*TB 9-4931-503-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DELAYING TIME BASE, TEKTRONIX, TYPE 5B42; TIME BASE, TEKTRONIX, TYPE 5B40; AND DUAL TRACE AMPLIFIER, TEKTRONIX, TYPE 5A48

Headquarters, Department of the Army, Washington, DC
10 February 2005

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, US Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use https://amcom2028.redstone.army.mil.

*This bulletin supersedes TB 9-4931-503-35, dated 25 February 2003.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Delaying Time Base, Tektronix, Type 5B42; Time Base, Tektronix, Type 5B40; and Dual Trace Amplifier, Tektronix, Type 5A48. The manufacturers' manuals were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. Variations among models are described in text.

b. Time and Technique. The time required for this calibration is approximately 2 hours, using the dc and low frequency technique.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported 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 parameters	Performance specifications
Delaying Time Base, Tektronix, Type 5B42 and Time Base, Tektronix, Type 5B40	
Main sweep	Range: unmag: .1 μs to 5 s per division in 24 steps mag: 10 ns to .5 s per division in 24 steps Accuracy: unmag: .1 and .2 μs ±4% .5 μs to 1 s ±3% 2 and 5 s ±4% mag: 10 and 20 ns ±5% 50 ns to .1 s ±4% .2 and .5 s ±5%
External horizontal deflection factor	Range: 50 mV/div Accuracy: ±3%
For Delaying Time Base, Tektronix, Type 5B42 Only	
Delayed sweep	Range: unmag: .1 μs to .5 s per division in 21 steps mag: 10 ns to 50 ms per division Accuracy: unmag: .1 and .2 μs ±4% .5 μs to .1 s ±3% .2 and .5 s ±4% mag: 10 and 20 ns ±5% 50 ns to 10 ms ±4% 20 and 50 ms ±5%
Delay time/differential time measurement	Range: 1 μs/div to 0.5 s/div delay time Accuracy: Less than 1% +0.2% of FS Range: 1 s/div to 5 s/div delay time Accuracy: Less than 2% +0.2% of FS
Dual Trace Amplifier, Tektronix, Type 5A48	
Vertical gain	Range: 1 mV/div and 2 mV/div Accuracy: ±5% Range: 5 mV/div to 10 V/div Accuracy: ±3%
Risetime	Range: (SN B068141 and above): Less than 14 ns: 1 mV/div, 2 mV/div Less than 7 ns: 5 mV/div to 10 V/div (SN B068140 and below): Less than 14 ns: 1 mV/div, 2 mV/div 5.8 ns: 5 mV/div to 10 V/div
Aberrations	4% on a Tektronix, Type 5400 series oscilloscope

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286. Alternate items may be used by the calibrating activity. 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 required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure. The following peculiar accessories are also required for this calibration: Extender, Tektronix, Type 067-0645-03 and Normalizer (24 pF), Tektronix, Type 067-0539-00.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
DELAYING TIME BASE	Supplied with TI	Tektronix, Type 5B42
DUAL TRACE AMPLIFIER	Supplied with TI	Tektronix, Type 5A48
OSCILLOSCOPE	Supplied with TI	Tektronix, Type 5400 series
OSCILLOSCOPE CALIBRATOR	Volts out: Range: 5 mV to 50 V Frequency: 1 kHz Accuracy: ±0.75% Time markers: Range: 10 ns to 5 s/div Accuracy: ±0.75% Risetime: <1.45 ns	Fluke, Model 5820A-5C-GHZ (5820A-5C-GHZ)

SECTION III
CALIBRATION PROCESS FOR
DELAYING TIME BASE, TEKTRONIX, TYPE 5B42

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** 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 as listed in table 2.

c. Unless otherwise specified, verify the result 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 contained in the manufacturers' manuals for this TI.

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

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Remove TI protective covers and oscilloscope cabinet panels.

b. Install TI into oscilloscope right compartment.

c. Connect dual trace amplifier to oscilloscope left compartment using extender.

d. Connect oscilloscope to a 115 V ac source and energize. Allow 30 minutes for warm-up.

e. Press dual trace amplifier pushbuttons as listed in (1) through (5) below:

(1) **DISPLAY ON** pressed.

(2) **MODE CH 1** pressed.

(3) **CH 1 VOLTS/DIV** switch to **.5**.

(4) **TRIGGER CH 1** pressed.

(5) All remaining pushbuttons released (out).

f. Position TI controls as listed in (1) through (9) below:

(1) **POSITION** control to midrange.

(2) **MAIN SEC/DIV** switch to **AMP**.

(3) **MAIN VARIABLE CAL** control fully cw to detent.

(4) **DELAY TIME MULT** dial to **1.00**.

(5) **DISPLAY MODE MAIN SWP** pushbutton pressed.

(6) **AUTO TRIG** pushbutton pressed.

(7) **+SLOPE** pushbutton pressed.

(8) **TRIG SOURCE EXT** pushbutton pressed.

(9) All remaining pushbuttons released (out).

g. Adjust oscilloscope **INTENSITY** and **FOCUS** controls for suitable viewing.

CAUTION

High intensity will damage oscilloscope crt. Adjust **INTENSITY** control to lowest possible level consistent with suitable display.

