TB 9-4931-504-50

CHANGE 6

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DUAL TRACE DELAYED SWEEP SAMPLER TEKTRONIX, TYPE 5S14N

Headquarters, Department of the Army, Washington, DC
11 September 2001

TB 9-4931-504-50, 31 May 1979, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

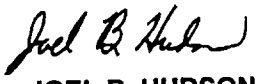
Remove pages	Insert pages
1 and 2	1 and 2
3 and 4	3 and 4

2. File this change in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

OFFICIAL:



JOEL B. HUDSON
Administrative Assistant to the Secretary of the Army
0121915

Distribution:
To be distributed in accordance with STD IDS No. RLC-1500, 11 May 1992, requirements for calibration procedure TB 9-4931-504-50.

PIN NO: 041718-006

TB 9-4931-504-50

Change 5

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DUAL TRACE DELAYED SWEEP SAMPLER TEKTRONIX, TYPE 5S14N

Headquarters, Department of the Army, Washington, DC
30 August 1988

TB 9-4931-504-50, 31 May 1979, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
7 and 8	7 and 8

2. File this change in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with STD IDS No. RLC-1500, 11 May 1992, requirements for calibration procedure TB 9-4931-504-50.

PIN NO: 041718-005

TB 9-4931-504-50

Change 4

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DUAL TRACE DELAYED SWEEP SAMPLER TEKTRONIX, TYPE 5S14N

Headquarters, Department of the Army, Washington, DC
9 November 1983

TB 9-4931-504-50, 31 May 1979, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
7 through 10	7 through 10

2. File this change in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-34C, Block No. 319, requirements for calibration procedures publications.

PIN NO: 041718-004

TB 9-4931-504-50

Change 3

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DUAL TRACE DELAYED SWEEP SAMPLER TEKTRONIX, TYPE 5S14N

Headquarters, Department of the Army, Washington, DC
5 December 1980

TB 9-4931-504-50, 31 May 1979, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
7 through 10	7 through 10

2. File this change in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-34C, Block No. 319, requirements for calibration procedures publications.

PIN NO: 041718-003

TB 9-4931-504-50

Change 2

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DUAL TRACE DELAYED SWEEP SAMPLER TEKTRONIX, TYPE 5S14N

Headquarters, Department of the Army, Washington, DC
28 May 1980

TB 9-4931-504-50, 31 May 1979, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
7 and 8	7 and 8

2. File this change in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-34C, Block No. 319, requirements for calibration procedures publications.

PIN NO: 041718-002

TB 9-4931-504-50

Change 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DUAL TRACE DELAYED SWEEP SAMPLER TEKTRONIX, TYPE 5S14N

Headquarters, Department of the Army, Washington, DC
30 November 1979

TB 9-4931-504-50, 31 May 1979, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
7 through 10	7 through 10

2. File this change in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-34C, Block No. 319, requirements for calibration procedures publications.

PIN NO: 041718-001

TB 9-4931-504-50

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DUAL TRACE DELAYED SWEEP SAMPLER, TEKTRONIX TYPE 5Sl4N

Headquarters, Department of the Army, Washington, DC
31 May 1979

REPORTING OF ERRORS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedure, please let us know. Mail your letter or DA Form 2028 to: Commander, U. S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5230. A reply will be furnished to you. You may also send in your comments electronically to our e-mail address: ls-lp@redstone.army.mil or FAX 256-842-6546/DSN 788-6546.

Approved for public release, distribution is unlimited.

CHANGE 6

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Dual Trace Delayed Sweep Sampler, Tektronix Type 5Sl4N. The manufacturer's manual was used as the prime data source in compiling these instructions. The above equipment will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None.

b. Time and Technique. The time required for this calibration is approximately 4 hours, using the dc (direct current) and low frequency technique.

2. Calibration Data Card, DA Form 2416

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TM 38-750. DA Form 2416 must be annotated in accordance with TM 38-750 for each calibration performed.

b. Adjustments to be reported on DA Form 2416 are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Test instrument	Performance specifications
VERTICAL SYSTEM	
Risetime	350 ps or less, 10 to 90% of step pulse signal
Bandwidth (-3 dB)	Dc to 1 GHz
Input resistance	50Ω within 2%
Deflection factor: Accuracy Variable	2 mV/div to 0.5 V/div in 8 steps of 1, 2, 5 sequence ±3% (with VARIABLE at CAL) At least 2.5:1
Input signal range: Maximum operation	 2 V p-p (dc + peak ac) ±2V
Dc offset range	±2 V or more
Displayed noise(tangential)	2 mV or less, LOW NOISE switch “out”
Low noise operation	Displayed noise reduced by at least 5 times
Vertical signal out	0.2 V/div of deflection, ±3%
Dot slash	Less than 0.1 div at 10 Hz and above
Delta t range	Shifts channel 2 at least ±1 ns with respect to channel 1

