Mr R. Bayliss

MILLIVOLT SOURCE 404S.

MILLIVOLT POTENTIOMETER

AND SOURCE 404N.

TECHNICAL MANUAL

397

TIME ELECTRONICS LTD.

BOTANY INDUSTRIAL ESTATE, TONBRIDGE, KENT, ENGLAND

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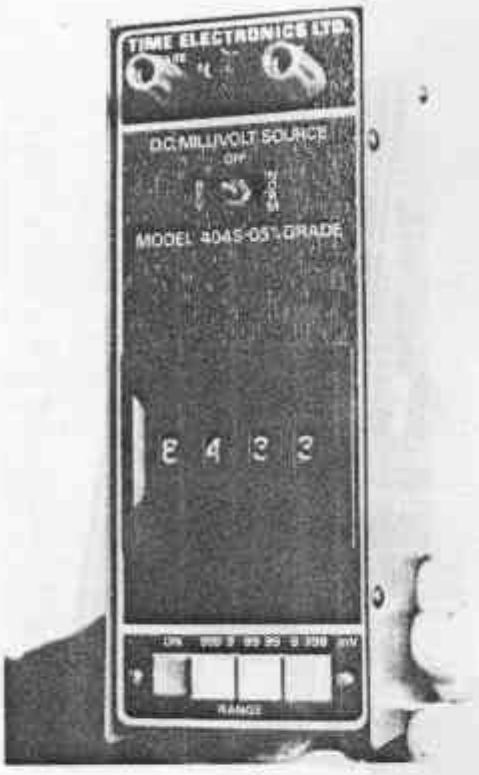


MILLIVOLT SOURCE 404S

- 3 RANGES
  - 0–1V (0.1mV steps)
  - 0–100mV (10 uV steps)
  - 0–10mV (1 uV steps)
- 0.05% ACCURACY
- 20mA OUTPUT CURRENT
- SHORT CIRCUIT AND OVERLOAD PROTECTED
- BATTERY POWERED – PORTABLE
- LOW COST

The 404S has been introduced to meet a need for an accurate low cost millivolt source.
Three output ranges are provided to give adjustable outputs from 1uV to 1V.

DESCRIPTION: The 404's basic reference source is a 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 404S 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 and output.

MILLIVOLT POTENTIOMETER AND SOURCE 404N

- 3 MEASURING RANGES
  - 0–1V
  - 0–100mV
  - 0–10mV
- 0.05% ACCURACY
- 1 MICRO-VOLT RESOLUTION NULL
- NO STANDARDISATION REQUIRED
- MILLIVOLT SOURCE OPERATION AS 404S

The 404N includes all the features of the 404S 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 404N 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.

SPECIFICATION

OUTPUT:
0–999.9mV in 3 ranges
0–999.9mV in 0.1mV steps
0–99.99mV in 10uV steps
0–9.999mV in 1uV steps

ACCURACY:
± 0.05% of setting
± 0.02% of range

OUTPUT RESISTANCE:
Less than 0.1 ohm on 1V and 100mV ranges.
1 ohm on 10mV range.

MAXIMUM OUTPUT CURRENT:
1V and 100mV ranges – 20mA
10mV range: Up to short circuit value although it should be noted that loads of less than 1 Kohm will give greater than 0.1% error.

OUTPUT VOLTAGE STABILITY:
Less than 60ppm/°C.
Less than 100ppm per 3 mnth.
(non cumulative)

OPERATING TEMPERATURE:
–10°C to +60°C.

OUTPUT POLARITY
Positive or negative switch selected. A centre 'off' position is also provided.

OUTPUT NOISE LEVEL
Less than 30ppm of f.s.

REFERENCE SOURCE:
Precision zener diode selected for stability and low temperature coefficient.

MAXIMUM OVERLOAD:
The instrument can withstand continuous short circuit on the output for all ranges.

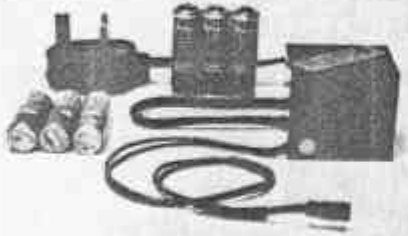
POWER SUPPLY:
6–U7 size (51 x 14mm) batteries. A battery condition display indicates when the batteries should be changed. An alternative power source is 6 Nickel Cadmium cells of the same dimensions – these can be recharged via a socket on the side of the unit. The 6 rechargeable batteries and mains recharger unit are available as an optional extra.

