# *TB 9-6625-2138-35

## DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

# CALIBRATION PROCEDURE FOR DATA ERROR ANALYZER HEWLETT-PACKARD, MODEL 1645A

Headquarters, Department of the Army, Washington, DC

18 September 2003



**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 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 technical bulletin supersedes TB 9-6625-2138-35, dated 8 January 1985, including all changes.

## SECTION I
## IDENTIFICATION AND DESCRIPTION

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Data Error Analyzer, Hewlett-Packard, Model 1645A. 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**. Variations among models are described in text.

**b. Time and Technique**. The time required for this calibration is approximately 4 hours, using the dc and low frequency technique.

**2. Forms, Records, and Reports**

**a.** Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

**b.** Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

**3. Calibration Description**. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

| Test instrument parameters | Performance specifications |
|---|---|
| Frequency | Range: 74 to 9603 Hz<br>Accuracy: ±0.03% |
| Dc voltage | Range: -23 to +15.5 V<br>Accuracy: ±0.34% |
| Ac voltage | Range: -12 to +12 V peak<br>Accuracy: ±3% |

## 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 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) |
|---|---|---|
| AUTOTRANSFORMER | Range: 105 to 125 V ac<br>Accuracy: ±1% | General Radio, Model W10MT3AS3 or Ridge, Model 9020F (7910809) |
| DIFFERENTIAL VOLTMETER | Range: -23 to +15.5 V dc<br>Accuracy: ±0.08% | John Fluke, Model 887AB/AN (887AB/AN) |
| FREQUENCY COUNTER | Range: 74 to 9603 Hz<br>Accuracy: ±0.007% | Hewlett-Packard, Model AN/USM459B (AN/USM459B) |
| OSCILLOSCOPE | Range: -12 to +12 V peak<br>Accuracy: ±3% | Tektronix, Type 2465BOPT46 (2465BOPT46) |
| PULSE GENERATOR | Range: 0 to 1 kHz, 5 V peak<br>Duty cycle: Adjustable to 40% | LeCroy, Model 9210 (9210) w/plug-ins, LeCroy, Models 9211 (9211) and 9215 (9215) |

## SECTION III
## CALIBRATION PROCESS

### 6. Preliminary Instructions

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

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

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

**d.** When indications specified in paragraphs **8** through **12** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **8** through **12**. Do not perform power supply check if all other parameters are within tolerance.

**e.** 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.** Set switches as listed in (1) through (11) below:

(1) **CLOCK** to **9600**.

(2) **PATTERN** to **1:1**.

(3) **EXPONENT RANGE to 2**.

(4) **SINGLE/CYCLE (PRINTER)** to **CYCLE** (**PRINTER)**.

(5) **OFF/LOOP** to **LOOP**.

(6) **OFF/XMIT ERRORS** to **OFF**.

(7) **OFF/FILTER** to **OFF**.

(8) **EVENT** to **JITTER/TOTAL PEAK**.

(9) **JITTER/TOTAL PEAK** to **JITTER**.

(10) **DATA-$\overline{\text{DATA}}$** to **DATA**.

(11) **DTR/RTS/BACKWARD CHANNEL** to **DTR**.

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

**c.** Connect TI to autotransformer.

**d.** Set **LINE OFF-ON** switch to **ON** and allow at least 3 minutes for warmup and stabilization.

## 8. Phase Lock Loop

### a. Performance Check

(1) Remove TI top cover and connect oscilloscope to **A14TP1** (fig. 1).

