



MODEL BWD 881 POWERSCOPE II

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SPECIFICATION

2.0 The following specifications apply to a BWD 881 Oscilloscope operating within the following limits, or those stated in the Specification.

1. Instrument must be warmed up for a period of at least 15 minutes and aligned at an ambient temperature between +20° and +30° C.
2. It must be operated between 0° to +50° C after a warm-up time of at least 15 minutes.

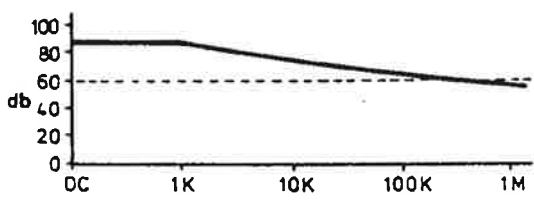
Due to the stable characteristics of the BWD 881, a delay of 15 minutes is not normally needed when making measurements, particularly at ambient temperatures between +10° and +40° C.

Table 1-1 Electrical Specification

2.1 VERTICAL AMPLIFIERS

No. of Channels:	Six, CH1, 2, 3 & 4 differential amplifiers. CH5 single ended amplifier. CH1 x 2 multiplier.
Display:	Individual selection of 1 to 4 traces from CH1, CH2, CH3 or CH1x2, CH4 or CH5.
Mode:	ALTERNATE 0.5msec/div and above. CHOPPED at 500kHz 1msec/div and below.
Delay Line:	A 120nsec delay line is incorporated to enable the leading edge of fast pulses to be displayed.

CH1 2 & 3 DIFFERENTIAL AMPLIFIERS

Sensitivity:	20mV to 200V/div. 0.1V to 200V/div direct, 20 & 50mV/div by x5 gain switch.						
Bandwidth: (8 div ref. at 50kHz)	DC or 5Hz (AC coupled) to 25MHz -3dB from 0.1V to 200V/div. Input signal from a 50 ohm terminated source. DC or 5Hz to 20MHz at 20 & 50mV/div.						
Rise Time: (Measured over 6 div.)	14nsec from 0.1V to 200V/div, 17ns at x5 gain.						
Common Mode Rejection:							
Max Common Mode Input:	350V rms or $\pm 500V$ from 20mV to 10V/div, 660V rms or $\pm 1000V$ from 20V to 200V/div.						
Max. Input:	$\pm 1000V$ or 660V rms. 3kV peak overload for 1 sec.						
Input C & R:	$1M\Omega \pm 2\%$ and $7.5pF \pm 1 pF$ each side of ground.						
Calibration:	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">10° to 40° C</td> <td style="width: 50%;">0° to 50° C</td> </tr> <tr> <td>$\pm 3\%$</td> <td>$\pm 4\%$</td> </tr> <tr> <td>$\pm 5\%$</td> <td>$\pm 6\%$</td> </tr> </table>	10° to 40° C	0° to 50° C	$\pm 3\%$	$\pm 4\%$	$\pm 5\%$	$\pm 6\%$
10° to 40° C	0° to 50° C						
$\pm 3\%$	$\pm 4\%$						
$\pm 5\%$	$\pm 6\%$						

CH4 DIFFERENTIAL AMPLIFIER with OFFSET

Specification identical to CH1, 2 & 3 except that Input Offset is incorporated in lieu of x5 gain. Offset is variable over a range equivalent to approx. $\pm 200V$ input level from 0.1 to 10V/div and $\pm 1000V$ from 20V to 200V/div.

CH1 x 2 MULTIPLIER

Sensitivity:

(Selected as an alternative display to CH3).

1:5 ratio to channels 1 x 2. i.e. 4 div on CH1 and 6 div on CH2 will produce a multiplied signal of $24/5 = 4.8$ div.

Bandwidth:

DC or 10Hz (AC coupled) to 10MHz -3dB.

0.1 to 200V/div only not available 20 & 50mV/div.

Accuracy:

Better than 10% up to 5MHz with AC signal applied to one channel and DC to the other.

CH5/EXT TRIGGER SINGLE ENDED AMPLIFIER

Sensitivity:

(Selected as alternative to CH4).
0.2V to 10V/div in 6 steps. $\pm 3\%$ 10° to 40°
 $\pm 4\%$ 0° to 50° C.

Bandwidth:

(6 div. ref. at 50kHz)

DC or 5Hz to 50MHz -3dB. Input signal from a 50 ohm terminated source.

Rise Time:

(Measured over 6 div.)

7nsec.

Max Input:

± 1000 or 660V rms. (overload condition)

Input C & R:

1M $\pm 2\%$ and 7.5pF ± 2 pF.

2.2 X-Y OPERATION

Single channel identical sensitivity X-Y display. Bandwidth & calibration, of Y channel identical to vertical display, X channel DC to 1MHz -3dB. Calibration $\pm 5\%$. Phase shift less than 1° DC to 200kHz.

2.2 TIME BASE

Range:

0.2 μ sec to 1 sec/div in 21 steps of 1.25 sequence. A vernier control covers the range between steps and extends the range to approx. 5sec/div.

Magnification:

x1 & x10. Maximum sweep speed 20nsec/div.

Calibration:

$\pm 10^\circ$ C to $\pm 40^\circ$ C, x1 mag $\pm 3\%$, x10 mag $\pm 5\%$

0° C to $+50^\circ$ C, x1 mag $\pm 4\%$, x10 mag $\pm 6\%$

1 sec/div. range only:

0° C to 50° C, x1 mag $\pm 6\%$, x10mag $\pm 8\%$

Note: The sweep accuracy applies after the first div. of deflection at x10 mag above 1 μ sec/div.

2.4 TRIGGERING

Source:

Channels 1,2,3,4,5, line frequency or phase marker pulse.

Coupling:

DC or AC, low frequency cut off approximately 5Hz.

LF Filter:

Switch selection of a DC to 400Hz low pass filter for stable triggering from very noisy low frequency waveforms.

Polarity:

+ or - with level select over 8 div of CRT deflection.

Modes:

Auto, normal or single sweep with manual or triggered initiation. Ready lamp indicates state of trigger under all conditions.

Sensitivity:

CH1 to 4, 0.5 div or greater DC to 2MHz increasing to 3 div at 25MHz.

CH5, 0.5 div or greater DC to 10MHz increasing to 3 div at 50MHz.

CH5 AS EXT TRIGGER:

Sensitivity range extends from 100mV to 100V p-p with a 1:1 probe and 1V to 1000V with a 10:1 probe.
Trigger sensitivity as CH5 amplifier.

PHASE MARKER TRIGGER:

The phase marker pulse can be selected to trigger the trace. This enables the time base speed to be expanded until the 1° wide phase marker is 1 div wide to obtain high resolution measurements of phase and pulse jitter.

2.5 PHASE GENERATOR

Range:

Selectable in 1° steps from 0 to 359° by individual Up/Down push buttons. Single degree steps occur when a button is momentarily depressed.