Table 1. Calibration Description - Continued

Test instrument	Performance specifications
HORIZONTAL SYSTEM	
Delaying time base:	
Time base range	100 µs/div to 10 ns/div
Time base accuracy	Within ±2%, excluding first 1/2 div of displayed sweep
Delay zero range	0-9 div or more
Delay time multiplier	Each turn equal to 1 crt division
Delay accuracy	Within 1% of full screen when measured between 1st and 10th crt division
Delayed time base:	
Range	100 µs/div to 100 ps/div in 19 steps of 1, 2, 5 sequence
Accuracy	±3%, excluding first 1/2 div of displayed sweep
Variable	At least 2.5:1
Time base display modes:	Conventional display, max lead time, left intensified dot indicates time zero (multiplier zero), right intensified dot indicates point at which delayed sweep starts. Time between dots is read from crt or delay time multiplier dial.
Delayed time base	Delayed sweep starts immediately at end of delay time. Set by delay plus delay time multiplier.
Triggering:	
Amplitude range	
External	10 mV to 2 V p-p
Internal	50 mV to 2 V p-p
Input resistance	51Ω +10%, ac coupled
Normal triggering modes:	
Sine waves	150 kHz to 100 MHz
Pulse	10 Hz to 100 MHz
Minimum rise rate	10 mV/µs
AUTO TRIG modes:	105 kHz to 100 MHz
Sine waves	10 mV p-p at 100 MHz (ext)
Minimum amplitude	1 kHz to 100 MHz
Pulse	10 ns at 1 kHz
Minimum pulse width	10 mV/µs
Minimum rise rage	100 MHz to 1 GHz
HF SYNC mode:	
Sine waves	
Scan controls:	24-40 Hz repetition rate
Repetitive	1 sweep/single sweep start pushbutton pressed
Single sweep	slightly greater than 10 div
Manual scan range	1 V/div ±5%
Ext scan	150 V
Max sensitivity	
Max input voltage	
Horizontal output signal	1 V/div ±5%
Amplitude	

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with the Secondary Transfer Calibration Set NSN 4931-00-621-7877 and is to be used in performing this procedure. Alternate items may be used by the calibrating activity when the equipment listed in table 2 is not available. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI.

5. Accessories Required. The accessories listed in table 3 are issued as indicated in paragraph 4 above, and are to be used in this calibration procedure. When necessary, these items may be substituted by equivalent items unless specifically prohibited.

Table 2. Minimum Specifications of Equipment Required

Item	Common name and/or (official nomenclature)	Minimum use specifications	Manufacturer, model and part number
A1	AC CALIBRATOR (AC PRECISION CALIBRATION STANDARD)	Range: 3.42 to 911 mV rms at 50 kHz Accuracy: ±0.75%	Hewlett-Packard, Model 745A-C90 (MIS-10342, Type 2)
A2	DIGITAL VOLTMETER	Range: -30.9 to +30.9 V dc Accuracy: ±0.75%	Dana, Model 5703-S-2127 (7912606)
A3	OSCILLOSCOPE	Must be supplied with TI	Tektronix, Type 5440 (MIS-28706-1)
A4	PULSE GENERATOR	Range: 87.5 ps or less	Hewlett-Packard, Model 1105A/ 1106A (MIS-10215)
A5	SIGNAL GENERATOR	Range: 10 to 500 MHz	Hewlett-Packard, Model 8640B (MIS-28707)
A6	SQUARE-WAVE GENERATOR	Range: 100 kHz	Tektronix, Type 106 (MIS-10284 TY 1)
A7	TEST OSCILLATOR	Range: 1 to 10 MHz	Hewlett-Packard, Model 652A (MIS-10224)
A8	TIME-MARK GENERATOR	Range: 2 ns to 10 ms Accuracy: +0.75%	Tektronix, Type 184 MOD146B (7912042-1)

Table 3. Accessories Required

Item	Common name and/or(official nomenclature)	Description and part number
B1	ADAPTER (DUAL INPUT CONNECTOR)	BNC dual input connector; 2 jacks, 1 plug; Tektronix, Type 067-0525-00 (067-0525-00)
B2	ADAPTER (ELECTRICAL PLUG (CONNECTOR)	7MM to BNC Jack (7913349-2)
B3	ADAPTER	BNC jack to N plug (10519457)
B4	CABLE (RADIO FREQUENCY CABLE ASSEMBLY)	30-in., RG-58/U; BNC plug terminations (7907467)
B5	CABLE (TEST LEAD)	36-in., RG-58/U; BNC plug to double banana plug terminations (7907471)
B6	EXTENDER [1]	Tektronix, Type 067-0645-00 (067-0645-00)

[1]Two required.

