



## *Time Electronics*

### 1006 DC Millivolt Source

and

### 1007 DC Millivolt Potentiometer & Source

### Technical Manual



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All Time Electronics' instruments are subject to continuous development and improvement and in consequence may incorporate minor detail changes from the information contained herein.

# 1. Descriptions

## 1.1. 1006 DC Millivolt Source

- 3 Ranges
  - 0-1V (0.1 mV steps)
  - 0-100mV (10 uV steps)
  - 0-10mV (1 uV steps)
- 0.02% Accuracy
- 20mA Output Current
- Short Circuit & Overload Protected
- Battery Powered – Portable
- Safety Terminals
- Battery Level Indicator



The 1006 has been introduced to meet a need for accurate, low cost millivolt source.

Three output ranges are provided to give adjustable outputs from 1 uV to 1 V.

**Description:** The 1006 basic reference source is precision reference diode and low temperature coefficient resistors are used throughout. Power is provided by 6-U7 (penlight size) batteries. Battery life is several months depending on usage - the battery condition is monitored by an indicator which is mounted on the side of the unit. The completely solid state circuitry allows up to 20mA output current and is short circuit and overload protected. A 'normal', 'off', 'reverse' output polarity switch is provided.

**Operation:** The 1006 is suitable for operation by unskilled personnel and does not require standardisation or calibration prior to use. For signal injection, the operator needs only to switch on, check the battery condition and select the required range output.



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## 1.2. 1007 Millivolt Potentiometer and Source

- 3 Ranges  
0-1V (0.1 mV steps)  
0-100mV (10 uV steps)  
0-10mV (1 uV steps)
- 0.02% Accuracy
- 1 Micro-Volt Resolution Null
- No Standardisation Required
- Millivolt Source Operation as 1006
- Safety Terminals
- Battery Level Indicator



The 1007 includes all the features of the 1006 with the addition of a microvolt null balance display. This enables it to be used for potentiometric voltage measurement in addition to its function as a calibrator. The null zero and sensitivity are adjustable via front panel controls - maximum sensitivity enables null balance to resolve 1 microvolt.

Applications are essentially those of conventional potentiometers with the following significant advantages:

1. No Standardisation is required.
2. 20mA output current.
3. Output remains stable without re-adjustment.
4. Electronic null with microvolt sensitivity.

**Operation:** The 1007 is suitable for operation by unskilled personnel and does not require standardisation or calibration before use. It is only necessary to zero the null amplifier prior to making a measurement.

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## 2. Specifications

<b>Output:</b>	0.999.9mV in 3 ranges 0.999.9mV in 0.1mV steps 0.99.99mV in 10uV steps 0.0.999mV in 1uV steps
<b>Accuracy:</b>	± 0.02% of setting ± 0.02% of range
<b>Output Resistance:</b>	Less than 0.1 ohm on 1V and 100mV ranges. 1 ohm on 10 mV range.
<b>Maximum Output Current:</b>	1V and 100mV ranges - 20mA. 10mV range: Up to short circuit value although it should be noted that loads of less than 1K ohm will give greater than 0.1% error.
<b>Output Voltage Stability:</b>	Less than 60ppm/°C. Less than 100ppm per 3 month. (non cumulative)
<b>Operating Temperature:</b>	-10°C to + 60°C.
<b>Output Polarity:</b>	Positive or negative switch selected. A centre 'off' position is also provided.
<b>Output Noise Level:</b>	Less than 30ppm of f.s.
<b>Reference Source:</b>	Precision zenor diode selected for stability and low temperature coefficient.
<b>Maximum Overload:</b>	The instrument can withstand continuous short circuit on the output for all ranges.
<b>Power Supply:</b>	6-U7 size (51 x 14mm) batteries. A battery condition display indicates when the batteries should be changed. An alternative power source is 6 Nickel Cadmium cells of the same dimensions - these can be recharged via a socket on the side of the unit. The 6 rechargeable batteries and mains re-charger unit are available as an optional extra.
<b>Null Balance Display:</b> (1007 only)	The null display is on a front panel meter, zero and sensitivity controls are provided.  Maximum sensitivity: ± 20uV fsd (2uV/div.) Minimum sensitivity: ± 20-0-20(20 divisions). Input resistance: Greater than 1M ohm at balance.
<b>Dimensions:</b>	200 x 75 x 110mm (215 x 100 x 120mm incl. protective boot)
<b>Weight:</b>	1.1kg (1.5kg incl. protective boot)

