sinclair

DIGITAL MULTIMETERS DM350 and DM450

INSTRUCTION MANUAL

INDEX

INTRODUCTION

The Sinclair DM350 and DM450 are laboratory quality, digital multimeters differing only in their accuracy and resolution (scale length).

Both instruments are battery-operated and housed in a robust, slim-style case, making them suitable for portable applications as well as bench work. The large LED display has an exceptionally wide viewing angle and has a variable brightness control.

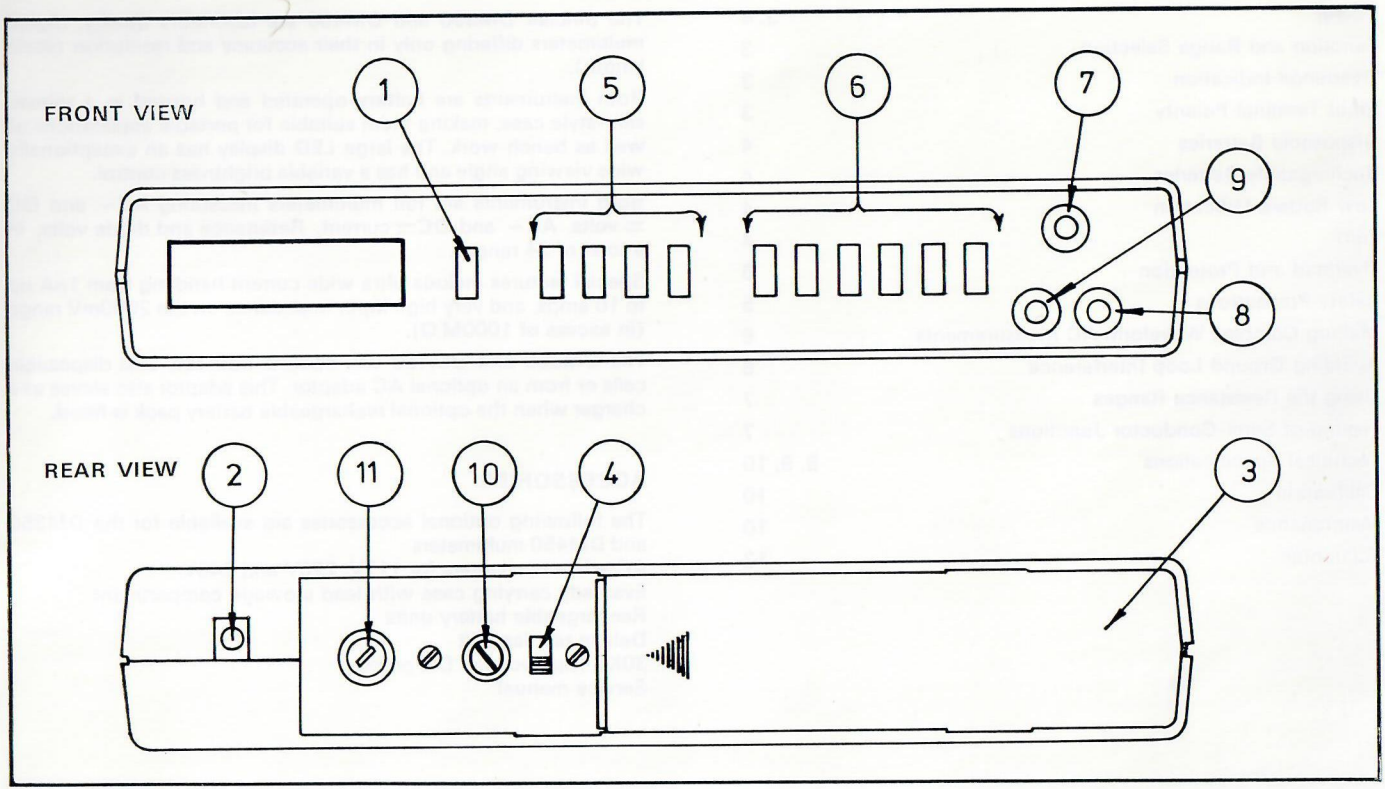
Both instruments are full multimeters measuring AC~ and DC ⎓ volts, AC~ and DC⎓ current, Resistance and diode volts, in a total of 34 ranges.

