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DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR PULSE FUNCTION ARBITRARY NOISE GENERATOR, AGILENT MODEL 81150A

Headquarters, Department of the Army, Washington, DC
20 November 2009

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.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Pulse Function Arbitrary Noise Generator Agilent Model 81150A. 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 5 hours, using the dc and low frequency and microwave techniques.

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 in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
DC Offset Accuracy	Range: -5 VDC to 20 VDC Accuracy: ± 5 V Voltage window ± (25 mV + 1%) ± 10 V Voltage window ± (50 mV + 1%) ± 20 V Voltage window ± (75 mV + 1%)
Amplitude Accuracy	Range: 0.100 V_{PP} to 10 V_{PP} Accuracy: ± (1.5% of setting + 5 mV)
Trigger Level Accuracy	Range: TTL (0 V to 2.5V nominal = amplitude 2.5V Range: ECL (-1.8 V to -0.85 nominal = amplitude 0.95V) Accuracy: Frequency TTL ECL 10.000 MHz ± 100 mV ± 100 mV 22.222 MHz ± 123 mV ± 109 mV 34.444 MHz ± 146 mV ± 118 mV 46.667 MHz ± 168 mV ± 127 mV 58.889 MHz ± 191 mV ± 136 mV 71.111 MHz ± 236 mV ± 155 mV 83.333 MHz ± 259 mV ± 164 mV 95.556 MHz ± 282 mV ± 173 mV 107.778 MHz ± 305 mV ± 182 mV 120.000 MHz ± 350 mV ± 200 mV

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Strobe Level Accuracy	Range: TTL (0 V to 2.5V nominal = amplitude 2.5V Range: ECL (-1.8 V to -0.85 nominal = amplitude 0.95V) Accuracy Frequency TTL ECL 10.000 MHz ± 100 mV ± 100 mV 15.556 MHz ± 123 mV ± 109 mV 21.111 MHz 146 mV ± 118 mV 26.667 MHz 146 mV ± 118 mV 32.222 MHz ± 168 mV ± 127 mV 37.778 MHz ± 168 mV ± 127 mV 43.333 MHz ± 191 mV ± 136 mV 48.889 MHz ± 191 mV ± 136 mV 54.444 MHz ± 214 mV ± 145 mV 60.000 MHz ± 214 mV ± 145 mV
Pulse Width Accuracy	Range: 10 ns to 90 ns at 10 MHz Accuracy: ± (500 pS + 50 ppm of setting)
Transition Times (Rise and Fall)	Range: 2.5 ns or 7.5 ns Accuracy: 2.5 ns ± 500 ps 7.5 ns ± 500 ps
Variable Delay Accuracy	Range: 0 ns to 1000s Accuracy: ±0.5% of programmed value + 1 ns
External In Threshold Accuracy	Range: -10 V to +10V Accuracy: ± 50 mV
Frequency Accuracy	Range: 1 µ Hz to 120 MHz (Max. Bandwidth Amplifier) Accuracy: Set frequency ± 50 ppm
Reference Out Frequency Accuracy	Range: 10 MHz Accuracy: ± 50 ppm
Harmonic Distortion	Range: 1 V_{PP} 3 V_{PP} (Max Bandwidth Amplifier) Accuracy: Frequency Range 1 V_{PP} 3 V_{PP} 1 µHz to 2 MHz <-65 dBc <-62 dBc 2 MHz to 10 MHz <-62 dBc <-55 dBc 10 MHz to 35 MHz <-50 dBc <-45 dBc 35 MHz to 70 MHz <-35 dBc <-30 dBc 70 MHz to 240 MHz <-22 dBc <-17 dBc Range: 10 V_{PP} (Max Amplitude Amplifier) Accuracy: Frequency Range 1 µHz to 1 MHz < -55 dBc 1 MHz to 10 MHz < -40 dBc 10 MHz to 50 MHz < -27 dBc

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 and Secondary Reference Calibration Standards Set, NSN 4931-00-621-7878. 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)
ATTENUATOR (FIXED)	Frequency: 0.1 MHz to 1.68 MHz Range: 3 to 20 dB Accuracy: Listed on test report ±0.2 dB	Weinschel, Model 9918, 9918-3dB, 9918-6 dB, 9918-10dB, 9918-20dB
FREQUENCY COUNTER	Frequency: 10 MHz to 120 MHz Accuracy: 6.25×10^{-6}	Fluke, Model PM6681/656(PM6681/656)
FUNCTION GENERATOR	DC -4.0V to 4.0V	Agilent, Model 33250A (33250A)
MULTIMETER	Range: -4.0 to 18.182 VDC Accuracy: ±1.625 mv of level	Hewlett Packard, Model 3458A (3458A)
OSCILLOSCOPE	Vertical gain: Range -1.8 V to +2.5V Accuracy: ± 25 mv (40.96 mv) Rise time 125 ps (583 ps) Fall Time: 125 ps (583 ps) Pulse Width- Range:10.0 ns to 90 ns Accuracy: ±0.125 ns of set pulse width Delay: 0ps to 1 ms Accuracy: 0.125% of indication +250 ps	Agilent, OS-303/G (OS-303/G)

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
SPECTRUM ANALYZER	Harmonic distortion 1Vpp 3Vpp 100kHz to 2 MHz < -62 dBc < -62 dBc 2 MHz to 10 MHz < -57 dBC < -52 dBc 10 MHz to 35 MHz <-45 dBc < -40 dBc 35 MHz to 70 MHz < -35 dBc < -30 dBc 70 MHz to 340 MHz <-22 dBC < -17 dBc 10Vpp 100kHz to 1 MHz < -55 dBc 1 MHz to 8 MHz < -40 dBc 8 MHz to 50 MHz < -25 dBc	Agilent, E4440A

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 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 checks where applicable.

