Operation Manual

OM AGZC-1

Group: **Chiller**	
Part Number: **331376301**	
Effective: **February 2010**	
Supercedes: **April 2009**	

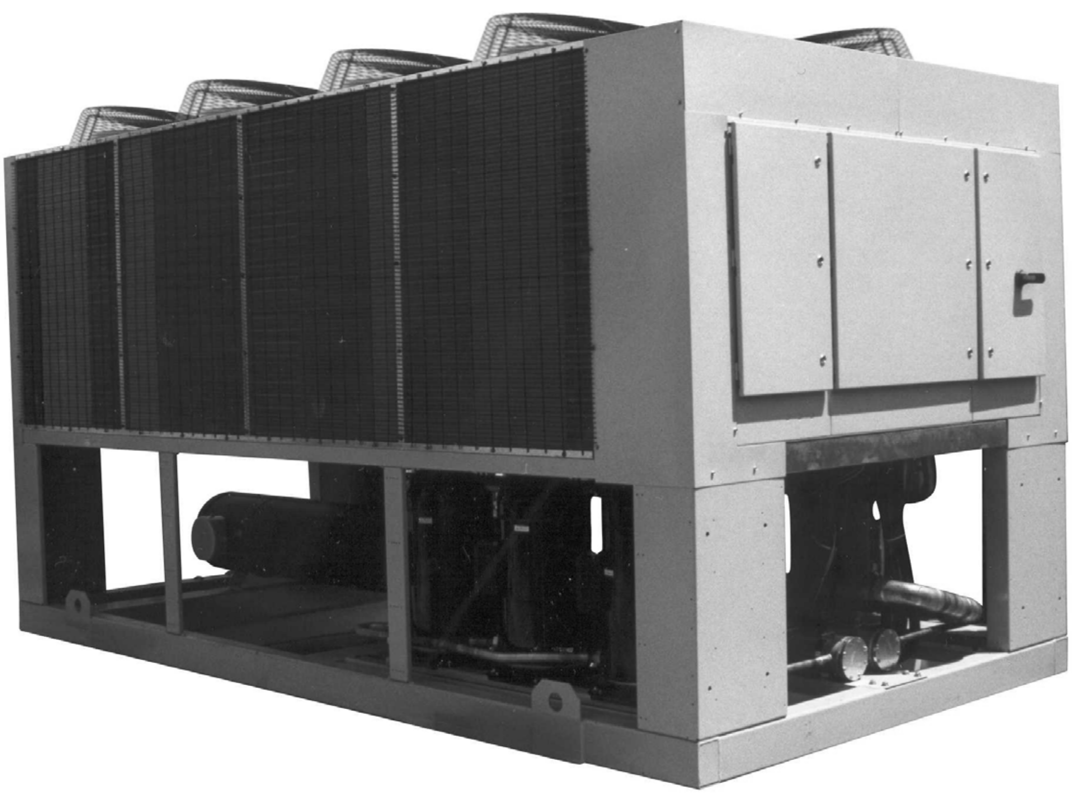
Air-Cooled Scroll Compressor Chiller

AGZ 030CH through 190CH, Packaged

AGZ 030CB through 190CB, Remote Evaporator

60 Hertz, R-410A

Software Version AGZDU0102G



McQuay® International

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Our facility is **ISO Certified**

Introduction

General Description

McQuay Air-Cooled Global Water Chillers are complete, self-contained automatic refrigerating units. Every unit is completely assembled, factory wired, charged, and tested (except remote evaporator option). Each unit consists of twin air-cooled condensers with integral subcooler sections, two tandem or triple scroll compressors, brazed-plate or replaceable tube, dual circuit shell-and-tube evaporator, and complete refrigerant piping. Liquid line components include manual liquid line shutoff valves, sight-glass/moisture indicators, solenoid valves, and thermal expansion valves. Other features include compressor crankcase heaters, an evaporator heater for chilled water freeze protection, limited pumpdown during “on” or “off” periods, automatic compressor lead-lag to alternate the compressor starting sequence, and sequenced starting of compressors.

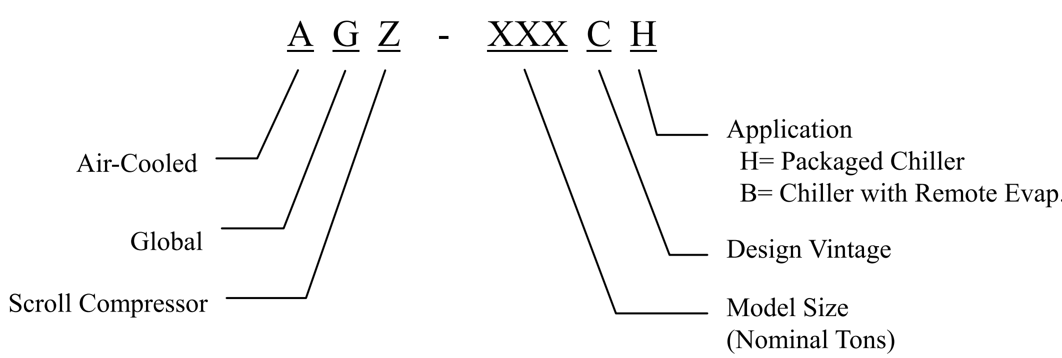
The electrical control center includes all equipment protection and operating controls necessary for dependable automatic operation. Condenser fan motors are protected in all three phases and started by their own three-pole contactors.

This manual covers units with **Software Version AGZDU0102G**. Installation, maintenance and service information is in IMM AGZC (or current, latest dash number) manual.

BOOT Version 3.0F

BIOS Version 3.62

Nomenclature



Ambient Air Temperature Limitations

Standard/High Ambient Panels

The AGZ-C units for high ambient operation (105°F to 125°F maximum) require the addition of the High Ambient Control Panel Option, which includes the addition of a small fan with a filter in the air intake to cool the control panel.

All units with the optional VFD low ambient fan control automatically include the High Ambient Control Panel Option. Operation of the VFD generates a quantity of panel heat best removed by use of a control panel fan.

Table 1, Panel Ratings

Voltage	Standard		Options	
	Standard Panel	Optional VFD	High Short Circuit Panel (kA)	High Interrupt Panel w/ Disconnect Swt. (kA)
208-230	35	5	120	120
240	35	5	100	100
380-460	35	5	65	65
575	5	5	25	25

Water Flow Limitations

The evaporator flow rates and pressure drops shown on page 9 (and following) are for full load design purposes in order to maintain proper unit control. The maximum flow rate and pressure drop are based on a 6 degree temperature drop. Avoid higher flow rates with resulting lower temperature drops to prevent potential control problems resulting from very small control bands and limited start up/shut off temperature changes.

The minimum flow and pressure drop is based on a full load evaporator temperature drop of 16 degrees. Evaporator flow rates below the minimum values can result in laminar flow causing freeze-up problems, scaling and poor control. Flow rates above the maximum values will result in unacceptable pressure drops and can cause excessive erosion, potentially leading to failure.

Variable Speed Pumping

Variable water flow involves changing the water flow through the evaporator as the load changes. McQuay chillers are designed for this duty provided that the rate of change in water flow is slow and the minimum and maximum flow rates for the vessel are not exceeded.

The recommended maximum change in water flow is 10 percent of the change per minute.

When units are operated with flow rates less than nominal (see Table 8), the "Evap Delta T" setpoint must be changed proportionally to match the minimum operating flow rate. The "Delta T" setting should be increased by the same percentage as the flow reduction is from the nominal rating in order to prevent short cycling. This will require reevaluation of "Cool LWT", "Startup Delta T", and "Stop Delta T" settings as well.

System Water Volume Considerations

All chilled water systems need adequate time to recognize a load change, respond to that load change and stabilize without undesirable short cycling of the compressors or loss of control. In air conditioning systems, the potential for short cycling usually exists when the building load falls below the minimum chiller plant capacity or on close-coupled systems with very small water volumes.

Some of the things the designer should consider when looking at water volume are the minimum cooling load, the minimum chiller plant capacity during the low load period and the desired cycle time for the compressors.

Assuming that there are no sudden load changes and that the chiller plant has reasonable turndown, a rule of thumb of "gallons of water volume equal to two to three times the chilled water gpm flow rate" is often used.

A properly designed storage tank should be added if the system components do not provide sufficient water volume.

Glycol Solutions

The use of a glycol/water mixture in the evaporator to prevent freezing will reduce system capacity and efficiency, as well as increase pressure drop. The system capacity, required glycol solution flow rate, and pressure drop with glycol may be calculated using the following formulas and tables.

1. **Capacity** – Multiply the capacity based on water by the *Capacity* correction factor from Table 2 through Table 5.
2. **Flow** – Multiply the water evaporator flow by the *Flow* correction factor from Table 2 through Table 5 to determine the increased evaporator flow due to glycol.

   If the flow is unknown, it can be calculated from the following equation:

$$\text{Glycol Flow (gpm)} = \frac{24 \times Tons\ Capacity\ (glycol)}{Delta\quad T} \times Flow\ Correction\ Factor$$

For Metric Applications – Use the following equation:

$$\text{Glycol Flow (l/s)} = \frac{kW\ Capacity}{4.18 \times Delta - T} \times Flow\ Correction\ Factor$$

3. **Pressure drop** -- Multiply the water pressure drop from page 10 by *Pressure Drop* correction factor from Table 2 through Table 5. High concentrations of propylene glycol at low temperatures can cause unacceptably high pressure drops.
4. **Power** -- Multiply the water system power by *Power* correction factor from Table 2 - Table 5.

Test coolant with a clean, accurate glycol solution hydrometer (similar to that found in service stations) to determine the freezing point. Obtain percent glycol from the freezing point tables below. It is recommended that a minimum of 25% solution by weight be used for protection against corrosion or that additional compatible inhibitors be added.

Concentrations above 35 % do not provide any additional burst protection and should be carefully considered before using.

⚠ WARNING

Do not use an automotive grade antifreeze. Industrial grade glycols must be used. Automotive antifreeze contains inhibitors which will cause plating on the copper tubes within the chiller evaporator. The type and handling of glycol used must be consistent with local codes

Table 2, Ethylene Glycol Factors for Models AGZ 030C to 130C

% E.G.	Freeze Point °F	Freeze Point °C	Capacity	Power	Flow	PD
10	26	-3.3	0.998	0.998	1.036	1.097
20	18	-7.8	0.993	0.997	1.060	1.226
30	7	-13.9	0.987	0.995	1.092	1.369
40	-7	-21.7	0.980	0.992	1.132	1.557
50	-28	-33.3	0.973	0.991	1.182	1.791

Table 3, Propylene Glycol Factors for Models AGZ 030C to 130C

% P.G.	Freeze Point °F	Freeze Point °C	Capacity	Power	Flow	PD
10	26	-3.3	0.995	0.997	1.016	1.100
20	19	-7.2	0.987	0.995	1.032	1.211
30	9	-12.8	0.978	0.992	1.057	1.380
40	-5	-20.6	0.964	0.987	1.092	1.703
50	-27	-32.8	0.952	0.983	1.140	2.251

Table 4, Ethylene Glycol Factors for Models AGZ 140C to 180C

% E.G.	Freeze Point °F	Freeze Point °C	Capacity	Power	Flow	PD
10	26	-3.3	0.994	0.998	1.038	1.101
20	18	-7.8	0.982	0.995	1.063	1.224
30	7	-13.9	0.970	0.992	1.095	1.358
40	-7	-21.7	0.955	0.987	1.134	1.536
50	-28	-33.3	0.939	0.983	1.184	1.755

Table 5, Propylene Glycol Factors for Models AGZ 140C to 180C

% P.G.	Freeze Point °F	Freeze Point °C	Capacity	Power	Flow	PD
10	26	-3.3	0.988	0.996	1.019	1.097
20	19	-7.2	0.972	0.992	1.035	1.201
30	9	-12.8	0.951	0.987	1.059	1.351
40	-5	-20.6	0.926	0.979	1.095	1.598
50	-27	-32.8	0.906	0.974	1.142	2.039

Altitude Correction Factors

Performance tables are based at sea level. Elevations other than sea level affect the performance of the unit. The decreased air density will reduce condenser capacity consequently reducing the unit's performance. For performance at elevations other than sea level, refer to Table 6 and Table 7.

Evaporator Temperature Drop Factors

Performance tables are based on a 10°F (5°C) temperature drop through the evaporator. Adjustment factors for applications with temperature ranges from 6°F to 16°F (3.3°C to 8.9°C) are in Table 6 and Table 7.

Temperature drops outside this 6°F to 16°F (3.3°C to 8.9°C) range can affect the control system's capability to maintain acceptable control and are not recommended.

The maximum water temperature that can be circulated through the evaporator in a non-operating mode is 100°F (37.8°C).

Fouling Factor

Performance tables are based on water with a fouling factor of:

$$0.0001 ft^2 \times hr \times °F / BTU \quad or \quad (0.0176 m^2 \times °C / kW)$$

per ARI 550/590-98.

As fouling is increased, performance decreases. For performance at other than 0.0001 (0.0176) fouling factor, refer to Table 6 or Table 7.

Foreign matter in the chilled water system will adversely affect the heat transfer capability of the evaporator and could increase the pressure drop and reduce the water flow. Maintain proper water treatment to provide optimum unit operation.

Table 6, Capacity and Power Derates, Models AGZ 030C to 130C

Altitude	Chilled Water Delta T		Fouling Factor							
			0.0001 (0.0176)		0.00025 (0.044)		0.00075 (0.132)		0.00175 (0.308)	
	°F	°C	Cap.	Power	Cap.	Power	Cap.	Power	Cap.	Power
Sea Level	6	3.3	0.978	0.993	0.975	0.991	0.963	0.987	0.940	0.980
	8	4.4	0.989	0.996	0.986	0.994	0.973	0.990	0.950	0.983
	10	5.6	1.000	1.000	0.996	0.999	0.984	0.994	0.961	0.987
	12	6.7	1.009	1.003	1.005	1.001	0.993	0.997	0.969	0.990
	14	7.7	1.018	1.004	1.014	1.003	1.002	0.999	0.978	0.991
	16	8.9	1.025	1.007	1.021	1.006	1.009	1.001	0.985	0.994
2000 feet	6	3.3	0.977	1.001	0.973	1.000	0.961	0.996	0.938	0.989
	8	4.4	0.987	1.006	0.984	1.004	0.971	1.000	0.948	0.993
	10	5.6	0.998	1.009	0.995	1.007	0.982	1.003	0.959	0.996
	12	6.7	1.007	1.011	1.004	1.010	0.991	1.006	0.967	0.998
	14	7.7	1.014	1.014	1.011	1.013	0.998	1.009	0.974	1.001
	16	8.9	1.022	1.016	1.018	1.014	1.005	1.010	0.981	1.003
4000 feet	6	3.3	0.973	1.011	0.970	1.010	0.957	1.006	0.935	0.998
	8	4.4	0.984	1.014	0.980	1.013	0.968	1.009	0.945	1.001
	10	5.6	0.995	1.019	0.991	1.017	0.979	1.013	0.955	1.005
	12	6.7	1.004	1.021	1.000	1.020	0.987	1.016	0.964	1.008
	14	7.7	1.011	1.024	1.007	1.023	0.994	1.018	0.971	1.011
	16	8.9	1.018	1.027	1.014	1.026	1.002	1.021	0.978	1.014
6000 feet	6	3.3	0.969	1.021	0.966	1.020	0.954	1.016	0.931	1.008
	8	4.4	0.980	1.026	0.977	1.024	0.964	1.020	0.942	1.013
	10	5.6	0.989	1.029	0.986	1.027	0.973	1.023	0.950	1.015
	12	6.7	0.998	1.033	0.995	1.031	0.982	1.027	0.959	1.020
	14	7.7	1.007	1.036	1.004	1.034	0.991	1.030	0.967	1.022
	16	8.9	1.014	1.037	1.011	1.036	0.998	1.031	0.974	1.024

Table 7, Capacity and Power Derates, Models AGZ 075 to 130

Altitude	Chilled Water Delta T		Fouling Factor							
			0.0001 (0.0176)		0.00025 (0.044)		0.00075 (0.132)		0.00175 (0.308)	
	°F	°C	Cap.	Power	Cap.	Power	Cap.	Power	Cap.	Power
Sea Level	6	3.3	0.990	0.997	0.976	0.994	0.937	0.983	0.868	0.964
	8	4.4	0.994	0.998	0.981	0.995	0.942	0.984	0.872	0.965
	10	5.6	1.000	1.000	0.987	0.996	0.947	0.986	0.877	0.967
	12	6.7	1.005	1.001	0.991	0.997	0.951	0.986	0.881	0.968
	14	7.7	1.009	1.002	0.995	0.998	0.955	0.987	0.884	0.968
	16	8.9	1.013	1.004	1.000	1.000	0.960	0.989	0.889	0.970
2000 feet	6	3.3	0.987	1.005	0.974	1.002	0.934	0.991	0.865	0.972
	8	4.4	0.992	1.006	0.979	1.003	0.940	0.992	0.870	0.973
	10	5.6	0.997	1.008	0.984	1.004	0.944	0.994	0.875	0.975
	12	6.7	1.002	1.009	0.989	1.005	0.949	0.994	0.879	0.975
	14	7.7	1.007	1.011	0.993	1.007	0.953	0.996	0.883	0.977
	16	8.9	1.011	1.012	0.998	1.008	0.958	0.997	0.887	0.978
4000 feet	6	3.3	0.985	1.014	0.972	1.010	0.933	0.999	0.864	0.980
	8	4.4	0.991	1.015	0.977	1.012	0.938	1.001	0.869	0.981
	10	5.6	0.995	1.016	0.982	1.013	0.943	1.002	0.873	0.982
	12	6.7	1.000	1.018	0.987	1.014	0.947	1.003	0.877	0.984
	14	6.8	1.005	1.019	0.991	1.015	0.951	1.004	0.881	0.985
	16	8.9	1.009	1.021	0.995	1.017	0.955	1.006	0.884	0.987
6000 feet	6	3.3	0.982	1.023	0.969	1.020	0.930	1.009	0.861	0.989
	8	4.4	0.988	1.025	0.975	1.022	0.935	1.010	0.866	0.991
	10	5.6	0.992	1.026	0.979	1.022	0.940	1.011	0.870	0.992
	12	6.7	0.997	1.028	0.984	1.024	0.944	1.013	0.875	0.994
	14	7.7	1.002	1.029	0.989	1.025	0.949	1.014	0.879	0.995
	16	8.9	1.006	1.031	0.992	1.027	0.952	1.016	0.882	0.996
8000 feet	6	3.3	0.979	1.034	0.966	1.031	0.927	1.019	0.859	1.000
	8	4.4	0.984	1.036	0.971	1.032	0.932	1.021	0.863	1.002
	10	5.6	0.990	1.037	0.976	1.033	0.937	1.022	0.868	1.002
	12	6.7	0.993	1.039	0.980	1.035	0.941	1.024	0.871	1.004
	14	7.7	0.998	1.041	0.985	1.037	0.945	1.026	0.875	1.006
	16	8.9	1.003	1.041	0.990	1.038	0.950	1.026	0.879	1.007

Evaporator Freeze Protection

Evaporator freeze-up can be a concern in the application of air-cooled water chillers. To protect against freeze-up, insulation and an electric heater cable are furnished with the unit. This protects the evaporator down to -20°F (-29°C) ambient air temperature. Although the evaporator is equipped with freeze protection, it does not protect water piping external to the unit or the evaporator itself if there is a power failure or heater cable burnout. Consider the following recommendations for additional protection.

1. If the unit will not be operated during the winter, drain evaporator and chilled water piping and flush with glycol. Drain and vent connections are provided on the evaporator to ease draining.
2. Add a glycol solution to the chilled water system to provide freeze protection. Freeze point should be approximately ten degrees below minimum design ambient temperature.
3. The addition of thermostatically controlled heat and insulation to exposed piping.
4. Continuous circulation of water through the chilled water piping and evaporator.

The evaporator heater cable is factory wired to the 115-volt circuit in the control box. This power should be supplied from a separate source, but it can be supplied from the control circuit. Operation of the heater cable is automatic through the ambient sensing thermostat that energizes the evaporator heater cable for protection against freeze-up. Unless the evaporator is drained in the winter, the disconnect switch to the evaporator heater must not be open.

Operating/Standby Limits

- Maximum standby ambient air temperature, 130° F (55° C)
- Maximum operating ambient air temperature 105° F (40.6° C)
- Minimum operating ambient temperature (standard), 35° F (2° C)
- Minimum operating ambient temperature (with optional low-ambient control), 0° F (-18°C)
- Leaving chilled water temperature, 40°F to 60°F (4.4° C to 15.6° C)
- Leaving chilled fluid temperatures (with anti-freeze), 15° F to 60° F (-9.4°C to 15.6°C)
- Design chilled water Delta-T range, 6 degrees F to 16 degrees F (3.3° C to 8.9° C)
- Part load minimum flow for variable flow systems, varies with unit size, see Table 8 below.
- Maximum operating inlet fluid temperature, 76° F (24° C)
- Maximum non-operating inlet fluid temperature, 100°F (38° C).

