FACTORY CALIBRATION PROCEDURE

CONTENTS:

317

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For all serial numbers.

INTRODUCTION:

This isn't a field recalibration procedure as is the procedure in your instruction manual. This is a guide in calibrating brand-new instruments, just assembled instruments that have never been turned on before. Therefore it calls out many procedures and adjustments that are rarely required for subsequent recalibration.

Even though we wrote this procedure primarily for our own factory test department, it's valuable to others also if used with some caution:

1. Special test equipment, if mentioned, is not available from Tektronix unless it's listed also in our current catalog. This special equipment is used in our test department to speed calibration. Usually you can either duplicate its function with standard equipment in your facility, devise alternate approaches, or build the special test equipment yourself.

2. Factory test limits are not guaranteed unless they also appear as catalog or instruction manual performance requirements. Factory test limits usually are tighter than advertised performance requirements. This helps insure the instrument will meet or exceed advertised performance requirements after shipment and during subsequent field recalibrations over several years of use. Your instrument may not meet factory test limits but should meet catalog or instruction manual performance requirements.

3. Presetting internal adjustments, if mentioned, usually is unnecessary. This is helpful for "first-time" calibration only. If internal adjustments are preset, a 100% recalibration will have to be performed. So don't preset internal controls unless you are certain a "start-from-scratch" policy is the best.

In this procedure, all front panel controls and TEKTRONIX instrument names are in capital letters (TIME/CM, etc.) and internal adjustments are capitalized only (Gain Adj., etc.).

ABBREVIATIONS:

a	amp
ac	alternating current
approx	approximately
b	base
bulb	light, lamp, etc.
c	collector
ccw	counterclockwise or full counterclockwise
cer	ceramic
cm	centimeter
comp	composition (resistor)
cps	cycles per second
crt	cathode ray tube
cw	clockwise or full clockwise
db	decibel
dc	direct current
dec	decoupled
div	division
e	emitter
emc	electrolytic, metal cased (capacitor)
emt	electrolytic, metal tubular
fil	filament
freq	frequency
gc	gigacycles
gmv	guaranteed minimum value (capacitor)
gnd	chassis ground
h	henry
hv	high voltage
inf	infinity
int	internal
k	kilo (10^3)
k	kilohm
m	milli (10^{-3})
ma	milliamp
max	maximum
mc	megacycle
meg	megohm
mh	millihenry
midr	midrange or centered
min	minimum
mm	millimeter
mpt	metalized, paper tubular (capacitor)
msec	millisecond
mt	mylar, tubular (capacitor)
mv	millivolt
μ	micro (10^{-6})
μf	microfarad
μh	microhenry
μsec	microsecond
n	nano (10^{-9})
nsec	nanosecond
Ω	ohm
p	pico (10^{-12})
pbt	paper, "bathtub" (capacitor)
pcc	paper covered can (capacitor)
pf	picofarad ($\mu\mu$f)
piv	peak inverse voltage
pmc	paper, metal cased (capacitor)
poly	polystyrene
pot	potentiometer
prec	precision (resistor)
pt	paper, tubular (capacitor)
ptm	paper, tubular molded (capacitor)
ptp	peak-to-peak
sec	second
sn	serial number
sswc	standard square-wave calibrator
term	terminal
tub	tubular (capacitor)
unreg	unregulated
v	volt
var	variable
w	watt
WW	wire wound
x-former	transformer

FACTORY TEST LIMITS

QUALIFICATIONS

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers listed beside the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

NOT INTENDED FOR INCOMING INSPECTION

We initially calibrate the instrument to factory test limits. These limits usually are tighter than advertised performance requirements, thus helping to insure the instrument will meet or be within advertised performance requirements after shipment and during subsequent recalibrations. Instruments that have left our factory may not meet factory test limits but should meet catalog or instruction manual performance requirements.

1. EQUIPMENT REQUIRED

2. PRELIMINARY INSPECTION

2b. Crt face plate tilt: 1/32", max.
2b. Crt face plate concavity: 1/32", max.
2b. Crt face plate convexity: 1/32", max.

3. 317 PRESETS

4. RESISTANCE CHECKS

5. POWER SUPPLIES

5b. -150 v: ±2%, max.
5c. +100 v and +300 v: ±2%, max.
5d. -1300 v: ±2%, max.
5f. Regulation: 103 to 127 v ac:

	max ptp ripple		
supply	103 v ac	117 v ac	127 v ac
-150	20 mv	10 mv	20 mv
+100	20 mv	10 mv	20 mv
+300	30 mv	15 mv	30 mv

6. CALIBRATOR ADJUST AND ACCURACY

6b. Error, all ranges: ±2%, max.

7. CALIBRATOR DUTY CYCLE

7a. Duty cycle: 45 to 55%.

8. SCALE ILLUM AND NEONS

9. CRT

9a. No part of CRT phosphor area may be more than 1/32" back of bezel.
9b. Geometry: 1/2 minor div max bowing in 10 major div.
9c. HV regulation: 103 to 127 v ac.
9e. Focus: no overlap of 1/2 minor div spaced vertical 180A marks in middle 8.8 major div.

10. VERTICAL AMPLIFIER

10a. Microphonics: main amp, 1 minor div; preamp, 2 minor div max.
10b. Grid current: 1 minor div shift max.
10d. Balance: within 1 major div max of center.
10e. Hum: 1/2 minor div max.
10h,i. Drift: .5 major div max 103 to 117 v ac and 117 v ac to 127 v ac.
Gain change: ±1.5 minor div max; 103 to 117 v ac and 117 v ac to 127 v ac.
10j. Compression and expansion: .5 minor div max total overall, added algebraically.

11. VOLTS/DIV

11a. Accuracy: ±2%, max.
11b. VARIABLE range: 2.5:1 min.

12. VOLTS/DIV COMPENSATION

12b. Compensations: ±1 trace width max.

13. LOW FREQ COMPENSATION

13a. Setting: mid r ±40% of total rotation.

14. TIME BASE TRIGGERING

14g. Must trigger properly under the following conditions:

TRIGGER SELECTOR	TRIGGERING LEVEL	CALIBRATOR signal
±INT AC	fixed*	.5 minor div
±EXT AC	fixed*	.1 v
±EXT DC	variable	.1 v
±INT DC	variable	1 minor div within ±1 minor div of graticule center.
	fixed*	±2 minor div
±INT AUTO	--	1/2 major div
±EXT AUTO	--	.1 v

*Fixed -- 0 v at R426-R427 junction.

15. LINE TRIGGER

15b. ±LINE: operable - fixed level.

16. HF SYNC

16b. Sync: 2 major div of 20 mc.

17. HORIZONTAL AMPLIFIER GAIN

18. SWEEP LENGTH

18a. Length: 10.2 to 10.8 major div.

19. NORM-MAG REGISTRATION

20. LF TIMING

20a. VARIABLE time/div ratio: 2.5 to 1 min.
20a. 1 and 2 SEC timing error: ±2.5% max.
20a. .5 SEC to .1 MILLISEC timing error: ±2% max.

21. HF TIMING

21a. 50 to .2 μSEC timing error: ±2% max except .04 μsec/cm ±4%.
21a. Linearity error in MAG: ±1% max.

22. EXTERNAL HORIZONTAL DEFLECTION FACTOR

22a. Gain: .75 major div deflection for 1 v input at center of graticule.
.7 major div deflection for 1 v input at edges of graticule.

23. FRONT PANEL WAVEFORMS

23a. SAWTOOTH OUT amplitude: 130 v min
+GATE OUT amplitude: 20 v min, no distortion.

24. HOLDOFF

24a.

TIME/DIV	holdoff
.2 and .5 μSEC	8 ~~.5~~ μsec ±50% max
1 to 50 μSEC	30 ~~25~~ μsec ±50% max
.1 to .5 MILLISEC	.2 ~~.2~~ millisec ±50% max
1 to 5 MILLISEC	3 ~~2~~ millisec ±50% max
10 to 50 MILLISEC	25 ~~20~~ millisec ±50% max
.1 to 2 SEC	.250 ~~.15~~ sec ±50% max

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25. CRT CATHODE INPUT

25b. Sweep must be intensity modulated with 10 v input.

26. VERTICAL AMPLIFIER HF ADJUSTMENTS

26c. Aberrations or tilt may not exceed 1% or 1 trace width in 3 major div.

27. FREQUENCY RESPONSE

27b. Preamp bandpass: -3 db @ 10 mc.
Main amp bandpass: -3 db @ 10.5 mc.

THE END.

CALIBRATION

1. EQUIPMENT REQUIRED

a. Test scope

1	530 series	Tektronix type scope
1	B	Tektronix type wide-band high-gain plug-in
1	P6006	Tektronix type 10X probe
1	P6028	Tektronix type 1X probe

b. Test equipment

1	105	Tektronix type square-wave generator
1	180A	Tektronix type time-mark generator
1	190B	Tektronix type constant amplitude sinewave generator

c. Test accessories

3	012-001	50 Ω 42" cable uhf connectors
1	011-045	50 Ω termination, uhf connectors
3	103-032	Bnc-uhf adapters
3	012-031	18" Jumper cables

d. Miscellaneous equipment

1	630	Triplett meter 20,000 Ω/v dc
	or 262	Simpson meter 20,000 Ω/v dc
1	--	Variable line voltage source with meter
1	special	STANDARD SQUARE-WAVE CALIBRATOR (SSWC)

NOTES

1. EQUIPMENT REQUIRED, SUBSTITUTION

Substitute equipment may be used; however, the user must determine that the substitute equipment is equivalent and must determine proper control settings, etc. It is assumed that all equipment listed is within its manufacturers specifications. If there is any doubt, the test equipment should be calibrated before it is used.

All substitutions at the factory must have the approval of the plant staff engineer.

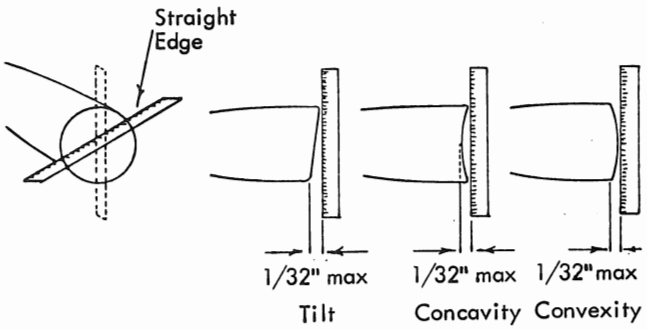
2. PRELIMINARY INSPECTION

a. General

Check controls for smooth mechanical operation and proper indexing.

b. Crt

Check that crt neck pin connections are tight and that hv shields are installed. Loosen crt clamp, remove graticule, push crt forward and check as follows:



Note crt manufacturing date and serial number on IBM card.

Inspect CRT for mechanical defects, cracks, scratches, holes and phosphor defects.

Replace graticule.

c. Fuse

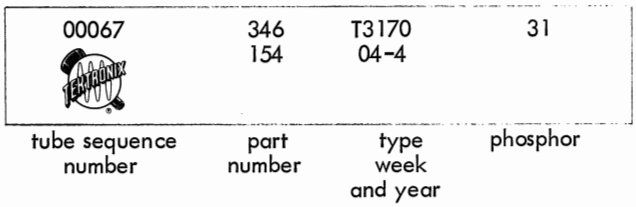
117 v	50-60 cps	159-005	3 amp	3 ag	Slo-Blo
234 v	50-60 cps	159-003	1.6 amp	3 ag	Slo-Blo

2b. Crt specs

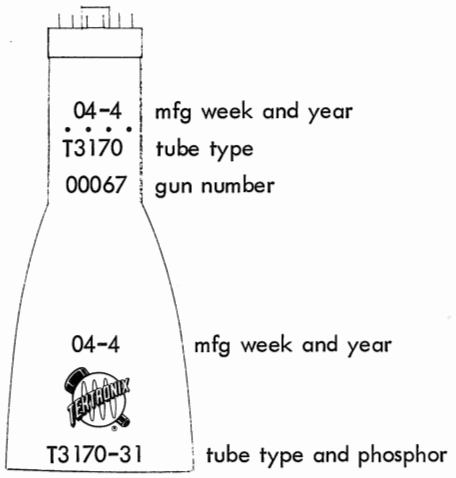
(1) These crt specifications are simplified. Do not reject crt without the authorization of a trained crt checker, or without reference to crt data.

2b. Cathode ray tube markings

(1) New procedure, vinyl tag at neck pins.



(2) Old procedure.



3. 317 PRESETS

a. External controls

FOCUS	ccw
INTENSITY	ccw
SCALE ILLUM	cw
VOLTS/DIV	.1
VARIABLE volts/div	cw (CALIBRATED)
AC-DC	DC
TRIGGER SELECTOR (red knob)	AC
TRIGGER SELECTOR (black knob)	+INT
STABILITY	ccw (not PRESET)
TRIGGERING LEVEL	mid r (tighten set screw enough that knob will rotate pot shaft)
HORIZ DISPLAY	NORM
TIME/DIV	1 MILLISEC
VARIABLE time/div	cw (CALIBRATED)
VERTICAL POSITIONING	mid r
HORIZONTAL POSITIONING	mid r
CALIBRATOR	OFF
POWER	off

b. Internal adjustments

C358	1/4 turn from max
All other internal adjustments except vertical amplifier and delay line adjustments	mid r

c. Leave controls and adjustments, for any step, as they were in the step preceding, unless otherwise noted.

3b. Presetting internal adjustments

(1) Presetting internal adjustments is helpful for "first-time" calibration but is usually unnecessary for recalibration. If controls are preset, a 100% recalibration must be performed. Don't preset internal adjustments unless you are certain a "start-from-scratch" policy is the best.

4. RESISTANCE CHECKS

a. Resistances to ground

Connect ohmmeter to proper slots on ceramic strip next to power transformer and check following resistances to ground:

supply	approx resistance
transformer term 1	inf
transformer term 4	inf
-150 v	4 k
+100 v	4 k
+300 v	12 k

5. POWER SUPPLIES

a. Apply power to 317.

Connect 317 to variable line source, set source to 117 v ac and turn POWER ON. Allow 60 sec warmup time.

5a. Catastrophic shorts

For first-time turn-on, on raw instruments, reduce line voltage to 1/6 normal line, set TRIGGERING SOURCE to LINE and measure the power transformer secondary voltages. Low readings indicate a shorted secondary circuit. It's important that any shorted filament secondaries are located before full line voltage is applied because the cables will usually burn up before the fuse blows.

b. -150 Adj R617 ±2% max

Adjust -150 v Adj R617 to bring -150 v to -150 v ±3 v.

5b. -150 v supply

(1) May have to be adjusted high within specs to bring +100 v supply into tolerance.

c. +100 v and +300 v supplies ±2% max

+100 v supply must measure +100 ±2 v and 300 v supply must measure 300 v ±6 v.

d. Adjust high voltage 1300 v ±2% max

Connect meter to High Voltage Test Point (left side of scope) and adjust High Voltage Adj for exactly -1300 v.

5d. High Voltage measurements

(1) High voltage can also be measured at term 20 and 21 of transformer except when scope contains a DC fan (Mod 101).

e. Elevated heaters

Elevated heater supplies as follows:

transformer terms	approx voltage
20-21	-1300 v
23-24	140 v
25-26	95 v

f. Ripple and regulation 103 v ac to 127 v ac.

supply	max ptp ripple 103 v ac	117 v ac	127 v ac
-150	20 mv	10 mv	20 mv
+100	20 mv	10 mv	20 mv
+300	30 mv	15 mv	30 mv

Return line voltage to 117 v ac.

g. Unregulated supplies

With test scope, check for 120 cps waveforms on all unregulated supplies and at pin 3 V154.

5f. Microphonic power supplies

(1) By slapping scope while looking at ripple you can often detect bad joints, tubes, etc. Noisy resistors show up as a very jumpy waveform.

5g. Unregulated supplies frequency

(1) 60 cps waveforms indicate trouble in power supply diode bridges.

6. CALIBRATOR ADJUST AND ACCURACY

a. Setup

Set CALIBRATOR to 100 VOLTS. Remove V573, the output half of the calibrator multi. Set test scope to .5 v/cm, ac.

Connect:

SSWC as instructed at end of procedure.

Test scope, vert input--50 Ω cable--output, SSWC

317 CAL OUT--50 Ω cable--unk in, SSWC

Set SSWC to 100 v mixed. Use test scope triggering controls to obtain a stable display.

b. Accuracy error, all ranges: ±2%, max

Check CALIBRATOR accuracy as follows:

317 CALIBRATOR (VOLTS)	SSWC (volts)	test scope sensitivity (v/cm, ac)	test scope deflection (max)
100	100	.5	adj to 0 with Cal Adj R566
50	50	.5	2 cm
20	20	.2	2 cm
10	10	.1	2 cm
5	5	.05	2 cm
2	2	.02	2 cm
1	1	.01	2 cm
.5	.5	.005	2 cm
.2	.2	.005	.8 cm
.1	.1	.005	.4 cm
.05	.05	.005	.2 cm

Replace V573. Remove standard calibrator signal.

NOTES

6b. Interpreting display

(1) The test scope display is a 60 cps square wave: one half of each cycle is the SSWC dc reference (accurate); the other half is the 317 calibrator dc reference (unknown accuracy).

(2) The amplitude of the display is the voltage difference between an accurate dc reference and a dc reference of unknown accuracy (the 317 calibrator, whose accuracy we're checking).

(3) 317 cal % error = $\frac{\text{voltage difference x 100}}{\text{CALIBRATOR setting}}$

(4) Example:

	case 1	case 2
SSWC:	100 volts	20 volts
CALIBRATOR setting:	100 VOLTS	20 VOLTS
Test scope vert sensitivity:	5 v/cm	.1 v/cm
Test scope vert deflection:	1 cm	2 cm

Case 1: % error = $\frac{5 \times 100}{100}$ = 5%

Case 2: % error = $\frac{.2 \times 100}{20}$ = 1%

(5) In the table of step 6b, we've worked out the settings so that the deflection listed is the maximum allowable to remain within test limits.

7. CALIBRATOR DUTY CYCLE

a. Duty cycle 45 to 55%

Connect a meter to Cal Test Pt. and note that in any CALIBRATOR switch position except OFF, meter reads between 45 and 55 v, indicating a duty cycle of 45 to 55%. Remove meter.

7a. Duty cycle

(1) If voltage is off tolerance, reverse C554 and C558 and/or change V573.

8. SCALE ILLUM AND NEONS

a. SCALE ILLUM

Turn SCALE ILLUM cw: both graticule lights must increase brilliance.

Turn SCALE ILLUM ccw: both graticule lights must extinguish completely.

b. Neons

Turn VARIABLE volts/div ccw from CALIBRATED: VERTICAL UNCALIBRATED neon must come on.

Return to CALIBRATED. Neon must extinguish.

Turn VARIABLE time/div ccw from CALIBRATED: TIME-BASE UNCALIBRATED neon must come on.

Return to CALIBRATED. Neon must extinguish.

Switch HORIZ DISPLAY to MAG: MAG neon must come on.

Return to NORM.

9. CRT

a. Align CRT

Turn STABILITY cw (free-run sweep). Use FOCUS, INTENSITY and POSITIONING controls to obtain a well defined trace. With CRT pliers, rotate CRT until trace is aligned with center horizontal graticule line. Push CRT forward against a straight edge and tighten CRT clamp. Recheck alignment of trace, and check that no part of phosphor area of CRT is more than 1/32" max back of CRT bezel (step 2b). Replace graticule, center on scan area and tighten hold-down screw.

b. Geometry R861 1/2 minor div

Connect:

180A marker out--50 Ω cable--VERTICAL INPUT
180A trigger out--50 Ω cable--TRIGGER INPUT

Set 180A for 1 msec and 100 μsec marks and 1 msec triggers. Set 317 TRIGGER SELECTOR (black knob) to +EXT. With STABILITY and TRIGGERING LEVEL controls, obtain a stable display on 317. Adjust Horiz Gain Adj and Mag Gain Adj for 1 large marker per major div.

Adjust Geometry R861 to a point where over the entire graticule area there is no more than 1/2 minor div of tilt or bow of the time marks.

9b. Triggering on time marks

(1) To obtain stable display trig level centering R437 may have to be preadjusted.

c. High voltage regulation

Slightly mis-adjust FOCUS to prevent phosphor burns. Connect meter to High Voltage Test Point. Rotate INTENSITY from ccw to cw and check display for no blooming (expanding vertically or horizontally) and check meter for less than 20 volt change of -1300 volt supply. Return INTENSITY to usuable level. Change line voltage control from 103 v ac to 127 v ac and make same checks as above.

Remove meter. Return line voltage to 117 v ac.

d. Phosphor

Set 180A to 5 mc. Adjust VOLTS/DIV so display completely covers the phosphor and check for burns, spots or holes. Remove 180A.

e. Astigmatism R856

Decrease amplitude of display of time marks to about 1 major div with VOLTS/DIV switch. Adjust FOCUS and Astigmatism R856 for best horizontal and vertical focus at center of display.

9e. FOCUS setting

(1) Dot on FOCUS knob should be at about 12 o'clock ±20° after adjusting Astigmatism. A wiring error may only show up as the dot being in a different location.

f. Focus

Increase display vertically so that 100 μsec marks are at least 8 major div high. Check that all 100 μsec marks within the middle 8.8 major div are well defined with no overlap.

10. VERTICAL AMPLIFIER

a. Microphonics — main amp 1 minor div max, preamp 2 minor div max, no ringing type

Ground VERTICAL INPUT. With VOLTS/DIV at .1, lightly rap top of scope with hand. Check for less than 1 minor div of microphonics. Switch VOLTS/DIV to .01 and repeat, check for less than 2 minor divisions of microphonics.

b. Grid current — 1 minor div shift, max

With VOLTS/DIV at .1, switch AC-DC to AC. Check for no more than 1 minor div shift of trace.

Set AC-DC switch back to DC.

Switch VOLTS/DIV to .05 and again check for no more than 1 minor div shift. Return to .1.

c. VARIABLE ATTEN BAL

Rotate VARIABLE volts/div and adjust VARIABLE ATTEN BAL for no trace shift during rotation. Return VARIABLE volts/div to CALIBRATED.

d. Balance — 1 major div max

With the VERTICAL POSITIONING control at mid r the trace must be within 1 major div of graticule center.

e. Preamp 60 cps hum — 1/2 minor div

Switch VOLTS/DIV to .01, TIME/DIV to 5 MILLISEC. Observe hum on trace. Must be less than 1/2 minor div. Remove ground from vertical INPUT.

f. Main amp gain R244

Apply .5 volts from SSWC to vertical INPUT. Switch VOLTS/DIV to .1, AC-DC to DC, TIME/DIV to .1 MILLISEC. Adjust Gain Adj R244 throughout its range checking for smooth operation. Note a minimum gain range of 4.5 to 5.5 major div of signal. Adjust to exactly 5.0 major div.

10c. Input balance drift

(1) This adjustment will drift and should be readjusted after calibration is completed.

10d. Amplifier balance

(1) If balance is out of specs, replace V223, swap V254 and V244, V224 and V214, V203 and V183. Readjust VARIABLE ATTEN BAL.

10e. Excessive hum

(1) Make sure chassis bolts are tight at front and rear of power supply chassis.

10f. Set gain in DC

(1) There is a slight difference in gain between AC and DC.

g. Preamp gain R154

Reduce SSWC voltage to .05 v. Switch VOLTS/DIV to .01. Adjust Preamp Gain throughout its range checking for smooth operation. Note a minimum gain range of at least 4.5 to 5.5 major div. Adjust to exactly 5.0 major div.

h. Low line drift and gain change
drift .5 major div max
gain ±1.5 minor div max

Switch VOLTS/DIV to .1. Obtain 4 major div of deflection with VARIABLE. Turn line voltage source to 103 v ac and note gain change (1.5 minor div) and vertical drift (.5 major div). Return to 117 v ac and allow to stabilize.

i. High line drift and gain change
drift .5 major div max
gain ±1.5 minor div max

Turn line voltage source to 127 v ac and again note gain change and drift. Return to 117 v ac and allow to stabilize.

j. Compression and expansion .5 min div max

With VARIABLE, obtain 2 major div of signal centered vertically on graticule. With VERTICAL POSITIONING move display to top of graticule and note gain change. Then move display to bottom of graticule and again note gain change. Total gain change, top and bottom added algebraically, must not exceed .5 minor div max. Return VARIABLE to CALIB.

10g. Noisy R154

(1) It is common for this pot to be jumpy.

10h. Line drift

(1) Leave at low line for at least 30 secs. While waiting, switch TIME/DIV to 2 SEC and check that sweep will repeat. If not change V83.

10j. Poor compression

(1) Excessive compression is usually caused by the output tubes V244 and V254.

11. VOLTS/DIV

a. Accuracy ±2% max

Apply SSWC to VERTICAL INPUT and check as follows:

VOLTS/DIV	SSWC volts	deflection	
.01	.05	*5 maj div	±.5 min div
.02	.1	5	±.5
.05	.2	4	±.4
.1	.5	*5	±.5
.2	1	5	±.5
.5	2	4	±.4
1	5	5	±.5
2	10	5	±.5
5	20	4	±.4
10	50	5	±.5
20	100	5	±.5
50	100	2	±.2

*adjusted previously.

b. VARIABLE range 2.5:1 min

Apply 50 volts from SSWC. Switch VOLTS/DIV to 20. Note 2.5 major div signal. Rotate VARIABLE, checking for smooth operation, to minimum deflection. Note a maximum of 1 major div. Return to CALIBRATED. Remove SSWC.

12. VOLTS/DIV COMPENSATIONS

a. Setup

105--10X Probe tip--cable--vertical INPUT

b. Compensations ±1 trace width max

Keep 105 adjusted for about 4 major div of 1 KC signal. Adjust STABILITY and TRIGGERING LEVEL for stable display. Adjust for best square wave as follows:

VOLTS/DIV	adjust front corner	adjust level
.1	compensate probe	
.2	C132	C130
.5	C126	C124
1	C118	C116
2	check*	check*
5	check*	check*
10	C112	C110
20	check*	check*
50	check*	check*
.05	C141	check*
.02	check*	check*
.01	check*	check*

*The flat top of the waveform must be within a trace width of being level. If necessary, detune positions involved, staying within specs, to bring stacked positions within specs.

13. LOW FREQ COMPENSATION

a. Low Freq Comp R175
mid r: ±40% of total rotation

Set VOLTS/DIV to .1, TIME/DIV to 5 MILLISEC, AC-DC to AC. Set 105 for 6 major div of 50 cps square wave. Note slant of waveform top.

Set VOLTS/DIV to .01. Reduce 105 signal to 6 major div. Adjust Low Freq Comp R175 for same slant of waveform as previously noted. Final setting of R175 must not be within 10% of rotation from either end.

14. TIME BASE TRIGGERING

a. Setup

Test scope: 10X probe to pin 6 V435. Input selector to AC, volts/cm to 1., time/cm to 1 millisec, trigger to auto +int.

Scope under calibration: R428-R426 junction grounded. Jumper cables from CAL OUT to vert INPUT and to trigger INPUT.

VOLTS/DIV	.5
CALIBRATOR VOLTS	.05
TIME/DIV	.5 MILLISEC
TRIGGER SELECTOR (black knob)	+INT
TRIGGER SELECTOR (red knob)	AC
STABILITY	cw

b. Trigger Sens R443 and Trigger Level Centering R437

Turn Trigger Sens R443 cw. Adjust Trigger Level Centering R437 until an oscillation is seen on test scope, then turn R443 ccw until oscillation ceases. Continue to do this until a stable square wave appears on test scope.

c. + and - Int

Turn STABILITY ccw until signal is triggered on scope under calibration. Check for proper polarity of signal. Switch to - and again check for proper polarity.

d. Int Trig DC Level Adj R258

Switch CALIBRATOR VOLTS to .1. Set TRIGGER SELECTOR (red knob) to DC. Center display on graticule. Adjust Int Trig DC Level Adj R258 for stable square wave on test scope. Check for + and - as before. Trace may have to be repositioned vertically to obtain proper + and - switching. Remove jumper from vertical INPUT.

e. Preset Stability

Connect 10X probe from test scope to center arm of Preset Stability pot. Switch test scope input to DC.

Set scope under calibration as follows:

TRIGGER SELECTOR (red knob)	AUTO
TRIGGER SELECTOR (black knob)	+LINE
STABILITY	PRESET
TIME/DIV	.1 MILLISEC

Rotate Preset Stability cw until trace appears and note dc level on test scope. Rotate Preset Stability further cw until trace brightens and again note dc level. Turn Preset Stability ccw until dc level is midway between the 2 noted levels. Remove 10X probe.

14e. Preset swing

(1) From where trace comes on to where it brightens should be at least 15 v.

f. TRIGGERING LEVEL knob

Set TRIGGER SELECTOR (black knob) to +INT, TRIGGER SELECTOR (red knob) to AC, TIME/DIV to .5 MILLISEC. Remove ground from R428, R426 junction. Reconnect jumper from CAL OUT to vertical INPUT. Adjust TRIGGERING LEVEL knob for stable triggered display. Carefully loosen set screw on TRIGGERING LEVEL knob until knob turns freely. Position white dot under "0" on front panel and tighten set screw, checking that a triggered display remains.

14f. Set screw adjustment

(1) Check that set screw is not tightened to the point that the concentric shafts bind.

g. Overall operation of trigger

Using signal from CALIBRATOR, check the triggering circuit for proper operation as follows:

INT: AUTO	Must trigger + and - on 1/2 major division of signal.
INT: AC	Must trigger + and - on .5 minor division of signal without moving TRIGGERING LEVEL control.
INT: DC	Must trigger + and - on 1 minor division of signal within ±1 minor division of graticule center. Must trigger on + and - 2 minor divisions of signal without moving TRIGGERING LEVEL control.
EXT: AUTO, AC and DC	Must trigger on .1 volt signal.

Remove jumper cables.

15. LINE TRIGGER

a. Setup

Set TIME/DIV to 5 MILLISEC and TRIGGER SELECTOR to AUTO, LINE. Connect a 10X probe from vertical INPUT to an external 117 v ac source.

b. Triggering

Check for proper slope on display, switching from + to - LINE. Disconnect probe.

16. HF SYNC

a. Setup

190B--atten head--50 Ω term--vertical INPUT

Switch TIME/DIV to .2 μSEC, HORIZ DISPLAY to MAG, and TRIGGER SELECTOR to HF SYNC +INT. Adjust 190B for 2 major div of 20 mc.

b. HF SYNC

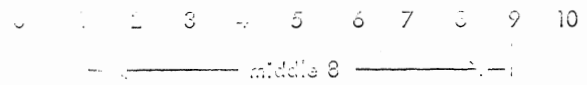
Rotate STABILITY until a stable trace is obtained. Slap top of scope to check for microphonic tubes. Remove 190B.

16b. Unstable sync

(1) If waveform is unstable or appears to be 2 or more out of phase signals, try replacing V83, V35, V52, V61.

17. HORIZONTAL AMPLIFIER GAIN

a. NOTE: Unless noted otherwise, use the middle 8 horizontal divisions when making horizontal amplifier gain and timing checks or adjustments.



b. Connect 180A

180A marker out--52 Ω cable--vertical INPUT

Set 180 for 1 msec and 100 μsec markers.

c. Presets

TIME/DIV	1 MILLISEC
HORIZ DISPLAY	NORM
TRIGGER SELECTOR (red knob)	AC
TRIGGER SELECTOR (black knob)	+INT
STABILITY	PRESET

Adjust TRIGGERING LEVEL for stable display.

Turn HORIZ DISPLAY to MAG.

d. Mag Gain Adj R358

Adjust Mag Gain Adj R358 for two 100 μsec marks per major division.

e. Horiz Gain Adj R325

Turn HORIZ DISPLAY to NORM and adjust Horiz Gain Adj R325 for one 1 msec mark per major division.

18. SWEEP LENGTH

a. Sweep Length R82 10.2 to 10.8 maj div

Adjust Sweep Length R82 for a trace length of 10.5 maj div.

19. NORM-MAG REGISTRATION

a. Norm/Mag Regis. R335

Set HORIZ DISPLAY to MAG and use HORIZONTAL POSITIONING control to bring first time mark (start of sweep) to graticule center. Switch HORIZ DISPLAY to NORM and adjust Norm/Mag Regis R335 to again bring first time mark to graticule center. Repeat adjustments until the first time mark does not shift when switching between NORM and MAG. Check at center and rear end of sweep. Leave HORIZ DISPLAY in NORM. Horizontal positioning should move 10th marker to at least center graticule mark.

20. LF TIMING

a. Check as follows:

TIME/CM	180A marks	check for	
.1 mSEC	100 μsec	1 mark/div	±.8 min div
.2 mSEC	100 μsec	2 marks/div	±.8 min div
.5 mSEC	500 μsec	1 mark/div	±.8 min div
1 mSEC*	1 msec	1 mark/div	±.8 min div
1 mSEC	10 msec		

Turn VARIABLE time/div ccw: UNCALIBRATED neon must light up and 3rd 180A mark must cross to left of the 8th graticule line. Return VARIABLE cw (CALIBRATED): UNCALIBRATED neon must go out.

2 mSEC	1 msec	2 marks/div	±.8 min div
5 mSEC	5 msec	1 mark/div	±.8 min div

Position base line off-screen to prevent phosphor burns.

10 mSEC	10 msec	1 mark/div	±.8 min div
20 mSEC	10 msec	2 marks/div	±.8 min div
50 mSEC	50 msec	1 mark/div	±.8 min div
.1 SEC	100 msec	1 mark/div	±.8 min div
.2 SEC	100 msec	2 marks/div	±.8 min div
.5 SEC	500 msec	1 mark/div	±.8 min div
1 SEC	1 sec	1 mark/div	± 1 min div
2 SEC	1 sec	2 marks/div	± 1 min div

*Adjusted previously.

b. Adjust C310

Set HORIZ DISPLAY to MAG and 180A to 10 μsec marks. Switch TIME/DIV back and forth between 50 μSEC and .1 MILLISEC. Adjust C310 for coincidence of first time mark. Leave in NORM.

CALIBRATION

NOTES

21. HF TIMING

a. Adjust as follows:

Connect 180A trigger out to TRIGGER INPUT and set 180A for 10 μsec triggers. Change TRIGGER SELECTOR (black knob) to +EXT, set STABILITY and TRIGGERING LEVEL for a stable display and adjust as follows:

TIME/DIV	180A marks	adjust	for
10 μSEC	10 μsec	C160E	1 mark/div, ±.8 min div
1 μsec	1 μsec	C160C	1 mark/div, ±.8 min div
.5 μsec	1 μsec	C160A	1 mark/2 div, ±.8 min div

Turn HORIZ DISPLAY to MAG.

.2 μsec	10 mc	C324	1 cycle/2 div, ±.8 min div

Switch 180A to 50 mc, remove cable from vertical INPUT and with a small cap in series, connect cable directly to one of the CRT vertical deflection plate pins. With HORIZONTAL POSITIONING, look at start of sweep and adjust C358 for best linearity between second and tenth cycles.

Position center of sweep to graticule center. Adjust C350 and C372 for 2 cycles/div. With HORIZONTAL POSITIONING, check timing and linearity, disregarding first and last 10% of sweep.

b. Timing ±2% except .04 μsec/cm ±4%

TIME/DIV	HORIZ DISPLAY	180A marks	check for
.2 μSEC	MAG	50 mc	2 cycles/div ±1.6 minor div
.2 μSEC	NORM	10 mc*	2 cycles/div ± .8 minor div
.5 μSEC	MAG	10 mc	1 cycle/div ± .8 minor div
.5 μSEC	NORM	1 μsec*	1 mark/2 div ± .8 minor div
1 μSEC	NORM	1 μsec*	1 mark/div ± .8 minor div
2 μSEC	NORM	1 μsec	2 marks/div ± .8 minor div
5 μSEC	NORM	5 μsec	1 mark/div ± .8 minor div
10 μSEC	NORM	10 μsec*	1 mark/div ± .8 minor div
20 μSEC	NORM	10 μsec	2 marks/div ± .8 minor div
50 μSEC	NORM	50 μsec	1 mark/div ± .8 minor div

Disconnect 180A.

*Previously adjusted.

21a. Final adjustments

(1) It may be necessary to recheck adjustments because of interaction. Final setting should leave timing within specs on all ranges.

21b. Poor linearity

(1) If linearity is out of specs (1%), swap V354 and V364.

(2) C350 and C372 should be adjusted together, i.e., equal capacitance.

22. EXT HORIZ DEFLECTION FACTOR

a. Gain

Apply 2 volts CALIBRATOR signal to HORIZ INPUT. Switch HORIZONTAL DISPLAY to EXT and TRIGGER SELECTOR to AC +INT. Turn STABILITY cw and note at least 1.5 major div of deflection with display centered horizontally and at least 1.4 major div with display at right and left graticule edges. Increase CALIBRATOR voltage to 10. Rotate STABILITY slowly ccw and check for erratic operation. With STABILITY fully ccw there should be no horizontal deflection.

From the test scope sawtooth out connect a jumper to VERTICAL INPUT. Obtain a stable display by triggering the test scope externally with the signal from the 317 CAL OUT.

Move the display with the HORIZONTAL POSITIONING. There should be no distortion of the display anywhere within the graticule limits.

Remove all connections and set HORIZ DISPLAY to NORM.

22a. External horiz attenuator

(1) With HORIZONTAL DISPLAY in EXT the STABILITY control becomes a variable attenuator for the HORIZ INPUT.

23. FRONT PANEL WAVEFORMS

a. Output amplitudes

Set TIME/DIV at 1 MILLISEC and free-run sweep. Use test scope and 10X probe to measure the following front panel waveforms:

SAWTOOTH OUT	130 v min, sawtooth
+GATE OUT	20 v min, square wave*

*The upper and lower dc level of the gate must have no roll-off with sweep speed at 1 MILLISEC.

b. High speed waveforms

Set TIME/DIV at .2 μSEC and again check +GATE OUT for no rounding of corner between lower dc level and rising portion of square wave.

Check SAWTOOTH OUT and note that waveform baseline is now about 20 volts above ground.

23b. +Gate high speed wave shape

24. TIME BASE HOLDOFF

a. Holdoff

Connect 10X probe from test scope to pin 3, V61. Check holdoff as follows:

TIME/DIV	holdoff, ±50%
.2 μSEC	5 μsec
.5 μSEC	5 μsec
1 μSEC	25 μsec
2 μSEC	25 μsec
5 μSEC	25 μsec
10 μSEC	25 μsec
20 μSEC	25 μsec
50 μSEC	25 μsec
.1 MILLISEC	.2 millisec
.2 MILLISEC	.2 millisec
.5 MILLISEC	.2 millisec
1 MILLISEC	2 millisec
2 MILLISEC	2 millisec
5 MILLISEC	2 millisec
10 MILLISEC	20 millisec
20 MILLISEC	20 millisec
50 MILLISEC	20 millisec
.1 SEC	.15 sec
.2 SEC	.15 sec
.5 SEC	.15 sec
1 SEC	.15 sec
2 SEC	.15 sec

Remove 10X probe.

25. CRT CATHODE INPUT

a. Remove crt gnd strap

Switch TIME/DIV to 1 MILLISEC. Loosen CRT CATH and GND binding posts on rear of scope and swing strap away from CRT CATH post (strap must pivot on GND post).

b. Intensity modulation 10 v min

Connect 10 v from CAL OUT to CRT CATH. Note that the calibrator signal intensity modulates the sweep at normal intensity.

Remove CAL OUT signal and replace strap on binding posts.

26. VERTICAL AMPLIFIER HF ADJUSTMENTS

a. Setup

105--50 Ω cable--50 Ω term--vertical INPUT

Set 105 to 500 kc VOLT/DIV to .1 and TIME/DIV to 2 μSEC. Adjust scope under calibration for a stable display of three major divisions of square wave centered vertically on CRT.

b. Delay line and termination

Beginning with trimmers at termination end and working toward front of line, go over line a time or two to straighten up level and smooth largest bumps.

Straighten up termination by turning slugs in coils the same direction equally. Do not unbalance these coils or the back of the line will ring. Coils should smooth all bumps from back of line. Continue along line until it is smooth and level; leave front end alone.

After you have the line smooth and level, place tweakers in coils at end of delay line. Bring up front end by turning slugs toward opening of coils. Turn both slugs equally. If this causes ringing in line that will not come out, turn the same coils in opposite directions from each other. If this does not help, reverse the direction of the slugs.

The two 6AU6 coils usually will not need further adjustment unless there is a spike or roll off on front corner.

c. Adjust preamp coils

Turn VOLTS/DIV to .01 and adjust 105 for three major divisions of signal. Set slug in L477 (.9-1.6 uh) to center of winding. Turn slug in L450 (23-55 uh) until front end straightens up.

Check that waveform has less than 1% aberrations or tilt (1 trace width).

Remove 105 signal.

27. FREQUENCY RESPONSE

a. Setup

190B--190B attenuator--50 Ω term--vertical INPUT

With VOLTS/DIV set to .01, adjust 190B for exactly 4 major divisions of 50 kc.

b. Frequency response preamp

-3 db (a) 10 mc min

Switch 190B to 10 mc and note vertical deflection: 2.8 major divisions min.

c. Frequency response main amp

-3 db (a) 10.5 mc

With volt/div set to .1 v, adjust 190B for exactly 4 major div of 50 kc. Switch 190B to 10.5 mc and note vertical deflection: 2.8 major divisions min.

Remove 190B.

Install high voltage and F and I shields.

THE END.

SPECIAL TEST EQUIPMENT

Special test equipment, if mentioned, is not available from Tektronix unless it's listed also in our current catalog. This special equipment is used in our test department to speed calibration.

Usually you can either duplicate its function with standard equipment in your facility, devise alternate approaches, or build the special test equipment yourself.

USE OF STANDARD CALIBRATOR

The standard calibrator, when calibrated, is traceable to NBS and is used to guarantee tolerances of vertical amplifiers and calibrators of Tektronix oscilloscopes.

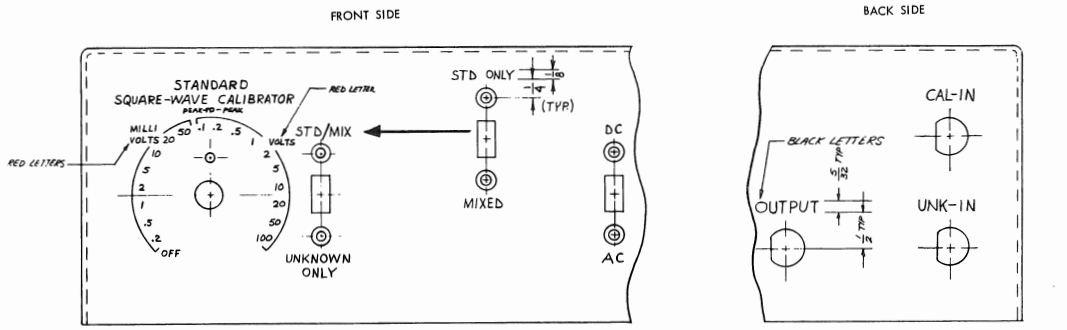
The circuit consists of a chopper and a divider network of 0.1% accurate resistors. The divider network provides a standard voltage output when loaded with 1 meg and when an accurate +100 v is applied to the input. The chopper allows the voltage output of the standard calibrator to switch between a known voltage and an unknown voltage. The difference between these voltages may then be determined by monitoring the output with an ac coupled scope.

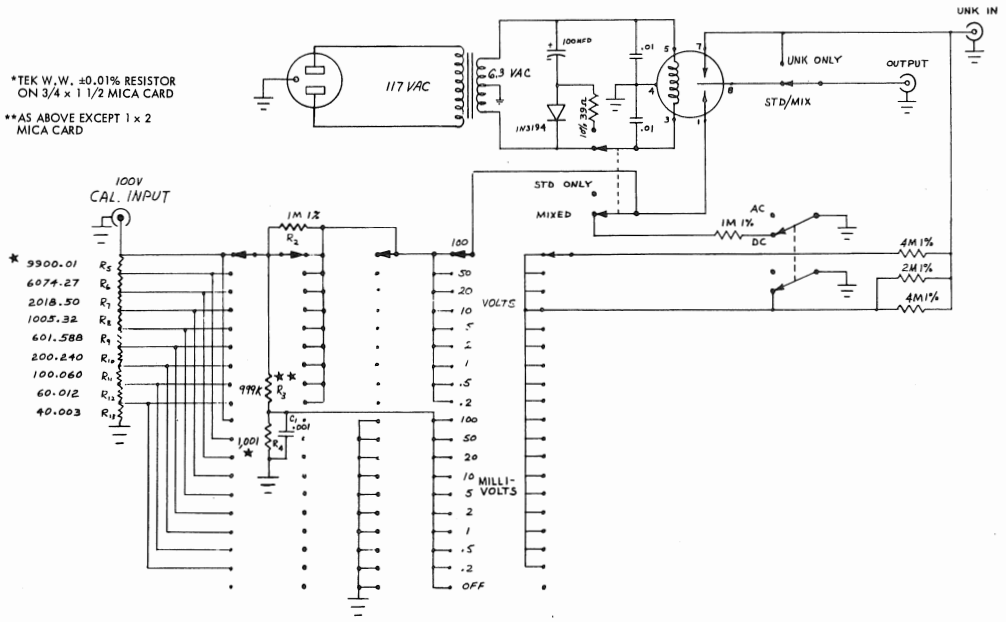
You must take the hum level of the standard calibrator into account when checking divider accuracy at low levels (.1 v and below). Measure the error introduced by hum level by turning both the standard calibrator and the calibrator of the scope under test to off. Observe the vertical displacement (hum level) and subtract this, when appreciable, from other readings.

Leave the standard calibrator in NORMAL when not in use.

STANDARD CALIBRATOR

Dwgs 600-B, 7-10-61 (front and rear panels); 601-B, 7-10-61 (schematic); 918-A, (parts).





STANDARD SQUARE-WAVE CALIBRATOR

PARTS LIST:

Amount	Description	Part No.
3	Amphenol jacks	131-081
1	Motor base plug	131-102
1	Octal socket	136-011
6	6-32 kep nuts	210-457
9	6-32 BHS	211-507
2	DPDT slide switch	260-447
1	SPDT " "	260-449
1	19 pos. 3 sec. rotary switch	260-253
2	.01 μfd 150 V discap	283-003
2	1 meg 1/2 watt 1% resistor	309-014
1	2 " " " " "	309-023
2	4 " " " " "	309-093
1	100 μfd 15 V capacitor	290-099
1	IN3194 diode	152-066
1	39 Ω 1/2 watt 10% resistor	302-390
1	.001 μfd discap 500 V	283-000
11	Special Tek w.w.	See Dwg. 601-B
1	Large black knob	366-060
1	Grommet	348-002
1	"	348-003
4	Rubber foot	348-013
1	7-Notch ceramic strip	124-089
2	Nylon spacer	361-008
6	6-32 x 1/4 FHS (Phillips)	211-541
6	#6 Lockwasher (Int.)	210-006
6	6-32 hex nut	210-401
1	James model C-1800 chopper	---
1	Stancor P-6134 transformer	---

HOOK UP OF STANDARD SQUARE-WAVE CALIBRATOR (SSWC)

Turn the TYPE 545B on its left side and remove bottom and right side panels. Disconnect both white, with yellow stripe, wires from R885 (9.5 kΩ) on the AMPLITUDE CALIBRATOR switch. Disconnect the switch end of R898 (100 Ω) and connect the wires previously removed from the switch to the free end of R898.

Replace the oscilloscope bottom panel and insert the plug-in to be used. Set AMPLITUDE CALIBRATOR to OFF and connect a cable from the CAL OUT connector to the CAL IN connector of the SSWC.

Turn the oscilloscope power on and allow a 10 minute warm up. Set SSWC to 100 v and attach a 1 mΩ resistor across the OUTPUT connector. Set the oscilloscope Cal Adj control for exactly 100 v across the 1 mΩ resistor. Remove the resistor. If the oscilloscope plug-in is changed, the above 100 v adjustment must be repeated.

Replace the side panel and set oscilloscope upright on the bench.

The SSWC switch will now control the voltage at its OUTPUT connector and the TYPE 545B AMPLITUDE CALIBRATOR switch will cause the SSWC output voltage to be dc (OFF) or a square-wave (some position other than OFF).

PE\PEM

INSTRUMENT REFERENCE BOOK

for the Tektronix types

317
RM17

oscilloscopes

For all serial numbers

MPI EXTRACT

MPI January 1964

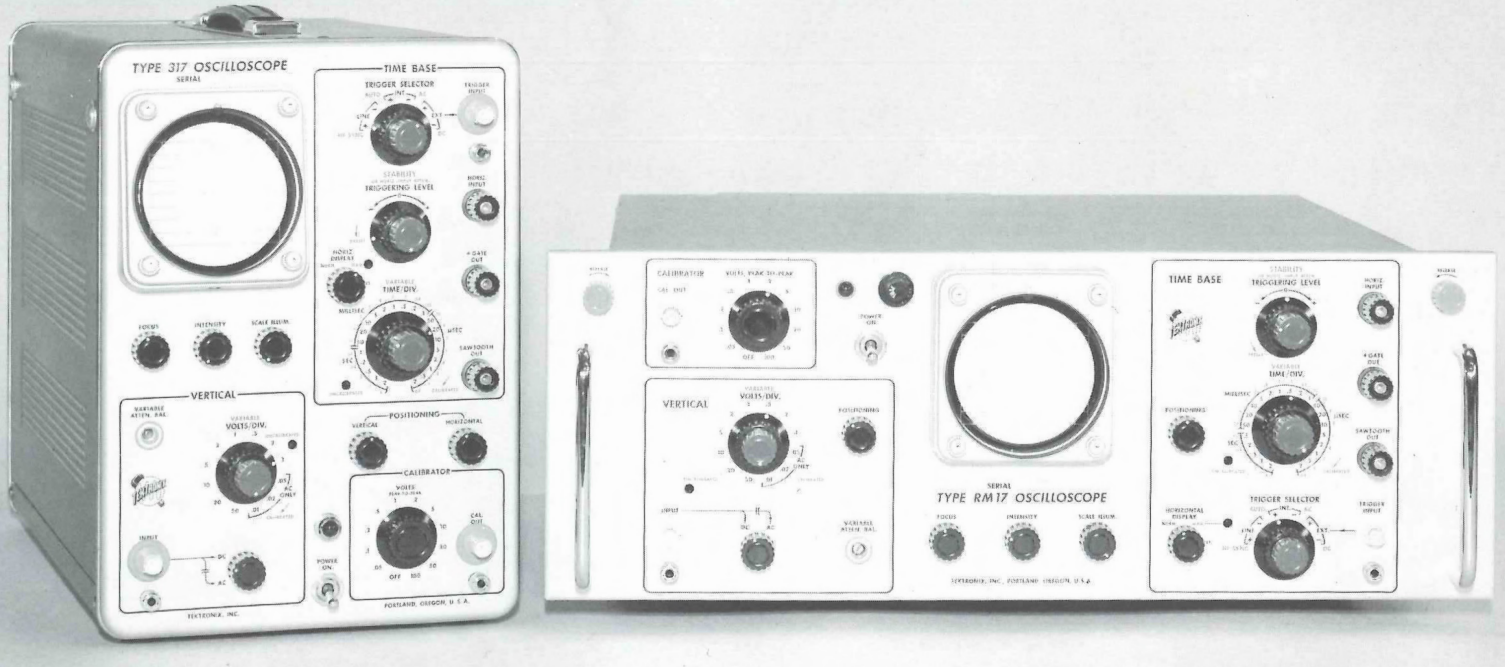
317 and RM17 (also see 317 IRB)		
Accessories included		061-499
Attenuator compensation problems	FEN	7-12-63
Brightness-intensifying narrow pulses, 317	FEN	7-13-62
Calibration procedure		061-042
*Chassis Trak, possible compatibility problem, RM17	FEN	12-14-62
*CRT, replacement T317's may require adjustable graticule	FEN	2-8-63
*Gate Out waveform, mod to improve	FEN	7-28-61
Instruction Manual		
317, composite, SN 101 up		070-297
RM17, composite, SN 101 up		070-325
*Instruction Manual errors	FEN	6-30-61
*LF boost	FEN	6-29-62
Maintenance spares list		061-286
*Schematics		
317		061-593
RM17		061-594
*Stopless pot mod	FEN	5-11-62
*Trigger circuit adjustment method	FEN	10-26-62
*Water-soluble chassis lacquer, SN range	FEI-165	4-28-61
*Waveform distortion, 1 kc	FEN	2-10-61

*Included within IRB.

Inter-City Mfg. Co., Inc.
St. Louis 11, Mo.

CONTENTS - SALES

Type 317 / RM17 DC-to-10MC—9-KV OSCILLOSCOPE



BRIGHT TRACE

ELECTRONICALLY-REGULATED DC SUPPLIES

COMPACT CABINET OR RACK-MOUNT MODELS

The Type 317 is an excellent oscilloscope for the daylight conditions often encountered in the field and at production test stations. Its brilliant trace, provided by 9-kv accelerating potential on a Tektronix 3-inch cathode-ray tube, is easily readable in bright areas... even at low sweep-repetition rates. And its dc-to-10 mc vertical response and wide sweep range easily take care of most of today's complex field and test station applications. Of course, these fine characteristics make it an excellent laboratory oscilloscope, too.

CHARACTERISTIC SUMMARY

VERTICAL

CALIBRATED SENSITIVITY—
Dc-coupled, 0.1 v/div to 50 v/div.
Ac-coupled, 0.01 v/div to 50 v/div.
PASSBAND—DC-coupled, dc to 10 Mc.
Ac-coupled, 2 cps to 10 Mc.
RISETIME—35 nsec.
INPUT—1 megohm, 40 pf.

HORIZONTAL

CALIBRATED SWEEP RANGE—0.2 μsec/div to 2 sec/div.
SWEEP MAGNIFIER—5X, extends sweep range to 0.04 μsec/div.
TRIGGER REQUIREMENTS—Internal: 0.5-div deflection.
External: 0.5 to 20 v.
EXTERNAL INPUT—1.4 v/div maximum sensitivity, dc to 400 kc.

CRT

DISPLAY AREA—8 x 10 div. Each div equal to ¼ inch.
ACCELERATING POTENTIAL—9 kv.

OTHER CHARACTERISTICS

AMPLITUDE CALIBRATOR—50 mv to 100 v, 1-kc square wave.
POWER REQUIREMENTS—105 to 125 v or 210 to 250 v, 260 watts.

VERTICAL-DEFLECTION SYSTEM

Frequency Specifications are at 3-db down

DC-Coupled Vertical Amplifier — Main amplifier passband is dc to 10 Mc, risetime is 35 nsec. Vertical deflection is calibrated in steps of 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 v/div. When ac coupled, the low frequency 3-db point is 2 cps direct or 0.2 cps with 10X Probe. An ac-coupled preamplifier switched in by the VOLTS/DIV control provides three additional calibrated steps of 0.01, 0.02 and 0.05 v/div at a frequency response of 2 cycles to 10 mc, risetime 35 nsec. In addition, a 2½-to-1 vernier (uncalibrated) control provides for continuous adjustment from 0.01 v/div to 125 v/div.

Calibration Accuracy — Internal adjustments are provided for setting the gain of the vertical amplifier. When these adjustments are accurately set with the VOLTS/DIV switch in the 0.1 v/div and 0.01 v/div positions, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Input Impedance—1 megohm paralleled by approximately 40 pf.

Delay Network—A signal delay of 0.25 μsec is introduced by the balanced delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

Probe—The vertical sensitivity of the Type 317 is reduced by a factor of ten by use of the 10-x attenuator probe supplied with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 9.5 pf.

Under daylight conditions, the trace is easily readable . . . even at low sweep-repetition rates on this portable Type 317.

HORIZONTAL-DEFLECTION SYSTEM

Wide Sweep Range—A single knob is used to select any of 22 calibrated sweep rates: 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/div, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/div, 0.1, 0.2, 0.5, 1, and 2 sec/div. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.2 μsec/div to 6 sec/div. Calibration accuracy of the 22 fixed sweep rates is within 3%.

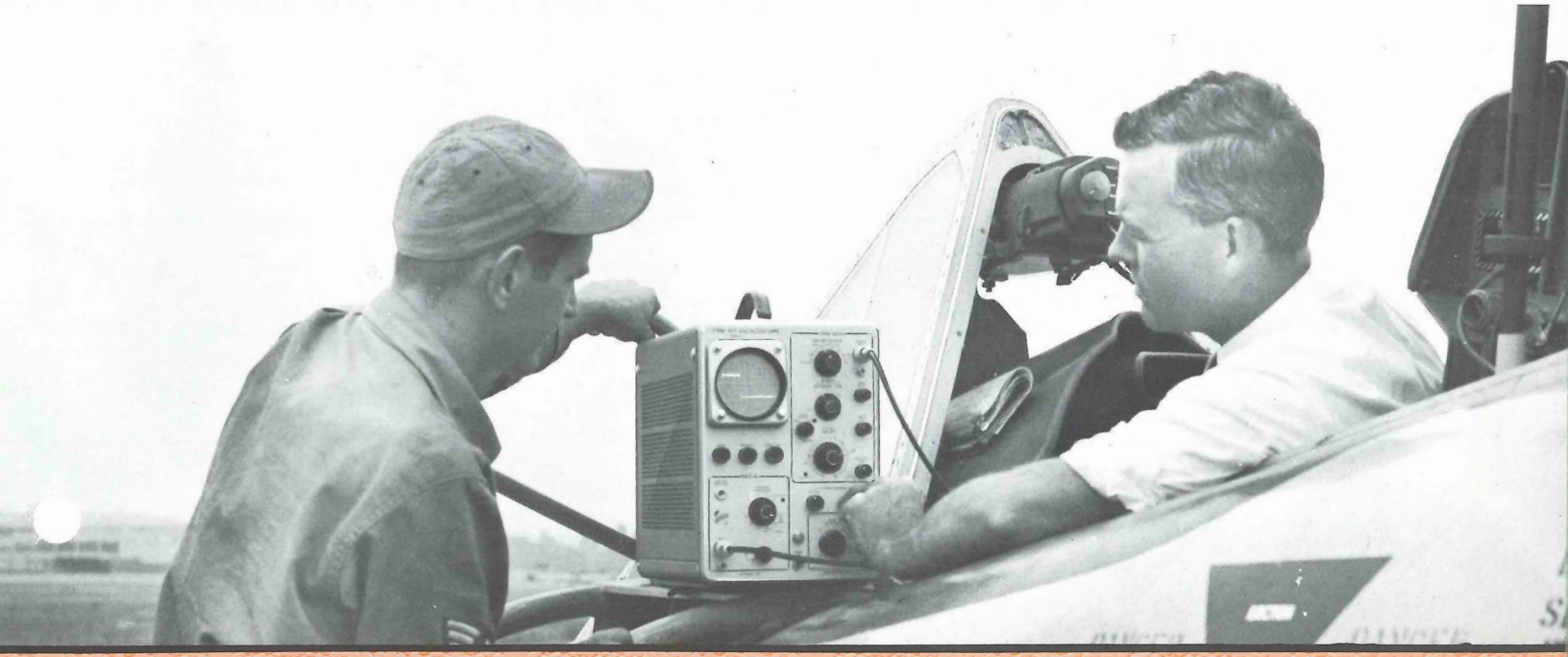
Sweep Magnifier—When the 5-x magnifier is switched in, calibrated sweep rates are read from the outer ring of numbers circling the TIME/DIV knob. The magnifier expands the normal sweep to fifty divisions, and the HORIZONTAL positioning control has sufficient range to display any ten divisions of the magnified sweep. Calibration accuracy is within 5% of the displayed portion of the magnified sweep.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the grid of the crt, assuring uniform grid bias for all sweep and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.



317
RM17

Automatic Triggering—Automatic level - seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 15 MC. Requires a signal large enough to cause a deflection of 0.2 div at 5 Mc, 2 div at 15 Mc, or an external signal of about 2 v.

Trigger Requirements—An internal signal causing deflections of 0.2 div increasing to 2 div at 5 Mc in AC MODE, 0.3 div increasing to 2 div at 5 Mc in DC MODE, and 0.5 div increasing to 2 div at 2 Mc in AUTO MODE, or an external signal of 0.5 v to 20 v.

Horizontal Input Amplifier—DC-Coupled external connection to the sweep amplifier is through a front-panel connector. Deflection factor is approximately 1.4 v/div. Frequency response is dc to 500 kc.

OTHER CHARACTERISTICS

Calibrator—A square wave calibration voltage is available through a front-panel coaxial connector. Eleven fixed peak-to-peak voltages are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 volts. Accuracy is within 3%. Square-wave frequency is about 1 kc.

Cathode-Ray Tube—A new Tektronix flat-faced 3" cathode-ray tube with helical post-accelerating anode is used in the Type 317. Accelerating potential is 9 kv. A P31 phosphor is normally supplied.

Output Waveforms—A 20 v (approx.) positive-gate waveform of the same duration as the sweep, and a 150 v (approx.) positive-going sweep sawtooth waveform are available at front-panel connectors.

Regulated Power Supplies—Electronic regulation compensates for line-voltage and load variations between 105 and 125 v, or 210 and 250 v.

Power Requirement—105 v to 125 v or 210 v to 250 v, 50 to 60 cps, typically 260 watts. Type 317 MOD101 operates on 50 to 400 cps supply, uses dc fan motor.

Unless otherwise specified, the instrument will be shipped wired for operation within the line-voltage range of 105 v to 125 v. The Type 317 can be ordered wired for operation on several nominal line voltages as follows:

Nominal Line Voltage (Figures taken at 60 cps)	Operating Range
110	99 to 117 volts
117	105 to 125 volts
124	111 to 132 volts
220	198 to 235 volts
234	210 to 250 volts
248	223 to 265 volts

A decal on the transformer gives complete instructions for changing the operating range.

Illuminated Graticule—The edge-lighted graticule is divided into 8 vertical and 10 horizontal ¼" divisions. Illumination is controlled by a front-panel knob.

Warning Indicators for Uncalibrated Settings—Separate front-panel neon lights indicate when the vertical-attenuator and sweep-rate controls are not in their calibrated positions.

Cabinet Model—Dimensions are 12⅜" high by 8⅝" wide by 19½" deep. Net weight is 33¼ pounds. Shipping weight is 47 pounds, approx.

TYPE 317 (50 to 60 cps operation)

Each instrument includes: 1—P6006 probe (010-127), 1—3 to 2-wire adapter (103-013), 1—BNC to binding-post adapter (103-033), 1—3-conductor power cord (161-010), 1—green filter (378-509), 1—red test lead (012-031), 2—instruction manuals (070-297).

TYPE 317MOD101 (50 to 400 cps operation)

Each instrument includes: 1—P6006 probe (010-127), 1—3 to 2-wire adapter (103-013), 1—BNC to binding-post adapter (103-033), 1—3-conductor power cord (161-010), 1—green filter (378-509), 1—red test lead (012-031), 2—instruction manuals (070-297).

Rack-Mount Model—Dimensions are 7" high by 19" wide by 17-5/8" deep. The instrument mounts to the standard 19" rack on slide-out tracks and can be pulled forward, tilted, and locked in any of 7 positions for easy servicing. Net weight is 35 pounds. Shipping weight is 66 pounds, approx.

For more mounting information, please refer to the catalog Mounting Dimension page.

TYPE RM17 (50 to 60 cps operation)

Each instrument includes: 1—P6006 probe (010-127), 1—3 to 2-wire adapter (103-013), 2—BNC to binding-post adapters (103-033), 1—3-conductor power cord (161-010), 1—guide track (351-017), 1—green filter (378-509), 1—red test lead (012-031), 2—instruction manuals (070-325).

TYPE RM17MOD101 (50 to 400 cps operation)

Each instrument includes: 1—P6006 probe (010-127), 1—3 to 2-wire adapter (103-013), 2—BNC to binding-post adapters (103-033), 1—3-conductor power cord (161-010), 1—guide track (351-017), 1—green filter (378-509), 1—red test lead (012-031), 2—instruction manuals (070-325).

SUPPORTING CRADLES

When the RM17 or RM17MOD101 is mounted in a backless rack, these supporting cradles are necessary for rear-slide support.

Order Part Number 040-345

Please refer to Terms and Shipment, General Information page.

file 317, RM317 RB

date 12-14-66

U.S. MARKETING SALES RELEASE

P6012 BECOMES STANDARD ACCESSORY FOR R317, 317, 310A, 321A, 422

The accessory change to provide two P6012 probe packages in place of two P6006 probe packages as standard accessories for the above instruments is being implemented. This change provides the purchaser of these products with added value at no increase in the price of these instruments.

The change will be made as follows:

PRODUCT	SERIAL NUMBER
R317	880
317	4870
310A	21740
321A	3130
422	6990

Shipments of products with the new probe package will start by December 27, 1966.

MODIFIED PRODUCTS

	Product	Mod	Description
	317	101A	50-400 Hz operation, DC fan.
	317	104A	Sweep lockout
	317	161F	Potted transformer, Tek #120-215 for export.
	317	813D	Three connectors changed to UHF.
	RM17	101A	50-400 HZ operation, DC fan.
##	RM17	101K	Special cooling fan for 50-60 or 360-440Hz power lines.
	RM17	119R	Paralleled rear trigger UHF input.
##	RM17	165E	24 1/2" box panel & cover (Customer-furnished); ruggedized; fan, slide-out tracks & chassis covers deleted, etc. For use in specialized system only.
	RM17	165J	Ruggedized for MIL-ECON show.
	RM17	165L	Same as Mod 165E plus panel, handle and latches.
	RM17	214J	Tube clamps, mounting, power connector, connectors, etc.
	RM17	214L	Tube clamps and remove slides.
	RM17	214M	Tube clamps (Mod 166A). Customer supplied power plug. Special slide rails, painted panel handles.
	RM17	214P	3/16" front panel, wire tube clamps, MS power connectors and special slides.
	RM17	214Q	Similar to Mod 214P with hardware changes.
	RM17	217E	Trim subpanel flush with instrument. 1/8" oversize panel. 7 UHF connectors with caps.
	RM17	401H	Single sweep. Oversized panel. Rear connectors.

RACKMOUNTS

RELEASE PAWL TO HAVE WIDER RANGE

FEN 1-24-64

The Southco fasteners presently used in the RM561A, RM15, RM17, 526, RM527, and 127 have an adjustment range of 0.156"--insufficient to accommodate both the thinnest (sheet metal) and thickest (rolled, cast or extruded) mounting flanges on various makes of racks (See FEN 5-23-63). Change S7648 will change the fasteners for these instruments to ones having an adjustment range of 0.281"--plenty to handle all of the rack brands of which we're aware.

The new right-hand fastener is 214-424; the left-hand one is 214-425. Stock of these new fasteners will probably not be available until March.

CHASSIS TRAK COMPATIBILITY

FEN 12-14-62

The question of whether the stationary part of a Chassis Trak is part of the instrument or a part of the rack leads to compatibility problems between Chassis Traks and some brands of racks. EIA (RETMA) says no part of a rackmount *instrument* shall project more than ±8-3/4" horizontally from the rack centerline at any point behind the front panel.

The outer surface of the stationary portion of a pair of Chassis Traks mounted directly to the rack extends ±8-27/32" (±1/16") from the rack centerline. The latch-pin--which prevents the instrument from falling in your lap when the tracks are fully extended--adds another 5/16", starting 1-1/4" behind the rear surface of the Chassis Trak mounting flange and extending about 2-3/4" back. An exception is the C-300-B Chassis Trak, used on the RM527, where the latch-pin and spring require the extra clearance starting 4-1/4" back of the flange.

This requires that the rack *not* have any support structures back of the mounting surface which block the space behind the panel area where the latch-pin and spring assembly are located.

The compatibility problem is only important with RM instruments in which the Chassis Traks mount directly to the rack. In instruments having cabinets (dust covers) which mount to the rack with the Chassis Traks *inside,* the problem does not exist (RM30/40 Series, 525).

MODIFICATION KIT

RELAY RACK CRADLE ASSEMBLY

040-345

For the following Tektronix Oscilloscopes:

Type RM16 serial numbers 101-up
Type RM17 serial numbers 101-up

DESCRIPTION

This modification provides a rear support cradle for mounting the above listed instruments in a backless relay rack by the use of slide-out tracks.*

The slide-out track allows the instrument to be pulled out of the rack like a drawer. When pulled out, the instrument can be locked in one of seven positions: horizontal, or 45°, 90°, or 105°, above and below the horizontal.

A detailed installation drawing is included, giving all dimensions necessary to design a relay rack to support these instruments.

NOTE: This modification replaces the Supporting Cradles, P/N 426-207.

* Order slide-out track assemblies separately as follows:

RM16, RM17	1 pair	351-083

Publication:
Instructions for 040-345
October 1964

PARTS LIST

Quantity	Description	Part Number
4 ea.	Lockwasher, int #10	210-010
4 ea.	Nut, hex, 10-32 x 5/16	210-410
4 ea.	Spacer, 7/32 ID x 1/2 OD x 0.125	210-872
4 ea.	Screw, 10-24 x 5/16 THS	212-533
4 ea.	Screw, 10-32 x 5/16 THS	212-535
4 ea.	Screw, 10-32 x 1/2, hex	213-090
1 ea.	Plate, alum, 0.080 x 3-7/8 x 18-3/4	386-817
1 ea.	Bracket, alum, right side	406-960
1 ea.	Bracket, alum, left side	406-961

INSTRUCTIONS

Install the Relay Rack Cradle Assembly as shown in drawing.

NOTE: The opening between the front rails of the rack must be at least 17-13/16 inches.

( ) 1. Bolt the rear of each slide-out track to the rear of the corresponding bracket (from kit), using the hardware supplied.

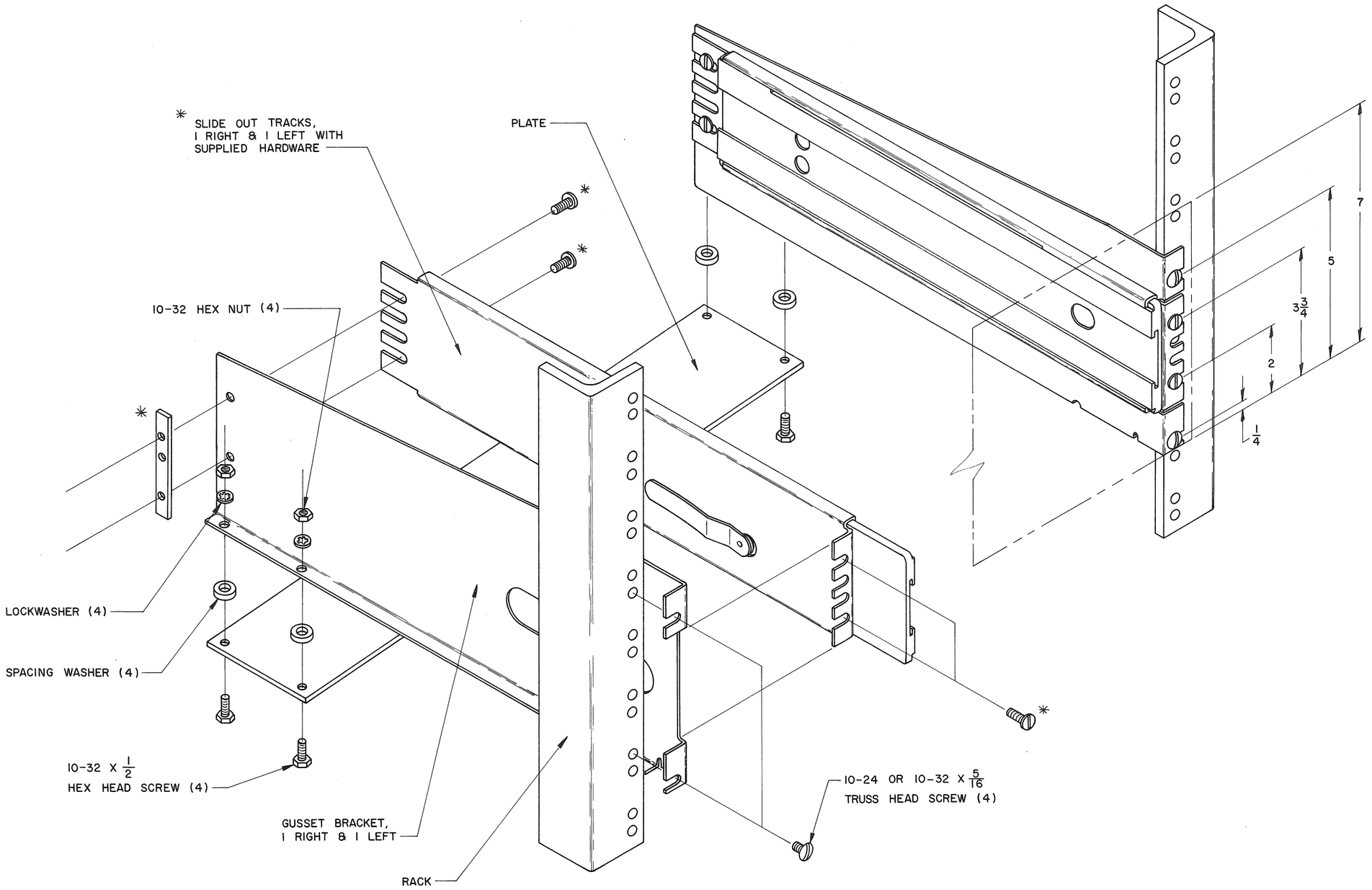
( ) 2. Using the drawing as a guide, mount the brackets and slide-out tracks on the front rails of the relay rack. Use the screws supplied with the kit and the slide-out tracks.

( ) 3. Fasten the bottom plate (from kit) across the rear of the brackets, using the hardware from the kit.

( ) 4. Place the instrument in the slide-out tracks, as shown in the instructions supplied with the tracks, and adjust as necessary.

THIS COMPLETES THE INSTALLATION

JT/GG:ls


* SLIDE OUT TRACKS, 1 RIGHT & 1 LEFT WITH SUPPLIED HARDWARE
PLATE
10-32 HEX NUT (4)
LOCKWASHER (4)
SPACING WASHER (4)
10-32 X 1/2 HEX HEAD SCREW (4)
GUSSET BRACKET, 1 RIGHT & 1 LEFT
RACK
10-24 OR 10-32 X 5/16 TRUSS HEAD SCREW (4)
7
5
3 3/4
2
1/4

040-345

CONTENTS-ENGINEERING

PERFORMANCE

EXT TRIGGER CONNECTOR SWITCHING TRANSIENT

5-15-63

Geoff Gass to Bob Coultas (Excerpt).

We have known for many years about the transient which occurs at the external trigger input connector when the triggering mode switch is set to AC (AC Slow) and the scope switch is changed from -Int to +Ext. In the past, when most of our customers were working with low-impedance or vacuum-tube circuitry, the transient was of minor consequence.

Mod 6777 was tentatively assigned to the 503/504 and RM's, but was cancelled when it was discovered that the maximum amplitude of the kickback was just a few volts, being determined by the vertical positioning voltage only. This amount of kickback will also be apparent from the 316, 317, 532, etc., if the trace is positioned off-screen, and then the AC-coupled trigger circuit is switched from Int to Ext.

Inter-City Mfg. Co., Inc
St. Louis 11, Mo.

CONTENTS-MAINTENANCE

MODIFICATION SUMMARY

317

POWER SUPPLY CABLE CHANGED SO THAT ALL SWITCHING TAKES PLACE IN 'HOT' SIDE OF LINE — INFORMATION ONLY — M2015

Effective Prod s/n 181

DESCRIPTION:

The thermal cutout is in the neutral leg. All switching should be done in the 'hot' leg.

Modify cable so that the fuse, power switch, and thermal cutout are all in the 'hot' side of the line and no switching or fusing takes place in the netural side. The cable color-code is standardized at the same time. Wire fuse so that with the fuse removed the outer ring is 'cold' (inner ring connected to motor base, outer ring to switch).

PREAMPLIFIER INPUT CAPACITOR REPLACED TO IMPROVE RELIABILITY AT A REDUCTION IN COST — INFORMATION ONLY — M2025

Effective Prod s/n 231

DESCRIPTION:

To obtain a more reliable part at a reduce cost, the Astron 0.1 µf 600 v capacitor is replaced with a Tek-made capacitor.

Parts Removed:			Parts Added:		
C101	0.1 µf 600 v	285-547	C101	0.1 µf 600 v	285-556

+300 V POWER SUPPLY RESISTOR REPLACED TO REDUCE 120 Hz RIPPLE — INFORMATION ONLY — M2176

Effective Prod s/n 231

DESCRIPTION:

Reduces the 120 Hz ripple in the +300 v power supply by increasing the value of R663 to 56 k.

Parts Removed:			Parts Added:		
R663	47 k 1/2 w 10%	302-473	R663	56 k 1/2 w 10%	302-563

CALIBRATOR RESISTOR CHANGED TO CENTER CAL ADJ RANGE — INFORMATION ONLY — M2177

Effective Prod SN 231

FRONT PANEL SYMPTOM: Cal Adj could not be adjusted below +100 V.

PROBLEM: Different bias requirements from tube to tube of V555A.

PRODUCTION CHANGE: R567 was changed from a 100 k 1/2 W 10% resistor to a 68 k 1/2 W 10% resistor.

Parts Removed:		
R567	Resistor, comp 100 k 1/2 W 10%	302-104

Parts Added:		
R567	Resistor, comp 68 k 1/2 W 10%	302-683

BINDING POST CHANGED FOR COMPATIBILITY

INFORMATION ONLY M2196

Effective Prod s/n 261

DESCRIPTION:

Binding posts are changed to a design compatible with our knobs.

Parts Removed:		Parts Added:	
Post, binding	129-030	Post, binding	129-036

TIME/DIV SWITCH END PLAY ELIMINATED BY ADDING SUPPORT BRACKET

INFORMATION ONLY M2198

Effective Prod s/n 261

DESCRIPTION:

Eliminates excessive end play in the TIME/DIV switch by adding a support bracket.

Parts Removed:		Parts Added:	
		Bracket, TIME/DIV support	406-481

FAN MOTOR RESISTOR CHANGED TO INSURE MOTOR START AT LOW LINE

INFORMATION ONLY M2205

Effective Prod s/n 261

DESCRIPTION:

Insures that the fan motor will start at low line by lowering the value of R602. This in turn increases the voltage across the fan motor windings. The new R602 also has an increased wattage rating to improve circuit reliability. To insure fan motor starting at 105 v, it was found necessary in certain cases to short out or shunt R602 to a lower value.

See M7855-4.

Parts Removed:		Parts Added:	
R602 200Ω 20w WW	308-028	R602 125w 25w WW	308-035
Washer, 20w res cent	210-808	Washer, 20w res cent	210-809

SWEEP MULTI RESISTOR CHANGED TO PERMIT USAGE OF 6AN8 TUBES FROM OTHER MANUFACTURERS

INFORMATION ONLY

M2209

Effective Prod s/n 275

DESCRIPTION:

Permits 6AN8 usage of more than one manufacturer by increasing the output of the Sweep Multivibrator. This was accomplished by increasing the value of R37 to a 1k 1/2w 10% resistor.

Parts Removed:			Parts Added:		
R37	680Ω 1/2w 10%	302-681	R37	1k 1/2w 10%	302-102

POWER SUPPLY SELENIUM RECTIFIERS REPLACED WITH SILICON DIODES TO IMPROVE RELIABILITY

See SQB

M2200-1

Effective Prod s/n 341

Usable in field instruments s/n 101-340

DESCRIPTION:

Improves the reliability of the power supply by replacing selenium rectifiers with silicon diodes.

Parts Removed:				Parts Added:			
T600	Power		120-064	T600	Power		120-112
SR150	Selenium		106-038	V142	T12G		158-001
SR154	Selenium		106-037	V152A,B, V602A-D, V632A-D, V662A-D,	Silicon		106-056
SR601	Selenium		106-015				
SR630	Selenium		106-031				
SR660	Selenium		106-030				
Cable, Power supply			179-252				
Lockwasher, ext no. 10		(5)	210-009	Cable, Power			179-346
Nut, 10-32 x 5/16		(5)	210-410	Shield, rectifier			337-314
Washer, no. 10S		(5)	210-805	Tube, spacing		(2)	166-099
Strip, cer, 7-notch			124-013	Screw, 6-32 x 5/16		(4)	211-507
Plate, rectifier			386-621	Strip, cer, 7-notch		(4)	124-014
				Lockwasher, ext no. 2		(6)	210-002
				Nut, 2-56		(6)	210-405
				Washer, flat, no. 2		(6)	210-850
				Plate, rectifier			386-932

Parts Required for Field Installation:

Field Modification Kit	040-0212-00

INSTALLATION INSTRUCTIONS:

Refer to kit instructions.

VERTICAL AMPLIFIER SUPPLY DROPPING RESISTOR AND GAIN ADJ CHANGED TO ELIMINATE EXCESSIVE VA GAIN AND IMPROVE FOCUS AND ASTIGMATISM

See SQB

M2200-2

Effective Prod s/n 341

Usable in field instruments s/n 101-340

DESCRIPTION:

To eliminate excessive vertical gain, and improve CRT Focus and Astimatism, the Vertical Amp plate supply voltages were altered by changing supply dropping resistors R297 and R248. Also, the Gain Adj potentiometer was increased in value.

Parts Removed:

R244	100Ω	311-003
R248	1.2k 5w WW	308-063
R297	1k 10w WW	308-089

Parts Added:

R244	200Ω	311-004
R248	220Ω 1/2w 10%	302-221
R297	1.2k 10w WW	308-086

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Replace Vertical Gain Adj potentiometer R244, located on a bracket below CRT shield.

b) Replace R248, located between ceramic strip and pin 3 of V244.

c) Replace R297, chassis mounted behind Power transformer T600.

HORIZONTAL OUTPUT AMPLIFIER COMPONENTS CHANGED TO IMPROVE HF TIMING LINEARITY

See SQB

M2200-3

Effective Prod s/n 341

Usable in field instruments s/n 101-340

DESCRIPTION:

To improve the HF timing linearity, the Horizontal Output Amp HF Compensation caps C350 and C372 were both made variable, and the Output Amp Cathode resistor was increased in value.

Parts Removed:

C350	10pf	281-504
C372	3-12pf var	281-009
R354	10k 5w WW	308-054

Parts Added:

C350, C372	5-25pf	281-011
R354	12k 2w 5%	305-123

INSTALLATION INSTRUCTIONS:

a) Replace C350, located between ceramic strip notches near R358, with a 5-25pf variable capacitor.

b) Replace C372, located between ceramic strip notches near C358, with a 5-25pf variable capacitor.

c) Replace R354, located between ceramic strips above V374, with a 12k 2w 5% resistor.

+100 V POWER SUPPLY RESISTOR CHANGED TO IMPROVE LOW LINE REGULATION

See SQB

M2243

Effective Prod s/n 370

Usable in field instruments s/n 101-369

DESCRIPTION:

Improves regulation of the +100 v supply at low line by decreasing the value of the series regulator (V637) shunt resistor R639.

Parts Removed:

R639	3 k 5 w WW	308-082

Parts Added:

R639	2 k 5 w WW	308-003

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R639, chassis mounted behind power transformer, with a 2 k 5 w WW resistor. Or, parallel R639 with a 6 k 5 w WW resistor (308-052) to make the total resistance equal to 2 k.

CERAMIC STRIPS CHANGED TO CLIP-MOUNTED TYPE FOR ECONOMY

INFORMATION ONLY

M2203

Effective Prod s/n 410

DESCRIPTION:

Screw-mounted ceramic strips are replaced by less expensive, easier-to-install clip-mounted strips.

Parts Removed:

Strip, cer, 11-notch	(4)	124-015
Strip, cer, 11-notch	(6)	124-016
Strip, cer, 9-notch	(11)	124-066
Strip, cer, 7-notch	(9)	124-014
Strip, cer, 7-notch		124-013
Strip, cer, 4-notch	(3)	124-012
Strip, cer, 2-notch	(6)	124-020
Strip, cer, 1-notch		129-017
Lockwasher, ext no. 2	(73)	210-002
Lug, solder, SE4	(3)	210-201
Nut, hex, steel	(86)	210-405
Washer, stell, no. 2 flat	(79)	210-850
Spacer, insulating	(2)	361-001

Parts Added:

Strip, cer, 11-notch	(12)	124-091
Strip, cer, 9-notch	(11)	124-090
Strip, cer, 7-notch	(13)	124-089
Strip, cer, 4-notch	(3)	124-088
Strip, cer, 2-notch	(2)	124-030
Strip, cer, 2-notch	(4)	124-086
Strip, cer, 1-notch	(7)	124-100
Lockwasher, ext no. 2	(7)	210-002
Lug, solder, SE8	(3)	210-205
Spacer, strip, nylon	(14)	361-007
Spacer, strip, nylon	(78)	361-009

CRT CATHODE CONNECTORS MOVED TO REDUCE HV RIPPLE PICK-UP

INFORMATION ONLY

M2283

Effective Prod s/n 410

DESCRIPTION:

Reduces HV ripple pick-up caused by close proximity of HV transformer to CRT EXT CATHODE Connectors by changing the design of Rear Overlay and Rear Subpanel, thereby relocating CRT Connectors away from HV transformer.

Parts Removed:		Parts Added:	
Plate, Rear Overlay	386-633	Plate, Rear Overlay	386-972
Plate, Rear Subplate	386-615	Plate, Rear Subpanel	386-971
Plate, CRT gnd strap (3/4")	386-427	Plate, CRT gnd strap (1-1/4")	386-374

MOTOR WIRING ON CERAMIC STRIP ALTERED TO EASE INSTALLATION OF SILICON DIODES FOR DC FAN MOD 101

INFORMATION ONLY

M2294

Effective Prod s/n 470

DESCRIPTION:

Simplifies the installation of DC Fan Mod 101 silicon diodes by rewiring a ceramic strip where the diodes will be mounted.

VERTICAL AMPLIFIER FILAMENT CAPACITORS ADDED TO ELIMINATE OBJECTIONAL SPIKE IN VERT AMP

See SQB

M2392

Effective Prod s/n 606

Usable in field instruments s/n 101-605

DESCRIPTION:

Provides additional decoupling for Vertical Amplifier filaments to eliminate objectionable spikes in the VA caused by the silicon diodes in the Power supply, by changing C690 and adding C691.

Parts Removed:			Parts Added:		
C690	0.01µf 150v	283-003	C690, C691	0.02µf 150v	283-004

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Replace C690, located between pin 4 of V263 and ground, with a 0.02µf 150v capacitor.

b) Add C691, a 0.02µf 150v capacitor, between pin 4 of V263 and ground.

DC FAN SELENIUM RECTIFIERS CHANGED TO SILICON DIODES TO IMPROVE RELIABILITY

INFORMATION ONLY

M2342

Effective Prod s/n 650 -- Mod 101 only

DESCRIPTION:

Improves DC Fan rectifier reliability by changing the selenium rectifiers to silicon diodes.

This mod has been incorporated in 50-400 Hz Mod Kit 040-0228-00.

Parts Removed:

SR317	Selenium	106-059
C317	6.25 µf 300 v	290-000
Clamp, cable 1/8		343-001
Screw, 6-32 x 5/16		211-534
Nut, 10-32 x 5/16	(3)	210-410
Lockwasher, int no.10	(3)	210-010
Clamp, CL16		343-015
Lug, solder, no.10	(2)	210-206
Washer, flat, no.6		210-803

Parts Added:

V317A-D	Silicon	106-056
C317	6.25 µf 300 v	290-025
Spacer, nylon	(2)	361-009
Strip, cer, 4-notch		124-088

TRIGGER RESISTOR CHANGED TO ELIMINATE HAND SELECTION OF INT TRIG DC LEVEL ADJ POT

INFORMATION ONLY

M2357

Effective Prod s/n 680

DESCRIPTION:

Eliminates the necessity of hand-selecting INT TRIG DC LEVEL potentiometer R258 by changing trigger resistor R257. See M3671.

Parts Removed:

R257	333 k 1/2 w 1%	309-053

Parts Added:

R257	349 k 1/2 w 1%	309-152

T12G DIODE PART NUMBER CHANGED — INFORMATION ONLY — M2371

Effective date 8-7-59

DESCRIPTION:

The T12G germanium diode is placed in the semiconductor category in the part number book. Also, the Hughes Products type HD2607 diode is set up as an alternate for Transitron T12G.

Parts Removed:			Parts Added:		
D142	T12G, Germanium	158-001	D142	T12G (or equiv)	152-008

NYLON POSTS REPLACED AND STANDARDIZED TO REDUCE COST AND ELIMINATE EXTRA POSTS — INFORMATION ONLY — M2397

Effective Prod s/n not given

DESCRIPTION:

Nylon posts produced from 1/4 in. nylon rod are replaced with molded delrin posts. The new posts are standardized to save time and expense, and to facilitate manufacture and installation.

Parts Removed:			Parts Added:		
Post, nylon	(3)	385-096	Post, delrin	(3)	385-136
Post, nylon		385-073	Post, delrin		385-134

V154 FILAMENT RESISTOR INCREASED TO REDUCE VOLTAGE CAUSED BY INSTALLATION OF SILICONS — See SQB — M2500

Effective Prod s/n 680 — Usable in field instruments s/n 341-679

DESCRIPTION:

Reduces the filament voltage of V154 to a nominal 6.3 v AC by increasing the value of R151 to 3.3Ω. The installation of silicon diodes, having less forward voltage drop than the previously used selenium rectifiers, has increased the filament voltage to 6.6 or 6.7 volts.

See Field Modification Kit 040-212.

Parts Removed:			Parts Added:		
R151	2.2Ω 1/2w 5%	308-116	R151	3.3Ω 1w 5%	307-015

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R151, located between C150 and ceramic strip notch, with a 3.3Ω 1w 5% resistor.

FRONT PANEL CONTROL SIMPLIFIED BY ADDING INSERT HOLE TO ALL PANELS

INFORMATION ONLY M2454

Effective date 8-26-59 -- Mod 101 only

DESCRIPTION:

Simplifies the control of front panels and allows more flexibility by setting up one front panel for Standard and Modified instruments. The new panel has a mod slot hole for the mod insert tag. Modified instruments receive an insert tag with the mod number stamped on the tag. Standard instruments receive a blank tag. The Mod 101 front panel is stocked under the standard number with a 'B' suffix following the part number.

Parts Removed:		Parts Added:	
Panel, front, Mod 101	333-535	Panel, front, w/mod tag slot	333-448B

SILICON DIODES CHANGED

INFORMATION ONLY M2567

Effective Prod s/n 680

DESCRIPTION:

Change silicon diodes from Motorola 106-056 to TI 152-011B. The new diodes are a direct replacement. The yellow end of the TI diode corresponds to the shell side of the Motorola type.

This mod is superseded by M3324.

Parts Removed:				Parts Added:			
V602A-D, V632A-D, V662A-D, V152A,B	Silicon		106-056	V602A-D, V632A-D, V662A-D, V152A,B	Silicon, 1N2070		152-011B
No number**	Silicon	(4)	106-056	No number**	Silicon	(4)	152-011B

** 317 - Mod 101 only

HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2793

Effective Prod s/n 720

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors caused by a high reject and failure rate from oil leaks. Replace 285-500 oil-filled capacitor with a ceramic capacitor.

Parts Removed:			Parts Added:		
C822, C823	470 pf 10 KV	285-500	C822, C823	500 pf 10 KV	281-556

PLASTIC DIODE SHIELD REMOVED TO REDUCE COSTS

INFORMATION ONLY

M2750

Effective Prod s/n 760

DESCRIPTION:

Removes the no longer needed plexi shield to reduce costs. The shield was originally used to shield silicon diodes to prevent a possible shock hazard.

Parts Removed:			Parts Added:
Shield, plexi		337-314	
Screw, 6-32 x 5/16 BHS	(4)	211-507	
Tube, spacing	(2)	166-099	

HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2872

Effective Prod s/n 760

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors caused by high reject and failure rates from oil leaks. Replace 285-513 oil-filled capacitor with a ceramic capacitor. To prevent distrubances in the unblanking, additional circuitry changes must be made.

Parts Removed:			Parts Added:		
C832, C834, C855, C857	0.015 µf 3 KV	285-513	C832, C834, C835, C855, C857	0.01 µf 2 KV	283-011
R834	100 k 1/2 w 10%	302-104	R834	33 k 1/2 w 10%	302-333

HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2847

Effective Prod s/n 810

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors caused by high reject and failure rates from oil leaks. Replace 285-509 oil-filled capacitor with a ceramic capacitor.

Parts Removed:			Parts Added:		
C821	0.0068 µf 5 KV	285-509	C821	0.005 µf 4 KV	283-034

UNCALIBRATED NEON OSCILLATION PREVENTED BY ADDING R67

See SQB

M2944

Effective Prod s/n 840

Usable in field instruments s/n 101-839

DESCRIPTION:

Prevents oscillation of the UNCALIBRATED neon when the Timing switch VARIABLE control is in the CALIBRATED position, by adding a 1 Meg resistor in parallel with the neon.

Parts Removed:

Parts Added:

R67	1 Meg 1/2w 10%	302-105

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

On SWEEP TIME/DIV switch, solder 1 Meg resistor from junction of 100k resistor and wire going to UNCALIBRATED neon (i.e., wafer 2 terminal 11) to adjacent grounded shield.

PILOT LAMP RESISTOR ADDED TO PROVIDE LONGER LIFE

See SQB

M2979

Effective Prod s/n 870

Usable in field instruments s/n 101-869

DESCRIPTION:

Extends the life of Pilot lamp B600 by adding a 10Ω 1/2w 10% resistor in series with the lamp.

Parts Removed:

Parts Added:

R599	10Ω 1/2w 10%	302-100

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS: Refer to drawing for all steps.

a) Move the CSA-7 end of R550 (150k 1/2W 10%) to near by V555 tube socket ground lug.

b) Remove #22 bare wire between CSA-7 and socket ground lug.

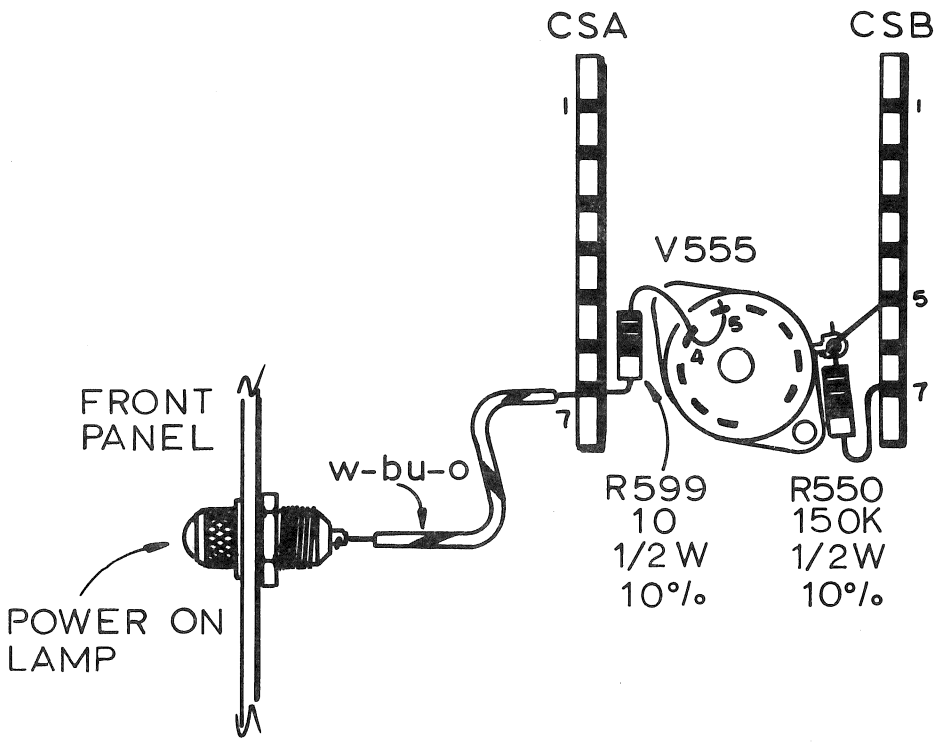
c) Remove #22 bare wire between CSA-4 and CSA-7.

d) Add #22 bare wire between socket ground lug and CSB-5.

e) Move the white-blue-orange wire connected to pin 4 of V555 to CSA-7.

f) Solder a 10Ω 1/2W 10% resistor (R599) between pin 4 of V555 and CSA-7.

continued.


CSA
CSB
1
1
V555
5
4
5
7
7
FRONT
PANEL
w-bu-o
R599
10
1/2W
10%
R550
150K
1/2W
10%
POWER ON
LAMP

TRIGGER CIRCUITRY CHANGED TO PROVIDE SENSITIVITY ADJUSTMENT

See SQB

M3049

Effective Prod s/n 900

Usable in field instruments s/n 101-899

DESCRIPTION:

Provides a Trigger sensitivity adjustment to correct for tube inconsistencies by changing R443 to a mini-potentiometer.

Parts Removed:

R443	330Ω 1/2w 10%	301-331

Parts Added:

R443	500Ω 1/10w mini	311-056
Plate, mounting, minipot		386-768
Screw, 4-40 x 3/16 BHS	(2)	211-007
Nut, hex, 1-72 x 5/32	(2)	210-438
Nut, hex, 4-40 x 3/16	(2)	210-406
Wire, no. 22 sol wh 6-1/2 in.	(2)	175-522

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Mount a 500Ω minipot on the minipot mounting plate with two 1-72 x 5/32 nuts.

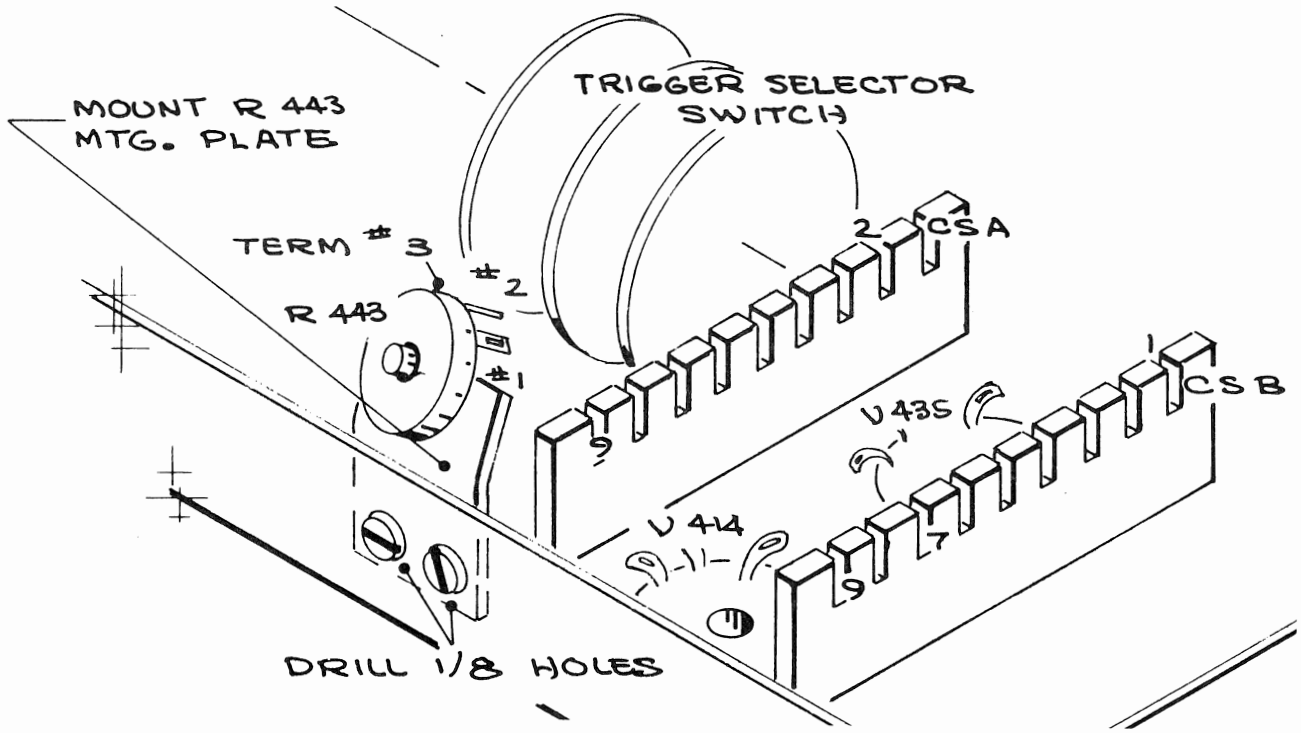
b) Drill two 1/8 in. holes 1/2 in. apart on the sweep chassis lip between the TRIGGER SLOPE switch and CSA.

c) Mount the potentiometer mounting plate on the sweep chassis lip with two 4-40 x 3/16 BHS screws.

d) Remove R433 (330Ω 1/2w 10% resistor) between CSB-1 and CSB-2.

e) Solder a 6-1/2 in. no. 22 white wire between R443 terminal 1 and CSB-2.

f) Solder a 6-1/2 in. no. 22 white wire between R443 terminal 2 and CSB-1.



HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2820

Effective Prod s/n 962

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors caused by high reject and failure rates from oil leaks. Replace 285-508 oil-filled capacitor with a ceramic capacitor.

Parts Removed:			Parts Added:		
C814, C820, C830	0.0068 µf 3 KV	285-508	C814, C820, C830	0.01 µf 2 KV	283-011

CABINET FINISH IMPROVED

INFORMATION ONLY

M2545

Effective Prod s/n 1020

DESCRIPTION:

To obtain a tougher, easier to clean finish and to reduce cost, change the material used for cabinet sides, bottoms, overlays, etc, to textured aluminum (Reynold's pebble grain, 5005, H154). Change the paint from blue wrinkle to blue vinyl of approximately the same color. Paint filter housings, top rails, bottom rails and dot fasteners with blue vinyl also.

Parts Removed:		Parts Added:	
Cabinet side (2)	386-735	Cabinet side (2)	387-051
Cabinet bottom	386-605	Cabinet bottom	387-052
Overlay, rear	386-972	Overlay, rear	387-054
Bar, alum, ext top	381-079	Bar, alum, ext top	381-164
Housing, air filter	380-009	Housing, air filter	380-016
Angle frame, ext bottom (2)	122-032	Angle frame, ext bottom (2)	122-064

CRT CLAMP CHANGED TO PROVIDE BETTER GRIPPING ACTION

INFORMATION ONLY

M3223

Effective Prod s/n 1230

DESCRIPTION:

The inside diameter of the CRT clamp ring is increased from 1.470 in. to 1.530 in. and a 3/8 x 4-3/8 in. piece of fine grit, pressure sensitive safety walk tape is added to the inside ring surface. This provides a better gripping action on the CRT.

SWEEP GENERATOR DIODE ADDED TO IMPROVE SWEEP LENGTH ADJUSTMENT

INFORMATION ONLY

M3466

Effective Prod s/n 1530

DESCRIPTION:

Improves the adjustment of the Sweep Length adjustment R82, and reduces changes in sweep length with variation in the Trigger controls, by adding a T12G diode in parallel with resistor R18. The color banded end (cathode) of the T12G is connected to the cathode of V83B.

Parts Removed:

Parts Added:

D18	T12G	152-008

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Install D18 in parallel with R18, a 4.7k 1/2w resistor, located between a ceramic strip notch and pin 8 of V83.

POWER SUPPLY DIODES REPLACED

INFORMATION ONLY

M3324

Effective Prod s/n 1650

DESCRIPTION:

To provide a more reliable hermetically sealed diode, replace silicon diode 1N2070 with silicon diode 1N2862, or equal. The larger diameter of the new top hat diode requires alternate diodes be dressed down between the strips. A plexi shield is also added to reduce shock hazard from the rectifier.

This mod is incorporated in Mod Kit 040-212. Also see M2200-1, M2567, and M2750.

Parts Removed:

V152A,B, V602A-D, V632A-D, V662A-D	1N2070	152-011
Plate, aluminum		386-932
Strip, cer, 7-notch		124-089
Spacer, nylon		361-009

Parts Added:

D152A,B, D602A-D, D632A-D, D662A-D	1N2862 (or equal)	152-047
Plate, aluminum		387-411
Strip, cer, 7-notch		124-094
Spacer, nylon		361-008
Tube, spacing, alum (2)		166-099
Shield, plexi, clear		337-314

MYLAR TIMING CAPACITOR PART NUMBERS CHANGED

INFORMATION ONLY

M3337

Effective Prod s/n not given

DESCRIPTION:

To reduce rejects by customers who purchase timing capacitors as spare parts, the tolerance specification is changed from +1/4% or -1/4% to a straight ±1/2%. The printed tolerance on capacitors is removed and the 'A' or 'B' suffix deleted on part numbers. This change will not cause difficulty in the timing of instruments.

Parts Removed:

C160G,H,J	1x.1x.01µf +1/4%	291-007A
C160G,H,J	1x.1x.01µf -1/4%	291-007B
C160F	.001µf +1/4% (wh)	291-008A
C160F	.001µf -1/4% (bk)	291-008B

Parts Added:

C160G,H,J	1x.1x.01µf ±1/2%	291-007
C160F	.001µf ±1/2%	291-008

DC FAN MOTOR DIODES REPLACED WITH HERMETICALLY SEALED SILICON DIODES TO IMPROVE RELIABILITY

INFORMATION ONLY

M3408

Effective Prod s/n 1665 -- Mod 101 only

DESCRIPTION:

Improves the reliability of the DC Fan Motor circuit by replacing 1N2070 diodes with more hermetically sealed silicon diodes. Also adds a filter circuit to improve filtering of brush noise. The diode circuit numbers were changed from 'V' to 'D' to standardize with other instruments.

Parts Removed:

V317A-D	1N2070	152-011
C317	6.25µf 300v	290-025
Spacer, nylon, cer strip (2)		361-009
Strip, cer, 4-notch		124-088

Parts Added:

D317A-D	1N2862	152-047
C317	0.1µf 100v	283-012
C625	50µf 50v	290-117
R625,R626	10Ω 2w 10%	306-100
Spacer, nylon cer strip (4)		361-008
Strip, cer, 5-notch (2)		124-093

CRT FILTER CIRCUIT ADDED TO REDUCE 400 Hz INTENSITY MODULATION

See SQB

M3546

Effective Prod s/n 1715 -- Mod 101 only

Usable in field instruments s/n 101-1714

DESCRIPTION:

Reduces 400 Hz (cps) intensity modulation caused by DC Fan motor brush transient voltages by adding a CRT filtering circuit consisting of B859, C859 and R859.

Parts Removed:

Parts Added:

B859	NE-2, raw	150-002
C859	0.01 µf 200 v	283-011
R859	1 M 1/2w 10%	302-105
Clamp, no. 20 wire for neon		343-043

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Relocate R858, 27k 1/2w resistor lead from CSB-5 to CSB-6.

b) Remove bare wire between CSB-5 and CSB-6.

c) Relocate C857, 0.01 µf discap lead from CSB-3 to CSB-2.

d) Remove bare wire between CSB-1 and CSB-3.

e) Install bare wire between CSB-1 and CSB-2.

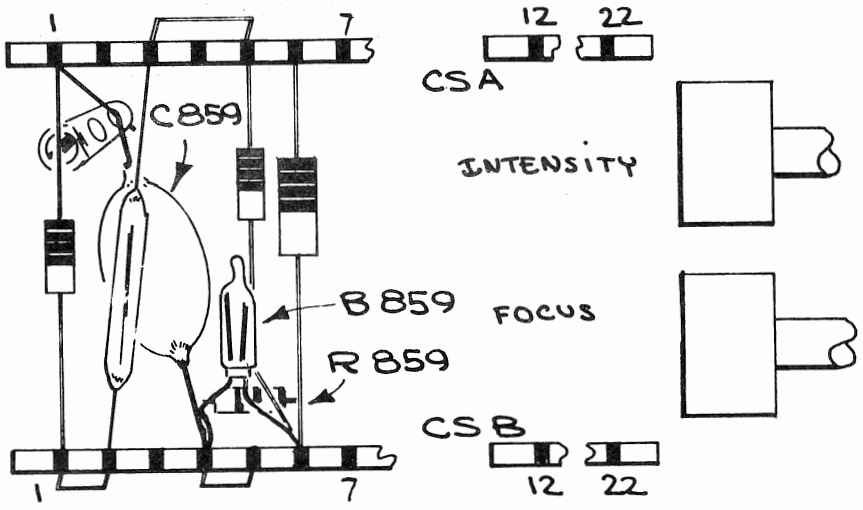
f) Solder C859, a 0.01 µf 2 KV discap, between solder lug and CSB-4.

g) Solder R859, a 1 Meg 1/2w resistor, between CSB-4 and CSB-6.

h) Solder B859, an NE-2 neon bulb, between CSB-4 and CSB-6.

i) Install a wire clamp to secure B859 at CSA-5.

k) Add a bare wire between CSB-4 and CSB-5.



HORIZ AMP RESISTORS RELOCATED FROM PLATE TO GRID CIRCUIT TO SUPPRESS PARASITIC OSCILLATIONS

See SQB

M3685

Effective Prod s/n 1860

Usable in field instruments s/n 101-1859

DESCRIPTION:

Relocates the Horizontal Amplifier resistor R351 and R374, from the plate circuit of the output amplifier stage (V354A and V374A) to the grid circuit of the cathode follower output stage (V354B and V374B), to suppress any parasitic oscillations.

On the 317, R351 must be changed as R374 is already wired direct to the grid of V374B. The Manual already shows R351 and R374 located correctly at the grids of V354B and V374B.

