McQuay®
Air Conditioning

Installation and Maintenance Data

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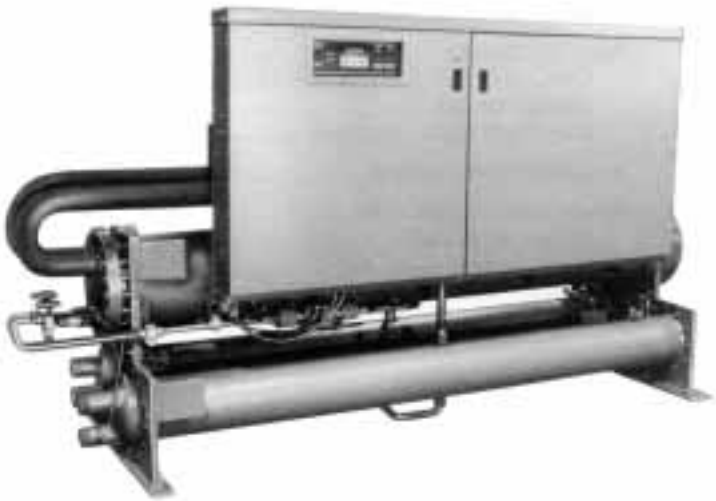
MicroTech® Reciprocating Chiller/Templifier Control

For Software Version RCPXX02C

Models ALR-035D thru 185D



Models WHR-040E thru 210E

Models THR-040D thru 170D

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Installation Precautions

⚠CAUTION

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. **McQuay International disclaims any liability resulting from any interference or for the correction thereof.**

⚠CAUTION

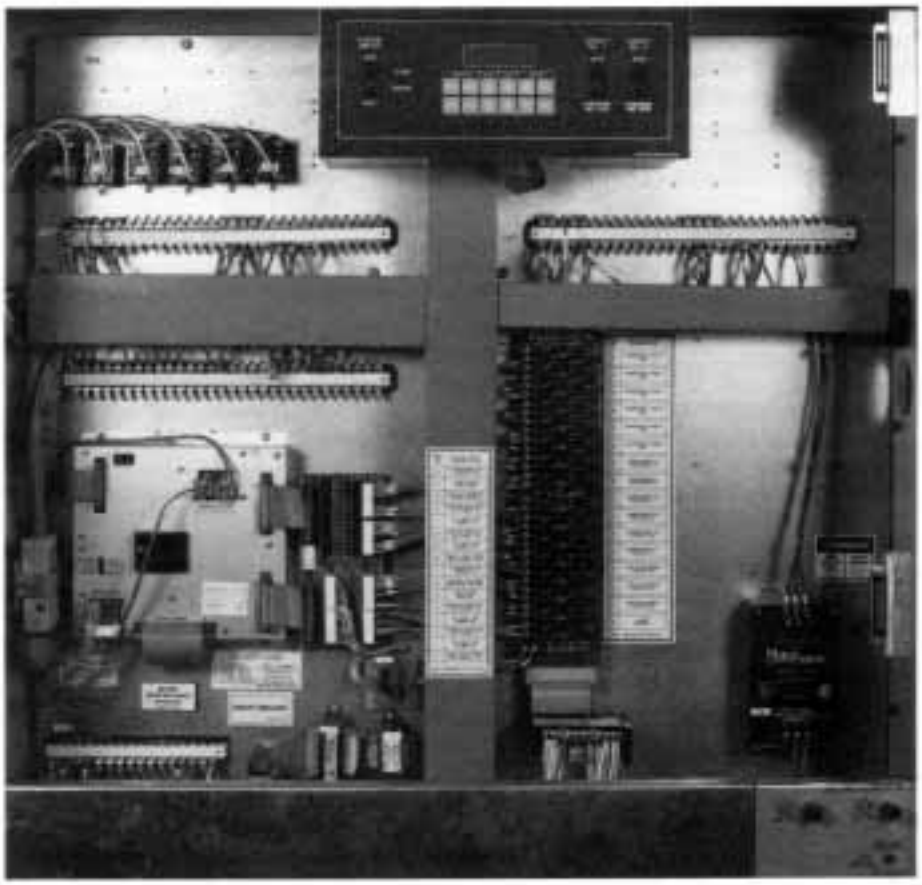
The McQuay MicroTech control panel contains static sensitive components. A static discharge while handling electronic circuit boards may cause damage to the components. To prevent such damage during service involving board replacement, McQuay International recommends discharging any static electrical charge by touching the bare metal inside the panel before performing any service work.

⚠CAUTION

Excessive moisture in the control panel can cause hazardous working conditions and improper equipment operation. When servicing equipment during rainy weather conditions, the electrical components in the main control panel must be protected.

The MicroTech controller is designed to operate within an ambient temperature range of -40 to 149°F and a maximum relative humidity of 95% (non-condensing).

Figure 1. Control cabinet interior



Introduction

This manual provides installation, setup and troubleshooting information for the MicroTech controller as provided on select models of McQuay reciprocating chillers and heat pumps. Please refer to the appropriate unit installation manual for unit application information as well as water and refrigerant piping details.

All operational descriptions contained in this manual are based on MicroTech controller software versions RCPXX02C. Operating characteristics and menu selections may vary with other versions of controller software. Contact McQuayService for software update information.

General Description

The MicroTech Unit Control Panel, available on some McQuay ALR, WHR, and THR products, contains a Model 250 microprocessor based controller which provides all monitoring and control functions required for the safe, efficient operation of the unit. The operator can monitor all operating conditions by using the panels built in 2-line by 16-character display and keypad or by using an IBM compatible computer running McQuay Monitor software. In addition to providing all normal operating controls, the MicroTech controller monitors all safety devices on the unit and will shut the system down and close a set of alarm contracts if an alarm condition develops. Important operating conditions at the time an alarm occurs are retained in the controllers memory to aid in troubleshooting and analysis.

The system is protected by a simple password scheme which only allows access by authorized personnel. A valid password must be entered into the panel keypad by the operator before any setpoints may be altered.

Features of the MicroTech Control Panel

- Enhanced head pressure control on air cooled units resulting in increased total unit SEER during transitional seasons.
- 12-key keypad for adjusting water temperature set points, low water temperature cutout, high pressure cutout, suction pressure cutout, and freeze protection. The operator can use the keypad to monitor various operating conditions, setpoints or alarm messages.
- Easy-to-read 2-line by 16-character display for plain English readout of operating temperatures and pressures, operating modes or alarm messages.
- Security password protection against unauthorized changing of set points and other control parameters.
- Complete plain English diagnostics to inform the operator of pre-alarms and alarms. All alarms are time and date stamped so there is no guessing of when the alarm condition occurred. In addition, some operating conditions that existed at the instant of shutdown can be recalled to aid in isolating the cause of the problem.
- Soft Loading feature to reduce electrical consumption and peak demand charges during start-up.
- Easy integration into building automation systems via separate 4-20 milliamp signals for chilled water reset and demand limiting *(chillers only)*.
- Internal time clock for on/off scheduling.
- Communications capabilities for local system monitoring, changing of set points, trend logging, remote reset, alarm and event detection via IBM-compatible PC. The optional modem kit supports the same features from an off-site PC running the McQuay Monitor software.
- Manual control mode to override automatic unit staging. Useful for system checkout.

Optional Sensor Packages

Water and air sensor package

Air cooled units:
- Entering evaporator water temperature
- Ambient outside air temperature

Water cooled units only:
- Entering evaporator water temperature
- Entering condenser water temperature
- Leaving condenser water temperature

Refrigerant sensor package

- Suction line temperature, circuit #1
- Suction line temperature, circuit #2
- Liquid line temperature, circuit #1
- Liquid line temperature, circuit #2

(Provides direct display of subcooling and superheat).

Unit amp package

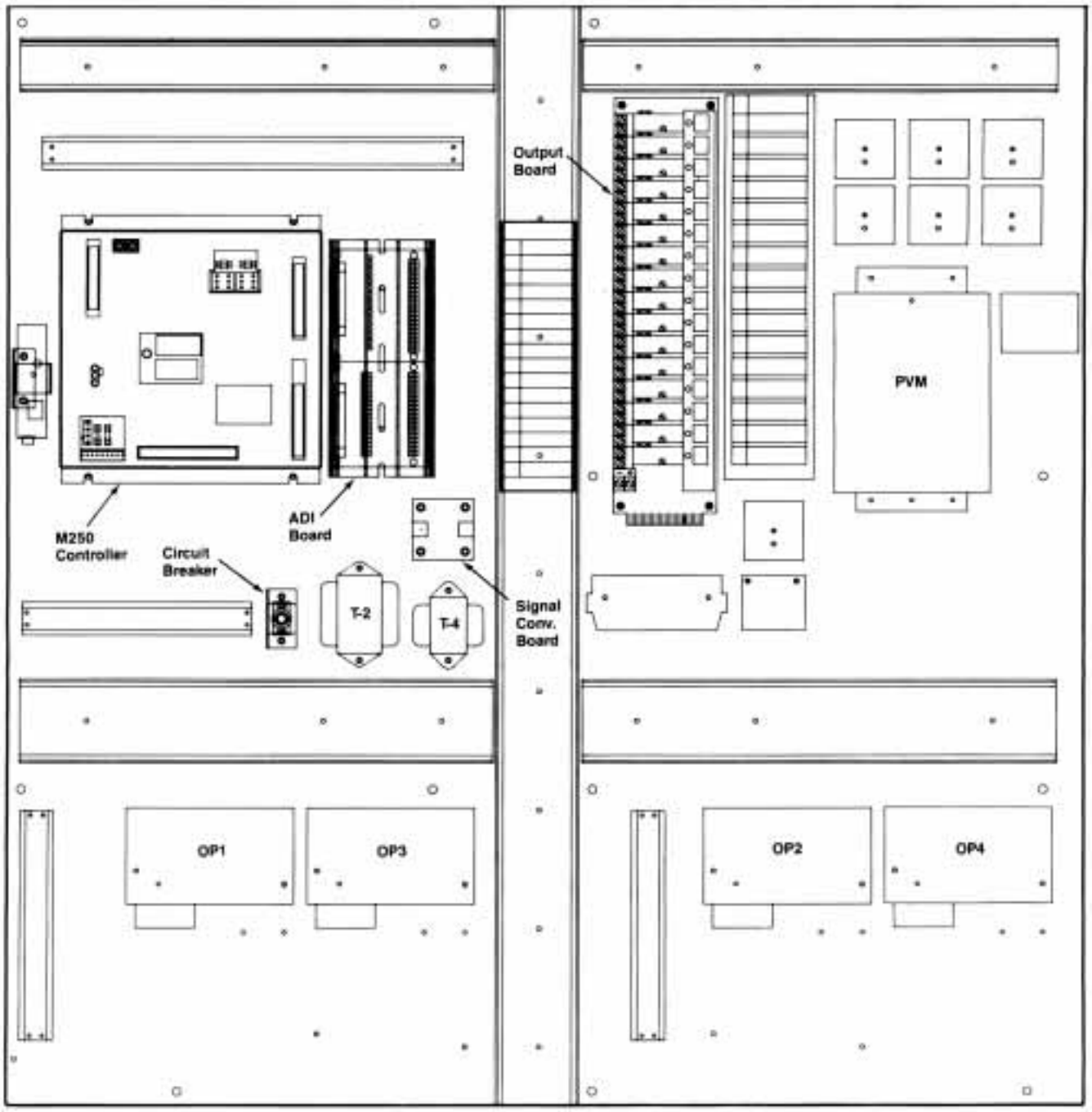
Percent total unit amperage including compressors and condenser fans. Does not include externally powered equipment such as water pumps.

Controller Layout

All major MicroTech components are mounted inside the control section side of the unit's control cabinet. The individual components are interconnected by ribbon cables, shielded multi-conductor cables or discrete wiring. Power for the system is provided by transformers T-2 and T-4. All field wiring must enter the control cabinet through the knockouts provided and is terminated on field wiring terminal strips.

The standard ALR keypad/display is located inside the control cabinet for protection from the weather while the back lit WHR and THR keypad/displays are accessible through the exterior of the control cabinet. See Figure 2 for typical control cabinet layout.

Figure 2. Typical control cabinet layout



Component Data

Microprocessor control board

The Model 250 Microprocessor Control Board contains the electronic hardware and software necessary to monitor and control the unit. The microprocessor control board receives input from the Analog/Digital Input Board (ADI) and sends commands to the output board, maintaining the unit's optimum operating mode for the current conditions. Status lights mounted on the control board indicate operating condition of the microprocessor.

Analog/digital input board (ADI)

The ADI board provides low voltage power for the temperature and pressure sensors. The ADI board also provides optical isolation between the microprocessor control board and all 24 volt switch inputs. LEDs on the ADI board provide visual indication of the status of all digital inputs. All analog and digital signals from sensors, transducers, and switches received by the ADI board and sent to the microprocessor control board for interpretation.

Output board

The output board contains up to 16 solid-state relays. These relays control all compressors, condenser fans, solenoid valves, and alarm annunciation. The output board receives control signals from the microprocessor control board through a 50 conductor ribbon cable.

Keypad and display

The keypad and display is the primary operator interfaces to the unit. When the operator has entered a valid password (see page 27), operating conditions, system alarms, and set points can be monitored from this display and all adjustable set points can be modified from this keypad.

Thermistor sensors

MicroTech panels use a negative temperature coefficient thermistor for temperature sensing. A sensor operating correctly will measure 3,392 ohms at 72°F. See Table 1 below for temperature conversion information.

Pressure transducers

Pressure transducers are selected for a specific operating range and provide an output signal proportional to the sensed pressure. Typical range for evaporator sensor is 5 to 145 psig with a resolution of 0.1 psig. Condenser pressure sensors have a range of 20 to 450 psig and a resolution of 0.5 psig. Pressure transducers require an external 5 volts DC power supply (provided at field wiring terminal #214) to operate. Do not use this connection to power any additional devices. The transducer output characteristics are shown in Figures 3 and 4 on page 8.

Table 1. MicroTech thermistors (resistance and voltage vs. temperature)

Temp °F	Temp °C	Resistance Ohms	VDC Input	Temp °F	Temp °C	Resistance Ohms	VDC Input	Temp °F	Temp °C	Resistance Ohms	VDC Input
0	-17.8	25,617	4.426	50	10.0	5,971	3.213	100	37.8	1,747	1.724
1	-17.2	24,817	4.410	51	10.6	5,814	3.183	101	38.3	1,708	1.698
2	-16.7	24,044	4.393	52	11.1	5,662	3.152	102	38.9	1,670	1.673
3	-16.1	23,299	4.376	53	11.7	5,514	3.121	103	39.4	1,633	1.648
4	-15.6	22,579	4.359	54	12.2	5,371	3.090	104	40.0	1,597	1.624
5	-15.0	21,883	4.341	55	12.8	5,231	3.059	105	40.6	1,562	1.600
6	-14.4	21,212	4.323	56	13.3	5,096	3.028	106	41.1	1,528	1.576
7	-13.9	20,563	4.305	57	13.9	4,965	2.996	107	41.7	1,494	1.552
8	-13.3	19,937	4.286	58	14.4	4,838	2.965	108	42.2	1,461	1.528
9	-12.8	19,332	4.267	59	15.0	4,714	2.934	109	42.8	1,430	1.505
10	-12.2	18,747	4.248	60	15.6	4,594	2.902	110	43.3	1,398	1.482
11	-11.7	18,182	4.228	61	16.1	4,477	2.871	111	43.9	1,368	1.459
12	-11.1	17,636	4.208	62	16.7	4,363	2.839	112	44.4	1,339	1.437
13	-10.6	17,108	4.187	63	17.2	4,252	2.808	113	45.0	1,310	1.415
14	-10.0	16,597	4.167	64	17.8	4,146	2.777	114	45.6	1,282	1.393
15	-9.4	16,104	4.145	65	18.3	4,042	2.745	115	46.1	1,254	1.371
16	-8.9	15,627	4.124	66	18.9	3,941	2.714	116	46.7	1,228	1.350
17	-8.3	15,166	4.102	67	19.4	3,843	2.683	117	47.2	1,201	1.328
18	-7.8	14,720	4.080	68	20.0	3,748	2.651	118	47.8	1,176	1.308
19	-7.2	14,288	4.057	69	20.6	3,655	2.620	119	48.3	1,151	1.287
20	-6.7	13,871	4.034	70	21.1	3,565	2.589	120	48.9	1,127	1.267
21	-6.1	13,467	4.011	71	21.7	3,477	2.558	121	49.4	1,103	1.247
22	-5.6	13,076	3.988	72	22.2	3,392	2.527	122	50.0	1,080	1.227
23	-5.0	12,690	3.964	73	22.8	3,309	2.496	123	50.6	1,058	1.208
24	-4.4	12,333	3.940	74	23.3	3,228	2.465	124	51.1	1,036	1.189
25	-3.9	11,979	3.915	75	23.9	3,150	2.434	125	51.7	1,014	1.170
26	-3.3	11,636	3.890	76	24.4	3,074	2.404	126	52.2	993	1.151
27	-2.8	11,304	3.865	77	25.0	3,000	2.373	127	52.8	973	1.133
28	-2.2	10,983	3.839	78	25.6	2,927	2.343	128	53.3	953	1.115
29	-1.7	10,672	3.814	79	26.1	2,857	2.313	129	53.9	933	1.097
30	-1.1	10,371	3.788	80	26.7	2,789	2.283	130	54.4	914	1.079
31	-0.6	10,079	3.761	81	27.2	2,723	2.253	131	55.0	895	1.062
32	0.0	9,797	3.734	82	27.8	2,658	2.223	132	55.6	877	1.045
33	0.6	9,523	3.707	83	28.3	2,595	2.194	133	56.1	859	1.028
34	1.1	9,258	3.680	84	28.9	2,534	2.164	134	56.7	842	1.012
35	1.7	9,002	3.653	85	29.4	2,474	2.135	135	57.2	825	0.995
36	2.2	8,753	3.625	86	30.0	2,416	2.106	136	57.8	809	0.980
37	2.8	8,512	3.597	87	30.6	2,360	2.077	137	58.3	792	0.963
38	3.3	8,278	3.569	88	31.1	2,305	2.049	138	58.9	777	0.948
39	3.9	8,052	3.540	89	31.7	2,251	2.020	139	59.4	761	0.932
40	4.4	7,832	3.511	90	32.2	2,199	1.992	140	60.0	746	0.917
41	5.0	7,619	3.482	91	32.8	2,148	1.964	141	60.6	731	0.902
42	5.6	7,413	3.453	92	33.3	2,099	1.937	142	61.1	717	0.888
43	6.1	7,213	3.424	93	33.9	2,051	1.909	143	61.7	703	0.874
44	6.7	7,019	3.394	94	34.4	2,004	1.882	144	62.2	689	0.859
45	7.2	6,831	3.365	95	35.0	1,959	1.855	145	62.8	676	0.846
46	7.8	6,648	3.335	96	35.6	1,914	1.828	146	63.3	662	0.831
47	8.3	6,471	3.305	97	36.1	1,871	1.802	147	63.9	649	0.818
48	8.9	6,299	3.274	98	36.7	1,829	1.776	148	64.4	627	0.794
49	9.4	6,133	3.244	99	37.2	1,788	1.750	149	65.0	625	0.792

Figure 3. Evaporator transducer

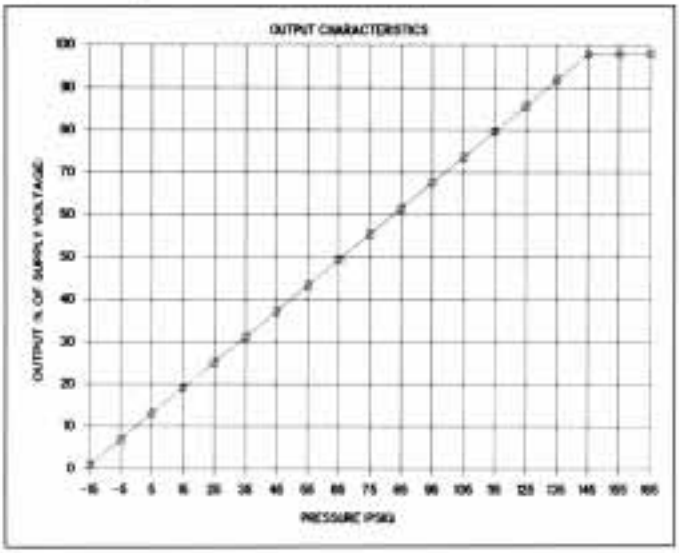
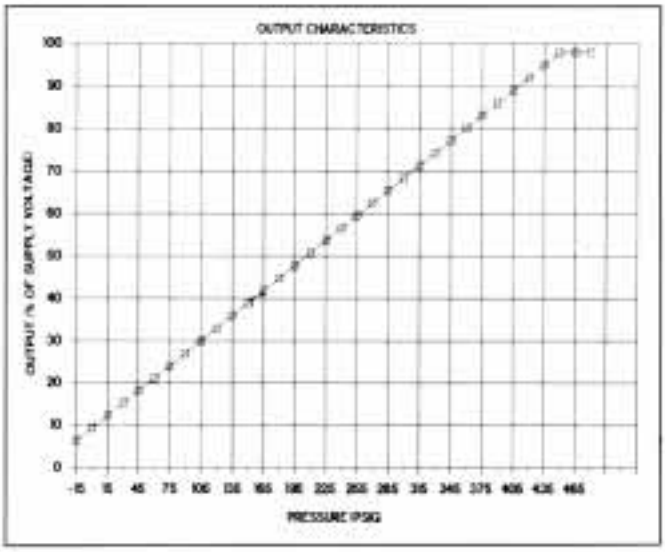


Figure 4. Condenser transducer



Installation and Maintenance

The MicroTech controller is shipped factory tested and configured for the unit being controlled.

Sensors and transducers

Sensors and transducers are mounted and connected to the MicroTech field wiring strip with shielded cable. Transducers are on Shrader fittings and sensors are in wells except the optional suction and liquid line sensors (in the refrigerant sensor package). The suction and liquid line sensors are placed in a copper sleeve that is brazed to the copper tubing. Insulation is placed around the assembly.

Sensors and transducers are connected to the MicroTech analog inputs with IDC connectors (Insulation Displacement Connectors).

To change the transducers, just unscrew and replace. The transducers have removable cables. High pressure transducers have a red dot on them and low pressure transducers have blue dots. Sensors do not have separate cables.

Control wiring

Low voltage control wiring is installed, labeled and tested by the factory before shipment.

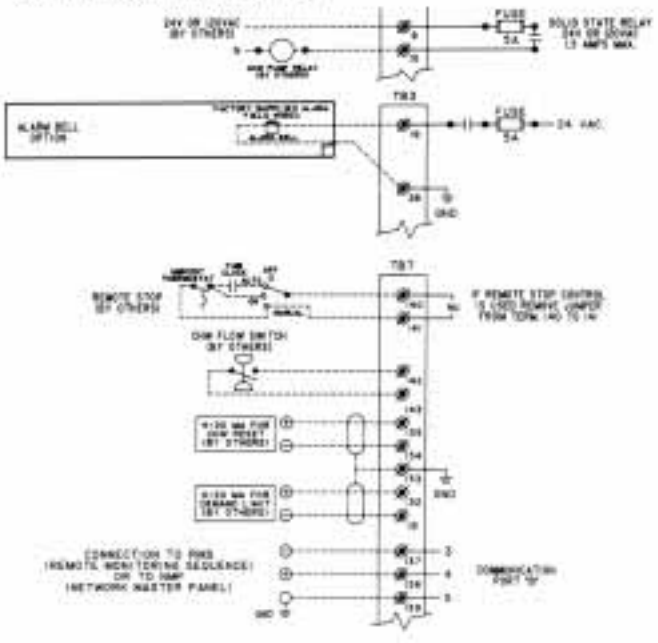
Remote 4-20 milliamp signals

Signals for leaving water reset and demand limiting can be provided by the customer and should be connected to the terminals on the field wiring strip inside the control cabinet. See to the Field Wiring section for more details.

Interlock wiring

All interlock wiring to field devices (such as flow switches and pump starters) is provided by the installing contractor. See Figure 5, unit wiring schematics, and field wiring diagrams at the end of this manual for details.

Figure 5. Typical field wiring



Unit set points and calibration

The control software is installed and tested by the factory before shipping. No periodic calibration of the controller is necessary. All control and safety set points must be checked by the installing contractor and adjusted as necessary before starting the unit. Controllers for McQuay chillers and Templifiers have default set points (shown on Menus 13 through 22, Table 8 pages 34-36) for:

- Control mode
- Leaving water temperature
- Head pressure settings
- Compressor staging
- Soft loading
- Holiday dates
- Internal scheduling
- Alarm functions

The default set points are suitable for most installations.

On Menu 13, the default control mode is set for "Manual Unit Off". Adjust this setting before continuing with unit operation. Check and set the control and safety settings for the application before staging the unit. For more information on menu items, see the Menu Description section of this manual.

Modem kit

An optional modem kit allowing remote monitoring of the chiller from an off-site PC running the McQuay Monitor™ software is available from McQuayService. The kit — complete with modem, mounting bracket, wiring harness, and installation instruction can be installed in the field or at the factory. Modem wiring is shown on the MicroTech wiring schematic. For more information, see "Telephone Line" in the Field Wiring section.

Optional sensors

Optional sensor kits, available from the factory, can be installed in the field. Thermistors in the optional sensor kit are negative coefficient type and have the same characteristics (see Table 1, page 7) as the thermistors used on McQuay centrifugal chillers. Contact McQuayService for Retrofit kits and ordering information.

Field Wiring

Interconnecting wiring for the reciprocating control panel consists of:

- 115 VAC power wiring
- Analog input signals
- Digital input signals
- Digital output signals
- Condenser pump
- Fan starter
- Communications to a personal computer
- Telephone line for remote modem access

See Figure 5 and unit field wiring diagrams at the end of this manual for more details.

Power wiring

Separate disconnects for the cooler heating tape and control circuit transformer are available as options on ALR units. The installing contractor provides the 115 VAC power source, disconnect, 10 amp fuse, and necessary wiring for these circuits. All wiring must conform to the National Electrical Code and applicable local building codes. If the separate power option is used, then the installing contractor must remove wires 540 and 545 from terminals #13 and #16 on TB2 before running the unit. See the ALR Field Wiring Diagram for more detail.

Power supplies

There are several internal power supplies used by the controller and related circuitry. The regulated 5 VDC power on terminal #214 is used to support the analog inputs on the ADI board. Do not use this power supply to operate external devices. An unregulated 12 VDC power supply is available on field wiring terminal #146 and an unregulated 24 VAC power supply is available on field wiring terminal #25.

Analog input signals

All sensors and transducers required for normal chiller operation are installed and wired at the factory. All optional analog signal wiring provided by the installing contractor must be twisted, shielded pair (Belden #8760 or equal). Figure 5 and unit field wiring diagrams at the end of this manual for more detail. The optional demand limit and leaving water reset signals are 4 to 20 milliamp DC signals. The resistive load that conditions the milliamp signal is a 249 ohm resistor mounted on the ADI board at the factory.

Remote demand limit

To use the demand limit function, the installer will connect the wiring to terminals #131 and #132 on TB7. Demand Limit can only be used on WHR and ALR units. See the MicroTech schematic and Field Wring diagrams at the end of this manual for more detail. More information on how Demand Limit works is available in the Remote Demand Limit section of this manual.

Leaving water reset*

Leaving water reset on ALRs, WHRs and THRs may be achieved by using the "4-20mA Reset" option on Menu 14. The installer must connect wiring to terminals #134 and #135 on TB7. See the Reset Options section of this manual for more detail.

Digital input signals

Remote contacts for all digital inputs into the MicroTech controller must be dry contacts suitable for the 24 VAC control signals from the reciprocating control panel. *Do not connect 120 VAC control power to these or any other connecting circuits.*

Remote stop/start

If remote stop/start control is preferred, then remove the jumper between terminals #140 and #141 on TB7. When the remote stop/start switch is open, the controller will be in the "off: remote Sw" mode. The unit is enabled when the switch is closed.

Chilled water flow switch

The chilled water flow switch is connected to field wiring terminals #142 and #143 on TB7. When the chilled water pump is enabled, the MicroTech controller checks for proof-of-flow through the flow switch digital input.

Digital outputs

The MicroTech output device is a normally open solid-state relay with an on-board, replaceable 5 amp fuse. The status of all outputs are shown by individual red LEDs.

*Not available on ALRs when Ice mode is selected.

Chilled water pump relay
The optional chilled water pump relay is connected to terminal #10 on TB2. When the unit is enabled, the chilled water pump relay is energized. Be sure the relay coil is rated for a maximum load of 1.8 amps at 120 VAC.

External alarm annunciator circuitry
An audible alarm connected to the Alarm Output of the reciprocating control panel is highly recommended to make certain the operator is alerted to any alarm condition.

The MicroTech panel can activate an external alarm circuit when an alarm or pre-alarm condition is detected. The alarm signal is de-energized during normal operations. During an alarm condition the alarm circuit will energize and the alarm status light will be lit. During a pre-alarm condition, the alarm output and status light will pulse "on" for one-half second and "off" for four seconds.

24 VAC is available at field wiring terminal #19 to power a bell, light, relay, or other external alarm devices. The installing contractor must provide and install an alarm anunciator rated for a maximum load of 1.8 amps at 24 VAC. See the field wiring diagrams at the end of this manual for terminal locations.

NOTE

The alarm signal is ***not*** active during a power failure and will not provide a "Loss of Power" alarm.

115 VAC power for the optional control transformer is obtained from the 3-phase power connection provided by the electrical contractor.

Condenser fan wiring for chillers without condensers
The first fan of each circuit is to be wired in parallel with the first compressor stage for each circuit. Each refrigerant circuit has three additional digital outputs available for refrigerant head pressure control. Each output will energize an additional bank of condenser fans with each bank consisting of 1 or 2 fans, depending on the size of the unit. The relays used to energize the fan motors must be rated for 120 VAC, 1.5 amps maximum per coil. If McQuay APD condenser is used, then the relays will be supplied by the factory. Relays and fans are denoted as M12 through M24. The first number indicates the circuit while the second number indicates the fan or fan bank number. See the Field Wiring Diagram and Staging Schematics at the end of this manual for more detail.

Condenser pump or fan starter

Terminals #11 and #12 on TB2 on water cooled units are reserved for starting the first fans of each circuit on a remote condenser or for starting a single condenser pump. The relay coils should be rated for a maximum load of 1.8 amps at 120 VAC. The terminals are wired in parallel with the compressor outputs so the coils will be energized with the first compressor stage.

To start a condenser pump, install a jumper between terminals #11 and #12 and connect a single starter between terminals #11 and #16 on TB2. When either of the lead compressor start, the condenser pump will start .

To start a fan, connect the first fan of circuit #1 to terminals #11 and #16 on TB2. Connect the first fan of circuit #2 to terminal #12 and #16 on TB2. When the lead compressor of a circuit starts, the first condenser fan will start. See the Field Wiring Diagram and Compressor Control Schematics in the back of this manual for more detail.