Pressure Drop Curves

Evaporator pressure drop curves on the following page. They apply to either packaged or remote evaporator applications. Figure 1, Evaporator Pressure Drops. See following page for curve cross-reference on the next page contains the evaporator reference letter and the minimum and maximum flows allowed for each unit.

Occasionally the same evaporator is used on multiple units resulting in overlapping lines. The minimum and maximum flows for a given unit will be at the point where the unit reference number appears.

Figure 1, Evaporator Pressure Drops. See following page for curve cross-reference

See following page for curve cross-reference and min/max flow rates.

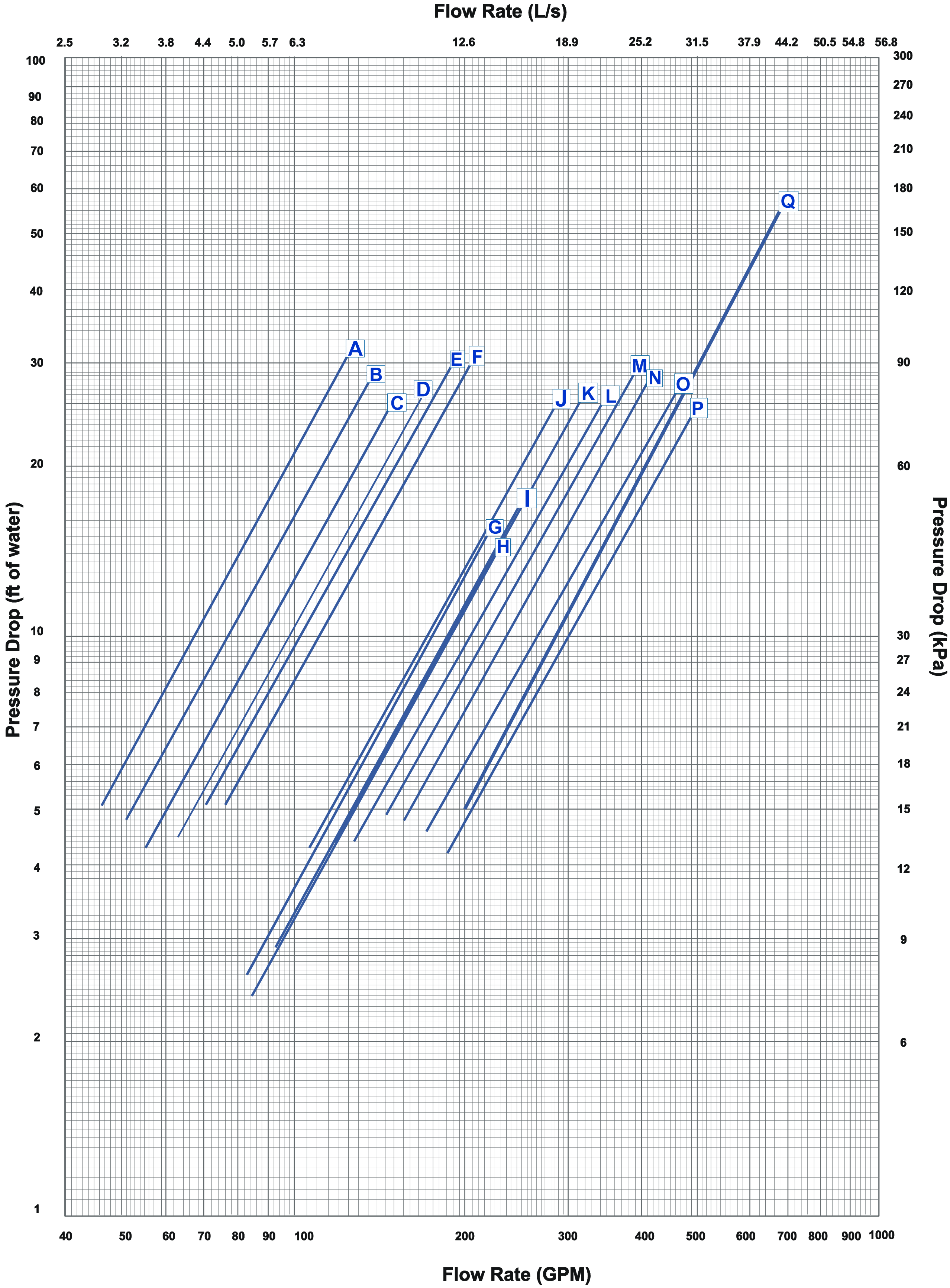
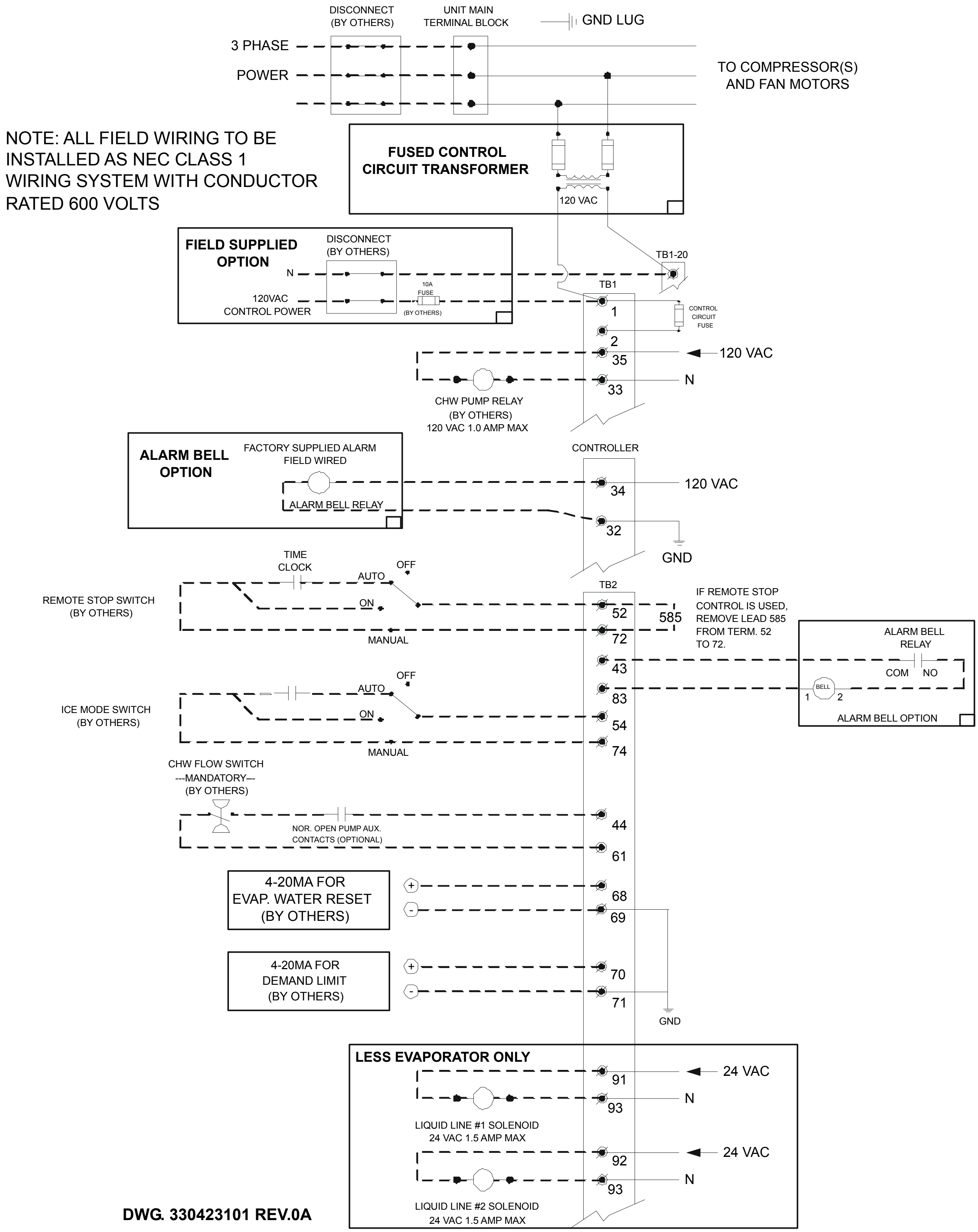


Table 8, Curve Cross-Reference, Min/Nominal/Max Flows

Curve Ref.	AGZ Unit Model	Evap Model	Minimum Flow Rate				Nominal Flow Rate				Maximum Flow Rate				Nom Tons
			Inch-Pound		S.I.		Inch-Pound		S.I.		Inch-Pound		S.I.		
			gpm	DP ft.	lps	DP kpa	gpm	DP ft.	lps	DP kpa	gpm	DP ft.	lps	DP kpa	
A	**030C**	ACH130-90DQ	47.3	5.1	3.0	15.4	75.6	12.0	4.8	35.9	126.0	30.1	8.0	90.0	31.5
B	**035C**	ACH130-102DQ	51.2	4.8	3.2	14.2	81.8	11.1	5.2	33.2	136.4	27.9	8.6	83.3	34.1
C	**040C**	ACH130-118DQ	55.7	4.3	3.5	12.8	89.0	10.0	5.6	29.9	148.4	25.1	9.4	75.0	37.1
D	**045C**	ACH130-138DQ	63.2	4.5	4.0	13.5	101.0	10.5	6.4	31.4	168.4	26.3	10.6	78.7	42.1
E	**050C**	ACH130-158DQ	71.4	5.1	4.5	15.1	114.2	11.8	7.2	35.3	190.4	29.6	12.0	88.5	47.6
F	**055C**	ACH130-178DQ	77.1	5.1	4.9	15.3	123.4	11.9	7.8	35.7	205.6	30.0	13.0	89.6	51.4
G	**060C**	ACH250-110DQ	82.7	2.6	5.2	7.8	132.2	6.1	8.3	18.1	220.4	15.2	13.9	45.4	55.1
H	**065C**	ACH250-122DQ	85.7	2.4	5.4	7.2	137.0	5.6	8.6	16.8	228.4	14.1	14.4	42.0	57.1
I	**070C**	ACH250-122DQ	93.4	2.9	5.9	8.6	149.5	6.8	9.4	20.2	249.1	16.8	15.8	50.5	62.3
J	**075C**	ACH350-118DQ	107.4	4.3	6.8	13.0	171.8	10.1	10.8	30.3	286.4	25.4	18.1	75.9	71.6
K	**080C**	ACH350-126DQ	119.3	4.4	7.5	13.2	190.8	10.3	12.0	30.7	318.0	25.7	20.1	76.9	79.5
L	**090C**	ACH350-142DQ	129.4	4.3	8.1	13.0	207.1	10.1	13.0	30.1	345.2	25.2	21.8	75.5	86.3
M	**100C**	ACH350-150DQ	146.7	4.9	9.2	14.7	234.7	11.4	14.8	34.3	391.2	28.7	24.7	85.9	97.8
N	**110C**	ACH350-162DQ	156.3	4.8	9.9	14.3	250.1	11.1	15.8	33.3	416.8	27.9	26.3	83.5	104.2
O	**125C**	ACH350-182DQ	171.5	4.6	10.8	13.8	274.3	10.8	17.3	32.1	457.2	27.0	28.8	80.6	114.3
P	**130C**	ACH350-210DQ	187.1	4.2	11.8	12.5	299.3	9.8	18.9	29.1	498.8	24.5	31.5	73.1	124.7
Q	**140C**	EV34191111/9	200.6	5.0	12.7	15.0	320.9	11.8	20.2	33.1	534.8	29.5	33.7	88.0	133.7
Q	**160C**	EV34191111/9	227.3	6.3	14.3	18.9	363.6	14.7	22.9	41.5	606.0	36.8	38.2	110.2	151.5
Q	**180C**	EV34191111/9	254.0	7.7	16.0	22.9	406.3	18.0	25.6	50.8	677.2	45.1	42.7	134.6	169.3
Q	**190C**	EV34191212/7	270.2	9.4	17.0	28.0	432.2	22.0	27.2	62.1	720.3	55.1	45.4	164.4	180.1

NOTE: Evaporators beginning with ACH are brazed-plate; those beginning with EV are shell-and-tube.

Figure 2, AGZ030C – AGZ 180C, Typical Field Wiring



MicroTech II Controller

Software Version AGZDU0102B

Controller Section Table of Contents

Overview

The MicroTech II® controller's state-of-the-art design not only permits the chiller to run more efficiently, but also can simplify troubleshooting if a system failure occurs. Every MicroTech II controller is programmed and tested prior to shipment to facilitate start-up.

Operator-friendly

The MicroTech II controller menu structure is separated into three distinct categories that provide the operator or service technician with a full description of 1) current unit status, 2) control parameters, and 3) alarms. Security protection prevents unauthorized changing of the setpoints and control parameters.

MicroTech II control continuously performs self-diagnostic checks, monitoring system temperatures, pressures and protection devices, and will automatically shut down a compressor or the entire unit should a fault occur. The cause of the shutdown will be retained in memory and can be easily displayed in plain English for operator review. The MicroTech II chiller controller will also retain and display the date/time the fault occurred. In addition to displaying alarm diagnostics, the MicroTech II chiller controller also provides the operator with a warning of limit (pre-alarm) conditions.

General Description

AGZ-C Inputs/Outputs

Table 9, Analog Inputs

#	Description	Type	Signal Source	Expected Range
1	Evaporator Refrigerant Pressure #1	C1	0.1 to 0.9 VDC	0 to 132 psi
2	Evaporator Refrigerant Pressure #2	C2	0.1 to 0.9 VDC	0 to 132 psi
3	Condenser Refrigerant Pressure #1	C1	0.1 to 0.9 VDC	3.6 to 410 psi
4	Leaving Evaporator Water Temperature	UT	NTC Thermister (10k@77°F)	-58 to 212°F
5	Outside Ambient Temperature	UT	NTC Thermister (10k@77°F)	-58 to 212°F
6	Condenser Refrigerant Pressure #2	C2	0.1 to 0.9 VDC	3.6 to 410 psi
7	Reset of Leaving Water Temperature	UT	4-20 mA Current	4-20 mA
8	Demand Limit	UT	4-20 mA Current	4-20 mA
9	Compressor Suction Temperature #1	C1	NTC Thermister (10k@77°F)	-58 to 212°F
10	Compressor Suction Temperature #2	C2	NTC Thermister (10k@77°F)	-58 to 212°F

NOTES:

1. C1 = Refrigerant Circuit #1, C2 = Refrigerant Circuit #2, UT = Unit

Table 10, Analog Outputs

#	Description	Output Signal	Range
1	Fan #1 VFD	0 to 10 VDC	0 to 100% (1000 steps resolution)
2	Fan #2 VFD	0 to 10 VDC	0 to 100% (1000 steps resolution)
3	EXV #1	0 to 10 VDC	0 to 100% (1000 steps resolution)
4	EXV #2	0 to 10 VDC	0 to 100% (1000 steps resolution)
5	Open	-	-
6	Open	-	-

Table 11, Digital Inputs

#	Description	Type	Signal	Signal
1	Unit OFF Switch	UT	0 VAC (Disable)	24 VAC (Enable)
2	Pump Down Switch #1	C1	0 VAC (Disable)	24 VAC (Enable)
3	Evaporator Water Flow Switch	UT	0 VAC (No Flow)	24 VAC (Flow)
4	Open			
5	Open			
6	Pump Down Switch #2	C2	0 VAC (Disable)	24 VAC (Enable)
7	Open			
8	Open			
9	Phase Voltage Fault #1 (See Note 1)	C1	0 VAC (Fault)	24 VAC (No Fault)
10	Phase Voltage Fault #2 (See Note 1)	C2	0 VAC (Fault)	24 VAC (No Fault)
11	Ground Fault Prot. #1 (See Note 2 Below)	C1	0 VAC (Fault)	24 VAC (No Fault)
12	Ground Fault Prot. #2 (See Note 2 Below)	C2	0 VAC (Fault)	24 VAC (No Fault)
13	Remote Start/Stop	UT	0 VAC (Disable)	24 VAC (Enable)
14	Open			
15	Mechanical High Pressure/Motor Protect Circ. 1	C2	0 VAC (Fault)	24 VAC (No Fault)
16	Mechanical High Pressure/Motor Protect Circ. 2	C2	0 VAC (Fault)	24 VAC (No Fault)
17	Ice Mode Switch	UT	0 VAC (Cool)	24 VAC (Ice)
18	Open			

NOTES:

1. Units with single point electrical connection will have one PVM with Inputs 9 and 10 wired together. Units with multiple point connection will have two PVM's with Input 9 for Electrical Circuit #1 and Input 10 for Electrical Circuit #2.
2. Units with single point electrical connection will have one GFP with Inputs 11 and 12 wired together. Units with multiple point connection will have two GFP's with Input 11 for Electrical Circuit #1 and Input 12 for Electrical Circuit #2.

Table 12, Digital Outputs

#	Description	Type	Output OFF	Output ON
1	Alarm	C1,C2,UT	Alarm OFF	Alarm ON
2	Evaporator Water Pump	UT	Pump OFF	Pump ON
3	Condenser Fan #1	C1	Fan OFF	Fan ON
4	Compr#1	C1	Compressor OFF	Compressor ON
5	Compr#3	C1	Compressor OFF	Compressor ON
6	Compr#5	C1	Compressor OFF	Compressor ON
7	Liquid Line #1	C1	Cooling OFF	Cooling ON
8	Condenser Fan #2	C2	Fan OFF	Fan ON
9	Compr#2	C2	Compressor OFF	Compressor ON
10	Compr#4	C2	Compressor OFF	Compressor ON
11	Compr#6	C2	Compressor OFF	Compressor ON
12	Liquid Line #2	C2	Cooling OFF	Cooling ON
13	Condenser Fan #3	C1	Fan OFF	Fan ON
14	Hot Gas Bypass #1	C1	Hot Gas OFF	Hot Gas ON
15	Hot Gas Bypass #2	C2	Hot Gas OFF	Hot Gas ON
16	Condenser Fan #4	C2	Fan OFF	Fan ON
17	Condenser Fan #5 & #7	C1	Fan OFF	Fan ON
18	Condenser Fan #6 & #8	C2	Fan OFF	Fan ON

Table 13, Expansion Valve I/O Controller

#	Description	Type	Output Off	Output On
1	Evap Water Pump Output #2	UT	Pump Off	Pump On
2	Open			
3	Condenser Fan #9 (or #9 and #11)	C1	Fan OFF	Fan ON
4	Condenser Fan #10 (or #10 and #12)	C2	Fan OFF	Fan ON

Setpoints

The setpoints shown in Table 14 are retained during power off, are factory set to the **Default** value, and can be adjusted within the values shown in **Range**.

The PW indicates the password. Passwords are as follows:O = Operator =0100 , M = Manager=2001

Table 14, Setpoints

Description	Default	Range	PW
Unit Enable	Off	Off, On	O
Unit Mode	Cool	Cool, Cool w/Glycol, Ice w/Glycol, Test	O
Control source	Switches	Keypad, Network, Switches	O
Available Modes	Cool	Cool, Cool w/Glycol, Cool/Ice w/Glycol, Ice w/Glycol, Test	M
Cool LWT Without Glycol	44. 0°F	40.0°F to 60.0°F	O
Cool LWT With Glycol	44. 0°F	15.0°F to 60.0°F	
Ice LWT	40. 0°F	15.0 to 40.0 °F	O
Evap Delta T	10. 0°F	6.0 to 16.0 °F	O
Startup Delta T	10.0°F	1.0 to 15.0 °F	O
Stop Delta T	0.5°F	0.5 to 3.0°F	O
Max Pulldown Rate	1.0°F	0.2 to 5.0 °F	M
Evap Recirculate Timer	30	15 to 300 sec	M
Evap Control	#1 Only	#1 Only, #2 Only, Auto, #1 Primary, #2 Primary	M
Low Ambient Lockout	35 °F	See following section	M
Demand Limit	No	No,Yes	M
Multipoint Power	No	No,Yes	M
Ice Time Delay	12 hrs	1 to 23 hrs	M
Clear Ice Delay	No	No, Yes	M
Refrigerant Type	Select Type	R22, R407C, R410A	M
Protocol	Modbus	BACnet, LONWORKS, MODBUS	M
Ident number	001	001-999	M
Baud rate	9600	1200,2400,4800,9600,19200	M
Compressor			
Number of Compressors	4	4,6	M
Stage Up Delay	240	120 to 480 sec	M
Stage Down Delay	30	20 to 60 sec	M
Start-Start	15 min	10 to 60 min	M
Stop-Start	5 min	3 to 20 min	M
Clear Cycle Timers	No	No,Yes	M
Compressor 1 Enable	Enable	Enable, Disable	M
Compressor 3 Enable	Enable	Enable, Disable	M
Compressor 5 Enable	Enable	Enable, Disable	M
Compressor 2 Enable	Enable	Enable, Disable	M

Continued next page.

