Leader Instruments Corporation
6484 Commerce Drive, Cypress, CA 90630
Tel. No. 1-800-645-5104 or 714-527-9300 Fax

LBO – 520A

DUAL TRACE OSCILLOSCOPE

SERVICE MANUAL

****

[WARNING]

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the service manual unless you are qualified to do so.

****

2nd edition Aug., 1987

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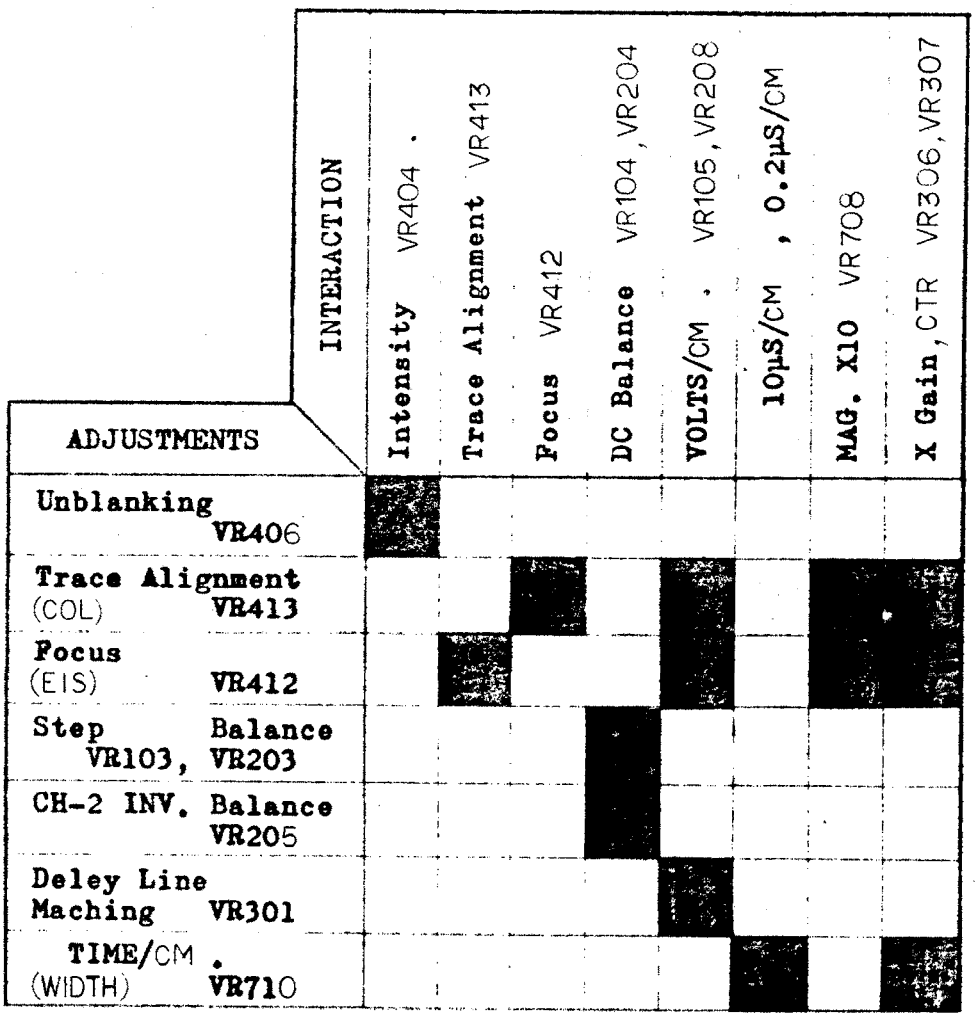
TEST EQUIPMENT REQUIRED

Description	minimum spec.
Volt meter	DC 0 ~ 1200V AC 0 ~ 600V
Amplitude Calibrator	square wave 20mV ~ 20Vp-p frequency: approx. 1KHz
Sine Wave Generator	10Hz ~ 35MHz constant amplitude
Fast Rise Square Wave Generator	1KHz ~ 100KHz Tr < 3nS
Capacitance Meter	35pF
Time Mark Generator	0.5S ~ 0.2μS
Oscilloscope	10mV 20MHz

INTERACTION by ADJUSTMENTS



1 POWER SUPPLY

Check and Adjust Power Supply DC Levels and Ripple.

Connect the DC Voltmeter between the Test Point and chassis.

Table-1

Voltage	Test Point	Adjust	Tolerance	Ripple
+15V	TP-401	VR401	±1%	less than 1mV
-15V	TP-402	VR402	±1%	less than 1mV
+ 35V	TP-403	VR403	±1%	less than 1mV
+130V	-	-	-	approx. 1.3Vp-p
*-1080V	TP-404	VR405	±3%	-

* -1750V for 520A

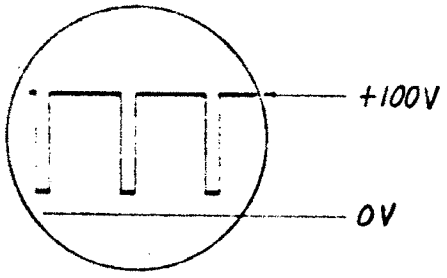
2 DISPLAY

1) Unblanking

SET: VERT. MODE — CH-1
TIME/CM — 0.1mS/CM
TRIG. MODE — AUTO

Connect the DC oscilloscope to the TP-405.

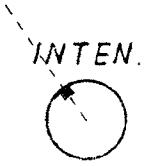
ADJUST: UNBLANKING ADJ (VR406) to make the display as follows.



2) Intensity

Set INTEN knob per the figure.

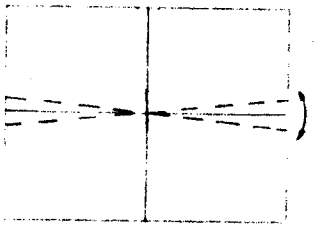
Adjust INTEN ADJ (VR404) so that trace barely comes out.



3) TRACE ROTATION

·ROTATION (front panel)

ROTATION to make the trace parallel with the center horizontal scale line.



ROTATION

4) Trace Alignment (pattern distortion: COL) (520 only)

SET:	CH-1 VOLT/CM	0.1V/CM
	TIME/CM	0.1mS/CM
	Time Mark Generator	connect to CH-1 Time: 0.1mS

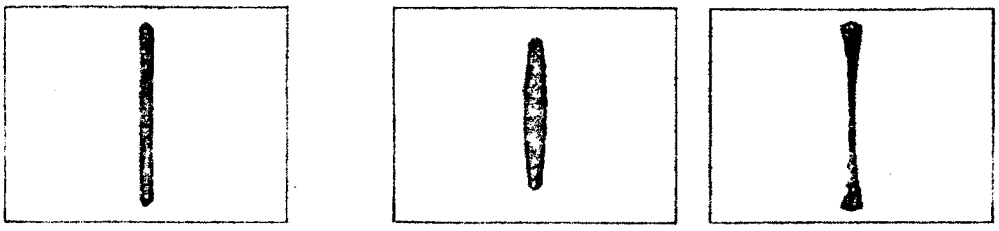
11 Time markers should fill the screen Vertically and set the base line to the bottoms end of scale.

Adjust the TRACE ALIGN. (COL) ADJ (VR413) for minimum curvature of the markers across the screen.

5) FOCUS (EIS)

SET:	FOCUS	fully counterclockwise
	ASTIG	fully counterclockwise
	TIME/CM	X-Y
	Sine wave generator	connect to CH-2 (Y) freq.: 1KHz output: 8div. display

Adjust the FOCUS (EIS) ADJ (VR412) so that the vertical line is same width from top to bottom.



Correct Incorrect

Adjust the FOCUS (front panel) and ASTIG control for best focused display.

3 VERTICAL

1) Gate Current Leak

SET:	VERT. MODE	CH-1
	AC-GND-DC	DC (both CH)
	VOLTS/CM	5mV (both CH)
	CH-1 IN	connect to GND

Position the trace to scale center.

CH-1 AC-GND-DC switch to AC .

CHECK: Trace shift is 0.1CM . or less when CH-1 AC-GND-DC SW is switched between AC and DC.

CH-2: Apply same procedure as the CH-1.

2) Step Balance

SET:	VERT. MODE	CH-1
	VOLTS/CM .	20mV
	AC-GND-DC	GND

Position the trace to scale center.

CHECK: Display for 0.5 CM . or less of trace shift when rotating the CH-1 VOLTS/CM . from 20mV to 5mV.

ADJUST: Set the VOLTS/CM . to 20mV/CM .

Position the trace to the scale center by V POSITION knob.

Set the VOLTS/CM . to 5mV/CM .

Position the trace to the scale center by CH-1 STEP BAL. ADJ (VR103).

Repeat the above procedure for minimum trace shift when ratating the CH-1 VOLTS/CM . knob.

CH-2: Apply same procedure as the CH-1.
CH-2 STEP BAL. ADJ: VR203

3) CH-2 INVERT Balance

Position the trace to scale center.

Push the INVERT button.

CHECK: 1DIV. or less of trace shift between INVERT IN and OUT.

ADJUST: INV. BAL. ADJ (VR205) for minimum trace shift between INVERT IN and OUT.

4) DC Balance

SET: VERT. MODE CH-1
VARIABLE fully counterclockwise

Position the trace to scale center.

VARIABLE knob rotate to fully clockwise (CAL'D).

CHECK: 0.5CM . or less of trace shift between VARIABLE knob CCW and CW.

ADJUST: Set the VARIABLE to fully counterclockwise.

Position the trace to the scale center by V POSITION knob.

Set the VARIABLE to CAL'D.

Position the trace to the scale center by CH-1 DC BAL. ADJ (VR104)

Repeat the above procedure for minimum trace shift when rotating the CH-1 VARIABLE knob.

CH-2: Apply same precedure as the CH-1.
CH-2 DC BAL. ADJ: VR204

5) ADD Balance

SET: VERT. MODE ALT

Position the two traces to the scale center.

Push the ADD button.

CHECK: 1CM or less of trace shift between ALT and ADD.

ADJUST: ADD BAL ADJ (VR305) for minimum trace shift between ALT and ADD.

6) ALT

SET: VERT. MODE ALT

Position the 2 traces about few cm apart.

CHECK: Sweep alternate at all settings of the TIME/CM .

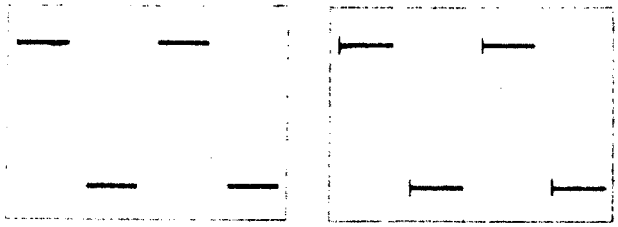
7) CHOP

SET: VERT. MODE CHOP
TIME/CM . 1μS

Position the 2 traces about few cm apart.

Adjust the LEVEL knob and TIME VARIABLE for a stable display.

CHECK: Display for wave form and blanking of switching transient between chopped segments.

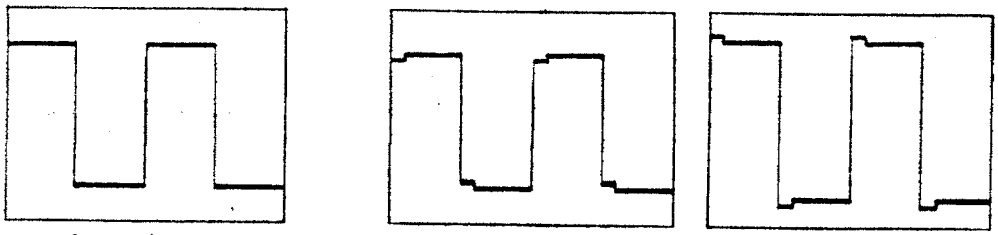


MATCHING ADJ (VR301)
<Ref: 8) >

8) MATCHING Adjustment of Delay Line

SET:	CH-1 VOLTS/CM .	20mV
	Square Wave Generator	connect to CH-1. freq.: 100KHz output: 4 cm . display.

CHECK: as follows



ADJUST: MATCHING ADJ (VR301) for a flat-top display.

9) VOLTS/CM . (Gain of Vertical Amplifier)

SET:	VOLTS/CM	5mV
	VARIABLE	CAL'D
	AC-GND-DC	DC
	Amplitude Calibrator	connect to CH-1. output: 20mV

CHECK: Display for 4 cm deflection, with in ±3%, Tolerance

ADJUST: CH-1 GAIN ADJ (VR105) for 4 cm.

CHECK and ADJUST of all VOLTS/CM . ranges according to Table 2.

CH-2: Apply same procedure as the CH-1.

