Operation and Maintenance Manual	OMM 1136-1
	Group: Chiller
	Part Number: OMM1136-1
	Date: February 2014

TGZ Scroll Compressor Templifiers™

TGZ040B to TGZ190B, Packaged Water Heater

600 to 3100 MBH

R134a

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Manufactured in an **ISO Certified facility**

Introduction

General Description

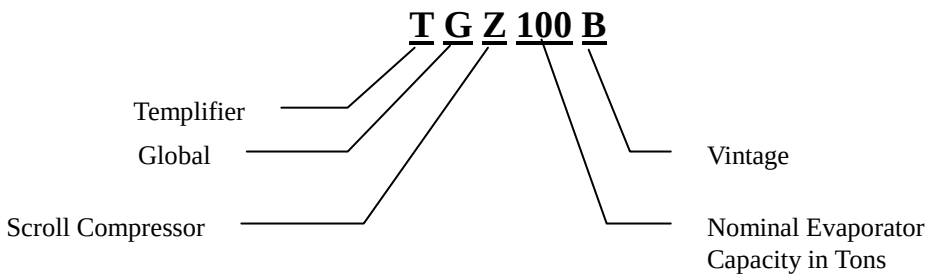
Daikin Type TGZ water heaters are scroll compressor refrigeration units that recover heat from warm fluid streams in the evaporator and deliver hot water, at a higher useful temperature, from the condenser to a heating load. They are designed for indoor installations only and are completely assembled, wired, charged and tested. Each unit consists of four or six (depending on unit size) scroll compressors, evaporators (brazed-plate on models 040 to 120 and shell-and-tube on models 150 to 190), shell-and-tube condenser/heater, and complete refrigerant piping.

There are two refrigerant circuits, each with manual liquid line shutoff valves, charging valves, filter-driers, liquid line solenoid valves, sight glass/moisture indicators, and expansion valves (thermal on TGZ040-120, electronic on TGZ150-190.

The electrical control center includes a MicroTech II control system and other components necessary for dependable automatic operation.

NOTE: Additional information not included in this manual, such as unit dimensions and weights, physical data, and performance data can be found in the Templifier *Catalog 614*.

Nomenclature



Water Pressure Drop

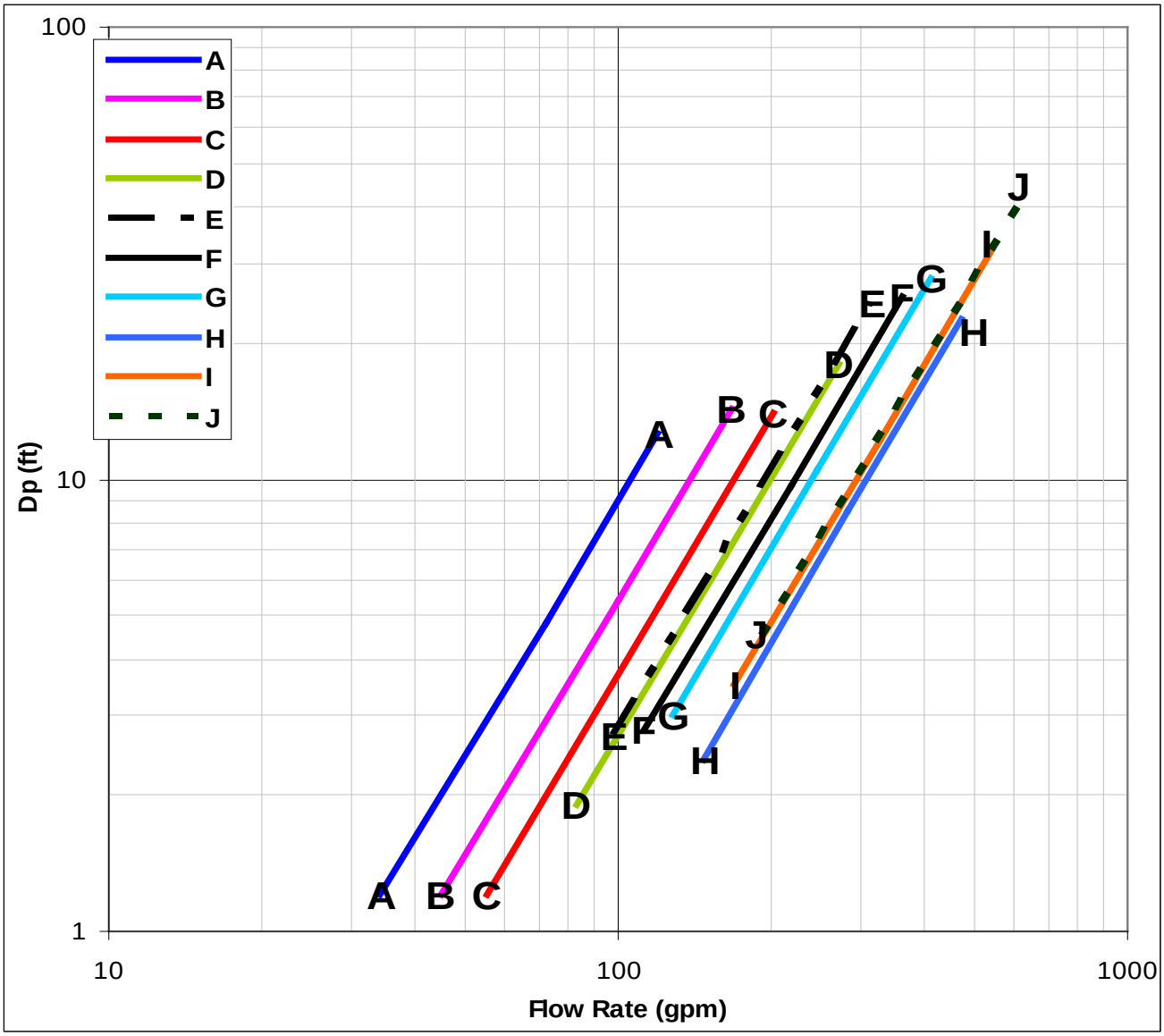
The vessel flow rates must fall between the minimum and maximum values shown on the appropriate evaporator and condenser curves on pages 4 through 6. Flow rates below the minimum values shown will result in laminar flow that will reduce efficiency, cause erratic operation of the expansion valve and could cause low temperature cutoffs. On the other hand, flow rates exceeding the maximum values shown can cause erosion on the evaporator water connections and tubes.

Measure the water pressure drop through the vessels at field installed pressure taps. It is important not to include valves or strainers in these readings.

The condenser flow rate will determine whether 2-pass or 4-pass condensers are used, according to the following table:

CONDENSER DELTA-T	PASSES	FLOW
10- to 20 Degrees F	2-Pass	High Flow Rate
20 to 40 Degrees F	4-Pass	Low Flow Rate

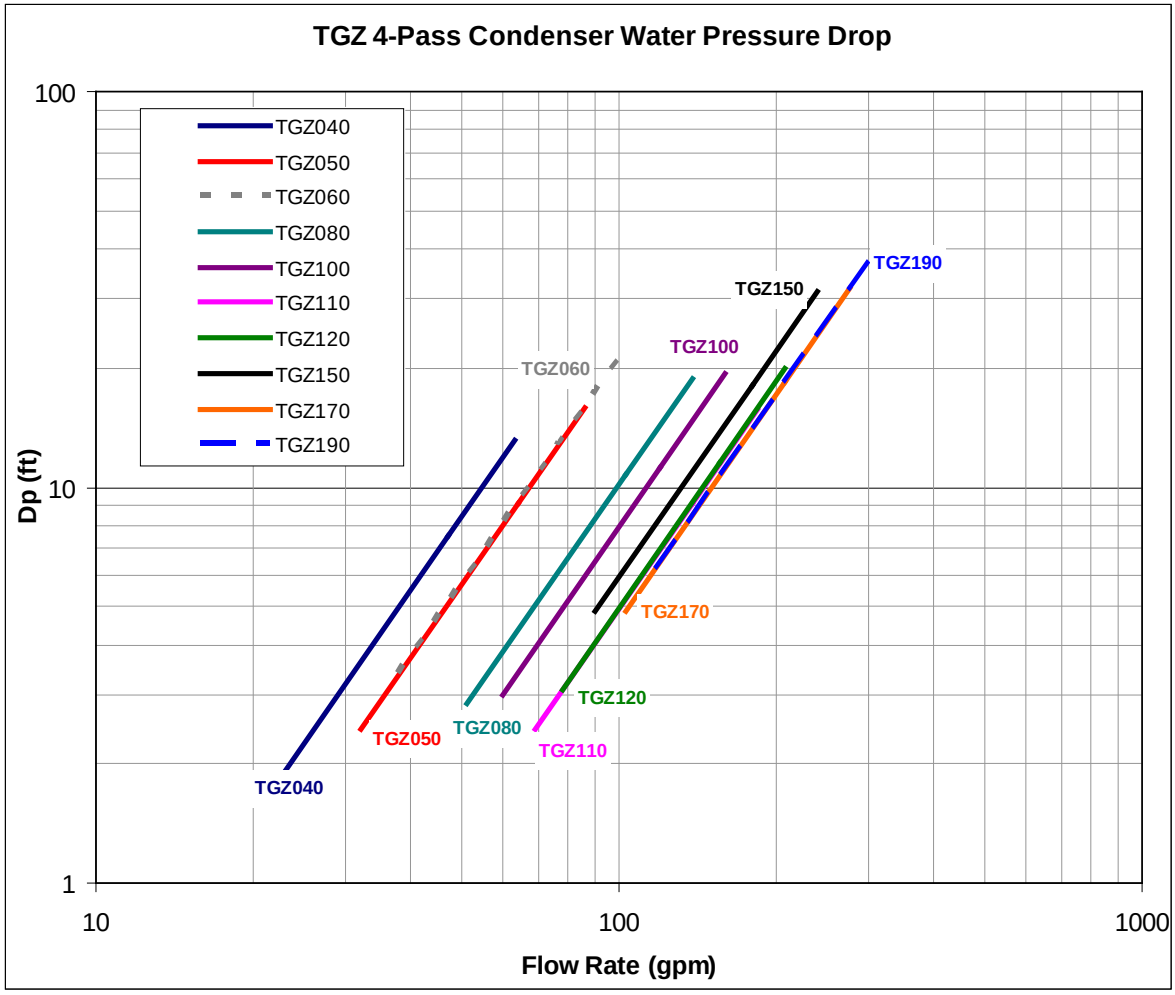
Figure 1, TGZ-B Evaporator Pressure Drop



Model	Evap. Model	Curve Ref	Minimum Flow & Pr. Drop				Nominal Flow & Pr. Drop				Maximum Flow & Pr. Drop			
			Inch-Pound		S.I.		Inch-Pound		S.I.		Inch-Pound		S.I.	
			GPM	Ft	L/S	kPa	GPM	Ft	L/S	kPa	GPM	Ft	L/S	kPa
TGZ040B	AC-500DQ-62H	**A**	34	1.2	2.1	3.4	72	4.8	4.5	14.4	120	12.7	7.6	37.9
TGZ050B	AC-500DQ-82H	**B**	45	1.2	2.8	3.5	100	5.4	6.3	16.1	167	14.3	10.5	42.8
TGZ060B	AC-500DQ-102H	**C**	55	1.2	3.5	3.5	121	5.3	7.6	15.8	202	14.0	12.7	42.0
TGZ080B	AC-500DQ-122H	**D**	83	1.9	5.2	5.7	162	6.8	10.2	20.3	270	18.0	17.0	53.7
TGZ100B	AC-500DQ-142H	**E**	98	2.7	6.2	8.0	189	9.3	11.9	27.8	315	24.6	19.9	73.4
TGZ110B	AC-500DQ-162H	**F**	113	2.8	7.1	8.2	218	9.6	13.8	28.7	363	25.3	22.9	75.6
TGZ120B	AC-500DQ-182H	**G**	128	3.0	8.1	9.1	246	10.5	15.5	31.4	410	27.7	25.9	82.9
TGZ150B	EV34191111/9	**H**	147	2.4	9.3	7.3	283	8.5	17.9	25.4	472	22.5	29.8	67.2
TGZ170B	EV34191212/7	**I**	169	3.5	10.7	10.5	326	12.2	20.6	36.5	543	32.2	34.3	96.2
TGZ190B	EV34191212/7	**J**	192	4.5	12.1	13.4	369	15.5	23.3	46.3	615	40.9	38.8	122.3

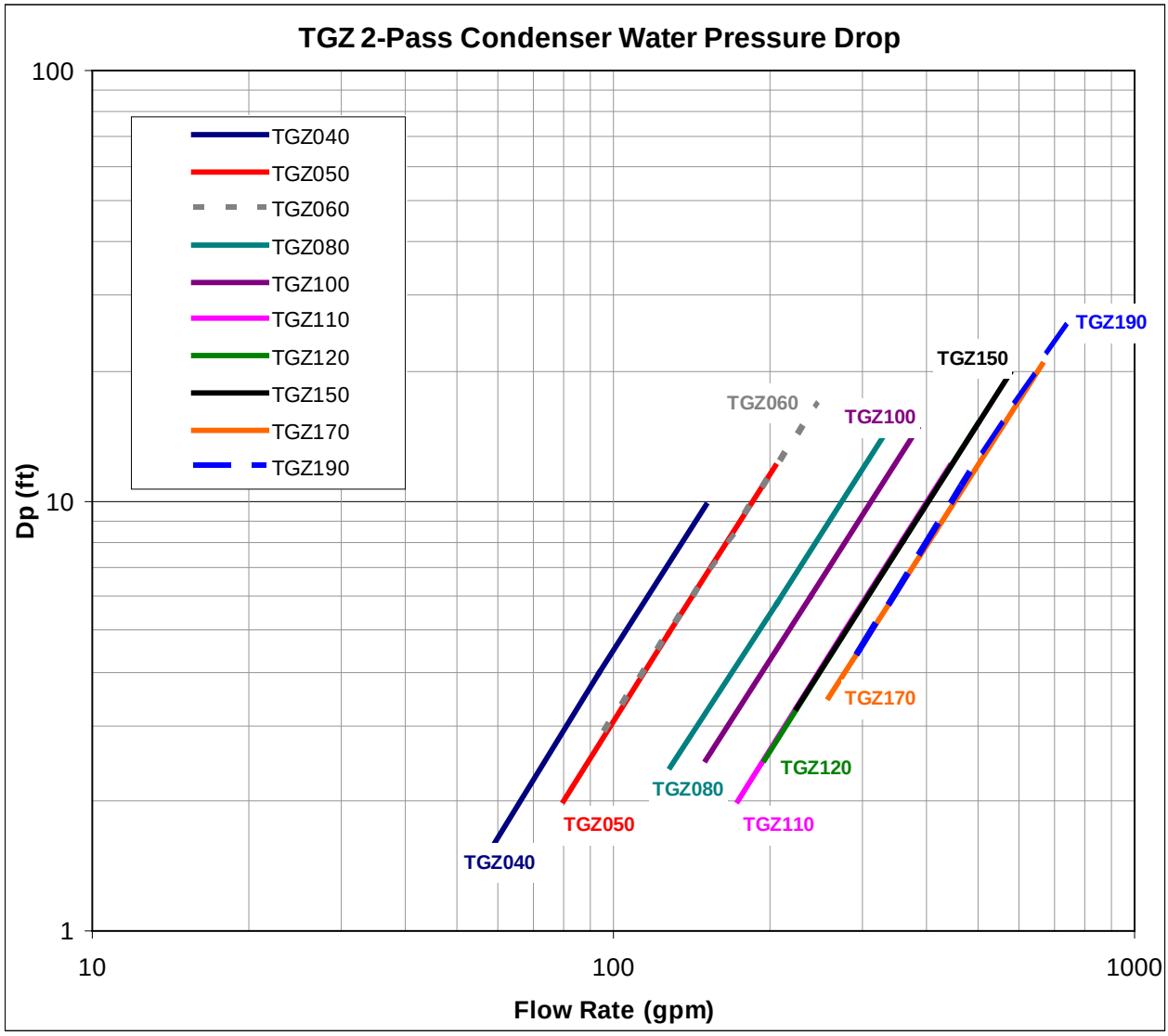
Note: Models 040B through 120B are 316 stainless steel brazed-plate DX evaporators. Models 150B through 190B are steel shell, copper tube DX evaporators.

