INSTRUMENT HANDBOOK

Applicable to Serial No.....

MODEL bwd-1722 OSCILLOSCOPE

COMPLETE WITH PLUG-INS

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INSTRUCTION MANUAL CHANGES

MODEL bwd .....1722.....

ROM SERIAL NO.	MAKE MANUAL CHANGES	FROM SERIAL NO.	MAKE MANUAL CHANGES
12200	No.1		

hange No.	Page	Sect.	Para.	AMENDMENT
1	11	6	1	Line 14 should read : - "networks D4 to D8 and Q7 to Q11
				PNP transistors driving Q5 and 10".
1	12	6	5	Line 7 in "-22V rail".
				Delete "to minimise dissipation in Q32 a proportion of the out-
				put current is diverted through R72
1	1A	P/list		These components are no longer required : R5, R6, R11, R12,
				R24, R25, R30, R31
1	2A	P/list		Change the following to read : -
				R57 6.8KΩ 6 Watt 5% MO F33
				R67 12KΩ ½ Watt 5% CC
				R70 5.6KΩ ½ Watt 5% CC
				R71 1KΩ ½ Watt 5% CC
				R72 100KΩ ½ Watt 5% CC
				R73 4.7KΩ ½ Watt 5% CC
1	3A	P/list		C23 0.01uF 160V 10% PYE

E ISSUED : 26.1.72

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A GUIDE TO THE CHARACTERISTICS & METHODS OF SPECIFYING BWD OSCILLOSCOPES

1. VERTICAL AMPLIFIER(s)

1a. Bandwidth, Typical Spec.

DC or 2Hz to 10MHz -3db referred to 4 cm deflection at 50kHz.

Method of Measurement

Attenuator set to maximum sensitivity. (Below 5mV where noise may be present, the attenuator is set a decade back, i.e. 50mV in lieu of 5mV). Vernier, if incorporated set to CAL. Time base at 100μSec and switched to AUTO.

A low distortion sine wave oscillator with an accurately monitored output (at the point of termination) or one with less than 1% change in level is coupled to the input-socket and correctly terminated. Frequency is set to 50kHz and input level adjusted for 4 cm peak to peak deflection.

The oscillator frequency is now increased and the level noted until it drops to 2.84 cms =-3db or 0.707 of the original level. This will be at 10MHz or higher.

If reference level is 5 or 6 cm etc. then input should be set to this level and -3db point is reached when deflection falls by 30%, i.e. 3.5 cm for 5 cm and 4.2 cm for 6 cm.

NOTE : It does not mean a 3db increase in the signal input will return the display back to 4 cm. This is due to inherent limitations in output amplifier deflection capabilities which largely determine the oscilloscope bandwidth.

Oscilloscope amplifier characteristics to note are : -

(i) The response starts to fall around 30% of the bandwidth, i.e. a -3db 10MHz amplifier starts to roll off around 3MHz and,

(ii) Full screen deflection is not normally available at the maximum bandwidth.

In low cost instruments it is available to approx. 50% of the bandwidth, i.e. up to 5MHz in a 10MHz oscilloscope, but in high performance and relatively high cost models it is available to over 80% of the bandwidth. Overdrive will produce a triangulated sine wave when deflection limit is reached.

1b. Low Frequency Response

With the input switched to DC, the amplifier response is constant (flat) down to zero frequency, enabling the oscilloscope to be used as a DC voltmeter. If the input is changed to AC, a capacitor (usual 0.1uF) is placed in series with the input removing the DC component and attenuating the low frequency AC signal. At 2Hz is slightly less than -3db down from the reference level. Square waves display sloping faces below about 200Hz. A 10-1 divider probe will extend this frequency response down by a factor of 10, i.e. -3db at 0.2Hz.

1c. Rise Time, Typical Spec.

35nSec over 4 cm.

Method of Measurement

This is most accurately obtained by interpolation. The formula, based on a step response

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DC1

with less than 2% overshoot or ringing and applicable to all BWD oscilloscopes is rise time = $\frac{350}{\text{bandwidth (-3db)}}$ nano Sec. e.g. $\frac{350}{10}$ = 35nSec.

A measured rise time on an oscilloscope must also accommodate the input pulse rise time. The formula for this is t display $=\sqrt{t^2}$ pulse + t^2 oscilloscope. The accompanying chart on page 4C provides direct read-out of the values.

NOTE : When measuring near the upper limit of oscilloscope pulse, amplitude should be contained within the limit of the bandwidth reference level, (e.g. 4cm from above example) for greatest accuracy of rise time.

1d. Input Impedance

This invariably consists of a 1MΩ resistance in parallel with a capacitive component. As the capacitance consists of strays and valve or F.E.T. input capacitance it is measured with the instrument working by a direct reading capacitance meter. In high sensitivity instruments an overvoltage applied by the meter can operate the protection circuits and change the input capacitance reading, so measurements are made at 100mV/cm.

NOTE : As input capacitance is added to lead capacitance when making direct measurements, it is always recommended a ÷ 10 high impedance probe be used to reduce this capacitive component down to 10-12pf where signal levels permit.

2. HORIZONTAL AMPLIFIER

General Specifications and measurement techniques are similar to vertical amplifiers and will be referred to where applicable.

2a. Bandwidth, Typical Spec.

DC to 750kHz -3db referred to 6 cm at 50kHz at max. gain.

Method of Measurement

Horizontal gain vernier turned fully clockwise or switched as applicable to max. gain, spot centered. 50kHz sine wave is coupled in and set to 6 cm deflection. Increase input frequency until trace width drops to 4.2cm; this is the -3db point. All notes relative to vertical amplifier section should also be applied to this section, i.e. max. deflection, roll off, rise time etc.

2b. Input Impedance

Many horizontal input amplifiers are transistors with a relative low input impedance, therefore input specifications vary widely from 56KΩ to 1MΩ, and capacitance varies from 10pf to 50pf. Input capacitance and resistance is measured at max. gain.

3. TIME BASE

This section is divided into the following sections : -

(i) Time Base; (ii) Magnification; (iii) Triggering;

3a. Time Base, Typical Spec.

200nSec to 2 Sec in 22 steps, calibration < 3%.

Method of Measurement

Set time base to 1mSec and vernier fully clockwise to CAL. Feed in a 1kHz square wave or pulse with better than 0.1% frequency accuracy. When the first pulse is lined

up with the first graticule line, then the 10th pulse should be within ±3 mm of the 10th graticule line, Checks made at all other time base steps with corresponding calibration pulses should be within the same limits.

NOTE : Calibration accuracy is not the accuracy of each individual division (unless specifically stated) but the overall accuracy, where any variation in trace linearity is averaged over the 10 div. (cm) deflection.
Where linearity is specified, it is usually measured between the 1st and 9th graticule lines to eliminate compression effects around the perimeter of the CRT.

3b. Magnification, Typical Spec.

3% accuracy at X1 and 5% at X5 up to 1μSec/cm.

Method of Measurement

After calibration check as above at 1mSec/cm trace is expanded to X5. 1kHz calibration pulses should be 5 cm apart ± 2.5 mm. With trace at X5, time base is increased to 5μSec/cm producing a 1μSec/cm magnified sweep. This is the limit of specified calibration although it is normally within spec. at X10 this sweep speed over most the trace length.

3c. Triggering, Typical Spec.

INT AUTO 1 cm defl. 5Hz to 10MHz.

This implies when the time base is adjusted for convenient viewing of input, i.e. 5-10 sine waves visible across screen 1 cm high irrespective of attenuator setting, the time base will present a stable display. Above a few MHz it may be necessary to select + or - slope to obtain greatest clarity of display.
NOTE : All bwd oscilloscopes incorporate an AUTO circuit which varies its rate as the time base range switch is changed, they also have a unique feature which increases the sensitivity of the time base if the trigger level drops at high frequencies - a feature which accounts for their superior triggering characteristics. At low frequencies the AUTO rate may exhibit an intermittant repetition rate. This is quite normal and in no way effects its excellent locking ability when a signal is present.

Typical Spec. Level Select ± 3 cm range 3Hz to 10MHz.

If the Select Control is turned clockwise from AUTO, the triggering point can be selected over a 6 cm range. At the upper and lower frequencies of the trigger range the level range reduces and becomes more critical to adjust.

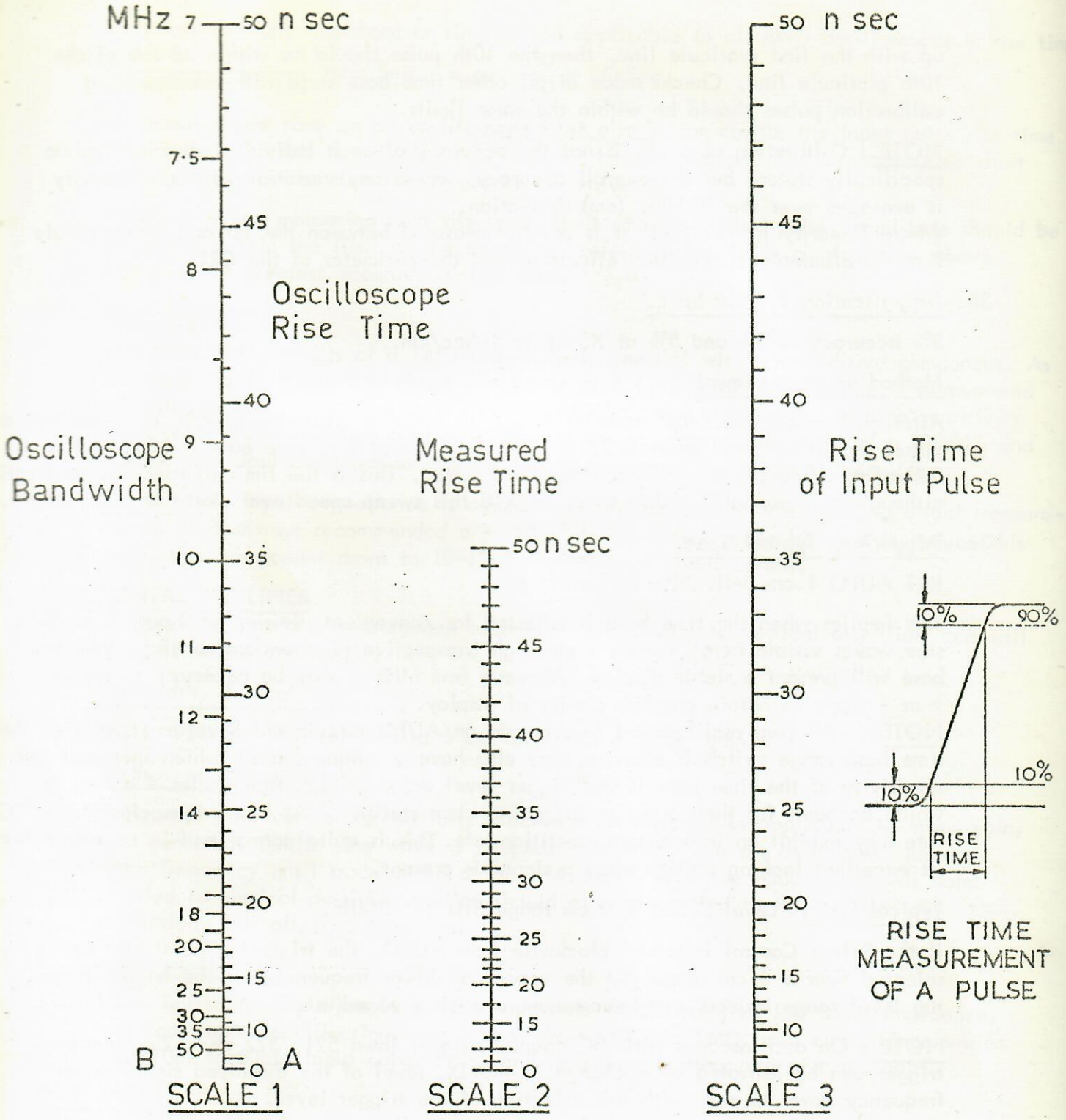
NOTE : On oscilloscopes with DC coupled trigger (bwd 521, 522 and 525) time base trigger can be initiated by a change in the DC level of the displayed signal or any frequency down to zero with full selection of the trigger level.