NOTE

Before connecting TI, the protective earth terminal of the instrument must be connected to the protective conductor of the line power cord. The line plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

a. Set TI **POWER** switch to **ON** and allow at least 30 minutes for TI to stabilize.

8. DC Offset

a. Performance Check

NOTE

To move within the TI display and edit output values, use **NAVIGATION KEYS, ROTARY KNOB, CURSOR KEYS**, and **DATA ENTRY** keypad as necessary.

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

(a) **STORE/RECALL**.

(b) SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(c) **UTILITY**.

(d) SOFTKEY: [**More**], SOFTKEY: [**System**], SOFTKEY: [**Diagnostics**], SOFTKEY: [**Calibration**]. Ensure all BNC cables are disconnected from TI. Press SOFTKEY: [**Yes**].

(2) After self calibration is complete, connect TI **Out 1** to multimeter input terminals using 50 Ω feedthrough termination and adapter.

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

(a) **STORE/RECALL**, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (factory defaults).

(b) **UTILITY**, SOFTKEY: [**DC Mode**], SOFTKEY: [**DC**] (DC On).

(c) SOFTKEY: [**Offset**]; set to first value listed in table 3.

(d) **UTILITY**, SOFTKEY:[**Output Setup**]; toggle SOFTKEY:[**Amplifier** Type] to select first Amplifier Type listed in row 1 of table 3.

(e) Press **OUT 1** (enable output).

(4) Set the multimeter for DC voltage measurement and Autoscale.

(5) Set TI as indicated in the first line of table 3. Multimeter will indicate within limits listed in table 3.

(6) Repeat technique of (5) above for remaining values listed in table 3.

Table 3. DC Offset

TI configuration					Multimeter indication (VDC)	
Output	Amplifier Type	Output Imp	Load Imp	DC offset	min	max
Out 1	max. Bandwidth	50	50	-5	-5.075	-4.925
Out 1	max. Bandwidth	50	50	-4	-4.065	-3.935
Out 1	max. Bandwidth	50	50	-3	-3.055	-2.945
Out 1	max. Bandwidth	50	50	-2	-2.045	-1.955
Out 1	max. Bandwidth	50	50	-1	-1.035	-0.965
Out 1	max. Bandwidth	50	50	1	0.965	1.035
Out 1	max. Bandwidth	50	50	2	1.955	2.045
Out 1	max. Bandwidth	50	50	3	2.945	3.055
Out 1	max. Bandwidth	50	50	4	3.935	4.065
Out 1	max. Bandwidth	50	50	5	4.925	5.075
Out 1	max. Amplitude[1]	50	50	-6	-6.110	-5.890
Out 1	max. Amplitude	50	50	-7	-7.120	-6.880
Out 1	max. Amplitude	50	50	-8	-8.130	-7.870
Out 1	max. Amplitude	50	50	-9	-9.140	-8.860
Out 1	max. Amplitude	50	50	-10	-10.150	-9.850
Out 1	max. Amplitude	50	50	10	9.850	10.150
Out 1	max. Amplitude	50	50	9	8.860	9.140

Table 3. DC Offset - Continued

TI configuration					Multimeter indication (VDC)	
Output	Amplifier Type	Output Imp	Load Imp	DC offset	min	max
Out 1	max. Amplitude	50	50	8	7.870	8.130
Out 1	max. Amplitude	50	50	7	6.880	7.120
Out 1	max. Amplitude	50	50	6	5.890	6.110
Out 1	max. Amplitude	5	50	-20	-20.275	-19.725
Out 1	max. Amplitude	5	50	-18	-18.255	-17.745
Out 1	max. Amplitude	5	50	-16	-16.235	-15.765
Out 1	max. Amplitude	5	50	-14	-14.215	-13.785
Out 1	max. Amplitude	5	50	-12	-12.195	-11.805
Out 1	max. Amplitude	5	50	-11	-11.185	-10.815
Out 1	max. Amplitude	5	50	11	10.815	11.185
Out 1	max. Amplitude	5	50	12	11.805	12.195
Out 1	max. Amplitude	5	50	14	13.785	14.215
Out 1	max. Amplitude	5	50	16	15.765	16.235
Out 1	max. Amplitude	5	50	18	17.745	18.255
Out 1	max. Amplitude	5	50	20	19.725	20.275
$\overline{\text{Out 1}}$[2]	max. Bandwidth[3]	50	50	-5	-5.075	-4.925
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	-4	-4.065	-3.935
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	-3	-3.055	-2.945
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	-2	-2.045	-1.955
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	-1	-1.035	-0.965