Continuous counting occurs at approximately 20°/second when either button is held depressed.

Readout:

In degrees on a 10mm 3 digit LED display.

Frequency Range:

15Hz to 2kHz. Operation is automatic with response time of less than 0.5sec for a 10% frequency change.

Phase Reference Source:

Channels 1,2,3,4,5, or zero cross over of the input power line to POWERSCOPE II.

0° Reference Switch:

The 0° reference mark together with the phase marker pulse may be switched in 60° steps from 0° to 300° to enable phase angles of multi-phase waveforms to be quickly compared.

0° Reference Variable Control:

Enables the zero reference point to be positioned at any point on a displayed line frequency waveform. Delay is from less than 100μsec to over 20msec.

Marker Pulse Jitter:

Less than 1° from a stable noise free source.

Phase Resolution:

Less than 0.5° between similar pulse in multi-phase circuits.

Noise Filter:

400Hz low pass to filter reference signals with multiple zero crossings that are not time or phase related to line frequency.

2.6 GENERAL DETAILS

Front Panel

Input Sockets:

Special snap fit shrouded, high voltage. BWD A8 adaptors convert the sockets to standard BNC connectors for use with standard probes and BNC cables.

Probe Adjust:	1kHz (approximately) rectangular wave, positive with respect to ground. 10V p-p 5%.
Beam Finder:	Push button returns trace to within limits of CRT screen and overrides intensity control.
CRT:	8x10 div. (1 div = 1 cm) operating at 10kV EHT. Supplied with P31 phosphor. Graticule, edge illuminated and fitted with a blue filter.
Rear Panel	
Output Signals:	Each individual channel at approximately 75mV p-p/div deflection is available at BNC jacks from approximately 600 ohm source. Combined signals as displayed on CRT at approximately 50mV p-p/div deflection are available at BNC jack from approximately 150 ohm source.
Z Modulation:	+5 with respect to ground will blank trace at normal intensity. Bandwidth: DC to greater than 10MHz. Input 10k ohm. Maximum input $\pm 30V$.
Power Requirements:	AC, 90 to 264 volt. 45 to 440Hz 50 watts max. DC 100 to 350V. DC, 20 to 32 volt, 1.5 amps at 24V (optional PS1 power supply adaptor). BP6 — Battery Pack.
Safety Standards:	Instrument closely conforms to IEC 348. In addition the entire operating section, controls, panel etc., are insulated and front panel sockets are deeply recessed to prevent contact with grounded metal surfaces.
<u>WARNING</u>	POWERSCOPE II <i>must</i> be grounded either via the power cord line or via the rear panel ground terminal to a substantial ground on the chassis of the equipment under test. See para. 5.26.

ENVIRONMENTAL SPECIFICATION

Temperature:	Operating, 0° C to +50° C.
Range:	Non-operating, -55° C to +75° C.
Humidity:	Specification is met at 95% RH between 0° C and +40° C. At 50% RH specification is met between 0° C and +50° C.

2.7 DIMENSIONS AND WEIGHT

Weight:	10.4kg with Front Cover. 9.4kg without Front Cover or Pouch. 12.0kg Domestic Shipping in Carton. 0.5kg PSI DC Power Supply. 7.4kg BP6 Battery Pack.
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MANUAL CHANGE INFORMATION FOR MODEL BWD:

FROM SERIAL NO.	ISSUE	DATE	FROM SERIAL NO.	ISSUE	DATE
59138	8	1.12.86			
59500	9	4. 5.87			

Issue	Sect.	Page	Cct.	AMENDMENT
8	10	2	2170 & 1	R30 was 348Ω, now 432Ω. R34 was 390Ω now 470Ω. R36 & 38 were 3K3 now 3K9.
8	10	3	"	R130 was 348Ω now 432Ω. R134 was 390Ω now 470Ω. R136 & 138 were 3K3 now 3K9.
8	10	17	"	RV6 & 106 were 200Ω now 100Ω cermet preset VTP.
8	10	22	"	D11, IN4148 diode added between D9 and +60V rail; collector to +60V.
8	10	7	2173	R432 was 10KΩ now 4K7.
				THE FOLLOWING ITEMS ARE CIRCUIT CORRECTIONS.
			"	R439 18K added from junction of R440 & 441 to +12V.
			"	C415 100nF added from pin 5 of X10A socket to ground.
			"	U404, 74C02 added to IC connected to Q401 collector.
8			2174	Q601 PN4121 added to transistor connected to R617.
			"	U606 added to IC LM351.
			"	U549A gate corrected to read 11 output, 12 & 13 input.
			"	R635 added to 3K9 resistor connected to R634.
8			2175	-2 on pin 8 of U541A corrected to +12.
			"	LF353 added to U541A & B.
			"	Pin 11 of U548A connected to +6V.
8	10	8	2175	R562 100KΩ 1/2W 5% MF resistor added across N/C contacts of switch S528.
8	10	22	2170 & 1	D8 BZX79/C2V4 Zener diode added to Parts List.
			"	D10 BZX79/C8V2 " " " " " "
9	10	22	2170	D9 BZX79/C5V1 Zener Diode removed, replaced by
	10	2	2171	R58 2K0 1/2W MF Resistor.
	10	6	2173	R350 2K2 & R351 10K 1/2W 5% Resistors removed replaced by 5KR CER Trim Pot RV355.
10	10	22	2170	R58 2K0 1/2W 1% MF Resistor replaced by D9 selected
		22	2171	BZX79/C5V1 Zener Diode.

MANUAL CHANGE INFORMATION FOR MODEL BMD-881

FROM SERIAL NO.	ISSUE	DATE	FROM SERIAL NO.	ISSUE	DATE
57821	4	3-6-86			
58020	5	23.6.86			
58525	6	16.9.86			
58600	7	1.11.86			

