

# FACTORY CALIBRATION PROCEDURE

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## INTRODUCTION:

This is the guide for calibrating brand-new instruments, it therefore, calls out many procedures and adjustments that are rarely required for subsequent recalibration. *This procedure is company confidential.* In this procedure, all front panel control labels or Tektronix equipment names are in capital letters (VOLTS/DIV, etc.) internal adjustment labels are capitalized only (Gain Adj, etc.).

Tek form number:

0-124

February 1967

For all serial numbers.



3B5

## FACTORY TEST LIMITS:

We initially calibrate the instrument to Factory Test Limits. These limits are often more stringent than advertised performance requirements. This helps insure that the instrument will meet advertised requirements after shipment, allows for inaccuracies of test equipment used, and may allow for changes in environmental conditions.

## QUALIFICATION:

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of 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 check-out methods and test equipment differ substantially from those in this procedure.

## ABBREVIATIONS:

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100.

## CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes that have been made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 47-261. (NC)



## EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

- a. TEKTRONIX Instruments
  - 1 TYPE 543B OSCILLOSCOPE
  - 1 TYPE K PLUG-IN UNIT
  - \* 1 TYPE 561A OSCILLOSCOPE
  - 1 TYPE 3A5 AUTOMATIC/PROGRAMMABLE AMPLIFIER
  - \* 1 TYPE 184 TIME MARK GENERATOR
  - \* 1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
- b. Test Fixtures and Accessories
  - 1 P6028 1X probe (010-0074-00)
  - 1 P6006 10X passive probe (010-0127-00)
  - 1 50 $\Omega$  BNC Terminator (011-0049-00)
  - 1 BNC T Connector (103-0030-00)
  - 2 50 $\Omega$  Coaxial Cables, BNC (012-0057-00)
  - 1 Flexible Plug-In Extension (012-0066-00)
  - \* 1 STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
  - 1 1k $\Omega$  1% resistor (309-0115-00)
- c. Other Equipment
  - 1 20,000 $\Omega$ /VDC Multimeter
  - 1 Sine Wave Generator (constant amplitude 1 Hz-1 MHz with >40V P to P amplitude, <1k $\Omega$  output impedance)
  - 1 External Program Checker (PMPE Dwg #1370-C, 1376-C, 1377-C, 1378-C, 1479-B, 1544-B)

\* This equipment must be traceable to NBS for instrument certification. Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

It is assumed that all equipment is provided with BNC connectors; if equipment used has other than BNC connectors, adapters, not listed, may be needed.

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## FACTORY TEST LIMITS

### QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of 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.

#### 1. PRELIMINARY

c. Resistance checks

#### 2. SETUP

#### 3. FRONT PANEL LIGHTS

#### 4. TRIGGER

- b. Adjust TRIG LEVEL CENTERING: no trigger with extreme settings of LEVEL control with + & - 20V ext input
- c. Adjust Auto Trigger Centering: 0.5 div display remains triggered with extreme settings of LEVEL control
- d. Check Internal Low Frequency Triggering  
 $\leq 0.4$  div @ 50 Hz
- e. Check External Low Frequency Triggering  
 AC:  $\leq 1V$  @ 50 Hz  
 DC:  $\leq 1V$  @ 10 Hz  
 DC:  $\leq 2V$  @ 1 Hz
- f. Check Trigger Level Range:  
 EXT DC + & - 10V  
 INT AC + & - 10V
- g. Check External High Frequency Triggering:  
 $\leq 1V$  @ 20 MHz
- h. Check Internal High Frequency Triggering:  
 $\leq 0.7V$  @ 20 MHz (at pin CC of time base board)

#### 5. TIMING

- b. Check Cal Range/Adjust CAL:  
 $\geq +$  &  $-$  5% to 15% (depends on CRT) above and below calibrated setting
- c. Align horizontal position knob
- d. Check Time/Div Variable Ratio:  
 $\geq 2.5:1$
- e. Check Sweep Length:  
 Mag off: 10.3-11.3 div  
 Mag on: 12-15 div
- \* f. Adjust Stop, Start/Check Jitter  
 Range:  $\geq +$  &  $-$  10% of rotation left after adjustment, jitter;  $\leq 0.2$  div
- g. Check Delay Range:  $\leq 0.2$  div to  $\geq 10$  div
- \* h. Check Delay incremental accuracy:  
 within 0.3% of full scale
- \* i. Check Delay Time Accuracy:  
 within 1% of full scale
- \* j. Check 1, 2 & 5ms Timing Accuracy (X1, X10, X100):  $\pm 2.5\%$
- \* k. Adjust 1 SEC Cal/Check Range:  
 accuracy:  $\pm 2.5\%$ ; range: + & -5%
- \* l. Check .1 to .5ms and 10ms to 5s Timing Accuracy (X1, X10, X100):  
 .1ms-1s:  $\pm 2.5\%$ ; 2 & 5s:  $\pm 4\%$
- \* m. Check/Adjust 1 $\mu$ s-.5 $\mu$ s Timing Accuracy:  $\pm 2.5\%$
- n. Pre-Adjust C547 & C551
- o. Adjust Mag Regis
- \* p. Adjust 50ns Timing:  $\pm 2.5\%$
- q. Adjust 10ns Linearity
- \* r. Adjust 20ns Timing:  $\pm 2.5\%$
- s. Check Timing Change with Position (20 & 50ns):  $\pm 4\%$  error
- \* t. Adjust 10ns Timing Accuracy:  $\pm 2.5\%$  error,  $\pm 4\%$  error with Position change
- \* u. Check X10, 1-5 $\mu$ s, Timing Accuracy:  
 $\pm 2.5\%$
- \* v. Check X100, 10-50 $\mu$ s, Timing Accuracy:  $\pm 2.5\%$

#### 6. EXT PROGRAM

- c. Check External Program Delay:  
 Range:  $\leq 0.2$  to  $\geq 10$  div
- d. Check External Program Time/Div:  
 Program all Time/Div settings
- e. Check External Program Position:  
 Range: + & - 3 div
- f. Check External Program Trigger:  
 Range:  $\geq +$  &  $-$  20V (EXT AC)

