*TB 9-6625-2024-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR OSCILLOSCOPE OS-245(P)/U, AND TEKTRONIX TYPES 7603 AND 7603N OPT 11S, VERTICAL AMPLIFIER AM-6565/U, AND TEKTRONIX TYPES 7A15A AND 7A15AN OPT 11, AND DUAL TIME BASE TD-1085/U AND TD-1159/U AND TEKTRONIX TYPES 7B53A, 7B53AN OPT 5 AND OPT 11S

Headquarters, Department of the Army, Washington, DC
12 December 2002

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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 immediately preceding the hard copy 2028. For the World Wide Web, use: https://amcom2028.redstone.army.mil.

*This bulletin supersedes TB 9-6625-2024-35, dated 27 June 1983, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Oscilloscope OS-245(P)/U, and Tektronix Types 7603 and 7603N OPT 11S, Vertical Amplifier AM-6565/U, and Tektronix Types 7A15A and 7A15AN OPT 11, and Dual Time Base TD-1085/U and TD1159/U and Tektronix Types 7B53A, 7B53AN OPT 5 and OPT 11S. TM 11-6625-2658-14 and the manufacturer's manuals were used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None that effects calibration.

b. Time and Technique. The time required for calibration of each TI 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
OSCILLOSCOPE OS-245(P)/U AND TEKTRONIX TYPES 7603 AND 7603N OPT 11S	
Power requirements	115 V ac at 60 Hz
Deflection factor (each vertical compartment)	Compatible with all 7000 series plug-in units. Difference between compartments; less than 1%.
Calibrator output Tektronix Types 7603 and 7603N OPT 11S	Range: 1 V dc or p-p, OS-245 (P)/U 4 V, .4 V, and .04 V dc or p-p for Accuracy: ±1%
Risetime (mainframe)	3.5 ns or less, aberrations 0.5 minor div or less
VERTICAL AMPLIFIER AM-6565/U AND TEKTRONIX TYPES 7A15A AND 7A15AN OPT 11	
Vertical gain and attenuation	Range: X1, 5 mV/div to 10 V/div; X10, 500 µV/div to 1 V/div Accuracy: X1, ±2% of indicated deflection factor with GAIN adjusted at 10 mV/div; X10, ±10%.
Risetime	X1: In OS-245 (P)/U or Tektronix Types 7603 or 7603N OPT 11S oscilloscope mainframe, 5.4 ns or less, aberrations 2% or less.
DUAL TIME BASE TD-1085/U	
Main sweep time (over center eight divisions)	Range: 0.05 µs/div to 5.0 s/div Accuracy: Unmag: ±3% Mag: ±5%
Delayed sweep time (over center eight divisions)	Range: 0.05 µs/div to 0.5 s/div Accuracy: Unmag ±3% Mag ±5%
Variable time delay differential delay time measurement	Range: 0 to 10 times the TIME/DIV OR DLY TIME control settings from 5 s/div to 1 µs/div Accuracy: 5 s/div to 1 s/div, within 1.4% of measurement plus 0.3% of FS[1] 0.5 s/div to 1 µs/div, within 0.7% of measurement pulse 0.3% of FS[1]
DUAL TIME BASE TEKTRONIX TYPES 7B53AN OPT 5 AND OPT 11S, 7B53A, AND TD-1159/U	
Main sweep time (over center eight divisions)	Range: 0.05 µs/div to 5.0 s/div Accuracy: ±2% unmag, 2.5% mag from 50 ms/div to 0.5 µs/div ±3% unmag, 3.5% mag, from 5 s/div to 0.1 s/div and 0.2 µs/div to 0.05µs/div

See footnote at end of table.

Table 1. Calibration Description - Continued

Test Instrument Parameters	Performance Specifications
DUAL TIME BASE TEKTRONIX TYPES 7B53AN OPT 5 AND OPT 11S, 7B53A, AND TD-1159/U (Continued)	
Delayed sweep time (over center eight divisions)	Range: 0.05 µs/div to 0.5 s/div Accuracy: ±3% unmag, 3.5% mag from 50 ms/div to 0.5 µs/div ±4% unmag, 4.5% mag from 0.5 s/div to 0.1 s/div and 0.2 µs/div to 0.05 µs/div
Variable time delay Differential delay time measurement	Range: 0 to 10 times the TIME/DIV OR DLY TIME control settings from 5 s/div to 1µs/div Accuracy: 5 s/div to 1 s/div, within 1.4% of measurement plus 0.3% of FS[1] 0.5 s/div to 1 µs/div, within 0.7% of measurement plus 0.3% of FS[1]

[1]Full scale is 10 times the **TIME/DIV OR DLY TIME** setting.

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, AN/GSM-287, or AN/GSM-705. 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 the 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 067-0589-00, and Standardizer, variable from 5 to 80 pF (7916146), and Calibration Adapter, Tektronix Type 067-0587-01.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
DIGITAL MULTIMETER	Range: -3049 to +140 V dc Accuracy: ±0.025%	Hewlett-Packard, Model 3490AOPT060 w/high voltage probe (3490AOPT060)
DUAL TIME BASE[1]	Must be compatible with required oscilloscope and vertical amplifier	Tektronix, Type 7B53A or 7B53AN OPT 5 or OPT 11S or TD 1085/U or TD-1159/U
OSCILLOSCOPE[1]	Must be compatible with required dual time base and vertical amplifier	Tektronix, Type 7603 or 7603N OPT 11S or OS-245 (P)/U

See footnote at end of table.

