*TB 9-6625-1959-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR LEVELED SINE WAVE GENERATOR TEKTRONIX, TYPE SG-503

Headquarters, Department of the Army, Washington, DC
24 March 2003

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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

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

*This bulletin supersedes TB 9-6625-1959-35, 20 January 1992.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Leveled Sine Wave Generator, Tektronix, Type SG-503. The manufacturer's manual 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 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

Common name	Minimum use specifications
Frequency	Range: 250 kHz to 250 MHz, +50 kHz reference frequency
Amplitude	Range: 5 mV to 5.5 V p-p over 3 decade ranges and terminated into a 50Ω load Accuracy: (at 50 kHz reference frequency) X1 range: ±3% of indicated amplitude X.1 range: ±4% of indicated amplitude X.01 range: ±5% of indicated amplitude
Harmonic content (harmonic suppression relative to fundamental) Second harmonic Third and higher harmonics	 At least 35 dB down At least 40 dB down
Flatness	Range: 250 kHz to 250 MHz (50 kHz reference) Accuracy: 250 kHz to 100 MHz, ±1.5% 100 to 250 MHz, ±3.0%

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. 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 1 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 accessory is also required for this calibration: Precision 36-inch, 50Ω BNC Cable, Tektronix, PN 0120482-00 supplied with TI.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUDIO ANALYZER	Range: .01679 to 1.82 V ac at 50 kHz Accuracy: ±0.75% (1%)	Boonton, Model 1120-S/10 (MIS-35954/2)
MULTIMETER	Range: 5.2 and -22 V dc Accuracy: ±.06%	Hewlett-Packard, Model 3458A (3458A)
MEASURING RECEIVER	Range: 100 kHz to 250 MHz at 1 V ac Flatness: ±.375% (±.65%)	Consisting of: Measuring receiver Hewlett-Packard, Model 8902A (8902A) and sensor module Hewlett-Packard, Model 11722A (11722A)
SIGNAL GENERATOR	Range: 1 V at 100 kHz	(SG-1207/U)
SPECTRUM ANALYZER	Range: 50 kHz to 250 MHz Capability: < -45 dBc	(AN/USM-489A)

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

(1) **AMPLITUDE MULTIPLIER** switch to **X1.**

(2) **FREQUENCY VARIABLE** control to midrange**.**

(3) **FREQUENCY RANGE (MHz)** switch to **REF** » **.05.**

b. Connect TI to power module, using plug-in extender.

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

d. Energize equipment and allow 20 minutes to warm up and stabilize.

8. Amplitude and Amplitude Multiplier

a. Performance Check

(1) Connect audio analyzer **INPUT HIGH** to TI **OUTPUT** using precision cable and 50Ω feedthrough termination.

(2) Adjust **OUTPUT AMPLITUDE VOLTS P-P** control to **5.0.** If audio analyzer does not indicate between 1.714 and 1.820 V ac, perform **b**(l) below.

(3) Adjust **OUTPUT AMPLITUDE VOLTS P-P** control to **0.5.** If audio analyzer does not indicate between 171.4 and 182.0 mV ac, perform **b**(2) below.

(4) Adjust **OUTPUT AMPLITUDE VOLTS P-P** control to **5.0.**

(5) Set **AMPLITUDE MULTIPLIER** switch to **X.1**. Audio analyzer will indicate between 169.6 and 183.9 mV ac.

(6) Set **AMPLITUDE MULTIPLIER** switch to **X.01.** Audio analyzer will indicate between 16.79 and 18.56 mV ac.

b. Adjustments

(1) Adjust R255 5V (fig. 1) for a 1.767 V ac indication on audio analyzer (R).

(2) Adjust R265 .5V (fig. 1) for a 176.8 mV ac indication on audio analyzer (R).

NOTE

R255 5V and R265 .5V adjustments interact. Repeat **a**(1) through (6) above until deviation from reference at both points is minimized.

