MODEL EC1x

ENVIRONMENTAL CHAMBER
USER AND REPAIR MANUAL

Covers EC1x and EC1xHA Environmental Chambers
which incorporate the TC10 controller

The information in this document has been carefully checked and is believed to be entirely reliable. No responsibility, however, is assumed for inaccuracies. Furthermore, such information does not convey to the purchaser of the product described any license under the patent rights of SUN ELECTRONIC SYSTEMS, INC., or others.

Sun Systems strives constantly to improve the quality and performance of all of its products, in design, construction, and cost. As a consequence, SUN ELECTRONIC SYSTEMS, INC. reserves the right to change specifications, or other data contained herein, without notice.

Any software, firmware, designs, and any other programs in Sun Systems' products remain the sole property of SUN ELECTRONIC SYSTEMS, INC. and may not be copied by any means. Purchase of said product constitutes agreement that software rights remain to the benefit of SUN ELECTRONIC SYSTEMS, INC. Upon purchase, Sun Systems grants perpetual license for use by the customer.

REV D

0304

Copyright 1991 by SUN ELECTRONIC SYSTEMS, INC.

INFORMATION ABOUT YOUR CHAMBER

MODEL _____ SERIAL NUMBER_____

OPTIONS INSTALLED:

COOLANT TYPE _____ PRESSURE _____ psi

COOLING OPTIONS INSTALLED_____

_____

OTHER OPTIONS INSTALLED:_____

_____

POWER _____ watts

VOLTAGE _____ vac , single phase _____ wire line cord.

PROBE TYPES : chamber _____ user _____

DEFAULT PID HEAT:

P= _____

I= _____

D= _____

DEFAULT PID COOL:

P= _____

I= _____

D=_____

FAIL-SAFE TYPE: Mechanical _____ Electronic _____

TESTED BY: _____ DATE: _____

Contents

SECTION 1. GENERAL INFORMATION 7
- INTRODUCTION 7
- LIMITED WARRANTY INFORMATION 7
- EC1X DESCRIPTION 8
- OPERATIONAL MODES 8
- USER PROBE 8
- LOCAL CONTROL PANEL OPERATION 9
- REMOTE GPIB OR RS232/422 OPERATION 9
- DATA ACQUISITION AND CONTROL INTERFACES 9
- EC1X COMPONENT IDENTIFICATION 9
- CHAMBER FRONT VIEW 10
- CHAMBER REAR VIEW OF EC1X WITH MECHANICAL FAIL-SAFE 11
- CHAMBER REAR VIEW OF EC1XHA WITH MECHANICAL FAIL-SAFE 12
- CHAMBER REAR VIEW OF EC1.3W WITH ELECTRONIC FAIL-SAFE 13
- CONTROLLER SECTION SEPARATED OF EC1X & EC1XHA 14
- CONTROLLER SECTION SEPARATED OF EC1.3W 15
- CONTROLLER SECTION MAIN BOARD COVER REMOVED 16
- CHAMBER WITH AIR BAFFLE REMOVED 17
- CHAMBER INTERNAL REAR VIEW 18
- CHAMBER INTERNAL REAR VIEW OF EC1.3W 19

SECTION 2. RECEIVING, SAFETY AND INSTALLATION 23
- INITIAL INSPECTION AND UNPACKING 23
- LOST OR DAMAGED EQUIPMENT 23
- SAFETY CONSIDERATIONS 23
- LIQUID CARBON DIOXIDE DELIVERY SYSTEMS 24
- LCO2 INSTALLATION PROCEDURE 24
- LCO2 3-TANK AUTO SWITCH 25
- LIQUID NITROGEN DELIVERY SYSTEMS 25
- LN2 INSTALLATION PROCEDURE 25
- LN2 2-TANK AUTO SWITCH 25
- LN2 AUTO LINE PURGE 25
- NITROGEN GAS PURGE 26
- AMBIENT AIR BLOWER SYSTEM 26
- AMBIENT AIR BLOWER INSTALLATION 26
- SETTING THE FAIL-SAFE 26
- SETTING THE MECHANICAL FAIL-SAFE 26
- SETTING THE ELECTRONIC FAIL-SAFE 27
- EC1X CHAMBER INSTALLATION 28
- INITIAL START UP {TO SET A SINGLE TEMPERATURE SEGMENT} 29
- SAMPLE LOCAL PROGRAM 30
- SAMPLE LOCAL PROGRAM 33

SECTION 3. OPERATION AND COMMAND OVERVIEW 35
- COMMAND OVERVIEW 35
- CONTROL PANEL OPERATORS 35
- PARAMETER ENTRY 36
- RS232/422 SERIAL PORT PROTOCOLS 36
- GPIB PORT PROTOCOLS 37
- POWER, HEAT, AND COOL ON/OFF CONTROL COMMANDS 37
- TEMPERATURE CONTROL COMMANDS 37
- TEMPERATURE SAFETY LIMIT COMMANDS 38
- CONTROL LOOP PARAMETER COMMANDS 39
- LOCAL PROGRAM COMMANDS 39

MODEL TC01/EC0X COMPATIBILITY COMMANDS 40
DEVICE I/O COMMANDS 41
SET DEFAULT MENU (SDEF) 41
LOCAL CONTROL OF THE SET DEFAULT MENU (SDEF) : 41
REMOTE CONTROL OF THE SET DEFAULT MENU (SDEF) 43
SET INTERRUPT MENU (SINT) 43
LOCAL CONTROL OF THE SET INTERRUPT MENU (SINT) 43
REMOTE CONTROL OF THE SET INTERRUPT MENU (SINT) 44
REMOTE INTERRUPT CHARACTERS 44
PROBE CALIBRATION MENU 45
CAL TO A STANDARD COMMANDS 46
SECTION 4. INPUT/OUTPUT INTERFACES 49
COMMUNICATION INTERFACES 49
FRONT PANEL INTERFACE 49
GPIB (IEEE-488) PARALLEL INTERFACE 49
RS232/422 SERIAL INTERFACE 50
RS232/422 SERIAL INTERFACE (DB25) 50
AUXILIARY I/O INTERFACES 50
BIT I/O INTERFACE 50
BIT I/O INTERFACE (26 PIN IDC) 50
BIT I/O PORT LOGIC 52
I/O BOARD LOGIC 53
DIGITAL PARALLEL USER I/O INTERFACE 54
USER PARALLEL I/O INTERFACE (26 PIN IDC) 54
USER PARALLEL I/O COMMANDS 54
MATRIX SYSTEM CONTROLLED BY DIGITAL PARALLEL USER I/O INTERFACE 55
MATRIX FUNCTIONAL BLOCK DIAGRAM 56
MATRIX USER INTERFACE 57
USER BUS SCHEMATIC 58
TIMING DIAGRAM 59
SAMPLE USER CIRCUIT 60
ANALOG I/O INTERFACE 61
ANALOG I/O INTERFACE (J2,DB15) 61
ANALOG I/O INTERFACE I/O COMMANDS 61
ANALOG PORT SCHEMATIC 62
HIGH SPEED SERIAL LINK INTERFACE 63
HIGH SPEED SERIAL LINK INTERFACE (DB9) 63
HIGH SPEED SERIAL LINK INTERFACE I/O COMMANDS 63
PARALLEL PRINTER AND EXTRA BIT I/O 63
PROBE INTERFACE 64
PROCESS CONTROL OUTPUTS 64
SECTION 5. DETAILED COMMAND DESCRIPTIONS 65
AB 65
BKPNT 66
BKPNTC 67
BKPNT? 67
C 68
CALAX 68
CALBX 69
CALC 69
COFF 70
CON 70
CSET 71
DELL 71
DELP 72
DEVL 73

EDIT 74
END 75
FOR/NEXT 76
GOSUB 77
HOFF 77
HON 78
I VARIABLES 78
IN 79
LIST 80
LLO 80
LTL 81
M 81
OFF 82
ON 82
OUT 83
PIDA 85
PIDC 86
PIDH 86
PWMP 87
RATE 88
RTL 89
RUN 90
RUN-TIME 91
S/! 92
SCALE 93
SDEF 94
SET 95
SINT 96
STATUS? 97
STOP 98
STOPE9 98
STORE 99
T 100
TANK 101
TEMP 101
TIME 102
TIMEE? 102
UCHAN 103
UTL 103
VER? 104
WAIT 105
SECTION 6. EC1X OPTIONS 107
POWER OPTIONS 107
COOLING OPTIONS 108
PORT AND WINDOW OPTIONS 108
SECTION 7. SPECIFICATIONS 110
SECTION 8. MAINTENANCE 113
BLOWER MOTOR INSPECTION AND CLEANING 113
EXPECTORANT FILTER CLEANING 113
SECTION 9. CHAMBER REPAIR 115
TEMPERATURE CONTROLLER SECTION REMOVAL AND REPLACEMENT 115
HEATER ELEMENT REMOVAL AND REPLACEMENT 115
HEATER ELEMENT REPLACEMENT TABLE 116
COOLING MODULE ASSEMBLY REPLACEMENT 117
MECHANICAL FAIL-SAFE REMOVAL AND REPLACEMENT 117
BLOWER MOTOR REPLACEMENT 118

110 VAC 3 WIRE SCHEMATIC 119
208 VAC 3 WIRE SCHEMATIC 120
208 VAC 4 WIRE SCHEMATIC 121
240 VAC 3 WIRE SCHEMATIC 122
EC1XHA 208 VAC SCHEMATIC 123
EC1.3W 208-240 VAC, 3 WIRE SCHEMATIC 124
EC1.3W 208-240 VAC, 4 WIRE SCHEMATIC 125
SECTION 10. REPLACEMENT PARTS 127
SECTION 11. ERROR MESSAGES 129

SECTION 1. GENERAL INFORMATION

INTRODUCTION

Thank you for your purchase of the EC1x Environmental Chamber!! Your new chamber was manufactured under stringent quality control procedures to ensure trouble free operation for many years of service. If you should encounter difficulties with the use or operation of your chamber, contact Sun Systems' "Customer Service Department" between the hours of 9:00 and 5:00 EST.

As with all Sun Systems' products, we would appreciate any comments, suggestions or criticisms that you may have or develop regarding your evaluation of this equipment. Please address your comments to:

Product Service Manager
Sun Electronic Systems, Inc.
1845 Shepard Drive
Titusville, FL 32780
Tel: (321) 383-9400
Fax: (321) 383-9412
Website: www.sunelectronics.com
Email: sales@sunelectronics.com

LIMITED WARRANTY INFORMATION

EC1A, EC11A, EC10, EC11, EC12, EC13, EC13HA, EC1.3W, EC15HA, EC16 & EC16HA ENVIRONMENTAL CHAMBER

SUN ELECTRONIC SYSTEMS, INC. WARRANTS THIS PRODUCT TO THE ORIGINAL PURCHASER TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP AND TO OPERATE WITHIN APPLICABLE SPECIFICATIONS FOR A PERIOD OF TWO (2) YEARS FROM THE DATE OF SHIPMENT, PROVIDED IT IS USED UNDER NORMAL OPERATING CONDITIONS. THIS WARRANTY DOES NOT APPLY TO SEALED ASSEMBLIES WHICH HAVE BEEN OPENED, OR TO ANY ITEM WHICH HAS BEEN REPAIRED OR ALTERED WITHOUT SUN SYSTEMS AUTHORIZATION.

RISK OF LOSS OR DAMAGE TO THE PRODUCT SHALL PASS TO THE CUSTOMER UPON DELIVERY, BY SUN SYSTEMS, TO THE CARRIER AT SUN SYSTEMS PREMISES.

WE WILL REPAIR OR AT OUR OPTION, REPLACE AT NO CHARGE ANY OF OUR PRODUCTS WHICH IN SUN SYSTEMS' JUDGMENT, ARE FOUND TO BE DEFECTIVE UNDER THE TERMS OF THIS WARRANTY. EXCEPT FOR SUCH REPAIR OR REPLACEMENT, SUN SYSTEMS WILL NOT BE LIABLE FOR ANY LOSS OR DAMAGE TO PERSONS OR PROPERTY CAUSED EITHER DIRECTLY OR INDIRECTLY BY USE OF THIS PRODUCT OR FOR ANY INCIDENTAL DAMAGES OR FOR ANY CONSEQUENTIAL DAMAGES. BEFORE USING, PURCHASER SHALL DETERMINE THE SUITABILITY OF THIS PRODUCT VIA THIS DOCUMENT FOR HIS INTENDED USE AND PURCHASER ASSUMES ALL RISK AND LIABILITY WHATSOEVER IN CONNECTION THEREWITH. NO STATEMENT OR RECOMMENDATION NOT CONTAINED HEREIN SHALL HAVE ANY FORCE OR EFFECT UNLESS IN AGREEMENT SIGNED BY AN OFFICER OF SUN ELECTRONIC SYSTEMS, INC.

EC1X DESCRIPTION

The Model EC1x subjects objects placed in the chamber area to either heated or cooled air which circulates from the intake in the rear of the test chamber area, up and across the roof of the test chamber, inside a baffle, and vertically downwards back into the test chamber area. Inside the test chamber area baffle, resistance heaters heat the circulating air and injected carbon dioxide, or optionally, liquid nitrogen, cools the air. Using Pulse Width Modulation techniques, which either turns on or off the heaters and/or coolant supply valve, the controller in the Model EC1x maintains the desired temperature or rate of change of temperature in the chamber test area. To accurately control the process of maintaining or changing temperatures within the test chamber area, the controller uses Proportional, Integral and Derivative (PID) control techniques. If necessary, you may tailor the characteristics of the PID algorithms independently for both heat and cool to the objects placed in the test chamber area. The Model EC1x is instructed to control temperature either by issuing single control commands or by writing and executing local control programs which may be stored in the Model EC1x, or by a combination thereof. Single commands and programs may be issued from either the local control panel located on the front of the EC1x or remotely from either the RS232/422 serial interface or the GPIB interface.

OPERATIONAL MODES

Temperature testing usually involves testing an object at one or several different temperatures. In the case of more than one temperature, the rate of change from one temperature to another and the time waiting at a particular temperature are considerations. In the single temperature mode, the Model EC1x accepts single commands defining an individual temperature segment containing rate of change from the present temperature to the final temperature, wait time at final temperature and final temperature setpoint information. At the end of a wait period, notification is given to the source of the command. If multiple temperature segments are to be performed by the Model EC1x automatically, the Model EC1x can be programmed by entering an EDIT mode and the program can be executed by entering a RUN mode. The Model EC1x stores up to 10 programs into battery backed memory. The number of temperature segments resident in each program is only limited by the Model EC1x's controller internal memory space. Programs can call other programs as subroutines.

The Model EC1x contains setup modes which are menu driven on the control panel. The CAL mode permits selection of temperature scale (C, F, K), probe type and probe calibration for both the chamber and USER probes. The SDEF mode permits modification of the Model EC1x default parameters such as GPIB address, D/A output configurations, alarm function and loudness, etc. The SINT mode permits modification of the Model EC1x interrupt configuration parameters such as audible alarm function, GPIB SRQ functions, etc.

USER PROBE

The USER probe is located within the test chamber area for direct measurement capability on the unit under test. The USER probe is electrically isolated from other chamber electronics permitting the probe to be directly attached to devices containing voltages up to 240 volts. In the CAL menu, the probe type for the USER probe can be selected to be an RTD, J or K Thermocouple, Solid State, 0-5 Volt, 0-20mA probe type. The unit is shipped with a type K thermocouple. The USER probe value is normally displayed on the control panel, line 2 , and may be read remotely from a host computer.

LOCAL CONTROL PANEL OPERATION

The Model EC1x can operate in a stand-alone configuration through the use of its control panel located on the front of the unit. Most keys perform one primary and two alternate functions. The primary function of any key is indicated by the black colored character below the key. The two alternate functions are indicated by the red and green character above the key. To select the primary function below the key, press only that key. To select an alternate function, for example, printed in red above the key, first press the red shift key, then press the function key, then press the blue ENTER key. The LED indicators provide positive indication that the alternate function is enabled. The blue ENTER key is required at the end of each command line to execute the command line and then is ready for the next line. The command entry may be edited using the green backup or cancel keys prior to pressing the blue ENTER key.

REMOTE GPIB OR RS232/422 OPERATION

The Model EC1x can operate remotely from a host computer over an IEEE-488 standard GPIB interface bus or over an RS-232 or RS-422 serial interface. Individual commands may be sent to the Model EC1x or programs may be downloaded and executed further relieving the host computer. A carriage return line feed is sent after an RS port interrupt character to simplify checking for interrupt by the host. To insure compatibility with Sun Systems Model TC01 temperature controller and the Model EC0x environmental chamber, the Model EC1x accepts the most commonly used TC01/EC0x commands. Section 3 has a complete list of single commands and program instructions for the Model EC1x.

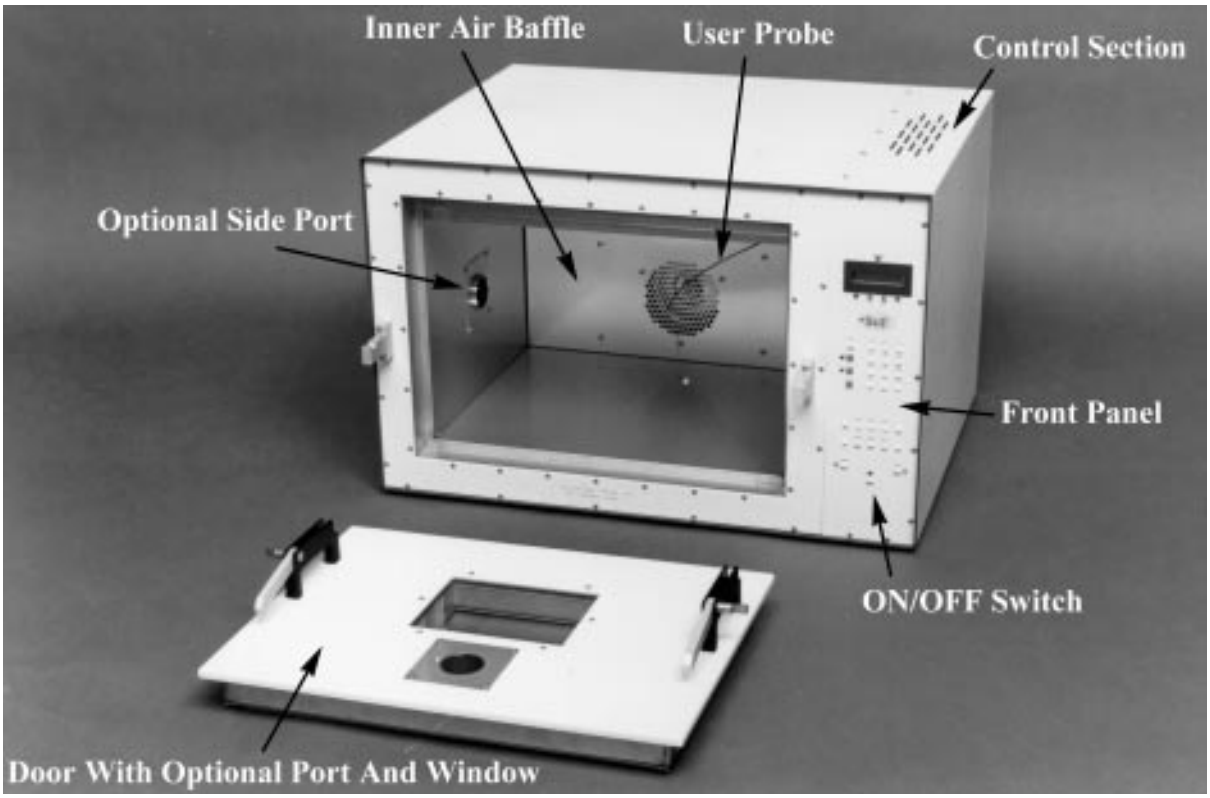
DATA ACQUISITION AND CONTROL INTERFACES

The Model EC1x provides an expanded I/O interface to facilitate special test fixtures and accessories provided by Sun Systems or for use by you for your custom test fixture requirements. Analog input and output channels, auxiliary relay control, USER digital parallel port and a High Speed Serial Link are available to you in implementing your test system design or for interfacing with other Sun Systems test accessories. Model EC1x commands permit read and write capability specifically to each device interface. Section 4 has a complete overview of the device interfaces and commands.

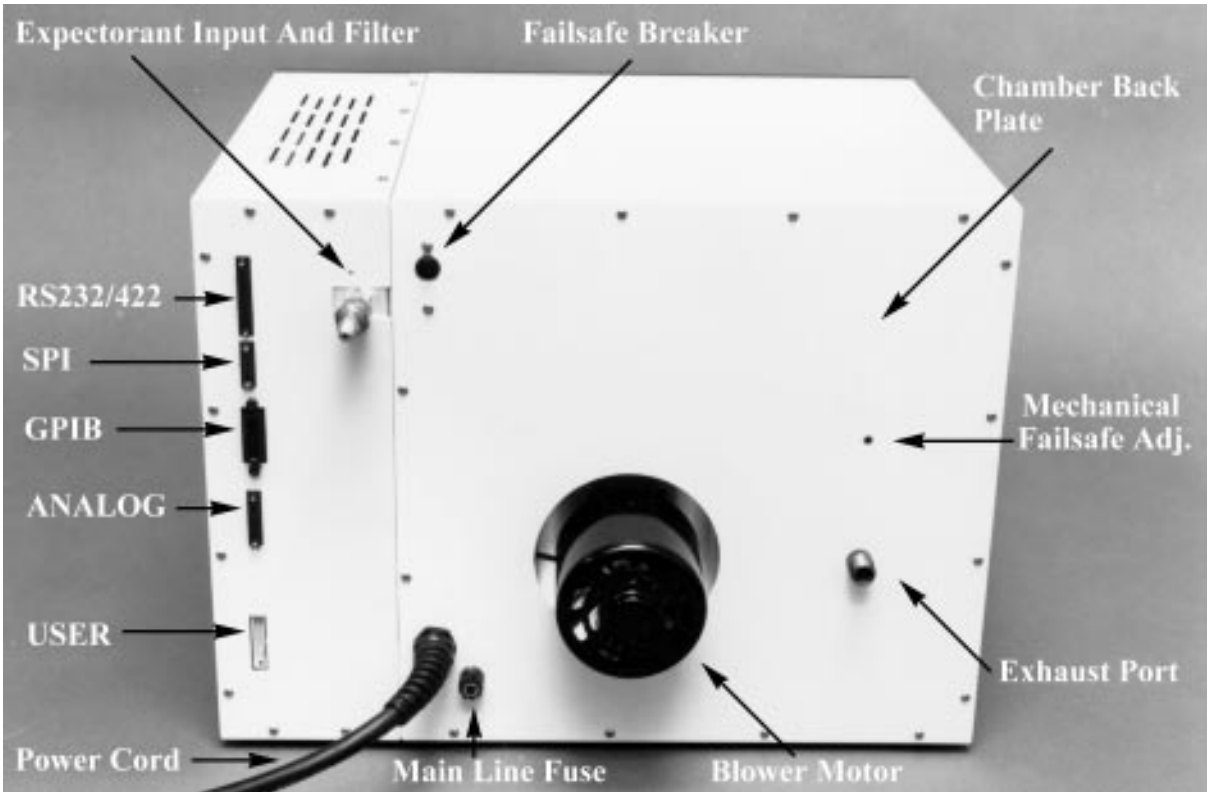
EC1X COMPONENT IDENTIFICATION

Take a moment to become familiar with the major components of your environmental chamber by reviewing the following figures. Refer to these figures when performing adjustments, routine maintenance or removal and replacement procedures.

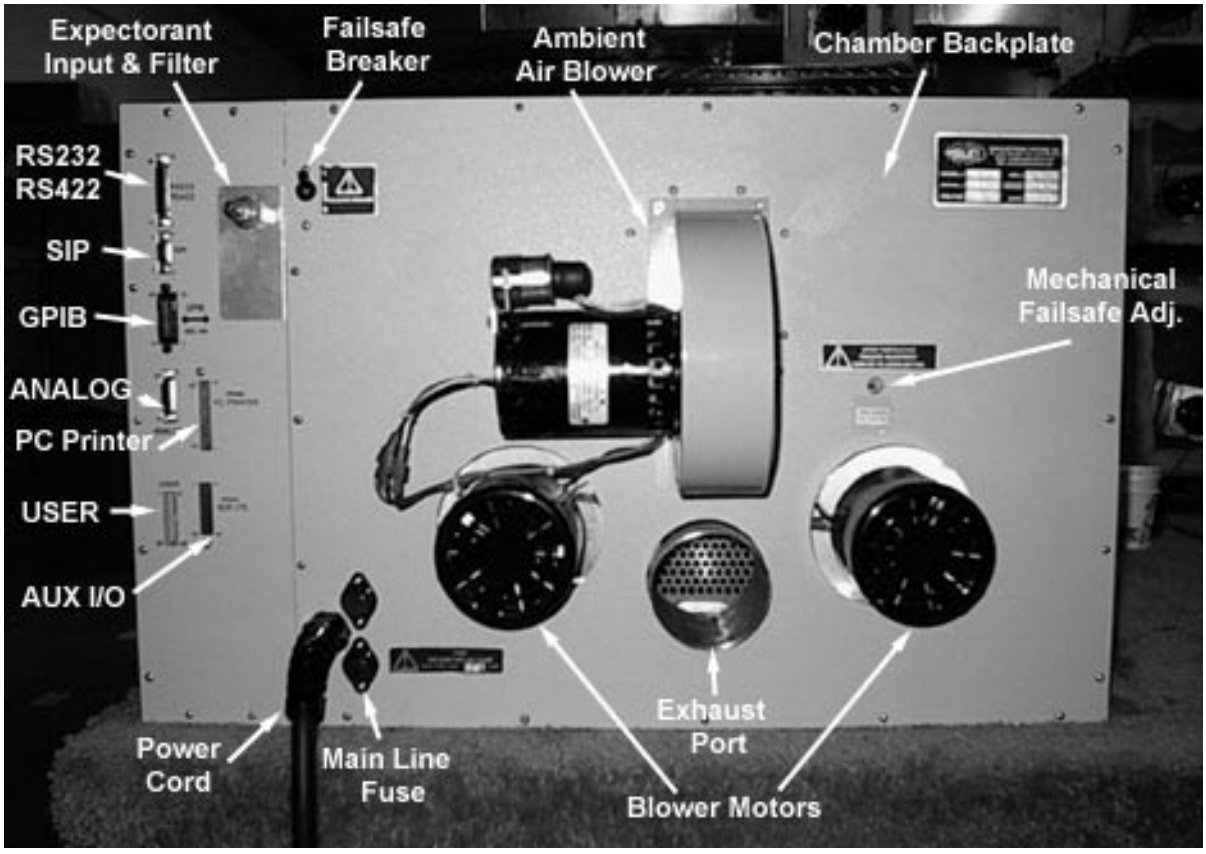
CHAMBER FRONT VIEW



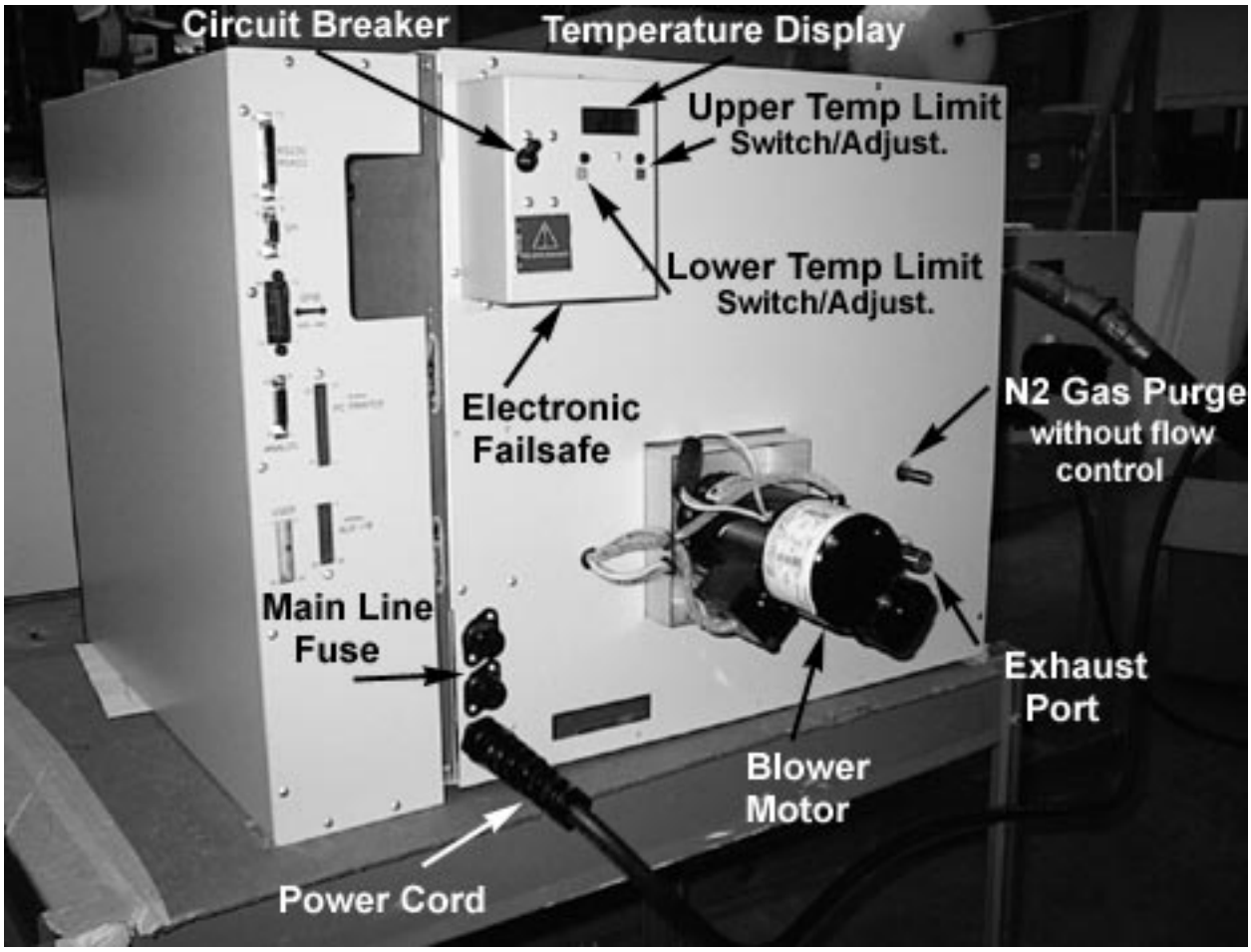
CHAMBER REAR VIEW OF EC1Xwith Mechanical Fail-Safe