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
OSCILLOSCOPE CALIBRATOR	Time markers: Range: 10 ns to 5 s Accuracy: ±0.75%, 10 to 20ns ±0.5%, 50 ns to 0.1 s 0.75%, 0.2 to 0.5 s Voltage amplitude: Range: 20 mV to 50 V at 1 kHz Accuracy: ±0.5% Pulses: Risetime: 1 ns or less	John Fluke, Model 5820A (5820A-5C-GHZ) MIS 38938
VERTICAL AMPLIFIER[1]	Must be compatible with required dual time base and oscilloscope	Tektronix, Type 7A15A, 7A15AN OPT 11 or AM-6565/U

[1]Normally supplied as a system.

SECTION III
PRELIMINARY OPERATIONS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** 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 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 and TM 11-6625-2658-14 for these TIs.

d. When indications specified in paragraphs **8** through **12** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **8** through **12**. Do not perform power supply check if all other parameters are within tolerance.

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

SECTION IV
CALIBRATION PROCESS FOR OSCILLOSCOPE OS-245(P)/U AND TEKTRONIX TYPE 7603 AND 7603N OPT 11S

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 side panels when required for access to adjustments.

b. Install dual time base in TI horizontal (right) compartment and vertical amplifier in TI left vertical compartment.

c. Position controls as listed in (1) through (4) below:

(1) **INTENSITY** control fully ccw.

(2) **GRAT ILLUM** control fully cw.

(3) **VERT MODE** switch to **LEFT** (pressed).

(4) **TRIG SOURCE** switch to **VERT MOD**E (pressed).

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

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

(2) **POLARITY** switch to **+UP**.

(3) **MAG** switch to **X1**.

(4) **VOLTS/DIV** switch to 50 mV (.5 V for Tektronix, Type 7603).

(5) **VARIABLE** control fully cw to detent.

(6) **AC/GND/DC** switch to **AC**.

e. Position dual time base controls as listed in (1) through (11) below:

(1) **MAIN TRIGGERING** pushbutton is as listed in (a) through (c) below:

(a) **MODE** to **AUTO (IN)**.
(b) **COUPLING** to **AC (IN)**.
(c) **SOURCE** to **INT (IN)**.

(2) **POSITION** and **FINE** controls to midrange.

(3) **LEVEL** to midrange.

(4) **SLOPE** to **+**.

(5) **MAG** pushbutton to **X1 (IN)**.

(6) **TIME/DIV** switch to .**2 ms**.

(7) **DLY TIME** switch to .**2 ms (PUSH FOR DYL'D)**.

(8) **VARIABLE** control fully cw to detent.

(9) Delayed triggering pushbuttons as listed in (a) through (c) below:

(a) **SLOPE** to **+** (positive) (**IN**).
(b) **COUPLING** to **AC** (**IN**).
(c) **SOURCE** to **INT** (**IN**).

(10) **DLY'D TRIG LEVEL** control adjusted to **RUNS AFTER DLY TIME**.

(11) **DELAY TIME MULT** control to **1.0**.

f. Pull oscilloscope **POWER** switch to on and allow at least 15 minutes for warm-up.

CAUTION

A sharply focused, high intensity spot will damage crt screen.
Use lowest beam intensity possible for suitable viewing.

g. Adjust oscilloscope **INTENSITY** and **FOCUS** controls for optimum trace on oscilloscope.

CAUTION

Remove oscilloscope power when required.

8. Calibrator

a. Performance Check

(1) Connect TI calibrator to **CH 1 INPUT**. (For Tektronix, Type 7603, connect TI calibrator **4V** and **GND** to **CH 1 INPUT**).

(2) Position vertical amplifier **VOLTS/DIV** controls for 5 divisions of vertical deflections on TI.

(3) Disconnect TI calibrator from **CH 1 INPUT**, and connect to oscilloscope calibrator **SOURCE/MEASURE CHAN 1**.

(4) Set oscilloscope calibrator **VOLTAGE** output to **1 VOLT** (for Tektronix Type 7603, **4V**).

(5) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 5 divisions of vertical deflection on TI. If oscilloscope calibrator **err** display readout does not indicate within ±1 percent, perform **b** below.

b. Adjustments

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

(2) Disconnect cable from oscilloscope calibrator **SOURCE/MEASURE CHAN 1** and connect to TI calibrator to **CH 1** input (for Tektronix, Type 7603 connect TI calibrator **4 V** and **GND** to **CH 1 INPUT**).

(3) Adjust R1077 (CAL ADJ) (fig. 1) for a 5-division indication on TI (R).

