# TB 9-6625-2371-24

**DEPARTMENT OF THE ARMY TECHNICAL BULLETIN**

# CALIBRATION PROCEDURE FOR FUNCTION GENERATOR (SRS MODEL DS360)

Headquarters, Department of the Army, Washington, DC
28 August 2007



**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, 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.


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## SECTION I
## IDENTIFICATION AND DESCRIPTION

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Function Generator (SRS Model DS360). The manufacturer's manual was 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.** None.

**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 | | |
|---|---|---|---|
| Amplitude | Range: Unbalanced Outputs | 50 Ω Load: | 5.0µ to 14.4 V pp |
| | | 600 Ω Load: | 5.0µ to 20.0 V pp |
| | | Hi-Z: | 10.0µ to 40.0 V pp |
| | Balanced Outputs | 50 Ω Load: | 10.0µ to 28.8 V pp |
| | | 150 Ω Load | 10.0µ to 28.8 V pp |
| | | 600 Ω Load: | 10.0µ to 40.0 V pp |
| | | Hi-Z: | 20.0µ to 80.0 V pp |
| | Accuracy: ±0.1 dB (± 1%) | | |
| Distortion | <5 kHz: (-106 dB) THD | | |
| | 5 to 20 kHz: (-100 dB) THD | | |
| | 20 to 40 kHz: (-96 dB) THD | | |
| | 40 to 100 kHz (-85 dB) THD | | |
| | 100 to 200 kHz (-68 dB) THD | | |
| Frequency | Range: 10 mHz to 200 kHz | | |
| | Accuracy: ±(25 ppm + 4mHz) | | |
| Offset | Range: Unbalanced Outputs: | 50 Ω Load: | 0-±7.4 VDC |
| | | 600 Ω Load: | 0-±10.0 VDC |
| | | Hi-Z: | 0-±20.0 VDC |
| | Accuracy: Sine, Square | 1%± 25mV (V pp + offset >0.63 V) | |
| | | 1%± 2.5mV (0.63V>V pp + offset >0.063 V) | |
| | | 1%± 250µV (63mV>V pp + offset >6.3 mV) | |
| | | 1%± 25µV (V pp + offset <6.3 mV) | |

Table 1. Calibration Description - Continued

| Test instrument parameters | Performance specifications | | |
|---|---|---|---|
| Output Impedance | Accuracy: | Balanced: | 50 Ω ± 3 %<br>150 Ω ± 2 %<br>600 Ω ± 1 %<br>Hi-Z (50 Ω ± 3 %) |
| | | Unbalanced: | 50Ω ± 3 %<br>600Ω ± 1 %<br>Hi-Z (25Ω ± 1Ω) |

## 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-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.

Table 2. Minimum Specifications of Equipment Required

| Common name | Minimum use specifications | Manufacturer and model (part number) |
|---|---|---|
| FREQUENCY COUNTER | Range: 9.7 Hz to 103 kHz<br>Accuracy: < 5ppm | Fluke, Model PM6681/656 (PM6681/656) |
| MULTIMETER | AC 1 Hz to 100kHz<br>Accuracy: ±0.1% | Hewlett-Packard, Model 3458A (3458A) |
| NOTCH FILTER | Range:10 Hz to 100 kHz<br>Accuracy: ±2% | Tektronix, Type 067-0938-00 (7917073) |
| OSCILLOSCOPE | Bandwidth: 100MHz | (OS303/G) |
| SPECTRUM ANALYZER | Range:20 Hz to 100 kHz<br>Capability: <-102 dB | Hewlett-Packard, Model 3585A (3585A) |

## 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 manufacturer's manual for this TI.

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

## 7. 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 115 V ac power source

**b.** Reset the TI by setting the **POWER ON/OFF** switch to **OFF**, wait 2 seconds, then turn the **POWER ON/OFF** switch to **ON** while pressing the **CLR** key. Allow at least 1 hour for equipment warm-up.

## 8. Frequency Accuracy

### a. Performance Check

(1) Connect the TI **BNC OUTPUT (+)** connector to the frequency counter. Set the frequency counter, as required, to make frequency measurements

(2) Set TI frequency to **10 Hz** and amplitude to **10 $V_{RMS}$**.

(3) Frequency counter will indicate between 9.99575 Hz and 10.00425 Hz

(4) Set TI frequency to settings in table 3 below. Frequency counter will indicate within limits specified.

