*TB 9-6625-2072-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR OSCILLOSCOPE, OS-189A(P), AND HEWLETT-PACKARD, MODELS 180A, 180C AND 180D; DUAL CHANNEL VERTICAL AMPLIFIER, PL-1186/USM-281 AND PL-1186A/USM-281A, AND HEWLETT-PACKARD, MODEL 1801A; AND TIME BASE AND DELAY GENERATOR, PL-1187/USM281 AND PL-1187A/USM-281A, AND HEWLETT-PACKARD, MODEL 1821A

Headquarters, Department of the Army, Washington, DC
12 March 2008

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, 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 send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: https://amcom2028.redstone.army.mil. Instructions for sending an electronic 2028 can be found at the back of this manual.

*This bulletin supersedes TB 9-6625-2072-35, dated 2 May 1988, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides Instructions for the calibration of Oscilloscope, OS-189A(P), and Hewlett-Packard, Models 180A, 180C, and 180D; Dual Channel Vertical Amplifier, PL1186/USM-281 and PL-1186A/USM-281A, and Hewlett-Packard, Model 1801A; and Time Base and Delay Generator, PL-1187/USM-281 and PL-1187A/USM-281A, and Hewlett-Packard, Model 1821A. 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 for each instrument, 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-189A(P), and Hewlett-Packard, Models 180A, 180C and 180D	
Power input requirement	115 V ac ±10%
Calibrator output	Range: 250 mV and 10 V p-p Accuracy: ±1%
Magnifier and horizontal gain	Range: 1 V/div X1; 0.2 V/div X5: 0.1 V/div X10 Accuracy: ±5%
Bandwidth	Range: dc to 5 MHz
Bandwidth: Risetime	X1 mode: 7 ns or less X5 mode: 18 ns or less (not on model 1801A) Accuracy: Aberrations less than ±3% of displayed square wave
Attenuator	Range: 0.005 to 20 V/div Accuracy: ±3%
Time Base and Delay Generator; PL-1187/USM-281, PL-1187A/USM-281A, and Hewlett-Packard, Model 1821A	
Main sweep time	Range: 0.1 to 1 µs to 2 s/div (0.1 µs to 1 s/div for model 1821A) Accuracy: ±3%
Sweep comparator	Range: 0.1 to 50 µs Accuracy: ±3%
Delayed sweep time	Range: 0.1 µs to 50 ms/div Accuracy: ±3%
Delay time	Range: 0.1 µs to 10 s Accuracy: ±1%

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 Sets 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. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

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: Probe High Voltage, Agilent, model K25-3490A and Plug-in Extender, Agilent, model 10407B.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ±1%	Ridge, Model 9020A (9020A)
DUAL TIME BASE	Must be compatible with oscilloscope and vertical amplifier	PL-1187 or PL-1187A/U or Hewlett-Packard, Model 1821A
OSCILLOSCOPE	Must be compatible with dual time base and vertical amplifier	OS-189A(P) or Hewlett-Packard, Models 180A, 180C or 180D
OSCILLOSCOPE CALIBRATOR	Voltage output: Range: 5 mV to 60 V at 1 kHz Accuracy: ±1% Pulses: Range: 1 ms and 1 µs Risetime: 1.75 ns or less Accuracy: ±0.75% Time marker: Range: 0.1 µs to 1 s Accuracy: ±0.75% Signal generator: Range: 0.05 to 5 MHz Accuracy: ±0.2%	Fluke, Model 5820A-5C-GHZ (5820A-5C-GHZ)
MULTIMETER	Range: -3165 to +100 V Accuracy: +0.1% with probe	Agilent, Model 3458A (3458A)
VERTICAL AMPLIFIER	Must be compatible with oscilloscope and dual time base	PL-1186 or PL-1186A/U or Hewlett-Packard, 1801A

SECTION III
CALIBRATION PROCESS FOR OSCILLOSCOPES; OS-189A(P)/USM-28IA, AND HEWLETT-PACKARD, MODELS 180A, 180C, AND 180D

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with Sections **I** through **III** 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.

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. Install vertical amplifier and dual time base into vertical and horizontal compartments.

b. Remove TI side covers.