Table-2

VOLTS/CM .	Calibrator output	deflection	GAIN ADJ		multiplier	
			CH-1	CH-2		
5mV	20mV	4 cm	VR105	VR208	X1	
10	50	5	—	—	X2	X1
20	0.1V	5	—	—	X4	
50	0.2	4	—	—	X1	
0.1V	0.5	5	-	-	X2	X10
0.2	1	5	-	-	X4	
0.5	2	4	—	—	X1	
1	5	5	-	-	X2	X100
2	10	5	-	-	X4	
5	20	4			X1	X1000

10) Vertical Amplifier High Frequency Compensation

SET: CH-1 VOLTS/CM . 20mV
VARIABLE CAL'D
Square Wave Generator connect to CH-1.
output: 4cm. display

CHECK: Display for a flat-top wave form with 5% or less overshoot, roll-off and ringing on the leading edge.

ADJUST: HIGH FREQ. COMP. ADJ (VC110,VR106,VC111,VC112.VC109, 301, 302, VR302, 304)
for the best flat-top wave form with overshoot, roll-off and ringing on the leading edge.

CHECK and ADJUST of other VOLTS/CM . ranges according to Table 3.

VOLTS/CM	HF COMP	
	CH-1	CH-2
5mV	VR106 VC109 VC110 VC111 VC112 VC301 VC302 (520 only) VR302 VR304 VR308 (520A only)	VR206 VR211 (520A only) VC209 VC210 VC211 VC212 VC213 (520A only)
50mV	VR101	VR201
0.5V	VR102	VR202
5V	VR108 VC108	VR209 VC208

Table-3

11) Step Attenuator Phase Compensation

SET: CH-1 VOLTS/CM . 50mV
Amplitude Calibrator connect to CH-1.
output: 0.2Vp-p

CHECK: Display for a flat-top wave form with 5% or less overshoot or roll-off on the leading edge.

ADJUST: PHASE COMP. ADJ (VC103) for the best flat-top wave form.

CHECK and ADJUST of other VOLTS/CM . ranges according to Table 4.

Table-4

VOLTS/CM .	PHASE COMP.	
	CH-1	CH-2
X10 (50mV~0.2V)	VC103	VC203
X100 (0.5V~2V)	VC105	VC205
X1000 (5V)	VC107	VC207

12) Input Capacitance

SET: AC-GND-DC DC
CH-1 VOLTS/CM . 20mV
Capacitance Meter connect to CH-1.

CHECK: If input Capacitance is 35pF ±3pF.

ADJUST: C-in ADJ (C101) to make the input capacitance to 35pF.

CHECK and ADJUST input capacitance of CH-1 and CH-2 in same procedure as follows.

Table-5

VOLTS/CM .	C-in ADJ	
	CH-1	CH-2
X1 (5mV~20mV)	VC101	VC201
X10 (50mV~0.2V)	VC102	VC202
X100 (0.5V~2V)	VC104	VC204
X1000 (5V)	VC106	VC206

13) Frequency Response

SET:	CH-1 VOLTS/CM .	20mV
	Sine Wave Generator	connect to CH-1. freq.: 1KHz output: 8cm . display

Set the sine wave generator to 30MHz. (35MHz for 520A)

CHECK: Display is 5.6cm or more.
Apply the same procedure for CH-2.

4 TIME BASE

1) 0.5S~20μS TIME/CM . (Horizontal Amplifier X1 Gain)

SET:	TIME/CM .	0.1mS/CM .
	VARIABLE	CAL'D
	Time Mark Generator	connect to CH-1. time; 0.1mS

CHECK: Display for 1 mark/1CM . ±3%

ADJUST: TIME/CM . ADJ (VR710) to make exactly 1 mark/1CM .

CHECK: 0.5S~20μS

• 10μS~0.5μS

SET:	TIME/CM .	10μS/CM .
	Time Mark Generator	10μS

CHECK: Display for 1 mark/1CM . ±3%.

ADJUST: 10μS~0.5μS ADJ (VC502) to make exactly 1 mark/1CM .

• 0.2μS

SET:	TIME/CM .	0.2μS/CM .
	Time Mark Generator	0.2μS

CHECK: Display for 1 mark/1CM . ±3%.

ADJUST: 0.2μS ADJ (VC501) to make exactly 1 mark/1CM .

2) MAG. X10 (Horizontal Amplifier X10 Gain)

SET:	TIME/CM .	0.1mS/CM .
	Time Mark Generator	10μS
	MAG.	X10 (push in)

CHECK: Display for 1 mark/CM . ±5%.

ADJUST: MAG. X10 GAIN ADJ (VR708) to make exactly 1 mark/1CM .

3) MAG. X10 Centering

SET:	TIME/CM .	0.1mS/CM .
	Time Mark Generator	0.5mS
	MAG.	X1 (push out)

Position the first time marker to the scale center.

Push the MAG X10 button in.

CHECK: The middle time marker is positioned the scale center.±2cm.

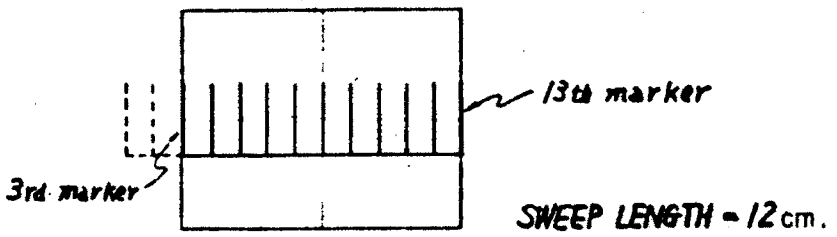
ADJUST: MAG. CENTER ADJ (VR709) to position the middle time marker to the scale center.

4) Sweep Length

SET:	TIME/CM .	0.1mS/CM .
	VARIABLE	CAL'D
	Time Mark Generator	connect to CH-1. time: 0.1mS

Set the 3rd time marker to the left end of the scale.

ADJUST: LENGTH ADJ (VR502) for extend to the right end of the scale.



5) Sweep Centering

SET:	TIME/CM .	0.1mS
	TRIG. MODE	AUTO
	H POSITION knob	center

CHECK: Sweep starting point is positioned at the left end of the scale.

ADJUST: SWEEP CENTER (VR707) to position the sweep starting point at the left end of the scale.

6) Horizontal Amplifier High Frequency Compensation

Set:	TIME/CM	0.2uS/CM
	MAG	x10 (Push in)

Connect Time Mark Generator to CH-1 INPUT and set the time to 0.1uS.

Adjust VC701 to obtain a best sweep linearity.

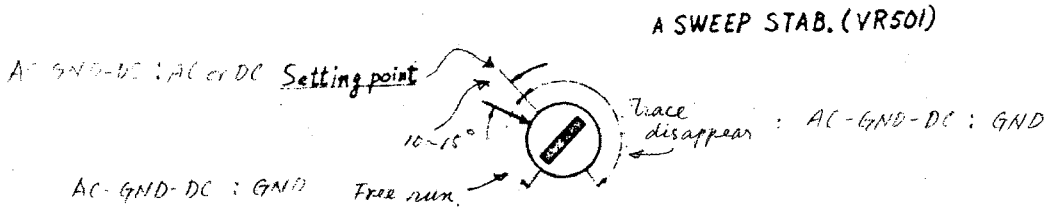
5 TRIGGER

1) SWEEP STAB.

SET:	TIME/CM .	0.2μS/CM .
	TRIG. MODE	NORM.
	Sine Wave Generator	connect to CH-1. freq.: 30 MHz output: 1CM . display

CHECK: Stable display can be obtained by rotating the LEVEL knob at near "0".

ADJUST: LEVEL: Near "0".
Adjust SWEEP STAB. ADJ (VR501) as follows.



CHECK: Stable display can be obtained by rotating the LEVEL knob.

2) PRESET (30MHz)

SET:	AC-GND-DC	GND
	SLOPE	+
	LEVEL	PRESET

Connect the DC Volt Meter to the P710 (TP for PRESET) and read the voltage (approx. +7V).

Then check the voltage when SLOPE button is pushed in (-).

CHECK: Both Voltage is same or no.

ADJUST: PRESET ADJ (VR703) to obtain same voltage at + and -.

3) LEVEL center

SET:	AC-GND-DC	AC
	LEVEL	center "0"
	Amplitude Calibrator	connect to CH-1. output: 1CM . display

CHECK: Stable display can be obtained by rotating the LEVEL knob at center "0".

ADJUST: LEVEL CENTER ADJ (VR702) to obtain stable display.

4) Shaping Circuit Bias Adjust

SET:	LEVEL	PRESET
	Amplitude Calibrator	connect to CH-1. output: 1CM . display

CHECK: Stable display can be obtained.

ADJUST: SHAPING CIRCUIT BIAS ADJ (VR704) to obtain stable display.

5) HF REJ.

SET:	COUPLING	HF REJ.
	TIME/CM .	1mS/CM .
	Sine Wave Generator	connect to Ch-1. freq.: 1KHz output: 1CM . display

Adjust LEVEL knob for a stable display.

SET:	TIME/CM .	1μS
	Sine Wave Generator	freq.: 1MHz

CHECK: No stable display with the LEVEL knob.

6) TV

• TV-V

SET:	COUPLING	TV
	TIME/CM .	0.1mS/CM .
	Sine Wave Generator	connect to CH-1. freq.: 1KHz

Adjust LEVEL knob for a stable display.

SET:	Sine Wave Generator	to 100Hz
	MAG.	X10 (push-in)

CHECK: No stable display (Do not touch TIME/CM . knob).

• TV-H

SET:	COUPLING	TV
	TIME/CM .	50μS/CM .
	Sine Wave Generator	connect to CH-1. freq.: 1KHz

Adjust LEVEL knob for a stable display.

SET: Sine Wave Generator to 10Hz

CHECK: No stable display (Do not touch TIME/CM . knob.)

7) EXT. Trig.

SET:	VOLTS/CM .	0.1V/CM . (CH-1)
	TIME/CM .	0.2μS/CM .
	Sine Wave Generator	connect to CH-1 and TRIG. IN freq.: 30MHz output: 5CM . display

Push in Trig. SOURCE for EXT. Trig.

CHECK: Adjust the LEVEL knob to stable display.

8) SINGLE Sweep

SET:	VOLTS/CM .	0.1V/CM . (CH-1)
	AC-GND-DC	DC (CH-1)
	TIME/CM .	10mS/CM .
	Sine Wave Generator	connect to CH-1 freq.: 100Hz output: 6CM . display

Adjust LEVEL knob for a stable display.

SET:	AC-GND-DC	GND
	SINGLE	push-in
	RESET	press

CHECK: READY lamp is lit.

AC-GND-DC: DC

CHECK: Single Sweep appears and READY lamp goes out.

Press SINGLE Sweep button.

CHECK: Single Sweep appears each time the RESET button is pressed.

6 X-Y Operation

1) X Gain

SET:	VOLTS/CM .	20mV/CM . (X)
	AC-GND-DC	DC (X)
	TIME/CM	X-Y
	Amplitude Calibrator	connect to CH-1 output: 100mV

CHECK: Display for 5 centimeter of deflection (Tolerance within ±3%)

ADJUST: X GAIN ADJ (VR306) for 5 CM .

2) X Position Centering

SET:	AC-GND-DC	GND
	X Position	center

CHECK: Spot is positioned in center of the horizontal scale line.

ADJUST: X CENTER ADJ (VR307) for center of horizontal scale line.