Spec. EXT AUTO 1V P-P 5Hz to 10MHz.
EXT LEVEL SELECT ± 5V P-P 3Hz to 10MHz.

Characteristics are as specified for internal trigger, but refer to an external trigger signal applied to the EXT trigger socket.

NOTE : Input levels to EXT trigger socket are often limited to ± 60V or 100V RMS. Do not exceed these limits or failure of input transistor may result.

4. Z MODULATION Typical Spec. -20V to modulate at normal intensity.
Set T.B to 1mSec/cm, feed in a 1kHz sine wave 20V P-P from low Z source. Trace should clearly change brightness level each cm.



RISE TIME MEASUREMENT OF A PULSE

To use the above chart read the rise time of the displayed waveform on the CRT between its 10% and 90% points. Find the point corresponding to this value on Scale 2. Join this with a straight edge to the value corresponding to the oscilloscope bandwidth on Scale 1B, the projection on Scale 3 is the true rise time of the input pulse.

For other rise time ranges Scales 1A, 2 & 3 can be multiplied by a convertion factor, e.g. 2, 5 or 10. Scale 1B must be divided by the same factor.

INSTRUMENT HANDBOOK

MODELS BWD-1722B, 1722R AND 1722D OSCILLOSCOPE

1. GENERAL

Model bwd-1722 is a very versatile large screen oscilloscope incorporating the following features -

1. Solid State silicon deflection circuitry.
2. Choice of three (3) Plug-In Amplifiers and Time Base Unit.
3. Three (3) Screen Phosphors.
4. Three (3) Forms of Mounting.

i.e.
- 1722R 19" Rack Mounted.
- 1722B Bench use with Front Panel Controls.
- 1722D Bench use with Rear Top Mounted Controls and a direct coupled 3" Monitor C.R.T.

Any version of Model bwd-1722 can be changed to the other by re-arranging the panels and sub-assemblies or addition of rack adaptors.

The deflection system is all transistor for minimum power dissipation, reliability and stability. All DC supplies including EHT are electronically regulated for complete stability over widely varying input voltages and operating conditions.

Time base plug-in is a precision triggered circuit calibrated to within 10% and has a linearity of better than 2% and covers a wide range from 10μSec/inch to slower than 5 second/inch. An unusual feature is a X5 expansion switch which expands the trace to 60" long for very detailed observation of the displayed waveform.

Versatile triggering from internal or external signals provides absolutely stable locking from DC to the limits of the amplifier response. The plug-in units are readily interchanged and provide a coverage of 500 μV/inch, DC to 15kHz and 4 Channel multiple displays.

C.R.T.

3 alternative C.R.T's are available as detailed under.

- 17CGP4 Blue - White Trace, short persistance.
- 17CGP7 Yellow Trace, long persistance.
- 17CGP26 Orange Trace, very long persistance

EHT approximately 8KV stabilised.

Fitted with neutral density graticule filter and an engraved graticule with ten (10) vertical and twelve (12) horizontal divisions and variable intensity edge illumination.

3. PERFORMANCE

VERTICAL AMPLIFIER (Fitted with 17A Plug-In, See separate handbooks for other units).

Bandwidth :	4" deflection DC to 20kHz - 3db. 8" deflection DC to 12kHz - 3db.
Rise Time:	< 30μSec. for 6" deflection.
Linearity:	Better than 3% at 10"deflection, measured at 1kHz.
Max. Deflection:	X2 screen height (20")
Shift:	X2 screen height (20")
Input Attenuator:	Calibrated in 25, 100, 500mV, 2, 10 and 50V per inch steps with continuously variable vernier (max. uncalibrated sensitivity approx. 12mV per inch (5mV/cm.).
Input Impedance:	Single ended 1MΩ and approx. 50 pf. Balanced 2MΩ and 25 pf.
Calibrator:	400mV (4" deflection) 50Hz square wave for calibration of amplifier. Accuracy 3%.

HORIZONTAL AMPLIFIER (When fitted with 17E Time Base Plug-In)

Bandwidth:	DC to 10kHz at 6" deflection.
Sensitivity:	X1, 100mV per inch approx. X5, 20mV/inch approx.
Input Attenuator:	Continuously variable potentiometer from zero to max. sensitivity. Max. input 500V p-p.
Input Impedance:	1MΩ and approx. 100 pf.
TIME BASE (17E)	Range 10μSec/inch to 500mSec/inch in 8 steps. A 10-1 vernier control between each step extends the slowest speed to less than 5 sec/inch (60 seconds full screen deflection).
Display:	Continuously variable from 0 to 12" trace length at X1. Continuously variable from 0 to 60" trace length at X5 expansion.
Trigger:	3 switches provide selection of the following facilities.

1	2	3
Norm	INT	+
HF (1kHz crossover)	50~	-
LF " "	EXT	

Auto Trigger:	Automatic trigger permits the display of any waveform from 30Hz to 20kHz with a deflection of greater than ½" on CRT or ± 1V external.
Level Select:	Selection of any input level over the full screen height of 8" or ± 10V external.
Preset Level:	Signals greater than 1 inch of deflection or 2V p-p ext. will trigger display over range 2Hz to 20kHz.

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4. FUNCTION OF CONTROLS

The controls on the panel are grouped for ease of use and are largely self explanatory, their operation is as detailed below:

MAIN PANEL 1722B

INTENSITY	Sets the required level of the display intensity.
GRATICULE	Sets the level of the graticule illumination.
FOCUS	Presets the Main C.R.T. display focus.
SYMMETRY	Adjusts the angularity between X and Y axis. May need resetting if Plug-In Units are changed.
"Z"	Socket Input for intensity modulation of Main C.R.T. Display. D.C. coupled to C.R.T. Cathode. When Option 25 is fitted sensitivity is increased to 1V p-p maximum for full blanking range.
CAL	Socket 1V p-p square wave at line frequency for calibration of amplifiers and time base.

MAIN PANEL 1722D (Rear Panel with Monitor C.R.T.)

All controls as for 1722B with the addition of -

FOCUS	(Alongside Monitor C.R.T.) Controls Monitor Focus.
INT	(Alongside Monitor C.R.T.) Controls Monitor Intensity.

REAR OF CABINET

ON-OFF	Mains Power Switch.
INDICATOR LIGHT	Indicates when power is switched on.
FUSE	Main A.C. Input Fuse (2 Amp slow blow)
NOTE:	Two additional fuses are located internally on the cnetre shield for the + and - 22 V supplies.

VERTICAL AMPLIFIER SECTION WITH 17A FITTED

SHIFT	Moves trace vertically on C.R.T. over a range of approximately ± 10" from centre line.
ATTENUATOR	Selects the desired vertical sensitivity in 25, 100, 500mV and 2, 10, and 50V steps over the range of 25mV to 50V per inch.
VERNIER	Provides a 5-1 continuously variable gain between each step and extends the maximum input to over 200V per inch.
A.C. - D.C.	Selects wither A.C. or D.C. Input coupling to amplifier.
BAL.	Preset adjustment to eliminate vertical movement of the trace when the VERNIER control is rotated.

FUNCTION OF CONTROLS (Cont'd)

VERTICAL AMPLIFIER SECTION WITH 17A FITTED (Cont'd)

CAL. Adjusted with attenuator switched to CAL and vernier fully clockwise for 4" display. Attenuator is then calibrated.

+ AND - INPUT TERMINALS
Balanced input terminals. Positive input applied to + input appears as a rising waveform. Positive input applied to - input appears as a falling waveform.

TIME BASE PLUG-IN 17E

SHIFT Moves trace horizontally.

TIME/INCH SWITCH
Selects the Time Base range required in eight ranges from 10μSec. to 500mSec./Inch and in conjunction with the VERNIER control extends the range down to 5 sec/Inch.

VERNIER Turned fully clockwise Time Base will be correctly calibrated according to the range switch. Rotation anticlockwise will reduce the speed over a 10 to 1 Range.

Pulling Out the knob will convert the Time Base to a free-running mode.

GAIN Fully clockwise Time Base will be approximately 12" long and correctly calibrated. Turned anticlockwise trace will reduce to zero. Pulling out the knob will increase trace length by X5. If the Time/Inch switch is turned fully anticlockwise to EXT TB, the internal TB is disabled and signals may be fed into the HORIZONTAL Input terminal.

The Gain control knob will now provide a horizontal sensitivity of approximately 100mV to over 50V/Inch with a pass band of DC to over 10kHz at 8" deflection.

A.C. - D.C. Switch selects the input coupling made for the horizontal amplifier.

NORM, HF, LF
Switch selects the Trigger Mode for the Time Base.

INT, 50~EXT Switch selects the appropriate trigger source for the time base.
NOTE: EXT. is DC coupled input.

TIME BASE PLUG-IN 17E (Cont'd)

TRIGGER LEVEL Control provides three (3) functions.

AUTO — With no input signal an automatic base line is produced until an input signal overrides the auto. action and triggers the display.

LEVEL SELECT — Rotation of the knob away from the auto. switch position permits the trigger level to be selected over an 8" display height.

PRESET — In the fully clockwise position, no base line is generated but a display over 1" deflection or 2V external will trigger the Time Base.

+ - Switch selects the polarity of the triggered signal.

5. OPERATION OF MODEL bwd-1722 OSCILLOSCOPE

Unless you are familiar with the triggered time base incorporated it is advisable that the following procedure be adopted to become familiarised with the instrument.

NOTE: Frequencies higher than 25kHz, particularly when of a high level, may cause the deflection circuit to overload and pull the main HT rails down resulting in a distorted trace and loss of time base. If the instrument is left in this condition for any length of time, the internal protective fuses may blow, requiring replacing before the instrument is usable, therefore, always endeavour to keep input frequencies below 25kHz or at a level where trace is normal and undistorted.

Set Front Panel Controls as follows -

PLUG-IN UNIT 17A	VERT. SHIFT	Mid Position.
	ATTENUATOR	CAL.
	VERNIER	Clockwise.
	AC - DC	AC
TIME BASE UNIT 17E	NORM. HF, LF	NORM.
	TRIGGER SELECTOR	INT.
	+ and -	+
	LEVEL CONTROL	AUTO. - full anticlockwise.
	AC - DC	AC
	HORIZ. GAIN	Clockwise, Pushed In.
	TIME BASE	5mSec/Inch
	VERNIER	Clockwise. Pushed In.
	SHIFT	Mid Position.

5. OPERATION OF MODEL bwd-1722 OSCILLOSCOPE (Cont'd)

Set Front Panel Controls as follows - (Cont'd)

MAIN PANEL	INTENSITY	Anticlockwise.
	GRATICULE	Anticlockwise.

