

advanced temperature control technology

MYDAX
2M8A
2-CHANNEL, AIR-COOLED
CHILLER / HEATER
USER'S MANUAL

MYDAX, INC.

12260 Shale Ridge Lane

Auburn, CA 95602

530-888-6662

FAX 530-888-0962

<http://www.mydax.com>

Revision History

Rev.	Date	Purpose
0	4/24/08	Release

Table of Contents

2M8A



SPECIFICATIONS	1
SAFETY & ENVIRONMENTAL CONCERNS	2
SYSTEM OVERVIEW	4
INSTALLATION	7
FRONT PANEL CONTROLS	11
ALARM & ERROR MESSAGES	13
DIAGNOSTIC DISPLAYS	14
SERVICE & WARRANTY	18
SHIPPING & STORAGE PREPARATION	20

APPENDIX

RS-232 SERIAL INTERFACE OPERATION

SYSTEM DESIGN

PARTS LIST
FRAME DRAWING
FLUID DIAGRAM
ELECTRICAL SCHEMATIC

DRAWINGS

CIRCUIT BOARD SCHEMATICS

MATERIAL SAFETY DATA SHEETS (MSDS)

ETHYLENE GLYCOL
R-507 REFRIGERANT
POE 32 REFRIGERANT OIL
LITHIUM COIN-CELL BATTERY

SPECIFICATIONS

SYSTEM CAPACITIES

	<u>Loop 1 (Closed Loop)</u>	<u>Loop 2 (Open Loop)</u>
Fluid Temperature Setpoint Range (<i>both loops</i>)	59°F to 95°F (+15°C to +35°C)	
Temperature Stability (<i>both loops</i>)	± 1.8°F (± 1.0°C) or better	
Net Cooling Capacity at 82°F (+27.7°C)	885 Watts (3,000 BTU/hr)	1,465 Watts (5,000 BTU/hr)
Stainless Steel Reservoir Volume	5 Gallons	None
Net Heating Capacity (<i>both loops</i>)	2,000 Watts	
Recirculating Fluid (<i>both loops</i>)	50% Water / 50% Ethylene Glycol ◆	
Recirculating Flow and Pressure (<i>both loops</i>)	4 Gpm at 30 Psi, 2 Gpm at 60 Psi	
Recirculating Supply and Return Fittings (<i>both loops</i>)	3/4" Stainless Steel FPT	
Condenser Air Flow	1,800 CFM, Front-to-Rear	
Maximum Heat Rejection to Ambient	24,000 BTU/hr	
Refrigeration Compressor	One (1) 3 Hp, Single-Stage, Hermetically-Sealed	
Refrigerant Charge	R-507, 10 lbs. ◆	
Electrical Service	208/230 VAC, 60 Hz, 3 Phase, 40 Amp Service	
System Dimensions	54" H x 36" W x 48" D	
Estimated Dry Weight	600 lbs.	
Installed Clearances	36" Front and Rear, 24" Sides	

STANDARD FEATURES

This chiller is complete with our microprocessor-controlled low-stress, refrigeration circuit and internal recirculating pumps. The refrigeration circuit uses all-brazed construction for extra strength and the heavy-duty frame is constructed of welded steel tubing mounted on casters and equipped with leveling feet.

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 LED's (light-emitting diodes). The control keyboard employs membrane switches with a sealed polycarbonate overlay for protection from liquid spills.

- ◆ Material Safety Data Sheets (MSDS) are included in the last section of this manual.

SAFETY and ENVIRONMENTAL CONCERNS

This Mydax chiller was designed to provide 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 provides insight to the operation of each stage of the refrigeration and fluid recirculating circuits.

- 1) Warning and Error Messages including coolant over-temperature warning and shutdown and others (Refer to the Alarm and Error Messages section of this manual.)
- 2) System Diagnostics including coolant and refrigerant temperatures, valve drives and parameters (Refer to the Diagnostic Displays section of this manual.)
- 3) Hardware safeguards include a series-wired interlock circuit which protects against refrigerant high or low pressures and thermal protection of the compressor motor. (Refer to the System Overview section of this manual.)

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.
- ! 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, serious injury or disability, such as loss of sight or limb.

HIGH TEMPERATURES



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 heats components to temperatures as high as +120°C. The label indicates that the area is hot and should not be touched until the unit is allowed to cool down.

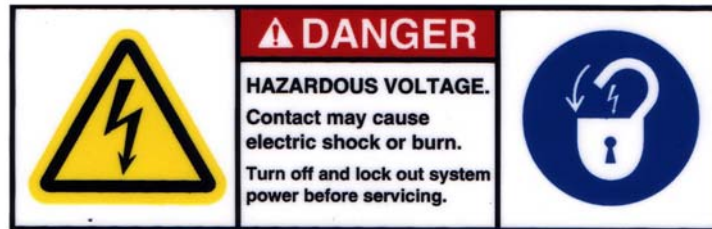
FLUIDS and CHEMICALS

This chiller contains fluids which may be slippery if spilled on the floor. Cleanup of any spills should follow the guide provided in the MSDS.

Service of the refrigeration system should only be performed by qualified and certified personnel. Refrigerant gas is not to be vented to the atmosphere. It should be handled according to regulations set forth by the local environmental authorities. R-507 is a fluorocarbon type material and subject to environmental regulations.

The compressor uses POE 32 oil. This MSDS is included in the last section of this manual. The compressor is semi-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



This "Hazardous Voltage" danger label has been placed on the clear guard inside the electrical enclosure and on each power junction box within the chiller cabinet. The label indicates that there are hazardous voltages of 208/230 VAC on the components at these locations. Before servicing, the equipment should be disconnected from the source supply and locked out with an appropriate device.

! DANGER Electrical maintenance should only be performed by qualified electricians and/or 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, it should be replaced with a compatible type, and the replaced battery should be recycled as required by local environmental regulations.

SYSTEM OVERVIEW

REFRIGERATION

Refer to drawing D3112, the fluid (refrigerant and fluid) diagram. The heart of the design is the refrigerant valves, shown at the left side of the drawing. These are pulse-width-modulated valves, controlled directly by the system's embedded microprocessor. By controlling the duration of the openings of the evaporator valves, a precisely determined flow of refrigerant is sent to the evaporators, allowing for exceptionally stable recirculating temperatures. This system is designed to control the recirculating output temperature to $\pm 1^{\circ}\text{C}$ or better over the entire temperature range of both recirculating loops.

The microprocessor sets the positions of the evaporator valves based upon the system heat load. If the load increases, the evaporator valves are opened for longer durations, passing more refrigerant. If the load decreases, the evaporator valves are opened for shorter durations, passing less refrigerant. The microprocessor controls the bypass condition by reducing the cooling capacity down to the compressor's lowest levels and increasing the heat into the evaporators. Using this technique, this system is able to run in load conditions of no-load to full-load and all combinations in between. During normal operation, the durations of the valve openings 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 Loop 1 pump, at the input line leading to the Loop 2 pump, at the output line leading from the Loop 2 heater module, in the refrigeration circuit between the condenser and receiver, at the suction accumulator inlet (superheat), and at the compressor crankcase. The controller reads these and other sensors constantly and sets the refrigerant valves accordingly.

Using these techniques, 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

Both recirculating loops of this system are designed to recirculate a solution of ethylene glycol and water as their heat transfer fluid. Approximately 6 gallons are required to initially fill of the 5 gallon stainless steel reservoir of **Loop 1, the closed loop**, and its associated plumbing. The reservoir is equipped with a 2,000 watt heater and two level sensors. One level sensor drives a **FILL TANK** alarm at the controller 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. When the fluid is below the TANK EMPTY level, a **PUSH RESET** message is displayed on the controller and the system will stop.

Loop 2, the open loop, has no internal reservoir and is designed to draw fluid from an external tank at atmospheric pressure. Once this fluid has entered the system, the internal pump sends it through a refrigeration evaporator and a 2,000 watt heater module in order to discharge the fluid back out to the external tank at the setpoint temperature.

Each recirculating loop offers a temperature setpoint range from 59°F to 95°F (+15°C to +35°C). The temperature setpoints for each loop are adjusted independently on the main controller. Each loop incorporates a 1 Hp canned motor turbine pump which delivers a 4 Gpm flow at 30 Psi and a 2 Gpm flow at 60 Psi. **Loop 1 is equipped with a rear panel mounted bypass valve intended to provide adjustment of recirculating flow and pressure.** Each of these plumbing circuits includes an adjustable pressure switch which has been factory set to break the interlock loop and stop the system in the event that the recirculating output exceeds 80 Psi, due to a closed valve or other obstruction.

SYSTEM ELECTRICAL SCHEMATIC

Refer to drawing D3114, the system electrical schematic. The central component of the electrical system is the M1001 controller, which is microprocessor-based and communicates with and controls various other circuit boards and components. Additional circuitry is laid out on circuit boards mounted in the main electrical enclosure. The controller is powered as long as the system circuit breakers are set, receiving 24 VAC power from a step-down control transformer.

The M1001 controller "reads" the RTD's in the system via the M1002 circuit board, mounted in the electrical enclosure. RTD's are included for the recirculating fluid temperatures, as well as for the refrigeration circuit. The refrigerant valve and heater drive signals are routed through the M1004 power supply 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.

A compressor crankcase heater is provided and is powered as long as the system circuit breaker is set and AC line voltage is present. The controller will prevent the system from starting until the crankcase temperature reaches +28°C, as sensed by the crankcase RTD.

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. The reset button is automatically set on initial power up to the chiller with a two-second time delay, provided that all interlock devices show no fault conditions.

Refer to the table below and the electrical schematic, drawing D3114. The system interlock loop is routed via terminal blocks on the M1011 circuit boards. If any component in the interlock loop opens, power to the loop is interrupted. The microprocessor senses this via the contactor RL1,C 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. For more information, see Diagnostic Displays section, Test Panel 19.

Interlock	Interlock Device	Location
A1	Pump 1 Over-Current Relay	OL1 in Electrical Enclosure
A2	Pump 2 Over-Current Relay	OL2 in Electrical Enclosure
A3	3-Phase Line Monitor	LM1 in Electrical Enclosure
A4	Pump 1 Over-Pressure Switch	S7 in Chiller Cabinet
B1	Refrigerant High Pressure Switch	S2 in Chiller Cabinet, Near Receiver
B2	Tank 1 Empty Switch	S5 in Chiller at Tank 1 Lid
B3	Tank 1 / Loop 2 Over-Temp Switches	S3 at Tank 1 Lid / S9 at Loop 2 Heater Module
B4	Pump 2 Over-Pressure Switch	S8 in Chiller Cabinet

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. The tripped EMO state disengages all power devices and leaves the control voltage for the microprocessor in force so that the controller can continue to record the status and condition of the refrigeration components. The EMO button should **NOT** be used to stop the system, except in the case of an emergency. To disengage the EMO button, gently twist the knob in the direction of the arrows, and release.

RS-232 SERIAL INTERFACE

RS-232 communication is accomplished via the 25-pin D-sub connector on the rear panel of the system labeled **RS-232**. Refer to the RS-232 Serial Interface Operation appendix of this manual for complete details.

INSTALLATION

LOCATING and SECURING

Most frequent access will be to the front control panel and to the fluid fill port on the top of the chiller. The condenser fans pull air through the condensing unit from the screen panel on the front of the chiller. This air is directed out the rear of the unit at a rate of up to 1,800 CFM. Placement of the chiller should be chosen such as to not obstruct the flow of air. Obstructions may cause loss of cooling capacity and eventual overheating. The total heat rejection to ambient can be as high as 24,000 BTU/hr.

This air-cooled chiller is rated for indoor use. Please refer to the specifications page at the beginning of this manual for a summary of the electrical and facilities requirement. The system is shipped with a refrigerant charge and does not require charging prior to use. Environmental regulations require that any necessary refrigeration service be performed by a qualified and certified, if necessary, refrigeration technician. Electrical servicing should only be performed by qualified electricians and/or trained service personnel.

In order to allow the compressor's oil to separate from the refrigerant, it is important that a period of one 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 is turned on. While the crankcase heater is warming the compressor, the plumbing connections can be made and the recirculating loops filled with fluid.

ACCESS PANELS

Within the aluminum panels and steel frame are all of the chiller's components. Access to these components, such as the compressor, condenser fans, pumps, heater module, 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 generally unnecessary except for service access. Service of the refrigeration equipment should be performed only by qualified and certified, if necessary, personnel.

! DANGER Prior to any electrical servicing inside of either the power box or the chiller cabinet, disconnect and lockout the main incoming power.

RESET BUTTON

The black **RESET** button, located on the front of the system, below the controller, must be pushed prior to starting the system and also if an error in the interlock circuit (such as a latched EMO button) has occurred. This push button resets the safety interlock circuit making it ready to protect the unit and the operator. Gently twist the EMO button to be sure it is unlatched.

POWER CONNECTIONS

Main electrical power connections to this system are made through the 1" conduit connection, labeled **POWER CABLE**, located on the rear panel of the unit. This internal conduit routes forward to the electrical enclosure on the front of the chiller. Install a watertight conduit and fitting consistent with national and local electric codes. This chiller requires a 4-wire connection (3 phase wires plus ground) 208/230 VAC, 60 Hz, 3 phase, 40 amp circuit.

! DANGER Prior to any electrical servicing inside of either the power box or the chiller cabinet, disconnect and lockout the main incoming power.

Access to the electrical enclosure is obtained by removing the front aluminum panel, below the controller, that encompasses the 40 amp circuit breaker (**CB1**) and RESET button. By removing the perimeter #2 phillips screws, a clear plastic shield is accessible. This shield provides tooled and guarded access to the hazardous voltages within the enclosure. Temporarily remove the clear plastic shield by removing the 6-32 flat-head screws which hold it in place.

Wire each the three phase wires run through the POWER CABLE conduit to each of the terminal connections at the top of CB1. Attach the ground wire run through the POWER CABLE conduit to the ground bar located to the right of CB1. Once the unit is wired and powered, turn on the CB1 circuit breaker and verify that the EMO button is unlatched. A message similar to the following appears on the LCD main display:

Tank 1	--- Warmup Delay ---	Local Set
72.3°F	0.0 Gpm	82.0°F

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 the voltage setting is correct and fluid levels are properly adjusted.

The unit will not run without proper phase wiring, if the display flashes "AC Fault," remove power to the system, swap two of the phase lines at CB1, re-apply power and re-check. Once the system is properly wired, the clear shield and aluminum panel can be re-installed.

Leave the unit turned on while plumbing connections are being made. This will allow time for the crankcase heater to warm the compressor and separate the oil from the refrigerant. Press the "Mute Alarm" button on the controller to silence the alarm for a period of 10 minutes.

! NOTICE The system should be powered for a period of approximately one hour before initial starting attempts. This will allow time for the crankcase heater to separate the refrigerant from the oil. This helps ensure good lubrication and extends the life of the compressor. A "Crankcase is warming up" message is displayed if the crankcase has not reached +28°C.

RECIRCULATING PLUMBING CONNECTIONS

The rear bulkhead panel is equipped a 1/2" stainless steel female pipe thread (SS FPT) drain fitting labeled **TANK 1 DRAIN**. For the convenience of future draining procedures, this drain fitting is equipped with a 1/4 turn ball valve. The recirculating loops are under pressure when the system is operating.

! NOTICE Due to the fact that Loop 2 of this system is not supplied with an internal reservoir, no "TANK 2 DRAIN" is supplied. All Loop 2 draining and filling procedures must be performed at the external tank.

The upper rear bulkhead panel is equipped with three of the four recirculating supply and return fittings. The 3/4" SS FPT fitting labeled **LOOP 1 OUT** must be plumbed to the inlet of the device to be cooled. The line returning from the device being cooled must be plumbed to the respective 3/4" FPT fitting labeled **LOOP 1 IN**.

The 3/4" SS FPT fitting labeled **LOOP 2 OUT** must be plumbed to the lower of the two fittings on the external tank. The 3/4" SS FPT fitting labeled **LOOP 2 IN** is installed on a floor-mounted bracket and protrudes through the rear screen. This fitting leads to the suction port of the Loop 2 recirculating pump and must be plumbed to the higher of the two fittings on the external tank.

! NOTICE The LOOP 2 IN fitting is located as low as possible on the 2M8A system and should be plumbed to the higher of the two fittings on the external tank for ease of priming the Loop 2 fluid circuit. The fluid level in the external tank must be maintained at a level above the higher of the two fittings. The recirculating pump must not be allowed to run dry.

FILL FLUID CIRCUITS

! CAUTION Do **NOT** press either the **START** key or the **RUN PUMP** key until heat transfer fluid has been introduced to both fluid circuits. Neither recirculating pump should be allowed to run dry.

Each recirculating loop of this chiller system has a temperature setpoint range of 59°F to 95°F (+15°C to +35°C) and both loops are designed to recirculate a solution of 50% ethylene glycol and 50% water.

! WARNING Verify that the heat transfer fluid used to fill both fluid circuits is an appropriate solution of ethylene glycol and water, in order to prevent freezing or boiling damage within the system.

Loop 1 Procedures Loop 1 of this chiller/heater is designed to recirculate through an external closed-loop system and is equipped with an internal 5 gallon stainless steel reservoir. Approximately 6 gallons are required to fill the reservoir and associated internal plumbing. More fluid will be required later - once the pump is started, based upon the size of and distance to the fixture plumbed to the output.