Special features include ultra wide current handling from 1nA up to 10 amps, and very high input impedance on the 2000mV range (in excess of 1000M Ω).

The DM350 and DM450 will operate from low cost disposable cells or from an optional AC adaptor. This adaptor also serves as a charger when the optional rechargeable battery pack is fitted.

ACCESSORIES

The following optional accessories are available for the DM350 and DM450 multimeters:
AC adaptor/chargers for 117V, 220V and 240V
Eveready carrying case with lead stowage compartment
Rechargeable battery units
Deluxe test lead kit
30KV High voltage DC probe
Service manual


FRONT VIEW
1
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9
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REAR VIEW
2
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3

OPERATION

Power

The instrument is switched on by depressing the power on-off button (1). If operation from AC line power is required, an approved AC adaptor (see Note 1 on page 4) may be plugged into the power jack at the rear of the instrument (2). Connecting the AC adaptor automatically increases the display brightness to maximum.

The instrument may be operated from disposable cells (see Note 2 on page 4) or from the optional rechargeable battery pack. Batteries should be fitted into the holder housed under the slide-off cover (3), care being taken to observe polarity. It is essential that the disposable/rechargeable selector switch (4) is positioned correctly before connecting the AC adaptor/charger.

Function and Range Selection

The Function and Range are selected by the push-buttons (5) and (6).

DC ⎓ volts: 6 ranges are available covering voltages up to 1200 volts. The input is applied between terminals (8) and (7). The 2000mV ultra high impedance range is selected by simultaneous depression of the V and mA buttons and a release of all the range buttons (half depression allows release). DM450 will read in $\frac{mV}{10}$

AC ~ volts: 5 ranges are available for inputs up to 750 volts rms connected to terminals (8) and (7). The instrument senses the mean value of the input signal and is calibrated to read the rms value of a sine wave. A DC level on the AC signal will not affect the accuracy of the AC reading provided that DC level plus AC rms level does not exceed the maximum reading of the range. DM450 displays only $3\frac{1}{2}$ digits on 200mV.

DC ⎓ Current: 8 ranges are available for inputs up to 10A continuous (20A intermittent). Connect to terminals (8) and (7) except 10A which is to (9) and (7). 20 μA and 2 μA ranges are available by depressing V and mA function buttons simultaneously — this gives a μA/10 function which can be used with the 200 or 20 range buttons.

AC ~ Current: As for DC current. Sensing information as for AC volts. DM450 displays only $3\frac{1}{2}$ digits.

Resistance: 6 ranges are available for resistances up to 20M Ω. Connect between terminals (8) and (7).

Diode Test: Select 2K Ω. Connect diode across terminals (8) and (7) with anode to common (7). Forward voltage drop is displayed in volts.

Overrange Indication

DM350: When a reading of 1999 is exceeded, overrange is indicated by blanking of all but the most significant digit which is displayed as a 1 with a negative sign if appropriate.

DM450: When a reading of 19999 is exceeded, overrange is indicated by a reading of ±0000 and flashing of the whole display.

When overrange indication occurs, the next highest range should be selected.

Input Terminal Polarity

The negative (common) terminal (7) is the low potential terminal with respect to ground. If the positive terminal is taken negative with respect to the common terminal, a negative sign will be automatically displayed. When measuring AC ~ signals, or DC ⎓ signals with AC ~ superimposed on them, the common terminal should be connected to the ground side of the signal being measured regardless of the actual polarity.

Power

Note 1 For safety reasons, only an approved adaptor may be used; use of any other will void the guarantee. In some countries, the correct Sinclair adaptor may not be available in which case, the dealer will supply an alternative approved unit.

