*TB 9-6625-086-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR POWER METER, HEWLETT-PACKARD MODEL 431C (AN/USM-260)

Headquarters, Department of the Army, Washington, DC
17 October 2007

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, 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.

*This bulletin supersedes TB 9-6625-086-35, 12 December 1975 including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Power Meter, Hewlett-Packard Model 431C (AN/USM-260). 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 1 hour, using the microwave or dc low 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
Zero carryover	Less than 0.5% of FS when zeroed on most sensitive scale
Range	0.01 to 10 mW in 7 ranges: -20 to +10 dBm in 5 -dBm steps
Accuracy	From +20°C to +35°C - .01 mW range, ± 2% of FS, .03 mW range, ± 1.5% of FS; all other ranges, ± 1% of FS From 0°C to +55°C, ± 3% of FS on all ranges

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with the secondary transfer calibration standards sets 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 accuracy 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 accessories are also required for this calibration: dc power supply, Elgar, model DCS40-30EM1-2 (13589313), and decade resistor, CMC, model 240C (7907234)

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUTOTRANSFORMER	Range: 105 to 125 V ac	Ridge, Model 9020A (9020A)
FREQUENCY COUNTER	Range: 9.950 kHz to 10.275 kHz Accuracy: ± 0.025%	Fluke, Model PM6681/656 (PM6681/656)
MULTIMETER	Range: 0 to 25 Vdc Accuracy: ± 0.05%	Agilent, Model 3458A (3458A)
POWER METER CALIBRATOR	Range: 0.01 to 10 mw Accuracy: ± 0.25%	Hewlett-Packard 8402B (7911026)
RESISTANCE STANDARD[1]	Range: 1 kohm Accuracy: ± 0.05%	Biddle-Gray, Model 71-631 (7910328)
THERMISTOR MOUNT	Range: 10 MHz to 12.4 GHz Accuracy: ± 5% 10 MHz to 10 GHz 8.2 to 12.4 GHz	Hewlett-Packard, Models 478A (7910461) X486A (7910460)

[1]Not used if power meter calibrator is available.

SECTION III
PRELIMINARY OPERATIONS

6. Preliminary Instructions

a. The instructions outlined in this section 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 and item identification number 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.

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.

7. Equipment Setup

a. Connect autotransformer to the power source and adjust for 115 volts ac.

CAUTION

Throughout this procedure, make sure the TI is deenergized while connecting or disconnecting a thermistor mount or when repositioning the **MOUNT RES** switch.

b. Connect the TI to autotransformer.

c. Adjust the TI mechanical zero setscrew clockwise until the pointer is left of zero, moving up scale. Stop when the pointer indicates zero.

NOTE

If pointer overshoots zero indication during adjustment, repeat **c** above.

d. Adjust the zero setscrew approximately 15 degrees counterclockwise to free the setscrew from the meter movement.

e. If the pointer moves while freeing the setscrew, repeat **c** and **d** above.

f. Connect 200 ohm thermistor mount to the TI, using cable furnished with the TI and terminate the mount with a 50 ohm termination.

g. Set the **CALIB FACTOR PERCENT** switch to **100** and leave it in this position for the remainder of the procedure.

SECTION IV
CALIBRATION PROCESS

NOTE

When indications specified in paragraphs **8** through **11** are not within tolerance, perform the oscillator frequency check in paragraph **12** and the power supply check in paragraph **13** before making adjustments. Do not perform the procedures in paragraphs **12** and **13** if all other parameters are within tolerance.

NOTE

Remove top and side covers from the TI only for adjustment. When adjustment is completed, reinstall the covers.

8. Coarse Null

a. Performance Check

(1) Position the TI **RANGE** switch to the **.01 MW** position.

(2) Adjust the TI **ZERO** controls for a 25 to 75 percent indication on the TI meter.

(3) Turn the **RANGE** switch to **NULL**.

(4) Adjust the **NULL**, control for minimum indication on the TI meter.

(5) Repeat (2) through (4) above until the TI meter pointer is within the **NULL** region. If the meter pointer does not indicate within the **NULL** region, perform **b** below.

NOTE

During calibration, if a 100 ohm thermistor mount is not available, disregard (6) through (8) below.

(6) Connect the 100 ohm thermistor mount to the TI.

(7) Set the TI **MOUNT RES** switch to **100Ω**.

(8) Repeat (2) through (5) above.

b. Adjustments. Adjust L1 (fig. 1) for null on the TI.

