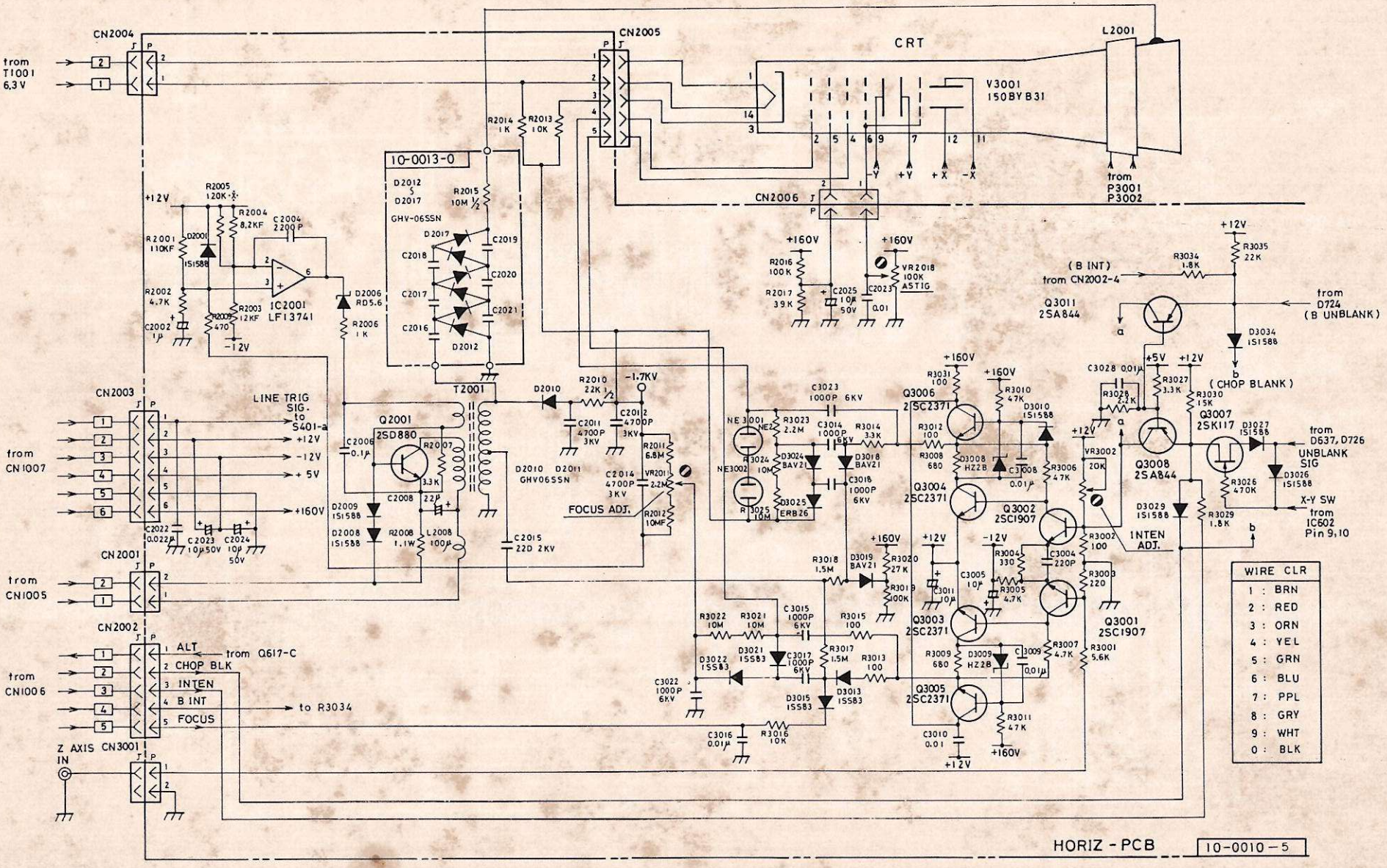
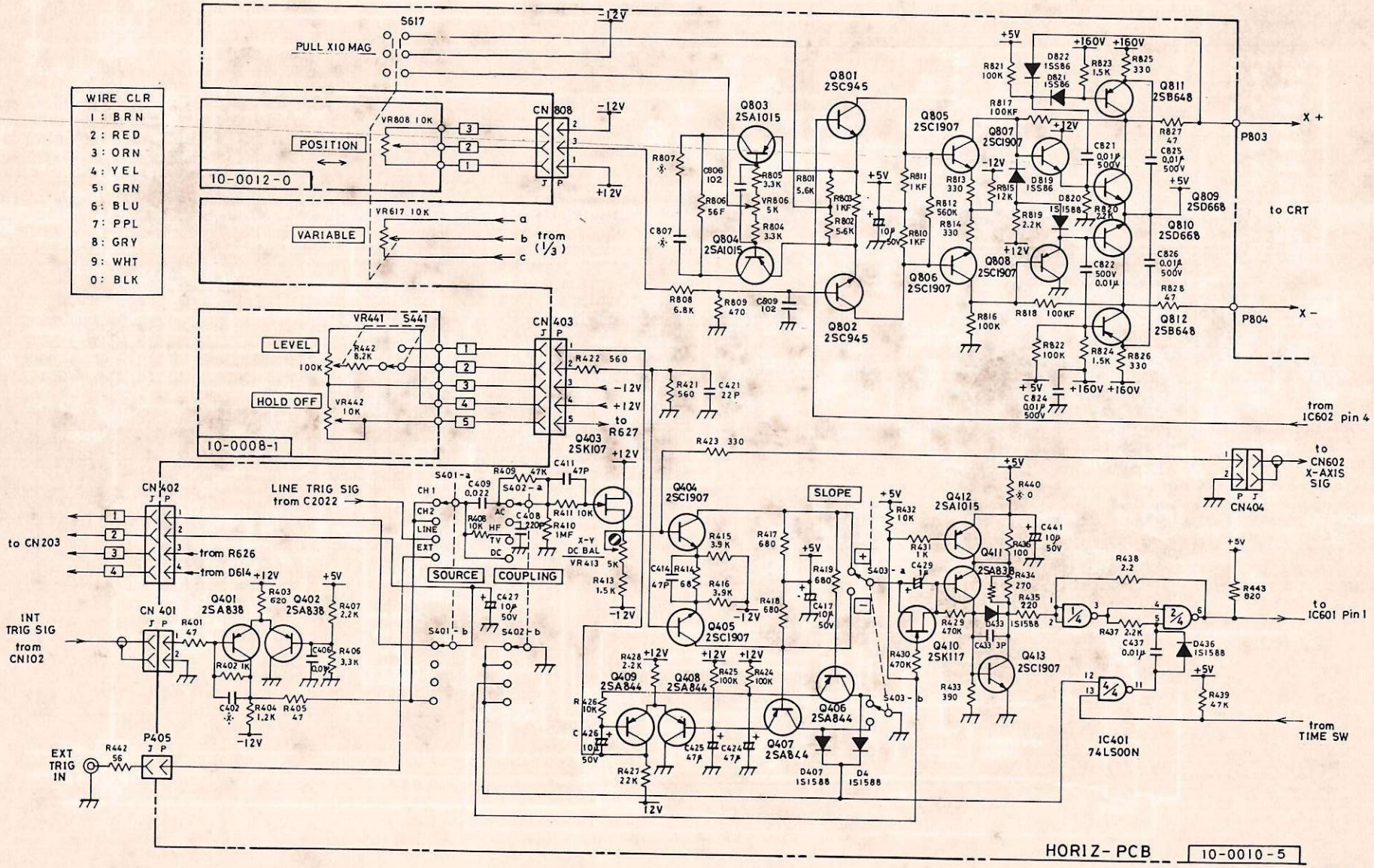
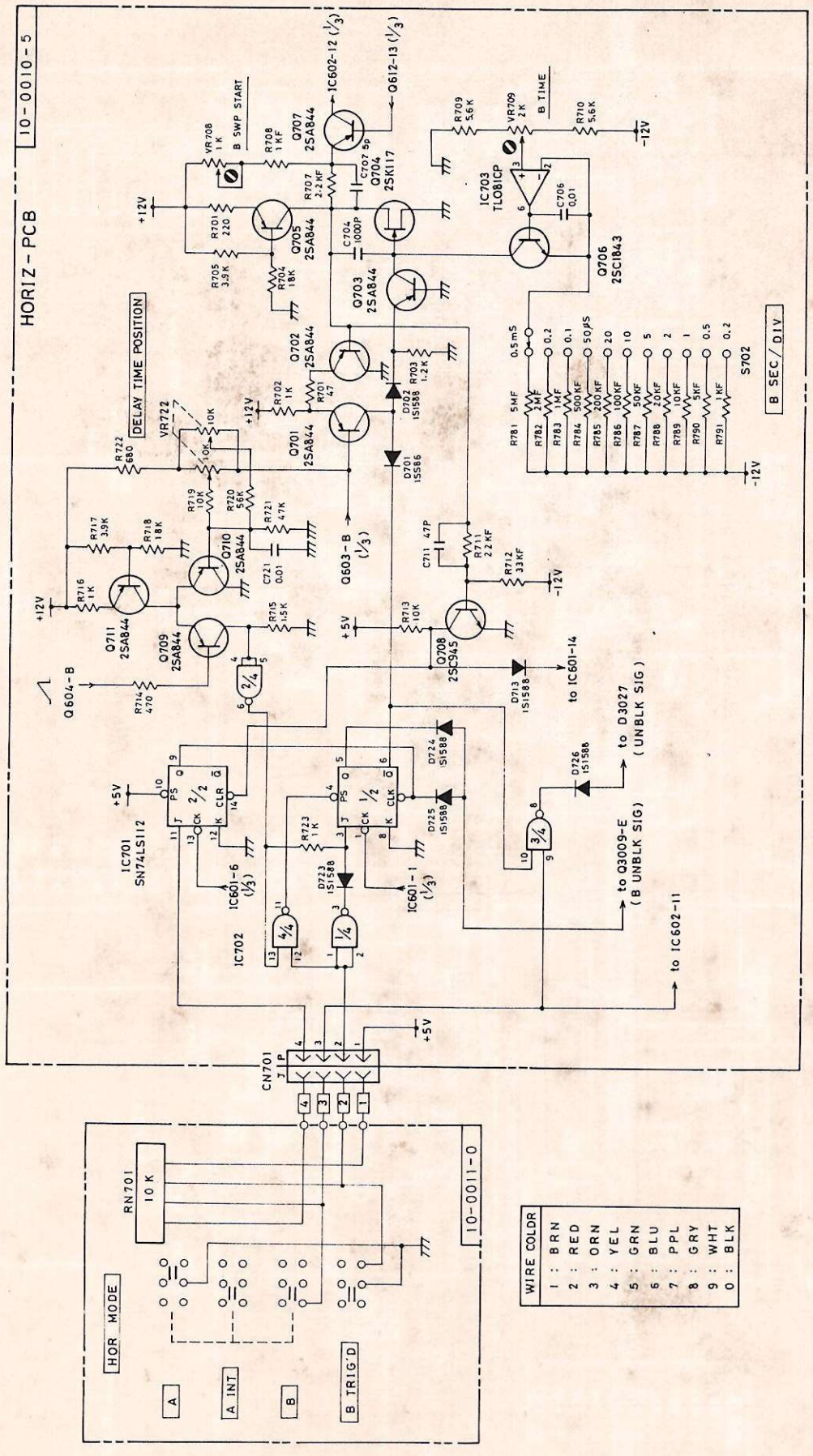
7.2.4 HV Supply and CRT Circuit Schematic



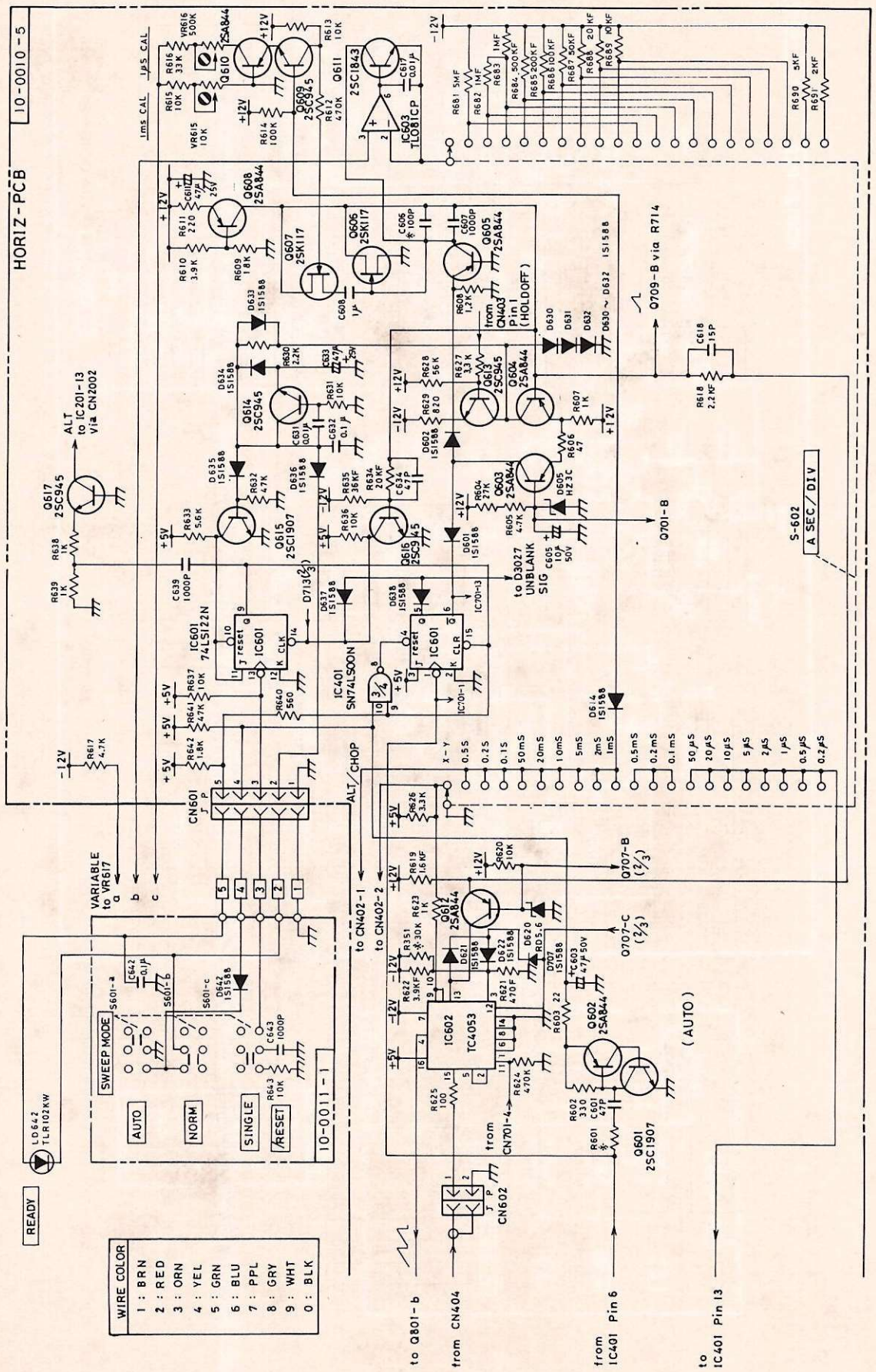
7.2.3 Horizontal/Time Base Schematic (3/3)