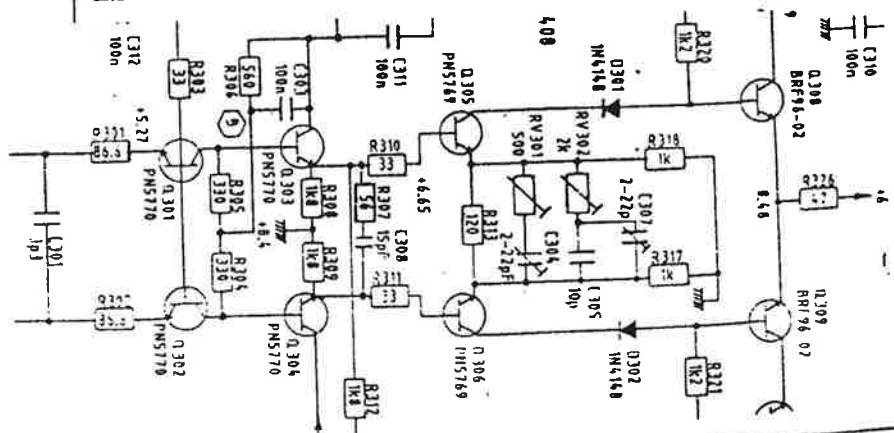
Issue	Sect.	Page	Cct.	AMENDMENT
4	10	5 & 13	2173	R360 39Ω/4W 5% resistor and C353 22μf 25V electrolytic decoupling added to U351 +12 sup
5	10	10	2176	R835 was 220K Ω $\frac{1}{4}$ W, now 390K $\frac{1}{4}$ W.
5	10	13	"	C412 was 100nF 250V, now 220nF 100V.
5	10	14	2175	C533 marked incorrectly in parts list as SiemB32: D1105-J. Should read ITT TAG.
5	10	14	2175	C536 parts list no. should read B32561-D1124-J.
5	10	18	2176	RV801 was VTP cermet. Now HTP cermet. RV803 " " " " " "
5	10	23	2176	D810 was BZX79/C35V, now BZX79/C36V.
5	10	14	2175	C541 was 1 μ F, now 2 μ 2, 35V TANT.
6			2175	U529-531, U536-538 should be Pt. No. CD45108
6	10	13	2172	C219 was 100pF now 68 pF 500V 10% CDS.
6	10	14	2175	C547 680pF 20% 500V CDS added between PIN 11 U532 and Ground
6	10	23	2176	D707 was BZX79/C13V now BZX79/C15V.
6	10	5	2172	R281 68 Ω 1/8W 5% MF resistor added in series with C219 across R228.
6	10	13	2173	C225 was 1nF 500V 20% CDS, now 100nF 50V monoblock CER.
6	10	13	2173	C226 100nF 50V monoblock CER added across pins 4 & 5 of U201 LF411.
7	10	4	2171	R179 & R180 were 47K $\frac{1}{4}$ W 5% now 220K $\frac{1}{4}$ W 5% MF R181 was 100 Ω $\frac{1}{4}$ W 5%MF now 47K $\frac{1}{4}$ W 5%MF R182 47K $\frac{1}{4}$ W 5% MF added between Pin 2 U175 and ground.

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MANUAL CHANGE INFORMATION FOR MODEL BWD: 881

FROM SERIAL NO.	ISSUE	DATE	FROM SERIAL NO.	ISSUE	DATE
57417	1	31-1-86			
57771	2	21-4-86			
57830	3	28-4-86			
57821	4	3.6.86			

Issue	Sect.	Page	Cct.	AMENDMENT
1	10	8	2175	R554, 68M Ω 1W added between pin 2 of U541A & -12V.
	10	13	2172	C225, 1nF 500V capacitor added between ground and Q211 collector.
	10	11	2170& 2171	C6 & C8 were 39pf, now 56pf 5% NPO 500V ceramic disc capacitors.
	10	12	2170& 2171	C106 & C108 were 39pf, now 56pf 5% NPO 500V ceramic disc capacitors.
2	10	10	2176	R815 was 220R 1/4W, now 330R 1/4W 5% MF.
	10	23	2176	D808 zener diode BZX79/C18V removed.
3	10	21	2176	Q806 was BUZ40, now IRF830.
	10	9	2174	R633 was 68R 1/4W, now 12K 1/4W 5% MF.
	10	14	2174	C616 was 8P2, now 4P7 NPO 500V CDS.
	10	14	2174	C619 added, 8P2 500V 10% NPO CDS.
	10	18	2176	RV803 was 200K, now 50K cermet preset.
	10	10	2176	R817 was 12K now 10K 1/4 5% MF resistor.
	10	13	2173	C309 was 100nf 500V mono block cer now 100nf 63V Siem.
	10	9 & 10	2176	B37449-C6104-S2.
	10	10	2176	R701, 702 & 822 were 3R3 2W WW 10% resistors, now 3R3 2W 5% MF resistors.
	10	10	2176	R819 was R22 2W 10% WW resistor, now R22 2W 5% MF resistor.
	10	8	2175	R554 was 68M Ω now 10M Ω 10% CF.
	10	17	2175	RV527 1M Ω cermet preset type VG 067TL1 added.
	10	9	2175	R678 47K 1/4W 5% MF added.
	10	9	2175	R677 15K " " " "
	10	9	2175	R658 680R " " " "
	10	18	2172	U201 now LF411, was LF351.
4	11	9	2174	R654 1K5 was marked R675 incorrectly
	11	15	2174	C651 10uf " " C659
	11	15	2174	C659 100nF " " C651
	11	5 & 13	2173	C308 & R307 added in series from emitter of Q303 to emitter of Q304



BWD 881 Maintenance

7.7 POWER SUPPLIES, ALIGNMENT

Test Equipment. See Table 7.1

Item 4	Sine Wave Generator
Item 5	Cable 50ohm
Item 9	Digital Voltmeter
Item 10	Oscilloscope & Probes
Item 11	Screwdriver
Item 13	Isolation Transformer
Item 14	Variable Voltage Transformer

7.8 **WARNING**

During the following procedure, connect the BWD881 Oscilloscope via an isolation transformer to the power mains. This will enable the switch mode regulator to be grounded, to enable a normal meter or oscilloscope to be connected to it without the danger of a live power line voltage being present.

Lethal voltages exist on the power supply board, even when supplied via an isolating transformer as the impedances are low and available current is high.

7.9 Set controls as follows:

INTENSITY	As desired
FOCUS	Focused Display
Vert Position Controls	Centred
VERTICAL DISPLAY	CH1
V/DIV	Any position
Horiz. Position	Centred
SEC/DIV	50 μ sec
VERNIER	CAL
X1-X10 Mag	X1 (pushed in)
LEVEL	Centred & pushed in for AUTO

All other controls, any position.

7.10

- Remove cover and rear panel.
- Connect the digital voltmeter low lead to common L801 and connect the volts lead to L802.
- CHECK reading is between +3V and +32V. Disconnect the leads if correct.
- Connect the digital voltmeter low lead to chassis ground and connect the volts lead to the +60V supply.
- Check that the reading is between +60.2 to +59.5V. Adjust RV801 for +60 if necessary. Remove the lead.
- Connect DVM leads between ground and +12V. CHECK the voltage is between +12.1 and +11.9V. Adjust RV701 for +12V if necessary. Remove the lead.
- Connect DVM leads between ground and -12V (TP5). CHECK the voltage is between -12.1V and -11.9V. Adjust RV702 for -12V if necessary. Remove lead.
- Check the remaining voltage rails as shown in Table.

VOLTAGE LIMITS AND RIPPLE

Rail	Limits	Ripple p-pmV
-12V	-12.1 to -11.9	Less than 10mV
+12V	+12.1 to +11.9	Less than 10mV
+45V	+46 to 44	Less than 10mV
+60V	+60.2 to +59.5	Less than 10mV
+98V	+99 to +97	Less than 10mV
-55V	-56 to -54	Less than 10mV

- i) Check the p-p ripple level using the test oscilloscope and a P32 Probe switched to X1. Connect the probe ground lead to 881 chassis, select AC coupling and check ripple levels on each rail.
- j) Another DC rail, +6.0V is regulated on the main PCB. It can be measured at TP7 as shown on the PCB on P7-9. Voltage should be +5.9V to +6.2V. Ripple less than 5mV p-p.
- k) Disconnect set up when tests completed.