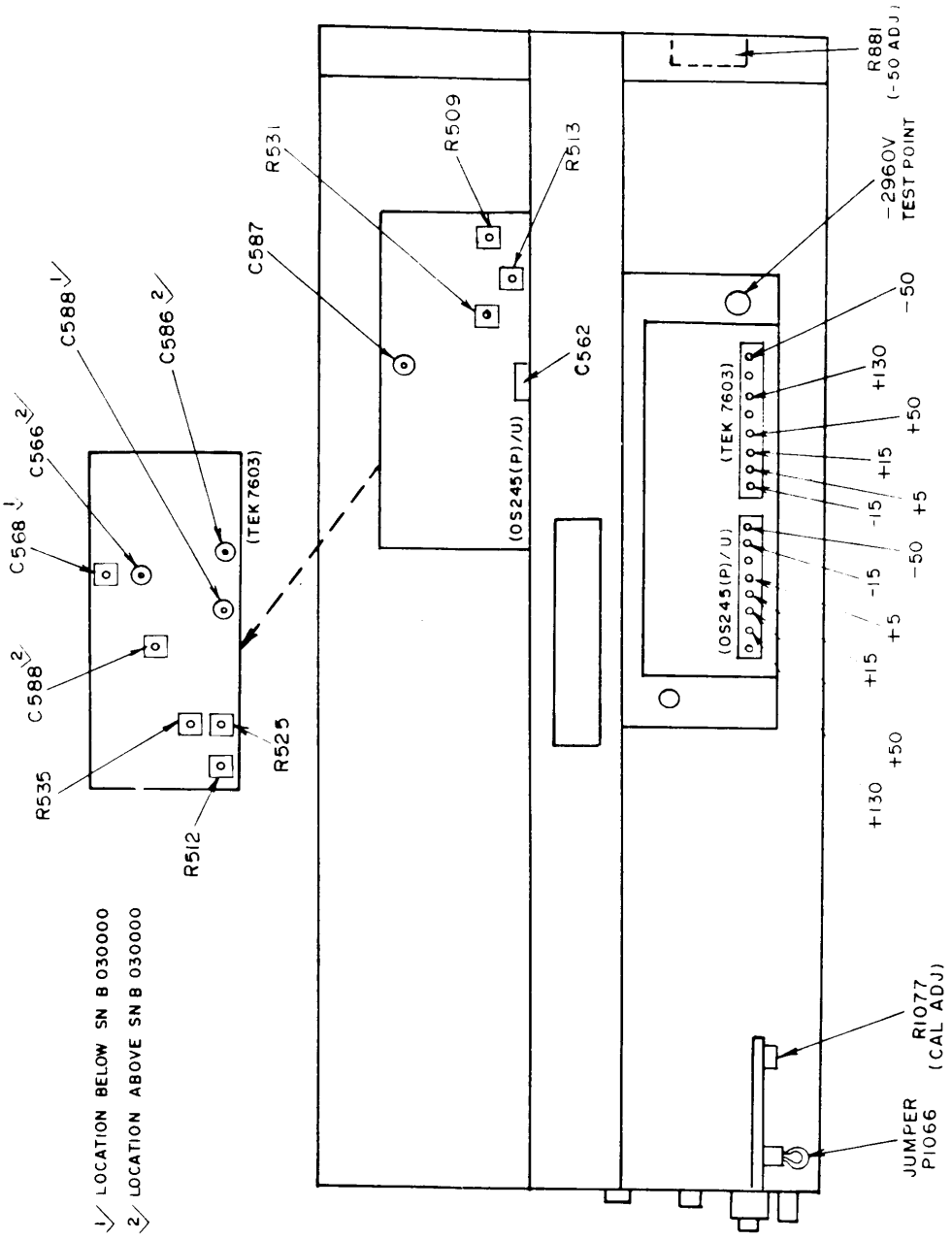

Figure 1. Test instrument – top view.

9. Vertical Amplifier Centering and Gain

a. Performance Check

(1) Install calibration adapter in left vertical compartment.

(2) Set calibration adapter **TEST** switch to **VERT OR HORIZ COM MODE**. If displayed trace is not within ±3 minor divisions of center horizontal graticule line, perform **b**(1) below.

(3) Set **POSITION** and **AMPLITUDE** controls on calibration adapter to midrange.

(4) Set calibration adapter **TEST** switch to **VERT OR HORIZ GAIN**.

(5) Set **REP RATE** control on calibration adapter to **100 kHz**.

(6) Using calibration adapter **POSITION** control, align bright center trace of display with center horizontal graticule line. If deflection over center 7 traces is not 6 divisions ±0.5 minor division, perform **b**(2) and (3) below.

(7) Remove calibration adapter front left vertical compartment and install in right vertical (middle) compartment.

(8) Press **VERT MODE RIGHT** pushbutton in.

(9) Using calibration adapter **POSITION** control, align bright center trace of display with center horizontal graticule line. If deflection over center 7 traces is not 6 divisions ±0.5 minor division, perform **b**(4) below.

b. Adjustments

(1) Adjust vertical centering R403 (fig. 2) to position trace to center horizontal graticule line (R).

(2) Adjust bias potentiometer R486 (fig. 2) for maximum deflection between traces (R).

(3) Adjust R447 (fig. 2) for 6 divisions of deflection over the center 7 traces (R).