Figure 2, Standard Four-pass Condenser Pressure Drop



TGZ-B UNIT MODEL	COND. MODEL	MINIMUM FLOW RATE				NOMINAL FLOW RATE				MAXIMUM FLOW RATE			
		INCH-POUND		S.I.		INCH-POUND		S.I.		INCH-POUND		S.I.	
		gpm	ft	L/s	kPa	gpm	ft	L/s	kPa	gpm	ft	L/s	kPa
TGZ040	C1010-62	23	1.93	1.45	5.77	47	7.5	3.0	22.4	63	13.1	4.0	39.1
TGZ050	C1010-62	32	2.44	2.02	7.29	64	9.1	4.0	27.2	86	16.0	5.4	47.7
TGZ060	C1010-76	38	3.40	2.40	10.16	77	13.0	4.9	38.9	103	22.6	6.5	67.5
TGZ080	C1410-112	51	2.84	3.22	8.49	103	10.8	6.5	32.3	138	18.8	8.7	56.3
TGZ100	C1410-128	60	3.00	3.79	8.97	120	11.2	7.6	33.5	160	19.3	10.1	57.8
TGZ110	C1610-164	69	2.44	4.35	7.29	138	9.1	8.7	27.2	184	15.7	11.6	47.0
TGZ120	C1610-164	78	3.08	4.92	9.21	156	11.5	9.8	34.4	208	19.9	13.1	59.4
TGZ150	C1612-164	90	4.85	5.68	14.50	180	18.1	11.4	54.1	240	31.3	15.1	93.4
TGZ170	C1612-184	103	4.89	6.50	14.60	207	18.4	13.1	55.0	276	31.8	17.4	95.0
TGZ190	C1612-184	117	6.24	7.38	18.66	234	23.3	14.8	69.6	312	40.2	19.7	120.3

Figure 3, Optional Two-pass Condenser



TGZ-B UNIT MODEL	COND. MODEL.	MINIMUM FLOW RATE				NOMINAL FLOW RATE				MAXIMUM FLOW RATE			
		INCH-POUND		S.I.		INCH-POUND		S.I.		INCH-POUND		S.I.	
		gpm	ft	L/s	kPa	gpm	ft	L/s	kPa	gpm	ft	L/s	kPa
TGZ040	C1010-62	59	1.6	3.7	4.9	94	4.0	5.9	12.0	150	9.8	9.5	29.3
TGZ050	C1010-62	80	2.0	5.0	6.0	128	4.9	8.1	14.6	205	12.0	12.9	35.8
TGZ060	C1010-76	96	2.9	6.1	8.5	154	7.0	9.7	20.9	246	17.0	15.5	51.0
TGZ080	C1410-112	129	2.4	8.1	7.1	206	5.8	13.0	17.3	330	14.2	20.8	42.3
TGZ100	C1410-128	150	2.5	9.5	7.3	240	6.0	15.1	17.9	384	14.7	24.2	43.8
TGZ110	C1610-164	173	2.0	10.9	6.0	276	4.9	17.4	14.6	442	12.0	27.9	35.8
TGZ120	C1610-164	195	2.5	12.3	7.6	312	6.2	19.7	18.5	499	15.1	31.5	45.3
TGZ150	C1612-164	225	3.3	14.2	9.9	360	8.1	22.7	24.2	576	19.8	36.3	59.1
TGZ170	C1612-184	259	3.5	16.3	10.4	414	8.5	26.1	25.4	662	20.8	41.8	62.1
TGZ190	C1612-184	293	4.4	18.5	13.2	468	10.8	29.5	32.3	749	26.4	47.2	78.8

Field Wiring Diagram

Figure 4, Field Wiring Diagram

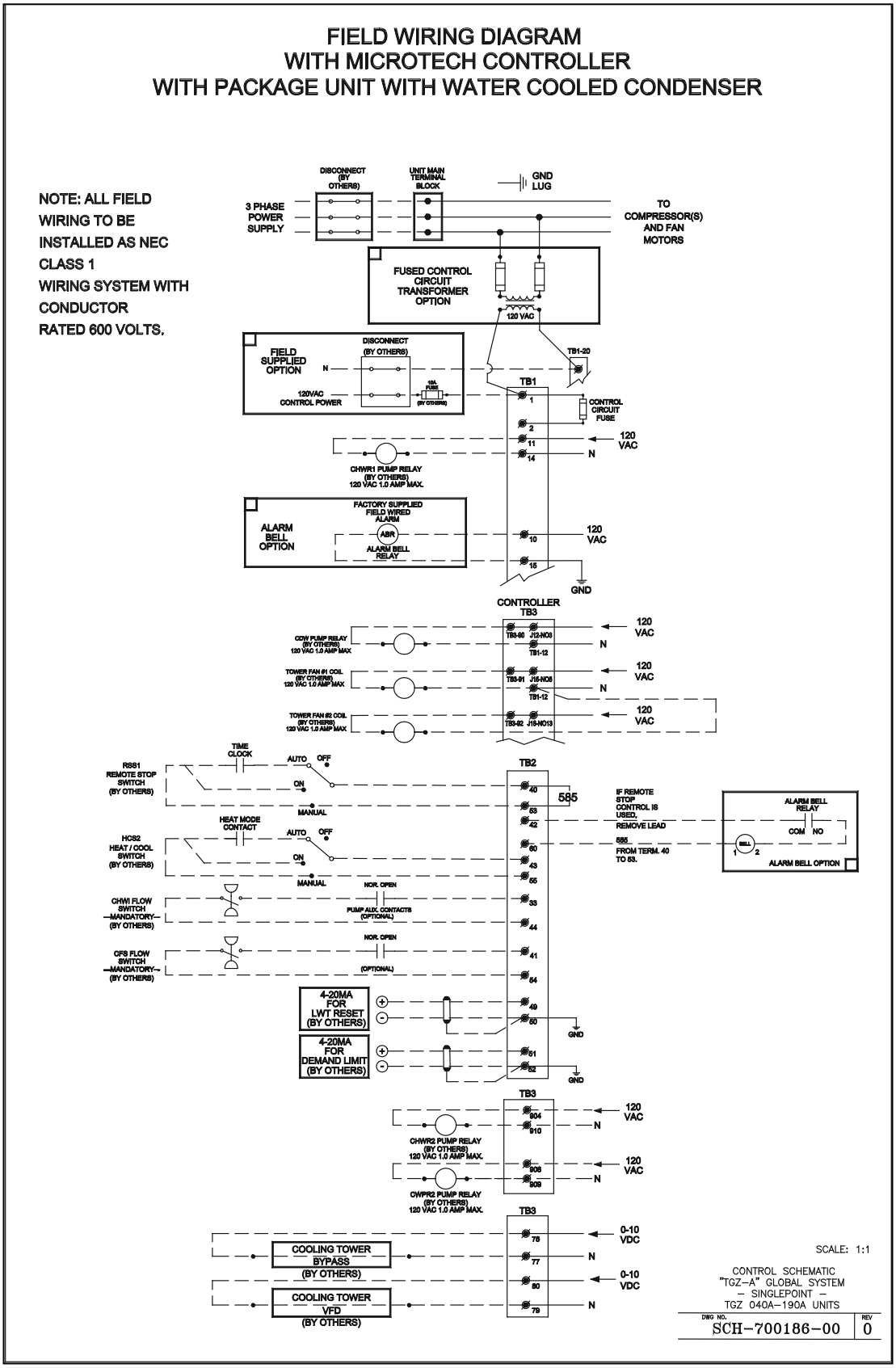
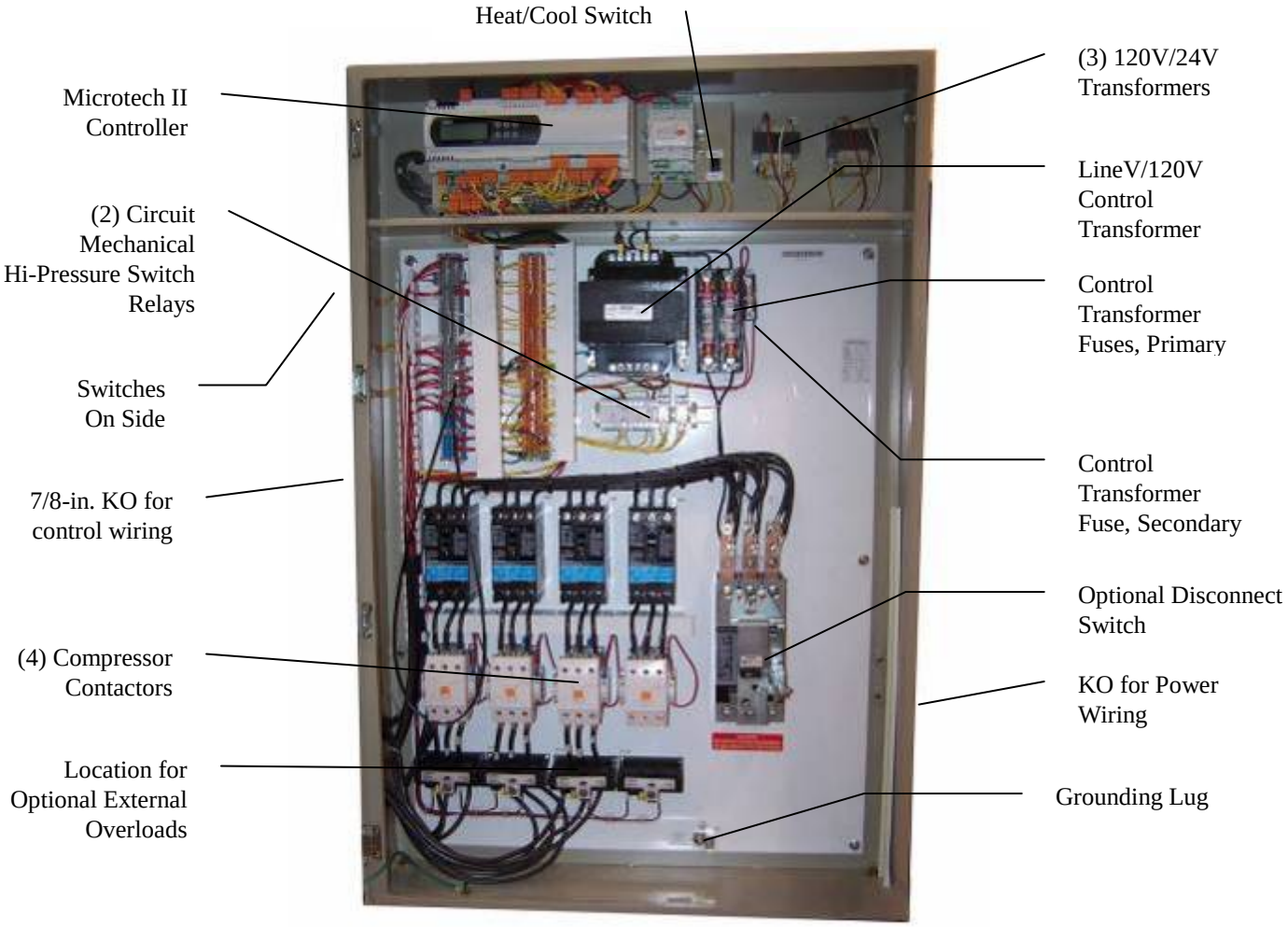


Figure 5, Control Center Layout



Start-Up and Shutdown

Pre Start-up

1. With main disconnect open, check all electrical connections in control panel and starter to be sure they are tight and provide good electrical contact. Although connections are tightened at the factory, they can have loosened enough in shipment to cause a malfunction.
2. Check and inspect all water piping. Make sure flow direction is correct and piping is made to correct connection on evaporator and condenser.
3. Open all water flow valves to the condenser and evaporator.
4. Flush the cooling tower (if one is in the system) and system piping to be sure the system is clean. Start source water pump and manually start hot water pump. 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 circuits should contain clean, non-corrosive water.
5. Check to see that the water temperature thermostat sensor is installed in the correct water line.
6. Making sure control stop switch S1 is open (off) and pumpdown switches PS1 and PS2 are on "manual pumpdown", move the main power and control disconnect switches to "on." This will energize crankcase heaters. Wait a minimum of 12 hours before starting up unit.
7. Check compressor oil level. The oil level should be at least one-third of the oil sightglass.
8. Check pressure drop across evaporator and condenser, and see that water flow is correct per the design flow rates and data on pages 4 through 6.
9. 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.
10. Make sure all wiring and fuses are of the proper size. Also make sure all interlock wiring is completed per Daikin diagrams.
11. Verify that all mechanical and electrical inspections by code authorities have been completed.
12. 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 suction and discharge shutoff valves until backseated. Replace valve caps.
2. Open the manual liquid line shutoff valve.
3. Check to see that the unit circuit breakers are in the "off" position.
4. Check to see that the pumpdown switches PS1 and PS2 are in the "manual pumpdown" position and the control system switch S1 is in the "off" position.
5. Check that the Heat/Cool Switch is in the correct position-Heat for straight water heating. Cool if the unit is to start in the cooling mode. See page 30for detailed instructions.
6. Place the main power and control circuit disconnects to the "on" position.
7. Verify crankcase heaters have operated for at least 12 hours. Crankcase should be warm.
8. Adjust the setpoint on the MicroTech controller to the desired hot water temperature.
9. Start the auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch and chilled water pump.
10. Check resets of all equipment protection controls.
11. Switch the unit circuit breakers to on.
12. Place pumpdown switch(es) PS1 and PS2 to "auto" for restart and normal operation.
13. Start the system by pushing the system switch S1 to on.
14. After running the unit for a short time, check the oil level in each compressor crankcase and check for flashing in the refrigerant sightglass.
15. After system performance has stabilized, it is necessary that the "Compressorized Equipment Warranty Form" (Form No. 206036A) be completed to obtain full warranty benefits. Be sure to list the pressure drop across both vessels. This form is shipped with the unit and after completion should be returned to the Daikin Service Department through your sales representative.

Weekend or Temporary Shutdown

Move pumpdown switches PS1 and PS2 to the “manual pumpdown” position.

Note: With the unit in this condition, it is capable of limited pumpdown. To defeat this mode of operation, simply move control system switch S1 to the “off” position.

⚠ CAUTION

The compressors must complete pump down before the water flow to the unit is interrupted to avoid freeze-up damage in the evaporator.

Start-up after Temporary Shutdown

1. Start the source water and hot water flow through the unit.
2. With the control system switch S1 in the “on” position, move the pumpdown switch(es) PS1 and PS2 to the “auto pumpdown” position.
3. Observe the unit operation for a short time, noting unusual sounds or cycling of compressors.

Extended Shutdown

1. Close the manual liquid line shutoff valves.
2. After the compressors have pumped down, stop or bypass the source water and hot water flow.
3. Turn off all power to the unit.
4. Move the control service switch S1 to the “off” position.
5. Close the suction and discharge shutoff valves on the compressor(s) and the liquid outlet valves at the condenser(s) or receiver(s).
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 and chilled water piping if the unit is to be shut down during the winter and exposed to below freezing temperatures. 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. Backseat the compressor suction and discharge valves. Always replace valve seal caps.
3. Open the manual liquid line shutoff valves.
4. Check circuit breakers. They must be in the “off” position.
5. Check to see that the pumpdown switches PS1 and PS2 are in the “manual shutdown” position and the control system switch S1 is in the “off” position.
6. Throw the main power and control circuit disconnects to the “on” position.
7. Allow the crankcase heaters to operate for at least 12 hours prior to start-up.
8. Start the source water flow and purge the water piping as well as the evaporator in the unit.
9. Start the auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch.
10. Adjust the setpoint on the MicroTech controller to the desired hot water temperature.
11. Check resets of all equipment protection controls.
12. Switch the unit circuit breakers to “on.”
13. Start the system by pushing the system switch S1 to “on.”

⚠ CAUTION

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

14. Place pumpdown switches PS1 and PS2 to the “auto pumpdown” position for restart and normal operation.
15. After running the unit for a short time, check the oil level in each compressor crankcase and for flashing in the refrigerant sightglass (see Maintenance section).

Sequence of Operation

The following sequence of operation is typical for TGZ Templifier models when in the heating mode. The sequence can vary slightly depending upon options.

Start-up/Compressor Staging (when compressors start and stop)

Stage Up Temperature (displayed on 'VIEW UNIT TEMP (3)' screen) is the Condenser Leaving Water Temperature by which the next compressor to start will stage up (start) after at least one compressor on the unit has started and is running.

Start Up Temperature (displayed on 'VIEW UNIT TEMP (3)' screen) is the Condenser Leaving Water Temperature by which the first compressor starts. The start up temperature equals the Stage Up Temperature minus the Start Delta Temperature set point. A higher Start Delta Temperature set point value will keep the unit off longer and reduce unit cycling at low loads. However, this high Start Delta Temperature set point will cause a larger excursion from the Active Heat Leaving Water Temperature set point before the unit starts. Stated another way, the Start Delta Temperature set point is the number of degrees *below* the Active Heat Leaving Water Temperature set point, minus ½ the Control Band, that determines when the *first* compressor starts. The Start Delta is in effect for only the first start after *all* compressors have been off. Additional compressor starts and stops are determined by the Condenser Leaving Water Temperature (LWT) with respect to the Control Band only. The Control Band is automatically set based upon the number of stages (compressors) for the unit. A four (4) compressor unit will have a Control Band that is 30% of the CondDeltaT set point. A six (6) compressor unit will have a Control Band that is 20% of the CondDeltaT set point.

The following sequence would occur for the settings shown below for a four compressor unit:

CondDelta T set point = 10.0°F

StartDelta set point = 5.0°F

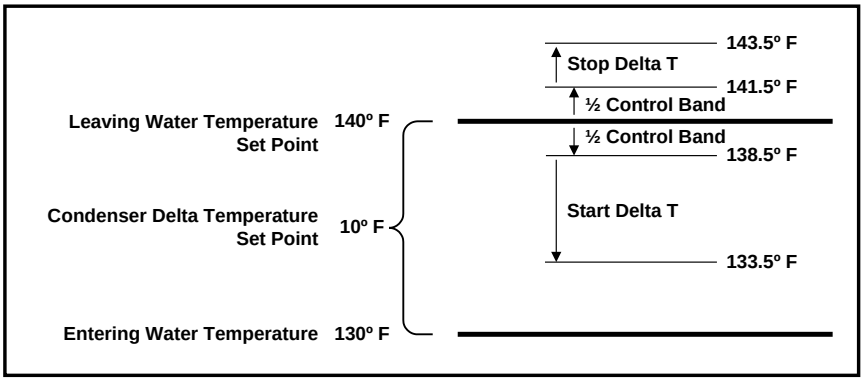
StopDelta set point = 2.0°F

Heat LWT set point = 140.0°F

The calculated Control Band will be 30% of 10ºF (Cond Delta T) which is 3ºF.

