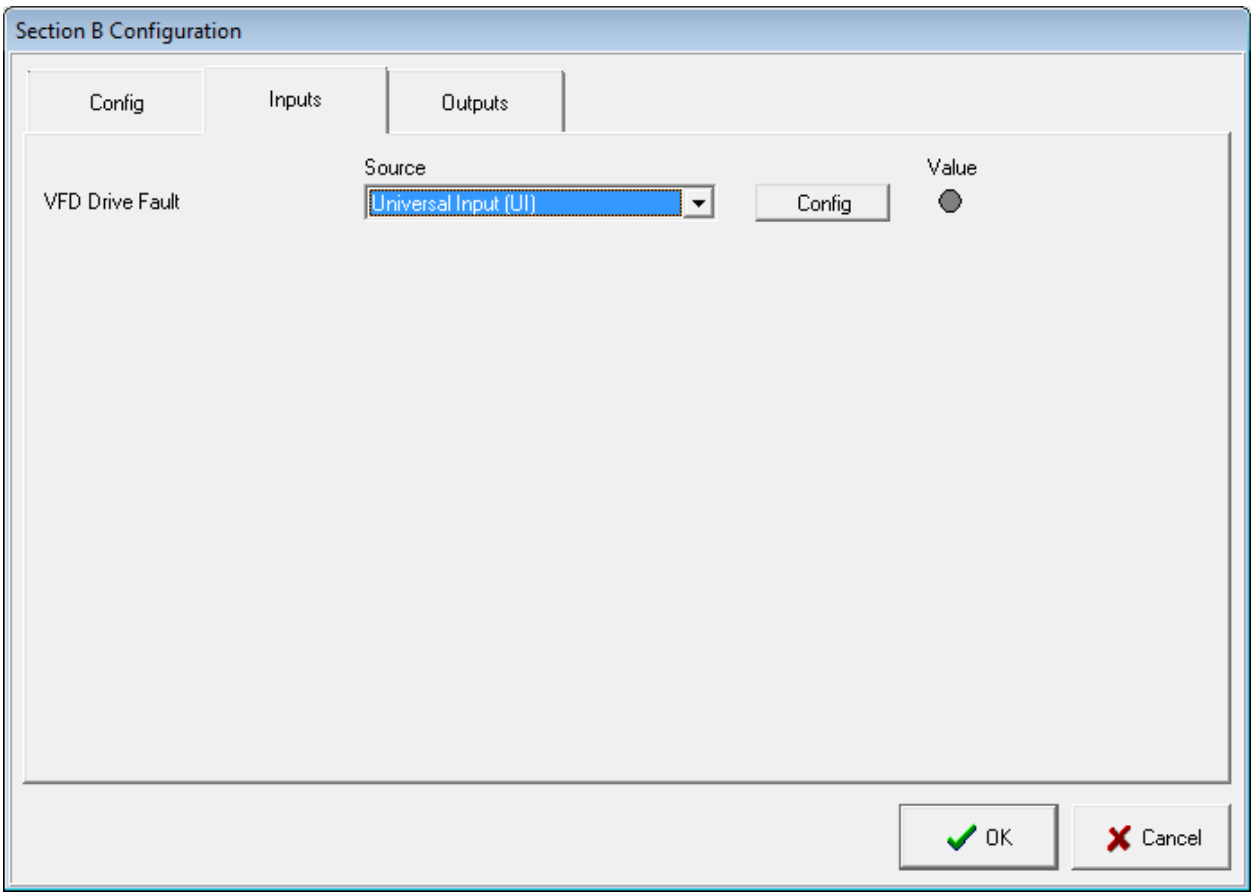
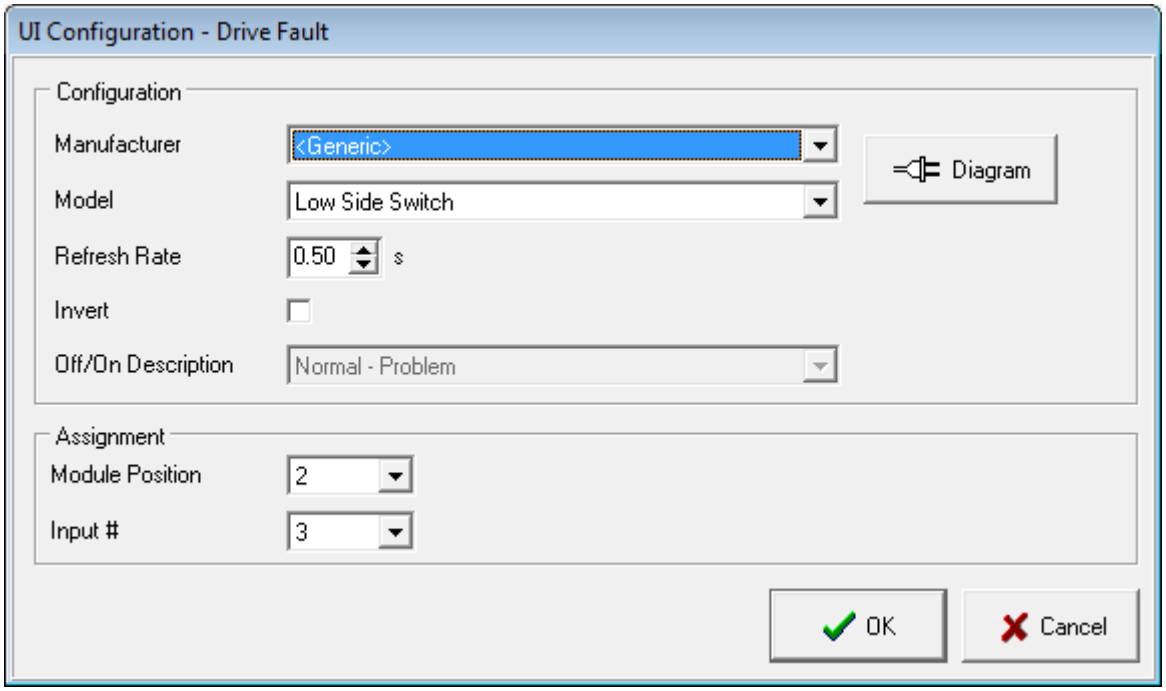


