1. Summary

BPL Electrolytic Condenser Bridge CB 154-D
Instr.No. 6904 HRSA Oct 2025

Capacity uF dial from 1 to 11, with 0.1 minor scale. 'Multiply capacity by' rotary range switch from 0.1 to 1000, so 0.1uF to 11,000uF span.

Tan delta x 100 dial from 0.5 to 45, with switched range for direct or +30. Tan delta = 1/Q = DF (dissipation factor) = ESR/|Xc|.

Bridge balance meter 1mA FSD, with sensitivity adjustment (min to max).

Polarising voltage range switch with FS steps of 8V, 25V, 80V, 250V, 800Vdc and mains-side rheostat adjustment control and custom meter. 0-5mAFS leakage meter, with switched FS settings of 50uA, 0.5mA, 5mA.

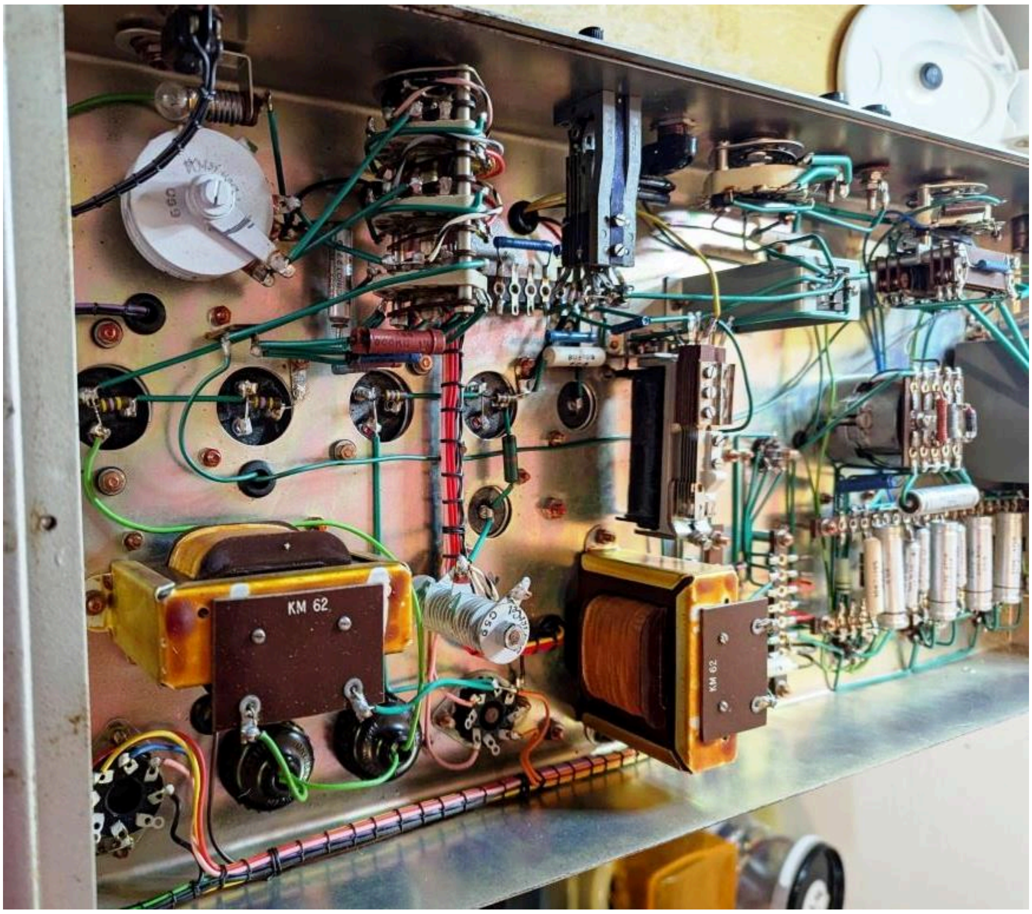
History: History: Radio Corp INV No. 09021, Contract Engineering Div Equipment No. 52. Radio Corporation made ASTOR brand radio's and then TV's from 1956 - Factory at Sturt St then Grant St Sth Melb.. Sold to Philips in 1970.