8. External Horizontal Gain

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **EXT HORIZ AMPL**.

(2) Set oscilloscope calibrator **VOLTAGE** output for .5 V, 1 kHz.

(3) Adjust TI **POSITION** control to position dots to extreme right and left vertical graticule lines.

(4) Adjust dual trace amplifier **CH 1 POSITION** control to vertically center the dots.

(5) Adjust oscilloscope calibrator **EDIT FIELD** knob for 10 divisions of horizontal deflection on oscilloscope. If oscilloscope calibrator **err** display does not indicate within ±3%, perform **b** below.

b. Adjustments Adjust oscilloscope calibrator **EDIT FIELD** knob for a 0.0% **err** display indication. Adjust R52 EXT HORIZ GAIN (fig. 1) for a 10 division horizontal deflection on oscilloscope (R).

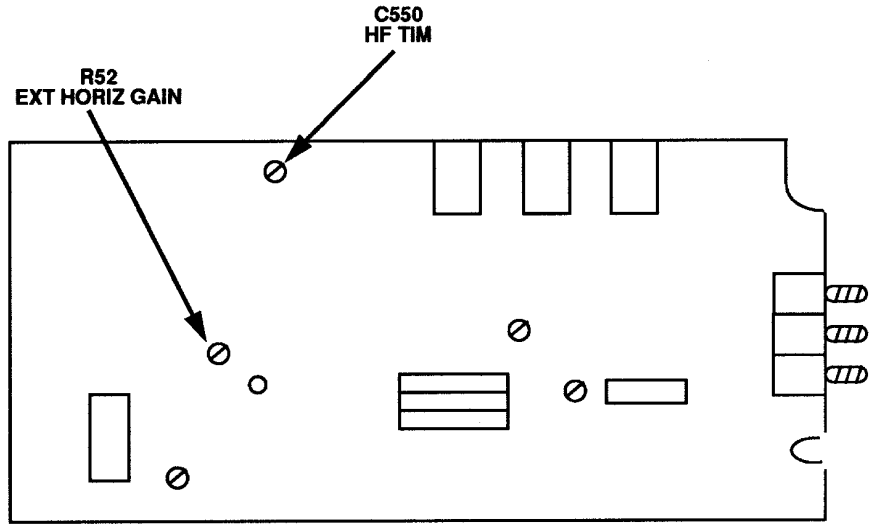

Figure 1. Test instrument A board - left-side view.

9. Main Sweep Timing

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to dual trace amplifier **CH 1** input.

(2) Press TI **TRIG SOURCE LEFT** pushbutton.

(3) Set TI **MAIN SEC/DIV** switch and oscilloscope calibrator **MARKER** output as listed in first row of table 3.

NOTE

If necessary, adjust TI **MAIN TRIG LEVEL** control for a stable display.

(4) Adjust TI **POSITION** control to align 2d marker with 2d vertical graticule line on oscill1scope.

(5) Adjust oscilloscope calibrator **EDIT FIELD** knob to align 10th marker with 10th vertical graticule line on oscilloscope. If oscilloscope calibrator **err** display indication is not within limits specified in first row of table 3, perform **b** below.

(6) Repeat technique of (3) through (5) above for remaining rows in table 3.

Table 3. Main Sweep Timing (Unmag)

Test instrument **MAIN SEC/DIV** switch settings	Oscilloscope calibrator	
	MARKER output settings	**err** display indications (±%)
.1 µs	.1 µS/D	4
.2 µs	.2 µS/D	4
.5 µs	.5 µS/D	3
1 µs	1 µS/D	3
2 µs	2 µS/D	3
5 µs	5 µS/D	3
10 µs	10 µS/D	3
20 µs	20 µS/D	3
50 µs	50 µS/D	3
.1 ms	.1 mS/D	3
.2 ms	.2 mS/D	3
.5 ms	.5 mS/D	3
1 ms	1 mS/D	3
2 ms	2 mS/D	3
5 ms	5 mS/D	3
10 ms	10 mS/D	3
20 ms	20 mS/D	3
50 ms	50 mS/D	3

Table 3. Main Sweep Timing (Unmag) - Continued

Test instrument **MAIN SEC/DIV** switch settings	Oscilloscope calibrator	
	MARKER output settings	**err** display indications (±%)
.1 s	.1 S/D	3
.2 s	.2 S/D	3
.5 s	.5 S/D	3
1 s	1 S/D	3
2 s	2 S/D	4
5 s	5 S/D	4

(7) Press TI **SWP MAG** pushbutton.

(8) Set TI **MAIN SEC/DIV** switch and oscilloscope calibrator **MARKER** output as listed in first row of table 4.

NOTE

If necessary, adjust TI **MAIN TRIG LEVEL** control for a stable display.

(9) Adjust TI **POSITION** control to align 2d marker with 2d vertical graticule line on oscilloscope.

(10) Adjust oscilloscope calibrator **EDIT FIELD** knob to align 10th marker with 10th vertical graticule line on oscilloscope. If oscilloscope calibrator **err** display indication is not within limits specified in table 4, perform **b** below.

(11) Repeat technique of (8) through (10) above for remaining rows in table 4.

