1. Summary

British Physical Laboratories A.C./D.C. Breakdown & Insulation Tester, Model RM215-L, S.N. 14985. eBay April 2010.

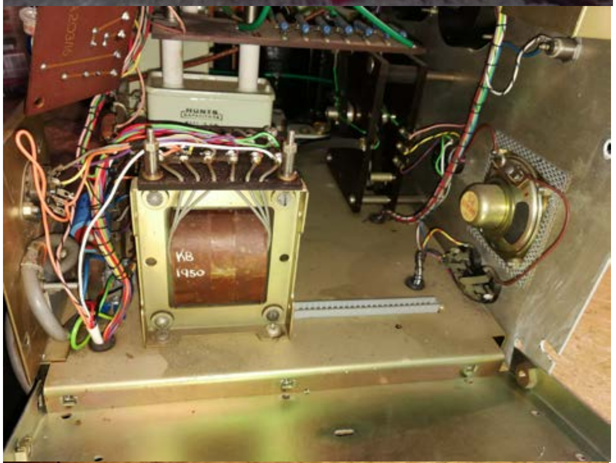
Transformer	KB2009; 6KV KB1950; 0,70,115,200,220,240V; HT; LT; 14V.
Capacitors	Hunts 7.5kV date codes: YI A, WH A and HI A (3rd, 12 and 23rd week, and 9 year) Hunts electro date codes: A YI, U WY, D YA (up to year 9) Static date code A4 Plessey electro: SEP60 Wima foil: date code A9 red overprint +5%
POTS	Colvern date code: 6937. Bercostat L75 2.4k 0.16A date code 6905
Resistors	R1 WW datecode: 6913
Meters	Type S30V, 100uA, Spec M419, 9486/A/7 Type S30V, 100uA, Spec M419, 9375/A/4
Diodes	SEI 46H33 (Salford Electrical Instruments - subsidiary of GEC) 1S107 top hat OAZ204 code 2PK OAZ206 code 1MM Lucas DD000 England 6904 OA200
Valve	EM84 Mullard V?? D6E4 (perhaps V32)
Amplifier	Newmarket Semiconductor PC5 + Mk VI 3W amp module (uses LIN circuit with 2 series germanium diodes for central biasing
BJT	Newmarket 453 N with datecode 6905 (NKT453 pnp germanium)
Speaker	RS 3Ω. ?95?

Original condition very good. Cap lead disconnected on removeable pcb, and 47R 2W discoloured but ok. Electrolytics. EM84 is not as sensitive as the EM87. Schematic incorrectly shows triode grid 1 associated with display anode and deflection grid, rather than its anode pin 9. Mains primary side wiring in cableforms with secondary side wiring – in separate sleeve in some sections. Mains A & N swapped when mains input socket replaced with cord. Mains wiring passes through LOW probe. PE lug metal screwed to chassis. Missing 1" 3/32" BSW cheese head bolt and round nut for LOW probe end fixing. Crushed HV lead on entry to HV probe – high lead resistance. No self discharge on the V1 B+ supply. Noisy rectifier bridge diodes, BC109, zener. Scratchy RV2.

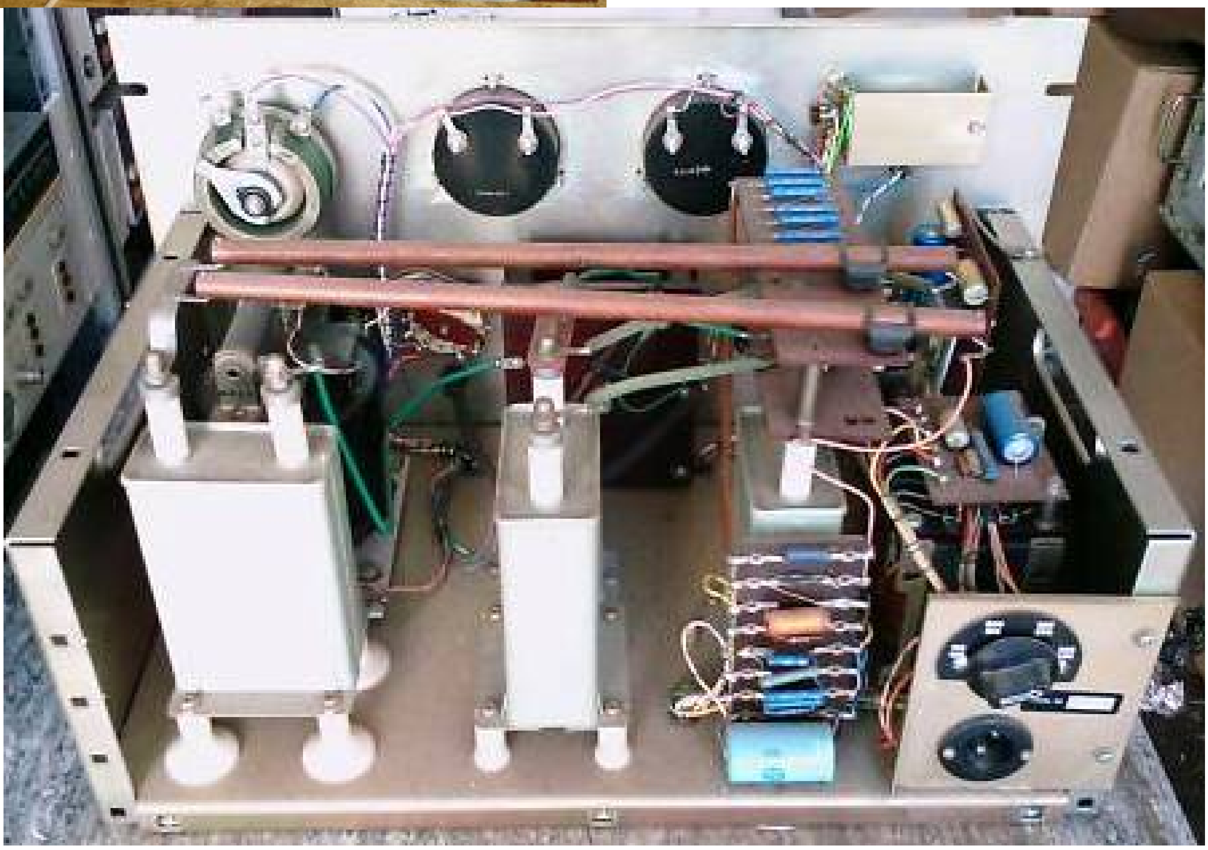
6kVAC, 12kVDC. 19" rack mount cabinet chassis in enclosure. Early version of RM215 with horizontal EM84 and no breakdown indicator level pot.