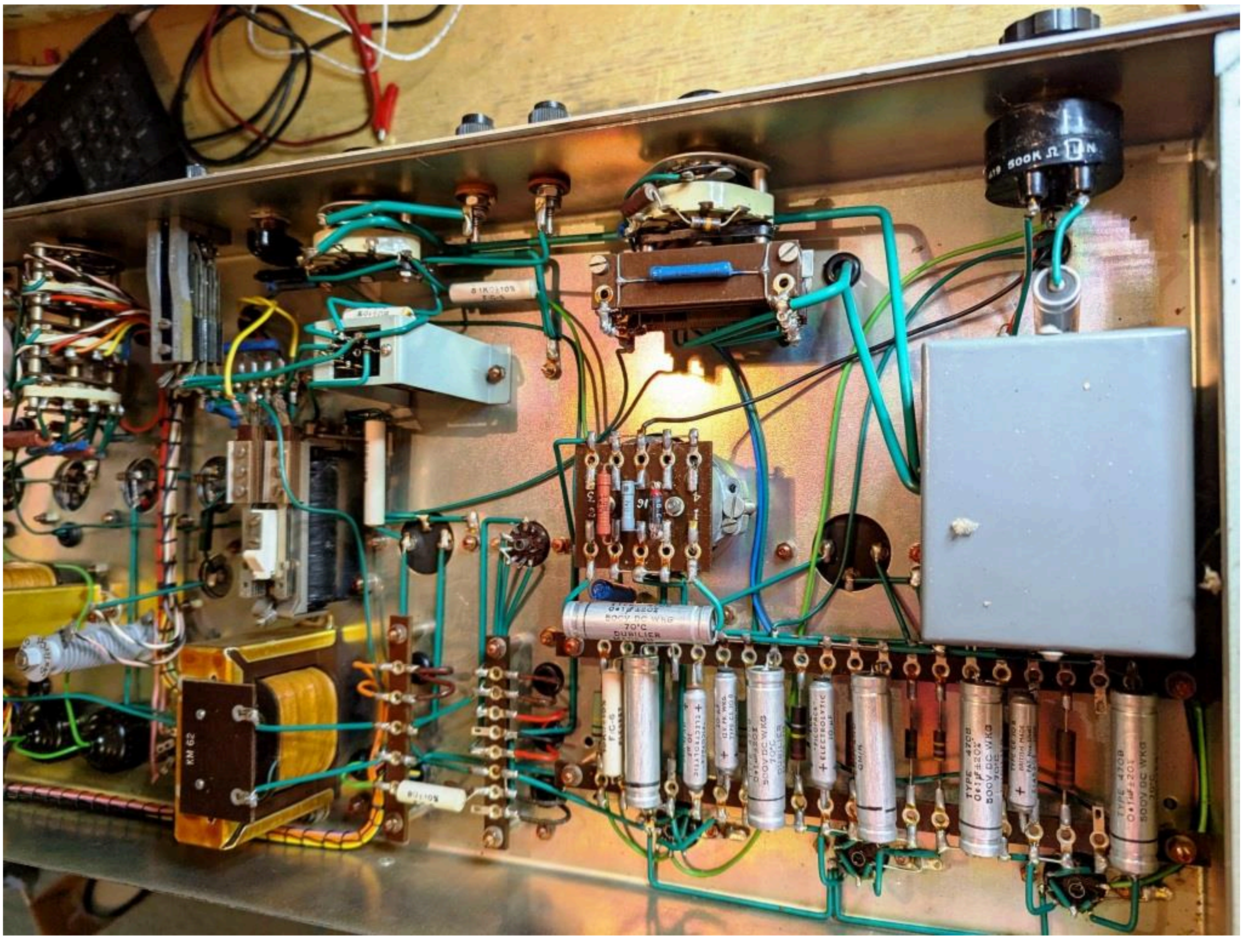
Version 154-D must be prior to 1962, as mentioned in US patent. The later MkII version has a three-position Tan δ switch of 0, +40 and +80, and a 1961 instruction book on AEF site library.