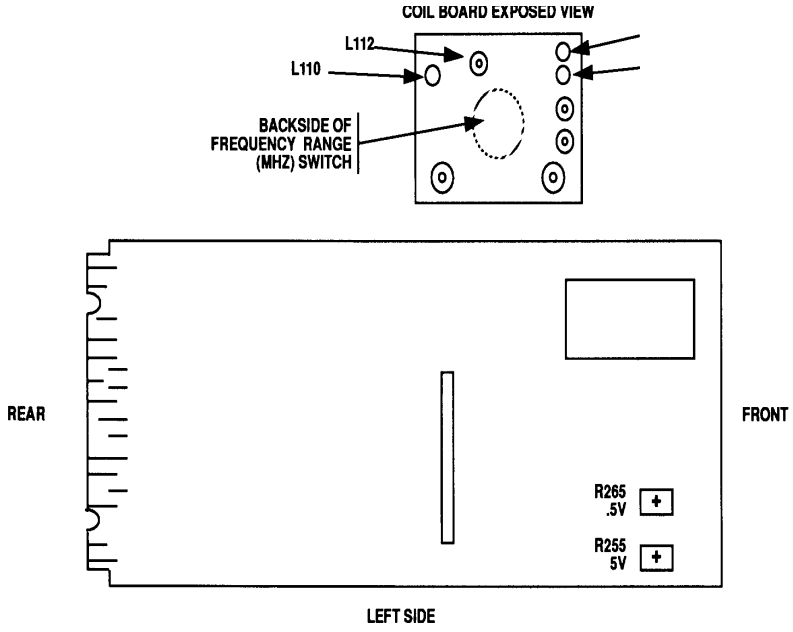

Figure 1. Main circuit board left side - adjustment locations.

9. Output Buffer Current and Harmonic Suppression

a. Performance Check

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

(a) **FREQUENCY RANGE (MHz)** switch to **100-250**.

(b) **FREQUENCY VARIABLE** control for a **100 MHz** display on **FREQUENCY MHZ** indicator.

(c) **OUTPUT AMPLITUDE VOLTS P-P** control to **5.5**.

(d) **AMPLITUDE MULTIPLIER** switch to **X1**.

(2) Connect TI **OUTPUT** to spectrum analyzer **INPUT 50** W.

(3) Set spectrum analyzer controls as listed in (a) through (e).

(a) **PRESET**.

(b) **AMPLITUDE**, **REF LVL** to **+20 dBm**.

(c) **AMPLITUDE**, **ATTENUATION** to **30 dB**.

(d) **FREQUENCY**, **CENTER FREQ 100 MHz**.

(e) **SPAN** to **2 MHz**.

(4) Allow the spectrum analyzer to sweep a few times then set spectrum analyzer as listed in (a) through (e).

(a) **PEAK SEARCH**.

(b) **MARKER ® CF**.

(c) **MARKER DELTA**.

(d) **FREQUENCY**, **CENTER FREQ**, (harmonic frequency listed in table 3) **MHz**.

(e) **PEAK SEARCH**.

(5) The spectrum analyzer D**MKR** will indicate less than or equal to the minimum limit listed in table 3. If spectrum analyzer is not less than or equal to the minimum limit listed in table 3, perform **b** below.

(6) Repeat (4)(d) and (e) through (5) above for remaining harmonic frequency listed in table 3.

Table 3. Output Buffer Current and Harmonic Suppression

Test Instrument Frequency (MHz)	Harmonic frequency	Harmonic	Spectrum analyzer Indication (dB) minimum (≤)
100 MHz	200 MHz	2nd	-35
100 MHz	300 MHz	3rd	-40

(7) Adjust **OUTPUT AMPLITUDE VOLTS P-P** control to **3.0**.

(8) Repeat (3) through (6) above.

(9) Adjust **OUTPUT AMPLITUDE VOLTS P-P** control to **0.5**.

(10) Repeat (3) through (6) above.

b. Adjustments. Adjust CURRENT ADJ R175 (fig. 2) until third harmonic is at least 40 dB down from reference while assuring that second harmonic amplitude remains 35 dB down from reference. If second harmonic is equal to or greater than 35 dB down, do not adjust CURRENT ADJ R175 (fig. 2) to reduce second harmonic at expense of increasing the third (R).

