Operating Manual	OM WGS-5
	Group: Chiller
	Part Number: 331373701
	Effective: November 2008
	Supersedes: OM WGS-4

Water-Cooled Screw Compressor Chillers

WGS 130AW to WGS 190AW, Packaged Water-Cooled Chiller

WGS 130AA to WGS 190AA, Chiller with Remote Condenser

120 to 200 Tons, 420 to 700 kW

R-134a, 60 Hz

Software Version WGSD30101H

McQuay® Air Conditioning

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BMA BACnet MANUFACTURERS ASSOCIATION MEMBER

Conform to the BACnet protocol (ANSI/ASHRAE 135-2001).

LONMARK 3.3

Unit controllers are LONMARK certified with an optional LONWORKS communications module.

Introduction

General Description

McQuay Model WGS water chillers are designed for indoor installations and are available with factory-mounted water-cooled condensers (Model WGS AW), or arranged for use with remote air-cooled or evaporative condensers (Model WGS AA). Each water-cooled unit (WGS-AW) is completely assembled and factory wired before factory evacuation, charging and testing. The units consist of two semi-hermetic rotary screw compressors, a two-circuit shell-and-tube evaporator, two shell-and-tube water-cooled condensers, and complete refrigerant piping.

Units manufactured for use with remote condensers (Models WGS-AA) have all refrigerant specialties factory-mounted and have two sets of connection points for refrigerant discharge and liquid lines to and from the remote condenser. Discharge valves are included

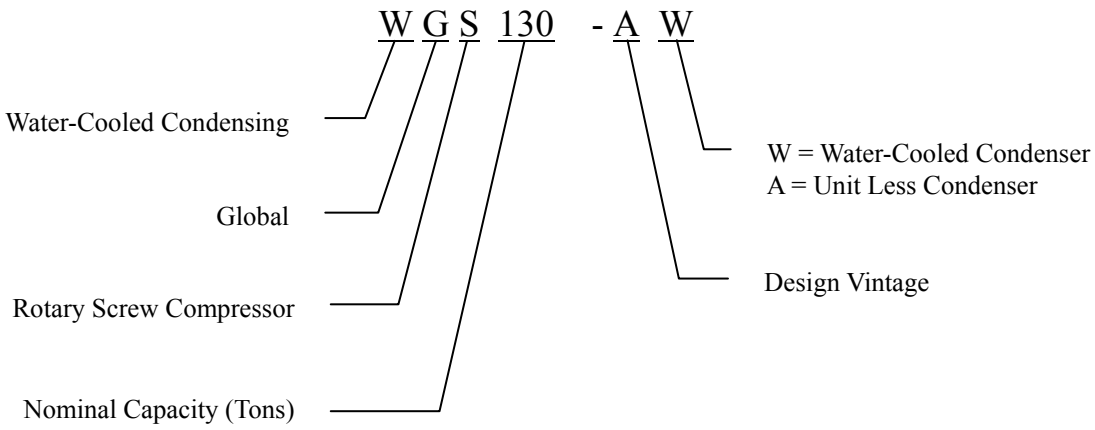
Each circuit's liquid line components are manual liquid line shutoff valve, charging valve, filter-drier, liquid line solenoid valve, sight glass/moisture indicator, and electronic expansion valve.

The electrical control center includes a MicroTech II™ microprocessor control system and equipment protection and operating controls necessary for dependable, automatic operation.

The compressor circuits are equipped with individual circuit breakers and a unit disconnect switch is available as an option over the standard power block.

This software revision adds fixes several bugs in the IP/SI units logic, improves the operation of remote evaporator units in low ambient air temperatures, improves communications with the solid state starter and provides compressor electrical data at the supervisor port for building automation systems.

Nomenclature



Definitions

Active Setpoint
The active setpoint is the setting in effect at any given moment. This variation occurs on setpoints that can be altered during normal operation. Resetting the chilled water leaving temperature setpoint by one of several methods, such as return water temperature, is an example.

Active Capacity Limit
The active setpoint is the setting in effect at any given moment. Any one of several external inputs can limit a compressor's capacity below its maximum value.

Condenser Recirc Timer
A timing function, with a 30-second default, that holds off any reading of condenser water for the duration of the timing setting. This delay allows the water sensors (especially water temperatures) to take a more accurate reading of the condenser water system conditions.

Condenser Saturated Temperature Target
The saturated condenser temperature target is calculated by first using the following equation:

Sat condenser temp target raw = 0.833(evaporator sat temp) + 68.34

The "raw" value is the initial calculated value. This value is then limited to a range defined by the Condenser Saturated Temperature Target minimum and maximum setpoints. These setpoints simply cut off the value to a working range, and this range can be limited to a single value if the two setpoints are set to the same value.

CPU Error
These are problems caused by a malfunction of the central processing unit.

Dead Band
The dead band is a set of values associated with a setpoint such that a change in the variable occurring within the dead band causes no action from the controller. For example, if a temperature setpoint is 44°F and it has a dead band of ± 2 degrees, nothing will happen until the measured temperature is less than 42°F or more than 46°F.

DIN
Digital input, usually followed by a number designating the number of the input.

Discharge Superheat
Discharge superheat shall be calculated for each circuit using the following equation:

Discharge Superheat = Discharge Temperature – Condenser Saturated Temperature

Error
In the context of this manual, "Error" is the difference between the actual value of a variable and the target setting or setpoint.

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

Evaporator Approach = LWT – Evaporator Saturated Temperature

Evap Recirc Timer
A timing function, with a 30-second default, that holds off any reading of chilled water for the duration of the timing setting. This delay allows the chilled water sensors (especially water temperatures) to take a more accurate reading of the chilled water system conditions.

EXV
Electronic expansion valve, used to control the flow of refrigerant to the evaporator, controlled by the circuit microprocessor.

High Saturated Condenser – Hold Value
High Cond Hold Value = Max Saturated Condenser Value – 5°F

This function prevents the compressor from loading whenever the pressures approach within 5 degrees of the maximum discharge pressure. The purpose is to keep the compressor online during periods of possibly temporary elevated pressures.

High Saturated Condenser – Unload Value
High Cond Unload Value = Max Saturated Condenser Value – 3°F

This function unloads the compressor whenever the pressures approach within 3 degrees of the maximum discharge pressure. The purpose is to keep the compressor online during periods of possibly temporary elevated pressures.

High Superheat Error
The degrees of temperature difference between 40°F and the actual discharge temperature.

Light load Stg Dn Point
The percent load point at which one of two operating compressors will shut off, transferring the unit load to the remaining compressor.

Load Limit
An external signal from the keypad, the BAS or a 4-20 ma signal that limits the compressor loading to a designated percent of full load. Frequently used to limit unit power input.

Load Balance
Load balance is a technique that equally distributes the total unit load among the running compressors.

Low Ambient Lockout
Prevents the unit from operating (or starting) at ambient temperatures below the setpoint.

Low Pressure Hold Setpoint
The psi evaporator pressure setting at which the controller will not allow further compressor loading.

Low/High Superheat Error
The difference between actual evaporator superheat and the superheat target.

LWT
Leaving water temperature. The “water” is any fluid used in the chiller circuit.

LWT Error
Error in the controller context is the difference between the value of a variable and the setpoint. For example, if the LWT setpoint is 44°F and the actual temperature of the water at a given moment is 46°F, the LWT error is +2 degrees.

LWT Slope
The LWT slope is an indication of the trend of the water temperature. It is calculated by taking readings of the temperature every few seconds and subtracting them from the previous value, over a rolling one-minute interval.

ms
Milli-second

Maximum Saturated Condenser Temperature
The maximum saturated condenser temperature allowed is calculated based on the compressor operational envelope.

NC
Normally closed - usually refers to a contactor or valve.

NO
Normally open - usually refers to a contactor. or valve.

OAT
Outside ambient air temperature.

Offset
Offset is the difference between the actual value of a variable (such as temperature or pressure) and the reading shown on the microprocessor as a result of the sensor signal. See notes on page 33 for explanation of sensor off set.

pLAN
Peco Local Area Network is the proprietary name of the network connecting the control elements.

Rapid Stop
A compressor stop process that circumvents the normal pumpdown cycle.

Refrigerant Saturated Temperature
Refrigerant saturated temperature is calculated from the pressure sensor readings for each circuit. The pressure is fitted to an R-134a temperature/pressure curve to determine the saturated temperature.

Soft Load
Soft Load is a control sub-routine that allows the chiller to load up gradually. It requires setpoint inputs of selecting it by Yes or No inputs, by selecting the percent load to start ramping up, and by selecting the time to ramp up to full load (up to 60 minutes).

SP
Setpoint

SSS
Solid state starter as used on McQuay screw compressors.

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

Suction Superheat = Suction Temperature – Evaporator Saturated Temperature

Stage Up/Down Accumulator
The accumulator can be thought of as a bank storing occurrences that indicate the need for an additional fan.

Stageup/Stagedown Delta-T
Staging is the act of starting or stopping a compressor or fan when another is still operating. Startup and Stop is the act of starting the first compressor or fan and stopping the last compressor or fan. The Delta-T is the “dead band” on either side the setpoint in which no action is taken.

Stage Up Delay
The time delay from the start of the first compressor to the start of the second.

Startup Delta-T
Number of degrees above the LWT setpoint required to start the first compressor.

Stop Delta-T
Number of degrees below the LWT setpoint required for the last compressor to stop.

VAC
Volts, Alternating current, sometimes noted as vac.

VDC
Volts, Direct current, sometimes noted as vdc.

VFD
Variable Frequency Drive, a device used to vary an electric motor’s speed.

Wiring Diagrams

Figure 1, WGS 130AW – 190AW Field Wiring Diagram (Optional Single Point Connection)

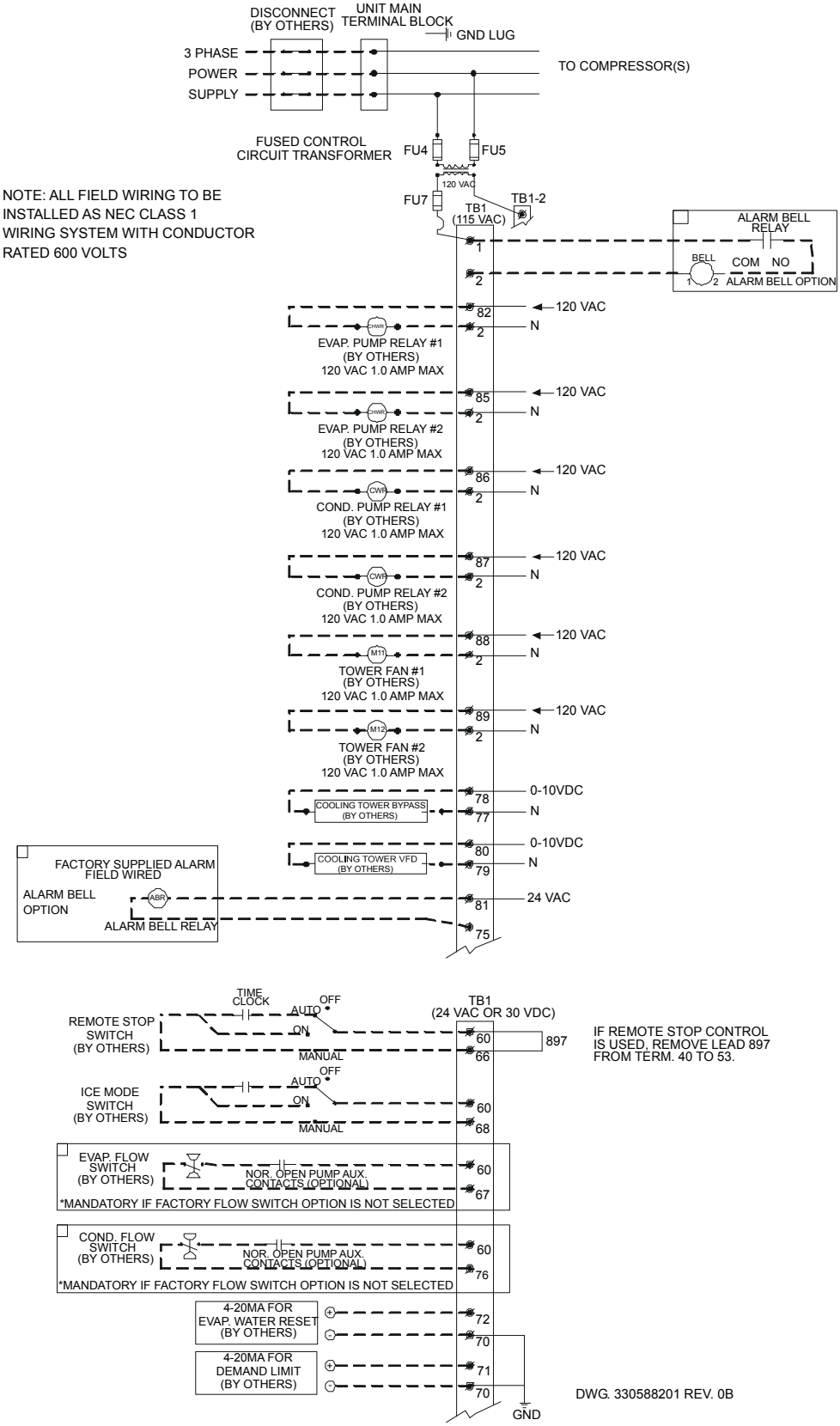
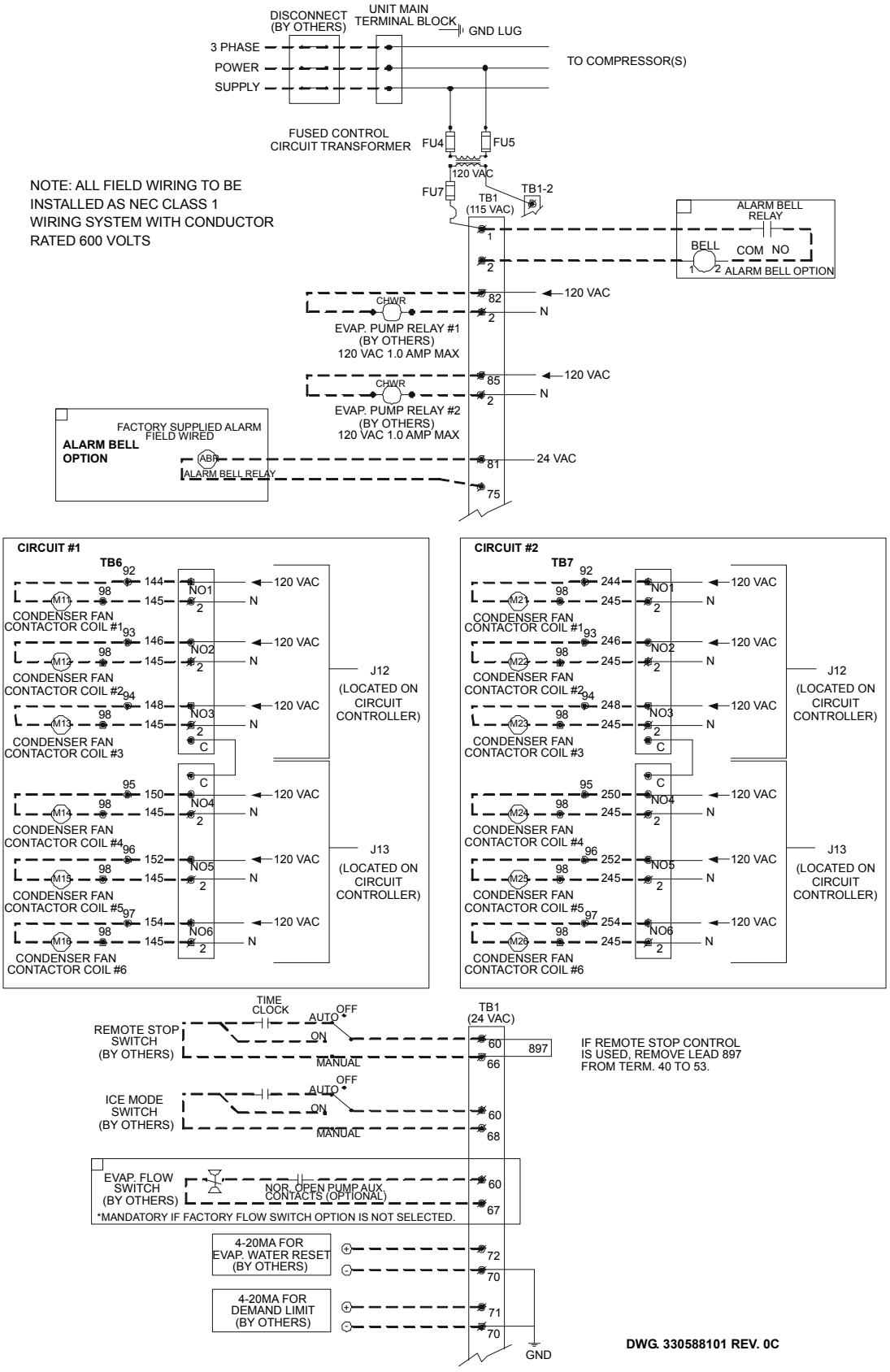
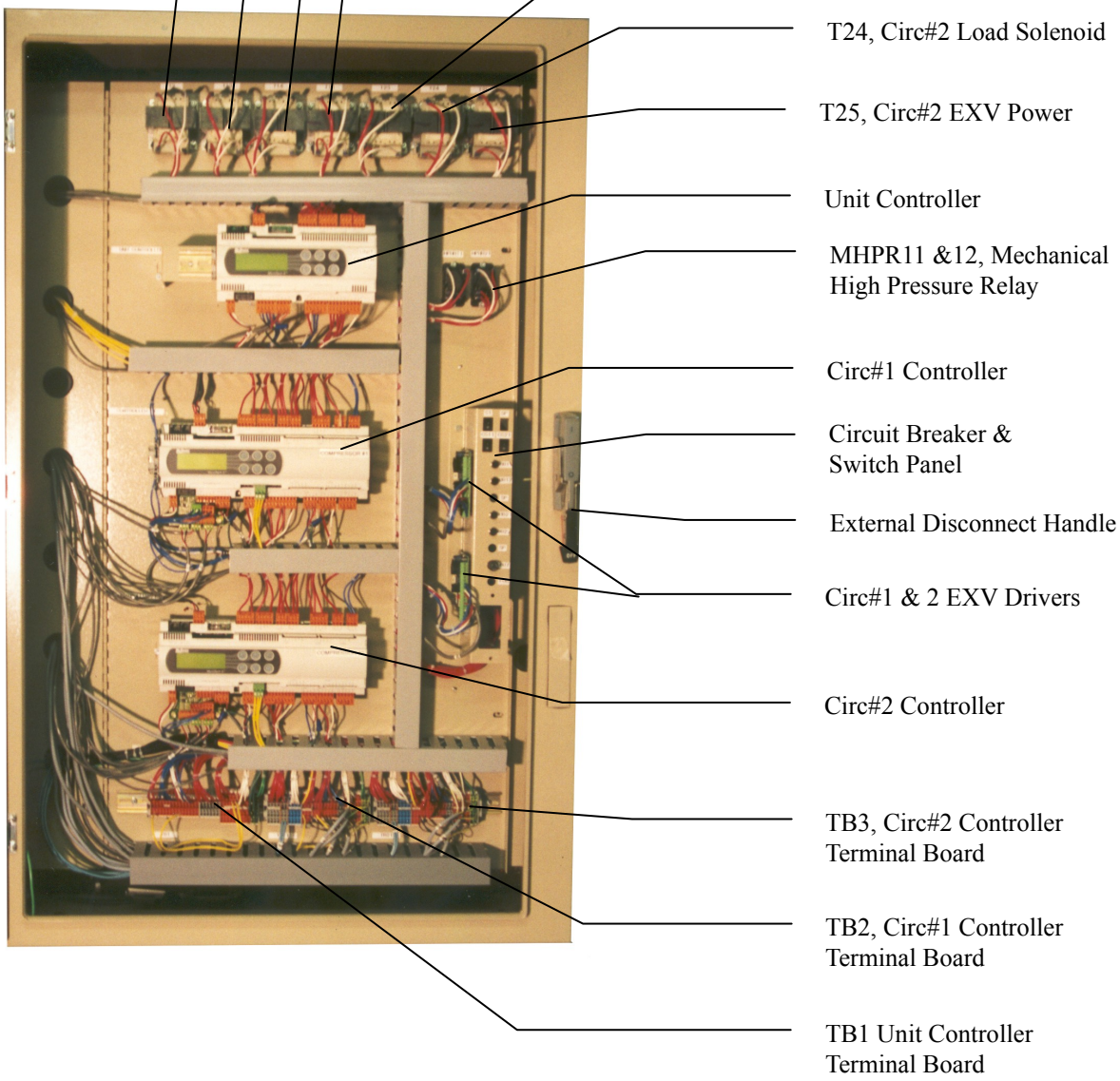


Figure 2, WGS 130AA – 190AA Field Wiring Diagram (Remote Air-cooled Condenser)



Control Panel Layout

Figure 3, Outer (Microprocessor) Panel



NOTES:

1. Transformers T2 through T25 are class 100, 120V to 12V.
2. Switches for MHPR 11 and 12 (Mechanical High Pressure Switches) are located on the compressors.
3. Mechanical High Pressure Switches Open at 310 psi, Close at 250 psi.

Figure 4, Inner (Power) Panel (Optional Single-Point Power with Disconnect Switches Shown)