- 6g. Check External Program Seek: must seek  
from external programmer
  - \* h. Check External Horizontal: deflection  
factory, 5V/Div  $\pm 5\%$ ; bandwidth,  $\geq 750$  kHz
  - i. Check Output DC Level:  $180 \pm 10V$
  - j. Check Single Sweep Operation
  - k. Check Sweep Output:  $40-60\mu A/DIV$
7. VOLTAGE LEVELS/WAVEFORMS
- b. Check Multi-trace Sync Pulse:  
> +5V and -7V
  - c. Check Intensified Pulse Levels:  
X1, -12V  $\pm 1V$   
X10, -6V,  $\pm 1V$   
X100, -0.5V to -1V
  - d. Check Seek Pulse Width: 1 S-1.8 S
  - e. Check Seek Cycling Time: 1-2 S
  - f. Check Cycles/Sweep Range: 1-7ms pulse width
  - g. Check Logic Window Gate Delay:  
 $\leq 0.3$  s
  - h. Check Advance Pulse Duration:  $\leq 500ms$
  - i. Check Elevated Filaments: +125V
  - j. Check V163 Grid Voltage: -2.5 to -3.5V
  - k. Check 3L10 Sawtooth Drive:  $68\mu A/DIV \pm 10\%$
  - l. Check Holdoff: must be sufficient to  
allow waveform to return to a DC level  
between sawtooths

## 8. SEEK

- b. Check Trigger Operation
- c. Check Seek Operation: 20 Hz-20 MHz
- d. Check Remote Seek: must seek from  
TYPE 3A5 REMOTE SEEK jack
- e. Check Seek Switch: must seek in  
all positions of TIME/DIV switch

THE END

\* Indicates measurement characteristic; test equipment used must be traceable to the NBS for instrument certification.

1. PRELIMINARY*a. General Inspection*

Check for unsoldered connections, rosin connections, lead dress and long ends. Check for loose hardware, foreign material and protruding parts. Check controls for smooth mechanical operation, proper indexing and knob spacing. Check the reed switches for proper alignment (see NOTES). Turn the DELAY control full ccw and mechanically align the dial to 0.00.

The kink in the contact lead of the double pole reed switches must be aligned so it is flush with the top edge of the hole in the coil form.

*b. Preset controls*TYPE 3B5

POSITION	midr
DLY'D SWP MAG	OFF
DELAY	0.00
TRIGGER	AUTO
TRIGGER LEVEL	midr
MANUAL TIME/DIV	1mS
VARIABLE	CAL
TRIG LEVEL CENTERING	midr
CAL	midr
CYCLES/SWEEP	midr

Preset all internal adjustments to midr.

TYPE 3A5

POSITION	midr
INPUT	DC
MANUAL VOLTS/DIV	1
VARIABLE	CAL

*c. Resistance Checks*

Check the resistance between ground and each pin on the amphenol connector. (-lead of ohmmeter grounded)

<u>Pin No.</u>	<u>Approximate Resistance</u>
1, 2	100k $\Omega$
3	$\infty$
4	9k $\Omega$ (X1K meter scale)
5	0
6	30k $\Omega$ (X10K meter scale)
7, 8	$\infty$
9	0
10	30k $\Omega$
11, 12	$\infty$
13	12k $\Omega$ (X1K meter scale)
14	4.2k $\Omega$
15	7.5k $\Omega$
16	15 $\Omega$ (X1 meter scale)

## 1c. (cont'd)

17	35k $\Omega$
18	75k $\Omega$
19	0
20	7.5k $\Omega$
21	35k $\Omega$
22	650 $\Omega$
23	2.5k $\Omega$
24	$\infty$

Resistance between pin 1 and 2: 1 $\Omega$

2. SETUP

Install the TYPE 3B5 and TYPE 3A5 in the HORIZONTAL and VERTICAL compartments of the TYPE 561A. Apply power to the TYPE 561A. Allow 5 minutes operating time before making adjustments or checks.

3. FRONT PANEL LIGHTS

Check that read out panel indicates NOT TRIG'D.

Check that the time/div indicated on the read out panel corresponds to each setting of the MANUAL TIME/DIV switch.

Change the DLY'D SWP MAG to X10. Check that the read out panel indicates MAG'D SWP and the indicated time/div is 1/10 of the setting of the MANUAL TIME/DIV switch from 5S to 1 $\mu$ S. Check that the MAG'D SWP light is extinguished and the read out panel indicates the same settings as the MANUAL TIME/DIV, in the .5 $\mu$ S to 10nS positions.

Change the DLY'D SWP MAG to X100. Check that the read out indicates MAG'D SWP and the indicated time/div is: 1/100 of the MANUAL TIME/DIV setting from 5S to 10 $\mu$ S, 1/10 of the MANUAL TIME/DIV setting from 5 $\mu$ S to 1 $\mu$ S and the same as the MANUAL TIME/DIV from .5 $\mu$ S to 10nS. Check that MAG'D SWP light is extinguished in the .5 $\mu$ S to 10nS positions.

## 3. (cont'd)

Return the DLY'D SWP MAG to OFF. Turn the VARIABLE CAL control ccw. Check that read out panel indicates UNCAL. Return the VARIABLE CAL to the calibrated detent.

Check that AUTO neon is lit only when the TRIGGER switch is in AUTO.

Depress the CHANGE SLOPE button several times. Check that + and - neons light alternately.

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4. TRIGGER*a. Setup*

Connect a BNC T connector to the TYPE 3A5 INPUT. Connect the OUTPUT of the SINE WAVE GENERATOR to one side of the T connector. Connect the other side of the T connector to the TYPE 3B5 EXT TRIG INPUT. Set the TRIGGER to EXT AC, SINE WAVE GENERATOR FREQUENCY to 50 Hz and adjust the AMPLITUDE for 40 volts.

*b. Adjust TRIG LEVEL CENTERING*

Adjust the TRIG LEVEL CENTERING so the display will not trigger with extreme cw and ccw settings of the LEVEL control with SLOPE in + and -.

*c. Adjust Auto Trigger Centering*

Set the front panel controls as follows:

TYPE 3A5

INPUT	DC
MANUAL VOLTS/DIV	1V

TYPE 3B5

MANUAL TIME/DIV	10mS
TRIGGER	AUTO

Adjust the SINE WAVE GENERATOR AMPLITUDE for a 0.5 div display.

## 4c. (cont'd)

Adjust the Auto Trigger Centering (R35) so the display is triggered in + and - slope with the LEVEL control at full cw and ccw settings.

d. *Check Internal Low Frequency*  
*Triggering*  $\leq 0.4 \text{ div @ } 50 \text{ Hz}$

Adjust the SINE WAVE GENERATOR AMPLITUDE for a 0.4 div display (frequency at 50 Hz).

Check that stable triggering can be obtained by adjusting the LEVEL control. Check in + and - slope.

Check that the lighting of the SLOPE neons correspond to the slope of the display.

Change the TRIGGER to INT AC and repeat the check.

