

advanced temperature control technology

MYDAX, INC.

1M9W-T WATER-COOLED CHILLER

USER'S MANUAL



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SPECIFICATIONS

SYSTEM CAPACITIES

Temperature Range	15°C to 25°C (59°F to 77°F)
Temperature Stability	± 0.02°C
Cooling Capacity @ +20°C	2,500 Watts (8,540 BTU/hr)
Polypropylene Reservoir Volume	20 gallons
Recirculating Fluid	Low Conductivity Water
Recirculation Flow, Pressure	10 GPM at 100 PSI
Recirculating Supply/Return Fittings	1" Stainless Steel FNPT
Fill Port	3/4" Stainless Steel MNPT
Fittings for Condenser supply/return	1/2" Stainless Steel FNPT
Condenser Cooling, Facilities Water	1.5 GPM @ 24°C (75°F), 20 PSI differential
Refrigerant Charge	R-22, 5 LBS. †
Electrical Service	208/230VAC, 60 Hz, 3 phase, 20 amp service With 10' power cord and L15-30P plug.
Overall Size	58"H x 24"W x 32"D, 475 lbs. dry weight

STANDARD FEATURES

This chiller is complete with our computer-controlled low-stress, refrigeration circuit, recirculating pump and fluid reservoir. The refrigeration circuit uses all-brazed construction for extra strength; the heavy-duty frame is constructed of welded steel tubing equipped with locking casters.

The microprocessor-based control system includes an extensive computer monitoring capability including comprehensive controls, error messages and diagnostics. System status is indicated via an 80 character alphanumeric LCD (liquid crystal display) and with colored LEDs (light-emitting diodes). The control keyboard employs membrane switches with a sealed polycarbonate overlay for protection from liquid spills.

† MSDS are included in Appendix C of this manual.

SAFETY AND ENVIRONMENTAL CONCERNS

Your Mydax chiller was designed to give years of trouble-free operation. Features were designed into the unit to provide early warning of failure mechanisms so that catastrophic failures can be avoided. Whether a chiller is at the factory or in the field, diagnostic information gives Mydax engineers insight to the operation of each stage of the refrigeration and recirculation circuits without having to attach service gauges.

1. **Warning & Error Messages:** including coolant over-temperature warning & shutdown, low tank level warning & shutdown and others (see ERROR MESSAGES section).
2. **System Diagnostics:** including coolant & refrigerant temperatures, valve drives and parameters (see DIAGNOSTIC DISPLAYS section).
3. **Hardware safeguards** include a series-wired interlock circuit which protects refrigerant high pressure, thermal protection of the pump and compressor motors.

Safety is important when using and servicing the chiller unit. Warning labels have been placed on the chiller in areas where potentially harmful conditions exist and in this manual to bring attention to such conditions. This chiller uses materials that are subject to environmental regulations; be sure to familiarize yourself with these components and their associated regulations pertinent to your location.

Warnings have been categorized according to the following guide:

- ! **NOTICE** Provides information that is important for proper installation, operation, or maintenance, but not critical to safety. Includes regulatory notices.
- ! **CAUTION** Identifies situations where improper action could cause damage to the equipment or product, or cause minor physical discomfort.
- ! **WARNING** Identifies situations where improper actions could cause minor to moderate injury or impaired health.
- ! **DANGER** Identifies potentially lethal hazards, where improper actions could cause death, or serious injury or disability, such as loss of sight or limb.

High Temperatures



Label 1

This "Hot Surface" caution label has been placed on the inside of the chiller cabinet, near the compressor's discharge area where the hot compressed refrigerant makes components as hot as 120°C. This label is placed on the Oil Separator and the Muffler as well. The label indicates that the area is hot and should not be touched until the unit is allowed to cool down.

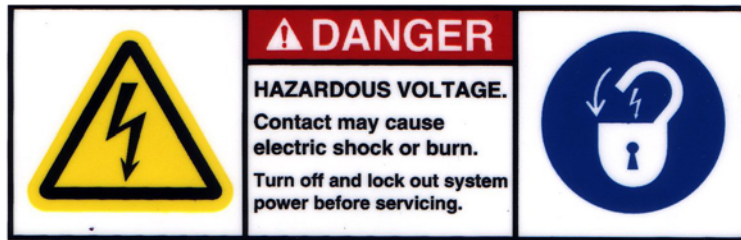
Fluids and Chemicals

This chiller contains fluids which may be slippery if spilled on the floor. The use of a drip pan may be required as a means of avoiding a potentially hazardous spill. Clean up of any spills should follow the guide provided in the MSDS.

Service of the refrigeration equipment shall be performed only by qualified and certified, if necessary, personnel. Refrigerant gas is not to be vented to the atmosphere; it shall be handled according to regulations set forth by the local environmental authorities. R-22 is fluorocarbon type materials and subject to environmental regulations.

The compressor uses POE oil; this MSDS is available from Mydax upon request. The compressor is hermetically sealed and no service should be required. In the event that cleanup is necessary, absorb oil with oil absorbent material and dispose of as a hazardous waste. Follow approved cleanup procedures as listed in the MSDS.

Electrical



Label 2

This "Hazardous Voltages" danger label has been placed on the clear guard inside the electrical panel box and on each power junction box within the chiller cabinet. The label indicates that there are hazardous voltages of 208/240VAC on the components within the protective enclosure. Before servicing, the equipment shall be disconnected from the source supply and locked out with an appropriate device.

Electrical maintenance shall be performed only by qualified electricians and trained service personnel.

LITHIUM BATTERY

The M1001 controller contains a Lithium battery to retain setup parameters and calibration data. If this battery were to fail (see Test Panel 7 in the Diagnostic Displays section of this manual), it shall be replaced with a compatible type, and the replaced battery shall be recycled as required by local environmental regulations.

SYSTEM OVERVIEW

SYSTEM FLUID SCHEMATIC

REFRIGERATION

Refer to drawing #D3021, the fluid (refrigerant & fluid) schematic. The heart of the design is the evaporator refrigerant valve, shown at the left side of the drawing. This is a pulse-width-modulated valve, controlled directly by the system's embedded microprocessor. By controlling the duration of the openings of the valve, a precisely determined flow of refrigerant is sent to the evaporator, allowing for exceptionally stable recirculating temperatures. This system is designed to control the recirculating output temperature to $\pm 0.02^{\circ}\text{C}$ or better over the entire temperature range.

The microprocessor sets the positions of the evaporator valve based upon the system heat load. If the load increases, the evaporator valve is opened for longer durations, passing more refrigerant. If the load decreases, the valve is opened for shorter durations, passing less refrigerant. Using this technique Mydax is able to run in load conditions of no-load to full-load and all combinations in between.

During normal operation, the duration of the valve opening remain nearly constant. Only major changes in heat load or system-wide power cycling cause large changes in the valve drives. In the case of a step-wise change in heat load, the microprocessor quickly drives the valves to the new settings and refrigerant flow soon settles at the proper level.

The controller sets the valve drives based primarily upon data received from RTD's (resistance temperature devices) located about the circuit. The drawing shows RTD's at the output line leading from the recirculating pump, in the reservoir, and in the refrigeration circuit between the condenser and receiver. The controller reads these and other sensors constantly and sets the refrigerant valve accordingly.

Thus refrigerant flow is truly proportioned, allowing continuous compressor operation without the normal addition of pressure-actuated hot gas bypass valves. All other refrigeration circuit components are used as in conventional systems. All permanent copper joints in the refrigeration circuit are brazed for extra strength. Much of the circuitry is insulated to eliminate cooling capacity loss and unpredictable operation due to drafts or fluctuating ambient air conditions.

RECIRCULATION

This system is designed to recirculate low conductivity water. It is not designed to recirculate solutions of automotive antifreeze. Approximately 20 gallons are required to fill the polypropylene reservoir and associated plumbing to its nominal fill level.

The heating elements are stainless steel cartridge heaters. The evaporator is a coaxial heat exchanger, located in the recirculating return line leading to the reservoir.

The reservoir is fitted with two level sensors. One level sensor drives a FILL TANK alarm at the main panel, indicating coolant level has dropped somewhat. The second sensor, the TANK EMPTY sensor, is connected to the safety interlock loop and shuts the system down if tripped.

The pump's recirculation flow and pressure may be adjusted by the VFD setting on Test Panel 5. This new feature allows the user to optimize the speed of the pump to get the desired flow rate and yet keep the work done by the pump to a minimum, which will maximize the cooling power available to the load. An over-pressure switch is set to trip at 115 psi to prevent exceeding the horsepower rating of the pump motor.

SYSTEM ELECTRICAL DIAGRAM

Refer to drawing #D3022, the system electrical wiring diagram. The central component of the electrical system is the M1001 controller; it is microprocessor-based and communicates with and controls various other circuit boards and components. Additional circuitry is laid out on PC boards mounted in the main electrical control cabinet. The controller is powered as long as the system circuit breaker is set, receiving 24 VAC power from a step-down control transformer.

The M1001 controller "reads" the RTD's in the system via board M1002, the Input Circuit Board, mounted in the electrical cabinet. RTD's are included for the recirculating fluid temperatures, as well as for the refrigerant circuit. Also routed through the M1002 board are the 100 Ohm and 120 Ohm precision RTD calibration resistor circuits.

The refrigerant valve and heater drive signals are routed through the M1004 power board. These signals are controlled up to 20 times each second to meter the amount of refrigerant through each valve and to control the heater to the desired power.

SAFETY INTERLOCK

A series-wired safety interlock loop protects all Mydax systems, disconnecting AC power from nearly all circuitry. If any link in the loop is opened, the PUSH RESET message is displayed and the audible alarm is sounded. Once the fault is corrected, the Reset button must be used to re-establish loop integrity.

See Table 1, and the electrical diagram. The system interlock loop is routed mostly via a terminal block on the M1002 board. The reset switch serves to feed power to the relay RL1. When energized, the contactor feeds power back to the relay so the reset switch may open up without cutting off power to the relay. If any component in the interlock loop opens, power to the loop is interrupted. The microprocessor senses this via the contactor RL1 connection at pin 23 of the M1002 board. Provided the system has power, if the loop trips out, the controller displays the PUSH RESET error message. Other diagnostic messages are also displayed if the temperature or level sensors are tripped. The loop must be reset when the fault condition is resolved.

Interlock Item	Purpose	Location
EMO Switch	Emergency Off	Front panel, near control panel
Pump's VFD fault	Protects pump motor	Inside chiller cabinet near pump
Refrigerant High Pressure Switch	Detect over-pressure, Opens at 375 PSI= 64°C (148°F) Resets at 265 PSI= 50°C (122°F)	Near input to receiver
Pump Over Pressure Switch	Protects pump and external plumbing, set to 115 psi.	Inside chiller, lower rear, near output bulkhead fitting.
Tank Over-Temperature Switch	Prevents thermal run-away >49°C	Inside tank, integrated into lid
Tank Empty Float Switch	Protects tank heater and pump	Inside tank, suspended from lid
Relay Coil, RL1	Latches circuit and gives indication to microprocessor.	Inside electrical cabinet

Table 1

The M1002 board also routes signals for the FILL TANK float switch. If this sensor trips, the controller displays a FILL TANK alarm to alert the user that the recirculation fluid is low. The "AC Fault" line, pin 21 of the M1002 board is driven by the Power Line Monitor to alert the user of a power problem or incorrect phase sequence.

EMERGENCY OFF BUTTON

The "EMO" or "Emergency Off" condition is established by pressing the red mushroom type EMO button. This opens the Safety Interlock Loop as described above, which opens the main power contactor. The tripped EMO state disengages the high power components (compressor and heaters) and leaves the control voltage for the microprocessor and VFD in force so that the controller can continue to record the status and condition of the refrigeration components.

A compressor crankcase heater is provided and is powered as long as the system circuit breaker is set; the AC line voltage is present even though the EMO is pressed.

INSTALLATION

LOCATING AND SECURING

This water-cooled chiller is rated for indoor use; refer to the specifications page at the beginning of this manual for a summary of the electrical and water facilities requirement. The unit is shipped with a refrigerant charge and does not require charging prior to use. Environmental regulations require that any necessary refrigeration service will be performed by a qualified and certified, if necessary, refrigeration technician. Electrical servicing shall be performed by a trained and qualified electrician.

In order to allow the compressor's oil to separate from the refrigerant, it is recommended that a period of one-half hour be allotted for the crankcase heater to warm the compressor. These instructions will guide the installation such that the electrical connections are performed first, and then power of the unit is turned on. While the crankcase heater is warming the compressor, the plumbing connections can be made and the reservoir filled with fluid.

POWER CONNECTIONS

Main electrical power connection to this system is made via the supplied power cord attached at the rear bulkhead. This routes forward to the electrical control cabinet located on the front face of the chiller. The 20 amp circuit breaker supplies the compressor, pump, heater, and electronic circuitry. Appropriate circuit protection is required according to the NEC and local ordinances.



DANGER: Prior to any electrical servicing inside either the power box or the chiller cabinet, disconnect all power sources and lockout the main breakers with a proper lockout device.

Once the unit is wired and plugged in, turn on the main circuit breakers mounted on the front of the system. The unit will not run without the proper phase wiring, if the display flashes "AC Power Fault", disconnect power and swap two of the incoming phase lines and re-check.

A message similar to the following appears on the LCD main display:

Tank	---	Warmup Delay	---	Local Set
25.02°C				25.0°C

This display indicates that the microprocessor is initializing. After a few seconds, the controller will finish initializing and the "Warm-up Delay" message will return to simply "Push Reset". On initial power-up, this is normal until phase wiring is correct and fluid levels are properly adjusted.

If an "Ac Power Fault" alarm is displayed, the internal phase detector is indicating that the phase of the main power must be reversed. To resolve this alarm, unplug the power cord and swap any two of the three incoming power lines going to the chiller.



NOTICE: The system should be powered for a period of at approximately one hour before initial starting, to allow the crankcase heater to separate the refrigerant from the oil. This helps ensure good lubrication and extends the life of the compressor.

CONDENSER WATER HOOKUP

The condenser inlet and outlet fittings are 1/2" stainless steel female pipe thread (FNPT). Plumb in facilities cooling water capable of at least 1.5 GPM at the fitting marked "CONDENSER IN". Plumb the return line to the "CONDENSER OUT" connection. To insure adequate cooling, be sure cooling source is turned on and at a temperature of 75°F (24°C) or less before starting the system. The chiller is factory set for an inlet pressure of 60 PSI. If after operation it is determined that the supply pressure is too low, adjustment of the condenser flow control valve will be necessary; consult Mydax for more information.