PC connection

The MicroTech controller can be connected to an IBM or IBM compatible computer for local or remote system monitoring. Communication network wiring uses low voltage shielded twisted pair cable (Belden 8760 or equal). The network uses the RS232 communications standard with a maximum cable length of 50 feet. An RS232/485 adapter may be used to allow for cable runs to 5000 feet. See the Personal Computer Specification section of this manual for hardware requirements.

Telephone line

If remote access and monitoring of the unit is chosen, then a voice quality direct dial telephone line is required. The line must be a dedicated line and used only for modem access. The phone line must be terminated with a standard RJ-11 modular phone plug. See the Start-Up and Shutdown section of this manual for more detail on start-up procedures.

Software Identification

Control software is factory installed and tested in each panel prior to shipment. The software is identified by a program code which is printed on a small label attached to the controller. The software version may also be displayed on the keypad display be viewing the last menu item in the Misc Setup menu (menu 23).

The software "version" is the 6th and 7th digit of the software identification. In this example, the version is "01" and the revision to the software is "B". Revisions are released in alphabetical order. The latest reciprocating chiller/Templifier codes are RCP2E01B and RCP2S01B, released July 1995.

The new reciprocating codes are from a single master code which combined chiller and Templifier functions. The new code enables selection of chiller or chiller/Templifier operation. A high memory chip is required to run this software. Controller series 250-4 and greater can successfully run on chiller/Templifier software versions.

Example of typical software identification

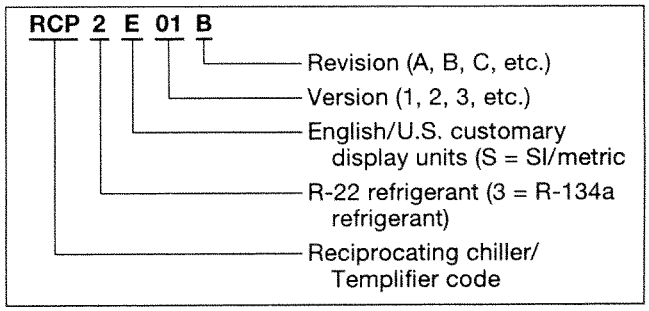
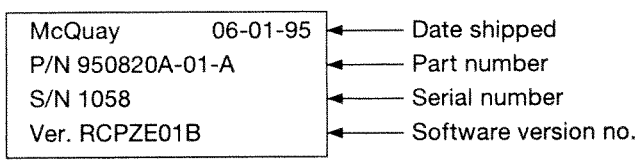


Figure 6. Software ID tag

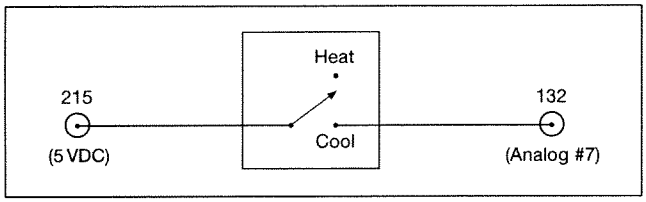


Analog inputs

Analog inputs are used to read the various temperatures and pressures on the chiller as well as any customer supplied 4-20mA reset signals. The controller's internal regulated 5 VDC and 12 VDC supplies provide the correct operating voltage for the sensors. See Table 2 for details.

Input No.	Description
0	**Leaving evaporator water temperature** Sensor is located in the leaving chilled water nozzle. The signal is used for capacity control and freeze protection.
1	**Evaporator pressure transducer circuit #1** Sensor is located in the common circuit #1 suction line. Used to determine suction saturated refrigerant pressure and temperature. This sensor also provides refrigerant freeze protection for circuit #1.
2	**Evaporator pressure transducer circuit #2** Sensor is located in the common circuit #2 suction line. Used to determine suction saturated refrigerant pressure and temperature. This sensor also provides refrigerant freeze protection for circuit #2.
3	**Condenser pressure transducer circuit #1** Saturated refrigerant pressure and temperature.
4	**Condenser pressure transducer circuit #2** Saturated refrigerant pressure and temperature.
5	**Transducer power voltage ratio signal** The signal is used to correct for differences between the controller power supply and an ideal 5 VDC supply. The controller uses this information to ensure temperature and pressure sensor accuracy and for alarm monitoring.
6	**Evaporator water temperature reset** A 4 to 20 milliamp DC signal from a building automation system or temperature transmitter to reset the leaving chilled water set point. The impedance of the ADI board is 249 ohms.
7	**Demand limit** A 4 to 20 milliamp signal from a building automation system to determine the maximum number of cooling stages which may be energized. The impedance of the ADI board is 249 ohms.
8	**Chiller/Templifier signal** *(on THR heat pumps only)* In place of the Demand Limit input, a 0 or 5 volt signal from a unit mounted switch allows the unit to run in heat (0 volts – switch open) or cool (5 volts – switch closed) modes.

Front panel mount heat/cool switch



Input No.	Description
9	**Entering evaporator water temp** *(optional)* Sensor is located in the entering chilled water nozzle. The signal is used for monitoring and for the return reset option if selected.
10	**Entering condenser water temp** *(optional)* *(O.A. temp for air cooled units)* Sensor is located in the common entering condenser water nozzle or located remotely as an outside air temp sensor for air cooled units. This sensor is used for monitoring purposes only.
11	**Leaving condenser water temperature** *(standard on THR heat pumps; optional on WHR chillers)* For WHRs, sensor is located in leaving water nozzle of one condenser only. For THRs, sensor is located in common line of manifolded condenser head. The signal is used for capacity control on THRs and for monitoring only on WHRs.
12	**Percent of total unit amps** *(optional)* A current transformer and adjustable voltage dropping resistor located in the power side of the control box along with a voltage converter board sends a DC signal proportional to total motor current to the microprocessor. *0 VDC = 0%, 4 VDC = 100%*
13	**Suction temp circuit #1** *(optional)* Sensor located in a copper sleeve brazed to the circuit #1 suction line measures refrigerant temperature to calculate superheat. This sensor is used for monitoring purposes only.
14	**Suction temp circuit #2** *(optional)* Sensor located in a copper sleeve brazed to the circuit #2 suction line measures refrigerant temperature to calculate superheat. This sensor is used for monitoring purposes only.
15	**Liquid line temp circuit #1** *(optional)* Sensor located in a copper sleeve brazed to the circuit #1 liquid line measures refrigerant temperature to calculate subcooling. This sensor is used for monitoring purposes only.
16	**Liquid line temp circuit #2** *(optional)* Sensor located in a copper sleeve brazed to the circuit #2 liquid line measures refrigerant temperature to calculate subcooling. This sensor is used for monitoring purposes only.

Table 2. Analog inputs

Input	LED	Description	Circuit	Closed	Open
0	0	Mechanical high pressure switch	Circuit #1	Normal	High pressure
1	1	Oil differential pressure switch	Compressor 1	Normal	Low oil pressure
2	2	Motor protection switch	Compressor 1	Normal	High compressor temperature
3	3	Oil differential pressure switch	Compressor 3	Normal	Low oil pressure
4	4	Motor protection switch	Compressor 3	Normal	High compressor temperature
5	5	System switch	Unit	Normal	Unit shutdown
6	6	Phase/voltage monitor	Unit	Normal	PVM alarm
7	7	Pumpdown switch	Circuit #1	Normal	Manual pumpdown
8	8	Mechanical high pressure switch	Circuit #2	Normal	High press
9	9	Oil differential pressure switch	Compressor 2	Normal	Low oil pressure
10	10	Motor protection switch	Compressor 2	Normal	High compressor temperature
11	11	Oil differential pressure switch	Compressor 4	Normal	Low oil pressure
12	12	Motor protection switch	Compressor 4	Normal	High compressor temperature
13	13	Remote stop switch	Unit	Run	Pumpdown & stop
14	14	Water flow switches	Unit	Normal	No evaporator *(condenser)* flow
15	15	Pumpdown switch	Circuit #2	Normal	Manual pumpdown

Digital inputs

Note: *All Digital Inputs are 24 VAC. At 7.5 VAC to 24 VAC the digital input contacts are considered closed. Below 7.5 VAC, the contacts are considered open. See Table 3 for details and operating characteristics.*

Table 3. Digital inputs

Input	Function	Location	Range	Resolution
0	Leaving Chw temperature	Leaving Chw nozzle	-40 to 263°F	0.1°F
1	Circuit #1 evaporator pressure	Circuit #1 suction line	5 to 145 psig	0.1 psi
2	Circuit #2 evaporator pressure	Circuit #2 suction line	5 to 145 psig	0.1 psi
3	Circuit #1 condenser pressure	—	20 to 450 psig	0.5 psi
4	Circuit #2 condenser pressure	—	20 to 450 psig	0.5 psi
5	Voltage ratio signal	EnGinn power supply	—	—
6	Chw reset signal	Supplied by others	4 to 20mA DC	—
7	Demand limit signal	Supplied by others	4 to 20mA DC	—
8	Entering evaporator water temperature	Entering Chw nozzle	-40 to 263°F	0.1°F
9	Entering condenser water temperature	Entering condenser water nozzle	-40 to 263°F	0.1°F
10	Leaving condenser water temperature	Leaving condenser water nozzle	-40 to 263°F	0.1°F
11	% total unit amps	Control cabinet	0 to 4 VDC	1%
12	Circuit #1 suction temperature	Circuit #1 suction line	-40 to 263°F	0.1°F
13	Circuit #2 suction temperature	Circuit #2 suction line	-40 to 263°F	0.1°F
14	Circuit #1 liquid line temperature	Circuit #1 liquid line	-40 to 263°F	0.1°F
15	Circuit #2 liquid line temperature	Circuit #2 liquid line	-40 to 263°F	0.1°F

Relay board outputs

All of the MicroTech panel outputs are controlled by solid-state relays which are driven by the model 250 controller. The controller activates a solid-state relay by sending a "trigger" signal to the output board via the attached ribbon cable. The relay responds to the trigger by lowering it's resistance which allows current to flow through it's "contacts". When the controller removes the trigger signal, the relay's resistance becomes very high, causing the current flow to stop. The outputs are individually protected by a 5 amp fuse mounted on the output board adjacent to each relay. Tables 4 and 5 provide additional information about each output. Refer to the MicroTech Stage Schematics for digital output wiring.

Table 4. ALR relay board outputs

Digital Output Number	Output Description	4-Stage Compressor Capacity		6-Stage Compr Capacity	8-Stage Compr Capacity
		2-Compressor		2-Compr	4-Compr
		035-070	050-070	050-070	085-185
0	Alarm circuit	Same	Same	Same	Same
1	Chilled water pump relay	Same	Same	Same	Same
2	Liq Sol Circ #1	Same	Same	Same	Same
3	Liq Sol Circ #2	Same	Same	Same	Same
4	Cooling	Compr 1 Circ #1	Compr 1 Circ #1	Compr 1 Circ #1	Compr 1 Circ #1
5	Cooling	Compr 2 Circ #2	Compr 2 Circ #2	Compr 2 Circ #2	Compr 2 Circ #2
6	Cooling	Compr 1 Unldr 1	Compr 1 Unldr 1	Compr 1 Unldr 1	Compr 1 Unldr 1
7	Cooling	Compr 2 Unldr 1	Compr 2 Unldr 1	Compr 2 Unldr 1	Compr 2 Unldr 1
8	Cooling	Not used	Not used	Compr 1 Unldr 2	Compr 3 Circ #1
9	Cooling	Not used	Not used	Compr 2 Unldr 2	Compr 4 Circ #2
10	Condenser fan(s) M12①	Same	Same	Same	Same
11	Condenser fan(s) M13	—	Same	Same	Same
12	Condenser fan(s) M14	—	Same	Same	Same
13	Condenser fan(s) M22	Same	Same	Same	Same
14	Condenser fan(s) M23	—	Same	Same	Same
15	Condenser fan(s) M24	—	Same	Same	Same

Note:
① Number of fans varies. Refer to the Head Pressure Control section of this manual for Fan Staging information.

Table 5. WHR and THR relay board outputs

Digital Output Number	Output Description	4-Stage Compr Capacity	6-Stage Compr Capacity	8-Stage Compr Capacity
		2-Compr	2-Compr	4-Compr
		WHR040-085E THR040-110D	WHR070-085E THR070-110D	WHR095-210E THR120-170D
0	Alarm circuit	Same	Same	Same
1	Chilled water pump relay	Same	Same	Same
2	Liq Sol Circ #1	Same	Same	Same
3	Liq Sol Circ #2	Same	Same	Same
4	Cooling	Compr 1 Circ #1	Compr 1 Circ #1	Compr 1 Circ #1
5	Cooling	Compr 2 Circ #2	Compr 2 Circ #2	Compr 2 Circ #2
6	Cooling	Compr 1 Unloader 1	Compr 1 Unloader 1	Compr 1 Unloader 1
7	Cooling	Compr 2 Unloader 1	Compr 2 Unloader 1	Compr 2 Unloader 1
8	Cooling	Not used	Compr 1 Unloader 2	Compr 3 Circ #1
9	Cooling	Not used	Compr 2 Unloader 2	Compr 4 Circ #2
10	Condenser fan(s) M12②	Same	Same	Same
11	Condenser fan(s) M13②	Same	Same	Same
12	Condenser fan(s) M14②	Same	Same	Same
13	Condenser fan(s) M22②	Same	Same	Same
14	Condenser fan(s) M23②	Same	Same	Same
15	Condenser fan(s) M24②	Same	Same	Same

Note:
② Condenserless WHR only.

Reset Options

User selectable reset options are found under Menu 14 on page, 29, item line G "ResetOpt= _____" for chillers and item line H "Reset Sig= ##.#mA" for Temperifiers. Most reset options apply to leaving chilled water only — ALRs, WHRs, and THRs operated in chiller mode. The only reset options available for THRs operated in heating mode (controlled by leaving condenser water) are: "None", "4-20mA", and "Network". Selected reset option settings for chilled and heated water temperatures are displayed in Menu #14.

None

"None" is the Default Values setting. When selecting "None", the following applies:

- Leaving evaporator water temperature or leaving condenser water temperature, whichever is applicable control the unit.
- Leaving evaporator water temperature control ALRs, WHRs, and THRs operating in the "chiller" mode.
- Leaving condenser water temperature control THRs operating in "heat pump" mode.

Return

By selecting "Return" as the reset mode, the controller resets the leaving chilled water temperature set point as required to maintain a constant return water temperature. To choose "Return" as the reset option, first select "Return" in the "ResetOpt" mode and press <ENTER>, then in the "ReturnSpt" item, select the return water set point temperature to be maintained. The return water set point algorithm is internal to the controller. No other action is required.

4-20mA *(remote reset signal)**
By selecting "4-20mA" as the reset option, the controller will

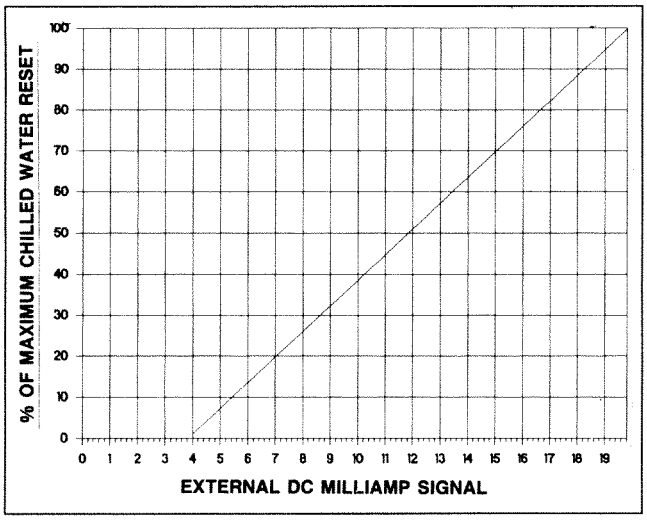
*Not available on ALRs when Ice mode is selected.

reset the leaving chilled water temperature to a higher value based on a percentage of the Maximum Chilled Water Reset ("MaxChWRst"). At 4mA or less, nothing happens. At 20mA, the chilled water set point resets to a value equal the Leaving Evaporator Water Set Point ("Lvg Evap") *plus* the Maximum Chilled Water Reset("MaxChWRst") set point. Any value between 4 and 20mA will add a proportional value of the Maximum Chilled Water Reset to the Leaving Chilled Water Set Point. The reset schedule is linear and may be determined using Figure 7, Leaving Water Reset, below. The external 4-20mA control signal displays under "Reset Sig=" on Menu 14.

For THRs operated in heating mode, the "Lvg Evap" indicates the degree of heating reset. Using the 4-20mA reset signal, a proportional value of the Maximum Chilled Water Reset "MaxChWRst" is *subtracted* from the Leaving Condenser Water Set Point ("Lvg Cond" Menu #4). The reset control signal will display on Menu #14, item line "Reset Sig". The reset schedule is linear and may be determined using Figure 7, Leaving Water Reset, below.

Terminals #134 and #135 on TB7 are the field wiring 4-20mA remote reset terminal. See the field wiring diagrams in the back of this manual for more detail.

Figure 7. Leaving water reset



Ice (remote reset signal)

When in "Ice" mode, all compressors will run 100% loaded (that is no unloaders energized) to make certain that compressors cool appropriately. As a result, the number of stages in "Ice" mode will equal the number of compressors. Maintain a minimum of 25% ethylene glycol in the chilled water loop to protect the system from freezing down to 10°F. If this mixture is not possible, then keep the solution at least 15°F lower than the ice set point. When Leaving Evaporator Water (Lvg Evap") is set less than 34°F, "Ice" mode must be used. Cylinder unloading of compressors when suction temperatures fall below 25°F will prevent the compressor motor from cooling adequately. The lowest Leaving Water Ice set point for McQuay reciprocating chillers is 21°F. With an Ice set point of 21°F, saturated suction temperatures of 12°F or 13°F are typical. This is the lowest recommended saturated suction temperature for McQuay reciprocating products.

Most ice storage applications require dual reset control. Use terminals #134 and #135 on TB7 for field wiring 4-20mA remote reset connections. See the field wiring diagrams at the end of this manual for more detail.

IMPORTANT

If a 4-20mA signal device is not available and a dual reset is required, then a dry contact between terminals #215 and #135 may be used to initiate reset. When using a dry contact, "open" will maintain the ice set point and "close" will initiate a full reset.

If the chiller is to be used for ice storage, select the "Ice" option in Menu 14. "LvgWater Spts", "ResetOpt=". To calculate the leaving chilled water set point, the control band (Menu 14 "CntrlBand=") and shut down delta-T (Menu 14 ShutDn D-T=") must first be selected. The equation to determine leaving chilled water temperature:

Lvg Evap = Desired Ice Temp + ½ "CntrlBand=" "ShutDn D-T="
Lvg Evap = 21°F + ½ (4) + 1.5°F
Lvg Evap = 21 + 2 + 1.5
Lvg Evap = 24.5

For day operation the maximum chilled water reset (Menu 14 "MaxChWRst=") is added to the "Lvg Evap" as calculated above to reach the desired day operating leaving chilled water temperature.

When the Ice option is selected, the resetting of the leaving chilled water set point (during day operation) via the 4-20mA input is not a functional option. To retain the option, the set points in Menu 14 must be changed by a Building Automation System through our MicroTech Open Protocol Monitor Software.

A 4-20mA signal is required to initiate ice reset. When a signal less than 4mA is received, nothing happens—the ice mode temperature will be maintained. When a signal of 4mA or more is received, the unit changes to a non-ice building mode temperature. The control signal will be displayed under "Reset Sig" on Menu #14.

The alarm setpoints (see Menu 22 on page 30) will also need to be adjusted. The following is an example of alarm set points for a typical ice operation:

1. **"Frz Stat":** Set to the saturated refrigerant pressure that corresponds to a temperature equal to 13.5°F below the ice set point. For example, if the ice set point is 23°F, the "Frz Stat" would be set at 33 psig, (which is 23°–13.5° = 9.5°F; 33 psig is R-22 saturation pressure at 9.5°F).
2. **"Frze H_2O":** Set at least 4°F below the ice set point, but not lower than the freezing point of the solution. In this example, the "Frze H_2O" would be set at 19°F.
3. **"LP CutOut":** Set 8 to 10 psi below the "Frz Stat" setting but never below 20 psig.
4. **"LP CutIn":** Set 15 to 20 psi above "LP CutOut".
5. **Freeze Timer ("FreezeTim") and Condenser High Pressure ("Hi Press"):** Do not need to be adjusted.

Network

Based on the Maximum Chilled Water Reset Set Point ("MaxChWRst"), the "Network" option allows a signal to be sent that reflects 0 to 100% reset of the Leaving Chilled Water Set Point ("Lvg Evap") for chillers (except Ice mode) or Leaving Condenser Water Set Point ("Lvg Cond") for THRs. This option functions similar to the 4-20mA option.

Remote Demand Limiting

Demand limiting applies to ALR and WHR chillers only. Remote demand limiting may be accomplished by connecting to terminals #131 and #132 on TB7. A 4-20mA signal is required. Based on the 4-20mA signal, demand limiting will cause the chiller limit the total number of stages regardless of the amount of cooling actually required. A signal of 4mA or less allow all stages to operate while a 20mA or more will allow only one stage to operate. The effect of the 4-20mA signal may be determined using Figures 8, 9 and 10. Under Menu #18, demand limits, the number of stages allowed by demand limiting will be displayed as well as the actual remote demand limit signal in milliamps.

Figure 8. Remote demand limit, 4-stage unit

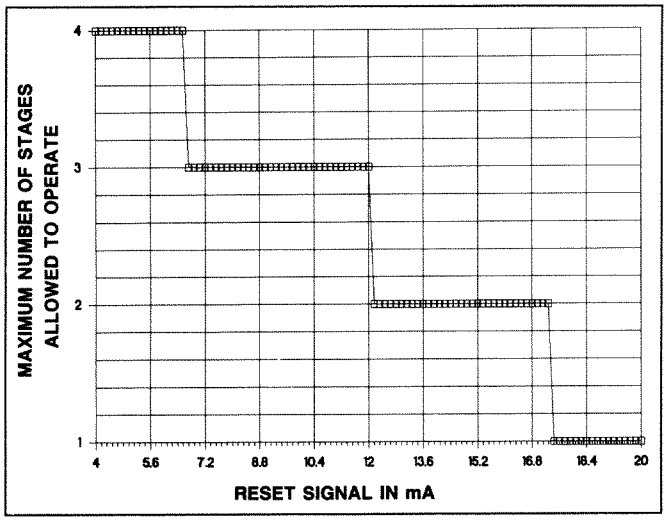


Figure 9. Remote demand limit, 6-stage unit

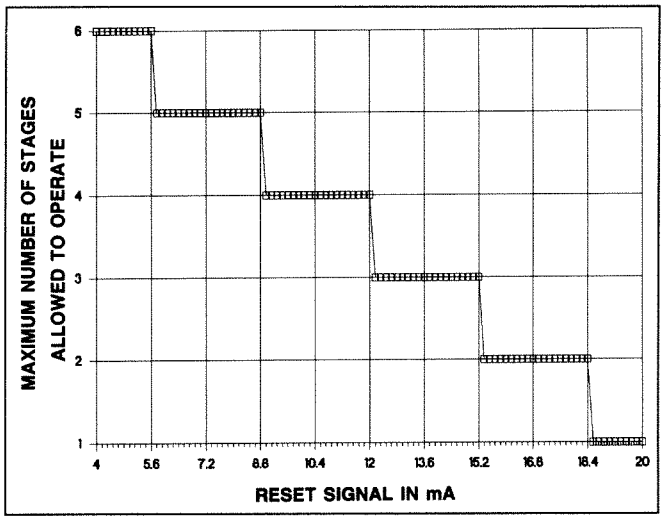
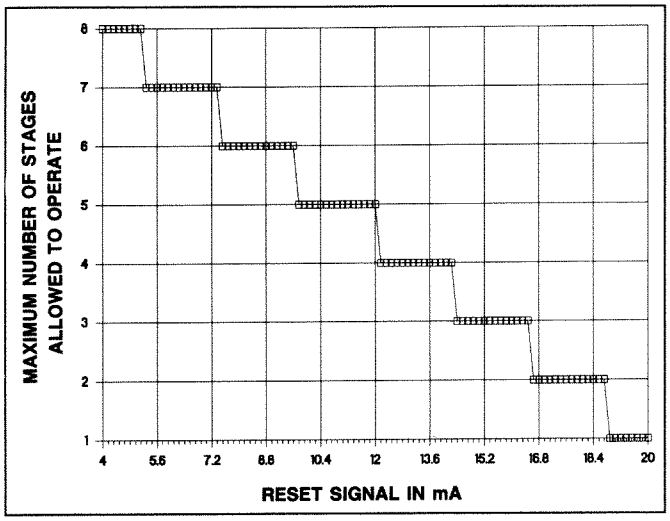


Figure 10. Remote demand limit, 8-stage unit



THR Heat/Cool Changeover

On THR heat pumps, instead of the demand limit input, a 0 to 5 volt signal from a front panel unit-mounted switch allows the unit to run in heat and cool modes. Five volts is obtained at terminal #215, wired through the unit mounted switch and then connected to terminal #132 on TB7. When the switch is "open", the unit is in heating mode. When the switch is "closed", the unit is in cooling mode. Menu #18 shows which mode the unit is in. "Chl/Tmp Sig = Temp" denotes heating mode and "Chl/Tmp Sig = Chil" denotes cooling mode. In chiller mode, the unit is controlled by the leaving evaporator water. To operate the unit as a Templifier, choose "ChlTmp" under Item E of Menu #23. See Normal Sequence of Operation section of this manual for more information.

Soft Loading

Soft loading limits the number of available stages when the unit is started to prevent excessive power consumption and possible overshoot of the leaving water temperature set point. Soft loading is in effect whenever the unit is started from an "off" cycle. This option is selectable and available in Menu #15 (see page 30).

On initial start-up, the controller will run the chilled water pump and sample the loop water temperature for a time equal to the Load Delay set point ("LoadDelay") on Menu #15. If cooling or heating is required at the end of the time-delay, then the liquid line solenoid valve will be open and refrigerant will flow. When the evaporator refrigerant pressure rises above the LP Cut In Set Point ("LP CutIn" see Menu #22), the controller will start the first compressor. On entering the "Stage" the controller starts a countdown timer to indicate how long the unit has been in the cool or heat stage mode. The number of stages allowed during soft loading is determined by the Soft Load Maximum Stages ("SoftLdMaxStg" see Menu #15). The duration of the soft load sequence is determined by the Soft Load Timer ("SoftLoad" see Menu #15). If the Soft Load Timer is set to zero, no soft loading will take place. When the soft load option is enabled, any time remaining in the Soft Load Timer will be displayed on Menu #15 under item "Time Left".

The following set points may be adjusted on Menu #15:

- **Soft Load:** This is the amount of time soft loading will be in effect after the controller begins staging. If set to zero, no soft loading is cancelled.
- **SoftLdMaxStg:** Determines the maximum number of cooling or heating stages which may be energized while soft loading is in effect.
- **LoadDelay:** The amouunt of time allowed for the controller to sample the loop water temperature before initiating cool or heat stages.

Compressor Control

The compressor staging logic uses an adjustable control band and interstage timer to determine the correct number of cooling or heating stages to activate. A project-ahead temperature calculation and a maximum pull down rate provide stable operation. Compressor set points are shown on Menu #16 (see page 30).

The Control Band is the temperature range on either side of the active leaving water set point that must be exceeded for a stage change to occur. When in chiller mode and after the unit has started, the controller will stage-up when the leaving water temperature rises to the Leaving Chilled Water Set Point *plus* half of the Control Band. The controller will stage-down when the leaving water temperature lowers to the Leaving Chilled Water Set Point *minus* half the Control Band. The THR, controlled from leaving condenser water, stages up and down in the reverse order of a unit in chiller operation.

The adjustable compressor Interstage Timer set point ("InterStg", see Menu #16) sets the time delay between the current cooling or heating stage and the next stage-up request. The compressor stage-down time delay is a fixed at a 1/3 ratio of the stage-up setting. For more information on staging, refer to the "Normal Sequence of Operation" section of this manual.

The controller performs a project-ahead temperature calculation to protect against an overshoot condition when the leaving water temperature is outside the control band. Project-ahead calculation also moderates the controller's response to a rapid increase and decrease in leaving water temperature. During cooling mode, if the chilled water temperature is above the control band and the project-ahead calculation has determined that the chilled water temperature will fall below the control band within 240 seconds (4 minutes), then the controller will unload the compressors and stage-down the unit until the condition is no longer true. For THRs in the heating mode, if the project-ahead calculation has determined that the leaving condensor water temperature will rise above the control band withing 240 seconds (4 minutes), then the controller will unload the compressors and stage-down the unit until the condition is no longer true.

As additional protection against overshooting the unit set point, the controller uses the maximum pull down rate ("MaxPullDn", on Menu #14) to determine if the leaving water temperature is pulling down or up too rapidly. Every minute, the controller checks the leaving water temperature and compares the temperature to the last reading. If the Pull Down Rate is exceeded, the controller delays additional stages. Maximum Pull Down ("MaxPullDn", on Menu #14) default setting is 0.5°F. This setting may be changed on Menu #14, Lvg Evap Spts, shown on page 29.

The MicroTech soft loading feature will also guard against problems of overshooting the set point. The Soft Load ("SoftLoad" on Menu #15) default setting is 20 minutes up to stage 4 of cooling and heating stages. See "Soft Loading" section of this manual for more information.

The Interstage Timer ("InterStg" on Menu #16) default setting is 180 seconds for cooling and heating stages. Interstage timers (anti-cycle) for compressors are 5 minute stop-to-start and 15 minute start-to-start.

Lead-Lag of Refrigerant Circuits

Automatic

The controller provides automatic lead-lag of refrigeration circuits. The circuit having the fewest number of starts on all compressors in the circuit will be started first. Changes to circuit capacity will be made by changing the position of the compressor unloaders when applicable. Compressors will be selected by changing unloader status. This prevents short-cycling of compressors when the cooling load is low. If both circuits are operating and a stage-down to one circuit is required, the circuit with the most operating hours will cycle off first.

Manual

The operator may manually select the lead refrigerant circuit or have the controller automatically select the lead refrigerant circuit to equalize compressor hours. Automatic lead-lag may be defeated by selecting circuit #1 or circuit #2 as the lead circuit ("Lead Circuit", Menu #16 shown on page 30).

Manual Operation

Manual operating modes are available to facilitate setup and troubleshooting of the unit. Any of the following manual modes may be selected from the Control Mode Menu.

ManualOff: Manual unit off.
Auto1Off2: Automatic Circ #1, Circ #2 off.
Auto2Off1: Automatic Circ #2, Circ #1 off.
ManualStaging: Manual Staging, Circ #1 & 2.

Note: *These manual settings are intended to aid in troubleshooting and should not be considered to be normal operating modes. The equipment should not be left unattended during manual operation as the automatic staging controls are disabled. The chiller will remain in the manual mode until Automatic operation is selected.*

Unit Status Modes

The operating status of the unit is displayed on the keypad/display when the information is requested by the operator. Description of each Unit Status Mode are listed below.