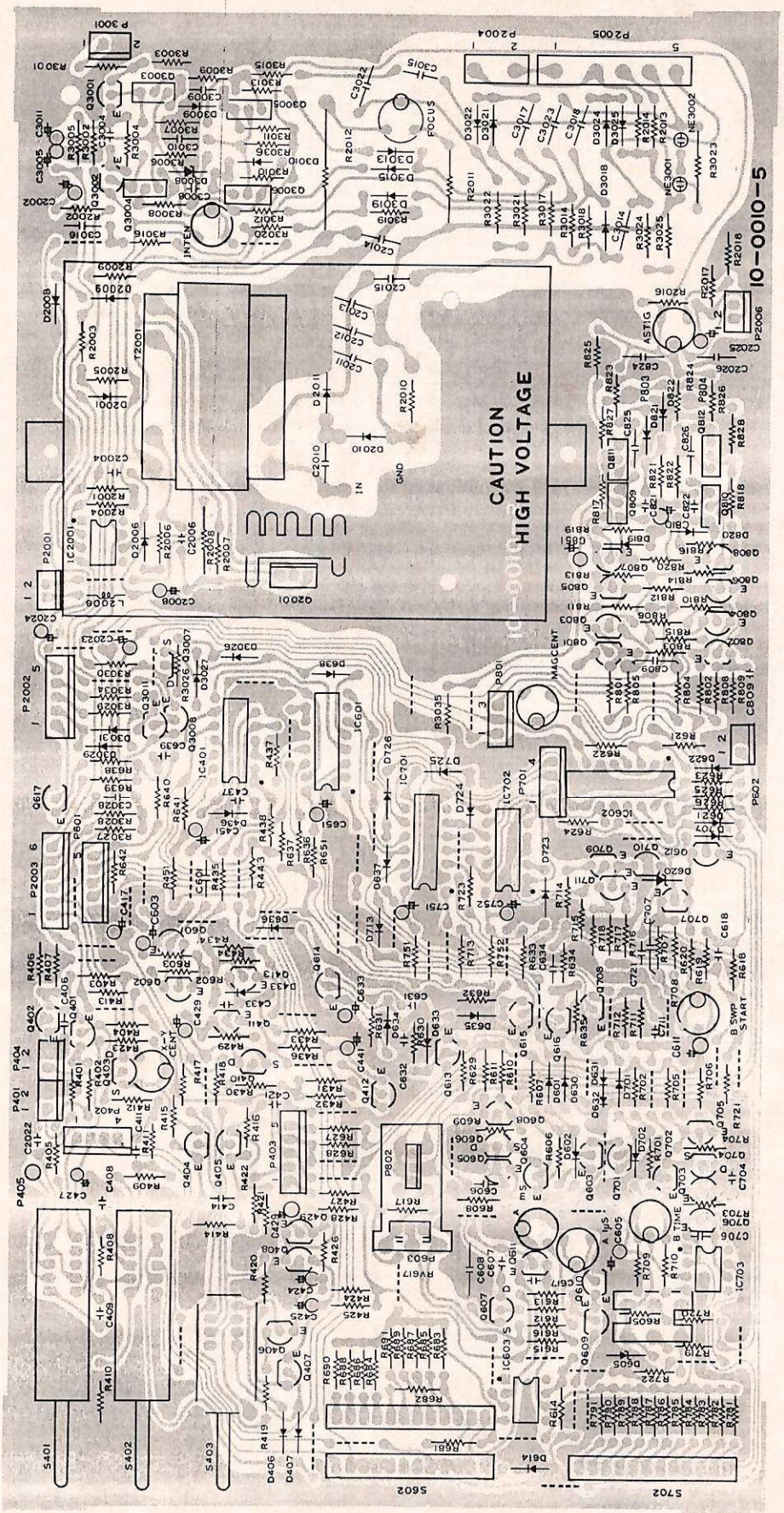
7.2.2 Horizontal/Time Base Schematic (2/3)



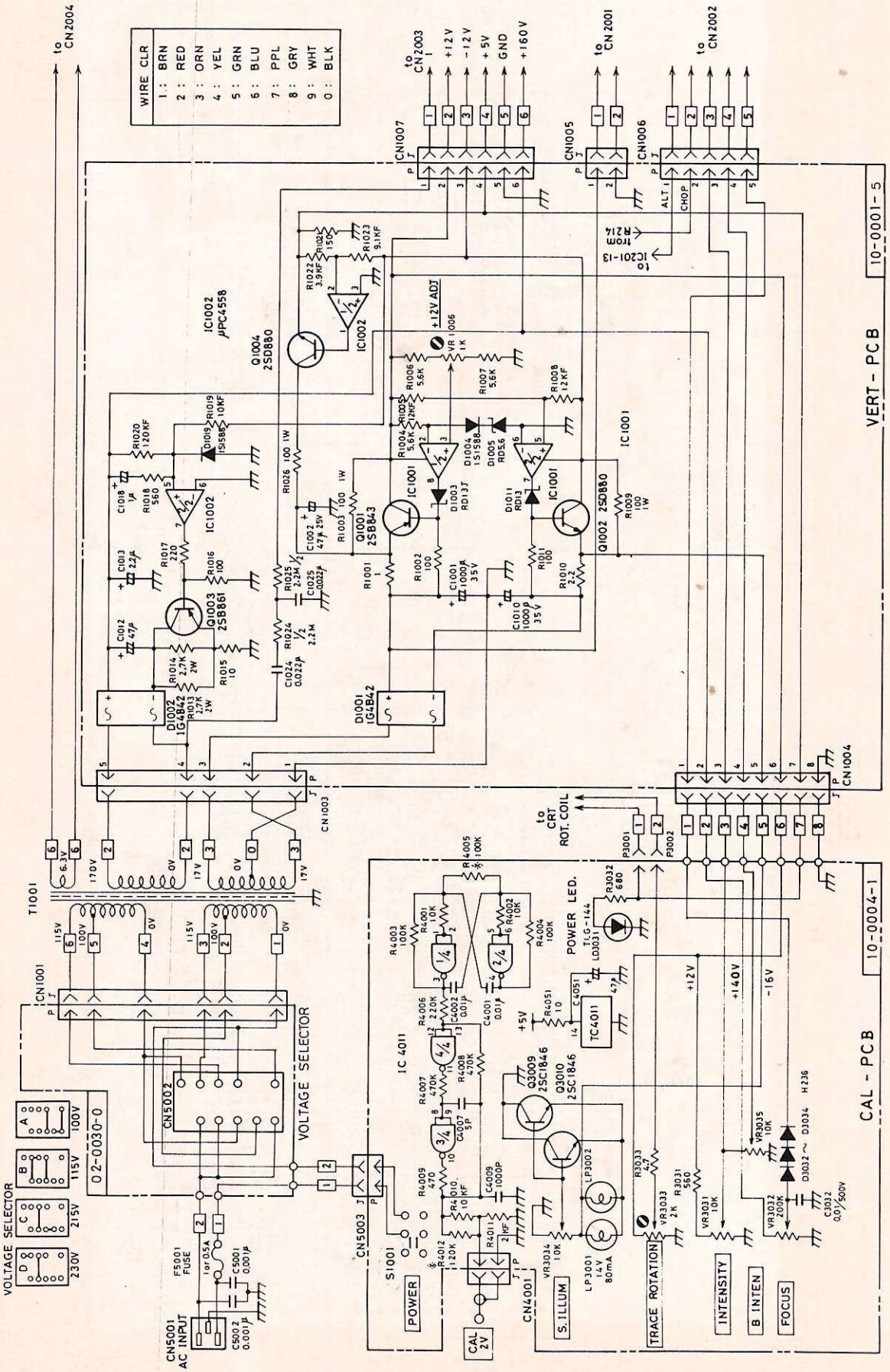
7.2.1 Horizontal/Time Base Schematic (1/3)



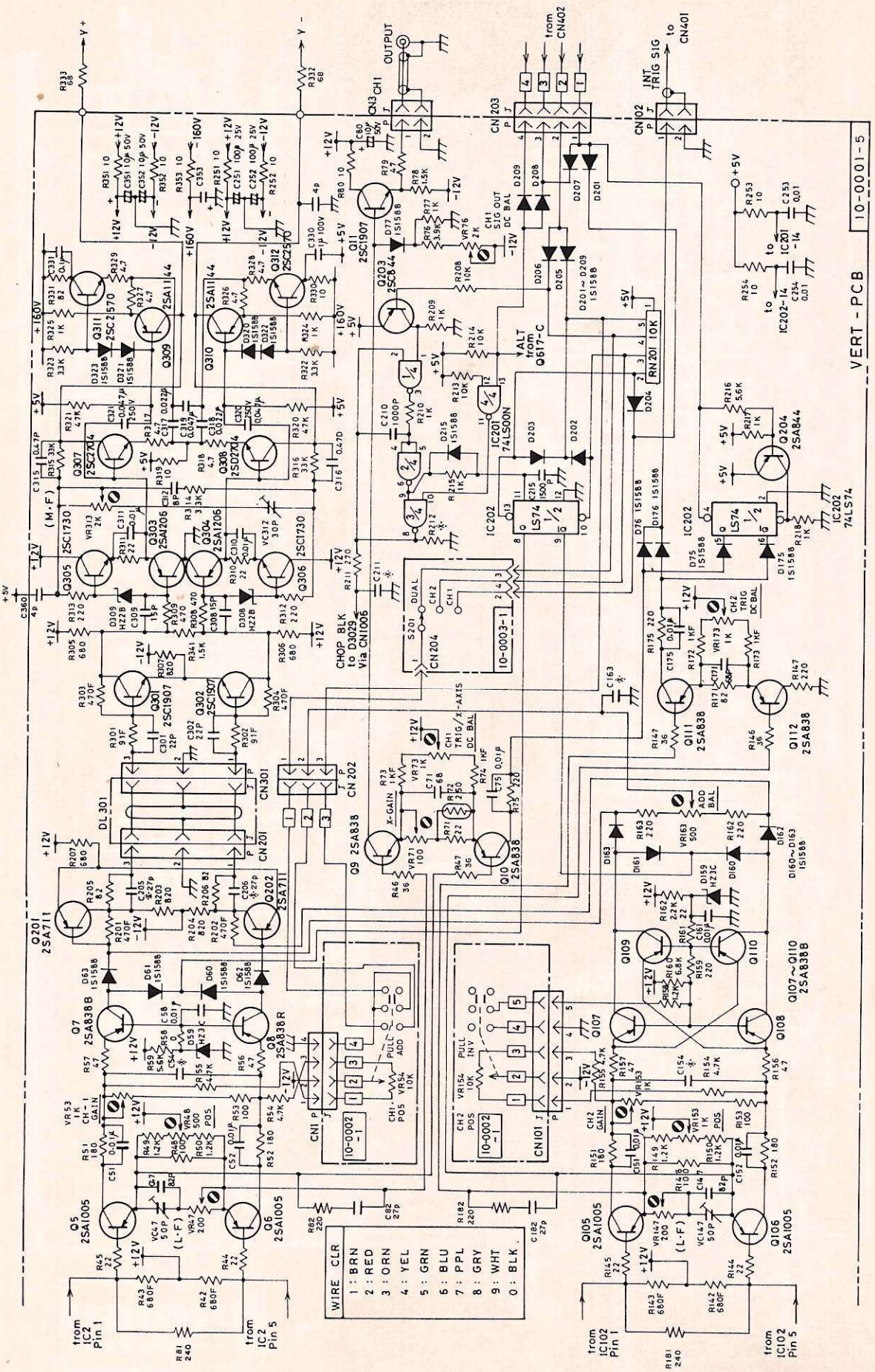
7.2 HORIZONTAL/TIME BASE/HV SUPPLY UNIT BOARD



