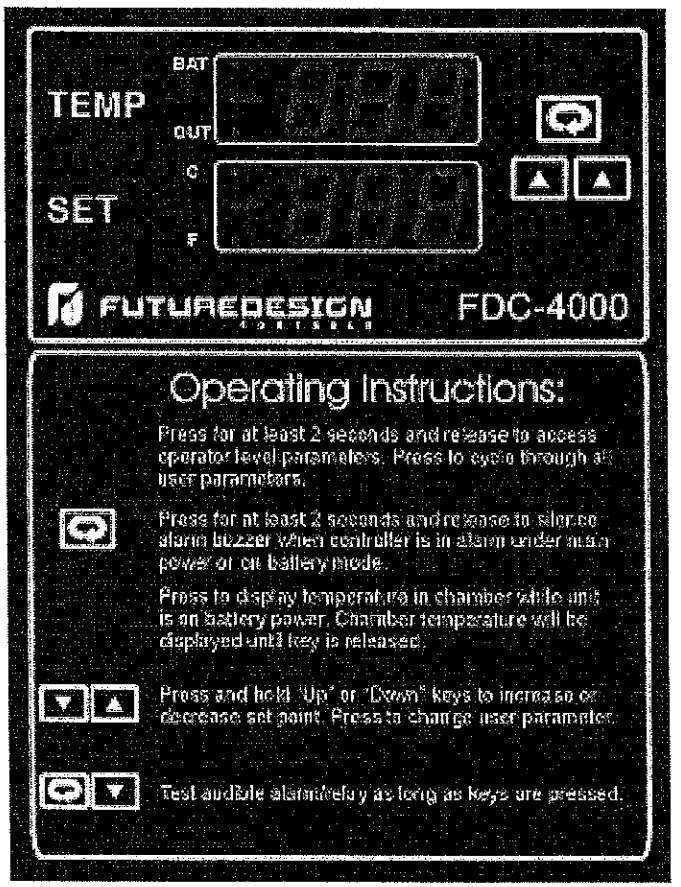
FUTUREDESIGN
CONTROLS

FDC-4000 Chamber Controller



Installation – Setup – Operation - Service

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FDC-4000 Chamber Controller

1-1 Features

* Simple operation
* Type "T" Thermocouple / RTD Input
* Degrees F or C operation
* Low voltage operation
* Programmable deadband alarm
* Power failure alarm
* Low battery indication
* Adjustable hysteresis for control and alarm outputs
* Process value calibration offset adjustment
* "RingBack" mode for audible alarm
* "Wake" mode for battery operation indication of PV
* Control and Alarm relay (DPDT) output contacts

The FDC-4000 microprocessor-based controller, incorporates dual, easy to read 4-digit LED displays. The LED displays indicate process value and set-point, as well as other controller operations. This unit features keys to select the various operator views as well as control parameters. The FDC-4000 has been designed specifically for low temperature chamber operation, providing simple to use, "hassle" free operation for startup and operation of the chamber.

The FDC-4000 incorporates a (DPDT) control relay output and a (DPDT) alarm relay output as standard. Programmable deadband alarm set-points allow the operator to monitor/indicate alarm conditions above and below chamber operational settings. "RingBack" operation allows an operator to silence the audible alarm for a programmable length of time. If the time has elapsed and the alarm condition still exists, the audible alarm will re-energize to alert the operator to the pre-existing alarm condition. Power failure mode will alert the operator when main power to the chamber is lost. During power failure, the audible alarm will sound and the alarm contact will be energized while on battery back-up. While operating on battery back-up power, pressing the ⟲ key will display the current chamber temperature on the top LED display until the key is released.

2-1 Installation

⚠ To minimize the possibility of fire or electric shock hazards, do not expose this instrument to rain or excessive moisture.

⚠ Do not use this instrument in areas under hazardous conditions such as excessive shock, vibration, dirt, moisture, corrosive gases or oil. The ambient temperature of the areas should not exceed the maximum ratings.

2-2 Unpacking

Upon receipt of the shipment, remove the unit from the carton and inspect it for shipping damage. If there is any damage due to transit, report and file a claim with the carrier. Write down the model number and serial number for future reference when corresponding with our service center.