Fill the Loop 1 reservoir according to the following guide:

- 1) Verify that all the Tank 1 drain valve is completely closed.
- 2) Verify that the Loop 1 Flow Adjust Valve is 1/4 turn opened from its fully closed position, as a reasonable starting point for filling and priming procedures.
- 3) Verify that all external recirculating lines are securely installed.
- 4) Verify that any valves installed in the recirculating lines are completely open.
- 5) Remove the fill port cap from the reservoir's 3/4" fill port.
- 6) Use a funnel or insert a hose into the reservoir's fill port and fill to the proper tank level.

To satisfy the TANK EMPTY float switch, add approximately 4 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, the **FULL** indicator LED lights, and the audible alarm stops.

Loop 2 Procedures Loop 2 of this chiller/heater is designed to recirculate through an external tank at atmospheric pressure and is not equipped with either an internal reservoir or drain. All filling and draining procedures for Loop 2 must be performed at the external tank. When filling the external tank, verify that the fluid level is at least six inches above the top of the tank's outlet fitting leading to the 3/4" SS FPT fitting labeled **LOOP 2 IN** protruding through the rear screen. Verify that any valves installed in the recirculating lines leading to or from the external tank are completely open.

PUMP / FLUID CIRCUIT PRIMING

Once all plumbing lines have been installed with all recirculating valves opened and both tanks (Loop 1 internal and Loop 2 external) have been filled, it is advisable to prime both pumps and fluid circuits via the **RUN PUMP** key on the main controller to fill both fluid circuits. Pressing the **RUN PUMP** key on the controller will start both recirculating pumps only, without starting the refrigeration system or heaters. The recirculating flow rates in Gpm for each loop will be displayed on the controller. Refer to the Front Panel Controls section of this manual. Both flow rates are visible simultaneously on Test Panel 4.

Additional fluid will need to be added to both tanks (Loop 1 internal and Loop 2 external) once the pumps have circulated fluid into the heat exchanger cavities and external plumbing. Have additional fluid on-hand and ready for use.

Both fluid circuits are equipped with low flow fatal alarms which will stop the system during normal operation in the event that the recirculating flow in either circuit drops below 1.0 Gpm, as sensed by the internal flowmeters.

! CAUTION Due to the time delay encountered during initial priming procedures, the low flow fatal alarms for this system are inactive when operating in RUN PUMP mode. Use caution during priming procedures to avoid conditions where either pump could run dry.

While priming the fluid circuits, the fluid level in the Loop 1 reservoir may drop sufficiently to trip the FILL TANK and/or TANK EMPTY switches. If this happens, add more fluid to the reservoir, following the procedures outlined above. Repeat this procedure as necessary to fill Loop 1.

The only method available to monitor the priming of the Loop 2 pump is to carefully watch the flow rate for Loop 2 on the controller display. If the flow rate in Loop 2 is not established within about 10 seconds, press the STOP key and try running in RUN PUMP mode again. It may become necessary to manually fill the line leading from the external tank to the LOOP 2 IN fitting by inserting a hose into the external tank fitting and introducing fluid directly. A turkey baster is a handy device to have on-hand for this procedure.

Top off the external tank as necessary to keep the fluid level at least six inches above the top of the tank's outlet fitting. Once the fluid circuits are filled, the FILL TANK and TANK EMPTY switches in Loop 1 are satisfied and even flow is established in the recirculating loops, press the STOP button on the controller.

! NOTICE Check all recirculating fluid connections now to ensure against leaks.

INITIAL STARTING

Refer to the Front Panel Controls section of this manual for details on panel operation.

PRESSURE GAUGES

Refer to drawing D3112, the fluid (refrigerant and fluid) diagram. The pressure gauges (PI1 and PI2), on the front panel, indicate the output pressures of the Loop 1 and Loop 2 recirculating pumps, respectively. The pump over-pressure switches (S7 and S8) are located directly behind their respective pressure gauges. These over-pressure switches have been factory set to break the interlock loop and stop the system in the event that the recirculating output pressure exceeds 80 Psi, due to a closed valve or other obstruction. Contact Mydax for adjustment procedures.

VENT

The Loop 1 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 reservoir to "breathe."

CONDENSER AIR FLOW

The condenser temperature can be viewed on Test Panel 2. Periodic maintenance should include making sure the air passageways are clear of debris.

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 and in concert with built-in diagnostics and error messages, are exceptionally comprehensive.

- POWER LED** Indicates unit is powered (the circuit breaker is set).

- RESET** This black 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 electrical power from all high voltage components. It will cause a PUSH RESET message to be displayed. This button is NOT to be used to stop the pumps and compressor, except in the case of an emergency.

- START** Starts the compressor and pumps and turns on the Compressor and Pump LED's.

- RUN PUMP** Starts only the pumps, turns on the Pump LED, displays flow rates in Gpm. If the chiller is already running (with the START button) this will STOP the compressor and leave the pumps running.

DISPLAY

Tank 1	--- MYDAX ---	Local Set
82.1 °F	4.3 Gpm	82.0 °F

Shows the actual Output (Tank) Temperature and Setpoint Temperature in °F. Also indicates that the LOCAL SET temperature mode is enabled. The flow rate measured by the in-line flowmeter is displayed as well.

! NOTICE **This system is designed to display actual and setpoint temperatures for both recirculating loops in °F on their main displays only. All temperatures on all other displays are read in °C. To change main display temperature data to °C, move DIP switch SW1-1 on the back of the M1001 controller to its "Off" position.**

- STOP** Stops both the compressor and pumps.

- 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.

- 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.
- 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-232 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. Refer to the RS-232 Appendix of this manual.
- ARROW KEYS** Toggles output (tank) temperatures, setpoint temperatures and flow rates data view modes for multiple channel systems.
- "." (DECIMAL)** Display shows model number and software revision date and copyright:
- | | |
|----------------------------|--------------------|
| 2M8A | 2008.04.22. |
| Copyright 1986-2008 | 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 a high discharge pressure condition with temperature over +55°C (131°F). This is only a warning message until the temperature reaches +65°C (149°F), at which point 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 fans, coils, and air flow.

Fill Tank Indicates low liquid level in the Loop 1 reservoir. The heat transfer fluid will shrink 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, Test Panels 8 and 9 should help indicate the fault. Furthermore, the specific item can be determined by viewing Test Panel 19. Refer to the Diagnostic Displays and the System Overview sections for details on how the interlock loop functions.

Low Flow Indicates that the flow in one of the recirculating loops, read by the flowmeter, is below 1 Gpm. The chiller is not designed to run at this low of flow rate. There is a short delay from the START to allow the pipes to prime and the flowmeter to respond.

Tank Too Hot Indicates that the recirculating temperature is more than 10°C above the highest allowable setpoint of +35°C (95°F). The microprocessor shuts down the system at +45°C (113°F) output temperature.

Low AC Line Indicates a low voltage condition exists on the input AC line and the system has shut down. See VAC on Test Panel 4 for current reading.

AC Power Fault Indicates that the 3-Phase Line Monitor has tripped due to power fluctuations beyond the allowable limits.

Freon Low If the suction pressure is below a normal operating range for more than 60 seconds, this alarm will indicate the chiller has likely developed a refrigeration leak and has a low 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. A message of "RTD open#_" denotes the faulty RTD number. The RTD must be replaced for the system to operate again. For a new RTD, order Mydax part number 03-4186-01175. A message of "RTD open#PS" indicates a problem with the Pressure Transducer (PT1).

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 1	--- MYDAX ---	Local Set
82.1°F	4.3 Gpm	82.0°F

This display shows the actual Loop 1 Output (RT4) and Setpoint Temperatures in °F, along with the Loop 1 recirculating flow rate. Also indicates that the LOCAL SET temperature mode is enabled. Pressing either the up or down ARROW key will toggle the Main Display to Loop 2 data.

Tank 2	--- MYDAX ---	Local Set
81.8°F	5.4 Gpm	82.0°F

This display shows the actual Loop 2 Input (RT6) and Setpoint Temperatures in °F, along with the Loop 2 recirculating flow rate. Pressing either the up or down ARROW key will toggle the Main Display back to Loop 1 data. **Actual and setpoint temperatures in the Main Displays for both loops of this system are read in °F. All temperatures on all other displays are read in °C.**

Diagnostic messages are displayed on the main LCD. Test Panel 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	16	10	10	12	Htr	4	6
Avg Valve	3	0	15	8	Htr	2	4

Numbers represent the drive signals for the evaporator 1, evaporator 2, bypass and superheat valves and tank heaters. The range for the valve drives is 0 (minimum) to 40 (maximum drive). The range for the heater drives is 0 to 20. Each digit represents 2.5% of the available 24VDC drive voltage. Avg Valve shows a 32-second running average of the valve or heater drive, displayed above it.

TEST PANEL 2

-5.0°	-21.4°	43.6	9.9°	10.0°	34.8°
Limit	Suct	Psia	SupHt	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 = Superheat Temp SHavg = Superheat Average 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 +50°C.

TEST PANEL 3

0822	0715	0000 Z	0.00	G 51.95	11.8
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 (0.1% tolerance or better, representing ideal nominal RTD's) are used as a reference.

TEST PANEL 4

+0.432	+0.540	+1.704	+ 25.71	0	255
Ext 1	Ext 2	Ext 3	VAC		Secs

This display shows auxiliary voltmeter readings of Ext 1, Ext 2 and Ext 3. Ext 1 is the voltage coming from the Loop 1 flowmeter, where **1V = 10 Gpm**. Ext 2 is the voltage from the Loop 2 flowmeter. Ext 3 is the input from the refrigerant pressure transducer. 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

27.75	27.7	- 0.2	27.75	27.7	+ 0.4
Tank1	Set1	DgMin	Tank2	Set2	DgMin

The left half of this diagnostic shows the Loop 1 Output temperature (RT4), the Loop 1 Setpoint temperature, and the Output temperature slope in °C. Slope is a measure of the direction and amount of the Loop 1 output temperature change per 60 seconds (DgMin).

The right half of this diagnostic shows the Loop 2 Input temperature (RT6), the Loop 2 Setpoint temperature, and the Input temperature slope in °C. For Loop 2, slope is a measure of the direction and amount of the input temperature change per 60 seconds (DgMin).

TEST PANEL 6 Identical to Test Panel 5

TEST PANEL 7

45.1		R507	5.00	0
Crankcase			Bat. OK	

This diagnostic shows the compressor crankcase RTD (RT9) temperature in °C. The system is programmed to prevent the compressor from running until the crankcase is warmed up to +28°C. This allows the refrigerant to separate from the cold oil and helps prevent damage to the compressor. The refrigerant type (R507) is shown.

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:	No Alarms
KEY	Run 2d 23:42:37

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	19.90	20.0	No Alarms.....		
Tank 1	4Ev	4By	37Cd	42Sh	0SA 4.0 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 which recirculating channel was last selected at the Main Display, the evaporator, bypass, condenser and discharge RTD temperatures in °C, and the flow rate in Gpm. Both the evaporator temperature and the flow rate are specific to the recirculating channel being viewed. 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.

A second level of Test Panels (11-19) are available for additional diagnostic information. Test Panel 19 contains information which may be very useful.

TEST PANEL 19

Interlock	A1	A2	A3	A4	B1	B2	B3	B4
	OK	OK	OK	OK	OK	OK	OK	OK

To access Test Panel 19, press the TEST button in rapid succession three times, once you see the X1: display (Test Panel 11), press the 9 key to get to Test Panel 19. Refer to drawing D3114, the system electrical schematic. This test panel is provided to show the status of the interlock switches capable of shutting the system down. On this specific system, the switch assignment is as follows:

Interlock	Interlock Device	Location
A1	Pump 1 Over-Current Relay	OL1 in Electrical Enclosure
A2	Pump 2 Over-Current Relay	OL2 in Electrical Enclosure
A3	3-Phase Line Monitor	LM1 in Electrical Enclosure
A4	Pump 1 Over-Pressure Switch	S7 in Chiller Cabinet
B1	Refrigerant High Pressure Switch	S2 in Chiller Cabinet, Near Receiver
B2	Tank 1 Empty Switch	S5 in Chiller at Tank 1 Lid
B3	Tank 1 / Loop 2 Over-Temp Switches	S3 at Tank 1 Lid / S9 at Loop 2 Heater Module
B4	Pump 2 Over-Pressure Switch	S8 in Chiller Cabinet

Refer to the system fluid and electrical schematics for more technical information. Contact Mydax service department in the case of repeated or unknown problems.

SERVICE and 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

Email: service@mydax.com

FAX: 530-888-0962

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 extended service contracts. Please call at least 3 months prior to the expiration of this warranty for details.

Customer Name: **Sub-Zero Freezer Co.**

Unit Model Number: **2M8A**

Warranty Start Date: **Refer to Invoice**

Unit Serial Number: **120-0862**

Warranty expires 12 months from above date.



MYDAX CUSTOMER SERVICE CONTACT INFORMATION

Phone: 530-888-6662

Address: 12260 Shale Ridge Lane

Fax: 530-888-0962

Auburn, California 95602

service@mydax.com

www.mydax.com

RE-SHIPPING and LONG-TERM STORAGE PREPARATION

Re-shipped 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 an **air-cooled** refrigeration condenser. The following instructions apply to shipment or long-term storage preparation:

- 1) 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.
- 2) Plug all recirculating and drain fittings to avoid leakage of any residual coolant during shipment or storage.

**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 - RS-232 Serial Interface Operation

RS-232C INTERFACING

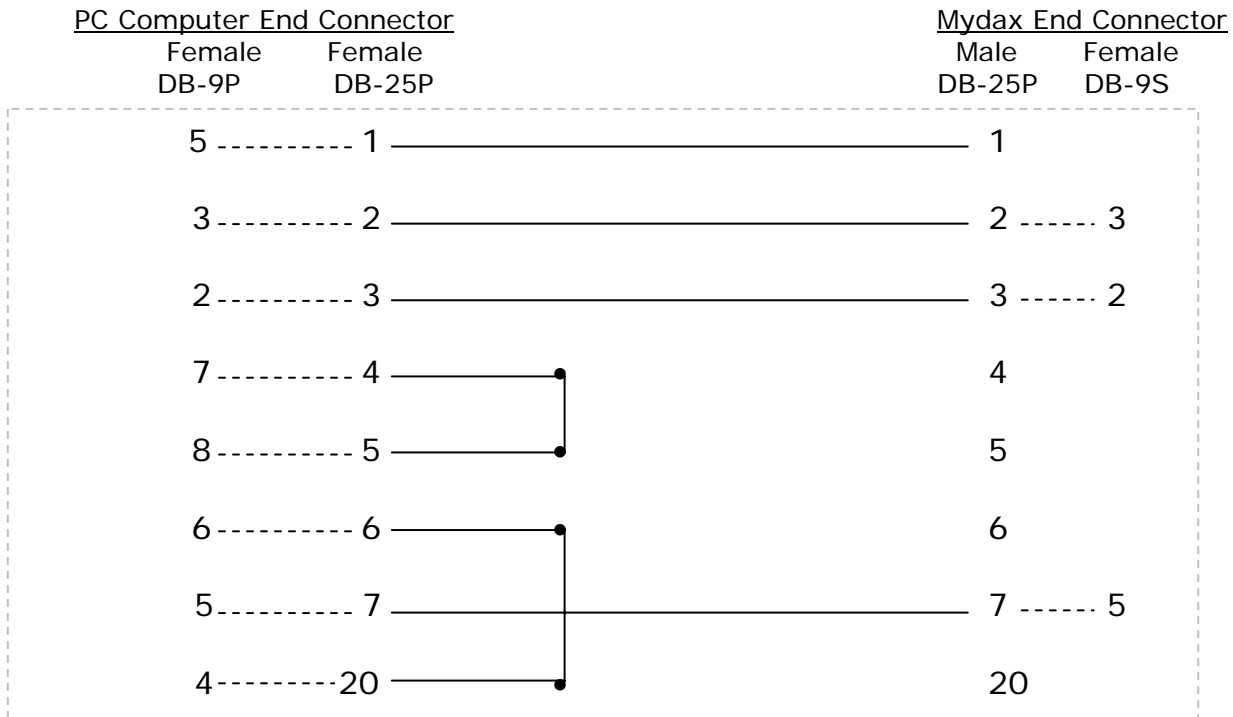
The use of an embedded microprocessor allows Mydax to offer an RS-232C (remote) interfacing capability. Mydax systems can be controlled from a computer with either the *MYDAX REMOTE* Window's™ software package or any control software of the user's choice. Full control and monitoring is possible, allowing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

Set up the computer's com port for 9600 baud, Data Bits=8, Parity=None, Stop Bits=1. Choose No handshaking or set Flow Control to *None* (uncheck the "Use Flow Control" box on Windows XP).

The connector on the rear panel of the chiller pin-out is as follows:

	DB-9P or Male	DB-25S Female
Shield		Pin 1
Transmit Data	Pin 3	Pin 2
Receive Data	Pin 2	Pin 3
Common	Pin 5	Pin 7

A typical interconnect cable for a 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.
V?xxx	Sets Pump's VFD Speed of tank "?" A, B or C. Settings outside the range default to the nearest limit. "xxx" is a number 0 to 100 specifying the percent of drive. For example: "SA100" selects 100% for tank A, "SA68" select 68% for tank A, "SB50" selects 50% for tank B. Configuration settings of the VFD may prevent that drive from being set below a minimum frequency.
DVxxx	Only available on certain custom models. Sets Diverter Valve (bypass flow valve) to a position value "xxx", a number 0 to 100 specifying the percentage open to external flow. Settings outside the range default to the nearest limit. For example: "DV100" selects 100% open, "DV25" selects 25% open (75% flow to bypass).
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.
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, and flow rate.
TE6	Sends transmission of custom values. This may be used for miscellaneous values on various custom chillers. For example may transmit the reading from the differential pressure transducer in psid.
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**, **TE4**, and **TE6** 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: 1VLH30W 2007.02.15"
- AL** Causes transmission of the alarm status. For example:
"ALARM: 0 0000000" denotes no alarm condition.
- AH** Causes transmission of the alarm history status. For example:
"ALHIS: 4 00100000" denotes one alarm.
- This history is the same as the Test display #8 followed by the Interlock information as displayed on Test display #19. 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

Mydax, Inc.