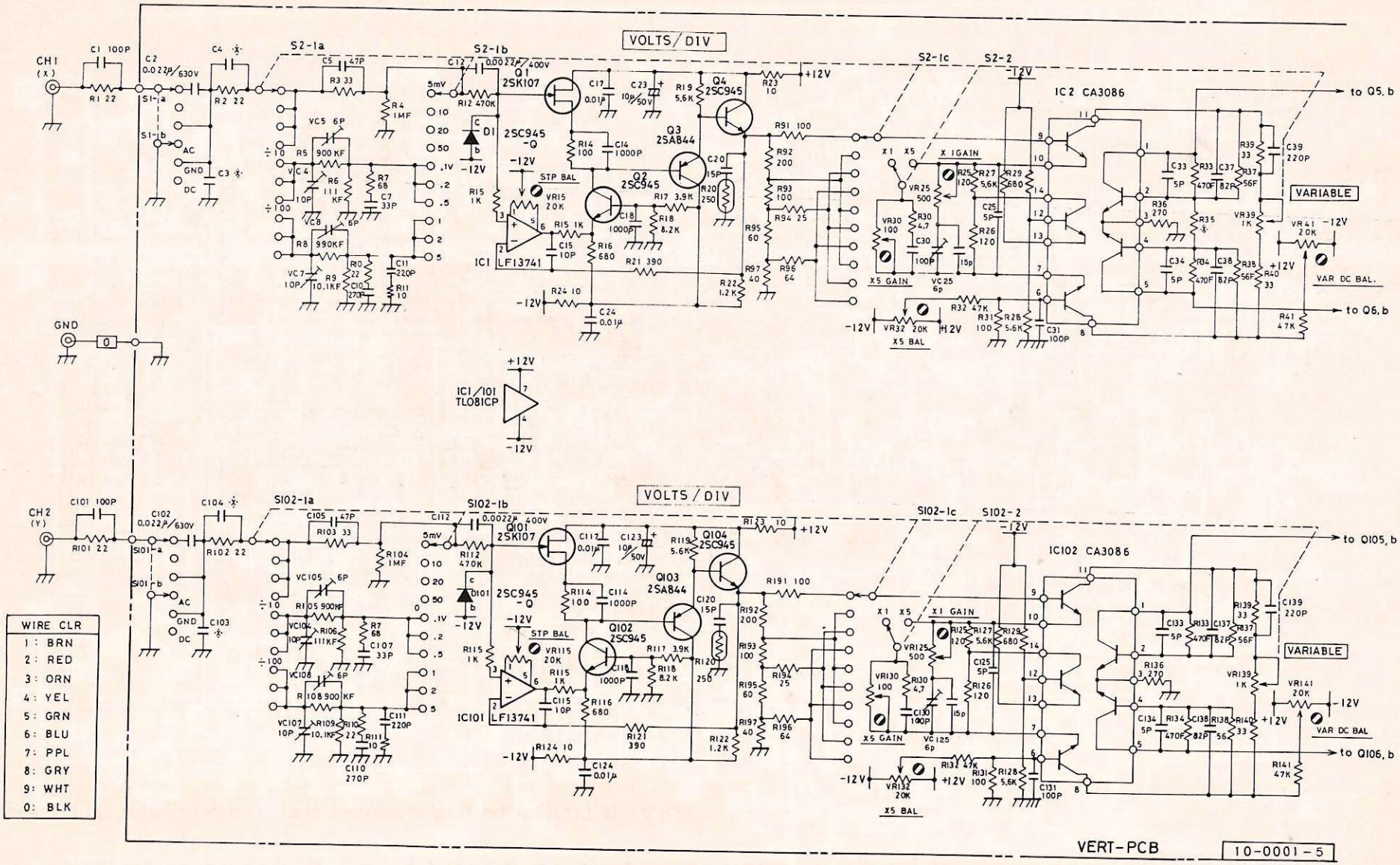
7.1.3 Power Supply and CAL Schematic



7.1.2 Vertical Amplifier Schematic (2/2)



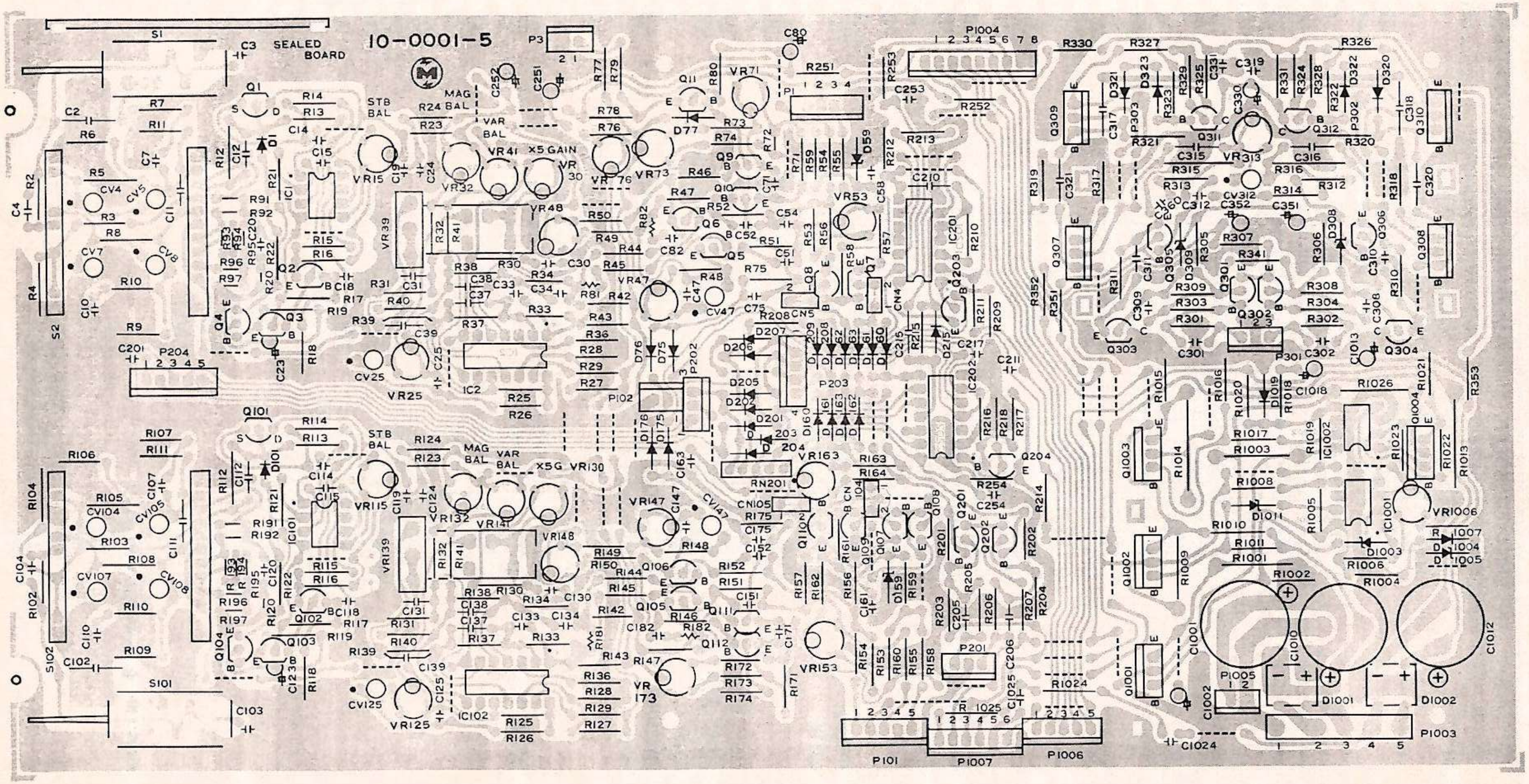
7.1.1 Vertical Amplifier Schematic (1/2)



WIRE CLR
1 : BRN
2 : RED
3 : ORN
4 : YEL
5 : GRN
6 : BLU
7 : PPL
8 : GRY
9 : WHT
0 : BLK

SECTION 7
PARTS LOCATION AND SCHEMATICS

7.1 VERTICAL AMPLIFIER/POWER SUPPLY UNIT BOARD



REF. NO.	PART NO.	DESCRIPTION			
R635	SN14K2E36kΩF	Metal Film Resistor	36kΩ	±1%	1/4W
R685	SN14K2E50kΩF	Metal Film Resistor	50kΩ	±1%	1/4W
R689,817,818	SN14K2E100kΩF	Metal Film Resistor	100kΩ	±1%	1/4W
R2001	SN14K2E110kΩF	Metal Film Resistor	110kΩ	±1%	1/4W
R684	SN14K2E200kΩF	Metal Film Resistor	200kΩ	±1%	1/4W
R688	SN14K2E500kΩF	Metal Film Resistor	500kΩ	±1%	1/4W
R682,683	SN14K2E1MΩF	Metal Film Resistor	1MΩ	±1%	1/4W
R681	SN14K2E5MΩF	Metal Film Resistor	5MΩ	±1%	1/4W
VR709	TM64K-3-PV2 2kΩB	Potentiometer	2kΩ	B	
VR413,806	TM64K-3-PV2 5kΩB	Potentiometer	5kΩ	B	
VR615	TM64K-3-PV2 10kΩB	Potentiometer	10kΩ	B	
VR3002	TM64K-3-PV2 20kΩB	Potentiometer	20kΩ	B	
VR2018	TM64K-3-PV2100kΩB	Potentiometer	100kΩ	B	
VR616	TM64K-3-PV2500kΩB	Potentiometer	500kΩ	B	
VR722	VR-5008	Potentiometer	10k+10k	B	
VR2011	EVM-HIGA00B26(2MΩ)	Potentiometer	2MΩ	B	
C3014,3015,3017,3012,	DD111DE102Z6K	Ceramic Capacitor	1000pF	±20%	6kWV
C3022,3023	DD111DE102Z6K	Ceramic Capacitor	1000pF	±20%	6kWV
C639,643	DD104DE102K50	Ceramic Capacitor	1000pF	±10%	50WV
C433	DD104CJ030C50	Ceramic Capacitor	3pF	±0.25pF	50WV
C406,617,3008,3009,3028	DD106F103Z50	Ceramic Capacitor	0.01μF		50WV
C411,414,601,634	DD106CH470K50	Ceramic Capacitor	47pF	±10%	50WV
C2004	DD105B222K50	Ceramic Capacitor	2200pF	±10%	50WV
C408,3004	DD111CH221K50	Ceramic Capacitor	220pF	±10%	50WV
C821,822,824-826	DD14E103P500	Ceramic Capacitor	0.01μF		50WV
C2026,3010,3016	DD14E103P500	Ceramic Capacitor	0.01μF		50WV
C618	DD104CH150K50	Ceramic Capacitor	15pF	±10%	50WV
C606	DD107CH101K50	Ceramic Capacitor	100pF	±10%	50WV
C632,642	DD312BC104Z25	Ceramic Capacitor	0.1μF		25WV
C424,425,603,611,633	RE-25V 470M	Electrolytic Capacitor	47μF	±20%	25WV
C417,426,427,441,	RE-50V 100M	Electrolytic Capacitor	10μF	±20%	50WV
C451,605,651,810	RE-50V 100M	Electrolytic Capacitor	10μF	±20%	50WV
C851,2023-2025	RE-50V 100M	Electrolytic Capacitor	10μF	±20%	50WV
C3005,3011	RE-50V 100M	Electrolytic Capacitor	10μF	±20%	50WV
C2008	RE-50V 220M	Electrolytic Capacitor	22μF	±20%	50WV
C2015	DE0707SL220K2K	Ceramic Capacitor	22pF	±10%	2kWV
C2010-2014,2016-2021	DE1610E472Z3K	Ceramic Capacitor	4700pF	±10%	3kWV
C607	ECQ-E102J100V	Mylar Capacitor	1000pF	±5%	100WV
C608	ECQ-K105J100V	Mylar Capacitor	1μF	±5%	100WV
C437	501N1003 103K	Mylar Capacitor	0.01μF	±10%	100WV
C2006	501N1003 104K	Mylar Capacitor	0.1μF	±10%	100WV
C409	501N1003 223K	Mylar Capacitor	0.022μF	±10%	50WV
C631	501N5002 103K	Mylar Capacitor	0.01μF	±10%	50WV
C2022	501N5002 223K50	Nylar Capacitor	0.022μF	±10%	50WV
C429,2002	SC-1V 105M		1μF		
L2008	LF-7.5 100μH	Ferri Inductor	100μH		
NE3001,3002	NE-2	Neon Lamp			
T2001	S-1820	Converter Transformer			
LD642	TLG-144	LED			

NOTE: Ordinary carbon resistors are not listed.

6.3 HORIZONTAL/TIME BASE/HV SUPPLY UNIT

REF. NO.	PART NO.	DESCRIPTION			
S401,402	SLR-524	Lever Switch			
S403	SLR-522	Lever Switch			
S702	SW-5003	Rotary Switch			
IC401,702	SN74LS00N	Logic IC			
IC601,701	SN74LS112N	Logic IC			
IC602	TC4053BP	Switching IC			
IC603,703	TL081CP	Linear IC			
IC2001	LF13741N	Linear IC			
Q401,402,411,808	2SA838-B	Transistor			
Q404,405,413,601,	2SC1907	Transistor			
Q615,805-807,3001,	2SC1907	Transistor			
Q3002	2SC1907	Transistor			
Q406-409,602-605,	2SA844D	Transistor			
Q608,610,612,701-703,705	2SA844D	Transistor			
Q709-711,3008,3011	2SA844D	Transistor			
Q412,803,804	2SA1015-Y	Transistor			
Q611,706	2SC1843-E	Transistor			
Q609,708	2SC945	Transistor			
Q809,810	2SD668A-C	Transistor			
Q811,812	2SB648A	Transistor			
Q2001	2SD880Y	Transistor			
Q3003-3006	2SC2371-L	Transistor			
Q403	2SK-107-3	FET			
Q410,606,607,3007,704	2SK-117-BL	FET			
D433,601,819,701	1SS86	Diode			
D406,407,436,602,614,	1S1588	Diode			
D621,622,630-638,642,	1S1588	Diode			
D702,707,713,723-726	1S1588	Diode			
D820,2001,2008,2009,	1S1588	Diode			
D3010,3026,3027,3029	1S1588	Diode			
D821,822,3013,3015,	1SS83	Diode			
D3021,3022	1SS83	Diode			
D2011-2017	GHV-06SSN	Diode			
D605	HZ3C-2	Diode			
D620,2006	RD5,6EL	Zener Diode			
D3018,3019,3024	BAV-21	Diode			
D3025	ERB26-20	Diode			
D3008,3009	HZ2B-3	Diode			
R410	RK14B2H1MΩF	Metal Film Resistor	1MΩ	±1%	1/2W
R2011	RK14B2H6.8MΩF	Metal Film Resistor	6.8MΩ	±1%	1/2W
R2015	RK14B2H10MΩF	Metal Film Resistor	10MΩ	±1%	1/2W
R2008	RSF1B1kΩF	Metal Film Resistor	1kΩ	±5%	1W
R2012	GS1B10MΩF	Metal Film Resistor	10MΩ	±5%	1W
R806	SN14K2E56ΩF	Metal Film Resistor	56±	±1%	1/4W
R621	SN14K2E470ΩF	Metal Film Resistor	470Ω	±1%	1/4W
R803,810,811	SN14K2E1kΩF	Metal Film Resistor	1kΩ	±1%	1/4W
R619	SN14K2E1.6kΩF	Metal Film Resistor	1.6kΩ	±1%	1/4W
R687	SN14K2E2kΩF	Metal Film Resistor	2kΩ	±1%	1/4W
R618	SN14K2E2.2kΩF	Metal Film Resistor	2.2kΩ	±1%	1/4W
R622	SN14K2E3.9kΩF	Metal Film Resistor	3.9kΩ	±1%	1/4W
R691	SN14K2E5kΩF	Metal Film Resistor	5kΩ	±1%	1/4W
R2004	SN14K2E8.2kΩF	Metal Film Resistor	8.2kΩ	±1%	1/4W
R686,812	SN14K2E10kΩF	Metal Film Resistor	10kΩ	±1%	1/4W
R2003	SN14K2E12kΩF	Metal Film Resistor	12kΩ	±1%	1/4W
R634,690	SN14K2E20kΩF	Metal Film Resistor	20kΩ	±1%	1/4W