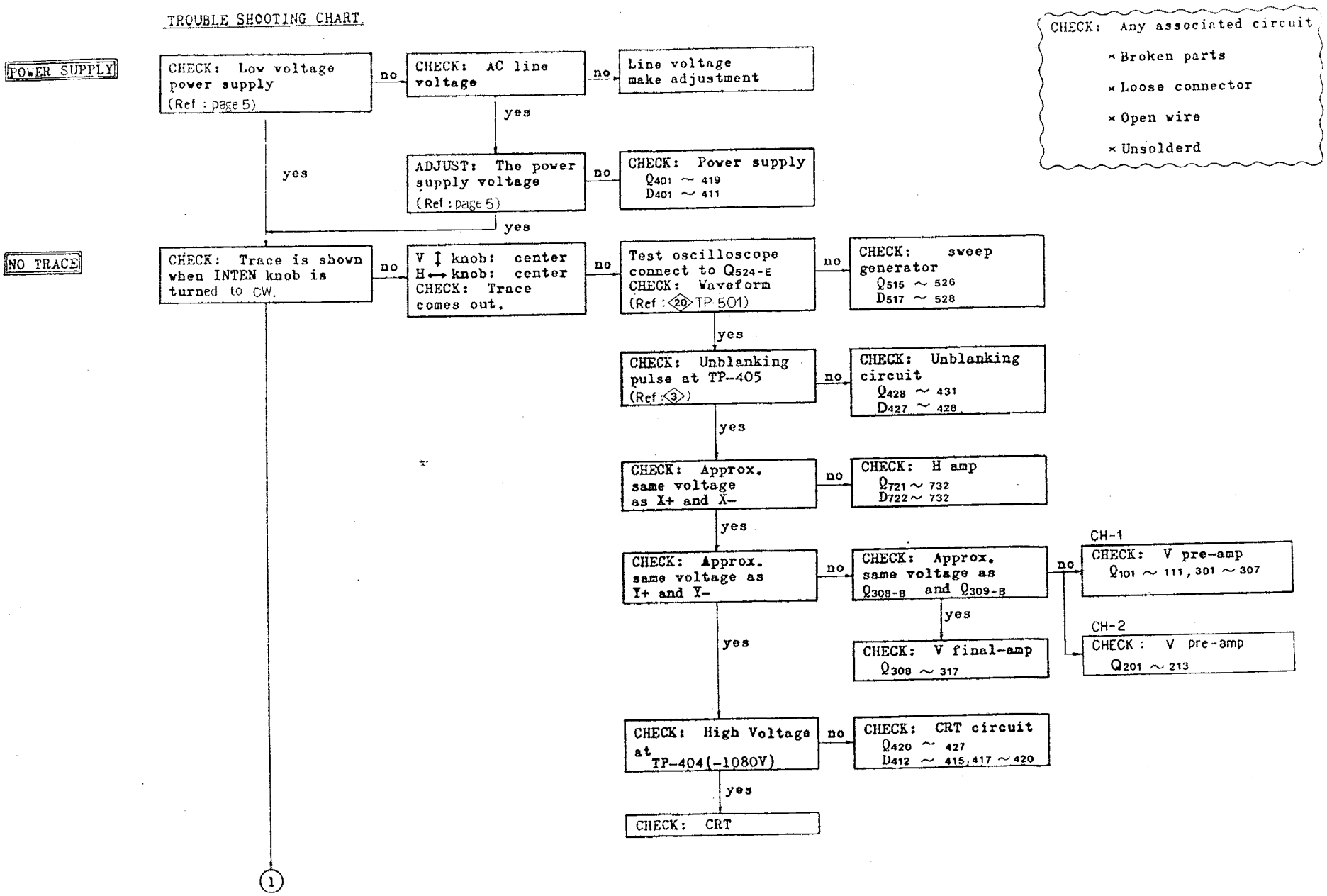
7 CALIBRATOR

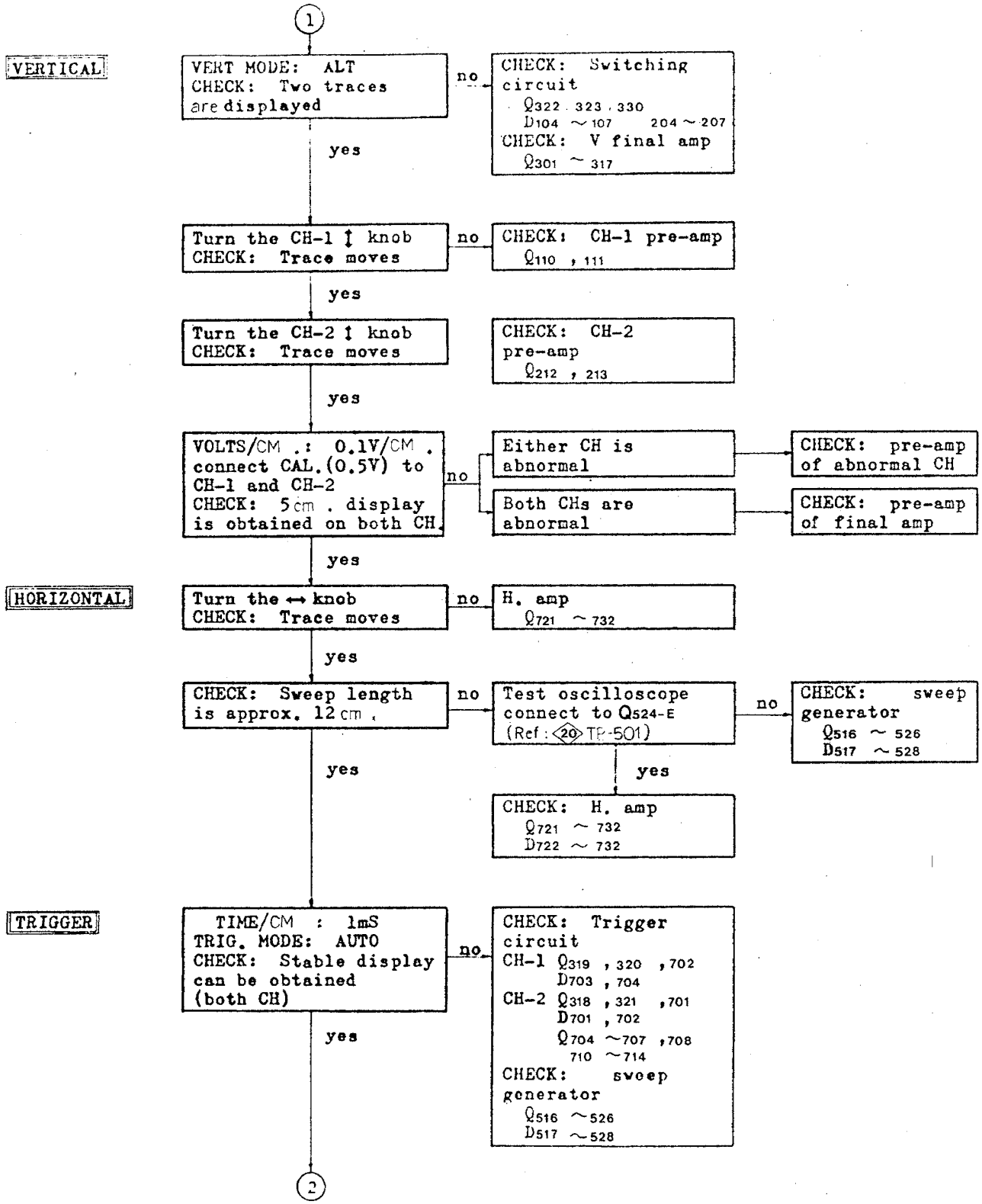
SET:	Test Oscilloscope	Volts/CM .: 0.1V/CM . Time/CM .: 0.2mS/CM . connect to CAL. tip

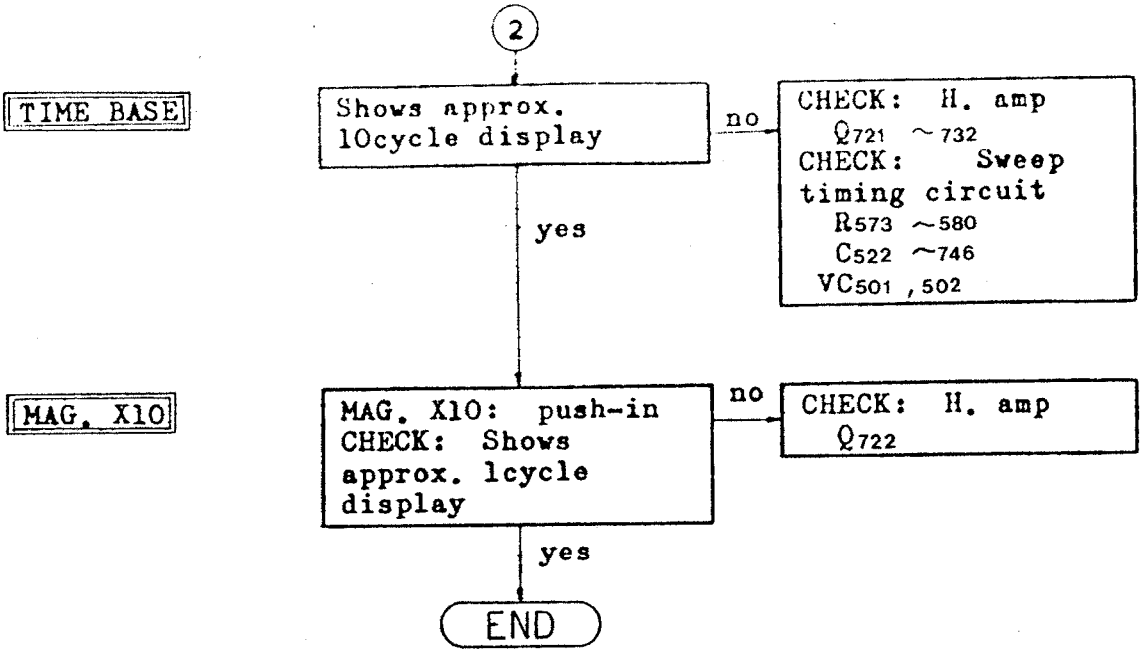
CHECK: Amplitude is 0.5Vp-p ±3%.

ADJUST: CAL. ADJ (VR407) for exactly 5 CM .