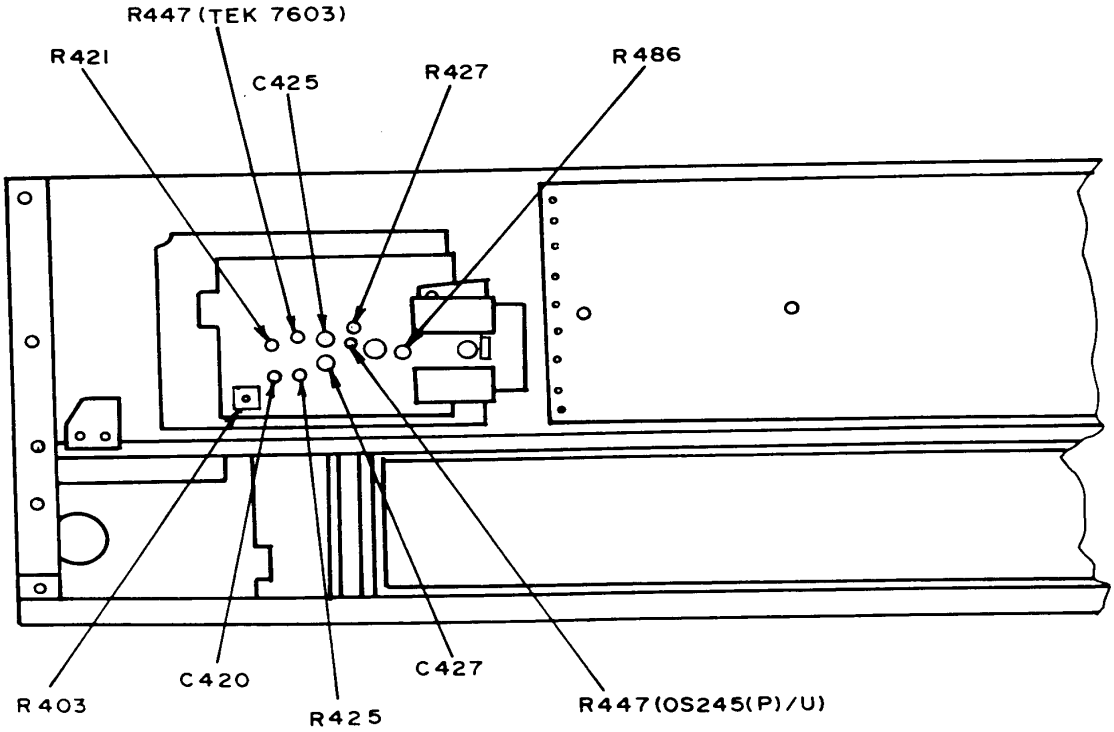

Figure 2. Test instrument - left view.

(4) Readjust R447 as necessary for best compromise within ±0.5 minor division in **a**(6) and (9) above (R).

10. Vertical High Frequency Compensation and Risetime

a. Performance Check

(1) Set calibration adapter **TEST** switch to **VERT OR HORIZ + STEP RESP** and **REP RATE** switch to **1 MHz.**

(2) Adjust calibration adapter **AMPLITUDE** and **POSITION** controls for a 6-division display centered vertically on crt.

(3) Release dual time base **MAG** pushbutton to **X10 (OUT)**.

(4) Adjust dual time base **TIME/DIV** or **DLY TIM**E switches for .05 µs and **LEVEL** control for a stable display triggered on rising portion of pulse. If displayed pulse does not have a square leading corner and a flat top with aberrations within ±0.5 minor division, perform **b** below.

(5) Measure risetime using standard risetime technique. Risetime will be 3.5 ns or less.

(6) Remove calibration adapter from right vertical compartment and install in left vertical compartment.

(7) Press **VERT MODE LEFT** pushbutton.

(8) Adjust calibration adapter **AMPLITUDE** and **POSITION** controls for a 6 division display centered vertically on crt.

(9) Adjust dual time base **TIME/DIV** or **DLY TIM**E switches for .05 µs and **LEVEL** control for a stable display triggered on rising portion of pulse. If displayed pulse does not have a square leading corner and a flat top with aberrations within ±0.5 minor division, perform **b** below.

(10) Measure risetime using standard risetime technique. Risetime will be 3.5 ns or less.

b. Adjustments. Perform appropriate adjustments listed in table 3.

Table 3. High Frequency Compensation

Test instrument	
Adjustments (fig. 2) (R)	Area of pulse most affected
C420 and R421	1st 50 ns
R425 and C425	1st 20 ns
C427 and R427	1st 5 ns

NOTE

Due to slight differences in electrical characteristics of the left and right vertical compartments, it may be necessary to press **VERT MODE RIGHT** pushbutton and repeat **a**(2), (4), and (5), and **b** above for best intolerance compromise.

11. Horizontal Amplifier Gain

a. Performance Check

(1) Install dual time base in left vertical compartment and calibration adapter in horizontal (right) compartment.

(2) Adjust calibration adapter **TEST** switch, **VERT OR HORIZ GAIN,** and **REP RATE** control to **100 kHz**.

(3) Set dual time base **TIME/DIV OR DLY TIME** switch to 0.1 µs and press **MAG** pushbutton to **X1 (IN)**.

(4) Adjust calibration adapter and dual time base **POSITION** controls to align bright trace on center vertical graticule line. If TI does not display 1 trace within ±0.5 minor division of each vertical graticule line, perform **b**(1) below.

(5) Set calibration adapter **TEST** switch to **VERT OR HORIZ COM MODE**. If trace is not aligned on center vertical line within ±1 minor division, perform **b**(2) and (3) below.

b. Adjustments

(1) Adjust R509 (R512 for Tektronix 7603) (fig. 1) for display of 1 trace for each vertical graticule line (R).