REF. NO.	PART NO.	DESCRIPTION			
R1014,1013	RSF2B2.7kΩJ	Metal Film Resistor	2.7kΩ	±5%	2W
R94,194	SN14K2B25ΩF	Metal Film Resistor	25Ω	±1%	1/8W
R97,197	SN14K2B40ΩF	Metal Film Resistor	40Ω	±1%	1/8W
R95,195	SN14K2B60ΩF	Metal Film Resistor	60Ω	±1%	1/8W
R96,196	SN14K2B64ΩF	Metal Film Resistor	64Ω	±1%	1/8W
R91,93,191,193	SN142KB100ΩF	Metal Film Resistor	100Ω	±1%	1/8W
R92,192	SN14K2E200ΩF	Metal Film Resistor	200Ω	±1%	1/8W
VR15,32,41,115,132,141	TM64K-3-PV2 20kΩB	Potentiometer	20kΩ	B	
VR30,71,130	TM64K-3-PV2 100ΩB	Potentiometer	100kΩ	B	
VR47,147	TM64K-3-PV2 200ΩB	Potentiometer	200Ω	B	
VR25,48,125,148,163	TM64K-3-PV2 500ΩB	Potentiometer	500Ω	B	
VR53,73,153,173,1006	TM64K-3-PV2 1kΩB	Potentiometer	1kΩ	B	
VR76,313	TM64K-3-PV2 2kΩB	Potentiometer	2kΩ	B	
VR39,139	VR-5004	Potentiometer	1kΩ	A	
VC4,7,104,107	ECV-1ZW10×65	Trimmer Capacitor	10pF		
VC5,8,105,108	ECV-1ZW06×65	Trimmer Capacitor	6pF		
VC25,125	ECV-1ZW20×65	Trimmer Capacitor	20pF		
VC312	ECV-1ZW30×65	Trimmer Capacitor	30pF		
VC47,147	ECV-1ZW50×65	Trimmer Capacitor	50pF		
C33,34,133,134,25,125	DO104CH050C50	Ceramic Capacitor	5pF	±0.25pF	50WV
C15,115,26,126,312	DO104CH100D50	Ceramic Capacitor	10pF	±0.5pF	50WV
C20,120,308,309	DO104CH150K50	Ceramic Capacitor	15pF	±10%	50WV
C14,18,114,118,210	DD104B102K50	Ceramic Capacitor	1000pF	±10%	50WV
C215	DD104B152K50	Ceramic Capacitor	1500pF	±10%	50WV
C301,302	DD105CH220K50	Ceramic Capacitor	22pF	±10%	50WV
C7,107	DD105CH330K50	Ceramic Capacitor	33pF	±10%	50WV
C17,24,51,52,58,75,	DD105CH103Z50	Ceramic Capacitor	0.01μF	$^{+80}_{-20}$	50WV
C117,124,151,152,161,	DD105CH103Z50	Ceramic Capacitor	0.01μF	$^{+80}_{-20}$	50WV
C175,201,253,254	DD105CH103Z50	Ceramic Capacitor	0.01μF	$^{+80}_{-20}$	50WV
C1	DD107CH101K50	Ceramic Capacitor	100pF	±10%	50WV
C71,171	DD107CH680K50	Ceramic Capacitor	68pF	±10%	50WV
C37,38,137,138,47,147	DD107CH820K50	Ceramic Capacitor	82pF	±10%	50WV
C30	DD111CH151K50	Ceramic Capacitor	150pF	±10%	50WV
C39,139	DD111CH221K50	Ceramic Capacitor	220pF	±10%	50WV
C10,11,110,111,130	DD112CH271K50	Ceramic Capacitor	270pF	±10%	50WV
C331	DD312BC104Z25	Ceramic Capacitor	0.1μF		25WV
C23,80,123,351,352	RE-50V100M	Electrolytic Capacitor	10μF	±20%	50WV
C251,252	RE-25V101M	Electrolytic Capacitor	100μF	±20%	25WV
C1001,1010	RE-35V102M	Electrolytic Capacitor	1000μF	±20%	35WV
C1002	RE-25V470M	Electrolytic Capacitor	47μF	±20%	25WV
C330,1018	RH-160V010M	Electrolytic Capacitor	1μF	±20%	160WV
C1012	RH-200V470M	Electrolytic Capacitor	47μF	±20%	200WV
C1013	RH-250V2R2M	Electrolytic Capacitor	2.2μF	±20%	250WV
C315,316	CGM-C 0.47PM	Ceramic Capacitor	0.47pF		
C2,102,317,318	CF921L2J223K	Metal Film Capacitor	0.022μF	±10%	630W
C320,321	CF921L2E473K	Metal Film Capacitor	0.047μF	±10%	250WV
C310,311	ECQ-E103J100V	Metal Film Capacitor	0.01μF	±5%	100WV
C319	ECQ-E473K100V	Metal Film Capacitor	0.047μF	±10%	100WV
C12,112	ECQ-E222K400V	Metal Film Capacitor	2200pF	±10%	400WV
C1024,1025	501N5002 223K50	Metal Film Capacitor	0.022μF	±10%	50WV
C4001,4002	501N5002 103J50	Metal Film Capacitor	0.01μF	±5%	50WV

6.2 VERTICAL AMPLIFIER/POWER SUPPLY UNIT

REF. NO.	PART NO.	DESCRIPTION		
S1,101	SLR-823	Lever Switch		
S2,102	PS22BP2-4-10/RV	Rotary Switch		
S201	SVE30	Push Switch		
IC1,101	LF1374N	Linear IC		
IC2,102	CA3086	Linear IC		
IC201	SN74LS00N	Logic IC		
IC1001,1002	μPC4558C	Linear IC		
Q1,101	2SK107-3	FET		
Q2,4,102,104	2SC945-Q	Transistor		
Q3,103,203,204	2SC844-D	Transistor		
Q5,6,105,106	2SC1005			
Q7,8,9,10,107,108,	2SA838-B	Transistor		
Q109,110,111,112	2SA838-B	Transistor		
Q1,301,302	2SC1907	Transistor		
Q305,306	2SC1730	Transistor		
Q201,202	2SA711	Transistor		
Q303,304	2SA1206	Transistor		
Q306,308	2SC2704	Transistor		
Q309,310	2SA1144	Transistor		
Q311,312	2SC2570	Transistor		
Q1001	2SB834-Y	Transistor		
Q1002,1004	2SD880-Y	Transistor		
Q1003	2SB861-C	Transistor		
Q3009,3010	2SC1846-R	Transistor		
D59,159	HZC-2	Diode		
D308,309	HZ2B-3	Diode		
D60-63,75-77	1S1588	Diode		
D160-163,175,176	1S1588	Diode		
D201-209,215,320-323	1S1588	Diode		
1004,1019	1S1588	Diode		
D1001,1002	1G4B-42	Diode		
D1003,1011	RD13EL			
D1005	RD5,6EL			
D1,101	2SC945Q	Transistor		
D3032-3034	HZ36L-2	Diode		
R20,72,120	251-2	Disc Thermistor	250Ω	±10%
R5,105	RK14B2H900kΩF	Metal Film Resistor	900kΩ	±1% 1/2W
R8,108	RK14B2H990kΩF	Metal Film Resistor	990kΩ	±1% 1/2W
R4,104	RK14B2H1MΩF	Metal Film Resistor	1MΩ	±1% 1/2W
R37,38,137,138	SN14K2E56ΩF	Metal Film Resistor	56Ω	±1% 1/4W
R301,302	SN14K2E91ΩF	Metal Film Resistor	91Ω	±1% 1/4W
R33,34,133,134,	SN14K2E470ΩF	Metal Film Resistor	470Ω	±1% 1/4W
R201,202,303,304	SN14K2E470ΩF	Metal Film Resistor	470Ω	±1% 1/4W
R42,43,142,143	SN14K2E680ΩF	Metal Film Resistor	680Ω	±1% 1/4W
R73,74,172,173	SN14K2E1kΩF	Metal Film Resistor	1kΩ	±1% 1/4W
R4011	SN14K2E2kΩF	Metal Film Resistor	2kΩ	±1% 1/4W
R1022	SN14K2E3.9kΩF	Metal Film Resistor	3.9kΩ	±1% 1/4W
R1023	SN14K2E9.1kΩF	Metal Film Resistor	9.1kΩ	±1% 1/4W
R4010,1019	SN14K2E10kΩF	Metal Film Resistor	10kΩ	±1% 1/4W
R9,109	SN14K2E10.1kΩF	Metal Film Resistor	10.1kΩ	±1% 1/4W
R1005,1008	SN14K2E12kΩF	Metal Film Resistor	12kΩ	±1% 1/4W
R6,106	SN14K2E111kΩF	Metal Film Resistor	111kΩ	±1% 1/4W
R1020	SN14K2E120kΩF	Metal Film Resistor	120kΩ	±1% 1/4W
R1001	RSF1B1ΩJ	Metal Film Resistor	1Ω	±5% 1W
R1003,1009,1026	RSF1B100ΩJ	Metal Film Resistor	100Ω	±5% 1W
R315,316	RSF1B33kΩJ	Metal Film Resistor	33kΩ	±5% 1W

SECTION 6
PARTS LIST

6.1 CHASSIS

REF. NO.	PART NO.	DESCRIPTION	
	3-13-12	Case Top	
	3-14-13	Case Bottom	
	3-2-1	Ornamental Panel	
	3-12-11	Side Escutcheon	
	3-6-5	Rear Panel	
	3-7-6	Frame (1)	
	3-8-7	Frame (2)	
	3-9-8	Frame (3)	
	3-16-15	CRT Holder	
	FSL-5-14B	CAL Terminal	
	Z-058	GND Terminal	
	205-1000-05	Power Connector	
	215-1000-05	CRT Socket	
	255-1006-03	CRT Band	
	260-1000-05	BNC Receptacle	
	400-1002-05	Handle	
	TM-127-N02	Plastic Leg	
	405-1004-03	Moulded Leg	
	405-1005-03	Stand	
	415-1002-03	Bezel	
	MS-0722	Knob for H.Position, H.Variable, V.Position × 2, Inten, Focus and Scale	
	MS-0720-01	Knob for Trig Level	
	MS-0721-01	Knob for Holdoff	
	MS-0723-02	Knob for V.Variable × 2, D.T.P	
	MS-0724-01	Knob for V.Range × 2, B SEC	
	MS-0726-01	Knob for A SEC	
	MO-1250-6	Knob for AC-GND-DC × 2, Slope, Coupling, Source	
	MO-1250-7	Knob for Mode SW × 6, Power SW	
	430-1000-04 (103)	CRT Screen Filter	
VR3031	VR-5002	Potentiometer for Intensity	10kΩ
VR3032	VR-5002 (200K)	Potentiometer for Focus	200kΩ
VR3034	VR-5002	Potentiometer for Scale Illum	10kΩ
VR808	VR-5002	Potentiometer for H.Position	10kΩ
VR617	VR-5003	Potentiometer for H.Variable	10kΩ
VR54,154	VR-5005	Potentiometer for V.Position	10kΩ
VR442	VR-5008	Potentiometer for Holdoff	10kΩ
VR441	VR-5008	Potentiometer for Level	100kΩ
T1001	S-1819	Power Transformer	
	050-1003-05	Rotation Coil	
	080-1002-05	Fuse	1A
	080-1004-05	Fuse	0.5A
		Fuse Holder	
CN5001	PC-235/SC-335	Voltage Selector	
V3001	150-BYB-31	CRT	

3. X10 MAG Center Adjustment
   a. Apply a time marker signal of 1 msec and set A SEC/DIV to 1 ms.
   b. Pull the time base VARIABLE knob and adjust VR806 so that the center pulse waveform conforms with a center vertical graticule line.

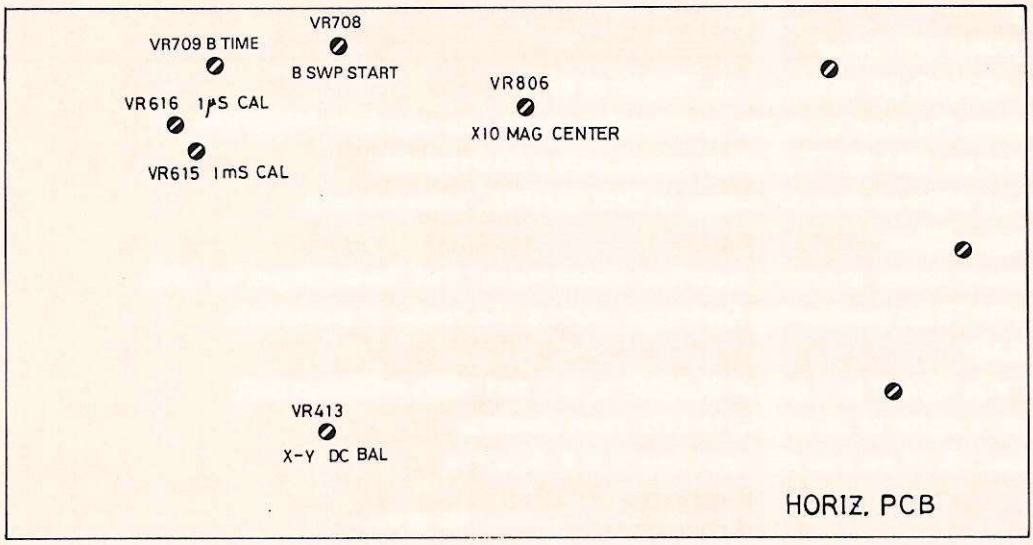


Fig. 14: Locations of Adjusters for Horizontal Axis

4. B Time Base Calibration
   Procedure is simular in step 2 described above except setting for the B sweep.
   a. Set HOR MODE to B and B TRIG'D.
   b. Set B SEC/DIV to 0.5 μs, and adjust VR703 to obtain the same starting position of sweep as A time base.
   c. Apply a time marker signal of 10 μsec to CH1 input and set B SEC/DIV to 10 μs.
   d. Adjust VR709 so that the displayed waveform conform with each division of vertical graticule.

b. Set VERT MODE to CH1, set SOURCE ⑲ to CH1 and display the signal with an amplitude of 6 divisions.
c. Set COUPLING ⑳ AC and set the trigger point to the center of the amplitude of the waveform with adjustement of LEVEL knob ⑱.
d. Change COUPLING to DC and adjust VR73 to position the trigger point at the center of the wave form.

10. CH1 OUTPUT DC Offset
a. Set AC-GND-DC to GND, VOLTS/DIV to 5mV.
b. Position the trace at center horizontal graticule line with CH1 POSITION.
c. Terminate CH1 OUTPUT (Rear panel) with a 50Ω resistor.
d. Adjust VR76 so that the output of CH1 OUTPUT becomes zero.

11. CH2 Trigger Offset
Procedure is similar in step 9 described above except that the setting is for CH2.
Adjust VR173 for positioning the trigger point at the center of waveform.

12. X-axis GAIN
a. Set VOLTS/DIV to 5 mV, A SEC/DIV to X-Y and VERT MODE to CH2.
b. Apply a signal of 20 mVp-p to CH1 input terminal.
c. Adjust VR 71 so that the trace length is 4 divisions.

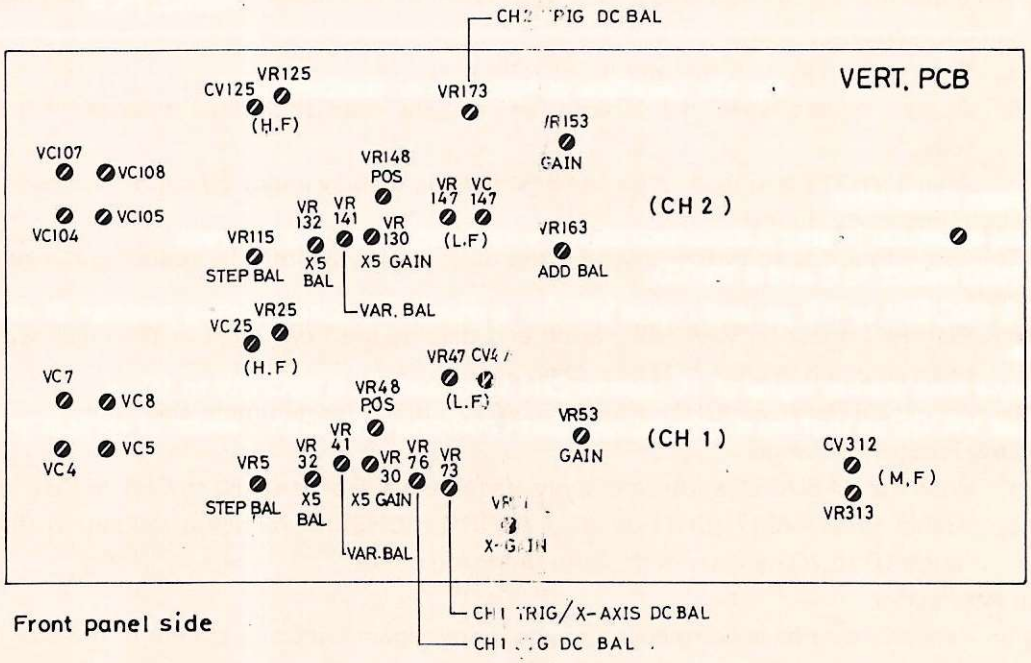


Fig. 13 Locations of Adjusters for Vertical Circuit

5.2.4 Horizontal Axis Adjustments

1. X-Y DC Balance Adjustment
a. Set A SEC/DIV to X-Y, set the horizontal POSITION ㉔ to midrange, and AC-GND-DC to GND.
b. Adjust VR413 for positioning the beam spot to the center of the screen.