PLUMBING INTERFACE CONNECTIONS

The chiller's 1" stainless steel FNPT fitting labeled TANK OUT must be plumbed to the inlet of the device to be cooled. The outlet of the device to be cooled must be plumbed to the chiller's 1" stainless steel FNPT fitting labeled TANK IN.

This system is equipped with a 1/2" FNPT fitting labeled DRAIN. For the convenience of future draining procedures, it is recommended that a valve be installed in the drain port prior to the initial filling of the reservoir. The recirculating loop is under pressure when the system is operating.



NOTICE: Check all fluid interface connections now to ensure against leaks.

FILL RESERVOIR

This Chiller/Heater has a temperature range of +15°C to +25°C and is designed to recirculate low conductivity water. Ensure that the fluid is correct in order to prevent freeze damage within the system. Do not use automotive antifreeze in this system.

Approximately 20 gallons are required to fill the reservoir and associated plumbing to the nominal level; more may be required based upon the size of the fixture plumbed to the output. Using an approved step ladder that meets OSHA requirements, fill the system's reservoir. Use a funnel or insert a hose into the 3/4" fill port on the top of the reservoir and fill to the proper tank level.

To satisfy the TANK EMPTY float switch, add approximately 10 gallons of fluid, then press the RESET button located on the front of the chiller. The PUSH RESET message should go away, leaving only a FILL TANK message flashing on the display and an audible alarm.

At this point, continue adding fluid until the FILL TANK message goes away and the audible alarm stops. Additional fluid will have to be added once the pump has circulated fluid into the heat exchanger cavities and external plumbing. Repeat this procedure as necessary to fill the recirculation loop.

The reservoir must be vented to provide for the expansion and contraction of the fluid as it heats and cools. The Vent cap has a small hole to allow the unit to "breathe"

PUSH RESET BUTTON

The RESET button, located near the bottom of the front electrical panel, must be pushed prior to starting the system if an error in the interlock circuit (such as TANK EMPTY or latched EMO button, etc.) has occurred. This push-button resets the safety interlock circuit making it ready to protect the unit and the operator, and clears the display of any error messages.

ACCESS PANELS

Within the aluminum panels and steel frame are all of the chiller's components. Access to these components, such as the compressor, tank, pump, heat exchangers, etc. is made by removing the panels. These panels are secured with #2 phillips head screws with finish washers for a clean look. **Removal of these panels is unnecessary except for service access. Service of the refrigeration equipment shall be performed only by qualified and certified, if necessary, personnel.**

To remove the panels, remove the screws and carefully lower the panel to the floor. An oil sight gauge is visible on the side of the compressor. The recirculation pump and associated VFD are located on the left-hand side of the chiller.

Access to the electrical panel is obtained by removing the front aluminum panel, below the controller, that encompasses the breakers and reset button. By removing the perimeter #2 phillips screws, a clear plastic shield is accessible. This shield provides tooling and guarded access to the hazardous electrical voltages within the panel.



DANGER: Prior to any electrical servicing inside of either the power box or the chiller cabinet, disconnect the power source and lockout the main breaker with a proper lockout device.

PARTICLE FILTER

A standard 10 micron particle filter is located inside the chiller cabinet, near the rear. Remove the rear upper screen access panel to change this filter. First, remove the insulation boot and then unscrew the filter housing. Replace cartridge with Mydax part # 07-0810-09120, or equivalent.

INITIAL STARTING

Read the following section on Front Panel Controls for details on the panel operation.

Once the above procedures are completed and the safety interlock loop is satisfied, press the RUN PUMP or START key.

FRONT PANEL CONTROLS

All Mydax chillers are controlled by a microprocessor which is accessed via the system control panel. System controls are simple, yet powerful, with built-in diagnostics and error messages.

- POWER LED:** Indicates unit is powered (the circuit breaker is set).
- RESET:** This button must be pressed prior to system start-up to energize the interlock loop. It is also used to reset a fault or fatal alarm.
- EMO:** This RED "mushroom" button breaks the interlock loop stopping the chiller by opening a contactor and removing electricity from the high power components. It will cause a PUSH RESET message to be displayed; this button is NOT to be used to stop the pump and compressor, except in emergency.
- RUN PUMP:** Starts only the pump, turns on the Pump LED. If the chiller is already running (with the START button) this will STOP the compressor and leave the pump running.
- START:** Starts compressor and pump and turns on LED's. Once the start-up routine is complete the display changes to the MAIN DISPLAY:
- DISPLAY:**
- | | | | | |
|-------------|-----|--------------|-----|------------------|
| Tank | --- | MYDAX | --- | Local Set |
| 25.01 °C | | | | 25.0 °C |
- Shows the actual Output (Tank) Temperature and Setpoint Temperature in °C. Also indicates that the LOCAL SET temperature mode is enabled.
- STOP:** Stops both the compressor and pump.
- MUTE ALARM:** May be used to deactivate audible alarm for 10 minutes, leaving alarm LED on. Pressing the CLEAR key reactivates the alarm, which sounds until the fault condition is eliminated or the MUTE ALARM switch is depressed again. Pressing MUTE ALARM when no alarm is active causes the alarm to sound once and the TEST ALARM display to appear.
- SET:** Enables SET TEMPERATURE MODE. SET MODE is disabled from panel if an alarm is active or if the unit is in REMOTE (RS-232 SET mode). To set, depress:
- SET:** "Set Mode" appears at the right of the display. Cursor flashes at "units" digit of the temperature display.
- ARROWS KEYS:** Changes temperature setting in one degree increments unless "." (decimal) key is depressed.
- "." (DECIMAL):** Moves cursor to the "tenths" digit of the temperature display and causes arrow keys to change setting in tenths of a degree.
- KEYPAD:** Changes temperature setting by entering numbers directly.
- CLEAR:** Erases an incorrect entry.
- ENTER:** Selects temperature setting and deselects SET mode.

- TEST:** Initiates Test Mode. See description under DIAGNOSTIC DISPLAYS section of this manual.
- ENTER:** Enters temperature selections while in the SET mode.
- CLEAR:** Erases incorrect temperature selections; exits Test Mode; clears Mute Alarm selection.
- MODE:** Toggles between the RS-232C remote control mode and Local Set mode. Pressing this key is the same as sending the "RO" and "RF" commands into the RS-232 port (see Appendix A).
- ARROW KEYS:** Changes temperature setpoint by 0.1 or 1°C increments/decrements; toggles tank temperature, setpoint temperature and evaporator data view modes for multiple channel systems.
- "," (DECIMAL):** Display shows model number and software revision date and copyright:
- 1M9W-T** **2006.03.01**
Copyright 2006 Mydax, Inc.
- X & Y:** For future use.
- Z:** See Test Panel 9 in the Diagnostic Displays Section.

ALARM and ERROR MESSAGES

A unique feature of Mydax systems is the error messages displayed on the front panel display. The microprocessor constantly checks various points and parameters throughout the system and automatically displays messages when error conditions are sensed. Many displays are announced by an audible alarm and red LED indicator. The alarm persists until the fault condition is resolved, provided that the fault condition was not fatal, resulting in a system shutdown.

WARNING ALARMS:

Condenser Hot Indicates high discharge pressure condition with temperature over +50°C (122°F). This is only a warning message until the temperature reaches 65°C (149°F), where the microprocessor shuts down the system. A separate mechanical over pressure switch, part of the safety interlock loop, also can shut the system down in case of an over pressure condition. The purpose of this message is to allow maintenance workers to correct the problem at an early stage. Check condenser cooling water pressure and flow rate; also could be caused by scale build-up within the condenser.

Fill Tank Indicates low tank liquid level. Fluid will shrink considerably when cold, so the fluid level should be adjusted when the chiller is at its coldest temperature.

SHUTDOWN ALARMS:

Push Reset Indicates that a fatal alarm in the interlock circuit has occurred and the operator must push the "Reset" button on the front face of the chiller in order to restart the system. If this error occurs, it is not necessarily possible to discern which item in the interlock loop failed unless other messages are also being reported. Test Panels #8 and #9 may help indicate the fault.

See the electrical description in the System Overview section for details on how the interlock loop functions.

Tank Too Hot Indicates that the reservoir temperature is more than 10°C above the highest allowable set point of 25°C. Microprocessor shuts down the system at 35°C output temperature.

Low AC Line Indicates a low voltage condition exists on the input AC line., the system is shut down. See VAC on test panel #4 for current reading.

AC Power Fault Generated by the Line Voltage Monitor, the system is shut down to prevent damage due to: low AC voltage (<200V) or unbalance (4% for > 5 seconds), phase loss or phase reversal (> 100 milliseconds).

Freon Low If the suction pressure is for more than 60 seconds, this will indicate refrigerant pressure is low. The chiller has likely developed a refrigeration leak and is low on refrigerant charge. Have unit serviced by Mydax or a qualified service center.

Open RTD Indicates that an RTD connected to the M1002 Input Board has failed and that the system has shut down to prevent damage due to lack of data. The RTD at fault may be located by accessing Test Panel #8. The RTD must be replaced for the system to operate again.

DIAGNOSTIC DISPLAYS

Mydax chillers are provided with a computerized self-diagnostic capability. This system is equipped with 9 different test panels, which are accessed by pressing the TEST key, followed by the test panel number. Diagnostic mode is terminated by pressing the CLEAR key, and results in a display similar to that below:

MAIN DISPLAY

Tank	---	MYDAX	---	Local Set
25.10°C				25.0°C

Diagnostic messages are displayed on the main LCD. Display #5 automatically appears when the TEST key is first depressed. Once in diagnostic mode, other displays can be selected by depressing number keys 1 through 9. The following describes each of the test displays:

TEST PANEL #1:

Valve	7	Htr	8
Avg Valve	5	Htr	6

Numbers represent the drive signals for the evaporator valves and tank heater. The range is 0 (minimum) to 20 (maximum drive). Each digit represents 5% of the available drive voltage. Avg Valve shows a 32 second running average of the valve's drive, displayed above it.

TEST PANEL #2:

4.0	-4.8	48.2	35.0
Limit	Suct	Psia	Sup.Ht SHavg Cond

This display shows the refrigerant circuit RTD temperatures in °C. The display reads:

Limit = Max Evaporator Temp	Suct = Suction Temp	Psia = Suction Pressure, Absolute
SupHt. = n/a	SHavg. = n/a	Cond = Condenser Temp

The condenser reading is a direct indicator of condenser temperature and pressure. The microprocessor sends the CONDENSER HOT error message if the condenser temperature exceeds +54°C.

TEST PANEL #3:

302B	0000	0000	Z	0.00	G	51.95	14.4
SS-1	SS-2	SS-3	RTD	Reference	SH	Avg	

The first 3 sets of 4-digit numbers are hexadecimal. They represent correction values for the slow gain servos for up to 3 reservoirs. The function of this servo is to dynamically adjust the main temperature control servo to near zero error and thereby maintain temperature stability.

The first 2 digits in each set of 4 show the gain offset. Each increment equals 0.05°C, so 14 Hex = 20 decimal = 1.0°C. This value is internally subtracted from the operator-entered temperature setpoint if the actual temperature is above the setpoint, thus reducing the coolant temperature. The setpoint offset is continuously monitored by the controller and adjusted according to current conditions.

The second 2 digits in each set of 4 show the time prescaler. This is a counter which increments or decrements once a second and times the next update of the setpoint offset. A typical value is 20 seconds per offset change. When the count reaches "00", the offset may or may not be changed and the count resets to "0A" Hex (10 decimal). Together these numbers show that the controller is internally changing the control setpoint to maintain temperature stability, and give the magnitude and timing of the change.

The center of the display shows readings for the RTD "Zero" and "Gain" calibration resistors. Precision

resistors 100W and 120W are used as a reference.

TEST PANEL #4:

1.182	-0.000	+1.780	+ 25.46	2	255
Ext 1	Ext 2	Ext 3	VAC		Secs

This display shows auxiliary voltmeter readings of Ext 1, Ext 2 and Ext 3. These are unused in this system. VAC is the 24 VAC internal control voltage. A typical value is in the range of 22.00 to 28.00. To the right of this value is an unused number ranging from 0 to 3. At the far right of this display is a time indicator in seconds. The timer stops at 255 seconds and is used internally for turn on routine procedures.

TEST PANEL #5:

20.00	20.0	0.0	96%
Tank	Set	DgMin	VFD

This is the display that comes up when the TEST button is first pressed.

This diagnostic shows the **Output** RTD (Tank) temperature in °C, the Output Setpoint temperature and Output temperature slope. Slope is a measure of the direction and amount of the output temperature change per 60 seconds.

Additionally, the pump's variable frequency drive (VFD) can be controlled to increase or decrease the available output flow and pressure. While on this display, use the UP and DOWN arrows, to the left of the keypad, to adjust the speed setting of the VFD. To view the actual frequency (in Hz), or gain access to the VFD (Allen Bradley), remove the left-side access panel of the chiller. The VFD is programmed according to the notes on the electrical schematic.

TEST PANEL #6:

19.80	19.79	20.00	20.02
-------	-------	-------	-------

This diagnostic shows the Tank temperature with resolutions of 0.05°C and 0.01°C, and the Output temperature with resolutions of 0.05°C and 0.01°C.

TEST PANEL #7:

+ 0.000	+ 0.000	+ 0.000	R22	6.00	0
- 0.000	- 0.000	- 0.000		Bat.	OK

This display shows voltmeter readings for up to 3 optional water resistivity monitor interface raw data outputs. Each resistance monitor channel has a positive and a negative voltage reading. These readings are approximately equal, but are of opposite polarity.

The refrigerant type that the control system is calibrated for is shown. For example: **R22**

The two numbers at the top, far right-hand side of this display represent the internally computed maximum evaporator temperature and a counter ranging from 0 to 99, which are used to adjust the valve drives and regulate the superheat temperature.

The second line of the right side of this display indicates the status of the lithium battery, mounted on the M1001 circuit board, used to run the system's elapsed run-time clock depicted in Test Panel 8 and the run/event recorder depicted in Test Panel 9. A "Bat. OK" message indicates that the battery is operational,

while a "No Bat." message indicates that the battery is dead and should be replaced.