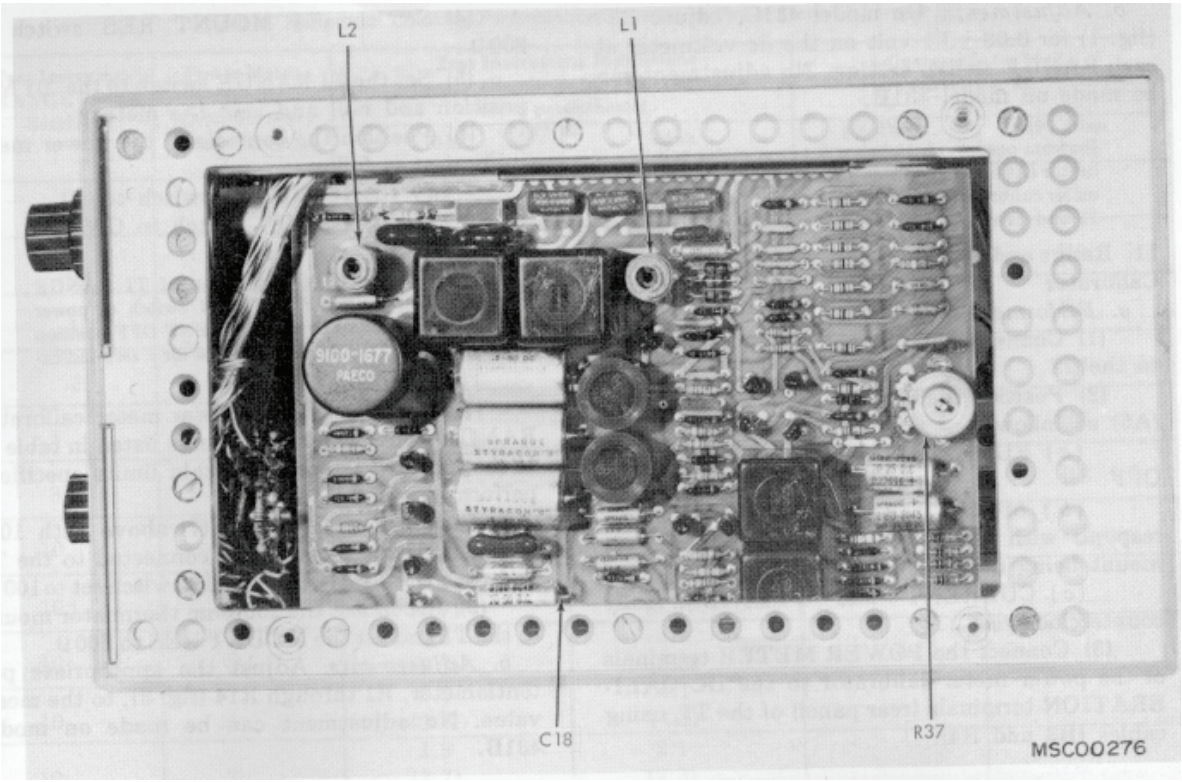


Figure 1. Right interior view.

9. Zero and Vernier

a. Performance Check

(1) Connect multimeter to the TI **DVM** output (rear panel).

(2) Position the TI **RANGE** switch to the **.01 MW** position and adjust the zero controls for 0.00 volt dc on the multimeter.

(3) Turn the TI **RANGE** switch to **.03-**, **.1-**, **.3-**, **l-**, **3-**, and **10-MW** positions while observing multimeter. If the multimeter does not indicate between -0.01 and +0.01 volts in each position of the **RANGE** switch, perform **b** below.

b. Adjustments. Adjust R37 (fig. 1) for 0.00 ± 0.01 volts on the multimeter at each **RANGE** switch setting.

NOTE

Perform paragraph **10** below if power meter calibrator is available as a standard. If a power meter calibrator is not available, omit paragraph **10** and proceed to paragraph **11**.

10. Range and Tracking Check with Power Meter Calibrator

a. Performance Check

(1) Connect the 200 ohm thermistor mount to the TI.

(2) Position the controls of the power meter calibrator as follows:

(a) **FUNCTION** switch to **CURRENT OFF**.

(b) **MOUNT RESISTANCE** to correspond with the resistance of the thermistor mount being used.

(c) **CURRENT** and **VERNIER** fully counterclockwise.

(3) Connect the **POWER METER** terminals of the power meter calibrator to the **DC CALIBRATION** terminals (rear panel) of the TI.

(4) Set the TI **MOUNT RES** switch to **200Ω**.

(5) Set the TI **RANGE** switch to the **.01 MW** position and null and zero the meter.