"Off: Remote SW" mode
Upon start-up, the panel will check the "Remote Stop Switch" digital input. If the switch is open, the controller will be in the "Off: Remote SW" mode. Note that from the factory, the unit will ship with a mechanical jumper between the field terminals. If remote stop/start control is desired, remove jumper between terminals 140 and 141.

"Off: Time Clock" mode
If the controller has been commanded to an off state via the internal time clock (Menu 20), the mode will be "Off: Time Clock". Note that if a customer wishes the unit to run 24 hours per day, the eight day clock must be set to start at 00:00 and stop at 23:59 for all days.

"Starting" mode
If the remote stop switch is closed and the internal time clock is calling for the unit to run, the controller will initiate "Starting" mode.

"Wait for Flow" mode
The chilled water pump output relay is energized any time the unit is enabled. The controller will check for the presence of chilled water flow via the normally open flow switch. If flow is not proven within 30 seconds, the alarm "LossofWater Flow" will be activated and the unit will remain in the "Waiting for Flow" mode until water flow is proven. Once flow is established, the alarm will automatically be cleared.

Loss of water flow during unit operation will cause the unit to log the alarm and return to the "Waiting for Flow" state. When chilled water flow has been re-established, the alarm will again automatically be cleared.

"Wait for Load" mode
With water flow established, the controller will wait for a period of time equal to the "Load Delay" set point to determine if the water loop is above or below the current active water set point. In chiller mode, if leaving chilled water temperature is above the leaving chilled water set point *plus* ½ of the control band plus the start-up delta-T, the controller will enter the stage mode otherwise the controller will wait until the end of the currently scheduled run period.

In heating mode (Templifier only), if the leaving condenser water temperature is below the leaving condenser water set point *minus* ½ the control band minus the start-up delta-T, the controller will enter the stage mode.

"Stages 1-8"
This is the normal mode the unit will be in while cooling or heating. The number of currently active stages will be displayed. The stage is only an indicator of system capacity and does not indicate which compressors or circuits are on.

"Off: Alarm"
This is the mode which will be displayed when a circuit is in an alarm condition which means no cooling or heating on that circuit is possible. Refer to the System Alarms and Circuit Alarms sections in this manual for additional details.

"Off: Manual" mode
If the control mode of the unit is "Manual Off" the unit status will be displayed as "Off: Manual" mode.

"Off: PumpDnSw's"
If the pumpdown switch digital inputs for both circuits are in the "manual" position, the mode of the unit is "Off: PumpDnSw's".

"Manual Stage"
If the control mode of the unit is "Manual Stage" the unit status will be displayed as "Manual Stage".

"Stage Up", "Stage Down"
These are momentary operating modes indicating a stage up or stage down is being initiated by the controller.

"Off: System Sw" mode
Upon start-up the panel will check the front panel "System Switch" position. If the switch is in the "stop" position, the mode will be "Off: System Sw".

"Off: RemoteComm"
If the controller has been commanded to an off state via remote network communications, the mode will be "Off: RemoteComm".

Circuit Status Modes

The operating status of each refrigeration circuit is displayed on the keypad/display when the information is requested by the operator. Descriptions of each Circuit Status Mode are listed below.

"Off:System Sw"
Off due to System Switch.

"Off:ManualMode"
Off due to Control Mode Set Point.

"Off: Alarm"
Off due to Alarm Condition.

"Off:PumpDnSw"
Off, the circuit pumpdown switch is in the manual position.

"Off:CycleTime"
Off due to anti-cycle timers.

"Off: Ready"
Off Ready to start or Standby.

"Pumping Down"
The circuit is in the process of pumping down, the solenoid valve is closed.

"Open Solenoid"
A request has been made for the circuit to be energized for cooling or heating, the solenoid is open and the controller is waiting for the pressure to rise above the LPCutIn set point.

"% Capacity"
Circuit is running, all operating conditions are normal. The circuit percent capacity is displayed.

Head Pressure Control

Air cooled units only
(ALRs & WHRs with remote condensers)

For each circuit, the first stage of condenser fans is wired in parallel with the compressor output that they are energized with the first compressor stage. The fans for each circuit are controlled independently, but use the same Head Pressure Set Points for staging. The transducers responsible for measuring condenser pressure are mounted on the head of the lead compressors' discharge. Refer to the sensor location charts towards the back of this manual for specific locations.

Each circuit has three additional digital outputs available for refrigerant head pressure control. Each output will energize an additional bank of condenser fans with each bank consisting of 1 or 2 fans, depending on the size of the unit.

The number of condenser fan stages per circuit controlled by MicroTech head pressure control is the number of fan contactors per circuit minus 1 since the first fan comes on with the compressor. The number of fan stages for each unit size is as follows:

ALR-035, 040D *1*
ALR-050D *2*
ALR-060 thru 185D *3*

Air cooled unit EERs are maximized by not allowing condenser fan stage 3 (the last fan stage) to operate when the unit capacity is below 50%.

Above 50% capacity, unit EER is maximized by energizing as many condenser fan stages as possible.

Lift pressure
The minimum acceptable lift pressure is determined by the expansion valve. "Lift Pressure" is defined as the difference between the saturated condensing pressure and the saturated evaporator pressure — or the minimum differential pressure to be maintained across the expansion valve. The "MinLift-35%" and the "MinLift-100%" set points on Menu 17, "Head Pres Spt" reflect the desired lift pressures at 35% and 100% circuit cooling capacity. At low circuit capacities, it is desirable to maintain a minimum lift of 85 psig. The first fan stage comes on with the first stage of compressors and the cooling capacity is roughly 33-35%. That is when the MicroTech starts evaluating the necessity of bringing on the second stage of fans. The Minimum Lift-35% set point is the minimum differential pressure to be maintained across the expansion valve when the unit is running at 35% circuit capacity. At higher tonnage capacities, a higher lift pressure must be maintained to accommodate the increased flow through the expansion valve. The Minimum Lift-100% set point is the minimum differential pressure to be at 100% capacity. At 100% circuit cooling capacity, a lift pressure of about 140 psig should be maintained to provide proper flow through the TXV. This is the default setting for the "MinLift-100%" setting. Even though the adjustable range for this item is 120-180, 140 should be the maximum used for virtually all cases to prevent high pressure alarms.

The lift pressure between 35% and 100% circuit capacity cooling is linear as shown in Figure 11. The Minimum Lift-35% and -100% endpoints define a minimum lift pressure line

which provides the MicroTech controller with the correct minimum lift pressure to be maintained at any unit operating capacity.

Fan staging logic

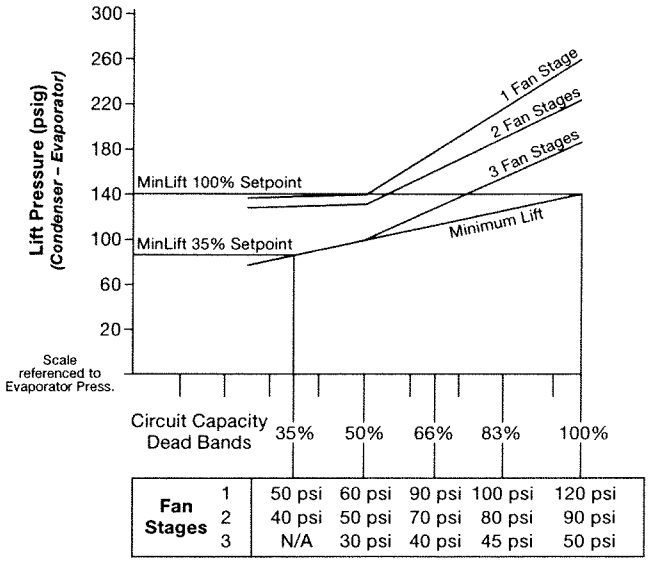
In the MicroTech logic, there are set dead band values which define pressure differential ranges above the minimum lift pressure within which no condenser fan staging will occur. The dead band table is shown in Figure 11. The dead band value used is based on the current circuit capacity and current number of condenser fans in operation as shown in the table. The dead band range lies entirely above the minimum lift pressure line. In Figure 11, the dead bands are graphically illustrated as the vertical distance between the minimum lift pressure line and the fan staging lines. No additional fan staging occurs if the head pressure is within the dead band zone. If the head pressure moves outside the dead band, the controller integrates the pressure error over time. The error calculation is based on minimum condenser pressure ("MinCondPr") and maximum condenser pressure ("MaxCondPr") values which MicroTech calculates internally. The values are calculated for each circuit and are based on the current evaporator pressure, the point on the minimum lift pressure line at which the unit is currently operating, and the current dead band being used. The "MinCondPr" equals the current evaporator pressure plus the point value on the minimum lift pressure line at which the unit is currently operating. Since the pressure scale in Figure 11 is referenced to evaporator pressure, the "MinCondPr" is represented by the minimum lift pressure line in Figure 11. "MaxCondPr" equals the current "MinCondPr" plus the current dead band value from Figure 11. Thus, the point value on the current fan staging line represents the "MaxCondPr". If the dead band multiplier is anything other than 1.0, the dead band value used in the "MaxCondPr" calculation becomes the dead band value from Figure 11 multiplied by the dead band multiplier.

The fan staging pressure error is integrated as follows: Every 4 seconds the controller calculates the error. The error is (Actual Head Pressure – MaxCondPress) or (MinCond Press – Actual Head Pressure), depending on if the pressure is above or below the dead band. After calculating the error, the error is added to the previous errors (totaled). Once the sum of errors exceed a maximum allowable limit, the controller will stage the fans up or down, whichever applies. By using the head pressure algorithm, the controller brings the head pressure back within the dead band. The cumulative pressure error is not displayed on MicroTech. The maximum allowable limit for a stage up request is the Stage Up Error ("StageUpErr" on Menu 17). The maximum allowable limit for a stage down request is the Stage Down Error ("StageDnErr" on Menu 17). The two staging error set points are user adjustable, but for most applications, the default values will suffice. The "MaxCondPr" and "MinCondPr" used for calculating the errors are displayed as items C and D on Menus 5 and 6.

Dead band multiplier

The dead band multiplier ("DeadBandMult" on Menu 17) gives some flexibility regarding the set pressure dead bands shown in the table. This variable is provided to adjust all the dead bands up or down in 10% increments. The dead band multiplier only dictates the response time of the condenser fans to a stage-up request. The fan stage-down request is dictated only by the minimum lift pressure line. In general, increasing the dead band multiplier will slow down the stage-up response of the condenser fans when a change in condenser pressure is detected. Decreasing the dead band multiplier will speed up the condenser fan stage-up response time. If a condenser fan is repeatedly cycling on and off, for instance, the dead band could be increased via this set point. However, in most instances, if left at the default setting of 1.0, fan operation will be fine.

Figure 11. Minimum lift and dead band table



Fan Stages	1	50 psi	60 psi	90 psi	100 psi	120 psi
	2	40 psi	50 psi	70 psi	80 psi	90 psi
	3	N/A	30 psi	40 psi	45 psi	50 psi

1. The dead band is equal to the table value times the dead band multiplier.
2. Fan stage 3 is not available when unit capacity is less than 50%.

Minimum lift set points

In Figure 11, the lift pressure scale is referenced to the evaporator pressure. The dead band is graphically illustrated by the vertical distance between the minimum lift line and the fan staging lines. Changing one of the Minimum Lift set points changes the slope of the minimum lift pressure line as well as the slopes of the fan staging lines. Flattening the curve does not widen the dead band; the dead band distance stays the same relative to the minimum lift pressure line and the fan staging lines. Raising the minimum lift set points causes the fans to stage at higher pressures while lowering the minimum lift set points causes the fans to stage at lower pressures. The fan stage up and stage down errors are still calculated in the same manner. For virtually all applications, the default settings for "MinLift-35%" and "MinLift-100%" should suffice. Consult the previous information for the effects that adjusting these set points will have on fan staging. Other considerations for adjusting the Minimum Lift Set Points include the existence of special options such as SpeedTrol head pressure control. Guidelines for Minimum Lift Set Points for unit with SpeedTrol follow.

WHR units with remote condenser

For WHR split systems, fan staging for remote condensing units is controlled in the same manner as ALR units as explained above. The unit must be declared as air cooled on the Misc Setup Menu 23. Also on Menu 23, the number of fan stages should be set to a value equaling the number of fan contactors per circuit minus 1. The MicroTech controller works in conjunction with the required field wiring from the controller's relay board to the fan contactors. The first bank of fans will start whenever one of the compressors is running. Each additional fan bank will run as required to control head pressure. Refer to the remote condenser option on the field wiring drawings towards the back of this manual.

SpeedTrol settings for air cooled units

(ALRs and WHRs with remote condensers)

When a chiller's first fan stage is controlled by a variable speed head pressure control device, the head pressure control set points should be adjusted slightly so that MicroTech and SpeedTrol do not conflict with one another.

For each circuit, the SpeedTrol fans are wired in parallel with the first compressor stage so they are energized with the compressors. The SpeedTrol pressure modulation device is not hooked into the MicroTech control and therefore operates independently of MicroTech.

The desired goal is for the SpeedTrol device to modulate the first fan up to full speed before MicroTech head pressure control logic decides that a second condenser fan should be turned on. To meet this objective, the "MinLift-35%" (item A on Menu 17 "Head Pres Spt") plus the Head Pressure Dead Band at 35% circuit capacity plus the evaporator pressure should equal the high end of the throttling range for the SpeedTrol device. The "MinLift-35%" is the minimum lift pressure that should be maintained at 35% circuit cooling capacity — when the first stage of fans and compressors come on. The SpeedTrol control has a throttling range of 170 psig to 230 psig. Thus it will modulate the fan to zero speed at 170 psig and full speed at 230 psig. The proper "MinLift-35%" setting is determined by the formula:

$$\textit{MinLift-35\%} = \textit{SpeedTrol top throttling range} - \textit{Typical evaporating pressure} - \textit{Dead band pressure at 35\% circuit capacity}$$

A typical evaporating pressure for chilled water mode is 65 psig. The dead band pressure at 35% circuit capacity is shown to be 50 psig in Figure 12. The formula becomes:

$$\textit{MinLift-35\%} = 230\ \text{psig} - 65\ \text{psig} - 50\ \text{psig}$$

In this example, the formula yields a recommended "MinLift-35%" setting of 115 psig. This setting can be used for virtually all SpeedTrol applications except for "Ice" mode.

Pumpdown Control

Pumpdown of each refrigerant circuit will always occur when the circuit is commanded from a "Staging" mode to an "Off: Ready" mode. The pumpdown sequence closes the solenoid valve and the lead compressor in the circuit is used to perform the pumpdown. The compressor is fully loaded during pumpdown if unloaders are present. An alarm condition in the refrigerant circuit will disable the pumpdown sequence.

Pumpdown will occur if the evaporator pressure is above the LPCutIn pressure and stop when the pressure reaches the LPCutOut pressure. If the evaporator pressure has not dropped to the LPCutOut set point after 180 seconds, the controller will stop all compressors and activate the "Can't Pump Down" alarm output.

Note that pumpdown can be commanded by the operator by moving the circuit switch from "Auto" to "Pumpdown and Stop". When manual pumpdown is activated, the circuit will pump down once and then shut off. No additional compressor operation will occur even if the evaporator pressure climbs above the LPCutIn set point. When the switch is moved to the "Auto" position, the first compressor will start and the unit will stage up as required if the controller is calling for cooling or heating. If cooling or heating is not requested, the circuits will pump down and the compressors will stop.

If the chiller is commanded Off by the Time Schedule, Remote Communications or the Remote Stop Switch, the chiller will pump down and stop when the evaporator pressure falls to the LPCutOut Set Point. In the event the evaporator pressure rises above the LPCutIn Set Point, the controller will initiate another pumpdown sequence. After the second pumpdown, the controller will allow only one additional pumpdown to occur every 120 minutes if required.

"Monitor Only" Sensors and Display Items

The MicroTech controller will shut down the chiller if one of the primary temperature or pressure sensors should fail. Some secondary "monitor only" sensors provide information to the display but are not critical to chiller operation. The microprocessor will not activate the external alarm contacts or shut down the unit if one of the "monitoring only" sensors fails. The display will simply indicate "Short" or "Open" on the keypad/display for the defective sensor. The "monitoring only" sensors and display items include:

- Compressor 1 Suction Temp
- Compressor 2 Suction Temp
- Evap Water Temp reset signal
- Demand Limit signal
- Entering Evap Water Temp
- Entering Condenser Water Temp (WHR & THR only)
- Leaving Condenser Water Temp (WHR only)
- Total Unit Amps
- Liquid Line Temperature Circuit #1
- Liquid Line Temperature Circuit #2
- Air Temperature (ALR only)

Safety Systems

MicroTech continuously performs self diagnostic checks, monitoring all system temperatures, pressures and safeties, and will automatically shut down a refrigerant circuit or the entire unit should a fault occur. The cause of the shutdown, time and date of occurrence and conditions at the time of alarm will be retained in memory and can be displayed for operator review. Current alarm conditions are displayed on Menus 24 and 25 by pressing the *"Alarms"* category on the keypad. MicroTech also records the type, time and date of previous faults (see Menus 26 and 27).

MicroTech has several safety systems to safeguard against potential damage of the chiller equipment. There are alarm and pre-alarm conditions. Alarm conditions cause the compressors to shut off and/or lock out. Pre-alarm conditions cause the unit to stage down in capacity in an attempt to avoid an alarm condition. For alarm conditions, the red *"Alarm Status"* light on the control panel will be solid. For all pre-alarm conditions, the light will pulse at the rate of .5 seconds on, 4 seconds off. When an alarm or a pre-alarm condition exists, the MicroTech display automatically switches to the alarm menu to alert the user of the condition.

MicroTech alarms can either be of the manual reset type or the auto reset type. Critical alarm conditions such as High Condenser Pressure, Refrigerant Freeze Protection, and Low Evaporator Pressure which protect against equipment damage are manual reset, which means they lockout compressor operation and must be cleared at the MicroTech keypad before operation can resume. Autoclearing alarm conditions cause the compressors to shut off on the affected circuit until the condition is corrected. When the condition is corrected, the chiller will resume normal operation on that circuit, provided the anti-cycle timers have cleared and sufficient load exists. All pre-alarm conditions are autoclearing. After the controller stages down the unit on a pre-alarm condition and the potential alarm condition has been avoided, the alarm will clear by itself and the unit will resume normal operation. If the alarm condition is not avoided, the alarm will be logged on the MicroTech display, causing lockout of compressors. Thus, the alarm must be manually cleared.

When a McQuay Reciprocating Chiller with MicroTech is used with the McQuay RMS (Remote Monitoring and Sequencing) Panel, the user must note that alarm nomenclature varies. The RMS has three possible categories of alarms: faults, problems, and warnings. The chiller alarm condition corresponds with the RMS "fault" condition. Thus, there are system and circuit faults. Chiller pre-alarm conditions correspond to the RMS "problem" designation. Reciprocating chillers do not have warning alarms.

Circuit Alarm Conditions

The "Circuit Alarm Conditions" are those alarms which only affect one circuit and cause the compressors of the affected circuit to be staged down (pre-alarm condition), temporarily shut off (autoclearing alarm) or locked out (alarm condition), whichever applies.

If a pre-alarm condition occurs, MicroTech will display the appropriate message and the *"Alarm Status"* light will pulse until the condition is corrected or the unit goes into full alarm. If an alarm occurs, the display will show which alarm condition has occurred and the red light will be solid. Operation will not resume until the alarm is cleared manually at the keypad. If an autoclearing alarm condition occurs, the display will show it and the red light will be solid. The unit will resume normal operation once the alarm causing condition has been corrected and the anti-cycle timers have cleared.

Compressor motor protection

Comp#1MtrProtect
Comp#2MtrProtect
Comp#3MtrProtect
Comp#4MtrProtect

During normal operation, each compressor's Motor Protection (MP) contacts and Motor Protection Relay (MPR) contacts will be closed. The MP contacts and associated MPR contacts will open on a high motor temperature condition or motor overload and the compressor will stop. The MP contacts will automatically reset after 2 minutes, however, the controller will temporarily lock out operation of the respective circuit until the condition is corrected and the contacts remake. This is an autoclearing alarm.

High condenser pressure

This high pressure cutout alarm condition is in response to the signal sent by the pressure transducer; thus it is a software controlled set point and alarm condition.

If the condenser pressure rises to within 30 psi of the Hi Pres set point, the controller will override any requests to increase current capacity and invoke the "HiCondPresStgHld" pre-alarm. The controller will hold the current capacity stage until the pressure is more than 30 psi below the Hi Pres set point.

If the condenser pressure rises to within 20 psi of the Hi Pres set point, the controller will automatically stage down every 10 seconds until the condenser pressure falls below the 20 psi band below the Hi Pres set point. The "HiCondPrssStgDwn" pre-alarm condition is invoked during this time.

If the condenser pressure reaches the Hi Pres set point, the "Hi Cond Pressure" alarm will be logged and the respective circuit will be locked out until cleared manually.

For WHR units setting = 360 psi
For THR units setting = 380 psi
For ALR units setting = 380 psi

Mechanical high pressure

During normal operation the HP1 and HP2 high pressure relay contacts will be closed. If the HP1 or HP2 relay contacts open, the controller will lock out operation of the respective circuit. The high pressure relay indicates a high compressor discharge pressure. The circuit will remain locked out until the alarm is cleared. The Mechanical High Pressure switches — MHP1, 2, 3, and 4 — must be reset first and the alarm on

MicroTech cleared second. MHP1-4 can be found in the upper right-hand corner of the control box. In all cases the high pressure condition will be detected first by the MicroTech "Hi Cond Pressure" alarm.

The Mechanical High Pressure switches should be set a minimum of 20 psi above the software controlled High Pressure Set Points. Recommended set points are shown below.

For WHR units setting = 380 psi
For THR units setting = 400 psi
For ALR units setting = 400 psi

Low evaporator pressure

If during a non-low ambient start, the evaporator pressure fails to rise above the Low Pressure Cut In Alarm Set Point (LP CutIn) within 80 seconds of the liquid line solenoid valve opening or, if during the cooling mode the evaporator pressure falls below the Low Pressure Cut Out Alarm Set Point (LP CutOut), a "Lo Evap Pressure" alarm will be generated. This alarm will also occur if the evaporator pressure drops to 2 psi for more than 20 seconds during low ambient start.

Oil differential/power

Comp#1LowOil/Pwr
Comp#2LowOil/Pwr
Comp#3LowOil/Pwr
Comp#4LowOil/Pwr

Each compressor is equipped with an oil differential pressure switch which closes when the net oil pressure reaches 14 psig. The controller will initiate a shutdown of all compressors in a circuit should one of the compressors in that circuit lose adequate oil pressure. Loss of oil pressure is detected when the oil pressure differential switch opens at 9 psig and this condition remains true for more than 30 consecutive seconds. If the switch re-closes before 30 seconds has elapsed, the timer is reset.

In addition, if a compressor never starts due to a tripped line voltage circuit breaker, the controller will think the compressor is running when it actually is not. After 30 seconds, the above alarm will catch this condition, thus the term "LowOil/Pwr".

Refrigerant freeze protection

If the saturated evaporator refrigerant pressure falls below the operator adjustable refrigerant freeze set point (Frz Stat) for a time period equal to the freeze timer set point (FreezeTim), the alarm will be "Freeze Stat Prot". This is true if the Freeze Timer is set at 30 seconds. If it is set higher (the default is 80 seconds), the controller will initiate a pre-alarm condition of "FreezeProtStgDwn" after the first 30 seconds and force the unit to stage down in capacity every 10 seconds until the pressure rises above the Frz Stat set point or until stage 1 cooling is reached. The unit will stay at stage 1 cooling until the saturated evaporator pressure rises above Frz Stat set point or until the Freeze Timer times out at which point the unit will go into the "Freeze Stat Prot" alarm.

Incomplete pumpdown

If the controller remains in a pumpdown operation for more than 180 seconds, the pumpdown operation is aborted and the circuit is shut down. The alarm "Can't Pump Down" is registered. This alarm can occur when a solenoid valve sticks open or some other refrigerant circuit problem exists. The pressure to which the compressor pumps down to is regulated by the Low Pressure Cut Out alarm set point (LP CutOut).

Bad pressure sensor

If the Evaporator Pressure Transducer or the Condenser Pressure Transducer signal is shorted to ground or open, the alarm "Bad Evap PresSen" or Bad Cond PresSen" is logged on the MicroTech display, whichever is appropriate. The circuit is locked out until the alarm is manually reset.

System Alarm Conditions

The "System Alarm Conditions" are those alarms which are common to both refrigeration circuits and require all compressors to be temporarily shut off or locked out, whichever applies. The following alarm conditions are checked continuously during all modes of operation by the controller. If one of the following alarm conditions is detected, the mode of the controller will switch to "Off: Alarm". The controller disables all compressor operation by turning off all Compressor Enable Outputs. Alarm Output #0 will be turned on to notify the operator of the alarm condition. The red *"Alarm Status"* light on the front of the control panel will be solid on the alarm condition and the MicroTech display will show the current alarm condition.

The chiller must have the manual reset system alarm conditions cleared before normal operation can resume. If the alarm which occurred is an autoclearing alarm, once the condition has corrected, the chiller will resume normal operation provided the anti-cycle timers have cleared and sufficient load exists.

Loss of water flow

Water flow must be present when the controller is attempting to provide capacity cooling or heating. Chilled water flow or condenser water flow are not required during pumpdown, manual off, system off, or other off conditions.

A time delay of 1.7 to 3.2 seconds has been built into this alarm function to accommodate momentary loss of flow due to air bubbles or pressure fluctuations in the water piping. The alarm shows up as "LossofWaterFlow". This alarm is logged when the evaporator flow is interrupted on chillers and Templifier heat pumps. The alarm is also logged when the condenser flow on Templifier heat pumps is interrupted if a flow switch is present.

The chiller status on this alarm will read "Wait for Flow" instead of "Off: Alarm". This is an autoclearing alarm.

Bad phase/voltage

This alarm is only valid if a phase volt monitor (PVM) is wired into MicroTech.

Upon detecting an opening of the normally closed PVM contacts, compressors are immediately de-energized by the PVM device. The controller will open compressor enabled outputs and log the alarm "BadPhase/Voltage". This is an autoclearing alarm.

Chilled water freeze protection

If the leaving chilled water temperature falls below the operator adjustable Chilled Water Freeze Alarm Setpoint (Frze H_2O), the unit is shut down and the alarm "WaterFreeze

Prot" is logged. There is not time delay — just one sampling of water at this low temperature will shut down the machine.

Volts ratio protection

The controller monitors the output of the internal 5VDC power supply into analog input #5. If the microprocessor is not receiving an acceptable volts ratio signal — between 4.15 and 4.94VDC — the unit will be shut down on the alarm "BadVoltsRatioSen". This alarm must be manually cleared before operation can resume.

Bad leaving water sensor

If the leaving water sensor fails, causing a short or open, the alarm "Bad Lvg Water Sen" will be logged and the unit shut down. The unit will only shut down when the control leaving water sensor is bad. For chillers and Templifiers operated in chill mode, the control sensor is the leaving evaporator sensor. For Templifiers operated in heat mode, the leaving condenser sensor is the control sensor.

Other Conditions

Low source water temperature (THRs only)

This is not an alarm condition. This condition is applicable only when the unit operation of "ChlTmp" is selected from Menu 23 and the unit is run in heating mode. If the leaving evaporator water temperature drops below the "LoSourcT" alarm setpoint, all running compressors will run unloaded. The forced condition will continue until the leaving evaporator water temperature rises above the "LoSourcT" setpoint or until an appropriate alarm condition is logged. This is an autoclearing condition. No alarm display is associated with this condition since it is not a true alarm condition, merely a safeguard.

Table 6 shows all of the circuit and system alarms and pre-alarms. The default values for adjustable set points are reflected in the table.

Table 6. MicroTech safety systems

Safety Description	Adjustment Range	ALR Setpoint	WHR Setpoint	THR Setpoint	Alarm Condition	Alarm	Reset Type
Mechanical high pressure	—	400 psig	380 psig	400 psig	Circuit	Alarm	Manual
High condenser pressure	280-425 psi	380 psig	360 psig	380 psig	Circuit	Alarm	Manual
High condenser stage down	—	360 psig	340 psig	360 psig	Circuit	Pre-alarm	Auto
High condenser stage hold	—	350 psig	330 psig	350 psig	Circuit	Pre-alarm	Auto
Low evaporator pressure	—	34 psig	34 psig	34 psig	Circuit	Alarm	Manual
Low oil differential/power	—	9 psig	9 psig	9 psig	Circuit	Alarm	Manual
ChW freeze protection	N/A, 0.5-40°F	34°F	34°F	34°F	System	Alarm	Manual
Freeze stat protection	20-54 psi	54 psig	54 psig	54 psig	Circuit	Alarm	Manual
Freeze stat stage down	—	54 psig	54 psig	54 psig	Circuit	Pre-alarm	Auto
Volts ratio protect	—	±7.5%	±7.5%	±7.5%	System	Alarm	Manual
Loss of water flow	—	—	—	—	System	Alarm	Auto
Compressor mtr protect	—	—	—	—	Circuit	Alarm	Auto
Incomplete pumpdown	—	34 psig	34 psig	34 psig	Circuit	Alarm	Manual
Bad pressure sensor	—	—	—	—	Circuit	Alarm	Manual
Bad lvg water sensor	—	—	—	—	System	Alarm	Manual
Bad phase/voltage	—	—	—	—	System	Alarm	Auto
Low source water temp	20-75°F	N/A	N/A	40°F	System	N/A	Auto

Normal Sequence of Operation

The following sequence of operation is typical of McQuay models ALR035D through ALR185D and WHR040E through WHR210E reciprocating water chillers and THR040D through THR170D Templifiers. The sequence may vary depending on various options which may be installed on the chiller.

Off conditions

With power supplied to the unit, 115 VAC power is applied through the control fuse F1 to the compressor crankcase heaters (HTR1, HTR2, HTR3 and HTR4), the compressor motor protectors (MP1, MP2, MP3 and MP4), the evaporator heater and the primary of the 24V control circuit transformer. The 24V transformer provides power to the MicroTech controller and related components. With 24V power applied, the controller will check the position of the front panel System Switch. If the switch is in the "stop" position the chiller will remain off and the display will indicate the operating mode to be OFF:SystemSw. The controller will then check the PumpDown Switches. If either switch is in the "stop" position, that circuit's operating mode will be displayed as OFF:PumpDownSw. If the remote Start/Stop Switch is open, the chiller will be OFF:RemoteSw. The chiller may also be commanded off via the communications network if a separate System Master Panel is installed. The display will show OFF:RemoteComm if this operating mode is in effect.

If an alarm condition exists which prevents normal operation of both refrigerant circuits, the chiller will be disabled and the display will indicate OFF:Alarm.

Assuming none of the above "Off" conditions are true, the controller will examine the internal time schedule to determine if the chiller should start. The operating mode will be OFF: TimeClock if the time schedule indicates an "off" time period.