Momentarily remove the signal from the 3A5 INPUT. Check that trace disappears and read out panel lights NOT TRIG'D.

e. *Check External Low Frequency*  
*Triggering* AC:  $\leq 1V @ 50 \text{ Hz}$   
 DC:  $\leq 1V @ 10 \text{ Hz}$   
 DC:  $\leq 2V @ 1 \text{ Hz}$

Set the SINE WAVE GENERATOR FREQUENCY to 50 Hz and adjust the AMPLITUDE for 1 volt. Change the TRIGGER to EXT AC. Check for stable triggering in + and - SLOPE. Momentarily remove the signal from the EXT TRIG INPUT jack and check that the display is not triggered.

Change the TRIGGER to EXT DC and the SINE WAVE GENERATOR FREQUENCY to 10 Hz. Check for stable triggering in + and - SLOPE.

Change the SINE WAVE GENERATOR FREQUENCY to 1 Hz and adjust the AMPLITUDE for 2 volts. Check for stable triggering in + and - SLOPE. Change the TRIGGER to EXT AC and check that the display will not trigger.

f. *Check Trigger Level Range*  
 EXT DC: + & - 10V  
 INT AC: + & - 10V

Set the front panel controls as follows:

SINE WAVE GENERATOR  
 AMPLITUDE 20V  
 FREQUENCY 60 Hz



4f. (cont'd)

TYPE 3A5

MANUAL VOLTS/DIV      10

TYPE 3B5

MANUAL TIME/DIV      5mS  
TRIGGER              EXT DC

Check that the display is not triggered with extreme cw and ccw settings of the LEVEL control. Check with SLOPE in + and -.

Change the TRIGGER to INT AC. Replace the TYPE 3A5 with a TYPE 3A1. Connect the T connector (that was connected to the TYPE 3A5 INPUT) to the TYPE 3A1 CH 1 INPUT. Set the TYPE 3A1 MODE to CH 1, CH 1 VOLTS/DIV to 10 and the CH coupling to DC. Monitor pin CC on the Time Base Board with the test scope. Adjust the SINE WAVE GENERATOR AMPLITUDE for 20V P to P signal at pin CC.

Check that the display is not triggered with extreme cw and ccw settings of the LEVEL control. Check in + and - slope.

Replace the TYPE 3A1 with the TYPE 3A5.

*g. Check External High Frequency  
Triggering       $\leq 1V$  @ 20 MHz*

Remove the SINE WAVE GENERATOR signal. Connect the OUTPUT of the TYPE 191 through a 50 $\Omega$  Terminator to the BNC T connector on the TYPE 3A5 INPUT. Set the TYPE 191 FREQUENCY to 20 MHz and AMPLITUDE to 1V.

Change the TYPE 3B5 MANUAL TIME/DIV to .1 $\mu$ S and the TRIGGER to EXT AC.

Check that stable triggering can be obtained in + and - slope, by adjusting the LEVEL control.

Change the TRIGGER to EXT DC and repeat the check.

## 4. (cont'd)

h. *Check Internal High Frequency Trigger*  
 $\leq 0.7V @ 20 \text{ MHz}$ 

Change the TRIGGER to AUTO. Monitor pin CC of the time base board with the test scope. Adjust the TYPE 191 AMPLITUDE for 0.7 volts at pin CC. Check that stable triggering can be obtained in + and - SLOPE, by adjusting the LEVEL control.

Repeat the check with the TRIGGER in INT AC.

Remove all cables and connectors.

h. If the frequency response of the test scope is not flat to 20 MHz it will be necessary to find the amplitude corresponding to 0.7V with a 20 MHz signal. Connect the TYPE 191 to the test scope vertical input. Set the TYPE 191 frequency to 50 kHz and adjust for 0.7 volts. Change the frequency to 20 MHz and note the displayed amplitude. Use the same VOLTS/CM setting and adjust for this amplitude at pin CC.

## 5. TIMING

a. *Setup*

Set the front panel controls as follows:

TYPE 3A5

MANUAL VOLTS/DIV .5

TYPE 3B5

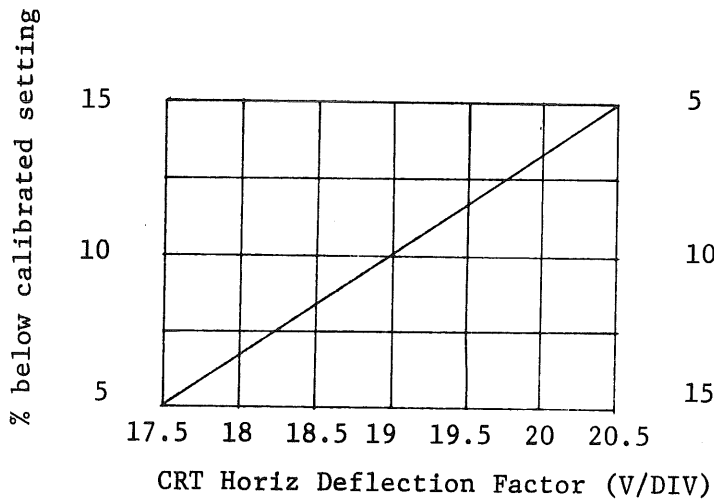
MANUAL TIME/DIV 1mS  
VARIABLE CAL  
TRIGGER INT AC

Connect the MARKER OUTPUT of the TYPE 184 through a 50 $\Omega$  Terminator to the TYPE 3A5 INPUT. Set the TYPE 184 for .1mS and 1mS time marks. Adjust the LEVEL control for a stable triggered display (+ slope).

b. *Check CAL Range/Adjust CAL*

Rotate the front panel CAL adjustment throughout its range. The CAL adjustment must have sufficient range to adjust above (timing long) and below (timing short) the calibrated setting by the amounts indicated on the following chart:

5b. (cont'd)



6b. Unless noted otherwise, make all timing adjustments and checks over the middle 8 div of the graticule.

Adjust the CAL adjustment for one 1mS mark/div.

c. *Align Horizontal Position Knob*

Adjust the HORIZONTAL POSITION so the trace starts on the left hand graticule line. Loosen the set screws in the HORIZONTAL POSITION knob and align the index mark to the center of the slot. Tighten the set screws.

d. *Check Time/Div Variable Ratio*  
>2.5:1

Rotate the VARIABLE CAL control full ccw. Check for smooth change in timing. With the control full ccw there must be at least 1mS time marks/2 div.

e. *Check Sweep Length*

Mag off: 10.3-11.3 div @ 1mS/DIV  
 Mag on: 12-15 div @ 1mS/DIV

Check for a sweep length of 10.3 to 11.3 div. Change the DLY'D SWP MAG to X10. Check for a sweep length of 12 to 15 div.

f. *Adjust Start, Stop/Check Jitter*

Range: >10% of rotation left after adjustment; Jitter: <2 parts in 10,000

Change the DLY'D SWP MAG to X100 and the TYPE 184 time marks to 1mS. Set the DELAY dial to 1.00.