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

ON 19.9 20 -63 3 41 34 102 44 23 22 0 2 2 0 4 10 8 9 75 5 21 0
(CR)(LF)
A B C D E F G H I J K L1 L2 L3 L4 L5 M1 M2 N O P Q R

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 00010000 (CR)(LF)
U V W X

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

STOP: KEY (CR)(LF)
Y Z

Key: A) System is ON or OFF

B) Actual Tank (Pump) Output Temperature in °C, as sensed by the Output RTD

C) Set point Temperature in °C

D) Calculated temperature in °C of the refrigerant line at the suction pressure transducer

E) Pressure in PSIA 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 only)

I) Temperature in °C of the crankcase RTD

J & K) Temperature in °C of the INPUT (Return) RTD and the optional Secondary Heat Exchanger Output (Rt6)

L1 & L2) Valve drives of evaporator valves 1 and 2; valve 2 is inactive in single channel systems (See "DIAGNOSTIC DISPLAYS, Test Panel 1" for explanation).

L3, L4, & L5) Bypass, Superheat, and Desuperheat valve drives. Desuperheat is used on 2-stage compressor designs only.

M1 & M2) Heater drive signals; Heater 2 is inactive in single channel systems (See "DIAGNOSTIC DISPLAYS, Test Panel 1" for explanation of drive signals.)

N) Flow rate in gallons-per-minute(GPM) of recirculation fluid. On systems without a flow meter, this number has no meaning.

Mydax, Inc.

O) Reading of differential pressure transducer in psid. Only available on some very custom systems.

P & Q) Flow rate in gallons-per-minute(GPM) and temperature (°C) of condenser cooling water. Not available on all systems.

R) Any active alarms, by code # (See the next section for a description of alarm codes.)

V &, W) Actual code(s) # for the alarm. See Alarm Codes in next page.

X) The last item in the Alarm sequence is an 8-bit output representation of the Interlock register [A1, A2, A3, A4, B0, B1, B2, B3, B4]. See "DIAGNOSTIC DISPLAYS, Test Panel #19" for more details. Also refer to the unit's electrical schematic for more information (not available on all systems).

Y) Stop is displayed whenever the system is halted.

Z) 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. Custom systems may have different meanings. Consult the factory for clarification if necessary.

- 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 FREON LOW:** Indicates pressure of refrigerant is low. Have unit serviced by Mydax or a qualified service center.
- 3 OPEN RTD:** 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 AC POWER FAULT:** Indicates the 3-Phase Line Monitor (SSAC) has tripped due to power fluctuations beyond the allowable limits. System shuts down.

Mydax, Inc.

- 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 FILL TANK #3 or NITROGEN PRESS?:** The tank 3 low level sensor has tripped. If coolant is not added "soon", the "empty" sensor trips and the system shuts down. On Systems with a Nitrogen Pressure Switch, this is mapped to the appropriate alarm indicating that a predetermined pressure, usually for the HTF reservoir or solenoid valves, is required.
- 10 DISCHARGE HOT or PHASE MISSING:** Indicates Compressor discharge temperature exceeds allowable limits. See Test Panel #2. 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 TEST ALARM:** This is sent when the MUTE ALARM button is pressed.
- 13 LOW AC LINE:** Indicates a low voltage condition exists on the input AC line.
- 14 RESISTANCE LOW or TEMP OUT OF TOL:** Indicates that the deionized water resistivity has dropped below the programmed limit or the fluid temperature has exceeded the allowable tolerance band.
- 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.

Version 2000.06.19

Major revision update.

Version 2004.01.27

Added M1011 Interlock Alarm bit pattern to AL and AH.

Version 2006.10.30

See addendum for standard 2-channel TE4 output string

Version: 2007.01.24

Added Condenser water's facilities flow rate and temperature.

Added secondary heat exchanger temperature.

Version: 2007.02.21

Added VA/B/C commands for VFD Speed.

Added DV command for Diverter Valve rotation setting.

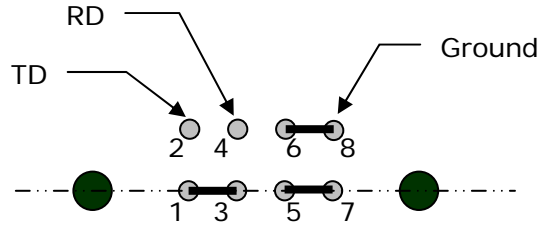
Added TE6 status line for PSID and added PSID value to TE4 after recirculation flow GPM.

Updated list of alarm codes for most relevant systems.

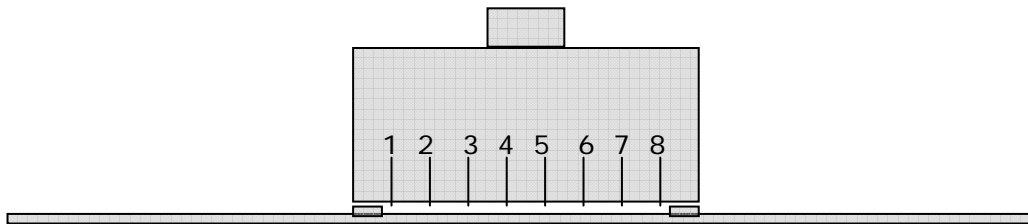
Version: 2007.06.01

Updated DB25 and DB9 connectivity table, page 1.

Mydax 8-Pin Modular Phone Jack to PC Connectivity



PC Board Component-Side
(Top View)



8-Pin PC-Mount Modular Jack
(Front View)

8-Pin Modular Phone Jack	DB25 pins at PC	DB9 pins at PC	Wire color to pin assignment of Reverse Style IDC Modular Cable and RJ-45 Jack with DB9/25 Hood
2 (TD)	3 (RD)	2 (RD)	Orange
4 (RD)	2 (TD)	3 (TD)	Red
6,8 (Ground)	1,7 (Ground)	5 (Ground)	Yellow, White(Grey)
1,3 (interconnect)	20,6,8 (DTR,DSR,CD*)	4,6,1 (DTR,DSR,CD*)	Blue, Black
5,7 (interconnect)	4,5 (RTS,CTS)	7,8 (RTS,CTS)	Green, Brown

* Connection of CD is not required in most cases.

2M8A Parts List

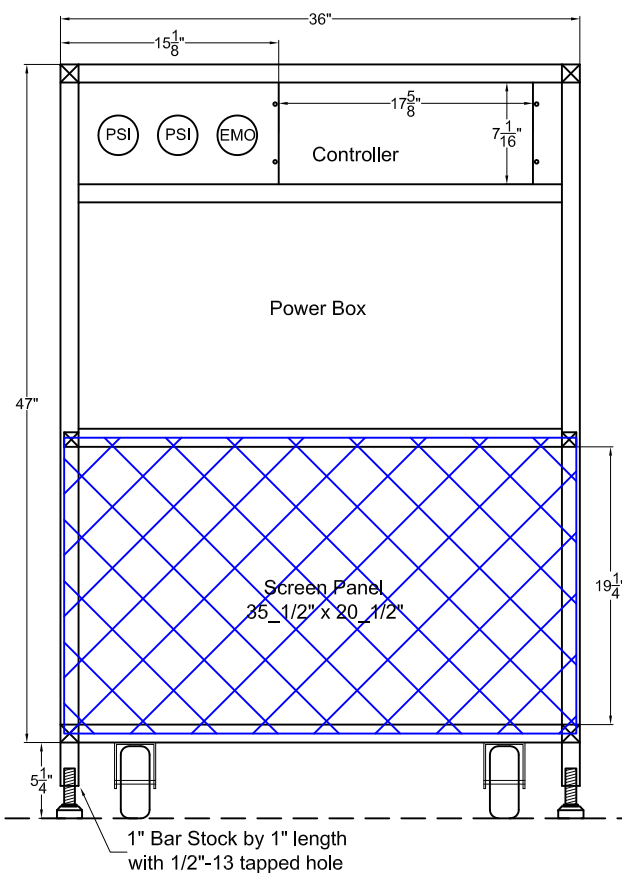
Reference	P/N	Qty	Title	Detail
CB1	03-4123-00692	1	Circuit Breaker, 3 Pole	40 AMP, 240 V
CB2	03-4123-00606	1	Circuit Breaker, 3 Pole	2 AMP, 480Y/277V, D-Curve
CND1	10-1100-12038-3	1	Condensing Package	3Hp, 220V 3ph, 60Hz
	10-1105-12110	10	R-507 Refrigerant	R-507 Refrigerant
CON1, CON2	03-4137-01916	2	Contacto, IEC	16A, 3 Pole, 24V 50/60Hz Coil
CON3	03-4137-00824	1	Contacto, DP	30A, 3 Pole, 24 V Coil
DB1	03-4180-01148	1	Connector, Adapter, RS-232	DB25S to RJ45
EMI1	00-3050-00002	1	Filter EMI	1A
EV1	10-1142-14013	1	Valve, Expansion	AKV10-4
EV1, EV2, EV4, EV5	10-1142-14038	4	Valve Coil	24V, 14W, w/Junction Box
EV2, EV4, EV5	10-1142-14014	3	Valve, Expansion	AKV10-5
FG1	10-1121-12218	1	Sight Glass	1/2" ODF Solder
FL1, FL2	07-0803-09222	2	Y Strainer, Bronze, Dema	3/4"FPT, 40 Mesh, W.O.G. 400 PSI 150°F
FL3	10-1102-12050	1	Filter Dryer, 2 Ton, Liquid	1/2"Soc, 6.00" x 3.00" dia
FM1, FM2	07-0802-08440	2	Flowmeter, Paddlewheel	Brass, 1/2", 1.5-12 GPM, 1 PSI
HE1, HE2, HE3	10-1110-11895	3	Heat Exchanger	B8X10 (4 X 7/8" Soc.)
HT1, HT2	07-0825-09229	2	Heater	2000W, 208V, 3Ph, 2" Pins, 1" NoHeat, 3/4" X 10"
HT3	10-1100-11903	1	Crankcase Heater	PTC Maneurop
HT4	10-1101-12016	1	Crankcase Heater	208 VAC, 58W, Wrap Around
L1	03-4160-00952	1	Indicator Lamp, Panel Mount	5/16" dia., Green LED, 5VDC
LM1	03-4102-01220	1	SSAC Line Monitor	3PH, DPST, 200-480V
LM1-S, TM1-S	03-4177-01136	2	Relay Socket	8 Pin Octal, 600V
OL1, OL2	03-4169-00816	2	Motor Starter, Overload Relay	600V, 3.2-16A Solid State
PCB1	89-1001-00002	1	M1001 Controller Board	DIP SW 3 INPUT
PCB2	89-1002-00007	1	M1002 RTD Board	+5VDC Terminal Block 50 to 56
PCB3	89-1007-00000	1	M1007 LCD Supply Board	Standard
PCB4	89-1004-00001	1	M1004 Power Supply Board	V-Fan Added, Header
PCB5, PCB6	89-1011-00000	2	M1011 Interlock Board	Standard
PCB7	89-1010-00045	1	M1010 Interface Board	PSIA Lo/1/2" Hoffer/Relay
PI1, PI2	07-0800-09050	2	Pressure Gauge, Liquid Filled	100 PSI 1/4"NPT CBM 2-1/2"Dia
PL1	03-4171-01035	1	Connector CPC Plug	9 Pin Size 13
PL2, PL3, PL4	03-4171-00625	3	Connector CPC Plug	4 Pin Size 11
PMP1, PMP2	08-0090-01005	2	Pump, Turbine, Canned	SS, 1HP, 3PH, 208/460V, -70C
PT1	10-1117-12110	1	Pressure Transducer, PSIA	mV Output, 300PSIA, 1/8-27 NPT, 2' Cable
RE1	03-4171-01040	1	Connector CPC Receptacle	9 Pin Size 13 Square Flange
RE2, RE3, RE4	03-4171-00628	3	Connector CPC Receptacle	4 Pin Size 11 Free Hanging
RL1	03-4175-01030	1	Relay, Clear, Socket Mount	3PDT, 24VAC
RL1-S	03-4175-01031	1	Relay Socket	11 Pin Double Tier
RT2 - RT4, RT6, RT7, RT9	03-4186-01175	6	RTD Thermalogic	Platinum 100 ohm 0.1%(±0.25°C), 1/8" x 2"
S1	03-4140-00884	1	Switch, Pushbutton, TW Series	N.O. Momentary Contact, B, R, G
S2	10-1111-12035	1	Switch, Pressure	NC, 375 PSI, Open on Rise
S3, S9	03-4140-04180	1	Switch, Over Temp.	180°F, .187 Quick
S4, S5	03-4140-03120	2	Switch, Float	Brass with 316 SS Float
S6-1, 2	03-4140-00834	1	Switch, EMO	1 NC Contact Block + Collar
S6-G	03-4140-00842	1	Switch, EMO	Guard
S6-P	03-4140-00848	1	Switch, EMO	Push-button, Twist Unlock
S7, S8	10-1111-12045	2	Switch, Pressure	10-150 PSI, SPDT
SSR1 - SSR4	03-4175-01080	4	Relay, SSR	12->280VAC, 5A, DIN Rail
SSR5 - SSR8	03-4175-01082	4	Relay SS	240V, 40A
T1	03-4197-01446	1	Transformer, Control Power	208V, 24V, 150VA

2M8A Parts List

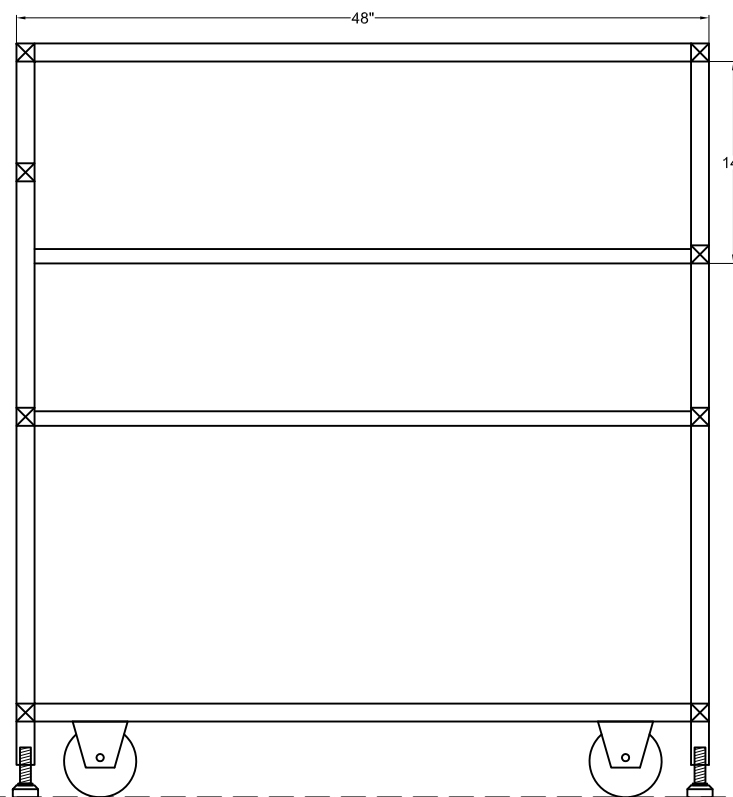
Reference	P/N	Qty	Title	Detail
TK1	07-0879-09011	1	SS Tank	5 GAL D2570-C
TK1-F	12-1330-14164	1	S/S Nipple	3/4" MPT x 4"
TK1-FC	07-0850-09450	1	Polypro Tank Cap	3/4"
TK1-S	07-0888-09576	1	Suction Screen	3/4"MPT, 20 Mesh
TK1-VC	07-0850-09446	1	Polypro Vent Cap	1/4" FPT 62164
TK3	10-1125-12232	1	Suction Accumulator	5" dia. x 13", 7/8" Soc. S-3738
TM1	03-4103-00507	1	Relay, Delay Timer	Delay on Make
V1	07-0880-05189	1	Valve, Globe, 90°, Bronze	1/2"FPT
VI1	10-1115-12176	1	Packless Vibration Absorber	7/8"OD, UL Style P-8A
WH1-4	13-1455-15011	4	Caster, 5" Locking Swivel	PhenolicWheel,ZincRig,RlrBearing,Vert Brake
ZNR1	00-5800-00390	1	MOV 390V	390V
ZNR2	00-5800-00047	1	MOV 47V	47V



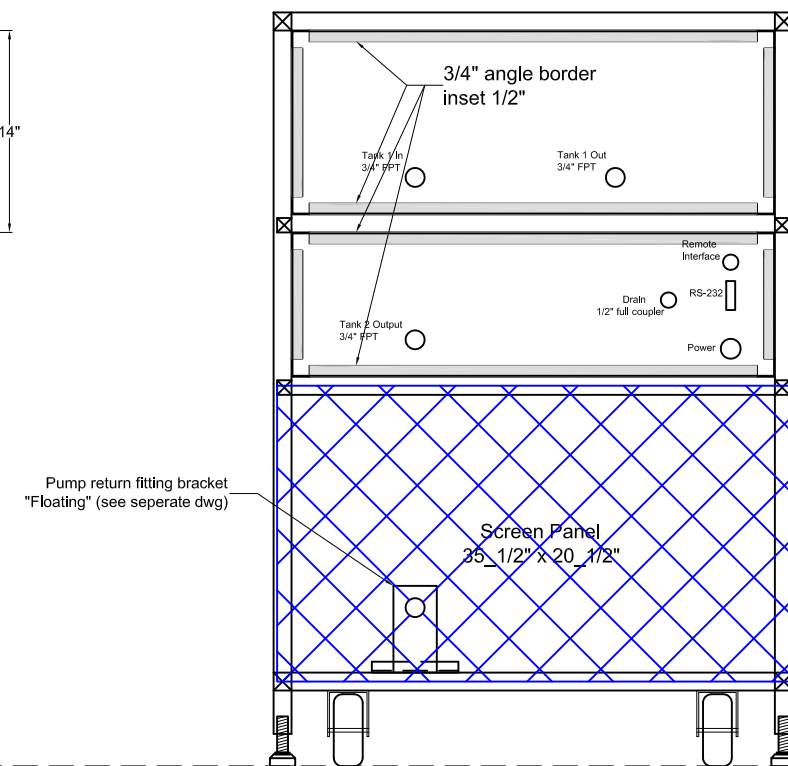
Top View



Front View



Right Side View



Rear View

Bulkhead panels are aluminum

Power box is 4 1/2" deep

NOTES: UNLESS OTHERWISE SPECIFIED

REV	DESCRIPTION	DWN	DATE

REVISIONS



Corporate Headquarters
12260 Shale Ridge Lane
Auburn, CA 95602

ALL DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

This drawing is the property of Mydax Inc. Reproduction of this drawing in any form, without the explicit consent of Mydax, is prohibited.