NULL BALANCE DISPLAY (404N only):
The null display is on a front panel meter, zero and sensitivity controls are provided.

Maximum sensitivity: ±20uV fsd (2uV/div.)

Minimum sensitivity: ±200mV fsd.
Meter scale: 20-0-20 (20 divisions).
Input resistance: Greater than 1Mohm at balance.

DIMENSIONS:



RECHARGEABLE BATTERIES
AND MAINS RECHARGER

BATTERY CONDITION DISPLAY
AND BATTERY RECHARGE SOCKET

AGENT:

A. OPERATING INSTRUCTIONS

The 404 is available in two versions:

a) Millivolt Source and Potentiometer TYPE 404N
b) Millivolt Source only TYPE 404S

The 404N incorporates a 404S 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

BATTERY INSERTION

To insert batteries, remove two black covers on top of 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.

404S 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.

1) Millivolt Source Operation:

Operation is as the 404S 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 counterclockwise)
d) Connect unkown voltage to output terminals (in the same polarity)
e) Adjust output digits and sensitivity for a null balance as required.

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 404 is by removing the blue cover which is located by 8 screws.

404S Millivolt Source

The 404S 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 404N, 2003N or 2004 can be used although any suitable microvoltmeter or sensitive D.V.M. may be used.

2) An accurate d.c. voltage source with a range 0 - 1V and accuracy better than 0.02%. A Time Electronics 2003S, 2003N or 2004 is suitable. Alternatively a high performance D.V.M. can be used.

Zero Setting Procedure:

1) Switch unit 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 $\pm$ 10uV reading. The maximum amount of adjustment available on this trimmer is approximately $\pm$ 100uV.
5) Check the zero reading for the other ranges. The readings should be as follows:

9.999mV	range	less	than	$\pm$ 2uV
99.99mV	"	"	"	" 10uV
999.9mV	"	"	"	" 100uV

404N Millivolt Source and Potentiometer.

The 404N incorporates a 404S with the addition of a microvolt null detector. With the front panel function switch in the 'SOURCE' position, the unit operates as a 404S and the ZERO and CALIBRATION setting procedures are identical to those for the 404S.

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. = ± 25uV. Min. sens. = ± 250mV and zero adjust range is approx. ± 100uV.

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 404N 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.