2. A Time Base Calibration
For calibrating the sweep time to the values indicated by A SEC/DIV, it is required to use marking signals with accurate time intervals of 1 msec and 1 μsec.
a. Apply a time marker signal of 1 msec to CH1 input and set A SEC/DIV to 1 ms.
b. Adjust VR615 so that the displayed waveform conforms with each division of vertical graticule.
c. Change the time interval of the input signal to 1 μsec and also set A SEC/DIV to 1 μs.
d. Adjust VR616 so that the displayed waveform conforms with each division of vertical graticule.

4. Sensitivity Calibration
   For this adjustment, a square wave generator with an output voltage, setting accuracy of 0.3% at 1 kHz, is required.
   a. Set the square wave generator for a 20 mV output and connect to the CH1 or CH2 input terminal through a 50 Ω BNC cable.
   b. Set the VARIABLE knob to CALibrate position and set the VOLT/DIV switch to 5 mV.
   c. Adjust VR53 (CH1) or VR153 (CH2) for exactly 4 divisions of amplitude.
5. X5 MAG Calibration
   a. Set the square wave generator for a 5 mV output.
   b. Pull the VARIABLE knob and set it to CAL-position.
   c. Set the VOLTS/DIV switch to 5 mV.
   d. Adjust VR30 (CH1) or VR130 (CH2) for exactly 5 divisions of amplitude.
6. ADD Balance
   a. Set the AC-GND-DC switches ⑧ to GND and set the trace lines of CH1 and CH2 respectively to the center of the screen.
   b. Change the VERT MODE switch ⑫ to ADD and adjust VR163 for positioning the trace at center of the screen.
7. Vertical Transient Response
   For this adjustment a square wave of high quality with a rise times of 1.0 nsec or faster is required.
   (1) Middle Frequency Range
      a. Set VOLTS/DIV to 5 mV and A SEC/DIV to 0.2 μs.
      b. Apply a square wave of 1 MHz to CH1 or CH2 input and adjust its level for 5 divisions of amplitude.
      c. Adjust VR313 and VC312 for the best flat-top display about 20 nanoseconds at the rising edge.
   (2) High Frequency Range
      This adjustment is to further sharpen the display of waveform by reducing the ringing at the leadig edge.
      a. Pull the horizontal VARIABLE knob and display the front edge of the pulse waveform which has been adjusted in step 7 (1) described above.
      b. Adjust VR25/VC25 (CH1) or VR125/VC125 (CH2) for minimum aberration.
   (3) Low Frequency Range
      a. Push the VARIABLE knob, and apply a square wave of 100 kHz to CH1 or CH2 input.
      b. Adjust VR47/VC47 (CH1) or VR147/VC147 (CH2) for reducing the sag in the waveform in the range 10 to 70 nanoseconds, from the rising edge.
8. Input Attenuator
   This procedure is for phase compensation and input capacitance adjustment of the attenuators.
   A square wave generator is required which provides a high quality waveform with rise time 1 μsec or faster and without sag or overshoot.
   a. Apply the signal for each of the ranges (0.1V, 1V), and display a waveform with an amplitude of 6 divisions.
   b. Adjust the phase compensation capacitors as shown below to obtain an ideal waveform display.
      0.1V (1/10): VC5 (for CH1), VC105 (for CH2)
      1 V (1/100): VC8 (for CH1), VC108 (for CH2)
   c. Connect a low-rang capacitance meter to CH1 or CH2 input and adjust the input capacitors as shown below that the capacitance at each range is 25 ± 2pF.
      0.1V (1/10): VC4 (for CH1), VC104 (for CH2)
      1 V (1/100): VC7 (for CH1), VC107 (for CH2)
9. CH1 Trigger Offset (X-axis DC Balance)
   a. Apply a sinusoidal signal of 1 kHz to the CH1 input and set AC-GND-DC to AC.

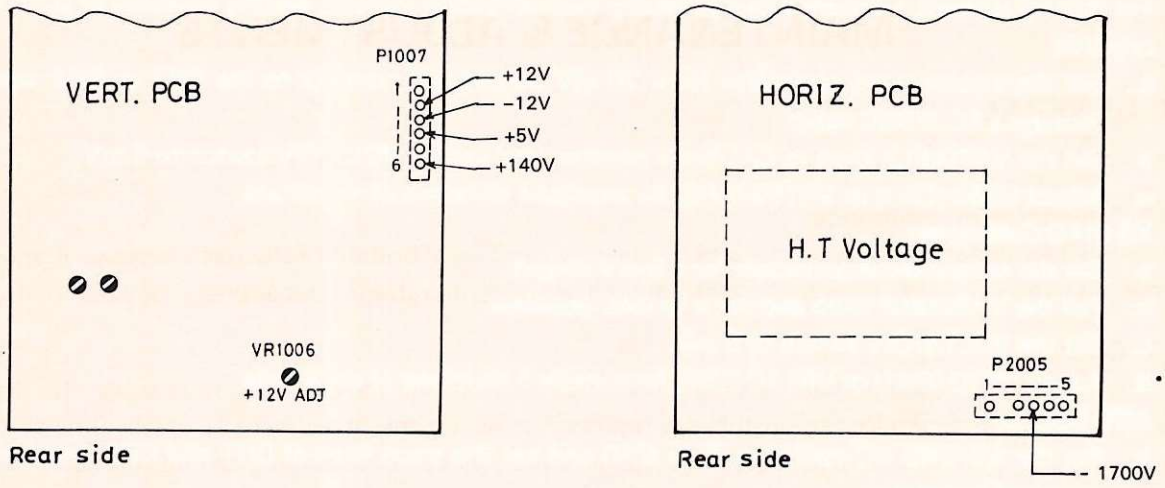


Fig. 11 Check points of DC supply

5.2.2 CRT Circuit Adjustments

1. Intensity
   Adjust VR3002 so that the trace line dims with the INTENSITY control at 10 o'clock setting.
2. Focus
   Adjust VR2011 to obtain the best focus with the FOCUS control at 12 o'clock setting.
3. Astigmatism
   Adjust VR2018 so that the shape of the displayed beam spot (at X-Y mode) becomes as circular as possible.

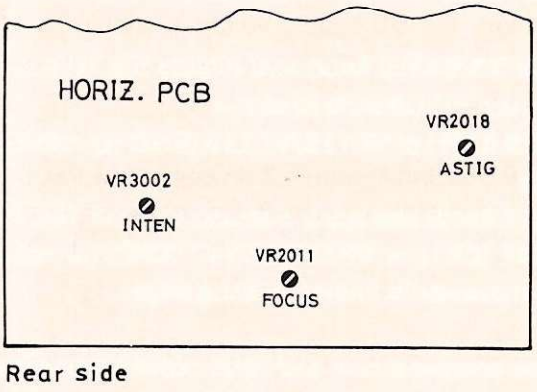


Fig. 12 Location of Adjusters of CRT Circuit

5.2.3 Vertical Axis Adjustments

1. STEP Balance
   When the trace line shifts with of VOLTS/DIV switch ⑩, adjust VR15 (for CH1) or VR115 (for CH2) to obtain minimum shift.
2. X5 MAG Balance
   When the trace line shift with pulling of VARIABLE knob ⑪ for X5 MAGnification, adjust VR32 (CH1) or VR132 (CH2) to obtain the minimum shift.
3. VARIABLE balance
   When the trace line shifts with turning of VARIABLE knob, adjust VR41 (CH1) or VR141 (CH2) for minimizing the shift.

SECTION 5
MAINTENANCE & ADJUSTMENTS

5.1 GENERAL

This section contains information for preventive maintenance, adjustment and calibration.

5.1.1 Preventive maintenance

Preventive maintenance consists of periodic cleaning, and recalibration of the oscilloscope. It should be performed on a regular bases to keep the instrument in its best operational and appearance condition.

5.1.2 Cleaning

Accumulation of dirt, dust and grime should be removed whenever they become noticeable. The frequency of cleaning is largely dependent upon the environment in which the instrument is used. Dirt on the outside covers may by removed with a soft cloth moistened with a diluted household cleaning solution.

5.1.3 Recalibration

Recalibration of the instrument at regular intervals will assure that measurements within the accuracy specification. It is recommended that the instrument be recalibrated after 1000 hours of operation, or twice a year. The calibration procedures are provided in the latter part of this section of the manual.

5.2 ADJUSTMENT AND CALIBRATION

Most of the problems resulting in a malfunction will be a defective component or a mechanical defect. The CRT display can be a useful aid in determining the area of many problems. The defect of any of the amplifiers, triggering and other circuits will be noticeable on the CRT.

5.2.1 Power Supply Adjustments

Before calibrating the instrument, the DC supply voltages should be checked. When the voltages are not proper, the adjustment of the +12V supply may be required using precision digital voltmeter. Check and adjustment points are indicated in Fig. 11.

1. +12V Adjustment
   Adjust RV1006 for +12 ± 0.05V between Pin 2 on connector P1007 (Vertical PCB) and ground. This voltage should be very carefully adjusted because it provides a reference for other supplies.
2. −12V Check
   Check pin 3 on P1007 for proper voltage, −12 ± 0.2V.
3. +5V Check
   Check pin 4 on P1007 for proper voltage, +5V ± 0.25V.
4. +140V Check
   Check pin 6 on P1007 for proper voltage, +140 ± 5V.
5. −1700V Check
   Check pin 3 on connector P2005 (Horizontal PCB) for approximately −1700 ± 50V. At this measurement, it is reqired to use a high input impedance voltmeter (10 MΩ or over).

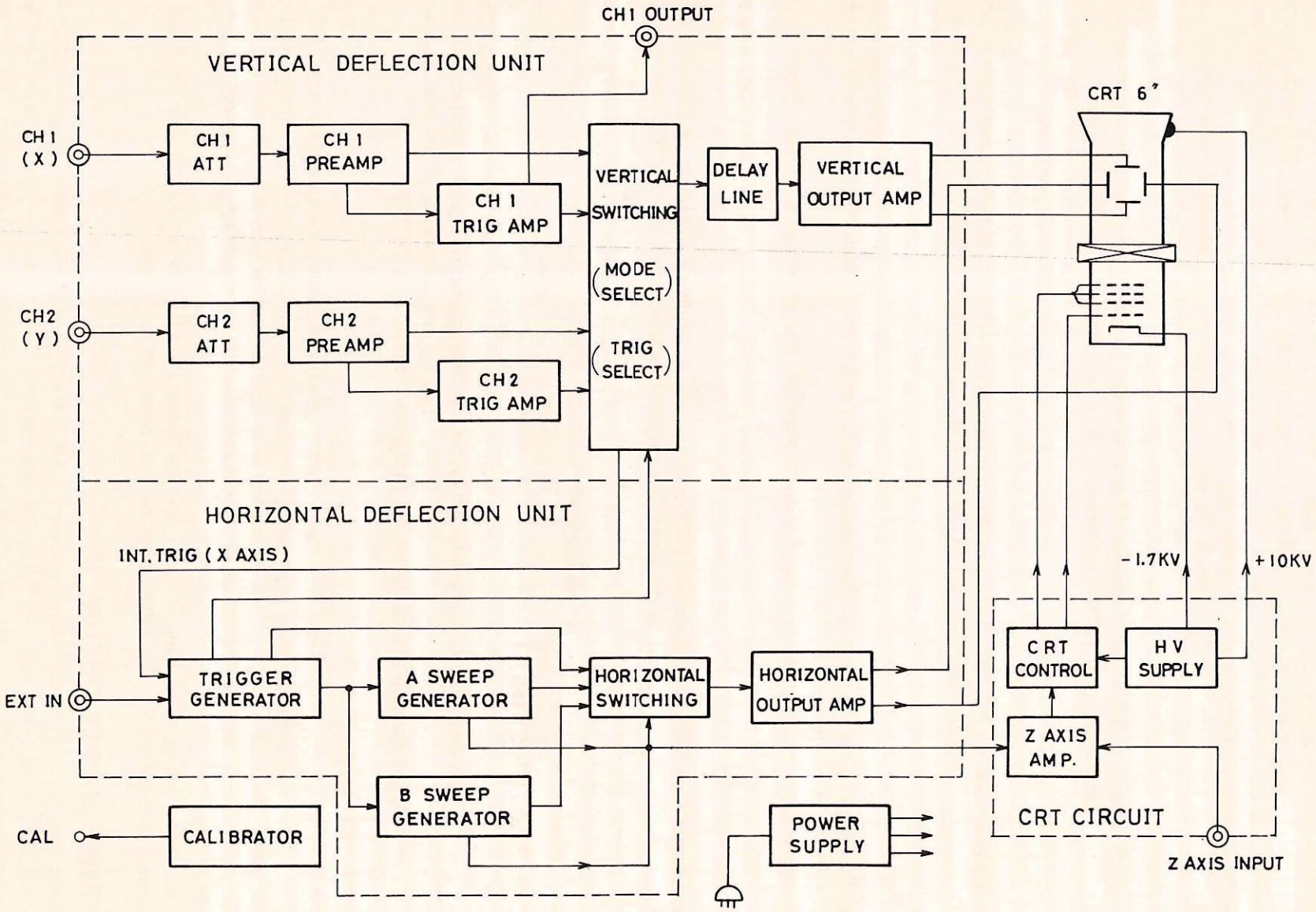


FIG. 10 Block Diagram

The sweep generators produce the sawtooth voltages those are amplified by the Horizontal Amplifier to provide horizontal deflection on the CRT. The sweep generator circuits also produce the gate waveforms used by the Z-axis circuit to unblank the CRT during the sweep time. The A Sweep Generator includes a sweep gate circuit (IC601-1/2), a sweep start comparator (Q603, 604), a sweep enable circuit (IC601-1/2), a hold off circuit (Q613), a sawtooth sweep generator and a sweep length circuit (Q616). The Sawtooth Sweep Generator is comprised of a gate transistor amplifier, a Miller integrator, an integration time constant switching circuit and a SEC/DIV switch which controls the switching circuit.
The gate transistor amplifier (Q603) controls the Miller integrator circuit in such manner that the start level control signal and the sweep gate signal of the sweep start comparator (Q605) produces the sawtooth voltage with the time constant selected by the A SEC/DIV switch.
The sawtooth voltage is fed to the Horizontal Output Amplifier through the Switching buffer circuit (Q612) and the display switching circuit (IC602) which selects the internal and the external signals.
The B sweep Generator includes a sweep gate (IC701-1/2), a sweep start comparator (Q701, 702), a sweep enable circuit (IC701-2/2), a sawtooth sweep generator and a sweep length circuit (Q708).
The sawtooth generator is simular as the A sweep.
The delay pickoff comparator (Q709-711) employs a differential circuit to obtain a certain delay time as set by the Delay Time Position potentiometer (VR722) with respect to the A sweep.
The comparator compares the A sweep output voltage with the voltage set by VR722, and generates a pulse to set the B sweep gate circuit for starting the delayed sweep.
When in the B TRIG'D mode, the B sweep gate circuit is not set directly with this delayed sweep start pulse but with the trigger pulse, i.e the B sweep signal is started at the time which determined by the combination of the D.P.T and the trigger pulses.
The horizontal Output Amplifier consists of a drive amplifier and an output amplifier. The drive amplifier (Q801 ~ 804) converts the single ended signal from the display switching circuit into a push-pull signal for driving the output amplifier. The gain of this amplifier can be multiplied by a factor of 10 in the X10MAG operation.
The output amplifier (Q805 ~ 812) consists of two signal-ended feedback amplifiers, and amplifies the signal at its input to produce the output to drive the horizontal deflection plates of the CRT. The signal current-amplified by Q805 and Q806 is converted into a voltage signal by Q807 ~ Q812 to obtain a sufficiently high level and an adequate low output impedance. By means of negative feedback resistors (R817, R818), stable gain and wide flat frequency response are achieved.