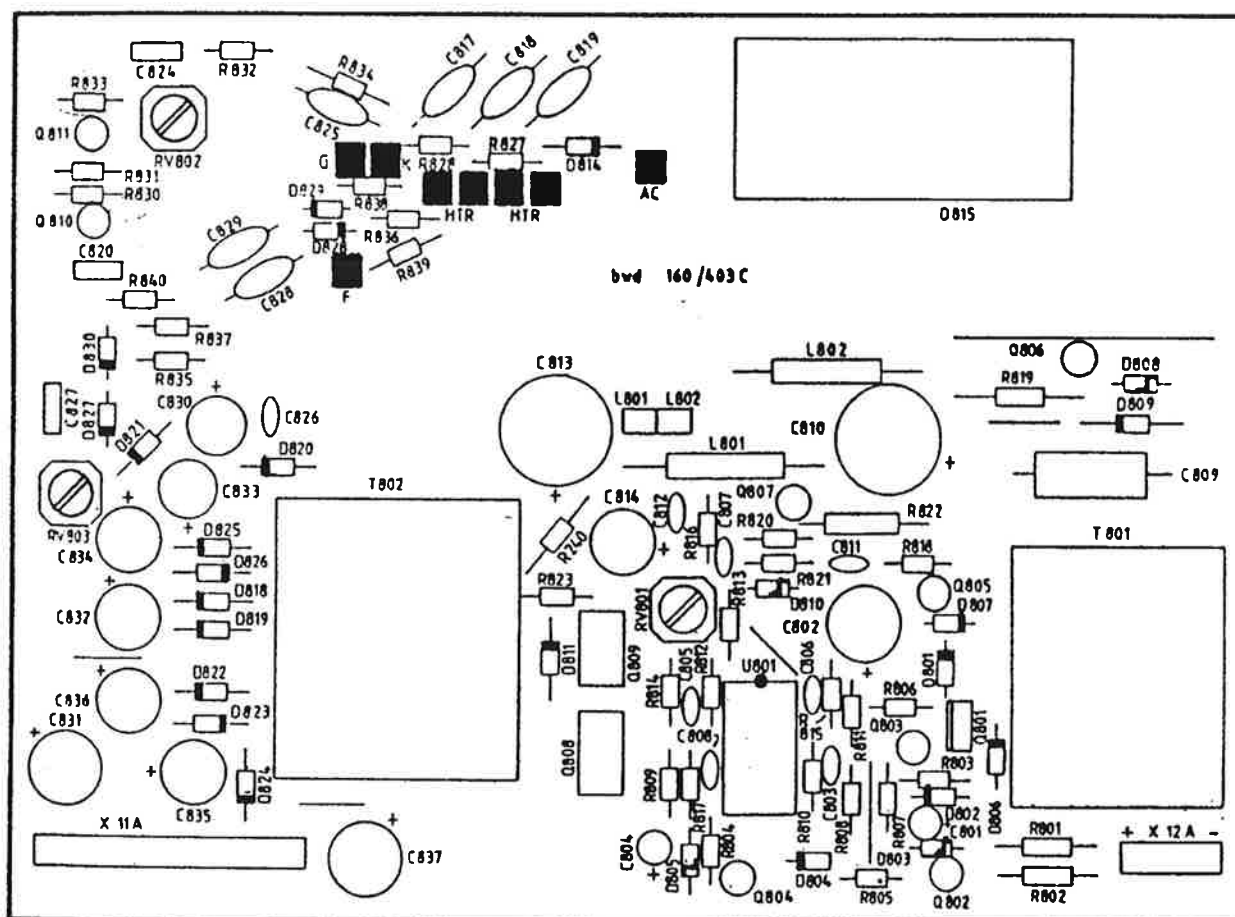
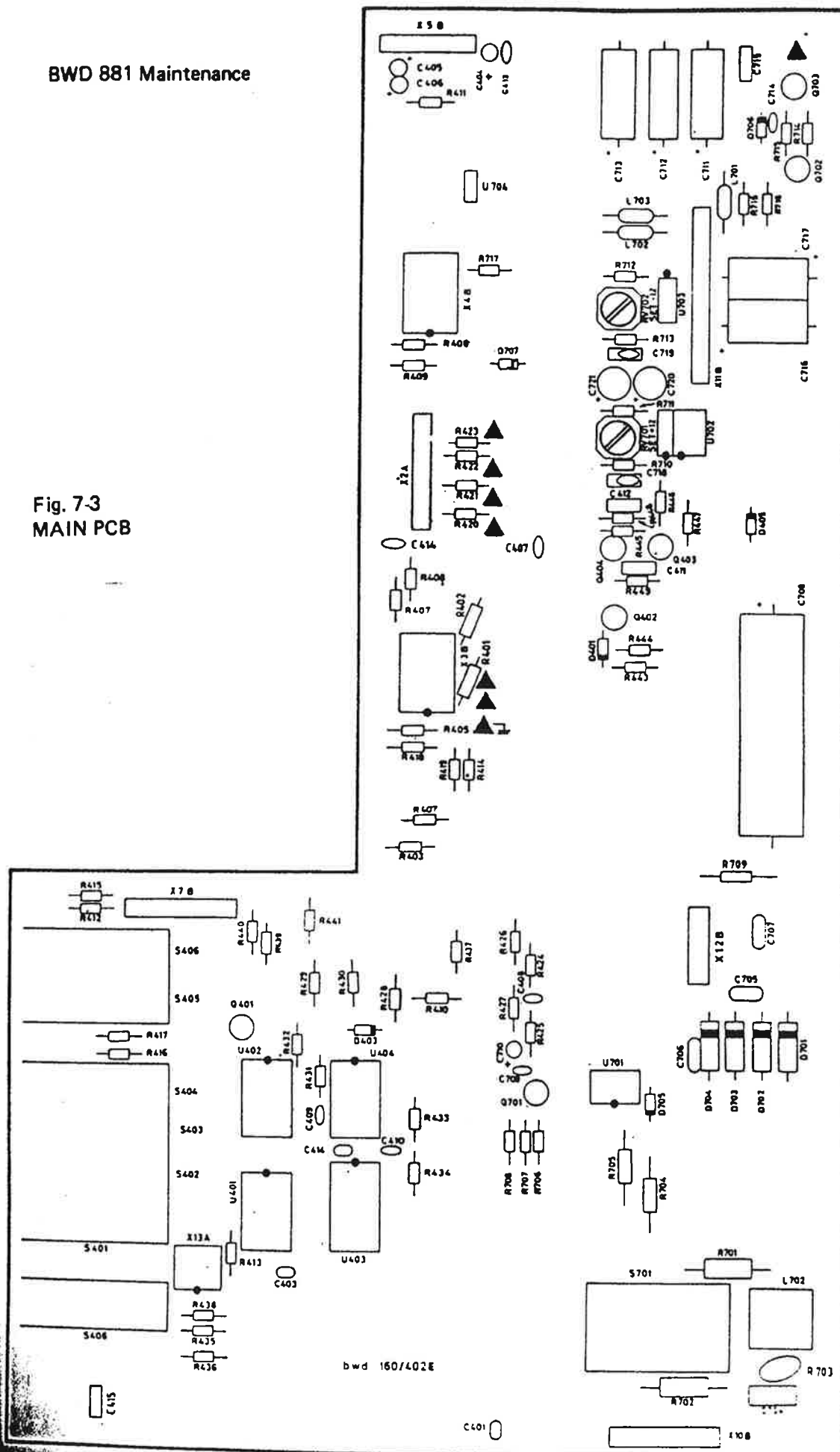