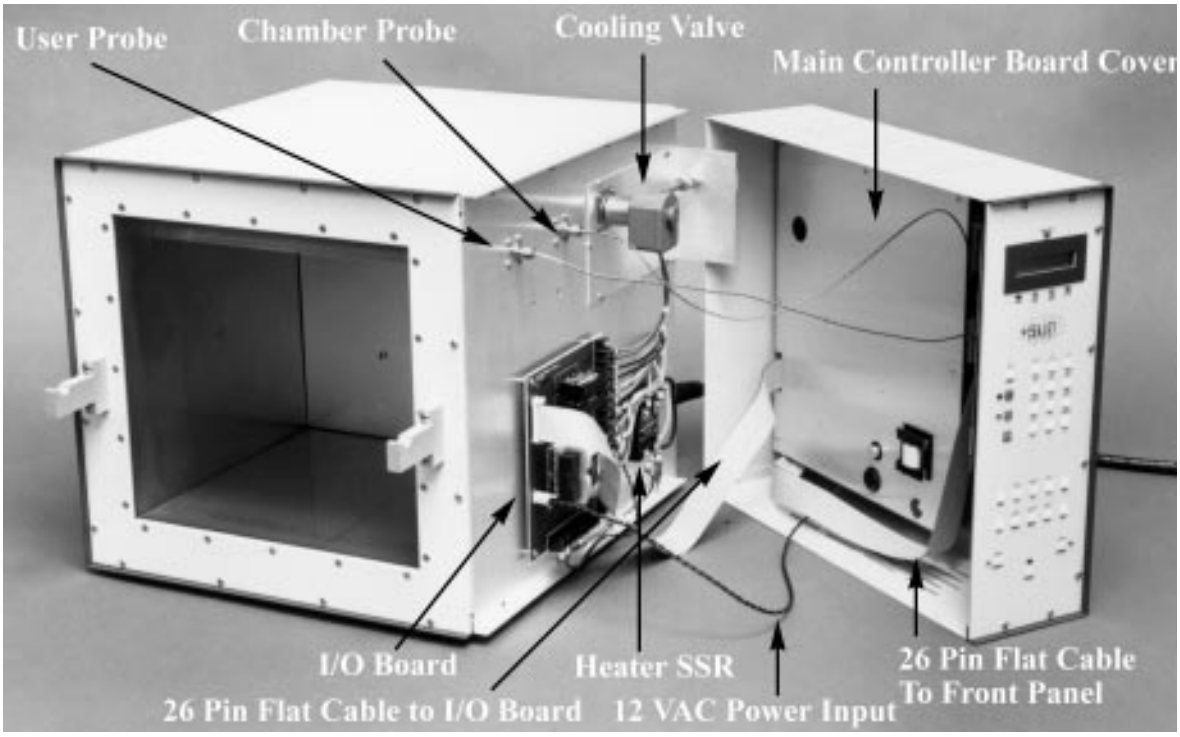
CHAMBER REAR VIEW OF EC1XHAwith Mechanical Fail-Safe



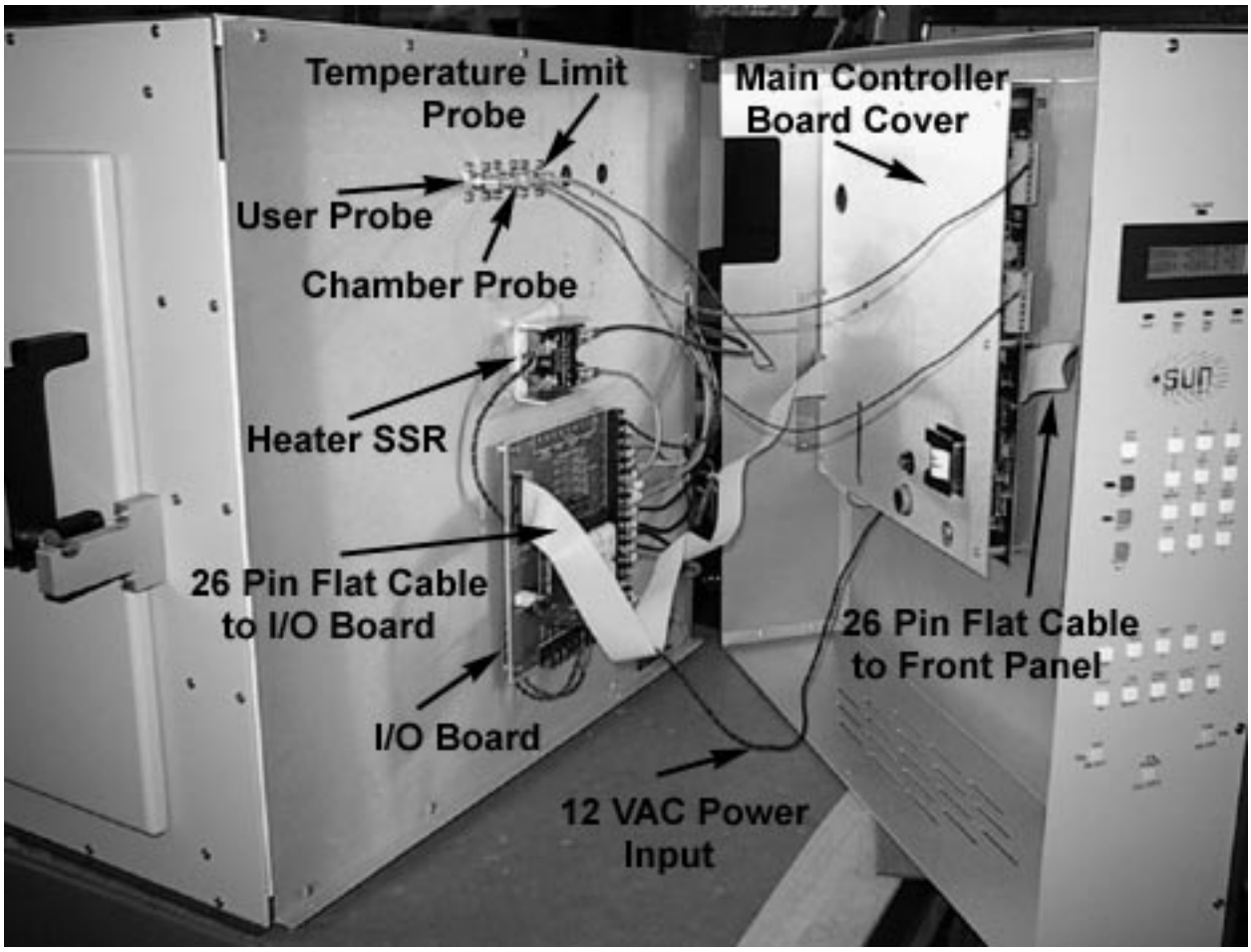
CHAMBER REAR VIEW OF EC1.3W with Electronic Fail-Safe



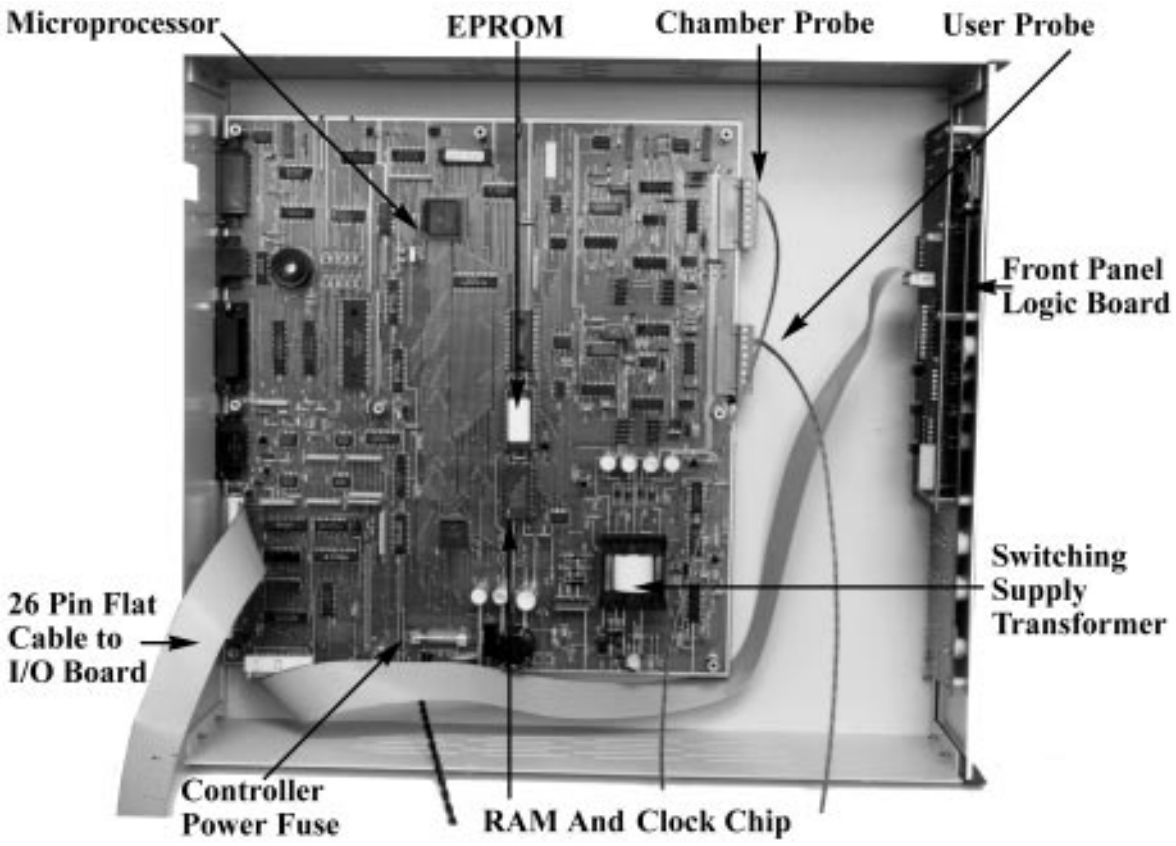
CONTROLLER SECTION SEPARATED OF EC1X & EC1XHA



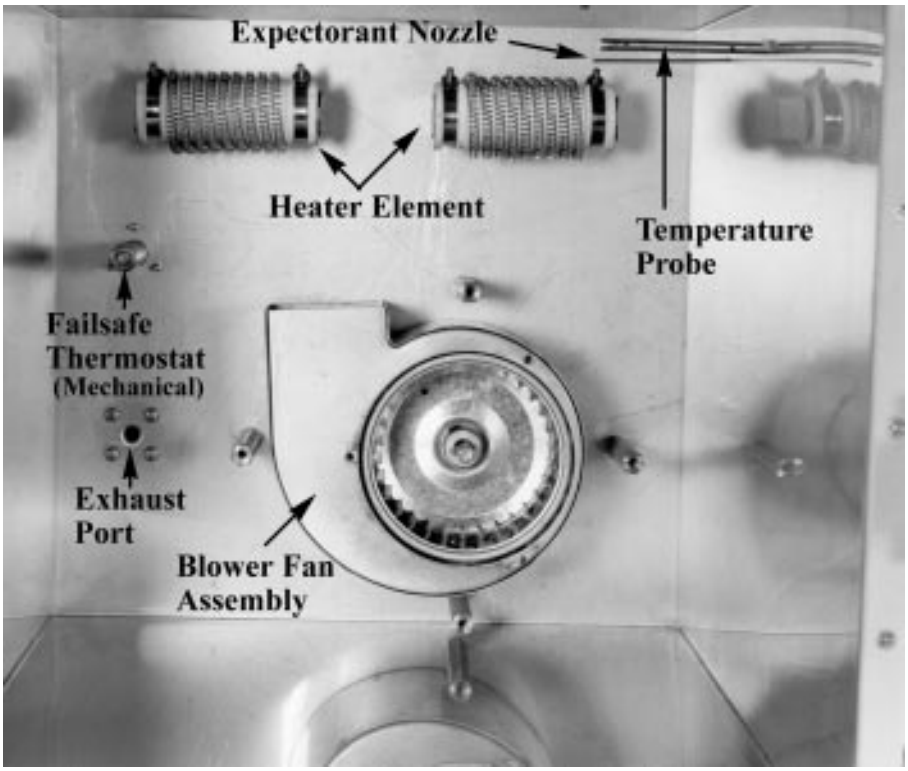
CONTROLLER SECTION SEPARATED OF EC1.3W



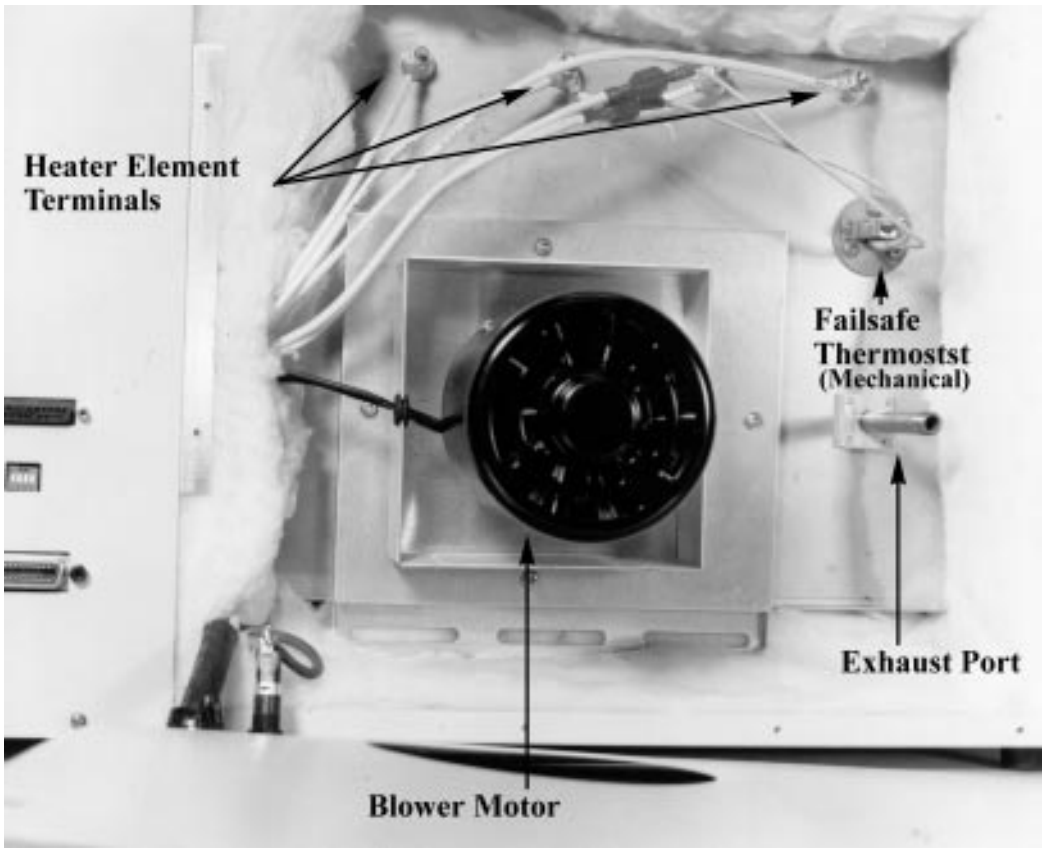
CONTROLLER SECTION MAIN BOARD COVER REMOVED



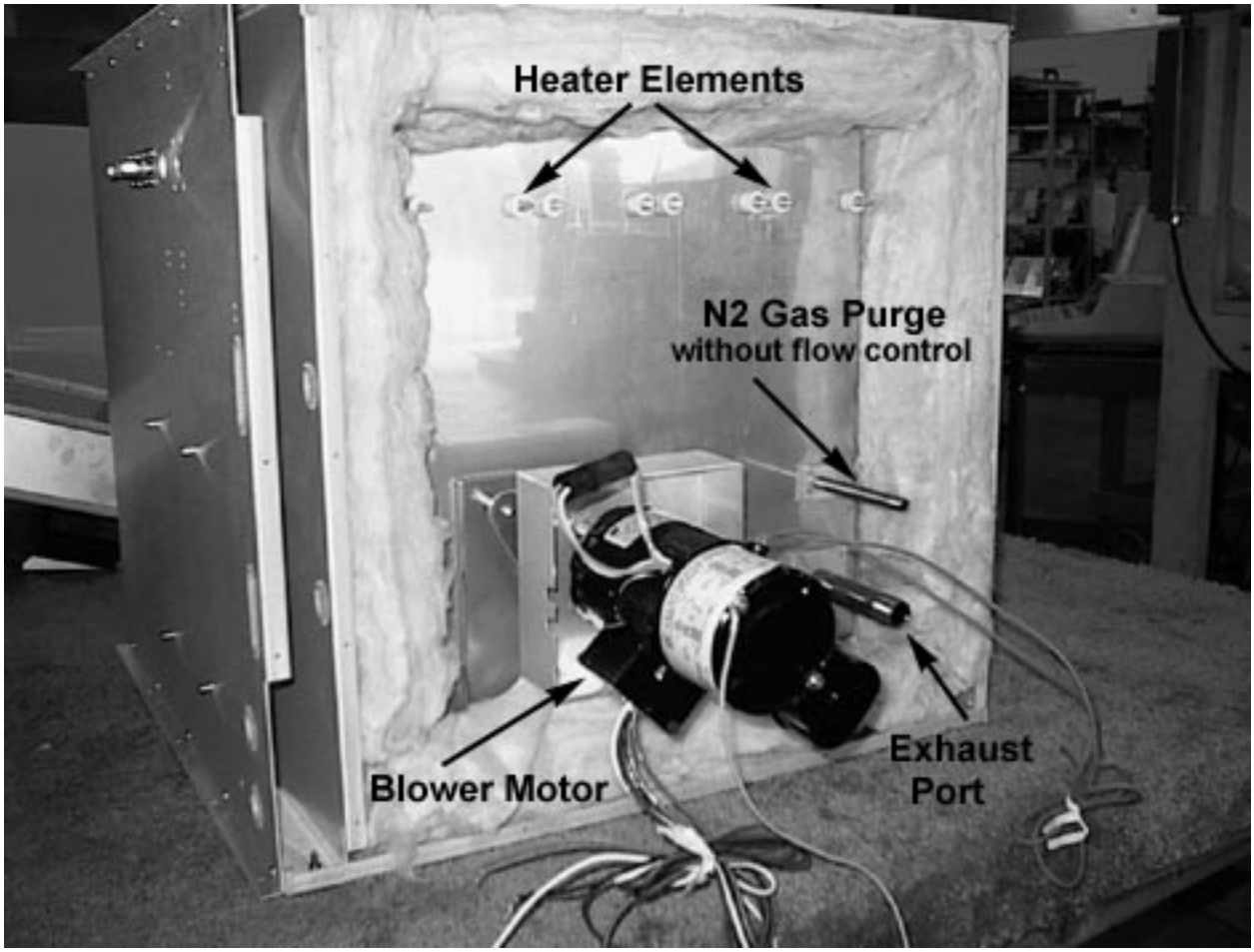
CHAMBER WITH AIR BAFFLE REMOVED



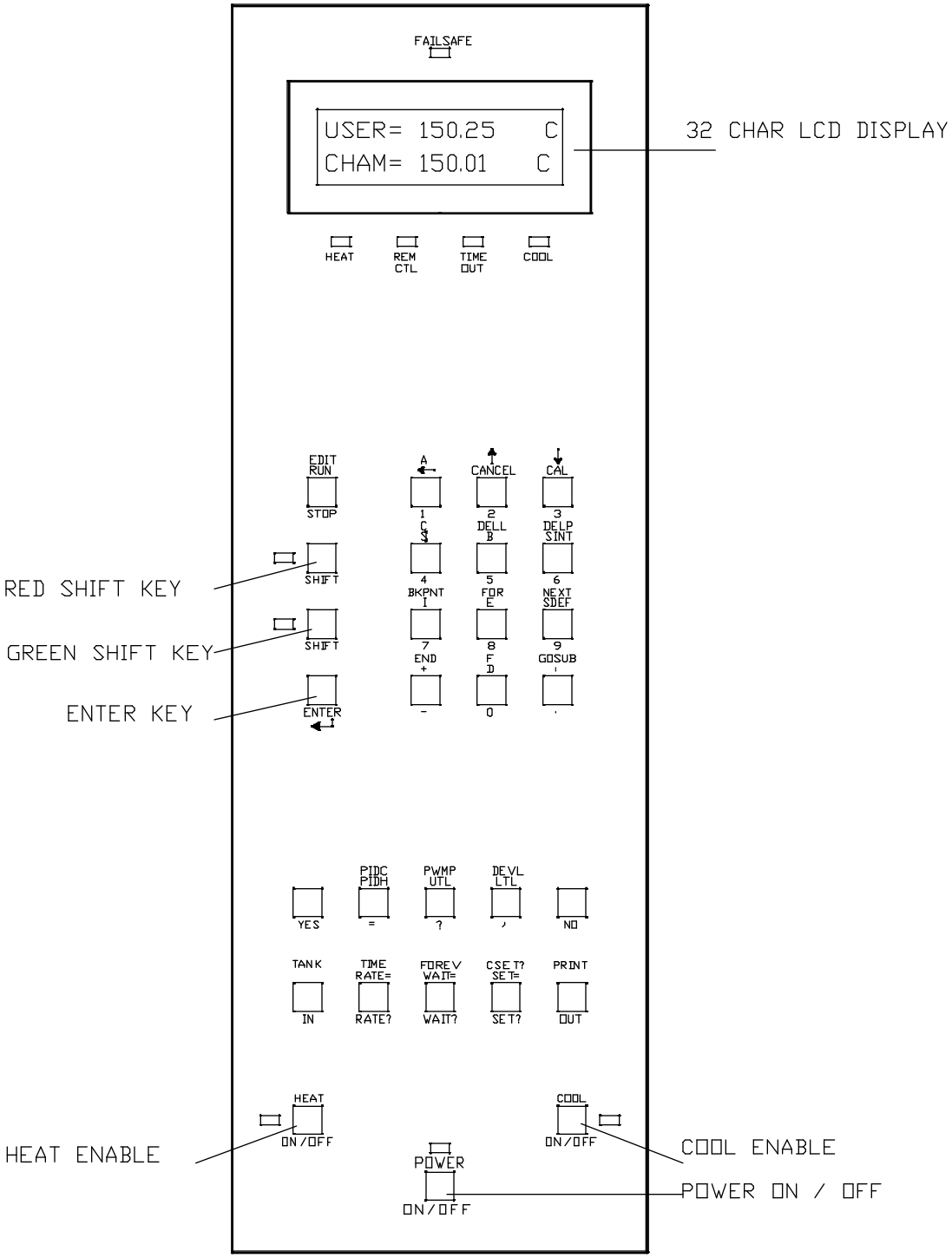
CHAMBER INTERNAL REAR VIEW

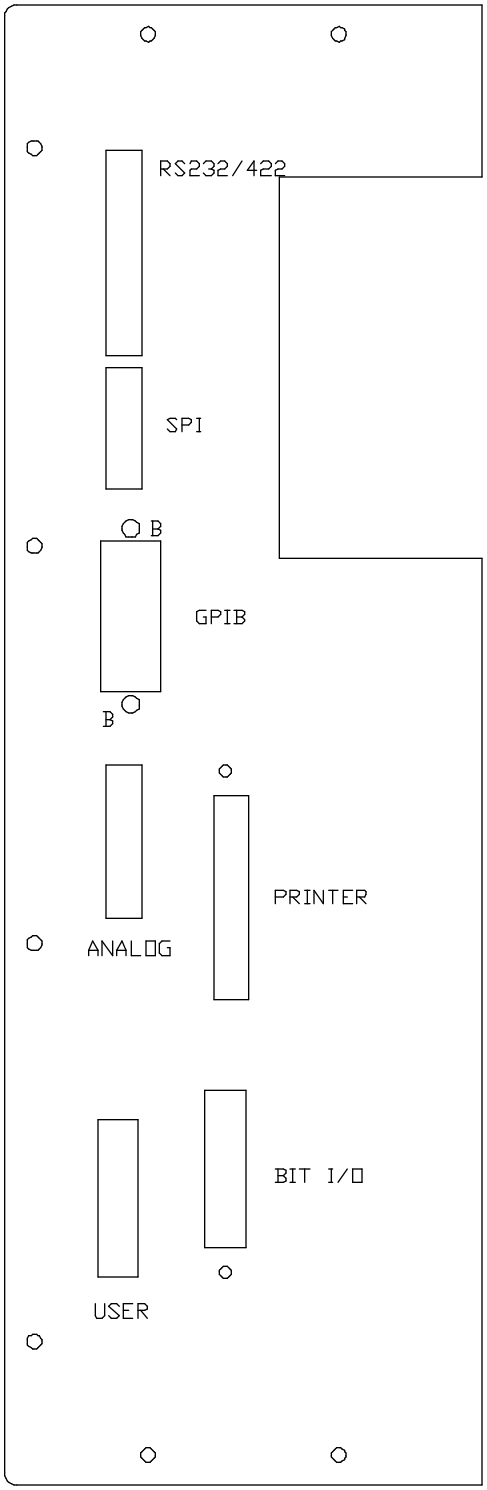


CHAMBER INTERNAL REAR VIEW OF EC1.3W



FRONT PANEL


FAILSAFE
USER= 150.25 C
CHAM= 150.01 C
32 CHAR LCD DISPLAY
HEAT
REM CTL
TIME OUT
COOL
EDIT RUN
STOP
A
CANCEL
CAL
1 C $
2 DELL B
3 DELP SINT
SHIFT
RED SHIFT KEY
4 BKPNT I
5 FOR E
6 NEXT SDEF
SHIFT
GREEN SHIFT KEY
7 END +
8 F D
9 GOSUB
ENTER
ENTER KEY
- 0 .
PIDC PIDH
PWMP UTL
DEVL LTL
YES
= ? , NO
TANK
TIME RATE=
FOREV WAIT=
CSET? SET=
PRINT
IN
RATE? WAIT? SET? OUT
HEAT
ON/OFF
HEAT ENABLE
COOL
ON/OFF
COOL ENABLE
POWER
ON/OFF
POWER ON / OFF



REAR PANEL

SECTION 2. RECEIVING, SAFETY AND INSTALLATION

INITIAL INSPECTION AND UNPACKING

Inspect the shipping container for obvious damage. If the shipping container is damaged, then a written note on the bill of lading describing the damage should be made while the delivery person is still on the premises. Unpack the EC1x and save all carton and cushioning material in case the unit needs to be returned. Verify the contents of the carton matches that of the items listed on the packing slip.

LOST OR DAMAGED EQUIPMENT

If you determine that the goods described on the packing slip are lost or damaged, first notify the transportation company to obtain the correct procedure for returning merchandise for repair or replacement. Then call Sun Systems for a return authorization number so that we may best handle the merchandise when it is returned.

SAFETY CONSIDERATIONS

Please take a moment to read the following safety precautions. If, for any reason, you do not fully understand the meaning of the cautions, please contact Sun Systems' customer service before proceeding.

CAUTION - Set the fail-safe as per setting the fail-safe section.

CAUTION - Lifting of the chamber should be done by two people to avoid injury.

CAUTION - Battery not user replacable.

CAUTION - Disconnect all electrical power sources before attempting any type of access or service to the interior of the chamber to prevent electrical shock. Turn off expectorant supplies and disconnect expectorant supply hose before attempting any type of service to the interior of the chamber.

CAUTION - Always operate the chamber with the case grounded to earth ground. Verify that the power outlet to be used has an earth ground and meets your local electrical codes.

CAUTION - Verify that the source of electrical power is compatible with the manufactured configuration of the chamber indicated on the rear of the unit.

CAUTION - Do not mount on or around flammable material.

CAUTION - Avoid personal contact with the interior portions of the test chamber area to prevent burns from heat or cold.

CAUTION - Use personal protective equipment such as gloves, goggles, face shields, etc., when working with or in an environment containing liquid carbon dioxide or liquid nitrogen.

CAUTION - Avoid any personal contact of the skin or eyes with liquid carbon dioxide or liquid nitrogen or supply lines and vessels carrying these liquids. Exposure to these liquids or the vessels which carry them can cause frostbite.

CAUTION - Operate the chamber in an environment with good ventilation to air. If the chamber is to be installed in an enclosed area, connect the chamber exhaust port to outside air. Never use the exhaust port for test access to the internal temperature chamber.

CAUTION - Do not block internal air circulation air inlet port. Reduced airflow may cause heater element failure.

CAUTION - Always follow the safety precautions supplied by the vendor for your liquid carbon dioxide or liquid nitrogen storage cylinders and vessels.

CAUTION - Verify that the correct type of expectorant source is connected to the chamber before operating the chamber at low temperature. Test the expectorant for cleanliness by discharging a small amount through a clean filter. Inspect for quantities of ice, oil, rust or water for contamination. Contaminated expectorants must not be used.

CAUTION - Do not leave liquid nitrogen trapped in a supply line as high pressures will be developed when the liquid absorbs heat and is transformed from a liquid to a gas. Bleed the supply hose when not in use.

CAUTION - To prevent premature LN_2 coolant valve failure, do not operate the chamber with the COOL enabled without a coolant connected to the chamber and turned on. The coolant flow through the solenoid acts as coolant for the valve. Set auto cool off to yes in SDEF MENU.

CAUTION - When operating the chamber at low temperatures for extended periods of time, operate the chamber at +100°C for an hour to dry any moisture which may accumulate in the fiberglass insulation material surrounding the test area of the chamber.

CAUTION - Avoid oil contamination of the fiberglass insulation material surrounding the test area of the chamber. Liquid oxygen may be formed in the insulation material when operating at low temperature. Liquid oxygen mixed with oil can be explosive.

LIQUID CARBON DIOXIDE DELIVERY SYSTEMS

There are three common delivery systems available with the use of liquid carbon dioxide. They consist of a room temperature 50 pound, 850 PSI type K cylinder, a 350 pound, 300 PSI Dewer's type vessel and 300 PSI bulk delivery systems. Delivery systems utilizing 300 PSI delivery pressure require option CLxVxT to be ordered with the chamber. Follow the recommendations of your LCO_2 supplier as to the correct methods to store and use your expectorant supply.

