

# 1350

## Triple Output Programmable DC Power Supply

## User Manual



# Safety Summary

A **WARNING** statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in injury or death to personnel.

A **CAUTION** statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in damage to or destruction of parts or the entire product.

The following safety precautions apply to both operating and maintenance personnel and must be followed during all phases of operation, service, and repair of this instrument.

## **WARNING**

Before applying power to this instrument:

- Read and understand the safety and operational information in this manual.
- Apply all the listed safety precautions.
- Verify that the voltage selector at the line power cord input is set to the correct line voltage. Operating the instrument at an incorrect line voltage will void the warranty.
- Make all connections to the instrument before applying power.
- Do not operate the instrument in ways not specified by this manual or by Global Specialties

## ***Electrical Power***

This instrument is intended to be powered from a CATEGORY II mains power environment. The mains power should be 120 V RMS or 240 V RMS. Use only the power cord supplied with the instrument and ensure it is appropriate for your country of use.

## ***Ground the Instrument***

### **WARNING**

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical safety ground. This instrument is grounded through the ground conductor of the supplied, three-conductor AC line power cable. The power cable must be plugged into an approved three-conductor electrical outlet. The power jack and mating plug of the power cable meet IEC safety standards.

### **WARNING**

Do not alter or defeat the ground connection. Without the safety ground connection, all accessible conductive parts (including control knobs) may provide an electric shock. Failure to use a properly-grounded approved outlet and the recommended three-conductor AC line power cable may result in injury or death.

### **WARNING**

Unless otherwise stated, a ground connection on the instrument's front or rear panel is for a reference of potential only and is not to be used as a safety ground.

## ***Do not operate in an explosive or flammable atmosphere***

### **WARNING**

Do not operate the instrument in the presence of flammable gases or vapors, fumes, or finely divided particulates.

## ***Use only in office-type indoor setting***

### **WARNING**

The instrument is designed to be used in office-type indoor environments. Do not operate the instrument:

- In the presence of noxious, corrosive, or flammable fumes, gases, vapors, chemicals, or finely-divided particulates.
- In relative humidity conditions outside the instrument's specifications.
- In environments where there is a danger of any liquid being spilled on the instrument.
- In air temperatures exceeding the specified operating tem-

peratures.

- In atmospheric pressures outside the specified altitude limits or where the surrounding gas is not air.
- In environments with restricted cooling air flow, even if the air temperatures are within specifications.
- In direct sunlight.

## **CAUTION**

This instrument is intended to be used in an indoor pollution degree 2 environment. The operating temperature range is 0 °C to 40 °C and the operating humidity range is up to 80% relative humidity with no condensation allowed. Measurements made by this instrument may be outside specifications if the instrument is used in non-office-type environments. Such environments may include rapid temperature or humidity changes, sunlight, vibration and/or mechanical shocks, acoustic noise, electrical noise, strong electric fields, or strong magnetic fields.

### ***Do not operate instrument if damaged***

If the instrument is damaged, appears to be damaged, or if any liquid, chemical, or other material gets on or inside the instrument, remove the instrument's power cord, remove the instrument from service, label it as not to be operated, and return the instrument to Global Specialties for repair. Notify Global Specialties of the nature of any contamination of the instrument.

### ***Clean the instrument only as instructed***

Do not clean the instrument, its switches, or its terminals with contact cleaners, abrasives, lubricants, solvents, acids/bases, or other such chemicals. Clean the instrument only with a clean dry lint-free cloth or as instructed in this manual.

## ***Not for critical applications***

### **WARNING**

This instrument is not authorized for use in contact with the human body or for use as a component in a life-support device or system.