2-3 Mounting

Make a panel cutout to the dimensions shown in the following figure:

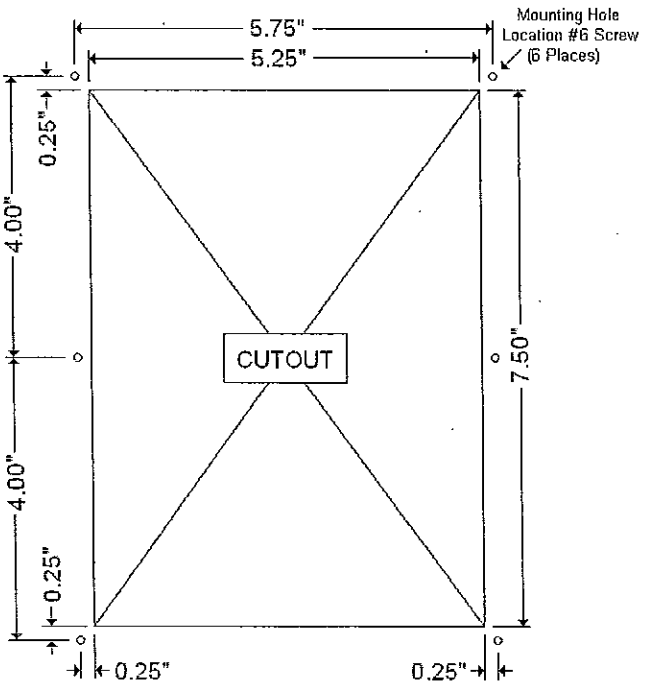


Figure 2.1 Mounting Dimensions

2-4 Power Wiring

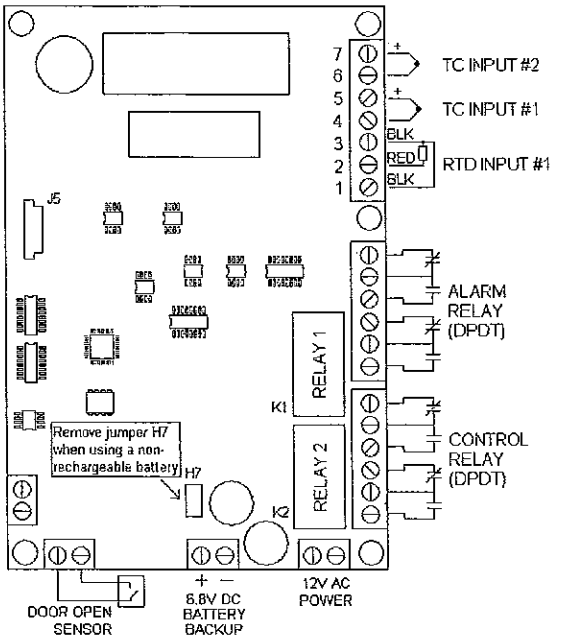


Figure 2.2 Controller Circuit Board

⚠ This equipment is designed for installation in an enclosure which provides adequate protection against electric shock. The enclosure must be connected to earth ground.

Local requirements regarding electrical installation should be rigidly observed. Consideration should be given to prevent unauthorized persons access to the power terminals.

Main Power Connection to the Circuit Board – The FDC-4000 controller uses 12Volts AC for its main power supply to the circuit board. An optional step-down transformer can be provided to supply the required power to the controller.

Battery Back-Up – Back-up power to the controller can be provided in the event of a main power failure. A 6Volt DC Lead Acid Rechargeable Battery is recommended for battery back-up. The controller unit will automatically recharge and maintain the rechargeable battery. A non-rechargeable 6Volt DC battery may also be used. However, before connecting the non-rechargeable battery to the controller circuit board, remove jumper H7. This will prevent the controller from sending a charge current to the battery. Note: Not removing this jumper (H7) may cause the non-rechargeable battery to leak or explode. A low battery (Lo bAt) indication will be shown on the lower display when the battery voltage is below 5.5Volts. Also, the audible alarm will give a brief "chirp" approximately every 30 seconds while the low battery condition exists. When the controller is operating only on battery power, both LED displays will go blank to conserve power. When the main power is restored, there will be a 7 second delay before energizing the control relay to allow the main power source to stabilize.

2-5 Sensor Installation Guidelines

Proper sensor installation can eliminate many problems in a control system. The sensor should be placed so that it can detect any temperature change with minimal thermal lag. Some experimentation with sensor location is often required to find the optimum position.