TEST PANEL #8:

Alarms:	Fill Tank !
KEY	Run 356d 11:31:25

The top left side of this display shows the alarm (error message) history. If there have been no alarms since the last history reset, the display reads "No Alarms". If alarms have occurred, the display shows them in sequence, like the main display. The history can be cleared 3 ways:

1. Power Off/On
2. Press START Key when unit is stopped
3. Press 0 Key when viewing Test Panel 8

The second line of the display can be read when the chiller is stopped. It indicates the reason that the chiller was last stopped: KEY, FATAL, RS232 or EXT. The right side of the second line indicates the elapsed run time on the system in days (from 0 to 9999), hours, minutes and seconds. This system is equipped with a battery which, if operational, saves the elapsed run time value when the system is stopped and restarted.

TEST PANEL #9:

T- 0:0: 0	14.95 15.0	No Alarms.....
Tank 1	4Ev 0By 37Cd 13Sh 14SA	Gpm

This display provides run/event recorder data. The run/event recorder continuously records important information into a non-volatile memory while the system is operating. Data is stored at one-second intervals for the last 120 seconds of run time and it is also stored at two-minute intervals for the last 240 minutes of run time.

The first line of this display indicates the run time in hours, minutes and seconds prior to the last system shutdown, the output and setpoint temperatures of whichever recirculating channel was last selected at the Main Display and the system-wide alarm history. The second line indicates the evaporator, bypass, condenser, and superheat temperatures in °C, and the flow rate in GPM. All refrigerant circuit RTD temperatures are truncated to the nearest 1°C for this display.

After the system is stopped and Test Panel 9 is selected, the memory is displayed at the last or most recent second (T- 0: 0: 0). The downward arrow key can be used to decrement time into the past. There are 120 "1-second slots" and 120 "2-minute slots". If the downward arrow key is held down, the time slots decrement at the rate of two slots per second. The upward arrow key increments to more recent time slots. If the "Z" key is depressed, the display goes to the oldest 1-second slot (T- 0: 1:59 if the actual run time was of at least that duration). If the "9" key is depressed while viewing Test Panel 9, the display reverts back to "T- 0: 0: 0", the stop time.

The alarm messages are accurate for the slot that is current. If the display is on the minutes slot, then the alarms indicated are any which have occurred during that 2-minute interval. Alarm messages cycle or flash in an identical fashion to those appearing in either the Main Display or in Test Panel 8.

SERVICE & WARRANTY

If a unit malfunctions, please contact the Mydax Service Department as soon as possible. Many small problems can lead to large problems if not dealt with immediately. Please have the serial number and model number on hand when calling.

Mydax Service Department: (530) 888-6662 FAX: (530) 888-0962
Email: service@mydax.com

RETURN OF UNIT FOR SERVICE

Many problems may be repaired by field exchanges of a module, pump, controller, etc. If return is required, please obtain a return authorization number from the Mydax Service Department or the unit may not be accepted at our receiving dock.

Please refer to the shipping instructions which follow.

SERVICE OF REFRIGERATION UNIT

Nearly all repairs to the refrigeration unit involve brazing or silver soldering. This should only be done by a person trained in refrigeration service and familiar with the Mydax system.

NOTE: Before servicing any refrigeration unit involving brazing, remove all refrigerant from the system. Evacuate to a 400 micron vacuum to remove refrigerant residues, then open all service valves to dry air or dry nitrogen before use of a torch.

In particular, service of Mydax refrigeration circuits requires attention to the following:

- 1) Use caution to protect components from heat damage.
- 2) Prevent any moisture from entering the circuit, as Mydax proportional valves do not function with moisture present. Once moisture has entered the system it cannot be removed.
- 3) Remove insulation and instrumentation wiring or use heat shields to protect them from torch heat during work.
- 4) Before recharging the circuit, evacuate it to 200 microns at a minimum room temperature of 75°F for three hours, or longer for units with 4 horsepower or larger compressors.

12 MONTH WARRANTY AGREEMENT

Mydax, Inc. warrants that its temperature control system, and the component parts thereof, will be free from defects in workmanship and materials for a period of 12 months from the date of shipment. All costs for parts and labor are covered for the term of this contract.

In the event that warranty service is required, the customer must contact Mydax Customer Service at the number listed below. The Mydax chiller is controlled with a microprocessor which continually records a history of the operation status of key components. It is important that troubleshooting begins by analyzing these diagnostics.

Call tracking is provided once diagnostics are performed and service personnel are dispatched. To expedite service, Mydax reserves the right to refer service to a qualified local service organization trained in the service of Mydax chillers.

Diagnostics will be provided by any one or more of the following means:

- Phone consultation, for thorough diagnostics and resolution of problem.
- Referral to Mydax web-site-based troubleshooting guide.
- On-site service by Mydax service personnel or qualified service organization.

Mydax offers an extended service contract; please call at least 3 months prior to the expiration of this warranty for details.

Customer Name: **Lawrence Berkeley Laboratory**

Unit Model Number: **1M9W-T**

Warranty Start Date: **See shipping invoice**

Unit Serial Number: **120-**

Warranty expires 12 months from above date.



MYDAX CUSTOMER SERVICE CONTACT INFORMATION:

Phone: 530-888-6662

Fax: 530-888-0962

Address: 12260 Shale Ridge Lane

Auburn, CA 95602

service@mydax.com

www.mydax.com

RESHIPPING & LONG-TERM STORAGE PREPARATION

Reshipped systems should be protected from freezing temperatures in shipment or during long-term storage, or serious damage may result. Freezing temperatures can be encountered in air and over-mountain surface shipments in any month of the year.

In-transit freeze-up can occur in the recirculating coolant loop and in a water-cooled condenser's water circuit. To protect against freezing, all water must be removed from these circuits, or ethylene glycol must be added.

This system has a **water-cooled** refrigeration condenser. The following instructions apply to shipment or long-term storage preparation:

- 1) Remove the condenser cooling lines and drain water from plumbing. While draining, remove the right side panel of the chiller and open the condenser flow regulating solenoid bypass valve. This will ensure complete draining of the condenser plumbing. Once water is completely drained, close valve and replace panel.
- 2) As much coolant as possible should be drained from the system before shipment. Coolant adds significant shipping weight and may damage electrical parts if it sloshes out of the tank.
- 3) Plug the TANK IN, TANK OUT, FILL, VENT and DRAIN fittings to avoid leakage of any residual coolant during shipment or storage. Also plug the CONDENSER IN and CONDENSER OUT fittings.

**FAILURE TO PERFORM THESE STEPS
PRIOR TO SHIPMENT MAY VOID THE WARRANTY.**

Call Mydax for shipment preparation help, if needed, at (530) 888-6662

-Appendix A - RS-232 Serial Interface Operation

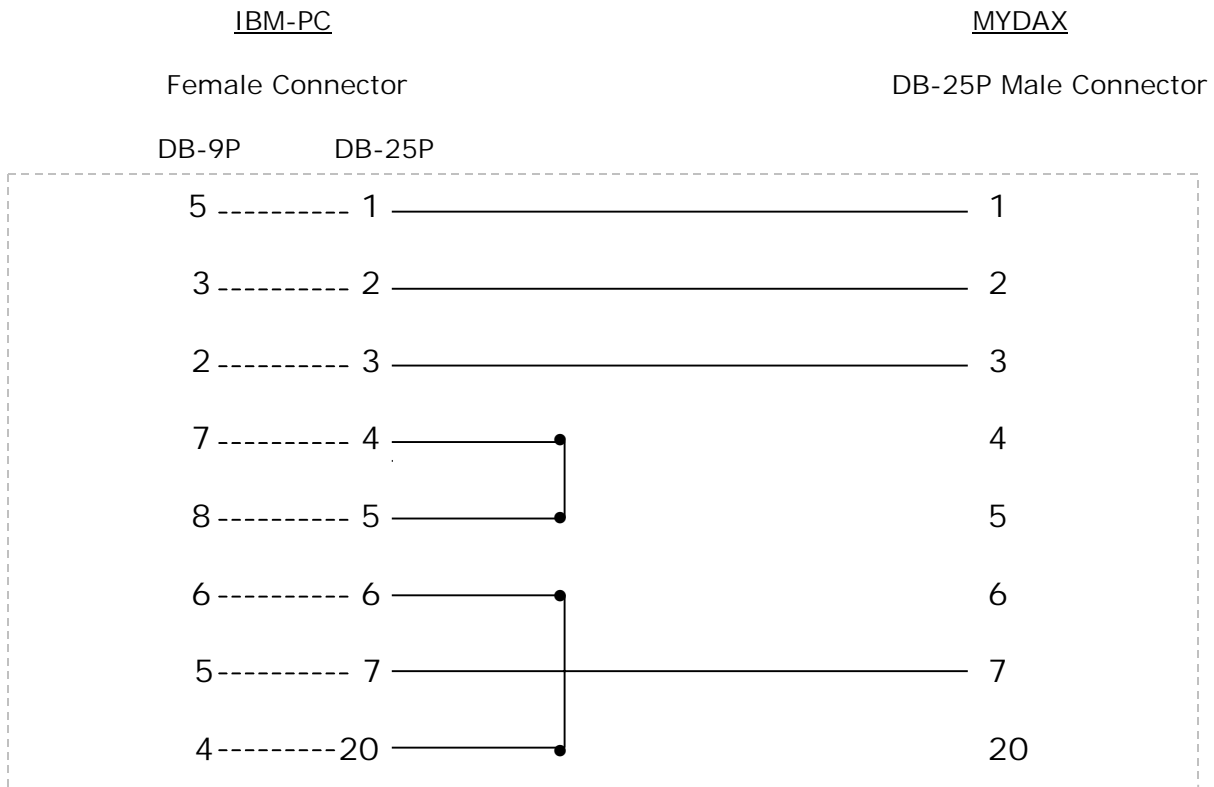
RS-232C INTERFACING

The use of an embedded microprocessor allows Mydax to offer an RS-232C (remote) interfacing capability. Mydax systems can be controlled from a computer with either the *MYDAX REMOTE* Window's™ software package or any control software of the user's choice. Full control and monitoring is possible, allowing complete system operation from any convenient location.

Cable connection is via a rear panel DB-25S connector. Connector pin-out is as follows:

- Pin 1 Shield
- Pin 2 Transmit Data
- Pin 3 Receive Data
- Pin 7 Common

A typical interconnect cable for an IBM-PC COM port should be wired as follows:



RS-232C COMMANDS

The following ASCII commands can be transmitted to the system MPU via the RS-232C link:

RO	Enables RS-232C control.
RF	Disables RS-232C control. With remote disabled, system only responds to RO.
GO	Starts the compressor and pump.
HA	Stops the compressor and pump.
RP	Run Pump only, active only on selected systems.
S?xy.z	Sets fluid temperature (x, y and z are any numbers) of tank A, B or C. Settings outside the range default to the nearest limit. Entering a decimal point is optional, as the last digit is assumed to be the tenths digit. For example: "SA180" selects +18.0°C for tank A, "SA245", "SA24.5" & "SA+24.5" all select +24.5°C for tank A, "SA93.2" selects +30.0°C for tank A.
TE1	Sends a transmission of abbreviated status including system on/off status, actual tank temperature and the set point temperature.
TE2	Causes transmission of flow and resistance, if the options exist. For example:
TE3	Transmits the contents of the 2 by 40-character main display over the RS-232 line.
TE4	Same output as TE1 plus RTD temperatures and valve & heater drive signals.
TR or TRO	Turns off repeat transmission mode.
TRx	Enables automatic periodic repeat transmission (x= 1-60 and represents the number of seconds between transmissions). The instructions which follow the TRx command are repeated at the transmission rate that was set by the TRx command. TE1 , TE2 , TE3 and TE4 are commands that can be repeated in all or any combination.
TPx	Changes the 2 by 40-character display at the main control panel to Test Panel "x" "0" = normal main display; "1" - "8" = diagnostic displays. See section on DIAGNOSTIC DISPLAYS. Does NOT cause transmission of the display over the RS-232C line (see command TE3)
ID	Causes transmission of the model number and software revision date. For example: "ID: 1VLH14W 1-24-2000"

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- AL** Causes transmission of the alarm status. For example:
"ALARM: 0" denotes no alarm condition.
- AH** Causes transmission of the alarm history status. For example:
"ALHIS: 13" denotes one alarm.
This history is the same as the Test 8 display. The history represents all alarms that have occurred since the last "Start" command.
- CH** Clears alarm history. This can also be cleared with the "Start" key or with the "0" key when viewing Test Panel 8.

A delimiter between command strings can be a carriage return (CR), a semi-colon (;) or a comma (.). If a command is understood, a (>) is returned for acknowledgment. If a command is not understood or ignored then a (?) is returned.

RS-232C STATUS MESSAGES

TE1 status messages include the following:

ON 19.95 20.0 (CR)(LF)
A B C

- Key: A) System is ON or OFF
B) Actual Tank Temperature in °C
C) Set point Temperature in °C

A TE4 status message consists of TE1/TE3 data plus RTD temperatures and valve & heater drives:

ON 19.9 20 -63 -8 41.5 34.5 102 0 2 2 0 4 10 8 2 11 (CR)(LF)
A B C D E F G H I J K L M N O P Q

An alarm status message is transmitted whenever there is an alarm that occurs for the first time and whenever the alarm status changes:

ALARM: 4 13 (CR)(LF)
R S T

A halt indication is transmitted when the system is stopped for any reason:

STOP: KEY (CR)(LF)
U V

- Key: A) System is ON or OFF
B) Actual Tank Temperature in °C, as sensed by the Output RTD

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- C) Set point Temperature in °C
- D) Calculated temperature in °C of the refrigerant line at the suction pressure transducer
- E) Pressure in PSIG of the refrigerant line at the suction pressure transducer
- F & G) Temperature in °C in the refrigerant line at the Superheat and Condenser RTDs
- H) Temperature in °C in the refrigerant line at the Discharge RTD (2-stage design only)
- I) Temperature in °C in the refrigerant line at the Subcooler RTD (inactive)
- J & K) Valve drives of evaporator valves 1 and 2; valve 2 is inactive in single channel systems (See "DIAGNOSTIC DISPLAYS, Test Panel 1" for explanation of drive signals.)
- L, M & N) Bypass, Superheat, and Desuperheat valve drives. Desuperheat is not available in all designs.
- O & P) Heater drive signals; Heater 2 is inactive in single channel systems (See "DIAGNOSTIC DISPLAYS, Test Panel 1" for explanation of drive signals.)
- Q) Flow rate in gallons-per-minute(GPM) of recirculation fluid. On systems without a flow meter, this number has no meaning.
- R) Any active alarms, by code # (See the next section for a description of alarm codes.)
- S & T) Actual code # for the alarm
- U) Stop is displayed whenever the system is halted
- V) Indicates the origin of the Stop Command (status message "S") whether it is from the system front panel (**KEY**), the external stop line (**EXT.**), an RS-232C command (**RS232**) or it originated from a fatal alarm (**FATAL**).

