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DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR FUNCTION GENERATOR SG-1288/G

Headquarters, Department of the Army, Washington, DC
10 August 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.

*This bulletin supersedes TB 9-6625-2233-35, dated 2 January 2003, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Function Generator, SG-1288/G. Procurement specification A3056257 was 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.

b. Time and Technique. The time required for this calibration is approximately 5 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
Frequency[1]	Range: 2 mHz to 19.99 Hz Accuracy: ±3% Range: 20 Hz to 999.9 kHz Accuracy: ±0.05% Range: 1 to 19.99 MHz Accuracy: ±0.1% Frequency vs line voltage variation (±10%):[2] Range: <20 Hz Accuracy: ±0.1% Range: >20 Hz Accuracy: ±0.01%

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Sine wave[3] Total harmonic distortion	Output amplitude: <10 V p-p Range: 2 mHz to 19.99 Hz Accuracy: <1% (-40 dBc) Range: 20 Hz to 99.9 kHz Accuracy: <0.5% (-46 dBc) Range: 100 to 999.9 kHz Accuracy: <1 % (-40 dBc) Range: 1 to 5.999 MHz Accuracy: <2% (-34 dBc) Range: 6 to 7.999 MHz Accuracy: <2.5% (-32 dBc) Range: 8 to 9.999 MHz Accuracy: <3% (-30 dBc) Range: 10 to 19.99 MHz Accuracy: <4% (-28 dBc) Output amplitude: >l0 V p-p Range: 2 mHz to 19.99 Hz Accuracy: <1 % (-40 dBc) Range: 20 Hz to 99.9 kHz Accuracy: <0.5% (-46 dBc) Range: 100 to 999.9 kHz Accuracy: <1 % (-40 dBc) Range: 1 to 5.999 MHz Accuracy: <2% (-34 dBc) Range: 6 to 7.999 MHz Accuracy: <3% (-30 dBc) Range: 8 to 9.999 MHz Accuracy: <4.5% (-27 dBc) Range: 10 to 19.99 MHz Accuracy: <5% (-26 dBc)
Sine wave[4] Non-harmonically related signals ±200 Hz of output	Range: <1 MHz Accuracy: <-60 dBc Range: 1 to 9.99 MHz Accuracy: <-40 dBc Range: 10 to 19.99 MHz Accuracy: <-36 dBc
Square wave	Rise/falltime: <13 ns Aberrations: <5%, ±20 mV of p-p amplitude Symmetry: 10 to 90% in l% steps to l MHz linearly decreasing to 50% fixed 20 MHz Accuracy: ±(l% +20 ns)

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Triangle wave	Linearity: (10 to 90%):[5] Range: 2 mHz to 99.99 kHz Accuracy: ±1% Range: 100 kHz to 1.99 MHz Accuracy: ±2% Range: 2 to 5 MHz Accuracy: ± 10% Symmetry: 10 to 90% in 1% steps to 1 MHz linearly decreasing to 5 MHz Accuracy: ±(1 % +20 ns)
Frequency modulation distortion	Range: 10 MHz carrier, 1 kHz modulation frequency at 100 kHz deviation Accuracy: <-35 dBc
Sine wave amplitude[6]	Range: 2 mHz to 99.99 kHz Range: 1 to 30 V[7] Accuracy: ±(2% +10 m V) Range: 100 mV to 1 V Accuracy: ±(2% +2 mV) Range: 1 to 100 mV Accuracy: ±(2% +1 mV) Range: 100 kHz to 999.9 kHz Range: 1 to 30 V Accuracy: ±(4% +10 mV) Range: 100 mV to 1 V Accuracy: ±(4% +2 mV) Range: 1 to 100 mV Accuracy: ±(4% +1 mV) Range: 1 to 4.999 MHz Range: 1 to 30 V Accuracy: ±(5% +10 mV) Range: 100 mV to 1 V Accuracy: ±(5% +2 mV) Range: 1 to 100 mV Accuracy: ±(5% +1 mV) Range: 5 to 15.99 MHz Range: 1 to 30 V Accuracy: ±(12%+10 mV) Range: 100 mV to 1 V Accuracy: ±(12%+2 mV) Range: 1 to 100 mV Accuracy: ±(12% +1 mV) Range: 16 to 19.99 MHz Range: 1 to 30 V Accuracy: ±(30% +10 mV)

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Sine wave amplitude[6] (cont)	Range: 100 mV to 1 V Accuracy: ±(30% +2 mV) Range: 1 to 100 mV Accuracy: ±(30% +1 mV)
Square/triangle amplitude (all values p-p)[6]	Range: 2 mHz to 99.99 kHz Range: 10 to 30 V Accuracy: ±(3% +20 mV) Range: 1 to 9.99 V Accuracy: ±(3% +l0 mV) Range: 0.1 to 0.999V Accuracy: ±(3% +4 mV) Range: 10 to 99.9 mV Accuracy: ±(3% +3 mV) Range: 1 to 9.99 mV Accuracy: ±(3% +2 mV) Range: 100 to 999.9 kHz Range: 10 to 30 V[5] Accuracy: ±(5% +20 mV) Range: 1 to 9.99 V Accuracy: ±(5% +10 mV) Range: 0. 1 to .999 V Accuracy: ±(5% +4 mV) Range: 10 to 99.9 mV Accuracy: ±(5% +3 mV) Range: 1 to 9.99 mV[5] Accuracy: ±(5% +2 mV) Range: 1 to 4.999 MHz Range: 10 to 30 V Accuracy: ±(6% +20 mV) Range: 1 to 9.99 V Accuracy: ±(6% +10 mV) Range: 0.1 to 0.999 V Accuracy: ±(6% +4 mV) Range: 10 to 99.9 mV Accuracy: ±(6% +3 mV) Range: 1 to 9.99 mV[5] Accuracy: ±(6% +2 mV) Range: 5 to 19.99 MHz (square wave only) Range: 10 to 30 V Accuracy: ±(12% +20 mV) Range: 1 to 9.99 V Accuracy: ±(12% +10 mV) Range: 0.1 to .999 V Accuracy: ±(12% +4 mV)