Start-up

(ALRs, WHRs, THRs operated in chiller mode)

If none of the above "off" conditions are true, the MicroTech controller will initiate a start sequence. The chilled water pump output relay is energized any time the chiller is enabled and the chiller will remain in the Waiting For Flow mode until the field installed flow switch indicates the presence of chilled water flow. If flow is not proven within 30 seconds, the alarm "Lossof WaterFlow" will be activated and the chiller will continue to wait for proof of chilled water flow. Once flow is established, the alarm will automatically be cleared and the unit will go into the Wait For Load mode.

Once flow is established the controller will sample the chilled water temperature and compare it against the Leaving Chilled Water Set Point, the Control Band and the Load Delay which have been programmed into the controller's memory. If the leaving chilled water temperature is above the Leaving Chilled Water Set Point plus ½ the Control Band *plus* the adjustable start-up Delta-T, the controller will select the refrigerant circuit with the fewest number of starts as the lead circuit and enter the first stage of the Cool Staging mode. The controller will open the liquid line solenoid valve of the lead refrigerant circuit (SV1 or SV2) allowing refrigerant to flow through the expansion valve and into the evaporator. When the evaporator refrigerant pressure rises above the LPCutIn Set Point, the controller will start the first compressor. If additional cooling capacity is required, the controller will de-energize the unloader. If the load is still not satisfied, the controller will start the lag refrigerant circuit in the same manner. The compressors and unloaders will automatically be staged up or down as required to meet the cooling needs of the system. Once the chiller has started, a stage up in capacity occurs when the leaving chilled water temperature rises above the Leaving Chilled Water Set Point ("Lvg Evap") *plus* ½ the Control Band. The delay between the current cooling stage and the next stage up request is controlled by the user-adjustable Inter Stage Timer ("InterStg", Menu 16). A stage down occurs when the water temperature falls below the Leaving Chilled Water Set Point *minus* ½ the Control Band. The stage down request time delay is a fixed ⅓ ratio of the stage up delay.

If the chiller is operating at minimum capacity (Stage 1) and the chilled water temperature falls below the Leaving Chilled Water Set Point *minus* ½ the Control Band *minus* the adjustable shutdown Delta-T, the controller will shut off the last operating compressor, enter the Waiting For Load mode, and monitor the chilled water temperature.

Start-up

(THRs operated in heating mode)

If none of the "off" conditions are true, the MicroTech controller will initiate a start sequence. The chilled water pump output relay is energized any time the Templifier is enabled, The Templifier will remain in the Waiting For Flow mode until the field installed flow switch indicates the presence of chilled water flow. If flow is not proven within 30 seconds, the alarm "LossofWaterFlow" will be activated and the Templifier will continue to wait for proof of chilled water flow. Once flow is established, the alarm will automatically be cleared and the unit will go into the Wait For Load mode.

Once flow is established, the controller will sample the condenser water temperature and compare it against the Leaving Condenser Water Set Point ("Lvg Cond"), the Control Band and the Load Delay which have been programmed into the controller's memory. If the leaving condenser water temperature is below the Leaving Condenser Water Set Point *minus* ½ Control Band *minus* the Start-up Delta-T, the controller will select the refrigerant circuit with the fewest number of starts as the lead circuit and enter the Staging mode. The controller will open the liquid line solenoid valve of the lead refrigerant circuit (SV1 or SV2) allowing refrigerant to flow through the expansion valve and into the evaporator. When the evaporator refrigerant pressure rises above the LPCutIn Set Point, the controller will start the first compressor and the condenser pump (if wired into MicroTech). If additional capacity is required, the controller will de-energize an unloader. If the load is still not satisfied, the controller will start the lag refrigerant circuit in the same manner. The compressors and unloaders will automatically be staged up or down as required to meet the heating needs of the system. Once the heat pump has started, a stage up in capacity occurs when the leaving condenser water temperature falls below the Leaving Condenser Water Set Point ("Lvg Cond") *minus* ½ the Control Band. The delay between the current heating stage and the next stage up request is controlled by the user-adjustable Inter Stage Timer ("InterStg", Menu 16). A stage down occurs when the water temperature rises above the Leaving Condenser Water Set Point *plus* ½ the Control Band. The stage down request time delay is a fixed ⅓ ratio of the stage up delay.

If the Templifier is operating at minimum capacity (Stage 1) and the leaving condenser water temperature rises above the Leaving Condenser Set Point *plus* ½ the Control Band *plus* the Shut Down Delta-T, the controller will shut off the last operating compressor, enter the Waiting For Load mode, and monitor the leaving condenser water temperature.

Condenser control

The first condenser fan stage will be started in conjunction with the first compressor to provide initial head pressure control. The MicroTech controller continuously monitors the lift pressure referenced to several head pressure control set points and will adjust the number of operating condenser fans as required to maintain proper head pressure. For WHR and THR water cooled units, the condenser pump will be started in conjunction with the first compressor to provide head pressure control.

Low ambient start

If the saturated condenser pressure is less than 102 psi (60°F) at the time of circuit start-up, the low ambient start logic will cause the following changes in the normal start-up sequence.

The first compressor will start when the solenoid valve is opened regardless of whether the evaporator pressure has risen above the LPCutIn set point. The refrigerant freeze protect set point will be ignored for 180 seconds to allow time for the refrigerant pressure to build. If at the conclusion of the 180 second timer the evaporator pressure is still below the freezestat set point, the circuit will shutdown and the alarm output "Lo Evap Pressure" be activated.

The chilled water freeze alarm set point is enforced during low ambient starts and will shut down the chiller if a water freeze condition is detected.

If at any time during low ambient start the evaporator pressure drops to 2 psi for more than 20 seconds, the chiller will shut off and a "Lo Evap Pressure" alarm will be generated.

This safety protects the compressor from operating in a vacuum during compressor start-up.

Pumpdown

As the system chilled water requirements diminish, the compressors will be unloaded. As the system load continues to drop, the liquid line solenoid valves will be de-energized and the refrigerant circuits will go through a PumpDown sequence. As the evaporator pressure falls below the LPCutOut Set Point while pumping down, the compressors

and condenser fans will stop. In the event the evaporator pressure rises above the LPCutIn Set Point while the refrigerant circuit is in a pumped down mode, the controller will initiate another pumpdown sequence. The controller will allow a maximum of one pumpdown sequence every two hours during this operating mode. Refer to the Pumpdown Control section in this manual for additional details. The chilled water pump output relay will remain energized any time the chiller is in an Off mode initiated by the system switch, remote switch, remote switch, pumpdown switches or network communications. When the chiller shifts from a Cooling/Heating mode to one of these Off modes, the chilled water pump output will remain energized for 60 seconds. This will maintain water flow through the evaporator during pumpdown and prevent rapid cycling of the chilled water pump.

Start-Up and Shutdown

Prestart checkout

Configuration set points are entered at the factory to set up the software for the type of unit to be controlled. Typical configuration set points will include (see Menu 23):

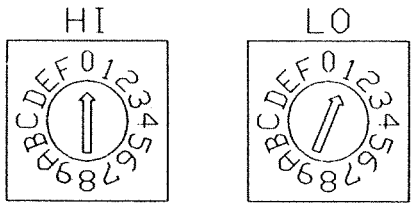
- Number of condenser fan stages (air cooled units only)
- Number of compressors (2 or 4)
- Number of stages of capacity (4, 6 or 8)
- Air or water cooled
- Unit operation (chiller or chiller/Templifier)

Setting of the hex address switches

The Controller Hex Address Switches for each unit determine its logical location in a MicroTech network. If the chiller is not connected to an RS485 communications loop, set the address switches as follows: Hi = 0; Lo = 1.

If network operation is required, refer to the separate Installation Manual accompanying the Network Master Panel.

Figure 12. Hex address switches



Control switches — Before applying power to the unit, verify that the Unit System Switch is in the stop position and that each Circuit Switch is in the Pumpdown and Stop position. If an optional Remote Stop Switch is installed, it should be in the run position.

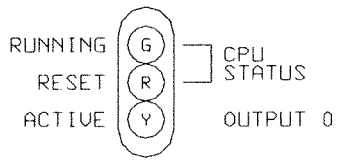
Ribbon cables — Make sure the field wiring for all flow switches, interlocks, or jumpers matches the connections detailed on the field wiring drawing at the end of this manual. Check the ribbon cables that connect the keypad, ADI board and output board to the controller. They should be fully seated with the locking tabs engaged.

Powering the control panel

Status LEDs — There are three Status LEDs located on the model 250 controller which will indicate the microprocessor's operating condition. When power is first applied to the control panel, the red RESET LED will illuminate for approximately 3 seconds. During this time, the microprocessor is checking the control software and performing internal hardware tests. When these tests are complete the RESET LED will turn off and the green RUNNING LED will illuminate indicating the controller's circuitry and software are operating correctly. If the RESET LED stays on or the RUNNING LED fails to illuminate, disconnect the controller power by opening circuit breaker CB-1 and re-check the field wiring. Observe the controller's LEDs while re-connecting power by closing CB-1.

If the RUNNING LED still does not turn on, refer to the troubleshooting section in this manual. The amber OUTPUT 0 ACTIVE LED is associated with the external alarm output on the solid-state relay board and will be illuminated during any alarm conditions. ADI Board LEDs #0, 1, 2, 3, 4, 6, 8, 9, 10, 11, 12 and 13 should be illuminated at this time and the keypad/display will indicate the unit status as OFF:SYSTEM SWITCH. Observe the LEDs on the ADI board while manually operating the field mounted devices such as flow switches to ensure they are connected to the correct terminals.

Figure 13. Status LEDs



McQuay chiller and Templifier MicroTech controllers come with factory installed default set points for the control mode, leaving water temperatures, soft loading, compressor staging, head pressure settings, internal scheduling, holiday dates and alarm functions. The Control Menus 13 through 22 (Table 8) contain the above items. The installing contractor should step through all the unit's set points by using the keypad/display and adjust them as required to meet the job specifications. The default set points should be appropriate for most common installations. On Menu 13, the control mode is set for a default of "Manual Unit Off". The setting should be adjusted before unit operation can proceed. Before staging the unit, the user should verify and set the correct control and safety settings for the application (Menu 22). For further information on the menu items, refer to the Menu Descriptions section of this manual. Any alarms appearing on the display should be cleared at this time by pressing the CLEAR key on the keypad/display.

Watch the LEDs on the output board to determine the operating status of the controller's outputs while performing the following system checks.

Move the System Switch to the Auto position. LED #5 on the ADI Board will turn on and if the internal time schedule indicates an "on" period, the chilled water pump output will be activated. The keypad/display will show the unit status as OFF:PumpDnSw's.

Move both Circuit Switches to the auto position. LEDs #7 and 15 on the ADI Board will illuminate. The controller will verify chilled water flow and both refrigerant circuits will go

through a pumpdown sequence if required. The controller will monitor the water loop temperature and if cooling or heating is required, the lead compressor will start. The unit will stage up automatically to meet system demand based on the set points stored in the controller's memory and the keypad/display will show the unit's current stage. Condenser fans for the lead refrigerant circuit will be cycled as required to maintain proper condenser pressure. All operating characteristics will be viewable on the keypad/display.

Temporary shutdown

Move the Circuit #1 and Circuit #2 switches to the "Pumpdown and Stop" position. Each circuit will pumpdown and the compressors will stop. In this condition, the compressors will remain off and no additional pumpdown will occur even if the evaporator pressure rises above the LPCutIn setpoint.

After both circuits have been pumped down, open the Remote Stop Switch and the controller will stop the chilled water pump.

Start-up after temporary shutdown — Move the Circuit #1 and Circuit #2 switches to the Auto position. If the controller is calling for cooling or heating, the compressors will start and the unit will stage up as required. If cooling or heating is not requested, the circuits may pump down and the compressors will stop.

Extended shutdown

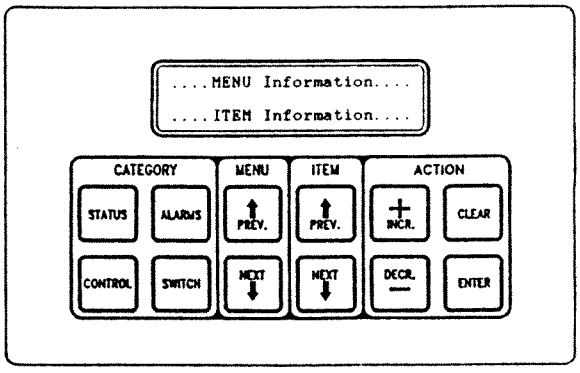
⚠CAUTION

It is the operator's responsibility to provide protection against water circuit freezing on ALR units. All water must be drained from the evaporator and associated piping and power for the cooler heating cable should be applied via separate disconnect if freezing ambient conditions are expected.

1. Close the manual liquid line shutoff valves. Move the circuit #1 and Circuit #2 switches to the "Pumpdown and Stop" position. Each operating circuit will pumpdown and the compressors will stop. In this condition, the compressors will remain off and no additional pumpdown will occur even if the evaporator pressure rises above the LPCutIn setpoint.
2. After both circuits have been pumped down, open the Remote Stop Switch and the controller will stop the chilled water pump.
3. Move the System Switch to the "Emergency Stop" position. Turn off main power to the unit and to the chilled water pump.
4. Close the compressor suction and discharge valves and the oil equalization line valve.
5. Tag all opened electrical disconnect switches to warn against start-up before opening the compressor suction, discharge and liquid line valves.
6. On ALR units, drain all water from the unit evaporator and chilled water piping and leave power applied to the cooler heating cable via separate disconnect if the unit will be exposed to freezing ambient temperatures.

Keypad/Display

Figure 14. Keypad/display



Menu structure (general description)

The information stored in the MicroTech controller can be accessed through the keypad using a tree-like structure. This tree structure is divided into *Categories, Menus* and *Menu Items*. There are three *Categories* which make up the tree structure: STATUS, CONTROL, and ALARM. Each category is divided into *Menus* and each *Menu* into *Menu Items*. The three categories are described below:

Status category — Menus and menu items in this category provide information on the MicroTech and unit operating conditions. The entries under each menu item in this category provide information only and are not changeable through the MicroTech keypad. Menus 1 through 12 are Status Menus.

Control category — Menus and menu items in this category provide for the input of all the unit control parameters. These include cooling and heating control, compressor control and condenser fan control parameters as well as time schedules and alarm limits. The entries under these menu items are changeable through the MicroTech keypad. Menu Items 13 through 23 are Control Menus.

Alarm category — Menu and menu items in this category provide information regarding current and previous alarm conditions. Menus 23 through 27 are Alarm Menus.

Display format

The information stored in the MicroTech controller tree structure can be viewed (one menu and menu item at a time) through a two line by sixteen character LCD display. The current MENU is shown on the top line and the current MENU ITEM is shown on the bottom line of the display.

MicroTech menu structure

A complete listing of the information stored in the MicroTech controller tree structure is shown in Tables 7, 8 and 9. These tables show the menu numbers and names along with their corresponding menu items and menu item entries as they appear on the MicroTech display. The # symbol is used where the controller would normally display a numerical value. Also included in this figure is the corresponding switch menu for each menu item. (The switch function is described in the section, Keypad Key Functions).

Notes:

1. **Status category** — Where ore than one menu item entry is listed under a menu item, the list includes all the entries which can appear in the display for the particular item. The entry that shows in the display depends on the operating status of the unit.
2. **Control category** — Where more than one menu item entry is listed under a menu item, the list includes all the choices from which the user can select. The selected entry appears in the display.
3. **Alarm category** — The entries listed include all the possible alarm messages. The display will show the current and previous alarm conditions for each circuit.

Password Information

When changing any menu item entry, the user is prompted to enter the access password. The change will not be allowed until the correct password is entered. The password for ALR and WHR units is always the successive pressing of the following "ACTION" group keys:

"ENTER" "ENTER" "ENTER" "ENTER"

Once this has been done, the user can make changes to the menu item entries. After entering the correct password, the controller will allow a 5 minute time period during which the operator may make any necessary set point adjustments. Any keypad activity will reset the timer for the full 5 minutes so the password only needs to be entered once per session. After 5 minutes of inactivity, the password access time will expire providing protection against unauthorized users.

Keypad Key Functions

The MicroTech keypad consists of twelve pressure sensitive membrane switches (refer to Figure 14). These keys are used to step through, access, and manipulate the information in the MicroTech controller tree structure. The keypad keys are divided into four groups with two or four keys in each. These groups of keys and their functions are described below.

Category group

The keys in this group provide quick access to strategic menus throughout the menu tree-structure. This reduces the need to step through all the menus, one by one, in order to reach the desired menu.

Status — Pressing the "STATUS" key at any time shifts the display to Menu #1 (Unit Status) which is the first menu of the *Status* category.

Control — Pressing the "CONTROL" key at any time shifts the display to Menu #13 (Control Mode) which is the first menu of the *Control* category.

Alarms — Pressing the "ALARMS" key at any time shifts the display to Menu #24, (Circ 1 Current Alarm) which is the first menu of the *Alarms* category.

Switch — Pressing the "SWITCH" key at any time toggles the display between the current menu (status/control) item and the related menu (control/status) item somewhere else in the tree-structure. For example, if this key is pressed while the current menu item is Menu Item 4A (Leaving Evaporator=), the display shifts to Menu 14B (Leaving Evaporator Set Point=). This provides for easy review of actual versus set point values. Tables 7, 8 and 9 include a listing of all the currently supported switching functions.

Menu group

The keys in this group are for stepping from menu to menu in the menu tree-structure.

Prev. — Pressing "PREV." shifts the display to the previous menu. ***Note:*** When Menu #1 is currently in the display (the first menu in the menu tree-structure), pressing "PREV." causes an "end of menus" message to appear in the display. Pressing "PREV." again causes the display to wrap around to Menu #27 (the last menu in the tree-structure).

Next — Pressing "NEXT" shifts the display to the next menu. ***Note:*** When Menu #27 is currently in the display (the last menu in the menu tree-structure), pressing "NEXT" causes and "end of menus" message to appear in the display. Pressing "NEXT" again causes the display to wrap around to Menu #1 (the first menu in the menu tree structure).

Item group

The keys in this group are for stepping from item to item within a menu.

Prev. — Pressing "PREV." shifts the display to the previous item in a menu. ***Note:*** When the first item in a menu is currently in the display, pressing "PREV." causing an "end of items" message to appear in the display pressing "PREV." again causes the display to wrap around to the last item in the menu.

Next — Pressing "NEXT" shifts the display to the next item in a menu. ***Note:*** When the last item in a menu is currently in the display, pressing "NEXT" causes an "end of items" message to appear in the display. Pressing "NEXT" again causes the display to wrap around to the first item in the menu.

Action group

The keys in this group are for making changes to unit control parameters or for clearing alarm conditions.

Note: Before a change to a parameter can be made or before an alarm can be cleared, the display prompts the user with an "Enter Password" message. At this point, the password must be entered before the user can continue with the action.

"ENTER" "ENTER" "ENTER" "ENTER"

Incr — When changing the value of a menu item entry, pressing "INCR. +" shifts the menu item display line to the next higher or next available selection.

Decr. — When changing the value of a menu item entry, pressing "DECR. –" shifts the menu item display line to the next lower value or previous available selection.

Enter — Once a change has been made to a desired value, pressing "ENTER" locks in the new value.

Clear — Pressing "ALARMS" followed by "CLEAR" clears the current alarm. Also, when a change is made to a menu item pressing "CLEAR" returns the display to the original value as long as "ENTER" has not been pressed.

Note: The cause of an alarm should always be determined and corrected before resetting the alarm through the keypad.

Example of Keypad Operation — As an example of using the keypad key functions, consider reprogramming the Leaving Evaporator Set Point from 44°F to 42°F. This consists of changing the Menu Item 14B (Leaving Evaporator Set Point) entry from "44°F to 42°F". Assume Menu #1 (Unit Status) is currently in the display. The following key sequence is followed.

1. Press the "CATEGORY" group "CONTROL" key one time. This switches the display to Menu #13 (the first menu in the "CONTROL" category).
2. Press the "MENU" group "NEXT" key once. This shifts the display to Menu Item 14A (Active Set Point).
3. Press the "ITEM" group "NEXT" key once. This shifts the display to Menu Item 14B. (Leaving Evaporator Set Point).
4. Press the "ACTION" group "DEC –" key one time. This prompts the user to enter the password.

   "ENTER" "ENTER" "ENTER" "ENTER"
5. After the "Password Verified" message, press the "ACTION" group "DEC –" key four times. This changes the menu item entry to 42°F.
6. Press the "ACTION" group "ENTER" key one time. This stores the new entry into the MicroTech controller memory.
7. Pressing the "CATEGORY" group "STATUS" key then shifts the display back to Menu #1.

Menu Descriptions

Status menus

Menus 1 through 12 provide chiller operating information and display of sensor readings. The items listed under these status menus are affected by the settings under the associated control menus and are not directly adjusted via the keypad.

Menu #1: Unit Status — The unit operating status is displayed as item 1 within this menu. The second item is the number of seconds remaining in the unit interstage timer. The third item displays the user chosen unit operation of chiller or Templifier (heat pump). Option chosen on Menu 23.

Menu #2: Circuit #1 Status — The current operating condition of refrigerant circuit #1 is displayed whenever this menu is selected. There is only one item displayed in this menu.

Menu #3: Circuit #2 Status — The current operating condition of refrigerant circuit #2 is displayed whenever this menu is selected. There is only one item displayed in this menu.

Menu #4: Water Temperatures — The evaporator leaving water temperature is displayed under item #1 under this menu. Additional items under this menu display the evaporator entering water temperature as well as the entering and leaving condenser temperatures if these optional sensors have been installed on the unit.

Menu #5: Circuit #1 Pressures — The circuit #1 evaporator and condenser refrigerant pressure readings are displayed under this menu. The calculated minimum and maximum condenser pressure values are also shown.

Menu #6: Circuit #2 Pressures — The circuit #2 evaporator and condenser refrigerant pressure readings are displayed under this menu. The calculated minimum and maximum condenser pressure values are also shown.

Menu #7: Circuit #1 Temperatures — The circuit #1 refrigerant temperatures are calculated from their corresponding pressure sensors and displayed here. If the optional sensors are not present, the line item will flash "Open".

Menu #8: Circuit #2 Temperatures — The circuit #2 refrigerant temperatures are calculated from their corresponding pressure sensors and displayed here. If the optional sensors are not present, the line item will flash "Open".

Menu #9: Chiller Amps — Displays the present amp draw of the chiller expressed as a percentage of the unit rated load amps under full load conditions (optional feature).

Menu #10: Compressor Run Hours — The total run hours for each compressor is available under this menu.

Menu #11: Compressor Starts — The total number of starts for each compressor is available under this menu.

Menu #12: Air Temperature — Displays the current outdoor air temperature if the optional OAT sensor is installed on the air cooled chiller and "Lcl" is selected from Menu 23. Also displayed here is the air temperature received from a network if the "Rmt" OAT select option from Menu 23 is selected.

Control menus

Menus 13 through 23 are the set point menus. All adjustable control parameters and set points, time schedules, control options, and alarm thresholds are accessed through these menus.

⚠CAUTION

Any changes to these parameters must be determined and implemented by qualified personnel with a thorough understanding of how these parameters affect the operation of the unit. Negligent or improper adjustment of these controls may result in damage to the unit or personal injury.

Menu #13: Control Mode — One of several automatic and manual operating modes may be selected from within this menu. Typically, the selected control mode will be Automatic which will allow the MicroTech controller to handle all compressor and condenser fan staging. Refrigerant circuit #2 may be locked off while still allowing circuit #1 to stage automatically by selecting AutoCir#1-Off#2 as the operating mode. OffCirc#1-Auto#2 allows the normal staging of refrigerant circuit #2 but circuit #1 is locked off. Select Manual Staging if manual control is desired. In this operating mode, the condenser fans are controlled by the MicroTech but the number of stages is determined manually via the keypad. If manual staging is selected, the second item under this menu indicates the number of active cooling or heating stages. Use the INCR or DECR keys to increase or decrease the number of active stages.

Menu #14: Leaving Water Set Points — The leaving water set points, control band, maximum pull down rate and water reset options are adjusted from this menu. The first menu item is The Active Set Point ("Active Spt"). The current control temperature — leaving evaporator or leaving condenser water — is displayed here. The Leaving Chilled Water Set Point ("Lvg Evap") for chillers and the Leaving Heated Water Set Point ("Lvg Cond") for THRs appear towards the top of this menu. These are the set points that will be maintained for chillers and Templifiers, respectively, if no reset options are in effect. Most reset options apply to leaving chilled water only — ALRs, WHRs and THRs operated in chiller mode. For THRs operated in heating mode (controlled off of leaving condenser water), the None, 4-20mA and Network reset options only are applicable. The Active Control Set Point ("Active Spt") will display the calculated chilled or heated water temperature to be maintained when one of the reset options is enabled.

If the 4-20 milliamp reset option is enabled, the controller will reset the leaving chilled water temperature to a higher value based on a percentage of the Maximum Chilled Water Reset set point ("MaxChWRst"). At 4mA or less, no reset will occur. At 20mA, the chilled water set point will be reset to a value equaling the Leaving Evaporator Water Set Point ("Lvg Evap") plus the value stored in the "MaxChWRst". Any milliamp value between 4 and 20mA will cause a proportional value of the Maximum Chilled Water Reset to be added to the Leaving Chilled Water Set Point. The reset schedule is linear and may be calculated using Figure 7. The external 4-20 milliamp control signal and current reset set point will be displayed under "Reset Sig" and "Active Spt", respectively, on Menu 14. For specific information, see the Reset Options portion of this manual. For THRs operated in heating mode, the "Active Spt" reflects the degree of *heating* reset. Based on the reset signal, a proportional value of the "MaxChWRst" will be subtracted from the "Lvg Cond" set point and displayed under "Active Spt".

By selecting Return as the reset mode, the leaving chilled water temperature will be reset by the controller as required to maintain a constant return water temperature. The user must select the "Return" option under "ResetOpt" and select the return set point to be maintained under "ResetSpt". The current leaving chilled water reset set point will be displayed under "Active Spt".

If the chiller is to be used for ice storage, select the "Ice" option in Menu 14 "LvgWater Spt", "ResetOpt=". To calculate the leaving chilled water set point, the control band (Menu 14 "CntrlBand=") and shut down delta-T (Menu 14 ShutDn D-T=") must first be selected. The equation to determine leaving chilled water temperature is:

Lvg Evap = Desired Ice Temp + ½ "CntrlBand=" + "ShutDn D-T="

Lvg Evap = 21°F + ½ (4) + 1.5°F

Lvg Evap 21 + 2 + 1.5

Lvg Evap = 24.5

For day operation the maximum chilled water reset (Menu 14 "MaxChWRst=") is added to the "Lvg Evap" as calculated above to reach the desired day operating leaving chilled water temperature.

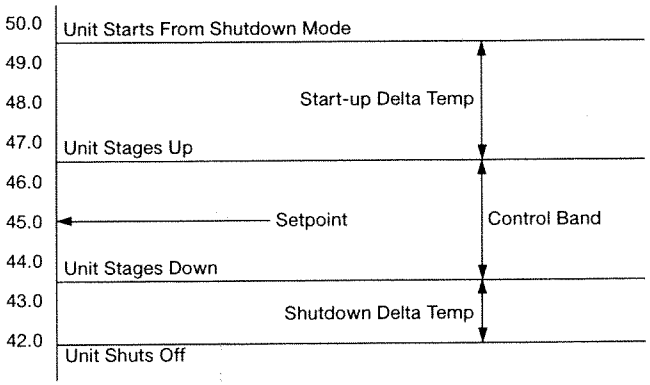
When the Ice option is selected, the resetting of the leaving chilled water set point (during day operation) via the 4-20mA input is not a functional option. To retain the option, the set points in Menu 14 must be changed by a Building Automation System through our MicroTech Open Protocol Monitor Software.

The "Network" reset option allows a signal to be sent reflecting 0-100% reset of the "Lvg Evap" set point (chillers) or "Lvg Cond" set point (THRs) based on the Maximum Chilled Water Reset set point. This function acts much like the 4-20 milliamp reset option as described above.

The Maximum Pull Down Rate set point ("MaxPullDn") will prevent overshooting the active water set point during initial start-up and normal operation. The controller will limit the rate at which the chilled water loop temperature is reduced and the rate at which the heated water loop (THRs) is increased based on an adjustable set point (default of 0.5°F/min). Every minute, the controller checks the leaving water temperature and compares it to the last reading. If the pull rate has been exceeded, the controller will delay additional unit stages.

The Control Band ("CntrlBand") set point defines the temperature range on either side of the active water set point that must be exceeded in order for a stage up or stage down to occur. The Start Up Delta-T ("StartUpD-T") and Shut Down Delta-T ("ShutDn D-T") define when the unit will start and shut down. In chiller mode, the unit will cycle on from a shut down mode once the leaving chilled water temperature has reached the Leaving Chilled Water Set Point *plus* half of the Control Band *plus* the Start Up Delta-T. After the chiller starts, it will stage up and down according to the leaving chilled water temperature ± half the Control Band. Once the load is met and the chiller has staged down to stage 1, the unit will shut completely off once the leaving chilled water temperature has reached the Leaving Chilled Water Set Point *minus* half of the Control Band *minus* the Shut Down Delta-T. The THR, controlled from leaving condenser water, stages up and down in the reverse manner of a chiller. For more information on staging, see the Normal Sequence Of Operation section of this manual.

Figure 15. Delta-T set points for chillers



Menu #15: Softload Set Points — The controller can limit the number of available stages when the unit is initially started to prevent excessive power consumption and help control overshoot of the water temperature set point. The maximum number of stages will equal the Soft Load Maximum Stages for the time period defined in the softload timer set point. If the softload timer is set to zero, no soft loading will take place. Any time remaining in the softload timer will be displayed when the soft load option is enabled. During morning start-up, the controller will run the chilled water pump and sample the loop water temperature for a time equal to the Load Delay set point. If cooling or heating is required at the end of this time delay, the first compressor will be started.

Menu #16: Compressor Set Points — This menu is used to set the lead-lag order of the refrigerant circuits. The lead compressor may be manually set to circuit #1 or circuit #2 or the Automatic mode may be enabled. In Automatic mode, the MicroTech controller will select the refrigerant circuit with the lowest number starts as the lead. The interstage timer set point sets the delay time between the current cooling stage and the next stage up request. The stage down request time delay is a fixed ⅓ ratio of the stage up delay.

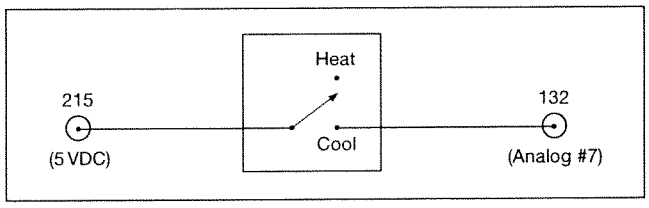
The minimum Start/Start and Stop/Start timers provide protection against compressor short cycling. During normal operation the Compressor Interstage Timers provide a time delay between cooling or heating stages.