Description	Default	Range	PW
Compressor 4 Enable	Enable	Enable, Disable	M
Compressor 6 Enable	Enable	Enable, Disable	M
Expansion Valve Type	Thermal	Thermal, Electronic	M
Circuit 1 EXV Control	Auto	Auto, Manual	M
Circuit 1 EXV Position	N/A	0 – 100%	M
Circuit 2 EXV Control	Auto	Auto, Manual	M
Circuit 2 EXV Position	N/A	0 – 100%	M
Alarms			
Low Evap Pressure-Hold	101 psi	Without Glycol, 97 to 115 psi With Glycol, 59 to 115 psi	M
Low Evap Pressure-Unload	100 psi		M
High Condenser Stage Down	600 psi	470 to 600 psi	M
High Condenser Pressure	615 psi	480 to 620 psi	M
Evap Flow Proof	5 sec	5 to 15 sec	M
Recirculate Timeout	3 min	1 to 10 min	M
Evaporator Water Freeze	38.0 °F	Without Glycol, 37 to 42 °F With Glycol, 12.5 to 42 °F	M
Phase Voltage Protection	No	No,Yes	M
Ground Fault Protection	No	No,Yes	M
Low OAT Start Time	165 sec	150 to 240 seconds	M
Condenser Fans			
VFD Enable	No	No,Yes	M
Number of Fans	4	4,6,8,10,12	M
Stage Up 2 Deadband	15.0°F	15.0 to 25.0 °F	M
Stage Up 3 Deadband	10.0°F	10.0 to 15.0 °F	M
Stage Up 4 Deadband	10.0°F	10.0 to 15.0 °F	M
Stage Down 1 Deadband	20.0°F	15.0 to 20.0 °F	M
Stage Down 2 Deadband	15.0°F	10.0 to 15.0 °F	M
Stage Down 3 Deadband	10.0°F	6.0 to 10.0 °F	M
Stage Down 4 Deadband	10.0°F	6.0 to 10.0 °F	M
VFD Max Speed	100%	90 to 110%	M
VFD Min Speed	25%	25 to 60%	M
Sat Condenser Temp Target	100	80 to 130 °F	M
Forced Fan 1	See	See Table 17	M
Forced Fan 2			M
Forced Fan 3			M

(*) These items are factory set prior to shipment.

Automatic Adjusted Ranges

The following are setpoints that will be limited based on the value of other setpoints.

Table 15, Low Evaporator Pressure Hold and Unload

The range for these setting is dependant on the Available Modes setpoint and the type of refrigerant selected.

	R410A
Without Glycol	97 to 115 psi
With Glycol	59 to 115 psi

Table 16, Low Ambient Lockout Temperature

Fan VFD	Range
VFD = N	35 to 60°F
VFD = Y	-10 to 60°F

Table 17, Forced Fan 1,2, 3

Number of fans	Range
4	1 – 2 fans
6	1 – 3 fans
8	1 – 4 fans
10	1 – 5 fans
12	1 – 5 fans

Dynamic Defaults

Some setpoints will have a particular default value loaded when another setting is changed.

Table 18, Refrigerant Dependant Defaults

Setpoint	R410A
Low Evaporator Pressure Hold	101 psi
Low Evaporator Pressure Unload	100 psi
High Condenser Pressure Unload	600 psi
High Condenser Pressure	615 psi

When the number of fans setting is changed, the forced fan setpoints will default to values as shown in Table 19:

Table 19, Number of Fans Dependant Defaults

Setpoint	Number of Fans Setpoint				
	4	6	8	10	12
Forced Fan 1	1	1	1	1	1
Forced Fan 2	1	1	2	2	2
Forced Fan 3	2	2	3	3	3

Security

All setpoints are protected using passwords. Two four-digit passwords provide operator and manager levels of access to changeable parameters. Operator level is the lowest level of access. Manager level is the next level, and can access Operator level parameters in addition to Manager level parameters.

Operator password: 0100
Manager password: 2001

Entering Passwords

Passwords can be entered using the ENTER PASSWORD screen on the unit controller, which is the last screen in the Unit SP's column. The password is entered by pressing the ENTER key, scrolling to the correct value with the UP and DOWN arrow keys, and pressing ENTER again. The entered password is not be shown after the enter key is pressed.

Once the correct password has been entered, the ENTER PASSWORD screen will indicate which password is active (none, operator, or manager). If the wrong password is entered, a message will temporarily appear stating this. If no valid password is active the active password level displays "none".

Entering an incorrect password while a password is active will render that password inactive. Entering a valid password that is not the same as the active password will result in the active password level being changed to reflect the new password level.

Editing Setpoints

After a valid password has been entered at the unit controller, setpoints on the circuit controllers and the unit controller may be changed. If the operator attempts to edit a setpoint for which the necessary password level is not active, no action will be taken.

Once a password has been entered, it remains valid for 4 hours after the last key-press on the unit controller.

Control Functions

Control Band

The Control Band defines the temperatures around the Cool Leaving Water Temperature setpoint where compressors will be staged on or off. The Control Band is calculated as follows:
*Control Band = Evap Delta Temperature Setpoint * 0.3   Four compressor units*
*Control Band = Evap Delta Temperature Setpoint * 0.2   Six compressor units*

If the Available Mode is set to Cool (without glycol):
When the Cool Leaving Water Temperature setpoint is more than half the Control Band above 39.0° F the Stage Up temperature is calculated as follows:
Stage Up Temperature = Cool LWT Setpoint + (Control Band/2)

The Stage Down temperature is calculated as:
Stage Down Temperature = Cool LWT Setpoint – (Control Band/2)

If the Cool Leaving Water Temperature setpoint is less than half the Control Band above 39.0°F the Stage Down temperature is calculated as:
Stage Down Temperature = Cool LWT Setpoint – (Cool LWT Setpoint - 39.0°F)

Stage Up Temperature is calculated as:
Stage Up Temp = Cool LWT Setpoint + Control Band – (Cool LWT Setpoint – 39.0°F)

For all other Available Mode settings (with glycol), the compressor staging temperatures are calculated as shown below:
Stage Up Temperature = Cool LWT Setpoint + (Control Band/2)
Stage Down Temperature = Cool LWT Setpoint – (Control Band/2)

The Startup and Shutdown temperatures are calculated from the Control Band. The Start Up temperature determines when the first compressor on the unit will start. The Startup temperature calculation is shown below:
Start Up Temperature = Stage Up Temperature + Start Up Delta Temperature

The Shutdown temperature defines when the last running compressor will shutdown. The Shutdown temperature calculation is:
Shutdown Temperature = Stage Down Temperature – Shutdown Delta Temperature

LWT Error

LWT error compares the actual LWT to the active LWT setpoint. The equation is:

LWT error = LWT – active LWT setpoint

LWT Slope

LWT slope is calculated such that the slope represents a time frame of one minute. Every 12 seconds, the current LWT is subtracted from the value 12 seconds back. This value is added to a buffer containing values calculated at the last five intervals. The final result is a slope value that is an average over the past 60 seconds.

Pulldown Rate

The slope value calculated above will be a negative value as the water temperature is dropping. For use in some control functions, the negative slope is converted to a positive value by multiplying by –1.

Evaporator Saturated Temperature

Evaporator saturated temperature is calculated from the evaporator pressure for each circuit. Calculations specific to each type of refrigerant will be used.

Condenser Saturated Temperature

Condenser saturated temperature is calculated from the condenser pressure for each circuit. Calculations specific to each type of refrigerant will be used.

Evaporator Approach

The evaporator approach is calculated for each circuit. The equation is as follows:

Evaporator Approach = LWT – Evaporator Saturated Temperature

Suction Superheat

Suction superheat is calculated for each circuit using the following equation:

Suction Superheat = Suction Temperature – Evaporator Saturated Temperature

Pumpdown Pressure

The pressure to which a circuit will pumpdown is based on the Low Evaporator Pressure Unload setpoint. The equation is as follows:

Pumpdown pressure = Low Evap Pressure Unload setpoint – 15 psi

Unit Enable

Enabling and disabling the chiller is controlled by the Unit Enable Setpoint with options of OFF and ON. This setpoint can be altered by the Unit OFF input, Remote input, keypad entry, and BAS request. The Control Source Setpoint determines which sources can change the Unit Enable Setpoint with options of SWITCHES, KEYPAD or NETWORK.

Changing the Unit Enable Setpoint can be accomplished according to the following table.

NOTE: An "x" indicates that the value is ignored.

Table 20, Enable Setpoint

Unit Off Input	Control Source Setpoint	Remote Input	Key-pad Entry	BAS Request	Unit Enable
OFF	x	x	x	x	OFF
x	SWITCHES	OFF	x	x	OFF
ON	SWITCHES	ON	x	x	ON
ON	KEYPAD	x	OFF	x	OFF
ON	KEYPAD	x	ON	x	ON
ON	NETWORK	x	x	OFF	OFF
ON	NETWORK	OFF	x	x	OFF
ON	NETWORK	ON	x	ON	ON

Unit Mode Selection

The overall operating mode of the chiller is set by the Unit Mode Setpoint with options of COOL, COOL w/Glycol, ICE w/Glycol, and TEST. This setpoint can be altered by the keypad, BAS, and Mode input. Changes to the Unit Mode Setpoint are controlled by two additional setpoints.

- Available Modes Setpoint: Determines the operational modes available at any time with options of COOL, COOL w/Glycol, COOL/ICE w/Glycol, ICE w/Glycol and TEST.
- Control Source Setpoint: Determines the source that can change the Unit Mode Setpoint with options of KEYPAD, NETWORK, or SWITCHES.

When the Control source is set to KEYPAD, the Unit Mode stays at its previous setting until changed by the operator. When the Control source is set to BAS, the most recent BAS mode request goes into effect even if it changed while the Control source was set to KEYPAD or DIGITAL INPUTS.

Changing the Unit Mode Setpoint can be accomplished according to the following table.
NOTE: An "x" indicates that the value is ignored.

Table 21, Unit Mode Setpoint

Control Source Setpoint	Mode Input	Keypad Entry	BAS Request	Available Modes Setpoint	Unit Mode
x	x	x	x	COOL	COOL
x	x	x	x	COOL w/Glycol	COOL w/Glycol
SWITCHES	OFF	x	x	COOL/ICE w/Glycol	COOL w/Glycol
SWITCHES	ON	x	x	COOL/ICE w/Glycol	ICE w/Glycol
KEYPAD	x	COOL w/Glycol	x	COOL/ICE w/Glycol	COOL w/Glycol
KEYPAD	x	ICE w/Glycol	x	COOL/ICE w/Glycol	ICE w/Glycol
NETWORK	x	x	COOL	COOL/ICE w/Glycol	COOL w/Glycol
NETWORK	x	x	ICE	COOL/ICE w/Glycol	ICE w/Glycol
x	x	x	x	ICE w/Glycol	ICE w/Glycol
x	x	x	x	TEST	TEST

Unit Test Mode

The unit test mode allows manual testing of controller outputs. Entering this mode requires the following conditions.

- Unit OFF input = OFF (i.e. entire chiller is shut down).
- Manager password active.
- Available Unit Mode setpoint = TEST
  A test menu can then be selected to allow activation of the outputs. It is be possible to switch each digital output ON or OFF and set the analog outputs to any value.

Unit State

The Unit is always in one of three states. These states are Off, Auto, and Pumpdown. Transitions between these states are shown in the following diagram.

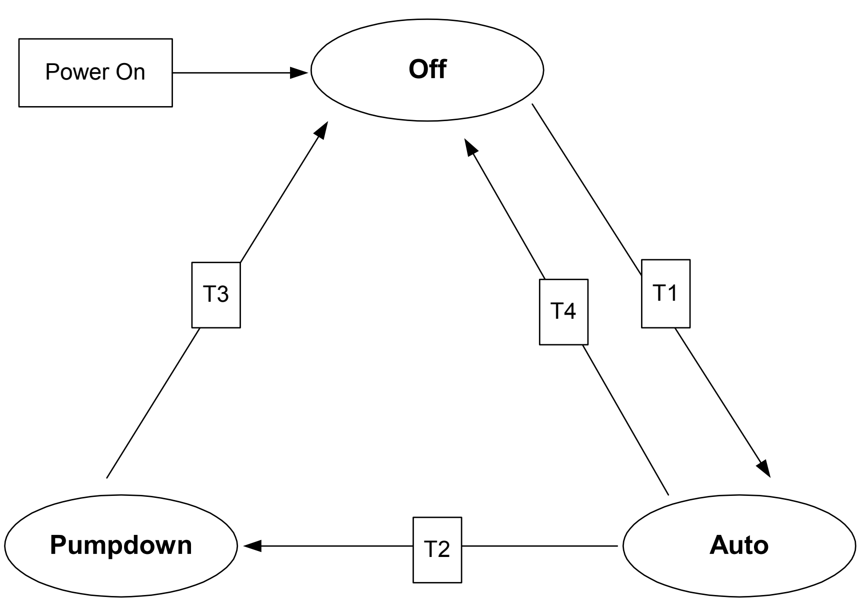
T1: Off to Auto
Unit Enable = True AND
No Unit Alarm AND
IF Unit Mode = Ice THEN [Cir 1 Available AND Cir 2 Available AND Ice Delay not active]
ELSE [Cir 1 Available OR Cir 2 Available]

T2: Auto to Pumpdown
Keypad Enable = Off OR
BAS Enable = Off OR
Remote Switch = Off OR
Unit Mode = Ice AND Either Circuit Unavailable OR
Unit Pumpdown Alarm

T3: Pumpdown to Off
Unit Rapid Stop Alarm OR
Unit Switch Off OR
No Compressors Running

T4: Auto to Off
Unit Rapid Stop Alarm OR
Unit Switch Off OR
No Compressors Running AND [Unit Mode = Ice AND Ice Delay Active] OR
No Compressors Running AND No Circuit Available

Unit State Diagram



Power Up Start Delay

After powering up the unit, the motor protectors may not work properly for up to 150 seconds. After the control is powered up, no compressor can start for 150 seconds. In addition, the motor protect inputs are ignored during this time so as to avoid tripping a false alarm.

Ice Mode Start Delay

An adjustable start to start ice delay timer will limit the frequency with which the chiller may start in Ice mode. The timer starts when the first compressor starts while the unit is in Ice Mode. While this timer is active, the chiller cannot restart in Ice Mode. The time delay is adjustable via the Ice Time Delay setpoint.

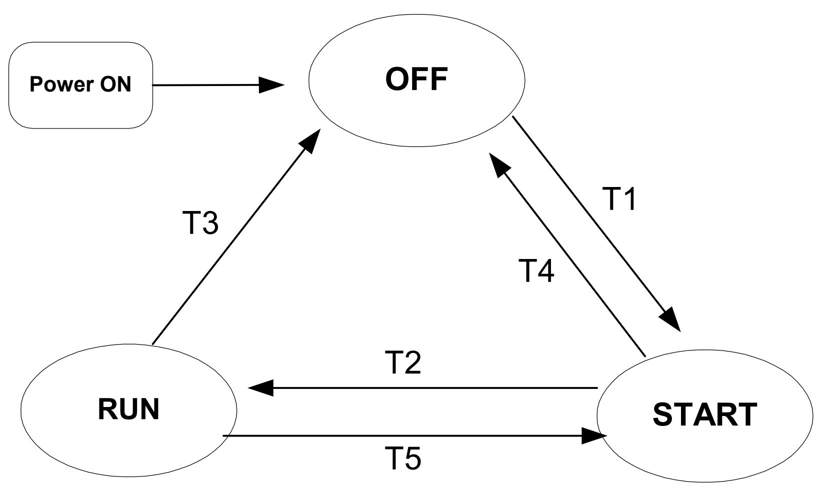
The Ice Delay Timer may be manually cleared to force a restart in Ice Mode. A setpoint specifically for clearing the ice mode delay is available. In addition, cycling the power to the controller will clear the Ice Delay Timer.

Low Ambient Lockout

If the OAT drops below the low ambient lockout setpoint, then all running circuits will do a normal stop. Once the lockout has been triggered, no compressors will start until the OAT rises to the lockout setpoint plus 5°F.

Evaporator Water Pump State

Operation of the evaporator pump is controlled by the state-transition diagram shown below.



Transitions:

T1 – Transition from Off to Start
Requires **any** of the following

- Unit state = Auto AND If Low OAT Lockout is active then LWT <= 40 °F
- LWT < Freeze setpoint - 1 °F

T2 – Transition from Start to Run

- Flow ok for time > evaporator recirculate time

T3 – Transition from Run to Off
Requires **any** of the following

- Unit state = Off AND LWT > Freeze setpoint
- Low OAT Lockout is active AND No compressors running AND LWT > 70°F

T4 – Transition from Start to Off

Requires **any** of the following

- Unit state = Off AND LWT > Freeze setpoint
- Low OAT Lockout is active AND No compressors running AND LWT > 70°F

T5 – Transition from Run to Start
Evaporator flow input low AND Evaporator state = Run for a time greater than Flow Proof setpoint

Pump selection

The pump output used is determined by the Evap Pump Control setpoint. This setting allows the following configurations:

#1 only – Pump 1 will always be used
#2 only – Pump 2 will always be used
Auto – The primary pump is the one with the least run hours, the other is used as a backup
#1 Primary – Pump 1 is used normally, with pump 2 as a backup
#2 Primary – Pump 2 is used normally, with pump 1 as a backup

Primary/Standby Pump Staging

The pump designated as primary will start first. If the evaporator state is start for a time greater than the recirculate timeout setpoint and there is no flow, then the primary pump will shut off and the standby pump will start. When the evaporator is in the run state, if flow is lost for more than half of the flow proof setpoint value, the primary pump will shut off and the standby pump will start. Once the standby pump is started, the flow loss alarm logic will apply if flow cannot be established in the evaporator start state, or if flow is lost in the evaporator run state.

Auto Control

If auto pump control is selected, the primary/standby logic above is still used. When the evaporator is not in the run state, the run hours of the pumps will be compared. The pump with the least hours will be designated as the primary at this time.

Leaving Water Temperature (LWT) Reset

The leaving water reset input uses a 4-20 mA signal to reset the leaving water setpoint to a higher value. The adjustment varies linearly from 0 to 10°F, with a reset of 0 for a 4 mA signal and a reset of 10 for a 20mA signal.

Active LWT Setpoint

The active LWT setpoint represents the current control setpoint based on unit mode and reset. If unit mode is ICE, then the active setpoint is equal to the ice setpoint. If the unit mode is COOL, the active setpoint is the cool setpoint plus the leaving water reset value.

At all times, the active leaving water setpoint is limited to a maximum of 60°F. The reset remains proportional within the 10-degree band, but the setpoint will simply stop resetting when it reaches the maximum.

Maximum LWT Rate

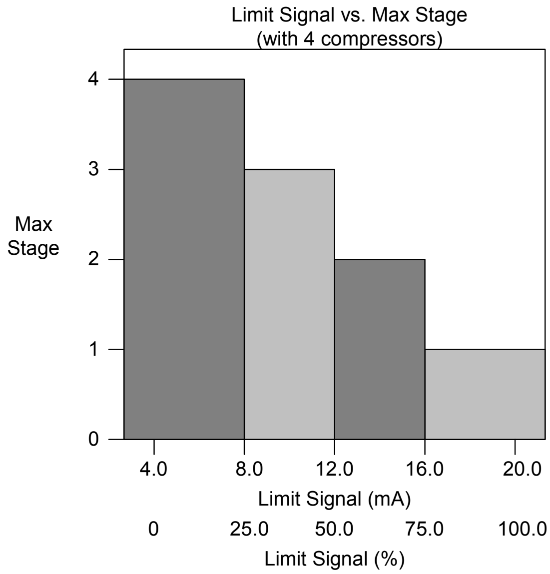
The maximum rate at which the leaving water temperature can drop is limited by the Maximum Pull-down Rate setpoint when the unit mode is COOL. If the rate exceeds this setpoint, no more compressors will be started until the Pull-down rate is less than the setpoint. Running compressors will not be stopped as a result of exceeding the maximum Pull-down rate.