4.4 CALIBRATOR CIRCUIT

The Calibrator Circuit provides a square-wave output signal with an accurate voltage of 2Vp-p (2% or less) which is used for calibration of the vertical deflection factor. The calibration signal is produced by generating a signal with the multivibrator (IC4001-1/4, 2/4), shaping the waveform with the Schmitt circuit (IC4001-3/4, 4/4) and dividing the voltage signal with resistors (R4010 ~ 4012).

4.5 CRT CIRCUIT

The CRT Circuit provides the voltage levels and control circuits necessary for operation of the CRT. Q2001 and associated circuitry compose the high-voltage oscillator which produces the drive for high-voltage transformer T2001. The high voltage output is rectified with D2010, and converted into a DC voltage of −1700 volts for supplying to the CRT cathode as an acceleration voltage. This voltage is stabilized by the regulator circuit (IC2001).
And a post-acceleration voltage (approx. +10 kV) applied to the CRT anode to accelerate the electron beam after passing through the X and Y deflection plates and mesh electrode area.

4.6 POWER SUPPLY CIRCUIT

The Power Supply circuit (Low voltage) provides the operating power for this instrument from four regulated power supplies (+140V, +5V, +12V, −12V) and one unregulated power supply (+16V). The primary winding of the power transformer (T1001) is a split type, in order that this instrument can be operated on various AC voltages using the line voltage selector. The output voltages of the two windings of the power transformer are rectifed and stabilized with use of electronic regulation, with exception of the +16V source which supplies power to the high voltage oscillator.

MAG switch (S2-2/102-2) for magnifying the vertical sensitivity by 5 times.
The second differential cascade amplifier (Q5, 6, 7, 8/Q105, 106, 107 ~ 110) amplifies the output from the first amplifier to a sufficient level for driving the vertical switching circuit. For the CH2 signal this amplifier also has a function of inverting its polarity by switching with the INV switch. The output signal of the 2nd amplifier is fed directly in the form of a current signal to the diode gate of the vertical switching circuit. The current signal for vertical positioning of the trace is added to the output current signal of the 2nd amplifier, being controlled by potentiometer (VR54/VR154) in the positioning circuit.
The signal is picked off from the 2nd amplifier through the collector of Q10 or Q111, and fed to the vertical switching circuit as a internal trigger signal. At CH1, this signal is also fed to the CH1 OUTPUT terminal through the impedance converter Q11, converting into low-impedance.
The vertical switching circuit determines whether the CH1 or the CH2 preamplifier signal or both will be connected to the vertical output amplifier circuit. This circuit is comprised of a diode gate circuit, which electronically switches the vertical signals of the CH1 and CH2, and a switching buffer (Q201, 202) which provides the switched signals to the vertical output amplifier after passing through the delay line circuit.
The delay line is used to provide a time delay for the signal to compensate the time lag in the horizontal deflection or the Z-axis amplifier circuits. (A 120 ns-delay cable is used.)
The vertical output amplifier is comprised of a drive amplifier and a final amplifier. The drive amplifier (Q301, 302) is a feedback amplifier, with low output impedance for driving the final amplifier.
The final amplifier circuit provides the final amplification for the signal before it is connected to the vertical deflection plates of the CRT. Transistors (Q3 ~ Q6) supply the adequate current for driving the final stage transistors (Q7 ~ Q10). The signal voltage-amplified in this stage is fed to the CRT for the vertical deflection.

4.3 HORIZONTAL/TIME BASE CIRCUIT

The trigger generator is comprised of a pulse generator circuit which produces a trigger pulse signal for driving the sweep generator, and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied.
The trigger pulse generator circuit includes a source switch (S401), a coupling switch (S402), an impedance converter (Q403), a level comparator (Q404, 405), a TV synchronization separator (Q410, 411), and a schmitt trigger circuit (IC401).
The source switch selects the internal trigger signal fed from Q401, the line trigger signal from R1025, the external signal from P401. The selected signal is fed to the coupling switch.
The coupling switch selects the mode of trigger coupling. In the AC, HF REJ and TV modes, the DC component of the trigger signal is blocked by coupling capacitor C409 and the frequency components below 10 Hz are attenuated. In the HF REJ trigger coupling mode, the high frequency components of the trigger signal above about 50 kHz are attenuated, while the lower frequency components (between about 10 Hz and 50 kHz) are passed without attenuation. In the TV mode, the sync signal is separated from the video signal by the TV synchronization separator. The DC mode of trigger coupling passes all signals from DC to 50 MHz and above.
The impedance converter is a source follwer (Q403) with an FET. It provides a high input impedance for the trigger signal and operates as a buffer between the trigger generator circuit and the trigger signal sources. The output signal from the impedance converter is fed to the Level comperator circuit.
The Level Comperator (Q404, 405) is a differential amplifier which adjusts the rise portion (or the fall portion) of the comparator output signal by applying the trigger signal from the impedance converter and the reference level from the LEVEL control (VR441). At the FIX position of the LEVEL control, the triger point is Locked at the center portion of the triger signal with the operation of the level fixing, circuit (Q406 ~ 409). The slope of the trigger signal is selected by the SLOPE switch (S403).
The output signal of the level comparator is fed to the buffer amplifier (Q410 ~ 413) and amplified sufficiently for driving the Schmitt circuit (IC401) of the next stage. The output of the Schmitt circuit drives the Sweep Generator and the AUTO circuit (Q601, 602) which converts the high-speed pulse signal of the Schmitt circuit into a DC signal for operating the Sweep generator in the AUTO mode.

SECTION 4
CIRCUIT DESCRIPTION

4.1 GENERAL

The block diagram of the MO-1254A is shown in Fig. 10.
It is comprised of a vertical deflection unit, a horizontal deflection unit, a calibrator circuit, and a power supply circuit.
The vertical deflection unit has two independent pre-amplifiers for CH1 and CH2, a vertical switching circuit, a delay line and a vertical output amplifier.
Each of the pre-amplifiers amplifies or attenuates its input signal to be fed to the switching circuit. The trigger signals also are picked off at this stage.
The vertical switching circuit electronically switches the signals received from the CH1 and CH2 pre-amplifiers. The switched signal is fed to the vertical output amplifier. The trigger signals also are switched and fed to the trigger generator for internal trigger signals.
The vertical signal is applied to its output amplifier for the vertical deflection.
The horizontal deflection unit has a trigger generator, a sweep generator, a horizontal switching circuit and a horizontal output amplifier.
The trigger signal from the vertical switching circuit or EXT IN connector is amplified and shaped to a triger pulse signal.
The A sweep generator is driven by the pulse signal from the trigger generator and produces the sawtooth signal in the triggered sweep mode.
The B sweep generator produces the B sweep signal, being driven by the delayed sweep start signal produced with respect to the A sweep signal when in the continuous delay mode (HOR MODE at B).
When in the triggered delay mode (HOR MODE at B TRIG'D), the B sawtooth signal is synchronized with the trigger pulse.
The horizontal switching circuit electronically switches the sawtooth signals from the A and B sweep generators in the normal mode and the trigger signals (internal, line and external) in X-Y mode, and send the switched signal to the horizontal output amplifier.
The horizontal output amplifier amplifies the output signal of the horizontal switching circuit to an adequate level for the horizontal deflection.
The CRT circuit is comprised of a high voltage regulator to accelerate the electron beam, a Z-axis amplifier for the signal to blank out the return traces and a CRT control circuit for optimal observation.
The high voltage regulator provides a 12 kV voltage to be applied to the CRT cathode to accelerate the electrons.
The Z-axis amplifier amplifies the unblanking signals received from the sweep generator and the intensity modulating signal for application to grid 1 of the CRT.
The CRT circuit provides various voltages for the electrodes so that the CRT operates in an optimal state. All the power supplies are regulated for stability in operation.

4.2 VERTICAL AMPLIFIER CIRCUIT

Each of the CH1 and CH2 attenuator circuit consists of two attenuators. The first attenuator is for 1/1, 1/10 and 1/100, and the second attenuator for 1/1, 1/2, 1/4 and 1/10. By switching these attenuators with the VOLTS/DIV switch (S2-1/S102-1), the signal can be attenuated in a range of 1/1 to 1/1000 in 10 steps. The voltage follower is inserted between the 1st and 2nd attenuators to obtain a high input impedance. The second attenuator is for the low-impedance output signal to be fed to the first differential cascade amplifier (IC2/IC102).
The first differential cascade amplifier is comprised of an emitter-connected differential current amplifier and a current-to-voltage converter (IC2 or IC102). This amplifier also has the VARIABLE circuit (VR39/VR139) for continuously-variable adjustment of the deflection factor between the steps of the VOLTS/DIV switch and X5

3.9.7 Servicing TV Sets

In this application, a triggered oscilloscope is indispensable. This instrument has synchronizing the TV-V (Frame) and TV-H (Line) of the video signal, blanking pedestal, VITS and vertical/horizontal synchronizing pulses.

3.9.8 Composite Video Analysis

The most important waveforms in TV servicing are the composite signals consisting of the video, blanking pedestal and sync pulses. Fig. 6 and Fig. 7 show composite signals synchronized with horizontal synchronizing and vertical blanking pulses.

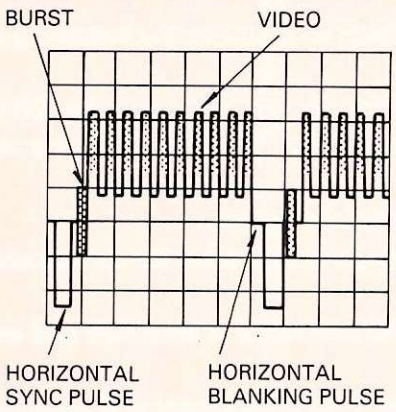


Fig. 6 Horizontal signal

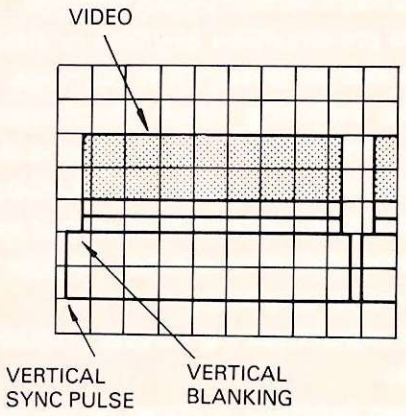


Fig. 7 Vertical signal

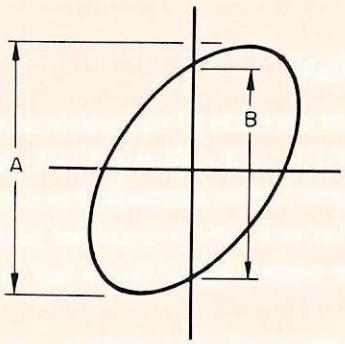
3.9.9 Frequency Measurement with X-Y Method

Set the SEC/DIV switch for X-Y operation. Connect a standard frequency signal to CH1 and the unknown to CH2. Then CH2 is the Y-axis and CH1 the X-axis. The display will be the Lissajous figure, examples of which are shown in Fig. 8.

Fig. 8 Lissajous figures for frequency measurement

3.9.10 Phase Measurement

With application of the X-Y function, connect the two input signal to the CH2 and CH1 connectors. The phase is calculated with the relation shown in Fig. 9.



$$\text{SINE } \phi = \frac{B}{A}$$

ϕ = PHASE ANGLE

Fig. 9 Phase measurement

NOTE: Input impedance of this instrument is 1 MΩ, 25 pF in shunt. With use of a probe with 10 : 1 attenuation (10 MΩ, 22 pF in shunt) multiply the voltage reading by 10.

3.9.2 DC Voltage Measurement

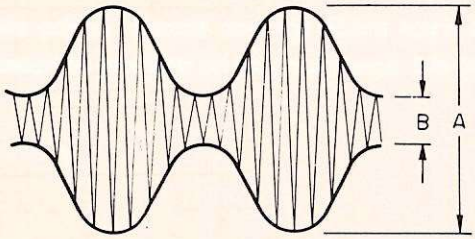
Set the AC-GND-DC switch to GND. Push the SWEEP MODE switch ㉓ to AUTO and then position the trace line on the scale for the 0V reference.

Set the AC-GND-DC switch to DC, whereupon the trace will shift upward for + or downward for – polarities.

DC voltage = Shift in Div x VOLTS/DIV setting.

3.9.3 AM Modulation Measurement

There are several methods but herein the envelope method is shown. The method is applicable when the carrier frequency is within the bandwidth of this instrument. Fig. 4 shows the display of a modulated wave.



$$\text{Mod.,\%} = \frac{A-B}{A+B} \times 100$$

Fig. 4 Envelope method of AM measurement

3.9.4 Dual Trace Applications

For this application, set the VERT MODE selector to DUAL. Signals of Channel 1 and 2 will be displayed simultaneously. The two signals can then be compared with respect to level, waveform, phase, etc.

3.9.5 Comparison of Levels

An example of interconnections is shown in Fig. 5 for the output/input level comparison of an amplifier.

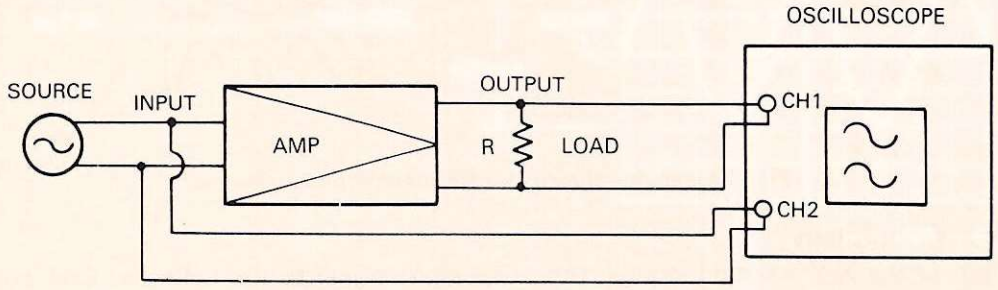


Fig. 5 Level comparison

Set the displays of CH1 and CH2 to be superimposed with use of the POSITION controls. The gain in the amplifier will be the difference in settings of the respective VOLTS/DIV switches. When signals are not matched, even if the VARIABLE controls are adjusted, this difference is due to distortion in the amplifier. In this case, set the VERT MODE selector to ADD and pull the POSITION knob of CH2 to view only the disportion; the trace will be a straight line when distortion is absent.