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

(1) **INTENSITY** control fully ccw.
(2) **FOCUS** control to midrange.
(3) **HORIZONTAL POSITION** controls to midrange.
(4) **HORIZONTAL MAGNIFIER** switch to **X10**.
(5) **HORIZONTAL DISPLAY** control cw to (but not in) detent position.
(6) **HORIZONTAL AC/DC COUPLING** switch to **AC**.
(7) **SCALE** control fully cw.
(8) **PHASE/BANDWIDTH** switch (fig. 1) to **BANDWIDTH**.

d. Position vertical amplifier controls as listed in (1) through (8) below:

(1) **A** and **B** position controls to midrange.
(2) **DISPLAY** switch to **A**.

(3) **A** and **B POLARITY** switches to **+ UP**.

(4) **A VOLTS/DIV** switch to **2**.

(5) **B VOLTS/DIV** switch to **.1**.

(6) **A** and **B VOLTS/DIV** vernier control to **CAL**.

(7) Channel A **AC/GND/DC** switch to **AC** and channel B **AC/GND/DC** switch to **GND**.

(8) **MAGNIFIER** switch to **X1** (not on all models).

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

(1) **MAIN** and **DELAYED VERNIER** controls to **CAL**.

(2) **TIME/DIV** sweep display (center) switch to **MAIN**.

(3) **MAIN TIME/DIV** switch to **.1 μs**.

(4) **DELAYED TIME/DIV** switch to **OFF**.

(5) **MAIN** and **DELAYED TRIGGER LEVEL** controls to **0**.

(6) **SWEEP MODE** switch to **AUTO**.

(7) **MAIN EXT ÷ 10/EXT/INT/LINE** switch to **INT**.

(8) **DELAYED INT/AUTO/EXT/EXT ÷ 10** switch to **AUTO**.

(9) **DELAY (DIV)** control to **0**.

(10) **MAIN** and **DELAYED SLOPE** switches to **+**.

(11) **MAIN** and **DELAYED ACS/ACF/AC/DC** switches to **AC**.

f. Connect TI to autotransformer. Connect autotransformer to a 115 V ac source and adjust for a 115 V ac output.

g. Set TI **ON-OFF** switch to **ON** and allow at least 15 minutes for warm-up.

h. Adjust **INTENSITY**, **HORIZONTAL**, and **VERTICAL** controls for display (spot) centered on TI.

i. Set **HORIZONTAL DISPLAY** control to **EXT CAL**. If display (spot) on TI is not centered, adjust R207 (R14 for models 180C and D) (fig. 1) to center display (spot) at center of graticule.

8. Calibrator Output and Stability

a. Performance Check

(1) Connect **CALIBRATOR 10 V** output to **EXT INPUT**.

(2) Adjust **HORIZONTAL DISPLAY** and **POSITION** controls for 9 divisions of horizontal deflection on TI.

(3) Disconnect **CALIBRATOR 10 V** output from **EXT INPUT** and connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **EXT INPUT**.

(4) Set oscilloscope calibrator for 10 V output at 1 kHz. Rotate oscilloscope calibrator knob located below **EDIT FIELD** button to adjust for 9 divisions of horizontal deflection on TI. Oscilloscope calibrator **err** readout will indicate within ±1 percent.