SECTION III
PRELIMINARY OPERATIONS

6. Preliminary Instructions

a. The instructions outlined in this section are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

WARNING

HIGH VOLTAGE is used during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

NOTE

Unless otherwise specified, all controls and control settings refer to the TI.

7. Equipment Setup

a. Remove TI side panels and connect to oscilloscope (A3) center and right-hand compartments, using two extenders (B6).

b. Position controls as listed in (1) through (8) below:

(1) CH1, INT CH1, REP pushbuttons pressed and all others released.

(2) DC OFFSET controls midrange.

(3) SCAN control fully cw (clockwise).

(4) TRIGGERING HOLDOFF control (center knob) fully ccw (counterclockwise).

(5) DELAYING SWEEP (dark gray) and DELAYED SWEEP SEC/DIV (light gray) switches to 5 μs, and DELAYED SWP VAR control fully ccw.

(6) DELAY ZERO (1st dot) and DELAY TIME MULT (2nd dot) controls ccw.

(7) CH1 and CH2 VOLTS/DIV switches to .2V.

(8) Both VOLTS/DIV CAL (red) controls fully ccw (to detent).

c. Energize and allow 30 minutes for warmup.

SECTION IV

CALIBRATION PROCESS

NOTE

Unless otherwise specified, verify the results of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is included in the manufacturer's manual for this TI.

NOTE

When indications specified in paragraphs 8 through 22 are not within tolerance, perform the power supply, check prior to making adjustments. After adjustments are made, repeat paragraphs 8 through 22. Do not perform power supply check if all other parameters are within tolerance.

8. Vertical Deflection

a. Performance Check

(1) Connect ac calibrator (Al) to CH1 and CH2 inputs, using adapter and cable (B1 and B5).

(2) Adjust ac calibrator frequency for 50 kHz (kilohertz) and amplitude for .3535 V rms (volt root mean square).

(3) Adjust TRIGGERING LEVEL control for stable display. If oscilloscope (A3) does not display 5 divisions of vertical deflection, adjust CH1 GAIN (front panel) control for 5 divisions of deflection.

(4) Adjust ac calibrator for 5 divisions of vertical deflection for settings and indications listed in table 4. Ac calibrator will indicate within limits specified.

Table 4. Vertical Deflection Check

Test instrument VOLTS/DIV switch settings	Ac calibrator indications (mV rms)	
	Min	Max
.5	857.238	910.263
.1	171.448	182.053
50mV	85.7238	91.0263
20mV	34.2895	36.4105
10mV	17.1448	18.2053

(5) Press CH2 pushbutton and repeat technique of (2) through (4) above for CH2.

b. Adjustments. No adjustments can be made.

9. Triggering

a. Performance Check

(1) Set CH1 VOLTS/DIV switch to 50 mV.

(2) Press CH1 pushbutton and set DELAYING SWEEP and DELAYED SWEEP to 1 μS.

(3) Connect test oscillator (A7) output to CH1 INPUT, using cable (B4).

(4) Adjust test oscillator frequency for 1 MHz (megahertz) and amplitude for 2 divisions of vertical deflection.

(5) Adjust TRIGGERING LEVEL control for stable display.

(6) Alternately press and release +SLOPE pushbutton. If display does not remain stable and white dot on TRIGGERING LEVEL control does not indicate between 11- and 1-o'clock positions, perform **b** below.

b. Adjustments. Set TRIGGERING LEVEL control to 12-o'clock position and adjust R212 (fig. 1) for stable display while pressing and releasing +SLOPE button.

10. Sync Level

a. Performance Check

(1) Connect signal generator (A5) output to CH1 INPUT, using adapter and cable (B3 and B4).

(2) Press HF SYNC and +SLOPE pushbuttons.

(3) Set DELAYING SWEEP switch to 20 nS and DELAYED SWEEP SEC/DIV switch to 2 nS.

(4) Adjust signal generator frequency for 480 MHz and amplitude for 2 divisions of vertical deflection.

