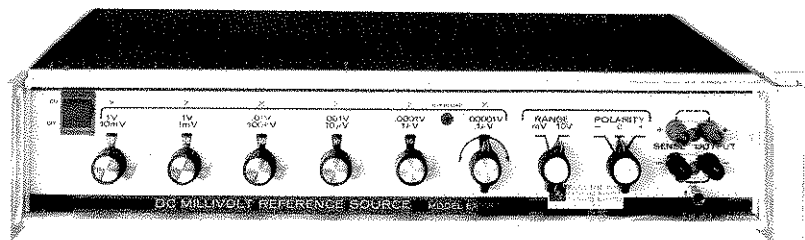


# *Model E100RC*

*DC Millivolt Reference Source*

*$\pm 1\mu\text{V}$  to  $\pm 10\text{Vdc}$  - 10ppm Resolution*



**KROHN-HITE  
CORPORATION**

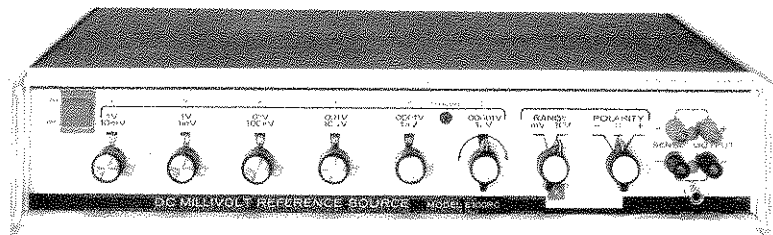
*Operating Manual*



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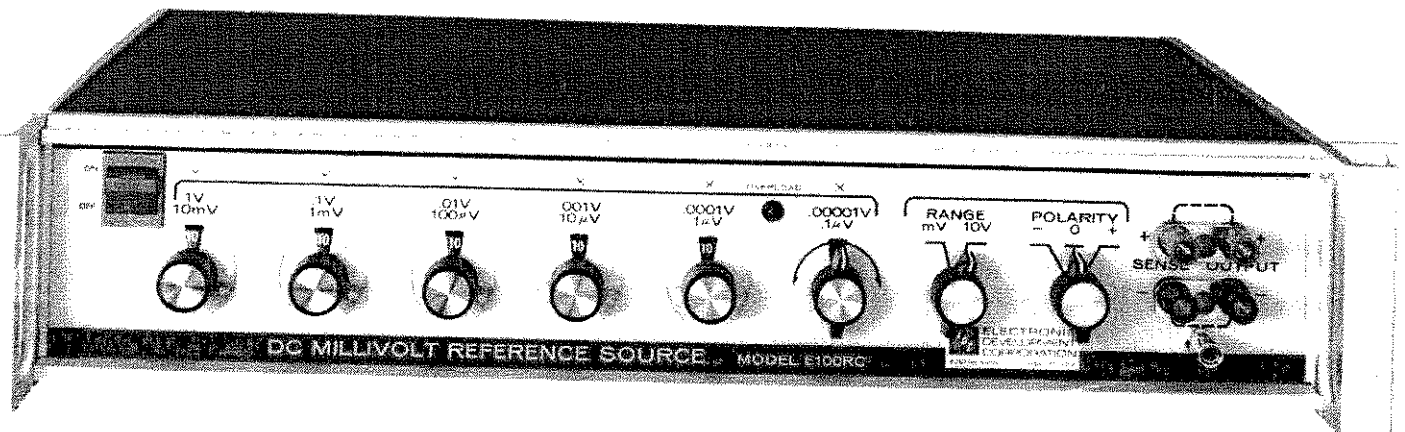
## LIST OF DRAWINGS

Description	Drawing Number
CA-4682A	Power Transformer Schematic
CA-4683B	Power Supply
CB-4684B	Main Board Schematic
CB-4680C	Calibration Layout
930727A	Reference Drawing

MANUALLY OPERATED  
DC VOLTAGE CALIBRATOR  
Model E-100-RC

Serial No. \_\_\_\_\_

# E-100-RC OPERATORS MANUAL



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Electronic Development Company  
255 Bodwell Street  
Avon, Massachusetts 02322  
E-mail: [Info@krohn-hite.com](mailto:Info@krohn-hite.com)  
[www.electronicdevelopment.com](http://www.electronicdevelopment.com)

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Information furnished in this manual is believed to be accurate and reliable. However, no responsibility is assumed by Electronic Development Company for its use; nor for any infringements of patents or other rights of third parties which may result from its use.