Proper sensor type is also a very important factor to obtain precise measurements. The sensor must have the correct temperature range to meet the process requirements. In special processes, the sensor may need to meet different requirements such as leak-proof, anti-vibration, antiseptic, etc.

The FDC-4000 controller has been designed to use a type "T" Thermocouple or Platinum RTD (2 or 3-wire) temperature sensor. Figure 2.2 shows the proper connection of the sensors to the controller. The controller will auto-detect which type of sensor is connected to the unit (for Input #1). In order for the controller to do this, the sensor must be connected before power is applied to the controller. Input #1 is used to display PV (on the upper LED display). Input #2 can only be a type "T" Thermocouple sensor. Input #2's temperature value is displayed while in the Factory Mode (prompt IN2). In the event of a sensor break, the display will show "Hi" and the control relay output will remain energized.

2-6 Control Relay

Connection to the control relay is made using the screw clamp terminal blocks provided on the controller circuit board (Figure 2.2). The control relay is a "double pole / double throw" (DPDT) configuration. The normally open (NO) and normally closed (NC) configuration when the control relay output is not energized is shown in Figure 2.2. The control relay will energize when the process value is at or above the set-point value. The control relay will de-energize when the process value is at or below the set-point value minus the control hysteresis (prompt OHY). The control relay will also de-energize when the controller is operating on battery power. The control relay is a latching type relay which means that the contacts will remain in their present state (open or closed) even when all power is removed from the controller.

2-7 Alarm Relay

Connection to the alarm relay is made using the screw clamp terminal blocks provided on the controller circuit board (Figure 2.2). The alarm relay is a "double pole / double throw" (DPDT) configuration. The normally open (NO) and normally closed (NC) configuration when no alarm condition is present is shown in Figure 2.2. The alarm relay will be energized when the process value is outside of the deadband temperature for the set-point or when the controller is operating on battery power. The alarm relay is a latching type relay which means that the contacts will remain in their present state (open or closed) even when all power is removed from the controller.

2-8 Control/Alarm Relay Hysteresis Operation

Control type for relay 2 output is cooling (direct) only. The control hysteresis (prompt OHY) is safe sided. The control relay's output will work in the following manner. For example, the control set-point value is -80° (F or C) and the control hysteresis value is 2.0. The control relay's output will be energized until the temperature reaches -82 deg and then de-energize. When the temperature rises to -80 deg or above, the control relay's output will again energize to maintain cooling in chamber. Note: When the control relay's output is energized, the control output status LED (labeled "OUT" on the front panel) will be lit.

Alarm type for relay 1 is deadband only. The alarm deadband (prompt ASP) follows the main controller set-point and is set evenly above and below the main controller set-point. For example, a main controller set-point value of -80° and a 10° deadband value equals alarm points at -70° and -90°. The alarm relay is energized only when the temperature is outside of the alarm deadband. Note: The upper LED display will flash when the temperature is outside of the alarm deadband (if alarm, prompt A1, is enabled in the Factory Mode and SHIP mode is not active).

Alarm hysteresis (prompt AHY) is safe sided. The alarm relay's output will work in the following manner. For example, the main controller set-point value is -80° (F or C), the alarm deadband value (prompt ASP) is 10° and the alarm hysteresis value (prompt AHY) is 2.0. The alarm relay will energize when the temperature is above -70° or below -90°. When the temperature falls within the hysteresis band (between -72° and -88°), the alarm relay will de-energize.

2-9 Door Sensor

The FDC-4000 controller can be used to detect when the door to the chamber is open. A simple on/off switch is connected to the "door sensor" screw clamp terminal block shown in Figure 2.2. When the switch is opened, the audible alarm will give short, quick "chirps" to indicate that the door is open. If this feature is not needed, simply place a wire jumper between the two terminals.

3-1 Keys and Displays

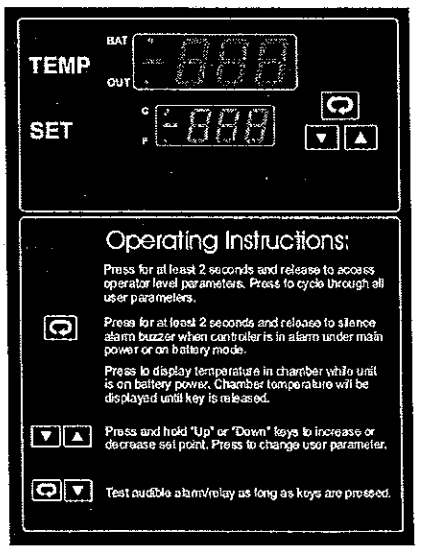
The FDC-4000 controller is programmed by using three keys on the front panel. The available key functions are listed in following table. Note: Only use the tip of your finger to depress the keys. Using a rigid object such as a pen, screwdriver or even your finger-nail may permanently damage the keypad.