Figure 76 CGC SECTION B – VFD FAULT CONFIGURATION SCREENSHOT



8.2.5.2 TROUBLESHOOTING

Table 3 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*

						Fault State		Recovery	
LED	Drive Status	Color and Flash sequence	Flash Rate	Color and sequence after recovered fault	Description	J3 (A/M) on	J3 (A/M) off	J3 (A/M) on	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 temperature is less than 90C	Toggle J3 (A/M) State when the IPM 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 AND CLEANING

If the Levitor Series II 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 start up, 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.

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. Use a water spray with an approved cleaning solution for finned tube coils, such as those used on air conditioning units. The water and cleaning solution should be sprayed on the coil surface opposite the direction of the fan airflow direction. The Levitor Series II units are equipped with convenient access panels to allow the cleaning spray wand to be inserted into the fan cabinet above the coil section and below each motor & fan.

10 REPLACEMENT PARTS LISTS

Figure 77 REPLACEMENT PARTS

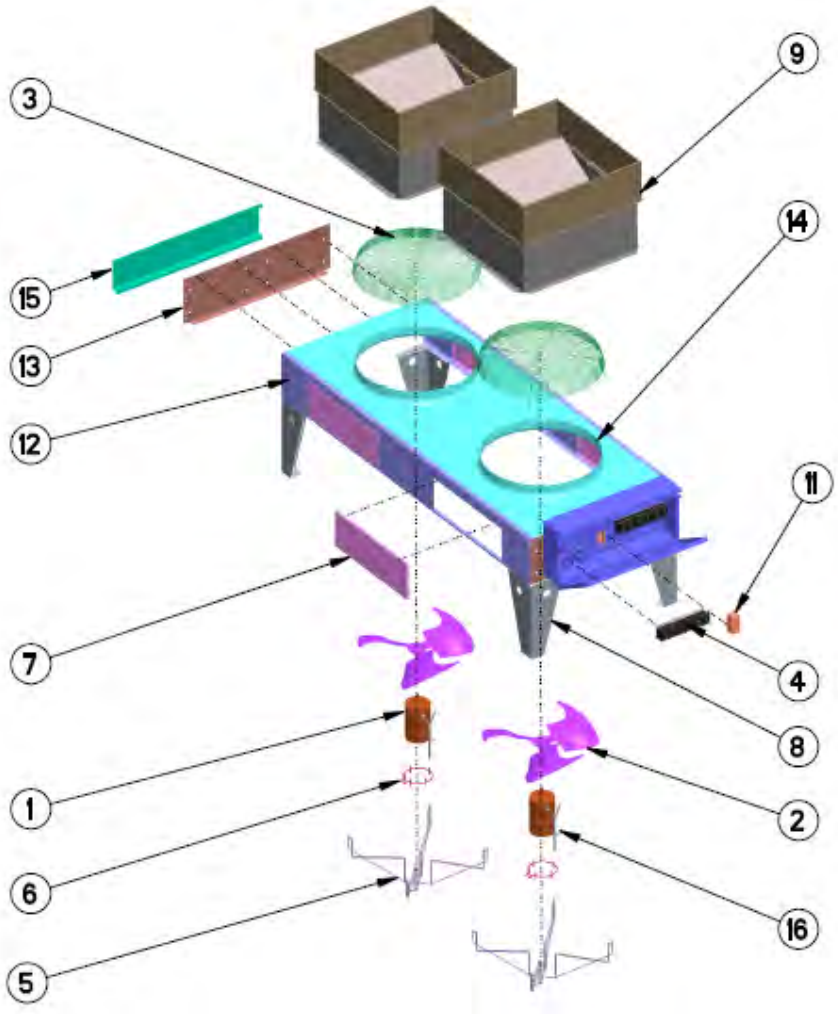


Table 53 REPLACEMENT PARTS

Item	General Description	Options Description	Krack BOM Part Number
1	MOTOR	**Refer Table 53 in next page for Motor combination**	
2	BLADE	**Refer Table 53 in next page for Motor combination**	
3	FAN GUARD	**Refer Table 53 in next page for Motor combination**	
4	MOTOR CONTACTOR (30AMPS)	24V 110V 230V	E209971004 E209971002 E209971003