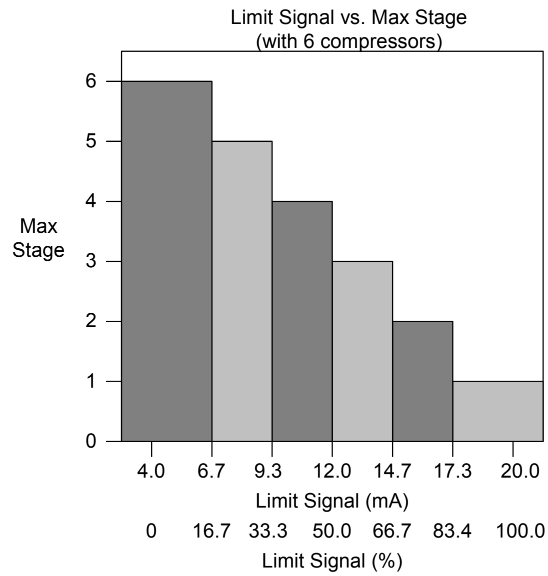
Unit Capacity Overrides

The following conditions override the automatic capacity control when the chiller is in COOL Mode only.

Demand Limit

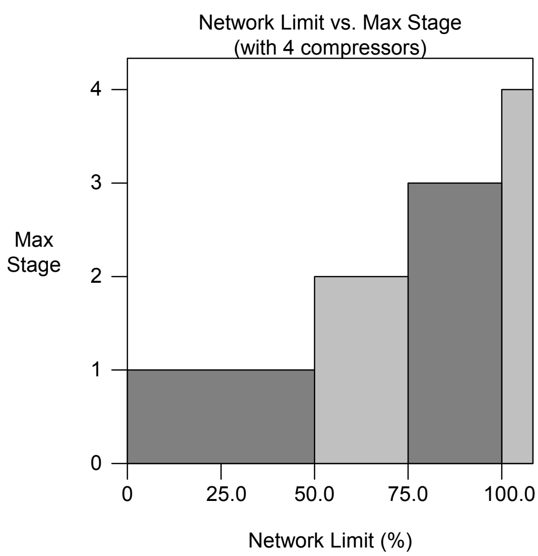
The maximum unit capacity can be limited by a 4 to 20 mA signal on the Demand Limit analog input. This function is only enabled if the Demand Limit setpoint is set to ON. The maximum unit capacity stage is determined as shown in the following graphs:

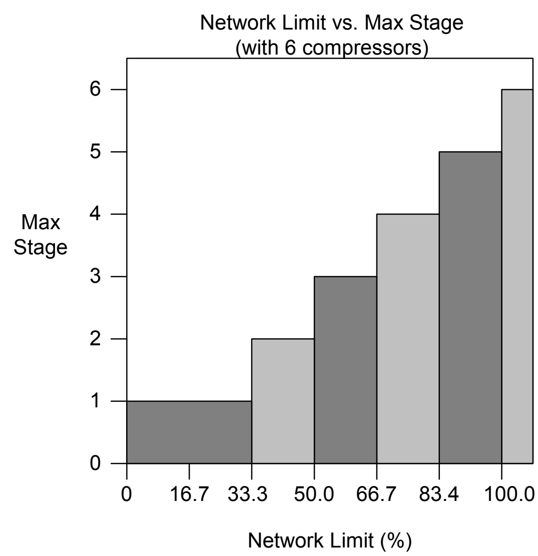




Network Limit

The maximum unit capacity can be limited by a network signal. This function is only enabled if the unit control source is set to network. The maximum unit capacity stage is based on the network limit value received from the BAS and is determined as shown in the following graphs:





Circuit Capacity Overrides – Limits of Operation

The following conditions override the automatic capacity control when the chiller is in COOL mode only. These overrides keep a circuit from entering a condition in which it is not designed to run.

Low Evaporator Pressure

If a compressor in a circuit is running, and the evaporator pressure drops below the Low Evaporator Pressure-Hold setpoint, no more compressors will be allowed to start on that circuit. This limit is active until the evaporator pressure reaches the hold setpoint plus 5.0 psi.

If two or more compressors are running in a circuit, and the evaporator pressure drops below the Low Evaporator Pressure-Unload setpoint, the circuit will begin reducing capacity. If two compressors are running, one of the running compressors will be stopped. If three compressors are running, then one compressor will be stopped immediately. Ten seconds later, if the pressure has not risen above the unload setpoint; an additional compressor will be stopped. The last compressor on a circuit will not stop due to the unload condition. The low evaporator pressure unload event will clear when the evaporator pressure rises 5.0 psi above the Low Evaporator Pressure Hold setpoint.

High Condenser Pressure

If the discharge pressure rises above the High Condenser Pressure Unload setpoint and more than one compressor on the circuit is running, the circuit will stage down. One compressor will shutdown as soon as the pressure rises above the unload setpoint, and if two remain running, then one more will shut down 10 seconds later if the pressure is still above the unload setpoint. No stage up will be allowed on the circuit until the condenser pressure drops to the unload setpoint less 100 psi and the outdoor ambient temperature drops 5 °F.

High Ambient Limit

On units not configured with multi-point power connections, the maximum load amps could be exceeded at high ambient temperatures. For single point power connections, if all circuit #1 compressors are running, (or all but one compressor), and the OAT is greater than 116° F, then circuit# 2 is limited to running all but one compressor. The circuit 2 status will indicate if this is the case. This action will allow the unit to operate at higher temperatures than 116° F.

Low Ambient Starts

A low OAT start is initiated if the condenser refrigerant saturated temperature is less than 85.0°F when the first compressor starts. Once the compressor starts, the circuit is in a low OAT start state for a time equal to the Low OAT Start Time setpoint. During Low OAT Starts, the freezestat logic and low evaporator pressure events are disabled. The absolute limit for low evaporator pressure is enforced and the compressor will shutdown if the evaporator pressure drops below that limit.

When the Low OAT Start Timer has expired, if the evaporator pressure is greater than or equal to the Low Evaporator Pressure Unload setpoint, the start is considered successful and normal alarm and event logic is reinstated. If the evaporator pressure is less than the Low Evaporator Pressure Unload setpoint when the Low OAT Start Timer expires, the start is unsuccessful and the compressor will shutdown.

Three compressor restarts are allowed when a compressor fails in a Low Ambient Start attempt. On the third failed Low Ambient Start attempt the Restart Alarm is triggered and the circuit will not attempt to restart a compressor until the Restart alarm has been cleared.

Compressor Sequencing

Circuit Available

A circuit is available if the circuit switch input is on, no circuit alarms are active, and at least one of the compressors on the circuit is enabled. Timers that delay startup or staging of a circuit do not render the circuit unavailable.

Compressor Available

A compressor is considered available to start if all the following are true:

- The corresponding circuit is available
- Unit state is Auto
- Evaporator state is Run
- No cycle timers are active for the compressor
- No limit events are active for the corresponding circuit
- OAT lockout is not active
- The compressor is not already running
- The corresponding circuit is not in pumpdown

Compressor Sequencing

Compressor staging is based primarily on compressor run hours and starts. Compressors that have less starts will normally start before those with more starts. Compressors that have more run hours will normally shut off before those with less run hours. In the event of a tie on number of starts, the lower numbered compressor will start first. In the event of a tie on run hours, the lower numbered compressor will shut off first. Run hours are compared in terms of tens of hours.

Compressor Start/Stop Timing

This section determines when to start or stop a compressor. There are two separate functions used, one for staging up and one for staging down.

Stage Up Now

The **Stage Up Now** flag is set based on the following tests:

If Unit mode = Cool AND
no compressors are running AND
LWT error > Start delta + 0.5 * Control Band AND
Motor Protect Timer expired AND
Stage up timer expired THEN

Stage Up Now = True

If Unit Mode = Cool AND
At least one compressor is running AND
LWT error > 0.5 * Control band AND
Pulldown rate <= Max pulldown rate AND
Compressors running < unit capacity limit AND
Stage up timer expired THEN

Stage Up Now = True

If Unit Mode = Ice AND
no compressors are running AND
LWT error > Start delta + 0.5 * Control Band AND
Motor Protect Timer expired AND
Ice Delay Timer expired AND
Stage up timer expired THEN

Stage Up Now = True

If Unit Mode = Ice AND
LWT error > 0 AND
At least one compressor running THEN

Stage Up Now = True

Stage Down Now

If possible, circuits will be balanced in stage. If a circuit is unavailable for any reason, the other circuit is allowed to stage all compressors on. When staging down, one compressor on each circuit is left on until each circuit has only one compressor running.

Required Parameters

1. Number of starts for all compressors
2. Number of run hours for all compressors
3. Status of all compressors (Available/Unavailable)
4. Compressor number

The Stage Down Now flag is set based on the following tests:

If Unit Mode = Cool AND
LWT error < -0.5 * Control band AND
More than one compressor running AND
Stage down timer expired THEN

Stage Down Now = True

If Unit Mode = Cool AND
LWT error < (-0.5 * Control band - stop delta) AND
One compressor running AND
Stage down timer expired THEN

Stage Down Now = True

If Unit Mode = Cool AND
Number of compressors running > Demand limit AND
Stage down timer expired THEN

Stage Down Now = True

If Unit Mode = Ice AND
LWT error < 0 THEN
Stage Down Now = True

Manual Compressor Control

The operator can manually enable and disable individual compressors. When a compressor has been disabled, it is considered unavailable to start in the staging logic. With Manual Compressor control, it is possible to take a damaged compressor offline while the remaining compressors on the circuit can still provide some cooling.

A running compressor can not be disabled until it has been shutdown. If all of the compressors on a circuit have been disabled, then the circuit is disabled. If both circuits have all of their compressors disabled, the Unit state will remain "Off".

Normal Circuit Shutdown

If a condition arises that requires a circuit to shut down, but it is not an emergency situation, then the circuit will do a pumpdown. A normal circuit shutdown will be initiated when any of the following occur:

- Unit State = Pumpdown
- Circuit Switch = Off
- Low Ambient Lockout
- A normal stagedown occurs, and only one compressor on the circuit is running
- Unit mode = Ice AND the ice setpoint is reached

Pumpdown Procedure

- If multiple compressors are running, compressors will shut off based on sequencing logic.
- With one compressor left running, hot gas and liquid line output will turn off
- The compressor will keep running until evaporator pressure reaches the pumpdown pressure, then stops.
- If evaporator pressure does not reach pumpdown pressure within two minutes, the compressor will stop and log pumpdown failure event.

Rapid Circuit Shutdown

A situation may arise that requires a circuit to shut down immediately, without doing a pumpdown. This rapid shutdown will be triggered by any of the following:

- Unit State = Off
- Circuit Alarm
- Low ambient start attempt failed

All compressors, hot gas, and liquid line outputs will be turned off immediately for a rapid shutdown.

Cycle Timers

When a compressor starts, a start-to-start timer starts. When a compressor stops, a stop to start timer starts. Restart of the compressor is not allowed until both timers have elapsed a time greater than that determined by the start-to-start and stop-to-start timer setpoints.

Liquid Line Solenoid

The liquid line output is on any time a compressor on the circuit is running and the circuit is not performing a pumpdown. This output should be off at all other times.

Hot Gas Bypass Solenoid

This output is on when one compressor on the circuit is running and the circuit is not performing a pumpdown. The output is off at all other times.

EXV Control

The EXV control logic is active regardless of the expansion valve type setting. While a circuit is in the run state, the EXV controls suction superheat. The superheat target is 8°F. A PID logic is used to control the superheat to the target value.

Any time the circuit is not in the run state, the EXV position should be 0.

EXV Control Range

Table 22 shows the EXV range based on the number of compressors running and the total number of fans on the unit.

Table 22, EXV Range

		Compressors Running		
		1	2	3
Num Fans = 4	EXV Min	8%	8%	-
	EXV Max	40%	60%	-
Num Fans = 6	EXV Min	8%	8%	-
	EXV Max	60%	100%	-
Num Fans = 8	EXV Min	8%	8%	8%
	EXV Max	40%	55%	70%
Num Fans = 10	EXV Min	8%	8%	8%
	EXV Max	50%	70%	100%

Manual EXV Control

The EXV position can be set manually. Manual control can only be selected when the circuit is in the run state. At any other time, the EXV control setpoint is forced to auto.

When EXV control is set to Auto, the manual EXV position setting follows the auto control position. When EXV control is set to Manual, the EXV position is equal to the manual EXV position setting.

Condenser Fan Control

VFD

Condenser pressure trim control is accomplished using an optional VFD to control the speed of the first fan on each circuit. This VFD speed signal is linear ranging from the Maximum Speed to the Minimum setpoints, centered on the Saturated Condenser Temperature Target setpoint in a temperature range of 20.0-degrees F.
The condenser fan VFD will start when the condenser refrigerant saturated temperature is 10.0°F below the Saturated Condenser Temperature Target.

The condenser fan VFD will stop when the condenser refrigerant saturated temperature is 20.0 ° F below the Saturated Condenser Temperature Target. All other fans on the circuit must be Off before the condenser fan VFD will stop.

Stage Up Compensation

In order to create a smoother transition when another fan is staged on, the VFD compensates by slowing down initially. This is accomplished by resetting the VFD target to the saturated condenser temperature at the time of the stage up. The higher target causes the VFD logic to decrease fan speed. Then, every 5 seconds, 0.5°F is subtracted from the VFD target until it is equal to the saturated condenser temperature target setpoint. This will allow the VFD to slowly bring the saturated condenser temperature back down.

Fantrol

Fans 1, 3, 5, and 7 are for circuit #31, and fans 2, 4, 6, and 8 are for circuit #2. Fans 1 and 2 start with the first compressor on the respective circuit when the ambient temperature is greater than 75°F. Below 75°F, these fans start when the condenser saturated temperature gets up to the target. The compressor must be running in order to run any fans.

Fan Stages

There are 2, 3, 4, or 5 fans available per circuit. On 8 fan units and 10 fan units, fans 5/7 and

6/8 are controlled by one contactor for each pair, using virtual stages to allow a difference of only one fan between stages. See Table 23:

Table 23, Fan Staging

4 and 6 Fan Units			8 Fan Units			10 Fan Units		
Stage	**Fans On Cir 1**	**Fans On Cir 2**	**Stage**	**Fans On Cir 1**	**Fans On Cir 2**	**Stage**	**Fans On Cir 1**	**Fans On Cir 2**
1	1	2	1	1	2	1	1	2
2	1,3	2,4	2	1,3	2,4	2	1,3	2,4
3	1,3,5	2,4,6	3	1,5,7	2,6,8	3	1,5,7	2,6,8
-	-	-	4	1,3,5,7	2,4,6,8	4	1,3,5,7	2,4,6,8
-	-	-	-	-	-	5	1,3,5,7,9	2,4,6,8,10

Normal Operation - Staging Up

At startup, the first fan will start when the saturated condenser temperature rises above the target.
After this, the stage up deadbands apply.

When the saturated condenser temperature is above the Target + the active deadband, a Stage Up error is accumulated.

Stage Up Error Step = Saturated Condenser Refrigerant temperature – (Target + Stage Up dead band).

The Stage Up Error Step is added to Stage Up Accumulator once every Stage Up Error Delay seconds. When Stage Up Error Accumulator is greater than the Stage Up Error Setpoint, another stage is started.

When a stage up occurs or the saturated condenser temperature falls back within the Stage Up dead band, the Stage Up Accumulator is reset to zero.

Normal Operation - Staging Down

There are four Stage Down dead bands, one for each stage.

When the saturated condenser refrigerant temperature is below the Target – the active deadband, a Stage Down error is accumulated.

Stage Down Error Step = (Target - Stage Down dead band) - Saturated Condenser Refrigerant Temperature

The Stage Down Error Step is added to Stage Down Accumulator once every Stage Down Error Delay seconds. When the Stage Down Error Accumulator is greater than the Stage Down Error Setpoint, another stage of condenser fans turns off. The last stage on will not shut off until the circuit is in an off state.

When a stage down occurs, or the saturated temperature rises back within the Stage Down dead band, the Stage Down Error Accumulator is reset to zero.

Forced Fan Stage At Start

Fans may be started simultaneously with the compressor based on outdoor ambient temperature (OAT). When the compressor starts, a Fantrol stage is forced, based on Table 24

Table 24, Forced Fan Staging

OAT	Fantrol Stage At Start
> 75 °F	Forced Fan 1 SP
> 90 °F	Forced Fan 2 SP
> 105 °F	Forced Fan 3 SP

Up to four fans may be forced on when the compressor starts. If the unit has the VFD option, then only three fans can start with the compressor, and the VFD will start normally when the saturated condenser temperature is higher than the target.

After forcing fans on, the saturated condenser temperature may temporarily stay below the target by some amount. In order to keep these fans from staging off, no stage down error can be accumulated until either the OAT drops below 75°F or the saturated condenser temperature goes above the target.

Alarms and Events

Situations may arise that require some action from the chiller or that should be logged for future reference. A condition that causes a shutdown and requires manual reset is known as a stop alarm. Other conditions can trigger what is known as an event, which may or may not require an action in response. All stop alarms and events are logged.

Unit Stop Alarms

The alarm output and red button LED on the controller keypad are turned ON when any stop alarm occurs. They are turned off when all alarms have been cleared.

Evaporator Flow Loss

Alarm description (as shown on screen): Evap Water Flow Loss

Trigger:
1: Evaporator Pump State = Run AND Evaporator Flow Digital Input = No Flow for time > Flow Proof Setpoint AND at least one compressor running

2: Evaporator Pump State = Start for time greater than Recirc Timeout Setpoint AND all pumps have been tried AND Evaporator Flow Digital Input = No Flow

Action Taken: Rapid stop all circuits.

Reset: This alarm can be cleared at any time manually via the keypad or via the BAS clear alarm signal.

If active via trigger condition 1:

When the alarm occurs due to this trigger, it can auto reset the first two times each day, with the third occurrence being manual reset.

For the auto reset occurrences, the alarm will reset automatically when the evaporator state is Run again. This means the alarm stays active while the unit waits for flow, then it goes through the recirculation process after flow is detected. Once the recirculation is complete, the evaporator goes to the Run state which will clear the alarm. After three occurrences, the count of occurrences is reset and the cycle starts over if the manual reset flow loss alarm is cleared.

If active via trigger condition 2:

If the flow loss alarm has occurred due to this trigger, it is always a manual reset alarm.

Evaporator Water Freeze Protect

Alarm description (as shown on screen): Evap Water Freeze

Trigger: Evaporator LWT drops below evaporator freeze protect setpoint AND Unit State = Auto

Action Taken: Rapid stop all circuits

Reset: This alarm can be cleared manually via the keypad or via the BAS clear alarm signal, but only if the alarm trigger conditions no longer exist.

Leaving Evaporator Water Temperature Sensor Fault

Alarm description (as shown on screen): Evap LWT Sens Fault

Trigger: Sensor shorted or open.

Action Taken: Normal stop all circuits

Reset: This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

Outdoor Air Temperature Sensor Fault

Alarm description (as shown on screen): OAT Sensor Fault

Trigger: Sensor shorted or open

Action Taken: Normal stop all circuits.

Reset: This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

Circuit Stop Alarms

All circuit stop alarms will shutdown the circuit on which they occur. Rapid stop alarms do not do a pumpdown before shutting off. All other alarms will do a pumpdown.

The red button LED on the circuit controller is turned on when any circuit stop alarm occurs. It is turned off when all circuit alarms have been cleared. In addition, the alarm status is sent to the unit control so the alarm output and the red button LED on the unit controller can be energized while alarms are active.

Alarm descriptions apply to both circuits, the circuit number is represented by 'N' in the description.

Low Evaporator Pressure

Alarm description (as shown on screen): Evap Press Low Cir N

Trigger: [Circuit State = Run AND Freezestat trip AND Low OAT Start not active]
OR Evaporator Press < Absolute Low Pressure Limit AND Circuit State = Run

The absolute low pressure limit is 20 psi with R-410A refrigerant.

Freezestat logic allows the circuit to run for varying times at low pressures. The lower the pressure, the shorter the time the compressor can run. This time is calculated as follows:

Freeze error = Low Evaporator Pressure Unload – Evaporator Pressure
Freeze time = 60 – freeze error
with R-410A refrigerant, limited to a range of 20-60 seconds or 40-80 seconds for units with 6 compressors, electronic expansion valve, and 10 or more fans

When the evaporator pressure goes below the Low Evaporator Pressure Unload setpoint, a timer starts. If this timer exceeds the freeze time, then a freezestat trip occurs. If the evaporator pressure rises to the unload setpoint or higher, and the freeze time has not been exceeded, the timer will reset.

Action Taken: Rapid stop circuit

Reset: This alarm can be cleared manually via the keypad if the evaporator pressure is above the absolute low pressure limit.

High Condenser Pressure

Alarm description (as shown on screen): Cond Press High Cir N

Trigger: Condenser Pressure > High Condenser Pressure Setpoint

Action Taken: Rapid stop circuit.

Reset: This alarm can be cleared manually via the keypad.

Mechanical High Pressure/Motor Protect

Alarm description (as shown on screen): MHP or Motor Prot N

Trigger: MHP/MP input is low and over 150 seconds lapsed since controller bootup.