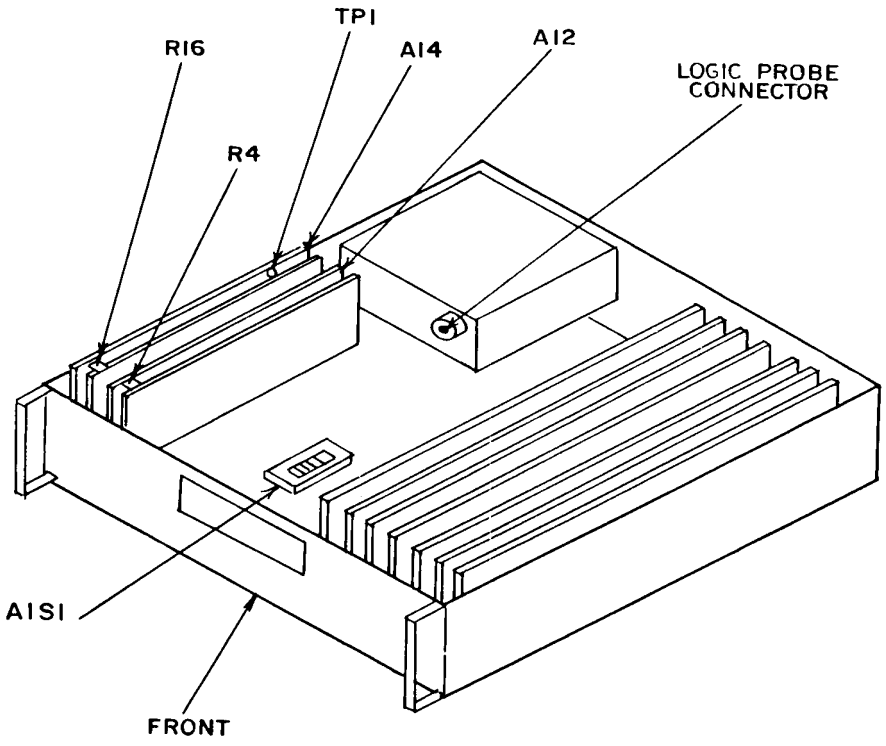


Figure 1. Test instrument - top view.

(2) Adjust oscilloscope controls as required to view one complete cycle of waveform. If waveform does not have a 50 percent duty cycle, perform **b** below.

(3) Set **PATTERN** switch to **(20)-1** and **CLOCK** switch to **75**.

(4) Momentarily set **START/STOP** switch to **START**. Observe **JITTER** readout for one minute. **JITTER** readout indication will be 2 percent or less.

**b. Adjustments**. Adjust **A14R16** (fig. 1) for an observed duty cycle of 50 percent (R).

**9. INT XMIT Clock**

**a. Performance Check**

(1) Connect frequency counter to **INT XMIT CLOCK** connector (rear panel)

(2) Set **COUNT D/O COUNT C/L** switch **A1S1** (fig. 1) to **COUNT D/O**.

(3) Set **CLOCK** switch to settings listed in table 3. Frequency counter indications will be within limits specified.

Table 3. INT XMIT Clock Accuracy

| Test instrument **CLOCK** switch settings | Frequency counter indications (Hz) | |
|---|---|---|
| | Min | Max |
| 9600 | 9597.12 | 9602.88 |
| 7200 | 7128.00 | 7272.00 |
| 4800 | 4752.00 | 4848.00 |
| 3600 | 3564.00 | 3636.00 |
| 2400 | 2376.00 | 2424.00 |
| 1800 | 1782.00 | 1818.00 |
| 1200 | 1188.00 | 1212.00 |
| 600 | 594.00 | 606.00 |
| 300 | 297.00 | 303.00 |
| 200 | 198.00 | 202.00 |
| 150 | 148.50 | 151.50 |
| 75 | 74.25 | 75.75 |

(4) Set **CLOCK** switch to **9600**.

(5) Connect oscilloscope to **INT XMIT CLOCK** (rear panel) connector using a 50Ω termination. Waveform amplitude will be no less than 2 V peak.

(6) Set **PATTERN** switch to **1:1** and **OFF/LOOP** switch to **OFF**.

(7) Connect oscilloscope without 50Ω termination to **BITS LOST** connector (rear panel). Waveform amplitude will be no less than 1.5 V peak.

(8) Connect frequency counter to **BITS LOST** connector.

(9) Set **CLOCK** switch to **75**. Frequency counter indication will be between 70 and 80 Hz.