## ***Do not touch live circuits***

### **WARNING**

Instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be made by qualified service-trained maintenance personnel who are aware of the hazards involved when the instrument's covers and shields are removed. Under certain conditions, even with the power cord removed, dangerous voltages may exist when the covers are removed. To avoid injuries, always disconnect the power cord from the instrument, disconnect all other connections (for example, test leads, computer interface cables, etc.), discharge all circuits, and verify there are no hazardous voltages present on any conductors by measurements with a properly-operating voltage-sensing device before touching any internal parts. Verify the voltage-sensing device is working properly before and after making the measurements by testing with known-operating voltage sources and test for both DC and AC voltages. Do not attempt any service or adjustment unless another person capable of rendering first aid and resuscitation is present. Do not insert any object into an instrument's ventilation openings or other openings.

### **WARNING**

Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists.

## ***Fuse replacement***

### **WARNING**

Fuse replacement must be done by qualified service-trained maintenance personnel who are aware of the instrument's fuse requirements and safe replacement procedures. Disconnect the instrument from the power line before replacing fuses. Replace

fuses only with new fuses of the fuse types, voltage ratings, and current ratings specified in this manual or on the back of the instrument. Failure to do so may damage the instrument, lead to a safety hazard, or cause a fire. Failure to use the specified fuses will void the warranty.

### ***Servicing*** **CAUTION**

Do not substitute parts that are not approved by Global Specialties or modify this instrument. Return the instrument to Global Specialties for service and repair to ensure that safety and performance features are maintained.

### ***Cooling fans*** **CAUTION**

This instrument contains one or more cooling fans. For continued safe operation of the instrument, the air inlet and exhaust openings for these fans must not be blocked nor must accumulated dust or other debris be allowed to reduce air flow. Maintain at least 25 mm clearance around the sides of the instrument that contain air inlet and exhaust ports. If mounted in a rack, position power devices in the rack above the instrument to minimize instrument heating while rack mounted. Do not continue to operate the instrument if you cannot verify the fan is operating (note some fans may have intermittent duty cycles). Do not insert any object into the fan's inlet or outlet.

### ***Use correctly sized wires*** **WARNING**

To connect a load to the power supply, use a wire diameter large enough to handle the maximum continuous output short-circuit current of the power supply without the wire overheating.

### ***For continued safe use of the instrument***

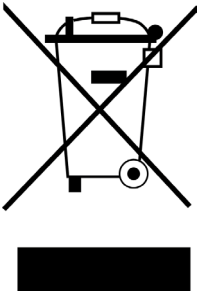
- Do not place heavy objects on the instrument.
- Do not obstruct cooling air flow to the instrument.

- Do not place a hot soldering iron on the instrument.
  - Do not pull the instrument with the power cord, connected probe, or connected test lead.
  - Do not move the instrument when a probe is connected
- Compliance

## Compliance Statements

### ***Disposal of Old Electrical & Electronic Equipment***

(Applicable in the European Union and other European countries with separate collection systems). This product is subject to Directive 2002/96/EC of the European Parliament and the



Council of the European Union on waste electrical and electronic equipment (WEEE), and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal waste. Please utilize your local WEEE collection facilities in the disposition of this product and otherwise observe all applicable requirements.

***The 1350 is CE and LVD compliant.***

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# 1 General Information

## 1.1 Product Overview

The 1350 programmable DC power supply features triple outputs, two variable and one fixed. The two variable outputs can be configured in series mode for up to 64 V output. The front panel keys provide a convenient means for setting values and adjusting parameters. Built-in memory supports storing and recalling user settings without the need to connect to an external PC. List Mode enables automatic operation of those stored settings. For remote controllability from a PC, there is a USB interface.

## 2.1 Features

- Three independent and electrically isolated outputs
- Separate 4-digit displays for voltage and current for both variable outputs (4 displays)
- 9 memory locations for instrument state storage & recall
- List Mode runs through all 9 memory locations
- High resolution: 10 mV and 1 mA
- High stability with less drift
- OVP and OCP protection on the variable outputs
- Overload protection on the fixed output
- Self-test with the displaying of error messages
- USB interface for PC remote operation
- Serial mode for 64 V operation
- Switchable AC input 120 or 240 V

## 3. Constant Voltage (CV) /Constant Current (CC) Mode

The working characteristic of this power supply is called a constant voltage/constant current automatic crossover type. This permits continuous transition from constant current to constant voltage modes in response to the load change. The intersection of constant voltage and constant current modes is called the crossover point. Figure 1 shows the relationship between this crossover point and the load.