5	BRACKET	**Refer Table 53 in next page for Motor combination**	
6	MOTOR MTG RING	**Refer Table 53 in next page for Motor combination**	
7	MOTOR SERVICE DOOR PANEL	MOTOR SERVICE DOOR PANEL	E86121
8	SUPPORT LEG	LEV-B SUPPORT LEG (18") L&R STATIONARY LEG SUPPORT (HORZ.) **15" LEG** WITH MOUNTING FASTNERS **22" LEG** WITH MOUNTING FASTNERS **30" LEG** WITH MOUNTING FASTNERS **36" LEG** WITH MOUNTING FASTNERS **42" LEG** WITH MOUNTING FASTNERS **48" LEG** WITH MOUNTING FASTNERS INCLUDING GUSSETS **60" LEG** WITH MOUNTING FASTNERS INCLUDING GUSSETS	E281661 E82971 E203297 E280914 E281663 E281653 E280915 E203522A E203580A
9	GRAVITY DAMPER/LOUVER	LAVB LAVA, C, E, F	CE82700 CE280870
10	PHASE MONITOR **(NOT SHOWN)**	230V 460V 575V	10989A E201708A BN04257A
11	BACKUP CONTROLS	P352AB-3C PRESSURE CONTROLLER S352AA-2C ADDER MODULE (PRESSURE) P399BAC-1C PRESSURE TRANSDUCER P352PN-3C PRESS CONTROL MODULE P499RCP-105K PRES TRANSDUCER A350AB-1 TEMPERATURE CONTROLLER Y350 R-1 POWER MODULE A99BC-300 TEMPERATURE SENSOR (9.75 FEET) S350AA-1 ADDER MODULE (TEMPERATURE) A99BC-1500C TEMP SENSOR 50 FT	E207051 E207052 E207053 E208200001 E208201001 E205533 E205534 E205564 E205535 E206053
12	PLENUM PANELS	SERVICE DOOR SIDE SERVICE PNL SIDE NO DOOR END/CENTER 1W* END/CENTER 2W* CENTER 2W W/FRAME* CENTER 1W W/FRAME* PARITION 2W PARITION 2W W/FRAME	E86121 E203436 E203581 E203433 E203434 E203451 E203450 E203435 E203452
13	SHELF MOUNT	LEV2 PLENUM END/CTR SHELF MNT 1W LEV2 PLENUM END/CTR SHELF MNT 2W LEV2 PLENUM CTR SHELF W/FRM 1W LEV2 PLENUM CTR SHELF W/FRM 2W MTR SUPT SHELF UPPER 182-215T	E208039 E208077 E208101 E208102 D256472

