

***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
25 February 2003

Approved for public release; distribution is unlimited

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, DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commander, U.S. Army Aviation and Missile Command, ATTN: 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>.

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*This bulletin supersedes TB 9-4931-503-35, 19 March 1993.

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**SECTION I
IDENTIFICATION AND DESCRIPTION**

1. Test Instrument Identification. This procedure 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 manufacturer's 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 μ s to 5 s per division in 24 steps mag: 10 ns to .5 s per division in 24 steps Accuracy: unmag: .1 and .2 μ s \pm 4% .5 μ s to 1 s \pm 3% 2 and 5 s \pm 4% mag: 10 and 20 ns \pm 5% 50 ns to .1 s \pm 4% .2 and .5 s \pm 5%
External horizontal deflection factor	Range: 50 mV/div Accuracy: \pm 3%
For Delaying Time Base, Tektronix, Type 5B42 Only	
Delayed sweep	Range: unmag: .1 μ s to .5 s per division in 21 steps mag: 10 ns to 50 ms per division Accuracy: unmag: .1 and .2 μ s \pm 4% .5 μ s to .1 s \pm 3% 2 and .5 s \pm 4% mag: 10 and 20 ns \pm 5% 50 ns to 10 ms \pm 4% 20 and 50 ms \pm 5%
Delay time/differential time measurement	Range: 1 μ s/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	
Deflection factor	Range: 1 mV/div and 2 mV/div Accuracy: \pm 5% Range: 5 mV/div to 10 V/div Accuracy: \pm 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**

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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 accessory is also required for this calibration: Extender, Tektronix, Type 067-0645-03.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
DELAYING TIME BASE	Must be compatible with TI	Tektronix, Type 51342 (MIS-28706/4)
DUAL TRACE AMPLIFIER	Must be compatible with TI	Tektronix, Type 5A48 (MIS-28706/3)
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% Risettime: <1.45 ns	John Fluke, Model 5820A, (5820A-5C-GHZ), (MIS-38938)

**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 manufacturer's 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 (3) below:
 - (1) **DISPLAY ON** pressed.
 - (2) **MODE CH 1** pressed.
 - (3) **TRIGGER CH 1** pressed.
- f.** Position TI controls as listed in (1) through (7) below:
 - (1) **POSITION** control to midrange.
 - (2) **MAIN SEC/DIV** switch to **AMP**.
 - (3) **MAIN SEC/DIV CAL** control fully cw to detent.
 - (4) **DELAY TIME MULT** dial fully ccw.
 - (5) **DISPLAY MODE MAIN SWP** pushbutton pressed.
 - (6) **AUTO TRIG** and **+SLOPE** pushbuttons pressed.
 - (7) All other 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 Input and Main Sweep Timing

a. Performance Check

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

(2) Set oscilloscope calibrator **VOLTAGE** output to 5 V and frequency to 1 kHz.

(3) Adjust TI **POSITION** control to position the 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) On oscilloscope calibrator rotate knob located below **EDIT FIELD** pushbutton for 10 divisions of horizontal deflection on oscilloscope. If oscilloscope calibrator **err** display does not indicate within $\pm 3\%$, perform **b(l)** below.

(6) Set dual trace amplifier **CH 1 VOLTS/DIV** switch to **.5**.

(7) Position TI controls as listed in (a) through (g) below:

(a) **MAIN SEC/DIV** switch to **1 ms**.

(b) **MAIN VARIABLE** control to **CAL**.

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

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

(e) **TRIG SOURCE LEFT** pushbutton pressed.

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

(g) All remaining pushbuttons released (out).

(8) Move connection located at TI **EXT HORIZ AMPL** and connect to dual trace amplifier **CH 1**.

(9) Set oscilloscope calibrator **MARKER** output as listed in 1st row of table 3.

(10) Adjust TI **MAIN TRIG LEVEL** control for a stable display.

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

(12) Rotated oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker with 10th vertical graticule line on oscilloscope. Oscilloscope calibrator **err** display will indicate as listed in table 3; if not, perform adjustment as listed in table 3.

