



**SG Labs**  
test & measurement instruments

**Solartron**  
INSTRUMENTATION GROUP

**Digital Multimeter 7045**

**Operating Manual**



SOLARTRON  
Schlumberger

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Your new 7045 from Solartron provides you with a whole new world of measurement technology. It employs the same circuit concepts as the 'big' Solartron voltmeters, backed by manufacturing and calibration facilities that are second to none. A special integrated circuit, designed by Solartron engineers, contains the pulse-width conversion system that is the heart of these products. Thus you can now use the sensitivity and precision of the most sophisticated voltmeters – here in 7045.

The push-button selectors on the front are identified with clear, concise captions. Measure what you will; voltage or current, dc or ac; resistance; even temperature. Automatic ranging and display is built in. But if you prefer to hold a range and change it manually, or to hold a reading and update on command, its all there, readily accessible at the touch of a few buttons.

A battery unit is supplied within 7045. Thus by fitting the optional rechargeable cells, battery operation is instantly available as an alternative to 230V (or 115V) ac mains.

## SAFETY.

Your 7045 has been carefully engineered with ease of use as one of the primary considerations. Attention has also been given to making the instrument immune to most inadvertent overloads and to ensuring operator safety. It should be appreciated, however, that even the most sophisticated measuring instrument can be dangerous when connected to high voltages, unless elementary safety precautions are observed.

VOLTAGE LIMITS ARE 1kV ON DC, 750V ON AC, this means that no damage will be caused to the instrument at these input levels. Other than the displayed reading, however, no indication is given to the user that a voltage of such a magnitude is present at the input terminals. Care should therefore be exercised whenever the multimeter input leads are being connected to/removed from live circuits, especially where high voltages are known to exist, or high transients could occur.

Similarly, when using the instrument on mains operated equipment capable of delivering high voltage outputs, it is strongly recommended that the equipment under test is NOT switched off with the multimeter still connected. For example, consider the 7045 connected across the secondary winding of a large mains transformer. The instrument's very high input resistance is such that, in the event of the mains supply being interrupted, the resultant back emf induced in the undamped secondary could be of the order of 100kV. This is obviously hazardous to the user and would certainly harm the multimeter.

## FEATURES.

- Automatic ranging:** with manual over-ride.
- Automatic display:** with manual hold/update
- Automatic warnings:**
  - Overload: flashing 1 - - - -
  - Invalid: flashing digits
  - Battery low\*: all decimal points

\* when battery is fitted.

## 2. MEASUREMENT RANGES.

The multimeter alone will measure the following:

- Voltage:** dc 1 $\mu$ V to 1000V  
ac 10 $\mu$ V to 750V
- Current:** dc 1nA to 1999.9mA  
ac 10nA to 1999mA
- Resistance:** 10m $\Omega$  to 19.999M $\Omega$
- Temperature:** ambient, -5°C to +40°C, without temperature probe.

Optional accessories permit the measurements to be extended:

- Temperature:** using the Temperature Probe;  
-20°C to +200°C
- DC Voltage:** using the HV Probe;  
1000V to 40kV
- AC Voltage:** using the RF Probe;  
100kHz to 750MHz (250mV to 30V)

### 3. PRELIMINARIES.

#### 3.1

Ensure that the mains supply plug is correctly connected. Figure 1 shows the correct coding.

The mains supply setting of the multimeter should correspond to the available mains supply -- carry out *either* the procedure on page 20 *or* move the mains selector switch (if fitted). Fig. 2 refers.

Note 1. Multimeters from Ser. No. 001101 onward are fitted with the selector switch, positioned where shown, in broken outline, in Fig. 2.

2. The mains supply adjustment given on page 20 should be carried out only by a competent engineer.

#### 3.2 FUSES

The following fuses are fitted: (Fig. 3 refers)

mains: 100mA sl-blo  
current measurement circuit: 2A

#### 3.3 BATTERIES

The battery unit is fitted as standard. If battery operation is required the four optional cells must be installed as described on page 23, and the cells must then be charged.