TITLE: SubZero 2M8A

DESCRIPTION: Frame

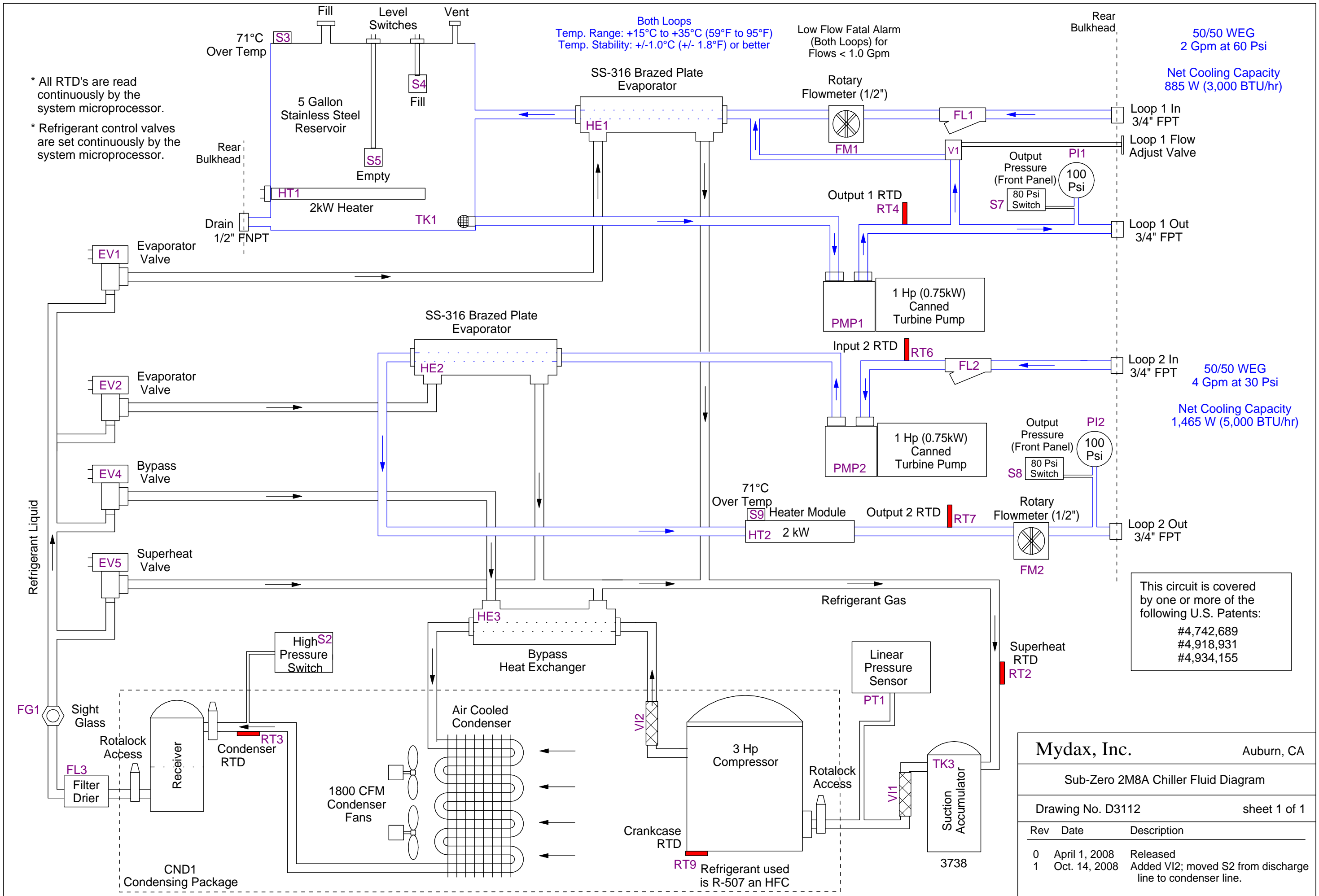
DATE: Jan. 21, 2008

STATUS: Released

DRAWING NUMBER: D3113

DRAWN BY: BH

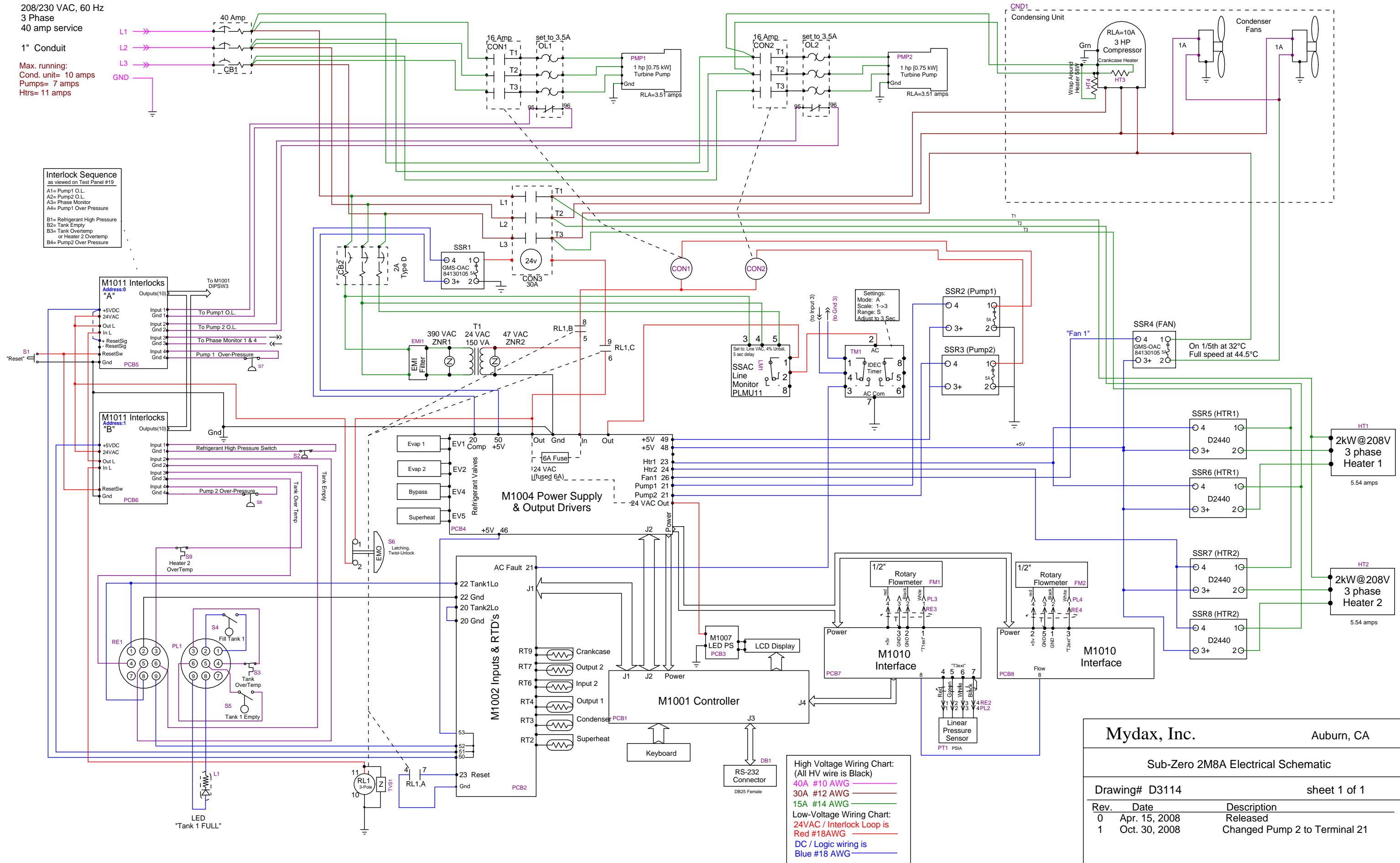
SHEET 1 OF 1



Mydax, Inc.		Auburn, CA
Sub-Zero 2M8A Chiller Fluid Diagram		
Drawing No. D3112		sheet 1 of 1
Rev	Date	Description
0	April 1, 2008	Released
1	Oct. 14, 2008	Added V12; moved S2 from discharge line to condenser line.

208/230 VAC, 60 Hz
 3 Phase
 40 amp service
 1" Conduit
 Max. running:
 Cond. unit= 10 amps
 Pumps= 7 amps
 Htrs= 11 amps

Interlock Sequence
 as viewed on Test Panel #19
 A1= Pump1 O.L.
 A2= Pump2 O.L.
 A3= Phase Monitor
 A4= Pump1 Over Pressure
 B1= Refrigerant High Pressure
 B2= Tank Empty
 B3= Tank Overtemp
 or Heater 2 Overtemp
 B4= Pump2 Over Pressure



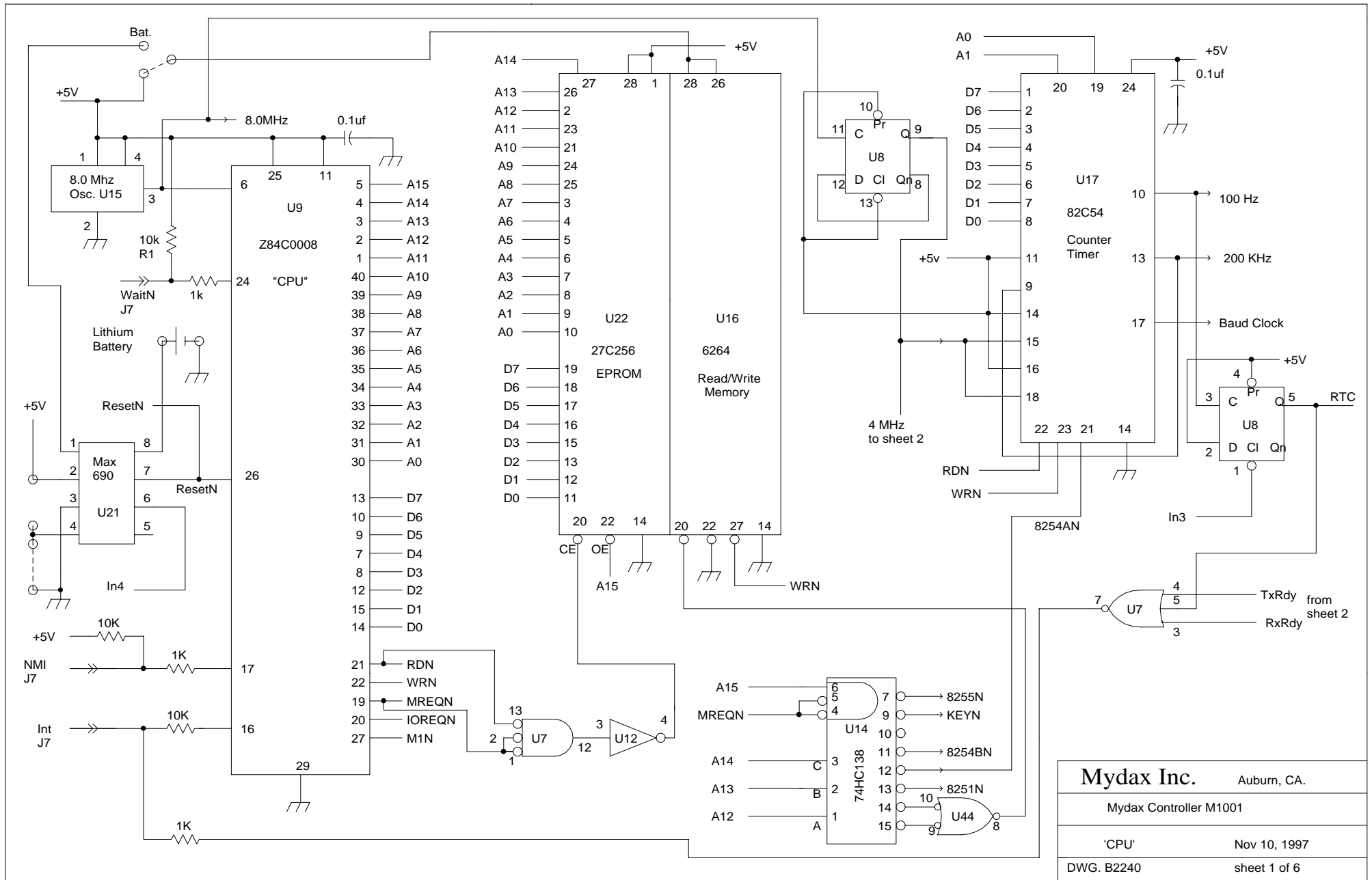
High Voltage Wiring Chart:
 (All HV wire is Black)
 40A #10 AWG
 30A #12 AWG
 15A #14 AWG
Low-Voltage Wiring Chart:
 24VAC / Interlock Loop is Red #18AWG
 DC / Logic wiring is Blue #18 AWG