Only one known advert in WW Apr 1957, and front panel switches are different from D or MkII versions, and description include for tantalum caps.

Mk2 notes: rectifier valve cathodes linked to heaters; capacitance measurement range different.; RL1 has no NC latch circuit; RL2 coil has R47 across coil, and 10R in //, and no R46/330R, and no RL1 NC in //; Cx is switched to bridge or switched to R4 and gnd; TAN δ switch S4 has three positions.

Good external condition and internal condition – somewhat dusty top chassis. Unmodified.


KM 62
KM 62


500K Ω
KM 62
TYPE 470B
500V DC WKG

Internet info:
https://www.aef.se/Biblioteket/Tabeller/Dokumentarkiv_A-F.htm

1.1 Parts

PT KB 955 0,110,200,220,240 18Ω; 300V-0-300V (314Ω, 327Ω); 6V3 0.6A; 6V3 1.2A; 5V 2A.

PT KB 1023 220V 33Ω; 5,4,3,2,1,0,1,2,3,4,5 (780V,245V,80V, 24.4V,8.0V,0,...) 680-790Ω, 238-220Ω, 77-72Ω. 700Meg 1kVdc mains to gnd. 520M no yell.

2x KM62 chokes 290DCR; 23H 12mAdc 10Vac; 19H 47mAdc 10.2Vac;

Meters:	Polarising Voltage	Volts D.C.	5522/3 1mA	BPL
	Leakage current	Milliamps	No markings	
	Balance Indicator		5083/1 1mA	BPL

Signal transformer 915 inside enclosure. 0.1uF 500V parallel to output winding. Input winding to leakage current switch and dials.

Sangamo Weston relay No.F4148 S115.1.126 15/0/0.15mA 350 ohm. 326R measured - works.

Selenium disk diodes SenTerCel C59, and C59 but different.

- Long tube rectifier is full-wave for 25Vdc polarising supply (centre terminal is connected to 1,000uF 25V can cap).
- Wide tube rectifier is full-wave for 8Vdc polarising supply (centre terminal is also connected to 1,000uF 25V can cap).

Silicon diode: GEC GEX 5/1 yellow

B TH C G 6 E BRITISH THOMSON HOUSTON, C for wire ended, Germanium diode
http://www.wylie.org.uk/technology/semics/BTHAEI/BTHAEI.htm

Valves
5R4GB Miniwatt 532
EZ80 Mullard CV1535
EF86 Miniwatt 365 8Y5 L7E5 8Y=EF86 likely 1957
EF86 Miniwatt 365 8Y5 L7E5
X79 NB 9 GEC H 25 triode-hexode N may be 1957
2x bulbs Osram 240V 15W (370R DCR) - in series, and in series with choke to 2nd filter cap.
50mA FSD bulb – Osram 6.5V 0.3A screw

Resistors:
Plessey F/C-5 , F/C-7 ,
1x heatstressed on Tan D x100 switch
5x WW
Painton 1% 1QG

Ceramic wafer rotary switches.

Caps:
Dubilier Type 470B OK/K, OM/K, OH/K maybe 1957.

TCC picopack TCB/OJ 2739 x5
Plessey CE540/8 MAR.60
Chassis e-caps, 1x with failing terminal surrounds - other ok.

2x poly 1uF caps on top of T2 pot core in metal enclosure bracket.

E-caps VL and MAR 60.

The chassis e-caps (2x48uF, 2x48uF) are not healthy enough to be used, so replace.