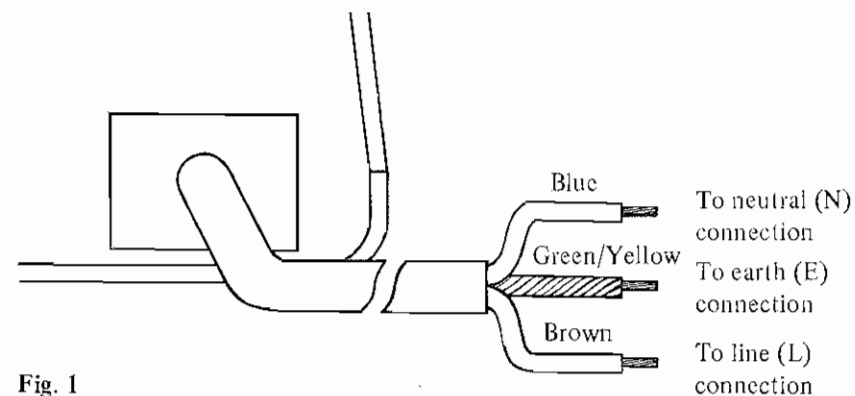


Fig. 1

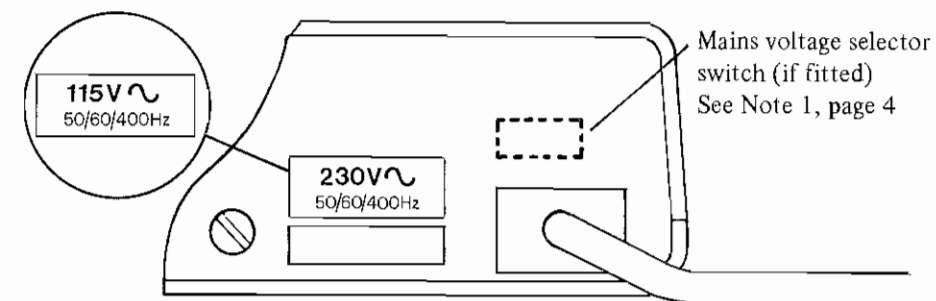


Fig. 2

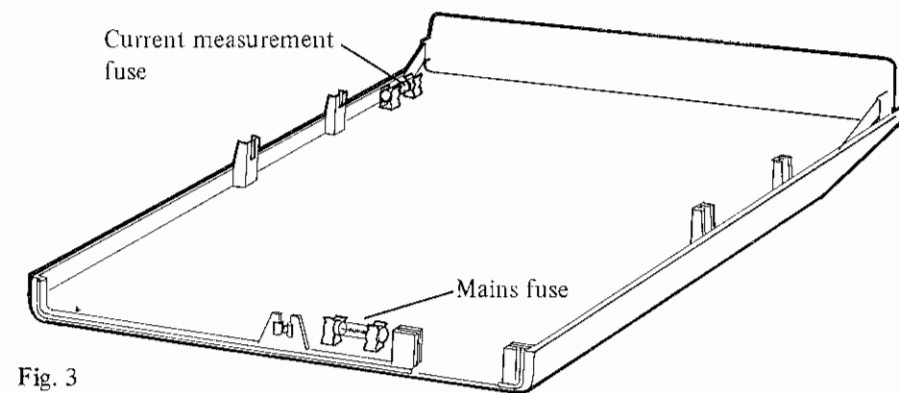


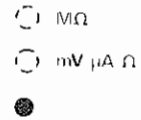
Fig. 3

## 4. FUNCTIONS OF CONTROLS.

**POWER** To switch instrument on

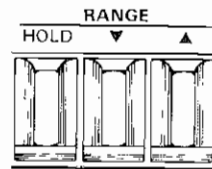


When battery fitted and mains connected:  
 POWER 'on' gives trickle charge  
 POWER 'off' gives fast charge\*



### RANGE

Normally instrument auto-ranges



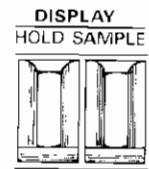
to maintain a range

to range down (more sensitive)

to range up (less sensitive)

### DISPLAY

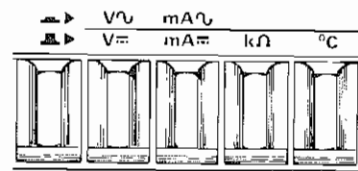
Normally updates automatically



to freeze the display

to update the display

### MEASUREMENT



select ac  
 (release for dc, kΩ, °C)

select quantity

\* Does not disconnect mains from internal circuits.

**MANUAL RANGING** To obtain the range required, operate the range selectors (▼ or ▲) to position the decimal point as shown in the relevant table and observe the annunciator indication.