Mydax, Inc. Auburn, CA

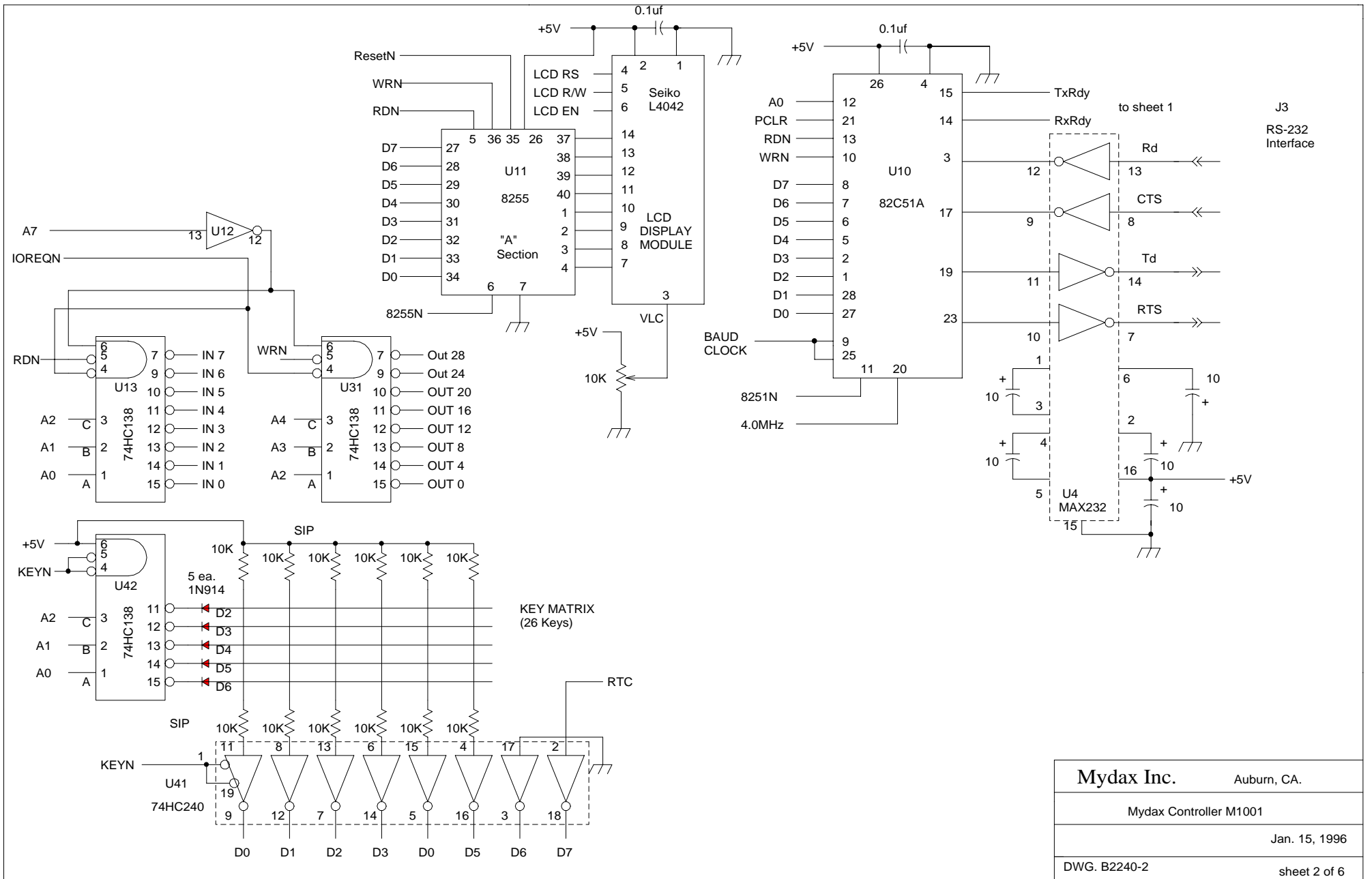
Sub-Zero 2M8A Electrical Schematic

Drawing# D3114 sheet 1 of 1

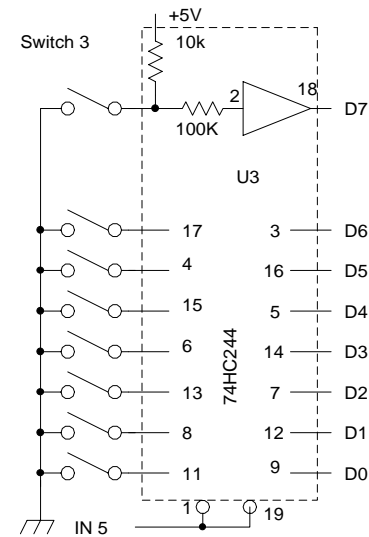
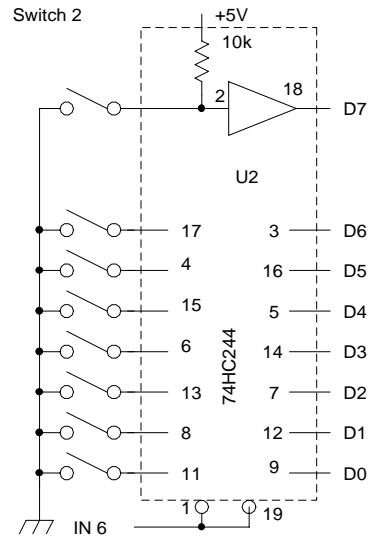
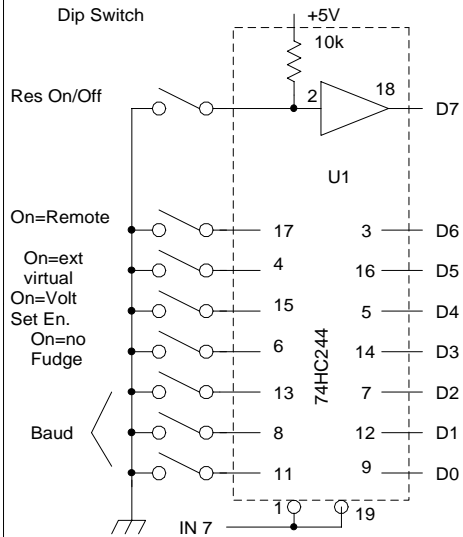
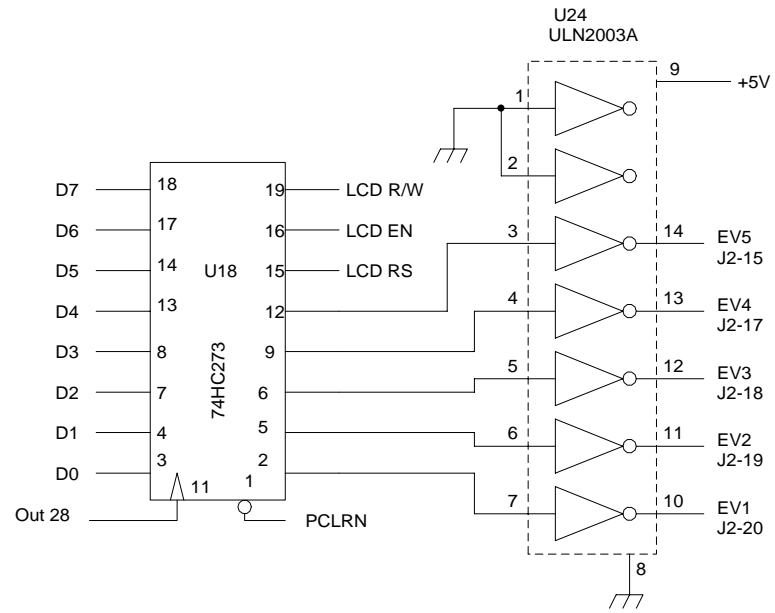
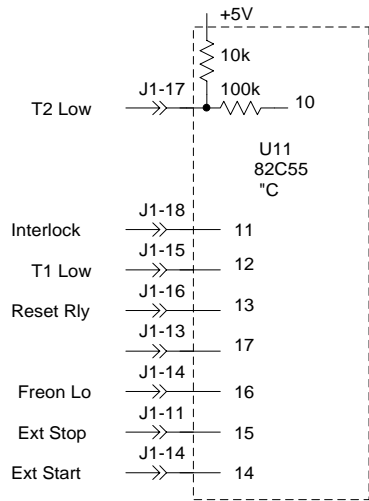
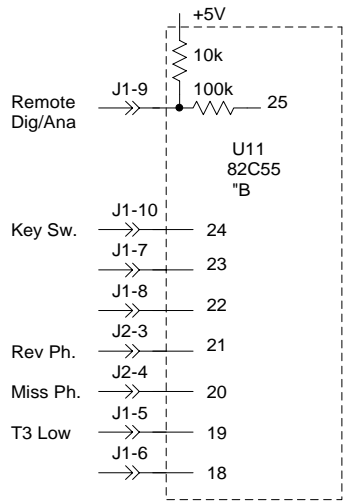
Rev.	Date	Description
0	Apr. 15, 2008	Released
1	Oct. 30, 2008	Changed Pump 2 to Terminal 21



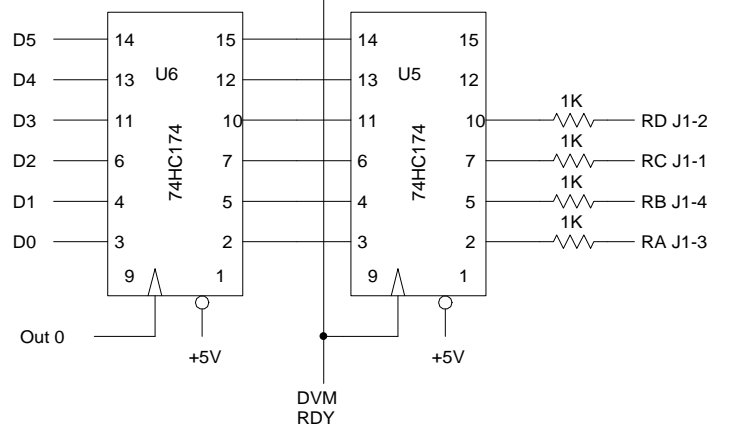
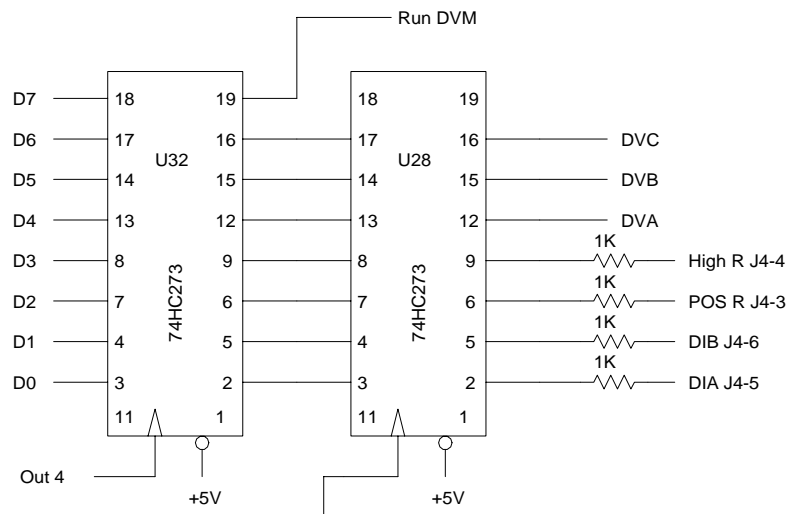
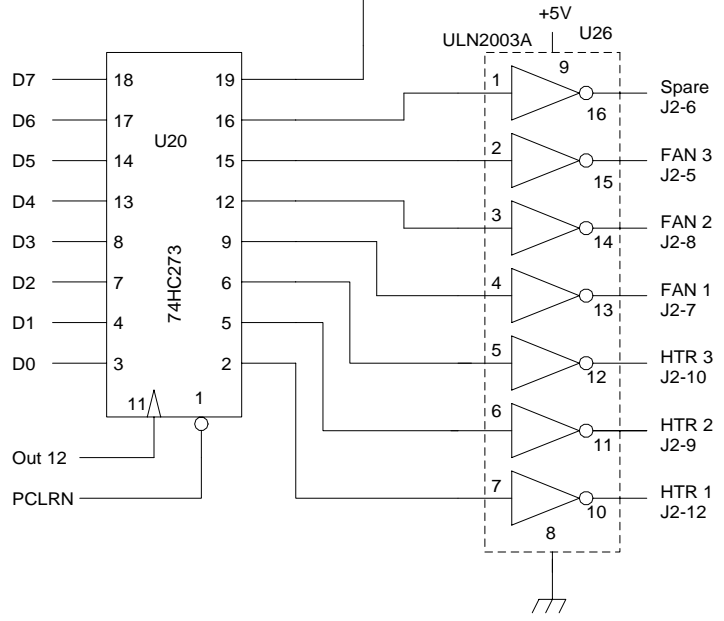
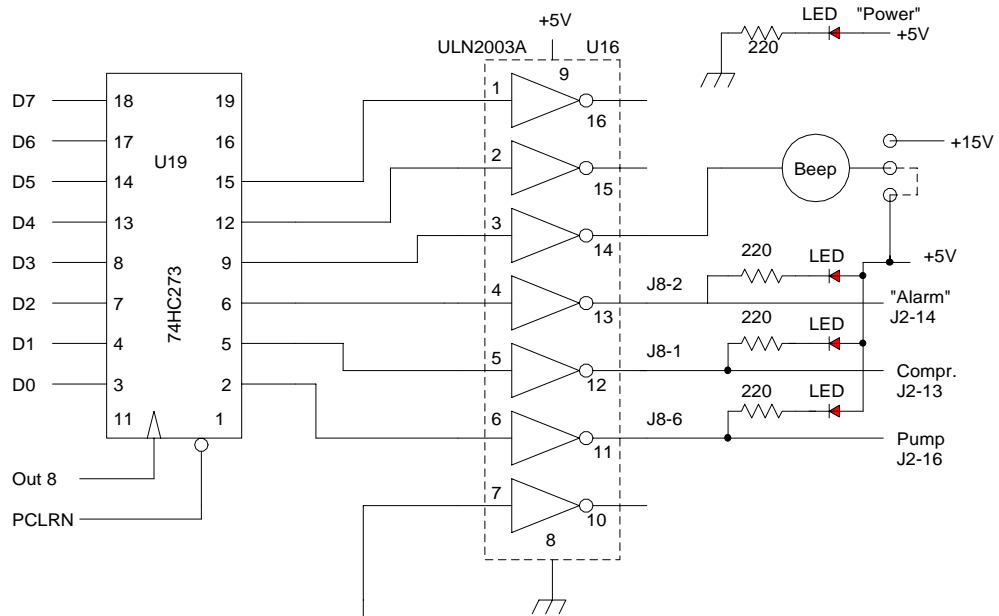
Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
'CPU'	Nov 10, 1997
DWG. B2240	sheet 1 of 6



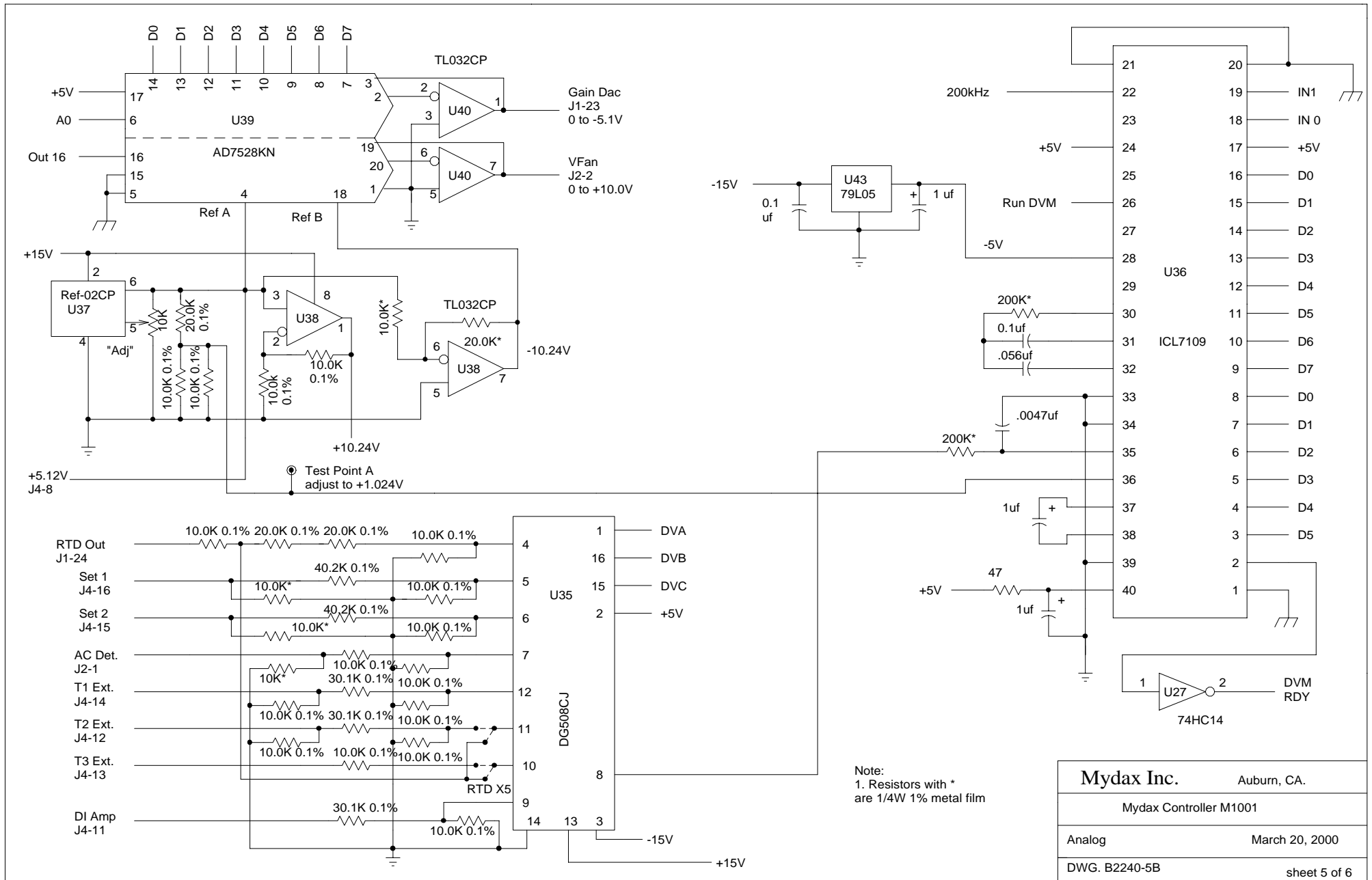
Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
Jan. 15, 1996	
DWG. B2240-2	sheet 2 of 6

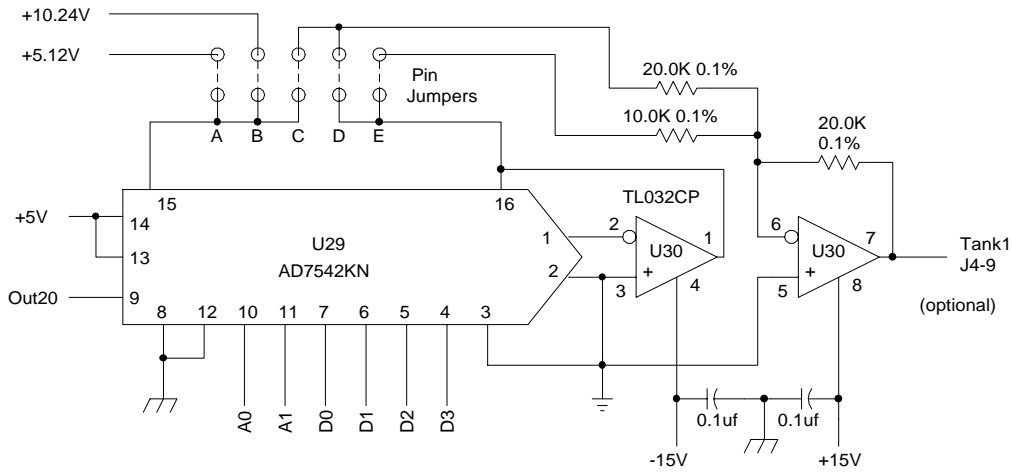


Mydax Inc.		Auburn, CA.
Mydax Controller M1001		
Input-Output	April 24, 1996	
DWG. B2240-3	sheet 3 of 6	