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## 3. Operating Instructions

The 1007 incorporates a 1006 with the addition of a microvolt null detector and enables the unit to be used for potentiometric measurements. The additional front panel components are:

- 1) Null Balance Meter
- 2) Null Zero Adjust Control
- 3) Null Sensitivity Adjust Control
- 4) Function Switch marked SOURCE:POTENTIOMETER:ZERO

### 3.1. Battery Insertion

To insert batteries, remove two black covers on top of the instrument by pressing in and turning 90° anti-clockwise. Three size AA batteries should be inserted in each tube with the positive (tip) terminal upmost. Note that if the optional battery charger is to be used, then nickel cadmium (NiCad) rechargeable batteries **must** be used in the instrument.

### 3.2. 1006 Operation

Switch on supply (push button) and check the battery level. The battery level indicator is mounted on the top (terminal end) of the unit, with a minimum line indicating when the batteries should be replaced or recharged. Select required range with push button and dial required output voltage. The output voltage polarity can be selected on the front panel switch - the centre position disconnects the output and provides a **short circuit** on the output terminals.

### 3.3. 1007 Operation

#### 1) Millivolt Source Operation:

Operation is as the 1006 when the function selector switch is in "SOURCE" position. The only difference being that the "OFF" position on the polarity voltage switch provides **open circuit** on the output terminals - this is to prevent accidental shorting of the voltage under test when the unit is being used as a potentiometer. It is desirable to keep the Null "SENSITIVITY" control set to minimum (fully anti-clockwise) when the unit is being used as a source.

#### 2) Millivolt Potentiometric Null Operation:

Due to the extreme sensitivity of the electronic null detector (2uV/div.) it is important to ensure that it is correctly zeroed before attempting accurate measurements.

#### Zero setting procedure:

- a) Set function switch to ZERO.
- b) Set RANGE switch to required position.
- c) Sensitivity (SENS) to maximum (fully clockwise).
- d) Adjust ZERO control for zero reading on null meter.

#### Measuring procedure:

- a) Set function switch to POTENTIOMETER.
- b) Set output polarity switch to NORM.
- c) Set sensitivity (SENS) to minimum (fully counter clockwise).
- d) Connect unknown voltage to output terminals (in the same polarity).
- e) Adjust output digits and sensitivity for a null balance as required.

### 3.4. Internal Preset Controls

#### **IMPORTANT NOTE:**

These controls are set in the factory before shipment and normally will not require readjustment.

If readjustment is considered necessary, it is important to check that the amount of adjustment required is within the range of the trimmer concerned. If it is greater than the trimmer range, there is no point in attempting to readjust and a fault condition will exist in the unit. The range of adjustment of the trimmers is given below.

Access to the 1006 or 1007 is by removing the blue cover which is located by 8 screws.

#### **1006 Millivolt Source**

The 1006 contains 3 (4 on instruments with serial number greater than 1320) internal preset trimmers. They are located on the module p.c.b. which also contains the range switches.

#### **Zero**

The 'ZERO' trimmer adjusts the circuit zero and is set to bring the output voltage (with all digits set to zero) within the specified limits.

#### **Calibration**

The 1V and 100mV 'CAL' trimmers adjust the full scale calibration (i.e. 9999) on the 1V and 100mV ranges respectively to within the specified limits. Instruments later than No. 1320 have an additional trimmer for the 10mV range.

It is important to set the ZERO before attempting CALIBRATION.

#### **Test Equipment Required**

- 1) A microvoltmeter with a resolution of better than 5 microvolts. The null amplifier section of Time Electronics 1007 can be used although any suitable microvoltmeter or sensitive D.V.M. may be used.
- 2) An accurate dc voltage source with a range 0-1V and accuracy better than 0.02%. A Time Electronics 1010 is suitable. Alternatively a high performance D.V.M. can be used.