(2) Adjust R513 (R525 for Tektronix 7603) (fig. 1) to midrange and adjust R531 (R535 for Tektronix 7603) (fig. 1) until vertical trace is aligned on center horizontal graticule line (R).

(3) Repeat **a**(2), (4), and (5) for best compromise.

12. Timing and Linearity

a. Performance Check

(1) Install calibration adapter in left vertical compartment.

(2) Install dual time base in horizontal (right) compartment.

(3) Set calibration adapter **TEST** switch to **VERT OR HORIZ AUX IN**.

(4) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to calibration adapter **AUX IN** input.

(5) Set oscilloscope calibrator **MARKER** output for **1 ms.**

(6) Set dual time base **TIME/DIV OR DLY TIME** switches to **1 ms.**

(7) Adjust dual time base **POSITION** control until second marker is aligned with second vertical graticule line. Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker with 10th vertical graticule line. If oscilloscope calibrator **err** display readout does not indicate within ±3% when using TD-1085/U or ±2% when using Tektronix 7B53A, 7B35AN, or TD-1159/U, adjust oscilloscope calibrator for 0 percent on **err** display and adjust **SWP CAL** control (front panel) for 1 marker per division.

(8) Set oscilloscope calibrator **MARKER** output to **10 ns**.

(9) Set dual time base **TIME/DIV OR DLY TIME** switches to .**1** m**s**.

(10) Adjust calibration adapter **POSITION** and **AMPLITUDE** controls to center display on TI crt horizontal graticule centerline.

(11) Press and release dual time base **MAG** pushbutton to **X10 (OUT)** position.

(12) Adjust dual time base **POSITION** control to align the nearest marker on second vertical graticule line. Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker with 10th vertical graticule line. If oscilloscope calibrator **err** display readout does not indicate within ±5% when using TD-1085/U or ±3.5% when using Tektronix 7B53A, 7B55-AN, or TD-1159/U, perform **b**(1) and (2) below.

NOTE

Perform (13) through (14) below for Tektronix 7603.

(13) Set dual time base **TIME/DIV OR DLY TIME** switches to **.05** µs.

(14) Adjust dual time base **POSITION** control to align the nearest marker on second vertical graticule line. Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align one marker per two divisions. If oscilloscope calibrator **err** display readout does not indicate within ±3.5%, perform **b**(3) and (4) below.

b. Adjustments

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

(2) Adjust C562 and C587 (C588 for Tektronix 7603 S/N above B030000, C568 and C588 for S/N below B030000, while maintaining approximately equal capacitances) (fig. 1) for one marker per division (R).

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

(4) Adjust C566 and C586 (fig. 1) for S/N above B030000 for one marker per 2 divisions. Readjust C568 and C588 for S/N below B030000 for best in-tolerance compromise while setting **TIME/DIV OR DLY TIME** switches between **.05** and **.1** m**s** (R).

13. Power Supply

NOTE

Remove all plug-ins during power supply checks.

NOTE

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

a. Performance Check

(1) Connect digital multimeter between TP -50V test point (fig. 1) and chassis ground. If multimeter does not indicate between -49.9 and -50.1 V dc, perform **b** below.

(2) Repeat technique of (1) above for test points and indications listed in table 4. Digital multimeter will indicate within limits specified.

Table 4. Power Supply Check

Test instrument test points (fig. 1) (V)	Digital multimeter indications (V Dc)	
	Min	Max
-15	-14.7	-15.3
+5	+4.85	+5.15
+15	+14.7	+15.3
+50	+49.4	+50.6
+130	+124.8	+135.2
-2960[1]	-2871	-3049

[1]Use high-voltage probe supplied with dc voltmeter.

b. Adjustments. Adjust R881 – 50 ADJ (fig. 1) for digital multimeter indication of 50 V dc (R).

14. 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 VERTICAL AMPLIFIER AM-6565/U AND TEKTRONIX TYPES 7A15A AND 7A15AN OPT 11

15. Equipment Setup

a. Remove left side panel from TI and oscilloscope.

b. Install TI into oscilloscope left vertical compartment and dual time base into horizontal (right) compartment.

c. Position TI controls as listed in (1) through (5) below:

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

(2) **POLARITY** switch to **+UP.**

(3) **MAG** switch to **X1.**

(4) **VOLTS/DIV** switch to **10 mV** and **VARIABLE** control fully cw (detent).

(5) **AC/GND/DC** switch to **DC**.

d. Press oscilloscope **VERT MODE LEFT** and **TRIG SOURCE LEFT** and **TRIG SOURCE VERT MODE** pushbuttons.

e. Set dual time base **TIME/DIV OR DLY TIME** switches to **1 ms** and **CAL** control fully cw to detent.

f. Energize equipment and allow at least 15 minutes for warm-up.

g. Adjust **POSITION** control to center trace on oscilloscope center horizontal graticule line.

h. Rotate **VARIABLE** control throughout its range. If oscilloscope display shifts more than 0.5 major division, adjust **R221 DC BAL** (fig. 3). for minimum shift as **VARIABLE** control is rotated throughout its range.

