ENVIRONMENTAL CHAMBER

- **0.7 FT³ WORKING VOLUME**
- **INTEGRAL USER**
  - Temperature Probe
- **LCO₂, -73°C TO +315°C COOLING**
  - Optional LN₂, -184°C to +315°C
- **IEEE-488, RS232, RS422**
  - Remote Communication
- **EXPANDED I/O ARCHITECTURE**
  - Analog Input Ports
  - Analog Output Ports
  - Auxiliary I/O Drivers
  - Digital Parallel Port
  - High Speed Serial Link
- **LOCAL TEMPERATURE**
  - Controlled Ramping

The EC11 is an advanced environmental chamber intended for automated test system and laboratory applications which require fast temperature cycling. Temperature ramping rates are locally controlled from 0.01°C/sec. The Model EC11 is ideally suited for many forms of MIL-883 testing and other forms of fast temperature cycling testing. Local programs are entered using a BASIC like command set programming language. In automated test systems, the EC11 functions as a remote data acquisition and control system using the capability of its expanded I/O architecture.

The electrically isolated user temperature probe allows for direct monitoring of critical temperatures on the device under test or certain areas inside the test chamber. As well as being displayed on the front panel, readings are accessible from the IEEE-488 or RS232/422 interfaces.

The EC11 command set, whether entered from the local keyboard or downloaded over the IEEE-488 or RS232/422 interfaces, provides for setting chamber temperature, temperature ramping rate and soak time at temperature, temperature deviation limits and temperature upper and lower limits.

Probe calibration procedures are built into the EC11 using local menu driven format. Special communication commands allow for communication to the analog I/O ports, the high speed serial port (SPI) and the parallel port. The chamber can be controlled remotely from the RS232/422 port or the IEEE-488 bus interface. When the IEEE-488 bus interface is used, transparent communication from the IEEE-488 bus to the RS232/422 port is supported. Programs and parameters are stored in battery-backed memory.

The PID coefficients used in the EC11 are user adjustable from the keyboard and remote interfaces. In addition, alarm function and sound level, BAUD rate, interrupt assignments and other communication port options are configurable from the front panel using an easy, menu driven format.

The EC11 supports several safety features including a mechanically adjustable over temperature thermostat, upper and lower software temperature limits, processor watchdog timer and open and short probe detection.

The EC11 is designed to be adaptable to your system application. If you have special requirements, call Sun Systems for solutions.
### GENERAL SPECIFICATIONS (subject to change without notice)

#### MECHANICAL

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Dimensions</td>
<td>(30.5cmW x 24.75cmH x 26.0cmD)</td>
</tr>
<tr>
<td>Test Volume</td>
<td>(0.020m³)</td>
</tr>
<tr>
<td>Overall Dimensions</td>
<td>(53.3cmW x 40.6cmH x 61.0cmD)</td>
</tr>
<tr>
<td>Exterior Construction</td>
<td>Painted Aluminum Alloy</td>
</tr>
<tr>
<td>Door (see options)</td>
<td>Blank door supplied with chamber</td>
</tr>
<tr>
<td>Interior Construction</td>
<td>Stainless Steel, with exhaust port</td>
</tr>
<tr>
<td>Coolant Input</td>
<td>LCO₂, 37º male fitting, 1/4” tube</td>
</tr>
<tr>
<td></td>
<td>(optional) LN₂, 45º male fitting, 1/2” tube</td>
</tr>
<tr>
<td>Exhaust</td>
<td>3/8” NPT, male</td>
</tr>
<tr>
<td>Weight</td>
<td>(22 kg typical; 31 kg shipping)</td>
</tr>
</tbody>
</table>