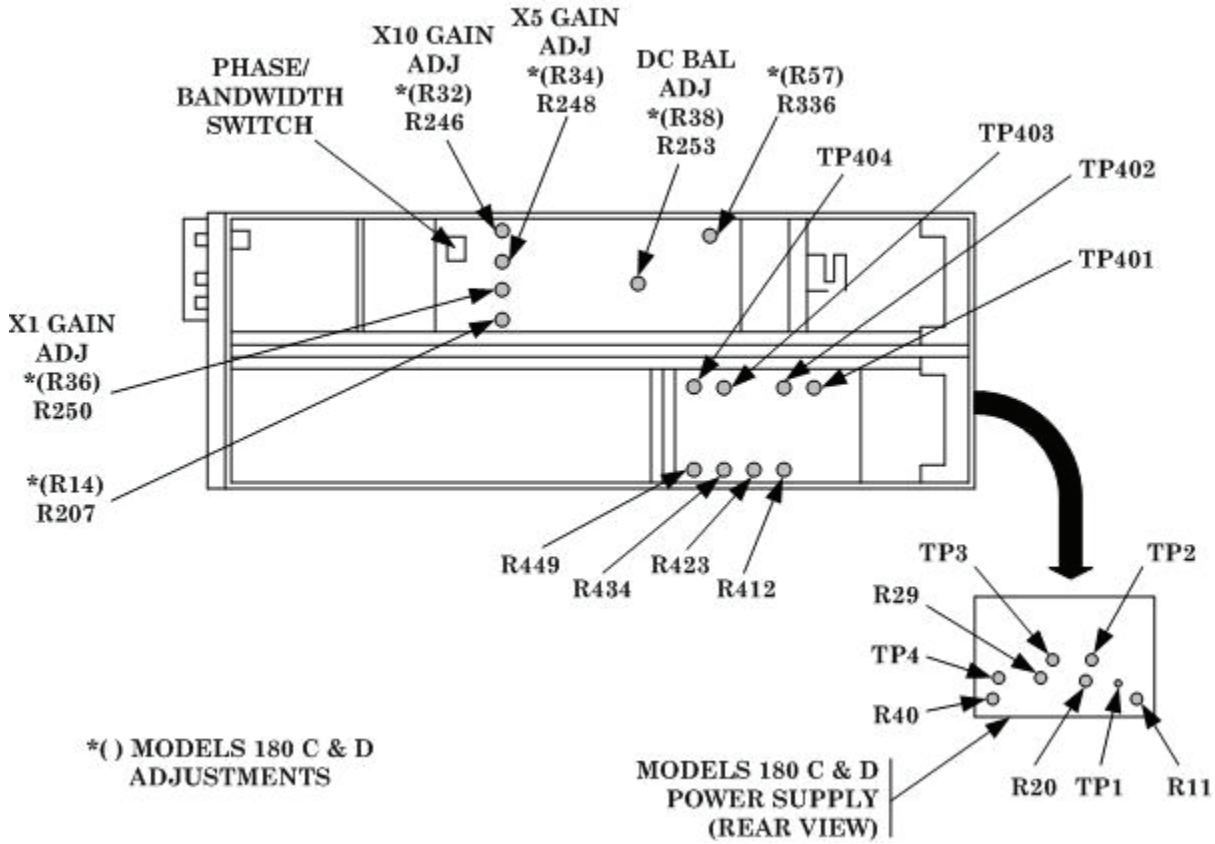

Figure 1. Oscilloscope - right view.

(5) Repeat (4) above at autotransformer settings of 105 and 125 V **err** readout indication will remain within ±1 percent.

(6) Adjust autotransformer to 115 V.

b. Adjustments. No adjustments can be made.

9. Magnifier and Horizontal Gain

a. Performance Check

(1) Set **HORIZONTAL DISPLAY** control to **EXT CAL** and **HORIZONTAL MAGNIFIER** switch to **X1**.

(3) Set oscilloscope calibrator for a 10 V output at 1 kHz. Rotate oscilloscope calibrator knob located below **EDIT FIELD** button to adjust for 10 divisions of horizontal deflection on TI. If oscilloscope calibrator **err** readout does not indicate within ±5 percent, perform **b** (1) and (2) below.

(4) Set oscilloscope calibrator for a 2 V output. Set **HORIZONTAL MAGNIFIER** switch to X5. Rotate oscilloscope calibrator knob located below **EDIT FIELD** button to adjust for 10 divisions of horizontal deflection on TI. If oscilloscope calibrator **err** readout does not indicate within ±5 percent, perform **b** (3) and (4) below.

(5) Set oscilloscope calibrator for a 1 V output. Set **HORIZONTAL MAGNIFIER** switch to X10. Rotate oscilloscope calibrator knob located below **EDIT FIELD** button to adjust for 10 divisions of horizontal deflection on TI. If oscilloscope calibrator **err** readout does not indicate within ±5 percent, perform **b** (5) and (6) below.

b. Adjustments

(1) Adjust oscilloscope calibrator output for 0 percent on **err** readout.

(2) Adjust R250 (R36 for models 180C and D) **X1 GAIN ADJ** (fig. 1) for 10 divisions of deflection on TI.

(3) Adjust oscilloscope calibrator output for 0 percent on **err** readout.