INSTALLATION INSTRUCTIONS:

Relocate no. 22 bare wire strap from CSN-8 and pin 7 of V354 to CSN-8 and pin 1 of V354.

See schematic on preceding page.

VOLTS/DIV SWITCH REPLACED WITH INTERCHANGEABLE TYPE

INFORMATION ONLY

M3630

Effective Prod s/n 1870

DESCRIPTION:

Changes the part number of the VOLTS/DIV switch to aid in providing a correct replacement part. Changes made in earlier production switches have made the current units non-interchangeable.

Parts Removed:			Parts Added:		
SW120	VOLTS/DIV	262-153	SW120	VOLTS/DIV	262-428

SILVER-BEARING SOLDER PROVIDED FOR CUSTOMER CONVENIENCE

INFORMATION ONLY

M3660

Effective Prod s/n not given

DESCRIPTION:

The customer is provided with a spool of silver-bearing solder, mounted on the instrument, for repair purposes. A 5/32 in. hole is added in a conspicuous location and a press-in nylon spool with 3 ft. of solder is installed.

Parts Removed:	Parts Added:	
	Spool, assembly, w/solder	214-210
	Spacer, nylon molded, 0.063	361-007

TIME BASE TRIGGER RESISTORS CHANGED TO IMPROVE TRIGGER LEVEL AND STABILIZE 'AUTO' SWEEP TRIGGERING

See SQB

M3671

Effective Prod s/n 1870

Usable in field instruments s/n 101-1869

DESCRIPTION:

Improves the minimum triggering level and stabilizes the 'Automatic' sweep triggering by relocating components to the grid of V263 away from power cable, and changing the value of plate load resistor of V414 to increase trigger gain. See M2357.

Parts Removed:

R413,R415 3.9k 1/2w 10% 302-392

Parts Added:

R413,R415 4.7k 1/2w 10% 302-472

Parts Required for Field Installation:

See 'Parts Added' and part listed below.

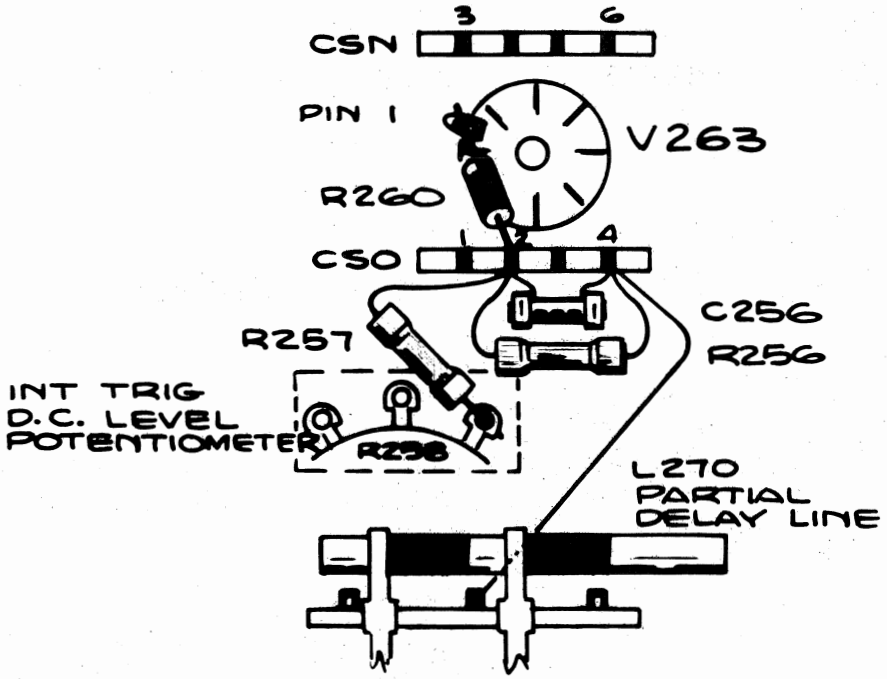
R257 349k 1/2W 1% 309-152 SN (101-679)

INSTALLATION INSTRUCTIONS:

a) Replace R413, located on sweep chassis between pin 1 of V414, and ceramic strip notch, with a 4.7k 1/2W 10% resistor.

b) Replace R415, located between pin 6 of V414, and ceramic strip notch, with a 4.7k 1/2W 10% resistor.

c) Remove bare wire, located on Power chassis, between CSO-2 and clockwise terminal of the INT TRIG DC LEVEL ADJ. See drawing below.



continued

INSTALLATION INSTRUCTIONS: (continued)

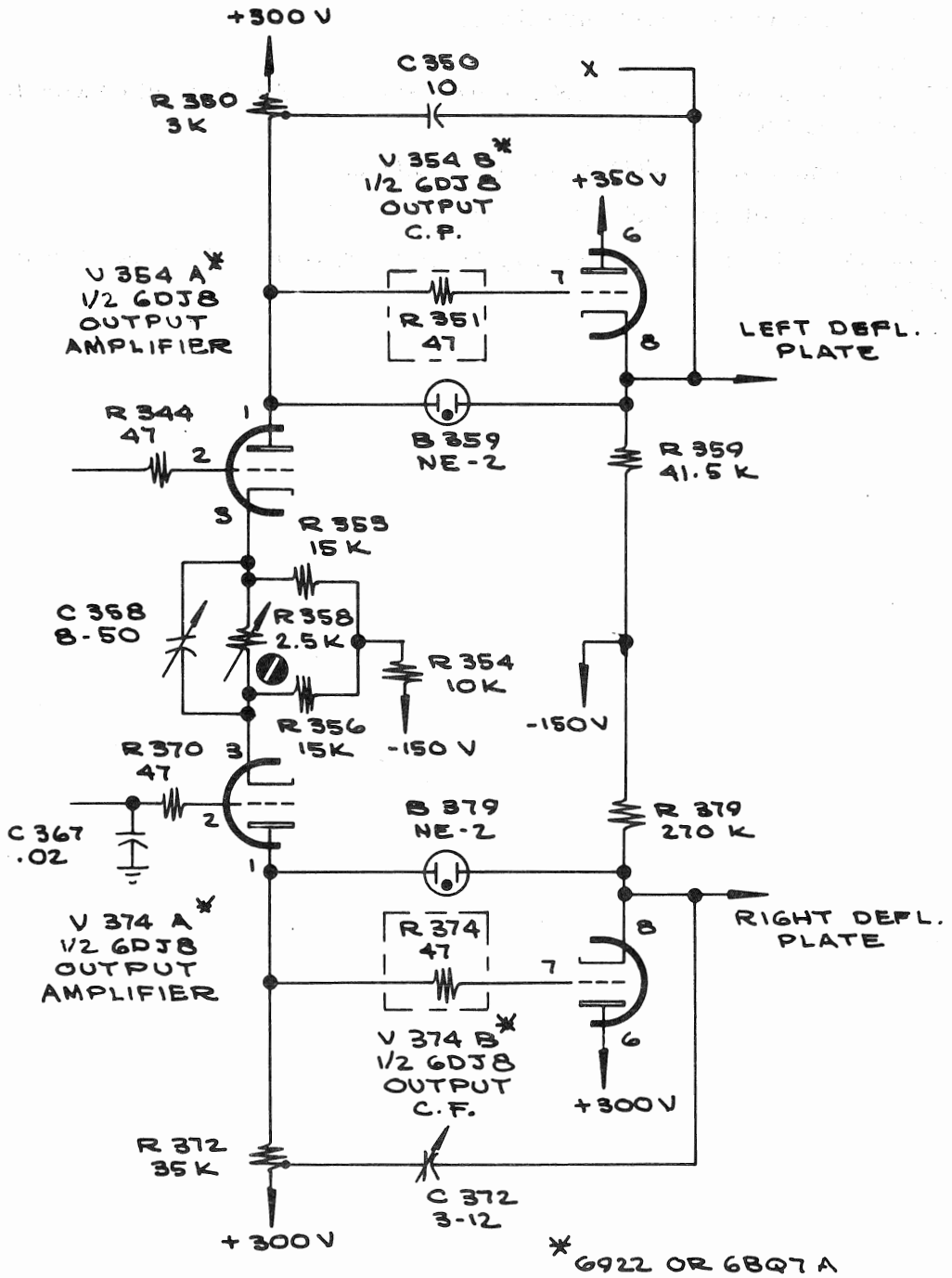
d) Remove bare wire between CSN-4 and CSN-5.

e) SN 101-679 ONLY:
Move R257 (349 k resistor) between CSN-4 and CSO-2 to CSO-2 and clockwise terminal of the INT TRIG DC LEVEL ADJ.

f) Move the CSN-4 end of R260 (47 Ω resistor) to CSO-2.

g) Move a #22 bare wire (delay line) from CSO-3 to CSO-4.

h) Move R256 (433 k resistor) and C256 (1.5 pF capacitor) from CSO-3 and CSN-5 to CSO-3 and CSO-4.



PARTIAL HORIZ. AMP.

SWEEP GENERATOR DISCONNECT DIODES REWIRED FOR CONFORMITY

INFORMATION ONLY

M3781

Effective Prod s/n 2040

DESCRIPTION:

Tie the inter-element shield (pin 6) of the disconnect diode, which is now 'floating', to one plate (pin 7). This will make the circuit conform to other instruments, as well as eliminate any possibility of the shield picking up a charge, thereby causing low-speed timing errors.

GATE OUT CIRCUIT RESISTOR TOLERANCE TIGHTENED TO ELIMINATE EXTREME GATE VOLTAGE AMPLITUDES

See SQB

M3721

Effective Prod s/n 2130

Usable in field instruments s/n 101-2129

DESCRIPTION:

Eliminates extreme voltage amplitudes of the GATE OUT waveform by changing R33 and R34 from 10% to 5% resistors.

Parts Removed:			Parts Added:		
R33	18k 1w 10%	304-183	R33	18k 1w 5%	303-183
R34	33k 2w 10%	306-333	R34	33k 2w 5%	305-333

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R33 and R34, located between ceramic strips above V43, with 5% resistors.

LV POWER SUPPLY RESISTORS WATTAGE RATINGS CHANGED TO MATCH CIRCUIT DEMANDS

INFORMATION ONLY

M5006

Effective Prod s/n 2150

FRONT PANEL SYMPTOM: None.

PROBLEM: The power being dissipated by the 1W resistor, R601, was higher than the power being dissipated by the 2W resistor, R630. Neither R601 nor R630 are dissipating powers which are in excess of one-half of their ratings.

PRODUCTION CHANGE: Resistor R601 was replaced with a 10Ω 2W 10% resistor. Resistor R630 was replaced with a 10Ω 1W 10% resistor. Effectively, R601 and R630 may be interchanged.

Parts Removed:

R601	Resistor, comp, 10Ω 1W 10%	304-100
R630	Resistor, comp, 10Ω 2W 10%	306-100

Parts Added:

R601	Resistor, comp, 10Ω 2W 10%	306-100
R630	Resistor, comp, 10Ω 1W 10%	304-100

CRT CAPACITOR CHANGED TO PREVENT TRACE DIMMING IN SWEEP SPEED RANGE 5 TO 10μSEC/DIV

See SQB

M5043

Effective Prod s/n 2170

Usable in field instruments s/n 101-2169

DESCRIPTION:

Prevents dimming of trace in the 5 to 10μsec/div sweep ranges by replacing C815 with a capacitor of higher value.

Parts Removed:			Parts Added:		
C815	0.022μf 400v	285-515	C815	0.047μf 400v	285-519

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace C815, located between ceramic strips above V814, with a 0.047μf 400v capacitor.

CRT PHOSPHOR CHANGED TO INCREASE WRITING RATE

INFORMATION ONLY

M5219

Effective Prod s/n 2200

DESCRIPTION:

Improves the light output efficiency of the CRT by changing the standard P2 phosphor to a P31. The P2 phosphor is still available as an option.

Parts Removed:			Parts Added:		
V859	T317P2	154-196	V859	T317P31	154-346

CRT VERTICAL SHIELD VOLTAGE DIVIDER CIRCUIT REMOVED

INFORMATION ONLY

M5310

Effective Prod s/n 2210

DESCRIPTION:

Remove the CRT Vertical shield voltage divider circuit consisting of C864, R863 and R864. The new cathode-ray tube Vertical shield was removed, thereby eliminating the need to establish a shield voltage which was provided by C864, R863 and R864.

Parts Removed:		
C864	0.005μf 500v	283-001
R863	150k 1/2w 10%	302-154
R864	120k 1/2w 10%	302-124

Parts Added:

VARIABLE ATTENUATOR POT CHANGED TO 360° TYPE

INFORMATION ONLY M3862

Effective Prod s/n 2240

DESCRIPTION:

To reduce cost and breakage, and to speed calibration, the Variable Attenuator potentiometer is changed to a 360° rotation type.

Parts Removed:			Parts Added:		
SW120	VOLTS/DIV	262-428	SW120	VOLTS/DIV	262-486
R216**	660Ω minimum	311-135	R216**	780Ω ±15%	311-281

** Part of VOLTS/DIV switch

VERT INPUT CAPACITOR RELIABILITY INCREASED

INFORMATION ONLY M5215

Effective Prod s/n 2490

DESCRIPTION:

To improve quality and reliability of 0.1µf 600v input capacitor 285-556 (or matched pair 295-054), while lessening production time, the following changes are made:

Case is changed from phenolic to tin-plated brass.
Seal is changed from epoxy to hermetic type.
New part number 285-603 (295-066 for matched pair) is assigned for non-insulated case type.

Parts Removed:			Parts Added:		
C101	0.1µf 600v	285-556	C101	0.1µf 600v	285-603

FRONT PANEL MOD SLOT ADDED TO STANDARD PANEL

INFORMATION ONLY M5929

Effective Prod s/n not given -- Mod 101 only

DESCRIPTION:

To reduce front panel stock and facilitate production, the standard front panel will now have a 'mod slot' so it may be used instead of the special panel (which has the same part number plus a 'B' suffix). Standard instruments will have a blank tag (334-829) added in the slot. Special mods will have a tag imprinted with the mod number.

Parts Removed:		Parts Added:	
Panel, front	333-448**	Panel, front	333-448

** Applies only to panels with 'B' suffix

VOLTS/DIV WIRE SHIELD CHANGED TO PROVIDE IMPROVED ATTENUATION COMPENSATION TRACKING

See SQB

M6388

Effective Prod s/n 2850

Usable in field instruments s/n 101-2849

DESCRIPTION:

Provides improved accuracy of attenuator compensation tracking between the main amplifier and preamp by balancing stray capacitances in the input circuit in each mode of amplification. This was accomplished by lengthening the VOLTS/DIV switch shield wire.

Mods 6559, 7855, 6388 and removing R145 (replaced with a wire strap) are all necessary to clean up the response of the 0.02 and 0.05 v/cm positions. The mods are installed in the order mentioned with Mods 6559 and 7855 producing little, if any, improvement. However, after performing Mod 6388 and removing R145, Mods 6559 and 7855 could not be removed without degrading the response.

All modifications can be performed in 30 minutes to an hour, and without removing the VOLTS/DIV switch.

Parts Removed:

Wire, flat shield (1-3/4 in.) 176-047

Parts Added:

Wire, flat shield (2-3/4 in.) 176-047

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Remove no. 22 wire located between W4-8R and W5-8F.

b) Remove no. 20 wire located between W3-3F and capacitor mounting bracket.

c) Relocate no. 22 wire end at W5-8F (other end to C132) to W4-8F.

d) Relocate the 1 Meg 1/2 w 1% resistor (R141) from W3-3F and W4-3F to between W4-3F and the rear switch shield.

e) Change the 1-3/4 in. ground braid to 2-3/4 in. This will allow the braid to dress between wafer 3 and R143 (47Ω 10%) which is located between W4-3F and pin 1 of V154.

NOTE: The following method is used to identify the VOLTS/DIV switch terminals:

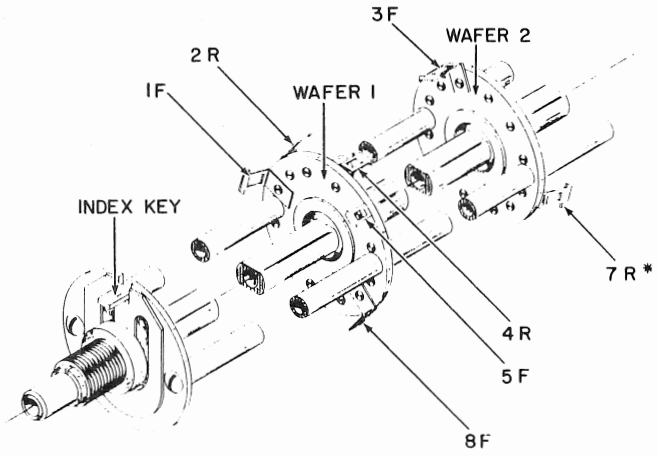
The wafers are numbered from the front to the rear.

The contact positions are numbered 1 through 12 relative to the index key as shown in the drawing.

The contacts have an 'F' or 'R' suffix which denotes that they are on the front or rear of the wafer.

Example: W2-7R (denoted by * on drawing) is contact 7 on rear of wafer 2.

(TYPICAL SWITCH CONFIGURATION)



CRT GRATICULE CHANGED TO PROVIDE ADJUSTMENT TO CENTER GRATICULE ON TRACE

INFORMATION ONLY

M6045

Effective Prod s/n 2880

DESCRIPTION:

Provides an adjustable CRT graticule to center the graticule on the trace by redesigning the graticule to have adjustable slots instead of 0.221 in. mounting holes. Additional holes were installed at the top of the graticule and CRT shield (4-40 tapped hole) to secure the graticule after adjustment with a 4-40 x 5/16 screw.

Prior to M6045, replacement T317's from Customer Service have been selected for perfectly centered scan to match the old graticules. On quantity orders for non-standard phosphors, however, selection can leave an overstock of CRT's with the wrong phosphor for production use. Therefore, replacement T317's will hereafter be shipped without special selection, and the customer may have to install an adjustable graticule.

Parts Replacement Kit 050-090 is available to facilitate the replacement of non-adjustable CRT graticules in earlier instruments. The kit includes a nut that replaces one of the four rubber washers normally mounted under the graticule cover. Tightening down this nut holds the graticule in position after centering to match the new CRT. If the customer uses a light filter, it may be easily modified to clear the nut.

The 050-090 kit becomes an automatic replacement on orders for the old graticule if the customer specifies that the graticule is for the 317 or RM17.

Parts Removed:		Parts Added:	
Graticule	331-042	Graticule	331-095
		Screw, 4-40 x 5/16 BHS	211-008

VERTICAL PREAMPLIFIER RESISTORS CHANGED TO REDUCE POSSIBILITY OF WAVEFORM DISTORTION

See SQB

M6559

Effective Prod s/n 3010

Usable in field instruments s/n 101-3009

DESCRIPTION:

To decrease the possibility of waveform distortion in the Vertical Amplifier, caused by excessive grid current, when using a 10X probe. This was accomplished by decreasing the value of R144.

Mods 6559, 7855, 6388, and removing R145 (replaced with a wire strap) are all necessary to clean up the response of the 0.02 and 0.05 v/cm positions. The mods were installed in the order mentioned with Mods 6559 and 7855 producing little, if any improvement. However, after performing Mod 6388 and removing R145, then Mods 6559 and 7855 could not be removed without degrading the response.

All modifications can be performed in 30 minutes to an hour without removing the VOLTS/DIV switch.

Parts Removed:			Parts Added:		
R144	22k 1/2w 10%	302-223	R144	15k 1/2w 10%	302-153

INSTALLATION INSTRUCTIONS:

Replace R144, located behind the INPUT AC-DC switch between ceramic strip notches, with a 15k 1/2w 10% resistor.

CRT SOCKET STANDARDIZED FOR COST SAVING

INFORMATION ONLY M5081

Effective Prod s/n 3168

DESCRIPTION:

The purchase specifications for the CRT socket are changed to permit using the same socket in other instruments.

Parts Removed:		Parts Added:	
Socket, 12-pin CRT	136-603	Socket, 12-pin CRT	136-081

UHF CONNECTORS REPLACED WITH BNC CONNECTORS

INFORMATION ONLY M6860

Effective Prod s/n 3357

DESCRIPTION:

The UHF connectors are replaced with BNC connectors, to match the military and manufacturing trend toward the BNC type. The BNC type has a constant 50Ω impedance and a lower input capacitance. It also requires less front panel space. See M8313

Parts Removed:		Parts Added:	
Adapter, binding post, UHF	013-004	Adapter, BNC to binding post	103-033
Adapter, BNC to UHF	103-015	Washer, 13/16 OD x 3/8 ID (3)	210-961
Connector, chassis, UHF (3)	131-038	Connector, chassis (3)	131-278

HANDLE REPLACED

INFORMATION ONLY M6692

Effective Prod s/n 3650

DESCRIPTION:

Replace the black leather carrying handle (367-001) with a superior, more economical blue rubber handle (367-037).

Parts Removed:		Parts Added:	
Bar, top support assembly	381-164	Bar, top support assembly	381-234

POWER SUPPLY PRIMARY WIRE COLOR-CODED TO INSURE PROPER CONNECTION

INFORMATION ONLY M7521

Effective Prod s/n not given

DESCRIPTION:

To eliminate a shock hazard when changing the line fuse, the wire from the 'hot' side of the motor base connector is connected to the end (center) terminal of the fuseholder. This wire is color-coded yellow-brown-red-brown to insure its proper connection.

BNC CONNECTOR COVER REMOVED TO IMPROVE APPEARANCE

INFORMATION ONLY M7551

Effective date 1-20-64

DESCRIPTION:

Plastic BNC connector cover, added to conceal the opening around the connector when changed from flange-type UHF to flange-type BNC, is removed. The cover has little aesthetic, mechanical or electrical value.

Parts Removed:

Washer, plastic, BNC connector cover (3) 210-961

Parts Added:

PATCH CORDS ADDED AS ACCESSORIES TO PROVIDE ADDITIONAL UTILITY AND ADAPTABILITY FOR INSTRUMENTS WITH BNC CONNECTORS

INFORMATION ONLY M7641

Effective Prod s/n 3720

DESCRIPTION:

Provides additional utility and adaptability to all BNC indicators by adding an 18 in. patch cord. The banana patch cords were deleted by M8313. Also see M6860.

Also provides BNC to binding post adapters with all BNC indicators.

Parts Removed:

Parts Added:

Cord, patch, red, 18 in. long 012-031
Adapter, BNC to binding post 103-033

VERT PREAMP GROMMET REMOVED TO DECREASE WAVEFORM HOOK ON 0.02 AND 0.05 V/DIV POSITIONS

See SQB

M7855-1

Effective Prod s/n 3800

Usable in field instruments s/n 2850-3799

DESCRIPTION:

Decreases waveform hook in the Vertical Preamplifier by removing a rubber grommet and relocating R143 in the center of the old grommet hole.

Mods 6559, 7855, 6388, and removing R145 (replaced with wire strap) are all necessary to clean up the response of the 0.02 and 0.05 v/cm positions. The mods were installed in the order mentioned with Mods 6559 and 7855 producing little, if any, improvement. However, after performing Mod 6388 and removing R145, then Mods 6559 and 7855 could not be removed without degrading the response.

All modifications can be performed in 30 min. to an hour without removing the VOLTS/DIV switch.

Parts Removed:			Parts Added:		
R143	47Ω 1/2w 10%	302-470	R143	47Ω 1/2w 10%	302-470

INSTALLATION INSTRUCTIONS:

a) Remove R143, a 47Ω 1/2w 10% resistor, between SW120 (VOLTS/DIV switch) and pin 1 of V154.

b) Remove the 1/4 in. chassis grommet from the chassis hole near V154.

c) Install a new 47Ω 1/2w 10% resistor between SW120 and pin 1 of V154 so that the resistor body is centered in the chassis hole.

VERT PREAMP RESISTOR CHANGED TO CENTER ADJUSTMENT RANGE OF LOW FREQ COMP POT

INFORMATION ONLY

M7855-2

Effective Prod s/n 3800

DESCRIPTION:

Centers the adjustment range of the Low Frequency Compensation potentiometer by replacing R174 with a 220k 1/2w 10% resistor.

Parts Removed:			Parts Added:		
R174	390k 1/2w 10%	302-394	R174	220k 1/2w 10%	302-224

TIME BASE GENERATOR RESISTOR CHANGED TO PROVIDE SUFFICIENT RANGE FOR SWEEP LENGTH POT

INFORMATION ONLY

M7855-3

Effective Prod s/n 3800

DESCRIPTION:

Provides sufficient range for Sweep Length potentiometer R82 by changing the value of R81.

Parts Removed:

R81	2.2k 1w 10%	304-222

Parts Added:

R81	3.3k 1w 10%	304-332

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Change R81, located on sweep chassis between CSE-3 and CSF-3, from 2.2k to 3.3k.

FAN MOTOR RESISTOR REMOVED TO INSURE OPERATION AT LOW LINE

See SQB

M7855-4

Effective Prod s/n 3800

Usable in field instruments s/n 261**-3799

DESCRIPTION:

Insures Fan Motor operation during low line voltages by removing R602 which is in series with the Fan Motor.

NOTE: If instruments are modified in the field, they should be checked for hum-modulation of the trace (X, Y or Z axis) at low intensity levels.

** See M2205.

Parts Removed:		Parts Added:
R602	125Ω 25w WW	308-035
Screw, 8-32 x 1-3/4 fil HS		212-037
Screw, 8-32 x 5/16 BHS		212-004
Washer, centering		210-809
Nut, 8-32 x 1/2		210-462

INSTALLATION INSTRUCTIONS:

Mod can be incorporated by either shorting out R602 or removing it from the circuit.

TO BYPASS R602

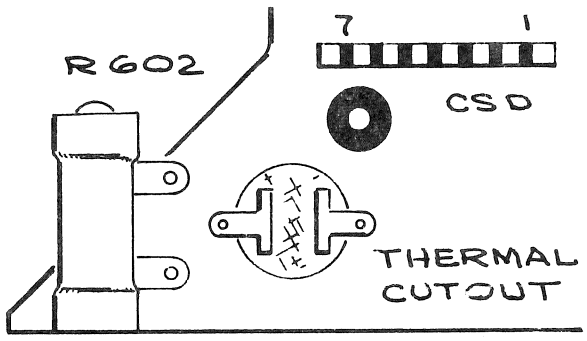
Solder a no. 22 bare wire between the 25w resistor terminals.

TO REMOVE R602

a) Remove R602 (125Ω 25w WW) mounted on power chassis.

b) Remove the two white-red wires connected between R602 and CSD-6 and CSD-7.

c) Relocate the fan motor lead from CSD-6 to CSD-7.



NEON BULBS REPLACED TO STABILIZE FIRING POTENTIAL AFTER PROLONGED DARKNESS

See SQB

M7843

Effective Prod s/n 3820

Usable in field instruments s/n 101-3819

DESCRIPTION:

NE-2 neons may not fire after they have been subjected to prolonged darkness, because of increased firing potential. They are replaced with NE-23 neons, which contain a small deposit of radioactive material to aid in the inioization process.

Parts Removed:			Parts Added:		
B68,B75, B77,B163, B217,B300, B359, B379	NE-2	150-002	B68,B75, B77,B163, B217,B300, B359,B379	NE-23	150-027
B859	NE-2 (Mod 101 only)	150-002	B859	NE-23 (Mod 101 only)	150-027

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace the following NE-2 neons with NE-23 neons.

a) B68, located in the UNCALIBRATED TIME/DIV neon holder.

b) B75 and B77, located near V61.

c) B163, located near V163.

d) B217, located in the UNCALIBRATED VERTICAL AMP neon holder.

e) B300, located in the MAG HORIZ DISPLAY neon holder.

f) B359, located near V354.

g) B379, located near V374.

h) B859, Mod 101 only.

INPUT AMPLIFIER RESISTOR REPLACED TO PROVIDE A COST SAVING AND MORE PRECISION COMPONENT

INFORMATION ONLY

M7983

Effective Prod s/n 3850

DESCRIPTION:

Replace usage of 41.5k 8w 1% Tektronix made resistors with new 41.5k 8w 1/2% resistors. New resistor is identical to old except for change in tolerance.

This mod offers a cost saving by eliminating a part number. The 1/2% resistor is required in the Type 543B Oscilloscope.

Parts Removed:			Parts Added:		
R359	41.5k 8w 1%	310-512	R359	41.5k 8w 1/2%	310-614

FAN MOTOR FILTER CAPACITOR REPLACED TO INCREASE RELIABILITY

See SQB

M7928

Effective Prod s/n 3851

Usable in field instruments s/n 101-3850

DESCRIPTION:

Accumulated breakdown failures in all types of instruments prompted a 'blanket' replacement of ceramic disc capacitor 283-012 with a higher rated capacitor.

Parts Removed:			Parts Added:		
C317	0.1µf 100v	283-012	C317	0.1µf 200v	283-057

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace 0.1µf 100v capacitor, C317, with an 0.1µf 200v capacitor.

ACCESSORIES CHANGED TO PERMIT PATCHING WITHOUT ADAPTERS — INFORMATION ONLY — M8313

Effective date 2-26-65

DESCRIPTION:

To permit patching from BNC to BNC connectors, or from BNC to UHF (or banana jack) connectors without the use of adapters, the present patch cords and/or adapters are changed/added as indicated below. See M6860 and M7641.

Also, these patch cords are set up as optional accessories:

6 inch red BNC to BNC	012-085
6 inch red BNC to banana plug	012-089
6 inch black BNC to BNC	012-084
6 inch black BNC to banana plug	012-088
18 inch black BNC to BNC	012-086
18 inch black BNC to banana plug	012-090

Parts Removed:

Adapter, BNC (2)	103-033
Cord, patch, red, 18in.	012-031

Parts Added:

Cord, patch, red, BNC to BNC 18in.	012-087
Cord, patch, red, BNC to banana plug 18in.	012-091
Jack, post, red, BNC	012-092

ELECTROLYTIC CAPACITOR ASSEMBLIES REPLACED WITH EQUIVALENT CAPACITOR, FLANGE, BASE OR COVER TO ELIMINATE UNNECESSARY PART NUMBERS AND TO FACILITATE REPLACEMENT — INFORMATION ONLY — S8959

Effective Prod. s/n not given

DESCRIPTION:

All electrolytic capacitor assemblies were replaced with their equivalent raw capacitor, metal or fiber flange, plastic cover and Delrin* base (when required) to eliminate unnecessary part numbers and to facilitate replacement of electrolytic capacitors by customers. For replacement of capacitor assemblies, Customer Service will supply raw capacitors with both metal and fiber flanges and plastic covers when required.

Parts Removed:

C146	3x10 µF 450 V	290-033
C660	125 µF 350 V	290-044
C601	160/10 µF 350 V	290-060
C150	2x1000 µF 15 V	290-050
C630	160/10 µF 350 V	290-061

Parts Added:

C146	3x10 µF 450 V	290-005
C660	125 µF 350 V	290-016
C601	160/10 µF 350 V	290-059
C150	2x1000 µF 15 V	290-022
C630	160/10 µF 350 V	290-059
Flange		386-253
Flange		386-254
Flange		386-255
Cover		200-258

* Du Pont Registered Trademark

SWEEP GENERATOR DISCONNECT DIODES SELECTED TO REDUCE LOW FREQUENCY MODULATION

INFORMATION ONLY

M9134

Effective Prod s/n 4480

DESCRIPTION:

Changes the Sweep Generator disconnect diode from a raw to a selected 6AL5 tube.

The 157-0104-01 6AL5 is selected for 20MV (peak-to-peak) or less heater to cathode hum at pin 1 with pin 4 grounded and 6.3 v AC at pin 3.

This selection process should yield tubes with at least 2000 hours service in the most critical applications. We have vendors who produce tubes with a low, medium and also a high yield - only to fall below our requirements before one year of service. The 157-0104-00 will be selected from vendors offering an acceptable tube.

This mod superseded by M10189 and M11409.

Parts Removed:			Parts Added:		
V52	6AL5	154-0016-00	V52	6AL5	157-0104-01

FRONT PANEL KNOB COLOR CHANGED TO CHARCOAL FOR COMPATIBILITY WITH NEW INSTRUMENTS

INFORMATION ONLY

M9172

Effective Prod s/n 4480

DESCRIPTION:

To standardize indicator and plug-in knob colors all knobs, switch buttons, binding posts, etc, on older instruments are changed to the charcoal colored ones used on the new instruments.

Parts Removed:			Parts Added:		
Knob, assembly		366-0028-00	Knob, assembly		366-0145-00
Knob, assembly	(2)	366-0029-00	Knob, assembly	(2)	366-0142-00
Knob, assembly		366-0030-00	Knob, assembly		366-0146-00
Knob, assembly	(7)	366-0033-00	Knob, assembly	(7)	366-0148-00
Knob, assembly		366-0040-00	Knob, assembly		366-0160-00
Post, binding	(5)	129-0036-00	Post, binding	(5)	129-0063-00
Bushing, binding post	(4)	358-0036-00	Bushing, binding post	(4)	358-0169-00

SAWTOOTH AND +GATE OUT CF NEON ADDED TO PREVENT EXCESSIVE GRID-CATHODE VOLTAGE DURING WARM-UP

See SQB

M9464

Effective Prod s/n 4500

Usable in field instruments s/n 101-4499

DESCRIPTION:

Excessive voltage from grid to cathode of V43A during warm-up. The tube shorts with destruction of R42, R47, R48, R660 and V617. This problem was corrected by adding an NE-23 neon between grid and cathode of V43A.

Parts Removed:

Parts Added:

B43	NE-23	150-0027-00
Clamp, neon bulb holder		343-0043-00

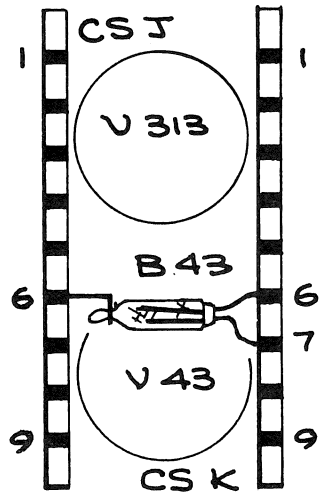
Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Install a NE-23 neon bulb between CSK-6 and CSK-7.

b) Install a wire neon bulb clamp to support the bulb tip at CSJ-6.



CRT FILTER SHAPE AND COLOR STANDARDIZED TO REDUCE COST

INFORMATION ONLY

M9022

Effective Prod s/n 4650

DESCRIPTION:

Provides a cost savings by standardizing the shape and color of CRT light filters. This was accomplished by replacing .060" thick green, blue and amber filters for 5" rectangular and round external graticule instruments and .030" thick smoke gray filter for 5" rectangular internal graticule instruments with new .030" thick green, blue, amber and smoke gray filters with configuration acceptable for both internal and external graticule use.

Also replaces .060" thick green, blue and amber filters for 3" CRT instruments with new .030" thick green, blue, amber and smoke gray filters with same configurations. Change the configuration of internal graticule clear scratch plates 387-0918-00 (5" round) and 387-0935-00 (5" rectangular) to conform to new filter configurations thereby allowing use of common tooling.

Smoke gray will replace green as standard filter shipped with external graticule instruments. Amber, green and blue filters in all configurations will be set up as optional filters supplied on customer demand and with special phosphors.

The recommended optional filters for various phosphors is as follows:

Smoke-gray filter	P1	P2	P20	P28	P31	P7	
Blue filter	P5	P11	P14	P17	P32		
Amber filter	P12	P13	P19	P25	P26	P27	P7
No filter necessary	P15	P16	P24				

P7 phosphor requires both a smoke-gray and an amber filter.

Parts Removed:		Parts Added:	
Filter, CRT, green	378-0509-00	Filter, CRT, smoke gray	378-0550-00
Filter, CRT, blue (optional)	378-0510-00	Filter, CRT, green (optional)	378-0551-00
Filter, CRT, amber	378-0511-00	Filter, CRT, blue	378-0552-00
Filter, CRT, yellow	378-0512-00	Filter, CRT, amber	378-0553-00

NEON INDICATING LAMPS AND HOLDERS REPLACED WITH IMPROVED TYPE

INFORMATION ONLY

M8002

Effective Prod SN 4740

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The indicating neon holders were replaced with a type which increased wide-angle visibility and is neater in apperance. The new holders, being slightly shorter, require a type NE-2V neon bulb and a shorter mounting screw.

Parts Removed:

B68,B217,B300	Bulb, neon, NE-23	150-0027-00
	Holder, neon, single	352-0008-00
	Screw, 4-40 x 1 FHS	211-0031-00

Parts Added:

B68,B217,B300	Bulb, neon, NE-2V	150-0030-00
	Holder, neon, single	352-0067-00
	Filter, lens, neon indicator	378-0541-00
	Screw, 4-40 x 7/8 FHS	211-0109-00

6AU6 & 12AU6 TUBES REPLACED BY PREMIUM 8425 & 8426 TUBES TO REDUCE MICROPHONICS, INTERFACE AND GRID CURRENT PROBLEMS

INFORMATION ONLY

M10548

Effective Prod SN 4780

FRONT PANEL SYMPTOM: Microphonics, interface, and grid current.

PROBLEM: Usage of 6AU6 & 12AU6 tubes results in high reject rate and length of selection time because of microphonics, interface, and grid current.

PRODUCTION CHANGE: Type 6AU6 & 12AU6 tubes were replaced by 8425 and 8426 premium tubes.

Parts Removed:

V183, V203, V214, V224	Tube, raw 6AU6	154-0022-00

Parts Added:

V183, V203, V214, V224	Tube, raw 8425/6AU6	154-0022-07

SILICON DIODE TYPE CHANGED TO REDUCE COST AND FACILITATE LAYOUT

INFORMATION ONLY

M9973

Effective Prod s/n 4800

FRONT PANEL SYMPTOM: None.

PROBLEM: A lower cost smaller diameter silicon diode was available to facilitate layout and improve dress.

PRODUCTION CHANGE: D152A-B, D602A-D, D632A-D, D662A-D were changed from top hat type diode to tubular type diode.

Parts Removed:

D152A-B, D602A-D, D632A-D, D662A-D	Diode, silicon 400 PIV 500 ma	152-0047-00

Parts Added:

D152A-B, D602A-D, D632A-D, D662A-D	Diode, silicon 400 PIV 500-750 ma	152-0066-00

SWEEP GENERATOR SILICON DIODE ADDED TO REDUCE SELECTION OF VACUUM TUBE DISCONNECT DIODE

See SQB

M10189

Effective Prod SN 4800

Usable in field instruments SN 101-4799

FRONT PANEL SYMPTOM: Slow speed timing error and jitter.

PROBLEM: Excessive leakage of the Miller disconnect diode was causing slow speed timing error and jitter.

PRODUCTION CHANGE: A low leakage semiconductor diode was added in series with the Miller tube control grid disconnect diode. This combines the low leakage characteristics of the semiconductor with the fast turn-off capability of the vacuum diode. Also, selected vacuum tube disconnect diodes (introduced by M9134) were changed back to raw tubes.

Note: Mod 11409 should be installed in conjunction with Mod 10189.

Parts Removed:

V52	Tube, checked 6AL5	157-0104-01

Parts Added:

V52	Tube, raw 6AL5	154-0016-00
* D52	Diode, low leakage silicon	152-0246-00

continued

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added' with asterisk and parts listed below.

C76	Capacitor, 0.001 μF 500 V	283-0000-00
R75	Resistor, 1.5 M 1/2 W 10%	302-0155-00
	Cable, coax, 75 Ω (10 in.)	175-0026-00

Installation Procedure:

a) Unsolder neon bulb B75, between CSG-5 and CSG-6 (see drawing). Save bulb for reuse.

b) Remove the 1.5 M 1/2 W resistor (R75), between CSG-6 and CSH-6.

c) Remove the 0.001 μF capacitor (C76), between CSG-3 and CSG-5.

d) Remove the bare wire between CSH-6 and CSJ-7.

e) Remove the bare wire between CSG-5 and CSG-7.

f) Remove the bare wire between CSG-5 and pin 6 of V61.

g) Move the neon bulb holder from CSH-5 to CSH-6.

h) Add a #22 bare wire between CSH-5 and CSJ-7.

i) Replace the coax cable between pin 1 of V52 and wafer 2 of the TIME/DIV switch, with a longer coax. Relocate the one end to CSG-5, as shown in the drawing.

k) Move one end of the 100 Ω 1/2 W resistor (R70) from pin 1 of V52 to CSG-5.

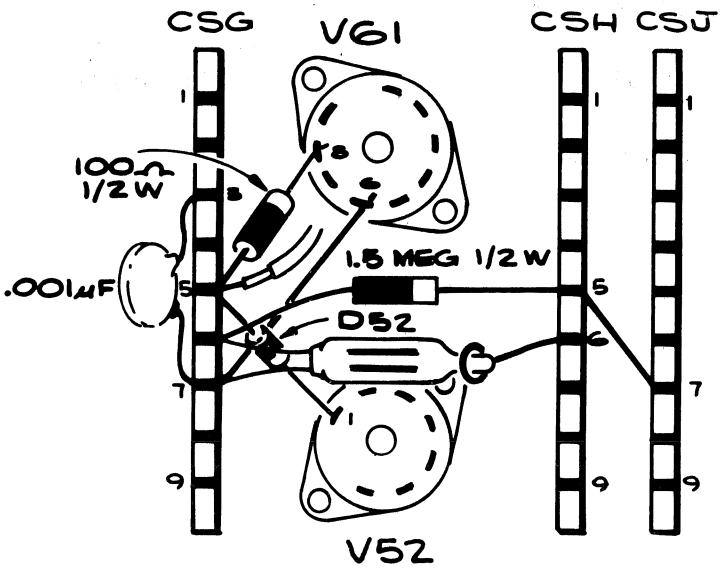
l) Add a #22 bare wire between CSG-7 and pin 6 of V61.

m) Add diode D52 between CSG-5 (banded end) and pin 1 of V52.

n) Add a new 1.5 M 1/2 W resistor (R75) between CSG-6 and CSH-5.

o) Add a new 0.001 μF capacitor (C76) between CSG-3 and CSG-7.

p) Reinstall the neon bulb (B75) between CSG-6 and CSG-7.



SWEEP GENERATOR DESCONNECT CIRCUIT IMPROVED BY ADDING A RESISTOR — See SQB — M11409

Effective Prod SN 4830 — Usable in field instruments SN 4800-4829 **

** Also, any instrument containing M10189.

FRONT PANEL SYMPTOM: Slow speed timing error and high speed jitter.

PROBLEM: Mod 10189 did not totally eliminate slow speed timing error and high speed jitter.

PRODUCTION CHANGE: A 6.8M 1/2W 10% resistor was installed in parallel with the Miller tube control grid disconnect diode V52. The added resistor shunts the heater to cathode leakage around the tube allowing the silicon diode D52 to remain off when V52 is turned off. Mod 11409 should only be utilized in instruments containing Mod 10189.

Parts Added:

R53	Resistor, 6.8M 1/2W 10%	302-0685-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Install a 6.8M 1/2W 10% resistor between pins 7 and 1 of V52.

MOTOR BASE CONNECTOR CHANGED TO FACILITATE ASSEMBLY AND REDUCE COST — INFORMATION ONLY — M9271

Effective Prod SN 4850

FRONT PANEL SYMPTOM: None.

PROBLEM: To reduce cost and facilitate fabrication of Tek-made motor bases by adapting them for automated machinery.

PRODUCTION CHANGE: Tek-made motor base 131-0102-00 was replaced with new Tek-made motor base 131-0102-01. New and old differ in method for their assembly and the subparts. Old motor base uses a #4 nut, lockwasher and screw on one side and a #4 nut, lockwasher and externally threaded ground post on other side. New motor base uses a #4 self-tapping screw into new cover 200-0185-01 on one side and a #4 sems screw into new internally threaded ground post 129-0041-00 on the other side.

Parts Removed:

Motor base	131-0102-00

Parts Added:

Motor base	131-0102-01

TIMING CAPACITOR SETS CHANGED TO LESS EXPENSIVE & MORE RELIABLE PARTS — INFORMATION ONLY — M10556

Effective Prod SN 4870

FRONT PANEL SYMPTOM: None.

PROBLEM: All timing capacitor sets were expensive, unreliable and difficult to produce.

PRODUCTION CHANGE: Timing capacitor 'cans' were replaced by a metal bracket that now holds the timing capacitors mounted on strips. The new timing capacitor sets will be numbered 295-xxxx-xx and the individual components will be 285-xxxx-xx. All 285-xxxx-xx numbers used in these sets are individual replaceable tubular capacitors with percent designations (letter coded). The letter code must be specified in addition to the part number when ordering replacement parts.

The wired timing switch will be given a new part number. The new switch is the same as the old except for the removal of the 0.001 μF (291-0008-00) tubular timing capacitor. This capacitor will now be included in the 295-xxxx-xx capacitor set number.

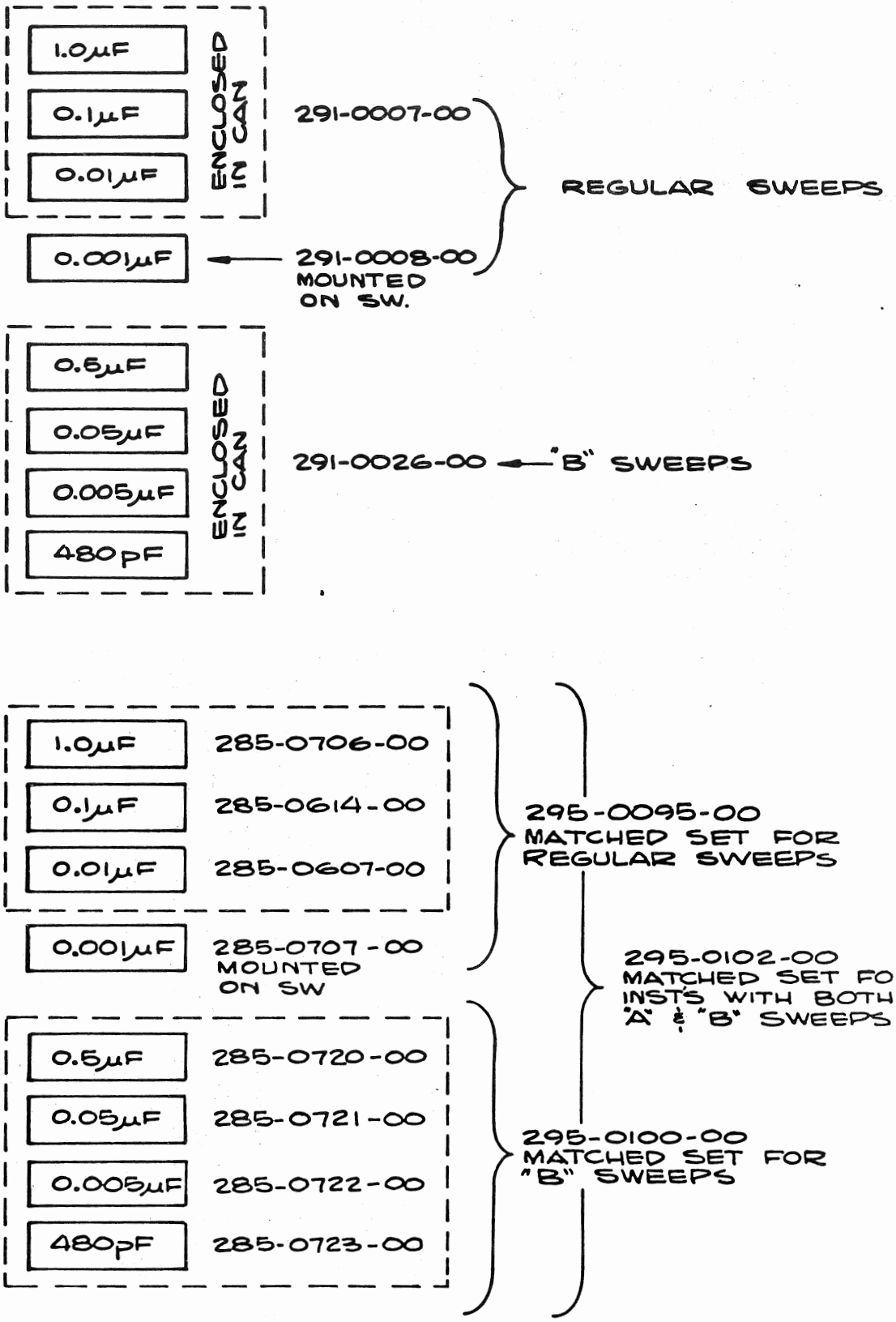
Parts Removed:

SW160	Switch, wired, TIME/CM	262-0182-00
C160J, C160H, C160G	Capacitor, 1 x .1 x .01 μF ±1/2%	291-0007-00
C160F	Capacitor, .001 μF ±1/2%	291-0008-00
	Nut, 6-32 x 1/4 (2)	210-0407-00
	Lockwasher, int #6	210-0006-00

Parts Added:

SW160	Switch, wired, TIME/CM	262-0182-01
C160F, C160G, C160H, C160J	Capacitor assembly, checked	295-0095-00
	Keps, nut 6-32 x 5/16 (2)	210-0457-00
	Bracket, cap mounting	407-0277-00

continued


1.0μF
0.1μF
0.01μF
ENCLOSED IN CAN
291-0007-00
REGULAR SWEEPS
0.001μF
291-0008-00
MOUNTED ON SW.
0.5μF
0.05μF
0.005μF
480pF
ENCLOSED IN CAN
291-0026-00 "B" SWEEPS
1.0μF 285-0706-00
0.1μF 285-0614-00
0.01μF 285-0607-00
0.001μF 285-0707-00
MOUNTED ON SW
295-0095-00
MATCHED SET FOR
REGULAR SWEEPS
295-0102-00
MATCHED SET FOR
INST'S WITH BOTH
"A" & "B" SWEEPS
0.5μF 285-0720-00
0.05μF 285-0721-00
0.005μF 285-0722-00
480pF 285-0723-00
295-0100-00
MATCHED SET FOR
"B" SWEEPS

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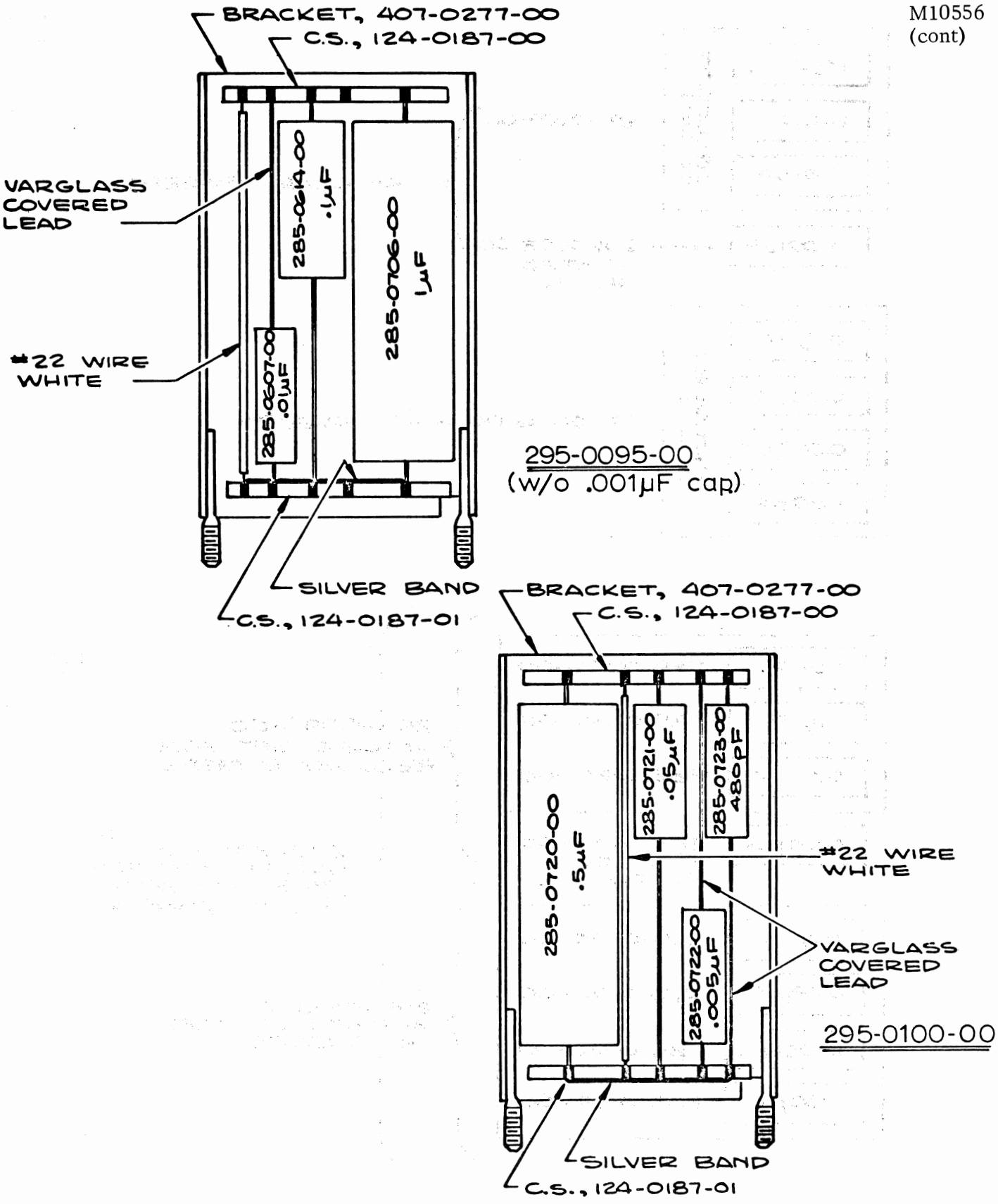

BRACKET, 407-0277-00
C.S., 124-0187-00
VARGLASS COVERED LEAD
#22 WIRE WHITE
285-0614-00 .1µF
285-0706-00 1µF
285-0607-00 .01µF
SILVER BAND
C.S., 124-0187-01
295-0095-00
(w/o .001µF cap)
BRACKET, 407-0277-00
C.S., 124-0187-00
285-0720-00 .5µF
285-0721-00 .05µF
285-0723-00 480pF
#22 WIRE WHITE
285-0722-00 .005µF
VARGLASS COVERED LEAD
295-0100-00
SILVER BAND
C.S., 124-0187-01

BE:fb

P6006 PROBE REPLACED BY P6012 TO STANDARDIZE ON PROBE TYPES — INFORMATION ONLY — M11641

Effective Prod SN 4870

FRONT PANEL SYMPTOM: None:

PROBLEM: New P6012 probe is now available to replace the P6006 prove, offering the following improvements: 1) usable with oscilloscopes having bandwidths up to 33 MHz. 2) its very small size permits use on subminiature circuitry. 3) it is capable of matching inputs of oscilloscopes with input capacitances of from 15 to 47 pF.

PRODUCTION CHANGE: P6006 probe was replaced by the P6012 as a standard accessory.

Parts Removed:

P6006	Probe pkg. 10 M 10X, 42"	010-0127-00

Parts Added:

P6012	Probe pkg, 10 M 10X, 42"	010-0203-00

TIME-BASE GENERATOR
6AN8 TUBE CHANGED TO EFC-80/6BL8 TO ELIMINATE TUBE SELECTION — INFORMATION ONLY — M11924

Effective Prod SN 4940

FRONT PANEL SYMPTOM: None.

PROBLEM: The 6AN8 vacuum tube has a poor screen-to-plate ratio causing sweep start problems.

PRODUCTION CHANGE: The 6AN8 tube used in the sweep gating multivibrator (V35) was replaced by an EFC-80/6BL8 type tube. The tube socket was rewired to conform to the new pin connections.

Parts Removed:

V35	Tube, raw vacuum 6AN8	154-0078-00

Parts Added:	Tube, raw vacuum EFC-80/6BL8	154-0278-00

3-WIRE POWER CORD FEMALE GROUND CONNECTION IMPROVED BY THE ADDITION OF A SPRING

See SQB (Accessories)

M11292

Effective Prod SN 4960

Usable in field instruments SN 101-4959

FRONT PANEL SYMPTOM: None.

PROBLEM: Inadequate ground connection between power cord and instrument motor base.

PRODUCTION CHANGE: A ground spring was added to the non-current carrying ground receptacle on the female connector end of the power cord.

Parts Removed:	None.	
Parts Added:	Spring, power cord ground (subpart of power cord 161-0010-03)	214-0698-00

INSTALLATION INSTRUCTIONS:

Parts Required:

See 'Parts Added', or part listed below.

Field Modification Kit 040-0424-01

NOTE: Field Mod Kit includes enough springs to modify 25 power cards.

Installation Procedure:

Refer to mod kit instructions.

POWER LIGHT COLOR CHANGED TO STANDARD GREEN

INFORMATION ONLY

M12031

Effective Prod SN 5030

FRONT PANEL SYMPTOM: None.

PROBLEM: More than one color was being used for the Power On light.

PRODUCTION CHANGE: All lights were changed to green.

Parts Removed:	Socket, light assy., w/6 V bulb	136-0031-00
Parts Added:	Socket, light green assy., w/6 V bulb	136-0031-01

BE:fb

MOTOR BASE CHANGED TO IMPROVE GROUND CONNECTION

See SQB

M12876

Effective Prod SN 5070

Usable in field instruments SN 101-5069

FRONT PANEL SYMPTOM: None.

PROBLEM: The present motor base grounding is not adequate, due to cold flow of the plastic between the ground post and the mounting plate.

PRODUCTION CHANGE: The method used to attach the ground post in the motor base assemblies was changed. The new mounting eliminates plastic between the ground post and the mounting plate and provides a metal to metal ground connection. To insure a good fit between mating parts, the size of the mounting screws was changed from #4 to #6, and the clearance holes in the mounting plate and shell were increased to #6.

To prevent corrosion between new ground post and mounting plate, the plate was changed from etched aluminum to cad plated steel.

Parts Removed:	Motor base	131-0102-01
Parts Added:	Motor base	131-0102-02

INSTALLATION INSTRUCTIONS:

See MI - 12876

FOCUS AND INTENSITY POTENTIOMETERS CHANGED TO REDUCE COST IMPROVE QUALITY AND PROVIDE BETTER SUPPLY OF POTENTIOMETERS

INFORMATION ONLY

M11639

Effective Prod SN 5080

FRONT PANEL SYMPTOM: None

PROBLEM: None

PRODUCTION CHANGE: FOCUS and INTENSITY pots were changed as indicated in the remove add list.

Parts Removed:

R831	Pot., comp., 1 M	311-0041-00
R852	Pot., comp., 2 M	311-0043-00

Parts Added:

R831	Pot., comp., 1 M	311-0041-02
R852	Pot., comp., 2 M	311-0043-02

HORIZONTAL AMPLIFIER RESISTORS CHANGED TO INCREASE HORIZONTAL POSITION RANGE

INFORMATION ONLY

M13200

Effective Prod SN 5130

FRONT PANEL SYMPTOM: None

PROBLEM: Selection of parts in the Horizontal Amplifier is necessary to make Horizontal Position range specs.

PRODUCTION CHANGE: The input divider ratio of the Horizontal Amplifier was lowered to allow more horizontal deflection with complete counterclockwise rotation of the Horizontal Position control.

Parts Removed:

R311	Resistor, prec., 1.11 M, 1% 1/2 W	309-0015-00

Parts Added:

R311	Resistor, prec., 1.0 M, 1% 1/2 W	309-0386-00

JT:bl

MODIFICATION SUMMARY

RM17

CERAMIC STRIPS CHANGED TO CLIP-MOUNTED TYPE FOR ECONOMY — INFORMATION ONLY — M2203

Effective Prod s/n 108

DESCRIPTION:

Screw-mounted ceramic strips are replaced by less expensive, easier-to-install clip-mounted strips.

Parts Removed:

Strip, cer, 9-notch	(18)	124-066
Strip, cer, 7-notch	(15)	124-014
Strip, cer, 4-notch	(7)	124-012
Strip, cer, 11-notch	(4)	124-016
Strip, cer, 5-notch		124-060
Strip, cer, 2-notch	(2)	124-020
Strip, cer, 2-notch	(2)	124-030
Connector, cer post 1/2"	(5)	129-009
Washer, steel #2 flat	(92)	210-850
Nut, hex, steel	(100)	210-405
Lockwasher, #2 ext	(94)	210-002
Lug, solder SE4	(4)	210-201
Connector, cer post		129-017
Spacer, 3/8 x 3/8	(2)	361-001

Parts Added:

Strip, cer, 9-notch	(18)	124-090
Strip, cer, 7-notch	(15)	124-089
Strip, cer, 4-notch	(5)	124-088
Strip, cer, 11-notch	(4)	124-091
Strip, cer, 5-notch		124-093
Strip, cer, 1-notch	(6)	124-100
Strip, cer, 2-notch	(4)	124-086
Lug, solder SE6		210-202
Lug, solder SE8	(3)	210-205
Nut, hex, steel		210-407
Screw, 6-32 x 1/4 BHS		211-504
Spacer, nylon molded	(5)	361-007
Spacer, nylon molded	(2)	361-008
Spacer, nylon molded	(92)	361-009

SWEEP GENERATOR RESISTOR CHANGED TO INCREASE SWEEP MULTIVIBRATOR OUTPUT — See SQB — M2210

Effective Prod s/n 108 — Usable in field instruments s/n 101-107

DESCRIPTION:

Permits the use of 6AN8 tubes from more than one manufacturer by replacing R147.

Parts Removed:

R147	680 Ω 1/2 w 10%	302-681

Parts Added:

R147	1 k 1/2 w 10%	302-102

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R147 located between ceramic strips above V145 (nearest the 150 k 1 w 10% resistor) with a 1 k 1/2 w 10% resistor.

VERTICAL AMP POTENTIOMETER REPLACED TO REDUCE EXCESSIVE VERTICAL GAIN

See SQB

M2215

Effective Prod s/n 108

Usable in field instruments s/n 101-107

DESCRIPTION:

Provides a decrease in vertical gain to compensate for the increase in CRT sensitivity caused by decreasing the accelerating potential from 10 kv to 9 kv. This was accomplished by replacing the Vertical Gain Adjust potentiometer R544 with a larger value control.

Parts Removed:			Parts Added:		
R544	100Ω pot	311-003	R544	200Ω pot	311-004

Parts Required for Field Installation"

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace the Vertical Gain Adjust pot R544 with a 200Ω 311-004 potentiometer.

VERTICAL AMP COMPONENTS CHANGED TO IMPROVE FOCUS AND ASTIGMATISM

See SQB

M2216-1

Effective Prod s/n 108

Usable in field instruments s/n 101-107

DESCRIPTION:

Improves the instrument FOCUS and ASTIGMATISM by changing the value of components in the Vertical Amplifier R548 and R597.

Parts Removed:			Parts Added:		
C350	10 pf 500 v	281-504	C350, C372	5-25 pf	281-011
C372	3-12 pf NPO	281-009	R354	12 k 2 w 5%	305-123
R354	10 k 5 w WW	308-054	R548	220Ω 1/2 w 10%	302-221
R548	1.2 k 5 w WW	308-063	R597	1.2 k 10 w WW	308-086
R597	1 k 10 w WW	308-089			

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Replace R548 located between +225 v and V544 pins 1 and 6 with a 220Ω 1/2 w 10% resistor.

b) Replace R597 chassis mounted near V563 with a 1.2 k 10 w resistor.

HORIZONTAL AMP COMPONENTS CHANGED TO IMPROVE HF TIMING LINEARITY

See SQB

M2216-2

Effective Prod s/n 108

Usable in field instruments s/n 101-107

DESCRIPTION:

Improves the instrument HF TIMING linearity by changing the value of components in the Horizontal Amplifier C350, C372 and R354.

Parts Removed:

C350	10 pf 500 v	281-504
C372	3-12 pf NPO	281-009
R354	10 k 5 w WW	308-054
R548	1.2 k 5 w WW	308-063
R597	1 k 10 w WW	308-089

Parts Added:

C350, C372	5-25 pf	281-011
R354	12 k 2 w 5%	305-123
R548	220Ω 1/2 w 10%	302-221
R597	1.2 k 10 w WW	308-086

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Replace C350 located on a ceramic strip near V354 with a 281-011 variable capacitor.

b) Replace C372 located on a ceramic strip near V374 with a 281-011 variable capacitor.

c) Replace R354 located between ceramic strip notches above V374.

+100 V POWER SUPPLY RESISTOR CHANGED TO IMPROVE LOW LINE REGULATION

See SQB

M2244

Effective Prod s/n 108

Usable in field instruments s/n 101-107

DESCRIPTION:

Improves regulation of the +100 v supply at low line by decreasing the value of the series regulator (V637) shunt resistor R639.

Parts Removed:

R639	3 k 5 w WW	308-062

Parts Added:

R639	2 k 5 w WW	308-091

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R639 between ceramic strip notches above V637 with a 308-091 resistor. Or parallel R639 with a 6 k 5 w resistor (308-052) to make the total resistance equal to 2 k.

POWER SUPPLY SELENIUM RECTIFIERS REPLACED BY MORE RELIABLE SEMI-CONDUCTOR DIODES

INFORMATION ONLY

M2252

Effective Prod s/n 126

DESCRIPTION:

Provides greater power supply reliability by replacing selenium rectifiers with silicon diodes.

Parts Removed:

SR454, selenium		106-037
SR750, selenium		106-038
Bracket, rectifier		406-314
Nut, 10-32		210-410
Washer, no.10		210-805
Lockwasher, no.6 int		210-006
Lockwasher, no.10 ext	(2)	210-009
Nut, 6-32	(2)	210-407
Screw, 6-32 x 5/16 BHS	(2)	211-507
Wire, no.22 w-y (2-1/2 in.)		175-522

Parts Added:

V442 T12G		158-001
SR750A,B, rect silicon	(2)	106-056
Strip, cer 4-notch		124-088
Spacer, ceramount	(2)	361-008

POWER SUPPLY CAPACITORS ADDED TO REMOVE SPIKE FROM VERTICAL

See SQB

M2395

Effective Prod s/n 126

Usable in field instruments s/n 101-125**

DESCRIPTION:

Capacitor C690 is changed and C691 is added from the other side of V263 filament to ground. This eliminates a spike in the vertical amplifier resulting from the silicon rectifiers in the power supply.

**Also recommended in earlier s/n instruments modified to include silicon rectifiers.

Parts Removed:

C690	0.01 µf	150 v	283-003

Parts Added:

C690, C691	0.02 µf	150 v	283-004

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Replace C690, located near V563 socket, with an 0.02 µf capacitor.

b) Add C691, 0.02 µf, from pin 3 of V563 to ground.

NYLON POSTS REPLACED AND STANDARDIZED TO REDUCE COST AND ELIMINATE EXTRA POSTS

INFORMATION ONLY

M2397

Effective Prod s/n not given

DESCRIPTION:

Nylon posts produced from 1/4 in. nylon rod are replaced with molded delrin posts. The new posts are standardized to save time and expense and to facilitate manufacture and installation.

Parts Removed:		Parts Added:	
Post, nylon	385-076	Post, delrin	385-138

TRIGGER RESISTOR CHANGED TO ELIMINATE HAND SELECTION OF INT TRIG DC LEVEL ADJ POT

See SQB

M2398

Effective Prod s/n 126

Usable in field instruments s/n 101-125

DESCRIPTION:

Eliminates the necessity of hand selecting INT TRIG DC LEVEL Potentiometer R258 by changing trigger resistor R257.

Parts Removed:		Parts Added:	
R557 300k 1/2w 1%	309-125	R557 349k 1/2w 1%	309-152

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R557, located (above V563 and near L554) between ceramic strips, with a 349 k 1/2 w 1% resistor.

FRONT PANEL CONTROL SIMPLIFIED BY ADDING INSERT HOLE TO ALL PANELS — INFORMATION ONLY — M2456

Effective date 8-26-59 (mod 101 only)

DESCRIPTION:

Simplifies the control of front panels and allows more flexibility by setting up one front panel for standard and modified instruments. The new panel has a mod slot hole for the mod insert tag. Modified instruments receive an insert tag with the mod number stamped on the tag. Standard instruments receive a blank tag. The mod 101 front panel is stocked under the standard number with a 'B' suffix following the part number.

Parts Removed:		Parts Added:	
Panel, front (mod 101)	333-525	Panel, front w/slot for mod tag	333-458B

V454 FILAMENT RESISTOR INCREASED TO REDUCE VOLTAGE CAUSED BY INSTALLATION OF SILICONS — See SQB — M2501

Effective Prod s/n 126 — Usable in field instruments s/n 101-125

DESCRIPTION:

Reduces the filament voltage of V454 to a nominal 6.3v AC by increasing the value of R751 to 3.3Ω. The installation of silicon diodes, having less forward voltage drop than the previously used selenium rectifiers, has increased the filament voltage to 6.6 or 6.7 volts. R751 was changed to 3.3Ω at the same s/n as the change from selenium to silicon rectifiers.

Parts Removed:		Parts Added:	
R751 2.2Ω 1/2w 5%	308-116	R751 3.3Ω 1w 5%	307-015

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R751 (2.2Ω 1/2W 5%) resistor between pin 3 of V454 and single notch ceramic strip.

POWER CHASSIS CABLE WIRES REWIRED TO AGREE WITH SCHEMATIC — INFORMATION ONLY — M2532

Effective Prod s/n 126

DESCRIPTION:

Rewires the Power Chassis cable to agree with the schematic as follows:

The lead from SR660 to SR630 is bypassing R630, 10Ω resistor, and is being tied to C630 side of resistor. The 316/317 power supplies are correct. The power cable 179-228 was changed by removing the gray-brown-brown 8-11 lead from breakout no.18 on cable board, and moving to breakout no.36. (Remove 8-11 wire from breakout no.18 to 24 and add gray-brown-brown 8-11 wire from breakout 24 to 36.)

DELAY LINE COILS CHANGED TO MAKE TUNING EASIER

See SQB

M2556

Effective Prod s/n 126

Usable in field instruments s/n 101-125

DESCRIPTION:

Increases the inductance of Delay Line inductors L589 and L590 to make tuning easier.

Parts Removed:			Parts Added:		
L589, L590	2.5 μh fixed	108-103	L589, L590	3.2 μh fixed	108-088

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace L589 and L590 located between the delay line sections, with 108-088 coils.

POWER SUPPLY SILICON DIODES CHANGED

INFORMATION ONLY

M2568

Effective Prod s/n 126

DESCRIPTION:

Change silicon diodes from Motorola 106-056 to T1 152-011B. The new diodes are a direct replacement. The yellow end of the T1 diode corresponds to the shell side of the Motorola type.

This mod is superseded by M3358. Also see M2592.

Parts Removed:				Parts Added:			
SR750 SR601 SR630 SR660	Silicon	(14)	106-056	SR750 SR601 SR630 SR660	Silicon 1N2070	(14)	152-011B

HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2794

Effective Prod s/n 126

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors due to the high reject rate and failure rate from oil leaks. Replace 285-500 oil-filled capacitor with a ceramic capacitor.

Parts Removed:			Parts Added:		
C822, C823	470 pf 10 kv PTM	285-500	C822, C823	500 pf 10 kv cer	281-556

CRT CIRCUIT RESISTOR CHANGED TO LIMIT CURRENT THROUGH V800 IF V814 SHOULD FAIL

See SQB

M2967

Effective Prod s/n 144

Usable in field instruments s/n 101-143

DESCRIPTION:

Protects the screen grid of V800, caused by a possible catastrophic failure of V814, by increasing the value of R803.

Parts Removed:		Parts Added:	
R803 27k 1/2w 10%	302-273	R803 47k 1/2w 10%	302-473

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R803 located between a ceramic strip notch and pin 1 of V800 with a 47k 1/2w 10% resistor.

HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2848

Effective Prod s/n 171

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors due to high reject rate and failure rate from oil leaks. Replace 285-509 oil-filled capacitor with a ceramic capacitor.

Parts Removed:		Parts Added:	
C821 0.0068μf 5kv PTM	285-509	C821 0.005μf 4kv cer	283-034

HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2873

Effective Prod s/n 171

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors due to high reject rate and failure rate from oil leaks. Replace 285-513 oil-filled capacitor with a ceramic capacitor. To prevent disturbances in the unblanking, additional circuitry changes must be made.

Parts Removed:

C832, C834, C855, C857	0.015μf	3kv	PTM	285-513
R835	1.5meg	1/2w		302-155

Parts Added:

C832, C834, C835, C855, C857	0.01μf	2kv	cer	283-011
R835	2.2meg	1/2w		302-225

UNCALIBRATED NEON OSCILLATION PREVENTED

See SQB

M2945

Effective Prod s/n 171

Usable in field instruments s/n 101-170

DESCRIPTION:

Prevent oscillation of the UNCALIBRATED neon when the Timing switch VARIABLE control is in the CALIBRATED position, by adding a 1 meg resistor in parallel with the neon.

Parts Removed:		Parts Added:	
		R159 1 meg 1/2 w	302-105

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

On TIME/DIV switch, solder 1 meg resistor from junction of 100 k resistor and wire going to UNCALIBRATED neon (i.e., wafer 2 terminal 11) to adjacent grounded shield.

NOTE: The following method is used to identify the TIME/DIV switch terminals:

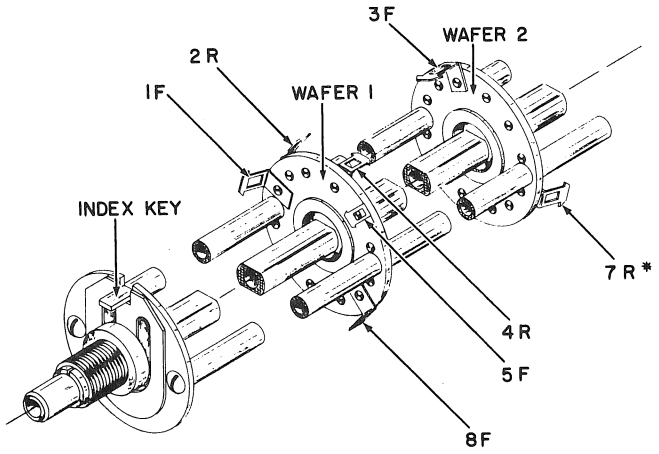
The wafers are numbered from the front to the rear.

The contact positions are numbered 1 through 12 relative to the index key as shown in drawing.

The contacts have an 'F' or 'R' suffix which denotes that they are on the front or the rear of the wafer.

Example: W2-7R (denoted by * on drawing) is contact no. 7 on the rear of wafer 2.

(TYPICAL SWITCH CONFIGURATION)



CABINET FINISH IMPROVED

INFORMATION ONLY

M2545

Effective Prod s/n 179

DESCRIPTION:

To obtain a tougher, easier to clean finish and to reduce cost, change the material used for cabinet sides, bottoms, overlays, etc. to textured aluminum (Reynold's pebble grain, 5005, H154). Change the paint from blue wrinkle to blue vinyl of approximately the same color. Paint filter housings, top rails, bottom rails and dot fasteners with blue vinyl also.

Parts Removed:		Parts Added:	
Dust cover (2)	386-739	Dust cover (2)	387-095
Housing, air filter	380-011	Housing, air filter	380-019

POWER SUPPLY RECTIFIER DESIGNATIONS CHANGED TO STANDARDIZE MANUALS — INFORMATION ONLY — M2529

Effective Prod s/n 201

DESCRIPTION:

Standardizes the manual and chassis circuit numbers on the silicon diodes by changing to 'V' numbers instead of 'SR' numbers. This was accomplished by changing chassis silk-screening and making manual corrections.

DC FAN MOTOR SELENIUM RECTIFIERS CHANGED TO SILICON DIODES — INFORMATION ONLY — M3077

Effective Prod s/n not given

DESCRIPTION:

Provides a more reliable rectifier for the DC Fan Motor circuit by replacing selenium rectifiers with silicon diodes.

Parts Removed:		Parts Added:		
Assembly, selenium rect	106-006	C317	6.25µf 300v	290-025
Bracket, rect	406-314	D317A-D	1N2070	152-011B
		Strip, cer, 2-notch		124-086
		Strip, cer, 3-notch		124-087
		Spacer, nylon CS (2)		361-009

POWER TRANSFORMER PRIMARY WIRES INTERCHANGED TO CORRECT PHASE OF LINE TRIGGER — See SQB — M3083

Effective Prod s/n 201 — Usable in field instruments s/n 101-200

DESCRIPTION:

Changes the phasing (180° out) of the line to provide correct line triggering. This was accomplished by reversing the leads connected to Power Transformer terminals 29-30 and 27-28.

INSTALLATION INSTRUCTIONS:

NOTE: The following cable wires are located in ceramic strip notches and are easily identified by locating the Power Transformer terminals:

a) Reverse the white-blue-gray and white-blue-red wires connected to T600 terminals no.29 and no.30.

b) Reverse the white-blue-green and white-blue-orange wires connected to T600 terminals no.27 and no.28.

SWEEP TRIGGER SENSITIVITY
POT ADDED TO COMPENSATE FOR INCONSISTENT 6DJ8 AT V35

See SQB

M3050

Effective Prod s/n 203

Usable in field instruments s/n 101-202

DESCRIPTION:

Compensates for inconsistencies at V35 to obtain correct trigger sensitivity by replacing R43 with a 500Ω minipot.

Parts Removed:

R43 330Ω 1/2w 10%	301-331
Bracket, 2pot	406-321

Parts Added:

R43 500Ω 1/10w	311-056
Bracket, minipot	406-602
Nut, minipot (2)	210-438
Wire,#22 w 3-7/8in. (2)	175-522

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Solder two 3-7/8 in. white wires to the CW terminal and center terminal of potentiometer R43.

b) Mount the potentiometer on the 406-602 bracket.

c) Replace the (406-321) SWEEP LENGTH and TRIG LEVEL CENT potentiometer bracket with the new 406-602 bracket.

d) Remove R43 (330Ω 1/2 w 10% resistor) located on a ceramic strip above V35.

e) Move C43 (0.005μf capacitor) located between ceramic strip above V35 from the inside to the outside of ceramic strip.

f) Solder the white wire from pot R43 center terminal to the ceramic strip notch with the C43 lead nearest the front panel.

g) Solder the remaining white wire connected from the CW terminal to the ceramic strip notch with the opposite C43 lead.

HV CAPACITORS CHANGED FROM OIL-FILLED TO CERAMIC

INFORMATION ONLY

M2821

Effective Prod s/n 210

DESCRIPTION:

The manufacturer is having difficulty supplying HV oil-filled capacitors due to high reject rate and failure rate from oil leaks. Replace 285-508 oil-filled capacitor with a ceramic capacitor.

Parts Removed:		Parts Added:		
C814, C820, C830	0.0068 µf 3 kv PTM 285-508	C814, C820, C830	0.01 µf 2 kv cer	283-011

CRT CLAMP CHANGED TO PROVIDE BETTER GRIPPING ACTION

INFORMATION ONLY

M3224

Effective Prod s/n 220

DESCRIPTION:

The inside diameter of the CRT clamp ring is increased from 1.470 in. to 1.530 in. and a 3/8 x 4-3/8 piece of fine grit, pressure sensitive safety walk tape is added to the inside ring surface. This provides a better gripping action on the CRT.

DC FAN DIODES REPLACED WITH MORE RELIABLE HERMETICALLY SEALED DIODES

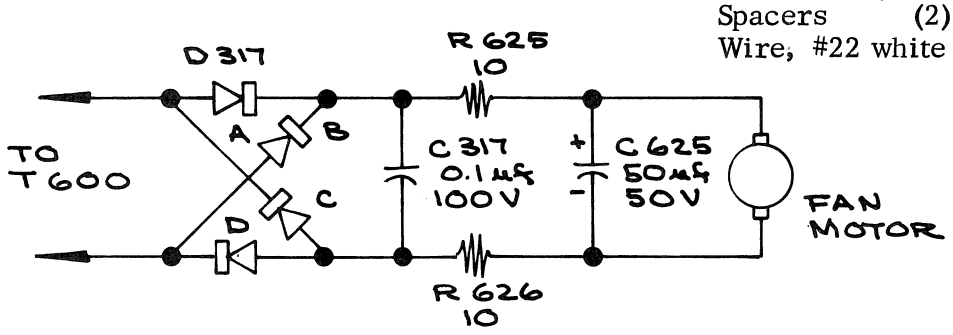
INFORMATION ONLY M3416

Effective Prod s/n 239

DESCRIPTION:

To provide a more reliable hermetically sealed diode, replace silicon diode 1N2070 with silicon diode 1N2862, or equal. The larger diameter of the new top hat diode requires alternate diodes to be dressed down between the strips. Also reduces brush noise picked up in the Vertical Amplifier by adding a filter circuit.

Parts Removed:		Parts Added:	
D317A-D 1N2070	152-011	D317A-D 1N2070	152-047
Strip, cer, 2-notch	124-086	Strip, cer, 4-notch	124-088
Strip, cer, 3-notch	124-087	Strip, cer, 7-notch	124-089
Capacitor, 6.25µf 300v	290-025	C625 50µf 50v	290-117
		R625, R626 10Ω 2w 10%	306-100
		C317 0.1µf 100v	283-012
		Spacers (2)	361-009
		Wire, #22 white 8 in. (2)	175-522



POWER SUPPLY DIODES REPLACED

INFORMATION ONLY M3358

Effective Prod s/n 240

DESCRIPTION:

To provide a more reliable hermetically sealed diode, replace silicon diode 1N2070 with silicon diode 1N2862, or equal. The larger diameter of the new top hat diode requires alternate diodes to be dressed down between the strips. A slight change in diode layout is also necessary.

This mod is incorporated in Modification kit 040-0216-00. Also, see M3416.

Parts Removed:			Parts Added:		
V602A-D, V632A-D, V662A-D, V162A-B	1N2070	152-011	V602A-D, V632A-D, V662A-D, V162A-B	1N2862 (or equal)	152-047

REPLACE 6U8 AND 6AU6 TUBES AND ASSOCIATED CIRCUITRY WITH 6DJ8 AND 12AU7 TUBES TO IMPROVE RELIABILITY

INFORMATION ONLY

M3231

Effective Prod s/n 310

DESCRIPTION:

Improves the reliability of circuitry containing 6U8 tubes by replacing them with 12AU7 and 6DJ8 tubes. Also requires making minor component changes.

Parts Removed:

R872	3.3meg	1/2w	10%	302-335
R876	2.7meg	1/2w	10%	302-275
R880	100k	1/2w	10%	302-104
R883	100Ω	1/2w	10%	302-101
Chassis, Calibrator				441-183
Wire, no.22 w-gn (4-1/2 in)				175-522
V875	6U8			154-033

Parts Added:

R872	3.9meg	1/2w	5%	301-395
R876	2.4meg	1/2w	5%	301-245
R880	68k	1/2w	10%	302-683
R883	1k	1/2w	10%	302-102
D131	T12G, germanium			152-008
Chassis, Calibrator				441-355
V875	12AU7			154-041

MYLAR TIMING CAPACITOR PART NUMBERS CHANGED

INFORMATION ONLY

M3337

Effective Prod s/n not given

DESCRIPTION:

To reduce rejects by customers who purchase timing capacitors as spare parts, the tolerance specification is changed from +1/4% or -1/4% to a straight ±1/2%. The printed tolerance on capacitors is removed and the 'A' or 'B' suffix deleted on part numbers. (This change will not cause difficulty in the timing of instruments.)

Parts Removed:

C160J, H, G	1x.1x.01μf+1/4%	291-007A
C160J, H, G	1x.1x.01μf-1/4%	291-007B
C160F	.001μf+1/4%	291-008A
C160F	.001μf-1/4%	291-008B

Parts Added:

C160J, H, G	1x.1x.01μf±1/2%	291-007
C160F	.001 μf ±1/2%	291-008

SEMICONDUCTOR INFORMATION STANDARDIZED

INFORMATION ONLY

M3535

Effective Prod s/n not given

DESCRIPTION:

The following changes are to be made, as applicable:

1. All semiconductor type numbers are deleted from the chassis, leaving only the circuit designation.
2. Circuit designations of silicon diodes change from 'V' to 'D'.
3. Circuit designations of transistors change from 'V' to 'Q'.

SILVER-BEARING SOLDER PROVIDED FOR CUSTOMER CONVENIENCE

INFORMATION ONLY

M3660

Effective Prod s/n not given

DESCRIPTION:

The customer is provided with a spool of silver-bearing solder, mounted on the instrument, for repair purposes. A 5/32 in. hole is added in a conspicuous location and a press-in nylon spool with 3 ft. of solder is installed.

Parts Removed:

Parts Added:

Spool, assembly, w/solder	214-210
Spacer, nylon molded 0.063	361-007

HORIZ AMP RESISTORS RELOCATED FROM PLATE TO GRID CIRCUIT TO SUPPRESS PARASITIC OSCILLATIONS

See SQB

M3687

Effective Prod s/n 310

Usable in field instruments s/n 101-309

DESCRIPTION:

Relocates Horizontal Amplifier resistors R351 and R374, from the plate circuit of the output amplifier stage (V354A and V374A) to the grid circuit of the cathode follower output stage (V354B and V374A), to suppress any parasitic oscillations.

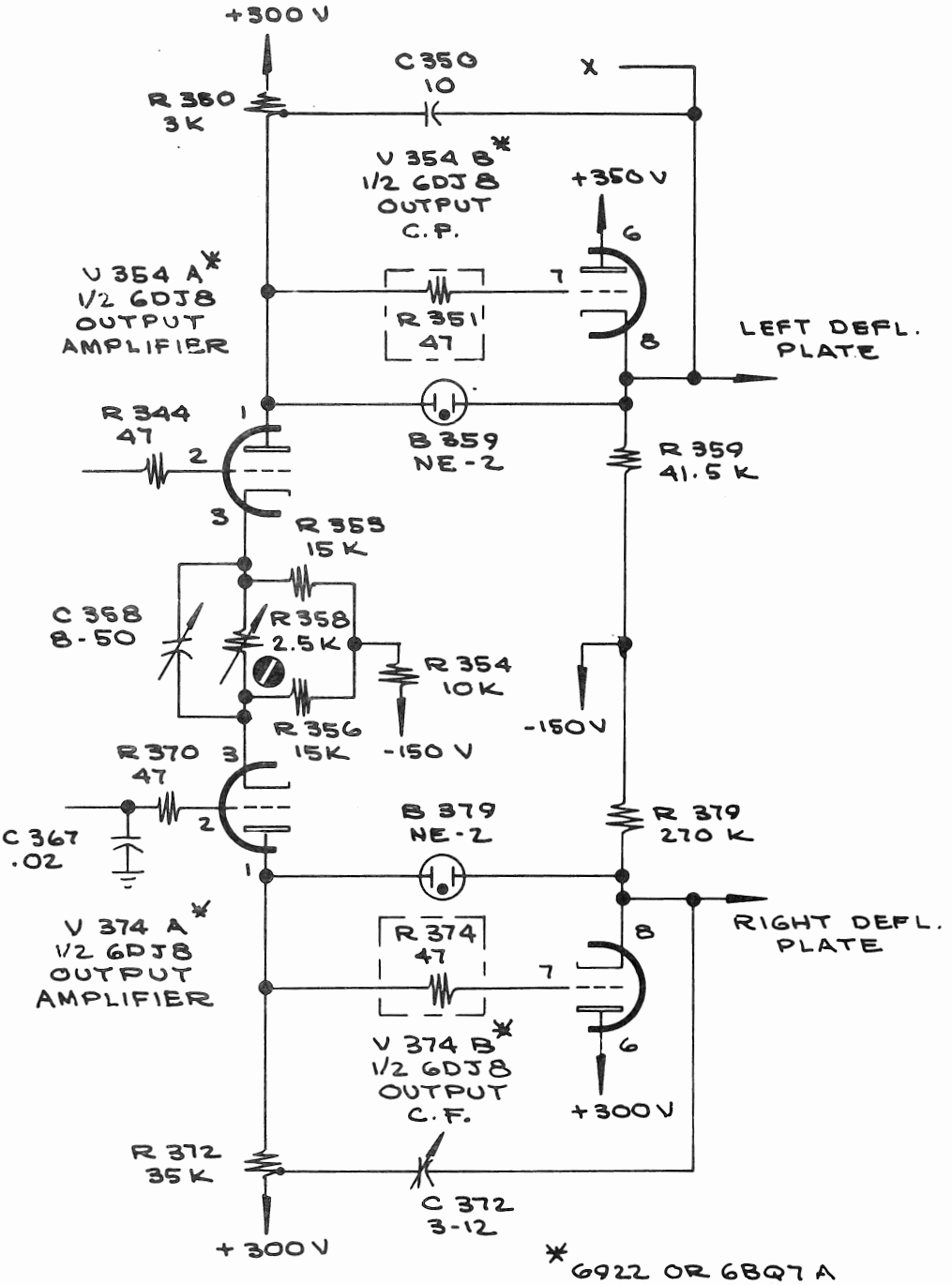
INSTALLATION INSTRUCTIONS:

a) Relocate no. 22 bare wire strap from CSH2, pin 7 of V374 to CSH2, pin 1 of V374.

b) Relocate no. 22 bare wire strap from CSH9, pin 7 of V354 to CSH9, pin 1 of V354.

Refer to schematic on following page.

(continued)



NOTE :
DOTTED LINES
INDICATE CHANGES

PARTIAL HORIZ. AMP.

GATE OUT CKT RESISTOR TOLERANCE TIGHTENED TO ELIMINATE EXTREME GATE VOLTAGE AMPLITUDES — See SQB — M3722

Effective Prod s/n 310 — Usable in field instruments s/n 101-309

DESCRIPTION:

Eliminates extreme voltage amplitudes of the 'GATE OUT' waveform by changing R195 and R196 from 10% to 5% resistors.

Parts Removed:			Parts Added:		
R195	18k 1w 10%	304-183	R195	18k 1w 5%	303-183
R196	33k 2w 10%	306-333	R196	33k 2w 5%	305-333

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R195 and R196 located between ceramic strip notches above the V193 tube socket with 5% resistors.

SWEEP GENERATOR DISCONNECT DIODES REWIRED FOR CONFORMITY — INFORMATION ONLY — M3776

Effective Prod s/n 310

DESCRIPTION:

Tie the inter-element shield (pin 6) of the disconnect diode, which is now 'floating', to one plate (pin 7). This will make the circuit conform to other instruments, as well as eliminate any possibility of the shield picking up a charge.

CRT CAPACITOR CHANGED TO PREVENT TRACE DIMMING IN SWEEP SPEED RANGE 5 TO 10 μSEC/DIV — See SQB — M5043

Effective Prod s/n 310 — Usable in field instruments s/n 101-309

DESCRIPTION:

Prevents dimming of trace in the 5 to 10 sec/div sweep ranges by replacing C815 with a capacitor of higher value.

Parts Removed:			Parts Added:		
C815	0.022μf 400v	285-515	C815	0.047 μf 400v	285-519

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Remove the 'DANGER HIGH VOLTAGE' shield.
b) Replace C815 located between ceramic strips above V814 with a 0.047μf 400v capacitor.
c) Reinstall shield.

CRT PHOSPHOR CHANGED TO INCREASE WRITING RATE — INFORMATION ONLY — M5219

Effective Prod s/n 310

DESCRIPTION:

Improves the light output efficiency of the CRT by changing the standard P2 phosphor to a P31. The P2 phosphor is still available as an option.

Parts Removed:				Parts Added:			
V859	T317	P2	154-196	V859	T317	P31	154-346

FRONT PANEL MOD SLOT ADDED TO STANDARD PANEL — INFORMATION ONLY — M5929

Effective Prod s/n not given (mod 101 only)

DESCRIPTION:

To reduce front panel stock and facilitate production, the standard front panel will now have a 'mod slot' so it may be used instead of the special panel (which has the same part number plus a 'B' suffix). Standard instruments will have a blank tag (334-829) added in the slot; special mods will have a tag imprinted with the mod number.

Parts Removed:		Parts Added:	
Panel, front	333-458**	Panel, front	333-458

**Applies only to panels with 'B' suffix

VARIABLE ATTENUATOR POT CHANGED TO 360° TYPE — INFORMATION ONLY — M3862

Effective Prod s/n 320

DESCRIPTION:

To reduce cost and breakage, and to speed calibration, the Variable Attenuator pot is changed to a 360° rotation type.

Parts Removed:			Parts Added:		
SW420, SW517	VOLTS/DIV	262-144	SW420, SW517	VOLTS/DIV	262-479
**R516	660Ω minimum	311-135	**R516	780Ω ±15%	311-281

**Part of VOLTS/DIV switch

CRT VERTICAL SHIELD VOLTAGE DIVIDER CIRCUIT REMOVED

INFORMATION ONLY

M5310

Effective Prod s/n 320

DESCRIPTION:

Removes the CRT vertical shield voltage divider circuit consisting of C864, R863 and R864. The new cathode ray tube vertical shield was removed thereby eliminating the need to establish a shield voltage which was provided by C864, R863 and R864.

Parts Removed:			Parts Added:
C864	0.005µf 500v	283-001	
R863	150k 1/2w	302-154	
R864	120k 1/2w	302-124	

VERTICAL INPUT CAPACITOR RELIABILITY INCREASED

INFORMATION ONLY

M5212

Effective Prod s/n 340

DESCRIPTION:

To improve quality and reliability of 0.1 µf 600v input capacitor 285-556 (or matched pair 295-054), while lessening production time, the following changes are made: case is changed from phenolic to tin-plated brass; seal is changed from epoxy to hermetic type; new part number, 285-603 is assigned for the non-insulated case type.

NOTE: 295-066 is part number for matched pair of 285-603.

Parts Removed:			Parts Added:		
C401	0.1µf 600v	285-556	C401	0.1µf 600v	285-603

VOLTS/DIV WIRE SHIELD CHANGED TO PROVIDE IMPROVED ATTENUATION COMPENSATION TRACKING

See SQB

M6388

Effective Prod s/n 370

Usable in field instruments s/n 101-369

DESCRIPTION:

Provides improved accuracy of attenuator compensation tracking between the main amplifier and pre-amp by balancing stray capacitances in the input circuit in each mode of amplification. This was accomplished by lengthening the VOLTS/DIV switch shield wire.

Mods 6559, 7855, 6388, and removing R145 (replaced with a wire strap) are all necessary to clean up the response of the 0.02 and 0.05 v/cm positions. The mods were installed in the order mentioned with Mods 6559 and 7855 producing little, if any, improvement. However, after performing Mod 6388 and removing R145, then Mods 6559 and 7855 could not be removed without degrading the response.

All modifications can be performed in 30 min. to an hour and without removing the Volts/Div switch.

Parts Removed:

Wire, flat shield (1-3/4 in.) 176-047

Parts Added:

Wire, flat shield (2-3/4 in.) 176-047

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Remove no.22 wire located between W4-8R and W5-8F.

b) Remove no.20 wire located between W3-3F and capacitor mounting bracket.

c) Relocate no.22 wire end at W5-8F (other end to C432) to W4-8R.

d) Relocate the 1 meg 1/2 w 1% resistor (R441) from W3-3F and W4-3F to between W4-3F and the rear switch shield.

e) Enlarge the 5/32 D hole located at 6-11/16 V 3-3/4 H, to 1/4 D.

f) Add a 1/4 in. grommet to the enlarged hole.

g) Reroute R484 and C484, located between W5-3R and CSV-1 (100 k, 0.005) combination from through the 2-1/4 in. x 1 in. slot to through the grommet.

NOTE: The following method is used to identify the VOLTS/DIV switch terminals:

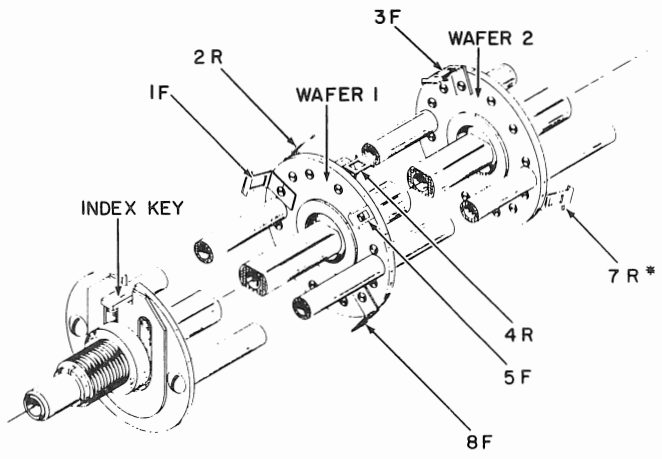
The wafers are numbered from the front to the rear.

The contact positions are numbered 1 through 12 relative to the index key as shown in drawing.

The contacts have an 'F' or 'R' suffix which denotes that they are on the front or rear of the wafer.

Example: W2-7R (denoted by * on drawing) is contact no.7 on the rear of wafer 2.

(TYPICAL SWITCH CONFIGURATION)



CRT GRATICULE CHANGED TO PROVIDE ADJUSTMENT TO CENTER GRATICULE ON TRACE

INFORMATION ONLY

M6045

Effective Prod s/n 400

DESCRIPTION:

Provides an adjustable CRT graticule to center the graticule on the trace by redesigning the graticule to have adjustable slots instead of 0.221 in. mounting holes. Additional holes were installed at the top of the graticule and CRT shield (4-40 tapped hole) to secure the graticule after adjustment with a 4-40 x 5/16 screw.

Prior to M6045, replacement T317's from Customer Service have been selected for perfectly centered scan, to match the old graticules. On quantity orders for non-standard phosphors, however, selection can leave an overstock of CRT's with the wrong phosphor for production use. Therefore, replacement T317's will hereafter be shipped without special selection, and the customer may have to install an adjustable graticule.

Parts Replacement kit 050-0090-00 is available to facilitate the replacement of non-adjustable CRT graticules in earlier instruments.

The kit includes a nut that replaces one of the four rubber washers normally mounted under the graticule cover. Tightening down this nut holds the graticule in position after centering to match the new CRT. If the customer uses a light filter, it may be easily modified to clear the nut.

The 050-0090-00 kit becomes an automatic replacement on orders for the old graticule if the customer specifies that the graticule is for the 317 or RM17.

Parts Removed:		Parts Added:	
Graticule	331-042	Graticule	331-095
		Screw, 4-40 x 5/16 BHS	211-008

VERTICAL PREAMPLIFIER RESISTORS CHANGED TO REDUCE POSSIBILITY OF WAVEFORM DISTORTION

See SQB

M6559

Effective Prod s/n 434

Usable in field instruments s/n 101-433

DESCRIPTION:

To decrease the possibility of waveform distortion in the Vertical Amplifier, caused by excessive grid current, when using a 10X probe. This was accomplished by decreasing the value of R444.

Mods 6559, 7855, 6388, and removing R145 (replaced with a wire strap) are all necessary to clean up the response of the 0.02 and 0.05 v/cm positions. The mods were installed in the order mentioned with Mods 6559 and 7855 producing little, if any, improvement. However, after performing Mod 6388 and removing R145, then Mods 6559 and 7855 could not be removed without degrading the response.

All modifications can be performed in 30 min. to an hour and without removing the Volts/Div switch.

Parts Removed:		Parts Added:	
R444 22k 1/2w 10%	302-223	R444 15k 1/2w 10%	302-153

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace R444 (22k 1/2w 10% resistor) between ceramic strip notches and connected to pin 6 of V454 through a 100Ω resistor with a 15k 1/2w 10% resistor.

CRT SOCKET STANDARDIZED FOR COST SAVING

INFORMATION ONLY

M5081

Effective Prod s/n 470

DESCRIPTION:

The purchase specifications for the CRT socket are changed to permit using the same socket in other instruments.

Parts Removed:		Parts Added:	
Socket, 12-pin CRT	136-603	Socket, 12-pin CRT	136-081

UHF CONNECTORS REPLACED WITH BNC CONNECTORS

INFORMATION ONLY

M6860

Effective Prod s/n 470

DESCRIPTION:

The UHF connectors are replaced with BNC connectors, to match the military and manufacturing trend toward the BNC type. The BNC type has a constant 50Ω impedance and a lower input capacitance. It also requires less front panel space. See M8313

Parts Removed:		Parts Added:	
Adapter, binding post UHF(2)	013-004	Adapter, binding post BNC (2)	103-033
Adapter, BNC to UHF	103-015		

PATCH CORDS ADDED AS ACCESSORIES TO PROVIDE ADDITIONAL UTILITY AND ADAPTABILITY FOR INSTRUMENTS WITH BNC CONNECTORS

INFORMATION ONLY

M7641

Effective Prod s/n 550

DESCRIPTION:

Provides additional utility and adaptability to all BNC indicators by adding an 18" patch cord. The banana patch cord was deleted by M8313. Also see M6860

Parts Removed:		Parts Added:	
		Cord, patch, red 18" long	012-031

C317 CAPACITOR REPLACED TO INCREASE RELIABILITY

See SQB

M7928

Effective Prod s/n 586

Usable in field instruments s/n 101-585

DESCRIPTION:

Accumulated breakdown failures in all types of instruments prompted a 'blanket' replacement of ceramic disc capacitor 283-012 with a higher rated capacitor.

Parts Removed:			Parts Added:		
C317	0.1μf 100v	283-012	C317	0.1μf 200v	283-057

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace 0.1μf 100v capacitor C317 in the DC fan mod circuit with an 0.1μf 200v capacitor.

VERT PREAMP GROMMET REMOVED TO DECREASE WAVEFORM HOOK ON 0.02 AND 0.05 V/DIV POSITIONS

See SQB

M7855-1

Effective Prod s/n 610

Usable in field instruments s/n 101-609

DESCRIPTION:

Decreases waveform hook in the Vertical Preamplifier by removing a rubber grommet and relocating R443 in the center of the old grommet hole.

Mods 6559, 7855, 6388, and removing R145 (replaced with a wire strap) are all necessary to clean up the response of the 0.02 and 0.05 v/cm positions. The mods were installed in the order mentioned with Mods 6559 and 7855 producing little, if any, improvement. However, after performing Mod 6388 and removing R145, then Mods 6559 and 7855 could not be removed without degrading the response.

All modifications can be performed in 30 min. to an hour and without removing the Volts/Div switch.

Parts Removed:			Parts Added:		
R443	47Ω 1/2w 10%	302-470	R443	47Ω 1/2w 10%	302-470

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

a) Remove R443 a 47Ω 1/2w 10% resistor between SW420 (VOLTS/DIV switch) and V454, pin 1.

b) Remove the 1/4 in. chassis grommet from the chassis hole near V154.

c) Install a new 47Ω 1/2w 10% resistor between SW420 and V454, pin 1, so that the resistor body is centered in the chassis hole.

VERT PREAMP RESISTOR CHANGED TO CENTER ADJUSTMENT RANGE OF LOW FREQUENCY COMPENSATION POT

INFORMATION ONLY

M7855-2

Effective Prod s/n 610

DESCRIPTION:

Centers the adjustment range of the Low Frequency Compensation potentiometer by replacing R474 with a 220k 1/2w 10% resistor.

Parts Removed:			Parts Added:		
R474	390k 1/2w 10%	302-394	R474	220k 1/2w 10%	302-224

TIME BASE GEN RESISTOR CHANGED TO PROVIDE SUFFICIENT RANGE FOR SWEEP LENGTH POT

INFORMATION ONLY

M7855-3

Effective Prod s/n 610

DESCRIPTION:

Provides sufficient range for Sweep Length potentiometer by changing the value of R174.

Parts Removed:			Parts Added:		
R174	2.2k 1w 10%	304-222	R174	3.3k 1w 10%	304-332

NEON BULBS REPLACED TO STABILIZE FIRING POTENTIAL AFTER PROLONGED DARKNESS

See SQB

M7843

Effective Prod s/n 690

Usable in field instruments s/n 101-689

DESCRIPTION:

NE2 neons may not fire after they have been subjected to prolonged darkness, because of increased firing potential. They are replaced with NE23 neons, which contain a small deposit of radioactive material to aid in the ionization process.

Parts Removed:			Parts Added:		
B163, B167, B170, B300, B359, B379, B463, B517	NE2	150-002	B163, B167, B170, B300, B359, B379, B463, B517	NE23	150-027

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace the following NE2 neons with NE23 neons:

a) B163, located in the TIME/DIV switch UNCALIBRATED neon holder.
b) B167 and B170, located between ceramic strips above V161.
c) B300, located in the HORIZONTAL DISPLAY MAG neon holder.
d) B359 and B379, located between ceramic strips above V354 and V374.
e) B463, located between ceramic strips near V463.
f) B517, located in the VOLTS/DIV UNCALIBRATED neon holder.

INPUT AMPLIFIER RESISTOR REPLACED TO PROVIDE A COST SAVING AND MORE PRECISION COMPONENT

INFORMATION ONLY

M7983

Effective Prod s/n 690

DESCRIPTION:

Replace usage of 41.5k 8w 1% Tektronix made resistors with new 41.5k 8w 1/2% resistors. New resistor is identical to old except for change in tolerance.

This mod offers a cost saving by eliminating a part number. The 1/2% resistor is required in the Type 543B Oscilloscope.

Parts Removed:			Parts Added:		
R359	41.5k 8w 1%	310-512	R359	41.5k 8w 1/2%	310-614

ACCESSORIES CHANGED TO PERMIT PATCHING WITHOUT ADAPTERS

INFORMATION ONLY

M8313

Effective date 2-26-65

DESCRIPTION:

To permit patching from BNC to BNC connectors, or from BNC to UHF (or banana jack) connectors without the use of adapters, the present patch cards and/or adapters are changed/added as indicated below. See M6860 and M7641.

Also, these patch cords are set up as optional accessories:

6 inch red BNC to BNC	012-085
6 inch red BNC to banana plug	012-089
6 inch black BNC to BNC	012-084
6 inch black BNC to banana plug	012-088
18 inch black BNC to BNC	012-086
18 inch black BNC to banana plug	012-090

Parts Removed:		Parts Added:	
Adapter, BNC (2)	103-033	Cord, patch, red, BNC to BNC 18in.	012-087
Cord, patch, red, 18 in.	012-031	Cord, patch, red, BNC to banana plug 18in.	012-091
		Jack, post, red, BNC	012-092

ELECTROLYTIC CAPACITOR ASSEMBLIES REPLACED WITH EQUIVALENT CAPACITOR, FLANGE, BASE OR COVER TO ELIMINATE UNNECESSARY PART NUMBERS AND TO FACILITATE REPLACEMENT

INFORMATION ONLY

S8959

Effective Prod. s/n not given

DESCRIPTION:

All electrolytic capacitor assemblies were replaced with their equivalent raw capacitor, metal or fiber flange, plastic cover and Delrin‡ base (when required) to eliminate unnecessary part numbers and to facilitate replacement of electrolytic capacitors by customers. For replacement of capacitor assemblies, Customer Service will supply raw capacitors with both metal and fiber flanges and plastic covers when required.

Parts Removed:

C703	2x20µF 450V	290-036
C446	3x10µF 350V	290-032
C701	2x20µF 450V	290-037
C601, C660	125µF 450V	290-044
C750	2x1000µF 15V	290-050
C630	125µF 450V	290-052

Parts Added:

C701, C703	2x20µF 450V	290-010
C446	3x10µF 350V	290-004
C601, C630, C661	125µF 450V	290-016
C750	2x1000µF 15V	290-022
	Flange	386-252
	Flange	386-253
	Flange	386-254
	Flange	386-255
	Cover	200-257
	Cover	200-258

‡Du Pont, Registered Trademark

SWEEP GENERATOR DISCONNECT DIODES SELECTED TO REDUCE LOW FREQUENCY MODULATION

INFORMATION ONLY

M9134

Effective Prod s/n 780

DESCRIPTION:

Change the Sweep Generator disconnect diode from a raw to a selected 6AL5 tube.

The 157-0104-01 6AL5 is selected for 20mv (peak to peak) or less heater to cathode hum at pin 1 with pin 4 grounded and 6.3v AC at pin 3.

This selection process should yield tubes with at least 2000 hours service in the most critical applications. We have vendors who produce tubes with a low, medium and also a high yield, only to fall below our requirements before one year of service. The 157-0104-01 will be selected from vendors offering an acceptable tube.

Superseded by M10189 and M11409.

Parts Removed:

V152	6AL5	154-0016-00

Parts Added:

V152	6AL5	157-0104-01

FRONT PANEL KNOB COLOR CHANGED TO CHARCOAL FOR COMPATIBILITY WITH NEW INSTRUMENTS

INFORMATION ONLY

M9172

Effective Prod s/n 780

DESCRIPTION:

To standardize indicator and plug-in knob colors all knobs, switch buttons, binding posts, etc., on older instruments are changed to the charcoal colored ones used on the new instruments.

Parts Removed:

Knob, assembly		366-0028-00
Knob, assembly	(2)	366-0029-00
Knob, assembly		366-0030-00
Knob, assembly	(7)	366-0033-00
Knob, assembly		366-0040-00
Post, binding	(3)	129-0036-00
Bushing, binding post	(3)	358-0036-00

Parts Added:

Knob, assembly		366-0145-00
Knob, assembly	(2)	366-0142-00
Knob, assembly		366-0146-00
Knob, assembly	(7)	366-0148-00
Knob, assembly		366-0160-00
Post, binding	(3)	129-0063-00
Bushing, binding post	(3)	358-0169-00

SAWTOOTH AND +GATE OUT OF NEON ADDED PREVENTING EXCESSIVE GRID-CATHODE VOLTAGE DURING WARM-UP

See SQB

M9464

Effective Prod s/n 790

Usable in field instruments s/n 101-789

DESCRIPTION:

Excessive voltage from grid to cathode of V43A/V193A during warm-up. The tube shorts with destruction of R42, R47, R48, R660 and V617. This problem was corrected by adding an NE-23 neon between grid and cathode of V43A/V193A.