	Range	Position of Point	Annunciator
Voltage	20mV	12.345	● mV μA Ω
	200mV	123.45	● mV μA Ω
	2V	1.2345	
	20V	12.345	
	200V	123.45	
	2000V*	1234.5	
Direct Current	20μA	12.345	● mV μA Ω
	200μA	123.45	● mV μA Ω
	2mA	1.2345	
	20mA	12.345	
	200mA	123.45	
Alternating Current	20μA	12.34	● mV μA Ω
	200μA	123.4	● mV μA Ω
	2μA	1.234	
	20mA	12.34	
	200mA	123.4	
Resistance	200Ω	123.45	● mV μA Ω
	2kΩ	1.2345	
	20kΩ	12.345	
	200kΩ	123.45	
	2MΩ	1.2345	● MΩ
	20MΩ	12.345	● MΩ

\* Max input 1000V on dc, 750V on ac.

## 5. OPERATING NOTES.

- 5.1 MΩ/mV μA Ω ANNUNCIATORS** These two annunciators indicate the value of units shown on the display, e.g. with kΩ selected and the MΩ annunciator lit, the displayed reading is in megohms.
- 5.2 MICROVOLT ADJUSTMENT** Although the instrument may be zeroed initially by using the μV adjuster in the front panel, after some 15 minutes warm-up the zero should be stable. This control can then be used to offset small spurious emfs that may occur in the circuit being measured.
- 5.3 TEMPERATURE MEASUREMENT** With no probe connected to the °C socket, the multimeter will measure ambient temperature once the appropriate switches have been selected.

To measure temperature using the optional Temperature Probe refer to page 9.

### 5.4 WARNING INDICATIONS

**Overload** A flashing 1 — — — display signifies that the input is too large for the selected range.

If the **Display Hold** facility is used and the input subsequently changes to a value beyond the selected range, the displayed reading will flash.

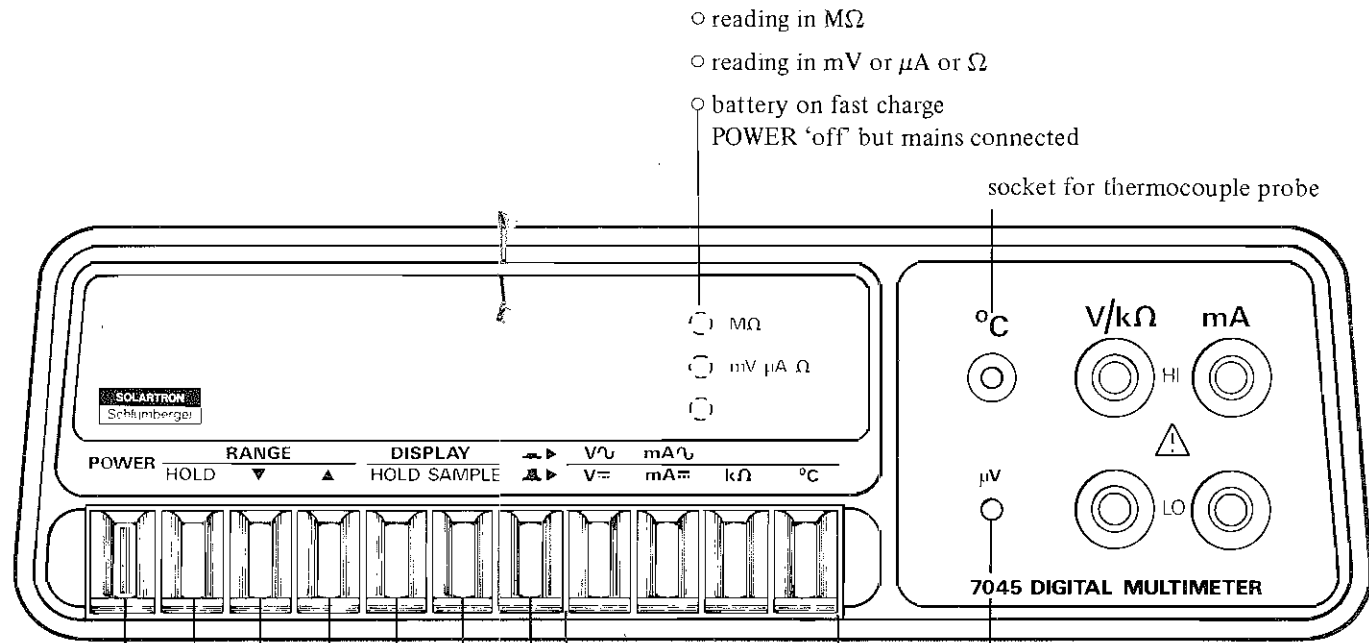
**Invalid** A flashing (random) display signifies that either kΩ or °C has been selected with the ac selector incorrectly set to ac functions.