		MTR SUPT SHELF LOWER 182-215T	D256473
		MOTOR SHELF 36" LENGTH	820390
14	FAN PANELS	LEV2 FAN PNL 30" 1W & 2W NARROW	E87128P
		LEV2 FAN PNL 30/24" 1W & 2W NARROW	E208168P
		LEV2 FAN PNL 30" 2W	D256804P
		LEV2 FAN PNL 30"W/24" FAN 2W	E208167P
		24" STD FAN PANEL	E86115P
15	COVERS	LEV2 COVER RETURN BEND	E203432
		LEV2 HEADER COVER	E203431
		LEV2 HEADER COVER DBL CIRC	E204989A
		LEV2 HEADER COVER DBL CIRC W/FRAME	E204989F
		LEV RETURN BEND COVER 24" FAN HEADER COVER LEV-B	E86127 E208165
16	WIRE HARNESS LEV2	WHA-P399-200C	E207054
		ACVV-W-F-G 1FAN WIRE HARNESS	805870
		LEV2 WIRE HARNESS 2F-(2W)4F LH	80588RB
		LEV2 WIRE HARNESS (2W)4F RH	80589RB
		LEV2 WIRE HARNESS 3F-(2W)6F LH	80590RB
		LEV2 WIRE HARNESS (2W)6F RH	80591RB
		LEV2 WIRE HARNESS 4F-(2W)8F LH	80592RB
		LEV2 WIRE HARNESS (2W)8F RH	80593RB
		LEV2 WIRE HARNESS 5F-(2W)10F LH	80594RB
		LEV2 WIRE HARNESS (2W)10F RH	80595RB
		LEV2 WIRE HARNESS 6F-(2W)12F LH	80596RB
		LEV2 WIRE HARNESS (2W)12F RH	80597RB
		ACVB-I 1 LH WIRE HARNESS	E83149
		LEV2-B WIRE HARNESS 2F-(2W)4F LH	E83150RB
		LEV2-B WIRE HARNESS (2W)4F RH	E83151RB
		LEV2-B WIRE HARNESS 3F-(2W)6F LH	E83152RB
		LEV2-B WIRE HARNESS (2W)6F RH	E83153RB
		LEV2-B WIRE HARNESS 4F-(2W)8F LH	E83154RB
		LEV2-B WIRE HARNESS (2W)8F RH	E83155RB
		LEV2-B WIRE HARNESS 5F-(2W)10F LH	E83156RB
		LEV2-B WIRE HARNESS (2W)10F RH	E83157RB
		LEV2-B WIRE HARNESS 6F-(2W)12F LH	E83158RB
		LEV2-B WIRE HARNESS (2W)12F RH	E83159RB
		LEV2-B WIRE HARNESS 2F-(2W)14F LH	E83160RB
		LEV2-B WIRE HARNESS (2W)14F RH	E83161RB
17	CONTROL PANEL VENTILATION ACCESSORIES FOR ‘‘K” MOTOR OPTION **(NOT SHOWN)**	VENT FAN-SQUARE AXIAL 6-15/16" 335 CFM CONTROL-THERMOSTAT GRAINGER 1ZHC5 INTAKE FILTER 2H05583/A-FLTR ASSM SC162-P15/60 FAN-GUARD 6-15/16	3089686 3082140 2H05583001 3074993
18	VFD “K” MOTOR OPTION **(NOT SHOWN)**	DRIVE-KB-280V-LEV-MX DRIVE-KB-460/380V-LEV-MX	3148881 3148880
19	CONTROL WIRE “K” MOTOR **(NOT SHOWN)**	CABLE BELDEN 22GA 2C 8761	0427376
20	VARIABLE SPEED CONTROLLERS FOR “K’’ MOTOR OPTION **(NOT SHOWN)** JCI/HUSSMANN	PEAK 1820 HS-OEM1820-0 TRANSDUCER JOHNSON P499ACP-105 (4-20 mA) P499RCP-105C PRESSURE TRANSDUCER (.5-4.5vdc) WHA-P399-200C WIRE HARNESS A99BC-300 TEMP SENSOR (set189a) 9.75FT LEAD	3075128 E211081001 E207053 E207054 E205564