3.9.6 Checking Stereo Systems

Stereo audio systems have two symmetrical amplifier circuits. Using the dual trace feature, it is possible to compare and check the operation in each circuit. Location of any defective portion is simplified.

3.6 DUAL TRACE DISPLAY

The MODE selector is set to DUAL. In this operating mode, procedures given above are the same.

3.7 SYNCHRONIZING TV SIGNALS

Set the Trigger COUPLING selector ⑳ to TV. The TV frame and line waveforms can be selected with use of the A SEC/DIV switch.

3.8 ADDITION AND SUBTRACTION OPERATION

When CH1 POSITION knob is pulled (ADD mode), the display will be the added waveforms of CH1 and CH2. The subtracted waveform is displayed when the CH2 vertical POSITION knob is pulled for INVERT.

3.9 APPLICATIONS

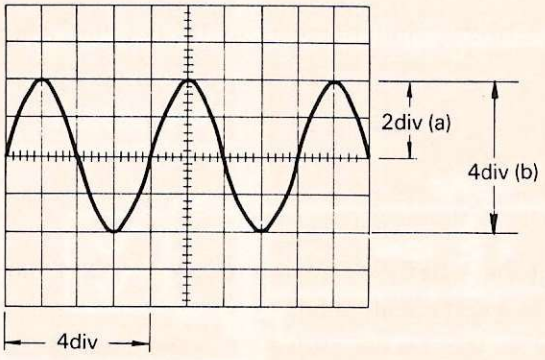
The MO-1254A has full capability of the single trace mode for two traces. In the single trace application, either Channel 1 or Channel 2 can be used. Channel 1 operation will be referred to hereunder for simplicity.
Control settings:

AC-GND-DC switch ..... AC
VERT MODE selector..... CH1
COUPLING selector ..... AC
SOURCE selector..... CH1
Probe cable ..... Connect to CH1 input

Connect the probe tip to the point of measurement and ground clip to the chassis or grounded part.

3.9.1 AC Voltage and Frequency Measurements

Initially, set the VARIABLE knobs of VOLTS/DIV and A SEC/DIV switches ⑪ and ㉕ to the CAL positions. An example is shown in Fig. 3.



VOLTS/DIV ..... at 0.5V
SEC/DIV ..... at 1 μs

Fig. 3 Voltage and frequency measurement

From Fig. 3:

Peak voltage ..... 0.5/div x 2 = 1V
P-P voltage..... 0.5/div x 4 = 2V
Effective voltage..... Peak V $\div \sqrt{2} = 0.707$V
Frequency, Hz ..... 1/Time (sec), or
Time = No. of DIVs per cycle x value of SEC/DIV

For the waveform in Fig. 3, frequency $= \dfrac{1}{1\,\mu s \times 4\ (div)} = \dfrac{1}{4\mu s}$

$= 250$ kHz

6. Connect a 10:1 probe to the input of CH1 and hook the tip to CAL 2V terminal.
7. Set the VOLTS/DIV switch of CH1 to 0.5V and also the VARIABLE knob to fully clockwise. Set the trigger SOURCE selector ⑲ to CH1. The square wave covering 4 divisions will then be displayed.
8. If the square wave is distorted adjust the trimmer in the probe.
9. Remove the probe hook from the CAL terminal.
   The instrument is now ready for use.

3.3 TRIGGERING THE SWEEP

In general, triggered oscilloscopes include circuits to display stable waveforms. The synchronizing pulse for the triggering is derived from the vertical or an integral number related signal. It is important that the triggering is exactly synchronized with the vertical input. The MO-1253 has four controls for this purpose.

1. SOURCE Selector ⑲
   CH1: For internal triggering with the CH1 input signal.
   CH2: For internal triggering with the CH2 input signal.
   LINE: The AC line frequency is used in triggering.
   EXT: For an external triggering signal connected to the EXT IN connector. Three benefits are apparent depending on operating conditions.
   a. Triggering is not affected by vertical signals. For example, the triggering level is dependent on the setting of the VOLTS/DIV switch since the synchronizing source voltage changes. Unless the external trigger voltage is changed, triggering is very stable and free from vertical controls.
   b. The input signal can be delayed with use of the delaying function of a pulse generator.
   c. A composite or modulated signal can be easily triggered.
2. COUPLING Selector ⑳
   Selects the synchronizing circuit coupling. "AC" is for AC coupling and the DC component is blocked. At HF REJ, a lowpass filter is used to suppress any RF noise interference. The TV setting is for the TV signal triggering; selection is made for TV-V or TV-H with the A SEC/DIV switch.
3. SLOPE Selector ㉑
   Selects the trigger slope, positive or negative, of the trigger signal. At TV synchronizing, the point is set to the rise or fall time of the pulse.
4. LEVEL Control ⑱
   For stable triggering control.

3.4 X-Y DISPLAY OPERATION

For special cases in using the X-Y application, set the A SEC/DIV switch to X-Y. All CH1 functions until operate as a horizontal amplifier while CH2 operates as a vertical amplifier.
CH1 input signal is used as the X-axis and CH2 as the Y-axis. However in the case of EXTernal triggering operation, i.e. setting the trigger SOURCE switch ⑲ to EXT, the signal applied to EXT IN connector ⑰ is used as X-asix. Both CH1 and CH2 input signals are available for display on the screen.

3.5 VOLTAGE MEASUREMENTS

Peak, peak-to-peak and DC voltages or a specific portion of a complex waveform can be measured with use of the instrument as a voltmeter. Either the CH1 or CH2 input may be used.

1. Set the VARIABLE control of the VOLTS/DIV to the CAL position. Next set the VOLTS/DIV switch for the trace amplitude to be used. Adjust the vertical POSITION control to set the reference level.
2. For DC or complex signals, first set the input switch to GND and then adjust the vertical POSITION control for the reference level. A positive voltage will deflect the trace upward and vice versa. For the voltage, multiply the vertical (division) deflection by the setting of the VOLTS/DIV switch.
   NOTE: When a 10 : 1 probe is used, the waveform display is only 1/10 of the actual voltage being measured.

B. Rear Panel

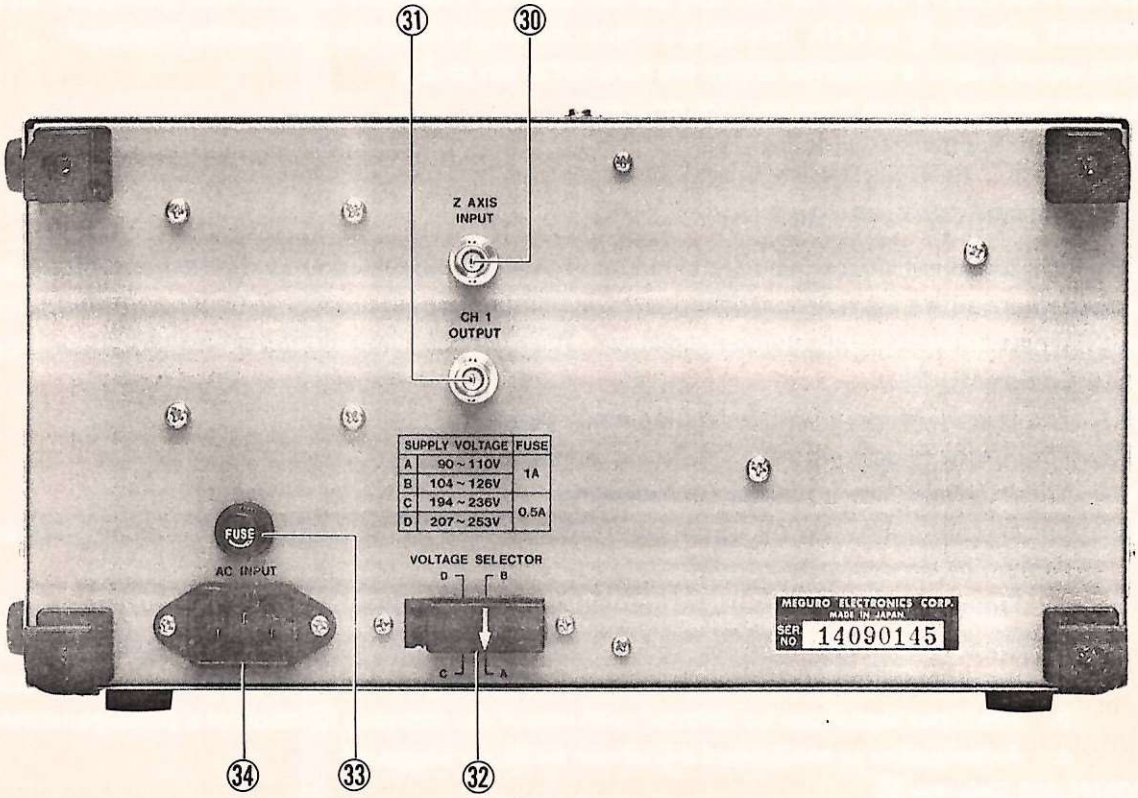


Fig. 2 Rear panel

㉚ Z AXIS INPUT Connector
BNC input connector for intensity modulation of the CRT display.

㉛ CH1 OUTPUT Connector
BNC output connector providing the signal from the CH1 vertical pre-amplifier.

㉜ VOLTAGE SELECTOR Plug and Socket
The plug is inserted with the arrow mark in direction of the line voltage as shown in the affixed table.

㉝ FUSE Holder
For the AC line fuse: rating given in the affixed table.

㉞ AC INPUT Socket
Receptacle for 3-wires AC power cord.

3.2 PRELIMINARY OPERATION

1. Control settings:
   1) POWER switch to OFF.
   2) All four POSITION controls to midrange.
   3) INTENSITY control to midrange.
   4) Push the knob of sweep VARIABLE ㉕ for normal conditions.
   5) Push the AUTO button of SWEEP MODE ㉓.
   6) Other controls may be at any position.
   7) Check the AC line voltage and plug inseted direction on rear panel.
2. Connect the AC line cord between the AC INPUT socket and local mains.
3. Set the POWER switch to ON. After about 20 seconds, a trace line with appear on the screen. If not adjust the INTENSITY control for proper brightness to suit local lighting conditions.
4. Adjust FOCUS and INTENSITY controls for a clear trace line.
5. Readjust the vertical and horizontal POSITION controls to obtain the desired trace line.

AC: Trigger signals are capacitively coupled to the trigger circuitry. Signals below 10 Hz are attenuated.

HF REJ: Attenuates triggering signals above 50 kHz.

TV: For use in observation of TV signals. The TV-V (0.5s ~ 0.1 ms) and TV-H (50 μs ~ 0.2 μs) steps of SEC/DIV switch ㉒ are applicable.

DC: All trigger signals are directly coupled to the trigger circuitry.

㉑ SLOPE Selector

Selects the triggering point on the positive or negative portions of the trigger signal.

㉒ A SEC/DIV Switch

Selects calibrated the A sweep rates from 0.5s/DIV to 0.2 μs/DIV in 1-2-5 sequence. (20 ranges)
At X-Y setting (fully counter-clockwise), operation is for the X-Y mode. The alternate or chop and TV-V or TV-H operations are possible with the switching.

㉓ SWEEP MODE Pushbutton Switch

AUTO: For normal triggering. Sweep free-runs in the absence of an adequate triggering signal.

NORM: For normal triggering. No CRT display in the absense of an adequate triggering signal.

SINGLE/RESET: Displays only one sweep until reset. Reset is made by pushing this switch and READY lamp lights.

㉔ POSITION Control

Positions the trace horizontally.

㉕ VARIABLE/PULL X10 MAG Control

Provides continuously variable sweeps rate to approximately 2.5 times the calibrated setting. At the CAL position, the sweep rate set with A SEC/DIV switch ㉒ is calibrated. When pulled out the sweep speed is expanded by 10 times.

㉖ HOR MODE Pushbutton Switch

A: Displays A sweep. Horizontal deflection provided by A SEC/DIV switch.

A INT: Same as above. Displays A sweep intensified for the duration of B sweep.

B: Displays B sweep. Horizontal deflection provided by B SEC/DIV switch.

B TRIG'D: Provides the triggering for B sweep (triggered delay).

㉗ B SEC/DIV Switch

Selects the B sweep rates from 0.5 ms/DIV to 0.2 μs/DIV in 1-2-5 sequence. (11 ranges)

㉘ DELAY TIME POSITION Control

Provides variable sweep delay between the delay times indicated by the B SEC/DIV switch ㉗.

㉙ B INTENsity Control

Adjusts the beam brightness for the portion of the B sweep.

⑧ AC-GND-DC Switch, CH1 and CH2

AC: Signal is capacitively coupled to the Vertical Amplifier.
Any DC component of signal is blocked, and Low-frequency Limit (–3 dB) is about 10 Hz.

GND: Grounds the amplifier input and opens the input circuit.

DC: All components of the input signal are coupled to the Vertical Amplifier.

⑨ CH1 (X) Connector

BNC connector for applying input signal to channel 1.

⑩ VOLTS/DIV Switch

Selects CH1 deflection factors from 5 mV/DIV to 5V/DIV in 10 steps.

⑪ VARIABLE Volts/DIV Control, CH1 and CH2

Fine adjusters for vertical attenuation.

Provides continuously variable deflection factors (sensitivity) between each steps of VOLTS/DIV switch; normally set to fully clockwise (CAL). When pulled , the sensitivity is magnified by a factor of 5.

⑫ VERT MODE Pushbutton Selector

CH1: Displays Channel 1 only.

DUAL: Dual-trace display by switching between CH1 and CH2 with alternate or chopped operation controlled by the SEC/DIV switch; chopping at approximately 250 kHz at 0.5s to 1 mS/DIV and alternate in 0.5 mS to 0.2 μs/DIV ranges.

CH2: Displays Channel 2 only.

⑬ Ground Terminal

Oscilloscope chassis ground, and to ground via 3-wire AC power cord.

⑭ CH2 (Y) Connector

BNC connector for applying input signal to channel 2.

⑮ POSITION/PUSH INVert Control

Positions the display vertically. In the X-Y mode, this control positions in the Y-axis. When pulled out, CH2 display is inverted.

⑯ HOLDOFF Control

Adjusts the time between sweep steps and used only when the timebase must be properly triggered for complex waveforms (e.g. repetitive complex pulses).

By turning clockwise from full counterclockwise (NORM), the holdoff time is continuously variable to 5 times or over of normal sweep time in the range from 0.2 μs/DIV to 1 ms/DIV.

⑰ EXT IN Connector

BNC connector providing input for external trigger signals. In X-Y mode operation, it is possible to use the signal applied to this connector for X-axis.

⑱ LEVEL control

Selects the starting point on the trigger source waveform when the sweep is triggered. The control knob is turned to fully counterclockwise (FIX) for fixing the triggering level.

⑲ SOURCE Selector

Selects the triggering source signal as follows:

CH1: CH1 signal for triggering.

CH2: CH2 signal for triggering.

LINE: AC line-frequency voltage for triggering.

EXT: The signal applied to the EXT IN ⑰ connector for triggering.