Note 2 For disposable cell operation, 4 off C size cells should be used. If possible, high power or Alkaline batteries should be used. A list of suitable types is given below — ask your dealer if in doubt. To obtain long battery life, the display brightness control (10) should be set to the minimum acceptable level and the meter switched off whenever measurements are not being made.

In the 'disposable' position, inserting the power jack will automatically disconnect the internal batteries. In the 'rechargeable' position, inserting the power jack will cause the internal batteries to be charged. This charging will take place at constant rate whether the instrument is switched 'on' or 'off'.

Disposable Batteries

Suitable cells for use in the DM350 and DM450 are as follows:

Size Classification:	ASA C	IEC R14	Japan AM2
Normal Types:	SP11, 835, 120, VS735, 114, 110LP, 214, U11MJ		
High Power Types:	HP11, 935, 814, VSO35A, M14-F, 111, IC, Z7		
Alkaline Types:	Mn 1400, E93, AL-1, VS1335		

Rechargeable Batteries

Special Sinclair rechargeable units are available. Full instructions for use are provided in the pack.

Low Battery Indication

Indication of failing batteries is provided by flashing of the display. This occurs when the voltage falls below 4.4 volts, and gives some time to continue making measurements before reading errors will occur.

Rechargeable batteries should not be allowed to fully discharge. Weak or dead disposable cells should never be left in the instrument since they may leak damaging chemicals.

Zero

Both instruments have automatic adjustment of zero. Zero offset can, however, occur as follows:

DC: Leakage currents of up to ±200pA can cause offsets on the 200mV and 2V ranges which will disappear when a low impedance source is connected. On the DM450 a zero reading of up to ± 0.02% of range may appear on 200mV, 20V, and all DC current ranges. This is allowed for in the specification but can be subtracted from the reading to obtain a more accurate result.
On 2000mV ultra high impedance, a zero will not be obtained until the input is connected to an external impedance.

AC: Zero reading should be disregarded until a source is connected. Zero reading of up to ±0.1% of range may occur on the 20 volt and 200mV ranges. This should not be subtracted from the reading.

Resistance: On the 200 Ω range, shorting out the leads will produce a non zero reading, which should be subtracted from the measurement reading.

Overload and Protection

All ranges with the exception of the 2000 range on AC and DC volts and the 20A range on AC and DC current, can be used up to the full scale display reading.

Voltage ranges have inherent protection. Resistance ranges have high voltage electronic protection. Current ranges are protected by a fuse mounted at the rear (11). This fuse should be a 2A fast blow ceramic or plastic body fuse — use of a slow-blow type will void the guarantee.

No protection is incorporated on the 10A range. This range can be used up to 20A for periods not exceeding 10 seconds.
The meter is fully protected against damage from accidental connection of high voltages such as AC line across sockets (7) and (8). The following rules should however be observed.

(a) Never connect an input of greater than the maximum permissable overload for the range.

(b) Always select the correct function and range before connecting the input.

(c) Never connect the meter to a voltage source when the current function is selected.

(d) Take extra care when connecting to the 10A socket (9) since it is unprotected.

Note

The standard leads and prods supplied with the meter are not suitable for currents in excess of 5 amps.

Safety Precautions

The DM350 and DM450 have been designed to the highest safety standards but safe operation depends on the user, so we recommend the following rules.