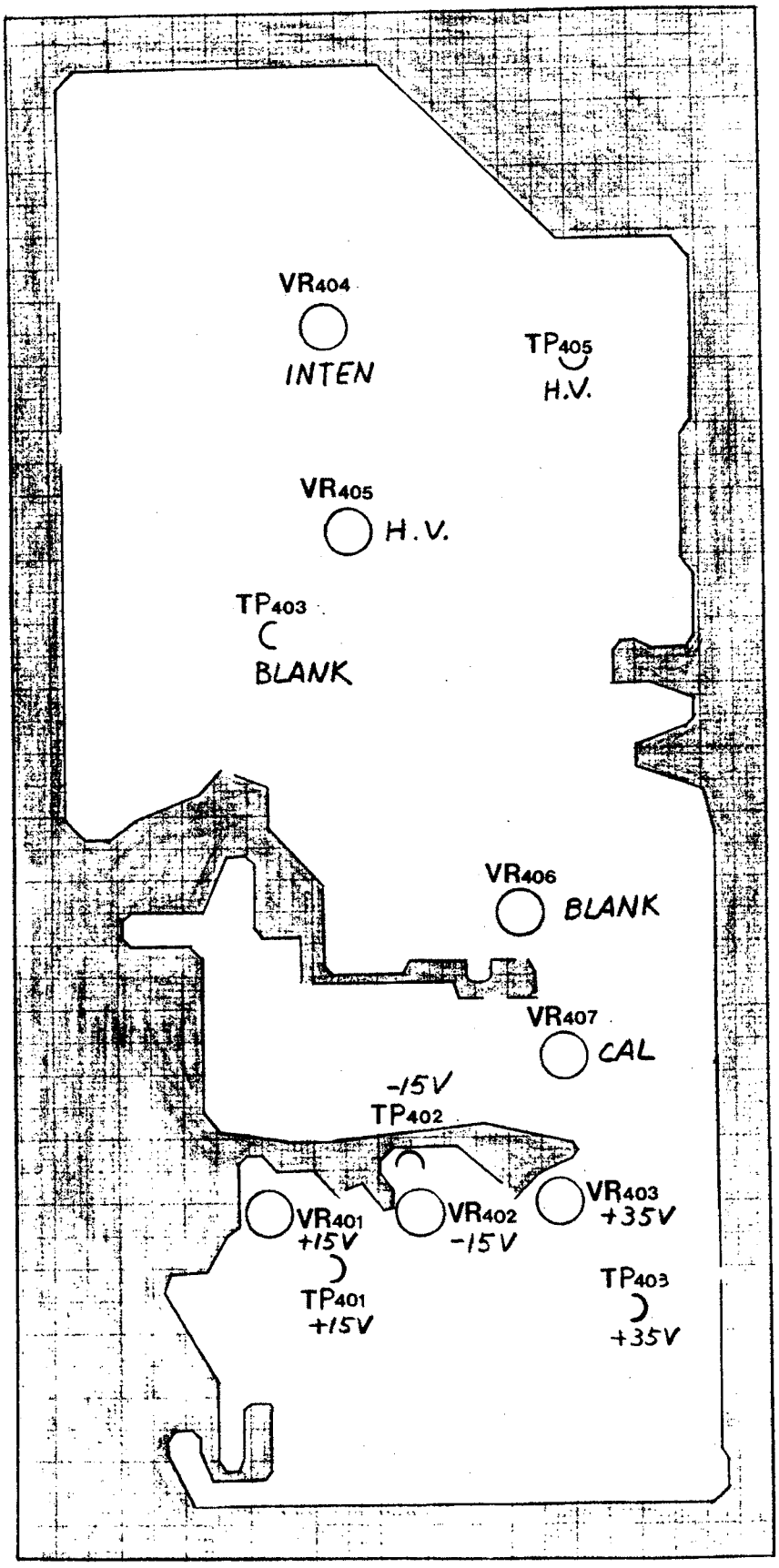
TROUBLE SHOOTING CHART



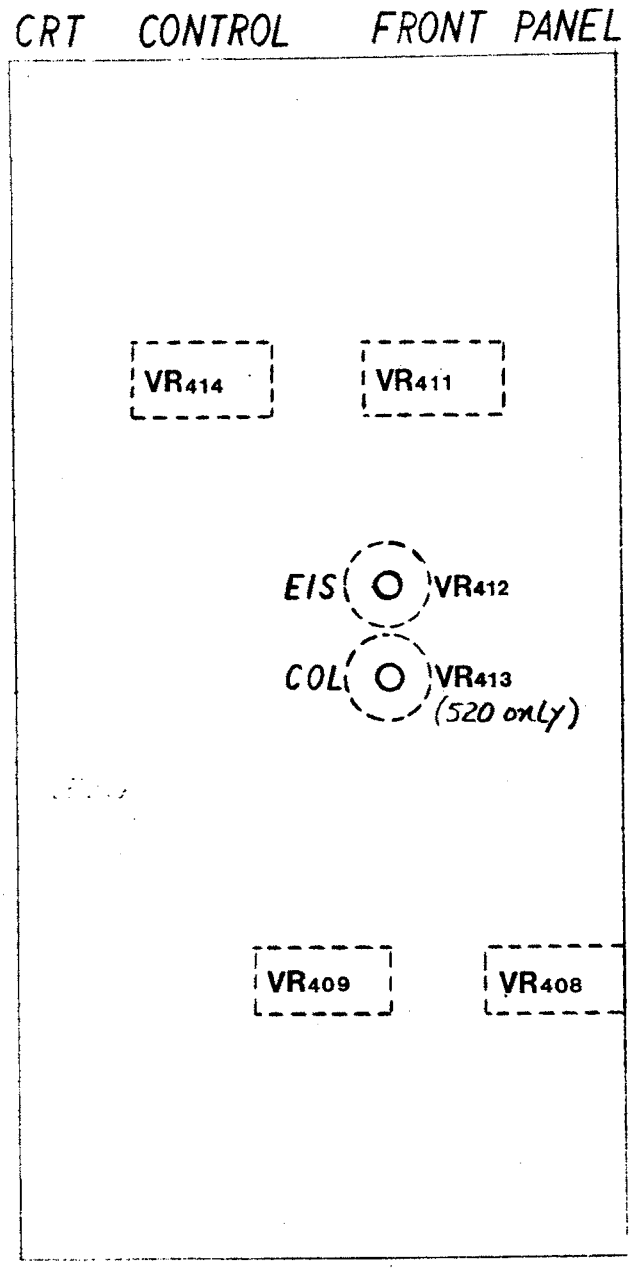

1
VERTICAL
VERT MODE: ALT
CHECK: Two traces are displayed
no
CHECK: Switching circuit
Q322 . 323 . 330
D104 ~ 107 204 ~ 207
CHECK: V final amp
Q301 ~ 317
yes
Turn the CH-1 ↕ knob
CHECK: Trace moves
no
CHECK: CH-1 pre-amp
Q110 , 111
yes
Turn the CH-2 ↕ knob
CHECK: Trace moves
CHECK: CH-2 pre-amp
Q212 , 213
yes
VOLTS/CM . : 0.1V/CM . connect CAL.(0.5V) to CH-1 and CH-2
CHECK: 5 cm . display is obtained on both CH.
no
Either CH is abnormal
CHECK: pre-amp of abnormal CH
Both CHs are abnormal
CHECK: pre-amp of final amp
yes
HORIZONTAL
Turn the ↔ knob
CHECK: Trace moves
no
H. amp
Q721 ~ 732
yes
CHECK: Sweep length is approx. 12 cm .
no
Test oscilloscope connect to Q524-E
(Ref : 20 TP-501)
no
CHECK: sweep generator
Q516 ~ 526
D517 ~ 528
yes
yes
CHECK: H. amp
Q721 ~ 732
D722 ~ 732
TRIGGER
TIME/CM : 1mS
TRIG. MODE: AUTO
CHECK: Stable display can be obtained (both CH)
no
CHECK: Trigger circuit
CH-1 Q319 , 320 , 702
D703 , 704
CH-2 Q318 , 321 , 701
D701 , 702
Q704 ~707 , 708
710 ~714
CHECK: sweep generator
Q516 ~526
D517 ~528
yes
2


2
TIME BASE
Shows approx. 10cycle display
no
CHECK: H. amp
Q721 ~732
CHECK: Sweep timing circuit
R573 ~580
C522 ~746
VC501 , 502
yes
MAG. X10
MAG. X10: push-in
CHECK: Shows approx. 1cycle display
no
CHECK: H. amp
Q722
yes
END