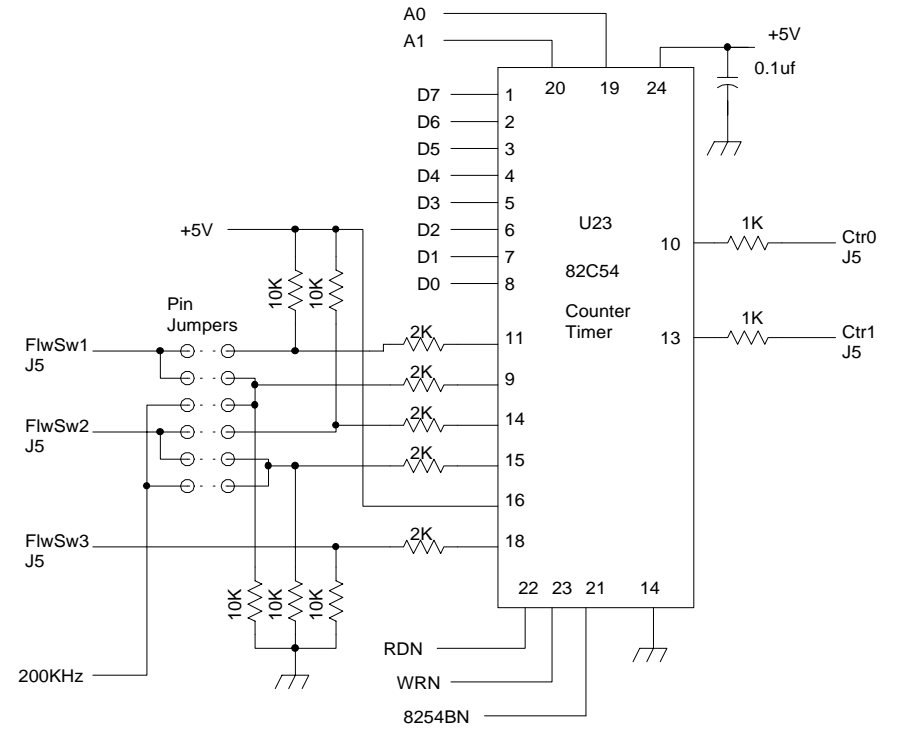
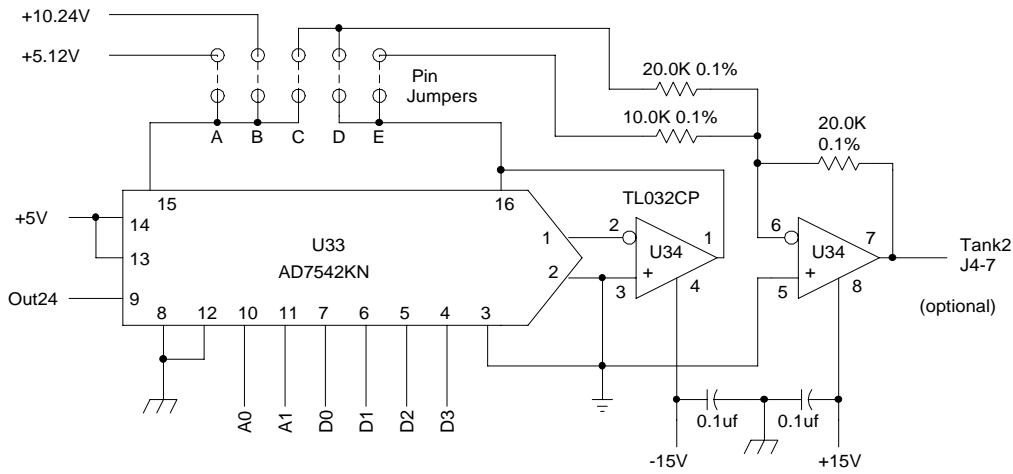


Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
Output	Dec 20, 1995
DWG. B2240-4	sheet 4 of 6

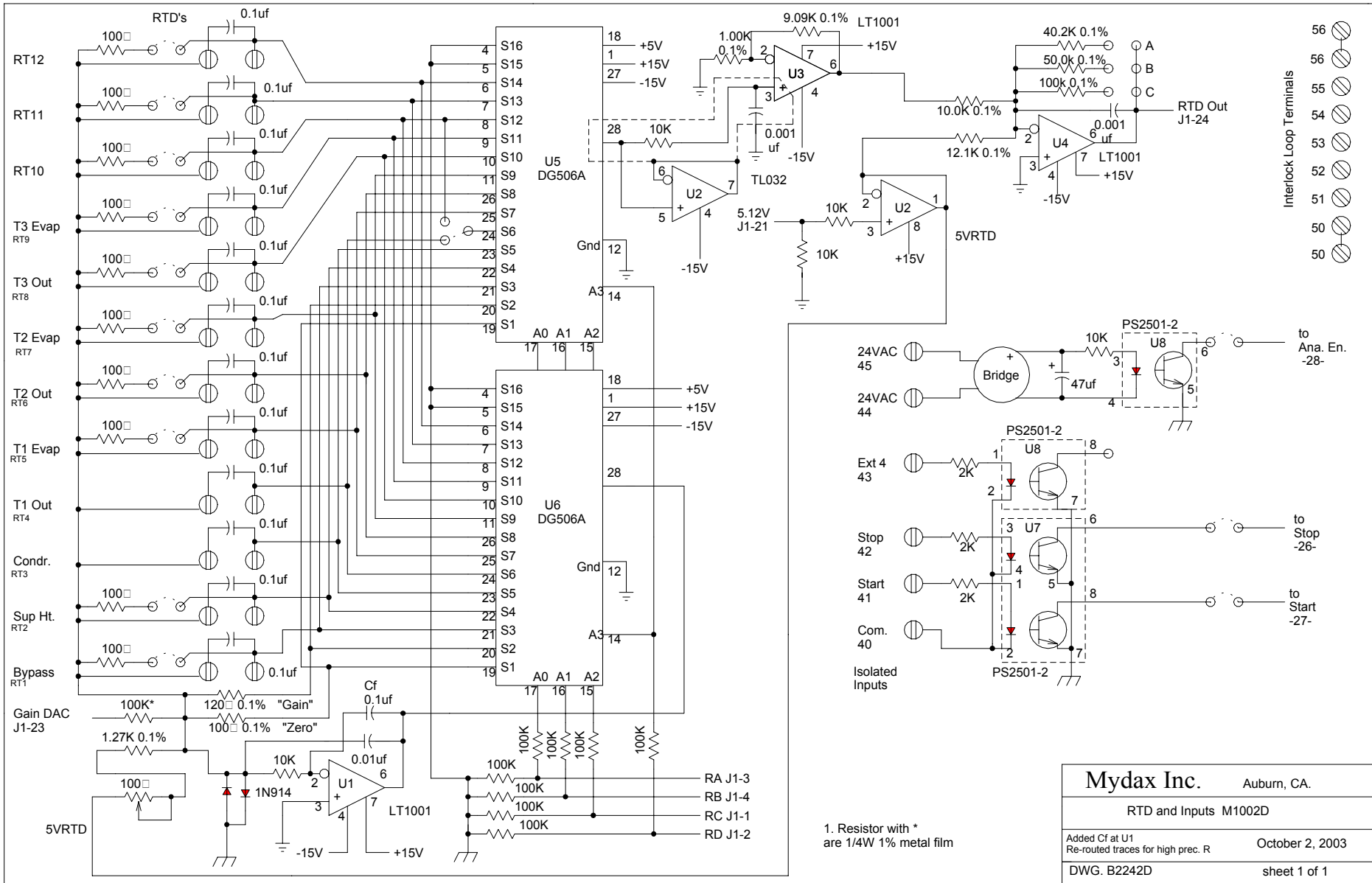




Range	A	B	C	D	E
+5.12V	on	-	-	on	-
+10.24V	-	on	-	on	-
+5.12V	on	-	on	-	on
+10.24V	-	on	on	-	on

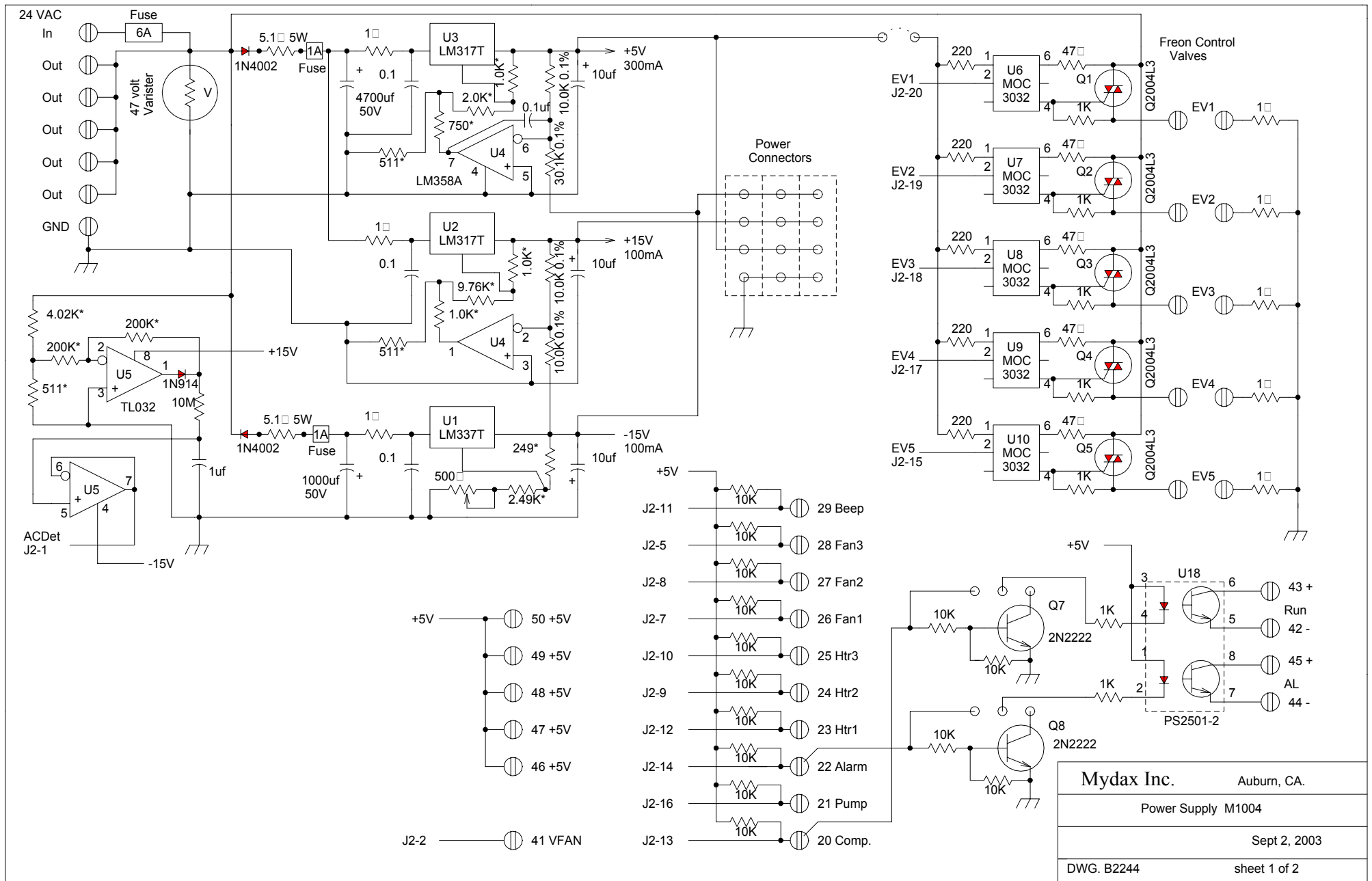


Mydax Inc.	Auburn, CA.
Mydax Controller M1001	
Optional	Jan. 15, 1996
DWG. B2240-6	sheet 6 of 6

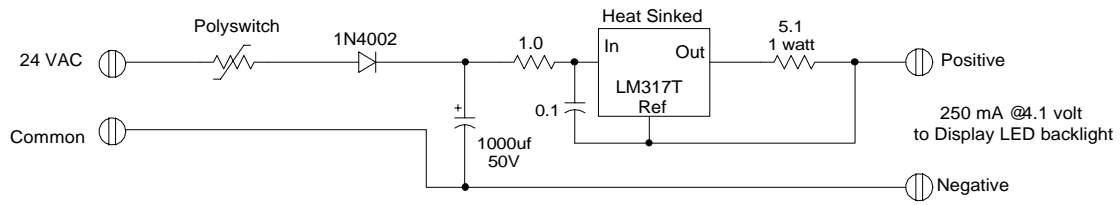


1. Resistor with *
are 1/4W 1% metal film

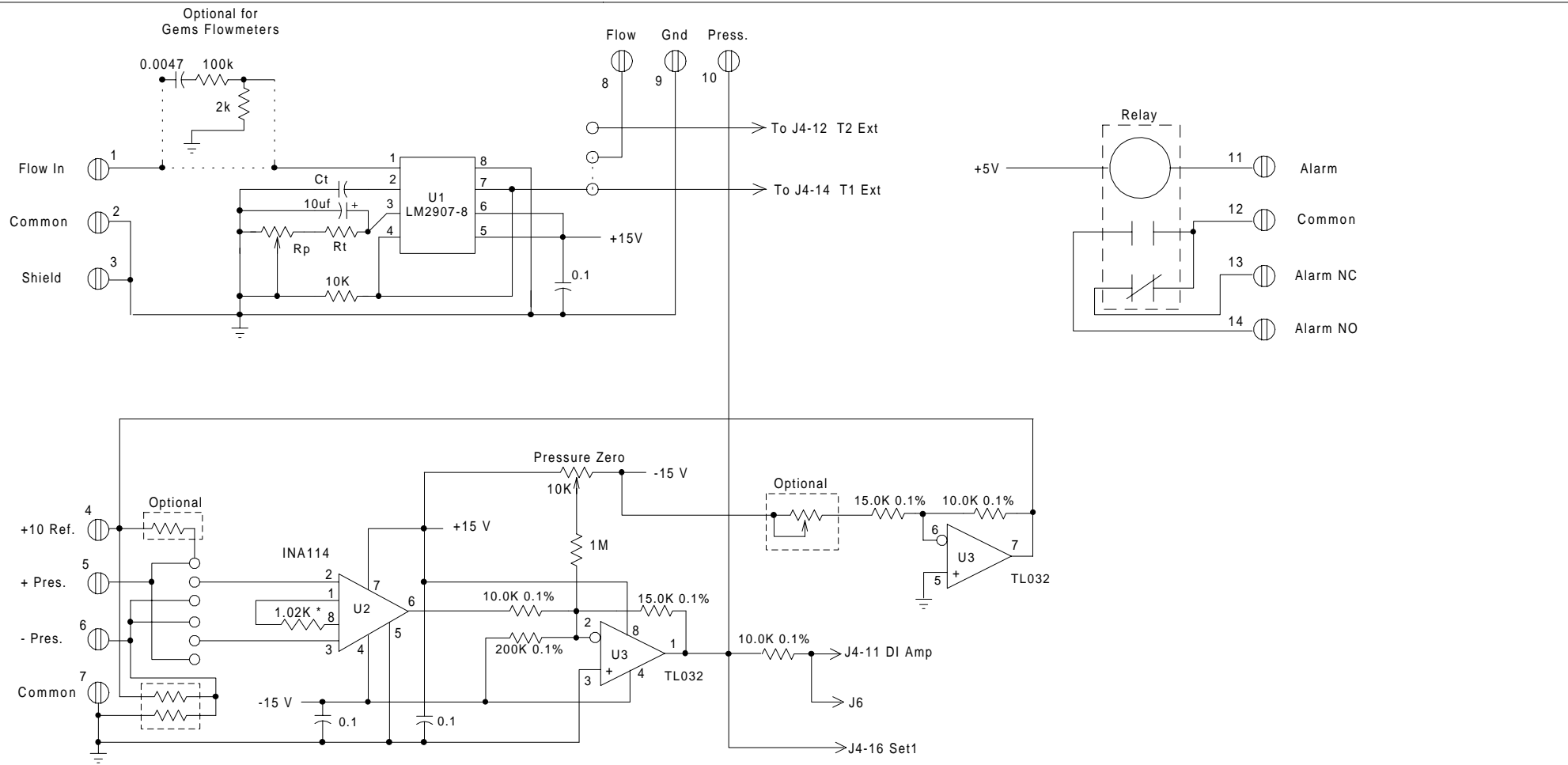
Mydax Inc.		Auburn, CA.
RTD and Inputs M1002D		
Added Cf at U1 Re-routed traces for high prec. R	October 2, 2003	
DWG. B2242D	sheet 1 of 1	



Mydax Inc.	Auburn, CA.
Power Supply M1004	
Sept 2, 2003	
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