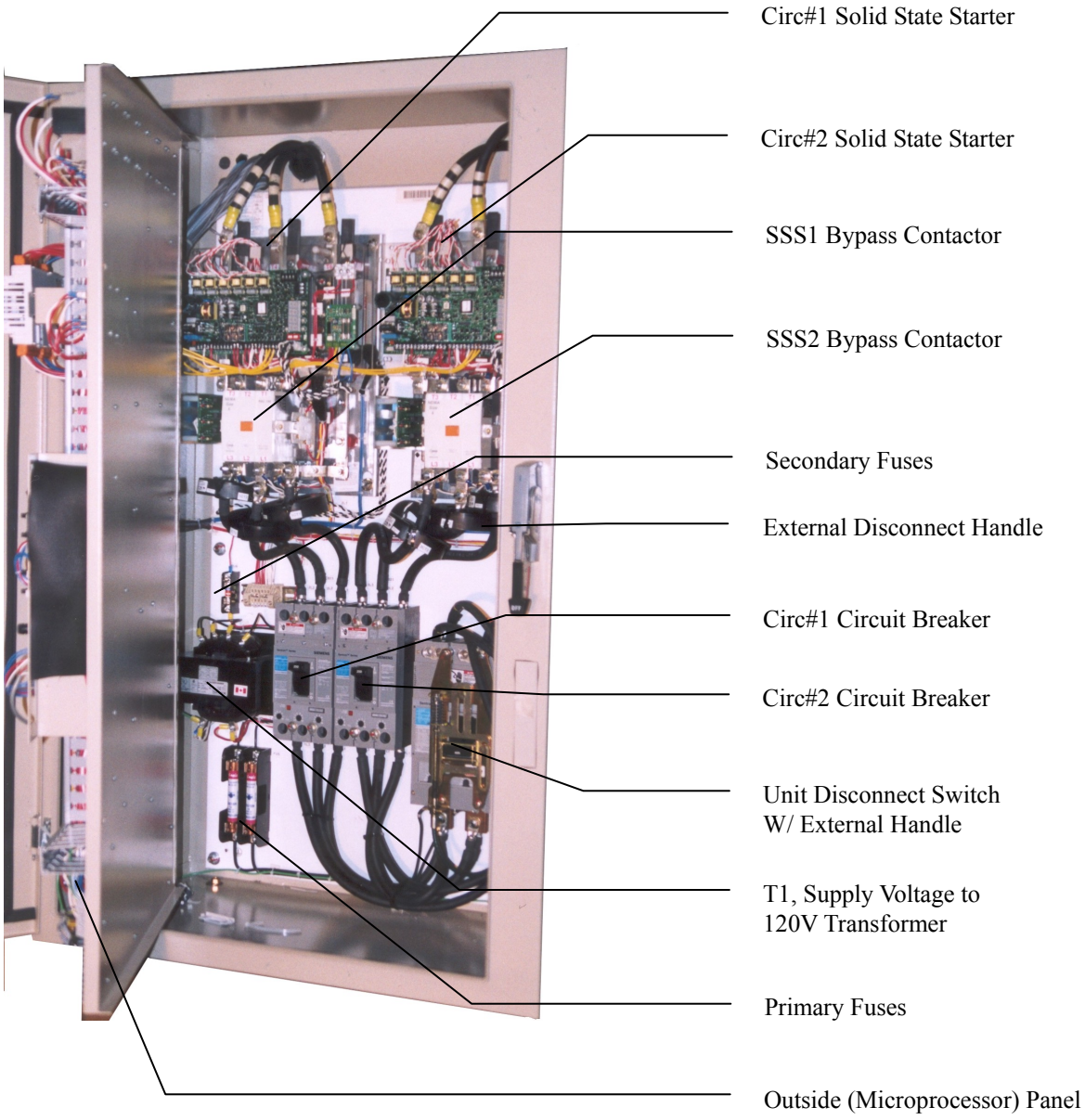
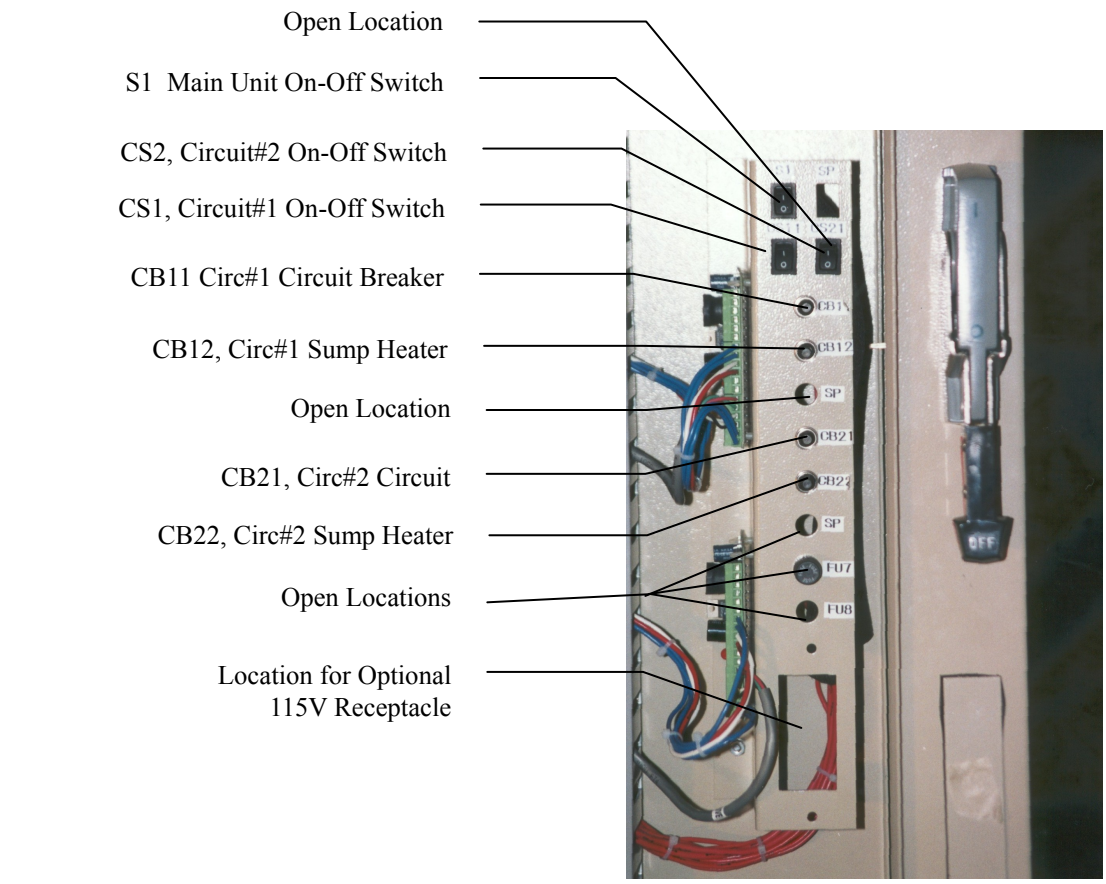
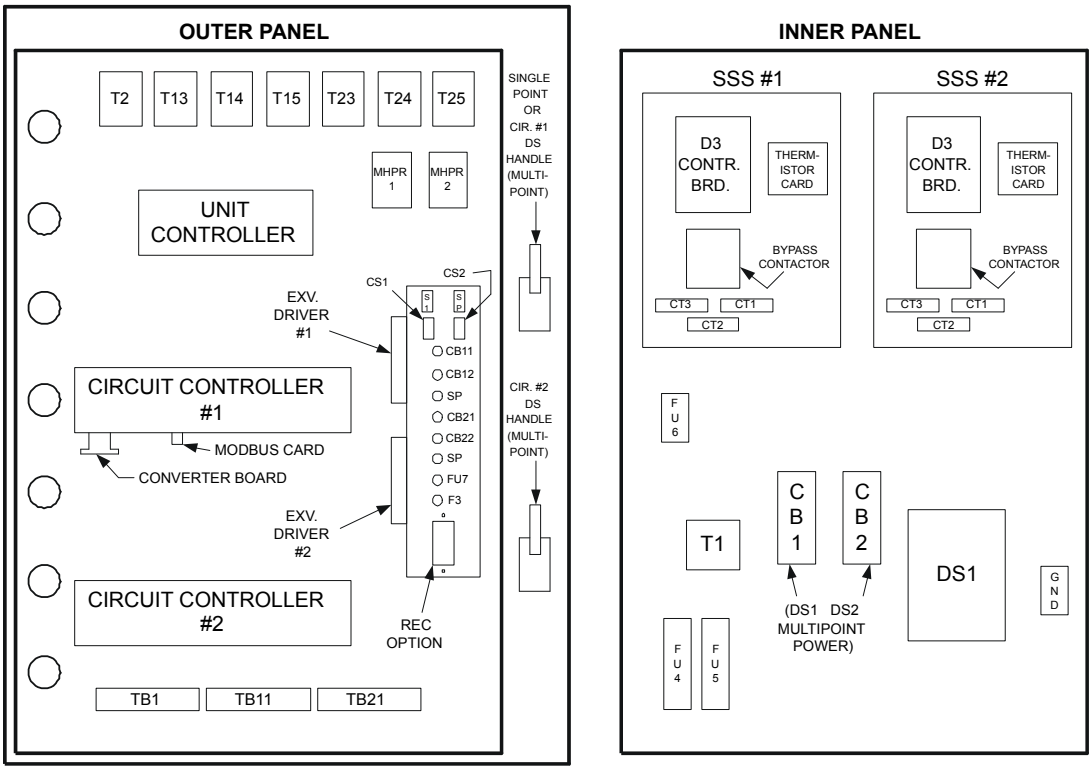


Figure 5, Circuit Breaker/Fuse Panel





330589001 REV. 00 - Legend

Software Version:WGSD30101E
Bios: 3.62
BOOT: 3.0F

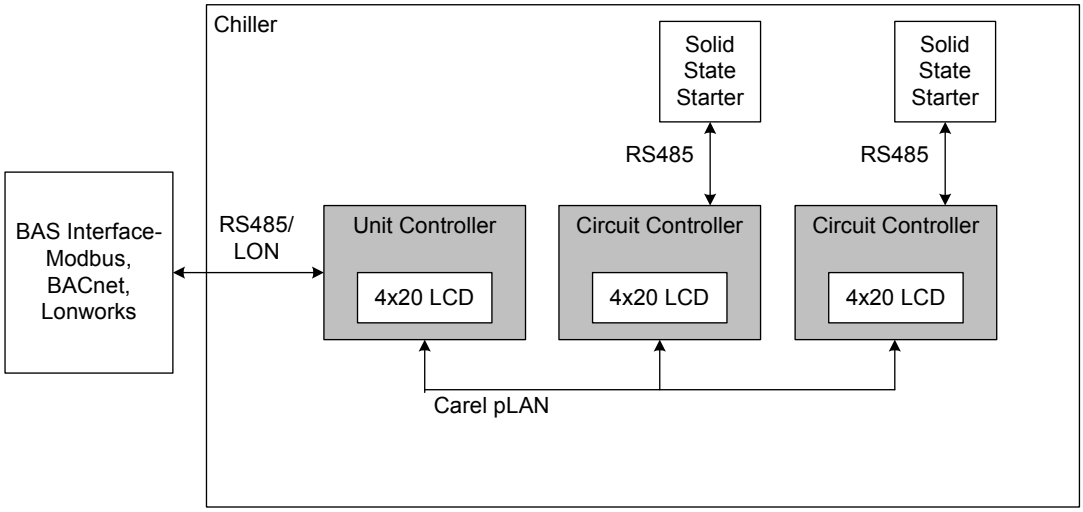
System Architecture

The WGS MicroTech II distributed control system consists of multiple microprocessor-based controllers that provide monitoring and control functions required for the controlled, efficient operation of the chiller. The system consists of the following components:

- Unit Controller, one per chiller – controls functions and settings that apply to the unit and communicates with the other controllers. It is located in the control panel and is labeled "UNIT CONTROL".
- Circuit Controllers for each compressor/circuit that control compressor functions and settings specific to the circuit. The controllers are located in the control panel and are labeled "CIRCUIT CONROL".

In addition to providing all normal operating controls, the MicroTech II control system monitors equipment protection devices on the unit and will take corrective action if the chiller is operating outside of its normal design envelope. If an alarm condition develops, the controller will shut down the compressor, or entire unit, and activate an alarm output. Important operating conditions at the time an alarm condition occurs are retained in the controller's memory to aid in troubleshooting and fault analysis.

The system is protected by a password scheme that allows access only by authorized personnel. The operator must enter the operator password into the controller's keypad before any setpoints can be altered.



PLAN Addressing

The pLAN (proprietary local area network) addressing is based on a commonly used scheme among all applications using pLAN networked MicroTech II controllers. Only three addresses are needed, and are designated as shown in the following table.

Controller	Address	Dip Sw 1 Position	Dip Sw 2 Position	Dip Sw 3 Position
Unit	5	Up	Down	Up
Circuit 1	1	Up	Down	Down
Circuit 2	2	Down	Up	Down

The Dip switches are located on the upper front of the controller above the screen.

General Description

The MicroTech II controller's design permits the chiller to run more efficiently, and it simplifies troubleshooting if a system failure occurs. Every MicroTech II controller is programmed and tested prior to shipment to assist in a trouble-free start-up. The MicroTech II controller can be used to cycle fans on remote air-cooled condensers for head pressure control when the setpoint Water Cooled=N is selected in one of the setpoint menu screens. Water Cooled=Y sets the chiller for operation with the water-cooled condenser and activates settings for cooling tower control. Remote evaporative condensers will have to have self-contained, on-board, head pressure control systems.

Units of measure

Version "C", as described in this manual, supports metric (SI) units of measure.

Inch-Pound	SI
°F to 0.1°F	°C to 0.1°C
psi to 0.1 psi	KPa to 1.0 kPa

Distributed Control

The WGS units have three MicroTech II microprocessors, a Unit Controller plus a Circuit Controller for each of the two circuits. The Circuit Controllers are independent such that either one will operate its circuit if the other Circuit Controller is out of service.

Operator-friendly

The MicroTech II controller menu structure is separated into three distinct categories, which provide the operator or service technician with a full description of the following:

1. Current unit status
2. Control parameters (setpoint settings and adjustment). Security protection prevents unauthorized changing of the setpoints and control parameters.
3. Alarm notification and clearing

The MicroTech II controller continuously performs self-diagnostic checks, monitoring system temperatures, pressures and protection devices, and will automatically shut down a refrigerant circuit or the entire unit if a fault occurs. The cause of the shutdown and date stamp are retained in memory and can be easily displayed in plain English for operator review, which is an extremely useful feature for troubleshooting. In addition to displaying alarm diagnostics, the MicroTech II controller also provides the operator with a warning of pre-alarm limit conditions.

Staging

The two screw compressors are loaded and staged on and off as a function of leaving chilled water temperature, number of starts and run-hours. See Sequence of Operation beginning on page 16.

Equipment Protection

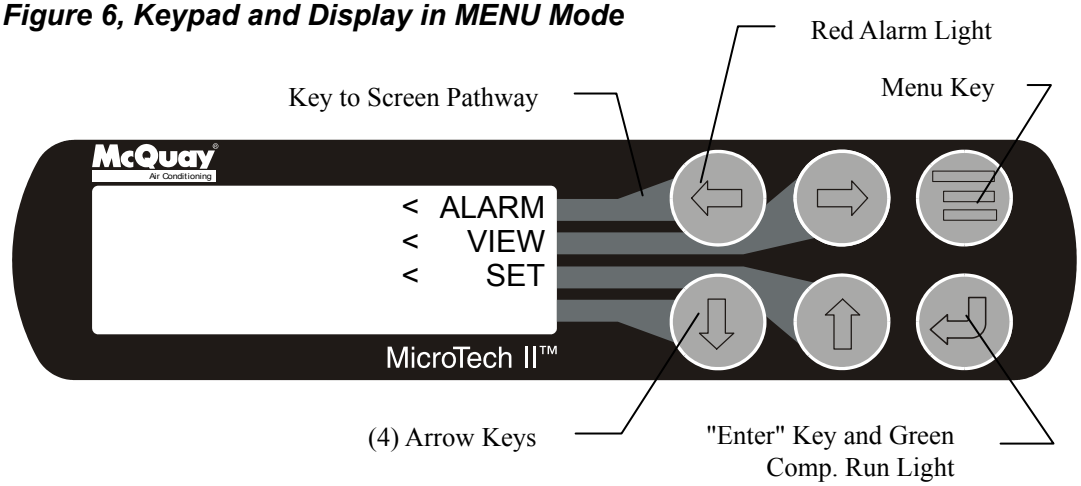
The unit is protected by alarms that shut it down and require manual reset, and also by limit alarms that limit unit operation in response to some out-of-ordinary condition. Shutdown alarms activate an alarm signal that can be wired to a remote device.

Unit Enable Selection
Enables unit operation from local keypad or digital input.

Unit Mode Selection
Selects standard cooling, ice, glycol, or test operation mode.

Keypad/Display
A 4-line by 20-character/line liquid crystal display and 6-key keypad is mounted on each controller. Its layout is shown below.

Figure 6, Keypad and Display in MENU Mode



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

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

LEFT	Default
RIGHT	Cancel
UP	Increment
DOWN	Decrement

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

Compressor Heaters

With the control power on, 120V power is applied through the control circuit Fuse FU7 to the compressor oil separator heater (HTR-OIL SEP).

Startup/Compressor Staging

During Cool Mode the following must be true to start a circuit operating. The evaporator and condenser pump (WGS-AW only) outputs must be energized and flow must be established for a period of time defined by the evaporator recirculate setpoint. Established flow will be detected by evaporator and condenser water flow switches. The water temperature leaving the evaporator must be greater than the Active Leaving Water Temperature setpoint, plus the Startup Delta-T, before a circuit will start. The first circuit to start is determined by sequence number. The lowest sequence numbered circuit will start first. If all sequence numbers are the same (default), then the circuit with the fewest number of starts will start first.

During operation, the slide valves for loading and unloading will be pulsed until the active leaving water temperature setpoint is maintained. The second circuit start will occur once the first circuit has loaded to 75% slide capacity or is in Capacity Limit and the water temperature leaving the evaporator is greater than the active leaving water temperature Setpoint plus Stage Delta-T. The circuits will load or unload simultaneously through a continuous capacity control to maintain the evaporator leaving water temperature. If all sequence numbers are the same, the circuit with the most run hours will be shut down first. The circuit with the most run hours will stop when the water temperature leaving the evaporator is less than the Active Leaving Water Temperature Setpoint minus Stage Delta-T. The last remaining circuit will shut down when the water temperature leaving the evaporator is lower than the Active Leaving Water Temperature Setpoint minus the Stop Delta-T.

Automatic Pumpdown

The Model WGS chiller has two separate refrigerant circuits so the refrigerant charge is stored in the condenser when the circuit is off. Pumpdown to the condenser helps keep refrigerant from migrating to the compressor. It also helps establish a pressure differential on start for oil flow. In a normal shutdown, each circuit will close its expansion valve, causing the evaporator pressure to reach a low-pressure setpoint. Once this setpoint is reached, or a specified amount of time has elapsed, the running circuit will be shut down.

Chilled Water and Condenser Water Pumps

The chiller's MicroTech II™ controller has a total of four pump outputs, two for the evaporator and two for the condenser (WGS-AW only). There is a manual setting in the software for the user to select either pump output 1 or 2. It is recommended that the chiller's outputs control the water pumps, as this will offer the most protection for the unit.

Cooling Tower Control

The MicroTech II controller can control the cooling tower fans and/or a tower bypass valve. This provides a simple and direct method to control the unit's discharge pressure. Programming directions and the sequence of operation can be found on page 49. Some means of discharge pressure control is recommended and must be installed if the entering condenser water temperature to the condenser can fall below 60°F.

Condenser Fan Control

The MicroTech II controller can be programmed to cycle air-cooled condenser fans on and off based on the discharge pressure. Details are on page 66.

Low Ambient Start Logic

Low pressure operation at start (due to low ambient air temperature)is allowed for every start regardless of the condenser saturated temperature at start or condenser configuration (water-cooled or remote condenser). This is called Start Logic. START Logic is active for a time period determined by the unit Startup Timer setpoint. This was called the Low OAT Start Timer in previous software versions.

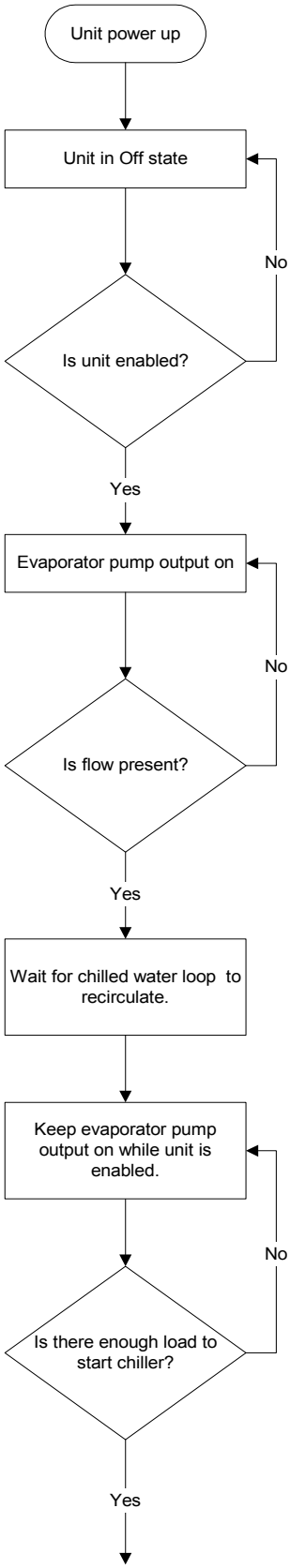
The Low OAT Restart Failure logic, which applies ONLY to units configured for remote condenser, still allows for three start attempts. If the condenser saturated temperature at start is less than 70°F, another start attempt is allowed until failure of the third attempt, which will generate an alarm.

Remote Condenser EXV Operation

For units configured for remote condensers, there is pre-open logic that allows the electronic expansion valve to open prior to starting the compressor. This allows the expansion valve to be in a better position for control at start-up. The factory mounted liquid line solenoid remains closed until the compressor starts. On units configured for remote condensers, if the evaporator pressure is greater than the condenser pressure at start, the pre-open logic is bypassed. NOTE: Pre-open logic also exists for units configured as packaged water cooled condensers.

Electronic expansion valve post-open logic has been added to help prevent hydraulic lock between the liquid line solenoid and the electronic expansion valve when a circuit cycles off. After the compressor performs a pump down and cycles off, the electronic expansion valve will re-open for 30 seconds and then return to its closed position.

Unit Controller Sequence of Operation



The chiller may be disabled via the unit switch, the remote switch, the keypad enable setting, or the BAS network. In addition, the chiller will be disabled if both circuits are disabled, either because of an alarm or the circuit pumpdown switch on each circuit, or if there is a unit alarm. If the chiller is disabled, the unit status display will reflect this and also show why it is disabled.

If the unit switch is off, the unit status will be **Off:Unit Switch**. If the chiller is disabled due to network command, the unit status will be **Off:BAS Disable**. When the remote switch is open, the unit status will be **Off:Remote Switch**. When a unit alarm is active, the unit status will be **Off:Unit Alarm**. In cases where no circuits are enabled, the unit status will be **Off:All Cir Disabled**.

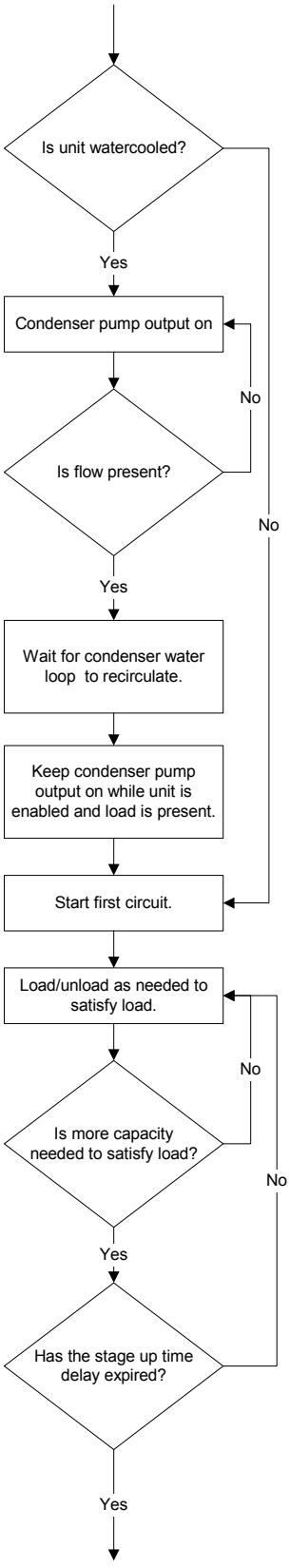
If the chiller is enabled, then the unit will be in the Auto state and the evaporator water pump output will be activated.

The chiller will then wait for the flow switch to close, during which time the unit status will be **Auto:Wait for flow**.

After establishing flow, the chiller will wait some time to allow the chilled water loop to recirculate for an accurate reading of the leaving water temperature. The unit status during this time is **Auto:Evap Recirc**.

The chiller is now ready to start if enough load is present. If the LWT is not high enough to start, the unit status will be **Auto:Wait Evap Flow**.

If the LWT is high enough to start, the unit status will be **Auto**.



If the unit is configured as watercooled, the condenser pump will need to be started. Otherwise, the unit can start the first circuit at this point.

If load is present, the condenser water pump output will be activated.

The chiller will then wait for the condenser flow switch to close, during which time the unit status will be **Auto:Wait Cond Flow**.

After establishing condenser flow, the chiller will wait some time to allow the condenser water loop to recirculate and guarantee consistent flow. The unit status during this time is **Auto:Cond Recirc**.

Once the condenser flow has been present for enough time, the unit status will become **Auto**. The tower control logic will start working to control the condenser water temperature, using outputs from the unit controller to control tower fans, bypass valves, and vfd's as determined by the tower set points.

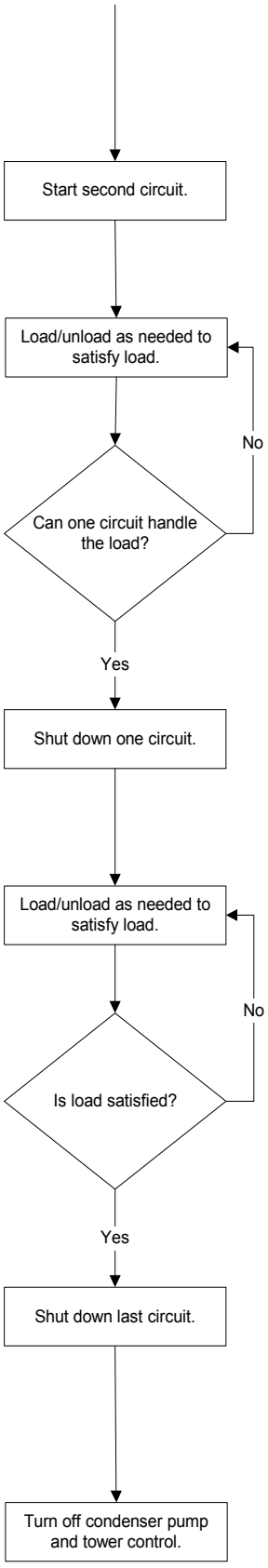
The first circuit to start is generally the one with the least number of starts, or circuit one if there is a tie. This circuit will go through its start sequence at this point.

A number of fans may be started with the compressor based on the OAT. Fan stages will be added/removed as needed to control condenser pressure. The EXV will begin controlling at this point as well. The compressor cannot start loading until it has at least 22^{o} discharge superheat for more than 30 seconds.

The first circuit will load and unload as needed in an attempt to satisfy the load. It will eventually get to a point where it is considered to be at full load. A circuit is at full load when it reaches 75% slide target, it reaches the max slide target setting, or it encounters a problem and is running in an inhibited state.

If a single circuit is not enough to satisfy the load, the second circuit will need to be started.

A minimum time must pass between the start of the first circuit and the second circuit.



The second circuit will go through its start sequence at this point.

A number of fans may be started with the compressor based on the OAT. Fan stages will be added/removed as needed to control condenser pressure. The EXV will begin controlling at this point as well. The compressor cannot start loading until it has at least 22° discharge superheat for more than 30 seconds.

Both circuits will now load/unload as needed to satisfy the load. In addition, they will load balance so that both circuits are providing nearly equal capacity.

As the load drops off, the circuits will unload accordingly. If the LWT gets low enough, or both circuits unload enough, one circuit can shut off.

The first circuit to shut off is generally the one with the most run hours. The circuit will do a pumpdown by closing the EXV and continuing to run the compressor until it reaches the pumpdown pressure or exceeds the pumpdown time limit. Then, the compressor and all fans will be turned off.

The single running circuit will load/unload as needed to satisfy the load.