Menu #17: Head Pressure Set Points — The set points for head pressure control are adjusted from within this menu. The Minimum Lift Pressure is the minimum differential pressure to be maintained across the expansion valve. The dead band defines the pressure differential range within which no fan staging will occur. If the head pressure moves outside of the deadband, the controller will integrate the pressure error over time. When the Pound/Second exceeds the Stage Up Error or Stage Down Error set point, the controller will adjust the fan staging up or down to bring the head pressure back within the deadband. Refer to the section on head pressure control in this manual for details.

Menu #18: Demand Limit — The Demand Limit set point defines the maximum number of cooling stages allowed by an external demand limit signal. The actual remote demand limit signal level in milliamps is also displayed here. Figures 8, 9 and 10 detail the effect that the remote demand limit signal will have on the chiller capacity.

Chiller/Templifier — Applicable when ChlTmp operation is selected from Menu 23 (Templifier heat pumps only). In place of demand limit input, a 0 or 5 volts signal from a unit mounted switch allows the unit to run in heat (0 volts – switch open) or cool (5 volts – switch closed) modes. Menu 18 displays the signal result; Chl/Tmp Sig=Temp denotes heating mode and Chl/Tmp Sig=Chil denotes cooling mode.

Front panel mount heat/cool switch



Menu #19: Time/Date — The MicroTech controller uses an internal calendar and clock to provide automatic operation for each day of the year. Provision is made for Manual Override to accommodate unscheduled building occupancy. Press the *Control* key to enter the control area of the menu structure then press the *Next Menu* key until the display shows Menu Item #24, Set Date/Time. If the date is incorrect, press the *Incr* or *Decr* key and the controller will prompt you for your password (see page 21). When you have entered the correct password, the controller will return to the Set Date/Time display. Press the *Incr* or *Decr* keys to scroll the month up or down. Press the *Enter* key when the display shows the correct month. The cursor will advance to the Date position on the display which can be set in the same manner. After pressing the *Enter* key to set the Date, the cursor will advance to the Year position on the display. Use the *Incr, Decr,* and *Enter* keys to set the correct Year.

Press the *Next Item* key. The display will show the current Day, Hour, Minute and Second. If this information needs to be changed, follow the same procedure used to set the Date in the previous section.

Menu #20: Daily Schedule — This section will help you to set the Daily Start/Stop time for automatic operation of the chiller. Pressing the *Next Menu* key and the *Next Item* key will advance the display to the Daily Time Schedule. This is where the Start and Stop times for each day of the week will be set using the 24 hour format. Beginning with Sunday, use the *Incr* and *Decr* keys to set the desired start and stop time and press the *Enter* key to store the information in the controller. If the chiller is to be programmed to run continuously 24 hours a day, set the stop tie for 1 minute before start time (Stop=23:59; Start=00:00). Press the *Next Item* key to advance through the remaining week days and Holiday Start/Stop times.

Menu #21: Holiday Date — Up to 14 holiday dates may be entered. When the MicroTech controller's current date matches a date set in the holiday schedule, the normal daily start/stop times are replaced by the holiday start/stop ties which were set in the previous section. At the date prompt, use the *Incr* and *Decr* keys to set the first holiday month and press *Enter* to advance to the Day position of the display. Use the *Incr, Decr* and *Enter* keys to set the first day of the holiday. Press *Next Item* to advance to Holiday 1 Duration. If the scheduled holiday spans more than one day, use the *Incr* and *Decr* keys to set the holiday duration and press *Enter* to store the information in the controller. Use the *Next Item* key to set additional holiday dates and durations for the entire year.

Menu #22: Alarm Set Points — On a call for cooling or heating, the controller will open the liquid line solenoid valve. When the evaporator pressure rises above the Low Pressure CutIn set point, the first compressor will be started. The Low Pressure CutOut set point determines the point at which the compressors will shut off during a pumpdown sequence. The Refrigerant Freeze and Water Freeze alarm set points may be adjusted as required. Water and refrigerant freeze alarm time delays may also be adjusted for this menu. If the condenser High Pressure set point is exceeded, the controller will shut off the unit.

When the unit's operation of ChlTmp is selected from Menu 23 and the unit is running in the heating mode (applicable to THR heat pumps only), if the leaving evaporator water temperature drops below the LoSourcT set point, all running compressors will run unloaded. The condition will continue until the leaving evaporator temperature rises to 40°F or an appropriate alarm condition is logged. For specific alarm information, see the Safety Systems portion of this manual.

Menu #23: Miscellaneous Setup — Several general operating characteristic are defined here. These are set at the factory prior to unit delivery and should not require adjustment. The control software version number is displayed form this menu. For Identification information, see page 10.

Item E on Menu 23 allows the user to select the unit as a chiller of a chiller/Templifier. The selection of "ChlTmp" should only be used when the unit is a THR (Templifier) heat pump.

Item F (OAT select) allows the user to select where the signal for outdoor air temperature is received from. Outdoor air temperature is displayed on Menu 12. "None" means there is no sensor original to be received. "Lcl" or Local means the signal is received from a sensor on the unit itself. "Lcl" is applicable to air cooled units only. "Rmt" or Remote means a signal is to be received from the network to which the chiller is connected.

Alarm menus

Menus 24 through 27 are used to display any alarm conditions which may be present in the unit. All alarm messages are accompanied by the date and time when the alarm occurred. Important operating conditions at the time of the alarm are stored in the controller's memory and may be viewed within the following alarm menus.

Menu #24: Circuit #1 Current Alarm — If refrigerant circuit #1 is in an alarm condition, the appropriate alarm message will be displayed here. The temperature and pressure readings at the time of the alarm will be stored in the controllers memory and may be displayed for analysis from this menu.

Menu #25: Circuit #2 Current Alarm — If refrigerant circuit #2 is in an alarm condition, the appropriate alarm message will be displayed here. The temperature and pressure readings at the time of the alarm will be stored in the controllers memory and may be displayed for analysis from this menu.

Menu #26: Circuit #1 Previous Alarm — The alarm type for the last recorded circuit #1 alarm may be displayed from this menu. The time and date at which the previous alarm occurred are also displayed here. This information will be replaced when a current alarm condition is cleared.

Menu #27: Circuit #2 Previous Alarm — The alarm type for the last recorded circuit #2 alarm may be displayed from this menu. The time and date at which the previous alarm occurred are also displayed here. This information will be replaced when a current alarm condition is cleared.

Table 7. Status menu

STATUS MENUS					
Menu No.	**Menu Line**	**Item Line**	**Default Values**	**Min-Max**	**Switch Menu No.**
1	Unit Status	A. Off:ManualMode Off:System Sw Off:RemoteComm Off:Remote Sw Off:Time Clock Off:Alarm Off:PumpDnSw'w Starting Wait For Flow Wait For Load Stage Up Stage Dn Stage # Manual Stage B. InterStg = ###sec C. Operation = Chil Operation = Templ*			4A
2	Circ #1 Status	A. Off:System Sw Off:ManualMde Off:Alarm Off:PumpDwnSw Off:CycleTime ## Off:Ready Pumping Down Open Solenoid % Capacity = ###			5A
3	Circ #2 Status	A. Off:System Sw Off:ManualMde Off:Alarm Off:PumpDwnSw Off:CycleTime ## Off:Ready Pumping Down Open Solenoid % Capacity = ###			6A
4	Water Temp's	A. Lvg Evap = ###.# °F Open °F Short °F B. Ent Evap = ###.# °F Open °F Short °F C. Ent Cond = ###.# °F Open °F Short °F D. Lvg Cond = ###.# °F Open °F Short °F			14B 14G, H 14C
5	Circ #1 Pres's	A. Evap ###.# psi ### °F 145 + N/A °F Open N/A °F Short N/A °F B. Cnd ###.# psi ### °F 450 + N/A °F Open N/A °F Short N/A °F C. MinCondPr = ### # D. MaxCondPr = ### #			5B 7A

*Only displayed when ChlTmp operation is selected (Menu 23).

Table 7. Status menu (continued)

STATUS MENUS					
Menu No.	**Menu Line**	**Item Line**	**Default Values**	**Min-Max**	**Switch Menu No.**
6	Circ #2 Pres's	A. Evap ###.# psi ### °F 145 + N/A °F Open N/A °F Short N/A °F B. Cnd ###.# psi ### °F 450 + N/A °F Open N/A °F Short N/A °F C. MinCondPr = ### # D. MaxCondPr = ### #			6B 8A
7	Circ #1 Temp's	A. Satur Evap = ### °F N/A °F B. SuctLine = ###.# °F Open °F Short °F C. Super Ht = ###.# °F N/A °F D. Satur Cond = ### °F N/A °F E. CondAppr = ###.# °F N/A °F F. LiquidLn = ###.# °F Open °F Short °F G. Subcoolg = ###.# °F N/A °F			7B 7C 7D 7E 7F 7G 5A
8	Circ #2 Temp's	A. Satur Evap = ### °F N/A °F B. SuctLine = ###.# °F Open °F Short °F C. Super Ht = ###.# °F N/A °F D. Satur Cond = ### °F N/A °F E. CondAppr = ###.# °F N/A °F F. LiquidLn = ###.# °F Open °F Short °F G. Subcoolg = ###.# °F N/A °F			8B 8C 8D 8E 8F 8G 6A
9	Chiller Amps	A. PercentRLA = #####			
10	Comp RunHours	A. Comp #1 = ##### B. Comp #2 = ##### C. Comp #3 = ##### D. Comp #4 = #####			
11	Compr Starts	A. Comp #1 = ##### B. Comp #2 = ##### C. Comp #3 = ##### D. Comp #4 = #####			
12	Air Temp	A. Outdoor = ###.#°F			

Table 8. Control menu

STATUS MENUS					
Menu No.	**Menu Line**	**Item Line**	**Default Values**	**Min-Max**	**Switch Menu No.**
13	Control Mode	A. Manual Unit Off Automatic Manual Staging AutoCirc#1-Off#2 OffCirc#1-Auto#2 B. Manual Stage = #	Manual Unit Off 0	N/A 0-8	1A
14	LvgWater Spts	A. Actv Spt = ##.# °F B. Lvg Evap = ##.# °F C. CntrlBand = #.# °F D. StartUpD-T = ##.# °F E. ShutDn D-T = ##.# °F F. MaxPullDn = ##.# °F G. ResetOpt = None Return 4-20mA Network Ice H. Reset Sg = ##.#mA I. MaxChWRst = ##.# °F J. ReturnSpt = ##.# °F	 44.0°F 3.0°F 3.0°F 1.5°F 0.5°F/min None 10.0°F 54.0°F	 10-80 1.0-5.0 0.0-5.0 0.0-3.0 0.1-1.0 0-45 15-80	4A 4A
14**	LvgWater Spts	A. Actv Spt = ###.# °F B. Lvg Evap = ##.# °F C. Lvg Cond = ### °F D. CntrlBand = #.# °F E. StartUpD-T = ##.# °F F. ShutDn D-T = ##.# °F G. MaxPullDn = ##.# °F H. ResetOpt = None 4-20mA Network I. Reset Sg = ##.#mA J. MaxChWRst = ##.#°F	 44.0°F 115°F 3.0°F 3.0°F 1.5°F 0.5°F None 10.0°F	 10-80 85-220 1.0-5.0 0.0-5.0 0.0-3.0 0.1-1.0 0-45	4A 4A 4D
15	SoftLoad Spts	A. Time Left = ### min B. SoftLoad = ### min C. SoftLdMaxStg = # D. LoadDelay = ### sec	 20 min 4 15 sec	0-254 0-254 1-8 0-254	
16	CompressorSpt	A. Lead Circuit Auto #1 #2 B. InterStg = ### sec C. MinST-ST = ### min D. MinSP-ST = ### min	Auto 180 sec 15 min 5 min	N/A 60-240 5-40 3-30	
17	Head Pres Spt	A. MinLift-35% = ### B. MinLift-100% = ### C. DeadBandMult = #.# D. StageUpErr = ### E. StageDnErr = ###	85 psi 140 psi 1.0 400 p/s 100 p/s	60-140 120-180 0.8-1.3 300-990 50-400	
18	Demand Limits	A. Demand Lim = # stg Demand Sg = ###.#mA		0-8 0-20mA	
18**	Chiller/Templ	Chl/Tmp Sig = Temp Chil			
19	Time/Date	A. Time = ##: ##: ## B. Sun / / ##/ / /##/ / /##	Current hour Current min Current sec Current day Current month Current date Current year	0-23 0-59 0-59 N/A 1-12 1-31 0-99	

**Applicable menus for ChlTmp (Templifier) operation.

Table 8. Control menu (continued)

STATUS MENUS					
Menu No.	**Menu Line**	**Item Line**	**Default Values**	**Min-Max**	**Switch Menu No.**
20	Schedule	A. Override = ##.## Hr	0.00	0-63.50	
		B. NMP Schedule = ## N/A	N/A	1-32	
		C. Sun ##: – :	0	0-23	
		Sun :##– :	0	0-59	
		Sun : –##:	23	0-23	
		Sun : – :##	59	0-59	
		D. Mon ##: – :	0	0-23	
		Mon :##– :	0	0-59	
		Mon : –##:	23	0-23	
		Mon : – :##	59	0-59	
		D. Tue ##: – :	0	0-23	
		Tue :##– :	0	0-59	
		Tue : –##:	23	0-23	
		Tue : – :##	59	0-59	
		F. Wed ##: – :	0	0-23	
		Wed :##– :	0	0-59	
		Wed : –##:	23	0-23	
		Wed : – :##	59	0-59	
		G. Thu ##: – :	0	0-23	
		Thu :##– :	0	0-59	
		Thu : –##:	23	0-23	
		Thu : – :##	59	0-59	
		H. Fri ##: – :	0	0-23	
		Fri :##– :	0	0-59	
		Fri : –##:	23	0-23	
		Fri : – :##	59	0-59	
		I. Sat ##: – :	0	0-23	
		Sat :##– :	0	0-59	
		Sat : –##:	23	0-23	
		Sat : – :##	59	0-59	
		J. Hol ##: – :	0	0-23	
		Hol :##– :	0	0-59	
		Hol : –##:	23	0-23	
		Hol : – :##	59	0-59	
21	Holiday Date	A. #1 Date = N/A	N/A	N/A-Dec	
		#1 Date = ##	0	0-31	
		#1 Dur = ## Day(s)	0	0-31	
		B. #2 Date = N/A	N/A	N/A-Dec	
		#2 Date = ##	0	0-31	
		#2 Dur = ## Day(s)	0	0-31	
		C. #3 Date = N/A	N/A	N/A-Dec	
		#3 Date = ##	0	0-31	
		#3 Dur = ## Day(s)	0	0-31	
		D. #4 Date = N/A	N/A	N/A-Dec	
		#4 Date = ##	0	0-31	
		#4 Dur = ## Day(s)	0	0-31	
		E. #5 Date = N/A	N/A	N/A-Dec	
		#5 Date = ##	0	0-31	
		#5 Dur = ## Day(s)	0	0-31	
		F. #6 Date = N/A	N/A	N/A-Dec	
		#6 Date = ##	0	0-31	
		#6 Dur = ## Day(s)	0	0-31	
		G. #7 Date = N/A	N/A	N/A-Dec	
		#7 Date = ##	0	0-31	
		#7 Dur = ## Day(s)	0	0-31	

Table 8. Control menu (continued)

STATUS MENUS					
Menu No.	**Menu Line**	**Item Line**	**Default Values**	**Min-Max**	**Switch Menu No.**
21	Holiday Date *(continued)*	H. # 8 Date = N/A # 8 Date = ## # 8 Dur = ## Day(s)	N/A 0 0	N/A-Dec 0-31 0-31	
		I. # 9 Date = N/A # 9 Date = ## # 9 Dur = ## Day(s)	N/A 0 0	N/A-Dec 0-31 0-31	
		J. #10 Date = N/A #10 Date = ## #10 Dur = ## Day(s)	N/A 0 0	N/A-Dec 0-31 0-31	
		K. #11 Date = N/A #11 Date = ## #11 Dur = ## Day(s)	N/A 0 0	N/A-Dec 0-31 0-31	
		L. #12 Date = N/A #12 Date = ## #12 Dur = ## Day(s)	N/A 0 0	N/A-Dec 0-31 0-31	
		M. #13 Date = N/A #13 Date = ## #13 Dur = ## Day(s)	N/A 0 0	N/A-Dec 0-31 0-31	
		N. #14 Date = N/A #14 Date = ## #14 Dur = ## Day(s)	N/A 0 0	N/A-Dec 0-31 0-31	
22	Alarm Spts R-22	A. LP CutIn = ## psi B. LP CutOut = ## psi C. Frz Stat = ## psi D. Frze H_2O = ##.# °F E. FreezeTim = ### sec F. Hi Pres = ### psi *G. LoSourcT = ##.# °F	60 psi 34 psi 54 psi 34.0°F 80 sec 380 psi 40.0°F	42-70 20-55 20-54 N/A, 0.5-40 30-120 280-425 20-75	
22	Alarm Spts R-134a	A. LP CutIn = ## psi B. LP CutOut = ## psi C. Frz Stat = ## psi D. Frze H_2O = ##.# °F E. FreezeTim = ### sec F. Hi Pres = ### psi *G. LoSourcT = ##.# °F	30 psi 14 psi 26 psi 34.0°F 80 sec 266 psi 40.0°F	12-36 0-36 20-54 N/A, 0.5-40 30-120 250-425 20-75	
23	Misc Setup	A. Type = Air Cooled Water Cooled B. # Compressors = # C. # Stages = # D. # Fan Stages = # E. Operation = Chl ChlTmp F. OAT Select = None Lcl Rmt G. # INDENT = RCP2E### RCP2S### H. Remote Cond =	Air Cooled 4 8 3 Chl None No	N/A 2-4 4, 6, 8 1-3 N/A N/A N/A No-Yes	

*Only displayed when ChlTmp operation is selected (Menu 23).

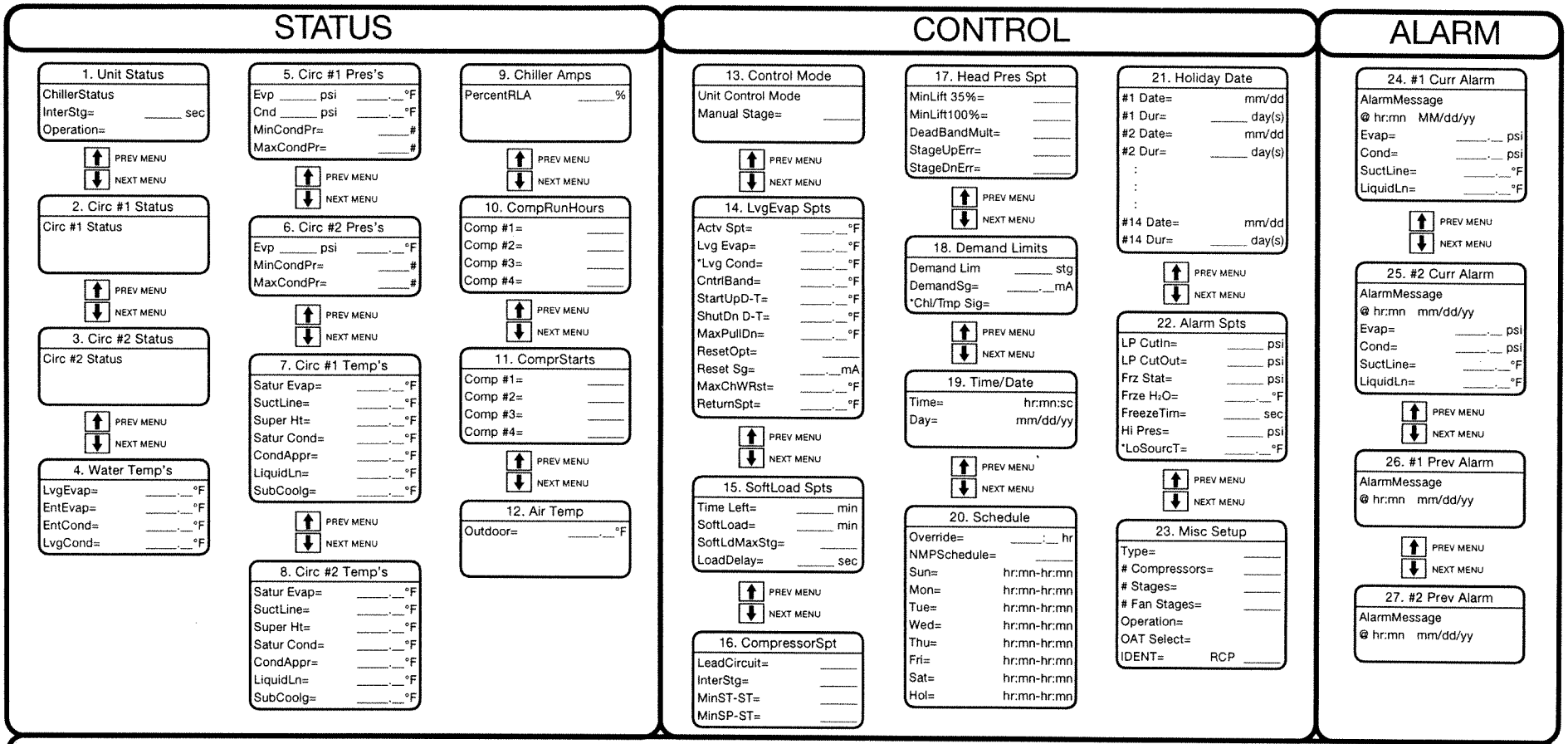
Table 9. Alarm menu

STATUS MENUS					
Menu No.	**Menu Line**	**Item Line**	**Default Values**	**Min-Max**	**Switch Menu No.**
24	#1 Curr Alarm	A. None HiCondPresStgHld HiCondPresStgDwn FreezeProtStgDwn LossofWaterFlow Can't Pump Down Freeze Stat Prot Lo Evap Pressure Comp#4MtrProtect Comp#3MtrProtect Comp#2MtrProtect Comp#1MtrProtect Comp#4LowOil/Pwr Comp#3LowOil/Pwr Comp#2LowOil/Pwr Comp#1LowOil/Pwr Hi Cond Pressure Mech Hi Pressure Bad Evap PresSen Bad Cond PresSen BadPhase/Voltage WaterFreeze Prot BadVoltsRatioSen Bad Lvg WaterSen B. @ ##:## = ##/##/## C. Evap = ###.# psi 145 + psi Open psi Short psi D. Cond = ###.# psi 450 + psi Open psi Short psi E. SuctLine = ###.# °F Open °F Short °F F. LiquidLn = ###.# °F Open °F Short °F	Time and date of alarm Conditions at time of alarm		Menu and item operator was viewing just prior to alarm
25	#2 Curr Alarm	A. None HiCondPresStgHld HiCondPresStgDwn FreezeProtStgDwn LossofWaterFlow Can't Pump Down Freeze Stat Prot Lo Evap Pressure Comp#4MtrProtect Comp#3MtrProtect Comp#2MtrProtect Comp#1MtrProtect Comp#4LowOil/Pwr Comp#3LowOil/Pwr Comp#2LowOil/Pwr Comp#1LowOil/Pwr Hi Cond Pressure Mech Hi Pressure Bad Evap PresSen Bad Cond PresSen BadPhase/Voltage WaterFreeze Prot BadVoltsRatioSen Bad Lvg WaterSen			Menu and item operator was viewing just prior to alarm

Table 9. Alarm menu (continued)

STATUS MENUS					
Menu No.	**Menu Line**	**Item Line**	**Default Values**	**Min-Max**	**Switch Menu No.**
25	#2 Curr Alarm *(continued)*	B. @ ##:## = ##/##/## C. Evap = ###.# psi 145 + psi Open psi Short psi D. Cond = ###.# psi 450 + psi Open psi Short psi E. SuctLine = ###.# °F Open °F Short °F F. LiquidLn = ###.# °F Open °F Short °F	Time and date of alarm Conditions at time of alarm		Menu and item operator was viewing just prior to alarm
26	#1 Prev Alarm	A. None HiCondPresStgHld HiCondPresStgDwn FreezeProtStgDwn LossofWaterFlow Can't Pump Down Freeze Stat Prot Lo Evap Pressure Comp#4MtrProtect Comp#3MtrProtect Comp#2MtrProtect Comp#1MtrProtect Comp#4LowOil/Pwr Comp#3LowOil/Pwr Comp#2LowOil/Pwr Comp#1LowOil/Pwr Hi Cond Pressure Mech Hi Pressure Bad Evap PresSen Bad Cond PresSen BadPhase/Voltage WaterFreeze Prot BadVoltsRatioSen Bad Lvg WaterSen B. @ ##:## = ##/##/##	Time and date of alarm		
27	#2 Prev Alarm	A. None HiCondPresStgHld HiCondPresStgDwn FreezeProtStgDwn LossofWaterFlow Can't Pump Down Freeze Stat Prot Lo Evap Pressure Comp#4MtrProtect Comp#3MtrProtect Comp#2MtrProtect Comp#1MtrProtect Comp#4LowOil/Pwr Comp#3LowOil/Pwr Comp#2LowOil/Pwr Comp#1LowOil/Pwr Hi Cond Pressure Mech Hi Pressure Bad Evap PresSen Bad Cond PresSen BadPhase/Voltage WaterFreeze Prot BadVoltsRatioSen Bad Lvg WaterSen B. @ ##:## = ##/##/##	Time and date of alarm		

Figure 16. Keypad/menu structure



SELECTING DATA FOR VIEWING

The keypad information is divided into 3 categories: Status, Control, and Alarms. See the chart (above) for information contained in each category.

To select a category, press the "STATUS", "CONTROL", or "ALARM" key. Note that the display contains two lines of data. The top line is the "Menu Line" and the bottom line is the "Item Line". A typical display is as follows:

4. Water Temp's	← Menu Line
Lvg Evap = 44.5°F	← Item Line

To select a menu, press the "NEXT MENU" key to scroll through the available menus.

To view items within a menu, press the "NEXT ITEM" key.

TO CHANGE A CONTROL SETPOINT

1. With the display showing the setpoint you wish to change, press the "INCR." or "DECR." key.
2. Enter the 4 character authorization password.
3. Press the "INCR." or "DECR." key. Note that the value begins to blink. Continue pressing the "INCR." or "DECR." key until the desired value is shown.
4. Press the "ENTER" key to set the value. Note the value stops blinking.

TO VIEW AND CLEAR A CURRENT ALARM

1. Press the "ALARM" key. Circuit #1 Current Alarm is displayed.
2. Press the "CLEAR" key. The alarm is cleared and normal operation of Circuit #1 is resumed.
3. Press the "NEXT MENU" key. Circuit #2 Current Alarm is displayed.
4. Press the "CLEAR" key. The alarm is cleared and normal operation of Circuit #2 is resumed.

See McQuay Publication IM 493 for detailed operating instructions.

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*Only displayed when ChlTmp operation is selected (Menu 23).

All of the following procedures assume that power is applied to the MicroTech control panel and the circuit break (CB1) is on. Some of the following procedures require the removal or replacement of the controller, fuses, connectors, terminals or jumpers. Always shut off the power before making the required changes.

Microprocessor control board

The MicroTech controller contains three LEDs which aid in controller diagnostics and indicate the microprocessor's operating condition. Table 10 details the operating condition indicated by these LEDs.

When power is first applied to the control panel, the red RESET LED will illuminate for approximately 3 seconds. During this time, the microprocessor is checking the control software and performing internal hardware tests. When the se tests are complete the red RESET LED will turn off and the green RUNNING LED will illuminate indicating the controller's circuitry and software are operating correctly. The amber OUTPUT 0 ACTIVE LED is associated with the external alarm output on the solid state relay board and will be illuminated during any alarm condition.

If the microprocessor status LEDs do not follow the normal sequence as shown in Table 10, there is a problem with the controller. Likely problems include loss of controller power, corrupted software or the controller itself may be defective. Following are troubleshooting procedures for the various symptoms.

Red LED remains on — If the red LED remains on after the 5-second self-test period, it is likely that the MCB is defective. Disconnect the controller power by opening circuit break CB1 and check the field wiring. Observe the controller's LEDs while reconnecting power by closing CB1. Sometimes field wiring problems can cause the red light to remain on. However this can also occur in some instances if there is a power supply problem. Refer to "Troubleshooting Power Problems" below

Red and green LEDs off — If the red and green LEDs do not turn on after power is applied to the controller, there is likely a defective component or a problem in the controller's power distribution circuits. Refer to "Troubleshooting Power Problems" below.

Red LED does not turn on — Check for 18 VAC between Control Board power supply input terminals 1 and 2. If 18 VAC is present, check the power fuses mounted adjacent to the power connector. If this fuse is blown, it should be replaced with a fuse of the same rating. If this fuse is not blow, it is likely that the controller is itself defective and must be replaced.

If 18 VAC is not present at the power connector, check for 24 VAC at terminals 25 and 27. If 24 VAC is present here, transformer T4 is probably defective.

Table 10. Controller status LEDs

Green LED	Red LED	Indication
Off	Off	No power to controller
Off	On	Self-test failure or power supply problem
On	Off	Microprocessor operating normally

Troubleshooting power problems

The Microprocessor Control Board (MCB) receives 18 VAC, center-tapped power from transformer T4. It then distributes both 5 VDC and 12 VDC power to the various MicroTech components. A problem in any of these components can affect the MCB and thus the entire control system. Power problems can be caused by an external short, which can either blow a fuse or create an excessive load on the power supply. An excessive load can lower the power supply voltages to unacceptable levels. Use the following procedure to isolate the problem. Note that this procedure may require two or three spare MCB fuses. Refer to the panel wiring diagram or the MicroTech Schematic as you proceed.

1. Verify that circuit breaker CB1 is closed.
2. Remove the MCB Power In terminal strip connector and check for 9 VAC between the terminals on the plus corresponding to terminals 2 and 3 on the board (see MicroTech Schematics 1 and 2). Then check for 9 VAC between the terminals on the plug corresponding to terminals 1 and 3 on the board. Readings of 9-12 VAC are acceptable.
   If 9 VAC is present between both sets of terminals, go to step 3.
   If 9 VAC is not present between both sets of terminals, check transformers T4 and T2 and all wiring between the 115 VAC source and the Power In plug.
3. Remove power from the controller by opening circuit breaker CB1. Check the MCB power supply input fuses (mounted adjacent to the power connector on the MCB) with an ohmmeter. A good fuse will have negligible resistance through it (less than 2 ohms).
   If either or both fuses are blown, replace them. Go to step 4.
   If the fuses are intact, the MCB is defective.
4. Reconnect the Power In plug and disconnect all other connectors on the MCB. Cycle power to the controller (close and then open CB1) and check the power fuses.
   If both fuses are intact, go to step 5.
   If either fuse blows, the MCB is defective.
5. Reconnect the keypad/display ribbon cable. Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 6.
   If either fuse blows, check the keypad/display and the connecting ribbon cable for shorts. Either one may be defective.
6. Reconnect the analog input ribbon cable. Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 7.
   If either fuse blows, check the ADI board, the connecting ribbon cable, the leaving water sensor and the optional package sensors (if present) for shorts. Any of these may be defective.
7. Reconnect the digital input cable. Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 8.
   If either fuse blows, check the ADI board, the connecting ribbon cable and the control circuit digital input wiring for shorts. Any of these may be defective. To rule out problems with digital input wiring from the control circuit components, disconnect wire 809 from terminal 25. This wire provides 25 VAC to the safety and control circuit components. An alarm will occur when disconnect wire 809. If shorts occur in the control circuit digital inputs, the wiring should be checked at the digital inputs. It may be necessary to trace the wiring back to the control circuitry. When finished checking the power input from terminal 25, reconnect wire 809 and clear alarm(s).