All caps, cap terminals to their enclosure, and from enclosure to chassis megger fine at 1kV. Mains side circuitry meggers above 1.2G at 1kV to chassis. All parts measure correct value except C4 and C7, and resistors measure high.

Dating: BPL displayed an RM215 in 1955 – this was an early version. EM87 introduced in 1959, and the EM84 in 1957. Newmarket Transistors Ltd name started in 1958 – the PC5 amp module came out in Jan 1964. AVO advertising the RM215L in 1975 – new look front panel.
So circa 1970 based on date codes for Hunts, WW resistor, Plessey cap, Newmarket 453's.


K8
1950


Newmarket
PC
5&7



1.1 British Physical Laboratories

1947 British Industries Fair Advert for Instruments "Made to Measure".
Manufacturers of Milliammeters, Voltmeters, Ohmmeters, Universal Bridges, Universal Test Sets, Signal Generators, Valve Voltmeters, Wobbulators, Breakdown Testers, Megohmmeter, Wheatstone Bridges, Schering Bridges, Electrolytic Condenser Bridges, Capacity Comparators, Coil Analysers, Coil Comparators, A.F. Oscillator. (Scientific and Optical Section - Olympia, Ground Floor, Stand No. A.1033).

"Multirange test meter using transistor amplifier", British Physical Laboratories Ltd., Houseboat Works, Radlett, Herts
Journal of Scientific Instruments, Volume 33, Number 1,
1956 J. Sci. Instrum. 33 38 doi: 10.1088/0950-7671/33/1/427

AVO and Biddle appear to have licenced use of equipment.

2. Modifications

- Separated mains side wiring from other wiring.
- Converted AC mains level switch in Low Probe to switching the low Y-Y 14VAC voltage to an ss bridge rectifier and 100uF 25V filter cap to 24VDC interposing relay coil (RCI484AC4 with A1 positive) – the relay NO contact then switches the AC mains to T1. Relay in cradle on din-rail between RV1 and M1.
- Replaced any poor electrolytics and foil caps, and replace key resistors (2x 47ohm, 2x 120 ohm, 1k5).
- Replaced mains cord with fused IEC socket. Fuse now directly at input. Lowered AC side fuse from 1A to 400mA T IEC. Disconnected front panel fuse holder (safety risk from unshrouded metal thread in cap).
- Added 33V back-to-back 1.5W zeners from HV supply positive end to chassis ground, to clamp circuitry if circuit path fails.
- Add MOV across T2 primary 240V winding, and T1 primary winding.
- Replaced poor electrolytics and resistors on Newmarket PC5 amp module and pcb assembly. Moved main 12V filter cap to incoming pcb.
- Replaced rectifier diodes with UF4007 and located main filter cap at bridge rectifier on pcb (poor ground trace introduced a lot of hum).
- Added self-discharge load on C3.
- Replaced BC109 (scratchy) with BC337 (high hfe screened).
- Replaced 12V zener supply (noisy) with 7812 regulator.
- Replaced 8k5 sense resistor (noisy).
- Modified grounding scheme to single-point grounding on chassis, and star point on pcbs.
- HT lead cut and re-inserted in to HT probe (lost about 10cm length).
- Hum/noise level heard on the speaker with DC selected is significantly higher than when AC is selected. The noise loop is via T1 secondary low end terminal (not the HV terminal going to doubler cap) that is internally connected to the transformer core/mounting (but is isolated from chassis via a plastic base panel), and via capacitive coupling to the neutral mains connection to T1 primary, and back via mains protective earth to the tester chassis. T1 primary winding is the inside winding and appears to have a substantial capacitance to core, and to the 'low' end of the secondary (which is next to the primary). T1 secondary winding resistance of 23kΩ appears to significantly attenuate the noise path along with C2 and MR2. Filtering the mains neutral to earth noise voltage with a 4N7 Y2 cap has negligible change. Using a DC blocker between chassis and star ground point has negligible

change. Use a 150VA or more isolation transformer with secondary neutral to protective earth link to achieve a 'quiet' neutral. Also need to check:
  - insert a mains earth DC blocker in the mains feed (ie. back-to-back 35A diode bridge) and to only earth any DUT chassis via the tester.
- Calibrate meter readings at full-scale.
- Confirm operation of breakdown indicator and relay.
- M2.5 25mm bolt and M2.5x3.8x3mm brass knurled nut used to replace missing 3/32" BSW bolt and nut in HV probe end.

3. Measurements

Voltage rail regulation. 238 Vrms mains.

Rail	Minimal Load
HT winding	126 Vrms
VS1	171 Vdc
Heater winding	6.4 Vrms
14V winding	14.7 Vrms
Vcc on pcb	18.2 Vdc

T1 secondary: 23kΩ DCR.

4. Design

Breakdown indicator:

- Relay turn on at about (0.6+0.6+0.6+0.6)/8k5 = 0.28mA. OA200 and BC109 and BS495A are all silicon junctions.
- Detector circuit protection by MR6 (OAZ204 is a 6.8V Zener) which will start clipping at about 6.8/8.5 = 0.8mA.
- Detection rise RC time constant is about 4k7 x 1nF = 4.7 usec, plus 4k7 x 1uF = 4.7 ms.
- Detection fall RC time constant is about 2M2 x 1uF = 2.2 sec.

Leakage eye indicator:

- Any AC signal across the 47k grid leak on the EM84 triode input grid is amplified across pin 9 anode 100k load resistor, and applied to the deflector of the eye.
- With no signal, the grid is effectively at 0V, and the shadow length is at maximum.
- With a peak AC signal voltage of 22Vpk, a negative going input grid voltage forces the shadow length to a minimum. The step leakage current required for minimum shadow length is 22V/13.3k = 1.65mA.
- The RC rise time of indication is 47k x 0.1u = 4.7 ms.

DC HV supply:

- HVDC fall time on release of LOW probe button is about 9.8M x 0.05uF = 4.9 sec.
- HVDC fall time on release of LOW probe button and shorting of probes is about (15k + 4k7 + 8k5) x 0.05uF = 1.4 msec.
- HVDC short circuit peak current is about 12kV/15k = 0.8mA.

Insulation resistance meter:

- FSD of 100uA has a dial reading of 10MΩ when set to DC output.
- 100uA will flow for 1kV supply and 10MΩ DUT. A 10kV supply would cause FSD for 100MΩ loading.