(5) Adjust TRIGGERING LEVEL control for stable display on oscilloscope (A3). If display will not stabilize, perform **b** below.

b. Adjustments

(1) Connect digital voltmeter (A2) negative lead to base of Q201 and positive lead to base of Q202 (fig. 1), using leads and adapters supplied with digital voltmeter.

(2) Adjust R530 (fig. 1) for 0 (zero) voltage indication on digital voltmeter.

(3) Connect test oscillator (A7) output to CH1 INPUT, using cable (B4).

(4) Adjust test oscillator frequency for 1 MHz (megahertz) and amplitude for 2 divisions of vertical deflection.

(5) Adjust TRIGGERING LEVEL control for stable display.

(6) Alternately press and release +SLOPE pushbutton. If display does not remain stable and white dot on TRIGGERING LEVEL control does not indicate between 11- and 1-o'clock positions, perform **b** below.

b. Adjustments. Set TRIGGERING LEVEL control to 12-o'clock position and adjust R212 (fig. 1) for stable display while pressing and releasing +SLOPE pushbutton.

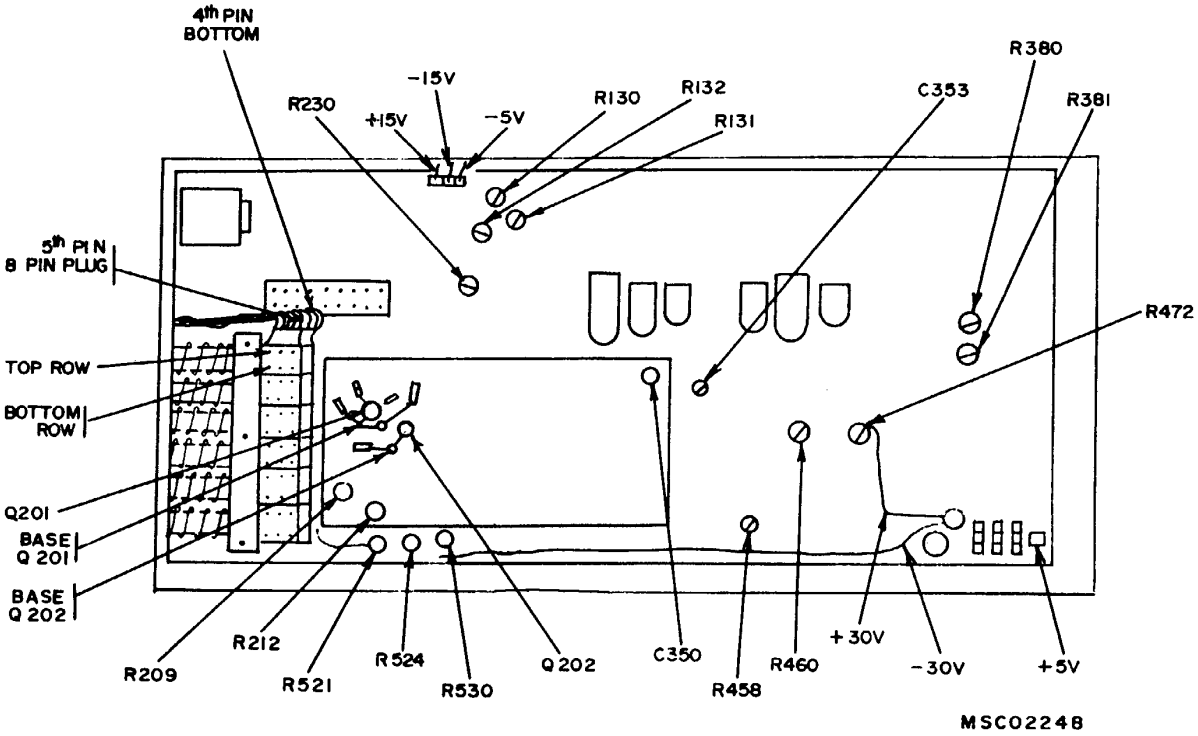


Figure 1. Test instrument - right -side view.

11. Positive and Negative Balance

a. Performance Check

(1) Position controls as listed in (a) through (e) below:

(a) CH2 VOLTS/DIV switch to 50 mV.
(b) DELAYING SWEEP and DELAYED SWEEP SEC/DIV switches to 1 μS.
(c) HF SYNC pushbutton released.
(d) INT CH1 pushbutton released.
(e) REP pushbutton pressed.