Parts Removed:

Parts Added:

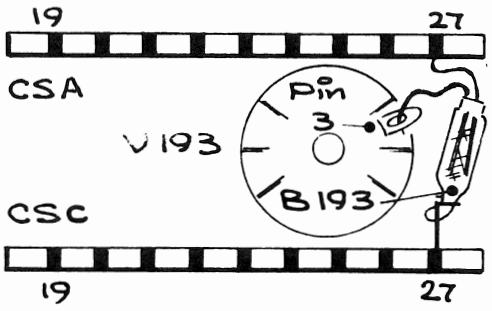
B193	NE-23	150-0027-00
Clamp, neon bulb holder		343-0043-00

INSTALLATION INSTRUCTIONS:

Refer to drawing of ceramic strips for the location of B193.

a) Install a NE-23 neon bulb between CSA-27 and pin 3 of V193.

b) Install a wire neon bulb clamp to support the bulb tip at CSC-27.



CRT FILTER SHAPE AND COLOR STANDARDIZED TO REDUCE COST

INFORMATION ONLY

M9022

Effective Prod s/n 840

DESCRIPTION:

Provides a cost savings by standardizing the shape and color of CRT light filters. This was accomplished by replacing .060" thick green, blue and amber filters for 5" rectangular and round external graticule instruments and .030" thick smoke gray filter for 5" rectangular internal graticule instruments with new .030" thick green, blue, amber and smoke gray filters with configuration acceptable for both internal and external graticule use.

Also replaces .060" thick green, blue and amber filters for 3" CRT instruments with new .030" thick green, blue, amber and smoke gray filters with same configurations. Change the configuration of internal graticule clear scratch plates 387-0918-00 (5" round) and 387-0935-00 (5" rectangular) to conform to new filter configurations thereby allowing use of common tooling.

Smoke-gray will replace green as standard filter shipped with external graticule instruments. Amber, green and blue filters in all configurations will be set up as optional filters supplied on customer demand and with special phosphors.

The recommended optional filters for various phosphors is as follows:

Smoke-gray filter	P1, P2, P20, P28, P31, P7
Blue filter	P5, P11, P14, P17, P32
Amber filter	P12, P13, P19, P25, P26, P27, P7
No filter necessary	P15, P16, P24

P7 phosphor requires both a smoke-gray and an amber filter.

Parts Removed:		Parts Added:	
Filter, CRT, green	378-0509-00	Filter, CRT, smoke-gray	378-0550-00
Filter, CRT, blue (optional)	378-0510-00	Filter, CRT, green (optional)	378-0551-00
Filter, CRT, amber (optional)	378-0511-00	Filter, CRT, blue (optional)	378-0552-00
Filter, CRT, yellow (optional)	378-0512-00	Filter, CRT amber (optional)	378-0553-00

NEON INDICATING LAMPS AND HOLDERS REPLACED WITH IMPROVED TYPE

INFORMATION ONLY M8002

Effective Prod SN 850

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The indicating neon holders were replaced with a type which has increased wide-angle visibility and is neater in appearance. The new holders, being slightly shorter, require a type NE-2V neon bulb and a shorter mounting screw.

Parts Removed:

B170, B300, B517	Bulb, neon, NE-23	150-0027-00
	Holder, neon, single	352-0008-00
	Screw, 4-40 x 1 FHS	211-0031-00

Parts Added:

B170, B300, B517	Bulb, neon, NE-2V	150-0030-00
	Holder, neon, single	352-0067-00
	Filter, lens, neon indicator	378-0541-00
	Screw, 4-40 x 7/8 FHS	211-0109-00

SILICON DIODE TYPE CHANGED TO REDUCE COST AND FACILITATE LAYOUT

INFORMATION ONLY M9973

Effective Prod s/n 850

FRONT PANEL SYMPTOM: None.

PROBLEM: A lower cost smaller diameter silicon diode was available to facilitate layout and improve dress.

PRODUCTION CHANGE: D602A-D, D632A-D, D662A-D were changed from top hat type diode to tubular type diode.

Parts Removed:

D602A-D D632A-D D662A-D	Diode silicon 400 PIV 500 mA	152-0047-00

Parts Added:

D602A-D D632A-D D662A-D	Diode silicon 400 PIV 500 - 750 mA	152-0066-00

SWEEP GENERATOR SILICON DIODE ADDED TO REDUCE SELECTION OF VACUUM TUBE DISCONNECT DIODE

See SQB

M10189

Effective Prod SN 850

Usable in field instruments SN 101-849

FRONT PANEL SYMPTOM: Slow speed timing error and jitter.

PROBLEM: Excessive leakage of the Miller disconnect diode was causing slow speed timing error and jitter.

PRODUCTION CHANGE: A low leakage semiconductor diode was added in series with the Miller tube control grid disconnect diode. This combines the low leakage characteristics of the semiconductor with the fast turn-off capability of the vacuum diode. Also, selected vacuum tube disconnect diodes (introduced by M9134) were changed back to raw tubes.

Mod 11409 should be installed in conjunction with Mod 10189.

Parts Removed:

V152	Tube, checked 6AL5	157-0104-01

Parts Added:

V152	Tube, raw 6AL5	154-0016-00
* D152	Diode, low leakage silicon	152-0246-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added' with asterisk and parts listed below.

R165	Resistor, 47 k 1 W 10%	304-0473-00
	Cable, coax 75 Ω (9in.)	175-0026-00

Installation Procedure:

a) Remove the bare wire between CSE-4 and CSE-5 (see drawing).

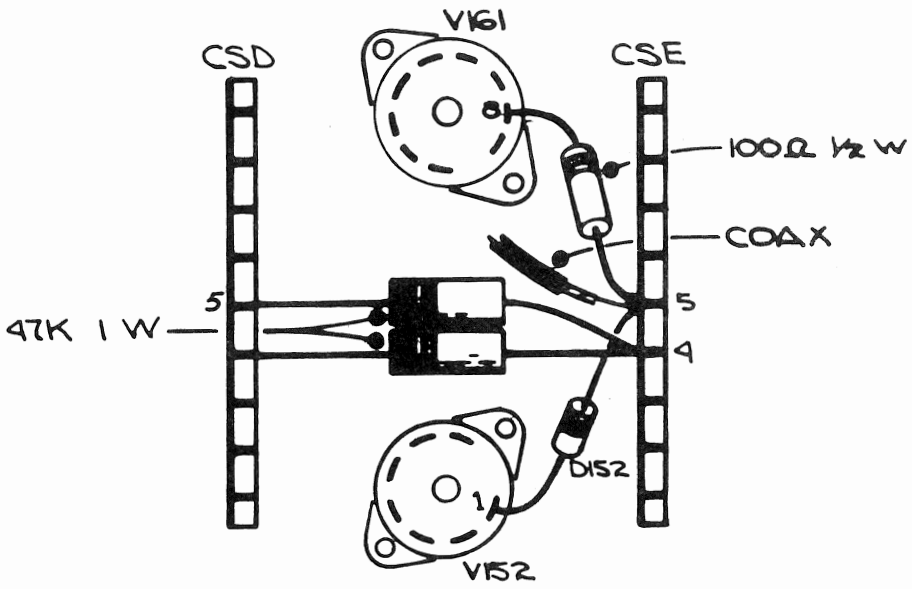
b) Replace the 47 k 1 W resistor (R165) between CSD-5 and CSE-5 with a new resistor, relocating it between CSD-5 and CSE-4.

c) Replace the coax between pin 1 of V152 and wafer 2 of the TIME/DIV switch with a new length of coax. Reconnect the one end to CSE-5.

d) Move one end of the 100 Ω resistor (R164) from pin 1 of V152 to CSE-5.

e) Add diode D152 between CSE-5 (banded end) and pin 1 of V152.

continued


V161
CSD
CSE
100Ω ½ W
COAX
47K 1 W
5
5
4
D152
1
V152

6AU6 & 12AU6 TUBES REPLACED BY PREMIUM 8425 & 8426 TUBES TO REDUCE MICROPHONICS, INTERFACE, AND GRID CURRENT PROBLEMS

INFORMATION ONLY

M10548

Effective Prod SN 850

FRONT PANEL SYMPTOM: Microphonics, interface, and grid current.

PROBLEMS: Usage of 6AU6 and 12AU6 tubes results in high reject rate and length of selection time because of microphonics, interface, and grid current.

PRODUCTION CHANGE: Type 6AU6 and 12AU6 tubes were replaced by 8425 and 8426 premium tubes.

Parts Removed:

V483, V503, V514, V524	Tube, raw 6AU6	154-0022-00

Parts Added:

V483, V503, V514, V524	Tube, raw 8425/6AU6	154-0022-07

SWEEP GENERATOR DISCONNECT CIRCUIT IMPROVED BY ADDING A RESISTOR

See SQB

M11409

Effective Prod SN 850

Usable in field instruments SN 101-849 **

** Only in instruments containing M10189.

FRONT PANEL SYMPTOM: Slow speed timing error and high speed jitter.

PROBLEM: Mod 10189 did not totally eliminate slow speed timing error and high speed jitter.

PRODUCTION CHANGE: A 6.8 M 1/2 W 10% resistor was installed in parallel with the Miller tube control grid disconnect diode V152. The added resistor shunts the heater to cathode leakage around the tube allowing the silicon diode D152 to remain off when V152 is turned off. Mod 11409 should only be utilized in instruments containing Mod 10189.

Parts Added:

R152	Resistor 6.8 M 1/2 W 10%	302-0685-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Install a 6.8 M 1/2 W 10% resistor between pins 7 and 1 of V152.

MOTOR BASE CONNECTOR CHANGED TO FACILITATE ASSEMBLY AND REDUCE COST

INFORMATION ONLY

M9271

Effective Prod SN 870

FRONT PANEL SYMPTOM: None.

PROBLEM: To reduce cost and facilitate fabrication of Tek-made motor bases by adapting them for automated machinery.

PRODUCTION CHANGE: Tek-made motor base 131-0102-00 was replaced with new Tek-made motor base 131-0102-01. New and old differ in method for their assembly and the subparts. Old motor base uses a #4 nut, lockwasher and screw on one side and a #4 nut, lockwasher and externally threaded ground post on other side. New motor base uses a #4 self-tapping screw into new cover 200-0185-01 on one side and a #4 sems screw into new internally threaded ground post 129-0041-00 on the other side.

Parts Removed:	Motor base	131-0102-00
Parts Added:	Motor base	131-0102-01

TIMING CAPACITOR SETS
CHANGED TO LESS EXPENSIVE
AND MORE RELIABLE PARTS

INFORMATION ONLY

M10556

Effective Prod SN 880

FRONT PANEL SYMPTOM: None.

PROBLEM: Old timing capacitor sets were expensive, unreliable, and difficult to produce.

PRODUCTION CHANGE: Timing capacitor 'cans' were replaced by a metal bracket that now holds the timing capacitors mounted on strips. The new timing capacitor sets will be numbered 295-xxxx-xx and the individual components will be 285-xxxx-xx. All 285-xxxx-xx numbers used in these sets are individual replaceable tubular capacitors with percent designations (letter coded). The letter code must be specified in addition to the part number when ordering replacement parts.

The wired timing switch will be given a new part number. The new switch is the same as the old except for the removal of the 0.001 μF (291-0008-00) tubular timing capacitor. This capacitor will now be included in the 295-xxxx-xx capacitor set number.

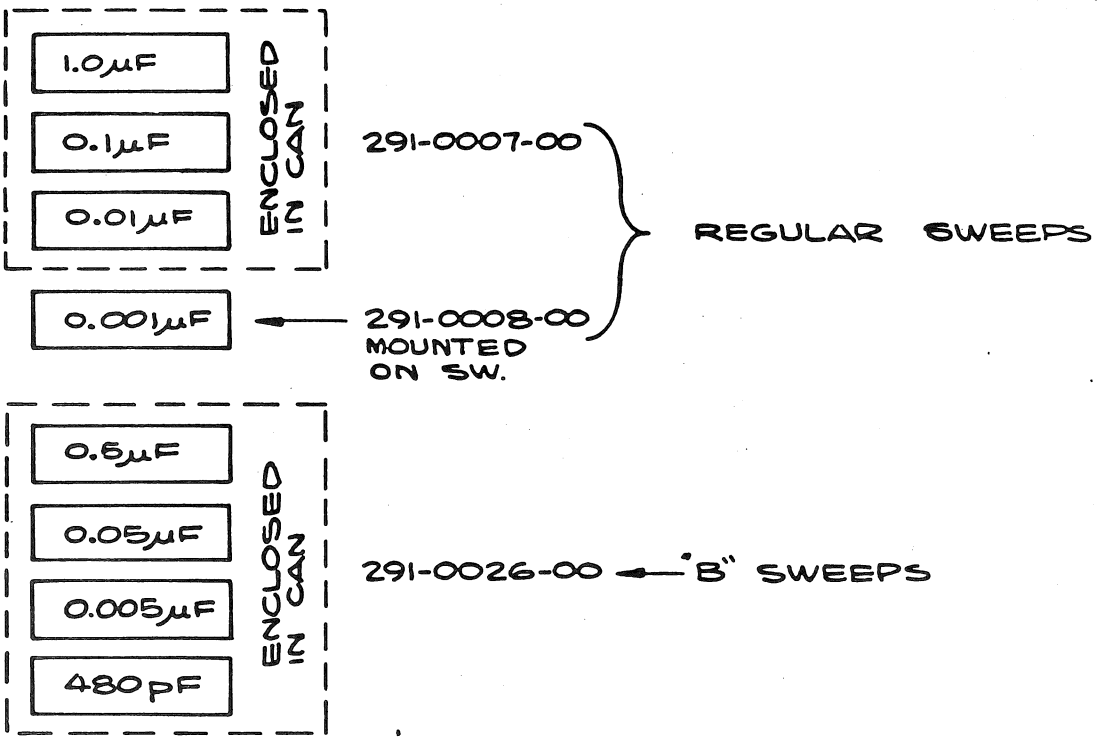
Parts Removed:

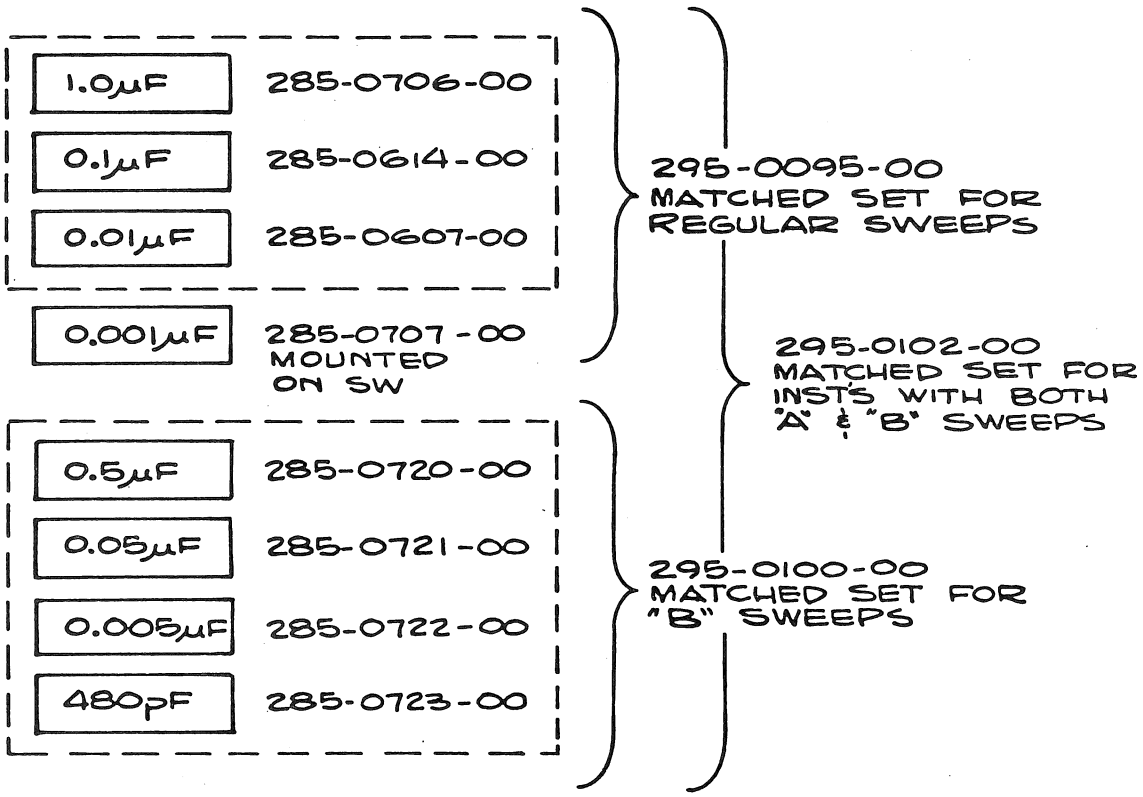
SW160	Switch, wired, TIME/CM	262-0182-00
C160J, C160H, - C160G,	Capacitor, 1 x .1 x .01 μF ±1/2%	291-0007-00
C160F	Capacitor, 0.001 μF ±1/2%	291-0008-00
	Nut, 6-32 x 1/4 (2)	210-0407-00
	Lockwasher, int #6	210-0006-00

Parts Added:

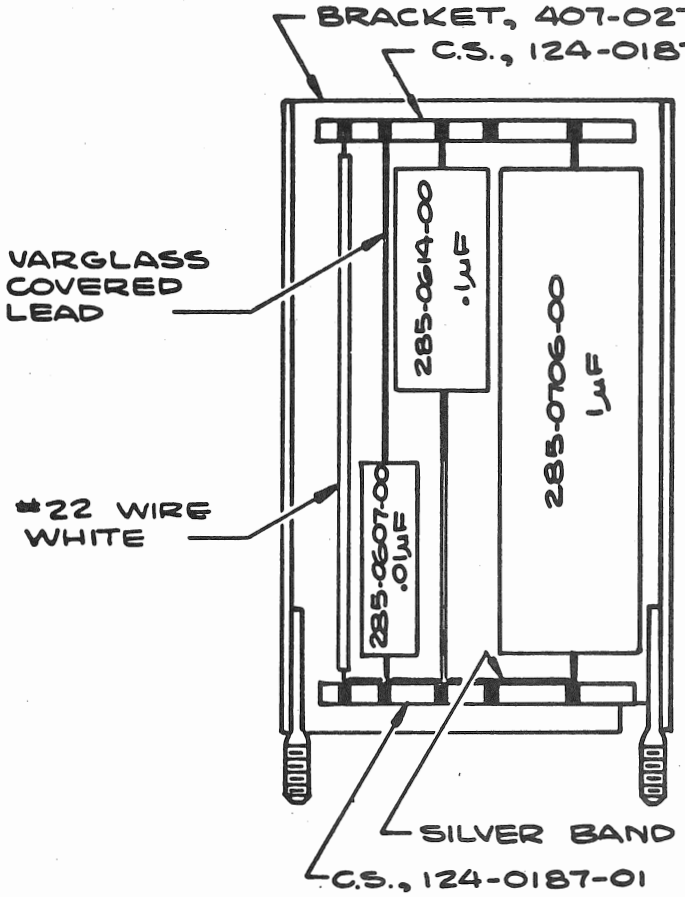
SW160	Switch, wired, TIME/CM	262-0182-01
C160F, C160G, C160H, C160J	Capacitor, assembly, checked	295-0095-00
	Keps nut, 6-32 x 5/16 (2)	210-0457-00
	Bracket, cap mounting	407-0277-00

continued

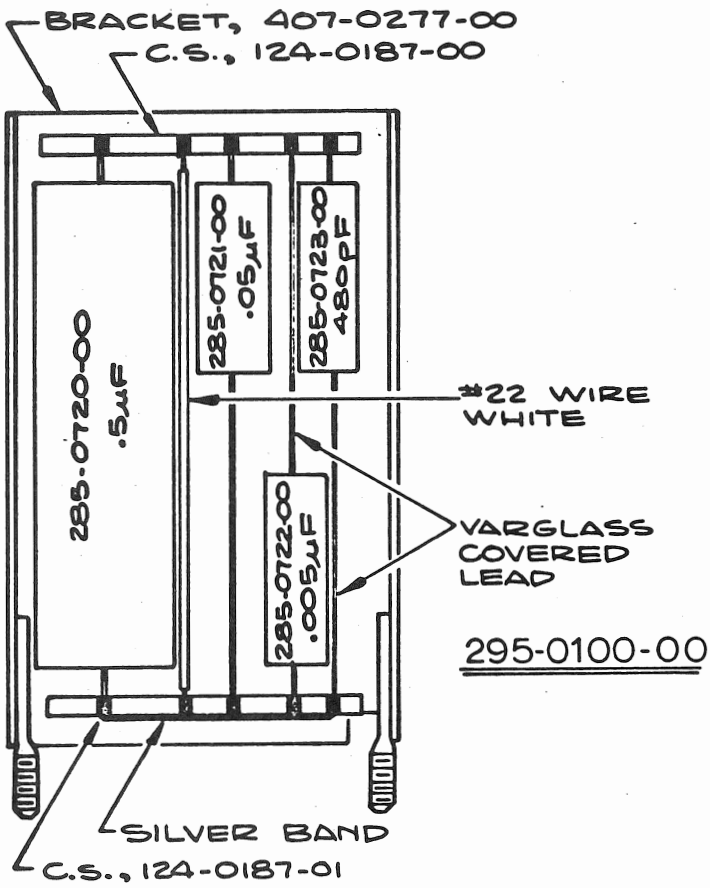

1.0μF
0.1μF
0.01μF
ENCLOSED IN CAN
291-0007-00
REGULAR SWEEPS
0.001μF
291-0008-00
MOUNTED ON SW.
0.5μF
0.05μF
0.005μF
480pF
ENCLOSED IN CAN
291-0026-00
"B" SWEEPS


1.0μF
285-0706-00
0.1μF
285-0614-00
0.01μF
285-0607-00
0.001μF
285-0707-00
MOUNTED ON SW
295-0095-00
MATCHED SET FOR REGULAR SWEEPS
295-0102-00
MATCHED SET FOR INST'S WITH BOTH "A" & "B" SWEEPS
0.5μF
285-0720-00
0.05μF
285-0721-00
0.005μF
285-0722-00
480pF
285-0723-00
295-0100-00
MATCHED SET FOR "B" SWEEPS

continued



295-0095-00
(w/o .001μF cap)



295-0100-00

P6006 PROBE REPLACED BY P6012 TO STANDARDIZE ON PROBE TYPES — INFORMATION ONLY — M11641

Effective Prod SN 880

FRONT PANEL SYMPTOM: None.

PROBLEM: New P6012 probe is now available to replace the P6006 probe, offering the following improvements: 1) usable with oscilloscopes having bandwidths up to 33 MHz. 2) its very small size permits use on subminiature circuitry. 3) it is capable of matching inputs of oscilloscopes with input capacitances of from 15 to 47 pF.

PRODUCTION CHANGE: P6006 probe was replaced by the P6012 as a standard accessory.

Parts Removed:

P6006	Probe pkg., 10 M 10X, 42"	010-0127-00

Parts Added:

P6012	Probe pkg., 10 M 10X, 42"	010-0203-00

TIME-BASE GENERATOR 6AN8 TUBE CHANGED TO EFC-80/6BL8 TO ELIMINATE TUBE SELECTION — INFORMATION ONLY — M11924

Effective Prod SN 890

FRONT PANEL SYMPTOM: None.

PROBLEM: The 6AN8 vacuum tube has a poor screen-to-plate ratio causing sweep start problems.

PRODUCTION CHANGE: The 6AN8 tube used in the sweep gating multivibrator (V35) was replaced by an EFC-80/6BL8 type tube. The tube socket was rewired to conform to the new pin connections.

Parts Removed:

V145	Tube, raw vacuum 6AN8	154-0078-00

Parts Added:

V145	Tube, raw vacuum EFC-80/6BL8	154-0278-00

Effective Prod SN 893

FRONT PANEL SYMPTOM: None.

PROBLEM: None

PRODUCTION CHANGE: Chassis tracks and hardware are standardized to facilitate mounting of tracks in assembly.

Parts Removed:	Guide, chassis track (1 pr)	351-0017-00
Parts Added:	Slide, stationary and intersections (1 pr)	351-0083-00

CABINET LATCH CHANGED TO IMPROVED DESIGN

INFORMATION ONLY

M8913

Effective Prod SN 893

DESCRIPTION:

The cabinet latch assembly is replaced by an improved assembly, providing a more positive ground and easier installation and removal of cabinet members. The new assembly is the same as that used on the new 540 series and 647 instruments and consists of spring 214-0359-00, pin 214-0400-00, bushing 358-0218-00 locking plate,387-0804-00 and index plate 387-0871-00.

Parts Removed:		Parts Added:	
Plate, cabinet side (2)	387-0051-00	Plate, cabinet side (2)	386-0161-00
Plate, cabinet bottom	387-0052-00	Plate, cabinet bottom	386-0162-00

3-WIRE POWER CORD FEMALE GROUND CONNECTION IMPROVED BY THE ADDITION OF A SPRING

See SQB (Accessories)

M11292

Effective Prod SN 900

Usable in field instruments SN 101-899

FRONT PANEL SYMPTOM: None.

PROBLEM: Inadequate ground connection between power cord and instrument motor base.

PRODUCTION CHANGE: A ground spring was added to the non-current carrying ground receptacle on the female connector end of the power cord.

Parts Removed:	None.	
Parts Added:	Spring, power cord ground (subpart of power cord 161-0010-03)	214-0698-00

INSTALLATION INSTRUCTIONS:

Parts Required:

See 'Parts Added, or part listed below.

Field Modification Kit	040-0424-01

NOTE: Field Mod Kit includes enough springs to modify 25 power cords.

Installation Procedure:

Refer to mod kit instructions.

POWER LIGHT COLOR CHANGED TO STANDARD GREEN — INFORMATION ONLY — M12031

Effective Prod SN 920

FRONT PANEL SYMPTOM: None

PROBLEM: More than one color was being used for the Power On light.

PRODUCTION CHANGE: All lights were changed to green.

Parts Removed:	Socket, light w/#4L red jewel assembly	136-0047-00
Parts Added:	Socket, light assembly w/green jewel	136-0079-00

FOCUS AND INTENSITY POTENTIOMETERS CHANGED TO REDUCE COST IMPROVE QUALITY AND PROVIDE BETTER SUPPLY OF POTENTIOMETERS — INFORMATION ONLY — M11639

Effective Prod SN 930

FRONT PANEL SYMPTOM: None

PROBLEM: None

PRODUCTION CHANGE: FOCUS AND INTENSITY potentiometers were changed as indicated in the remove add list.

Parts Removed:

R831	Potentiometers, comp., 1 M	311-0041-00
R852	Poteniometers, comp., 2 M	311-0043-00

Parts Added:

R831	Potentiometers, comp., 1M	311-0041-02
R852	Potentiometers, comp., 2 M	311-0043-02

MOTOR BASE CHANGED TO IMPROVE GROUND CONNECTION

See SQB

M12876

Effective Prod SN 930

Usable in field instruments SN 101-929

FRONT PANEL SYMPTOM: None.

PROBLEM: The present motor base grounding is not adequate, due to cold flow of the plastic between the ground post and the mounting plate.

PRODUCTION CHANGE: The method used to attach the ground post in the motor base assemblies was changed. The new mounting eliminates plastic between the ground post and the mounting plate and provides a metal to metal ground connection. To insure a good fit between mating parts, the size of the mounting screws was changed from #4 to #6, and the clearance holes in the mounting plate and shell were increased to #6.

To prevent corrosion between new ground post and mounting plate, the plate was changed from etched aluminum to cad plated steel.

Parts Removed:	Motor base	131-0102-01
Parts Added:	Motor base	131-0102-02

INSTALLATION INSTRUCTIONS:

See MI - 12876

HORIZONTAL AMPLIFIER RESISTORS CHANGED TO INCREASE HORIZONTAL POSITION RANGE

INFORMATION ONLY

M13200

Effective Prod SN 940

FRONT PANEL SYMPTOM: None

PROBLEM: Selection of parts in the Horizontal Amplifier is necessary to make Horizontal Position range specs.

PRODUCTION CHANGE: The input divider ratio of the Horizontal Amplifier was lowered to allow more horizontal deflection with complete counterclockwise rotation of the Horizontal Position control.

Parts Removed:

R311	Resistor, prec., 1.11M, 1% 1/2W	309-0015-00

Parts Added:

R311	Resistor, prec., 1.0M, 1% 1/2W	309-0386-00

JT:bl

MODIFICATION INSTRUCTIONS

MI - 12876

GENERAL

Serial Numbers - See Below

MOTOR BASE REDESIGNED TO IMPROVE GROUNDING

The present motor base ground post mounts against the plastic motor base body. Due to cold flow in the plastic it is possible for the ground post to loosen, causing poor ground connection.

A new motor base has been designed which eliminates the plastic between the ground post and the metal mounting plate, thereby assuring a good ground connection.

Instrument	Serial No.	Instrument	Serial No.	Instrument	Serial No.
106	200-1354	317	101-5069	543B/RM	100-1588
109	101-1479	RM17	101-929	544/RM	100-979
111	101-1327	422	100-10649	545B/RM	100-8229
114	100-1699	502A	20000-27719	546	100-1099
R116	100-1199	RM503	101-6859	RM546	100-519
125	101-3129	RM504	101-2549	547/RM	100-7209
127	101-2317	507	101-822	549	
129	100-599	515A	1001-9679	551	101-7009
130	101-9879	RM15	101-3539	555	
132	101-2419	516	101-4419	556	100-2085
133	101-789	519	101-1148	R556	100-1049
160A	620-11499	524AD	101-7858	561A	5001-19207
175	101-794	526	101-2723	RM561A	5001-12409
184	100-2628	531A	20001-27419	564	101-10719
191	100-1878	RM531A	1001-27419	RM564	101-2919
262	101-549	533A	3001-5529	565/RM	101-2749
1121	101-1709	RM533A	1001-5529	567/RM	101-3039
067-0502-00	2210-869	535A	20001-34929	575	101-12389
R293		RM535A	1001-34929	581A	3975-6149
310A	10001-22319	536	101-3749	585A	5969-13429
				RM585A	100-1689
				R647	
				661	101-3459

Parts required for the following:

106	191	RM15	RM531A	RM543B	581A
109	317	516	533A	RM544	585A
111	RM17	519	RM533A	RM545B	RM585A
127	RM503	524AD	535A	RM546	661
130	RM504	526	RM535A	RM547	1121
160A	515A	531A	536	567/RM	067-0502-00

PARTS REQUIRED:

Quantity	Tektronix Part Number	Description
1 ea	131-0102-02	Connector, motor base

continued

Parts required for the following:

114	175	543B	549	561A	575
125	R293	544	551	RM561A	RM647
129	310A	545B	555	564	016-0072-00
132	502A	546	556	RM564	
133	507	547	R556	565/RM	

PARTS REQUIRED:

Quantity	Tektronix Part Number	Description
1 ea	131-0572-00	Connector, motor base

Parts required for the following: R116 184

PARTS REQUIRED:

Quantity	Tektronix Part Number	Description
1 ea	131-0430-02	Connector, motor base

INSTALLATION

Replace the motor base connector with the new type.

JT:fb

MODIFICATION KIT

SILICON RECTIFIER

040-212

For Tektronix Oscilloscopes:

Types 316 serial numbers 101-1082
317 serial numbers 101- 340

DESCRIPTION

This modification replaces the selenium rectifiers used in the power supplies of the above instruments with silicon rectifiers, offering more reliability and longer life.

The following selenium rectifiers are replaced: SR601 (part number 106-015), SR630 (106-031), SR660 (106-030), and SR150 (106-039).

Publication:
Instructions for 040-212
June 1966

Supersedes:
January 1965

PARTS LIST

Quantity	Description	Part Number
1 ea.	Assembly, silicon rectifier, consisting of:	
2 ea.	Strip, cer, 3/4 x 7 notches, clip-mounted	124-089
2 ea.	Strip, cer, 3/4 x 11 notches, clip-mounted	124-091
14 ea.	Diode, silicon, 500-750ma 400 PIV	152-066
3 ea.	Tube, spacer, aluminum, 21/32, tapped 8-32	166-098
1 ea.	Lug, solder, 8L	210-228
3 ea.	Screw, 8-32 x 1/4 BHS	212-001
1 ea.	Resistor, WW, 30 Ω 3 w 5%	308-142
1 ea.	Resistor, WW, 60 Ω 5 w 5%	308-162
8 ea.	Spacer, nylon molded, 0.156	361-008
1 ea.	Bracket, silicon rectifier mounting	406-518
1 ea.	Wire, no.22 solid, 9 in. white-blue	(175-522)
3 ea.	Screw, 8-32 x 1/4 BHS	212-001
2 ea.	Capacitor, cer, 0.02 µf 150 v Hi-Kap	283-004
1 ea.	Resistor, comp, 3.3 Ω 1 w 5%	307-015
1 ea.	Tubing, plastic, no.13 black, 8 in.	(162-015)
1 ea.	Wire, no.22 solid, 6 in. black	(175-514)
1 ea.	Wire, no.22 solid, 10 in. white	(175-522)
1 ea.	Wire, no.22 solid, 6 in. gray	(175-544)
1 ea.	Wire, no.20 solid, 6 in. bare	(176-004)
1 ea.	Wire, solder, silver-bearing, 24 in.	

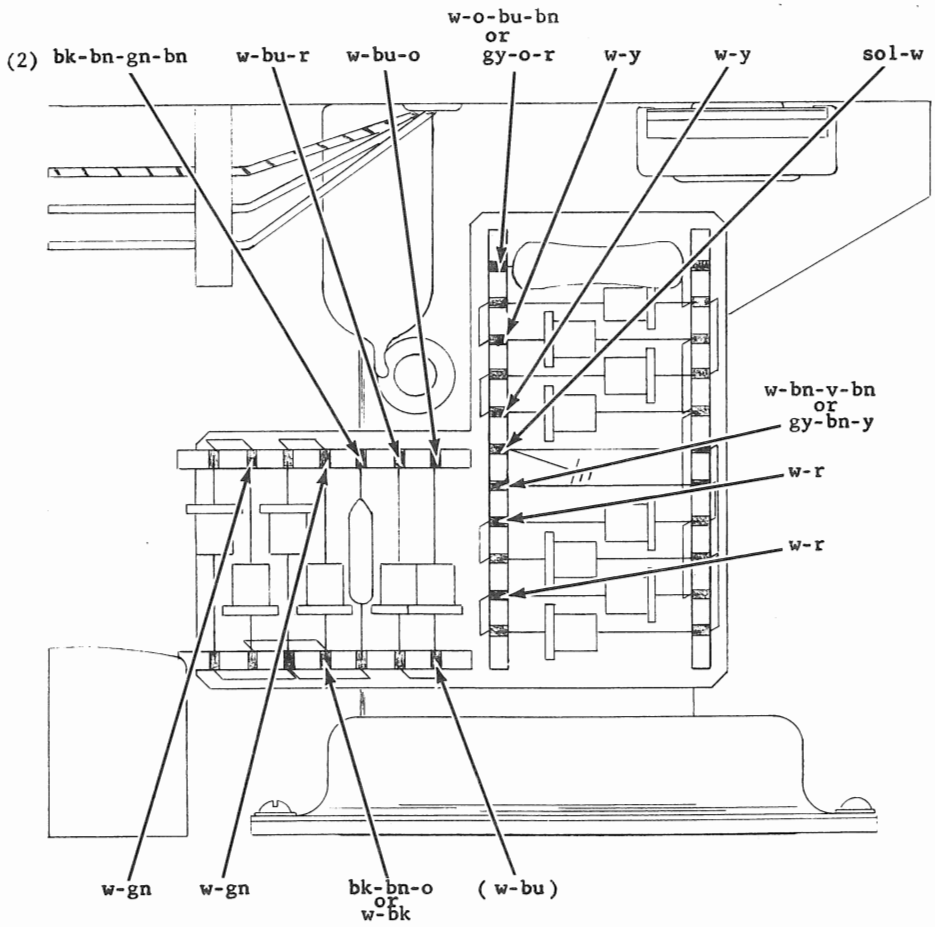


Fig. 1

INSTRUCTIONS

IMPORTANT: When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

( ) 1. Unsolder all wires from selenium rectifiers SR601, SR630, SR660 and SR150 (SR150 located on back of rectifier bracket).

( ) 2. Remove the selenium rectifiers from the instrument.

( ) 3. Cut the lacing from the rectifier wires back to the grommet.

( ) 4. Locate the wires (white-blue-red and white-blue-orange) that were connected to SR150.

( ) Dress these wires through the grommet alongside the other rectifier wires.

( ) 5. Mount the silicon rectifier bracket in the three holes vacated by SR601, SR630 and SR660 (see Fig. 1). Use the three 8-32 x 1/4 BHS screws from the kit.

( ) 6. Dress the white-blue wire, attached to the silicon rectifier assembly, through the grommet and downward to the seven-notch ceramic strip, below the former location of SR150.

( ) 7. Unsolder and remove the bare wire, which connected SR150 to the first notch on the ceramic strip referred to in the previous step.

( ) 8. Solder the white-blue wire (step 6) to the same notch on the above ceramic strip.

( ) 9. Solder the wires to the silicon rectifier assembly, as shown in Fig. 1. Trim and dress the wires as necessary.

NOTE: If any wires are too short, splice them with a length of wire from the kit. Place a length of plastic tubing (from kit) over the splice.

( ) 10. Locate V263, on the LV power chassis.

( ) Remove the 0.01 μf capacitor between pin 4 of V263 and ground.

( ) 11. Locate V244, near V263.

( ) Solder a 0.02 μf ceramic capacitor (from kit) between pin 5 of V244 and the nearest ground lug.

( ) Similarly, solder a 0.02 μf ceramic capacitor (from kit) between pin 4 of V244 and the ground lug.

( ) 12. Locate C150, on the bottom of the power chassis, near transformer T600 (see Fig. 2).

( ) Unsolder and remove the bare wire connecting the two sections of C150.

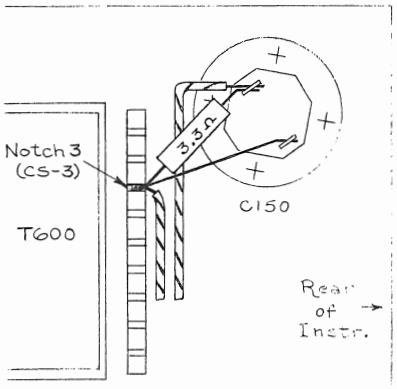


Fig. 2

Perform steps 13 and 14 ONLY if there are two white-blue wires connected to C150.

( ) 13. Move one ONLY of the white-blue wires from C150 to CS-3 (see Fig. 2).

( ) 14. Solder the 3.3 Ω resistor (from kit) between CS-3 and the terminal of C150 to which the remaining white-blue wire is still soldered (see Fig. 2).

Do step 15 ONLY if there is a resistor soldered to one terminal of C150.

( ) 15. Replace the 2.2 Ω resistor between C150 and CS-3 with the 3.3 Ω resistor from the kit (see Fig. 2).

( ) 16. Solder a bare wire (from kit) between CS-3 and the vacant terminal of C150 (see Fig. 2).

THIS COMPLETES THE INSTALLATION

( ) Check wiring for accuracy.

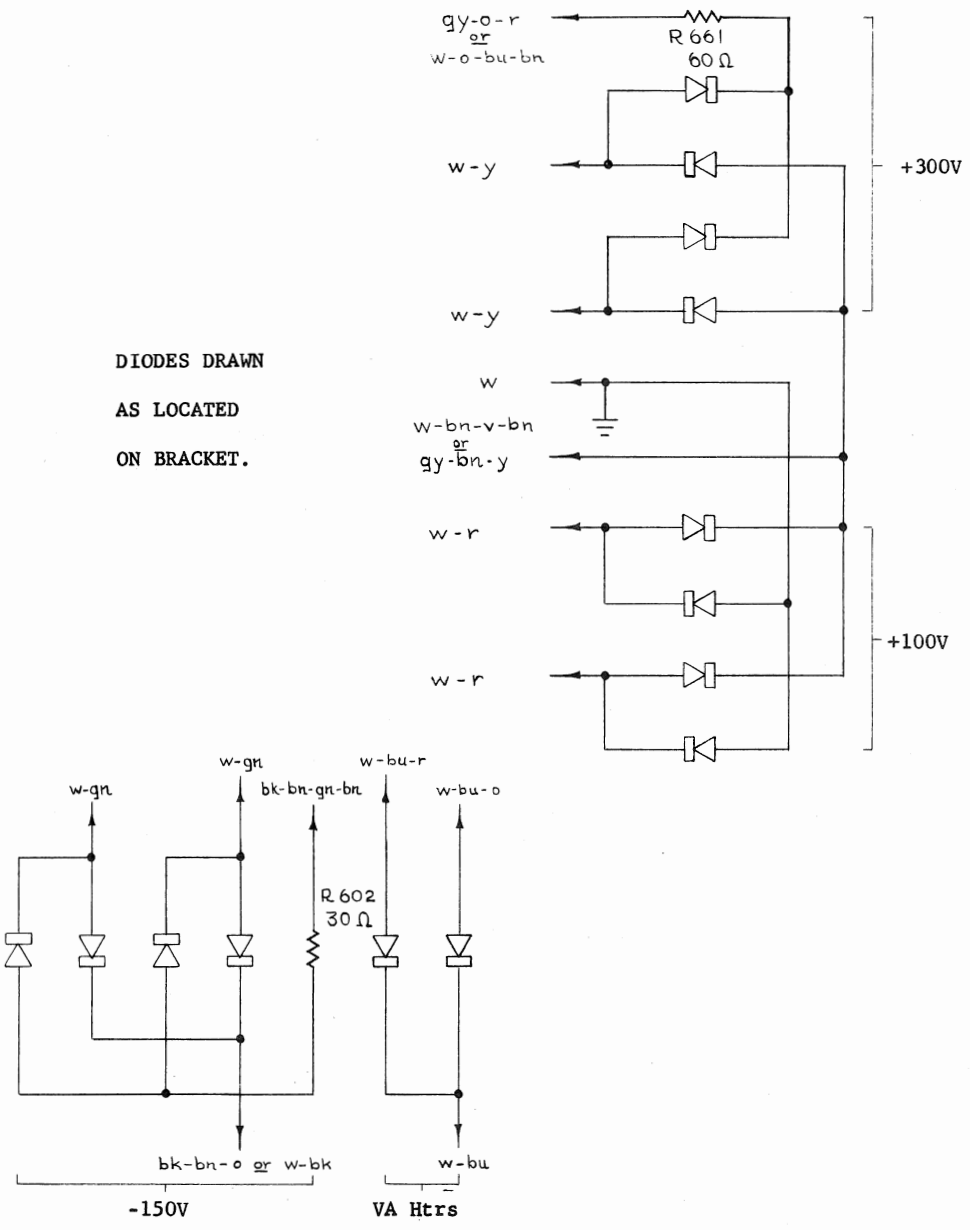
( ) Turn the instrument on and check the power supply for proper voltages and regulation.

NOTE: If adjustments are made to the power supply, it will be necessary to check the calibration of the rest of the instrument.

( ) Insert the Manual pages in your Instruction Manual.

JB:cc

BRACKET WIRING



SILICON RECTIFIER

Type 316 -- s/n 101-1082
Type 317 -- s/n 101- 340

GENERAL INFORMATION

This modification replaces the selenium rectifiers used in the Types 316 and 317 power supplies with silicon rectifiers, offering more reliability and longer life.

ELECTRICAL PARTS LIST

Values fixed unless marked variable. Only new parts listed.

CAPACITORS

Tolerance ±20% unless otherwise indicated.

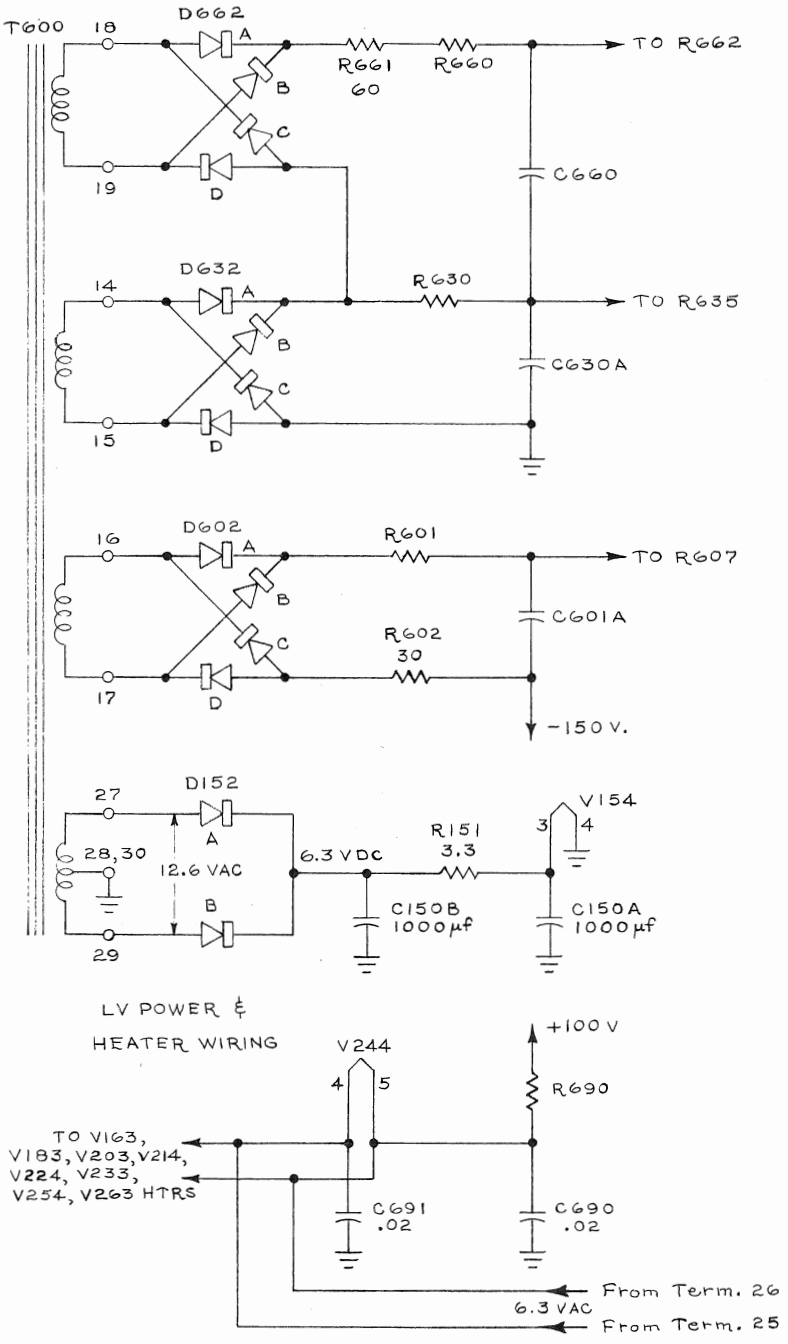
Ckt. No.	Part Number	Description			
C690	283-004	0.02 µf	150 v	cer	Hi-Kap
C691	283-004	0.02 µf	150 v	cer	Hi-Kap

DIODES

D152A,B	152-066	500-750 ma	400 P IV	Silicon	
D602A,B,C,D	152-066	500-750 ma	400 P IV	Silicon	
D632A,B,C,D	152-066	500-750 ma	400 P IV	Silicon	
D662A,B,C,D	152-066	500-750 ma	400 P IV	Silicon	

RESISTORS

R151	307-015	3.3 Ω	1 w	comp	5%
R602	308-142	30 Ω	3 w	WW	5%
R661	308-162	60 Ω	5 w	WW	5%


T600
18
19
D662
A
B
C
D
R661
60
R660
TO R662
C660
D632
14
15
R630
TO R635
C630A
D602
16
17
R601
TO R607
C601A
R602
30
-150 V.
D152
27
28,30
29
12.6 VAC
6.3 VDC
R151
3.3
V154
3
4
C150B
1000μf
C150A
1000μf
LV POWER &
HEATER WIRING
V244
4
5
+100 V
R690
TO V163,
V183, V203, V214,
V224, V233,
V254, V263 HTRS
C691
.02
C690
.02
From Term. 26
6.3 VAC
From Term. 25

FIELD MODIFICATION KIT

DC FAN

For Tektronix Types 316 and 317 Oscilloscopes
All serial numbers

INTRODUCTION:

Installation of this modification enables the Types 316 and 317 Oscilloscopes to be operated from a 50 to 400 cycle power source. Replaces 040-141.

KIT LIST:

Quantity	Description	Part Number
1 ea.	Assembly, DC Fan, consisting of:	
1 ea.	Motor, DC	147-005
1 ea.	Ring, fan, 5-3/4 ID	354-051
1 ea.	Mount, fan motor	426-049
1 ea.	Bracket, DC fan rectifier	406-809
2 ea.	Strip, cer. 7/16 x 7 notches, clip-mounted	124-094
4 ea.	Spacer, nylon molded, .313	361-009
4 ea.	Diode, silicon, 750 mA 400 PIV	152-066
1 ea.	Capacitor, PTM, .1 µf 200 V	285-572
1 ea.	Capacitor, EMT, 50 µf 50 V	290-117
2 ea.	Resistor, comp. 10 Ω 2 w. 10%	306-100
1 ea.	Clamp, cable, 5/16 plastic	343-004
1 ea.	Clamp, cable, 7/16 plastic	343-005
3 ea.	Shockmount, rubber, 1/2 x 1/2, solid round	348-008
4 ea.	Screw, 6-32 x 1/4 PHS	211-504
2 ea.	Screw, 6-32 x 5/16 PHS	211-507
2 ea.	Screw, 6-32 x 3/8 PHS	211-510
3 ea.	Washer, flat, 8S x 3/8 x .032	210-804
2 ea.	Washer, flat, 6L x 3/8 x .032	210-803
6 ea.	Lockwasher, ext. #8	210-007
6 ea.	Lockwasher, ext. #6	210-005
6 ea.	Lockwasher, int. #8	210-008
2 ea.	Lockwasher, int. #6	210-006
6 ea.	Nut, hex, 8-32 x 5/16	210-409
2 ea.	Nut, hex, 6-32 x 1/4	210-407
2 ea.	Nut, Keps, 6-32 x 5/16	210-457
1 ea.	Foot, rubber, black, 1/2 in.	348-013
1 ea.	Grommet, rubber, 1/4 in.	348-002

*

KIT LIST: (continued)

Quantity	Description	Part Number
	DC Fan Assembly (cont)	
1 ea.	Tubing, plastic, #20 black, 6in.	(162-504)
1 ea.	Wire, #20 stranded, 10in. white	175-512
1 ea.	Wire, #20 stranded, 9-1/2in. white	175-512
1 ea.	Capacitor, ceramic 0.01 μF 2kV discap	283-011
1 ea.	Resistor, comp, 1M 1/2W 10%	302-105
1 ea.	Bulb, neon NE-23, raw	150-027
1 ea.	Lug, solder, SE6, w/2 wire holes	210-202
2 ea.	Screw, thread-cutting, 4-40 x 1/4 PHS, Phillips	213-035
6 ea.	Screw, thread-cutting, 6-32 x 5/8, Truss HS, Phillips	213-041
1 ea.	Tag, voltage rating, 117V 50-400 cycles	334-661
1 ea.	Tag, voltage rating, 234V 50-400 cycles	334-664
1 ea.	Clamp, neon bulb, #18 solid wire, pre-bent, 3in. bare	176-120
1 ea.	Spool, w/3' silver-bearing solder	214-210

INSTRUCTIONS:

IMPORTANT: When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

( ) 1. **Unsolder the two black fan motor leads from the fan strip located on the rectifier mounting plate (see Fig. 2, page 3).**

( ) 2. **Remove the filter housing and filter from the rear of the instrument.**

( ) 3. **Remove the fan blade.**

( ) 4. **Remove the six (6) screws holding the fan ring (see Fig. 1) and pull the fan ring and AC motor assembly from the instrument.**

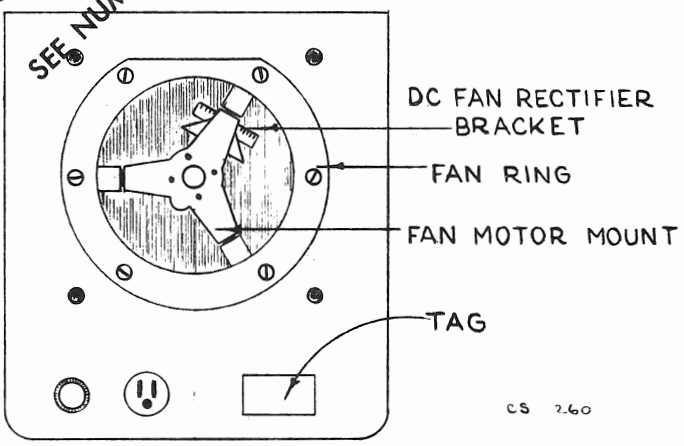


FIG. 1

( ) 5. **Loosen the shockmount <u>outer</u> nuts on the DC fan assembly from the kit (see Fig. 2, Step 5).**

*

INSTRUCTIONS: (continued)

( ) 6. Temporarily mount the DC fan assembly, as shown in Fig. 1.

( ) 7. Adjust the position of the shockmounts in the slotted holes to provide at least 3/16 in. clearance beyond the end of the DC motor (see Fig. 2, Step 7).

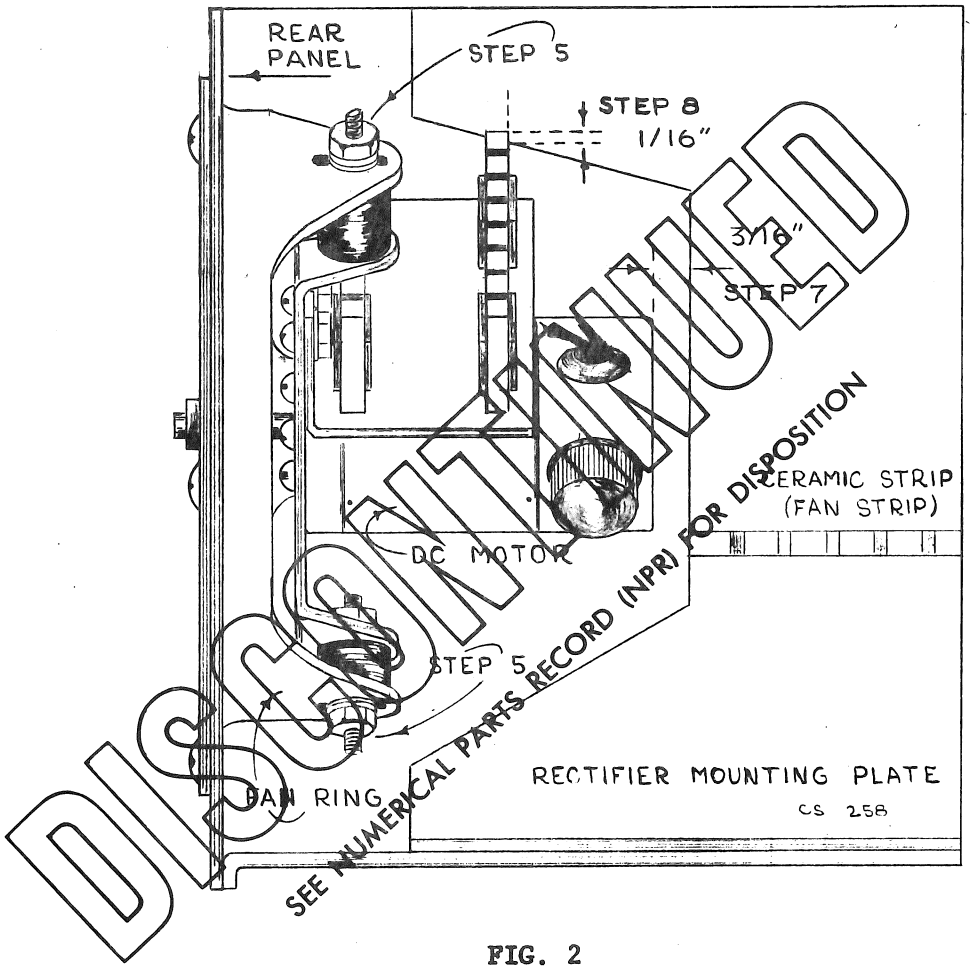


FIG. 2

( ) 8. If there is not at least 1/16 in. clearance between the rectifier mounting plate and the ceramic strip (see Fig. 2, Step 8), turn the DC fan rectifier bracket slightly by loosening the two mounting screws.

( ) 9. Tighten all nuts and screws on the DC fan assembly and mount the assembly permanently in place. Use the 6-32 thread-cutting screws from the kit.

( ) 10. Solder the two (2) white wires from the DC fan rectifier to the two (2) white wires (from T600, terminals 11 & 12) on the fan strip (see Fig. 2).

NOTE: Leave plenty of slack in the wires.

*

INSTRUCTIONS: (continued)

( ) 11. Mount the fan blade on the motor shaft so that the blade does not extend beyond the fan ring (see Fig. 3, Step 11). Tighten the set-screw down on the flat side of the shaft.

( ) 12. IMPORTANT --
To minimize vibration, check the fan blade alignment and pitch as follows:

( ) a. Hold a pencil stationary, so that the front edges of the blade fins barely clear the pencil point (see Fig. 3, Step A). Each fin should clear the pencil by exactly the same amount.

( ) b. Similarly, check the clearance of the rear edges of the blade fins (see Fig. 3, Step B).

( ) c. Carefully bend the blade fins where necessary and repeat Steps (a) and (b) until the blade is properly aligned.

( ) d. In some cases, the above procedure may not reduce vibration sufficiently, and the fan blade must be replaced.

( ) 13. Briefly turn the instrument on and check the fan for proper operation. The DC fan may be somewhat noisier than the original AC fan.

( ) 14. Replace the filter and filter housing.

NOTE: If the shaft of the DC motor touches the filter, it may be necessary to "pack down" the center of the filter.

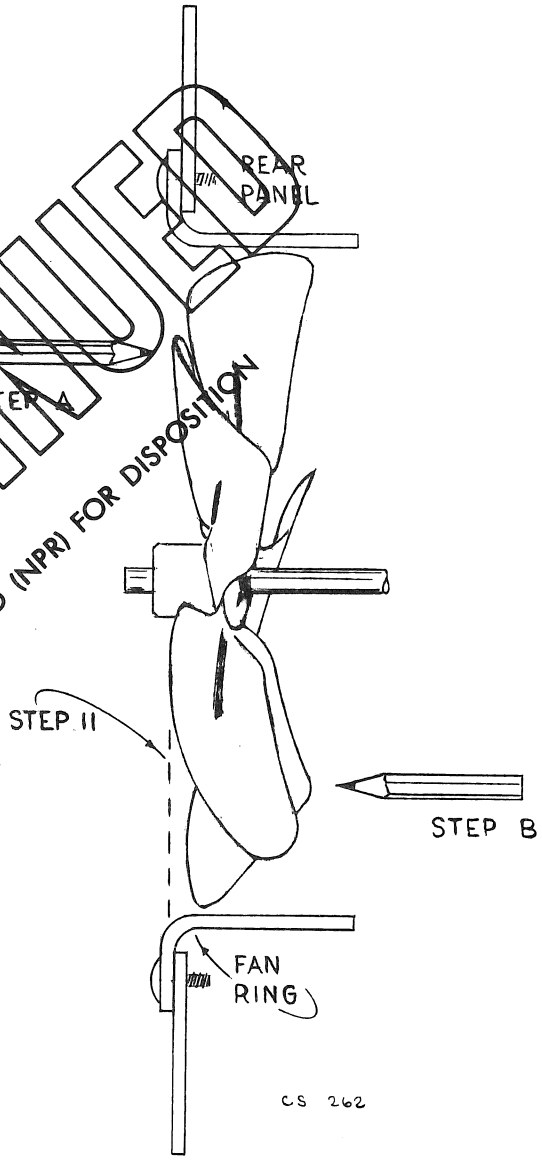


FIG. 3

( ) 15. Replace the voltage rating tag on the rear panel (Fig. 1) with the new tag (from kit). Select the tag which corresponds to the line voltage used. (See NOTE on page 5).

*

INSTRUCTIONS: (15. continued)

NOTE: If there is no voltage rating tag on the instrument, drill two (2) #43 holes and install the new tag to the right of the AC Input connector. Use the two (2) 4-40 thread-cutting screws from the kit.

Steps 16 thru 26 - 317 only --

( ) 16. Locate the Focus & Intensity (F & I) chassis (directly beneath the CRT). Remove the HV shield from the side.

( ) 17. Install the solder lug (from kit) under one of the screws holding the F & I chassis to the support bracket (see Fig. 4, Step 17).

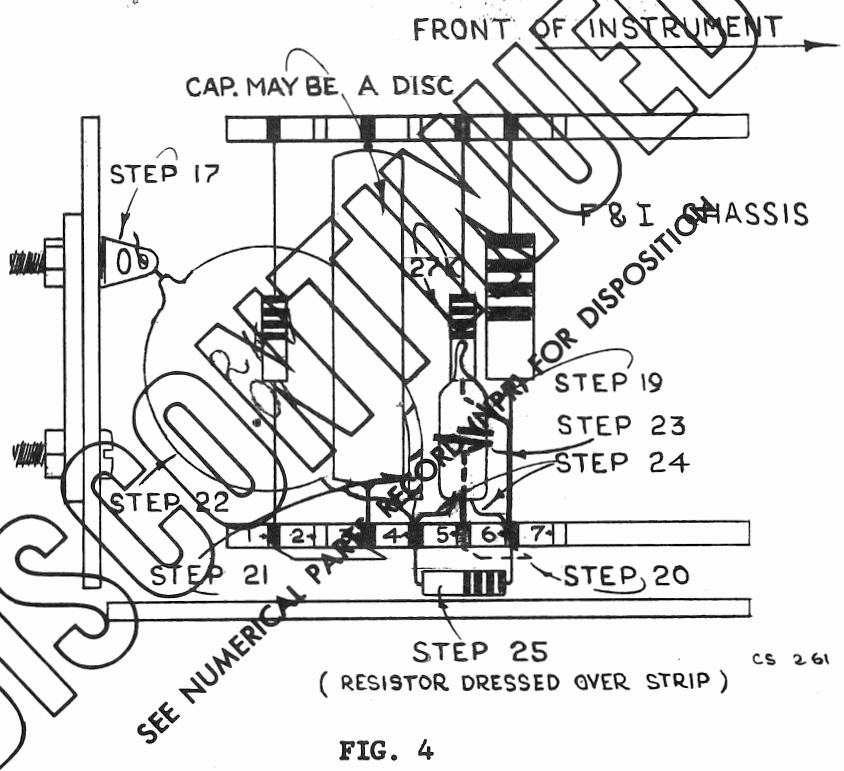


FIG. 4

( ) 18. Locate the ceramic strip shown at the bottom of Fig. 4. Note how the notches are numbered in the drawing.

( ) 19. Unsolder the 27 K resistor lead from notch 5. Bend the lead sharply near the resistor body and bend it again to lie next to the adjacent resistor lead (see Fig. 4, Step 19). Solder the lead to notch 6.

( ) 20. Remove the bare wire between notches 5 and 6 (see Fig. 4, Step 20).

( ) 21. Move the white-brown wire from notch 5 to notch 4 (Fig. 4, Step 21).

( ) 22. Dress the .01 μf discap (from kit) parallel and close to the chassis. Solder one lead to the solder lug and the other lead to notch 4 (see Fig. 4, Step 22).

*

INSTRUCTIONS: (continued)

( ) 23. Solder the neon bulb clamp (from kit) in notch 5, so that the loop "points" upward (see Fig. 4, Step 23).

NOTE: Dress the neon bulb clamp and the resistor leads so they can not touch.

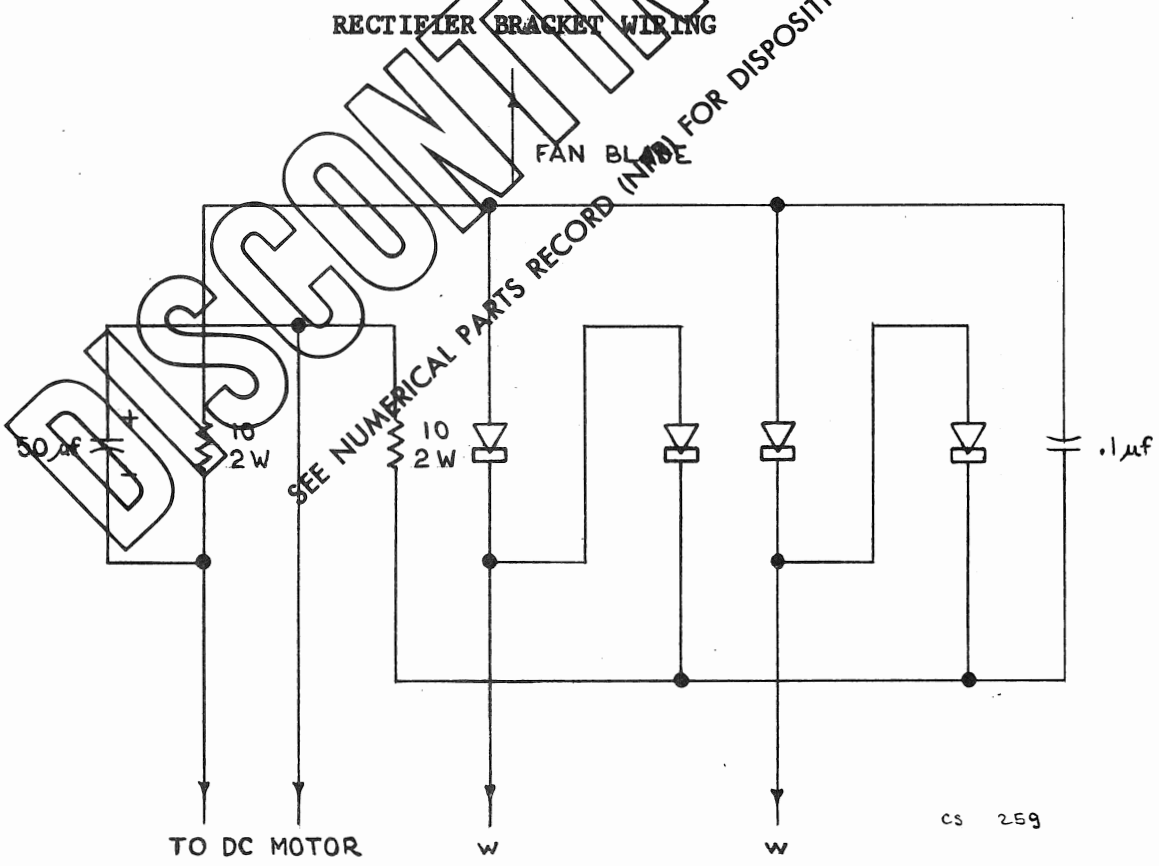
( ) 24. Slip the neon bulb (from kit) into the bulb clamp and solder the bulb leads to notches 4 and 6 (see Fig. 4, Step 24). Dress the leads slightly away from the ceramic strip.

( ) 25. Dress the 1 meg resistor (from kit) directly over the ceramic strip and solder the leads to notches 4 and 6 (see Fig. 4, Step 25).

( ) 26. Replace the HV shield.

( ) 27. THIS COMPLETES THE INSTALLATION. Recheck the wiring for possible errors.

Insert the Manual Parts List and Schematic in your Instruction Manual.



DIODES DRAWN AS LOCATED ON BRACKET

*

MANUAL PARTS LIST *

Types 316/317 -- All serial numbers

DC FAN MODIFICATION
040-228

BULBS

B859	NE-2 3	Neon	Raw		150-027

CAPACITORS

C317	.1 µf	200 V	PTM		285-572
C625	50 µf	50 V	EMP		290-117
C859	.01 µf	2 KV	Cer.	discap	283-011

DIODES

D317A,B,C,D	(4)	750 mA	400 PIV	silicon	152-066

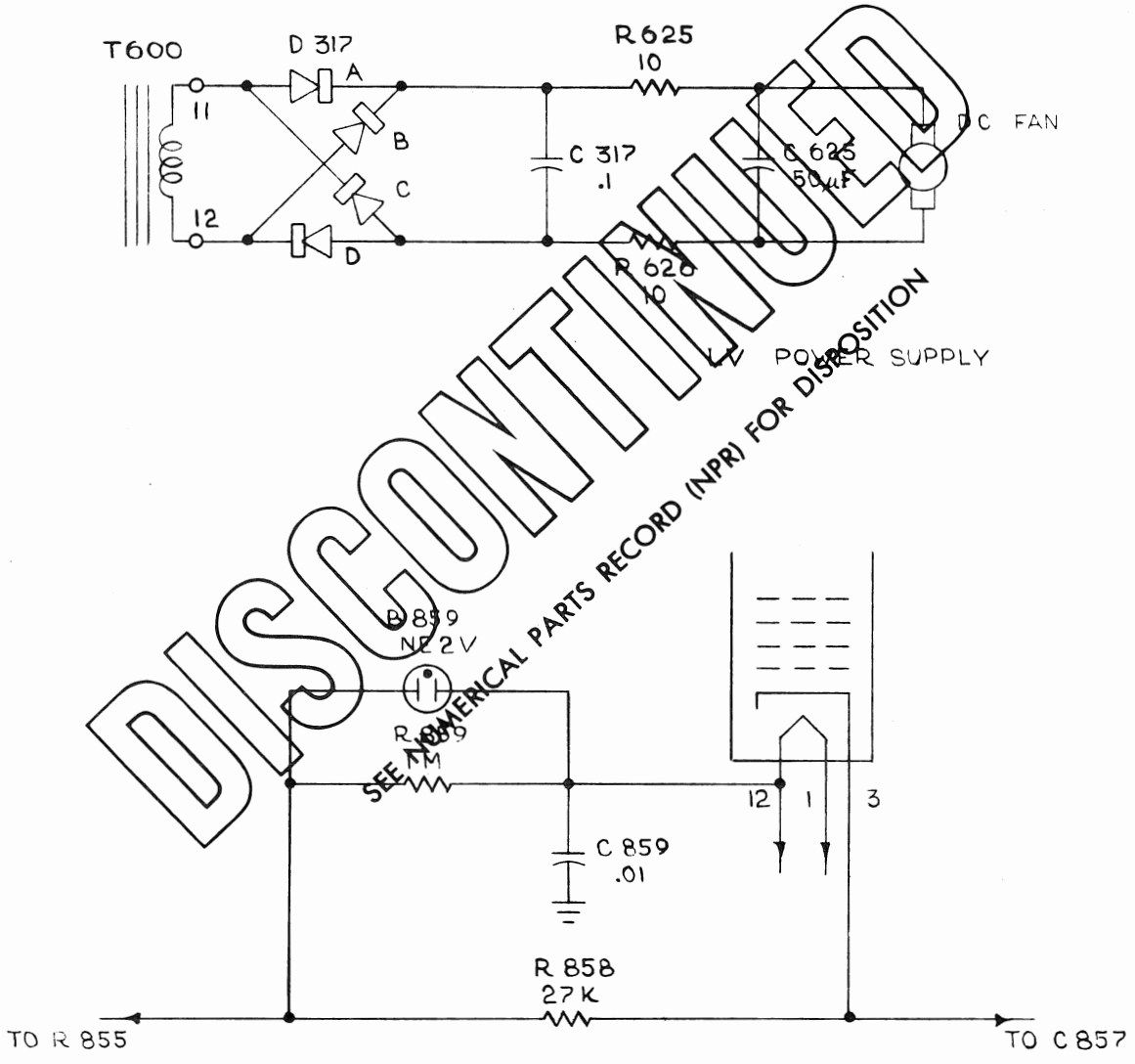
MOTORS

DC Fan		147-005

RESISTORS

R625	10 Ω	2 w.	Comp.	10%	306-100
R626	10 Ω	2 w.	Comp.	10%	306-100
R859	1 meg	1/2 w.	Comp.	10%	302-105

* only new parts listed



CRT CIRCUIT CS 257

MODIFICATION KIT

SILICON RECTIFIER

040-0389-00

For the following Tektronix Oscilloscopes:

Type 533 serial numbers 101-1190
Type RM33 serial numbers 101- 129
Type 543 serial numbers 101- 949
Type RM43 serial numbers 101- 105
Type RM16 serial numbers 364- 447
Type RM17 serial numbers 101- 125
Type RS16 serial numbers 101- 177

DESCRIPTION

This modification replaces the selenium rectifier SR752 (or SR750), part number 106-0038-00, used in the V152 (or V454) heater supply of the above-listed instruments, with silicon diodes. The new diodes offer longer life and greater reliability.

A resistor is added, in series with the diodes, to compensate for the difference in voltage drop across the rectifier.

To replace the remaining selenium rectifiers in the instruments with silicon diodes, order Modification Kit 040-0216-00 or 040-0395-00.

Publication:
Instructions for 040-0389-00
September 1966

Supersedes:
February 1965

PARTS LIST

Quantity	Description				Part Number
1 ea.	Assembly, silicon rectifier, consisting of:				
	1 ea.	Strip, cer, 7/16 x 5 notches (large)			124-0093-00
	2 ea.	Diode, silicon,	750 ma	400 PIV 1N3194	152-0066-00
	1 ea.	Lockwasher, ext #6			210-0005-00
	1 ea.	Screw, 6-32 x 5/16 BHS			211-0507-00
	1 ea.	Resistor, WW,	1 Ω	1/2 w 5%	308-0141-00
	2 ea.	Spacer, nylon molded, 0.156			361-0008-00
	1 ea.	Rod, hex, alum, 1/4 OD x 9/32 long, tapped 6-32 thru			385-0127-00
	1 ea.	Bracket, alum			406-0555-00
1 ea.	Lockwasher, ext #6				210-0005-00
1 ea.	Washer, steel, flat, 6L x 3/8 x 0.032				210-0803-00
1 ea.	Screw, 6-32 x 1/4 BHS				211-0504-00
1 ea.	Spool, w/3 ft. of silver-bearing solder				214-0210-00
1 ea.	Tag, MODIFIED INSTRUMENT, gummed back				(001-0910-00)

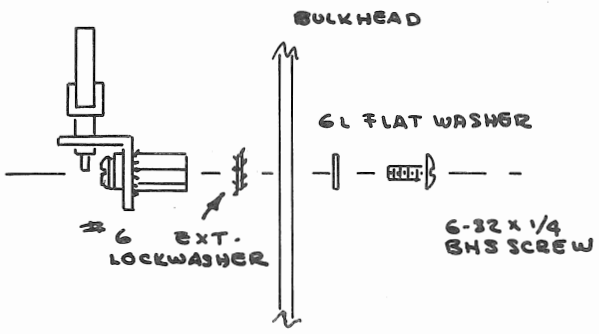


Fig. 1

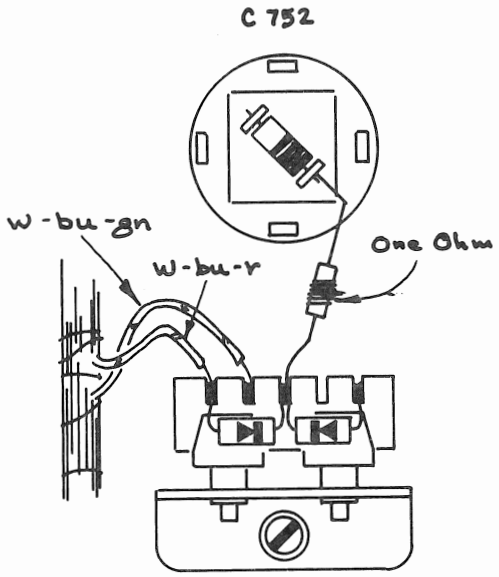


Fig. 2

INSTRUCTIONS

IMPORTANT: When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

A. TO INSTALL SILICON ASSEMBLY IN TYPES 533/RM AND 543/RM INSTRUMENTS:

( ) 1. Unsolder and remove the bare wire between selenium rectifier SR752 and the filter capacitor C752.

( ) 2. Unsolder and remove SR752.

( ) 3. Mount the silicon rectifier assembly (from kit) in the hole vacated by the selenium rectifier (see Fig. 1). Use the hardware from the kit.

( ) 4. Solder the white-blue-red and white-blue-green wires to the ceramic strip, as indicated in Fig. 2.

( ) 5. Solder the 1 Ω resistor (on assembly) to the capacitor lug from which the bare wire was removed in step 1 (see Fig. 2).

B. TO INSTALL SILICON ASSEMBLY IN TYPES RM16, RS16, AND RM17 INSTRUMENTS:

( ) 1. Unsolder and remove the three wires connected to SR750.

( ) 2. Replace SR750 on its mounting bracket with the assembly (from kit), using the hole vacated by the selenium rectifier (see Fig. 1). Use the hardware from the kit.

( ) 3. Solder the white-blue-red and white-blue-orange wires to the ceramic strip as indicated in Fig. 3.

( ) 4. Dress the 1 Ω resistor (on assembly) to the ceramic strip notch indicated in Fig. 3, and solder both the resistor and the white-blue wire to this notch.

THIS COMPLETES THE INSTALLATION

( ) Check wiring for accuracy.

( ) Moisten back of MODIFIED INSTRUMENT tag (from kit) and place it on the Power Supply schematic in your Manual.

( ) Install the insert page in your Manual.

CH:ceb

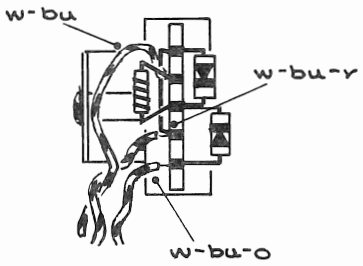


Fig. 3

SILICON RECTIFIER

Type RM16 s/n 364-447
RM17 s/n 101-125
RS16 s/n 101-177

Installed in Type _____ s/n _____

GENERAL INFORMATION

This modification replaces the selenium rectifier SR750 (106-0038-00), used in the V454 heater supply, with silicon diodes. The new diodes offer longer life and greater reliability.

A resistor is added, in series with the diodes, to compensate for the difference in voltage drop across the rectifier.

The information on this page supersedes the information in your Manual.

ELECTRICAL PARTS LIST

Values fixed unless marked variable.

DIODES

Ckt. No.	Part Number		Description
D162A, B	152-0066-00	Silicon	1N3194

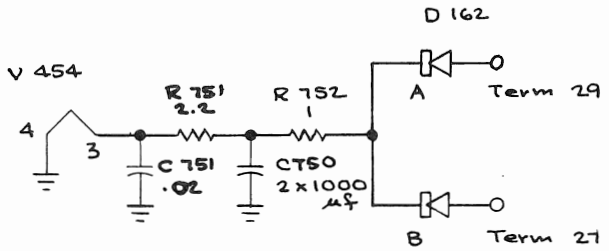
RESISTORS

R752	308-0141-00	1 Ω	1/2 w	WW	5%

MECHANICAL PARTS LIST

	Part Number
Bracket, aluminum	406-0555-00
Lockwasher, ext #6	210-0005-00
Rod, hex, alum, 1/4 OD x 9/32 long, tapped 6-32 thru	385-0127-00
Screw, 6-32 x 1/4 BHS	211-0504-00
Screw, 6-32 x 5/16 BHS	211-0507-00
Spacer, hylon molded, 0.156	361-0008-00
Strip, cer, 7/16 x 5 notches (large)	124-0093-00
Washer, steel, 6L x 3/8 x 0.032	210-0803-00

SCHEMATICS



POWER SUPPLY
(Partial Diag.)

SILICON RECTIFIER

Types 533 s/n 101-1190; RM33 s/n 101-129;
543 s/n 101- 949; RM43 s/n 101-105

Installed in Type _____ s/n _____

GENERAL INFORMATION

This modification replaces the selenium rectifier SR752 (106-0038-00), used in the V152 heater supply, with silicon diodes. The new diodes offer longer life and greater reliability.

A resistor is added, in series with the diodes, to compensate for the difference in voltage drop across the rectifier.

The information on this page supersedes the information in your Manual.

ELECTRICAL PARTS LIST

Values fixed unless marked variable.

DIODES

Ckt. No.	Part Number	Description
D752A, B	152-0066-00	Silicon 1N3194

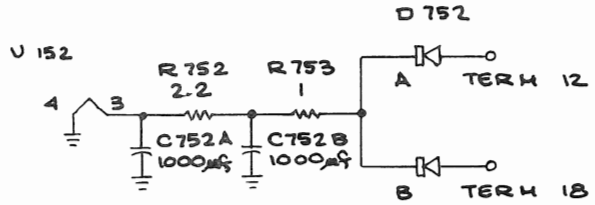
RESISTORS

R753	308-0141-00	1 Ω	1/2 w	WW	5%

MECHANICAL PARTS LIST

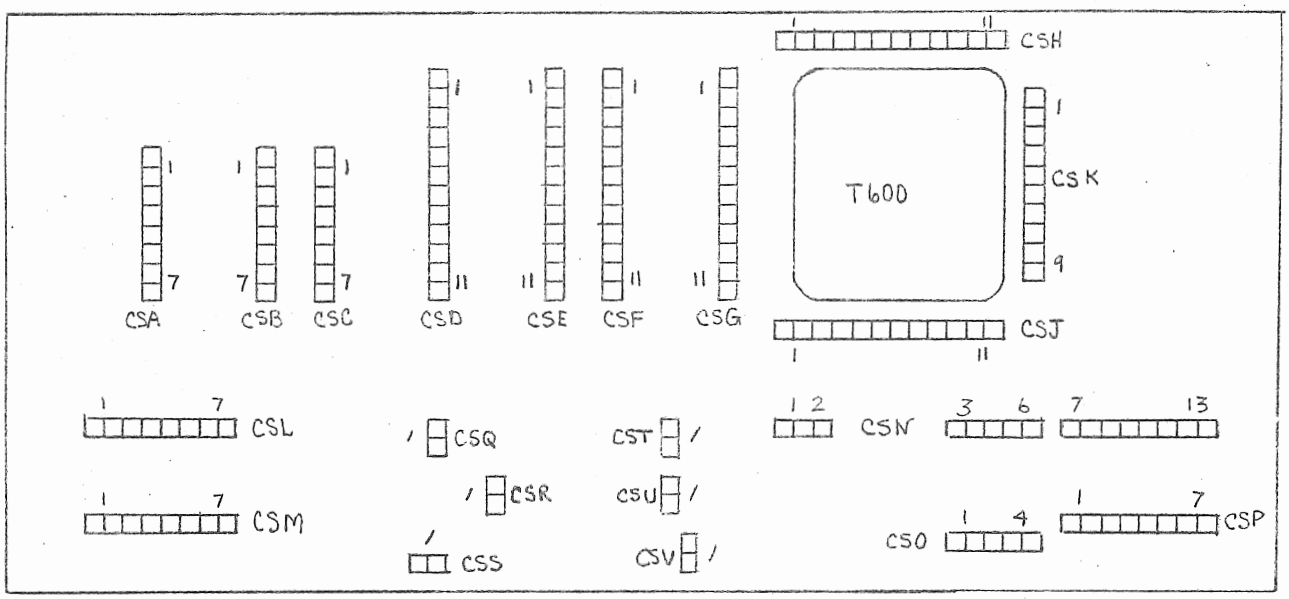
	Part Number
Bracket, aluminum	406-0555-00
Lockwasher, ext #6	210-0005-00
Rod, hex, alum, 1/4 OD x 9/32 long, tapped 6-32 thru	385-0127-00
Screw, 6-32 x 1/4 BHS	211-0504-00
Screw, 6-32 x 5/16 BHS	211-0507-00
Spacer, nylon molded, 0.156	361-0008-00
Strip, cer, 7/16 x 5 notches (large)	124-0093-00
Washer, steel, flat, 6L x 3/8 x 0.032	210-0803-00

SCHEMATICS

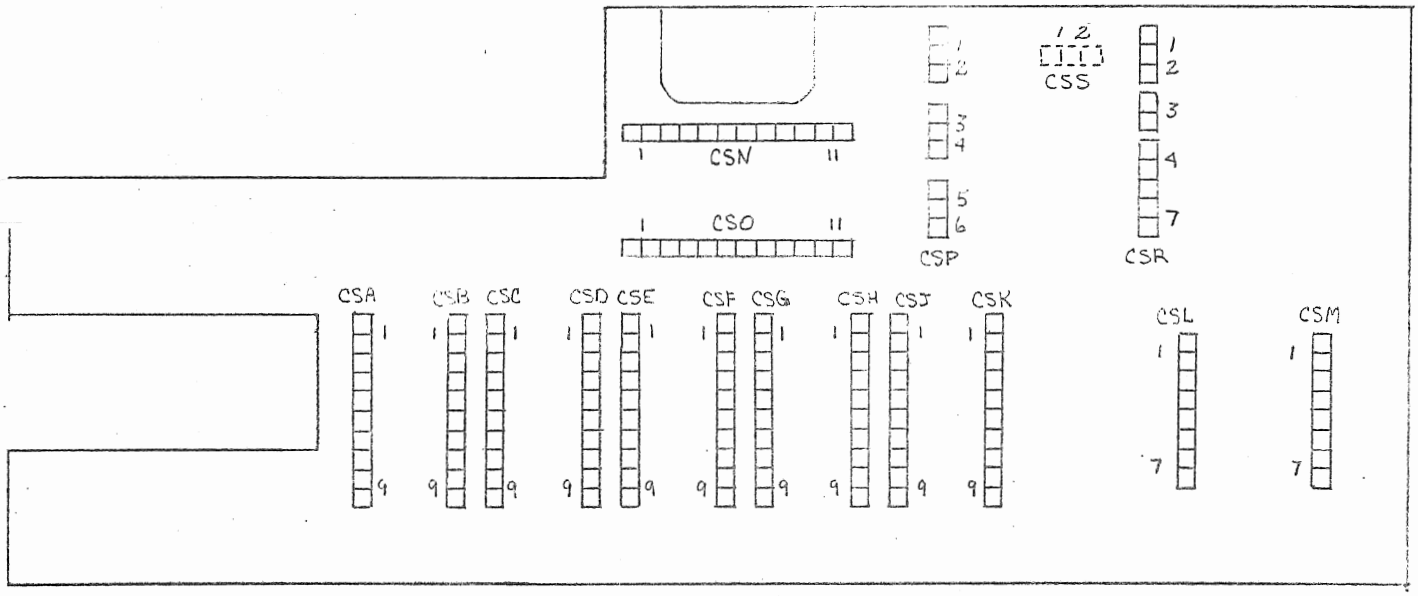


POWER SUPPLY
PARTIAL DIAGRAM
(Sweep Chassis Heaters)

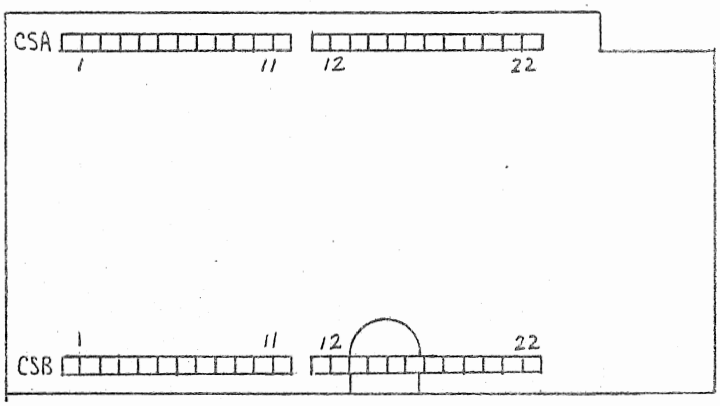
STRIP LAYOUT— 317



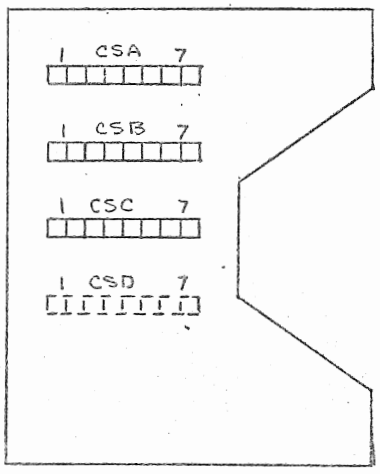
V.A. & POWER CHASSIS 615-418



SWEEP CHASSIS 619-419



F & I CHASSIS 624-417

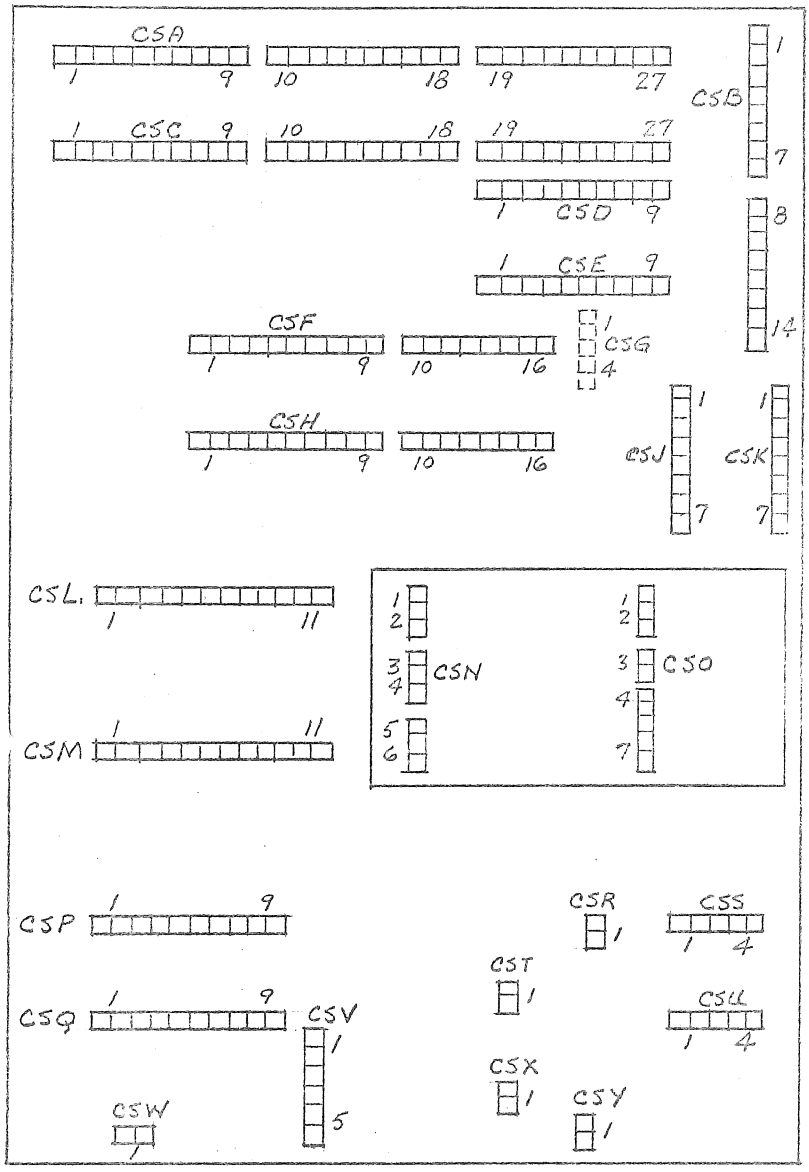


RECTIFIER BRKT.

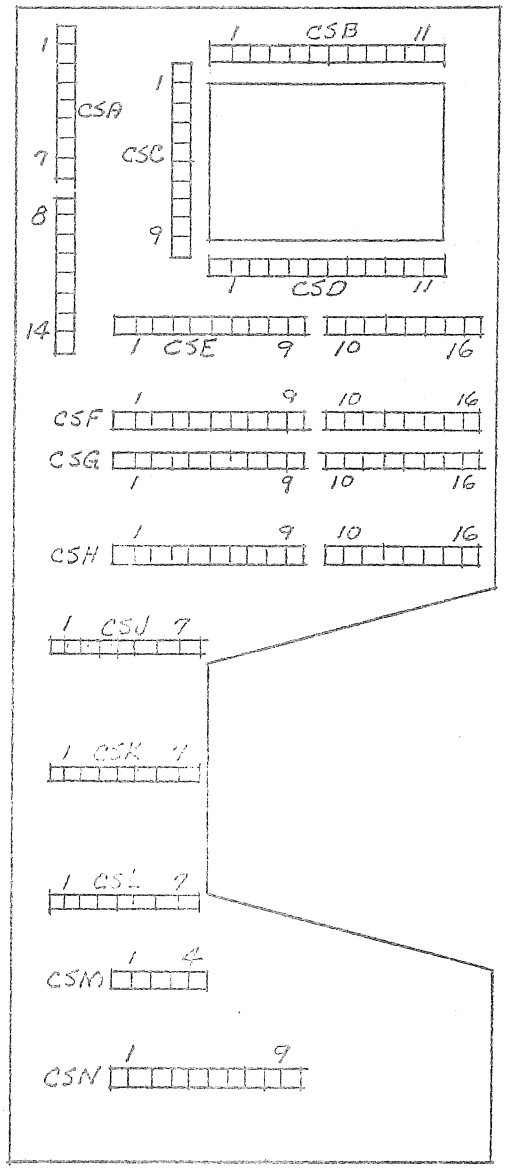
6/1/60

STRIP LAYOUT RM 17

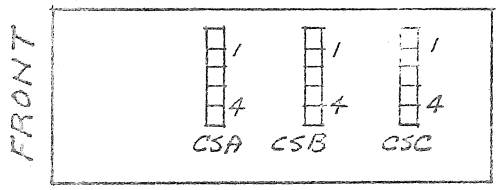
INDICATOR CHASSIS 610-419



POWER CHASSIS 610-415



CAL. BRACKET 610-402



8-17-59

MAINTENANCE NOTES

WATER SOLUBLE CHASSIS LACQUER

4-28-61

317 sn 595-1200
RM17 110-210

Silk-screening on aluminum parts of this sn range may be damaged if washed. Clean only with compressed air and dry brush.

VERTICAL POSITION POTS, BAD BATCH

5-8-64

Some 5000 Clarostat 311-028 2 x 100 k pots from batches code-dated 6313 and 6314 have been shipped in instruments, prior to discovery that a sizeable percentage of these pots may be defective. The defect is a mechanical misalignment in some cases sufficient to allow the rotor in some position to contact the element in two places, thus shorting out about 2/3 of the element. In its typical VERTICAL POSITION control applications, the pot is wired directly to the power supply bus, and may be damaged by excessive dissipation.

The instrument types which may contain defective pots were all shipped in summer and early fall 1963. Serial ranges are: 317 3250-3510
RM17 460-500

Defective 311-028 pots should be returned to Roger Ady.

R335 SILK-SCREENING ERROR

3-59

317's shipped before January 7, 1959, contained a silk-screening error. The Sweep Magnifier Registration pot was labeled R235 instead of R335.

RM17 MANUAL ERRORS

6-30-61

Manuals shipped before June 30, 1961, contain schematic errors and missing modification data:

1. Phantom resistor: R857 does not now exist and never has existed. C857 (crt cathode) goes straight to ground. Delete R857 from your schematic and parts list.

2. Phantom capacitor: C795 (low voltage power supply, V617 filament) was never used in production instruments. Delete C795 from your schematic and parts list.

3. Missing resistor: R794 (270 k) appears in the parts list but not in the low voltage power supply schematic. Add R794 from the top of R795 to the +300 v supply to complete the filament elevation divider.

4. Filament connections: The filament buss at the upper left-hand corner of the low voltage power supply schematic (V14, V35, etc.) should be shown going to transformer terminal 29, not 28 (ground) as shown.

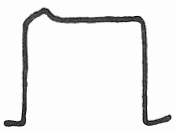
5. Missing mods data: instruments now being shipped have all hv capacitors changed over to ceramic discap and doorknob types, and there are several value changes:

   All .015 μf 3 kv changed to .01 μf 2 kv
   C835, .01 μf, is added in parallel with C834 (now .01 μf)
   All .0068 μf 3 kv changed to .01 μf 2 kv
   C821, .0068 μf 5 kv changed to .005 μf 4 kv
   Both 470 pf 10 kv changed to 500 pf 10 kv

   These mods come in at different serial numbers and Manuals department is tracking down the necessary data for blue mod sheets. Meanwhile, the necessary Tek numbers for replacement parts may be taken from the 317 manual.

RM17---20 and 50 V/cm DISTORTION 2-10-61

We had some trouble compensating the 20 and 50 V/cm attenuator settings of an RM17, SN 204. Shorting the preamp input grid (V454 pin 1) to ground eliminated the problem.



We traced the trouble to the white stranded wire from the attenuator switch to C444. The wire was about 2" longer than necessary and was dressed under the attenuator switch. When a 100 V calibrator signal was applied to the vertical INPUT connector the wire picked up some spike, fed it to the preamp and amplified it. This amplified spike was then coupled into C484 (grid of vertical amplifier input tube, V483) because of its close proximity to C471 in the preamp output tube, V463B. We cured the trouble by shortening the lead.

---

120 CYCLE RIPPLE 12-64

Sometimes a Type 317 Oscilloscope will exhibit 120 cycles of ripple on the trace when the VOLTS/DIV switch is in the 10, 20, or 50 mV AC position. This may be due to a ground loop between C154 (a 500 μfd, ETM capacitor in the preamplifier circuit) and ground. Placing a short jumper between C154 and the front panel reduces the amount of ripple. By lifting the can of C154 above ground at its grounding strap and then running a separate ground from C154 to the shield of the Vertical Volts/Div switch you will completely eliminate the problem.

SELECTED 6AL5 (157-104) Buck Murphy, 1-29-65

Considerable selection of the 6AL5 twin diode exists for usage in the time-base generator of many instruments. A decision to select this tube for 20 mV (peak to peak) or less heater to cathode hum, has been made. This selection process should yield tubes with at least 2000 hours service in the most critical applications. We have vendors who produce tubes with a low, medium and also high yield--only to fall below our requirements before one year of service. The 157-104 will be selected from vendors offering an acceptable tube.

We suggest the Repair Centers stock only the checked version of this tube.

6AN8 SELECTION PROBLEM--317, 515/515A and 516 Nick Stadtfeld, 1-24-67
Revised, 1-27-67

Anyone replacing the 6AN8 in the sweep-gating multivibrator of

##	317	V35	515A	V120
	RM17	V145	516	V145
	515	V120		
	RM15	V120		

may find that the sweep just won't run.

Manufacturing informs us that they are having a 50% yield on 6AN8's for these slots, even though all tubes meet manufacturer's specs. Similar yield could be expected in the field.

Manufacturing is rewiring tube sockets so that they can use the 6BL8, which has
no yield problem -- 317, RM17, 515, RM15, 515A and 516 -- all Mod 11924.

In the field, it should be sufficient to warn you that you may have to do some selecting. Should the situation deteriorate, we may have to go to a selected tube with a special part number or, as a last resort, a mod to rewire tube sockets for 6BL8.

GENERAL PARTS INFORMATION

CRT STANDARD PHOSPHOR CHANGE

11-28-61

Engineering, with Marketing's tentative approval, plans to specify P31 as the standard 317 crt phosphor. The beginning date for the change depends on crt stocks and schedules, but will be announced in ample time to notify customers who plan to order 317's.

The P31 phosphor may now be specified on any crt we manufacture, but additional will be required in most cases. After the change, the present standard P2 phosphor will be available as a special with additional delay.

VARIABLE VOLTS/DIV

5-11-62

Modification 3862 converts 317's, sn 2240 and up, RM17's, sn 320 and up, to the new Tek-made "stopless" potentiometers. These new pots have two advantages:

1. Provide a new, more relistic design-center resistance value and tolerance.
2. Remove the stop, for continuous rotation (but with a detent for the "calibrated" position). This should eliminate many shaft and pot problems and provide greater operator convenience.

Change:

R216 (316) or R516 (RM16)
to resistor, 780Ω ±15% Tek-made var (311-281)
from resistor, 660Ω Tek-made var (311-135)

The change in Tek number was due to the small change in resistance. Some customers insist on resistance value rather than application as the critical part of purchase description.

REPLACEMENT T317'S MAY REQUIRE ADJUSTABLE GRATICULE

FEN 2-8-63

Mod 6045 for the 317 and RM17 changed the CRT shield-mount casting and the graticule to provide for about ±1-1/2 minor division vertical adjustment to center the graticule in the vertical scan area.

Until now, replacement T317's from Customer Service has been selected for perfectly centered scan, to match the old graticules. On quantity orders for non-standard phosphors, however, selection can leave an overstock of CRT's with the wrong phosphor for production use. Therefore, replacement T317's will hereafter be shipped without special selelction, and the customer may have to install an adjustable graticule.

Rather than ask the customer to drill and tap his CRT shield-mount casting as was done in the production mod, though, we're making available and 050-090 kit which contains the new adjustable graticule (331-095) and a nut that replaces one of the four rubber washers normally mounted under the graticule cover. Tightening down this nut holds the graticule in position after centering to match the new CRT. If the customer uses a light filter, it may be easily modified to clear the nut.

The 050-090 kit becomes an automatic replacement on orders for the old graticule if the customer specifies that the graticule is for the 317 or RM17. The price has not yet been set.

The 050-090 kit may be ordered at N/C if ordered at the same time as a replacement T317 CRT for a 317 SN 101-2879 or RM17 SN 101-399. The kit is not included with every T317 since after a while, nearly all 317's will have been modified, and the kit will be needed only rarely.

Customer Service Parts Notice No. 31, covering all necessary data, will be referenced in the NPR, as a reminder.

PARTS REPLACEMENT KIT

GERMANIUM RECTIFIER

050-0067-00

For the following Tektronix Instruments:

Types 53B	s/n	101 - 3300
53/54B	s/n	3301 - 11009
B	s/n	11010 - 13359
53/54L	s/n	101 - 3550
L	s/n	3551 - 4829
316	s/n	101 - 1082
RM16	s/n	101 - 447
RS16	s/n	101 - 177
317	s/n	101 - 340
RM17	s/n	101 - 125

DESCRIPTION

The 152-0008-00 germanium diode replaces the selenium rectifiers 106-0022-00 and 106-0037-00 previously used to protect the cathode bypass capacitors against inverse voltages.

The germanium diode costs less and offers greater reliability and longer life.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions as P/N 152-0008-00 is a direct replacement.

Publication:
Instructions for 050-0067-00
April 1966

Supersedes:
February 1964

PARTS LIST

Qty.	Part Number	Description
1 ea	152-0008-00	Diode, Germanium
1 ea	210-0206-00	Lug, solder, #10L
1 ea	210-0228-00	Lug, solder, #8L
1 ea	210-0410-00	Nut, 10-32 x 5/16
1 ea	212-0014-00	Screw, 8-32 x 2-1/4 RHS
1 ea	212-0518-00	Screw, 10-32 x 5/16 PHS

INSTRUCTIONS

NOTE: These instructions are divided according to instrument type. Be sure to select the right set for your instrument. In all cases, after the installation is completed, check the instrument for proper operation and make the necessary corrections to the Parts List in your Instruction Manual.

53B PLUG IN UNITS (s/n 101-3300):

( ) 1. Unsolder and remove the selenium rectifier (SR3342) from the end of R3342.

( ) Remove the fiber washers from the screw.

( ) 2. In its place, mount the #10 solder lug from the kit.

( ) 3. Solder the germanium diode (from kit) between the solder lug and the terminal on R3342 from which the selenium rectifier was removed, with the color bands (cathode) nearest this terminal.

THIS COMPLETES THE INSTALLATION for the 53B Plug-in unit.

TYPES 53/54B and B PLUG-IN UNITS (s/n 3301-13359):

( ) 1. Remove the selenium rectifier (SR4362) mounting nut.

( ) 2. With heavy cutters, cut off the terminal of the selenium rectifier and remove the rectifier, leaving the leads from C4362 and the GAIN ADJ potentiometer connected.

( ) 3. Mount the #10 solder lug (from kit) at the point from which the selenium rectifier was removed, with the 10-32 x 5/16 PHS screw and nut from the kit.

( ) 4. Solder the germanium diode (from kit) between the solder lug and the junction from which the selenium rectifier was cut, with the color bands (cathode) nearest the junction.

THIS COMPLETES THE INSTALLATION for the 53/54B and B Plug-in units.

INSTRUCTIONS (cont)

TYPES 53/54L and L PLUG IN UNITS (s/n 101-4829):

( ) 1. Unsolder and remove selenium rectifier (SR5972) from the unit.

( ) Clip off the unsoldered wire lead from pin 7 of V5942.

( ) 2. Mount the #10 solder lug (from kit) in the hole from which SR5972 was removed, with the 10-32 x 5/16 PHS screw and nut from the kit.

( ) 3. Solder the germanium diode (from kit) between pin 7 of V5942 and the solder lug, with the color bands (cathode) nearest V5942.

THIS COMPLETES THE INSTALLATION for the 53/54L and L Plug-in units.

TYPES 316 and 317 OSCILLOSCOPES:

( ) 1. Locate R152 (or R155) on the bottom of the instrument near the front panel, and remove the mounting screw.

( ) 2. Place the #8 solder lug (from kit) on the 8-32 x 2-1/4 RHS screw from the kit.

( ) Install this screw in place of the one removed in step 1. Tighten with the solder lug pointing toward the center of the instrument.

( ) 3. Unsolder the two leads from the terminal of SR154.

NOTE: Since removal of SR154 is difficult, it can be left in place if desired.

( ) 4. Unsolder and remove the bare wire strap connected to R154 that was connected to SR154.

( ) 5. Solder the lead from the capacitor (C154) to the wire strap which connects R154 to R152 (or R155).

( ) 6. Solder the germanium diode (from kit) between solder terminal installed in step 2 and the nearest terminal of R152 (or R155), with the color bands (cathode) nearest R152 (or R155).

THIS COMPLETES THE INSTALLATION for the Types 316 and 317 Oscilloscopes.

TYPES RM16, RS16, and RM17 OSCILLOSCOPES:

1. Locate SR454, on the bottom side of the Vertical Amplifier chassis, near front panel.

( ) Unsolder and remove the white-yellow wire connected between SR454 and R452.

NOTE: Since removal of SR454 is difficult, it can be left in place if desired.

( ) 2. Solder the germanium diode (from kit) between the R452 terminal, from which the white-yellow wire was removed, and the ground lug near V454. The color-banded end (cathode) should go to R452.

THIS COMPLETES THE INSTALLATION for the Types RM16, RS16, and RM17 Oscilloscopes.

GG:cet

PARTS REPLACEMENT KIT

ADJUSTABLE GRATICULE

050-090

For the following Tektronix Oscilloscopes:

Types 317 s/n 101-2879
RM17 s/n 101- 399

DESCRIPTION

Slotted graticule, 331-095, replaces 331-042.

The new graticule can be centered within the vertical scan limits of the CRT spot.

Publication:
Instructions for 050-090
September 1963

Supersedes:
February 1963

PARTS LIST

Quantity	Description	Part Number
1 ea.	Nut, hex, 10-32 x 5/16 x 1/16	210-597
1 ea.	Graticule, 3 in.	331-095

INSTRUCTIONS

( ) 1. Remove the graticule cover, rubber washers (or filter) and graticule.

( ) 2. Install the slotted graticule (from kit), centering it within the vertical scan limits of the CRT spot. Make sure the horizontal (undeflected) CRT trace is parallel to the graticule lines.

( ) Fasten with a special thin nut from the kit. Use any one of the graticule studs.

( ) 3. IF A FILTER IS USED: Cut off the corner of the filter adjacent to the special

Step 3 con'd
nut, place the filter over the graticule and install the graticule cover.

( ) 4. IF NO FILTER IS USED: Place the rubber washers (removed in step 1) over the three remaining graticule studs and install the graticule cover.

THIS COMPLETES THE INSTALLATION

( ) Record the part numbers of the new graticule and special nut in your Instruction Manual for reference.

JB:cc

PARTS REPLACEMENT KIT

HV CAPACITORS

050-198

For the following Tektronix Oscilloscopes:

Type 317 serial numbers 101-759
Type RM17 serial numbers 101-170

DESCRIPTION

High voltage ceramic capacitor 283-011 replaces the oil-filled high voltage capacitor 283-513 previously used.

The manufacturer has discontinued the oil-filled capacitors due to a high reject rate. The new ceramic capacitors offer greater reliability and longer life.

Future replacement of C832, C834, C835, C855 or C857 may be made by ordering part number 283-011.