8. Reconnect the Aux/Out connector plug to the MCB. Disconnect the 5 VDC regulated power plug for the transducers from the MCB. Cycle power to the controller and check the power fuses.

   If both fuses are intact, go to step 9.

   If either fuse blows, check the transducers and their wiring for shorts or scrapes. If a modem is present, check it's wiring and operation. If the 12 VDC unregulated signal from terminal #146 is being used, check the wiring back to the controller Aux/Out connector. This power supply may be used to power the 4-20mA reset signals for leaving water reset and/or demand limiting. Disconnecting the reset connections at terminal #146 can rule out or isolate a power problem with these external signals.

9. Reconnect the digital output ribbon cable to the MCB. Cycle power to the controller and check the power fuses.

   If both fuses are intact, the problem may be indeterminate. Obtain factory service.

   If either fuse blows, check the output board, the solid state relays and the connecting ribbon cable for shorts. Any one may be defective. See below for testing the output board and solid state relays.

ADI board

All digital and analog input signals are conditioned by the ADI Board. Power for the board is derived from the Microprocessor Control Board via the interconnecting ribbon cables. If the ADI Board appears inoperative, make sure these ribbon cables are fully seated in their sockets and the locking tabs are engaged.

The digital inputs indicate the presence of 24 VAC by illuminating its corresponding LED. At 7.5 VAC to 24 VAC the digital input contacts are considered closed and the LED will be on. Below 7.5 VAC the contacts are considered open and the LED will be off. Individual digital inputs may be tested by momentarily installing a jumper between terminal 25 and the ADI Board terminal to be tested. If the input is operating properly, the LED will illuminate when 24 VAC from terminal 25 is applied. See Schematic 1.

Temperature sensors receive operating power from the ADI Board which relies on the Microprocessor Control Board's regulated 5 VDC power supply. If all temperature sensors appear to have failed, check the 5 VDC supply on the controller.

Troubleshooting the keypad/display board

Operating power for the keypad/display is provided by the MCB via the interconnecting ribbon cable. An inoperative keypad/display can be caused by a loose or damaged ribbon cable or the loss of the controller's power supply. The keypad/display is also thermally sensitive.

Display is hard to read

The clarity of the LCD display can be affected by ambient temperature. Typically, less contrast will result with cooler temperatures. If the display is difficult to read, adjust the yellow contrast trim pot has no effect, it is likely that either the keypad/display or its ribbon cable is defective.

Display is blank or garbled

If the MCB appears to be functioning properly and the display is completely blank or garbled, perform the following procedure:

1. Try cycling power to the controller by opening and then closing circuit breaker CB1 *(see note)*.
2. Try adjusting the contrast trim pot, which is located on the back of the keypad/display assembly on the left-hand corner. If the contrast trim pot has no effect, it is likely that either the keypad/display or its ribbon cable is defective.
3. After removing power from the controller, check the ribbon cable and connections between the keypad/display and the MCB. Look for bent pins. Restore power after reconnecting the ribbon cable.
4. Try swapping a known good ribbon cable and keypad/display. These may come, for example, from a RMS panel — the keypad/display is the same. Swap these components separately to isolate the problem. Remove power from the controller before disconnecting the suspect component, and restore power after connecting the replacement component. If the problem persists, it is likely that the MCB is defective.

NOTE

The keypad/display and MCB must be powered up together; otherwise, the display will be blank. Therefore, if the keypad/display is ever disconnected from the MCB and then reconnected, power to the controller must be cycled to restore the display. Cycle power to the controller by opening and then closing circuit breaker CB1.

Open or shorted temperature sensor circuits

The controller has built-in functions which will aid in the diagnosis of temperature sensor problems. The controller will display either "open" or "short" instead of a temperature value on menus 4, 7 and 8 of the keypad/display for monitor only and control sensors or display an alarm indicating "Bad Lvg WaterSen" for the control sensor.

If the menus indicate a problem, check the sensor circuit wiring for shorts, disconnections or scrapes. If the sensor circuit wiring and connections are intact, the sensor is probably defective. Verify this by performing the following "Erroneous Temperature Readings Procedure".

Erroneous temperature readings and/or "Bad Lvg WaterSen" alarm condition

If it is suspected that the controller is operating using erroneous temperature data or the control sensor alarm has tripped, the following procedure can be used to check for problems:

1. Remove power from the controller by opening circuit breaker CB1. Verify that the ribbon cable connections between the controller and the keypad/display and the controller and the ADI board are proper. Look for bent pins. After reconnecting the ribbon cables, restore power to the controller.
2. Measure the temperature at the suspect sensor location using an accurate thermometer.
3. Determine the sensor's associated terminals on the ADI board. Refer to the panel wiring diagram.
4. Remove power from the controller. Remove the white cap covering the IDC connectors which connect the sensor wiring to the ADI board. Unplug the red IDC connector block from the ADI board and measure the resistance across the conductors. Using the thermistor chart *(Table 1)*, compare this value with the measured temperature.

   If the measured resistance and temperature match, go to step 5.

   If the measured resistance and temperature do not match, either there is a wiring problem or the sensor is defective. Check the sensor circuit wiring and connections for defects.
5. Re-insert the IDC connector onto the ADI board and restore power to the controller. Measure the DC voltage across the metal portion of the IDC connector. Using the thermistor chart, compare this value with the measured temperature.

If the measured voltage and temperature do not match, the ADI board or the ADI board-to-MCB ribbon cable is probably defective.

If the measured voltage and temperature match, the MCB is probably defective. The above steps ruled out problems with the sensor, the sensor wiring, the ribbon cables and the keypad/display.

Erroneous pressure readings

If the evaporator or condenser pressure reading, as read through menus 5 and 6 on the keypad, appear erroneous or unrealistic, or if the alarm conditions of "Bad Evap PresSen" or "Bad Cond PresSen" are logged, the following procedure should be followed to check the pressure transducers:

1. Check for proper ribbon cable and other connections.
2. Measure the voltage (0 to 5 VDC) across the suspected pressure transducer at ADI Board terminal A1, A2, A3 or A4, whichever applies.
3. Compare this reading with what the value should be according to that shown in Figures 3 and 4, the transducer output characteristics *(see note below).*
4. Check for 5 VDC at terminal 214 as supplied by the MCB and also at the MCB itself.

   If the voltage is 5 VDC in both places, the sensor is probably defective.

   If the voltage is not 5 VDC at terminal 214, check wire 814 to the MCB for shorts or scrapes.

   If the voltage at the MCB is not 5 VDC, check wiring between the MCB and T2. There could be shorts or other wiring problems from the incoming power. Refer to "Troubleshooting Power Problems" under the troubleshoot section for the Microprocessor Control Board.

NOTE

The actual pressure to the transducer must be known. If that transducer is not defective, then it is likely that the ADI board itself is defective and must be replaced.

Freezestat alarm condition

The MicroTech "Freeze Stat Prot" alarm condition can occur due to several factors. Following is a list of different suggestions on items to inspect or set points to adjust when the alarm occurs frequently. The suggestions do not have to be performed in sequence as they are in no particular order.

1. Check the set points for the "LP CutIn", "Frz Stat" and "Frze H_2O" on Menu 22. They should be adjusted according to the individual job. If the job includes glycol, it is a low temperature job and/or is an ice job, these items should be adjusted accordingly. Ice jobs are considered to be jobs in which the leaving chilled water set point is 34°F or less. Refer to the Reset Options section for information on ice job set points.
2. Check the Leaving Evaporator Set Points for the "ControlBand", the "StartUpD-T" (Start-up Delta-T) and the ShutDn D-T" (Shut Down Delta-T) on Menu 14. A good rule of thumb for the Control Band setting is to use the formula:

$$\textit{Typical Control Band} = \frac{\textit{Evaporator T}}{\textit{\# Unit Stages}} + 0.5°F$$

The Start Up Delta-T and the Shut Down Delta-T define when the unit will start from an off condition and shut completely down. The Start Up Delta-T can be raised to ensure the unit doesn't turn on too soon. The Shut Down Delta-T can be decreased so that the unit shuts off before the leaving water temperature gets too low. Refer to Normal Sequence of Operation and the Menu Description sections of this manual for further information on these set points.

3. Check the water flow through the unit; are the pumps running continuously, are the pumps shut off at night, is there a variable water flow situation, is there adequate water mass in the chilled water system, is the water loop too short? McQuay reciprocating chillers and Templifiers require a constant adequate flow of water through the evaporator. Refer to the unit installation and maintenance manual for water and glycol flow charts. When short water loops are present, the chilled water is pulled down quickly. A good rule of thumb is that the water temperature should be pulled down no more than 1°F every 15 to 20 minutes — a 20-minute water loop. Inadequate water mass in the chilled water system has the same effect. Refer to McQuay literature regarding applications.
4. Investigate physical considerations in the refrigerant circuit. This is especially important when only one circuit is consistently tripping on the "Freeze Stat Prot" alarm and the other is not. The alarm, head pressure and leaving evaporator set points are used for both circuits so the only difference between the two circuits would be physical. Check the operation of the expansion valve (TXV). Check the site glass and take a sample of the refrigerant to check for moisture. Visually inspect and leak test the machine. The unit could be low on charge, causing low suction pressure. Check to make sure the superheat and/or low subcooling are within acceptable guidelines. High superheat and/or low subcooling can cause low suction pressure. Check the evaporator pressure transducer for correct operation. Refer to the Erroneous Pressure Readings troubleshooting section.
5. Verify that the Head Pressure Set Points on Menu 17 are suitable for the particular job. Adjustment of the "MinLift-35%", the "MinLift-100%" and/or the "DeadBandMult" set points may be necessary. Refer to the Head Pressure Control section of this manual for head pressure adjustment guidance.

Output board

Solid-state relays on the MicroTech Controller Output Board all have contacts open when de-energized. However, because these relays are "solid-state", the contacts are not "open" in the sense that electromechanical relays open their contacts. Instead, the relay switches from low to high resistance.

When checking the voltage in a circuit where these relays have been incorporated, it is possible to be confused by the presence of voltage on the load side of the relay. If there is a load on the relay, the circuit will behave like a traditional relay circuit. That is, if the relay switches to "off", the voltage will drop to zero at the output of the relay. But, should the circuit be "open" between the relay output and the load, and the output relay is "off", the high resistance of the relay and the voltmeter form a series circuit. A digital voltmeter will not indicate any decrease in voltage and an analog voltmeter will typically indicate a minor decrease in voltage when the relay turns "off".

Testing Solid-State Relays

The input resistance of most digital voltmeters is on the order of 10,000,000 to 12,000,000 ohms (10 to 12 megohms). Analog meters with 20,000 ohms/volt movements would have an input resistance of 5 megohms on the 250 volt scale. Connecting a voltmeter into the circuit adds very little load to the relay. When the solid-state relay switches to "off", the resistance increases to approximately 100K ohms. This is a 100:1 ratio of resistance between the digital meter and the load, and a 50:1 ratio between the analog meter and the load. This will cause 100 times more voltage to be dropped across the digital meter as is dropped across the relay, and 50 times more voltage to be dropped across the analog meter as is dropped across the relay. A low wattage lightbulb (of the appropriate voltage) will load the circuit enough to eliminate the false voltage signal. (***Note:*** The cold resistance of a 25 watt/120 volt bulb is approximately 48 ohms.) In this instance, an incandescent test lamp is a better tool than a voltmeter.

The output contacts of each solid-state output relay on the Output Board is equipped with a 5 amp fuse. These fuses resemble tiny resistors and are located on the Output Board adjacent to the relay they protect. These are pressed into place and can be removed by lifting them out with a needle nose pliers.

The LED located on the solid-state relay base responds to the input of the solid-state circuit. If the LED does not glow, the relay is probably not energized. These relays require the existence of 5 VDC to initiate closure. When the relay is energized, the LED should glow.

MicroTech Monitoring and Networking Options

PC monitoring

A PC (personal computer) equipped with the appropriate Monitor software can be used to provide a high-level interface with a MicroTech network (see PC specification below). Monitor software features a Windows™-based display, multi-level password access, and advanced trendlogging. The PC can be connected to the Reciprocating MicroTech controller either directly, via one twisted pair, shielded cable, or remotely, via phone lines with an optional modem. For more information on connecting the PC to the controller, refer to Network Systems literature.

PC specification

A direct or remote connected computer can be used for monitoring reciprocating chiller and Templifier unit operation, changing set points, scheduling, trend logging, downloading software and diagnostic. The PC must be an IBM or 100% true compatible. Table 11 shows the preferred and minimum PC specifications.

Other networking options

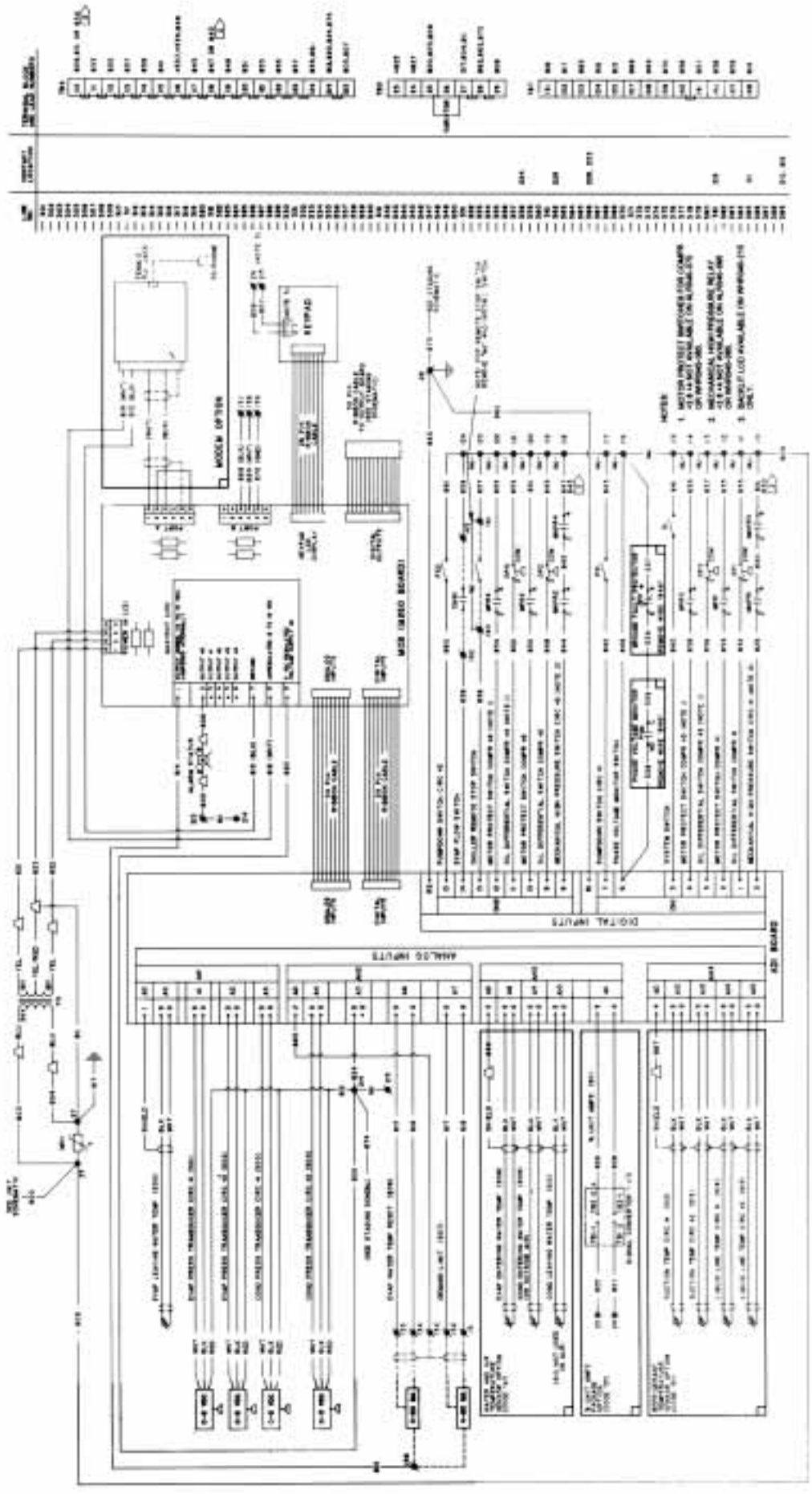
Additional network products available for use with reciprocating chillers and Templifiers include the Remote Monitoring and Sequencing (RMS) Panel, the Network Master Panel (NMP), the Chiller System Controller (CSC) and Open Protocol. For information regarding the application and usage of these MicroTech network systems products, refer to Network Systems literature.

Table 11. PC specification

Preferred Configuration	Minimum Configuration
486DX processor, 66 MHz or better	386SX processor, 16 MHz
8 MB of RAM or better	4 MB of RAM 4 MB of RAM
120 MB hard disk drive or better	60 MB hard disk drive
3½" floppy disk drive	3½" floppy disk drive
Serial port (9 pin male; Com1 or Com2)	Serial prot (9 or 25 pin male; Com1 or Com2)
Parallel port	—
Internal time clock, battery backed	Internal time clock, battery backed
Super VGA graphics capability	VGA graphics capability
Super VGA monitor	VGA monitor
Printer	—
Bus mouse or trackball	*Serial mouse or Trackball
101 enhanced keyboard	101 enhanced keyboard
9600 baud modem, compatible with the AT command set *(optional)*	1200 baud modem, compatible with the AT command set *(optional)*
MS-DOS® 6.2 or higher	MS-DOS® Window™ 3.1
Microsoft® Monitor™ 3.1 or higher	Microsoft® Window™ 3.1
MicroTech® Monitor™ *for Windows software*	MicroTech® Monitor™ *for Windows software*

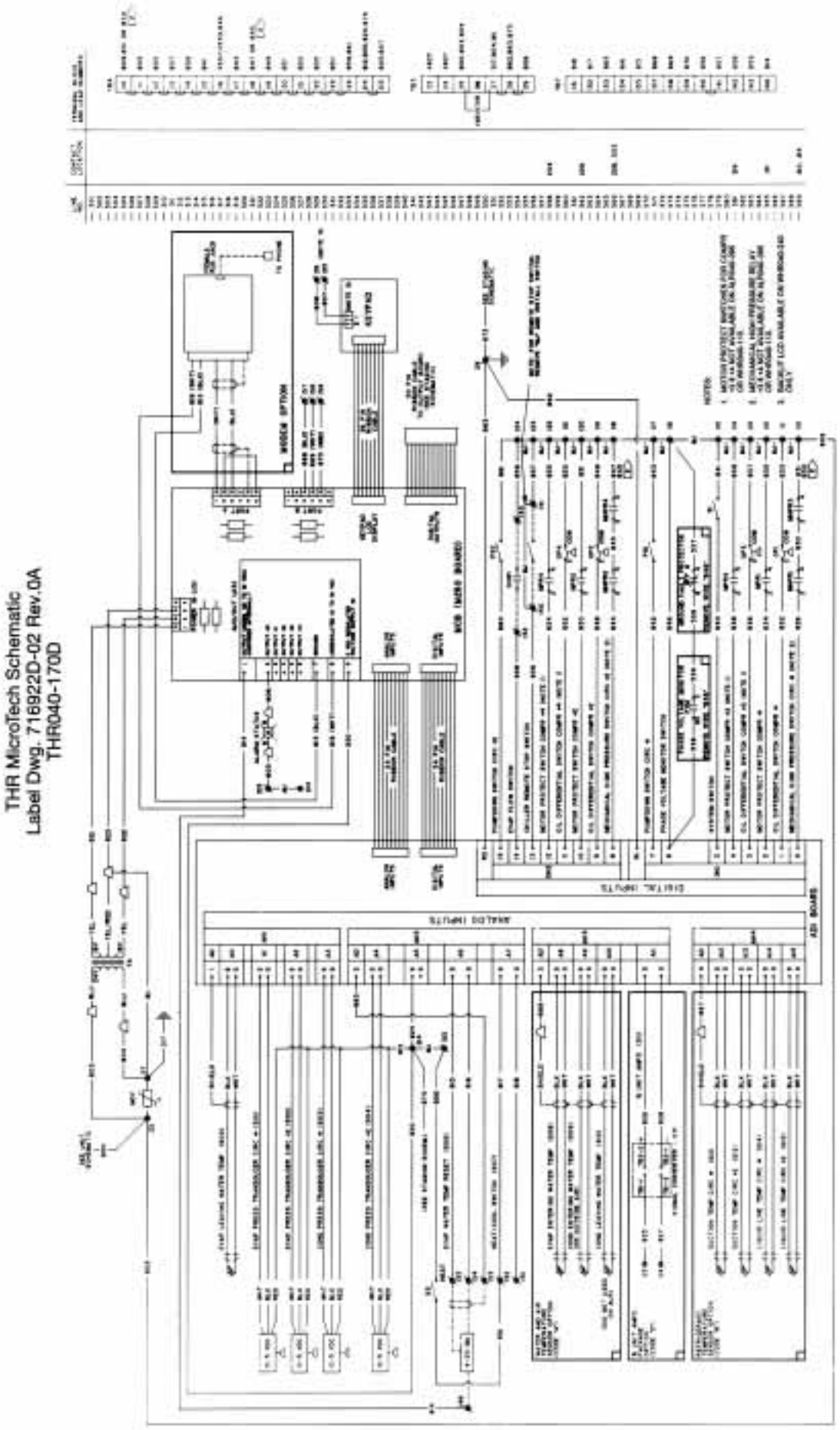
*If a serial point device is used, there must be another serial port (Com1 or Com2) available for connecting the PC to the MicroTech controller.

Schematic 1. ALR and WHR MicroTech wiring



ALR & WHR MicroTech Schematic
Label Dwg. 716358D-02 Rev.0A
ALR035-185D/WHR040-210E

Schematic 2. THR MicroTech wiring

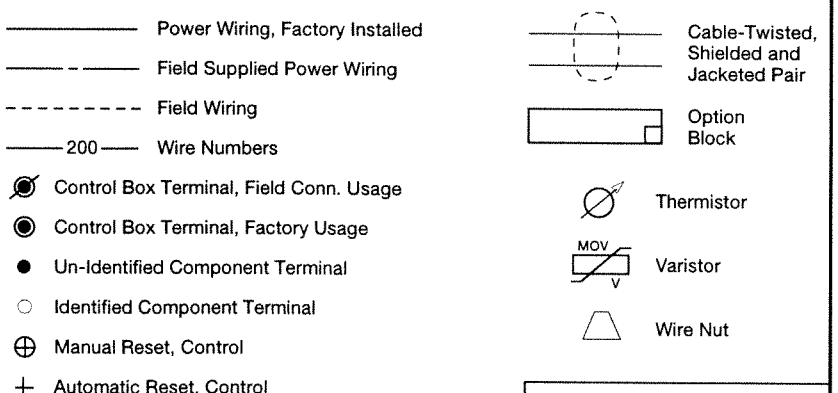


ALR035-185D Electrical Legend

Designation	Description	Standard Location
AB	Alarm Bell	Back or Side of Control Box
ADI	Analog/Digital Input Board	Control Box, Control Panel
C11, C21	Capacitors for SpeedTrol Motors	Back of Control Box or on Bulkhead
CB	Circuit Breaker (MicroTech)	Control Box, Control Panel
CB1-CB8	Circuit Breaker (Power)	Control Box, Power Panel
CHWI	Chilled Water Interlock	Field Installed
Compr 1-4	Compressors 1-4	Base of Unit
CT1	Current Transformer	Control Box, Power Panel
CTR1-CTR4	Counter Compressor, Total Hours	Control Box, Switch Panel
DS1	Disconnect Switch, Main	Control Box, Power Panel
F1	Fuse, Control Circuit	Control Box, Control Panel
F2	Fuse, Evaporator Heater	Control Box, Switch Panel
F3	Fuse, 115V Outlet	Control Box, Control Panel
FB5	Fuseblock, Control Power	Control Box, Power Panel
GFP	Ground Fault Protector	Control Box, Power Panel
GRD, GND	Ground	Control Box
HM1-HM-4	Hour-Meter, Compressor	Control Box, Switch Panel
HTR1-HTR4	Compressor Heater, Crankcase	On Compressors
HTR5	Heater, Evaporator	Wrapped around Evaporator
J1-J13, JJ1, JJ2	Jumpers (Lead)	Control Box, Control Panel
JB5	Junction Box for Evaporator Heater	Near Evaporator on Base Rail
Keypad	Keypad Switch 8 Display	Control Box, Keypad Panel
M1-M8	Contactors, Compressor	Control Box, Power Panel
M11-M27	Contactors, Fan Motors	Control Box, Power Panel
M250	Model 250P Comm. Board	Control Box, Control Panel
MHP1-MHP4	Mechanical High Pressure Switch	Control Box, Control Panel
MHPR1-MHPR4	Mech High Pressure Switch Relay	Control Box, Control Panel
MJ	Mechanical Jumper	Control Box, Control Panel
Modem	Modem, MicroTech	Control Box, Control Panel
MPR1-MPR4	Motor Protect Relay	Control Box, Control Panel
MTR11-MTR27	Motors, Condenser Fans	Condenser Section
MP1-MP4	Motor Protect, Compressor	On Compressor
NB	Neutral Block	Control Box, Control Panel
OB	Output Board, MicroTech	Control Box, Control Panel
OP1-OP4	Oil Pressure Switch	Control Box, Control Panel
PB1-PB3	Power Block, Main	Control Box, Power Panel
PS1, PS2	Pumpdown Switch, Circ #1, Circ #2	Control Box, Keypad Panel
PVM	Phase Voltage Monitor	Control Box, Control Panel
REC1	115V Convenience Outlet	Control Box, Control Panel
RES1	Resistor, Current Transformer	Control Box, Power Panel
R9-R12	Relays, Starting	Control Box, Control Panel

Designation	Description	Standard Location
S1	Switch, System	Control Box, Keypad Panel
SC11, SC12	Speed Controls	Back of Control Box or on Bulkhead
Sig Conv	Signal Converter	Control Box, Control Panel
SV1, SV2	Solenoid Valve, Liquid Line	On Liquid Lines
SV5, SV6	Solenoid Valve, Hot Gas Bypass	On Line to Hot Gas Valve
T1	Transformer, Main Control	Control Box, Power Panel
T2	Transformer, 120/24V Control	Control Box, Control Panel
T3	Transformer, Fan SpeedTrol	On Bulkhead
T4	Transformer, 24/18V Control	Control Box, Control Panel
TB2	Terminal Block, 120V Field	Control Box, Control Panel
TB3	Terminal Block, 24V Field	Control Box, Control Panel
TB4-TB8	Terminal Block, Control	Control Box, Control Panel
TB7	Terminal Block, less than 24V	Control Box, Control Panel
TC2	Thermostat, Evaporator	On Evaporator
TD5-TD8	Time Delay, Compr Part Winding	Control Box, Control Panel
U1, U2	Unloader	On Compressors