(4) Adjust R248 (R34 for models 180C and D) **X5 GAIN ADJ** (fig. 1) for 10 divisions of deflection on TI.

(5) Adjust oscilloscope calibrator output for 0 percent on **err** readout.

(6) Adjust R246 (R32 for models 180C and D) **X10 GAIN ADJ** (fig. 1) for 10 divisions of deflection on TI.

10. Bandwidth

a. Performance Check

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

(2) Set oscilloscope calibrator for a 50 kHz **LEVEL SINE** output and adjust output amplitude for 10 divisions of horizontal deflection on TI.

(3) Increase oscilloscope calibrator frequency to 5 MHz. TI display will be at least 7.1 divisions.

b. Adjustments. No adjustments can be made.

11. Low Voltage Power Supply

a. Performance Check

NOTE

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

NOTE

Perform (1) through (4) below for all models except 180C and 180D. For models 180C and 180D, perform (5) through (8) below.

(1) Connect multimeter between TP404 (fig. 1) and chassis ground. If multimeter does not indicate between -99.90 and -100.10 V, perform **b** (1) below.

(2) Move positive lead to TP401 (fig. 1). If multimeter does not indicate between 99.90 and 100.10 V, perform **b** (2) below.

(3) Move positive lead to TP402 (fig. 1). If multimeter does not indicate between 14.9 and 15.1 V, perform **b** (3) below.

(4) Move positive lead to TP403 (fig. 1). If multimeter does not indicate between -12.5 and -12.7 V, perform **b** (4) below.

(5) Connect multimeter between TP1 (fig. 1) and chassis ground. If multimeter does not indicate between 99.9 and 100.1 V, perform **b** (5) below.

(6) Move positive lead to TP2 (fig. 1) and chassis ground. If multimeter does not indicate between 14.90 and 15.10 V, perform **b** (6) below.

(7) Move positive lead to TP3 (fig. 1) and chassis ground. If multimeter does not indicate between -12.5 and -12.7 V, perform **b** (7) below.

(8) Move positive lead to TP4 (fig. 1) and chassis ground. If multimeter does not indicate between -99.9 and -100.1 V, perform **b** (8) below.

b. Adjustments

(1) Adjust R449 (fig. 1) for -100.00 V indication on multimeter (R).

(2) Adjust R412 (fig. 1) for +100.00 V indication on multimeter (R).

(3) Adjust R423 (fig. 1) for +15.0 V indication on multimeter (R).

(4) Adjust R434 (fig. 1) for -12.6 V indication on multimeter (R).

(5) Adjust R11 (fig. 1) for +100 V indication on multimeter (R).

(6) Adjust R20 (fig. 1) for +15.0 V indication on multimeter (R).

(7) Adjust R29 (fig. 1) for -12.6 V indication on multimeter (R).

(8) Adjust R40 (fig. 1) for -100.00 V indication on multimeter (R).

12. High Voltage Power Supply

a. Performance Check. Connect multimeter between TP301 (TP1 for models 180C and D) (fig. 2) and chassis ground, using high voltage probe. If multimeter does not indicate between -2935 and -2965 V for all models except models 180C and D, and -3135 and -3165 V for models 180C and D, perform **b** below.

b. Adjustments. Adjust R302 (fig. 2) for -2950 V indication on multimeter for all models except models 180C and D. Adjust R49 (fig. 2) for V indication on multimeter for models 180C and D.

13. Final Procedure

a. Deenergize and disconnect all equipment and reinstall protective cover on TI.

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

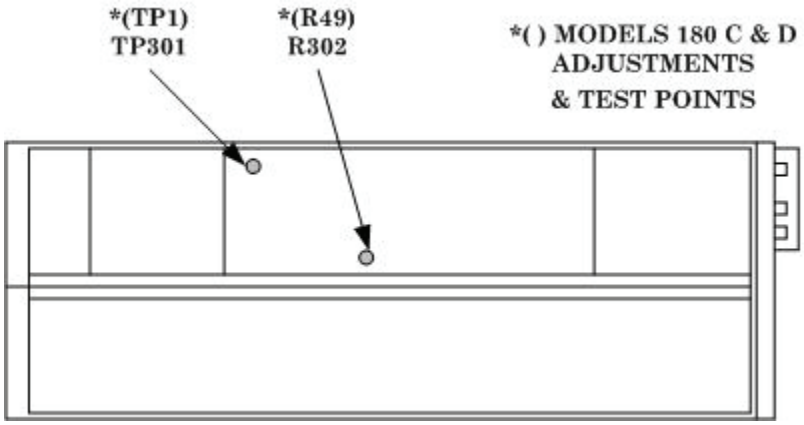

Figure 2. Oscilloscope - left view.