#### **Zero Setting Procedure**

- 1) Switch unit on and check battery condition is good.
- 2) Select 99.99 mV range and set all digits to zero.
- 3) Select 'NORMAL' output polarity.
- 4) Connect microvoltmeter to output and adjust ZERO trimmer for less than - 10uV reading. The maximum amount of adjustment available on this trimmer is approximately  $\pm 100\mu\text{V}$ .
- 5) Check the zero reading for other ranges. The readings should be as follows:

9.999mV range less than  $\pm 2\mu\text{V}$   
99.99mV range less than  $\pm 10\mu\text{V}$   
999.9mV range less than  $\pm 100\mu\text{V}$

### Calibration Procedure

- 1) Check zero output is correct as described on Page 6.
- 2) Select 999.9 mV range and 'normal' output polarity.
- 3) Set output digits to 9999.
- 4) Connect the accurate voltage source and microvolt null meter to the 404S output in a potentiometric mode.
- 5) Set the voltage source to 999.9mV output and adjust the '1V CAL' trimmer on the module to bring the 1006 output within specification. The maximum amount of adjustment available on this trimmer is 0.8%.
- 6) Select 99.99 mV range on the 1006 and set the voltage source to 99.99 mV. Adjust the '100mV CAL' trimmer to bring the output within specification. The maximum amount of adjustment available on this trimmer is 0.8%.
- 7) The specified allowable errors for these two ranges are:

999.9mV range less than  $\pm 550\mu\text{V}$  at f.s. output

99.99mV range less than  $\pm 55\mu\text{V}$  at f.s. output

- 8) The 9.999mV range is obtained by resistive attenuation of the 999.9mV range. A 100:1 attenuation ratio is used and adjustment is by preselected resistor values. Unless overload damage to the attenuator resistors has occurred, the calibration of the 1 volt range will automatically ensure the calibration of the 9.999mV range. The specified allowable error for this range is  $\pm 6\mu\text{V}$  at f.s. output.

**Note:** All instruments with serial numbers later than 1320 incorporate an additional single turn trimmer to adjust the f.s. calibration of this range.



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### **1007 Millivolt Source and Potentiometer**

The 1007 incorporates a 1006 with the addition of a microvolt null detector. With the front panel function switch in the 'SOURCE' position, the unit operates as a 1006 and the ZERO and CALIBRATION setting procedures are identical to those for the 1006.

The potentiometer position of the function switch connects a high performance null balance system in series with the output. The null zero and sensitivity are adjustable by front panel controls. Maximum sens. =  $\pm 25\mu\text{V}$ . Min. sens. =  $\pm 250\text{mV}$  and zero adjust range is approx.  $\pm 100\mu\text{V}$ .

The null amplifier circuitry is located on a small p.c.b. which is fixed to the underside of the output terminals. The circuitry incorporates two preset trimmers for adjustment of the null amplifier input voltage and current offsets.

**Important Note: It is important to check that the 1007 is operating correctly as a millivolt source and that the source zero setting is within specification before considering readjustment of the null amplifier trimmers.**

#### **Null Amplifier trimmer adjustment procedure**

##### **Voltage Offset (10K trimmer):**

- 1) Select 'ZERO' position on the function switch.
- 2) Set all digits to zero. Select 9.999mV range.
- 3) Adjust trimmer for equal swing (about zero) of the front panel zero control.

##### **Current Offset (500K trimmer):**

- 1) Select 'ZERO' function, all digits zero, 9.999mV range.
- 2) Select potentiometer operation.
- 3) Connect a 47K ohm Resistor across output terminals.
- 4) Adjust trimmer for zero reading on the null display - the null sensitivity can be increased gradually to maximum during adjustment.

**Note:** A low offset current is important when measurements are to be made in high resistance circuits, but will not affect accuracy of measurements in low resistance circuits.

## 4. Guarantee & Servicing

### Guarantee Period

This unit is guaranteed against defects in materials and workmanship for a period of **one year** from its delivery to the customer.

We maintain comprehensive after sales facilities and the unit can, if necessary be returned to us for servicing. During this period, Time Electronics Ltd will, at its discretion, repair or replace the defective items. For servicing under guarantee, the instrument type and serial number must always be quoted, together with details of any fault and the service required. The purchaser of the instrument must prepay all shipping charges. Time Electronics Ltd will pay return shipping charges.

This guarantee is void if servicing has been attempted by an unauthorised person or agent. If, during the guarantee period, failure is due to misuse or abuse of the unit, the repair will be put in hand without delay and charged unless other instructions are received.

### Service After Guarantee Period

Even after the guarantee period has expired, Time Electronics Ltd., can still service your instrument. As the manufacturer, we have the specialised knowledge needed to keep your instrument in peak condition and we also maintain a comprehensive spare parts service.

Please enclose details of the service required and your full company details including a contact name when returning for servicing.

### Returning Instruments

When returning instruments, please ensure that they have been adequately packed, preferably in the original packing supplied. **Time Electronics Ltd will not accept responsibility for units returned damaged.** Please ensure that all units have details of the service required and all relevant paperwork.

Send the instrument, shipping charges paid to:-

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