For example, if the load is such that the power supply is operating in the constant voltage mode, a regulated output voltage is provided. The output voltage remains constant as the load increases, up until the point where the preset current limit is reached. At that point, the output current becomes constant and the output voltage drops in proportion to further increases in load.

The crossover point is indicated by the front panel LED indicators. The crossover point is reached when the CV indicator goes off and the CC indicator comes on. Similarly, crossover from the constant current to the constant voltage mode automatically occurs from a decrease in load.

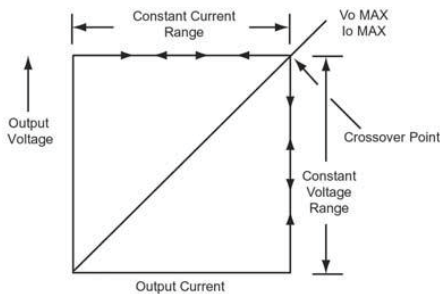


Figure 1. CC/CV Characteristics

#### 4. Package Contents

Please inspect the instrument mechanically and electrically upon receiving it. Unpack all items from the shipping carton, and check for any obvious signs of physical damage that may have occurred during transportation. Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment. The package includes the following:

- 1350 Power Supply
- AC Power Cord
- User Manual
- Banana Plug to Alligator Clip Lead Wires (Black & Red)

## 5. Front Panel Overview

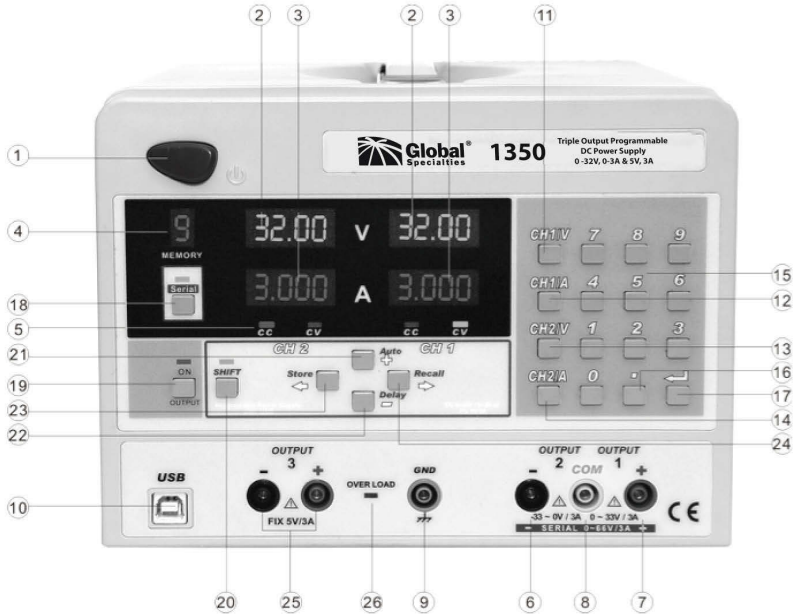


Figure 2. Front Panel

### Front Panel Description

- |     |  |
|-----|--|
| 1.  | Power button: Power on or off.   |
| 2.  | Voltage display: Indicates the setting voltage of CH1 and CH2 or the testing voltage value.                        |
| 3.  | Current display: Indicates the setting current of CH1 and CH2 or the testing current value.                        |
| 4.  | Memory Display: Indicates the present data location number in memory or in List Mode it displays the current step. |
| 5.  | Status Display: Indicates the operational status.  |
| 6.  | - Output BNC (CH2): Negative output terminal.  |
| 7.  | + Output BNC (CH1): Positive output terminal.  |
| 8.  | COM BNC connector: Output reference terminal.  |
| 9.  | GND BNC connector: Ground terminal.  |
| 10. | USB Input terminal.  |
| 11. | CH1V: Enter CH1 Voltage mode.  |