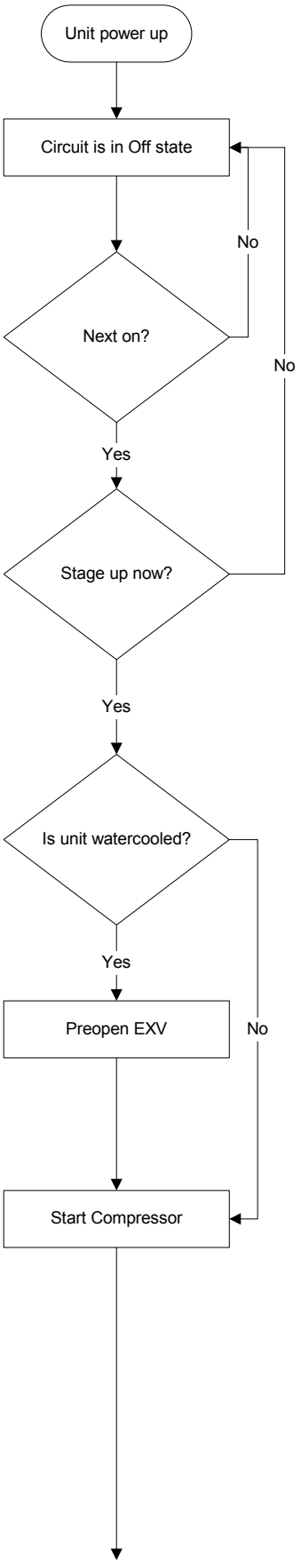
With one circuit running, the load may drop off to the point where even minimum unit capacity is too much. The load has been satisfied when the LWT drops below the shutdown point. At this time the only running circuit can shut down.

The last circuit running now shuts down. The circuit will do a pumpdown by closing the EXV and continuing to run the compressor until it reaches the pumpdown pressure or exceeds the pumpdown time limit. Then, the compressor and all fans will be turned off.

The unit should be ready to start again when the LWT gets high enough. The unit status at this time will be **Auto:Wait for load**.

The condenser pump and tower control outputs are turned off until the LWT is high enough to start again.

Circuit Controller Sequence of Operation



When the circuit is in the Off state the EXV is closed, compressor is off, and all fans are off. The oil heater will be on at this time as long as oil is detected in the separator.

If the compressor is ready to start when needed, the circuit status will be **Off:Ready**. When the circuit switch is off, the circuit cannot start and the status will be **Off:Pumpdown Switch**.

If this compressor has the least starts, the other compressor is disabled for some reason, or the other compressor is already running, then this compressor will be designated as the next one on.

If there is a need for more cooling capacity, the compressor designated as next on can start.

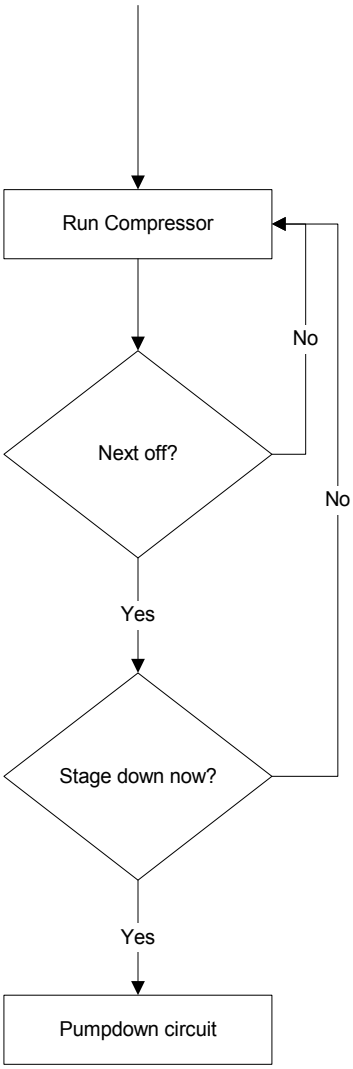
If the unit is configured as watercooled, then the EXV preopen process must be performed. Otherwise, this is skipped and the compressor can be started.

At this point, the EXV will perform a preopen. While the compressor is off, the EXV is opened for a period of time to prime the evaporator and avoid low pressure at startup. The circuit status will display **EXV Preopen**.

When the compressor starts, the EXV will open (if not already open) and hold at 3000 steps for 15 seconds.

If the unit is aircooled, depending on the OAT, a number of fans may be started with the compressor to keep condenser pressure from climbing too fast.

The circuit status will normally be **Run: Disc SH Low** after the compressor starts.



When in the Run state, the compressor will load/unload as needed to satisfy the load. The compressor will also load/unload to load balance with the other compressor if it is running and not in a limited condition. However, it cannot load up until the discharge superheat has been over 22 F for at least 30 seconds. After this, the circuit status will be **Run:Normal**.

The EXV will operate in either Pressure Control or Superheat Control. In Pressure Control, the evaporator pressure is controlled to a target pressure, which is adjusted based on LWT and discharge superheat. In Superheat Control, the suction superheat is controlled to a target that varies with discharge superheat.

If unit is aircooled, fans will be staged on and off to control the condenser pressure. The condenser pressure is controlled to a target that is based on evaporator pressure, with the target getting higher as the evaporator pressure gets higher.

If this compressor has the most run hours or the other compressor is already off, then this compressor will be designated as the next one off.

If less cooling capacity is needed, the compressor designated as next off can shut down. This condition may arise when either the LWT has dropped far enough below the active set point or both circuits are running at a low capacity.

When the circuit does a normal shutdown, a pumpdown is performed. The EXV is closed while the compressor continues to run. As soon as the pumpdown is initiated, the compressor is unloaded to the minimum. The condenser fans continue to control normally during this process. The circuit status during this time is **Run:Pumpdown**.

After the evaporator pressure drops below the pumpdown pressure or enough time has passed, the compressor and fans are shut off to end the pumpdown process. The circuit status will normally be **Off:Cycle Timers** at this time.

Start-Up and Shutdown

Pre Start-up

1. Flush and clean the chilled-water system. Proper water treatment is required to prevent corrosion and organic growth. A 20-mesh strainer is required at the evaporator chilled-water inlet and should be cleaned after system flushing.

⚠ CAUTION

Failure to flush, clean and provide system water treatment can damage the unit.

2. With the main disconnect open, check all electrical connections in control panel and starter to be sure they are tight and provide good electrical contact. Connections are tightened at the factory, but can loosen enough in shipment to cause a malfunction.

⚠ CAUTION

Lock and tag out all power sources when checking connections. Electrical shock can cause severe personal injury or death..

3. Check and inspect all water piping. Make sure flow direction is correct and that piping is made to the correct connection on evaporator and condenser.
4. Check that refrigerant piping on remote condensers is connected to the correct circuits and not crossed and has been properly leak tested and evacuated.
5. Open all water flow valves to the condenser and evaporator.
6. Flush the cooling tower and system piping to be sure the system is clean. Start evaporator pump and manually start condenser pump and cooling tower. Check all piping for leaks. Vent the air from the evaporator and condenser water circuit, as well as from the entire water system. The cooler circuit should contain clean, treated, non-corrosive water.
7. Check to see that the evaporator water temperature sensor is securely installed.
8. Make sure the unit control switch S1 is open OFF and the circuit switches CS1 and CS2 are open. Place the main power disconnect switch to ON. This will energize the compressor sump heaters. Wait a minimum of 12 hours before starting the unit.
9. Measure the water pressure drop across the evaporator and condenser, and check that water flow is correct (on pages 26 and 27) per the design flow rates.
10. Check the actual line voltage to the unit to make sure it is the same as called for on the compressor nameplate, within + 10%, and that phase voltage unbalance does not exceed 2%. Verify that adequate power supply and capacity is available to handle load.
11. Make sure all wiring and fuses are of the proper size. Also make sure that all interlock wiring is completed per McQuay diagrams.
12. Verify that all mechanical and electrical inspections by code authorities have been completed.
13. Make sure all auxiliary load and control equipment is operative and that an adequate cooling load is available for initial start-up.

Start-up

1. Open the compressor discharge shutoff valves until backseated. Replace valve seal caps.
2. Open the two manual liquid line shutoff valves (king valves).

3. Verify that the compressor sump heaters have operated for at least 12 hours prior to start-up. Crankcase should be warm to the touch.
4. Check that the MicroTech II controller is set to the desired chilled water temperature.
5. Start the system auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch and water pumps.
6. Switch on the unit circuit breakers.
7. Set circuit switches CS1 and CS2 to ON for normal operation.
8. Start the system by setting the unit system switch S1 to ON.
9. After running the unit for a short time, check the oil level in each compressor, rotation of condenser fans (if any), and check for flashing in the refrigerant sight glass.

Weekend or Temporary Shutdown

Move circuit switches CS1 and CS2 to the OFF pumpdown position. After the compressors have shut off, turn off the chilled water pump if not on automatic control from the chiller controller or building automation system (BAS). With the unit in this condition, it will not restart until these switches are turned back on.

Leave on the power to the unit (disconnect closed) so that the sump heaters will remain energized.

Start-up after Temporary Shutdown

1. Start the water pumps.
2. Check compressor sump heaters. Compressors should be warm to the touch.
3. With the unit switch S1 in the ON position, move the circuit switches CS1 and CS2 to the ON position.
4. Observe the unit operation for a short time, noting unusual sounds or possible cycling of compressors.

Extended Shutdown

1. Close the manual liquid line shutoff valves.
2. After the compressors have shut down, turn off the water pumps.
3. Turn off all power to the unit.
4. Move the unit control switch S1 to the OFF position.
5. Close the discharge shutoff valves.
6. Tag all opened disconnect switches to warn against start-up before opening the compressor suction and discharge valves.
7. Drain all water from the unit evaporator, condenser and chilled water piping if the unit is to be shut down during the winter and exposed to below-freezing temperatures. To help prevent excessive corrosion, do not leave the vessels or piping open to the atmosphere over the shutdown period.

Start-up after Extended Shutdown

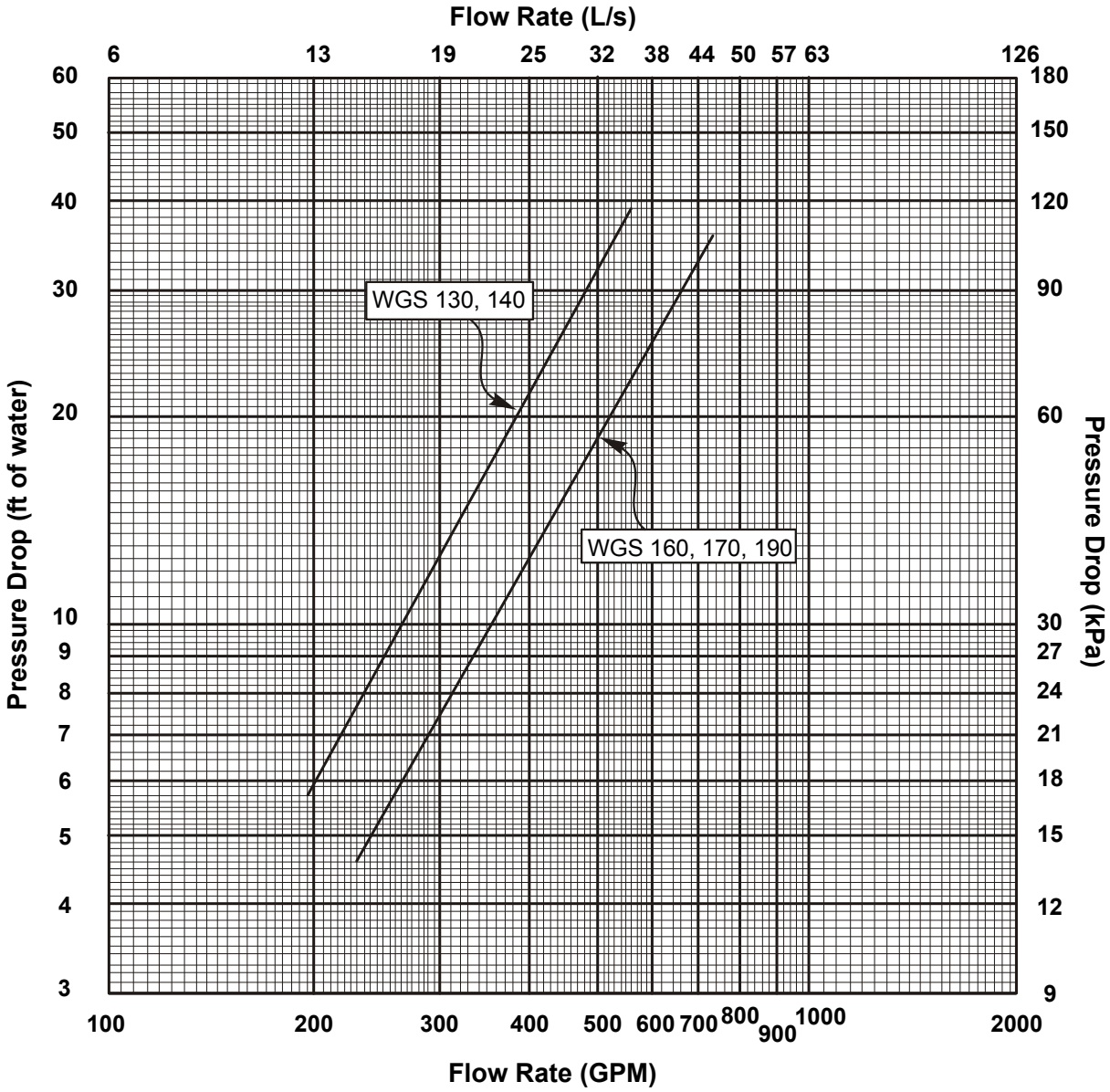
1. Inspect all equipment to see that it is in satisfactory operating condition.
2. Remove all debris that has collected on the surface of the condenser coils (remote condenser models) or check the cooling tower, if present.
3. Open the compressor discharge valves until backseated. Always replace valve seal caps.
4. Open the manual liquid line shutoff valves.
5. Check circuit breakers. They must be in the OFF position.
6. Check to see that the circuit switches CS1 and CS2 and the unit control switch S1 are in the OFF position.
7. Close the main power disconnect switch. The circuit disconnects switches should be off.
8. Allow the sump heaters to operate for at least 12 hours prior to start-up.
9. Start the chilled water pump and purge the water piping as well as the evaporator in the unit.
10. Start the system auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch.
11. Check that the MicroTech II controller is set to the desired chilled water temperature.
12. Switch the unit circuit breakers to ON.
13. Start the system by setting the system switch S1 and the circuit switches to ON.

⚠ CAUTION

Most relays and terminals in the control center are powered when S1 is closed and the control circuit disconnect is on. Therefore, do not close S1 until ready for start-up or serious equipment damage can occur.

14. After running the unit for a short time, check the oil level in the compressor oil sight glass and check the liquid line sight glass for bubbles.

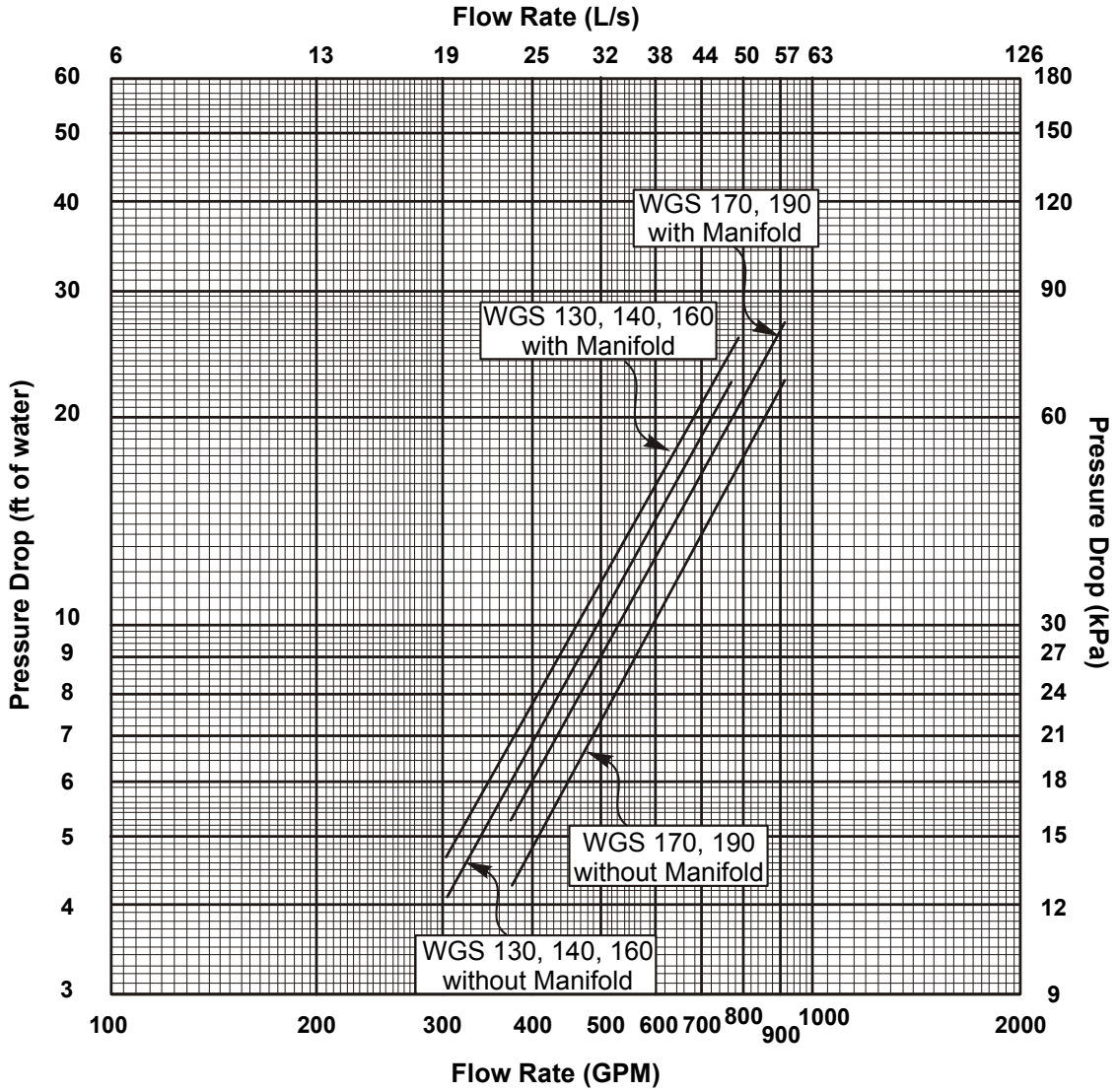
Figure 7, Evaporator Pressure Drop WGS 130 – WGS 190



WGS Model	Minimum Flow				Nominal Flow				Maximum Flow			
	Flow Rate		Pressure Drop		Flow Rate		Pressure Drop		Flow Rate		Pressure Drop	
	gpm	L/s	Ft.	kPa	gpm	L/s	Ft.	kPa	gpm	L/s	Ft.	kPa
130AW/AA	195	12.3	5.8	17.4	312	19.7	13.5	40.4	520	32.9	33.9	101.1
140AW/AA	211	13.4	6.7	20.0	338	21.4	15.6	46.6	563	35.6	39.0	116.5
160AW/AA	235	14.9	4.6	13.8	376	23.8	10.8	32.3	627	39.7	27.3	81.6
170AW/AA	254	16.1	5.3	15.9	407	25.8	12.5	37.3	678	42.9	31.6	94.2
190AW/AA	273	17.3	6.1	18.1	437	27.7	14.2	42.5	728	46.1	35.9	107.2

Note: Minimum, nominal, and maximum flows are at a 16°F, 10°F, and 6°F chilled water temperature range respectively and at ARI tons.

Figure 8, Condenser Pressure Drop WGS 130 – WGS 190



Pressure Drop *Without* Optional Condenser Manifold												
WGS Model	Minimum Flow				Nominal Flow				Maximum Flow			
	Flow Rate		Pressure Drop		Flow Rate		Pressure Drop		Flow Rate		Pressure Drop	
	gpm	L/s	Ft.	kPa	gpm	L/s	Ft.	kPa	gpm	L/s	Ft.	kPa
130AW	304	19.2	4.1	12.2	390	24.7	6.5	19.3	650	41.1	16.0	47.9
140AW	304	19.2	4.1	12.2	422	26.7	7.4	22.2	704	44.5	18.5	55.1
160AW	304	19.2	4.1	12.2	470	29.8	9.0	26.9	784	49.6	22.4	66.8
170AW	372	23.5	4.3	12.8	509	32.2	7.9	23.7	848	53.7	19.8	59.1
190AW	372	23.5	4.3	12.8	546	34.6	9.0	26.9	911	57.6	22.5	67.1

Pressure Drop *With* Optional Condenser Manifold												
WGS Model	Minimum Flow				Nominal Flow				Maximum Flow			
	Flow Rate		Pressure Drop		Flow Rate		Pressure Drop		Flow Rate		Pressure Drop	
	gpm	L/s	Ft.	kPa	gpm	L/s	Ft.	kPa	gpm	L/s	Ft.	kPa
130AW	304	19.2	4.7	14.0	390	24.7	7.4	22.0	650	41.1	18.5	55.1
140AW	304	19.2	4.7	14.0	422	26.7	8.5	25.3	704	44.5	21.3	63.5
160AW	304	19.2	4.7	14.0	470	29.8	10.3	30.7	784	49.6	25.8	77.1
170AW	372	23.5	5.3	15.8	509	32.2	9.4	28.1	848	53.7	23.8	71.1
190AW	372	23.5	5.3	15.8	546	34.6	10.7	32.0	911	57.6	27.1	80.9

Unit Inputs/Outputs

Table 1, Analog Inputs

#	Description	Signal Source	Range
1	Condenser EWT or Outdoor Ambient Temp.	Thermister (10k@25°C)	-58 to 212°F
2	Demand Limit	4-20 mA Current	0 to 100% limit
3	Chilled Water Reset	4-20 mA Current	0 to 10 degrees 60°F max.
4	Leaving Evaporator Water Temp.	Thermister (10k@25°C)	-58 to 212°F
5	Entering Evaporator Water Temp.	Thermister (10k@25°C)	-58 to 212°F

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

Table 2, Analog Outputs

#	Description	Output Signal	Range
1	Cooling Tower Bypass Valve Position	0 to 10 VDC	0 to 100%
2	Cooling Tower VFD Speed	0 to 10 VDC	0 to 100%
3	Open		
4	Open		

Table 3, Digital Inputs

#	Description	Signal	Signal
1	Unit Switch	0 VAC (Stop)	24 VAC (On)
2	Remote Switch	0 VAC (Stop)	24 VAC (Start)
3	Evaporator Water Flow Switch	0 VAC (No Flow)	24 VAC (Flow)
4	Mode Switch	0 VAC (Cool)	24 VAC (Ice)
5	Condenser Water Flow Switch	0 VAC (No Flow)	24 VAC (Flow)
6	Open		
7	Open		
8	Open		

Table 4, Digital Outputs

#	Description	Load	Output OFF	Output ON
1	Evaporator Water Pump 1	Pump Contactor	Pump OFF	Pump ON
2	Evaporator Water Pump 2	Pump Contactor	Pump OFF	Pump ON
3	Condenser Water Pump 1	Pump Contactor	Pump OFF	Pump ON
4	Condenser Water Pump 2	Pump Contactor	Pump OFF	Pump ON
5	Tower Fan 1	Fan Contactor	Fan OFF	Fan ON
6	Tower Fan 2	Fan Contactor	Fan OFF	Fan ON
7	Remote Run Status		All Circuits Off	Any Circuit On
8	Alarm	Remote Alarm	No alarm	Stop alarm

Unit Setpoints

The following parameters are retained during power off, are factory set to the **Default** value, and can be adjusted to any value in the **Range** column.

The **Type** defines whether the setpoint is part of a coordinated set of duplicate setpoints in different controllers. Types are as follows:

N = Normal setpoint – Not copied from, or copied to, any other controller
M = Master setpoint – Setpoint is copied to all controllers in the "Sent To" column

The **PW** (password) column indicates the password level that must be active in order to change the setpoint. Passwords are as follows:

O = Operator [0100] M = Manager (8745)

Toggle: Setpoints that have two choices, such as ON and OFF are toggled between the two settings using the Up or Down keys on the controller.
NOTE: in some software versions the terms "inhibit" and "hold" are used interchangeably.