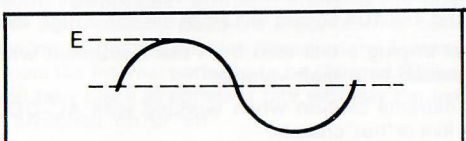
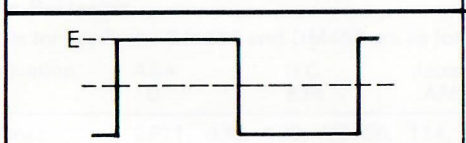
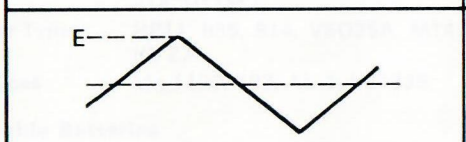
1. Never connect a voltage to the instrument which causes the common terminal to be raised more than 750 volts above ground.
2. Never use anything but an approved AC adaptor to power the instrument.
3. Use extreme caution when working with voltages above 50V. Always disconnect power from the circuit being tested whilst connecting or disconnecting test leads.
   If the common terminal is at a high voltage with respect to ground, the 10A socket will be at the same high voltage.
4. Never unplug a test lead from the instrument while it is still connected to a high voltage.
5. Use extreme caution when working with AC-DC equipment with live or 'hot' chassis.

Making Complex Waveform AC Measurements

The Sinclair DM350 and DM450 are calibrated to display the rms value of a sine wave whose average half-wave rectified value is actually measured. Thus, if the input waveform is not sinusoidal, the displayed value will not be the rms but will be in error by an amount dependent on the waveform shape. Although the rms value gives the heating power of the waveform, this is often less valuable to know than the peak waveform height. The table below shows how to obtain both from the reading displayed.

Avoiding Ground Loop Interference

If the AC adaptor/charger is connected, ground loop currents can be set up if the signal source ground is at a different potential than AC power ground. This effect will be greatly attenuated by the meter, but to avoid it completely, revert to battery operation. When making AC measurements, AC potential differences can also inject signals by capacitive coupling through the adaptor. Again revert to battery operation if this becomes a problem.

Wave-form	Displayed Value	True rms Value	Multiply Displayed Value by for rms	for peak
	sine	0.707E	0.707E	1.0	1.414
	square	1.11E	1.0E	0.9	0.9
	triangle	0.555E	0.547E	1.034	1.801

Using the Resistance Ranges

With the exception of the 200 Ω range, the resistance ranges are 'high power', ie they generate voltage across the resistor at –20mV per 1% of full scale reading. If the resistor is in place across a semiconductor junction, this junction could forward bias and cause an error if the reading is above 10% of range. To avoid this, either select the next range, or reverse the leads.
(On the 20M Ω range instability of reading may result from noise pick-up across the high impedance. To avoid this, use short leads, or twist leads together).

Testing of Semiconductor Junctions

The 2K Ω resistance range acts effectively as a 1 mA constant current source with the common socket as positive terminal. By connecting a semiconductor junction such that it is forward biased, the meter will read the approximate forward voltage drop in volts.

When the junction is connected in reversed bias mode, the current source will saturate to its maximum open circuit voltage, and the meter will read overrange. A further indication of the condition of the junction can be obtained by selecting higher resistance ranges until a reading is obtained. The appropriate low voltage reverse leakage current can then be determined by referring to the excitation current for the range quoted in the specification on page 9.

SPECIFICATION

(19°C—24°C)

r = of reading fs = of full scale

DC⎓ VOLTAGE

Range	DM450 Accuracy	DM450 Resolution	DM350 Accuracy	DM350 Resolution	Max. Permissable Overload	Input Impedance
200mV	0.05%r±0.02%fs	10μV	0.1%r ±0.1%fs	100μV	400Vpk	10MΩ
2000mV	0.05%r±0.01%fs	100μV	0.1%r ±0.05%fs	1mV	400Vpk	>1000MΩ
2V	0.05%r±0.01%fs	100μV	0.1%r ±0.05%fs	1mV	400Vpk	10MΩ
20V	0.1%r ±0.01%fs	1mV	0.25%r±0.05%fs	10mV	1200Vpk	10MΩ
200V	0.1%r ±0.01%fs	10mV	0.25%r±0.05%fs	100mV	1200Vpk	10MΩ
1200V	0.1%r ±0.01%fs	100mV	0.25%r±0.05%fs	1V	1200Vpk	10MΩ