12.	CH1A: Enter CH1 Current mode.
13.	CH2V: Enter CH2 Voltage mode.
14.	CH2A: Enter CH2 Current mode.
15.	0-9: Data input.
16.	“ . ”: Decimal.
17.	“ ←↵ ”: Enter.
18.	Serial button: Push this button to enter Serial Mode and light the LED. Push again and the instrument will go back to Independent Mode.
19.	OUTPUT button: Push to turn on the output. The LED will come on. Push again to turn off.
20.	SHIFT button: Push this button to access secondary functions.
21.	↑ (Auto): Push this key to increase the setting value, or push SHIFT-Auto enter List Mode.
22.	↓ (Delay): Push this key to decrease the setting value, or push SHIFT-Delay to enter delay times.
23.	← (Store): Push this key to shift the digit to the left, or push SHIFT-Store to save the current settings.
24.	→ (Recall): Push this key to shift the digit to the right, or push SHIFT-Recall to see saved settings.
25.	Fixed 5V /3A output: Standard 5V / 3A power output.
26.	Over Load indicator.

## 6. Rear Panel Overview



Figure 3. Image3313.JPG

### Rear Panel Description

- |     |   |
|-----|---|
| 27. | Heat sink: Heat dissipation for power transistor.   |
| 28. | Ventilation fan: 8" 24 V DC fan.  |
| 29. | Power input socket  |
| 30. | The input power voltage indicator: The ▲ mark points to the set input line voltage  |
| 31. | Fuse holder and input voltage selector: The selected input voltage is set to the voltage shown near the ▼ mark which points to the set input line voltage |

## 2 Getting Started

### 1. Input Power and Fuse Requirements

The supply has a selectable AC input that accepts line voltage input within:

Test Equipment Depot - 800.517.8431 - 99 Washington Street Melrose, MA 02176

TestEquipmentDepot.com

- Voltage: 115 V or 1230 V ( $\pm 10\%$ )
- Frequency: 47 Hz – 63 Hz

Before connecting to an AC outlet or external power source, be sure that the power switch is in the OFF position and verify that the AC power cord, including the extension line, is compatible with the rated voltage/current and that there is sufficient circuit capacity for the power supply. Once verified, connect the cable firmly.

**WARNING**

The included AC power cord is safety certified for this instrument operating in rated range. To change a cable or add an extension cable, be sure that it can meet the required power ratings for this instrument. Any misuse with wrong or unsafe cables will void the warranty.

**WARNING**

The power cord provides a chassis ground through a third conductor. Verify that your power outlet is of the three-conductor type with the correct pin connected to earth ground.

**2. Fuse Requirements**

An AC input fuse is necessary when powering the instrument. The below table shows the fuse required for all models operating with either 120 VAC or 240 VAC input.

Selector	Line Voltage	Fuse
120 V	114 – 126 V, 50/60 Hz	6 A, 250 V
240 V	228 – 252 V, 50/60 Hz	3 A, 250 V

**3. Line Voltage Selection**

The power supplies can be selected to operate with 110 V input or 220 V input. To ensure that your instrument is properly configured to operate at the desired AC line voltage, please

follow the steps below:

## WARNING

For safety, no power should be applied to the instrument while changing line voltage operation. Disconnect all cables connected to the instrument before proceeding.

### a. Check and/or Change Fuse

- Locate the fuse box next to the AC input connector in the rear panel (see Figure 3).
- With a small flat blade screwdriver, insert into the fuse box slit to pull and slide out the fuse box as indicated below.
- Check and replace fuse (if necessary) for the desired line voltage operation (see section 2.2).