Fig. 7-2 POWER SUPPLY PCB

BWD 881 Maintenance

Fig. 7-3
MAIN PCB



7.11 CRT NEGATIVE SUPPLY ADJUSTMENT

- a) Turn the POWER supply OFF by rotating the INTENSITY control fully counter clockwise.
- b) Connect the DVM low lead to chassis and the signal lead to Q810 collector. Switch the DVM to the 200V range. Turn the oscilloscope ON.
- c) Check the voltage reads between +40V and +50V with the INTENSITY control set to minimum brightness. Adjust RV802 if necessary for +45V.
- d) Whilst the DVM is still connected, turn the intensity control fully clockwise to display a full intensity trace. The DVM reading should not drop below +5V.
- e) Disconnect DVM.

7.12 CRT FOCUS AND ASTIGMATISM ADJUSTMENT

- a) Connect the sine wave generator to CH1 input, frequency 50kHz. Centre display and adjust level until it just fills the CRT graticule area.
- b) Adjust both the front panel FOCUS control and the ASTIGMATISM preset RV352 for the best focused display over the entire screen area and intensity control range.
- c) Disconnect signal from input.

7.13 CRT MINIMUM INTENSITY PRESET ADJUSTMENT

- a) Switch the SEC/DIV time base switch to X-Y.
- b) Rotate the INTENSITY control fully counter clockwise.
- c) ADJUST – Both the min. intensity adjustment RV803 and the FOCUS control for a visible dot. Then back off the RV803 preset until the dot just disappears.

7.14 VERTICAL AMPLIFIERS

Performance Check & Alignment. Test Equipment – see Table 7.1.

Item

- 1. Calibration Generator
- 2. Square Wave Generator
- 3. Sine Wave Generator
- 4. Cables
- 5. 50ohm Termination
- 6. T-piece BNC
- 7. DVM
- 8. P32 Probes
- 9. Low capacitance Screwdriver

7.15 INPUT COUPLING CHECK

- a) Set V/DIV to 2V.
CHANNEL SELECT to CH1
Input coupling to DC and Trigger Selector to CH1
- b) Apply the 1kHz PROBE ADJUST signal via a P80 or P85 Probe at 1:1 to CH1 + Ve input.

BWD 881 Maintenance

- c) Position the signal with the bottom line on the graticule centreline.
- d) Switch input selector to AC, the trace should move down the screen to become approximately centre.

7.16 VERTICAL DEFLECTION

- a) Set all V/DIV to 1V/DIV TRIG SELECT TO CH1
CHANNEL SELECT TO CH1 SEC/DIV to 0.5msec
DC-AC TO DC
- b) Connect the 1kHz Calibration Generator output to CH1. Select a 6 div output and 1V range (i.e. 6V p-p output).
- c) Check amplitude is within the limit of 5.82 to 6.18 divisions.
- d) Repeat the test at each attenuator step feeding 6 div of deflection. Verify amplitude is within the limit in paragraph c above up to 20 V/DIV. From 50V to 200V/DIV amplitude will fall to 2.3div at 50V, 1.25div at 100V and 0.62div at 200 V/DIV.
- e) Set the V/DIV to 0.1V then pull out the Position Control to X5 magnification.
- f) Reduce input level to 6 div at 20mV (i.e. 120mV). Check calibration is within limit of para c.
- g) Set Channel Select to CH2 and TRIG SEL to CH2.
Repeat b to g for CH2. Repeat for CH3, 4 & 5 within its sensitivity range.

7.17 BANDWIDTH CHECK CH1 to 4

- a) Set all V/DIV to 0.1V
DC-AC Selector to AC
CHANNEL SELECT to CH1
SEC/DIV to 20 μ sec
TRIGGER SELECT to CH1
- b) Connect Constant Amplitude sine wave generator to CH1, via a terminated 50ohm cable and BWD A8 adaptor. Set output at 50kHz to 8 div deflection.
- c) Change the generator to 25mHz. The deflection should not fall below 5.6div.
- d) Return generator to 50kHz. Pull out Position control to X5 gain (20mV/div). Reduce 50kHz input to 8 div deflection.
- e) Increase frequency to 20MHz. Check amplitude does not fall below 5.6DIV.
- f) Set CHANNEL SELECT to CH2 and TRIGGER SELECT to CH2.
Repeat b to e for CH2. Then repeat for CH3 & CH4 repeat a to c.

7.18 COMMON MODE REJECTION

- a) Set all V/DIV switches to 0.1V. Position controls pushed in.
- b) Connect the line frequency source to CH1 + & - inputs via identical length P80 Probes.
- c) Set input level to 350Vrms (994V p-p). Adjust CH1 CMR panel preset for min signal level - Should be below 4mm deflection.

- d) Switch off line input source and change leads over for two BNC cables joined by a Tee piece. A third cable should be connected to a 1MHz sine wave source. Fit BWD A8 adaptors to free ends of two cables and plug into + & - inputs of CH1.
- e) Amplitude of signal on CRT should be 1/600 of input signal applied to one input only. Note: the X5 gain may be used on CH1, 2 & 3 to increase measurement accuracy without affecting CMR.

7.19 CH5 BANDWIDTH

- a) Set V/DIV to 0.1V. DC-AC switch to AC, Select CH5.
- b) Connect constant amplitude sine wave generator to CH5 via a terminated 50ohm cable and A8 adaptor. Set output at 50kHz to 6 div deflection.
- c) Change generator to 50MHz. The deflection should not fall below 4.2 div.

7.20 CH1 X 2 MULTIPLIER SENSITIVITY AND BANDWIDTH CHECK

- a) Set CH1 & 2 V/DIV to 1V and DC-AC switch to DC.
- b) Connect Constant Amplitude sine wave generator to CH2, set level at 50kHz to 6 divisions.
- c) Connect a DC supply to CH1 +ve input and set input to +5V.
- d) Select 1 x 2. The display should be 6 div centred on the CRT and within 5.5 and 6.5 div amplitude.
- e) Increase input frequency in CH1 to 10MHz. Amplitude should not fall below 4.2 div.