Ensure mains voltage is between 210 and 250V. Connect AC power lead and switch. Allow a minute for instrument to warm up. Rotate INTENSITY control until trace appears. Centre with shift controls if not in centre, or off screen.

Next, turn the trigger LEVEL control from the AUTO position. The trace will disappear and then re-appear when knob is rotated slowly clockwise. It will be observed that the start of the trace moves slowly up and down the calibration waveform as the control is rotated. This demonstrates the LEVEL Selection facility. Fully clockwise will select the PRESET condition and provide very stable locking at all frequencies.

If the + and - switch is removed to -, triggering will now occur on the falling slope of the waveform. The + or - positions and AUTO position of the LEVEL control suit most applications. However, if low frequencies below approximately 500Hz with noise or high frequencies super-imposed are displayed greater stability of trigger may be obtained in the LF + or - positions. Similarly, when frequencies above 1000Hz are displayed with super-imposed low frequencies such as line frequency, the HF + or - positions may provide better stability of display.

HORIZONTAL GAIN

Rotation of this control will reduce the trace length to zero in the anticlockwise position.

X1 - X5 SWITCH

(Pull out GAIN control) Expands horizontal display by a factor of 5 times.

FREE RUNNING TIME BASE

Operate the Oscilloscope as previously described with the calibration waveform displayed, but pull out the VERNIER control to switch the time base to a free-running condition.

The display will wander across the screen, but, by turning the TIME BASE VERNIER control until the time base speed is an exact ratio to the signal being displayed, the trace will SYNCHRONISE with the signal.

5. OPERATION OF MODEL bwd-1722 OSCILLOSCOPE (Cont'd)

FREE RUNNING TIME BASE (Cont'd)

This facility is of considerable use when two unrelated frequencies are contained in a waveform (such as hum signals in an audio amplifier super-imposed on a test frequency) and the normal triggered condition will allow either to initiate the time base, producing a jittery display. By synchronising to the required frequency a more stable display may be obtained.

MEASUREMENT OF WAVEFORMS USING THE CALIBRATED CONTROLS

AC MEASUREMENT

Set the vertical amplifier input selector to the AC position. Couple the signal to be viewed into the + VERTICAL INPUT socket and lead from the EARTH terminal to the Chassis (of the Signal Source) with the Vertical Attenuator to 50V per inch position. If the display is too small, increase the sensitivity of the amplifier with the switch control until a suitable amplitude of signal appears. Then, with the Trigger selector switch in the INT and + positions and the trigger level control in the 'AUTO' position, adjust the Time Base and VERNIER until the required number of waveforms are displayed. When measuring a waveform for amplitude and time, the attenuator and time base VERNIER controls and HORIZONTAL GAIN should be turned fully clockwise to their calibrated positions.

With complex waveforms better triggering may be obtained in the - position or in the high frequency (HF) or low frequency (LF) positions or by selecting the trigger level by using the Trigger Level Control as mentioned in the previous section.

When a trace is stable, the vertical amplitude may be read directly - e.g. a 4" display with the Attenuator Switch set to 2V per inch indicates the waveform is 4 x 2V p-p = 8V p-p. To obtain RMS voltage the peak to peak reading should be divided by 2.84.

The frequency or time duration of the waveform is also read directly, e.g. a waveform 5" long with the switch at 200uSec/in. is 5 x 200µSec = 1000µSec Duration. To obtain the repetition frequency divide 1 Sec., i.e. 1,000,000µSec by the duration of the waveform in µSec. For the previous example $\frac{1,000,000}{1,000}$ = 1,000 Hz i.e. 1kHz.

DC MEASUREMENT

Set up instrument as for AC measurements, but set Input Selector to DC position. If a small battery is connected with the positive to the + input socket and negative to the earthy terminal, the trace will deflect upwards when contact is made. Reverse the battery and the trace will fall, indicating a negative voltage has been applied to the input. The DC input is one of the most useful features of this Oscilloscope and can be used for any of the following applications: -

5. OPERATION OF MODEL bwd-1722 OSCILLOSCOPE (Cont'd)

MEASUREMENT OF DC VOLTAGES

Centre trace on a graticule line. Now apply the voltage to be measured between + input and ground, by adjusting the Attenuator until the trace deflection is within the limits of the graticule, the voltage can be measured by multiplying the deflection between the two traces in inches, by the Attenuator setting in volts or mVolts. If deflection is up, voltage is positive, If deflection is down, voltage is Negative.

AC SIGNALS SUPERIMPOSED ON DC

If it is required, for example, to check an AC waveform at the anode of a valve or the collector of a transistor to check for example that no bottoming or overloading occurs, connect a lead from the Earth terminal of the Oscilloscope to the chassis of the circuit under test.

Then connect a lead from the + input terminals to the anode of the valve or particular point at which the signal is appearing. The trace will move up or down the C.R.T. face depending on the D.C. present and the A.C. signal will appear super-imposed at this new level. By initially setting the trace with zero input against a particular graticule line which becomes the common reference, then touching the lead on the DC supply for the circuit under test and adjusting the Attenuator to make the trace fall on the other edge of the graticule, the display then represents a graph of the signal being observed.

To display the collector swing of a transistor, align the trace with the graticule calibration 3" down from centre. Now connect the signal lead to the collector supply (assume 12V) and adjust the attenuator to 2V/inch. The trace will now be 3" above the centre line as each inch = 2V. Connect the lead to the transistor collector and the waveform appearing can now be measured and checked to see that it is swinging within the required limits.

LOW FREQUENCY MEASUREMENTS

Below 100Hz a square wave will exhibit tilt on its top or bottom faces if displayed in the AC coupled condition. This is due to the time constant of the input circuit which produces a fall of -3db (0.707) at 2Hz. The RC time constant being 0.1 second.

To enable the true signal to be seen at low frequencies it is necessary to use DC input with the signal applied between + and earth or + and -.

INVERTED DISPLAYS

If it is desired to display a waveform inverted to its normal direction, the input signal should be coupled into the - input socket and AC or DC coupled as required.

5. OPERATION OF MODEL bwd-1722 OSCILLOSCOPE (Cont'd)

BALANCED OR DIFFERENTIAL MEASUREMENTS

It is often necessary to measure the signal appearing between two (2) points in a circuit neither of which is at earth (ground) potential, e.g. across a push pull primary of a transformer, across scanning coils of a magnetic deflection system, between electrodes of a transistor,valve, S.C.R., etc., or across loads associated with thyratrons or S.C.R's etc. Connected directly in a 240V AC power line with no isolation. At the same time, signals common to both points such as HT ripple on a push pull output transformer must be suppressed as much as possible. This can be done with the balanced input facility provided.

To use this facility, switch input Selector to AC then connect from the + input terminal to one side of the component across which the waveform is developed and another lead from the -ve Input Socket to the other side. The attenuator is adjusted to present a suitable display and the resultant C.R.T. trace is then an indication of the waveform being developed between the points to which the leads are coupled. Measurement of voltage and time may be made as described previously as the calibration remains irrespective of the input facility employed.

NOTE: Maximum common mode signal applied to both input terminals, i.e. the signal it is required to reject must not be greater than 100X the attenuator setting. Minimum differential rejection is 10 - 1 at all attenuator settings.

EXTERNAL HORIZONTAL INPUT (17E TIME BASE FITTED)

To use the Oscilloscope with an external horizontal display the following settings should be made -

Time Base Switch EXT TB (fully anticlockwise)

All other controls are used normally or do not affect the operation. Input sensitivity is continuously variable between 100mV to over 50V/inch by means of the GAIN control Input may be either AC or DC coupled as required. The X1 - X5 switch increases the horizontal sensitivity to 20mV p-p/inch of deflection, however, hum and noise will increase at this high gain.

X - Y PLOTTING

By using two (2) 17A or 17D/1 single channel amplifiers for both vertical and horizontal inputs identical X and Y sensitivities with balanced inputs may be obtained.

4 INDEPENDENT X - Y DISPLAYS

Can be obtained with two (2) 17B/1, 4 channel amplifiers in the vertical and horizontal positions operating in the CHOPPED mode. See 17B/1 handbook for further details.

5. OPERATION OF MODEL bwd-1722 OSCILLOSCOPE (Cont'd)

RASTER DISPLAY

Two 17E time base units will provide an X and Y raster type display at any frequency within the time base range provided. External triggering and Z Modulation are used to produce a locked intensity modulated display.

6. CIRCUIT DESCRIPTION - See separate handbook for Plug-In Amplifiers and Time Base.

VERTICAL DEFLECTION AMPLIFIER DRG. NO. 862

The balanced signal from the Plug-In Amplifier is directly coupled into Q1 and Q14 PNP balanced Amplifier. Negative feedback from the deflection yoke is also applied to Q1 and Q14 bases through R7 and R10 and mixed with the input signal and shift voltages. A potentiometer placed between the emitters varies the degeneration in the Amplifier and controls the overshoot on square or pulse waveforms. It is adjusted for optimum response with minimum overshoot.

The output at Q1 and Q14 collectors is directly connected to the emitter follower drivers, Q4 and 9.

The vertical deflection amplifiers are arranged as a symetrical NPN-PNP bridge circuit. Q5 and Q6, Q8 and Q10 are single ended push pull pairs driving the balanced split yoke in push pull. Drive to the deflection transistors is applied directly to Q5 and Q8 from emitter follower drivers Q4 and 9 and through diode networks D4 to 7 and D8 to 11 to Q7 and Q11 PNP transistors driving Q5 and 10 PNP stages.

Each section of the yoke is taken to ground through a 10Ω resistor R8 and 9 across which a voltage is developed proportional to the current flow in the yoke. This voltage is fed back to the input amplifiers to linearise the deflection and increase the bandwidth. The voltage across the 10Ω resistors is also taken to PL5 for the monitor CRT when fitted in Model 1722D, and to PS8 for remote slave drive circuit.

HORIZONTAL DEFLECTION AMPLIFIER

The basic deflection amplifier is identical to the vertical system other than in a few minor details.

For correct display on CRT the average DC voltage on each yoke must be identical. To enable this to be readily preset, a front panel control marked SYMMETRY is brought out (RV2), (Drg. No. 604). This varies the emitter loads of Q15 and 18 and therefore changes the current flowing in the transistors. This change of operating current changes the drop across R21 and R34 and so varies the average DC level across the deflection drivers and yoke enabling the X and Y axis to be equalised when plug-in units are changed.

C.R.T.

The 17" CRT requires +8.0KV EHT and a second anode voltage of +380. Focus is electrostatic and is adjusted by RV15 preset. Unblanking of the trace is provided by direct coupling of the CRT grid to the time base generator as described in 17E circuit description. External Z modulation signals are directly coupled to the CRT cathode or via an amplifier for high sensitivity modulation when option 25 is incorporated.

POWER SUPPLIES

T1 astatically wound power transformer supplies all AC and DC supplies in this instrument othern than the 8KV EHT.

-22V RAIL

D29 and 30 full wave rectify the 25-0-25V AC winding. C8 single stage filter reduces hum to 2.5V p-p. The transistor regulator is a single amplifier stage Q34 with D1 Zener diode reference. The Output Voltage is applied across divider R43 and 44 RV5 to the base of Q34 via R73. Difference signals between base and emitter are amplified and applied to Q33 emitter follower which provides the base current necessary to drive Q32 series power transistor. To minimise disipation in Q32 a proportion of the output current is diverted through R72. Output is separately fused by F3 mounted on the centre deflection shield. This must always be replaced by a three (3) Amp fast blow type.