### b. Check and/or Change Line Voltage Switch

The input power voltage indicator is a black arrow ▲ on the rear panel near the AC input connector. See Figure 3, number 30. The fuse holder (Figure 3, number 31) has both a smaller white arrow ▽ (120 V) and a smaller black arrow ▼ (240 V) on it. The fuse holder should be rotated so that the fuse holder arrow of the appropriate voltage is pointing to the larger black input power voltage indicator arrow. See Figure 4.

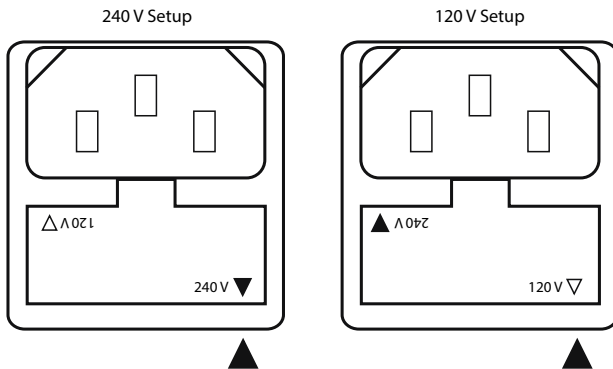


Figure 4. Fuse Selector

## **CAUTION**

Do not connect power to the instrument until the line voltage selection is setup correctly. Applying an incorrect line voltage or configuring the line voltage selection improperly may damage the instrument and void all warranty.

### 4. Ventilation

## **CAUTION**

Also make sure the ventilation holes are not blocked. Ensure the ventilation fan is working well (it should turn on at power-on). Do not load the output if fan is not working otherwise it may cause overheating.

## **3 Operating the Power Supply**

### 1. Settings Voltage & Current

To set the voltage, push the CH1/V or CH2/V button, key in the voltage, and then press Enter. To set the current, push the CH1/A or CH2/A button, key in the current, and then press Enter.

### 2. Output Button

Pressing the OUTPUT button will light up the LED and begin to output power to your load. To stop sending power to your load, press the OUTPUT button again. The LED will turn off.

### 3. Independent Mode

Connect the appropriate load between the positive (red) and common (yellow) terminal of Output 1 for 0 to +32 V. Connect the common (yellow) and negative (black) terminal of Output 2 for 0 to -32 V.

### 4. Serial Mode

Push the "Serial" button. The LED will light up to show you are now in Serial Mode. The output of CH2 will be automatically



changed to the same as CH1. Connect the appropriate load between the positive (red) and negative (black) terminal for 0 to 64 V output.

## 5. Fixed 5V / 3A Output

This is a standard 5 V / 3 A output useful for supplying power to TTL logic circuits. When the load attempts to draw more than 3 amps from the output, the OVERLOAD indicator will light and the power supply will fold back, reducing both the output voltage and current to well below the normal operating limits.

## 6. Savings Settings

There are 10 locations of internal memory. To save the settings, push SHIFT-Store. Then key in the number of the storage location, and Enter. For example, to store the current settings in memory Location #5, push SHIFT-Store-5-Enter. The data of both CH1 V & A and CH2 V & A will be stored in Location #5. The location numbers are 0-9. The "0" location is an out-of-list location. This means you can use this location to save and recall settings, but it will be excluded when operating in List Mode. Location #9 will only be used for timing while in List Mode.

## 7. Recalling Settings

To recall the saved settings, push SHIFT-Recall key in the number of the memory location (0-9), and hit Enter. The data will be shown on the displays. For example, to recall the stored settings from Location #4, push SHIFT-Recall-4-Enter. The data will be shown on the displays.

## 8. List Mode

The 1350 features List Mode allowing you to run the supply through a preset list of settings. In List Mode the supply will automatically execute the settings in order starting first with your current settings, then from Locations #1 - #8.