LCO2 INSTALLATION PROCEDURE

1. If the chamber was ordered for use with 850 PSI LCO_2 bottles then simply connect the hose supplied with the chamber between the LCO_2 inlet fitting on the back of the chamber, and the type K cylinder. No regulators, etc. are required. The adaptor connected to the hose should fit on the LCO_2 bottle. Turn on the LCO_2 supply and check for leaks.
2. If the chamber was ordered for use with 300 PSI LCO_2 then connect the hose supplied with the dewer vessel or bulk system to the LCO_2 inlet fitting on the back of the chamber. Hoses used with

300 PSI LCO_2 should be thermally insulated since 300 PSI LCO_2 is approximately at 0º C. The adaptor between the hose and delivery system is not supplied. Turn on the LCO_2 delivery system and check for leaks.

LCO_2 3-TANK AUTO SWITCH

The 3-tank LCO_2 automatic switching option is available on the EC1x chambers. When enabled in the SDEF MENU the controller will sense when the cooling rate is low and automatically switch to the next LCO_2 tank. This is a useful feature for users that use bottled LCO_2, 850 psi, for its long storage life without boil off, when performing extended test profiles. (Refer to the TANK and TANK? command in Section 5) Three hoses and adaptors are provided to connect three tanks to the three inlets on the back of the chamber.

LIQUID NITROGEN DELIVERY SYSTEMS

Chambers configured with the Liquid Nitrogen option as the cooling expectorant are able to operate as low as -184ºC in temperature. Liquid nitrogen (LN_2) is commonly supplied in either a vessel (also called a dewar) or a bulk delivery system. Delivery pressure for these systems vary. A bulk delivery system normally runs low pressure (this pressure should not be below 25 psi). Delivery from a vessel is available in low or high pressure. Low pressure is 25psi to 50psi. High pressure is approximately 100psi. Other pressure set ups are available, please contact factory. The pressure specified for the chamber at time of order is recorded on page 2 of this manual and on the I.D. Tag found on the back of the chamber.

LN_2 INSTALLATION PROCEDURE

1. The EC1x is equipped with a 3/8", SAE 45 degree flare male fitting on the rear of the chamber (tank fitting CGA 295). Connect the user supplied cryogenic supply hose to this fitting. A 3/8" I.D. thermally insulated supply hose should be used for best chamber operation.

2. Connect the other end of the cryogenic supply hose to the LN_2 supply.

3. Insure fittings are secure. Turn on the LN_2 supply and check for leaks.

LN_2 2-TANK AUTO SWITCH

The 2-tank LN_2 automatic switching option is available on the EC1x chambers. When enabled in the SDEF MENU the controller will sense when the cooling rate is low and automatically switch to the next LN_2 tank. This feature is useful when performing extended test profiles. (Refer to the TANK and TANK? command in Section 5)

LN_2 AUTO LINE PURGE

The LN_2 auto-purge option is available on the EC1x chambers. This feature supports the liquid nitrogen automatic hose cool down. When enabled in the SDEF MENU the controller senses low cooling rate and automatically turns on a second nitrogen valve. This second valve injects nitrogen at a fast rate to provide the initial flow of nitrogen that may be necessary to quickly cool the hose that runs between your LN_2 source and the chamber. Answer yes to auto purge SDEF MENU prompt if the auto purge option is installed.

NITROGEN GAS PURGE

A nitrogen gas purge option is available for EC1x chambers. The purpose of this option is to provide a dry nitrogen environment for the Device Under Test (DUT) during temperature testing. Inherent with expectorant cooled chambers a dry gas condition exists when cooling since LN_2 or LCO_2 is injected into the chamber. To maintain dry conditions during heating, the purge is used. The nitrogen gas purge option consists of a flow meter, needle valve, on/off control valve and 6' hookup line. The 6' line is 1/4" OD plastic hose with 1/8" NPT male fitting on both ends. The rear of the chamber has a 1/8" NPT female fitting. The following commands are used to turn on/off the gas flow.

OUT0:4,1	turn on gas flow
OUT0:4,0	turn off gas flow

AMBIENT AIR BLOWER SYSTEM

The EC1xHA chambers incorporate an air blower that blows ambient room air into the chamber to provide a means to cool the chamber from higher than room temperature point down to near room temperature without consuming expectorant. After the ambient air blower cools the chamber to near room temperature, normal expectorant cooling would be used to cool to the low temperature point. Cooling provided by the blower follows an exponential curve. When the difference between the chamber and ambient temperature is large very high rates of cooling are realized. Use of this feature saves a considerable amount of expectorant when cycling between high and low temperature points. To control the ambient blower refer to Chapter 5: Detailed Command Descriptions, command AB and command OUT.

AMBIENT AIR BLOWER INSTALLATION

The EC1xHA chambers come with an ambient air blower which must be installed on the mounting screws on the back of the chamber. The hardware consists of the blower, four washers and four screws. The blower has three leads. The green lead with the ring terminal is ground and should be attached to a mounting screw on the back of the chamber. The red and black leads with the male terminators should be attached to the two red leads coming out of the chamber. Since the blower motor is AC powered the two wires may be plugged-in in either order.

SETTING THE FAIL-SAFE

There are two types of fail-safe, mechanical and electronic. To determine which fail-safe your Model chamber has, see INFORMATION ABOUT YOUR CHAMBER on page two or look at the back of the chamber. Chambers with a mechanical fail-safe will have a small adjustment screw located on the back of the chamber. Chambers with an electronic fail-safe will have a small box containing a digital display, circuit breaker and two adjustment buttons mounted on the back of the chamber. Refer to photos in Section 1, CHAMBER REAR VIEW.

SETTING THE MECHANICAL FAIL-SAFE

The mechanical fail-safe provided with the chamber is a safety device to prevent the chamber from inadvertently overheating. You will need to determine the maximum temperature that you can

allow the chamber to reach. This temperature is set to +155ºC from the factory. To change this temperature, perform the procedure listed below. If this maximum temperature is ever reached in your chamber, the fail-safe light on the front of the chamber will light and the circuit breaker on the rear of the chamber will trip, thus removing power from the heaters.
STEP1: Locate the fail-safe adjusting hole on the rear of the EC1x and displace any insulation material which may block access to the fail-safe adjusting screw.

STEP2: If the desired trip point is higher than +155ºC, the fail-safe adjusting screw must be turned counterclockwise a couple of turns. This sets the fail-safe at a higher value and will not trip the circuit breaker. If the desired trip point is lower than+155ºC, it is not necessary to adjust the screw at this time.

STEP3: Set the chamber temperature to the desired trip point temperature and set the wait time to 10 minutes. For example, if the desired trip point is +155ºC, the following keystrokes from the front panel would be necessary:

SET=155
ENTER
WAIT=10
ENTER

To set the trip point for a temperature other than +155ºC, replace the 155 with the desired trip point. (Note: the above assumes that ºC is the default setting for units for the chamber probe).

STEP4: After the chamber is at the set point for 10 minutes, the buzzer will sound and the Time Out LED will light on the front panel. The fail-safe can now be set.

STEP5: Using a small blade screwdriver, slowly adjust the screw clockwise to lower the fail-safe trip point until the heater circuit breaker on the rear of the unit trips. The fail-safe LED on the front panel will also light. When this occurs, stop turning the screw clockwise and turn the screw 1/4 of a turn counterclockwise and reset the heater circuit breaker to restore normal operation. If the circuit breaker does not reset, adjust the fail-safe slightly more in the counterclockwise direction until the circuit breaker remains on and the chamber functions normally.

SETTING THE ELECTRONIC FAIL-SAFE

The electronic fail-safe provided with the chamber is a safety module to protect the chamber from a number of possible conditions. The Temperature Limit Module detects the following conditions and causes the dual pole circuit breaker to open;

1. If the chamber temperature exceeds the Upper Temp Limit (UTL) setting of the module.
2. If the chamber temperature goes below the Lower Temp Limit (LTL) setting of the module.
3. If the module's thermocouple should fail as an open circuit.
4. If the module's power supply should fail. Such as its fuse blowing.
5. If a current of 2 amps or more is detected to the chamber chassis earth ground. This condition can occur, for example, if a heater element fails in such a way that the heater element wire breaks and comes in contact with the inner chamber wall.

When the 2 pole breaker opens all line power is removed from the heater circuitry. Opening of the breaker also causes a signal to be sent to the chamber main controller electronics. The main controller, upon indication of the breaker open state, then turns off all fans and valves and turns on the FAIL-SAFE LED. Once the breaker is tripped open, it will stay in the open tripped state until manually reset by moving the handle to the up position. Before resetting the breaker it is necessary to correct the cause of the breaker trip, else it will trip again within a few seconds. Never hold the breaker lever in the up position, just push it up and release the lever.

The breaker and Limit Module are located on the rear of the chamber. There is a 3 1/2 digit LCD display that normally display's the chamber temperature as sensed by the Limit Module. Note that the Limit Module's temperature accuracy is much less than the temperatures displayed on the front panel (see temperature table that follows). There are two push keys and two screws that can be removed to access the UTL and LTL adjustment pots. To view the current UTL setting, push and hold the RED key. To adjust the UTL setting, remove the screw above the red key then while holding the red key use a small flat tipped screw driver and adjust the UTL setting. The LTL setting is done in a like manner using the BLUE key and its adjustment pot that is located above the blue key.

The following table gives approximate module temperature readings relative to the actual temperature. The module was designed to be a simple analog circuit to provide reliable chamber protection. Its temperature accuracy was not a design goal. For example, to cause the trip at 300 deg C actual chamber temperature you may need to set the module UTL to 303 deg C or so.

ACTUAL TEMP deg C	MODULE READOUT deg C
-200	-146
-100	-88
-60	-55
-20	-19
0	0
100	100
200	202
300	303
400	415

EC1X CHAMBER INSTALLATION

The EC1x is factory wired for AC sources delivering 110, 208 or 240 VAC, 50/60 Hz. A tag located on the back panel of the chamber indicates the proper voltage to be applied. Insure that the current rating of the service is sufficient to provide the necessary amounts of power required by the chamber (see Section 7: Specifications). Install the chamber on a surface which is flat, rigid and free from shock and vibration. Orient the chamber in such a manner that the control panel, door and coolant connection are readily accessible. Insure that 2 inches of free air space exists between the rear of the blower motor and any other objects.

Once all packing material has been removed from around and within the Model EC1x, the unit is connected to its primary power source, a coolant supply is connected to the unit and, if required, an appropriate exhaust vehicle is connected to the exhaust port. Now the Model EC1x is ready for operation. Press the yellow power key located on the bottom of the front panel. After selfcheck is complete the Model EC1x should power up with the LCD display indicating Chamber probe temperature and USER probe temperature. The blower located in the rear of unit should be operating. The Model EC1x is now ready to accept commands.

INITIAL START UP {TO SET A SINGLE TEMPERATURE SEGMENT}

1. *First set the rate of change of temperature to 30 deg / min.*

   press green alternate function key
   RATE=

   3

   0

   blue **ENTER** [Displays RATE=30]

2. *Next set the wait time to 1 minute and 10 sec*

   green alt key
   WAIT=

   green alt key
   :

   1

   green alt key
   :

   1

   0

   blue **ENTER** [Displays WAIT=0:1:10]

3. *Then set the target temperature to 40 degrees*

   green alt key
   SET=

   4

   0

   blue **ENTER** [Displays SET=40]

To enable the heat and cool outputs, press the yellow heat ON/OFf and cool ON/OFf keys. The chamber will ramp to 40 deg and after 1 minute 10 sec will time out.

SAMPLE LOCAL PROGRAM

The following program demonstrates some of the most used features. The program will cause the chamber to go to 50 deg at a rate of 30 deg / minute and stay there for 5 minutes. After the 5 minutes at 50 deg the buzzer will sound and BKPNT 1 will be displayed. To continue from the breakpoint press ENTER . The chamber will then go to 0 deg, at a rate of 25 deg / minute and stay there for 7 and 1/2 minutes. Then BKPNT 2 will be executed, press ENTER to continue. Then the above will be repeated 5 times by the FOR - NEXT loop. To ENTER the program in program #0 follow the key strokes listed below.

red alt key *[to delete existing prog #0 (if any)]*
DELP

0

ENTER

red alt key *[to create a program]*
EDIT

0

ENTER *[free memory is displayed, then line #1 is displayed , if program is empty then END is displayed]*

*NOT*E: While in edit mode red up and down arrow keys allow you to move in the local program. The red DELl allows you to delete the current displayed program line. A line can be inserted in front of the current displayed program line by ENTERing the new line.

red alt key
FOR

0

=

1

,

6

ENTER *[Displays* FOR I0=1,*6]* *to set number of cycles* =5
green alt key
RATE=

3

0

ENTER *[Displays* RATE=3*0]* *to set ramping rate for 30 deg./mi*n

green alt key
WAIT=

5

ENTER *[Displays* WAIT=*5*] *wait 5 minute*s

green alt key
SET=

5

0

ENTER *[Displays* SET=5*0]* *at 50 degree*s

red alt key
BKPNT

1

ENTER *[Displays* BKPNT*1] Pause (see BKPNT command*)

green alt key
RATE=

2

5

ENTER *[Displays* RATE=2*5]* *set ramp rate for 25 deg./min*

green alt key
WAIT=

0
green alt key
:

7

green **SHIFT**
:

3
0

ENTER *[Displays* WAIT=0:7:3*0]* *wait 7 min and 30 sec*

green alt key
SET=

0

ENTER *[Displays* SET=*0]* *at 0 degrees*

red alt key
BKPNT
2

ENTER *[Displays* BKPNT*2] Pause (see BKPNT command*)

red alt key
NEXT

0

ENTER *[Displays* NEXT I*0]* *end of For/Next loop of 5 cycles*

red alt key
END

ENTER *[Displays* END LP*]* *local edit now done;*

To run the program, green alt key ,RUN, 0, **ENTE**R *Runs Local Program #*0

SAMPLE LOCAL PROGRAM

Red Edit 0 ENTER	Edit Program 0
Red FOR 0 = 0, 20 ENTER	Cycles = 20
Green RATE= 100 ENTER	Set Ramping Rate for 100ºC/min
Green Wait= 45 ENTER	Wait 45 minutes
Green Set= 125 ENTER	at 125ºC,
Green Wait= 30 ENTER	Wait 30 minutes
Green Set= -55 ENTER	at -55ºC ,
Red Next 0 ENTER	End For/Next loop of 20 Cycles
Green Wait= 1 ENTER	Wait 1 minute
Green Set= 25 ENTER	at 25ºC
Red End ENTER	End Local program edit

To start the program, Green RUN 0 ENTER

* See Commands in back of manual - in alphabetical order.

SECTION 3. OPERATION AND COMMAND OVERVIEW

The Model EC1x is very adaptable to your test system architecture requirements. Whether issuing commands from the local front panel keyboard or remotely from over the IEEE-488 GPIB interface or RS232/422 serial interface, you have full control of the Model EC1x capabilities. This chapter starts off with a command overview section to assist users who are new to the operation of the Model EC1x followed by sections which define in detail the operation of the Default, Interrupt and Calibrate Menus. Setting of the fail-safe was covered in section 2. Section 5 contains an alphabetically sorted, detailed description for all commands which may be used as a programming reference.

COMMAND OVERVIEW

This section groups the various commands available for the Model EC1x by function and gives a brief definition for the command. Consult Section 5 for a detailed definition on a particular command.

Commands from the local control panel described in the following sections may require several keystrokes followed by depressing the **ENTE**R key. Commands from the GPIB interface are terminated with the EOI and/or a line feed character. Command lines from the RS232/422 interface may be terminated with a line feed or carriage return character or both carriage return and line feed characters. Numeric values with leading and trailing zeros and spaces are accepted and integer, fixed and floating point values are converted as required. Lower case characters are automatically converted to upper case.

If an error is made during command entry, either locally or remotely, a COMMAND ERROR message is displayed. To determine the cause of the error, you may press the [?] Key followed by the **ENTE**R Key from the local keyboard or ENTER ? from a remote interface. The controller will provide a 2 line response. The first line will be a copy of the last command received. The second line will be either a pointer to the error, or an explanation of the error. If there was no error in the last command received, the controller will respond with a two line “OK” “OK” message.

CONTROL PANEL OPERATORS

To permit easy command entry and local program generation, the following operators on the local control panel permit command entry, command cancellation, menu decisions, single command line editing during STOP mode and program editing during EDIT mode.

UP,DOWN ARROWS	Line editing during Local Program editing.
DELL	Delete current program line
DELP n	Delete local program number n
LEFT ARROW	Character backspace during command entry.
CANCEL	Cancels present command entry.
ENTER	ENTERs command into Model EC1x controller.

	or inserts a line into the local program.
YES, NO	Operators for SDEF, SINT and CAL menus.

PARAMETER ENTRY

Parameters are used for numeric data entry, delimiters and function operators in command lines.

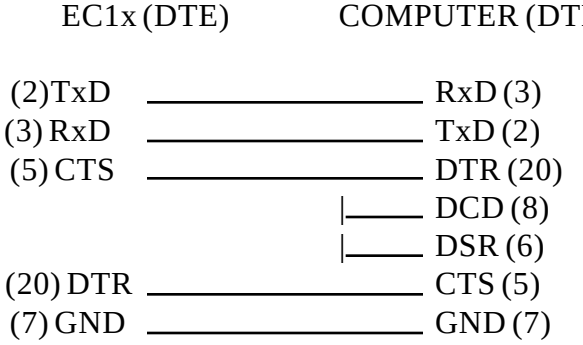
0-9 . + _	Numeric data (depicted as nnn.n in following sections)
. : ,	Numeric delimiter.
E	Exponent for scientific notation.
=	Set variable left side equal to value right side.
?	Examine variable left side .

RS232/422 SERIAL PORT PROTOCOLS

The serial port's operation depends on whether CMD ERROR INT'S are enabled or disabled in the SINT menu. If command error interrupts are disabled, no indication to the host computer communicating to the serial interface is given as to whether a command was accepted or rejected. To determine last command status the ? command may be used. If command error interrupts are enabled, the controller responds with a ? prompt if the command received was rejected. If the command was accepted and the type of command does not invoke a reply, i.e., such as a SET=nnn.n command, the controller will reply with an OK message. If the accepted command invokes a reply, then the reply is sent without the OK message. The CMD ERROR INT ENABLED mode is convenient since every command sent to the controller generates a reply back to the host computer thereby providing a handshake.

As covered, many of the RS port operating parameters are set up in the SDEF menu. The SDEF menu allows setting of the BAUD RATE,RS232 or RS422 levels, ECHO on / off, and whether to use hardware handshake. The serial port sends a zero for the parity bit and does not check incoming parity (8 Data Bits, No Parity, 1 STOP Bits). When DTR/CTS is not selected, only the TRAN DATA, REC DATA and GROUND signal lines are significant to the controller. When DTR/CTS control is selected the following recommended wiring should prove effective for RS232.

RS232 INTERFACE



GPIB PORT PROTOCOLS

When CMD ERROR INT'S are enabled, the GPIB port sends a CMD ERROR SRQ interrupt on commands received with errors. If command error interrupts are disabled, then no response is sent to the GPIB port if command errors are detected. In all cases, the only data that is sent to the GPIB interface by the controller is that which is requested by a command received by the controller. The GPIB port does not respond with "OK" after commands that do not send back data, since it does not require extra command handshaking.

The SDEF menu allows you to set the GPIB address, and the GPIB LOCKUP TIME, which is the length of time that the controller will wait for the host to accept data before generating a GPIB LOCKUP interrupt. The SINT menu also provides the ability to set up the parallel poll.

POWER, HEAT, AND COOL ON/OFF CONTROL COMMANDS

These commands turn the Model EC1x main power on/off and enable or disable the heat and cool functions. On the Model EC1x control panel, these functions have separate function keys located at the bottom of the panel. The switches operate in a push-on/push-off or alternate action fashion. The indicator is on when the function is enabled. The following commands are for remote operation only. When the Model EC1x main power is OFF and the unit is plugged in, the controller will only accept the ON or STATUS? commands from a remote interface.

ON	Turn Model EC1x main power on.
OFF	Turn Model EC1x main power off.
HON	Enable heat function.
HOFF	Disable heat function.
CON	Enable cool function.
COFF	Disable cool function

TEMPERATURE CONTROL COMMANDS

Temperature control commands allow you to set or examine temperature segment parameters. A temperature segment in the Model EC1x is defined by the rate of change of temperature (RATE) from the present chamber temperature to the final temperature (SET) and by the amount of time to wait (WAIT) at the final temperature before continuing with the next temperature segment. Upon detection of a SET command, the controller uses the values as given by the RATE and WAIT commands and initiates the proper action to implement the temperature segment. For best operation ENTER the RATE and WAIT information before ENTERing the SET point. The CSET? command allows you to examine the current temperature which the controller is attempting to control during ramps from one temperature to another. This value changes at the rate defined by the RATE command until the SET value is reached. At that point CSET is equal to the SET value. The chamber and user temperature may be read remotely at any time and are displayed on the LCD display.

SET=nnn.n[u]	Set segment final temperature.
SET?	Examine present segment final temperature.
WAIT=nn:nn:nn	Set temperature soak period at final temperature (HRS:MIN:SEC)

WAIT=nn	set wait time (MIN)
WAIT=F{OREVER}	Wait Period never times out.
WAIT?	Examine present wait period.
RATE=nnn.nn[u]	Set temperature ramping rate at nnn.nn degrees per minute
RATE?	Examine present temperature ramping rate.
CSET?	Examine present temperature of which controller is attempting to control.
UCHAN?	Examine USER probe value.
TEMP?	Examine CHAMBER probe value.
SCALE#1?	Examine Units of Scale for the Chamber Probe, C,F, or K.
SCALE#2?	Examine Units of Scale for the USER Probe, C, F, or K.
TIME=hh:mm:ss	Set Time of Day
TIME?	Examine present Time of Day
STOP	Prematurely terminate the run mode or make set=none if run mode not active

[u] is optional units character C,F, or K.

TEMPERATURE SAFETY LIMIT COMMANDS

Temperature limit commands are used for safety reasons and to insure test parameters are not exceeded. Lower and upper temperature limits prevent setting temperatures in violation of the limit setting. In addition, upper and lower temperature limit commands shall generate an interrupt to the active remote device if the chamber exceeds one of the temperature limits. If the chamber temperature exceeds the upper temperature limit, the controller will automatically turn off chamber heating. If the chamber temperature exceeds the lower temperature limit, the controller will automatically turn off chamber cooling. The deviation limit generates an interrupt to the remote interface, if enabled in the SINT menu, if the chamber temperature exceeds the tolerance you specified via DEVL command.

LTL=nnn.n[u]	Set chamber lower temperature limit.
LTL?	Examine lower temperature limit
UTL=nnn.n[u]	Set chamber upper temperature limit.
UTL?	Examine upper temperature limit.
DEVL=nnn.n[u]	Sets maximum +/- chamber temperature deviation limit.
DEVL?	Examine deviation limit.

CONTROL LOOP PARAMETER COMMANDS

The Model EC1x permits the user to modify PID and PWM characteristics with these commands. When examining PID coefficients, P,I, and D are displayed approximately 3 seconds apart with the value following a P,I and D on control panel display. These commands typically apply to unique circumstances which involve varying loads of mass or radiant power. The PID coefficients are set at the factory for normal operation. If it is necessary to change the default settings Sun Systems can provide a PID Application Note containing an instructional overview on how to set the PID coefficients for a particular chamber and load. The Pulse Width Modulator (PWMP) parameter permits the controller to adjust the control rate at which the temperature is maintained in the chamber. This feature may conserve coolant valve wear when long soak durations are applicable and larger deviations are permissible by increasing the PWM time period. For normal operation, the PWM rate should be set at the minimum rate of 2 seconds as shipped.

PIDH= n.nn, n.nn, n.nn	Set Heat PID coefficients P,I, D
PIDH?	Examine Heat PID coefficients.
PIDC= n.nn, n.nn, n.nn	Set Cool PID coefficients P, I, D.
PIDC?	Examine Cool PID coefficients.
PWMP=nn	Set PWM period (2 to 30seconds).
PWMP?	Examine present PWMP value.
PIDA?	Examine advanced PID setting
PIDA=n[,mmm.m]	Set advanced PID mode

LOCAL PROGRAM COMMANDS

The Model EC1x provides commands to control the flow of local programs which permit automatic test operation by the chamber. Up to 10 programs may be ENTERed into the Model EC1x either from the local control panel or from either the GPIB or RS232/422 interfaces. Programs may call other programs as subroutines with the GOSUBn instruction. The Model EC1x provides 10 global integer variables designated by the letter I. The I variable may be used in FOR In/NEXT In statements for multiple pass loops, the I variable may be used in IN and OUT instructions for communication with Model EC1x I/O interfaces and it may be used in arithmetic expressions containing additions and subtractions. The END instruction designates the end of a local program or subroutine. The red END command is used to terminate the edit mode.

A program is ENTERed into the Model EC1x locally from the front panel by using the EDIT m function, where m is the number of the program, 0 thru 9. Programs may be downloaded from a remote interface using the STORE command. Command DELL permits deleting program lines during local edit. DELP m deletes program m, where m is 0 thru 9. A program is executed using the RUN m and prematurely terminated with the STOP command.

Debug assistance and host computer synchronization is provided with the BKPNT nn or BKPNT Im commands, which permit the operator to place breakpoints in the program that suspend program execution until the ENTER key is depressed on the local control panel or until a remote BKPNTC

command is received. BKPNTnn displays the value nn and BKPNT Im displays the value of variable Im when encountered during local program execution. The remote BKPNT? command is provided so that the host computer may determine the breakpoint value.

EDITm	EDIT program m, m=0 thru 9.
RUNm	RUN program m, m=0 thru 9.
RUN m TIME=nn	RUN program m at time of day
STOP	STOP all program execution.
DELL	DELETE LINE currently being displayed during edit mode.
DELPm	DELETE PROGRAM m, m=0-9.
BKPNTnnn	BREAKPOINT, suspends program operation and displays Integer Bkpnt nnn value
BKPNTIm	BREAKPOINT, suspends program operation and displays current "Im" value

FORIm=[starting integer value] , [ending integer value], [+ / -]

where m=0 thru 9	FOR statement marks the beginning of a loop. The "Im" variable is either incremented [+, default] or decremented [-] from the starting integer to the ending integer. FOR statements may be nested 4 deep.
NEXTIm	NEXTIm marks the end of the FOR loop.
Im=nnnn	where m=0 thru 9 and nnnn= -32767 thru 32768 Set integer "Im" to 16 bit signed integer value
GOSUBm[m=0 thru 9]	GOSUB calls a program as a subroutine and may be nested 4 deep.
END	End of program statement. Or return if called as a subroutine
LIST#m	List program "m" to a remote interface.
STORE#m	Store program "m" from a remote interface.

MODEL TC01/EC0X COMPATIBILITY COMMANDS

The Model EC1x provides limited upwards compatibility with our Model TC01 temperature controller and our Model EC0x environmental chambers as described below. Consult your TC01 manual for a complete definition of these commands.

nnn.nC	Set Chamber Temperature (deg C)
C	Examine Chamber Temperature (deg C)
nnn.nM	Set Time at Temperature, Wait time (minutes)
M	Examine Time at Temperature (minutes)
T	Examine Chamber Temperature in deg C always
nnnUTL	Set Upper Temperature Limit (deg C)
UTL	Examine Upper Temperature Limit (deg C)

!sss...sss	Transfer String sss...sss received from GPIB to RS232/422 interface
S	Transfer next string received from RS232/422 interface to GPIB

DEVICE I/O COMMANDS

The device I/O commands permit communication from the local control panel or from a host computer to or from the many I/O devices resident in the Model EC1x. Consult Section 4 for the proper format of the command for the particular device you wish to communicate with.

INj:k,In	Read input port number "j" address "k" into integer variable In
In?	read value of integer variable In
OUTj:k,l	Write to output port number "j" address "k" data "l". An I variable may also be used in data field

NOTE: j=0 for BIT I/O, j=1 for USER PORT, j=2 for SPI, j=3 for ANALOG PORT

SET DEFAULT MENU (SDEF)

The Model EC1x contains default values which may be tailored to your individual test system requirements. The values are stored in nonvolatile memory eliminating the need to reload after a power interruption. Refer to Section 5, command STOPE9, for information about restoring the factory default settings. This command will delete all local programs.

LOCAL CONTROL OF THE SET DEFAULT MENU (SDEF) :

The default values may be set locally from the control panel by depressing the SDEF, ENTER keys followed by responding to the menu oriented questions on the control panel display with either a YES or NO or a numeric value. To maintain current settings, that is displayed inside parentheses ( ), just press ENTER key. The format of the menu is as follows :

SDEF	ENTER Set Default mode.
Set Up Defaults? [Y/N]	ENTER YES if you want to modify defaults.
GPIB Address? 0-30	ENTER GPIB address.
GPIB Lockup Time? 0,2-59 sec	ENTER GPIB interface max. lockup time. If Time=0, then GPIB lockup interrupts are disabled.
Timeout Pre_Time? 0-59 sec	ENTER GPIB SRQ or Serial Interface advanced interrupt generation before actual wait period timeout.
Power Down Restart? 0-59 min	Disables automatic restart of controller above set minutes.
D/A Output A? 1= 0 to +5V, 2 = -5 to +5V	ENTER 1 or 2

D/A Output B? 1= 0 to +5V, 2 = -5 to +5V	ENTER 1 or 2
D/A Output C? 1= 0 to +5V, 2 = -5 to +5V	ENTER 1 or 2
D/A Output D? 1= 0 to +5V, 2 = -5 to +5V	ENTER 1 or 2
Serial Port Mode? 1=RS232, 2=RS422	ENTER 1 or 2
RS Char Echo On? [Y/N]	ENTER YES for serial port character echo
Baud Rate 1=9600 to 6=300	ENTER 1 through 6 1= 9600 Baud 4 = 1200 Baud 2 = 4800 Baud 5 = 600 Baud 3 = 2400 Baud 6 = 300 Baud
RS DTR-CTS on? [Y/N]	ENTER YES for hardware handshake
Buzzer Volume 0 = OFF to 3	ENTER 0=OFF, 1=SOFT, 2=MEDIUM, 3=LOUD
Line Frequency 1= 60 Hz, 2 = 50 Hz	ENTER 1 for 60 Hz or 2 for 50 Hz line frequency
Chart CHAM on A? [Y/N]	Chart chamber temperature on D/A output channel A. ENTER Yes or No. If YES, then the controller prompts: ENTER Low value - ENTER lowest value to chart (in degrees) for this channel. ENTER High value - ENTER highest value to chart (in degrees) for this channel.
Chart USER on B? [Y/N]	Chart USER probe temperature on D/A output channel B. ENTER Yes or No. If YES, then the controller prompts: ENTER Low value - ENTER lowest value to chart (in degrees) for this channel. ENTER High value - ENTER highest value to chart (in degrees) for this channel.
If printer option installed: Enable Printer [Y/N] ?	ENTER YES to enable line printer if installed.
Lines/min 1 to 6	If answered YES to printer, then select # of lines/min to print
Low Chart value ?	ENTER chart low end temperature
High Chart Value ?	ENTER chart high end temperature
PID to D/A C [Y/N]	ENTER YES to output PID control to D/A output channel C
+/- at Wait Trigger ?	ENTER temperature tolerance at which the controller starts wait time countdown.
Setup Coolant Valves?	ENTER YES to change coolant type If you answered YES to Setup Coolant Valves:
LCO_2 (850 PSI) ?	ENTER YES if your chamber is setup for 850 PSI LCO_2.