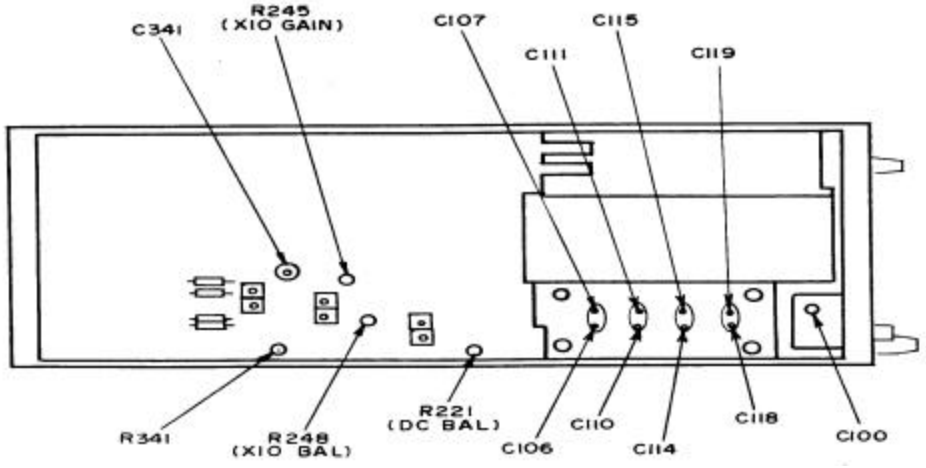

Figure 3. Test instrument - left view.

i. Set **MAG** switch to **X10**. If oscilloscope display shifts more than ±1.0 major division from center horizontal graticule line, adjust R248 X10 BAL (fig. 3) for minimum shift while **MAG** pushbutton is moved between **X1** and **X10**.

16. Amplifier Gain and Attenuation

a. Performance Check

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

(2) Set **MAG** switch to **X1**.

(3) Set oscilloscope calibrator **VOLTAGE** output to **50 mV** and output frequency to **1 kHz.**

(4) Adjust **GAIN** control (front panel) for 5 divisions of vertical deflection on oscilloscope crt.

(5) Set oscilloscope calibrator **VOLTAGE** output for **5 mV**.

(6) Set **MAG** switch to **X10**.

(7) Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 5 divisions of vertical deflection on oscilloscope crt. If oscilloscope calibrator **err** display readout does not indicate within ±10%, perform **b** below.

(8) Set **MAG** switch to **X1**.

(9) Repeat technique of (7) above at settings and oscilloscope vertical deflection listed in table 5. Oscilloscope calibrator **err** display readout will indicate within ±2% at each setting.

Table 5. Attenuation Check

Test instrument **VOLTS/DIV** switch settings	Oscilloscope calibrator voltage output	Oscilloscope vertical deflection (divisions)	Oscilloscope calibrator **err** display limits ± %
5 mV	20 mV	4	2
20 mV	.1 V	5	2
50 mV	.2 V	4	2
.1 V	.5 V	5	2
.2 V	1 V	5	2
.5 V	2 V	4	2
1 V	5 V	5	2
2 V	10 V	5	2
5 V	20 V	4	2
10 V	20 V[1]	4	2

[1]Set MULTIPLIER to X2.

b. Adjustments

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

(2) Adjust R245 X10 GAIN (fig. 3) for oscilloscope indication of 5 divisions of vertical deflection (R).

17. Attenuator Compensation

a. Performance Check

(1) Set **VOLTS-TS/DIV** switch to **5 mV**.

(2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **INPUT**, using standardizer.

(3) Set oscilloscope calibrator **MARKER** output to **1 ms** and rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for 6 divisions of display on oscilloscope .

(4) Set dual time base **TIME/DIV OR DLY TIME** switches to **.2 ms**.

(5) Adjust standardizer for optimum square wave display on oscilloscope. If standardizer has insufficient range, then it will be necessary to remove TI from mainframe to adjust C100 (fig. 3) to midrange, reinstall TI, then readjust standardizer for optimum square wave (R).

(6) Set **VOLTS/DIV** switch to positions listed in table 6 and repeat technique of (3) above. If oscilloscope does not display an optimum square wave at each switch position, perform the appropriate adjustment listed in table 6.

Table 6. Attenuator Compensation Adjustments

Test instrument		
VOLTS/DIV switch settings	Adjustments (fig. 3) (R)	
	Square corner	Flattop
10 mV	C106	C107
20 mV	C110	C111
50 mV	C114	C115
0.5 V[1]	C118	C119

[1]Adjust for square wave on + (positive) portion of square wave only.

b. Adjustments. No further adjustments can be made.

18. Risetime

a. Performance Check

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

(2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **INPUT**.

(3) Set oscilloscope calibrator **EDGE** output to **1** m**s** and rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for a convenient display on oscilloscope.

(4) Adjust dual time base controls as listed in (a) through (c) below:

(a) **TIME/DIV OR DLY TIME** switches to **.05** m**s**.
(b) **MAG X10** pushbutton to **OUT**.
(c) **POSITION** control for convenient display of pulse.

(5) Measure risetime using standard risetime technique. If risetime is not 5.4 ns or less, perform **b** below.

b. Adjustments. Adjust C341 and R341 (fig. 3) for optimum square wave (R).

19. Final Procedure

a. Deenergize and disconnect all equipment.