(13) Repeat technique of (11) and (12) above using the **MAIN SEC/DIV** switch settings and oscilloscope calibrator output settings for remaining rows listed in table 3. Oscilloscope calibrator **err** display will indicate as listed in table 3; if not, perform adjustments if listed.

Table 3. Main Sweep Timing (Unmag)

Test instrument MAIN SEC/DIV switch settings	Oscilloscope calibrator MARKER output settings	Oscilloscope calibrator Err display indications (±%)	Test instrument adjustments
1 ms	1 mS/D	3	b(2)
1 ms 1	1 mS/D	4	b(3)
.5 μs	5 μS/D	3	b(4)
.1 μs 2	.1 μS/D	4	
.2 μs 2	.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 s1	2 S/D	3	
5 s1	5 S/D	3	

¹ Press TI **SWP MAG** pushbutton and release TI **SWP MAG** pushbutton after this test

²Adjust **C550 HF TIM** (fig. 1) for best compromise if out-of-tolerance conditions exist between .5, .1, and .2 μs positions.

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

(15) Repeat technique of (11) and (12) above using the TI **MAIN SEC/DIV** switch settings and oscilloscope calibrator output settings listed in table 4. Oscilloscope calibrator **err** display will indicate within limits listed in table 4.

Table 4. Main Sweep Timing (Mag)

Test instrument MAIN SEC/DIV SWP MAG switch settings	Oscilloscope calibrator MARKER output settings	Oscilloscope calibrator 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 s1	.2 S/D	4
.5 s1	.5 S/D	4

b. Adjustments

(1) On oscilloscope calibrator rotate knob located below **EDIT FIELD** pushbutton to adjust **MARKER** output for 0.0% indication on **err** display. Adjust R52 EXT HORIZ GAIN (fig. 1) for a 10 division horizontal deflection on oscilloscope (R).

(2) On oscilloscope calibrator, rotate knob located below **EDIT FIELD** pushbutton to adjust output for 0.0% indication on **err** display. Adjust R655 LF TIM (fig. 2) to align one time marker per division (R).

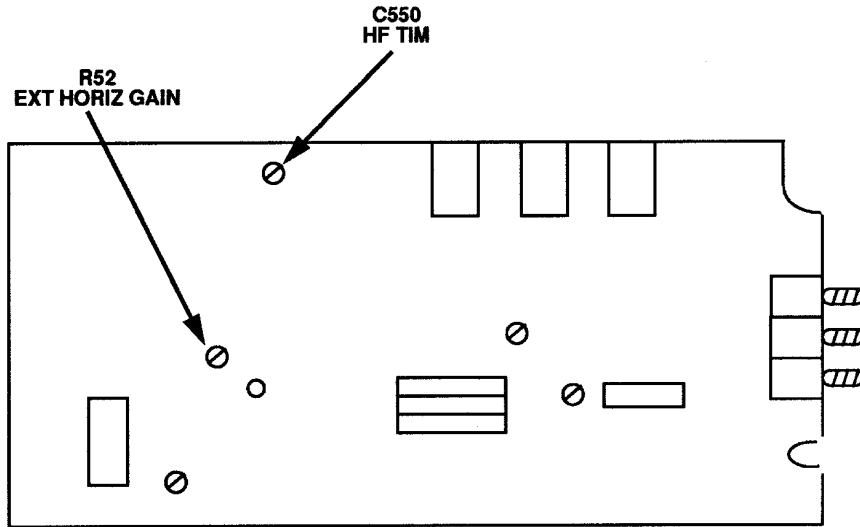


Figure 1. Tektronix, Type 51342 A board - left-side view.

(2) On oscilloscope calibrator rotate knob located below **EDIT FIELD** pushbutton to adjust output for 0.0% indication on **err** display. Adjust R655 LF TIM (fig. 2) to align one time marker per division (R).