Auto 3 Tank CO_2	ENTER YES if chamber is setup for 3 tank LCO_2.
CO_2 (300 PSI) ?	If you answered NO to 850 PSI LCO_2, ENTER YES if your chamber is setup for 300 PSI LCO_2.
Auto 2 Tank CO_2	ENTER YES if chamber is setup for 2 tank LCO_2
Liquid Nitrogen ?	ENTER YES if your chamber is setup for LN_2
Redundant Valves ?	ENTER YES if your chamber has redundant valve option installed.
LN_2 Line Purge ?	ENTER YES if your chamber has line purge valve option installed.
Auto 2 Tank LN2 ?	ENTER YES if your chamber is setup for 2 tank LN_2.
AMB_BLOWER_COOL?	Only applies to EC1xHA chambers (Ver 3.23 & up) and is intended to be used on EC1xHA chambers that do not have coolant hooked up. ENTER YES to enable the automatic cooling of chamber with ambi ent air when the set point is > or = 25 Deg C and the chamber tempera ture exceeds the set point by 1 Deg C. Expectorant cooling will occur as usual as long as the cool enable is ON. (See AB and OUT Command)
Auto SENSE IN0 ?	ENTER YES if your chamber is setup to automatically detect logic on input bit 0 and shut off Heat and Cool. This is commonly used for a "Door Open" sensor. Default setting is NO. If enabled (yes) & chamber is not set up for this, Error - b0 Force H&C OFF occurs.
SENSE LOGIC (Hi=1, Lo=0)	Enter 0 or 1 based on the logic setup in your chamber. (Refer to "Your equipment configuration in the manual)

REMOTE CONTROL OF THE SET DEFAULT MENU (SDEF)

The interrupt values may be set remotely from the GPIB, RS-232 or RS422 by utilizing the SDEF=xxxxxxxxn command. Refer to Section 5, command SDEF for details.

SET INTERRUPT MENU (SINT)

The Model EC1x contains interrupt assignment values for the local alarm, serial interface, and GPIB interface/SRQ interrupt. The values are stored in nonvolatile memory eliminating the need to reload after a power interruption. Refer to Section 5, command STOPE9, for information about restoring the factory default settings. This command will delete all local programs.

LOCAL CONTROL OF THE SET INTERRUPT MENU (SINT)

The interrupt values may be set locally from the control panel by depressing the SINT, ENTER keys followed by responding to the menu oriented questions on the control panel display with a YES, NO or numeric response. To maintain current setting, that is displayed inside (), just press **ENTER.**. The format of the menu is as follows.

SINT	ENTER Set Interrupt mode.
Set up Interrupts?[Yes/No]	ENTER Yes if you want to modify interrupts.
BUZZ LP Timeout? [Yes/No]	ENTER Yes to enable BUZZER after each temperature segment timeout during Local Program execution

BUZZ LP Done? [Yes/No]	ENTER Yes to enable BUZZER when the end of a Local Program is encountered.
BUZZ Single T.O.? [Yes/No]	ENTER Yes to enable BUZZER at the end of each temperature segment timeout in single temp. mode.
INT LP Timeout? [Yes/No]	ENTER Yes to enable Timeout Interrupts after each temperature segment timeout during Local Program execution
INT LP Done? [Yes/No]	ENTER Yes to enable LP Done interrupt when the end of a Local Program is encountered.
INT SINGLE T.O.? [Yes/No]	ENTER Yes to enable a Single Temp. Timeout interrupt at the end of each temperature segment in single temp. mode.
DEVIATION INT? [Yes/No]	ENTER Yes to enable DEVIATION Interrupts.
CMD ERROR INT'S? [Yes/No]	ENTER Yes to enable Command Error Interrupts
BKPNT INTERRUPT [Yes/No]	ENTER Yes to enable breakpoint Interrupts
P_POLL{1-8} 0=NO	ENTER 0 to disable parallel poll or 1 thru 8 to set bit position for parallel poll
CAL menu access code?	The number that is ENTERed will become the code that the CAL menu will expect to grant access. A 0 number will turn off CAL access code.

REMOTE CONTROL OF THE SET INTERRUPT MENU (SINT)

The interrupt values may be set remotely from the GPIB, RSS232 or RS422 by utilizing the SINT=xxxxxxxxxxn command. Refer to Section 5, command SINT for details.

REMOTE INTERRUPT CHARACTERS

Condition	**Serial Port**	**GPIB Port (HEX)**
No Interrupt	(n/a)	$00
Single T.O. INT	I	$41
Command Error INT	?	$42
LP Timeout INT	P	$43
LP Done INT	E	$45
DEVIATION INT	D	$46
OVER Temperature INT	O	$47

UNDER Temperature INT	U	$4A
GPIB Lock-up INT	(n/a)	$4F
POWER Going Down	!	(none)
POWER Up no auto cont.	Z	(none)
POWER Up auto cont.	X	(none)
BKPNT	B	$50

PROBE CALIBRATION MENU

The Model EC1x contains two electrically isolated, high performance probe front ends capable of interfacing to a variety of different probe types. There are two ways to calibrate the chamber and/or user probes. The CAL menu permits you to select a probe type, calibrate the probe, and/or select the units of measure for the probes. The CAL menu must be used if you are changing the probe type. If the type of probe is not going to be changed then the " CAL TO A STANDARD " commands may be used. When calibrating a probe using the CAL menu it is necessary to place the probe to be calibrated at 0º C and at 100º C. This requires removing the probes from the chamber, which is inconvenient. The CAL TO A STANDARD commands allow calibrating to a known accurate house temperature standard without removing probes. Listed below is the dialog if calibrating at 0ºC and +100ºC or with voltage or current inputs.

green **SHIFT** CAL, **ENTER** ENTER CAL mode.

The types of probes that it is currently configured for will be display for about 3 seconds. Top line is chamber probe, Bottom line is user probe.

Calibrate Probes? [Yes/No] ENTER Yes if you really want to change a probe type and/or calibrate a probe. ENTER No if you only desire to modify scale (ºC,ºF,ºK) for the CHAMBER and/or USER probe.

If you answer Yes to above;

ENTER CAL ACCESS CODE ? At this point the menu is asking for an access number to reduce the chance of unauthorized or accidental entry to the CAL routines. The default access code as shipped from the factory is 9. The access code may be changed to any floating point number in the SINT menu.

CAL CHAM Probe? [Yes/No] ENTER Yes to calibrate the chamber probe

If you answer Yes to CAL CHAM PROBE, select probe type.

*NOT*E: Once a type is selected you are committed to calibrating at 0ºC and 100ºC for probes. EC1x chambers are shipped from factory with type K thermocouples installed for chamber and user probes.

RTD.385 PROBE? [Yes/No] range = -200º to +320º C [DIN 43760]
RTD.392 PROBE? [Yes/No] range = -200º to +320º C

J Thermocouple [Yes/No]?	range = -200º to +320º C
K Thermocouple [Yes/No]?	range = -200º to +320º C
T Thermocouple [Yes/No]?	range = -200º to +320º C
Solid State? [Yes/No]	range = -60º to +160º C
0 to 5 Volt IN [Yes/No]	range: min=0V max=5V
0 to 20mA IN [Yes/No]	range: min=0mA max=20mA

If a temperature probe type was selected;

Probe at 0ºC [ICE WATER]?(Y/N)	Set probe to 0ºC. ENTER YES when ready.
Probe at 100ºC [BOILING WATER]?(Y/N)	Set probe to 100ºC. ENTER YES when ready.
Temperature Units? (1=C, 2=F, 3=K)	ENTER 1, 2, or 3

If voltage or current was selected;

Low Scale Input (Y/N)	Supply low level voltage or current to input and ENTER Yes when ready.
Low Scale Value ?	ENTER the number that represents low end process value.
High Scale Input (Y/N)	Supply high level voltage or current to input and ENTER Yes when ready.
High Scale Value?	ENTER the number that represents high end process value.
CAL USER PROBE [Yes/No]?	Repeat process similar to "CAL CHAM PROBE" for user probe.

If a "NO" answer was given to the “CAL PROBES” prompt, then you are asked if you wish to change the default units of measure for each channel.

CAL TO A STANDARD COMMANDS

Cal to a standard allows calibration of the chamber to your temperature standard instrument. Three commands are supplied to perform the calibration. "CALA" performs an offset cal to the first temperature point while "CALB" performs a gain cal between the first point and the second temperature supplied with the CALB command. "CALC" clears both the offset and gain cal adjustments.

To perform the cal to a standard:

1. CALC,access code Clears existing standard cal
2. Place your standard probe as close as possible to the probe or probes to be calibrated.

3. Set the chamber to go to the first temperature point.

4. Allow 15 to 20 minutes for chamber stabilization.

5. CALA1,access code,standard reading Calibrates the chamber probe offset

6. CALA2,access code,standard reading Calibrates the user probe offset

*Not*e: The access code is the CAL menu access code number (default 9). The standard reading is the temperature reading that your instrument is reading. The cal commands (ie.CALC,CALA1) are supported remotely by ENTERing the ASCII string and locally by ENTERing keystrokes,

For example, by depressing:

CAL A 1 , 9 , 2 0 0 **ENTER** is equal to CALA1,9,200 where 9 is the access code and 200 is the standard temperature reading

7. Set the chamber to go to the second temperature point. The larger the difference between the two points the more accurate the gain cal will be.

8. Allow 15 to 20 minutes for chamber stabilization.

9. CALB1,access code,standard reading Calibrates the chamber probe gain

10. CALB2,access code,standard reading Calibrates the user probe gain

SECTION 4. INPUT/OUTPUT INTERFACES

The Model EC1x contains three types of interfaces. The first type of interface is the COMMUNICATION interface. The RS232/422, GPIB, and the front panel are classified as communication interfaces since these interfaces may send/receive commands and data to the controller. The second class of interface is the AUXILIARY interface. Auxiliary interfaces consist of 5 on/off event outputs, 8 on/off inputs, up to 4 analog outputs and inputs, a high speed synchronous serial I/O port, and a digital parallel I/O port. The third is the PROCESS interface type. The process interfaces consist of the two sensor input channels and the outputs that control the process. Process control outputs consist of 3 on/off outputs, and the on/off fail-safe input.

COMMUNICATION INTERFACES

FRONT PANEL INTERFACE

The 32 key - 32 alphanumeric control panel interface permits Model EC1x operation in a stand-alone configuration. The control panel may request or send information from/to an AUXILIARY I/O interface by issuing the appropriate IN or OUT instructions.

GPIB (IEEE-488) PARALLEL INTERFACE

The Model EC1x incorporates a standard IEEE-488 GPIB interface for communication with a host computer. The bus address and timeout values can be set from the local control panel during the SDEF menu. The Model EC1x functions as a Talker/Listener on the bus and provides an SRQ/serial poll and parallel poll interrupt capability. The GPIB interface may request or send information from/to another I/O device interface by issuing the appropriate IN or OUT instructions. The signal pin assignments are as follows.

PIN #	SIGNAL	PIN #	SIGNAL
1	DIO1	13	DIO5
2	DIO2	14	DIO6
3	DIO3	15	DIO7
4	DIO4	16	DIO8
5	EOI	17	REN
6	DAV	18	GND
7	NRFD	19	GND
8	NDAC	20	GND
9	IFC	21	GND
10	SRQ	22	GND
11	ATN	23	GND
12	SHIELD	24	GND LOGIC

RS232/422 SERIAL INTERFACE

The Model EC1x provides an RS-232 or RS-422 serial interface for communication with a host computer that is selectable via the SDEF menu. The RS232/422 serial interface may request or send information from/to an AUXILIARY I/O interface by issuing the appropriate IN or OUT instructions. The signal pin assignments are as follows.

RS232/422 SERIAL INTERFACE (DB25)

PIN#	DESCRIPTION
1,7,13,15,17	GROUND
2	TXD RS-232 Transmitted Data from Model EC1x
3	RXD RS-232 Received Data to Model EC1x
5	CTS RS-232 Clear to send
20	DTR RS-232 Data Term Ready
12	+TXD RS-422 Tran Data +
25	-TXD RS-422 Tran Data -
10	+RXD RS-422 Received Data +
23	-RXD RS-422 Received Data -
9	+CTS RS-422 Clear to Send +
22	-CTS RS-422 Clear to Send -
11	+DTR RS-422 Data Term Ready +
24	-DTR RS-422 Data Term Ready -

AUXILIARY I/O INTERFACES

BIT I/O INTERFACE

The auxiliary interface is used by the chamber to control heating, cooling, and fan circuits and for the fail-safe input. The EC1xHA models also use the F3 output (address 2) to control the ambient blower. Unused inputs/outputs are available to the user internal to the controller section chassis. The Auxiliary I/O interface contains 8 drivers for controlling TTL or solid state relays and 8 inputs for sensing TTL or dry relay contacts and a fail-safe input. Outputs are open collector 50 volt 100 mA and are designated F1 thru F8. Pull up resistors of 270 OHM, connected to +5Volts are provided on signals designated P1 thru P8. Sense inputs are designated G1 thru G8. The signal pin assignments are as follows.

BIT I/O INTERFACE (26 PIN IDC)

PIN#	DESCRIPTION
2,4,6,8,10,12,14,16	F1 thru F8 outputs
18,20,22,24,26,25,23,21	P1 thru P8 pull ups
19,17,15,13,11,9,7,5	G1 thru G8 Inputs
3	Ground
1	FAIL-SAFE SIGNAL

In the Model EC1x, the auxiliary port interfaces to the I/O PC board which drives the heaters, blowers and coolant supply valve. An 8 position terminal block, located within the controller section chassis, with one spare input and one spare output is provided for optional control and sensing. The terminal block pin assignments and commands for turning on and off the auxiliary output and the command for reading the auxiliary input are as follows.

BIT I/O INTERFACE (TERMINAL BLOCK)

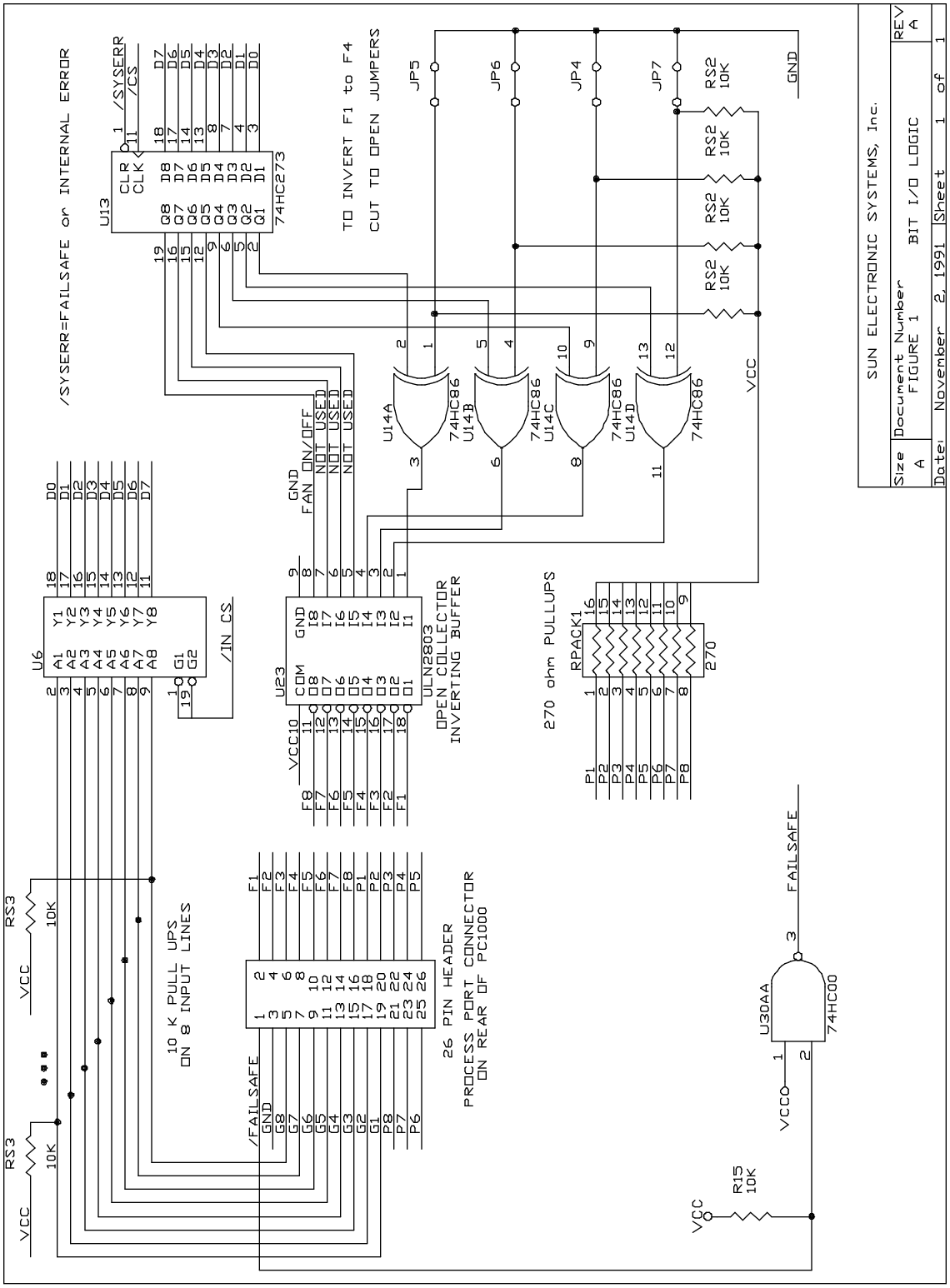
PIN#	**DESCRIPTION**
3	Ground
4	Auxiliary Sense Input
7	Auxiliary Open Collector Output
8	Auxiliary Output 270 OHM Pull-up

Bit I/O Interface Commands

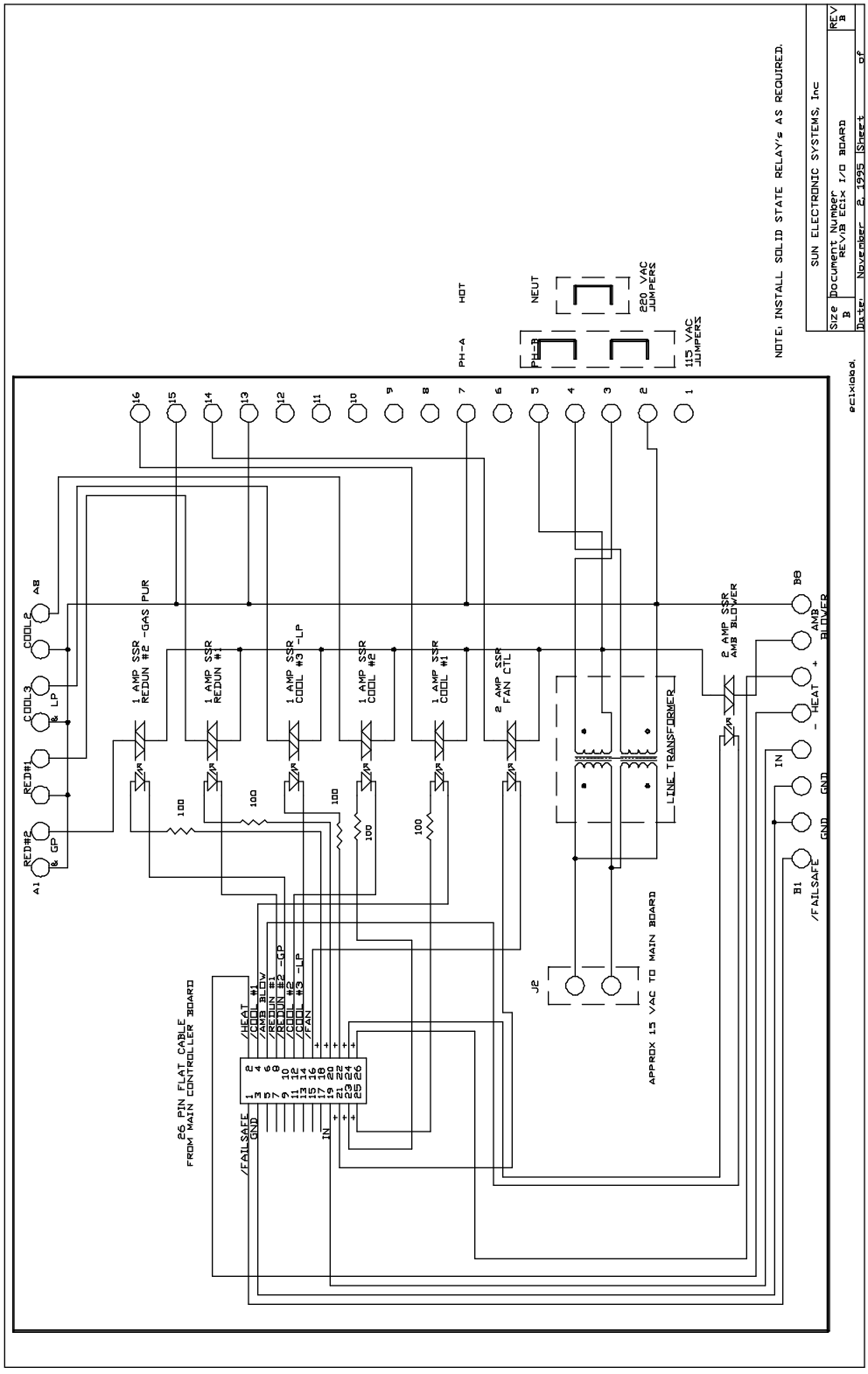
OUT0:2,1	Turns ON auxiliary output (goes low JP6 in)
OUT0:2,0	Turns OFF auxiliary output (goes high JP6 in)
IN0:0,Im	Returns a 1= open (TTL High), 0= closed (TTL Low) in variable Im

The following figures provide the aux port logic and the I/O board logic.

BIT I/O PORT LOGIC



I/O BOARD LOGIC



DIGITAL PARALLEL USER I/O INTERFACE

The digital parallel I/O interface permits the Model EC1x to easily interface with either Sun Systems test accessories or custom test accessories which you may require. The interface consists of a multiplexed 16 bit address and an 8 bit data bus. Control signals for upper and lower address and data permit de-multiplexing of the 8 bit multiplexed bus. The pin assignments are as follows.

USER PARALLEL I/O INTERFACE (26 PIN IDC)

PIN#	DESCRIPTION
2,4,6,8,	QAD7 thru QAD0 - Multiplexed 8 bit
10,12,14,16	Address/data bus (2)=QAD7...(16)=QAD0
18	QE_U - Active high either reads data from a device or writes data to a device depending on the state of the Q_R/W signal. During a WRITE operation, data is stable for the duration of QE_U. During a READ operation, the device must place data on the data bus, QAD7-0, within 1micro second after QU_E going active high.
20	Q_R/W - High defines a READ from a device, Low defines a WRITE to a device.
22	Q_ASM - Active high indicates that the data present on QAD7-0 is the upper 8 bits of a 16 bit address field.
24	Q_ASL - Active high indicates that the data present on QAD7-0 is the lower 8 bits of a 16 bit address field.
26	Reserved.
11,13,15,17, 19,21,23,25	GROUND
1,3,5,7,9	V UNREG - Unregulated DC voltage provide as operating power for test accessories. The nominal voltage is 15VDC with a tolerance of +/- 20%. The maximum current capability of the voltage source is 1.0Amp max. Fuse protected on the EC1x controller.

The control panel, Local Programs, GPIB and RS232/422 communication interfaces can read and write to devices attached to the USER parallel I/O interface by issuing the following device I/O commands.

USER PARALLEL I/O COMMANDS

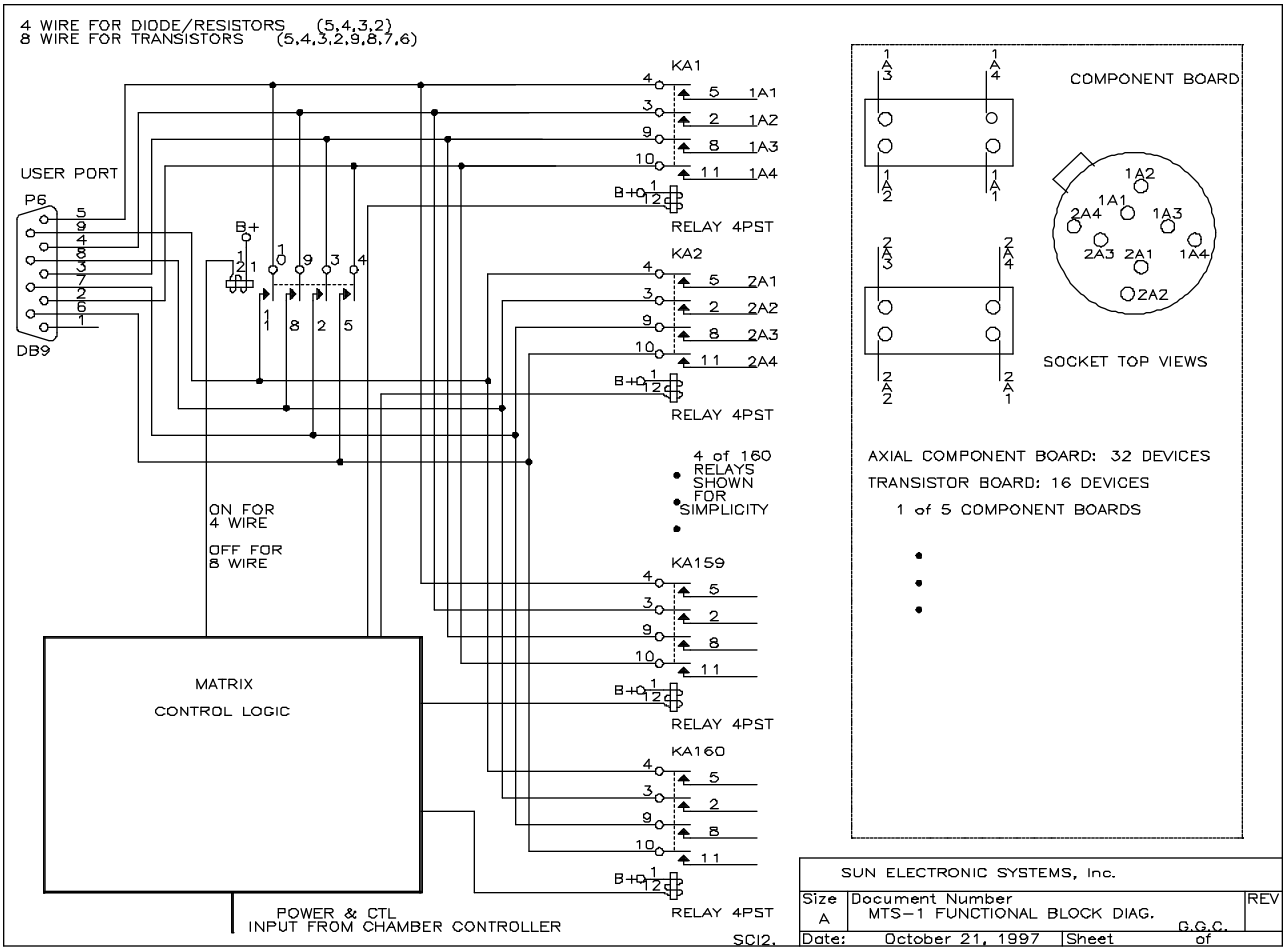
OUT1:[address] , [data]	Where address may be any 16 bit integer and data may be an 8 bit value or the lower 8 bits of a 16 bit integer.
IN1:[address], Im	Where address may be any 16 bit integer.