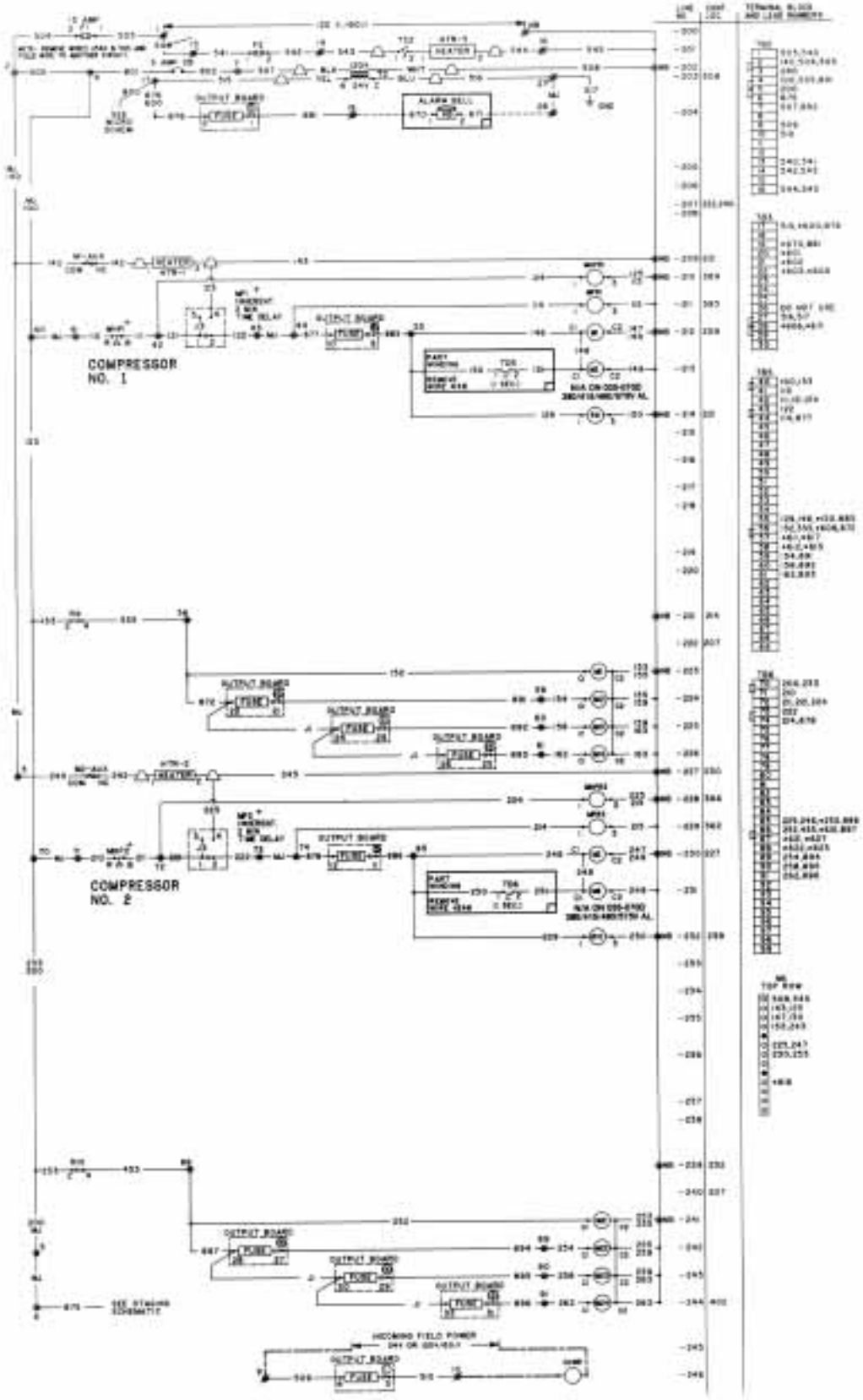
Wiring Symbols



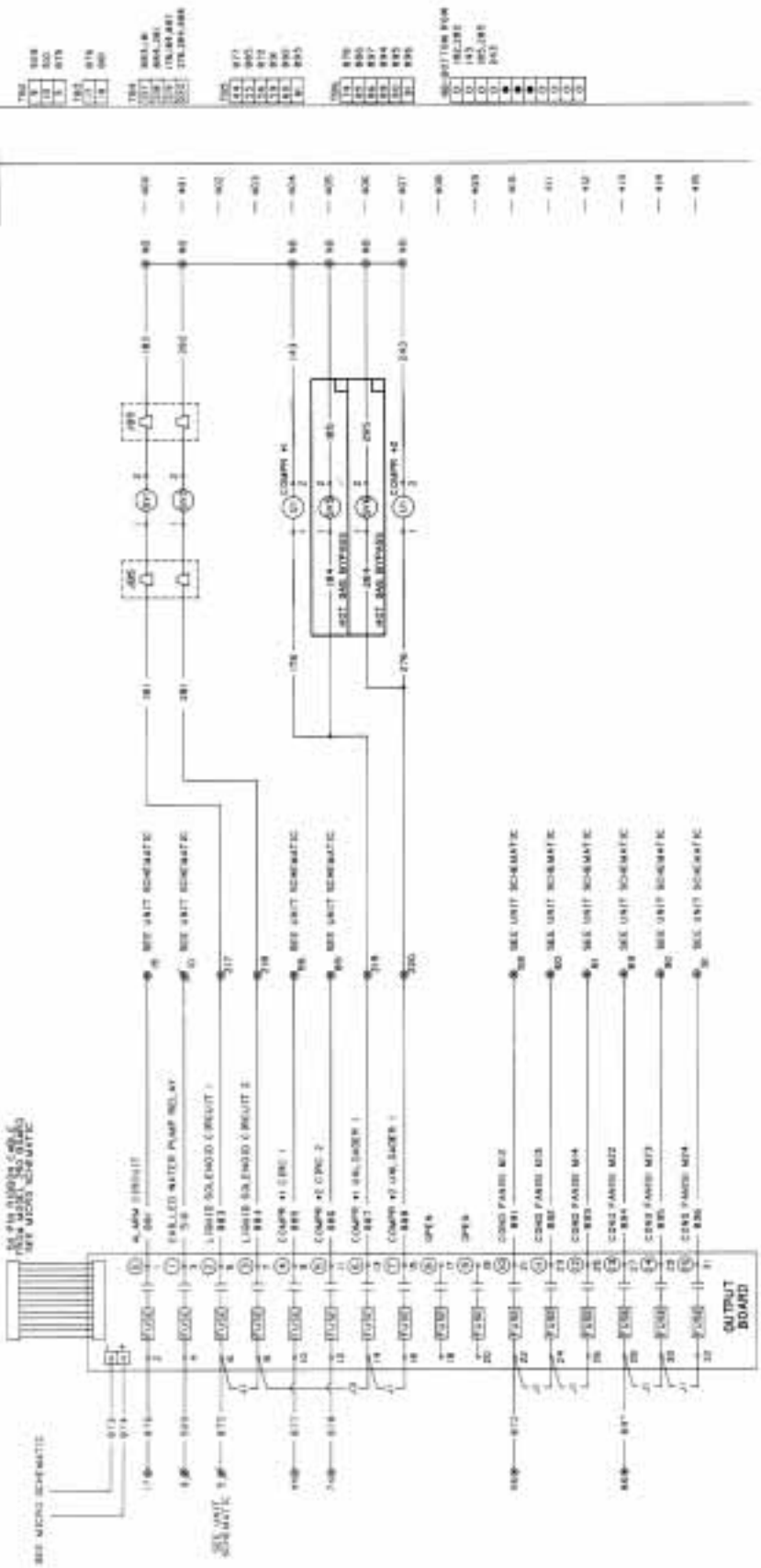
Drawing 704359C-02 Rev. OA

Schematic 4. Control wiring, ALR035-070D

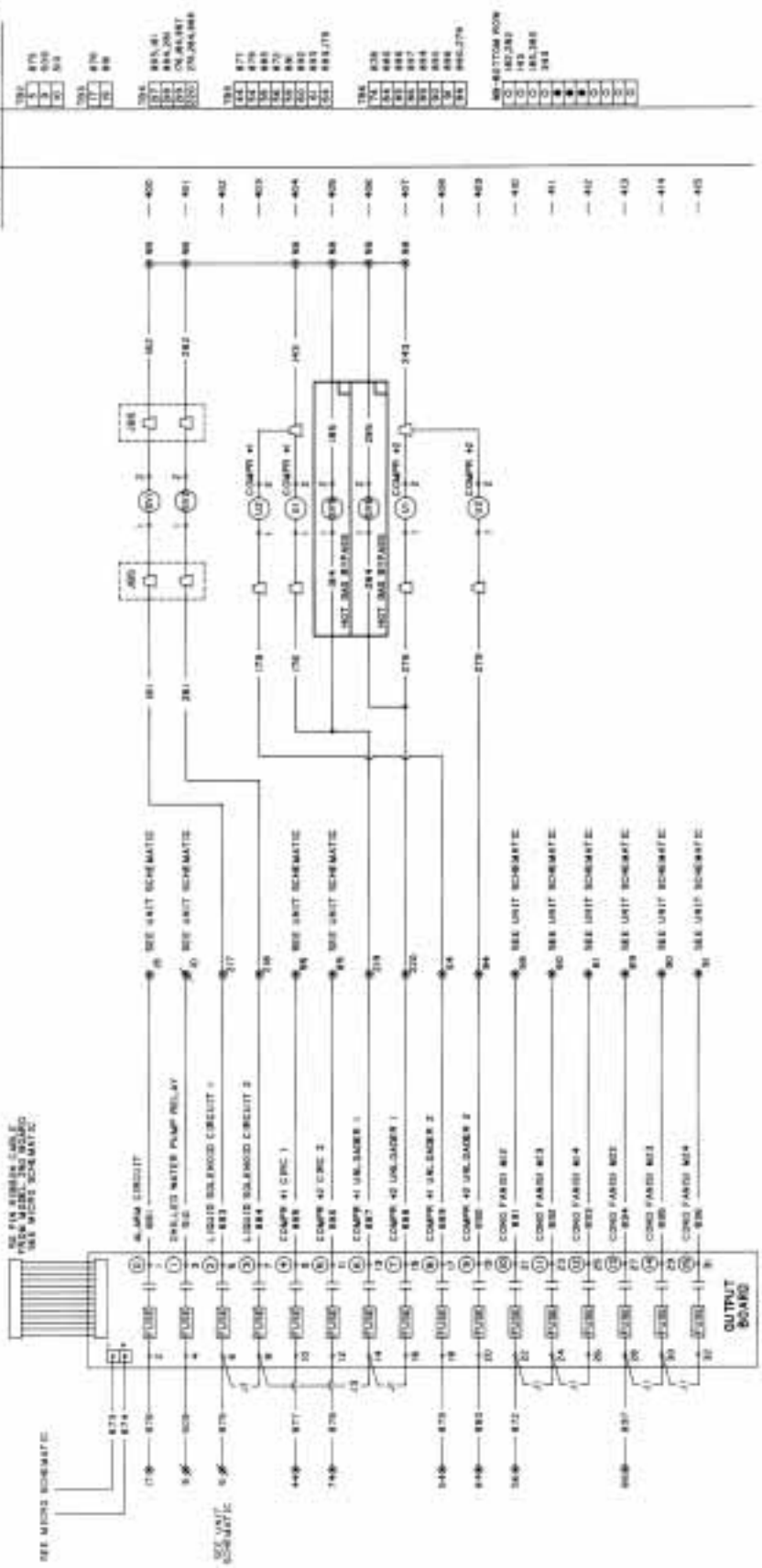
Compressor Control Schematic for ALR035-070D
Label Dwg. 716368D-02 Rev.0A



MicroTech 4-Stage Schematic for 2-Compressor Units
Label Dwg. 7163555D-02 Rev.0A
ALR035-070D

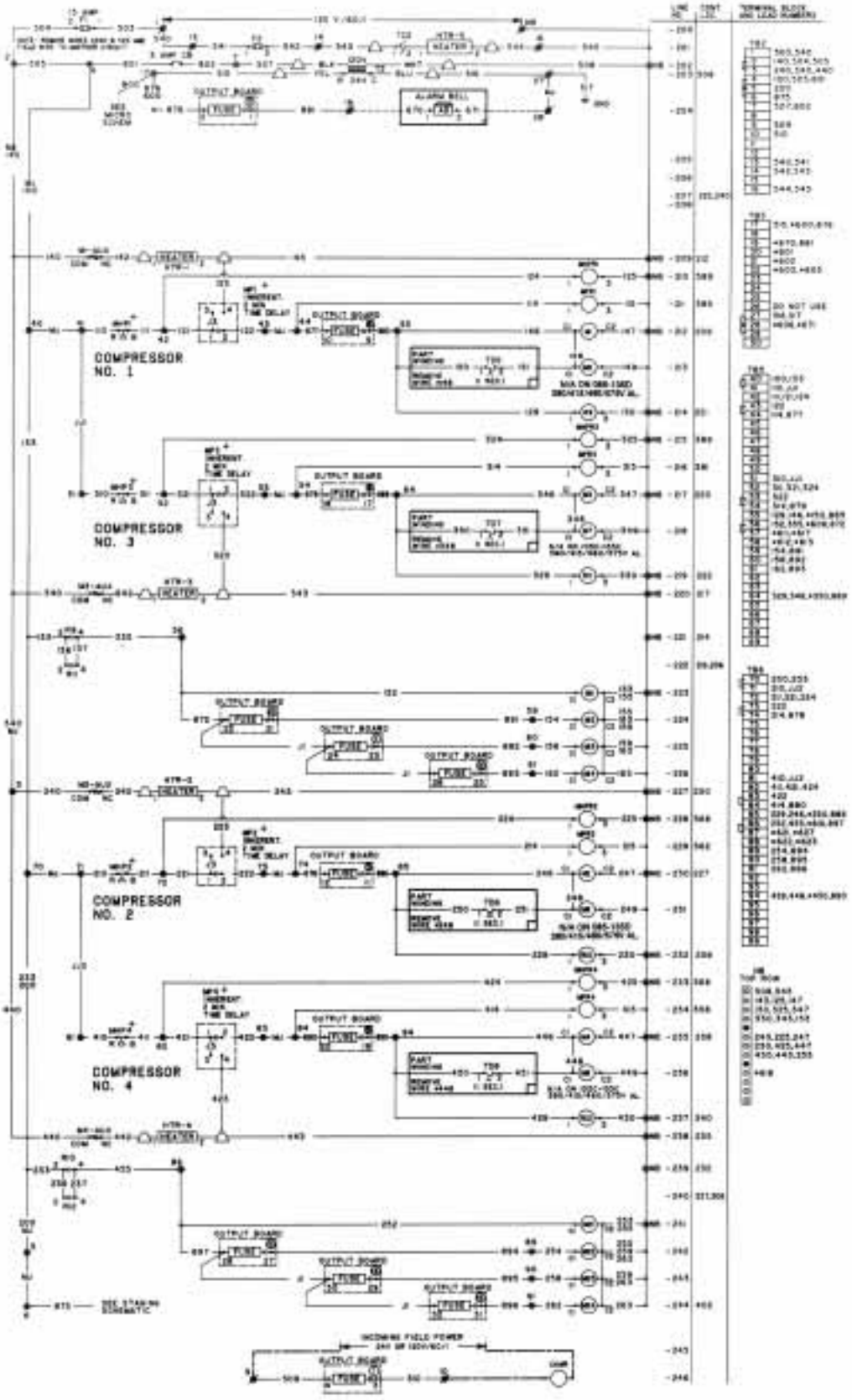


MicroTech 6-Stage Schematic for 2-Compressor Units
Label Dwg. 716376D-02 Rev.0A
ALR050-070D

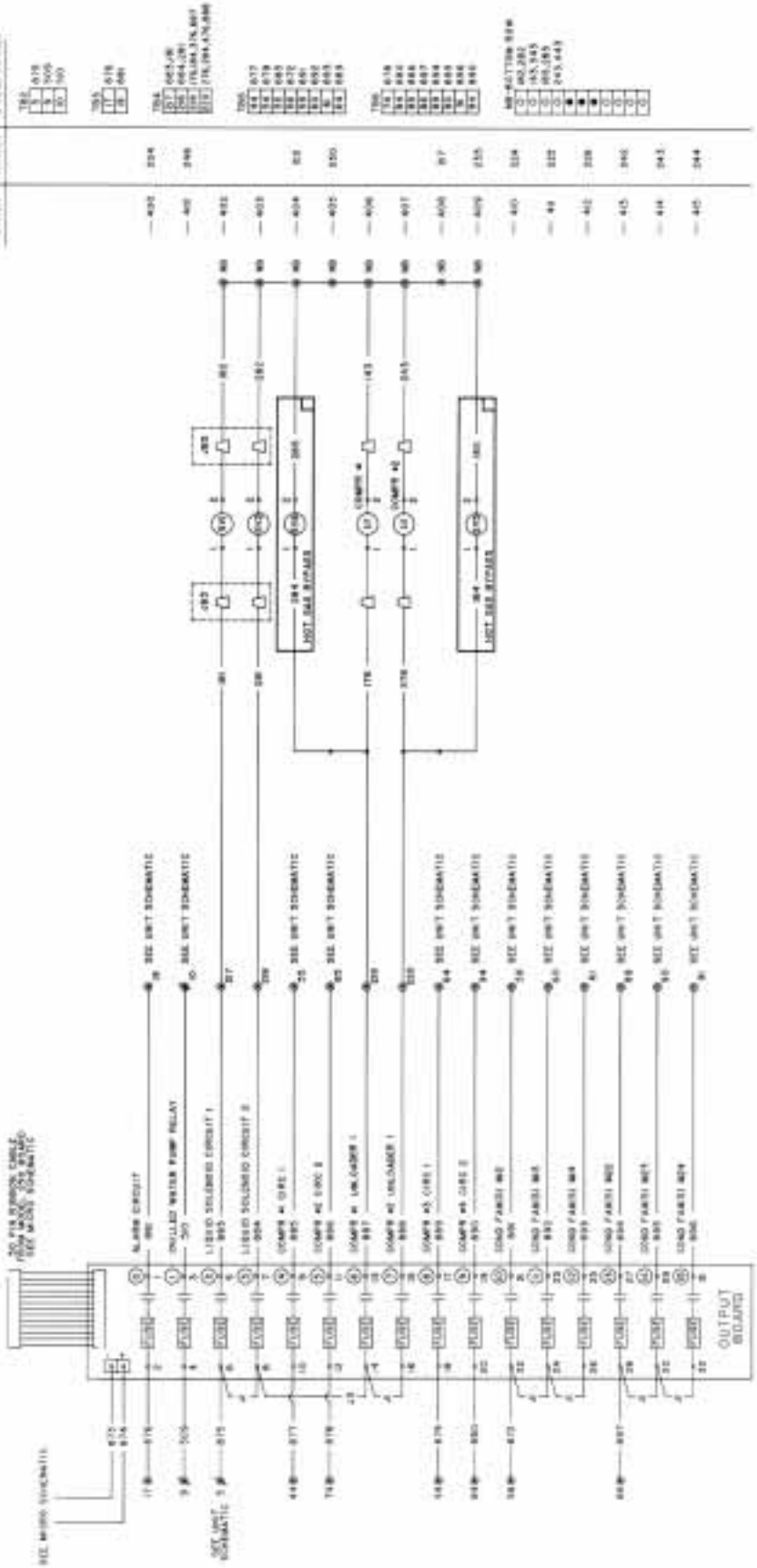


Schematic 7. Control wiring, ALR085-185D

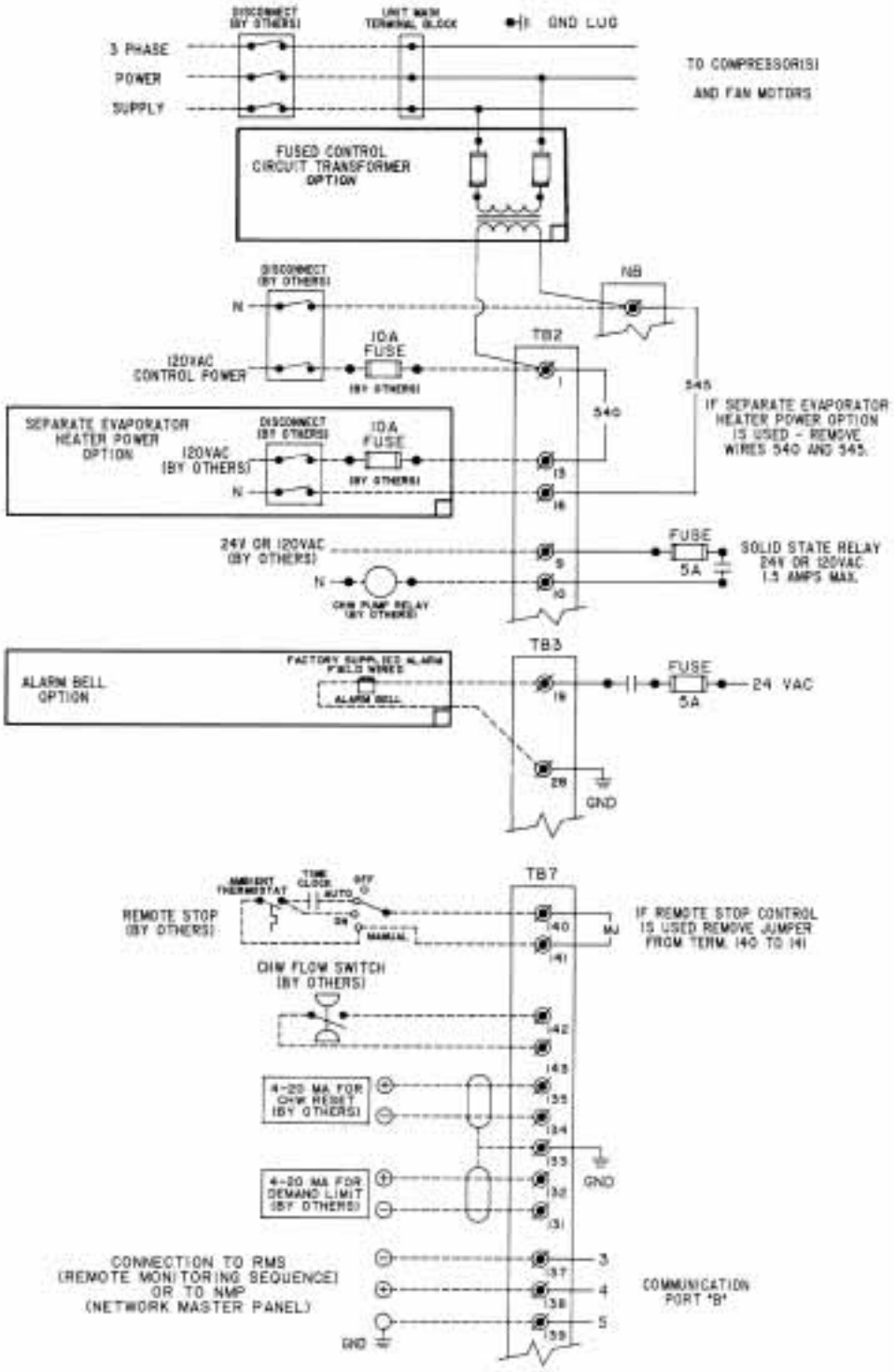
Compressor Control Schematic for ALR085-185D
Label Dwg. 716371D-02 Rev.0A



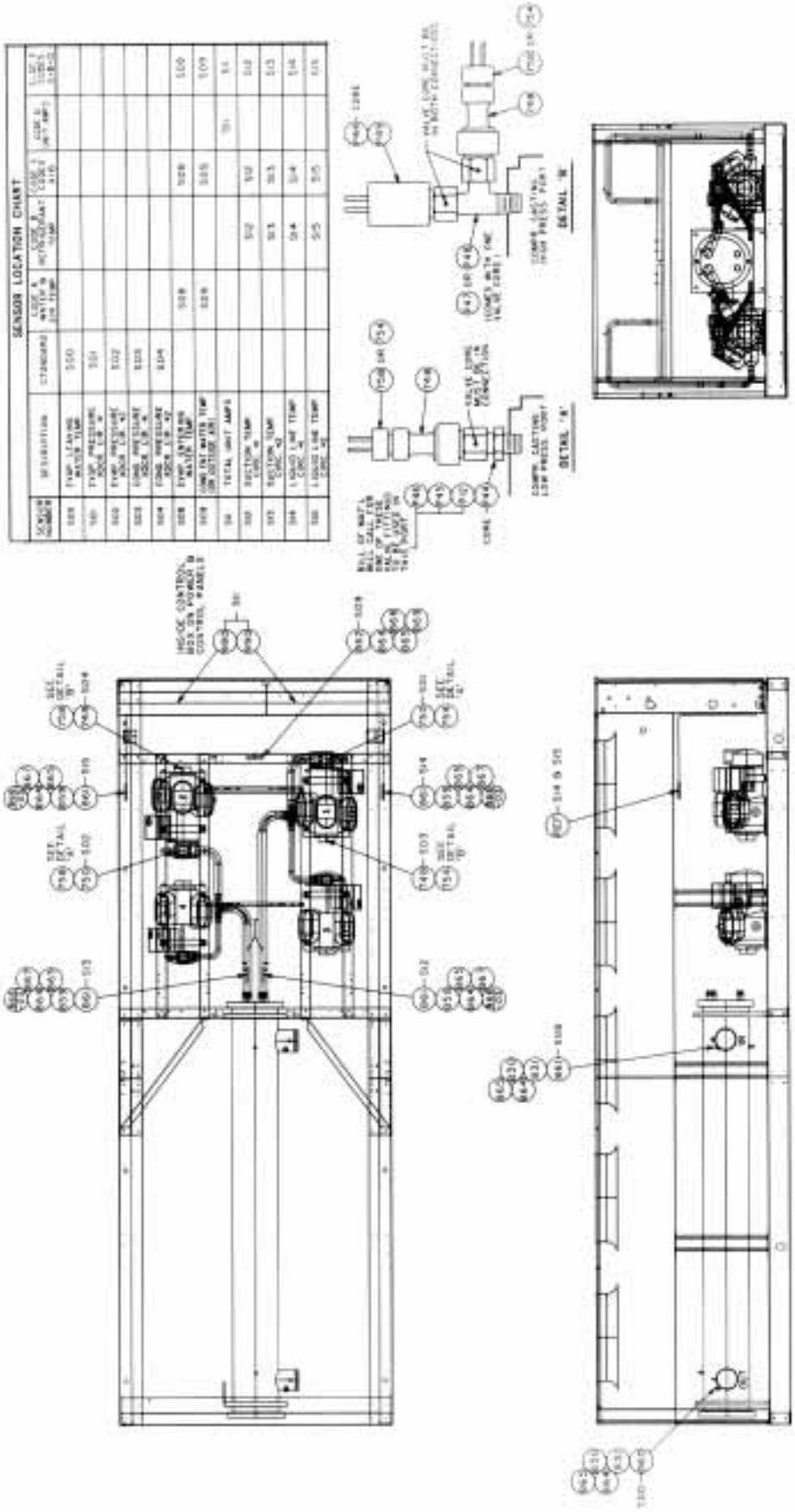
MicroTech 8-Stage Schematic for 4-Compressor Units
Label Dwg. 7163600-02 Rev.0A
ALR085-185D



Field Wiring Diagram for ALR035-185D
Label Dwg. 717422C-02 Rev.0A



Schematic 10. Sensor location, ALR035-185D



WHR040-210E and THR040-170D Electrical Legend

Designation	Description	Standard Location
AB	Alarm Bell	Back or Side of Control Box
ADI	Analog/Digital Input Board	Control Box, Control Panel
CB	Circuit Breaker (MicroTech)	Control Box, Control Panel
CB1-CB8	Circuit Breaker (Power)	Control Box, Power Panel
CHWI	Chilled Water Interlock	Field Installed
Compr 1-4	Compressors 1-4	Base of Unit
CT1	Current Transformer	Control Box, Power Panel
CTR1-CTR4	Counter Compressor, Total Hours	Control Box, Switch Panel
DS1	Disconnect Switch, Main	Control Box, Power Panel
F1	Fuse, Control Circuit	Control Box, Control Panel
F2	Fuse, Evaporator Heater	Control Box, Switch Panel
FB5	Fuseblock, Control Power	Control Box, Power Panel
GFP	Ground Fault Protector	Control Box, Power Panel
GRD, GND	Ground	Control Box
HM1-HM-4	Hour-Meter, Compressor	Control Box, Switch Panel
HTR1-HTR4	Compressor Heater, Crankcase	On Compressors
HTR5	Heater, Evaporator	Wrapped around Evaporator
J1-J13, JJ1, JJ2	Jumpers (Lead)	Control Box, Control Panel
Keypad	Keypad Switch 8 Display	Control Box, Keypad Panel
M1-M8	Contactors, Compressor	Control Box, Power Panel
M11-M27	Contactors, Fan Motors	Control Box, Power Panel
M250	Model 250P Comm. Board	Control Box, Control Panel
MHP1-MHP4	Mechanical High Pressure Switch	Control Box, Control Panel
MHPR1-MHPR4	Mech High Pressure Switch Relay	Control Box, Control Panel
MJ	Mechanical Jumper	Control Box, Control Panel
Modem	Modem, MicroTech	Control Box, Control Panel
MPR1-MPR4	Motor Protect Relay	Control Box, Control Panel
MTR11-MTR27	Motors, Condenser Fans	Condenser Section
MP1-MP4	Motor Protect, Compressor	On Compressor
NB	Neutral Block	Control Box, Control Panel
OB	Output Board, MicroTech	Control Box, Control Panel
OL1-OL8	Overload	Control Box, Power Panel
OP1-OP4	Oil Pressure Switch	Control Box, Control Panel
PB1-PB3	Power Block, Main	Control Box, Power Panel
PS1, PS2	Pumpdown Switch, Circ #1, Circ #2	Control Box, Keypad Panel
PVM	Phase Voltage Monitor	Control Box, Control Panel
RES1	Resistor, Current Transformer	Control Box, Power Panel

Designation	Description	Standard Location
R9-R12	Relays, Starting	Control Box, Control Panel
S1	Switch, System	Control Box, Keypad Panel
Sig Conv	Signal Converter	Control Box, Control Panel
SV1, SV2	Solenoid Valve, Liquid Line	On Liquid Lines
SV5, SV6	Solenoid Valve, Hot Gas Bypass	On Line to Hot Gas Valve
T1	Transformer, Main Control	Control Box, Power Panel
T2	Transformer, 120/24V Control	Control Box, Control Panel
T3	Transformer, Fan SpeedTrol	On Bulkhead
T4	Transformer, 24/18V Control	Control Box, Control Panel
TB2	Terminal Block, 120V Field	Control Box, Control Panel
TB3	Terminal Block, 24V Field	Control Box, Control Panel
TB4-TB8	Terminal Block, Control	Control Box, Control Panel
TB7	Terminal Block, less than 24V	Control Box, Control Panel
TC2	Thermostat, Evaporator	On Evaporator
TD5-TD8	Time Delay, Compr Part Winding	Control Box, Control Panel
U1, U2	Unloader	On Compressors

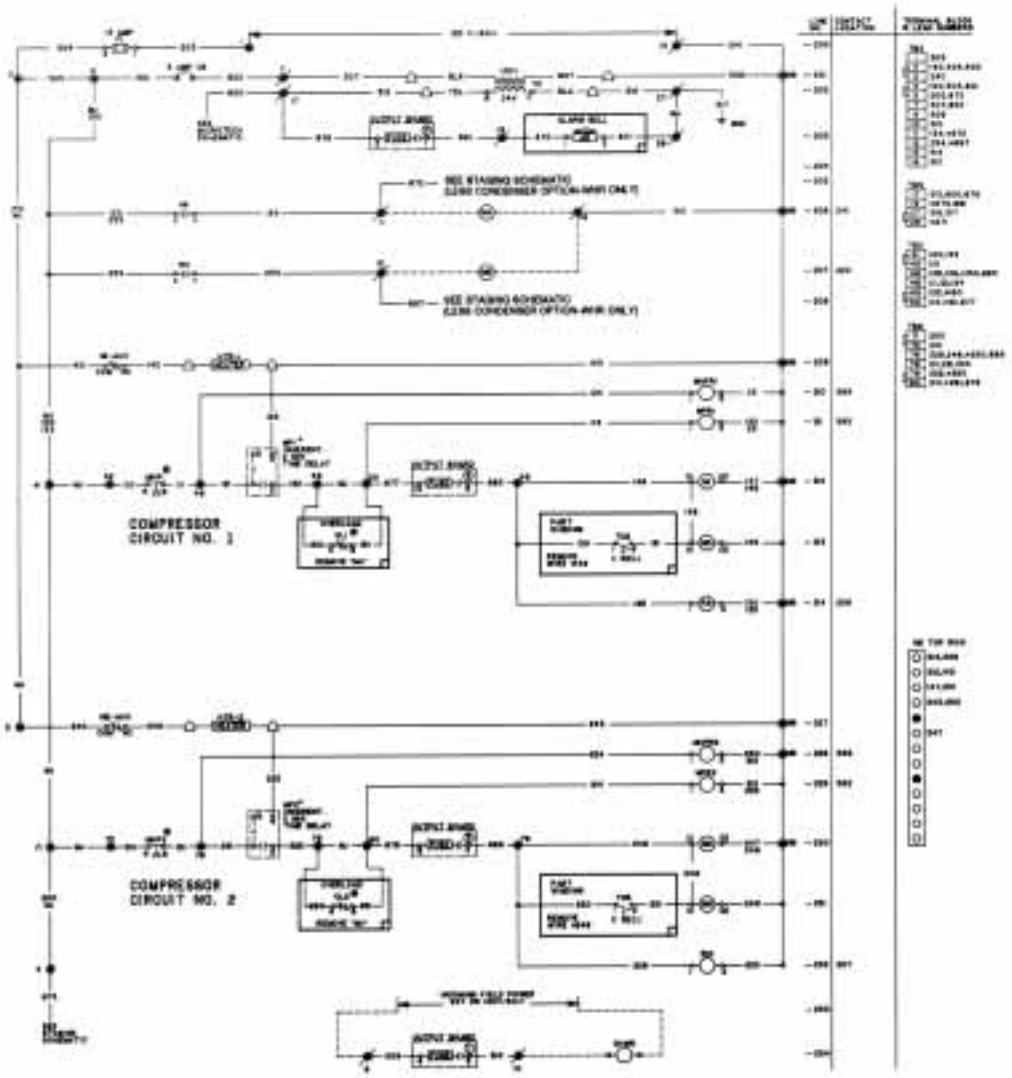
Wiring Symbols

- Power Wiring, Factory Installed
- Field Supplied Power Wiring
- Field Wiring
- 200 — Wire Numbers
- Control Box Terminal, Field Conn. Usage
- Control Box Terminal, Factory Usage
- Un-Identified Component Terminal
- Identified Component Terminal
- Manual Reset, Control
- Automatic Reset, Control
- Cable-Twisted, Shielded and Jacketed Pair
- Option Block
- Thermistor
- MOV — Varistor
- Wire Nut