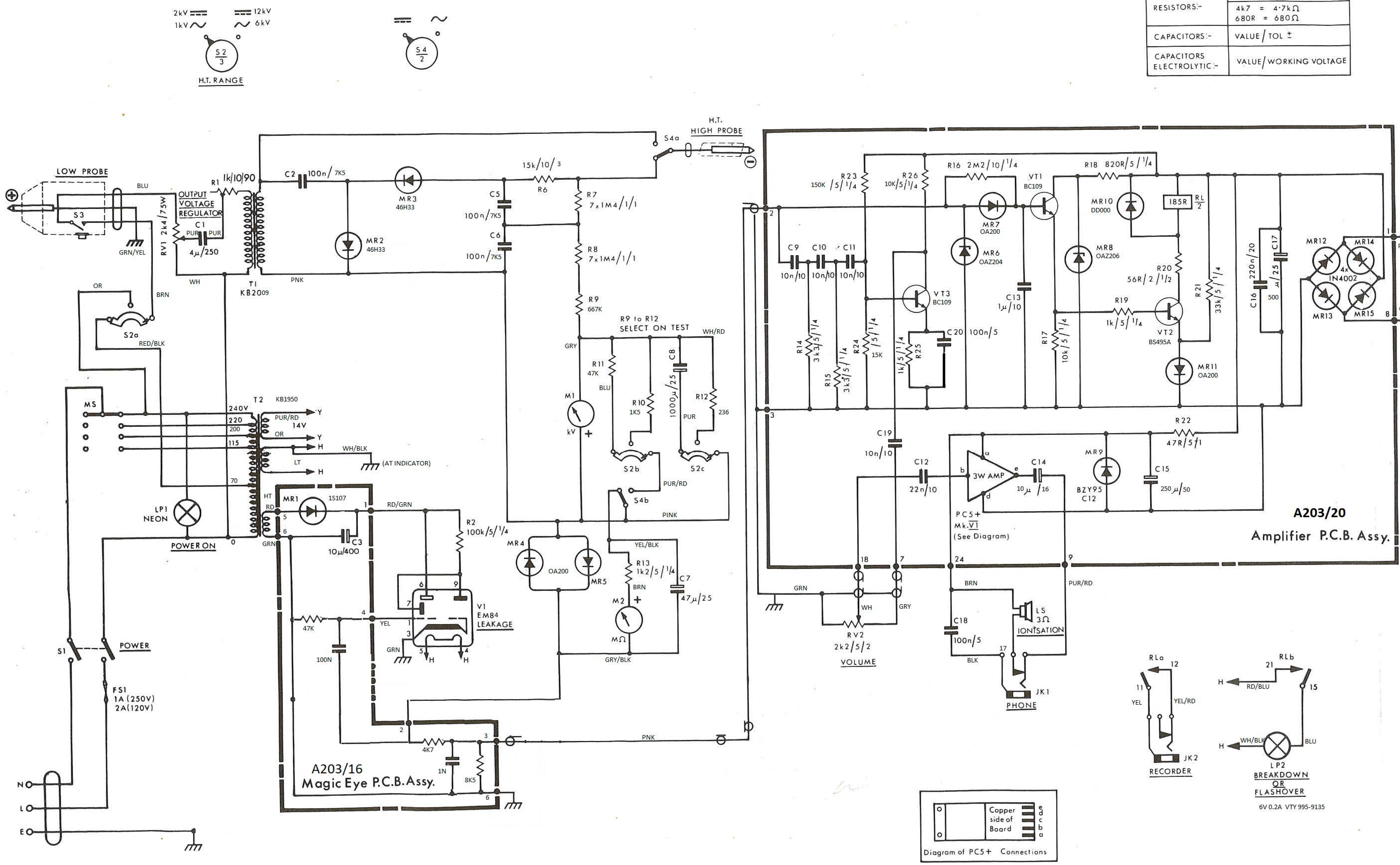
DC Ionisation audible detector:

- AC signal from ionisation current is high-pass filtered with 5kHz corner frequency CR filters, and amplified by VT3 with a 1.6kHz bass roll-off, to provide a hissing noise. 50Hz AC signal is supressed. VT3 collector is centre-biased by 15k/150k divider presenting about 1.5V on base, and 0.9V on emitter for 0.9mA collector current and 9V drop from nominal 18V supply.

Newmarket PC5 + Mk6 amplifier:

- Supply voltage limited by MR9 to about 12V. MR9 dissipates up to about 0.7W and shows it has heat stressed 47Ω dropper (which dissipates about 0.6W).
- Almost a direct clone to H.C. Lin Sept 1956 Electronics article schematic. Two series germanium diodes clamped to heatsinks to track bias with temperature. Feedback take-off from output stage mid-point (before coupling cap). Simpler input stage biasing. Pot trims output stage mid-point voltage, but no adjustment for output stage bias current.

CIRCUIT REFERENCE CODING	
RESISTORS:-	VALUE / TOL ± / WATTAGE 4k7 = 4·7kΩ 680R = 680Ω
CAPACITORS:-	VALUE / TOL ±
CAPACITORS ELECTROLYTIC:-	VALUE / WORKING VOLTAGE



BRITISH PHYSICAL LABORATORIES

Serial Number: 14985
Manufactured: ~ 1970-71

Model RM 215-L/1 AC/DC Breakdown and Ionisation Tester

MANUFACTURERS' PRODUCTS

NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Miniature Capacitors

SILVERED mica capacitors in values from 10 to 2,000 pF are available from Alston Capacitors Ltd., of Diss, Norfolk. The components are epoxy-resin encapsulated and meet the DEF5132 specification to H1 humidity category from −55 to +125°C.

4WW 383 for further details

Colour Television Monitor

IN anticipation of the development of colour television broadcasting in Europe, Standard Elektrik Lorenz A.G. have developed in their Schaub-Lorenz division at Pforzheim a transistor monitoring receiver using a rectangular shadow mask tube giving a picture of 28×21 cm. Silicon planar transistors (BFY37 and BFY39) are used in the line timebase and the circuit is subdivided into plug-in (DIN41 490) printed circuit units performing separate functions. Front controls include the usual contrast, brightness, saturation, line and vertical hold.

4WW 384 for further details

Low-frequency Signal Generator

SINE or square wave outputs may be obtained over a frequency range of 5 c/s to 125 kc/s from the SG66 low frequency signal generator manufactured by Advance Components Ltd., Hainault, Essex. The output voltage may be read from a calibrated voltmeter. The sine wave output has an impedance of 5 or 600Ω. At the full output of 1 W, the distortion is less than 0.5%; hum and noise level is less than 0.25% of full output. The rise-time of the square wave is not greater than 0.75μsec at all frequencies.