The user bus logic, bus timing diagram and an example circuit follow

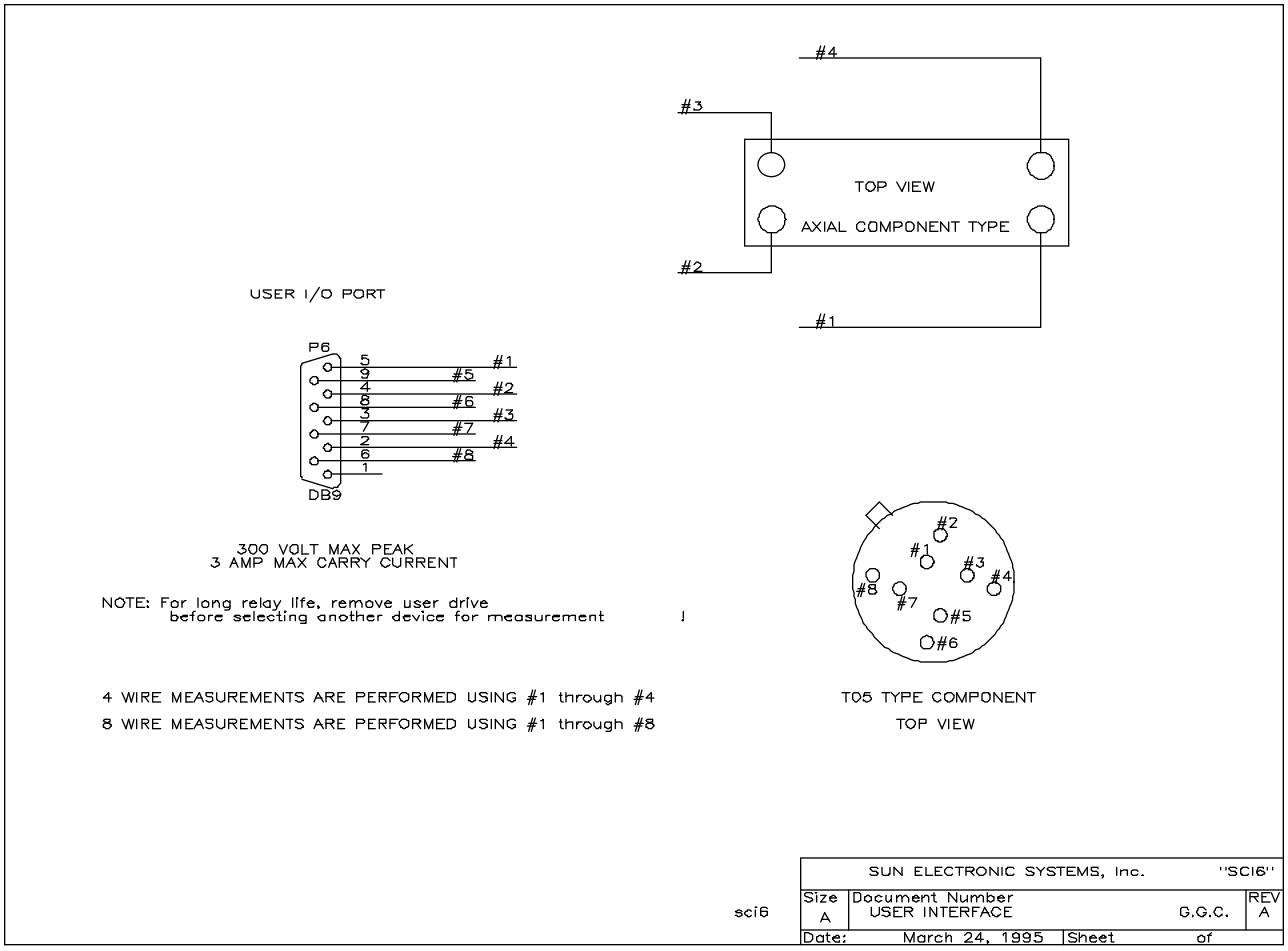
MATRIX SYSTEM CONTROLLED BY DIGITAL PARALLEL USER I/O INTERFACE

Sun Systems' automatic switching matrix is designed to provide automated temperature testing of electronics components such as resistors, diodes, capacitors, 3 and 4 lead transistors, etc. The matrix consists of the control logic and switching built on the chamber door and the cards that hold the components under test inside the chamber. If you wish to receive detailed information on the MATRIX system please call and ask for the data sheet. The MATRIX system is controlled via the chamber controllers user port. For 4 wire Kelvin measurements, one of a hundred and sixty devices can be selected. For 6 or 8 wire Kelvin measurements, one of eighty devices can be selected. The OUT command is provided to drive the MATRIX, see section 5.

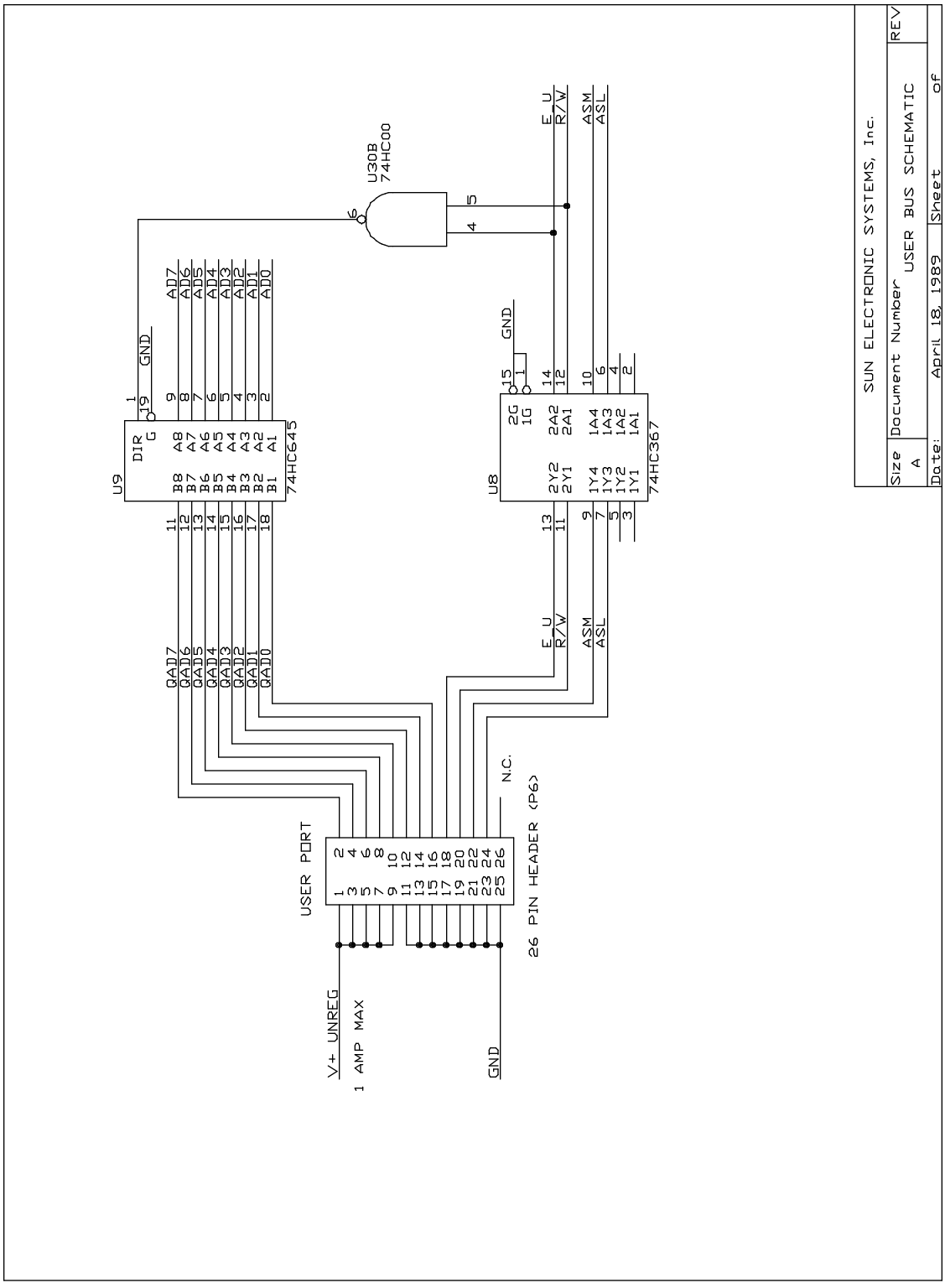
MATRIX FUNCTIONAL BLOCK DIAGRAM



MATRIX USER INTERFACE

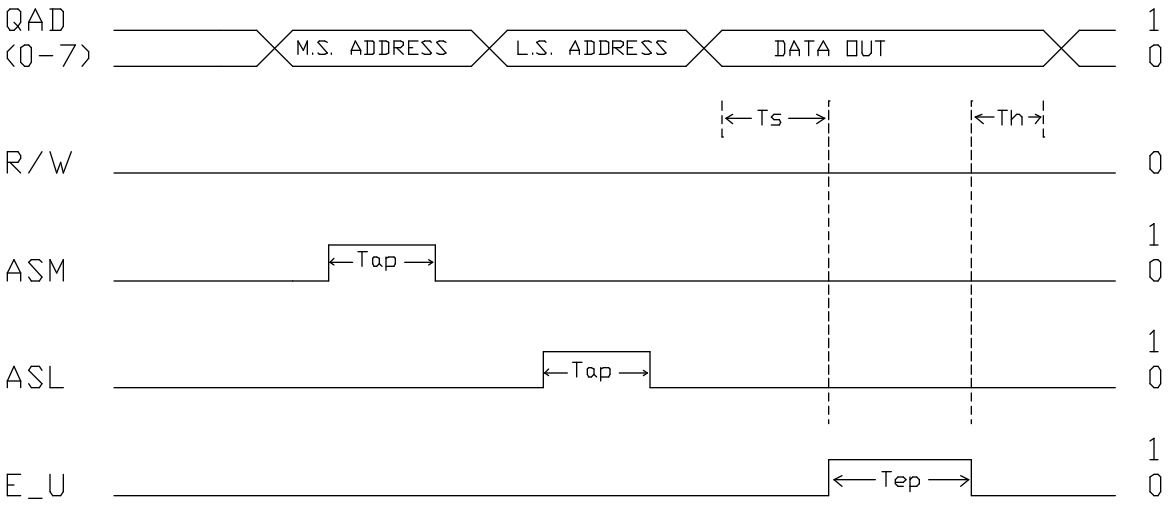


USER BUS SCHEMATIC

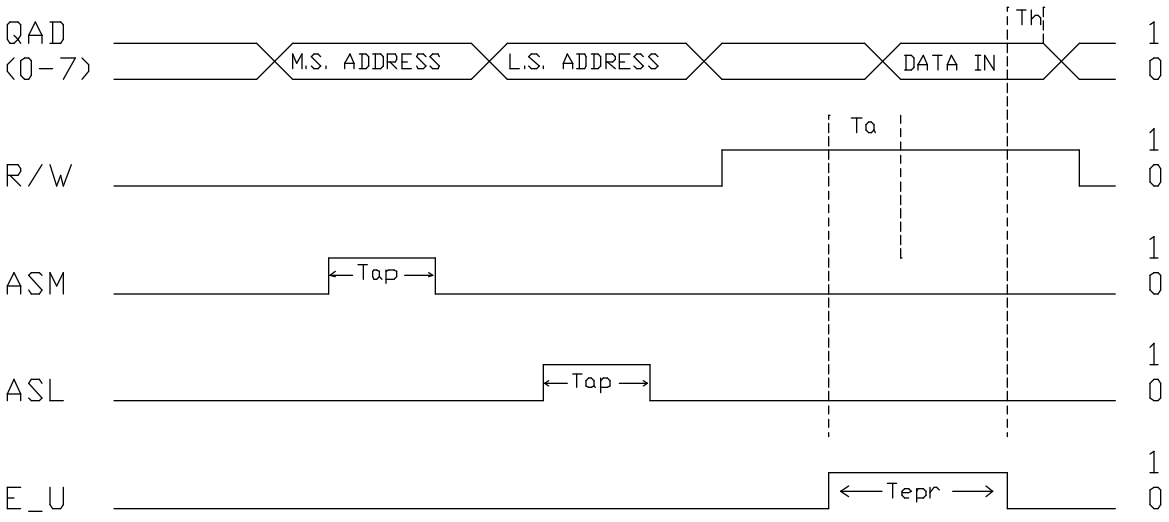


USER BUS TIMING

(WRITE)



(READ)

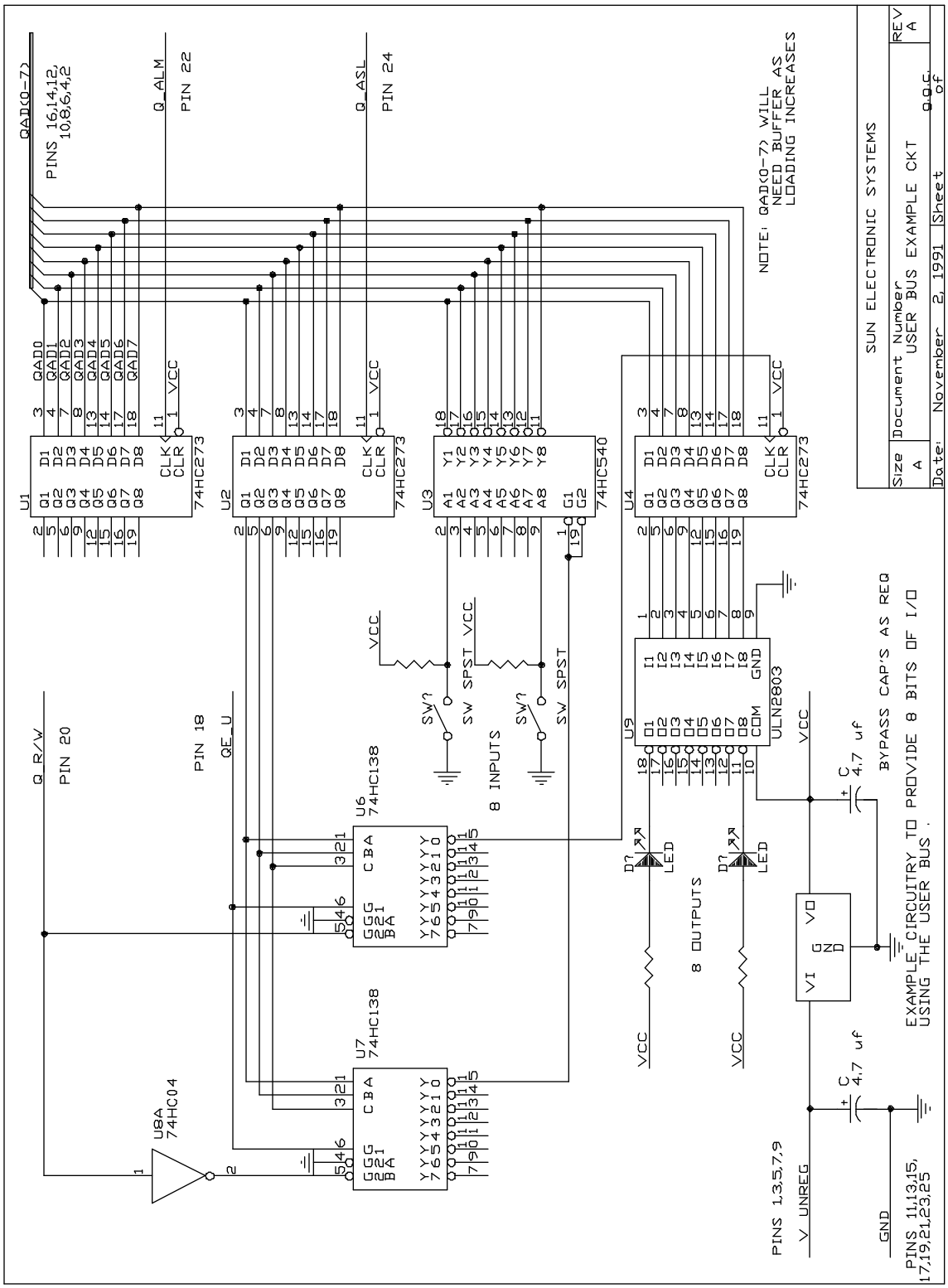


Ts=6 uS MIN
Thw=3 uS MIN
Tap=4.8 uS
Tep=6 uS

Ta <= 3 uS
0 =< Th < 2 uS
Tepr=11 uS

SUN ELECTRONIC
SYSTEMS Inc.

SAMPLE USER CIRCUIT



ANALOG I/O INTERFACE

The analog I/O interface is useful for interfacing with sensors, instrumentation and control devices. A communication interface may output 8 bit data to up to 4 different channels of analog output designated channel AO(0-3). In addition, a communication interface may read an 8 bit value corresponding to the analog voltage present on up to 4 channels of analog input designated channels AN0-3. In the SDEF menu, analog output channels may be independently defined as unipolar with a 0 to +5V output range or bipolar with a -5V to +5v output range. Analog output channel 3 provides a separate 0 to 20mA current source associated with the voltage output range of 0 to +5V, unipolar. Analog output channels A and B can be configured to drive a chart recorder. Output channel A can chart the chamber probe reading and output channel B can chart the user probe reading. Analog input channels accept a 0 to +5V input and AN0 may be jumper configured to accept 0-20mA current input. A 220 OHM resistor pulled high to +12VDC is provided for supplying 0-20mA passive devices on signal AN0+.The A/D and D/A data is $00 at low level and $FF at high level. The pin assignments for the analog I/O interface are as follows.

ANALOG I/O INTERFACE (J2,DB15)

PIN#	**DESCRIPTION**
1	AN0 - Analog Input Channel 0
2	AN1 - Analog Input Channel 1
3	AN2 - Analog Input Channel 2
4	AN3 - Analog Input Channel 3
5	AO_0 - Analog Output Channel A
6	AO_1 - Analog Output Channel B
7	AO_2 - Analog Output Channel C
8	AO_3 - Analog Output Channel D
9	AN0+ - 220 OHM Pull Up Resistor to +12VDC
10,11	GROUND
12	-IL3 0-20mA Current Source, -LEAD
13	+IL3 0-20mA Current Source, +LEAD
14,15	No connection

Communication interfaces may read and write data from/to the analog I/O interface by issuing the following instructions.

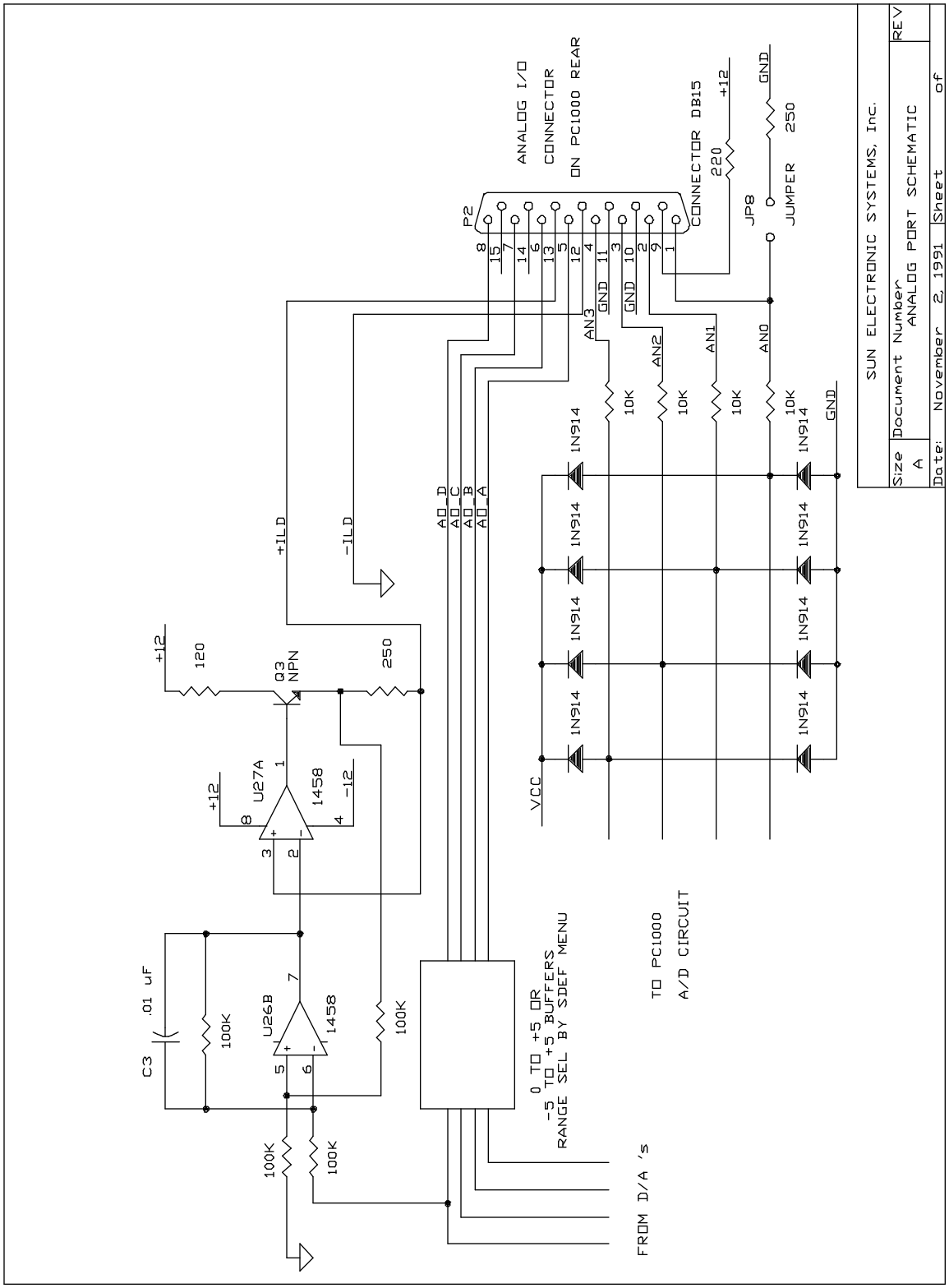
ANALOG I/O INTERFACE I/O COMMANDS

OUT3:[analog output channel number, 0-3] , [8 bit data value]

IN3:[analog input channel number,0-3], Im

The analog port schematic follows.

ANALOG PORT SCHEMATIC



HIGH SPEED SERIAL LINK INTERFACE

The Model EC1x provides a 56K bit/sec synchronous serial data interface which is intended primarily for processor to processor communication between Sun Systems products containing the popular MC68HC11A8 microprocessor. The Model EC1x is configured as master device and interface levels meet RS-422 standards. Should you choose to use this port, consult Motorola's documentation for the SPI port timing in the HC11 microprocessor or call Sun Systems directly. The pin assignments for the high speed serial link interface is as follows.

HIGH SPEED SERIAL LINK INTERFACE (DB9)

PIN#	DESCRIPTION
1	SCK+
6	SCK-
2	MOSI+
7	MOSI-
3	MISO+
8	MISO-
4,5,9	Ground

Communication interfaces may read and write data from/to the high speed serial link interface by issuing the following instructions.

HIGH SPEED SERIAL LINK INTERFACE I/O COMMANDS

OUT2:[16 bit address] , [8 bit data value]
IN2:[16 bit address], Im

PARALLEL PRINTER AND EXTRA BIT I/O

The printer port option for the EC1x chambers allows the use of an inexpensive PC dot matrix printer to automatically provide logging and a plotted chart of the chamber, user, and set temperatures. The printer port was designed to use a standard IBM PC type printer with a parallel interface using the standard PC printer cable. This port can be used in addition to the standard analog outputs that are provided for charting or in lieu of the analog chart when a line printer is more available. The printer port option also provides an additional 8 bits of on/off output and 8 bits of on/off input. The additional I/O may be used to control or monitor external devices such as your device under test power supplies, etc. See the SDEF MENU in Section 3 to enable printer and set parameters.

PRINTER COMMANDs:
Print N ; To print a local program number N on the printer.
Print = red shifted out key on front panel.
#(string) ; To print (string) on printer (remote only).
Out 0 : m,n ; Write to one of 8 output bits. m = 8 to 15, n = 0 or 1.
In 0: m, In ; Read one of the 8 input bits. m = 8 to 15 , In is I variable.

PROBE INTERFACE

The dual probe interface on the Model EC1x accepts several different type of sensors. The type of probe and the calibration for the probe selected is accomplished by running the CAL menu from the local control panel, refer to Section 3. The following represents the connections to the probe connector located inside the controller section for either the Chamber channel or the USER channel. The chambers are equipped with standard K thermocouples.

PROBE TYPE	**CONNECTION INFORMATION**
2 WIRE RTD	PIN 1 - RTD OUT, PIN 4 - RTD IN (jump 3 to 4)
3 WIRE RTD	PIN 1 - RTD OUT, PIN 3, 4 - RTD IN
4 WIRE RTD	PIN 1, 2 - RTD OUT, PIN 3, 4 - RTD IN
THERMOCOUPLE	PIN 7 - +LEAD, PIN 6 - -LEAD
SOLID STATE	PIN 5 - +LEAD, PIN 8 - -LEAD
CURRENT(20mA)	PIN 5 - +LEAD, PIN 6 - -LEAD
VOLTAGE(+5V)	PIN 7 - +LEAD, PIN 6 - -LEAD

PROCESS CONTROL OUTPUTS

See BIT I/O section under AUXILIARY I/O in section 4.

SECTION 5. DETAILED COMMAND DESCRIPTIONS

AB

***Function*:** Controls the ambient air blower

***Syntax*:**

AB=n.n	turns on ambient blower for n.n minutes
AB=n.n,m.m	turn on ambient blower for n.n minutes or until m.m degrees,set temperature,is reached

Description:

If in the SDEF Menu, AMB_BLOWER_COOL? is set to NO then:

AB=n.n command automatically disables heating and cooling during the time that the blower is on. When encountered in a local program, program execution will be suspended until the blower has finished then the program will continue at the next line. A command error will result if the chamber temperature is less than +25ºC since the ambient blower is to be used to cool the chamber only.

AB=n.n,m.m command turns on the blower until the time limit expires or until the set temperature is reached. m.m must be greater than +25ºC and the chamber temperature must be greater than m.m when the command is executed. Heating is disabled during the time the command is active. You must disable cooling if none is desired.

If in the SDEF Menu, AMB_BLOWER_COOL? is set to YES:
and the AB command is used to enable the ambient air blower, then the AB command gets precedence. However, if you enable the air blower using the OUT0:2,1 command the AMB_BLOWER_COOL gets precedence and will automatically shut the air blower off if the difference between the chamber temperature and the set point is less than 1 Deg C.

***Restrictions*:** This command is for EC1xHA Models which incorporate the ambient blowers.

***See Also*:** OUT command and AMB_BLOWER_COOL? in the SDEF MENU

***Example*:** Local Program example, using AB=n.n where n.n is minutes.

```
RATE=20
WAIT=12
SET=100          go to +100º for 12 minutes
AB=5             turn on ambient blower for 5 minutes
WAIT=10
SET=-25          then go to -25º for 10 minutes
etc.
```

Local Program example, using AB=n.n, m.m

```
RATE=20
WAIT=0:5:30
SET=125          go to +125º for 5 min 30 sec
AB=5,30          turn on blower for 5 minutes or until +30º is reached.
WAIT=30
SET=-55          go to -55º for 30 minutes
etc.
```

BKPNT

Function: Local program breakpoint or pause command

Syntax:

BKPNTnnn	display number nnn at breakpoint
BKPNTIm	display I variable value at breakpoint

Description:

The breakpoint command allows for local program operation to be suspended until the ENTER key is depressed on the front panel display or until the remote controller issues a BKPNTC command. This command permits program debugging by providing convenient pauses in local program execution such that an operator may examine local program performance and is also useful when a host controller may wish to perform I/O at a point in the local program. One form of the breakpoint command displays a number on the front panel display when encountered which is useful for identifying different breakpoints within a program. The other form of the breakpoint command displays the value of one of the I variables, 0-9, which is useful for breakpoints that are placed within FOR/NEXT loops.

Restrictions: Breakpoint values displayed on front panel display. To read over remote bus issue BKPNT? command.

See Also: BKPNT?, BKPNTC

Example: Editing from the local keyboard

EDIT#0«	edit program #0
END	controller response
BKPNT100«	set breakpoint 100
END	controller response
FOR I2=1,10«	begin FOR/NEXT loop
END	controller response
BKPNTI2«	set breakpoint for I variable #2
END	controller response
NEXTI2«	end FOR/NEXT loop
END	controller response
END«	terminate program entry

BKPNTC

Function: Remote bus command to continue from breakpoint

Syntax: BKPNTC

Description:

When the BKPNT interrupt is enabled by the SINT menu and a local program is started via a remote RUN command, then when a BKPNT is reached during local program execution the breakpoint interrupt is sent to the appropriate remote bus. The host controller upon receiving the breakpoint interrupt may issue a BKPNT? command to read the value of the breakpoint issue commands and then issue a BKPNTC to continue local program execution.

Restrictions: Remote only command

BKPNT?

Function: Remote bus command to read value of breakpoint

Syntax: BKPNT?

Description:

When the BKPNT interrupt is enabled by the SINT menu and a local program is started via a remote RUN command, then when a BKPNT is reached during local program execution the breakpoint interrupt is sent to the appropriate remote bus. The host controller upon receiving the breakpoint interrupt may issue a BKPNT? command to read the value of the breakpoint and issue a BKPNTC to continue local program execution.

Restrictions: Remote only command

C

Function: Set or examine the current set temperature in deg C

Syntax:

nnn.nC	set current set temperature
C	examine current set temperature

Description:

The C command is a TC01 controller compatible command which either sets the current set temperature or examines the controller for the current set temperature. The set or response is in degrees centigrade always. The C command returns with a value of -1999 if the current set temperature is equal to none. Use the more general set command if possible.

Restrictions: Remote interface command only.

See Also: SET

Example:

150.0C«	Set current set temperature to 150.0ºC
C«	Send command to examine current set temp.
150.0	Controller response, temp. = 150ºC
SET?«	Examine current set temp with SET command
150.0	Controller response

CALAX

Function: The CALAx command allows for an offset adjustment on the measurement reading of channel x

Syntax: CALAx, access code, standard reading

where	x	1 or 2 (1 is chamber probe, 2 is user probe)
	access code	Defined by user (default = 9)
	standard reading	Known measurement value

Description: The CALAx command allows user to offset the measurement value of channel x. See CAL TO A STANDARD COMMANDS, Section 3, for the actual calibration procedure. The CALAx command may be issued after an initial calibration sequence to fine tune the calibration of a particular channel.

See Also: CALC, CALBx, See Section 3. ,CAL TO A STANDARD COMMANDS

Example: Offset adjustment of sensor #1:
Sensor #1 is placed at 0 ºC
After stabilizing, sensor #1 reads 0.5 ºC
The command CALA1,9,0.0 is issued.
The sensor now reads 0 ºC.

CALBX

Function: The CALBx command allows for a gain adjustment on the measurement reading of channel x

Syntax: CALBx, access code, standard reading

where	x	1 or 2 (1 is chamber probe, 2 is user probe)
	access code	Defined by user(default=9)
	standard reading	Known measurement value.

Description:

The CALBx command allows users to modify the gain of channel x. See CAL TO A STANDARD COMMANDS, Section 3, for the actual calibration procedure. This calibration command must only be issued after a CALA has been done on the channel.

See Also: CALC, CALAx, See Section 3 ,CAL TO A STANDARD COMMANDS

Example: Gain adjustment of sensor #1:
Sensor #1 is placed at 100 ºC.
After stabilizing, sensor #1 reads 97.5 ºC.
The command CALB1,9,100.0 is issued.
The sensor now reads 100.0 ºC.

CALC

Function: The CALC command allows the user to clear all offset and gain adjustments for both of the EC1x's sensors.

Syntax: CALC, access code

where access code is Defined by user(default=9)

Description:

The CALC command allows users to clear both of the EC1x's channels standard gain and offset adjustments. See the CAL TO A STANDARD COMMANDS section for the actual calibration procedure.