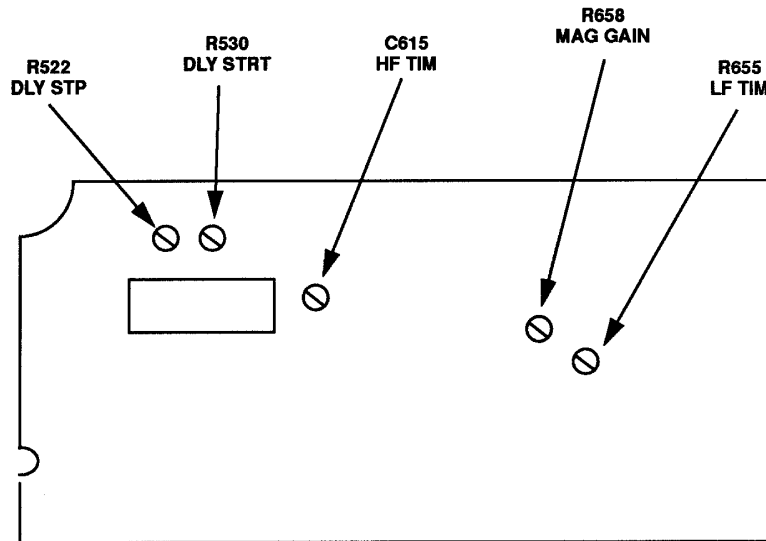


Figure 2. Type 5B42 B board - right-side view.

(3) On oscilloscope calibrator rotate knob located below **EDIT FIELD** pushbutton to adjust for 0.0% indication on **err** display. Adjust R658 MAG GAIN (fig. 2) to align one time marker per division (R).

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(4) On oscilloscope calibrator rotate knob located below **EDIT FIELD** pushbutton to adjust for 0.0% indication on **err** display. Adjust C550 HF TIM (fig. 1) to align one time marker per division (R).

9. Delayed Sweep and Delay Time/ Differential Time Measurement

a. Performance Check

- (1) Position TI controls as listed in (a) through (d) below:
 - (a) **SWP MAG** pushbutton released (out).
 - (b) **MAIN SEC/DIV** switch to **.1 ms**.
 - (c) **DISPLAY MODE INTENS SWP** pushbutton pressed.
 - (d) **DLY'D SEC/DIV** switch to **10ms**.
- (2) Set oscilloscope calibrator **MARKER** output for 1 mS/D.
- (3) Adjust **MAIN TRIG LEVEL** control for a stable display on oscilloscope.
- (4) Adjust oscilloscope **INTENSITY** control until intensified portion of trace is clearly visible.
- (5) Adjust **POSITION** control to start trace at extreme left graticule line of display.
- (6) 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(l)** through (4) below.
- (7) 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(l)** through (4) below.
- (8) Position TI controls as listed in (a) and (b) below:
 - (a) **DISPLAY MODE DLY'D SWP** pushbutton pressed.
 - (b) **DELAY TIME MULT** dial to **1.00**.
- (9) Set TI and oscilloscope calibrator settings as listed in first row of table 5.
- (10) Adjust **MAIN TRIG LEVEL** and **POSITION** controls for a stable display on oscilloscope and align 2d time marker with 2d vertical graticule line on display.
- (11) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker with 10th vertical graticule line. If oscilloscope calibrator **err** display does not indicate as listed in first row of table 5, perform **b(5)** below.
- (12) Repeat technique of (9) through (11) above, using TI switch settings and oscilloscope calibrator output settings for remaining rows listed in table 5. Oscilloscope calibrator **err** display will indicate within limits specified in table 5.
- (13) Press **SWP MAG** pushbutton.

Table 5. Delayed Sweep Timing (Unmag)

Test instrument		Oscilloscope calibrator	
MAIN SEC/DIV switch settings	DLY'D MAIN SEC/DIV switch settings	MARKER output settings	Err display limits (± %)
.5 μs	1 μs	5 μS/D	3
1 μs	.1 μs	.1 μS/D	4
1 μs	.2 μs	.2 μS/D	4
2 μs	1 μs	1. 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 s1	.2 S/D	3
.5 s	.5 s1	.5 S/D	3

(14) Repeat technique of (9) through (11) above using TI switch settings and oscilloscope calibrator output settings listed in table 6. Oscilloscope calibrator **err** display will indicate within limits specified in table 6.