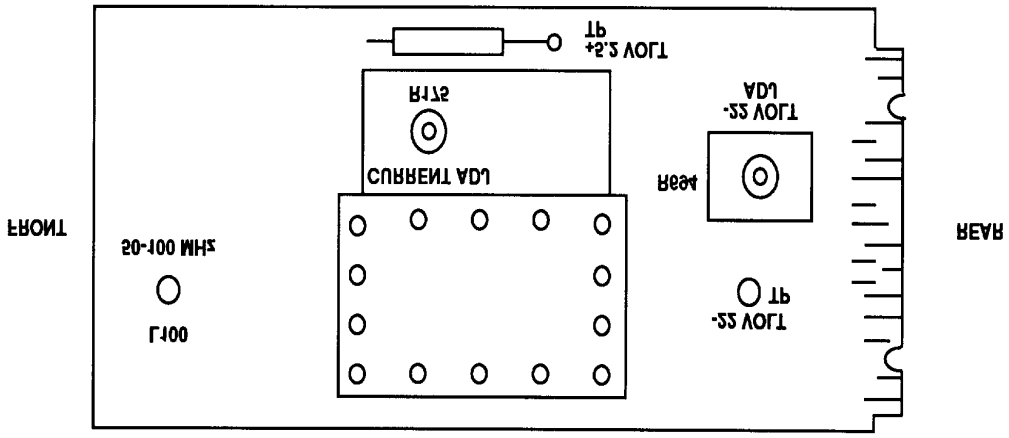

Figure 2. Main circuit board adjustment locations - right side.

10. Frequency and Harmonics

NOTE

It is not essential that displayed frequency count agrees exactly with values listed, but it is necessary that harmonic suppression requirements are satisfied over entire range.

a. Performance Check

(1) Connect TI **OUTPUT** to spectrum analyzer **INPUT 50** W.

(2) Position controls as listed in (a) through (f) below:

(a) **OUTPUT AMPLITUDE VOLTS P-P** control to **5.5.**

(b) **AMPLITUDE MULTIPLIER** switch to **Xl.**

(c) **FREQUENCY RANGE (MHz)** switch to **100-250.**

(d) **FREQUENCY VARIABLE** control fully cw. **FREQUENCY MHz** indicator will display 250 MHz or greater.

(e) **FREQUENCY VARIABLE** control fully ccw. **FREQUENCY MHz** indicator will display 100 MHz or less.

(f) **FREQUENCY VARIABLE** control for a 250 MHz (high end) display on **FREQUENCY MHz** indicator.

(3) Set spectrum analyzer controls as listed in (a) through (e).

(a) **PRESET**.

(b) **AMPLITUDE**, **REF LVL** to **+20 dBm**.

(c) **AMPLITUDE**, **ATTENUATION** to **30 dB**.

(d) **FREQUENCY**, **CENTER FREQ**, (to TI **VARIABLE FREQUENCY** control setting listed in table 4).

(e) **SPAN** (to spectrum analyzer span setting listed in table 4).

(4) Allow the spectrum analyzer to sweep a few times then set spectrum analyzer as listed in (a) through (e).

(a) **PEAK SEARCH.**

(b) **MARKER ® CF.**

(c) **MARKER DELTA.**

(d) **FREQUENCY**, **CENTER FREQ**, (2^{nd} harmonic frequency listed in table 4) **MHz**.

(e) **PEAK SEARCH**.

(5) The spectrum analyzer D**MKR** will indicate less than or equal to the minimum limit listed in table 4. If spectrum analyzer is not less than or equal to the minimum limit listed in table 4, perform **b** below.

(6) Repeat (4)(d) and (e) through (5) above for the 3rd harmonic frequency listed in table 4.

(7) Set spectrum analyzer marker to normal by pressing the **MARKER NORMAL** softkey.

(8) Adjust **FREQUENCY VARIABLE** control for a display of the next frequency listed in table 4 on **FREQUENCY MHz** indicator.

(9) Repeat steps (3)(d) through (7).

(10) Repeat steps (8) and (9) for the remaining TI **FREQUENCY VARIABLE** settings listed in table 4.

Table 4. Frequency and Harmonics

Test instrument		Spectrum analyzer			
FREQUENCY RANGE (MHz) switch settings	**FREQUENCY VARIABLE** control settings	Span setting	Harmonic frequency	Harmonic	Indications (dB) minimum (≤)
100-250	250	2 MHz	500 MHz	2nd	-35
		2 MHz	750 MHz	3rd	-40
	175	2 MHz	350 MHz	2nd	-35
		2 MHz	525 MHz	3rd	-40
	100	2 MHz	200 MHz	2nd	-35
		2 MHz	300 MHz	3rd	-40
50-100	50	2 MHz	100 MHz	2nd	-35
		2 MHz	150 MHz	3rd	-40
	75	2 MHz	150 MHz	2nd	-35
		2 MHz	225 MHz	3rd	-40
	100	2 MHz	200 MHz	2nd	-35
		2 MHz	300 MHz	3rd	-40
25-50	50	2 MHz	100 MHz	2nd	-35
		2 MHz	150 MHz	3rd	-40
	37.5	2 MHz	75 MHz	2nd	-35
		2 MHz	112.5 MHz	3rd	-40
	25	2 MHz	50 MHz	2nd	-35
		2 MHz	75 MHz	3rd	-40
10-25	10	2 MHz	20 MHz	2nd	-35
		2 MHz	30 MHz	3rd	-40
	17.5	2 MHz	35 MHz	2nd	-35
		2 MHz	52.5 MHz	3rd	-40
	25	2 MHz	50 MHz	2nd	-35
		2 MHz	75 MHz	3rd	-40
5-10	10	2 MHz	20 MHz	2nd	-35
		2 MHz	30 MHz	3rd	-40
	7.5	2 MHz	15 MHz	2nd	-35
		2 MHz	22.5 MHz	3rd	-40
	5	2 MHz	10 MHz	2nd	-35
		2 MHz	15 MHz	3rd	-40
2.5-5	2.5	2 MHz	5 MHz	2nd	-35
		2 MHz	7.5 MHz	3rd	-40
	3.75	2 MHz	7.5 MHz	2nd	-35
		2 MHz	11.25 MHz	3rd	-40
	5	2 MHz	10 MHz	2nd	-35