Table 3. DC Offset - Continued

TI configuration					Multimeter indication (VDC)	
Output	Amplifier Type	Output Imp	Load Imp	DC offset	min	max
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	1	0.965	1.035
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	2	1.955	2.045
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	3	2.945	3.055
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	4	3.935	4.065
$\overline{\text{Out 1}}$	max. Bandwidth	50	50	5	4.925	5.075
$\overline{\text{Out 1}}$	max. Amplitude[1]	50	50	-6	-6.110	-5.890
$\overline{\text{Out 1}}$	max. Amplitude	50	50	-7	-7.120	-6.880
$\overline{\text{Out 1}}$	max. Amplitude	50	50	-8	-8.130	-7.870
$\overline{\text{Out 1}}$	max. Amplitude	50	50	-9	-9.140	-8.860
$\overline{\text{Out 1}}$	max. Amplitude	50	50	-10	-10.150	-9.850
$\overline{\text{Out 1}}$	max. Amplitude	50	50	10	9.850	10.150
$\overline{\text{Out 1}}$	max. Amplitude	50	50	9	8.860	9.140
$\overline{\text{Out 1}}$	max. Amplitude	50	50	8	7.870	8.130
$\overline{\text{Out 1}}$	max. Amplitude	50	50	7	6.880	7.120
$\overline{\text{Out 1}}$	max. Amplitude	50	50	6	5.890	6.110
$\overline{\text{Out 1}}$	max. Amplitude	5	50	-20	-20.275	-19.725
$\overline{\text{Out 1}}$	max. Amplitude	5	50	-18	-18.255	-17.745
$\overline{\text{Out 1}}$	max. Amplitude	5	50	-16	-16.235	-15.765
$\overline{\text{Out 1}}$	max. Amplitude	5	50	-14	-14.215	-13.785
$\overline{\text{Out 1}}$	max. Amplitude	5	50	-12	-12.195	-11.805

Table 3. DC Offset - Continued

TI configuration					Multimeter indication (VDC)	
Output	Amplifier Type	Output Imp	Load Imp	DC offset	min	max
$\overline{\text{Out 1}}$	max. Amplitude	5	50	-11	-11.185	-10.815
$\overline{\text{Out 1}}$	max. Amplitude	5	50	11	10.815	11.185
$\overline{\text{Out 1}}$	max. Amplitude	5	50	12	11.805	12.195
$\overline{\text{Out 1}}$	max. Amplitude	5	50	14	13.785	14.215
$\overline{\text{Out 1}}$	max. Amplitude	5	50	16	15.765	16.235
$\overline{\text{Out 1}}$	max. Amplitude	5	50	18	17.745	18.255
$\overline{\text{Out 1}}$	max. Amplitude	5	50	20	19.725	20.275

[1]Press **Utility** button, SOFTKEY: [**Output Setup]**, toggle SOFTKEY: [**Amplifier Type**] to select max. Amplifier. Press **Utility** button to return to Offset menu.
[2]Switch cable to **Out 1**
[3]Press **Utility** button, SOFTKEY: [**Output Setup]**, toggle SOFTKEY: [**Amplifier Type**] to select max. Bandwidth. Press **Utility** button to return to Offset menu.

(7) Set all outputs to minimum.

b. Adjustments No adjustments can be made.

9. Amplitude Accuracy

a. Performance Check

(1) Set multimeter for AC voltage, auto range measurement.

(2) Connect TI **Out1** to multimeter input terminals using appropriate adaptor.

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

(a) **STORE/RECALL**, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) **SQUARE**

(c) SOFTKEY: [**Frequency**] 1 kHz.

(d) SOFTKEY: [**Amplitude**], 5 V_{pp} (first line in table 4).

(e) **Utility**, SOFTKEY: [**Output Setup**], Amplifier Type: max. Bandwidth.

(f) **Utility** (returns to main menu).

(g) **Out 1** (enabled).

(4) Multimeter will indicate within limits listed in table 4.

(5) Repeat (3) (d) and (4) above for remaining TI settings listed in table 4.

Table 4. Amplitude Accuracy

TI settings			Multimeter indication (VAC)	
Output	Amplifier	Amplitude Vpp	Min (V)	Max (V)
Out 1	max. Bandwidth	5.000	4.9200	5.0800
Out 1	max. Bandwidth	2.505	2.4624	2.5476
Out 1	max. Bandwidth	1.255	1.2312	1.2788
Out 1	max. Bandwidth	0.628	0.6136	0.6424
Out 1	max. Bandwidth	0.314	0.3043	0.3237
Out 1	max. Bandwidth	0.157	0.1496	0.1644
Out 1	max. Bandwidth	0.100	0.0935	0.1065
Out 1[1]	max. Amplitude	10.000	9.8450	10.1550
Out 1	max. Amplitude	5.011	4.9308	5.0912
Out 1	max. Amplitude	2.511	2.4683	2.5537
Out 1	max. Amplitude	1.258	1.2341	1.2819
Out 1	max. Amplitude	0.630	0.6156	0.6445
Out 1	max. Amplitude	0.315	0.3053	0.3247
Out 1	max. Amplitude	0.200	0.1920	0.2080
$\overline{\text{Out 1}}$[2]	max. Bandwidth	5.000	4.9200	5.0800
$\overline{\text{Out 1}}$	max. Bandwidth	2.505	2.4624	2.5476
$\overline{\text{Out 1}}$	max. Bandwidth	1.255	1.2312	1.2788
$\overline{\text{Out 1}}$	max. Bandwidth	0.628	0.6136	0.6424
$\overline{\text{Out 1}}$	max. Bandwidth	0.314	0.3043	0.3237

Table 4. Amplitude Accuracy - Continued

TI settings			Multimeter indication (VAC)	
$\overline{\text{Out 1}}$	max. Bandwidth	0.157	0.1496	0.1644
$\overline{\text{Out 1}}$	max. Bandwidth	0.100	0.0935	0.1065
$\overline{\text{Out 1}}$	max. Amplitude	10.000	9.8450	10.1550
$\overline{\text{Out 1}}$	max. Amplitude	5.011	4.9308	5.0912
$\overline{\text{Out 1}}$	max. Amplitude	2.511	2.4683	2.5537
$\overline{\text{Out 1}}$	max. Amplitude	1.258	1.2341	1.2819
$\overline{\text{Out 1}}$	max. Amplitude	0.630	0.6156	0.6445
$\overline{\text{Out 1}}$	max. Amplitude	0.315	0.3053	0.3247
$\overline{\text{Out 1}}$	max. Amplitude	0.200	0.1920	0.2080

[1]Change amplifier as described in (3) (e) and (f) above.
[2] Move connection from TI Out1 to **$\overline{\text{Out1}}$**.