5e. (cont'd)

Adjust the Start Adjustment (R330) so the magnified sweep starts on the leading edge of the second lms time mark.

Change the DELAY dial to read 9.00.  
Adjust the Stop Adjustment (R333) so the unmagnified sweep starts on the leading edge of the tenth lms time mark.

Due to interaction it will be necessary to repeat the Start/Stop Adjustments several times.

There must be at least 10% of rotation left (after adjustment) on the Delay Start and Delay Stop Adjustments.

The jitter on the second and tenth time mark (when completely displayed in the magnified area) must not exceed 0.2 div.

*g. Check Delay Range  $\leq 0.2$  div to  $\geq 10$  div*

Rotate the DELAY dial through its range. The start of the magnified sweep must vary from  $\leq 0.2$  div to  $\geq 10$  div (referenced from the start of the trace).

*h. Check Delay Incremental Accuracy  
 $\pm 0.3\%$  of full scale*

Set the DELAY dial so the magnified sweep starts on the second lms time mark. Note the dial reading. Adjust the DELAY dial so the magnified sweep starts on the third lms time mark. Note the dial reading. The difference between the two dial readings must be 50  $\pm 1.5$  minor div.

Repeat this check for each major dial setting (i.e. 2.00 to 3.00, 3.00 to 4.00, etc.).

5. (cont'd)

- i. *Check Delay Time Accuracy (1mS)*  
 $\pm 0.4\%$  of full scale  
 $\pm 1\%$  of full scale

+ Valid only when checked in the same main frame, and at the same line voltage, that the unit was calibrated in.

Adjust the DELAY dial (approx 1.00) so the magnified sweep starts on the second 1mS time mark. Note the dial reading. The dial must be  $1.00 \pm 5$  minor div  $\pm (1.00 \pm 2$  minor div). Adjust the DELAY dial (approx 2.00) so the magnified sweep starts on the third time mark. The dial must read  $2.00 \pm 5$  minor div  $\pm (2.00 \pm 2$  minor div). Repeat this check for each major dial division between 2.00 and 9.00. The max deviation from any major dial setting must not exceed 5 minor div  $\pm (2$  minor div).

- j. *Check 1, 2 & 5ms Timing Accuracy:  $\pm 2.5\%$*

Set the DELAY dial to 0.00. Check for the specified marks/div with the controls set as follows:

MANUAL TIME/DIV	DLY'D SWP MAG	TYPE 184	MARKS/DIV
1mS	X10	.1mS	1 $\pm 2.5\%$
1mS	X100	10 $\mu$ S	1 $\pm 2.5\%$
2mS	X100	10 $\mu$ S	2 $\pm 2.5\%$
2mS	X10	.1mS	2 $\pm 2.5\%$
2mS	OFF	1mS	2 $\pm 2.5\%$
5mS	OFF	5mS	1 $\pm 2.5\%$
5mS	X10	.5mS	1 $\pm 2.5\%$
5mS	X100	50 $\mu$ S	1 $\pm 2.5\%$

Return the DLY'D SWP MAG to OFF.

- k. *Adjust 1 Sec Cal/Check Range*  
*accuracy:  $\pm 2.5\%$*   
*range: + & - 5%*

Change the MANUAL TIME/DIV to 1S and the TYPE 184 time marks to 5S. Adjust the HORIZONTAL POSITION so the first 5S time mark is aligned with the 0cm graticule mark. Turn the 1 Sec Cal (R395) full cw. The second 5S time mark must occur at least 0.25 div to the left of the 5cm graticule mark. Turn R395 full ccw. The second 5S time mark must occur at least 0.25 div to the right of the 5cm graticule mark.

Change the TYPE 184 time marks to 1S. Adjust R395 for 1 mark/div  $\pm 2.5\%$ .

## 5. (cont'd)

- \* l. Check .1 to .5ms and 10ms to 5 s  
 Timing Accuracy .1ms-1s:  $\pm 2.5\%$   
 2 & 5s:  $\pm 4\%$

Check for the specified marks/div with the controls set as follows:

MANUAL TIME/DIV	DLY'D SWP MAG	TYPE 184	MARKS/DIV
1S	X10	.1 S	1 $\pm 2.5\%$
1S	X100	10mS	1 $\pm 2.5\%$
2S	X100	10mS	2 $\pm 4\%$
2S	X10	.1 S	2 $\pm 4\%$
2S	OFF	1 S	2 $\pm 4\%$
5S	OFF	5 S	1 $\pm 4\%$
5S	X10	.5 S	1 $\pm 4\%$
5S	X100	50mS	1 $\pm 4\%$
.5 S	OFF	.5 S	1 $\pm 2.5\%$
.2 S	OFF	.1 S	2 $\pm 2.5\%$
.1 S	OFF	.1 S	1
50mS	OFF	50mS	1 $\pm 2.5\%$
20mS	OFF	10mS	2 $\pm 2.5\%$
10mS	OFF	10mS	1 $\pm 2.5\%$
.5mS	OFF	.5mS	1 $\pm 2.5\%$
.2mS	OFF	.1mS	2 $\pm 2.5\%$
.1mS	OFF	.1mS	1 $\pm 2.5\%$

- m. Check/Adjust 1 $\mu$ s to .5 $\mu$ s Timing Accuracy  
 $\pm 2.5\%$

Check or adjust the timing accuracy with the controls set as follows:

MANUAL TIME/DIV	TYPE 184	adjust/ check	MARKS/DIV
1 $\mu$ S	1 $\mu$ S	C168	1 $\pm 2.5\%$
2 $\mu$ S	1 $\mu$ S	check	2 $\pm 2.5\%$
5 $\mu$ S	5 $\mu$ S	check	1 $\pm 2.5\%$
10 $\mu$ S	10 $\mu$ S	C315	1 $\pm 2.5\%$
20 $\mu$ S	10 $\mu$ S	check	2 $\pm 2.5\%$
50 $\mu$ S	50 $\mu$ S	check	1 $\pm 2.5\%$
.1 $\mu$ S	.1 $\mu$ S	C502	1 $\pm 2.5\%$
.2 $\mu$ S	.1 $\mu$ S	check	2 $\pm 2.5\%$
.5 $\mu$ S	.5 $\mu$ S	check	1 $\pm 2.5\%$

## 5. (cont'd)

*n. Pre-Adjust C547, C551*

Change the MANUAL TIME/DIV and TYPE 184 time marks to  $.1\mu\text{S}$ . Adjust C547 and C551 so the timing between the 1st and 2nd time marks is approx the same as the timing between the succeeding time marks.