(2) Connect test oscillator (A7) to CH1 input and EXT INPUT, using adapter and cable (B1 and B4).

(3) Adjust test oscillator frequency for 1 MHz and amplitude for 2 divisions of vertical deflection on oscilloscope (A3).

(4) Adjust TRIGGERING LEVEL control for stable display. If stable display cannot be obtained, perform **b** below.

(5) Press AUTO TRIG pushbutton and adjust TRIGGERING LEVEL CONTROL for stable display.

(6) Press and release +SLOPE pushbutton. Display will remain stable while triggering on positive and negative slope of waveform.

(7) Set CH1 VOLTS/DIV switch to 5 mV and adjust test oscillator for 2 divisions of vertical deflection.

(8) Repeat technique of (4) through (6) above.

(9) Set DELAYING SWEEP and DELAYED SWEEP SEC/DIV switch to .1 μS and adjust test oscillator frequency to 10 MHz and amplitude for 2 divisions of vertical deflection.

(10) Repeat technique of (4) through (6) above.

(11) Substitute signal generator (A5) for test oscillator, using adapter and cable (B3 and B4).

(12) Set DELAYING SWEEP and DELAYED SWEEP SEC/DIV switches to 10 nS and adjust signal generator frequency to 100 MHz and amplitude for 2 divisions of vertical deflection.

(13) Repeat technique of (4) through (6) above.

b. Adjustments

(1) Remove test oscillator from equipment setup.

(2) Press AUTO TRIG pushbutton and turn TRIGGERING LEVEL control fully cw.

(3) Connect digital voltmeter (A2) negative lead to base of Q201 and positive lead to base of' Q202 (fig. 1), using leads and adapters supplied with digital voltmeter.

(4) Adjust R524 (fig. 1) for a +60-mV dc indication on digital voltmeter.

(5) Turn TRIGGERING LEVEL control ccw and adjust R521 (fig. 1) for a -60-mV dc indication on digital voltmeter.

NOTE

When adjustments are performed, reconnect equipment as applicable in **a** above.

12. Sync Bias

a. Performance Check

(1) Connect signal generator (A5) to CH1 INPUT, using adapter and cable (B3 and B4).

(2) Set TI CH1 VOLTS/DIV switch to 50 mV and press INT CH1 and HF SYNC pushbuttons.

(3) Adjust signal generator frequency for 100 MHz and amplitude for one-half divisions of vertical deflection.

(4) Adjust LEVEL control for stable display on oscilloscope (A3) crt (cathode ray tube). If display does not stabilize with LEVEL control, perform **b** below.

b. Adjustments. Preset TRIGGERING LEVEL control fully ccw and adjust R209 (fig. 1) fully ccw and then slowly cw (clockwise) until display synchronizes.

13. Timing

a. Performance Check

(1) Position TI controls as listed in (a) through (e) below:

(a) CH1, INT CH1, SWP, +SLOPE, and REP pushbuttons pressed.

(b) CH1, VOLTS/DIV switch to .5 V.

(c) DELAYING SWEEP and DELAYED SWEEP SEC/DIV switches to 1 μS.

(d) Adjust DELAY ZERO (1st dot) fully ccw and DELAY TIME MULT (2nd dot) dial to 10.00.

(e) Press and release HF SYNC.

(2) Connect time-mark generator (A8) to CH1 INPUT, using cable (B4).

(3) Set time-mark generator to 1 μS marker output.

(4) Adjust TRIGGERING LEVEL control for stable display.

(5) Adjust HORIZ POS (front panel) control to aline second marker with second vertical graticule line.

(6) Adjust SWP CAL, (front panel) control to aline 10th marker with 10th vertical graticule line. Readjust HORIZ POSITION control as necessary to keep second marker aimed with second vertical graticule line. If one marker per division is not displayed within ±.1 division over center 8 divisions, perform **b**(l) below.

NOTE

It may be necessary to reduce oscilloscope intensity before performing (7) below.

(7) Adjust HORIZ POS to aline first dot on first graticule line. If second dot is not alined on 11th graticule line, perform **b**(2) below.

(8) Release SWP pushbutton and set DELAY TIME MULT (2nd dot) fully ccw. Adjust DELAY ZERO (1st dot) to aline a marker on second vertical graticule line. If 10th marker is not alined with 10th vertical graticule line, perform **b**(3) below.

b. Adjustments

(1) Adjust R132 (fig. 1) to aline one marker per each vertical graticule line (R).

(2) Adjust R130 and R131 (fig. 1) until first dot is alined on first graticule and second dot is alined on 11th graticule (R).