7.21 CH4 OFFSET

- a) Set V/DIV to 10V, DC-AC switch to DC, Select CH4.
- b) Connect +200V DC to + input socket.
- c) Pull out position control to engage offset voltage, turn control to bring trace back on screen.

7.22 CH5 AMPLIFIER ALIGNMENT

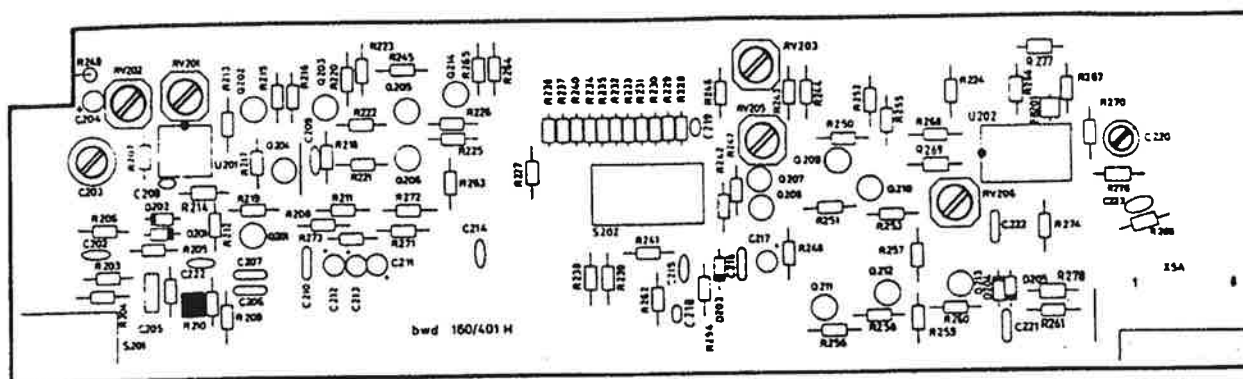
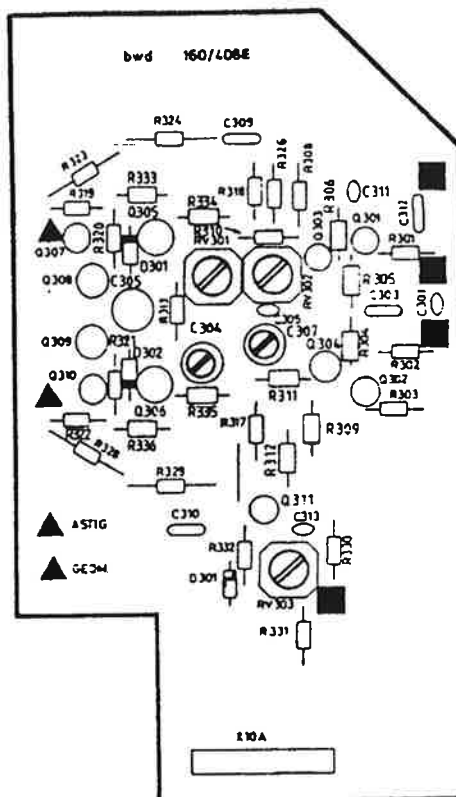


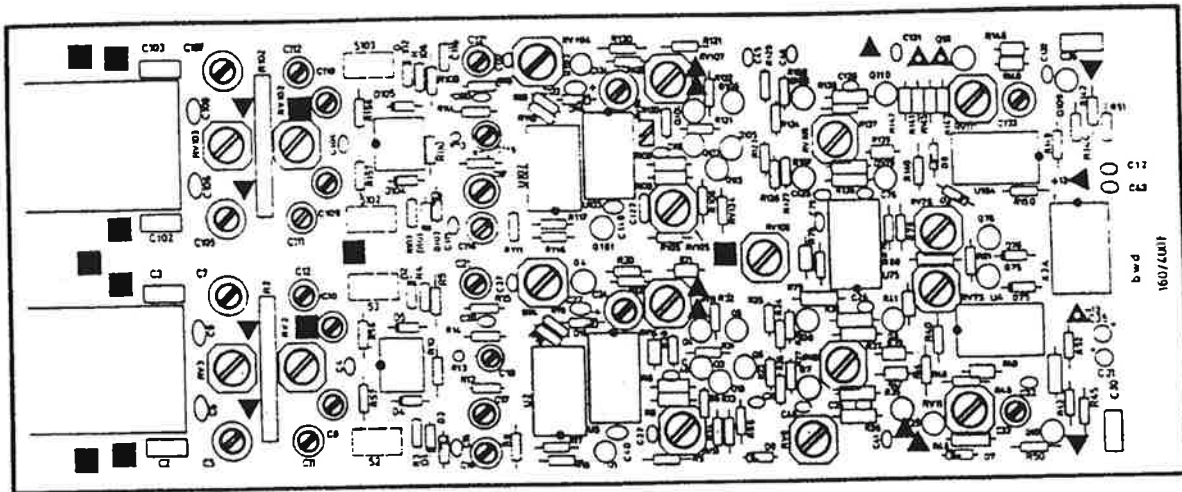
Fig. 7-4 CH5 AMPLIFIER PCB

Fig. 7-5 VERT. OUTPUT PCB

- Set V/DIV to 1V, DC-AC to DC, CHANNEL SELECT to CH5, SEC/DIV to 1msec, TRIGGER SOURCE to 5.
- Connect the 1kHz Calibration Generator to CH5, select 6 div 1V range (i.e. 6V p-p output).
- Adjust RV205 for 6 div deflection.
- Remove Calibration Generator and substitute Square wave generator correctly terminated, set to 6 div amplitude at 1kHz. Set V/DIV to 0.2V.
- Adjust C203 for best square wave shape, increase frequency to 10 kHz and adjust RV202 for best square wave shape. Repeat until square wave is ideal shape.
- Remove input signal, set V/DIV to 10V, check position control has equal up-down movement, equalise with RV203 if necessary.
- Return V/DIV to 0.2V, adjust RV201 to eliminate trace movement as V/DIV switch is turned from 0.2 to 10 V/DIV.
- Adjust voltage at pin 2 of output socket (trigger take off) to 0V with RV206.
- Recheck b) & c), then reconnect square wave generator to CH5 correctly terminated. Set V/DIV to 1V. Increase generator frequency to 1MHz.
- High frequency response alignment requires the preset trimmers and capacitors on the vertical output PCB to be adjusted together with C220 on CH5 PCB. C220 affects the slope on the top of the square wave, R302 and C307 sets the wave shape behind the leading edge, C304, R301 and C305 control the leading edge shape. As each can effect the total shape adjustment should be repeated as necessary to optimise the square wave shape.



