*TB 9-6625-2188-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR OSCILLATOR, TEKTRONIX, TYPES SG505 AND SG505 OPTION 01

Headquarters, Department of the Army, Washington, DC
4 March 2004

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

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

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*This bulletin supersedes TB 9-6625-2188-35, 15 October 1990.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Oscillator, Tektronix, Types SG505 and SG505 Option 01. 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 test, tables, and figures.

b. Time and Technique. The time required for this calibration is approximately 4 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
Distortion ($R_L \geq 600\ \Omega$)	20 Hz to 20 kHz: $\leq$0.0008% (-102 dB) THD 10 to 20 Hz and 20 to 50 kHz: $\leq$0.0018% (-95 dB) THD 50 to 100 kHz: $\leq$0.0032% (-90 dB) THD
Flatness: (1 kHz reference)	Range: 10 Hz to 20 kHz Accuracy: ±0.1 dB
Frequency	Range: 10 Hz to 100 kHz Accuracy: ±3% of setting Vernier: $\geq$±l% of setting
Output level	Range: +10 to -60 dBm into 600Ω Accuracy: ±0.2 dB at 0 dBm and 1 kHz Step accuracy: ±0.1 dB/10 dB step

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. 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: Extender, Tektronix, Type 067-0645-02; Power Module, Tektronix, Type TM 500 series.

Table 2. Minimum Specifications of Equipment Required

Common Name	Minimum use specifications	Manufacturer and model (part number)
DIFFERENTIAL VOLTMETER	Range: 706 μV to 9..97874 V ac Accuracy: ±0.5%	Fluke, Model 887AB/AN (887AB/AN)
FREQUENCY COUNTER	Range: 9.7 Hz to 103 kHz Accuracy: ±0.75%	Fluke, Model PM6681/656 (PM6681/656)
NOTCH FILTER[1]	Range:10 Hz to 100 kHz Accuracy: ±2%	Tektronix, Type 067-0938-00 (7917073)
SPECTRUM ANALYZER[1]	Range:20 Hz to 100 kHz Capability: <-102 dB	Hewlett-Packard, Model 3585A (3585A)

[1]Limited deployed items.

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

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

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

7. Equipment Setup

WARNING

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

a. Connect TI to power module using extender.

b. Connect power module to a 115 V ac source.

c. Pull power module **PULL ON POWER** switch to **ON** and allow at least 30 minutes for TI to reach operating temperature.

8. Frequency Accuracy

a. Performance Check

(1) Connect **SYNC OUT** to frequency counter.

(2) Position controls as listed in (a) through (g) below.

(a) **FREQUENCY Hz** dial to **4**.
(b) Frequency multiplier pushbutton **x1k** pressed.
(c) **OUTPUT LEVEL (dBm)** switch to **0**.
(d) **OUTPUT LEVEL (dBm) CAL** control fully cw (to detent).
(e) **ON-OFF** pushbutton to **ON** (in).
(f) **GNDED FLTG** pushbutton to **FLTG** (out).
(g) **INTERMOD TEST SIG** pushbutton to **OFF** (out).

(3) If frequency counter does not indicate between 3.880 and 4.120 kHz, perform **b** below.

(4) Position controls for values listed in table 3 below. Frequency counter will indicate within limits specified.

Table 3. Dial Accuracy

Test instrument		Frequency counter indications	
FREQUENCY HZ dial positions	Frequency multiplier pushbuttons positions (In)	Min	Max
1	x10	9.700 Hz	10.300 Hz
5	x10	48.500 Hz	51.500 Hz
10	x10	97.000 Hz	103.000 Hz
1	x100	97.000 Hz	103.000 Hz
5	x100	485.000 Hz	515.000 Hz
10	x100	.970 kHz	1.030 kHz
1	x1 k	.970 kHz	1.030 kHz
5	x1 k	4.850 kHz	5.150 kHz
10	x1 k	9.700 kHz	10.300 kHz
1	x10 k	9.700 kHz	10.300 kHz
5	x10 k	48.500 kHz	51.500 kHz
10	x10 k	97.000 kHz	103.000 kHz

(5) Press frequency multiplier **x1k** pushbutton and adjust **FREQUENCY Hz** dial for a frequency counter indication of 1.000 kHz.

(6) Adjust **FREQ VERN** control fully ccw. Frequency counter will indicate 0.990 kHz or less.

(7) Adjust **FREQ VERN** control fully cw. Frequency counter will indicate 1.010 kHz or greater.

(8) Adjust **FREQ VERN** control to center position.

b. Adjustments

(1) Remove left side cover.

(2) Loosen set screws on shaft behind front panel of **FREQUENCY Hz** dial.

(3) Turn shaft until frequency counter and **FREQUENCY Hz** dial reads 4.000 kHz. Tighten set screws (R).