Table 4. Main Sweep Timing (Mag)

Test instrument **MAIN SEC/DIV** switch settings	Oscilloscope calibrator	
	MARKER output settings	**err** display indications (± %)
10 ns	10 nS/D	5
20 ns	20 nS/D	5
50 ns	50 nS/D	4
.1 µs	.1 µS/D	4
.2 µs	.2 µS/D	4
.5 µs	.5 µS/D	4
1 µs	1 µS/D	4
2 µs	2 µS/D	4
5 µs	5 µS/D	4
10 µs	10 µS/D	4
20 µs	20 µS/D	4
50 µs	50 µS/D	4

Table 4. Main Sweep Timing (Mag) - Continued

Test instrument **MAIN SEC/DIV** switch settings	Oscilloscope calibrator	
	MARKER output settings	**err** display indications (± %)
.1 ms	.1 mS/D	4
.2 ms	.2 mS/D	4
.5 ms	.5 mS/D	4
1 ms	1 mS/D	4
2 ms	2 mS/D	4
5 ms	5 mS/D	4
10 ms	10 mS/D	4
20 ms	20 mS/D	4
50 ms	50 mS/D	4
.1 s	.1 S/D	4
.2 s	.2 S/D	5
.5 s	.5 S/D	5

b. Adjustments

(1) Release TI **SWP MAG** pushbutton (out), set TI **MAIN SEC/DIV** switch to **1 m** and oscilloscope calibrator **MARKER** output for 1 mS/D. If necessary, adjust oscilloscope calibrator **EDIT FIELD** knob for a 0.0% **err** display indication.

(2) Adjust TI **POSITION** control to align 1st time marker with 1st vertical graticule line (extreme left). Adjust R655 LF TIM (fig. 2) to align one time marker per division (R).

(3) Press TI **SWP MAG** pushbutton. Adjust R658 MAG GAIN (fig. 2) to align one time marker per division (R).

(4) Release TI **SWP MAG** pushbutton (out), set TI **MAIN SEC/DIV** switch to **.5 μ** and oscilloscope calibrator **MARKER** output for .5 μS/D.

(5) Adjust TI **POSITION** control to align 1st time marker with 1st vertical graticule line (extreme left). Adjust C550 HF TIM (fig. 1) to align one time marker per division (R).

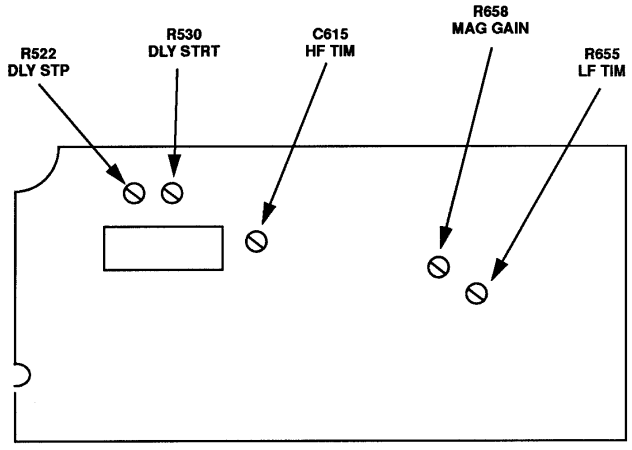

Figure 2. Test instrument B board - right-side view.

10. Delayed Sweep and Delay Time/ Differential Time Measurement

a. Performance Check

(1) Release **SWP MAG** pushbutton (out).

(2) Press **DISPLAY MODE DLY'D SWP** pushbutton.

(3) Set TI switches and oscilloscope calibrator output as listed in first row of table 5.

NOTE

If necessary, adjust TI **MAIN TRIG LEVEL** control for a stable display.

(4) Adjust TI **POSITION** control to align 2d time marker with 2d vertical graticule line on display.

(5) Adjust oscilloscope calibrator **EDIT FIELD** knob to align 10th marker with 10th vertical graticule line. If oscilloscope calibrator **err** display does not indicate within limits specified in first row of table 5, perform **b** (1) and (2) below.

(6) Repeat technique of (3) through (5) above for remaining rows in table 5.

Table 5. Delayed Sweep Timing (Unmag)

Test instrument		Oscilloscope calibrator	
MAIN SEC/DIV switch settings	**DLY'D SEC/DIV** switch settings	**MARKER** output settings	**err** display indications (± %)
1 µs	.1 µs	.1 µS/D	4
1 µs	.2 µs	.2 µS/D	4
1 µs	.5 µs	.5 µS/D	3
2 µs	1 µs	1 µS/D	3
2 µs	2 µs	2 µS/D	3
5 µs	5 µs	5 µS/D	3
10 µs	10 µs	10 µS/D	3
20 µs	20 µs	20 µS/D	3
50 µs	50 µs	50 µS/D	3
.1 ms	.1 ms	.1 mS/D	3
.2 ms	.2 ms	.2 mS/D	3
.5 ms	.5 ms	.5 mS/D	3
1 ms	1 ms	1 mS/D	3
2 ms	2 ms	2 mS/D	3
5 ms	5 ms	5 mS/D	3
10 ms	10 ms	10 mS/D	3
20 ms	20 ms	20 mS/D	3
50 ms	50 ms	50 mS/D	3
.1 s	.1 s	.1 S/D	3
.2 s	.2 s	.2 S/D	4
.5 s	.5 s	.5 S/D	4

(7) Press **SWP MAG** pushbutton.