Table 6. Delayed Sweep Timing (Mag)

Test instrument		Oscilloscope calibrator	
MAIN SEC/DIV switch settings	DLY'D MAIN SEC/DIV switch settings	MARKER output settings	Err display limits (± %)
.1 μs	10 ns	10 nS/D	5
.1 μs	20 ns	20 nS/D	5
.1 μs	50 ns	50 nS/D	5
.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

Table 6. Delayed Sweep Timing (Mag) - Continued

Test instrument		Oscilloscope calibrator	
MAIN SEC/DIV switch settings	DLY'D MAIN SEC/DIV switch settings	MARKER output settings	Err display limits (± %)
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

b. Adjustments

(1) 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).

(2) 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).

(3) 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.

(4) Press **DISPLAY MODE INTENS SWP** pushbutton and repeat (1) through (3) above, as necessary, for best compromise.

(5) On oscilloscope calibrator rotate knob located below **EDIT FIELD** pushbutton for 0.0% indication on **err** display. Adjust C615 HF TIM (fig. 2) to align one time marker per division (R).

10. Final Procedure

a. Deenergize and disconnect all equipment.

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

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

11. Preliminary Instructions

a. The instructions outlined in paragraphs **11** and **12** 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.

12. 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 (3) below:
 - (1) **DISPLAY ON** pushbutton pressed.
 - (2) **MODE CH 1** pushbutton pressed.
 - (3) **TRIGGER CH 1** pushbutton pressed.
- 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).

13. 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 to 5 V and frequency to 1 kHz.

(3) Adjust TI **POSITION** control to position the 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) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 10 divisions of horizontal deflection on the oscilloscope. If oscilloscope calibrator **err** display does not indicate within $\pm 3\%$, perform **b** below.

b. Adjustments. On oscilloscope calibrator, rotate knob located below **EDIT FIELD** pushbutton to adjust for **0.0%** indication on **err** display. Adjust R315 EXT HORIZ GAIN (fig. 3) for a 10 division horizontal deflection on oscilloscope (R).

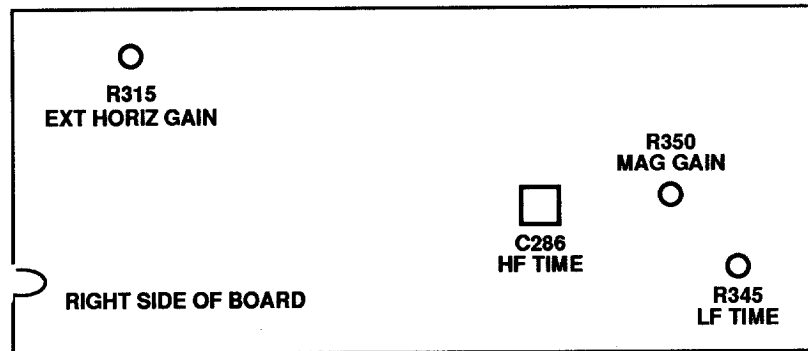


Figure 3. Type 51340 - adjustment locations.

14. Horizontal Time Accuracy

a. Performance Check

(1) Set dual trace amplifier **VOLTS/DIV** switch to **.5 V**.

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

(3) Set TI **SECONDS/DIV** switch and oscilloscope calibrator settings as listed in 1st row of table 7 and press **TRIGGERING SOURCE LEFT** pushbutton.

(4) Adjust TI **LEVEL** control for stable display.

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

(6) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker with 10th vertical graticule line on oscilloscope. Oscilloscope calibrator **err** display will indicate within limits listed in first row of table 7; if not, perform related TI adjustment list in table 7.

(7) Repeat technique of (4) through (6) above for remaining rows listed in table 7. Oscilloscope calibrator **err** display will indicate within limits listed in table 7, if not perform related TI adjustments if required as listed in table 7.