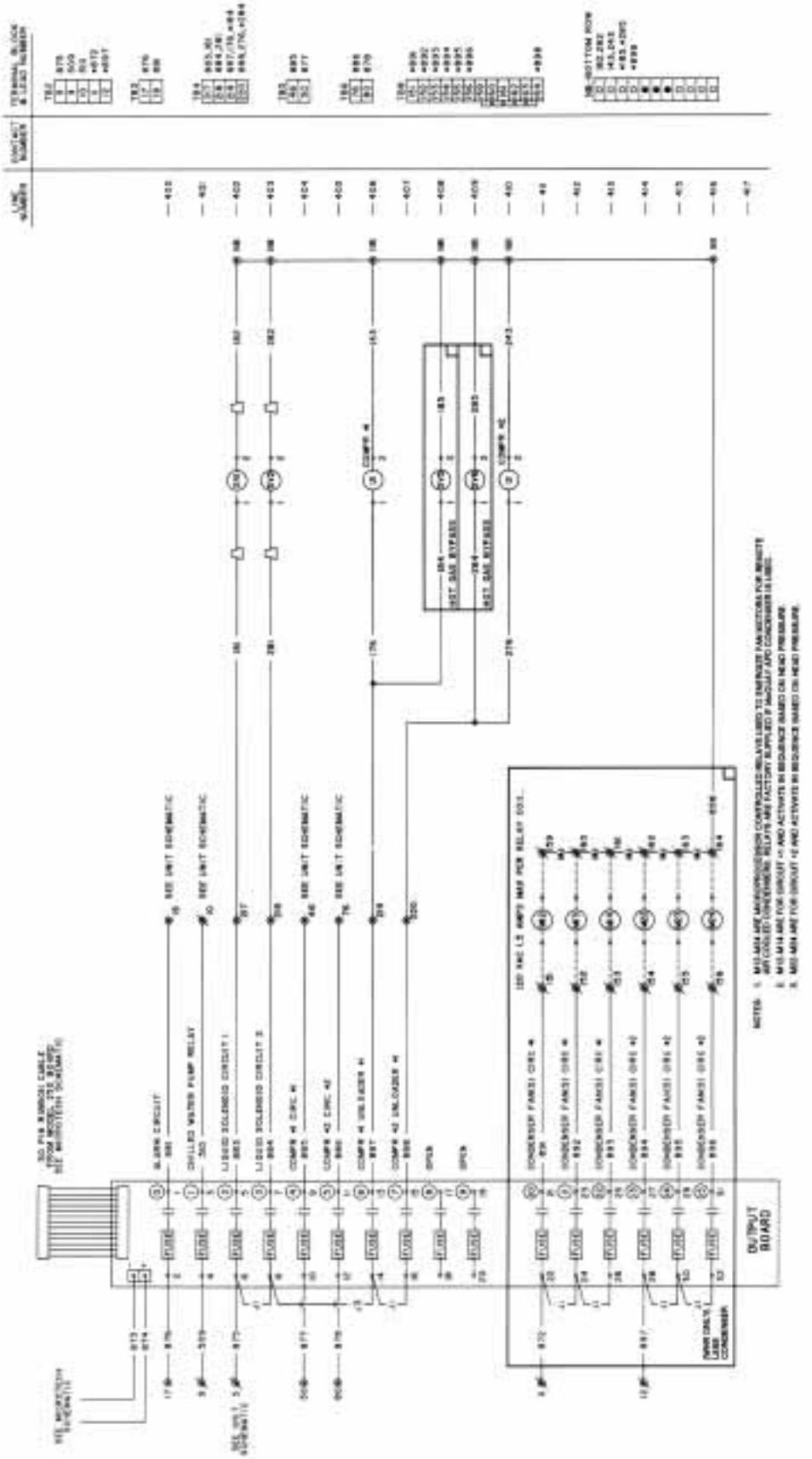
Drawing 708896C-02 Rev. 00

Schematic 12. Control wiring, WHR040-085E and THR040-110D

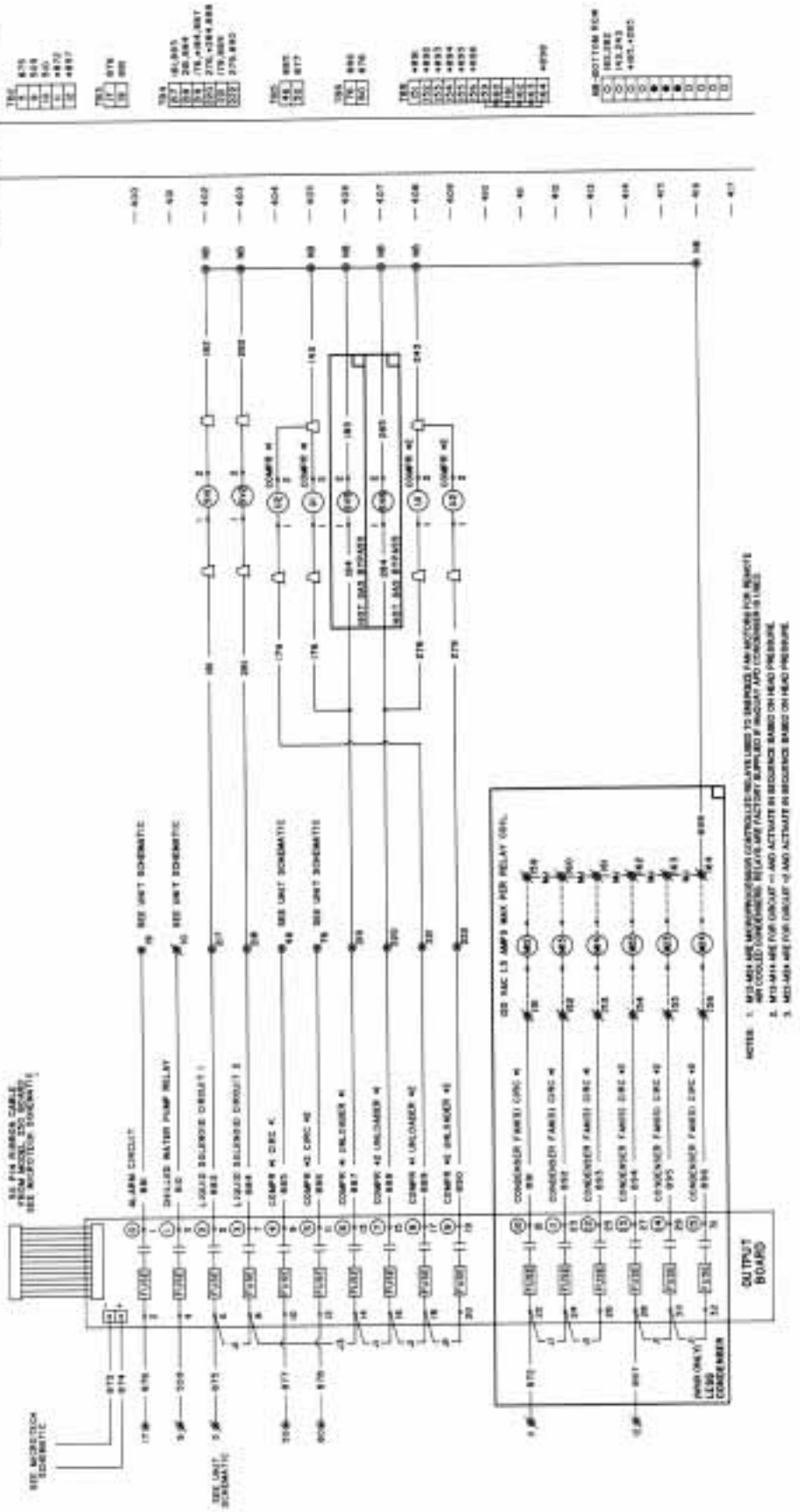
Compressor Control Schematic for ALR040-085E and THR040-110D
Label Dwg. 716362D-02 Rev.0A



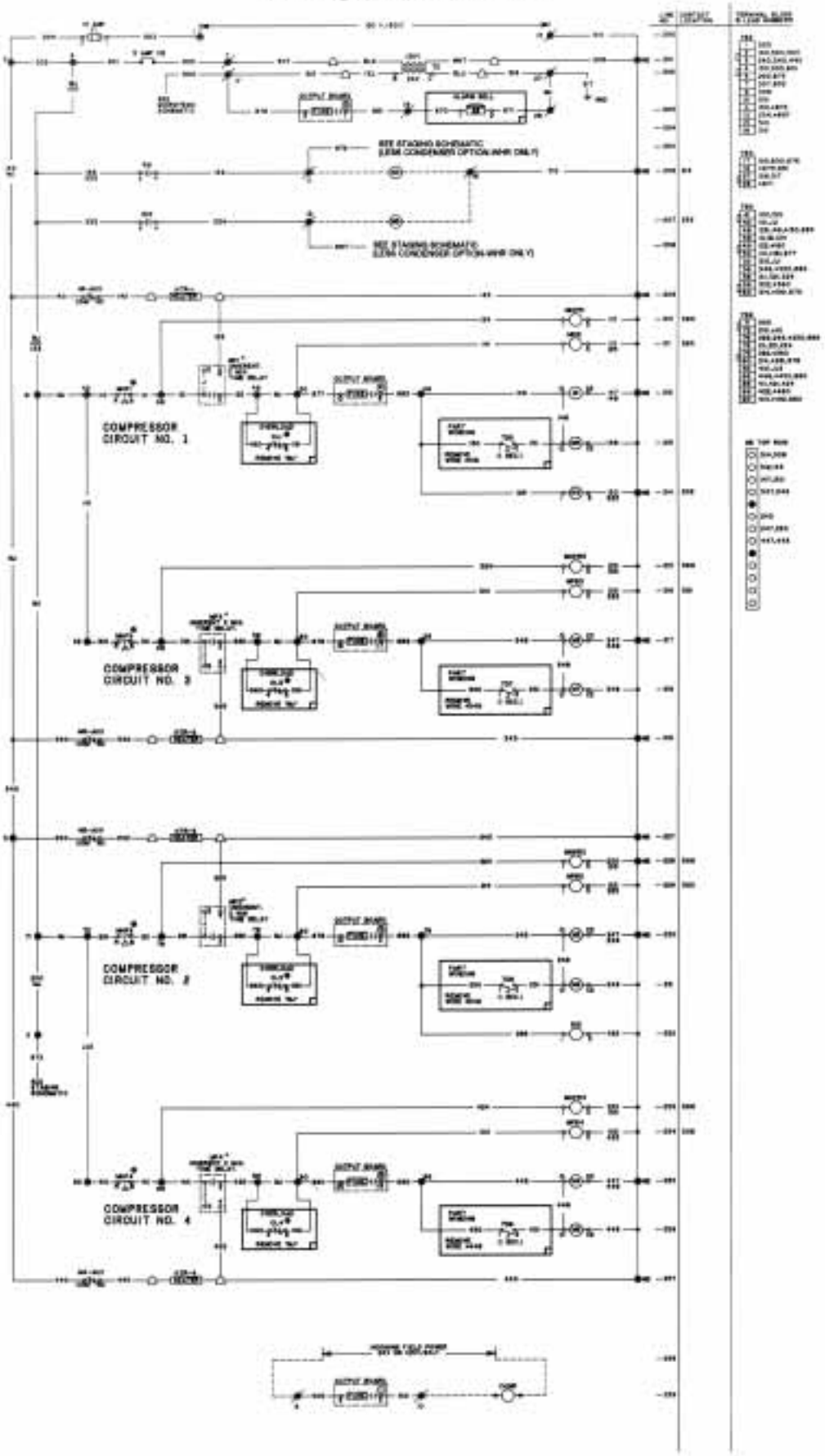
MicroTech 4-Stage Schematic for 2-Compressor Units
Label Dwg. 716356D-02 Rev.0A
ALR040-085E and THR040-110D



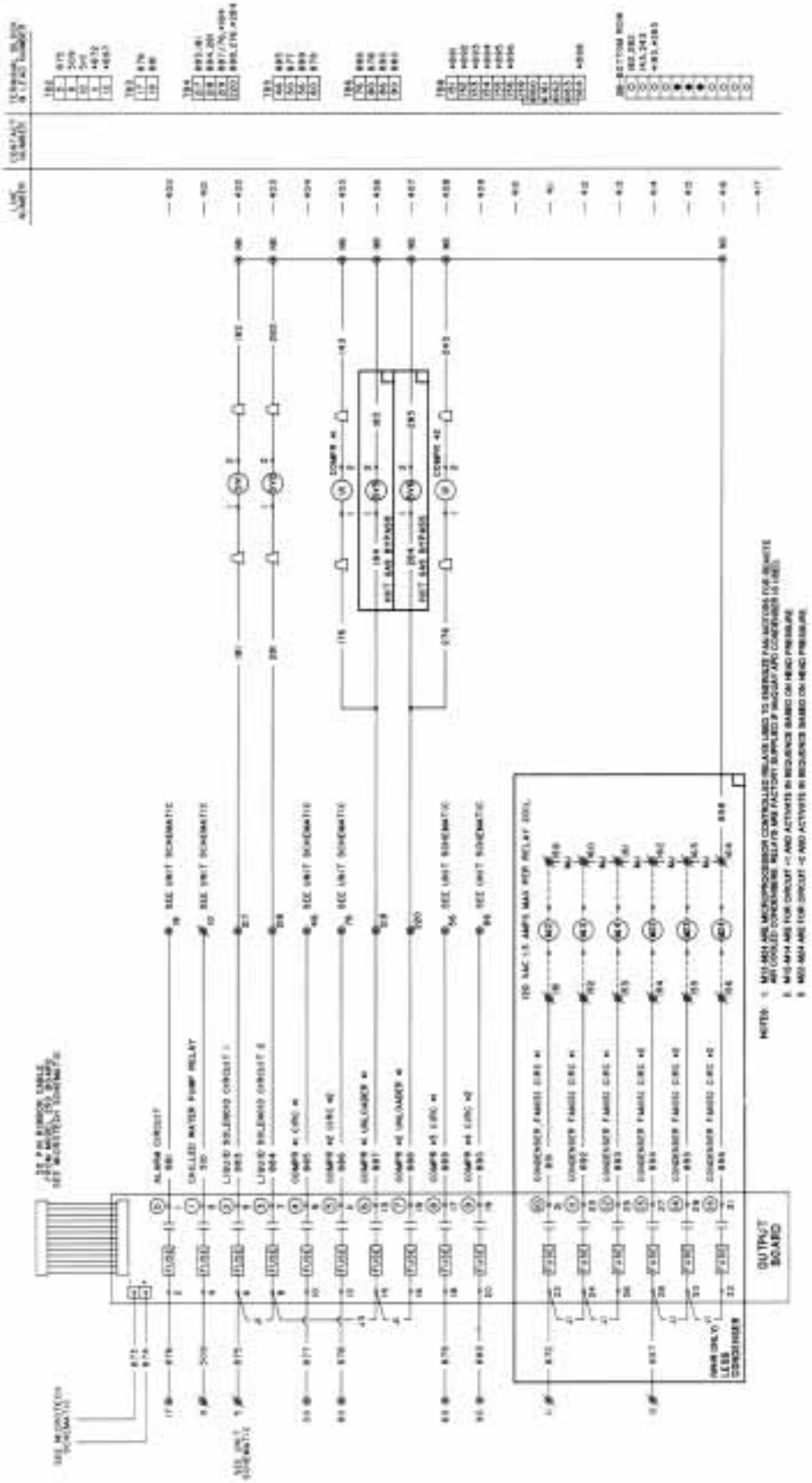
MicroTech 6-Stage Schematic for 2-Compressor Units
Label Dwg. 716357D-02 Rev.0A
ALR070-085E and THR070-110D



Compressor Control Schematic for WHR095-210E and THR120-170D
Label Dwg. 716365D-02 Rev.0A

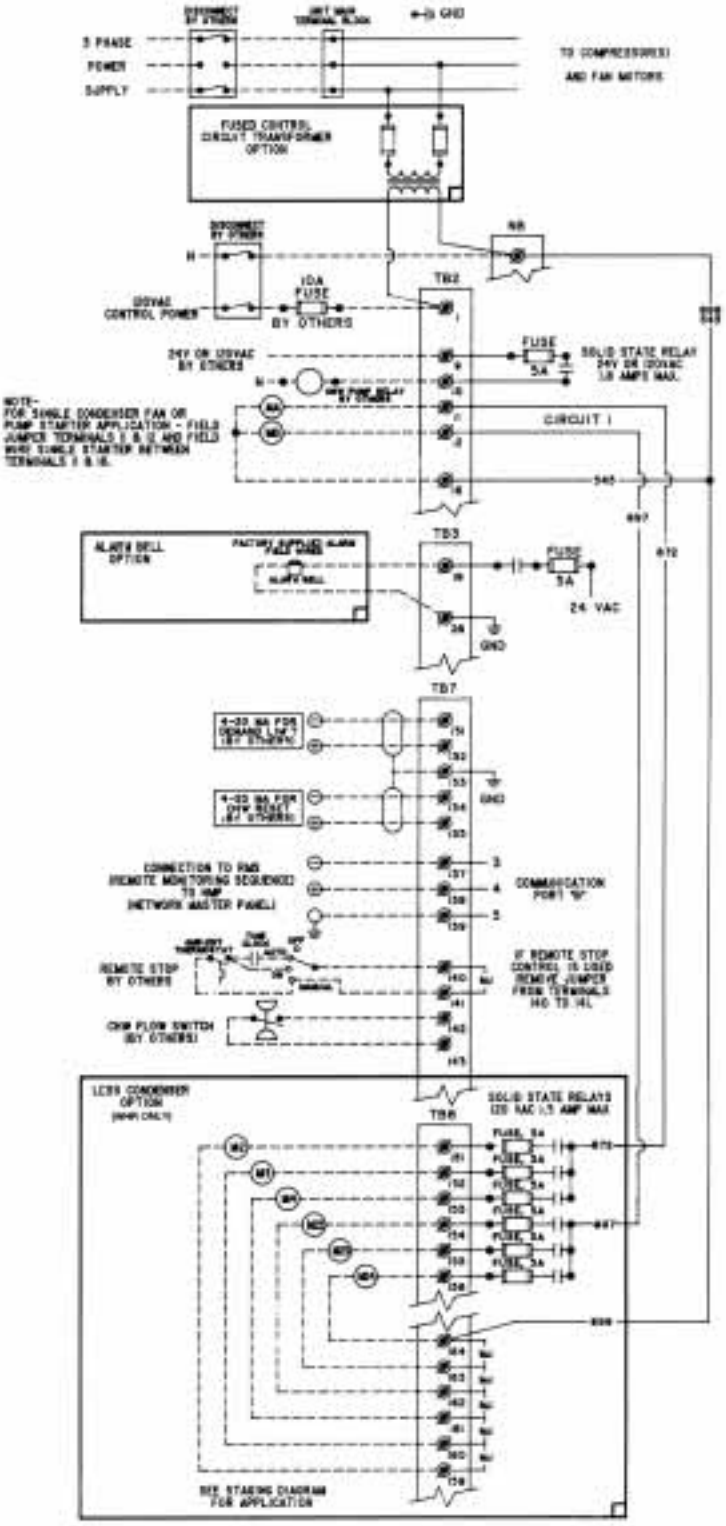


MicroTech 8-Stage Schematic for 4-Compressor Units
Label Dwg. 716375D-02 Rev.0A
WHR095-210E and THR120-170D

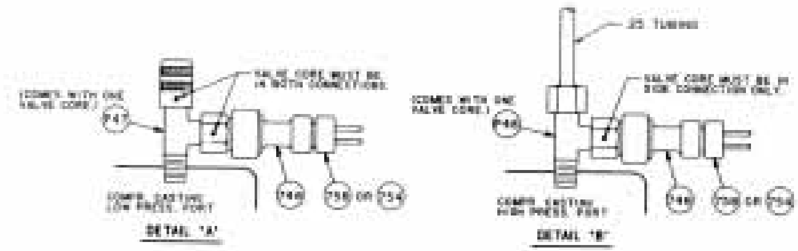


Schematic 17. Field wiring, WHR040-210E and THR040-170D

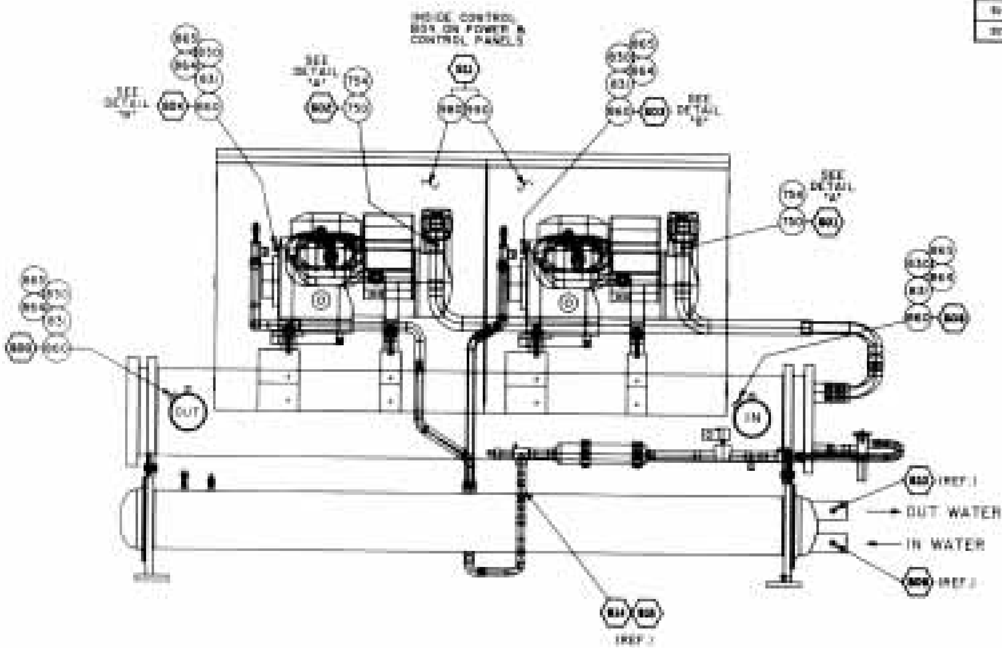
Field Wiring Diagram for ALR040-210E and THR040-170D
Label Dwg. 708897C-02 Rev.00

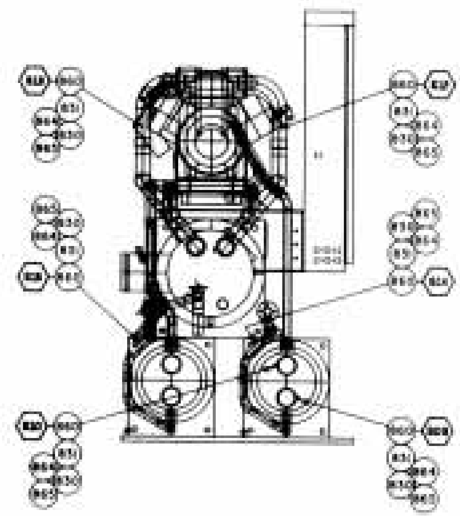


Schematic 18. Sensor location, WHR040-210E



SENSOR LOCATION CHART							
SENSOR NUMBER	DESCRIPTION	STANDARD	CODE A WATER & AIR TEMP.	CODE B REFRIGERANT TEMP.	CODE C CODES A+B	CODE D UNIT AMPS	CODE E CODES A+B+D
500	EVAP. LEAVING WATER TEMP.	500					
501	EVAP. PRESSURE TRANSDUCER CIRC. #1	501					
502	EVAP. PRESSURE TRANSDUCER CIRC. #2	502					
503	COND. PRESSURE TRANSDUCER CIRC. #1	503					
504	COND. PRESSURE TRANSDUCER CIRC. #2	504					
508	EVAP. ENTERING WATER TEMP.		508		508		508
509	COND. ENTERING WATER TEMP.		509		509		509
510	COND. LEAVING WATER TEMP.		510		510		510
511	TOTAL UNIT AMPS					511	511
512	SUCTION TEMP CIRC. #1			512	512		512
513	SUCTION TEMP CIRC. #2			513	513		513
514	LIQUID LINE TEMP CIRC. #1			514	514		514
515	LIQUID LINE TEMP CIRC. #2			515	515		515





Terms and Definitions

ASCII ..... (American Standard Code for Information Interchange). Method with which all alphanumeric characters are assigned a unique number between 1 and 127.

Baud ..... Normally ranges from 300 to 9600 and indicates the speed of computer communication, the higher the BAUD, the faster the data transfer. The BAUD rate is changeable for each communications port.

Checksum ..... The operating system of the microprocessor, upon power up or a reset, sweeps through the application program memory space and adds the values of all memory locations together. The resultant number is referred to as the checksum and is used to insure that the application program space has not been corrupted.

CPU ..... (Central Processing Unit). The main component of the computer system. It interprets and executes program instruction, contains computational circuits, and input/output ports. Each MicroTech has its own CPU which allows it to operate independently.

Download ..... The act of sending information from a terminal to an MicroTech Controller: can be either individual set points or an entire new logic program.

EEPROM ..... (Electronically Erasable Programmable Read Only Memory). Enables the MicroTech Controller to retain its memory even during power outages yet allows changing of values from a remote location.

Hexadecimal ..... Refers to the base 16 number system in which the basic digits are represented by 0-9 and A-F:

Decimal	Hexadecimal	Decimal	Hexadecimal
0-9	0-9	13	D
10	A	14	E
11	B	15	F
12	C	16	10

Computers operate in base 2 but since that quickly becomes complicated and it doesn't convert easily to decimal, hexadecimal is commonly used for computer applications.

Input ..... The MicroTech Controller allows up to 16 inputs from sensors that return a voltage of 0 to 5 volts. Each reading is converted to a number between 0 and 255. *Examples:* Temperature sensor, pressure transducer, potentiometer, etc.

Modem ..... Device that allows communication with a controller network over a telephone line. Two modems are required, one at the terminal end of the phone line and one wired to a controller in the network.

Output ..... The MicroTech Controller allows up to 16 outputs capable of turning a device on or off.

Parity Check ..... A check of whether the total number of 1's in a data byte is even or odd. Used in data transmission to insure error-free communication, data bytes are converted to either even or odd parity before transmission by setting their eighth bit.

Port ..... A communications channel on a controller for talking either to other controllers or to a terminal. Each unit has 2 ports for various network connections. Each port must be pre-set for specific communications purposes.

Pressure Transducer ..... Device used to convert a reading of static pressure into a voltage for input into the MicroTech Controller.

RAM ..... (Random Access Memory). Computer memory that will *not* hold its contents through a power outage. The MicroTech Controller also contains some RAM for storage of temporary variables. RAM memory values may be changed an infinite number of times without any problem, whereas EEPROM's may only be overwritten approximately 10,000 times before they begin to fail.

RS232C ..... Refers to a hardware configuration standard used for communications between computers and computer equipment. Many personal computers are equipped with RS232C connections and this is required for liking a PC with the controller network.

RS422/485 ..... Another hardware configuration that is very common for linking of computer equipment into networks because of its resistance to transmission errors at high BAUD rates. It involves the use of a twisted pair of wires to connect components and requires one controller to coordinate the communications between all other units.

Set Point ..... A desired value for some measured quantity. The MicroTech Controller operates to maintain comfort based upon the values of specific set points. *Example:* Leaving chilled water temperature, discharge air temperature, room temperature, minimum and maximum CFM.

Terminal ..... Normally refers to a personal computer but could be any computer equipment capable of RS232C communications and ASCII protocol. An IBM compatible person computer is preferred.

Temperature Sensor ..... The room is measured as output from a thermistor which the controller reads as a number between 0 and 1024 and then calculates a Fahrenheit temperature.

Timing Constants ..... Refers to adjustable tie values that the controller uses to manage its inputs and outputs. The time between room temperature readings or the amount of time to turn on an actuator are two examples. They may range from a tenth of a second to 62 hours or they may also indicate *always* and *never*.

UART ..... (Universal Asynchronous Receiver-Transmitter). Typically, a single computer chip that converts serial data transmissions into parallel information. The fact that the MicroTech Controller contains a UART means that it can transmit and receive at different BAUD rates. It also maintains automatic parity error checking and speeds the entire communications process.

Product Warranty

Standard Warranty (North America)

McQuay International, hereinafter referred to as the "Company," warrants that it will provide, at the Company's option, either free replacement parts or free repair of components in the event any product manufactured by the Company and used in the United States and Canada proves defective in material or workmanship within twelve (12) months from initial start-up or eighteen (18) months from the date shipped by the Company, whichever comes first.

In addition, labor to replace warranty parts during McQuay normal working hours is provided on products with rotary screw compressors, centrifugal compressors, and on absorption chillers.

Warranty labor is not provided for products with reciprocating compressors, on fluid coolers, on air cooled condensers, or on direct expansion coolers.

Factory start-up on absorption, centrifugal, and screw compressor products is mandatory and must be performed by McQuayService in the U.S. and by McQuayService or Authorized Service Agency in Canada.

Exceptions

- Warranty labor does not include diagnostic visits or inspections.
- All warranties apply only to the original owner.
- Replaced parts are warranted for the duration of the original warranty.
- Abuse, misuse, or alteration of the product in any manner voids the warranty.
- Accidental damage to the equipment is not warranted.
- All warranties are void if equipment start up is not performed in accordance with this warranty statement.

Owner Responsibility

For products started by other than McQuayService, the registration form accompanying the product must be completed and returned to the Company within ten (10) days of original equipment start-up. If that is not done, the date of shipment shall be presumed to be the date of start-up and the warranty shall expire twelve (12) months from that date.

The owner is responsible for maintaining the equipment in accordance with the maintenance manual shipped with the unit. Failure to do so will void the warranty.

Assistance

To obtain assistance under this warranty, contact the selling agency. To obtain information regarding this warranty from the factory, contact McQuay International, P.O. Box 2510, Staunton, VA 24402-2510; telephone: 540-248-0711.

Sole Remedy

This warranty constitutes the buyer's sole remedy. It is given in lieu of all other warranties. There is no implied warranty of merchantability or fitness for a particular purpose. In no event and under no circumstance shall the Company be liable for incidental or consequential damages, whether the theory be breach of this or any other warranty, negligence or strict liability in tort.

No person (including any agent, salesman, dealer or distributor) has the authority to expand the Company's obligation beyond the terms of this express warranty, or to state that the performance of the product is other than that published by the Company.

Certain other extended warranties as described on the original purchase order may be in effect.

McQuay International

13600 Industrial Park Boulevard, P.O. Box 1551, Minneapolis, MN 55440 USA (612) 553-5330

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