Recheck the  $.1$  to  $.5\mu\text{s}$  timing. If necessary readjust C502.

*o. Adjust Mag Regis*

Set the TRIGGER SLOPE to +. Change the TYPE 184 time marks to  $1\mu\text{s}$ . Position the first time mark to the 1 div graticule line. Switch the MANUAL TIME/DIV between  $50\text{nS}$  and  $.1\mu\text{S}$  and adjust R505 so the leading edge of the first time mark does not shift when switching the MANUAL TIME/DIV.

*p. Adjust 50ns Timing  $\pm 2.5\%$* 

Change the MANUAL TIME/DIV to  $.1\text{mS}$ . Adjust the HORIZONTAL POSITION so the trace starts on the left edge of the graticule. Change the MANUAL TIME/DIV and the TYPE 184 time marks to  $50\text{nS}$ .

Adjust C507 for optimum linearity. Adjust R508 for 1 mark/div  $\pm 2.5\%$

Due to interaction between adjustments it may be necessary to repeat the adjustment of C507 and R508 several times.

*q. Adjust 10ns Linearity*

Change the MANUAL TIME/DIV to  $10\text{ns}$  and the TYPE 184 time marks to  $20\text{ns}$ . Adjust C547 for best sweep linearity with closest timing accuracy (C551 will also have slight effect on linearity).

*r. Adjust 20ns Timing and Linearity  
 $\leq 2.5\%$  timing error*

Change the MANUAL TIME/DIV to  $20\text{ns}$ . Adjust C551 for optimum timing and linearity (C547 will also have slight effect on timing accuracy and linearity). The timing error after adjustment must not exceed  $2.5\%$ .

5p, q, r. See picture at end of step t.

## 5. (cont'd)

s. *Check Timing Error with Position Change*  
≤4% error

Check the 20 and 50ns timing error (with cw rotation of the POSITION control) at several points along the extended sweep. The timing error in any 8 div segment must not exceed ±4%.

Due to interaction between adjustments it will be necessary to repeat step o-s.

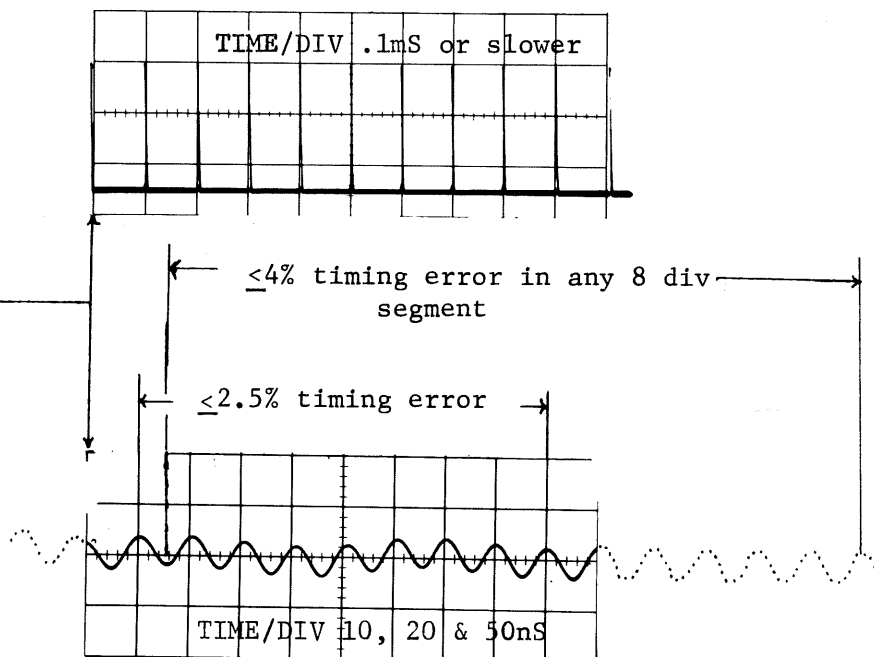
t. *Adjust 10ns Timing* ≤2.5% error  
≤4% error with position change

Change the MANUAL TIME/DIV to .1ms and adjust the POSITION control so the sweep starts on the left edge of the graticule. Change the MANUAL TIME/DIV to 10ns and the TYPE 184 time marks to 20ns.

Do not change the setting of the HORIZONTAL POSITION control any more than necessary. Select R390 for optimum 10ns timing accuracy. The timing error must not exceed ±2.5%.

Check the 10ns timing error (with cw rotation of the HORIZONTAL POSITION control) at several points along the extended sweep. The timing error in any 8 div segment must not exceed ±4%.

Adjust start of sweep to 1st graticule mark at a slow TIME/DIV setting. Do not reposition the trace any more than necessary in steps p to r.





5. (cont'd)

u. Check X10, 1-5 $\mu$ s, Timing Accuracy  $\pm 2.5\%$

Change the DLY'D SWP MAG to X10. Check the X10 magnified timing accuracy with the controls set as follows:

MANUAL		
TIME/DIV	TYPE 184	MARKS/DIV
1 $\mu$ S	.1 $\mu$ s	1 $\pm 2.5\%$
2 $\mu$ S	.1 $\mu$ s	2 $\pm 2.5\%$
5 $\mu$ S	.5 $\mu$ s	1 $\pm 2.5\%$

v. Check X100, 10-50 $\mu$ s, Timing Accuracy  $\pm 2.5\%$

Change the DLY'D SWP MAG to X100. Check the X100 magnified timing accuracy with the controls set as follows:

MANUAL		
TIME/DIV	TYPE 184	MARKS/DIV
10 $\mu$ S	.1 $\mu$ s	1 $\pm 2.5\%$
20 $\mu$ S	.1 $\mu$ s	2 $\pm 2.5\%$
50 $\mu$ S	.5 $\mu$ s	1 $\pm 2.5\%$

Return the DLY'D SWP MAG to OFF.

6. EXT PROGRAM

a. Setup

Set the front panel controls as follows:

TYPE 3A5

INPUT DC  
MANUAL VOLTS/DIV 5

TYPE 3B5

MANUAL TIME/DIV 1mS  
TRIGGER AUTO  
POSITION adjust so sweep starts  
at left edge of graticule

PROGRAM CHECKER

DLY'D SWP MAG OFF  
DELAY ccw  
POSITION midr  
TIME/CM 1mS  
EXT PROG, OFF OFF  
TRIGGER AUTO  
POLARITY +  
LEVEL midr  
SEEK OFF

## 6. (cont'd)

*b. Check External Program Power*

Connect the cannon plug from the PROGRAM CHECKER to the PROGRAM jack on the TYPE 3B5. Change the EXT PROG POWER sw to 3A5-3B5. Check for the following indications:

TYPE 3B5: Changes to EXT mode (EXT light on) read out panel reads: 1mS/DIV, NOT TRIG'D; AUTO and + SLOPE neon lit. Sweep must be present.