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

SECTION VI
CALIBRATION PROCESS FOR DUAL TIME BASE TD- 1085/U, TD-1159/U AND TEKTRONIX TYPES 7B53A AND 7B53AN OPT 5 AND OPT 115

20. Equipment Setup

a. Remove side panels from TI and install TI into oscilloscope horizontal (right) compartment.

b. Press oscilloscope **VERT MODE LEFT** and **TRIG SOURCE LEFT** pushbuttons.

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

(1) Set **TIME/DIV OR DLY TIME** switches to **1 ms (PUSH FOR DLY'D)**.

(2) Turn **VARIABLE** control fully cw (to detent).

(3) **MAIN TRIGGERING** as listed in (a) through (d) below:

(a) **LEVEL** control to midrange.
(b) **MODE** pushbutton to **NORM**.
(c) **COUPLING** pushbutton to **DC**.
(d) **SOURCE** pushbutton to **INT**.

(4) **DLY'D TRIG** pushbuttons as listed in (a) through (c) below:

(a) **SLOPE** to **+** (positive) **(IN)**.
(b) **COUPLING** to **AC (IN)**.
(c) **SOURCE** to **INT (IN)**.

(5) **POSITION** and **FINE** controls to midrange.

(6) **MAG** pushbutton to **X1 (IN)**.

(7) **DELAY TIME MULT** dial to **1.0**.

(8) **DLY'D TRIG** to **RUNS AFTER DLY TIME** (fully cw).

d. Insert vertical amplifier in left vertical compartment.

e. Energize equipment and allow at least 15 minutes for warm-up.

21. Sweep Length, Magnifier Gain, and Timing

a. Performance Check

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

(2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to vertical amplifier input.

(3) Set oscilloscope calibrator **MARKER** output for **1 ms**. If display on oscilloscope does not indicate 1 marker per division and a trace length of at least 10.4 divisions, perform **b**(1) and (2) below.

(4) Pull out **DLY TIME** switch to .2 ms and **PUSH FOR DLY'D**. If delayed sweep length is not at least 10.4 divisions, perform **b**(3) below.

(5) Set **DLY TIME** switch to **1 ms** and **PUSH FOR DYL'D**.

(6) Press and release **MAG** pushbutton to **X10 (OUT)** position.

(7) Set oscilloscope calibrator **MARKER** output for **.1 ms**.

NOTE

Tolerances in parenthesis are for TD1159/U and 7B53A and 7B53AN OPT 5 and OPT 11S.

(8) Adjust **POSITION** control to align second marker on second vertical graticule line. Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker on 10th vertical graticule line. If oscilloscope calibrator **err** display readout does not indicate within ±5% (2.5%), rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for indication of 0.0% on **err** display and perform **b**(4) below.

(9) Press **MAG** pushbutton to **X1 (IN)** position and set **TIME/DIV OR DLY TIME** switches to **.1 ms.**

(10) Set oscilloscope calibrator **MARKER** output for **.1 ms**.

(11) Adjust **POSITION** control to align second time marker on second vertical graticule line. Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker on 10th vertical graticule line. If oscilloscope calibrator **err** display readout does not indicate within ±3% (3%), rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton for indication of 0.0% on **err** display and perform **b**(5) below.

(12) Set **TIME/DIV** switch to **.2 ms** and **DLY TIME** switch to **.1 ms (PUSH FOR DYL'D)**.

(13) Adjust **POSITION** control to align second marker on second vertical graticule line. Rotate oscilloscope calibrator knob located below **EDIT FIELD** pushbutton to align 10th marker on 10th vertical graticule line. If oscilloscope calibrator **err** display readout does not indicate within ±3% (±4%), rotate oscilloscope calibrator knob located

below **EDIT FIELD** pushbutton for indication of 0.0% on **err** display and perform **b**(6) below.

(14) Repeat technique of (13) above for **TIME/DIV** switch settings listed in table 7. Oscilloscope calibrator **DEVIATION** indications will be ±3% for TD-1085/U and as indicated in table 7 for all other models.

Table 7. Dual Time Base Switch Timing

Test instrument TIME/DIV TIME switch settings	Oscilloscope calibrator	
	Marker outputs	**err** display limits (±%)
.05 µs	50 nS	3
.2 µs	.2 µs	3
.5 µs	.5 µs	2
1 µs	1 µs	2
2 µs	2 µs	2
5 µs	5 µs	2
10 µs	10 µs	2
20 µs	20 µs	2
50 µs	50 µs	2
.1 ms	.1 mS	2
.2 ms	.2 mS	2
2 ms	2 mS	2
5 ms	5 mS	2
10 ms	10 mS	2
20 ms	20 mS	2
50 ms	50 mS	2
.1 s	.1 S	3
.2 s	.2 S	3
.5 s	.5 S	3

b. Adjustments

(1) Adjust **SWP CAL** (front panel) for 1 marker per division.

(2) Adjust R564 MAIN SWEEP LENGTH (fig. 4) for sweep length of 10.4 divisions (R).

(3) Adjust R652 DLY'D SWEEP LENGTH (fig. 4) until both sweep lengths are 10.4 divisions while alternately pulling out and pressing **DLY TIME** switch (R).

(4) Adjust R762 MAG GAIN (fig. 4) until 1 marker is aligned on each vertical graticule line (R).