AC~ VOLTAGE 50/60Hz

							Frequency Response within 1½% additional error
200mV	0.2%r ±0.1%fs	100μV	0.25%r±0.2%fs	100μV	250V rms	10MΩ	20Hz – 20kHz
2V	0.2%r ±0.02%fs	100μV	0.25%r±0.1%fs	1mV	250V rms	10MΩ	20Hz – 20kHz
20V	0.25%r±0.1%fs	1mV	0.4%r ±0.2%fs	10mV	750V rms	10MΩ	20Hz – 20kHz
200V	0.25%r±0.02%fs	10mV	0.4%r ±0.1%fs	100mV	750V rms	10MΩ	20Hz – 20kHz
750V	0.25%r±0.02%fs	100mV	0.4%r ±0.1%fs	1V	750V rms	10MΩ	20Hz – 500Hz 5 x 10^6VHz max.

DC⎓ CURRENT

						Max. Voltage Burden
2μA	0.15%r±0.1%fs	0.1nA	0.2%r±0.1%fs	1nA	2A	2V
20μA	0.15%r±0.02%fs	1nA	0.2%r±0.1%fs	10nA	2A	2V
200μA	0.15%r±0.02%fs	10nA	0.2%r±0.1%fs	100nA	2A	200mV
2mA	0.15%r±0.02%fs	100nA	0.2%r±0.1%fs	1μA	2A	200mV
20mA	0.5%r ±0.02%fs	1μA	0.5%r±0.1%fs	10μA	2A	200mV
200mA	0.5%r ±0.02%fs	10μA	0.5%r±0.1%fs	100μA	2A	200mV
2000mA	0.5%r ±0.02%fs	100μA	0.5%r±0.1%fs	1mA	2A	300mV
10A	2.0%r ±0.1%fs	1mA	2.0%r±0.1%fs	10mA	10A (20A 10 secs)	1V

AC~ CURRENT 50/60Hz

						Max. Voltage Burden	Frequency response within 1½% additional error
2μA	0.3%r ±0.2%fs	1nA	0.35%r±0.2%fs	1nA	2A	2V	20Hz – 10kHz
20μA	0.3%r ±0.15%fs	10nA	0.35%r±0.15%fs	10nA	2A	2V	20Hz – 10kHz
200μA	0.3%r ±0.15%fs	100nA	0.35%r±0.15%fs	100nA	2A	200mV	20Hz – 10kHz
2mA	0.3%r ±0.15%fs	1μA	0.35%r±0.15%fs	1μA	2A	200mV	20Hz – 10kHz
20mA	0.65%r±0.15%fs	10μA	0.65%r±0.15%fs	10μA	2A	200mV	20Hz – 10kHz
200mA	0.65%r±0.15%fs	100μA	0.65%r±0.15%fs	100μA	2A	200mV	20Hz – 10kHz
2000mA	0.65%r±0.15%fs	1mA	0.65%r±0.15%fs	1mA	2A	300mV	20Hz – 10kHz
10A	2.5%r ±0.15%fs	10mA	2.5%r ±0.15%fs	10mA	10A (20A 10 secs)	1V	20Hz – 1kHz

RESISTANCE

						Excitation Current Approx.	Max. o/c Voltage
200 Ω	0.1%r±0.1%fs	10m Ω	0.2%r±0.1%fs	100m Ω	400Vpk	1.5mA	4V
2K Ω	0.1%r±0.02%fs	100m Ω	0.2%r±0.05%fs	1 Ω	400Vpk	1mA	4V
20K Ω	0.1%r±0.02%fs	1 Ω	0.2%r±0.05%fs	10 Ω	400Vpk	100μA	4V
200K Ω	0.1%r±0.02%fs	10 Ω	0.2%r±0.05%fs	100 Ω	400Vpk	10μA	4V
2000K Ω	0.1%r±0.02%fs	100 Ω	0.2%r±0.05%fs	1K Ω	400Vpk	1μA	4V
20M Ω	1.0%r±0.1%fs	1K Ω	1.0%r±0.1%fs	10K Ω	400Vpk	0.1μA	4V
DIODE TEST					400Vpk	1mA	4V

Accuracy specification at calibration maintained typically for 6 months.