+22V RAIL

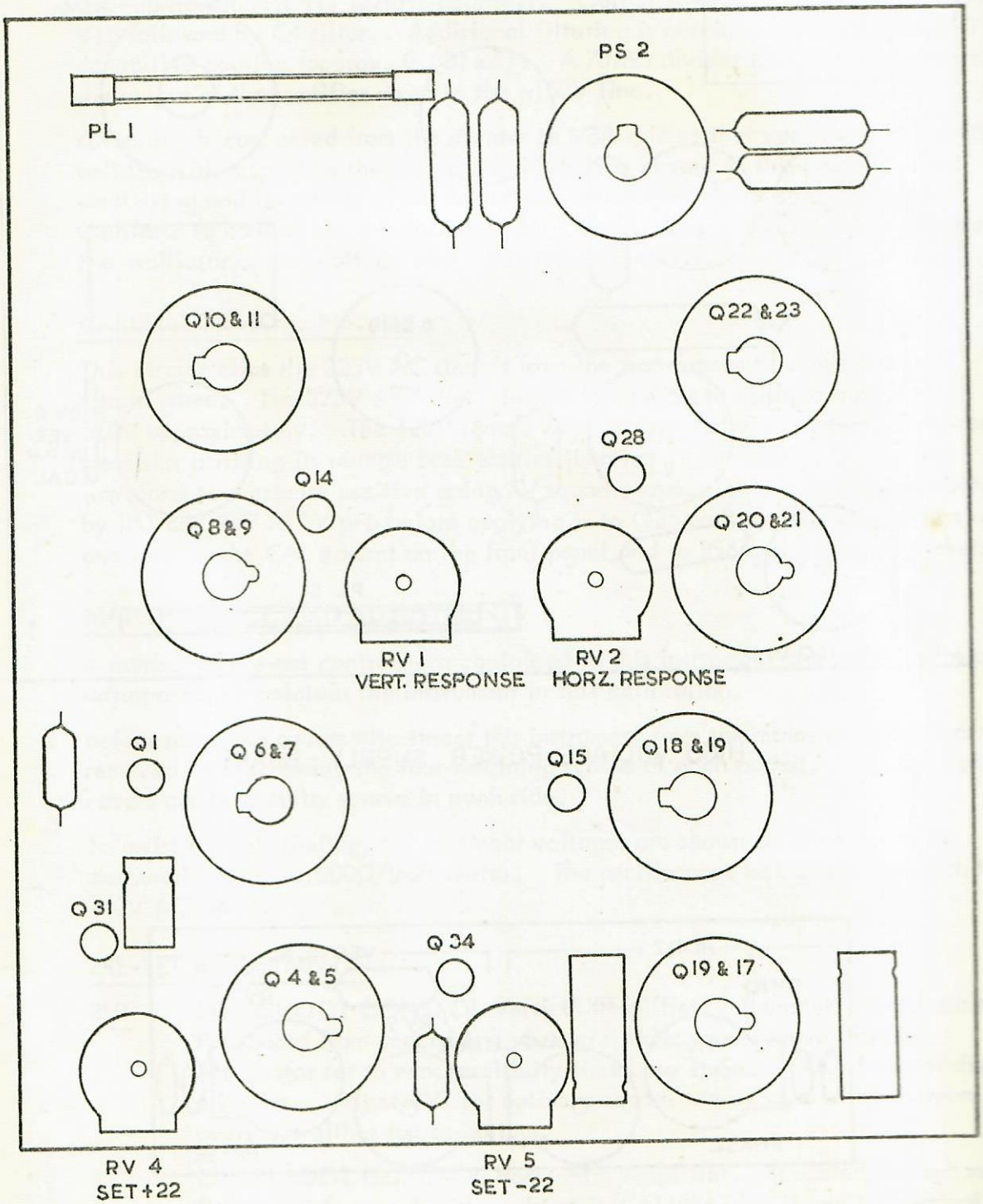
This supply is similar to the -22V supply but uses the -22V rail as its reference and an auxilliary +44V rail for the collector load, diode D28 and resistor R70 supplies Q31 until +44V is available on switch on. (applies only to instruments fitted with rectifiers valve V1.)

-150V RAIL

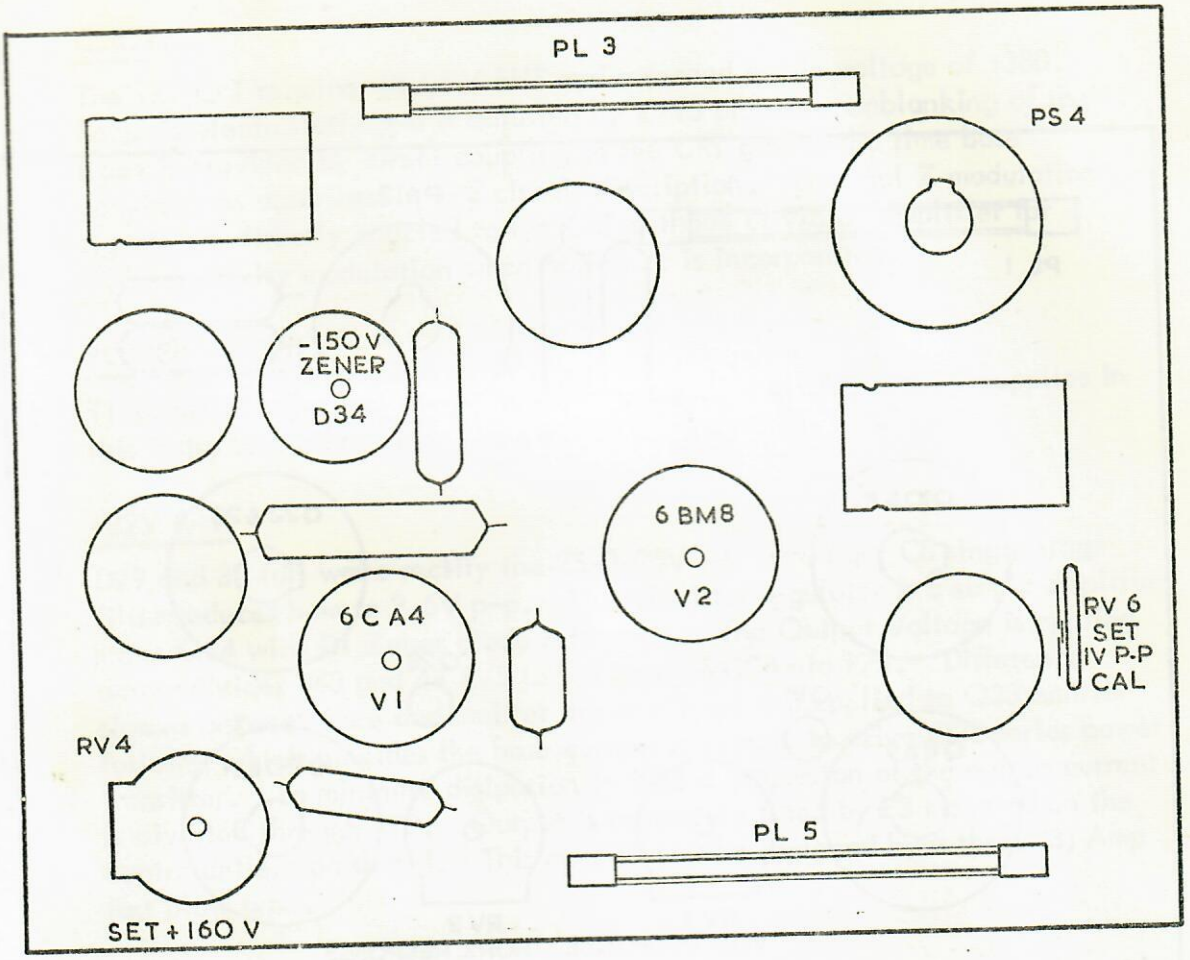
D24 and 25 in series, half wave rectify 325V RMS which is then filtered by a two (2) stage RC filter C12, R67, C13. D34 stabilises the line at -150V which is finally filtered by R53 and C17.

+390, +380 and +160V

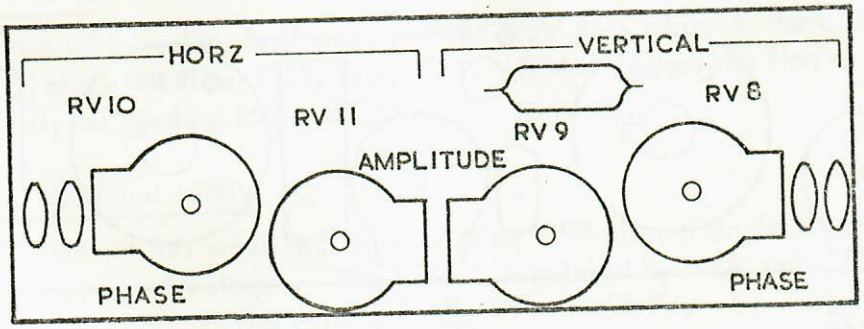
V1 or D36-39 full wave rectifier supplies +390 after a single filter stage and +380 after two (2) stages. The +160 is regulated by V2A and V2B or Q37 and Q38. RV5 enables the voltage to be set to +160 1V. D3 Zener diode provides the reference for the +160V supply.



BWD 1722 DEFLECTION BOARD
SHOWING LOCATION OF CONTROLS ETC.



HIGH VOLTAGE POWER SUPPLY BOARD



HUM BALANCING BOARD

6. CIRCUIT DESCRIPTION (Cont'd)

+8.0K EHT (Drg. No. 610)

V38 is a feedback oscillator operating at the natural resonance frequency of the step-up transformer T1, (22kHz approx.). Output is voltage doubled by V1 and V12 followed by C4 filter. Additional filtering is obtained by R1 and the CRT capacitive coating (approx. 0.001 μF). A 70MΩ divider R2-10 is placed across the output of the rectifier down to the -150V line.

A tapping is connected from the divider to V3A grid so that variations in the EHT voltage with respect to the regulated -150V line appear at this point. After amplifying and inverting, these variations are applied to the screen of V38 oscillator to control the current drawn by it and therefore control the amplitude of the oscillator output voltage which sets the output EHT.

CALIBRATOR (Drg. No. 862

This circuit clips the 325V AC signals from the transformer to convert it to a square wave. The 325V AC is fed via R59 to B5 NE2 to clip the output to ±60V approximately. The 120V square wave is then fed via R58 to Q36 planar transistor utilising its reverse base emitter junction zener facility to clip the waveform to a precise positive going 7V square wave. This is further attenuated by R57 and RV7 to 1V p-p before applying it to Q35 emitter follower driver stage and then to the CAL socket on the front panel and to PS6 and 7 Plug-In sockets.

7. MAINTENANCE AND ADJUSTMENTS

A number of pre-set controls are contained in this instrument and may require periodical adjustments to maintain the instrument in full calibration.

Before removing covers disconnect the instrument from the mains supply. Rear panel is removed by unscrewing the four retaining screws at each corner. Top and bottom covers are held on by screws in each side.

To assist in fault finding, all pertinent voltages are shown on the circuits as measured with a 20,000Ω/Volt Meter. The oscilloscope being supplied with the 240V AC mains.

