Operation Manual

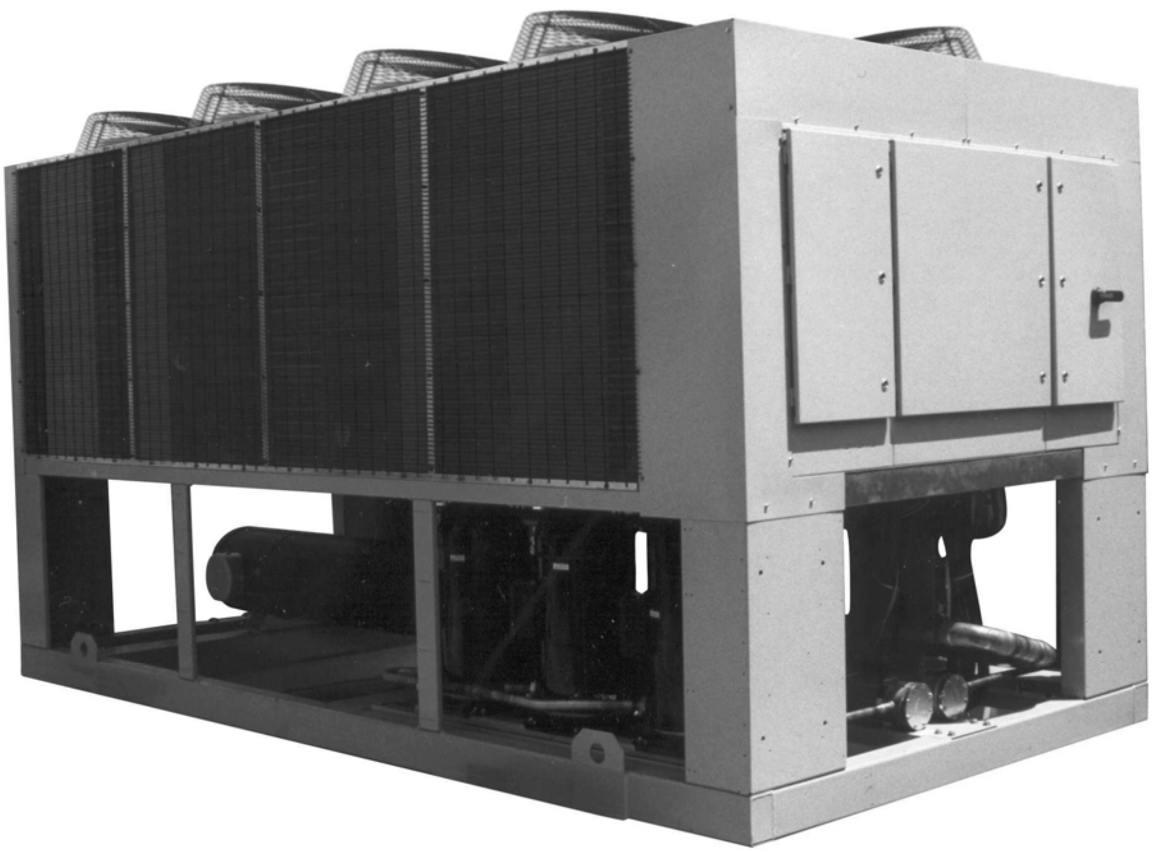
OM AGZ-1
Group: **Chiller**
Part Number: **331374101**
Effective: **July 2007**
Supercedes: **January 2007**

Air-Cooled Scroll Compressor Chiller

Packaged and Remote Evaporator

AGZ 026BS/M through 130BS/M
60 Hertz
R-22, R407c

Software Version AGZDU0102C



McQuay® Air Conditioning

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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. 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.

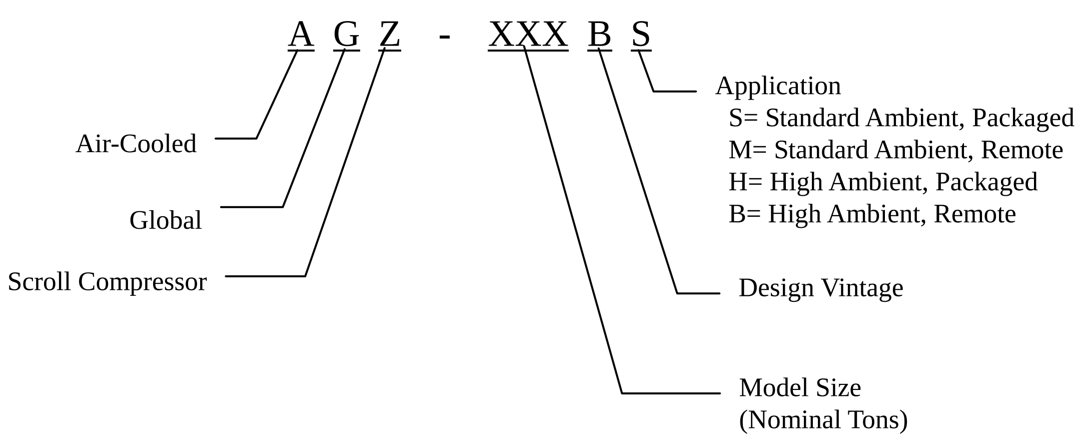
The electrical control center includes all equipment protection and operating controls necessary for dependable automatic operation. Condenser fan motors are protected in all three phases and started by their own three-pole contactors.

This manual covers units with **software version AGZDU0102C**. Installation, maintenance and service information is in IMM AGZ-7 (or current latest dash number) manual.

BOOT Version 3.0F

BIOS Version 3.56

Nomenclature



Ambient Air Temperature Limitations

Standard/High Ambient Panels

Models AGZ-B (26 to 130 tons, two circuit) have electrical data and subsequent field wiring requirements that are tailored to individual applications.

There are many installations where the expected summer ambient air temperatures will be at 105°F (40.1°C) or less, resulting in smaller unit electrical requirements compared to operation at 106°F (41.1) and above. In these lower temperature cases, there can be considerable installation cost savings by using smaller and more appropriate electrical service.

Therefore, the AGZ electrical data is divided into two classifications based on the design ambient temperature where the unit will operate. Standard Ambient unit electrical data (BS and BM models) is for operation in ambient temperatures of 105°F (40.1°C) or less. Units with the High Ambient designation (BH and BB models) are for use above 105°F (40.1°C) to 125°F (51.7°C).

The AGZ-B units for high ambient operation 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, and a unit nameplate that lists the larger electrical requirements.

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.

Winter Operation Temperatures	0°F to 34°F		35°F and Above	
Fan Control	Optional High VFD (1)		Standard FanTrol (2)	
Design Ambient Air Temperature	≤105°F	>106°F	≤105°F	>106°F
Electrical Data (3)	Standard Ambient	High Ambient	Standard Ambient	High Ambient
Panel Fan Required (4)	Yes	Yes	No	Yes
Model Designator (5)				
Packaged	BS	BH	BS	BH
Remote Evaporator	BM	BB	BM	BB

NOTES

1. VFD is variable speed, fan control through the MicroTech Ii controller.
2. FanTrol is fan cycling off discharge pressure.
3. Standard Ambient and High Ambient electrical data is located in the installation and maintenance manual.
4. The VFD option automatically includes the factory-installed panel fan and filter set
5. The designator is the last two characters in the model number, i.e. AGZ 100**BS.**

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 11 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.

This *full load* minimum flow is not to be confused with the *part load* minimum flow rate that must be maintained for chillers operating in primary variable flow pumping systems. As chiller capacity drops, the flow rate for this pumping system will reduce proportionally. See the following table for the *part load* minimum flow rates.

These minimum flow rates assume that flow will be reduced proportionally to the cooling load.

Table 1, Minimum Part Load Flow Rates

AGZ Model	026	030	035	040	045	050	055	060	065
Minimum Part Load Flow (GPM)	26	29	32	37	41	45	50	55	59
AGZ Model	**070**	**075**	**085**	**090**	**100**	**110**	**120**	**130**	
Minimum Part Load Flow (GPM)	63	71	119	128	146	161	180	194	

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.

Variable Speed Pumping

Variable water flow involves reducing the water flow through the evaporator as the load decreases. McQuay chillers are designed for this duty provided that the rate of change in water flow is not greater than 10 percent of the change per minute.

The water flow through the vessel must remain between the minimum and maximum values listed on page 11. If flow drops below the minimum allowable, large reductions in heat transfer can occur. If the flow exceeds the maximum rate, excessive pressure drop and tube erosion can occur.

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:

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

   For Metric Applications – Use the following equation for metric applications:

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

3. **Pressure drop --** Multiply the water pressure drop from page 11 by *Pressure Drop* correction factor from Table 2 through Table 5. High concentrations of propylene glycol at low temperatures may cause unacceptably high pressure drops.

4. **Power --** Multiply the water system power by *Power* correction factor from Table 2 through 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 table 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 percent do not provide any additional burst protection and should be carefully considered before using.