(10) Observe that **OUT OF LOCK** and **LOSS OF DATA** (**RCV DATA INV** on some models) indicators are on.

(11) Set **OFF/LOOP** switch to **LOOP**. Frequency counter indication will be between 0 and 1 Hz.

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

**10. Transmit Pattern**

**a. Performance Check**

(1) Set TI as listed in (a) through (g) below:

(a) **CLOCK** to **9600**.
(b) **EXPONENT RANGE** to **AUTO**.
(c) **SINGLE/CYCLE** (**PRINTER** on some models) to **SINGLE**.

(d) **OFF/LOOP** to **OFF**.
(e) **OFF/XMIT ERRORS** to **XMIT ERRORS**.
(f) **EVENT** to **BIT ERROR**.
(g) **COUNT D/O COUNT C/L** switch to **COUNT C/L**.

(2) Connect equipment as shown in figure 2.

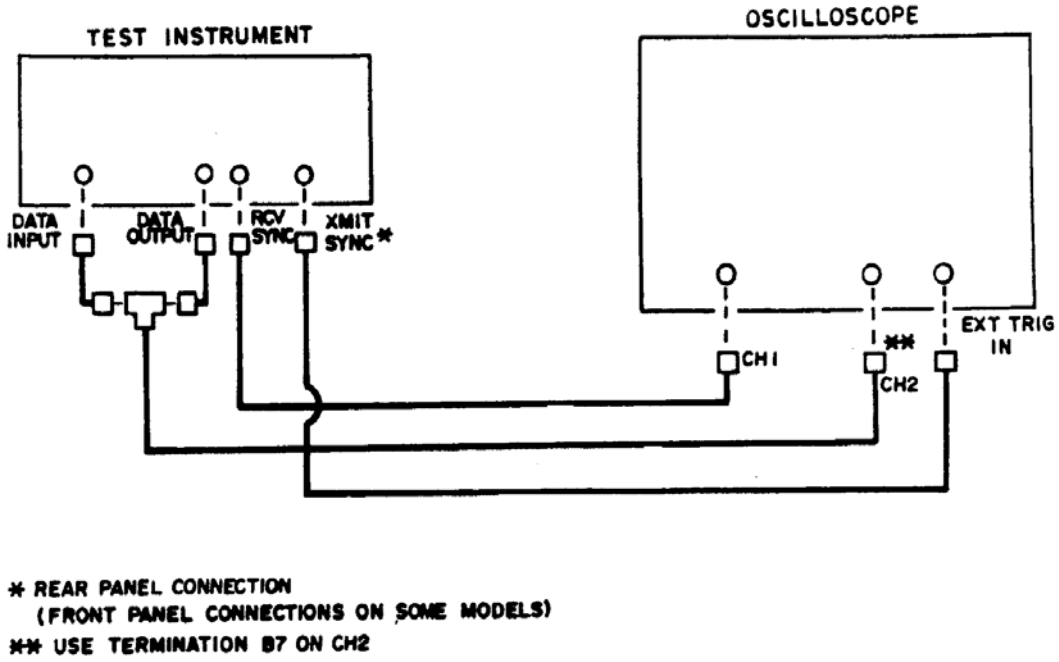


Figure 2. Transmit - equipment setup.

(3) Set **PATTERN** and **DATA/$\overline{\text{DATA}}$** switches to settings listed in table 4. At each setting momentarily set **START/STOP** switch to **START**. Observe that **TEST ON** indicator is on while readout is counting, and then goes out when counting stops. After **TEST ON** indicator goes out, observe that readout and oscilloscope indications are as listed in table 4 and figure 3.