Table 4. Frequency and Harmonics - Continued

Test instrument					
FREQUENCY RANGE (MHz) switch settings	**FREQUENCY VARIABLE** control settings	Spectrum analyzer span setting	Harmonic frequency	Harmonic	Spectrum analyzer indication (dB) minimum (≤)
		2 MHz	15 MHz	3rd	-40
1-2.5	2.5	1 MHz	5 MHz	2nd	-35
		1 MHz	7.5 MHz	3rd	-40
	1.75	1 MHz	3.5 MHz	2nd	-35
		1 MHz	5.25 MHz	3rd	-40
	1	1 MHz	2 MHz	2nd	-35
		1 MHz	3 MHz	3rd	-40
.5-1	.5	500 kHz	1 MHz	2nd	-35
		500 kHz	1.5 MHz	3rd	-40
	.75	500 kHz	1.5 MHz	2nd	-35
		500 kHz	2.25 MHz	3rd	-40
	1	500 kHz	2 MHz	2nd	-35
		500 kHz	3 MHz	3rd	-40
.25-.5	.5	200 kHz	1 MHz	2nd	-35
		200 kHz	1.5 MHz	3rd	-40
	.375	200 kHz	.75 MHz	2nd	-35
		200 kHz	1.125 MHz	3rd	-40
	.25	200 kHz	.5 MHz	2nd	-35
		200 kHz	.75 MHz	3rd	-40
REF≈.05	.05	50 kHz	.1 MHz	2nd	-35
		50 kHz	.15 MHz	3rd	-40

Table 5. Frequency Overlapping and Harmonic Suppression

Test Instrument		Adjustments (R)
FREQUENCY RANGE (MHz) switch settings	**FREQUENCY VARIABLE** control (typical) settings	
100-250	97.5-260	- - -
50-100	41.0-109	L100 (fig. 3) 50-100 MHz
25-50	23.7-52.5	L110 (fig. 1)
10-25	9.09-27.3	L112 (fig. 1)
5-10	4.70-11.1	L114 (fig. 1)
2.5-5	2.30-5.50	L116 (fig. 1)
1-2.5	.950-2.55	- - -
.5-1	.480-1.05	- - -
.25-.5	.240-.520	- - -
REF ≈ .05	.049-.051	- - -

b. Adjustments. Tuning slugs (coils) associated with **FREQUENCY RANGE** (**MHz**) **50-100**, **25-50**, **10-25**, **5-10**, and **2.5-5** switch settings are adjustable for overlapping of frequencies and harmonic suppression. Adjustment of tuning slugs will affect both frequency and harmonic suppression. If a tuning slug is adjusted to suppress harmonics, it may be necessary to readjust to maintain both frequency overlapping and harmonic suppression. No tuning slug should be adjusted for more than marginal deviations in frequency range or harmonic suppression. Generation of large harmonic amplitudes or large deviations in tuning range, listed in table 5, indicates circuit faults which must be corrected.

11. Flatness

a. Performance Check

(1) Connect power sensor module to measuring receiver **CALIBRATION RF POWER OUTPUT**.

(2) Calibrate and save the calibration of the power sensor.

(3) Disconnect the power sensor module from the measuring receiver **CALIBRATION RF POWER OUTPUT**.

(4) Connect the power sensor module to the signal generator output.

(5) Set measuring receiver to indicate power level in millivolts and auto measurement mode.

(6) Press the measuring receiver **.100** and **MHz** keys.