## WARRANTY

The ELECTRONIC DEVELOPMENT COMPANY (E.D.C.) warrants to the original purchaser each instrument manufactured by them to be free from defects in material and workmanship. This warranty is limited to servicing, repairing and/or replacing any instrument or part thereof returned to the E.D.C. factory for that purpose in accordance with the instructions set forth below; and furthermore to repair or replace all materials, except tubes, fuses, transistors and other semiconductor devices which shall within one year of shipment to the original purchaser be returned to the E.D.C. factory and upon examination be deemed defective.

E.D.C. instruments may not be returned to the factory under the terms of this warranty without the prior authorization of the E.D.C. Service Department. All instruments returned to E.D.C. for service hereunder should be carefully packed and shipped. All transportation charges shall be paid by the purchaser.

EDC reserves the right to discontinue instruments without notice and to make changes to any instrument at any time without incurring any obligation to so modify instruments previously sold.

This warranty is expressly in lieu of all other obligations or liabilities on the part of EDC. No other person or persons is authorized to assume in the behalf of EDC any liability in the connection with the sale of its instruments.

**CAUTION:** The instrument you have purchased is a precision instrument manufactured under exacting standards. Any attempts to repair, modify or otherwise tamper with the instrument by anyone other than an EDC employee or authorized representative may result in this warranty becoming void.

# FACTORY SERVICE REQUEST AND AUTHORIZATION

## WARRANTY SERVICE

Instruments may be returned only on prior authorization. Please obtain a RETURN AUTHORIZATION NUMBER either directly from the factory or from an authorized E.D.C. Representative. (See General Information below.)

## CHARGEABLE REPAIRS

If requested, an estimate of charges will be submitted prior to repairs. We suggest that you request a RETURN AUTHORIZATION NUMBER to facilitate handling.

## GENERAL INFORMATION

- A) Please provide the following information in order to expedite the repair:
- 1) Indicate MODEL
  - 2) Serial Number
  - 3 Complete description of the trouble:  
  
Symptoms, measurements taken, equipment used, lash-up procedures, attempted repairs, suspected location of failure and any other pertinent information.
- B) Freight Charges must be PREPAID.
- C) The RETURN AUTHORIZATION NUMBER should be noted on your documentation.
- D) See Packing Suggestions - next page.



## PACKING SUGGESTION

Although your E.D.C. instrument is built for laboratory, production environment and some field environment, it is NOT ruggedized. Therefore...

1. Be sure the carton is **STRONG** enough to carry the weight of the instrument, e.g. use double wall corrugation.
2. Be sure the carton is **LARGE** enough to allow for sufficient packing material, e.g., at least 2 inches all around the instrument. The packing material should be able to be compressed and then return to its approximate original volume.
3. For better handling, the shipment should always be by **AIR FREIGHT** (expect for short distances). You might use either UPS "blue label" or common air freight carrier, second day air.

Please do not bounce it across the country in a truck. It may not hurt it, but it certainly is not going to do a laboratory instrument much good.

4. **QUESTIONS?** Just contact us. We will be pleased to help you.