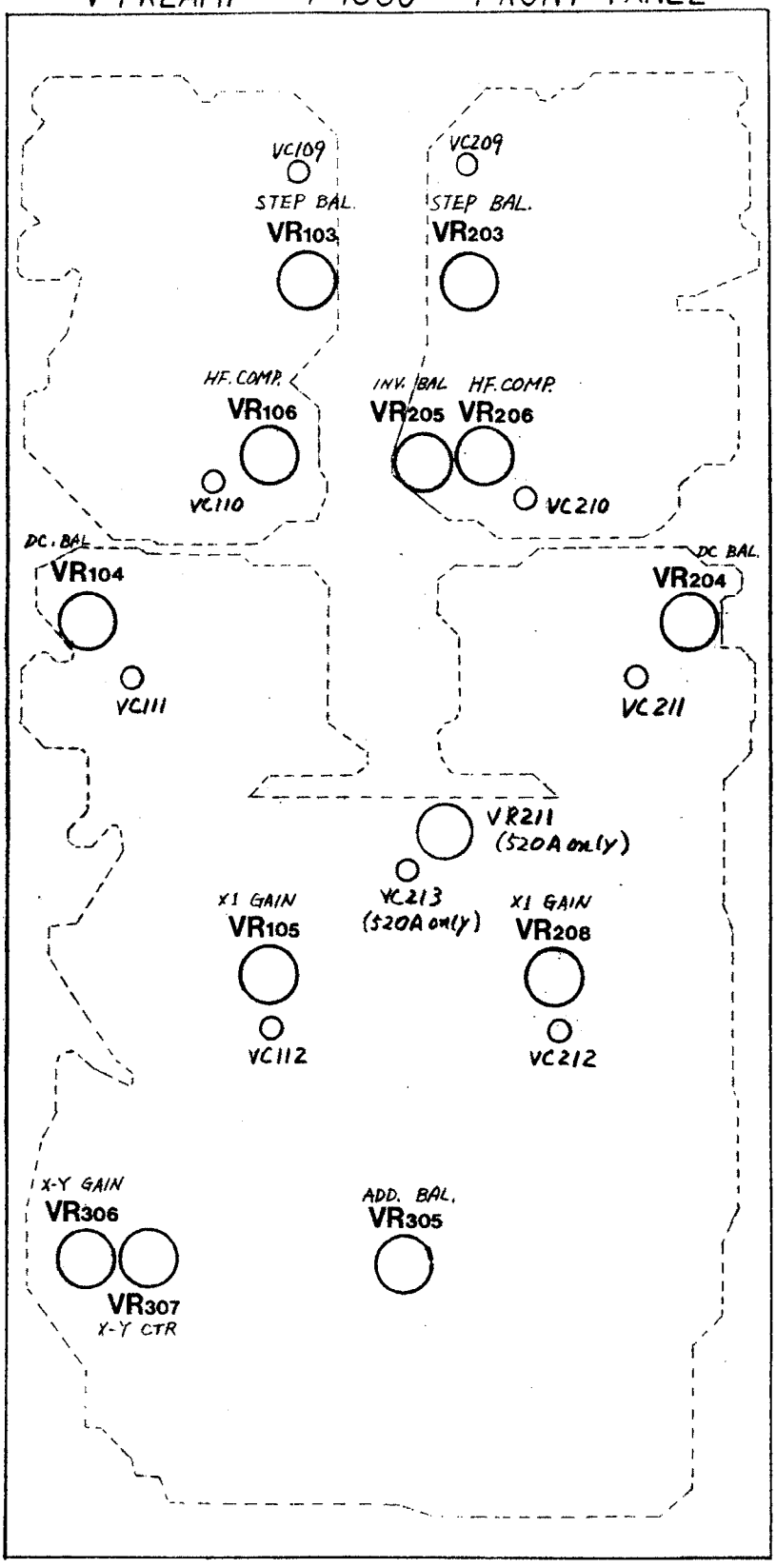
POWER FRONT PANEL 520/520A

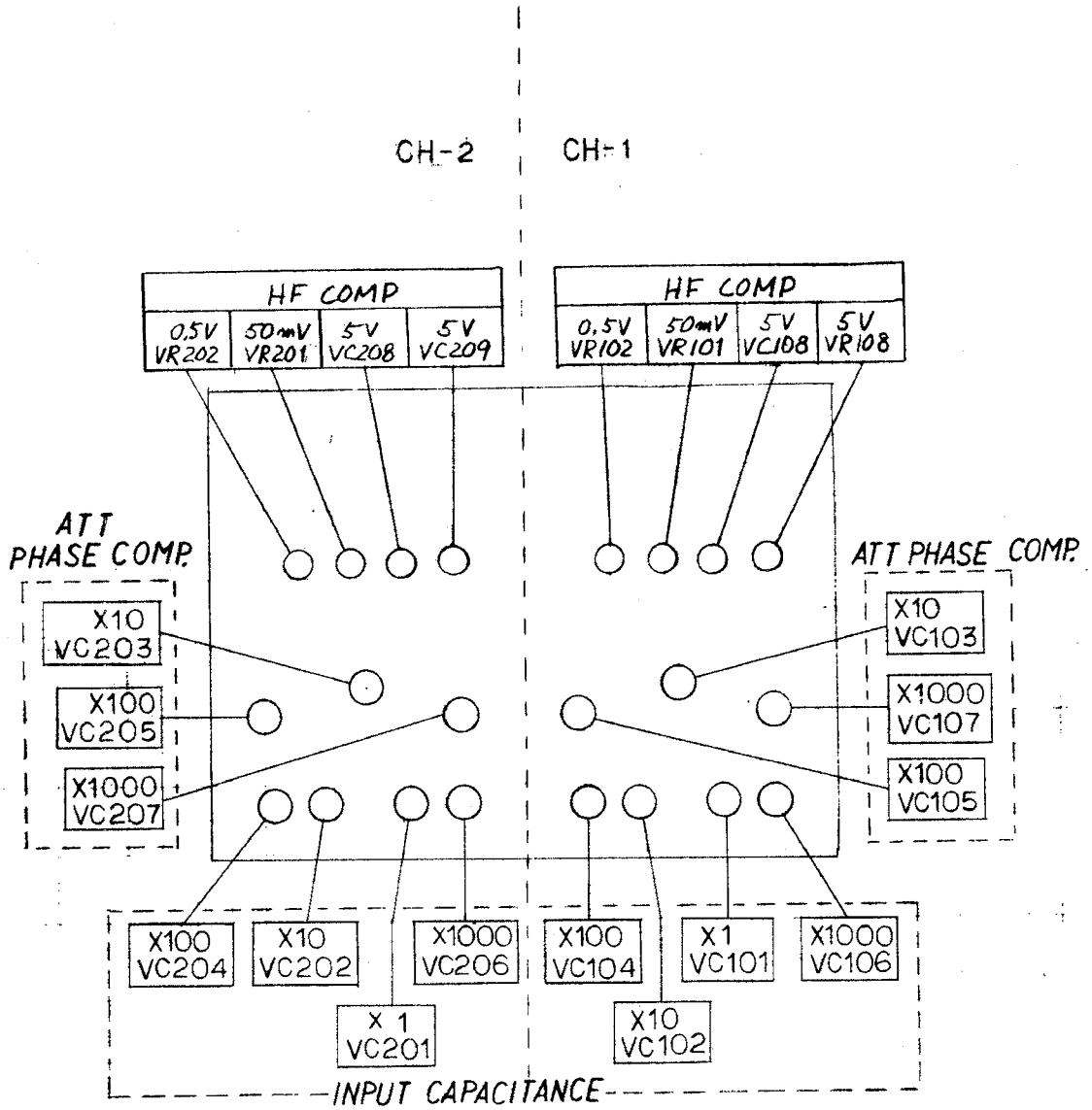


T-1329

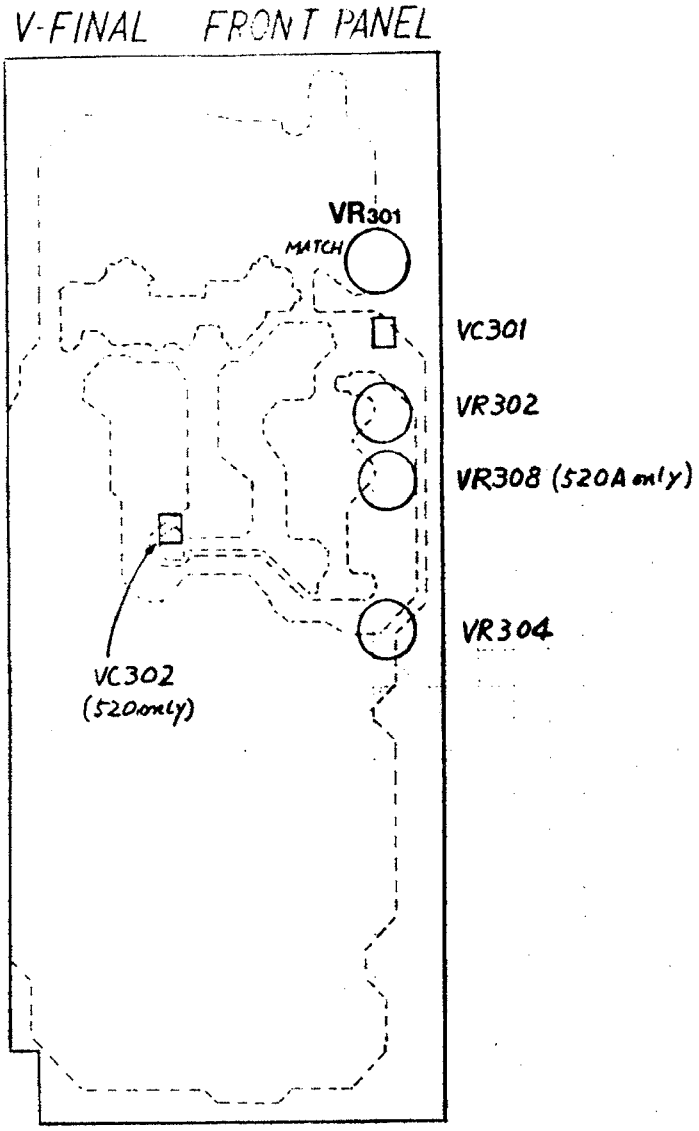

CRT CONTROL FRONT PANEL
VR414
VR411
EIS
VR412
COL
VR413
(520 only)
VR409
VR408

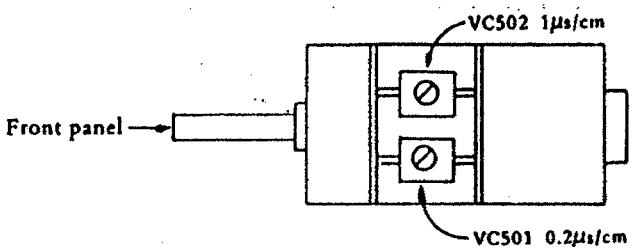
V-PREAMP T-1380 FRONT PANEL





V-ATT FRONT PANEL

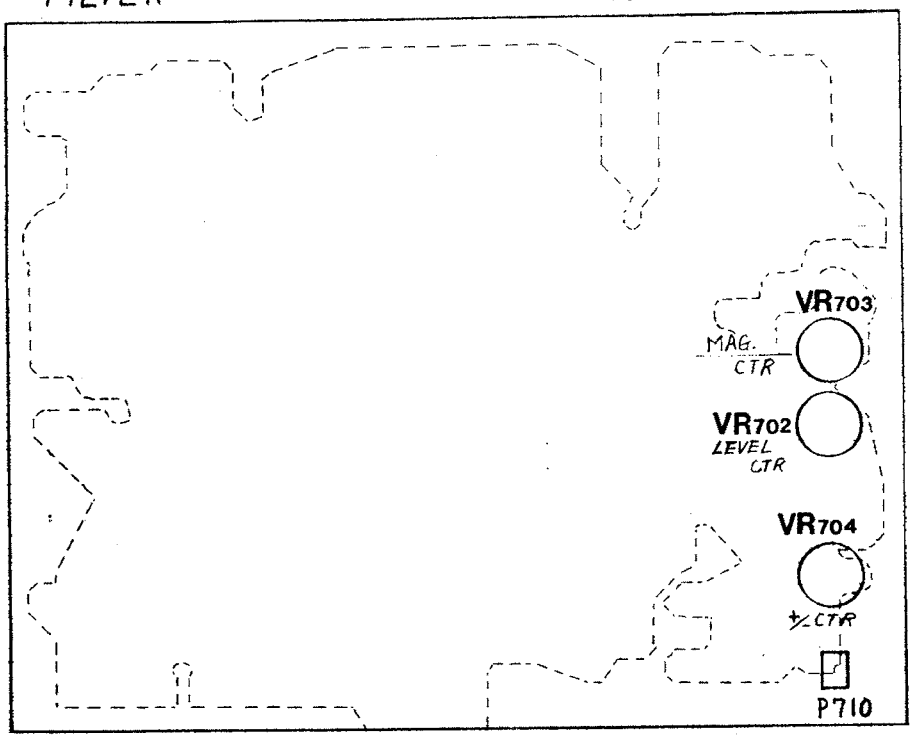




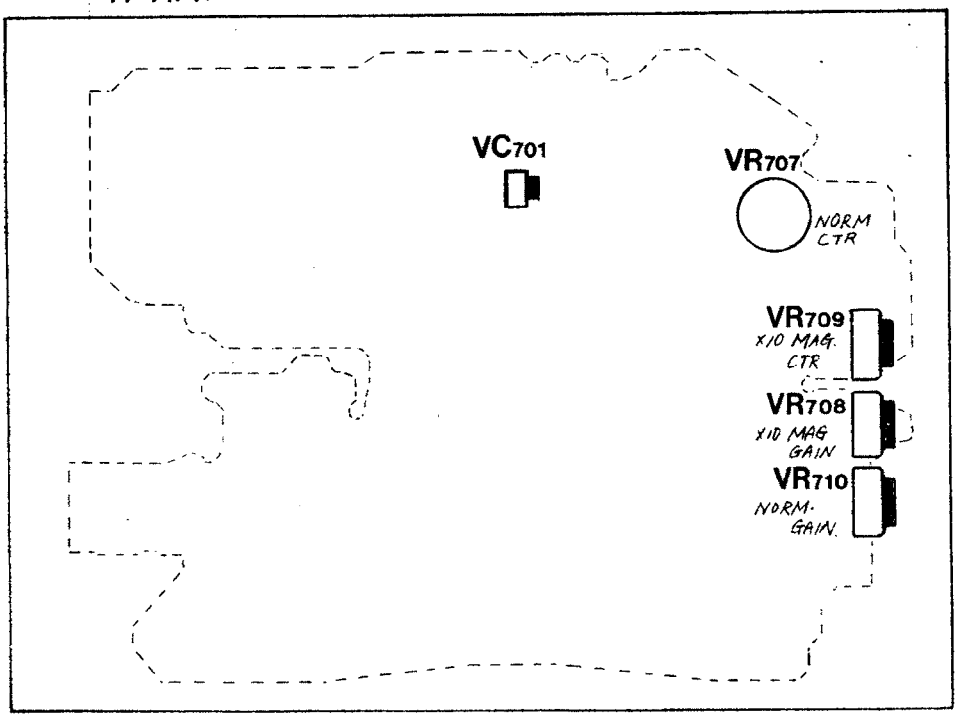
Time Base Switch Adjusters
(Viewed from the Right Side)

520 only

FILTER FRONT PANEL

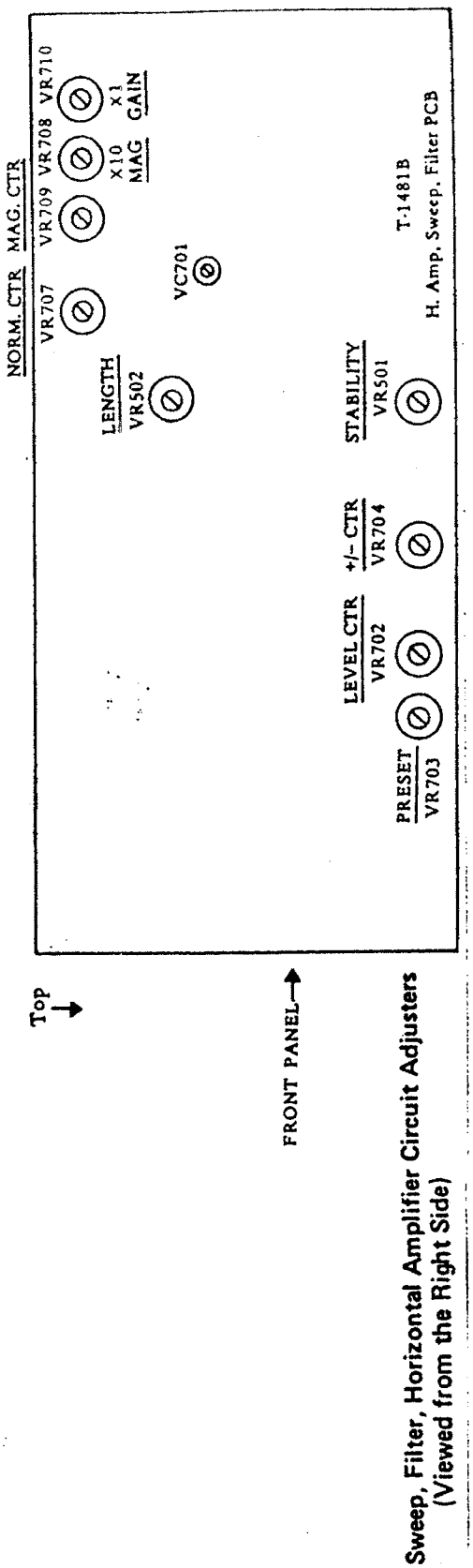


H-AMP FRONT PANEL



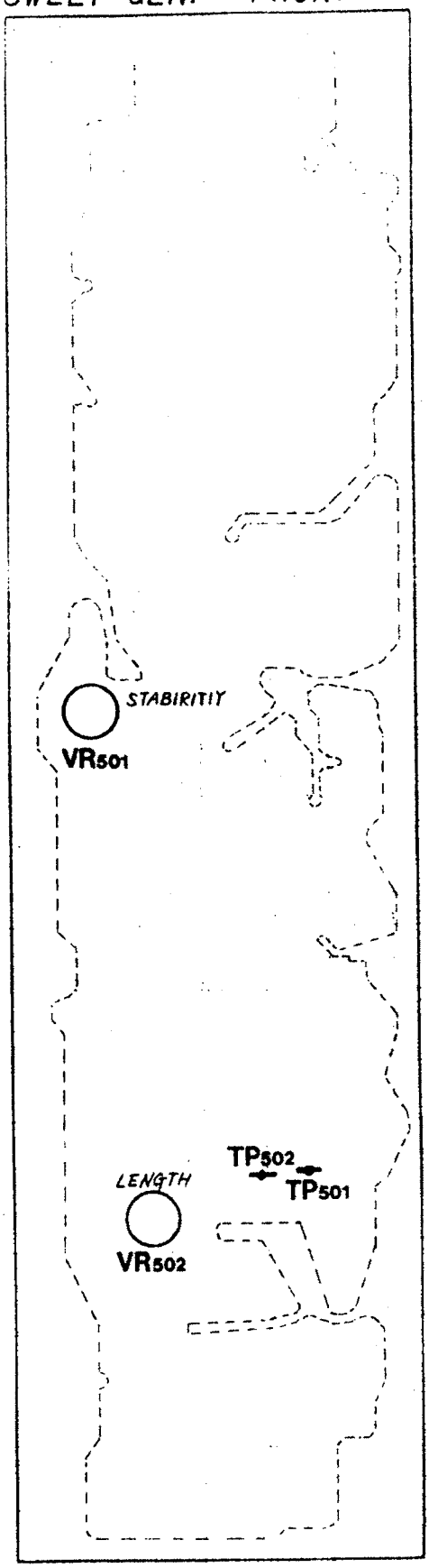
520A only

520 only

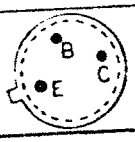
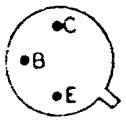
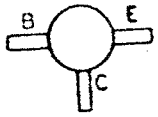
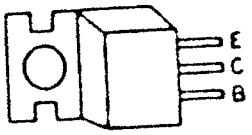
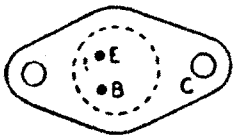


Sweep, Filter, Horizontal Amplifier Circuit Adjusters
(Viewed from the Right Side)

