

## CALIBRATION PROCEDURE FOR TU-50

## Recommended Equipment:

Tektronix type 540 series oscilloscope  
 Plug-in type L or K and CA  
 1X probe  
 10X probe  
 DC voltmeter 20,000  $\Omega/v$   
 Variac (TU-75B)  
 A 52 $\Omega$  cable  
 2 type B52-R 52 $\Omega$  terminators  
 180A Time Mark generator or TU-50 (180)

## Preliminary Inspection:

Check for unsoldered joints, rosin joints, poor wire dress, check that the door swings freely, check resistance of transformer primaries and power supplies to ground. The fuse should be a 4.0 amp Slow Blow for 117v.

## Pre-set the controls of TU-50 as follows:

Function Selector switch to Time Mark Generator (180)  
 180 marker switches to OFF position  
 Trigger Selector switch to 10 $\mu$ sec. position  
 Signal Selector switch to Markers position  
 Square Wave Generator (105) Frequency Range switch to 1-10kc position  
 Square Wave Generator Amplitude control maximum (cw)  
 Square Wave Generator Frequency control maximum (cw)  
 Fast-rise Output (107) Amplitude control maximum (cw)  
 Constant Amplitude Signal Generator (190) Amplitude control maximum (cw)  
 190 Frequency switch to 50kc position

## Resistance Checks: (1k scale except when noted)

Transformer primaries	Infinite
TIME MARK GENERATOR (180)	
-150 volts	30K
+225 volts	40K
+350 volts	300K (100K scale)
-17 volts	45K
-8 volts	6.8K

## TIME MARK GENERATOR (180)

## Recommended Equipment:

Tektronix type 540 series oscilloscope

Plug-in L or K

1X probe

10x probe

DC voltmeter 20,000  $\Omega/v$

Variac TU-75B

A 52 $\Omega$  cable

A type B52-R 52 $\Omega$  terminator

## POWER SUPPLY ADJUSTMENT

Connect instrument to Variac with #1 light in. Turn power on. Voltage should rise to 60 volts on Variac; then with #1 and #2 lights, voltage should rise to 110 volts.

To adjust -150 volt supply, the meter may be connected on the middle ceramic strip, third notch, near the transformer on the bottom (power chassis) of the TU-50.

Check output voltage of the +225 volt supply on the same ceramic strip (first notch). The voltage should be within  $\pm 2\%$  of 225 volts.

Check output voltage of the +350 volt supply on the same ceramic strip (second notch). The voltage should be within  $\pm 3\%$  of 350 volts.

To check the -17 volt bias supply, connect meter to the negative side of C770 (.01 $\mu$ fd) located on the door chassis. The -17 volt supply should be between -15 $\frac{1}{2}$  and -17 $\frac{1}{2}$  volts.

To check the -8 volt supply, measure the voltage at the junction of R774 (6.8k) and R776 (120k) on the chassis. The -8 volt supply should read between -7.5 and -8.5 volts.

## POWER SUPPLY RIPPLE AND REGULATION CHECK

The line voltage should be varied from 105 to 125 volts with the signal selector switch thrown to the 50mc position at low line for the regulation check.

The ripple on the supplies should not exceed:

-150 volts      25 millivolts  
 +225 volts      80 millivolts  
 +350 volts      50 millivolts

These measurements are made neglecting the hash due to the markers' operation.

#### ADJUSTMENT OF TIME MARKERS

Use the following front panel control settings of the Test scope and L unit.

Stability	Preset
Triggering level	As appropriate
Triggering Mode	AC slow, External, Positive
Time/CM	1 $\mu$ sec.
Magnifier	OFF
"L" Input	DC
Volts/CM	.2
Variable	Calibrated

Check the 10X probe compensation with the Test scope calibrator.

Connect the probe to the ~~MARKER~~ <sup>SIGNAL OUTPUT</sup> jack of the 180 and a 52 $\Omega$  coax cable between the 180 trigger ~~IN~~ <sup>OUTPUT</sup> jack and the Test scope external trigger jack.