Warning: The CALC command should only be used prior to calibration of both sensors on the EC1x. All cal to a standard adjustments on channels 1 and 2 will be lost.

See Also: CALAx, CALBx, See Section 3, CAL TO A STANDARD COMMANDS

Example:

CALC,9 All gain and offset adjustments cleared for both channels

COFF

Function: Disable chamber cooling

Syntax: COFF

Description: The COFF command permits a remote interface to disable chamber cooling by the controller. The front panel COOL switch also disables controller cool function when depressed if cooling was enabled. When editing local programs from the front panel keyboard, depressing the COOL switch on the front panel ENTERs either CON or COFF. If the opposite action is desired, cancel the entry and re-ENTER to get the correct action. All local programs default to CON at the beginning.

Restrictions: None

See Also: CON, HOFF, HON

Example: COFF« disable chamber cooling

CON

Function: Enable chamber cooling

Syntax: CON

Description:

The CON command permits a remote interface to enable chamber cooling operation. The COOL switch located on the front panel can also enable chamber cooling operation if depressed when cooling is disabled. When editing local programs from the front panel keyboard, depressing the COOL switch on the front panel ENTERs either CON or COFF. If the opposite action is desired, cancel the entry and re-ENTER to get the correct action. All local programs default to CON at the beginning.

Restrictions: None

See Also: COFF, HON, HOFF

Example: CON« Enable chamber cooling operation

CSET

Function: Examine the present control value.

Syntax: CSET?

Description:

The CSET command allows for examining the present temperature that the controller is attempting to control to. During ramping, this value is alternately displayed with the USER probe temperature on LINE2 of the front panel LCD display.

Restrictions: None

See Also: TEMP?, UCHAN?

Example: assumes scale in degrees C

RATE=10«	define temperature segment, RATE=10°C/min
WAIT=30«	wait=30 min.
TEMP?«	examine present temperature
25.0	controller response, 25.0°C
SET=35.0«	set new final temperature, 35.0°C
	wait 30 seconds
CSET?«	examine present ramp target temperature
30.0	controller response, 30.0°C

DELL

Function: Delete current line during local program edit

Syntax: DELL

Description:

The delete line (DELL) command allows for deleting program lines during local program editing on the front panel keyboard. The line currently displayed will be deleted when the DELL command is ENTERed.

Restrictions: Local front panel command only

See Also: DELP

Example:

EDIT#2«	edit local program #2
GOSUB#0	controller response, first line of LP
[DOWN -ARROW]	use up/down arrows for scrolling LP
BKPNT1	controller response
DELL«	delete breakpoint command
GOSUB#5	controller response, next line of program

DELP

Function: Delete or clear local program

Syntax: DELPm or DELP#m

Description:

The delete program command allows for deleting, which in this case is the same as clearing, a single local program defined by the variable m, where m is in the range of 0 to 9. Programs may be deleted either from the local front panel or from a remote interface. Before using the STORE command from a remote interface, the local program selected, 0 through 9, must be deleted if any commands are present in that particular local program.

Restrictions: None

See Also: DELL, STORE

Example: from a remote interface

DELP#0«	clear local program #0
STORE#0«	prepare controller for accepting commands
***	send local program commands
END«	terminate local program download

DEVL

Function: Set or examine the deviation limit

Syntax:

DEVL=nnn.n[u]	Set deviation limit
DEVL?	Examine deviation limit

Description:

The DEVL command sets the deviation limits for the chamber probe in default units or optional u units. If the deviation limit interrupt is enabled in the SINT menu and the chamber probe temperature varies by more than the set limit, an interrupt will be generated to the active remote interface.

Restrictions: Deviation Limit range is between 0.1 and 300.

See Also: UTL, LTL, SINT Menu

Example:

if SCALE#1=C	
DEVL=2.5«	set deviation limit to 2.5°C
DEVL?«	examine deviation limit
2.5	controller response, 2.5°C
RATE=30«	define temp. segment
WAIT=03:00:00«	wait for 3 hours
SET=-55.0«	set final temp. to -55.0°C

If after 1 hour, the chamber runs out of coolant supply and chamber temperature starts to rise, and if deviation interrupts are enabled in the SINT menu, a deviation interrupt will be sent to the active remote interface.

EDIT

Function: Edit local program from the local keyboard.

Syntax: EDITm or EDIT#m

Description:

The EDIT command allows for program loading and editing from the local keyboard. A local program, specified by m in the range of 0 to 9, may be edited by using the up and down arrows, delete line (DELL) command or by ENTERing new commands which are placed in front of the command presently displayed on the front panel LCD display. Local program editing is terminated by ENTERing the END command.

Restrictions: Local keyboard command only.

See Also: STORE, LIST, END

Example: This example illustrates ENTERing and editing a local program from the front panel keyboard. The local program consists of a call to LP#2, a breakpoint which displays the number 1, and a call to LP#5.

EDIT#0«	edit local prog. #0
END	controller response on LCD display
GOSUB#2«	ENTER prog. call to local prog #2
END	controller response
GOSUB#5«	ENTER prog. call to local prog #5
END	controller response
[UP-ARROW]«	scroll up
GOSUB#5	controller response
BKPNT1«	insert breakpoint between calls to LP#2 and LP#5
GOSUB#5	controller response
END«	ENTER end local program editing command

END

Function: Terminate local program editing or remote program downloading.

Syntax: END

Description:

The END command terminates program editing when editing local programs from the local keyboard and terminates remote program downloading when using the STORE command from a remote host computer.

Restrictions: None

See Also: EDIT, STORE

Example: This example illustrates ENTERing a local program from the front panel keyboard. The local program consists of a call to LP#2, a breakpoint which displays the number 1, and a call to LP#5.

```
EDIT#0«      edit local prog. #0
END          controller response on LCD display
GOSUB#2«     ENTER prog. call to local prog #2
END          controller response
BKPNT1«      ENTER breakpoint between calls
             to LP#2 and LP#5
END          controller response
GOSUB#5«     ENTER prog. call to local prog #5
END          controller response
END«         end local program editing
```

FOR/NEXT

***Function*:** Loop definition command for local programming

***Syntax*:** FOR Im = <Beginning Value>,<Ending Value> or
FOR Im = <Beginning Value>,<Ending Value>, + or
FOR Im = <Beginning Value>,<Ending Value>, -
NEXT Im

***Description*:**

The FOR/NEXT loop command provides looping capability for local program operation. Commands contained within the boundaries between the FOR statement and the NEXT statement are repeated as defined by the FOR statement. The beginning or ending value may be any integer value or an I variable value. The FOR/NEXT loop either increments the beginning value until the beginning value is equal to or greater than the ending value or decrements the beginning value, when the minus option is used, until the beginning value is equal to or less than the ending value. The number of loop executions is equal to the absolute value of the ending value minus the beginning value. Without regard to the beginning and ending values, the loop is always executed one time. FOR/NEXT loops may be nested four deep when considering the first loop as nest#1.

***Restrictions*:** None

***See Also*:** GOSUB

***Example*:**

DELP#2	clear program #2
EDIT#2	EDIT local program #2
FOR I5=1,5«	FOR I variable #5, step 1,2,3,4
FOR I2=5,I5,-«	FOR I variable #2, 5, I variable #5, decrement
	step 5,4,3,2 (Pass 1)
	step 5,4,3 (Pass 2)
	step 5,4 (Pass 3)
	step 5 (Pass 4)
BKPNT I2«	set breakpoint, display I variable #2
NEXT I2«	end FOR/NEXT nest #2
NEXT I5«	end FOR/NEXT nest #1
END«	end program store
RUN#2	run program #2

When the program is run, the breakpoint value will display the step sequence for the FOR/NEXT I2 variable loop. The ENTER key must be pressed from the front panel or the BRKPTC command must be ENTERed remotely to continue the program when a breakpoint is encountered.

GOSUB

***Function*:** Execute local program "m" as a subroutine

***Syntax*:** GOSUBm or GOSUB#m

***Description*:**

The GOSUB command allows local programs to be called by other local programs as subroutines. At the end of a local program called by a GOSUB command, execution commences at the command following the GOSUB command in the calling program. Nesting is supported for four levels with the top level program as nest#1. I variables are global to all local programs.

***Restrictions*:** None

***See Also*:** FOR/NEXT

***Example*:**

```
FOR I3=0,10     set FOR/NEXT for 10 cycles
GOSUB#0         execute program in LP#0
GOSUB#1         execute program in LP#1
NEXTI3          end FOR/NEXT loop for I variable #3
END             end of LP#2
```

HOFF

***Function*:** Disable chamber heating

***Syntax*:** HOFF

***Description*:**

The HOFF command permits a remote interface to disable chamber heating by the controller. The front panel HEAT switch also disables controller heat function when depressed if heat was enabled. When editing local programs from the front panel keyboard, depressing the HEAT switch on the front panel ENTERs either HON or HOFF. If the opposite action is desired, cancel the entry and re-ENTER to get the correct action. All local programs default to HON at the beginning.

***Restrictions*:** None

***See Also*:** CON, COFF, HON

***Example*:**

```
HOFF«           disable chamber heating
```

HON

***Function*:** Enable chamber heating

***Syntax*:** HON

***Description*:**

The HON command permits a remote interface to enable chamber heating operation. The HEAT switch located on the front panel can also enable chamber heating operation if depressed when heating is disabled. When editing local programs from the front panel keyboard, depressing the HEAT switch on the front panel ENTERs either HON or HOFF. If the opposite action is desired, cancel the entry and re-ENTER to get the correct action. All local programs default to HON at the beginning.

***Restrictions*:** None

***See Also*:** COFF, CON, HOFF

***Example*:** HON« Enable chamber heating operation

I VARIABLES

***Function*:** Set or examine I variables.

***Syntax*:**

Im= <value>	set Im equal to value
Im= Im + <value>	set Im equal to sum of values
Im= Im - <value>	set Im = to difference of values
Im?	examine I variable m

***Description*:**

I variables are used in local programs for loop control and general purpose Integer arithmetic. A value may be any integer in the range of + 32768/-32767 or another I variable. The controller supports 10 I variables, where "m" ranges from 0 to 9. I variables are global between all local programs and as such, care should be taken to insure that the same I variable is not used in two different applications within any active group of local programs.

***Restrictions*:** None

***See Also*:** FOR/NEXT, IN, OUT, BKPNT

***Example*:**

I0=52«	set I variable #0 to 52
I2=I0«	set I variable #2 equal to I variable #0
I5=I0-9«	set I var.#5 = I var.#0- 9 = 43
I6=I0+I5«	set I var.#6 = I var.#0 + I var.#5 = 95
I6?«	examine I variable #6
95	controller response

IN

***Function*:** Input data from the Bit I/O, USER bus, SPI port, or A/D port

***Syntax*:** IN<device number>:<address>,Im
where <device number> is: 0 for Bit I/O
1 for USER bus
2 for SPI port
3 for Analog port

***Description*:**

The IN command allows data read capability from either the Bit I/O port, USER bus, SPI port or analog to digital convertors. Data values read from a particular device are stored in I variables. For proper operation of each device interface consult the appropriate section describing the device in full.

***Restrictions*:** None

***See Also*:** OUT, I variables

***Example*:**

IN0:5,I2«	Read Bit I/O bit 5, store in I var.#2, bit 0
IN1:7,I2«	Read USER bus, address 7, store in I var.#2
IN1:$F,I2«	Read USER bus, addr. HEX F, store in I2
IN2:I3,I2«	Read SPI port, addr in I3, store in I2
IN3:2,I2	Read A/D channel 2 into I var.#2

LIST

***Function*:** List a local program from a remote interface

***Syntax*:** LISTm or LIST#m

***Description*:**
The LIST command permits a remote interface to upload a local program from the controller. This command allows a remote operator to verify the results of a STORE instruction, which downloads programs to the controller. In addition, some communication programs allow for capturing data to text files. In this manner, local programs can be maintained on a personal computer and downloaded or uploaded if required.

***Restrictions*:** Remote interface command only

***See Also*:** STORE

***Example*:**

DELP#0«	clear local program #0
STORE#0«	ready controller for local program download
***	send local program
END«	end download
LIST#0«	request upload of LP#0
***	local program displayed

LLO

***Function*:** RS-232/422 Command to lockout local keyboard

***Syntax*:** LLO

***Description*:**
The Local Lockout (LLO) command may be issued from a host processor to lockout the local keyboard. The LLO command only applies to host computers communicating over the RS-232 or RS-422 serial interfaces. Local keyboard function may be unlocked thru the use of the RTL command. Local keyboard lockout operation for host processors communicating over the IEEE-488 interface is a bus interface command. The syntax varies according to the particular host computer.

***Restrictions*:** RS-232/422 remote interface command only. Each host GPIB interface uses unique syntax for local lockout commands.

***See Also*:** RTL

***Example*:**

LLO«	lockout local keyboard run sensitive testing
RTL«	unlock local keyboard

LTL

***Function*:** Set or examine the lower temperature limit

***Syntax*:**

LTL=nnn.n[u]	Set LTL, where u=variable units (ºC, ºF, ºK)
LTL?	Examine LTL, default units

***Description*:**

The LTL command allows for setting the lower temperature limit which the controller will attempt to control. The units for the LTL command are those as selected in the CAL menu for the chamber probe or the optional u units. The optional u units can be accepted remotely only and will be converted automatically to default units.

***Restrictions*:** Temperature values for the LTL command must range between -200°C and the UTL setting.

***See Also*:** UTL

***Example*:**

If scale is set to °C	
LTL=-100.0«	set LTL to -100°C
LTL?«	examine LTL
-100.0	controller response, -100°C

M

***Function*:** Set or examine the current wait at temperature time.

***Syntax*:**

nnn.nM	Set the temperature segment wait time
M	Examine the current temperature wait time

***Description*:**

The M command is a TC01 controller compatible command which either sets the current temperature segment wait time, sometimes referred as soak period, or allows a remote interface to examine the current setting. When setting wait times, nnn.n represents the wait time in minutes. If wait time is equal to forever, M returns 1999. Use the more general wait command is possible.

***Restrictions*:** Remote command only.

***See Also*:** WAIT

***Example*:**

12.1M«	Set wait time for 12.1 minutes
M«	Examine wait time
12.1	Response from controller
WAIT?«	Examine wait time with WAIT command
00:12:06	Response from controller

OFF

***Function*:** Turn off chamber power

***Syntax*:** OFF

***Description*:**
The OFF command turns off the power to the chamber. As long as the chamber is connected to an appropriate line voltage, the controller in the chamber is still powered on. The OFF command turns off the front panel display, indicators and switch functions, except for the POWER switch. In addition, commands received over the remote interfaces are ignored except for the ON command and the STATUS? command. Depressing the POWER switch when the chamber is ON results in the same function as the OFF command.

***Restrictions*:** Remote interface command only

***See Also*:** ON

***Example*:** OFF« Turn OFF chamber

ON

***Function*:** Turn on power to chamber

***Syntax*:** ON

***Description*:**
The ON command enables power and function of the chamber. When the chamber is plugged in to an appropriate line voltage the controller is powered on and can accept a power on command from either the front panel by depressing the power switch or from a remote interface by using the ON command.

***Restrictions*:** Remote interface command only

***See Also*:** OFF

***Example*:** ON« Turn on chamber power

OUT

Function: Output data to the Bit I/O port, USER bus, SPI port, and/or A/D port. Also turns on/off ambient blower (ambient blower applies to EC1xHA models only).

Syntax: OUT<device number>:<address>,<data>
where <device number> 0 for BIT I/O, 1 for USER PORT,
2 for SPI, 3 for ANALOG PORT

Description: The OUT command permits data to be transferred to an output device such as the Bit I/O port, USER bus, SPI port, or digital to analog convertors. The ambient blower is controlled via the BIT I/O. For a complete description on operating with an I/O device, consult the particular device in Section 4.

Restrictions: None

See Also: IN,
AB and AMB_BLOWER_COOL in SDEF Menu for EC1xHA chambers only

Example:

OUT0:5,1«	set Bit I/O port bit 5
OUT1:7,0«	output data 0 to address 7 for the USER bus
OUT1:$20,$0F«	output HEX F to addr. HEX 20, USER bus
OUT2:I2,I3«	output I var#3 to addr. Ivar#2, SPI port
OUT3:2,$80«	output HEX 80 to channel 2, D/A port
OUT0:2,1	turn on ambient blower
OUT0:2,0	turn off ambient blower

***Example for Ambient Blowe*r:
Note: Care must be used when using the OUT command to control the blower since there is no chamber temperature checking or heat and cool disable.

RATE=20	
WAIT=10	
SET=100	goto 100º for 10 minutes
HOFF	disable heating
WAIT=0:0:5	set a short 5 second wait time
OUT0:2,1	turn on the blower
SET=35	cool to 35 with blower and expectorant
OUT0:2,0	turn off ambient blower
HON	enable heating
WAIT=10	
SET=-25	now continue to -25 deg
etc.	

Also if you enable the air blower using the OUT0:2,1 command while the AMB_BLOWER_COOL is enabled in the SDEF MENU, the AMB_BLOWER_COOL gets precedence and will automatically shut the air blower off if the difference between the chamber temperature and the set point is less than 1 Deg C. See AMB_BLOWER_COOL? in the SDEF MENU.

OUT Cont.

Example for Switching Matrix:

The following commands are provided for selection of components for test via the SUN SYSTEMS matrix. The following commands are sent to the chamber controller via the built in RS232 or RS422 or GPIB busses. The controller then controls the matrix system via its USER bus. These commands are suported in firmware versions 2.2 and higher.

For 4 wire Kelvin measurements; {2 lead axial or radial components}

Select 1 of 160 devices;
OUT4:n,m where: n=device number (1 to 32)
m=component board number (1 to 5)

For 6 or 8 wire Kelvin measurements; {3 or 4 lead components}

Select 1 of 80 devices;
OUT5:n,m where: n=device number (1 to 16)
m=component board number (1 to 5)

For example, to measure a 2 leaded part in socket number 17 on component board number 3, issue OUT4:17,3 command then issue ? command. Read on display a response of "OK" if command was accepted, then perform your measurement on the part.

The following is an example of a local program that can be used to step through each 2 leaded part. Issue the following commands from the front panel.

```
I0=1
I1=1
DELP 0          ; to delete program 0 if one exists
EDIT 0          ; begin editing program 0

FOR I1=1,6      ; loop 5 boards
FOR I0=1,33     ; loop 32 components per board
OUT4 : I0, I1
BKPNT I0        ; display number and wait for ENTER key
NEXT I0
NEXT I1
END             ; end program edit

RUN 0           ; to run the local program 0
```

The program will sequentially step through each component one at a time. The program will display the component number, beep, and wait for you to press the ENTER key after selecting each component.

PIDA

Function: Set or examine PID settings for advanced chamber control.

Syntax: PIDA?
PIDA=n[,mmm.m]

Description:

This command solves the problem of controlling your device under test (DUT) temperature at the setpoint rather than just controlling the chamber air temperature. In the standard chamber control mode the chamber probe provides feedback to the PID control loop thereby controlling the air temperature of the chamber. This command allows the user to control the temperature to the average of chamber and user probe temperature or bring the user probe temperature to the set value.

Restrictions: None

Example:

PIDA?	to determine current setting
PIDA=n	where n=0,1,2,3, or 4
	0=normal PID mode
	1=control to the average of chamber and user probe temp
	2=slowly force user probe temp to the set value
	3=Use user probe for control
	4=Control to average then move user to set
	mmm.m; When above n is 2 or 4 a damping coefficient may be ENTERed to control loop speed.
	Damping range = 0 to 1000. default=400.

When mode 2 or 4 is selected a damping coefficient may be set. If you don't specify a damping the default value of 400 is used. The larger the damping the slower the controller will move the chamber to the user reading. For more information see the PIDA application note.

Example: PIDA=4,500 ;Set mode 4 with a damping

PIDC

Function: Set or examine PID coefficients for cool control

Syntax:		
	PIDC=nnn.n,nnn.n,nnn.n	set cool PID coefficients
	PIDC?	examine cool PID coefficients

Description:

The PIDC command permits modification and examination of the proportional, integral and derivative (PID) coefficients used in the algorithm which controls the chamber cooling process. PID coefficients may be changed to accommodate varying changes in mass or radiant power in the test chamber area. The PID Application Note contains a procedure for tuning PID coefficients to a particular application. PID coefficients are stored in battery backed memory.

Restrictions: None

See Also: PIDH, PWMP

Example:		
	PIDC=.25,1e-3,.10«	set PID coefficients
	PIDC?«	examine PID coefficients
	0.25	controller response, P
	0.001	controller response, I
	0.10	controller response, D

PIDH

Function: Set or examine PID coefficients for heat control

Syntax:		
	PIDH=nnn.n,nnn.n,nnn.n	set heat PID coefficients
	PIDH?«	examine heat PID coefficients

Description:

The PIDH command permits modification and examination of the proportional, integral and derivative (PID) coefficients used in the algorithm which controls the chamber heating process. PID coefficients may be changed to accommodate varying changes in mass or radiant power in the test chamber area. The PID Application Note contains a procedure for tuning PID coefficients to a particular application. PID coefficients are stored in battery backed memory.

Restrictions: None

See Also: PIDC, PWMP

Example:		
	PIDH=.25,1e-3,.10«	set PID coefficients
	PIDH?«	examine PID coefficients
	0.25	controller response, P
	0.001	controller response, I
	0.10	controller response, D

PWMP

Function: Set or examine the pulse width modulator period

Syntax:

PWMP=nnn.n	set PWM period
PWMP?	examine PWM period

Description:

The PWMP command permits modification of the period allocated to the pulse width modulation algorithm. In the control of the chamber, the controller uses a constant period of time of which the controller calculates the portion of time for which heat or cool should be turned on. This is based on the feedback from the chamber probe and the PID coefficients. Shorter periods of time for pulse width modulation translates into faster tracking of changes in the test chamber. When changes in the test chamber are expected not to change for an extended time, during long soak periods for example, it is more economical not to adjust quite so frequently. In this case, increasing the PWM period, reducing the modulation rate, conserves power and coolant and reduces wear on coolant supply valves. However, increasing the PWMP above it's default value of 2 may cause control loop instability.

Restrictions: Period range from 2 seconds to 30 seconds

See Also: PIDH, PIDC

Example:

PWMP=2«	set PWM period to 2 seconds
TEMP?«	examine current temperature
25.0	controller response
RATE=10«	define new temperature segment
WAIT=5«	set wait for 5 min., stabilize mass
SET=35.0«	set new temp to 35.0
	after 1 min for ramp and
	after 5 min for wait timeout
PWMP=15«	set PWM period for 15 sec.
WAIT=10:00:00«	set long wait period, 10 hrs.
SET=35.0«	again, set temperature

RATE

Function: Set the current rate of change for ramping

Syntax:

RATE=nnn.n[u]	Set the current ramping rate
RATE?	Examine the current ramping rate

Description:

The RATE command allows for setting or examining the rate at which the controller will control the change from one setpoint to another setpoint within the chamber. Rate is based on the chamber probe and on the units of SCALE set up for the chamber probe in the CAL menu or optional u units. When setting or examining the rate, nnn.n represents units per minute.

Restrictions: Chamber dynamics limit the maximum ramping rate.

See Also: SET, WAIT

Example: If SCALE for the chamber probe is in °C

RATE=10.0«	set ramping rate for 10.0°C/minute
RATE?«	examine present ramping rate
10.0	controller response, 10.0°C/min.
TEMP?«	read present chamber temperature
25.0	controller response, for example 25.0°C
SET=35.0«	set new setpoint, for example 35°C
	after waiting 30 seconds
TEMP?«	read present chamber temperature
30.0	controller response, up 5°C in one half min.

RTL

Function: RS-232/422 Command to unlock local keyboard

Syntax: RTL

Description:

The Return to Local (RTL) command may be issued from a host processor to unlock the local keyboard. The RTL command only applies to host computers communicating over the RS-232 or RS-422 serial interfaces. Local keyboard function may be locked thru the use of the LLO command. Local keyboard unlock operation for host processors communicating over the IEEE-488 interface varies according to the particular host computer syntax requirements.

Restrictions: RS-232/422 remote interface command only. GPIB interface host computers have unique methods for returning to local operation.

See Also: LLO

Example:

	LLO«	lockout local keyboard
		run sensitive testing
	RTL«	unlock local keyboard

RUN

Function: Starts the execution of a local program

Syntax: RUNm or RUN#m

Description:

The RUN command initiates the execution of local program defined by m, where m selects a local program in the range of 0 to 9. Local programs are ENTERed into the controller using the EDIT command from the local keyboard or downloaded from a remote host computer using the STORE command. Local program execution may be prematurely terminated by issuing a STOP command.

Restrictions: None

See Also: RUN-TIME, EDIT, STOP, STORE, END

Example: This example downloads a simple program from remote processor and then executes the program. Scale in °C.

DELP#0«	delete current program 0
STORE#0«	prepare controller for ENTERing local prog
FOR I2=0,10«	set FOR loop for 10 loops
RATE=10«	define temp. segment 1, RATE=10°C/m
WAIT=15«	wait = 15 minutes
SET=-55.0«	set final temp to -55.0°C
SET=125.0«	define temp. segment 2, rate=10°C/m
	wait=15 minutes, final temp = +125.0°C
NEXT I2«	mark end of FOR loop, I2
END«	mark end of local prog. and end of STORE
RUN#0«	run local prog. 0

RUN-TIME

Function: Starts the execution of a local program at a specific time of day.

Syntax: RUNmTIME=hh:mm:ss or RUN#mTIME=hh:mm:ss

Description:

The RUN-TIME command initiates the execution of local program defined by m, where m selects a local program in the range of 0 to 9, at a specific time of day. Local programs are ENTERed into the controller using the EDIT command from the local keyboard or downloaded from a remote host computer using the STORE command. Local program execution may be prematurely terminated by issuing a STOP command.

Restrictions: None

See Also: RUN, EDIT, STOP, STORE, LIST, END

Example: This program lists the current program in local program 0 from a remote interface and then prepares for executing the program at 5:00 PM.

LIST#0«	list local program 0
	controller response:
FOR I2=0,10	set FOR loop for 10 loops
RATE=10	wait = 15 minutes
SET=-55.0	set final temp to -55.0°C
SET=125.0	define temp. segment 2, rate=10°C/m
	wait=15 minutes, final temp = +125.0°C
NEXT I2	mark end of FOR loop, I2
END	mark end of local prog. and end of STORE
RUN#0TIME=17:00:00«	run local prog. 0 at 5:00 PM

S/!

Function: Transmit and receive ASCII data from the RS-232/422 to the GPIB Interface.

Syntax:

!sss...sss	transmit string sss...sss to the serial interface
S	receive string from serial interface.

Description:

The S/! command is a TC01 compatible command which allows the GPIB interface to transmit ASCII data to the RS-232/422 serial interface or receive data from the serial interface. Care should be taken that a serial device does not transmit data to the controller until an S command has been issued, since, data received from a serial device without an S command pending will be interpreted as command data for the chamber controller. An S command is required for each string of characters, terminated with a carriage return and/or line feed, to be transferred to the GPIB interface. GPIB lock-up time is inhibited for the S command to allow time for a serial device to respond to a prompt message.

Restrictions: GPIB remote interface command only.

Example: these commands must originate from the GPIB interface

S«	GPIB interface sends request for reply prior to sending a prompt message to insure that the reply message is sent to the GPIB interface by the controller.
!send status«	the string “send status” is sent from the controller's serial interface to prompt serial interface device.
I’m OK	controller response, transfers message received from serial interface to the GPIB interface.

SCALE

Function: Examine present scale for the chamber or user probes

Syntax: SCALE#1? examine chamber probe scale
SCALE#2? examine USER probe scale

Description:

The SCALE command allows a remote interface to examine the present scale of units for the chamber or USER probe. The scale of units for the two probes are set in the CAL menu. SET, RATE, and limit commands that do not specify a scale of units are assumed to be in the scale of the chamber probe.

Restrictions: Remote interface command only

See Also: CAL Menu

Example:

SCALE#1?«	examine chamber probe scale
DEG C	controller response, degrees Centigrade
SCALE#2?«	examine USER probe scale
DEG F	controller response, degrees F

SDEF

Function: Set or examine the set default menu (SDEF) parameters

Syntax:

SDEF=xxxxxxxn	Sets SDEF parameters where x is Y or N character where n is a digit from 0 to 3
SDEF?	Examines the SDEF parameters by returning an 8 character string

where position

1;	Y=RS echo is on
2;	Y=chart chamber temp on D/A A
3;	Y=chart user temp on D/A B
4;	Y=optional printer enabled
5;	Y=auto cool off enabled
6;	Y=auto 3 tank LCO_2 switching enabled
7;	Y=LN_2 auto purge enabled
8;	0 to 3 for buzzer volume 0=off

Description:

The SDEF command allows for setting or examining the set default parameters over the GPIB, RS232 or RS422.

Restrictions: Remote command only

See Also: See Set Default Menu in Section 3 of this manual

Example: SDEF=YNNYNYN2

where position

1;	Y=RS echo is on
2;	N=do not chart chamber temp on D/A A
3;	N=do not chart user temp on D/A B
4;	Y=optional printer enabled
5;	N=auto cool off disable
6;	Y=auto 3 tank LCO_2 switching enabled
7;	N=LN_2 auto purge disabled
8;	2= medium buzzer volume

SET

Function: Set or examine temperature segment final temperature

Syntax:

SET=nnn.n[u]	Set segment final temperature
SET?	Examine segment final temperature

Description:

The SET command allows for setting or examining the final temperature within a temperature segment. The temperature segment consists of the change of temperature, defined by the RATE command, from the chamber present temperature to the temperature defined by the SET command, plus the time specified by the WAIT command to soak at the temperature defined by the SET command. The units accepted by the SET command are those chosen in the probe CAL menu for the chamber probe if not specified by optional u. For best results a temperature segment should be ENTERed as RATE, WAIT then SET.

Restrictions: The value set by the SET command must range between the value***s*** se***t*** for the LTL and UTL commands.

See Also: RATE, WAIT, LTL, UTL

Example: If SCALE for the chamber probe is in °C

RATE=10.0«	set ramping rate for 10.0°C/minute
WAIT=5	set wait = 5 minutes
TEMP?«	read present chamber temperature
25.0	controller response, for example 25.0°C
SET=95.0 F«	set new setpoint, for example 95º F = 35°C
SET?	examine present set temp.
35.0	controller response
	{ after waiting 30 seconds }
TEMP?«	read present chamber temperature
30.0	controller response, up 5°C in one half minute.