NOTE

Due to interaction, R130 and R131 must be readjusted for best compromise.

(3) Adjust R460 (fig. 1) to aline 1 marker per each vertical graticule line (R).

14. Scan Rate

a. Performance Check

(1) Connect time-mark generator (A8) to CH1 INPUT, using cable (B4).

(2) Set time-mark generator to 10 mS markers output.

(3) Press HF SYNC pushbutton and release INT CH1 pushbutton. Adjust SCAN control ccw until time markers stop drifting in one direction. The first point at which time markers stop drifting, oscilloscope will display three time markers. If oscilloscope does not display three time markers, perform **b** below.

b. Adjustments. Adjust R381 (fig. 1) until oscilloscope displays 3 time markers drifting toward right on crt.

15. Lead Time and Register

a. Performance Check

(1) Position controls as listed in (a) through (e) below:

(a) HF SYNC pushbutton released.
(b) INT CH1 pushbutton pressed.
(c) DELAY ZERO (1st dot) control fully ccw.
(d) DELAY TIME MULT (2nd dot) dial to 0.00.
(e) DELAYING SWEEP and DELAYED SWEEP SEC/DIV switches to .2 μS.

(2) Set time-mark generator (A8) markers output to .1 μS.

(3) Adjust TRIGGERING LEVEL control for a stable crt display and alternately press and release SWP pushbutton. If first narrow time marker does not aline on second vertical graticule line within ±0.l divisions perform **b** below.

b. Adjustments

(1) Release SWP pushbutton and adjust R472 (fig. 1) until a marker is alined on second vertical graticule line.

(2) Press SWP pushbutton and adjust R230 (fig. 1) until first narrow time mark is alined on second vertical graticule line.

(3) Repeat **a**(3) and **b**(1) and (2) above for best compromise.

16. Delay Timing

a. Performance Check

(1) Connect time-mark generator (A8) to CH1 INPUT, using cable (B4).

(2) Release SWP pushbutton. Oscilloscope (A3) will display two time markers per each major graticule division within ±0.3 division of each graticule line.

(3) Press SWP pushbutton for same results in (2) above.

(4) Release SWP pushbutton and set DELAYING SWEEP and DELAYED SWEEP SEC/DIV switches to 1 μS.

(5) Set time-mark generator MARKER OUT to 1 μS and adjust TRIGGERING LEVEL control for stable display.

(6) Set DELAY TIME MULT (2nd dot) dial to 0.00 and turn DELAY ZERO (1st dot) control cw until a time mark is centered on second vertical graticule line.

(7) Turn DELAY TIME MULT (2nd dot) dial to 1.00. Peak of time mark will remain within ±0.1 division of second graticule line.

(8) Repeat technique of (7) above for DELAY TIME MULT (2nd dot) setting of 2.00 through 9.00 in consecutive order for same results as in (6) above.

(9) Set DELAY TIME MULT (2nd dot) to 0.00 and press SWP pushbutton.

(10) Set dot on first time marker with DELAY ZERO (1st dot) control.

NOTE

It may be necessary to reduce intensity on oscilloscope for suitable viewing of dots.

(11) Set DELAY TIME MULT control to 1.00 and observe that first intensified dot is within ±0.l division of second time marker. Repeat this technique for DELAY TIME MULT settings of 2.00 through 9.00. Intensified dot will be within 0.1 division of each marker.

(12) Reset dot on first time marker with DELAY TIME MULT control.

b. Adjustments. No adjustments can be made.

17. 10 nS/DIV Delay

a. Performance Check

(1) Set CH1 VOLTS/DIV switch to .5 V and DELAYING SWEEP and DELAYED SWEEP SEC/DIV switches to 10 nS. Press HF SYNC pushbutton.

(2) Set time-mark generator (A8) to 10 nS markers output.

(3) Adjust TRIGGERING LEVEL control for stable display on oscilloscope (A3).

(4) Adjust HORIZ POS (front panel) control to aline second cycle on second graticule line. If oscilloscope does not indicate 1 cycle per graticule division over center 8 divisions within ±0.2 division, perform **b**(l) below.

(5) Release SWP pushbutton. If oscilloscope does not display 1 cycle per graticule division over center 8 divisions within ±0.2 division, perform **b**(2) below.

b. Adjustments

(1) Adjust C350 (fig. 1) until 10th cycle is alined with 10th vertical graticule line (R).