Publication:
Instructions for 050-198
June 1964

PARTS LIST

Quantity	Description			Part Number
5 ea.	Capacitor, ceramic,	0.01 μf	2kv	283-011
1 ea.	Resistor, comp,	2.2meg	1/2w 10%	302-225
1 ea.	Resistor, comp,	33k	1/2w 10%	302-333
12 in.	Wire, solder, silver-bearing			

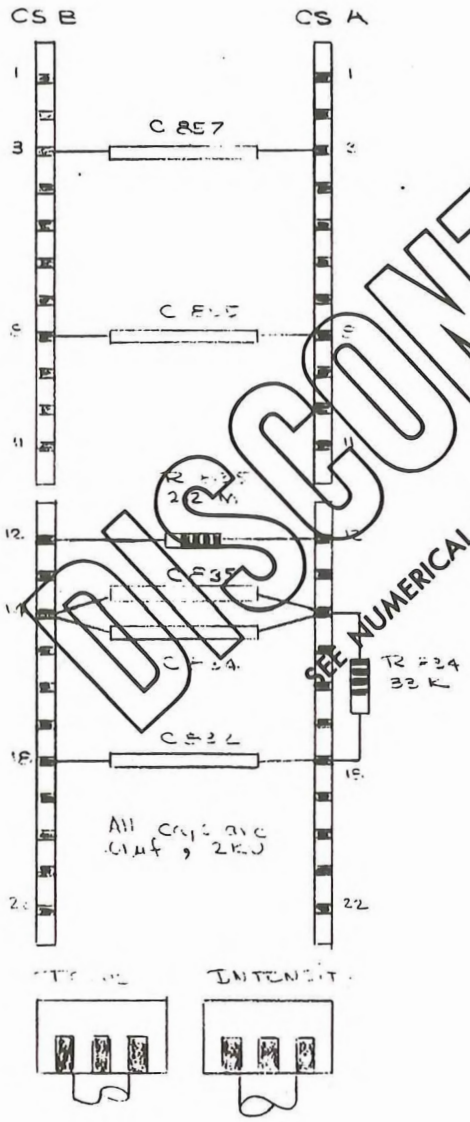


Fig. 1

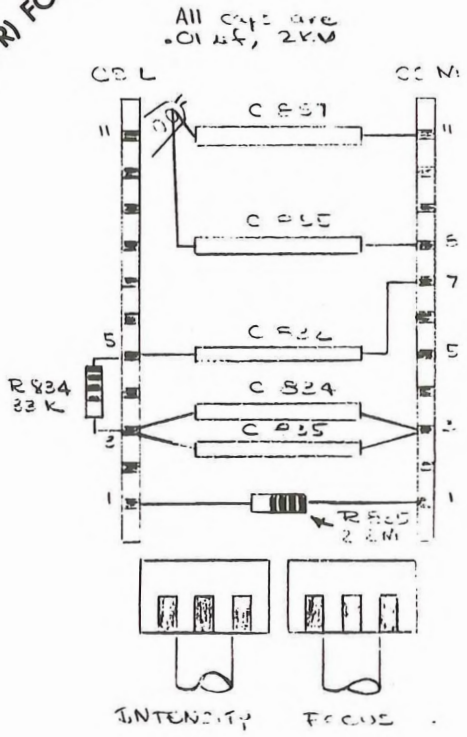


Fig. 2

INSTRUCTIONS

IMPORTANT: When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

A. TO REPLACE THE HV CAPACITORS (TYPE 317 ONLY):

REFER TO FIG. 1

( ) 1. Replace C832 (0.015 µf 3kv), on the Focus and Intensity chassis, with a 0.01 µf 2kv capacitor from the kit. Solder between CSB-18 and CSA-18.

( ) 2. Replace C855 (0.015 µf 3kv) with a 0.01 µf 2kv capacitor from the kit. Solder between CSB-8 and CSA-8.

( ) 3. Replace C857 (0.015 µf 3kv) with a 0.01 µf 2kv capacitor from the kit. Solder between CSB-3 and CSA-3.

( ) 4. Replace C834 (0.015 µf 3kv) with two 0.01 µf 2kv capacitors (from kit) in parallel. Solder between CSB-14 and CSA-14.

( ) 5. Replace R834 (100k 1/2w) with a 33k 1/2w resistor from the kit. Solder between CSA-18 and CSA-14.

( ) 6. Replace R835 (1.5meg 2w) with a 2.2meg 1/2w resistor from the kit. Solder between CSB-12 and CSA-12.

B. TO REPLACE THE HV CAPACITORS (TYPE RM17 ONLY):

REFER TO FIG. 2

( ) 1. Replace C832 (0.015 µf 3kv) with a 0.01 µf 2kv capacitor from the kit. Solder between CSL-5 and CSM-7.

( ) 2. Replace C855 (0.015 µf 3kv) with a 0.01 µf 2kv capacitor from the kit. Solder between CSM-8 and ground lug.

( ) 3. Replace C857 (0.01 µf 3kv) with a 0.01 µf 2kv capacitor from the kit. Solder between CSM-11 and ground lug.

( ) 4. Replace C834 (0.01 µf 3kv) with two 0.01 µf 2kv capacitors (from kit) in parallel. Solder between CSL-3 and CSM-5.

( ) 5. Replace R834 (100k 1/2w) with a 33k 1/2w resistor from the kit. Solder between CSL-3 and CSL-5.

( ) 6. Replace R835 (1.5meg 2w) with a 2.2meg 1/2w resistor from the kit. Solder between CSL-1 and CSM-1.

THIS COMPLETES THE INSTALLATION

( ) Check wiring for accuracy.

Add the following part to your Instruction Manual Parts List:

( ) C835 283-011 0.01 µf Disc Type 2kv

Change the following parts in your Instruction Manual Parts List:

( )	C832	283-011	0.01 µf	Disc Type	2kv
( )	C834	283-011	0.01 µf	Disc Type	2kv
( )	C855	283-011	0.01 µf	Disc Type	2kv
( )	C857	283-011	0.01 µf	Disc Type	2kv
( )	R834	302-333	33k	1/2w	10%
( )	R835	302-225	2.2meg	1/2w	10%

JB:ls

PARTS REPLACEMENT KIT

SILICON DIODES REPLACE 106-039

050-222

For the following Tektronix Oscilloscopes:

Type 316 serial numbers 101-1129
Type 317 serial numbers 101-649

DESCRIPTION

1N3194 silicon diodes, 152-066 replace selenium rectifier 106-039, offering more reliability and longer life.

This modification replaces the selenium rectifier SR317, which supplies power for an early DC Fan mod. At the same time SR150, the selenium rectifier which supplies DC filament voltage for V154, is replaced.

If Silicon Diode Mod 040-212 has been installed, disregard instructions regarding SR150. SR150 is a part of Mod 040-212.

NOTE: If the serial number of your instrument is above those listed, or if this kit has already been installed, disregard the instructions, as part number 152-066 is a direct replacement.

Publication:
Instructions for 050-222
November 1964

PARTS LIST

Quantity	Description				Part Number
1 ea.	Assembly, silicon rectifier, consisting of:				
	2 ea.	Strip, ceramic 7/16 x 7 notches			124-094
	6 ea.	Diode, silicon 1N3194			152-066
	1 ea.	Lockwasher, steel #8			210-007
	1 ea.	Screw 8-32 x 1/4 BHS			212-001
	4 ea.	Spacer, nylon molded 0.063			361-007
	1 ea.	Rod, alum, hex 3/8 x 9/16 Tap 8-32 thru			385-121
	1 ea.	Bracket, mounting silicon diode			407-110
	1 ea.	Wire, #20 solid	white	4 in.	(175-510)
	1 ea.	Wire, #20 solid	white	5 in.	(175-510)
	1 ea.	Wire, #20 solid	white-blue	6 in.	(175-510)
1 ea.	Lockwasher, steel Ext. #8				210-007
2 ea.	Lockwasher, Int. #10				210-010
1 ea.	Screw, 8-32 x 1/4 BHS				212-001
1 ea.	Spool, solder w/3 ft. silver-bearing solder				214-210
1 ea.	Capacitor, ceramic	0.02 μf	150 v		283-004
1 ea.	Resistor, comp,	3.3 Ω	1 w	5%	307-015
1 ea.	Wire, #16 solid	bare		6 in.	(176-002)

INSTRUCTIONS

IMPORTANT: When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

TYPE 316 SERIAL NUMBERS 101-287 ONLY, PERFORM STEPS 1 THROUGH 4.

REFER TO FIG. 1 WHILE PERFORMING STEPS 4 THROUGH 5.

NOTE: If Silicon Diode Mod 040-212 has been installed, disregard steps 1 through 6.

( ) 1. Remove the bare wires that connect terminals 1 and 28 of the power transformer (T600) to the solder lugs.

( ) 2. Replace the solder lugs with #10 lockwasher from the kit.

( ) 3. Install a length of bare #16 wire (from kit) between terminals 1 and 28 of the power transformer (T600) and the ground lug on V617 tube socket.

( ) 4. Remove the two white-blue wires from the center terminal of C150. Using an Ohm-meter, determine which of the two wires connects to pin 3 of V154, and connect it to CSK-3. Connect the other wire to C150.

( ) 5. Remove R151, a 2.2 Ω 1/2 w resistor, if present, from CSK-3 to the center terminal of C150 and install the 3.3 Ω 1 w resistor from the kit.

( ) 6. Install C151, an 0.02 μf capacitor, if not present, from pin 3 of V154 to ground lug.

( ) 7. Remove SR150 and SR317 (or V317A, B), selenium rectifiers, from the bulkhead.

( ) 8. Install the silicon rectifier assembly (from kit) in the selenium rectifier mounting hole, using the #8 screw and lockwasher from the kit. Wire as shown in Fig. 2.

THIS COMPLETES THE INSTALLATION

( ) Recheck your work.

( ) For future reference, correct your Instruction Manual Parts List as required.

( ) Refer to the Maintenance Section of your Instruction Manual and recalibrate your instrument as required.

JT:ceb

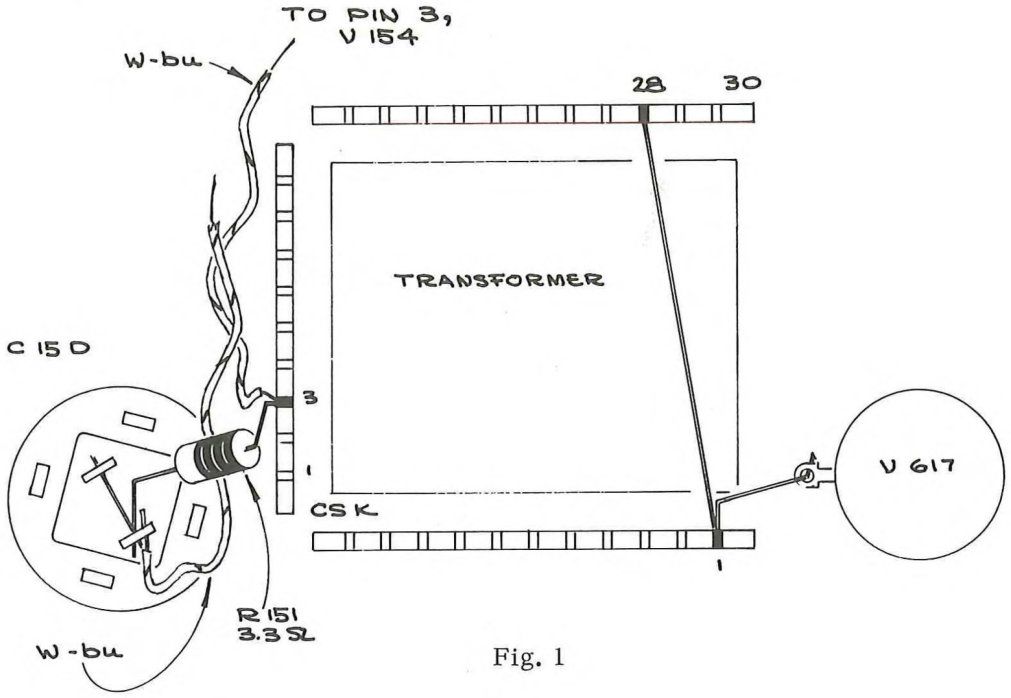

TO PIN 3,
V 154
W-bu
28
30
TRANSFORMER
C 15 D
3
1
CS K
V 617
R 151
3.3 Ω
W-bu

Fig. 1

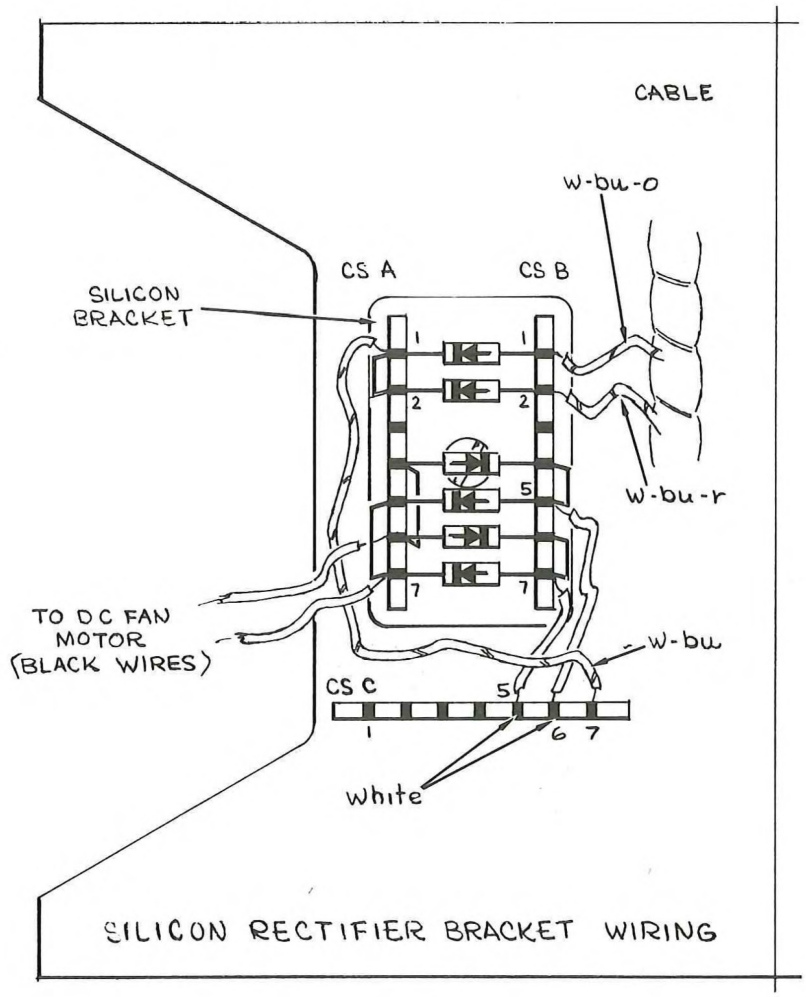

CABLE
W-bu-o
CS A
CS B
SILICON
BRACKET
1
2
5
7
W-bu-r
TO DC FAN
MOTOR
(BLACK WIRES)
W-bu
CS C
White
SILICON RECTIFIER BRACKET WIRING

Fig. 2

PARTS REPLACEMENT KIT

SILICON RECTIFIERS FOR DC FAN

050-0228-00

For the following Tektronix Oscilloscopes:

Types 315D	SN 101-up	RM15	SN 101-820
515	SN 101-1000	RM16	SN 101-580
515A	SN 1001-4029	RS 16	SN 101-up
		RM17	SN 101-309

DESCRIPTION

The selenium rectifier 106-0006-00, which is no longer available, is replaced by silicon diodes. An assembly is provided which includes four silicon diodes (152-0066-00) and mounting bracket.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions as PN 152-0066-00 is a direct replacement.

Publication:
Instructions for 050-0228-00
April 1967

Supersedes:
February 1965

PARTS LIST

Quantity	Part Number	Description
(1 ea)		Assembly, silicon rectifier, consisting of:
2 ea	124-0088-00	Strip, cer, 3/4 x 4-notch (large), clip-mounted
4 ea	152-0066-00	Diode, silicon, 1N3194 400PIV
1 ea	210-0006-00	Lockwasher, steel, int #6
1 ea	210-0803-00	Washer, steel #6L, 3/8 x 0.032
1 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips
4 ea	361-0007-00	Spacer, nylon molded, 0.063
1 ea	385-0080-00	Rod, hex, 1/4 x 7/16
1 ea	406-0531-00	Bracket, silicon rectifier mounting
1 ea	210-0006-00	Lockwasher, steel, int #6
1 ea	210-0803-00	Washer, steel #6L, 3/8 x 0.032
1 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Phillips
1 ea	214-0210-00	Spool, w/3 ft. silver-bearing solder
2 ea		Wire, #22 solid, 175-0522-00, white 3 in.
2 ea		Wire, #22 solid, 175-0522-00, white-red 3 in.

INSTRUCTIONS

IMPORTANT: When soldering to the ceramic strip, use the silver-bearing solder supplied with this kit.

A. TO REPLACE SELENIUM RECTIFIER IN THE FOLLOWING INSTRUMENTS: See Fig. 1
Type 515 SN 101-1000; Type 515A SN 1001-4029

( ) 1. Replace the selenium rectifier on the Power chassis with the assembly from the kit. Position the assembly as shown, using a lockwasher (from kit) between the assembly and the chassis.

( ) 2. Solder the two white and two white-red wires (from kit) between the assembly and the adjacent ceramic strip as shown.

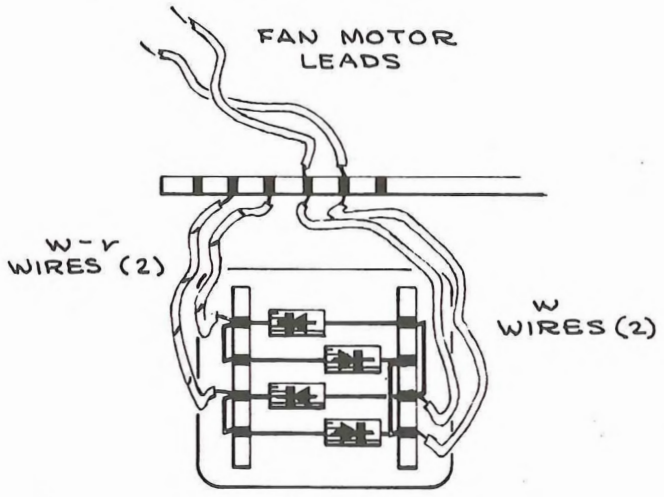


FIG. 1

INSTRUCTIONS (cont)

B. TO REPLACE SELENIUM RECTIFIER IN TYPE 315D: See Fig. 2

( ) 1. Unsolder and remove the selenium rectifier and its mounting bracket.

( ) 2. Install the silicon assembly (from kit), using the rear mounting hole of the two used for the selenium mounting bracket. Position the assembly as shown.

( ) 3. Solder the wires removed from the selenium rectifier to the new assembly as shown.

C. TO REPLACE SELENIUM RECTIFIER IN THE FOLLOWING INSTRUMENTS: See Fig. 3
Types RM15 SN 101-820; RM16 SN 101-580; RS16 SN 101-up; RM17 SN 101-309

( ) 1. Replace the selenium rectifier stack with the silicon rectifier assembly from the kit.

( ) 2. Wire the new assembly as shown.

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Correct your Instruction Manual Parts List and Power Supply schematic as necessary.

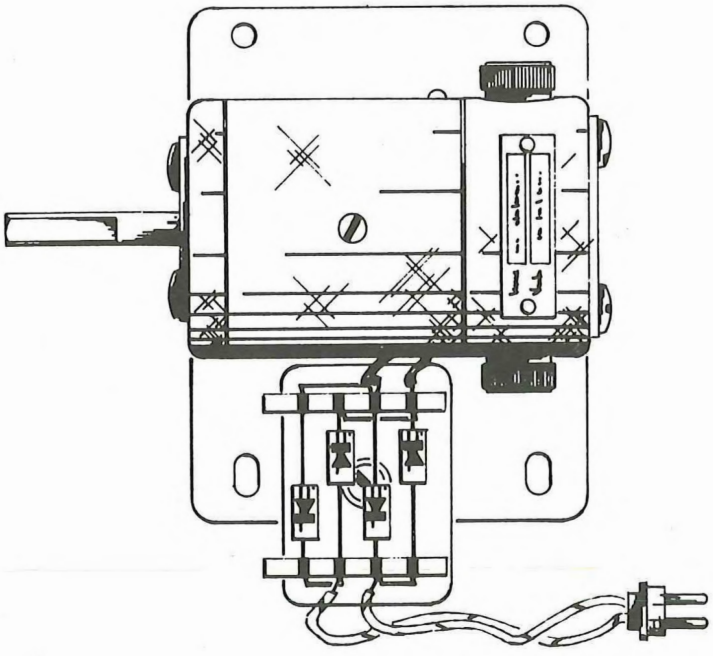


FIG. 2

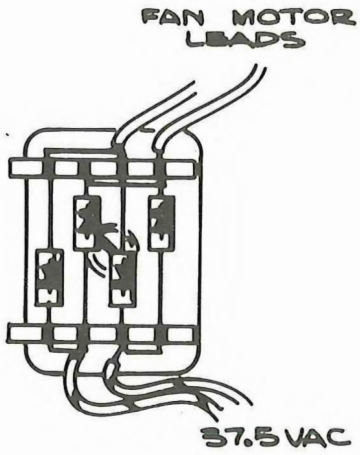


FIG. 3

DF:ls

EARL KING SALES CO.
Los Angeles, Calif.

freely along the wire so that a slight fillet will be formed as shown in Fig. 5-3.

General Soldering Considerations

When replacing wires in terminal slots clip the ends neatly as close to the solder joint as possible. In clipping the ends of wires take care the end removed does not fly across the room as it is clipped.

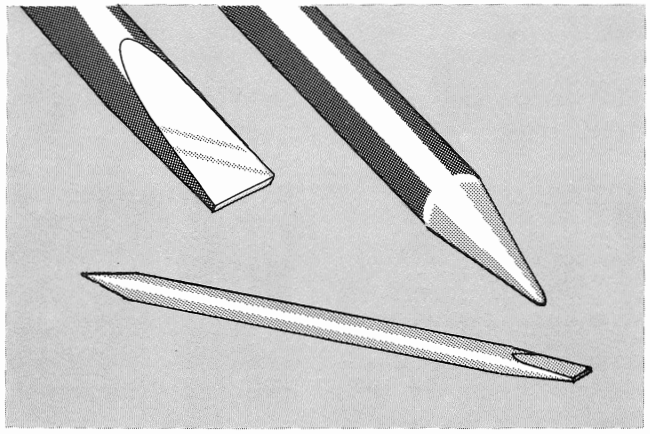


Fig. 5-5. A soldering aid constructed from a 1/4 inch wooden dowel.

Occasionally you will wish to hold a bare wire in place as it is being soldered. A handy device for this purpose is a short length of wooden dowel, with one end shaped as shown in Fig. 5-5. In soldering to terminal pins

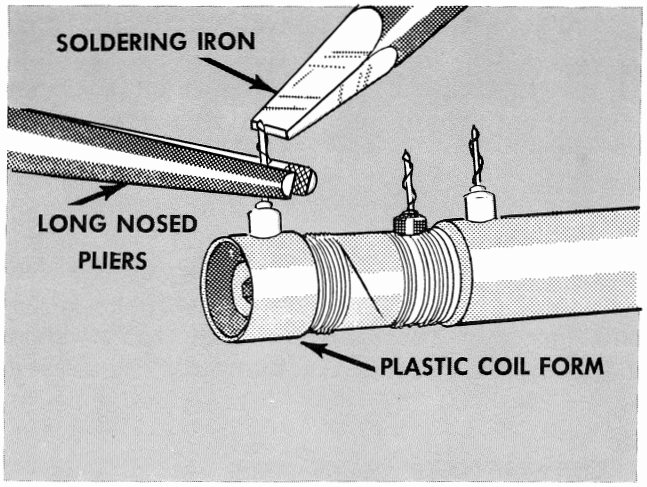


Fig. 5-6. Soldering to a terminal mounted in plastic. Note the use of the long-nosed pliers between the iron and the coil form to absorb the heat.

mounted in plastic rods it is necessary to use some form of "heat sink" to avoid melting the plastic. A pair of long-nosed pliers (see Fig. 5-6) makes a convenient tool for this purpose.

Ceramic Strips

Two distinct types of ceramic strips have been used in Tektronix instruments. The earlier type mounted on the chassis by means of #2-56 bolts and nuts. The later type is mounted with snap-in plastic fittings. Both styles are shown in Fig. 5-7.

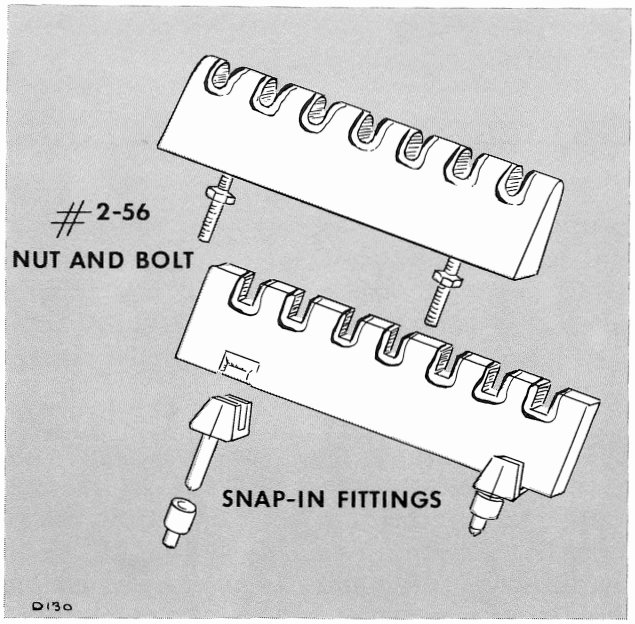


Fig. 5-7. Two types of ceramic strip mountings.

To replace ceramic strips which bolt to the chassis, screw a #2-56 nut onto each mounting bolt, positioning the nut so that the distance between the nut and the bottom of the ceramic strip equals the height at which you wish to mount the strip above the chassis. Secure the nuts to the bolts with a drop of red glyptal. Insert the bolts through the holes in the chassis where the original strip was mounted, placing a #2 starwasher between each nut and the chassis. Place a second set of #2 flatwashers on the protruding ends of the bolts, and fasten them firmly with another set of #2-56 nuts. Place a drop of red glyptal over each of the second set of nuts after fastening.

Mounting Later Ceramic Strips

To replace strips which mount with snap-in plastic fittings, first remove the original fittings from the chassis. Assemble the mounting post

on the ceramic strip. Insert the nylon collar into the mounting holes in the chassis. Carefully force the mounting post into the nylon collars. Snip off the portion of the mounting post which protrudes below the nylon collar on the reverse side of the chassis.

Note

Considerable force may be necessary to push the mounting rods into the nylon collars. Be sure that you apply this force to that area of the ceramic strip directly above the mounting rods.

TROUBLESHOOTING PROCEDURE

This section of the manual contains information for troubleshooting your oscilloscope. Before attempting to troubleshoot the instrument, however, make sure that any apparent trouble is actually due to a malfunction within the instrument and not to improper control settings.

Tube failure is the most prevalent cause of circuit failure. For this reason, the first step in troubleshooting any circuit in the instrument is to check for defective tubes, preferably by direct substitution. Do not depend on tube testers to adequately indicate the suitability of a tube for certain positions within the instrument. The criterion for usability of a tube is whether or not it works satisfactorily in the instrument. Be sure to return all good tubes to their sockets; if this procedure is followed less recalibration of the instrument will be required upon completion of the servicing.

When replacing any tube in the instrument, check first to see that components through which the tube draws current have not been damaged. Shorted tubes will sometimes overload and damage plateload and cathode resistors. These damaged components can generally be located by a visual inspection of the wiring. If no damaged components are apparent, and if tube replacement does not restore operation, it will be necessary to make measurements or other checks within the circuit to locate the trouble.

The component number of each resistor, inductor, capacitor, vacuum tube, control and switch is shown on the circuit diagrams. The following chart lists the component numbers associated with each circuit:

All numbers less than 100	Time-Base Trigger
100 series	Time-Base Generator
300 series	Horizontal Amplifier
400 series	Preamplifier
500 series	Vertical Amplifier
600 series and 700 series	Low-Voltage Power Supply
800 series	CRT Circuits, High Voltage and Square-Wave Calibrator

Switch wafers shown on the schematic diagrams are coded to indicate the position of the wafer on the actual switches. The number position of the code refers to the wafer number on the switch assembly. Wafers are numbered from the front of the switch to the rear. The letters F and R indicate whether the front or the rear of the wafer is used to perform the particular switching function.

PRELIMINARY INSPECTION

If your Type RM17 Oscilloscope fails to operate, make sure that it is properly connected to a source of power. If the pilot lamp on the front panel, and the fan at the rear of the instrument, do not come on when the instrument is turned on, check the source of power, the power cord connections and the fuse.

If the instrument is turned on, but no spot or trace is visible on the crt, check the position and intensity controls. Be sure that an input signal is not driving the beam off the screen.

Although your oscilloscope is a complex instrument, it can be conveniently divided into basic circuits, as shown on the Block Diagram. The first circuit to check, for partically any type of trouble, is the low-voltage power supply. Proper operation of every circuit in the oscilloscope depends on proper operation of the regulated power supplies.

The low-voltage supply should be checked and if an improper voltage reading is obtained the first thing to suspect is the tubes. Make sure that any tubes found to be good, however, are returned to their original socket. Color-coded wires, following the standard REMTA code, are used to identify the regulated supply voltages. The -150-volt bus wire is coded brown, green, brown; the +100-volt bus is coded brown, black, brown; and the +300-volt bus is coded orange, black, brown. The widest stripe always identifies the first color in the code.

For any troubles involving the loss of vertical and/or time-base calibration, the high-voltage supply must also be checked. This voltage can be measured at the -1675 TEST PT.

WARNING

Be careful of the power-supply voltages. The lower-voltage buses are considerably more dangerous than the high voltages in the crt circuit, due to the higher current capabilities and the larger filter capacitors used.

If the power supplies prove to be operating normally, the next step in troubleshooting an oscilloscope is to isolate the source of the trouble down to a particular circuit. The procedure for doing this is explained in the section that follows, entitled " Trouble Analysis and Circuit Isolation." Once the circuit at fault is known, you can then troubleshoot within this circuit to locate the component (or components) at fault. The Circuit Description for the circuit involved may prove useful when troubleshooting within a given circuit.

Note

After servicing the oscilloscope, it is important to check its calibration. For this, refer to the Recalibration Procedure section of this manual.

TROUBLE ANALYSIS AND CIRCUIT ISOLATION

Troubles that may be produced by a circuit failure in the Type RM17 Oscilloscope are as follows.

1. No spot or trace.
2. Insufficient or no vertical deflection.
3. Insufficient or no horizontal deflection.
4. Nonlinear horizontal sweep.
5. Improper sweep timing (horizontal sweep linear).
6. Improper triggering.
7. Waveform distortion.

As mentioned previously, the purpose of this section is to help you isolate the source of trouble to a particular section or circuit. Once the faulty circuit is known, the component(s) causing the trouble can be located by normal trouble-shooting procedures; i.e., voltage and resistance measurements, tube and component substitution.

1. No spot or trace

When no spot or trace is visible on the crt, the circuit at fault can be:

a. The low-voltage power supply (which will also affect the high-voltage supply.)

b. The high-voltage power supply and the crt circuit.

c. The crt itself.

d. The vertical amplifier and/or the delay line.

e. The horizontal amplifier.

f. The time-base generator.

If the power supplies are operating normally, the following checks can be made to isolate the circuit causing the trouble. Short the vertical deflection plates together (at the neck pins on the crt) with a screwdriver. (Be careful not to short the vertical neck pins to any other pins, or to the metal tube shield.) Adjust the Horizontal POSITIONING control and see if the spot or trace appears on the crt. If so, a state of unbalance in the vertical-deflection system is indicated.

Next, short together the plates of the Output Amplifier (V544-V554). If the trace reappears, the Delay Line can be eliminated as the source of the trouble. The shorting strap can now be moved back, across correspondingly--opposite sides of the Vertical Amplifier, until a point is reached where the trace no longer appears. The state immediately following this point will be the one in which the unbalance is being produced.

If the spot or trace does not appear, during the previous check, turn the instrument off and remove the leads that connect to the horizontal-deflection plates (make sure that the metal clips on the end of each lead to not touch the chassis). Turn the instrument back on and (after warmup) adjust the Vertical POSITIONING control. If the spot now appears on the crt, either the Horizontal Amplifier or the Time-Base Generator is causing the trouble.

To determine which circuit is at fault, reconnect the leads to the horizontal-deflection plates and turn the HORIZONTAL DISPLAY switch to the EXT. position. If the spot now reappears, the Horizontal Amplifier is in balance, and the trouble is being caused by an inoperative condition in the Time-Base Generator. To troubleshoot this circuit, turn the HORIZONTAL DISPLAY switch to the NORM. position, and turn the STABILITY control to the free-running (full right) position. Next, turn the TIME/DIV. switch through its range. If a sweep or trace appears for some positions of the switch, the trouble will be occuring in the components associated with the Timing Switch.

If no trace appears in any position of the TIME/DIV. switch, replace the tubes in the Time-Base Generator one at a time. Make sure that all tubes found to be good are returned to their original socket. If this does not reveal the source of the trouble, the voltages throughout the circuit can be checked. In particular, check to see that the STABILITY control varies the voltage at the grid of V135A. Neon lamp B167 is an important part of the Time-Base circuit; check to see that it is not burned out.

It is important that you understand the operation of the Time-Base Generator before proceeding with an extensive investigation of the circuit. For this reason we suggest that you thoroughly study that portion of the Circuit Description that pertains to this circuit.

If no spot appeared on the crt when the HORIZONTAL DISPLAY switch was turned to the EXT. position, the Horizontal Amplifier is causing the trouble. The faulty stage in this circuit can be isolated by shorting together correspondingly-opposite sides of the amplifier and checking for a spot or trace on the crt. This is the same procedure that was explained in troubleshooting the Vertical Amplifier.

If none of the previous checks indicates the source of the trouble, a defective crt is indicated.

2. Insufficient or no vertical deflection

If there is no vertical deflection on the crt, an inoperative condition in the vertical-deflection system is indicated. The source of this trouble can be:

a. The delay line.

b. The vertical amplifier.

If the trace can be moved with the Vertical POSITIONING control, the trouble is originating ahead of the control in one of the input stages to the Vertical Amplifier (Input C.F., Input Amplifier).

If the trace cannot be moved with the Vertical POSITIONING control, one of the stages following the control, or the Delay Line, is inoperative. In either of the above cases the tubes should first be replaced. If the trouble still exists, connect a voltmeter between the two plates of the Output Amplifier (V544-V554). If the voltage at this point varies as the Vertical POSITIONING control is rotated, the Delay Line is causing the trouble. If the voltage at this point does not vary, the voltmeter can be moved back, point by point, across opposite sides of the amplifier. The stage producing the trouble will be indicated when a point is reached where the voltage does vary as the Vertical POSITIONING control is adjusted.

If there is some vertical deflection on the crt, but not enough to correspond to the calibrated value, the Vertical Amplifier can be investigated for insufficient gain. If there is only a slight deficiency in the deflection, as will usually be the case, the amplifier can generally be recalibrated for gain. Refer to

the Recalibration Procedure for this. However, if the amplifier cannot be recalibrated, or if the decrease in gain is more pronounced, it will be necessary to check the tubes and circuit components.

If the trouble described in this section only appears when the VOLTS/DIV. switch is in one of the positions marked AC ONLY, the trouble is originating in the Preamplifier. Or, if the trouble only appears in one position of the VOLTS/DIV. switch, the Attenuator(s) associated with this setting of the switch will be at fault.

3. Insufficient or no horizontal deflection

If there is no horizontal deflection on the crt, the circuit at fault can be:

a. The time-base generator.

b. The horizontal amplifier.

The operation of the Time-Base Generator can be checked from the front panel. Set the HORIZONTAL DISPLAY SWITCH to NORM., the TIME/DIV. switch to .5 SEC., and adjust the STABILITY control for a free-running sweep (full right). Connect a voltmeter between the SAWTOOTH OUT connector and ground. If the voltage varies between zero and +150 volts, as the Miller circuit runs up and back, the Time-Base Generator is operating properly. No voltage variation at this jack indicates an inoperative Time-Base Generator circuit.

When the trouble has been isolated to either the Time-Base Generator or the Horizontal Amplifier, the circuit at fault can be located by following the procedure outlined in Section 1.

If there is some horizontal deflection on the crt, but not enough to cover the ten-division length of the graticule, the trouble will either be due to insufficient output from the Time-Base Generator, or to insufficient gain in the Horizontal Amplifier.

The Time-Base Generator can be checked in the same manner as described previously. That is, by measuring for a 150-volt variation at the SAWTOOTH OUT connector, at a slow sweep rate. If this reading is not obtained, the Time-Base Generator is at fault, and its circuitry can be investigated. The SWEEP LENGTH control (R176) is very important in this respect, and its setting should be checked first. For the proper adjustment of this control, refer to the Recalibration Procedure.

If the voltmeter indicates the proper reading at the SAWTOOTH OUT connector, the Horizontal Amplifier will be the circuit at fault. There are two gain adjustments in this circuit: the HORIZ. GAIN ADJ. (R325) and the MAG. GAIN ADJ. (R358). Any adjustment of these controls, however, will also affect the sweep timing. Be sure to refer to the Recalibration Procedure before making any adjustments in the Horizontal Amplifier.

4. Nonlinear horizontal sweep

The linearity of the horizontal-deflection circuit can be checked by connecting a marker-generator to the Vertical INPUT connector and adjusting the Time-Base controls for a stationary display. If the displayed markers are not equally spaced across the graticule, a nonlinear horizontal sawtooth, at the horizontal deflection plates, is indicated. This can be caused by nonlinear amplification in the Horizontal Amplifier, or by nonlinear operation of the Time-Base Generator.

If another oscilloscope is available, the linearity of the Time-Base Generator can be checked by observing the sawtooth available at the SAWTOOTH OUT connector. If the slope of the trace portion of the sawtooth is constant, the Time-Base Generator is producing a linear sawtooth and the nonlinearity is being produced in the Horizontal Amplifier. If the slope of the trace is not constant, however, the nonlinearity is being produced by the Time-Base Generator circuitry.

5. Improper sweep timing (horizontal sweep linear)

If the timing of the horizontal sweep appears to be improper, check to see if this is occuring in all positions, or just in certain positions, of the TIME/DIV. switch. If the timing appears to be off in all positions of the switch, the Horizontal Amplifier will probably be out of adjustment. Two adjustments, the HORIZ. GAIN ADJ. (R325) and the MAG. GAIN ADJ. (R358), affect the timing at all sweep rates. Refer to the Recalibration Procedure for the adjustment of these controls.

If the timing is off in just one setting, or in just one group of settings, of the TIME/DIV. switch, one (or more) of the components associated with the Timing Switch have probably changed in value. There are three variable capacitors associated with this switch: C160A, C160C and C160E. These capacitors should be adjusted only if the timing in the μSEC range appears to be off.

6. Improper triggering

If the waveform you are observing cannot be triggered (locked into position) properly, the trouble can be:

a. The trigger-pickoff circuit (Trigger C.F. V563) in the vertical amplifier.

b. The time-base trigger circuit.

c. The time-base generator circuit.

The operation of the Trigger C.F. can be checked as follows: connect an external triggering signal (preferably the signal-input waveform) to the TRIGGER INPUT connector. Set the black TRIGGER SELECTOR knob to EXT. (+ or -). Check to see if the waveform can now be triggered. If so, the Trigger C.F. stage V563 is at fault; it is not passing the internal signal that develops the triggering pulse.

If the waveform cannot be triggered in either the INT. or EXT. positions of the TRIGGER SELECTOR switch, some circuit in either the Time-Base Trigger or the Time-Base Generator is not operating properly. The Time-Base Generator can be eliminated if the trace can be turned off and on with the STABILITY control.

7. Waveform distortion

Waveform distortion can be divided into two categories: (a) low-frequency distortion, shown in Fig. 5-8. Any low-frequency distortion apparent in the waveform will be produced by the Preamplifier. The main Vertical Amplifier is dc-coupled; therefore its response is flat down to dc.

Low-frequency attenuation will produce the type of distortion shown in Fig. 5-9. This is caused by cathode and screen-bypass capacitors, and by coupling capacitors. Before attempting any component replacement, however, be sure to check the adjustment of the L.F. ADJ. control R475, as explained in the Recalibration Procedure.

Overcompensation of low frequencies is shown in Fig. 5-8. This condition is produced by excessive low-frequency "boost". Refer to the Circuit Description for an explanation of how the "boost" circuit operates.

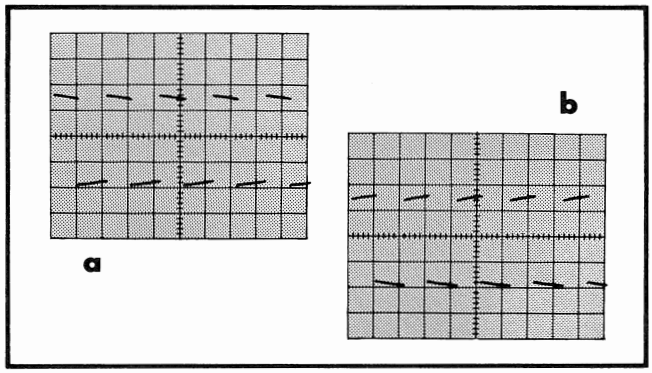


Fig. 5-8. Two types of low-frequency distortion.

NOTE: Low-frequency distortion can also be produced by an improperly adjusted probe. Refer to the article on "Use of Probes", page 3-3.

High-frequency distortion can be produced in the Attenuators (shown on the Preamplifier diagram), the Preamplifier, the main Vertical Amplifier, and the Delay Line. When the VOLTS/DIV. switch is in the .1 (straight through) position the Attenuators and the Preamplifier are bypassed. Any distortion observed in the waveform, when the switch is in this position, will be produced by either the Vertical Amplifier or the Delay Line.

Insufficient high-frequency peaking, which limits the risetime and consequently the bandwidth, will produce the rounded-corner type of distortion illustrated in Fig. 5-9a. Tubes are often a cause of this type of distortion. Shorted, or partially shorted, peaking coils are another common source.

The overshoot condition, illustrated in Fig. 5-9b, is the result of excessive high-frequency peaking, and is produced by improperly adjusted peaking coils. The "wrinkle" condition, shown in Fig. 5-9c, is produced by an improperly adjusted Delay Line. Refer to the Recalibration Procedure for the Delay Line adjustment procedure.

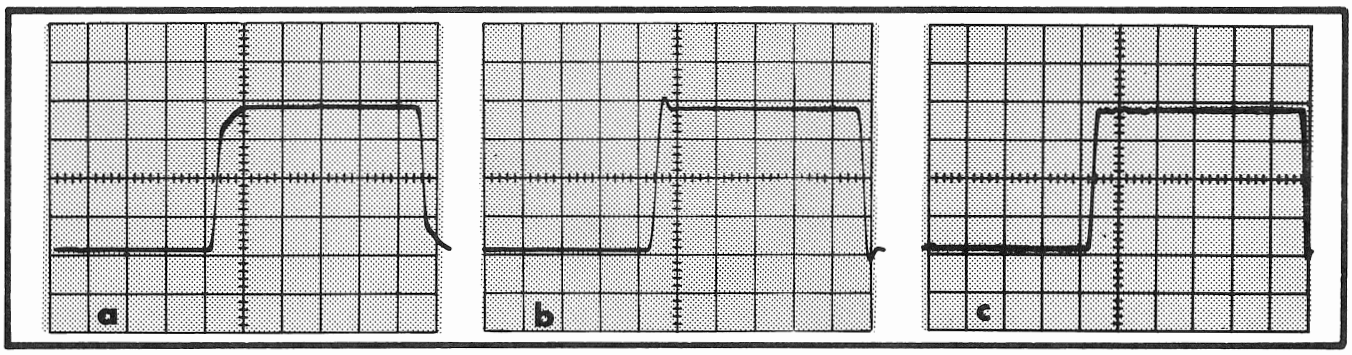


Fig. 5-9. Three types of high-frequency distortion.

NOTES

PARTS LIST

Values are fixed unless marked Variable.

Bulbs

Circuit No.	Tektronix Part No.	Description	S/N Range
B43	150-0027-00	Neon, Type NE-23	X4500-up
B68	Use 150-027	Neon, Type NE-23 Uncalibrated	101-4739
B68	150-0030-00	Neon, Type NE-2V Uncalibrated	4740-up
B75	Use 150-027	Neon, Type NE-23	
B77	Use 150-027	Neon, Type NE-23	
B163	Use 150-027	Neon, Type NE-23	
B217	Use 150-027	Neon, Type NE-23 Uncalibrated	101-4739
B217	150-0030-00	Neon, Type NE-2V Uncalibrated	4740-up
B300	Use 150-027	Neon, Type NE-23 Mag	101-4739
B300	150-0030-00	Neon, Type NE-2V Mag	4740-up
B359	Use 150-027	Neon, Type NE-23	
B379	Use 150-027	Neon, Type NE-23	
B600	150-004	Incandescent, Type #328 Pilot Light	
B601	150-001	Incandescent, Type #47 Graticule Light	
B602	150-001	Incandescent, Type #47 Graticule Light	

Capacitors

Tolerance ±20% unless otherwise indicated.

Tolerance of all electrolytic capacitors are as follows: (with exceptions)

3 V — 50 V = —10% +250%
51 V — 350 V = —10% + 100%
351 V — 450 V = —10% + 50%

C20	281-513	27 μμf	Cer.		500 v	
C22	283-001	.005 μf	Discap		500 v	GMV
C24	281-503	8 μμf	Cer.		500 v	±0.5 μμf
C26	281-544	5.6 μμf	Cer.		500 v	10%
C28	283-001	.005 μf	Discap		500 v	GMV
C33	281-504	10 μμf	Cer.		500 v	10%
C42	283-001	.005 μf	Discap.		500 v	GMV
C46	283-000	.001 μf	Discap		500 v	GMV
C52	281-521	56 μμf	Cer.		500 v	10%
C72	281-525	470 μμf	Cer.		500 v	
C76	283-000	.001 μf	Discap.		500 v	GMV
C101	Use *285-603	.1 μf	PTM		600 v	
C103	283-000	.001 μf	Discap		500 v	GMV
C110	281-010	4.5-25 μμf	Cer.	Var.		
C112	281-005	1.5-7 μμf	Cer.	Var.		
C114	283-543	250 μμf	Mica		500 v	5%
C116	281-010	4.5-25 μμf	Cer.	Var.		
C118	281-010	4.5-25 μμf	Cer.	Var.		
C120	283-544	150 μμf	Mica		500 v	10%
C124	281-010	4.5-25 μμf	Cer.	Var.		
C126	281-007	3-12 μμf	Cer.	Var.		
C130	281-007	3-12 μμf	Cer.	Var.		
C132	281-010	4.5-25 μμf	Cer.	Var.		
C136	281-543	270 μμf	Cer.		500 v	10%

Capacitors *(continued)*

Circuit No.	Tektronix Part No.	Description					Serial No.
C141	281-005	1.5-7 μμf	Cer.	Var.			101-347
	281-027	.7-3 μμf	Tub.	Var.			348-up
C145	283-001	.005 μf	Discap		500 v	GMV	
C146 A,B,C	Use 290-0005-00	3 x 10 μf	EMC		450 v		
C150	Use 290-0022-00	2 x 1000 μf	EMC		15 v		
C151	283-004	.02 μf	Discap		150 v	GMV	X288-up
C154	290-030	500 μf	EMT		6 v		
C160 A	281-007	3-12 μμf	Cer.	Var.			
C160 B	283-534	82 μμf	Mica		500 v	5%	
C160 C	281-010	4.5-25 μμf	Cer.	Var.			
C160 D	283-534	82 μμf	Mica		500 v	5%	
C160 E	281-010	4.5-25 μμf	Cer.	Var.			
C160 F	*291-008	.001 μf	Mylar			±½%	101-4869
C160 G, C160 H, C160 J	*291-007	.01 μf, 0.1 μf, 1 μf	Mylar Timing Series			±½%	101-4869
C160F, C160G, C160H, C160J	*295-0095-00	.001 μf, .01 μf, .1 μf, 1 μF	Timing Capacitor Assembly				4870-up
C165	283-001	.005 μf	Discap		500 v	GMV	
C166	283-001	.005 μf	Discap		500 v	GMV	
C171	285-526	.1 μf	PTM		400 v		
C180 A	283-509	180 μμf	Mica		500 v	10%	
C180 B	285-543	.0022 μf	PTM		400 v		
C180 C	285-515	.022 μf	PTM		400 v		
C180 D	285-526	.1 μf	PTM		400 v		
C180 E	285-526	.1 μf	PTM		400 v		
C181	281-516	39 μμf	Cer.		500 v	10%	
C182	283-000	.001 μf	Discap		500 v	GMV	
C183	281-500	2.2 μμf	Cer.		500 v	±0.5 μμf	
C184	283-001	.005 μf	Discap		500 v	GMV	
C190	283-001	.005 μf	Discap		500 v	GMV	
C194	283-002	.01 μf	Discap		500 v	GMV	
C207	283-002	.01 μf	Discap		500 v	GMV	
C256	281-526	1.5 μμf	Cer.		500 v	±0.5 μμf	
C262	283-001	.005 μf	Discap		500 v	GMV	
C267	281-037	.7-3 μμf	Tub.	Var.			
C268	281-534	3.3 μμf	Cer.		500 v	±.25 μμf	
C269	281-037	.7-3 μμf	Tub.	Var.			
C271-83	281-037 (13)	.7-3 μμf	Tub.	Var.			
C284-93	281-037 (10)	.7-3 μμf	Tub.	Var.			
C295	281-037	.7-3 μμf	Tub.	Var.			
C310	281-010	4.5-25 μμf	Cer.	Var.			
C315	281-509	15 μμf	Cer.		500 v	10%	
C324	281-009	3-12 μμf	Cer.	Var.			
C333	281-526	1.5 μμf	Cer.		500 v	±0.5 μμf	
C350	281-504	10 μμf	Cer.		500 v	10%	101-339
	281-011	5-25 μμf	Cer.	Var.			340-up
C358	281-023	9-180 μμf	Mica	Var.			
C367	283-006	.02 μf	Discap		600 v		
C372	281-009	3-12 μμf	Cer.	Var.			101-339
	281-011	5-25 μμf	Cer.	Var.			340-up
C407	285-510	.01 μf	PTM		400 v		
C410	283-000	.001 μf	Discap		500 v	GMV	

Circuit No.	Tektronix Part No.	Description				Serial No.
C413	281-530	100 μμf	Cer.	500 v	10%	
C414	283-000	.001 μf	Discap	500 v	GMV	
C423	283-003	.01 μf	Discap	150 v	GMV	
C425	283-003	.01 μf	Discap	150 v	GMV	
C435	281-542	18 μμf	Cer.	500 v	10%	
C443	283-001	.005 μf	Discap	500 v	GMV	
C554	283-518	330 μμf	Mica	500 v	10%	
C558	283-518	330 μμf	Mica	500 v	10%	
C576	281-513	27 μμf	Cer.	500 v		
C601 A, C601 B	Use 290-0059-00	160 μf, 10 μf	EMC	350 v		
C603	285-510	.01 μf	PTM	400 v		
C614	285-510	.01 μf	PTM	400 v		
C630 A, C630 B	Use 290-0059-00	160 μf, 10 μf	EMC	350 v		
C638	285-510	.01 μf	PTM	400 v		
C660	Use 290-0016-00	125 μf	EMC	350 v		
C668	285-510	.01 μf	PTM	400 v		
C690	283-003	.01 μf	Discap	150 v	GMV	101-605
	283-004	.02 μf	Discap	150 v	GMV	606-up
C691	283-004	.02 μf	Discap	150 v	GMV	X606-up
C803	283-000	.001 μf	Discap	500 v	GMV	
C805	283-002	.01 μf	Discap	500 v	GMV	
C806	285-502	.001 μf	PTM	1000 v		
C807	290-094	8 μf	EMT	450 v		
C814	285-508	.0068 μf	PTM	3000 v		101-961
	283-011	.01 μf	Discap	2000 v		962-up
C815	use 285-519	.047 μf	PTM	400 v		
C820	285-508	.0068 μf	PTM	3000 v		101-961
	283-011	.01 μf	Discap	2000 v		962-up
C821	use 283-034	.0068 μf	PTM	5000 v		101-809
	283-034	.005 μf	Discap	4000 v		810-up
C822	use 281-556	470 μμf	PTM	10,000 v		101-719
	281-556	500 μμf	Cer.	10,000 v		720-up
C823	use 281-556	470 μμf	PTM	10,000 v		101-719
	281-556	500 μμf	Cer.	10,000 v		720-up
C825	283-002	.01 μf	Discap	500 v	GMV	
C830	285-508	.0068 μf	PTM	3000 v		101-961
	283-011	.01 μf	Discap	2000 v		962-up
C832	285-513	.015 μf	PTM	3000 v		101-759
	283-011	.01 μf	Discap	2000 v		760-up
C834	285-513	.015 μf	PTM	3000 v		101-759
	283-011	.01 μf	Discap	2000 v		760-up
C835	283-011	.01 μf	Discap	2000 v		X810-up
C855	285-513	.015 μf	PTM	3000 v		101-759
	283-011	.01 μf	Discap	2000 v		760-up
C856	283-001	.005 μf	Discap	500 v		
C857	285-513	.015 μf	PTM	3000 v		101-759
	283-011	.01 μf	Discap	2000 v		760-up
C864	283-001	.005 μf	Discap	500 v		101-2209X

Diodes

Circuit No.	Tektronix Part No.	Description	Serial No.
D18	152-008	T12G	X1530-up
D52	152-0246-00	Silicon Low Leakage 0.25 w, 40 v	X4800-up
D142	152-008	T12G	X341-up
D152 A,B,	use 152-047	Silicon Diode	X341-4799
D152A,B	152-0066-00	Silicon 1N3194	4800-up
D602 A,B,C,D	use 152-047	Silicon Diode	X341-4799
D602A,B,C,D	152-0066-00	Silicon 1N3194	4800-up
D632 A,B,C,D	use 152-047	Silicon Diode	X341-4799
D632A,B,C,D	152-0066-00	Silicon 1N3194	4800-up
D662 A,B,C,D	use 152-047	Silicon Diode	X341-4799
D662A,B,C,D	152-0066-00	Silicon 1N3194	4800-up

Fuses

F601	159-005	3 Amp 3 AG Slo-Blo 117 v Operation 50 & 60 Cycles
	159-003	1.6 Amp 3 AG Slo-Blo 234 v Operation 50 & 60 Cycles

Inductors

L150	*114-086	23-55 μh	Var.	core 276-511
L157	*108-054	6.4 μh		
L177	*114-051	.9-1.6 μh	Var.	core 276-506
L213	*114-076	15-30 μh	Var.	core 276-506
L227	*114-076	15-30 μh	Var.	core 276-506
L240	*108-103	2.5 μh		
L244	*114-077	12-25 μh	Var.	core 276-506
L250	*108-103	2.5 μh		
L254	*114-077	12-25 μh	Var.	core 276-506
L270	*108-123	Delay Line, 2 Section		
L271	*108-123	Delay Line, 2 Section		
L274	*108-125	Delay Line, 12 Section		
L275	*108-125	Delay Line, 12 Section		
L283	*108-103	2.5 μh		
L284	*108-103	2.5 μh		
L285	*108-124	Delay Line, 10 Section		
L286	*108-124	Delay Line, 10 Section		
L293	*114-075	17-34 μh	Var.	core 276-506
L294	*114-075	17-34 μh	Var.	core 276-506

Resistors

Resistors are fixed, composition, ±10%, unless otherwise indicated.

R10†	311-099	500 k	2 w	Var.	STABILITY
R11	311-026	100 k	2 w	Var.	Preset Stability
R14	302-104	100 k	½ w		
R16	301-273	27 k	½ w		5%
R17	301-393	39 k	½ w		5%
R18	302-472	4.7 k	½ w		
R20	302-101	100 Ω	½ w		
R22	302-101	100 Ω	½ w		
R23	303-362	3.6 k	1 w		5%
R24	303-362	3.6 k	1 w		5%

† Furnished as a unit with R330, R429 and SW10.

Circuit No.	Tektronix Part No.	Description					Serial No.
R25	302-101	100 Ω	½ w				
R26	303-433	43 k	1 w			5%	
R27	303-333	33 k	1 w			5%	
R28	302-101	100 Ω	½ w				
R29	308-054	10 k	5 w		WW	5%	
R30	302-105	1 meg	½ w				
R31	302-470	47 Ω	½ w				
R33	use 303-183	18 k	1 w			5%	
R34	use 305-333	33 k	2 w			5%	
R36	302-470	47 Ω	½ w				
R37	302-681	680 Ω	½ w				101-310
	302-102	1 k	½ w				311-up
R38	304-154	150 k	1 w				
R41	302-470	47 Ω	½ w				
R42	302-470	47 Ω	½ w				
R43	302-103	10 k	½ w				
R46	302-104	100 k	½ w				
R47	302-470	47 Ω	½ w				
R48	302-470	47 Ω	½ w				
R49	304-104	100 k	1 w				
R52	302-681	680 Ω	½ w				
R53	302-0685-00	6.8 meg	½ w				X4830-up
R64	302-822	8.2 k	½ w				
R65†	311-108	20 k	2 w	Var.	WW	VARIABLE	
R67	302-105	1 meg	½ w				X840-up
R68	302-104	100 k	½ w				
R70	302-101	100 Ω	½ w				
R72	304-473	47 k	1 w				
R73	304-473	47 k	1 w				
R75	302-155	1.5 meg	½ w				
R76	302-224	220 k	½ w				
R77	302-101	100 Ω	½ w				
R80	308-054	10 k	5 w		WW		
R81	Use 304-332	3.3 k	1 w				
R82	311-008	2 k	2 w	Var.		Sweep Length	
R83	308-052	6 k	5 w		WW	5%	
R86	302-475	4.7 meg	½ w				
R88	302-101	100 Ω	½ w				
R103	302-100	10 Ω	½ w				
R112	309-013	990 k	½ w		Prec.	1%	
R114	309-034	10.1 k	½ w		Prec.	1%	
R118	309-111	900 k	½ w		Prec.	1%	
R120	309-046	111 k	½ w		Prec.	1%	
R122	302-270	27 Ω	½ w				
R126	309-110	800 k	½ w		Prec.	1%	
R128	309-109	250 k	½ w		Prec.	1%	
R132	309-003	500 k	½ w		Prec.	1%	

† Concentric with SW160. Furnished as a unit.

Resistors *(continued)*

Circuit No.	Tektronix Part No.		Description				Serial No.
R134	309-014	1 meg	1/2 w		Prec.	1%	
R136	302-220	22 Ω	1/2 w				
R141†	312-583	1 meg	1/2 w		Prec.	1% (Selected)	
R143	302-470	47 Ω	1/2 w				
R144	302-153	15 k	1/2 w				
R145	302-101	100 Ω	1/2 w				
R146	306-123	12 k	2 w				
R150	*310-539	3 k	2 w		Prec.	1%	
R151	308-116	2.2 Ω	1/2 w		WW	5%	101-679
	307-015	3.3 Ω	1 w			5%	680-up
R152	308-024	15 k	10 w		WW	5%	
R154	311-097	200 Ω	1/2 w	Var.		Preamp. Gain Adj.	
R157	302-470	47 Ω	1/2 w				
R160 A	309-045	100 k	1/2 w		Prec.	1%	
R160 B	309-051	200 k	1/2 w		Prec.	1%	
R160 C	309-003	500 k	1/2 w		Prec.	1%	
R160 D	309-014	1 meg	1/2 w		Prec.	1%	
R160 E	309-023	2 meg	1/2 w		Prec.	1%	
R160 F	309-087	5 meg	1/2 w		Prec.	1%	
R160 G	309-095	10 meg	1/2 w		Prec.	1%	
R160 H	309-095	10 meg	1/2 w		Prec.	1%	
R160 J	309-095	10 meg	1/2 w		Prec.	1%	
R163	306-223	22 k	2 w				
R165	302-470	47 Ω	1/2 w				
R166	302-102	1 k	1/2 w				
R167	301-154	150 k	1/2 w			5%	
R168	301-204	200 k	1/2 w			5%	
R171	304-822	8.2 k	1 w				
R174	Use 302-224	220 k	1/2 w				
R175	311-042	2 meg	2 w	Var.		Low Freq. Comp.	
R180 A	302-474	470 Ω	1/2 w				
R180 B	302-475	4.7 meg	1/2 w				
R183†	312-583	1 meg	1/2 w		Prec.	1% (Selected)	
R184	302-104	100 k	1/2 w				
R187	302-470	47 Ω	1/2 w				
R190	302-470	47 Ω	1/2 w				
R193	304-393	39 k	1 w				
R194	302-470	47 Ω	1/2 w				
R195	304-393	39 k	1 w				
R201	311-068	500 k	.2 w	Var.		VAR. ATTEN. BAL.	
R203	302-394	390 k	1/2 w				
R205	302-475	4.7 meg	1/2 w				
R206	302-392	3.9 k	1/2 w				
R207	302-470	47 Ω	1/2 w				
R210	302-100	10 Ω	1/2 w				
R212	302-122	1.2 k	1/2 w				
R213	*310-533	1.8 k	2 w		Prec.	1%	
R216	Use *311-281	780 Ω			WW	VARIABLE	
R217	302-104	100 k	1/2 w				
R219	304-103	10 k	1 w				

† R141, R183 Furnished together as a matched pair.

Circuit No.	Tektronix Part No.	Description					Serial No.
R220	304-103	10 k	1 w				
R223	308-007	8 k	5 w		WW	5%	
R225	302-100	10 Ω	½ w				
R227	*310-533	1.8 k	2 w		Prec.	1%	
R230	302-823	82 k	½ w				
R231	311-028	2 x 100 k	2 w	Var.		VERTICAL POS.	
R232	302-823	82 k	½ w				
R233	302-100	10 Ω	½ w				
R234	302-100	10 Ω	½ w				
R235	303-153	15 k	1 w			5%	
R236	303-153	15 k	1 w			5%	
R240	302-270	27 Ω	½ w				
R244	311-003	100 Ω	2 w	Var.		Gain Adj.	101-340
	311-004	200 Ω	2 w	Var.		Gain Adj.	341-up
R245	308-082	3 k	5 w		WW	5%	
R246	308-082	3 k	5 w		WW	5%	
R248	308-063	1.2 k	5 w		WW	5%	101-340
	302-221	220 Ω	½ w				341-up
R250	302-270	27 Ω	½ w				
R256	309-001	433 k	½ w		Prec.	1%	
R257	use 309-152	333 k	½ w		Prec.	1%	101-679
	309-152	349 k	½ w		Prec.	1%	680-up
R258	311-023	50 k	2 w	Var.		Int. Trig DC Level Adj.	
R260	302-470	47 Ω	½ w				
R262	302-470	47 Ω	½ w				
R264	304-393	39 k	1 w				
R293	*310-534	1.8 k	7 w			(.53 k Tap) 1%	
R294	*310-534	1.8 k	7 w			(.53 k Tap) 1%	
R297	308-089	1 k	10 w		WW		101-340
	308-086	1.2 k	10 w		WW		341-up
R300	302-104	100 k	½ w				
R310	309-149	1.2 meg	½ w		Prec.	1%	
R311	309-015	1.11 meg	½ w		Prec.	1%	101-5129
R311	309-0386-00	1 meg	½ w		Prec.	1%	5130-up
R314 A,B	311-090	2 x 20 k	2 w	Var.	WW	HORIZ. POS.	
R315	302-561	560 Ω	½ w				
R316	302-470	47 Ω	½ w				
R318	306-473	47 k	2 w				
R324	309-091	120 k	½ w		Prec.	1%	
R325	311-078	50 k	.1 w	Var.		Horiz. Gain Adj.	
R330†	311-099	100 k	2 w	Var.		Horiz. Input Atten.	
R333	309-126	400 k	½ w		Prec.	1%	
R334	309-109	250 k	½ w		Prec.	1%	
R335	311-023	50 k	2 w	Var.		Norm/Mag. Regis.	
R337	302-470	47 Ω	½ w				
R340	306-683	68 k	2 w				
R344	302-470	47 Ω	½ w				
R350	*310-524	7-35 k	7 w		Mica Plate	1%	
R351	302-470	47 Ω	½ w				
R353	303-153	15 k	1 w			5%	
R354	308-054	10 k	5 w		WW	5%	101-340
	305-123	12 k	2 w			5%	341-up

† Furnished as a unit with R10, R429 and SW10.

Resistors *(continued)*

Circuit No.	Tektronix Part No.		Description				Serial No.
R356	303-153	15 k	1 w			5%	
R358	311-120	2.5 k	.2 w	Var.		Mag. Gain Adj.	
R359	Use *310-614	41.5	8 w		Mica Plate	½%	
R365	304-223	22 k	1 w				
R366	302-104	100 k	½ w				
R367	302-562	5.6 k	½ w				
R368	304-153	15 k	1 w				
R369	302-102	1 k	½ w				
R370	302-470	47 Ω	½ w				
R372	*310-524	7-35 k	7 w		Mica Plate	1%	
R374	302-470	47 Ω	½ w				
R379	304-274	270 k	1 w				
R409	302-105	1 meg	½ w				
R410	302-474	470 k	½ w				
R412	302-101	100 Ω	½ w				
R413	302-392	3.9 k	½ w				101-1869
R413	302-472	4.7 k	½ w				1870-up
R414	302-270	27 Ω	½ w				
R415	302-392	3.9 k	½ w				101-1869
R415	302-472	4.7 k	½ w				1870-up
R417	308-081	20 k	8 w		WW	5%	
R419	302-101	100 Ω	½ w				
R422	302-104	100 k	½ w				
R423	302-101	100 Ω	½ w				
R424	302-224	220 k	½ w				
R425	302-104	100 k	½ w				
R426	302-395	3.9 meg	½ w				
R427	302-824	820 k	½ w				
R428	302-105	1 meg	½ w				
R429†	311-099	100 k	2 w	Var.		TRIGGERING LEVEL	
R431	302-225	2.2 meg	½ w				
R432	302-102	1 k	½ w				
R433	301-222	2.2 k	½ w			5%	
R435	302-154	150 k	½ w				
R436	302-124	120 k	½ w				
R437	311-026	100 k	2 w	Var.		Trig. Level Centering	
R439	302-101	100 Ω	½ w				
R440	302-821	820 Ω	½ w				
R441	302-105	1 meg	½ w				
R442	304-223	22 k	1 w				
R443	302-331	330 Ω	½ w				101-899
	311-056	500 Ω	.1 w	Var.			900-up
R444	304-223	22 k	1 w				
R550	302-154	150 k	½ w				
R552	302-102	1 k	½ w				
R554	301-395	3.9 meg	½ w			5%	
R556	301-245	2.4 meg	½ w			5%	
R558	302-102	1 k	½ w				
R562	302-683	68 k	½ w				
R564	304-333	33 k	1 w				
R566	311-016	10 k	2 w	Var.		Cal. Adj.	
R567	use 302-683	100 k	½ w				101-230
	302-683	68 k	½ w				231-up

† Furnished as a unit with R10, R330 and SW10.

Circuit No.	Tektronix Part No.	Description					Serial No.
R572	302-102	1 k	½ w				
R577	309-100	10 k	½ w		Prec.	1%	
R578	309-099	6 k	½ w		Prec.	1%	
R579	309-098	2 k	½ w		Prec.	1%	
R580	309-115	1 k	½ w		Prec.	1%	
R581	309-097	600 Ω	½ w		Prec.	1%	
R582	309-073	200 Ω	½ w		Prec.	1%	
R583	309-112	100 Ω	½ w		Prec.	1%	
R584	309-067	60 Ω	½ w		Prec.	1%	
R585	309-064	20 Ω	½ w		Prec.	1%	
R586	309-096	10 Ω	½ w		Prec.	1%	
R587	309-096	10 Ω	½ w		Prec.	1%	
R599	302-100	10 Ω	½ w				X870-up
R600	311-055	50 Ω	2 w	Var.	WW	SCALE ILLUM.	
R601	use 306-100	10 Ω	2 w				
R602	use 308-035	200 Ω	20 w		WW	5%	101-260
	308-035	125 Ω	25 w		WW	5%	261-3799X
R603	302-333	33 k	½ w				
R605	302-562	5.6 k	½ w				
R606	302-224	220 k	½ w				
R607	302-683	68 k	½ w				
R609	302-105	1 meg	½ w				
R610	302-102	1 k	½ w				
R612	302-183	18 k	½ w				
R614	302-105	1 meg	½ w				
R616	309-042	68 k	½ w		Prec.	1%	
R617	311-015	10 k	2 w	Var.	WW	—150 v Adj.	
R618	309-090	50 k	½ w		Prec.	1%	
R620	308-102	1.25 k	25 w		WW		
R630	use 304-100	10 Ω	1 w				
R632	302-473	47 k	½ w				
R633	302-333	33 k	½ w				
R635	302-105	1 meg	½ w				
R636	302-105	1 meg	½ w				
R638	302-102	1 k	½ w				
R639	use 308-003	3 k	5 w		WW	5%	101-369
	308-003	2 k	5 w		WW	5%	370-up
R641	310-056	333 k	1 w		Prec.	1%	
R642	310-057	490 k	1 w		Prec.	1%	
R660	306-100	10 Ω	2 w				
R662	304-274	270 k	1 w				
R663	use 302-563	47 k	½ w				101-230
	302-563	56 k	½ w				231-up
R666	302-105	1 meg	½ w				
R668	302-102	1 k	½ w				
R669	308-102	1.25 k	25 w		WW	5%	
R671	309-014	1 meg	½ w		Prec.	1%	
R672	309-002	490 k	½ w		Prec.	1%	
R690	302-104	100 k	½ w				
R694	302-274	270 k	½ w				

Resistors *(continued)*

Circuit No.	Tektronix Part No.		Description			Serial No.
R695	302-104	100 k	½ w			
R803	302-473	47 k	½ w			
R804	302-473	47 k	½ w			
R805	302-472	4.7 k	½ w			
R807	302-331	330 Ω	½ w			
R810	302-155	1.5 meg	½ w			
R811	311-042	2 meg	2 w	Var.	HV Adj.	
R812	302-225	2.2 meg	½ w			
R813	302-475	4.7 meg	½ w			
R814	302-475	4.7 meg	½ w			
R815	302-475	4.7 meg	½ w			
R825	302-332	3.3 k	½ w			
R830	302-473	47 k	½ w			
R831	311-041	1 meg	2 w	Var.	INTENSITY	101-5079
R831	311-0041-02	1 meg	2 w	Var.	INTENSITY	5080-up
R832	306-475	4.7 meg	2 w			
R833	306-475	4.7 meg	2 w			
R834	302-104	100 k	½ w			101-809
	302-333	33 k	½ w			810-up
R835	306-155	1.5 meg	2 w			101-809
	302-225	2.2 meg	½ w			810-up
R850	306-225	2.2 meg	2 w			
R851	306-225	2.2 meg	2 w			
R852	311-043	2 meg	2 w	Var.	FOCUS	101-5079
R852	311-0043-02	2 meg	2 w	Var.	FOCUS	5080-up
R853	304-105	1 meg	1 w			
R855	302-103	10 k	½ w			
R856	311-023	50 k	2 w	Var.	ASTIGMATISM	
R857	302-105	1 meg	½ w			
R858	302-273	27 k	½ w			
R861	311-026	100 k	2 w	Var.	Geom. Adj.	
R863	302-154	150 k	½ w			101-2209X
R864	302-124	120 k	½ w			101-2209X

Rectifiers†

SR150	*106-038	1-250 ma plate/leg	101-340X
SR154	Use *050-067	1-100 ma plate/leg	101-340X
SR601	*106-015	5-100 ma plates/leg	101-340X
SR630	*106-031	5-250 ma plates/leg	101-340X
SR660	*106-030	6-250 ma plates/leg	101-340X

† Mod. Kit is available to convert from Selenium Rectifiers to Silicon Diodes. Order Mod. Kit #040-212.

Switches

	Unwired	Wired		
SW10††	311-099		PRESET	
SW101	*260-122		Rotary AC/DC	
SW120	*260-187	Use *262-486	Rotary VOLTS/DIV	
SW160†††	*260-226	*262-182	Rotary TIME/DIV	101-4869
SW160†††	260-0226-00	*262-0182-01	Rotary TIME/DIV	4870-up
SW300	*260-186	*262-201	Rotary HORIZ. DISPLAY	

† S/N 341-up, see V142, V152, V606, V632 and V662.

†† Furnished as a unit with R10, R330 and R429.

††† Concentric with R65. Furnished as a unit.

Switches *(continued)*

Circuit No.	Tektronix Part No. Unwired	Wired	Description	Serial No.
SW410	*260-151	*262-196	Rotary TRIGGER SELECTOR	
SW420				
SW555	*260-098	*262-120	Rotary SQUARE WAVE CALIBRATOR	
SW600	260-134		Toggle POWER ON	

Thermal Cutout

TK601	260-120		Thermal Cutout, 137°F ±5°	

Transformers

T600	*120-064		L. V. Power	101-340
T600	*120-112		L. V. Power	341-up
T801	*120-116		H. V. Power	

Electron Tubes

V25	154-187	6DJ8		
V35	154-078	6AN8		101-4939
V35	154-0278-00	EFC-80/6BL8		4940-up
V43	154-187	6DJ8		
V52	Use *157-0104-01	6AL5	Selected	101-4799
V52	154-0016-00	6AL5		4800-up
V61	154-078	6AN8		
V83	154-187	6DJ8		
V154	154-030	6CB6		
V163	154-187	6DJ8		
V183	154-022	6AU6		101-4779
V183	154-0022-07	8425		4780-up
V203	154-022	6AU6		101-4779
V203	154-0022-07	8425		4780-up
V214	154-022	6AU6		101-4779
V214	154-0022-07	8425		4780-up
V224	154-022	6AU6		101-4779
V224	154-0022-07	8425		4780-up
V233	154-187	6DJ8		
V244	154-031	6CL6		
V254	154-031	6CL6		
V263	154-022	6AU6		
V313	154-187	6DJ8		
V354	154-187	6DJ8		
V374	154-187	6DJ8		
V414	154-187	6DJ8		
V435	154-187	6DJ8		
V555	154-041	12AU7		
V573	154-022	6AU6		
V606	154-078	6AN8		
V609	154-052	5651		
V617	154-056	6080		
V636	154-022	6AU6		
V637	154-044	12B4		
V666	154-022	6AU6		
V800	154-167	6CZ5		

Electron Tubes *(continued)*

Circuit No.	Tektronix Part No.	Description	Serial No.
V814	154-041	12AU7	
V820	154-051	5642	
V821	154-051	5642	
V822	154-051	5642	
V823	154-051	5642	
V824	154-051	5642	
V859†	*154-346	CRT T3170-31 Standard Phosphor	101-2879
V859	*154-0346-00	CRT T3170-31 Standard Phosphor	2880-up

†S/N 101-2879 add *050-090. See CSPN #31.

MECHANICAL PARTS LIST

CONTENTS

PUBLICATION NO.
062-051

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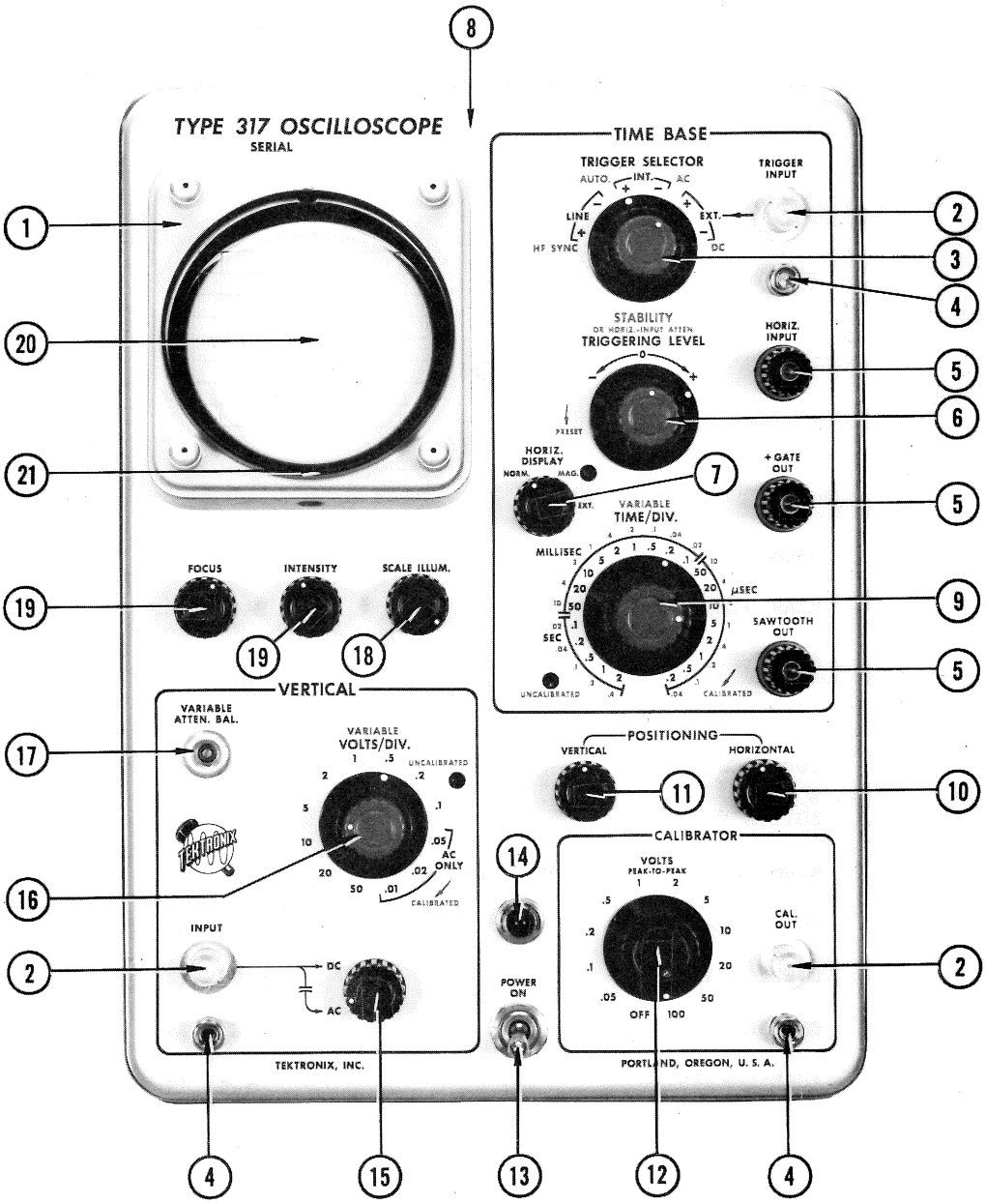
(Revised)

FRONT



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	200-073			1	COVER, graticule
	- - - -			-	Mounting Hardware: (not included)
	210-434			4	NUT, knurled, graticule
	210-844			4	WASHER, neoprene, 7/32 ID x 3/8 inch OD
2	131-038	101	3356	3	CONNECTOR, chassis mount, female, UHF
	131-278	3357		3	CONNECTOR, chassis mount, female, BNC
	- - - -			-	Mounting Hardware For Each: (not included)
	211-038			2	SCREW, 4-40 x 5/16 inch FHS phillips
	210-004			2	LOCKWASHER, internal #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
	210-961	X3357		3	WASHER, plastic, 13/16 OD x 3/8 inch ID

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
3	366-0029-00	101	4479	1	KNOB, large black--TRIGGER SELECTOR
	366-0142-00	4480		1	KNOB, large charcoal--TRIGGER SELECTOR
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0031-00			1	KNOB, small red--HF SYNC
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0196-00			1	SWITCH, wired--TRIGGER SELECTOR
	- - - - - -			-	switch includes:
	260-0151-00			1	SWITCH, unwired--TRIGGER SELECTOR
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
4	129-0035-00			3	POST, binding, assembly
	- - - - - -			-	each post includes:
	355-0507-00			1	STEM, adapter
	200-0103-00			1	CAP
	210-0011-00			1	LOCKWASHER, internal, 1/4 inch
	210-0455-00			1	NUT, hex, 1/4-28 x 3/8 inch
5	129-0030-00	101	260	3	POST, binding, black
	129-0036-00	261	4479	3	POST, binding, black
	129-0063-00	4480		3	POST, binding, charcoal
	- - - - - -			-	mounting hardware for each: (not included w/post)
	358-0036-00	101	4479	1	BUSHING, binding post, black
	358-0169-00	4480		1	BUSHING, binding post, charcoal
	210-0445-00	101	3579	2	NUT, hex, 10-32 x 3/8 inch
	220-0410-00	3580		1	NUT, keps, 10-32 x 3/8 inch
	210-0010-00	101	3579X	1	LOCKWASHER, internal, #10
	210-0206-00	101	3579X	1	LUG, solder, SE10
6	366-0030-00	101	4479	1	KNOB, large black--TRIGGERING LEVEL
	366-0146-00	4480		1	KNOB, large charcoal--TRIGGERING LEVEL
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0032-00			1	KNOB, small red--STABILITY
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	MOUNTING HARDWARE FOR POT:
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-0207-00			1	LUG, solder, 3/8 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
7	366-0033-00	101	4479	1	KNOB, small black--HORIZ. DISPLAY
	366-0148-00	4480		1	KNOB, small charcoal--HORIZ. DISPLAY
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0201-00			1	SWITCH, wired--HORIZ. DISPLAY
	- - - - - -			-	switch includes:
	260-0186-00			1	SWITCH, unwired--HORIZ. DISPLAY
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	358-0029-00			1	BUSHING, hex., panel
	- - - - - -			-	mounting hardware: (not included w/bushing)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
8	333-0448-00			1	PANEL, front
	386-0602-00			1	PLATE, front sub-panel
	- - - - - -			-	plate includes:
	354-0061-00			1	RING, ornamental
9	366-0040-00	101	4479	1	KNOB, large black--TIME/DIV
	366-0160-00	4480		1	KNOB, large charcoal--TIME/DIV
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0038-00			1	KNOB, small red--VARIABLE
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0182-00	101	4869	1	SWITCH, wired--TIME/DIV
	262-0182-01	4870		1	SWITCH, wired--TIME/DIV
	- - - - - -			-	switch includes:
	260-0226-00			1	SWITCH, unwired--TIME/DIV
	384-0147-00			1	ROD, extension
	376-0014-00			1	COUPLING, pot
	- - - - - -			-	MOUNTING HARDWARE FOR POT:
	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	337-0141-00			1	SHIELD, switch
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0449-00			2	NUT, hex., 5-40 x 1/4 inch
	210-0017-00			1	LOCKWASHER, spring, #5
	210-0202-00			1	LUG, solder, SE6
	348-0003-00			2	GROMMET, 5/16 inch
	- - - - - -			-	mounting hardware for each: (not included w/grommet)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
10	366-0033-00	101	4479	1	KNOB, small black--HORIZONTAL POSITIONING
	366-0148-00	4480		1	KNOB, small charcoal--HORIZONTAL POSITIONING
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	MOUNTING HARDWARE FOR POT:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-0207-00			1	LUG, solder, 3/8 inch

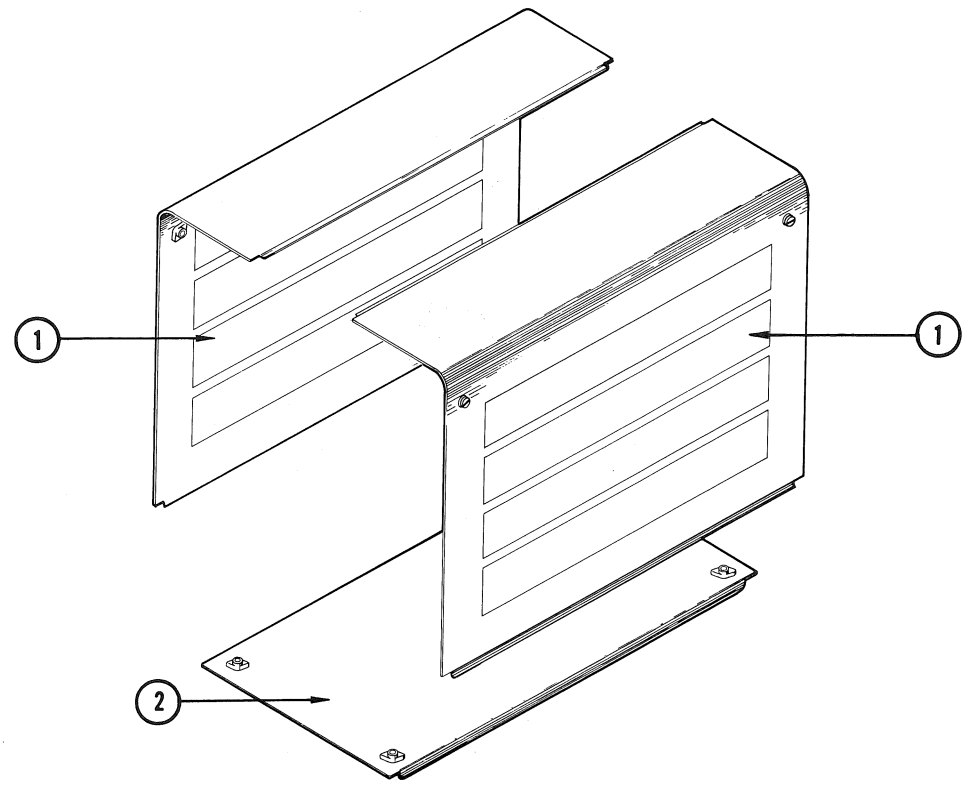
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
11	366-0033-00	101	4479	1	KNOB, small black--VERTICAL POSITIONING
	366-0148-00	4480		1	KNOB, small charcoal--VERTICAL POSITIONING
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	MOUNTING HARDWARE FOR POT:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-0207-00			1	LUG, solder, 3/8 inch
12	366-0028-00	101	4479	1	KNOB, large black--CALIBRATOR
	366-0145-00	4480		1	KNOB, large charcoal--CALIBRATOR
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0120-00			1	SWITCH, wired--CALIBRATOR
	- - - - - -			-	switch includes:
	260-0098-00			1	SWITCH, unwired--CALIBRATOR
	377-0106-00			1	SHIELD, switch
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
	210-0004-00			2	LOCKWASHER, internal, #4
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
13	260-0134-00			1	SWITCH, toggle--POWER
	- - - - - -			-	switch includes:
	210-0414-00			1	NUT, hex., 15/32-32 x 9/16 inch
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0473-00			1	NUT, switch, 12 sided
	210-0902-00			1	WASHER, 0.470 ID x 21/32 inch OD
	354-0055-00			1	RING, locking, switch
14	136-0031-00	101	5029	1	SOCKET, light, red
	136-0031-01	5030		1	SOCKET, light, green
	- - - - - -			-	socket includes:
	210-0414-00			1	NUT, hex., 15/32-32 x 9/16 inch
	210-0021-00			1	LOCKWASHER, 0.480 inch ID
15	366-0033-00	101	4479	1	KNOB, small black--AC/DC
	366-0148-00	4480		1	KNOB, small charcoal--AC/DC
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	260-0122-00			1	SWITCH, unwired--AC/DC
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
16	366-0029-00	101	4479	1	KNOB, large black--VOLTS/DIV
	366-0142-00	4480		1	KNOB, large charcoal--VOLTS/DIV
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0031-00			1	KNOB, small red--VARIABLE
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0153-00	101	1869	1	SWITCH, wired--VOLTS/DIV
	262-0428-00	1870	2239	1	SWITCH, wired--VOLTS/DIV
	262-0486-00	2240		1	SWITCH, wired--VOLTS/DIV
	- - - - - -			-	switch includes:
	260-0187-00			1	SWITCH, unwired--VOLTS/DIV
	406-0286-00			1	BRACKET, capacitor mounting
	- - - - - -			-	mounting hardware: (not included w/bracket)
	211-0007-00			2	SCREW, 4-40 x 3/16 inch, BHS
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	213-0034-00	101	1228	16	SCREW, thread cutting, 4-40 x 5/16 inch, RHS
	214-0153-00	1229		8	FASTENER, snap, double pronged
	- - - - - -			-	MOUNTING HARDWARE FOR VARIABLE POT:
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
	124-0009-00			1	STRIP, brass
	- - - - - -			-	mounting hardware: (not included w/strip)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
17	- - - - - -			-	MOUNTING HARDWARE FOR MINIATURE POT:
	358-0043-00			1	BUSHING, panel
	361-0003-00			1	SPACER, pot
	210-0046-00			1	LOCKWASHER, internal, 0.400 OD x 0.261 inch ID
	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
18	366-0033-00	101	4479	1	KNOB, small black--SCALE ILLUM.
	366-0148-00	4480		1	KNOB, small charcoal--SCALE ILLUM.
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	MOUNTING HARDWARE FOR POT:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0207-00			1	LUG, solder, 3/8 inch
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
19	366-0033-00	101	4479	2	KNOB, small black--FOCUS & INTENSITY
	366-0148-00	4480		2	KNOB, small charcoal--FOCUS & INTENSITY
	- - - - - -			-	each knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	MOUNTING HARDWARE FOR EACH POT:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch

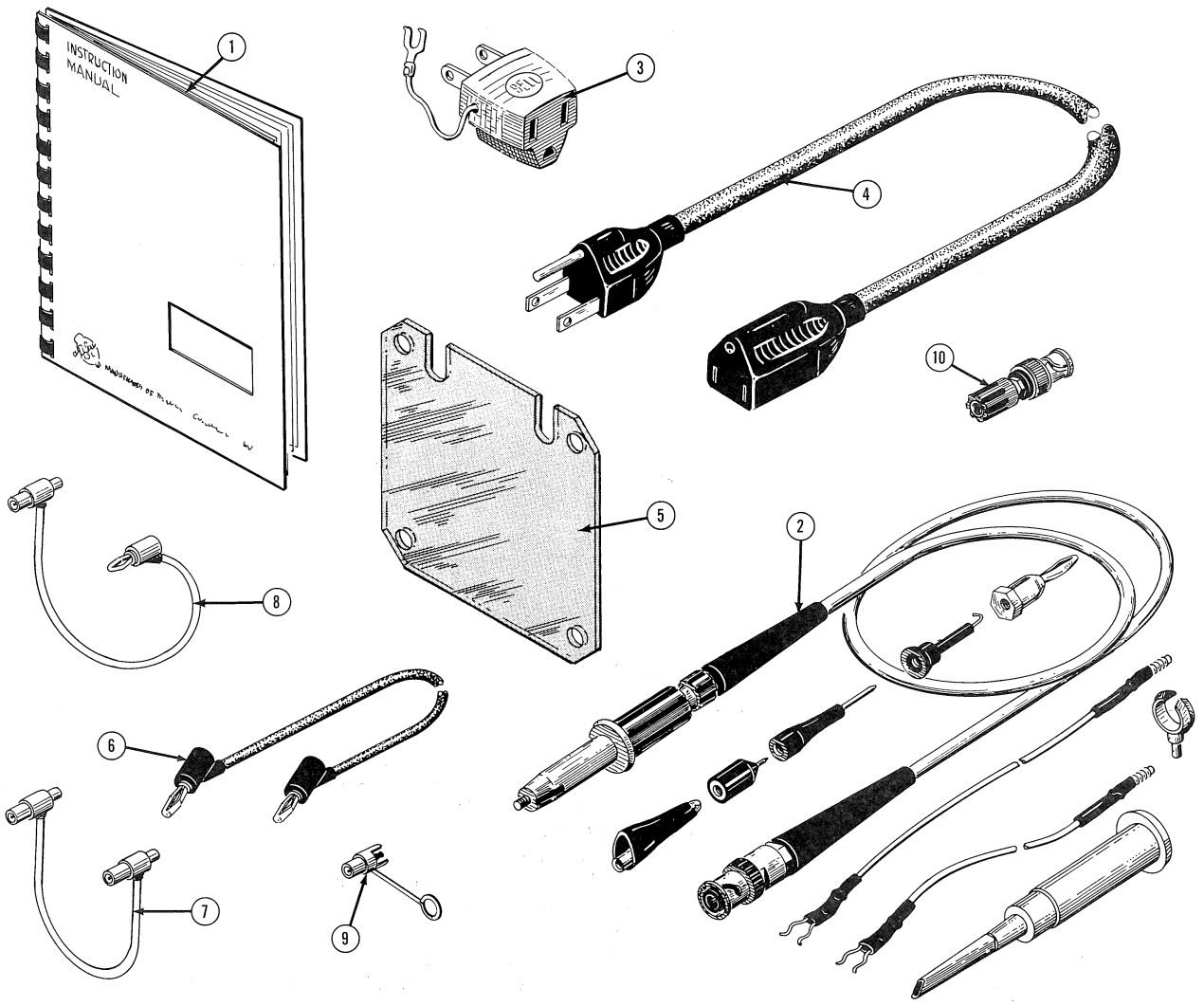
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	385-0073-00	101	1469	1	ROD, nylon
	385-0134-00	1470		1	ROD, delrin
	- - - - - -			-	mounting hardware: (not included w/rod)
	211-0507-00	101	1469	1	SCREW, 6-32 x 5/16 inch, BHS
	213-0041-00			1	SCREW, thread cutting, 6-32 x 3/8 inch, THS phillips
2	- - - - - -			-	MOUNTING HARDWARE FOR EACH POT:
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
4	406-0278-00			1	BRACKET, pot
	- - - - - -			-	mounting hardware: (not included w/bracket)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, BHS
4	210-0207-00			2	LUG, solder, 3/8 inch
5	385-0123-00			1	ROD, nylon
	- - - - - -			-	mounting hardware: (not included w/rod)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
6	386-0859-00			1	PLATE, pot mounting
	- - - - - -			-	mounting hardware: (not included w/plate)
	385-0017-00			2	ROD, nylon
	211-0507-00			4	SCREW, 6-32 x 5/16 inch, BHS
	210-0202-00			2	LUG, solder, SE6
7	- - - - - -			-	MOUNTING HARDWARE FOR MINIATURE POT:
	210-0583-00			1	NUT, hex, 1/4-32 x 5/16 inch
	210-0046-00			1	LOCKWASHER, internal, .400 OD x .261 inch ID
8	124-0016-00	101	409	2	STRIP, ceramic, 3/4 inch x 11 notches
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00			2	NUT, hex, 2-56 x 3/16 inch
	210-0002-00			2	LOCKWASHER, external, #2
	210-0850-00			2	WASHER, flat, #2
	124-0091-00	410		2	STRIP, ceramic, 3/4 inch x 11 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch
9	385-0127-00			3	ROD, hex
	- - - - - -			-	mounting hardware for each: (not included w/rod)
	211-0513-00			1	SCREW, 6-32 x 5/8 inch, BHS
10	385-0124-00			1	ROD, high voltage shield support
	- - - - - -			-	mounting hardware: (not included w/rod)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
11	124-0014-00	101	409	2	STRIP, ceramic, 3/4 inch x 7 notches
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00			2	NUT, hex, 2-56 x 3/16 inch
	210-0002-00			2	LOCKWASHER, external, #2
	210-0850-00			2	WASHER, flat, #2
	124-0089-00	410		2	STRIP, ceramic, 3/4 inch x 7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch
12	179-0253-00			1	CABLE HARNESS, sweep

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
13	210-0201-00			1	LUG, solder, SE4
	- - - - - -			-	mounting hardware: (not included w/lug)
	213-0044-00			1	SCREW, thread cutting, 5-32 x 3/16 inch, PHS phillips
14	124-0066-00	101	409	10	STRIP, ceramic, 3/4 inch x 9 notches
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
	210-0002-00			2	LOCKWASHER, external, #2
	210-0850-00			2	WASHER, flat, #2
	124-0090-00	410		10	STRIP, ceramic, 3/4 inch x 9 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, 0.313 inch
15	386-0768-00	X900		1	PLATE, pot mounting
	- - - - - -			-	mounting hardware: (not included w/plate)
	211-0007-00			2	SCREW, 4-40 x 3/16 inch, BHS
16	- - - - - -			-	MOUNTING HARDWARE FOR MINIATURE POT:
	210-0438-00	X900		2	NUT, hex., 1-72 x 5/32 inch (not shown)
17	124-0020-00	101	409	1	STRIP, ceramic, 3/4 inch x 2 notches
	- - - - - -			-	mounting hardware: (not included w/strip)
	210-0405-00			1	NUT, hex., 2-56 x 3/16 inch
	210-0002-00			1	LOCKWASHER, external, #2
	210-0850-00			1	WASHER, flat, #2
	124-0086-00	410		1	STRIP, ceramic, 3/4 inch x 2 notches
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, nylon
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			1	SPACER, nylon, 0.313 inch
18	441-0214-00	101	4939	1	CHASSIS, sweep
	441-0214-01	4940		1	CHASSIS, sweep
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0538-00			2	SCREW, 6-32 x 5/16 inch, FHS phillips
	211-0559-00			1	SCREW, 6-32 x 3/8 inch, FHS phillips
	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
19	348-0012-00			1	GROMMET, 5/8 inch
20	348-0002-00			5	GROMMET, 1/4 inch
21	407-0279-00			1	BRACKET, switch
	- - - - - -			-	mounting hardware: (not included w/bracket)
	211-0511-00			2	SCREW, 6-32 x 1/2 inch, BHS
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0407-00			1	NUT, hex., 6-32 x 1/4 inch
22	348-0005-00			1	GROMMET, 1/2 inch
23	385-0096-00	101	1469	3	ROD, nylon
	385-0136-00	1470		3	ROD, delrin
	- - - - - -			-	mounting hardware for each: (not included w/rod)
	211-0507-00	101	1469	1	SCREW, 6-32 x 5/16 inch, BHS
	213-0041-00	1470		1	SCREW, thread cutting, 6-32 x 3/8 inch, THS phillips

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
24	136-0015-00			3	SOCKET, STM9G
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch, PHS w/lockwasher
	210-0004-00			4	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	337-0005-00			3	SHIELD, socket
25	348-0004-00			2	GROMMET, 3/8 inch
26	348-0003-00			2	GROMMET, 5/16 inch
27	136-0008-00			1	SOCKET, STM7G
	- - - - - -			-	mounting hardware: (not included w/socket)
	213-0044-00			2	SCREW, thread cutting, 5-32 x 3/16 inch, PHS phillips
28	136-0022-00			1	SOCKET, STM9S
	- - - - - -			-	mounting hardware: (not included w/socket)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch, PHS w/lockwasher
	210-0004-00			1	LOCKWASHER, internal, #4
	210-0201-00			1	LUG, solder, SE4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
29	343-0036-00			1	CLAMP, capacitor
	- - - - - -			-	mounting hardware: (not included w/clamp)
	214-0012-00			1	BOLT, spade, 6-32 x 3/8 inch
	211-0504-00			1	SCREW, 6-32 x 1/4 inch, BHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
30	136-0015-00			8	SOCKET, STM9G
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	213-0044-00			2	SCREW, thread cutting, 5-32 x 3/16 inch,PHS phillips



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	386-0735-00	101	1019	2	PLATE, cabinet side
	387-0051-00	1020		2	PLATE, cabinet side
	- - - - - -			-	Each Includes:
	214-0057-00			2	FASTENER, cabinet latch assembly
	- - - - - -			-	Each Consisting Of:
	105-0007-00			1	STOP
	210-0480-00			1	NUT, latch, nylon
	210-0847-00			1	WASHER, nylon, .164 ID x .500 inch OD
	213-0033-00			1	SCREW, fastening
2	386-0605-00	101	1019	1	PLATE, cabinet bottom
	387-0052-00	1020		1	PLATE, cabinet bottom
	- - - - - -			-	Includes:
	214-0057-00			4	FASTENER, cabinet latch assembly
	- - - - - -			-	Each Consisting Of:
	105-0007-00			1	STOP
	210-0480-00			1	NUT, latch, nylon
	210-0847-00			1	WASHER, nylon, .164 ID x .500 inch OD
	213-0033-00			1	SCREW, fastening



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	070-0297-00			2	MANUAL, instruction
2	010-0127-00	101	4869	1	PROBE, P6006
	010-0203-00	4870		1	PROBE, P6012
3	103-0013-00			1	ADAPTER, 3 to 2 wire
4	161-0010-00	101	4959	1	CORD, power
	161-0010-03	4960		1	CORD, power
5	378-0509-00	101	4649	1	FILTER, light, green
	378-0550-00	4650		1	FILTER, light, smoke gray
6	012-0031-00	X3720	4274	1	CORD, patch
7	012-0087-00	4275		1	CORD, patch
8	012-0091-00	X4275		1	CORD, patch
9	012-0092-00	X4275		1	JACK, BNC-post
10	013-0004-00	101	3556	1	ADAPTER, binding post
	103-0033-00	3357	3719	1	ADAPTER, BNC to binding post
	103-0033-00	3720	4274X	2	ADAPTER, BNC to binding post

SCHEMATICS

317

Publication:
NOT STOCKED
January 1964

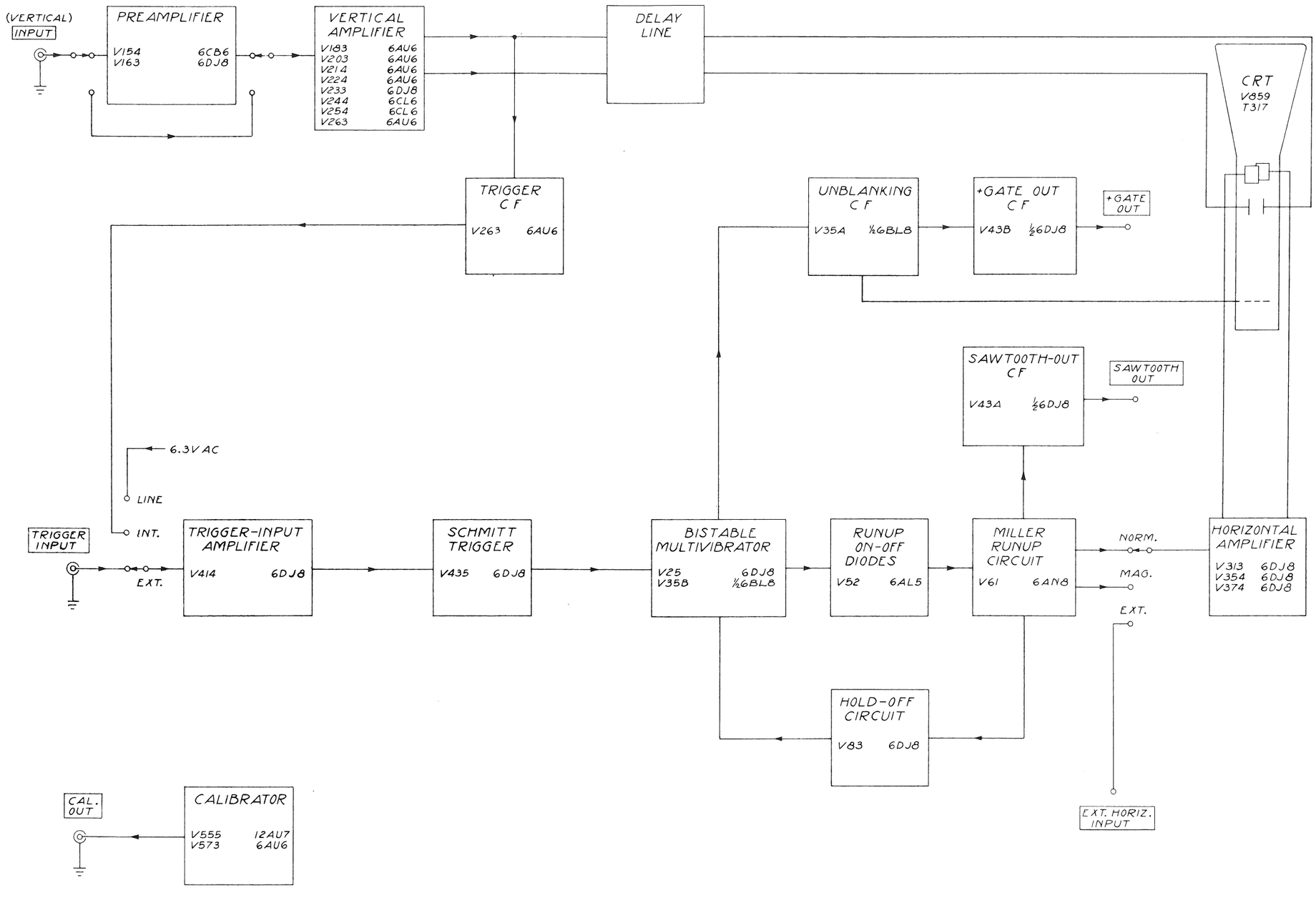
Supersedes
September 1962

For 317 only, all serial numbers. Not for RM17.

CONTENTS:

ABBREVIATIONS:

cer	ceramic
comp	composition
emc	electrolytic, metal cased
gmv	guaranteed minimum value
h	henry
k	kilo (10^3)
k	kilohm
m	milli (10^{-3})
ma	milliamp
meg	megohm
mh	millihenry
mpt	metalized, paper tubular
mt	mylar, tubular
mv	millivolt
μ	micro (10^{-6})
μf	microfarad
μh	microhenry
μsec	microsecond
n	nano (10^{-9})
nsec	nano second
Ω	ohm
p	pico (10^{-12})
pbt	paper, "bathtub"
pcc	paper covered can
pf	picofarad ($\mu\mu$f)
piv	peak inverse voltage
pmc	paper, metal cased
poly	polystyrene
prec	precision
pt	paper, tubular
ptm	paper, tubular molded
sn or S/N	serial number
tub	tubular
v	working volt, dc
var	variable
w	watt
WW	wire wound

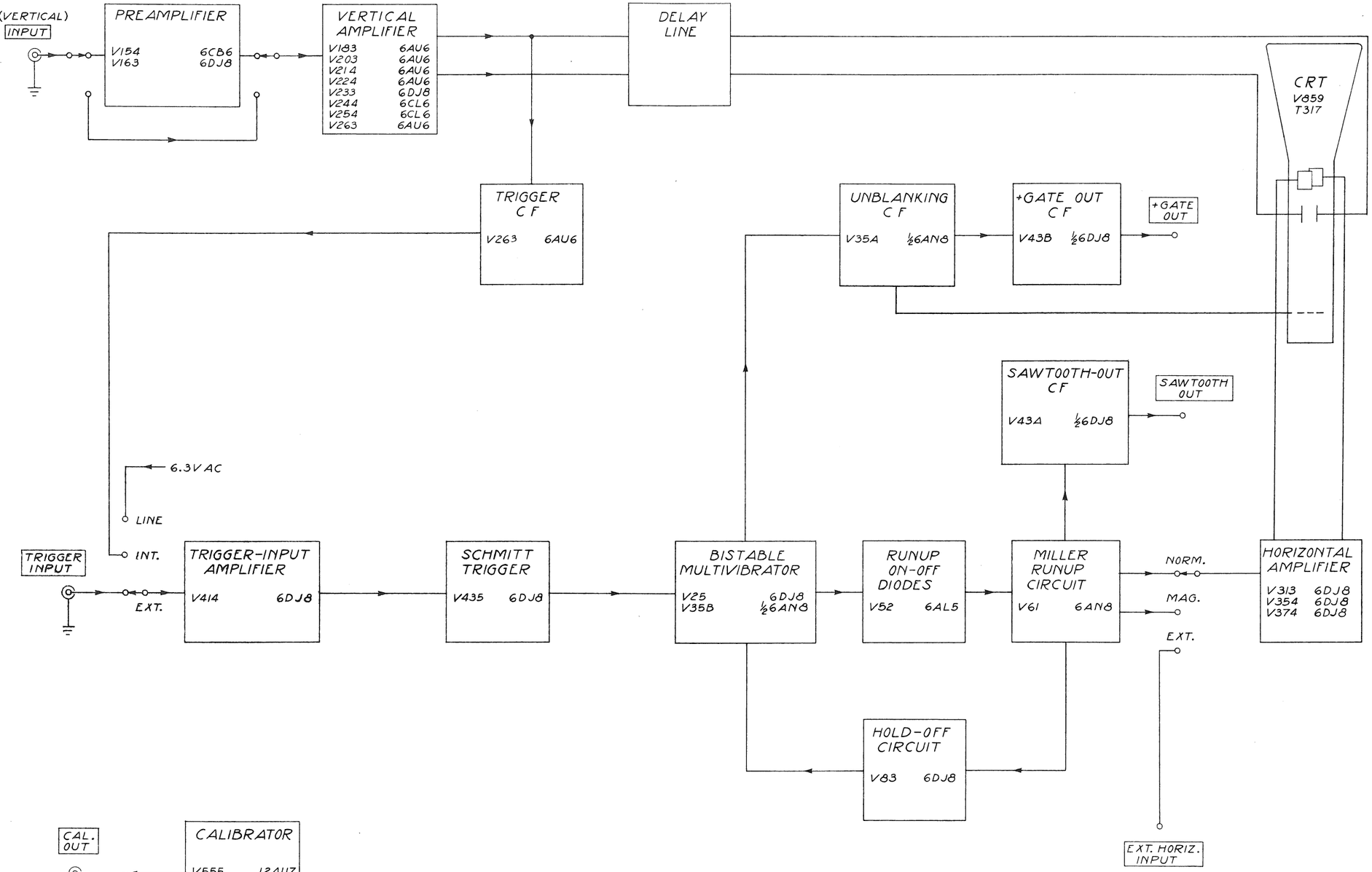


R.O.W.
7-1-59

BLOCK DIAGRAM

TYPE 317 OSCILLOSCOPE

AA2

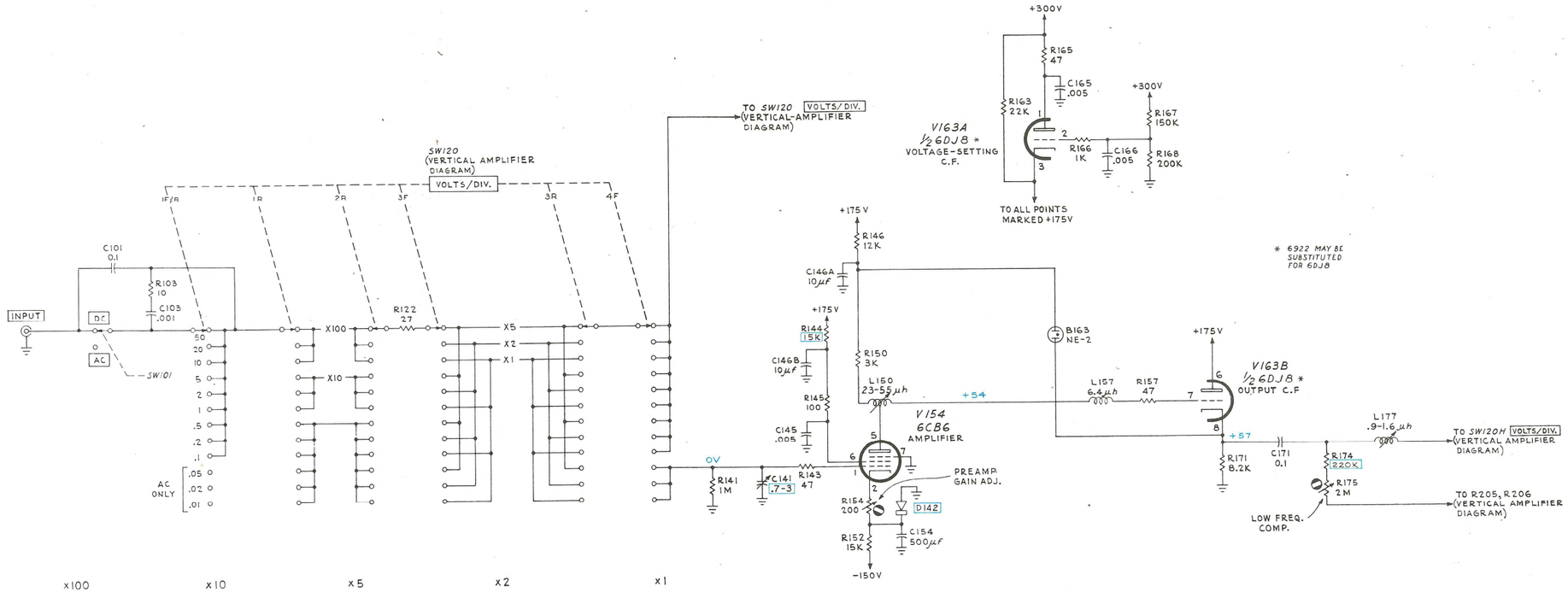


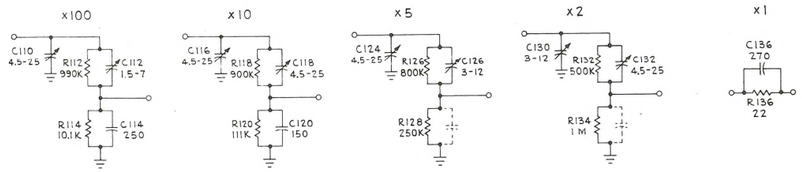
R.O.W.
7-1-59

BLOCK DIAGRAM

TYPE 317 OSCILLOSCOPE

AA





ATTENUATOR DETAILS

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

VOLTAGE READINGS WERE OBTAINED
WITH CONTROLS SET AS FOLLOWS:
INPUT SIGNAL ..... NONE
TRIGGER SELECTOR (RED KNOB) ..... AUTO
VERTICAL POSITION ..... TRACE CENTERED
SEE ALSO IMPORTANT NOTE ON TIME-BASE TRIGGER DIAGRAM.