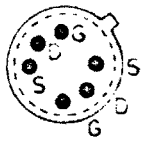
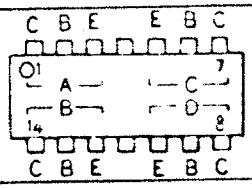
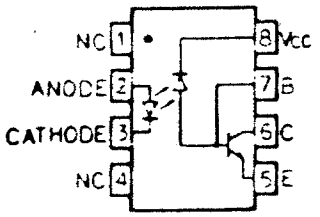
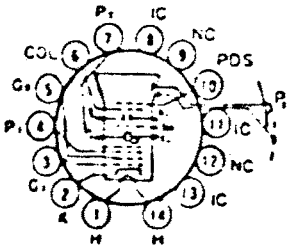
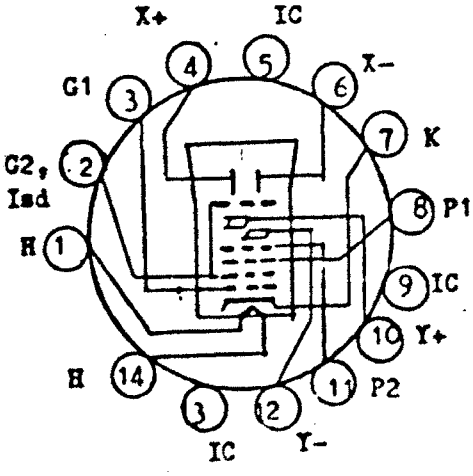
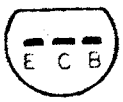
SWEEP GEN. FRONT PANEL

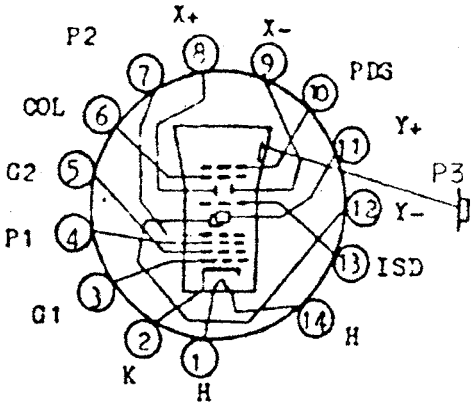
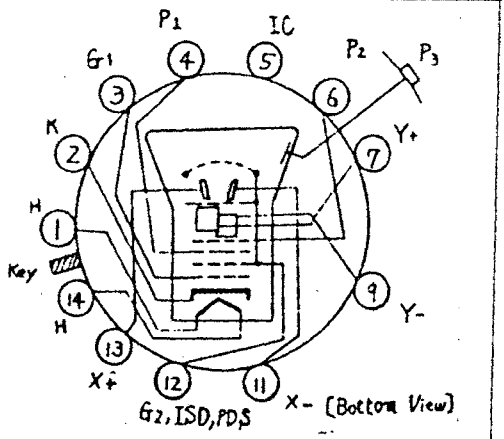


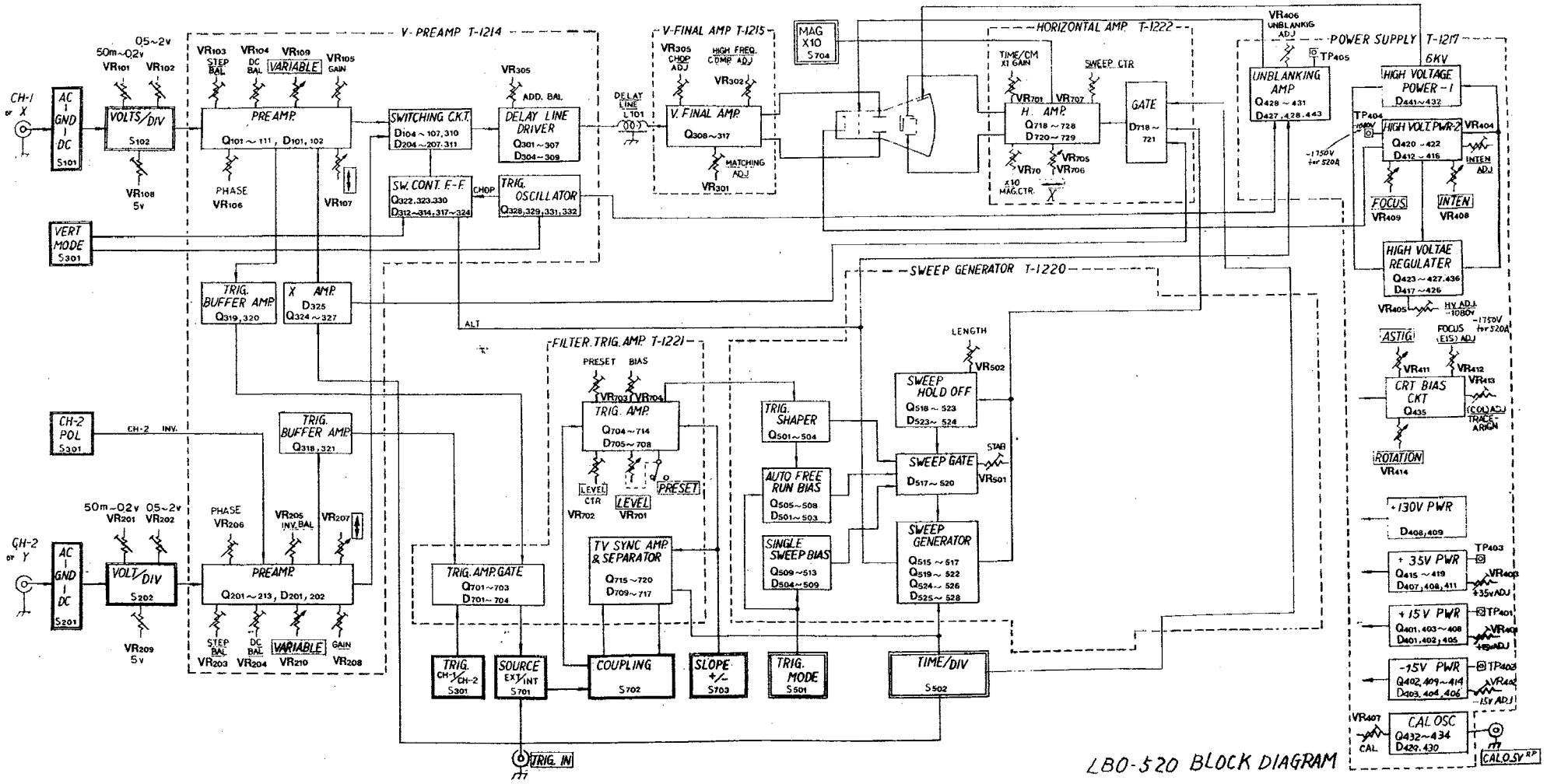
PIN CONNECTION, TRANSISTOR and CRT

name	type	connection
2SA-495 2SA-561	PNP	
2SC-372 2SC-780A 2SC-373 2SC-752	NPN	
2SA-628	PNP	
2SA-678	PNP	
S-A92	PNP	
2SA-497 2SA-711	PNP	
2SC-507 2SC-1012A 2SC-1216	NPN	
2N-3866		
2SC-288A	NPN	
2SC-1279 2SC-1215 2SC1815	NPN	
2SC-1569 2SC-1625	NPN	
2SD-315	NPN	
2SK-30A	FET	
2SK-33	FET	

PIN CONNECTION, TRANSISTOR and CRT

name	type	connection
IMF-3958 2N-3958	Pair FET	
ITS-30809	Pair FET	
TR. quard array MPQ-918	NPN	
photocoupler 5082-4351	NPN	
E2663B31	CRT	
130BXB31 C5S66P31B (For 520)	CRT	
2SA1015	TR	

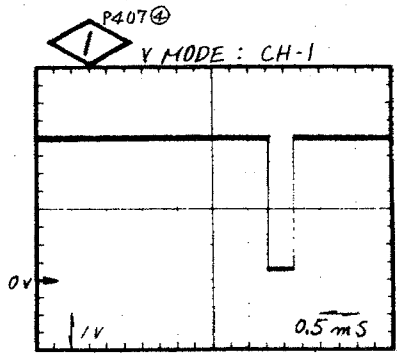
name	type	connection
130BYB31 (For 520)	CRT	
140CGB31 (For 520A)	CRT	

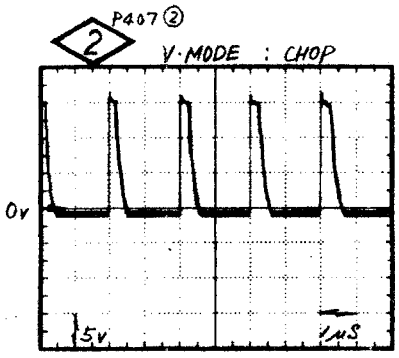

V-PREAMP T-1214
V-FINAL AMP T-1215
MAG X10 S704
HORIZONTAL AMP T-1222
POWER SUPPLY T-1217
SWEEP GENERATOR T-1220
FILTER TRIG. AMP T-1221
CH-1 or X
CH-2 or Y
AC GND DC S101
AC GND DC S201
VOLTS/DIV S102
VOLT/DIV S202
PREAMP Q101~111, D101, 102
PREAMP Q201~213, D201, 202
SWITCHING C.K.T. D104~107, 310 D204~207, 311
SW. CONT. F-F Q322, 323, 330 D312~314, 317~324
DELAY LINE DRIVER Q301~307 D304~309
TRIG. OSCILLATOR Q328, 329, 331, 332
DELAY LINE L101
V. FINAL AMP Q308~317
H. AMP Q718~728 D720~729
GATE D718~721
UNBLANKING AMP Q428~431 D427, 428, 443
HIGH VOLTAGE POWER-1 D441~432
HIGH VOLT. PWR-2 Q420~422 D412~416
HIGH VOLTAE REGULATER Q423~427, 436 D417~426
CRT BIAS CKT Q435
VERT MODE S301
CH-2 POL S301
TRIG. BUFFER AMP Q319, 320
X AMP D325 Q324~327
TRIG. BUFFER AMP Q318, 321
TRIG. AMP Q704~714 D705~708
TRIG. AMP. GATE Q701~703 D701~704
TV SYNC AMP & SEPARATOR Q715~720 D709~717
TRIG. SHAPER Q501~504
AUTO FREE RUN BIAS Q505~508 D501~503
SINGLE SWEEP BIAS Q509~513 D504~509
SWEEP HOLD OFF Q518~523 D523~524
SWEEP GATE D517~520
SWEEP GENERATOR Q515~517 Q519~522 Q524~526 D525~528
+130V PWR D408, 409
+35V PWR Q415~419 D407, 408, 411
+15V PWR Q401, 403~408 D401, 402, 405
-15V PWR Q402, 409~414 D403, 404, 406
CAL OSC Q432~434 D429, 430
TRIG. CH-1/CH-2 S301
SOURCE EXT/INT S701
COUPLING S702
SLOPE +/- S703
TRIG. MODE S501
TIME/DIV S502
TRIG. IN
LBO-520 BLOCK DIAGRAM

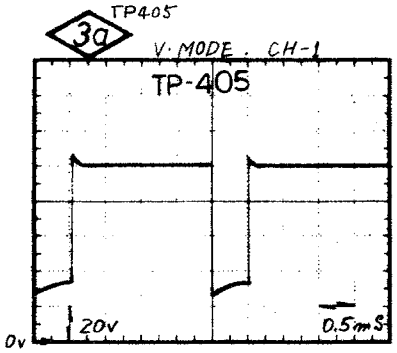
PWR SUPPLY

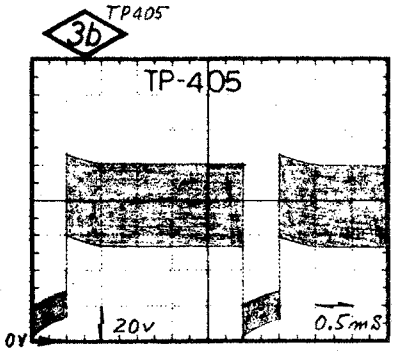
VERT MODE	CH-1
AC-GND-DC	DC
VOLT/CM	0.1v/CM
CAL connect to	CH-1
TIME/CM	0.2mS
GAIN VARIABLE	CAL.