LHS series connection of 2x 48uF, with 470k balancing resistors. - ok
LHS: Plessey CE540/8 MAR.60 16-32uF 450V max wkg ; 470K BLEED = 460K
Red 14.2uF 100Hz R=7.8R D=.07 ~100uA 400Vdc None 30.4uF, D=.07, R=3.5R, <50uA 400Vdc
RHS: Plessey CE540/8 MAR.60 16-32uF 450V max wkg ; 470K BLEED = 481K
Red 16.3uF 100Hz R=7.8R D=.08 ~60uA 400Vdc None 27.8uF, D=.06, R=3.6R, ~50uA 400Vdc

Middle series connection of 2x 48uF, with 470k balancing resistors.
LHS: Plessey CE540/8 MAR.60 16-32uF 450V max wkg ; 470K BLEED = 469K
Red 16.7uF 100Hz R=7.8R D=.08 ~70uA 400Vdc None 33.3uF, D=.07, R=3.1R, ~50uA 400Vdc
RHS: Plessey CE540/8 MAR.60 16-32uF 450V max wkg ; 470K BLEED = 611K ****
Red 16.5uF 100Hz R=8.4R D=.09 ~200uA 350Vdc None 32uF, D=.08, R=4.0R, ~uA 400Vdc
continued high leakage for minutes after voltage rise - don't use.
Chemicon KXL 47uF 450V: 41uF 100Hz 0.04 to 0.05D 1.5 to 1.8R typ over
Leakage spec <0.45mA 20C

DALY 8-8uF 500V can VL, damaged terminal exits – don’t use – replace with 2x 15uF 450V.

other end DALY 8-8uF 500V can VL - replace with 2x 15uF 450V.
9.5uF 0.06D 100Hz R=10.0 1.02uF 1.35D 100Hz R=11.6 terminal corroded

1,000uF 25V near diode stack - ok
1,110uF 100Hz D=0.09 R=0.126 12uA at 25V

1,000uF 25V near relay - ok
1,097uF 100Hz D=0.11 R=0.25 25uA at 25V

20uF 12V TCC picopack - replace all 4x - use 3x 6u8 35V in // (typ 21uF, 0.026D, 1.9R)
end 78uF .06D 100Hz 1.28R
29uF .05D 2.76R
678nF .14D 335R
16uF 0.13D 13.0R

Resistors above novel sockets - end: 1M 0.969M; 2k2 2k77** (//12k); 220k 233k; 470k 452k; 1M 1M28 (//4M7); 2k2 2k60** (//15k); 270k 255k; 220 197** (+22); 220k 256k** (//1M5); 10k 9k76; 150k 141k; 100k 100.8k; 4k//7k 2k43. Adjustments made.

0.1uF 500V 470B	7x total – need to manage at least 410Vdc – replaced with 47nF 250Vac
sensitivity pot	93.1nF D=0.015 R=258R 100Hz 23uA 400Vdc increasing to 35uA.
Tx	97nF D=0.013 R=210R 100Hz 14uA 400Vdc increasing to 15uA.
End	99.7nF 0.025D 400R 100Hz 140uA 400V ****
next	94.4nF 0.014D 235R 100Hz 19uA 400Vdc
	101nF 0.02D 309R 100Hz 56uA 400Vdc increasing to 64uA. ****

	101nF 0.015D 241R 100Hz 18uA 400Vdc increasing to 23uA.
	97nF 0.011D 177R 100Hz 7uA 400Vdc up to 10uA
pot core	104nF 0.018D 231R 100Hz 34uA 400Vdc up to 38uA

Cap range ww resistors - K179 with 0.16 short

0	.1
1	2.00115
2	200.229
3	20.159
4	2.153
5	0.352

Polarising range resistors - K197
800k 797k, 250k 250.8k, 79k 78k88, 24k 23k98, 7k 7k023

TAN Ω switch resistor 4k7 (SOT).