7.23 CH1, 2, 3 & 4 ALIGNMENT

Fig. 7-6 CH1 - 4
AMPLIFIER PCB

- a) Set V/DIV of CH1, 2, 3 & 4 to 1V
DC-AC to DC
CHANNEL SELECTOR TO CH1
SEC/DIV to 1msec
TRIGGER SOURCE to 1
- b) Connect the 1kHz Calibration Generator to CH1 +ve input, select 6 div 1V range (i.e. 6V p-p output).
- c) Adjust RV7 for 6 div deflection, pull out the vertical position control for X5 gain. Reduce input to 6 div at 0.2V (i.e. 1.2V p-p output). Set RV9 for 6 divisions deflection. Return X5 gain back to normal. Remove input. (RV9 is located on vert position control PCB at rear of amplifiers).
- d) Turn V/DIV switch to 0.1V, if trace moves, recentre with RV4, repeat until no movement occurs between 0.1 and 1V/DIV. Turn V/DIV to 20V then back to 10V, if trace moves adjust RV5 to eliminate it. Trace should not move over entire V/DIV range.
- e) Connect square wave generator correctly terminated to CH1 +ve input, set to 1kHz 6 division deflection. Adjust C5 for best square wave, increase frequency to 10kHz. Optimise for best square wave between the two settings. Repeat for -ve input adjusting C7.
- f) Connect square wave generator correctly terminated to CH1 +ve input set frequency to 1MHz 6 division deflection. Adjust C24, R13, C33 and RV11 for optimum square wave shape with sharpest leading edge.
- g) Change V/DIV to 0.5V. Set generator for 6 div. Adjust C21 for best square wave shape.
- h) Change V/DIV to 0.2V. Set generator for 6 div. Adjust C19 for best square wave shape.
- i) Change V/DIV to 0.1V. Set generator for 6 div. Adjust C16 and C17 for best square wave.
- j) Reset V/DIV to 20V. Set max output from generator at 10kHz and adjust trigger to lock trace. Adjust C9 and C11 for +ve input and C10 and 12 for -ve input for best square wave response. Check at 1MHz and optimise if necessary.
- k) Repeat step e as input compensating capacitors interact.

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- l) Check position control range, equilibrate if necessary with RV8.
- m) Check output DC level on R50 with no input. Set to OV with RV6.
- n) Repeat steps b to k for CH2, 3 and 4. Eliminate X5 gain setting in step 4 for CH4.

7.24 MULTIPLIER ALIGNMENT

- a) CHANNEL SELECTOR TO CH1, 2 & 1 X 2.
V/DIV 1V on both CH1 & 2
SEC/DIV to 1msec & AUTO
Position controls on CH1 & 2 pushed in.
- b) With no input to CH1 or 2 move traces away from CRT centre. Adjust RV76 to position 1 X 2 trace on CRT centre line.
- c) Apply 1kHz 6 division sine wave to CH1 input AC coupled. If a signal is present on the multiplier trace adjust RV108 in CH2 to eliminate it, check voltage on R150 is still zero, reset to OV by RV106 if necessary. Repeat steps until no signal is present on trace and RV150 is at OV.
- d) Remove input from CH1 and connect it to CH2. Repeat step c adjusting RV8 for zero signal and RV6 for OV on R50.
- e) Return signal to CH1 set for 6 div deflection.
Set DC-AC input switch of CH2 to DC. Connect a +5V DC input from Calibration Generator to CH2 +ve input. Adjust RV75 for a 6 division display on the multiplier trace. i.e.
$$\frac{6V \times 5V}{5} = 6 \text{ div display.}$$
- f) Increase input frequency to 10MHz. Multiplier signal should not drop below 4.2 div.

7.2 CMR ALIGNMENT

WARNING

Use great care in this procedure and use only insulated tools.

If a high voltage AC power supply is not available use the AC power line in tests requiring its use.

- a) CHANNEL SELECTOR to CH1
DC-AC Switch
V/DIV to 1V/DIV
SEC/DIV to 10msec
TRIGGER SELECTOR to LINE ~
- b) Connect 350Vrms (994V p-p) line frequency (50-60Hz) to CH1 + & - inputs.
- c) Adjust front panel CMR preset and internal preset RV2 for minimum deflection. Increase V/DIV to 0.1V and X5 gain for final setting. (Should be less than 40mV). Verify that input does not overload with less than 350Vrms input.
- d) Increase input voltage to 660Vrms and change V/DIV to 20V/DIV. Adjust RV3 for minimum residual signal. (Should be adjusted to a straight line).
Note: RV3 on CH4 is located on the offset PCB at the rear of the attenuator on the vertical position control.

- e) Remove the AC signal source from CH1 inputs. Apply a 200V square wave from the calibrator, to + & - inputs. V/DIV switched to 0.1V. Adjust the insulated wire on top of the input thick film resistors for minimum signal level.
- f) Replace input with high voltage sine wave generator (BWD 112B etc.). Check CMR up to 1MHz. Pull out position control for X5 gain (CH1, 2 & 3 only). Correct settings should produce the following results:

Input Freq.	Input Voltage	Signal level (0.1V and x5. gain).
50 or 60 Hz	350Vrms	1 div
1kHz	55V p-p	1mm
10kHz	55V p-p	1div
100kHz	55V p-p	4div
1MHz	55V p-p	5div

Max.

- g) Repeat steps a to f for CH2, 3 & 4 except that CH4 alignment is made at 0.1V/DIV sensitivity.
- h) No alignment is required for the offset facility.

7.26 TIME BASE & HORIZONTAL AMPLIFIER

Performance Checks & Alignment

Test Equipment (see Table 7.1)

Item

1. Calibration Generator
4. Sine Wave Generator
5. 50ohm Cable
6. A8 bnc Adaptor
7. 50ohm Termination
11. Screwdriver
12. Low Capacitance Tool.

7.27 TIME BASE CALIBRATION CHECK

- a) Set Controls as follows:
- | | |
|---------------------|------------------|
| INTENSITY | As required |
| FOCUS | Focussed display |
| Vertical Position | Centred |
| V/DIV | 0.5V |
| VERTICAL DISPLAY | CH1 |
| Horizontal Position | Centred |
| SEC/DIV | 1msec |
| VERNIER | CAL |
| X10 Mag | Off (X1) |
| TRIGGER | AUTO, + & CH1 |
- b) Connect 1msec markers from the Calibration Generator via a 50ohm terminated cable to CH1.
- c) Centre the trace and adjust LEVEL Control for a stable trace.
- d) Position the trace until the first marker 1msec after the start of the trace is aligned with the second vertical graticule line.

7.29 HORIZONTAL POSITION RANGE

- Set SEC/DIV to $100\mu\text{sec}$.
- Apply $500\mu\text{sec}$ markers to CH1 and adjust for a 3 or 4 division deflection. Adjust LEVEL if necessary to lock display.
- Align the 2nd marker pulse with the graticule centreline, then pull out the X10 mag knob, the 2nd marker should not move.
- Check the right hand marker can be positioned to the left of the graticule centreline and that the 1st marker can be positioned to the right of it when the horizontal position control is turned.
- Push TB VERNIER to x1, centre display horizontally on screen and disconnect marker generator.