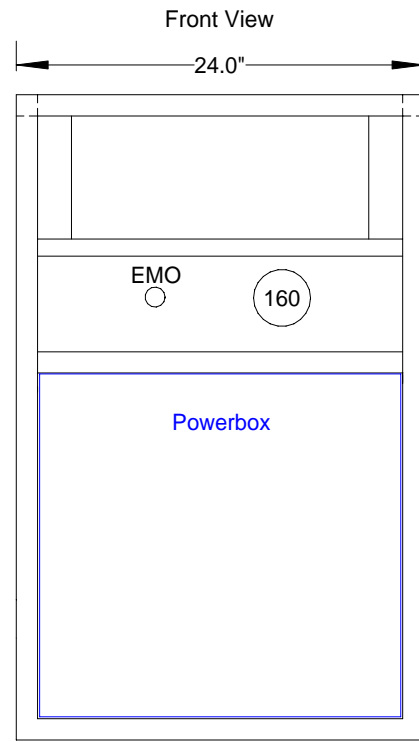
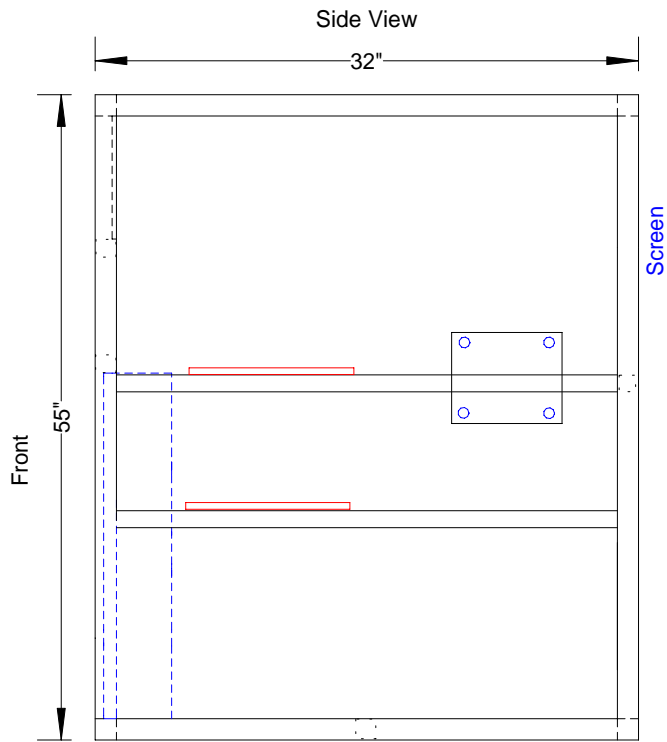
RS-232C ALARM CODES

The following alarm codes may be transmitted in an **AL** or **AH** status message. Not all of these codes are possible in every system:

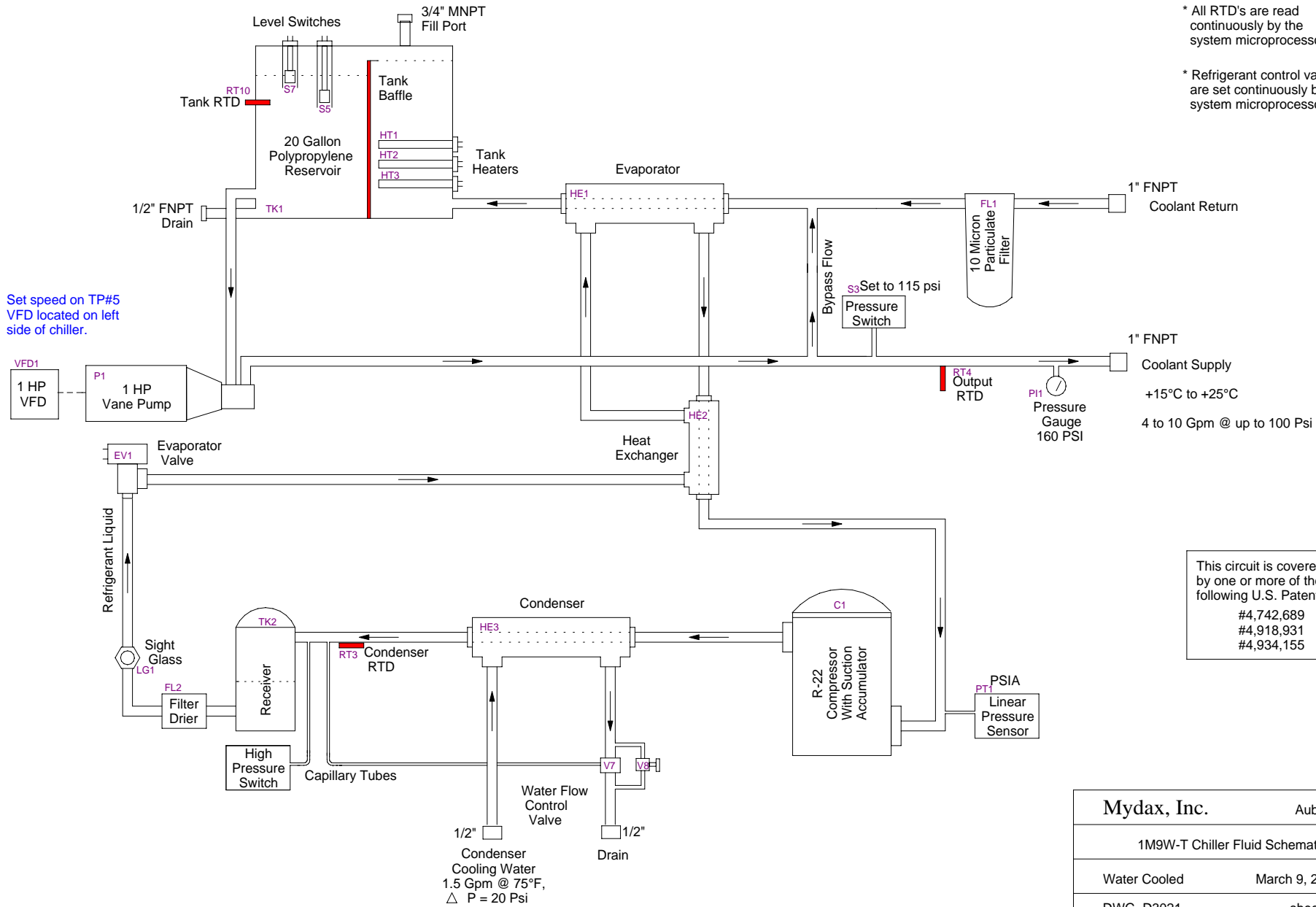
- 1 **CONDENSER HOT:** The reading from the condenser RTD indicates a temperature in excess of +50°C. The system microprocessor incrementally reduces the evaporator valve drive to reduce the flow of refrigerant into the evaporator. This effectively reduces the heat-rejecting capacity of the system, which keeps the temperature in the condenser at acceptable levels.
- 2 **LOW FREON:** Indicates pressure of refrigerant is low. Have unit serviced by Mydax or a qualified service center.
- 3 **RTD OPEN:** Indicates that one of the system RTD's has failed and the system has shut down to protect itself. The main display shows which RTD is faulty by giving its pin number location on the M1002 or M1005 circuit board.
- 4 **PUSH RESET:** The interlock loop has been broken and the reset switch must be depressed to re-establish it.
- 5 **FILL TANK #1:** The tank 1 low level sensor has tripped. If coolant is not added "soon", the "empty" sensor trips and the system shuts down.
- 6 Inactive in this system.
- 7 **FILL TANK #2:** The tank 2 low level sensor has tripped. If coolant is not added "soon", the "empty" sensor trips and the system shuts down.
- 8 **LOW FLOW:** Indicates that a low flow condition exists in one of the recirculating channels.
- 9 Inactive.
- 10 **PHASE MISSING:** Indicates one or two of the three electrical power phases is missing. Inactive on single-phase units.
- 11 **PHASE REVERSED:** Indicates incorrect electrical power phase relationship. May be corrected by reversing any 2 phases. Inactive on single-phase units.
- 12 Inactive in this system.
- 13 **LOW AC LINE:** Indicates a low voltage condition exists on the input AC line.
- 14 **RESISTANCE LOW:** Indicates that the deionized water resistivity has dropped below the programmed limit.
- 15 **TANKx TOO HOT / EXTREME TEMP:** Indicates that the tank temperature is either more than +10.0°C above its upper maximum set point, or too close to freezing and that the system has shut down.

1M9W-T Parts List

Reference	P/N	Title	Detail
FB1	03-2200-10873	Fuse Block, Class CC	3 Pole, 30A
F1, F2, F3	03-2200-10874	Fuse, 13/32" x 1-1/2", Class CC	10A 600V Fast Blow
LM1	03-4102-01220	SSAC Line Monitor	3PH, DPST, 200-480V
CB1	03-4123-00604	Circuit Breaker, 3 Pole	20 AMP, 240 V
CB2	03-4123-00725	Circuit Breaker, 3 Pole, Supplimentary Protector	2 AMP, 480 Y/277 V, D-Curve
CON1	03-4137-00816	Contact, DP	20A, 3 Pole, 24V Coil
S1	03-4140-00874	Switch, Pushbutton, TW Series, 22mm	N.C. Momentary Contact, Red Mushroom
S6	03-4140-00884	Switch, Pushbutton, TW Series, 22mm	N.O. Momentary Contact, B, R, G
S5, S7	03-4140-03220	Switch, Float	Polypropylene
S4	03-4140-04120	Switch, Over Temp.	120°F, .187 Quick
	03-4157-00940	Plug, Twist-Lock	L21-30P, 30A, 3Ph, 120/208V, 2811
	03-4171-00609	Connector CPC Cable Clamp	Size 11 .500"
	03-4171-00625	Connector CPC Plug	4 Pin Size 11
	03-4171-00628	Connector CPC Receptacle	4 Pin Size 11 Free Hanging
RL1	03-4175-01040	Relay, Clear, Socket Mount	4PDT, 24VAC
RL1-S	03-4175-01041	Relay Socket	14 Pin Double Tier
SSR1	03-4175-01064	Relay SS	120V, 2.5A
SSR2, SSR3, SSR4	03-4175-01082	Relay SS	240V, 40A
LM1-S	03-4177-01136	Relay Socket	8 Pin Octal, 600V
	03-4180-01148	Connector, Adapter, RS-232	DB25S to RJ45
RT3, RT4, RT10	03-4186-01175	RTD Thermalogic	Platinum 100 ohm 0.1%(±0.25°C), 1/8" x 2"
T1	03-4197-01424	Transformer, Control Power	208V, 24VAC, 100VA
VFD1	03-4198-00015	VFD	1 Hp, 240 V, 3 Ph
PI1	07-0800-09060	Pressure Gauge, Liquid Filled	160 PSI 1/4"NPT CBM 2-1/2"Dia
FL1-E	07-0810-09120	Filter	10 Micron 10"
FL1	07-0810-09140	Filter Housing	Blue 10" x 3/4"FPT
HT1, HT2, HT3	07-0825-09206	Heater	1000W 240V
V8	07-0879-09226	Valve, Ball, Brass	1/4"FPT, Wedge Handle
P1	08-0090-01117	Pump, Vane	1HP, 3 PH
C1	10-1100-11900	Compressor, Hermetic	1.5HP, 230V 3Ph
HT4	10-1100-11903	Crankcase Heater	PTC Maneurop
FL2	10-1102-12037	Filter Dryer, 2 Ton, Liquid	3/8"Soc, 5.88"x 3.00"dia
	10-1111-12035	Switch, Pressure	NC, 375 PSI, Open on Rise
S3	10-1111-12045	Switch, Pressure	10-150 PSI, SPDT
HE2	10-1114-10580	Heat Exchanger, Condenser	1-1/2 Ton
HE1	10-1114-10581	Heat Exchanger, Evaporator	1-1/2 Ton
HE3	10-1114-10582	Heat Exchanger, Subcooler	3/8Hp
PT1	10-1117-12110	Pressure Transducer	mV Output, 300PSIA, 1/8-27 NPT, 2' Cable
TK2	10-1119-12012	Receiver	REFRID RSRCH 1911
LG1	10-1121-12211	Sight Glass	3/8" ODF Solder
EV1	10-1142-14014	Valve, Expansion	AKV10-5
EV1-C	10-1142-14038	Valve Coil	24V, 14W, w/Junction Box
V7	10-1144-12200	Valve, Water Flow Cntrl, 3/8"	V46AA-1
	13-1455-15010	Caster, 3-1/2" Locking Swivel	Roll Master Wheel, Zinc Rig, Ball Bearing, w/Brake
PCB1	89-1001-00010	1001 Controller Board	X5
PCB2	89-1002-00020	M1002C RTD Board	Tested/Saturation Mod. on RTD7
PCB4	89-1004-00001	1004 Power Supply	V-Fan Added
PCB3	89-1007-00000	1007 LCD Supply	Standard
PCB5	89-1010-00022	1010 Interface Board	PSIG/PSIA-Low gain/Relay



Mydax Inc.	Auburn, CA.
LBL 1M9W-T Frame	
March 8, 2006	
DWG. D3020 1M9W-S LBL Frame	sheet 1 of 1