(8) Set TI switches and oscilloscope calibrator output as listed in first row of table 6.

NOTE

If necessary, adjust TI **MAIN TRIG LEVEL** control for a stable display.

(9) Adjust TI **POSITION** control to align 2d time marker with 2d vertical graticule line on display.

(10) Adjust oscilloscope calibrator **EDIT FIELD** knob to align 10th marker with 10th vertical graticule line. Oscilloscope calibrator **err** display will indicate within limits specified in first row of table 6.

(11) Repeat technique of (8) through (10) above for remaining rows in table 6.

Table 6. Delayed Sweep Timing (Mag)

Test instrument		Oscilloscope calibrator	
MAIN SEC/DIV switch settings	**DLY'D SEC/DIV** switch settings	**MARKER** output settings	**err** display indications (± %)
.1 µs	10 ns	10 nS/D	5
.1 µs	20 ns	20 nS/D	5
.1 µs	50 ns	50 nS/D	4
.2 µs	.1 µs	.1 µS/D	4
.2 µs	.2 µs	.2 µS/D	4
.5 µs	.5 µs	.5 µS/D	4
1 µs	1 µs	1 µS/D	4
2 µs	2 µs	2 µS/D	4
5 µs	5 µs	5 µS/D	4
10 µs	10 µs	10 µS/D	4
20 µs	20 µs	20 µS/D	4
50 µs	50 µs	50 µS/D	4
.1 ms	.1 ms	.1 mS/D	4
.2 ms	.2 ms	.2 mS/D	4
.5 ms	.5 ms	.5 mS/D	4
1 ms	1 ms	1 mS/D	4
2 ms	2 ms	2 mS/D	4
5 ms	5 ms	5 mS/D	4
10 ms	10 ms	10 mS/D	4
20 ms	20 ms	20 mS/D	5
50 ms	50 ms	50 mS/D	5

(12) Position TI controls as listed in (a) through (d) below:

(a) **SWP MAG** pushbutton released (out).

(b) **DLY'D SEC/DIV** switch to **10 µ**.

(c) **MAIN SEC/DIV** switch to **.1 m**.

(d) **DISPLAY MODE INTENS SWP** pushbutton pressed.

(13) Set oscilloscope calibrator **MARKER** output for .1 mS/D.

(14) Adjust **MAIN TRIG LEVEL** control for a stable display on oscilloscope.

(15) Adjust oscilloscope **INTENSITY** control until intensified portion of trace is clearly visible.

(16) Adjust **POSITION** control to start trace at extreme left graticule line of display.

(17) Adjust **DELAY TIME MULT** dial to position start of intensified portion of trace on 2d vertical graticule line. If **DELAY TIME MULT** dial does not indicate between .97 and 1.03, perform **b** (3) through (6) below.

(18) Adjust **DELAY TIME MULT** dial to position start of intensified portion of trace on 10th vertical graticule line. If **DELAY TIME MULT** dial does not indicate between 8.89 and 9.11, perform **b** (3) through (6) below.

b. Adjustments

(1) Set TI **MAIN SEC/DIV** switch to **1 μ**, **DLY'D SEC/DIV** switch to **.5 μ** and oscilloscope calibrator **MARKER** output for .5 μS/D. If necessary, adjust oscilloscope calibrator **EDIT FIELD** knob for a 0.0% **err** display indication.

(2) Adjust TI **POSITION** control to align 1st time marker with 1st vertical graticule line (extreme left). Adjust C615 HF TIM (fig. 2) to align one time marker per division (R).

(3) Adjust **DELAY TIME MULT** dial to **1.00** and adjust R530 DLY STRT (fig. 2) until intensified portion of trace starts on 2d vertical graticule line (R).

(4) Adjust **DELAY TIME MULT** dial to **9.00** and adjust R522 DLY STP (fig. 2) until intensified portion of trace starts on the 10th vertical graticule line (R).

(5) Press **DISPLAY MODE DLY'D SWP** pushbutton. Adjust R530 DLY STRT and R522 DLY STP (fig. 2) equally until time marker is just visible at start of trace.

(6) Press **DISPLAY MODE INTENS SWP** pushbutton and repeat (3) through (5) above, as necessary, for best compromise.

11. Final Procedure

a. Deenergize and disconnect all equipment. Replace protective covers and cabinet panels.

b. Annotate and affix DA label/form in accordance with TB 750-25.

SECTION IV
CALIBRATION PROCESS FOR
TIME BASE, TEKTRONIX, TYPE 5B40

12. Preliminary Instructions

a. The instructions outlined in paragraphs **12** and **13** 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 as listed in table 2.

c. 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 contained in the manufacturer's manual for this TI.

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

13. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each set within the performance check when applicable.

a. Remove TI protective covers and oscilloscope cabinet panels.

b. Install TI in oscilloscope right compartment.

c. Connect dual trace amplifier to oscilloscope left compartment using extender.

d. Connect oscilloscope to a 115 V ac source and energize. Allow 30 minutes for warm-up.

e. Position dual trace amplifier controls as listed in (1) through (5) below:

(1) **DISPLAY ON** pushbutton pressed.