TOUCH KEYS	FUNCTION	DESCRIPTION
▲	Up Key	Press and release to increase the control set-point (while in normal control mode) or to change lower display program parameter (while in User Menu or Factory Mode). Press and hold to accelerate increment speed.
▼	Down Key	Press and release to decrease the control set-point (while in normal control mode) or to change lower display program parameter (while in User Menu or Factory Mode). Press and hold to accelerate decrement speed.
Pressing ⟲ key while in normal control mode	Scroll Key	Press and hold for at least 2 seconds and release (while in normal control mode) to access operator level parameters. Press and release to cycle through all user parameters. Press and hold for 2 seconds and release to silence audible alarm under normal power or on battery power. While unit is in an alarm condition, the external alarm relay contacts will remain energized until the alarm condition no longer exists. Press and hold to display chamber temperature while the controller is on battery power. Chamber temperature will be displayed until key is released. Alarm contact will remain energized while operating on battery power.
Press both keys simultaneously ▲ ⟲	Current Power Reading	Displays current AC power (i.e. 110VAC) as long as keys are pressed. If power is 110VAC or 220VAC, unit will display 110. Mode is only active during normal control mode (when top display = PV, Lower display = SP). N/A on battery power.
Press both keys simultaneously ▼ ⟲	Alarm Test	Energize audible alarm and alarm relay output as long as keys are pressed. Mode is only active during normal control mode (when top display = PV, Lower display = SP). N/A on battery power.

Note: When the controller is displaying temperature in normal control mode, press/release or press/hold the up/down keys to change the set-point value. This set-point mode does not apply to power off modes.

The upper display is used to show the process value or menu prompt. The lower display is used to show the set-point value or menu value. Both displays are blank while on battery power unless the ⟲ button is pressed to display the process value. Note: When operating on battery power, the battery status LED (labeled "BAT" on the front panel) will be lit.

Status for battery, control output and temp units.



3 Buttons for ease of control setup and set-point adjustment.

A	A	E	E	I	I	N	n	S	S	X	
B	b	F	F	J	J	O	o	T	t	Y	y
C	C	G	G	K	K	P	P	U	u	Z	
c	c	H	H	L	L	Q		V	v	?	?
D	d	h	h	M	m	R	r	W		=	-

◤: Confused Character

Table 3.2 Display Form of Characters

Operating instructions on front panel for ease of use.