# SECTION I

## 1.0.0 DESCRIPTION AND APPLICATIONS

### 1.1.0 General Description

- 1.1.1 The precision DC Voltage Standard Source is a highly versatile reference source, designed to meet the needs of computer systems, production line testing, automated calibration, and standards laboratories.
- 1.1.2 The instruments have a specified accuracy, and are traceable through a bank of saturated standard cells to the U. S. National Institute of Standards and Technology.
- 1.1.3 Depending on the model of the instrument, resolutions of 0.1 ppm are attainable.
- 1.1.4 The instruments are highly accurate references which can be used for calibration of digital voltmeters, analog meters, semiconductor analyzing systems, analog references for computers, analog-to-digital converters, telemetry and data acquisition systems, and where ever a stable source is required.
- 1.1.5 There are no adjustments made during normal operation. The trims are made during calibration and are described under the calibration procedure.
- 1.1.6 The circuitry is completely solid state made of discrete, hybrid and/or integrated circuits packaged on etched glass circuit boards. These are proven circuits, using derated components to insure long life and maximum reliability.
- 1.1.7 The instrument is overload and short-circuit proof, and is fully operational in adverse environmental conditions.
- 1.1.8 The Standard Source will drive a short circuit indefinitely without damage to the instrument, and will recover to rated specifications in less than 2 minutes.
- 1.1.9 When used with a voltmeter, the source becomes a potentiometer for measuring DC voltages.

## E100RC SERIES

### 1.2.0 Output Specifications

#### 1.2.1 Output:

Range 1	$\pm 10$ Vdc +10% over-ranging
Range 2	$\pm 100$ mV dc +10% over-ranging

#### 1.2.2 Resolution:

Range 1	100 $\mu$ V (10 ppm) 5 decades
Range 2	1 $\mu$ V (10 ppm) 5 decades

#### 1.2.3 Accuracy:

Range 1	$\pm 0.005\%$ of setting +50 $\mu$ V
Range 2	$\pm 0.01\%$ of setting +5 $\mu$ V

#### 1.2.4 Stability:

1 hour	$\pm 0.0005\%$
8 hours	$\pm 0.0010\%$
1 year	$\pm 0.0025\%$ of range +5 $\mu$ V

#### 1.2.5 Ripple & Noise, rms (Band pass 0.8 Hz to 100 kHz)

Range 1	100 $\mu$ V rms
Range 2	1 $\mu$ V rms

#### 1.2.6 Current:

Range 1	75 mA with short circuit protection
Range 2	1 M $\Omega$ load minimum

#### 1.2.7 Load Regulation

(non-additive)  $\pm 0.0005\%$   
no load to full load

#### 1.2.8 Impedance

Range 1	50 milliohms
Range 2	20 Ohms (constant)

#### 1.2.9 Thermal EMF

mV,  $\mu$ V ranges 1  $\mu$ V

#### 1.2.10 Vernier Control

Range 1	$\pm 100$ $\mu$ V
---------	-------------------

Vernier Control allows for infinite resolution and operates through zero.

### 1.3.0 General Specifications

1.3.1 Warm Up Time: 30 seconds (min); 15 minutes (max)

#### 1.3.2 Temperatures:

Calibration	23°C ±1°C
Ambient	20°C to 30°C
Operating Limit	-10°C to 50°C
Storage	-40°C to 85°C

#### 1.3.3 Temperature Coefficient:

Ambient	±0.0005%/°C
Operating Limit	±0.001%/°C

#### 1.3.4 Power Requirements

10 W, 50 - 400 Hz	105 Vac to 125 Vac 220 Vac to 240 Vac
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#### 1.3.5 Dimensions:

Bench Series	3 1/2 x 16 3/4 x 7 inches
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1.3.6 Weight: 10 lbs.; 4.53 kg

1.3.7 Shipping Weight: 15 lbs; 6.81 kg

1.3.8 Circuit Condition Indicator: Front panel indicator for short circuit, overload, over-voltage condition low line voltage or malfunction.

1.3.9 Protection: Short circuit and overload protection. Automatic recovery.

#### 1.3.10 Documentation:

- A) Certification of Compliance traceability to U. S. National Institute of Standards and Technology.
- B) Calibration laboratory certification.
- C) Operators' manual including block diagrams, mechanical layout and schematics.

1.3.11 Warranty: One year - includes accuracy and stability.

## **SECTION II**

### **2.0.0 INSTALLATION**

#### **2.1.0 General Information**

- 2.1.1 Electronic Development Corporation's instruments may be obtained in several case configurations.
- 2.1.2 This portable unit is rugged and light weight. EDC Model E100RC is completely enclosed.
- 2.1.3 Rack mountable instruments are designed primarily for mounting in the standard 19" relay rack. We recommend that nylon inserts be placed between the cup washer and the front panel to prevent scratching the paint while installing into the rack.
- 2.1.4 All instruments are supplied with a standard three (3) prong polarized plug and power cord.
- 2.1.5 A multi-tap transformer is provided, however it is set to 115 Vac or 230 Vac via the slide switch on the internal chassis. Other voltages can be accommodated by making the proper selections of the transformer taps.