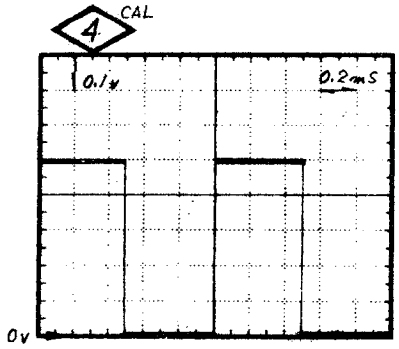
V-POS :

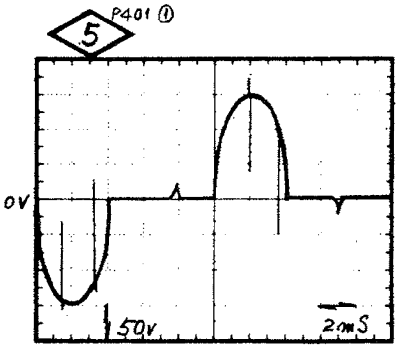


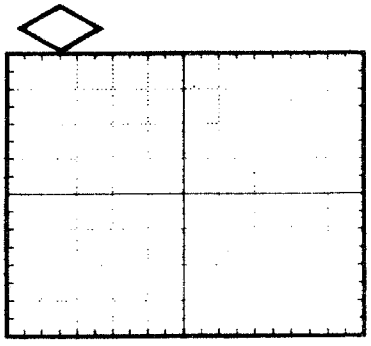


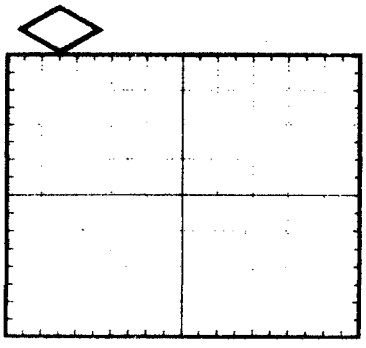


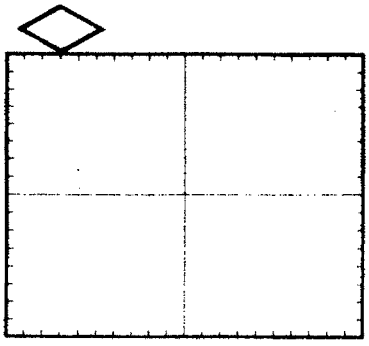


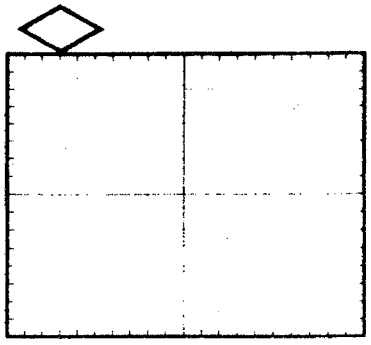


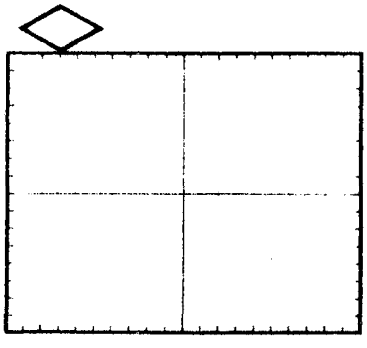


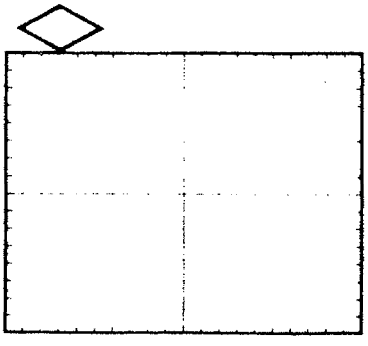


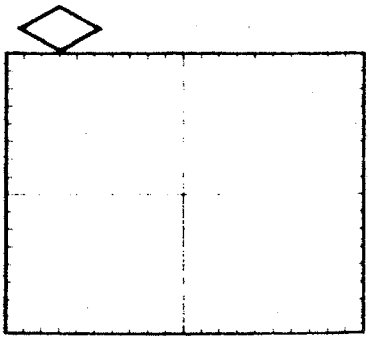


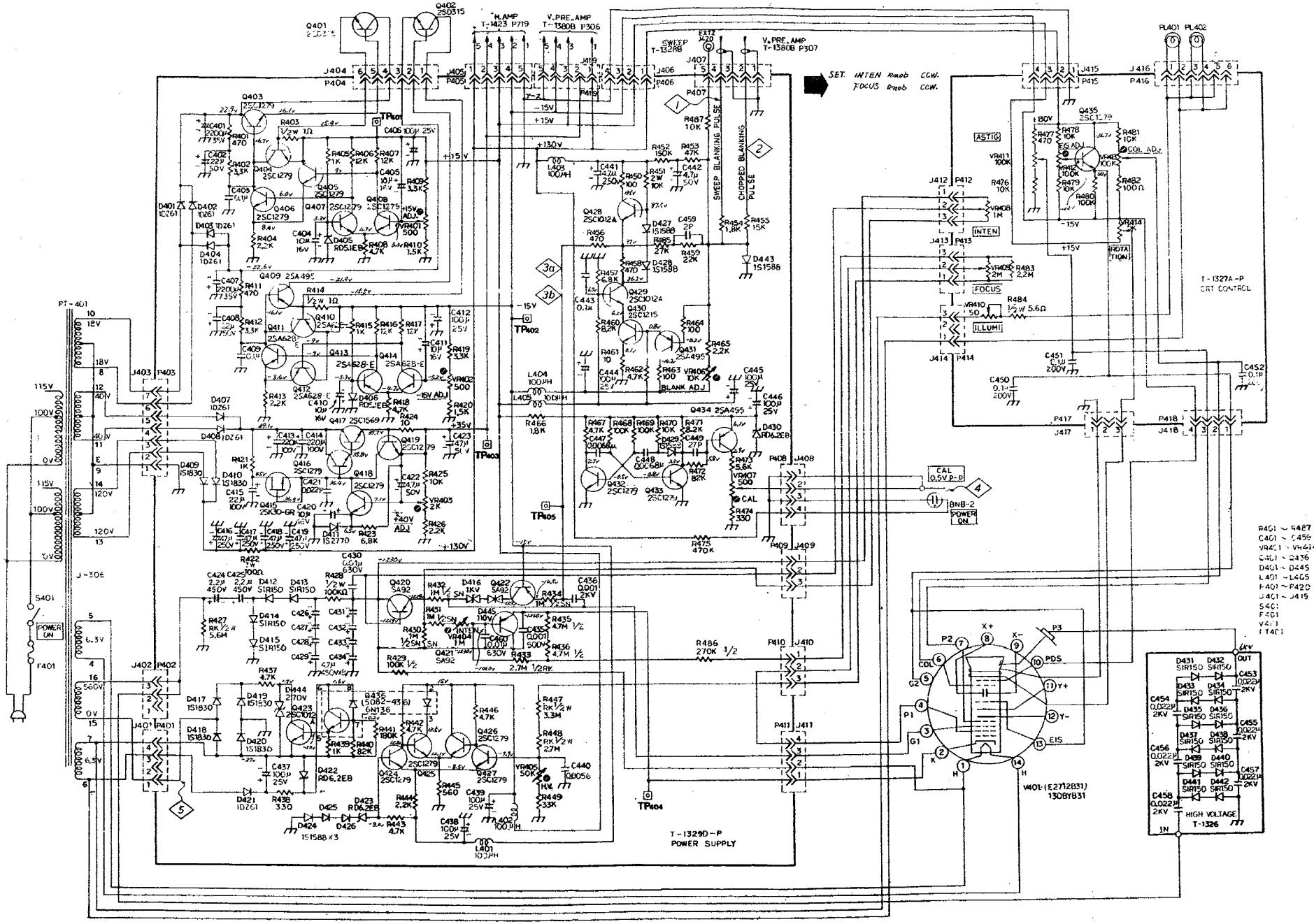








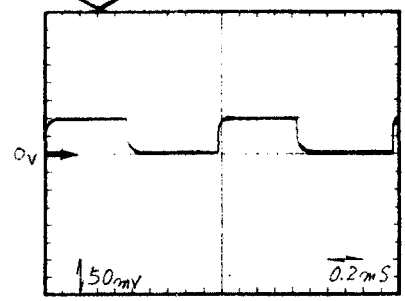




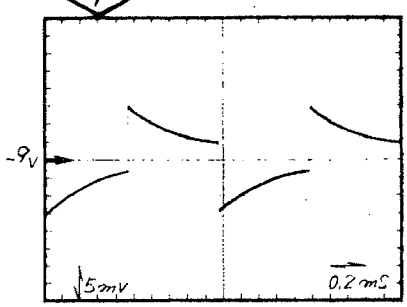
SCHEMATIC	Model LBO-520	O-1009 (1/4)
		LEADER ELECTRONICS CORP.