Switch in 1 $\mu$ sec. and 5 $\mu$ sec. markers and place Trigger Selector switch to the 10 $\mu$ sec. position. Adjust Test scope trigger level for proper display and adjust the 5 $\mu$ sec. pot in the 180. Adjust C116 so that the 1 $\mu$ sec. markers are the same amplitude as the 5 $\mu$ sec. markers when they are viewed separately.

180	Test Scope Sweep	Adjust	180 Trigger
1 & 5 $\mu$ sec	1 $\mu$ sec	5 $\mu$ sec	10 $\mu$ sec
5 & 10 $\mu$ sec	1 $\mu$ sec	10 $\mu$ sec	10 $\mu$ sec
10 & 50 $\mu$ sec	10 $\mu$ sec	50 $\mu$ sec	100 $\mu$ sec
50 & 100 $\mu$ sec	50 $\mu$ sec	100 $\mu$ sec	100 $\mu$ sec
100 & 500 $\mu$ sec	100 $\mu$ sec	500 $\mu$ sec	1msec
500 $\mu$ sec & 1msec	500 $\mu$ sec	1msec	1msec
1 & 5msec	1msec	5msec	10msec
5 & 10msec	5msec	10msec	10msec
10 & 50msec	10msec	50msec	100msec
50 & 100msec	50msec	100msec	100msec
100 & 500msec	100msec	500msec	1sec
500msec & 1sec	500msec	1 sec	1sec
1 & 5 sec	1sec	5sec	1sec

## CHECK MARKER AMPLITUDE

The amplitude of the markers should be 5 volts or more. For TU-50's under Serial #200, amplitude of markers should be 2 volts or more.

## CHECK TRIGGER AMPLITUDE

The amplitude of the triggers must be at least 6 volts and if it is over 8 volts, check V562 (T-126). (If open, trigger generally is 10 volts or more.) The trigger rates must correspond to the switch markings.

## SET FREQUENCY &amp; AMPLITUDE OF 5, 10, &amp; 50 MC SINE WAVES.

Trigger scope externally from the 180 at 10 $\mu$ sec. Connect a 52 $\Omega$  terminator to the 180 ~~output~~ <sup>16, 11, 12</sup> connector and the 10X probe to the terminator (probe must be grounded). The coupling link on the 5MC coils should be adjusted to the extreme upper end of the coils and "Q" doped. Set Test scope at .2 $\mu$ sec/CM and adjust C123 & C129 for maximum output at 5MC. (It is possible to set this range at 6MC). The 1MC modulation on the 5MC Sinewave should not exceed 0.2 volts. Set Test scope at .1 $\mu$ sec/CM and adjust C133 & C139 for maximum output at 10MC. Turn magnifier to X5 position for 50MC and adjust C143 & C149 for maximum output at 50MC. (It is possible to set this range at 40MC). If there is trigger pulling generally a slight re-adjustment of the 5 & 10 $\mu$ sec markers will cure this fault. (Make sure that the crystal socket screws are tight for it can cause a poor ground). Also, this may be due to stages out of count, bad tubes, open LR combinations in the 5, 10, & 50 $\mu$ sec stages. There should be no trigger pulling on any triggering rates. The minimum output of 5, 10, & 50MC should be at least 3 volts, but the 50MC output should be an indicated 1.4 volts due to bandpass of 540 series scope.

## SET CRYSTAL FREQUENCY

The Test scope is triggered externally from the 180 under calibration at 10 $\mu$ sec, then connect probe from plug-in to another 180 at 1 $\mu$ sec or any source of accurate frequency. Set the test scope to 1 $\mu$ sec/CM and adjust C105 to stop the drift to one side or the other. There should be enough range left to cause it to drift in the opposite direction.