For a cold start-up (no compressors running), the first compressor will start at any temperature below 133.5°F. Each subsequent compressor will start after the Stage Up Timer has timed out and if the temperature is below the Control Band, 138.5°F in this case.

Figure 1, Staging/Starting Temperatures



If the

Condenser Leaving Water Temperature stays below 138.5°F, all three (or five) remaining compressors will eventually stage on after the Stage Up Timer times out between each stage. At some point, the Condenser Leaving Water Temperature will be rising and begin to approach the point when compressors should begin staging off, which is the Active Heat Leaving Water Temperature set point plus ½ of the Control Band, 141.5°F in this case.

If the Condenser Leaving Water Temperature remains above the Active Heat Leaving Water Temperature set point plus ½ Control Band and the Stage Down Timer times out, additional compressors will stage off. The *last* compressor will stage off when the Condenser Leaving Water Temperature raises above the Active Leaving Water Temperature set point plus ½ the Control Band plus the Stop Delta T. The Stop Delta T is in effect for only the last compressor running.

If the condenser leaving water temperature falls below 141.5°F, all running compressors will remain on. No compressor staging occurs within the Control Band. The next-on compressor will start when the condenser leaving water temperature drops below 138.5°F and the Stage Up Timer times out. In the example shown in Figure 7, the Shutdown Temp (last compressor off) would be 143.5°F.

Manual Compressor Disable Logic

Logic is available that allows the operator to manually enable and disable compressors. When a compressor is disabled, it is considered unavailable to start in the staging logic. This allows a damaged compressor to be taken offline while the remaining compressor can still provide some cooling

- The Compressor Disable set points are found on Compressor Set Points screens three and four.
- A running compressor cannot be disabled until it has been shutdown.
- If all of the compressors on a circuit are disabled, then the circuit will be disabled.
- If both circuits have all of their compressors disabled, the Unit State will remain Off

Automatic Pumpdown

TGZ units are equipped with single pumpdown control. When the last compressor running on either circuit is ready to shut off, the liquid line solenoid valve (LLSV) is closed first and the compressor continues to run until the pumpdown pressure is reached, at which time the compressor shuts off. The shut off pressure is set at 15 psi below the Low Evaporator pressure Unload setpoint.

When the first compressor on a circuit starts, the LLSV opens simultaneously.

Manual Pumpdown

When the Pumpdown Switch is in the pumpdown position all compressors except #1 and #2 will shut off. Then the Liquid Line and Hot Gas Bypass Valves will close. The operating compressor will pump out the refrigerant. When the Suction Pressure is at 40 psig, the compressors will stop.

Evaporator and Condenser Water Pumps

Most TGZ Templifier unit applications are not arranged to control the pumps from the TGZ MicroTech II control system. But if desired, the chiller MicroTech II controller can be programmed to start and stop the system evaporator and condenser water pumps. They may also be controlled by the BAS or manually. Programming directions and the sequence of operation can be found beginning on page 32.

TGZ Controller Software Version

This manual is based on software version WGZDU0102E. The “02E” is the version descriptor. This software is also used on the WGZ water chillers and is selected for Templifier operation through a setpoint selection. The software version installed in a unit can be viewed by pressing the MENU and ENTER keys simultaneously, then pressing MENU to return to the regular menu screen.

General Description

The MicroTech II controller’s design will not only permit the chiller to run more efficiently but will also simplify 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.

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

1) Current unit status

2) Control parameters (setpoints)

3) Alarms.

Security protection prevents unauthorized changing of the setpoints and control parameters

The MicroTech II controller continuously performs self-diagnostic checks, monitoring all system temperatures, pressures and protection devices, and will automatically shutdown a compressor, a refrigerant circuit or the entire unit should a fault occur. The cause of the shutdown and date stamp is 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 chiller controller also provides the operator with a warning of pre-alarm conditions.

Staging

The four scroll (or six) compressors are staged on and off as a function of leaving hot water temperature in the Heating Mode or leaving evaporator water temperature in the Cooling Mode, number of starts and number of run-hours. See Sequence of Operation on page 11.

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-limit condition. Shut down 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.

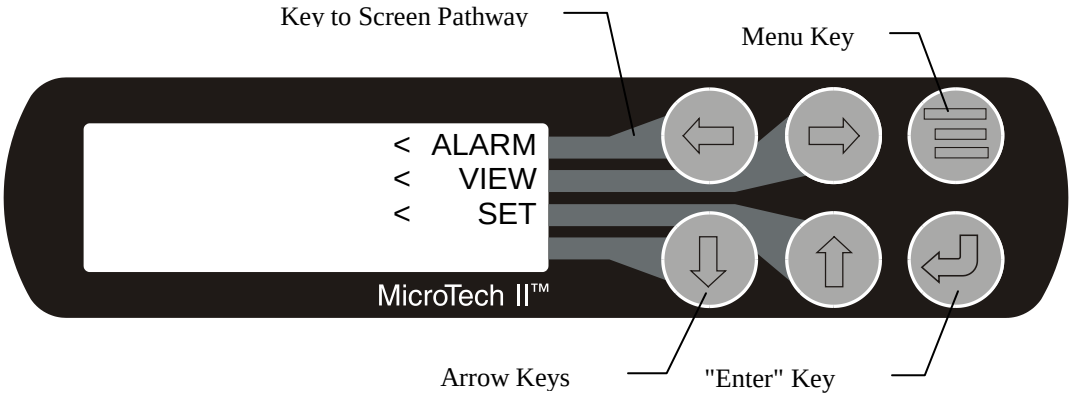
Unit Mode Selection

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 the unit 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 abbreviation on the right side of the display (this mode is entered by pressing the ENTER key).

Inputs and Outputs

The main controller used in the TGZ may have an expansion module for additional outputs on some unit configurations. The software is designed for use with WGZ R-410a water chillers as well as TGZ R-134a Templifier units. The setpoint selection of the type of refrigerant (R-134a) is made at the factory and sets certain inputs and outputs.

Table 1, Analog Inputs

The following parameters are analog inputs to this controller.
Type: C1 = Refrigerant Circuit #1, C2 = Refrigerant Circuit #2, UT = Unit

#	Description	Type	Signal Source	Range
*1	Evaporator Refrigerant Pressure #1	C1	0.1 to 0.9 VDC	0 to 132 psi
*2	Evaporator Refrigerant Pressure #2	C2	0.1 to 0.9 VDC	0 to 132 psi
*3	Condenser Refrigerant Pressure #1	C1	0.1 to 0.9 VDC	3.6 to 410 psi
4	Leaving Evaporator Water Temperature	UT	NTC Thermister (10k@25°C)	-58 to 212°F
5	Condenser Entering Water Temperature	UT	NTC Thermister (10k@25°C)	-58 to 212°F
*6	Condenser Refrigerant Pressure #2	C2	0.1 to 0.9 VDC	3.6 to 410 psi
7	Reset of Leaving Water Temperature	UT	4-20 mA Current	0-(10 to 80°F)
*8	Condenser Leaving Water Temperature	UT	NTC Thermister (10k@25°C)	-58 to 212°F
9	Compressor Suction Temperature #1	C1	NTC Thermister (10k@25°C)	-58 to 212°F
10	Compressor Suction Temperature #2	C2	NTC Thermister (10k@25°C)	-58 to 212°F

Table 2, Analog Outputs

The following parameters are analog outputs from this controller.

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

Table 3, Digital Inputs

The following parameters are digital inputs to this controller.
C1 = Refrigerant Circuit #1, C2 = Refrigerant Circuit #2, UT = Unit, & *n = Refrigerant Dependent

#	Description	Type	Signal	Signal
1	Unit OFF Switch	UT	0 VAC (Stop)	24 VAC (Auto)
2	Pump Down Switch #1	C1	0 VAC (Stop)	24 VAC (Start)
3	Evaporator Water Flow Switch	UT	0 VAC (No Flow)	24 VAC (Flow)
*4	Open			
5	Open			
6	Pump Down Switch #2	C2	0 VAC (Stop)	24 VAC (Start)
*7	Open			
*8	Condenser Water Flow Switch	UT	0 VAC (No Flow)	24 VAC (Flow)

Continued on next page.

Table 3, Digital Inputs, Continued

#	Description	Type	Signal	Signal
9	Phase Voltage Fault #1 (See Note 1 Below)	C1	0 VAC (Fault)	24 VAC (No Fault)
10	Phase Voltage Fault #2 (See Note 1 Below)	C2	0 VAC (Fault)	24 VAC (No Fault)
11	Ground Fault Prot. #1 (See Note 2 Below)	C1	0 VAC (Fault)	24 VAC (No Fault)
12	Ground Fault Prot. #2 (See Note 2 Below)	C2	0 VAC (Fault)	24 VAC (No Fault)
13	Remote Start/Stop	UT	0 VAC (Stop)	24 VAC (Start)
*14	Open			
*15	Motor Protection #1	C1	0 VAC (Fault)	24 VAC (No Fault)
*16	Motor Protection #2	C2	0 VAC (Fault)	24 VAC (No Fault)
17	Ice Mode Switch	UT	0 VAC (Normal)	24 VAC (Ice)
18	Heat Mode Switch	UT	0 VAC (Normal)	24 VAC (Heat)

Notes:

1. See Safety Alarms Table for “Phase Voltage Protection”. Units with single point electrical connection will have one PVM with Inputs 9 and 10 wired together. Units with multiple point connection will have two PVM’s with Input 9 for Electrical Circuit #1 and Input 10 for Electrical Circuit #2.

2. See Safety Alarms Table for “Ground Fault Protection”. Units with single point electrical connection will have one GFP with Inputs 11 and 12 wired together. Units with multiple point connection will have two GFP’s with Input 11 for Electrical Circuit #1 and Input 12 for Electrical Circuit #2.

Table 4, Digital Outputs

The following parameters are digital outputs from this controller.
C1 = Refrigerant Circuit #1, C2 = Refrigerant Circuit #2, UT = Unit, & *n = Refrigerant Dependent

#	Description	Type	Load	Output OFF	Output ON
1	Alarm	C1,C2, UT	Alarm Indicator	Alarm OFF	Alarm ON
2	Evaporator Water Pump	UT	Pump Contactor	Pump OFF	Pump ON
3	Condenser Water Pump – Water Cooled = Y	C1 / UT	Fan Contactor/ Pump Contactor	Fan OFF	Fan ON
4	Motor Control Relay #1 = Compr#1	C1	Starter	Compressor OFF	Compressor ON
5	Motor Control Relay #3 = Compr#3	C1	Starter	Compressor OFF	Compressor ON
*6	Motor Control Relay #5 = Compr#5	C1	Starter	Compressor OFF	Compressor ON
7	Liquid Line #1	C1	Solenoid	Cooling OFF	Cooling ON
8	Tower Fan #1-Water Cooled=Y	C2 /UT	Fan Contactor	Fan OFF	Fan ON
9	Motor Control Relay #2 = Compr#2	C2	Starter	Compressor OFF	Compressor ON
10	Motor Control Relay #4 = Compr#4	C2	Starter	Compressor OFF	Compressor ON
*11	Motor Control Relay #6 = Compr#6	C2	Starter	Compressor OFF	Compressor ON
12	Liquid Line #2	C2	Solenoid	Cooling OFF	Cooling ON
13	Condenser Fan #3	C1	Fan Contactor	Fan OFF	Fan ON
14	Hot Gas Bypass #1	C1	Solenoid	Cooling OFF	Cooling ON
15	Hot Gas Bypass #2	C2	Solenoid	Cooling OFF	Cooling ON
*16	Condenser Fan #4 (R134a)	C2	Fan Contactor	Fan OFF	Fan ON
*17	Condenser Fan #5&7 (R134a)	C1	Fan Contactor	Fan OFF	Fan ON
18	Condenser Fan #8	C2	Fan Contactor	Fan OFF	Fan ON
18	Condenser Fan #6&8	C2	Fan Contactor	Fan OFF	Fan ON

Expansion I/O Controller

Table 5, Digital Outputs

The following parameters are digital outputs from this controller.
Types: C1 = Refrigerant Circuit #1, C2 = Refrigerant Circuit #2, & UT = Unit

#	Description	Type	Output Off	Output On
1	Evap Water Pump Output #2	UT	Pump Off	Pump On
2	Cond Water Pump Output #2	UT	Pump Off	Pump On
3	Condenser Fan #9	C1	Fan OFF	Fan ON
4	Condenser Fan #10	C2	Fan OFF	Fan ON

Table 6, Analog Inputs

The following parameters are digital outputs from this controller.
Types: C1 = Refrigerant Circuit #1, C2 = Refrigerant Circuit #2, & UT = Unit

#	Description	Type	Output Off	Output On
1	Entering Evaporator Water Temperature	UT	NTC Thermister (10k@25°C)	-58 to 212°F
2	Demand Limit	UT	4-20 mA Current	0-100 % Load
3	Liquid Line Temperature #1	C1	NTC Thermister (10k@25°C)	-58 to 212°F
4	Liquid Line Temperature #2	C2	NTC Thermister (10k@25°C)	-58 to 212°F

Setpoints

The following parameters are 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 level that must be active in order to change the setpoint. Passwords are as follows:

O = Operator [0100] M = Manager [2001]

Table 7, Setpoints

Description	Default	Range	PW
Unit Enable	Off	Off, On	O
*Unit Mode	Cool	Cool, Cool w/Glycol, Heat Test	O
Control source	Switches	Keypad, Network, Switches	O
*Available Modes (R134a)	Cool	Cool, Cool w/Glycol, Heat, Test Cool/Heat, Cool/Heatw/Glycol, Heatw/Glycol	M
Evap LWT	44. 0 °F	40.0 to 60.0 °F, No Glycol 20.0 to 60.0, With Glycol:°	O
Heat LWT	110.0°F	110.0 to 165.0°F	
Evap LWT sensor offset	0.0	± 5.0 degrees F	O
Cond LWT sensor offset	0.0	± 5.0 degrees F	O
Evap EWT sensor offset	0.0	± 5.0 degrees F	O
Cond EWT sensor offset	0.0	± 5.0 degrees F	O
Evap Delta T	10.0 °F	6.0 to 16.0 °F	O
Cond Delta T			O
Startup Delta T	10.0 °F	1.0 to 15.0 °F	O
Stop Delta T	0.5 °F	0 to 3.0 °F	O
Max Pulldown Rate	1.0 °F	0.5 to 5.0 °F	M
Max Rate (R134a)	1.0 ºF	0.5 to 5.0 ºF	M
Evap Recirculate Timer	30	15 to 300 seconds	M

Continued next page.

Table 7, Setpoints, Continued

Description	Default	Range	PW
Evap Pump	#1 Only	#1 Only, #2 Only, Auto, #1 Prim, #2 Prim	M
Cond Delta T	10.0 ºF	5.0 to 40.0 ºF	O
Cond Pump Recirculate Timer	30	15 to 90 seconds	M
Cond Pump	#1 Only	#1 Only, #2 Only, Auto, #1 Prim, #2 Prim	M
Demand Limit	Off	Off, On	M
Hot Gas Delay Time	30 seconds	30 to 180 seconds	M
BAS Protocol	Modbus	BACnet, LonWorks, Modbus	M
Ident number	001	000-200	M
Baud rate	9600	1200,2400,4800,9600,19200	M
Units	F/psi	F/psi (only)	
Language	English	English (only)	
* Refrigerant Select	None	R134a,R22, R407C,R410A	
Cooling Reset Type	None	None, 4-20mA, [Return(Refrig = R134a only)]	O
Cooling Maximum Reset	10 ºF	0 to 16 ºF	O
Cooling Start Reset Delta T	10 ºF	0 to 16 ºF	O
Heating Reset Type	None	None, 4-20mA, Return	O
Heating Maximum Reset	10 ºF	0 to 40 ºF	O
Heating Start Reset Delta T	10 ºF	0 to 40 ºF	O
Compressor			
# of Compressors	4	4, 6	M
Clear Cycle Tmr	Off	On/Off	M
Stage Up Delay	240 seconds	120 to 480 seconds	M
Stage Down Delay	30	20 to 60 sec	M
Start-Start	15 min	10 to 60 min	M
Stop-Start	5 min	3 to 20 min	M
Expansion Valve Type, Thermal for TGZ040-120, Electronic for TGZ150-190	Thermal	Thermal, Electronic	M
Circuit 1 EXV Control	Auto	Auto, Manual	M
Circuit 1 EXV Position	N/A	0-100%	M
Circuit 2 EXV Control	Auto	Auto, Manual	M
Circuit 2 EXV Position	N/A	0-100%	M
Alarms			
Low Evap Pressure-Hold	See Table 8 and Table 9	See Table 8 and Table 9	M
Low Evap Pressure-Unload			M
High Cond Pressure – Unload			M
High Cond Pressure – Stop			M
Evap. Freeze	38.0 °F	w/water 37 to 42 °F w/glycol: 12.5 to 42.0 °F	M
Cond. Freeze	34.0 °F	18 to 42 °F	M
High Condenser Pressure Stop	185 psi	170 to 425 psi	M
Evap Flow Proof	5 seconds	5 to 15 seconds	M
Cond Flow Proof	5 seconds	5 to 15 seconds	M
Recirc Timeout	3 minutes	1 to 10 minutes	M
* Phase Voltage Protection	N	N,Y	M
* Ground Fault Protection	N	N,Y	M
Cooling Tower TGZ in Cooling Mode			
Tower Control	None	None, Temperature	M
Tower Stages	2	0 to 2	M

Continued next page.