**Battery Low** Indicated by the illumination of all the decimal points in addition to the displayed reading. This occurs only when the cells have been fitted.

## 6. TEMPERATURE PROBE.

This optional accessory enables the temperature of surfaces, fluids etc. to be monitored and read on the multimeter in °C. The necessary compensation for the temperature of the reference ('cold') junction is built in 7045 and is appropriate to Chromel/Alumel (type K) thermocouples.

The fully assembled thermocouple probe plugs into the °C socket on the front of the multimeter. With the probe tip pressed against a surface, or placed in the environment whose temperature is required, and °C selected, the multimeter reads °C. When assessing the temperature of small items the thermal mass of the probe may mean that a few moments are required to attain a stable result.



**POWER** with mains or battery:  
Switches instrument 'on'  
See also Battery Charging page 23

**RANGE** normally auto-ranging  
**HOLD:** existing range is held  
▼ : moves to more sensitive range  
▲ : moves to less sensitive range

**DISPLAY** normally automatic  
**HOLD:** existing reading is held  
**SAMPLE:** updates when in Hold

**QUANTITY SELECTORS**

**AC SWITCH**  
(in): ac V or mA  
(out): dc V, mA,  $k\Omega$  or  $^{\circ}C$

FIG.



## 7. HIGH VOLTAGE PROBE.

The H.V. Probe effectively increases the dc voltage range of the 7045 to a maximum of 40kV.

The displayed reading should be multiplied by 1000 to obtain the true reading.

### 7.1 Safety Precautions

When using the H.V. Probe, the following safety precautions should be observed:

1. Know the equipment under test; locate all high voltage points before commencing work.
2. Do not work alone.
3. Do not depend on the insulation of high voltage cables for protection.
4. Remember that high voltage may appear at unexpected points in defective equipment. Furthermore, bleeder resistors may be open and capacitors may retain high voltages even though power is off.
5. High voltages can discharge from point to point or from point to air (corona). Keep hand closed on handle of probe and away from all high voltage points.
6. Keep hands, shoes, and test areas absolutely dry.
7. Ensure that the surface of the probe is clean and moisture free.
8. BEFORE MAKING ANY MEASUREMENTS, ENSURE THAT THE GROUND LEAD OF THE PROBE IS CONNECTED TO THE LOW POTENTIAL OR GROUND SIDE OF THE HIGH VOLTAGE SUPPLY BEING MEASURED.

### 7.2 USING THE H.V. PROBE

- a. Fit Cone, or Hook adaptor, to probe end as appropriate.
- b. Connect the two test leads to V/k $\Omega$  Hi and Lo input terminals.
- c. Set multimeter switches for dc voltage measurement/auto-range.
- d. Connect probe ground lead (see 8 above).
- e. Connect probe to point being measured.

## 8. RADIO FREQUENCY PROBE.

The R.F. Probe permits voltage measurement within the range 100kHz to 750MHz at levels between 250mV and 30V.

The probe provides a rectified (dc) input to the multimeter proportional to the peak value of the ac signal, but is rms calibrated.

### 8.1 USING THE R.F. PROBE

- a. Connect appropriate adaptor to probe end.
- b. Insert 4mm dual plug into multimeter V/k $\Omega$  Hi and Lo input sockets observing the correct polarity. ("Hi" has the Red insert)
- c. Set multimeter selector switches to measure dc voltage.
- d. Connect the free lead to signal Lo or to chassis earth.
- e. Place tip of Probe on point being measured.

## 9. SPECIFICATION.

Voltage measurement Calibration temp 20°C

### Direct voltage

Range	Sensitivity	Limits of Error				Temp Coeff/°C ± [% rdg + digits]	
		24 hrs ± 1°C ± [% rdg + digits]		1 year ± 5°C ± [% rdg + digits]			
19.999mV	1μV	0.02	4	0.03	6	0.0025	2
199.99mV	10μV	0.01	1	0.02	2	0.0025	0.2
1.9999V	100μV	0.01	1	0.02	1	0.0025	—
19.999V	1mV	0.02	1	0.03	1	0.003	0.2
199.99V	10mV	0.02	1	0.03	1	0.003	—
1000V	100mV	0.02	1	0.03	1	0.003	--