## SECTION III

### 3.0.0 OPERATION OF INSTRUMENT

#### 3.1.0 Front Panel Controls

3.1.1 Power Switch:Rocker off-on, line power.

3.1.2 Polarity Switch: This switch has 3 settings with the polarity switch on "+" the red output terminals are positive with respect to the black terminals. On "-" the red output terminals are negative with respect to the black terminals. On "0" a short circuit exists between the red and black voltage output terminals, the current terminals are open circuit.

3.1.3 Voltage Output and Sense Terminals: 4 terminals are provided for output and sense. The red terminals represent the polarity with respect to the black as the common terminals. The red terminals are indicated by the polarity switch.

3.1.4 If a high impedance or a low current load is connected, the output and sense terminals may be shorted with the sense links (provided) e.g. plus output to plus sense.

3.1.5 When drawing relatively large amounts of current in the voltage mode, or if the load is far from the source, the remote sense capability should be used. The advantage of remote sense is that you have a 4 wire output and the sense lines are brought directly to the load, thus eliminating the IR drop of the output lines.

3.1.6 The metal terminal is case ground.

3.1.7 Decade Switches: The decade switches are used to select the desired output.

3.1.8 A Vernier Control is to provide a means of adjusting out any undesirable offset. The range of adjustment is  $\pm 100 \mu V$ . The adjustment is disabled when the vernier control is set to its maximum counter clock-wise position.

3.1.9 Range Switch: The range switch is used to manually select one of the 2 range modes.

#### 3.2.0 Front Panel Indicators

3.2.1 Overload lamp: This lamp will be on during initial power on. It should turn off after a few seconds. This lamp is used to indicate failure in the chopper stage. Refer to section 4.7.0 of the manual.

### 3.3.0 Operation as a Voltage Source

- 3.3.1 With power switch off, connect power cord to recommended power source, e.g. 115 VAC 60 Hz or 220 VAC 50 Hz. (See paragraph 2.1.5.)
- 3.3.2 Connect the output terminals of the instrument to their respective loads as required, observing the sensing rules (see drawing #930727)

#### *NOTICE: THE SENSING CIRCUIT MUST BE COMPLETE*

Please refer to DRAWING #930727, in the rear of this manual, for the two wire and four wire connections.

#### *CAUTION*

Do not place more than a 500 volt potential between the output terminals and chassis ground when using a floating output. In some applications it may be necessary to isolate chassis from line common. This practice is not recommended.

- 3.3.3 With polarity switch on "0" position, place power on switch to the "On" position. This procedure will prevent any possible turn on transient from appearing across the output terminals.
- 3.3.4 Select the desired output voltage on the decade switches, set range switch to appropriate range, and switch the polarity switch to required polarity.