(2) **MODE CH 1** pushbutton pressed.

(3) **CH 1 VOLTS/DIV** switch to **.5**.

(4) **TRIGGER CH 1** pushbutton pressed.

(5) All remaining pushbuttons released (out).

f. Position TI controls as listed in (1) through (7) below:

(1) **POSITION** control to midrange.

(2) **SECONDS/DIV** switch to **AMP**.

(3) **SECONDS/DIV CAL** control fully cw to detent.

(4) **AUTO TRIG** pushbutton pressed.

(5) **+ SLOPE** pushbutton pressed.

(6) **TRIGGERING SOURCE EXT** pushbutton pressed.

(7) All remaining pushbuttons released (out).

g. Adjust oscilloscope **INTENSITY** and **FOCUS** controls for suitable viewing.

CAUTION

High intensity will damage oscilloscope crt. Adjust **INTENSITY** control to lowest possible level consistent with suitable display.

14. External Horizontal Gain

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **EXT HORIZ AMP**.

(2) Set oscilloscope calibrator **VOLTAGE** output for .5 V, 1 kHz.

(3) Adjust TI **POSITION** control to position dots to the extreme right and left vertical graticule lines.

(4) Adjust dual trace amplifier **CH 1 POSITION** control to vertically center the dots.

(5) Adjust oscilloscope calibrator **EDIT FIELD** knob for 10 divisions of horizontal deflection on oscilloscope. If oscilloscope calibrator **err** display does not indicate within ±3%, perform **b** below.

b. Adjustments. Adjust oscilloscope calibrator **EDIT FIELD** knob for a 0.0% **err** display indication. Adjust R315 EXT HORIZ GAIN (fig. 3) for a 10 division horizontal deflection on oscilloscope (R).

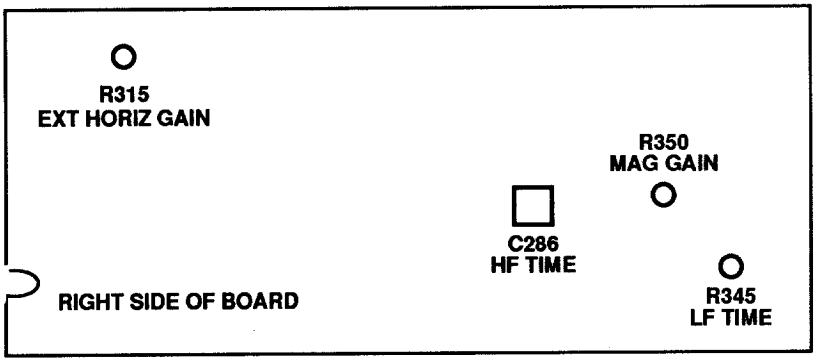

Figure 3. Test instrument - adjustment locations.

15. Horizontal Time

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to dual trace amplifier **CH 1** input.

(2) Press **TRIGGERING SOURCE LEFT** pushbutton.

(3) Set TI **SECONDS/DIV** switch and oscilloscope calibrator **MARKER** output as listed in first row of table 7.

NOTE

If necessary, adjust TI **LEVEL** control for a stable display.

(4) Adjust TI **POSITION** control to align 2d marker with 2d vertical graticule line on oscilloscope.

(5) Adjust oscilloscope calibrator **EDIT FIELD** knob to align 10th marker with 10th vertical graticule line on oscilloscope. If oscilloscope calibrator **err** display indication is not within limits specified in first row of table 7, perform **b** below.

(6) Repeat technique of (3) through (5) above for remaining rows in table 7.

Table 7. Sweep Timing (Unmag)

Test instrument **SECONDS/DIV** switch settings	Oscilloscope calibrator	
	MARKER output settings	**err** display indications (± %)
.1 µs	.1 µS/D	4
.2 µs	.2 µS/D	4
.5 µs	.5 µS/D	3
1 µs	1 µS/D	3
2 µs	2 µS/D	3
5 µs	5 µS/D	3
10 µs	10 µS/D	3
20 µs	20 µS/D	3
50 µs	50 µS/D	3
.1 ms	.1 mS/D	3
.2 ms	.2 mS/D	3
.5 ms	.5 mS/D	3
1 ms	1 mS/D	3
2 ms	2 mS/D	3
5 ms	5 mS/D	3
10 ms	10 mS/D	3
20 ms	20 mS/D	3
50 ms	50 mS/D	3
.1 s	.1 S/D	3
.2 s	.2 S/D	3
.5 s	.5 S/D	3
1 s	1 S/D	3
2 s	2 S/D	4
5 s	5 S/D	4

(7) Press TI **SWP MAG** pushbutton.

(8) Set TI **SECONDS/DIV** switch and oscilloscope calibrator settings as listed in first row of table 8.

NOTE

If necessary, adjust TI **LEVEL** control for a stable display.

(9) Adjust TI **POSITION** control to align 2d marker with 2d vertical graticule line on oscilloscope.