## a. Delay

Each location has a delay time which is the length of delay (in seconds) before that location's settings are activated. For instance, a delay time of 9 seconds in Location #2 will mean that 9 seconds will pass before Location #2 will be activated. To set the delay time, first Recall (see section 3.7) the location you wish edit. Now push SHIFT-Delay-Time-Enter. Lastly, SHIFT-Store-Enter.

For example, say you wish to set the delay time for Location #3 to 45 seconds. First, call up location 3: SHIFT-Recall-3-enter. Now set the time: SHIFT-delay-45-enter. Now save it: SHIFT-Store-enter.

## b. Running the List

To execute List Mode push SHIFT-Auto. The displays will flash while running through the list. Step "1" will now show in the MEMORY display. Step 1 activates the settings that were showing on the displays when List Mode was activated. After the time delay set in Location #1, the output will switch to Location #1 settings. These will remain for the length of the Location #2 time delay, and so forth. See Figure 6 below. To interrupt the list in process, just push "SHIFT" again. The display should stop flashing and List Mode will be discontinued.

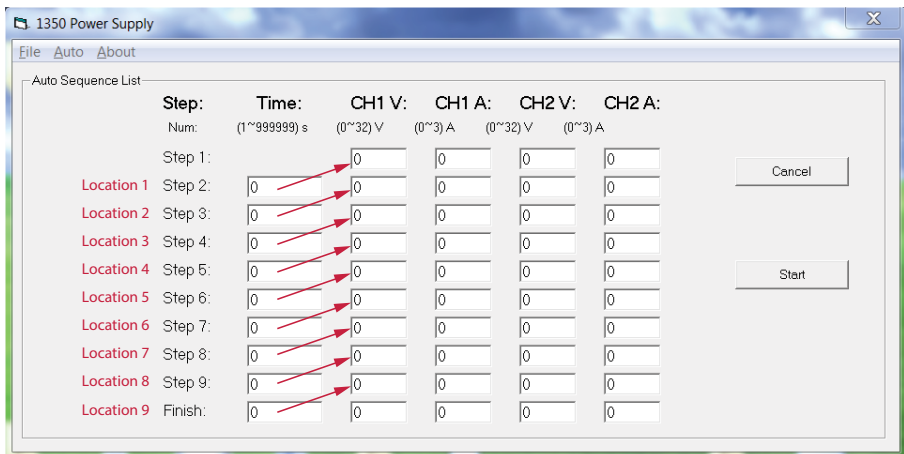


Figure 5. List Mode

## 9. USB Input

1. Download the 1350 software from our website at [globalspecialties.com](http://globalspecialties.com).
2. Install the appropriate driver. Now connect the 1350 to the computer via USB.
3. Install the application "1350.exe" software on your computer. The setup program will guide the program installation. The 1350 is compatible with Windows 98, Windows ME, Windows XP, and Windows 7.
4. Open the 1350 Program. The program will confirm the COM port. Say "No" to COM 1. The program should now offer the correct COM Port. If you are uncertain which COM port is being used, see the Device Manager.
5. The power supply will enter the PC Mode and will be controlled by the computer only. The output will be according to the command from the computer. After you have set the data, push "Enter" key to execute.
6. The output is set to "Off" as in Figure 4. Click the On/Off to start output as in Figure 5. Clicking it again will return to "Off" position.
7. Serial mode is "Off" by default. Click it to enter Serial Mode. The data of CH1 will be copied to CH2 automatically. Click it again to return to Normal mode.
8. Auto Mode. Click: "Auto" of Fig.6. The computer will display Fig.7. Set the delay time ( in second). CH1V / A and CH2 V / A etc. for each memory step. Total 9 steps.
9. After you have set the data click "Start." The output will execute from Step 1 to step 9 automatically.
10. After all nine steps have been executed the computer will display "Finish".
11. If you desire to return to front panel control, switch off the power supply and disconnect the USB lead. Then switch on the power supply again.