**Input Resistance:** 10.1MΩ ±0.2%

**Settling Time:** 0.5s to stated Limits of Error.

**Temp Coeff:** applies beyond the zones given under Limits of Error.

**Overload Immunity:**

**In autorange:** dc + ac peak: 1000V (max ac 400V rms)

**20mV, 200mV, 2V ranges:** continuous dc + ac rms: 400V

**20V, 200V, 1kV ranges:** continuous dc + ac peak: 1000V

### Alternating voltage

Mean sensing, rms calibrated.  
Specification for 1 year ±5°C

Range	Sensitivity	Limits of Error				Temp Coeff/°C ± % rdg at 1kHz		
		40Hz to 20kHz ± [% rdg + digits]		20Hz to 50kHz ± [% rdg + digits]				
199.99mV	10μV	0.15	10	0.5	30	2.0	50	0.01
1.9999V	100μV	0.15	10	0.5	30	2.0	50	0.01
19.999V	1mV	0.2	10	1.0	30	4.0	50	0.015
199.99V	10mV	0.2	10	1.0	30	4.0	50	0.015
750V	100mV	0.2	10	not specified				0.015

**Input Impedance:** 1MΩ//<100pF

**Settling Time:** <2s to stated Limits of Error

**Temp Coeff:** applies outside the zone ±5°C

**High Freq:** useful measurements may be made up to 500kHz on the 200mV and 2V ranges, with errors typically <1dB

**Overload immunity:**

**In autorange:** 10<sup>6</sup> VHz (limit 1kV pk or 750V rms)

**200mV, 2V ranges:** 2 x 10<sup>5</sup> VHz (limit 300V rms)

**20V, 200V, 1kV ranges:** 10<sup>7</sup> VHz (limit 1kV pk or 750V rms)

**Maximum dc input:** 400V

**Limits of Error:** apply for inputs >1% f.s.

Current measurement Calibration temp 20°C

### Direct current

Specification for 1 year ±5°C

Range	Sensitivity	Measuring Resistance	Burden at fs	Limits of Error ± [% rdg + digits]	Temp Coeff/°C ± [% rdg + digits]		
19.999μA	1nA	1kΩ	< 20mV	0.2	8	0.005	2
199.99μA	10nA	1kΩ	<200mV	0.2	4	0.005	0.2
1.9999mA	100nA	10Ω	< 22mV	0.2	8	0.005	2
19.999mA	1μA	10Ω	<220mV	0.2	4	0.005	0.2
199.99mA	10μA	0.1Ω	< 50mV	0.4	8	0.005	2
1999.9mA	100μA	0.1Ω	<600mV	0.4	4	0.005	0.2

**Settling Time:** 0.5s to stated Limits of Error.

**Max. Burden:** approx 1.2V on overload.

**Max. Input:** 2A from <250V source, fuse protected.

**Temp Coeff:** applies outside the zone ±5°C

### Alternating current

40Hz to 10kHz. Specification for 1 year ±5°C

Range	Sensitivity	Measuring Resistance	Burden at fs	Limits of Error ± [% rdg + digits]	Temp Coeff/°C ± [% rdg + digits]		
19.99μA	10nA	1kΩ	< 20mV	0.3	10	0.01	0.1
199.9μA	100nA	1kΩ	<200mV	0.3	1	0.01	0.1
1.999mA	1μA	10Ω	< 22mV	0.3	10	0.01	0.1
19.99mA	10μA	10Ω	<220mV	0.3	1	0.01	0.1
199.9mA	100μA	0.1Ω	< 50mV	0.5	10	0.01	0.1
1999mA	1mA	0.1Ω	<600mV	0.5	1	0.01	0.1

**Settling Time:** <2s to stated Limits of Error

**Max. Burden:** approx 1.2V pk on overload

**Temp Coeff:** applies outside the zone ±5°C

**Limits of Error:** apply for inputs >1% f.s.

## Resistance measurement Calibration temp 20°C

Range	Sensitivity	Current through R	Limits of Error			Temp Coeff/°C ±[% rdg + digits]		
			24 hrs ± 1°C ±[% rdg + digits]	1 year ± 5°C ±[% rdg + digits]				
199.99Ω	10mΩ	100μA	0.02	10	0.04	10	0.0075	2
1.9999kΩ	100mΩ	100μA	0.02	4	0.04	4	0.0075	0.2
19.999kΩ	1Ω	100μA	0.02	2	0.04	2	0.0075	—
199.99kΩ	10Ω	1μA	0.02	2	0.04	2	0.0075	0.2
1.9999MΩ	100Ω	1μA	0.03	2	0.05	2	0.0075	—
19.999MΩ	1kΩ	0.1μA	0.1	2	0.2	2	0.01	—

Max allowable input: 350V peak

Max dissipation in unknown: <1mW

Max voltage across unknown: 6V

Max open circuit voltage: 6V

## Temperature measurement

Resolution: 0.1°C

Ambient: without the optional thermocouple probe the multimeter will show ambient temperature.