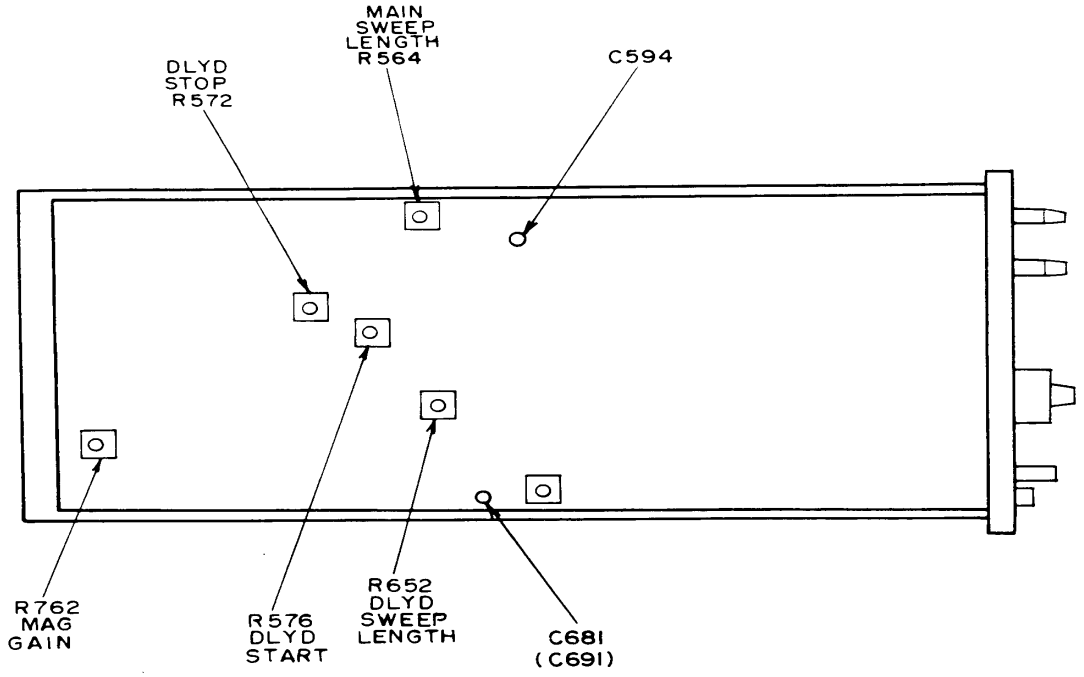

Figure 4. Test instrument - left view.

(5) Adjust C594 (fig. 4) to align 1 marker on each vertical graticule line over center 8 divisions (R).

(6) Adjust C681 (C691 for Tektronix 7B53A, 7B53AN, and TD-1159/U) (fig. 4) to align 1 marker on each vertical graticule line over center 8 divisions (R).

22. Delay Time Multiplier Start/Stop, Linearity, and Time Accuracy

a. Performance Check

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

(a) **TIME/DIV** switch to **1 mS**.

(b) **DLY TIME** switch to **10** m**S** and **PUSH FOR DLY'D**.

(c) **DELAY TIME MULT** dial to **1.0.**

(2) Set oscilloscope calibrator **MARKER** output for **1 mS**.

(3) Adjust horizontal **POSITION** control to align second marker with center vertical graticule line.

(4) Adjust **DELAY TIME MULT** dial to 2.0. If third marker is not within ±3.7 divisions of center graticule line, perform **b** below.

(5) Adjust **DELAY TIME MULT** dial to 6.0. Set **DLY TIME** switch to 20 μs; if seventh marker is not within ±3.3 divisions of center graticule line and **b** was not performed in (4) above, perform **b** below.

(6) Adjust **DELAY TIME MULT** dial to **9.0**. If 10th marker is not within ±4.3 divisions of center graticule line and **b** was not performed in (4) or (5) above, perform **b** below.

b. Adjustments

(1) Adjust **DELAY TIME MULT** dial to **1.0.**

(2) Pull **DLY TIME** switch to **PULL FOR INTENS** and adjust horizontal position control to align one time marker per division division. If intensified portion of sweep displayed on oscilloscope does not start on second time marker, adjust R576 DLY'D START (fig. 4) so intensified portion of sweep starts at second time marker.

(3) Adjust **DELAY TIME MULTI** dial to **9.0**. If intensified portion of sweep does not start on 10th time marker, adjust R572 DLY'D STOP (fig. 4) so intensified portion of sweep starts at 10th time marker.

(4) Adjust **DELAY TIME MULTI** dial to **1.0** and push **DLY TIME** switch to **PUSH FOR DLY'D**. If second time marker does not start at the beginning of delayed sweep, adjust R576 (fig. 4) so second time marker starts at the beginning of delayed sweep (R).

(5) Adjust **DELAY TIME MULTI** dial to **9.0.** If time marker does not start at the beginning of delayed sweep, adjust R572 (fig. 4) so 10th time marker starts at the beginning of delayed sweep (R).

NOTE

Interaction exists between adjustments R576 and R572. Repeat **b**(4) and (5) above as necessary for best compromise.

(6) Repeat **a**(1) through (6).

23. 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. **Sumitter 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.

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
0229404

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To be distributed in accordance with initial distribution number (IDN) 342186, requirements for calibration procedures publications.