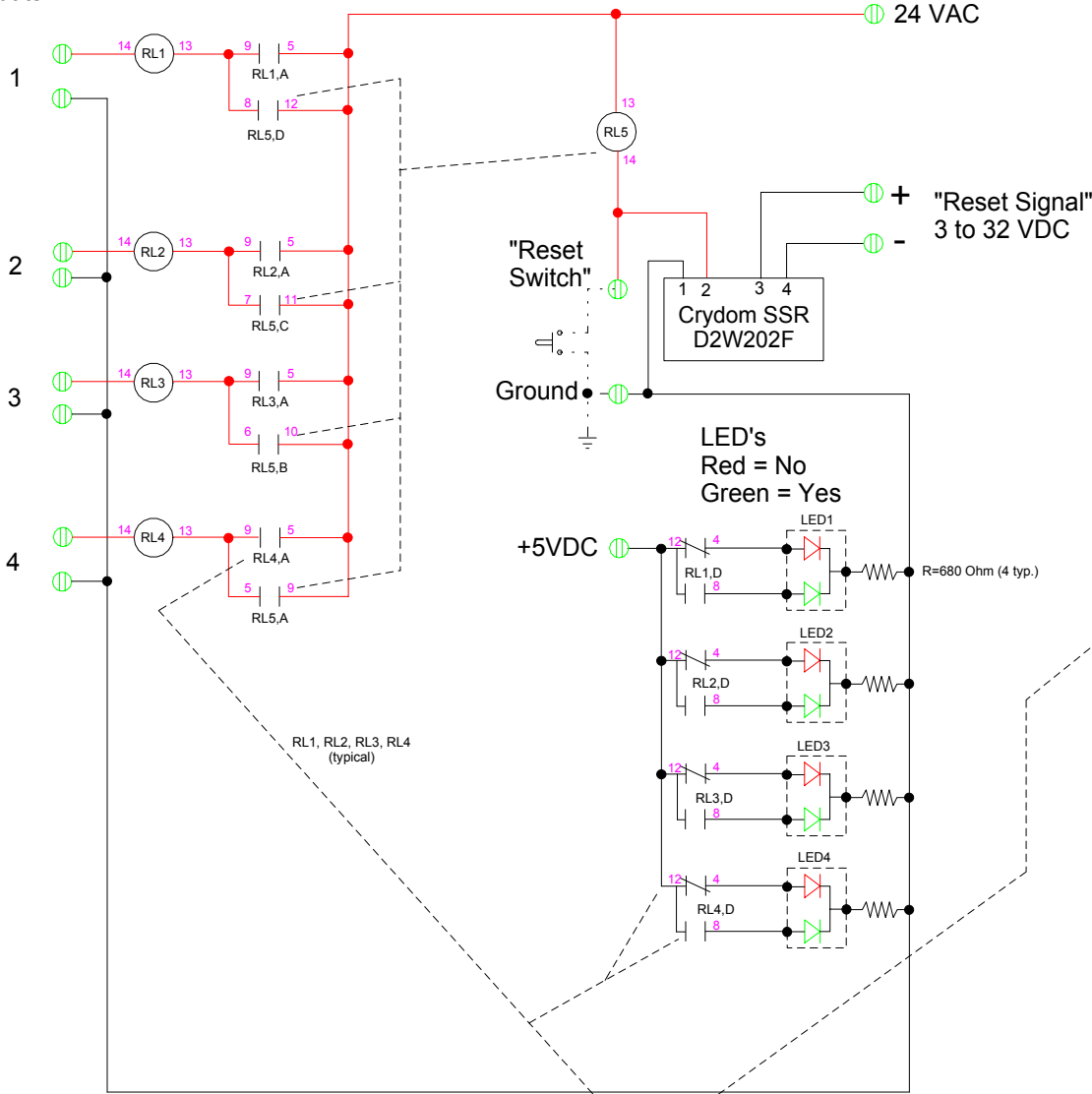
4. For Gems 1/2" Lo range,
 Rp= 20k, Rt=30.1k, Ct= 0.01uf
 100 Hz=0.595 V

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

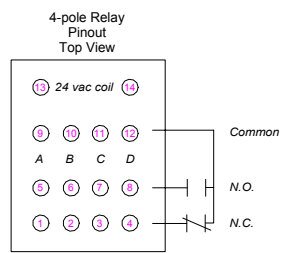
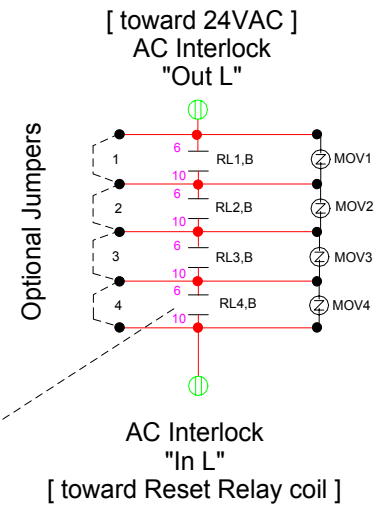
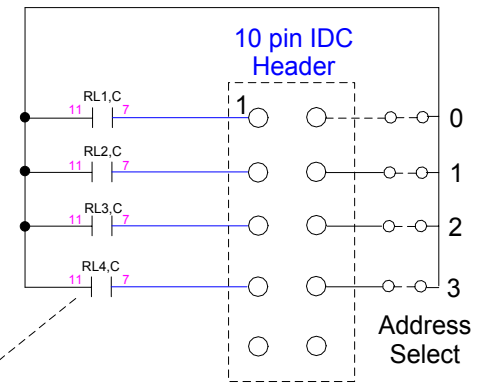
Mydax Inc.	Auburn, CA.
Interface M1010	
Jan 25, 2000	
DWG. D2616	sheet 1 of 1

Interlock Inputs



- Note:
1. Relays RL1-RL5 are Omron MY4-AC24, 4PDT, 3 Amp.
 2. Items are Phoenix screw terminals

Interlock Error Outputs



Mydax, Inc.	Auburn, CA
M1011 Interlock Board Schematic	
Drawing # D2919	Date: Nov. 7, 2002
Updated: May 17, 2004 ... added dotted lines.	

MSDS: Ethylene Glycol

VAN WATERS & ROGERS -- ETHYLENE GLYCOL (REGULAR) - ANTIFREEZE
 MATERIAL SAFETY DATA SHEET
 NSN: 6850006641399
 Manufacturer's CAGE: OSTM5
 Part No. Indicator: A
 Part Number/Trade Name: ETHYLENE GLYCOL (REGULAR)

 =====
 General Information
 =====

Item Name: ANTIFREEZE
 Company's Name: VAN WATERS AND ROGERS INC
 Company's Street: 6100 CARILLON POINT
 Company's City: KIRKLAND
 Company's State: WA
 Company's Country: US
 Company's Zip Code: 98033
 Company's Emerg Ph #: 206-889-3400
 Company's Info Ph #: 206-889-3400
 Distributor/Vendor # 1: CHEMICAL COMMODITIES AGENCY, INC.
 Distributor/Vendor # 1 Cage: 60777
 Record No. For Safety Entry: 002
 Tot Safety Entries This Stk#: 002
 Status: SE
 Date MSDS Prepared: 01JUL93
 Safety Data Review Date: 29APR96
 Supply Item Manager: CX
 MSDS Serial Number: BYRRR
 Specification Number: A-A-870
 Hazard Characteristic Code: N1
 Unit Of Issue: QT
 Unit Of Issue Container Qty: 1 CAN
 Type Of Container: CAN
 Net Unit Weight: UNKNOWN

 =====
 Ingredients/Identity Information
 =====

Proprietary: NO
 Ingredient: ETHYLENE GLYCOL (SARA 313) (CERCLA)
 Ingredient Sequence Number: 01
 Percent: >99
 NIOSH (RTECS) Number: KW2975000
 CAS Number: 107-21-1
 OSHA PEL: NOT ESTABLISHED
 ACGIH TLV: C 50 PPM,VAPOR; 9495
 Other Recommended Limit: NONE RECOMMENDED

 =====
 Physical/Chemical Characteristics
 =====

Appearance And Odor: COLORLESS LIQUID, PRACTICALLY ODORLESS.
 Boiling Point: 387F,197C
 Vapor Pressure (MM Hg/70 F): 0.12 @25C
 Vapor Density (Air=1): 2.14
 Specific Gravity: 1.1155
 Solubility In Water: COMPLETELY MISCIBLE.

 =====
 Fire and Explosion Hazard Data
 =====

Flash Point: 247F,119C
 Flash Point Method: SCC
 Lower Explosive Limit: 3.2
 Upper Explosive Limit: N/DETERMINED
 Extinguishing Media: WATER FOG, ALCOHOL FOAM, CO2, DRY CHEMICAL.
 Special Fire Fighting Proc: WEAR POSITIVE-PRESSURE, SELF-CONTAINED

BREATHING APPARATUS.

Unusual Fire And Expl Hazrds: NONE EXPECTED UNDER NORMAL STORAGE/HNDLG CONDITIONS(I.E. AMBIENT TEMPS).HOWEVER ETHYLENE GLYCOL OR SOLUTIONS OF ETHYLENE GLYCOL & WATER CAN FORM FLAMM (SUPPLEM)

Reactivity Data

Stability: YES

Cond To Avoid (Stability): WILL IGNITE IN AIR @775F.

Materials To Avoid: OXIDIZING MATERIAL.

Hazardous Decomp Products: BURNING PRODUCES NORMAL PRODUCTS OF COMBUSTION, SUCH AS CARBON MONOXIDE, CARBON DIOXIDE, & WATER.

Hazardous Poly Occur: NO

Conditions To Avoid (Poly): NOT APPLICABLE

Health Hazard Data

LD50-LC50 Mixture: ORAL DL50 RATS 6000-13000MG/KG.

Route Of Entry - Inhalation: YES

Route Of Entry - Skin: NO

Route Of Entry - Ingestion: YES

Health Haz Acute And Chronic: EYE:MAY CAUSE SLIGHT TRANSIENT(TEMP)IRRIT. CORNEAL INJURY UNLIKELY.VAP/MIST IRRIT. SKIN:ESSENTIALLY NON-IRRIT. SKIN ABSORPTION:REPEATED EXPO TO LG QUANT MAY RESULT IN ABSORPTION OF HARMFUL AMTS. INGEST:SINGLE DOSE ORAL TOXICITY MODERATE.EXCESSIVE EXPO MAY CAUSE CNS EFFECTS,CARDIO-PULM EFFECTS,KIDNEY FAILURE.(SUPPLEMENT)

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Explanation Carcinogenicity: PER MSDS:DID NOT CAUSE CANCER IN LONG-TERM ANIMAL STUDIES.

Signs/Symptoms Of Overexp: EXCESSIVE EXPO IRRIT TO UPPER RESP TRACT. EXPO BY INHAL/SKIN PRIMARY ROUTES OF OCCUPATIONAL EXPO HAVE MINIMAL/ ESSENTIALLY NO EFFECT ON FETUS.

Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.

Emergency/First Aid Proc: EYE:IRRIGATE IMMED W/WATER FOR @LEAST 5MINS. SKIN:WASH OFF IN FLOWING WATER/SHOWER.INGEST:INDUCE VOMIT IMMED AS DIRECTED BY MED PERSON.NEVER GIVE ANYTHING BY MOUTH IF UNCONSC.INHAL:REMOVE TO FRESH AIR.CONSULT PHYSICIAN.NOTE TO PHYSICIAN:EARLY ADM OF ETHANOL MAY COUNTER TOXIC EFFECTS-METABOLIC ACIDOSIS & RENAL DMG.HEMODIALYSIS OR PERITONEAL DIALYSIS HAVE BEEN BENEFITIAL.TREAT BASED ON DR TO RESPONSES

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: AVOID ENTRY INTO SEWERS/NATURAL WATERS.SMALL SPILLS:SOAK UP W/ABSORBENT MATL.LARGE SPILLS:DIKE/PUMP INTO SUITABLE CNTNRS FOR DISPOSAL.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Method: BURN IN APPROVED INCINERATOR IN ACCORDANCE W/ALL LOCAL, STATE AND FEDERAL REGULATIONS, OR SALVAGE.CONTAINS CHEM SUBJ TO SARA SEC313 TITLE III REPORTING:ETHYLENE GLYCOL.

Precautions-Handling/Storing: AVOID INGEST.PRACTICE REASONABLE CAUTION/ PERSONAL CLEANLINESS.AVOID SKIN/EYE CONTACT.

Other Precautions: TRACE QUANT OF ETHYLENE OXIDE MAY BE PRESENT IN PROD. WHILE THESE QUANT COULD ACCUMULATE IN HEADSPACE AREA OF STORAGE/TRANSP VESSELS THEY'RE NOT EXPECTED TO CREATE CONDITION RESULTING IN IN CONCEN >0.5PPM(TWA)IN BREATHZONE.(OSHA 1.0PPM)

Control Measures

Respiratory Protection: ATMOSPHERIC LEVELS SHOULD BE MAINTAINED BEL EXPO GUIDELINE.WHEN RESP PROTECTION IS REQUIRED FOR CERTAIN OPERATIONS USE APPROVED AIR-PURIFYING RESPIRATOR.

Ventilation: GOOD GENERAL VENTILATION SHOULD BE SUFFICIENT FOR MOST

CONDITIONS.LOCAL EXHAU VENTI MAY BE NECESSARY FOR SOME OPERATIONS
Protective Gloves: IMPERVIOUS GLOVES.
Eye Protection: SAF GLASSES,FULL-FC RESP FOR EYE DISCOMF
Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER.
Work Hygienic Practices: WASH HANDS AFTER HANLDING.
Suppl. Safety & Health Data: FIRE/EXPLO HAZ:VAP W/AIR IF HEATED
SUFFICIENTLY. HEALTH HAZ:AMTS INGESTED INCIDENTAL TO INDUSTRIAL HNDLG NOT
LIKELY TO CUASE INJURY;HOWEVER INGEST OF LG AMTS COULD CAUSE SERIOUS
INJURY,DEATH.INHAL:HEAT/SPRAY/AEROSOL CONCEN MAY BE ATTAINED SUFFICIENT TO
CAUSE IRRIT/OTHER EFFECTS.

=====
Transportation Data
=====

Trans Data Review Date: 96120
DOT PSN Code: ZZZ
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
IMO PSN Code: ZZZ
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IATA PSN Code: ZZZ
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI PSN Code: ZZZ
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION

=====
Disposal Data
=====

=====
Label Data
=====

Label Required: YES
Technical Review Date: 29APR96
Label Status: F
Common Name: ETHYLENE GLYCOL (REGULAR)
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: EYE:SLT TRANS(TEMP)IRRIT.CORNEAL INJURY
UNLIKELY.IRRIT.SKIN:ESSENTIALLY NON-IRRIT.SKIN ABSORP:REPEAT EXPO TO LG AMT
RESULT IN HARMFUL AMTS ABSORPTION.INGEST:SINGLE DOSE ORAL TOXICITY
INDUCE VOMIT IMMED PER MED PERSON.NEVER GIVE ANYTHING BY MOUTH IF UNCONSC.
INHAL:MOVE TO FRESH AIR.SE DR.NOTE TO DR:EARLY ADM OF ETHANOL MAY COUNTER
TOXIC EFFECTS-METABOLIC ACIDOSIS/RENAL DMG.HEMODIALYSIS/PERITONEAL DIALYSIS
HAVE BEEN BENEFITIAL.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: VAN WATERS AND ROGERS INC
Label Street: 6100 CARILLON POINT
Label City: KIRKLAND
Label State: WA
Label Zip Code: 98033
Label Country: US
Label Emergency Number: 206-889-3400

MSDS Number: 6123FR

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.

"SUVA" 507

6123FR

Revised 24-MAR-1999

CHEMICAL PRODUCT/COMPANY IDENTIFICATION
Material Identification

"SUVA" is a registered trademark of DuPont.

Corporate MSDS Number : DU007297

Company Identification

MANUFACTURER/DISTRIBUTOR

DuPont
Chemicals
1007 Market Street
Wilmington, DE 19898

PHONE NUMBERS

Product Information : 1-800-441-7515
Transport Emergency : CHEMTREC 1-800-424-9300
Medical Emergency : 1-800-441-3637

COMPOSITION/INFORMATION ON INGREDIENTS
Components

Material	CAS Number	%
HFC-125	354-33-6	50
HFC-143a	420-46-2	50

HAZARDS IDENTIFICATION

Potential Health Effects

Potential Health Effects

SKIN CONTACT

Immediate effects of overexposure may include: Frostbite, if liquid or escaping vapor contacts the skin. Significant skin permeation, and systemic toxicity, after contact appears unlikely.

INHALATION

Gross overexposure may cause: Central nervous system depression with dizziness, headache, confusion, incoordination, drowsiness or unconsciousness. Suffocation, if air is displaced by vapors. Based on animal data, this material may cause: Irregular heart beat with a strange sensation in the chest, "heart thumping", cardiac arrhythmias, apprehension, lightheadedness, feeling of fainting, dizziness, inadequate circulation, weakness, sometimes progressing to loss of consciousness and death.

At flame temperatures, this material can decompose to hydrogen fluoride which can be lethal at much lower concentrations.

ADDITIONAL HEALTH EFFECTS

Increased susceptibility to the effects of this material may be observed in persons with pre-existing disease of the: cardiovascular system.

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, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash contaminated clothing before reuse. Treat for frostbite if necessary by gently warming affected area.

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
Flammable limits in Air, % by Volume	
LEL	: Not applicable
UEL	: Not applicable
Autoignition	: Not determined

Fire and Explosion Hazards:

Cylinders may rupture under fire conditions. Decomposition may occur.

Contact of welding or soldering torch flame with high concentrations of refrigerant can result in visible changes in the size and color of torch flames. This flame effect will only occur in concentrations of product well above the recommended exposure limit, therefore stop all work and ventilate to disperse refrigerant vapors from the work area before using any open flames.