(2) Adjust DELAY ZERO (1st dot) control to set peak of one cycle on second vertical graticule line; then adjust C353 (fig. 1) until 10th cycle is alined with 10th vertical graticule line (R).

18. 1 nS Linearity

a. Performance Check

(1) Connect time-marker generator (A8) HF OUTPUT to CH1 INPUT, using cable (B4).

(2) Set time-mark generator to 2 nS output.

(3) Set CH1 VOLTS/DIV switch to .5 V, DELAYING SWEEP switch to 10 nS, and DELAYED SWEEP SEC/DIV switch to 1 nS.

(4) Adjust TRIGGERING LEVEL control for stable display and adjust DELAY ZERO (1st dot) control to aline cycle on second graticule line. If oscilloscope (A3) does not indicate 4 cycles over center 8 divisions within ±0.3 division, perform **b** below.

b. Adjustments. Adjust R380 (fig. 1) for 4 cycles of display over center 8 divisions.

19. Risetime

a. Performance Check

(1) Connect pulse generator (A4) output to CH1 and CH2 INPUTS, using cable supplied with pulse generator and adapters (B1 and B2).

(2) Position controls as listed in (a) through (f) below:

(a) Press CH1, INT CH1, +SLOPE, and REP pushbuttons and release all others.

(b) DELAY ZERO (1st dot) and DELAY TIME MULT (2nd dot) fully ccw.
(c) CH1 and CH2 VOLTS/DIV switches to 50 mV.
(d) DELAYED SWEEP SEC/DIV switch to .1 nS.
(e) TRIGGERING LEVEL control for stable display.
(f) LOW NOISE pushbutton pressed.

NOTE

It may be necessary to adjust DELAY TIME MULT (2nd dot) dial, DC OFFSET, and TRIGGERING controls for proper pulse presentation

(3) Measure risetime, using standard risetime technique. If risetime is not between 300 and 350 ps (picoseconds), perform **b**(l) below.

(4) Press CH2 pushbutton and repeat technique of (2)(e) and (3) above. If risetime is not between 300 and 350 ps, perform **b**(2) below.

b. Adjustments

(1) Adjust channel 1 R20 (fig. 2) for a risetime between 300 and 350 ps.

(2) Adjust channel 2 R20 (fig. 2) for a risetime between 300 and 350 ps.

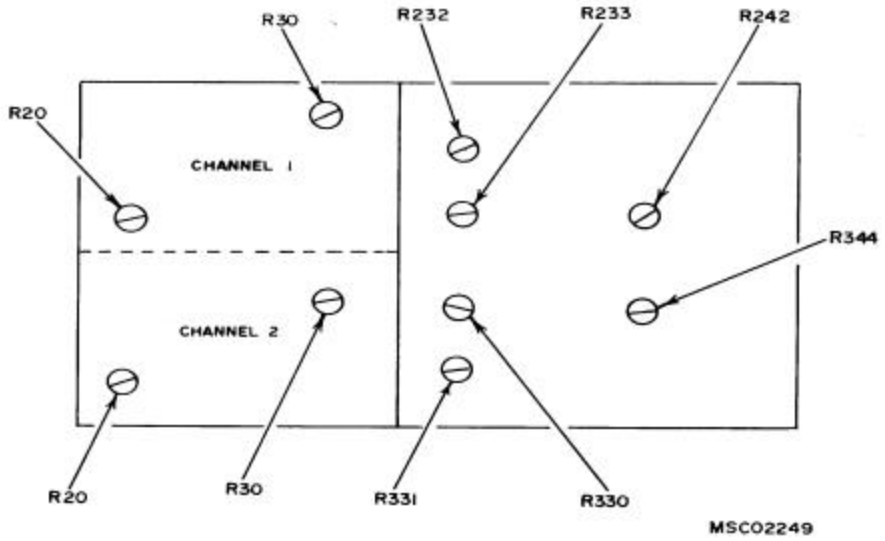


Figure 2. Test instrument - left-side view.

20. Delta t Center

a. Performance Check

(1) Connect pulse generator (A4) to CH1 and CH2 inputs, using cable supplied with pulse generator and adapters (B1 and B2).

(2) Position controls as listed in (a) through (c) below:

(a) CH1 and CH2 pushbuttons pressed.
(b) DELAYED SWEEP SEC/DIV switch to 1 ns.
(c) TRIGGERING LEVEL control for stable display.

(3) Superimpose two displays on oscilloscope (A3), using CH1 and CH2 DC OFFSET controls.