Table 3. Frequency Accuracy

| Test instrument frequency | Frequency counter indications | |
|---|---|---|
| | Min | Max |
| 100 Hz | 99.9935 Hz | 100.0065 Hz |
| 1 kHz | 999.971 Hz | 1.000029 kHz |
| 10 kHz | 9.999746 kHz | 10.000254 kHz |
| 100 kHz | 99.997496 kHz | 100.002504 kHz |
| 200 kHz | 199.994996 kHz | 200.005004 kHz |

**b. Adjustments**. No adjustments can be made.

## 9. Amplitude

### a. Performance Check

(1) Connect the TI **BNC OUTPUT (+)** to the multimeter

(2) Connect the TI **SYNC OUT** to the multimeter trigger input. Set the multimeter to synchronous ACV measurement function with external sync.

(3) Set TI output frequency to **1 kHz** and amplitude to **14 $V_{RMS}$**.

(4) Multimeter will indicate between 13.86 and 14.14 $V_{RMS}$.

(5) Set TI amplitude to settings in table 4 below. Multimeter will indicate within limits specified.

(6) Connect the **TI BNC OUTPUT (-)** output to the multimeter. Repeat steps 3 through 5 above for the **(-)** channel.

Table 4. Unbalanced Attenuator Test

| Voltage ($V_{RMS}$) @ 1 kHz | Multimeter indication | |
|---|---|---|
| 12.0 | 11.88 $V_{RMS}$ | 12.12 $V_{RMS}$ |
| 10.0 | 9.90 $V_{RMS}$ | 10.10 $V_{RMS}$ |
| 7.0 | 6.93 $V_{RMS}$ | 7.07 $V_{RMS}$ |
| 4.0 | 3.96 $V_{RMS}$ | 4.04 $V_{RMS}$ |
| 0.4 | 0.396 $V_{RMS}$ | 0.404 $V_{RMS}$ |
| 0.04 | 39.6 $mV_{RMS}$ | 40.4 $mV_{RMS}$ |
| 0.004 | 3.96 $mV_{RMS}$ | 4.04 $mV_{RMS}$ |
| 0.00125 | 1.238 $mV_{RMS}$ | 1.263m $V_{RMS}$ |

(7) Reconnect TI **BNC OUTPUT (+)** to the multimeter.

(8) Set TI output amplitude to **1 $V_{RMS}$** and frequency to **10 Hz**.

(9) Multimeter will indicate between 0.99 and 1.01 $V_{RMS}$.

(10) Set TI frequency to settings in table 5 below. Multimeter will indicate within limits specified.

Table 5. Sinewave Flatness, Antialaising Filter Amplitude

| TI frequency | Multimeter indication $V_{RMS}$ | |
|---|---|---|
| 20 Hz | 0.99 | 1.01 |
| 50 Hz | 0.99 | 1.01 |
| 100 Hz | 0.99 | 1.01 |
| 200 Hz | 0.99 | 1.01 |
| 500 Hz | 0.99 | 1.01 |
| 1 kHz | 0.99 | 1.01 |
| 2 kHz | 0.99 | 1.01 |
| 5 kHz | 0.99 | 1.01 |
| 10 kHz | 0.99 | 1.01 |
| 20 kHz | 0.99 | 1.01 |
| 50 kHz | 0.99 | 1.01 |
| 100 kHz | 0.99 | 1.01 |
| 200 kHz | 0.99 | 1.01 |

(11) Position controls as listed in (a) through (d) below.

(a) TI **OUTPUT ▼** to select balanced output.

(b) **[SHIFT][TRG SRC]** turn the spin knob until **Src. Etn** (external source) is displayed.

(c) **[START/CENTER][1][Hz]**.

(d) **[STOP/BW] [10][Hz]**.

(12) Multimeter will indicate between 0.99 and 1.01 $V_{RMS}$.

(13) Repeat (11) (d) for remaining frequency values listed in table 5 above. Multimeter will indicate within limits specified.

(14) Disconnect the **TI BNC OUTPUT (+)** from the multimeter and connect the **+ (red)** banana output to the + multimeter input. Connect the **− (white)** banana output to the multimeter − input. Connect the **common (black)** banana to the multimeter guard input.

(15) Set TI amplitude to **8.0 $V_{RMS}$**.

(16) Multimeter will indicate between 7.92 and 8.08 $V_{RMS}$.

(17) Set TI output to settings in table 6 below. Multimeter will indicate within limits specified.