#### PERFORMANCE

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Temperature Range (LCO₂)</td>
<td>(-100ºF to +600ºF)</td>
</tr>
<tr>
<td>With LN₂ Option</td>
<td>(-300ºF to +600ºF)</td>
</tr>
<tr>
<td>Temperature Ramping Rate Range</td>
<td>(0.02ºF to 86ºF/min)</td>
</tr>
<tr>
<td>Number of Programmable Temperature Setpoints</td>
<td>Typically 100+</td>
</tr>
<tr>
<td>Time at Temperature Setpoint Range</td>
<td>1.0 sec to 99 hr, 59 min, 59 sec</td>
</tr>
<tr>
<td>Number of Programmable Set Times</td>
<td>Typically 100+</td>
</tr>
<tr>
<td>Air Circulation</td>
<td>120 CFM, vertical</td>
</tr>
<tr>
<td>Absolute Error Over Temp Range</td>
<td>(±0.9ºF)</td>
</tr>
<tr>
<td>Temperature Resolution (approx.)</td>
<td>(0.04ºF)</td>
</tr>
<tr>
<td>Long Term Stability (per month)</td>
<td>(±0.4ºF)</td>
</tr>
<tr>
<td>Line Voltage Sensitivity</td>
<td>(±0.2ºF)</td>
</tr>
<tr>
<td>Temperature Control Technique</td>
<td>Dual PID Algorithm, PWM</td>
</tr>
<tr>
<td>Ambient Temperature Operating Range</td>
<td>(32ºF to 122ºF)</td>
</tr>
<tr>
<td>Local Control</td>
<td>29 Key Keyboard (2 Line LCD Display)</td>
</tr>
<tr>
<td>Remote Control</td>
<td>RS232 / RS422 / IEEE-488 bus</td>
</tr>
<tr>
<td>IEEE-488 to RS232/RS422</td>
<td>Software/Bidirectional Transparent Operation</td>
</tr>
</tbody>
</table>

#### SAFETY

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Voltage Dropout</td>
<td>Program and Parameters Stored in Battery Backed Memory</td>
</tr>
<tr>
<td></td>
<td>(Programmable Automatic Restart after Power Loss)</td>
</tr>
<tr>
<td>Fail Safe</td>
<td>Open/Short Probe Detection, Watch-dog Timer, Software Temperature Limits, Over-temperature Thermostat</td>
</tr>
</tbody>
</table>

#### ELECTRICAL

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Input</td>
<td>3600 Watts</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>4200 Watts max, 220 VAC, 50/60 Hz, 1 phase</td>
</tr>
<tr>
<td></td>
<td>Optional 240 VAC (see Options)</td>
</tr>
</tbody>
</table>
LOCAL AND REMOTE CONTROL INTERFACES

The EC11 supports stand-alone operation with a full function keyboard, a 2-line LCD and a powerful programming language. For automated test systems, a complete talker/listener IEEE-488 interface is available with serial and parallel poll capability. For remote operation over long distances, RS232 and RS422 serial interfaces are provided. With few exceptions, the commands for the local keyboard and RS232/422 and IEEE-488 interfaces are identical.

FRONT PANEL

<table>
<thead>
<tr>
<th>Application</th>
<th>EC11  Local Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator Manual Program, Parameter Input</td>
<td>29 Key Keyboard</td>
</tr>
<tr>
<td>Operator Menu-Driven Visual Output</td>
<td>2 Line Alpha-numeric LCD</td>
</tr>
<tr>
<td>Visual Indicators</td>
<td>Cool, Heat, Failsafe, Remote, Timeout, Heat Enable, Cool Enable, Power</td>
</tr>
<tr>
<td>Audible Alarm</td>
<td>User Programmable for Volume and Function</td>
</tr>
</tbody>
</table>

IEEE-488 BUS INTERFACE

<table>
<thead>
<tr>
<th>Application</th>
<th>EC11  Remote Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>Talker / Listener</td>
</tr>
<tr>
<td>Bus Address</td>
<td>0-30, Set from Keyboard</td>
</tr>
<tr>
<td>Interrupt Capability</td>
<td>SRQ / Serial Poll and Parallel Poll</td>
</tr>
</tbody>
</table>

RS232 / RS422 SERIAL INTERFACE

<table>
<thead>
<tr>
<th>Application</th>
<th>EC11  Remote Control or IEEE-488 Bi-directional Transparent Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>ASCII Character Oriented with Selectable XON/XOFF Protocol, Character ECHO, Parity</td>
</tr>
<tr>
<td>Data Rates</td>
<td>300-9600 BAUD</td>
</tr>
</tbody>
</table>
TEMPERATURE CHAMBER FEATURES

PID CONTROL

Optimum accuracy and stability in the test environment are ensured by the use of Proportional, Integral and Derivative (PID) control algorithms for both heating and cooling.