PRE-SET ADJUSTMENTS

RV1 OVERSHOOT CONTROL Vertical Amplifier. (Located through main P/C board from underside.) Set up a 1kHz square wave display. Attenuator set to max.sensitivity time base 1mSec. Amplitude of display 6 inches. Adjust RV1 for optimum square wave shape with minimum overshoot either top or bottom.

RV2 OVERSHOOT CONTROL Horizontal Amplifier. (Located through main P/C Board from underside. Feed in CALIBRATOR Signal to Vertical Amplifier and a 1kHz square wave to the Horizontal input. Adjust RV2 for minimum overshoot on either side of wave pattern.

7. MAINTENANCE AND ADJUSTMENTS (Cont'd)

PRE-SET ADJUSTMENTS - Cont'd

RV4 +22V control (located through main P/C Board from underside.)
Set for +22V ± -0.5V (adjust after RV5).

RV5 -22V control (located through main P/C Board from underside.)
Set for -22V ± 0.5V.

RV6 +160V control (located through small P/C Board from underside.)
Set for +160V ± 1V.

RV7 CALIBRATE WAVEFORM (Located at edge of small P/C Board.)
Check at front panel output socket with a calibrated oscilloscope.
Set CAL waveform for 1V p-p against known oscilloscope standard.

RV2 SYMMETRY Set up 1kHz square wave display 8 Div. high time base 1mSec/inch.
Adjust RV2 for best geometry and linearity of display.

RV4 CRT FOCUS (Front Panel) with CAL. waveform displayed adjust RV4 for best focus at normal trace intensity.

RV8 & 9 VERTICAL HUM BALANCE. Feed in 1kHz square wave and adjust for 4" vertical deflection. Turn time base to 200μSec/inch vernier fully clockwise. Adjust RV9 for minimum detectable hum on top and bottom faces of waveform, then adjust RV8 phase control for complete null. Repeat as necessary for zero hum..

RV10 & 11 HORIZONTAL HUM BALANCE. Set up oscilloscope as above for RV8 & 9. Adjust RV11 for minimum detectable hum on vertical faces of waveform, then adjust RV8 phase control for complete null. Repeat as necessary.

When replacing valves no preset controls should need re-setting unless valve is very out of tolerance.

Alignment of amplifiers and time base is shown in the individual handbooks.

ALTERNATIVE VALVE TYPE

V1	6CA4 or EZ81 (Main chassis)
V2	6BM8, ECL82 (Main chassis)
V1	1X2B 1X2A (EHT Supply)
V2	1X2B 1X2A (EHT Supply)
V3	6GV8

8. REPLACEMENT PARTS

Spares are normally available from the manufacturer, B.W.D. ELECTRONICS PTY. LTD. When ordering, it is necessary to indicate the serial number of the instrument. If exact replacements are not to hand, locally available alternatives may be used, provided they possess a specification not less than, or physical size not greater than the original components.

As the policy of B.W.D. ELECTRONICS PTY. LTD. is one of continuing research and development, the Company reserves the right to supply the latest equipment and make amendments to circuits and parts without notice.

9. GUARANTEE

The equipment is guaranteed for a period of twelve (12) months from the date of purchase, against faulty materials and workmanship, with the exception of Cathode Ray Tubes, which are covered by their manufacturer's own warranty.

Please refer to Guarantee Registration Card Number ..... which accompanied instrument, for full details of conditions of warranty.

MONITOR C.R.T.

TYPE 1722D

Deflection signals seen on the monitor C.R.T. are exactly proportional to those seen on the main C.R.T. Display. The current through the deflection yokes is proportional to the deflection of the beam on the main C.R.T. This deflection current also passes through R8, 9, 27 and 28 feedback sensing resistors where it developes a voltage proportional to the current flowing. This signal voltage is connected through the inter connecting plug PL5 to the deflection amplifier in the Monitor Unit. Vertical amplifier is Q1 and 2. Horizontal Q3 and 4. RV2 sets the vertical sensitivity and RV7 sets the horizontal sensitivity. Centering is by RV1 and RV6 to align the deflection on the monitor graticule to that on the mains graticule.

EHT supply is obtained by voltage doubling one side of the 325V AC supply AC supply by D1 and 1 and adding it to the -22V supply. C2, R3, C3, remove the EHT ripple and supplies the CRT with -560V.

All components other than the focus and intensity controls are located on the monitor printed circuit board attached to the C.R.T. shield.

B.W.D. ELECTRONICS PTY.LTD.

REPLACEABLE PARTS

1. This section contains information for ordering replacement parts, it provides the following details : -

   (a) Description of part (see list of abbreviations).
   (b) Typical manufacturer or supplier of the part (see list of abbreviations).
   (c) Manufacturer's Part Number, and
   (d) Defence Stock Number, where applicable.

2. Ordering - Please quote Model Type No., e.g. bwd 511, Serial No. Circuit Reference No. and component details as listed in parts list.

COMPONENT DESIGNATORS

A	Assembly	H	Heater	RV	Resistor Variable
B	Lamp	J	Jack (socket)	S	Switch
C	Capacitor	L	Inductor	T	Transformer
D	Diode	M	Meter	TH	Thermistor
DL	Delay Line	P	Plug	V	Valve
E	Misc. Elect. Part	Q	Transistor	VDR	Voltage Dependent Resistor
F	Fuse	R	Resistor		

ABBREVIATIONS

Amp	Ampere	L	Inductor
C	Capacitor	lin	Linear
cc	Cracked Carbon	Log	Logarithmic Taper
c	Carbon	m	Milli = 10^{-3}
cd	Deposited Carbon	MHz	Mega Hertz = 10^{6}Hz
comp	Composition	MF	Metal Film
CDS	Ceramic Disc Capacitor	ma	Milli Ampere
cer	ceramic	MΩ	Meg Ohm = $10^{6}\Omega$
Com	Common	mfr	Manufacturer
DPST	Double Pole Single Throw	MO	Metal Oxide
DPDT	Double Pole Double Throw	MHT	Polyester/Paper Capacitor
elec	Electrolytic	MPC	Metalised Polyester Capacitor
F	Farad	Ne	Neon
f	Fuse	NPO	Zero temperature co-efficient
FET	Field Effect Transistor	nsr	Not separately replaceable
Ge	Germanium	NC	Normally Closed
H	Henry(ies)	NO	Normally Open
H.S.	High Stability	ns	Nano second
HTC	High Temp Coating	obd	Order by Description
ins	Insulated	OD	Outside Diameter
kHz	Kilo Hertz = 10^{3}Hz	p	Peak
KΩ	Kilo Ohm = $10^{3}\Omega$	pf	pico farad = 10^{-12}F

COMPONENT ABBREVIATIONS (cont.)

PL	Plug
PS	Socket
Preset	Internal Preset
PYE	Polyester
pot	Potentiometer
prec	Precision
PC	Printed circuit
PIV	Peak Inverse Voltage
PYS	Polystyrene
p-p	Peak to Peak
P.Shaft	Plain Shaft
Q	Transistor
R	Resistor
rot	rotary
R log	Reverse Logarithmic Taper
rms	Root Mean Squared
SPDT	Single Pole Double Throw
SPST	Single Pole Single Throw
S.Shaft	Slotted Shaft
Si	Silicon
Ta	Tantalum
tol	Tolerance
trim	trimmer
V	Volt(s)
var	variable
vdcw	Volts Direct Current Working
w	Watt(s)
ww	Wire Wound
Z	Zener
*	Factory Selected value, nominal value may be shown
**	Special component, no part no. assigned

MANUFACTURERS ABBREVIATIONS

AB	A.B. Electronics
AEE	AEE Capacitors
AN	Anodeon
AST	Astronic Imports
AWA	Amalgamated Wireless of Aust.
ACM	Acme Engineering Pty.Ltd.
AMP	Aircraft Marine Products(Aust.) P/L
AR	A. & R. Transformers
AUS	Australux Fuses
AWV	Amalgamated Wireless Valve Co.
ACA	Amplifier Co. of Aust.
ARR	Arrow
BWD	B.W.D. Electronics Pty.Ltd.
BL	Belling & Lee Pty.Ltd.
BR	Brentware (Vic.) Pty.Ltd.
BU	Bulgin
CF	Carr Fastener
CAN	Cannon Electrics Pty.Ltd.
CIN	Cinch
DAR	Darstan
DIS	Distributors Corporation Pty.Ltd.
ELN	Elna Capacitors (Sonar Elec.P/L)
ETD	Electron Tube Dist.
F	Fairchild Australia Pty.Ltd.
GRA	General Radio Agencies
GE	General Electric (USA)
GEC	General Electric Co. (UK)
GES	General Electronic Services
HW	Hurtle Webster
HOL	R.G. Holloway
H	Haco Distributors (National)
HS	Hawker Sidley
J	Jabel
McH	McKenzie & Holland(Westinghouse)
MAS	Master Instrument Co.Pty.Ltd.
MOR	Morganite (Aust.) Pty.Ltd.
MSP	Manufacturers Special Products (AWA)
McM	McMurdo (Aust.) Pty.Ltd.
MOT	Motorola
NU	Nu Vu Pty.Ltd.
NAU	A.G. Naunton Pty.Ltd.
NS	National Semiconductor
PA	Painton
PAL	Paton Elect. Pty.Ltd.
PI	Piher Resistors (Sonar Electronics)
PH	Philips Electrical Industries Pty.Ltd.
PL	Plessey Pacific
PRO	Procel
PV	Peaston Vic.
RC	Radio Corporation (Electronic Inds.)
RCA	Radio Corporation of America
RHC	R.H. Cunningham
STC	Standard Telephone & Cables
SI	Siemens Electrical Industries
SIM	Simonson Pty.Ltd.
SE	Selectronic Components
SON	Sonar Electronics
TR	Trimax Erricson Transformers
TI	Texas Instruments Pty.Ltd.
TH	Thorn Atlas
UC	Union Carbide
W	Wellyn Resistors (Cannon Elec. P/L)
WH	Westinghouse
Z	Zephyr Prod. Pty.Ltd.