Figure 3.1 Front Panel View

3-2 Menu Parameter Descriptions

Contained In	Parameter Notation	Display Prompt	Parameter Description	Range	Default Value
User Menu Each time key is pressed	INU	inu	Input Unit Selection	oC Degree C unit oF Degree F unit	oF
	SHF	SHF	PV Shift (offset) Value	Min:(-20.0) Max:(+20.0)	0.0
	ASP	ASP	Alarm Deadband Value	Min: (0) Max: (100)	18 °F (10 °C)
	AHY	AHY	Hysteresis Control for Alarm	Min: (0.1) Max: (14.0 °C/25.2 °F)	0.1
	OHY	oHY	Hysteresis Control for Output	Min: (0.1) Max: (14.0 °C/25.2 °F)	0.1
	RB	rb	Alarm RingBack Time	Min: (0 Min.) Max: (60 Min.)	0
	Note: Each time the scroll key is pressed, the upper display will cycle through the parameters in the order shown above. The upper display will show the prompt, the lower display will show the value for edit. Press the "Up" or "Down" keys to change the value shown in the lower display. After the last user prompt is displayed, pressing the scroll key will return the unit back to the normal control mode (PV = top display, SP = lower display). The unit will also revert back to the normal display mode when the user does not press a key for 5 seconds. Above prompts will only be displayed if configured for viewing in the Factory Mode. If no prompts are configured for view, pressing the scroll key will do nothing.				
Factory Mode Press and hold key in normal control mode for 10 seconds. Use Up/Down keys to change value on lower display Press scroll key to display next prompt	SHP	SHP	Ship Mode. If set to "on", the next time the chamber is powered up, alarm activation is delayed for 8 hours.	oFF Ship Mode Not Active on Ship Mode Active	oFF
	SPL	SPL	SP adjust LOW limit	Min: (-150) Max: (200)	-100
	SPH	SPH	SP adjust HI limit	Min: (-150) Max: (200)	100
	A1	A1	Alarm status	oFF Alarm is not active on Alarm is active	on
	INU	inu	Temperature units displayed in User Menu	oFF Prompt not displayed in user mode on Prompt displayed in user mode	on
	SHF	SHF	PV shift (offset) value displayed in User Menu	oFF Prompt not displayed in user mode on Prompt displayed in user mode	on
	ASP	ASP	Alarm deadband value displayed in User Menu	oFF Prompt not displayed in user mode on Prompt displayed in user mode	on
	AHY	AHY	Alarm hysteresis value displayed in User Menu	oFF Prompt not displayed in user mode on Prompt displayed in user mode	on
	O1HY	oHY	Control output hysteresis displayed in User Menu	oFF Prompt not displayed in user mode on Prompt displayed in user mode	on
	RB	rb	RingBack value displayed in User Menu	oFF Prompt not displayed in user mode on Prompt displayed in user mode	on
	SP	SP	Set-point adjustment status	oFF Set-point adjustment disabled on Set-point adjustment enabled	on
	IN2	in2	Thermocouple input #2	Displays temperature of second probe input	on

Parameter Definitions

SHP: Ship mode on/off. If "on", sets delay timer for alarm (8 hours) after next power up.
SPL: Lower limit of user adjustable set-point range (no decimal point).
SPH: Upper limit of user adjustable set-point range (no decimal point).
A1: Alarm enable/disable.
INU: Temperature units selection for controller (degrees F or C).
SHF: PV shift (offset) calibration value, to calibrate input #1's temperature value (1 decimal point).
ASP: Alarm Deadband value (no decimal point).
AHY: Alarm output hysteresis (1 decimal point).
OHY: Control output hysteresis (1 decimal point).
RB: RingBack time (minutes). Time delay is activated after alarm silence button is pressed when alarm is active. RingBack is active during normal and battery power conditions (no decimal point).
SP: Enable/disable user from adjusting set-point value.
IN2: Display the temperature value of input #2 (type "T" thermocouple).

Note: When in User Menu or Factory Mode, the upper LED will display the programming prompt and the lower LED will display the numeric value to match upper display prompt. Up/Down arrows will adjust the lower display value. The scroll key will advance to the next menu prompt.

4-1 Error Codes and Troubleshooting

⚠ This procedure requires access to the circuitry of a live power unit. Dangerous accidental contact with line voltage is possible. Only qualified personnel are allowed to perform these procedures. Potentially lethal voltages are present.

Troubleshooting Procedures:

(1) If an error message is displayed, refer to Table 4.2 to see what caused the error and apply the corrective action.
(2) Check each point listed below. Experience has proven that many control problems are caused by defective external devices or improper wiring.

* Line wires are improperly connected
* No voltage between line terminals
* Incorrect voltage between line terminals
* Connections to terminals are open, missing or loose
* Thermocouple is open at tip
* Thermocouple lead is broken
* Shorted thermocouple leads
* Short across terminals
* Open or shorted cooling circuit
* Open coil in external contactor
* Burned out line fuses
* Burned out relay inside control
* Defective solid-state relays
* Defective line switches
* Burned out contactor
* Defective circuit breakers