Table 6. Balanced Attenuator Test

| TI balanced output $V_{RMS}$ | Multimeter indication | |
|---|---|---|
| 0.80 | 0.792 $V_{RMS}$ | 0.808 $V_{RMS}$ |
| 0.08 | 79.2m $V_{RMS}$ | 80.8 $mV_{RMS}$ |
| 0.008 | 7.92 $mV_{RMS}$ | 8.08 $mV_{RMS}$ |

(18) Disconnect banana leads and connect oscilloscope and multimeter to TI **BNC OUTPUT (+)** utilizing BNC T connector.

**NOTE**

Ensure oscilloscope input is set to 1 MΩ.

(19) Position controls as listed in (a) through (d) below.

(a) TI **OUTPUT [▼]** to select unbalanced output.

(b) FUNCTION **[▼]** to change the function to a square wave.

(c) **[AMPL][2][VPP]**.

(d) **[FREQ][100][Hz]**.

(20) Multimeter will indicate between 0.99 and 1.01 $V_{RMS}$. Oscilloscope will indicate between 1.98 and 2.02 V pp

(21) Press TI **[FREQ] [20][Hz]**.

(22) Record the V PEAK-PEAK value from the oscilloscope.

(23) Repeat step (21) and (22) for remaining frequency values listed in table 7 below. Record oscilloscope indications.

Table 7. Square Wave Flatness

| TI Frequency | | Oscilloscope indication |
|---|---|---|
| 50 | Hz | |
| 100 | Hz | |
| 200 | Hz | |
| 500 | Hz | |
| 1 | kHz | |
| 2 | kHz | |
| 5 | kHz | |
| 10 | kHz | |
| 20 | kHz | |
| 50 | kHz | |
| 100 | kHz | |
| 200 | kHz | |

(24) Calculate the flatness using the minimum (Min) and maximum (Max) values from the peak to peak values.

$$\frac{(Max - Min)}{(\frac{Max + Min}{2})} * 100\% = \_\_\_\_\_\%$$

(25) Flatness will be within 99% and 101%.

**b. Adjustments.** No adjustments can be made.

**10. Total Harmonic Distortion**

**a. Performance Check**

**NOTE**
Keep cables as short as possible.

(1) Reset the TI by setting the **POWER ON/OFF** switch to **OFF**, wait 2 seconds, then turn the **POWER ON/OFF** switch to **ON** while pressing the **CLR** key.

(2) Connect TI **BNC OUTPUT (+)** to notch filter input. Set TI output frequency to **1 kHz** and amplitude to **1 $V_{RMS}$**.

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

(4) Position notch filter controls to measure 1 kHz fundamental frequency.

(5) Adjust spectrum analyzer controls to display fundamental frequency of 1 kHz.

(6) Set spectrum analyzer **MARKER** control to **1 kHz** and record fundamental frequency amplitude in dBm.

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

(8) Set spectrum analyzer center frequency to 2d, 3d, 4th, and 5th harmonic. Record harmonic amplitude 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 8 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 8. Notch Filter Correction Factors

| Harmonic values | Notch frequency switch settings [1] | | |
|---|---|---|---|
| | 20 Hz to 20kHz | 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 |

[1]Correction factors obtained from notch filter test report.

(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 9, interpolate corresponding value in additive factor column.

Example:

-112.2
-108.0
4.2 = difference value

(12) Locate difference value (4.2) in table 9 below and determine corresponding additive factor (1.42). Algebraically add additive factor to the numerically lower dB value (2d harmonic) of (11) above.

Example:

-108.2
+ 1.42
-106.58 = resulting number

Table 9. 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 9 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 9 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 ≤ -106 dB.

(17) Repeat technique of (4) through (16) above for TI and notch filter settings listed in table 10 below. THD will be within limits specified.

Table 10. Total Harmonic Distortion Accuracy

| Test instrument settings (kHz) | Notch filter settings (kHz) | Calculated THD (dB) |
|---|---|---|
| 10 | 10 | ≤-100 |
| 20 | 20 | ≤-96 |
| 50 | 50 | ≤-85 |
| 100 | 100 | ≤-68 |

**b. Adjustments.** No adjustments can be made.

**11. DC Offset**

**a. Performance Check**

(1) Connect the TI **BNC OUTPUT (+)** to the multimeter. Set the multimeter for DC measurement.

(2) Set TI amplitude to **0 Vpp/DC** and **OFFST** to **+20 Vpp/DC**.

(3) Multimeter will indicate between 19.775 and 20.225 V dc.

(4) Repeat steps (2) and (3) above for remaining TI settings listed in table 11 below. Multimeter will indicate within limits specified.