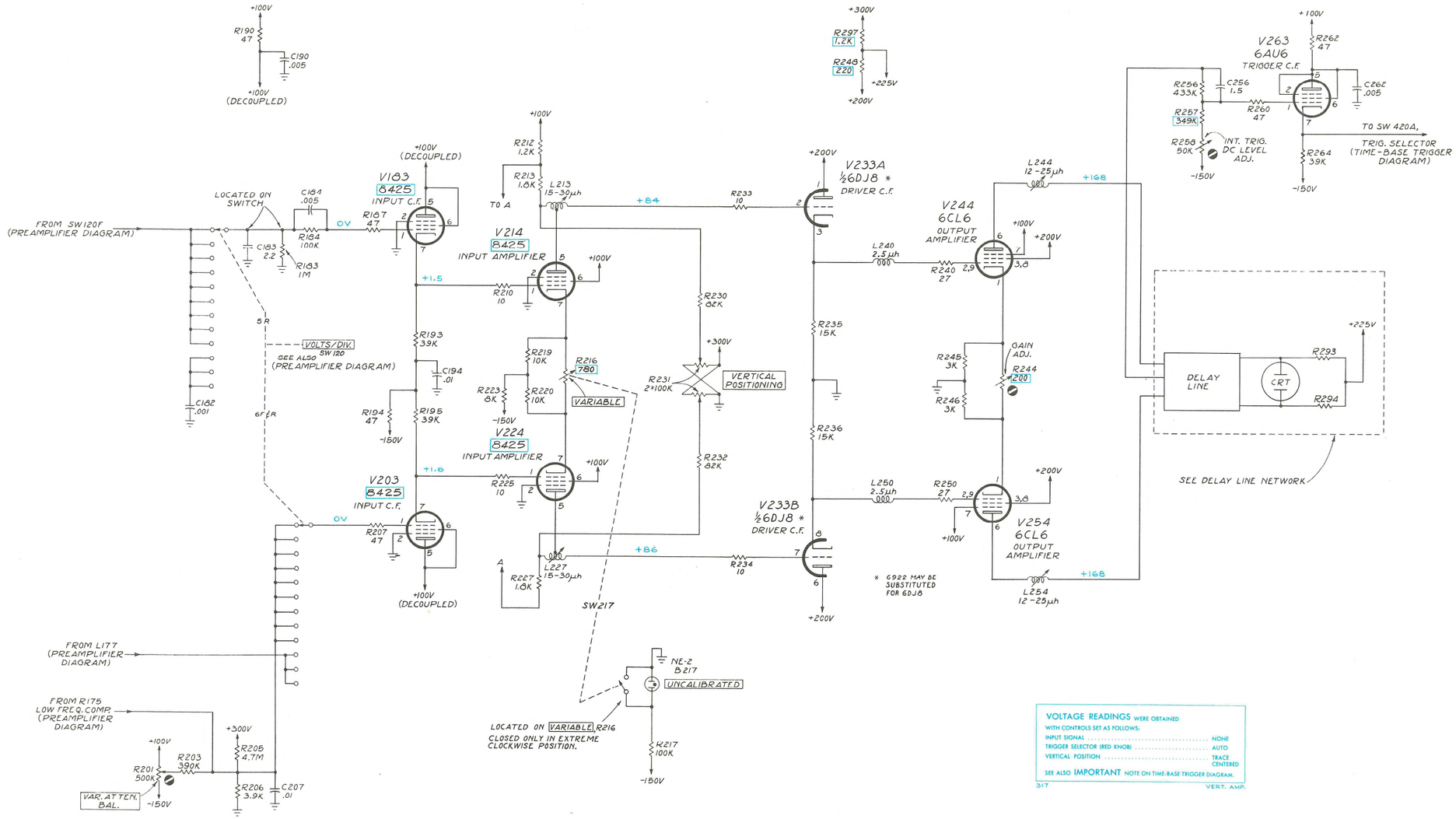
317 PREAMP

R.B.H. 664

TYPE 317 OSCILLOSCOPE

PREAMPLIFIER

AC



VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

INPUT SIGNAL	NONE
TRIGGER SELECTOR (RED KNOB)	AUTO
VERTICAL POSITION	TRACE CENTERED

SEE ALSO **IMPORTANT** NOTE ON TIME-BASE TRIGGER DIAGRAM.

317 VERT. AMP.

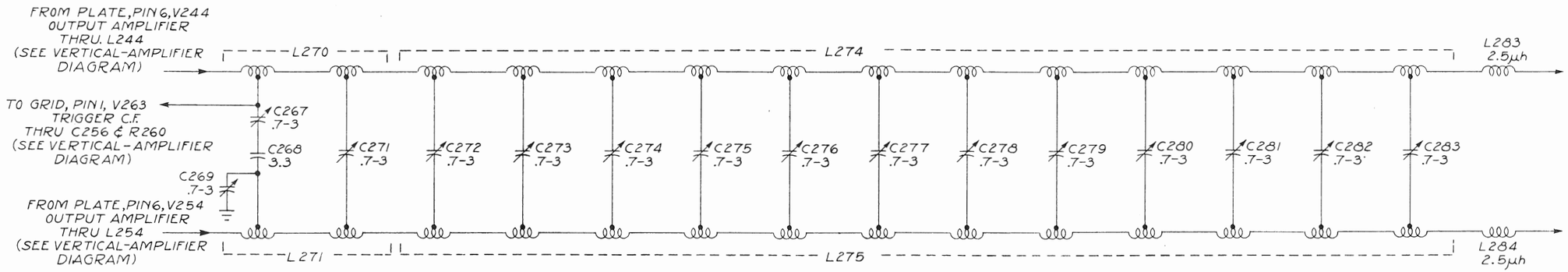
R.Q.W. 1266

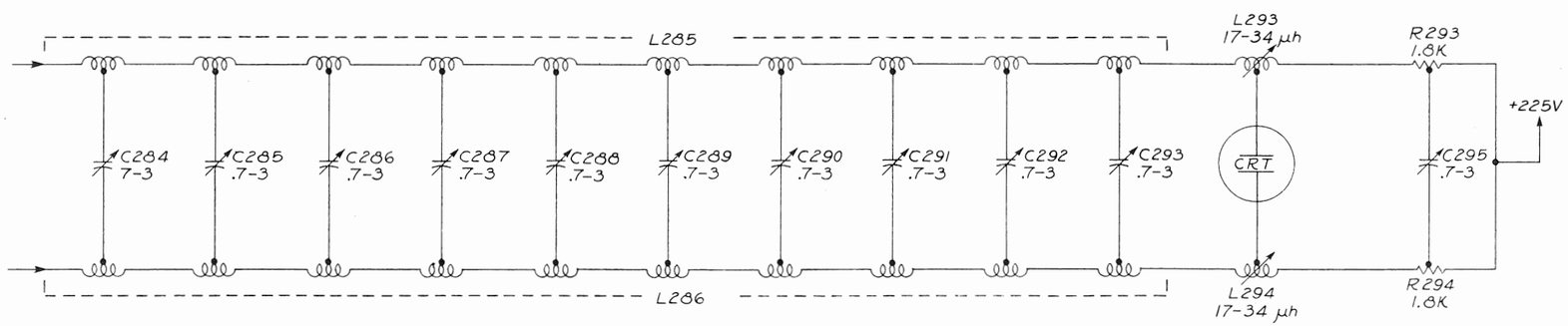
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

TYPE 317 OSCILLOSCOPE

AC

VERTICAL AMPLIFIER



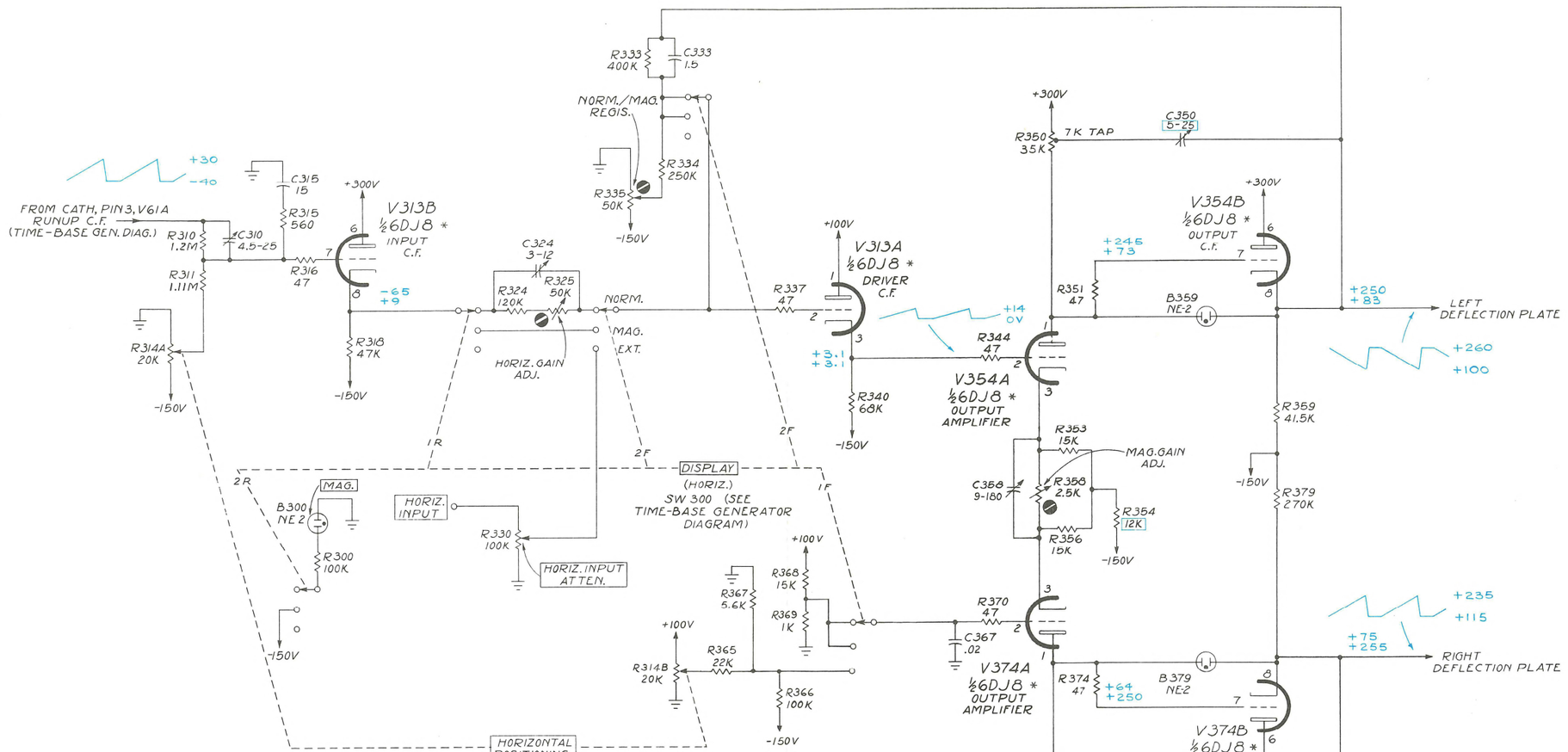


R. O. W.

DELAY LINE

TYPE 317 OSCILLOSCOPE

AA



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

WAVEFORMS AND VOLTAGE READINGS

WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

EXT. HORIZ. INPUT	NONE
HORIZ. DISPLAY	
FOR WAVEFORMS	NORM.
FOR VOLTAGE READINGS	EXT.
HORIZONTAL POSITION	
FOR UPPER VOLTAGE READINGS	CCW
FOR LOWER VOLTAGE READINGS	CW

SEE ALSO IMPORTANT NOTE ON TIME-BASE TRIGGER DIAGRAM.

317 HORIZ. AMP

* 6922 OR 6BQ7A MAY BE SUBSTITUTED FOR 6DJ8

R. O. W.
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HORIZONTAL AMPLIFIER

** CONCENTRICALLY MOUNTED

IMPORTANT

WAVEFORMS ARE IDEALIZED BUT CLOSELY APPROXIMATE THOSE TO BE FOUND IN THIS INSTRUMENT PROVIDED CONTROLS ARE SET AS INDICATED BELOW AND ON EACH SCHEMATIC. VOLTAGE READINGS, IF TAKEN WITH A VTVM, WILL BE WITHIN ±10% OF THE INDICATED VALUE. BEFORE STARTING TO CHECK THIS INSTRUMENT THE FOLLOWING CONTROLS SHOULD BE SET AND NOT DISTURBED UNLESS OTHERWISE NOTED ON SCHEMATICS BEING USED. RETURN CONTROLS TO THE POSITIONS LISTED BELOW BEFORE MOVING TO THE NEXT SCHEMATIC.

CALIBRATOR	OFF
HORIZ. DISPLAY	NORM.
TIME/DIV	1 mSEC
VARIABLE (TIME DIV)	CW (CALIBRATED)
TRIGGER SELECTOR (RED KNOB)	AC
TRIGGER SELECTOR (BLACK KNOB)	+LINE
TRIGGERING LEVEL	CENTERED
STABILITY	PRESET

TRIGGER-INPUT AMPLIFIER

SCHMITT TRIGGER

** RED KNOB
TRIGGER SELECTOR
SW410 (SEE TIME-BASE GEN. DIAG.)

3R 4F 3F 5F 5R

+100V
R414 27
C414 .001

TO ALL POINTS MARKED +100V (DEC.)

+100V (DEC.)
C413 100
R413 4.7K
+98 +68

+100V (DEC.)
R415 4.7K
+73 +96

+102 +70

C423 .01
R423 100
R422 100K
R424 220K

V414 6DJ8 *
R412 100
R419 100
-7.5 +7.3
A B
0V 0V
R417 20K
-150V

+300V
DC
AC
AUTO
HF SYNC
R432 1K
R433 2.2K
R431 2.2M

* 6922 MAY BE SUBSTITUTED FOR 6DJ8

V435A ½6DJ8 *
+66 +92

+295 +281
R435 150K
C435 18
+86 +78
R439 100

V435B ½6DJ8 *
+292 +297
R441 1M

+300V
R440 820
+287 +280
TO GRID, PIN2, V25A, BISTABLE MULTI, THRU. C20, R20. (TIME-BASE GENERATOR DIAGRAM)

R436 120K
TRIGGERING LEVEL CENTERING
R437 100K
-150V

R443 500
TRIGGER SENSITIVITY ADJUST
+100
C443 .005
R442 22K
R444 22K

FOR VALUES OF COMPONENTS SEE VERTICAL AMPLIFIER DIAGRAM

TRIGGER INPUT

+100V
R262
C262
FROM L270 (DELAY LINE DIAGRAM)
R256
C256
R257
R260
V263
R258
R264
-150V
-150V
INT. TRIG. DC LEVEL ADJ.

C407 .01
DC
AC
AUTO.
HF SYNC
EXT.
INT.
LINE
6.3VAC
+8.5
-8.5

C410 .001
R410 470K
R409 1M

C425 .01
R425 100K

+100V
R426 3.9M
R428 1M
R429 100K
R427 820K
-150V
TRIGGERING LEVEL

DC
AC
AUTO.
HF SYNC

1F 1R 2F 2R 2R

TRIGGER SELECTOR
** BLACK KNOB SW420

WAVEFORMS AND VOLTAGE READINGS
WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:
TRIGGERING LEVEL
FOR WAVEFORMS ..... CENTERED
FOR UPPER VOLTAGE READINGS ..... CCW
FOR LOWER VOLTAGE READINGS ..... CW
SEE ALSO IMPORTANT NOTE ON THIS DIAGRAM.

317 TIME-BASE TRIG.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

R.O.W. 664

TYPE 317 OSCILLOSCOPE

AB2

TIME-BASE TRIGGER

TIME BASE TRIGGER

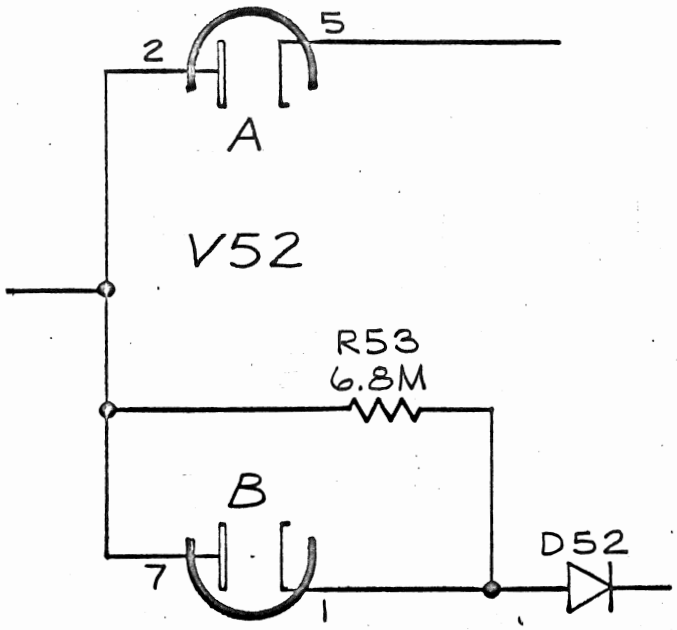
TYPE 317 TENT SN 4830

PARTS LIST CORRECTION

ADD:

R53	302-0685-00	6.8 MΩ	½ W	10%

SCHEMATIC CORRECTION



PARTIAL TIME-BASE GENERATOR DIAGRAM

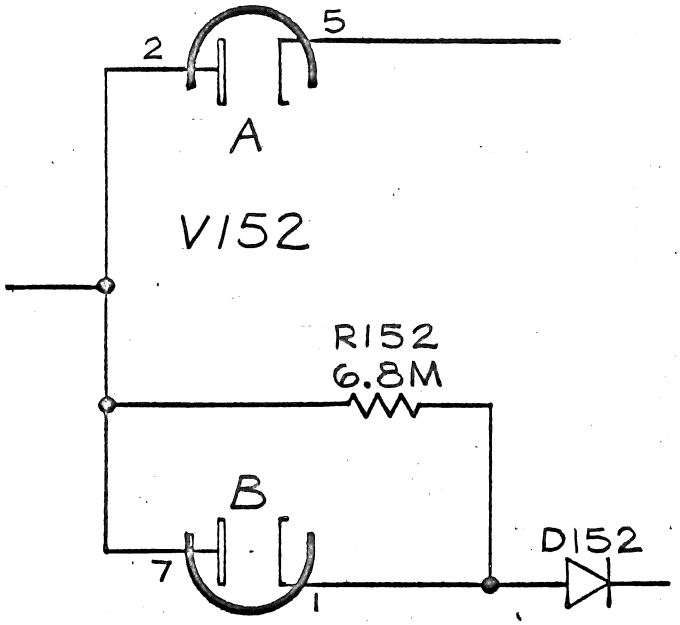
TYPE RM17 TENT SN 850

PARTS LIST CORRECTION

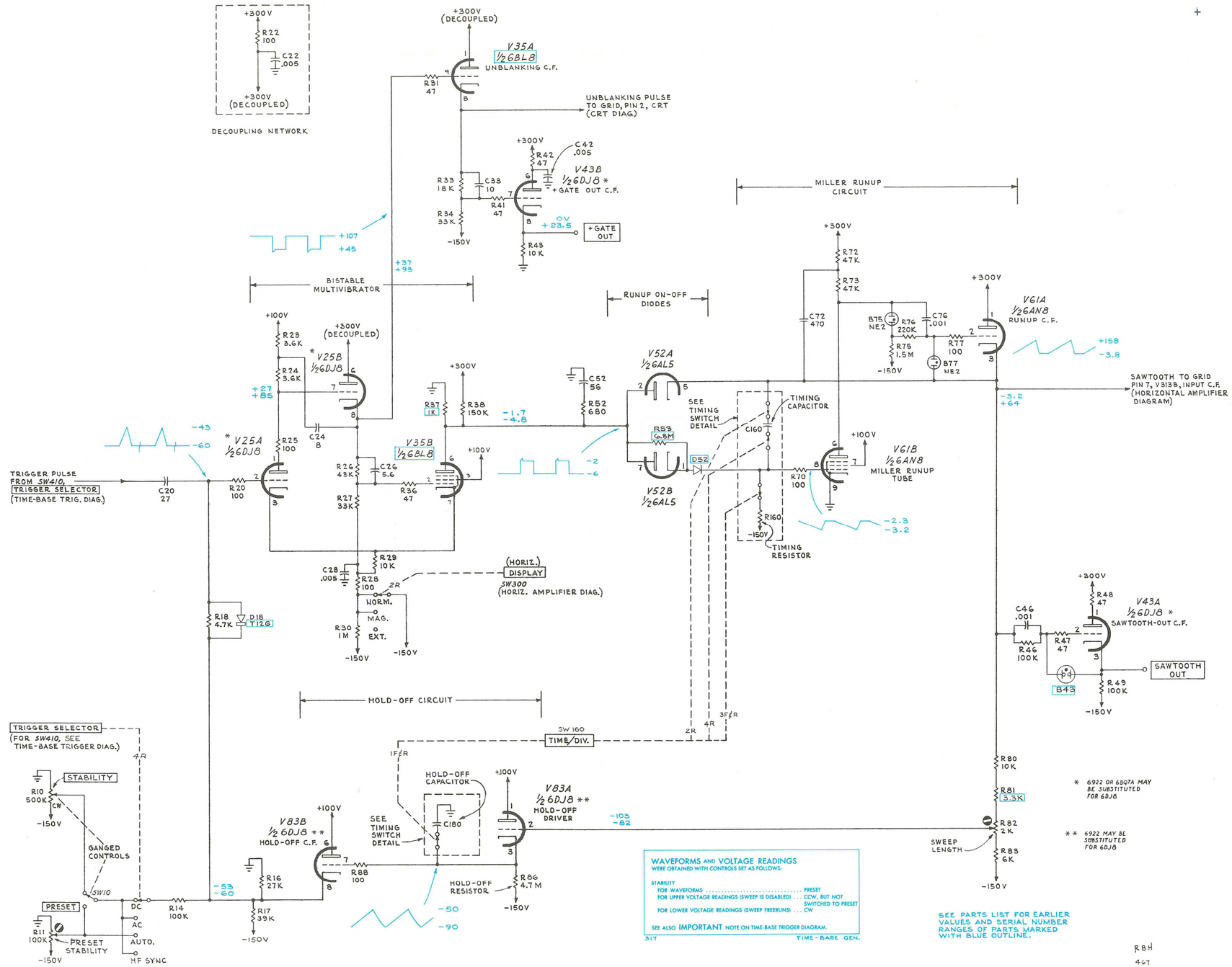
ADD:

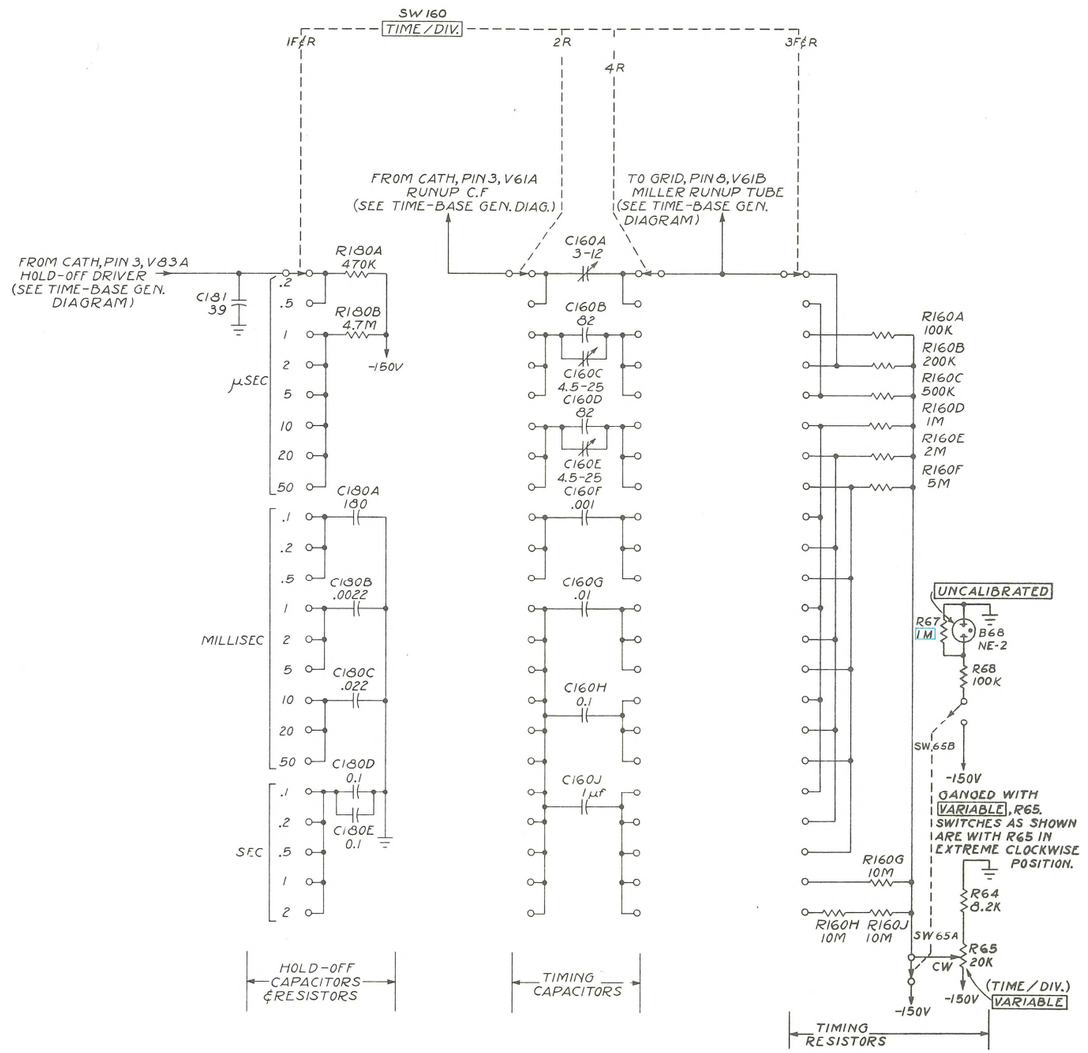
R152	302-0685-00	6.8 MΩ	½ W	10%

SCHEMATIC CORRECTION



PARTIAL TIME-BASE GENERATOR DIAGRAM


DECOUPLING NETWORK
+300V
R22 100
C22 .005
+300V (DECOUPLED)
+300V (DECOUPLED)
V35A ½6BL8 UNBLANKING C.F.
R31 47
UNBLANKING PULSE TO GRID, PIN 2, CRT (CRT DIAG)
R33 18K
C33 10
R34 33K
-150V
R41 47
R42 47
C42 .005
V43B ½6DJ8 * +GATE OUT C.F.
+23.5
+GATE OUT
R43 10K
+107
+45
+37
+95
BISTABLE MULTIVIBRATOR
RUNUP ON-OFF DIODES
MILLER RUNUP CIRCUIT
+100V
R23 3.6K
R24 3.6K
+27
+85
+300V (DECOUPLED)
* V25B ½6DJ8
C24 8
-43
-60
* V25A ½6DJ8
R25 100
TRIGGER PULSE FROM SW410, TRIGGER SELECTOR (TIME-BASE TRIG. DIAG.)
C20 27
R20 100
R18 4.7K
D18 T12G
R26 49K
C26 5.6
R27 33K
R29 10K
C28 .005
R28 100
2R
NORM.
MAG.
EXT.
R30 1M
-150V
(HORIZ.) DISPLAY
SW300 (HORIZ. AMPLIFIER DIAG.)
+300V
R38 150K
R37 1K
V35B ½6BL8
R36 47
+100V
-1.7
-4.8
-2
-6
C52 56
R52 680
V52A ½6AL5
V52B ½6AL5
SEE TIMING SWITCH DETAIL
TIMING CAPACITOR
C160
R53 6.8M
D52
R160
-150V
TIMING RESISTOR
R70 100
+100V
V61B ½6AN8 MILLER RUNUP TUBE
-2.3
-3.2
+300V
R72 47K
R73 47K
C72 470
B75 NE2
R76 220K
C76 .001
R75 1.5M
-150V
B77 NE2
R77 100
+300V
V61A ½6AN8 RUNUP C.F.
+158
-3.8
-3.2
+64
SAWTOOTH TO GRID PIN 7, V313B, INPUT C.F. (HORIZONTAL AMPLIFIER DIAGRAM)
HOLD-OFF CIRCUIT
SW 160 TIME/DIV.
1F
2R
4R
3F
R
TRIGGER SELECTOR (FOR SW410, SEE TIME-BASE TRIGGER DIAG.)
4R
STABILITY
R10 500K
CW
-150V
GANGED CONTROLS
SW10
PRESET
R11 100K
PRESET STABILITY
-150V
DC
AC
AUTO.
HF SYNC
-53
-60
R14 100K
R16 27K
R17 39K
-150V
V83B ½6DJ8 ** HOLD-OFF C.F.
+100V
R88 100
HOLD-OFF CAPACITOR
C180
SEE TIMING SWITCH DETAIL
-50
-90
V83A ½6DJ8 ** HOLD-OFF DRIVER
+100V
-103
-82
HOLD-OFF RESISTOR
R86 4.7 M
-150V
SWEEP LENGTH
R80 10K
R81 3.3K
R82 2K
R83 6K
-150V
* 6922 OR 6BQ7A MAY BE SUBSTITUTED FOR 6DJ6
** 6922 MAY BE SUBSTITUTED FOR 6DJ6
WAVEFORMS AND VOLTAGE READINGS
WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:
STABILITY
FOR WAVEFORMS ..... PRESET
FOR UPPER VOLTAGE READINGS (SWEEP IS DISABLED) ... CCW, BUT NOT SWITCHED TO PRESET
FOR LOWER VOLTAGE READINGS (SWEEP FREERUNS) ... CW
SEE ALSO IMPORTANT NOTE ON TIME-BASE TRIGGER DIAGRAM.
317 TIME-BASE GEN.
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
R B H
4-67
+300V
R48 47
V43A ½6DJ8 * SAWTOOTH-OUT C.F.
C46 .001
R46 100K
R47 47
B43
SAWTOOTH OUT
R49 100K
-150V



TYPE 317 OSCILLOSCOPE

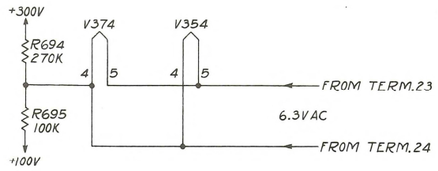
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

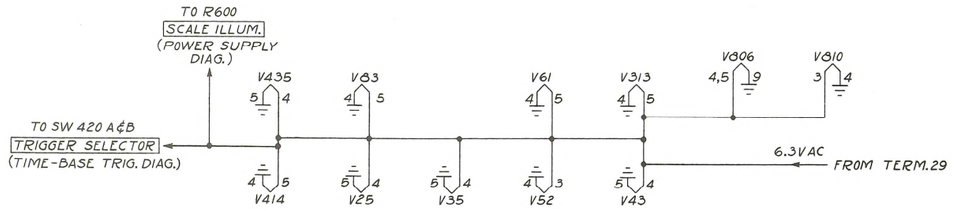
AA2

TIMING SWITCH

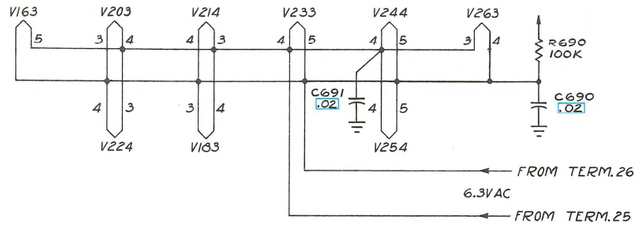
(TIME / DIV.)

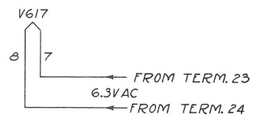
R.O.W.
664

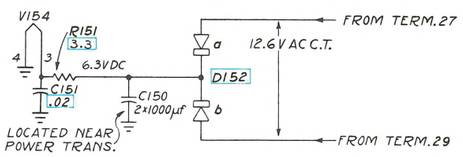


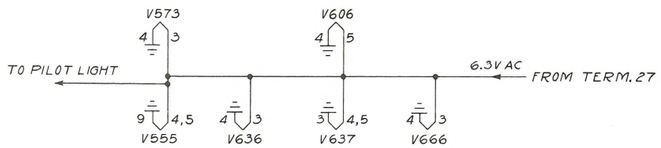


TIME - BASE DECK





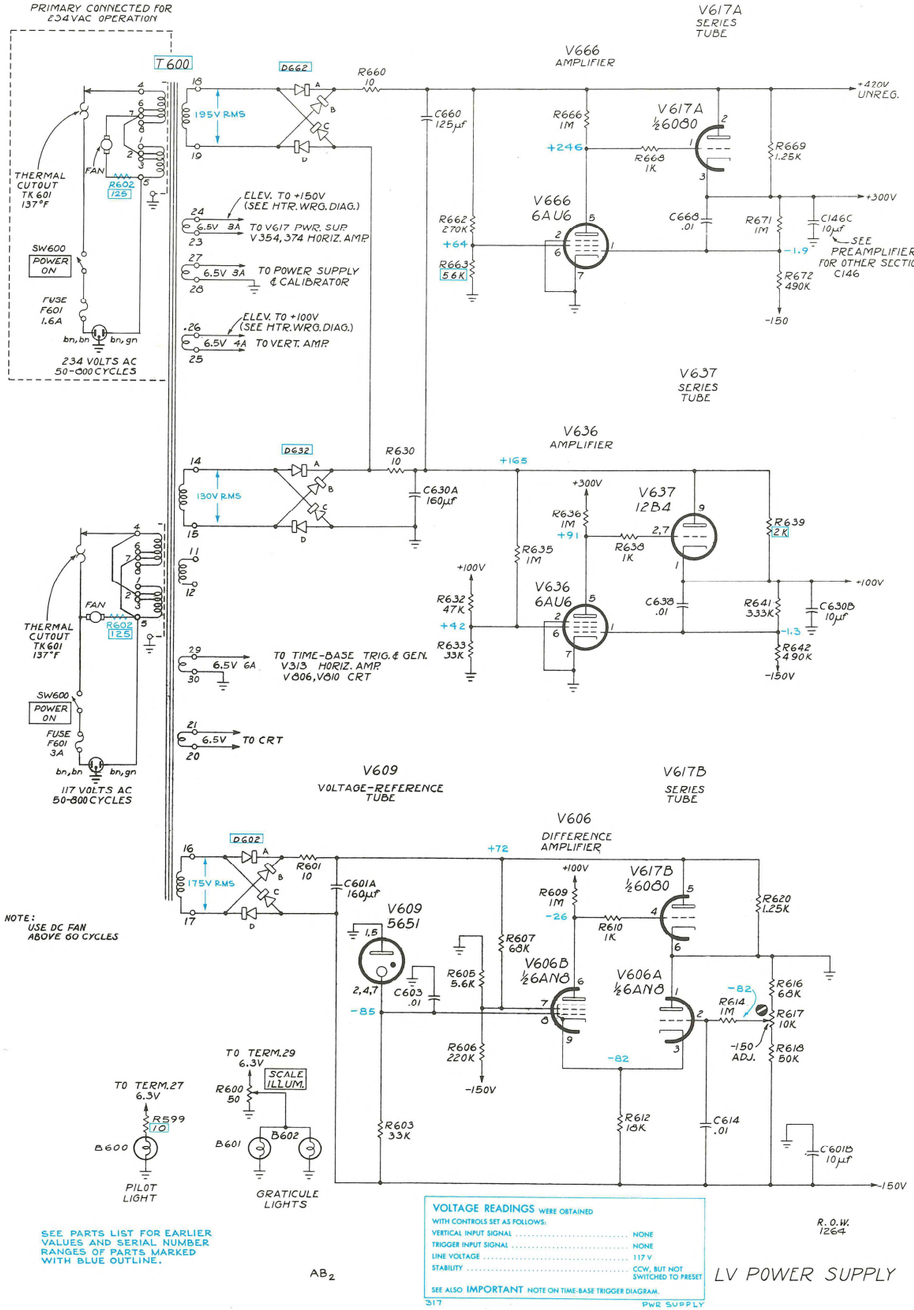




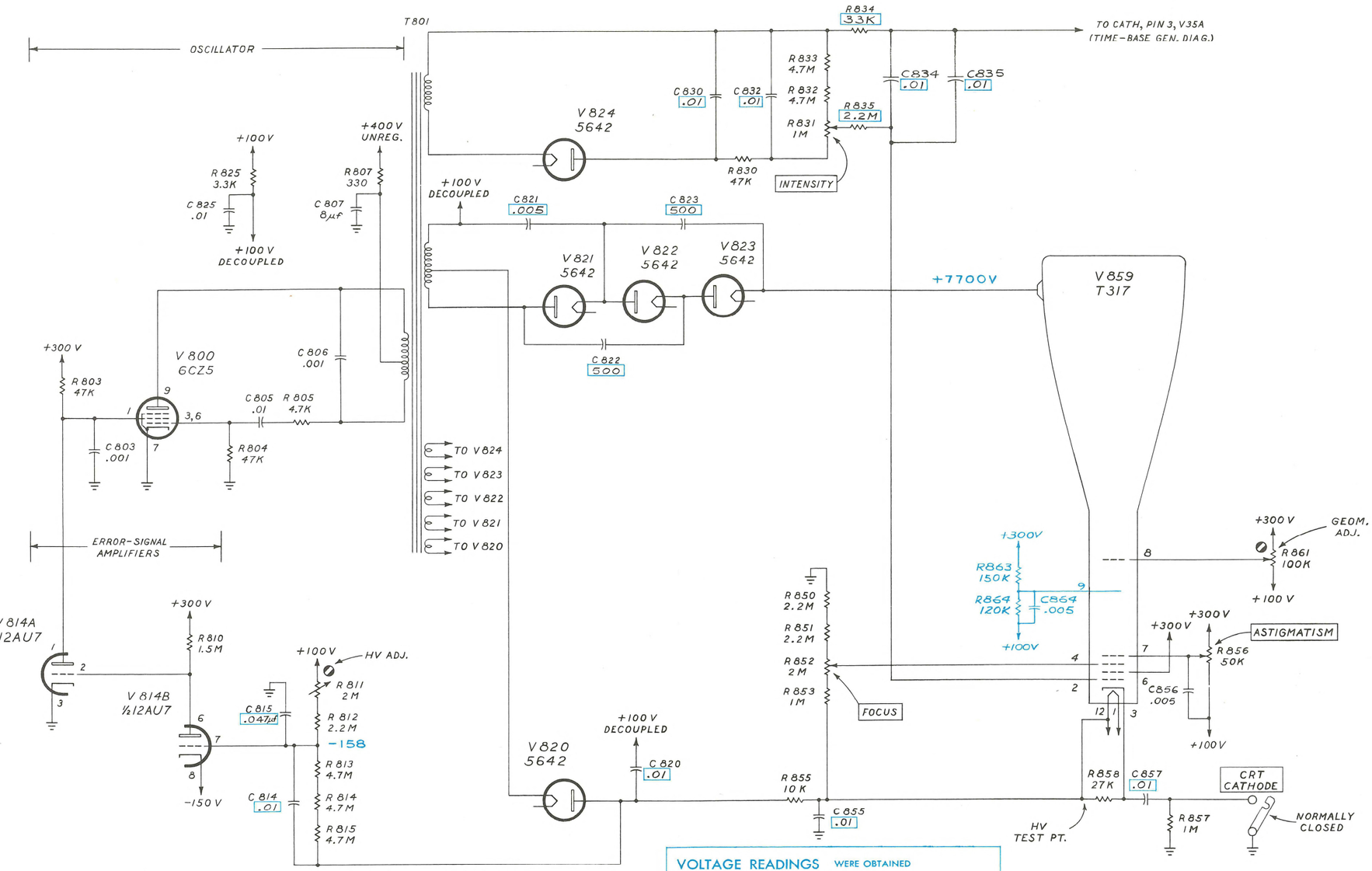
POWER DECK

TYPE 317 OSCILLOSCOPE

HEATER WIRING DIAGRAM



LV POWER SUPPLY



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

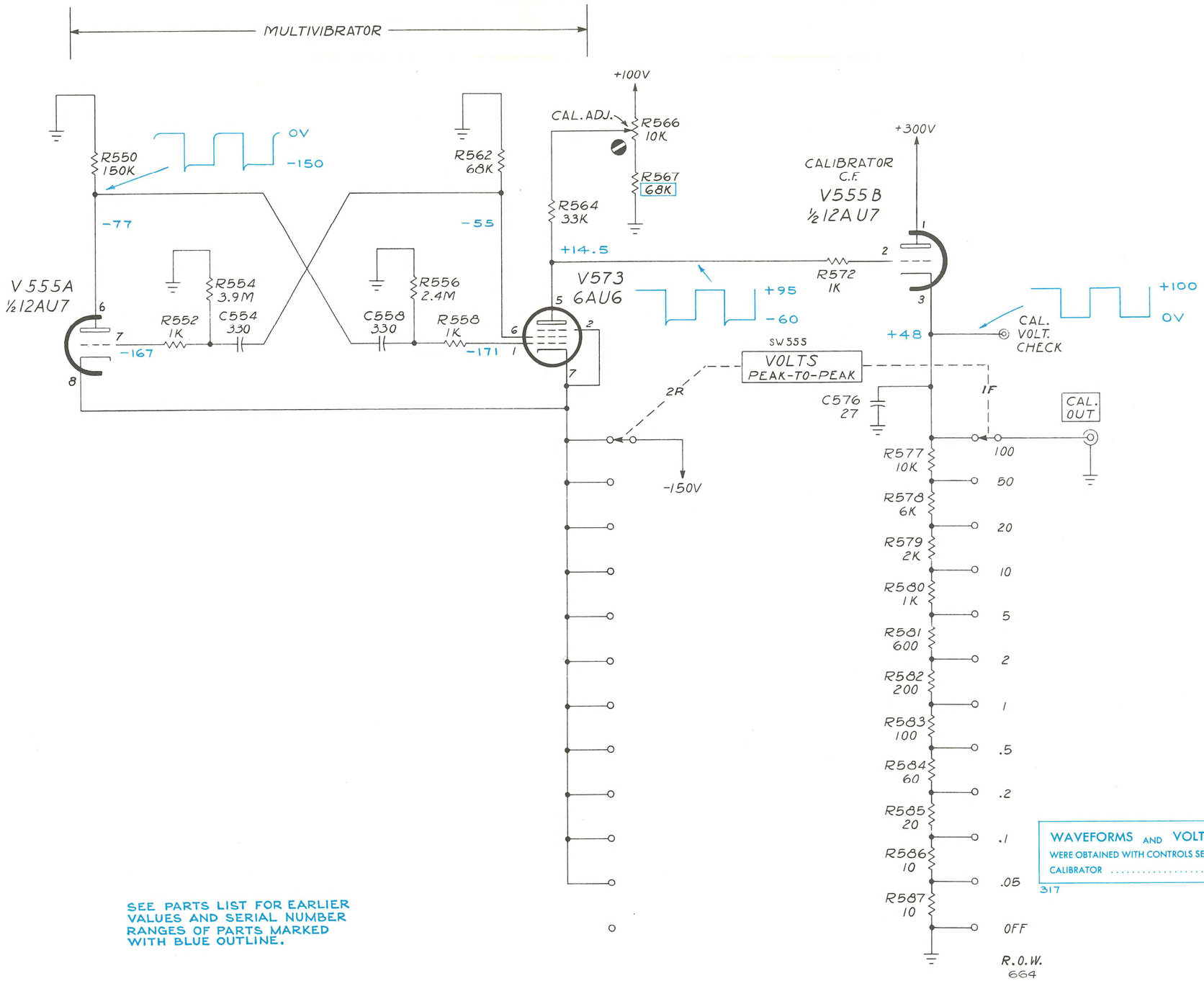
INTENSITY ..... CCW

SEE ALSO **IMPORTANT** NOTE ON TIME-BASE TRIGGER DIAGRAM.

317 CRT

D.B.L. 664

CRT CIRCUIT



WAVEFORMS AND VOLTAGE READINGS
WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:
CALIBRATOR ..... ON

317 CALIB.

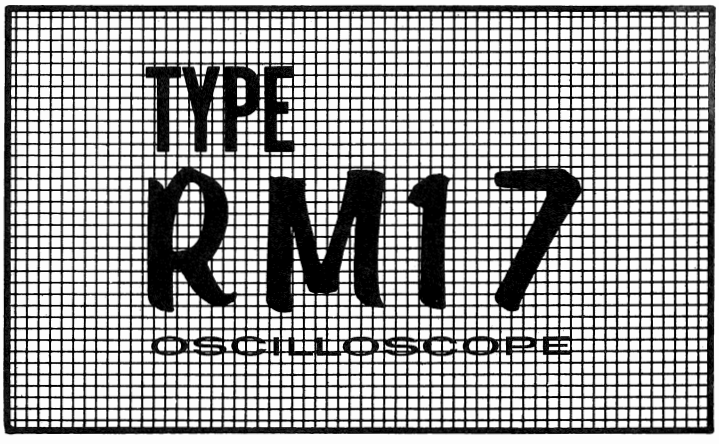
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

CALIBRATOR

EARL KING SALES CO.
Los Angeles, Calif.

INSTRUCTION MANUAL

Serial Number _____



Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-325

WARRANTY

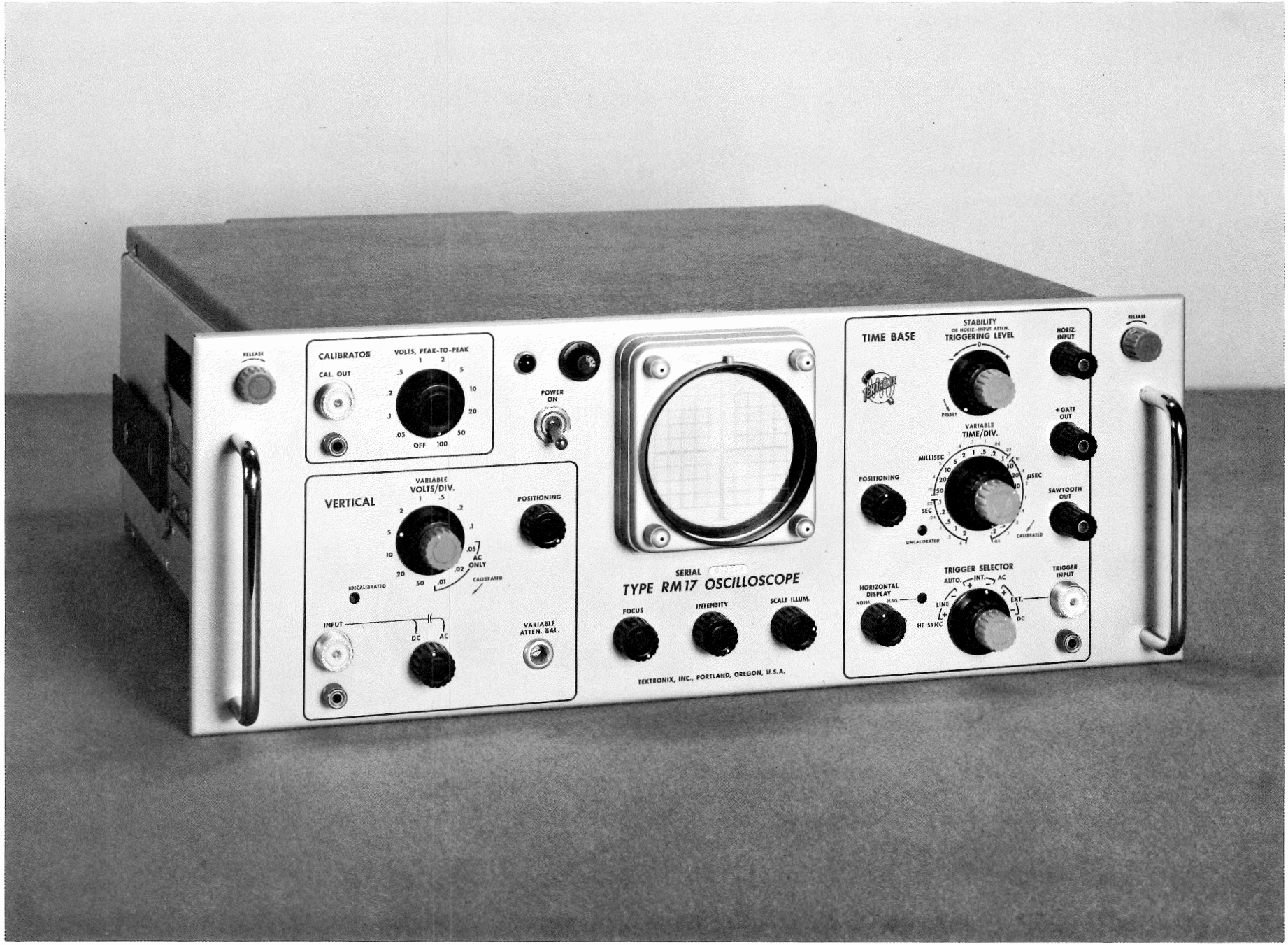
All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

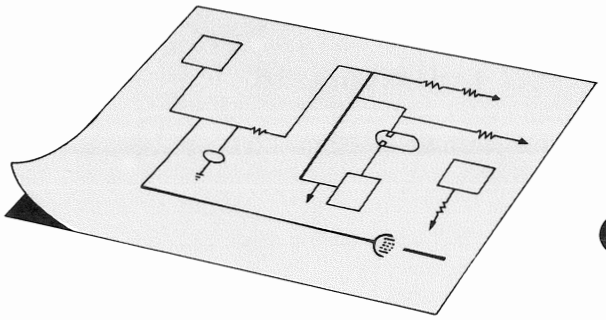
Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

CONTENTS


RELEASE
CALIBRATOR
VOLTS, PEAK-TO-PEAK
CAL. OUT
OFF
POWER ON
VERTICAL
VARIABLE VOLTS/DIV.
UNCALIBRATED
CALIBRATED
AC ONLY
POSITIONING
INPUT
DC
AC
VARIABLE ATTEN. BAL.
SERIAL
TYPE RM17 OSCILLOSCOPE
FOCUS
INTENSITY
SCALE ILLUM.
TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.
TIME BASE
STABILITY
TRIGGERING LEVEL
PRESET
HORIZ. INPUT
+GATE OUT
VARIABLE TIME/DIV.
MILLISEC
μSEC
SEC
SAWTOOTH OUT
TRIGGER SELECTOR
AUTO.
INT.
AC
LINE
EXT.
DC
HF SYNC
HORIZONTAL DISPLAY
NORM
MAG
TRIGGER INPUT



SECTION 1

CHARACTERISTICS

General

The Type RM17 is a compact, rack-mounting, general-purpose oscilloscope. The dc-coupled vertical amplifier and wide range of sweep rates, combined with small physical size, makes this instrument desirable for many rack-mounted applications.

VERTICAL-DEFLECTION SYSTEM

Input Characteristics

Direct connection-1 megohm, 38 pf.

With P510A Probe-10 megohm, 13 pf.

With P6017 Probe-10 megohm, 14 pf.

Deflection Factor

Twelve-position switch provides calibrated deflection factors from .1 v/div to 50 v/div, dc coupled, and from .01 v/div to 50 v/div, ac coupled accurate within 3%.

Continuously variable deflection factors are available from .01 v/div to approximately 125 v/div.

Frequency response

.1 v/div to 50 v/div:

DC coupled-dc to 10 mc.

AC coupled-2 cps to 10 mc (.2 cps to 10 mc when a Type P510A or P6017 Attenuator Probe is used.)

.01 v/div to .05 v/div;

2 cps to 9 mc (1.3 cps to 9 mc when a Type P510A or P6017 Attenuator Probe is used.)

Risetime

.035 microseconds.

HORIZONTAL-DEFLECTION SYSTEM

Sweep rates

Twenty-two-position switch provides calibrated sweep rates from 2 sec/div to .2 μsec/div.

Accuracy typically within 1% of full scale; in all cases, within 3% of full scale.

Continuously variable sweep rates are available which will slow the calibrated sweep rates down by a factor of approximately 2.5X.

Magnifier

Expands sweep 5 times to the right and left of the crt-screen center. Extends the fastest sweep rate to .04 μsec/div.

Accurate within 5%.

Unblanking

DC coupled.

Triggering signal requirements

Internal-.2 major graticule division.

External-.2 v to 20 v, peak-to-peak.

Frequency range-dc to 15 mc.

Synchronizing frequency range

5 mc to 15 mc.

Horizontal input

Deflection factor-approx. 1.3 v/div.

Frequency response-dc to 500 kc.

OTHER CHARACTERISTICS

Cathode-ray tube

Type T317P31, P2, P7 and P11 phorphors optional.

Accelerating potential-9,000 volts.

Deflection factor at plates:

Vertical-approximately 7.6 v/div. (30.4 v/in).

Horizontal-approx. 16.5 v/div (66 v/in).

Voltage calibrator

Square-wave output at approximately 1 kc.

Eleven fixed voltages from .05 volts to 100 volts, peak-to-peak.

Accuracy: +or- 3%.

Output waveforms available

Positive gate of same duration as sweep, approximately 20 volts. Positive-going sweep sawtooth, approximately 150 volts.

Power requirements

Line voltage-100 to 130 or 200 to 260 v, 50-60 cycles.

Power-260 w at 117 v line voltage.

Type RM17 mechanical specifications

Mounting-steel slide arms mounted on central pivot.

Fingertip release of pivot allows chassis to be locked in any of seven positions after it has been slid clear of rack.

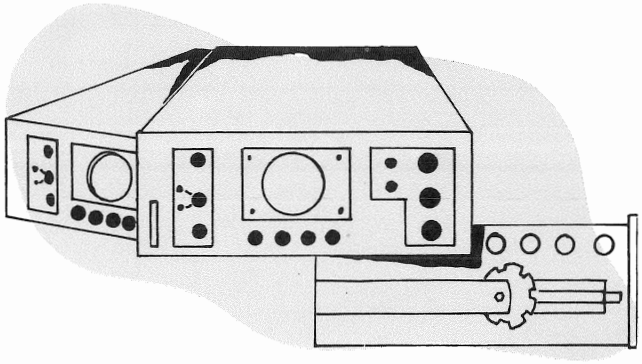
Ventilation-filtered, forced-air.

Finish, anodized panel.

Dimensions-19" wide, 7" high, 19" deep.

Accessories including

See Standard accessory list in this manual for accessories supplied with this instrument. For optional accessories, see the current Tektronix, Inc. catalog.



SECTION 2

INSTALLATION INSTRUCTIONS

TYPE RM17 INSTALLATION

Cabinet Rack Mounting

To mount the RM17 in a cabinet rack:

1. Mark the point on the rack where you want to position the top of the front panel. Mark a second position 3 1/4 inches below this point. The center of the top mounting screw should fall on the second mark.

2. Using two 8-32 screws for each bar nut, fasten an 8-32 bar nut to the mounting holes. The top screw will go in the hole found in Step 1, and the bottom screw will go through a mounting hole approximately 1 3/4 inches below the first.

Note

In some cases it may be necessary to enlarge the mounting holes in

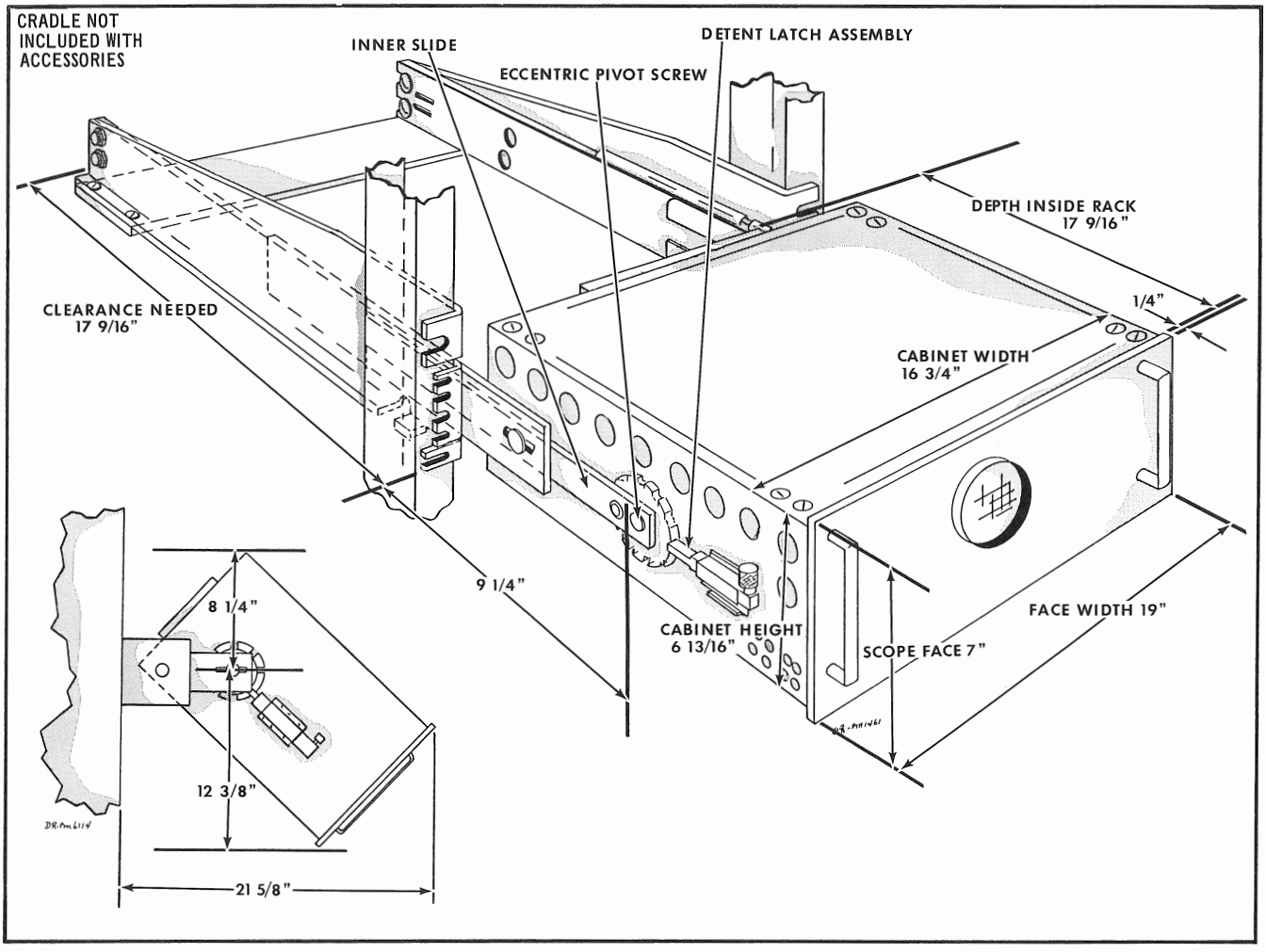


Fig. 2-1 Type RM17 Mounting dimensions.

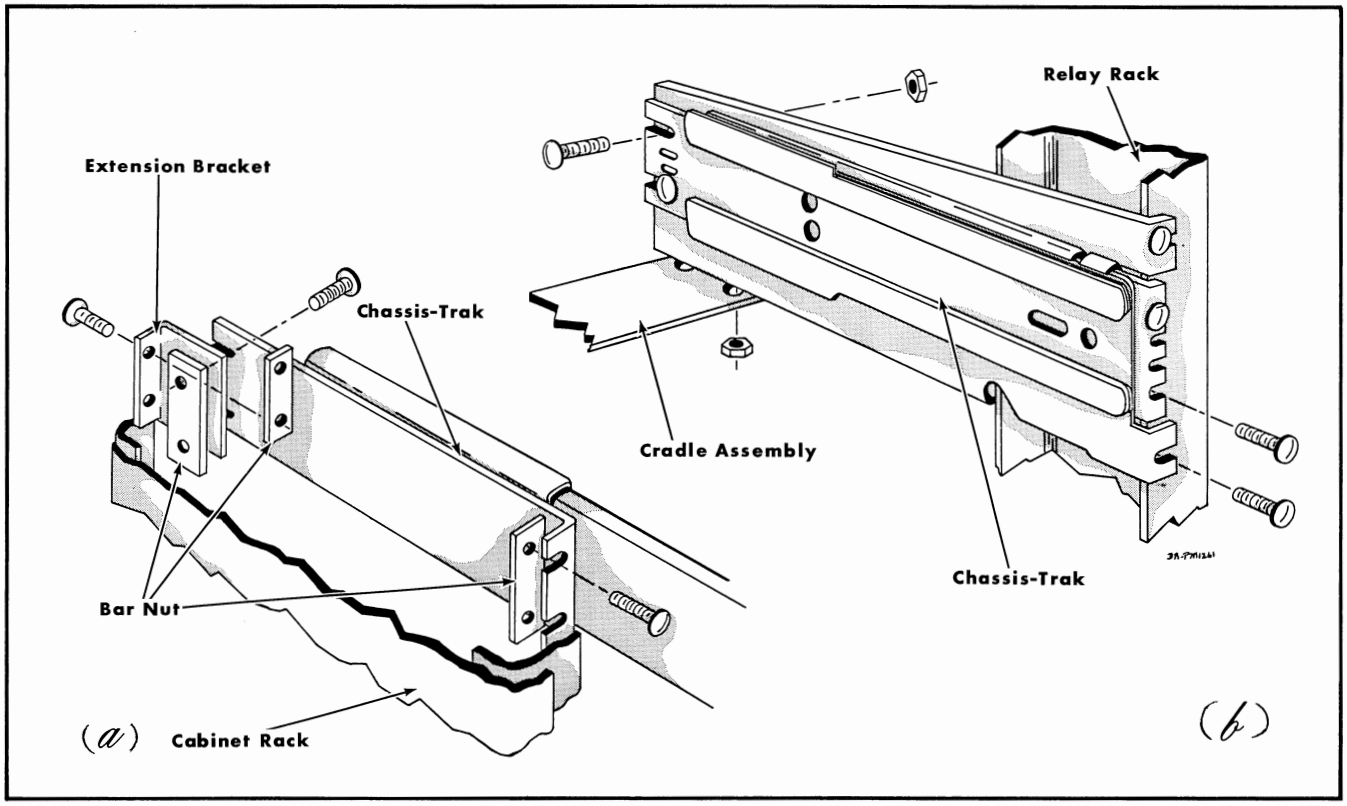


Fig. 2-2. Mounting the Chassis-Trak slides.
(a) The Chassis-Trak installed in an enclosed relay
(b) The Chassis-Trak installed in an open relay rack.

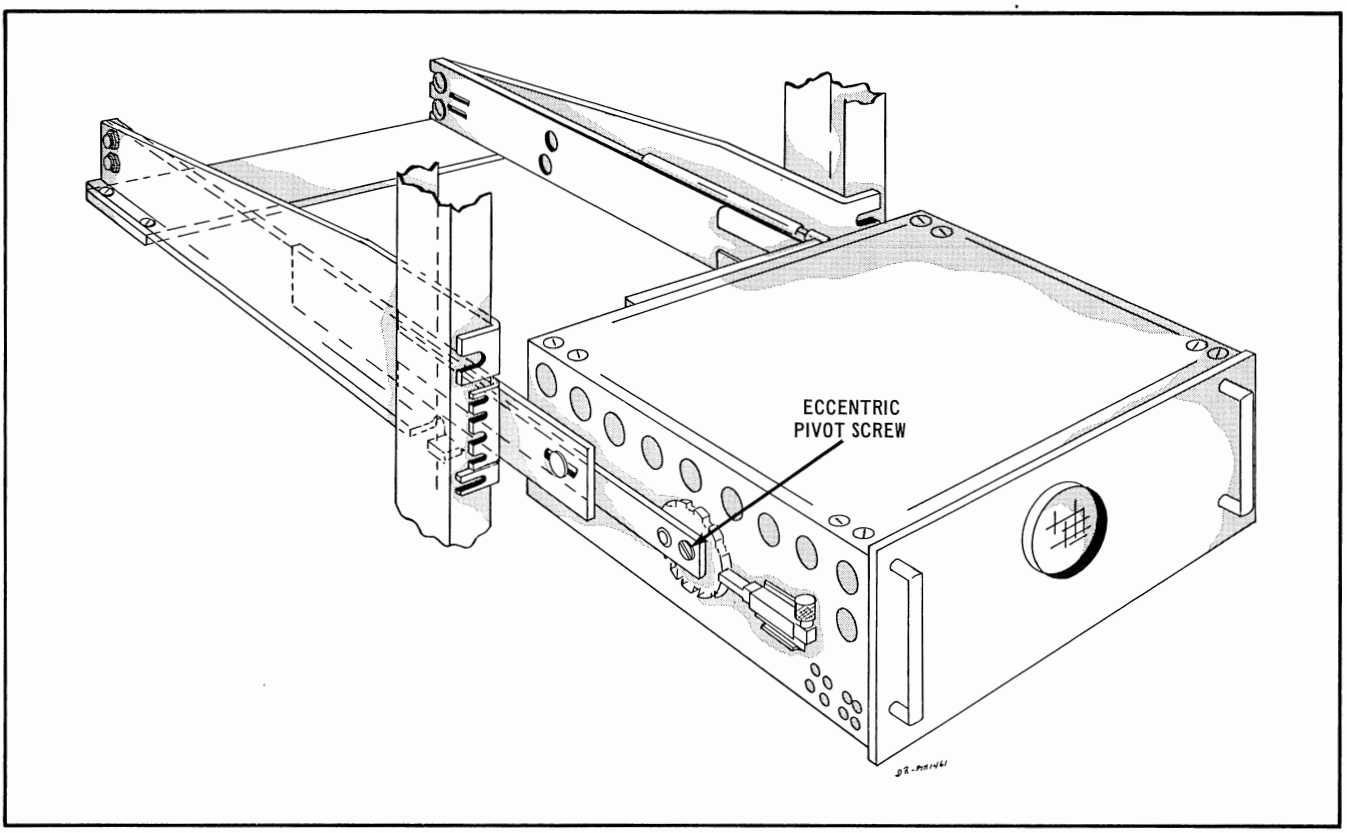


Fig. 2-3. The completed installation. It may be necessary to loosen the bolts and allow the slide mechanism to adjust to the weight of the instrument.

the relay rack rails slightly to permit the mounting screws to turn freely.

3. Slip the front lip of the Chassis-Trak between the cabinet and the bar nut as shown in Figure 2-2.

4. Tighten the 8-32 screws so that the Chassis-Trak is held securely to the rail of the cabinet rack.

5. In some types of cabinets you may need the extension brackets furnished with the Chassis-Traks. Figure 2-2 shows you how to assemble the extension brackets furnished with each set of tracks.

6. Slide the Type RM17 into the Chassis-Trak slides. Pull the instrument out and push it back into the slides several times. If the slide mechanism seems to work stiffly, loosen mounting screws slightly and allow the Chassis-Traks to adjust to the weight of the instrument. When the slide mechanism is working smoothly retighten all screws.

7. If the detent latch assemblies and inner slides are not parallel, loosen pivot nuts and adjust the eccentric pivot screws for parallel alignment. Retighten the pivot nuts.

Relay Rack Mounting

To mount the Type RM17 in a relay rack:

1. Bolt the rear of the Chassis-Trak to the rear of the corresponding cradle section using the 8-32 nuts and bolts provided as shown in Figure 2-2.

2. Mark a point on the relay rack where you want to position the top of the front panel. Mark a second position 2 inches below this point. The center of the top mounting screw should fall at this point.

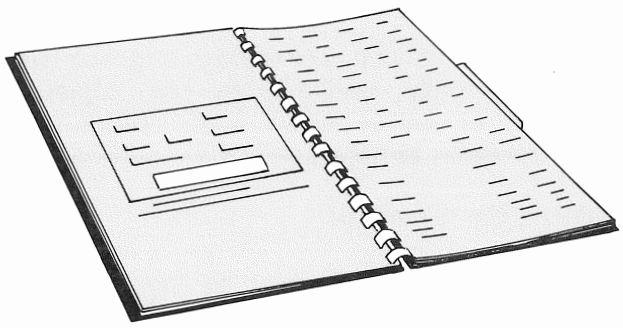
3. Using Figure 2-2 as a guide, assemble the cradle and Chassis-Trak on the corresponding rails of the relay rack, allowing 2 inches between the center of the top mounting screw and the position you selected for the top of the RM17 front panel.

4. Fasten the brace across the rear of the cradle assembly, making sure that it is mounted on the bottom of the cradle sides.

5. Place the Type RM17 in the Chassis-Trak slides as shown in Figure 2-3. Operate the slide mechanism several times with the instrument installed. If the operation of the slides is not smooth, loosen the mounting bolts and allow the slide mechanism to adjust to the weight of the instrument. Be sure to retighten all bolts after the mounting has been adjusted. Adjust eccentric pivot screw if necessary for smooth operation.

6. If the detent latch assemblies and inner slides are not parallel, loosen pivot nuts and adjust the eccentric pivot screws for parallel alignment. Retighten the pivot nuts.

NOTES



SECTION 3

OPERATING INFORMATION

General

The Type RM17 Oscilloscope is an extremely versatile instrument which is adaptable to a great number of applications. However, to make full use of the instrument, it's important that you understand the operation and function of the various controls. This section of the Manual is designated to give you this information.

PRELIMINARY INSTRUCTIONS

Cooling

A fan maintains safe operating temperature in the Type RM17 by circulating filtered air over the rectifiers and other components. When in operation, the instrument must be placed so that the air intake at the back is clear of any obstruction that might impede the flow of air. Side panels should also be in place for proper air circulation. The air filter should be kept clean, in accordance with the cleaning instructions found in the Maintenance Section of the manual.

Under no circumstances should your Type RM17 oscilloscope be operated without the fan running. Without the fan, inside temperature of the oscilloscope will rise to a dangerous level in five or ten minutes. In this event, the thermal cutout switch will disconnect the power and keep it disconnected until the temperature drops to a safe level.

Power Requirements

Unless tagged otherwise, this instrument is connected at the factory for operation at 117 volts. However, provisions are made for easy conversion to other voltages.

TRANSFORMER PRIMARY CONNECTIONS

LINE VOLTAGE OPERATING RANGE	NOMINAL LINE VOLTAGE	CONNECT JUMPER WIRE OR WIRES BETWEEN TERMINALS AS FOLLOWS
100 to 117	110	3 to 4 and 5 to 6
105 to 125	117	2 to 4 and 5 to 7
112 to 130	124	1 to 4 and 5 to 8
200 to 234	220	3 to 6
210 to 250	234	2 to 7
224 to 260	248	1 to 8

Fan Connections

The cooling fan is powered by a 117-volt ac motor. If the instrument is converted to operate from a 234-volt line, a change in the fan wiring must be made so that it operates from a 117-volt source.

The power connections for the fan are terminated on a ceramic strip in front of the fan. The correct connections for 200 to 260 volt operation are shown in Figure 3-1. To connect the fan for 100 to 130 volt operation, move the right-hand fan lead from the second slot to the fourth.

Fuse Data

Use only the recommended fuses for maximum over-current protection. See your parts list.

OSCILLOSCOPE OPERATION INFORMATION

Initial control settings.

Set the oscilloscope controls as follows:

FOCUS	centered
INTENSITY	full left (counter-clockwise)
POWER	ON

VOLTS/DIV (black knob)	5
VARIABLE VOLTS/DIV (red knob)	CALIBRATED (full right)
AC-DC	AC
TRIGGER SELECTOR (black knob)	+INT.
TRIGGER SELECTOR (red knob)	AUTO
STABILITY	PRESET
TRIGGERING LEVEL	full right or full left
DISPLAY	NORM
TIME/DIV (black knob)	.5 MILLISEC (black numbers)
VERTICAL POSITIONING	centered
HORIZONTAL POSITIONING	centered
CALIBRATOR	10

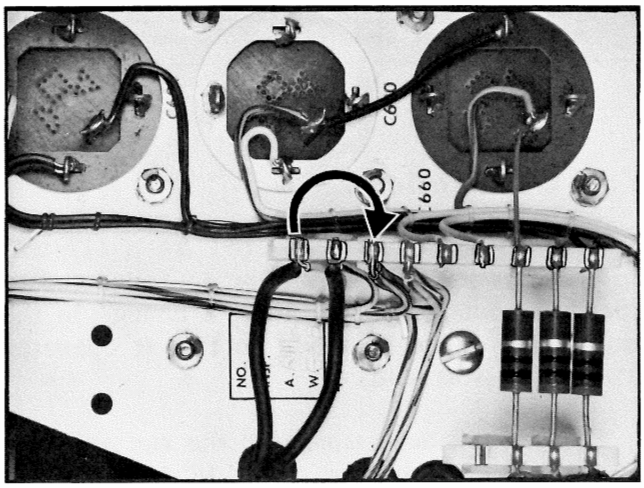


Fig. 3-1. Fan connections for 220, 234 or 248 nominal line volts. For 110, 117 or 124-volt operation, move left-hand fan lead 2 notches to the right.

Focus and Astigmatism Controls

The FOCUS and ASTIGMATISM controls operate in conjunction with each other to allow you to obtain a sharp, clearly defined display. To adjust the FOCUS and ASTIGMATISM controls, put a signal in from the CAL OUT connector of about two major divisions. Now with the FOCUS and ASTIGMATISM controls adjust the displayed waveform for the sharpest vertical and horizontal trace lines available. The area of the display you should observe, is an area two divisions high and two divisions wide with its center where the center vertical and horizontal lines of the graticule meet. Keep the intensity at a level just high enough for you to see the waveform, during this adjustment. If you are using a green filter on your scope, make sure the adjustment is done at an intensity high enough to be seen through the filter.

Intensity Control

The INTENSITY control is used to adjust the brightness of the oscilloscope display. This permits you to compensate for changes in brightness resulting from changes in the sweep triggering rate. The INTENSITY control is rotated clockwise to increase brightness and counterclockwise to decrease it. Be careful when you use the INTENSITY control that the brightness is not turned up to where it will permanently damage the face of the cathode-ray tube. If brightness is turned up to the point where a halo forms around the spot, it should be turned down immediately.

Graticule Illumination Control

The graticule used with the Type RM17 Oscilloscope is accurately marked with 10 horizontal and 8 vertical divisions. These graticule markings allow you to make time and voltage measurements from the oscilloscope screen.

The graticule is illuminated by two lamps located at the top edge of the graticule.

Graticule illumination is adjusted by the SCALE ILLUM. control located just under the oscilloscope screen. Rotating the control clockwise increases the brightness of the graticule markings, and turning it counterclockwise decreases brightness.

As a general rule, white graticule lines are superior to red for photographic purposes. Where it is desired to photograph a display, it may be desirable to remove the red plastic inserts from the graticule so the lines will appear white. Where the volume of photographic work warrants it, you may want to obtain a clear graticule from your Tektronix Field Engineer.

Positioning Controls

Two controls are used with the Type RM17 for positioning the trace on the oscilloscope screen. One control is used to set horizontal positioning of the trace. This is located on

the front panel of the instrument. The second control is used to set vertical positioning, and is located on the front panel of the scope.

The HORIZONTAL POSITION control causes the trace to move to the right when it is rotated in the clockwise direction and to the left when rotated counterclockwise.

The vertical positioning control has enough range to allow the trace to be positioned completely off the top or bottom of the screen or anywhere in between. The trace moves up when the control is turned clockwise and down when the control is turned counterclockwise.

Input Signal Connections

The electrical waveform to be observed is applied to the input connector. The waveform is then connected through the vertical-deflection system of the oscilloscope to cause the spot to be deflected vertically and to trace out the waveform on the screen of the crt. The vertical size of the displayed waveform is adjusted with the VOLTS/DIV. switch. The VOLTS/DIV. switch is an accurately calibrated control which, when used with the graticule, allows you to make precise voltage measurements from the displayed waveforms.

Certain precautions must be taken when you are connecting the oscilloscope to the input signal source to insure that accurate information is obtained from the oscilloscope display. This is particularly true when you are observing low-level signals or waveforms containing high or extremely low frequency components. For applications where you are observing low-level signals, unshielded input leads are unsatisfactory because they tend to pick up stray signals which produce erroneous oscilloscope displays. Shielded cables should be used whenever possible, with the shield connected to the chassis of both the oscilloscope and the signal source. Regardless of the type of input lead used, keep them as short as possible.

Distortion of the input waveform may result if very low-frequency input signals are ac coupled into the oscilloscope, if high-frequency waveforms are not properly terminated, or if the input waveform contains high-frequency components which exceed the passband of the oscilloscope. You must be aware of the limitations of the instrument.

In analyzing the displayed waveform, you must consider the loading effect that the oscilloscope has on the input signal source. In most cases this loading effect is negligible, but in some applications, loading caused by the oscilloscope may materially alter the results obtained. In such cases you may want to use a probe to reduce the amount of loading.

Vertical-Amplifier Operation

Coupling

It is sometimes unnecessary or undesirable to display the dc level of the waveform. In the AC position of the AC-DC switch, a capacitor in series with the input blocks the dc component of the waveform so that only the ac component is displayed.

Deflection Sensitivity

The VOLTS/DIV. switch inserts frequency-compensated attenuators ahead of the amplifier. The Variable control provides continuous adjustment of the deflection sensitivity (2.5 to 1 attenuation ratio) between the values indicated by the VOLTS/DIV. switch. The VARIABLE control must be clockwise against the stop for the sensitivity to be as indicated by the VOLTS/DIV. switch. The UNCALIBRATED light indicates when the VARIABLE control is not fully clockwise.

VARIABLE ATTEN. Balance Adjustment

After the scope has been in use for a period of time you will notice that the trace will change position as the VARIABLE control is rotated. This is caused by tube aging and the resultant shift in operating potentials. To correct this condition rotate the VARIABLE control back and forth and adjust the VARIABLE ATTEN. BAL control until the trace position is no longer affected by rotation of the VARIABLE control.

Use of Probes

Occasionally, connecting the input of an oscilloscope to a signal source loads the source enough to adversely affect both the operation of the source and the waveform displayed on the oscilloscope. When this occurs, both capacitive and resistive loading due to the

oscilloscope can be reduced to a negligible value by using an attenuator probe.

In addition to providing isolation of the oscilloscope from the signal source, an attenuator probe also decreases the amplitude of the displayed waveform by the attenuation factor of the probe. Use of a probe allows you to increase the vertical deflection factors of the oscilloscope to look at large amplitude signals which are beyond the normal limits of the oscilloscope. Signal amplitudes, however, must be limited to the maximum allowable value of the probe used.

Before using a probe, you must check (and adjust if necessary) the compensation of the probe to prevent distortion of the applied waveform. To adjust the probe compensation, place the DISPLAY switch at NORMAL (X1), the TRIGGER SELECTOR (Red knob) switch at AUTO, and the TRIGGER SELECTOR (Black knob) switch at +INT. Turn up the intensity until the trace is visible and connect the probe tip to the CAL OUT connector. Set the CALIBRATOR for 2 major divisions of displayed signal. Set the TIME/DIV. switch to display approximately 3 or 4 cycles of the Calibrator waveform and adjust the probe compensation control to obtain flat tops on the displayed Calibrator square waves as shown in Fig. 3-2.

The method of setting the compensation control depends on the probe in use. If your oscilloscope is equipped with a Type P510A probe, compensation is by means of a screwdriver adjustment through the hole near the nose end of the probe body. If a P6000 type probe is used, it is necessary to first unlock the Locking Sleeve by turning it counterclockwise. The probe is then compensated by rotating the probe body while watching the oscilloscope display for the desired waveform. When compensation is completed, carefully turn the Locking Sleeve clockwise to lock it without disturbing the adjustment of the probe.

If a P6017 type probe is used it can be compensated by adjusting the capacitor mounted in the box which will be near the coax fitting for the scope. The capacitor can be reached through the hole in the box. See Fig. 3-2 for the different probes.

HORIZONTAL-DEFLECTION SYSTEM

Trigger Operation

For most uses of the oscilloscope a stable display of some waveform is required. To accomplish this the oscilloscope can be operated so that the horizontal sweep starts at a given point on the displayed waveform. This is known as "triggered" operation. For the present, we will refer to the starting of the sweep, at the

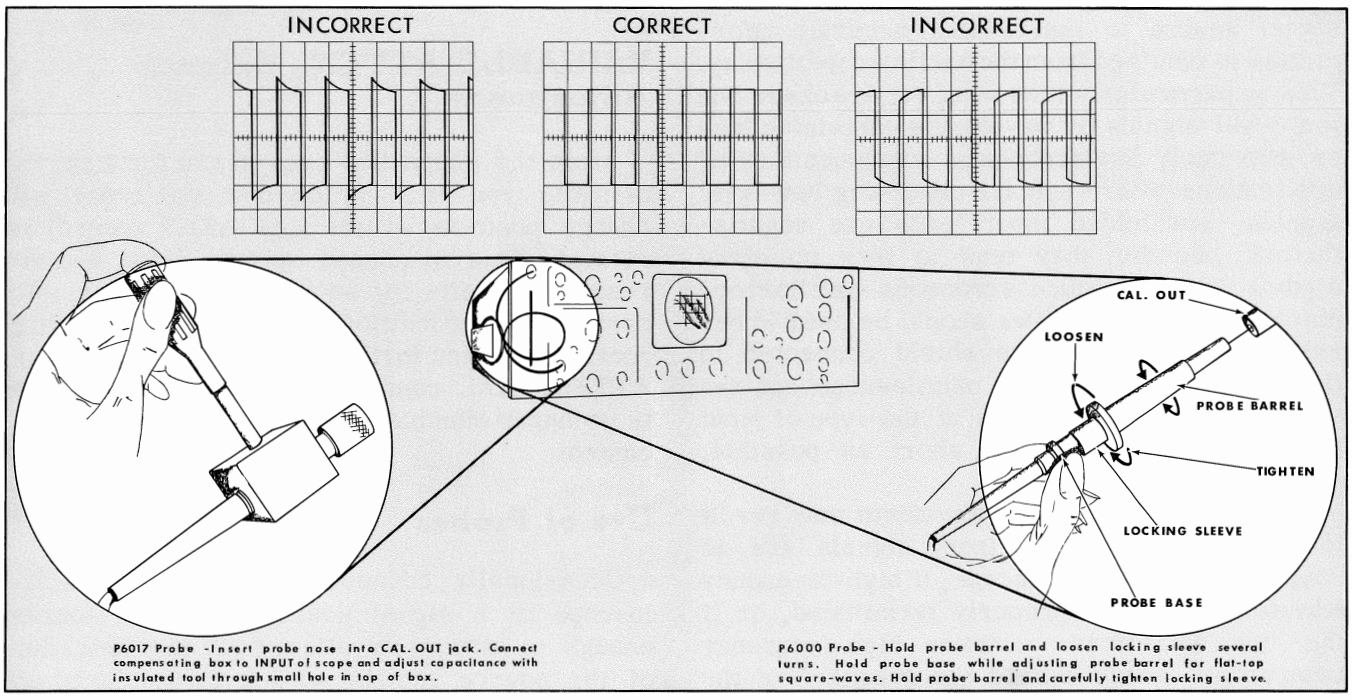


Fig. 3-2. When compensating the probe, it is adjusted to obtain an undistorted presentation of the calibrator square-wave.

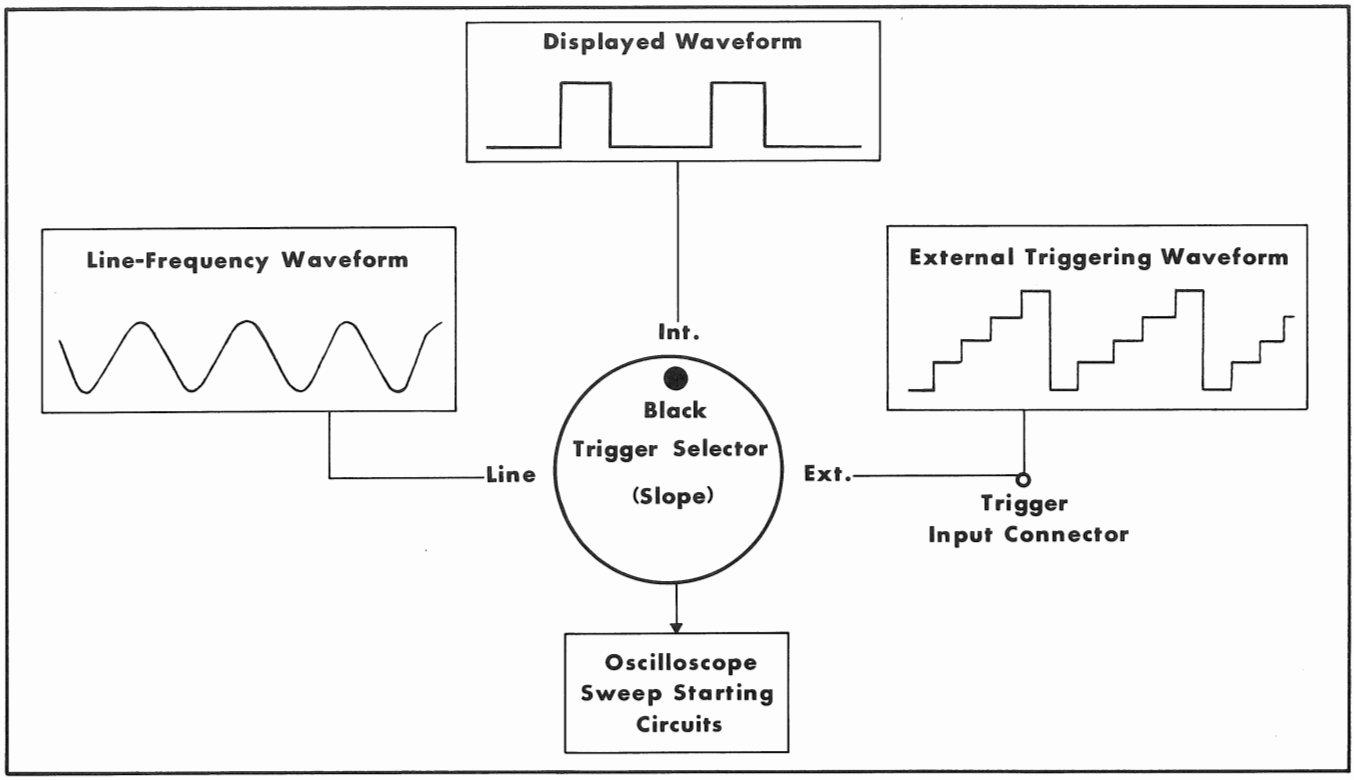


Fig. 3-3. The triggering signal is selected from three possible sources with the TRIGGER SELECTOR control (black knob).

left side of the graticule, as "triggering" the sweep.

Triggered operation is useful for observing a waveform which may occur only once, or which may occur at random intervals. For these uses, the oscilloscope can be used in such a way that each horizontal sweep is triggered by some wavefom other than the one being observed, but which bears a time relationship to the observed waveform.

The waveform used to start the horizontal sweep is called the "triggering signal", whether it is the waveform being observed, or some other waveform. The instructions that follow tell you how to select this signal. They also contain information on triggering according to various modes, depending on the nature of the triggering signal.

Selecting the Triggering Signal

1. To trigger the sweep from the waveform being observed, set the black TRIGGER SELECTOR knob to INT. (+ or -).

2. To trigger the sweep from the powerline wave (as in the case when observing a waveform which has a time relationship to the powerline wave), set the black TRIGGER SELECTOR knob to LINE (+ or -).

3. To trigger the sweep from some external waveform (one having a time relationship to the waveform being observed), connect the source of the triggering signal to the TRIGGER INPUT connector and set the black TRIGGER SELECTOR knob to EXT. (+ or -).

Refer to Fig. 3-3 for a complete pictorial presentation of the various triggering source options.

Selecting the Triggering Slope

The horizontal sweep can be triggered on either the rising (+ slope) or falling (- slope) portion of the triggering waveform as determined by the position of the TRIGGER SELECTOR switch. When the switch is in one of the + positions, the sweep is triggered on the rising portion of the triggering waveform; when the

TRIGGER SELECTOR switch is on one of the - positions, the sweep is triggered on the falling portion of the waveform. (See Fig. 3-4).

In many applications the triggering slope is not important, since triggering on either slope will provide a display which is suitable to the application. However, in many other cases such as pulse measurements, the triggering slope is very important. If, while using a fast sweep, you wish to see the rise of a pulse, it will be necessary for you to trigger the sweep on the rising portion of the waveform by placing the TRIGGER SELECTOR (black knob) switch in one of the + positions. To observe the fall of a pulse at a fast sweep rate, it will be necessary to trigger the sweep on the falling portion of the waveform by placing the TRIGGER SELECTOR (black knob) switch in one of the - positions. In either case, selection of the wrong triggering slope will make it impossible for you to see the portion of the waveform you want to check.

Using the STABILITY and TRIGGERING LEVEL Controls

Triggered operation in all modes except AUTOMATIC and HF SYNC will require proper setting of the STABILITY and TRIGGERING LEVEL controls. The TRIGGERING LEVEL control has no effect in either AUTOMATIC or HF SYNC modes.

The STABILITY control has a PRESET position at the fully counterclockwise setting of the control. This position permits proper triggering in many applications without necessitating additional adjustment of the STABILITY control. If it becomes difficult or impossible for you to obtain proper triggering with the STABILITY control at PRESET, you must then adjust the control. This is done with the TRIGGERING LEVEL control fully counterclockwise. The STABILITY control is rotated clockwise with the PRESET position until a trace appears on the screen. The proper Stability setting for a triggered display is then

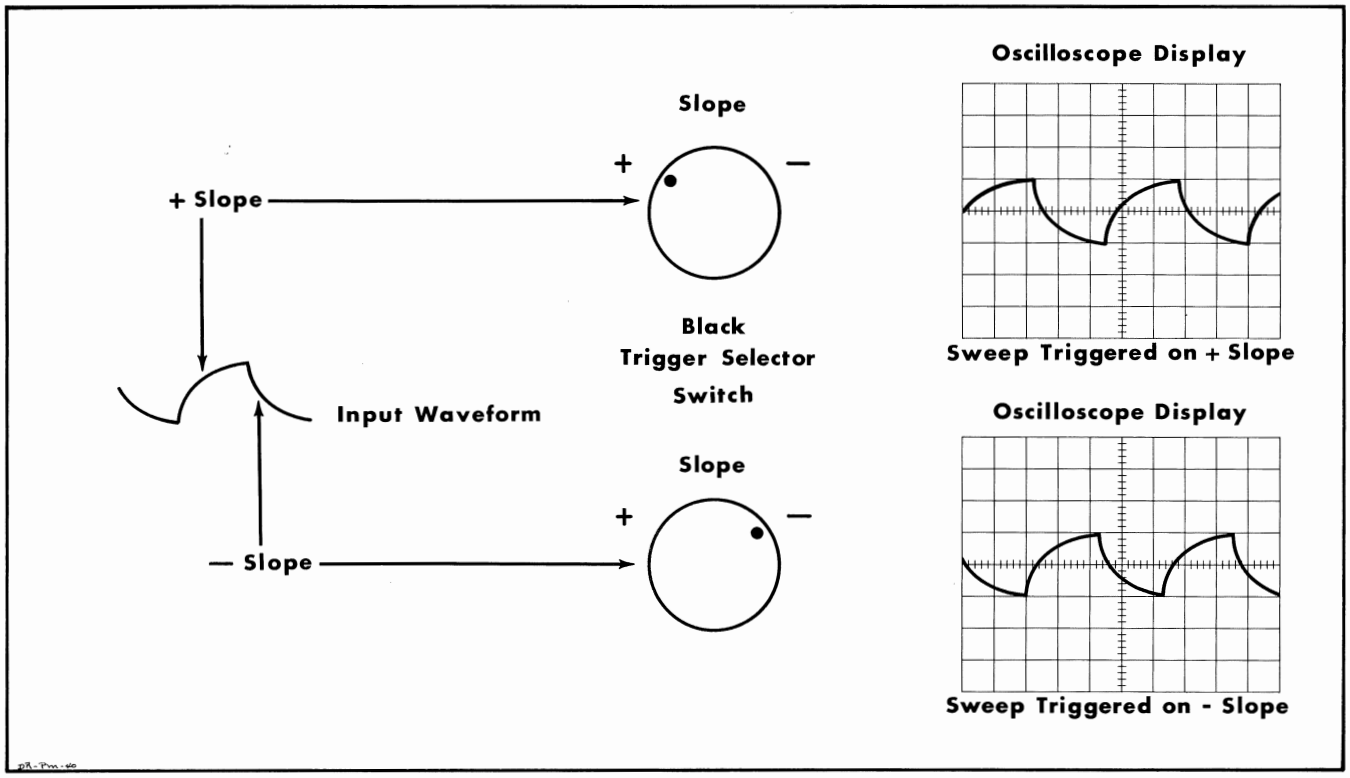


Fig. 3-4. Effects on the oscilloscope display produced by + and - settings of the TRIGGER SELECTOR control (black knob).

obtained by turning the knob slowly counterclockwise until the trace just disappears.

The TRIGGERING LEVEL control should then be turned slowly toward the 0 position until a stable display appears on the screen. The TRIGGERING LEVEL control also determines the exact point on the triggering waveform where triggering of the sweep occurs. Turning the control clockwise causes the sweep to trigger at more positive points on the waveform, while turning the control counterclockwise causes the sweep to trigger at more negative points. If the displayed waveform is vertically centered under the graticule, setting the TRIGGERING LEVEL control at 0 will cause the sweep to start at approximately the mid-voltage point of the waveform, except in DC mode.

Selecting the Triggering Mode

After selecting the triggering source and triggering slope, it is next necessary to select the triggering mode which will allow you to obtain the desired display. Four triggering modes are available. In the Type RM17, they are DC, AC, AUTOMATIC and HIGH FREQUENCY SYNC.

Each of the triggering modes is designed to provide stable triggering from a certain type of waveform. For most applications however, several of the triggering modes will work equally well. For applications of this type, the triggering mode used is purely a matter of choice. The primary thing to consider in choosing the triggering mode is whether or not it allows you to obtain the display you want.

To determine the best mode of operation for a particular application, it is usually best to try each triggering mode in the application. The Automatic mode should be tried first since this triggering mode provides stable triggering in most applications without the necessity of setting the STABILITY or TRIGGERING LEVEL controls. If the Automatic mode does not provide the desired display, it will then be necessary for you to try one or more of the other triggering modes.

AUTOMATIC Triggering Mode

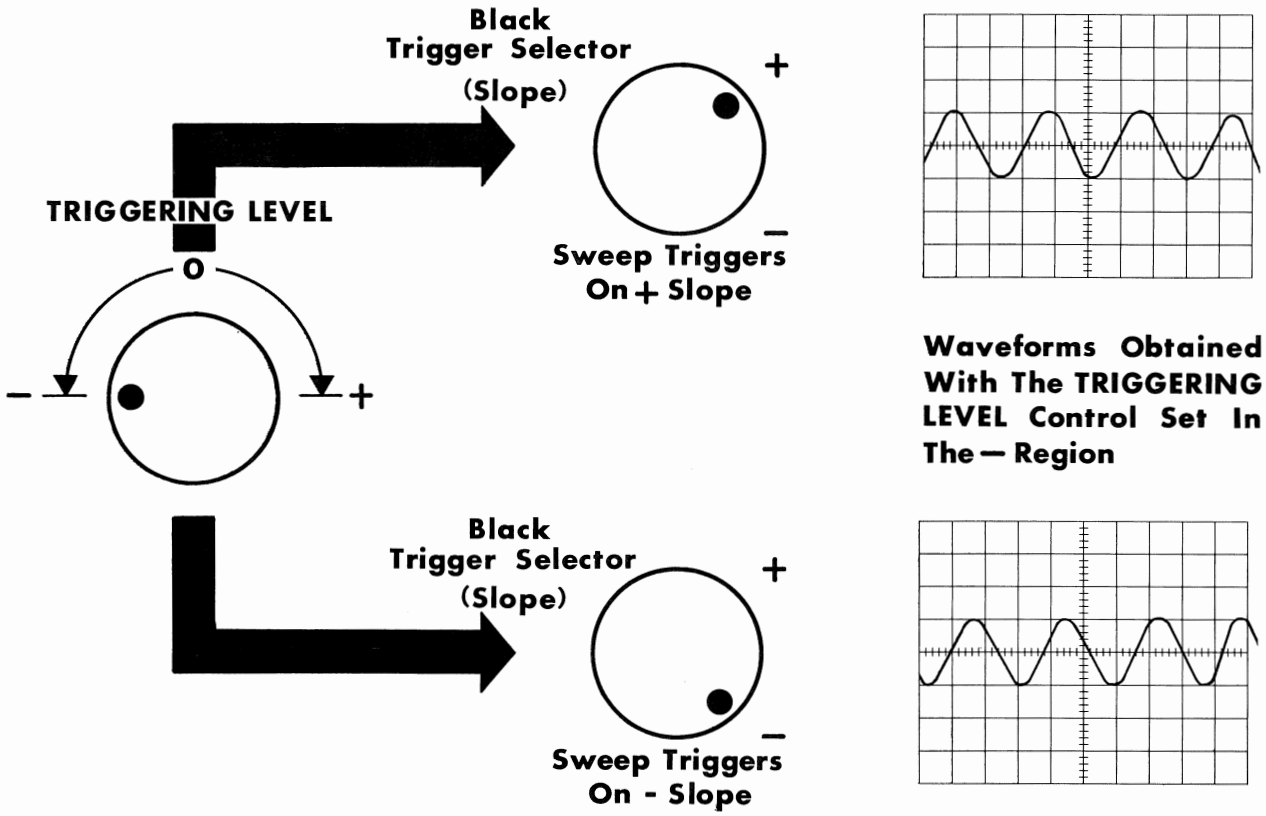
The AUTOMATIC mode is most frequently used because of its ease of operation. This mode is useful in obtaining stable triggering from waveforms with frequencies of from approximately 60 cycles to 2 megacycles. The principal advantage of this type of operation is that it is not necessary to adjust either the STABILITY or TRIGGERING LEVEL controls to obtain a stable display. This permits you to observe a large number of waveforms with different shapes and amplitudes without adjusting any of the triggering controls. In the absence of a triggering signal, the sweep continues to run to provide a convenient reference trace on the oscilloscope screen.

The AUTOMATIC triggering mode is selected by placing the TRIGGER SELECTOR (red knob) switch in the AUTO. position. The triggering source and slope is then selected and the input signal is applied to the oscilloscope. No other control adjustments are required. Since the TRIGGERING LEVEL control has no effect on the display when automatic triggering is used, it is impossible to select the point on the triggering waveform where the sweep is triggered. Each sweep is instead triggered at the average voltage point of the waveform.

DC Triggering Mode

In the DC mode, the sweep can be triggered from periodic signals in the range from dc to 5 mc. This mode is especially useful with trigger signals that change slowly, and is also useful when it is desired to trigger at a certain point (voltage level) on a waveform with respect to ground.

Another application of the DC triggering mode is to attain a stable display of a random-pulse train. The average voltage of this type of signal is dependent upon the time duration and amplitude of each pulse and the time lapse between successive pulses. Since these are variable quantities in a random-pulse train, the average voltage will also vary. This is likely to cause unstable triggering in the AC mode. In the dc mode, however, the circuits are sensitive to the instantaneous voltage only. Changes in the average voltage do not alter the operation of the circuits. As a result, the TRIGGERING LEVEL control can be adjusted to initiate a sweep whenever a pulse reaches the desired voltage.



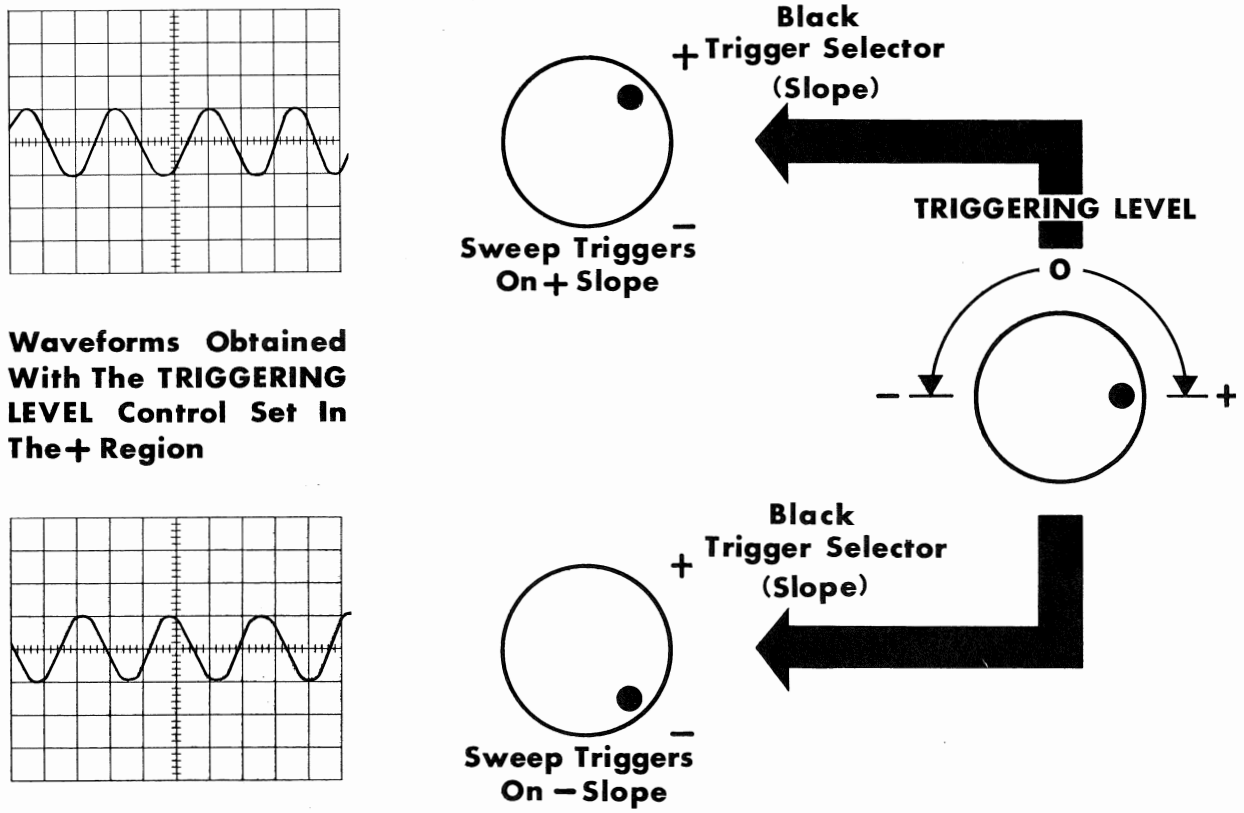


Fig. 3-5. Effects on the oscilloscope display produced by + and - settings of the TRIGGERING LEVEL control. When the TRIGGERING LEVEL control is set in the + region, the sweep is triggered on the upper portion of the input waveform; when it is set in the - region, the sweep is triggered on the lower portion of the input waveform. The TRIGGER SELECTOR control (black knob) determines whether the sweep is triggered on the rising portion or the falling portion of the input waveform.

AC Triggering Mode

Selection of the AC triggering mode is made by placing the TRIGGER SELECTOR (red knob) switch in the AC position. This mode provides useful triggering in the frequency range of approximately 15 cycles to 5 mc. These frequency limits vary slightly depending upon the shapes and amplitude of the triggering waveform. In the AC mode, triggering is unaffected by the dc components of the triggering signal or by the vertical positioning of the trace. The triggering level can be selected to provide the desired display using the STABILITY and TRIGGERING LEVEL controls. These two controls are set as described for the DC mode.

HF SYNC Triggering Mode

The High Frequency Synchronization Mode permits stable displays of waveforms with frequencies higher than approximately 5 mc. Stability of the display is adjusted with the STABILITY control. The TRIGGERING LEVEL control is not used. To use the High Frequency Synchronization Mode, place the Trigger Selector (red knob) switch in the HF SYNC position. Turn the STABILITY control clockwise until a trace appears. Continue to adjust the STABILITY control until a stable display is obtained.

Although the synchronization signal source is selected with the TRIGGER SELECTOR (black knob) control, the slope cannot be selected. Also you cannot use the PRESET position of the STABILITY control in this mode.

Free-Running Sweep Operation

In the usual oscilloscope application, the sweep is triggered or synchronized by the input waveform. However, in some applications it may be more desirable to reverse the process and initiate the input waveform through use of a periodically recurrent waveform from the oscilloscope. In this type of application the sweep is caused to free-run and an output from either the + GATE OUT or SAWTOOTH OUT connectors is used to trigger or synchronize the input waveform. (See Fig. 3-6).

The sweep can be made to free run with any setting of the TRIGGER SELECTOR (black knob) switch by turning the STABILITY control fully clockwise. In all positions of the TRIGGER SELECTOR (red knob) switch except AUTOMATIC the number of sweeps per second is determined by the setting of the TIME/DIV. controls. In the AUTOMATIC position, the sweep repetition rate remains at approximately 50 sweeps per second regardless of the setting of the TIME/DIV. control.

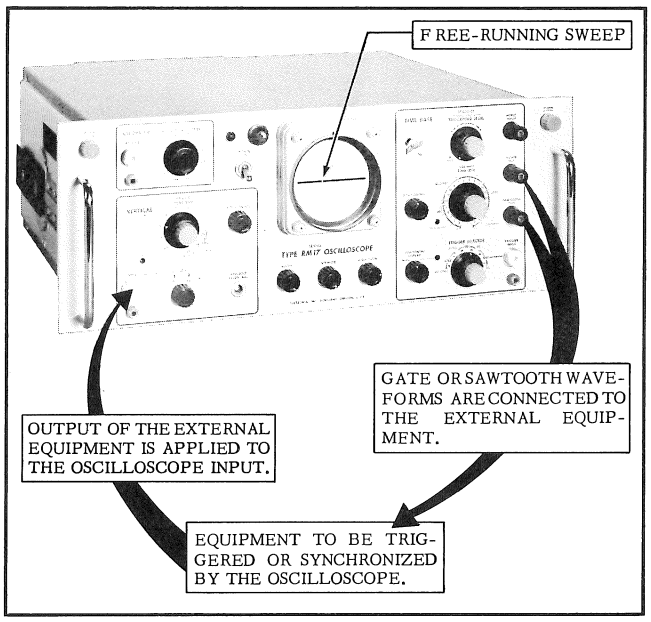


Fig. 3-6. Using the Gate or Sawtooth output waveforms to synchronize or trigger external equipment.