SINT

Function: Set or examine the set interrupt parameters

Syntax: SINT=xxxxxxxxxxn Sets SINT parameters
where x is Y or N character
where n is a digit from 0 to 8

SINT? Examines the SINT parameters by returning an 11 character string where position

1; Y=all remote serial RS port interrupts off
2; Y=single timeout interrupt enabled
3; Y=deviation interrupt enabled
4; Y=Local Program (LP) timeout interrupt enabled
5; Y=Local Program (LP) done interrupt enabled
6; Y=buzz single timeout
7; Y=buzz Local Program (LP) done
8; Y=buzz Local Program (LP) timeout
9; Y=command error interrupt enabled
10; Y=BKPNT interrupt enabled
11; 0= no parallel pole . or bit 1 to 8

Note: When ENTERing from the front panel a 1 may be used for Y and 0 for N.

Description:

The SINT command allows for setting or examining the set interrupt parameters over the GPIB, RS232 or RS422.

Restrictions: Remote command only

See Also: See Set Interrupt Menu, in Section 3 of this manual

Example: SINT=NYYYYNNNYY0
where position
1; N=all remote interrupts ARE NOT off
2; Y=single timeout interrupt enabled
3; Y=deviation interrupt enabled
4; Y=Local Program (LP) timeout interrupt enabled
5; Y=Local Program (LP) done interrupt enabled
6; N=buzz single timeout disabled
7; N=buzz Local Program (LP) done disabled
8; N=buzz Local Program (LP) timeout disabled
9; Y=command error interrupt enabled
10; Y=BKPNT interrupt enabled
11; 0= no parallel pole
1 to 8 to define parallel pole bit

STATUS?

Function: Allows polling in lieu of interrupts for remote operation

Syntax: STATUS?

Description:

This command will allow polling to take place instead of interrupts when controlling the chamber via one of the remote busses.

Restrictions: Remote command only

Example: STATUS? Returns with 18 character response
where char position:

1; Y=power is on
2; Y=command error last command
3; Y=time out LED is on
4; Y=waiting for timeout
5; Y=heat output is enabled
6; Y=cool output is enabled
7; Y=valid set temperature
8; Y=deviation limit exceeded
9; Y=currently ramping
10; Y=chamber temp < lower limit
11; Y=chamber temp > upper limit
12; Y=waiting at a BKPNT
13; Y=in LP run mode
14; Y=in LP remote store mode
15; Y=in local edit LP mode
16; Y=waiting to run LP at TOD
17; Y=GPIB bus timeout
18; Y=in local keyboard lockout mode

STOP

Function: Terminate local program execution and single temperature segment execution.

Syntax: STOP

Description:

If in Local Program operation, the STOP command terminates local program execution by the controller. If running in single temperature mode, then ENTERing the STOP command terminates the temperature segment and sets SET=NONE and WAIT=FOREVER and also will cancel a pending run at time of day.

Restrictions: None

See Also: RUN

Example:

DELP#0«	clear LP area #0
STORE#0«	ready controller for accepting LP commands
***	send LP commands
END«	terminate store operation
LIST#0«	display local program
***	controller displays local program
RUN#0«	execute local program
***	

STOPE9

Function: Restores SDEF and SINT variables to factory default settings and clears all local program data.

Syntax: STOPE9

Description:

The STOPE9 command resets the settings in the SDEF and SINT MENU, deletes all local programs and all limits. You may wish to write down settings that will be needed during your setup. Calibration information is not affected by this command. This is a controller software reboot command.

Restrictions: None

See Also: Set Default Menu and Set Interrupt Menu in Section 3.

Example:

STOPE9	Depress the STOP key then the E then 9 then ENTER
	The EC1x chamber will reset defaults, do a soft
	reboot and go to power off mode

STORE

Function: Stores a downloaded local program from a remote interface

Syntax: STOREm or STORE#m

Description:

The STORE command allows a remote interface to download a local program to the controller's local memory, where "m" identifies one of ten possible local program areas, 0 through 9. Once downloaded, local programs may be executed by issuing a RUN command. Prior to downloading a program to the controller, the local program must be cleared by using the DELP command. Local programs can be displayed or uploaded by using the LIST command. The response to the STORE command is the number of free bytes in controller RAM.

Restrictions: Remote interface command only.

See Also: LIST, RUN, DELP, STOP

Example:

DELP#0«	clear LP area #0
STORE#0«	ready controller for accepting LP commands
nnn	controller response, # free bytes
***	send LP commands, OK response to each command
END«	terminate store operation
LIST#0«	display local program
***	controller displays local program
RUN#0«	execute local program

T

Function: Examine current chamber temperature in °C

Syntax: T

Description:

The T command is a TC01 controller compatible command which examines the present temperature associated with the chamber probe. The response is always in degrees centigrade. Use the more general temperature command if possible.

Restrictions: Remote interface command only.

See Also: TEMP?, UCHAN?

Example:

SET=25.0«	Set current set temperature to 25°C
	After ramp period ended
T«	Examine current chamber temperature
25.1	Actual chamber temperature returned
TEMP?«	Examine current chamber temperature
25.1	Actual chamber temperature returned

TANK

Function: Set or Examine status of LCO_2 or LN_2 Tank

Syntax: Tank=F Reset tank status to full
Tank? Examine status of tank

Description:

These commands only apply if the LCO_2 or LN_2 , 2 or 3 tank auto switch option is installed on your EC1x and the Auto-Switch LCO_2 or LN_2 must be enabled in the SDEF menu. The TANK=F command is used to reset the tank status to full for all tanks. This would be done after replacing the empty tanks. The TANK? command is used to determine the full or empty status of each tank.

Restrictions: Only applicable to the 3 tank LCO_2 or 2 tank LN_2 auto switch manifold.
Auto-Switch LCO_2 or LN_2 must be enabled in the set default menu.

Example:

TANK=F	where TANK is red shifted IN key on the front panel resets all tanks to full
TANK?	where TANK is the red shifted IN key from the front panel
1=E,2=F,3=F (1)	The response is tank1 empty, tank2 full, tank3 full. The number (1) indicates that tank 1 is currently being used for cooling. This could also read (2) or (3) for tanks 2 or 3. The switching time between tanks is approx. 30 seconds.

TEMP

Function: Examine current chamber temperature

Syntax: TEMP?

Description:

The TEMP command provides the means for a remote interface to read the present value of the chamber probe. This value is normally displayed on the first line of the front panel LCD display. The units for the chamber probe are set in the CAL menu for °F, °C, or °K.

Restrictions: Remote Interface command only.

See Also: T, UCHAN

Example: TEMP?« read chamber probe
25.0 controller response, 25.0 units

CHAM? Same function as TEMP?

TIME

Function: Set or examine time of day

Syntax: TIME=hh:mm:ss set time of day
TIME? examine present time of day

Description:
The TIME command is useful for documenting report outputs and for starting local programs at a specific time of day. Time is ENTERed and displayed in a 24 hour format, i.e., hours (hh) range from 00 to 23; minutes (mm) range from 00 to 59 and; seconds (ss) range from 00 to 59.

Restrictions: None

See Also: RUN#mTIME=hh:mm:ss

Example: TIME=13:30:00« set time to 1:30 PM
TIME?« examine time of day
13:30:00 controller response

TIMEE?

Function: Reads the accumulated elapsed time in hours that the chamber has been running

Syntax: TIMEE? examine accumulated elapsed hours

Description:
The TIMEE? command keeps track of the amount of time (in hours) that the chamber has been running. The elapsed time is saved in EEROM to protect against RAM memory loss. The time is updated whenever the unit is turned off or when a TIMEE? command is received and at least one hour has elapsed since the last update.

Restrictions: None

Example: TIMEE? examine elapsed hours of
+32.37 controller response is 32.37 Hours

UCHAN

Function: Examine the USER channel probe value.

Syntax: UCHAN?

Description:
The UCHAN command permits a remote interface to examine the value of the USER probe. The units of measure for the USER probe are set in the CAL menu. Units may be set in °F, °C, or °K. The USER probe value is normally displayed on the second line of the front panel LCD display.

Restrictions: Remote interface command only.

See Also: TEMP, T, SCALE

Example:

UCHAN?«	examine USER channel probe value
25.0	controller response, 25.0 units

USER? Same function as UCHAN?

UTL

Function: Set or examine the upper temperature limit

Syntax:

nnn.nUTL	TC01 compatible set UTL in °C
UTL	TC01 compatible examine UTL in °C
UTL=nnn.n[u]	Set UTL, variable units
UTL?	Examine UTL, variable units

Description:
The TC01 compatible commands provide for setting and examining the UTL in degrees centigrade only. If temperature units are desired to be the same as that set in the CAL menu for the SCALE variable, then the UTL=nnn.n and UTL? command formats should be used. If the chamber temperature exceeds the UTL setting, then an over temperature interrupt will be generated to the active remote interface and the heat output will be disabled.

Restrictions: TC01 compatible commands operate from the remote interface only.

See Also: LTL

Example:

If scale is set to °F	
150.0UTL«	set UTL to 150°C
UTL«	examine UTL in °C
150.0	controller response, 150.0°C
UTL?«	examine UTL in units of SCALE, °F
302.0	controller response, 302°F

VER?

Function: Examine the version number of the software in the controller

Syntax: VER?

Description:

The VER? command allows the user to check the version of software that the EC1x chamber is running. Version 2.20 and up will also display on the front panel when the unit is turned on.

Restrictions: RS232/422 remote interface command only.

See Also: Version number will also appear at the back of the first page of your EC1x user manual.

Example: VER?

WAIT

Function: Set or examine the temperature segment wait period

Syntax:

WAIT=hh:mm:ss	set wait in hours:minutes:seconds
WAIT=mm	set wait in minutes only (mm=00 to 59)
WAIT=F[OREVER]	set WAIT to forever
WAIT?	examine current wait setting

Description:

The WAIT command provides timing for the length of time the controller has maintained the set temperature. The "+/- AT SET TRIGGER" variable in the SDEF menu determines when timing is started. Once the wait period begins, the wait time continues regardless of changes in chamber temperature. When running a local program, the next command in the program is executed after the wait period has timed out. In single temperature mode, the controller continues to maintain the set temperature after the wait period timeout. During the wait period, examination of WAIT returns the time remaining in the wait period. After the end of a wait time-out, the WAIT is reset to forever. For best operation the temperature segment should be ENTERed RATE, WAIT then SET.

Restrictions: Range from 99:59:59 to 00:00:01

See Also: SET, RATE, M

Example:

RATE=10«	define temperature segment, rate=10°C/min
WAIT=00:10:30«	wait=10 min, 30 sec
TEMP?«	examine current chamber temperature
25.0	controller response, 25.0°C
SET=35.0«	set new temperature, 35°C
	after 1 minute, set temperature is reached, wait period begins; after 1 more minute,
WAIT?«	examine wait setting
00:09:30	controller response, 9 min, 30 sec remaining

SECTION 6. EC1X OPTIONS

POWER OPTIONS

The EC1x is intended to operate from a variety of power sources. Options allow for line voltages to meet domestic and foreign requirements. The EC1x chambers are configured by the manufacturer and may not be reconfigured.

Input Voltage	Model#	Plug Hubble#	Receptacles Hubble#	European Receptacles	* Fuse Sun Part #
95 - 125 Vac,	**EC1A**	5266-C	5261	3 pin, IEC309, 16amp, 100-250Vac	650011
3 Wire	**EC10**	5266-C	5261	3 pin, IEC309, 16amp, 100-250Vac	650011
50/60 Hz	**EC12**	5366-C	5361	3 pin, IEC309, 16amp, 100-250Vac	650012
Single Phase					
(95-125Vac not available on Models EC11A, EC11, EC13, EC13HA,EC1.3W, EC15HA, EC16 & EC16HA)					
200 - 240 Vac	**EC1A**	5666-C	5661	3 pin, IEC309, 32 amp,100-250Vac	650011
3 Wire	**EC10**	5666-C	5661	3 pin, IEC309, 32 amp,100-250Vac	650011
50/60 Hz	**EC11A**	2321	2320	3 pin, IEC309, 32 amp,100-250Vac	650013
Single Phase	**EC11**	2321	2320	3 pin, IEC309, 32 amp,100-250Vac	650013
	EC12	5666-C	5661	3 pin, IEC309, 32 amp,100-250Vac	650011
	EC13	5666-C	5661	3 pin, IEC309, 32 amp,100-250Vac	650011
	EC13HA	2621	2620A	3 pin, IEC309, 32 amp,100-250Vac	650009
	EC1.3W	5666-C	5661		650011
	EC15HA	2621	2620A	3 pin, IEC309, 32 amp, 100-250Vac	650009
	EC16	2621	2620A	3 pin, IEC309, 32 amp,100-250Vac	650009
	EC16HA	2621	2620A	3 pin, IEC309, 32 amp,100-250Vac	650009
200- 240 Vac	**EC1A**	2411	2410	Not offered to European market	650011
4 Wire	**EC10**	2411	2410	Not offered to European market	650011
50/60 Hz	**EC11**	2411	2410	Not offered to European market	650013
Single Phase	**EC12**	2411	2410	Not offered to European market	650011
	EC13	2411	2410	Not offered to European market	650011
	EC13HA	2711	2710A	Not offered to European market	650009
	EC1.3W	2411	2410		650011
	EC15HA	2711	2710A	Not offered to Europeanmarket	650009
	EC16	2711	2710A	Not offered to European market	650009
	EC16HA	2711	2710A	Not offered to European market	650009

* FUSE #	FUSE TYPE & RATING
650009	30 Amp, 250v, fast acting, BLN30 or BAN30
650011	15 Amp, 250v, fast acting, BLN15 or BAN15
650012	20 Amp, 250v, fast acting, BLN20or BAN20
650013	25 Amp, 250v, fast acting, BLN25 or BAN25

Table 1.3-1 AC. Power Connectors

COOLING OPTIONS

The standard EC1x is intended to operate directly from liquid carbon dioxide. The carbon dioxide is to be provided from an industry standard 50 pound siphon type K cylinder. The draw pressure from the cylinder is approximately 850 PSI at room temperature. A hose and fitting necessary to interface between the EC1x and LCO_2 cylinder is provided. No other valves or regulators are necessary. The lower temperature limit of LCO_2 is -73ºC.

Option OPECCO30x provides the capability for the delivery of low pressure LCO_2 from a 300 PSI dewer's vessel or bulk delivery system. Extra insulation is provided and a special nozzle assembly is used. Due to the variation of fittings, a tank adaptor is not supplied, but may be available from Sun Systems as a separate item. A hose is provided, however.

Option LNxVxT provides for the extended operating range of liquid nitrogen. Chambers configured with the Liquid Nitrogen option as the cooling expectorant are able to operate as low as -184ºC in temperature. Liquid nitrogen (LN_2) is commonly supplied in either a vessel (also called a dewar) or a bulk delivery system. Delivery pressure for these systems vary. A bulk delivery system normally runs low pressure (this pressure should not be below 25 psi). Delivery from a vessel is available in low or high pressure. Low pressure is 25psi to 50psi. High pressure is approximately 100psi. Other pressure set ups are available, please contact factory. The pressure specified for the chamber at time of order is recorded on page 2 of this manual and on the I.D. Tag found on the back of the chamber.

PORT AND WINDOW OPTIONS

Several options provide standard port and window options for convenience when working with the EC1x. Standard options include 1", 2", 3" or 4" ports in the door and/or sides of the chamber. A window may also be installed in the door. Please call with your special requirements.

SECTION 7. SPECIFICATIONS

Model #	EC1A	EC11A	EC10	EC11	**EC1.3W	EC12
Chamber Volume	0.37 ft^3	0.37 ft^3	0.7 ft^3	0.7 ft^3	1.37ft^3	2.2 ft^3
Internal Dim.	10.0"W 8.0"H 8.0"D	10.0"W 8.0"H 8.0"D	12.0"W 9.75"H 10.25"D	12.0"W 9.75"H 10.25"D	14.0"W 13.0"H 13.0"D	20.0"W 12"H 16.0"D
External Dim.	17.5"W 13.25"H 20.0"D	17.5"W 13.25"H 20.0"D	21.0"W 16.0"H 24.0"D	21.0"W 16.0"H 24.0"D	26.5"W 21.0"H 31.0"D	30.0"W 19.5"H 30.0"D
Temp. Resolution	0.02ºC	0.02ºC	0.02ºC	0.02ºC	0.02ºC	0.02ºC
User Probe	Yes	Yes	Yes	Yes	Yes	Yes
Battery Backup	Yes	Yes	Yes	Yes	Yes	Yes
IEEE-488	Yes	Yes	Yes	Yes	Yes	Yes
RS232	Yes	Yes	Yes	Yes	Yes	Yes
RS422	Yes	Yes	Yes	Yes	Yes	Yes
Max. Rate of Change	.5ºC/sec 30ºC/min	1.0ºC/sec 60ºC/min	.5ºC/sec 30ºC/min	.8ºC/sec 48ºC/min	.33ºC/sec 20ºC/min	.25ºC/sec 15ºC/min
CFM Vertical	60 ft^3/min	120 ft^3/min	60 ft^3/min	120 ft^3/min	250 ft^3/min	150 ft^3/min
110/115 VAC 50/60 Hz Single Phase	*		*			*
208/220 VAC, 50/60Hz Single Phase, 3/4 Wire	*	*	*	*	*	*
240 VAC, 50Hz Single Phase,3 Wire	*	*	*	*	*	*
Power Req.	1600 Watts	4200 Watts	1800 Watts	4200 Watts	3000 Watts	2200 Watts
Net/Shipping Weight	38/55lbs	38/55lbs	49/68lbs	49/68lbs	77/94 lbs	80/100lbs

Environment, Operating

Temperature:	-94 to 608 F(-70 to 320 C) using Carbon Dioxide -299 to 608 F (-184 to 320 C) using Liquid Nitrogen
Barometric Pressure:	Ambient
Humidity:	20 - 95% non-condensing

Environment, Shipping & Storage

Temperature:	0 to 110 F (-18 to 43 C)
Barometric Pressure:	5.54 to 30 in. Hg (0.184 to 1.003atm)
Vibration and Shock:	As encountered in normal shipping and handling with no degradation

Temperature Range (ºC)

LCO_2 cooling -73 to 315º C for all of the above models, Except for **EC1.3W -73 to +400ºC
LN_2 cooling -184 to 315º C for all of the above models, Except for **EC1.3W -184 to +400ºC

SAFETY:

Probe Malfunction	Open / Short Probe Detection
Controller Malfunction	Hardware Watch Dog Timer
Temperature Limits	Upper and Lower software limits and Adjustable Thermostat

Model #	EC13	EC13HA	EC15HA	EC16	EC16HA
Chamber Volume	3.0 ft³	3.0 ft³	5.0 ft³	6.16 ft³	6.16 ft³
Internal Dim.	20"W 12"H 22"D	20"W 12"H 22"D	20"W 12"H 36"D	22"W 22"H 22"D	22"W 22"H 22"D
External Dim.	30.0"W 19.5"H 36.0"D	30.0"W 19.5"H 36.0"D	30.0"W 19.5"H 50.0"D	32.0"W 29.5"H 36.0"D	32.0"W 29.5"H 36.0"D
Temp. Resolution	0.02ºC	0.02ºC	0.02ºC	0.02ºC	0.02ºC
User Probe	Yes	Yes	Yes	Yes	Yes
Battery Backup	Yes	Yes	Yes	Yes	Yes
IEEE-488	Yes	Yes	Yes	Yes	Yes
RS232	Yes	Yes	Yes	Yes	Yes
RS422	Yes	Yes	Yes	Yes	Yes
Max. Rate of Change	.25ºC/sec 15ºC/min	.5ºC/sec 30ºC/min	.4ºC/sec 24ºC/min	.4ºC/sec 24ºC/min	.4ºC/sec 24ºC/min
CFM Vertical	300 ft³/min	600 ft³/min	600 ft³/min	600 ft³/min	600 ft³/min
110/115 VAC 50/60 Hz Single Phase					
208/220 VAC, 50/60 Hz Single Phase, 3/4 Wire	*	*	*	*	*
240 VAC, 50 Hz Single Phase, 3 Wire	*	*	*	*	*
Power Req.	3000 Watts	6000 Watts	6000 Watts	6000 Watts	6000 Watts
Net/Shipping Weight	98/115lbs	108/125lbs	138/175lbs	139/160lbs	165/185lbs

Environment, Operating	Temperature:	-94 to 608 F(-70 to 320 C) using Carbon Dioxide -299 to 608 F (-184 to 320 C) using Liquid Nitrogen
	Barometric Pressure:	Ambient
	Humidity:	20 - 95% non-condensing
Environment, Shipping & Storage	Temperature:	0 to 110 F (-18 to 43 C)
	Barometric Pressure:	5.54 to 30 in. Hg (0.184 to 1.003atm)
	Vibration and Shock:	As encountered in normal shipping and handling with no degradation
Temperature Range (ºC)	LCO_2 cooling -73 to 315º C for all of the above models	
	LN_2 cooling -184 to 315º C for all of the above models	

SAFETY:

Probe Malfunction	Open / Short Probe Detection
Controller Malfunction	Hardware Watch Dog Timer
Temperature Limits	Upper and Lower software limits and Adjustable Thermostat

SECTION 8. MAINTENANCE

The EC1x series of environmental chambers was designed to be as maintenance free as possible. To prolong your chamber's useful product life and to maintain it at its optimum working condition, Sun Systems recommends performing routine maintenance to the blower motor and expectorant filter on a semiannual basis. Refer to figures in section 1. Before using any cleaner or decontamination method except those recommended by the manufacturer, users should check with the manufacturer that the proposed method will not damage the equipment.

BLOWER MOTOR INSPECTION AND CLEANING

This procedure is to insure proper air flow is received by the blower motor for cooling.

STEP 1
Unplug chamber and position the chamber such that access is allowed to the rear of the chamber.

STEP 2
Clean the intake of the blower motor with a brush or vacuum / brush combination.

STEP 3
Reposition the chamber insuring that at least 2 inches of free air space exists between the rear of the blower motor and any other objects.

EXPECTORANT FILTER CLEANING

This procedure is necessary to insure proper working order of the cooling system.

STEP 1
Position the chamber such that access to the rear of the unit is possible.

STEP 2
Turn off the expectorant supply and remove the expectorant supply hose from the rear of the chamber. The hose connects to the filter assembly.

STEP 3
Remove the filter back section and then the filter itself.

STEP 4
Remove any contamination from the filter. If need be, tap the filter lightly as not to damage the filter.
STEP 5
Replace the filter and filter back body section

STEP 6
Reconnect the expectorant supply hose and turn on the expectorant supply. Check for leaks around the fittings.

SECTION 9. CHAMBER REPAIR

TEMPERATURE CONTROLLER SECTION REMOVAL AND REPLACEMENT

The temperature controller section is located on the right side of the chamber when viewed from the front. Follow the procedure outlined below for the removal and replacement of the controller section.

STEP 1
Remove all electrical power from the chamber, i.e., unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that all of the components of the chamber have reached ambient temperature.

STEP 2
Position the chamber on its left side as viewed from the front. Remove the (4) or (5) 6-32 screws located on the exposed bottom of the chamber / control section intersection. Then remove the (4) or (5) 6-32 screws located on the top of the chamber / control section intersection.

STEP 3
Carefully separate the controller chassis from the chamber section being careful not to stress the wiring or probe connections.

STEP 4
If probes are to stay with controller then remove probes from chamber section. If probes are to stay with chamber then remove probe connectors from controller main PC board.

STEP 5
Disconnect the 26 pin flat cable from the I/O board that is mounted on the chamber section wall and also unplug the 2 wire power input cable from the I/O board.

REPLACEMENT Reverse steps 1-5

HEATER ELEMENT REMOVAL AND REPLACEMENT

The heating elements are located behind the air baffle located inside the test chamber area. Follow the procedure below for removal and replacement.

STEP 1
Unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the heating elements and the interior of the chamber have had time to reach ambient temperature.
REMOVE AIR BAFFLE

STEP 2
Remove the (3) 6-32 screws and the (4) 8-32 screws located around the blower air intake on the rear wall of the interior of the test chamber

STEP 3
Remove the (2) 6-32 screws located on the ceiling of the test chamber and the air baffle.

REMOVE CHAMBER BACK PLATE

STEP 4
Remove the (14) or (18) #6 screws located on the perimeter of the chamber back plate and carefully pivot back plate away without stress to the line or fuse wiring.

HEATER ELEMENT REMOVAL

STEP 5
Carefully remove the fiberglass insulation from the heater mounting area. Remove the 6-32 nut and flat washer from each side of the heater element. Remove the wired ring terminals from the heater element mounts.

STEP 6
Remove the next 6-32 nut and beveled washer from both mounting sides.

NOTE: When reinstalling, always place the wide part of the bevel washer towards the ceramic insulator. Tighten the nut finger tight plus 3/4 of a turn or use 4 inch pounds of torque.

STEP 7
Stand to the side of the chamber. While supporting the two ceramic insulators from falling with one hand, reach inside and grasp the heater element and pull towards the front of the chamber.

REPLACEMENT- Defective heater elements are replaced with new ceramic insulators and new heater element. Reverse steps 2 thru 7 for installation

HEATER ELEMENT REPLACEMENT TABLE

The following is a guide to the number and type of heater elements used in each chamber.
Chambers using both wattages, the upper elements on each side are 800w and lower are 600w.

Model #	PN# 980201 (600 watt)	PN# 980205 (800 watt)
EC1A, EC10	2	
EC11A		4
EC11	2	2
EC1.3W	4	
EC12		2
EC13	4	
EC13HA, EC15HA	4	4
EC16, EC16HA	4	4

COOLING MODULE ASSEMBLY REPLACEMENT

The cooling module consists of the nozzle, cool solenoid valve and associated plumbing necessary to deliver the expectorant to the test chamber.

STEP 1
Unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect supply hose from the chamber. Insure that the components which carry the expectorant have had time to reach ambient temperature.
STEP 2
Follow the steps required to remove the controller chassis as described in "Temperature controller section removal".

SOLENOID VOLTAGE DISCONNECT
STEP 3
Locate and follow the two wires attached to the cool module and disconnect the two wires from the I/O board terminal block. Write down positions that the two wires are connected so that you reconnect the wires in the same fashion.
STEP 4
The cooling assembly has a 6" nozzle which protrudes into the test chamber area. Carefully remove the (5) #6 screws which hold the cooling assembly on the mounting plate and pull the module off the mounting plate in a perpendicular fashion.

REPLACEMENT Reverse steps 2 thru 4

MECHANICAL FAIL-SAFE REMOVAL AND REPLACEMENT

This applies only to the mechanical fail-safe which is installed on all Models expect the Model EC1.3W. If the electronic failsafe on the EC1.3W needs service contact Sun Electronic Systems. The fail-safe thermostat is located internally on the rear of the chamber. If replacement of the fail-safe is deemed necessary, follow the procedure below.

STEP 1
Unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the heating elements and the interior of the chamber have had time to reach ambient temperature.

REMOVE CHAMBER BACK PLATE

STEP 2
Remove the (14) or (18) #6 screws located on the perimeter of the chamber back plate and carefully pivot back plate away without stress to the line or fuse wiring.

STEP 3
Remove the fiberglass insulation which covers the fail-safe thermostat. Locate the thermostat and disconnect the (2) wires attached in line to the thermostat utilizing quick disconnect terminals.

STEP 4
Remove the (3) #6 screws which hold the thermostat to the rear wall of the test chamber and remove the thermostat.

REPLACEMENT Reverse steps 2 thru 4. Calibrate the thermostat under the procedures described in section 2 of this manual.

BLOWER MOTOR REPLACEMENT

If a faulty blower has been determined, perform the following procedure for removal and replacement.

STEP 1
Unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the heating elements and the interior of the chamber have had time to reach ambient temperature.

STEP 2
Follow the steps required to remove the temperature controller section as described earlier.
REMOVE AIR BAFFLE

STEP 3
Remove the (3) 6-32 screws and the (4) 8-32 screws located around the blower air intake on the rear wall of the interior of the test chamber

STEP 4
Remove the (2) 6-32 screws located on the ceiling of the test chamber and the air baffle.

REMOVE CHAMBER BACK PLATE

STEP 5
Remove the (14) or (18) #6 screws located on the perimeter of the chamber back plate and carefully pivot back plate away without stress to the line or fuse wiring.

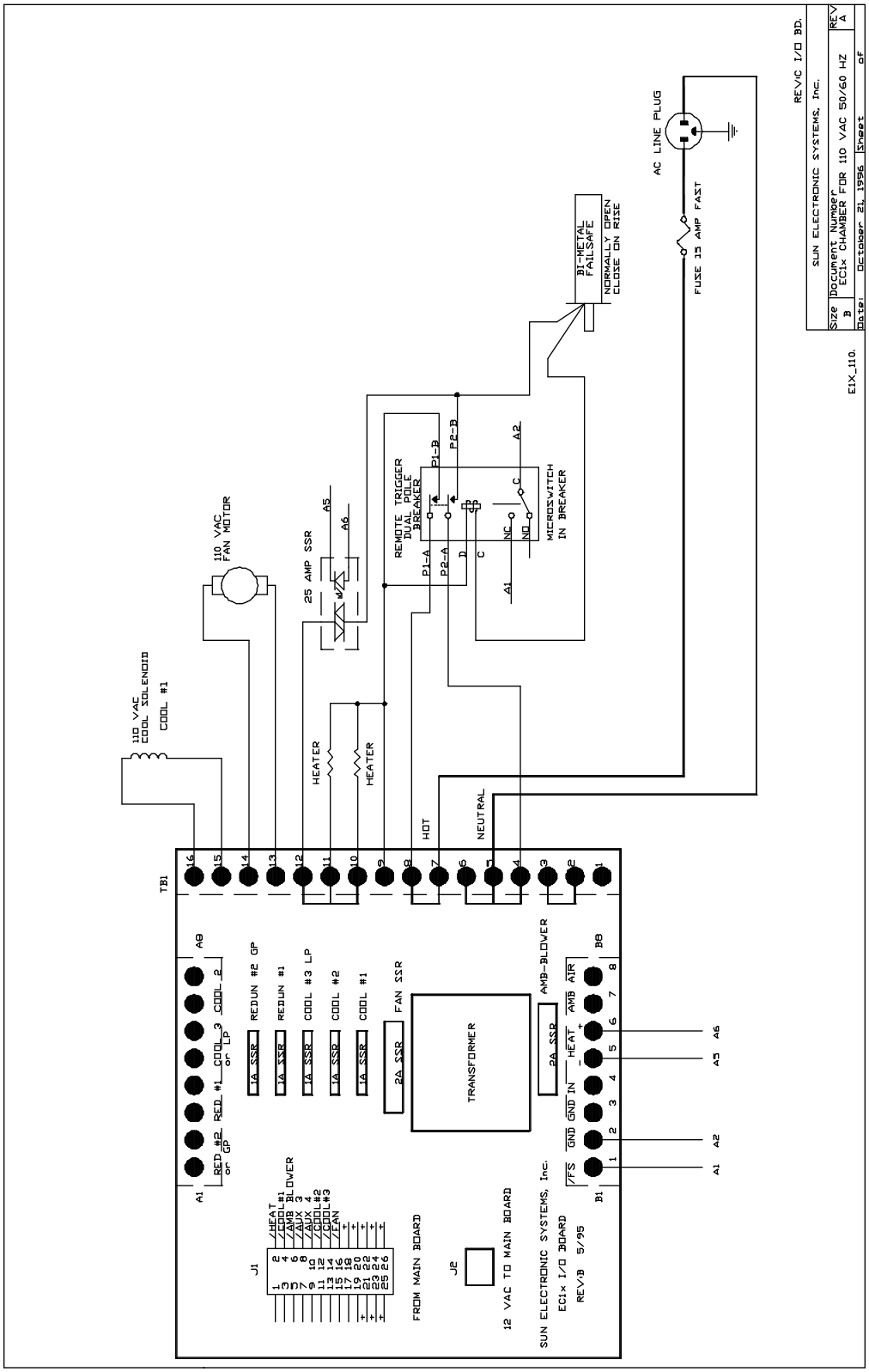
STEP 6
From inside the test chamber, remove the blower wheel by loosening the set screw which holds the wheel to the motor shaft.