Table 7, Setpoints, Continued

Description	Default	Range	PW
Stage Up Time	2 min	1 to 60 min	M
Stage Down Time	5 min	1 to 60 min	M
Stage Differential	3.0 °F	1.0 to 10.0 °F	M
Stage #1 On	70 °F	40 to 120 °F	M
Stage #2 On	75 °F	40 to 120 °F	M
Valve/VFD Control	None	None, Valve Set point, Valve Stage, VFD Stage, Valve SP/VFD Stage	M
Valve Setpoint	65 °F	60 to 120 °F	M
Valve Deadband	2.0 °F	1.0 to 10.0 °F	M
Stage Fan Down @	20%	0 to 100%	M
Stage Fan Up @	80%	0 to 100%	M
Valve Control Range (Min)	10%	0 to 100%	M
Valve Control Range(Max)	90%	0 to 100%	M
Valve Type	NC to tower	NC, NO	M
Minimum Start Position	0%	0 to 100%	M
Minimum Position @	60 °F	0 to 100 °F	M
Maximum Start Position	100%	0 to 100%	M
Maximum Position @	90 °F	0 to 100 °F	M
Error Gain	25	10 to 99	M
Slope Gain	25	10 to 99	M

*Set at Daikin factory.

Table 8, Automatic Adjusted Limits

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

For Evaporator Leaving Water Temperature (not applicable)

Mode	Refrigerant Type	Range
Unit Mode = Cool	R134a, R22, R407c, R410a	40 to 60°F
Unit Mode = Cool w/Glycol	R134a, R22, R407c	20 to 60°F

For Condenser Leaving Water Temperature

Mode	Refrigerant Type	Range
Unit Mode=HEAT	R134a	110 to 160ºF

Evaporator Freeze Temperature

Mode	Refrigerant Type	Range
Unit Mode = Cool	R134a,R22, R407c, R410a	36 to 42°F
Unit Mode = Cool w/Glycol, Ice w/Glycol	R134a,R22, R407c	18 to 42°F

Low Evaporator Pressure Inhibit Loading and Unloading

Mode	Refrigerant Type	Range
Unit Mode = Cool	R134a	26 to 54 psi
Unit Mode = Cool w/Glycol, Ice w/Glycol	R134a	12 to 54 psi

Table 9, Dynamic Defaults (Refrigerant Dependent)

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

Defaults

Set Point	Refrigerant Type
	R134a
Low Evaporator Pressure Hold	29 psi
Low Evaporator Pressure Unload	28 psi
High Condenser Pressure Unload	170 psi
High Condenser Pressure	185 psi

Events & Alarms

Protection (Shutdown) Alarms

Equipment protection alarms trigger a rapid compressor shutdown. The following section identifies each equipment protection alarm, gives the trigger that causes the alarm to occur, states the action taken because of the alarm and reset method. Most equipment protection alarms require a manual reset. These alarms will energize a remote alarm if the unit is so wired in the field.

Alarms and Events

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

Unit Stop Alarms

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

Evaporator Flow Loss

Alarm description (as shown on screen): Evaporator Flow Loss

Trigger:

1: Evaporator Pump State = Run AND Evaporator Flow Digital Input = No Flow for time > Evap 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 AND Evaporator Flow Digital Input = No Flow.

Action Taken: Rapid stop all circuits.

Reset:

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

If active via trigger condition 1:
When the alarm occurs due to this trigger, it can auto reset the first two times each day, with the third occurrence being manual reset.

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

If active via trigger condition 2:
If the flow loss alarm has occurred due to this trigger, it is always a manual reset alarm.

Condenser Flow Loss

Alarm description (as shown on screen): Condenser Flow Loss
Trigger:
1: Condenser Pump State = Run AND Condenser Flow Digital Input = No Flow for time > Cond 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 AND Condenser Flow Digital Input = No Flow.
Action Taken: Rapid stop all circuits.
Reset:
This alarm can be cleared at anytime 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 condenser pump 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 pump 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.

Low Evaporator Pressure

Alarm description (as shown on screen): Evap Press Low Cir N
Trigger: [Circuit State = Run AND Freezestat trip AND Low OAT Start not active]
OR Evaporator Press < Absolute Low Pressure Limit AND Circuit State = Run
The absolute low pressure limit is 5 psi with R134a, R22, and R407C refrigerants and 20 psi with R410A refrigerant.

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

Freeze error = Low Evaporator Pressure Unload – Evaporator Pressure
Freeze time =
[60 – 2.7 x freeze error] with R134a refrigerant, limited to a range of 20-60 seconds
[60 – 1.6 x freeze error] with R22 and R407C refrigerant, limited to a range of 20-60 seconds
[60 – freeze error] with R410A refrigerant, limited to a range of 20-60 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 'Evap Press Low Cir N' alarm 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 keypad if the evaporator pressure is above the absolute low-pressure limit.

High Condenser Pressure

Alarm description (as shown on screen): Cond Press High Cir N
Trigger: Condenser Pressure > High Condenser Pressure Set Point
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the keypad.

Mechanical High Pressure/Motor Protect

Alarm description (as shown on screen): MHP or Motor Prot N
Trigger: MHP/MP input is low and over 150 seconds lapsed since controller boot-up
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the keypad if the MHP/MP input is high.

Phase Voltage Protection

Alarm description (as shown on screen): Phase/Voltage Cir N
Trigger: PVM input is low and Phase Voltage set point = enable.
Action Taken: Rapid stop circuit
Reset: Auto reset when PVM input is high

Ground Fault Protection

Alarm description (as shown on screen): Ground Fault Cir N
Trigger: GFP input is low and Ground Fault set point = enable.
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the keypad.

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

Leaving Evaporator Water Temperature Sensor Fault

Alarm description (as shown on screen): Evap LWT Sens Fault
Trigger: Sensor shorted or open
Action Taken: Normal stop all circuits
Reset: This alarm can be cleared manually via the keypad if the sensor is back in range.

Leaving Condenser Water Temperature Sensor Fault

Alarm description (as shown on screen): CondLWT Sens Fault
Trigger: Sensor shorted or open AND TGZ unit (refrig = R134a) AND operating in 'heat' mode.
Action Taken: Normal stop all circuits
Reset: This alarm can be cleared manually via the keypad if the sensor is back in range.

Suction Temperature Sensor Fault

Alarm description (as shown on screen): SuctT Sensor Fail N
Trigger: Sensor shorted or open AND Expansion Valve Type = Thermostatic
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the keypad if the sensor is back in range.

Evaporator Pressure Sensor Fault

Alarm description (as shown on screen): EvapP Sensor Fail N
Trigger: Sensor shorted or open. If failing high (open), logic has been added that requires the Leaving Evaporator Temperature to be below 75°F. This will prevent nuisance trips due to conditions where the evaporator water temperature is high which could cause false alarms.
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the keypad if the sensor is back in range.

Condenser Pressure Sensor Fault

Alarm description (as shown on screen): CondP Sensor Fail N
Trigger: Sensor shorted or open
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the keypad if the sensor is back in range.

Condenser Entering Sensor Fault

Alarm description (as shown on screen): OAT Sensor Fault
Trigger: Sensor shorted or open
Action Taken: Normal stop all circuits
Reset: This alarm can be cleared manually via the keypad if the sensor is back in range

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
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.

No Evaporator Pressure Drop

Alarm description (as shown on screen): No Evap Press Drop N
Trigger: After start of first compressor on the circuit, either a 1 psi drop in evaporator pressure OR a 5 psi rise in condenser pressure has not occurred after 15 seconds
Action Taken: Rapid stop circuit
Reset: This alarm can be cleared manually via the keypad.

EXB Comm Failure on CP1

Alarm description (as shown on screen): No EXB comm CP1
Trigger: CP1 does not have communication with either EXB1 for 60 seconds after power up. This alarm will only occur if 10 Fan , evaporator pump #2, or condenser pump #2 operation is selected. After communication is established, when communication is lost to either EXB an immediate shutdown occurs.
Action Taken: Rapid stop all circuits
Reset: Auto clear when EXB1 is communicating with CP1.

Alarm Log

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

Active Alarms

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

Clearing Alarms

A password is NOT required to clear an active alarm. Active alarms must be cleared at the unit controller. To clear active alarms scroll down to the end of the Active Alarm list press Enter to clear all active alarms. If the user attempts to clear an alarm while the alarm condition still exists, a new alarm will be generated immediately.

Limit Events

The following events do not cause a rapid stop but limit operation of the chiller in some way as described in the Action Taken. All limit events do NOT appear in the Active Alarm window and are NOT logged in the Alarm Log

Low Evaporator Pressure - Hold

Event description (as shown on screen): Evap Press Low HoldN
Trigger:
This event is triggered if all of the following are true:

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

Action Taken: Inhibit staging on of additional compressors on the circuit.
Reset: While still running, the event will be reset if evaporator pressure > (Low Evaporator Pressure - Hold set point is 8 psi for TGZ The event is also reset if the circuit state is no longer run.

Low Evaporator Pressure - Unload

Event description (as shown on screen): EvapPressLow Unload N
Trigger:
This event is triggered if all of the following are true:

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

Action Taken: Stage off one compressor on the circuit every 10 seconds, except the last one.
Reset: While still running, the event will be reset if evaporator pressure > (Low Evaporator Pressure - Hold set point + 8psi for R134a/R22/R407C or 13 psi for R410A). The event is also reset if the circuit state is no longer run.

High Condenser Pressure - Unload

Event description (as shown on screen): CondPressHighUnloadN
Trigger:
This event is triggered if all of the following are true:

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

Action Taken: Stage off one compressor on the circuit every 10 seconds, except the last one.
Reset: While still running, the event will be reset if condenser pressure drops below the "Hold Clear @" value which is displayed on that circuit's VIEW CIRCUIT n (1) screen. The "Hold Clear @" is calculated based on number of compressors, refrigerant, and number of High Condenser Pressure – Unload occurrences since the circuit has cycled off or since midnight. See table below:

CONDENSER CONFIGURATION	COMPRESSORS	R134a	STEP-INCREASE
Water Cooled	4	30 psi	10 psi
	6	20 psi	10 psi

Failed Pumpdown

Event description (as shown on screen): Pumpdown Fail Cir N
Trigger: Circuit state = pumpdown for time > 60 seconds
Action Taken: Shutdown circuit
Reset: N/A

Condenser Freeze Event

Event description (as shown on screen): Cond Freeze Circ N
Trigger: Cond Sat Refr Temperatre < Condenser Freeze Set Point AND Condenser Pump State = OFF
Action Taken: Start condense pump.
Reset: N/A

Condenser Freeze Event (Water Cooled = Y Only)

Event description (as shown on screen): Cond Freeze Circ N
Trigger: Cond Sat Refr Temp < Condenser Freeze Set Point AND Condenser Pump State = OFF
Action Taken: Start condenser pump.
Reset: Cond Sat Refr Temp > Condenser Freeze Set Point plus 2°F.

Suction Temperature Sensor Fail

Event description (as shown on screen): SuctT Sensor Fail N
Trigger: Sensor shorted or open.
Action Taken: None.
Reset: N/A

Entering Evaporator Water Temperature Sensor Failure

Event description (as shown on screen): Evap EWT Sensor Fail
Trigger: Sensor shorted or open.
Action Taken: None.
Reset: N/A

Liquid Line Temperature Sensor Fail (TGZ unit only)

Event description (as shown on screen): Low Source Temp
Trigger: Sensor shorted or open.
Action Taken: None.
Reset: N/A

Low Source Water Temperature (TGZ unit in 'heat' mode only)

Event description (as shown on screen): LiqL Sensor Fail N
Trigger: Unit is in heat mode and the leaving evaporator water temperature drops below the Low Source Temperature set point.
Action Taken: Stage off one compressor immediately and the remaining being staged off based upon the "InterStage Dn" set point time interval.
Reset: N/A

EXB Comm Failure on CP1 (TGZ unit only)

Event description (as shown on screen): No EXB comm CP1
Trigger: CP1 does not have communication with either EXB1 for 60 seconds after power up. This event is only active when the expansion board is not intended to operate evaporator or condenser pump #2.
Action Taken: None.
Reset: N/A.

Event Log

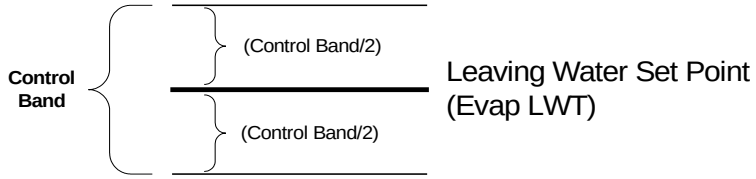
An Event Log similar to the Alarm Log stores the last 25 Event occurrences. There must be an active password for access to the Event Log. To navigate to the Event log press the Left Arrow key from any Alarm Log screen. When an event occurs, it is recorded in the first slot in the Event Log. All other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

Calculations

Control Band

The Control Band defines the temperatures around the Cool Leaving Water Temperature set point where compressors will be staged on or off. The Control Band is calculated as follows:

*Control Band = Evap Delta Temperature Set Point * 0.3* *Four compressor units*
*Control Band = Evap Delta Temperature Set Point * 0.2 Six compressor units*



If the Unit mode is Cool:

When the Cool Leaving Water Temperature set point is more than half the Control Band above 39.0° F the Stage Up temperature is calculated as follows:

Stage Up Temperature = Cool LWT + (Control Band/2)

The Stage Down temperature is calculated as:

Stage Down Temperature = Cool LWT – (Control Band/2)

If the Cool Leaving Water Temperature set point is less than half the Control Band above 39.0° F the Stage Down temperature is calculated as:

Stage Down Temperature = Cool LWT – (Cool LWT - 39.0 °F)

Stage Up temperature is calculated as:

Stage Up temperature = Cool LWT + Control Band – (Cool LWT – 39.0 °F)

In all other Unit modes the compressor staging temperatures are calculated as shown below:

Stage Up Temperature = Cool LWT + (Control Band/2)
Stage Down Temperature = Cool LWT – (Control Band/2)

The Start up and Shutdown temperatures are calculated from the Control Band. The Start Up temperature determines when the first compressor on the unit will start. The Start Up temperature calculation is shown below:

Start Up Temperature = Stage Up Temperature + Start Up Delta Temperature

The Shutdown temperature defines when the last running compressor will shutdown. The Shutdown temperature calculation is:

Shutdown Temperature = Stage Down Temperature – Shutdown Delta Temperature

Leaving Water Reset

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

Active LWT Set Point

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

LWT Error

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

LWT error = LWT – active LWT set point

LWT Slope

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

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

Pull Down Rate

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

Evaporator Saturated Temperature

Evaporator saturated temperature is calculated from the circuit evaporator pressure.

Condenser Saturated Temperature

Condenser saturated temperature is calculated from the condenser pressure for each circuit.

Evaporator Approach

The evaporator approach shall be calculated for each circuit.:

Evaporator Approach = LWT – Evaporator Saturated Temperature

Suction Superheat

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

Suction superheat = Suction Temperature – Evaporator Saturated Temperature

Pumpdown Pressure

The pressure to which a circuit will pump down is based on the Low Evaporator Pressure Unload set point. The equation is as follows:

Pumpdown pressure = Low evap pressure unload – 15 psi

The low limit for the calculated Pumpdown Pressure set point is 10.0 psi

Unit Enable

The Unit Enable Set Point controls enabling and disabling the unit. The Unit Enable Set Point has options of OFF and ON. The Unit OFF input, Remote input, keypad entry, and BAS request can alter this set point. The Control Source Set Point determines which sources can change the Unit Enable Set Point with options of SWITCHES, KEYPAD or NETWORK.

Changing the Unit Enable Set Point can be accomplished according to the following table. NOTE: An “x” indicates that the value is ignored.

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

Unit Mode

The overall operating mode of the unit is set by the Unit Mode Set Point with options of COOL, COOL w/Glycol, and TEST. This set point can be altered by the keypad, BAS, and Mode input. Changes to the Unit Mode Set Point are controlled by two additional set points.
Templifier operation is selected by setting the Refrigerant Selection setpoint to R134a. Additional modes are then made available for Templifier operation. They are: COOL, COOL w/Glycol, Heat, Test, Cool/Heat, Cool/Heatw/Glycol, Heatw/Glycol. Normally Heat is selected for heating only operation or Cool/Heat for units doing heating or cooling.

Control Source Set Point: Determines the source that can change the Unit Mode Set Point with options of KEYPAD, NETWORK, or SWITCHES.

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

Changing the Unit Mode Set Point can be accomplished according to the following table. NOTE: An “x” indicates that the value is ignored.