SECTION IV
CALIBRATION PROCESS FOR DUAL CHANNEL VERTICAL AMPLIFIER; PL-1186/USM-281, PL-1186A/USM-281A, AND HEWLETT-PACKARD, MODEL 1801A

14. Preliminary Instructions

a. The Instructions outlined in paragraphs **14** and **15** are preparatory to the calibration process. Personnel should become familiar with Sections **I**, **II**, and **IV** 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.

15. 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. Install TI and dual time base into oscilloscope vertical and horizontal compartments, using plug-in extender for TI.

b. Remove oscilloscope side covers.

c. Connect oscilloscope to autotransformer. Connect autotransformer to a 115 V ac source and adjust for a 115 V ac output.

d. Set oscilloscope **ON-OFF** switch to **ON** and allow at least 15 minutes for warm-up.

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

(1) **A** and **B VOLTS/DIV** switches to **.005** and **VERNIER** controls to **CAL**.

(2) A and B **AC/GND/DC** switches to **AC**.

(3) **DISPLAY** switch to **A**.

(4) **A** and **B POLARITY** switches to **+ UP**.

(5) **MAGNIFIER** switch to X5 (not on all models).

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

(1) **HORIZONTAL DISPLAY** switch to **INT**.

(2) **HORIZONTAL AC/DC** coupling switch to **AC**.

(3) **PHASE/BANDWIDTH** switch (fig. 1) to **BANDWIDTH**.

(4) **HORIZONTAL MAGNIFIER** switch to **X1**.

g. Position dual time base controls as listed in (1) through (7) below:

(1) **TIME/DIV** sweep display (center) switch to **MAIN**.

(2) **MAIN TIME/DIV** switch to **1 ms**.

(3) **DELAYED TIME/DIV** switch to **OFF**.

(4) **MAIN** and **DELAYED** coupling **ASC/ACF/AC/DC** switches to **ACS**.

(5) **MAIN** and **DELAYED VERNIER** controls to **CAL**.

(6) **MAIN** and **DELAYED SLOPE** switches to **+**.

(7) **MAIN** and **DELAYED** trigger source switches to **INT**.

16. Gain and Attenuator Accuracy

a. Performance Check

NOTE

Do not perform (2), (3), and (5) below for model 1801A.

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

(2) Set oscilloscope calibrator for a **VOLTAGE** output of 5 mV at 1 kHz. If oscilloscope does not display 5 divisions of vertical deflection, within ±3 percent as indicated

on oscilloscope calibrator **err** readout adjust oscilloscope calibrator output for 0 percent on **err** readout, and adjust **CAL** (front panel) for exactly 5 divisions.

(3) Set **MAGNIFIER** switch to **X1**.

(4) Set **A VOLT/DIV** switch to positions listed in table 4 and adjust oscilloscope calibrator for 6 divisions of vertical deflection on oscilloscope. Oscilloscope calibrator **err** readout will be within ±3 percent of output specified in table 4.

Table 4. Attenuator Accuracy

Test instrument **VOLTS/DIV** switch settings	Oscilloscope calibrator output
0.005	30 mV
0.01	60 mV
0.02	120 mV
0.05	0.3 V
0.1	0.6 V
0.2	1.2 V
0.5	3.0 V
1	6.0 V
5	30.0 V

(5) Set **DISPLAY** switch to **B**.

(6) Repeat technique of (1) through (4) above for channel **B VOLTS/DIV** switch.

b. Adjustments. No further adjustments can be made.

17. Attenuator Compensation and Input Capacitance

a. Performance Check

(1) Set dual time base **MAIN TIME/DIV** switch to **20 μs**.

(2) Connect oscilloscope calibrator **SORUCE/MEASURE CHAN 1** to TI **A INPUT**, using, 50 Ω feed through termination and 5 – 80 pF standardizer.