PROGRAM CHECKER: -100, +125 and -12 voltage neons lit.

*c. Check External Program Delay  
    <0.2->10 div*

Change the Program Checker DLY'D SWP MAG to X10. Check that MAG'D SWP on read out panel is lit. Rotate the Program Checker DELAY control from full cw to full ccw. The start of the magnified sweep must vary from 0.2 div or less to at least 10 div beyond the start of the sweep.

Change the Program Checker DLY'D SWP MAG to X100 and repeat the check. Return the DLY'D SWP MAG to OFF.

*d. Check External Program Time/Div  
    Program all Time/Div settings*

Rotate the Program Checker TIME/DIV throughout its range. The TIME/DIV indicated on the read out panel must correspond to each setting of the Program Checker TIME/DIV switch.

Change the Program Checker MAG to X10. Check that the read out panel indicates MAG'D SWP and the indicated time/div is 1/10 of the setting of the TIME/DIV switch from 5S to 1μS. Check that the MAG'D SWP light is extinguished and the read out indicates the same settings as the TIME/DIV, in the .5μS to 10nS positions.

Change the Program Checker MAG to X100. Check that the read out indicates MAG'D SWP and the indicated time/div is: 1/100 of the TIME/DIV setting from 5S to 10μS, 1/10 of the TIME/DIV setting from 5μS to 1μS and the same as the TIME/DIV from .5μS to 10nS. Check that MAG'D SWP light is extinguished in the .5μS to 10nS positions. Return the MAG to OFF.

## 6. (cont'd)

- e. *Check External Program Position*  
range: + & - 3 div

Set the Program Checker TIME/DIV to 1mS.  
Apply 1mS time marks to the TYPE 3A5 INPUT.  
Rotate the Program Checker POSITION control full ccw. The first time mark must position to the right of the 3cm graticule mark.  
Rotate the POSITION control full cw. The last time mark must position to the left of the 7cm graticule mark. Remove the TYPE 184 signal.

- f. *Check External Program Trigger*  
LEVEL range:  $\geq +$  & - 20V (EXT AC)

Connect a BNC T connector to the 3A5 INPUT.  
Connect a 50 $\Omega$  coaxial cable from one side of the T connector to the 3B5 EXT TRIG INPUT.  
Connect a 50 $\Omega$  coaxial cable from the SINE WAVE GENERATOR OUTPUT to the other side of the T connector. Set the SINE WAVE GENERATOR FREQUENCY to 1 kHz and adjust the AMPLITUDE for a 1 div display.

Set the PROGRAM CHECKER TRIGGER switch to INT AC. Check that stable triggering can be obtained in + and - slope, by adjusting the LEVEL control. Check that the slope of the display and the SLOPE neons on the 3B5 correspond to the setting of the SLOPE switch on the PROGRAM CHECKER. Momentarily remove the signal from the 3A5 INPUT. Check that the trace disappears and the read out panel indicates NOT TRIG'D.

Change the PROGRAM CHECKER TRIGGER switch to EXT AC and adjust the SINE WAVE GENERATOR AMPLITUDE for 1V. Check that stable triggering can be obtained, in + and - slope, by adjusting the LEVEL control. Momentarily remove the signal from the EXT TRIG INPUT. Check that the trace disappears and the read out panel indicates NOT TRIG'D.

Increase the SINE WAVE GENERATOR AMPLITUDE to 40V. Check that the display will not trigger at the extreme cw and ccw settings of the LEVEL control. Check with + and - SLOPE.

Change the TRIGGER to EXT DC. Change the SINE WAVE GENERATOR FREQUENCY to 1 Hz and adjust the AMPLITUDE for 3V. Check that stable triggering can be obtained, in + and - slope, by adjusting the LEVEL control.

6f. (cont'd)

Change the TRIGGER to EXT AC. Check that the display will not trigger with any setting of the LEVEL control.

*g. Check External Program Seek*

Change the PROGRAM CHECKER POWER sw to OFF. Change the PROGRAM CHECKER SEEK switch to 3B5. Check that the TYPE 3B5 changes to the SEEK mode. Remove the SINE WAVE GENERATOR signal from the EXT TRIG INPUT and the TYPE 3A5 INPUT. Return the POWER sw to 3A5-3B5.

*h. Check External Horizontal*

*Bandwidth: >750 kHz*

*Deflection factor: 5V/div  $\pm 5\%$*

Change the PROGRAM CHECKER MODE to EXT and TRIGGER to AUTO. Connect the OUTPUT of the SINE WAVE GENERATOR to the EXT jack on the Program Checker. Set the SINE WAVE GENERATOR FREQUENCY to 35 kHz and adjust the AMPLITUDE for a 6 div horizontal display. Change the SINE WAVE GENERATOR FREQUENCY to 750 kHz. The display amplitude must be  $\geq 4.2$  div.

Remove the SINE WAVE GENERATOR signal and connect the OUTPUT of the SAC to the EXT jack. Set the SAC for a 20V square-wave. Check for a display amplitude of 4 div  $\pm 5\%$ . Remove the SAC signal.

*i. Check Output DC Level 180  $\pm 10V$*

Change the MANUAL TIME/DIV to 1mS and the TRIGGER to INT AC. Connect a voltmeter between the CRT horizontal deflection plates. Adjust the HORIZONTAL POSITION control for 0V. Connect the voltmeter between one of the deflection plates and gnd. The voltage reading must be 180  $\pm 10V$ . Remove the voltmeter.

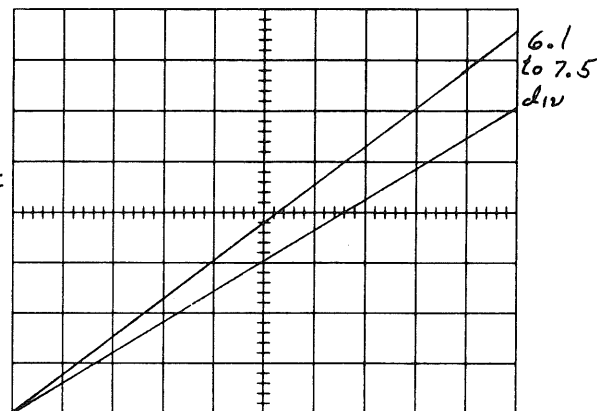
*j. Check Single Sweep Operation*

Change the PROGRAM CHECKER MODE switch to NORM and TRIGGER to INT AC. Connect the SAC signal to the TYPE 3A5 INPUT. Adjust the LEVEL control for a triggered display. Remove the SAC signal and change the MODE to SINGLE SWEEP. Depress the RESET button. Reconnect the SAC signal. A single sweep must occur. Remove the SAC signal.