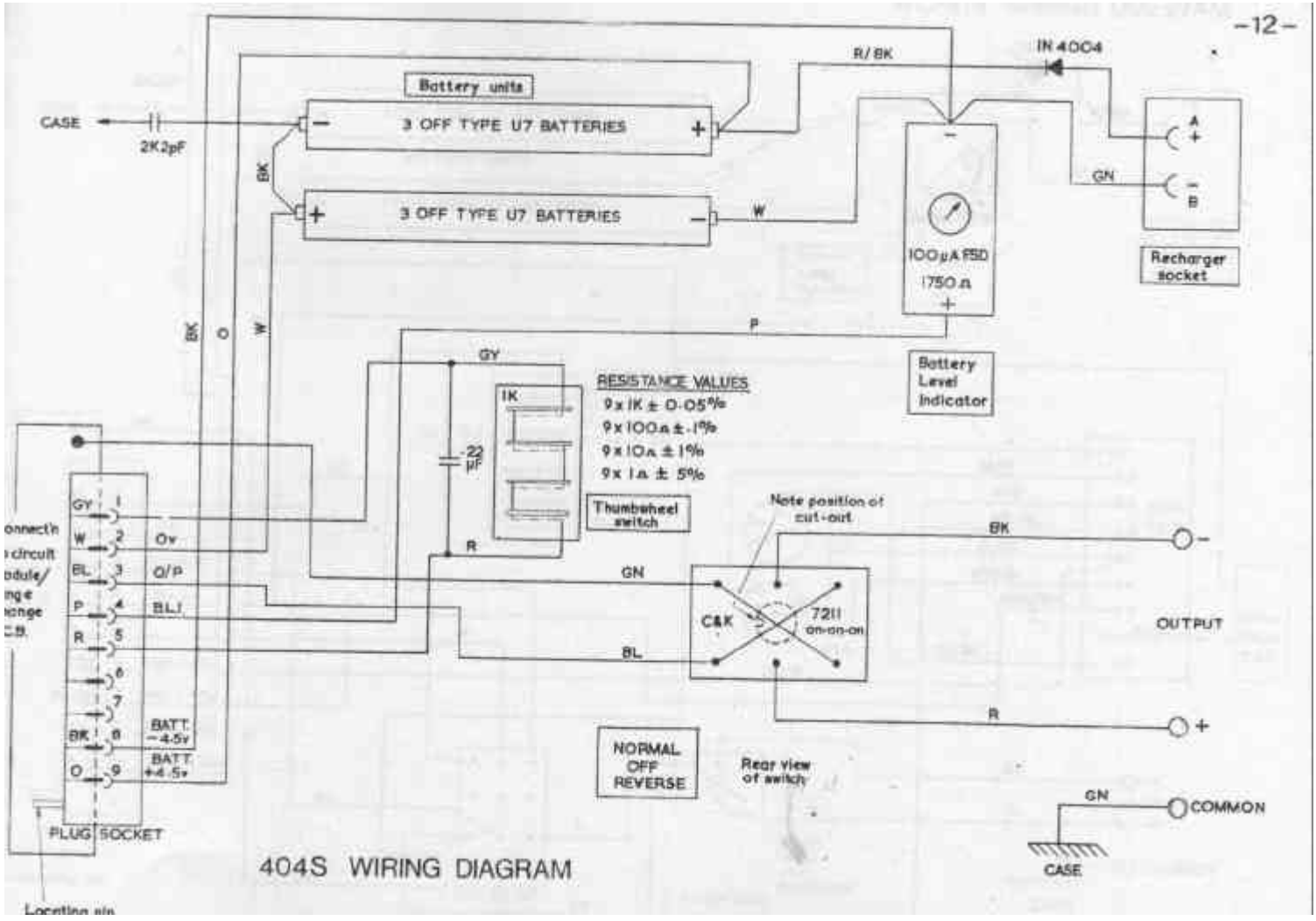
Note: A low offset current is important when measurements are to be made in high resistance circuits, but will not affect accuracy of measurements in low resistance circuits.

C. SERVICE/REPAIRS

Should service on this instrument be required, or if additional information on operation be required, contact:

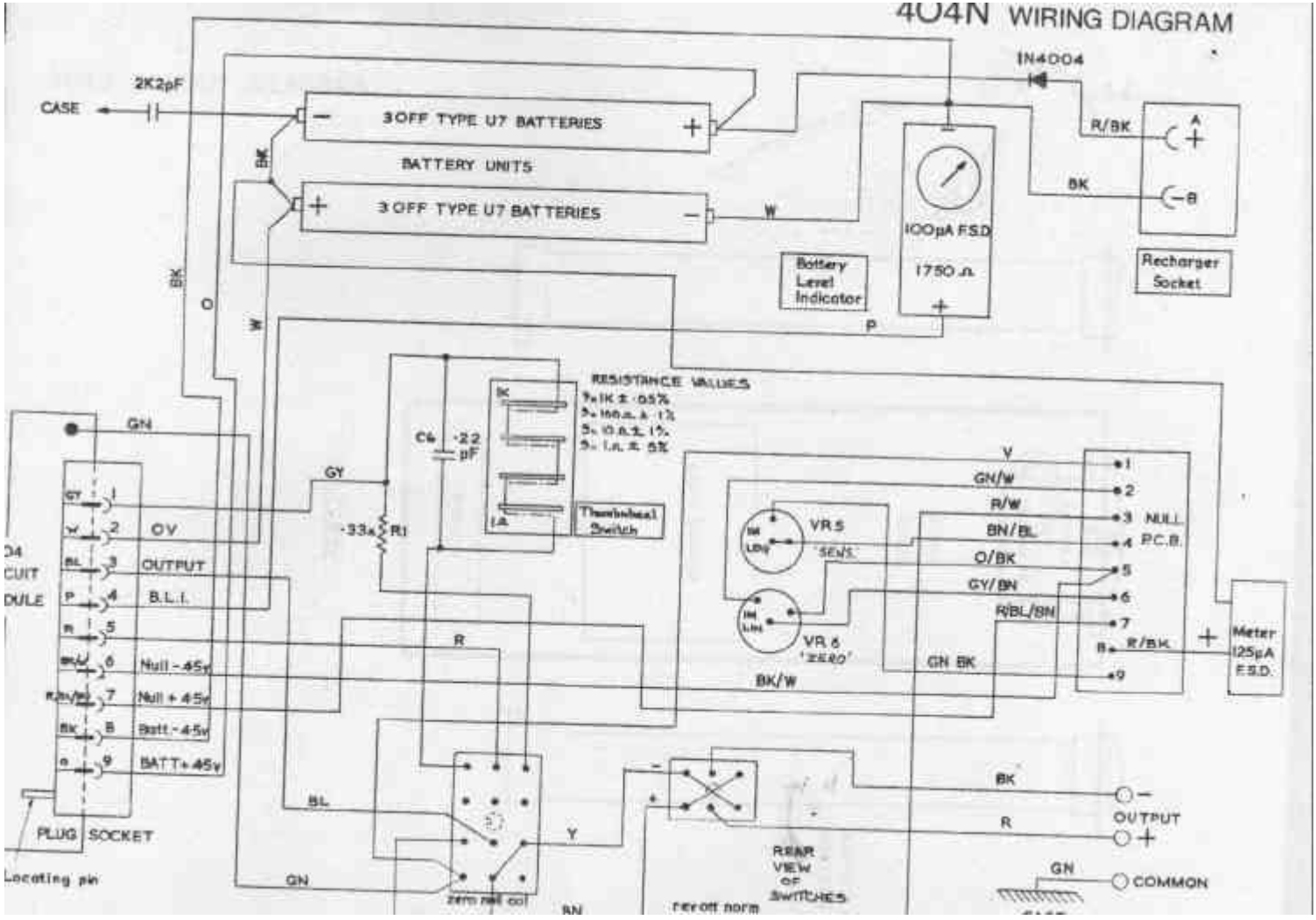
TIME ELECTRONICS LIMITED
Botany Industrial Estate,
Tonbridge, Kent. TN9 1RS
Tel: Tonbridge (0732) 355993