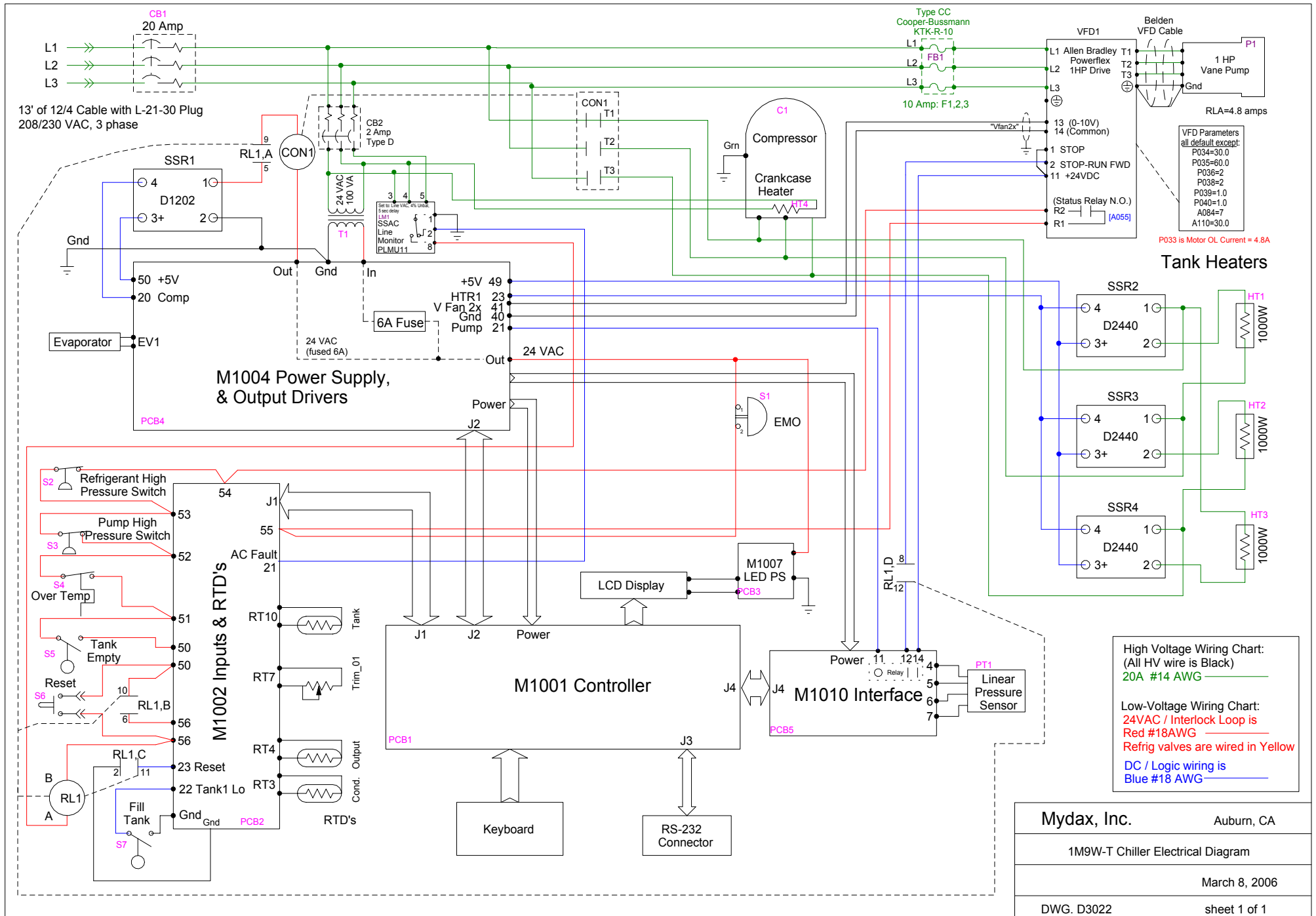
Set speed on TP#5 VFD located on left side of chiller.

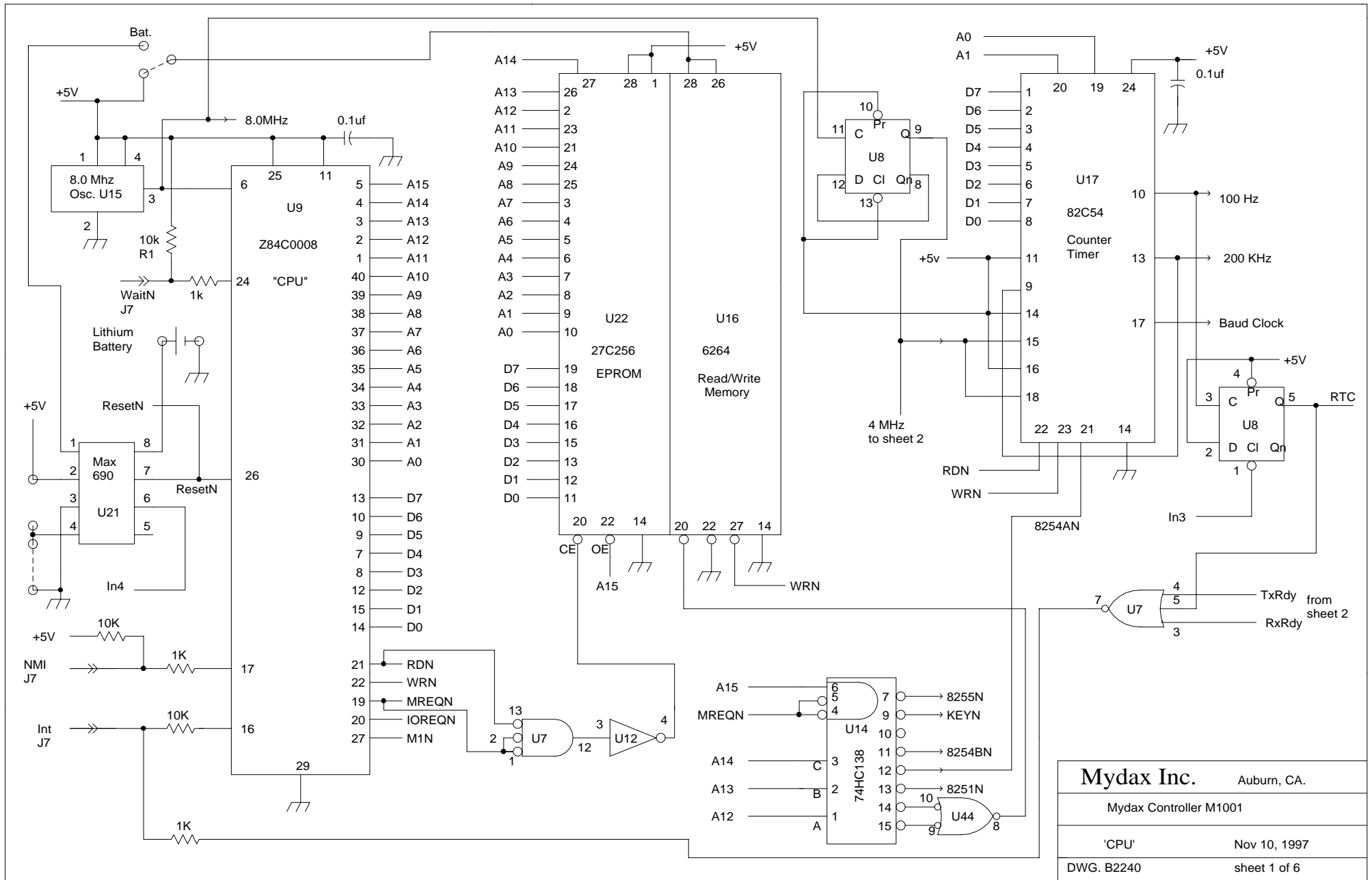
* All RTD's are read continuously by the system microprocessor.

* Refrigerant control valves are set continuously by the system microprocessor.

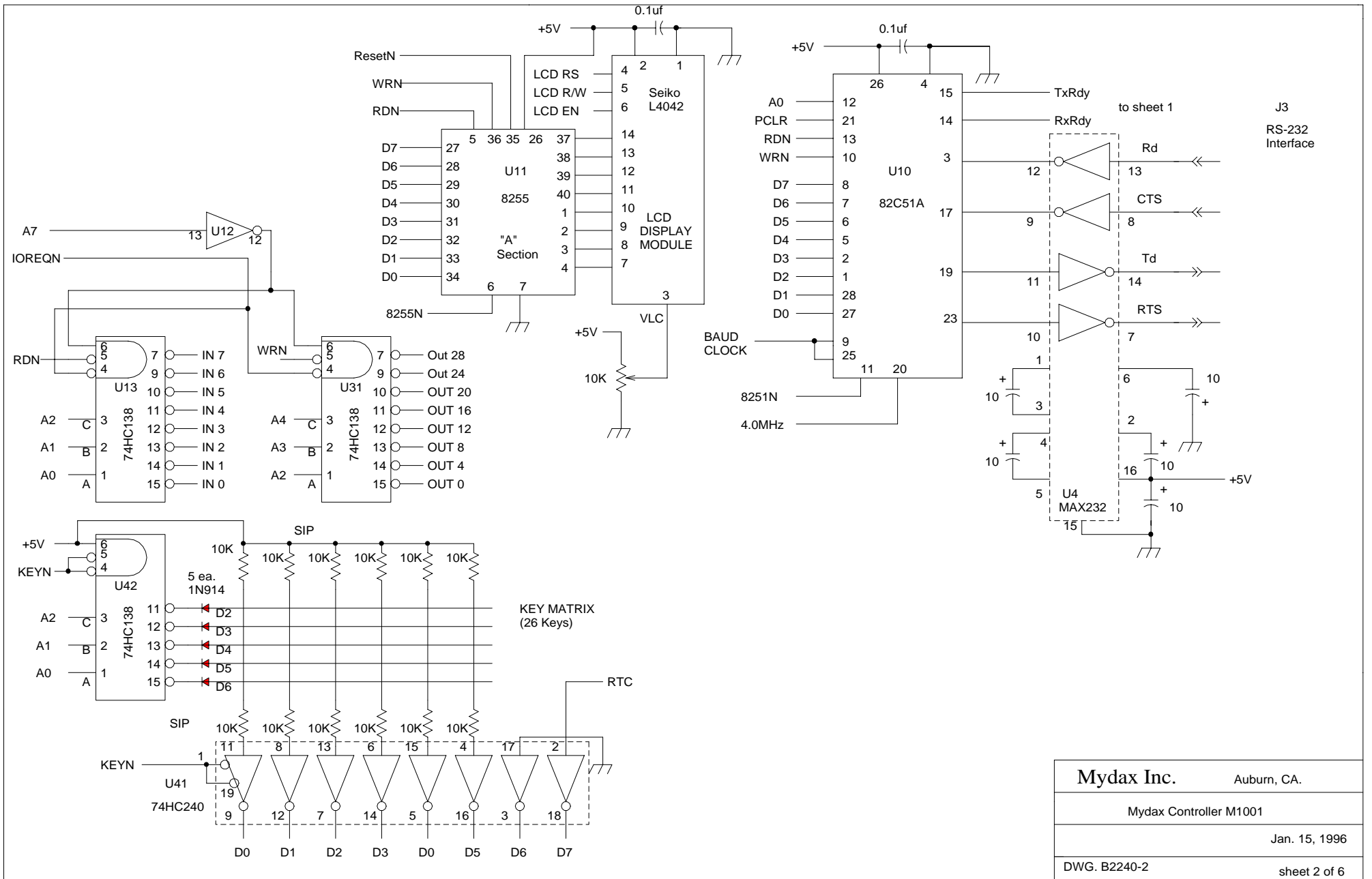
This circuit is covered by one or more of the following U.S. Patents:
 #4,742,689
 #4,918,931
 #4,934,155

Mydax, Inc.	Auburn, CA
1M9W-T Chiller Fluid Schematic	
Water Cooled	March 9, 2006
DWG. D3021	sheet 1 of 1

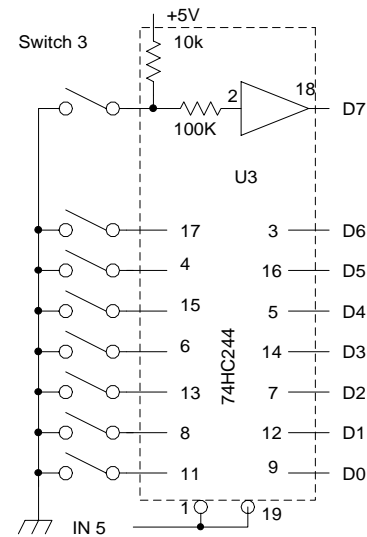
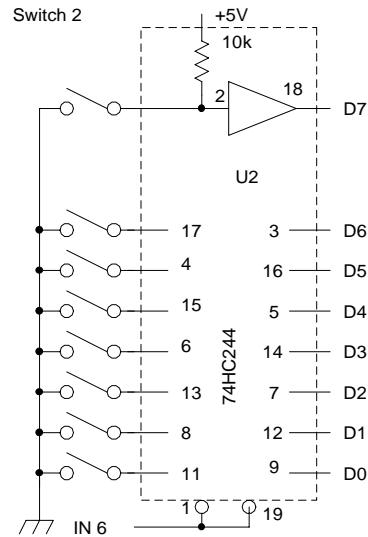
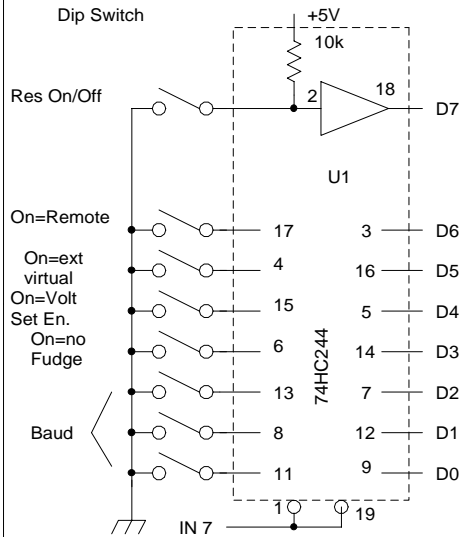
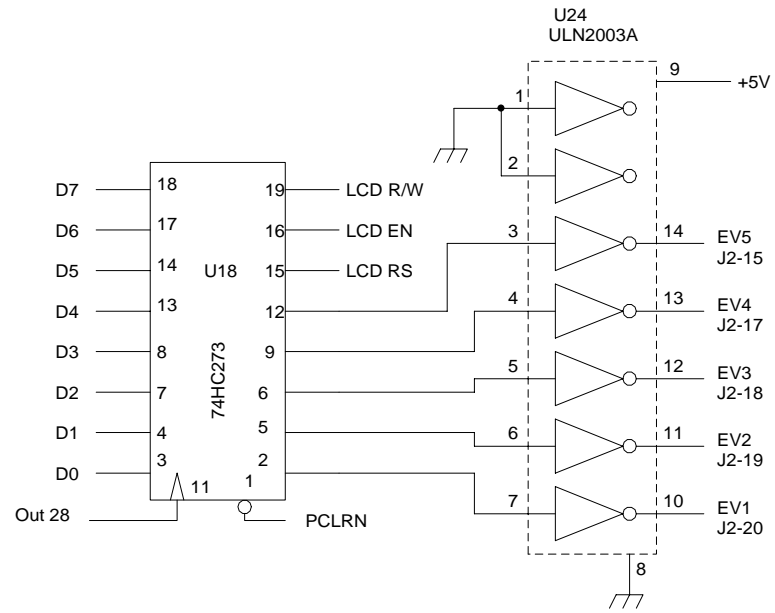
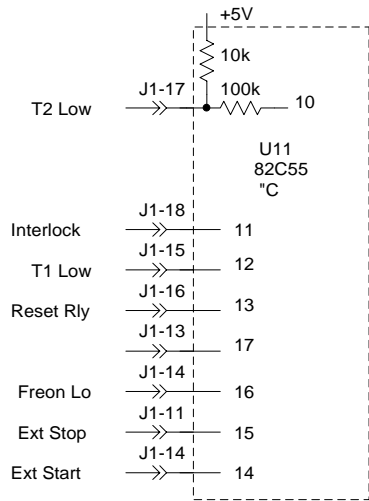
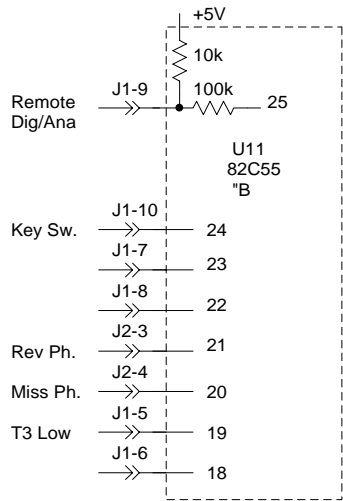