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Square/triangle amplitude (all values p-p)[6]	Range: 10 to 99.9 mV Accuracy: ±(12% +3 mV) Range: 1 to 9.99 mV Accuracy: ±(12% +2 mV)
Dc offset	Range: -10 to -0.5 and 0.5 to 10 V Accuracy: ±(1 % +20 mV) Range: -1 to -500 and 1 to 500 mV Accuracy: ±(1% +5 mV)
Sync out	Amplitude: Between 1 and 2.5 V p-p into 50 Ω Rise/falltime: <13 ns

[1]Not checked below .02 Hz.
[2]Verified to ±9.7% in this procedure.
[3]Not checked below 10 Hz or above 100 kHz.
[4]Checked only at 1 kHz.
[5]Specifications are not verified within this procedure.
[6]Not checked below 50 Hz.
[7]20.0 to 30.0 V p-p circuit accuracy (±3% +10 mV).

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 the calibration procedure. The following peculiar accessory is also required for this calibration: 50 Ω feedthrough termination (dummy load); BNC plug to BNC jack, Hewlett-Packard, Model 11048C.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUDIO ANALYZER	Range: 1 kHz ~1 V[1] Capability: Distortion measurements Accuracy: <60 dBc (.1%)	Boonton, Model 1121 (1121)
AUTOTRANSFORMER	Range: 105 to 125 V	General Radio, Type W10MT3AS3 (7910809) or Ridge, Model 9020A (9020A) or Ridge, Model 9020F (9020F)
FREQUENCY COUNTER	Range: 10 mHz to 20 MHz Accuracy: ±.0125%.	Fluke, Model PM6681/656 (PM6681/656)
MEASURING RECEIVER	Modulation range: 10 MHz carrier 1 kHz rage 100 kHz deviation Accuracy:[1] Power range: 26.28 mV to 5.571 V rms 100 kHz to 4.999 MHz Accuracy: ±1%	Hewlett-Packard, Model 8902A (8902A) w/sensors, Hewlett-Packard, Model 11722A (11722A)
MULTIMETER	Range: -4.01 to 5.07 V dc Accuracy: ±0.35% Range: 0.00194 to 7.74 V ac 50 Hz to 99.99 kHz Accuracy: ±0.5%	Hewlett-Packard, Model 3458A (3458A)
OSCILLOSCOPE	Range: Rise/falltime: <3.5 ns Amplitude: Range: 5.8 mV to 19.5 V p-p, Accuracy: ±1.6% (±2%)	(OS-303/G)
TUNABLE ACTIVE FILTER	Range: 1 kHz, 200 Hz bandpass Accuracy: <72 dBc	Krohn-Hite, Model 3940 (3940)

[1]Combined distortion <-47 dBc.

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 TM 11-6625-3198-40 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.

NOTE

Replace the RAM protection battery with a fresh one prior to the calibration attempt. Battery NSN is 6135-01-320-4815.

NOTE

Due to TI recall of previous setups, it may be necessary to press a multiple choice pushbutton more than one time to obtain the needed parameter.

a. Connect TI to autotransformer.

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

c. Set **POWER** switch to **ON** and allow 25 minutes for TI to warm-up and stabilize.

d. Press pushbuttons and verify display indications as listed in (1) through (11) below:

(1) **RESET** indicates reset (V1.02).

(2) **FREQUENCY** indicates **FREQ 1 kHz**.

(3) **AMPLITUDE** indicates **AMPL 5 VPP**.

(4) **DISPLAY** indicates **INTENSITY 16**.

(5) **SYMMETRY** indicates **SYMM 50 PCT**.

(6) **PHASE** indicates **PHASE 0 DEG**.

(7) **OFFSET** indicates **DCOFF 0 VDC**.

(8) **MODULATION START/STOP** indicates **START 2 HZ**.

(9) **MODULATION START/STOP** indicates **STOP 2 KHZ**.

(10) **MODULATION TIME** indicates **SWPTIME 1 SEC**.

(11) **MODULATION TIME** indicates **SWPRATE 1 HZ**.

8. Frequency and Line Stability

a. Performance Check

(1) Connect **SYNC OUT** output to frequency counter using a 50 Ω feedthrough termination.

(2) Press pushbuttons as listed in (a) through (e) below:

(a) **CALIBRATE** (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).

(b) **RESET**.

(c) **FREQUENCY**.
(d) **19**.
(e) **ENTER**.

(3) Frequency counter will indicate between 18.43 and 19.57 Hz.

(4) Record frequency counter indication.

(5) Adjust autotransformer for a 108 V output.

(6) Frequency counter will display within 0.1 percent of frequency recorded in (4) above.

(7) Adjust autotransformer for a 125 V output and repeat (6) above.

(8) Adjust autotransformer for 115 V output.

(9) Set TI for an output frequency of 1 MHz. Frequency counter will indicate between 999 and 1001 kHz.

(10) Record frequency counter indication.

(11) Adjust autotransformer for a 125 V output.

(12) Frequency counter will display within 0.01 percent of frequency recorded in (10) above.

(13) Adjust autotransformer for a 108 V output and repeat (12) above.

(14) Adjust autotransformer for a 115 V output.

(15) Repeat measurements for frequencies and frequency counter indications listed in table 3.

Table 3. Output Frequency Test

Test instrument frequency	Frequency counter display indications	
	Min	Max
19.00 MHz	18.981000 MHz	19.019000 MHz
900.0 kHz	899.55 kHz	900.45 kHz
20.0 Hz	19.99 Hz	20.01 Hz
19.0 Hz	18.43 Hz	19.57 Hz
10.0 Hz	9.70 Hz	10.30 Hz
1.0 Hz[1]	970.87 ms	1030.9 ms
0.1 Hz	9.7087 s	10.309 s
0.02 Hz	48.544 s	51.546 s

[1]Set frequency counter for time measurement, DC coupling, single ON, Holdoff ON, and press restart to begin measurement.

b. Adjustments. No adjustments can be made.