Table 5, Unit Controller Setpoints

Description	Default	Range	Type	PW
Unit				
Unit Enable	OFF	OFF, ON	N	O
Unit Mode	Cool	Cool, Ice, Test	M	O
Control source	Switches	Switches, Keypad, Network	N	O
Available Modes	Cool	Cool, Cool w/Glycol, Cool/Ice w/Glycol, ICE w/Glycol, TEST	N	T
Cool LWT	44 °F	30(40) to 60 °F	N	O
Ice LWT	25 °F	20 to 38°F	N	O
Start Delta T	10 °F	0 to 10 °F	M	O
Stop Delta T	1.5 °F	0 to 3 °F	M	O
Stage Up Delta T	2 °F	0 to 3 °F	M	O
Stage Down Delta T	1 °F	0 to 3 °F	M	O
Max Pulldown	5 °F/min	0.5-5.0 °F /min	M	M
Evap Recirc Timer	30	0 to 300 seconds	N	M
Evap Pump Select	#1 Only	#1 Only, #2 Only, Auto	N	M
Water-cooled	Yes	No, Yes	N	M
Cond Recirc Timer (water-cooled only)	30	0 to 300 seconds	N	M
Cond Pump Select (water-cooled only)	#1 Only	#1 Only, #2 Only, Auto	N	M
LWT Reset Type	NONE	NONE, RETURN, 4-20mA, OAT	N	M
Max Reset	0 °F	0 to 20 °F	N	M
Start Reset Delta T	10 °F	0 to 20 °F	N	M
Soft Load	Off	Off, On	N	M
Begin Capacity Limit	40%	20-100%	N	M
Soft Load Ramp	20 min	1-60 minutes	N	M
Demand Limit	Off	Off, On	N	M
Low OAT Operation (air-cooled only)	No	No, Yes	N	M
Low Ambient Lockout (air cooled only)	55 °F	-10(35) to 70 °F	N	M
Ice Time Delay	12	1-23 hours	N	M
Clear Ice Timer	No	No,Yes	N	M
Evap LWT sensor offset	0	-5.0 to 5.0 deg	N	M
Evap EWT sensor offset	0	-5.0 to 5.0 deg	N	M
Cond EWT/OAT sensor offset	0	-5.0 to 5.0 deg	N	M
Cond LWT sensor offset	0	-5.0 to 5.0 deg	N	M
Units	°F/psi	°F/psi, °C/kPa	N	M
BAS Protocol	Modbus	BACnet, LonWorks, Modbus	N	M
Ident number	1	0-200	N	M
Baud Rate	19200	1200,2400,4800,9600,19200	N	M
Compressors				
Sequence # Cir 1	1	1-2	M	M
Sequence # Cir 2	1	1-2	M	M
Max Comps ON	2	1-2	N	M
Start-start timer	20 min	15-60 minutes	M	M
Stop-start timer	5 min	3-20 minutes	M	M
Pumpdown Pressure	25 psi	10 to 40 psi	M	M
Pumpdown Time Limit	120 sec	0 to 180 sec	M	M
Light Load Stg Dn Point	25%	20 to 50%	M	M

Continued next page.

Description	Default	Range	Type	PW
Stage Up Delay	5 min	0 to 60 min	M	M
Disc. Temp Sensor Type	PT1000	NTC, PT1000	M	M
Alarms				
Low Evap Pressure-Unload	28 psi	[0,26] to 45 psi	M	M
Low Evap Pressure-Hold	30 psi	[0,28] to 45 psi	M	M
Low Oil Level Delay	120 sec	10-180 sec	M	M
High Oil Press Diff Delay	15 sec	0-90 sec	M	M
High Discharge Temperature	200 °F	150 to 200 F	M	M
High Lift Pressure Delay	5 sec	0 to 30 sec	M	M
Evaporator Water Freeze	36 °F	15(36) to 42 °F	N	M
Evaporator Flow Proof	3 sec	3 to 10 sec	N	M
Recirculate timeout	3 min	1 to 10 min.	N	M
Startup Timer	60 sec	20 to 90 sec.	M	M
Condenser Water Freeze (water cooled only)	38 °F	34 to 42 °F	N	M
Condenser Flow Proof (water cooled only)	3 sec	3 to 10 sec	N	M
Cooling Tower(available for Water cooled only)				
Tower Control	None	None, Temperature	N	M
Tower Stages	2	0 to 2	N	M
Stage #1 On	70 °F	40 to 120 °F	N	M
Stage #2 On	75 °F	40 to 120 °F	N	M
Stage Differential	3.0 °F	1.0 to 10.0 °F	N	M
Stage Up Time	2 min	1 to 60 min	N	M
Stage Down Time	5 min	1 to 60 min	N	M
Stage Fan Down @	20%	0 to 100%	N	M
Stage Fan Up @	80%	0 to 100%	N	M
Valve/VFD Control	None	None, Valve Setpoint, Valve Stage, VFD Stage, Valve SP/VFD Stage	N	M
Valve Type	NC to tower	NC, NO	N	M
Valve Setpoint	65 °F	60 to 120 °F	N	M
Valve Deadband	2.0 °F	1.0 to 10.0 °F	N	M
Minimum Start Position	0%	0 to 100%	N	M
Minimum Position @	60 °F	0 to 100 °F	N	M
Maximum Start Position	100%	0 to 100%	N	M
Maximum Position @	90 °F	0 to 100 °F	N	M
Valve Control Range (Min)	10%	0 to 100%	N	M
Valve Control Range(Max)	90%	0 to 100%	N	M
Error Gain	25	10 to 99	N	M
Slope Gain	25	10 to 99	N	M

Auto Adjusted Ranges

The following settings have different ranges of adjustment based on other settings.

Table 6, Cool LWT

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

Table 7, Evaporator Water Freeze

Mode	Range
Unit Mode = Cool	34 to 42°F
Unit Mode = Cool w/Glycol, Ice w/ Glycol	15 to 42°F

Table 8, Low Evaporator Pressure Inhibit

Mode	Range
Unit Mode = Cool	30 to 45 Psig
Unit Mode = Cool w/Glycol, Ice w/ Glycol	15 to 45 Psig

Table 9, Low Evaporator Pressure Unload

Mode	Range
Unit Mode = Cool	28 to 45 Psig
Unit Mode = Cool w/Glycol, Ice w/ Glycol	15 to 45 Psig

Circuit Controller

Circuit Inputs and Outputs

Table 10, Analog Inputs

#	Description	Signal Source	Range
1	Evaporator Pressure	0.1 to 0.9 VDC	0 to 132 psi
2	Condenser Pressure	0.1 to 0.9 VDC	3.6to 410 psi
3	Open		
4	Suction Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
5	Discharge Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
6	Open		
7	Slide Load Indicator	4 to 20 mA	0 to 100%
8	Condenser LWT (circuit 1, water cooled only)	NTC Thermister (10k@25°C)	-58 to 212°F

Table 11, Analog Outputs

#	Description	Output Signal	Range
1	Fan VFD (air cooled only)	0 to 10 VDC	0 to 100% (1000 steps resolution)
2	Open		
3	EXV Driver	0 to 10 VDC	0 to 6386 steps (1000 steps resolution)
4	Open		

Table 12, Digital Inputs

#	Description	Signal	Signal
1	Circuit Switch	0 VAC (Off)	24 VAC (Auto)
2	Open		
3	Open		
4	VFD Fault	0 VAC (Fault)	24 VAC (No Fault)
5	Oil Differential Pressure Switch	0 VAC (Fault)	24 VAC (No Fault)
6	Mechanical High Pressure Switch	0 VAC (Fault)	24 VAC (No Fault)
7	Open		
8	Open		
9	Oil Level Sensor	0 VAC (Fault)	24 VAC (No Fault)
10-14	Open		

The status of digital inputs may be viewed on Circuit Status screen 5, on the circuit controllers only.

Table 13, Digital Outputs

#	Description	Output OFF	Output ON
1	Fan 1 Contactor (air cooled only)	Fan off	Fan on
2	Fan 2 Contactor (air cooled only)	Fan off	Fan on
3	Fan 3 Contactor (air cooled only)	Fan off	Fan on
4	Fan 4 Contactor (air cooled only)	Fan off	Fan on
5	Fan 5 Contactor (air cooled only)	Fan off	Fan on
6	Fan 6 Contactor (air cooled only)	Fan off	Fan on
7	Load/Unload Pulse	Hold load slide	Move load slide
8	Load/Unload Select	Unload	Load
9	Compressor SSS Contact	Compressor off	Compressor on
10	Open		
11	Oil Heater	Heater off	Heater on
12	Interstage Injection (future use)	Injection off	Injection on
13	EXV Close Signal	EXV follows 0 –10 VDC	EXV closed, ignores 0 – 10 VDC

Circuit Setpoint Table

The following parameters must be remembered during power off, are factory set to the **Default** value, and can be adjusted to any value in the **Range** column.

The PW (password) column indicates the password that must be active in order to change the setpoint. Codes are as follows:

O = Operator (100) M = Manager

Table 14, Circuit Setpoints

Description	Default	Range	PW
Compressor			
Circuit Mode	enable	Disable, enable, test	M
Slide Control	auto	Auto, manual	M
Slide target	0	0-100	M
Compressor Size	167	167, 179, 197	M
Clear Cycle Timers	No	No, Yes	M
Full Load Amps	10	1 to 341 amps	M
Rated load Amps	10	1 to 341 amps	M
Service Factor	125%	100 to 199%	M
Ground Fault Enable	Disable	Disable, enable	M
Ground Fault Trip Level	1%	1 to 100%	M
Overload Class	10	0 to 40	M
Initial Motor Current	225%	50 to 400% FLA	M
Maximum Motor Current	300%	100 to 800%	M
Ramp Time	7 seconds	0 to 300 seconds	M
Up to Speed Time (UTS)	10 seconds	1 to 900 seconds	M
Stop Mode	CoS	Coast(CoS), volt decel(dcL)	M
Rated RMS Voltage	460 volts	100 to 1000 volts	M
Over Voltage Trip Level	10%	1 to 40% rated volts	M
Under Voltage Trip Level	10%	1 to 40% rated volts	M
Ovr/Undr Volt Trip Delay	1.0 seconds	0.1 to 90.0 seconds	M
Current Unbalance Trip Level	15%	5 to 40%	M
Auto Fault Reset Time	60 seconds	0 to 120 seconds	M
CT Ratio	864:1	72-8000:1	M
Maximum Slide Target	100.0	0-100.0%	M

Continued next page

Description	Default	Range	PW
EXV			
EXV control	Auto	Auto, manual	M
Manual EXV position	0	0-6386	M
Service Pumpdown	No	No,Yes	M
Preopen Timer (water cooled only)	20	20 to 120 seconds	M
Sensors (NOTE 1)			
Evap pressure offset	0	-10.0 to 10.0 psi	M
Cond pressure offset	0	-10.0 to 10.0 psi	M
Suction temp offset	0	-5.0 to 5.0 deg	M
Discharge temp offset	0	-5.0 to 5.0 deg	M
Slide Minimum Position Offset	0	-15 to 15%	M
Slide Maximum Position Offset	0	-15 to 15%	M
Fans (available for air-cooled only)			
Fan VFD enable	On	Off, On	M
Number of fans	4	4 to 6	M
Saturated Condenser Temp Target Min	90.0	80.0-110.0 °F	M
Saturated Condenser Temp Target Max	110.0	90.0-120.0 °F	M
Stage 1 On Deadband	8.0	1.0-20.0 °F	M
Stage 2 On Deadband	10.0	1.0-20.0 °F	M
Stage 3 On Deadband	11.0	1.0-20.0 °F	M
Stage 4 On Deadband	12.0	1.0-20.0 °F	M
Stage 2 Off Deadband	20.0	1.0-25.0 °F	M
Stage 3 Off Deadband	16.0	1.0-25.0 °F	M
Stage 4 Off Deadband	11.0	1.0-25.0 °F	M
Stage 5 Off Deadband	8.0	1.0-25.0 °F	M
VFD Max Speed	100%	90 to 110%	M
VFD Min Speed	25%	20 to 60%	M
Forced Fantrol 1	2	1 to 4	M
Forced Fantrol 2	3	1 to 4	M
Forced Fantrol 3	4	1 to 4	M

Notes:

1. Offsets are used to fine-tune certain readings generated by sensors. For example, if the controller was showing a 125 psi value and a calibrated pressure gauge at the same location showed 127 psi, an offset of +2 psi would be entered and the controller would then read the corrected value of 127 psi.

Table 15, RLA/FLA Values

Compressor	575V	460V	380V	230V	208V	400V (50Hz)
RLA						
197	113	141	178	282	312	141
179	94	122	145	240	267	122
167	85	112	128	210	232	112
FLA						
All	113	141	178	282	312	141

NOTE: Table values used for circuit controller input.

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

Unit Stop Alarms

The alarm output and red button led shall be turned ON when any stop alarm occurs. They shall be turned off when all alarms have been cleared.

Evaporator Flow Loss

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

Trigger:

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

2: Evaporator Pump State = Start for time greater than Recirc Timeout Set Point and all pumps have been tried

Action Taken: Rapid stop all circuits

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

If active via trigger condition 1:

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

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

If active via trigger condition 2:

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

Condenser Flow Loss

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

Trigger:

1: Condenser Pump State = Run AND Condenser Flow Digital Input = No Flow for time > Flow Proof Set Point AND at least one compressor running

2: Condenser Pump State = Start for time greater than Recirc Timeout Set Point and all pumps have been tried

Action Taken: Rapid stop all circuits

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

If active via trigger condition 1:

The alarm will reset automatically when the condenser state is Run again. This means the alarm stays active while the unit waits for flow, then it goes through the recirculation process after flow is detected. Once the recirculation is complete, the condenser goes to the Run state which will clear the alarm.

If active via trigger condition 2:

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

Evaporator Water Freeze Protect

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

Trigger: Evaporator LWT drops below evaporator freeze protect set point AND Unit State = Auto AND Evaporator LWT Sensor Fault not active

Action Taken: Rapid stop all circuits

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

Leaving Evaporator Water Temperature Sensor Fault

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

Trigger: Sensor shorted or open

Action Taken: Rapid stop all circuits

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

Entering Condenser Water Temperature Sensor Fault

Alarm description (as shown on screen): Cond EWT Sens Fault

Trigger: Sensor shorted or open

Action Taken: Rapid stop all circuits

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

Outdoor Air Temperature Sensor Fault

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

Trigger: Sensor shorted or open AND unit is aircooled

Action Taken: Rapid stop all circuits

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

pLAN Failure

Alarm description (as shown on screen): pLAN Failure

Trigger: No circuit controllers found on pLAN for 60 seconds

Action Taken: Rapid stop all circuits

Reset: This alarm can be cleared manually via the keypad, but only if at least one circuit is connected to pLAN.

Unit Events

The following unit events are logged in the event log with a time stamp.

Entering Evaporator Water Temperature Sensor Fault

Event description (as shown on screen): Evap EWT Sens Fault

Trigger: Sensor shorted or open

Action Taken: Return water reset cannot be used.

Reset: Auto reset when sensor is back in range.

Leaving Condenser Water Temperature Sensor Fault

Event description (as shown on screen): Cond LWT Sens Fault

Trigger: Sensor shorted or open AND unit is watercooled

Action Taken: None

Reset: Auto reset when sensor is back in range.

Circuit Stop Alarms

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

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

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

Low Evaporator Pressure

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

Trigger: [Freezestat trip AND Compressor State = Run AND Low OAT Start not active AND Evap Pressure Sensor Fault not active] OR [Evaporator Press < -10 psi AND startup timer complete AND Evap Pressure Sensor Fault not active] and the compressor has been running longer than the Startup Timer setting

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

Freeze error = Low Evaporator Pressure Unload – Evaporator Pressure

Freeze time = 70 – 6.25 x freeze error, limited to a range of 20-70 seconds

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

Action Taken: Rapid stop circuit

Reset: This alarm can be cleared manually via the Unit Controller keypad if the evaporator pressure is above –10 psi.

High Lift Pressure

Alarm description (as shown on screen): Lift Pressure High N

Trigger: Condenser Saturated Temperature > Max Saturated Condenser Value for time > High Lift Delay set point

Action Taken: Rapid stop circuit

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

Mechanical High Pressure

Alarm description (as shown on screen): Mech High Pressure N

Trigger: Mechanical High Pressure switch input is low

Action Taken: Rapid stop circuit

Reset: This alarm can be cleared manually via the Unit Controller keypad if the MHP switch input is high.

High Discharge Temperature

Alarm description (as shown on screen): Disc Temp High N

Trigger: Discharge Temperature > High Discharge Temperature set point AND compressor is running AND Discharge Temperature Sensor Fault is not active

Action Taken: Rapid stop circuit

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

Low Oil Level

Alarm description (as shown on screen): Oil Level Low N

Trigger: Oil Level Switch input is open for time greater than Low Oil Level Delay while compressor is in the Run state AND the Low Oil Level Event has occurred in the past hour.

Action Taken: Rapid stop circuit

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

High Oil Pressure Difference

Alarm description (as shown on screen): Oil Pres Diff High N

Trigger: Oil DP switch input is low for time greater than High Oil Pressure Difference Delay set point AND compressor is running

Action Taken: Rapid stop circuit

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

Low Evaporator Pressure Start

Alarm description (as shown on screen): LowPress StartFail N
Trigger: Saturated condenser temperature greater than 70°F at start and circuit failed a Start Logic attempt.
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the Unit Controller keypad.

No Evaporator Pressure Drop After Start

Alarm description (as shown on screen): No Evap Press Drop N

Trigger: After start of compressor, at least a 1 psi drop in evaporator pressure has not occurred after 15 seconds

Action Taken: Rapid stop circuit

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

No Pressure Change At Start

Alarm description (as shown on screen): NoPressChgAtStart N
Trigger: After start of compressor, at least a 1 psi drop in evaporator pressure or 5 psi rise in discharge pressure has not occurred after 15 seconds.
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the Unit Controller keypad.

Circuit Events

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

Low Evaporator Pressure - Hold

Event description (as shown on screen): EvapPress Low Hold N
trigger: The low pressure events are not enabled until the compressor has started and the evaporator pressure has risen above the Low Evaporator Pressure - Hold set point. The unit mode must also be Cool. Then, while running, if evaporator pressure <= Low Evaporator Pressure - Hold set point the event is triggered.
Action Taken: Inhibit loading by only allowing the slide target to be reduced.
Reset: While still running, the event will be reset if evaporator pressure > (Low Evaporator Pressure - Hold SP + 2psi). The event is also reset if the unit mode is switched to Ice, or the compressor state is no longer Run.

Low Evaporator Pressure - Unload

Event description (as shown on screen): EvapPressLowUnload N
Trigger: The low pressure events are not enabled until the compressor has started and the evaporator pressure has risen above the Low Evaporator Pressure - Hold set point. The unit mode must also be Cool. Then, while running, if evaporator pressure <= Low Evaporator Pressure - Unload set point the event is triggered.
Action Taken: Unload the compressor by decreasing the slide target 5% every five seconds until the evaporator pressure rises above the Low Evaporator Pressure – Unload set point.
Reset: While still running, the event will be reset if evaporator pressure > (Low Evaporator Pressure - Hold SP + 2psi). The event is also reset if the unit mode is switched to Ice, or the compressor state is no longer Run.

High Lift Pressure - Hold

Event description (as shown on screen): LiftPressHigh Hold N
Trigger: While the compressor is running and unit mode is Cool, if saturated condenser temperature >= High Saturated Condenser - Hold Value, the event is triggered.
Action Taken: Inhibit loading by only allowing the slide target to be reduced.
Reset: While still running, the event will be reset if saturated condenser temperature < (High Saturated Condenser - Hold Value – 10°F). The event is also reset if the unit mode is switched to Ice, or the compressor state is no longer Run.

High Lift Pressure - Unload

Event description (as shown on screen): LiftPressHighUnloadN
Trigger: While the compressor is running and unit mode is Cool, if saturated condenser temperature >= High Saturated Condenser - Unload Value, the event is triggered.
Action Taken: Unload the compressor by decreasing the slide target 5% every five seconds until the condenser pressure drops below the High Saturated Condenser - Unload Value.

Reset: While still running, the event will be reset if saturated condenser temperature < (High Saturated Condenser - Unload Value – 10°F). The event is also reset if the unit mode is switched to Ice, or the compressor state is no longer Run.

Oil Level Low

Event description (as shown on screen): Oil Level Low Cir N
Trigger: Oil Level Switch input is open for time greater than Low Oil Level Delay while compressor is in the Run state AND the Low Oil Level Event has not occurred in the past hour**.**
Action Taken: Rapid stop circuit
Reset: Compressor state = off

Failed Pumpdown

Event description (as shown on screen): Pumpdown Fail Cir N
Trigger: Circuit state = pumpdown for time > Pumpdown Time set point
Action Taken: Shutdown circuit
Reset: N/A

Power Loss While Running

Event description (as shown on screen): Run Power Loss Cir N
Trigger: Circuit controller is powered up after losing power while compressor was running
Action Taken: Delay start of compressor by time equal to the Start-Start timer set point.
Reset: N/A

Condenser Freeze Protect

Event description (as shown on screen): Cond Frz Protect Cir N
Trigger: Cond Sat Refr Temp < Condenser Freeze SP AND Cond Pump State = Off AND unit is watercooled
Action Taken: Start condenser pump
Reset: Cond Sat Refr Temp > Condenser Freeze SP + 2 °F

VFD Fault

Event description (as shown on screen): VFD Fault Cir N
Trigger: VFD enabled and VFD fault input goes low
Action Taken: None
Reset: N/A

Slide Positioning Error

Event description (as shown on screen): Slide Pos Error Cir N
Trigger: [Slide Position > Slide Target + 25% OR Slide Position < Slide Target – 25%] for time > 5 minutes
Action Taken: None
Reset: Circuit State = Off

Alarm Logging

When an alarm occurs, the alarm type, date, and time are stored in the active alarm buffer corresponding to that alarm (viewed on the Alarm Active screens) and also in the alarm history buffer (viewed on the Alarm Log screens). The active alarm buffers hold a record of all current alarms. The active alarms can be cleared by pressing the Edit key when the end of the list has been reached by scrolling. Active alarms may only be cleared if at least the Operator password level is active.

A separate alarm log stores the last 25 alarms to occur. When an alarm occurs, it is put into the first slot in the alarm log and all others are moved down one, dropping the last alarm. In the alarm log, the date and time the alarm occurred are stored, as well as a list of other parameters. These parameters include unit state, OAT, LWT, and EWT for all alarms. If the alarm is a circuit alarm, then the circuit state, refrigerant pressures and temperatures, EXV control state, EXV position, slide position, slide target, number of fans, and compressor run time on are also stored.

Event Logging

An event log similar to the alarm log holds the last 25 events to occur. When an event occurs, it is put into the first slot in the event log and all other entries are moved down one, dropping the last event. Each entry in the event log includes an event description as well as the time and date of the occurrence. No additional parameters are logged for events.
The event log shall only be accessible with the Manager password.

Clearing Alarms

Alarms may be cleared at the unit controller and no password is required. The BAS can clear evaporator flow loss, evaporator water freeze and pLAN failure regardless of what other alarms are active.

Unit Controller Functions

Calculations

LWT Slope

LWT slope is calculated such that the slope represents the change in LWT over a time frame of one minute.

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

Pulldown Rate

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

Unit Capacity

Unit capacity is estimated based on the slide target of each running circuit. The capacity of a running circuit is estimated with this equation:

Circuit capacity = 0.8(slide target) + 20

A circuit that is off is assumed to be at 0% capacity. The unit capacity is then calculated by this equation:

Unit capacity = (Circuit 1 capacity + Circuit 2 capacity)/2

Unit Enable

Enabling and disabling the chiller is controlled by the Unit Enable Setpoint with options of OFF and ON. Enabling allows the unit to start if there is a call for cooling and also starts the evaporator pump.

This setpoint (in other words, enabling the unit to run) can be altered by the:

- Unit OFF input (unit On/Off switch)
- a field installed remote stop switch
- a keypad entry
- a BAS request

The Control Source Setpoint determines which sources can change the Unit Enable Setpoint with options of SWITCHES, KEYPAD or NETWORK.

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

Table 16, Unit Enable Combinations

Unit On/Off Switch	Control Source Setpoint	Remote Stop Switch	Key-pad Entry	BAS Request	Resultant Unit Enable Status
OFF	x	x	x	x	OFF
ON/OFF	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

Example:

1. If the Control Source is set to "Switches", enabling is controlled by the field-installed remote stop switch. If the unit-mounted On/Off switch is either On or Off, the unit will be disabled if the remote switch is Off. If the unit-mounted On/Off switch is On, the unit will be enabled if the remote switch is On.

Chiller Control Source Options:

Set Unit Setpoints Screen #1 (shown below) has three fields: "Enable", "Mode" and "Source."

Unit Setpoints

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

The Enable field can only be used with Source = Keypad, to enable and disable the chiller through the key pad, any other control inputs including unit and pumpdown switches and BAS controls are ignored. The Enable field toggles between On and Off using the Up or Down key on the controller.

1. The Mode field is an informational display, showing the active control mode of the chiller. It is used as an input only when the source is set to keypad, only then can this field be changed manually.
2. The Source field has three options, "SWITCHES"(default), "KEYPAD", and "BAS NETWORK".

a. Switches source is used when there is no BAS interface used. This allows the unit switches to function as pumpdown and shut down switches for the circuit. This option is also used with applications using the remote start/stop input and not using a BAS interface.

b. Keypad source is used to override BAS or remote start/stop commands. This would be used for servicing only.

c. BAS Network source would be used for those applications using "MODBUS", "BACnet", or "LON" communications through a building automation system. BAS Protocol is set at Set Unit Setpoints item #14.

All methods of disabling the chiller, except for the unit switch, will cause a normal pumpdown shutoff of any running circuits. Any time the unit switch is used to disable the chiller, all running circuits will shut down immediately, without pumping down.

Shutdown by the unit switch without going through the pumpdown cycle is undesirable and should only be used for an emergency shutdown or for manually and locally disabling the unit after both circuits have gone through a normal shutdown.

Unit Mode Selection

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

- Available Modes setpoint: usually set during initial setup and determines the operational modes available at any time with options of:
  - COOL, cooling only operation, with setpoints available for normal chilled water temperatures
  - COOL w/Glycol, cooling only operation, allows lower setpoints than COOL
  - COOL/ICE w/Glycol, allows both cooling and ice mode operation, switchable by a field-installed remote ICE mode switch, by the BAS or through the keypad.
  - ICE w/Glycol, ice mode only, i.e., full load operation until LWT setpoint is reached
  - TEST
- Control Source Setpoint: The setting determines the source that can change the Unit Mode Setpoint with options of KEYPAD, NETWORK, or SWITCHES.