⑳ COUPLING Selector

Selects the triggering mode as follows:

SECTION 3
OPERATION

3.1 CONTROLS AND CONNECTORS

A. Front Panel Functions

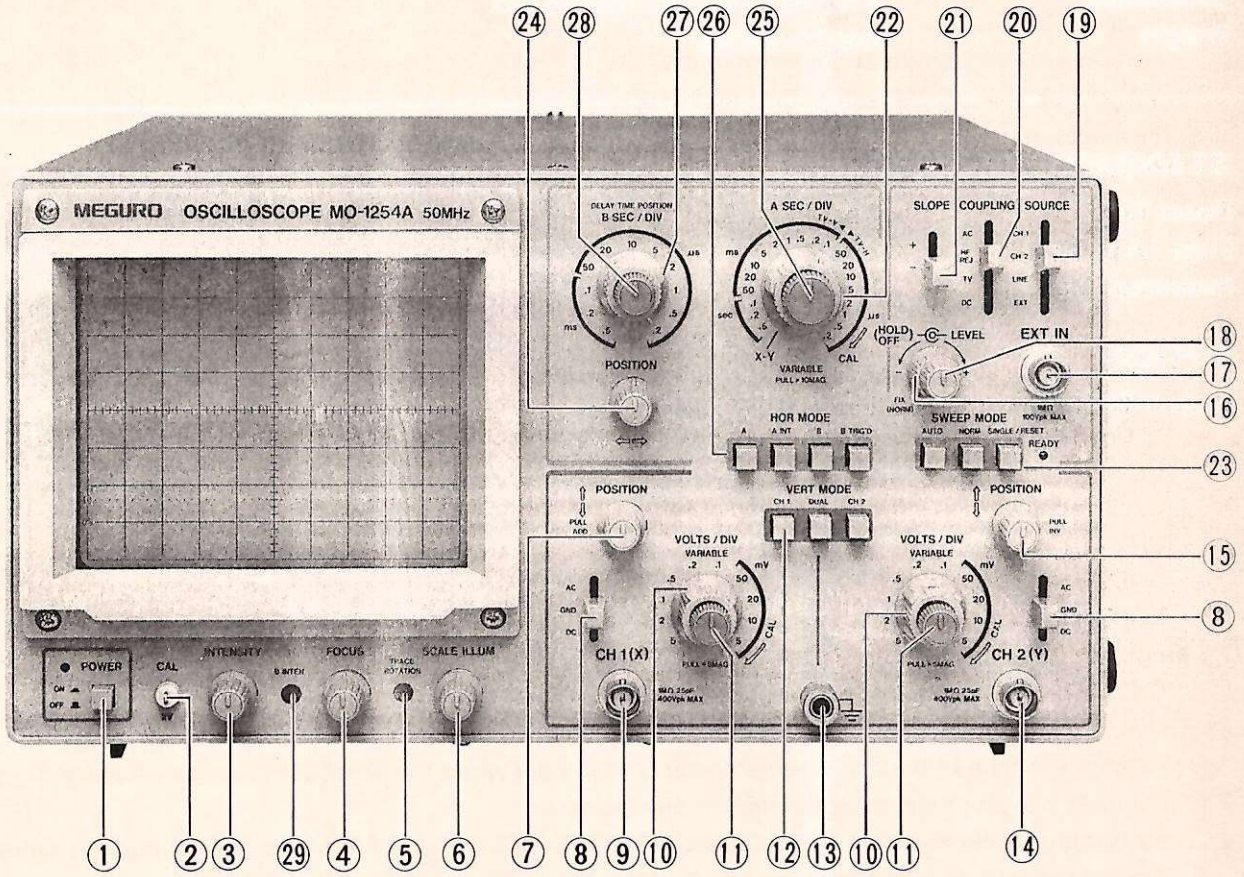


Fig. 1 Front panel controls and connectors

① POWER Pushbutton
Turns the instrument on or off.

② CAL 2V Terminal
1 kHz square wave output; used in checking the amplifier gain, waveform compensation of probe, etc.

③ INTENSITY Control
Adjusts the beam brightness.

④ FOCUS Control
Adjusts the clarity of the beam.

⑤ TRACE ROTATION Adjuster
Used when offsetting the effect of earth's magnetic field in the trace line.

⑥ SCALE ILLUM Control
Used for the adjustment of scale illumination.

⑦ POSITION/PULL ADD Control
Positions the display vertically. In X-Y mode, this control positions in the X-axis. When pulled out (ADD mode), CH1 and CH2 input signals are algebraically added.

GENERAL

CRT Accelerating Voltage	Approx. 12 kV.
Calibration Voltage	2 Vp-p ±2%, 1 kHz square wave (positive-going).
Power Requirements	100V, 117V, 220V and 240V (voltage selector provided). 50/60 Hz; approx, 35 VA
Dimensions	315 (W) × 165 (H) × 435 (D) mm
Weight	Approx. 7.5 kg.

STANDARD ACCESSORIES

Power Cord	1 ea.
Fuse, 1A or 0.5A	2 ea.
Instruction Manual	1 ea.

OPTION

Probe (MP-3050)	2 ea. (10:1/1: selectable).

HORIZONTAL DEFLECTION

Horizontal Mode	A, A INT, B and B TRIG'D
A Sweep	
Sweep Time	0.2 μs to 0.5 s/DIV, 20 steps in 1-2-5 sequence with fine control and X-Y.
Magnification	× 10 (maximum sweep time 20 ns/DIV).
Sweep Time Accuracy	3% (6% at × 10 MAG).
Holdoff Time	Longer than 5 times of sweep length in 0.2 μs/DIV to 1 ms/DIV RANGES.
Lineavity	3% (6% at × 10 MAG).
B Sweep	
Delay System	Continuous and triggered delay.
Sweep Time	0.2 μs to 0.5 ms/DIV. 20 ns to 50 μs/DIV at × 10 MAG.
Sweep Time Accuracy	3% (6% at × 10 MAG).
Delay Time	2 μs to 5 ms/DIV.
Delay Time Accuracy	4%.
Delay Jitter	1/10,000 or less.
X-Y Operation	Mode selected with SEC/DIV switch: CH1: X-axis. CH2: Y-axis.
Sensitivity	Same as CH1 vertical axis.
Frequency Response	DC to 2 MHz (–3 dB).
Phase Shift	Within 3° at 100 kHz.
EXT HOR mode	Trace swept by signal applied to EXT IN terminal.
Sensitivity	Approx. 0.1 V/DIV.
Frequency Response	DC to 2 MHz (–3 dB).
Phase Shift	Within 3° at 100 kHz.

TRIGGER

Source	CH1, CH2, LINE and EXT.
Sensitivity	INT : 0.5 DIV or more (DC to 30 MHz). 1.5 DIV or more (DC to 50 MHz). EXT: 100 mVp-p or more (DC to 30 MHz). 200 mVp-p or more (DC to 50 MHz).
Coupling	AC, HF REJ, TV and DC. AC : Attenuates signal components below 10 Hz. HF REJ: Attenuates signal components above 50 kHz.
Polarity	+ or –
Mode	AUTO, NORM and SINGLE.
Level Fix	Available from 50 Hz to 50 MHz.
External Input	EXT IN terminal is used. Input Impedance: 1 MΩ, 30 pF. Maximum Input : 100V (DC + AC peak).

INTENSITY MODULATION (Z-axis)

Input Voltage	3 Vp-p or higher (Bright at negative-going input).
Input Resistance	Approx. 5 kΩ.
Maximum Input	50 Vp-p (DC + AC peak).
Frequency Range	DC to 5 MHz.

SECTION 1
INTRODUCTION

1.1 GENERAL

The Model MO-1254A is a dual trace 50 MHz oscilloscope using a high brightness CRT.
The vertical amplifiers have maximum sensitivity of 1 mV/DIV and flat frequency response with smooth rolloff above 50 MHz. The maximum sweep time is 20 ns/DIV.
The oscilloscope employs a 6-inch rectangular type CRT with red internal graticule.
The oscilloscope has the various convenient features and excellent functions, but easy to operate.
It is suitable to use in development work of electronic devices and equipments and it can be also be used for production lines, maintenance and servicing.

1.2 FEATURES

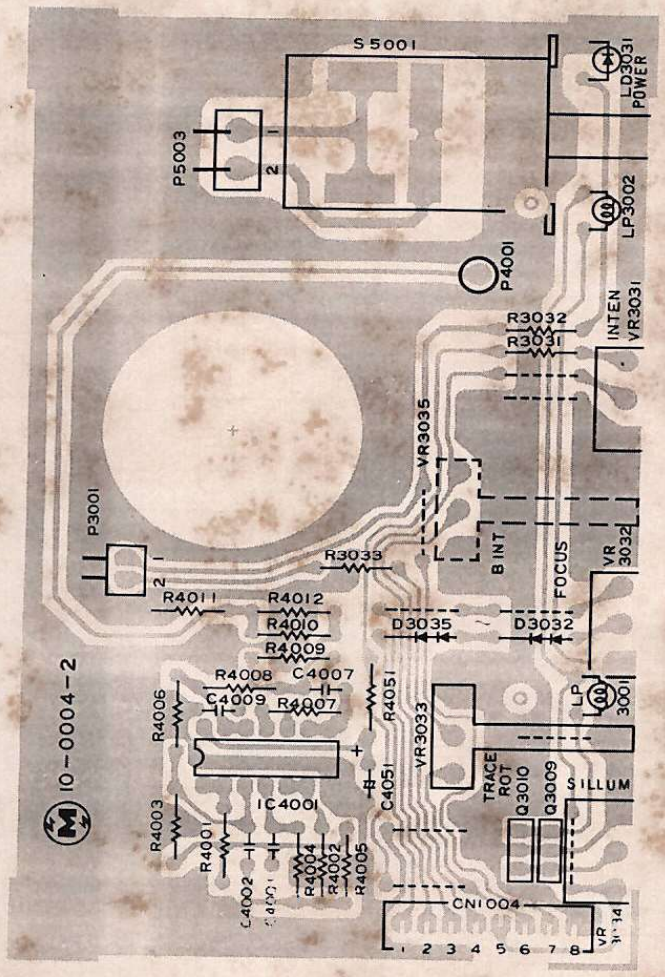
1. Wide bandwidth and high sensitivity.
2. High stability with low drift.
3. High sensitivity X-Y mode.
4. Z-axis modulation applicable.
5. TV VIDEO SYNC filter included.
6. Trigger level lock function usable.
7. Variable hold off incorporated.
8. Single sweep function permitting accurate measurement of single-shot waveform.
9. Delay sweep function convenient for waveform detail observation.

SECTION 2
SPECIFICATIONS

VERTICAL DEFLECTION

Deflection Factor	5 mV to 5 V/DIV ±3%, 10 steps in 1-2-5 sequence and with fine control.
Magnification	5 times (1 mV/DIV to 1 V/DIV at × 5 MAG).
Bandwidth, –3dB	DC: DC to 50 MHz (DC to 20 MHz at × 5 MAG). AC: 10 Hz to 50 MHz (10 Hz to 20 MHz at × 5 MAG). with reference at 50 kHz, 8 DIV.
Rise Time	Approx. 7.0 ns (Approx. 17.5 ns at × 5 MAG).
Overshoot	Less than 3%.
Input Impedance	1 MΩ shunted by 25 ±3 pF.
Maximum Input	400 Vp-p, or 200V (DC + AC peak).
Operating Modes	CH1, CH2, DUAL and ADD.
Chop Frequency	Approx. 250 kHz.
Channel Separation	More over 60 dB at 50 kHz, 30 dB at 50 MHz.
CH1 Signal Output	Approx. 100 mV/DIV (open).
CH2 Polarity	Inversion possible, variation less than 1 DIV.
Signal Delay Time	Approx. 40 ns.

TABLE OF CONTENTS

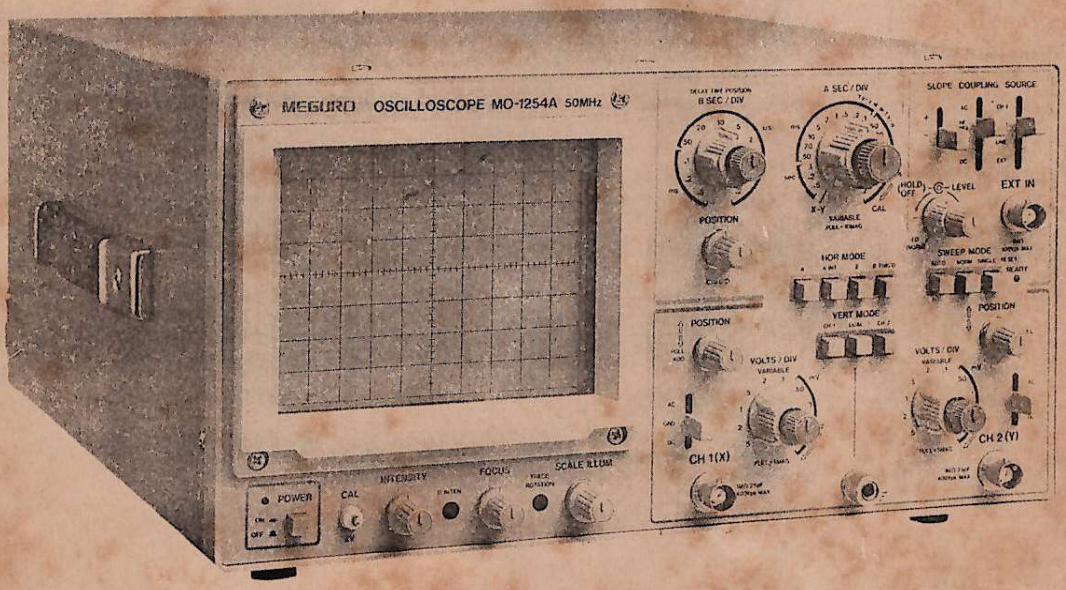

10-0004-2
S5001
P5003
P4001
P3001
LD3031 POWER
LP3002
INTEN VR3031
R3032
R3031
VR3035
R3033
B INT
FOCUS
VR 3032
D3035
D3032
LP 3001
R4011
R4012
R4010
R4009
R4008
C4007
C4009
R4007
R4051
C4051
VR3033
TRACE ROT Q3010
Q3009
SILLUM
R4006
R4003
R4001
IC4001
C4002
R4004
R4002
R4005
CN1004
1 2 3 4 5 6 7 8

MEGURO

MO-1254A

50 MHz OSCILLOSCOPE (DUAL CHANNEL)

INSTRUCTION MANUAL



MEGURO ELECTRONICS CORPORATION

1-5, 2-CHOME CHUO-CHO
MEGURO-KU TOKYO JAPAN

PRECAUTIONS FOR USE

1. Inspect the shipping carton for serious damage which might have caused failure of the instrument during transit. If damage is noted, notify the sales representative before any handling.
2. Before applying power to the oscilloscope, make certain that the voltage selector plug, on rear panel, has been inserted with the arrow marking in direction of the line voltage in use, and at the same time, confirm the fuse rating.
3. Do not leave the bright beam on the CRT screen for long periods. This is to prevent permanent damage to the screen.
4. This instrument is convection-cooled and must always be operated in a position that the cooling vents are not obstructed.
5. To insure stable operation over long periods, care should be taken to avoid subjecting the instrument to vibration, direct sunlight, extreme temperature variations, high humidity, dust and electromagnetic fields.