1.2 Modifications

- Replaced Bulgin mains socket with IEC socket/fuse/switch+indicator combo and 0.5A T 5x20. Voltage selector octal not used. Cable loom and octal used for L,N,E, but added permanent wire for protective earth to chassis.
- Separated mains side wiring from secondary side wiring. Mains circuit extends to Polarising Voltage Control rheostat, and to the KB1023 input winding marked 220V. The mains wiring loom included secondary side 6Vac (grn), brn, 2x orange.
- Replaced 20uF 12Vdc e-caps, and 2x 8+8uF with 15+15uF 450V, and 16+32uF with 47uF 450V and matched balancing R's (PRO2 200k+200k=400k bleed). Replaced 6x 0.1uF 500V foil caps with 47nF//47nF 250Vac MKT.
- Adjusted resistor values back to nominal if >10% drift.
- Added 3x 1N4007 series protection to each 5R4 anode.
- Added 1N4007 series protection to each EZ80 anode. Added 110k PRO2 bleed after choke.
- Sprayed switch contacts – some relay contacts needed fine paper.
- Adjusted voltmeter ranges: R39/1k//2k2 for accurate 8V and 25V; R36/79k//3M3 for 80V; R37/250k//6M2 for 250V; R38/800k//34M for 800V.
- Adjusted rectifier on-voltage for 25V range using //1N4004+100Ω with each arm.
- Adjusted max voltage of all ranges to give no more than FS with 240Vac mains – to avoid accidentally exceeding max range voltage, even though meter shows actual voltage.
- Replaced failed R14/180 with 189Ω for accurate 5mA FS.

To do:

- Volt meter needle has some slight stiction, typically towards FS – screen needs tapping. Not apparent when meter is on its side.

Option:

- Further limit 800V range to 600V max to avoid accidental over-voltage (perhaps with phase arm zeners).

2. Measurements

KB8955 voltages initially measured by disconnecting YEL to rheostat, and removing EZ80.

Mains	200, 0.16-0.045
VS1	286
VS2	281
VS3 (10k)	253
VS4 (150k)	149
heater	5.2
EF86/1 pin 6,3	76,2.08
EF86/2 pin 6,3	27 ,1.13
X79 pin 6,8	43,0.62
8V	7.85Vdc
25V (max)	20.8Vdc
80V	82.3, 26281.0
250V	264, 262 0.51Vac
800V **	460, 458 0.51Vac

Leakage current inaccurate. R14/180 was open/burnt. Replaced with 2W to manage 50mA or more. 5mAFSD trimmed with 180+12. All readings at ‘4’ were within 0.1 div.

RL1 contacts cleaned, and confirmed turns on when RL2 contact closes, which damps the meter level and turns on SL1 bulb. ~38Vdc used for RL1 coil. RL2 coil energises when ~5.5mA passes through it and //8R//10R (SOT part).

Voltmeter reads -3.9%, -3.5%, -3.8%, -3.9%, -2.5% on 8,25,80,250,800V ranges. Adjusted.

Installed IEC and final wiring: mains to chassis 700Meg at 1kVdc IR.

3. Design

Power supply for EZ80 from 300V-0-300V with 348R effective. With 15uF-23H/290R-15uF the PSUD2 loaded output is 300Vdc at 60mA, 347V at 30mA, 374V at 15mA, 385V at 10mA. Peak turn-on voltage of 405V.

Heater loading 6V3: 2x0.2 + 0.3 + 0.21 = 0.91A + relay contact to leakage bulb

Mains current at 240V for idle is 0.20A.

Power supply for polarising voltage needs to restrict maximum output to 800V to manage capacitor max continuous rating of 2x 450V. Bleed on each half cap needs to be matched. So 940/2=470k min bleed. Voltage range switch with 800k load, so total load of 296k or 2.7mA with no leakage. Max leakage of 5mA, indicates 7.7mA loading, with PSUD2 giving 1,040V on first set of caps for 134k load. Choke with extra 780R from bulbs.

Max 800V rail appears to be designed for 800V nominal with up to 5mA leakage, and includes significant series resistance.

Measured max polarising levels at 200V mains indicated the 25V range had a lower max level than other ranges. Modified by paralleling a 1N4007+100Ω with each half rectifier.

The R45/2k5 100W control rheostat was modified to restrain the max voltage available on all ranges to rated range max – those limits were originally achieved at about 200Vac mains. A 15-% 405Ω 6x3=18W common resistor was added in series with R45. No load max was then 8.1V, 25.0V, 83V, 266V and 815V.