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

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

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

Table 17, Unit Mode Setpoint Sources

Control Source Setpoint	Remote ICE Mode Switch	Keypad Entry	BAS Request	Available Modes Setpoint	Resultant 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

The Remote ICE Mode Switch (usually a time clock) is a field installed option and is used to switch from *ice* mode operation at night to *cooling* mode operation during the day. This requires that the Control Source be set to SWITCHES, which in this case refers to the Remote ICE Mode Switch.

There are really only three operational modes for the unit, although they can be used in combination:

1. COOL, the unit unloading and compressor staging is controlled by the Active LWT Setpoint. COOL w/ Glycol is a special case, providing for lower setpoint ranges.
2. ICE, the unit runs with all compressors fully loaded until the LWT (set for making ice) is reached, and the unit shuts off. The Ice Delay Timer can be set to prevent restarting until the next ice making cycle.
3. TEST, manually energize controller outputs to test functionality.

Unit Test Mode

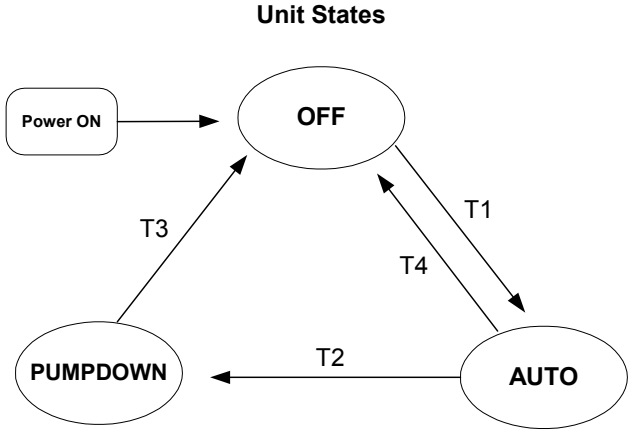
The unit test mode allows manual testing of controller outputs. Entering this mode shall require the following conditions.

– Unit OFF input = OFF (i.e. entire chiller is shut down).
– Technician password active.
– Available Circuit Mode setpoint = TEST

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

Unit States

The unit will always be in one of three states.



Transitions:

T1 – Transition from Off to Auto

Requires **all** of the following

- Unit enabled based on settings and switches
- If unit mode is ice, the ice timer has expired
- No unit alarms exist
- At least one circuit is enabled and available to start

T2 – Transition from Auto to Pumpdown

Requires **any** of the following

- Control source is keypad and the unit enable keypad setting is “off”
- Control source is BAS and either the remote switch is “off” or the BAS command is “off”
- Control source is switches and the remote switch is “off”

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

- All circuits have finished pumpdown and are off
- A unit alarm is active
- Unit switch is "off"

T4 – Transition from Auto to Off
Requires **any** of the following

- Unit switch is "off"
- A unit alarm is active
- All circuits are unavailable to start (cannot start even after any cycle timers have expired)
- The unit mode is ice, all circuits are off, and the ice mode delay is active

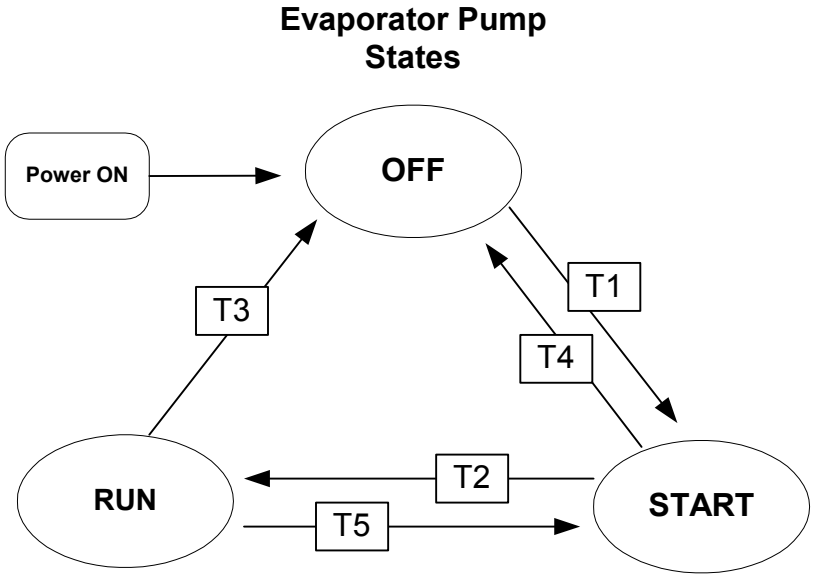
Ice Mode Start Delay

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

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

Evaporator Pump Control

The state-transition diagram shown below controls operation of the evaporator pump.



Transitions:

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

- Unit state = Auto AND [If Low OAT Lockout active then LWT <=40]
- LWT < Freeze setpoint - 1

T2 – Transition from Start to Run

- Flow ok for time > evaporator recirculate time

T3 – Transition from Run to Off
Requires **any** of the following
- Unit state = Off AND LWT > Freeze setpoint
- Low OAT Lockout is active AND No compressors running AND LWT > 70°F

T4 – Transition from Start to Off
Requires **any** of the following
- Unit state = Off AND LWT > Freeze setpoint
- Low OAT Lockout is active AND No compressors running AND LWT > 70°F

T5 – Transition from Run to Start
Requires **all** of the following
- Evaporator water flow loss for time > flow proof

Pump Selection

The pump output used will be determined by the Evap Pump Control set point. This setting allows the following configurations:

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

Primary/Standby Pump Staging

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

Auto Control

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

Leaving Water Temperature (LWT) Reset

The Active Leaving Water variable shall be set to the current Leaving Water Temperature (LWT) setpoint unless the unit is in COOL mode and any of the reset methods below are selected. The type of reset in effect is determined by the LWT Reset Type setpoint. The Active Leaving Water variable is sent from the unit controller to all circuits for capacity control after the applicable reset is applied.

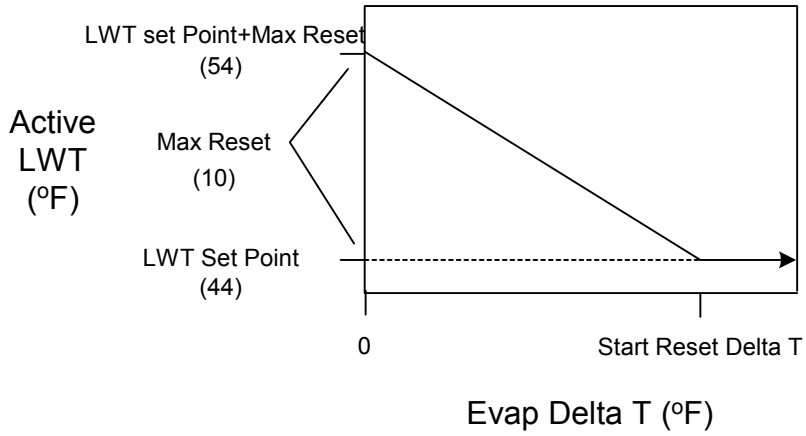
Reset Type – NONE

The Active Leaving Water variable is set equal to the current LWT setpoint.

Reset Type – RETURN

The Active Leaving Water variable is adjusted by the return water temperature.

Return Reset



The active setpoint is reset using the following parameters:

1. Cool LWT setpoint
2. Max Reset setpoint
3. Start Reset Delta T setpoint
4. Evap Delta T

Reset is accomplished by changing the Active Leaving Water variable from the Cool LWT setpoint to the Cool LWT set-point + Max Reset setpoint as the Evaporator EWT – LWT (Evap Delta T) varies from the Start Reset Delta T setpoint to 0.

Referring to the above figure as an example, the LWT is 44°F and a 10-degree maximum reset value was selected. The Active LWT setpoint would range from the normal 44°F setting up to 54°F depending on the Evap Delta-T. The amount of reset would be at the maximum value (10 degrees) when the Evap Delta-T is zero and at the minimum value when the Evap Delta-T is at the Start Reset Delta T value and is proportional in between. The Start Reset Delta T function is available so that the start of reset can be adjusted. For example, on a system with a 10-degree Delta-T, it may be desirable to not start the resetting until the evaporator Delta-T goes down to eight degrees (80% load), or some other value.

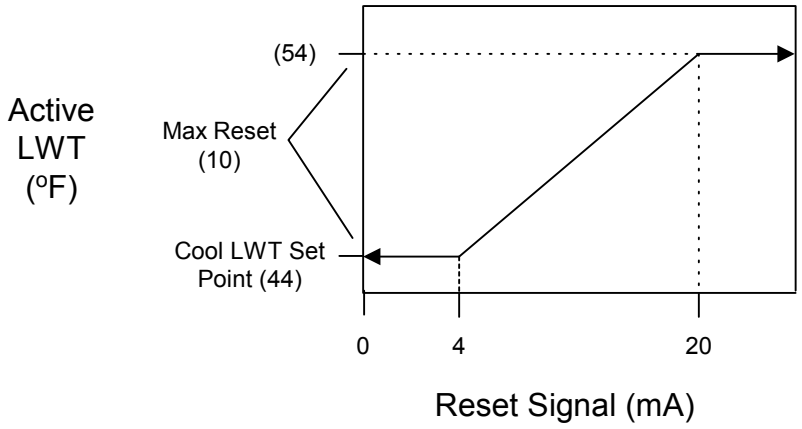
Reset Type – 4-20 mA

The Active Leaving Water setpoint is adjusted by the 4 to 20 mA reset analog input, using:

1. Cool LWT setpoint
2. Max Reset setpoint
3. LWT Reset signal

Reset is 0 if the reset signal is less than or equal to 4 mA. Reset is equal to the Max Reset Delta T setpoint if the reset signal equals or exceeds 20 mA. The amount of reset will vary linearly between these extremes if the reset signal is between 4 mA and 20 mA. An example of the operation of 4-20 reset in Cool mode is shown below.

4-20 mA Reset - Cool Mode



Reset Type – OAT

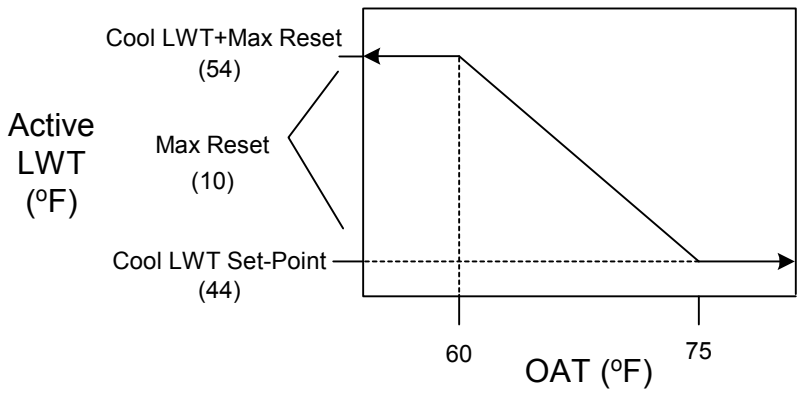
This reset can only be used if the unit is configured as air-cooled.

The Active Leaving Water variable is reset based on the outdoor ambient temperature. Parameters used:

1. Cool LWT setpoint
2. Max Reset setpoint
3. OAT

Reset is 0 if the outdoor ambient temperature is greater than 75 F. From 75 down to 60 F the reset varies linearly from no reset to the max reset at 60 F. At ambient temperatures less than 60 F, reset is equal to the Max Reset setpoint.

OAT Reset



Planned Unit Capacity Overrides

Unit capacity limits can be used to limit total unit capacity in COOL mode only. Multiple limits may be active at any time, and the lowest limit is always used in the compressor capacity control.

The estimated unit capacity and the active capacity limit are sent to all circuits for use in compressor capacity control.

Soft Load

Soft Loading is a configurable function used to slowly ramp up the unit capacity over a given time. The setpoints that control this function are:

- Soft Load – (ON/OFF)
- Begin Capacity Limit – (Unit %)
- Soft Load Ramp – (seconds)

The Soft Load Unit Limit increases linearly from the Begin Capacity Limit setpoint to 100% over the amount of time specified by the Soft Load Ramp setpoint. If the option is turned off, the soft load limit is set to 100%.

Demand Limit

The maximum unit capacity can be limited by a 4 to 20 mA signal on the Demand Limit analog input at the unit controller. This function is only enabled if the Demand Limit setpoint is set to ON.

As the signal varies from 4 mA up to 20 mA, the maximum unit capacity changes linearly from 100% to 0%. Although the demand limit can call for 0% capacity, this signal will never cause a running compressor to shut down. Rather, all running compressors will be held at minimum load, and this may occur at a demand limit value that is actually less than 20mA.

Network Limit

The maximum unit capacity can be limited by a network signal. This function is only enabled if the unit control source is set to network. The signal will be received through the BAS interface on the unit controller.

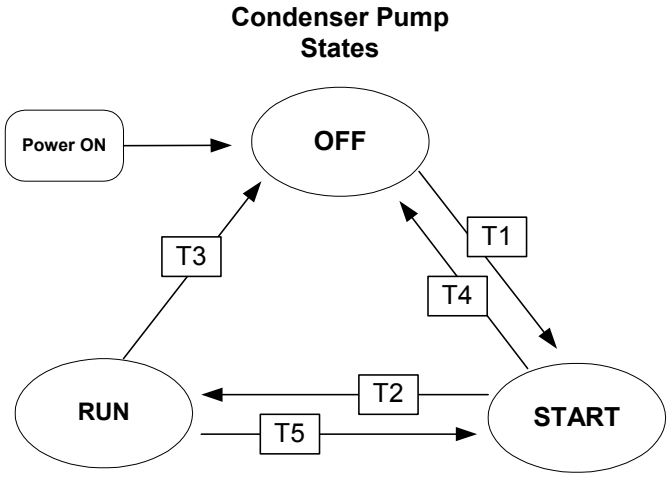
As the signal varies from 0% up to 100%, the maximum unit capacity changes linearly from 0% to 100%. Although the network limit can call for 0% capacity, this signal will never cause a running compressor to shut down. Rather, all running compressors will be held at minimum load, and this may occur at a network limit value that is actually less than more than 0%.

Condenser Pump and Tower Control

Condenser pump and cooling tower control logic requires that the unit be configured as water-cooled in order to be active. The unit controller controls water-cooled components such as condenser pumps and tower controls, since there is usually one tower per unit. Air-cooled equipment, associated with the remote condenser option, is controlled by the circuit controllers. Remote evaporative condensers require a self-contained, on-board, discharge pressure control system.

Condenser Water Pump State Control

If the unit is configured as water-cooled, then the condenser pump is controlled by the state-transition diagram shown below.



Transitions:

T1 – Transition from Off to Start

Requires **any** of the following

- Unit state = Auto AND any circuit available AND LWT error > Startup Delta
- Cond Water Freeze Alarm

T2 – Transition from Start to Run

- Flow ok for time > cond recirculation timer setpoint

T3 – Transition from Run to Off

Requires **all** of the following

- Unit state = Off OR No circuit available OR LWT error < Start Delta-1
- Cond Water Freeze Alarm not active
- No compressors running

T4 – Transition from Start to Off

Requires **all** of the following

- Unit state = Off OR No circuit available OR LWT error < Start Delta
- Cond Water Freeze Alarm not active
- No compressors running

T5 – Transition from Run to Start

Requires **all** of the following

- Condenser water flow loss for time > flow proof
- All circuits in Off state

Pump Selection

The pump output used will be determined by the Condenser Pump Control setpoint. This setting allows the operator to select pump #1, pump #2, or auto. The first two selections will use a single pump output all the time. The auto selection will start the pump with the least run hours.

The selected output will be ON if the Evap State is set to START or RUN. Both outputs will be OFF if the Evap State is set to OFF.

Cooling Tower Control

Tower Fans

Tower fan control is active when the unit is set up as water-cooled, Tower Control is set to Temperature, and the condenser pump is in the RUN state. Staging is based on Condenser Entering Water Temperature. Operation depends on the following parameters.

- Condenser pump state
- Condenser EWT
- Stage up and stage down timer values
- Tower setpoints (Tower Control, Tower Stages, Stage Up Time, Stage Down Time, Stage Differential, Stage #1 ON, Stage #2 ON, Stage Down @, Stage Up @)

When the condenser pump starts, the stage up timer shall start. The first stage shall turn ON when the following conditions are met:

- The stage up timer completes
- The Condenser EWT is > Stage #1 ON setpoint
- Bypass valve position is > the Stage Up @ setpoint (only if Valve/VFD Control setpoint = Valve Stage)
- VFD Speed is > the Stage Up @ setpoint (only if Valve/VFD Control setpoint = VFD Stage OR Valve SP/VFD Stage)

Additional stages can turn on (up to the number specified by the Tower Stages setpoint) when above conditions are met for the next stage.

Down staging shall occur when the following conditions are met:

- The stage down timer completes
- The Condenser EWT is < Stage #X ON (Temp) setpoint – Stage Differential (Temp) setpoint
- Bypass valve position is < the Stage Down @ setpoint (only if Valve/VFD Control setpoint = Valve Stage)
- VFD Speed is < the Stage Down @ setpoint (only if Valve/VFD Control setpoint = VFD Stage OR Valve SP/VFD Stage)

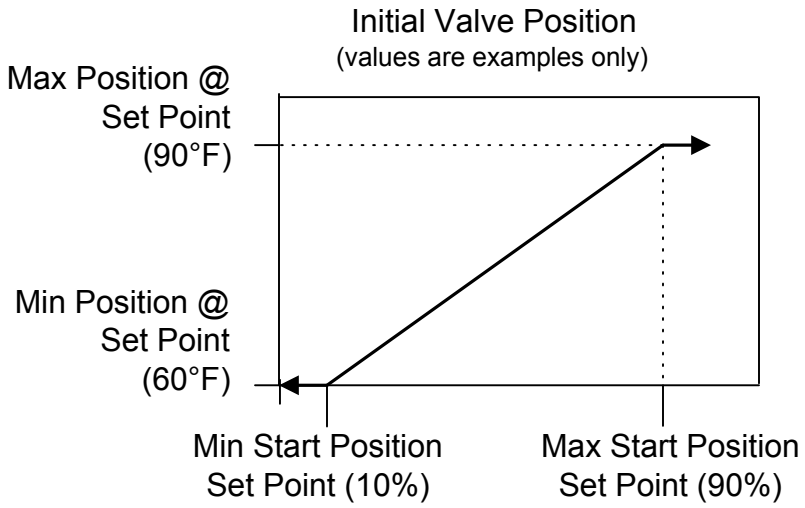
Each stage up or stage down event shall restart both the stage up and stage down timers. Only one fan output shall be switched at a time (except that all outputs switch OFF when the condenser pump state equals OFF).

Cooling Tower Bypass Valve

When the Valve/VFD Control setpoint is set to None OR VFD Stage, this output shall be set to 0. Otherwise, it shall be controlled as described below.

Initial Valve Position

When the condenser pump is not in the RUN state, the valve output shall be set as a function of entering condenser water temperature (ECWT)) per the following graph.



Operation After Start

When the condenser pump is in the RUN state, the valve output shall be controlled in one of two modes as specified by the Valve/VFD Control setpoint. The controlled parameter shall be the condenser entering water temperature. When the desired output signal varies from 0 to 100%, the output voltage shall vary as shown below.

– 0 to 10 VDC (Valve Type = NC to tower)
– 10 to 0 VDC (Valve Type = NO to tower)

Valve Setpoint Mode

This mode is operational when the Valve/VFD Control setpoint is set to Valve setpoint OR Valve SP/VFD Stage. In this mode the valve output is varied with a proportional-derivative

(PD) algorithm (with deadband) in order to maintain the controlled parameter (CP) at the desired value. The output is always limited between the Valve Control Range (Min) setpoint and the Valve Control Range (Max) setpoint. A valve increment shall be computed once every 5 seconds according to the following equation.

- Increment = [(Error) * (Error Gain setpoint)] + [(Slope) * (Slope Gain setpoint)] Where:
  Error = ECWT – Valve Setpoint Slope = (Present CP) – (Previous CP)

When the Error is > the Valve Deadband setpoint, the valve position analog output (% of full scale) is updated according to the following equation.

- New %Position = Old %Position + Increment/10.

Valve Stage Mode

This mode is only operational when the Valve/VFD Control setpoint is set to Valve Stage. In this mode the valve output is controlled as for Valve setpoint mode (above) except that the active setpoint for the controlled parameter is selected according to the following table.

# of Fans ON	Active Setpoint
0	Valve Setpoint
1	Stage #1 ON
2	Stage #2 ON

Cooling Tower Fan VFD

When the Valve/VFD Control setpoint is set to None, Valve Setpoint, OR Valve Stage, this output shall be set to 0. Otherwise, it shall be controlled in a manner identical to Valve Stage Mode (above) except that (1) it shall be kept at zero until the first fan stage is ON and (2) the following setpoints do not apply.

– Valve Control Range (Min)
– Valve Control Range (Max)
– Valve Type

Evaporative Condenser Control

It is acceptable to use WGS-A chillers (less condenser) with evaporative condensers. It is the installer's responsibility to provide the evaporative condenser control because this condenser type is not available from McQuay. The WGS-A software does not directly support evaporative-cooled applications since there is a variety of fan configurations and pumps available from the manufacturers of evaporative condensers. In addition, the WGS software does not support the auxiliary functions of the evaporative condenser such as make up water valves, sump drain valves, electronic make up water valves, water freeze protection, variable frequency drives, damper controls or water treatment options. The WGS software will provide equipment protection and operational limits as if it were a remote air-cooled condenser application. See other sections of this manual for complete descriptions.

The system must be comprised of two controls systems that operate together to make a complete system. First, the WGS-A software provided with the unit will control the indoor chiller section of the unit including compressor loading/unloading, equipment protection, BAS interface (when applicable), and other functions as described in this manual without the condenser control. The WGS software setup shall be treated as a remote air-cooled application. The second control system is required to control the condenser and auxiliary functions. The best method for interfacing the two systems is through the "first on, last off" fan contacts as if the application was a remote air-cooled condenser. At start up of the compressors, the Fan 1 Contactor fan contacts will close and activate the condenser control

system provided by others. At shut down, the reverse occurs where the condenser control will be deactivated when the compressor stops as the Fan 1 fan contacts open.

Special considerations must be given to the condenser control including (but not limited to) the following items.

1. All WGS-A chillers have two refrigerant circuits and an evaporative condenser with two refrigerant circuits is also required.
2. A control system for each refrigerant circuit is required. It is best to have separate fans and pumps for each refrigerant circuit to prevent "fighting" of control signals between the two refrigerant circuits.
3. The control system shall maintain a minimum condenser pressure at all times.
4. The normal control philosophy is to maintain the lowest possible condensing pressure above the minimum allowable to provide the best operating efficiency throughout the chiller's entire operating range.
5. For a normal starting sequence, it is best to start the fans first with minimum airflow. As the condenser pressure rises, increase the airflow by increasing the fan RPM, opening inlet vanes, opening outlet dampers, or other meaning of increasing airflow. If condensing pressure continues to rise after maximum airflow is reached, start the circulating pump (s). Reverse the sequence for the shut down procedure.
6. Provide the maximum number of condenser staging steps as possible to provide as stable operation as possible.
7. Recognize that condenser pressure will change drastically and rapidly, when the water pump starts and stops. This is the reason for starting the fan first in an increasing capacity situation and stopping the fan operation last with a shutdown procedure.
8. It is important for the control pressure settings for the fans and pumps to have a large control band so that condenser component cycling does not occur. It is also good practice for the fan and pump control to "overlap". Overlap means that the control bands must be determined so that there is a pressure range between when a pump starts/ stops with fan operation. Use caution to be certain that fan & pump cycling does not occur which causes rapid changes in condensing pressure which causes instability in the refrigeration system.
9. Refer to the installation, operation and maintenance manuals of the manufacturer of the evaporative condenser for their guidelines and recommendations. Give special consideration to preventing freezing conditions, make up water, and other functions common to evaporative condensers that should be described in those brochures.

⚠ CAUTION

Use water treatment with evaporative condensers. Failure to prevent microbiology growth, scaling and corrosion can damage the unit.

10. Damage caused or contributed by improper water treatment may not be covered by McQuay's warranty.

11. For recommendations and answers to system questions, contact the McQuay Applications Group in Staunton, Virginia.

Building Automation System (BAS) interface and monitoring is an optional accessory required for many systems. The WGS-A interface options are communication cards supporting LONWORKS, BACnet or Modbus. Refer to the other McQuay brochures listed in this manual for a complete description of capabilities. As a general statement, the McQuay communication cards do NOT support the evaporative condenser. The desired interface points for the condenser must be provided by others and through the control system provided with the evaporative condenser. Use caution in the ability to change condenser setpoints through the BAS system as such changes can impact chiller operation.

Refrigerant Calculations

Refrigerant Saturated Temperature

Refrigerant saturated temperature is calculated from the pressure sensor readings for each circuit. The pressure will be fitted to a curve made up of 12 straight line segments. The points used to define these segments are shown in the following tables.