## 6. (cont'd)

k. Check Sweep Output  $68\mu\text{A}/\text{DIV} \pm 10\%$ 

Change the PROGRAM CHECKER MODE to NORM, TRIGGER to AUTO and TIME/DIV to 1mS. Set the TYPE 3A5 MANUAL VOLTS/DIV to 10. Connect the SWP OUT (pin 16 of PROGRAM jack) to the TYPE 3A5 INPUT. Adjust the HORIZONTAL and VERTICAL POSITION controls so the display starts at the bottom left corner of the graticule. The ramp waveform must rise 6.1 to 7.5 div in 10 horiz div.



## 7. VOLTAGE LEVELS/WAVEFORM

## a. Setup

Remove the TYPE 3B5. Install the Logic and Counter cards. Connect the TYPE 3B5 to the TYPE 561A VIA the Flexible Plug-In Extension. Change the MANUAL TIME/DIV to  $10\mu\text{S}$  and the TRIGGER to AUTO.

b. Check Multitrace Sync Pulse  $\geq +5$   $-7\text{V}$ 

Connect a 10X probe from the test scope to pin 4 of P21. Set the test scope vertical to 2 VOLTS/CM, TIME/CM to  $20\mu\text{SEC}$  and TRIGGERING SLOPE to -. Adjust the test scope TRIGGERING STABILITY and LEVEL for a stable display. Check for a negative and positive going spike of at least +5 and -7 volts.

## c. Check Intensified Pulse levels

X1:  $-12\text{V} \pm 1\text{V}$

X10:  $-6\text{V} \pm 1\text{V}$

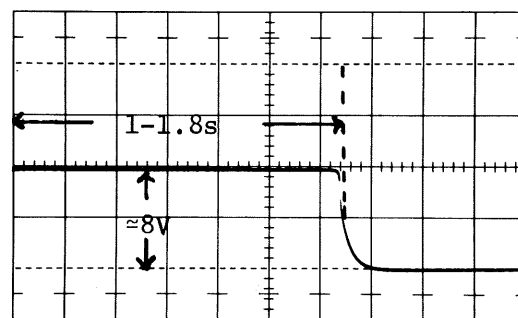
X100:  $-1\text{V}$  to  $-0.5\text{V}$

Set the MANUAL TIME/DIV to 5S, DLY'D SWP MAG to OFF, DELAY dial to 0.00 and the TRIGGER to AUTO. Set the test scope TIME/CM to 1mSEC and free run the sweep. Set the test scope input coupling to DC and VOLTS/CM to .5. Position the trace on the test scope to graticule center and connect the 10X probe to pin 14 on P21. Check for a DC level of  $-12\text{V} \pm 1\text{V}$ . Change the DLY'D SWP MAG to X10. Check for a DC level of  $-6\text{V} \pm 1\text{V}$ . Change the DLY'D SWP MAG to X100. Check for a DC level of  $-0.5$  to  $-1\text{V}$ . Remove the 10X probe.

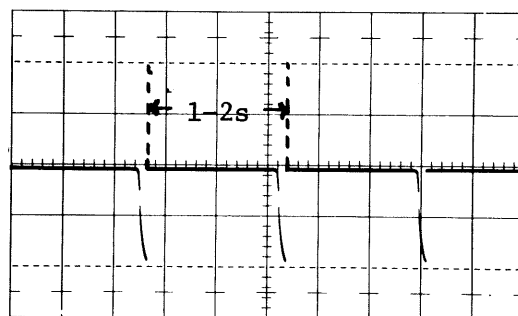
## 7. (con't)

*d. Check Seek Pulse Width 1 S-1.8 S*

Connect the 10X probe from the test scope to pin 8 of J400. Set the test scope vertical VOLTS/CM to .5, TIME/CM to .2 SEC and the TRIGGERING SLOPE to +. Push the SEEK button and release. Check the test scope for a positive going square wave of approx 8V in amplitude and from 5-9cm (1 S-1.8 S) in duration.

*e. Check Seek Cycling Time 1-2 S*

Change the test scope TIME/CM to .5 SEC. Hold the SEEK button down. Check the test scope for a waveform period of 1 to 2 S.

*f. Check Cycle/Sweep Range <1mS to >7mS pulse width*

Change the MANUAL TIME/CM to 1mS and the TRIGGER to AUTO. Connect the 10X probe from the test scope to TP664 on the Logic Card. Set the test scope VOLTS/CM to .1 and TRIGGERING SLOPE to - and TIME/CM to 1mSEC. Adjust the TRIGGERING STABILITY and LEVEL for a stable display. Check the width of the negative going pulse while varying the CYCLES/SWEEP adjustment throughout its range.

The negative going pulse width must vary from <1cm (1mS) to >7cm (7mS). Adjust the CYCLES/SWEEP for a 1.8cm nominal pulse width.

*g. Check Logic Window Gate Delay*  
*≤ 0.3μs*

Change the MANUAL TIME/DIV to .2μs and the TRIGGER to EXT. Apply 10μs time marks from the TYPE 184 to the EXT TRIG INPUT. Adjust the LEVEL control for a triggered sweep. Set the TYPE 3A5 MANUAL VOLTS/DIV to .2 VOLTS. Connect a 10X probe from the TYPE 3A5 INPUT to pin U of J400. Adjust the HORIZONTAL POSITION control so the leading edge of the negative going sweep gate is on the first graticule mark.

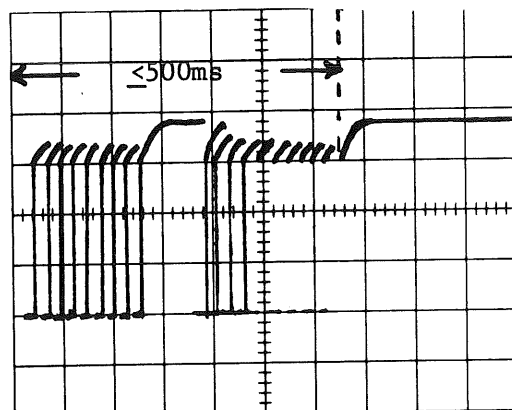
Connect the 10X probe to TP664. The leading edge of the logic window gate must be no more than 1.5 div from the first graticule mark.

Remove the 10X probe and the TYPE 184 time marks.