Leakage dc current through Cx, assumes no leakage through C2 (2x 0.1uF polystyrene), and no S1A link across Cx, or S1B link to 0V. Mk1 uses a different circuit than Mk2.

- 91.1mV across M2 for 4.9mAFS. C1 leakage takes a few seconds for C1 leakage to cause negligible meter change with C1 connected or not.
- R14/180R was burnt open. It needs to survive 50mA at least, and likely higher depending on polarising voltage feed sag. Aim for at least 2W – original was marginal at 0.5W.

Leakage greater than 5mA causes RL2 to energise, and RL1 to energise, and meter to be shunted by R11/200Ω (M2 then 50mAFS), and indicator SL1 to turn on, and RL2 coil to latch on.

Capacitance range has multiplier from 0.1x to 1000x, with 1000x using the lowest resistance balancing arm of 0R1 (so 11,000uF max).

Loss angle TAN δ x100 dial spans 0.5 to 45 markings, with a switch for direct or +30. So measured TAN δ span is from 0.005 to 0.45, or 0.305 to 0.75.

TAN δ = 1/Q = D (dissipation factor) = ESR/|Xc| for series RC circuit model.

Rp = ESR $(1+D^2)/D^2$ for parallel RC circuit model.

The difference between Cs and Cp is small for D<0.1, and 1% when D=0.1.

The measurement frequency is mains 50Hz.

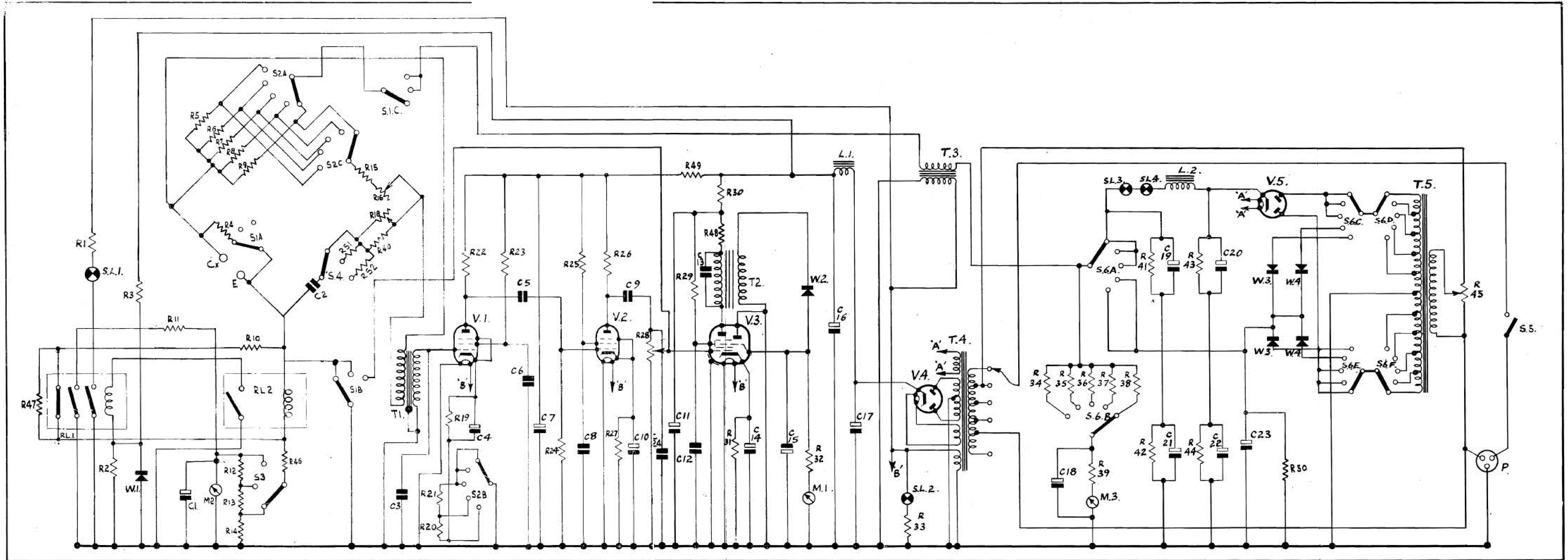
For series circuit model, and a 30uF cap at 50Hz (|Xc|=106), that measures TAN δ <0.005, the ESR is < 0.005 x 106 (ie. <500mΩ).
With +1Ω series, TAN δ x100 ~1. So ESR ~ 0.01x106 = 1.06
With +10Ω series, TAN δ x100 ~9.5. So ESR ~ 0.095x106 = 10.07
With +43Ω series, TAN δ x100 ~40.5, and 10.5 with +30 switch. So ESR ~ 0.405x106 = 42.9
MCP BR2822 with corrected Kelvin probes: 100Hz 30.22uF 0.0008D 0.042R 1250Q series. With 43R in series, D=0.814, 43R 1.23Q.