(6) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

10. Trigger Level Accuracy

a. Performance Check

(1) Set oscilloscope for Channel 1, DC coupling, 50 Ω input impedance, averaging enabled with 32 averages, and Volts/div to 500 mV. Select measurements of V min(1) and V max(1).

(2) Connect TI **Trigger Out 1** to oscilloscope channel 1.

(3) Press pushbuttons on TI as listed in (a) through (h) below:

(a) **Store/Recall**, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) **Trig**.

(c) SOFTKEY: [**More**].

(d) SOFTKEY: [**Source**].

(e) SOFTKEY: [**Source**] (again).

(f) SOFTKEY: [**Internal**].

(g) **Square**.

(h) Int. Freq. 10.00 MHz.

(4) Oscilloscope will indicate within limits for V min and V max as indicated in table 5.

(5) Repeat technique of (4) above for remaining TI frequencies and trigger out logic levels as indicated in table 5.

Table 5. Trigger Out

TI		Oscilloscope			
Frequency (MHz)	Trigger out logic level	V min minimum (V)	V min maximum (V)	V max minimum (V)	V max maximum (V)
10.000	TTL	-0.100	0.100	2.400	2.600
22.222	TTL	-0.123	0.123	2.377	2.623
34.444	TTL	-0.146	0.146	2.354	2.646
46.667	TTL	-0.168	0.168	2.332	2.668
58.889	TTL	-0.191	0.191	2.309	2.691
71.111	TTL	-0.236	0.236	2.264	2.736
83.333	TTL	-0.259	0.259	2.241	2.759
95.556	TTL	-0.282	0.282	2.218	2.782
107.778	TTL	-0.305	0.305	2.195	2.805
120.000	TTL	-0.350	0.350	2.150	2.850
10.000	ECL	-1.900	-1.700	-0.950	-0.750
22.222	ECL	-1.909	-1.691	-0.959	-0.741
34.444	ECL	-1.918	-1.682	-0.968	-0.732
46.667	ECL	-1.927	-1.673	-0.977	-0.723
58.889	ECL	-1.936	-1.664	-0.986	-0.714
71.111	ECL	-1.955	-1.645	-1.005	-0.695
83.333	ECL	-1.964	-1.636	-1.014	-0.686
95.556	ECL	-1.973	-1.627	-1.023	-0.677
107.778	ECL	-1.982	-1.618	-1.032	-0.668
120.000	ECL	-2.000	-1.600	-1.050	-0.650

(6) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

11. Strobe Level Accuracy

a. Performance Check

(1) Set oscilloscope for Channel 1, DC coupling, 50 Ω input impedance, averaging enabled with 32 averages, and Volts/div to 500 mV. Select measurements of V min(1) and V max(1).

(2) Connect TI **Strobe Out 1** to oscilloscope input.

(3) Press TI pushbuttons as listed in (a) through (c) below:

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) Frequency: 10 MHz.

(c) **Burst** (Burst enabled)

(4) Oscilloscope will indicate within limits for V min and V max as indicated in table 6.

(5) Press TI **Burst** button (Burst disabled). Enter next frequency from table 6.

(6) Repeat technique of (3) (c) through (5) for remaining frequencies and Strobe Out logic states listed in table 6.

Table 6. Strobe Out 1 Level Accuracy

TI		Oscilloscope			
Frequency (MHz)	Strobe out logic state	Low level min (V)	Low level max (V)	High level min (V)	High level max (V)
10.000	TTL	-0.100	0.100	2.400	2.600
15.556	TTL	-0.123	0.123	2.377	2.623
21.111	TTL	-0.146	0.146	2.354	2.646
26.667	TTL	-0.146	0.146	2.354	2.646
32.222	TTL	-0.168	0.168	2.332	2.668
37.778	TTL	-0.168	0.168	2.332	2.668
43.333	TTL	-0.191	0.191	2.309	2.691
48.889	TTL	-0.191	0.191	2.309	2.691
54.444	TTL	-0.214	0.214	2.286	2.714
60.000	TTL	-0.214	0.214	2.286	2.714
10.000	ECL[1]	-1.900	-1.700	-0.950	-0.750
15.556	ECL	-1.909	-1.691	-0.959	-0.741
21.111	ECL	-1.918	-1.682	-0.968	-0.732
26.667	ECL	-1.918	-1.682	-0.968	-0.732
32.222	ECL	-1.927	-1.673	-0.977	-0.723
37.778	ECL	-1.927	-1.673	-0.977	-0.723
43.333	ECL	-1.936	-1.664	-0.986	-0.714
48.889	ECL	-1.936	-1.664	-0.986	-0.714
54.444	ECL	-1.945	-1.655	-0.995	-0.705
60.000	ECL	-1.945	-1.655	-0.995	-0.705

[1] Press **Cont** button to display menu with Strobe Out and Trigger Out logic states. Use navigation buttons and soft keys to change Strobe Out logic state to ECL.