⚠ CAUTION

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 026B to 070B

% E.G.	Freeze Point		Capacity	Power	Flow	PD
	°F	°C				
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 026B to 070B

% P.G.	Freeze Point		Capacity	Power	Flow	PD
	°F	°C				
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 075B to 130B

% E.G.	Freeze Point		Capacity	Power	Flow	PD
	°F	°C				
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 075B to 130B

% P.G.	Freeze Point		Capacity	Power	Flow	PD
	°F	°C				
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

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 026 to 070

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

Standard Ambient Unit, 105°F (40.6°C) and below, Models BS and BM

High Ambient Unit, above 105°F (40.6°C) to 125°F 51.7°C), Models BH and BB

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, R-22, 40°F to 60°F (4.4°C to 15.6°C)

Leaving chilled water temperature, R-407C, 42°F to 60°F (5.5°C to 15.6°C)

Leaving chilled fluid temperatures (with anti-freeze), 20°F to 60°F (-7°C to 16°C

Design chilled water Delta-T range, 6 degrees F to 16 degrees F (3.3 degrees C to 8.9 degrees C)

Part load minimum flow for variable flow systems, varies with unit size, see table below.

Maximum operating inlet fluid temperature, 76°F (24°C)

Maximum non-operating inlet fluid temperature, 100°F (38°C)

Water Flow Limitations, Variable Flow

The full load, minimum flow limitation for constant flow is not to be confused with the part load minimum flow rate that must be maintained for chillers operating in primary *variable* flow pumping systems. As chiller capacity drops, the flow rate for this pumping system will reduce proportionally. See the following table for the *part load* minimum flow rates.

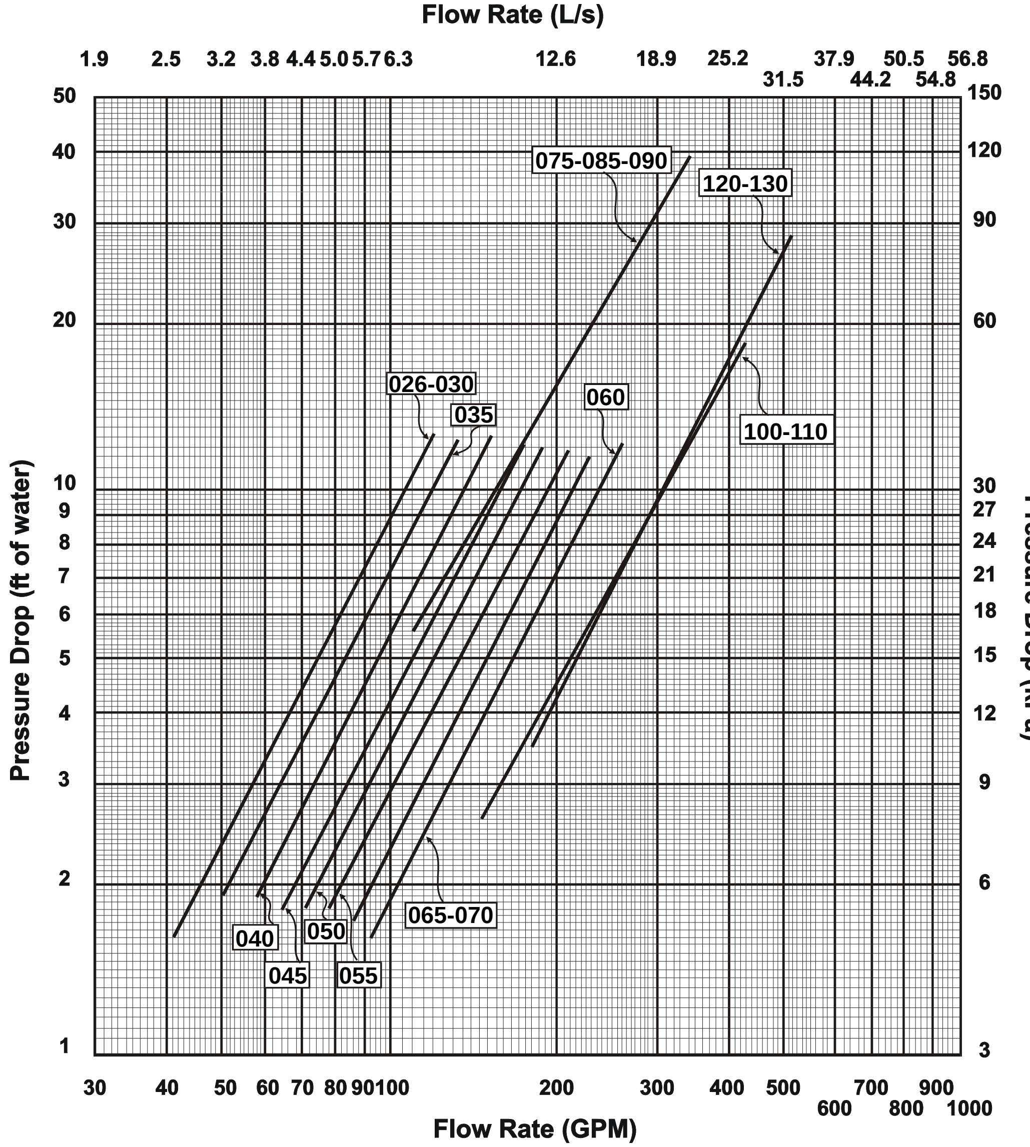
Other design practices for variable flow systems requiring a range of evaporator flow rates can be found below.

These minimum flow rates assume that flow will be reduced proportionally to the cooling load.

Table 8, Minimum Part Load Flow Rates

AGZ Model	010	013	017	020	025	029	034	026	030	035	040	045
Minimum Part Load Flow (GPM)	10	13	15	20	22	27	33	26	29	32	37	41
AGZ Model	**050**	**055**	**060**	**065**	**070**	**075**	**085**	**090**	**100**	**110**	**120**	**130**
Minimum Part Load Flow (GPM)	45	50	55	59	63	71	119	128	146	161	180	194

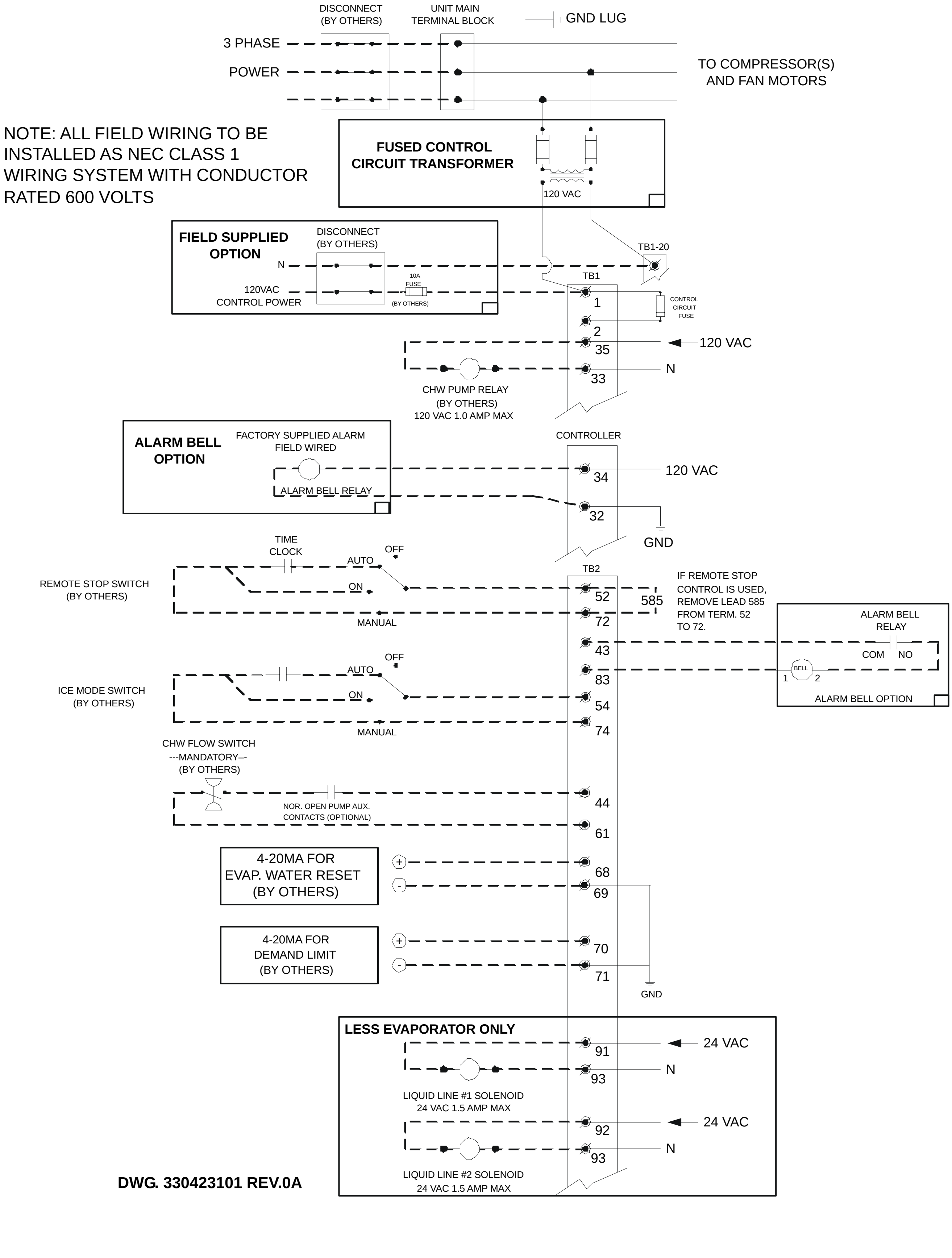
Figure 1, AGZ 026B – 130B, Evaporator Pressure Drop