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

Unit Test Mode

The unit test mode allows manual testing of controller outputs. Entering this mode shall require the following conditions.
Unit Switch = OFF
Manager password active.
Available Unit Mode set point = 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.

Heat/Cool Changeover

With the proper piping and valving arrangement designed and installed, Templifiers can be switched from heating mode (controlled by the condenser leaving temperature) to cooling mode (controlled by the evaporator leaving temperature).

Care must be exercised when changeover occurs to avoid mixing water streams that could possibly contaminate a water system. For example a unit can have chilled water in the evaporator and tower water in the condenser when in the cooling mode. Changeover to heating could put tower water through the evaporator and hot water (possibly potable water) through the condenser. This could introduce tower water into the chilled water system and into the hot water system and should be avoided.

The changeover procedure can be manual or automatic and consists of the following steps:

1. Shut down the evaporator and condenser pumps and then the Templifier.
2. Change over the system valves
    a. Manual: Manually position valves for the correct flow through the Templifier vessels and system.
    b. Automatic: The external Heat/Cool Switch must position the motorized valves for the correct flow through the Templifier vessels and system..
3. Change over the Templifier operating mode.
    a. Manual: Switch the unit-mounted manual Heat/Cool Switch to the correct position. It is located in the upper-center of the electric panel.
    b. Automatic: The external Heat/Cool Switch (see Field Wiring Diagram on page 7) must switch as required. **NOTE;** The panel-mounted Heat-Cool Switch must be in the Cool position for the external switch to function.
4. Restart the pumps, and then restart the Templifier.

Circuit Available

A circuit is available if the circuit switch is in the on position and no circuit alarms are active. Timers that delay startup or staging of a circuit do not render it unavailable.

Power Up Start Delay

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

Ice Mode Start Delay

An adjustable start to start ice delay timer will limit the frequency with which the chiller may start in Ice mode. The timer starts when the first compressor starts while the unit is in

ice mode. While this timer is active, the chiller cannot restart in Ice mode. The time delay is user adjustable.

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

Low Ambient Lockout

This feature is only available on air cooled units (WaterCooled=Off).
If the OAT drops below the low ambient lockout set point, then all running circuits will do a normal stop. Once the lockout has been triggered, no compressors will start until the OAT rises to the lockout set point plus 5°F.

Unit State

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

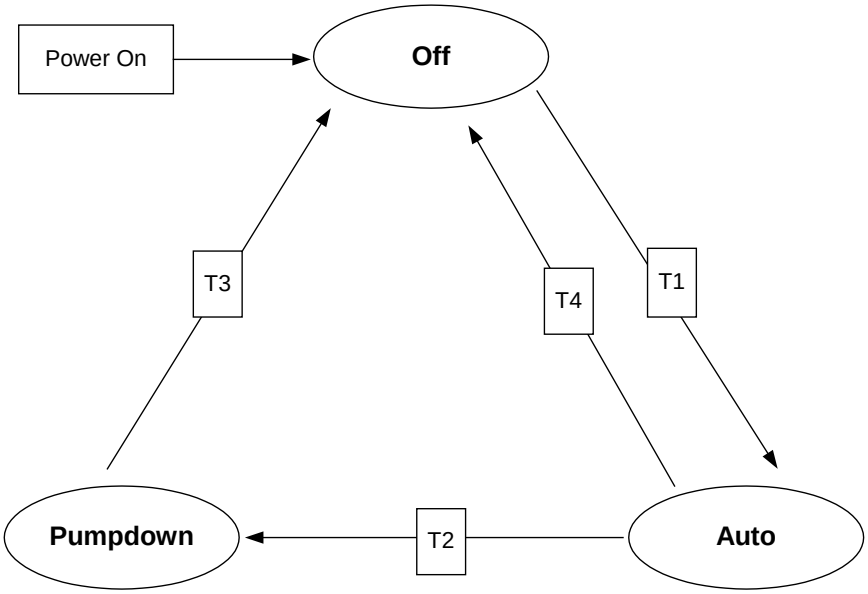
T1: Off to Auto
Unit Enable = True AND
No Unit Alarm AND
IF Unit Mode = Cir 1 Available OR Cir 2 Available

T2: Auto to Pumpdown
Keypad Enable = Off OR
BAS Enable = Off OR
Remote Switch = Off OR

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

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

Unit State Diagram

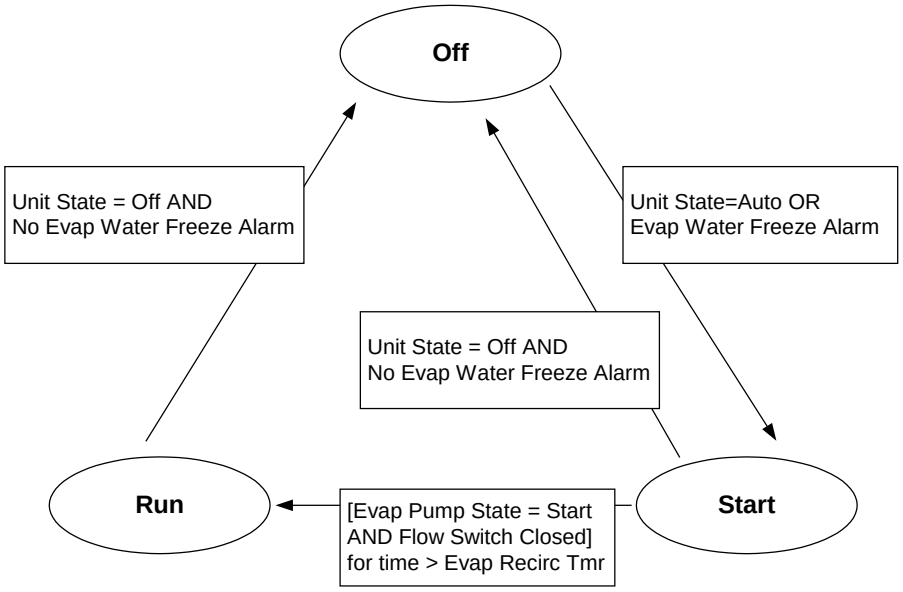


Evaporator Water Pump State Control (Evap State)

Most Templfier applications will not use automatic starting of evaporator pumps by the unit. This feature is commonly used on conventional chilled water applications. Simply not wiring a field installed pump relay to the unit will obviate unit pump control.

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

Evaporator Pump State Diagram



Pump Selection

The pump output used will be determined by the Evap Pump Control set point. The 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 value, the primary pump will shut off and the standby pump will start. Once the standby pump is started, the flow loss alarm logic will apply if flow cannot be established in the evaporator start state, or if the flow is lost in the evaporator run state.

Auto Control

If auto pump control is selected, the primary/standby logic above is till 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.

Evaporator Water Flow Loss

The Evaporator Water Flow Loss logic allows the Unit to shutdown compressors on a loss of flow up to two times every twenty-four hours before locking the unit out on a Evaporator Flow Loss Alarm.

- If there are no compressors running when Evaporator Water Flow Loss is indicated the Unit Status changes to Auto:Wait for flow. The evaporator water pump state changes to Start and no alarms are indicated.
- If an Evaporator Water Flow Loss occurs while a compressor is running all of the running compressors will be shutdown. The alarm indicators are turned On and the Circuit Status for any circuit with running compressors becomes Off: Ready, the Unit Status becomes Auto: Wait For Flow and the evaporator water pump state changes to Start
- When flow is reestablished the Unit Status becomes Auto: Recirculate while the Evaporator Flow Recirculation Timer counts down. If there is continuous evaporator water flow while the Evaporator Recirculation Timer counts down the Alarm indicator is turned off, and the unit resumes normal start up procedures based on water temperature and cycle timers.
- If second Evaporator Water Flow Loss occurs within twenty-four hours the process described above is repeated.
- If a third loss of flow is indicated in a twenty-four hour time frame the unit will shut down on an Evaporator Water Flow Loss alarm and it will be locked out until this alarm is manually cleared.
- The twenty-four hour timer that limits the auto restart is reset when the control clock rolls over 00:00 each night.

Condenser Pump and Tower Control – Water Cooled

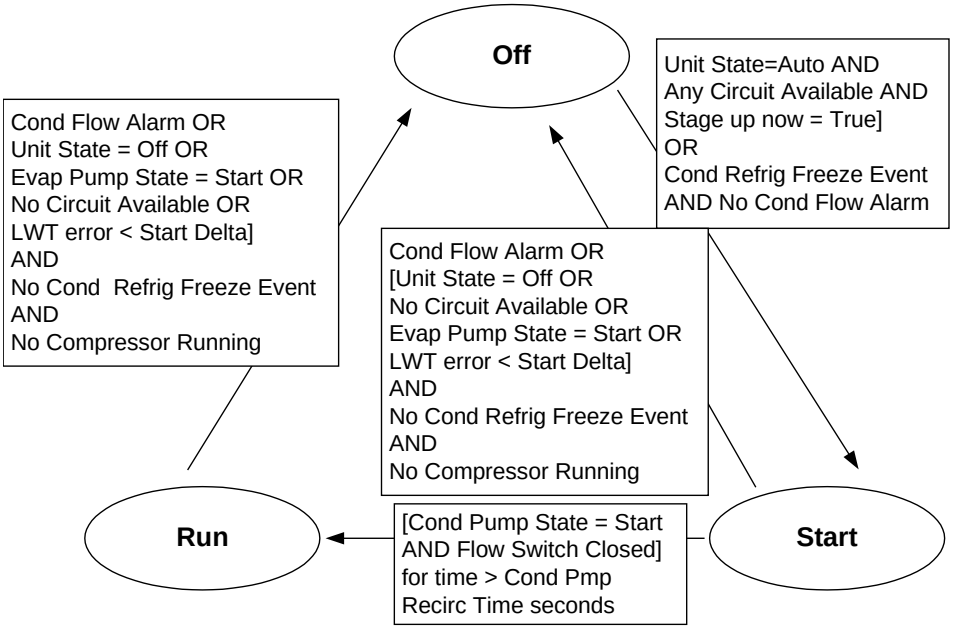
Most Templfier applications will not use automatic starting of condenser pump by the unit. This feature is commonly used on conventional chilled water applications. Simply not wiring a field installed pump relay to the unit will obviate unit pump control.

Condenser pump and cooling tower control logic requires that the unit be configured as water-cooled in order to be active.

Condenser Water Pump State Control (Cond State)

If the unit is configured as water-cooled, then the state-transition diagram shown below defines the condenser pump control logic.

Condenser Pump State Diagram



Pump Selection

The pump output used will be determined by the Cond Pump Control set point. The 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 condenser state is start for a time greater than the re-circulate timeout set point and there is no flow, then the primary pump will shut off and the standby pump will start. When the condenser is in the run state, if flow is lost for more than half of the flow proof set point value, the primary pump will shut off and the standby pump will start. Once the standby pump is started, the flow loss alarm logic will apply if flow cannot be established in the condenser start state, or if the flow is lost in the condenser run state.

Auto Control

If auto pump control is selected, the primary/standby logic above is till used. When the condenser 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

Condenser Water Flow Loss

The Condenser Water Flow Loss logic allows the Unit to shutdown compressors on a loss of flow up to two times every twenty-four hours before locking the unit out on a Condenser Flow Loss Alarm.

If there are no compressors running when Condenser Water Flow Loss is indicated the Unit Status changes to Auto:Wait for flow. The condenser water pump state changes to Start and no alarms are indicated.

If a Condenser Water Flow Loss occurs while a compressor is running all of the running compressors will be shutdown. The Alarm indicators are turned On and the Circuit Status for any circuit with running compressors becomes Off: Ready, the Unit Status becomes Auto: Wait For Flow and the condenser water pump state changes to Start

When flow is reestablished the Unit Status becomes Auto: Recirculate while the Condenser Flow Recirculation Timer counts down. If there is continuous evaporator water flow while the Condenser Recirculation Timer counts down the Alarm indicator is turned off, and the Unit resumes normal start up procedures based on water temperature and cycle timers.

If second Condenser Water Flow Loss occurs within twenty-four hours the process described above is repeated.

If a third loss of flow is indicated in twenty-four hour time frame the Unit will shut down on an Condenser Water Flow Loss alarm and it will be locked out until this alarm is manually cleared.

The twenty-four hour timer that limits the auto restart is reset when the control clock rolls over 00:00 each night.

Tower Fans (Cooling Mode Only)

Tower fan control is not normally used in Templifier applications. If tower fan control is desirable, the following will apply.

Tower fan control is active when the unit is set up as water cooled (WaterCooled=On), Tower Control 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

Stage up and stage down timer values

Tower set points (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 starts. The first stage turns ON when the following conditions are met:

The stage up timer completes

The ECWT is > Stage #1 ON set point

Bypass valve position is > the Stage Up @ set point (only if Valve/VFD Control set point = Valve Stage)

Additional stages can turn on (up to the number specified by the Tower Stages set point) when above conditions are met for the next stage plus the following condition:
VFD Speed is > the Stage Up @ set point (only if Valve/VFD Control set point = VFD Stage OR Valve SP/VFD Stage)

Down staging occurs when the following conditions are met:
The stage down timer completes
The ECWT is < Stage #X ON (Temp) set point – Stage Differential (Temp) set point
Bypass valve position is < the Stage Down @ set point (only if Valve/VFD Control set point = Valve Stage)
VFD Speed is < the Stage Down @ set point (only if Valve/VFD Control set point = VFD Stage OR Valve SP/VFD Stage)

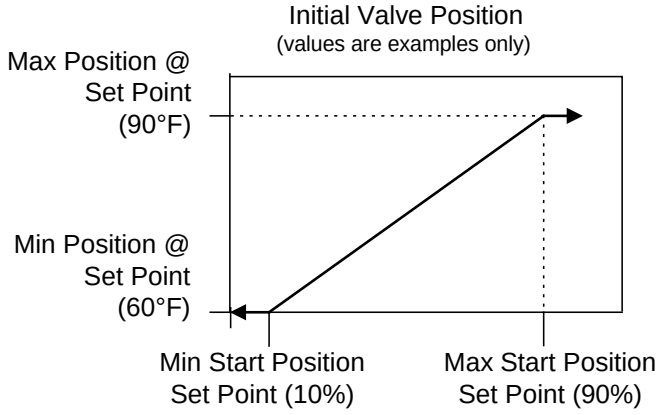
Each stage up or stage down event will restart both the stage up and stage down timers. Only one fan output will be switched at a time (except that all outputs switch OFF when the condenser pump state equals OFF).

Cooling Tower Bypass Valve

When the Valve/VFD Control set point is set to None OR VFD Stage, this output will 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 will 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 will be controlled in one of two modes as specified by the Valve/VFD Control set point. The controlled parameter will be the condenser entering water temperature. When the desired output signal varies from 0 to 100%, the output voltage will vary as shown below.
0 to 10 VDC (Valve Type = NC to tower)
10 to 0 VDC (Valve Type = NO to tower)

Valve Set Point Mode

This mode is operational when the Valve/VFD Control set point is set to Valve Set Point OR Valve SP/VFD Stage. In this mode the valve output is varied with a proportional-derivative (PD) algorithm (with dead band) in order to maintain the controlled parameter (CP) at the desired value. The output is always limited between the Valve Control Range

(Min) set point and the Valve Control Range (Max) set point. A valve increment shall be computed once every 5 seconds according to the following equation.
Increment = [(Error) * (Error Gain set point)] + [(Slope) * (Slope Gain set point)]
Where: Error = ECWT – Valve Set Point Slope = (Present CP) – (Previous CP)

When the Error is > the Valve Deadband set point, 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 set point is set to Valve Stage. In this mode the valve output is controlled as for Valve Set Point mode (above) except that the active set point for the controlled parameter is selected according to the following table.

Number Of Fans ON	Active Set Point
0	Valve Set Point
1	Stage #1 ON
2	Stage #2 ON

Cooling Tower Fan VFD

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

Compressor Start/Stop Timing

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

Stage Up Now

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

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

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

If Unit mode = Heat AND
no compressors are running AND
LWT error > Start delta + 0.5 * Control Band AND

Motor Protect Timer expired AND
Stage up timer expired THEN
Stage Up Now = True

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

Stage Down Now

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

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

If Unit Mode = Cool AND
LWT error < (-0.5 * Control band – stop delta) AND
One compressor running AND
Stage down timer expired THEN
Stage Down Now = True
If Unit Mode = Cool AND
Number of compressors running > Demand limit AND
Stage down timer expired THEN
Stage Down Now = True

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

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

Compressor Sequencing

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

If possible, only one compressor per circuit will start before starting the second compressor on any circuit. If a circuit is unavailable for any reason, the other circuit shall be allowed to stage the second compressor on. When staging down, one compressor on each circuit shall be left on until each circuit has only one compressor running.

Circuit Capacity Overrides

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

Low Evaporator Pressure

If a compressor in a circuit is running and the evaporator pressure drops below the Low Evaporator Pressure Hold set point, no more compressors will be allowed to start on that circuit. The limit shall be active until the evaporator pressure reaches the hold Low Evaporator Hold set point plus 5.0 psi. A Low Evaporator Pressure Hold event will be recorded in the Event Log.