The frequency coverage of the instrument is achieved in five ranges and the accuracy of calibration is within ±1%. The cost is £65 and a mains power supply of 100/130 or 200/260 V 40 to 60 c/s is required. The dimensions are $16\frac{1}{2} \times 10\frac{1}{2} \times 8\frac{3}{4}$in.

4WW 385 for further details

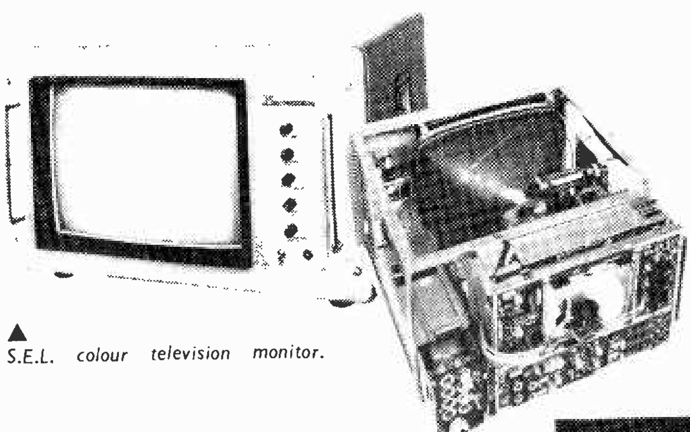
Audio Amplifier

A MINIATURE audio amplifier suitable for the audio stages of a car radio receiver, high-power domestic radio and record player is available from Newmarket Transistors Ltd., Newmarket, Suffolk. The power requirement of the amplifier, which is transformerless, is 12 V (direct). The input impedance is 1 kΩ and two versions, differing in sensitivity, are available. The PC5 requires an input signal of 50 mV r.m.s. for 3 W output, the PC5+, 5 mV for 3 W output. At this output, and with a lkc/s signal, the total distortion is 3%. The frequency response extends from 50 c/s to 15 kc/s. The amplifier operates satisfactorily over a temperature range of 0 to 45° C. Weighing only 2 oz, the dimensions are $5\frac{1}{2} \times 1\frac{3}{4} \times \frac{3}{4}$ in.

4WW 386 for further details

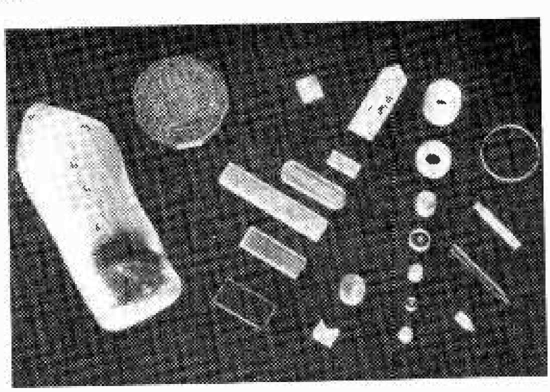
Synthetic Sapphire Components

WINDOWS for optical and microwave applications are fabricated in synthetic sapphire by Agate Products Ltd. of Sutton, Surrey Discs from

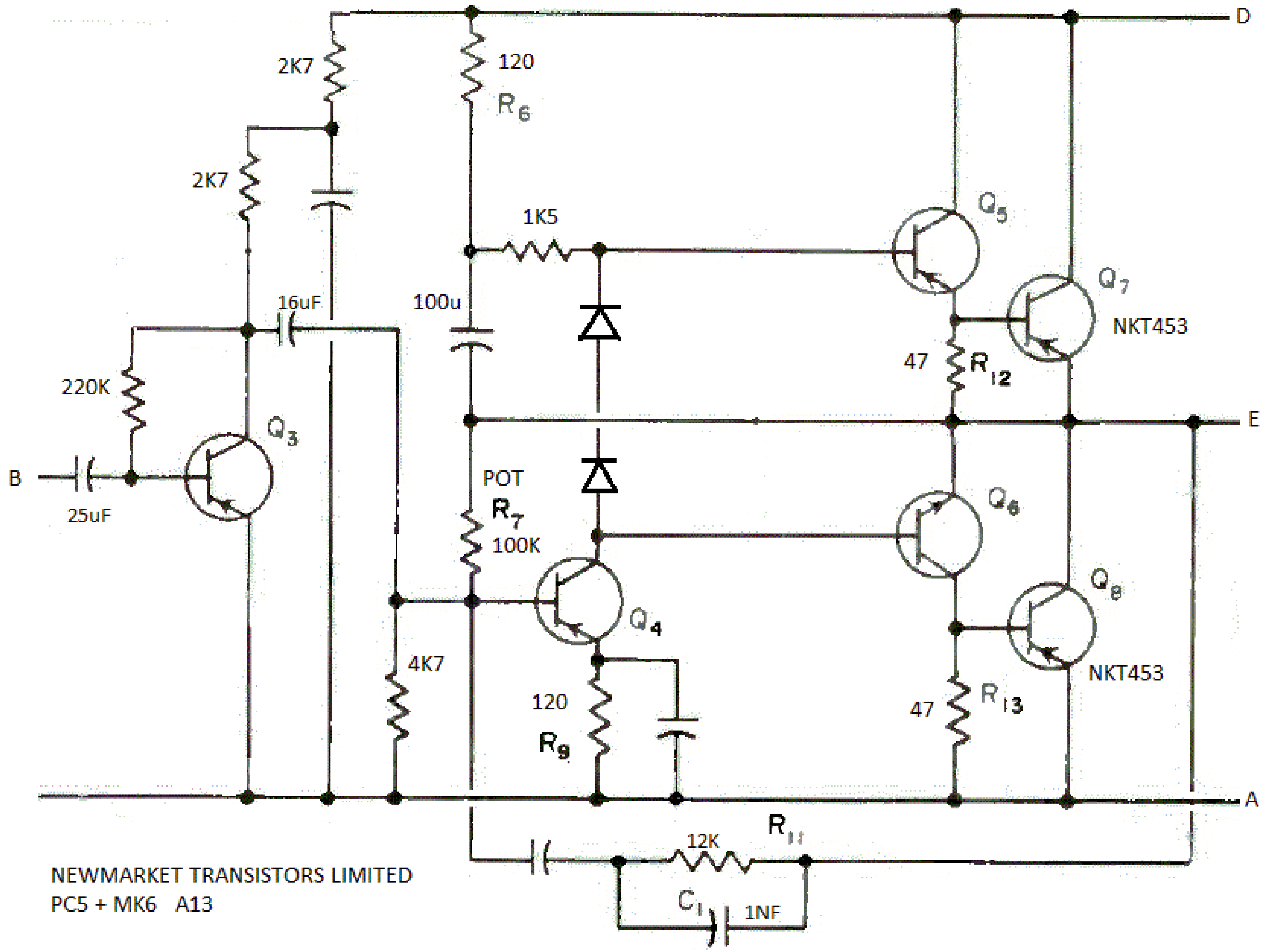


▲ S.E.L. colour television monitor.