# 4 Maintenance

## 1. Preventive Maintenance

Clean and recalibrate the instrument in a regular basis to keep the instrument looking nice and working well. Remove any dirt, dust and grime whenever they become noticeable on the outside cover with a soft cloth moistened with a mild cleaning solution.

## 2. Servicing

If the instrument ever becomes inoperative or damaged, refer servicing to a qualified repair facility.

# 5 Specifications

All specifications apply to the unit after a temperature stabilization time of 15 minutes over an ambient temperature range of 25 °C ±5 °C.

<b>1350 Power Supply</b>	
<b>Output Parameters</b>	
Max Output Power	207 W
Number of Outputs	3 electrically isolated outputs
Range	Variable: 0-30 VDC / 0-3 A (2) Fixed: 5 V / 3 A (1)
<b>Load Regulation</b>	
CC Mode	≤ ±10 mA
CV Mode	≤ ±20 mV
<b>Line Regulation</b>	
CC Mode	≤ ±10 mA
CV Mode	≤ ±20 mV
<b>Ripple &amp; Noise</b>	
CC Mode	≤ 3mArms
CV Mode	Ripple ≤ 1mVrms / 3mVp-p Noise ≤ 2mVrms / 6mVp-p
Fixed 5 V Output	≤ 2mVrms
<b>Tracking Operation</b>	
Slave Tracking Error	≤ 0.1% + 50mV
<b>Display</b>	
Resolution	10 mV, 1 mA

Voltage & Current Accuracy	$\leq 0.5\% \pm 10 \text{ mV}, \leq 0.5\% \pm 1 \text{ mA}$
Fixed 5 V Output Accuracy	$5 \text{ V} \pm 0.25 \text{ V}, 3 \text{ A} \pm 0.02 \text{ A}$
<b>General</b>	
Response Time: Voltage Up 10 to 90%	$\leq 100\text{mS}$
Response Time: Voltage Down 90 to 10%	$\leq 100\text{mS}$
Read Back Temperature: Voltage	$\leq 100\text{ppm} \pm 20\text{mV}$
Read Back Temperature: Coefficient	$\leq 150\text{ppm} \pm 10\text{mA}$
Drift: Voltage	$\leq 100\text{ppm} \pm 20\text{mV}$
Drift: Current	$\leq 150\text{ppm} \pm 10\text{mA}$
Memory	9 locations
Step Time	1 sec to 999999 sec
Timer Resolution	1 sec
AC Input	VAC 120/240 $\pm 5\%$ , 50/60Hz
Operating Temperature	50 °F to 104 °F (10 °C to 40 °C)
Operating Humidity	90% R.H.
Temperature Coefficient	$\leq 100\text{ppm} + 20 \text{ mV}, \leq 150\text{ppm} + 10 \text{ mA}$
Dimensions (W x H x D)	9 x 7 x 12 in (230 x 170 x 310 mm)
Weight	17.6 lbs (8.0 kg)
Included Accessories	Power cord, user manual, one pair of test leads
Warranty	One Year Warranty

Specifications are subject to change without notice. To ensure the most current version of this manual, please download the current version from our website: [globalspecialties.com](http://globalspecialties.com).

## 6 Service and Warranty Information

### 1.Á Warranty

Cal Test Electronics warrants this product to be free from defective material or workmanship for a period of 1 year from the date of original purchase. Under this warranty, Cal Test Electronics is limited to repairing the defective device when returned to the factory, shipping charges prepaid, within the warranty period.

Units returned to Cal Test Electronics that have been subject to abuse, misuse, damage or accident, or have been connected, installed or adjusted contrary to the instructions furnished by Cal Test Electronics, or that have been repaired by unauthorized persons, will not be covered by this warranty.

Cal Test Electronics reserves the right to discontinue models, change specifications, price, or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees, or agents.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Cal Test Electronics is authorized to assume any other obligation in connection with the sale and purchase of this device.



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