Action Taken: Rapid stop circuit.

Reset: This alarm can be cleared manually via the keypad if the MHP/MP input is high.

Phase Voltage Protection

Alarm description (as shown on screen): Phase/Voltage Cir N

Trigger: PVM input is low and Phase Voltage setpoint = enable.

Action Taken: Rapid stop circuit.

Reset: Auto reset when PVM input is high.

Ground Fault Protection

Alarm description (as shown on screen): Ground Fault Cir N.

Trigger: GFP input is low and Ground Fault setpoint = enable.

Action Taken: Rapid stop circuit.

Reset: Auto reset when GFP input is high.

Low OAT Restart Fault

Alarm description (as shown on screen): Low OAT Start Fail N.

Trigger: Circuit has failed three low OAT start attempts.

Action Taken: Rapid stop circuit.

Reset: This alarm can be cleared manually via the keypad.

No Pressure Change At Start

Alarm description (as shown on screen): NoPressChgAtStart N

Trigger: After start of first compressor on the circuit, at least a 1 psi drop in evaporator pressure OR a 5 psi increase in condenser pressure has not occurred after 15 seconds

Action Taken: Rapid stop circuit

Reset: This alarm can be cleared manually via the keypad.

Evaporator Pressure Sensor Fault

Alarm description (as shown on screen): EvapP Sensor Fail N.

Trigger: Sensor shorted or open.

Action Taken: Rapid stop circuit.

Reset: This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

Condenser Pressure Sensor Fault

Alarm description (as shown on screen): CondP Sensor Fail N.

Trigger: Sensor shorted or open.

Action Taken: Rapid stop circuit.

Reset: This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

Suction Temperature Sensor Fault

Alarm description (as shown on screen): SuctT Sensor Fail N.

Trigger: Sensor shorted or open AND Expansion Valve Type = Electronic.

Action Taken: Rapid stop circuit.

Reset: This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

Circuit Events

The following events limit operation of the circuit in some way as described in the Action Taken section for each event. The occurrence of a circuit event only affects the circuit on which it occurred. Circuit events are logged in the event log.

Low Evaporator Pressure - Hold

Event description (as shown on screen): Evap Press Low HoldN.

Trigger:
This event is triggered if all of the following are true:

- circuit state = Run.
- circuit is not currently in a low OAT start.
- it has been at least 30 seconds since a compressor has started on the circuit.
- evaporator pressure <= Low Evaporator Pressure - Hold setpoint.

Action Taken: Inhibit staging on of additional compressors on the circuit.

Reset: While still running, the event will be reset if evaporator pressure > (Low Evaporator Pressure - Hold setpoint + 13 psi for R-410A). The event is also reset if the circuit state is no longer run.

Low Evaporator Pressure - Unload

Event description (as shown on screen): EvapPressLow Unload N

Trigger:

This event is triggered if all of the following are true:

- circuit state = Run.
- more than one compressor is running on the circuit.
- circuit is not currently in a low OAT start.
- it has been at least 30 seconds since a compressor has started on the circuit.
- evaporator pressure <= Low Evaporator Pressure - Unload setpoint for a time greater than half of the current freezestat time.

Action Taken: Stage off one compressor on the circuit every 10 seconds, except the last one.

Reset: While still running, the event will be reset if evaporator pressure > (Low Evaporator Pressure - Hold setpoint + 13 psi for R-410A). The event is also reset if the circuit state is no longer run.

High Condenser Pressure - Unload

Event description (as shown on screen):
CondPressHighUnloadN.

Trigger:
This event is triggered if all of the following are true:

- circuit state = Run
- more than one compressor is running on the circuit
- condenser pressure > High Condenser Pressure – Unload setpoint

Action Taken: Stage off one compressor on the circuit every 10 seconds, except the last.

Reset: While still running, the event will be reset if condenser pressure <= (High Condenser Pressure - Unload setpoint - 100psi for R-22/R-407C or 125 psi for R-410A). The event is also reset if the circuit state is no longer run.

Failed Pumpdown

Event description (as shown on screen):
Pumpdown Fail Cir N

Trigger: Circuit state = pumpdown for time > 60 seconds

Action Taken: Shutdown circuit

Reset: N/A

Alarm Log

An alarm log stores the last 25 alarms and/or events that occur. When an alarm or event occurs, it is put into the first slot in the alarm log and all others are moved down one, dropping the last entry. In the alarm log, the date and time the alarm occurred are stored, as well as a list of other parameters. These parameters include compressor states, evaporator pressure, condenser pressure, number of fans on, OAT, and evaporator LWT.

Event Log

An Event Log similar to the Alarm Log stores the last 25 event occurrences. There must be an active password for access to the Event Log. To navigate to the Event log press the Left Arrow key from any Alarm Log screen. When an event occurs, it is recorded in the first slot in the Event Log. All other entries are moved down in the Event Log and the last entry is dropped if 25 earlier event occurrences have been logged. Each Event Log entry includes an event description and a time and date stamp for the event occurrence.

Active Alarms

When an alarm or event occurs, it appears in the active alarm list. The active alarm list holds a record of all active alarms and events, which includes the date and time each occurred.

Clearing Alarms

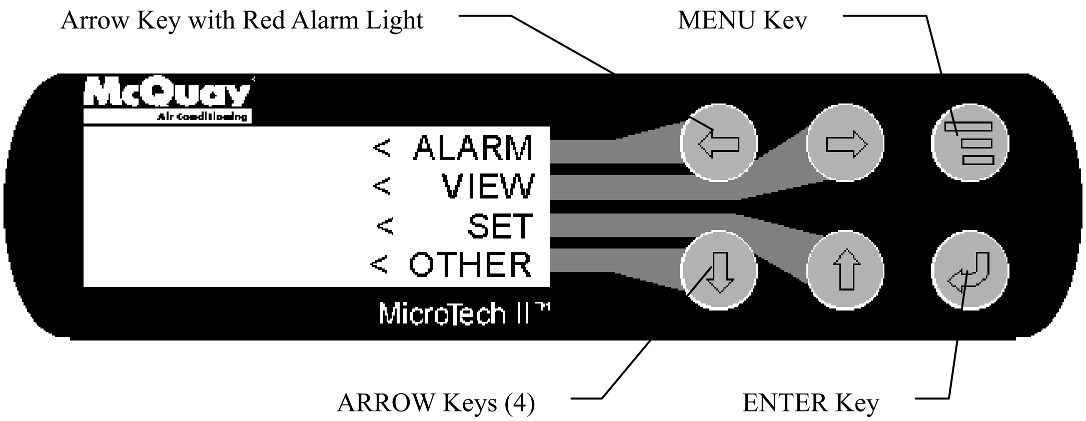
A password is NOT required to clear active alarms under the "Alarm Active" menu. View the active alarm(s) and correct any potential causes. Once the appropriate corrective actions have been taken, press the down arrow until the screen reads "Alarm Active, No more alarms, Press ENTER to clear all active alarms." Pressing the ENTER button will clear the alarm(s) unless the trip condition still exists. If the alarm clears, the red left arrow alarm light will go out and no active alarms will be displayed. Attempting to clear an alarm while the condition still exists will immediately generate a new alarm.

4x20 Display & Keypad

Layout

A 4 line by 20 character/line liquid crystal display (LCD) and 6-key keypad is be available on each controller. Its layout is shown below.

Figure 3, Display (in MENU mode) and Keypad



Getting Started

There are two basic procedures to learn in order to utilize the MicroTech II controller:

1. Knowing where a particular screen is located and navigating through the menu matrix to reach it.
2. Knowing what is contained in a menu screen and how to read that information, or how to change a setpoint contained in the menu screen.

Navigating Through the Menus

The menus are arranged in a matrix of screens across a top horizontal row. Some of these top-level screens have sub-screens located under them. The general content of each screen and its location in the matrix are shown in Table 26 on page 38. A detailed description of each menu begins on page 40.

There are two ways to navigate through the menu matrix to reach a desired menu screen.

1. Scroll Mode: Scroll through the matrix from one screen to another using the four ARROW keys.
2. Menu Mode: Use shortcuts to work through the matrix hierarchy. From any menu screen, pressing the MENU key will take you to the top level of the hierarchy. The display will show ALARM, VIEW, and SET as shown in Figure 3. This corresponds to the second row of screens on Table 26. One of these groups of screens can then be selected by pressing the key connected to it via the pathway.

For example, selecting ALARM will go the next row of menus under ALARM (ALARM LOG or ACTIVE ALARM). Selecting VIEW will go the next level of screens under VIEW (VIEW UNIT STATUS or VIEW UNIT TEMP). Selecting SET will go to a series of screens for viewing and changing setpoints.

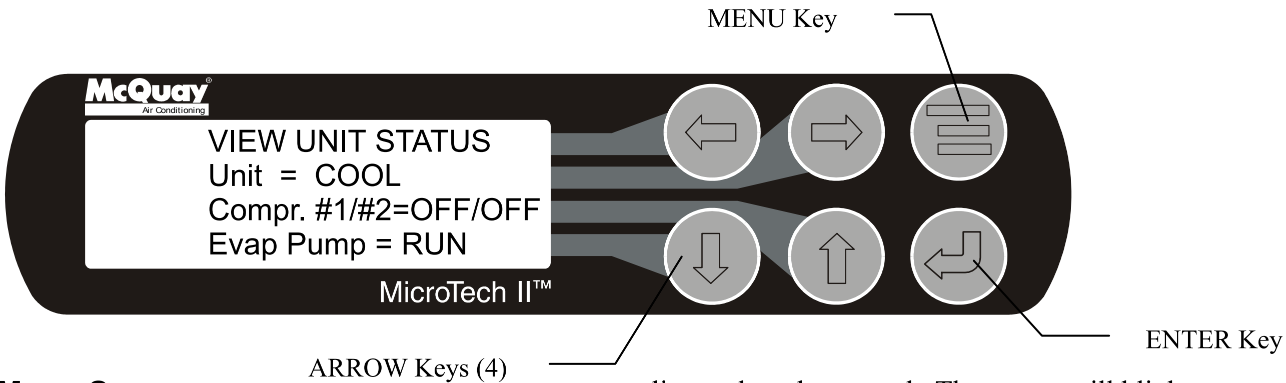
MENU Key

The MENU key is used to switch between the shortcut method (known as the MENU mode and as shown in Figure 3) and scrolling method (known as the SCROLL mode shown inFigure 4). The MENU mode is the shortcut to specific groups of menus used for checking ALARMS, for VIEWING information, or to SET setpoint values. The SCROLL mode allows the user to move about the matrix (from one menu to another, one at a time) by using the four ARROW keys. A typical menu screen is shown in

Figure 4.

Pressing the MENU key from any menu screen will automatically return you to the MENU.

Figure 4, Display in the Shortcut (SCROLL) Mode and Keypad Layout



Menu Screens

The menus are shown in the controller display. Each menu screen shows specific information; in some cases menus are used only to *view* the status of the unit, in some cases they are used for checking and clearing *alarms*, and in some cases they are used to *set* setpoint values.

The ARROW keys on the controller can be used to navigate through the menus. The keys are also used to change numerical setpoint values contained in certain menus.

Changing Setpoints

Pressing the ENTER key changes the function of the ARROW keys to the editing function as shown below:

- LEFT key Default, changes a value to the factory-set default value.
- RIGHT key Cancel, cancels any change made to a value and returns to the original setting.
- UP key Increment, increases the value of the setting.
- DOWN key Decrement decreases the value of a setting.

These four edit functions are indicated by one-character abbreviation on the right side of the display (this mode is entered by pressing the ENTER key).

Most menus containing setpoint values have several different setpoints shown on one menu. When in a setpoint menu, the ENTER key is used to proceed from the top line to the second line and on downward. The cursor will blink at the entry point for making a change. The ARROW keys (now in the edit mode) are used to change the setpoint, as described above. When the change has been made, press the ENTER key to enter it. No setting is changed until the ENTER key is pressed.

For example, to change the chilled water setpoint:

1. Press MENU key to go to the MENU.
2. Press SET (the UP Key) to go to the setpoint menus.
3. Press UNIT SPs (the Right key) to go to setpoints associated with unit operation.
4. Press the DOWN key to scroll down through the setpoint menus to the third menu which contains Evap LWT=XX.X°F.
5. Press the ENTER key to move the cursor down from the top line to the second line in order to make the change.
6. Use the ARROW keys (now in the edit mode as shown above) to change the setting.
7. When the desired value is achieved, press ENTER to enter it. The cursor will automatically move down.

At this point, the following actions can be taken:

1. Change another setpoint in this menu by scrolling to it with the ENTER key
2. Using the ENTER key, scroll to the first line in the menu. From there the ARROW keys can be used to scroll to different menus.

Keys

Arrow Keys

The four arrow keys (UP, DOWN, LEFT, RIGHT) have three modes of use.

1. Scroll between data screens as indicated by the arrows (default mode).
2. Select a specific data screen in a hierarchical fashion using dynamic labels on the right side of the display (this mode is entered by pressing the MENU key).
3. Change field values in edit mode according to the following table:

LEFT	Default
RIGHT	Cancel
UP	Increment
DOWN	Decrement

These four edit functions are indicated by one-character abbreviations on the right side of the display (this mode is entered by pressing the ENTER key).

MENU Key

The MENU key (upper right corner) switches the arrow keys between “scroll” and “menu” modes for selecting a specific data screen according to the following table:

Current Mode of Arrow Keys	Mode After MENU Key is Pressed
Scroll (default)	Menu (top level)
Menu (top level)	Scroll
Menu (lower level)	Menu (up one level)

Enter Key

On screens with changeable fields, pressing this key switches the arrow keys to “edit” mode and selects the first field on the screen (if the required password is active). Pressing this key again selects the next field to edit. When the last field is selected, pressing this key switches the display out of “edit” mode and returns the arrow keys to “scroll” mode. This key also clears alarms in the active alarm column.

Navigation

Shortcut Menus

A hierarchical menu structure is available to access the various screens. One to four levels may be used with two or three being typical. Optionally, the last menu selection can access one of a set of screens that can be navigated with the UP/DOWN arrow keys (see the scrolled menu structure below). Menu selection is initiated by pressing the MENU key which changes the display from a data screen to a menu screen. Menu selections are then made using the arrow keys according to labels on the right side of the display (the arrows are ignored). When the last menu item is selected, the display changes to the selected data screen. An example follows showing the selection of the “VIEW FANS screen on the unit controller.

Suppose the initial screen is:

```
ALARM LOG
      (data)
      (data)
      (data)
```

After pressing the MENU button, the top level menu screen will appear:

```
             < ALARM
             <  VIEW
             <   SET
             <
```

After pressing the “VIEW” menu button, a menu screen will appear:

```
VIEW    <       UNIT
        < CIR STATUS
        <REFRIGERANT
        <       FANS
```

After pressing the “FANS” menu button, the selected data screen will show:

```
VIEW FANS          (1)
Fans On, Cir 1 = 0
Fans On, Cir 2 = 0
```

The arrow keys will automatically return to the “scroll” mode at this time.

Shortcut Menu Structure

These menus are accessed by pressing the menu button at any time. The hierarchical structure of the shortcut menus is shown in Table 25.

Table 25, Shortcut Menu Structure

Level 1	Level 2	Level 3	Level 4	
TOP LEVEL	VIEW	UNIT	STATUS	> VIEW UNIT STATUS (1)
			TEMP	> VIEW UNIT TEMP (1)
		CIRCUIT	CIRCUIT 1	> VIEW CIRCUIT 1 (1)
			CIRCUIT 2	> VIEW CIRCUIT 2 (1)
		REFRIGERANT	CIRCUIT 1	> VIEW REFRG CIR 1 (1)
			CIRCUIT 2	> VIEW REFRG CIR 2 (1)
		FANS	> VIEW FANS/TOWER (1)	
	ALARM	LOG	> ALARM LOG (1)	
		ACTIVE	> ALARM ACTIVE (1)	
	SET	UNIT SPS	> SET UNIT SPs (1)	
		COMPRESSOR SPS	> SET COMP SPs (1)	
		ALARM LIMITS	> SET ALARM LIMITS (1)	
		FANS	> SET FANS SPs (1)	

Scrolling

As an alternate to selecting screens using the shortcut menus, it is possible to scroll through the menu matrix with the 4 arrow keys. The unit controller and circuit controllers each have their own menu matrix. The left and right arrow keys move left and right through the columns in the matrix, and the up and down keys move up or down within the columns.

If the user scrolls to the leftmost or rightmost column in the matrix, further key presses in that direction will have no effect. When the top or bottom screen in a column is reached, the up/down keys will cause the display to wrap around to the top or bottom screen.

Menu Matrix

When scrolling through the screens, the following matrix is used:

Table 26, MENU Matrix

VIEW UNIT STAT (1)	VIEW UNIT TEMP (1)	VIEW CIR 1 (1)	VIEW CIR 2 (1)	VIEW REFRG CIR 1 (1)	VIEW REFRG CIR 2 (1)	VIEW FANS (1)	Event LOG (1)	ALARM LOG (1)	ALARM ACTIVE (1)	SET UNIT SPs (1)	SET COMP SPs (1)	SET ALARM LIMITS (1)	SET FANS SPs (1)	TEST UNIT (1)
VIEW UNIT STAT (2)	VIEW UNIT TEMP (2)	VIEW CIR 1 (2)	VIEW CIR 2 (2)	VIEW REFRG CIR 1 (2)	VIEW REFRG CIR 2 (2)	VIEW FANS (2)	. . . .	. . . .	. . . .	. . . .	SET COMP SPs (2)	SET ALARM LIMITS (2)	. . . .	TEST UNIT (2)
VIEW UNIT STAT (3)	VIEW UNIT TEMP (3)	VIEW CIR 1 (3)	VIEW CIR 2 (3)	VIEW REFRG CIR 1 (3)	VIEW REFRG CIR 2 (3)	VIEW FANS (3)	. . . .	. . . .	. . . .	. . . .		SET ALARM LIMITS (3)	. . . .	TEST UNIT (3)
VIEW UNIT STAT (4)	VIEW UNIT TEMP (4)	VIEW CIR 1 (4)	VIEW CIR 2 (4)				. . .	. . .	. . .	. . .		SET ALARM LIMITS (4)	. . .	TEST UNIT (4)
VIEW UNIT STAT (5)							Event LOG (n)	ALARM LOG (n)	ALARM ACTIVE (n)	SET UNIT SPs (15)			SET FANS SPs (6)	TEST UNIT (5)

Version Screen

The software version and type can be viewed using a combination key press. Pressing the enter key and menu key simultaneously will take you to the version screen. This screen is not part of the menu matrix, so scrolling will not exit. To get back to the menu matrix, press the menu key. Then, either use the shortcut menus, or press the menu key again to go to the Unit Status column.

Editing

Editing is accomplished by pressing the ENTER key until the desired field is selected. This field is indicated by a blinking cursor under it. The arrow keys then operate as defined below:

LEFT=	CANCELReset the current field to the value it had when editing began.
RIGHT=DEFAULT	Set value to original factory setting.
UP=INCREMENT	Increase the value or select the next item in a list.
DOWN=DECREMENT	Decrease the value or select the previous item in a list.

During edit mode, the display shows a two-character wide menu pane on the right as shown below.

```
SET UNIT SPs (X)   <D
     (data)        <C
     (data)        <+
     (data)        <-
```

Additional fields can be edited by pressing the ENTER key until the desired field is selected. When the last field is selected, pressing the ENTER key switches the display out of "edit" mode and returns the arrow keys to "scroll" mode.

Screen Definitions – MENU

Top level menu

```
             < ALARM
             <  VIEW
             <   SET
             <
```

Unit Mode is NOT TEST

```
             < ALARM
             <  VIEW
             <   SET
             <  Test
```

Unit Mode is TEST

```
ALARM       < ACTIVE
            <    LOG
            <
            <
```

```
VIEW   <        UNIT
       <     CIRCUIT
       < REFRIGERANT
       <        FANS
```

```
VIEW   <      STATUS
UNIT   <        TEMP
```

```
VIEW         <  CIR 1
CIRCUIT      <  CIR 2
```

```
VIEW         <  CIR 1
REFRIGERANT  <  CIR 2
```

```
SET <   ALARM LIMITS
    <      UNIT SPs
    < COMPRESSOR SPs
    <      FANS SPs
```

Screen Definitions – VIEW

This section contains information on each menu screen. The menu screens are in order of the matrix in Table 26, going from left to right and then down when there are sub-menus. Many menus are self-explanatory.