7. (cont'd)

h. Check Advance Pulse Train Duration  
≤500ms

Apply .1μS time marks from the TYPE 184 to the TYPE 3A5 INPUT. Set the TYPE 3B5 TRIGGER to AUTO and adjust the LEVEL control for a triggered display. Connect the 10X probe from the test scope to pin 11 on the Logic card. Set the test scope TIME/CM to 50mSEC. Depress the SEEK button. The duration of the negative going pulse train must be ≤10cm (500ms). Remove the 10X probe and the TYPE 184 signal.



i. Check Elevated Filaments +125V

Check for a voltage of +125V between gnd and the junction of R579 and pin 5 of V564.

j. Check V163 Grid Volts (Sample Check)  
-2.5 to -3.5V

Set the TRIGGER to EXT DC. Connect a DC coupled 10X probe from the test scope to the grid (pin 4) of V163. The grid voltage must read -2.5 to -3.5V.

k. Check 3L10 Sawtooth Drive 60-70μA/DIV

Install the TYPE 3B5 in the TYPE 561A. Connect a 1kΩ 1/2W 1% resistor between pin 18 of P21 and gnd. Set the MANUAL TIME/DIV to 1ms and the TRIGGER to AUTO. Connect a 1X probe from the TYPE 3A5 INPUT to the 1kΩ resistor and set the MANUAL VOLTS/DIV to .1.

Adjust the HORIZONTAL and VERTICAL POSITION controls so the displayed ramp waveform starts at the bottom left-hand corner of the graticule. The ramp waveform must rise 6.0-7.0 vertical div in 10 horizontal div.

Remove the probe and the 1kΩ resistor.

l. Check holdoff

Set the front panel controls as follows:

TYPE 3B5

TRIGGER	AUTO
LEVEL	cw
MANUAL TIME/DIV	.5μs
VARIABLE	ccw

71. (cont'd)

Test Scope

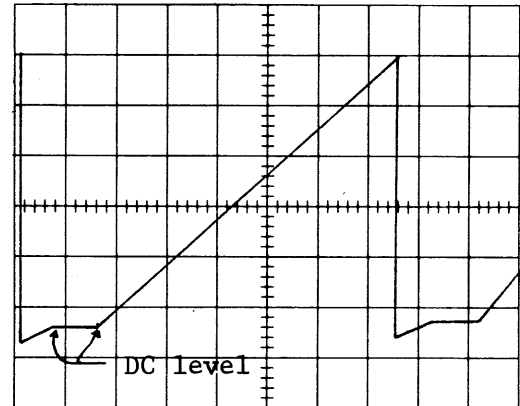
VOLTS/CM 2  
 Input Coupling AC  
 TIME/CM 1 $\mu$ SEC  
 TRIGGERING SLOPE -

Connect a 10X probe from the test scope to pin 3 of V564B (top of R566).

Check that the holdoff time is sufficient to allow the sweep generator to return to a DC level before starting another sawtooth.

MANUAL TIME/DIV	TIME/CM (test scope)
.5 $\mu$ s	1 $\mu$ SEC
5 $\mu$ s	20 $\mu$ SEC
50 $\mu$ s	50 $\mu$ SEC
.5ms	.2mSEC

Return the VARIABLE to the CAL detent.



8. SEEK

*a. Setup*

Connect a BNC T connector to the TYPE 3A5 INPUT. Connect a 50 $\Omega$  coaxial cable from one side of the T to the EXT TRIG INPUT. Connect the OUTPUT of the SINE WAVE GENERATOR to the other side of the T connector. Set the SINE WAVE GENERATOR FREQUENCY to 50 Hz and AMPLITUDE to 2V. Set the TYPE 3A5 INPUT to DC and MANUAL VOLTS/DIV to .5. Set the TYPE 3B5 MANUAL TIME/DIV to 10mS, TRIGGER to EXT DC and SLOPE to +. Adjust the LEVEL control for a triggered display.

*b. Check Trigger Operation*

Depress the TYPE 3B5 SEEK button. The TYPE 3B5 must seek and remain triggered in DC EXT. Remove the trigger signal from the EXT TRIG INPUT. The TYPE 3B5 must retrigger in auto and the AUTO neon must light. Check that the trace remains triggered and the AUTO neon is lit with all settings of the TRIGGER switch and LEVEL control.



## 8b. (cont'd)

Return the TRIGGER switch to DC EXT and recenter the LEVEL control. Depress the MAN button. The NOT TRIG'D must light and the AUTO neon must extinguish.

Reconnect the trigger signal to the EXT TRIG INPUT. Depress the SEEK button. The sweep must retrigger and the AUTO neon must remain off.

## c. Check Seek Operation 20 Hz-20 MHz

Change the SINE WAVE GENERATOR FREQUENCY to 20 Hz.

Depress the TYPE 3B5 SEEK button. The read out panel should indicate 20mS/DIV and there should be 4 cycles/10 div displayed. Slight readjustment of the CYCLES/SWEEP may be necessary to obtain the above indication. Check for the specified read out with the Generator frequency set as follows: (The SEEK button must be depressed after each frequency change.)

<u>Approx GENERATOR FREQUENCY</u>	<u>READ OUT</u>	<u>Approx cycles/10 div</u>
20 Hz	20mS/DIV	4
40 Hz	10mS/DIV	4
80 Hz	5mS/DIV	4
200 Hz	2mS/DIV	4
400 Hz	1mS/DIV	4
800 Hz	.5mS/DIV	4
2 kHz	.2mS/DIV	4
4 kHz	.1mS/DIV	4
8 kHz	50μS/DIV	4
20 kHz	20μS/DIV	4
40 kHz	10μS/DIV	4
80 kHz	5μS/DIV	4
200 kHz	2μS/DIV	4
400 kHz	1μS/DIV	4
800 kHz	.5μS/DIV	4

It may be necessary to readjust the CYCLES/SWEEP to obtain the correct indication.

Replace the SINE WAVE GENERATOR with the TYPE 191.

2 MHz	.2μS/DIV	4
4 MHz	.1μS/DIV	4
10 MHz	.1μS/DIV	10
15 MHz	.1μS/DIV	15
20 MHz	.1μS/DIV	20

## 8. (cont'd)

*d. Check Remote Seek*

Depress the MAN button. Ground the REMOTE SEEK jack on the 3A5. The 3B5 must seek. Remove the gnd from the REMOTE SEEK jack.

*e. Check Seek Switch*

Alternately change the MANUAL TIME/DIV switch and depress the SEEK button. The TYPE 3B5 must change to the SEEK mode when the SEEK button is depressed and change to the MAN mode when the MANUAL TIME/DIV switch is changed. Make this check for each position of the MANUAL TIME/DIV switch.

THE END