Potential combustibility:

"Suva" 507 is not flammable at temperatures up to 100 deg C (212 deg F) at atmospheric pressure. However, mixtures of "Suva" 507 with high concentrations of air at elevated pressure can become combustible at ambient temperature. As the temperature of the mixture is increased, lower pressure (but still greater than atmospheric pressure) can create the same effect. Therefore, "Suva" 507 should not be mixed with air under pressure for leak testing or other purposes. In general, "Suva" 507 should not be used or allowed to exist with high concentrations of air above atmospheric pressure.

Extinguishing Media

As appropriate for combustibles in area.

Fire Fighting Instructions

Cool cylinder with water spray or fog. Self-contained breathing apparatus (SCBA) is required if cylinders rupture and 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 (using forced ventilation), 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)

Avoid breathing high concentrations of vapor. Avoid contact of liquid with eyes and prolonged skin exposure. Use with sufficient ventilation to keep employee exposure below recommended limits.

Contact with chlorine or other strong oxidizing agents should also be avoided. See Fire and Explosion Data section.

Storage

Do not heat above 52 C (126 F). Store in a clean, dry place.

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Refrigerant concentration monitors may be necessary to determine vapor concentrations in work areas prior to use of torches or other open flames, or if employees are entering enclosed areas.

Exposure Guidelines

Applicable Exposure Limits

HFC-125

PEL (OSHA)	: None Established
TLV (ACGIH)	: None Established
AEL * (DuPont)	: 1000 ppm, 8 & 12 Hr. TWA
WEEL (AIHA)	: 1000 ppm, 4900 mg/m ³ , 8 Hr. TWA

HFC-143a

PEL (OSHA) : None Established
TLV (ACGIH) : None Established
AEL * (DuPont) : 1000 ppm, 8 & 12 Hr. TWA
WEEL (AIHA) : 1000 ppm, 8 Hr. TWA

* 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

% Volatiles : 100 %
Evaporation Rate : >1
Solubility in Water : Not Determined
Odor : Ethereal (slight).
Form : Liquified Gas.
Color : Clear, Colorless.
Boiling Point : -46.9 C (-52.4 F) @ 1 atm
Vapor Pressure : 184.9 psia @ 25 C (77 F)
Specific Gravity : 1.079 @ 25 C (77 F)

STABILITY AND REACTIVITY

Chemical Stability

Stable at normal temperatures and storage conditions.

However, avoid open flames and high temperatures.

Incompatibility with Other Materials

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

Decomposition

Decomposition products are hazardous. This material can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrofluoric acid and possibly carbonyl fluoride. These materials are toxic and irritating. Contact should be avoided.

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

HFC-125

INHALATION:

4 hour, ALC, rat: > 709,000 ppm (Very low toxicity).

Single exposure to high doses caused: Lethargy. Labored breathing. Weak cardiac sensitization, a potentially fatal disturbance of heart rhythm caused by a heightened sensitivity to the action of epinephrine. Repeated exposure caused: No significant toxicological effects.

No-Observed-Adverse-Effect-Level (NOAEL): 50,000 ppm

ADDITIONAL TOXICOLOGICAL EFFECTS:

No animal data are available to define the following effects of this material: carcinogenicity, reproductive toxicity. In animal testing this material has not caused developmental toxicity. Tests have shown that this material does not cause genetic damage in bacterial or mammalian cell cultures, or in animals. This material has not been tested for its ability to cause permanent genetic damage in reproductive cells of mammals (not tested for heritable genetic damage).

HFC-143a

Inhalation 4 hour LC50: > 540,000 ppm in rats (Very low toxicity by inhalation)

INHALATION: Single exposure to 500,000 ppm caused anaesthesia, but no mortality at 540,000 ppm. Cardiac sensitization occurred in dogs at 300,000 ppm from the action of exogenous epinephrine. Two, 4-week inhalation studies have been conducted. In the first study, pathological changes in the testes were observed at all exposures concentrations; no effects were observed in females. The testicular effect was considered related to the method used to expose the rats to HFC-143a. In the second study using the same exposure concentrations, no effects were noted in males at any concentration. Data from a 90-day study revealed no effects in male or female rats at exposures up to 40,000 ppm.

INGESTION: Long-term exposure caused significantly decreased body weights in male rats fed 300 mg/kg for 52 weeks, but there was no effect on mortality. During this long-term exposure study, tests in rats demonstrated no carcinogenic activity when HFC-143a was administered orally in corn oil at 300 mg/kg/day, five days a week, for 52 weeks and observed for an additional 73 weeks. Tests in animals demonstrate no developmental toxicity. No animal test reports are available to define reproductive hazards. Tests in bacterial cell cultures demonstrate mutagenic activity, but the compound did not induce oncogenic transformation of mammalian cells in culture. HFC-143a was not mutagenic in animals.

ECOLOGICAL INFORMATION

Ecotoxicological Information

AQUATIC TOXICITY:

HFC-143a

The compound is very low to slightly toxic.
96 hr. LC50, rainbow trout: > 40 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/IATA

Proper Shipping Name : LIQUEFIED GAS, N.O.S.
(PENTAFLUOROETHANE AND TRIFLUOROETHANE)

Hazard Class : 2.2

UN No. : 3163

DOT/IMO Label : NONFLAMMABLE GAS

Shipping Containers

Tank Trucks.

Cylinders.

REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : Listed.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : No

Chronic : No

Fire : No

Reactivity : No

Pressure : Yes

HAZARDOUS CHEMICAL LISTS

SARA Extremely

Hazardous Substance - No

CERCLA Hazardous Substance - No

SARA Toxic Chemical - No

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 Fluorochemicals
Address : Health and Regulatory Affairs
> : P.O. Box 80023, Barley Mill Plaza
> : Wilmington, DE 19880-0023
Telephone : (302) 999-4946

Indicates updated section.

End of MSDS



MATERIAL SAFETY DATA SHEET
EMKARATE RL 32CF

MSDS:
POE 32

I - PRODUCT IDENTIFICATION

Company Name: Nu-Calgon Wholesaler, Inc.
Address: 2008 Altom Court, St. Louis, MO 63146-4151
Product Name: EMKARATE RL 32CF
Synonyms: Refrigeration Oil

Tel No: (314) 469-7000, (800) 554-5499
CHEMTREC: (800) 424-9300
Product Number: 4314-CF

II - HAZARDOUS INGREDIENTS OF MIXTURES

<u>MATERIAL</u>	<u>CAS#</u>	<u>% By Wt</u>	<u>TLV</u>	<u>PEL</u>
Polyol Ester		>99	N/A	N/A
Additives		<1	N/A	N/A

Ingredients not precisely identified are proprietary or nonhazardous. Values are not product specifications.
All ingredients are TSCA listed.

III - PHYSICAL DATA

Vapor Pressure: (mm Hg at 20 ° C): <10	Vapor Density (Air=1) 60-90° F: No data
Evaporation Rate:	VOC Content (% by wt.): No data
Solubility in H₂O: <1%	pH @ Solution: No data
Freezing Point °F:	pH as Distributed: No data
Boiling Point °F: 572	Appearance: Liquid
Specific Gravity H₂O=1 @25° C: 0.972	Odor: Mild Odor

IV - FIRE AND EXPLOSION

Flash Point F: 490 ° F, 254 ° C (COC) **Flammable Limits: (STP)**No data
Extinguishing Media: Water fog, foam, carbon dioxide, dry chemical, halogenated agents
Special Fire Fighting Procedures: Self-contained breathing apparatus with full face piece and protective clothing.
Unusual Fire and Explosion Hazards: None known

V - REACTIVITY DATA

Stability - Conditions to avoid: Stable under normal conditions.
Incompatibility: Oxidizing agents
Hazardous Decomposition Products: Combustion products: Carbon dioxide, carbon monoxide.
Conditions Contributing to Hazardous Polymerizations: Will not occur.

VI - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE (Medical Conditions Aggravated/Target Organ Effects),
A. ACUTE (Primary Route of Exposure) Inhalation: No toxic effects are known to be associated with inhalation of vapors from this material. High concentrations of mist may be slightly irritating to the upper respiratory tract. Thermal decomposition will evolve irritant vapors. **Ingestion:** The acute oral LD50 in rat is probably above 2,000 mg/kg. Relative to other materials, this material is classified as "slightly toxic" by ingestion. **Eyes:** No irritation is likely to develop following contact with human eyes. **Skin:** Short contact periods with human skin are not usually associated with skin irritation; repeated and/or prolonged contact may result in mild skin irritation. This product will probably not be absorbed through human skin.
B. SUBCHRONIC, CHRONIC, OTHER: No other adverse clinical effects have been associated with exposures to this material. Short term tests and a consideration of the structure indicate that this substance is unlikely to be a carcinogenic hazard to humans
C. MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:

VII - EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove victim to fresh air. If a cough or other respiratory symptoms develop, consult medical attention.

EYES: Immediately flush with plenty of water for at least 15 minutes. If redness, itching, or a burning sensation develops, have eyes examined and treated by medical personnel.

SKIN: Wash material off of the skin with plenty of soap and water. If redness, itching, or a burning sensation develops, get medical attention. Wash contaminated and decontaminate footwear before reuse.

INGESTION: Do not induce vomiting. Give 1 or 2 glasses of water to drink and refer person to medical personnel. (Never give anything by mouth to an unconscious person.)

VIII - SPILL OR LEAK PROCEDURE

Spill Management: Wear skin protection during cleanup. Contain spill. Keep out of sewers and drains. Soak up material with absorbent and shovel into a chemical waste container.

Waste Disposal Methods: Discarded product is not a hazardous waste under RCRA, 40 CFR 261. Empty container retains product residue. Observe all hazard precautions. Do not distribute, make available, furnish, or reuse empty container except for storage and shipment of original product. Remove all product residue from container and puncture or otherwise destroy empty container before disposal. Ecological

Information: Persistency and degradation: The product is substantially biodegradable in water

IX - PROTECTION INFORMATION/CONTROL MEASURES

Respiratory: Use MSHA-NIOSH approved respirator for organic vapors, dusts and mists whose TLV is greater than 0.05 mg/m³.

Eye Protection: Chemical tight goggles **Glove:** Impervious gloves and apron.

Other Clothing and Equipment: Eyewash station and safety shower in work area.

Ventilation: Use ventilation adequate to maintain safe levels.

X - SPECIAL PRECAUTIONS

Precautions to be taken in Handling and Storing: Prevent skin contact. Avoid inhalation of high concentrations of mists.

Additional Information:

NFPA

Health Hazard.....: 1

Fire Hazard.....: 1

Reactivity.....: 0

Specific Hazard....:

HMIS RATING

Health Hazard.....: 1

Fire Hazard.....: 1

Reactivity.....: 0

Personal Protection....: X (Sec. 9)

Revision Date: 02/11/2003

Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions. While Seller believes that the information contained herein is accurate, such information is offered solely for its customers' consideration and verification under their specific use conditions.

Product Information Sheet

MSDS: Lithium
Battery

Panasonic Batteries

Panasonic Industrial Company
A Division Panasonic Corporation of North America
Two Panasonic Way
Secaucus, NJ 07094
Toll Free: 877-726-2228
Fax: 847468-5750
Internet: www.panasonic.com/batteries
e-mail: oembatteries@us.panasonic.com

Product: Manganese Dioxide (CR Type) Lithium Batteries
Applicable models/sizes: All CR type cylindrical and coin batteries

Revision: E; Dated 08107106

The batteries referenced herein are exempt articles and are not subject to the OSHA Hazard Communication Standard requirement. This sheet is provided as a service to our customers.

MSDS

Material Safety Data Sheets (MSDS) are a sub-requirement of the Occupational Safety and Health Administration (OSHA) Hazard communication Standard, 29 CFR Subpart 1910.1200. This Hazard communication Standard does not apply to various subcategories including anything defined by OSHA as an "article". OSHA has defined "article" as a manufactured item other than a fluid or particle; (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g. minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees.

Because all of our batteries are defined as "articles", they are exempt from the requirements of the Hazard Communication Standard; hence a MSDS is not required.

The following components are found in a Panasonic Manganese Dioxide (CR) Lithium battery:

Cylindrical Cell Components	Material	Formula	CAS #
Positive Electrode	Manganese Dioxide	MnO ₂	1313-13-9
Negative Electrode	Lithium	Li	7439-93-2
Electrolyte	Propylene Carbonate-Solvent	C ₄ H ₆ O ₃	108-32-7
	1,2 Dimethoxyethane-Solvent	C ₄ H ₁₀ O ₂	110-71-4
	Lithium Triflate-Salt	CF ₃ SO ₃ Li	33454-82-9
Coin Cell Components	Material	Formula	CAS #
Positive Electrode	Manganese Dioxide	MnO ₂	1313-13-9
Negative Electrode	Lithium	Li	7439-93-2
Electrolyte	Propylene Carbonate-Solvent	C ₄ H ₆ O ₃	108-32-7
	1,2 Dimethoxyethane-Solvent	C ₄ H ₁₀ O ₂	110-71-4
	Lithium Perchlorate-Salt	LiClO ₄	7791-03-9

Lithium Triflate is Lithium Trifluoromethanesulfonate.

DISPOSAL

Lithium batteries are neither specifically listed nor exempted from the Federal Environmental Protection Agency (EPA) hazardous waste regulations as promulgated by the Resource Conservation and Recovery Act (RCRA). The only metal of possible concern in a lithium battery is lithium that is not a listed or characteristic toxic hazardous waste. Waste lithium batteries can be considered a reactive hazardous waste if there is a significant amount of unreacted, or unconsumed lithium remaining in the spent battery. The key to disposing of a lithium battery as a non-hazardous waste is to guarantee that it is fully or mostly discharged. Once it is discharged it can be disposed of as non-hazardous waste. You can dispose of a fully charged or partially discharged lithium battery as a hazardous waste after they are first neutralized through an approved secondary treatment. The need for a secondary treatment prior to disposal is a requirement of the U.S. Land Ban Restrictions of the Hazardous and Solid Waste Amendments of 1984. A secondary treatment center can only receive these batteries as manifested hazardous waste. The waste code for charged lithium

Notice: The information and recommendations set forth are made in good faith and are believed to be accurate at the date of preparation. Panasonic Industrial Company makes no warranty expressed or implied.

batteries is D003, reactive. In either case, button cell batteries contain so little lithium that they never qualify as a reactive hazardous waste. These batteries are safe for disposal in the normal municipal waste stream. Disposal of large quantities of undischarged lithium batteries should be performed by permitted, professional disposal firms knowledgeable in Federal, State and local hazardous materials and hazardous waste transportation and disposal requirements. As always, households are exempt from the RCRA hazardous waste guidelines.

In California, packages that contain CR lithium coin cells and the Owners/Operating Instructions of products that contain CR lithium coin cells must include the following statement: "Perchlorate Material – special handling may apply, See www.dtsc.ca.gov/hazardouswaste/perchlorate". The effective date for this Perchlorate label is July 1, 2006 for non-consumer products and January 1, 2007 for consumer products.

TRANSPORTATION

All Panasonic lithium batteries when transported by ground are not subject to the requirements of the Department of Transportation (DOT) Subchapter C, Hazardous Materials Regulations because each of our batteries meet the exceptions under 173.185 (b).

All Panasonic lithium batteries are exempt from the DOT Hazardous Materials Subchapter as long as they are separated to prevent short circuits and packed in strong packing for conditions normally encountered in transportation.

Effective January 1, 2003, all Panasonic lithium batteries are regulated as a Hazardous Material by the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) if you transport more than 24 cells or 12 batteries in a single package. These must be transported in accordance with the requirements of Special Provision "A45".

Effective January 1, 2004, all Panasonic lithium batteries will be regulated as a Hazardous Material by the International Maritime Organization (IMO) if you transport more than 24 cell or 12 batteries in a single package. These will have to be transported in accordance with the requirements of Special Provisions 188 and 230.

If you build any of our lithium cells into a battery pack, you must also assure that they are tested in accordance with the UN Model Regulations, Manual of Test and Criteria. Part III, subsection 38.3.

Effective December 29, 2004, the DOT requires that the outside of each package that contains primary lithium batteries, regardless of size or number of batteries, be labeled with the following statement: 'PRIMARY **LITHIUM** BATTERIES- FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT'. The labeling requirement covers shipments via highway, rail, vessel or cargo-only aircraft and covers all shipments inside, into or out of the US. The label must be in contrasting color and the letters must be 12 mm (0.5 in) in height for packages weighing more than 30 Kg and 6 mm (0.25 in) in height for packages weighing less than 30 Kg.

If you plan on transporting any untested prototype battery packs contact your Panasonic Sales Representative for regulatory information.

First Aid

If you get electrolyte in your eyes, flush with water for 15 minutes without rubbing and immediately contact a physician. If you get electrolyte on your skin wash the area immediately with soap and water. If irritation continues, contact a physician. If a battery is ingested, call the National Capital Poison Center (NCPC) at 202-625-333 (Collect) or your local poison center immediately

General Recommendations

CAUTION: Risk of fire, explosion and burns. Do not recharge, crush, heat above 212^oF (100^oC) or incinerate.

Fire Safety

In case of fire, you can use a Class "D" fire extinguisher or other smothering agent such as Lith-X, copper powder or dry sand. If you use water, use enough to smother the fire. Using an insufficient amount of water will only make the fire worse. Cooling the exterior of the batteries will help prevent rupturing. Burning of these batteries will generate toxic and corrosive lithium hydroxide fumes. Fire fighters should use self-contained breathing apparatus.

Notice: The information and recommendations set forth are made in good faith and are believed to be accurate at the date of preparation.
Panasonic Industrial Company makes no warranty expressed or implied.