View Unit Status

```
VIEW UNIT STATUS (1)
Off:Unit Switch
Cool Stage=0
Evap Pump=Off
```

The unit status displayed may be any of the following:

Auto	Off:Ice Mode Timer	Off:Ice Mode N/A
Off:All Cir Disabled	Off:Unit Alarm	Off:Keypad Disable
Off:Remote Switch	Off:BAS Disable	Off:Unit Switch
Off:Test Mode	Auto:Unit Cap Limit	Auto:Wait for load
Auto:OAT Low	Auto:Evap Recirc	Auto:Wait for flow
Auto:Pumpdown	Auto:High LWT Pulldn	

```
VIEW UNIT STATUS (2)
Demand Limit= Stg X
Network Limit=Stg X
```

```
VIEW UNIT STATUS (3)
Stg Up Delay=XXXXsec
Stg Dn Delay=XXXXsec
Ice Delay=   XXh XXm
```

The Ice Delay is displayed only when the unit mode is ICE.

```
VIEW UNIT STATUS (4)
D.O.      111111111
 123456789012345678
 111111111111111111
```

Outputs are numbered from 1 to 18, left to right. The bottom row shows the actual status of each output, with 0 meaning off and 1 meaning on.

```
VIEW UNIT STATUS (5)
D.I.      111111111
 123456789012345678
 111111111111111111
```

Inputs are numbered from 1 to 18, left to right. The bottom row shows the actual status of each input, with 0 meaning off and 1 meaning on.

```
VIEW UNIT STATUS (6)
   Analog Outputs
   (volts X 100)
1=XXX.X   2=XXX.X
```

```
VIEW UNIT STATUS (7)
Analog Inputs (mA)
Demand Limit= XX.X
   LWT Reset= XX.X
```

```
VIEW UNIT STATUS (8)
EXB1 Online
D.O.  1 3 4
      1 1 1
```

View Unit Temp

```
VIEW UNIT TEMP   (1)
Evap LWT =  XXX.X °F
OAT = XXX.X °F
LWT Target = XX.X °F
```

```
VIEW UNIT TEMP   (2)
LWT Pulldn=XX.X °F/m
Control Band=XX.X °F
```

```
VIEW UNIT TEMP   (3)
Control Temps:
Start Up XX.X °F
Stage Up XX.X °F
```

```
VIEW UNIT TEMP   (4)
Control Temps:
Stage Down XX.X °F
Shut Down  XX.X °F
```

View Circuit Status

The following four screens are duplicated for circuit # 2. Units with two compressors per circuit (AGZ 030C through AGZ 100C) will not have screen #4 present. Circuit 1 has compressor #1, #3, (#5), circuit 2 has compressor #2, #4, (#6).

```
VIEW CIR X STATUS(1)
Off:Pumpdown Switch
```

```
VIEW CIR X STATUS(2)
CompX=Off
Hours= XXXXX
Starts= XXXXX
```

```
VIEW CIR X STATUS(3)
CompX=Off
Hours= XXXXX
Starts= XXXXX
```

```
VIEW CIR X STATUS(4)
CompX=Off
Hours= XXXXX
Starts= XXXXX
```

View Refrigerant

The following four screens are duplicated for circuit # 2

```
VIEW REFRG CIR X (1)
Evap Press= XXX.Xpsi
Cond Press= XXX.Xpsi
```

```
VIEW REFRG CIR X (2)
```

```
Sat Evap= XXX.X °F
Sat Cond= XXX.X °F
```

```
VIEW REFRG CIR X (3)
Suct Temp= XXX.X °F
Superheat= XXX.X °F
Evap Appr= XX.X °F
```

Evap Appr (evaporator approach temperature) is the difference between the leaving fluid temperature and the saturated evaporator temperature. It is an indication of the evaporator efficiency; an increasing approach temperature indicates decreasing heat transfer efficiency.

```
VIEW REFRG CIR X (4)
EXV Ctrl=Closed
EXV Pos=XXX.X
SH Target= XX.X °F
```

```
VIEW REFRG CIR X (5)
EXV Ctrl Range
 XX.X% - XXX.X%
```

View Fans

```
VIEW FANS         (1)
  Fans On  VFD Speed
Cir 1= X     XXX.X%
Cir 2= X     XXX.X%
```

VFD speed is displayed only when the VFD option is enabled.

```
VIEW FANS         (2)
Stg Error  Up   Down
Cir 1=     XXX  XXX
Cir 2=     XXX  XXX
```

```
VIEW FANS         (3)
Sat Cond
 Target= XXX.X°F
```

Screen Definitions – ALARM/EVENT

```
Alarm Active
Alarm Description
Time/Date
```

.

```
Alarm Active
No more alarms
Press ENTER to clear
   all active alarms
```

If the unit is off on a shutdown alarm, or running, but in a limit alarm condition, the cause, date/time, and UNIT STATUS will appear in the ALARM ACTIVE screen. The remote alarm relay will close, and a red light will appear behind the LEFT button. The light will go out when the fault is cleared. If there is a simultaneous occurrence of more than one alarm, the others will appear in additional screens below this one, accessed by the DOWN ARROW.

If an alarm occurs, press the MENU button, then the LEFT button for ALARM, and then the left button again to reach the ALARM ACTIVE screen.

The cause of the alarm must be remedied before attempting to clear the alarm. To clear the alarm(s), scroll down to the last screen (bottom screen above) and press ENTER. The SET UNIT SPs screen will appear and the password will be asked for. Press ENTER and the cursor will flash in the password field. Press the UP button to scroll the numbers up to the required password. Press ENTER to clear.

If other faults have appeared, they will all be cleared at the same time.

```
Alarm Log        (X)
Alarm Description
Time/Date
Data:Edit and scroll
```

The last 25 alarms, either shutdown or limit, are shown in this menu with earlier alarm menus stored under it. ARROW DOWN from this menu will go to the next-to-last alarm, ARROW DOWN again will go to the second from last, and so on through the last 25 occurrences. The screens are numbered (1), (2), (3),....(X).

```
EVENT Log        (X)
Event Description
Hh:mm mm/dd/yy
```

Screen Definitions – SET

Changing setpoints; in general, setpoints are changed as follows:

1. Select the desired menu by scrolling through SET menus with the UP, DOWN, LEFT and RIGHT ARROWS. Alternatively, press the MENU button, select the type of setpoint desired, then up or down to the exact screen.

2. When the desired menu is selected, select the desired field within the menu by moving between lines using the ENTER key. Some fields may not be accessible due to settings in other menus.

3. If a numerical value is being changed, use the INCREMENT key (UP ARROW) to increase or the DECREMENT key (DOWN ARROW) to decrease the value of the setpoint.

   If a word-type setpoint (for example, YES or NO) is to be selected, the choices are loaded into the menu and selected by scrolling through the available setpoint options using the UP ARROW key.

4. Enter the desired value or word into the controller by pressing the ENTER key.

Stated another way, once the desired set screen is reached, editing is accomplished by pressing the ENTER key until the desired field is selected within the set screen. This field is indicated by the cursor blinking on it. The arrow keys will then operate as defined below.

CANCEL	Reset the current field to the value it had when editing began.
DEFAULT	Set value to original factory setting.
INCREMENT	Increase the value or select the next item in a list.
DECREMENT	Decrease the value or select the previous item in a list.

During edit mode, the display shows a two-character-wide menu pane on the right as shown below. These characters relate to the functions shown above. After a field has been set to the desired new values, press ENTER. This enters the value and scrolls to the next field.

```
SET UNIT SPs (X)   <D
     (data)        <C
     (data)        <+
     (data)        <-
```

Additional fields can be edited by pressing the ENTER key until the desired field is selected.

Two four-digit passwords provide OPERATOR and MANAGER levels of access to setpoints. The passwords are preprogrammed into the controller. The Operator Password is 0100, the Manager Password is 2001. Either password must be entered using the ENTER PASSWORD screen (15) before a protected setting can be changed.

This screen can be accessed either through the SET OTHER menu, or by simply pressing the ENTER key while on one of the SET screens. The controller will automatically go from the screen with the setting change to this screen. After the correct password has been entered, the controller will automatically return to the original set screen.

Once a password has been entered, it remains valid for 15 minutes after the last key-press.

NOTE: Setpoint default and range settings are given in Table 14 on page 16.

Unit Setpoints

```
SET UNIT SPs     (1)
Unit Enable = OFF
Mode = COOL
Source = KEYPAD
```

Unit Enable can only be edited when the source is set to keypad.
Mode can only be edited when the source is set to keypad and the available mode is set to Cool/Ice w/Glycol.

Unit Enable is an external signal, or a keypad setting, that keeps the unit off when the setting is OFF and *allows* it to run if there is a call for cooling when the setting is ON. The source for the signal is selected in the 4th line and can be:

1. KEYPAD- in which case the selection is made in line 2 and would be normally selected as ON. This is the normal setting when no external signals are controlling the unit.

2. SWITCHES- (Digital input), in which an external switch is wired across terminals #25 and #35. (See wiring diagram page 10).
3. NETWORK- used with BAS signal.

Unit Mode settings can be:

1. COOL- normal setting used with chilled water air-condition applications.
2. COOL w/GLYCOL- used with low temperature glycol applications. It allows a lower LWT setpoint to be used.
3. ICE w/GLYCOL- used with ice storage systems, allows changing from chilled glycol operation to lower temperature ICE operation. In ICE, the unit runs at full load until the ICE setpoint is reached, at which time the unit shuts off. A three-position switch wired to terminals #28 and #38 initiates the change from glycol cooling to making ice. (See wiring diagram on page 10.)
4. TEST- for use by service technician for certain test procedures.

```
SET UNIT SPs     (2)
Available Modes
  =COOL
Set w/UnitSwitch Off
```

Available Modes settings can be COOL, COOL w/Glycol, ICE w/Glycol, or TEST as selected from the available modes imbedded in the menu. The 4th line is a reminder that the ON/OFF switch on the front panel (FP) must be in the OFF position before the MODE can be changed. This prevents a mode change while the unit is operating.

```
SET UNIT SPs     (3)
Evap LWT = XX.X°F
Ice  LWT = XX.X°F
```

```
SET UNIT SPs     (4)
Evap Delta T= XX.X°F
Start Delta= XX.X°F
Stop Delta= XX.X°F
```

```
SET UNIT SPs     (5)
Max Pulldn=X.X°F/min
Evap Recirc=XXX sec
Evap Pump= #1 Only
```

```
SET UNIT SPs     (6)
Demand Limit=No
LowAmbLock= XX.X°F
Multipoint Power=No
```

```
SET UNIT SPs     (7)
Ice Time Delay=XXhrs
Clear Ice Delay=No
```

```
SET UNIT SPs     (8)
```

```
      CLOCK
    dd/mm/yyyy
    hh:mm weekday
```

```
SET UNIT SPs     (9)
Units = °F/psi
Lang  = ENGLISH
Refrig = SELECT TYPE
```

Units settings are only °F/psi at the present time. °C/kPa will be available later.

Lang (Language) settings can be only ENGLISH at present.

```
SET UNIT SPs    (10)
Protocol = Modbus
Ident Number=001
Baud Rate=9600
```

Ident Number and Baud Rate are accessible only when the protocol is set to Modbus®. For the other options, LONWORKS and BACnet®, the ident number and baud rate are locked to settings required for those protocols.

```
SET UNIT SPs    (11)
Evap Pressure Sensor
Cir1 Offset= XX.Xpsi
Cir2 Offset= XX.Xpsi
```

The pressure offsets on menus 10 and 11 and the temperature offsets on menus 12, 13 and 14 correct the controller's display of the parameters. The sensors used in these units have a high degree of repeatability but may need initial correction (offset). An accurate pressure gauge or thermometer is used to determine the correct temperature or pressure. A positive or negative offset value is then entered to make the controller reading agree with the measured value.

```
SET UNIT SPs    (12)
Cond Pressure Sensor
Cir1 Offset= XX.Xpsi
Cir2 Offset= XX.Xpsi
```

```
SET UNIT SPs    (13)
Suction Temp Sensor
Cir 1 Offset= XX.X°F
Cir 2 Offset= XX.X°F
```

```
SET UNIT SPs    (14)
Leaving Evaporator
Water Temp Sensor
Offset= XX.X°F
```

```
SET UNIT SPs    (15)
Outside Ambient
Temperature Sensor
Offset= XX.X°F
```

```
SET UNIT SPs    (16)
ENTER PASSWORD: XXXX
 Active Password
 Level: None
```

Compressor Setpoints

```
SET COMP SPs (1)
# of Compressors=X
Stop-Start  =XXmin
Start-Start =XXmin
```

This menu sets the anti-recycle timers. Stop-Start is the time required before starting a compressor after it has *stopped*. Start-Start is the time required before starting a compressor after the last time it has *started*. It is recommended that these default values not be changed.

```
SET COMP SPs (2)
InterStgUp  =XXXsec
InterStgDown= XXsec
Clear Cycle Tmrs=no
```

InterStageUp is the time delay since the last stage change before a compressor can stage on.

InterStageDn is the time delay since the last stage change before a compressor can stage off normally (not by an alarm).

The clear cycle timer resets the Stop-Start and Start-Start timers. It does not clear the interstage timers.

```
SET COMP SPs (3)
Compressor 1=Enable
Compressor 3=Enable
```

Four Compressor Units

```
SET COMP SPs (3)
Compressor 1=Enable
Compressor 3=Enable
Compressor 5=Enable
```

Six Compressor Units

```
SET COMP SPs (4)
Compressor 2=Enable
Compressor 4=Enable
```

Four Compressor Units

```
SET COMP SPs (4)
Compressor 2=Enable
Compressor 4=Enable
Compressor 6=Enable
```

Six Compressor Units

```
SET COMP SPs (5)
Expansion Valve
  Type= Thermal
```

```
SET COMP SPs (6)
Cir 1 EXV
EXV Control=Auto
Manual EXV Pos=XXX.X
```

```
SET COMP SPs (7)
Cir 2 EXV
EXV Control=Auto
Manual EXV Pos=XXX.X
```

Alarm Setpoints

```
SET ALARM LIMITS(1)
LowEvPrHold=XXXpsi
LowEvPrUnld=XXXpsi
```

If two compressors are running, the LowEvPrUnld is in effect and the lag compressor will be shut off to unload the unit. If one compressor is running, the LowEvPrHold is in effect and the lag compressor is prevented from starting, thereby holding the unit capacity.

```
SET ALARM LIMITS (2)
Evap Freeze= XX.X°F
EvapFlowProof=XXXsec
```

Evap Freeze (the unit freeze protection shutdown) is actually a stop alarm and shuts off the unit when the LWT reaches 38°F. It is cleared by going to the CLEAR ALARM menu in the ACTIVE ALARM hierarchy.

EvapFlowProof is a time delay on the flow switch trip that reduces nuisance low flow trips. The default setting is 3 seconds.

```
SET ALARM LIMITS (3)
HiCondPr = XXX.Xpsi
HiPrStgDn= XXX.Xpsi
```

HighCondPr (the unit high-discharge-pressure shutdown) is a stop alarm that shuts off the circuit when the discharge pressure reaches the setting. The default setting is 385 psi. The HiCondStDn is a limit alarm that unloads the unit in an attempt to prevent total shutdown from the HighCondPr. The stage down is set at 370 psi.

```
SET ALARM LIMITS (4)
PhaseVoltage = NO
GroundFault = NO
LowOATStartTmr=XXXs
```

Fan Setpoints

```
SET FANS SPs     (1)
Number of fans=X
Fan VFD=no
```

The Number of Fans line tells the controller the number of fans on the unit. The UP ARROW toggles between 4, 6 and 8.

Fan VFD tells the controller whether the optional low ambient fan VFD is installed in the unit. The UP ARROW toggles between YES and NO. The setting changes the range available: YES = -2°F to 60°F, NO = 35°F to 60°F.

```
SET FANS SPs     (2)
Stg Up Deadband(°F)
  Stg2  Stg3  Stg4
  XX.X  XX.X  XX.X
```

```
SET FANS SPs     (3)
Stg Dn Deadband(°F)
Stg0 Stg1 Stg2 Stg3
XX.X XX.X XX.X XX.X
```

```
SET FANS SPs     (4)
VFD Min Speed=  XX%
VFD Max Speed= XXX%
```

```
SET FANS SPs     (5)
Cond Sat Temp Target
Setpoint= XXX.X °F
```

```
SET FANS SPs      (6)
# Fans On At Startup
 >75°F >90°F >105°F
    1     2     3
```

Screen Definitions – TEST

The field test screens are only available when the unit is in TEST mode. Using these screens, digital and analog outputs can be controlled manually. The compressor outputs will only stay on for 10 seconds. All others will stay on indefinitely, but will automatically be set back to off when the unit leaves test mode.

```
TEST UNIT         (1)
Alarm Signal= Off
Evap Pump= Off
```

```
TEST UNIT         (2)
Liq Line Sol 1=Off
Compressor  HG1=Off
1=Off 3=Off 5=Off
```

```
TEST UNIT         (3)
Liq Line Sol 2=Off
Compressor  HG2=Off
2=Off 4=Off 6=Off
```

```
TEST UNIT         (4)
Fan 1= Off
Fan 3= Off
Fan 5/7= Off
```

```
TEST UNIT         (5)
Fan 2= Off
Fan 4= Off
Fan 6/8= Off
```

```
TEST UNIT         (6)
Fan VFD 1= 000.0%
Fan VFD 2= 000.0%
```

```
TEST UNIT         (7)
EXV Cir 1= 000.0%
EXV Cir 2= 000.0%
```

Building Automation System Interface

The BAS interface uses the supervisor port on the controller as a connection point.

Protocols Supported

The following building automation system (BAS) protocols are supported. It is possible to change the building automation interface without loading different software.

BACnet®

When protocol is set to BACnet, the baud rate and ident setpoints are not accessible. The ident setting is locked at 1 for BACnet, and the baud rate is locked to 19200.

LonTalk®

With protocol set to LON, the baud rate and ident setpoints are not accessible. The ident setting is locked at 1 for LON, and the baud rate is locked to 4800.

Modbus®

With the protocol set to Modbus, the baud rate and ident setpoints are accessible.

Available Parameters

Types: A = Analog, I= Integer, D= Digital
I/O: I = Input only, O = Output only, I/O = Input/Output

Table 27, BAS Parameters

Type	Index	I/O	Description	LONWORKS	BACnet	Modbus
A	1	I/O	Network Cool LWT setpoint	x	x	x
A	2	O	Active LWT setpoint	x	x	x
A	3	I/O	Network limit setpoint	x	x	x
A	6	O	Evap LWT	x	x	x
A	10	O	Unit capacity (%)	x	x	x
A	11	I	Network Cool LWT setpoint default	x		
A	15	O	Suction temp	x	x	x
A	16	O	Evap sat temp	x	x	x
A	17	O	Evap pressure	x	x	x
A	20	O	Cond sat temp	x	x	x
A	21	O	Cond pressure	x	x	x
A	39	O	OAT	x	x	x
A	42	O	Active Capacity Limit	x	x	x
A	50	I/O	Network Ice LWT setpoint	x	x	x
I	1	O	Active alarms 1	x	x	x
I	2	O	Active alarms 2	x	x	x
I	3	O	Active alarms 3	x	x	x
I	4	O	Active alarms 4	x	x	x
I	5	O	Active alarms 5	x	x	x
I	6	O	Active alarms 6	x	x	x
I	7	O	Active alarms 7	x	x	x
I	8	O	Active alarms 8	x	x	x
I	9	O	Active alarms 9	x	x	x
I	10	O	Active alarms 10	x	x	x

Continued next page.

Type	Index	I/O	Description	LONWORKS	BACnet	Modbus
I	11	O	Active alarms 11	x	x	x
I	12	O	Active alarms 12	x	x	x
I	13	O	Active alarms 13	x	x	x
I	14	O	Active alarms 14	x	x	x
I	15	O	Active alarms 15	x	x	x
I	16	O	Active alarms 16	x	x	x
I	17	I	Network chiller mode setpoint	x	x	x
I	18	O	LON Chiller run mode	x		x
I	19	O	Active chiller mode	x	x	x
I	20	I	Network demand limit default setpoint	x		
I	21	I	Network chiller mode default setpoint	x		
I	28	O	Unit model type, refrigerant	x	x	x
I	29	O	Unit language	x	x	x
I	30	O	Unit software version	x	x	x
I	32	I	Compressor select	x	x	x
I	35	I/O	Clock year		x	x
I	36	I/O	Clock month		x	x
I	37	I/O	Clock day of month		x	x
I	38	I/O	Clock day of week		x	x
I	39	I/O	Clock hours		x	x
I	40	I/O	Clock minutes		x	x
I	45	O	Compressor starts		x	x
I	46	O	Compressor run hours		x	x
I	47	O	Evaporator pump run hours #1, #2	x	x	x
D	1	I/O	Network chiller enable setpoint	x	x	x
D	2	O	Chiller enable status	x	x	x
D	3	O	Active alarm indicator	x	x	x
D	4	O	Chiller run enabled	x	x	x
D	5	O	Chiller local control	x	x	x
D	6	O	Chiller capacity limited	x	x	x
D	7	O	Evap flow	x	x	x
D	9	I	Network chiller enable default setpoint	x		
D	10	I	Ignore network defaults	x		
D	12	I	Set clock command		x	x
D	19	I	Pump select	x	x	x
D	24	I	Network clear alarm signal	x	x	x
D	29	O	Evap pump	x	x	x

Parameter Details

Units of Measure

Parameters are expressed in different units dependant on the protocol selected.