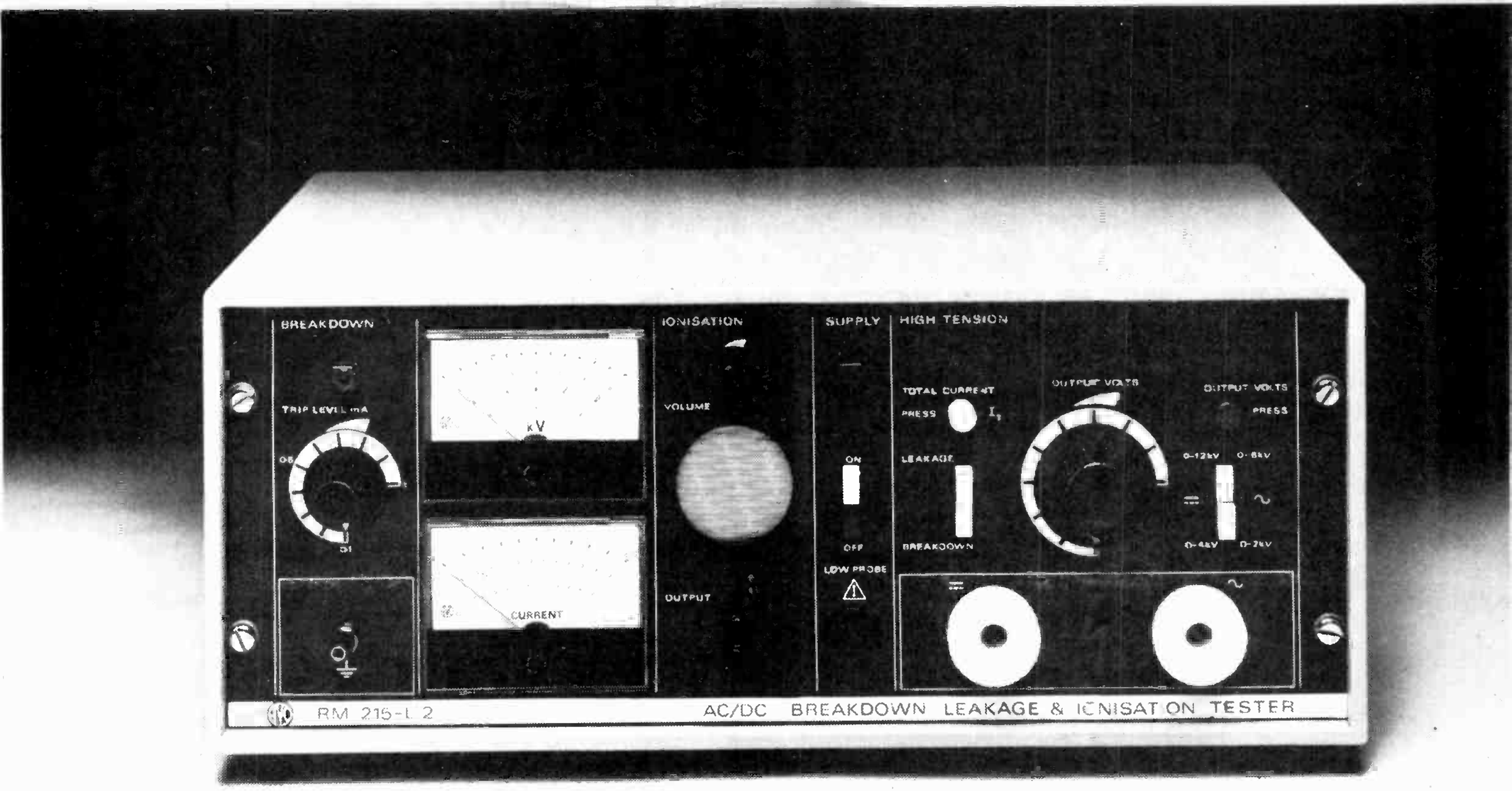
Type SG66 low frequency signal generator manufactured by Advance Components. ▼



▲ Synthetic-sapphire components manufactured by Agate Products.



NEWMARKET TRANSISTORS LIMITED
PC5 + MK6 A13



Ion out your quality control problems

The AVO Breakdown and Ionisation Tester RM215-L/2 is specifically designed to help solve all manner of quality control problems.

It measures resistive leakage current under both AC & DC voltage testing conditions as well as total AC leakage current. Test voltages up to 12 kV DC and 6 kV AC are continuously variable and breakdown current level is adjustable up to 1 mA. A built-in loudspeaker gives audible detection of ionisation and there are connections for earphone or an oscilloscope.

The circuit features low internal resistance yet at the same time limits the maximum output current, even at short circuit.

With the RM215-L/2 you can carry out general flash testing, measurement of breakdown voltage – even after breakdown – and the detection (and counting) of spurious flashovers.

Equally suited to both destructive and non-destructive testing, the RM215-L/2 is a piece of test equipment you cannot afford to be without. If you have some problems that need to be 'ioned' out, get in touch for full details.

APPLICATIONS

- Flash testing of electrical components.
- Measurement of breakdown voltage on electrical components and materials.
- Measurement of insulation resistance at high voltage.
- Measurement of d.c. leakage current.
- Measurement of a.c. leakage current and total current.
- Non-destructive insulation testing of materials and components.
- Detection of ionisation in electrical assemblies.

Designed to meet B.S., V.D.E. and I.E.C. Safety Requirements.

Avo Limited, Dover, Kent.
Tel: Dover (0304) 202620.

THORN Thorn Measurement Control and Automation Division.

WW—064 FOR FURTHER DETAILS

OPERATING INSTRUCTIONS

AC/DC BREAKDOWN AND IONISATION TESTER

MODEL RM 215-L/1

CONTENTS

1.0 INTRODUCTION

The AC/DC Breakdown and Ionisation Tester, Model RM 215-L/1 is suitable for general flash testing, for the measurement of breakdown voltages of electrical components and insulating materials, and for the detection of ionisation in electrical assemblies.

The instrument provides a further facility which enables d.c. measurement of leakage current or equivalent insulation resistance to be read directly on a separate meter. This function, in conjunction with the ionisation test facility, enables non-destructive testing of electrical components and materials to be performed.