(10) Adjust oscilloscope calibrator **EDIT FIELD** knob to align 10th marker with 10th vertical graticule line on oscilloscope. If oscilloscope calibrator **err** display indication is not within limits specified in first row of table 8, perform **b** below.

(11) Repeat technique of (8) through (10) above for remaining rows in table 8.

Table 8. Sweep Timing (Mag)

Test instrument **SECONDS/DIV** switch settings	Oscilloscope calibrator	
	MARKER output settings	**err** display indications (± %)
10 ns	10 nS/D	5
20 ns	20 nS/D	5
50 ns	50 nS/D	4
.1 µs	.1 µS/D	4
.2 µs	.2 µS/D	4
.5 µs	.5 µS/D	4
1 µs	1 µS/D	4
2 µs	2 µS/D	4
5 µs	5 µS/D	4
10 µs	10 µS/D	4
20 µs	20 µS/D	4
50 µs	50 µS/D	4
.1 ms	.1 mS/D	4
.2 ms	.2 mS/D	4
.5 ms	.5 mS/D	4
1 ms	1 mS/D	4
2 ms	2 mS/D	4
5 ms	5 mS/D	4
10 ms	10 mS/D	4
20 ms	20 mS/D	4
50 ms	50 mS/D	4
.1 s	.1 S/D	4
.2 s	.2 S/D	5
.5 s	.5 S/D	5

b. Adjustments

(1) Release TI **SWP MAG** pushbutton (out), set **SECONDS/DIV** switch to **1 m** and oscilloscope calibrator **MARKER** output for 1 mS/D. If necessary, adjust oscilloscope calibrator **EDIT FIELD** knob for a 0.0% **err** display indication.

(2) Adjust TI **POSITION** control to align 1st time marker with 1st vertical graticule line (extreme left). Adjust R345 LF TIME (fig. 3) to align one time marker per division (R).

(3) Press TI **SWP MAG** pushbutton and adjust TI **POSITION** control to align 1st time marker with 1st vertical graticule line (extreme left). Adjust R350 MAG GAIN (fig. 3) to align one time marker per division (R).

(4) Release TI **SWP MAG** pushbutton (out), set **SECONDS/DIV** switch to **.5 µ** and set oscilloscope calibrator **MARKER** output for .5 µS/D.

(5) Adjust TI **POSITION** control to align 1st time marker with 1st vertical graticule line (extreme left). Adjust C286 HF TIME (fig. 3) to align one time marker per division (R).

16. Final Procedure

a. Deenergize and disconnect all equipment. Replace protective covers and cabinet panels.

b. Annotate and affix DA label/form in accordance with TB 750-25.

SECTION V
CALIBRATION PROCESS FOR
DUAL TRACE AMPLIFIER, TEKTRONIX, TYPE 5A48

17. Preliminary Instructions

a. The instructions outlined in paragraphs **17** and **18** 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 as listed in table 2.

c. Unless otherwise specified, verify the result 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 contained in the manufacturer's manual for this TI.

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

18. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each set within the performance check when applicable.

a. Remove TI protective covers as required to make adjustments.

b. Install TI into oscilloscope center compartment, and delaying time base into horizontal (right) compartment.

c. Connect oscilloscope to a 115 V ac source and energize. Allow at least 20 minutes for warm-up.

d. Position TI controls as listed in (1) through (6) below:

(1) **DISPLAY ON** pushbutton pressed.

(2) **MODE CH 1** pushbutton pressed.

(3) **TRIGGER CH 1** pushbutton pressed.

(4) **CH 1** and **CH 2 VOLTS/DIV CAL** control fully cw (to detent).

(5) **CH 1** and **CH 2 POSITION** controls to midrange.

(6) All remaining pushbuttons released (out).

e. Position delaying time base controls as listed in (1) through (8) below:

(1) **POSITION** control to midrange.

(2) **MAIN SEC/DIV** switch to **1 m**.

(3) **MAIN VARIABLE CAL** control fully cw to detent.

(4) **AUTO TRIG** pushbutton pressed.

(5) **+SLOPE** pushbutton pressed.

(6) **DISPLAY MODE MAIN SWP** pushbutton pressed.

(7) **TRIG SOURCE RIGHT** pushbutton pressed.

(8) All remaining pushbuttons released (out).

f. Adjust oscilloscope **INTENSITY** and **FOCUS** controls for suitable viewing.

19. Vertical Gain

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **CH 1** input.

(2) Set TI **CH 1 VOLT/DIV** switch and oscilloscope calibrator **VOLTAGE** output, at 1 kHz, as listed in first row of table 9.

Table 9. CH 1 Vertical Gain

Test instrument **CH 1 VOLTS/DIV** switch settings	Oscilloscope calibrator **VOLTAGE** output at 1 kHz settings	Oscilloscope calibrator **err** display indications (± %)
1 mV	5 mV	5
2 mV	10 mV	5
5 mV	25 mV	3
10 mV	50 mV	3
20 mV	.1 V	3
50 mV	.25 V	3
.1 V	.5 V	3
.2 V	1 V	3
.5 V	2.5 V	3
1 V	5 V	3
2 V	10 V	3
5 V	25 V	3
10 V	50 V	3

NOTE

If necessary, adjust delaying time base controls for a stable display.