AGZ Unit Model	Minimum				Nominal				Maximum			
	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
026B	41	1.6	2.6	4.7	65	3.9	4.1	11.6	109	10.4	6.9	30.9
030B	45	1.9	2.9	5.7	72	4.7	4.6	14.1	121	12.7	7.6	37.8
035B	50	1.9	3.1	5.6	80	4.6	5.0	13.8	133	12.4	8.4	36.9
040B	58	1.9	3.6	5.7	92	4.7	5.8	14.0	154	12.6	9.7	37.5
045B	64	1.8	4.0	5.4	102	4.5	6.4	13.4	170	12.1	10.7	35.9
050B	71	1.8	4.4	5.4	113	4.5	7.1	13.3	188	12.0	11.9	35.7
055B	78	1.8	4.9	5.3	125	4.4	7.9	13.0	209	11.7	13.2	34.8
060B	86	1.7	5.4	5.2	137	4.3	8.6	12.8	228	11.5	14.4	34.2
065B	92	1.6	5.8	4.9	147	4.1	9.3	12.1	246	10.9	15.5	32.5
070B	98	1.9	6.2	5.6	157	4.6	9.9	13.7	262	12.3	16.5	36.8
075B	111	5.6	7.0	16.5	177	12.5	11.2	37.4	295	30.4	18.6	90.7
085B	119	6.3	7.5	18.9	191	14.3	12.1	42.7	318	34.8	20.1	103.6
090B	128	7.2	8.1	21.4	205	16.2	12.9	48.4	342	39.4	21.6	117.3
100B	146	2.6	9.2	7.7	234	6.1	14.8	18.2	390	15.5	24.6	46.2
110B	161	3.1	10.2	9.2	258	7.3	16.3	21.7	430	18.5	27.1	55.1
120B	180	3.5	11.3	10.4	288	8.9	18.1	26.5	479	24.6	30.2	73.4
130B	194	4.1	12.2	12.1	311	10.4	19.6	30.9	518	28.7	32.7	85.6

NOTE: Minimum and maximum flows are established to ensure the Delta-T for each unit size falls within the 6 - 16°F range for proper unit control.

Figure 2, AGZ 026B – AGZ 130B, Typical Field Wiring



R-407C Units

AGZ chillers are available with R-407C refrigerant as non-ARI certified units. R-407C is a zeotropic blend of three compounds, and as such exhibits the characteristic of glide. It does not behave as one substance like R-22 does. Glide is the difference (in degrees F) between the beginning and end phase-change process in either the evaporator or condenser. During these processes, different ratios of the refrigerant's components change phase from the beginning to the end of the process. The following functions, conditions and settings will differ from units charged with R-22.

1. Polyolester lubricants are used instead of mineral oil.
2. The saturated pressure/temperature relationship
3. Control and alarm settings
4. Charging procedures

1. Lubrication. The units are factory-charged with polyoester (POE) lubricant and one of the following lubricants must be used if lubricant is to be added to the system:

Copeland Ultra 22 CC
Mobil EAL™ Arctic 22 CC
ICI EMKARATE RL RL™ 32CF

POEs are very hydroscopic and will quickly absorb moisture if exposed to air. Pump the lubricant into the unit through a closed transfer system. Avoid overcharging the unit.

2. Pressure/temperature relationship. See Figure 3 on page 14 for the saturated pressure-temperature chart. Due to refrigerant glide, use the following procedures for superheat and subcooling measurement.

To determine superheat, only vapor must be present at the point of measurement, no liquid. Use the temperature reading, the pressure reading and the Saturated P/T Chart. If the pressure is measured at 78 psig, the chart shows the saturated vapor temperature to be 50.6°F. If the temperature is measured at 60°F, the superheat is 9.4 degrees F.

To determine subcooling, only liquid must be present, no vapor. Use the temperature reading, the pressure reading and the Saturated P/T Chart. If the pressure is measured at 250 psig, the chart shows the saturated liquid temperature to be 108.2°F. If the temperature is measured at 98°F, the subcooling is 10.2 degrees F.

The P/T relationship between R-407C and R-22 is similar enough to allow the use of R-22 expansion valves. The valves may be marked as "R-22' or "R-22/R-407C".

3. Control and alarm settings. The software that controls the operation of the unit is factory-set for operation with R-407C, taking into account that the pressure/temperature relationship differs from R-22. The software functionality is the same for either refrigerant.

4. Charging procedure. The units are factory-charged with R-407C. Use the following procedure if recharging in the field is necessary:

Whether topping off a charge or replacing the circuit's entire charge, always remove the refrigerant from the charging vessel as a liquid. Many of the cylinders for the newer refrigerants have a dip tube so that liquid is drawn off when the cylinder is in the upright position. Do not vapor charge out of a cylinder unless the entire contents will be charged into the system.

With the system in a 250-micron or lower vacuum, liquid can be charged into the high side. Initially charge about 80 percent of the system total charge.

Start the system and observe operation. Use standard charging procedures (liquid only) to top off the charge.

It may be necessary to add refrigerant through the compressor suction. Because the refrigerant leaving the cylinder must be a liquid, exercise care to avoid damage to the compressor. A sight glass can be connected between the charging hose and the compressor. It can be adjusted to have liquid leave the cylinder and vapor enter the compressor.

Figure 3, R-407C Saturated Pressure/Temperature Chart

Pressure (PSIG)	Liquid Temp (°F)	Vapor Temp (°F)	Pressure (PSIG)	Liquid Temp (°F)	Vapor Temp (°F)
20	-10.7	1.5	150	74.8	84.9
22	-8.2	4.0	155	76.8	86.8
24	-5.7	6.4	160	78.7	88.7
26	-3.4	8.7	165	80.6	90.5
28	-1.1	11.0	170	82.5	92.3
30	1.1	13.1	175	84.3	94.0
32	3.2	15.2	180	86.1	95.8
34	5.3	17.2	185	87.8	97.5
36	7.3	19.2	190	89.6	99.1
38	9.2	21.0	195	91.3	100.7
40	11.1	22.9	200	92.9	102.3
42	12.9	24.7	205	94.6	103.9
44	14.7	26.4	210	96.2	105.4
46	16.4	28.1	215	97.7	107.0
48	18.1	29.7	220	99.3	108.4
50	19.7	31.3	225	100.8	109.9
52	21.3	32.9	230	102.3	111.4
54	22.9	34.4	235	103.8	112.8
56	24.4	35.9	240	105.3	114.2
58	25.9	37.4	245	106.7	115.6
60	27.4	38.8	250	108.2	116.9
62	28.8	40.2	255	109.6	118.2
64	30.2	41.6	260	111.0	119.6
66	31.6	43.0	265	112.3	120.9
68	33.0	44.3	270	113.7	122.1
70	34.3	45.6	275	115.0	123.4
72	35.6	46.9	280	116.3	124.7
74	36.9	48.1	285	117.6	125.9
76	38.2	49.3	290	118.9	127.1
78	39.4	50.6	295	120.2	128.3
80	40.6	51.8	300	121.4	129.5
82	41.9	52.9	305	122.7	130.7
84	43.0	54.1	310	123.9	131.8
86	44.2	55.2	315	125.1	133.0
88	45.4	56.3	320	126.3	134.1
90	46.5	57.4	325	127.5	135.2
92	47.6	58.5	330	128.7	136.3
94	48.7	59.6	335	129.8	137.4
96	49.8	60.7	340	131.0	138.5
98	50.9	61.7	345	132.1	139.6
100	51.9	62.7	350	133.2	140.6
105	54.5	65.2	355	134.3	141.7
110	57.0	67.7	360	135.4	142.7
115	59.5	70.0	365	136.5	143.7
120	61.8	72.3	370	137.6	144.7
125	64.1	74.6	375	138.7	145.7
130	66.4	76.7	380	139.8	146.7
135	68.5	78.8	385	140.8	147.7
140	70.7	80.9	390	141.8	148.7
145	72.8	82.9	395	142.9	149.6

MicroTech II Controller

Software Version AGZDU0102B

Controller Section Table of Contents

Overview

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-B Inputs/Outputs

Table 9, Analog Inputs

No.	Description	Type	Signal Source	Range
1	Evaporator Refrigerant Pressure #1	C1	0.5 - 4.5 VDC (NOTE 2)	0 to 132 psi
2	Evaporator Refrigerant Pressure #2	C2	0.5 - 4.5 VDC (NOTE 2)	0 to 132 psi
3	Condenser Refrigerant Pressure #1	C1	0.5 - 4.5 VDC (NOTE 2)	3.6 to 410 psi
4	Leaving Evaporator Water Temperature	UT	NTC Thermister (10k@25°C)	-58 to 212°F
5	Outside Ambient Temperature	UT	NTC Thermister (10k@25°C)	-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	0 to10 degrees 60°F max inlet
8	Demand Limit	UT	4-20 mA Current	0-100 % Load
9	Compressor Suction Temperature #1	C1	NTC Thermister (10k@25°C)	-58 to 212°F
10	Compressor Suction Temperature #2	C2	NTC Thermister (10k@25°C)	-58 to 212°F

NOTES:

1. C1 = Refrigerant Circuit #1, C2 = Refrigerant Circuit #2, UT = Unit
2. Value at the converter board input. Value at the converter board output is 0.1 VDC – 0.9 VDC.