4. Operation

Always return the Polarising Voltage Control to zero.
Always confirm e-cap voltage has discharged to zero before removing.
Always confirm polarity of e-cap connection.
Keep Polarising Voltage selector at 8V, and Mode switch at ‘Discharge’ when not in use.

Watch Leakage current on 5mAFS meter rise as DUT voltage increases, to both charge capacitance and reform dielectric.

Final level of Polarizing potential will rise as leakage current subsides during initial connection of an e-cap.



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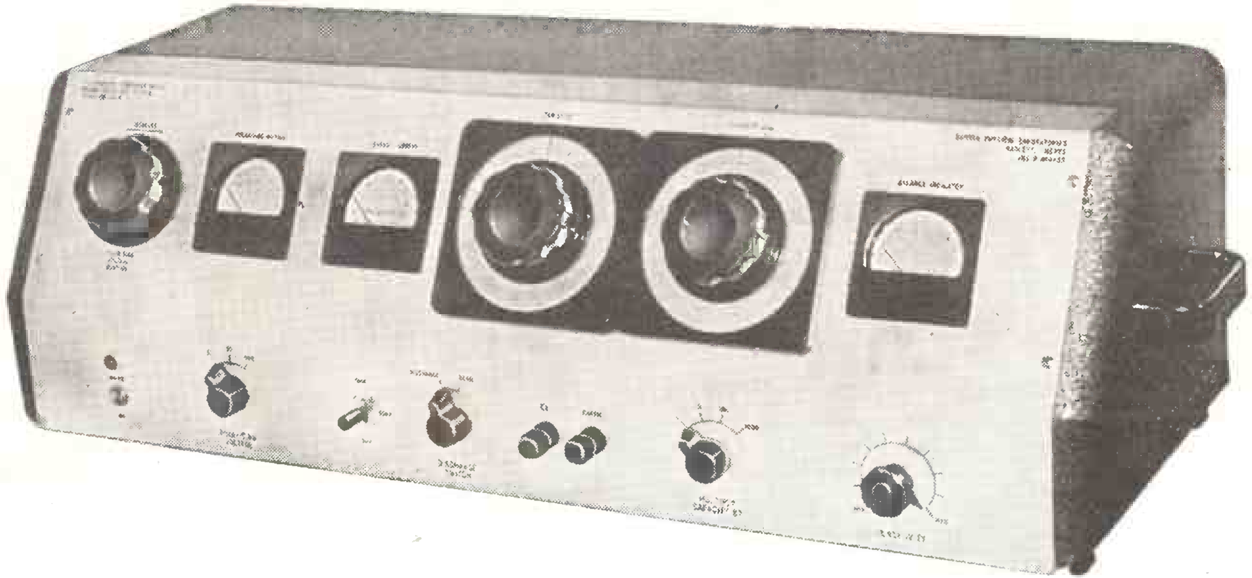
TITLE. CB 154-D MK II

ELECTROLYTIC CAPACITOR BRIDGE

BRITISH PHYSICAL LABORATORIES RADLETT HERTS

D306 SHEET.1. OF 3 SHEETS



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