The equipment is mains operated and provides a continuously variable a.c. or d.c. output voltage. The source impedance of this voltage is low enough to permit the rapid testing of high capacitance components whilst at the same time automatically limiting the available output current to a safe value. In addition to breakdown measurements, the instrument also indicates insulation/leakage by means of a cathode ray indicator fitted with a magnifying lens. Ionisation is indicated by an aural signal which is transmitted by means of a built-in loudspeaker or alternatively by external headphones.

Because of the high output voltage available, a micro switch is fitted to the earthed test prod, which normally keeps the high tension supply switched off.

For d.c. and a.c. tests, the instrument is provided with an indicator device, which enables short period flash-over to be detected. The equipment which incorporates a delay circuit indicates such a fault condition by switching on a red signal lamp and relay contacts for remote use.

1.1 TECHNICAL SPECIFICATION

1.1.1. Output Voltage

d.c. 0 to 2kV, 0 to 12kV (negative high output)
a.c. 0 to 1kV, 0 to 6kV r.m.s.

1.1.2. Maximum current available at Short Circuit

d.c. range 0 to 2kV: not greater than 1mA
d.c. range 0 to 12kV: not greater than 4mA
a.c. range 0 to 1kV: not greater than 2 mA r.m.s.
a.c. range 0 to 6kV: not greater than 8 mA r.m.s.

1.1.3. Voltage Indication

3" scale Taylor Fyneline meter for both a.c. and d.c.
Accuracy: d.c. ± 3% a.c. ± 5%.

1.1.4 D.C. Ripple Content. This is dependent on external load. On open circuit this amounts to less than 2% P/P of the output voltage.

1.1.5. D.C. and A.C. Breakdown and Flash-over Indication

The voltmeter needle returns to zero and the 'magic eye' closes. When the breakdown current exceeds a pre-determined limit the front panel signal lamp is illuminated and remains so for approximately 3 seconds after breakdown has occurred. The current limit is set by a front panel potentiometer, marked INDICATOR LEVEL, to a value from at least 100μA to 1mA.

1.1.6. D.C. Leakage Indication

D.C. reading of microammeter scaled 0-100μA and 10-200 MΩ relative to 1 kV.

1.1.7. D.C. Ionisation Detector

Aural indication via built-in loudspeaker or external 3-4Ω headphones.

1.1.8. Power Requirements

115, 125, 220, 240 Volts a.c., 50 or 60 Hz.

1.2. GENERAL DESCRIPTION

The equipment is completely self contained. The output voltage is brought out via high and low tension cables which are terminated with specially designed test prods.

1.2.1. Leakage Indicator This consists of a "magic eye" detector mounted behind a lens with a vertical optical axis. Partial closure indicates leakage current in the test sample and complete closure indicates voltage breakdown.

1.2.2. Voltmeter. This is a 3" moving coil meter calibrated 0 to 2 kV, 0 to 12 kV d.c. and 0 - 1kV, 0 to 6 kV a.c., and is used in conjunction with the H.T. Range switch. This voltmeter directly indicates the voltage available at the test prods.

1.2.3. Output Voltage Regulator. This control provides a means of varying the output voltage.

1.2.4. A.C./D.C. Switch The specially designed switch enables the operator to select either a.c. or d.c. output voltages.

1.2.5. Test Prods These test prods have been designed for operation at high voltages. A micro switch is fitted in the earth test prod to switch the output voltage on or off.

NOTE: When carrying out d.c. tests, a d.c. voltage is still present at the test prods when the micro switch is released. See section 3.2.1. This voltage remains and is a function of an internal time constant of approximately 1 second. The discharge time can be accelerated by short circuiting the test prods. The residual voltage is always indicated by the voltmeter.

1.2.6. Fuse. 1A (250V), 2A (120V)

1.2.7. Volume Control This permits the output level of the ionisation indicator to be adjusted.

1.2.8. Breakdown or Flashover Indicator A signal lamp which lights up at the moment of breakdown. See section 1.1.5.

1.2.9. Phones A jack for connecting an external pair of 3-4Ω headphones instead of the internal loudspeaker.

1.2.10 Recorder A jack for connecting to a pair of relay contacts which close at the moment of breakdown.

2.0 TECHNICAL DESCRIPTION

2.1. The a.c. output voltage is obtained from a high voltage mains transformer T.1 the output of which is manually controlled by the potentiometer R.V.1. The capacitor C.1 and the primary of the transformer T.1 form a series resonant circuit which ensures that the source impedance of the output voltage is comparatively low prior to breakdown. When breakdown occurs the resultant load on the transformer T.1 reduces the Q of the primary causing a primary voltage drop by potentiometer action with R.1.

The same transformer T.1 is used in conjunction with MR2, C2, MR3, C5 and C6, to give the d.c. output voltage. A switch S.4 is used to select an a.c. or d.c. output voltage.

In both a.c. and d.c. tests, the meter M.1 continuously monitors the voltage applied to the test sample.

A.C. or D.C. leakage current flows through R4 and RV3, the grid-cathode resistance of the magic eye leakage indicator V.1 which closes, giving indication of leakage in the sample. In addition, the d.c. leakage current or equivalent d.c. insulation resistance is measured by the meter M.2.

The micro switch S.3, connected in series with the supply to the primary of the transformer T.1, is physically mounted in the EARTH test prod as a safety precaution.

2.2 Ionisation in a test sample develops a signal voltage across resistors R.4 and RV3. This is applied via a high pass filter to the audio amplifier PC.5 which energises the loudspeaker LS or external phones.

2.3 In addition to breakdown indication by means of the magic eye and the voltmeter returning to zero, a red signal light shows for a pre-set period. The signal voltage across R.4 and RV3 is also applied via an integrating network to the emitter follower VT1. The value of C.13 determines the time constant of the network. The output of VT1 drives the relay stage VT2, which is normally in the off condition due to the presence of diode MR11.

3.0 OPERATING INSTRUCTIONS

3.1 INSTALLATION

This instrument is designed for operation on mains voltages of 110 to 130 volts or 210 to 250 volts a.c., 50 to 60 Hz. Before connecting the instrument to the supply, verify that the mains voltage selector is adjusted to the correct setting. Voltage adjustments are made on the panel situated at the rear of the case.

For the correct operation of the Breakdown Tester it is imperative that the mains lead should be connected as follows: Brown to line, Blue to neutral and Green/yellow to earth.

3.2. SAFETY PRECAUTIONS

Whilst every effort has been taken to ensure safety, it is most important that the following notes are observed.

3.2.1 After completion of d.c. tests, a voltage will remain at the test terminals for a period that is determined by the time constant 0.05μF and 20MΩ. This voltage will be indicated by the voltmeter. Therefore, before proceeding with the next test, the test prods may be shorted together, taking care not to depress the micro-switch.