9. Symmetry

a. Performance Check

(1) Connect **SYNC OUT** output to oscilloscope **Vertical 1** input.

(2) Press pushbuttons as listed in (a) through (e) below:

(a) **CALIBRATE** (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).
(b) **RESET**.
(c) **SYMMETRY**.
(d) **1 0**.

(e) **ENTER**.

(3) Set oscilloscope to display at least two waveform cycles at a convenient amplitude and measure duty cycle.

(4) Oscilloscope duty cycle will display between 89.098 and 90.902 %.

(5) Repeat technique used in (2) (d) and (e) and (3) and (4) above, substituting control settings and frequency counter indications listed in table 4.

b. Adjustments. No adjustments can be made.

Table 4. Symmetry

Test instrument		Oscilloscope duty cycle display indications (%)	
Pushbuttons pressed	Symmetry (displayed value)	Min	Max
2, 0, Enter	20 PCT	79.198	80.802
3, 0, Enter	30 PCT	69.298	70.702
4, 0, Enter	40 PCT	59.398	60.602
5, 0, Enter	50 PCT	49.498	50.502
6, 0, Enter	60 PCT	39.598	40.402
7, 0, Enter	70 PCT	29.698	30.302
8, 0, Enter	80 PCT	19.798	20.202
9, 0, Enter	90 PCT	9.898	10.102

10. FM Distortion

a. Performance Check

(1) Press pushbuttons as listed in (a) through (k) below:

(a) **CALIBRATE** (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).
(b) **RESET**.
(c) **FREQUENCY**.
(d) **1**.
(e) **EXP**.
(f) **7**.
(g) **ENTER**.
(h) **AMPLITUDE**.
(i) **.15**.
(j) **ENTER**.
(k) **MODULATION FM/VCF**.

(2) Connect equipment as shown in figure 1.

NOTE

Ensure audio analyzer and measuring receiver modulation analyzer are in **LOCAL** mode.

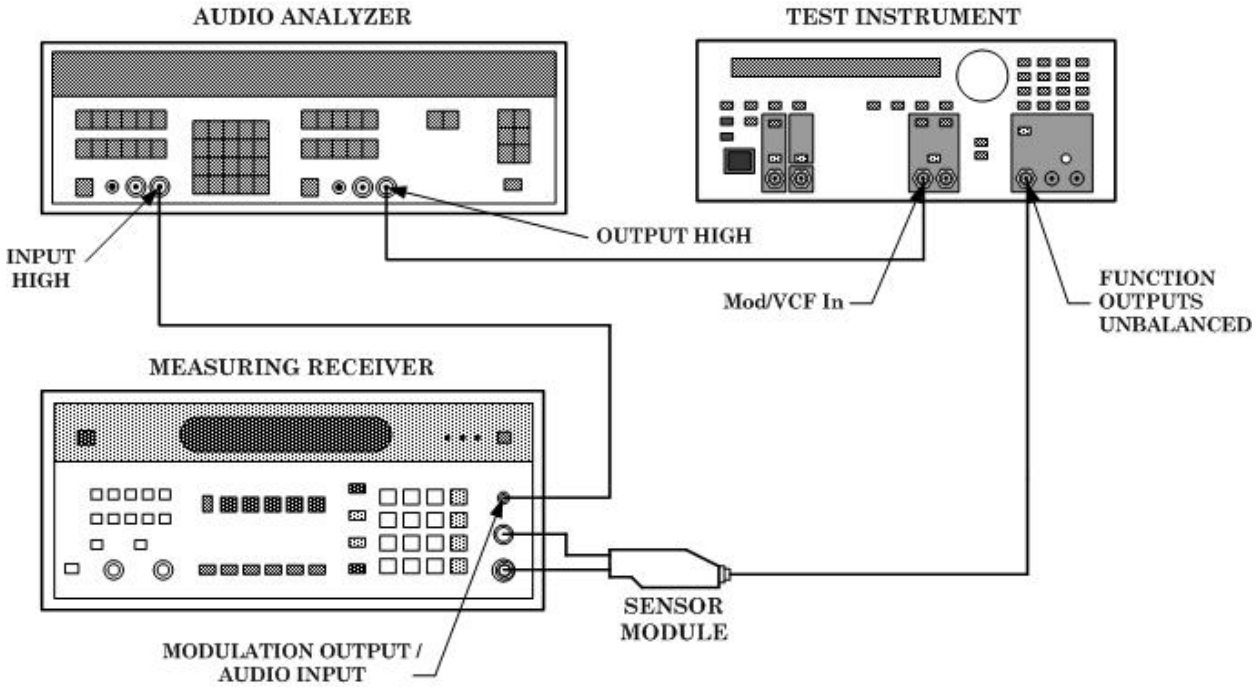

Figure 1. FM distortion - equipment hookup.

(3) Adjust audio analyzer frequency for 1 kHz and output level (approximately 36 mV) to obtain 100 kHz frequency deviation indication on the measuring receiver modulation analyzer.

(4) Measure distortion using the audio analyzer. Verify indicated distortion is <-35 dBc.

(5) Disconnect audio analyzer from **MOD/VCF IN**.

b. Adjustments. No adjustments can be made.

11. Pulse Characteristics

a. Performance Check

(1) Press pushbuttons as listed in (a) through (k) below:

(a) **CALIBRATE** (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).
(b) **RESET**.
(c) **FREQUENCY**.
(d) **1**.
(e) **EXP**.
(f) **6**.
(g) **ENTER**.
(h) **AMPLITUDE**.
(i) **5**.
(j) **ENTER**.
(k) **FUNCTION** ⅂ (square wave).