STEP 7
Locate and follow the two wires connected to the blower motor back to the I/O board terminal block located in the controller section and remove from (13) and (14). Feed wires thru access hole in chamber side plate and let hang near blower motor.

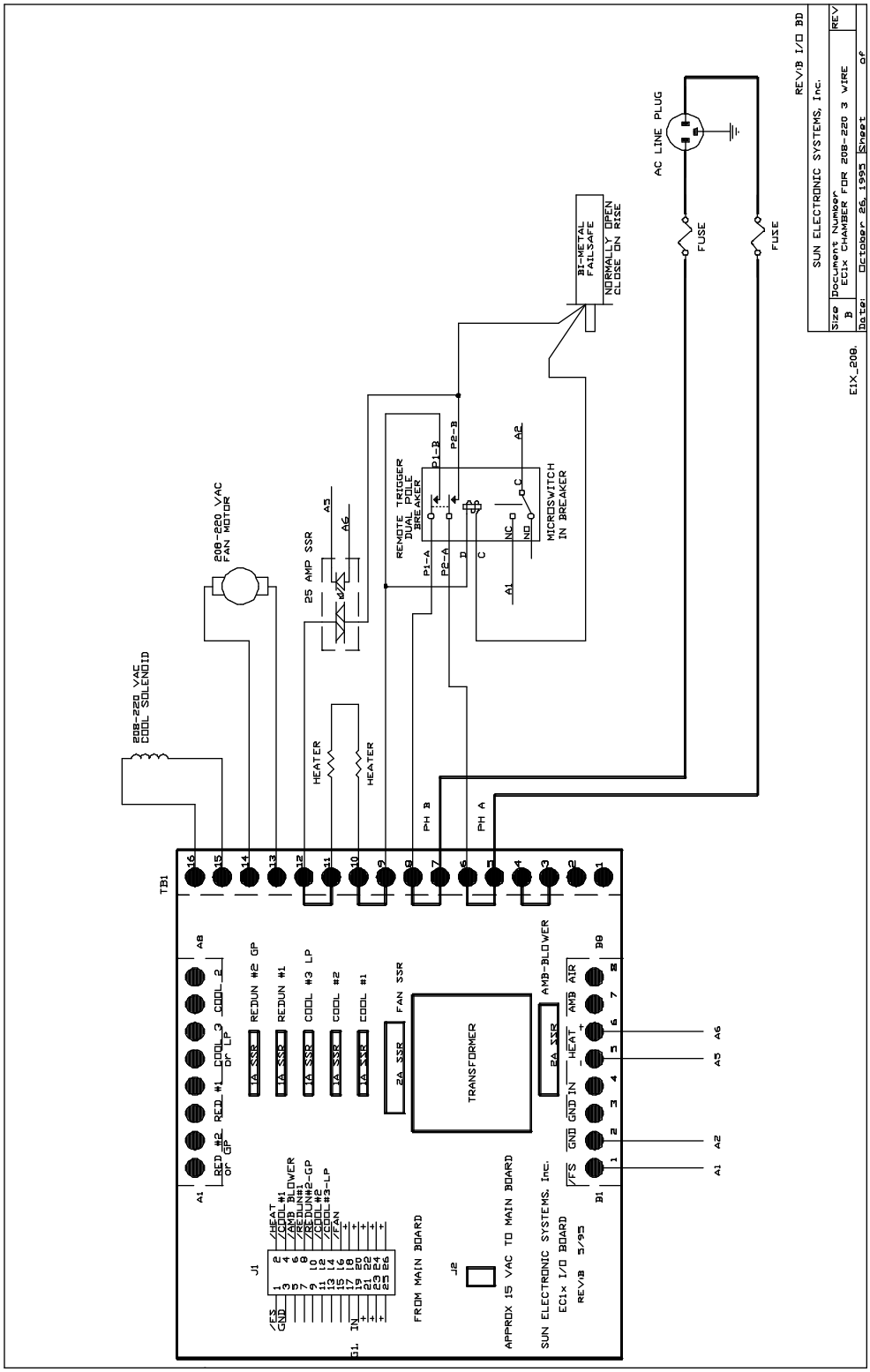
STEP 8
Remove the (4) 8-32 screws which secure the blower motor adapting plate and remove the blower motor in a perpendicular fashion.

REPLACEMENT Reverse steps 2 thru 8

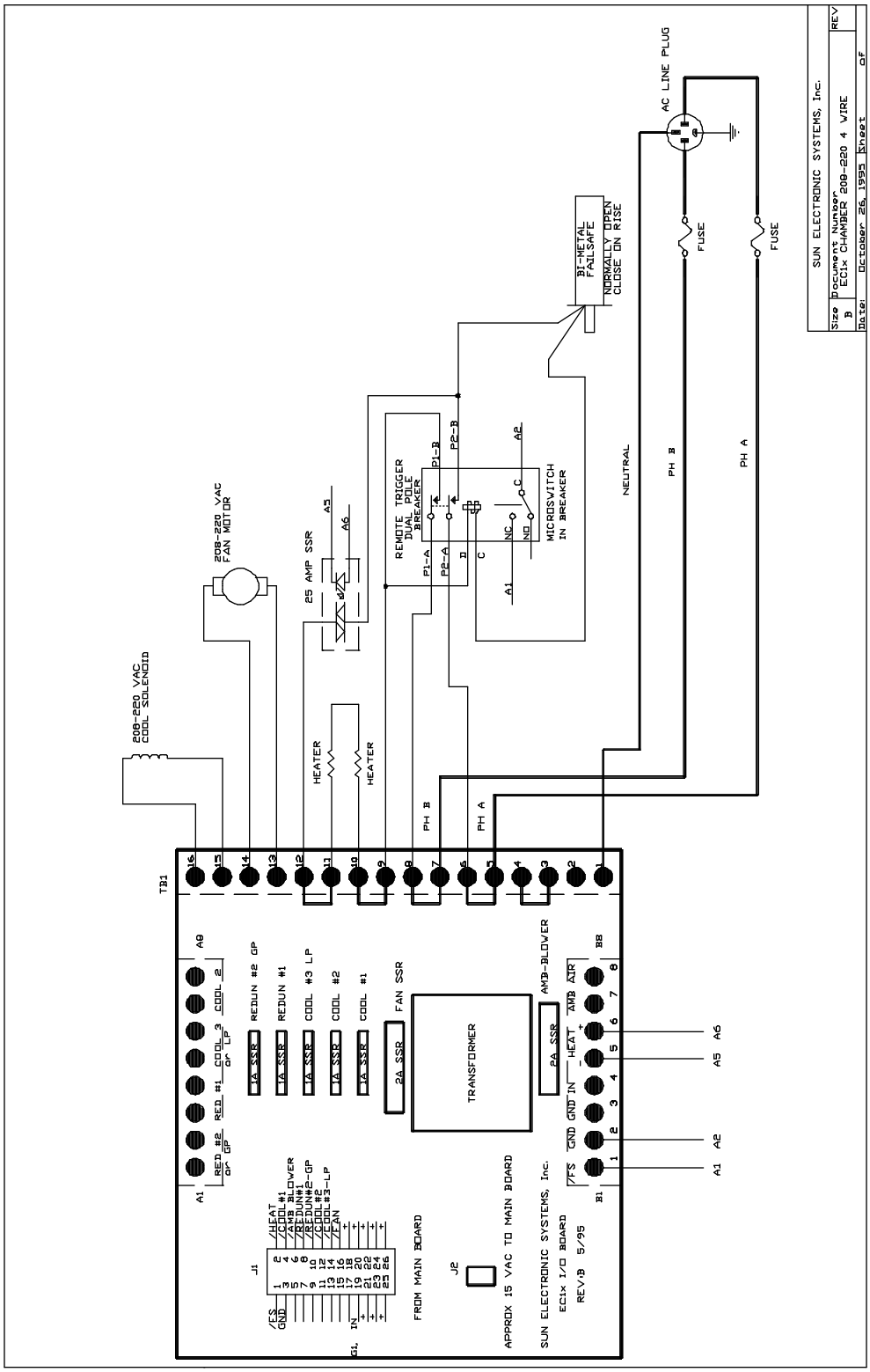
110 VAC 3 WIRE SCHEMATIC



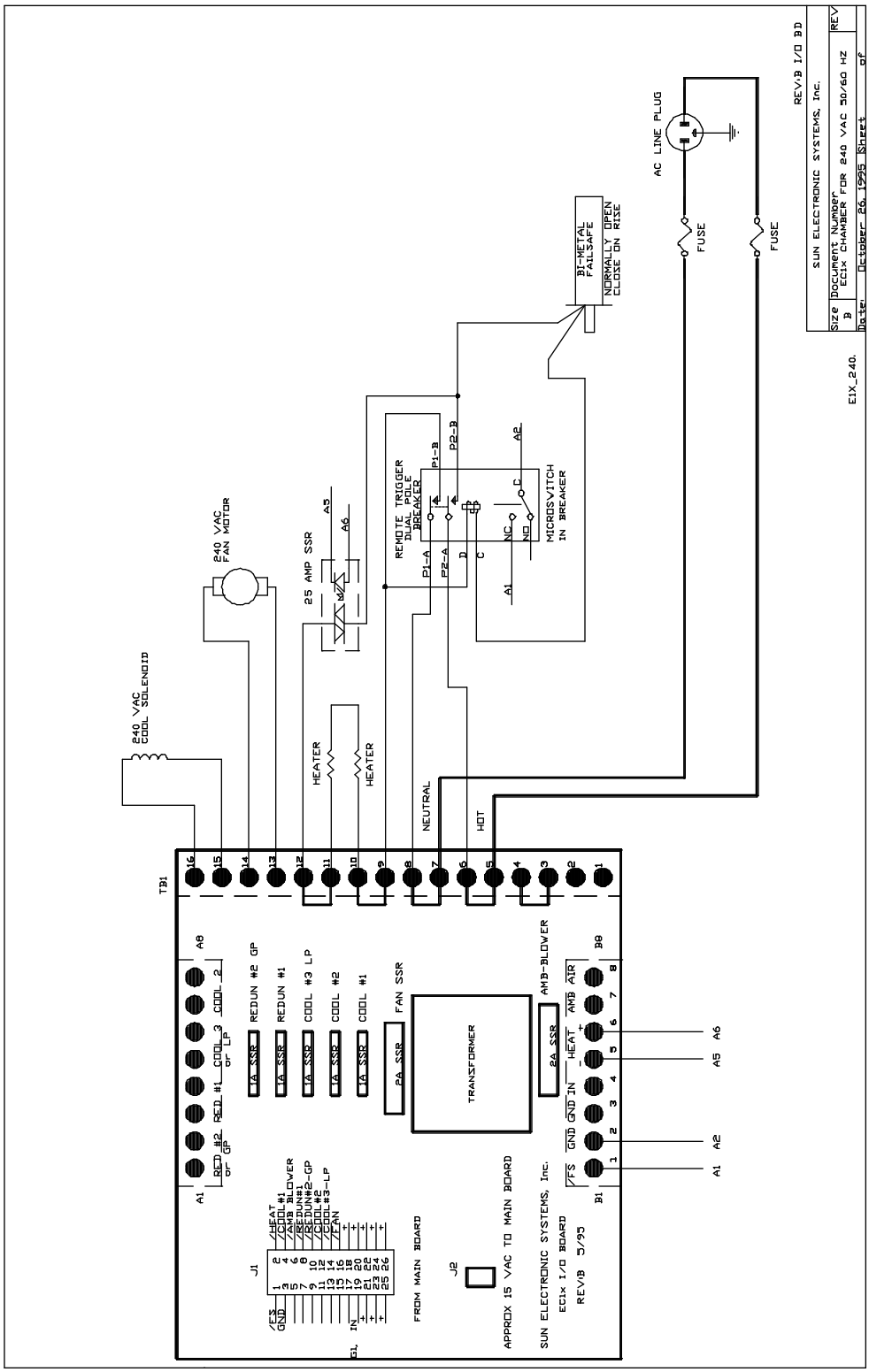
208 VAC 3 WIRE SCHEMATIC



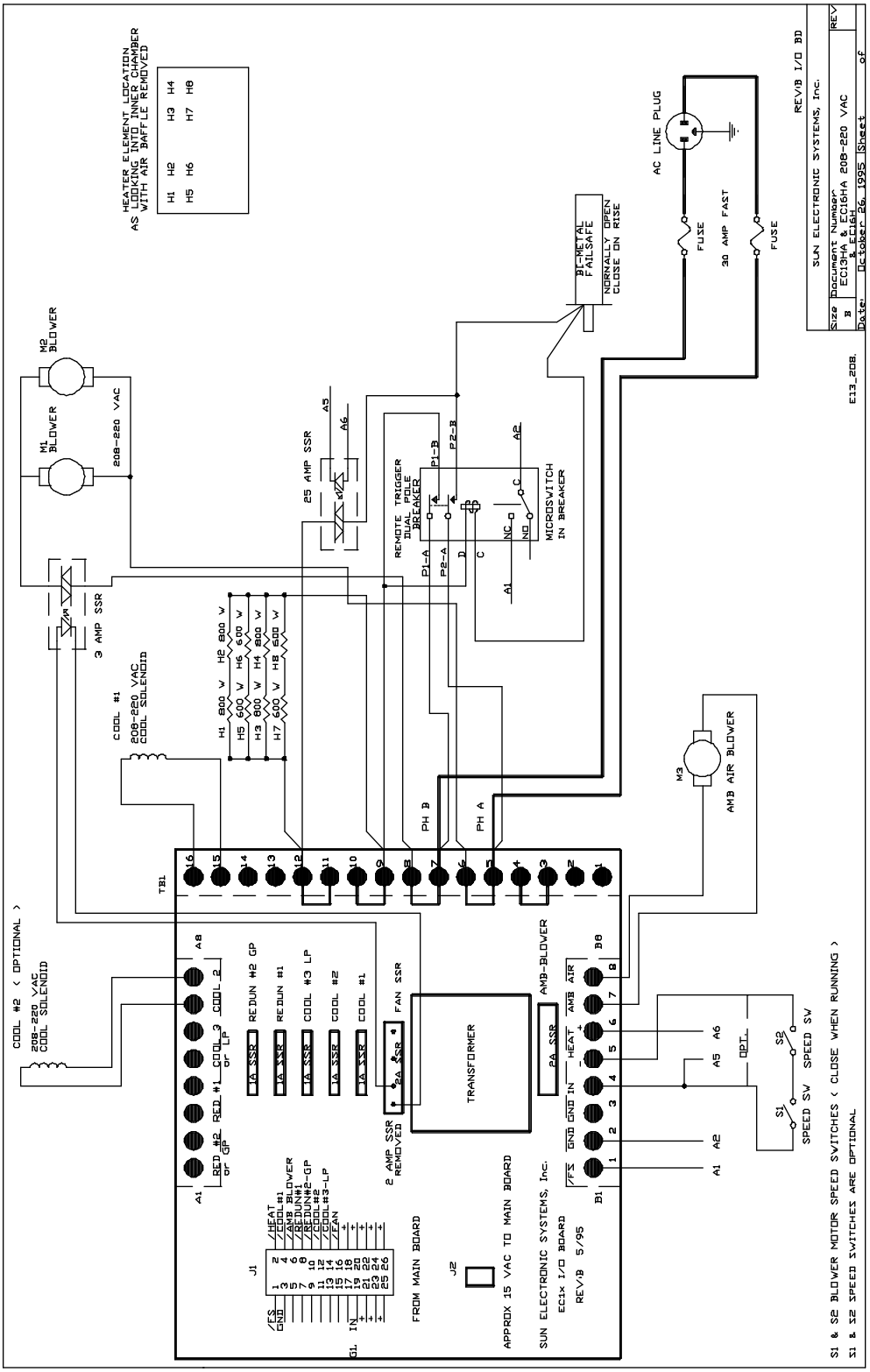
208 VAC 4 WIRE SCHEMATIC



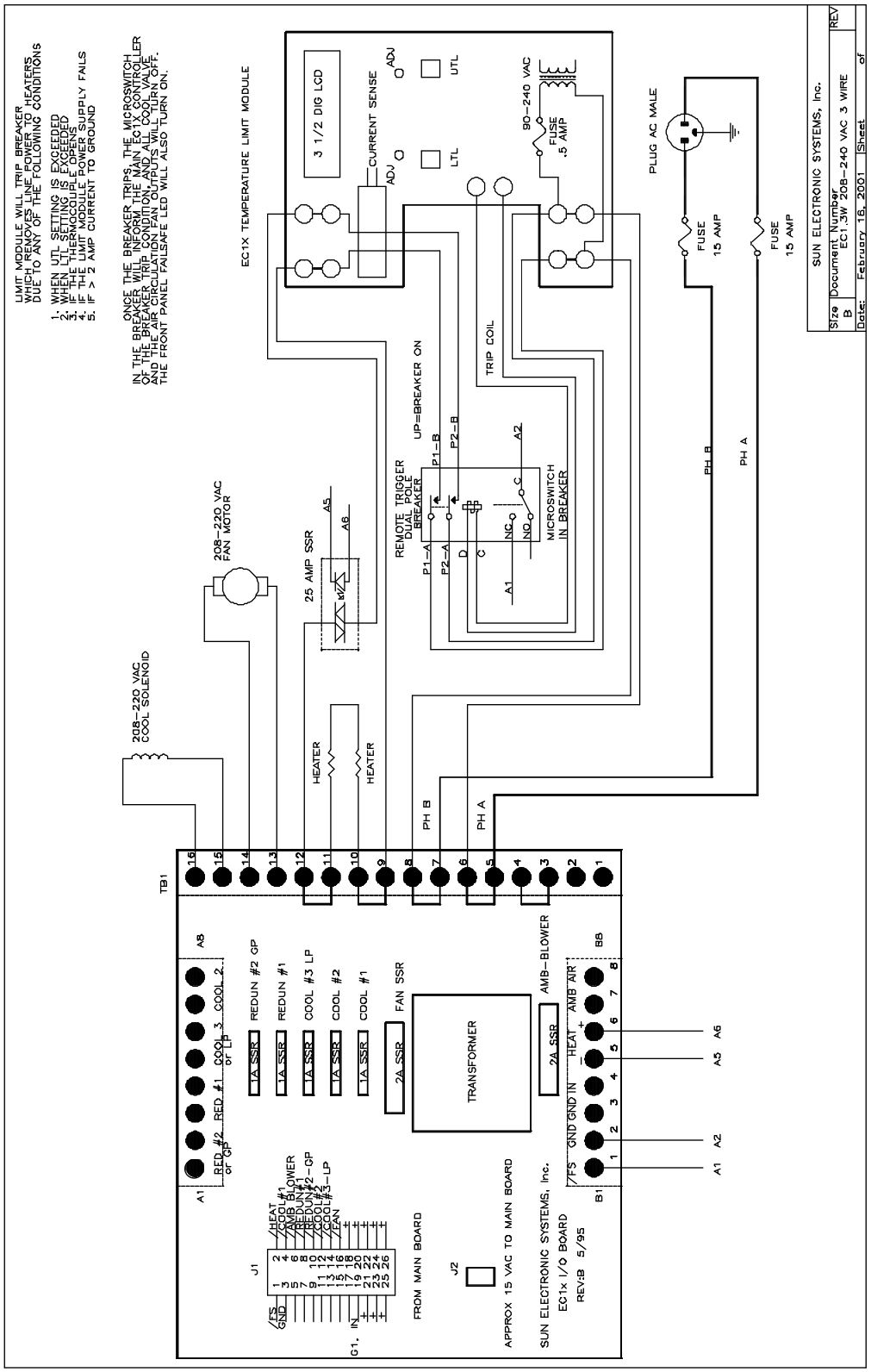
240 VAC 3 WIRE SCHEMATIC



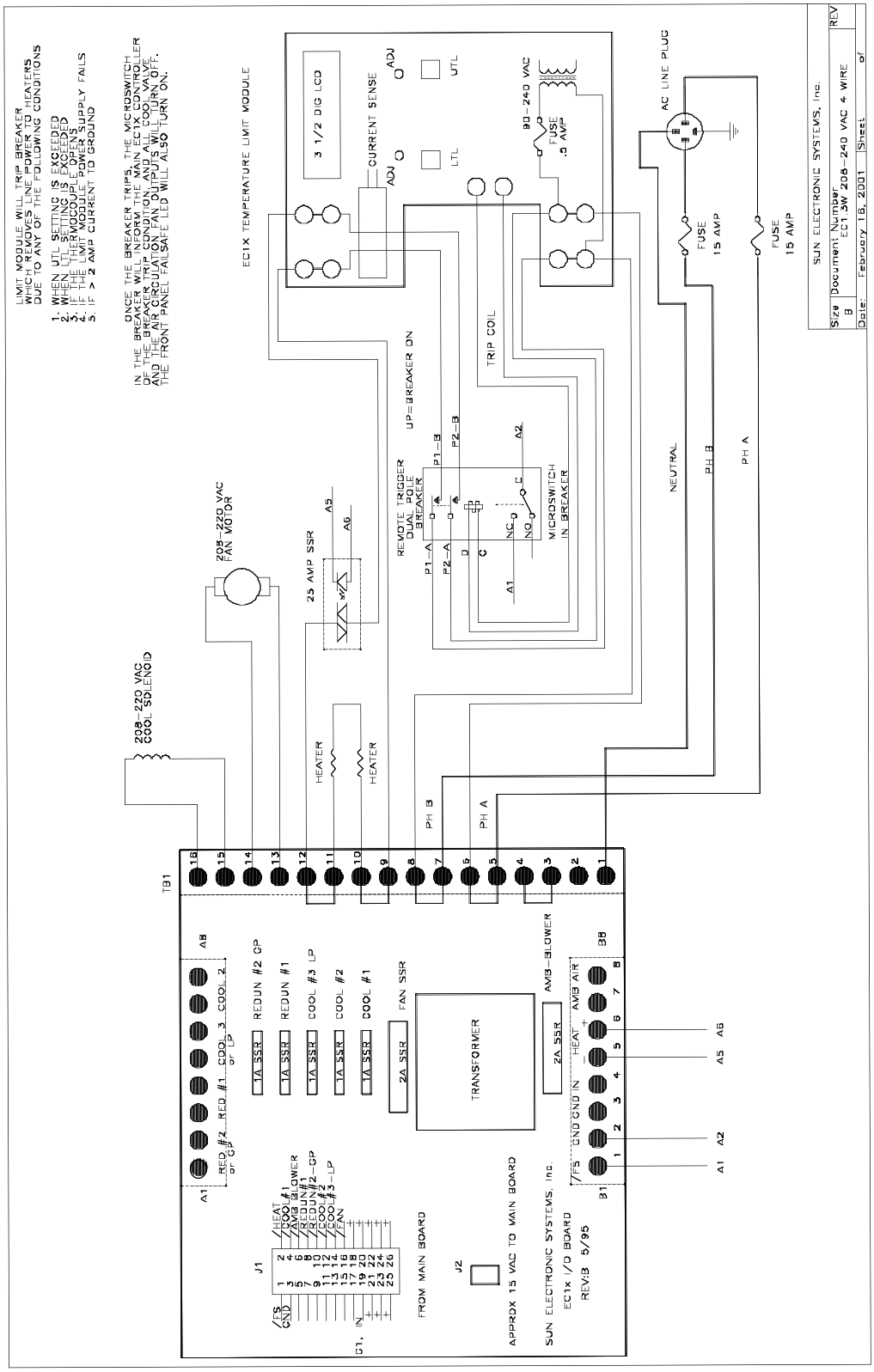
EC1XHA 208 VAC SCHEMATIC



EC1.3W 208-240 VAC, 3 WIRE SCHEMATIC



EC1.3W 208-240 VAC, 4 WIRE SCHEMATIC



SECTION 10. REPLACEMENT PARTS

COOL ASSEMBLY	850 PSI LCO_2 110 VAC (980236)
COOL ASSEMBLY	850 PSI LCO_2 208 -240 VAC (980237)
COOL ASSEMBLY	300 PSI LCO_2 110 VAC (980223)
COOL ASSEMBLY	300 PSI LCO_2 208-240 VAC (980224)
COOL ASSEMBLY	LN2 110 VAC (LN1V1T) specify Hi or Low PSI
COOL ASSEMBLY	LN2 208-240 VAC (LN2V1T) specify Hi or Low PSI

BIMETAL FAIL-SAFE, NORMALLY OPEN (800008)
EC1A, EC11A, EC10, EC11 BLOWER WHEEL (490002)
EC12, EC1.3W BLOWER WHEEL (490003)
EC13 BLOWER WHEEL (490010)
EC13HA, EC15HA, EC16, EC16HA BLOWER WHEEL- COUNTER CLOCKWISE (490009)
EC13HA, EC15HA, EC16, EC16HA BLOWER WHEEL - CLOCKWISE (490010)

TYPE K CHAMBER PROBE (980090)
TYPE K USER PROBE - 38" EC1A/10/11/1.3W (980091)
TYPE K USER PROBE - 44" EC12/13/13HA (980092)
TYPE K USER PROBE - 48" EC16/16HA (980094)

ASSEMBLED I/O BOARD (980036)
HEATER 25 AMP SSR (800003)
EXPECTORANT FILTER ASSEMBLY LCO2 (980240)
EXPECTORANT FILTER ASSEMBLY LN_2 (980241)

600 WATT HEATER ELEMENT (980201)
900 WATT HEATER ELEMENT (980205)

LEFT DOOR HANDLE ASSEMBLY (980501)
RIGHT DOOR HANDLE ASSEMBLY (980502)
DOOR POST EC1A/10/11 (910031)
DOOR POST EC12/13/13HA/1.3W/16/16HA (910005)
DOOR GASKET EC0A/1A/11A (980518)
DOOR GASKET EC01/10/11 (980512)
DOOR GASKET EC02/03/12/13/13HA/15HA (980516)
DOOR GASKET EC16/16HA (980519)

6 FT STAINLESS LCO_2 HOSE (WITHOUT FITTINGS) (570002)
LN_2 HOSE, 6 FT (570020)
LCO_2 TANK ADAPTOR (980239)
2 POLE PLATE BREAKER (650010)

EXTRA EC1x MANUAL (MANEC1X)

SECTION 11. ERROR MESSAGES

Error Messages Possible Cause/Recovery

ERROR = SET < LTL

This error means that the SET temperature is set lower than the LOWER TEMPERATURE LIMIT. (i.e. LTL = 0 and SET = -50) If this is the case, you need to adjust your Lower Temperature Limit (LTL). See LTL and SET command in Section 5 of this manual. The LTL is a software safety feature. If the SET value is set below the LTL you will get "ERROR = SET< LTL" and the unit will not go to that set point unless you lower the LTL below the SET value or increase the SET value to be above that of the LTL.

ERROR = SET > UTL

This error means that the SET temperature is set higher than the UPPER TEMPERATURE LIMIT. (i.e. UTL = 100 and SET = 150) If this is the case, you need to adjust your Upper Temperature Limit (UTL). See UTL and SET command in Section 5. of this manual. The UTL is a software safety feature. If the SET value is set above the UTL you will get " ERROR = SET > UTL" and the unit will not go to that set point unless you increase the UTL value above the SET value or decrease the SET value to be below that of the UTL.

COMMAND ERROR !

Syntax Error. Press **? ENTER,** on the display will be a two line response. The first line will be a copy of the last command received. The second line will be a pointer indicating the spot in the command where the error occurred.

INVALID IN LP!

This error means you are in the EDIT mode where you enter a local program and the command you entered is not acceptable in Local Program.

RAM BATT LO

The clock/battery backed RAM I.C. needs to be replaced. Call factory for replacement pn# 510064

PROBE #1 ERROR or PROBE #2 ERROR

NOTE: To avoid violation of chamber warranty, contact our Service Department before attempting to trouble shoot this error.

This error means that either the chamber probe (normally located in the top of the chamber) is bad or there is a problem on the probe front end of the motherboard. To determine if the problem is with the probe or on the motherboard you will need to separate the controller from the chassis. (see photograph "Controller Section Separated") Disconnect both green probe connectors labeled Chamber and User Probe from the motherboard (see photograph "Controller Section Main Board Cover Removed", photographs can be found in the front of this manual.) Switch the two connectors leaving the probes attached. If the controller display still reads Probe #2 ERROR, the problem is in the front end of the motherboard and it must come back to Sun for repair. If the controller display now reads Probe #1 Error, the probe itself is bad.

b0 FORCE H&C OFF

Refer to the SDEF menu, "Auto SENSE IN0". This error occurs when the default setting of NO has been changed to YES enabling the "Auto SENSE IN0" but your chamber is not set up to detect logic on input bit 0 and shut off Heat and Cool.