This precaution is not necessary when carrying out a.c. tests.

3.2.2 On completing voltage proof tests on capacitive components, care should be exercised when removing the capacitor from the prods as the capacitor will remain charged for some time, although the micro-switch has been released. Discharge may be effected through the internal 20MΩ resistor, the state of charge being indicated by the voltmeter.

3.3 OPERATION - PRODUCTION TESTS

3.3.1 Switch on and allow the instrument a few minutes to warm up before proceeding with tests. The 'magic eye' LEAKAGE INDICATOR will light up and indicate that the instrument is ready for use.

3.3.2 <u>Flash tests:</u> For establishing that a test sample does not break-down at a specified voltage: set the selector switch to a.c. or d.c., press the micro-switch fitted in the handle of the earth test prod and, using the OUTPUT VOLTAGE REGULATOR, set the output voltage to the desired test level. Release the micro-switch.

3.3.3 Connect the test prods to the test sample, and operate the micro-switch.

3.3.4 The design of the instrument is such that a continuous short circuit current for any length of time will not damage the instrument.

3.3.5 In the case of a d.c. pass test, the voltmeter will return to its pre-set value, and none of the other indicators will remain activated after the initial current surge due to any capacitive component which may be present.

3.3.6 In the case of an a.c. pass test with capacitance present in the component, the magic-eye will show a deflection, and according to the capacitance and test voltage, the red breakdown indicator may light up. Pass indication in this case is given by the voltmeter remaining at its pre-set value. For high values of capacitance, the a.c. current drain will be of such an order that the output voltage cannot be maintained, and therefore a proper test cannot be effected.

3.3.7 D.C. Leakage Tests. In cases of insulation leakage, the 'magic-eye' indicator shadow will partially close. A quantitive measurement of the leakage can be observ-ed on the LEAKAGE CURRENT meter in terms of micro-amperes or Megohms (relative to 1kV).

Leakage current readings are direct but the insulation resistance reading is a function of the applied test voltage, i.e.

$$\text{Insulation Resistance} = \text{Reading in Megohms} \times \frac{\text{Test Voltage}}{1000}$$

3.3.8 A.C. Leakage Tests. The 'magic eye' indicator will partially close but no quantitive measurement is provided. For effect of capacitance see paragraph 3.3.6.

3.3.9 Ionisation Tests (d.c.only) Set the Volume control to a suitable level. A hissing noise should be audible. However, under certain circumstances the noise may become ultra sonic.

3.3.10 Breakdown When breakdown occurs, the voltmeter returns to zero, the 'magic-eye' shadow closes and the red signal lamp lights up (see note under 2.3). In addition the recorder contacts operate. For d.c. operation the leakage current meter will also give an f.s.d. reading. For a.c. operation see also paragraph 3.3.6.

3.3.11 Flash-over In this case the red signal lamp will light up and the recorder contacts will operate. Due to the short duration of the current pulse, the other indicators will not operate. The detection of pinholes and the testing of 'self-healing' capacitors are typical examples.
An external electro-magnetic counter may be connected to the jack marked RECORDER which enables the number of breakdowns to be recorded. This is particularly useful when testing insulating strips or sheets for pin holes.

For a.c. flashover tests see also paragraph 3.3.6.

3.4 OPERATION: - LABORATORY TESTS

When it is required to determine the actual breakdown voltage, the following procedure should be adopted:

3.4.1 Adjust the OUTPUT VOLTAGE REGULATOR to the minimum position i.e. fully anti-clockwise.

3.4.2 Using the a.c. - d.c. switch, select the desired output voltage mode.

3.4.3 Apply the test prods to the sample under test.

3.4.4 Depress the micro switch on the Earth test prod, and slowly advance the OUTPUT VOLTAGE REGULATOR in the clockwise direction.

In many tests, and in particular when testing to the requirements of British Standards Specifications, the voltage is required to be increased from zero at a specified rate and then held at a specific voltage for a period of one minute.

3.4.5 The LEAKAGE INDICATOR should be observed in conjunction with the VOLTMETER. At the threshold of breakdown, the LEAKAGE INDICATOR will commence to close. Any further increase in voltage will cause complete breakdown and the voltmeter reading to fall to zero and the LEAKAGE INDICATOR to close. See paras. 3.3.7 and 3.3.8.

3.4.6 Testing for Pin-holes. Due to the short discharge period, the breakdown indicators are inoperative, except the red signal lamp and recorder contacts. See paragraph 3.3.11.

3.4.7 Non-Destructive Tests. Increase the d.c. voltage as described under 3.4.4. and observe the onset of ionisation by means of the sound emitted by the loudspeaker. Adjust the Volume control to combat surrounding noise levels enabling clear detection. As soon as ionisation is detected note the voltmeter reading and break off the test. This voltage is the maximum which can be applied without damaging the test sample.

NOTE: Should there be a short circuit in the test sample, the voltmeter will not normally move from zero when attempting to operate the VOLTAGE CONTROL. A partial short will cause the voltmeter to return to its zero position. In either case the LEAKAGE INDICATOR will be partially or fully closed and the breakdown lamp operative.

WARNING: Due to the nature of and high voltages encountered with this instrument the safety precautions described in section 3.2 cannot be over emphasised. Ensure that the proper caution is used at all times.

4.0 SERVICE AND MAINTENANCE

Should the instrument fail in service it is strongly recommended that the instrument be returned to the manufacturer or its agents.