9. Output Attenuator and Flatness

a. Performance Check

(1) Connect TI **OUTPUT** to notch filter **INPUT**.

(2) Connect **OUTPUT** of notch filter to differential voltmeter.

(3) Position controls on notch filter as listed in (a) through (d) below:

(a) **NOTCH FREQUENCY** switch to **1 kHz**.
(b) **ADJUST FOR NULL** controls to center.
(c) **MODE** pushbutton to **FLAT** (out).
(d) **ATTEN** pushbutton to **0 dB** (out).

(4) If differential voltmeter does not indicate between 0.756965 and 0.792639 V ac, perform **b** below.

(5) Set **OUTPUT LEVEL (dBm)** switch to settings listed in table 4. Differential voltmeter will indicate within limits specified.

Table 4. Attenuator Accuracy

Test instrument **OUTPUT LEVEL** switch settings (dBm)	Differential voltmeter indications (V)	
	Min	Max
+10	2.36633	2.53557
-10	0.236633	0.253557
-20	0.073973	0.081110
-30	0.023125	0.025946
-40	0.007229	0.008300
-50	0.002260	0.002655
-60	0.000706	0.000849

(6) Set **OUTPUT LEVEL (dBm)** switch to **0**.

(7) Adjust **OUTPUT LEVEL (dBm) CAL** control for a 0.774597 V ac indication on differential voltmeter.

(8) Adjust **FREQUENCY Hz** dial and frequency multiplier pushbuttons to values listed in table 5 below. Differential voltmeter will indicate within limits specified.

(9) Adjust **OUTPUT LEVEL (dBm) CAL** control fully cw (to detent).

b. Adjustments. Remove left side cover from TI and adjust R1423 (fig. 1) for 0.775 V ac indication on digital voltmeter (R).

Table 5. Flatness Accuracy

Test instrument		Differential voltmeter indications (V ac)	
FREQUENCY HZ dial positions	Frequency multiplier pushbuttons positions (in)	Min	Max
1 2	x10 x10k	0.765730	0.783566
5 10	x10k x10k	0.756965	0.792639

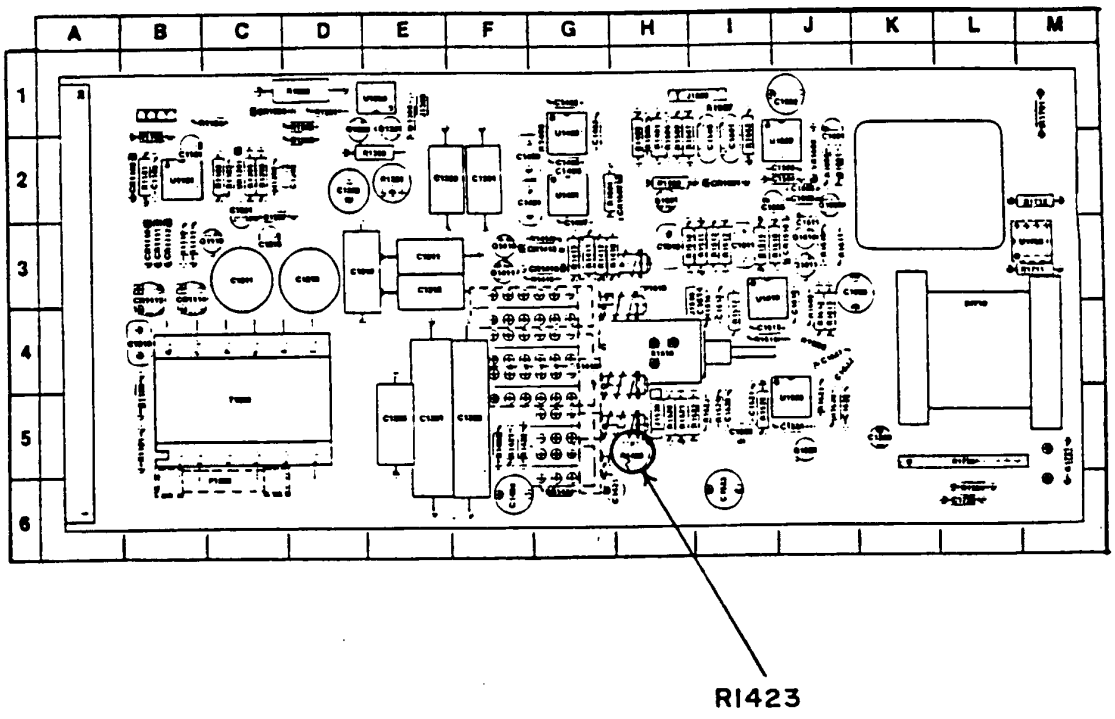

Figure 1. Output attenuator adjustment - equipment location (SG505, SG505 opt 01).