(3) Adjust oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope. If oscilloscope calibrator **err** display indication is not within limits specified in first row of table 9, perform **b** (1) through (16) below. (No adjustment can be made on TIs with main board (SN B056205 and below)).

(4) Repeat technique of (2) and (3) above for remaining rows in table 9.

(5) Move oscilloscope calibrator **SOURCH/MEASURE CHAN 1** connection to TI **CH 2** input.

(6) Press **MODE CH 2** and **TRIGGER CH 2** pushbuttons.

(7) Set TI **CH 2 VOLTS/DIV** switch and oscilloscope calibrator **VOLTAGE** output, at 1 kHz, as listed in first row of table 10.

Table 10. CH 2 Vertical Gain

Test instrument **CH 2 VOLTS/DIV** switch settings	Oscilloscope calibrator **VOLTAGE** output at 1 kHz settings	Oscilloscope calibrator **err** display indications (± %)
1 mV	5 mV	5
2 mV	10 mV	5
5 mV	25 mV	3
10 mV	50 mV	3
20 mV	.1 V	3
50 mV	.25 V	3
.1 V	.5 V	3
.2 V	1 V	3
.5 V	2.5 V	3
1 V	5 V	3
2 V	10 V	3
5 V	25 V	3
10 V	50 V	3

NOTE

If necessary, adjust delaying time base controls for a stable display.

(8) Adjust oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope. If oscilloscope calibrator **err** display indication is not within limits specified in first row of table 10, perform **b** (17) through (32) below. (No adjustment can be made on TIs with main board (SN B056205 and below)).

(9) Repeat technique of (7) and (8) above for remaining rows in table 10.

b. Adjustments

(1) Connect oscilloscope calibrator **SOURCH/MEASURE CHAN 1** to TI **CH 1** using 24 pF normalizer.

(2) Set TI **CH 1 VOLTS/DIV** switch to **20 m** and press **CH 2 GND** pushbutton to in position.

(3) Set delaying time base **MAIN SEC/DIV** switch to **1 m**.

NOTE

Adjust TI and delaying time base controls as necessary to view waveform.

(4) Set oscilloscope calibrator **EDGE** output for 100 mV, 1 kHz and adjust **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(5) If square wave level, roll off, or overshoot exceeds ±4%, adjust C134 (fig. 4) for flat top on waveform.

(6) Set TI **CH 1 VOLTS/DIV** switch to **50 m**.

(7) Set oscilloscope calibrator **EDGE** output for 250 mV, 1 kHz and adjust **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(8) If square wave level, roll off, or overshoot exceeds ±4%, adjust C124 (fig. 4) for flat top and C126 (fig. 4) for square corner on waveform.

(9) Set TI **CH 1 VOLTS/DIV** switch to **.5**.

(10) Set oscilloscope calibrator **EDGE** output for 2.5 V, 1 kHz and adjust **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(11) If square wave level, roll off, or overshoot exceeds ±4%, adjust C114 (fig. 4) for flat top and C116 (fig. 4) for square corner on waveform.

(12) Release **CH 2 GND** pushbutton to out position. Remove 24 pF normalizer from equipment setup and connect oscilloscope calibrator **SOURCH/MEASURE CHAN 1** to TI **CH 1**.

(13) Set TI **CH 1 VOLTS/DIV** switch to **2 m** and oscilloscope calibrator **VOLTAGE** output for 10 mV, 1 kHz. If necessary, adjust oscilloscope calibrator **EDIT FIELD** knob for a 0.0% **err** display indication.

(14) Adjust R205 (fig. 4) for 5 divisions of vertical deflection on oscilloscope (R).

(15) Set TI **CH 1 VOLTS/DIV** switch to **10 m** and oscilloscope calibrator **VOLTAGE** output for 50 mV, 1 kHz.

(16) Adjust R188 (fig. 4) for 5 divisions of vertical deflection on oscilloscope (R).

(17) Connect oscilloscope calibrator **SOURCH/MEASURE CHAN 1** to TI **CH 2** using 24 pF normalizer.

(18) Set TI **CH 2 VOLTS/DIV** switch to **20 m** and press **CH 1 GND** pushbutton to in position.

(19) Set delaying time base **MAIN SEC/DIV** switch to **1 m**.

NOTE

Adjust TI and delaying time base controls as necessary to view waveform.

(20) Set oscilloscope calibrator **EDGE** output for 100 mV, 1 kHz and adjust **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(21) If square wave level, roll off, or overshoot exceeds ±4%, adjust C334 (fig. 4) for flat top on waveform.

(22) Set TI **CH 2 VOLTS/DIV** switch to **50 m**.

(23) Set oscilloscope calibrator **EDGE** output for 250 mV, 1 kHz and adjust **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(24) If square wave level, roll off, or overshoot exceeds ±4%, adjust C324 (fig. 4) for flat top and C326 (fig. 4) for square corner on waveform.

(25) Set TI **CH 2 VOLTS/DIV** switch to **.5**.

(26) Set oscilloscope calibrator **EDGE** output for 2.5 V, 1 kHz and adjust **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(27) If square wave level, roll off, or overshoot exceeds ±4%, adjust C314 (fig. 4) for flat top and C316 (fig. 4) for square corner on waveform.