Specification Degradation for 1 Year

DM450:	DC Voltage	+0.05%
	AC Voltage	+0.15%
	DC and AC Current	+0.2%
	Resistance	+0.05%
DM350:	DC Voltage	+0.1%
	AC Voltage	+0.2%
	DC and AC Current	+0.25%
	Resistance	+0.1%

Typical Temperature Co-efficients
0°C — 19°C, 24°C — 40°C

DM450:	DC Ranges	0.01%/°C
	AC Ranges	0.04%/°C
	Resistance	0.01%/°C
DM350:	DC Ranges	0.02%/°C
	AC Ranges	0.05%/°C
	Resistance	0.02%/°C

Reading Rate: 3 per second

Display: 3½ or 4½ digit 0.3" (8mm) LEDs

Dimensions: 10" x 5.8" x 1.6" (255 x 148 x 40mm)

Weight: 1½ lbs (670g)

Sockets: Standard 4mm for resilient plugs, ¾" (19mm) spacing

Fuse: 20mm or 1"/1 ¼" 2A 250V fast blow ceramic or plastic body

Power: Four x 1½V disposable cells or Sinclair Rechargeable Battery Pack or approved AC adaptor

Calibration

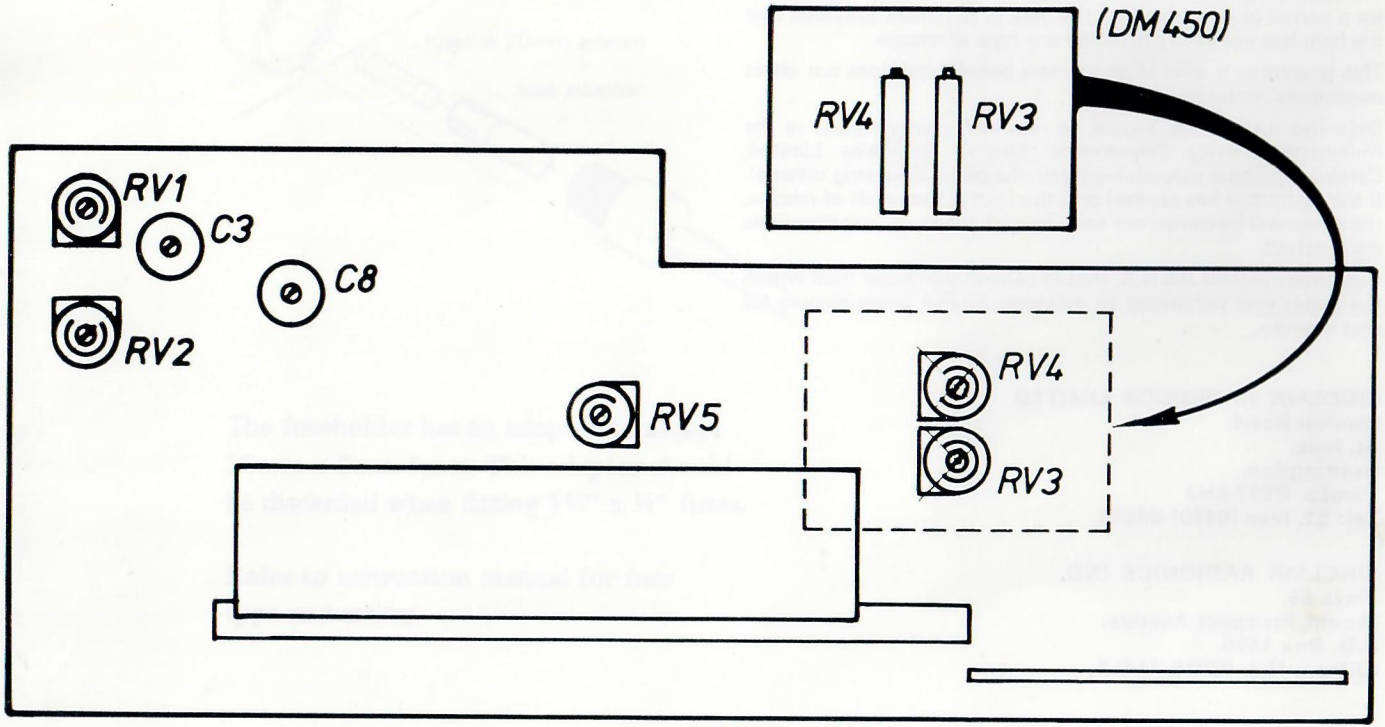
Calibration is guaranteed as in the technical specification. Sinclair Radionics provide a re-calibration service as do most of their agents overseas.
Where an owner wishes to carry out his own re-calibration, this may be done providing sources whose values are known to a sufficient accuracy are available. Invert the instrument, remove the rubber feet and remove the six recessed and one surface screw. Removing the case lower then gives access to the PCB. Proceed as follows:

Select	Approx. Input	Adjust
2V DC	+1.9V	RV4
200mV DC	+0.19V	RV3
20V DC	+19V	RV1 (if fitted)
2V AC	1V rms 50/60Hz	RV5
20V AC	10V rms 12KHz	C3
200V AC	100V rms 12KHz	C8
10A DC	7 amps	RV2

No other adjustments are provided, and if every range cannot be brought into calibration by adjusting these presets, no further attempts should be made.

Maintenance

Sinclair Radionics, or their agents overseas, will provide repair for any meter developing a fault. Where owners wish to undertake their own maintenance work, this should only be done in conjunction with the Service Manual which may be purchased directly from Sinclair Radionics or their agents overseas.


(DM450)
RV4
RV3
RV1
C3
C8
RV2
RV5
RV4
RV3

GUARANTEE

The Multimeter is guaranteed against defects arising in normal use for a period of one year from the date of purchase, provided that the fault has not been caused by any type of misuse.

This guarantee is offered as an extra benefit and does not affect consumers' statutory rights.

Defective instruments should be returned, carriage paid, to the Multimeter Service Department, Sinclair Radionics Limited. Careful packing is essential — retain the original packing material. If the guarantee has expired or if the fault is the result of misuse, the repair will be carried out and charged unless other instructions are received.

Customers outside the U.K. should contact the dealer from whom the meter was purchased to ascertain service arrangements for that country.

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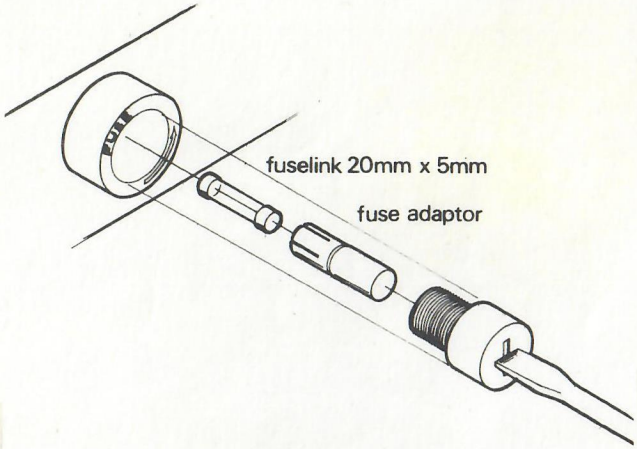
SINCLAIR RADIONICS INC.
Plaza 66,
Mount Prospect Avenue,
P.O. Box 1528,
Clifton, N.J. 07015, U.S.A.



The fuseholder has an adaptor to accept 20mm x 5mm fuses. This adaptor should be discarded when fitting 1¼" x ¼" fuses.

Refer to instruction manual for fuse type and rating.

INSTRUCTION SHEET PT. No.
48581-0140

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