Limits of Error: ±1°C over -5 to +40°C

Thermocouple: using the optional thermocouple probe the multimeter will compensate for the 'cold' junction and display probe temperature.

Limits of Error: ±2°C over -20 to +200°C

## Interference rejection

### SERIES MODE

At 50Hz ±0.1% and each 10Hz above: >70dB

### EFFECTIVE COMMON MODE

With 1kΩ imbalance in the Lo lead

#### DC measurement:

Rejection of dc >120dB

Rejection of 50Hz ±0.1% and each 10Hz above >120dB

#### AC measurement:

Rejection of dc >120dB

Rejection of 50Hz ±0.1% and each 10Hz above >70dB

Max permissible common mode: dc + ac peak 1000V

Isolation of input to earth: >10GΩ//<300pF

## 10. GENERAL DATA.

### A-to-D conversion:

Pulse-width, with calibration balance

Integration time: 100ms

Reading rate: nominal 4/s

### Display: /-bar LED

Over-range: flashing digits

Battery Low: all decimal points

### Temperature:

Operating, to specification 0 to +50°C

Operating, without damage -5 to +50°C

Storage, without batteries -20 to +70°C

Storage, with batteries -20 to +50°C

### Humidity: 80% RH at 40°C

### Dimensions:

width 200mm

height 70mm

depth 260mm

### Weight:

without batteries 1.45kg

with batteries 2.1kg

### Power Supply:

AC mains: 115V/230V +10% -10%

50/60/400Hz 6VA

Batteries (Optional) 4 - type D cells

Operating time: >6 h

Recharge time: <15 h

## 11. ACCESSORIES.

### 11.1 ACCESSORIES SUPPLIED WITH 7045

Mains lead	480140220
Input lead-probe Red	359900190
Input lead-probe Black	359900180
Crocodile clip 2 off	355901030
Current measurement fuse, 2A	360106150
Mains fuse, 100mA	360106260
Operating Manual	70450010

### 11.2 OPTIONAL ACCESSORIES

The following optional accessories are available to enhance the range of use of the 7045 multimeter.

#### RADIO FREQUENCY PROBE (70457F)

Peak-sensing, the probe provides dc voltage to the multimeter, which displays the rms value. Complete with fittings and adaptors.

**Limits of Error:** 100kHz to 500MHz (1V rms sine wave)  $\pm 1$ dB  
100kHz to 750MHz (1V rms sine wave)  $\pm 3$ dB

**Voltage Range:** 250mV to 30V

**DC Isolation:** 200V

**Working Temperature:** 0 to +50°C

**Lead Length:** 1m

#### HIGH VOLTAGE PROBE (70457E)

Extends measurement of dc voltage to 40kV Complete with fittings and adaptors.

**Voltage Range:** 1kV to 40kV

**Division Ratio:** at 20kV, 20°C (1000: 1)  $\pm 0.5\%$

**Limits of Error:** 1kV to 40kV, 23°C  $\pm 3\%$

**Temp Coeff:**  $< 200$  ppm/°C

**Working Temperature:** 0 to +50°C

**Lead Length:** 1.8m

#### TEMPERATURE PROBE (70457)

This consists of a thermocouple probe connected to an input plug. Used with 7045 multimeter the reading is directly in °C.

**Thermocouple:** NiCr/NiAl Type K  
**Temperature Range:** -20 to 200°C  
**Limits of Error:** 1 year  $\pm 2$ °C

#### BATTERY (800400180 4 off required)

Ni-Cd rechargeable cells. The battery unit is built into the basic multimeter, but the cells to fit it are supplied separately.

#### CARRYING CASE (70459)

Semi-waterproof, simulated leather with shoulder strap. Lid contains pocket for storage of leads. Multimeter may be operated from mains or batteries while in the case, thus providing "hands-off" operation.

## 12. MAINS SUPPLY ADJUSTMENT.

Applicable only where mains selector switch is not fitted. (see page 4).