Table 28, Units of Measure

Parameter Type	Modbus Units	BACnet Units	LONWORKS Units
Temperature	^{o}F X 10	^{o}F X 10	^{o}C X 100
Pressure	PSI X 10	PSI X 10	KPa X 10
Percentage	% X 10	% X 10	% X 200

Chiller Mode

Applies to Integer 17 and Integer 19. Network Chiller Mode Setpoint and Active Chiller Mode use the same numbering scheme to represent ice mode or cool mode. The output representing the mode is shown below for each protocol.

Mode	LONWORKS	BACnet	Modbus
Cool	3	2	2
Ice	11	1	1

Any time the chiller is not in Ice mode, Cool mode will be assumed.

LON Chiller Run Mode

Applies to Integer 18. The LON Chiller Run Mode parameter indicates the unit state as follows:

State	LONWORKS	BACnet	Modbus
Off	0	1	1
Run	2	3	3
Pumpdown	3	4	4
Service	4	5	5

State = Off any time the state is not Run or Service
State = Run when the unit state is Auto
State = Service when the unit is in Test mode

Unit Identification

Integer 28 indicates the unit model type and refrigerant. This value is set to 12.

Integer 29 indicates the unit language. For the AGZ-C the language can only be English, so output is 1.

Integer 30 indicates the software version and revision. The hundreds digit represents the version, and the remaining part represents the revision letter.

Compressor Select

Compressor Select is used to select the compressor for which the associated parameters will be sent to the BAS interface. The input should equal the number of the compressor for which data is desired. If a 0 is sent from the BAS, this will also select compressor 1.

Timeclock Setting

The chiller time and date may be changed through the BAS interface. Time and date are updated by first setting the values for the time and date inputs on the BAS. When the BAS sets digital index 12 high, the time and date in the controller is set to the values supplied by the BAS. The values used are as follows:

Year: Integer # 35 (00 to 99)
Day of Month: Integer # 37 (1 to 31)
Hour: Integer # 39 (0 to 23)
Month: Integer # 36 (1 to 12)
Day of Week: Integer # 38 (1 to 7)
Minute: Integer # 40 (0 to 59)

Network Defaults

The network setpoint default values are used only for the LONWORKS network. Digital index 10 determines whether the network defaults should be loaded at startup. The startup process is as follows.

Immediately after the controller powers up, the protocol is checked. If the network is LONWORKS, then the current status of the BAS unit enable setpoint, digital 1, is stored in a temporary location and the BAS enabled setpoint is set to disable. A ten second timer should lapse, then the "ignore network defaults" setting is checked. If this is set low, then the defaults for BAS cool setpoint, network limit, unit enable, and unit mode will be loaded. If the setting is set high, then no defaults are loaded and the status of the BAS enable setpoint is restored to the original value.

Table 29, Digital Output Parameters

Type	Index	I/O	Description	Details
D	2	O	Chiller enable status	Set whenever the chiller is enabled by all settings and switches
D	3	O	Active alarm indicator	Set when any alarm is active. Active events do not set this output
D	4	O	Chiller run enabled	Set when the unit state is auto
D	5	O	Chiller local control	Set when the unit control source is set to keypad or switches.
D	6	O	Chiller capacity limited	Set when a unit capacity limit is active, any circuit is disabled, or any circuit is limited in capacity.
D	7	O	Evap flow	Set when evap flow switch is closed

Optional Low Ambient VFD

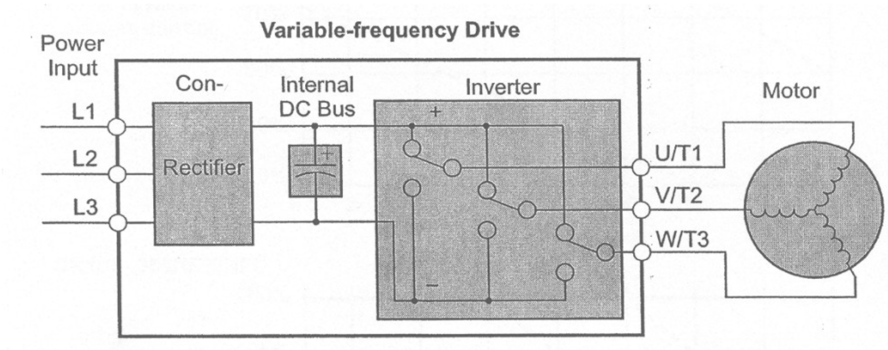
Low ambient air temperature control is accomplished by using the Optional Low Ambient VFD to control the speed of the first fan on each circuit. This VFD control uses a proportional integral function to drive the saturated condenser temperature to a target value by changing the fan speed. The target value is normally the same as the saturated condenser temperature target setpoint.

The fan VFD always starts when the saturated condenser temperature rises higher than the target.

What is an Inverter?

The term inverter and variable-frequency drive are related and somewhat interchangeable. An electronic motor drive, for an AC motor, controls the motor's speed by varying the frequency of the power sent to the motor.

In general., an inverter is a device that converts DC power to AC power. The figure below shows how the variable-frequency drive employs an internal inverter. The drive first converts incoming AC power to DC through a rectifier bridge, creating an internal DC bus voltage. Then the inverter circuit converts the DC back to AC again to power the motor. The special inverter can vary its output frequency and voltage according to the desired motor speed.

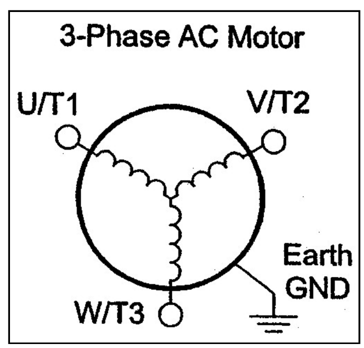


Inverter Output to the Motor

⚠ WARNING

Avoid swapping any 2 of the 3 motor lead connections, which will cause reversal of the motor direction. In applications where reversed rotation could cause equipment damage or personnel injury, be sure to verify direction of rotation before attempting full-speed operation. For safety to personnel, the motor chassis ground must be connected to the ground connection at the bottom of the inverter housing.

The AC motor must be connected only to the inverter's output terminals. The output terminals are uniquely labeled (to differentiate them from the input terminals) with the designations U/T1, V/T2, and W/T3. This corresponds to typical motor lead connection designations T1, T2, and T3. The consequence of swapping any two of the three connections is the reversal of the motor direction. This must not be done. In applications where reversed rotation could cause equipment damage or personnel injury, be sure to verify direction of rotation before attempting full-speed operation. For safety to personnel, the motor chassis ground must be connected to the ground connection at the bottom of the inverter housing.



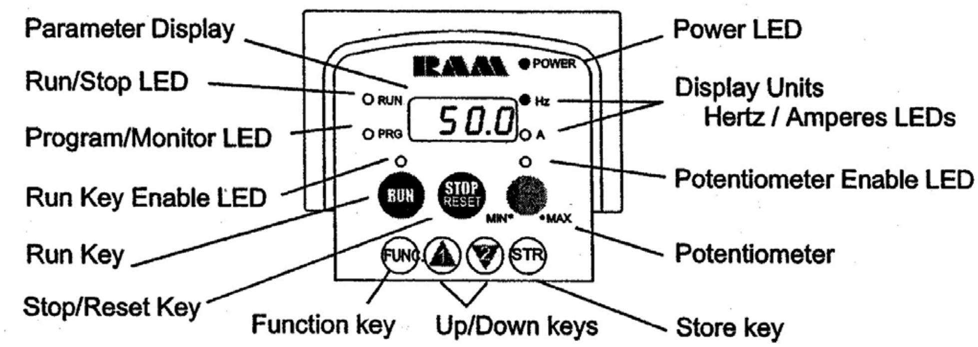
Notice the three connections to the motor do not include one marked "Neutral" or "Return." The motor represents a balanced "Y" impedance to the inverter, so there is no need for a separate return. In other words, each of the three "Hot" connections serves also as a return for the other connections because of their phase relationship.

Do not to switch off power to the inverter *while the motor is running* (unless it is an emergency stop) to avoid equipment damage. Also, do not install or use disconnect switches in the wiring from the inverter to the motor (except thermal disconnect).

Inverter Front Panel Keypad

The CR100 Series inverter front keypad contains all the elements for both monitoring and programming parameters. The keypad layout is pictured in Figure 5. The fan VFD is programmed in the factory before shipment and no field programming is required.

Figure 5, Front Panel Keypad Layout



Key and Indicator Legend

Run/Stop LED - ON when the inverter output is ON and the motor is developing torque (Run Mode), and OFF when the inverter output is OFF (Stop Mode).

Program/Monitor LED - This LED is ON when the inverter is ready for parameter editing (Program Mode). It is OFF when the parameter display is monitoring data (Monitor Mode).

Run Key Enable LED - is ON when the inverter is ready to respond to the Run key, OFF when the Run key is disabled.

Run Key - Press this key to run the motor (the Run Enable LED must be ON first). Parameter F_04, Keypad Run Key Routing, determines whether the Run key generates a Run FWD or Run REV command.

Stop/Reset Key - Press this key to stop the motor when it is running (uses the programmed deceleration rate). This key will also reset an alarm that has tripped.

Potentiometer -Allows an operator to directly set the motor speed when the potentiometer is enabled for output frequency control.

Potentiometer Enable LED - ON when the potentiometer is enabled for value entry.

Parameter Display - A 4-digit, 7-segment display for parameters and function codes.

Display Units, Hertz/Amperes - One of these LEDs will be ON to indicate the units associated with the parameter display.

Power LED - This LED is ON when the power input to the inverter is ON.

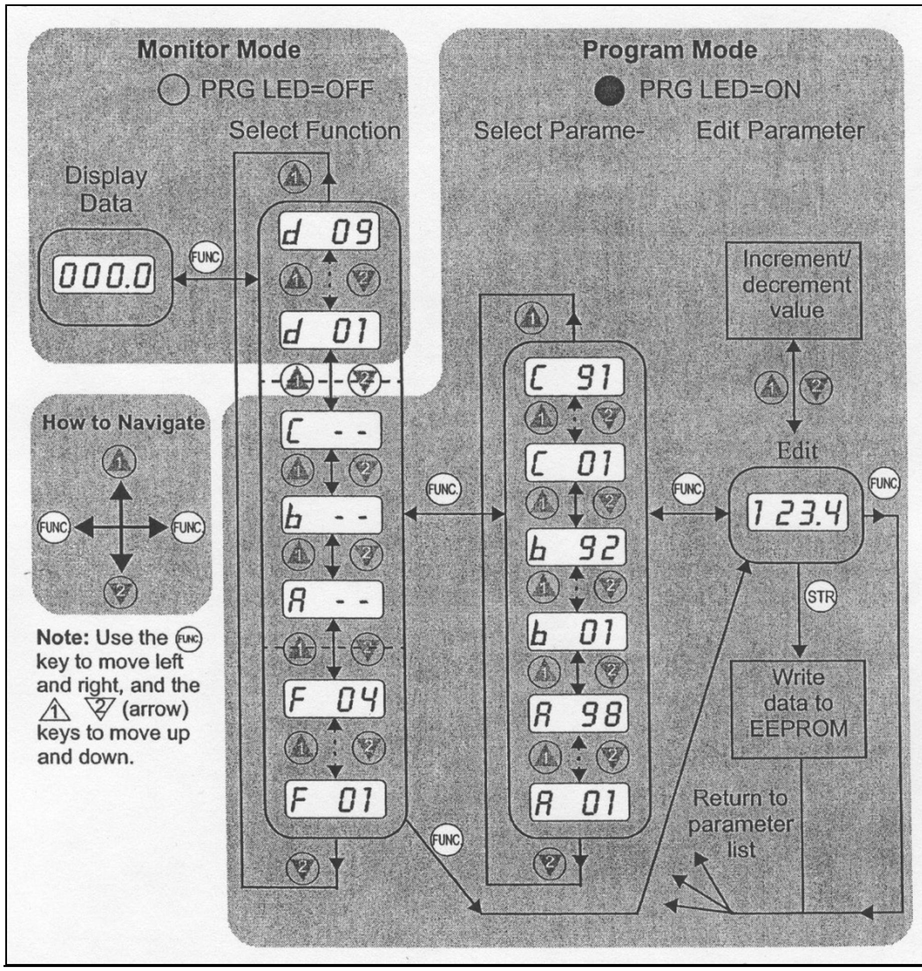
Function Key - This key is used to navigate through the lists of parameters and functions for setting and monitoring parameter values.

Up/Down (△1 , ▽2 *)* Keys - Use these keys alternately to move up or down the lists of parameter and functions shown in the display, and increment/decrement values.

Store (STR) Key - When the unit is in Program Mode and you have edited a parameter value, press the Store key to write the new value to the EEPROM.

Keypad Navigational Map

The CR100 Series inverter front keypad contains all the elements for both monitoring and programming parameters. The diagram below shows the basic navigational map of parameters and functions.



NOTE: The inverter 7-segment display shows lower case "b" and "d," meaning the same as the upper case letters "B" and "D" used in this manual (for uniformity "A to F").

NOTE: The Store Key saves the edited parameter (shown in the display) to the EEPROM in the inverter, regardless of the programming device. Upload and download of parameters is accomplished through a separate command—do not confuse *Store* with *Download* or *Upload.*

Troubleshooting Tips

The table below lists typical symptoms and the corresponding solution(s).

Symptom Condition		Probable Cause	Solution
The motor will not run.	The inverter outputs [U], [V], [W] are not supplying voltage.	• Is the frequency command source A_01 parameter setting correct? • Is the Run command source A-02 parameter setting correct?	• Make sure the parameter setting A-01 is correct. • Make sure the parameter setting A-02 is correct.
		• Is power being supplied to terminals [L1], [L2], and [L3/N]? If so, the POWER lamp should be ON.	• Check terminals [L1], [L2], and [L3/N], then [U/T1], [V/T2], and [W/T3]. • Turn ON the power supply or check fuses.
		• Is there an error code *E X X* displayed?	• Press the Func. key and determine the error type. Eliminate the error cause, then clear the error (Reset).
		• Are the signals to the intelligent input terminals correct? • Is the Run Command active? Is the {FW] terminal (or [RV]) connected to [P24] (via switch, etc.)	• Verify the terminal functions for C_01 – C_05 are correct. • Turn ON Run Command enable. • Supply 24V to {FW] or [RV] terminal, if configured.
		• Has the frequency setting for F_01 been set greater than zero? • Are the control circuit terminals [H], [O], and [L] connected to the potentiometer?	• Set the parameter for F_01 to a safe, non-zero value. • If the potentiometer is the frequency setting source, verify voltage at [O] > 0V.
		• Is the RS (reset) function or FRS (free-run stop) function ON?	• Turn OFF the command(s).
	Inverter outputs [U], [V], [W] are supplying voltage.	• Is the motor load too heavy?	• Reduce load, and test the motor independently.
	The optional remote operator is used (SRW).	• Are the operational settings between the remote operator and the inverter unit correct?	• Check the operator type setting.
The direction of the motor is reversed.		• Are the connections of output terminals [U/T1], [V/T2], and [W/T3] correct? • Is the phase sequence of the motor forward or reverse with respect to [U/T1], [V/T2], and [W/T3]?	• Make connections according to the phase sequence of the motor. In general: FWD = U-V-W, and REV = U-W-V.
		• Are the control terminals [FW] and [RW] wired correctly? • Is parameter F_04 properly set?	• Use terminal [FW] for forward, and [RV] for reverse. • Set motor direction in F_04.
The motor speed will not reach the target frequency (desired speed).		• If using the analog input, is the current or voltage at [O] or [OI]?	• Reduce the load. • Heavy loads activate the overload restriction feature (reduces output as needed).
		• Is the load too heavy?	• Reduce the load • Heavy loads activate the overload restriction feature (reduces output as needed).
		• Is the inverter internally limiting the output frequency?	• Check max frequency setting (A_04). • Check frequency upper limit setting (A_61).

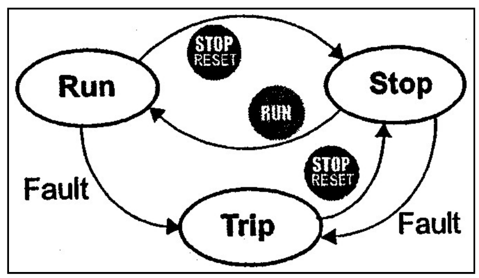
Continued on next page.

Symptom Condition		Probable Cause	Solution
The RPM of the motor does not match the inverter output frequency setting.		• Is the maximum frequency setting A_04 correct? • Does the monitor function D_01 display the expected output frequency?	• Verify the V/f settings match motor specification. • Make sure all scaling (such as A_11 to A_14) is properly set.
Inverter data is not correct.	No downloads have occurred.	• Was power turned OFF after a parameter edit but before pressing the Store key?	• Edit the data and press the Store key once.
		• Edits to data are permanently stores at power down. Was the time from power OFF to power ON less than six seconds?	• Wait six seconds or more before turning power OFF after editing data.
	A download to the inverter was attempted.	• Was the power turned OFF within six seconds after the display changed from REMT to INV?	• Copy data to the inverter again, and keep power ON for six seconds or more after copying.
A parameter will not change after an edit (reverts to old setting).	True for certain parameters.	• Is the inverter in Run Mode? Some parameters cannot be edited during Run Mode.	• Put inverter in Stop Mode (press the Stop/reset key). Then edit the parameter.
	True for all parameters.	• If you're using the [SFT] intelligent input (software lock function)—is the [SFT] input ON?	• Change the state of the SFT input, and check the B_31 parameter (SFT mode).

Monitoring Trip Events, History, & Conditions

Fault Detection and Clearing

The microprocessor in the inverter detects a variety of fault conditions and captures the event, recording it in a history table. The inverter output turns OFF, or "trips", similar to the way a circuit breaker trips due to an over-current condition. Most faults occur when the motor is running (refer to the diagram to the right). However, the inverter could have an internal fault and trip in Stop Mode. In either case, you can clear the fault by pressing the Stop/Reset key.



Error Codes

An error code will appear on the display automatically when a fault causes the inverter to trip. The following table lists the cause associated with the error.

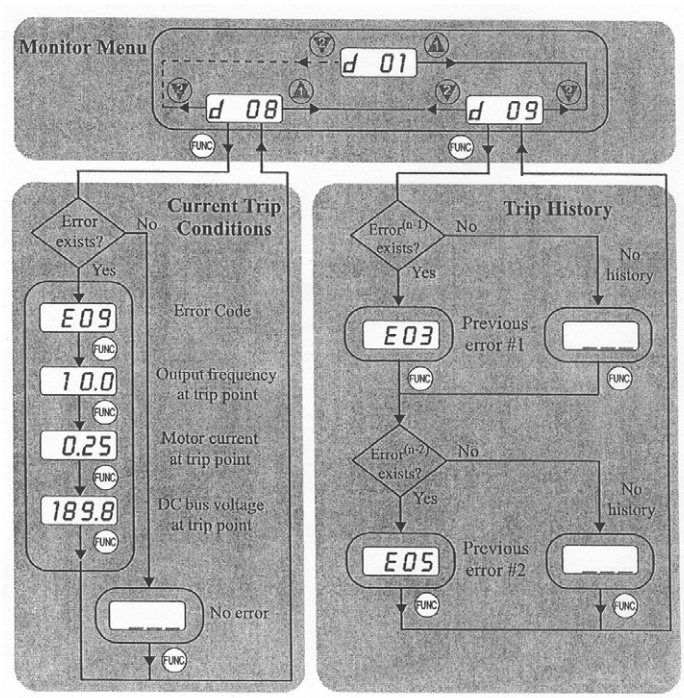
Error Code	Name	Cause(s)
E01	Over current event while at constant speed	The inverter output was short-circuited, or the motor shaft is locked or has a heavy load. These conditions cause excessive current *for the* inverter, so the inverter output is turned OFF. The dual-voltage motor is wired incorrectly.
E02	Over current event during deceleration	
E03	Over current event during acceleration	
E04	Over current event during other conditions	
E05	Overload protection	When a motor overload is detected by the electronic thermal function, the inverter trips and turns OFF its output.
E07	Over voltage protection	When the DC bus voltage exceeds a threshold, due to regenerative energy from the motor.
E08	EEPROM error	When the built-in EEPROM memory has problems due to noise or excessive temperature, the inverter trips and turns OFF its output to the motor.
E09	Under-voltage error	A decrease of internal DC bus voltage below a threshold results in a control circuit fault This condition can also generate excessive motor heat or cause low torque. The inverter trips and turns OFF its output.
E11 E22	CPU error	A malfunction in the built-in CPU has occurred, so the inverter trips and turns OFF its output to the motor.
E12	External trip	A signal on an intelligent input terminal configured as EXT has occurred. The inverter trips and turns OFF the output to the motor.
E13	USP	When the Unattended Start Protection (LJSP) is enabled, an error occurred when power is applied while a Run signal is present. The inverter trips and does not go into Run Mode until the error is cleared.
E14	Ground fault	The inverter is protected by the detection of ground faults between the inverter output and the motor during powerup tests. This feature protects the inverter, and does not protect humans.
E15	Input over-voltage	When the input voltage is higher than the specified value, it is detected 100 seconds after powerup and the inverter trips and turns OFF its output.
E21	Inverter thermal trip	When the inverter internal temperature is above the threshold, the thermal sensor in the inverter module detects the excessive temperature of the power devices and trips, turning the inverter output OFF.
E35	Thermistor	When a thermistor is connected to terminals {5} and [CM1] and the inverter has sensed the temperature is too high, the inverter trips and turns OFF the output.
---U	Under-voltage (brownout) with output shutoff	Due to low input voltage, the inverter turns its output OFF and tries to restart. If it fails to restart, then the alarm trips to record the under-voltage error event.