Table 18, Evaporator Pressure Conversion:

Pressure (PSI)	Temperature (°F)
0	-15.0
7.1	0
19.0	20.0
34.7	39.0
50.7	54.0
70.4	69.0
99.6	87.0
129.2	102.0
166.8	118.0
205.4	132.0
246.5	145.0
320.0	165.0
428.5	188.1

Table 19, Condenser Pressure Conversion:

Pressure (PSI)	Temperature (°F)
0	0.6
17.5	18.5
31.5	35.9
50.0	53.7
76.0	73.4
115.0	95.6
161.5	116.2
185.0	125.2
260.0	149.2
284.5	155.9
349.5	172.0
365.5	175.5
428.5	188.1

Circuit Operating Mode

The circuits on the chiller can each be individually enabled or disabled. Test mode on each circuit can also be entered independent of all other circuits. With the circuit switch on, the circuit mode setpoint offers settings of either enable or disable. This simply allows the circuit to be disabled through a keypad setting.

Circuit Test Mode

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

– Circuit Switch = OFF
– Technician password active
– Circuit 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. Upon entering test mode, all outputs will always default to the off state. Upon leaving test mode, all outputs will automatically reset to the off state.

Compressors cannot be started in TEST mode.

Compressor Control

Multiple Compressor Staging

This section defines which compressor is the next one to start or stop. Compressors with fewer starts will normally start first, and compressors with more run hours will normally stop first.

Functions

– Can start/stop compressors according to an operator defined sequence.
– Can start compressors based on number of starts (run hours if starts are equal) and stop on run hours.
– The above two modes can be combined, so that there are two or more groups, where all compressors in the first group are started (based on number of starts/hours) before any in the second group, etc. Conversely, all compressors in a group are stopped (based on run hours) before any in the preceding group, etc.

Multiple Compressor Start/Stop Timing – Cool Mode

This section defines when a compressor is to start or stop when the chiller is operating in cool mode.

– Required Parameters
– Startup Delta T setpoint.
– Stage Up Delta T setpoint
– Stage Down Delta T setpoint
– Stop Delta T setpoint
– LWT error (See definition under Compressor Capacity Control section.)
– Full load indicator for each compressor

Full Load Indicator

A circuit is considered to be at full load in the compressor staging logic when any of the following occur:

– Slide control = manual
– A low or high pressure limit event has been active for 10 seconds
– Slide target >= 75% AND max slide target > 75%
  Slide target >= max slide target AND max slide target <= 75%

Starting
A compressor will start (stage up):

IF LWT is above the Active LWT Setpoint plus the Startup Delta-T SP AND no compressors are running OR all running compressors are at full load

Stopping
A compressor will stop (stage down);

IF LWT is below the Active LWT Setpoint minus the Stop Delta-T SP AND other compressors are running or not;

OR IF LWT is below the Active LWT Setpoint minus the Stop Delta-T SP AND all other running compressor's slide position is less than the light load stagedown setpoint.

Multiple Compressor Start/Stop Timing – Ice Mode
This section defines when a compressor is to start or stop when the chiller is operating in ice mode.

Required Parameters
- Startup Delta T setpoint.
- Stage Up Delta T setpoint
- LWT error (See definition under Compressor Capacity Control section.)

Starting
A compressor will start (stage up):

IF LWT is above the Active LWT Setpoint plus the Startup Delta-T SP AND no compressors are running OR all running compressors are at full load.

Stopping
The compressor will stop.

IF LWT reaches the ICE LWT Setpoint

Compressor Capacity Control
Compressor capacity is determined by calculating a slide position target. Adjustment to the slide target for normal running conditions occurs every 5 seconds. For loading a maximum change of 1% is allowed, and for unloading a maximum change of 2% is allowed.

Required parameters
- Count In Load Balance status for each compressor
- Slide targets of all compressors
- LWT error
- LWT slope

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

LWT error = LWT – active LWT setpoint

LWT Slope
LWT slope is calculated in the unit controller and sent to circuits via pLAN.

In the unit controller, this value is calculated such that the slope represents a time frame of one minute.

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

Count In Load Balance Flag

A circuit will be counted for load balancing only if all of the following are true:

- Compressor state is run
- Compressor is able to load up (no limits in effect due to pressure or superheat)
- Slide control is auto
- Slide position target is less than the max slide target setpoint

Cool Mode

When the chiller is in COOL mode, capacity of the compressor is adjusted to maintain leaving water temperature at the Active LWT setpoint while balancing the load between running circuits. Load balance offset, LWT error, and LWT slope are used to calculate a change in slide position as described below.

Load balance offset:

IF other compressor is flagged to be counted in load balance
THEN Load Balance Offset = slide target - (cir 1 target + cir 2 target)/2
ELSE Load Balance Offset = 0

LWT Error:

LWT Error = (Leaving Evaporator Water Temp) – (Active LWT setpoint).

LWT slope:

Slope (deg/minute) = sum of last five LWT changes as calculated every 12 seconds

Slide target adjustment = [LWT Error + (LWT Slope x 4) – Load Balance Offset] / # Compressors Running

Ice Mode

In ICE mode, the compressor capacity is increased at the maximum rate continuously until reaching the maximum slide position. Load balancing, LWT error, and LWT slope are ignored.

Low OAT Start Logic

In order to avoid low pressure alarms at the start of a circuit, low OAT start logic allows for running at low pressures for a longer time than normal, as well as multiple start attempts. This logic is only used for air-cooled operation.

A low OAT start is initiated if the condenser saturated temperature is less than 60°F when the compressor starts. Once this happens, the circuit is in the low OAT start state for a time equal to the low OAT start timer setpoint. During this time, the freezestat logic and the low pressure events are disabled. The absolute limit of –10 psi is still enforced.

At the end of the low OAT start, the evaporator pressure is checked. If the pressure is greater than, or equal to, the low evaporator pressure unload setpoint, the start is considered successful. If the pressure is less than the unload setpoint, the start is not successful and the compressor will stop. Three start attempts are allowed before tripping on the restart alarm; so if on the third attempt the start is not successful, the restart alarm is triggered.

The restart counter will be reset when either a start is successful or the circuit is off on an alarm.

Internal Capacity Overrides

The following conditions override the automatic slide control when the chiller is in COOL mode or ICE mode. These overrides keep the circuit from entering a condition in which it is not designed to run. Any compressor running with capacity limits because of these conditions is considered to be at full load in the compressor staging logic.

Low Evaporator Pressure

If the evaporator pressure drops below the Low Evaporator Pressure Hold setpoint while the compressor is running, the Low Evaporator Pressure Inhibit (Hold) event is triggered. When triggered, the compressor will not be allowed to increase in capacity.

If the evaporator pressure drops below the Low Evaporator Pressure Unload setpoint while the compressor is running, the Low Evaporator Pressure Unload event is triggered. When triggered, the compressor will begin reducing capacity. The maximum allowed slide target will be adjusted down 5% every 5 seconds until the evaporator pressure rises above the Low Evaporator Pressure-Unload setpoint.

These events are logged to an event log when they occur. Both remain active until the evaporator pressure rises above the hold setpoint plus 2 psi, or the circuit goes to a state other than Run.

High Lift Pressure

If the compressor is running and the condenser pressure rises above the High Lift Pressure Hold setpoint, the High Lift Pressure Inhibit event is triggered. When this happens, the compressor will not be allowed to increase capacity. This event is active until the condenser pressure drops 10 psi below the hold setpoint.

If the compressor is running above minimum load capacity and the condenser pressure rises above the High Lift Pressure Unload setpoint, the High Lift Pressure Unload event is triggered. When this happens, the compressor will begin reducing capacity. The maximum allowed slide target will be adjusted down 5% every 5 seconds until the condenser pressure drops below the High Condenser Pressure Unload setpoint. The compressor will not be allowed to increase in capacity until the condenser pressure drops to 10 psi below the unload setpoint.

Maximum LWT Pulldown Rate

The maximum rate at which the leaving water temperature can drop is limited by the Maximum Rate setpoint, only when the LWT is less than 60°F and the unit mode is Cool. A slope unload factor is used to reduce the slide target if the pulldown rate exceeds the Maximum Rate setpoint.

Slope Unload Factor: Maximum Rate + LWT slope

If the pulldown rate is too fast, then the slide adjustment made will be equal to the slope unload factor.

High Water Temperature Capacity Limit

If the evaporator LWT exceeds 55°F, compressor slide position will be limited to a maximum of 75%. Compressors shall unload to 75% or less if running at greater than 75% slide position when the LWT exceeds the limit. This feature is to keep the circuit running within the capacity of the condenser coil.

Unit Capacity Overrides

Unit capacity limits override the automatic slide control when the chiller is in COOL mode only. The active capacity limit as well as the estimated unit capacity will be calculated in the unit controller and sent to all circuits.

If the unit capacity is greater than the active capacity limit, then no circuit will increase slide position. If the unit capacity is greater than the active limit plus 1%, the circuits will unload until the unit capacity is less than 1% greater than the active limit.

Pumpdown

When a circuit reaches a condition where the compressor needs to shut down normally, a pumpdown will be performed. The slide target will automatically go to 0 while pumping down, and the compressor will run until the pumpdown pressure has been reached, or the pumpdown time has been exceeded.

Service Pumpdown

If the option for a service pumpdown is enabled, then on the next pumpdown the pressure setpoint will be 5 psi. The circuit will pumpdown to this pressure and shut off. When the compressor has completed the service pumpdown, the setpoint is reset to No.

Slide Positioning

Slide Position Indicator

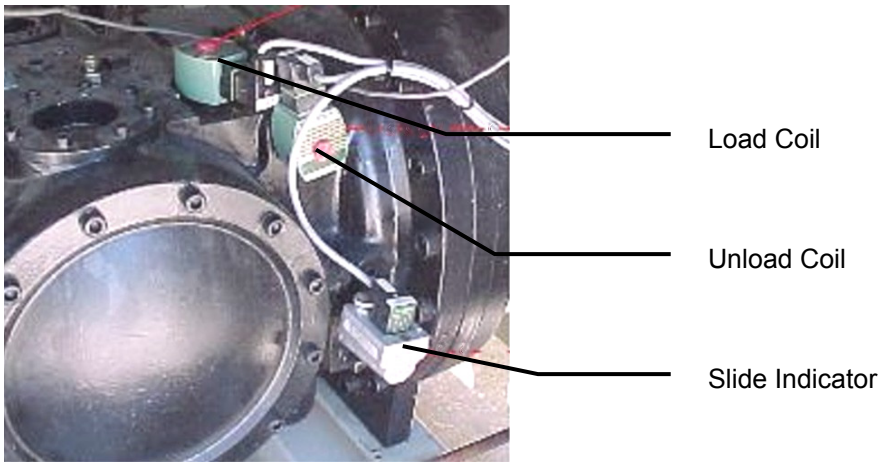
Each compressor estimates its slide load percentage from the present value of the slide position indicator. The percentage is based on the 4-20mA signal from the slide load indicator. A percentage value of 0 corresponds to approximately a 4mA signal, a percentage value of 100 corresponds to approximately a 20mA signal.

Slide Calibration Procedure

Slide Position is a relative capacity adjustment from 0.0%(Min load) to 100.0%(Max Load). There are two MicroTech readings that apply to the indicator, Slide Target and Slide Position. It is important to understand the difference between these. The **Slide Target** is the value in which the controller uses to display the calculated prediction of slide position, this value represents the destination or goal of pulsing the load and unload solenoid coils. The slide target is used for direction of control for all load and unload operations, including alarm limit events. When putting a circuit in Manual mode, the slide target is the value that you will be adjusting. The controller will load or unload the chiller to match, with in about 3%, the target entered with the current slide position value. The second value is the **Slide Position (Pos)** this is the slide position value which is the 4-20mA reading received from the position indicator. These values can be viewed at the circuit controller on screen "VIEW CIR STATUS (1)".

A slide target of 0.0% is fully unloaded and the unload solenoid will be constantly energized. A slide target of 100.0% means that the chiller is at full load and the load solenoid is continually energized. The chiller will regulate the slide position to infinite steps between 0% and 100% by pulsing the appropriate solenoid. Facing the discharge end of the compressor, looking along the left side, the solenoid coil on the top is for load (oil vent) and the solenoid coil on the side is for unload (oil feed). During normal operation, the controller makes decisions to move the Slide target, the calculated value, and pulses the proper solenoid in order to keep the actual and the target position with in a few percent.

Figure 9, Slide Indicator and Coils



Calibration Procedure:

1. The circuit to be calibrated should be near normal operating temperatures. Note that the compressor requires sufficient oil pressure to unload the compressor while it is running, and may load up due to lack of oil feed pressure.
2. On the Circuit controller, first verify what your current slide target is at screen "View Circ Status (1)" and then go to screen "SET COMP SPs (2)" to switch circuit into manual slide control. Note: Some hold limits will be ignored but all alarm limits are still active while in manual slide control.
3. Slowly take the circuit to 0% slide position. When the slide target is at 0%, verify that the unload coil is energized.
4. Find the slide indicator device located on the left side of the compressor facing the discharge end. Unscrew the metal cap and press the calibrate button beside the LED. The red LED will come on for about 30 seconds and then start to blink. The indicator is now calibrated at 0%.
5. Now, slowly take the circuit to 100% slide position, watching that the suction pressure and other unit readings are OK. Always keep discharge superheat above 22°F. When the slide target is at 100%, verify that the load coil is energized. Press the calibrate button. The red LED will come on for about 30 seconds and then the green LED will come on. The indicator is now calibrated at 100%.
6. The mechanical calibration is now complete for the compressor you are working with. Replace the calibration cap.
7. Once you have the mechanical slide calibration complete you may fine tune the calibration from the circuit controller, if necessary. On the circuit controller scroll all the way to the right, this is the calibration and offsets menu. Scroll down until you see "SET SENSOR OFFSET(3)". You will see an adjustment for Min Load and Max Load and on the bottom line you will see the value of actual slide position indicator. Add offset until value is within +/-.5% of the corresponding full load or minimum load position.
8. Repeat calibration procedure until all circuits have min and max positions calibrated.

Note: The Slide Indicator Transducers may vary a considerable amount with temperature change, and therefore they need to be calibrated at typical running temperatures.

Manual Slide Control Mode

The slide position on each circuit can be controlled manually. A setting on the compressor setpoints screen in each circuit controller allows the operator to select manual slide control. On the same screen, a slide target can be selected, from 0% to 100%.

Anytime a circuit is in manual slide control, it is considered to be at full load in the staging logic. It also will not be considered in load balancing calculations. None of the capacity limits outlined above will apply in manual slide control, but all stop alarms are still applicable.

Slide control will revert back to automatic control if a stop alarm occurs on the circuit or unit, or the slide control has been manual for four hours.

Slide Pulse

The slide pulse output moves the compressor slide in order to reach the capacity requested by the slide position target. The output will pulse for 200 ms every 6 seconds while the Slide Pulse flag is true, that is, whenever there is a difference between the actual slide position and the requested position.

Expansion Valve Control

The EXV can be in one of four control states. Each state is described below.

Preopen

At the time of a start request, the EXV will perform a pre-open function. This mode applies to both remote air cooled and packaged water cooled condenser operation and helps prime the evaporator prior to starting as well as getting the EXV in a better starting position. For remote air-cooled condenser operation, this function is disabled should the condenser pressure be less than the evaporator pressure at start. For remote air-cooled condenser operation, the liquid line solenoid shall remain closed until the compressor starts. During pre-open, the EXV signal is held at 3000 steps.

For remote condenser configuration units that come equipped with a factory mounted liquid line solenoid, a post-open logic has been added to prevent hydraulic lock between the liquid line solenoid and the electronic expansion valve. After the compressor performs a pump down and cycles off, the electronic expansion valve will re-open for 30 seconds and then return to its closed position.

Pressure Control

In pressure control, the evaporator pressure is controlled by the EXV position. The pressure target varies based on evaporator LWT and discharge superheat values. PID logic will be used to control the pressure to the target value.

The base pressure target is calculated using the following formula:

Base target = 0.6(LWT) – 2

The base target is limited to a range from low pressure inhibit set point + 2 psi, to 52 psi.

The pressure control target may be adjusted if the discharge superheat is not within an acceptable range. If the superheat is less than 22oF, the base pressure target will be reduced by a value equal to the low superheat error. If the superheat is more than 40°F, the base pressure target will be increased by a value equal to the high superheat error. At any time, the adjusted target pressure cannot go below the low pressure inhibit set point or above 52 psi.

When the EXV transitions to the pressure control state, the target will start at the current evaporator pressure value. The pressure target will then decrement 0.2 psi every second until reaching the normal calculated target. If the pressure at transition is less than the calculated target, then pressure control will start immediately with the calculated target.

Superheat Control

In superheat control, suction superheat is controlled directly by the EXV. The superheat target varies linearly from 6 to 10 degrees F as discharge superheat changes from 30 degrees F to 22 degrees F. PID logic controls the superheat to the target value.

When the EXV transitions to the superheat control state, the target will start at the current suction superheat value. This target will then decrement 0.1 degree F every second until reaching the normal target.

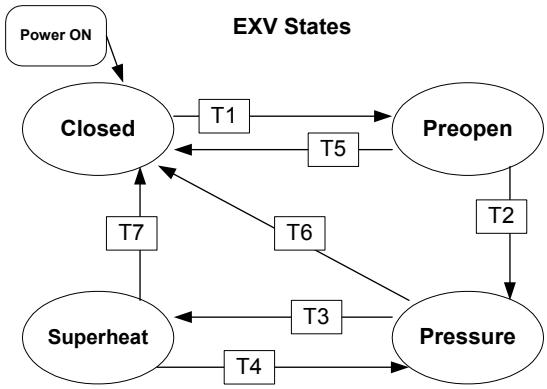
Closed

Any time the EXV is not in pressure control or superheat control, it will be in a closed state. At this time, the EXV position is 0 steps and the EXV close signal (digital output) is active.

After the compressor performs a pumpdown and cycles off, the electronic expansion valve will re-open for 30 seconds. After these 30 seconds, the expansion valve will return to its closed position. This logic has been added to help prevent hydraulic lock between the liquid line solenoid and the electronic expansion valve.

EXV State Transitions

The following state diagram shows the transitions between EXV control states for both packaged water-cooled and remote air-cooled condenser configurations. Preopen is not performed for remote air cooled condenser configurations when the evaporator pressure is greater than condenser pressure. See "EXV State Transitions – Aircooled" on page 63.



Transitions:

T1 – Transition from Closed to Preopen
Requires **all** of the following

- Unit State = Auto
- Evap State = Run
- Compressor is available
- Compressor is next on
- Stage up now flag is set
- Compressor State = Off

OR (as in the case when a circuit cycles off)

- Compressor State = Off and unit configured for remote air-cooled condenser, (will perform a pre-open for 30 seconds (post open time) then return to Closed state)

T2 – Transition from Preopen to Pressure Control
Requires the following

- EXV State has been Preopen for a time greater than the preopen timer set point

T3 – Transition from Pressure Control to Superheat Control
Requires **all** of the following
- Suction Superheat > Superheat target
- Evap LWT <= 60 F
- EXV State = Pressure AND Discharge Superheat >= 22 F for at least 3 minutes

T4 – Transition from Superheat Control to Pressure Control
Requires **any** of the following
- Evap LWT > 63 F
- Low Evap Pressure Unload event active
- Discharge Superheat < 22 F or > 40 F

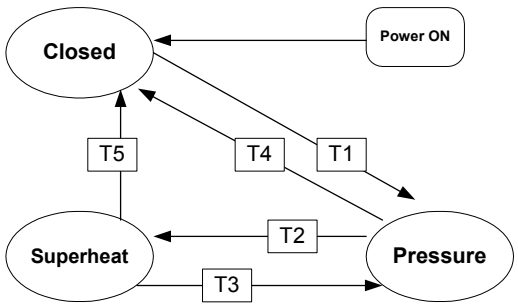
T5 – Transition from Pre-open to Closed state
- Compressor State = Off and unit configured for remote air-cooled condenser and EXV post open timer (non-field-adjustable at 30 seconds) has expired.
- Compressor State not Run

T6, T7 – Transition from any state to Closed state
Requires the following
- Compressor State not Run

EXV State Transitions – Aircooled

The following state diagram shows the transitions between EXV control states for remote air-cooled operation when evaporator pressure is greater than condenser pressure at start.

EXV States



Transitions:

T1 – Transition from Closed to Pressure Control
Requires **all** of the following
- Unit State = Auto
- Evap State = Run
- Compressor is available
- Compressor is next on
- Stage up now flag is set
- Compressor State = Off

T2 – Transition from Pressure Control to Superheat Control
Requires **all** of the following
- Suction Superheat >= Superheat target
- Evap LWT <= 60°F

- EXV State = Pressure AND Discharge Superheat >= 22 degrees F for at least 3 minutes
- Discharge Temperature <= 180°F

T3 – Transition from Superheat Control to Pressure Control
Requires **any** of the following
- Evap LWT > 63°F
- Low Evap Pressure Unload event active
- Discharge Superheat < 22°F
- Discharge Temperature > 185°F

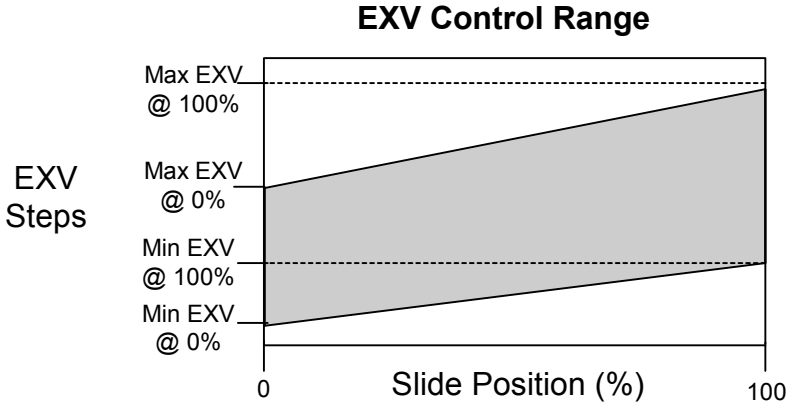
T4, T5 – Transition from any state to Closed state
Requires the following
- Compressor State not Run

EXV Control Range

The table below shows the EXV range for each size compressor at minimum and maximum capacity. The minimum and maximum values vary linearly with slide position, defining a new EXV control range for every change in slide position.

EXV	Slide %	Compressor Size		
		167	179	197
Min	0	250	250	250
Max	0	3000	3000	3000
Min	100	870	1080	1300
Max	100	3400	4200	5000

Based on the values in the above table, the EXV control range varies as shown in the table below. The shaded area the control range.



Manual EXV Control

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

When EXV control is set to manual, the EXV position is equal to the manual EXV position setting. If set to manual when the compressor state transitions from run to another state, the control setting is automatically set back to auto.

Oil Heater Control

The oil heater shall be on when the compressor is not running AND the oil level input is closed for 15 seconds. This output will turn off immediately when either the oil level switch opens or the compressor state is no longer off.

Starter Communications

The Modbus protocol is used to establish communications between the compressor starter and the circuit controller on the supervisor port, with the circuit controller acting as the master and the starter as the slave.

Table 20, Parameters to be Read/Written:

Register	Description	R/W	Range	Units
1020	Starter Control	R/W	Bit Mask 0: Run/Stop 1: Fault Reset	-
1021	Starter Status	R	Bit Mask 0: Ready 1: Running 2: UTS 3: Alarm 4: Fault 5: Lockout	-
1026	Avg Current	R		Amps
1027	L1 Current	R		Amps
1028	L2 Current	R		Amps
1029	L3 Current	R		Amps
1032	Avg Voltage	R		Volts
1033	L1-L2 Voltage	R		Volts
1034	L2-L3 Voltage	R		Volts
1035	L3-L1 Voltage	R		Volts
1037	PF	R	-99 to 100 (in 16 bit two's compliment signed format)	0.01
1038	KW	R		KW
1039	KVA	R		KVA
1045	Motor FLA	R/W	1-9999	Amps
1046	Motor RLA	R/W	1-9999	Amps
1057	Ground Fault Trip Enable	R/W	0: Disabled 1: Enabled	-
1058	Ground Fault Trip Level	R/W	1-100	% RLA
1078	Fault Code – Most Recent Fault Log Entry	R		-

Read-only parameters are displayed at the circuit controller, and sent over pLAN to the unit controller where they will also be displayed. Read/write parameters are accessible at the circuit controller only. These read/write parameters are changeable when the starter communication is working and the proper password is active.

Starter Faults

Starter faults can be viewed from the unit controller. Some starter faults will be implemented as unique alarms, and others are grouped into a generic starter fault alarm.