SQUARE WAVE GENERATOR (105) & FAST-RISE OUTPUT (107)

Recommended Equipment:

Tektronix type 540 series oscilloscope  
Plug-in type K or L  
1X probe  
10X probe  
A 52 $\Omega$  coax cable  
2 type B52-R 52 $\Omega$  terminators  
DC voltmeter 20,000 $\Omega$ /v

Pre-set 105 front panel controls as follows:

Frequency range switch to 100-1000cps position  
Frequency control to maximum  
Amplitude control to minimum  
Amplitude control 107 to maximum

Power Supply adjustment:

Check -150 volts from A to A-150  
Adjust -160 volts from A to ground as follows:  
Adjust the -160v adjust pot from its minimum (ccw) position through a dip in voltage of less than -2 volts to a setting of -4 volts. Turn amplitude control (105) to maximum and bridge the output amplitude pot with a selected 1/2 watt resistor for a setting of -160 volts. This resistor (640) is located across the switch in front of the capacitors of the multivibrator.

Power Supply ripple & regulation check.

Amplitude & Frequency controls maximum  
The line voltage should be varied from 105-125 volts to check for regulation of the -160v & A-150 supplies.

Power Supply ripple:

A-150        25 millivolts  
-160 volts   20 millivolts

Both of these ripples will be riding on a Square Wave of approximately 1KC.

Set Multivibrator screen volts adjust and Symmetry pot

Use the following settings of the Test scope, K or L, and 105 section

Test Scope

Triggering mode                      Automatic, Internal, Positive  
 Time/CM                                      .1 millisecc  
 Magnifier                                      OFF

K or L

Input    DC  
 Volts/CM                                      .5v  
 Variable                                      Calibrated

105

Freq. range                                      1-10KC  
 Amplitude                                      3CM  
 Freq. control                                      10K (1cycle/CM)

Connect the 52Ω cable with B52-R 52Ω terminators at each end to the Test scope and to the 105 output. Connect meter from one side of C6(100pf) or C19(100pf) to the other <sup>SIDE</sup> ~~opposite~~ and adjust screen voltage for 80 volts with Screen volts Adjust located nearest the front panel. Change Time/CM switch of the Test scope to 10μsec for 1 cycle/10CM. Adjust for correct symmetry with the Symmetry pot located just behind Screen Volts Adj. pot. These two adjustments interact, so it may take several adjustments to obtain the proper settings. Check output for ~~30~~ <sup>90</sup> volts peak-to-peak or more; without the two terminators the peak-to-peak voltage should be ~~30~~ <sup>90</sup> volts or more.

Check frequency ranges and symmetry

Check for a 10 to 1 ratio by rotating frequency pot.

Freq. Range	Test Scope	Display
1 - 10KC	10μ <sup>sec</sup> /CM	1 cycle/10CM
100 - 1000 cps	0.1msec/CM	1 cycle/10CM
10 - 100 cps	1.0msec/CM	1 cycle/10CM

Adjust frequency & symmetry of 50K-500KC range

Preset C14 & C15 to mid-range

C14 symmetry control (Located on right side of switch)

C15 frequency control (Located on left side of switch)

Set Test scope to .5μsec/CM and set frequency control to display the positive portion of the square wave at 50CM(half cycle). Adjust C14 for the correct symmetry and C15 for the correct frequency. These two adjustments interact and it will be necessary to repeat these steps to obtain the proper setting.

Set at 2.5v  
 then 2.5v  
 for 100cps and adjust



Check fast-rise output (107)

Switch the TU-50 to the 50KC-500KC fast-rise position and terminate the 52 $\Omega$  coax lead with a 52 $\Omega$  terminator at the Test scope. Check the symmetry, it should be the same as the 105's 50KC-500KC square wave symmetry. The amplitude of the fast-rise output should be at least 0.4 volts and without termination, it should be at least 0.8 volts.

Compensation of 500KC square wave

Connect 10X probe on junction of C25 & R31, R32 and adjust L25 for a square corner on the top half of the square wave.

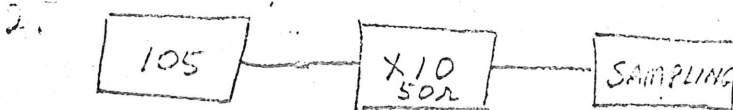
Connect 10X probe to R64 and adjust L34 to remove spike from the lower half of the square wave. This may be adjusted with the output of the 105 directly to the scope.