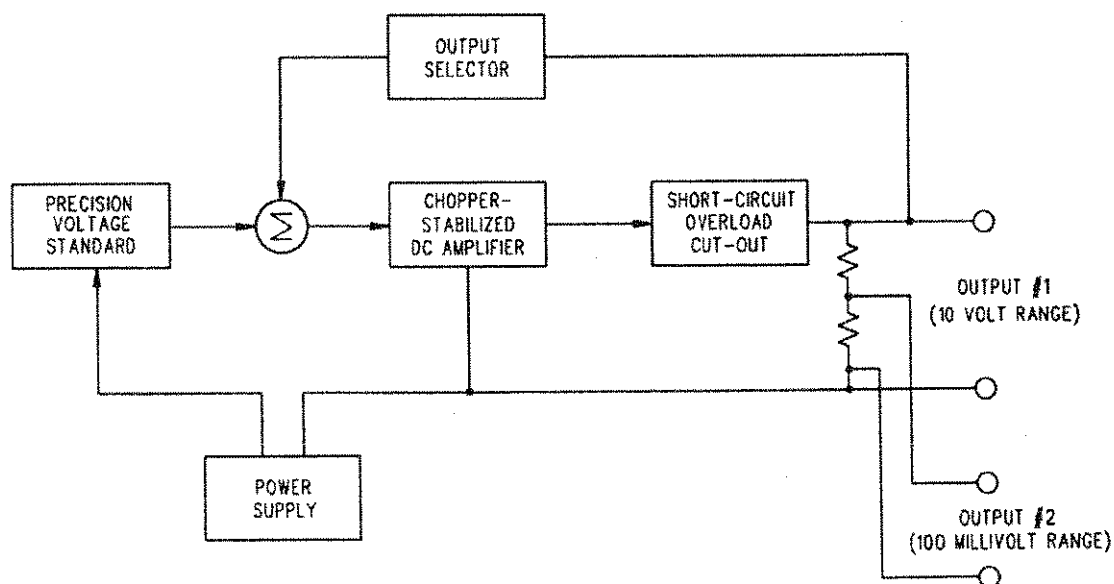
## SECTION IV

### 4.0.0 THEORY OF OPERATION

#### 4.1.0 Introduction

As shown in the block diagram below, the model E100RC is conveniently broken down into functional blocks.

TYPICAL UNIT BLOCK DIAGRAM



MODEL "MV" SERIES

4.1.1 The Basic Circuitry for Electronic Development Company's standards/sources are similar. Refer to Drawings CA-4682A, CA-4683B, and CB4684B. The Basic circuitry is:

1. Power supply
2. Internal Precision Zener reference
3. Precision Amplifier
4. Feedback circuitry
5. Output selector
6. Overload circuitry



#### 4.2.0 Power Supply

4.2.1 The main line power is stepped down via the power transformer. The secondary windings of the transformer drives a bridge rectifier. The voltage rectifier output is clamped to  $\pm 24$  volts. This  $\pm 24$  volts drive  $\pm 15$  volt linear regulators located on the main boards.

#### 4.3.0 Internal Precision Reference

4.3.1 The internal reference is made up of a "0" temperature coefficient zener driven by a constant current source.

#### 4.4.0 Precision Amplifier

4.4.1 The basic amplifier has a very high open-loop gain in order to maintain the high accuracy.

4.4.2 Brief Mathematical Model of the Operation of a Voltage Reference Source.

4.4.3 An operational amplifier using negative feedback tries to drive the summing or error point to ground potential. This is useful in that the current flow into the error point through the ( $R_f$ ) feedback string is equal to the current ( $IR_i$ ) flowing through the input resistance ( $R_i$ ), e.g. if  $R_f = 63 \text{ k}\Omega$  then:

$$E_o = \frac{-E_i R_f}{R_i} = -6.3V \times \frac{63K}{63K} = -6.3V (1) = -6.3V$$

4.4.4 It is interesting to note that  $F_f$  times the input current ( $IR_i$ ) is the same output voltage therefore:

$$E_o = -I_{Rin} \times R_{Fb} = -100 \mu A \times 100K = -10V$$

#### 4.5.0 Feedback

4.5.1 The feedback resistor string is made up of the decade switches mounted on the front panel. These low resistance switches have precision resistors used for the amp feedback mounted to them.

4.5.2 With all decades set to zero, the feedback resistor and output goes to zero. With the MSD decade set to ten, the feedback resistor totals 100Kohms. This will generate full scale output for the range that is selected.

#### 4.6.0 Output selector

4.6.1 The output selector (polarity switch) is used to connect the amp output to the correct output terminals. This switch has three positions. Refer to section 3.1.2

#### 4.7.0 Overload circuitry

4.7.1 Overload protection is provided by a current limiting resistor in the output stage. In the event of an overload or short circuit, the amplifier will be saturated and its output will be approximately +14 V. This condition is detected by a comparator. The comparator output goes negative and turns on the indicator light driver transistor.

4.7.2 Overload indicator light basically shows the condition of the output of the Amplifier. Any or all of the following conditions can cause the indicator to light:

- 1) Amplifier is correcting output voltage
- 2) Low line voltage
- 3) Load is drawing more than rated current
- 4) Short circuit on output
- 5) Sense loops open