Table 11. DC Offset

| Offset voltage V dc | Multimeter indications | |
|---|---|---|
| +2.0 | 1.955 V dc | 2.045 V dc |
| +0.2 | 195.5 mV dc | 204.5 mV dc |
| +0.02 | 19.55 mV dc | 20.45 mV dc |
| +0.002 | 1.955 mV dc | 2.045 mV dc |
| -20.0 | -19.775 V dc | -20.225 V dc |
| -2.0 | -1.955 V dc | -2.045 V dc |
| -0.2 | -195.5 mV dc | -204.5 mV dc |
| -0.02 | -19.55 mV dc | -20.45 mV dc |
| -0.002 | -1.955 mV dc | -2.045 mV dc |

(5) Set TI **OFFST** to **0 Vpp/DC** and **AMPL** to **10 $V_{RMS}$**.

(6) Multimeter will indicate between -166 mV dc and +166 mV dc.

(7) Press function **[▼]** or **[▲]** to select appropriate waveform listed in table 12 below.

(8) Repeat steps (5) through (9) for remaining TI settings listed in table 13 below. Multimeter will indicate within limits specified.

Table 12. Residual Offset

| TI waveform | TI amplitude $V_{RMS}$ | Multimeter indications | |
|---|---|---|---|
| Sine | 10.000 | -166 mV dc | +166 mV dc |
| Sine | 1.000 | -39.1 mV dc | +39.1 mV dc |
| Sine | 0.100 | -3.91 mV dc | +3.91 mV dc |
| Sine | 0.010 | -391 uV dc | +391 uV dc |
| Sine | 0.001 | -39.1 uV dc | +39.1 uV dc |
| Square | 1.000 | -35 mV dc | +35m V dc |

**b. Adjustments.** No adjustments can be made.

**12. Output Impedance**

**a. Performance Check**

(1) Reset the TI by setting the **POWER ON/OFF** switch to **OFF**, wait 2 seconds, then turn the **POWER ON/OFF** switch to **ON** while pressing the **CLR** key.

(2) Connect the TI **BNC OUTPUT (+)** to the multimeter through the 50 Ω feed through termination. Set the multimeter to measure AC volts.

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

(a) **[SHIFT] [Hi-Z]**.
(b) **[AMPL] [1] [$V_{RMS}$]**.

(4) Multimeter will indicate between 0.632 and 0.701 $V_{RMS}$.

(5) Repeat steps (3) and (4) for remaining TI settings listed in table 13 below. Multimeter will indicate within limits specified.

Table 13. Output Impedance

| Impedance | Amplitude VRMS | Lower Limit VRMS | Upper Limit VRMS |
|---|---|---|---|
| 600 Unbal | 1.0 | 0.151 | 0.157 |
| 50 Unbal | 1.0 | 0.958 | 1.040 |
| 600 Bal | 1.0 | 0.140 | 0.145 |
| 150 Bal | 1.0 | 0.387 | 0.413 |

(6) Disconnect the TI **BNC OUTPUT (+)** from the multimeter. Connect the TI **BNC OUTPUT (-)** to the multimeter. Repeat steps (3) through (5).

**b. Adjustments.** No adjustments can be made.

**13. Final Procedure**

**a.** Deenergize and disconnect all equipment.

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

By Order of the Secretary of the Army:

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

Official:

JOYCE E. MORROW
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*Secretary of the Army*

0717701

Distribution:

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## Instructions for Submitting an Electronic 2028

**c.** 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.

**d.** From: "Whomever" whomever@redstone.army.mil
**e.** To: <2028@redstone.army.mil

**f.** Subject: DA Form 2028
**g.** 1. **From**: Joe Smith
**h.** 2. Unit: home
**i.** 3. **Address**: 4300 Park
**j.** 4. **City**: Hometown
**k.** 5. **St**: MO
**l.** 6. **Zip**: 77777
**m.** 7. **Date Sent**: 19-OCT –93
**n.** 8. **Pub no:** 55-2840-229-23
**o.** 9. **Pub Title**: TM
**p.** 10. **Publication Date**: 04-JUL-85
**q.** 11. Change Number: 7
**r.** 12. Submitter Rank: MSG
**s.** 13. **Submitter FName**: Joe
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**w.** 17. **Problem**: 1
**x.** 18. Page: 2
**y.** 19. Paragraph: 3
**z.** 20. Line: 4
**aa.** 21. NSN: 5
**bb.** 22. Reference: 6
**cc.** 23. Figure: 7
**dd.** 24. Table: 8
**ee.** 25. Item: 9
**ff.** 26. Total: 123
**gg.** 27. **Text**
**hh.** This is the text for the problem below line 27.