In addition to providing the means of controlling an applied waveform, a free-running sweep also provides a convenient reference trace on the oscilloscope screen without requiring an input signal. This trace can then be used to position the sweep or to establish a voltage reference line.

To magnify a particular part of a display, position that portion of the display with the HORIZONTAL POSITION control so that it appears near the center of the graticule. Then turn the DISPLAY control to MAG. position. That part of the display which formerly occupied the middle section of the graticule will now be expanded. The apparent time calibration of the X (sweep) axis will be equal to the setting of the TIME/DIV. control divided by 5.

External Horizontal Deflection

In some instances it may be necessary to deflect the beam horizontally by means of an externally derived waveform, rather than by means of the internal sweep. To accomplish

this, set the DISPLAY switch to EXT. and connect the source of the waveform to the HORIZ. IN connector. Set the VARIABLE for the desired amount of horizontal deflection.

Output Waveforms

The SAWTOOTH OUT waveform starts at about ground and rises linearly to a peak amplitude of about 150 volts.

The start and duration of the rising part of the sawtooth coincides with the start and duration of the horizontal sweep on the crt. The rate at which the sawtooth rises is determined by the setting of the TIME/DIV. control.

A positive rectangular waveform is available at the + GATE OUT connector. This waveform starts at ground and rises to about 20 volts. The starting time and duration of each pulse coincides with the starting time and duration of the positive-going part of the sawtooth available at the SAWTOOTH OUT connector.

AUXILIARY FUNCTIONS

Calibrator

The calibrator provides a convenient source of square waves of known amplitude at a frequency of approximately 1 kc. The square-waves are used primarily to adjust probes and to verify the calibration of the vertical deflection system of the oscilloscope.

Calibrator square-waves are adjustable from .05 volts peak to peak, to 100 volts peak to peak, in 11 steps. The VOLTS PEAK TO PEAK knob controls the full range of 11 outputs, ranging in steps from .05 volts to 100 volts.

The peak to peak calibrator voltage is within 3 percent of the CALIBRATOR switch setting when the output is connected to a high impedance load.

Intensity Modulation

The crt display of the Type RM17 Oscilloscope can be intensity modulated by an external signal to display additional information. This is done by disconnecting the grounding strap from the CRT CATHODE connector at the rear of the instrument and connecting the external signal to this terminal.

When you wish to make very accurate time measurements from the crt display, you can intensity modulate the beam with time markers presented on the screen. A positive signal of approximately 25 volts is required to cut off the beam from normal intensity.

Direct Connection to CRT Deflection Plates

The vertical deflection plate pins are located on the side of the crt neck. The horizontal deflection plate pins are located on the top. In some applications, it is advantageous to connect a signal directly to either one, or both sets of these deflection plate pins--bypassing the internal oscilloscope amplifiers. Maintain the average dc voltage on the deflection plates between +150 and 200 volts. If the voltage is not within this range, the crt display becomes defocused.

For dc coupling, it is necessary to supply positioning voltages from the signal source. These voltages should fall within the +150 to +300 volt range. When dc coupling the signal to the deflection plates, you should tape the ends of the wires you have removed from the crt pins. This prevents shorting to the chassis and damage to the amplifier. The external signal source is then connected to the crt.

In many application, it is advantageous to use ac coupling. This is necessary for those signals which cannot be made to have the right dc voltage. Positioning is controlled through the vertical amplifier with its normal positioning control.

The usual direct deflection application is to make use of the ultimate rise-time capability of the crt in the oscilloscope. This requires careful connection to the deflection plates from coaxial cables through damping resistors, and physically small coupling capacitors. These leads should be set close to the crt pins, should be short, and should be rigid. Tie down the coax so that a pull on the coax will not break the crt.

Referring to Fig. 3-7, connect the damping resistor to the coax center conductor. Connect the other damping resistor to the coax outer conductor. The size of the damping resistor will depend upon the coaxial line impedance, the leads lengths, and the coupling capacitor

type. The best value is found by passing a fast-rise signal through the coax and adjusting the resistance until the display is just short of overshoot. A good starting value is 68Ω for a 52-Ω coaxial cable. No damping resistors are needed for cables with impedance above approximately 200Ω.

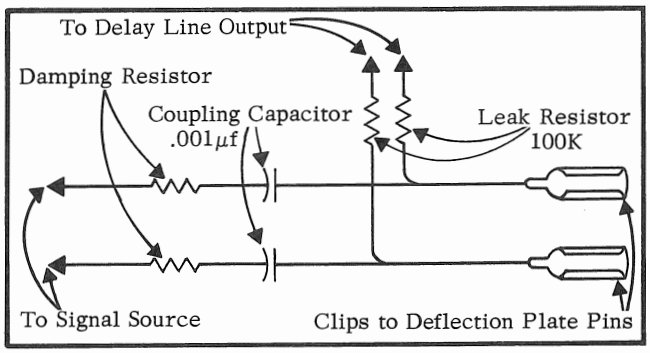


Fig. 3-7. Connecting to the crt deflection plates by ac coupling.

In order to realize the desired amount of deflection sensitivity in the Type T317 Cathode Ray Tube, the deflection plates have been placed as close as possible to the path of the electron beam. As a result, a small amount of current will flow in the deflection plate circuits. This current flow varies nonlinearly with the beam position, increasing rapidly in that plate toward which the beam is positioned. In the Type RM17 oscilloscope, the effects of these currents are negligible. However, if the resistance is increased, these currents can cause objectionable voltage drops. For values of resistance greater than 110K for the leak resistor, you may experience some difficulty from the current collected on the deflection plates. Some defocusing or distortion may be evident. These effects are most noticeable when the display is positioned close to the limits of the crt graticule.

The low frequency response required will determine the size of the coupling capacitor needed. The formula for the size of the coupling capacitor is $C = 1/(2RF)$, where R is the leak resistor, and F is the desired low-frequency cutoff. For example, to find the coupling capacitor needed when the low frequency cutoff is 1600 cps and the leak resistor is 100 K, take the reciprocal of 2RF. The Coupling capacitor is .001μf.

The coupling capacitor should be spaced about 1/4" to 3/8" from the damping resistor, and should be of the ceramic disc type, or equivalent, to preserve the fast-rise capability of the Type T317 crt.

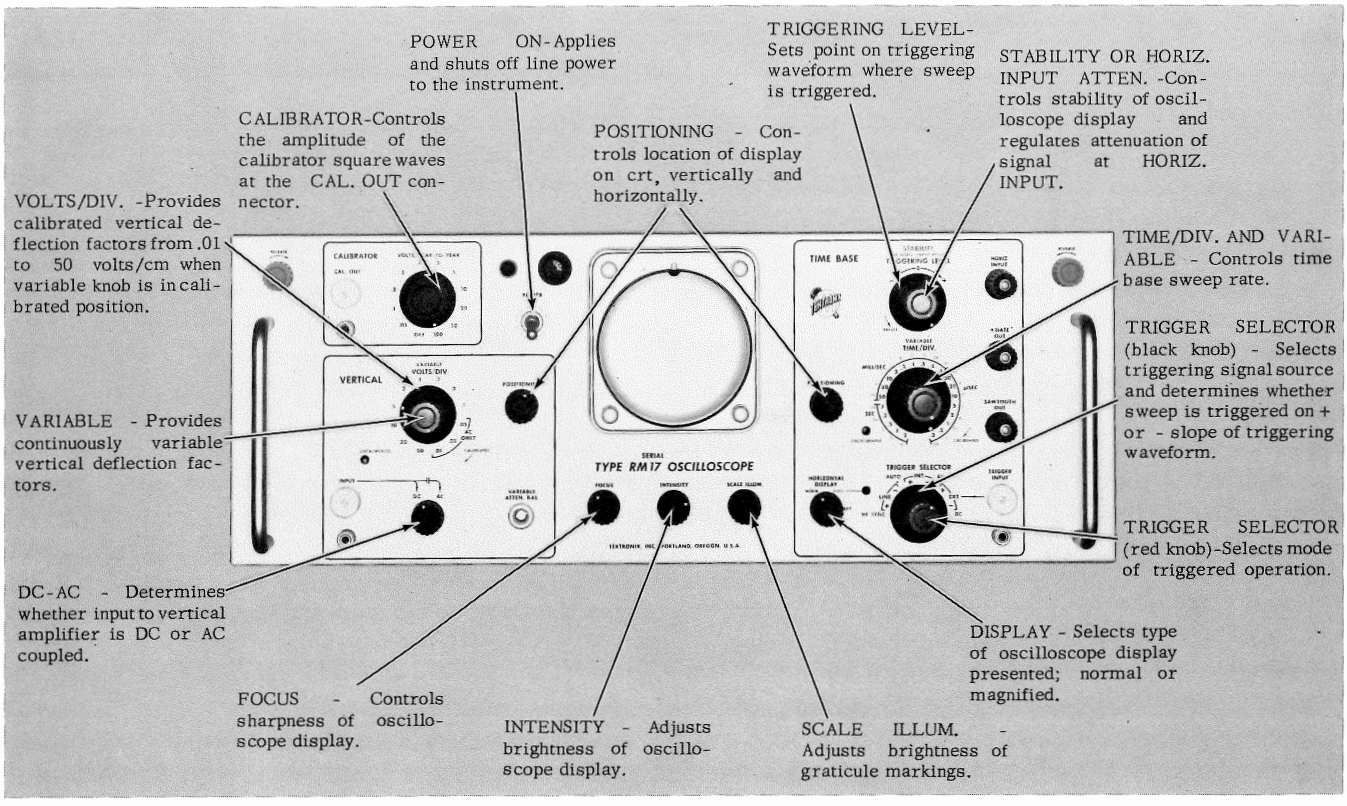
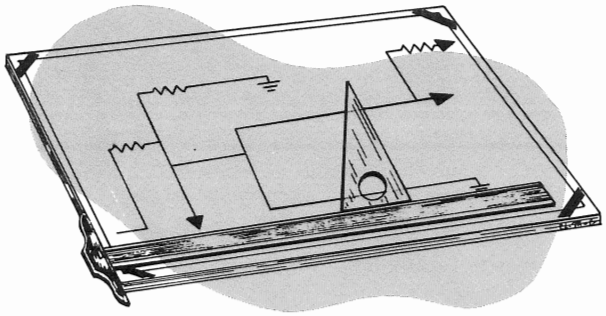


Fig. 3-8. Functions of the Type RM17 Oscilloscope front panel controls.

NOTES



SECTION 4

CIRCUIT DESCRIPTION

VERTICAL-DEFLECTION SYSTEM

Preamplifier

The Vertical Amplifier in the Type RM17 Oscilloscope requires an input signal voltage of 0.1 v, peak-to-peak, to produce one major division of calibrated deflection on the crt. In order to satisfy this condition, and to make the instrument applicable to a wide range of input voltages, a calibrated attenuation network and a Preamplifier are incorporated into the vertical-deflection system.

When the VOLTS/DIV. switch (shown on the Preamplifier circuit diagram) is in the .1 position, the signal is coupled through the X1 network--in which the attenuation is negligible--to the main Vertical Amplifier. The X1 network compensates for lead inductance in the input circuit. For settings of the VOLTS/DIV. switch between .2 and 50, the Attenuators are switched into the circuit, either singly or in tandem pairs, so that the input voltage to the main Vertical Amplifier is always .1 v for each division of crt deflection when the VARIABLE knob is in the CALIBRATED position.

The Attenuators are frequency-compensated voltage dividers. For low-frequency signals they are resistive dividers, and the degree of attenuation is proportional to the ratio of the resistances. The reason for this is that the impedance of the capacitors, at low frequencies, is so high that their effect in the circuit is negligible. As the frequency of the input signals increases, however, the impedance of the capacitances decreases and their effect in the circuit becomes pronounced. For high-frequency signals the impedance of the capacitances is so low, compared to the resistance of the circuit, that the Attenuators become capacitive voltage dividers. For these frequencies, the degree of attenuation is inversely proportional to the ratio of the capacitances.

The variable capacitor at the input to each Attenuator (except for the X1 network) provides a means for adjusting the input capacity of the Attenuator to equal that of the main Vertical Amplifier. Similarily, C441 provides a method of adjusting the input capacity of the Preamplifier. In this manner the probe, connected to the INPUT connector, works into the same input capacity regardless of the setting of the VOLTS/DIV. switch. In the "straight through" (X1) position, the probe works directly into the main Vertical Amplifier, so no adjustment is required for this network.

By means of the AC-DC switch (SW401), the signal may be either ac-coupled or dc-coupled to the Vertical Amplifier. In the AC position, the signal is coupled through C401; in the DC position, C401 is bypassed with a direct connection. When the VOLTS/DIV. switch is in any of the three positions marked AC ONLY, the AC-DC switch is electrically removed from the circuit and the signal is coupled through C401.

When working with very small voltages, greater sensitivity than that furnished by the main Vertical Amplifier may be required or desired. To provide this, the Preamplifier can be switched into the circuit by turning the VOLTS/DIV. switch to any of the positions marked AC ONLY. The Preamplifier is used in conjunction with either the X1, the X2 or the X5 Attenuator, depending on the setting of the switch, and provides three additional ranges of vertical sensitivity.

The Preamplifier, which has a calibrated signal gain of 10, consists of a single amplifier stage V454, a cathode follower output stage V463B, and a voltage-setting cathode follower V463A. The Voltage-Setting C.F. provides a +175-volt source for the plate and screen circuits of V454, and for the plate of V463B.

The gain of the Preamplifier is regulated by the setting of the Preamp Gain Adj. R454. This control regulates the gain of V454 over an approximate range of 7 to 17 by varying the degeneration in its cathode circuit. For calibrated operation, however, this control must be set so that the gain is exactly 10. (See Recalibration Procedure.)

High-frequency compensation for the Preamplifier is provided by a series-shunt peaking coil L450, and by series peaking coils L457 and L477. L450 and L477 provide a means for adjusting the circuit for optimum high-frequency response. R457 is included in the grid circuit of V463B to prevent parasitic oscillations that might occur.

Low-frequency accentuation for the Preamplifier is provided mainly by C446A in the plate circuit of V454. Together with R446 and R450, this circuit forms a low-frequency "boost" network to compensate for the attenuation in the cathode circuit, the screen circuit, and the rc coupling network between the Output C.F. and the Vertical Amplifier. The amount of compensation added to the circuit is, of course fixed. The amount of attenuation, however, can be varied over a range with the L.F. ADJ. control R475. By adjusting the amount of attenuation to equal that of the compensation, low-frequency distortion in the amplifier is eliminated.

There are two protective devices incorporated in the design of the Preamplifier. One is the diode V442, which protects the electrolytic capacitor C454 from inverse voltage in the event the cathode circuit of V454 should go negative. That would occur, for example, if V454 were removed from its socket when the power was turned on. The other protective device is the neon lamp B463. This prevents the potential between the grid and cathode of V463B from exceeding the break-down rating of the tube in the interval from the time the instrument is first turned on and the time that V463 is warmed up to its operating condition.

Vertical Amplifier

The Vertical Amplifier consists of two stages of direct-coupled, push-pull amplification, each preceeded by a cathode follower. V483 is the signal-input cathode follower when the VOLTS/DIV. switch is in any position other than those marked AC ONLY (in other words, when the Preamplifier is not connected into the circuit). R484, bypassed by C484, prevents the grid from drawing excessive current in the event the stage should be overdriven when DC input coupling is used. R487 is a suppressor for parasitic oscillations.

The Input Amplifier stage, composed of V514 and V524, is a cathode-coupled phase inverter. This is, it converts a single-ended input signal to a push-pull output signal. The VARIABLE control, located between the two cathodes, regulates the gain of the stage over a 2 1/2 to 1 range by varying the amount of degeneration in the cathode circuit.

When the Preamplifier is not connected into the circuit, as mentioned previously, the Input Amplifier stage receives its signal voltage from V483. The opposite cathode follower, V503, couples a fixed dc voltage from the VARIABLE ATTEN. BAL. control to the grid of V524. When this control is properly set, the cathode voltage at the two Input Amplifier tubes will be equal and no change in vertical trace positioning will occur as a result of any change in the setting of the VARIABLE gain control.

When the Preamplifier is connected into the circuit, by turning the VOLTS/DIV. switch to any of the positions marked AC ONLY, V503 becomes the signal-input cathode follower. This action removes V483 from the signal path by returning its grid circuit to ac ground through C482. The switching of Input C.F. tubes compensates for the 180-degree shift of signal polarity introduced by the Preamplifier. With this arrangement, positive-going portions of the input signal always produce an upward deflection of the crt beam. Thus, the Input Amplifier may receive its signal from either of the input cathode followers.

Vertical positioning of the crt beam is accomplished through the action of the VERTICAL POSITIONING control R531. This is a dual control, connected between +300 volts and ground. It is connected electrically so that as the voltage between ground the the movable arm in one increases, the voltage between ground and the movable arm in the other decreases. The voltage at the arm of each control can vary a maximum of 300 volts. The 300-volt variation is attenuated by a factor of 82 to 1.8 (the ratio of R530 to R513 on

one side, and the ratio of R532 to R527 on the other) so that the maximum variation in voltage at the grids of V533 is about 6.5 volts. This change in grid voltage at the Driver C.F. stage will be reflected as a change in vertical deflection-plate voltage at the crt, since direct coupling is used between these two points.

The Input Amplifier stage, as well as all succeeding stages, contains high-frequency peaking coils to improve the high-frequency response of the amplifier. However, since direct-coupling is employed throughout, there is no low-frequency loss in the circuit and no low-frequency compensation is required.

The Input Amplifier is coupled to the Output Amplifier by the Driver C.F. V533. The Gain Adj. control, R544, sets the gain of the Output Amplifier to correspond with the front panel calibration when the VARIABLE control is turned full right to the CALIBRATED position.

Delay Line

The output signal from the Vertical Amplifier is coupled through the balanced Delay Line to the vertical-deflection plates of the crt. The function of the Delay Line is to retard the arrival of the waveform at the deflection plates until the crt has been unblanked and the horizontal sweep has been started. This delay insures that the very "front" of fast vertical signals can be observed. Because of the delay time and certain other characteristics, irregularities are introduced in the crt display when the delay line is misadjusted. And it is through analyzing the shape and position of these irregularities that we are able to effect the necessary adjustments.

So that you will better understand the adjustment procedure (described in the Recalibration Procedure, we have outlined in the paragraphs that follow a brief description of the delay line operation and how it affects the crt display.

Consider the sequence of events when a step function is applied to the delay-line input terminals (waveform a in Fig. 4-1). We'll assume for the moment that the delay line is in good adjustment to the crt deflection plates.

0.25 microseconds after the application of the step function, the leading edge of the waveform will arrive at the crt deflection plates. The crt end of the delay line is terminated, and in normal operation the signal energy would be dissipated in the terminating resistors. However, the misadjustment of the two capacitors creates a slight impedance mismatch, resulting in the reflection of a small amount of signal energy. This reflected energy travels down the delay line toward the input terminals, while at the same time the original step function is being traced on the crt screen.

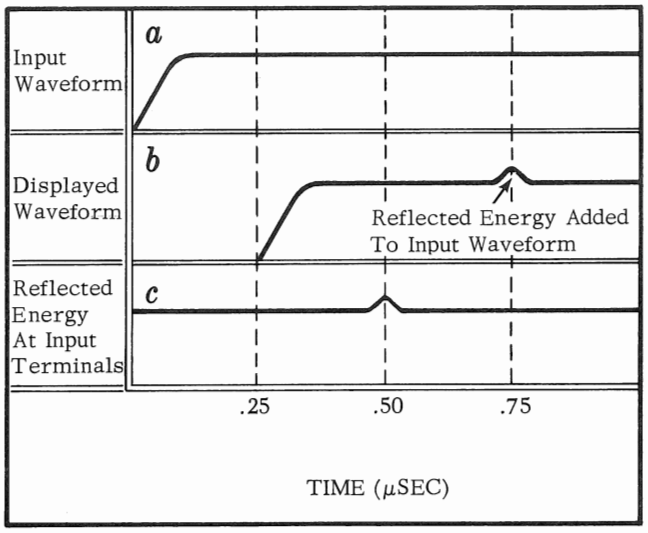


Fig. 4-1. Time relationship of delay-line signals. The reflected energy is caused initially by a slight misadjustment in the delay-line termination network. As a result, the irregularity in the displayed waveform is called the Termination Bump.

The reflected energy reaches the delay-line input terminals in 0.25 microseconds (the delay time of the delay line) and is once again reflected since there are no terminating resistors to absorb the energy (waveform b in Fig. 4-1). As a result, the reflected energy is present at the crt deflection plates 0.5 microseconds (twice the delay-line delay time) after it was initially reflected. This energy is manifest in the crt display as an irregularity occuring 0.5 microseconds after the leading edge of the step function (waveform c in Fig. 4-1). Because the reflected energy is the result of a misadjustment in the delay-line terminating network, we call the irregularity on the displayed waveform the Termination Bump. For ease of discussion in the following paragraphs, we shall refer to the lapsed time from leading edge to Termination Bump as time T.

Consider next the effect of a misadjustment located 1/4 of the delay-line length from the

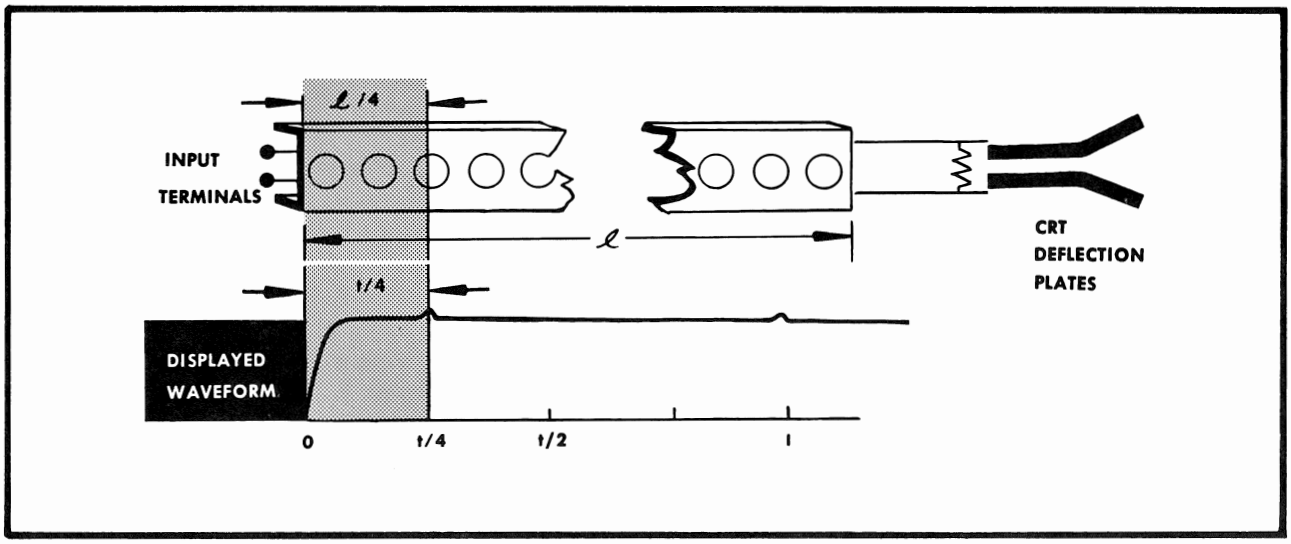


Fig. 4-2. Relationship of displayed waveform irregularities to delay-line misadjustment. The relative position of an irregularity between the start of the display and the Termination Bump corresponds to the relative position of the delay-line misadjustment between the input terminals and the terminating resistors.

input terminals. Because the velocity of propagation is uniform over the length of the delay line, the step functil will reach the point of misadjustment 1/4 of the delay-line delay time after application. This is equivalent to 1/8T. At this point, a small amount of energy is reflected back to the input terminals due to the impedance mismatch caused by the misadjustment. The reflected energy will reach the input terminals 1/8T after being reflected or 1/4T after application of the step-function. This means, then, that the reflected energy will reach the crt deflection plates 1/4T after the leading edge of the step function and will result in a bump located 1/4 of the distance from the leading edge to the Termination Bump on the displayed waveform (see Fig. 4-2).

If the misadjustment of the previous paragraph were located elsewhere on the delay-line, it could be shown that its relative position between input terminals and termination network would correspond to the position of the resulting bump on the displayed waveform. It is this characteristic of the delay-line that allows us to locate and remedy a misadjustment.

Since the Delay Line is the load for the Vertical Output stage, it is elevated above ground by an amount equal to the plate voltage of the Output Amplifier stage. R593 and R594, in addition to terminating the line, are the plate load resistors for the output stage.

When internal triggering of the Time Base Generator is desired (black TRIGGER SELECTOR knob in either the + or -INT. position), a "sample" of the vertical output signal is used to develop the triggering pulse. The "sample" is obtained from a tap on a coil at the input to the Delay Line. This point provides a signal suitable for good triggering action, yet presents minimum loading to the Output Stage and the Delay Line. The "triggering" signal is coupled to the Time-Base Trigger circuit by the Trigger C.F. V563, shown on the Vertical Amplifier circuit diagram.

HORIZONTAL-DEFLECTION SYSTEM

Time-Base Trigger

The function of the Time-Base Trigger circuitry is to develop a negative-going triggering pulse to trigger the Time-Base Generator in the proper time sequence. The signal from which the negative-going triggering pulse is produced may emanate from one of three sources, as determined by the setting of the TRIGGER SELECTOR switch (black knob) SW20. When the switch is in the + or -EXT. position, an external signal is employed in the development of the triggering pulse. When the switch is in the + or -INT. position, the vertical signal itself is used to develop the triggering pulse. This was explained at the conclusion of the previous section. In the + or -LINE position of the switch, a voltage at the power line frequency is used to develop the triggering pulse.

In addition to selecting the source of the triggering voltage, switch SW20 (TRIGGER

SELECTOR, black knob) also arranges the input circuit of the Trigger-Input Amplifier so that a negative-going pulse is always produced at the plate of V14B regardless of whether the switch is in a + or in a - position.

The Trigger-Input Amplifier V14 is a polarity-inverting, cathode-coupled amplifier. The output is always taken from the plate of V14B, but the grid of either stage may be connected to the input-signal source. When the black TRIGGER SELECTOR knob is in the - position (EXT., INT. or LINE range, the grid of V14A is connected to the input-signal source. The grid of V14B is connected to a dc bias source, adjustable by means of the TRIGGERING LEVEL control. This bias voltage establishes the quiescent voltage at the plate of V14B. When the TRIGGER SELECTOR knob is in the + position (for any of the three ranges), the grid of V14B is connected to the input-signal source and V14A is connected to the bias source.

The voltage at the grid of V14A and the voltage at the plate of V14B are in phase with each other; that is, they both go through ac zero in the same direction at the same time. Therefore, when the switch is in any of the - positions (the signal applied to the grid of V14A), the voltage at the plate of V14B is in phase with the input-signal voltage. By this arrangement, V14A acts as a cathode follower, having a gain of approximately unity, and the signal voltage developed across the cathode resistor becomes the input signal to V14B.

When the switch is moved to any of the + positions, the grid of V14B is connected to the input-signal source. With this configuration, the voltage at the plate of V14B will be 180 degrees out of phase with the input-signal voltage. Thus, depending on the setting of the switch (+ or -), V14B plate signal swing may be in phase, or 180 degrees out of phase, with the input-signal voltage.

The Schmitt Trigger consists of V35, A and B, connected as a dc-coupled multivibrator. In the quiescent state, i.e., ready to receive a signal, V35A is conducting and its plate voltage is down. This holds the grid of V35B below cutoff, since the two circuits are dc-coupled by the voltage divider R35, R36 and R37. With V35B in a state of cutoff, its plate voltage is up; hence no output is being developed.

A negative-going signal is required at the grid of V35A to drive the Schmitt Trigger into its other state in which a triggering pulse can be produced. However, the signal coupled to the grid of V35A is a component of the vertical input signal, and therefore contains both negative- and positive-going voltages.

The negative-going portion will drive the grid of V35A in the negative direction, and the cathodes of both tubes will follow the grid down. At the same time V35A plate voltage starts rising, which causes V35B grid voltage to rise. With V35B grid going up and its cathode going down, V35B starts conducting. The cathodes will not follow the grid of V35B; hence the cathode voltages start going up. With the grid of V35A down and its cathode up, V35A cuts off. As V35B conducts its plate voltage drops, creating a negative step at the output. This transition occurs very rapidly, regardless of how slowly V35A grid signal falls.

When the signal at the grid of V35A starts in the positive direction, just the opposite will occur. That is, V35A will start conducting again, V35B will be cutoff, and the circuit will revert to its original state with V35B plate voltage up. This completes the negative step voltage output from the Schmitt Trigger circuit.

The operation of the Schmitt Trigger circuit is exactly the same for both + and - positions of the black TRIGGER SELECTOR knob. However, since there is a reversal in signal polarity--between these two settings, triggering will occur at different points with respect to the signal being observed. For example, when the switch is in the + position, triggering will occur during the positive slope of the waveform being observed. That is, the start of the trace will occur when the waveform is going in the positive direction. Conversely, when the switch is in the - position, the trace will start when the waveform is going in the negative direction.

The TRIGGER SELECTOR switch with the red knob, SW10, selects the type, or mode, of triggering. In the DC position, the vertical-input signal is dc-coupled from the Trigger C.F. to the Trigger-Input Amplifier, which in turn is dc-coupled to the V35A grid of the Schmitt Trigger. R22 isolates V14B plate circuit from the capacitance of the switch; R24 isolates V35A grid circuit from the switch.

In the AC position the switch capacitor C7 is connected into the input circuit; this, of course, removes any dc component of the input waveform. The Trigger-Input Amplifier, however, is still dc-coupled to the Schmitt Trigger stage.

In the AUTO. position of the switch, the Schmitt Trigger is converted from a bistable configuration to a recurrent configuration. This is accomplished by coupling the grid circuit of V35B to the grid circuit of V35A via R31. In addition, the dc-coupling between the Trigger-Input Amplifier and the Schmitt Trigger is removed when the switch is in this position.

The addition of R31 to the circuit causes the Schmitt Trigger to free-run in the absence of a vertical-input signal. For example assume the grid of V35A is just being driven into cutoff. The voltage at the plate of V35A starts to rise, carrying with it the grid voltage of V35B. The grid of V35B is coupled to the grid of V35A through R31 and R24. This causes the grid voltage of V35A to start rising. The time constant of the rc network, R31, R24 and C23 is such that it takes about .01 second for the grid voltage of V35A to rise exponentially from its starting point, below cutoff, to a value where plate current can flow.

As V35A starts to conduct, its plate voltage drops, which in turn lowers the voltage at the grid of V35B. The voltage at the grid of V35A then starts dropping exponentially toward cutoff. When the grid of V35A reaches cutoff again, the circuit has completed one cycle of its approximately 50-cycle triangular waveform.

The range of voltage at the grid of V35A, between V35A cutoff and V35B cutoff, is about 3 volts when the circuit is used in the AUTO. mode (that is increased from about 0.5 volt, for the AC or DC mode, by the addition of R32 to the circuit). Since V35A grid is never more than 3 volts from cutoff a triggering signal with a peak-to-peak amplitude of 3 volts or more can drive the grid to cutoff at any time and produce a trigger output. Smaller signals can also produce trigger output, but only if they occur at a time when the sum of the signal voltage and the triangular grid voltage is sufficient to drive the grid of V35A to cutoff. However, the duty cycle of operation is somewhat reduced when smaller triggering signals are being received.

With the circuit configuration just described, the horizontal sweep can be triggered with repetitive signals, over a wide range of frequencies, without readjustment. When not receiving triggers, the sweep continues at approximately a 50-cycle rate. Thus, in the absence of any vertical signal, the sweep generates a base line which indicates that the oscilloscope is adjusted to display any signal that might be connected to the vertical-deflection system.

When switch SW10 is in the HF SYNC position, the Time-Base Trigger circuits are bypassed and the input "triggering" signal is applied directly to the Time-Base Generator. This signal now acts as a synchronizing voltage, superimposed on the holdoff waveform (to be discussed in the section that follows). This synchronizes the Time-Base Generator at a sub-multiple of the triggering-signal frequency. This mode is useful for input signals in the range from 5 megacycles to 15 megacycles.

Time-Base Generator

The Time-Base Trigger produces a negative-going waveform which is coupled to the Time-Base Generator. This waveform is differentiated in the grid circuit of V135A to produce a sharp negative-going triggering pulse to trigger the Time-Base Generator in the proper time sequence. Positive-going pulses are also produced in the differentiation process, but they are not used in the operation of the Time-Base Generator.

The Time-Base Generator consists of three main circuits: a Bistable Multivibrator, a Miller Runup Circuit, and a Hold-Off Circuit. The Bistable Multivibrator consists of V135A, V145B and the cathode follower V135B. The essential components in the Miller Runup circuit are the Miller Tube V161B, the Runup C.F. V161A, the On-Off Diodes V152, the Timing Capacitor C160 and the Timing Resistor R160. The Hold-Off Circuit consists of the Hold-Off Driver V183A, the Hold-Off C.F. V183B, the Hold-Off capacitor C180 and the Hold-Off Resistor R181.

In the quiescent state, V135A is conducting and its plate voltage is down. This cuts off

V145B through the cathode follower V135B, the voltage divider R141-R142, and the cathode resistor R143.

The quiescent state of the Miller Tube is determined by a dc network between plate and grid. This network consists of the neon lamp B167, the Runup C.F. V161A, and the On-Off Diode V152. The purpose of the dc network is to establish a voltage at the plate of the Miller Tube of such a value that the tube will operate above the knee, and thus over the linear region, of its characteristic curve.

In the quiescent stage, the grid of the Miller Tube rests at about -2 volts. There is about a 1 1/2 volt drop in the Runup On-Off Diodes, about 18.5 volts bias on the Runup C.F., and about a 55 volt drop across the neon lamp. This establishes a quiescent voltage of about +33 volts at the plate of the Miller Tube.

If the STABILITY control is now advanced, making the grid of V135A more negative, a point will be reached where a negative-going triggering pulse from the Schmitt Trigger stage will cause the Bistable Multivibrator to switch rapidly to its other state. This is, V135A will be cutoff and V145B will start to conduct. As V145B conducts, its plate voltage, and the voltage at the diode plates, drops. As a result the diodes are cutoff, which permits the grid of the Miller Tube and the cathode of the Runup C.F. to seek their own voltages. Any spiking that may occur, during this transition period, is attenuated by the R150-C150 network.

As there is no diode conduction at this time, the grid of the Miller Tube starts negative, since it is connected to -150 volts through the Timing Resistor R160. The plate of the Miller Tube then starts positive, carrying with it the grid and cathode of the cathode follower V161A. This raises the voltage at the top of the Timing Capacitor C160, which in turn raises the voltage at the grid of the Miller Tube and prevents it from going negative. The gain of the Miller Tube, as a Class A amplifier, is approximately 200. This means that a 150-volt change in plate voltage will maintain the grid voltage constant within three-quarters of a volt.

The Timing Capacitor C160 starts charging with current from the -150-volt bus. Since the voltage at the grid of the Miller Tube remains essentially constant, the voltage drop across the Timing Resistor, and hence the charging current through it, remains essentially constant. Thus, C160 charges linearly, and the voltage at the cathode of the Runup C.F. V161A rises linearly. Any departure from a linear rise in the voltage at this point will produce a change in the voltage at the grid of the Miller Tube in such a direction as to correct for the error.

The linear rise of voltage at the cathode of V161A is used as the sweep time base. Timing Capacitor C160 and Timing Resistor R160 are selected by means of the TIME/DIV. switch (SW160). The Timing Resistor determines the current that charges the Timing Capacitor. By means of the TIME/DIV. switch, both the size of the capacitor being charged and the current charging the capacitor can be selected to cover a wide range of sawtooth slopes (sweep rates). For high-rate sweeps the bootstrap capacitor C165 helps supply current to charge the stray capacitance at the plate of the Miller Tube, which permits the plate voltage to rise at the required rate.

If uncalibrated sweep rates are desired, the VARIABLE TIME/DIV. (red knob) control may be turned away from the CALIBRATED position. This control, R162, varies the sweep rate over a 2 1/2 to 1 range. Switch SW162 is ganged with the VARIABLE control in such a way that the UNCALIBRATED light comes on when the control is turned away from the CALIBRATED position.

As explained previously, the sweep rate (the rate at which the spot moves across the face of the crt) is determined by the timing circuit C160 and R160. The length of the sweep (the distance the spot moves across the face of the crt), however, is determined by the setting of the Sweep Length control R176. As the sweep voltage rises linearly at the cathode of V161A, there will be a linear rise in voltage at the arm of the Sweep Length control R176. This will increase the voltage at the grid and cathode of V183A, and at the grid and cathode of V183B. As the voltage at the cathode of V183B rises, the voltage at the grid of V135A will rise. When the voltage at this point is sufficient to bring V135A out of cutoff, the multivibrator circuit will rapidly revert to its original state with V135A conducting and V145B cutoff. The voltage at the plate of V145B rises, carrying with it the voltage at the diode plate

V152B. The diode then conducts and provides a discharge path for C160 through R147 and R148, and through the resistance in the cathode circuit of V161A. The plate voltage of the Miller Tube now falls linearly, under feedback conditions essentially the same as when it generates the sweep portion of the waveform, except for a reversal of direction. The resistance through which C160 discharges is much less than that of the Timing Resistor (through which it charges). The capacitor current for this period will therefore be much larger than during the sweep portion, and the plate of the Miller Tube will return rapidly to its quiescent voltage. This produces the retrace portion of the sweep sawtooth, during which time the crt beam returns rapidly to its starting point.

The Hold-Off Circuit prevents the Time-Base Generator from being triggered during the retrace interval. That is, the hold-off allows a finite time for the Time-Base circuits to regain a state of equilibrium after the completion of a sweep.

During the trace portion of the sweep sawtooth the Hold-Off Capacitor C180 charges through V183A, as a result of the rise in voltage at the cathode of V183A. At the same time, the grid of V135A is being pulled up, through the Hold-Off C.F. V183B, until V135A comes out of cutoff and starts to conducting. As mentioned previously, this is the action that initiates the retrace. At the start of the retrace interval C180 starts discharging through the Hold-Off Resistor. The time constant of this circuit is long enough, however, so that during the retrace interval (and for a short period of time after the completion of the retrace) C180 holds the grid of V135A high enough so that it cannot be triggered. However, when C180 discharges to the point that V183 is cutoff, it loses control over the grid of V135A and the grid returns to the level established by the STABILITY control. The hold-off time required is determined by the size of the Timing Capacitor. For this reason the TIME/DIV. switch changes the time constant of the Hold-Off Circuit simultaneously with the change of Timing Capacitors.

The STABILITY control R110 regulates the dc level at the grid of V135A. In use, this control is adjusted so that the grid voltage is just high enough to prevent the circuit from free-running. Adjusted in this manner, a sweep will only be produced when a negative-going triggering pulse from the Schmitt Trigger can drive the stage into cutoff. For convenience, a PRESET Stability control can be connected into the circuit via switch SW110. When in this position a fixed negative dc voltage is obtained from R111 and applied to the grid of V135A. This control, adjusted at the factory, can be used in most triggering applications of the instrument. Where triggering may be critical, however, the variable STABILITY control should be used.

The positive rectangular pulse appearing at the cathode of V135B is coupled through the Unblanking C.F. to the grid circuit of the crt. This pulse, whose start and duration are coincident with that of the sweep portion of the sawtooth, unblanks the crt and permits the trace to be observed.

The unblanking pulse is also coupled through another cathode follower, V193B, to a jack on the front panel labeled + GATE OUT. This positive pulse, which starts at ground and rises to +20 volts, has a start and duration which are likewise coincident with the sweep portion of the sawtooth.

The sweep sawtooth voltage at the cathode of V161A, in addition to being coupled to the Horizontal Amplifier, is also coupled through the cathode follower V193A to a jack on the front panel labeled SAWTOOTH OUT. This provides a 150-volt linear rise in voltage, starting near zero volts with respect to ground.

Horizontal Amplifier

The Horizontal Amplifier consists of an input cathode follower, a driver cathode follower, a push-pull amplifier and an output cathode follower stage.

The sweep waveform is coupled to the grid of the Input C.F. V313B via the frequency-compensated voltage divider R310-R311. The Horizontal POSITIONING control R314A supplies a manually adjustable dc voltage to the grid of V313B for horizontal positioning of the crt beam. The R315-C315 network produces a small step at the start of the waveform at the faster sweep rates. This step is necessary to compensate for the bandpass-limiting effect of the stray capacitance in the amplifier. By

its application the waveform will start linearly at the faster sweep rates. The Input C.F. V313B provides the necessary low impedance to drive the switch capacitances and the Driver C.F. V313A isolates the Output amplifier from the HORIZONTAL DISPLAY switch.

In the MAG. position of the HORIZONTAL DISPLAY switch, the waveform is coupled by cathode follower V313A to the Output Amplifier stage. This stage, V354A and V374A, a cathode-coupled phase inverter, converts the single-ended input to a push-pull output. The waveform is then coupled by the Output C.F. stage, V354B and V374B, to the horizontal-deflection plates. The Mag. Gain Adj. R358 varies the degeneration in the cathode circuit of the Output Amplifier and thus sets the gain of the stage. C358 reduces the degeneration at higher frequencies and thus compensates the amplifier for faster sweep rates. Bootstrap capacitors C450 and C372 also improve the response at the faster sweep rates by supplying current from the output cathode followers to charge the stray capacitance at the plates of the Output Amplifier. Neon lamp B300 is connected in the circuit when the HORIZONTAL DISPLAY switch is in the MAG. position to indicate that the magnifier circuits are in operation.

In the NORM. position of the HORIZONTAL DISPLAY switch the gain of the amplifier is reduced by a factor of five by a feedback loop between the cathode circuit of V354B and the grid circuit of V313A. This loop consists of R333 shunted by C333, and R324 and R325 shunted by C324. The amount of feedback, and hence the gain of the amplifier, is adjusted by means of R325, the Horiz. Gain Adj. In the NORM. position of the HORIZONTAL DISPLAY switch both the Mag. Gain Adj. and the Horiz. Gain Adj. will vary the gain; for this reason the Mag. Gain Adj. must only be set when the HORIZONTAL DISPLAY switch is in the MAG. position.

The Norm./Mag. Regis. control R335 adjusts the voltage at the grid of V313A to equal the voltage at the cathode of V313B when the spot is in the center of the screen and the HORIZONTAL DISPLAY switch is in the NORM. position. This insures that the portion of the waveform within the center two graticule divisions, when the HORIZONTAL DISPLAY switch is in the NORM. positon, will be expanded the full length of the graticule when the HORIZONTAL DISPLAY switch is set to the MAG. position.

In the EXT. position of the HORIZONTAL DISPLAY switch the Driver C.F. is connected to an external binding post on the front panel marked HORIZ. INPUT. With this arrangement the horizontal waveform is obtained from an external source rather than from the Time-Base Generator. The HORIZ. INPUT ATTEN. control R330 varies the input voltage so that the waveform may be adjusted for the desired amplitude. In the EXT. position, horizontal beam positioning is provided by R314B rather than by R314A.

POWER SUPPLY

Plate and filament power for the tubes in the Type RM17 is furnished by a low voltage power transformer, T600. A two section tapped primary on the power transformer, T600, permits operation on the following nominal line voltages: 110, 117, 124, 220, 234 or 248 volts. Silicon rectifiers are employed for the three separate fullwave, bridge-type, power supplies. The three supplies furnish regulated dc voltages of -150 volts, +100 volts and +300 volts. The +300-volt supply also has an unregulated output of about +400 volts for the oscillator tube in the high-voltage supply for the crt. It is unnecessary to regulate this supply as the high-voltage power supply has its own regulation circuits.

Reference voltage for the -150-volt supply is established by a gas diode Voltage-Reference tube V609. This tube, which has a constant voltage drop, establishes a fixed potential of about -84 volts at the grid of V606B, one-half of a Difference Amplifier. The grid potential for the other half of the Difference Amplifier, V606A, is obtained from a voltage divider consisting of R616, R617 and R618. R617, the -150 Adj., determines the percentage of total voltage that appears at the grid of V606A and thus determines the total voltage across the divider. When this control is properly adjusted the output voltage is exactly -150 volts.

Should the loading on the supply tend to change the output voltage, the potential at the grid of V606A will change in proportion, and an error voltage will exist between the two grids of the Difference Amplifier. The error signal is amplified by V606B, whose plate is dc-

coupled to the grid of the Series Tube V617B. The error voltage appearing at the grid of the Series Tube will change the voltage drop across the tube, and hence change the voltage at the plate of the tube. This change in voltage at the plate of the Series Tube, which will be in a direction to compensate for the change in the output voltage, is coupled through C601 to the output and thus pulls the output voltage back to its established value of -150 volts. C614 improves the ac gain of the feedback loop, and thus increases the response of the circuit to sudden changes in output voltage.

The -150 volt supply serves as a reference for the +100 volt supply. The voltage divider R641-R642 establishes a voltage of essentially zero at the grid of the Amplifier V636. (The actual voltage at this grid will be equal to the bias voltage required by the tube.) If the loading should tend to change the output voltage, an error voltage will appear at the grid of the Amplifier. The error voltage will be amplified and will appear at the grid of the Series Tube V637. The cathode of V637 will follow the grid, and thus the output voltage will be returned to its established voltage of +100 volts. C638 improves the response of the regulator circuit to sudden changes in output voltage.

A small sample of the unregulated-bus ripple will appear at the screen of V636 through R635. This ripple signal appearing at the screen (which acts as an injector grid) will produce a ripple component at the grid of V637 which will be opposite in polarity to the ripple appearing at the plate of V637. This tends to cancel the ripple at the cathode of V637, and hence reduces the ripple on the +100 volt bus. This same circuit also improves the regulation of the circuit in the presence of line voltage variation.

The +300 volt supply functions in the same manner as the +100 volt supply. Rectified voltage from terminals 18 and 19 of the power transformer is added to the voltage supplying the +100 volt regulator to supply power for the +300 volt regulator. As mentioned previously, the +300 volt supply also provides an unregulated +400 volt output for the crt high-voltage supply.

CRT CIRCUIT

High-Voltage Supply

A single 60-kilocycle Oscillator circuit furnishes energy for the two power supplies that provide accelerating voltages for the crt. The Oscillator is in the Hartley type, whose main components are V800 and the primary of T801 tuned by C806.

The rectifier circuits are of the half-wave type, with capacitor-input filter networks. Separate supplies are required for the grid and cathode circuits in order to provide dc-coupled unblanking to the grid supply. V824 supplies about -1400 volts for the grid of the crt (the actual voltage depends on the setting of the INTENSITY control). V820 supplies -1300 volts for the cathode. The voltage-tripler consisting of V823, V822, and V821 supplies 7700 volts for the crt helix. The accelerating potential for the crt beam is the sum of the pose accelerating voltage (7700) and the cathode voltage (-1300), or 9 kilovolts.

In order to provide a constant deflection sensitivity in the oscilloscope, and thereby maintain its calibration, it is necessary that the accelerating potentials in the crt remain constant. This is accomplished by regulating the grid and cathode supplies by comparing a sample of the high voltage to the regulated -150 volt supply. The "sample" voltage, obtained from the voltage divider R811 through R815 is applied to the grid of V814B; the cathode of this tube is connected to the regulated -150 volt supply. The error signal is amplified by V814B and V814A. The output of V814A varies the screen voltage of the Oscillator tube, thus controlling its output.

Unblanking

As mentioned previously, dc-coupled unblanking is accomplished by employing separate high-voltage supplies for the grid and cathode. The cathode supply is tied to the +100-volt supply via the decoupling network R824 and C824.

The grid supply, on the other hand, is not tied to any other supply and is therefore "floating". The unblanking pulses from the Time-Base Generator are transmitted to the grid of the crt via the floating grid supply.

At the faster sweep rates the strap capacitance in the circuit would make it difficult to move the floating supply fast enough to unblank the crt in the required time. To overcome this, an isolation network composed of C834, C835, R834, and R835 is employed. The fast leading edge of the unblanking pulse, at the faster sweep rates, is coupled directly to the grid of the crt via C834 and C835; the power supply itself is not appreciably moved during this time due to the isolating resistors R834 and R835.

For longer unblanking pulses (at slower sweep rates) the stray capacitance of the circuit is charged through R834; this holds the grid at the unblanked potential for the duration of the pulse.

CALIBRATOR

The Calibrator is a square-wave generator whose approximately 1-kilocycle output is available at a front-panel jack labeled CAL. OUT. It consists of a Multivibrator, V875, connected so as to switch the Cathode Follower V883 between two operating states--cutoff and conduction.

During the negative portion of the Multivibrator waveform the grid of V883 is driven well below cutoff and the cathode rests at ground potential. During the positive portion of the waveform the grid of V883 rises to slightly less than 100 volts. By means of the Cal. Adj. R879, the grid voltage can be adjusted so that the voltage at the Cal. Test Pt (cathode) can be set to exactly 100 volts.

The Calibrator C.F. has a calibrated tapped voltage divider for its cathode resistor. By means of the VOLTS, PEAK TO PEAK switch, eleven calibrated voltages from .05 v to 100 v are available.

CALIBRATOR

RM17 S/N 280 and up

The Calibrator is a square-wave generator whose approximately 1-kilocycle output is available at a front-panel jack labeled CAL OUT. It consists of a Multivibrator, V875A and V883, connected so as to switch the Cathode Follower V875B between two operating states--cutoff and conduction.

During the negative portion of the Multivibrator waveform the grid of V875B is driven well below cutoff and the cathode rests at ground potential. During the positive portion of the waveform the grid of V875B rises to slightly less than 100 volts. By means of the Cal. Adj. R879, the grid voltage can be adjusted so that the voltage at the Cal. Test Pt (cathode) can be set to exactly 100 volts.

The Calibrator C.F. has a calibrated rapped voltage divider for its cathode resistor. By means of the VOLTS, PEAK TO PEAK switch, eleven calibrated voltages from .05 v to 100 v are available.

NOTES

MISCELLANEOUS CALIBRATION INFORMATION

NEW TRIGGER CIRCUIT ADJUSTMENT METHOD

FEN 10-26-62

This is a fast, simple, accurate method, requiring only a screwdriver and one or two jumper leads. Normally, it doesn't require any "adjust this while tweaking that for minimum this." It works on all 530-540 scopes, 551, 555, 316, 317, 516 and 515A; it won't work on a trigger circuit that has no Trig Sens adjust.

1. Set the PRESET adjustment by the standard method. (Set the TRIGGER MODE to AUTO and the TIME/CM to 100 μSEC. Set the PRESET adjustment halfway between the points where the trace first appears and where it brightens.) Position this trace to the vertical center of the graticule; you'll need it there later. Leave the STABILITY control in PRESET for the rest of this procedure.

2. Set the trigger controls to EXT AC, either + or -, and ground the junction of R19 and R20 (R16 and R17 in the non-A models).

3. Turn the TRIG SENS fully clockwise. You may or may not get a trace on the screen.

4. Set the TRIG LEVEL CENTERING adjustment to the center of the region which makes a trace appear on the screen. (If you can't get a trace by adjusting the TRIG LEVEL CENTERING, the Trigger Schmitt circuit is not working properly.)

5. Flip the SLOPE switch between +EXT and -EXT, and readjust the TRIG LEVEL CENTERING, if necessary, to get a trace in both + and -. If you can't, the Trigger Amplifier is bad (probably a gassy tube).

6. Set the triggering controls to INT DC, either + or -. The trace will probably disappear.

7. Set the INT TRIG DC LEVEL adjustment to the middle of the region which makes the trace appear on the screen. This region will probably be very narrow.

8. Remove the grounding strap you connected in Step 2, and adjust the TRIGGERING LEVEL control until the trace reappears. The white spot on the knob should be at or near the top (opposite the 0 on the panel). If it is not, loosen the set screw in the knob and adjust it.

9. Turn the TRIG SENS adjustment counterclockwise until the trace just disappears and then about 45° further counterclockwise. This will provide adequate triggering capabilities for most uses and will probably put the scope within factory trigger specs. If you want to make sure, go on to steps 10 and 11.

10. Set the triggering controls to EXT AC and apply .2 volt of Calibrator signal to the TRIGGER INPUT connector. Also apply this .2 volt Calibrator signal to the vertical input connector, with the VOLTS/CM switch set to .1 or .05.

11. Turn the TRIG SENS adjustment counterclockwise until the trace disappears and then clockwise just far enough to get proper triggering in both + and -. If the scope won't trigger in both + and -, touch up the TRIG LEVEL CENTERING adjustment until it does.

Theory: In step 3, you are setting the Trigger Schmitt to free run when the dc voltage on its input grid matches its inherent hysteresis level. In step 4, you are setting this hysteresis level to match the dc level of the Trigger Amplifier output plate with both amplifier grids at zero volts. In step 5, you are checking the Trigger Amplifier tube for gas under much more rigorous conditions than would ever be present in normal scope use (one grid to ground through 1 meg, the other to ground through 47 ohms). In step 7, you are adjusting the INT TRIG DC LEVEL to the point where the vertical amplifier places zero volts on the Trigger Amplifier grid when the trace is centered on the screen. In step 11, you are adjusting the circuit so that it will trigger on .2 volt external but not on much less than that. (The hysteresis gap closes as the Schmitt tube ages; if the TRIG SENS is set too sensitive, you may be adjusting it again next week.)

You can cause a low frequency *boost* by even a slight misadjustment of the 316's low frequency compensation. The boost can be as much as 3 db at about 5 cps when a probe is used in the high-gain positions.

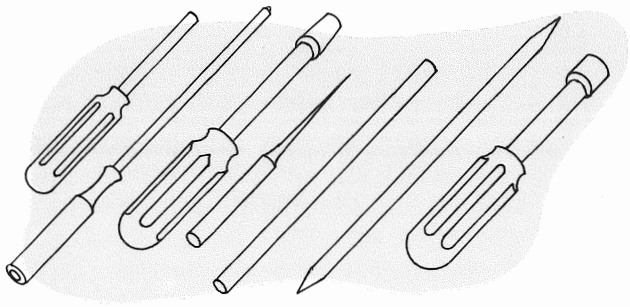
The problem is this: There are *two* capacitors in the circuit--the input coupling cap and the coupling capacitor in the preamp. The LF Comp or LF Adj controls are intended to compensate *only* for the second time constant, so the response will be substantially the same as in the regular AC-coupled positions. If the compensation is adjusted to correct partially the *input* time constant as well, the use of a probe (which increases the input time constant) will result in low frequency boost.

One good tweaking procedure is that given in the L Unit manual. Use a strap to short out the input coupling cap while tweaking the LF Compensation. Then double-check the result by observing a 50 cps square wave using a 10 x probe (after removing the shorting strap) in the AC-coupled, high-gain positions. There should be no upward tilt to the waveform, though the flat top may be somewhat bowed. This bowing represents a small, but not critical, boost at low frequencies. Customers interested in accurate low frequency measurements should be careful to verify the exact roll-off and LF boost characteristics of the particular scope being used, if AC-coupling is required.

The square-wave adjustment as outlined is probably the best approach; however, we still experience a rise at approximately 5 cps when doing it this way. If a particular customer is interested in low frequency sine-wave response, he may want to adjust accordingly.

The two plate-load decoupling electrolytics (LF boost circuit) in the X10 amp also get into the act to complicate the multiplier time constant.

Many persons would prefer the simplicity of just tweaking the LF response using a 10 x probe in the first place. This is okay, but the "straight in" operation (no probe) should be double-checked afterwards.



SECTION 6

RECALIBRATION PROCEDURE

The Type RM17 Oscilloscope is a stable instrument and should not require frequent recalibration. However, it will be necessary to recalibrate certain parts of the instrument when tubes or components are changed, and a periodic recalibration is desirable. In the instructions that follow, the steps are arranged in the proper sequence for a full recalibration of the instrument. Each numbered step contains the information necessary to make one adjustment. If you are aware of the interaction between adjustments, you can refer to a particular adjustment procedure and make the adjustment wtihtout performing unnecessary steps.

Outline of Procedure

For purposes of recalibration, the Type RM17 Oscilloscope can be divided into five distinct parts: (1) the power-supply and crt circuits, (2) the triggering circuits, (3) the horizontal amplifier and time-base generator, (4) the vertical amplifier and (5) the delay line. Calibration adjustments made in any one of these categories will frequently affect another adjustment in the same category. For example, the HORIZ. GAIN ADJ. control affects the calibration of the time-base generator at all sweep rates when the DISPLAY switch is in the NORMAL position, and therefore affects the adjustment of C160E, the 10-microsecond per division timing adjustment. On the other hand, calibration adjustments made in one category will usually have little or no effect on adjustments in another category. There are a few exceptions, the most notable being the power-supply voltage adjustments.

Interaction of Adjustments

If you find it necessary to effect a single adjustment without recalibrating the rest of the instrument, it is most important that you are fully aware of the interaction of adjustments. Generally speaking, the interaction of controls will be apparent in the schematic diagram. If you are in doubt, check the calibration of the entire section on which you are working. For example, if you make an adjustment in the horizontal-deflection system, check all of the adjustments listed under the heading in these instructions.

EQUIPMENT REQUIRED

The following equipment or its equivalent is necessary for a full recalibration of the RM17 Oscilloscope.

1. DC voltmeter (at least 5000 ohms per volt) calibrated for an accuracy within 1% at 100 volts, 150 volts and 300 volts, and calibrated for an accuracy within 3% at 1675 volts. Be sure your meter is accurate.

2. Accurate rms-reading ac voltmeter, 0-150 volts (0-250 or 0-300 for 200- to 260-volt operation).

3. Variable autotransformer (Powerstat, Variac, etc.) having a raging of at least 3 amperes.

4. Time-Mark Generator, Tektronix Type 180 or Type 181.

If neither of these instruments is available, it will be necessary to substitute a time-mark generator having output markers of 100, 10 and 1 microseconds, and a sine-wave output of 10 megacycles, with an accuracy of at least 1%.

5. Square-Wave Generator, Tektronix Type 105, with a Type B52-R Terminating Resistor, a Type B52-L10 "L" Pad and a Type P52 Coaxial Cable.

In these instructions, a Type 105 Square-Wave Generator is used to describe the technique of adjusting the amplifier high- and low-frequency compensation. If you do not have a Tektronix Type 105, it will be necessary to substitute a generator with the following specifications: (1) output of approximately 50 cycles, and 400 kilocycles, (2) risetime no more than 20 nanoseconds (when properly terminated) and (3) output amplitude variable from about 40 millivolts to 100 volts.

6. Constant-Amplitude Signal Generator, Tektronix Type 190 or Type 190A. In these instructions, a Type 190A is used to describe the techniques of measuring the bandwidth of the Type RM17 Vertical Amplfier. To make this measurement, it is necessary to have available at the INPUT connector of the Type RM17 a signal variable from one megacycle to over twelve megacycles, and having at least two amplitudes: 30 millivolts and 300 millivolts. It is also necessary that the output be adjustable (manually or automatically) for equal amplitude to all frequency settings.

7. Tektronix Type P510A or P6017 probe.

8. Insulated alignment tools. See Fig. 6-1.

The tools can be purchased through your Tektronix Field Engineer or direct from the factory.

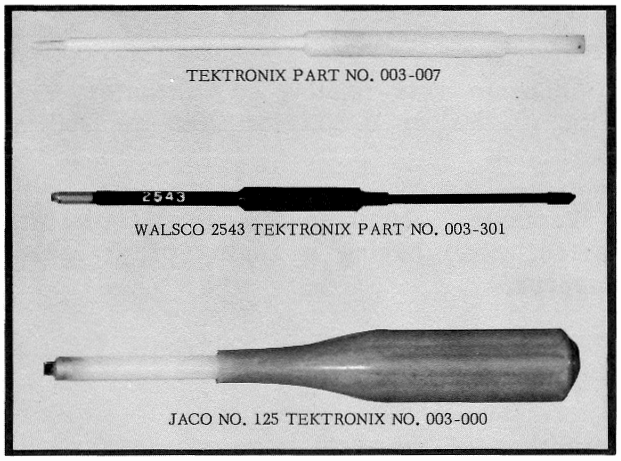


Fig. 6-1. Handtools necessary for calibrating the Type RM17 oscilloscope.

POWER SUPPLY AND CRT CIRCUITS

In this section, you will find six calibration steps outlining the method of adjusting the power-supply voltages, the crt circuits and the internal calibrator. Two of these adjustments will affect the calibration of the entire instrument. They are Step 1, "Low-Voltage Supply" and Step 3, "High-Voltage Supply." If you find it is necessary to make these adjustments, you will also have to check the calibration of the rest of the instrument. Therefore, before you adjust the controls, double check your meter readings to be sure the adjustment is needed. In the instructions that follow it is assumed that the power transformer is connected for a nominal line voltage of 117 volts.

Preliminary

Preset the front-panel controls of the Type RM17 as follows:

POWER	off
INTESNITY	full counterclockwise
TRIGGER SELECTOR (black)	+ INT.
TRIGGER SELECTOR (red)	AC
DISPLAY	NORM.
TRIGGERING LEVEL	centered
STABILITY	full clockwise
TIME/DIV. (black)	.5 MILLISEC
TIME/DIV. (red)	CALIBRATED (full clockwise)
VERTICAL POSITIONING	centered
HORIZONTAL POSITIONING	centered
VOLTS/DIV. (black)	1
VOLTS/DIV. (red)	CALIBRATED (full clockwise)
AC-DC	AC
CALIBRATOR	OFF

Remove the top and bottom plates from the Type RM17 and connect the power cord and the ac meter to the output of the variable autotransformer. Switch the Type RM17 power on and adjust the autotransformer for a meter reading of 117 volts. Maintain the autotransformer output voltage at 117 volts during the calibration procedure. If the power transformer in your instrument is connected for 234-volt operation, adjust the autotransformer for a meter reading of 234 volts.

1. Low-Voltage Power Supply

Proper operation of your instrument is dependent upon correct power-supply voltages.

Because the -150-volt supply is used as a reference for all of the other supplies, it is important that it is properly adjusted.

Measure the output voltage at the -150 volts, +100 volts and +300 volt supplies at the points indicated. Be sure your meter is accurate. The output voltage of the -150 volt supply must be between -147 and -153 volts, and the output voltages of the +100 volt and +300 volt supplies must be within 3% of their rated values. You should be able to set the -150 ADJ. control so that all of these voltages are within their specified tolerances. Bear in mind that the calibration of the entire instrument is affected by changes in the power-supply voltages.

To check the operation of the voltage regulating circuits, vary the autotransformer output voltage from 105 to 125 volts (or from 210 to 250 volts if the power transformer is connected for 234-volt operation) while observing the effect on the regulated power-supply voltages. All of the voltages should remain essentially constant.

2. Internal-Calibrator Adjustment

When the CAL. ADJ. control is properly set, the calibrator output will be within 3% of the voltages indicated on the front panel. To make this adjustment, connect a voltmeter between the CAL. CHECK POINT and ground, turn the CALIBRATOR switch to OFF and adjust the CAL. ADJ. control for a meter reading of exactly 100 volts. To assure suitable symmetry of the calibrator waveform, the voltage at this point should not be less than 45 volts nor greater than 55 volts when the calibrator is turned on. Readings outside of this range are generally caused by an unbalanced multivibrator tube.

3. High-Voltage Power Supply

This adjustment determines the total accelerating voltage on the crt and thus affects the deflection sensitivity.

Connect the voltmeter between ground and the H.V. test point which can be reached through the cutout in the high-voltage shield. Adjust the H.V. ADJ. control for a meter reading of -1300 volts. This voltage should not vary more than 10 volts between the following limits:

Upper Limit: Line Voltage--125 v; INTENSITY control turned full left. Lower Limit: Line Voltage--105 v; INTENSITY control turned full right.

Note

To avoid possible burning of the crt screen while performing this check, position the crt spot off the screen.

4. CRT Alignment

The crt in the Type RM17 is held in position by a single clamp around the tube base. If the instrument is subject to considerable handling, the clamp may loosen--permitting the crt to turn. This would cause the crt display to appear canted in relation to the graticule lines. Your job will be made easier if you align the crt at this point in the calibration procedure.

With no signal connected to the INPUT connector, free-run the Time-Base Generator by turning the STABILITY control full right. Position the free-running trace directly behind the center horizontal graticule line. If the trace and the graticule line do not coincide over the width of the graticule, it will be necessary to loosen the crt base clamp and rotate the crt until they do.

After you have aligned the crt trace with the graticule line, push the crt forward so that it rests snugly against the graticule. Then, tighten the crt base clamp. Recheck the alignment of the crt after tightening the clamp to be sure it didn't move while the clamp was being tightened.

5. CRT Astigmatism

Need for adjustment of the ASTIGMATISM control is indicated if the display appears to be defocussed and it is impossible to improve the focus with the front-panel control.

Connect a jumper from the CAL. OUT connector to the VERTICAL INPUT connector and adjust the controls for a reasonably bright display of four or five square-waves having a vertical deflection of 2 or 3 major divisions. Now adjust the ASTIG. and FOCUS controls for the sharpest possible display. Changes in INTENSITY or ambient light conditions may require readjustment of these two controls.

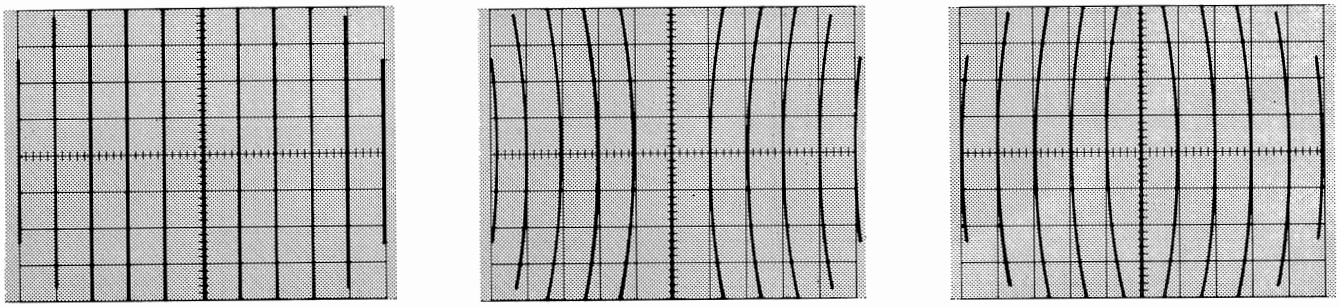


Fig. 6-2. Checking the crt geometry by displaying vertical lines. When the GEOM ADJ. control is properly adjusted, the displayed lines will coincide with the vertical graticule lines as shown in the picture at the left.

6. CRT Geometry

The geometry of the crt display is adjustable over a limited range by means of the GEOM. ADJ. control. To achieve optimum linearity, vertical lines are displayed on the crt and the GEOM. ADJ. control is adjusted for minimum curvature in the lines. Nonlinearity is most noticeable at the edges of the graticule.

To make this adjustment, preset the oscilloscope controls as described at the beginning of this section with the exception of the TIME/DIV. and the VOLTS/DIV. controls. Set these controls to .2 MILLISEC and at .2 volts respectively. Next, connect the Time-Mark Generator to the INPUT connector and display 100-microsecond markers. Position the base line of the timing comb below the bottom edge of the crt face so that it is not visible. The display should appear similar to one of the drawings in Fig. 6-2. Adjust the GEOM. ADJ. control for straight vertical lines.

The calibrator output waveform can be used in place of the Time-Mark Generator to make this adjustment, but due to the dimness of the trace, the adjustment is more difficult.

TRIGGERING CIRCUITS

In this section you will find a three-step procedure for adjusting the triggering circuits. These adjustments should not affect the calibration of any other part of the oscilloscope and therefore can be adjusted separately. Steps 7 and 8 interact, however, and these adjustments should be made in the order given.

7. Trigger Level Centering

When displaying a symmetrical waveform of small amplitude and with the red TRIGGER SELECTOR knob at AC, there should be a setting of the TRIGGERING LEVEL control where the display appears to invert as you switch the black TRIGGER SELECTOR knob from +INT. to -INT. without requiring readjustment of the TRIGGERING LEVEL control. Failure of the oscilloscope to perform in this manner indicates improper adjustment of the TRIG. LEVEL CENT. control.

To prepare the oscilloscope for this adjustment, connect a jumper from the CAL. OUT connector to the INPUT connector, and set the front-panel controls as follows:

TRIGGER SELECTOR (red)	AC
TRIGGER SELECTOR (black)	+INT
TRIGGERING LEVEL	0
STABILITY	*PRESET
DISPLAY	NORM.
TIME/DIV. (black)	.5 MILLISEC
TIME/DIV. (red)	CALIBRATED
VERTICAL POSITIONING	centered
HORIZONTAL POSITIONING	centered
CALIBRATOR	1
VOLTS/DIV. (black)	1
AC-DC	AC

*If your oscilloscope has not been calibrated for some time, it may be necessary to manually adjust the STABILITY control.

The control settings given above should result in a display of the calibrator waveform having a height of 1 major graticule division.

With a short clip lead, ground the junction of R26, R27, R28, and C25 (see Figure 6-3). Then, reduce the amplitude of the displayed signal with the VARIABLE VOLTS/DIV. control until the display disappears.

You will be able to return the display to the screen by slightly adjusting the TRIG. LEVEL CENT. control.

Continue to reduce the amplitude of the display until the vertical deflection is 2 minor divisions. Then, while switching the black TRIGGER SELECTOR knob back and forth between +INT. and -INT., slightly readjust the TRIG. LEVEL CENT. control to get stable triggering for both positions of the switch.

Remove the clip lead from the TRIGGER SELECTOR switch and check for reliable triggering in both positions of the black TRIGGER SELECTOR switch with the TRIGGERING LEVEL control set at 0. If the triggering point occurs at other than the 0 position, it will be necessary to loosen the set screw of the TRIGGERING LEVEL knob and rotate the knob to the 0 position (without rotating the shaft).

S/N 203 and up

In the above example of setting up the trigger circuit, adjusting the TRIG. LEVEL CENT. control is mentioned. In these adjustments you now adjust a TRIG. SENS. ADJ. pot along with the TRIG. LEVEL CENT. Make sure in adjusting the TRIG. SENS. ADJ. that you keep the circuit as insensitive as you can, while still obtaining clean triggering.

8. Internal Trigger DC Level Centering

In the DC Triggering mode, if the TRIGGERING LEVEL control is set at 0, the crt display should start at the center horizontal graticule marker when the black TRIGGER SELECTOR knob is set at +INT. or -INT. If this does not occur, need for adjustment of the INT. TRIG. DC LEVEL ADJ. control is indicated.

To make this adjustment, set the oscilloscope controls as described in step 7 with the exception of the red TRIGGER SELECTOR knob. Set this control to DC. Do not disturb the setting of the TRIGGERING LEVEL control established during the last part of Step 7.

As in Step 7, reduce the amplitude of the display with the VARIABLE VOLTS/DIV. control until the display disappears. This time, however, you must keep the display centered about the center horizontal graticule line as you decrease the amplitude. You will be able to return the display to the screen by slightly adjusting the INT. TRIG. DC LEVEL ADJ. control.

Continue to reduce the amplitude of the display until the vertical deflection is 3 minor divisions and the waveform is centered about the center horizontal graticule line. Then, while switching the black TRIGGER SELECTOR knob back and forth between +INT. and -INT. slightly readjust the INT. TRIG. DC LEVEL ADJ. control to get stable triggering for both positions of the switch.

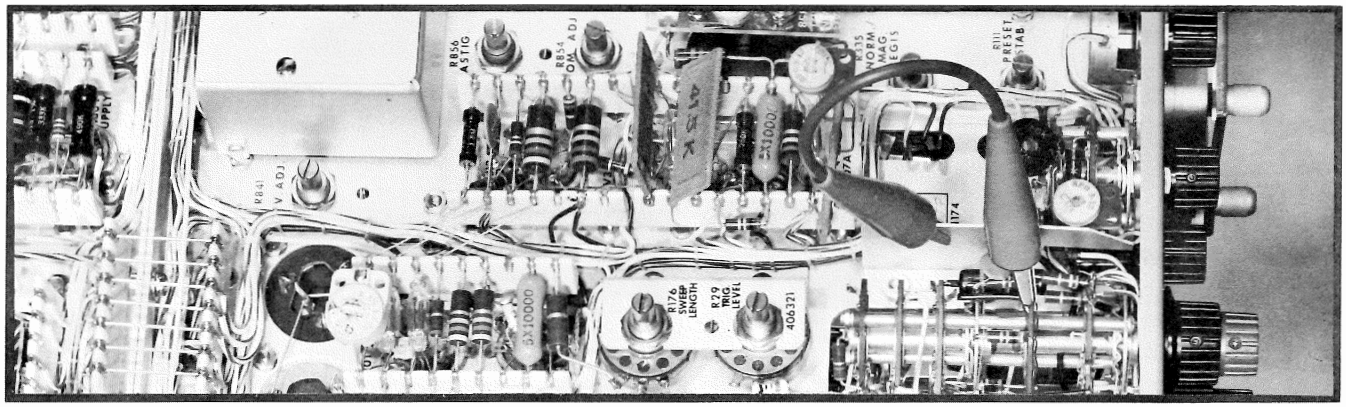


Fig. 6-3. Grounding the junction of R26, R27, R28 and C25. Connecting the shorting jumper as shown simplifies the adjustment of the Trig. Level Centering control.

9. Preset Stability

In the AUTO. mode of triggering, or when the STABILITY control is set at PRESET, the PRESET STAB. control provides a stability setting suitable for most triggering applications. If you cannot get reliable triggering, when the STABILITY control is set at PRESET, but experience no difficulty in manually setting the control, the trouble is probably due to faulty adjustment of the PRESET STAB. control.

To make this adjustment, set the oscilloscope controls as described in Step 7 with the exception of the red TRIGGER SELECTOR knob. Do not connect a jumper from the CAL. OUT connector to the INPUT connector. Set the red TRIGGER SELECTOR knob to AUTO. Turn, the PRESET STAB. control to its full-left (counterclockwise) position.

Now slowly advance the PRESET STAB. control to the right until a trace appears on the crt screen. Note the position of the screwdriver slot. Then, turn the PRESET STAB. control further to the right until the trace brightens. Finally, set the control to a position midway between the points where the trace appeared and where it brightened.

TIME-BASE GENERATOR

The time-base circuits should not require frequent readjustment. As a general rule, if the need for adjustment is indicated, you should first check all of the time-base ranges before making any adjustments. Often only one control is misadjusted, yet it may be the control for the range in which you first noticed the trouble.

If nonlinearity is present in the time-base, it will generally be confined to the first major division of horizontal deflection. Therefore, in these instructions, we recommend calibrating the time-base generator on the basis of time markers appearing between the second and ninth vertical graticule lines.

In the 6-step instructions that follow, all but two of the adjustments interact to some degree. The two exceptions are Steps 12 and 13. For this reason, it is important that you make the adjustments in proper sequence.

Some of the horizontal amplifier adjustments described in the following section affect the horizontal position of the crt display. As a result, it will be necessary to reposition the display with the HORIZONTAL POSITIONING control to keep the time markers properly positioned with respect to the graticule lines.

10. Magnifier Gain

The MAG. GAIN ADJ. control determines the gain of the horizontal amplifier when the DISPLAY switch is in the MAG. position. To make this adjustment, set the front-panel controls as follows:

TRIGGER SELECTOR (red)	AC
TRIGGER SELECTOR (black)	+INT.
TRIGGERING LEVEL	0
STABILITY	PRESET
DISPLAY	NORM.
TIME/DIV. (black)	1 MILLISEC
TIME/DIV. (red)	CALIBRATED
VERTICAL POSITIONING	centered
HORIZONTAL POSITIONING	centered

Next, connect the Time-Mark Generator to the INPUT connector, set the controls for 100-microsecond marker output and adjust the oscilloscope VOLTS/DIV. control for a vertical deflection of approximately 2 major divisions. Center the display on the graticule with the POSITIONING controls.

To calibrate the magnifier circuits, turn the DISPLAY switch to MAG. and adjust the Mag. Gain Adj. control so that there are two time markers for every major graticule line. The Mag. Gain Adj. control is located on the plastic plate next to high voltage section of scope.

11. Horizontal Amplifier Gain

The Horizontal Gain Adj. control R325, is part of a feedback circuit that reduces the gain of the horizontal amplifier by a factor of five when the DISPLAY switch is in the NORM. position.

To make this adjustment, set the front-panel controls as described in Step 10 with the exception of the TIME/DIV. switch. Set this control to .1 MILLISEC.

Display 100 microsecond markers from the Time-Mark Generator and adjust the Horiz. Gain Adj. control so that each time-marker coincides with the vertical graticule line.

12. Sweep Length

The Sweep Length control prevents the beam from hitting the sides of the crt when the display is centered on the screen.

To make this adjustment, free-run the time-base generator at any convenient sweep speed in the millisecond range and adjust the Sweep Length control for a sweep length of 10.5 major divisions.

13. Magnifier Registration

When the Norm Mag. Regis. control is properely set, that part of the display immediately under the center vertical graticule line will remain there as the DISPLAY switch is turned from NORM. to MAG.

Prepare the oscilloscope for making this adjustment by turning the STABILITY control as far left as possible without actuating the internal preset switch, and turn the red TRIGGER SELECTOR knob to any position other than AUTOMATIC. Next, turn the INTENSITY control to the right until a spot is just visible on the crt. With the POSITIONING controls, position the spot to the center of the crt.

Now, set the DISPLAY switch to MAG. and position the spot directly under the center graticule lines.

With the spot accurately centered on the crt screen, turn the DISPLAY switch to NORM. and adjust the Norm/Mag. Regis. control to return the spot to the center of the screen.

14. Setting of Horizontal Amplifier Compensation

Set up your scope controls as explained in Step 10, except for the TIME/DIV. switch, which will be set at 50 μsec. Apply 10 μsec markers, 2 major division high, from your 180A Time-Mark Generator. Set the first left marker of the trace on the center graticule line. Now switch the TIME/DIV. switch to .1 msec and return the first left marker to the center line of the graticule by adjusting C310. Switch between 50 μsec and .1 msec until the first left marker no longer moves. If you wish this step may be done with the 5X Mag. on. This will make for a finer adjustment.

15. High Sweep Rate Adjustments

Time-Mark Generator	Time/Div. Switch	Adjust	CRT Display	Display Switch
*10 μsec	10 μsec	C160E	1 mark/div.	NORM.
5 μsec	5 μsec	C160C	1 mark/div.	NORM.
1 μsec	2 μsec	C324 approximate adjustment	2 marks/div. (first major division only)	NORM.
1 μsec	.5 μsec	C160A	1 mark/every 2 div.	NORM.
**10MC sine wave	.2 μsec	C324	2 cycles/div.	NORM.
**†50MC sine wave	.2 μsec	C350 and C372	2 cycles/div.	NORM.

*Set C358 to maximum capacitance before starting this adjustment.
**Externally trigger these adjustments with 100 μs markers from the Time Mark Generator
†The 50MC must be applied to one of the vertical plates of the CRT through a 100 $\mu\mu$f capacitor.

The above adjustments interact with each other.

VERTICAL AMPLIFIER

In this section you will find instructions on how to perform six adjustments to the vertical amplifier. One of the adjustments (VARIABLE ATTEN. BAL.) is explained in the Operating Instructions and is repeated here for completeness. Of the remaining five, Steps 17 and 18 are interacting, as are Steps 19 and 20. None of the adjustments listed in this section affect the operation of any other part of the oscilloscope.

16. Variable Attenuator Balance

This adjustment is performed by the operator of the oscilloscope during the course of normal operation. However, the maintenance technician must also make the adjustment before he can proceed to calibrate the vertical amplifier.

Misadjustment of the control is indicated if the entire crt display is positioned vertically as the variable attenuator control is rotated. To perform this adjustment, it is first necessary to get a horizontal reference trace on the crt. This can be done most easily by turning

the red TRIGGER SELECTOR control to AUTO., and the TIME/DIV. switch to 1 MILLISEC.

With the trace vertically centered on the screen, adjust the VARIABLE ATTEN. BAL. control so that the trace remains stationary as the red VOLTS/DIV. control is turned back and forth through its range.

17. Amplifier Gain

This adjustment determines the gain of the vertical amplifier and therefore, the calibration of the VOLTS/DIV. control.

To adjust the Gain Adj. control, first set the oscilloscope front-panel controls as follows:

TRIGGER SELECTOR (red knob)	AUTO.
TRIGGER SELECTOR (black knob)	+INT.
TRIGGERING LEVEL	full left or right
STABILITY	PRESET
DISPLAY	NORM.
TIME/DIV. (black knob)	.5 MILLISEC
TIME/DIV. (red knob)	CALIBRATED
VERTICAL POSITIONING	centered
HORIZONTAL POSITIONING	centered
CALIBRATOR	.5
VOLTS/DIV. (black)	.1
VOLTS/DIV. (red)	CALIBRATED

Connect a jumper from the CAL. OUT connector to the VERTICAL INPUT connector.

Set the Gain Adj. control for five major divisions of vertical deflection.

18. Preamplifier Gain

The Preamp. Gain Adj. control determines the gain of the preamplifier and therefore the calibration of the VOLTS/DIV. switch in the .01, .02, and .05 positions.

Set the oscilloscope controls as outlined in Step 17 with the exception of the VOLTS/DIV. and CALIBRATOR controls. Set these controls at .01 and .05 respectively. Connect a jumper CALIBRATOR connector to the VERTICAL INPUT connector.

Adjust the Preamp. Gain Adj. control for exactly 5 major divisions of vertical deflection.

19. Attenuator High-Frequency Compensation (Square-Corner) and Input Capacitance (Flat Top)

Set the scope up as explained in Step 17 except AC-DC switch is set to DC position. Attach a probe cable to the scope's vertical INPUT connector. Now touch the end of the probe to the CAL. OUT connector and hook the ground lead to the nearest ground. Adjust the VOLTS PEAK TO PEAK switch so that you display about 5 major divisions of signal. In the .1 position of the VOLTS/DIV. switch (black knob) adjust the compensation in the probe for a level top. The following table gives the adjustments, in the scope, for the other positions of the VOLTS/DIV. (black knob) switch.

VOLTS/DIV. Switch	Adjust For Optimum Square Corner	Adjust For Optimum Level Top
.2	C432	C430
.5	C426	C424
1	C418	C416
10	C412	C410
.02		C441

Check all the other ranges of the VOLTS/DIV. switch for the level top and square corner.

20. Preamplifier Low-Frequency Compensation

Need for the adjustment of the Low-Freq. Comp. control is indicated by a loss of low frequency response. Waveforms indicative of this trouble are shown in Figure 6-4.

To make this adjustment, set the front-panel controls as outlined in Step 17 with the exception of the TIME/DIV. control-set this control to 10 MILLISEC. Connect a Type P510A or P6017 Probe to the VERTICAL INPUT connector. Set the Type 105 controls for a fifty-cycle output signal and connect a Type B52-R Terminating Resistor to the output connector. Connect the oscilloscope to the Type 105 by touching the probe tip to the center condutor of the coax connector on the Terminating Resistor and fastening the ground clip to the case of the Terminating Resistor. If excessive hum is encountered, reinstall the bottom plate on the oscilloscope

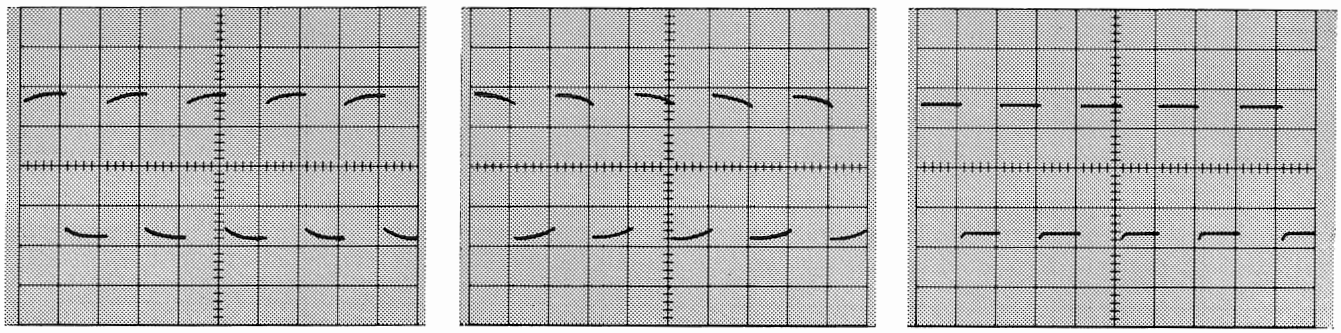


Fig. 6-4. Compensating the preamplifier low-frequency response. The right-hand drawing shows the resulting display of a 50-kc waveform when the Low Freq. Comp. control is correctly adjusted.

Make sure the vertical AC-DC switch is in AC. Note the slant on the top of the square-wave. Now turn the VOLTS/DIV. (black knob) to the .01 position and adjust the Low Freq. Comp. control for the same slant on the top of the square-wave.

DELAY LINE

Including Amplifier High-Frequency Compensation

Of all of the adjustments you may be called up to perform on the Type RM17, the adjustment of the delay line and the vertical-amplifier high-frequency compensation will be the most difficult. This is due largely to interaction between adjustments. There are 26 variable capacitors and 2 variable inductors associated with the delay line, and 6 variable inductors in the vertical amplifier. All of these adjustments interact to some degree.

Before attempting to perform any of the adjustments described in this section, read the instructions carefully until you are sure of what is to be done. Study the pictures and drawings to gain a clear mental picture of the result of each adjustment. Refer to the Circuit Description of this manual for an explanation of the operation of the Delay Line (page 4-3). Attempts to adjust the delay line without adequate preparation frequently lead to a misadjustment more severe than the initial condition.

Displaying the Test Signal

To determine the extent of misadjustment of the delay line in your instrument, you will need to closely examine a displayed 400-kilocycle square wave. The square wave used to make this examination must have a risetime of no more than 20 nanoseconds and must also be free of waveform irregularities during the positive half of the cycle. A Tektronix Type 107 or Type 105 Square-Wave Generator is recommended.

By following the recommendations in these instructions for terminating resistors and cables, you should not experience any difficulty in arriving at the desired results. If, however, it is necessary to use a signal generator other

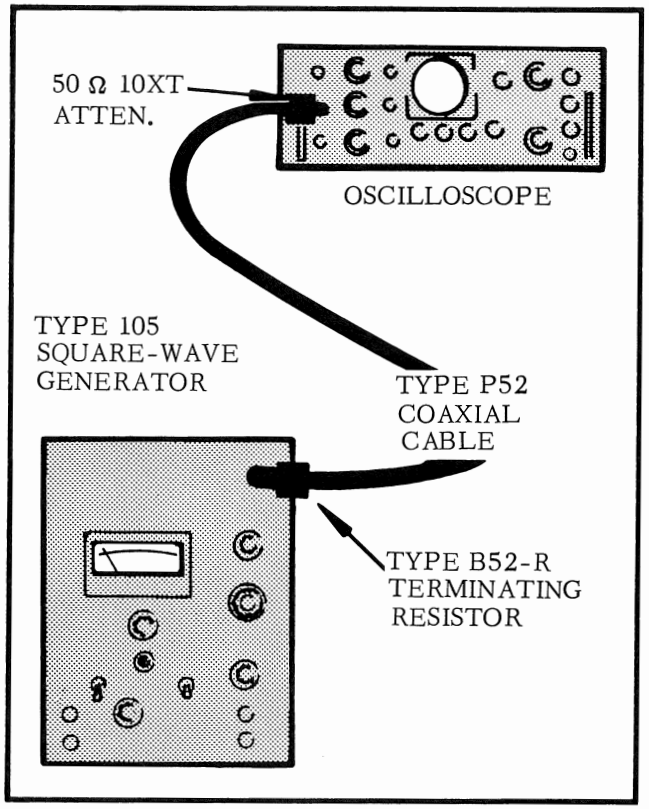


Fig. 6-5. Connecting the Type 105 Square-Wave Generator to the oscilloscope. The Type 105 requires the use of both a Terminating Resistor and "L" pad.

than a Type 105 or Type 107, you must exercise caution in connecting the instrument to the Type RM17. A good check on the suitability of your test equipment is to display the output waveform on another Tektronix oscilloscope (of a type having a delay line) known to be in good adjustment.

Fig. 6-5 and Fig. 6-6, show the desired methods for connecting either the Type 105 or the Type 107 Square-Wave Signal Generator to the Type RM17 input connector.

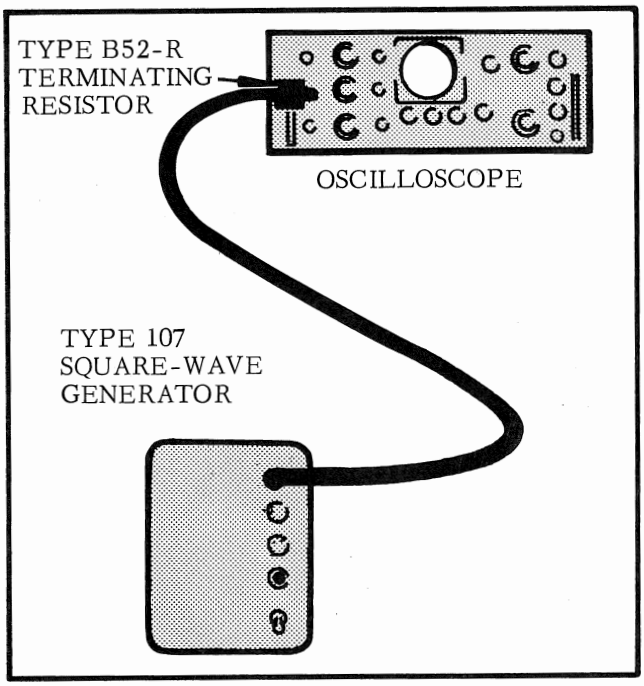


Fig. 6-6. Connecting the Type 107 Square-Wave Generator to the oscilloscope. Only the Terminating Resistor is necessary when connecting the Type 107 to the oscilloscope.

To display a 400 kilocycle waveform, set the square-wave generator controls for a 400 kilocycle output (a few degrees away from full-left on the Type 107 APPROXIMATE FREQUENCY control) and set the oscilloscope front-panel controls as follows:

TRIGGER SELECTOR (red)	AC
TRIGGER SELECTOR (black)	-INT.
STABILITY	PRESET
DISPLAY	NORM.
TIME/DIV. (black)	.5 μSEC
TIME/DIV. (red)	CALIBRATED
VOLTS/DIV. (black)	1
VOLTS/DIV. (red)	CALIBRATED
AC-DC	DC

Adjust the TRIGGERING LEVEL control for a stable display and adjust the square-wave generator output-amplitude control for approximately 4 major divisions of vertical deflection. Position the display so that it is similar to Fig. 6-7. You may have to adjust the square-wave generator output-frequency control slightly to get the desired number of cycles displayed on the crt screen.

There are three general characteristics which you will have to appraise, and to do this, you will need to use three different sweep rates. The first characteristic to look for is the "level" of the display; the second is the amount of "bumpiness" contained in the flat top of the displayed waveform; and the third is the "squareness" of the leading edge and corner of the displayed waveform.

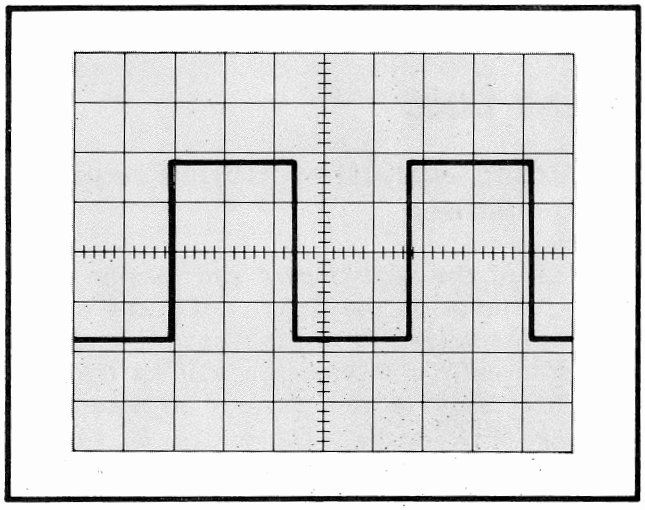


Fig. 6-7. The Type 107 output waveform displayed on a correctly adjusted Type RM17. The frequency of the displayed waveform is approximately 400KC.

Determining the "Level" of the Display

If the display of Fig. 6-8 were positioned on the screen so that the positive portion coincided with a graticule line, we would refer to the horizontal plane of the graticule line as the "level" of the display. If the crt trace coincided with the graticule line over the entire length of the positive half-cycle, we would say, "The display is level". If the leading corner were to fall below the graticule line, we would say, "The display has a downward slope."

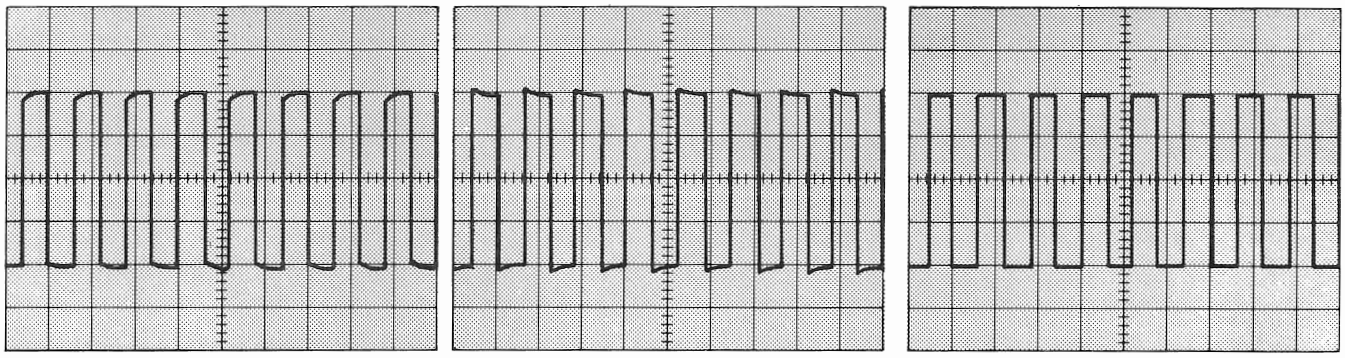


Fig. 6-8. Determining the "level" of a display. Departures from a "level" display occur as a result of the collective misadjustment of the delay-line capacitors. The "level" is most easily observed at a sweep rate of 2 or 5 μsec/div.

Fig. 6-8 shows the three conditions described in the previous paragraph. Although it is possible to observe an upward or downward slope at a sweep rate of .5 μsec/div, the "level" is most easily observed at 2 to 5 μsec/div.

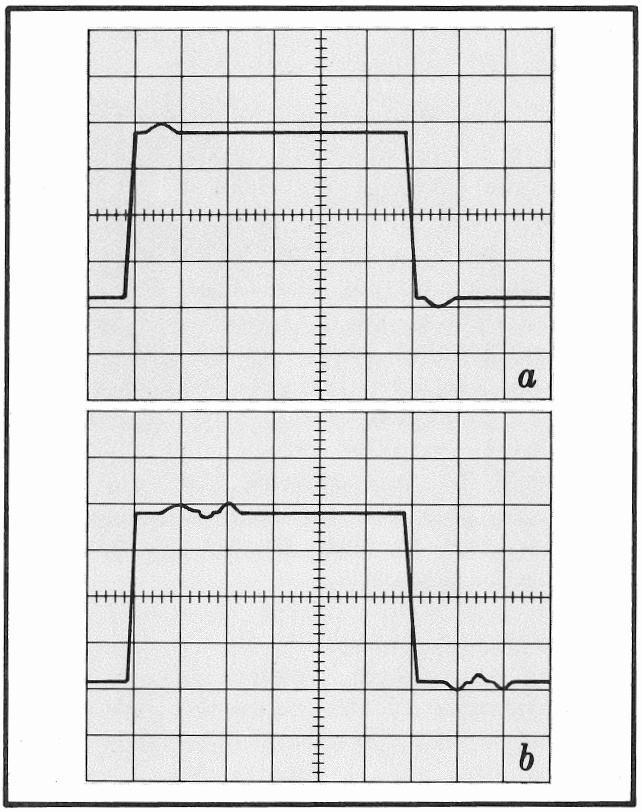


Fig. 6-9. Two types of "bumps" caused by delay-line misadjustment. The "bump" in waveform A is caused by the misadjustment of a group of capacitors. The bumps in waveform B are the result of misadjustment of single capacitors.

Determining the "Bumpiness" of the Display

The next characteristic to look for in the displayed waveform is the "bumpiness" of the first half of the positive portion; that is, the portion that is affected by the delay-line adjustments. To make this observation, you will use two sweep rates: .5 μsec/div. and .2 μsec/div.

There are two general types of bumps to be found in a poorly adjusted delay line. They are shown in Fig. 6-9. The first type is the irregularity caused by the misadjustment of a group of capacitors. This type is most easily observed at a sweep rate of .5 μsec/div. If the bumps occur at random intervals along the delay line, they are probably due to misadjustment of the delay line and can usually be corrected by a few slight adjustments. However, if there is a certain rhythmic waviness or symmetry to their appearance, the trouble may be due to a faulty adjustment in the terminating network or in the high-frequency compensation of the amplifier and a detailed adjustment may be necessary.

The second kind of bump is caused by misadjustment of a single delay-line capacitor. Use a sweep rate of .2 μsec/div. to see bumps of this kind.

Determining the HF Response

The third characteristic to be investigated in the displayed waveform is the extreme leading edge and corner. This part of the waveform is affected by the vertical-amplifier HF peaking coils and the delay-line adjustments collectively, they determine the high-frequency response of the vertical-deflection system and for that reason are of the utmost importance.

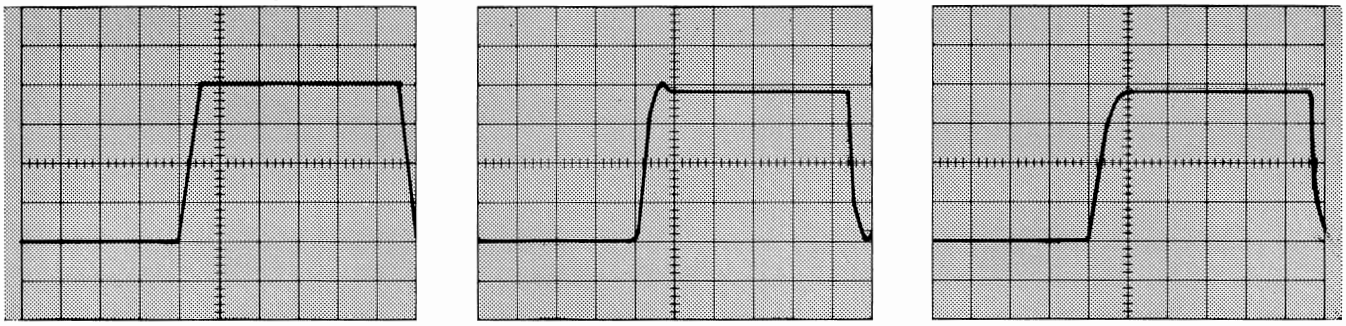


Fig. 6-10. Compensating the amplifier high-frequency response. The left-hand drawing is typical of an instrument in good adjustment. The right-hand waveform will usually be the result of presetting the adjustments as described in the text. The middle waveform is the result of overcompensation.

The "squareness" of the leading corner is best observed by turning the TIME/DIV. switch to .2 μSEC. The corner should be as sharp as possible with no overshoot. Fig.6-10 shows the three possibilities. While it is necessary that the corner be as sharp as possible for optimum frequency response, it is also necessary that there be no wrinkling or "bumpiness" in this portion of the display.

There is a good deal of similarity in the effect of the amplifier peaking coils and the delay-line adjustments. For this reason, it is sometimes difficult to ascertain which adjustments are faulty. Perhaps the simplest way to determine the source of misadjustment is to check the physical position of each adjustment and compare it to Fig. 6-11.

ADJUSTMENT PROCEDURE

There are four major steps in adjusting the delay line and vertical amplifier of the Type RM17. They are: (1) physically presetting the adjustments, (2) establishing a level display, (3) removing the bumps and wrinkles from the display and (4) adjusting the high-frequency compensation. In the instructions that follow, we outline a method for performing these steps.

Physical Presetting

Perhaps the most important single bit of information for the novice is knowledge of the approximate positions of the various adjust-adjustments in a properly adjusted instrument. This knowledge will give him a good "starting" point. Later during the adjustment procedure, he can use the information as a check on his progress.

The variable inductors in the vertical amplifier can be preset according to Fig. 6-11. By positioning them as shown, you will reduce the effects of the inductors during the delay-line adjustment procedure.

If, in your preliminary investigation, you detected a cycle waviness in the display, or if there was extreme overshoot at the leading edge, you will probably save yourself considerable time by presetting the variable inductors. Usually, turning the slugs too far out of the coil winding will only result in a rounding off of the leading edge. On the other hand, turning the slugs too far into the coil winding will result in severe wrinkles in the displayed square-wave--wrinkles which can frequently be reduced by misadjusting the delay line. This might give you the impression that the delay line was at fault instead of the high-frequency peaking coils.

The variable capacitors in the delay line will not, as a rule, require presetting. If the performance of the instrument has deteriorated as a result of normal use and handling, the delay line should require only "touching up," and the original physical positions of the capacitors should be very nearly correct. On the other hand if the instrument has been tampered with, or it if has been subject to severe vibration or rough handling, it may be desirable to preset the delay-line capacitors as described in the following paragraph.

In a properly adjusted delay line, the adjusting screw extends above the capacitor body

about 3/8 inch. The important characteristic is that the tops of all the delay-line adjusting screws be at about the same height. It is very important to keep this characteristic in mind as you adjust the delay line.

If you can observe a waviness in the heights of the adjusting screws (while, at the same time, the display is "level"), the trouble is probably due to misadjustment of the inductors in the vertical amplifier. In this event, you should recheck the physical positions of the slugs as described in the previous paragraphs.

The inductors and capacitor at the terminated (crt) end of the delay line are the first to be adjusted in the adjustment procedure and therefore are not usually preset. Should you have difficulty in adjusting the delay line, you can use the approximate positions shown in Fig. 6-11 as a guide to help you locate the source of trouble. The positions shown are typical of those in a properly adjusted instrument.

If, in the preliminary inspection, you noticed a bump following the Termination Bump (that is, on the portion of the delay line not normally affected by delay-line misadjustments), be sure to check the termination inductors for balance. The slugs in both inductors should be equidistant from the coil windings as shown in Fig. 6-11. When you adjust the slugs, be sure to adjust each slug the same amount.

As a final step in the Physical Presetting procedure, dress the leads to the crt vertical-deflection plates. They are to be uniformly spaced--both with respect to each other and with respect to the crt shield.

Establishing a "level" Display

The "level" of the flat top of the displayed square wave is determined by the collective effects of all of the delay line capacitors. The characteristics to look for are described

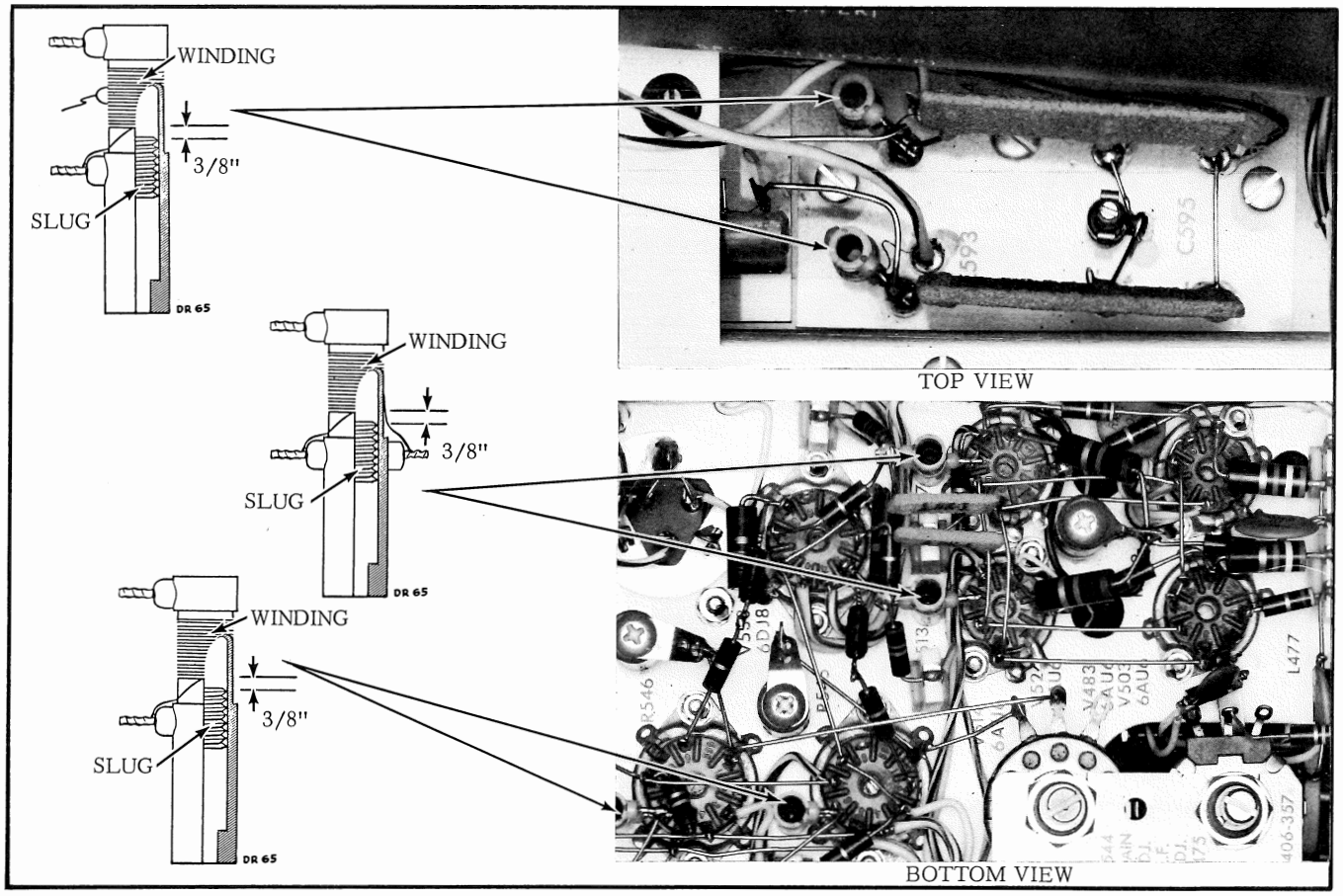


Fig. 6-11. Approximate physical positions of adjustments in a correctly adjusted instrument. Initially, the adjustments can be preset as shown above. During the calibration procedure, they will be moved slightly.

in the Preliminary Inspection section of these instructions and are shown in Fig. 6-8.

To make the display "level", you will need to adjust each delay-line capacitor a small amount in a direction that will result in a "level" display. Start at the termination network by adjusting the two inductors and the capacitor (see Fig. 6-11) for minimum Termination Bump. Then advance from capacitor to capacitor on the delay line; working toward the amplifier end. During your first attempt, you will probably find it most convenient to use a sweep rate of 5 μsec/div. After you have adjusted all of the capacitors to gain an average "level" over the length of the flat top of the displayed square-wave, you can advance the sweep rate to 2 μsec/div. and repeat the procedure. This time, however, try to adjust the capacitors for a smooth transition from bump to bump while at the same time, maintaining a satisfactory "level". The important thing to remember is to reduce the amplitude of all of the bumps by the same amount and try not to achieve a perfectly straight line at this time.

Removing the Bumps and Wrinkles

After you have established a "level" display with the amplitude of the bumps and wrinkles reduced to within a trace width of the "level" line, you can start to remove the wrinkles and bumps over small sections of the display.

Set the TIME/DIV. switch to .5 μSEC and proceed to remove the bumps caused by the termination network. Do not try to arrive at a perfectly straight line during your first attempt. Just reduce the bumps by one half. Then, advance to the first group of 4 or 5 capacitors in the delay line and adjust them for a smooth line over the portion of the display that they affect. Keep in mind that each capacitor will only require a slight adjustment--a mere "touch"--and that it is the combined effect of the group of capacitors that you should be concerned with.

While you are adjusting a group of capacitors to remove a bump or wrinkle, be sure to frequently turn to a sweep rate of 2 or 5 μsec/div. and check the level of the display.

Advance along the delay line from each group of capacitors to the next until you have traversed the entire length. Then, turn the TIME/DIV. switch to .2 μSEC and repeat the process. This time, however, you must be extra careful. The capacitors that require adjustment will only need a slight touch--to do otherwise might nullify all of your efforts up to this point. Be sure to check the "level" of the display frequently. It is very easy to concentrate on removing a particularly stubborn bump and in so doing, introduce an upward or downward slope in the display.

At this point in the adjustment procedure, it will not be necessary to adjust each capacitor. "Touching up" here and there will probably produce the desired resuls.