Table 10, Analog Outputs

No.	Description	Output Signal	Range
1	Fan #1 VFD	0 to 10 VDC	20 to 60 Hz
2	Fan #2 VFD	0 to 10 VDC	20 to 60 Hz

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 Circuit 1	C2	0 VAC (Fault)	24 VAC (No Fault)
16	Mechanical High Pressure/Motor Protect Circuit 2	C2	0 VAC (Fault)	24 VAC (No Fault)
17	Ice Mode Switch	UT	0 VAC (Cool)	24 VAC (Ice)
18	Open			

NOTES:

1. See Safety Alarms Table for "Phase Voltage Protection". 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. See Safety Alarms Table 14 for "Ground Fault Protection". 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

No.	Description	Type	Load	Output OFF	Output ON
1	Alarm	C1,C2,UT	Alarm Indicator	Alarm OFF	Alarm ON
2	Evaporator Water Pump	UT	Pump Contactor	Pump OFF	Pump ON
3	Condenser Fan #1	C1	Fan Contactor	Fan OFF	Fan ON
4	Motor Control Relay #1 = Compr#1	C1	Starter	Compressor OFF	Compressor ON
5	Motor Control Relay #3 = Compr#3	C1	Starter	Compressor OFF	Compressor ON
6	Motor Control Relay #5 = Compr#5	C1	Starter	Compressor OFF	Compressor ON
7	Liquid Line #1	C1	Solenoid	Cooling OFF	Cooling ON
8	Condenser Fan #2	C2	Fan Contactor	Fan OFF	Fan ON
9	Motor Control Relay #2 = Compr#2	C2	Starter	Compressor OFF	Compressor ON
10	Motor Control Relay #4 = Compr#4	C2	Starter	Compressor OFF	Compressor ON
11	Motor Control Relay #6 = Compr#6	C2	Starter	Compressor OFF	Compressor ON
12	Liquid Line #2	C2	Solenoid	Cooling OFF	Cooling ON
13	Condenser Fan #3	C1	Fan Contactor	Fan OFF	Fan ON
14	Hot Gas Bypass #1	C1	Solenoid	Cooling OFF	Cooling ON
15	Hot Gas Bypass #2	C2	Solenoid	Cooling OFF	Cooling ON
16	Condenser Fan #4	C2	Fan Contactor	Fan OFF	Fan ON
17	Condenser Fan #5 (&#7 on 8 Fans Only)	C1	Fan Contactor	Fan OFF	Fan ON
18	Condenser Fan #6 (&#8 on 8 Fans Only)	C2	Fan Contactor	Fan OFF	Fan ON

Setpoints

The setpoints shown in Table 13 are retained by battery-back-up and remembered during power off, are factory set to the **Default** value, and can be adjusted within the values shown in **Range**.

The PW (password) column indicates the password. Passwords are as follows:

O = Operator =0100 M = Manager=2001

Table 13, 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	DIGITAL IN	KEYPAD, BAS, DIGITAL INPUT	O
Available Modes	COOL	COOL, COOL w/GLYCOL, COOL/ICE w/GLYCOL, ICE w/GLYCOL. TEST	M
Cool LWT	44. 0°F	20.0(40.0) to 60.0 °F	O
Ice LWT	40. 0°F	20.0 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
Low Ambient Lockout	35 °F	–2 to 70°F	M
Demand Limit	No	No,Yes	M
* Refrigerant Select	None	R22, R407c	--
* Multipoint Power	No	No,Yes	M
Ice Time Delay	12	1 to 23 hrs.	
Clear Ice Delay	No	No, Yes	
Protocol	Modbus	BACnet, LonWorks, Modbus	M
Ident number (Modbus only)	001	001-999	M
Baud rate (Modbus only)	9600	1200,2400,4800,9600,19200	M
Compressor			
* Number of Compressors	4	4,6	M
Stage Up Delay	240	90 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
Alarms			
Low Evap Pressure-Hold, R22	59 psi	Glycol =31 to 65 psi Cool=55 to 65 psi	M
Low Evap Pressure-Hold,R407c	60 psi	Glycol =26 to 75 psi Cool=58 to 75 psi	M
Low Evap Pressure-Unload,R22	58 psi	Glycol =31 to 65 psi Cool=55 to 65 psi	M
Low Evap Pressure-Unload,R407	59 psi	Glycol =26 to 75 psi Cool=58 to 75 psi	M
High Condenser Stage Down	370 psi	365 to 380 psi	M
High Condenser Pressure	385 psi	385 to 390 psi	M
Evaporator Water Freeze	38.0 °F	18(37) to 42°F	M
* Phase Voltage Protection	No	No,Yes	M
* Ground Fault Protection	No	No,Yes	M
Evap Flow Proof	3 sec	1 to 10 sec	A
Condenser Fans			
VFD Enable	No	No,Yes	M
* Number of Fans	4	4,6,8	M
Stage Up 2 Deadband	15°F	15 to 25°F	M
Stage Up 3 Deadband	10°F	10 to 15°F	M
Stage Up 4 Deadband	10°F	10 to 15°F	M
Stage Down 0 Deadband	15°F	15 to 20°F	M
Stage Down 1 Deadband	15°F	10 to 15°F	M
Stage Down 2 Deadband	10°F	6 to 10 F	M
Stage Down 3 Deadband	10°F	6 to 10°F	M
VFD Max Speed	100%	90 to 110%	M
VFD Min Speed	25%	25 to 60%	M
Sat Condenser Temp Target	100	90 to 120°F	M
Forced Fan 1	1	1 to # Fans Per Circuit	M
Forced Fan 2	2	1 to # Fans Per Circuit	M
Forced Fan 3	3	1 to # Fans Per Circuit	M

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

Automatic Adjusted Ranges

The following are setpoints that will be limited based on the option selected.

Evaporator Leaving Water Temperature

Mode	Range
Unit Mode = Cool	40 to 60°F
Unit Mode = Cool w/Glycol	20 to 60°F

Evaporator Freeze Temperature

Mode	Range
Unit Mode = Cool	37 to 42°F
Unit Mode = Cool w/Glycol, Ice w/Glycol	18 to 42°F

Low Evaporator Pressure Hold and Unload

Mode	Range
Unit Mode = Cool	55 to 65 Psig
Unit Mode = Cool w/Glycol, Ice w/Glycol	31 to 65 Psig

Low Ambient Lockout Temperature

VFD	Range
VFD = N	35 – 60°F
VFD = Y	-2 – 60°F

Forced Fan 1,2,3

Number of Fans	Range
4	1 – 2 fans
6	1 – 3 fans
8	1 – 4 fans

Shutdown Alarms

Shutdown alarms (also know as “Stop Alarms” or “Safeties”) execute rapid compressor shutdown and require manual reset. They are also logged in the Alarm Log.

The following table identifies each equipment protection alarm, gives the condition that causes the alarm to occur, and states the action taken because of the alarm. If the alarm is auto-clearing, the reset condition is also shown. Otherwise, the alarm is manually reset, requiring the operator to clear the alarm.