PARTS LIST MODEL bwd 1722

MAIN FRAME DRG. 862

CCT Ref.	DESCRIPTION				Mfrs. or Supply	PART No.	
	RESISTORS						
R1	68KΩ	½W	5%	cc	PI		
R2	8.2KΩ	½W	5%	cc	PI		
R3	15KΩ	½W	5%	cc	PI		
R4	120KΩ	½W	5%	cc	PI		
R5	0.5Ω	5W	10%	ww	Reco	AABI	
R6	0.5Ω	5W	10%	ww	Reco	AABI	
R7	8.2KΩ	½W	5%	cc	PI		
R8	10Ω	4W	5%	MO	Metox	F32	
R9	10Ω	4W	5%	MO	Metox	F32	
R10	8.2KΩ	½W	5%	cc	PI		
R11	0.5Ω	5W	10%	ww	Reco	AABI	
R12	0.5Ω	5W	10%	ww	Reco	AABI	
R13	120KΩ	½W	5%	cc	PI		
R14	8.2KΩ	½W	5%	cc	PI		
R15	15KΩ	½W	5%	cc	PI		
R16	22KΩ	20W	5%	ww	H.W		
R17	68KΩ	½W	5%	cc	PI		
R18	220Ω	½W	5%	cc	PI		
R19	500Ω	20W	5%	ww	H.W		
R20	68KΩ	½W	5%	cc	PI		
R21	8.2KΩ	½W	5%	cc	PI		
R22	6.8KΩ	½W	5%	cc	PI		
R23							
R24	0.5Ω	5W	10%	ww	Reco	AABI	
R25	0.5Ω	5W	10%	ww	Reco	AABI	
R26	8.2KΩ	½W	5%	cc	PI		
R27	10Ω	4W	5%	MO	Metox	F32	
R28	10Ω	4W	5%	MO	Metox	F32	
R29	8.2KΩ	½W	5%	cc	PI		
R30	0.5Ω	5W	10%	ww	Reco		
R31	0.5Ω	5W	10%	ww	Reco	AABI	
R32	6.8KΩ	½W	5%	cc	PI		
R33							
R34	8.2K	½W	5%	cc	PI		
R35	68KΩ	½W	5%	cc	PI		
R36	1KΩ	½W	5%	cc	PI		
R37	6.8KΩ	½W	5%	cc	PI		
R38	18KΩ	½W	5%	cc	PI		
R39	18KΩ	½W	5%	cc	PI		
R40	1KΩ	½W	5%	cc	PI		
R41	10KΩ	½W	5%	cc	PI		
R42	6.8KΩ	½W	5%	cc	PI		

PARTS LIST MODEL bwd 1722

MAIN FRAME DRG. 862

CCT Ref.	DESCRIPTION				Mfrs. or Supply	PART No.	
	RESISTORS (Cont'd)						
R43	15KΩ	½W	5%	cc	PI		
R44	4.7KΩ	½W	5%	cc	PI		
R45	5.6KΩ	4W	5%	MO	Metox	F32	
R46	1MΩ	½W	5%	cc	PI		
R47	390Ω	1W	5%	cc	PH		
R48	1KΩ	½W	5%	cc	PI		
R49	82Ω	½W	5%	cc	PI		
R50	120KΩ	½W	5%	cc	PI		
R51	10Ω	½W	5%	cc	PI		
R52	390KΩ	½W	5%	cc	PI		
R53	1K	½W	5%	cc	PI		
R54	470KΩ	½W	5%	cc	PI		
R55	82Ω	½W	5%	cc	PI		
R56	18KΩ	½W	5%	cc	PI		
R57	47KΩ	½W	5%	cc	PI		
R58	100KΩ	½W	5%	cc	PI		
R59	220KΩ	1W	5%	cc	PI		
R60	5.6KΩ	½W	5%	cc	PI		
R61	100Ω	½W	5%	cc	PI		
R62	100Ω	½W	5%	cc	PI		
R63	100Ω	½W	5%	cc	PI		
R64	100Ω	½W	5%	cc	PI		
R65	100KΩ	½W	5%	cc	PI		
R66	2.2KΩ	4W	5%	MO	Metox	F32'	
R67	6.8KΩ	6W	5%	MO	Metox	F33	
R68	1KΩ	½W	5%	cc	PI		
R69	100KΩ	½W	5%	cc	PI		
R70	12KΩ	½W	5%	cc	PI		
R71	100KΩ	½W	5%	cc	PI		
R72	22Ω	10W	10%	ww	Merlin		
R73	5.6KΩ	½W	5%	cc	PI		
R74	22Ω	10W	10%	ww	Merlin		
	CAPACITORS						
C1	.1	100V	10%	PYE	Elna	Type N	
C2	.047	160V	10%	PYE	PH	C296BA/A47K	
C3	250μF	25V	elec		PH	C437AR/F250	
C4	250μF	25V	elec		PH	C437AR/F250	
C5	2000μF	50V	elec		DUC	EMG 1682S	
C6	0.047μF	160V	10%	PYE	PH	C2968A/A47K	
C7	50uF	40V	elec		PH	C426AR/F50	

PARTS LIST MODEL bwd 1722

MAIN FRAME DRG 862

CCT Ref.	DESCRIPTION	Mfrs. or Supply	PART NO.
	CAPACITORS (Cont'd)		
C8	2000µF 50V elec	DUC	EMG16825
C9	0.047µF 160V 10% PYE	PH	C296AA/A47K
C10	50µF 40V elec	PH	C426AR/F50
C11	32µF 500V elec	DUC	EO5F
C12	32µF 500V elec	DUC	EO5F
C13	32µF 500V elec	DUC	EO5F
C14	0.1µF 160V 10% PYE	PH	C296AA/A10K
C15	50µF 150V elec	PH	C436AR/K50
C16	32µF 500V elec	DUC	EO5F
C17	50µF 150V elec	PH	C436AR/K50
C18	0.033µF 160V 10% PYE	PH	C296AA/A33K
C19) to C22)	0.1µF 100V 10% Green Cap	S	
	POTENTIOMETERS		
RV1	100Ω lin Preset c	PH	E097AD/100E
RV2	100Ω lin Preset c	PH	E097AD/100E
RV3			
RV4	4.7KΩ lin Preset c	PH	E097AD/4K7
RV5	4.7KΩ lin Preset c	PH	E097AD/4K7
RV6	470KΩ lin Preset c	PH	E097AD/470K
RV7	10KΩ lin Preset c	PH	E097AC/10K
RV8	100KΩ lin Preset c	PH	E097AD/100K
RV9	100KΩ lin Preset c	PH	E097AD/100K
RV10	100KΩ lin Preset c	PH	E097AD/100K
RV11	100KΩ lin Preset c	PH	E097AD/100K
	TRANSISTORS		
Q1	-60V Vce hfe 100 SI PNP	F	2N3645
Q2			
Q3			
Q4	60V Vce 5A 25w SI NPN	RCA	2N3054
Q5	60V Vce 15A 115w SI NPN	RCA	2N3055
Q6	-60V Vce 10A 85w SI PNP	MOT	MJE2955
Q7	-60V Vce 1A 30w SI NPN	TI	TIP30A
Q8	60V Vce 15A 115w SI NPN	RCA	2N3055
Q9	60V Vce 5A 25w SI NPN	RCA	2N3054
Q10	-60V Vce 10A 85w SI PNP	MOT	MJE2955
Q11	-60V Vce 1A 30w SI PNP	TI	TIP30A
Q12			
Q13			
Q14	-60V Vce hfe 100 SI PNP	F	2N3645

PARTS LIST MODEL bwd 1722

MAIN FRAME DRG.862

CCT	DESCRIPTION	Mfr. or Supply	PART NO.
	TRANSISTORS (Cont'd)		
Q15	-60V Vce hfe 100 SI PNP	F	2N3645
Q16	60V Vce 5A 25W SI NPN	RCA	2N3054
Q17	60V Vce 15A 115W SI NPN	RCA	2N3055
Q18	-60V Vce 1A 30W SI PNP	TI	TIP30A
Q19	-60V Vce 10A 85W SI PNP	MOT	MJE2555
Q20	60V Vce 15A 115W SI NPN	RCA	2N3055
Q21	60V Vce 5A 25W SI NPN	RCA	2N3054
Q22	-60V Vce 10A 85W SI PNP	MOT	MJE2955
Q23	-60V Vce 1A 30W SI PNP	TI	TIP30A
Q24			
Q25			
Q26			
Q27	-60V Vce hfe 100 SI PNP	F	2N3645
Q28	60V Vce 15A 115W SI NPN	RCA	2N3055
Q29	360V Vce .5A 20W SI NPN	MOT	MJE340
Q30	45V Vce hfe 100 SI NPN	F	2N3642
Q31	60V Vce 15A 115W SI NPN	RCA	2N3055
Q32	300V Vce .5A 20W SI NPN	MOT	MJE340
Q33	45V Vce hfe 100 SI NPN	F	2N3642
Q34	45V Vce hfe 100 SI NPN	PH	BC107
Q35	-25V Vce hfe 25 SI PNP	F	2N3638
Q36	45V Vce hfe 25 SI NPN	F	2N3642
Q37			
	DIODES		
D1	100V PIV DIODE 30mA GE	PH	OA95/OA91
D2	100V PIV DIODE 30mA GE	PH	OA95/OA91
D3	150V PIV DIODE 50mA SI	PH	IN4148
D4 - D11	100V PIV DIODE .5A SI	STC	EM401
D12	24V ZENER DIODE 1W SI	IR	IN4749
D13	150V PIV DIODE 50mA SI	PH	IN4148
D14	150V PIV DIODE 50mA SI	PH	IN4148
D15	150V PIV DIODE 50mA SI	PH	IN4148
D16	150V PIV DIODE 50mA SI	PH	IN4148
D17 - D20	100V PIV DIODE .5A SI	STC	EM401
D21	150V PIV DIODE 50mA SI	PH	IN4148
D22 - D25	100V PIV DIODE .5A SI	STC	EM401
D26 - D27	200V PIV DIODE 15A SI	PH	BYX21/200

PARTS LIST MODEL bwd 1722

MAIN FRAME DRG. 862

CCT REF	DESCRIPTION	Mfr. or Supply	PART NO.
	DIODES (Cont'd)		
D28	100V PIV DIODE .5A SI	STC	EM401
D29 - D30	200V PIV DIODE 15A SI	PH	BYX21/200
D31	6.2V ZENER DIODE 400mW SI	PH	BZY88/6V2
D32	400V PIV DIODE .5A SI	STC	EM401
D33	400V PIV DIODE .5A SI	STC	EM401
D34	150V ZENER DIODE 3W SI	IR	IN3011B
D35	75V ZENER DIODE 400mW SI	PH	BZX70/C75
	VALVES		
V1	Dual Diode Rectifier	PH	6CA4
V2	Triode Pentode	PH	6BM8
	LAMPS		
B1	6.3V 0.25A	PH	6913
B2	6.3V 0.25A	PH	6913
B5	Neon NE2 CC3L	DUC	CC3L
	SUNDRY		
PL1	10 Way Plug	McM	PP10
PS2	Octal Socket	McM	X8/UPC
PL3	10 Way Plug	McM	PP10
PS4	Octal Socket	McM	X8/UPC
PL5	10 Way Plug	McM	PP/UPC
L1-L4	Yoke	Rola	SK1152
	Printed Circuit Epoxy Glass	BWD	160/117
T1	Power Transformer	A & R	PT2453
	Printed Circuit Epoxy Glass	BWD	160/023
	4 Pole Fan Motor	WD	Type 10/4
	Printed Circuit Epoxy Glass	BWD	160/092
F1	2A Delay Fuse	Y	
F2	4A Fast Blow Fuse	Y	
F3	3A Fast Blow Fuse	Y	
B3	Neon Indicator	TH1	HBN-02-6300
	DPST Toggle Switch	NSF	8370/K8
	7-6" Power Card and 3 Pin Plug	BWD	
	ALL OTHER ITEMS ORDER BY DESCRIPTION		

A / 2	MODIFICATIONS:
C / 1	ISSUE 3 4-67 PRODUCTION.
RV / 5	ISSUE 4 6-69. RV5 ADDED.
SK / 3.	