(7) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

12. Width Accuracy

a. Performance Check

(1) Connect TI **Out 1** to oscilloscope input 1.

(2) Set oscilloscope input impedance to 50 **Ω**, DC coupling, volts/div for 500 mV, and select positive pulse width measurement.

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

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) Frequency: 10 MHz.

(c) **Pulse.**

(d) SOFTKEY: [**Width**]: 10.0 ns

(e) SOFTKEY: [**More**], SOFTKEY [**Amplitude**]: 2.5 V_{pp}

(f) SOFTKEY: [**Offset**]: 1.25 V_{DC}

(g) **Out 1** (Output enabled).

(4) Oscilloscope will indicate within limits of table 7 for 10 ns pulse width.

(5) Set the TI to the next pulse width setting in table 7. Adjust oscilloscope controls as necessary to measure pulse width. Oscilloscope will indicate within the limits of table 7.

(6) Repeat technique of (5) above for remaining pulse widths in table 7.

Table 7. Pulse Width (Max. Bandwidth)

TI Pulse width (ns)	Oscilloscope	
	min (ns)	max (ns)
10.0	9.500	10.500
18.8	18.300	19.300
27.7	27.199	28.201
36.6	36.098	37.102
45.5	44.998	46.002
54.4	53.897	54.903

Table 7. Pulse Width (Max. Bandwidth)- Continued

TI Pulse width (ns)	Oscilloscope	
	min (ns)	max (ns)
63.3	62.797	63.803
72.2	71.696	72.704
81.1	80.596	81.604
90.0	89.496	90.505

(7) Set oscilloscope to measure negative pulse width, and TI for first pulse width in table 7 above.

(8) Disable TI **Out 1**. Move connection from TI **Out 1** to TI $\overline{\textbf{Out 1}}$. Enable TI $\overline{\textbf{Out 1}}$.

(9) Repeat (4) through (6) above measuring negative pulse width for TI $\overline{\textbf{Out 1}}$.

(10) Disable TI $\overline{\textbf{Out 1}}$. Move connection from TI $\overline{\textbf{Out 1}}$ to TI **Out 1**.

(11) Set oscilloscope input impedance to 50 Ω, DC coupling, volts/div for 500 mV, and select positive pulse width measurement.

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

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) **Utility**, SOFTKEY: [**Output Setup**], SOFTKEY: [**Amplifier Type**], SOFTKEY: [**Amplifier Type**] (to select max. Amplitude).

(c) **Utility** (disable).

(d) Frequency: 10 MHz.

(e) **Pulse.**

(f) SOFTKEY: [**Width**]: 15.0 ns

(g) SOFTKEY: [**Lead Edge**]: 7.5 ns

(h) SOFTKEY: [**More**], SOFTKEY: [**Trail Edge**]: 7.5 ns

(i) SOFTKEY: [**Amplitude**]: 2.5 V_{pp}

(j) SOFTKEY: [**Offset**]: 1.25 V_{DC}

(k) **Out 1** (Output enabled).

(13) Oscilloscope will indicate within limits of table 8 for 15 ns pulse width.

(14) Set the TI to the next pulse width setting in table 8. Adjust oscilloscope controls as necessary to measure pulse width. Oscilloscope will indicate within the limits of table 8.

(15) Repeat technique of (14) above for remaining pulse widths in table 8.

Table 8. Pulse Width Accuracy (Max. Amplitude)

TI Pulse width (ns)	Oscilloscope	
	min (ns)	max (ns)
15.0	14.499	15.501
22.7	22.199	23.201
30.5	29.998	31.002
38.3	37.798	38.802
46.1	45.598	46.602
53.8	53.297	54.303
61.6	61.097	62.103
69.4	68.897	69.903
72.2	71.696	72.704
85.0	84.496	85.504

(16) Set oscilloscope to measure negative pulse width, and TI for first pulse width in table 8 above.

(17) Disable TI **Out 1**. Move connection from TI **Out 1** to TI **$\overline{\text{Out 1}}$**. Enable TI **$\overline{\text{Out 1}}$**.

(18) Repeat (13) through (15) above measuring negative pulse width for TI **$\overline{\text{Out 1}}$**.

(19) Set all outputs to minimum.

b. Adjustments: No adjustments can be made.

13. Transition Times Accuracy

a. Performance Check

(1) Connect TI **Out 1** to oscilloscope input 1.

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

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) Frequency: 10 MHz.

(c) **Pulse.**

(d) SOFTKEY: [**More 1 of 3**], SOFTKEY: [**Amplitude**]: 0.2 V_{pp}

(e) **Out 1** (output enabled).

(3) Set oscilloscope as listed in (a) through (f) below:

(a) Select factory default setup.

(b) DC coupling

(c) 50 Ω input impedance.

(d) Averaging enabled (in Setup, Acquisition, drop down menu).

(e) **Auto-scale**.

(f) Enable rise time and fall time measurement.

(4) Oscilloscope will indicate within limits listed in Table 9 for transition times (rise and fall).

(5) Repeat technique of (3) (e) and (4) above for remaining TI levels listed in table 9.

Table 9. Transition Times Max. Bandwidth Amplifier

TI Output (Vpp)	Oscilloscope indication	
	Min (ns)	Max (ns)
0.200	2	3
0.750	2	3
1.250	2	3
1.500	2	3
2.000	2	3
2.500	2	3
3.000	2	3
3.500	2	3
4.000	2	3
4.500	2	3
5.000	2	3

(6) Turn off TI **Out 1**. Move connection from TI **Out 1** to TI **Out 1**. Enable TI **Out 1**.