(2) Connect TI function outputs **UNBALANCED** to oscilloscope **Vertical 1** input using a 50 Ω feed through termination.

(3) Measure rise and falltime of displayed square wave using standard technique. Rise and falltime will be <13 ns.

(4) Measure positive and negative transition aberrations of displayed square wave. If peak-to-peak aberrations are not <5.4 %, perform **b** below.

(5) Remove cable from **UNBALANCED** and reconnect to **SYNC OUT**.

(6) Repeat technique of (3) above for **SYNC OUT** signal.

b. Adjustments

(1) Set **POWER** switch to **OFF**.

(2) Remove top cover.

NOTE

Keep top cover and shield in place during this procedure except when necessary to make an internal adjustment.

(3) Set **POWER** switch to **ON**.

(4) Press and hold (down) A2SW1 (fig. 2) and then press **CALIBRATE** pushbutton.

(5) Observe display indication of **WVTK SN X, XXX, XXX** or **WVTK SN 0**.

(6) Press **CURSOR** { pushbutton and allow enough time for calibrating mode to complete.

(7) Observe display indication of **ARMY SN X, XXX** or **ARMY SN 0**.

(8) Repeat (6) above observing display indication of **PEAKING C22**.

(9) Connect **UNBALANCED** output to oscilloscope **Vertical 1** input, using a 50 Ω feedthrough termination.

(10) Adjust A3C22 (fig. 3) for a peak-to-peak aberration of less than 5.4% displayed on oscilloscope (R).

(11) Press **CALIBRATE** pushbutton and verify display indicates **CALIBRATION OFF**.

(12) Disconnect equipment setup and reinstall top cover.

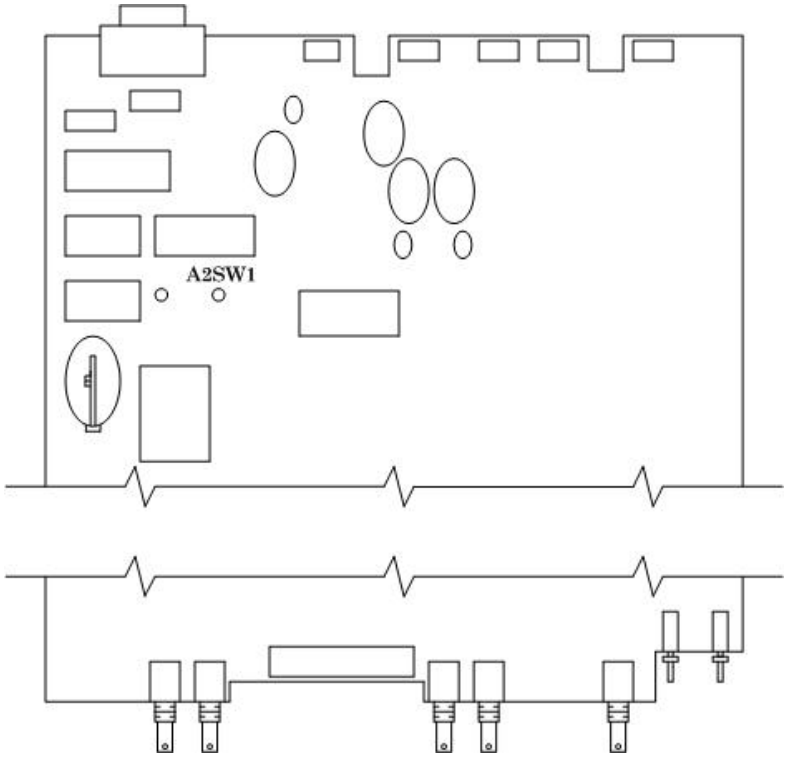

Figure 2. A2 motherboard.

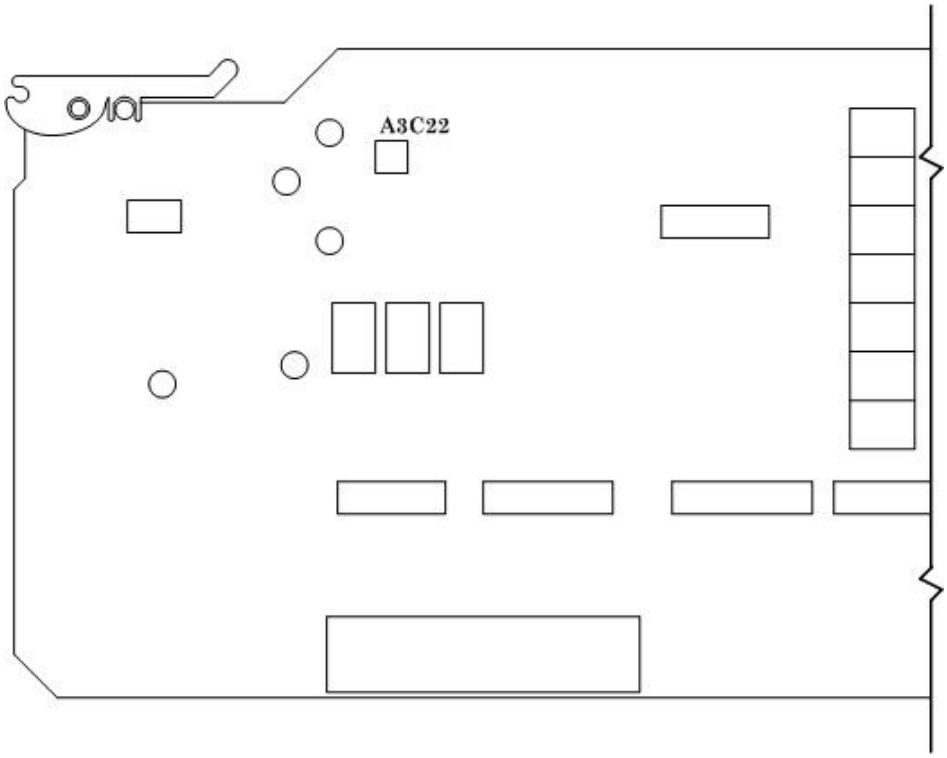

Figure 3. A3 output circuit card adjustment location.