10. Total Harmonic Distortion

a. Performance Check

NOTE
Keep cables as short as possible.

(1) Connect TI **OUTPUT** to notch filter input.

(2) Connect **OUTPUT** of notch filter to spectrum analyzer **1M Ω INPUT**.

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

(a) **FREQUENCY Hz** dial to **2**.
(b) Frequency multiplier pushbutton to **x10**.
(c) **OUTPUT LEVEL (dBm)** to +10**.**
(d) **OUTPUT LEVEL (dBm) CAL** just out of detent.

(4) Position notch filter controls as listed in (a) through (d) below:

(a) **NOTCH FREQUENCY** switch to **20 Hz**.
(b) **ADJUST FOR NULL-COARSE** and **FINE** controls centered.
(c) **MODE** push button to **FLAT** (out).
(d) **ATTEN** pushbutton to **0 dB** (out).

(5) Adjust spectrum analyzer controls to display fundamental frequency of 20 Hz and four harmonics.

(6) Set spectrum analyzer **MARKER** control to **20 Hz** and record fundamental frequency amplitude in dBm.

(7) Set notch filter **MODE** pushbutton to **NOTCH** (in).

(8) Record amplitude of 2d, 3d, 4th, and 5th harmonic as indicated on spectrum analyzer.

(9) Subtract value recorded in (6) above from each harmonic value recorded in (8) above and record.

Example:

2d harmonic = -91.5 - +26 = -117.5 dB
3d harmonic = -92.2 - +26 = -118.2 dB
4th harmonic = -98.5 - +26 = -124.5 dB
5th harmonic = -105.4 - +26 = -131.4 dB

(10) Add the notch filter test report correction factors from table 6 to total harmonic values recorded in (9) above and record.

Example:

2d harmonic = -117.5 +9.5 = -108.0
3d harmonic = -118.2 +6.0 = -112.2
4th harmonic = -124.5 +4.5 = -120.0
5th harmonic = -131.4 +3.5 = -127.9

Table 6. Notch Filter Correction Factors

Harmonic values	**NOTCH FREQUENCY** switch settings		
	20 Hz to 20 Hz	50 kHz	100 kHz
2d	9.5	10	10.5
3d	6.0	6.5	7
4th	4.5	5	5.5
5th	3.5	4	4.5

(11) Compute arithmetic difference between the two numerically lower dB values (2d and 3d) harmonic recorded in (10) above.

NOTE

If difference value falls between two difference values in table 7, interpolate corresponding value in additive factor column.

Example:

-112.2
-108.0
4.2 = difference value

(12) Locate difference value (4.2) in table 7 below and determine corresponding additive factor (1.42). Algebraically add additive factor to the numerically lower dB value (2d harmonic) of (10) above.

Example:

-108.0
1.42
-106.58 = resulting number

Table 7. Factors for THD Computation

Difference values	Additive factors		Difference values	Additive factors
0.0	3.01		10.0	0.41
0.5	2.77		11.0	0.33
1.0	2.54		12.0	0.27
2.0	2.12		13.0	0.21
3.0	1.76		14.0	0.17
4.0	1.46		15.0	0.14
5.0	1.19		16.0	0.11
6.0	0.97		17.0	0.09
7.0	0.79		18.0	0.07
8.0	0.64		19.0	0.05
9.0	0.51		20.0	0.04

(13) Repeat technique above using resulting number from (12) above and the next numerically lower dB value (4th harmonic) of (10) above.

Example:

-120.0
-106.58
13.42 = difference value

(14) Locate difference value (13.42) in table 7 and determine corresponding additive factor (0.20). Algebraically add additive factor to resulting number of 12 above.

Example:

-106.58
.20
-106.38 = resulting number

(15) Compute arithmetic difference between the remaining dB value (5th harmonic) of (10) above and resulting number of (14) above.

Example:

-127.9
-106.38
21.52 = difference value

(16) Locate difference value (21.52) in table 7 and determine corresponding additive factor (0.00). Algebraically add additive factor to resulting number of (14) above. The result is in THD.

Example:

-106.38
0.00
-106.38 = THD

The calculated THD in (16) above will be ≤ -102 dB.

(17) Repeat technique of (3) through (16) above for TI and notch filter settings listed in table 8. THD will be within limits specified

Table 8. Total Harmonic Distortion Accuracy.

Test instrument settings (kHz)	Notch filter settings (kHz)	Calculated THD (dB)
1	1	≤-102
50	50	≤-95
100	100	≤-90 (≤85)

b. Adjustments. No adjustments can be made.

11. Final Procedure

a. Deenergize and disconnect all equipment.

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

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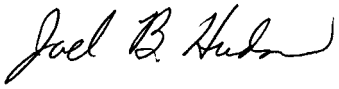

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army

0401204

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

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Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
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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.