Adjusting the High-Frequency Compensation

If you have successfully completed the adjustment procedure up to this point, the display on your oscilloscope should appear similar to Fig. 6-10c. During this final part of the adjustment procedure, you will strive for a square corner of the leading edge, while at the same time maintaining the proper "level" without introducing wrinkles or bumps.

Set the TIME/DIV. switch at .2 μSEC and position the display to afford a good view of the leading edge and corner. Each pair of inductors in the amplifier affect the same part of the display. It is very important that you adjust each inductor the same amount as its corresponding opposite. That is, the slug in L544 should be in the same position as the slug in L554 when you complete this adjustment. This is also true for the slugs in L513 and L527.

Adjust the inductors, in pairs, for a square corner on the display. It may be necessary to readjust the first two or three capacitors in the delay line to achieve a wrinkle-free corner.

L477 and L450 determine the high-frequency response of the preamplifier and must be adjusted separately. To do this, set the VOLTS/DIV. switch at .01 and reduce the output signal from the signal generator. If using a Type 107, substitute a Type B52T10 Pad for the B52R Terminating Resistor.

The coils are adjusted in the same manner as the coils in the main amplifier, however, do not adjust the delay-line capacitors. They

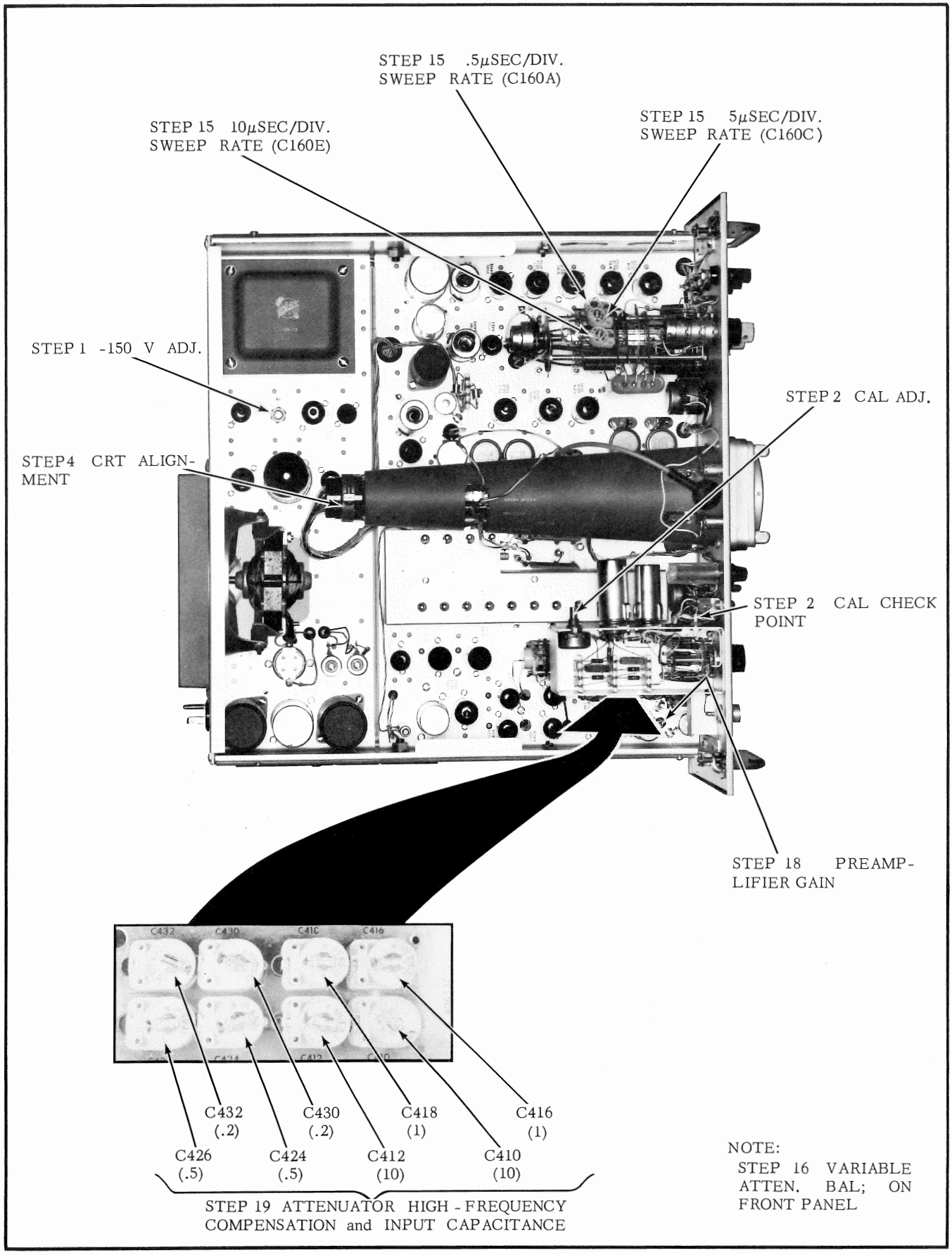


Fig. 6-12. Top view of the Type RM17, showing steps in calibration.

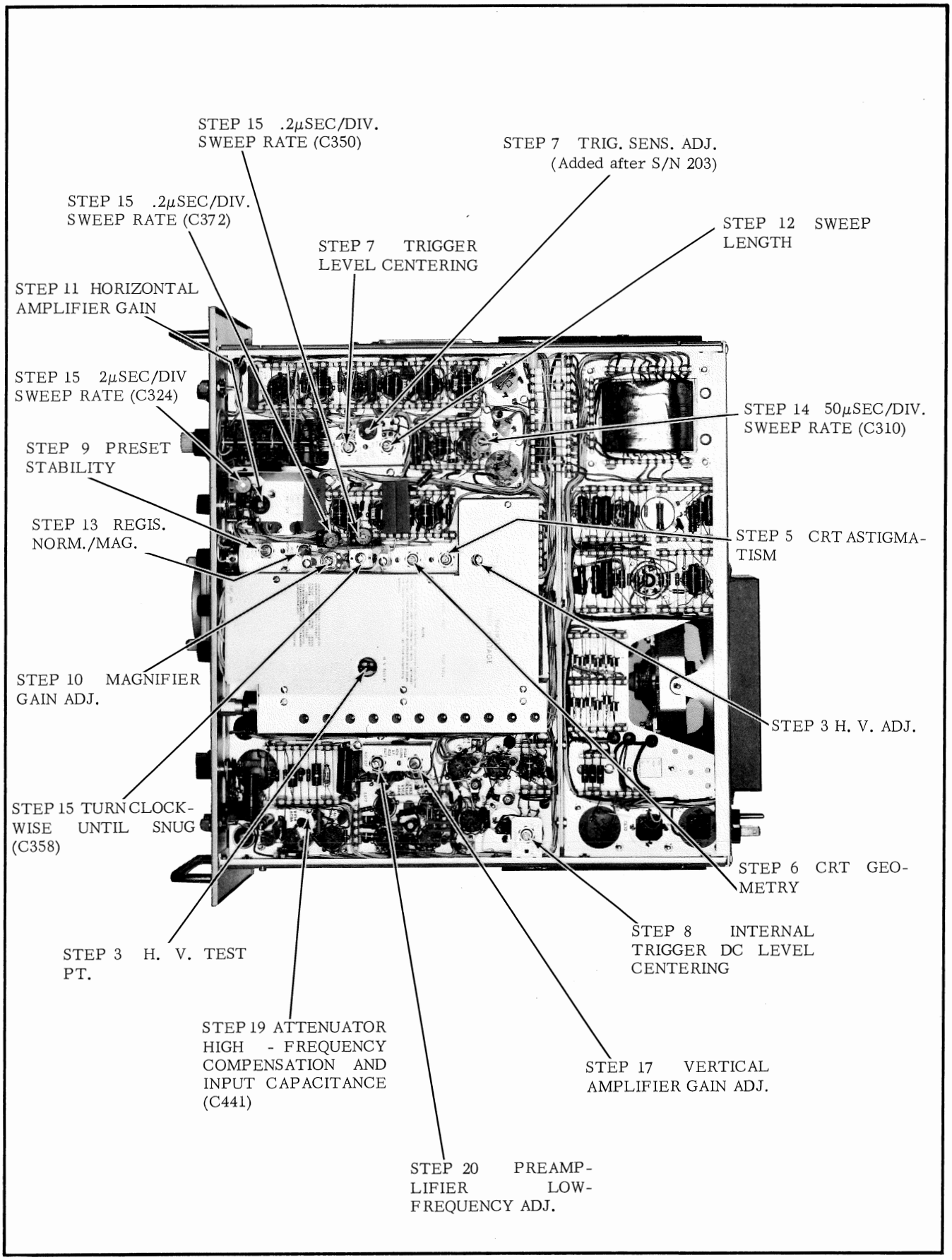


Fig. 6-13. Bottom view of the Type RM17.

are only to be adjusted when the VOLTS/DIV. switch is set at .1.

Main Amplifier Bandwidth

A good check on the completeness of your adjustments to the delay line and vertical amplifier is to measure the bandpass of the vertical-deflection system. To make this check, it is necessary to establish a reference deflection on the crt. Then, without altering the oscilloscope control settings or the amplitude of the input signal, increase the frequency of the input signal until the crt deflection is reduced to .71 of the reference deflection. The input signal frequency at this point will be the high-frequency 3-db-down point and represents the upper frequency limit of the bandpass.

To measure the bandpass of the main amplifier, connect the output of a Type 190A Constant-Amplitude Signal Generator to the Type RM17 input connector through a Type B52R Terminating Resistor. Set the front-panel controls of the instruments as follows:

TRIGGER SELECTOR (red)	AUTO.
TRIGGER SELECTOR (black)	+INT.
STABILITY	PRESET
TRIGGERING LEVEL	full right or full left
DISPLAY	NORM.
TIME/DIV.	1 MILLISEC
TIME/DIV. VARIABLE	CALIBRATED
VOLTS/DIV.	.1
VOLTS/DIV. VARIABLE	CALIBRATED
AC-DC	AC

Type 190A:

RANGE SELECTOR	.35-.75MC
RANGE IN MEGACYCLES	.50
ATTENUATOR	10
OUTPUT AMPLITUDE	See text

Adjust the Type 190A OUTPUT AMPLITUDE control for a vertical deflection of exactly four major divisions on the graticule. Then, turn the Type 190A RANGE SELECTOR to 9-21.

Next, without adjusting any other controls, advance the Type 190A RANGE IN MEGACYCLES control until you reach the point where the crt display is reduced to .28 major divisions. You may have to position the display with the VERTICAL POSITIONING control to make this measurement, but do not adjust any other controls.

With the vertical deflection reduced to 2.8 major divisions, read the high-frequency, 3 db down frequency, directly from the dial of the Type 190A. Typically, this frequency should fall within the range from 10 megacycles of 11 megacycles.

Preamplifier Bandwidth

To measure the bandwidth of the preamplifier, set the front-panel controls as described in the previous step with the exception of the VOLTS/DIV. switch and the Type 190A ATTENUATOR switch. Set these controls to .01 and 1, respectively. Adjust the Type 190A OUTPUT AMPLITUDE control for four major divisions of vertical deflection.

Increase the frequency of the Type 190A output signal, just as you did in the previous step, until the vertical deflection falls to 2.8 major divisions of deflection. Read the 3-db-down frequency directly from the dial of the Type 190A. Typically, the upper frequency limit should be between 9 and 10.5 megacycles.

PARTS LIST

Values are fixed unless marked Variable.

Bulbs

Ckt. No.	Tektronix Part Number	Description		S/N Range
B163	Use 150-0027-00	Neon, Type NE-23	UNCALIBRATED	
B167	Use 150-0027-00	Neon, Type NE-23		
B170	Use 150-0027-00	Neon, Type NE-23		101-849
B170	150-0030-00	Neon, Type NE-2 V		850-up
B193	150-0027-00	Neon, Type NE-23		X790-up
B300	Use 150-0027-00	Neon, Type NE-23	MAG	101-849
B300	150-0030-00	Neon, Type NE-2 V	MAG	850-up
B359	Use 150-0027-00	Neon, Type NE-23		
B379	Use 150-0027-00	Neon, Type NE-23		
B463	Use 150-0027-00	Neon, Type NE-23		
B517	Use 150-0027-00	Neon, Type NE-23	UNCALIBRATED	101-849
B517	150-0030-00	Neon, Type NE-2 V	UNCALIBRATED	850-up
B600	150-018	Incandescent, GE Type #12	Pilot Light	
B601	150-001	Incandescent, #47	Graticule Light	
B602	150-001	Incandescent, #47	Graticule Light	

Capacitors

Tolerance ±20% unless otherwise indicated.

Tolerance of all electrolytic capacitors as follows (with exceptions):

3 V —50 V = —10%, +250%
51 V —350 V = —10%, +100%
351 V —450 V = —10%, +50%

C7	285-510	.01 μf	PTM		400 v		
C10	283-000	.001 μf	Discap		500 v	GMV	
C13	281-523	100 μf	Cer.		350 v		
C14	283-000	.001 μf	Discap		500 v	GMV	
C23	283-003	.01 μf	Discap		150 v	GMV	
C25	283-003	.01 μf	Discap		150 v	GMV	
C35	281-542	18 μμf	Cer.		500 v	10%	
C43	283-001	.005 μf	Discap		500 v	GMV	
C131	281-513	27 μμf	Cer.		500 v		
C133	281-503	8 μμf	Cer.		500 v	±.5 μμf	
C138	283-001	.005 μf	Discap		500 v	GMV	
C141	281-544	5.6 μμf	Cer.		500 v	10%	
C144	283-001	.005 μf	Discap		500 v	GMV	
C150	281-521	56 μμf	Cer.		500 v	10%	
C160A	281-007	3-12 μμf	Cer.	Var.			
C160B	283-534	82 μμf	Mica		500 v	5%	
C160C	281-010	4.5-25 μμf	Cer.	Var.			
C160D	283-534	82 μμf	Mica		500 v	5%	
C160E	281-010	4.5-25 μμf	Cer.	Var.			
C160F	*291-008	.001 μf	Mylar			±½%	101-879
C160G		.01 μf					
C160H	*291-007	.1 μf		Mylar Timing Series		±½%	101-879
C160J		1 μf					
C160F		.001 μf					
C160G	*295-0095-00	.01 μf	Timing Capacitor Assembly				880-up
C160H		.1 μf					
C160J		1 μf					
C165	281-525	470 μμf	Cer.		500 v		
C167	283-000	.001 μf	Discap		500 v	GMV	

Capacitors *(continued*

Ckt. No.	Tektronix Part Number		Description				S/N Range
C180A	283-509	180 μμf	Mica		500 v	10%	
C180B	285-543	.0022 μf	PTM		400 v		
C180C	285-515	.022 μf	PTM		400 v		
C180D	285-526	.1 μf	PTM		400 v		
C180E	285-526	.1 μf	PTM		400 v		
C181	281-516	39 μμf	Cer.		500 v	10%	
C191	283-000	.001 μf	Discap		500 v	GMV	
C195	281-504	10 μμf	Cer.		500 v		
C310	281-010	4.5-25 μμf	Cer.	Var.			
C315	281-509	15 μμf	Cer.		500 v	10%	
C324	281-009	3-12 μμf	Cer.	Var.			
C333	281-526	1.5 μμf	Cer.		500 v	±.5 μμf	
C350	281-504	10 μμf	Cer.		500 v		101-107
	281-011	5-25 μμf	Cer.	Var.			108-up
C358	281-023	9-180 μμf	Mica	Var.			
C367	283-006	.02 μf	Discap		600 v		
C372	281-009	3-12 μμf	Cer.	Var.			101-107
	281-011	5-25 μμf	Cer.	Var.			108-up
C401	Use *285-603	.1 μf	PTM		600 v		
C403	283-000	.001 μf	Discap		500 v	GMV	
C410	281-010	4.5-25 μμf	Cer.	Var.			
C412	281-005	1.5-7 μμf	Cer.	Var.			
C414	283-543	250 μμf	Mica		500 v	5%	
C416	281-010	4.5-25 μμf	Cer.	Var.			
C418	281-010	4.5-25 μμf	Cer.	Var.			
C420	283-544	150 μμf	Mica		500 v	10%	
C424	281-010	4.5-25 μμf	Cer.	Var.			
C426	281-007	3-12 μμf	Cer.	Var.			
C430	281-007	3-12 μμf	Cer.	Var.			
C432	281-010	4.5-25 μμf	Cer.	Var.			
C436	281-543	270 μμf	Cer.		500 v	10%	
C441	281-027	.7-3 μμf	Tub.	Var.			
C445	283-001	.005 μf	Discap		500 v	GMV	
C446A,B,C	Use 290-0004-00	3 x 10 μf	EMC		350 v		
C454	290-030	500 μf	EMT		6 v		
C465	283-001	.005 μf	Discap		500 v	GMV	
C471	285-526	.1 μf	PTM		400 v		
C482	283-000	.001 μf	Discap		500 v	GMV	
C483	281-500	2.2 μμf	Cer.		500 v	±.5 μμf	
C484	283-001	.005 μf	Discap		500 v	GMV	
C490	283-001	.005 μf	Discap		500 v	GMV	
C494	283-002	.01 μf	Discap		500 v	GMV	
C507	283-003	.01 μf	Discap		150 v	GMV	
C556	281-547	2.7 μμf	Cer.		500 v	10%	
C562	283-001	.005 μf	Discap		500 v	GMV	
C567	281-037	.7-3 μμf	Tub.	Var.			
C568	281-537	.68 μμf	Cer.		500 v	±.136 μμf	
C569	281-037	.7-3 μμf	Tub.	Var.			
C571-93	281-037 (23)	.7-3 μμf	Tub.	Var.			
C595	281-037	.7-3 μμf	Tub.	Var.			

Capacitors *(continued*

Ckt. No.	Tektronix Part Number		Description			S/N Range
C601	Use 290-0016-00	125 μf	EMC	350 v		
C603	285-510	.01 μf	PTM	400 v		
C614	285-510	.01 μf	PTM	400 v		
C630	Use 290-0016-00	125 μf	EMC	350 v		
C638	285-510	.01 μf	PTM	400 v		
C660	Use 290-0016-00	125 μf	EMC	350 v		
C668	285-511	.01 μf	PTM	600 v		
C701A,B	Use 290-0010-00	2 x 20 μf	EMC	450 v		
C703	Use 290-0010-00	2 x 20 μf	EMC	450 v		
C750	Use 290-0022-00	2 x 1000 μf	EMC	15 v		
C751	283-004	.02 μf	Discap	150 v	GMV	
C790	283-003	.01 μf	Discap	150 v	GMV	101-125
	283-004	.02 μf	Discap	150 v	GMV	126-up
C791	283-004	.02 μf	Discap	150 v	GMV	X126-up
C803	283-000	.001 μf	Discap	500 v	GMV	
C805	283-002	.01 μf	Discap	500 v	GMV	
C806	285-502	.001 μf	PTM	1000 v		
C807	290-094	8 μf	EMT	450 v		
C814	285-508	.0068 μf	PTM	3000 v		101-209
	283-011	.01 μf	Discap	2000 v		210-up
C815	Use 285-519	.047 μf	PTM	400 v		
C820	285-508	.0068 μf	PTM	3000 v		101-209
	283-011	.01 μf	Discap	2000 v		210-up
C821	Use 283-034	.0068 μf	PTM	5000 v		101-170
	283-034	.005 μf	Discap	4000 v		171-up
C822	Use 281-556	.00047 μf	PTM	10,000 v		101-125
	281-556	500 μμf	Cer.	10,000 v		126-up
C823	Use 281-556	.00047 μf	PTM	10,000 v		101-125
	281-556	500 μμf	Cer.	10,000 v		126-up
C825	283-002	.01 μf	Discap	500 v	GMV	
C830	285-508	.0068 μf	PTM	3000 v		101-209
	283-011	.01 μf	Discap	2000 v		210-up
C832	285-513	.015 μf	PTM	3000 v		101-170
	283-011	.01 μf	Discap	2000 v		171-up
C834	285-513	.015 μf	PTM	3000 v		101-170
	283-011	.01 μf	Discap	2000 v		171-up
C835	283-011	.01 μf	Discap	2000 v		X171-up
C855	285-513	.015 μf	PTM	3000 v		101-170
	283-011	.01 μf	Discap	2000 v		171-up
C857	285-513	.015 μf	PTM	3000 v		101-170
	283-011	.01 μf	Discap	2000 v		171-up
C860	283-001	.005 μf	Discap	500 v		
C864	283-001	.005 μf	Discap	500 v		101-319X
C872	283-518	330 μμf	Mica	500 v	10%	
C876	283-518	330 μμf	Mica	500 v	10%	
C885	281-548	27 μf	Cer.	500 v		

Diodes

D131	152-008	T12G		X310-up
D152	152-0246-00	Silicon	Low leakage, 0.25 w, 40 v	X850-up
D162A,B	152-047	Silicon Diode		X126-849
D162A,B	152-0066-00	Silicon	1N3194	850-up

Diodes *(continued)*

Ckt. No.	Tektronix Part Number	Description	S/N Range
D442	152-008	T12G	X126-up
D602A,B,C,D	152-047	Silicon Diode	X201-849
D602A,B,C,D	152-0066-00	Silicon 1N3194	850-up
D632A,B,C,D	152-047	Silicon Diode	X201-849
D632A,B,C,D	152-0066-00	Silicon 1N3194	850-up
D662A,B,C,D	152-047	Silicon Diode	X201-849
D662A,B,C,D	152-0066-00	Silicon 1N3194	850-up

Fuses

F601	159-005	3 Amp 3 AG Slo-Blo 117 v oper. 50 & 60 cycle	
	159-003	1.6 Amp 3 AG Slo-Blo 234 v oper. 50 & 60 cycle	

Inductors

L450	*114-086	23-55 μh	Var.	core 276-511	
L457	*108-054	6.4 μh			
L477	*114-051	.9-1.6 μh	Var.	core 276-506	
L513	*114-076	15-30 μh	Var.	core 276-506	
L527	*114-076	15-30 μh	Var.	core 276-506	
L540	*108-103	2.5 μh			
L544	*114-077	12-25 μh	Var.	core 276-506	
L550	*108-103	2.5 μh			
L554	*114-077	12-25 μh	Var.	core 276-506	
L574	*108-124	Delay Line, 10 sec.			
L575	*108-124	Delay Line, 10 sec.			
L583	*108-146	5 μh on 15 meg, ½ w resistor			
L584	*108-146	5 μh on 15 meg, ½ w resistor			
L585	*108-124	Delay Line, 10 sec.			
L586	*108-124	Delay Line, 10 sec.			
L589†	Use *108-088	2.5 μh			101-125
	*108-088	3.2 μh			126-up
L590 †	Use *108-088	2.5 μh			101-125
	*108-088	3.2 μh			126-up
L591	*108-140	Delay Line, 4 sec.			
L592	*108-140	Delay Line, 4 sec.			
L593	*114-075	17-34 μh	Var.	core 276-506	
L594	*114-075	17-34 μh	Var.	core 276-506	

Rectifiers ††

SR454	Use *050-067	1-100 ma plate/leg	101-125X
SR601	*106-015	5-100 ma plates/leg	101-200X
SR630	*106-031	5-250 ma plates/leg	101-200X
SR660	*106-030	6-250 ma plates/leg	101-200X
SR750	*106-038	1-250 ma plate/leg	101-125X

†S/N 101-125, L589 and L590 have to be replaced at the same time.

†† S/N 126-up, see D162 and D442; S/N 201-up, see D602, D632, and D662.
A Mod Kit is available to convert from Selenium Rectifiers to Silicon Diodes. Order Mod Kit #040-389.

Resistors

Ckt. No.	Tektronix Part Number	Description				S/N Range
Resistors are fixed, composition, ±10% unless otherwise indicated.						
R9	302-105	1 meg	½ w			
R10	302-474	470 k	½ w			
R12	302-101	100 Ω	½ w			
R13	302-392	3.9 k	½ w			
R14	302-270	27 Ω	½ w			
R15	302-392	3.9 k	½ w			
R17	308-081	20 k	8 w	WW	5%	
R19	302-101	100 Ω	½ w			
R22	302-104	100 k	½ w			
R23	302-101	100 Ω	½ w			
R24	302-224	220 k	½ w			
R25	302-104	100 k	½ w			
R26	302-395	3.9 meg	½ w			
R27	302-824	820 k	½ w			
R28	302-105	1 meg	½ w			
R29†	311-099	100 k	½ w	Var.	TRIGGERING LEVEL	
R31	302-225	2.2 meg	½ w			
R32	302-102	1 k	½ w			
R33	301-222	2.2 k	½ w		5%	
R35	302-154	150 k	½ w			
R36	302-124	120 k	½ w			
R37	311-026	100 k	2 w	Var.	TRIGGERING LEVEL CENTERING	
R39	302-101	100 Ω	½ w			
R40	302-821	820 Ω	½ w			
R41	302-105	1 meg	½ w			
R42	304-223	22 k	1 w			
R43	302-331	330 Ω	½ w			101-202
	311-056	500 Ω	.1 w	Var.	TRIGGER SENSITIVITY	203-up
R44	304-223	22 k	1 w			
R110††	311-099	500 k	½ w	Var.	STABILITY	
R111	311-026	100 k	2 w	Var.	PRESET STABILITY	
R114	302-104	100 k	½ w			
R115	301-273	27 k	½ w		5%	
R116	301-393	39 k	½ w		5%	
R131	302-472	4.7 k	½ w			
R132	302-101	100 Ω	½ w			
R133	303-362	3.6 k	1 w		5%	
R134	303-362	3.6 k	1 w		5%	
R135	302-101	100 Ω	½ w			
R138	302-101	100 Ω	½ w			
R140	302-470	47 Ω	½ w			
R141	303-433	43 k	1 w		5%	
R142	303-333	33 k	1 w		5%	
R143	308-054	10 k	5 w	WW	5%	
R144	302-101	100 Ω	½ w			

†Concentric with R110, R330, and SW110. Furnished as a unit.

††Concentric with R29, R330, and SW110. Furnished as a unit.

Resistors *(continued)*

Ckt. No.	Tektronix Part Number		Description				S/N Range
R145	302-105	1 meg	½ w				
R146	302-470	47 Ω	½ w				
R147	302-681	680 Ω	½ w				101-107
	302-102	1 k	½ w				108-up
R148	304-154	150 k	1 w				
R150	302-681	680 Ω	½ w				
R152	302-0685-00	6.8 meg	½ w				X850-up
R159	302-105	1 meg	½ w				X171-up
R160A	309-045	100 k	½ w		Prec.	1%	
R160B	309-051	200 k	½ w		Prec.	1%	
R160C	309-140	500 k	½ w		Prec.	1%	
R160D	309-014	1 meg	½ w		Prec.	1%	
R160E	309-023	2 meg	½ w		Prec.	1%	
R160F	309-087	5 meg	½ w		Prec.	1%	
R160G	309-095	10 meg	½ w		Prec.	1%	
R160H	309-095	10 meg	½ w		Prec.	1%	
R160J	309-095	10 meg	½ w		Prec.	1%	
R161	302-822	8.2 k	½ w				
R162†	311-108	20 k	2 w	Var.	WW	VARIABLE	
R163	302-104	100 k	½ w				
R164	302-101	100 Ω	½ w				
R165	304-473	47 k	1 w				
R166	304-473	47 k	1 w				
R167	302-155	1.5 meg	½ w				
R168	302-224	220 k	½ w				
R170	302-101	100 Ω	½ w				
R173	308-054	10 k	5 w		WW	5%	
R174	Use 304-332	3.3 k	1 w				
R176	311-008	2 k	2 w	Var.		Sweep Length	
R178	308-052	6 k	5 w		WW	5%	
R180A	302-474	470 k	½ w				
R180B	302-475	4.7 meg	½ w				
R181	302-475	4.7 meg	½ w				
R183	302-101	100 Ω	½ w				
R191	302-104	100 k	½ w				
R192	302-470	47 Ω	½ w				
R193	302-470	47 Ω	½ w				
R194	304-104	100 k	1 w				
R195	Use 303-183	18 k	1 w			5%	
R196	Use 305-333	33 k	2 w			5%	
R197	302-470	47 Ω	½ w				
R199	302-103	10 k	½ w				
R300	302-104	100 k	½ w				
R310	309-149	1.2 meg	½ w		Prec.	1%	
R311	309-015	1.11 meg	½ w		Prec.	1%	101-939
R311	309-0386-00	1 meg	½ w		Prec.	1%	940-up
R314A,B	311-090	2 x 20 k	2 w				
R315	302-561	560 Ω	½ w				
R316	302-470	47 Ω	½ w				
R318	306-473	47 k	2 w				
R324	309-091	120 k	½ w		Prec.	1%	
R325	311-078	50 k	.1 w	Var.		Horiz. Gain Adj.	

†Concentric with SW160. Furnished as a unit.

Resistors *(continued)*

Ckt. No.	Tektronix Part Number		Description				S/N Range
R330†	311-099	100 k	½ w	Var.		Horiz. Input Atten.	
R333	309-126	400 k	½ w		Prec.	1%	
R334	309-109	250 k	½ w		Prec.	1%	
R335	311-023	50 k	2 w	Var.		Norm/Mag. Regis	
R337	302-470	47 Ω	½ w				
R340	306-683	68 k	2 w				
R344	302-470	47 Ω	½ w				
R350	*310-524	7—35 k	7 w		Mica Plate	1%	
R351	302-470	47 Ω	½ w				
R353	303-153	15 k	1 w			5%	
R354	308-054	10 k	5 w		WW	5%	101-107
	305-123	12 k	2 w			5%	108-up
R356	303-153	15 k	1 w			5%	
R358	311-120	2.5 k	.2 w	Var.		Mag. Gain Adj.	
R359	Use *310-614	41.5 k	8 w		Mica Plate	½%	
R365	304-223	22 k	1 w				
R366	302-104	100 k	½ w				
R367	302-562	5.6 k	½ w				
R368	304-153	15 k	1 w				
R369	302-102	1 k	½ w				
R370	302-470	47 Ω	½ w				
R372	*310-524	7—35 k	7 w		Mica Plate	1%	
R374	302-470	47 Ω	½ w				
R379	304-274	270 k	1 w				
R403	302-100	10 Ω	½ w				
R412	309-013	990 k	½ w		Prec.	1%	
R414	309-034	10.1 k	½ w		Prec.	1%	
R418	309-111	900 k	½ w		Prec.	1%	
R420	309-046	111 k	½ w		Prec.	1%	
R422	302-270	27 Ω	½ w				
R426	309-110	800 k	½ w		Prec.	1%	
R428	309-109	250 k	½ w		Prec.	1%	
R432	309-003	500 k	½ w		Prec.	1%	
R434	309-014	1 meg	½ w		Prec.	1%	
R436	302-220	22 Ω	½ w				
R441 ††	*312-583	1 meg	½ w		Prec.	.1%	
R443	302-470	47 Ω	½ w				
R444	Use 302-153	15 k	½ w				
R445	302-101	100 Ω	½ w				
R446	306-123	12 k	2 w				
R450	*310-539	3 k	2 w		Mica Plate	1%	
R452	308-024	15 k	10 w		WW	5%	
R454	311-097	200 Ω	.5 w	Var.		Preamp Gain Adj.	
R457	302-470	47 Ω	½ w				
R463	306-223	22 k	2 w				

†Concentric with R29, R110, and SW110. Furnished as a unit.

††R441 and R483 matched to .1% each other. Furnished as a unit.

Resistors *(continued)*

Ckt. No.	Tektronix Part Number		Description				S/N Range
R465	302-470	47 Ω	½ w				
R466	302-102	1 k	½ w				
R467	301-154	150 k	½ w			5%	
R468	301-204	200 k	½ w			5%	
R471	304-822	8.2 k	1 w				
R474	Use 302-224	220 k	½ w				
R475	311-042	2 meg	2 w	Var.		L. F. Adj.	
R483†	*312-583	1 meg	½ w		Prec.	.1%	
R484	302-104	100 k	½ w				
R487	302-470	47 Ω	½ w				
R490	302-470	47 Ω	½ w				
R493	304-393	39 k	1 w				
R494	302-470	47 Ω	½ w				
R495	304-393	39 k	1 w				
R501	311-034	500 k	2 w	Var.		VAR. ATTEN. BAL.	
R503	302-394	390 k	½ w				
R505	302-475	4.7 meg	½ w				
R506	302-392	3.9 k	½ w				
R507	302-470	47 Ω	½ w				
R510	302-100	10 Ω	½ w				
R512	302-122	1.2 k	½ w				
R513	*310-533	1.8 k	2 w		Mica Plate	1%	
R516††	Use *311-281	780 Ω		Var.	WW	VARIABLE	
R517	302-104	100 k	½ w				
R519	304-103	10 k	1 w				
R520	304-103	10 k	1 w				
R523	308-007	8 k	5 w		WW	5%	
R525	302-100	10 Ω	½ w				
R527	*310-533	1.8 k	2 w		Mica Plate	1%	
R530	302-823	82 k	½ w				
R531	311-028	2 x 100 k	2 w	Var.		VERTICAL POSITIONING	
R532	302-823	82 k	½ w				
R533	302-100	10 Ω	½ w				
R534	302-100	10 Ω	½ w				
R535	303-153	15 k	1 w			5%	
R536	303-153	15 k	1 w			5%	
R540	302-100	10 Ω	½ w				
R544	Use 311-004	100 Ω	2 w	Var.		Gain Adj.	101-107
	311-004	200 Ω	2 w	Var.			108-up
R545	308-082	3 k	5 w		WW	5%	
R546	308-082	3 k	5 w		WW	5%	
R548	308-063	1.2 k	5 w		WW	5%	101-107
	302-221	220 Ω	½ w				108-up
R550	302-100	10 Ω	½ w				
R556	309-001	433 k	½ w		Prec.	1%	

†R483 and R441 matched to .1% each other. Furnished as a unit.

††Concentric with SW420 and SW517.

Ckt. No.	Tektronix Part Number		Description				S/N Range
R557	Use 309-152	300 k	½ w		Prec.	1%	101-125
	309-152	349 k	½ w		Prec.	1%	126-up
R558	311-023	50 k	2 w	Var.		Int. Trig. DC Level Adj.	
R560	302-470	47 Ω	½ w				
R562	302-470	47 Ω	½ w				
R564	304-393	39 k	1 w				
R593	*310-534	1.8 k	7 w		Mica Plate	1%	
R594	*310-534	1.8 k	7 w		Mica Plate	1%	
R597	308-089	1 k	10 w		WW	5%	101-107
	308-086	1.2 k	10 w		WW	5%	108-up
R600	311-055	50 Ω	2 w	Var.	WW	SCALE ILLUM.	
R601	304-100	10 Ω	1 w				
R603	304-333	33 k	1 w				
R605	302-562	5.6 k	½ w				
R606	302-224	220 k	½ w				
R607	302-683	68 k	½ w				
R609	302-105	1 meg	½ w				
R610	302-102	1 k	½ w				
R612	304-183	18 k	1 w				
R614	302-105	1 meg	½ w				
R616	310-054	68 k	1 w		Prec.	1%	
R617	311-015	10 k	2 w	Var.	WW	—150 Adj.	
R618	310-086	50 k	1 w		Prec.	1%	
R620	308-102	1.25 k	25 w		WW	5%	
R630	304-100	10 Ω	1 w				
R632	302-473	47 k	½ w				
R633	302-333	33 k	½ w				
R635	302-105	1 meg	½ w				
R636	302-105	1 meg	½ w				
R638	302-102	1 k	½ w				
R639	Use 308-091	3 k	5 w		WW	5%	101-107
	308-091	2 k	5 w		WW	5%	108-up
R641	310-056	333 k	1 w		Prec.	1%	
R642	310-057	490 k	1 w		Prec.	1%	
R660	304-100	10 Ω	1 w				
R662	304-274	270 k	1 w				
R663	302-563	56 k	½ w				
R666	302-105	1 meg	½ w				
R668	302-102	1 k	½ w				
R669	308-102	1.25 k	25 w		WW	5%	
R671	310-100	1 meg	1 w		Prec.	1%	
R672	310-057	490 k	1 w		Prec.	1%	
R751	308-116	2.2 Ω	½ w		WW	5%	101-125
	307-015	3.3 Ω	1 w			5%	126-up
R790	302-104	100 k	½ w				
R794	302-274	270 k	½ w				
R795	302-104	100 k	½ w				
R803	Use 302-473	27 k	½ w				101-143
	302-473	47 k	½ w				144-up
R804	302-473	47 k	½ w				

Resistors *(continued)*

Ckt. No.	Tektronix Part Number		Description				S/N Range
R805	302-472	4.7 k	½ w				
R807	302-331	330 Ω	½ w				
R810	302-155	1.5 meg	½ w				
R811	311-042	2 meg	2 w	Var.		H. V. Adj.	
R812	302-225	2.2 meg	½ w				
R813	302-475	4.7 meg	½ w				
R814	302-475	4.7 meg	½ w				
R815	302-475	4.7 meg	½ w				
R825	302-332	3.3 k	½ w				
R830	302-473	47 k	½ w				
R831	311-041	1 meg	½ w	Var.		INTENSITY	101-929
R831	311-0041-02	1 meg	½ w	Var.		INTENSITY	930-up
R832	306-475	4.7 meg	2 w				
R833	306-475	4.7 meg	2 w				
R834	302-104	100 k	½ w				101-170
	302-333	33 k	½ w				171-up
R835	306-155	1.5 meg	2 w				101-170
	302-225	2.2 meg	½ w				171-up
R850	306-225	2.2 meg	2 w				
R851	306-225	2.2 meg	2 w				
R852	311-043	2 meg	½ w	Var.	WW	FOCUS	101-929
R852	311-0043-02	2 meg	½ w	Var.	WW	FOCUS	930-up
R853	304-105	1 meg	1 w				
R855	302-103	10 k	½ w				
R858	302-273	27 k	½ w				
R860	311-023	50 k	2 w	Var.		ASTIGMATISM	
R861	311-026	100 k	2 w	Var.		Geom. Adj.	
R863	302-154	150 k	½ w				101-319X
R864	302-124	120 k	½ w				101-319X
R870	302-154	150 k	½ w				
R871	302-102	1 k	½ w				
R872	302-335	3.3 meg	½ w				101-309
	301-395	3.9 meg	½ w			5%	310-up
R874	302-683	68 k	½ w				
R875	302-102	1 k	½ w				
R876	302-275	2.7 meg	½ w				101-309
	301-245	2.4 meg	½ w			5%	310-up
R878	304-333	33 k	1 w				
R879	311-016	10 k	2 w	Var.		Cal Adj.	
R880	302-104	100 k	½ w				101-309
	302-683	68 k	½ w				310-up
R883	302-101	100 Ω	½ w				101-309
	302-102	1 k	½ w				310-up
R885	309-100	10 k	½ w		Prec.	1%	
R886	309-099	6 k	½ w		Prec.	1%	
R887	309-098	2 k	½ w		Prec.	1%	
R888	309-115	1 k	½ w		Prec.	1%	
R889	309-097	600 Ω	½ w		Prec.	1%	
R890	309-073	200 Ω	½ w		Prec.	1%	

Resistors *(continued)*

Ckt. No.	Tektronix Part Number		Description			S/N Range
R891	309-112	100 Ω	½ w	Prec.	1%	
R892	309-067	60 Ω	½ w	Prec.	1%	
R893	309-064	20 Ω	½ w	Prec.	1%	
R894	309-096	10 Ω	½ w	Prec.	1%	
R895	309-096	10 Ω	½ w	Prec.	1%	

Switches

	Unwired	Wired		
SW10, SW20	*260-151	*262-196	Rotary	TRIGGER SELECTOR
SW110†	311-099			PRESET
SW160††	*260-226	*262-182	Rotary	TIME/DIV. 101-879
SW160††	260-0226-00	*262-0182-01	Rotary	TIME/DIV 880-up
SW300	*260-186	*262-224	Rotary	DISPLAY
SW401	260-122		Rotary	AC/DC
SW420†††, SW517†††	*260-187	Use *262-479	Rotary	VOLTS/DIV.
SW600	260-134		Toggle	POWER ON
SW870	*260-098	*262-145	Rotary	VOLTS PEAK-TO-PEAK
TK601	260-120		Thermal Cutout 137° ±5°	

Transformers

T600	*120-112	L. V. Power
T801	*120-129	H. V. Power

Electron Tubes

V14	154-187	6DJ8	
V35	154-187	6DJ8	
V135	154-187	6DJ8	
V145	154-078	6AN8	101-889
V145	154-0278-00	EFC-80/6BL8	890-up
V152	Use *157-0104-01	6AL5 Selected	101-849
V152	154-0016-00	6AL5	850-up
V161	154-078	6AN8	
V183	154-187	6DJ8	
V193	154-187	6DJ8	
V313	154-187	6DJ8	
V354	154-187	6DJ8	
V374	154-187	6DJ8	
V454	154-030	6CB6	
V463	154-187	6DJ8	
V483	154-022	6AU6	101-849
V483	154-0022-07	8425	850-up
V503	154-022	6AU6	101-849
V503	154-0022-07	8425	850-up
V514	154-022	6AU6	101-849
V514	154-0022-07	8425	850-up
V524	154-022	6AU6	101-849
V524	154-0022-07	8425	850-up
V533	154-187	6DJ8	
V544	154-031	6CL6	
V554	154-031	6CL6	

†Concentric with R29, R110 and R330. Furnished as a unit.

††Concentric with R160. Furnished as a unit.

†††SW420, SW517, and R516 are concentric.

Electron Tubes *(Cont'd)*

Ckt. No.	Tektronix Part Number	Description	S/N Range
V563	154-022	6AU6	
V606	154-078	6AN8	
V609	154-052	5651	
V617	154-056	6080	
V636	154-022	6AU6	
V637	154-044	12B4	
V666	154-022	6AU6	
V800	154-167	6CZ5	
V814	154-041	12AU7	
V820	154-051	5642	
V821	154-051	5642	
V822	154-051	5642	
V823	154-051	5642	
V824	154-051	5642	
V859†	Use *154-346	T3170-31 CRT Standard Phosphor	101-399
	*154-0346-00	T3170-31 CRT Standard Phosphor	400-up
V875	154-033	6U8	101-309
	154-041	12AU7	310-up
V883	154-022	6AU6	

† S/N 101-399 add *050-090. See CSPN #31.

MECHANICAL PARTS LIST

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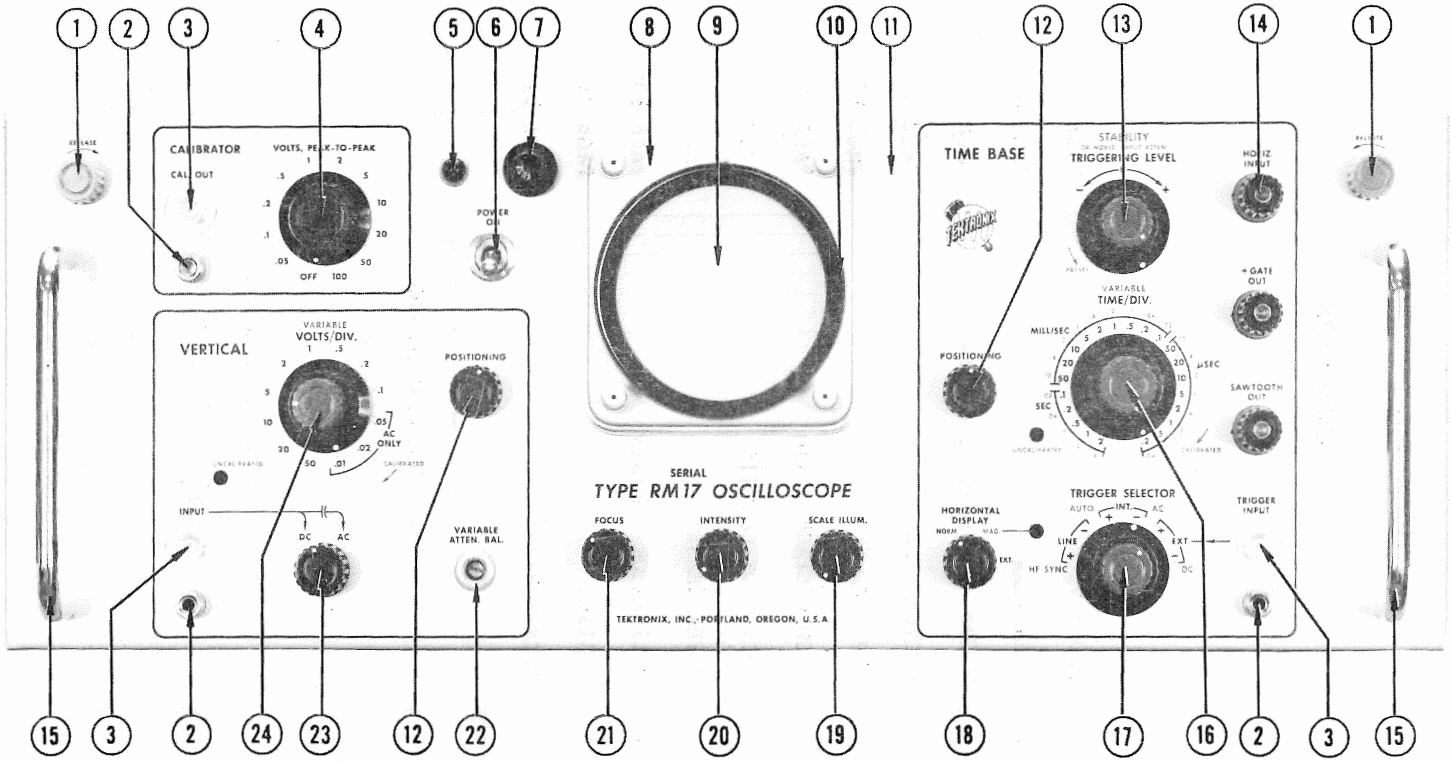
CALIBRATOR
VOLTS, PEAK-TO-PEAK
CAL. OUT
OFF
VERTICAL
VARIABLE VOLTS/DIV.
POSITIONING
INPUT
DC
AC
VARIABLE ATTEN. BAL.
POWER ON
SERIAL
TYPE RM17 OSCILLOSCOPE
FOCUS
INTENSITY
SCALE ILLUM.
TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.
TIME BASE
STABILITY
TRIGGERING LEVEL
HORIZ INPUT
+GATE OUT
VARIABLE TIME/DIV.
MILLISEC
μSEC
SEC
SAWTOOTH OUT
POSITIONING
HORIZONTAL DISPLAY
NORM
MAG.
EXT.
TRIGGER SELECTOR
AUTO.
INT.
LINE
EXT.
HF SYNC
TRIGGER INPUT
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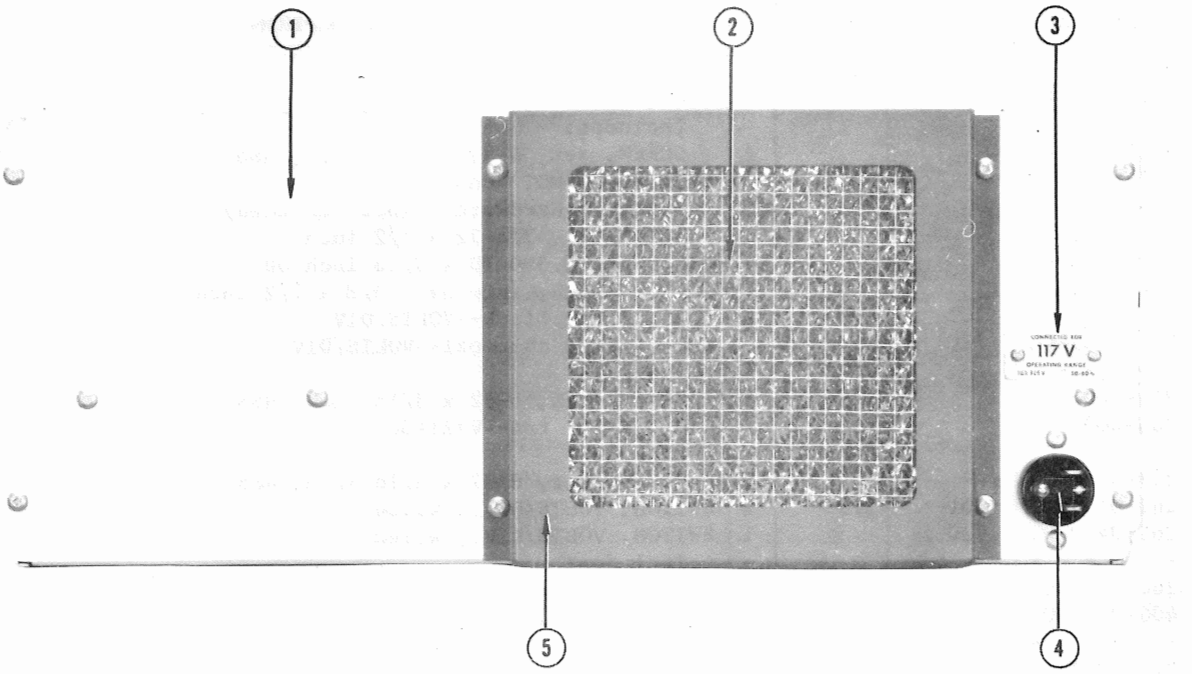
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	366-0061-00			2	KNOB, small gray
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HHS
2	129-0035-00			3	POST, binding, assembly
	- - - - - -			-	each post includes:
	355-0507-00			1	STEM, adapter
	200-0103-00			1	CAP
	210-0455-00			1	NUT, hex., 1/4-28 x 3/8 inch
	210-0046-00			1	LOCKWASHER, internal, 0.400 OD x 0.261 inch ID
3	131-0081-00	101	469	3	CONNECTOR, chassis mount, 1 contact, UHF
	131-0126-00	470		3	CONNECTOR, chassis mount, 1 contact, BNC
4	366-0028-00	101	779	1	KNOB, large black--VOLTS, PEAK-TO-PEAK
	366-0145-00	780		1	KNOB, large charcoal--VOLTS, PEAK-TO-PEAK
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0145-00			1	SWITCH, VOLTS, PEAK-TO-PEAK, wired
	- - - - - -			-	switch includes:
	260-0098-00			1	SWITCH, unwired
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
5	136-0047-00	101	919	1	SOCKET, light, with red jewel
	136-0079-00	920		1	SOCKET, light, with green jewel
6	260-0134-00			1	SWITCH, POWER ON, toggle
	- - - - - -			-	switch includes:
	210-0414-00			1	NUT, hex., 15/32-32 x 9/16 inch
	- - - - - -			-	mounting hardware: (not included w/nut)
	210-0473-00			1	NUT, switch, 15/32-32 x 5/64 inch, 12 sided
	210-0902-00			1	WASHER, 0.470 ID x 21/32 inch OD
	354-0055-00			1	RING, locking, switch
7	352-0014-00			1	HOLDER, fuse
8	200-0073-00			1	COVER, graticule
	- - - - - -			-	mounting hardware: (not included w/graticule)
	212-0509-00			4	SCREW, 8-32 x 5/8 inch, BHS
	210-0434-00			4	NUT, knurled, graticule
	210-0844-00			4	WASHER, enoprene, 7/32 ID x 3/8 inch OD
9	331-0042-00	101	399	1	GRATICULE, 8 vertical x 10 horizontal
	331-0095-00	400		1	GRATICULE, 3-1/2 x 3-5/16 inches
	- - - - - -			-	mounting hardware: (not included w/graticule)
	211-0008-00	X400		1	SCREW, 4-40 x 1/4 inch, BHS
10	124-0050-00			1	STRIP, felt (not shown)
11	333-0458-00			1	PANEL, front
	386-0663-00			1	PLATE, front sub-panel
12	366-0033-00	101	779	2	KNOB, small black--POSITIONING
	366-0148-00	780		2	KNOB, small charcoal--POSITIONING
	- - - - - -			-	each knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	Mounting Hardware For Each Pot:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
13	366-0030-00	101	779	1	KNOB, large black--TRIGGERING LEVEL
	366-0146-00	780		1	KNOB, large charcoal--TRIGGERING LEVEL
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0032-00			1	KNOB, small red--STABILITY
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	Mounting Hardware for Pot:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch
14	129-0036-00	101	779	3	POST, binding, black
	129-0063-00	780		3	POST, binding, charcoal
	- - - - - -			-	Mounting Hardware For Each: (not included)
	358-0036-00	101	779	1	BUSHING, binding post, black
	358-0169-00	780		1	BUSHING, binding post, charcoal
	210-0010-00	101	499X	1	LOCKWASHER, internal, #10
	210-0445-00	101	499	2	NUT, hex., 10-32 x 3/8 inch
	220-0410-00	500		1	NUT, keps, 10-32 x 3/8 inch
	210-0206-00	101	499X	1	LUG, solder, SE10, long
15	367-0008-00			2	HANDLE, drawer
	- - - - - -			-	Mounting Hardware For Each: (not included)
	212-0506-00			2	SCREW, 10-32 x 3/8 inch, FHS, phillips
16	366-0040-00	101	779	1	KNOB, large black--TIME/DIV
	366-0160-00	780		1	KNOB, large charcoal--TIME/DIV
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0038-00			1	KNOB, small red--VARIABLE
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0182-00	101	879	1	SWITCH, TIME/DIV., wired
	262-0182-01	880		1	SWITCH, TIME/DIV., wired
	- - - - - -			-	Includes:
	260-0226-00			1	SWITCH, unwired
	384-0147-00			1	ROD, extension
	376-0014-00			1	COUPLING, pot
	337-0141-00			1	SHIELD, switch
	- - - - - -			-	Mounting Hardware:
	210-0449-00			2	NUT, hex., 5-40 x 1/4 inch
	210-0017-00			1	LOCKWASHER, spring, #5
	210-0202-00			1	LUG, solder, SE6
	348-0003-00			2	GROMMET, 5/16 inch
	- - - - - -			-	Mounting Hardware For Pot:
	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch

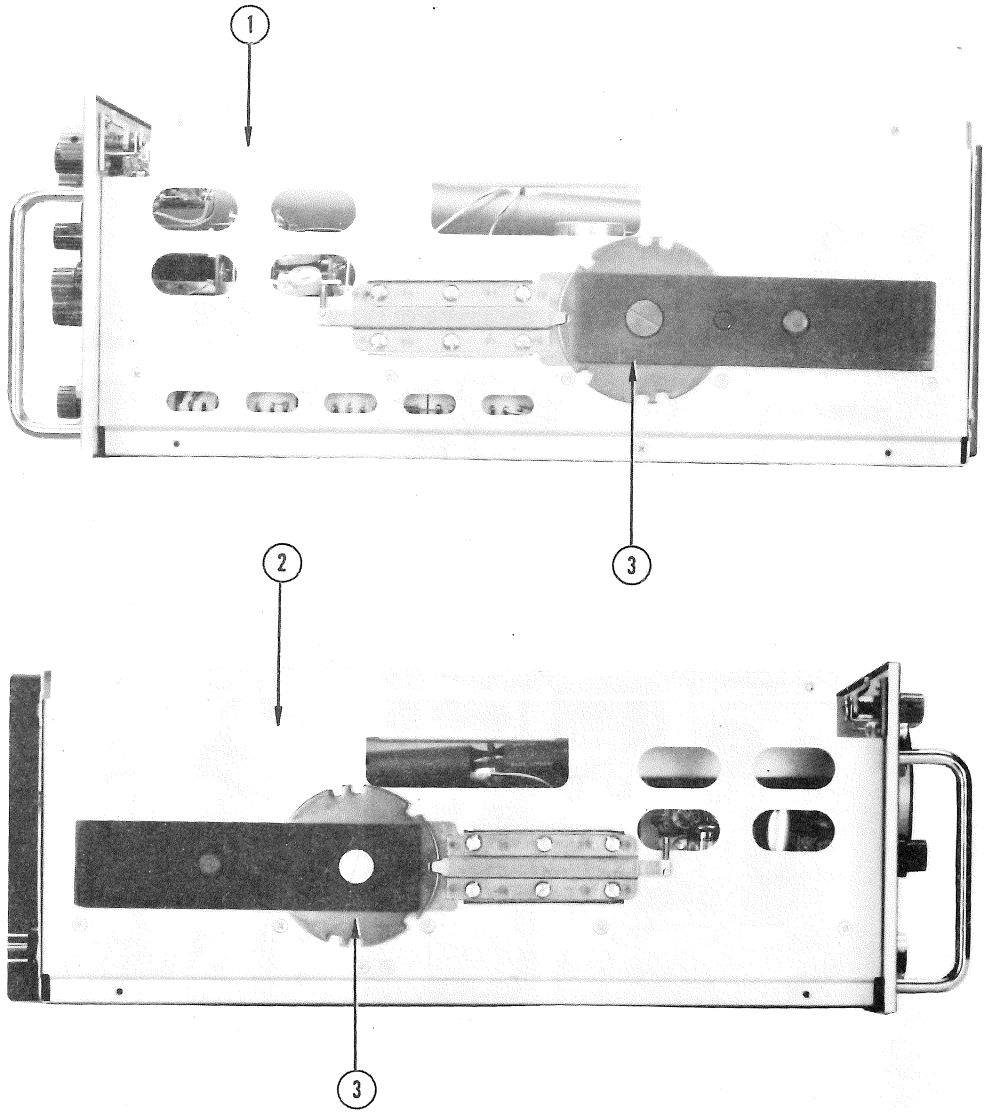
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
23	366-0033-00	101	779	1	KNOB, small black--AC-DC
	366-0148-00	780		1	KNOB, small charcoal--AC-DC
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	260-0122-00			1	SWITCH, AC/DC, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
24	366-0029-00	101	779	1	KNOB, large black--VOLTS/DIV
	366-0142-00	780		1	KNOB, large charcoal--VOLTS/DIV
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0031-00			1	KNOB, small red--VARIABLE
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0144-00	101	319	1	SWITCH, VOLTS/DIV., wired
	262-0479-00	320		1	SWITCH, VOLTS/DIV., wired
	- - - - - -			-	Includes:
	260-0187-00			1	SWITCH, unwired
	406-0337-00			1	BRACKET, capacitor
	- - - - - -			-	Mounting Hardware:
	211-0007-00			2	SCREW, 4-40 x 3/16 inch, BHS
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
	213-0034-00	101	218	16	SCREW, thread cutting, 4-40 x 5/16 inch, RHS
	214-0153-00	219		8	FASTENER, snap, double pronged
	124-0009-00			1	STRIP, brass
	- - - - - -			-	Mounting Hardware For Pot:
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch

REAR



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	386-0666-00			1	PLATE, back
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			4	SCREW, 6-32 x 5/16 inch, BHS
	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch
2	378-0017-00			1	FILTER, air
3	334-0649-00			1	TAG, voltage rating
	- - - - - -			-	Mounting Hardware: (not included)
	213-0088-00			2	SCREW, thread forming, 4-40 x 1/4 inch, PHS, phillips
4	131-0102-00	101	869	1	CONNECTOR, chassis mount, motor base
	131-0102-01	870		1	CONNECTOR, chassis mount, motor base
	- - - - - -			-	assembly includes:
	129-0041-00	101	869	1	POST, ground
	129-0041-01	870		1	POST, ground
	200-0185-00	101	869	1	COVER, plastic
	200-0185-01	870		1	COVER, plastic
	210-0003-00	101	869X	2	LOCKWASHER, external, #4
	210-0551-00	101	869X	2	NUT, hex., 4-40 x 1/4 inch
	211-0132-00	X870		1	SCREW, sems, 4-40 x 1/2 inch, PHS
	211-0015-00	101	869	1	SCREW, 4-40 x 1/2 inch, RHS
	213-0088-00	870		1	SCREW, thread forming, 4-40 x 1/4 inch, PHS
	214-0078-00			2	PIN, connecting
	377-0041-00	101	869	1	INSERT, plastic
	377-0041-01	870		1	INSERT, plastic
	386-0933-00			1	PLATE, mounting
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, BHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
5	380-0011-00	101	178	1	HOUSING, air filter
	380-0019-00	179		1	HOUSING, air filter
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			4	SCREW, 6-32 x 5/16 inch, BHS

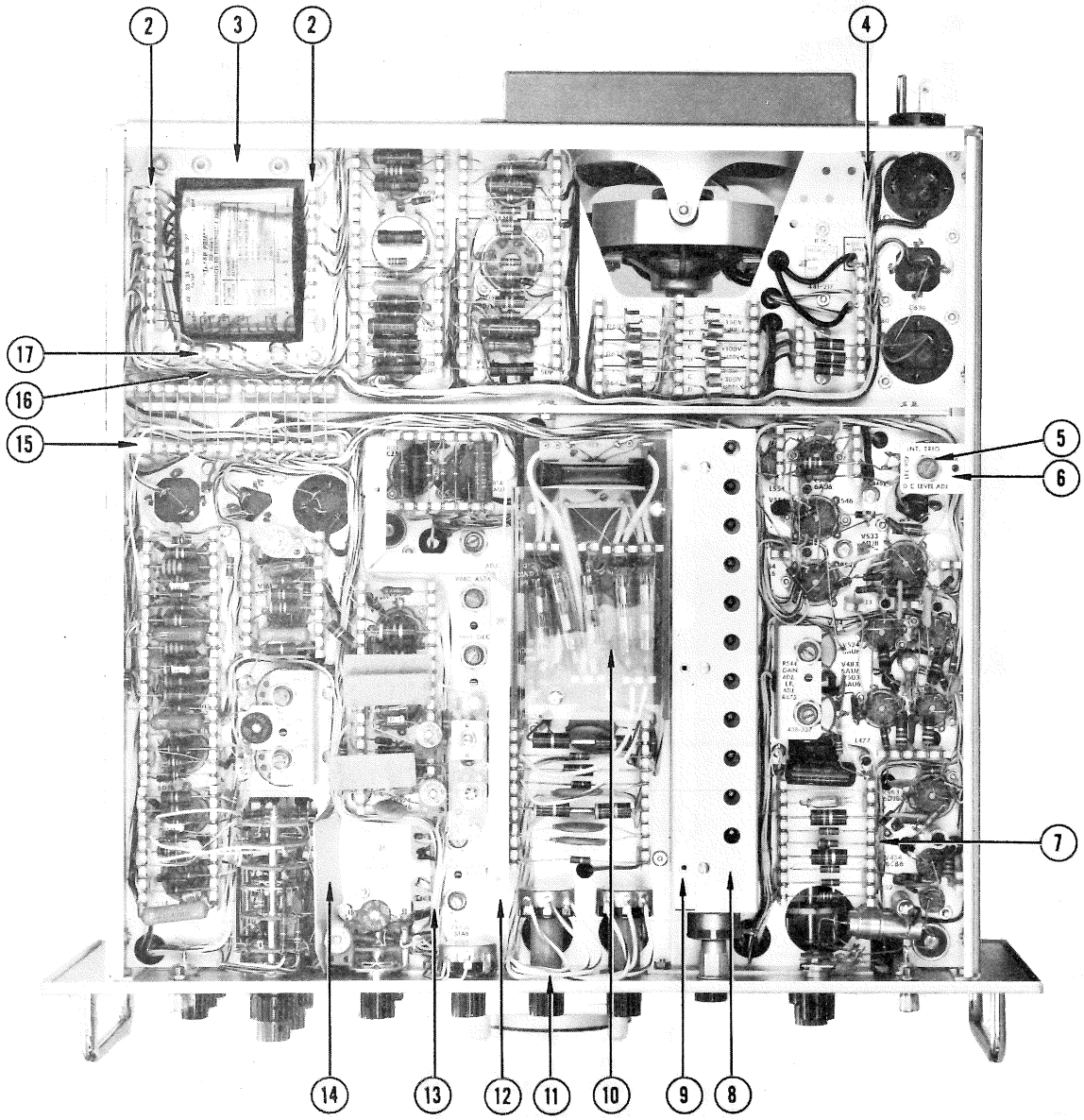
RIGHT SIDE — LEFT SIDE



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	386-665			1	PLATE, right side
	- - - -			-	Mounting Hardware: (not included)
	211-538			3	SCREW, 6-32 x 5/16 inch FHS phillips
	210-457			3	NUT, keps, 6-32 x 5/16 inch
2	386-664			1	PLATE, left side
	- - - -			-	Mounting Hardware: (not included)
	211-538			3	SCREW, 6-32 x 5/16 inch FHS, phillips
	210-457			3	NUT, keps, 6-32 x 5/16 inch
3	351-027			1	SLIDE, chassis track, 1 pair, left & right
	- - - -			-	Includes Mounting Hardware:
	212-023			12	SCREW, 8-32 x 3/8 inch BHS
	210-008			12	LOCKWASHER, internal, #8
	210-409			12	NUT, hex, 8-32 x 5/16 inch

BOTTOM

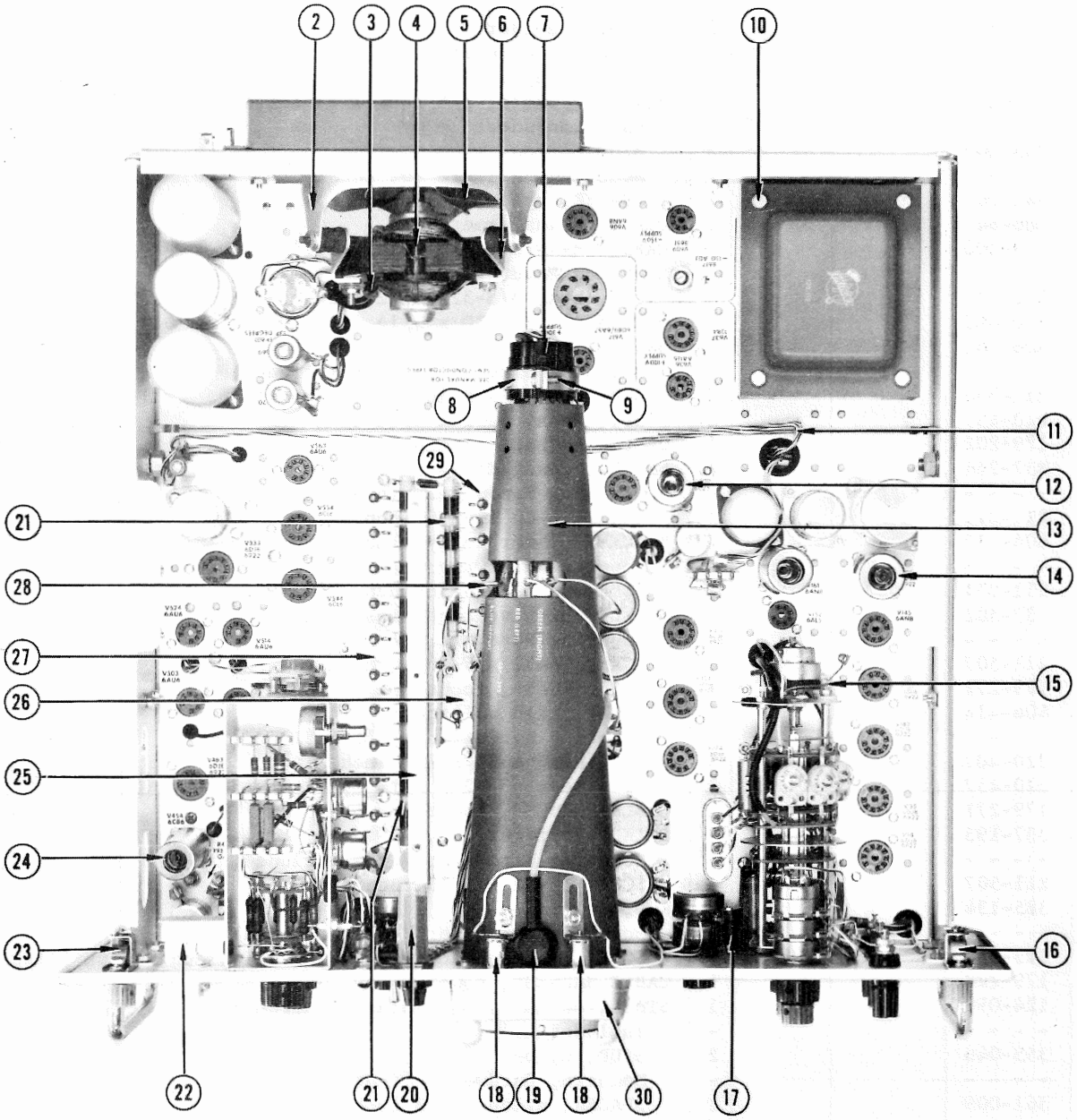
(1) HIGH VOLTAGE SHIELD & SOLDER HOLDER



BOTTOM

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	337-265			1	SHIELD, high voltage (not shown)
	- - - -			-	Mounting Hardware: (not included)
	211-007			6	SCREW, 4-40 x 3/16 inch BHS
	348-012			1	GROMMET, 5/8 inch (not shown)
	214-210			1	SPOOL, solder, assembly (not shown)
	- - - -			-	Includes:
	214-209			1	SPOOL, solder
	- - - -			-	Mounting Hardware: (not included)
	361-007			1	SPACER, nylon, .063 inch
2	124-091			2	STRIP, ceramic, 3/4 inch X 11 notches
	- - - -			-	Each Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			2	SPACER, nylon, .313 inch
3	386-645			1	PLATE, transformer
4	179-200			1	CABLE HARNESS, 110 volt, power
5	- - - -			-	Mounting Hardware For Pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
6	406-341			1	BRACKET, pot
	- - - -			-	Mounting Hardware: (not included)
	211-538			2	SCREW, 6-32 x 5/16 inch FHS phillips
	210-457			2	NUT, keps, 6-32 x 5/16 inch
7	179-202			1	CABLE HARNESS, preamplifier
8	337-264			1	SHIELD, lower delay line
	- - - -			-	Mounting Hardware: (not included)
	211-011			3	SCREW, 4-40 x 5/16 inch BHS
9	406-413			1	BRACKET, lower delay line
	- - - -			-	Mounting Hardware: (not included)
	211-011			2	SCREW, 4-40 x 5/16 inch BHS
10	337-302			1	SHIELD, high voltage, insulating
	- - - -			-	Mounting Hardware: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
11	179-272			1	CABLE HARNESS, focus and intensity
12	406-414			1	BRACKET, high voltage
	- - - -			-	Mounting Hardware: (not included)
	210-407			3	NUT, hex, 6-32 x 1/4 inch
	210-457			3	NUT, keps, 6-32 x 5/16 inch
13	179-271			1	CABLE HARNESS, indicator
14	337-193			1	SHIELD, trigger
	- - - -			-	Mounting Hardware: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
15	385-134			1	ROD, delrin
	- - - -			-	Mounting Hardware: (not included)
	213-068			1	SCREW, thread cutting, 6-32 x 5/16 inch FHS phillips
16	179-228			1	CABLE HARNESS, power
17	124-090			1	STRIP, ceramic, 3/4 inch x 9 notches
	- - - -			-	Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware: (not included)
	361-009			2	SPACER, nylon, .313 inch

(1) DELAY LINE SHIELD



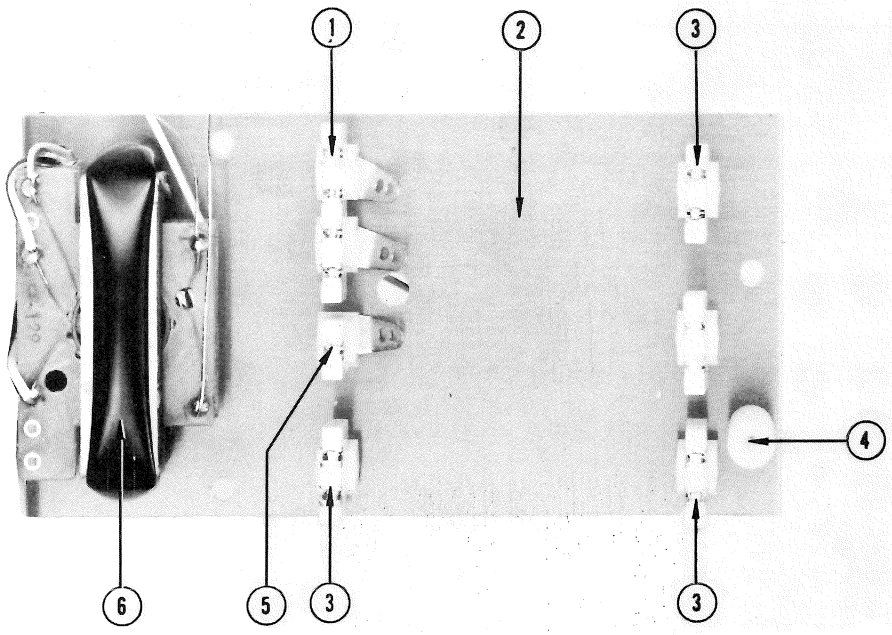
TOP

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	337-202			1	SHIELD, upper delay line (not shown)
	- - - -			-	Mounting Hardware: (not included)
	211-011			3	SCREW, 4-40 x 5/16 inch BHS
2	354-065			1	RING, fan
	- - - -			-	Mounting Hardware: (not included)
	213-041			4	SCREW, thread cutting, 6-32 x 3/8 inch THS phillips
3	343-002			1	CLAMP, cable, 3/16 inch
	- - - -			-	Mounting Hardware: (not included)
	212-031			1	SCREW, 8-32 x 1-1/4 inch RHS
4	147-021			1	MOTOR, AC, 110 V, 2770 RPM, 35 W
	- - - -			-	Includes:
	NO NUMBER			2	SCREW, 8-32 x 1 inch RHS
	210-008			2	LOCKWASHER, internal #8
	210-409			2	NUT, hex, 8-32 x 5/16 inch
5	369-011			1	FAN, 4-1/2 inch, clockwise
6	406-431			1	BRACKET, motor
	- - - -			-	Mounting Hardware: (not included)
	348-008			3	SHOCKMOUNT
	210-008			3	LOCKWASHER, internal #8
	210-409			3	NUT, hex, 8-32 x 5/16 inch
7	136-110			1	SOCKET, CRT
8	343-029			1	CLAMP, CRT socket
	- - - -			-	Mounting Hardware: (not included)
	211-538			4	SCREW, 6-32 x 5/16 inch FHS phillips
	210-803			4	WASHER, 6L x 3/8 inch
	210-457			4	NUT, keps, 6-32 x 5/16 inch
9	212-557			1	SCREW, 10-32 x 1/2 inch RHS
	210-501			1	NUT, square, 10-32 x 3/8 inch
10	- - - -			-	Mounting Hardware For Transformer:
	212-515			4	SCREW, 10-32 x 2-1/4 inch HEX HS
	210-812			4	WASHER, fiber, #10
	210-445			4	NUT, hex, 10-32 x 3/8 inch
	210-010			4	LOCKWASHER, internal #10
	210-564			4	NUT, hex, 10-32 x 3/8 inch
11	179-201			1	CABLE HARNESS, 110 volt, indicator
12	337-009			1	SHIELD, tube, 2-13/32 inch
13	337-292			1	SHIELD, CRT
	- - - -			-	Mounting Hardware: (not shown)
	212-509			4	SCREW, 10-32 x 5/8 inch BHS
14	337-008			3	SHIELD, tube, 1-15/16 inch
15	406-483			1	BRACKET, switch
	- - - -			-	Mounting Hardware: (not included)
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
	210-457			1	NUT, keps, 6-32 x 5/16 inch
16	214-424			1	FASTENER, pawl right, with stop
	- - - -			-	Mounting Hardware: (not included)
	211-038			2	SCREW, 4-40 x 5/16 inch FHS phillips
	210-004			2	LOCKWASHER, internal #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
17	352-008			3	HOLDER, neon bulb, single
	- - - -			-	Mounting Hardware For Each: (not included)
	211-031			1	SCREW, 4-40 x 1 inch FHS
	210-406			2	NUT, hex, 4-40 x 3/16 inch
18	136-001			2	SOCKET, graticule light
	- - - -			-	Mounting Hardware For Each: (not included)
	211-534			1	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-803			1	WASHER, 6L x 3/8 inch
	210-457			1	NUT, keps, 6-32 x 5/16 inch

TOP

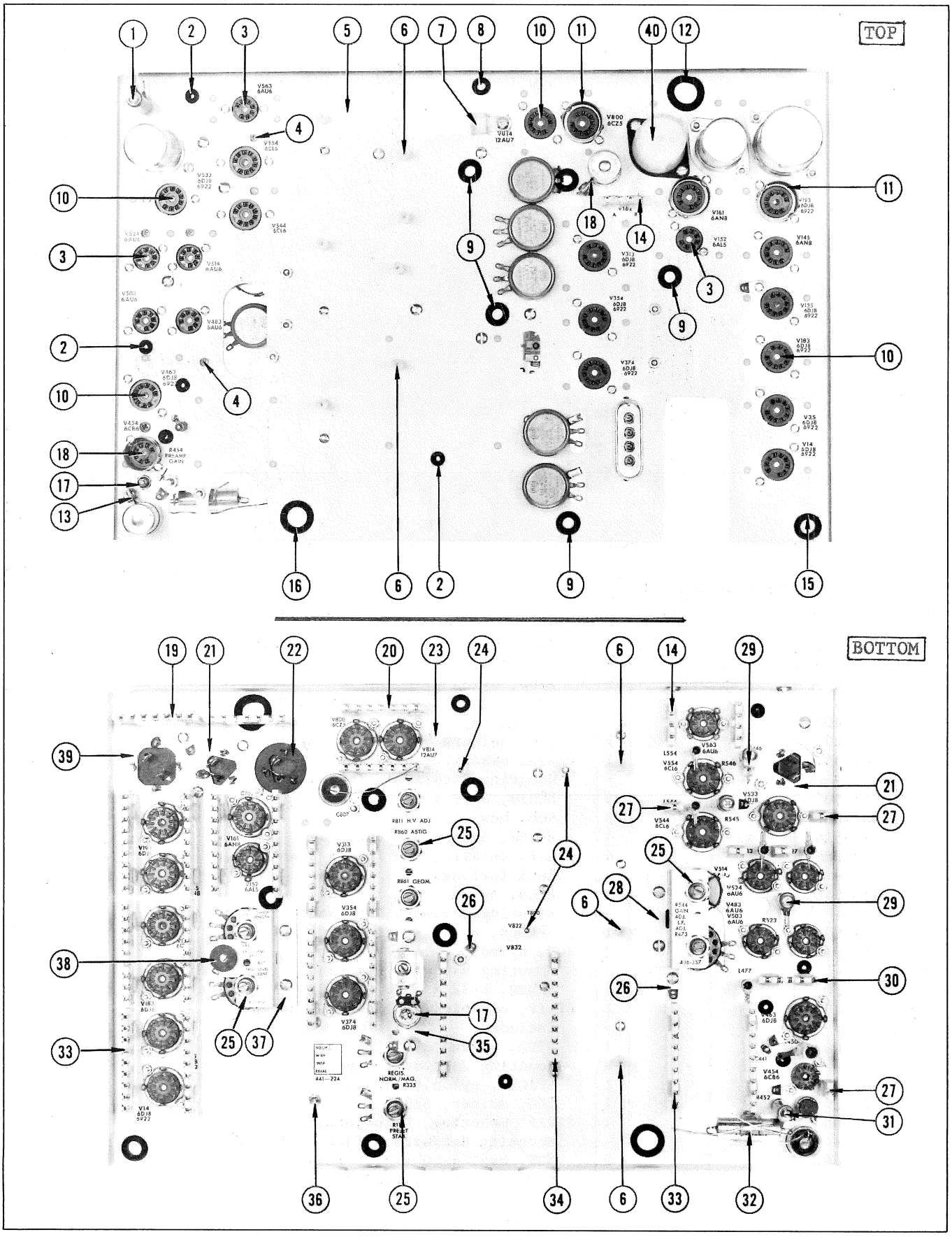
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
19	131-084			1	CONNECTOR, cable, anode assembly
	- - - -			-	Consisting Of:
	131-073			1	CONNECTOR, CRT brush
	200-110			1	CAP, CRT anode connector
	200-197			1	COVER, CRT anode (not shown)
	134-031			1	PLUG, CRT contact
20	200-237			1	COVER, insulation, fuse holder
21	352-013			6	HOLDER, coil form
22	337-192			1	SHIELD, calibrator
23	214-425			1	FASTENER, pawl left, with stop
	- - - -			-	Mounting Hardware: (not included)
	211-038			2	SCREW, 4-40 x 5/16 inch FHS phillips
	210-004			2	LOCKWASHER, internal #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
24	337-007			2	SHIELD, tube, 1-3/4 inch
25	406-412			1	BRACKET, upper delay line
	- - - -			-	Mounting Hardware: (not included)
	211-011			2	SCREW, 4-40 x 5/16 inch BHS
26	386-729			1	PLATE, plexiglass, load rest
	- - - -			-	Mounting Hardware: (not included)
	211-011			2	SCREW, 4-40 x 5/16 inch BHS
27	386-733			2	PLATE, plexiglass, delay line
	- - - -			-	Mounting Hardware For Each: (not included)
	211-011			3	SCREW, 4-40 x 5/16 inch BHS
28	175-586			1	WIRE, CRT lead, .960 foot, stripped brown, with connector
	175-592			1	WIRE, CRT lead, .960 foot, stripped green, with connector
	175-593			1	WIRE, CRT lead, .333 foot, stripped blue, with connector
	175-595			1	WIRE, CRT lead, .960 food, stripped red, with connector
29	386-732			1	PLATE, plexiglass, upper dealy line
	- - - -			-	Mounting Hardware: (not included)
	211-011			2	SCREW, 4-40 x 5/16 inch BHS
30	426-058			1	MOUNT, CRT
	- - - -			-	Mounting Hardware: (not included)
	211-532			4	SCREW, 6-32 x 3/4 inch Fil HS

HIGH VOLTAGE BOARD



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	124-088			1	STRIP, ceramic, 3/4 inch x 4 notches
	- - - -			-	Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware: (not included)
	361-009			2	SPACER, nylon, .313 inch
	210-205			2	LUG, solder, SE8
2	386-358			1	PLATE, bakelite, high voltage
	- - - -			-	Mounting Hardware: (not included)
	211-507			5	SCREW, 6-32 x 5/16 inch BHS
	385-080			3	ROD, hex
	211-514			1	SCREW, 6-32 x 3/4 inch BHS
3	124-086			4	STRIP, ceramic, 3/4 inch x 2 notches
	- - - -			-	Each Includes:
	355-046			1	STUD, nylon
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			1	SPACER, nylon, .313 inch
4	385-018			2	ROD, nylon
	- - - -			-	Mounting Hardware For Each: (not included
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
5	124-100			1	STRIP, ceramic, 3/4 inch x 1 notch
	- - - -			-	Includes:
	355-046			1	STUD, nylon
	- - - -			-	Mounting Hardware: (not included)
	361-009			1	SPACER, nylon, .313 inch
	210-205			1	LUG, solder, SE8
6	346-001			1	STRAP, mounting, transformer
	- - - -			-	Mounting Hardware: (not included)
	210-406			2	NUT, hex, 4-40 x 3/16 inch
	210-004			2	LOCKWASHER, internal #4

INDICATOR CHASSIS



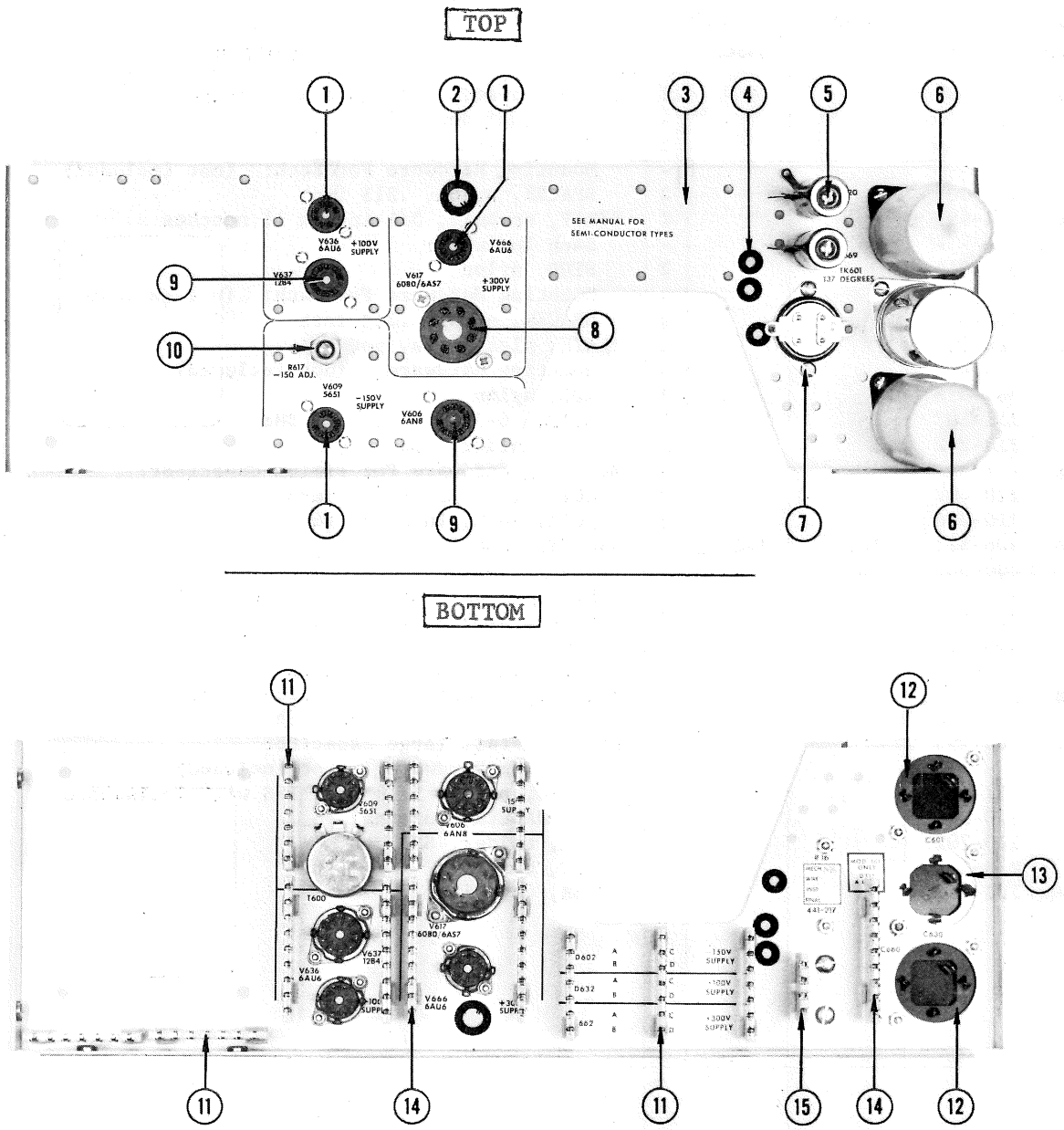
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	- - - - - -			-	Mounting Hardware For 10 Watt Resistor:
	211-0553-00			1	SCREW, 6-32 x 1-1/2 inch RHS phillips
	210-0601-00			1	EYELET
	210-0478-00			1	NUT, hex., resistor mounting
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
2	348-0002-00			4	GROMMET, 1/4 inch
3	136-0008-00			6	SOCKET, STM7G
	- - - - - -			-	mounting hardware for each: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
4	- - - - - -			-	mounting hardware for each coil:
	213-0035-00			1	SCREW, thread cutting, 4-40 x 1/4 PHS phillips
5	441-0224-00	101	889	1	CHASSIS, indicator
	441-0224-01	890		1	CHASSIS, indicator
	- - - - - -			-	mounting hardware: (not included)
	211-0559-00			8	SCREW, 6-32 x 3/8 inch FHS phillips
	210-0457-00			8	NUT, keps, 6-32 x 5/16 inch
6	385-0107-00			10	ROD, nylon
	- - - - - -			-	mounting hardware for each: (not included)
	211-0011-00			1	SCREW, 4-40 x 5/16 inch, BHS
7	343-0042-00			1	CLAMP, cable, 5/16 inch, half
	- - - - - -			-	mounting hardware: (not included)
	213-0041-00			1	SCREW, thread cutting, 6-32 x 3/8 inch, THS phillips
	210-0803-00			1	WASHER, 6L x 3/8 inch
8	348-0003-00			1	GROMMET, 5/16 inch
9	348-0004-00			5	GROMMET, 3/8 inch
10	136-0015-00			16	SOCKET, STM9G
	- - - - - -			-	mounting hardware for each: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
11	337-0005-00			3	SHEILD, socket
12	348-0006-00			1	GROMMET, 3/4 inch
13	343-0036-00			2	CLAMP, capacitor
	- - - - - -			-	mounting hardware for each: (not included)
	214-0012-00			1	BOLT, spade, 6-32 x 3/8 inch
	211-0504-00			1	SCREW, 6-32 x 1/4 inch, BHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
14	124-0012-00	101	107	2	STRIP, ceramic, 3/4 inch x 4 notches
	124-0088-00	108		2	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, 0.313 inch
15	348-0005-00			1	GROMMET, 1/2 inch
16	348-0012-00			1	GROMMET, 5/8 inch
17	- - - - - -			-	mounting hardware for each miniature pot:
	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
	210-0046-00			1	LOCKWASHER, internal, 0.400 OD x 0.261 inch ID

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
18	136-0009-00			1	SOCKET, STM7, shielded
	- - - - - -			-	mounting hardware: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch, PHS with lockwasher
	210-0004-00			1	LOCKWASHER, internal, #4
	210-0201-00			1	LUG, solder, SE4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
19	124-0014-00	101	107	6	STRIP, ceramic, 3/4 inch x 7 notches
	124-0089-00	108		6	STRIP, ceramic, 3/4 inch x 7 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, 0.313 inch
20	- - - - - -			-	mounting hardware for coil:
	213-0054-00			1	SCREW, thread cutting, 6-32 x 5/16 inch, PHS phillips
21	386-0253-00			2	PLATE, metal, small capacitor
	- - - - - -			-	mounting hardware for each: (not included)
	211-0534-00			2	SCREW, 6-32 x 5/16 inch, PHS with lockwasher
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
22	386-0252-00			1	PLATE, fiber, small capacitor
	- - - - - -			-	mounting hardware: (not included)
	211-0534-00			2	SCREW, 6-32 x 5/16 inch, PHS with lockwasher
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
23	385-0076-00	101	239	1	ROD, nylon
	385-0138-00	240		1	ROD, delrin
	- - - - - -			-	mounting hardware: (not included w/rod)
	211-0507-00	101	239	1	SCREW, 6-32 x 5/16 inch, BHS
	213-0041-00	240		1	SCREW, thread cutting, 6-32 x 3/8 inch, THS phillips
24	385-0080-00			3	ROD, hex.
	- - - - - -			-	mounting hardware for each: (not included)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
25	- - - - - -			-	mounting hardware for each pot:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch
26	210-0202-00			2	LUG, solder, SE6
	- - - - - -			-	mounting hardware for each: (not included)
	211-0504-00			1	SCREW, 6-32 x 1/4 inch, BHS
	210-0407-00			1	NUT, hex., 6-32 x 1/4 inch
27	129-0009-00	101	107	5	POST, ceramic
	124-0100-00	108		5	STRIP, ceramic, 3/4 inch x 1 notch
	- - - - - -			-	each strip includes:
	355-0046-00	X108		1	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included)
	210-0405-00	101	107X	2	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	1	LOCKWASHER, external, #2
	210-0850-00	101	107X	1	WASHER, flat, #2
	361-0007-00	X108		1	SPACER, nylon, 0.063 inch

INDICATOR CHASSIS

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
33	124-090			12	STRIP, ceramic, 3/4 inch x 9 notches
	- - - -			-	Each Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			2	SPACER, nylon, .313 inch
34	124-091			2	STRIP, ceramic, 3/4 inch x 11 notches
	- - - -			-	Each Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			2	SPACER, nylon, .313 inch
35	386-859			1	PLATE, plexiglass, pot
	- - - -			-	Mounting Hardware: (not included)
	385-018			2	ROD, nylon
	211-507			4	SCREW, 6-32 x 5/16 inch BHS
	210-202			2	LUG, solder, SE6
36	- - - -			-	Mounting Hardware For Timing Capacitor:
	210-407			2	NUT, hex, 6-32 x 1/4 inch
	210-006			2	LOCKWASHER, internal #6
37	406-321	101	202	1	BRACKET, pot
	406-602	203		1	BRACKET, pot
	- - - -			-	Mounting Hardware: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
38	- - - -			-	Mounting Hardware For Miniature Pot:
	210-438	X203		2	NUT, hex, 1-72 x 5/32 inch
39	386-255			1	PLATE, metal, large capacitor
	- - - -			-	Mounting Hardware: (not included)
	211-534			2	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-006			1	LOCKWASHER, internal #6
	210-202			1	LUG, solder, SE6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
40	200-257			1	COVER, capacitor

POWER CHASSIS

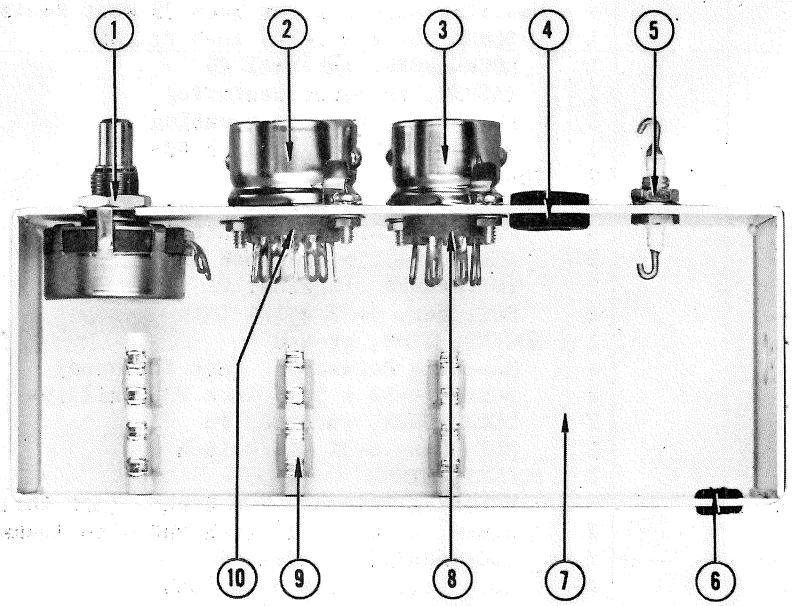


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	136-008			3	SOCKET, STM7G
	- - - -			-	Mounting Hardware For Each: (not included)
	211-033			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-004			2	LOCKWAHSER, internal #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
2	348-005			1	GROMMET, 1/2 inch
3	441-217			1	CHASSIS, power
	- - - -			-	Mounting Hardware: (not included)
	211-538			6	SCREW, 6-32 x 5/16 inch FHS phillips
	210-457			2	NUT, keps, 6-32 x 5/16 inch
	211-507			3	SCREW, 6-32 x 5/16 inch BHS
	213-049			5	SCREW, 6-32 x 5/16 inch HHS
4	348-003			3	GROMMET, 5/16 inch

POWER CHASSIS

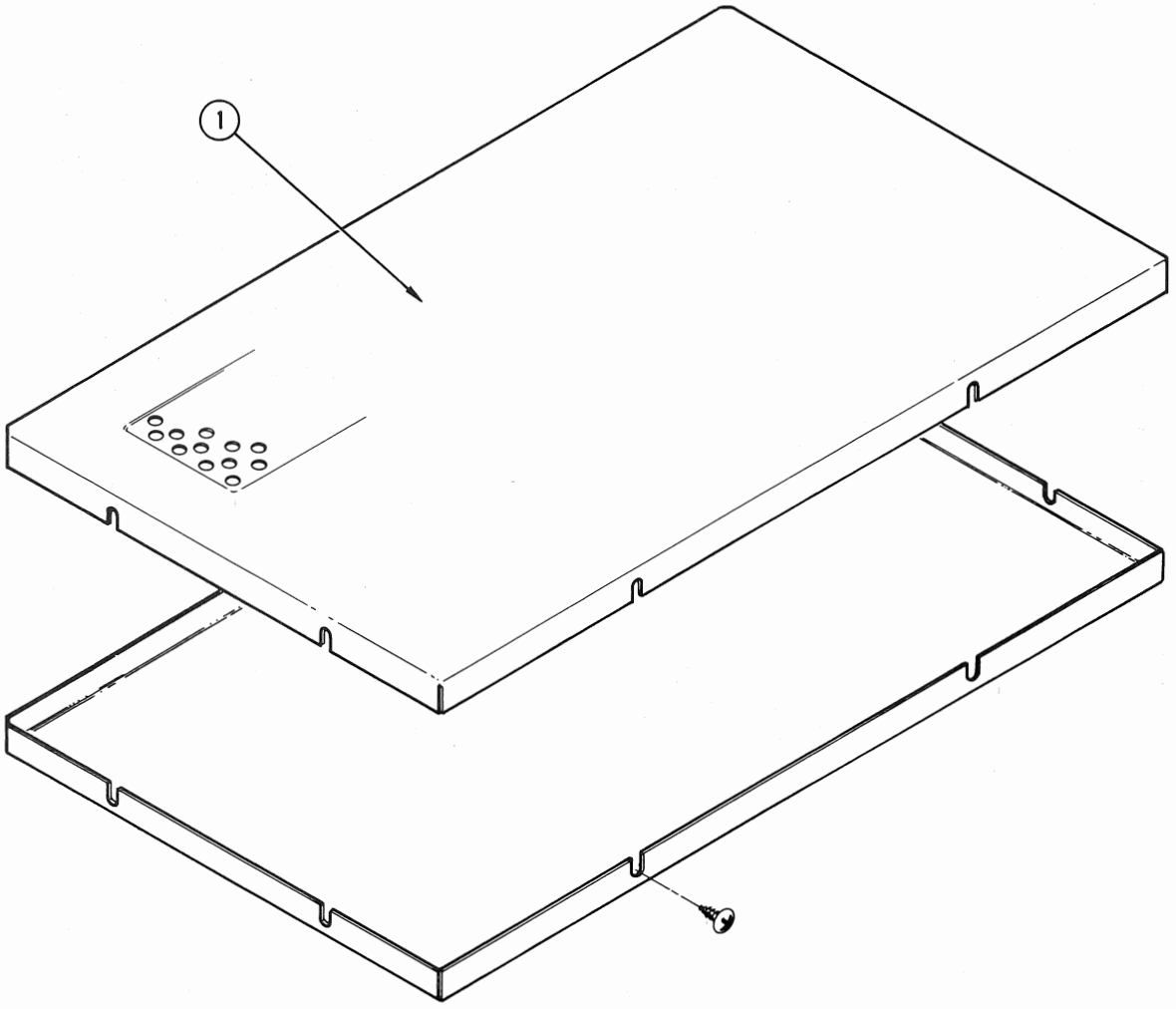
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
5	- - - -			-	Mounting Hardware For Each 25 Watt Resistor:
	212-037			1	SCREW, 8-32 x 1-3/4 inch Fil HS
	210-008			1	LOCKWASHER, internal #8
	210-809			1	WASHER, resistor centering
	210-462			1	NUT, hex, resistor mounting
	212-004			1	SCREW, 8-32 x 5/16 inch BHS
6	200-258			2	COVER, capacitor
7	260-120			1	SWITCH, thermal cutout
	- - - -			-	Mounting Hardware: (not included)
	211-504			2	SCREW, 6-32 x 1/4 inch BHS
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
8	136-011			1	SOCKET, STM8, ground
	- - - -			-	Mounting Hardware: (not included)
	211-538			2	SCREW, 6-32 x 5/16 inch FHS phillips
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
9	136-015			2	SOCKET, STM9G
	- - - -			-	Mounting Hardware For Each: (not included)
	211-033			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-004			2	LOCKWASHER, internal #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
10	- - - -			-	Mounting Hardware For Pot:
	210-444			1	NUT, hex, 3/8-32 x 1/2 x 5/8 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
11	124-089			9	STRIP, ceramic, 3/4 inch x 7 notches
	- - - -			-	Each Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			2	SPACER, nylon, .313 inch
12	386-254			2	PLATE, fiber, large capacitor
	- - - -			-	Mounting Hardware For Each: (not included)
	211-543			2	SCREW, 6-32 x 5/16 inch RHS
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
13	386-255			1	PLATE, metal, large capacitor
	- - - -			-	Mounting Hardware: (not included)
	211-534			2	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1/4 inch
14	124-090			5	STRIP, ceramic, 3/4 inch x 9 notches
	- - - -			-	Each Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			2	SPACER, nylon, .313 inch
15	124-088			1	STRIP, ceramic, 3/4 inch x 4 notches
	- - - -			-	Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware: (not included)
	361-009			2	SPACER, nylon, .313 inch

CALIBRATOR CHASSIS



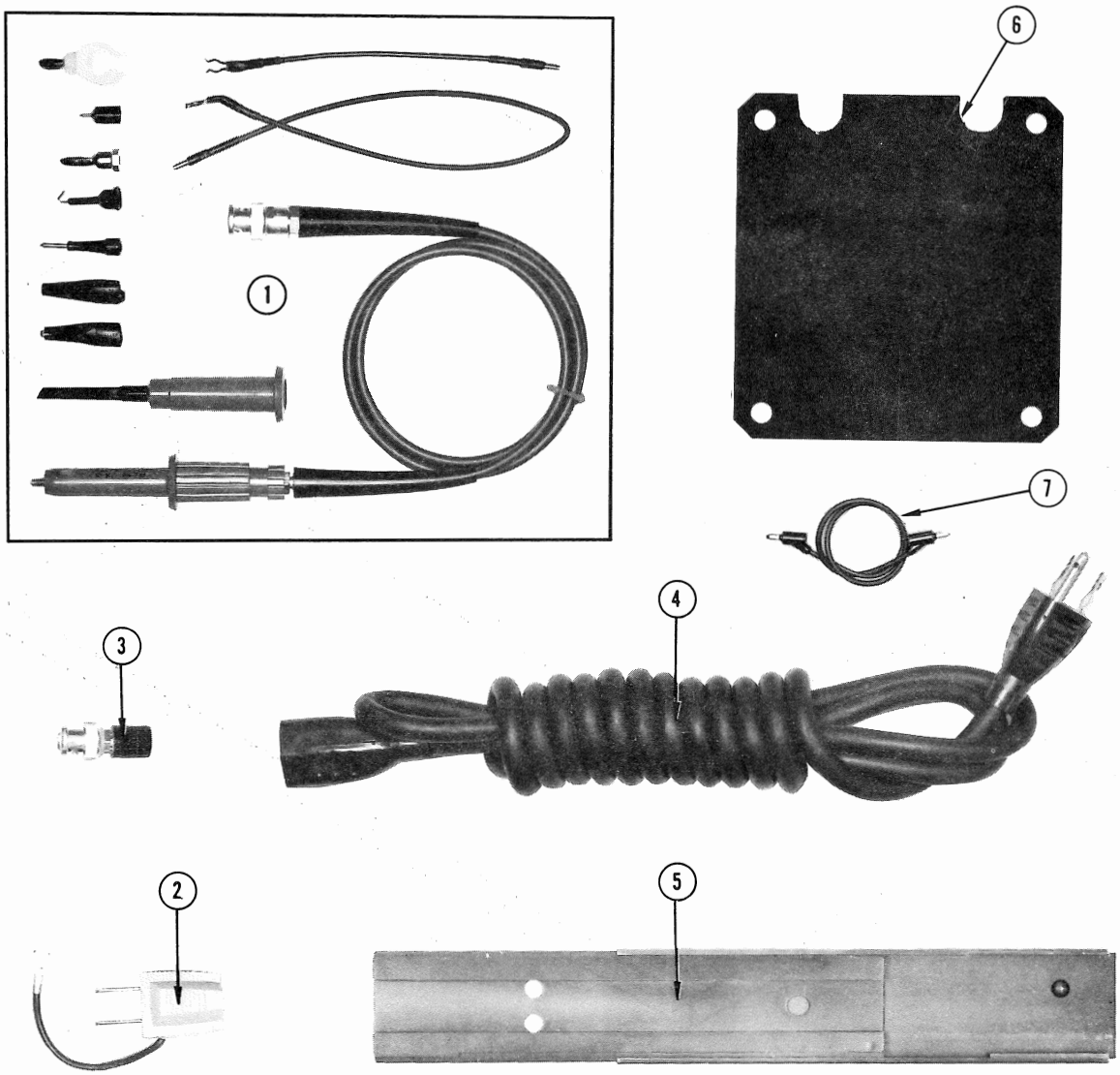
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	- - - -				Mounting Hardware For Pot:
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
2	337-005			1	SHIELD, socket
3	337-004			1	SHIELD, socket
4	348-004			1	GROMMET, 3/8 inch
5	- - - -			-	Mounting Hardware For Capacitor:
	210-467			1	NUT, hex, 12-28 x 5/16 inch
	210-020			1	LOCKWASHER, internal #12
6	348-002			1	GROMMET, 1/4 inch
7	441-183	101	309	1	CHASSIS, calibrator
	441-355	310		1	CHASSIS, calibrator
8	136-010			1	SOCKET, 7 pin, without center pin
	- - - -			-	Mounting Hardware: (not included)
	211-033			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-004			2	LOCKWASHER, internal #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
9	124-088			3	STRIP, ceramic, 3/4 inch x 4 notches
	- - - -			-	Each Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware For Each: (not included)
	361-009			2	SPACER, nylon, .313 inch
10	136-022			1	SOCKET, STM9S
	- - - -			-	Mounting Hardware: (not included)
	211-033			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-004			1	LOCKWASHER, internal #4
	210-201			1	LUG, solder, SE4
	210-406			2	NUT, hex, 4-40 x 3/16 inch

CABINET



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	386-739	101	178	2	PLATE, dust cover
	387-095	179		2	PLATE, dust cover
	- - - -			-	Mounting Hardware For Each: (not included)
	211-507			4	SCREW, 6-32 x 5/16 inch BHS

ACCESSORIES



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	010-127			1	PROBE, package, P6006
	- - - -			-	Includes:
	010-128			1	PROBE, only, P6006
2	103-013			1	ADAPTER, power cord
3	013-004	101	469	2	ADAPTER, binding post
	103-033	470		2	ADAPTER, BNC-to-binding post
4	161-010			1	CORD, power
5	351-017			1	GUIDE, chassis track, 1 pair, left and right
6	378-509			1	FILTER, light, green
7	012-031	X550		1	CORD, red, patch

MECHANICAL PARTS LIST

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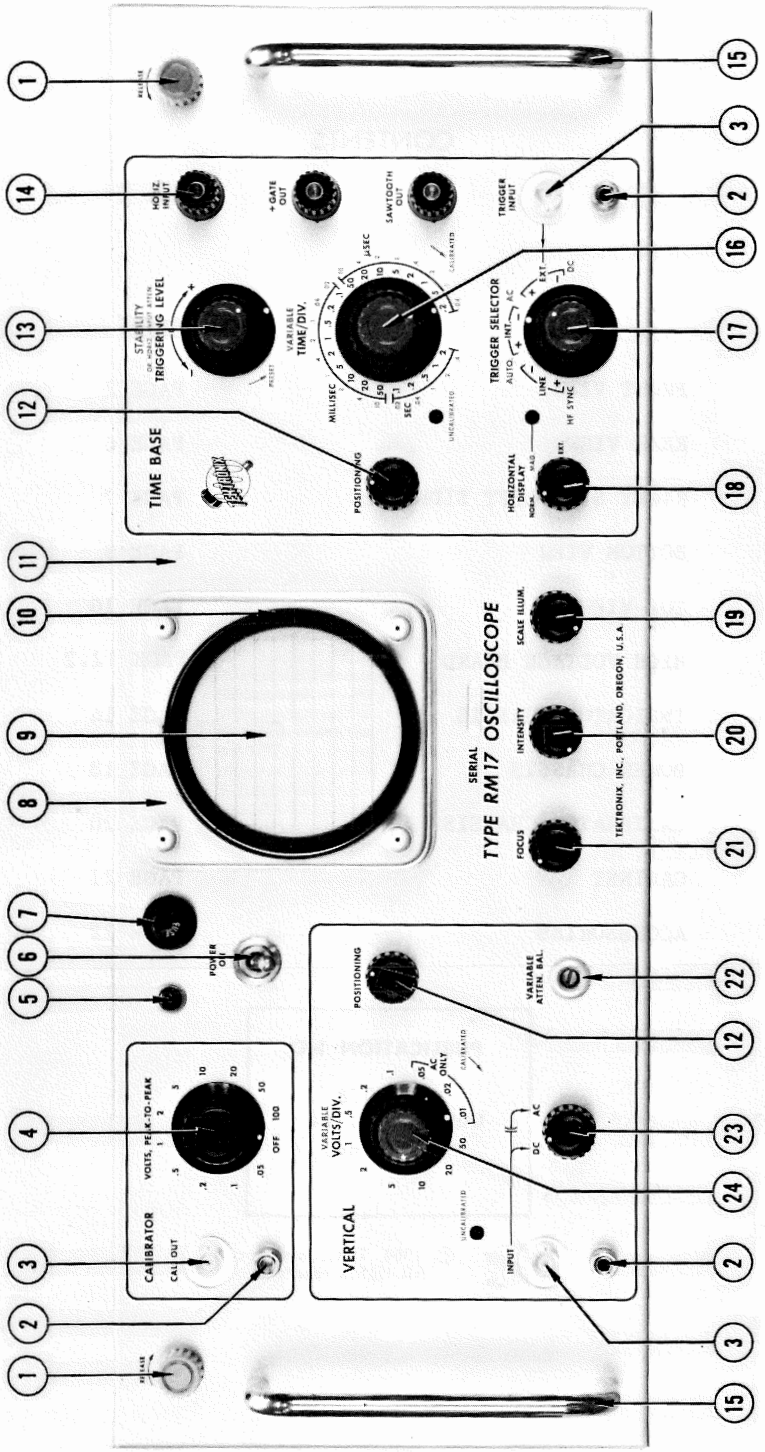
PUBLICATION NO.