Table 14, Shutdown Alarms

Description	Occurs When:	Action Taken	Reset
No Evaporator Water Flow	Evap Pump State = RUN AND Evap Flow Digital Input = No Flow for time > Evap Flow Proof SP	Rapid Stop Unit	Manual
Low Evaporator Pressure	Evaporator Press < Low Evap Pressure SP for time > Low Evap Pressure Delay SP	Rapid Stop Circuit	Manual
High Condenser Pressure	Condenser Press > High Condenser Pressure SP	Rapid Stop Circuit	Manual
Mechanical High Condenser Pressure/Motor Protect	Digital Input = Off On Power Up: Delay 150 Sec. before checking	Rapid Stop Circuit	Manual
Phase Voltage Protection (opt.)	If Phase Voltage Protection = Y, Then Digital Input Off= Phase/Voltage Problem	Rapid Stop Circuit	Phase/Voltage Input returns to normal
Ground Fault Protection (opt.)	If Phase Voltage Protection = Y, Then Digital Input Off= Phase/Voltage Problem	Rapid Stop Circuit	Manual
Re-Start Fault	Re-Start = Third Time	Rapid Stop Circuit	Manual
Evap. Freeze Protect	Evap LWT < Evaporator Freeze SP AND Unit state = enable	Rapid Stop Unit	Manual
Leaving Evap. Water Temp. Sensor Fault	Sensor shorted or open	Normal Stop Unit	Manual
Evaporator Pressure Sensor Fault	Sensor shorted or open	Rapid Stop Circuit	Manual
Condenser Pressure Sensor Fault	Sensor shorted or open	Rapid Stop Circuit	Manual
Outside Ambient Temp. Sensor Fault	Sensor shorted or open	Normal Stop Unit	Manual

Events (Limit Alarms)

The following events limit the operation of the chiller in some way, as described in the Action Taken column. These events are auto-clearing based on reaching the conditions in the reset column.

Table 15, Events, Limit Alarms

Description	Occurs When:	Action Taken	Reset
Condenser Pressure Stage Down	Pressure > High Condenser Stage Down Setpoint	Shutoff Stage #2	Condenser Press drops below (SP – 100psi)
Low Ambient Lockout	Any compressor is running AND Outside Ambient < Low Amb Lockout SP	Shutoff Stages #1 & #2	Outside Ambient > Low Amb Lockout, (SP + 5ºF)
Low Evaporator Pressure – Hold	Pressure < Low Evap Pressure–Hold Setpoint	Hold @ Stage 1	Evap Press rises above (SP + 8psi)
Low Evaporator Pressure – Unload	Pressure < Low Evap Pressure–Unload Setpoint	Shutoff Stage 2	Evap Press rises above (SP + 10 psi)
Failed Pumpdown	Circuit fails to reach the setpoint	Shut off circuit	Not applicable

NOTES:
1. Low and high pressure events are disabled in the ICE mode.

Logging

When an alarm or event occurs, the description, date, and time are stored in the active alarm buffer and can be viewed on the Alarm Active screens or on the Alarm Log or Event Log screens. The active alarm buffers hold a record of all current alarms. The active alarms can be cleared by pressing the Enter key when the end of the list has been reached by scrolling.

A password is NOT required to clear active alarms at the unit controller. The cause for an alarm must be remedied before clearing the alarm. If the user attempts to clear an alarm while the alarm condition still exists, a new alarm will be generated immediately.

Separate alarm and event logs store the last 25 alarms and events respectively. When an alarm or event occurs, it is put into the first slot in the log, and all others are moved down one, dropping the last entry.

If the alarm is a circuit alarm, then the circuit state, refrigerant pressures and temperatures, and number of fans on are also stored. The parameters may be accessed by scrolling the last line on the alarm log screen (similar to a setpoint).

Control Logic

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, Digital Input, keypad entry, or BAS request. The Control Source setpoint determines which source can change the Unit Enable setpoint with options of DIGITAL INPUT, KEYPAD, or BAS.

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

Table 16, Unit Enable Conditions

Unit Off Input	Control Source Setpoint	Remote Input	Keypad Entry	BAS Request	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

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

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 mode setting 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, 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.

Table 17, Unit Mode Selection

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

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

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).

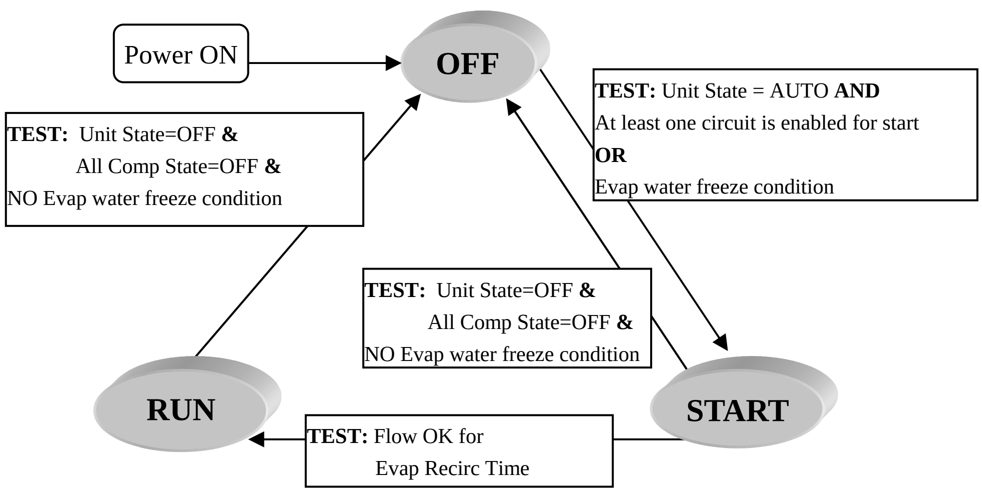
Manager password active.

Available Unit Mode setpoint = TEST

A test menu can then be selected to allow activation of the outputs. It is possible to switch each digital output ON or OFF and set the analog outputs to any value.

Chilled Water Pump Control

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



Compressor Control

Compressor Sequencing

This section defines <u>which</u> compressor is the next one to start or stop. The next section defines <u>when</u> the start, or stop, is to occur.

Compressor sequencing is based primarily on compressor run-hours and starts. Compressors that have less starts will start before those with more starts. Compressors that have more run-hours will shut off before those with less run-hours. In the event of a tie on number of starts, the lower numbered compressor starts first. In the event of a tie on run-hours, the lower numbered compressor shuts off first.

If possible, the number of running compressors on each circuit will be balanced. If a circuit is unavailable for any reason, the other circuit is allowed to stage on all compressors.

Required Parameters

- Number of starts for all compressors
- Number of run-hours for all compressors
- Status of all compressors (Available/Unavailable)
- Compressor number

Compressor Start/Stop Timing-Cool Mode

This section defines when a compressor is to start, or stop, and the scenario for doing so.

Initial Start Time Delay

There is a 150-second delay after power-up before any compressor is allowed to start. This is required since the motor overloads and the Manual High Pressure (MHP) are ignored during this time.

Required Parameters

1. Start Delta setpoint.
2. Max Pulldown Rate setpoint
3. Evap Delta T setpoint
4. Number of Compressors/Circuit setpoint
5. LWT error
6. LWT Slope
7. Number of compressors running
8. Interstage timer status

Stage Up

For 2 compressors/circuit:
Control band = Evap Delta T x .25

For 3 compressors/circuit:
Control band = Evap Delta T x .17

IF [LWT Error > Startup_Delta_T_SP + 0.5(Control band)
AND No Compressors Running
AND Stage Up Timer Expired]
THEN Stage_Up_Now = YES
ELSE IF
[LWT Error > 0.5(Control band) AND LWT Slope <= Max Pulldown setpoint
AND Stage Up Timer Expired]
THEN Stage_Up_Now = YES

Stage Down

IF [LWT Error < -0.5(Control band)
AND Stage Down Timer Expires**]**
THEN Stage_Down_Now = YES

Compressor Start/Stop Timing – Ice Mode

This section defines when a compressor is to start, or stop, and the scenario for doing so.

Required Parameters

Start Delta setpoint
Evap Delta T setpoint
Number of Compressors/Circuit setpoint
LWT error
Number of compressors running
Interstage timer status
Ice timer status (12 hours between starts)

Stage Up

For 2 compressors/circuit:

Control band = Evap Delta T x .3

For 3 compressors/circuit:

Control band = Evap Delta T x .2

IF

[LWT Error > Startup_Delta_T_SP + 0.5(Control band)

AND Number Comps Running = 0

AND Ice Timer Expired]

THEN Stage_Up_Now = YES

ELSE IF

[LWT Error > 0

AND Number Comps Running > 0

AND Stage Up Timer Expired]

THEN Stage_Up_Now = YES

Stage Down

IF LWT Error < 0

THEN Stage_Down_Now = YES

Leaving Water Reset

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

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.

Circuit Capacity Overrides – Limits of Operation

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

Low Evaporator Pressure

If 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 8 psi.

If a circuit is running with two or three compressors on, 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 initially. Ten seconds later, if the pressure has not risen above the unload setpoint, another compressor will be stopped. The last compressor on a circuit will not stop due to the unload condition.

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 degrees F.

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 degrees F.

If the unit is shutdown because the outside air temperature is to low (Low OAT Lockout) then the evaporator pump will be shut down after all active circuits have been pumped down.

The evaporator pump will remain off as long is the chiller is locked out on a low ambient air temperature condition.