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

Description	Low Evap Press Time	Requirement to continue
Check #1	15 seconds after start	Evap Press >(0.48*Low Evap Press SP)
Check #2	30 seconds after start	Evap Press >(0.66*Low Evap Press SP)
Check #3	45 seconds after start	Evap Press >(0.83*Low Evap Press SP)
Check #4	60 seconds after start	Evap Press > Low Evap Press SP

High Condenser Pressure – Unload Logic

If the discharge pressure rises above the High Condenser Pressure Unload set point and more than one compressor on the circuit is running, the circuit will stage down. One compressor will shut down as soon as the pressure rises above the unload set point and if two remain running then one more will shut down 10 seconds later if the pressure is still above the unload set point. On that circuit's VIEW CIRCUITn (1) screen is displayed the "Hold Clear @" value which is the limit by which the condenser pressure must drop to allow for additional loading. A High Condenser Pressure Unload event will be recorded in the Event Log.

No stage up will be allowed on the circuit until the condenser pressure drops below the unload set point less an offset value which is calculated based on 1) type refrigerant, 2) number of compressors, 3) condenser configuration, and 4) how many high pressure unload occurrences since the previous mid-night. See below for initial offset value and step-increase for each additional occurrence.

Hold Clear Reset Value =

High Pressure Unload set point – ["Initial Offset" + ["Step-Increase" x ["number of occurrence"-1]]]

Initial Offset & Step Increase

Condenser Configuration	No. of Compressors	R134a	Step Increase
Water-Cooled	4	30 psi	10 psi
	6	20 psi	10 psi
Air-Cooled	4	N/A	15 psi
	6	N/A	15 psi

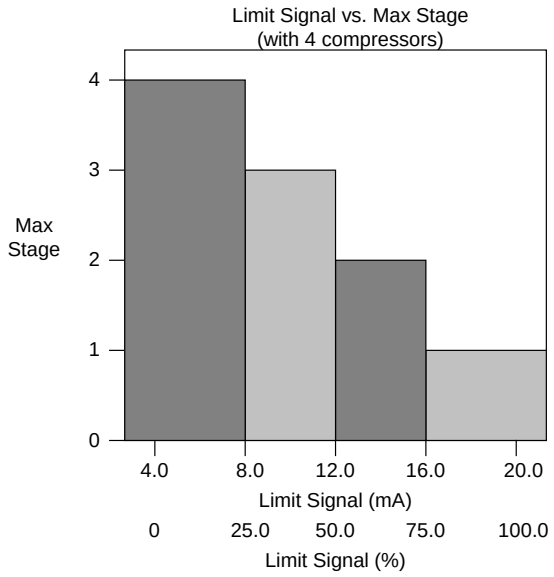
Example of Operation: Assume a packaged water-cooled WGZ unit with 4 compressors using R410A as the refrigerant. Circuit number one is fully loaded (both compressors running) when that circuit's condenser pressure exceeds the High Condenser Pressure Unload set point. Circuit number one will unload by turning one of the two compressors off immediately. This circuit will not be allowed to load back up until its condenser pressure decreases below the "Hold Clear @" value which is displayed on the "VIEW CIRCUIT 1 (1)" screen. Since this is the first High Condenser Pressure – Unload occurrence for that circuit, the circuit will be allowed to load once the condenser pressure drops below the High Condenser Pressure Unload set point minus 40 psi. If using default value (405 psi) this will be 365 psi. After some time, the condenser pressure is allowed to decrease below this value and circuit number one is again allowed to load up. Again its condenser pressure exceeds the High Condenser Pressure Unload set point and it unloads. Because this is the second High Condenser Pressure – Unload occurrence for that circuit, the circuit will not be allowed to load until the condenser pressure drops below the High Condenser Pressure Unload set point minus 50 psig (40 psi plus step-increase10psi). If using default values, this will be 355 psi. As you can see, for each occurrence the discharge pressure must get lower and lower (based on Step-Increase value) before the circuit is allowed to again load. This logic is intended to prevent excessive cycling of compressors.

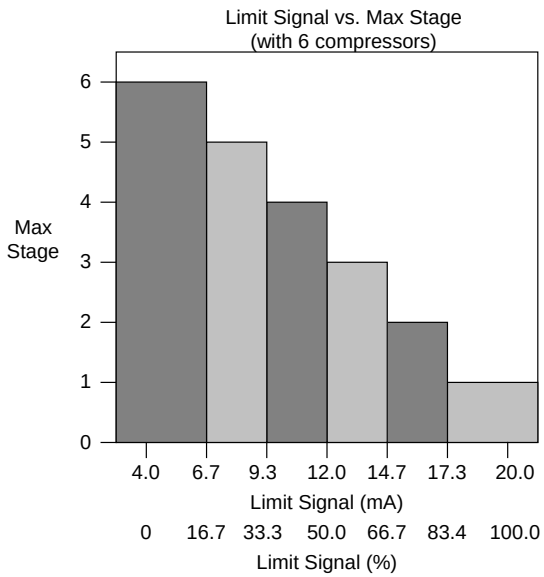
Unit Capacity Overrides

The following conditions shall override the automatic capacity control when the chiller is in cool mode only.

Demand Limit

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

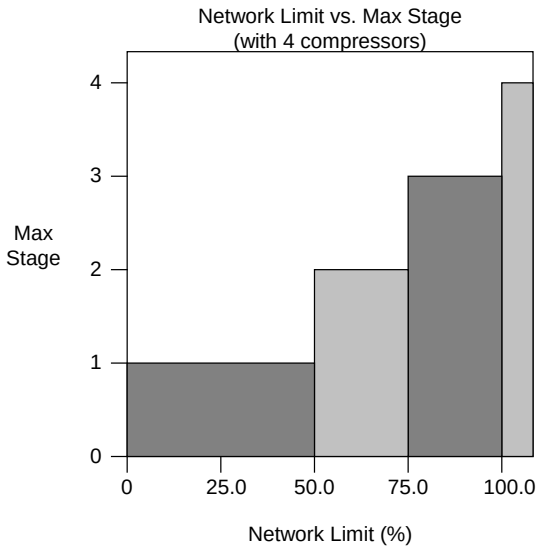


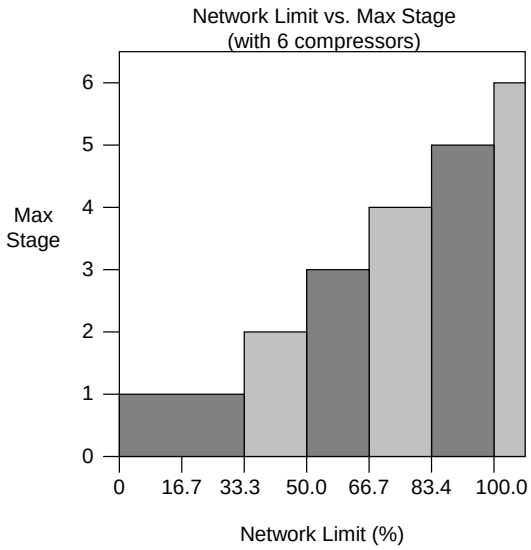


Any signal less than 4 mA does not limit the chiller capacity.

Network Limit

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





In order to allow all stages to run, a signal of 100.0% is required.

Maximum LWT Rate

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

Manual Compressor Control

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

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

Normal Circuit Shutdown

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

- Unit State = Pump Down
- Circuit Switch = Off
- A normal stage down occurs, and only one compressor on the circuit is running

Pump Down Procedure

- If both compressors are running, shut off the appropriate compressor based on sequencing logic
- With one compressor left running, turn off hot gas output and liquid line output
- Keep running until evaporator pressure reaches the pump down pressure, then stop compressor
- If evaporator pressure does not reach pump down pressure within two minutes, stop compressor and record a Failed Pumpdown event in the Event Log.

Rapid Circuit Shutdown

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

- Unit State = Off
- Circuit Alarm

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

Liquid Line Solenoid

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

Hot Gas Bypass Solenoid

This output shall be on when one compressor on the circuit is running and the circuit is not performing a pump down. The output should be off at all other times including the delay time described below.

The hot gas bypass valve opening will be delayed for Hot Gas Bypass Time set point seconds (the default is 30 seconds) when the first compressor starts on each circuit.

EXV Control

The EXV control logic is active (but not necessarily used) regardless of the valve type setting. While a circuit is in the run state, the EXV controls suction superheat. The superheat target is 8°F. PID logic will be used to control the superheat to the target value.

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

EXV Control Range

The table below shows the EXV range based on the number of compressors running and number of compressors on unit.

Number of Compressors	Valve Position	Compressors Running		
		1	2	3
4	EXV Min	8%	8%	-
	EXV Max	60%	100%	-
6	EXV Min	8%	8%	8%
	EXV Max	35%	45%	65%

Manual EXV Control

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

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

Maximum EXV Operating Pressure

This logic only applies to TGZ units equipped with electronic expansion valves (Models TGZ150-190). The purpose of this logic is to prevent the operating circuit's evaporator pressure from exceeding the 'MaxOpPress' set point (found on "SET COMP SPs (6) screen) and overloading the compressors. The electronic expansion valves (EEV) will close to prevent the operating circuit's evaporator pressure from exceeding the 'MaxOpPress' set point.

Using the Controller

Getting Started

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

Navigating through the menu matrix to reach a desired menu screen and knowing where a particular screen is located.

Knowing what is contained in a menu screen and how to read that information or how to change a setpoint contained in the menu screen.

Navigating Through the Menus

The menus are arranged in a matrix of screens across a top horizontal row. Some of these top-level screens have sub-screens located under them. The general content of each screen and its location in the matrix are shown in Figure 8. (A detailed description of each menu begins on page 46.) There are two ways to navigate through the menu matrix to reach a desired menu screen.

One is to scroll through the matrix from one screen to another using the four ARROW keys.

The other way is to use shortcuts to work through the matrix hierarchy. From any menu screen, pressing the MENU key will take you to the top level of the hierarchy. The display will show ALARM, VIEW, and SET as shown in Figure 6. This corresponds to the second row of screens on Figure 8. One of these groups of screens can then be selected by pressing the key connected to it via the pathway shown in Figure 6 on page 14.

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

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

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

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

```
VIEW    < COMPRESSOR
        <       UNIT
        < EVAPORATOR
        <       FANS
```

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

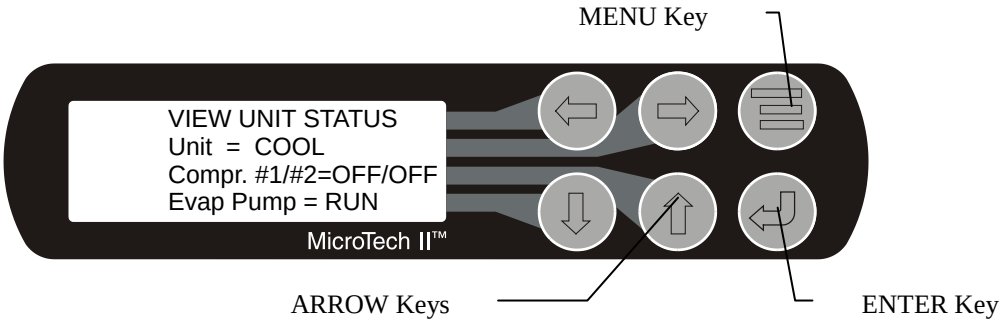
```
VIEW EVAP
   (screen data)
   (screen data)
   (screen data)
```

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

MENU Key

The MENU key is used to switch between the shortcut method (known as the MENU mode and as shown in Figure 6) and scrolling method (known as the SCROLL mode). The MENU mode is the shortcut to specific groups of menus used for checking ALARMS, for VIEWING information, or to SET setpoint values. The SCROLL mode allows the user to move about the matrix (from one menu to another, one at a time) by using the four ARROW keys. A typical menu screen is shown in the following figure. Pressing the MENU key from any menu screen will automatically return you to the MENU mode.

Figure 7, 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).

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 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.

Menu Screens

Various menus are shown in the controller display. Each menu screen shows specific information, in some cases menus are only to *view* status of the unit, in some cases for checking *alarms*, and in some cases they are used to *set* 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 Figure 8. A description of each menu begins on page 46.

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.

Figure 8, Menu Matrix

							"**MENU**"
"**VIEW**" MENUS							
UNIT		CIRCUITS		REFRIGERANT		FANS	EVENT
VIEW UNIT STATUS (1)	VIEW UNIT TEMP (1)	VIEW CIRC #1 STATUS (1)	VIEW CIRC #2 STATUS (1)	VIEW REFRIGERANT CIRCUIT #1 (1)	VIEW REFRIGERANT CIRCUIT #2 (1)	VIEW FAN/TOWER (1)	VIEW EVENT LOG (1)
VIEW UNIT STATUS (5)	VIEW UNIT TEMP (2)	VIEW COMP #1 STATUS (3)	VIEW CIRC #2 STATUS (3)	VIEW EVAP (2)	VIEW EVAP (2)	VIEW FAN/TOWER (n)	VIEW EVENT LOG (n)

⇐ Continued ⇐

(Right side of matrix continued from above)m

"**ALARM**" MENUS		"**SET**" MENUS				
ALARM LOG (LAST) TYPE, TIME	ACTIVE ALARM (1) TYPE, TIME	SET UNIT SPs, (1)	SET COMP SPs (1)	SET LIMIT ALARMS (1)	SET FANS (1) STAGES FANTROL	SET TOWER (1)
ALARM LOG (NEXT TO LAST)	ACTIVE ALARM (2) TYPE, TIME ADDITIONAL	SET UNIT SPs, (2)	SET COMP SPs (2)	SET LIMIT ALARMS (2)	SET FANS (2) STAGE ON	SET TOWER (2)
ALARM LOG (SECOND TO LAST)	ACTIVE ALARM (3) CLEAR/VIEW	SET UNIT SPs, (3)		SET LIMIT ALARMS (3)	SET FANS (3) STAGE OFF	SET TOWER (3)
ALARM LOG LAST 25 SHOWN		SET UNIT SPs, (4) (to 19)				SET TOWER (to n)

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.

Menu Descriptions

This section contains information on each screen. The menu screens are in order of the matrix in Figure 8 going from left to right and 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, WaterCooled = Y (Yes).

Screen Definitions – MENU

Top level menu:

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

ALARM menu:

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

VIEW menu:

```
VIEW   <  COMPRESSOR
       <        UNIT
       <  EVAPORATOR
       <  FANS/TOWER
```

VIEW UNIT menu:

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

SET menu:

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

Screen Definitions – VIEW

View Unit Status

```
VIEW UNIT STATUS (1)
Auto
Cooling Stage = 0
Evap Pump = RUN
```

Unit states can be OFF, COOL, GYLCOL, or ALARM as determined from the Unit Mode setpoint, the Unit Enable, and the presence of an alarm.

Circuit states can be OFF/OFF, ON/OFF, OFF/ON, and ON/ON.

Evaporator Pump States can be OFF, STRT, or RUN.

When more than one screen are stacked (i.e., relate to each other on the same subject), they are numbered sequentially with the numbers appearing in the upper-right corner.

```
VIEW UNIT STATUS (2)
Demand Limit=Stg 4
Network Limit=Stg 4
```

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

```
VIEW UNIT STATUS (4)
D.O.     111111111
123456789012345678
000000000000000000
```

This menu gives the status of digital outputs (D.O.), 1=ON, 0=OFF. Numbers are 1 through 18. See Table 4 on page 16 for number reference.

```
VIEW UNIT STATUS (5)
D.I.     111111111
123456789012345678
000000000000000000
```

This menu gives the status of digital inputs (D.I.), 1=ON, 0=OFF. Numbers are 1 through 18. See Table 3 on page 15 for number reference.

```
VIEW UNIT STATUS (6)
    Analog Output
    (volts x 100)
 1 = 000.0  2 =
000.0
```

```
VIEW UNIT STATUS (7)
    Analog Output
    (volts x 100)
 3 = 000.0  4 =
000.0
```

```
VIEW UNIT STATUS (8)
EXB1 Online
D.O.  1  2  3  4
      0  0  0  0
```

View Unit Tempertures

TGZ, Cooling Mode

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

TGZ, Heating Mode

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

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

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

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

TGZ Unit Only in Cool Mode

```
VIEW UNIT TEMP  (5)
Cond LWT   XX.X°F
Evap EWT   XX.X°F
```

TGZ Unit Only in Heat Mode

```
VIEW UNIT TEMP  (5)
Cond LWT   XX.X°F
Evap EWT   XX.X°F
```

View Circuit

```
VIEW CIRCUIT#1  (1)
OFF
```

```
VIEW CIRCUIT#1  (2)
Comp 1   = OFF
Hours  = XXXXX
Starts = XXXXX
```

```
VIEW CIRCUITt#1 (3)
Comp 3   = OFF
Hours  = XXXXX
Starts = XXXXX
```

If # of Compresors = 6

```
VIEW CIRCUIT 1   (4)
Comp5=Off
Hours  = XXXXX
Starts = XXXXX
```

```
VIEW CIRCUIT 2   (1)
Off
```

```
VIEW CIRCUIT#2  (2)
Comp 2   = OFF
Hours  = XXXXX
Starts = XXXXX
```

```
VIEW CIRCUIT#2  (3)
Comp 4   = OFF
Hours  = XXXXX
Starts = XXXXX
```

If # of Compresors = 6

```
VIEW CIRCUIT 2   (4)
Comp6=Off
Hours  = XXXXX
Starts = XXXXX
```

View Refrigerant

```
VIEW REFRG Cir 1 (1)
Evap Press XXX.X psi
Cond Press XXX.X psi
```

```
VIEW REFRG Cir 1 (2)
Sat Evap XXX.X °F
Sat Cond XXX.X °F i
```

```
VIEW REFRG Cir 1 (3)
SuctionTemp=XXX.X°F
Surperheat = XXX.X°F
EvapApproach= XX.X°F
```

TGZ Only (R134a)

```
VIEW REFRG Cir 1 (4)
LiqLineTemp=XXX.X°F
Subcooling = XXX.X°F
CondApproach= XX.X°F
```

Units with EEV only

```
VIEW REFRG Cir 1 (5)
EXV Ctrl = XXX
EXV Pos = XXX.X%
SH Target = XX.X°F
```

TGZ Units Only (R134a)

```
VIEW REFRG Cir 1 (6)
EXV Ctrl Range
XX.X% ---XX.X%
```

```
VIEW REFRG Cir 2 (1)
Evap Press XXX.X psi
Cond Press XXX.X psi
```

```
VIEW REFRG Cir 2 (2)
Sat Evap XXX.X °F
Sat Cond XXX.X °F i
```

```
VIEW REFRG Cir 2 (3)
SuctionTemp=XXX.X°F
Surperheat = XXX.X°F
EvapApproach= XX.X°F
```

TGZ Only (R134a)

```
VIEW REFRG Cir 2 (4)
LiqLineTemp=XXX.X°F
Subcooling = XXX.X°F
CondApproach= XX.X°F
```

Units with EEV only

```
VIEW REFRG Cir 2 (5)
EXV Ctrl = XXX
EXV Pos = XXX.X%
SH Target = XX.X°F
```

TGZ Units Only (R134a)

```
VIEW REFRG Cir 2 (6)
EXV Ctrl Range
XX.X% ---XX.X%
```

View Tower

```
VIEW TOWER (1)
Stages ON = 1 of 2
EntCondTemp = XXX °F
   Setpoint = XXX °F
```

The first Stages ON value is the number of fan stages ON. The second number is the Tower Stages setpoint (0 if Tower Control = None). This screen shows the number of tower fans "on" for each circuit. This screen will show the fans "on" whether they are actually connected to and controlled by the MicroTech II controller or not.