12. Output Distortion

a. Performance Check

(1) Connect TI function outputs **UNBALANCED** to audio analyzer **INPUT HIGH** using a 50 Ω feedthrough termination.

(2) Press **CALIBRATION** pushbutton (allow enough time to complete and verify **AUTOCALIBRATED** is displayed) and then press **RESET** pushbutton.

(3) Press **FREQUENCY** pushbutton and enter **1000**. Measure distortion using standard distortion measurement technique. If total harmonic distortion is not <0.5% (-46 dBc), perform **b** below.

(4) Repeat (3) above substituting values from <10 V section of table 5.

(5) Press **AMPLITUDE** (until **VPP** is displayed) and enter **15.0**. Repeat (3) above substituting values from ≥10 V section of table 5.

Table 5. Sine Wave Distortion

Test instrument frequency settings	Maximum total harmonic distortion
<10 V	
1.00 kHz	<0.5% (-46 dBc)
20.00 Hz	<0.5% (-46 dBc)
99.9 kHz	<0.5% (-46 dBc)
100.0 kHz	<1% (-40 dBc)
≥10 V	
1.00 kHz	<0.5% (-46 dBc)
20.00 Hz	<0.5% (-46 dBc)
99.9 kHz	<0.5% (-46 dBc)
100.0 kHz	<1% (-40 dBc)

(6) Reduce outputs to minimum. Disconnect cable and 50 Ω feedthrough termination from the audio analyzer **INPUT HIGH** and connect to tunable active filter input.

(7) Connect tunable active filter output to the audio analyzer **INPUT HIGH**.

(8) Press pushbuttons as listed in (a) through (h) below:

(a) **FREQUENCY**.
(b) **1**.
(c) **EXP**.
(d) **3**.
(e) **ENTER**.
(f) **AMPLITUDE**.
(g) **5**.
(h) **ENTER**.

(9) Set tunable active filter for a bandpass of 800 to 1200 Hz and repeat (3) above substituting a distortion indication of <.1% (-60 dBc).

(10) Disconnect equipment setup.

b. Adjustments

(1) Position **POWER** switch to **OFF**.

(2) Remove top cover.

NOTE

Keep top cover and shield in place during this procedure except when necessary to make an internal adjustment.

(3) Position **POWER** switch to **ON**.

(4) Press and hold (down) A2SW1 (fig. 2) and then press **CALIBRATE** pushbutton.

(5) Press **CURSOR** { pushbutton three times and observe display indication of **R33**, **97**, **64**, **VSINE XXX.**

(6) Set TI for 5 V p-p output at 9.8 kHz.

(7) Connect **SYNC OUT** output to oscilloscope **Vertical 2** input.

(8) Connect audio analyzer monitor output (rear panel) to oscilloscope **Vertical 1** input and set oscilloscope controls for display of peak distortion.

(9) Adjust R33 (fig. 4) until waveform peaks are clearly visible in the residue.

(10) Adjust R97 (fig. 4) until waveform peaks are symmetrical, above and below the average value of the residue signal.

(11) Adjust R33 (fig. 4) until peaks disappear back into the residue.

(12) Observe the overall ripple in the residue in the area of the waveform zero crossings as displayed on the oscilloscope. Adjust **CONTROL** knob cw for clearly visible peaks displayed on oscilloscope and repeat (11) above.

NOTE

If the overall ripple has decreased, continue the test of (12) above turning the **CONTROL** knob clockwise. If the overall ripple has increased, continue technique of (12) above turning **CONTROL** knob counterclockwise.

(13) Repeat technique of (11) and (12) above until minimum overall ripple is displayed on oscilloscope.

(14) Connect MULTIMETER **+** lead to TP 10 (fig. 4) and **-** lead to TP 11 (fig. 4) and adjust R64 (fig. 4) for display of <1 mV dc.

(15) Press **CALIBRATE** pushbutton and verify display indicates **CALIBRATION OFF**.

13. Sine Wave Amplitude

a. Performance Check

(1) Connect **UNBALANCED** output to multimeter input using a 50 Ω feedthrough termination.

(2) Press pushbuttons as listed in (a) through (h) below:

(a) **CALIBRATE** (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).

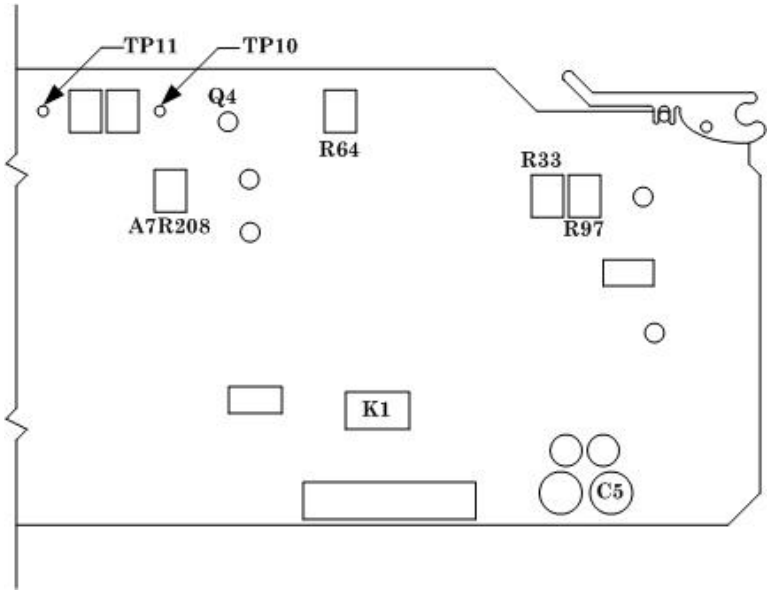

Figure 4. A7 phase lock loop circuit card adjustment location.