7.30 X GAIN CHECK

- Set CH2 to 1V
CHANNEL SELECT to CH1
SEC/DIV switch to X-Y
X1 x 10 mag to X10 (TB VERNIER pulled out)
TRIGGER SELECT to CH3 or 4.
- Apply a 1V x 6div (6V p-p— 1kHz calibration wave to CH2 input. Centre the trace horizontally.
- The trace should be 6 div $\pm$ 0.3 divisions, i.e. 5.7 to 6.3 divisions wide. Disconnect calibration signal.

7.31 X BANDWIDTH CHECK

- Apply a 50kHz sine wave to CH2 input via a terminated 50ohm cable from a constant amplitude generator. Centre trace and adjust for 6 div deflection.
- Increase generator frequency 1MHz.
- Check trace length is 4.2 div or greater.
- Disconnect sine wave generator.

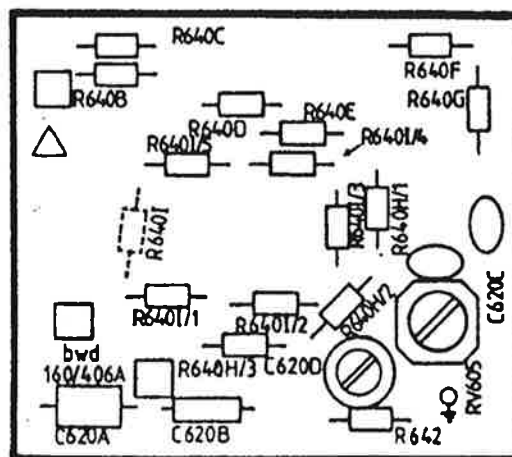


Fig. 7-8 TIME BASE SWITCH PCB



Fig. 7-9 TIME BASE & PHASE GENERATOR PCB

7.32 TIME BASE CALIBRATION

- a) Set controls as follows:
 CHANNEL SELECT to CH5
 TRIGGER SELECT to CH5
 SEC/DIV to 1msec
 X10 to off
 VERNIER CONTROL to CAL
- b) Connect 1msec marker pulses to CH5 input. Adjust amplitude for 3 or 4 divisions and trigger LEVEL for a stable display.
- c) Position the first pulse against No. 1 graticule line, then adjust RV603 for 1 marker pulse per div.
- d) Increase the marker pulse rate to 0.5msec. Turn the SEC/DIV to 0.5msec.
- e) Adjust C620 on rear of time base switch for one pulse per div.

7.33 X10 MAGNIFIER CALIBRATION AND REGISTRATION

- a) Reset controls as in para 7.31 a. Apply 100μsec timing pulses to CH5 input. Pull out the X10 mag control.
- b) Adjust RV651 for 1 marker pulse per division.
- c) Reduce the marker pulses to 5msec.
- d) Align the middle marker with the graticule vertical centreline with the horizontal position control.
- e) Push in the X10 mag knob. Realign the middle marker to the graticule centreline with RV653.
- f) Repeat steps d and e until no movement occurs between X1 & X10 magnification.

7.34 TIME BASE TRIGGERING

Performance Checks and Alignment

Test Equipment.

Item

- 4. Sine Wave Generator
- 5. Cables
- 6. A8 Adaptor
- 7. Termination

7.35 TRIGGER CHECK CH1 - 4

- a) Set Controls as follows:
 CHANNEL SELECT to CH1
 CH1 V/DIV to 0.1V
 SEC/DIV to 0.2μsec
 VERNIER to CAL
 X10 Mag off
 LEVEL control centred
 TRIGGER SLOPE +
 SOURCE CH1
- b) Apply 2MHz sine wave to CH1 input. Adjust level for a 5 division display. Adjust intensity if necessary and centre display.

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- c) Switch the CH1 V/DIV to 1V, then adjust the Trigger LEVEL control for a stable display of a 0.5 div signal.
- d) Check operation is correction for both + & - slope and AUTO and NORM mode.
- e) Increase input frequency to 25MHz and amplitude to 3 divisions.
- f) Repeat step d.

7.36 CH5 TRIGGER CHECK

- a) Set controls as follows:
CH5 V/DIV to 0.2V
SEC/DIV to 0.2 sec.
CHANNEL SELECT to CH5
- b) Apply 10MHz sine wave to CH5. Adjust amplitude to 5 divisions.
- c) Switch CH5 V/DIV to 2V then adjust the trigger LEVEL control for a stable display. Check operation for both + & - slope, AUTO & NORM trigger operation.
Increase the input frequency to 50MHz and amplitude to 3 div.
- d) Check that a stable display is obtained for + & - slope and AUTO or NORM operation.

7.37 TRIGGER SENSITIVITY ADJUSTMENT

- a) Set controls as follows:
CHANNEL SELECT to CH5
CH5 V/DIV to 0.2V
SEC/DIV to 2msec
TRIGGER NORM
TRIGGER SELECT CH5, +, AC
- b) Apply a line frequency (50 or 50 Hz) sine wave to CH5 input. Adjust input level for an 8 div display.
- c) Set the trigger LEVEL control until it is triggering near the top of the waveform, then adjust RV651 until double triggering occurs, back off the control until display is stable.
- d) Move the trigger point up and down the waveform. Set + or - slope and re-adjust RB651 for the highest sensitivity without double triggering at any point.
- e) If the signal level is reduced, it will be found to provide stable triggering to below 0.5 div deflection.

7.38 IDENTICAL X-Y PHASE & CALIBRATION ALIGNMENT

- a) Set controls as follows:
CH1 & 2 V/DIV to 2V
DC-AC Switch to DC
CHANNEL SELECT to CH1
SEC/DIV to X-Y
X1-X10 mag to X10
TRIGGER SELECT CH3

- b) Apply a 6V p-p 2kHz signal to both CH1 & CH2 +ve inputs. Centre display vertically with CH1 position and horizontally with the horizontal position control.
- c) Press CH1 GND button then adjust RV606 for a 6div horizontal line.
- d) Release CH1 GND button, increase the input frequency to 200 kHz, if the diagonal trace is slightly elliptical adjust RV605 on the rear of the TB switch PCB for a straight line. If this changes the horizontal trace length correct RV606 to recalibrate it. The optimum position of RV605 & 606 is when the input frequency does not cause the trace to widen to an ellipse below approximately 300kHz.

7.39 CRT SIGNAL OUTPUT

- a) Set controls as follows:
CHANNEL SELECT CH1, 2, 3 & 4.
SEC/DIV 0.5msec
- b) Position all traces on top of each other on CRT centre line.
- c) Connect a bnc cable from the CRT DISPLAY bnc on the rear panel to an oscilloscope set to 50mV/DIV.
- d) Centre the oscilloscope trace by grounding its input, then adjust RV303 on the Vertical Output Amplifier PCB to recentre the trace on the oscilloscope trace.

ALIGNMENT & TESTING COMPLETE