062-078
October 1964
(Revised)

FRONT


TIME BASE
STABILITY
TRIGGERING LEVEL
VARIABLE TIME/DIV.
MILLISEC
SEC
μSEC
CALIBRATED
UNCALIBRATED
POSITIONING
HORIZ INPUT
+GATE OUT
SAWTOOTH OUT
TRIGGER INPUT
TRIGGER SELECTOR
AUTO
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HF SYNC
EXT
DC
HORIZONTAL DISPLAY
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SCALE ILLUM.
INTENSITY
FOCUS
TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.
POWER
OFF
VERTICAL
VARIABLE VOLTS/DIV.
VOLTS, PEAK-TO-PEAK
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CALIBRATOR
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INPUT
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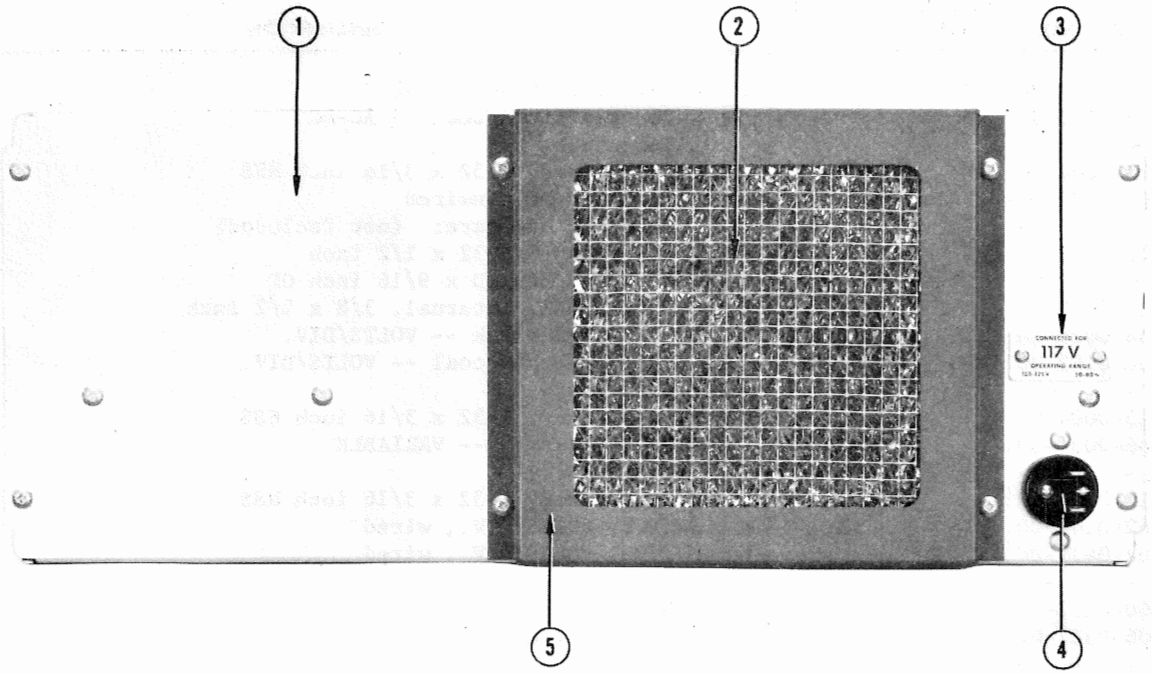
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	366-0061-00			2	KNOB, small gray
	- - - - - -			-	Each Includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HHS
2	129-0035-00			3	POST, binding, assembly
	- - - - - -			-	Each consisting of:
	355-0507-00			1	STEM, adapter
	200-0103-00			1	CAP
	210-0455-00			1	NUT, hex., 1/4-28 x 3/8 inch
	210-0046-00			1	LOCKWASHER, internal, 0.400 OD x 0.261 inch ID
3	131-0081-00	101	469	3	CONNECTOR, chassis mount, 1 contact, UHF
	131-0126-00	470		3	CONNECTOR, chassis mount, 1 contact, BNC
4	366-0028-00	101	779	1	KNOB, large black--VOLTS, PEAK-TO-PEAK
	366-0145-00	780		1	KNOB, large charcoal--VOLTS, PEAK-TO-PEAK
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0145-00			1	SWITCH, VOLTS, PEAK-TO-PEAK, wired
	- - - - - -			-	Includes:
	260-0098-00			1	SWITCH, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
5	136-0047-00			1	SOCKET, light, with red jewel
6	260-0134-00			1	SWITCH, POWER ON, toggle
	- - - - - -			-	Switch Includes:
	210-0414-00			1	NUT, hex., 15/32-32 x 9/16 inch
	- - - - - -			-	Mounting Hardware: (not included)
	210-0473-00			1	NUT, switch, 15/32-32 x 5/64 inch, 12 sided
	210-0902-00			1	WASHER, 0.470 ID x 21/32 inch OD
	354-0055-00			1	RING, locking, switch
7	352-0014-00			1	HOLDER, fuse
8	200-0073-00			1	COVER, graticule
	- - - - - -			-	Mounting Hardware: (not included)
	212-0509-00			4	SCREW, 8-32 x 5/8 inch, BHS
	210-0434-00			4	NUT, knurled, graticule
	210-0844-00			4	WASHER, neoprene, 7/32 ID x 3/8 inch OD
9	331-0042-00	101	399	1	GRATICULE, 8 vertical x 10 horizontal
	331-0095-00	400		1	GRATICULE, 3-1/2 x 3-5/16 inches
	- - - - - -			-	Mounting Hardware: (not included)
	211-0008-00	X400		1	SCREW, 4-40 x 1/4 inch, BHS
10	124-0050-00			1	STRIP, felt (not shown)
11	333-0458-00			1	PANEL, front
	386-0663-00			1	PLATE, front subpanel
12	366-0033-00	101	779	2	KNOB, small black--POSITIONING
	366-0148-00	780		2	KNOB, small charcoal--POSITIONING
	- - - - - -			-	Each includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	Mounting Hardware For Each Pot:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
13	366-0030-00	101	779	1	KNOB, large black--TRIGGERING LEVEL
	366-0146-00	780		1	KNOB, large charcoal--TRIGGERING LEVEL
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0032-00			1	KNOB, small red--STABILITY
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	- - - - - -			-	Mounting Hardware for Pot:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch
14	129-0036-00	101	779	3	POST, binding, black
	129-0063-00	780		3	POST, binding, charcoal
	- - - - - -			-	Mounting Hardware For Each: (not included)
	358-0036-00	101	779	1	BUSHING, binding post, black
	358-0169-00	780		1	BUSHING, binding post, charcoal
	210-0010-00	101	499X	1	LOCKWASHER, internal, #10
	210-0445-00	101	499	2	NUT, hex., 10-32 x 3/8 inch
	220-0410-00	500		1	NUT, keps, 10-32 x 3/8 inch
	210-0206-00	101	499X	1	LUG, solder, SE10, long
15	367-0008-00			2	HANDLE, drawer
	- - - - - -			-	Mounting Hardware For Each: (not included)
	212-0506-00			2	SCREW, 10-32 x 3/8 inch, FHS, phillips
16	366-0040-00	101	779	1	KNOB, large black--TIME/DIV
	366-0160-00	780		1	KNOB, large charcoal--TIME/DIV
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	366-0038-00			1	KNOB, small red--VARIABLE
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
	262-0182-00	101	879	1	SWITCH, TIME/DIV., wired
	262-0182-01	880		1	SWITCH, TIME/DIV., wired
	- - - - - -			-	Includes:
	260-0226-00			1	SWITCH, unwired
	384-0147-00			1	ROD, extension
	376-0014-00			1	COUPLING, pot
	337-0141-00			1	SHIELD, switch
	- - - - - -			-	Mounting Hardware:
	210-0449-00			2	NUT, hex., 5-40 x 1/4 inch
	210-0017-00			1	LOCKWASHER, spring, #5
	210-0202-00			1	LUG, solder, SE6
	348-0003-00			2	GROMMET, 5/16 inch
	- - - - - -			-	Mounting Hardware For Pot:
	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
17	366-0029-00	101	779	1	KNOB, large black -- TRIGGER SELECTOR
	366-0142-00	780		1	KNOB, large charcoal -- TRIGGER SELECTOR
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, 6-32 x 3/16 inch HSS
	366-0031-00			1	KNOB, small red -- HF SYNC
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-0196-00			1	SWITCH, TRIGGER SELECTOR, wired
	- - - - - -			-	Includes:
	260-0151-00			1	SWITCH, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
18	366-0033-00	101	779	1	KNOB, small black -- HORIZONTAL DISPLAY
	366-0148-00	780		1	KNOB, small charcoal -- HORIZONTAL DISPLAY
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-0224-00			1	SWITCH, HORIZONTAL DISPLAY, wired
	- - - - - -			-	Includes:
	260-0186-00			1	SWITCH, unwired
19	366-0033-00	101	779	1	KNOB, small black -- SCALE ILLUM.
	366-0148-00	780		1	KNOB, small charcoal -- SCALE ILLUM.
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - - - -			-	Mounting Hardware For Pot:
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch
20	366-0033-00	101	779	1	KNOB, small black -- INTENSITY
	366-0148-00	780		1	KNOB, small charcoal -- INTENSITY
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - - - -			-	Mounting Hardware For Each Pot:
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
21	366-0033-00	101	779	1	KNOB, small black -- FOCUS
	366-0148-00	780		1	KNOB, small charcoal -- FOCUS
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	- - - - - -			-	Mounting Hardware For Pot:
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
22	- - - - - -			-	Mounting Hardware For Pot:
	358-0010-00			1	BUSHING, 3/8-32 x 9/16 inch
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-0494-00			1	NUT, hex, 3/8-32 x 1/2 x 11/16 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
23	366-0033-00	101	779	1	KNOB, small black -- AC-DC
	366-0148-00	780		1	KNOB, small charcoal -- AC-DC
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	260-0122-00			1	SWITCH, AC/DC, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
24	366-0029-00	101	779	1	KNOB, large black -- VOLTS/DIV.
	366-0142-00	780		1	KNOB, large charcoal -- VOLTS/DIV.
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	366-0031-00			1	KNOB, small red -- VARIABLE
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
	262-0144-00	101	319	1	SWITCH, VOLTS/DIV., wired
	262-0479-00	320		1	SWITCH, VOLTS/DIV., wired
	- - - - - -			-	Includes:
	260-0187-00			1	SWITCH, unwired
	406-0337-00			1	BRACKET, capacitor
	- - - - - -			-	Mounting Hardware:
	211-0007-00			2	SCREW, 4-40 x 3/16 inch BHS
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	214-0153-00			8	FASTENER, snap, double pronged
	124-0009-00			1	STRIP, brass
	- - - - - -			-	Mounting Hardware For Pot:
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch

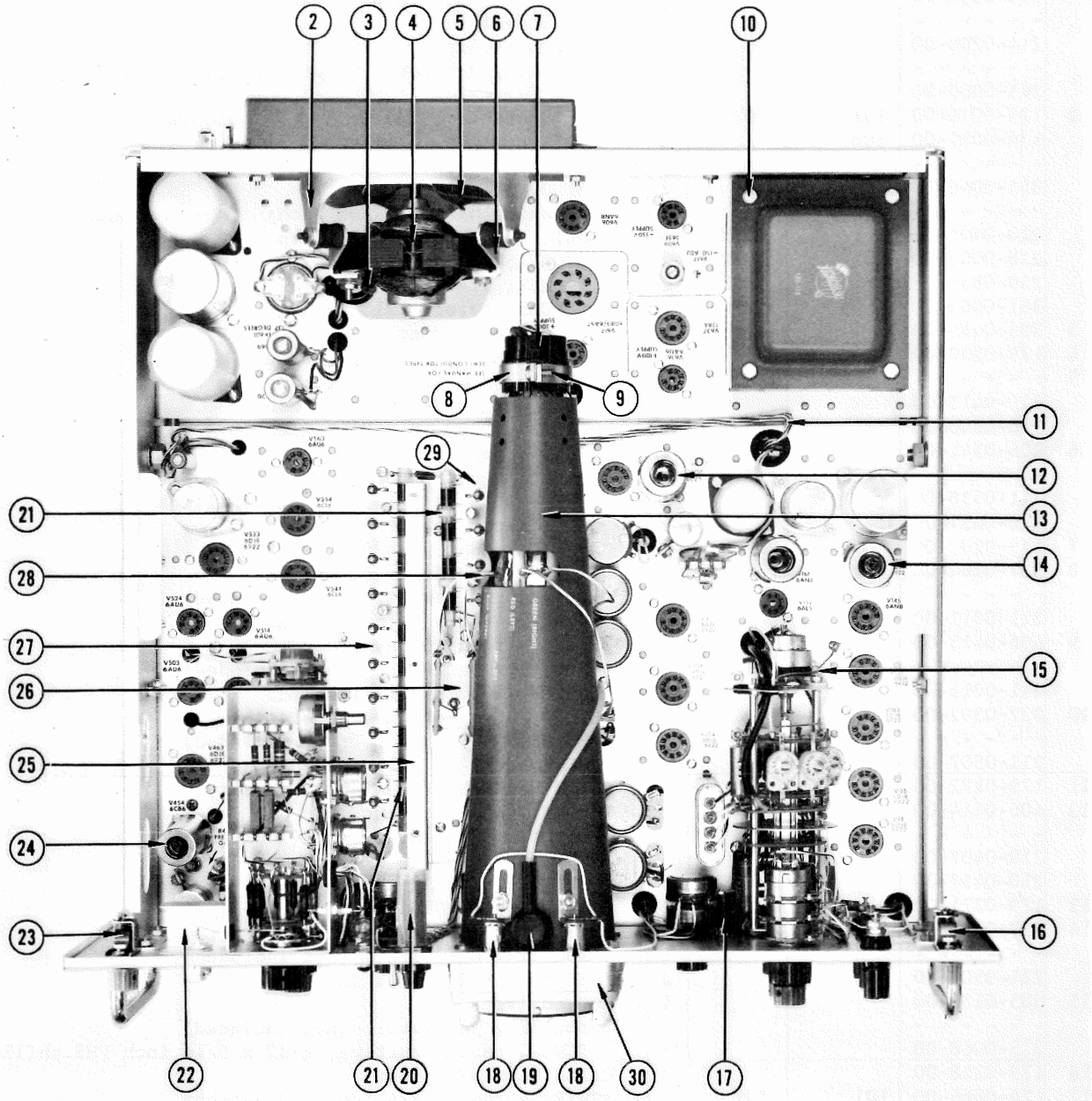
REAR



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	386-666			1	PLATE, back
	- - - -			-	Mounting Hardware: (not included)
	211-507			4	SCREW, 6-32 x 5/16 inch BHS
	210-457			4	NUT, keps, 6-32 x 5/16 inch
2	378-017			1	FILTER, air
3	334-649			1	TAG, voltage rating
	- - - -			-	Mounting Hardware: (not included)
	213-088			2	SCREW, thread forming, 4-40 x 1/4 inch PHS, phillips
4	131-102			1	CONNECTOR, chassis mount, motor base
	- - - -			-	Consisting of:
	129-041			1	POST, ground
	200-185			1	COVER, motor base
	210-003			2	LOCKWASHER, external, #4
	210-551			2	NUT, hex, 4-40 x 1/4 inch
	211-015			1	SCREW, 4-40 x 1/2 inch RHS
	214-078			2	PIN, connecting
	377-041			1	INSERT, black urea
	386-933			1	PLATE, motor base
	- - - -			-	Mounting Hardware: (not included)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
	210-457			2	NUT, keps, 6-32 x 5/16 inch
5	380-011	101	178	1	HOUSING, air filter
	380-019	179		1	HOUSING, air filter
	- - - -			-	Mounting Hardware: (not included)
	211-507			4	SCREW, 6-32 x 5/16 inch BHS

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	337-0265-00			1	SHIELD, high voltage (not shown)
	- - - - - -			-	Mounting Hardware: (not included)
	211-0007-00			6	SCREW, 4-40 x 3/16 inch BHS
	348-0012-00			1	GROMMET, 5/8 inch (not shown)
	214-0210-00			1	SPOOL, solder, assembly (not shown)
	- - - - - -			-	Includes:
	214-0209-00			1	SPOOL, solder
	- - - - - -			-	Mounting Hardware: (not included)
	361-0007-00			1	SPACER, nylon, .063 inch
2	124-0016-00	101	107	2	STRIP, ceramic, 3/4 inch x 11 notches
	124-0091-00	108		2	STRIP, ceramic, 3/4 inch x 11 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, .313 inch
3	386-0645-00			1	PLATE, transformer
4	179-0200-00			1	CABLE HARNESS, 110 volt, power
5	- - - - - -			-	Mounting Hardware For Pot:
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
6	406-0341-00			1	BRACKET, pot
	- - - - - -			-	Mounting Hardware: (not included)
	211-0538-00			2	SCREW, 6-32 x 5/16 inch FHS phillips
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
7	179-0202-00			1	CABLE HARNESS, preamplifier
8	337-0264-00			1	SHIELD, lower delay line
	- - - - - -			-	Mounting Hardware: (not included)
	211-0011-00			3	SCREW, 4-40 x 5/16 inch BHS
9	406-0413-00			1	BRACKET, lower delay line
	- - - - - -			-	Mounting Hardware: (not included)
	211-0011-00			2	SCREW, 4-40 x 5/16 inch BHS
10	337-0302-00			1	SHIELD, high voltage, insulating
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch BHS
11	179-0272-00			1	CABLE HARNESS, focus and intensity
12	406-0414-00			1	BRACKET, high voltage
	- - - - - -			-	Mounting Hardware: (not included)
	210-0407-00			3	NUT, hex, 6-32 x 1/4 inch
	210-0457-00			3	NUT, keps, 6-32 x 5/16 inch
13	179-0271-00			1	CABLE HARNESS, indicator
14	337-0193-00			1	SHIELD, trigger
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch BHS
15	385-0134-00			1	ROD, delrin
	- - - - - -			-	Mounting Hardware: (not included)
	213-0068-00			1	SCREW, thread cutting, 6-32 x 5/16 inch FHS phillips
16	179-0228-00			1	CABLE HARNESS, power
17	124-0066-00	101	107	1	STRIP, ceramic, 3/4 inch x 9 notches
	124-0090-00	108		1	STRIP, ceramic, 3/4 inch x 9 notches
	- - - - - -			-	strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, .313 inch

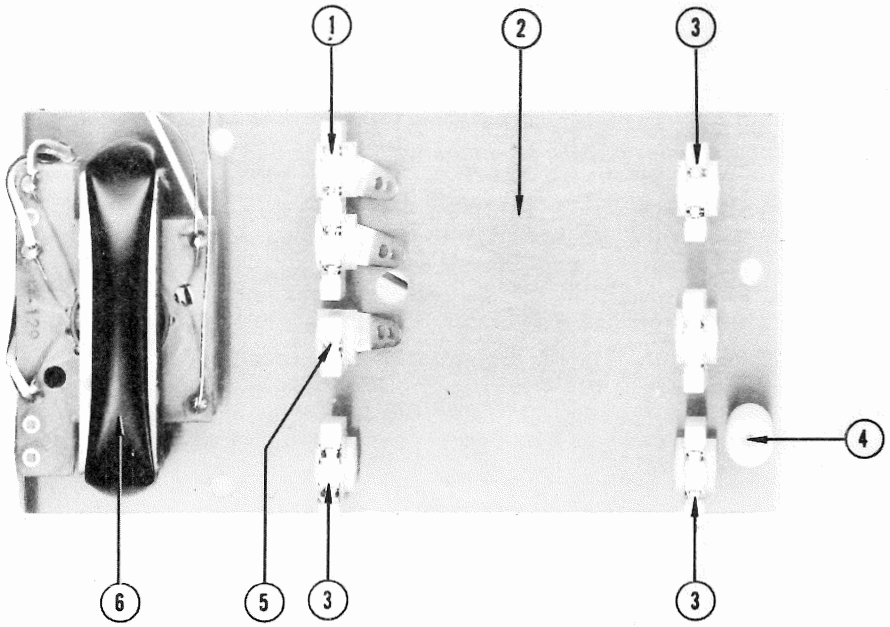
(1) DELAY LINE SHIELD



TOP

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	337-0202-00			1	SHIELD, upper delay line (not shown)
	- - - - - -			-	mounting hardware: (not included)
	211-0011-00			3	SCREW, 4-40 x 5/16 inch, BHS
2	354-0065-00			1	RING, fan
	- - - - - -			-	mounting hardware: (not included)
	213-0041-00			4	SCREW, thread cutting, 6-32 x 3/8 inch, THS phillips
3	343-0002-00			1	CLAMP, cable, 3/16 inch
	- - - - - -			-	mounting hardware: (not included)
	212-0031-00			1	SCREW, 8-32 x 1-1/4 inch, RHS
4	147-0021-00			1	MOTOR, AC, 110 V, 2770 RPM, 35 W
	- - - - - -			-	Includes:
	NO NUMBER			2	SCREW, 8-32 x 1 inch, RHS
	210-0008-00			2	LOCKWASHER, internal, #8
	210-0409-00			2	NUT, hex., 8-32 x 5/16 inch
5	369-0011-00			1	FAN, 4-1/2 inch, clockwise
6	406-0431-00			1	BRACKET, motor
	- - - - - -			-	mounting hardware: (not included)
	348-0008-00			3	SHOCKMOUNT
	210-0008-00			3	LOCKWASHER, internal, #8
	210-0409-00			3	NUT, hex., 8-32 x 5/16 inch
7	136-0110-00			1	SOCKET, CRT, assembly
	- - - - - -			-	socket includes:
	136-0063-00	101	469	1	SOCKET, CRT
	136-0081-00	470		1	SOCKET, CRT
8	343-0029-00			1	CLAMP, CRT socket
	- - - - - -			-	mounting hardware: (not included)
	211-0538-00			4	SCREW, 6-32 x 5/16 inch, FHS, phillips
	210-0803-00			4	WASHER, 6L x 3/8 inch
	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch
9	212-0557-00			1	SCREW, 10-32 x 1/2 inch, RHS
	210-0501-00			1	NUT, square, 10-32 x 3/8 inch
10	- - - - - -			-	Mounting Hardware For Transformer:
	212-0515-00			4	SCREW, 10-32 x 2-1/4 inch HEX HS
	210-0812-00			4	WASHER, fiber, #10
	210-0445-00			4	NUT, hex., 10-32 x 3/8 inch
	210-0010-00			4	LOCKWASHER, internal, #10
	210-0564-00			4	NUT, hex., 10-32 x 3/8 inch
11	179-0201-00			1	CABLE HARNESS, 110 volt, indicator
12	337-0009-00			1	SHIELD, tube, 2-13/32 inch
13	337-0292-00			1	SHIELD, CRT
	- - - - - -			-	mounting hardware: (not included)
	212-0509-00			4	SCREW, 10-32 x 5/8 inch, BHS
14	337-0008-00			3	SHIELD, tube, 1-15/16 inch
15	406-0483-00			1	BRACKET, switch
	- - - - - -			-	mounting hardware: (not included)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
16	214-0052-00	101	579	1	FASTENER, right, with stop
	214-0424-00	580		1	FASTENER, right, with stop
	- - - - - -			-	mounting hardware: (not included)
	211-0038-00			2	SCREW, 4-40 x 5/16 inch, FHS, phillips
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
17	352-0008-00	101	849	3	HOLDER, neon bulb, single, black
	352-0067-00	850		3	HOLDER, neon bulb, single, gray
	378-0541-00	X850		3	FILTER, lens, neon
	- - - - - -			-	mounting hardware for each: (not included)
	211-0031-00	101	849	1	SCREW, 4-40 x 1 inch, FHS
	211-0109-00	850		1	SCREW, 4-40 x 7/8 inch, FHS
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
18	136-0001-00			2	SOCKET, graticule light
	- - - - - -			-	mounting hardware for each: (not included)
	211-0534-00			1	SCREW, 6-32 x 5/16 inch, PHS, with lockwasher
	210-0803-00			1	WASHER, 6L x 3/8 inch
	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
19	131-0084-00			1	CONNECTOR, cable, anode assembly
	- - - - - -			-	Consisting Of:
	131-0073-00			1	CONNECTOR, CRT brush
	200-0110-00			1	CAP, CRT anode connector
	200-0197-00			1	COVER, CRT anode (not shown)
	134-0031-00			1	PLUG, CRT contact
200	200-0237-00			1	COVER, insulation, fuse holder
21	352-0013-00			6	HOLDER, coil form
22	337-0192-00			1	SHIELD, calibrator
23	214-0053-00	101	579	1	FASTENER, left, with stop
	214-0425-00	580		1	FASTENER, left, with stop
	- - - - - -			-	mounting hardware: (not included)
	211-0038-00			2	SCREW, 4-40 x 5/16 inch, FHS, phillips
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
24	337-0007-00			2	SHIELD, tube, 1-3/4 inch
25	406-0412-00			1	BRACKET, upper delay line
	- - - - - -			-	mounting hardware: (not included)
	211-0011-00			2	SCREW, 4-40 x 5/16 inch, BHS
26	386-0729-00			1	PLATE, plexiglass, load rest
	- - - - - -			-	mounting hardware: (not included)
	211-0011-00			2	SCREW, 4-40 x 5/16 inch, BHS
27	386-0733-00			2	PLATE, plexiglass, delay line
	- - - - - -			-	mounting hardware for each: (not included)
	211-0011-00			3	SCREW, 4-40 x 5/16 inch, BHS
28	175-0586-00			1	WIRE, CRT lead, 0.960 foot, striped brown, with connector
	175-0592-00			1	WIRE, CRT lead, 0.960 foot, striped green, with connector
	175-0593-00			1	WIRE, CRT lead, 0.333 foot, striped blue, with connector
	175-0595-00			1	WIRE, CRT lead, 0.960 foot, striped red, with connector
29	386-0732-00			1	PLATE, plexiglass, upper delay line
	- - - - - -			-	mounting hardware: (not included)
	211-0011-00			2	SCREW, 4-40 x 5/16 inch, BHS
30	426-0058-00			1	MOUNT, CRT
	- - - - - -			-	mounting hardware: (not included)
	211-0532-00			4	SCREW, 6-32 x 3/4 inch, Fil HS



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	124-0012-00	101	107	1	STRIP, ceramic, 3/4 inch x 4 notches
	124-0088-00	108		1	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - -			-	strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0201-00	101	107	2	LUG, solder, SE4
	210-0205-00	108		2	LUG, solder, SE8
	361-0009-00	X108		2	SPACER, nylon, .313 inch
2	386-0358-00			1	PLATE, bakelite, high voltage
	- - - - - -			-	mounting hardware: (not included)
	211-0507-00			5	SCREW, 6-32 x 5/16 inch BHS
	385-0080-00			3	ROD, hex
	211-0514-00			1	SCREW, 6-32 x 3/4 inch BHS
3	124-0020-00	101	107	4	STRIP, ceramic, 3/4 inch x 2 notches
	124-0086-00	108		4	STRIP, ceramic, 3/4 inch x 2 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		1	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	2	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	1	LOCKWASHER, external, #2
	361-0009-00	X108		1	SPACER, nylon, .313 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
4	385-0018-00			2	ROD, nylon
	- - - - - -			-	mounting hardware for each: (not included)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
5	129-0017-00	101	107	1	POST, ceramic
	124-0100-00	108		1	STRIP, ceramic, 3/4 inch x 1 notch
	- - - - - -			-	strip includes:
	355-0046-00	X108		1	STUD, nylon
	- - - - - -			-	mounting hardware: (not included)
	210-0405-00	101	107X	2	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	1	LOCKWASHER, external, #2
	210-0201-00	101	107	1	LUG, solder, SE4
	210-0205-00	108		1	LUG, solder, SE8
	361-0009-00	X108		1	SPACER, nylon, .313 inch
6	346-0001-00			1	STRAP, mounting, transformer
	- - - - - -			-	mounting hardware: (not included)
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	210-0004-00			2	LOCKWASHER, internal #4

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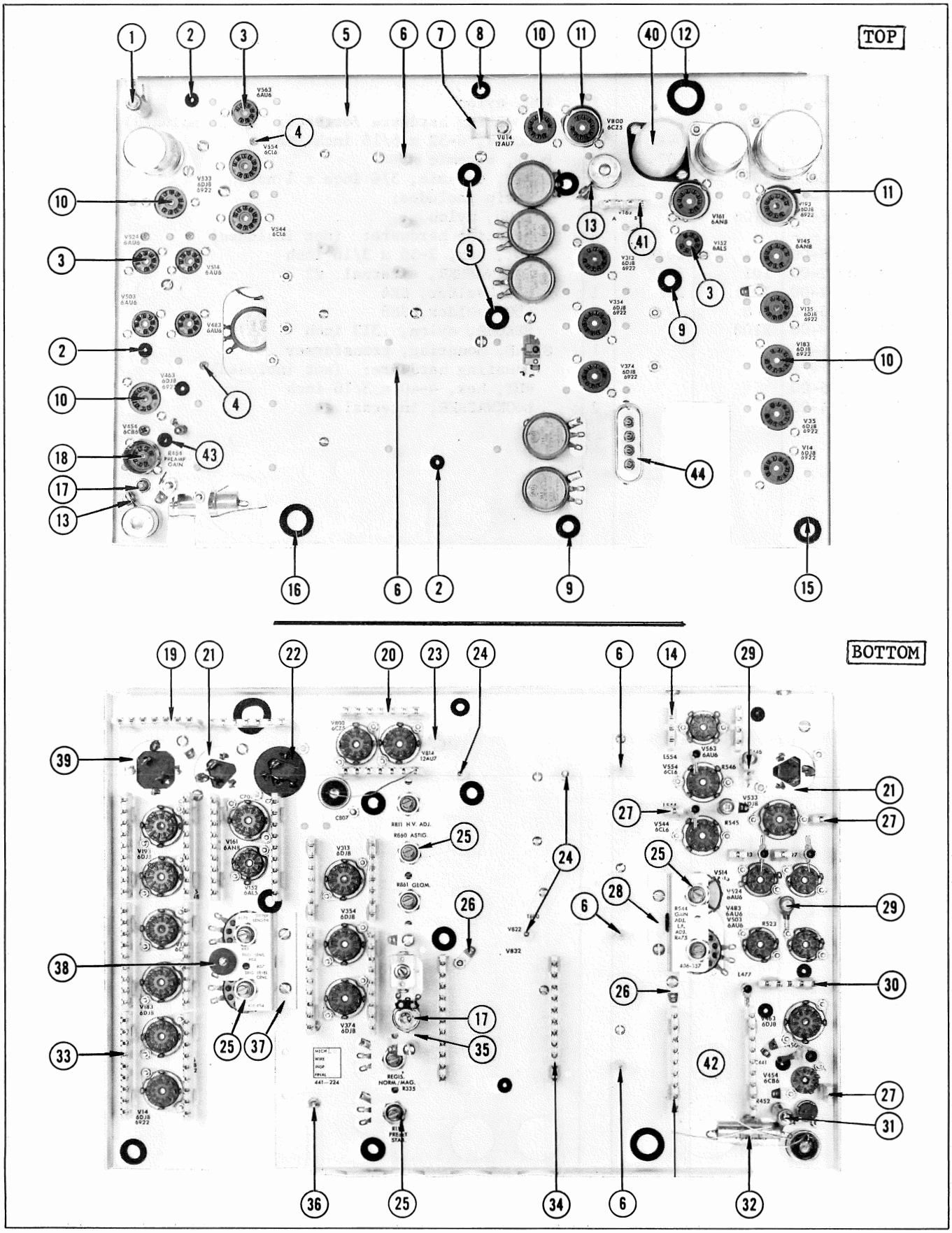
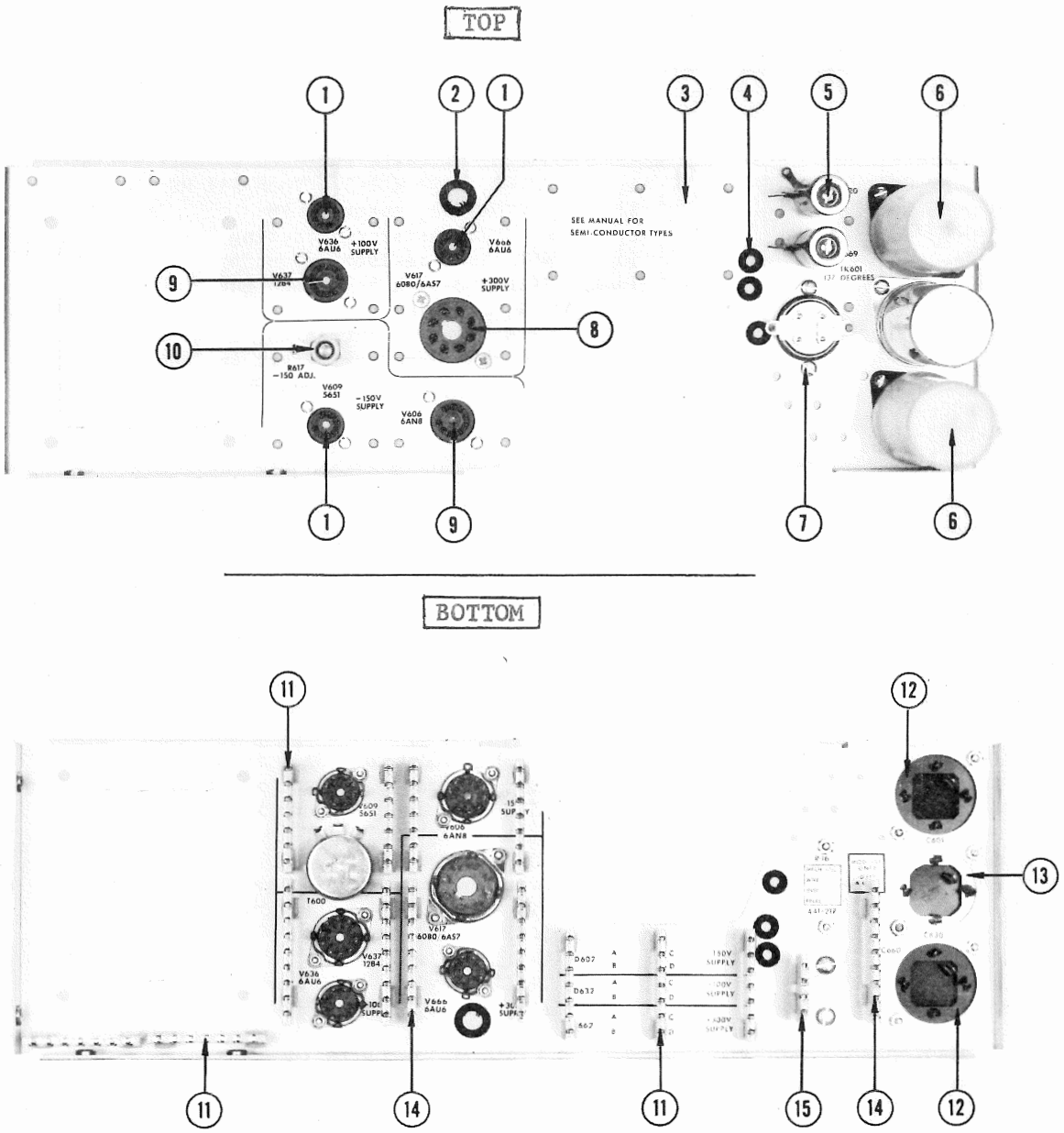


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	- - - - - -			-	Mounting Hardware For 10 Watt Resistor:
	211-0553-00			1	SCREW, 6-32 x 1-1/2 inch RHS phillips
	210-0601-00			1	EYELET
	210-0478-00			1	NUT, hex, resistor mounting
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
2	348-0002-00			4	GROMMET, 1/4 inch
3	136-0008-00			6	SOCKET, STM7G
	- - - - - -			-	mounting hardware for each: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
4	- - - - - -			-	mounting hardware for each coil:
	213-0035-00			1	SCREW, thread cutting, 4-40 x 1/4 PHS phillips
5	441-0224-00			1	CHASSIS, indicator
	- - - - - -			-	mounting hardware: (not included)
	211-0559-00			8	SCREW, 6-32 x 3/8 inch FHS phillips
	210-0457-00			8	NUT, keps, 6-32 x 5/16 inch
6	385-0107-00			10	ROD, nylon
	- - - - - -			-	mounting hardware for each: (not included)
	211-0011-00			1	SCREW, 4-40 x 5/16 inch BHS
7	343-0042-00			1	CLAMP, cable, 5/16 inch, half
	- - - - - -			-	mounting hardware: (not included)
	213-0041-00			1	SCREW, thread cutting, 6-32 x 3/8 inch THS phillips
	210-0803-00			1	WASHER, 6L x 3/8 inch
8	348-0003-00			1	GROMMET, 5/16 inch
9	348-0004-00			5	GROMMET, 3/8 inch
10	136-0015-00			16	SOCKET, STM9G
	- - - - - -			-	mounting hardware for each: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
11	337-0005-00			3	SHIELD, socket
12	348-0006-00			1	GROMMET, 3/4 inch
13	343-0036-00			2	CLAMP, capacitor
	- - - - - -			-	mounting hardware for each: (not included)
	214-0012-00			1	BOLT, spade, 6-32 x 3/8 inch
	211-0504-00			1	SCREW, 6-32 x 1/4 inch BHS
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
14	124-0012-00	101	107	2	STRIP, ceramic, 3/4 inch x 4 notches
	124-0088-00	108		2	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, .313 inch
15	348-0005-00			1	GROMMET, 1/2 inch
16	348-0012-00			1	GROMMET, 5/8 inch
17	- - - - - -			-	mounting hardware for each miniature pot:
	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
	210-0046-00			1	LOCKWASHER, internal, 0.400 OD x 0.261 inch ID

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
18	136-0009-00			1	SOCKET, STM7, shielded
	- - - - - -			-	mounting hardware: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch, PHS with lockwasher
	210-0004-00			1	LOCKWASHER, internal, #4
	210-0201-00			1	LUG, solder, SE4
	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
19	124-0014-00	101	107	6	STRIP, ceramic, 3/4 inch x 7 notches
	124-0089-00	108		6	STRIP, ceramic, 3/4 inch x 7 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, 0.313 inch
20	- - - - - -			-	mounting hardware for coil:
	213-0054-00			1	SCREW, thread cutting, 6-32 x 5/16 inch, PHS phillips
21	386-0253-00			2	PLATE, metal, small capacitor
	- - - - - -			-	mounting hardware for each: (not included)
	211-0534-00			2	SCREW, 6-32 x 5/16 inch, PHS with lockwasher
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
22	386-0252-00			1	PLATE, fiber, small capacitor
	- - - - - -			-	mounting hardware: (not included)
	211-0534-00			2	SCREW, 6-32 x 5/16 inch, PHS with lockwasher
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
23	385-0076-00	101	239	1	ROD, nylon
	385-0138-00	240		1	ROD, delrin
	- - - - - -			-	mounting hardware: (not included w/rod)
	211-0507-00	101	239	1	SCREW, 6-32 x 5/16 inch, BHS
	213-0041-00	240		1	SCREW, thread cutting, 6-32 x 3/8 inch, THS phillips
24	385-0080-00			3	ROD, hex.
	- - - - - -			-	mounting hardware for each: (not included)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
25	- - - - - -			-	mounting hardware for each pot:
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, 0.390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 inch
26	210-0202-00			2	LUG, solder, SE6
	- - - - - -			-	mounting hardware for each: (not included)
	211-0504-00			1	SCREW, 6-32 x 1/4 inch, BHS
	210-0407-00			1	NUT, hex., 6-32 x 1/4 inch
27	129-0009-00	101	107	5	POST, ceramic
	124-0100-00	108		5	STRIP, ceramic, 3/4 inch x 1 notch
	- - - - - -			-	each strip includes:
	355-0046-00	X108		1	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included)
	210-0405-00	101	107X	2	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	1	LOCKWASHER, external, #2
	210-0850-00	101	107X	1	WASHER, flat, #2
	361-0007-00	X108		1	SPACER, nylon, 0.063 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
28	406-0357-00			1	BRACKET, pot
	- - - - - -			-	mounting hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, BHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
29	- - - - - -			-	mounting hardware for each 5 warr resistor:
	211-0544-00			1	SCREW, 6-32 x 3/4 inch, THS phillips
	210-0202-00			1	LUG, solder, SE6
	210-0478-00			1	NUT, hex., resistor mounting
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
30	124-0060-00	101	107	1	STRIP, ceramic, 7/16 inch x 5 notches
	124-0093-00	108		1	STRIP, ceramic, 7/16 inch x 5 notches
	- - - - - -			-	strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0008-00	X108		2	SPACER, nylon, 0.188 inch
31	- - - - - -			-	mounting hardware for 10 warr resistor:
	212-0014-00			1	SCREW, 8-32 x 2-1/4 inch RHS
	210-0601-00			2	EYELET
	210-0228-00			1	LUG, solder, SE8, long
	210-0409-00			1	NUT, hex., 8-32 x 5/16 inch
32	343-0006-00			1	CLAMP, cable, 1/2 inch
	- - - - - -			-	mounting hardware: (not included)
	214-0012-00			1	BOLT, spade, 6-32 x 3/8 inch
	211-0510-00			1	SCREW, 6-32 x 3/8 inch, BHS
	210-0803-00			1	WASHER, 6L x 3/8 inch
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			3	NUT, hex., 6-32 x 1/4 inch
33	124-0066-00	101	107	12	STRIP, ceramic, 3/4 inch x 9 notches
	124-0090-00	108		12	STRIP, ceramic, 3/4 inch x 9 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, 0.313 inch
34	124-0016-00	101	107	2	STRIP, ceramic, 3/4 inch x 11 notches
	124-0091-00	108		2	STRIP, ceramic, 3/4 inch x 11 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex., 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, 0.313 inch

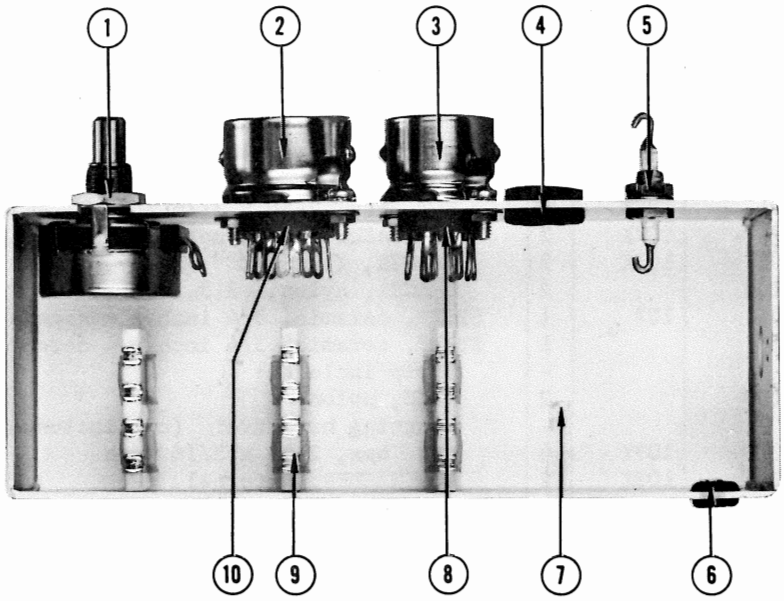
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
35	386-0859-00			1	PLATE, plexiglass, pot
	- - - - - -			-	mounting hardware: (not included)
	385-0018-00			2	ROD, nylon
	211-0507-00			4	SCREW, 6-32 x 5/16 inch, BHS
	210-0202-00			2	LUG, solder, SE6
36	- - - - - -			-	mounting hardware for timing capacitor:
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
	210-0006-00			2	LOCKWASHER, internal, #6
37	406-0321-00	101	202	1	BRACKET, pot
	406-0602-00	203		1	BRACKET, pot
	- - - - - -			-	mounting hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, BHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
38	- - - - - -			-	mounting hardware for miniature pot:
	210-0438-00	X203		2	NUT, hex., 1-72 x 5/32 inch
39	386-0255-00			1	PLATE, metal, large capacitor
	- - - - - -			-	mounting hardware: (not included)
	211-0534-00			2	SCREW, 6-32 x 5/16 inch, PHS with lockwasher
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0202-00			1	LUG, solder, SE6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
40	200-0257-00			1	COVER, capacitor
41	406-0314-00	101	125X	1	BRACKET, rectifier (not shown)
	- - - - - -			-	mounting hardware: (not included w/bracket)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, BHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
	- - - - - -	101	125X	1	RECTIFIER (not shown)
	- - - - - -			-	mounting hardware: (not included w/rectifier)
	210-0805-00			1	WASHER, 10S x 7/16 inch
	210-0009-00			1	LOCKWASHER, external, #10
	210-0410-00			1	NUT, hex., 10-32 x 5/16 inch
	124-0088-00	X126		1	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0008-00			2	SPACER, nylon, 0.188 inch
42	- - - - - -	101	125X	1	RECTIFIER (not shown)
	- - - - - -			-	mounting hardware: (not included w/rectifier)
	210-0805-00			1	WASHER, 10S x 7/16 inch
	210-0009-00			1	LOCKWASHER, external, #10
	210-0410-00			1	NUT, hex., 10-32 x 5/16 inch
43	348-0002-00	101	609X	1	GROMMET, 1/4 inch
44	- - - - - -			1	CAPACITOR
	- - - - - -			-	capacitor includes:
	407-0277-00	X880		1	BRACKET, capacitor
	124-0187-00	X880		1	STRIP, ceramic, 7/16 inch h, w/5 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	124-0187-01	X880		1	STRIP, ceramic, 7/16 inch h, w/5 notches & silver band
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	361-0007-00	X880		4	SPACER, plastic



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	136-0008-00			3	SOCKET, STM7G
	- - - - - -			-	mounting hardware for each: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
2	348-0005-00			1	GROMMET, 1/2 inch
3	441-0217-00			1	CHASSIS, power
	- - - - - -			-	mounting hardware: (not included)
	211-0538-00			6	SCREW, 6-32 x 5/16 inch FHS phillips
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
	213-0049-00			5	SCREW, 6-32 x 5/16 inch HHS
4	348-0003-00			3	GROMMET, 5/16 inch

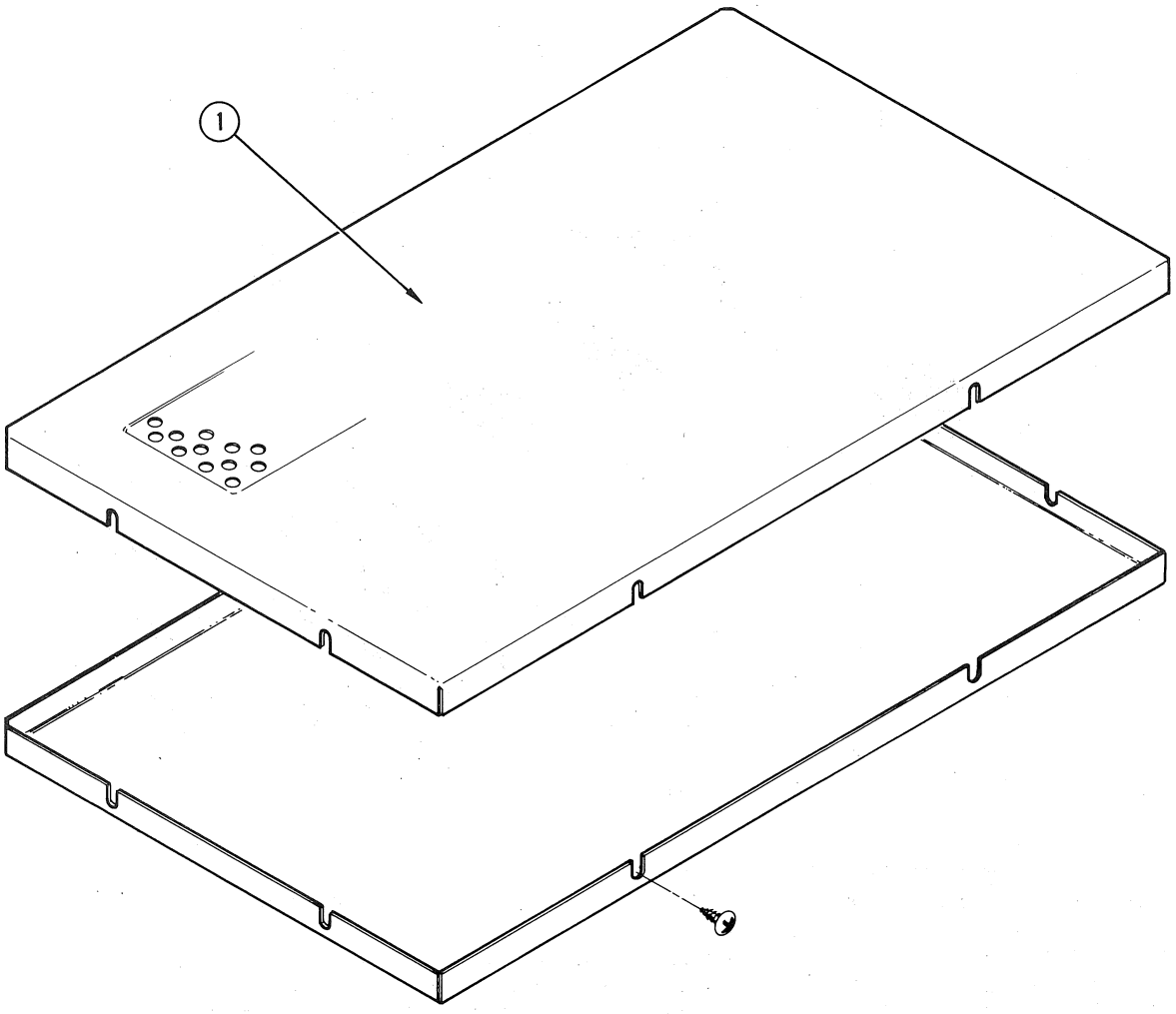
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
5	- - - - - -			-	mounting hardware for each 25 watt resistor:
	212-0037-00			1	SCREW, 8-32 x 1-3/4 inch Fil HS
	210-0008-00			1	LOCKWASHER, internal #8
	210-0809-00			1	WASHER, resistor centering
	210-0462-00			1	NUT, hex, resistor mounting
	212-0004-00			1	SCREW, 8-32 x 5/16 inch BHS
6	200-0258-00			2	COVER, capacitor
7	260-0120-00			1	SWITCH, thermal cutout
	- - - - - -			-	mounting hardware: (not included)
	211-0504-00			2	SCREW, 6-32 x 1/4 inch BHS
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
8	136-0011-00			1	SOCKET, STM8, ground
	- - - - - -			-	mounting hardware: (not included)
	211-0538-00			2	SCREW, 6-32 x 5/16 inch FHS phillips
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
9	136-0015-00			2	SOCKET, STM9G
	- - - - - -			-	mounting hardware for each: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
10	- - - - - -			-	mounting hardware for pot:
	210-0444-00			1	NUT, hex, 3/8-32 x 1/2 x 5/8 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
11	124-0014-00	101	107	9	STRIP, ceramic, 3/4 inch x 7 notches
	124-0089-00	108		9	STRIP, ceramic, 3/4 inch x 7 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, .313 inch
12	386-0254-00			2	PLATE, fiber, large capacitor
	- - - - - -			-	mounting hardware for each: (not included)
	211-0543-00			2	SCREW, 6-32 x 5/16 inch RHS
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
13	386-0255-00			1	PLATE, metal, large capacitor
	- - - - - -			-	mounting hardware: (not included)
	211-0534-00			2	SCREW, 6-32 x 5/16 inch PHS with lockwasher
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
14	124-0066-00	101	107	5	STRIP, ceramic, 3/4 inch x 9 notches
	124-0090-00	108		5	STRIP, ceramic, 3/4 inch x 9 notches
	- - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, .313 inch
15	124-0012-00	101	107	1	STRIP, ceramic, 3/4 inch x 4 notches
	124-0088-00	108		1	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - -			-	strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - -			-	mounting hardware: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, .313 inch

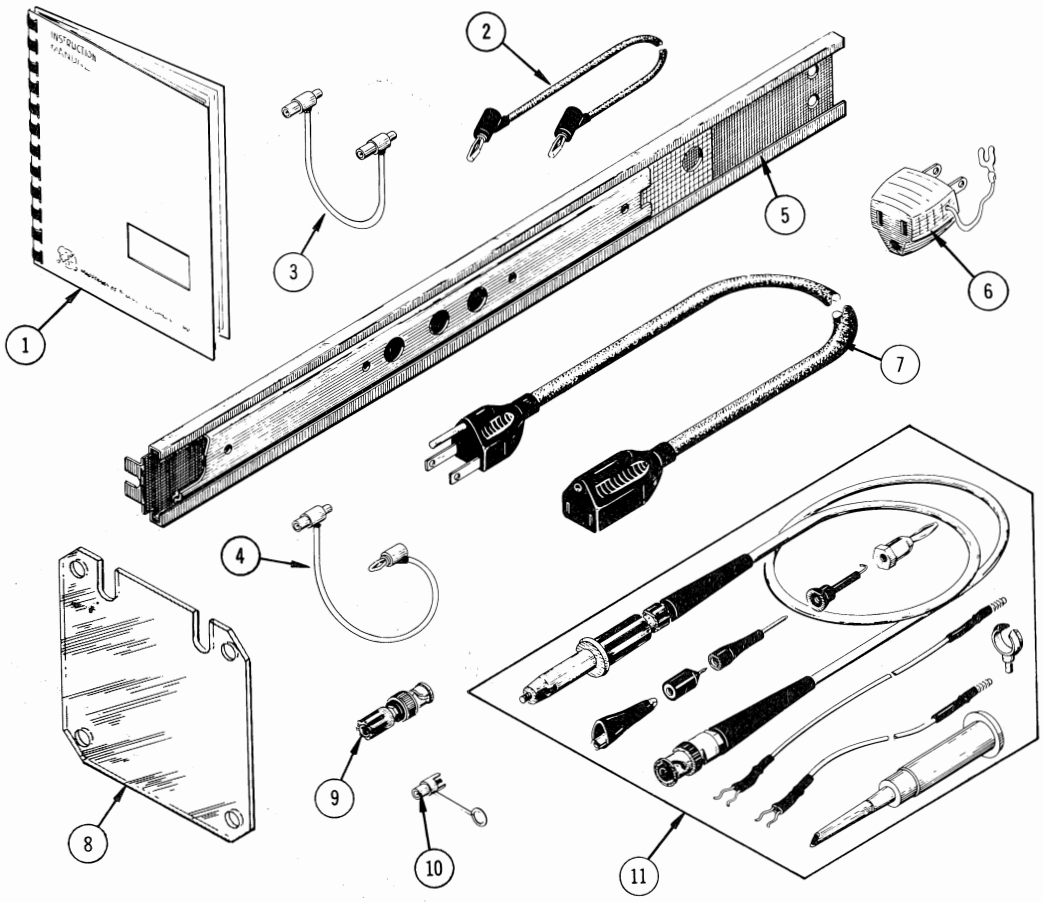


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	- - - - - - -			-	mounting hardware for pot:
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
2	337-0005-00			1	SHIELD, socket
3	337-0004-00			1	SHIELD, socket
4	348-0004-00			1	GROMMET, 3/8 inch
5	- - - - - - -			-	mounting hardware for capacitor:
	210-0467-00			1	NUT, hex, 12-28 x 5/16 inch
	210-0020-00			1	LOCKWASHER, internal #12
6	348-0002-00			1	GROMMET, 1/4 inch
7	441-0183-00	101	309	1	CHASSIS, calibrator
	441-0355-00	310		1	CHASSIS, calibrator
8	136-0010-00			1	SOCKET, 7 pin, without center pin
	- - - - - - -			-	mounting hardware: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
9	124-0012-00	101	107	3	STRIP, ceramic, 3/4 inch x 4 notches
	124-0088-00	108		3	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - - -			-	each strip includes:
	355-0046-00	X108		2	STUD, nylon
	- - - - - - -			-	mounting hardware for each: (not included w/strip)
	210-0405-00	101	107X	4	NUT, hex, 2-56 x 3/16 inch
	210-0002-00	101	107X	2	LOCKWASHER, external, #2
	210-0850-00	101	107X	2	WASHER, flat, #2
	361-0009-00	X108		2	SPACER, nylon, .313 inch
10	136-0022-00			1	SOCKET, STM9S
	- - - - - - -			-	mounting hardware: (not included)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS with lockwasher
	210-0004-00			1	LOCKWASHER, internal #4
	210-0201-00			1	LUG, solder, SE4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch

CABINET



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	386-739	101	178	2	PLATE, dust cover
	387-095	179		2	PLATE, dust cover
	- - - -			-	Mounting Hardware For Each: (not included)
	211-507			4	SCREW, 6-32 x 5/16 inch BHS



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	070-0325-00			2	MANUAL, instruction
2	012-0031-00	X550	769	1	CORD, patch-banana, 18 inch, red
3	012-0087-00	770		1	CORD, patch, BNC to BNC, red, 18 inches long
4	012-0091-00	X770		1	CORD, patch, BNC to banana, red, 18 inches long
5	351-0017-00	101	892	1	GUIDE, chassis track, 1 pair, left & right
	351-0083-00	893		1	SLIDE, stationary & inter section (1 Pair)
6	103-0013-00			1	ADAPTER, power cord, 3 to 2 wire
7	161-0010-00	101	899	1	CORD, power, 16 gauge, 8 foot, 3 wire
	161-0010-03	900		1	CORD, power, 16 guage, 8 foot, 3 wire
8	378-0509-00	101	839	1	FILTER, light, green, plexiglas, 5 inch, w/cam hole
	378-0550-00	840		1	FILTER, light, smoke gray
9	013-0004-00	101	469	2	ADAPTER, binding post
	103-0033-00	370	769X	2	ADAPTER, BNC to binding post
10	012-0092-00	X770		1	JACK, BNC-POST
11	010-0127-00	101	879	1	PROBE, P6006, 10 MEG, 10X, 42 inch BNC
	010-0203-00	880		1	PROBE, P6012, 10 MEG, 10X, 42 inch BNC

SCHEMATICS

RM17

Publication:
NOT STOCKED
January 1964

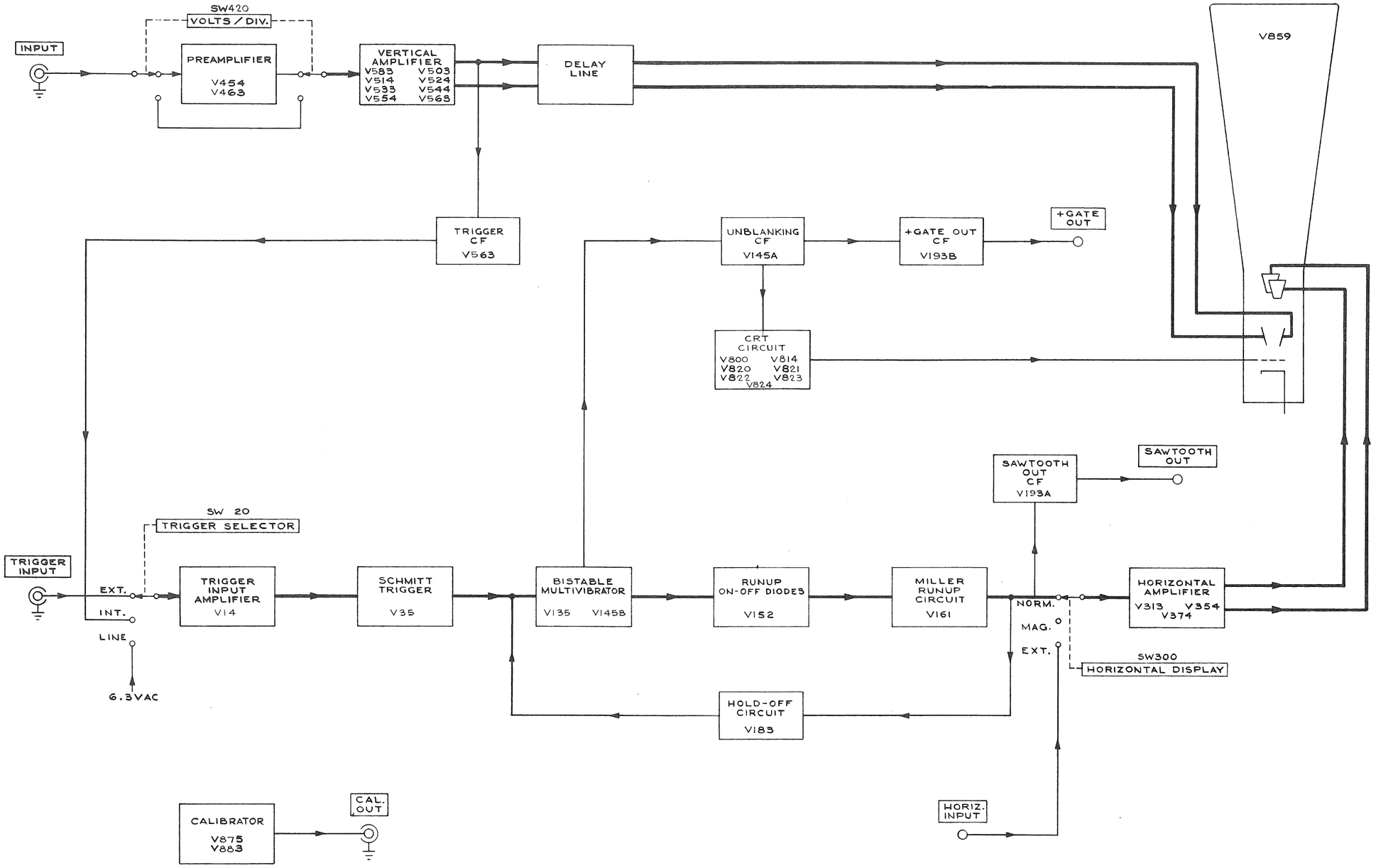
Supersedes
September 1962

For RM17 only, all serial numbers. Not for 317.

CONTENTS:

ABBREVIATIONS:

cer	ceramic
comp	composition
emc	electrolytic, metal cased
gmv	guaranteed minimum value
h	henry
k	kilo (10^3)
k	kilohm
m	milli (10^{-3})
ma	milliamp
meg	megohm
mh	millihenry
mpt	metalized, paper tubular
mt	mylar, tubular
mv	millivolt
μ	micro (10^{-6})
μf	microfarad
μh	microhenry
μsec	microsecond
n	nano (10^{-9})
nsec	nano second
Ω	ohm
p	pico (10^{-12})
pbt	paper, "bathtub"
pcc	paper covered can
pf	picofarad ($\mu\mu$f)
piv	peak inverse voltage
pmc	paper, metal cased
poly	polystyrene
prec	precision
pt	paper, tubular
ptm	paper, tubular molded
sn or S/N	serial number
tub	tubular
v	working volt, dc
var	variable
w	watt
WW	wire wound



MRH
1-5-62

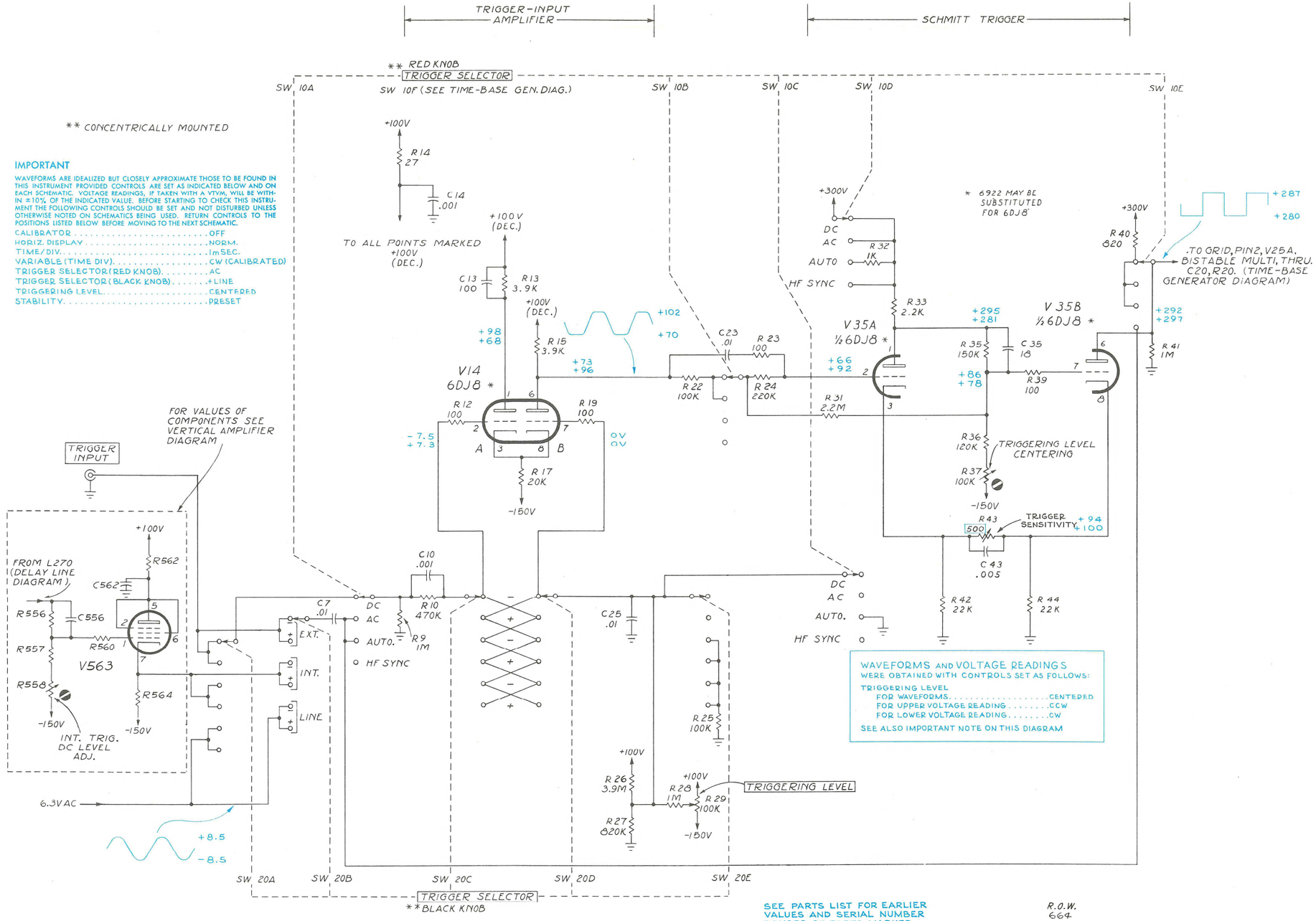
BLOCK DIAGRAM

** CONCENTRICALLY MOUNTED

IMPORTANT

WAVEFORMS ARE IDEALIZED BUT CLOSELY APPROXIMATE THOSE TO BE FOUND IN THIS INSTRUMENT PROVIDED CONTROLS ARE SET AS INDICATED BELOW AND ON EACH SCHEMATIC. VOLTAGE READINGS, IF TAKEN WITH A VTVM, WILL BE WITHIN ±10% OF THE INDICATED VALUE. BEFORE STARTING TO CHECK THIS INSTRUMENT THE FOLLOWING CONTROLS SHOULD BE SET AND NOT DISTURBED UNLESS OTHERWISE NOTED ON SCHEMATICS BEING USED. RETURN CONTROLS TO THE POSITIONS LISTED BELOW BEFORE MOVING TO THE NEXT SCHEMATIC.

CALIBRATOR . . . . . OFF
HORIZ. DISPLAY . . . . . NORM.
TIME/DIV. . . . . 1mSEC.
VARIABLE (TIME DIV). . . . . CW (CALIBRATED)
TRIGGER SELECTOR (RED KNOB). . . . . AC
TRIGGER SELECTOR (BLACK KNOB). . . . . +LINE
TRIGGERING LEVEL. . . . . CENTERED
STABILITY. . . . . PRESET



WAVEFORMS AND VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

TRIGGERING LEVEL
FOR WAVEFORMS. . . . . CENTERED
FOR UPPER VOLTAGE READING . . . . . CCW
FOR LOWER VOLTAGE READING . . . . . CW

SEE ALSO IMPORTANT NOTE ON THIS DIAGRAM

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

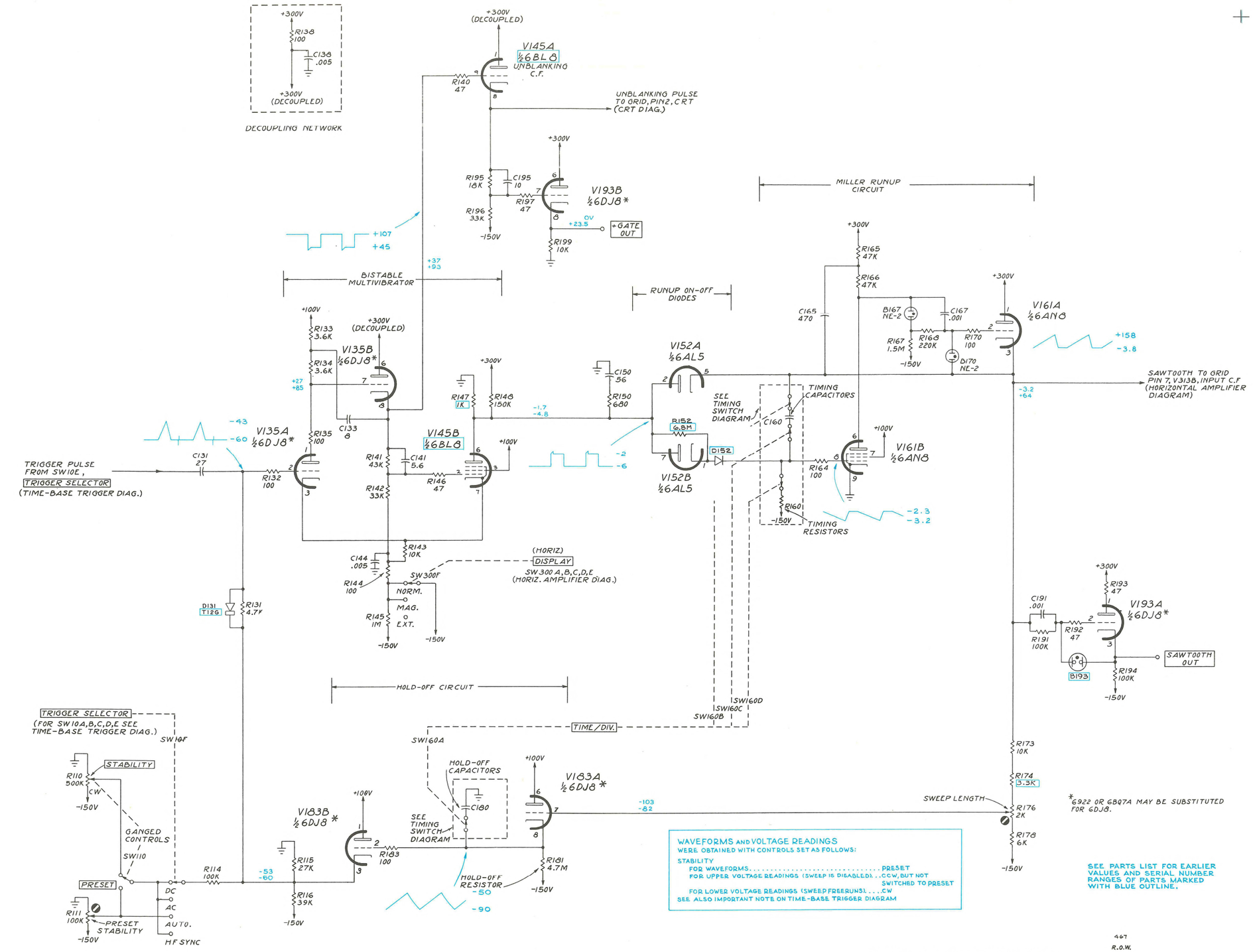
R.O.W. 664

CIRCUIT NUMBERS 1 THRU 49

TYPE RM17 OSCILLOSCOPE

AA2

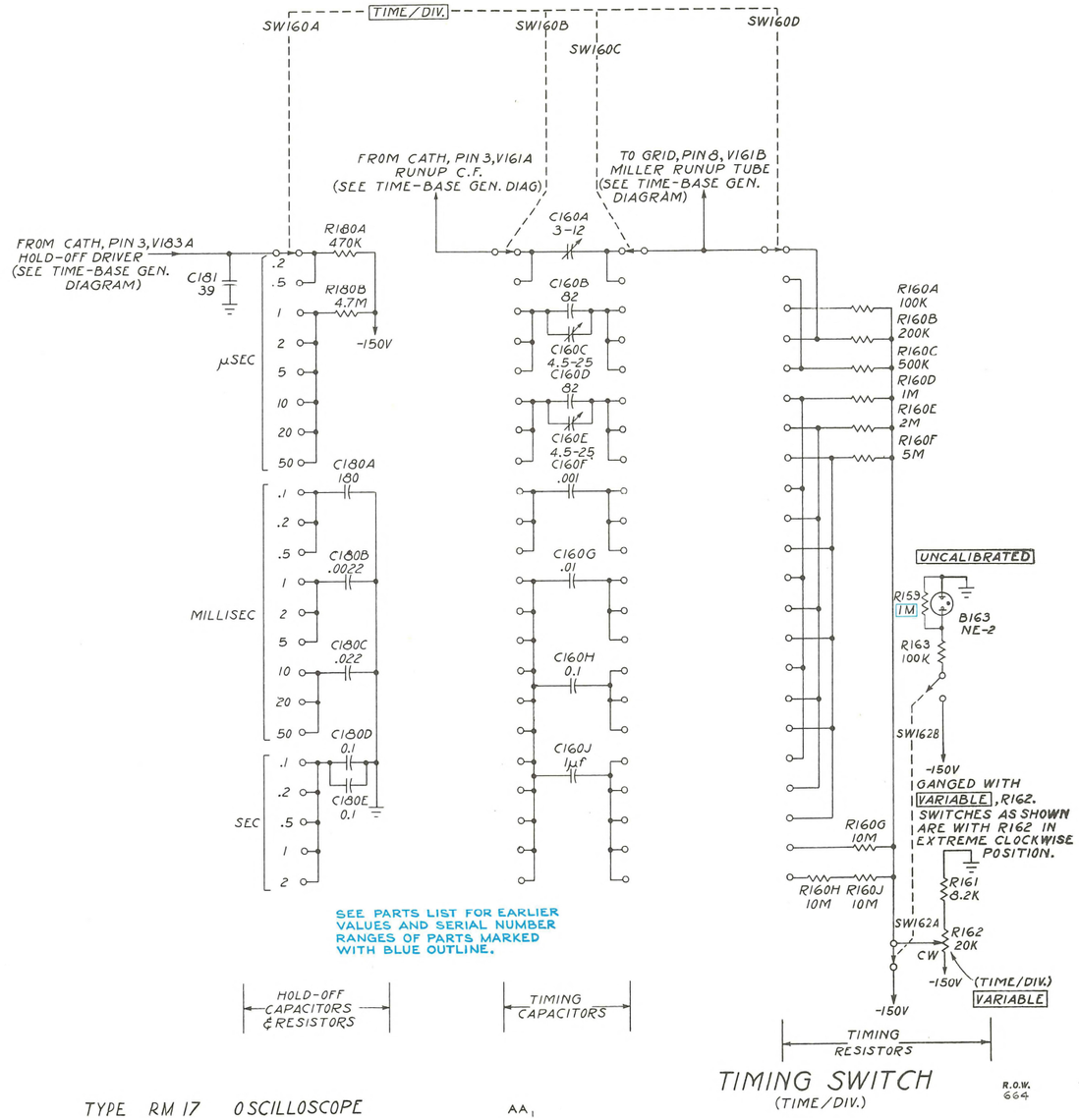
TIME-BASE TRIGGER



TYPE RM 17 OSCILLOSCOPE

TIME-BASE GENERATOR

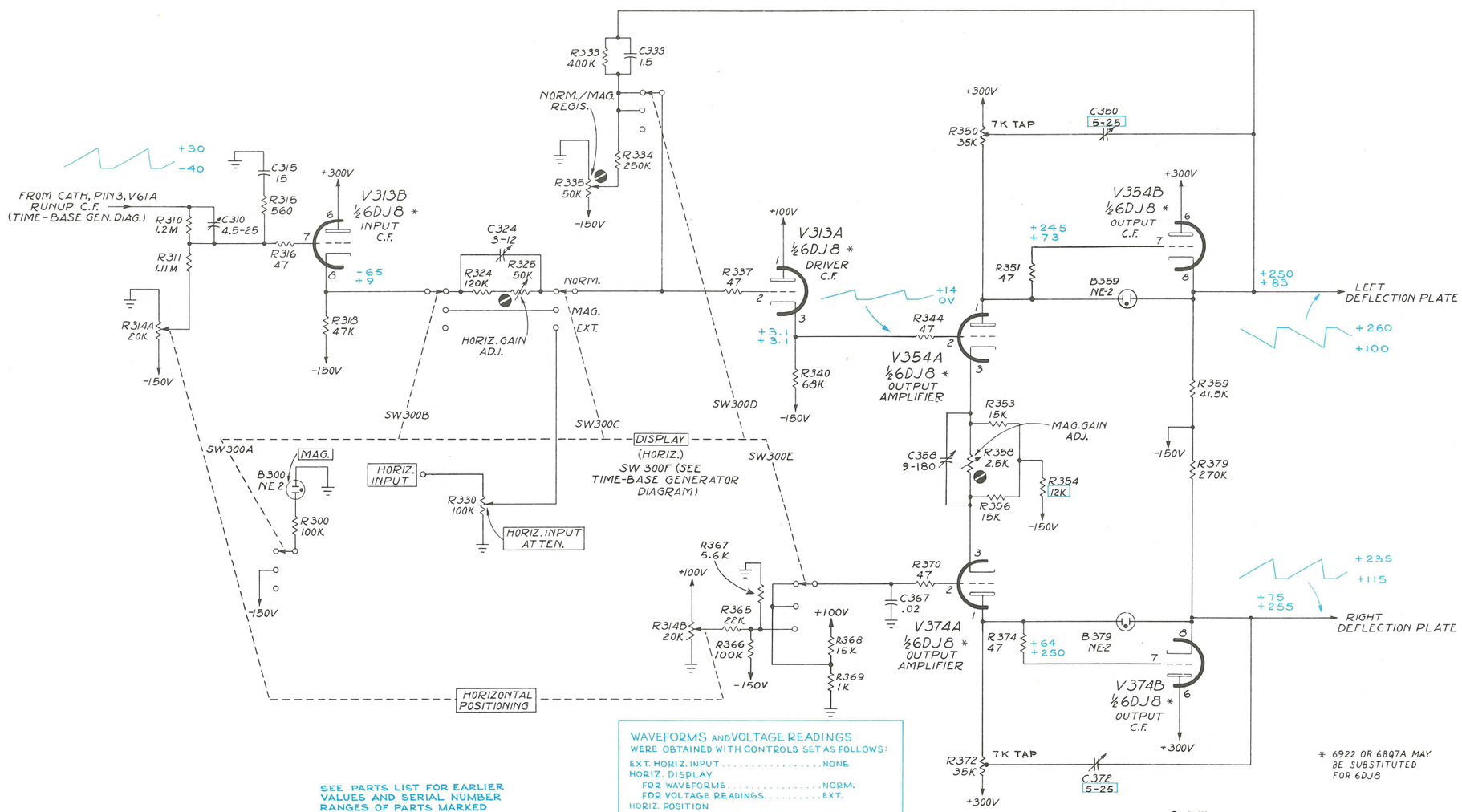
CIRCUIT NUMBERS 100 THRU 199



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

TIMING SWITCH
(TIME/DIV.)

R.O.W. 664



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

WAVEFORMS AND VOLTAGE READINGS
WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

EXT. HORIZ. INPUT . . . . . NONE
HORIZ. DISPLAY
FOR WAVEFORMS . . . . . NORM.
FOR VOLTAGE READINGS. . . . . EXT.
HORIZ. POSITION
FOR UPPER VOLTAGE READING . . . . . CCW
FOR LOWER VOLTAGE READING . . . . . CW

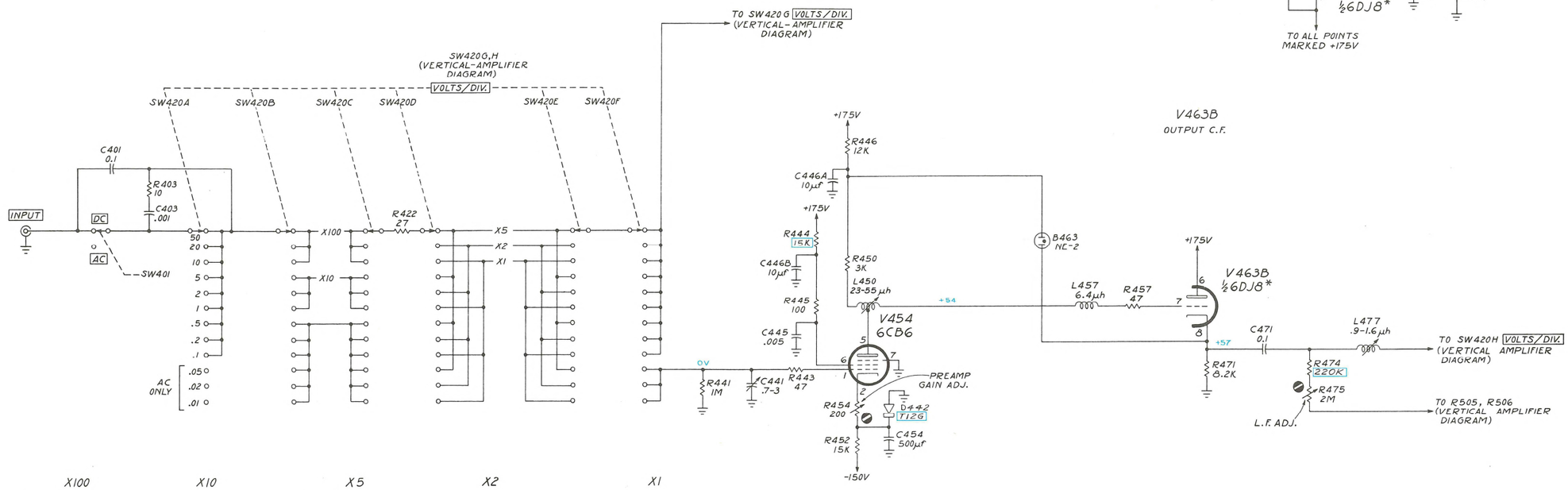
SEE ALSO IMPORTANT NOTE ON TIME-BASE TRIGGER DIAGRAM.

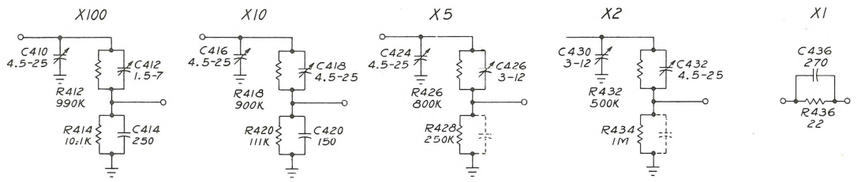
* 6922 OR 6BQ7A MAY BE SUBSTITUTED FOR 6DJ8

R. O. W. 664

CIRCUIT NUMBERS 300 THRU 379

HORIZONTAL AMPLIFIER





ATTENUATOR DETAILS

*6922 MAY BE SUBSTITUTED FOR 6DJ8.

VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

INPUT SIGNAL	NONE
TRIGGER SELECTOR (RED KNOB)	AUTO
VERTICAL POSITION	TRACE CENTERED

SEE ALSO IMPORTANT NOTE ON TIME-BASE TRIGGER DIAGRAM.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

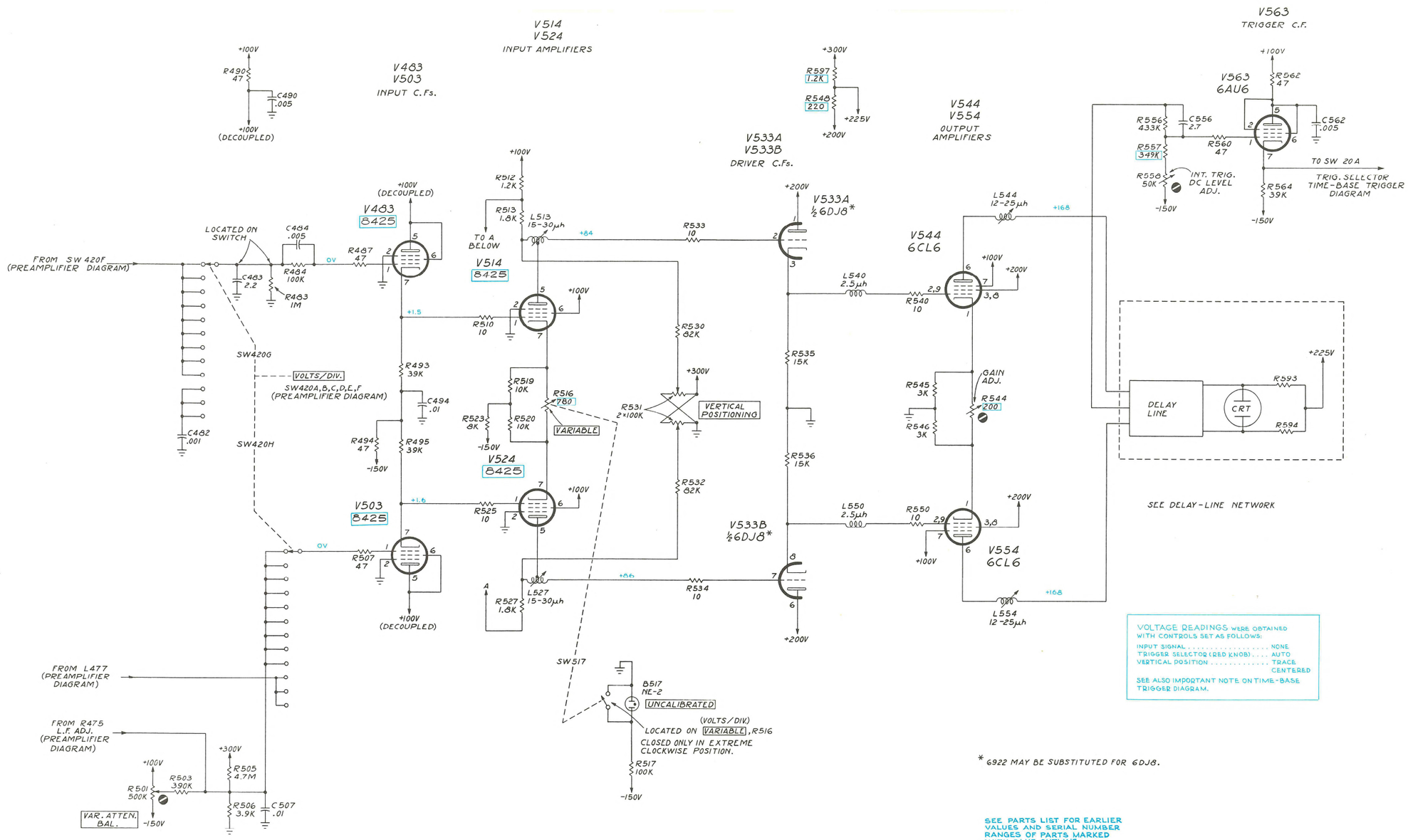
CIRCUIT NUMBERS 400 THRU 419

PREAMPLIFIER

R.O.W. 664

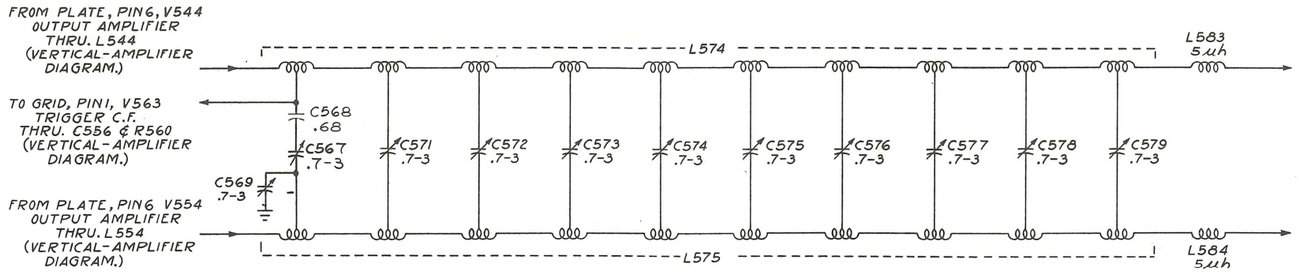
TYPE RM 17 OSCILLOSCOPE

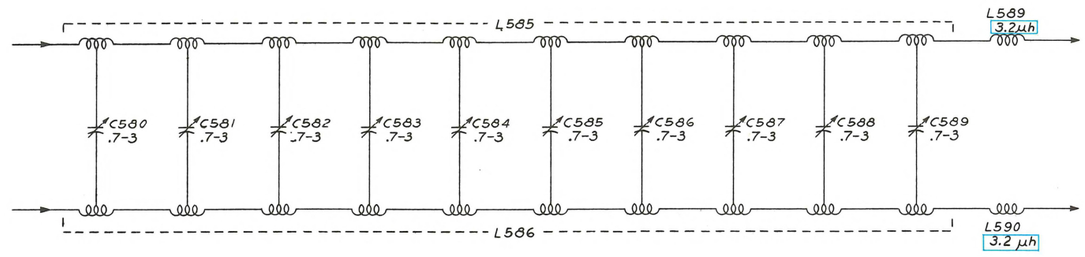
AC

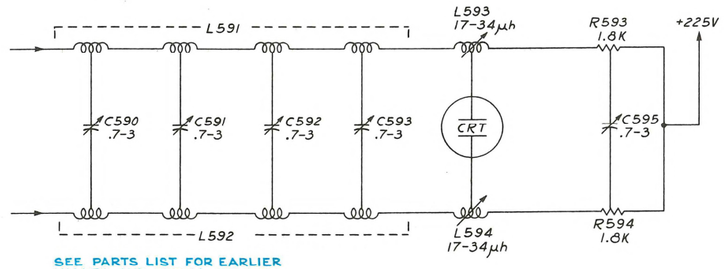


* 6922 MAY BE SUBSTITUTED FOR 6DJ8.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.







SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

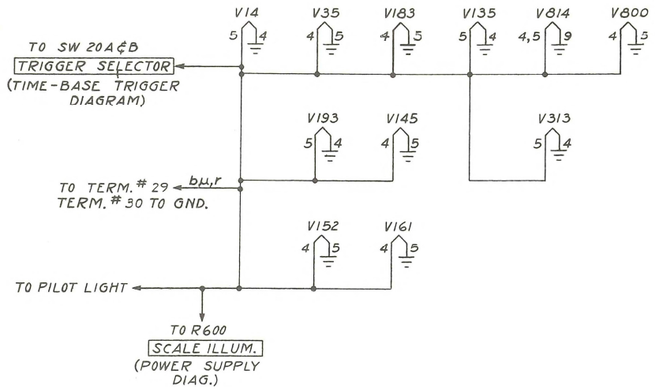
CIRCUIT NUMBERS 565 THRU 599

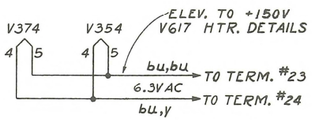
R.O.W 664

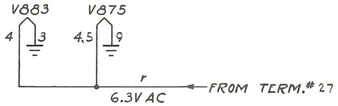
TYPE RM 17 OSCILLOSCOPE AA_2

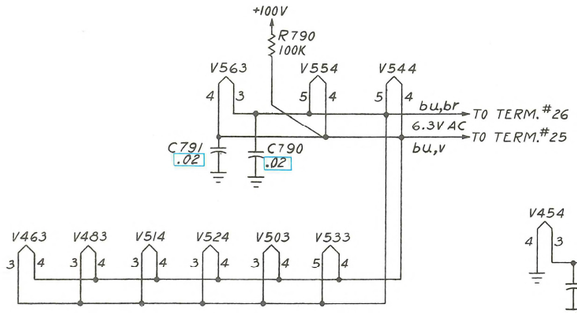
DELAY LINE

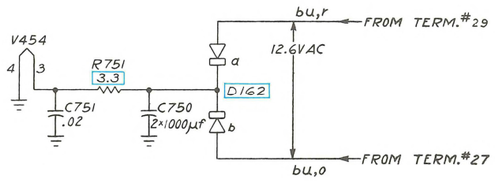
DELAY LINE



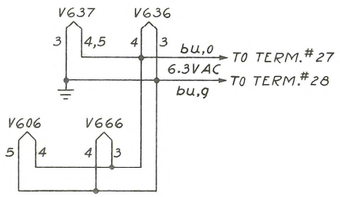


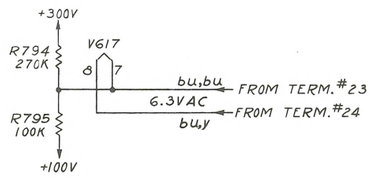




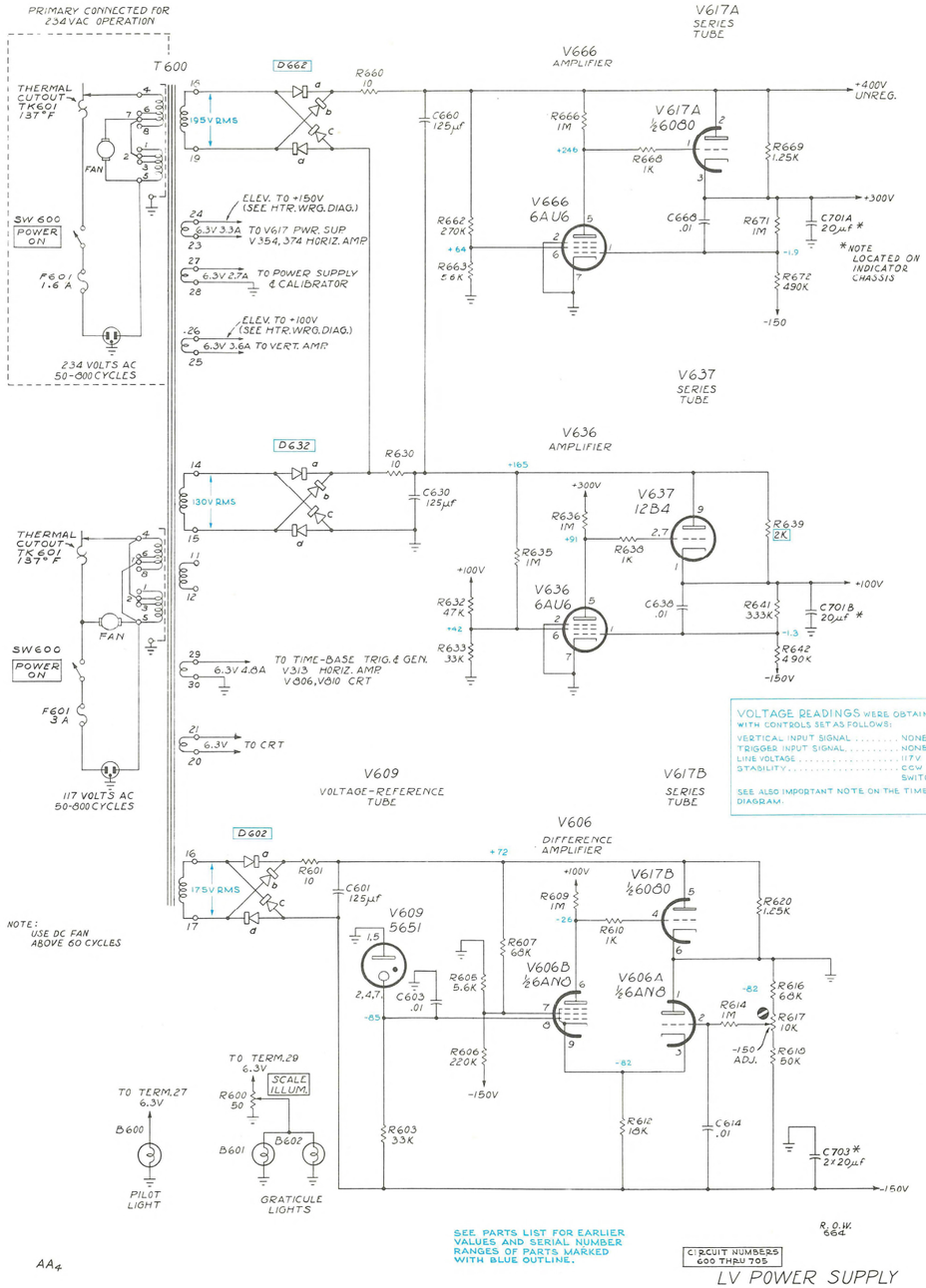


INDICATOR CHASSIS





POWER SUPPLY CHASSIS

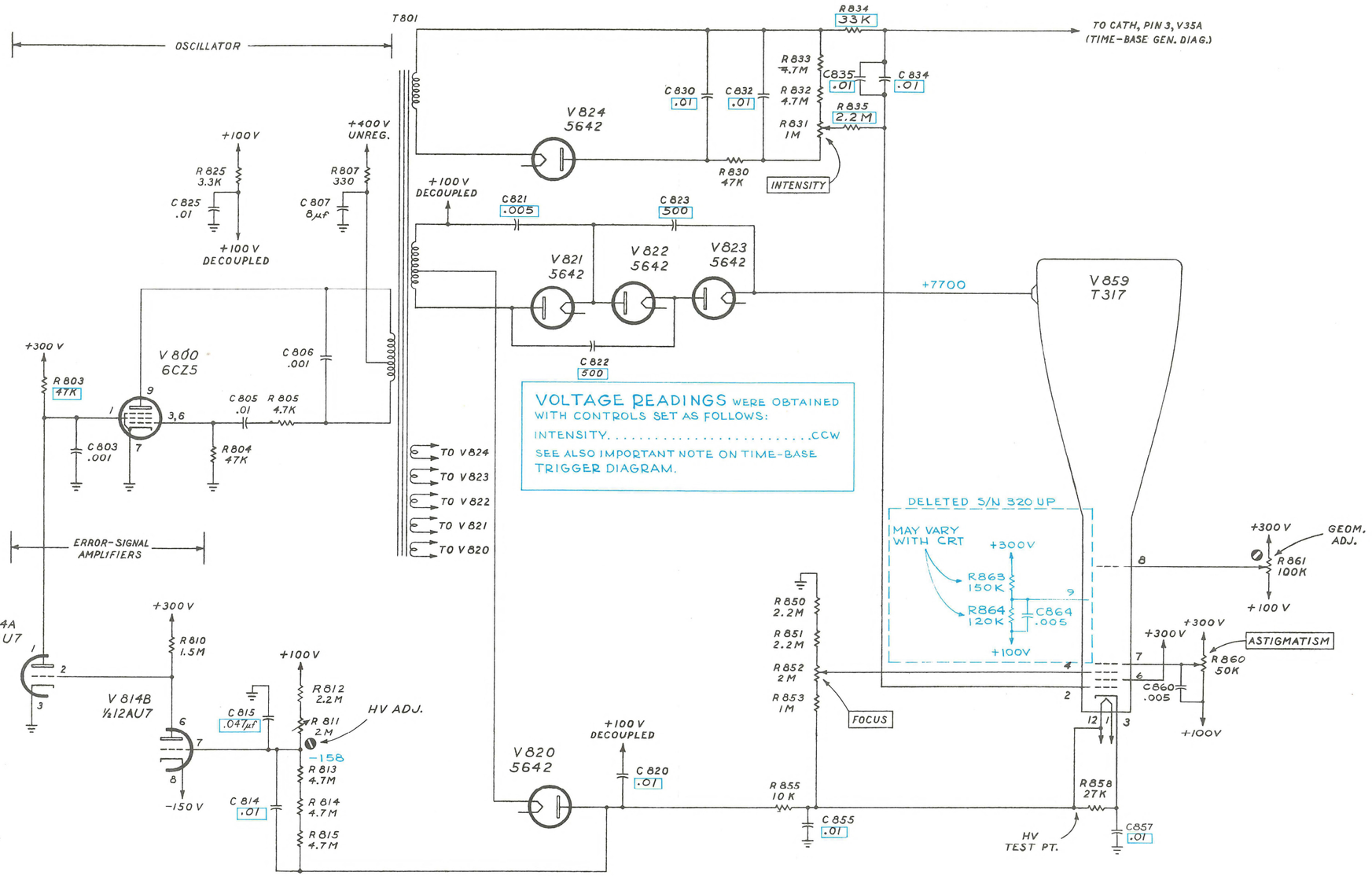


TYPE RM 17 OSCILLOSCOPE

HEATER WIRING DIAGRAM

R.O.W

AA4



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

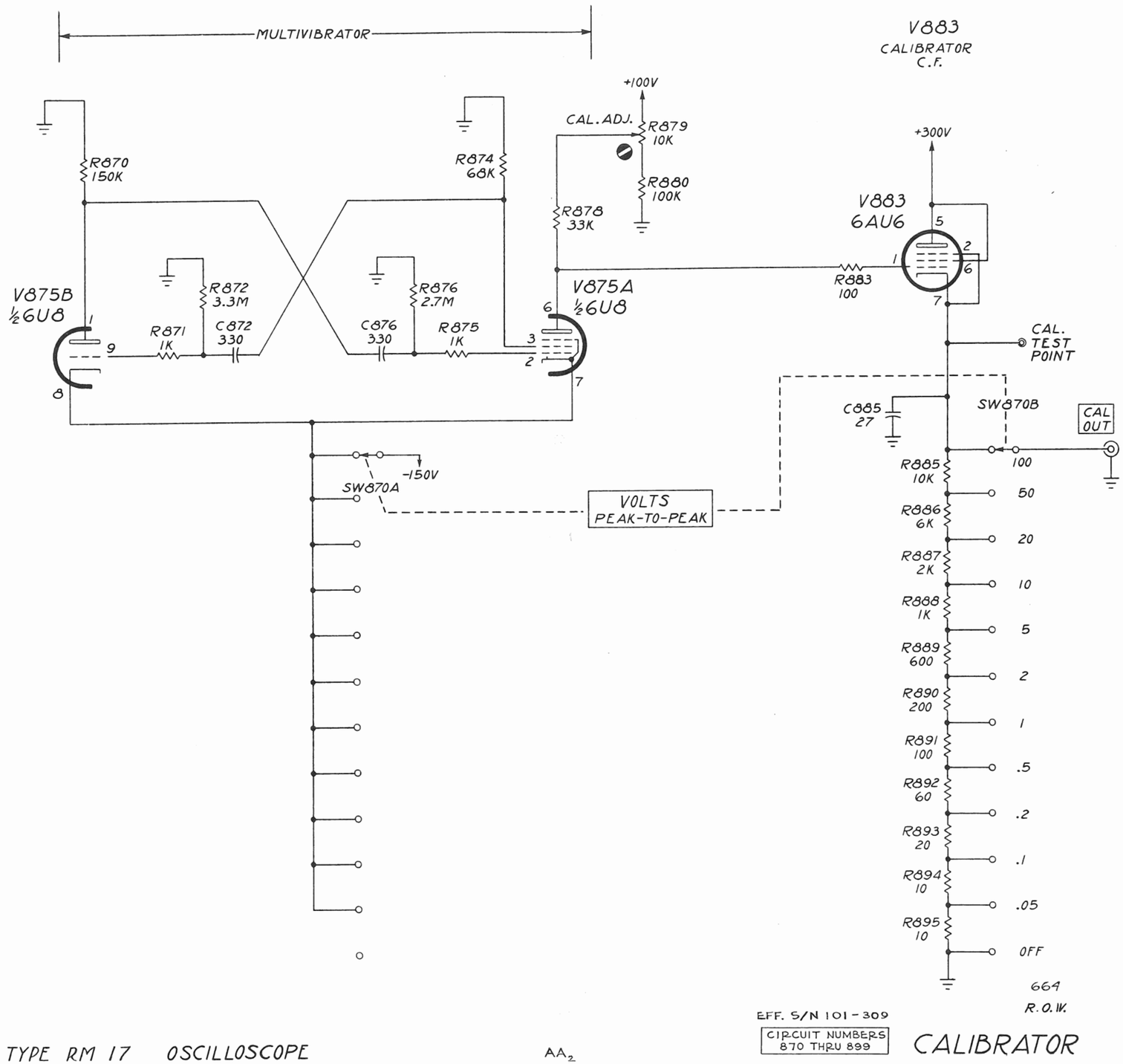
D.B.L. 664

TYPE RM 17 OSCILLOSCOPE

AA4

CRT CIRCUIT

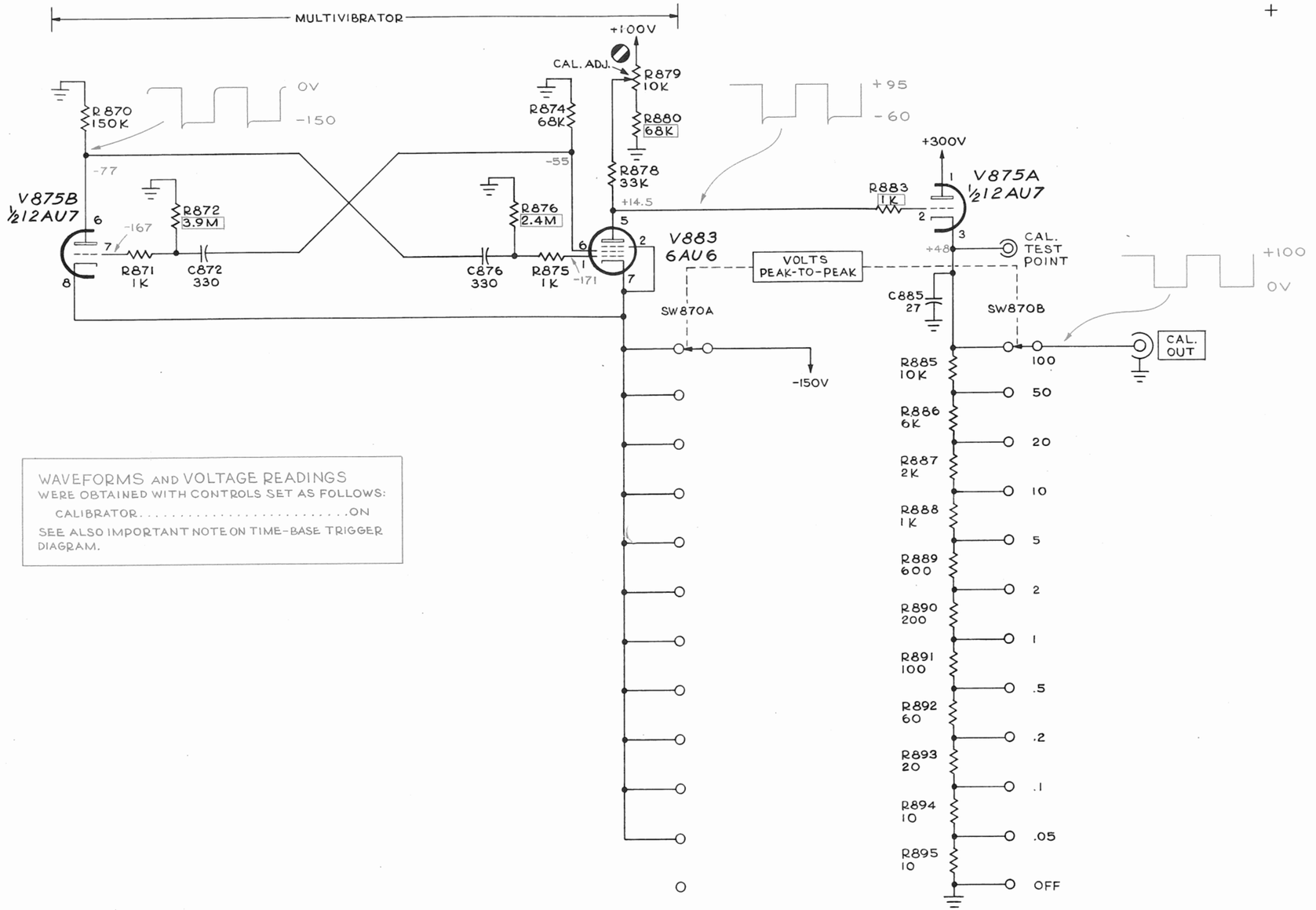
CIRCUIT NUMBERS 800 THRU 869



EFF. S/N 101 - 309

CIRCUIT NUMBERS
870 THRU 899

CALIBRATOR



WAVEFORMS AND VOLTAGE READINGS
WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

CALIBRATOR.....ON

SEE ALSO IMPORTANT NOTE ON TIME-BASE TRIGGER DIAGRAM.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

EFF. S/N 310 & UP

UN 664

CALIBRATOR

CIRCUIT NUMBERS 870 THRU 899