CONTROLS

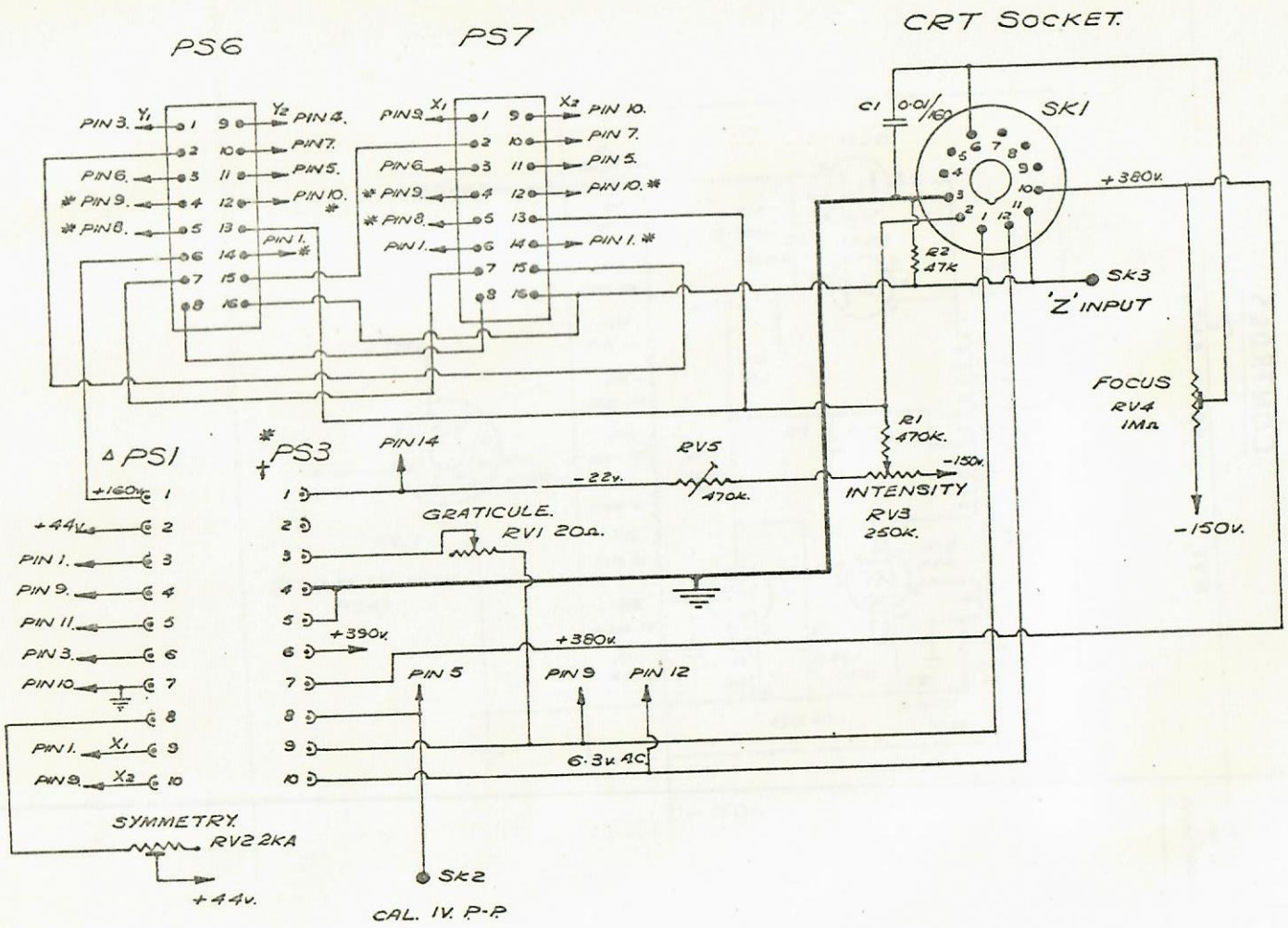
RV1. GRATICULE INTENSITY.

RV2. SYMMETRY.

RV3. CRT. INTENSITY.

RV4. CRT. FOCUS.

RV5. MAX. INTENSITY PRESET.



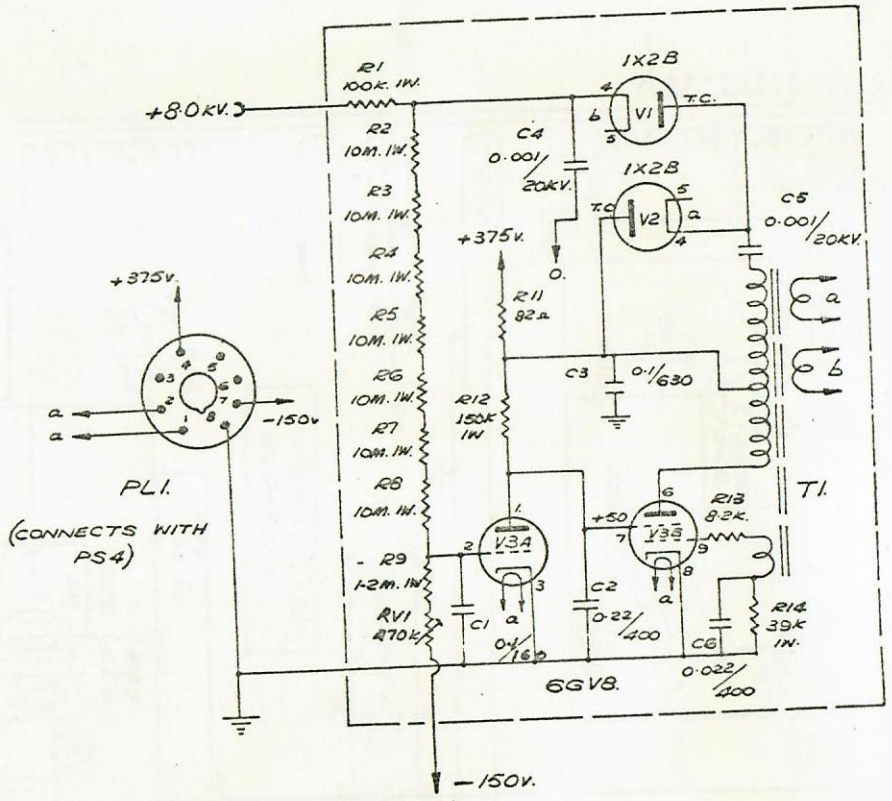
* INDICATES PS3.
† CONNECTS WITH PL3.
Δ CONNECTS WITH PL1.

			ISSUE	1722	B.W.D. ELECTRONICS P/L. MELB. AUSTR	Drg. N°
				DRAWN	CONTROL PANEL CCTS	604

R 15	MODIFICATIONS.
C 7	ISSUE 2 PRODUCTION.
	ISSUE 3 +380V REMOVED
	ISSUE 4 T.C. V2 WAS TAKEN TO EARTH. R12 WAS 220K 1W. R9 WAS 150K 1W. C1 WAS 0·001/400.

CONTROLS

RV1 SET EHT



ISSUE	1722	B.W.D. ELECTRONICS P/L. MELBOURNE.	DRG. N°
4	DRAWN JB	EHT SUPPLY MODEL 1722	610
	DATE 4/68		
	TRACED DC		
8/69	CHECKED [illegible]		

R36 TO R74
C5 TO C22
D26 TO D35
Q29 TO Q36

MODIFICATIONS

ISSUE 2. 6-72
R52 - 390K CHANGED TO 270K

CONTROLS

RV4 SET + 22V

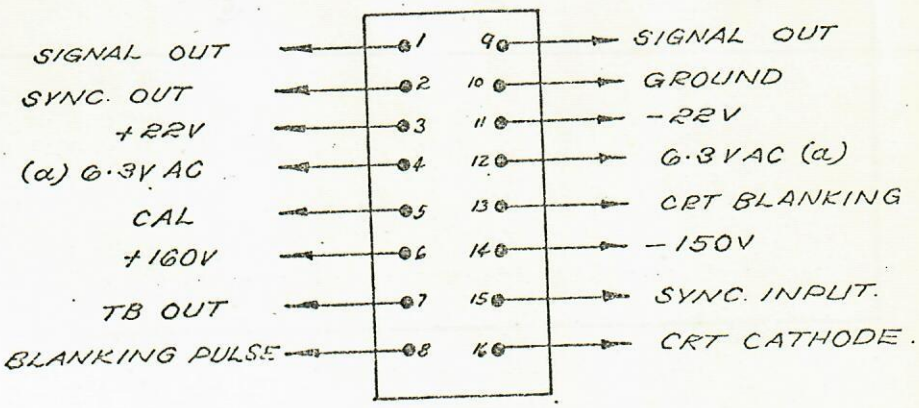
RV5 SET - 22V

RV6 SET + 160V

RV7 SET 1V P-P CAL OUTPUT.