The most recent fault code shall be stored in the alarm log parameter list. The fault reset signal is sent to the starter when the operator clears the active alarm on the unit controller. The starter fault codes and their corresponding alarms are shown in the table below:

Table 21, Starter Fault Codes

Fault Code	Starter Fault Description	Alarm Triggered
00	No Fault	N/a
01	UTS Time Limit Expired	No Starter Transition
02	Motor Thermal Overload Trip	Compressor Current Overload Trip
10	Phase Rotation Error, not ABC	Phase Reversal
12	Low Line Frequency	Starter Fault
13	High Line Frequency	Starter Fault
15	Input power not three phase	Phase Loss
21	Low Line L1-L2 Voltage	Undervoltage
22	Low Line L2-L3 Voltage	Undervoltage
23	Low Line L3-L1 Voltage	Undervoltage
24	High Line L1-L2 Voltage	Overvoltage
25	High Line L2-L3 Voltage	Overvoltage
26	High Line L3-L1 Voltage	Overvoltage
27	Phase Loss	Phase Loss
28	No Line Voltage	Undervoltage
30	Instantaneous Overcurrent	Compressor Current Overload Trip
31	Overcurrent	Compressor Current Overload Trip
37	Current Imbalance	Motor Current Imbalance
38	Ground Fault	Ground Fault Protection
39	No Current at Run	Low Motor Current
40	Shorted/Open SCR	Starter Fault
47	Stack Protection Fault	Starter Fault
48	Bypass Contactor Fault (on Stop Input)	No Starter Transition
50	Control Power Low	Starter Fault
51	Current Sensor Offset Error	Starter Fault
52	Burden Switch Error	Starter Fault
60	Thermistor Trip (on DIN#1)	High Motor Temperature
61	Stack OT Switch Trip (on DIN#2)	Starter Fault
71	Analog Input Trip	Starter Fault
82	Modbus Timeout	Starter Fault (detected by circuit controller)
94	CPU Error – Software Fault	Starter Fault
95	CPU Error – Parameter Storage Fault	Starter Fault
96	CPU Error – Illegal Instruction Trap	Starter Fault
97	CPU Error – Software Watchdog Fault	Starter Fault
98	CPU Error – Spurious Attempt	Starter Fault
99	CPU Error – Program Storage Fault	Starter Fault

If a starter fault is active and the active alarms are cleared at the unit controller, the clear alarm signal will also be sent to the starter to clear the alarm status in the starter.

Loss of Starter Comm

If starter communication is lost for 10 seconds while the circuit is in a state other than Off or there is a start request, then the Starter Fault alarm will be triggered. Without communication, the fault code cannot be read from the starter so the code 82 will be automatically logged with the alarm.

Condenser Fan Control

Condenser fan control from the MicroTech II controller is used only for air-cooled condenser operation. Head pressure control, as part of the condenser, can be used instead.

Remote evaporative condensers require their own self-contained, on-board, head pressure controls. See page 51.

Fan Stages

There are up to 6 stages of Fantrol available. See the table below:

Table 22, Fantrol Staging

Fantrol Stage	Fans On
1	1
2	1,2
3	1,2,3
4	1,2,3,4
5	1,2,4,5,6
6	1,2,3,4,5,6

Staging Up

The controller looks at high the discharge pressure is and how quickly it is rising by accumulating "points" in a collection bin called the "Stage Up Accumulator".

There are four Stage Up deadbands that apply to the Fantrol stages. Stages one through three use their respective deadbands. Stage four to six share the fourth Stage Up dead band.

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). If the condensing temperature is high (rising quickly) relative to the Target plus the dead band, multiple Stage Up Error Steps will be accumulated. This will start a fan sooner than if the temperature is rising slowly.

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

When a stage up occurs *or* the saturated condenser temperature falls back within the Stage Up deadband, the Stage Up 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. Since this logic applies only to Fantrol fans, the VFD fan is not affected.

Table 23, Forced Fan Staging

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

Staging Down

There are four Stage Down dead bands. Stages one through three use their respective deadbands. Stages four to eight share the fourth Stage Down deadband.

The Stage Down process is similar to the Stage Up except in reverse.

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 turned off.

When a stage down occurs or the saturated temperature rises back within the Stage Down deadband, the Stage Down Error Accumulator is reset to zero. The accumulator is also held at zero after startup until either the outside ambient temperature is less than or equal to 75°F, *or* the saturated condenser temperature is greater than the condenser target less the active stage down deadband.

Condenser Fan VFD

Fan VFD operation is available for use with remote condenser units.
For units configured with remote condensers, there is an option to enable fan VFD operation.

- Fan VFD speed and target are displayed.
- Fan VFD minimum speed and maximum speed set points are available.
- An input for fan VFD fault was added at digital input 4 on each circuit controller. VFD faults are logged in the event log, and notification sent on BAS interface.
- Fan VFD speed is sent on BAS interface.

Digital Output Control

Each digital output is controlled according to the following rules. All outputs are initialized to OFF at power on.

Alarm – (Terminals J12 – NO1)

This output is turned ON when any Equipment Protection ALARM occurs. It is turned OFF when all alarms have been cleared.

Evaporator Pump – (Terminals J12 – NO2)

An Evaporator Water Pump output is ON if the Evap State is set to START or RUN.

Fan #1 to #8 (Air-Cooled Condensers)

[Water Cooled = N] - 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.

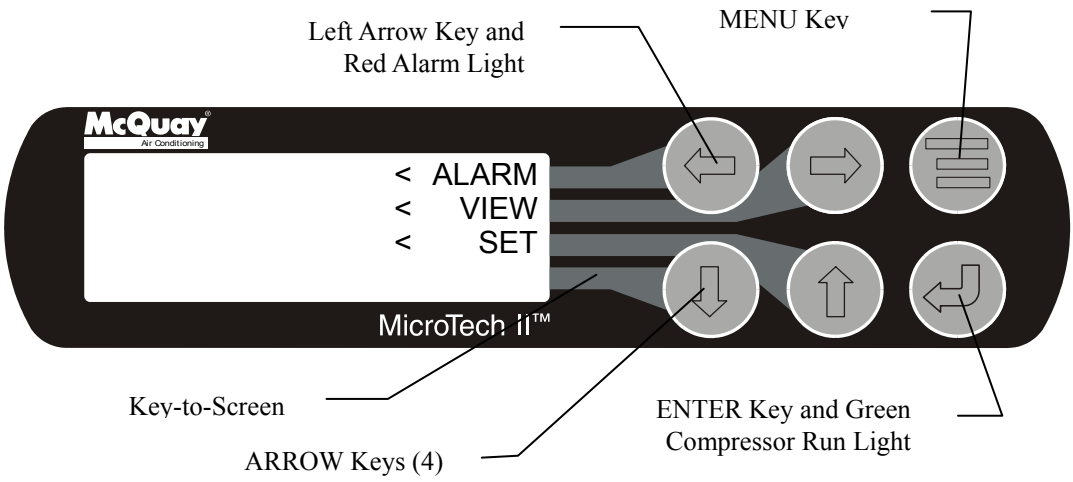
Using the Controller

4x20 Display & Keypad

Layout

The 4-line by 20-character/line, liquid crystal display and 6-key keypad for both of the circuit controller and the unit controller is shown below.

Figure 10, 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. There is no display line associated with the Down Arrow.

Arrow Keys

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

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

LEFT	Default (D)
RIGHT	Cancel (C)
UP	Increment (+)
DOWN	Decrement (-)

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

Getting Started, Navigating - Press the MENU key to get started. The navigating procedures are the same for both the unit controller and the circuit controller.

MENU Key

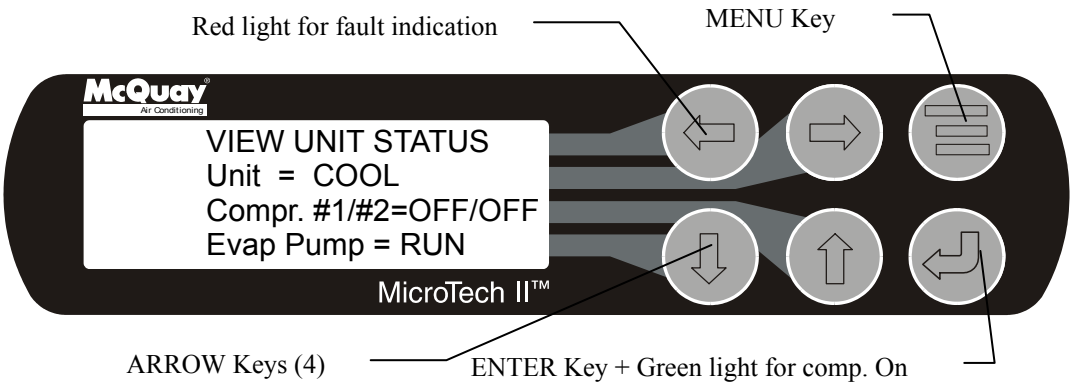
The MENU key is used to switch between the MENU mode as shown in Figure 10 and the SCROLL mode as shown in Figure 11. The MENU mode is basically a shortcut to specific groups of menus used for checking ALARMS, for VIEWING information, or to SET

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.

When in the MENU mode (as shown in Figure 10), pressing the LEFT ARROW key will select the ALARM menus, the RIGHT ARROW key will select the VIEW menus and the UP key the SET menus. The controller will go the next lower menu in the hierarchy, and then other menus can be accessed by using the ARROW keys. Pressing the MENU key from any menu screen will automatically return to the MENU mode as shown in Figure 10.

Another way to navigate through the menus is to press the MENU key when in the MENU mode (as above). This will switch the controller to the SCROLL mode. The controller will automatically go to the first screen as shown below (the upper-left menu on the menu matrix shown on pages 72 and 87. From there, the four ARROW keys can be used to scroll up, down, or across to any other menu.

Figure 11, Display in the Shortcut (SCROLL) Mode and Keypad Layout



ENTER Key

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).

Changing Setpoints

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. Nothing 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.
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 and also move the cursor 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.

Security

All setpoints on the unit controller, as well as the circuit controllers, are protected using passwords. Two four-digit passwords provide OPERATOR and MANAGER levels of access to changeable parameters.

Entering Passwords

Passwords can be entered using the ENTER PASSWORD screen on the unit controller, which is the last screen in the Unit SPs column. The password is entered by pressing the ENTER key, scrolling to the correct value with the UP and DOWN arrow keys, and pressing ENTER again. The longer a key is held down, the faster it will increment. The entered password is not shown after the enter key is pressed. The operator password is 100.

Once the correct password has been entered, the ENTER PASSWORD screen indicates which password is active (none, operator, technician, or manager). If the wrong password is entered, a temporary message will appear so stating. If no valid password is active, the active password level displays “none”.

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

Editing Setpoints

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

Once a password has been entered, it remains valid for 60 minutes after the last key-press on the unit controller.

Clearing Alarms

Alarms are only shown on the unit controller and are cleared at the unit controller. No password is required.

To clear an alarm, go to the unit controller Alarm Log. Scroll down to the last alarm listed. The screen will note “No More Alarms”. Press and hold ENTER for several seconds until the circuit controllers get a clear signal. If there are no active alarms, the red Alarm light will be off and alarms status will clear from the unit and circuit controllers.

Menu Descriptions

Unit Controller

Various 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 case they are used to *set* the setpoint values that can be changed.

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 content of each screen and its location in the matrix are shown in Unit Controller Menu Matrix. Each menu screen's detailed description begins on page 73.

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

As an alternate to selecting screens with the menu function, it is possible to scroll through all of them with the 4 arrow keys. For this use, the screens are arranged logically in a matrix as shown below.

Shortcut Menus

These menus are accessed by pressing the Menu button at any time. The hierarchical structure of the shortcut menus is shown below.

Table 24, Unit Controller Shortcut Menus

LEVEL 1	LEVEL 2	LEVEL 3	
VIEW	UNIT	STATUS	VIEW UNIT STATUS (1-4)
		TEMP	VIEW UNIT TEMP (1-3)
	CIR STATUS	CIR 1	VIEW CIR 1 STATUS (1-5)
		CIR 2	VIEW CIR 2 STATUS (1-5)
	REFRIGERANT	CIR 1	VIEW REFR CIR 1 (1-5)
		CIR 2	VIEW REFR CIR 2 (1-5)
	FANS	VIEW FANS	
	TOWER	VIEW TOWER (1-2)/	
ALARM	LOG	EVENT/ALARM LOG	
	ACTIVE	ALARM ACTIVE	
SET	UNIT SPs	SET UNIT SPs (1-15)	
	COMPRESSOR SPs	SET COMP SPs (1-4)	
	ALARM LIMITS	SET ALARM LIMITS (1-4)	
	TOWER SPs	SET TOWER SPs (1-8)	

Unit Controller Menu Matrix

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

"VIEW" SCREENS									
VIEW UNIT STATUS (1)	VIEW UNIT TEMP (1)	VIEW CIR 1 (1)	VIEW CIR 2 (1)	VIEW REFRG CIR 1 (1)	VIEW REFRG CIR 2 (1)	VIEW FANS	VIEW TOWER (1)	EVENT LOG (1)	
VIEW UNIT STATUS (2)	VIEW UNIT TEMP (2)	VIEW CIR 1 (2)	VIEW CIR 2 (2)	VIEW REFRG CIR 1 (2)	VIEW REFRG CIR 2 (2)		VIEW TOWER (2)	. . . .	
VIEW UNIT STATUS (3)	VIEW UNIT TEMP (3)	VIEW CIR 1 (3)	VIEW CIR 2 (3)	VIEW REFRG CIR 1 (3)	VIEW REFRG CIR 2 (3)			. . . .	**CONTINUED BELOW**
VIEW UNIT STATUS (4)		VIEW CIR 1 (4)	VIEW CIR 2 (4)	VIEW REFRG CIR 1 (4)	VIEW REFRG CIR 2 (4)			EVENT LOG (25)	
		VIEW CIR 1 (5)	VIEW CIR 2 (5)	VIEW REFRG CIR 1 (5)	VIEW REFRG CIR 2 (5)				

	"ALARM" SCREENS		"SET SCREENS"				TEST
CONTINUATION FROM ABOVE	ALARM LOG (1)	ALARM ACTIVE (1)	SET UNIT SPs (1)	SET COMP SPs (1)	SET ALARM LMTS (1)	SET TOWER SPs (1)	TEST UNIT
	. . . .	. . . .	. . . .	SET COMP SPs (2)	SET ALARM LMTS (2)	. . . .	
	. . . .	. . . .	. . . .	SET COMP SPs (3)	SET ALARM LMTS (3)	. . . .	
	ALARM LOG (25)	ALARM ACTIVE (n)	SET UNIT SPs (15)	SET COMP SPs (4)	SET ALARM LMTS (4)	SET TOWER SPs (8)	

Selection can be made within the matrix by using the LEFT/RIGHT keys to move between columns and the UP/DOWN keys to move between rows.

Unit Controller Menu Descriptions

This section contains information on each screen of the unit controller. The menu screens are in order of the matrix above, going from left to right and also down when there are sub-menus. Many menus are self-explanatory. A Setpoint menu allows selection of whether the unit has a water-cooled condenser, Water-Cooled = Y (Yes) or a remote condenser, Water-Cooled = N (No). This selection will alter some menus as appropriate to the type of condenser.

Screen Definitions – MENU

Top level menu:

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

ALARM menu:

ALARM	< ACTIVE
	< LOG
	<
	<

VIEW menu:

Water-cooled			Air-cooled		
VIEW	<	UNIT	VIEW	<	UNIT
	<	CIR STATUS		<	CIR STATUS
	<	REFRIGERANT		<	REFRIGERANT
	<	TOWER		<	FANS

VIEW UNIT menu:

VIEW	<	STATUS
UNIT	<	TEMP
	<	
	<	

VIEW CIRCUIT STATUS menu:

VIEW CIR	<	CIR 1
STATUS	<	CIR 2
	<	
	<	

VIEW REFRIGERANT menu:

VIEW REFR	<	CIR 1
	<	CIR 2
	<	
	<	

SET menu:

Water-cooled			**Air-cooled**		
SET	<	ALARM LIMITS	SET	<	ALARM LIMITS
	<	UNIT SPs		<	UNIT SPs
	<	COMPRESSOR SPs		<	COMPRESSOR SPs
	<	TOWER SPs			

Screen Definitions – VIEW

View Unit Status

Water-cooled:	**Air-cooled:**
VIEW UNIT STATUS (1) {Unit Status} Evap Pump= {state} Cond Pump= {state}	VIEW UNIT STATUS (1) {Unit Status} Evap Pump= {state}

Unit Status will display one of the following:

Auto	Off:Ice Mode Timer	Off:All Cir Disabled
Off:Unit Alarm	Off:Keypad Disable	Off:Remote Switch
Off:BAS Disable	Off:Unit Switch	Off:Test Mode
Auto:Wait for load	Auto:Cond Recirc	Auto:Evap Recirc
Auto:Wait Cond Flow	Auto:Wait Evap Flow	Auto:Pumpdown

Pump states include Off, Start, and Run. The condenser pump state is visible only for water-cooled operation.

```
VIEW UNIT STATUS (2)
Softload Limit=XXX.X
Demand Limit= XXX.X
Network Limit= XXX.X
```

```
VIEW UNIT STATUS (3)
Unit Capacity=XXX.X%
Ice Delay= XXh XXm
```

Ice Delay will be visible only when unit mode is ice. It prevents the unit from undesirable starts before the next day's ice-making cycle.

```
VIEW UNIT STATUS (4)
      1 2 3 4 5 6 8
D.O.  X X X X X X X
D.I.  X X X X X
```

The digital input and output status will show either a "0" or a "1" designating Off and On states respectively.

View Unit Temperature

```
VIEW UNIT TEMP   (1)
Evap LWT= XXX.X °F
Evap EWT= XXX.X °F
Active SP= XXX.X °F
```

```
VIEW UNIT TEMP   (2)
LWT Pulldn= 0.0 °F/m
Evap Delta T= XX.X
```

Water-cooled:

```
VIEW UNIT TEMP   (3)
Cond EWT= XXX.X °F
Cond LWT= XXX.X °F
```

Air-cooled:

```
VIEW UNIT TEMP   (3)
OAT= XXX.X °F
```

View Circuit Status

In the following VIEW CIR screens, the N field indicates which circuit (#1, #2) is being viewed. Certain screens located in the circuit controller are also displayed here on the unit controller for convenience.

```
VIEW CIR N STATUS(1)
{Circuit Status}
Slide Pos=   000.0%
Slide Target=000.0%
```

Circuit Status will display one of the following:

Off:Ready	Off:Cycle Timer	Off:Low OAT Lock
Off:Keypad Disable	Off:Pumpdown Switch	Off:Alarm
Off:Test Mode	EXV Preopen	Run:Pumpdown
Run:Normal	Run:LWT PullDn Limit	Run:Unit Cap Limit
Run:High LWT Limit	Run:Evap Press Low	Run:Lift Press High
Off:pLAN failure		

```
VIEW CIR N STATUS(2)
Hours  = XXXXX
Starts = XXXXX
```

```
VIEW CIR STATUS  (3)
Current (amps)
 L1   L2   L3  Avg
 XXX  XXX  XXX  XXX
```

```
VIEW CIR STATUS  (4)
Voltage
L1-2 L2-3 L3-1  Avg
XXX  XXX  XXX   XXX
```

```
VIEW CIR STATUS  (5)
PF= 0.XX  %RLA=XXX.X
KW=  XXX
KVA= XXX
```

View Refrigerant

In the following VIEW REFR screens, the N field indicates which circuit (#1, #2) is being viewed.

```
VIEW REFR CIR N (1)
Evap Press=XXX.X psi
Cond Press=XXX.X psi
```

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

```
VIEW REFRG CIR N (3)
Suct Temp = XXX.X °F
Disc Temp = XXX.X °F
```

```
VIEW REFRG CIR N (4)
Suct SH=   XXX.X °F
Disc SH=   XXX.X °F
```

```
VIEW REFRG CIR N (5)
Evap Approach=XX.X°F
Cond Approach=XX.X°F
EXV position = XXXX
```

View Fans

This screen is only viewable when unit is configured for air-cooled.

```
VIEW FANS
Fans On, Cir 1= X
Fans On, Cir 2= X
```

View Tower

These screens is only viewable when unit is configured for water-cooled.

```
VIEW TOWER       (1)
Fans On= X of X
Cond EWT= XXX.X °F
Set Point=XXX °F
```

```
VIEW TOWER       (2)
Bypass Valve=XXX.X%
VFD Speed=   XXX.X%
```

Screen Definitions – ALARM

```
ALARM LOG: XX
{Alarm Description}
hh:mm mm/dd/yy
{Parameters}
```

The most recent 25 alarms, either shutdown or limit, are shown in this menu and subsequent menus located under it. The last alarm is shown first. 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), etc.

Alarm Description will indicate which alarm occurred. If the alarm is a circuit alarm, then the circuit for which the alarm occurred will also be indicated.

Parameters at the time of the alarm are shown on the bottom line of the screen one at a time. These are scrolled through by pressing the edit key and using the up and down arrows to scroll through the list. Parameters include:

Unit State	Evap LWT	Evap EWT
Cond EWT/OAT	Circuit State	Evaporator Pressure
Condenser Pressure	Suction Temperature	Discharge Temperature
Discharge Superheat	EXV Position	EXV State
Slide Position	Fans On	

Starter Fault Code (will show “00” when the alarm logged is not a starter fault)

```
EVENT LOG: XX
{Event Description}
hh:mm mm/dd/yy
```

```
   *** ALARM ***
    hh:mm mm/dd
{Alarm Description}
```

```
   NO MORE ALARMS
Press ENTER to clear
```

If the unit is off on a shutdown alarm or running, but in a limit alarm condition, the cause and date will appear in the above screen. If there is a simultaneous occurrence of more than one alarm, the others will appear in additional screens below the first one, accessed by the DOWN ARROW. Either type alarm will light a red light in back of the LEFT-ARROW KEY. The light will go out when the fault is cleared. To clear the fault, scroll down to the last screen and press ENTER. If other faults have appeared, they will all be cleared at the same time.

Screen Definitions – SET

Unit Set Points

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

Unit Enable settings can be OFF and ON as determined from the Unit Enable setpoint.

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, in which an external switch is wired across terminals #60 and #66. (See wiring diagram page 8 or 9.)
3. NETWORK, used with BAS signal, which is wired to the three communication ports.

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 #60 and #68 initiates the change from glycol cooling to making ice. (See wiring diagrams on page 8 or 9.)

Unit Mode settings can be COOL COOLw/Glycol, or ICEw/Glycol, as determined from the Unit Mode setpoint.

Source settings can be KEYPAD, SWITCHES, or NETWORK as determined from the Mode Source setpoint.

```
SET UNIT SPs      (2)
Available Modes
    = COOL
Select w/Unit Off
```

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

```
SET UNIT SPs      (4)
StopDelta= X.X°F
Stg Up Delta= X.X°F
Stg Down Delta=X.X°F
```

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

Water-cooled:

```
SET UNIT SPs      (6)
Watercooled= Yes
CondRecTimer=XXX sec
Cond Pump= #1 Only
```

Air-cooled:

```
SET UNIT SPs      (6)
Watercooled= No
```

```
SET UNIT SPs      (7)
Reset Type= none
Max Reset = XX.X°F
StrtResetDT= XX.X°F
```

```
SET UNIT SPs      (8)
Soft Load= Off
Begin Capacity= XXX%
SoftLoadRamp= XXmin
```

Water-cooled:

```
SET UNIT SPs      (9)
Demand limit= Off
```

Air-cooled:

```
SET UNIT SPs      (9)
Demand limit= Off
LowOAT Operation=No
Low Amb Lock= XX.X°F
```

```
SET UNIT SPs     (10)
Ice Time Delay=XXhrs
Clear Ice Timer=No
```

```
SET UNIT SPs     (11)
Sensor Offset
Evap LWT= XX.X°F
Evap EWT= XX.X°F
```

Water-cooled:

```
SET UNIT SPs     (12)
Sensor Offset
Cond EWT= XX.X°F
Cond LWT= XX.X°F
```

Air-cooled:

```
SET UNIT SPs     (12)
Sensor Offset
OAT= XX.X°F
```

```
SET UNIT SPs     (13)
       CLOCK
     mm/dd/yyyy
     hh:mm  day
```

```
SET UNIT SPs     (14)
Units = °F/psi
Lang  = ENGLISH
```

After entering a valid manager password, selecting °F/psi will provide IP units; selecting °C/kPa will provide SI units.

```
SET UNIT SPs     (15)
Protocol=
Ident Number=
Baud Rate=
```

```
SET UNIT SPs     (16)
Enter Password:0000
 Active Password
 Level:none
```

Compressor Set Points

```
SET COMP SPs      (1)
Seq # Comp 1= X
Seq # Comp 2= X
```

```
SET COMP SPs      (2)
Max Comps On = x
Start-Start =XX min
Stop-Start =XX min
```

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 the default values of 5 minutes and 15 minutes not be changed. Max Comps On can be 1 or 2 with 2 being the default.

```
SET COMP SPs      (3)
Pumpdown
Pressure=  XX.X psi
Time Limit= XXX sec
```

```
SET COMP SPs      (4)
Light Load Stage
Down Point=XX% slide
Stg Up Delay= XX min
```

```
SET COMP SPs      (5)
Discharge Temp
 Sensor Type=PT1000
```

Alarm Set Points

```
SET ALARM LIMITS (1)
Low Evap Pressure
Hold=XX.Xpsi
Unload=XX.Xpsi
```

The LowEvPrHold (Low Evaporator Pressure Hold) and LowEvPrUnld (Low Evaporator Pressure Unload) have the same default value of 59 psi. 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.