(4) Adjust CH1 TIME DIFF CH2 control (front panel) fully cw and then fully ccw. If one display does not lead the other by 1 ns (nanosecond) or more, perform **b** below.

(5) Press ADD and CH2 INVERT pushbuttons and adjust CH1 TIME DIFF CH2 control for minimum amplitude.

b. Adjustments. Adjust R458 (fig. 1) in conjunction with CH1 TIME DIFF CH2 (front panel) control until either adjustment has equal control over leading edge or lagging edges of display.

21. Balance and Loop Gain

a. Performance Check

(1) Connect pulse generator (A4) to CH1 and CH2 INPUTS, using cable supplied with pulse generator and adapters (B1 and B2).

(2) Release ADD, CH2, and CH2 INVERT pushbuttons.

(3) Press SWP pushbutton and set DELAYED SWEEP SEC/DIV and DELAYING SWEEP switches to 2 μS. If dot displayed on leading edge is not within one-half division of top display, perform **b**(l) through (7) below.

(4) Press CH2 pushbutton. If dot displayed on leading edge is not within one-half division of top display, perform **b**(8) through (12) below.

b. Adjustments

(1) Remove connection from CH1 and set both DELAYED SWEEP SEC/DIV and DELAYING SWEEP switches to 1 μS and press HF SYNC pushbutton.

(2) Adjust R233 (fig. 2) for no vertical movement while simultaneously adjusting R232 (fig. 2) back and forth between fully ccw and 90-degree position. Readjust R232 fully ccw.

(3) Set CH1 VOLTS/DIV switch to 10 mV. Center trace on horizontal graticule with DC OFFSET control.

(4) Press LO NOISE pushbutton and adjust R242 (fig. 2) for no trace shift while pressing and releasing NO NOISE button.

(5) Release LO NOISE and HF SYNC pushbuttons. Set CH1 VOLTS/DIV switch to 50 mV and DELAYED SWEEP SEC/DIV and DELAYING SWEEP switches to 2 μS.

(6) Reconnect pulse generator to CH1 and release HF SYNC pushbutton.

(7) Adjust R232 until first dot is on rise of pulse and level with top lead corner of display.

(8) Repeat (1) above for channel 2.

(9) Adjust R330 (fig. 2) for no vertical shift while simultaneously adjusting R331 (fig. 2) back and forth between fully ccw and 90-degree position. Readjust R331 fully ccw.

(10) Repeat technique of (3) and (4) above for CH2, except adjust R344 (fig. 2).

(11) Repeat technique of (5) and (6) above for CH2.

(12) Adjust R331 until first dot is on rise of pulse and level with top lead corner of display.

22. Low Frequency Comparator

a. Performance Check

(1) Set VOLTS/DIV switch to 10 mV and DELAYED SWEEP SEC/DIV and DELAYING SWEEP switches to 1 μS.

(2) Connect square-wave generator (A6) FAST RISE + OUTPUT to CH1 and CH2 INPUTS, using cable and adapter supplied with square-wave generator and adapter (B1).

(3) Adjust square-wave generator frequency for 100 kHz and amplitude for 4 divisions of display. If oscilloscope (A3) does not display square wave with flat top and level within 0.2 division, perform **b** below.

(4) Press CH1 and release CH2 pushbuttons.

(5) Repeat technique of (3) above for channel 1.

b. Adjustments. Adjust channel 2, R30 (channel 1, R30) (fig. 2) for optimum square-wave display.

23. Power Supply

NOTE

Do not perform power supply, check if all other parameters are within tolerance.

a. Performance

(1) Connect digital voltmeter (A2) to +30 V test point (fig. 1) and chassis ground, using leads supplied with digital voltmeter. Digital voltmeter will indicate between +29.1 and +30.9 V dc.

(2) Repeat technique of (1) above for test points and digital voltmeter indications listed in table 5. Digital voltmeter will indicate within limits specified.

Table 5. Power Supply Check

Test instrument test points (fig. 1)	Digital voltmeter indications (V dc)	
	Min	Max
+15	+14.55	+15.45
-30	-29.10	-30.90
-15	-14.55	-15.45
-5	-4.85	-5.15
+5	+4.85	+5.15

b. Adjustments. No adjustments can be made.

24. Final Procedure

a. Deenergize and disconnect equipment and replace TI side panels.

b. In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument).

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with STD IDS No. RLC-1500, 11 May 1992, requirements for calibration praocedure TB 9-4931-504-50.

U.S. GOVERNMENT PRINTING OFFICE 1979-640-042/1268

PIN NO: 041718-000