The PID coefficients define system response to the difference between set temperature and actual chamber temperature, the length of time that a difference in temperature may exist and the rate of change of the error temperature.

The default settings for the PID coefficients are generally suitable for most uses but, if necessary, each can be tailored to a particular application.

ZERO VOLTAGE SWITCHING

Control of power to the heaters and cooling solenoid is provided by zero voltage switching solid state relays to provide reliability and to reduce electrical noise.

SPECIAL FEATURES

Chart Recorder

Custom Fixturing
EXPANDED I/O ARCHITECTURE

The expanded I/O architecture provides for easy test fixture interfacing, strip chart recorder drive and additional sensor interfacing. Each interface is accessed by using the device IN and OUT commands.

ANALOG INPUT/OUTPUT INTERFACE

Input Channels.........................................................................................................................4 Channel, 8 Bit A/D Converter
Applications.................................................................................................................................Analog Data Acquisition
Input Range.................................................................................................................................0 to +5 VDC
(0 or 4 to 20 mA Input Jumper Selectable for Channel 0)
Input Leakage...............................................................................................................................1 µA
Conversion Time..............................................................................................................................26 µsec
Output Channels............................................................................................................................4 Channel, 8 Bit D/A Converter
Applications.................................................................................................................................Chart Recording and Analog Data Control
Output Ranges (Software Selectable)
UniPolar Voltage..........................................................................................................................0 to +5 VDC
BiPolar Voltage............................................................................................................................-5 to +5 VDC
Current (Channel 3 Only)............................................................................................................0 to 20 mA
Settling Time.................................................................................................................................10 µsec

Common Specifications
Non-Linearity.................................................................................................................................±1/2 LSB
Absolute Accuracy..........................................................................................................................±1 LSB
Conversion Rate.............................................................................................................................I/O Limited
Device Address.............................................................................................................................DEV#4
Connector.........................................................................................................................................15 Pin D Type

USER PARALLEL PORT

Applications.................................................................................................................................Local Automated Switch and Test Accessories
Protocol.................................................................................................................................16 Bit Address / 8 Bit Bi-Directional Data
Multiplexed, Byte Oriented
Interface Voltage...........................................................................................................................TTL Levels
DC Supply Voltage Provided to User.............................................................................................+12 VDC Unregulated
DC Supply Current (fuse protected).............................................................................................1.0 Amp max.
Device Address.............................................................................................................................DEV#3
Connector.......................................................................................................................................26 Pin Flat Cable Header

HIGH SPEED SYNCHRONOUS SERIAL PORT

Applications.................................................................................................................................Distributed Processor Communication Link
Protocol.................................................................................................................................Byte Oriented, Master
Data Rate.................................................................................................................................56K BAUD
Interface Voltage..........................................................................................................................RS422 Levels
Device Address.............................................................................................................................DEV#2
Connector.......................................................................................................................................9 Pin D Type

AUXILIARY I/O INTERFACE

Applications.................................................................................................................................Relay Drive
Protocol.................................................................................................................................Bit SET/RESET/SENSE
Interface Voltage..........................................................................................................................High Current Open Collector Drive / TTL Sense
Device Address.............................................................................................................................DEV#4
Connector.......................................................................................................................................Terminal Block or 26 Pin Flat Connector
(located internal to the unit)
**ENVIRONMENTAL CHAMBER**

**EC11**

**MENU-DRIVEN CONTROLLER SETUP (Front Panel)**

### CALIBRATION

[GREEN SHIFT] [CAL] [ENTER]

- **Calibrate Probes?** [Yes/No]
- **CAL Access Code?** [Access Code]
- **Calibrate Chamber Probe?** [Yes/No]
- **[Selection of Probe Types, V or A]?
  - [Yes/No]
  - [Temperature Set Points and Units]? [Yes/No] or [Value]
- **Calibrate User Probe?** [Yes/No]
- **Modify Chamber Scale?** [Yes/No]
- **Desired Scale?** 1=ºC, 2=ºF, 3=ºK
- **Modify User Scale?** [Yes/No]

Enter CAL Mode.