High Ambient Limit

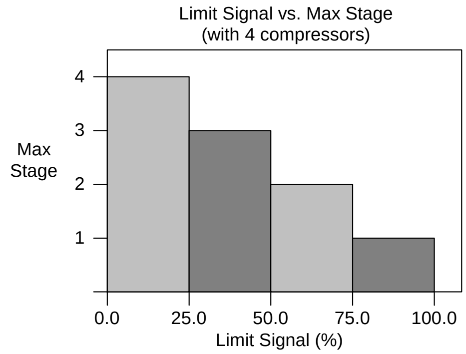
On units not configured with multi-point power connections, the maximum load amps could be exceeded at high ambient temperatures. If all circuit 1 compressors are running or all but one compressor on circuit 1, power connection is single point, and the OAT is greater than 116°F, circuit 2 is limited 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.

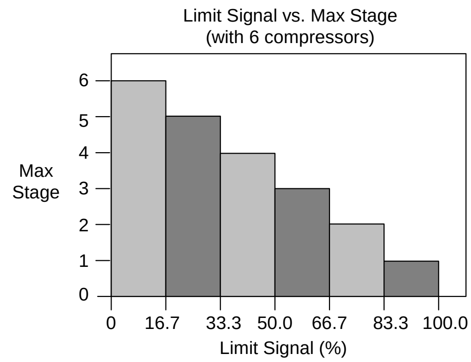
Unit Capacity Overrides

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:





BAS Limit

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

Maximum LWT Rate

The maximum rate at which the leaving water temperature can drop is limited at all times by the Maximum Rate setpoint. If the rate exceeds this setpoint, no more compressors will be started until the pulldown rate is less than the setpoint.

Pumpdown

When a circuit reaches a condition where it needs to shut down normally, a pumpdown cycle will be performed. All but the lowest numbered running compressor will shut off. During pumpdown, the hot gas bypass and liquid line valves are closed, while a compressor continues to run. The pumpdown is complete when the evaporator pressure is less than the low evaporator pressure unload setpoint, less 15 psi, or the circuit has been in the pumpdown state for 60 seconds.

Condenser Fan Control

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 adding the new fan stage up deadband to the VFD target. The higher target causes the VFD logic to decrease fan speed. Then, every 10 seconds, 0.5 degree 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

Condenser Fans Staging is based on condenser pressure as selected by Fan Stage On & Off setpoints. Fans 1, 3, 5, and 7 are for circuit 1, 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 pressure gets up to the stage on setpoint. The compressor must be running in order to run any fans.

Fan Stages

There are 2, 3, or 4 fans available per circuit. On 8 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 the tables below:

4 and 6 Fan Units

Stage (3-Fan)	Fans On Cir. 1	Fans On Cir. 2
1	1	2
2	1,3	2,4
3	1,3,5	2,4,6

8 Fan Units

Stage (2&4-Fan)	Fans On Cir 1	Fans On Cir. 2
1	1	2
2	1,3	2,4
3	1,5,7	2,6,8
4	1,3,5,7	2,4,6,8

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. When the compressor starts, a FanTrol stage is forced based on the following table.

Table 18, Forced Fan Staging

,	**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 Optional Low Ambient 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.

Low Ambient Startup

A new low ambient start logic has been implemented in this version. A low ambient start takes place if the saturated condenser temperature is less than 85.0°F when the first compressor starts. The low ambient start is active for a time defined by the Low OAT Start Timer set point. This set point is found on screen four in the alarm set points menus.

During the low ambient start, the freezestat logic for the low pressure stop alarm and the low pressure events are disabled. The low pressure stop alarm can still be triggered if the evaporator pressure drops below 5.0 psi at any time while the circuit is in the ‘Run’ state. Also, during the low ambient start the second compressor is not allowed to start.

The evaporator pressure is checked at the end of the low ambient start timeframe. If the pressure is less than the low pressure unload set point, then the low ambient start is not successful and the compressor will shut off. This will not be a manual reset alarm until three consecutive attempts have failed. The circuit alarm triggered after the third failed attempt is a Low OAT Restart fault.

Low Ambient Stage Up

In colder ambient conditions, the evaporator pressure may take several minutes to rise and stabilize after the first compressor starts. Starting the second compressor too soon will cause a low-pressure situation that usually cannot be recovered from. To avoid this problem the following occurs:

- The Interstage Up Time Delay set point range is 90 to 480 seconds.
- The default value of the Interstage Up Time Delay set point is 240 seconds.

When a second compressor stages on, there is a temporary drop in evaporator pressure until the TXV has a chance to react. This condition is especially evident in colder conditions. In order to avoid short cycling the second compressor just after it starts, the following logic exists:

- The low evaporator pressure events are disabled temporarily after the second stage starts up. The delay time is 30 seconds.
- Normal protection against low evaporator pressure conditions resumes after the 30-second delay timer expires

Evaporator Pressure Control

Low Evaporator Pressure Protection

- The minimum time allowed to run in low evaporator pressure conditions with the freezestat logic has been changed from 10 to 20 seconds.
- The absolute minimum pressure limit logic has been changed to trip the low-pressure alarm only when the circuit state is in a Run state.

Low Evaporator Pressure Hold Events

- The Low Evaporator Pressure Hold can trigger with two compressors running. With this logic, the Hold event can be logged and if the evaporator pressure continues to drop enough to trip the Low Evaporator Pressure Unload event, the Unload event will be added to the Event log.
- The Low Evaporator Pressure Hold event reset logic will clear the Hold event at 5.0 psi above the Hold set point.
- The logic will allow the Low Evaporator Pressure Hold events to occur when the Unit is in the Ice mode.

Low Evaporator Pressure Unload Events

- The Low Evaporator Pressure Unload events clear with the Low Evaporator Pressure Hold events.
- The logic allows the Low Evaporator Pressure Unload events to occur when the Unit is in the Ice mode

Optional Low Ambient VFD

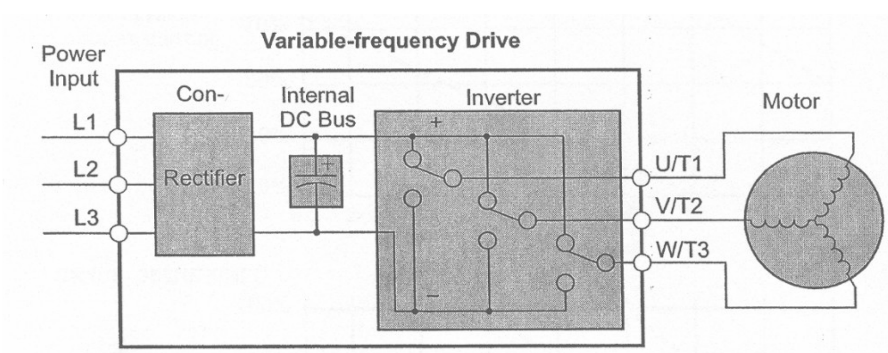
Low ambient air temperature control is accomplished by using the Optional Low Ambient VFD to control the speed of the first fan on each circuit. This VFD control uses a proportional integral function to drive the saturated condenser temperature to a target value by changing the fan speed. The target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

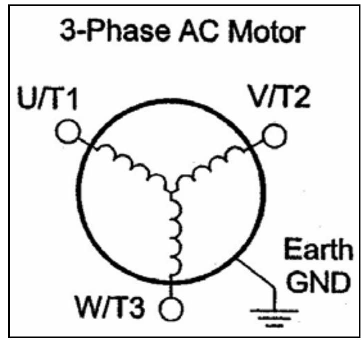
What is an Inverter?

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.

An inverter, in general, 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



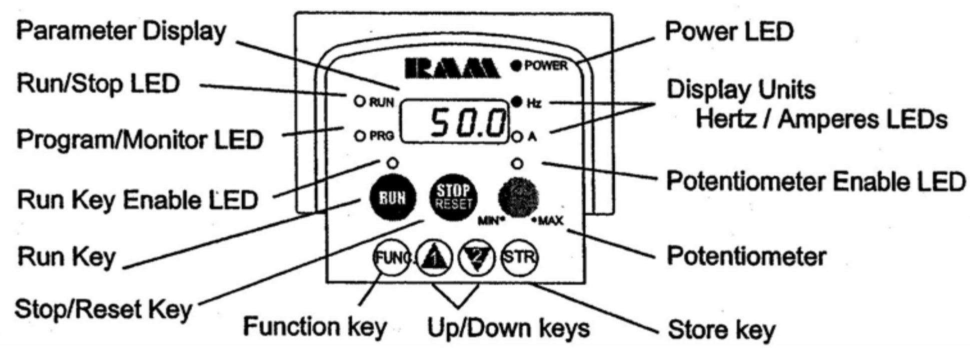
The AC motor must be connected only to the inverter's output terminals. The output terminals are uniquely labeled (to differentiate them from the input terminals) with the designations U/T1, V/T2, and W/T3. This corresponds to typical motor lead connection designations T1, T2, and T3. The consequence 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). 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 below. The fan VFD is programmed in the factory before shipment and no field programming is required.



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.