(7) Repeat (3) (e) through (5) above for TI **Out 1**.

(8) Turn off TI **Out 1**. Connect TI **Out 1** to oscilloscope input 1 using a 50 Ω feedthrough termination. Set oscilloscope to 1 M Ω input impedance.

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

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) Frequency: 10 MHz.

(c) **Pulse.**

(d) SOFTKEY: [**More 1 of 3**], SOFTKEY: [**Amplitude**]: 0.2 V_{pp}

(e) SOFTKEY: [**Trail Edge**]: 7.5 ns.

(f) SOFTKEY: [**More 2 of 3**], SOFTKEY: [**More 3 of 3**], SOFTKEY: [**Lead Edge**]: 7.5 ns.

(g) **Utility**, SOFTKEY: [**Output Setup**], SOFTKEY: [**Amplifier Type**], SOFTKEY: [**Amplifier Type**] (to select max. Amplitude).

(h) **Out 1** (output enabled).

(10) Press Auto-scale on oscilloscope.

(11) Oscilloscope will indicate within limits listed in table 10 for transition times (rise and fall).

(12) Set TI for next voltage listed in table 10.

(13) Repeat technique of (10) through (12) above for remaining TI output levels listed in table 10.

Table 10. Transition times max. Amplitude Amplifier

TI Output Vpp	Oscilloscope indication	
	Min (ns)	Max (ns)
0.2	6.5	8
1.3	6.5	8
2.5	6.5	8
3.5	6.5	8
4.5	6.5	8
5.5	6.5	8
6.5	6.5	8
7.5	6.5	8
8.5	6.5	8
10.0	6.5	8

(14) Turn off TI **Out1**. Move connection from TI **Out 1** to TI $\overline{\textbf{Out 1}}$. Enable TI $\overline{\textbf{Out 1}}$.

(15) Repeat technique of (9) through (13) above for TI $\overline{\textbf{Out 1}}$.

(16) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

14. Variable Delay Accuracy

a. Performance Check

(1) Connect TI **Out 1 t**o Oscilloscope channel 1 input. Connect TI **Trigger 1 Out** to oscilloscope channel 2 input.

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

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) **Trig.**

(c) SOFTKEY: [**MORE**], SOFTKEY: [**Source**], SOFTKEY: [**Source**], SOFTKEY: [**Internal**] (source to internal).

(d) SOFTKEY: [**Internal Frequency**], SOFTKEY: [**Internal Frequency**] (to select Int. Period). Set Int. Period: 1 uS.

(e) Press **Square** button twice (to return to Set to defaults menu).

(f) SOFTKEY: [Frequency] (to toggle to Period); 20 nS.

(g) Amplitude: 2.5 V_{pp}

(h) Offset: 1.25 V_{DC}

(i) Delay to 10 ns.

(j) **Out 1** (Output enabled).

(3) Set the oscilloscope to measure the delay from the TI Out 1 signal (channel 1) to the TI Trigger Out signal with trigger source set to Channel 2. Oscilloscope ΔTime will indicate within limits listed in table 11.

(4) Repeat technique of (3) above for remaining TI settings listed in table 11.

Table 11. Variable Delay Accuracy

TI settings			Calculated ΔT limits	
Internal period	Period	Delay	Min	Max
1 uS	20 nS	10 ns	8.95 nS	11.05 nS
10 uS	200 nS	100 ns	98.5 nS	101.5 nS
100 uS	2 uS	1 uS	0.994 uS	1.006 uS
1 mS	20 uS	10 uS	9.949 uS	10.051 uS
1 ms	200 uS	100 uS	99.5 uS	100.5 uS
10 ms	2 mS	1 ms	0.995mS	1.005 mS
100 mS	20 ms	10 ms	9.95 mS	10.05 mS
500 mS	200 mS	100 mS	99.5 mS	100.5 mS

(5) Disable **TI Out 1**. Move connection to TI $\overline{\textbf{Out 1}}$.

(6) Repeat technique of (2) through (4) above for TI $\overline{\textbf{Out 1}}$.

(7) Set outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

15. External In Threshold Accuracy

a. Performance check.

(1) Connect equipment as shown in figure 1.

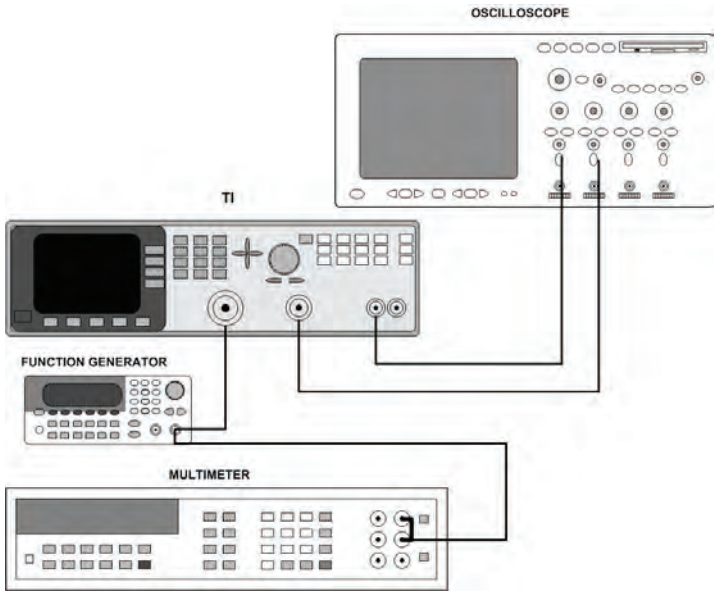


Figure 1. External In threshold accuracy set up.