Table 7. Sweep Timing (Unmag)

Test instrument SECONDS/DIV switch settings	Oscilloscope calibrator MARKER output settings	Oscilloscope calibrator err display limits (± %)	Test instruments adjustments
1 ms	1 m/D	3	b(1)
1 ms ¹	1 m/D	4	b(2)
.5 μs	5 μS/D	3	b(3)
1 μs ²	.1 μS/D	4	
.2 μs ²	.2 μS/D	4	
.5 μs ²	.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 s1	2 S/D	3	
5 s1	5 S/D	3	

¹ Press TI **SWP MAG** pushbutton in and release TI **SWP MAG** pushbutton after test
²Adjust C286 HF TIM (fig. 3) for best compromise if out-of-tolerance conditions exist between .5, .1, and .2 μs positions.

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(8) Press TI **SWP MAG** pushbutton and repeat technique of (4) through (6) above using TI **SECONDS/DIV** switch settings and oscilloscope calibrator output settings listed in table 8. Oscilloscope calibrator **err** display will indicate within limits as listed in table 8.

Table 8. Mag Sweep Timing

Test instrument SECONDS/DIV switch settings	Oscilloscope calibrator MARKER output settings	Oscilloscope calibrator err display limits (± %)
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 s1	.2 S/D	4
.5 s1	.5 S/D	4

b. Adjustments

(1) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 0.0% indication on **err** display. Adjust R345 LF TIME (fig. 3) to align one time marker per division (R).

(2) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 0.0% indication on **err** display. Adjust R350 MAG GAIN (fig. 3) to align one time marker per division (R).

(3) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 0.0% indication on **err** display. Adjust C286 HF TIME (fig. 3) to align one time marker per division (R).

15. Final Procedure

- a. Deenergize and disconnect all equipment.
- b. Annotate and affix DA label/form in accordance with TB 750-25.

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

16. Preliminary Instructions

- a. The instructions outlined in paragraphs **16** and **17** 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.

17. 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 set power switch **ON** and allow at least 20 minutes for warm-up.
- d. Position TI controls as listed in (1) through (7) below:
 - (1) **DISPLAY ON** pushbutton pressed.
 - (2) **MODE CH 1** pushbutton pressed.

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- (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 VOLTS/DIV** switch to **2 m**.
- (6) **CH 1** and **CH 2 POSITION** controls to midrange.
- (7) 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 **1m**.
 - (3) **MAIN SEC/DIV 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.

18. Gain and Deflection

a. Performance Check

- (1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **CH 1**.
- (2) Set oscilloscope calibrator **VOLTAGE** output as listed in first row of table 9 and frequency to 1 kHz.

Table 9. Deflection (CH 1)

Test instrument VOLTS/DIV switch settings	Oscilloscope calibrator VOLTAGE output settings	Oscilloscope vertical deflection (div)	Oscilloscope calibrator err display limits (± %)	Test instrument adjustments
2 mV	10 mV	5	5	b(1), b(2)
10 mV	50 mV	5	3	b(3), b(4)
1 mV	1 mV	5	5	
5 mV	20 mV	4	3	
20 mV	.1 mV	5	3	
50 mV	.2 mV	4	3	
.1 mV	.5 mV	5	3	
.2 mV	1 mV	5	3	
.5 mV	2 mV	4	3	
1 mV	5 mV	5	3	
2 mV	10 mV	5	3	
5 mV	20 mV	4	3	
10 mV	50 mV	5	3	

- (3) Adjust delaying time base controls for a stable display.
- (4) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for vertical deflection divisions as listed in table 9 on oscilloscope crt. Oscilloscope calibrator **err** display will indicate within limits listed in table 9, if not perform related adjustments if necessary as listed in table 9.
- (5) Repeat technique of (2) through (4) above for remaining rows of table 9. Oscilloscope calibrator **err** display limits will indicate within limits listed in table 9; if not, perform related adjustments if listed in table 9. (No adjustment can be made on TIs with main board (SN B056205 and below.))
- (6) Move connection at oscilloscope calibrator **SOURCH/MEASURE CHAN 1** to **CHAN 2**.

NOTE

Press oscilloscope calibrator **CHANNEL** pushbutton. Press blue soft pushbutton located below **CHAN 2** on oscilloscope calibrator when **SELECT CHANNEL** is displayed.