(b) **RESET**.
(c) **AMPLITUDE**.
(d) **1. 1 1**.
(e) **ENTER**.
(f) **FREQUENCY**.
(g) **50**.
(h) **ENTER**.

(3) Multimeter will indicate between minimum and maximum values listed in table 6.

(4) Repeat technique of (2) (c) through (h) and (3) above substituting settings and indications listed in table 6.

Table 6. Sine Wave Amplitude Accuracy 50 Hz to 99.99 kHz

Test instrument		Multimeter rms indications (V)	
Frequency	Output (V p-p)	Min	Max
50 Hz	1.11	0.381	0.404
50 Hz	.099	.0339	.0361
50 Hz	.2	.06858	.07282
50 Hz	.999	.345	.361
50 Hz	2	.689	.725
50 Hz	15	5.14	5.46
99.9 kHz	1.11	0.381	0.404
99.9 kHz	.099	.0339	.0361
99.9 kHz	.2	.06858	.07282
99.9 kHz	.999	.345	.361
99.9 kHz	2	.689	.725
99.9 kHz	15	5.14	5.46

(5) Reduce TI output to minimum. Set the measuring receiver to measure power.

(6) Connect measuring receiver power sensor to **CALIBRATOR RF POWER** connector and zero and cal the measuring receiver. Then disconnect measuring receiver power sensor from **CALIBRATOR RF POWER** connector.

(7) Set the measuring receiver to measure power in millivolts.

(8) Disconnect TI **UNBALANCED** output from multimeter and connect **UNBALANCED** output to measuring receiver power sensor (do not use the 50 Ω feedthrough termination).

(9) Press pushbuttons as listed in (a) through (h) below:

(a) **FREQUENCY**.
(b) **100**.
(c) **EXP**.
(d) **3**.
(e) **ENTER**.
(f) **AMPLITUDE**.
(g) **.099**.
(h) **ENTER**.

(10) Measuring receiver will indicate within minimum maximum limits as listed in table 7.

(11) Repeat technique of (9) (a) through (h) and (10) above substituting settings and indications listed in table 7.

Table 7. Sine Wave Amplitude Accuracy 100 kHz to 4.999 MHz

Test instrument		Measuring receiver indications (mV)	
Frequency	Output (V p-p)	Min	Max
100 kHz	.099	33.2	36.8
100 kHz	.2	67.17	74.24
100 kHz	.999	338	368
100 kHz	2	675	739
100 kHz	15	5086	5518
999.9 kHz	.099	33.2	36.8
999.9 kHz	.2	67.17	74.24
999.9 kHz	.999	338	368
999.9 kHz	2	675	739
999.9 kHz	15	5086	5518
1 MHz	.099	32.9	37.1
1 MHz	.2	66.46	74.94
1 MHz	.999	335	372
1 MHz	2	668	746
1 MHz	15	5034	5571
4.999 MHz	.099	32.9	37.1
4.999 MHz	.2	66.46	74.94
4.999 MHz	.999	335	372
4.999 MHz	2	668	746
4.999 MHz	15	5034	5571

(12) Reduce TI output to minimum. Disconnect **UNBALANCED** output from measuring receiver power sensor and connect **UNBALANCED** output to oscilloscope **Vertical 1** input using a 50 Ω feedthrough termination.

(13) Press pushbuttons as listed in (a) through (h) below:

(a) **FREQUENCY**.
(b) **5**.
(c) **EXP**.
(d) **6**.
(e) **ENTER**.
(f) **AMPLITUDE**.
(g) **.099**.
(h) **ENTER**.

(14) Set oscilloscope **Vertical 1** inputs for **DC Coupling**, **1MΩ Input**, scaling for approximately 4 or 5 divisions displayed, sweep speed for approximately 4 or 5 cycles displayed and volts pk-pk measurement.

(15) Oscilloscope will indicate within minimum maximum limits as listed in table 8.

(16) Repeat technique of (13) through (15) above substituting settings and indications listed in table 8.

Table 8. Sine Wave Amplitude Accuracy 5 MHz to 19.99 MHz

Test instrument		Oscilloscope indications (V p-p)	
Frequency	Output (V p-p)	Min	Max
5 MHz	.099	.086	.112
5 MHz	.2	.174	.226
5 MHz	.999	.877	1.12
5 MHz	2	1.75	2.25
5 MHz	15	13.2	16.8
15.99 MHz	.099	.086	.112
15.99 MHz	.2	.174	.226
15.9 MHz	.999	.877	1.12
15.99 MHz	2	1.75	2.25
15.99 MHz	15	13.2	16.8
19.99 MHz	.099	.068	.130
19.99 MHz	.2	.138	.262
19.99 MHz	.999	.697	1.30
19.99 MHz	2	1.39	2.61
19.99 MHz	15	10.5	19.5

b. Adjustments. No adjustments can be made.

14. Triangle Wave Amplitude

a. Performance Check

(1) Connect **UNBALANCED** output to multimeter input using 50 Ω feedthrough termination.

(2) Press pushbuttons as listed in (a) through (i) below:

(a) Calibrate (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).
(b) **RESET**.
(c) **FUNCTION** (triangle wave).
(d) **AMPLITUDE**.
(e) **.009**.
(f) **ENTER**.
(g) **FREQUENCY**.
(h) **50**.
(i) **ENTER**.

(3) Multimeter will indicate between 1.94 and 3.25 mV rms.

(4) Repeat technique of (2) (c) through (i), and (3) above substituting settings and indications listed in table 9.