(2) Press TI pushbuttons as listed in (a) through (f) below.

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) **Gated**.

(c) SOFTKEY: [**External In Threshold**].

(d) SOFTKEY: [**Voltage**].

(e) **-4.0** [SOFTKEY]: [**V**].

(f) **Out 1** (output enabled).

(3) Set oscilloscope for DC coupling, 50 **Ω**, channel 2 triggered signal.

(4) Set multimeter for DC voltage measurement.

(5) Set function generator for first DC output voltage listed in table 12. Adjust voltage level with rotary knob until oscilloscope triggers, with 10 horizontal divisions of signal displayed.

(6) Measure the trigger threshold voltage with the multimeter. The trigger level threshold voltage will indicate within the limits listed in table 12.

(7) Repeat technique of (5) and (6) above for remaining external in threshold voltages listed in table 12.

Table 12. External In Threshold Accuracy

Pulse generator DC output (V)	TI External In threshold (VDC)	Multimeter indication	
		Minimum trigger level (VDC)	Maximum trigger level (VDC)
-4.000	-4	-4.025	-3.975
-2.000	-2	-2.025	-1.975
0.000	0	-0.025	0.025
2.000	2	1.975	2.025
4.000	4	3.975	4.025

(8) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

16. Frequency Accuracy

a. Performance Check

(1) Set frequency counter for frequency measurement, AC coupling, and 50Ω input impedance.

(2) Connect TI **Out 1** to frequency counter Channel A input.

(3) Press TI pushbuttons as listed in (a) through (d) below:

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) Frequency: 10 MHz.

(c) **Square.**

(d) **Out 1** (Output enabled).

(4) Verify frequency counter indicates within limits as indicated in table 13.

(5) Repeat 3 (b) and (4) above for remaining frequencies in table 13.

(6) Move connection from TI **Out 1** to TI $\overline{\textbf{Out 1}}$.

(7) Repeat technique of (1) through (5) above for TI $\overline{\textbf{Out 1}}$.

Table 13. Frequency Accuracy

TI Frequency (MHz)	Frequency counter	
	min (MHz)	max (MHz)
10.000	9.99950000	10.00050000
22.222	22.22088890	22.22311110
34.444	34.44227780	34.44572220

Table 13. Frequency Accuracy - Continued

TI Frequency (MHz)	Frequency counter	
	min (MHz)	max (MHz)
46.667	46.66466665	46.66933335
58.889	58.88605555	58.89194445
71.111	71.10744445	71.11455555
83.333	83.32883335	83.33716665
95.556	95.55122220	95.56077780
107.778	107.77726110	107.78338900
120.000	119.99400000	120.00600000

(8) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

17. Reference Out Frequency Accuracy

a. Performance Check

(1) Press TI **Store/Recall**, SOFTKEY: [Set to Defaults], SOFTKEY: [Yes] (Instrument setting restored to default message should scroll).

(2) Connect TI **10 MHz Ref Out 1 V_{pp}** to frequency counter input **A**.

(3) Set frequency counter for frequency measurement and one second gate time.

(4) Frequency counter will indicate between 9.9995 MHz and 10.0005 MHz.

(5) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

18. Harmonic Distortion

a. Performance Check

(1) Connect TI **Out 1** to spectrum analyzer **RF Input 50 Ω** using a 10 dB and a 3 dB attenuator with appropriate adaptors.

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

(a) Store/Recall, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) SOFTKEY: [**Freq**]: 100 kHz.

(c) **Sine**.

(d) SOFTKEY: [**Ampl**]: 1 V_{pp}.

(e) SOFTKEY: [**Offset**]: 0 V_{DC}.

(f) **Out 1** (Output enabled).

(3) Set up spectrum analyzer as listed in (a) through (f) below:

(a) **Preset**

(b) **Input/Output**, SOFTKEY: [**RF Coupling**] select DC.

(c) Center Frequency: 0.100 MHz.

(d) Span: 0.100 MHz.

(e) Attenuation: 20 dB (Ensure spectrum analyzer Scale/Div is 10 dB).

(f) **Measure**, SOFTKEY: [**More**], SOFTKEY: [**Harmonic Distortion**], **Meas Setup**, SOFTKEY: [**Harmonics**], **7**, SOFTKEY: [**Enter]**.

(4) Verify Spectrum analyzer indications for all harmonics listed are below level listed for 0.1 MHz in Table 14.

(5) Turn off harmonic distortion measurement on spectrum analyzer by pressing SOFTKEY: [**More**], SOFTKEY: [**Meas Off**].

(6) Set TI and spectrum analyzer for measurement settings listed in next row of table 14. Repeat (3) (f) above to set up the spectrum analyzer for automatic harmonic distortion measurement.

(7) Repeat (4) through (6) above to for remaining rows in table 14.

Table 14. Harmonic Distortion Max. Bandwidth 1 V_{pp}

TI Frequency (MHz)	Spectrum analyzer		
	Center frequency (MHz)	Frequency span (MHz)	Max level < (dBc)
0.1	0.1	0.1	-62
1.0	1.0	1.0	-62
1.9	1.9	1.9	-62
9.9	9.9	9.9	-57
34[1]	34	34	-45
69	69	69	-35
120	120	120	-22
240	240	100	-22

[1]Set spectrum analyzer input coupling to AC.