(28) Release **CH 1 GND** pushbutton to out position. Remove 24 pF normalizer from equipment setup and connect oscilloscope calibrator **SOURCH/MEASURE CHAN 1** to TI **CH 2**.

(29) Set TI **CH 2 VOLTS/DIV** switch to **2 m** and oscilloscope calibrator **VOLTAGE** output for 10 mV, 1 kHz. If necessary, adjust oscilloscope calibrator **EDIT FIELD** knob for a 0.0% **err** display indication.

(30) Adjust R405 (fig. 4) for 5 divisions of vertical deflection on oscilloscope (R).

(31) Set TI **CH 2 VOLTS/DIV** switch to **10 m** and oscilloscope calibrator **VOLTAGE** output for 50 mV, 1 kHz.

(32) Adjust R388 (fig. 4) for 5 divisions of vertical deflection on oscilloscope (R).

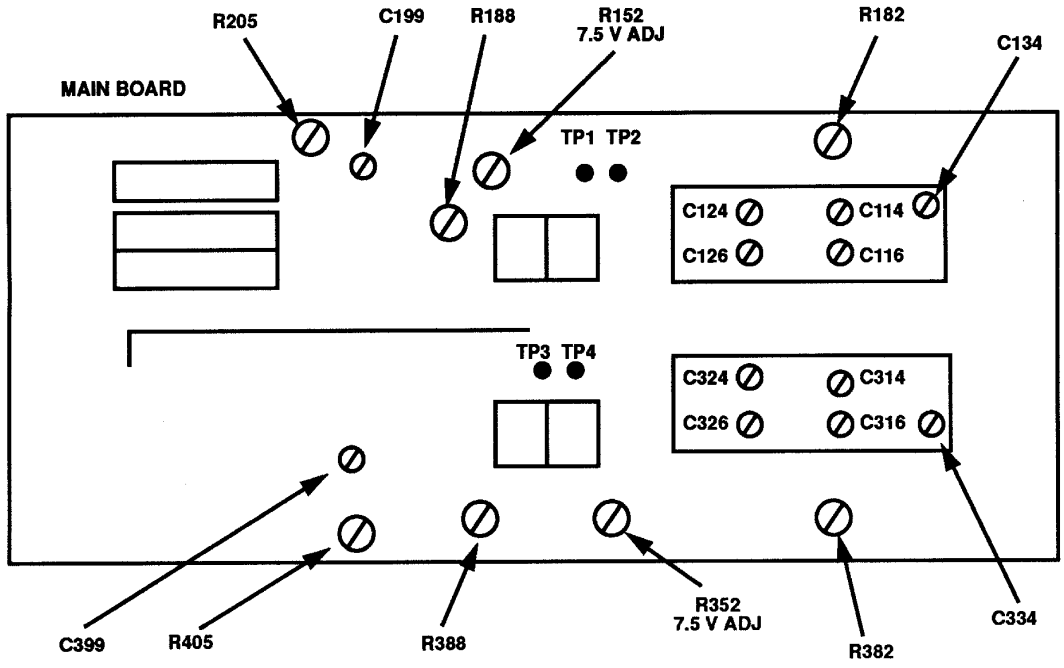

Figure 4. Test instrument - left-side view.

20. Aberrations and Risetime

a. Performance Check

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

(a) **CH 1** and **CH 2 VOLTS/DIV** switches to **10 m**.
(b) **MODE CH 1** pushbutton pressed.
(c) **TRIGGER CH 1** pushbutton pressed.

(2) Press delaying time base **SWP MAG** pushbutton and set **MAIN SEC/DIV** switch to **10 n**.

(3) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **CH 1** input using 50 Ω feedthrough termination.

(4) Set oscilloscope calibrator **EDGE** output for 50 mV, 1 MHz.

(5) Adjust delaying time base **MAIN TRIG LEVEL** and **POSITION** controls and TI **CH 1 POSITION** control as necessary to view leading edge of waveform near center of display.

(6) Adjust oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(7) If aberrations are not within ±4%, adjust C199 (C399 for **CH 2**) (fig. 4) for best square corner on waveform (R).

(8) Measure risetime using standard risetime technique. Risetime will be 5.8 ns or less for SN B068140 and below (7 ns or less for SN B068140 and above).

(9) Set oscilloscope calibrator **EDGE** output for 5 mV, 1 MHz and TI **CH 1 VOLTS/ DIV** switch to **1 m**.

(10) Adjust delaying time base **MAIN TRIG LEVEL** and **POSITION** controls and TI **CH 1 POSITION** control as necessary to view leading edge of waveform near the center of display.

(11) Adjust oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection on oscilloscope.

(12) Measure risetime using standard risetime technique. Risetime will be 14 ns or less.

(13) Press **MODE CH 2** and **TRIGGER CH 2** pushbuttons.

(14) Repeat technique of (3) through (12) above for **CH 2**.

b. Adjustments

. No further adjustments can be made.

21. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official

SANDRA R. RILEY
Administrative Assistant to the
Secretary of the Army
0434302

Distribution:
To be distributed in accordance with the initial distribution number (IDN) 342862, requirements for calibration procedure TB 9-4931-503-35.

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The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@redstone.army.milT
To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.