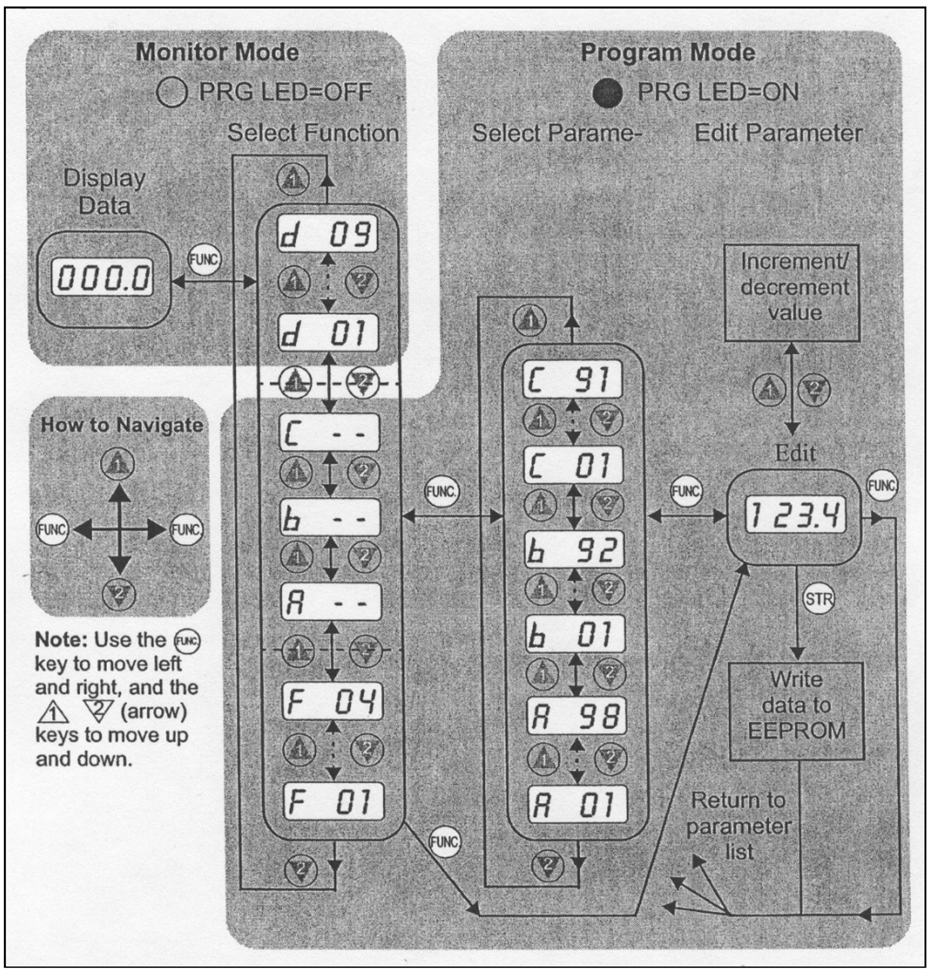
Potentiometer -Allows an operator to directly set the motor speed when the potentiometer is enabled for output frequency control.
Potentiometer Enable LED - ON when the potentiometer is enabled for value entry.
Parameter Display - A 4-digit, 7-segment display for parameters and function codes.
Display 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).

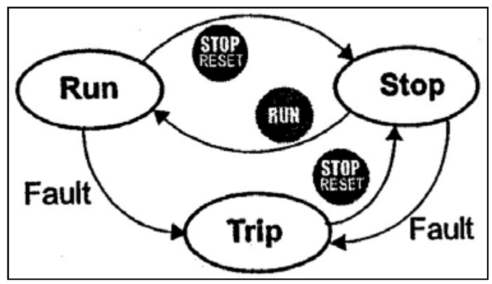
Continued on next page.

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.

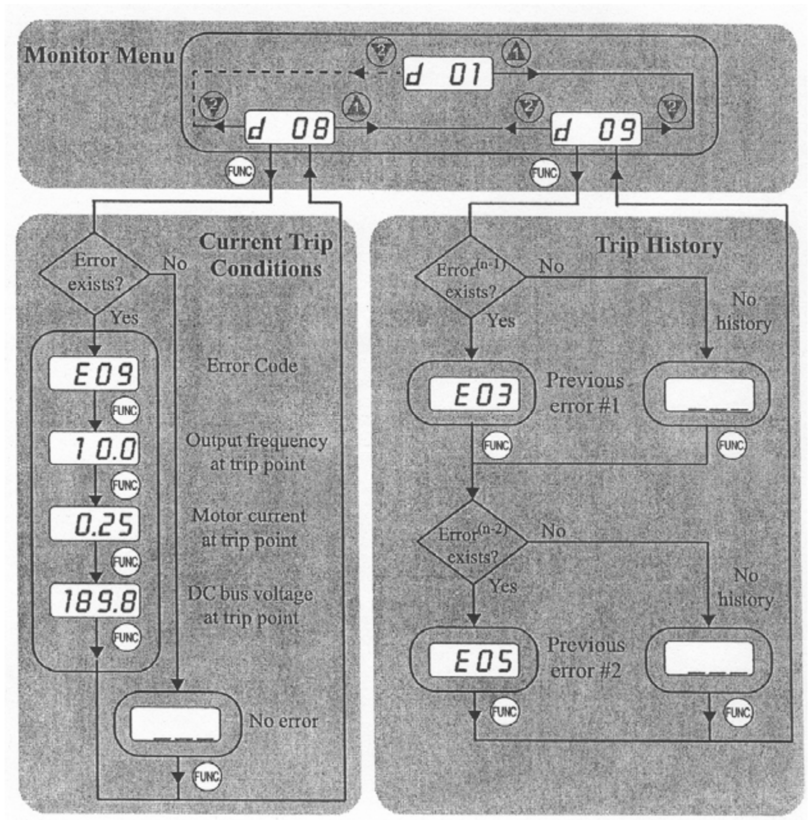
Error Code	Name	Cause(s)
E01	Over current event while at constant speed	The inverter output was short-circuited, or the motor shaft is locked or has a heavy load. These conditions cause excessive current *for the* inverter, so the inverter output is turned OFF. The dual-voltage motor is wired incorrectly.
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.

⚠ WARNING

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

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

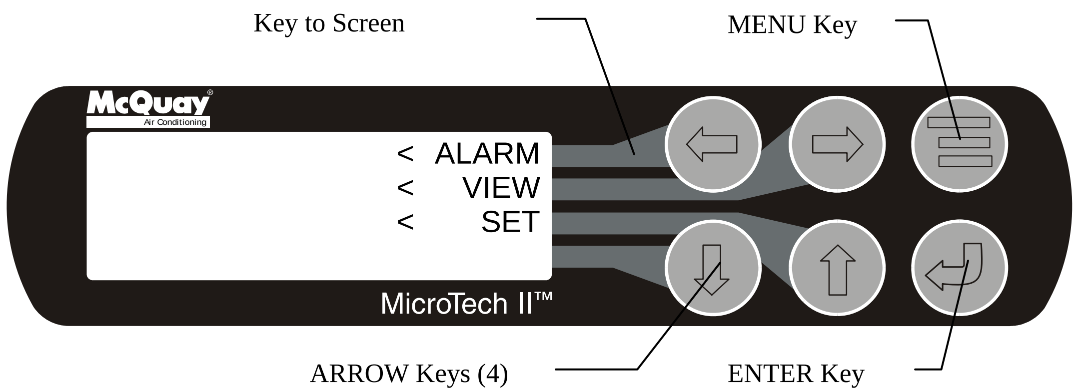
Using the Controller

4x20 Display & Keypad

Layout

The 4-line by 20-character/line liquid crystal display and 6-key keypad are shown below.

Figure 4, Display (in MENU mode) and Keypad Layout



Note that each ARROW key has a pathway to a line in the display. Pressing an ARROW key will activate the associated line when in the MENU mode.

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 Figure 6 on page 42. A detailed description of each menu begins on page 43.

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 4. This corresponds to the second row of screens on Figure 6. One of these groups of screens can then be selected by pressing the key connected to it via the pathway shown in Figure 4.

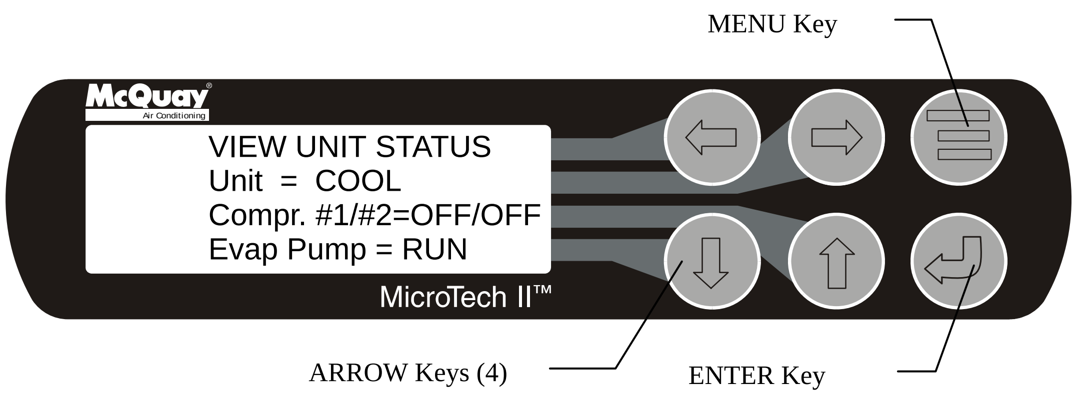
For example, selecting ALARM will go the next row of menus under ALARM (ALARM LOG or ACTIVE ALARM). Selecting VIEW will go the next level of screens under VIEW (VIEW UNIT STATUS or VIEW UNIT TEMP). Selecting SET will go to a series of screens for viewing and changing setpoints.