(8) Disable **Out 1**. Move connection from TI **Out 1** to TI $\overline{\textbf{Out 1}}$.

(9) Repeat (2) through (6) above for TI $\overline{\textbf{Out 1}}$.

(10) Turn off TI $\overline{\textbf{Out 1}}$.

(11) Connect TI **Out 1** to spectrum analyzer using a 10 dB and a 6 dB attenuator with appropriate adaptors.

(12) Press TI pushbuttons as listed in (a) through (f) below:

(a) **Store/Recall**, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) SOFTKEY: [**Freq**]: 100 kHz.

(c) **Sine.**

(d) SOFTKEY: [**Ampl**]: 3 V_{pp}.

(e) SOFTKEY: [**Offset**]: 0 V_{DC}.

(f) **Out 1** (Output enabled).

(13) Set Spectrum Analyzer as listed in (a) through (f) below:

(a) **Preset**

(b) **Input/Output**, SOFTKEY: [**RF Coupling**] select DC.

(c) Center Frequency: 0.100 MHz.

(d) Span: 0.100 MHz.

(e) Attenuation: 20 dB (Ensure spectrum analyzer Scale/Div is 10 dB).

(f) **Measure**, SOFTKEY: [**More**], SOFTKEY: [**Harmonic Distortion**], **Meas Setup**, SOFTKEY: [**Harmonics**], **7**, SOFTKEY: [**Enter]**.

(14) Verify Spectrum analyzer measurements for all harmonics displayed are below level listed for 0.1 MHz in table 15.

(15) Turn off harmonic distortion measurement on spectrum analyzer.

(16) Set TI and spectrum analyzer for measurement settings listed in next row of table 15. Repeat (13) (f) above to set up the spectrum analyzer for automatic harmonic distortion measurement.

(17) Repeat (14) through (16) above to for remaining rows in table 15.

Table 15. Harmonic Distortion Max. Bandwidth 3 V_{pp}

TI Frequency (MHz)	Spectrum analyzer		
	Center frequency (MHz)	Frequency span (MHz)	Max level < (dBc)
0.1	0.1	0.1	-62
1.0	1.0	1.0	-62
1.9	1.9	1.9	-62
9.9	9.9	9.9	-52
34[1]	34	34	-40
69	69	69	-30
120	120	120	-17
240	240	240	-17

[1]Set spectrum analyzer input coupling to AC.

(18) Turn off **Out 1**.

(19) Move connection from TI **Out 1** to TI $\overline{\textbf{Out 1}}$.

(20) Repeat (12) through (17) above for TI **$\overline{\text{Out 1}}$.**

(21) Turn off TI **$\overline{\text{Out 1}}$**.

(22) Connect TI **Out 1** to spectrum analyzer using a 20 dB and 6 dB attenuator with appropriate adaptors.

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

(a) **Store/Recall**, SOFTKEY: [**Set to Defaults**], SOFTKEY: [**Yes**] (Instrument setting restored to default message should scroll).

(b) **Utility**, SOFTKEY: [**Output Setup**], SOFTKEY: [**Amplifier Type**] (to select max. Amplitude).

(c) **Utility** (return to main menu)

(d) **Sine**

(e) Frequency: 100 kHz.

(f) Amplitude: 10 V_{pp}

(g) Offset: 0 V_{DC}

(h) **Out 1** (Output enabled).

(24) Set Spectrum Analyzer as listed in (a) through (f) below:

(a) **Preset**

(b) **Input/Output**, SOFTKEY: [**RF Coupling**] select DC.

(c) Center Frequency: 0.1 MHz

(d) Span: 0.1 MHz.

(e) Attenuation: 20 dB (Ensure spectrum analyzer Scale/Div is 10 dB).

(f) **Measure**, SOFTKEY: **Mor**e, SOFTKEY: [**Harmonic Distortion**], **Meas Setup**, SOFTKEY: [**Harmonics]**, **7**, **Enter**.

(25) Verify Spectrum analyzer measurements for all harmonics displayed are below level listed for 0.1 MHz in table 16.

(26) Turn off harmonic distortion measurement on spectrum analyzer.

(27) Set TI and spectrum analyzer for next measurement listed in table 16. Repeat (24) (f) above to set up the spectrum analyzer for automatic harmonic distortion measurement.

Table 16. Harmonic distortion max. Amplitude 10 V_{pp}

TI Frequency (MHz)	Spectrum Analyzer		
	Center frequency (MHz)	Frequency span (MHz)	Max level < (dBc)
0.1	0.1	0.1	-55
0.99	0.99	5.94	-55
7.9	7.9	47.4	-40
50[1]	50	300	-25

[1]Change input coupling on spectrum analyzer to AC.

(28) Repeat technique of (25) through (27) above for remaining TI frequencies listed in table 16.

(29) Disable TI **Out 1**. Move connection from TI **Out 1** to TI $\overline{\textbf{Out 1}}$.

(30) Repeat technique of (23) through (28) above for TI $\overline{\textbf{Out 1}}$.

(31) Set all outputs to minimum and disconnect equipment set-up.

b. Adjustments: No adjustments can be made.

19. Final Procedure

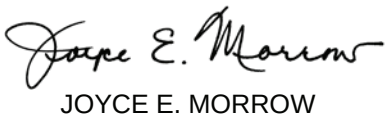
a. De-energize and disconnect all equipment.

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
Administrative Assistant to the
Secretary of the Army

0931303

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3. **Address**: 4300 Park
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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
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