	EMERSON CPC	CPC MULTIFLEX 810-3063 88AO CPC TRANSDUCER 0-500PSI #800-2500 (0.5-4.5 vdc) SNSR TEMP LOW PIPE HLC5011125	E210857001 E152353 0706186
	DANFOSS	DANFOSS MCX06D 24V AKS 32 PRESSURE TRANSDUCER 0-500 PSIG METER WIRE 060G3991 084N002900 AKS-11 TEMP PROBE	3087943 E208130 E208131
	MICRO-THERMO	MT-784A 8UI-4RO CONTROLLER MT-722F 23-0073 AMBIENT TEMP SENSOSR 952-0002 500PSI TRANSDUCER	3095039 3094789 E207161 E208140

TABLE 54 – MOTOR, FAN BLADE, MOTOR RING, FAN GUARD AND BRACKET COMBINATION FOR DIFFERENT MOTORS

MOTOR TYPE	VOLTAGE	FAN MOTOR	FAN BLADE	MOTOR RING	FAN GUARD	MOTOR BRACKET (Two Per Motor)
MOTOR TYPE A - 850RPM, 1HP,	208/3/60	11503IN	E208057	800340	E280792	E208055
	460/3/60					
	380/3/60					
	380/3/50					
	575/3/60	E205307IN	E208057	800340	E280792	E208055
MOTOR TYPE B - 1140RPM, 0.5HP	208/1/60	E205529	E206876	N/A	E82691	N/A
	208/3/60	11525IN	E206876	N/A	E82691	N/A
	460/3/60	11525IN	E206876	N/A	E82691	N/A
	380/360	11525IN	E206876	N/A	E82691	N/A
	575/3/60	E208100	E206876	N/A	E82691	N/A
MOTOR TYPE C - 850RPM, 1.5HP	208/3/60	E151976IN	E208058	800340	E280792	E208055
	460/3/60					
	380/360					
	575/3/60	E151976A	E208058	800340	E280792	E208055
MOTOR TYPE E - 575RPM, 0.5HP	208/3/60	E2068808IN	E208056	800340	E280792	E208055
	460/3/60					
	380/360					
	575/3/60	E318680	E208056	800340	E280792	E208055
MOTOR TYPE F - 1140, 1.5HP	208/3/60	E205492IN	E209267001	E209540001	E280792	E209538001
	460/3/60					
	380/360					
	575/3/60	E206689IN	E209267001	E209540001	E280792	E209538001
MOTOR TYPE K - 1140, 1.5HP	208/3/60	3055269	E209267001	800340	E209813001	E280793
	460/3/60	3080452	E209267001	800340	E209813001	E280793

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