(3) Position controls as listed in (a) and (b) below:

(a) **A** and **B VOLTS/DIV** switches **.005**.

(b) **DISPLAY** switch to **A**.

(4) Set oscilloscope calibrator **VOLTAGE** output frequency to 10 kHz and output amplitude for 6 divisions of vertical deflection on oscilloscope.

(5) Adjust standardizer for optimum square wave display.

(6) Set **VOLTS/DIV** switch to positions listed in table 5 and adjust oscilloscope calibrator **VOLTAGE** output amplitude for 6 divisions of vertical deflection on oscilloscope. If overshoot or undershoot is more than 2 minor divisions, perform corresponding adjustments listed in table 5 for optimum square wave display.

Table 5. Input Capacitance and Attenuator Compensation

Test instrument **VOLTS/DIV** switch settings	Channel A adjustments (fig. 3)	Channel B adjustments (fig. 3)
0.01	C120	C220
0.02	C125	C225
0.05	C103	C203
	C105	C205
0.1	C118	C218
0.2	C123	C223
0.5	C107	C207
	C109	C209
5	C112	C212
	C114	C214

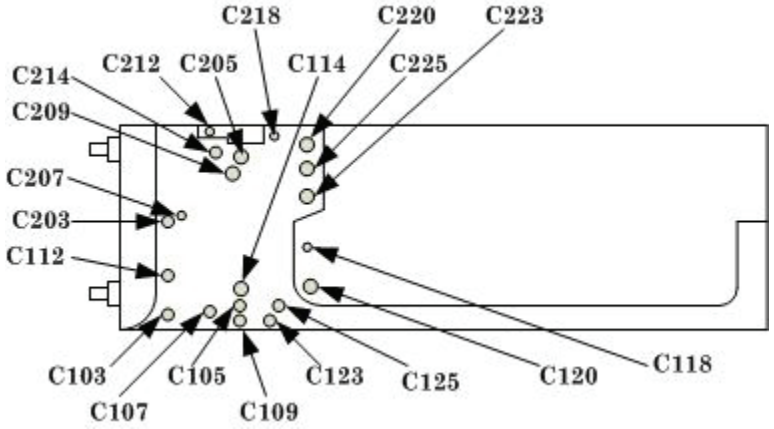

Figure 3. Dual channel vertical amplifier - bottom view.

(7) Disconnect oscilloscope calibrator from **A INPUT** and connect to **B INPUT**.

(8) Set **DISPLAY** switch to B and repeat technique of (2) through (6) above for channel B.

b. Adjustments. No further adjustments can be made.

18. Final Procedure

a. Deenergize and disconnect all equipment and reinstall protective cover on TI.

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

SECTION V
CALIBRATION PROCESS FOR TIME BASE AND DELAY GENERATOR PL-1187/USM-281, PL-1187A/USM-281A, AND HEWLETT-PACKARD, MODEL 1821A

19. Preliminary Instructions

a. The instructions outlined in paragraphs **20** and **21** are preparatory to the calibration process. Personnel should become familiar with Sections **I**, **II**, and **V** 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.

20. 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 oscilloscope side panels.

b. Install vertical amplifier and TI into oscilloscope.

c. Connect oscilloscope to autotransformer. Connect autotransformer to a 115 V ac source and adjust for a 115 V ac output.

d. Set oscilloscope **ON-OFF** switch to **ON** and allow at least 15 minutes for warm-up.

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

(1) **HORIZONTAL DISPLAY** switch to **INT**.

(2) **AC/DC** coupling switch to **AC**.

(3) **PHASE/BANDWIDTH** switch (fig. 1) to **BANDWIDTH**.

(4) **HORIZONTAL MAGNIFIER** switch to **X1**.

f. Position vertical amplifier controls as listed in (1) through (3) below:

(1) **DISPLAY** switch to **A**.

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

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

g. Position TI controls as listed in (1) through (10) below:

(1) **MAIN** and **DELAYED VERNIER** controls fully cw **(CAL)**.

(2) **DELAYED INT/AUTO/EXT/EXT + 10** switch to **INT**.

(3) **MAIN EXT ÷ 10/EXT/INT LINE** switch to **INT**.

(4) **MAIN** and **DELAYED ACS/ACF/AC/DC** switches to **AC**.