- (7) Press **MODE CH 2** and **TRIGGER CH 2** pushbuttons.
- (8) Set oscilloscope calibrator **VOLTAGE** output as listed in first row of table 10 and frequency to 1 kHz.

Table 10. Deflection (CH 2)

Test instrument VOLTS/DIV switch settings	Oscilloscope calibrator VOLTAGE output settings	Oscilloscope vertical deflection (div)	Oscilloscope calibrator Err display limits (± %)	Test instrument adjustments
2 mV	10 mV	5	5	b(5), b(6)
10 mV	50 mV	5	3	b(7), b(8)
1 mV	5 mV	5	5	
5 mV	20 mV	4	3	
20 mV	.1 mV	5	3	
50 mV	.2 mV	4	3	
.1 mV	.5 mV	5	3	
.2 mV	1 mV	5	3	
.5 mV	2 mV	4	3	
1 mV	5 mV	5	3	
2 mV	10 mV	5	3	
5 mV	20 mV	4	3	
10 mV	50 mV	5	3	

- (9) Adjust delaying time base controls for a stable display.
- (10) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 5 divisions of vertical deflection on oscilloscope. Oscilloscope calibrator **err** display will indicate within limits listed in table 10; if not, perform related adjustments as listed in table 10. (No adjustment can be made on TIs with main board (SN B056205 and below.))

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(11) Repeat technique of 8) through (10) above for remaining rows of table 10. Oscilloscope calibrator **err** display limits will indicate within limits listed in table 10, if not, perform related adjustments if listed in table 10.

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

- (a) **CH 1** and **CH 2 VOLTS/DIV** switches to **20m**.
- (b) **MODE CH 1** pushbutton pressed.
- (c) **TRIGGER CH 1** pushbutton pressed.

(13) Set delaying time base **MAIN SEC/DIV** switch to **.2m**.

(14) Move connection at oscilloscope calibrator **SOURCH/MEASURE CHAN 1** to **CHAN 2** using a 24 pF normalizer.

NOTE

Press oscilloscope calibrator **CHANNEL** pushbutton. Press blue soft pushbutton located below **CHAN 1** on oscilloscope calibrator when **SELECT CHANNEL** is displayed.

(15) Set oscilloscope calibrator **EDGE** output for 1 kHz and 5 divisions of vertical deflection on oscilloscope.

(16) If square-wave level, roll off, or overshoot exceeds $\pm 4\%$, perform the appropriate adjustments listed in table 11.

Table 11. Attenuator Compensation

Test instrument				
VOLTS/DIV switch settings	Adjustments (fig. 4)			
	CH 1		CH 2	
	Square corner	Flattop	Square corner	Flattop
20 m	---	C134	---	C334
50 m	C126	C124	C326	C324
.5 ¹ m	C116	C114	C316	C314

¹Remove 50Ω feedthrough termination.

(17) Repeat technique of (15) and (16) above for the remaining **VOLTS/DIV** switch settings listed in table 11.

(18) Press **MODE CH 2** and **TRIGGER CH 2** pushbuttons. Repeat technique of (14) through (17) above for **CH 2**.

b. Adjustments

(1) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 0.0% **err** display indication.

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

(3) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 0.0% **err** display indication.

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

- (5) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 0.0% **err** display indication.
- (6) Adjust R405 (fig. 4) for 5 divisions of vertical deflection on oscilloscope (R).
- (7) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 0.0% **err** display indication.
- (8) Adjust R388 (fig. 4) for 5 divisions of vertical deflection on oscilloscope (R).