To remove the case (Figure 5):

- Switch off mains supply and disconnect mains plug from multimeter.
- Remove the single retaining screw on rear panel (see Note) and remove panel.
- Remove the two bottom securing screws and lift off top cover.

**Note.** Later multimeter types have an additional screw in each top corner of the rear panel; these should be *loosened* before the rear panel can be removed.

Carry out the adjustments as follows:

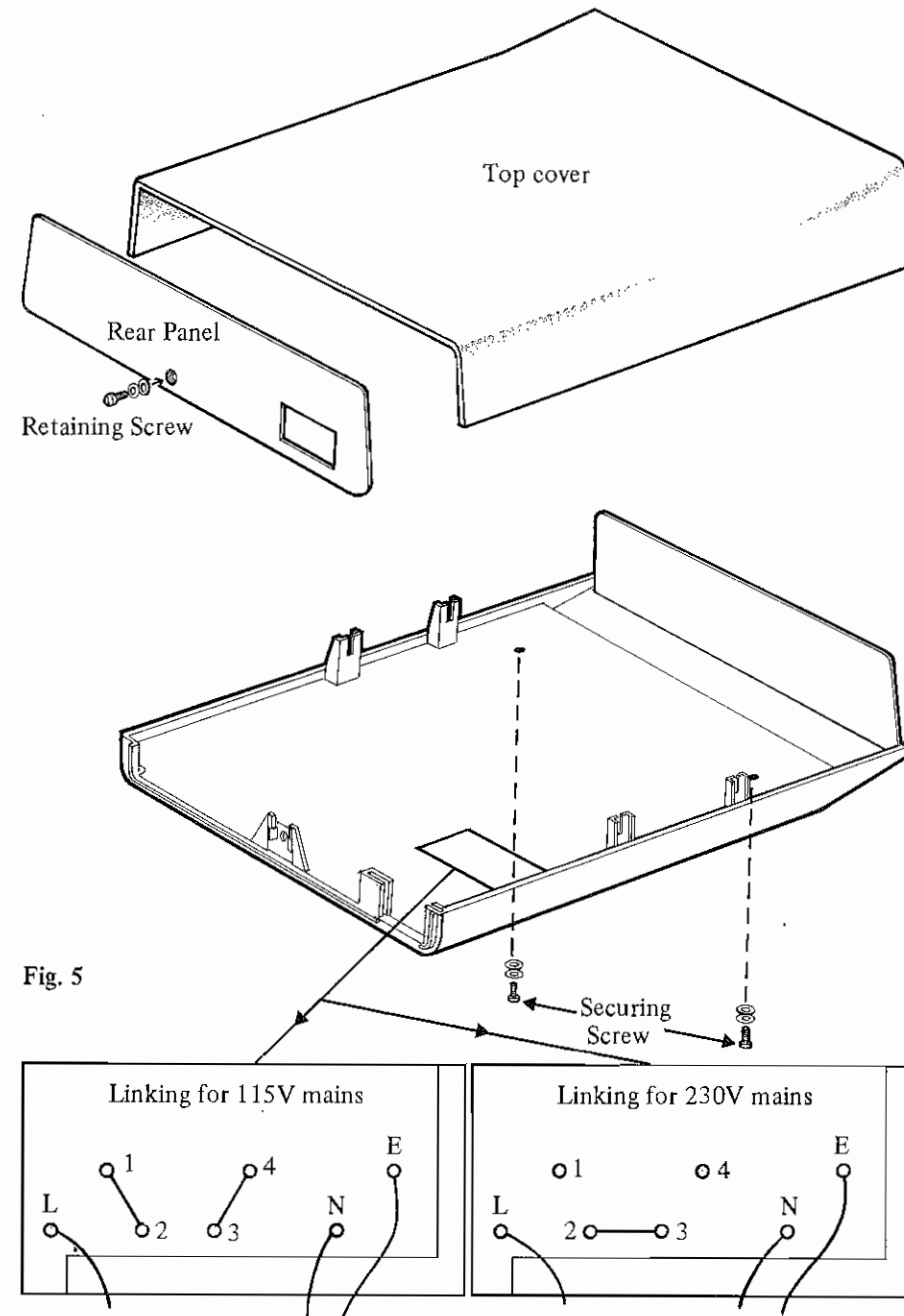
- Examine the terminal board linking. This should be:

For 115V supply: link between terminal posts 1 and 2 also 3 and 4.

For 230V supply: link between terminal posts 2 and 3.