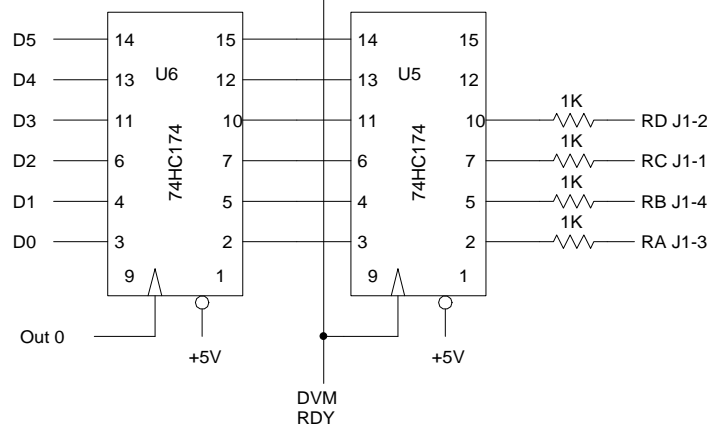
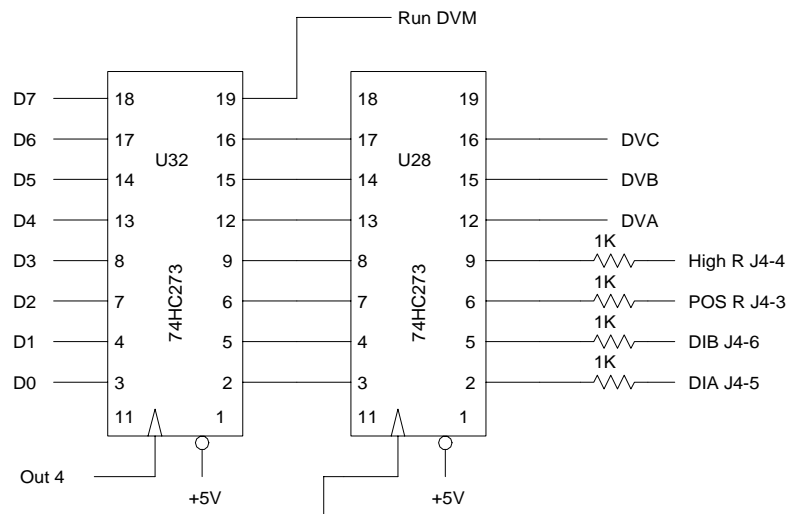
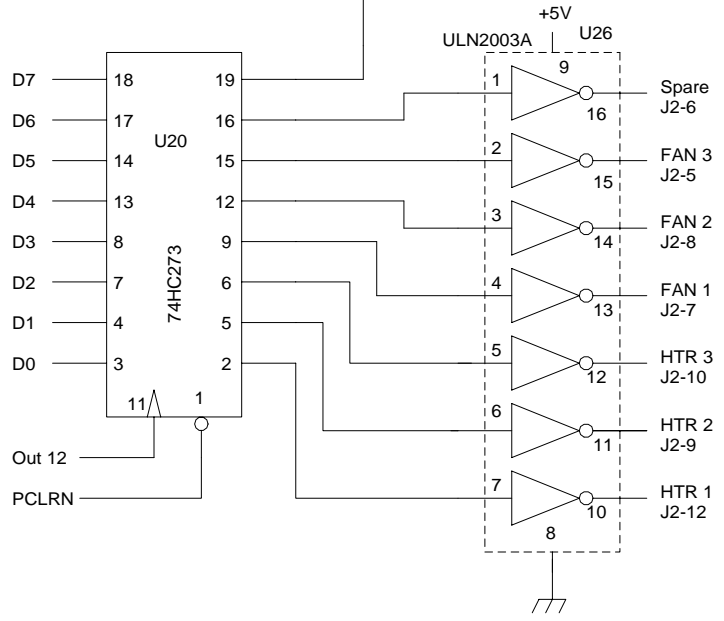
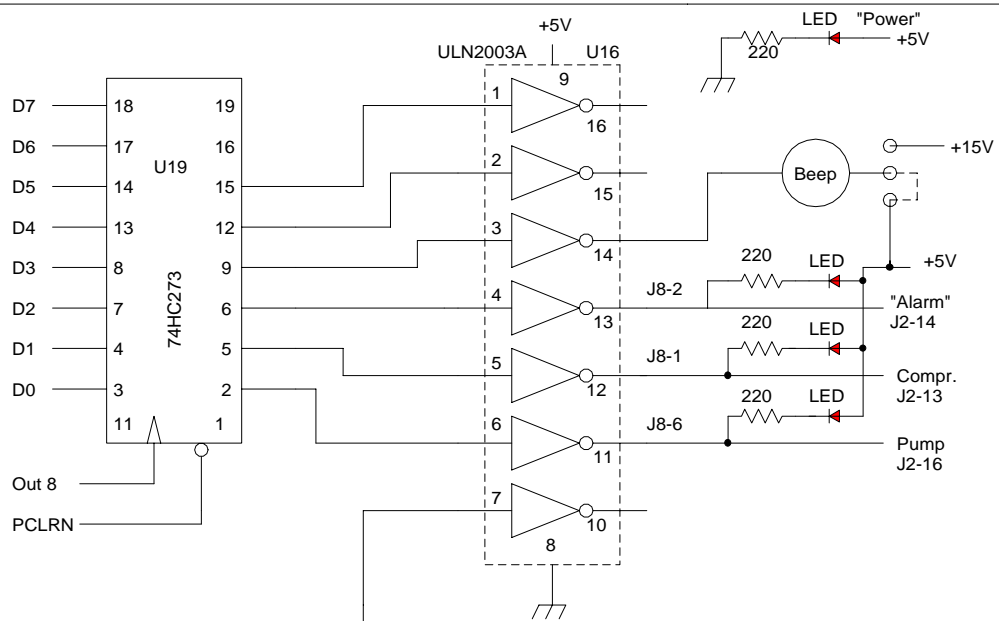
Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
'CPU'	Nov 10, 1997
DWG. B2240	sheet 1 of 6



Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
Jan. 15, 1996	
DWG. B2240-2	sheet 2 of 6

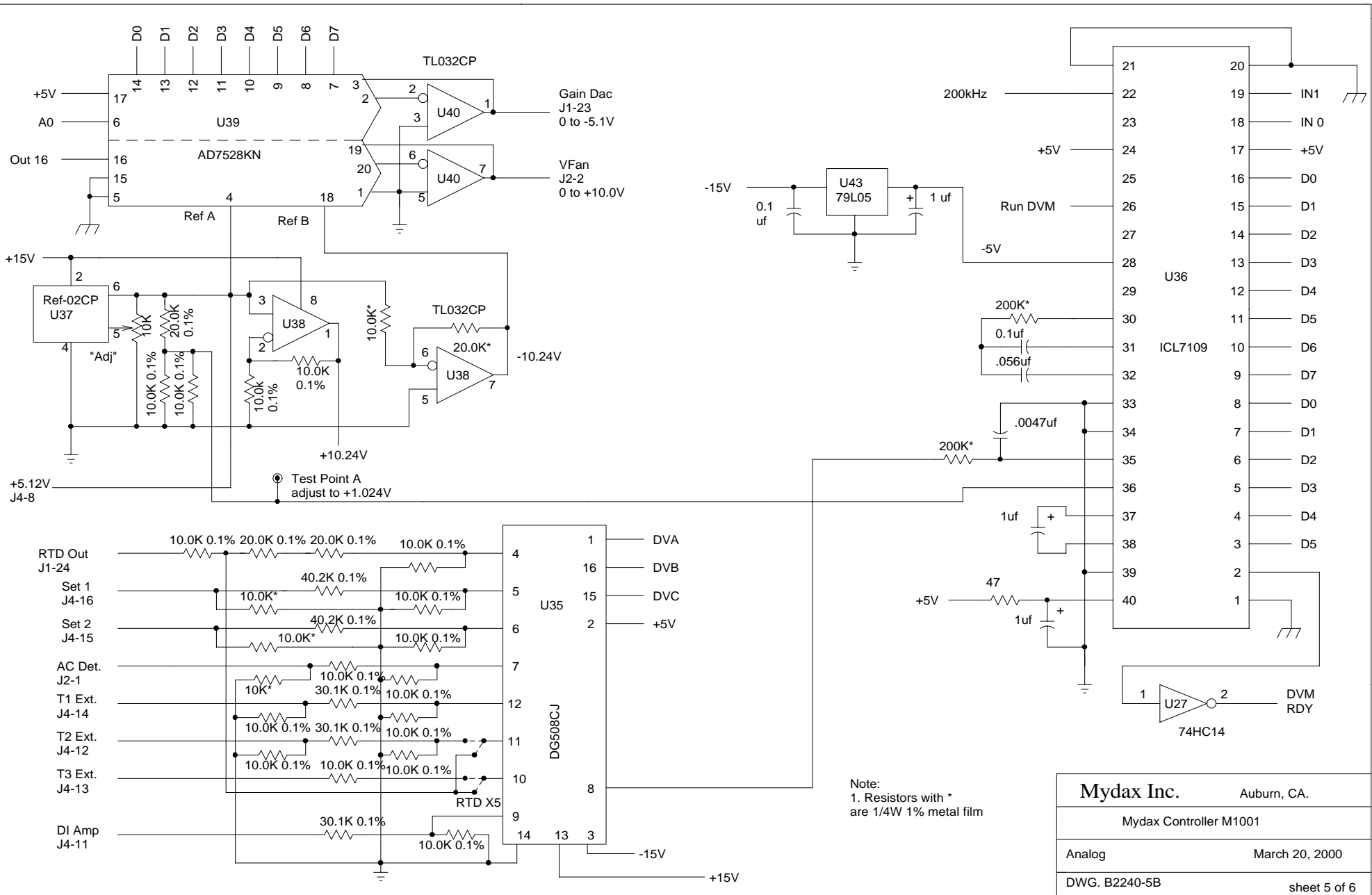


Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
Input-Output	April 24, 1996
DWG. B2240-3	sheet 3 of 6



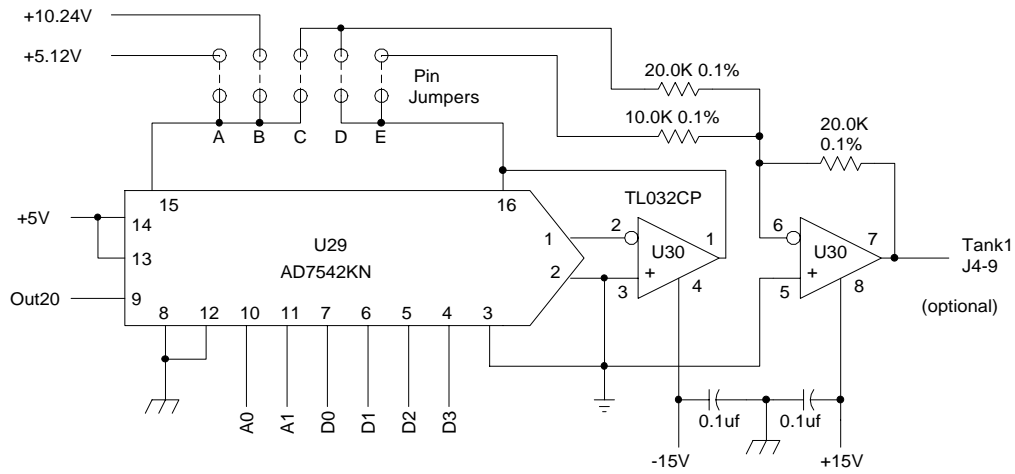
DVM RDY

Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
Output	Dec 20, 1995
DWG. B2240-4	sheet 4 of 6