Table 9. Triangle Wave Amplitude Accuracy 50 Hz to 99.99 kHz

Test instrument		Multimeter RMS indications	
Frequency (Hz)	Output (V p-p)	Min	Max
50	.01	1.93 mV	3.84 mV
50	.099	26.9 mV	30.3 mV
50	.1	26.8 mV	30.9 mV
50	.999	.279 V	.298 V
50	1	.277 V	.300 V
50	9.99	2.79 V	2.97 V
50	10	2.79 V	2.98 V
50	15	4.19 V	4.47 V
99.99 k	.01	1.93 mV	3.84 mV
99.99 k	.099	26.9 mV	30.3 mV
99.99 k	.1	26.8 mV	30.9 mV
99.99 k	.999	.279 V	.298 V
99.99 k	1	.277 V	.300 V
99.99 k	9.99	2.79 V	2.97 V
99.99 k	10	2.79 V	2.98 V
99.99 k	15	4.19 V	4.47 V

(5) Reduce TI output to minimum. Set the measuring receiver to measure power.

(6) Connect measuring receiver power sensor to **CALIBRATOR RF POWER** connector and zero and cal the power meter. Then disconnect measuring receiver power sensor from **CALIBRATOR RF POWER** connector.

(7) Set the measuring receiver to measure power in millivolts.

(8) Disconnect **UNBALANCED** output from multimeter and connect **UNBALANCED** output to measuring receiver power sensor (do not use the 50 Ω feedthrough termination).

(9) Press pushbuttons as listed in (a) through (h) below:

(a) **FREQUENCY**.
(b) **100**.
(c) **EXP**.
(d) **3**.

(e) **ENTER**.
(f) **AMPLITUDE**.
(g) **.099**.
(h) **ENTER**.

(10) Measuring receiver power meter will indicate within minimum maximum limits as listed in table 10.

Table 10. Triangle Wave Amplitude Accuracy 100 kHz to 4.999 MHz

Test instrument		Measuring receiver indications (mV)	
Frequency (Hz)	Output (V p-p)	Min	Max
100 k	.099	26.28	30.87
100 k	.1	26.27	31.47
100 k	.999	272.8	304.0
100 k	1	271.4	306.0
999.9 k	.099	26.28	30.87
999.9 k	.1	26.27	31.47
999.9 k	.999	272.8	304.0
999.9 k	1	271.4	306.0
1 M	.099	26.00	31.16
1 M	.1	25.98	31.75
1 M	.999	270.0	306.8
1 M	1	268.5	308.9
4.999 M	.099	26.00	31.16
4.999 M	.1	25.98	31.75
4.999 M	.999	270.0	306.8
4.999 M	1	268.5	308.9

(11) Repeat technique of (9) (a) through (h) and (10) above substituting settings and indications listed in table 10.

(12) Reduce TI output to minimum. Disconnect **UNBALANCED** output from measuring receiver power sensor and connect **UNBALANCED** output to oscilloscope **Vertical 1** input using a 50 Ω feedthrough termination.

(13) Press pushbuttons as listed in (a) through (h) below:

(a) **FREQUENCY**.
(b) **1**.
(c) **EXP**.
(d) **6**.
(e) **ENTER**.
(f) **AMPLITUDE**.
(g) **9.99**.
(h) **ENTER**.

(14) Set oscilloscope **Vertical 1** inputs for **DC Coupling**, **1MΩ Input**, scaling for approximately 4 or 5 divisions displayed, sweep speed for approximately 4 or 5 cycles displayed and volts pk-pk measurement.

(15) Oscilloscope will indicate within minimum maximum limits as listed in table 11.

(16) Repeat technique of (13) through (15) above substituting settings and indications listed in table 11.

Table 11. Triangle Wave Amplitude 1 to 4.999 MHz

Frequency (Hz)	Output (V p-p)	Oscilloscope indications (V p-p)	
		Min	Max
1 M	9.99	9.38	10.6
1 M	10	9.38	10.6
1 M	15	14.1	15.9
4.999 M	9.99	9.38	10.6
4.999 M	10	9.38	10.6
4.999 M	15	14.1	15.9

b. Adjustments. No adjustments can be made.

15. Square Wave Amplitude

a. Performance Check

(1) Connect **UNBALANCED** output to multimeter input using 50 Ω feedthrough termination.

(2) Press pushbuttons as listed in (a) through (i) below:

(a) Calibrate (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).
(b) **RESET**.
(c) **FUNCTION** (square wave).
(d) **AMPLITUDE**.
(e) **.009**.
(f) **ENTER.**
(g) **FREQUENCY**.
(h) **50**.
(i) **ENTER**.

(3) Multimeter will indicate between 3.37 and 5.64 mV rms.

(4) Repeat technique of (2) (c) through (i), and (3) above substituting settings and indications listed in table 12.

Table 12. Square Wave Amplitude Accuracy 50 Hz to 99.99 kHz

Test instrument		Multimeter	
Frequency (Hz)	Output (V p-p)	rms indications	
		Min	Max
50	.01	3.35 mV	6.65 mV
50	.099	46.5 mV	52.5 mV
50	.1	46.5 mV	53.5 mV
50	.999	.483 V	.516 V
50	1	.480 V	.520 V
50	9.99	4.84 V	5.15 V
50	10	4.84 V	5.16 V
50	15	7.27 V	7.74 V
99.9 k	.01	3.35 mV	6.65 mV

Table 12. Square Wave Amplitude Accuracy 50 Hz to 99.99 kHz - Continued

Test instrument		Multimeter	
Frequency (Hz)	Output (V p-p)	rms indications	
		Min	Max
99.9 k	.099	46.5 mV	52.5 mV
99.9 k	.1	46.5 mV	53.5 mV
99.9 k	.999	.483 V	.516 V
99.9 k	1	.480 V	.520 V
99.9 k	9.99	4.84 V	5.15 V
99.9 k	10	4.84 V	5.16 V
99.9 k	15	7.27 V	7.74 V

(5) Reduce TI output to minimum. Set the measuring receiver to measure power.

(6) Connect measuring receiver power sensor to **CALIBRATOR RF POWER** connector and zero and cal the power meter. Then disconnect measuring receiver power sensor from **CALIBRATOR RF POWER** connector.