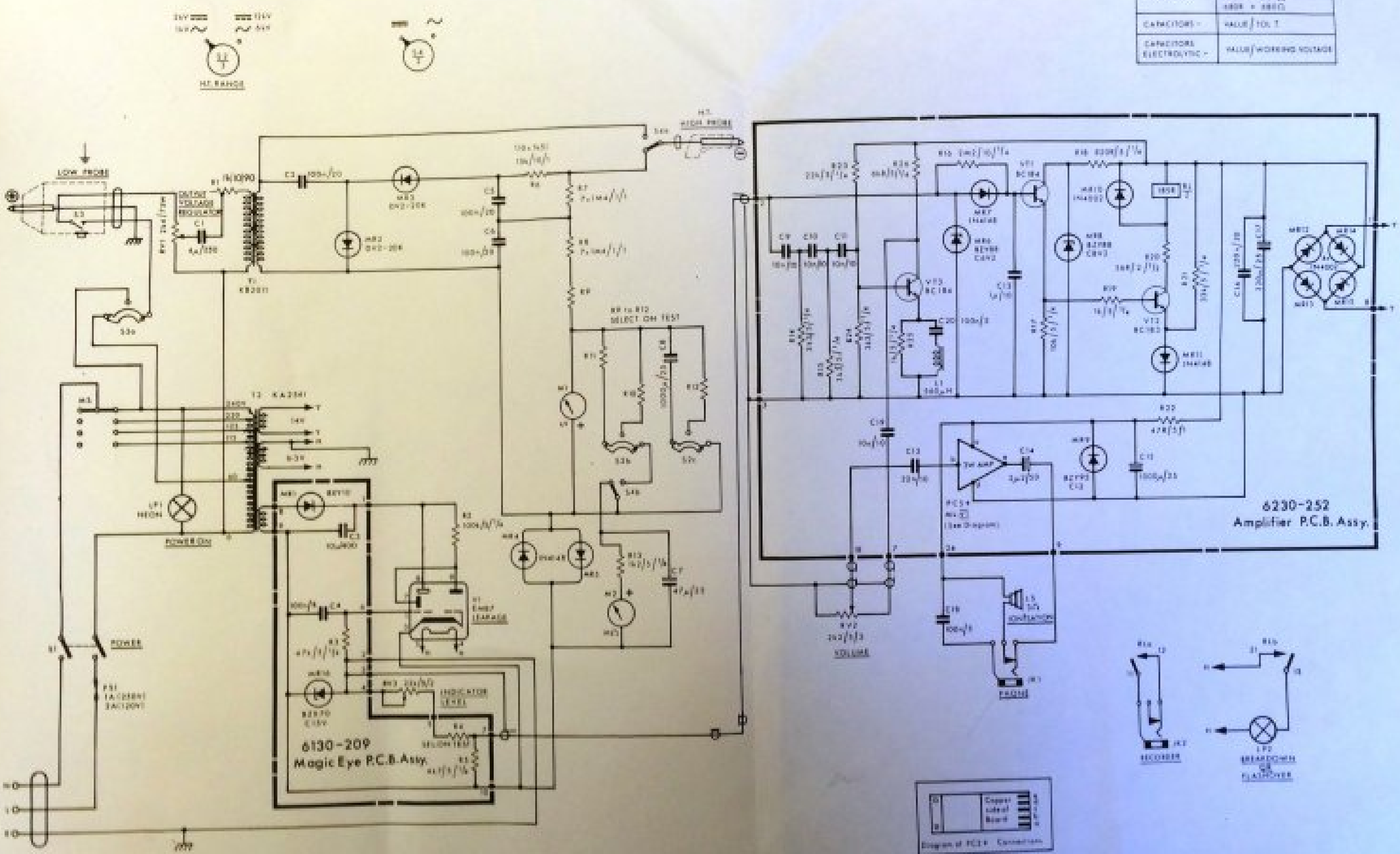
In such cases where the voltage output is normal but the other indicators do not operate, remove the printed circuit plug in board, and replace with a new one. These are obtainable from the local agent or directly from Avo Limited.

COMPONENT LIST

REF	DESCRIPTION
C1	4μF 250V
C2	100nF±20% 7.5kV
C3	10μF 400V Electrolytic
C4	100nF±5% 160V
C5	100nF±20% 7.5kV
C6	100nF±20% 7.5kV
C7	47μF 25V Electrolytic
C8	1000μF 25V Electrolytic
C9	10nF±10% 400V
C10	10nF±10% 400V
C11	10nF±10% 400V
C12	22nF±10% 160V
C13	1μF±10% 160V
C14	2.2μF 50V Electrolytic
C15	1000μF 25V Electrolytic
C16	220nF±20% 400V
C17	220μF 25V Electrolytic
C18	100nF±5% 160V
C19	10nF±10% 400V
C20	100nF±5% 160V
FS1	1A (250V)
	2A (120V)
LP1	Neon Lamp 200-250V
LP2	Lamp 6V, 0.2A S6/8
JK1	Jack Phone
JK2	Jack Recorder
L1	RF Choke 560μH
LS	Loudspeaker 3Ω
M1	Meter 100μA DC (kV meter)
M2	Meter 100μA DC (MΩ meter)
MR1	BXY10
MR2	DV2-20k
MR3	DV2-20k
MR4	IN4148
MR5	IN4148
MR6	BZY88C6V2 Zener
MR7	IN4148
MR8	BZY88C8V2 Zener
MR9	BZY95-C12 Zener
MR10	IN4002
MR11	IN4148
MR12	IN4002
MR13	IN4002
MR14	IN4002
MR15	IN4002
MR16	BZX70-C15V Zener
MS	Mains Selector 240-220-125-115V

REF	DESCRIPTION
PC5+	3W Amplifier Mk VI
R1	1000Ω ± 10% 90W
R2	100kΩ ±5% $\frac{1}{4}$W
R3	47kΩ ±5% $\frac{1}{4}$W
R4	Select on Test
R5	4k7Ω ± 5% $\frac{1}{4}$W
R6	15kΩ ±10% 1W (10 x 1.5kΩ)
R7	7 x 1M4Ω ± 1% 1W
R8	7 x 1M4Ω ± 1% 1W
R9	Select on Test
R10	Select on Test
R11	Select on Test
R12	Select on Test
R13	1k2Ω ±5% $\frac{1}{4}$W
R14	3k3Ω ± 5% $\frac{1}{4}$W
R15	3k3Ω ± 5% $\frac{1}{4}$W
R16	2M2Ω ± 10% $\frac{1}{4}$W
R17	10kΩ ± 5% $\frac{1}{4}$W
R18	820Ω ± 5% $\frac{1}{4}$W
R19	1kΩ ± 5% $\frac{1}{4}$W
R20	56RΩ ± 2% $\frac{1}{2}$W
R21	33kΩ ± 5% $\frac{1}{4}$W
R22	47RΩ ± 5% 1W
R23	22kΩ ± 5% $\frac{1}{4}$W
R24	3k3Ω ± 5% $\frac{1}{4}$W
R25	1kΩ ± 5% $\frac{1}{4}$W
R26	6k8Ω ± 5% $\frac{1}{4}$W
RV1	2.4kΩ 75W Potentiometer
RV2	2k2Ω ± 5% 2W Potentiometer
RV3	22kΩ ± 5% 2W Potentiometer
T1	KB 2011
T2	KA2541
V1	EM87 (Leakage)
VT1	BC184
VT2	BC183
VT3	BC184

CIRCUIT REFERENCE CODING	
RESISTORS -	VALUE / TOL % / WATTAGE 4K7 = 4·7kΩ 680R = 680Ω
CAPACITORS -	VALUE / TOL %
CAPACITORS ELECTROLYTIC -	VALUE / WORKING VOLTAGE



Model RM 215-L/1
AC/DC Breakdown and Ionisation Tester