Place the Test scope triggering mode to automatic, internal, negative.

Connect 10X probe to the top of R81 at pin 1 of V84 and adjust L74 for a square on the lower half of the square wave.

## RISE TIME CHECK

1. USE SAMPLING UNIT TIMED WITH 180 TRACEABLE TO NBS.



PLACING 50 $\Omega$  TERM AT  
GEN. VERTUALLY  
HAS NO EFFECT UPON  
RISE TIME.

## CONSTANT AMPLITUDE SIGNAL GENERATOR (190)

## Recommended equipment:

Tektronix type 540 series oscilloscope  
 Plug-in Type CA  
 180A Time Mark generator or TU-50 (180)  
 1X probe  
 Head phones (High impedance, crystal)  
 Type 190A attenuator

Power supply adjustment

## Preset controls as follows:

Amplitude control maximum  
 Frequency range switch to 50KC  
 Type 190A attenuator 10  
 Check the +105 volts at pin 1 of V869. (Normal reading is +108 volts.)  
 Check the unregulated +350 volts on the sixth notch of the ceramic strip nearest the front panel. (Normal reading is +340 - 360 volts.)  
 Check the unregulated +550 volts on the fifth notch of the same ceramic strip. (Normal reading is +500-520 volts.)

Power supply ripple and regulation check

The line voltage should be varied from 105-125 volts to check for regulation.

+105 volts	70 millivolts
+350 volts	3.5 volts
+550 volts	7 volts

Check output amplitude and attenuator ratio.

Check the amplitude on the 50KC range. The amplitude should be at least 10volts at maximum and 4 volts at minimum amplitude. Set plug-in in at 5v/CM and 190A attenuator head at 10. Check the attenuator through its ranges for a 2:1 and 2.5:1 ratio. \* 503 HEAD (.1V MAX TO 0.4V MIN)  
 ATTENUATION IS 2:1 ALL THE WAY.

Calibrate frequency

Connect the output of the 190 to channel B of the CA in the Test scope and set amplitude to 10 volts. Set the Test scope to 20µsec/CM and adjust the 50KC coil L836 for 1 cycle/CM. Connect the 100µsec of the 180 to channel A of the CA. Switch both channels of the CA to .05v/CM and to added algebraically. Connect the pair of earphones (crystal) to the vertical signal out on the Test scope and adjust L836 for a zero beat. On all frequency ranges, set Channel A to .05v/CM.



Range Selector	Coil	Ch. "B"	Frequency Standard
50KC	L836	.05v/CM	100µsec
5MC	L840	.2v/CM	1µsec 1mV
10MC	L844	.2v/CM	5MC
		.05v/CM	10MC
15MC	L846	.5v/CM	5MC *1
20MC	L850	.05v/CM	10MC
25MC	L854	.5v/CM	5MC *2
30MC	L858 & C858	.05v/CM	10MC

- \*1 15MC range can be set to 17MC when using the 10MC frequency standard
- \*2 25MC range can be set to 27MC when using the 10MC frequency standard
- \*3 C858 pre-set at midrange. When adjusting 30MC range, adjust L858 for a zero beat.

After this zero beat process, check for proper frequencies.

FOR: 100KC, 200KC, 300KC, 400KC, & 450KC  
 USE A 50MS BEAT FROM TRACEABLE 180

<u>FREQUENCY</u>	<u>TIME</u> (µMS X5 3 in 5 cm)	
30 MC	0.033 MS	
10 MC	0.1 MS	1 in 1 cm
1 MC	1 MS	1 in 1
50 KC	50 MS	1 in 1
100 KC	10 MS	1 in 1
200 KC	5 MS	1 in 1
300 KC	3.3 MS	3 in 2 cm
400 KC	2.5 MS	5 µs 4 in 2 cm
450 KC	2.2 µs	5 µs 9 in 4 cm