(5) **TIME/DIV** sweep display switch to **MAIN**.

(6) **MAIN TIME/DIV** switch to **0.1 μs**.

(7) **SWEEP MODE** switch to **AUTO**.

(8) **DELAYED TIME-DIV** switch to **OFF**.

(9) **MAIN** and **DELAYED SLOPE** switches to **+**.

(10) **DELAY (DIV)** control to **1.00**.

21. Sweep Time

a. Performance Check

(1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to vertical amplifier **A INPUT**, using 50 Ω feedthrough termination.

(2) Set oscilloscope calibrator for a 0.1 μs **MARKER** output.

(3) Adjust vertical amplifier **VOLTS/DIV** controls for approximately 3 divisions of vertical deflection on oscilloscope.

(4) Adjust **MAIN TRIGGER LEVEL** control for stable display.

(5) Adjust oscilloscope **HORIZONTAL POSITION** control to align second marker with second vertical graticule line. Rotate knob located below **EDIT FIELD** button on oscilloscope calibrator to align 10th marker with 10th vertical graticule line. If oscilloscope calibrator **err** readout is not within ±3 percent, perform **b** (1) below.

(6) Repeat technique of (2) through (5) above for **MAIN TIME/DIV** switch settings listed in table 7. If oscilloscope does not display 1 marker per division between 2d and 10th vertical graticule lines within ±3 percent indication on oscilloscope calibrator **err** readout, perform corresponding adjustments listed in table 7.

(7) Set **MAIN MIXED DELAYED** switch to **DELAYED**.

(8) Set **DELAYED TIME/DIV** switch to **.1 μSEC** and **MAIN TIME/DIV** switch to **.2 μSEC**.

(9) Repeat technique of (2) through (6) above for **DELAYED TIME/DIV** switch. If 10th marker is not aligned with 10th vertical graticule line within ±3 percent on oscilloscope calibrator **err** readout, perform **b** (2) below.

b. Adjustments

(1) Adjust oscilloscope calibrator to 0 percent indication on **err** readout and adjust C510 (fig. 4) for 1 marker per division between 2d and 10th vertical graticule lines (R).

(2) Repeat technique of **b**(1) above for **DELAYED TIME/DIV** switch and adjust C532 (fig. 4) (R).

Table 7. Sweep Time

Test instrument **TIME/DIV** switch settings	Oscilloscope calibrator marker output	Adjustments[1] (fig. 4) ®	
		Main Sweep	Delayed Sweep
0.2 µs	0.2 µs	C508	C530
0.5 µs	0.5 µs	- - -	- - -
1 µs	1 µs	- - -	- - -
2 µs	2 µs	C506	C528
5 µs	5 µs	- - -	- - -
10 µs	10 µs	- - -	- - -
20 µs	20 µs	R516	R539
50 µs	50 µs	- - -	- - -
0.1 ms	0.1 ms	- - -	- - -
0.2 ms	0.2 ms	R515	R538
0.5 ms	0.5 ms	- - -	- - -
1 ms	1 ms	- - -	- - -
2 ms	2 ms	R514	R537
5 ms	5 ms	- - -	- - -
10 ms	10 ms	- - -	- - -
20 ms	20 ms	R513	- - -
50 ms	50 ms	- - -	- - -
0.1 sec[2]	0.1 sec	- - -	- - -
0.2 sec[2]	0.2 sec	- - -	- - -
0.5 sec[2]	0.5 sec	- - -	- - -
1 sec[2]	1 sec	- - -	- - -

[1]Perform listed adjustments to obtain best in-tolerance compromise of error for corresponding **TIME/DIV** switch positions.
[2]For **MAIN TIME/DIV** switch only.