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

The Bypass Valve value shall be “None” (in place of XXX%) if the Valve/VFD Control setpoint = None or VFD Stage. The VFD Speed value shall be “None” if the Valve/VFD Control setpoint = None, Valve Setpoint, or Valve Stage.

Screen Definitions – ALARM

```
ALARM ACTIVE (X)
Alarm Description
hh:mm:ss dd/mmm/yyyy
```

OR

```
ALARM ACTIVE (X)
No more alarms
Press ENTER to clear all
active alarms
```

If the unit is off on a shutdown alarm or running, but in a limit alarm condition, the cause and date will appear in the upper 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. It is not necessary to have a password open to clear alarms.

```
ALARM LOG (X)
Alarm Description
hh:mm:ss dd/mmm/yyyy
Data
```

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

Screen Definitions – EVENT LOG

```
EVENT LOG (X)
Alarm Description
hh:mm:ss dd/mmm/yyyy
Data
```

Screen Definitions – SET

Set Unit Setpoints

```
SET UNIT SPs (1)
Unit Enable = OFF
Unit 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:

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.

SWITCHES, in which an external switch is wired across terminals #40 and #53. (See wiring diagram on page 7).

NETWORK, used with BAS signal, which is wired to the three communication ports.

Unit Mode settings can be

- COOL, normal setting used with chilled water air-condition applications.
- COOL w/GLYCOL, used with low temperature, glycol applications. It allows a lower LWT setpoint to be used.
- HEAT, Used when heating hot water..

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

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

Cooling Mode

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

EvapDeltaT= XX.X°F
```

Heating Mode

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

```
SET UNIT SPs    (4)
Start Delta= XX.X°F
Stop Delta= XX.X°F
Demand Limit = ON
```

See pages 11 and 37 for an explanation of compressor staging.

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

Evap Pump choices are; #1 Only, #2 Only, Auto, #1 Primary, #2 Primary.

Cooling Mode

```
SET UNIT SPs     (6)

Cond Recirc=XXX sec
Cond Pump = #1 Only
```

Heating Mode

```
   SET UNIT SPs   (6)
Cond Delta T – XX.X°F
Cond Recirc=XXX sec
Cond Pump = #1 Only
```

```
SET UNIT SPs    (7)
Ice Time Delay=Xxsec
Clear Ice Delay=No
H.G. Delay = XX sec
```

H.G. Delay, hot gas bypass delay, keeps the hot gas solenoid valve closed when the first compressor on a circuit starts. This delay allows sufficient condenser pressure to build up. The Ice entries do not apply to TGZ units.

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

```
SET UNIT SPs    (9)
Units = °F/psi
Lang  = ENGLISH
Refrig = R134a
```

Refrigerant type is factory-set.

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

BAS interface settings, available mid-2003.

```
SET UNIT SPs    (11)
Evap Press Sensor
Cir 1 Cir 2 Offset
 00.0  00.0  (psi)
```

The pressure offsets on menus 8 and 9 and the temperature offsets on menus 10, 11 and 12 correct the controller's display. The sensors used in these units have a high degree of repeatability but may need correction (offset). An accurate pressure gauge or thermometer is used to determine the correct temperature or pressure. A positive or negative offset value is then entered to make the controller reading agree with the measured value.

```
SET UNIT SPs    (12)
Cond Press Sensor
Cir 1 Cir 2 Offset
 00.0  00.0  (psi)
```

```
SET UNIT SPs    (13)
LWT Sensors
Evap offset= 00.0°F
Cond Offset= 00.0°F
```

```
SET UNIT SPs    (14)
EWT Sensors
Evap offset= 00.0°F
Cond Offset= 00.0°F
```

```
SET UNIT SPs    (15)
Suction Temp Sensor
Cir 1 Offset =
Cir 2 Offset
```

```
SET UNIT SPs    (16)
Liq Line Temp Sensors
Circ1 Offset=00.0 ºF
Circ2 Offset=00.0 ºF
```

```
SET UNIT SPs     (17)
Clg ResType = X
Clg MaxRes = XX.X ºF
Clg StrtRes = XX.X ºF
```

TGZ Unit in Heat Mode.

```
SET UNIT SPs     (18)
Htg ResType = X
Htg MaxRes = XX.X ºF
Htg StrtRes = XX.X ºF
```

Cooling Mode

```
SET UNIT SPs    (19)
ENTER PASSWORD: XXXX
 Active Password
 Level: None
```

Heating Mode

```
SET UNIT SPs    (19)
ENTER PASSWORD: XXXX
 Active Password
 Level: None
```

Two four-digit passwords provide OPERATOR and MANAGER levels of access to changeable parameters. The passwords are preprogrammed into the controller. Either password must be entered using the ENTER PASSWORD (12) screen before a protected setting can be changed. The operator password is 0100. The manager level is 2001.

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

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

Set Compressor Setpoints

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

This menu sets the anti-recycle timers. Stop-Start is the time required before starting a compressor after it has *stopped*. Start-Start is the time required before starting a compressor after the last time it has *started*. Do not change default values of 5/10 minutes.

```
SET COMP SPs   (2)
InterStgUp  =XXXsec
InterStgDown= XXsec
Clear Cycle Tmr = NO
```

InterStageUp is the time delay since the last stage change before a compressor can stage on, default is 120 sec.

InterStageDn is the time delay since the last stage change before a compressor can stage off normally (not by an alarm). Default is 30 sec. It is recommended that these settings not be changed.

# of Compressors = 4

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

# of Compressors = 6

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

# of Compressors = 4

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

# of Compressors = 6

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

Enable screens #3 and #4 require the manager password to change.

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

TGZ040-120 have thermal expansion valves, TGZ150-190 have electronic valves.

Expansion Valve Type = Electronic

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

Expansion Valve Type = Electronic

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

SET ALARM LIMITS

```
SET ALARM LMTS  (1)
Low EVAP Pressure
    Hold=XXXpsi
   Unload=XXXpsi
```

The Hold and 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 LMTS (2)
High Cond Pressure
   Unload= XX.X°F
     Stop=XXXsec
```

Unload is a limit alarm that unloads the unit at 370 psi in an attempt to prevent total shutdown from the HighCondPr at 380 psi. The stage down is set at 370 psi. It is recommended that these settings not be changed.

Stop (the unit high-discharge-pressure shutdown) is a stop alarm that shuts off the unit when the discharge pressure reaches the setting. The default setting is 380 psi.

LowEvPrDelay is a time delay on the low pressure trip that reduces nuisance low-pressure trips. The default setting is 30 seconds.

```
SET ALARM LMTS (3)
GroundFault = N
PhaseVoltage = N
Low OATStartTMR=XXsec
```

GroundFault and PhaseVoltage entries are Y (Yes) or N (No) depending on whether the options are on the unit.

CondFreeze is an alarm that reduces the chance of freezing the water in the condenser (when compressors are not running). An alarm is registered and the condenser pump is energized at the same time. The alarm setpoint is 34F saturated condenser temperature and it resets at +2□F above the setpoint.

```
SET ALARM LMTS (4)
Evap Freeze = XX.X°F
EvapFlowProff=XXXsec
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.

EvapFlowProof 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.

LowAmbientLock applies to units with air-cooled condensers and prevents unit operation below the setting. The available range is -2□F to 60□F with a default of 35□F.

WaterCooled=ON

```
SET ALARM LIMITS (5)
Cond Freeze= XX.X °F
CondFlowProof= XX sec
```

TGZ unit for heat mode operation

```
SET ALARM LIMITS (6)
LowSourceTmp=XX.X °F
LowSourceDif=XX.X ºF
```

Set Cooling Tower Control (TGZ in cooling mode)

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.

[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 = X
StageUP/DN=XXX/XXX%
```

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 ON (Temp)°F
  #1    #2
 XXX   XXX
```

Stage ON Temp is the entering condenser water temperature (ECWT) that will turn on tower fan #1 and #2. Default settings are 70□F and 75□F. Cold condenser water will improve unit efficiency but too cold can cause erratic operation. Settings below 60□F are not recommended.

```
SET TOWER SPs (3)
StageDiff = XX.X°F
Stage Up Tmr=XX min
StageDn  Tmr=XX min
```

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=
  ValveSP/VFDStage
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 (5) below.
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

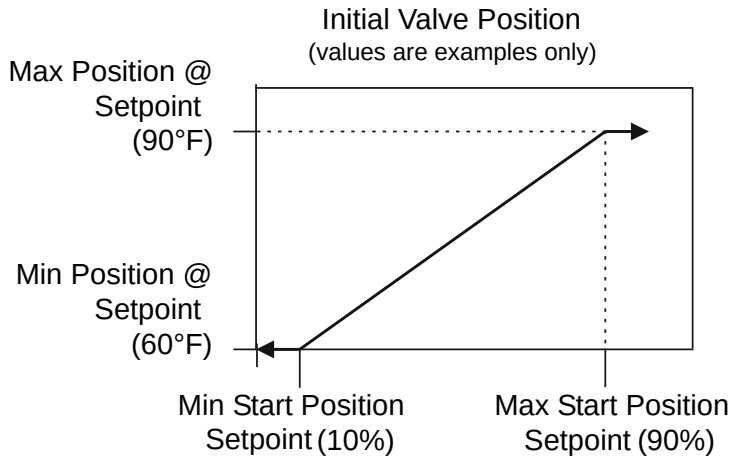
VFD Stage, ValveSP/VFDStage, When the Valve/VFD Control setpoint is set to None, Valve Setpoint, OR Valve Stage, this output is set to 0. Otherwise, it will be controlled in a manner identical to Valve Stage Mode (above) except that (1) it shall be kept at zero until the first fan stage is ON, and (2) 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 9, 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 °F
Valve DB = XX.X °F
```

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)
ValveStartPosition
 Min = XXX% @XXX°F
 Max = XXX% @XXX°F
```

The ValveStartposition 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.

TEST

The test screens are only available when the unit is in TEST mode. Using these screens, any digital output can be controlled manually.

```
TEST UNIT        (1)
Alarm Signal =OFF
Evap Pump 1 = OFF
Evap Pump 2 = OFF
```

# of Compressors = 4

```
TEST UNIT        (2)
Liq Line Sol #1= OFF
CompressorHG1 = OFF
1= OFF  3= OFF
```

# of Compressors = 6

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

# of Compressors = 4

```
TEST UNIT        (3)
Liq Line Sol #2=OFF
Compressor HG2 = OFF
2= OFF  4= OFF
```

# of Compressors = 6

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

Water Cooled = ON

```
TEST UNIT        (4)
Cond Pump 1 = OFF
Cond Pump 2 = OFF
TwrFan1=OFF Fan2=OFF
```

Water Cooled = ON

```
TEST UNIT        (5)
Twr Bypass= XXX.X %
Twr VFD=    XXX.X %
```

```
TEST UNIT        (6)
EXV Cir 1= XXX.X %
EXV Cir 2= XXX.X %
```

Editing Review

Editing shall 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 shall show 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.

Combination Heating-Cooling

With proper piping and valving installed, the Templifier can be used a combination heating and cooling unit; cooling chilled water for air conditioning duty or heating hot water for heating duty.

Care must be exercised when changeover occurs to avoid mixing water streams that could possibly contaminate a water system. For example a unit can have chilled water in the evaporator and tower water in the condenser when in the cooling mode. Changeover to heating could put tower water through the evaporator and hot water (possibly potable water) through the condenser. This could introduce tower water into the chilled water cooling system and into the hot water heating system and must be avoided. Heat exchangers are often employed to facilitate this separation.

At changeover, the unit is switched from heating to cooling on the *MODE* setpoint located on screen 1 of the Set Unit Setpoints screens. See pages 52 and following.

BAS Interface

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

Protocols Supported

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

BACnet

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

LONworks

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

Modbus

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

Available Parameters

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

Type	Index	I/O	Description	LONWORKS	BACnet	Modbus
A	1	I/O	Network Cool LWT set point	x	x	x
A	2	O	Active LWT set point	x	x	x
A	3	I/O	Network limit set point	x	x	x
A	6	O	Evap LWT	x	x	x
A	7	O	Cond EWT	x	x	x
A	10	O	Unit capacity (%)	x	x	x
A	11	I	Network Cool LWT set point default	x		
A	15	O	Suction temp	x	x	x
A	16	O	Evap sat temp	x	x	x
A	17	O	Evap pressure	x	x	x
A	20	O	Cond sat temp	x	x	x
A	21	O	Cond pressure	x	x	x
A	39	O	OAT	x	x	x

Continued next page.

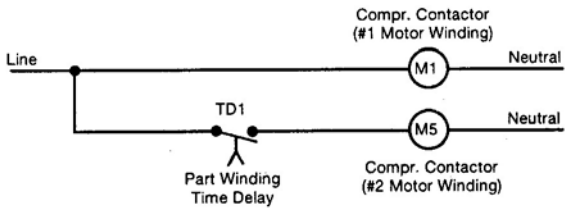
Type	Index	I/O	Description	LONworks	BACnet	Modbus
A	42	O	Active Capacity Limit	x	x	x
A	50	I/O	Network Ice LWT set point	x	x	x
I	1	O	Active alarms 1	x	x	x
I	2	O	Active alarms 2	x	x	x
I	3	O	Active alarms 3	x	x	x
I	4	O	Active alarms 4	x	x	x
I	5	O	Active alarms 5	x	x	x
I	6	O	Active alarms 6	x	x	x
I	7	O	Active alarms 7	x	x	x
I	8	O	Active alarms 8	x	x	x
I	9	O	Active alarms 9	x	x	x
I	10	O	Active alarms 10	x	x	x
I	11	O	Active alarms 11	x	x	x
I	12	O	Active alarms 12	x	x	x
I	13	O	Active alarms 13	x	x	x
I	14	O	Active alarms 14	x	x	x
I	15	O	Active alarms 15	x	x	x
I	16	O	Active alarms 16	x	x	x
I	17	I	Network chiller mode set point	x	x	x
I	18	O	LON Chiller run mode	x		x
I	19	O	Active chiller mode	x	x	x
I	20	I	Network demand limit default set point	x		
I	21	I	Network chiller mode default set point	x		
I	22	O	Sequence Status Bit 1 – Unit Full Load Flag Bit 2 – Circuit One Available Flag Bit 3 – Circuit Two Available Flag	x	x	x
I	28	O	Unit model type, refrigerant	x	x	x
I	29	O	Unit language	x	x	x
I	30	O	Unit software version	x	x	x
I	32	I	Compressor select	x	x	x
I	35	I/O	Clock year		x	x
I	36	I/O	Clock month		x	x
I	37	I/O	Clock day of month		x	x
I	38	I/O	Clock day of week		x	x
I	39	I/O	Clock hours		x	x
I	40	I/O	Clock minutes		x	x
I	45	O	Compressor starts		x	x
I	46	O	Compressor run hours		x	x
D	1	I/O	Network chiller enable set point	x	x	x
D	2	O	Chiller enable status	x	x	x
D	3	O	Active alarm indicator	x	x	x
D	4	O	Chiller run enabled	x	x	x
D	5	O	Chiller local control	x	x	x
D	6	O	Chiller capacity limited	x	x	x
D	7	O	Evap flow	x	x	x
D	8	O	Cond flow	x	x	x
D	9	I	Network chiller enable default set point	x		
D	10	I	Ignore network defaults	x		
D	24	I	Network clear alarm signal	x	x	x

Part Winding Start

Part winding start is available on all voltage units and consists of a solid-state time delay wired in series with the contactor that energizes the second winding of each compressor motor. Its purpose is to limit current inrush to the compressors upon start-up. As each compressor starts, the contactor of the first motor winding is delayed for 1 second.