Note: If an EEPROM error (E08) occurs, be sure to confirm the parameter data values are still correct. If the power is turned OFF while the [RS] (Reset) intelligent input terminal is ON, an EEPROM error will occur when power is restored.

Trip History and Inverter Status

Always find the cause of the fault before clearing it. When a fault occurs, the inverter stores important performance data at the moment of the fault. To access the data, use the monitor functions (D_xx) and select D_08 for details about the present fault (E^{n}), or the error code for the past two trip events (E^{n-1}) and E^{n-2}) using the D_09 Trip History function.

The following Monitor Menu map shows how to access the error codes. When fault(s) exist, you can review their details by first selecting the proper function: D_08 displays current trip data, and D09 displays trip history.



VFD Monthly and Yearly Inspection Chart

Item Inspected		Check for ...	Frequency		Inspection Method	Criteria
			Month	Year		
Overall	Ambient environment	Extreme Temperatures & humidity	✓		Thermometer, hygrometer	Ambient temperature between – 10 to 40°C, non-condensing
	Major devices	Abnormal noise & vibration	✓		Visual & aural	Stable environment for electronic controls
	Power supply voltage	Voltage tolerance	✓		Digital volt meter, measure between inverter terminals [L1], [L2], [L3}	200V class: 200 to 240V 50/60 Hz 400V class: 380 to 460V 50/60 Hz
Main circuit	Ground Insulation	Adequate resistance		✓	Digital volt meter, GND to terminals	5 Meg. Ohms or greater
	Mounting	No loose screws		✓	Torque wrench	M3: 0.5 – 0.6 Nm M4: 0.98 – 1.3 Nm M5: 1.5 – 2.0 Nm
	Components	Overheating		✓	Thermal trip events	No trip events
	Housing	Dirt, dust		✓	Visual	Vacuum dust & dirt
	Terminal block	Secure connections		✓	Visual	No abnormalities
	Smoothing capacitor	Leading, swelling	✓		Visual	No abnormalities
	Relay(s)	Chattering		✓	Aural	Single click when switching ON or OFF
	Resistors	Cracks or discoloring		✓	Visual	Use Ohm meter to check braking resistors
	Cooling fan	Noise	✓		Power down, manually rotate	Rotation must be smooth
		Dust	✓		Visual	Vacuum to clean
Control circuit	Overall	No order, discoloring, corrosion		✓	Visual	No abnormalities
	Capacitor	No leaks or deformation	✓		Visual	Undistorted appearance
Display	LEDs	Legibility	✓		Visual	All LED segments work

Important Messages

⚠ WARNING

WARNING HIGH VOLTAGE: Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

⚠ DANGER

Wait at least five (5) minutes after turning OFF the input power supply before performing maintenance or an inspection. Otherwise, electric shock can occur.

Introduction

This section lists the parameters for the CR100 series inverters and the values as programmed in the factory.

Unit identification

Inverter model CR100 [ ]

MFG. No. [ ]

This information is printed on the specification label located on the right side of the inverter.

Parameter Settings for Keypad Entry

Main Profile Parameters

"F" Group Parameters		McQuay Setting
Function Code	**Name**	
F_01	Output Frequency Setting	0.0
F_02	Acceleration (1)	10.0
F_03	Deceleration (1)	10.0
F_04	Keypad Run Key Routing	00

Standard Functions

"A" Group Parameters		McQuay Setting
Function Code	Name	
A_01	Frequency source setting	01
A_02	Run command source setting	01
A_03	Base frequency setting	60.0
A_04	Maximum frequency setting	60.0
A_11	O-L input active range start frequency	0
A_12	O-L input active range end frequency	0
A_13	O-L input active range start voltage	0
A_14	O-L input active range end voltage	100
A_15	O-L input start frequency enable	01
A_16	External frequency filter time constant	8
A_20	Multi-speed 0 setting	0
A_21	Multi-speed 1 setting	0
A_22	Multi-speed 2 setting	0
A_23	Multi-speed 3 setting	0
A_24	Multi-speed 4 setting	0
A_25	Multi-speed *5* setting	0
A_26	Multi-speed 6 setting	0
A_27	Multi-speed 7 setting	0
A_28	Multi-speed 8 setting	0
A_29	Multi-speed 9 setting	0
A_30	Multi-speed 10 setting	0
A_31	Multi-speed 11 setting	0
A_32	Multi-speed 12 setting	0
A_33	Multi-speed 13 setting	0
A_34	Multi-speed 14 setting	0
A_35	Multi-speed 15 setting	0
A_38	Jog frequency setting	1.0
A_39	Jog stop mode	00
A_41	Torque boost method selection	00
A_42	Manual torque boost value	11
A_43	Manual torque boost frequency adjustment	10.0
A_44	V/f characteristic curve selection	00
A_45	V/f gain setting	100
A_51	DC braking enable	00
A_52	DC braking frequency setting	0.5

"A" Group Parameters		McQuay Setting
Function Code	Name	
A_53	DC braking wait time	0.0
A_54	DC braking force during deceleration	0
A_55	DC braking time during deceleration	0.0
A_61	Frequency upper limit setting	0.0
A_62	Frequency lower limit setting	0.0
A_63, A_65, A_67	Jump (center) frequency setting	0.0
A_64- A_66 A_68	Jump (hysteresis) frequency width setting	0.5
A_71	PID Enable	00
A_72	PID proportional gain	1.0
A_73	PID integral time constant	1.0
A_74	PID derivative gain	0.0
A_75	PV scale conversion	1.00
A_76	PV source setting	00
A_81	AVR function select	00
A_82	AVR voltage select	230/460
A_92	Second acceleration time setting	15.0
A_93	Second deceleration time setting	15.0
A_94	Select method to switch to second accel/decel profile	00
A_95	Acc1 to Acc2 frequency transition point	0.0
A_96	Dec1 to Dec2 frequency transition point	0.0
A_97	Acceleration curve selection	00
A_98	Deceleration curve selection	00

Fine Tuning Functions

"B" Group Parameters		McQuay Setting
Function Code	Name	
B_01	Selection of automatic restart	00
B_02	Allowable under-voltage power failure time	1.0
B_03	Retry wait time before motor restart	1.0
B_12	Level of electronic thermal setting	Rated current for each inverter
B_13	Electronic thermal characteristic	01
B_21	Overload restriction operation mode	01
B_22	Overload restriction setting	Rated current x 1.25
B_23	Deceleration rate at overload restriction	1.0
B_31	Software lock mode selection	01
B_32	Reactive current setting	Rated current x 0.58
B_81	{FM] terminal analog meter adjustment	80
B_82	Start frequency adjustment	0.5
B_83	Carrier frequency setting	5.0
B_84	Initialization mode (parameters or trip history)	00
B_85	Country code for initialization	02
B_86	Frequency scaling conversion factor	1.0
B_87	STOP key enable	00
B_88	Restart mode after FRS	00
B_89	Data select for digital op. OPE-J	01

Intelligent Terminal Functions

"C" Group Parameters		McQuay Setting
Function Code	Name	
C_01	Terminal [1] function	00
C_02	Terminal [2] function	01
C_03	Terminal [3] function	16
C_04	Terminal [4] function	13
C_05	Terminal [5] function	18
C_11	Terminal [1] active state	00
C_12	Terminal [2] active state	00
C_13	Terminal [3] active state	00
C_14	Terminal [4] active state	01
C_15	Terminal [5] active state	00
C_21	Terminal [11] function	01
C_22	Terminal [12] function	00
C_23	[FM] signal selection	00
C_31	Terminal [11] active state (-FU)	00
	Reserved (-FE / FR)	
C_32	Terminal [12] active state (-FU)	00
	Terminal [11] active state (-FE / FR)	
C_33	Alarm relay terminal active state	01
C_41	Overload level setting	Inverter rated current
C_42	Frequency arrival setting for accel	0.0
C_43	Arrival frequency setting for decel	0.0
C_44	PID deviation level setting	3.0
C_91	Debug mode enable	00

Startup

Pre Start-up

The chiller must be inspected to ensure no components became loose or damaged during shipping or installation.

Start-Up

Refer to the MicroTech II Controller section beginning on page 13 to become familiar with its operation before starting chiller.

There should be adequate building load (at least 50 percent of the unit full load capacity) to properly check the operation of the chiller refrigerant circuits.

Be prepared to record all operating parameters required by the "Compressorized Equipment Warranty Form". Return this information within 10 working days to McQuay International as instructed on the form to obtain full warranty benefits.

1. Verify chilled water flow.
2. Verify remote start / stop or time clock has requested the chiller to start.
3. Set the chilled water setpoint to the required temperature. (The system water temperature must be greater than the total of the leaving water temperature setpoint plus one-half the control band before the MicroTech II controller will stage on cooling).
4. Set the Evap Delta T and the Start Delta T as a starting point.
5. Put both pumpdown switches (PS1 and PS2) to the ON position.
6. Put system switch (S1) to ON position.

Switch	Switch Position	
	ON	OFF
PS1, PS2, Pumpdown Switches	Circuits will operate in the normal automatic mode	Circuit will go through the normal pumpdown cycle and shut off
S1, System Switch	Unit will operate in the normal automatic mode	Unit will shut off immediately without pumping down (emergency stop)

7. There may be a delay of 2 minutes after closing S1. The time delay is due to the compressor inherent motor protection or the Stage Up Timer counting. This should only occur on initial start-up or when power to the chiller has been turned off and back on. More than one compressor will not start at the same time.
8. After the chiller has been operating for a period of time and has become stable, check the following:
    - Compressor oil level. (Some scroll compressors do not have oil sight glasses).
    - Refrigerant sight glass for flashing
    - Rotation of condenser fans
9. Complete the "Compressorized Equipment Warranty Form."

Shutdown

Temporary

1. Put both circuit switches to the OFF position (Pumpdown and Stop).
2. After compressors have stopped, put System Switch (S1) to OFF (emergency stop).
3. Turn off chilled water pump. Chilled water pump to operate while compressors are pumping down.

To start the chiller after a temporary shutdown, follow the start-up instructions.

Extended

1. Front seat both condenser liquid line service valves.
2. Put both circuit switches to the OFF position (Pumpdown and Stop position).
3. After the compressors have stopped, put System Switch (S1) to the OFF position (emergency stop).
4. Front seat both refrigerant circuit discharge valves (if applicable).
5. If chilled water system is not drained, maintain power to the evaporator heater to prevent freezing. Maintain heat tracing on the chilled water lines.
6. Drain evaporator and water piping to prevent freezing.
7. If electrical power to the unit is on, the compressor crankcase heaters will keep the liquid refrigerant out of the compressor oil. This will minimize start-up time when putting the unit back into service. The evaporator heater will be able to function.
8. If electrical power is off, make provisions to power the evaporator heater (if chilled water system is not drained). Tag all opened electrical disconnect switches to warn against start-up before the refrigerant valves are in the correct operating position. At start-up, electrical power must be on for 24 hours before starting the chiller.

To start the chiller after an extended shutdown, follow the prestart-up and start-up instructions.

Water Piping Checkout

1. Check the pump operation and vent all air from the system.
2. Circulate evaporator water, checking for proper system pressure and evaporator pressure drop. Compare the pressure drop to the evaporator water pressure drop curve.
3. Clean all water strainers before placing the chiller into service.

Refrigerant Piping Checkout

1. Check all exposed brazed joints for evidence of leaks. Joints may have been damaged during shipping or when the unit was installed.
2. Check that all refrigerant valves are either opened or closed as required for proper operation of the chiller.
3. A thorough leak test must be done using an approved electronic leak detector. Check all valve stem packing for leaks. Replace all refrigerant valve caps and tighten.
4. Check all refrigerant lines to insure that they will not vibrate against each other or against other chiller components and are properly supported.
5. Check all flare connections and all refrigerant threaded connectors.
6. Look for any signs of refrigerant leaks around the condenser coils and for damage during shipping or installation.
7. Leak detector is applied externally to refrigerant joints at the factory. Do not confuse this residue with an oil leak.
8. Connect refrigerant service gauges to each refrigerant circuit before starting unit.

Electrical Check Out

> ⚠ **CAUTION**
>
> Electrical power must be applied to the compressor crankcase heaters 24 hours before starting unit to drive off refrigerant from the oil and prevent damage to the unit.

1. Open all electrical disconnects and check all power wiring connections. Start at the power block and check all connections through all components to and including the compressor terminals. These should be checked again after 3 months of operation and at least yearly thereafter.
2. Check all control wiring by pulling on the wire at the spade connections and tighten all screw connections. Check plug-in relays for proper seating and to insure retaining clips are installed.
3. Put System Switch (S1) to the Emergency Stop position.
4. Put both circuit #1 & #2 switches to the Pumpdown and Stop position.
5. Apply power to the unit. The panel Alarm Light will stay on until S1 is closed. Ignore the Alarm Light for the check out period. If you have the optional Alarm Bell, you may wish to disconnect it.
6. Check at the power block or disconnect for the proper voltage and proper voltage between phases. Check power for proper phasing using a phase sequence meter before starting unit.
7. Check for 120Vac at the optional control transformer and at TB-2 terminal #1 and the neutral block (NB).
8. Check between TB-2 terminal #7 and NB for 120 vac supply for transformer #2.
9. Check between TB-2 terminal #2 and NB for 120 vac control voltage. This supplies the compressor crank case heaters.
10. Check between TB-3 terminal #17 and #27 for 24 vac control voltage.

Operation

Hot Gas Bypass (Optional)

This option allows the system to operate at lower loads without excessive on/off compressor cycling. The hot gas bypass option is required to be on both refrigerant circuits because of the lead/lag feature of the controller.

This option allows passage of discharge gas into the evaporator inlet (between the TX valve and the evaporator) which generates a false load to supplement the actual chilled water or air handler load.

Note: The hot gas bypass valve cannot generate a 100% false load.

The pressure regulating valves are a Sporlan HGBE-8-75/150-7/8 ODF on models AGZ 030 to 065 and Sporlan HGBE-8-75/150-1 1/8 ODF on AGZ 070 to 190. They are factory set to begin opening at 100 psig (R-410A) and can be changed by changing the pressure setting. The adjustment range is 75 to 150 psig. To raise the pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. Do not force the adjustment beyond the range it is designed for, as this will damage the adjustment assembly. The regulating valve opening point can be determined by slowly reducing the system load while observing the suction pressure. When the bypass valve starts to open, the refrigerant line on the evaporator side of the valve will begin to feel warm to the touch.

The bypass valve includes a solenoid valve that is controlled by the MicroTech II controller. It is active when the first stage of cooling on a circuit is active.

⚠ WARNING

The hot gas line may become hot enough to cause injury. Be careful during valve checkout.

VFD Low Ambient Control (Optional)

The optional VFD fan control is used for unit operation below 35°F (2°C) down to a minimum of 0°F (-17°C). The control looks at the saturated discharge temperature and varies the fan speed to hold the temperature (pressure) at the "target" temperature. This temperature is established as an input to a setpoint screen labeled "Sat Condenser Temp Target".

Filter-Driers

Each refrigerant circuit is furnished with a full flow filter drier (AGZ 030C – 100C) or a replaceable core type filter-drier (AGZ 140C – 180C). The core assembly of the replaceable core drier consists of a filter core held tightly in the shell in a manner that allows full flow without bypass.

Pressure drop across the filter drier at full load conditions must not exceed 10 psig at full load. See page for maximum pressure drop at other load points. Replace the filter drier if the pressure drop exceeds maximum.

⚠ WARNING

Pump out refrigerant before removing end flange for replacement of core(s) to remove liquid refrigerant and lower pressure to prevent accidental blow off of cover.
EPA recovery regulations apply to this procedure.

A condenser liquid line service valve is provided for isolating the charge in the condenser, but also serves as the point from which the liquid line can be pumped out. With the line free of refrigerant, the filter-drier core(s) can be easily replaced.

System Adjustment

To maintain peak performance at full load operation, the system superheat and liquid subcooling may require adjustment. Read the following subsections closely to determine if adjustment is required.

Liquid Line Sight Glass

The color of the moisture indicator is an indication of the dryness of the system and is extremely important when the system has been serviced. Immediately after the system has been opened for service, the element may indicate a wet condition. It is recommended that the equipment operate for about 12 hours to allow the system to reach equilibrium before deciding if the system requires a change of drier cores.

Bubbles in the sight glass at constant full load indicates a shortage of refrigerant, a plugged filter-drier, or a restriction in the liquid line. However, it is not unusual to see bubbles in the sight glass during changing load conditions.

Refrigerant Charging

Liquid line subcooling at the liquid shut-off valve should be between 15 and 20 degrees F at full load. If the unit is at steady full load operation and bubbles are visible in the sight glass, then check liquid subcooling.

Thermostatic Expansion Valve

The expansion valve performs one specific function. It keeps the evaporator supplied with the proper amount of refrigerant to satisfy the load conditions.

The sensing bulb of the expansion valve is installed in the closest straight run of suction line from the evaporator. The bulb is held on by clamps around the suction line and is insulated to reduce the effect of surrounding ambient temperatures. In case the bulb must be removed, simply slit the insulation on each side of the bulb, remove the clamps and then remove the capillary tubing that runs along the suction line from the valve. The power element is removable from the valve body.

NOTE: Before adjusting superheat, check that unit charge is correct and liquid line sight glass is full with no bubbles and that the circuit is operating under stable, full load conditions.

The suction superheat for the suction leaving the evaporator is set at the factory for 8 to 12 degrees F at full load. To have full rated unit performance, the superheat must be about 8 degrees F at 95°F outdoor ambient temperature.

Crankcase Heaters

The scroll compressors are equipped with externally mounted band heaters located at the oil sump level. The function of the heater is to keep the temperature in the crankcase high enough to prevent refrigerant from migrating to the crankcase and condensing in the oil during off-cycle.

Power must be supplied to the heaters 24 hours before starting the compressors.

Evaporator

Models AGZ 030C through 130C

The evaporator is a compact, high efficiency, single or dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates.

The evaporator is protected with an electric resistance heater and insulated with 3/4" (19mm) thick closed-cell polyurethane insulation. This combination provides freeze protection down to -20°F (-29°C) ambient air temperature.

The water side working pressure is 363 psig (2503 kPa). Evaporators are designed and constructed according to, and listed by, Underwriters Laboratories (UL).

Models AGZ 140C through 180C

The evaporator is direct expansion, shell-and-tube type with water flowing in the baffled shell side and refrigerant flowing through the tubes. Two independent refrigerant circuits within the evaporator serve the unit's dual refrigerant circuits.

The evaporator is wrapped with an electric resistance heater cable and insulated with 3/4" (19mm) thick vinyl nitrate polymer sheet insulation, protecting against water freeze-up at ambient air temperatures to -20°F (-29°C). An ambient air thermostat controls the heater cable. The fitted and glued-in-place insulation has a K factor of 0.28 Btu in/hr ft^2 °F at 75°F.

The refrigerant (tube) side maximum working pressure is 300 psig (2068 kPa). The water side working pressure is 152 psig (1048 kPa). Each evaporator is designed, constructed, inspected, and stamped according to the requirements of the ASME Boiler and Pressure Vessel Code. Double thickness insulation is available as an option.

Phase Voltage Monitor (Optional)

Factory settings are as follows:

- Trip Delay Time, 2 seconds
- Voltage Setting, set at nameplate voltage.
- Restart Delay Time, 60 seconds

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