Table 4. Transmit Pattern Check

| **Switch** settings | | **READOUT** indications | | | | | Channel 2 oscilloscope indications |
|---|---|---|---|---|---|---|---|
| **PATTERN** | **DATA/$\overline{\text{DATA}}$** | **BIT ERROR** | **CARR LOSS** | **CLK SLIP** | **BLOCK ERROR** | **SKEW** | |
| 2047 | DATA | EXP 488(+1)(-)6 | EXP 0(-)6 | EXP 0(-)6 | EXP 488(+1)(-)3 | _ _ _ | Fixed bit[1] pattern |
| 511 | DATA | EXP 196(±1)(-)5 | EXP 0(-)5 | EXP 0(-)5 | EXP 100(±1)(-)2 | _ _ _ | Fixed bit[1] pattern |
| 63 | DATA | EXP 159(±1)(-)4 | EXP 0(-)4 | EXP 0(-)4 | EXP 10(±1)(-)1 | 98% | Fixed bit[1] pattern |
| 63 | $\overline{\text{DATA}}$ | EXP 159(±1)(-)4 | EXP 0(-)4 | EXP 0(-)4 | EXP 10(±1)(-)1 | 0% | Fixed bit pattern will be inverted |
| 7:1[2] | $\overline{\text{DATA}}$ | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)1 | FLASHING | Fig. 3A |
| 7:1 | DATA | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)1 | FLASHING | Fig. 3B |
| 3:1 | DATA | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)1 | FLASHING | Fig. 3C |
| 1:1 | DATA | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)4 | EXP 0(-)1 | FLASHING | Fig. 3D |

[1] Pattern will vary as PATTERN switch is adjusted.
[2] Set EXPONENT RANGE switch to 4.