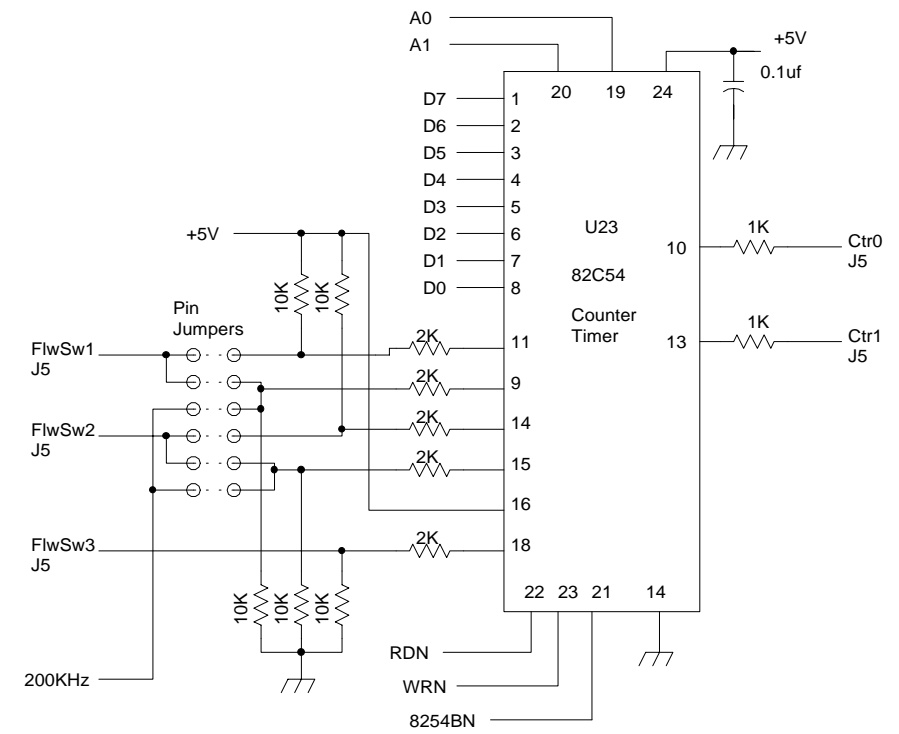
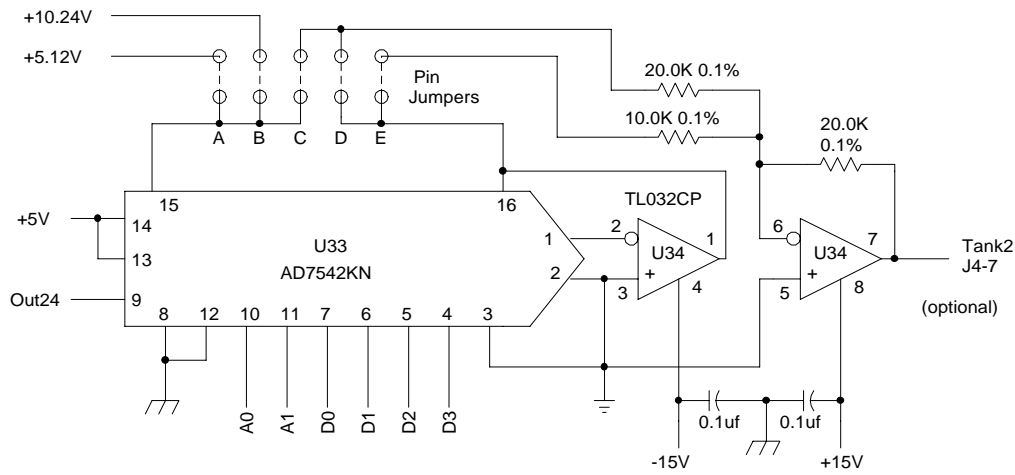


Note:
1. Resistors with *
are 1/4W 1% metal film

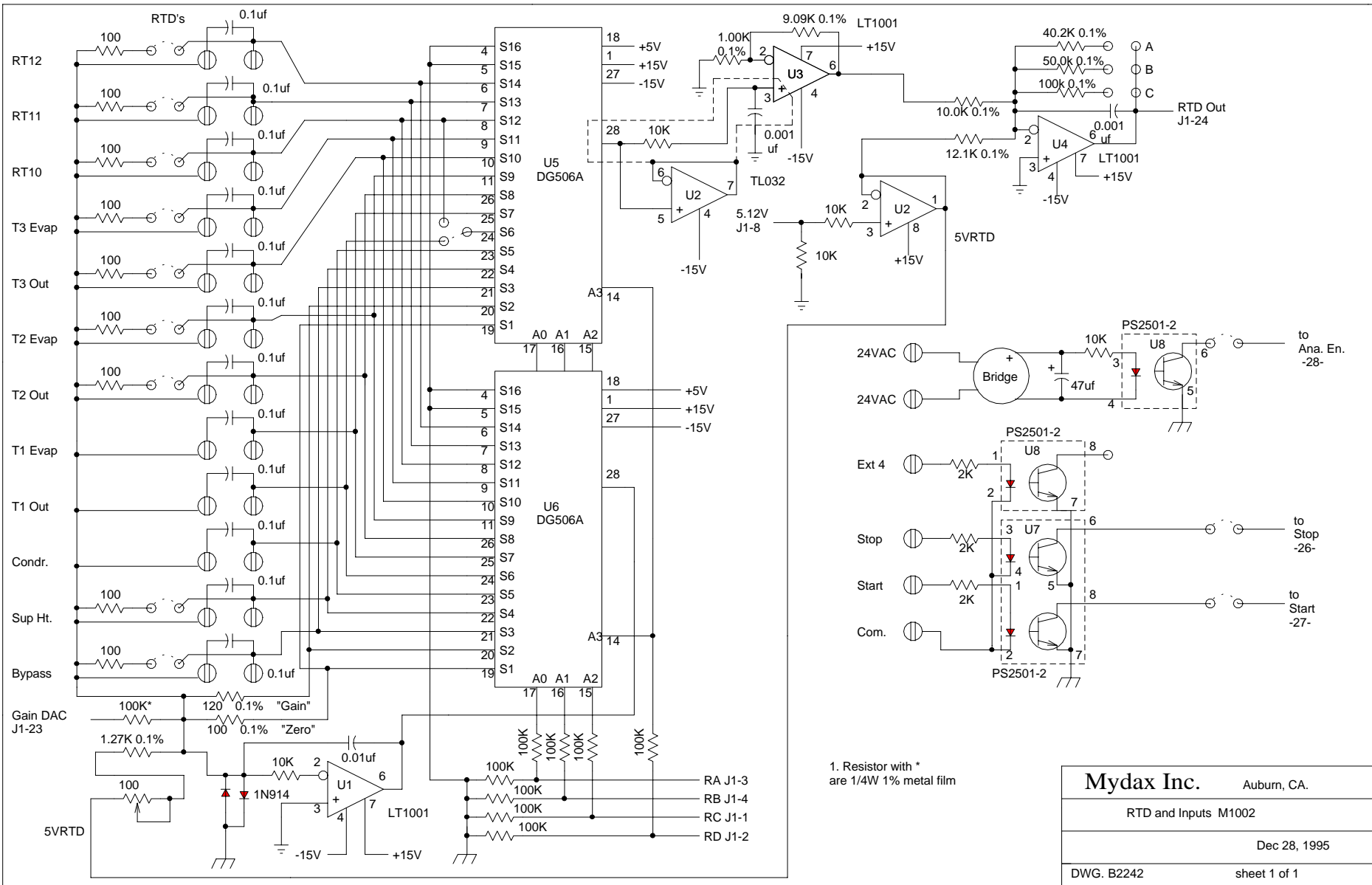
Mydax Inc.		Auburn, CA.
Mydax Controller M1001		
Analog	March 20, 2000	
DWG. B2240-5B	sheet 5 of 6	



Range	A	B	C	D	E
+5.12V	on	-	-	on	-
+10.24V	-	on	-	on	-
+5.12V	on	-	on	-	on
+10.24V	-	on	on	-	on

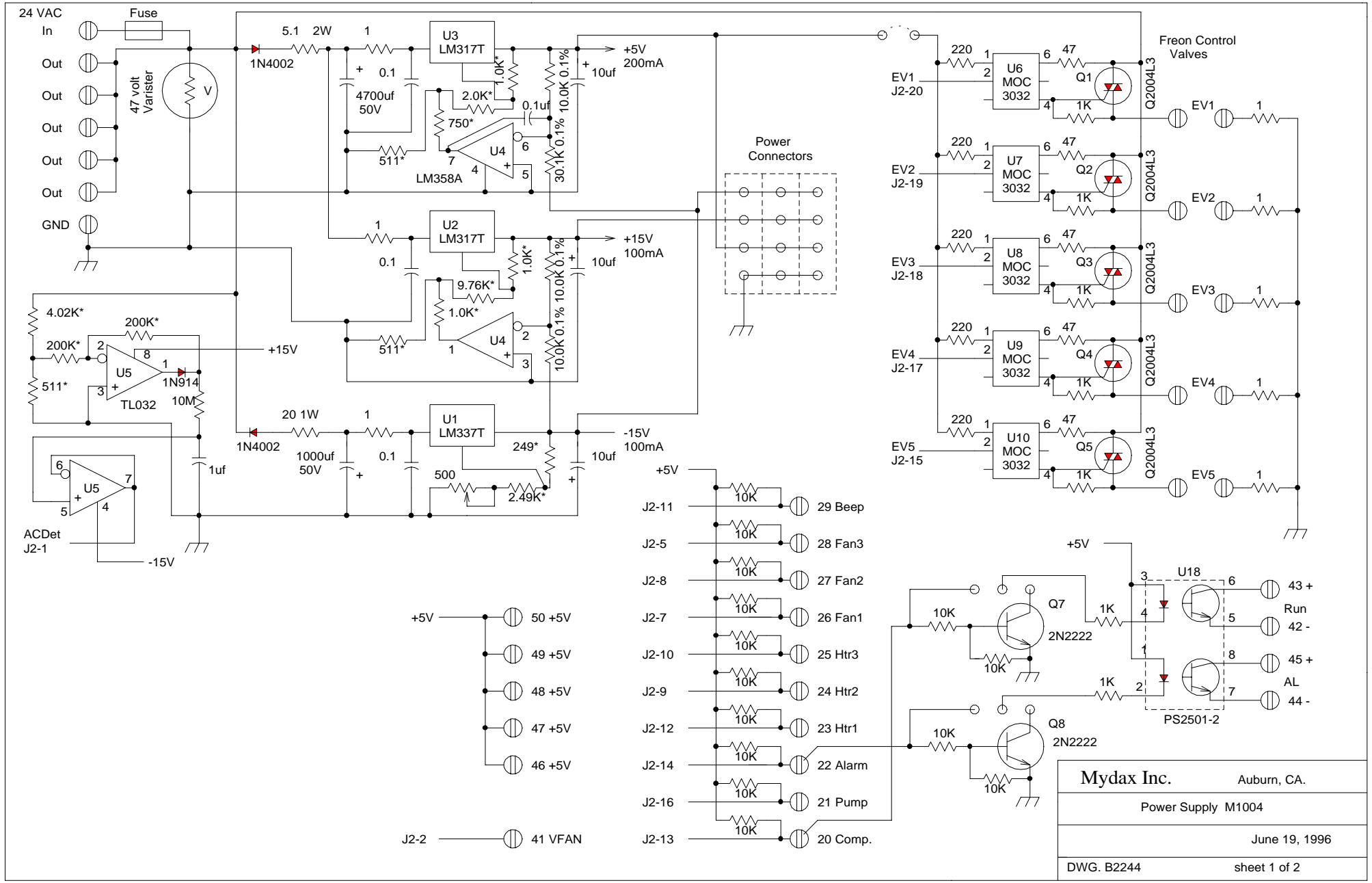


Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
Optional	Jan. 15, 1996
DWG. B2240-6	sheet 6 of 6

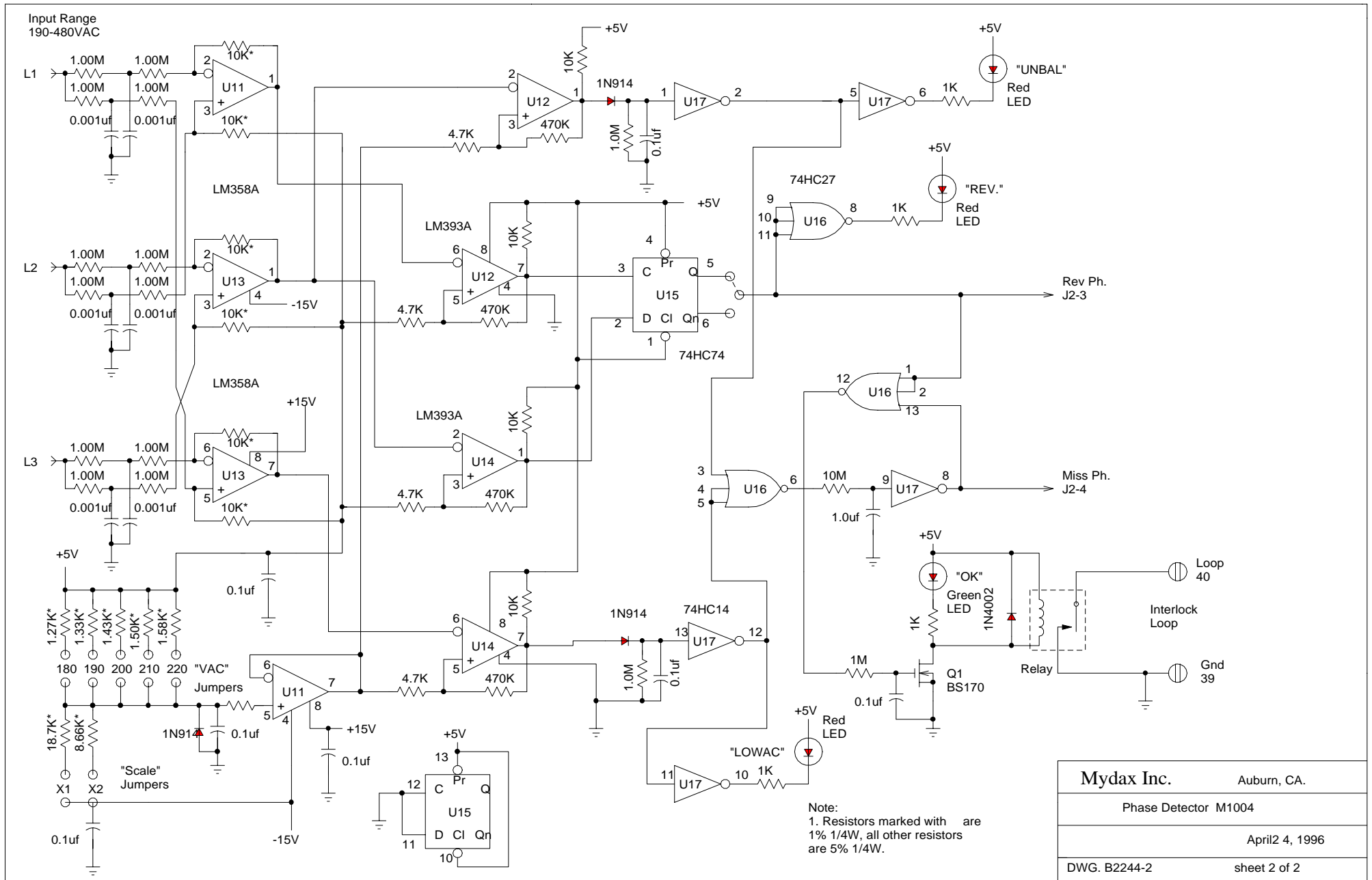


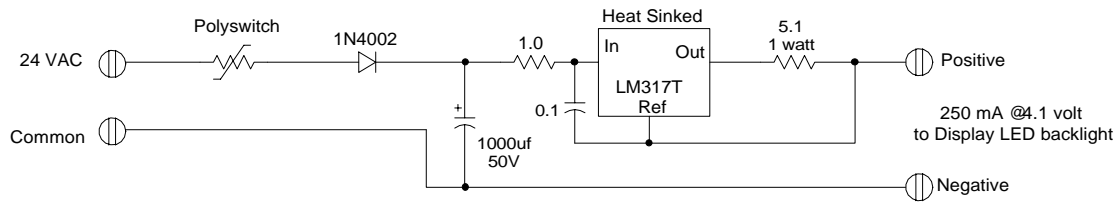
1. Resistor with *
are 1/4W 1% metal film