If the links are incorrectly set for the available mains supply:

- Unsolder the links and re-solder in correct position.
- Fit the correct size of fuse;  
100mA for 230V mains operation.  
200mA for 115V mains operation.
- Replace top cover and rear panel.
- Ensure rear panel indicates correct voltage setting; use adhesive label (supplied) if necessary.



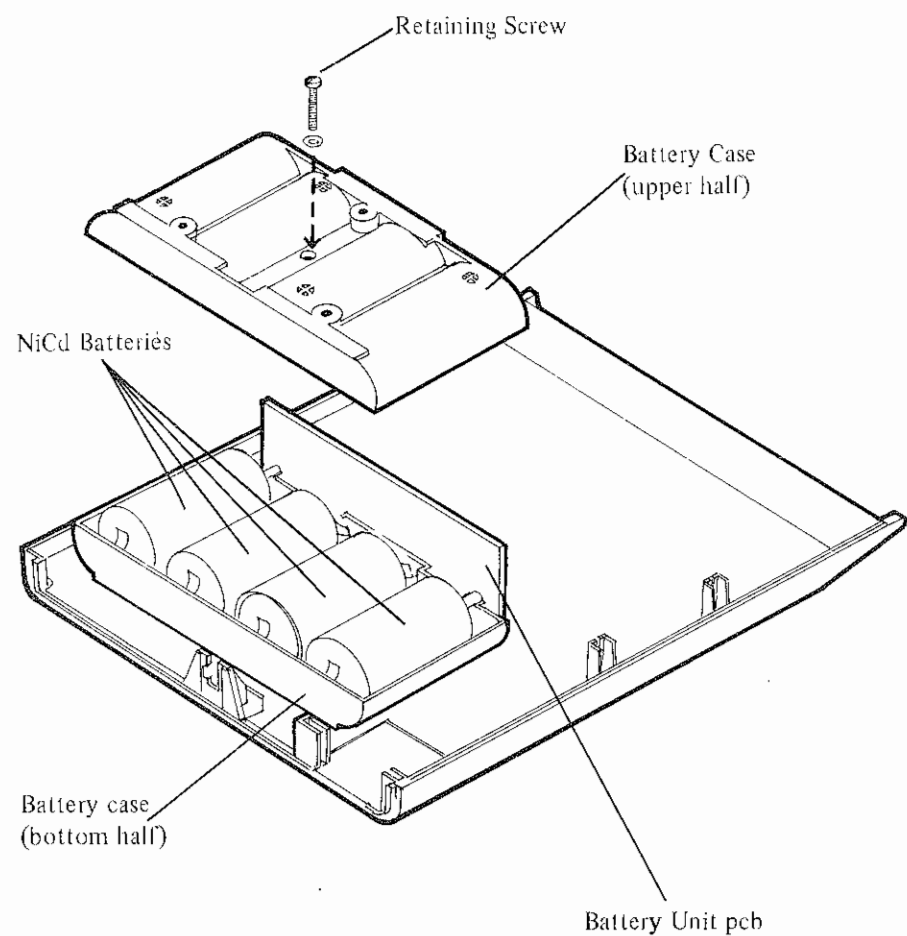


Fig. 6

## 13. BATTERY UNIT.

The 7045 multimeter is supplied with a fitted Battery Unit (less batteries). Four nickel cadmium batteries are available as optional extras should battery operation be required. Since these are supplied in a discharged condition, in situ charging of the batteries is necessary before use.

**WARNING** Only sealed nickel cadmium batteries should be used in the battery unit. Any attempt to charge ordinary primary cells could result in leakage of corrosive compounds and possible explosion.

### FITTING THE BATTERIES (see Figure 6)

To fit the batteries; first remove multimeter rear panel and top cover (page 20). Lift off upper half of battery case after removing the single retaining screw. Observing the correct polarity, insert the batteries.

### CHARGING THE BATTERIES

The batteries can be charged in situ in one of two ways;

- a. With mains supply connected and power switch OFF, batteries receive fast charge. (Charging Annunicator illuminated).
- b. With multimeter in normal (mains operated) use, batteries receive a trickle charge. (Battery Annunicator remains OFF).

From a discharged condition the batteries require approximately 14 hours (i.e. over-night) on fast charge to become fully charged. Prolonged over-charging at the fast rate is to be avoided.

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TEL FARNBOROUGH 44433 (STD 0252)  
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TELEX 854245 SOLARTRON FARNBOROUGH