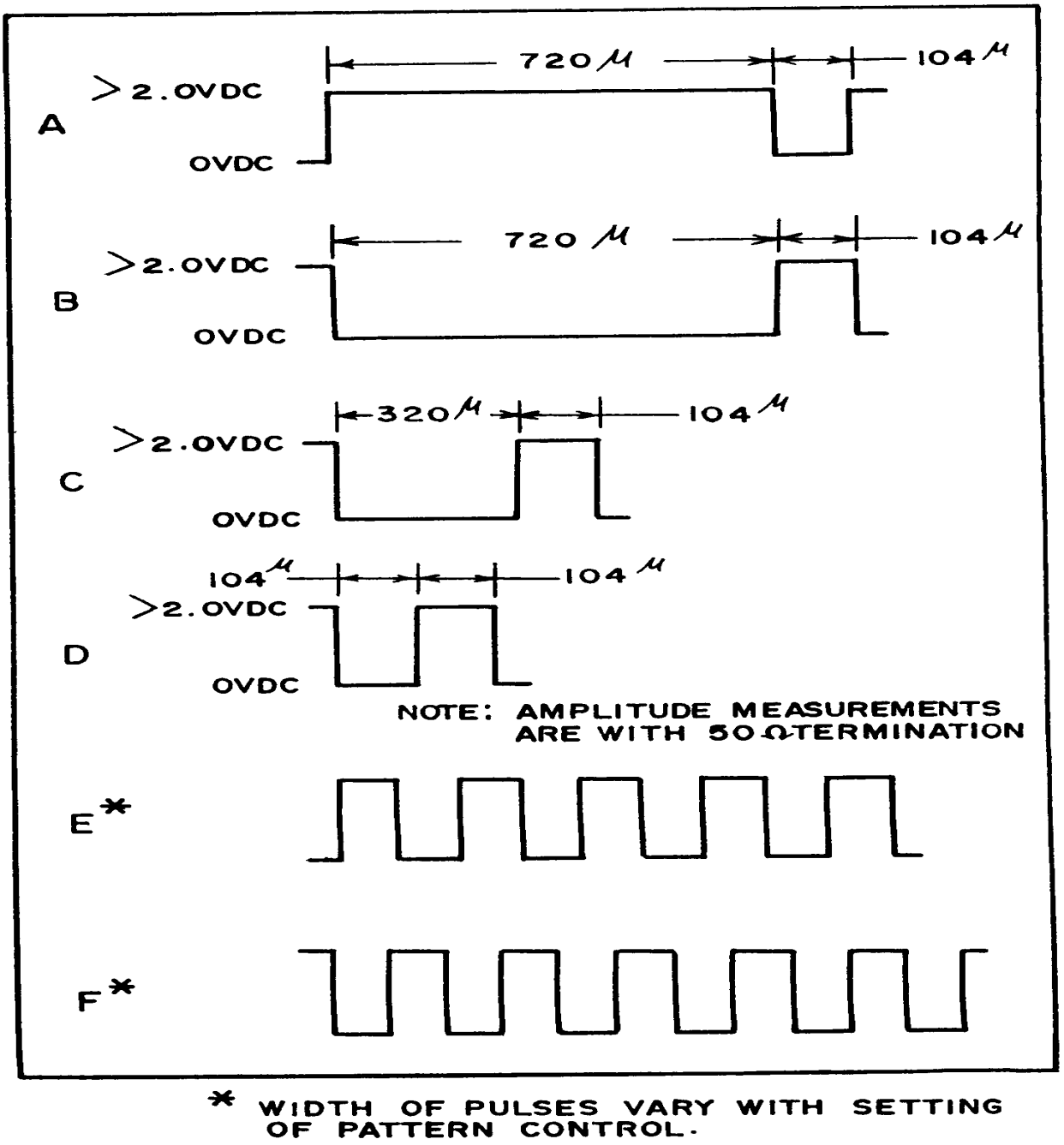


Figure 3. Transmit pattern waveforms.

(4) Set **PATTERN** switch to **MARK**. Observe that **OUT OF LOCK** and **LOSS OF DATA** (**RCV DATA INV**) indicators are on. Oscilloscope channel 2 indication will be at least +2.0 V dc.

(5) Set **DATA/$\overline{\text{DATA}}$** switch to **$\overline{\text{DATA}}$**. Oscilloscope indication will be 0 V dc level.

(6) Set **PATTERN** switch to **1:1**. Channel 1 waveform amplitude indication will be no less than 1.5 V peak.

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

**11. Jitter/Total Peak**

**a. Performance Check**

(1) Set TI switches as listed in (a) through (e) below:

(a) **EXPONENT RANGE** to **2**.
(b) **SINGLE/CYCLE (PRINTER)** to **CYCLE (PRINTER)**.
(c) **OFF/XMIT ERROR** to **OFF**.
(d) **EVENT** to **JITTER/TOTAL PEAK**.
(e) **JITTER/TOTAL PEAK** to **TOTAL PEAK**.

(2) Remove top cover and set **COUNT D/O COUNT C/L** switch to **COUNT D/O**.

**CAUTION**

To prevent damage to circuitry, be sure RS232C interface board is installed in TI, and pulse generator is adjusted for minimum output before connecting as shown in figure 4.

(3) Connect equipment as shown in figure 4.

(4) Adjust pulse generator for external triggered operation. Adjust output for +3 V peak and pulse width for 40 percent duty cycle as monitored on channel 2 of oscilloscope. Damage of data input circuit will occur if this is not done. If digital readout is not between 18 and 22 percent and oscilloscope channel 1 waveform is not at least a 2-V p-p square wave, perform **b** below.

(5) Set **JITTER/TOTAL PEAK** switch to **JITTER**. Digital readout will indicate less than 2 percent.