Control checkout is best accomplished by observation as each contactor is pulled in to see that the 1 second delay occurs before the second contactor pulls in.

Figure 10, Part Winding Start Option



Note: Line is only hot when the unit calls for compressor to run.

Phase/Voltage Monitor (Optional)

The phase/voltage monitor is a device that provides protection against three-phase electrical motor loss due to power failure conditions, phase loss, and phase reversal. Whenever any of these conditions occur, an output relay is deactivated, disconnecting power to the thermostatic control circuit. The compressor will automatically pump down.

The output relay remains deactivated until power line conditions return to an acceptable level. Trip and reset delays have been provided to prevent nuisance tripping due to rapid power fluctuations.

When three-phase power has been applied, the output relay should close and the “run light” should come on. If the output relay does not close, perform the following tests.

1. Check the voltages between L1-L2, L1-L3, and L2-L3. These voltages should be approximately equal and within +10% of the rated three-phase line-to-line voltage.
2. If these voltages are extremely low or widely unbalanced, check the power system to determine the cause of the problem.
3. If the voltages are good, turn off the power and interchange any two of the supply power leads at the disconnect.

This can be necessary as the phase/voltage monitor is sensitive to phase reversal. Turn on the power. The output relay should now close after the appropriate delay.

Hot Gas Bypass (Optional)

This option allows passage of discharge gas to the evaporator permitting operation at lower loads than available with compressor unloading. It also keeps the velocity of refrigerant gas high enough for proper oil return at light load conditions. A solenoid valve in the hot gas bypass line is wired in parallel with the compressor unloader U1. Thus, the hot gas solenoid cannot open unless the compressor is operating in an unloaded mode. If only one hot gas valve is specified for the unit, the hot gas bypass is wired in the first refrigerant circuit and

the lead-lag switches are therefore eliminated. The hot gas bypass option is also available for the second refrigerant circuit whereby the lead-lag switches remain.

The pressure regulating valve is factory set to begin opening at 58 psig (400 kPa). This setting can be changed by changing the pressure of the air charge in the adjustable bulb. To raise the pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. Do not force the adjustment beyond the range it is designed for, as this will damage the adjustment assembly. The regulating valve opening point can be determined by slowly reducing the system load while observing the suction pressure. When the bypass valve starts to open, the refrigerant line on the evaporator side of the valve will begin to feel warm to the touch.

⚠ CAUTION

The hot gas line can become hot enough to cause injury in a very short time; care should be taken during valve checkout.

Figure 11, Hot Gas Bypass Piping

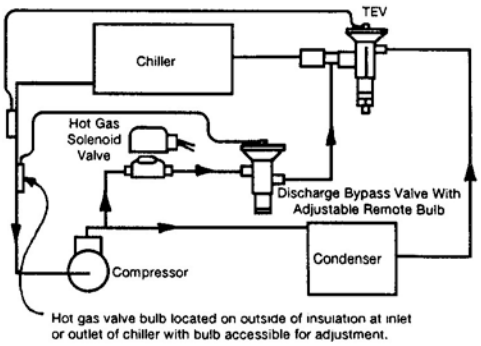
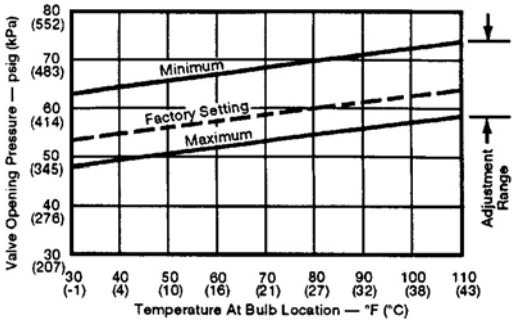


Figure 12, Hot Gas Bypass Adjustment Range



System Maintenance

General

To provide smooth operation at peak capacity and to avoid damage to package components, a program of periodic inspections should be set up and followed. The following items are intended as a guide to be used during inspection and must be combined with sound refrigeration and electrical practices to provide trouble-free performance.

The liquid line sightglass/moisture indicator on all circuits must be checked to be sure the glass is full and clear and the moisture indicator indicates a dry condition. If the indicator shows that a wet condition exists or if bubbles show in the glass, even with a full refrigerant charge, the filter-drier element must be changed.

Water supplies in some areas can tend to foul the TGZ heat exchangers to the point where cleaning is necessary. The fouled vessel will be indicated by an abnormally high condensing pressure or low evaporating pressures and can result in nuisance trip-outs. To clean the vessels, a chemical descaling solution should be used according to the manufacturer's directions. A 40-mesh strainer is required in the water inlet to the evaporator.

The compressor oil level must be checked periodically to be sure the level is at the center of the oil sightglass. Low oil level can cause inadequate lubrication and oil must be added, use oils referred to in "Compressor Oil Level" section below.

A pressure tap has been provided on the liquid line downstream of the filter-drier and solenoid valve but before the expansion valve. An accurate subcooled liquid pressure and temperature reading can be taken here. The pressure read here could also provide an indication of excessive pressure drop through the filter-drier and solenoid valve due to a clogging filter-drier.

Note: A normal pressure drop through the solenoid valve is approximately 3 psig (20.7 kPa) at full load conditions.

⚠ CAUTION

Warranty may be affected if wiring is not in accordance with specifications. A blown fuse or tripped protector indicates a short ground or overload. Before replacing fuse or restarting compressor, the trouble must be found and corrected. It is important to have a qualified control panel electrician service this panel. Unqualified tampering with the controls can cause serious damage to equipment and void the warranty.

⚠ Warning

The panel is always energized to ground even though the system switch is off.
If it is necessary to de-energize the complete panel including crankcase heaters, pull the main unit disconnect. Failure to do so can result in serious personal injury.

If motor or compressor damage is suspected, do not restart until qualified service personnel have checked the unit.

Electrical Terminals

⚠ Warning

To avoid injury from electric shock hazard, turn off all power before continuing with the following service.

All power electrical terminals should be retightened every six months, as they tend to loosen in service due to normal heating and cooling of the wire.

Operating Limits

- Maximum allowable condenser water pressure is 225 a psig (1552 kPa).
- Maximum allowable evaporator water pressure is 175 psig (1207 kPa).
- Maximum leaving condenser water temperature is 130°F (54.4°C) with R-22 and 160°F (71.1°F) with R-134a.
- Maximum allowable water temperature to evaporator in a nonoperating cycle is 105°F (40.5°C). Maximum entering water temperature for operating cycle is 90°F (32.2°C) (for example, during system changeover from heating to cooling cycle).
- Minimum leaving water temperature from the cooler without fluid freeze protection is 40°F (4.4°C).
- Minimum entering condenser water temperature is 60°F (15.6°C).

Compressor POE Oil

POE type oil is used for compressor lubrication. This type of oil is extremely hygroscopic, which means it will quickly absorb moisture if exposed to air and may form acids that can be harmful to the chiller. Avoid prolonged exposure of POE oil to the atmosphere to prevent this problem. For more details on acceptable oil types, contact your Daikin Applied service representative.

⚠ CAUTION

POE oil must be handled carefully using proper protective equipment (gloves, eye protection, etc.) The oil must not come in contact with certain polymers (e.g. PVC), as it may absorb moisture from this material. Also, do not use oil or refrigerant additives in the system.

It is important that only the manufacturer's recommended oils be used. Acceptable POE oil types are:

- CPI/Lubrizol Emkarate RL32-3 MAF
- Exxon/Mobil EAL Arctic 22 CC*
- Hatcol 22CC*
- Everest 22CC*
- Copeland Ultra 32-3 MAF
- Parker Emkarate RL32-3MAF
- Virginia LE323MAF
- Nu Calgon 4314-66

Note - * These types of oils can only be used as "Top Off" oils. This is defined as adding less than 50% of the total amount of oil in the unit.

Oil Equalization

All compressor models come equipped with oil equalization lines connecting the crankcases of the compressors. This allows the oil to move from one compressor crankcase to the other during normal operation, and balance between the two when the compressors are off. This method of equalization prohibits the oil level from dropping below the bottom level of the sightglass in one compressor. Some difference in crankcase oil levels will still exist during unit operation due to compressor internal pressures.

Small compressors have an oil level sightglasse in the compressor housing and a small equalization line. Larger compressors have a larger equalization line with an oil level sightglass in it.

Sightglass and Moisture Indicator

The refrigerant sight glasses should be observed periodically. A monthly observation should be adequate. A clear glass of liquid indicates that there is adequate refrigerant charge in the system to provide proper feed through the expansion valve. The sight glass should be clear when:

- Ambient temperature is above 75°F (23°C)
- Both compressors on a circuit are running
- All fans on a circuit are running

Bubbling refrigerant in the sight glass may occur at other conditions and *may* indicate that the system is short of refrigerant charge. Refrigerant gas flashing in the sight glass could also indicate an excessive pressure drop in the line, possibly due to a clogged filter-drier or a restriction elsewhere in the system. An element inside the sight glass indicates what moisture condition corresponds to a given element color. If the sight glass does not indicate a dry condition after about 12 hours of operation, the unit should be pumped down and the filter-driers changed.

If the system is suspected of being short of refrigerant, contact a qualified service technician with EPA certification to check out the unit and add refrigerant if necessary.

Crankcase Heaters

The compressors are equipped with crankcase heaters. The function of the heater is to keep the temperature in the crankcase high enough to prevent refrigerant from migrating to the crankcase and condensing in the oil during off-cycle. When a system is to be started up initially, the power to the heaters should be turned on for at least 12 hours before the compressors are started. The crankcase should be at about 80°F (26.7°C) before the system is started up, to minimize lubrication problems or liquid slugging of compressor on start-up.

If the crankcase is cool (below 80°F) (26.7°C) and the oil level in the sight glass is full to top, allow more time for oil to warm before starting the compressor.

The crankcase heaters are on whenever power is supplied to the unit and the compressor is not running.

Maintenance Schedule

	Monthly	Quarterly	Semi-Annually	Annually	As Required By Performance
I. Compressor					
A. Performance Evaluation (Log & Analysis) *	O				
B. Motor					
• Meg. Windings			X		
• Ampere Balance (within 10%)		X			
• Terminal Check (tight connections, porcelain clean)				X	
• Motor Cooling (check temperature)		X			
C. Lubrication System					
• Oil Level	O			X	
• Oil Appearance (clear color, quantity)	O				
• Oil change if indicated by oil analysis					X
II. Controls					
A. Operating Controls					
• Check Settings and Operation			X		
B. Protective Controls					
• Test Operation of:					
Alarm Relay		X			
Pump Interlocks		X			
High and Low Pressure Cutouts		X			
III. Condenser					
B. Test Water Quality		X			
C. Clean Condenser Tubes (or as required)				X	
D. Eddycurrent Test - Tube Wall Thickness					X
E. Seasonal Protection					X
IV. Evaporator					
B. Test Water Quality		X			
C. Clean Evaporator Tubes (or as required)					X
D. Eddycurrent Test - Tube Wall thickness (or as required)					X
E. Seasonal Protection					X
V. Expansion Valves					
A. Performance Evaluation (Superheat Control)		X			
VI. Compressor - Chiller Unit					
A. Performance Evaluation	O				
B. Leak Test:					
• Compressor Fittings and Terminal		X			
• Piping Fittings		X			
• Vessel Relief Valves		X			
C. Vibration Isolation Test		X			
D. General Appearance:					
• Paint				X	
• Insulation				X	
VII. Starter(s)					
A. Examine Contactors (hardware and operation)		X			
B. Verify Overload Setting and Trip		X			
C. Test Electrical Connections		X			
VIII. Optional Controls					
A. Hot Gas Bypass (verify operation)		X			

Key: O = Performed by in-house personnel X = Performed by service personnel

⚠ Warning

To avoid injury from electric shock hazard, turn off all power before continuing with the following service.

⚠ NOTICE

Anyone servicing this equipment shall comply with the requirements set forth by the EPA concerning refrigerant reclamation and venting.

Filter-Driers

To change the filter-drier, pump the unit down by moving pumpdown switches PS1 and PS2 to the manual pumpdown" position.

Unit Size	Circuit Number	Jumper Across Terminals
All Sizes	1	42 to 44
	2	72 to 74

Move the control switch S1 to the "off" position. Turn off all power to the unit and install jumpers across the terminals shown in the table. This will jump out the low pressure control. Close the manual liquid line shutoff valve(s). Turn power to the unit back on and restart the unit by moving the control switch S1 to the "on" position. The unit will start pumping down past the low pressure setting. When the evaporator pressure reaches 0 to 5 psig, (0 to 34.5 kPa) move control switch S1 to the "off" position. Remove the jumper.

Front seat the suction line King valve(s). Remove and replace the filter-drier(s). Evacuate the lines through the liquid line manual shutoff valve(s) to remove noncondensables that may have entered during filter replacement. A leak check is recommend before returning the unit to operation.

Liquid Line Solenoid Valve

The liquid line solenoid valve(s), which are responsible for automatic pumpdown during normal unit operation, do not normally require any maintenance. However, in the event of failure they can require replacement of the solenoid coil or of the entire valve assembly.

The solenoid coil can be removed from the valve body without opening the refrigerant piping by moving pumpdown switch(es) PS1 and PS2 to the "manual pumpdown" position.

The coil can then be removed from the valve body by simply removing a nut or snap ring located at the top of the coil. The coil can then be slipped off its mounting stud for replacement. Be sure to replace the coil on its mounting stud before returning pumpdown switch(es) PS1 and PS2 to the "auto pumpdown" position.

To replace the entire solenoid valve, follow the steps involved when changing a filter-drier.

Troubleshooting Chart

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 heating 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 lines. 4. Repair or replace. 5. Determine type and cause of shutdown and correct it before resetting safety switch. 6. None. Wait until unit calls for heating. 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 crankcase. 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 3. Noncondensables in system. 4. System overcharge with refrigerant. 5. Discharge shutoff valve partially closed. 6. Condenser undersized.	1. Investigate ways to increase hot water supply or lower the temperature of the hot water. Check operation of the supplementary heater. 2. Clean. 3. Purge the noncondensables. 4. Remove excess refrigerant. 5. Open valve. 6. Check condenser rating tables against the operation.
Low Discharge Pressure	1. Suction shutoff valve partially closed. 2. Insufficient refrigerant in system. 3. Low suction pressure. 4. Compressor operating unloaded. 5. Condenser too large. .	1. Open valve. 2. Check for leaks. Repair and add charge. 3. See corrective steps for low Suction pressure below. 4. See corrective steps for failure of compressor to load. 5. Check condenser rating table against the operation.
High Suction Pressure	1. Excessive load. 2. Expansion valve overfeeding. 3. Compressor unloaders open.	1. Reduce load or add additional equipment. 2. Check remote bulb. Regulate superheat. 3. See corrective steps for failure of compressor to load.
Low Suction Pressure	1. Lack of refrigerant. 2. Evaporator dirty. 3. Clogged liquid line filter-drier. 4. Clogged suction line or compressor suction gas strainers. 5. Expansion valve malfunctioning. 6. Condensing temperature too low. 7. Insufficient water flow.	1. Check for leaks. Repair and add charge. 2. Clean chemically. 3. Replace cartridge(s). 4. Clean strainers. 5. Check and reset for proper superheat. Replace if necessary. 6. Check means for regulating condensing temperature. 7. Adjust flow.
Compressor will Not Unload or Load Up	1. Defective capacity control. 2. Faulty thermostat stage or broken capillary tube. 3. Stages not set for application.	1. Replace 2. Replace 3. Reset thermostat setting to fit application.
Compressor Loading/Unloading Intervals Too Short	1. Erratic water thermostat. 2. Insufficient water flow.	1. Replace 2. Adjust flow.

Table continued on next page.

Troubleshooting Chart, Continued

Little or No Oil Pressure	1. Clogged suction oil strainer. 2. Excessive liquid in crankcase. 3. Oil pressure gauge defective. 4. Low oil pressure safety switch defective 5. Worn oil pump. 6. Oil pump reversing gear stuck in wrong position. 7. Low oil level. 8. Loose fitting on oil lines. 9. Pump housing gasket leaks. 10. Flooding of refrigerant into crankcase.	1. Clean. 2. Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. 3. Repair or replace. Keep valve closed except when taking reading. 4. Replace 5. Replace 6. Reverse direction of compressor rotation by switching compressor leads. 7. Add oil. 8. Check and tighten system. 9. Replace gasket. 10. Adjust thermal expansion valve.
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. 7. Failure of second starter to pull in on part winding start system.	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. 7. Repair or replace starter or time delay mechanism.
Compressor Thermal Switch Open	1. Operating beyond design conditions. 2. Discharge valve partially shut. 3. Blown valve plate gasket.	1. Add facilities so that conditions are within allowable limits. 2. Open valve. 3. Replace gasket.
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.”

Daikin Applied Training and Development

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