(7) Set signal generator controls for a 100 kHz output and adjust output level for approximately 1000 mV indication on measuring receiver.

(8) Press **RATIO** key on measuring receiver.

(9) Set audio analyzer to measure 1000 mV ac.

(10) Disconnect the power sensor module from the signal generator output.

(11) Without disturbing signal generator settings, connect signal generator output to audio analyzer **INPUT HIGH** using the 50Ω feedthrough termination to be used with TI in (14) below.

(12) Press **RATIO** key on audio analyzer.

(13) Disconnect signal generator output from audio analyzer **INPUT HIGH.**

(14) Connect TI **OUTPUT** to audio analyzer **INPUT HIGH** using precision cable and the 50Ω feedthrough termination used in (11) above.

(15) Set **FREQUENCY RANGE (MHz)** switch to **REF** » **.05** and **FREQUENCY VARIABLE** control for a **FREQUENCY MHz** indication of .**050 MHz**.

(16) Set **AMPLITUDE MULTIPLIER** switch to **X1** and adjust **OUTPUT AMPLITUDE VOLTS P-P** control for a 100.00 percent indication on audio analyzer.

(17) Disconnect precision cable from 50Ω feedthrough termination and connect to measuring receiver power sensor using necessary adapter.

(19) Set TI controls to the first **FREQUENCY VARIABLE** control setting listed in table 6.

(20) Set the measuring receiver to the first **FREQUENCY VARIABLE** control setting listed in table 6 using the numeric key pad and the **MHz** keys.

NOTE

Do not take the measuring receiver out of the ratio mode

(21) Measuring receiver will indicate between the minimum and maximum values listed in table 6 for the selected frequency

(22) Repeat (19) through (21) above for each remaining frequency listed in table 6.

Table 6. Flatness

Test instrument		Measuring receiver indication	
FREQUENCY RANGE (MHz) switch settings	**FREQUENCY VARIABLE** control settings	Min	Max
.25-.5	.25	98.5%	101.5%
	.375	98.5%	101.5%
	.50	98.5%	101.5%
.5-1.0	1.0	98.5%	101.5%
	.75	98.5%	101.5%
	.50	98.5%	101.5%
1-2.5	1.0	98.5%	101.5%
	1.25	98.5%	101.5%
	1.50	98.5%	101.5%
	1.75	98.5%	101.5%
	2.00	98.5%	101.5%
	2.25	98.5%	101.5%
	2.50	98.5%	101.5%
2.5-5.0	5.00	98.5%	101.5%
	4.50	98.5%	101.5%
	4.00	98.5%	101.5%
	3.50	98.5%	101.5%
	3.00	98.5%	101.5%
	2.50	98.5%	101.5%
5.0-10	5.0	98.5%	101.5%
	6.0	98.5%	101.5%
	7.0	98.5%	101.5%
	8.0	98.5%	101.5%
	9.0	98.5%	101.5%
	10	98.5%	101.5%

Table 6. Flatness - Continued

Test instrument		Measuring receiver indication	
FREQUENCY RANGE (MHz) switch settings	**FREQUENCY VARIABLE** control settings	Min	Max
10-25	25	98.5%	101.5%
	22.5	98.5%	101.5%
	20	98.5%	101.5%
	17.5	98.5%	101.5%
	15	98.5%	101.5%
	12.5	98.5%	101.5%
	10	98.5%	101.5%
25-50	25	98.5%	101.5%
	30	98.5%	101.5%
	35	98.5%	101.5%
	40	98.5%	101.5%
	45	98.5%	101.5%
	50	98.5%	101.5%
50-100	100	98.5%	101.5%
	90	98.5%	101.5%
	80	98.5%	101.5%
	70	98.5%	101.5%
	60	98.5%	101.5%
	50	98.5%	101.5%
100-250	100	97%	103%
	125	97%	103%
	150	97%	103%
	175	97%	103%
	200	97%	103%
	225	97%	103%
	250	97%	103%

b. Adjustments. No adjustments can be made.

12. Power Supply

NOTE

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

a. Performance Check

(1) Connect multimeter **HI** to-22 VOLT TP (fig. 2) and **LO** to chassis ground. If multimeter does not indicate between -21.95 and -22.05 V dc, perform **b** below.

(2) Connect multimeter **HI** to +5.2 VOLT TP (fig. 2). Multimeter will indicate between 5.0 and 5.4 V dc.

b. Adjustments. Adjust R694 -22 VOLT ADJ (fig. 2) for a -22 V indication on multimeter.

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:

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OFFICIAL:

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