Enter CAL if you really want to calibrate probes. Enter NO if you only desire to set units.

Enter Access Code. (Set Access Code in Interrupts Menu.)

Enter YES to calibrate Chamber Probe. Enter NO to modify Chamber and User display units (ºC,ºF,ºK).

- **Select Probe type. Voltage or Current.**
- **If Probe selected, set 0ºC and 100ºC and select display units (ºC, ºF, ºK).**
- **If Voltage or Current selected, set Inputs and Values.**

Repeat calibration procedure for User Probe.

Enter YES to modify display units for Chamber Probe.

Enter preferred scale.

Repeat selection procedure for User Probe display units.

### DEFAULT VALUES

[GREEN SHIFT] [SDEF] [ENTER]

- **Set Up Defaults?** [Yes/No]
- **GPIB Address?** [0-30]
- **GPIB Lockup Time?** [0, 2-59 sec]
- **Power Down Restart?** [0-59 min]
- **D/A Output A, B, C, D?** [Voltage Range]
- **Serial Port Mode?** [RS232 or RS422]
- **Baud Rate?** [Required Baud Rate]
- **Power Down Restart?** [0 to 59 min]
- **Buzzer Volume?** [Desired Volume]
- **Line Frequency?** [60Hz or 50Hz]
- **Chart CHAM On A?** [Yes/No] [Select Values]
- **Chart USER On B?** [Yes/No] [Select Values]
- **PID to D/A C?** [Yes/No]
- **+/- AT SET TRIG?**
- **Auto Cool Off?** [Yes/No]

Enter SET DEFAULT Mode.

Enter YES if you really want to modify defaults.

Enter GPIB Address.

Enter GPIB Interface maximum lockup time (0 to disable).

Enter GPIB SRQ or Serial Interface advanced interrupt generation before actual wait period timeout.

Disables automatic restart of controller above set minutes.

Select 0 to +5 V or -5 to +5V for channels A, B, C and D.

Select Serial Port.

Enter YES for serial port character echo.

Select baud rate from 300 to 9600 Baud.

Select audible volume.

Select buzzer volume.

Set correct line frequency.

Chart chamber temperature on D/A channel A. If YES, enter High/Low values.

Chart user probe on D/A channel B. If YES, enter High/Low values.

Enter YES to output PID control to D/A channel C.

Enter YES to turn off cool enable when expectorant tank becomes empty.

### INTERRUPTS

[GREEN SHIFT] [SINT] [ENTER]

- **Set up Interrupts?** [Yes/No]
- **BUZZ LP Timeout?** [Yes/No]
- **BUZZ Single T.O.?** [Yes/No]
- **INT LP Timeout?** [Yes/No]
- **INT LP Done?** [Yes/No]
- **INT Single T.O.?** [Yes/No]
- **DEVIATION INT?** [Yes/No]
- **CMD ERROR INT’s?** [Yes/No]
- **BKPTN INTERRUPT?** [Yes/No]
- **P_POLL[1-8] 0=NO**
- **CAL Menu Access Code?**

Enter SET INTERRUPT Mode.

Enter YES if you really want to modify interrupts.

Enter YES to enable BUZZER after each temperature segment timeout during local program execution.

Enter YES to enable BUZZER when the end of a local program is encountered.

Enter YES to enable Timeout Interrupts after each temp. segment timeout during local program execution.

Enter YES to enable Single Temp. Timeout Interrupt at end of each temp sequence.

Select Parallel Poll or between 0 and 8 to set bit position for Parallel Poll.

The number that is entered will become the code that the CAL menu will expect to grant access. 0 to disable.
COMMAND SUMMARY

nn.n = Any fixed or floating point number
hh:mm:ss = Hours:Minutes:Seconds
[ ] = Optional
In = One of the ten global I variables