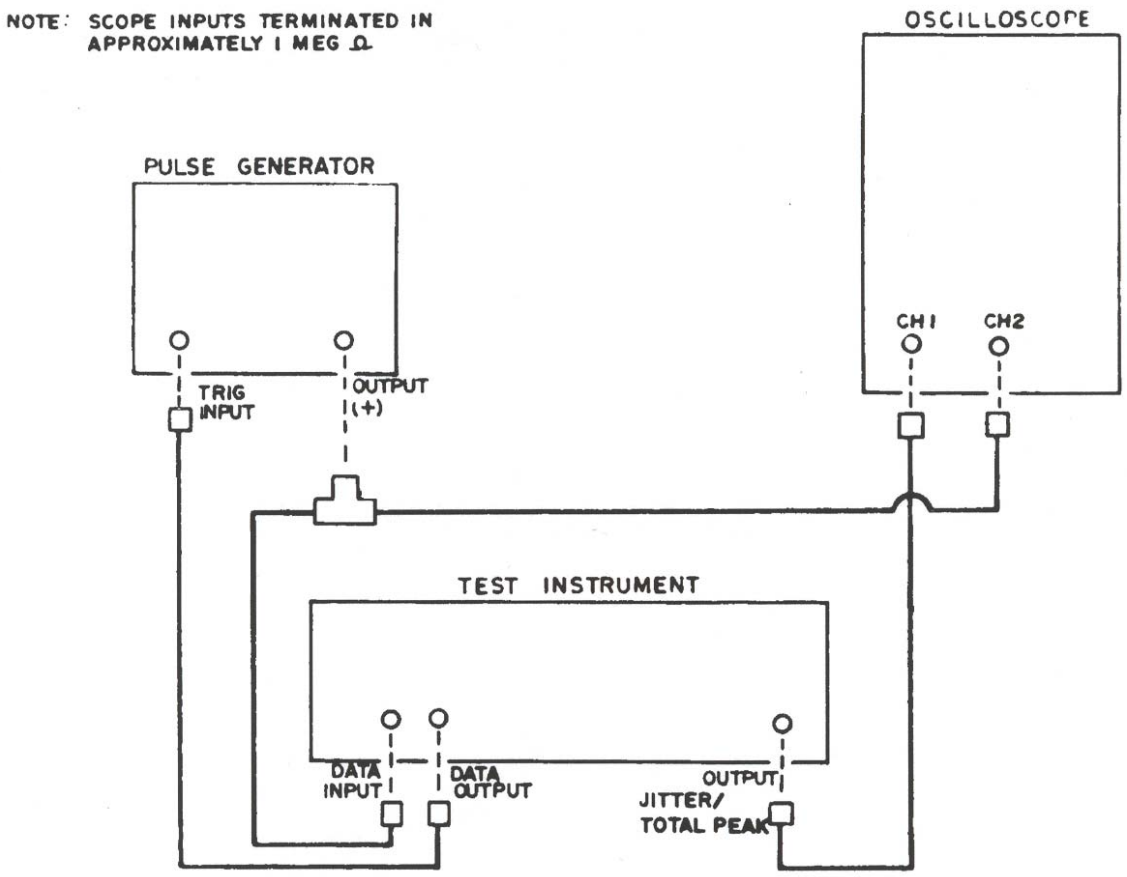


Figure 4. Jitter-total peak - equipment setup.

(6) Set TI switches as listed in (a) through (c) below:

(a) **CLOCK** to **75**.
(b) **PATTERN** to **(20)-1**.
(c) **OFF/LOOP** to **LOOP**.

(7) Momentarily set **START/STOP** switch to **START**. Digital readout will indicate less than 2 percent and **TEST ON** indicator will flash on and off.

(8) Set TI switches as listed in (a) through (d) below:

(a) **CLOCK** to **9600**.
(b) **PATTERN** to **1:1**.
(c) **OFF/LOOP** to **OFF**.

(d) **JITTER/TOTAL PEAK** to **TOTAL PEAK**.

(9) Adjust pulse generator amplitude for +5V peak. If digital readout does not indicate between 18 and 22 percent and oscilloscope channel 1 waveform is not at least a 2V peak to peak square wave, perform **b** below.

(10) Set **JITTER/TOTAL PEAK** switch to **JITTER**. Digital readout will indicate less than 3 percent.

(11) Disconnect all equipment.

**b. Adjustments**. Adjust **A12R4** (fig. 1) for a 2-V p-p square wave on oscilloscope channel 1, and a digital readout of 20 percent (R).

**12. Dropout**

**a. Performance Check**

**CAUTION**

To prevent damage to circuitry, be sure RS232 or RS232C interface board is installed.