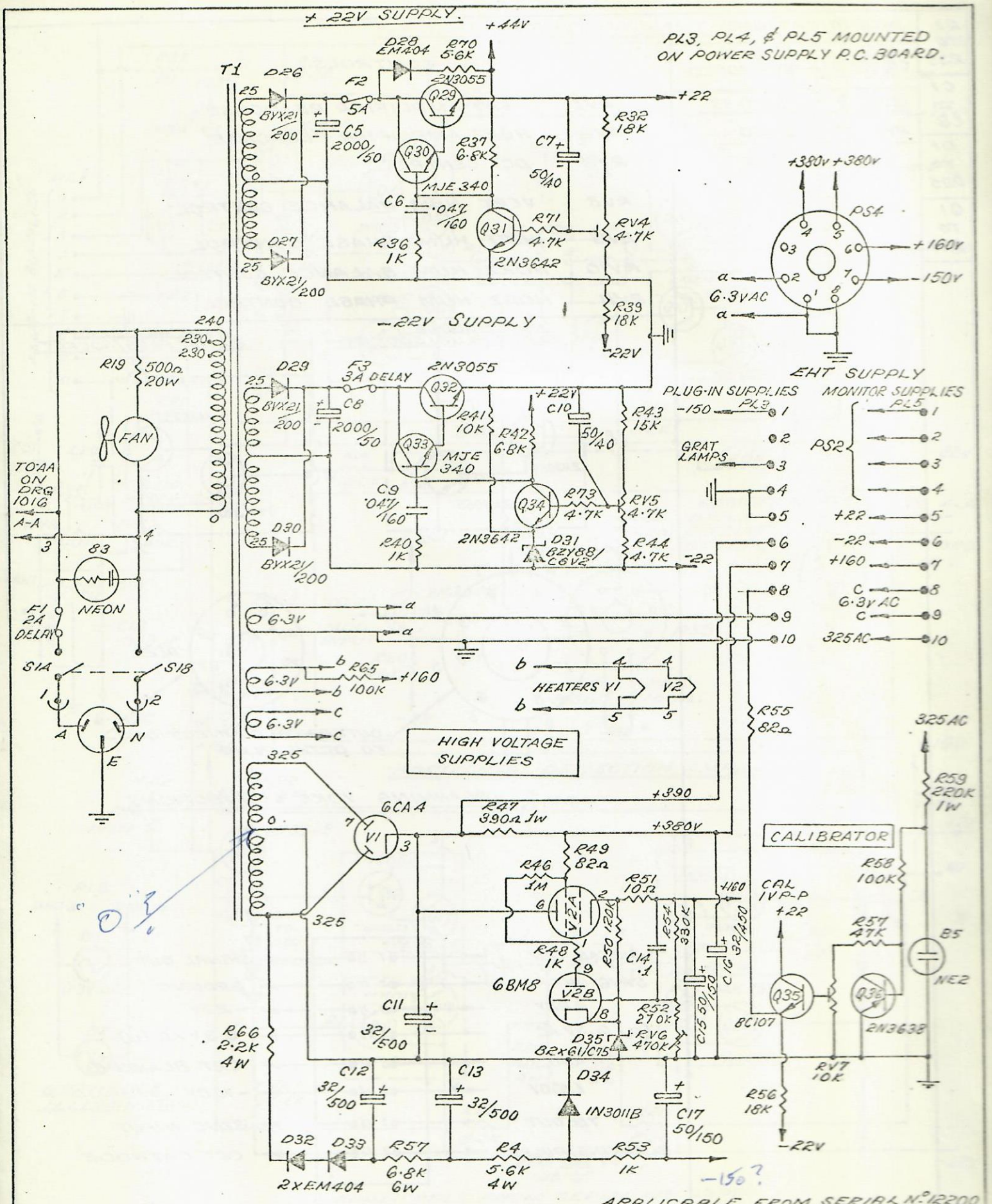
SWITCHES

S1A & B AC POWER



PLUG-IN SOCKET INTERCONNECTIONS

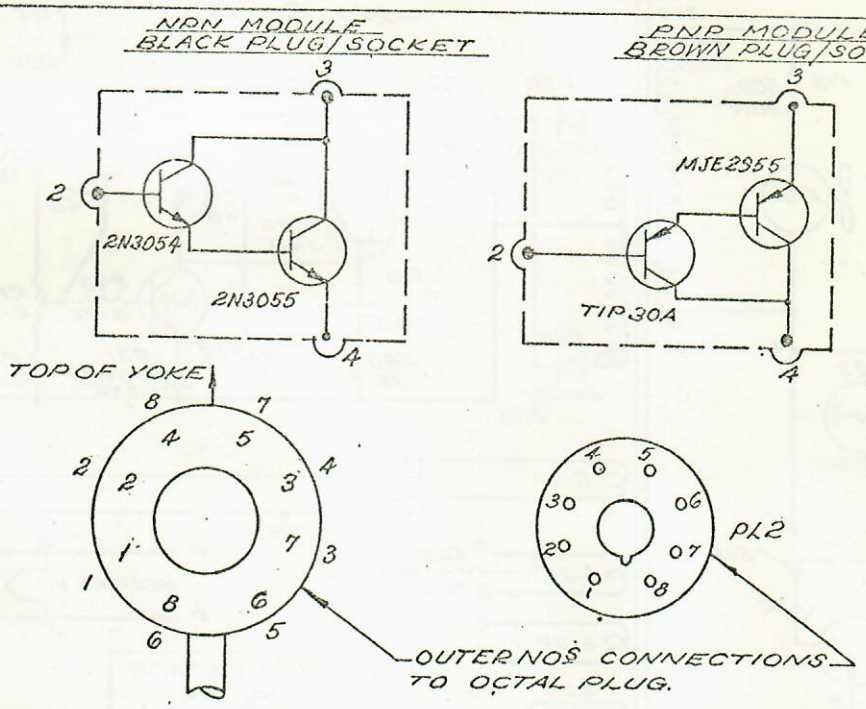
SEE DRG. No 604


+22V SUPPLY.
+44V
D28 EM404
R70 5·6K
T1
D26
F2
5A
2N3055
Q29
+22
R32 18K
BYX21/200
C5 2000/50
Q30
MJE 340
R37 6·8K
C7 50/40
C6 ·047/160
Q31
R71 4·7K
RV4 4·7K
R36 1K
2N3642
D27
BYX21/200
R39 18K
-22V SUPPLY
-22V
PL3, PL4, & PL5 MOUNTED ON POWER SUPPLY P.C. BOARD.
+380V +380V
PS4
+160V
-150V
6·3VAC
EHT SUPPLY
240
230
230
R19 500Ω 20W
FAN
TO AA ON DRG 1016
A-A
S3
NEON
F1 2A DELAY
S1A
S1B
A
N
E
D29
F3 3A DELAY
2N3055
Q32
C8 2000/50
Q33
MJE 340
R41 10K
R42 6·8K
+22V
C10 50/40
R43 15K
C9 ·047/160
Q34
R73 4·7K
RV5 4·7K
R40 1K
2N3642
D30
BYX21/200
D31 BZY88/C6V2
R44 4·7K
-22
PLUG-IN SUPPLIES
MONITOR SUPPLIES
-150
PL3
GRAT LAMPS
PS2
PL5
+22
-22
+160
C
6·3V AC
325AC
6·3V
R65 100K
+160
HEATERS V1 V2
R55 82Ω
HIGH VOLTAGE SUPPLIES
325
325AC
R59 220K 1W
6CA4
V1
R47 390Ω 1W
+390
+380V
CALIBRATOR
R49 82Ω
R46 1M
R51 10Ω
V2A
R50 120K
R54 330K
C14 ·1
C16 32/450
CAL 1VP-P
+22
R58 100K
R57 47K
B5
NE2
R48 1K
6BM8
V2B
C11 32/500
R52 270K
C15 50/150
RV6 470K
D35 BZX61/C15
Q35
Q36
BC107
2N3638
R66 2·2K 4W
C12 32/500
C13 32/500
D34
IN3011B
C17 50/150
RV7 10K
R56 18K
-22V
D32
D33
2×EM404
R57 6·8K 6W
R4 5·6K 4W
R53 1K
-150?
APPLICABLE FROM SERIAL Nº 12200
NOTE- COMPONENTS MAY VARY FROM THOSE DESIGNATED DUE TO SUPPLY OR TO OPTIMISE PERFORMANCE.
2
5 - 72
DRAWN L.P
TRACED L.P
CHK'D B.R.L
DATE 1·2·72
POWER SUPPLY
(1722)
DRG. Nº
1015

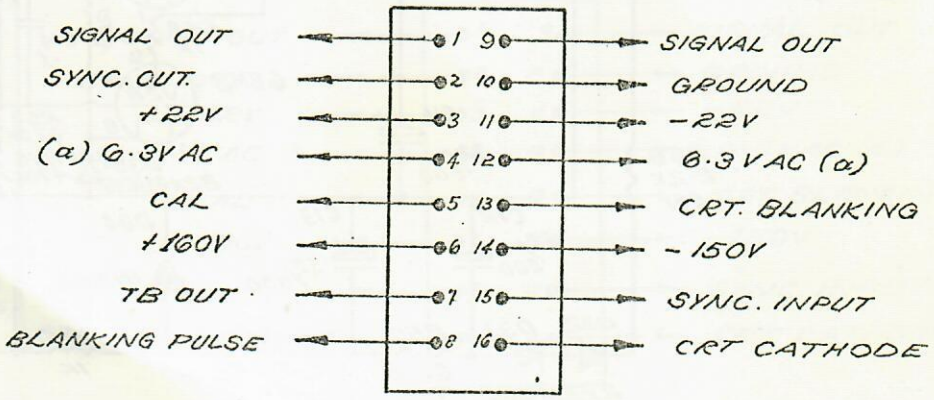
R1 TO R35	MODIFICATIONS
	ISSUE 2 17-8-73
	C5, 6, 7, 8, — 10PF ADDED
C1 TO C8	ISSUE 3 9-11-73
	RV3 47K ADDED
D1 TO D25	
Q1 TO Q28	

CONTROLS

RV1	VERT AMPLIFIER RESPONSE
RV2	HORZ AMPLIFIER RESPONSE
RV3	DC CENTRE
RV8	VERT HUM BALANCE CONTROL
RV9	VERT HUM PHASE CONTROL
RV10	HORZ HUM BALANCE CONTROL
RV11	HORZ HUM PHASE CONTROL.

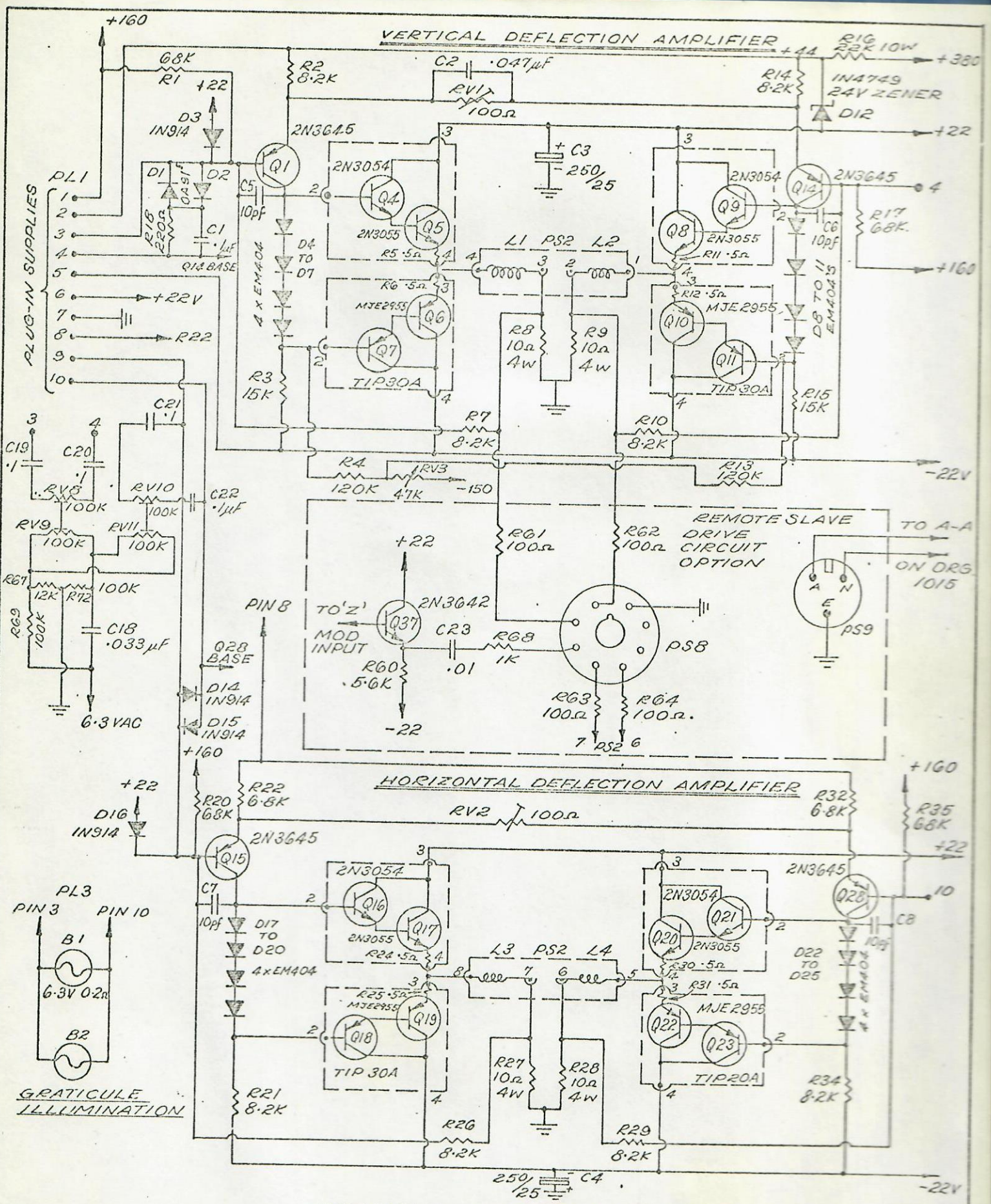


SCANNING YOKE CONNECTIONS



PLUG-IN SOCKET INTERCONNECTIONS

SEE DRG Nº 604.



APPLICABLE FROM SERIAL Nº 22,000

NOTE- COMPONENTS MAY VARY FROM THOSE DESIGNATED DUE TO SUPPLY OR TO OPTIMISE PERFORMANCE.

3 / 11-73	DRAWN L.P.	DEFLECTION AMPLIFIER (1722)
	TRACED L.P.	DRG. Nº 1016
	CHK'D BRL	
	DATE 2-2-72	