SINGLE COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
<th>SET</th>
<th>EXAMINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment Temperature</td>
<td>SET = nn.n [C, F, K]</td>
<td>SET? or C</td>
</tr>
<tr>
<td>Read Current Chamber Temperature</td>
<td>(n/a)</td>
<td>TEMP? or T</td>
</tr>
<tr>
<td>Read Current Set Temperature During Ramping</td>
<td>(n/a)</td>
<td>CSET?</td>
</tr>
<tr>
<td>Read Current User Probe Value</td>
<td>(n/a)</td>
<td>UCHAN?</td>
</tr>
<tr>
<td>Temperature Soak Period</td>
<td>WAIT = hh:mm:ss or WAIT = mm or mmM or WAIT = Forever</td>
<td>WAIT? or M</td>
</tr>
<tr>
<td>Temperature Ramping Rate</td>
<td>RATE = nnn.n</td>
<td>RATE?</td>
</tr>
<tr>
<td>Upper Temperature Limit</td>
<td>UTL = nnn.n or nnnUTL</td>
<td>UTL?</td>
</tr>
<tr>
<td>Lower Temperature Limit</td>
<td>LTL = nnn.n</td>
<td>LTL?</td>
</tr>
<tr>
<td>Deviation Limit</td>
<td>DEVL = n.n TC01 DEVL</td>
<td>DEVL?</td>
</tr>
<tr>
<td>Heating PID Adjust</td>
<td>PIDH = n.n, n.n, n.n, n.n</td>
<td>PIDH?</td>
</tr>
<tr>
<td>Cooling PID Adjust</td>
<td>PIDC = n.n, n.n, n.n, n.n</td>
<td>PIDC?</td>
</tr>
<tr>
<td>Pulse Width Modulation Adjust</td>
<td>PWMP = nn</td>
<td>PWMP?</td>
</tr>
<tr>
<td>Device I/O Commands</td>
<td>OUT (dev. no.):(addr.),(data)</td>
<td>IN (dev. no.):(addr.),(data)</td>
</tr>
<tr>
<td>Time of Day</td>
<td>TIME = hh:mm:ss</td>
<td>TIME?</td>
</tr>
<tr>
<td>Read Units of Temperature</td>
<td>(n/a)</td>
<td>Scale#n? (n=1 or n=2)</td>
</tr>
<tr>
<td>Controller Power On/Off</td>
<td>ON or OFF</td>
<td>(n/a)</td>
</tr>
<tr>
<td>Heater Enable On/Off</td>
<td>HON or HOFF</td>
<td>(n/a)</td>
</tr>
<tr>
<td>Coolant Enable On/Off</td>
<td>CON or COFF</td>
<td>(n/a)</td>
</tr>
</tbody>
</table>

PROGRAM COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Execution Commands</td>
</tr>
<tr>
<td>STOP; RUNn; RUNn TIME=hh:mm:ss (Start RUN at Time of Day)</td>
</tr>
<tr>
<td>Edit Commands</td>
</tr>
<tr>
<td>EDITn; INS; DELL; DELPn; LISTn; STOREn</td>
</tr>
<tr>
<td>Control Commands</td>
</tr>
<tr>
<td>FOR In; NEXT In; GOSUBn; END</td>
</tr>
<tr>
<td>Debug Commands</td>
</tr>
<tr>
<td>BKPNTn</td>
</tr>
</tbody>
</table>
ENVIRONMENTAL CHAMBER

**Standard Options**

- 220 VAC, 50/60 Hz *
- 240 VAC, 50 Hz (International) *
- LCO₂, 850psi (hose supplied) *
- LCO₂, 300psi
- LN₂, 100psi
- LN₂, 25psi
- 3-Tank LCO₂ Manifold
- Ambient Air Blower

- Blank Door *
- Door with 4" x 6" Window
- Hinge Option for Door
- 1", 2", 3" or 4" Dia Left Side Access Port
- 2 Year Warranty *
- Custom Work §
- Fast Delivery

* no charge items

§ Due to the variety of applications, Sun Systems provides Custom Work per your specification.

Call Sun Systems for solutions to your custom temperature testing requirements.

(All dimensions nominal.)

(Data subject to change) © Sun Electronic Systems, Inc., December 1989

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**Accessories**

Sun Systems can provide a wide variety of test system accessories in support of your temperature testing requirements. Blank doors and doors specifically modified for component temperature cycle testing are available along with switch matrix cards that can be tailored to your test fixture requirements. Extra LCO₂ and LN₂ hoses and fittings, equipment racks and temperature probes can be provided at your request.

We want to work with you.

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