or their authorised agents.

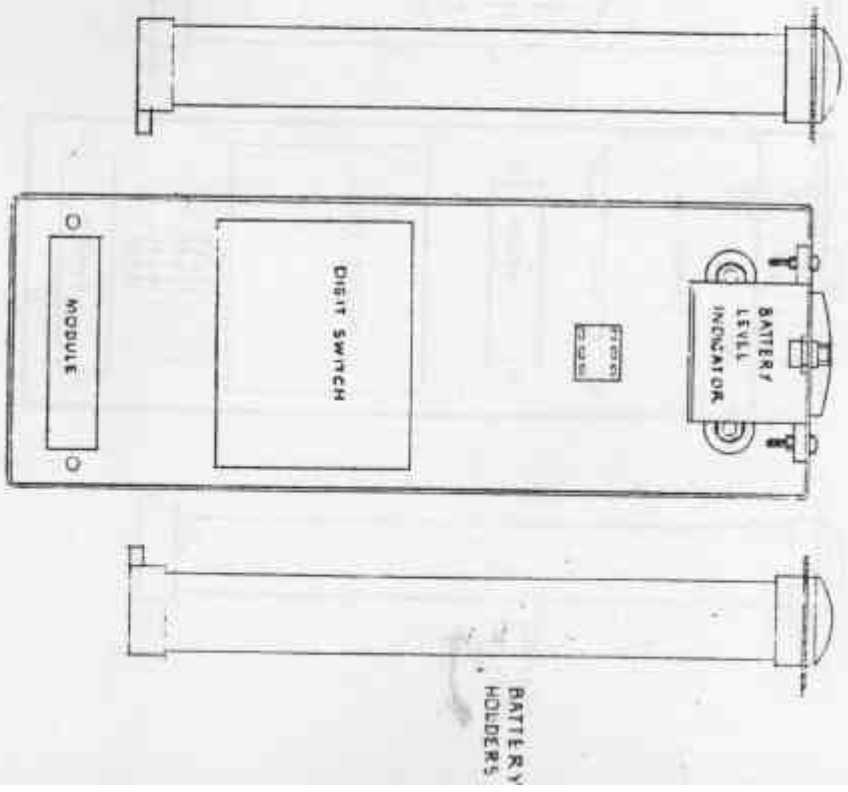


404S WIRING DIAGRAM

404N WIRING DIAGRAM



404S LAYOUT DIAGRAM.



404N LAYOUT DIAGRAM.