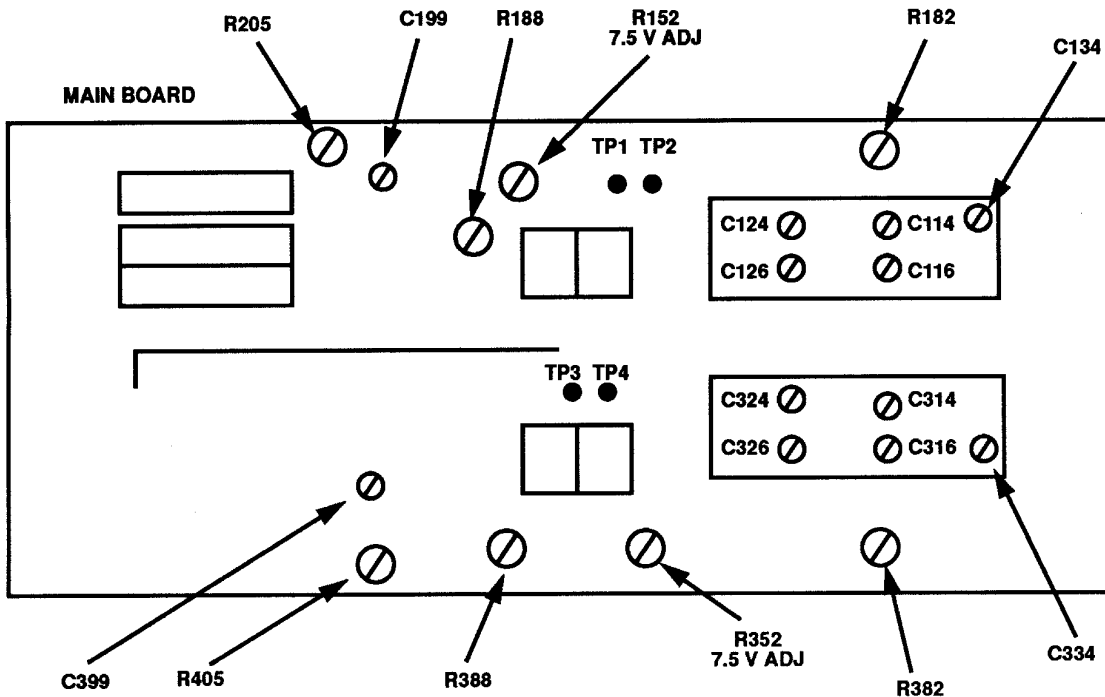


Figure 4. Dual trace amplifier, Tektronix, Type 5A48 - left-side view.

19. 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 **10m**.
 - (b) **MODE CH 1** pushbutton pressed.
 - (c) **TRIGGER CH 1** pushbutton pressed.
- (2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **CH 1** using an X10 attenuator and 50Ω feedthrough termination.
- (3) Press delaying time base **SWP MAG** pushbutton and set **MAIN SEC/DIV** switch to **10 ns**.
- (4) Set oscilloscope calibrator **EDGE** output to 500 mV at 1 MHz.

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(5) Adjust **POSITION** and **MAIN TRIG LEVEL** controls as necessary to view leading edge of waveform near the center of display.

(6) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 5 divisions of vertical deflection on oscilloscope.

(7) If aberrations are not within $\pm 4\%$, 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 to 50 mV and **CH 1 VOLTS/ DIV** switch to **1 m**.

(10) Adjust **POSITION** and **MAIN TRIG LEVEL** controls as necessary to view leading edge of waveform near the center of display.

(11) On oscilloscope calibrator rotate knob located below **EDIT FIELD** pushbutton for 5 divisions of vertical deflection on oscilloscope.

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

(13) Disconnect oscilloscope calibrator output from **CH 1** and connect to **CH 2**.

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

NOTE

Press oscilloscope calibrator **CHANNEL** pushbutton. Press blue soft pushbutton located below **CHAN 2** on oscilloscope calibrator when **SELECT CHANNEL** is displayed.

(15) Repeat technique of (4) through (12) above for **CH 2**.

b. Adjustments. No further adjustments can be made.

20. Final Procedure

a. Deenergize and disconnect all equipment.

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

THESE ARE THE INSTRUCTIONS FOR SENDING AN ELECTRONIC 2028

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@avma27.army.mil

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:** TB 9-6625-xxxx-35
9. **Pub Title:** Calibration Procedure for ...
10. **Publication Date:**
11. **Change Number:**
12. **Submitted 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:**

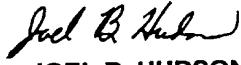
This is the text for the problem below line 27.

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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

0236405

Distribution:

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

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