(1) Set TI as listed in (a) through (f) below:

(a) **PATTERN** to **63**.
(b) **SINGLE/CYCLE PRINTER** to **SINGLE**.
(c) **OFF/ XMIT ERRORS** to **XMIT ERRORS**.
(d) **EVENT** to **BIT ERROR**.
(e) **EXPONENT RANGE** to **CONT**.
(f) **DTR/RTS/BACKWARD CHANNEL** to **DTR**.

(2) Remove top cover and set **COUNT D/O COUNT C/L** switch to **COUNT C/L**.

(3) Observe indicator status to be as follows:

(a) **OUT OF LOCK** on.
(b) **LOSS OF DATA** on.
(c) **DATA SET READY** off.
(d) **CLEAR TO SEND** off.
(e) **TEST ON** off.
(f) **BIT ERROR** on.
(g) **CARR LOSS** off.
(h) **BLOCK ERROR (RCV DATA)** on.

**NOTE**

If block error light is not lit set loop switch to loop and back to off.

(4) Set **LINE** switch to **OFF**.

(5) Short pins on **A15J1 connector** on rear panel (**DATA INTERFACE board RS232 or RS232C**) as listed in (a) through (c) below:

(a) **Pin 4** to **pin 5**.
(b) **Pin 6** to **pin 20**.
(c) **Pin 8** to **pin 19**.

(6) Set **LINE** switch to **ON**. TI indications will be as listed in (a) through (h) below.

(a) **OUT of LOCK** on.
(b) **LOSS OF DATA** on.
(c) **DATA SET READY** on.
(d) **CLEAR TO SEND** off.
(e) **TEST ON** off.
(f) **BIT ERROR** on.
(g) **CARR LOSS** on.
(h) **CLK SLIP** off.

(7) Set **DTR/RTS/BACKWARD CHANNEL** switch to **RTS**. **CLEAR TO SEND** indicator will be on.

(8) Set **DTR/RTS/BACKWARD CHANNEL** switch to **BACKWARD CHANNEL**. **CARR LOSS** indicator will be off.

(9) Set **LINE** switch to **OFF** and remove shorts installed in (5) above.

(10) Set **DTR/RTS/BACKWARD CHANNEL** switch to **DTR**.

(11) Set **LINE** switch to **ON**.

(12) Connect differential voltmeter between **pin 4 of A15J1** connector on rear panel and **chassis ground**. Differential voltmeter indication will be between -5 and -12 V.

(13) Set **DTR/RTS/BACKWARD CHANNEL** switch to **BACKWARD CHANNEL**. Differential voltmeter indication will be between +5 and +12 V.

(14) Adjust pulse generator for oscilloscope indication as shown in figure 5A, and connect pulse generator output to **BACKWARD CHANNEL DATA** connector (rear panel).

(15) Connect oscilloscope between **pin 14 of A15J1** connector on rear panel (**RS232C DATA INTERFACE**) and **chassis ground**. Oscilloscope indication will be as shown in figure 5B.

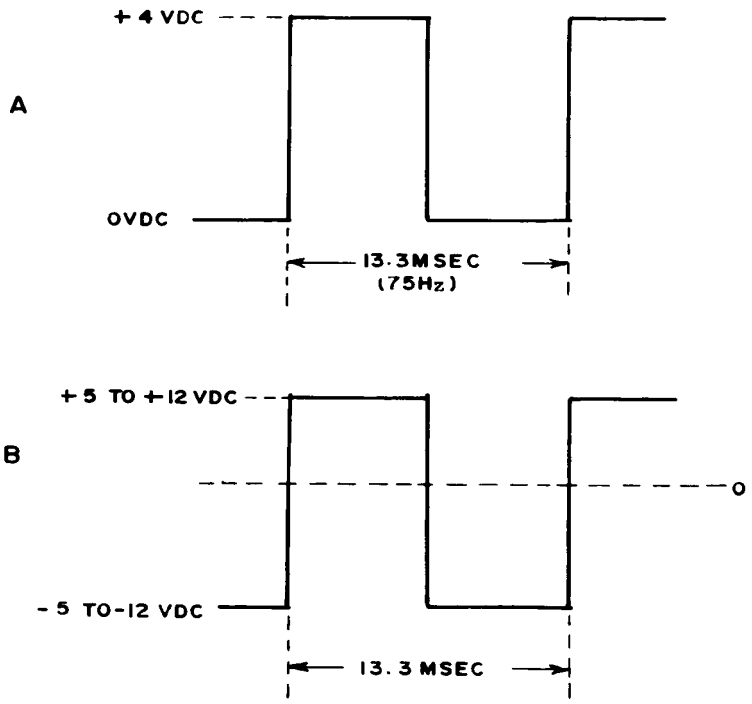


Figure 5. Dropout waveforms.