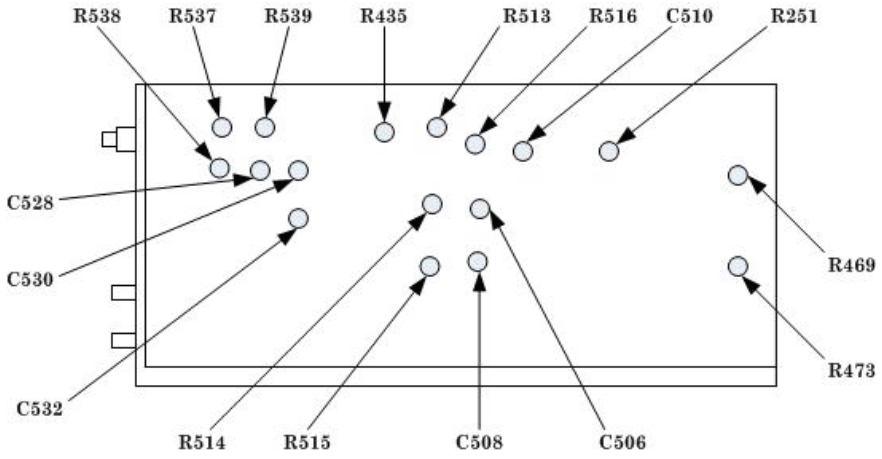

Figure 4. Time base and delay generator - right view.

22. Sweep Comparator

a. Performance Check

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

(a) **TIME/DIV** sweep display switch to **MAIN**.

(b) **MAIN TIME/DIV** switch to **1 ms**.

(c) **DELAYED TIME/DIV** switch to **10 μsec**.

(d) Set **DELAYED INT/AUTO/ EXT/EXT + 10** switch to **AUTO**.

(2) Set oscilloscope calibrator for a 1 ms **MARKER** output. If intensified portion of sweep displayed on oscilloscope does not start on 2d time marker, perform **b** (1) below.

(3) Adjust **DELAY (DIV)** control to **9.00**. If intensified portion of sweep does not start on 10th time marker, perform **b** (2) below.

(4) Set **TIME/DIV** sweep display switch to **DELAYED**. Adjust **DIV DELAY** control to **1.00** and continue adjusting control until the leading edge of the displayed trace is one division from the start of the sweep. If the indication on the **DIV DELAY** control is not 1.00 ±1 minor dial division, perform **b** (3) below.

(5) Adjust **DIV DELAY** control to **9.00** and continue adjusting the control until the leading edge of the displayed trace is one division from the beginning of the trace. If the **DIV DELAY** control is not 9.00 ± 8 minor divisions, perform **b** (4) and (5) below.

b. Adjustments

(1) Adjust R473 (fig. 4) until intensified portion of trace starts on 2d time mark on 2d vertical graticule line (R).

(2) Adjust R469 (fig. 4) until intensified portion of trace starts on 10th time mark on 10th vertical graticule line (R).

NOTE

Interaction exists between R473 (fig. 4) and R469 (fig. 4).

(3) Adjust **DIV DELAY** control to **1.00** and adjust R473 (fig. 4) to align leading edge of first marker one division from start of sweep (R).

(4) Set **DIV DELAY** control to **9.00**. Adjust R469 (fig. 4) to align leading edge of 10th marker one division from start of sweep (R).

(5) Repeat **a** (1) through (4) above.

23. Risetime

a. Performance Check

NOTE

Set oscilloscope **OFF/ON** switch to **OFF**. Remove TI and plug-in extender. Place TI in oscilloscope. Set **ON/OFF** switch to **ON** and **MAG** switch to **X10**.

(1) Connect oscilloscope calibrator **SOURCE/MAESURE CHAN 1** to **A INPUT**, using 50 Ω feed through termination.

(2) Position vertical amplifier and dual time base controls as listed in (a) through (d) below:

(a) **DISPLAY** switch to **A**.

(b) **MAIN TIME/DIV** switch to **0.1 μs**.

(c) **A** and **B VOLTS/DIV** switches to **.05 mV**.

(d) **TIME/DIV** display switch to **MAIN**.

(3) Set oscilloscope calibrator **EDGE** output for 1 MHz, and adjust output amplitude for a display of 8 divisions.

(4) Measure rise time using standard rise time technique. Rise time will be 7 ns or less.

(5) Set **DISPLAY** switch to **B** and repeat technique of (1) through (4) above for channel B.

b. Adjustments. No adjustments can be made.

24. Final Procedure

a. Deenergize and disconnect all equipment and reinstall protective cover on TI.

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

By Order of the Secretary of the Army:

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army

0802805

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 342216 requirements for calibration procedure TB 9-6625-2072-24.

INSTRUCTIONS FOR SUBMITTING 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@redstone.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:** 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.

PIN: 084639-000