The last action to take place is the shutoff of all compressors running when the LowEvPrStop setting is reached (default is 58 psi). Reducing these time intervals will increase detrimental compressor cycling. It is recommended that these settings not be changed.

```
SET ALARM LIMITS (2)
LowOilDelay= XXX sec
HighOilDpDel=XXX sec
```

Water-cooled:

```
SET ALARM LIMITS (3)
High Disc Temp=XXX°F
HighLift Delay=XXsec
```

Air-cooled

```
SET ALARM LIMITS (3
High Disc Temp=XXX°F
HighLift Delay=XXsec
LowOATStartTmr=XXsec
```

:

```
SET ALARM LIMITS (4)
Evap Freeze= XX.X°F
Evap Flow Proof=XXXs
Recirc Timeout=xxmin
```

Evap Freeze (the unit freeze protection shutdown) is actually a stop alarm and shuts off the unit when the LWT reaches 36°F. It is cleared by going to the CLEAR ALARM menu in the ACTIVE ALARM hierarchy.

Evap/Cond FlowProof is the flow switch interlock. Closing the flow switch, and therefore proving the existence of chilled water flow, resets this trip. It is recommended that these settings not be changed.

```
SET ALARM LIMITS (5)
Cond Freeze= XX.X°F
Cond Flow Proof=XXXs
```

Set Alarm Limits (5) is accessible only if unit is configured as water-cooled.

Tower Setpoints

Tower set points are only available when the unit is configured as water-cooled.

The MicroTech II controller is capable of controlling cooling tower water temperature on chillers using water-cooled condensers. Output wiring connection points are shown on the field wiring diagrams beginning on page 8.

[Water Cooled = Y] - Condenser Pump on with first Compressor on. Tower fan control is active when the Tower Control setpoint is set to Temperature and the condenser pump is in the RUN state. Staging is based on Entering Condenser Water Temperature (ECWT). Operation depends on the following parameters.

- Condenser pump state
- ECWT OR Lift pressure
- Stage up and stage down timer values
- Tower setpoints (Tower Control, Tower Stages, Stage Up Time, Stage Down Time, Stage Differential, Stage #1 ON, Stage #2 ON, Stage Down @, Stage Up @)

When the condenser pump starts, the stage up timer shall start. The first stage shall turn ON when the following conditions are met:

- The stage up timer completes
- The ECWT is > Stage #1 ON setpoint
- Bypass valve position is > the Stage Up @ setpoint (only if Valve/VFD Control setpoint = Valve Stage)

Additional stages can turn on (up to the number specified by the Tower Stages setpoint) when above conditions are met for the next stage plus the following condition:

- VFD Speed is > the Stage Up @ setpoint (only if Valve/VFD Control setpoint = VFD Stage OR Valve SP/VFD Stage)

Down staging shall occur when the following conditions are met:

- The stage down timer completes
- The ECWT is < Stage #X ON (Temp) setpoint – Stage Differential (Temp) setpoint point
- Bypass valve position is < the Stage Down @ setpoint (only if Valve/VFD Control setpoint = Valve Stage)
- VFD Speed is < the Stage Down @ setpoint (only if Valve/VFD Control setpoint = VFD Stage OR Valve SP/VFD Stage)

Each stage-up or stage-down event shall restart both the stage-up and stage-down timers. Only one fan output shall be switched at a time (except that all outputs switch OFF when the condenser pump state equals OFF).

```
SET TOWER SPs     (1)
Tower Control=None
Tower Stages= 2
```

When Tower Control is None, the control of condenser water temperature is not by the MicroTech II controller and assumed to be furnished elsewhere.

Tower Stages is the number of tower fans to be staged by the controller, choices are 0, 1, or 2. "0" indicates control will be by a bypass valve or variable speed pump controlled by the MicroTech II controller.

StageUP/DN imposes a time delay between fan stages when turning on or turning off.

```
SET TOWER SPs     (2)
Stage 1 On =XXX
Stage 2 On =XXX
StageDiff = XX.X
```

```
SET TOWER SPs     (3)
Stage Up Tmr= XX min
Stage Dn Tmr= XX min
Stage Up/Dn=XXX/XXX%
```

StageDiff is the number of degrees below the Stage ON that will turn off the tower fans. For example, if Stage ON #1 is 70°F and StageDiff is 5°F, tower fan #1 will stage off when the ECWT drops to 65°F and stage the fan on when the ECWT rises to 70°F. The same is true for fan #2.

Stage Up timer is the number of minutes that must elapse between the condenser pump starting (it starts with the unit) and fan #1 starting or the time between fan #1 starting and fan #2 starting.

StageDown is the elapsed time between staging down the fan motors.

```
SET TOWER SPs     (4)
Valve/VFD Control=
  None
Valve Type=NC to twr
```

Valve/VFD Control settings are None, Valve Setpoint, Valve Stage, VFD Stage, or ValveSP/VFDStage. Default is None which results in no control of the tower from the MicroTech II controller.

- Valve Setpoint, the valve will control (bypass tower) to hold the minimum temperature as established by the Set Tower SPs in screen number 5 shown on the following page.

  This mode is operational when the Valve/VFD Control setpoint is set to Valve Setpoint OR Valve SP/VFD Stage. In this mode the valve output is varied with a proportional-derivative (PD) algorithm (with deadband) in order to maintain the controlled parameter (CP) at the desired value. The output is always limited between the Valve Control Range (Min) setpoint and the Valve Control Range (Max) setpoint. A valve increment shall be computed once every 5 seconds according to the following equation. (Error Gain and Slope Gain are set in menu screen #8.)

Increment = [(Error) * (Error Gain setpoint)] + [(Slope) * (Slope Gain setpoint)]
Where: Error = ECWT – Valve Setpoint
Slope = (Present CP) – (Previous CP)

When the Error is > the Valve Deadband setpoint, the valve position analog output (% of full scale) is updated according to the following equation.

New %Position = Old %Position + Increment/10

- Valve Stage, controls from the fan stage setpoint in use. It is recommended that the Valve Setpoint method explained above be used rather than this mode.

  This mode is only operational when the Valve/VFD Control setpoint is set to Valve Stage. In this mode the valve output is controlled as for Valve Setpoint mode (above), except that the active setpoint for the controlled parameter is selected according to the following table.

# Of Fans ON	Active Setpoint
0	Valve Setpoint
1	Stage #1 ON
2	Stage #2 ON
3	Stage #3 ON
4	Stage #4 ON

- VFD Stage, ValveSP/VFDStage, When the Valve/VFD Control setpoint is set to None, Valve Setpoint, OR Valve Stage, this output is set to 0. Otherwise, it will be controlled in a manner identical to Valve Stage Mode (above) except that (1) it shall be kept at zero until the first fan stage is ON, and (2) the following setpoints do not apply.

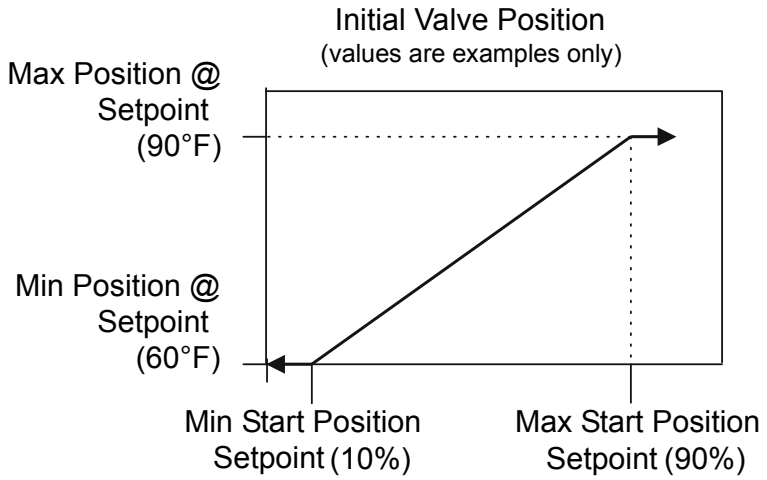
  Valve Control Range (Min)
  Valve Control Range (Max)
  Valve Type

Valve Type settings are NC (normally closed to tower) or NO (normally open).
These settings establish the operation of a tower bypass valve (must be a 3-way valve).

Initial Valve Position

When the condenser pump is not in the RUN state, the valve output shall be set as a function of entering condenser water temperature (ECWT) per the following graph.

Figure 12, Initial Valve Position



Operation After Start

When the condenser pump is in the RUN state, the valve output shall be controlled in one of two modes as specified by the Valve/VFD Control setpoint. The controlled parameter shall be the condenser entering water temperature. When the desired output signal varies from 0 to 100%, the output voltage shall vary as shown below.

0 to 10 VDC (Valve Type = NC)

10 to 0 VDC (Valve Type = NO)

```
SET TOWER SPs     (5)
Valve SP=XXX
Valve DB=XX.X
```

Valve SP is the minimum tower water temperature acceptable, default is 65°F.

Valve DB is the dead-band in degrees, default is 2.0°F.

```
SET TOWER SPs     (6)
Valve Start Position
 Min= XXX%  @XXX
 Max= XXX%  @XXX
```

The ValveStart position is the position of the valve when the unit starts. Default for minimum start position is 0%, and 100% for maximum position.

```
SET TOWER SPs     (7)
Valve Control Range
  Min= XXX%
  Max= XXX%
```

Defaults are 10% minimum and 90% maximum.

```
SET TOWER SPs     (8)
PD Control Loop
  Error Gain=XX
  Slope Gain=XX
```

Defaults are 25 for both error and slope.

Screen Definitions – TEST

```
TEST UNIT         (1)
Alarm Out=Off
Evap Pump 1= Off
Evap Pump 2= Off
```

```
TEST UNIT         (2)
Cond Pump 1= Off
Cond Pump 1= Off
```

```
TEST UNIT         (3)
```

```
Tower Fan 1= Off
Tower Fan 2= Off
```

```
TEST UNIT          (4)
Tower Bypass=   XXX.X
Tower VFD Spd= XXX.X
```

Circuit Controller

The display on the circuit controller displays information about the circuit that it is controlling. Setpoint availability will be limited to setpoints that are unique to that circuit. Other set points are changed at the Unit Controller.

Shortcut Menus

Pressing the Menu button at any time accesses these menus. The hierarchical structure of the shortcut menus is shown below.

LEVEL 1	LEVEL 2	LEVEL 3 (No. of Screens)
VIEW	UNIT	VIEW UNIT (1-2)
	CIR STATUS	VIEW CIR STATUS (1-9)
	REFRIGERANT	VIEW REFRIGERANT (1-7)
	FANS	VIEW FANS (1-2)
SET	COMPRESSOR SPs	SET COMP SPs (1-4)
	EXV SPs	SET EXV SPs (1-2)
	FAN SPs	SET FANS (1-6)
	SENSOR OFFSETS	SET SENSOR OFFSET (1-3)

Menu Matrix

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

VIEW UNIT (1)	VIEW CIR STATUS (1)	VIEW REFRG (1)	VIEW FANS (1)	SET COMP SPs (1)	SET EXV SPs (1)	SET FANS (1)	SET SENSOR OFFSETS (1)	TEST CIRCUIT (1)
VIEW UNIT (2)	VIEW CIR STATUS (2)	VIEW REFRG (2)	VIEW FANS (2)	SET COMP SPs (2)	SET EXV SPs (2)	SET FANS (2)	SET SENSOR OFFSETS (2)	TEST CIRCUIT (2)
	VIEW CIR STATUS (3)	VIEW REFRG (3)		SET COMP SPs (3)		SET FANS (3)	SET SENSOR OFFSETS (3)	TEST CIRCUIT (3)
	- - - -	- - - -		SET COMP SPs (4)		- - - -		TEST CIRCUIT (4)
	VIEW CIR STATUS (9)	VIEW REFRG (7)		SET STARTER SPs (3-8)		SET FANS (5)		

Screen Definitions – MENU

Top level menu:

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

View menu:

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

Fan data is available only when unit is configured as air-cooled.

Set menu:

```
SET  <COMPRESSOR SPs
     <        EXV SPs
     <        FAN SPs
     <SENSOR OFFSETS
```

Fan setpoints are available only when unit is configured as air-cooled.

Screen Definitions – VIEW

View Unit Status

Water cooled:

```
VIEW UNIT          (1)
{Unit status}
Evap pump = {State}
Cond pump = {State}
```

Air cooled:

```
VIEW UNIT          (1)
{Unit status}
Evap pump = {State}
```

Unit Status will display one of the following:

Auto	Off:Ice Mode Timer	Off:All Cir Disabled
Off:Unit Alarm	Off:Keypad Disable	Off:Remote Switch
Off:BAS Disable	Off:Unit Switch	Off:Test Mode
Auto:Wait for load	Auto:Cond Recirc	Auto:Evap Recirc
Auto:Wait Cond Flow	Auto:Wait Evap Flow	Auto:Pumpdown

Pump states include Off, Start, and Run. The condenser pump state is visible only for water-cooled operation.

```
VIEW UNIT          (2)
Evap LWT= XXX.X°F
Active SP= XX.X°F
LWT pulldn= XX.X°F/m
```

View Circuit Status

```
VIEW CIR STATUS   (1)
{Circuit Status}
Slide Pos= XXX.X%
Slide Target= XXX.X%
```

Circuit Status will display one of the following:

Off:Ready	Off:Cycle Timer	Off:Low OAT Lock
Off:Keypad Disable	Off:Pumpdown Switch	Off:Alarm
Off:Test Mode	EXV Preopen	Run:Pumpdown
Run:Normal	Run:LWT PullDn Limit	Run:Unit Cap Limit
Run:High LWT Limit	Run:Evap Press Low	Run:Lift Press High
Off:pLAN failure	Off:Stage Up Delay	

```
VIEW CIR STATUS  (2)
Hours  = XXXXX
Starts = XXXXX
KW Hours= XXXXXXX
```

A KW hours counter has been added to the Circuit control Circuit Status Screen. The KW Hours field will display up to 9,999,999 kW-Hours.

```
VIEW CIR STATUS  (3)
Current (amps)
 L1   L2   L3  Avg
XXX  XXX  XXX  XXX
```

```
VIEW CIR STATUS  (4)
Voltage
L1-2 L2-3 L3-1  Avg
XXX  XXX  XXX   XXX
```

```
VIEW CIR STATUS  (5)
PF= 0.XX  %RLA=XXX.X
KW=  XXX
KVA= XXX
```

```
VIEW CIR STATUS  (6)
   Digital Outputs
1 2 3 4 5 6 7 8 9 10
X X X X X X X X X X
```

Status will be “0” for OFF and “!” for ON.

```
VIEW CIR STATUS  (7)
Digital Outputs
11 12 13
 X  X  X
```

```
VIEW CIR STATUS  (8)
   Analog Outputs
    (volts X 100)
1=XXXX   3=XXXX
```

```
VIEW CIR STATUS  (9)
   Digital Inputs
   1 3 4 5 6 9
   X X X X X X
```

View Refrigerant

```
VIEW REFRIGERANT (1)
Evap Press=XXX.X psi
Cond Press=XXX.X psi

VIEW REFRIGERANT (2)
```

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

```
VIEW REFRIGERANT (3)
Suct Temp = XXX.X °F
Disc Temp = XXX.X °F
```

```
VIEW REFRIGERANT (4)
Suct SH=   XXX.X °F
Disc SH=   XXX.X °F
```

```
VIEW REFRIGERANT (5)
Evap Approach=XX.X°F
Cond Approach=XX.X°F
```

```
VIEW REFRIGERANT (6)
MaxCondSatT= XXX.X°F
EXV Ctrl=Superheat
SH target= XX.X°F
```

```
VIEW REFRIGERANT (7)
EXV Steps= XXXX
EXV ctrl range:
 XXXX - XXXX steps
```

View Fans

View Fans screens are only available when the unit is configured as air-cooled.

```
VIEW FANS        (1)
Fans Running= X
Stage Up Err= XXX
Stage Dn Err= XXX
```

```
VIEW FANS        (2)
Target Sat T=XXX.X°F
VFD Speed=XXX.X%
VFD Target=XX.X°F
```

Screen Definitions – SET

Compressor Set Points

```
SET COMP SPs     (1)
```

```
Clear Cycle Tmr= no
Comp Size= XXX
Max Slide= XXX.X %
```

```
SET COMP SPs      (2)
Circuit Mode=Enable
Slide Target= XXX.X%
Slide Control=auto
```

```
SET STARTER SPs   (3)
Motor FLA= XXX amps
Motor RLA= XXX amps
```

The starter set points are stored in permanent memory on the starter and the Circuit control set points will be reset to the values stored on starter when the Circuit control is powered up.

When the Circuit control is powered up the starter set points **MUST** be adjusted from the Circuit control.

Ground Fault Enable, Ground Fault Trip Level, Rated RMS Voltage and CT Ratio set points are **NOT** adjustable while the compressor is running.

```
SET STARTER SPs   (4)
Ground Fault=No
GF Trip Level= XXX%
```

EXV Set Points

```
SET EXV SPs       (1)
Manual EXV Pos= XXXX
EXV Control=auto
Service Pumpdown=No
```

```
SET EXV SPs       (2)
Preopen Timer=XXXsec
```

Sensor Offsets

```
SET SENSOR OFFSET(1)
Evap Press= XX.X psi
Cond Press= XX.X psi
```

```
SET SENSOR OFFSET(2)
Suct Temp= X.X °F
Disch Temp= X.X °F
```

```
SET SENSOR OFFSET(3)
Slide min pos= XX%
Slide max pos= XX%
```

```
  Slide Pos= XXX.X%
```

Fan Set Points

```
SET FAN SPs       (1)
Number of fans = X
Fan VFD = Enable
```

```
SET FAN SPs       (2)
Stg On Deadband(°F)
Stg1=XX.X  Stg2=XX.X
Stg3=XX.X  Stg4=XX.X
```

```
SET FAN SPs       (3)
Stg Off Deadband(°F)
Stg2=XX.X  Stg3=XX.X
Stg4=XX.X  Stg5=XX.X
```

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

```
SET FAN SPs       (5)
Cond Sat Temp Target
Max= XXX.X °F
Min= XXX.X °F
```

```
SET FAN SPs       (6)
# Fans On At Startup
 >75°F  >90°F  >105°F
   X      X      X
```

Screen Definitions – TEST

```
TEST CIRCUIT      (1)
Slide
Direction = Unload
Pulse = Off
```

```
TEST CIRCUIT      (2)
Oil Heater= Off
EXV Closed= Off
```

```
TEST CIRCUIT      (3)
EXV Position=XXXX
```

```
TEST CIRCUIT      (4)
Condenser Fans:
1=Off  2=Off  3=Off
4=Off  5=Off  6=Off
```

Editing Review

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

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

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

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

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

Alarms

When an alarm occurs, the alarm type, limit value (if any), date, and time are stored in the active alarm buffer corresponding to that alarm (viewed on the Alarm Active screens) and also in the alarm history buffer (viewed on the Alarm Log screens). The active alarm buffers hold a record of the last occurrence of each alarm and whether or not it has been cleared. The alarm can be cleared by pressing the Edit key. A separate buffer is available for each alarm (High Cond Pressure, Evaporator Freeze Protect, etc.). The alarm history buffer holds a chronological account of the last 25 alarms of any type.

Security

Two four-digit passwords provide OPERATOR and MANAGER levels of access to changeable parameters. Either password can be entered using the ENTER PASSWORD screen which can be accessed either through the SET OTHER menu or by simply pressing the ENTER key while on one of the SET screens. The password can then be entered by pressing the ENTER key, scrolling to the correct value with the UP and DOWN arrow keys, and pressing ENTER again. Once the correct password has been entered, the previously selected screen will reappear. Once a password has been entered, it will remain valid for 15 minutes after the last key-press.

BAS Interface

The MicroTech II controller is equipped with the Protocol Selectability™ feature, an exclusive McQuay feature that provides easy unit interface with a building automation system (BAS). If the unit will be tied into a BAS, the controller should have been purchased with the correct factory-installed interface module. The modules can also be added in the field during or after installation.

If an interface module was ordered, one of the following BAS interface installation manuals was shipped with the unit. Contact your local McQuay sales office for a replacement, if necessary or download from www.mcquay.com.

- IM 735, LONWORKS® Communication Module Installation
- IM 736, BACnet® Communication Module Installation
- IM 743, Modbus® Communication Module Installation
- ED 15062-0, MicroTech II Chiller Protocol Information – BACnet® and LONWORKS®
- ED 15063-0, MicroTech II Chiller Unit Controller Protocol Information – Modbus®

Unit Controller Setting

Settings are made in the unit controller. Set Unit Setpoints, Menu 1 is set to Source = Network. The specific protocol being used is set in Set Unit Setpoints, menu 15.

Connection to Chiller

Connection to the chiller for all BAS protocols will be at the unit controller. An interface card will have to be installed in the unit controller depending on the protocol being used.

NOTE:

In this revision (D), the starter electric data in the table below is now available to the Building Automation System at the unit control supervisor port:

Starter Parameter	Supervisor Type	Index Number
Compressor Average Amps	Analog Output	26
Compressor Kilowatts	Analog Output	27
Compressor Average Volts	Analog Output	29

Unit Troubleshooting Chart

⚠ WARNING

Troubleshooting can cause severe personal injury or death. Troubleshooting must be performed by trained, experienced technicians only.

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor Will Not Run	1. Main switch, circuit breakers open. 2. Fuse blown. 3. Thermal overloads tripped or fuses blown. 4. Defective contactor or coil. 5. System shut down by equipment protection devices. 6. No cooling required. 7. Liquid line solenoid will not open. 8. Motor electrical trouble. 9. Loose wiring.	1. Close switch 2. Check electrical circuits and motor winding for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected. 3. Overloads are auto reset. Check unit closely when unit comes back on line. 4. Repair or replace. 5. Determine type and cause of shutdown and correct it before resetting protection switch. 6. None. Wait until unit calls for cooling. 7. Repair or replace coil. 8. Check motor for opens, short circuit, or burnout. 9. Check all wire junctions. Tighten all terminal screws.
Compressor Noisy or Vibrating	1. Flooding of refrigerant into compressor. 2. Improper piping support on suction or liquid line. 3. Worn compressor.	1. Check superheat setting of expansion valve. 2. Relocate, add or remove hangers. 3. Replace.
High Discharge Pressure	1. Condenser water insufficient or temperature too high. 2. Fouled condenser tubes (water-cooled condenser). Clogged spray nozzles (evaporative condenser). Dirty tube and fin surface (air cooled condenser). 3. Noncondensables in system. 4. System overcharge with refrigerant. 5. Discharge shutoff valve partially closed. 6. Condenser undersized (air-cooled). 7. High ambient conditions.	1. Readjust temperature control or water regulating valve. Investigate ways to increase water supply. 2. Clean. 3. EPA purge the noncondensables. 4. Remove excess refrigerant. 5. Open valve. 6. Check condenser rating tables against the operation. 7. Check condenser rating tables against the operation.
Low Discharge Pressure	1. Faulty condenser temp. regulation. 2. Insufficient refrigerant in system. 3. Low suction pressure. 4. Condenser too large. 5. Low ambient conditions.	1. Check condenser control operation. 2. Check for leaks. Repair and add charge. 3. See corrective steps for low suction pressure below. 4. Check condenser rating table against the operation. 5. Check condenser rating tables against the operation.
High Suction Pressure	1. Excessive load. 2. Expansion valve overfeeding.	1. Reduce load or add additional equipment. 2. Check remote bulb. Regulate superheat.

Continued on next page.

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Low Suction Pressure	1. Lack of refrigerant. 2. Evaporator dirty. 3. Clogged liquid line filter-drier. 4. Expansion valve malfunctioning. 5. Condensing temperature too low. 6. Compressor will not unload. 7. Insufficient water flow.	1. Check for leaks. Repair and add charge. 2. Clean chemically. 3. Replace cartridge(s). 4. Check and reset for proper superheat. Replace if necessary. 5. Check means for regulating condensing temperature. 6. See corrective steps for failure of compressor to unload. 7. Adjust flow.
Little or No Oil Pressure	1. Clogged suction oil strainer. 2. Excessive liquid in crankcase. 3. Low oil level. 4. Flooding of refrigerant into crankcase.	1. Clean. 2. Check sump heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. 3. Add oil. 4. Adjust expansion valve.
Compressor Loses Oil	1. Lack of refrigerant. 2. Velocity in risers too low (A-C only). 3. Oil trapped in line.	1. Check for leaks and repair. Add refrigerant. 2. Check riser sizes. 3. Check pitch of lines and refrigerant velocities.
Motor Overload Relays or Circuit Breakers Open	1. Low voltage during high load conditions. 2. Defective or grounded wiring in motor or power circuits. 3. Loose power wiring. 4. High condensing temperature. 5. Power line fault causing unbalanced voltage. 6. High ambient temperature around the overload relay	1. Check supply voltage for excessive line drop. 2. Replace compressor-motor. 3. Check all connections and tighten. 4. See corrective steps for high discharge pressure. 5. Check Supply voltage. Notify power company. Do not start until fault is corrected. 6. Provide ventilation to reduce heat.
Compressor Thermal Switch Open	1. Operating beyond design conditions. 2. Discharge valve partially shut.	1. Add facilities so that conditions are within allowable limits. 2. Open valve.
Freeze Protection Opens	1. Thermostat set too low. 2. Low water flow. 3. Low suction pressure.	1. Reset to 42°F (6°C) or above. 2. Adjust flow. 3. See “Low Suction Pressure.”

All McQuay equipment is sold pursuant to McQuay's Standard Terms and Conditions of Sale and Limited Product Warranty. Consult your local McQuay Representative for warranty details. Refer to form 933-430285Y-00-A (09/08). To find your local representative, go to www.mcquay.com

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