Mydax Inc.		Auburn, CA.
RTD and Inputs M1002		
Dec 28, 1995		
DWG. B2242	sheet 1 of 1	



Mydax Inc.	Auburn, CA.
Power Supply M1004	
June 19, 1996	
DWG. B2244	sheet 1 of 2





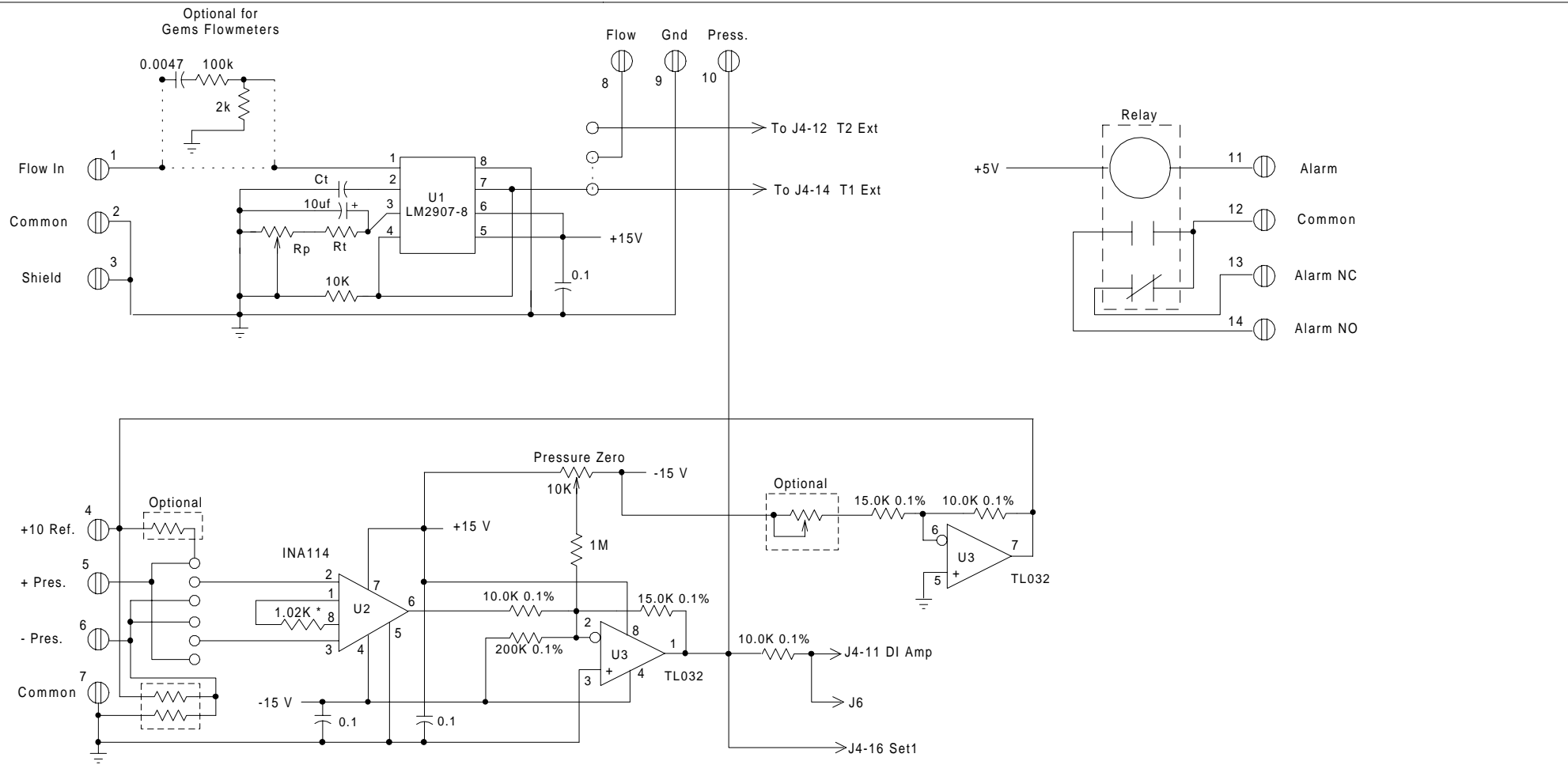
Mydax Inc. Auburn, CA.

M1007 LED Power Supply

Sept 24, 1997

DWG. D2729

sheet 1 of 1



Note:
1. Resistors with *
are 1/4W 1% metal film.

2. For Proteus 500C-high
Ct=0.0047uf, Rt=69.8K*
Rp=50K, 100Hz=0.714V

3. For Proteus 550C
Ct=0.01uf, Rt=49.9K*
Rp=50K, 100Hz=0.97V

4. For Gems 1/2" Lo range,
Rp= 20k, Rt=30.1k, Ct= 0.01uf
100 Hz=0.595 V

Using Sensym STImV300G1A sensor:
0 psig= 1.125 volt, 300 psig= 8.625 volt

Using Sensym STImV300A1A sensor:
0 psia= 1.125 volt, 300 psia= 8.625 volt
Sea level mean pressure= 14.7 psia = 1.4925 volt

Mydax Inc.	Auburn, CA.
Interface M1010	
Jan 25, 2000	
DWG. D2616	sheet 1 of 1

MSDS: R-22

Information in this format is provided as a service to our customers and is intended only for their use. Others may use it at their own discretion and risk.

The MSDS format adheres to U.S. standards and regulatory requirements and may not meet regulatory requirements in other locations.

This information is based upon technical information DuPont believes to be reliable. It is subject to revision as additional knowledge and experience are gained. Please return to this website for the most current version.

"FREON" 22

2008FR

Revised 5-OCT-1996

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

Corporate MSDS Number : DU000025
Formula : CHClF2
Molecular Weight : 86.47
CAS Name : "FREON" 22

Tradenames and Synonyms

CHLORODIFLUOROMETHANE
HCFC-22
CC0335

Company Identification

MANUFACTURER/DISTRIBUTOR
DuPont
1007 Market Street
Wilmington, DE 19898

PHONE NUMBERS

Product Information : 1-800-441-9442
Transport Emergency : CHEMTREC: 1-800-424-9300
Medical Emergency : 1-800-441-3637

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material	CAS Number	%
*METHANE, CHLORODIFLUORO- (HCFC 22)	75-45-6	100

* Disclosure as a toxic chemical is required under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372.

HAZARDS IDENTIFICATION

Potential Health Effects

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness or death. Intentional misuse or deliberate inhalation may cause death without warning. Vapor reduces oxygen available for breathing and is heavier than air. Liquid contact can cause frostbite.

HUMAN HEALTH EFFECTS:

Skin contact with the liquid may include frostbite. Prolonged overexposure may cause defatting or dryness of the skin. Eye contact with liquid may include eye irritation with discomfort, tearing, or blurring of vision.

Inhalation may include temporary nervous system depression with anesthetic effects such as dizziness, headache, confusion, incoordination, and loss of consciousness.

Higher exposures may lead to temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation. Fatality may occur from gross overexposure.

Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to the toxicity of excessive exposures.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid

INHALATION

If inhaled, immediately remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT

In case of contact, flush area with lukewarm water. Do not use hot water. If frostbite has occurred, call a physician.

EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION

Ingestion is not considered a potential route of exposure.

Notes to Physicians

Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should only be used with special caution in situations of emergency life support.

FIRE FIGHTING MEASURES

Flammable Properties

Flash Point : Will not burn
Autodecomposition : 632 C (1170 F)

Other burning materials may cause HCFC-22 to burn weakly.

Chlorodifluoromethane is not flammable at ambient temperatures and atmospheric pressure. However, chlorodifluoromethane has been shown in tests to be combustible at pressures as low as 60 psig at ambient temperature when mixed with air at concentrations of 65 volume % air. Experimental data have also been reported which indicate combustibility of "FREON" 22 in the presence of certain concentrations of chlorine.

Fire and Explosion Hazards:

Cylinders may rupture under fire conditions. Decomposition may occur.

Extinguishing Media

As appropriate for combustibles in area. Extinguishant for other burning material in area is sufficient to stop burning.

Fire Fighting Instructions

Use water spray or fog to cool containers. Self-contained breathing apparatus (SCBA) is required if cylinders rupture or contents are released under fire conditions. Water runoff should be contained and neutralized prior to release.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Accidental Release Measures

Ventilate area, especially low or enclosed places where heavy vapors might collect. Remove open flames. Use self-contained breathing apparatus (SCBA) for large spills or releases.

HANDLING AND STORAGE

Handling (Personnel)

Use with sufficient ventilation to keep employee exposure below recommended limits. "FREON" 22 should not be mixed with air for leak testing. In general, it should not be used or allowed to be present with high concentrations of air above atmospheric pressure. Contact with chlorine or other strong oxidizing agents should also be avoided.

Storage

Clean, dry area. Do not heat above 52 C (125 F).

EXPOSURE CONTROLS/PERSONAL PROTECTION**Engineering Controls**

Normal ventilation for standard manufacturing procedures is generally adequate. Local exhaust should be used when large amounts are released. Mechanical ventilation should be used in low or enclosed places.

Personal Protective Equipment

Impervious gloves and chemical splash goggles should be used when handling liquid. Under normal manufacturing conditions, no respiratory protection is required when using this product. Self-contained breathing apparatus (SCBA) is required if a large release occurs.

Exposure Guidelines**Applicable Exposure Limits**

METHANE, CHLORODIFLUORO- (HCFC 22)
 PEL (OSHA) : None Established
 TLV (ACGIH) : 1,000 ppm, 3,540 mg/m3, 8 Hr. TWA, A4
 AEL * (DuPont) : None Established

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

PHYSICAL AND CHEMICAL PROPERTIES**Physical Data**

Boiling Point : -40.8 C (-41.4 F)
 Vapor Pressure : 151 psig @ 25 C (77 F)
 Vapor Density : 3.03 (Air=1.0) @ 25 C (77 F)
 % Volatiles : 100 WT%
 Evaporation Rate : >1 (CCl4=1.0)
 Solubility in Water : 0.3 WT% @ 25 C (77 F)
 pH : Neutral
 Odor : Slight ethereal
 Form : Liquified Gas.
 Color : Clear, Colorless.
 Liquid Density : 1.194 g/cm3 @ 25 C (77 F)

STABILITY AND REACTIVITY**Chemical Stability**

Material is stable. However, avoid open flames and high

temperatures.

Incompatibility with Other Materials

Incompatible with alkali or alkaline earth metals--powdered Al, Zn, Be, etc.

Decomposition

Decomposition products are hazardous. HCFC-22 can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric and hydrofluoric acids, and possibly carbonyl halides. These materials are toxic and irritating. Contact should be avoided.

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

INHALATION:

4 hour, LC50, rat: 220,000 ppm.

The compound is a skin irritant and a slight eye irritant, but is not a skin sensitizer in animals.

Effects from single high exposures include central nervous system depression, anesthesia, rapid breathing, lung congestion and microscopic liver changes. Cardiac sensitization occurred in dogs at 50,000 ppm or greater from the action of exogenous epinephrine.

No toxic effects or abnormal histopathological observations occurred in rats repeatedly exposed to concentrations ranging from 10,000 to 50,000 ppm (v/v). Long-term exposures to 50,000 ppm (v/v) of vapors produced organ weight increases and a decrease in body weight gain, but no increased mortality or adverse hematological effects. In chronic inhalation studies, HCFC-22, at a concentration of 50,000 ppm (v/v), produced a small, but statistically significant increase of late-occurring tumors involving salivary glands in male rats, but not female rats or male or female mice. In the same studies, no increased incidence of tumors was seen in either species at concentrations of 10,000 ppm or 1,000 ppm (v/v).

Long-term administration in corn oil produced no effects on body weight or mortality.

HCFC-22 was mutagenic in some strains of bacteria in bacterial cell cultures, but not mammalian cell cultures or animals. It did not cause heritable genetic damage in mammals.

A slight, but significant increase in developmental toxicity was observed at high concentrations (50,000 ppm) of HCFC-22, a concentration which also produced toxic effects in the adult animal. Based on these findings, and other negative developmental studies, HCFC-22 is not considered a unique hazard to the conceptus. Studies of the effects of HCFC-22

on male reproductive performance have been negative. Specific studies to evaluate the effect on female reproductive performance have not been conducted, however, limited information obtained from studies on developmental toxicity do not indicate adverse effects on female reproductive performance at concentrations up to 50,000 ppm.

ECOLOGICAL INFORMATION

Ecotoxicological Information

Aquatic Toxicity:

HCFC-22
48 hour EC50 - Daphnia magna: 433 mg/L

DISPOSAL CONSIDERATIONS

Waste Disposal

Comply with Federal, State, and local regulations. Reclaim by distillation or remove to a permitted waste disposal facility.

TRANSPORTATION INFORMATION

Shipping Information

DOT/IMO
Proper Shipping Name : CHLORODIFLUOROMETHANE
Hazard Class : 2.2
UN No. : 1018
DOT/IMO Label : NONFLAMMABLE GAS

Shipping Containers

Tank Cars.
Tank Trucks.
Cylinders.

REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : Reported/Included.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : Yes
Chronic : No
Fire : No
Reactivity : No
Pressure : Yes

HAZARDOUS CHEMICAL LISTS

SARA Extremely Hazardous Substance: No
CERCLA Hazardous Substance : No
SARA Toxic Chemical - See Components Section

OTHER INFORMATION

NFPA, NPCA-HMIS

NPCA-HMIS Rating
Health : 1
Flammability : 0
Reactivity : 1

Personal Protection rating to be supplied by user depending on use conditions.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS : DuPont Chemicals
Address : Engineering & Product Safety
> : P.O. Box 80709, Chestnut Run
> : Wilmington, DE 19880-0709
Telephone : (302) 999-4946

Indicates updated section.

End of MSDS