(7) Set the measuring receiver to measure power in millivolts.

(8) Disconnect **UNBALANCED** output from multimeter and connect **UNBALANCED** output to measuring receiver power sensor (do not use the 50 Ω feedthrough termination).

(9) Press pushbuttons as listed in (a) through (h) below:

(a) **FREQUENCY**.
(b) **100**.
(c) **EXP**.
(d) **3**.
(e) **ENTER**.
(f) **AMPLITUDE**.
(g) **.099**.
(h) **ENTER**.

(10) Measuring receiver power meter will indicate within minimum maximum limits as listed in table 13.

(11) Repeat technique of (9) (a) through (h) and (10) above substituting settings and indications listed in table 13.

Table 13. Square Wave Amplitude 100 kHz to 4.999 MHz

Frequency (Hz)	Output (V p-p)	Measuring receiver indications (mV)	
		Min	Max
100 k	.099	45.52	53.48
100 k	.1	45.50	54.50
100 k	.999	472.5	526.5
100 k	1	470.0	530.0
999.9 k	.099	45.52	53.48
999.9 k	.1	45.50	54.50
999.9 k	.999	472.5	526.5
999.9 k	1	470.0	530.0

Table 13. Square Wave Amplitude 100 kHz to 4.999 MHz- Continued

Frequency (Hz)	Output (V p-p)	Measuring receiver indications (mV)	
		Min	Max
1 M	.099	45.03	53.97
1 M	.1	45.00	55.00
4.999 M	.099	45.03	53.97
4.999 M	.1	45.00	55.00

(12) Reduce TI output to minimum. Disconnect **UNBALANCED** output from measuring receiver power sensor and connect **UNBALANCED** output to oscilloscope **Vertical 1** input using a 50 Ω feedthrough termination.

(13) Press pushbuttons as listed in (a) through (h) below:

(a) **FREQUENCY**.
(b) **1**.
(c) **EXP**.
(d) **6**.
(e) **ENTER**.
(f) **AMPLITUDE**.
(g) **.999**.
(h) **ENTER**.

(14) Set oscilloscope **Vertical 1** inputs for **DC Coupling**, **1MΩ Input**, scaling for approximately 4 or 5 divisions displayed, sweep speed for approximately 4 or 5 cycles displayed and volts pk-pk measurement.

(15) Oscilloscope will indicate within minimum maximum limits as listed in table 14.

(16) Repeat technique of (13) through (15) above substituting settings and indications listed in table 14.

Table 14. Square Wave Amplitude 1 to 19.99 MHz

Frequency (Hz)	Output (V p-p)	Oscilloscope indications (V p-p)	
		Min	Max
1 M	.999	.935 mV	1.06 V
1 M	1	.930 mV	1.07 V
1 M	9.99	9.38 V	10.6 V
1 M	10	9.38 V	10.6 V
1 M	15	14.1 V	15.9 V
4.999 M	.999	.935 mV	1.06 V
4.999 M	1	.930 mV	1.07 V
4.999 M	9.99	9.38 V	10.6 V
4.999 M	10	9.38 V	10.6 V
4.999 M	15	14.1 V	15.9 V
5 M	.009	5.92 mV	12.1 mV
5 M	.01	5.8 mV	14.2 mV
5 M	.099	84 mV	114 mV
5 M	.1	84 mV	116 mV
5 M	.999	875 mV	1.12 V
5 M	1	870 mV	1.13 V
5 M	9.99	8.78 V	11.2 V

Table 14. Square Wave Amplitude 1 to 19.99 MHz - Continued

Frequency (Hz)	Output (V p-p)	Oscilloscope indications (V p-p)	
		Min	Max
5 M	10	8.78 V	11.2 V
5 M	15	13.2 V	16.8 V
19.99 M	.009	5.92 mV	12.1 mV
19.99 M	.01	5.8 mV	14.2 mV
19.99 M	.099	84 mV	114 mV
19.99 M	.1	84 mV	116 mV
19.99 M	.999	875 mV	1.12 V
19.99 M	1	870 mV	1.13 V
19.99 M	9.99	8.78 V	11.2 V
19.99 M	10	8.78 V	11.2 V
19.99 M	15	13.2 V	16.8 V

(17) Reduce TI output to minimum.

b. Adjustments. No adjustments can be made.

16. Dc Offset and Attenuator

a. Performance Check

(1) Connect **UNBALANCED** output to multimeter using 50 Ω feedthrough termination.

(2) Press pushbuttons as listed in (a) through (g) below:

(a) **CALIBRATE** (allow enough time to complete and verify **AUTOCALIBRATED** is displayed).

(b) **FUNCTION OUTPUTS 50** (pressed).

(c) **RESET**.

(d) **FUNCTION DC**.

(e) **OFFSET**.

(f) **5**.

(g) **ENTER**.

(3) Observe multimeter indication between 4.930 and 5.070 V dc.

(4) Repeat technique of (2) (f) through (g) and (3) above for control settings listed in table 15 below. Digital voltmeter will indicate between specified limits.

(5) Reduce output to minimum and disconnect equipment setup.

b. Adjustments. No adjustments can be made.

Table 15. Dc Offset Accuracy

Offset voltage (V)	Multimeter indications (Vdc)	
	Min	Max
2	1.96	2.04
1	.97	1.03
.501	.47599	.52601
.499	.48901	.50899
.25	.2425	.2575

Table 15. Dc Offset Accuracy - Continued

Offset voltage (V)	Multimeter indications (Vdc)			
	Min		Max	
.1	94.0	mV	106.0	mV
.05	44.5	mV	55.5	mV
.025	19.75	mV	30.25	mV
.01	4.9	mV	15.1	mV
.005	-.05	mV	10.05	mV
.003	-2.03	mV	8.03	mV

17. 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:

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

Official:

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

0416103

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344361, requirements for calibration procedure TB 9-6625-2233-35.

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.