MENU Key

The MENU key is used to switch between the shortcut method (known as the MENU mode and as shown in Figure 4) and scrolling method (known as the SCROLL mode shown in Figure 5). 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 5.

Pressing the MENU key from any menu screen will automatically return you to the MENU mode as shown in Figure 4.

Figure 5, 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 mode (see Figure 4).
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.

Figure 6, Menu Matrix

"MENU"						
"VIEW" MENUS						
VIEW UNIT STATUS (1)	VIEW UNIT TEMP (1)	VIEW CIR #1 STATUS (1)	VIEW CIR #2 STATUS (1)	VIEW REFRIG CIR #1 STATUS (1)	VIEW REFRIG CIR #2 STATUS (1)	VIEW FAN S (1)
⇓	VIEW UNIT TEMP (2)	⇓	⇓	⇓	⇓	⇓
VIEW UNIT STATUS (5)		VIEW CIR #1 STATUS (4)	VIEW COMP #2 STATUS (2)	VIEW REFRIG CIR #1 STATUS (3)	VIEW REFRIG CIR #2 STATUS (2)	VIEW FAN S (3)

⇐ Continued ⇐

(Right side of matrix continued from above)

"ALARM" MENUS		"SET" MENUS				
ALARM LOG (LAST) TYPE, TIME	ACTIVE ALARM (1) TYPE, TIME	SET UNIT SPs, (1)	SET COMP SPs (1)	SET ALARM LIMITS (1)	SET FANS SP(1)	TEST UNIT (1)
ALARM LOG (NEXT TO LAST)	ACTIVE ALARM (2) TYPE, TIME	⇓	SET COMP SPs (2)	⇓	⇓	⇓
ALARM LOG LAST 25 SHOWN ⇓	ACTIVE ALARM (n) CLEAR/VIEW	SET UNIT SPs, (13)		SET ALARM LIMITS (4)	SET FANS SP (3)	TEST UNIT (6)

Menu Structure (Hierarchical)

As discussed previously, a hierarchical menu structure can be used to access the various screens. One to twenty-five levels can be used below the top-level menu, 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 that changes the display from a regular 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 COMPRESSOR (n) screen.

Assume the initial screen resembles the screen below or any other menu screen:

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

After pressing the MENU key, the top level menu screen will show:

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

After pressing the "VIEW" menu key, a menu screen will show:

```
VIEW    <       UNIT
        < COMPRESSOR
        < REFRIGRANT
        <       FANS
```

Selection of any of these will advance to the appropriate data menu. For example, after pressing the "**REFRIGERANT**" menu button, the selected data screen will show:

```
VIEW REFRIG
          PSI    °F
SAT EVAP XXX.X  XX.X
SAT COND XXX.X  XX.X
```

The ARROW keys will automatically return to the "scroll" mode at this time.

Screen Definitions: VIEW

This section contains information on each menu screen. The menu screens are in order of the matrix in Figure 6, 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
```

Unit states can be OFF, AUTO, and ALARM as determined by the authority Switch, Remote, Etc.

```
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
```

Ice Delay only appears when in the ICE mode.

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

This menu gives the status of digital outputs (D.O.), 1=ON, 0=OFF. Numbers are 1 through 18. See Table 12, Digital Outputs, on page 17 for number reference.

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

This menu gives the status of digital inputs (D.I.). 1=ON, 0=OFF. Numbers are 1 through 18. See Table 11, Digital Inputs, on page 17 for number reference.

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

This menu give the output voltage for fans #1 and #2 VFD. Divide by 100 for actual voltage.

VIEW UNIT TEMPERATURES

```
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 CIRCUIT STATUS

The following four screens are duplicated for circuit # 2. Units with two compressors per circuit (AGZ 026 through AGZ 090) will not have screen #4 present. Circuit 1 has compressor #1, #3, (#5), circuit 2 has compressor #2, #4, (#6).

```
VIEW CIR1 STATUS (1)
Off:Pumpdown Switch
```

```
VIEW CIR1 STATUS (2)
Comp1=Off
Hours= XXXXX
Starts= XXXXX
```

```
VIEW CIR1 STATUS (3)
Comp3=Off
Hours= XXXXX
Starts= XXXXX
```

```
VIEW CIR1 STATUS (4)
Comp5=Off
Hours= XXXXX
Starts= XXXXX
```

SCREEN DEFINITION: VIEW REFRIGERANT

The following three screens are duplicated for circuit #2.

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

```
VIEW REFRG CIR 1 (2)
Sat Evap= XXX.X °F
Sat Cond= XXX.X °F
VFD Target= XXX.X °F
```

```
VIEW REFRG CIR 1 (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.

SCREEN DEFINITION: VIEW FANS

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

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

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

See explanation of fan operation on page 26.

Screen Definitions – ALARM

```
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).

```
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.

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 13 on page 18.

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

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 12).

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 12.)
4. TEST, for use by service technician for certain test procedures.

```
SET UNIT SPs (2)
Available Modes
  =COOL w/Glycol
Set w/ FP Switch 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)
EvapDeltaT= XX.X°F
StartDelta= XX.X°F
Stop Delta = XX.X°F
```

See the Compressor Control section beginning on page 22 for explanation.

```
SET UNIT SPs     (5)
Max Pulldn=X.X°F/min
Evap Recirc=XXX sec
LowAmbLock= XX.X°F
```

```
SET UNIT SPs     (6)
Demand Limit=No
Multipoint Power=No
```

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

```
SET UNIT SPs (8)
       CLOCK
     dd/mmm/yyyy
       hh:mm:weekday
```

Initial Screen

```
SET UNIT SPs    (9)
Units = °F/psi
Lang  = ENGLISH
Refrig = None
```

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.

The refrigerant type entry is made one-time only, in the factory, and cannot be changed thereafter. The choices are R22 or R407c.

```
SET UNIT SPs (9)
Protocol = MODBUS
Ident Number=001
Baud Rate=9600
```

```
SET UNIT SPs    (10)
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    (11)
Cond Pressure Sensor
Cir1 Offset= XX.Xpsi
Cir2 Offset= XX.Xpsi
```

```
SET UNIT SPs    (12)
Suction Temp Sensor
Cir 1 Offset= XX.X °F
Cir 2 Offset= XX.X °F
```

```
SET UNIT SPs    (13)
Leaving Evaporator
Water Temp Sensor
Offset= XX.X °F
```

```
SET UNIT SPs    (14)
Outside Ambient
Temperature Sensor
Offset= XX.X °F
```

```
SET UNIT SPs (15)
ENTER PASSWORD XXXX
Active Password
Level:None
```

SET COMP 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)
InterStageUp=XXXsec
InterStageDn=XXXsec
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 LIMIT ALARMS

```
SET ALARM LMTS (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 LMTS (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 LMTS (3)
HighCondPr = XXXpsi
HiCondStgDn = XXXpsi
```

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 LMTS (4)
PhaseVoltage=YES/NO
GroundFault=YES/NO
LowOATStrtTMR=XXXsec
```

SET FAN STAGES

```
SET FANS SPs (1)
Number of Fans = X
Fan VFD = YES/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, any digital output can be controlled manually.

```
TEST UNIT        (1)
Alarm Signal=Off
EvapWaterPump=Off

```

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

Compressor has 10-second run limit in test.

```
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%

```

Building Automation System Interface (BAS)

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

Additional Information

Additional information on specific communication protocols can be found in the following manuals. They are available from the local McQuay sales office or can be downloaded from www.mcquay.com under Air-cooled Chillers, Installation and Operating Manuals.

- BACnet, IM 736-2
- LONMARK, IM 735-2
- Modbus, IM 743-2

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

LONWORKS

With protocol set to LON, the baud rate and ident set points 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 set points are accessible.

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.

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 120Vac supply for transformer #2.
9. Check between TB-2 terminal #2 and NB for 120Vac control voltage. This supplies the compressor crank case heaters.
10. Check between TB-3 terminal #17 and #27 for 24Vac 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 valve is a Sporlan SHGBE-8 and factory set to begin opening at 69 psig and can be changed by changing the pressure setting. The adjustment range is 0 to 100 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 026 – 070) or a replaceable core type filter-drier (AGZ 075 – 130). 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 11 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 026 through 070

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 075 through 130

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

This document contains the most current product information as of this printing. For the most up-to-date product information, please go to **www.mcquay.com.**