(16) Remove top cover and set **COUNT D/O COUNT C/L** switch to **COUNT D/O**. Replace cover.

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

## 13. Power Supply

**NOTE**

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

### a. Performance Check

(1) Connect differential voltmeter between **+5 V test point** (fig. 6) and **chassis ground**. Differential voltmeter indication will be between 4.75 and 5.25 V dc.

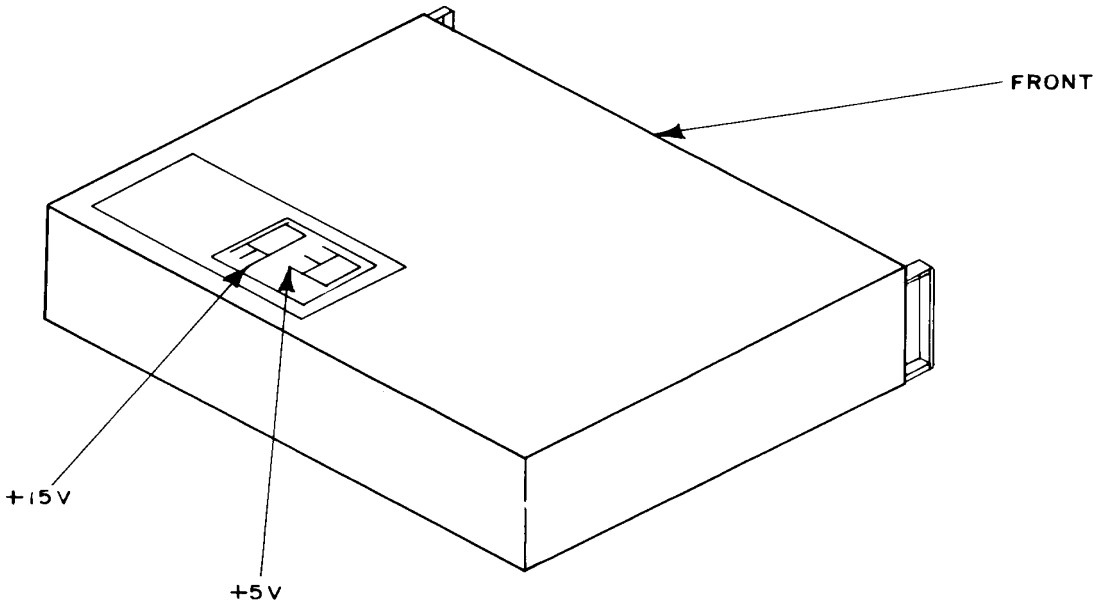


Figure 6. Test instrument - bottom interior view.

(2) Connect differential voltmeter between **+15 V test point** (fig. 6) and **chassis ground**. Differential voltmeter indication will be between 14.5 and 15.75 V dc.

**NOTE**

Top cover of TI must be removed to gain access to **LOGIC PROBE CONNECTOR** (fig. 1).

(3) Connect differential voltmeter between center conductor of **LOGIC PROBE CONNECTOR** and **chassis ground**. Differential voltmeter indication will be between 4.75 and 5.25 V.

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

## 14. 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:**

Official:

*JOHN M. KEANE*
*General, United States Army*
*Acting Chief of Staff*

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

0320202

Distribution:

To be distributed in accordance with IDN 342244, requirements for calibration procedure TB 9-6625-2138-35.

## 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.

**PIN: 056840-000**