Symptom	Probable Cause	Corrective Action
Keypad not functioning.	Bad connection between PCB and keypad.	- Remove and re-insert flex cable of keypad into connector on PCB. - Replace keypad.
LED's will not light.	- No power to instrument. - Power supply defective.	- Check power line connections. - Replace power supply board.
Some segments of display not lit or lit erroneously.	- LED display or LED lamp defective. - Related LED driver defective.	- Replace LED display or LED lamp. - Replace the related IC chip.
Display unstable.	- Thermocouple or RTD sensor defective. - Intermittent connection of sensor wiring. - Analog portion or A/D converter defective.	- Check output of sensor. - Check sensor wiring connections. - Replace related components on circuit board.
Considerable error in temperature indication.	- Wrong sensor or thermocouple type. - Incorrect "Shift" value entered in control.	- Check sensor or thermocouple type. -Access USER MENU and configure "Shift" value.
Display goes in reverse direction (displayed temp increases as process temp decreases).	- Reversed wiring of sensor.	-Check wiring and correct.
Cool output stays on but indicator reads normal.	- Output device shorted or power service shorted.	- Check and replace.
Control abnormal or operation incorrect.	- Incorrect set-up values. - CPU or EEPROM (non-volatile memory) defective.	- Read set-up procedures carefully. - Check and replace.
Display blinks.	- Electromagnetic interference (EMI) or Radio Frequency interference (RFI).	- Suppress arcing contacts in system to eliminate high voltage spike sources. - Separate sensor and controller wiring from "dirty" power lines. - Check all "ground" connections.

Table 4.1 Common Failure Causes and Corrective Actions

Error Code	Error Description	Corrective Action
Er1	Button on keypad collapsed or stuck.	Replace keypad.
Er2	Error reading/writing to non-volatile memory.	Replace EEPROM (requires returning unit to the factory for service).
H,	Upscale sensor break.	Check sensor connections, verify output of sensor is valid.

Table 4.2 Error Codes and Corrective Actions

5-1 Controller Specifications

Power Requirements
Main: 12VAC (420mA), 5VA Max.
Battery Back-up: 6 VDC
(Lead Acid Re-chargeable, 1.2Ah min.)
Battery Charge Current: < 400mA

Accuracy
+/- 1 Digit

Input #1
Type "T" Thermocouple or
Platinum 100 Ohm RTD (0.00385 Ohms/Ohm/°C)

Input #2
Type "T" Thermocouple

Input Type	PT.100	Type "T" TC
Range Low	-230 °C (-382 °F)	-250 °C (-418 °F)
Range High	400 °C (752 °F)	300 °C (572 °F)

Table 5.1 Input Ranges

Sensor Break Detection
Sensor open for TC or RTD

Sensor Break Response Time
< 4 seconds for TC or RTD

Control Mode
Control Output: Direct (Cooling)
On/Off with adjustable set-point and hysteresis.

Alarm Output: Programmable Deadband with
adjustable hysteresis.

Control and Alarm Output
DPDT Relay, 2A @ 30 VDC, 2A @ 125 VAC, 1A @ 230VAC (all resistive loads)

User Interface
Dual 4-Digit LED Displays:
Upper Display 0.55" (14mm)
Lower Display 0.40" (10mm)
Keypad (3 touch keys)

Overall Dimensions
6-1/4" x 8-1/2"
(158.75mm x 215.90mm)

Environmental
Operating Temp: 0 to +60°C
Storage Temp: -40 to +60°
Humidity: 0 to 90% RH
(non-condensing)

Approvals
UL / CUL / CE Pending

Backup Battery Life
70 hours using 6VDC, 1.2A
rechargeable battery

(60 Watts total switching power)

6-1 Controller Part Number

FDC-4000- _ _ _ _ _ _

Power Input
1: 12VAC. 110/230VAC transformer supplied.

9: Special Order

Signal Input
1: Standard Input
Type "T"
Thermocouple
RTD: PT100 DIN.

Output 1
0: None
1: Relay (DPDT) rated 2A/125VAC (Direct)

Communications
0: None
1: RS-485 interface (Modbus)

Alarm
0: None
1: Relay (DPDT) rated 2A/125VAC (Band)
2: Relay (DPDT) rated 2A/125VAC

7-1 Warranty

Future Design Controls warranties or representations of any sort regarding the fitness for use, or the application of its products by the Purchaser. The selection, application or use of Future Design products is the Purchaser's responsibility. No claims will be allowed for any damages or losses, whether direct, indirect, incidental, special or consequential. Specifications are subject to change without notice. In addition, Future Design reserves the right to make changes without notification to Purchaser to materials or processing that do not affect compliance with any applicable specification. Future Design products are warranted to be free from defects in material and workmanship for one year after delivery to the first purchaser for use. An extended period is available with extra cost upon request. Future Design's sole responsibility under this warranty, at Future Design's option, is limited to replacement or repair, free of charge, or refund of purchase price within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse or abuse.

RETURN MATERIAL AUTHORIZATION:
Please contact Future Design Controls for Return Material Authorization Number prior to returning to factory.

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