V-AMP

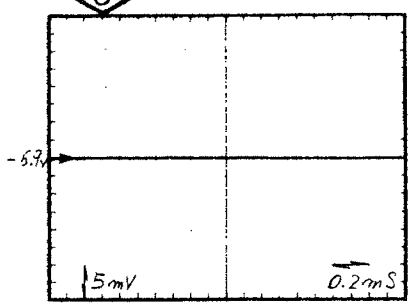
6 P101



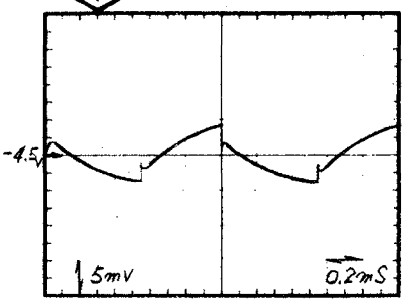
7 D106 Ⓐ



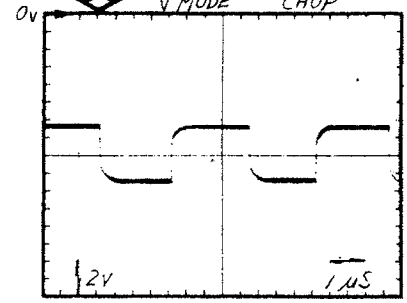
8 Q301 Ⓑ



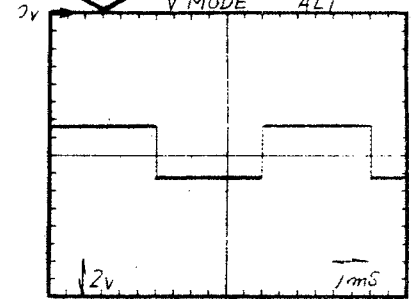
9 D107 Ⓐ



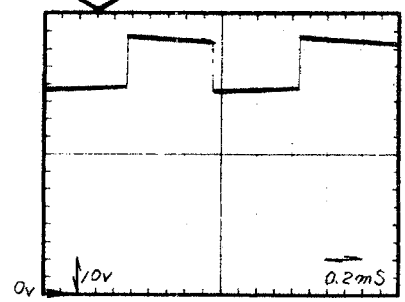
10a D105 Ⓚ V MODE CHOP



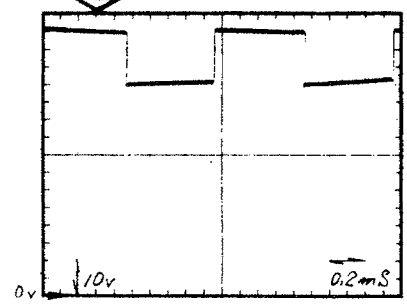
10b D105 Ⓚ V MODE ALT



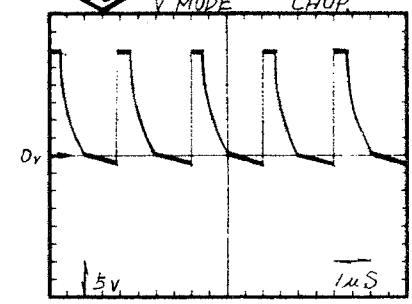
11 Q316 Ⓒ



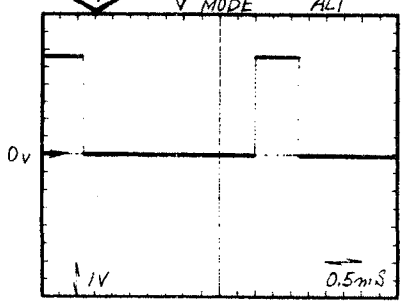
12 Q317 Ⓒ



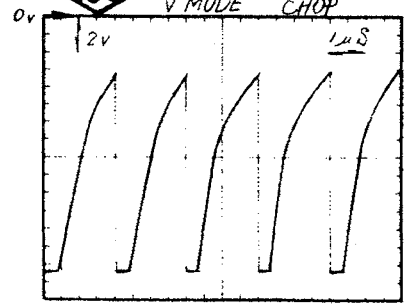
13 V MODE CHOP



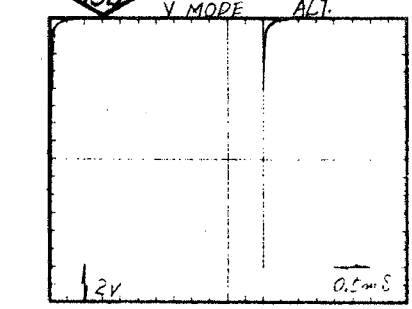
14 P307 Ⓐ V MODE ALT

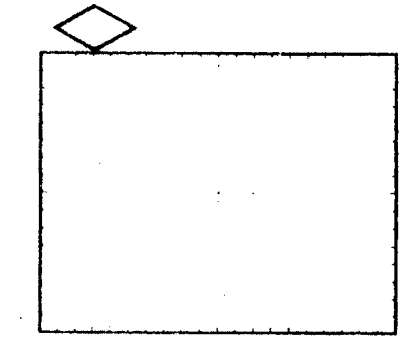


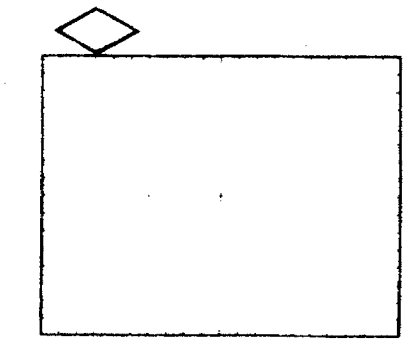
15a Q330 Ⓒ V MODE CHOP

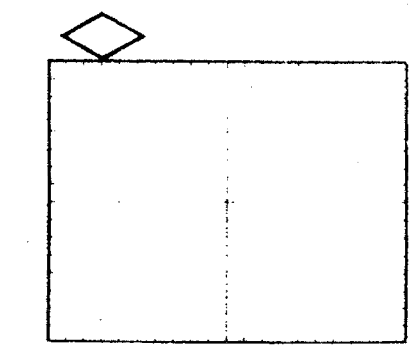


15b Q330 Ⓒ V MODE ALT



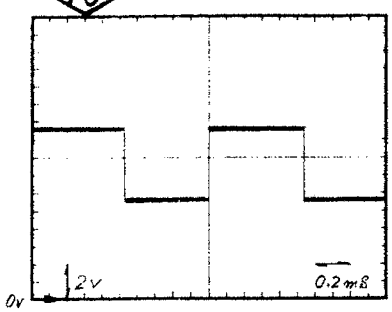




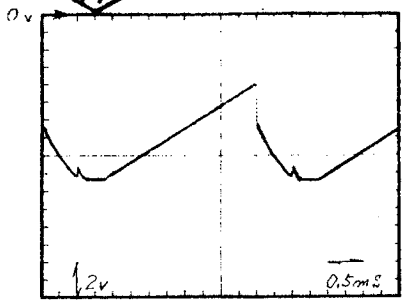


SWEEP GEN.

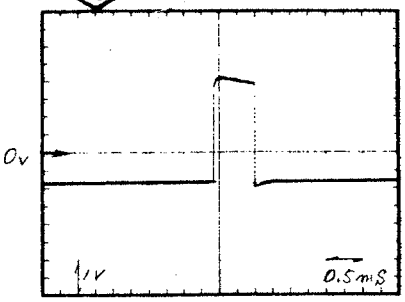
16 Q501 (B)



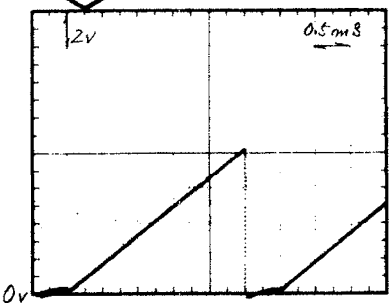
17 D517 (K)



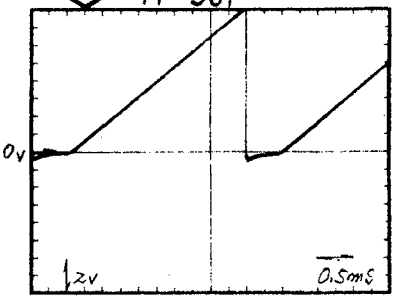
18 Q517 (C)



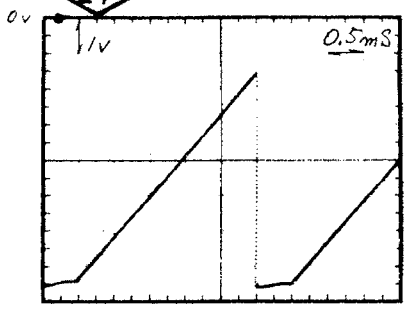
19 Q519 (C)



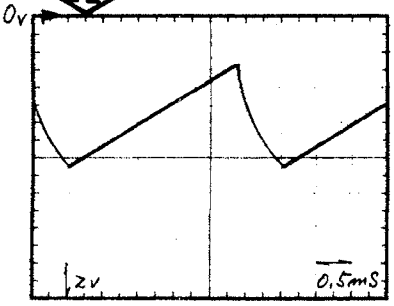
20 TP-501



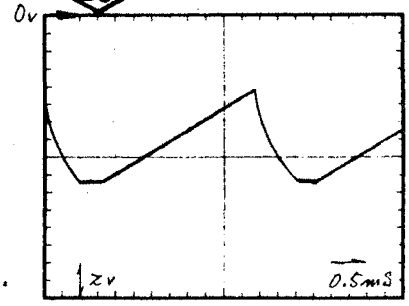
21 Q523 (B)



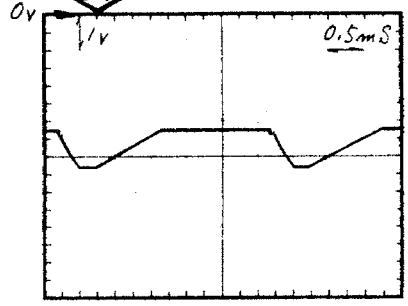
22 Q518 (B)



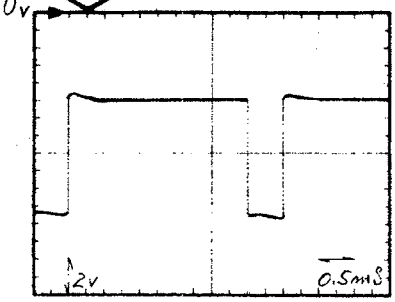
23 D519 (K)



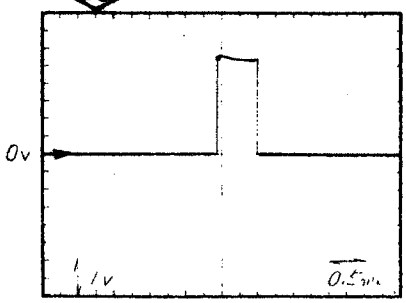
24 D519 (A)

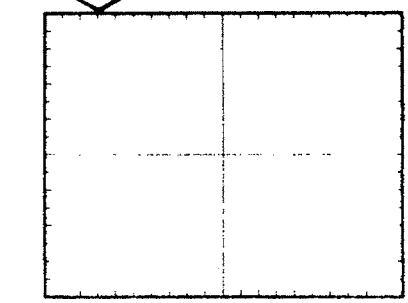


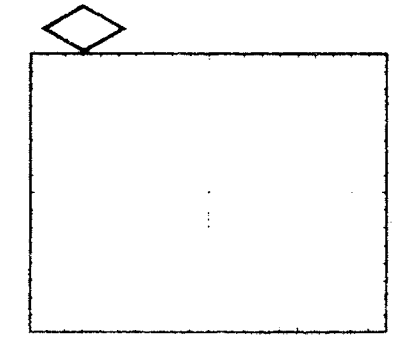
25 Q515 (E)

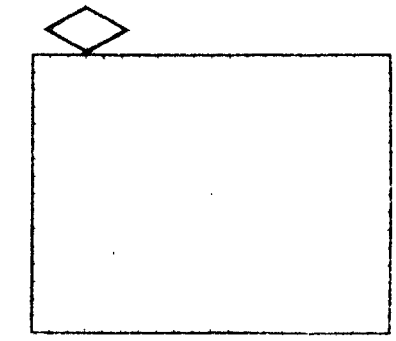


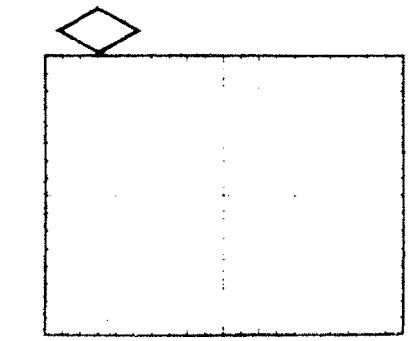
26 Q520 (E)





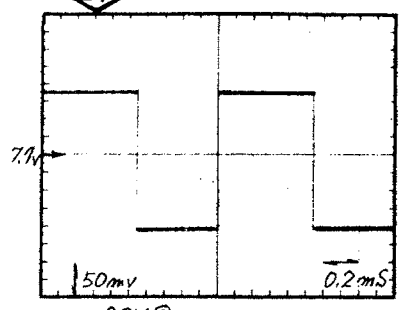




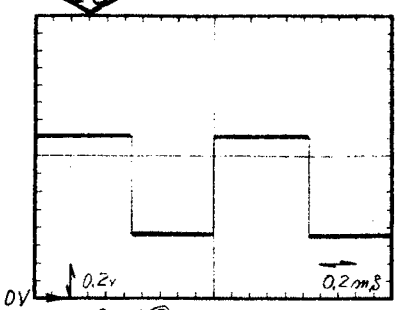


FILTER, H-AMP

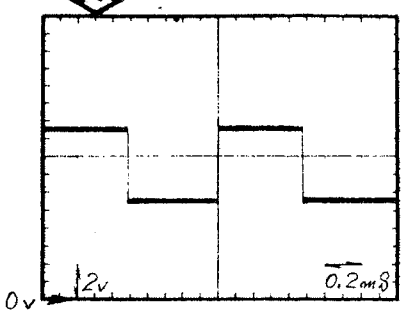
27 Q702 (B)



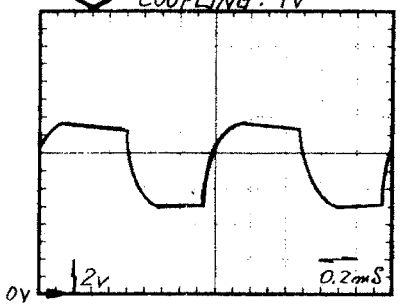
28 Q707 (E)



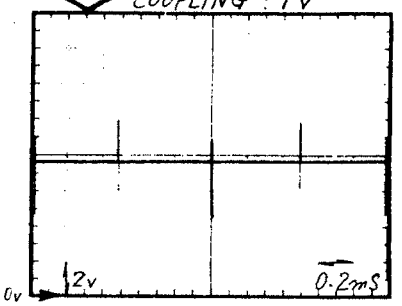
29 Q714 (E)



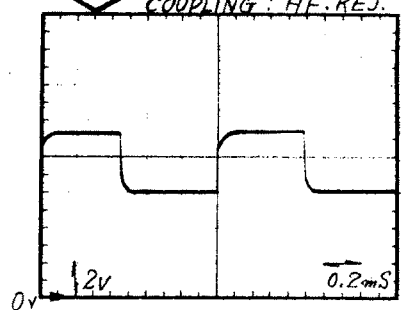
29A Q714 (E) TIME/CM : TV-V COUPLING : TV



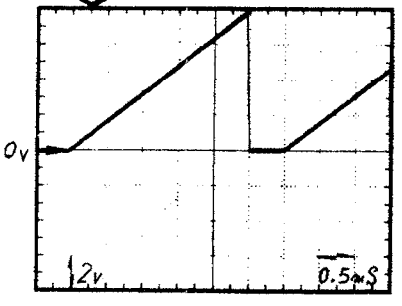
29C Q714 (E) TIME/CM : TV-H COUPLING : TV



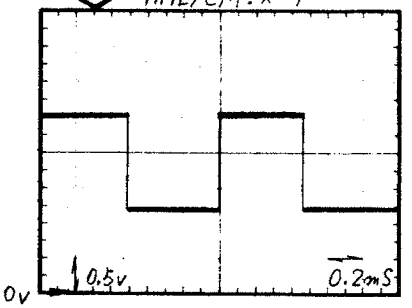
29D Q714 (E) COUPLING : HF. REJ.



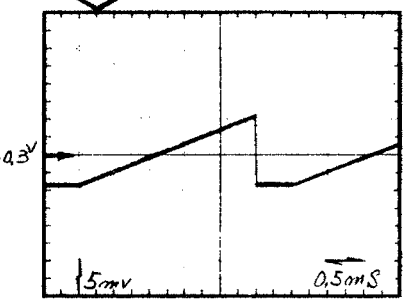
30 P722 (3)



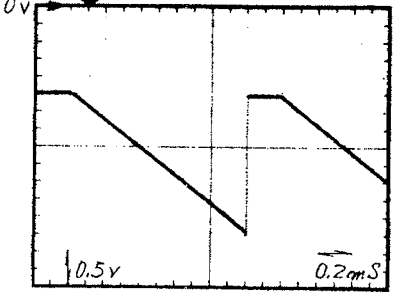
31 P722 (1) TIME/CM : X-Y



32 P722 (K)



33 Q727 (B)



34 Q731 (E)