(6) Position the controls of the power meter calibrator as follows:

(a) **RANGE (MW)** switch to .01.

(b) **FUNCTION** switch to **CAL**.

NOTE

After each change in position of TI **RANGE** switch, turn the **FUNCTION** switch of power meter calibrator to the **CURRENT OFF** position and adjust the TI zero controls for a zero indication.

(7) Turn the TI and power meter calibrator **RANGE** switches to the settings listed in table 3. If the indications are not within limits specified, perform **b** below.

Table 3. Range and Trucking Performance Check (with Power Meter Calibrator)

Test instrument **RANGE** switch settings	Power meter calibrator **RANGE (MW)** switch settings	Test instrument indications (mw)		Adjustments	
		Min	Max	200 ohm mount	100 ohm mount
.01	**.01**	0.0098	0.0102	R14	R1
.03	**.03**	0.0295	0.0305	R13	R2
.1	**.1**	0.099	0.101	R12	R3
.3	**.3**	0.297	0.303	R11	R4
1	**1**	0.990	1.010	R10	R5
3	**3**	2.970	3.030	R9	R6
10	**10**	9.900	10.100	R8	R7
10[1]	**8**	7.9	8.1		
10	**6**	5.9	6.1		
10	**4**	3.9	4.1		
10	**2**	1.9	2.1		

[1]Before performing this check, adjust the TI **ZERO** controls for 10 mW on the TI and power meter calibrator **RANGE** switches still set to 10 mW.

(8) Repeat (1) through (7) above with 100 ohm thermistor mount connected to the TI and with the TI **MOUNT RES** switch set to **100Ω.**

(9) Reconnect the 200 ohm thermistor mount to the TI and set the **MOUNT RES** to **200Ω**.

b. Adjustments. Adjust the appropriate potentiometer, R1 through R14 (fig. 2), to the mean value.

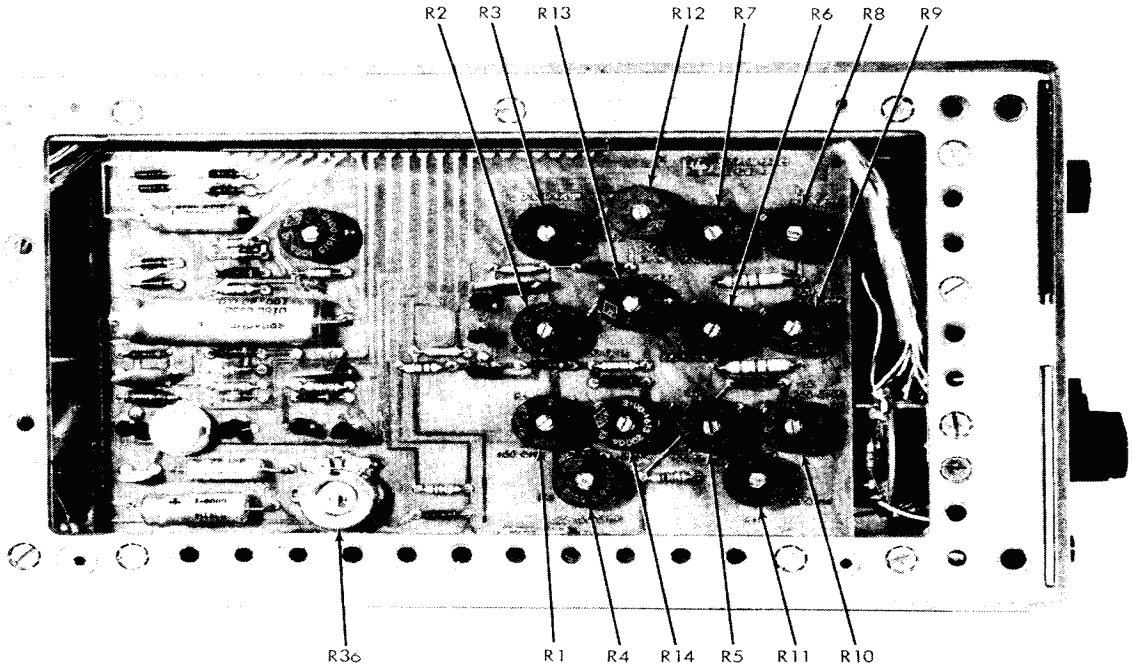


Figure 2. Left interior view.

11. Range and Tracking Check Without Power Calibrator

a. Performance Check

(1) Connect the equipment as shown in figure 3.

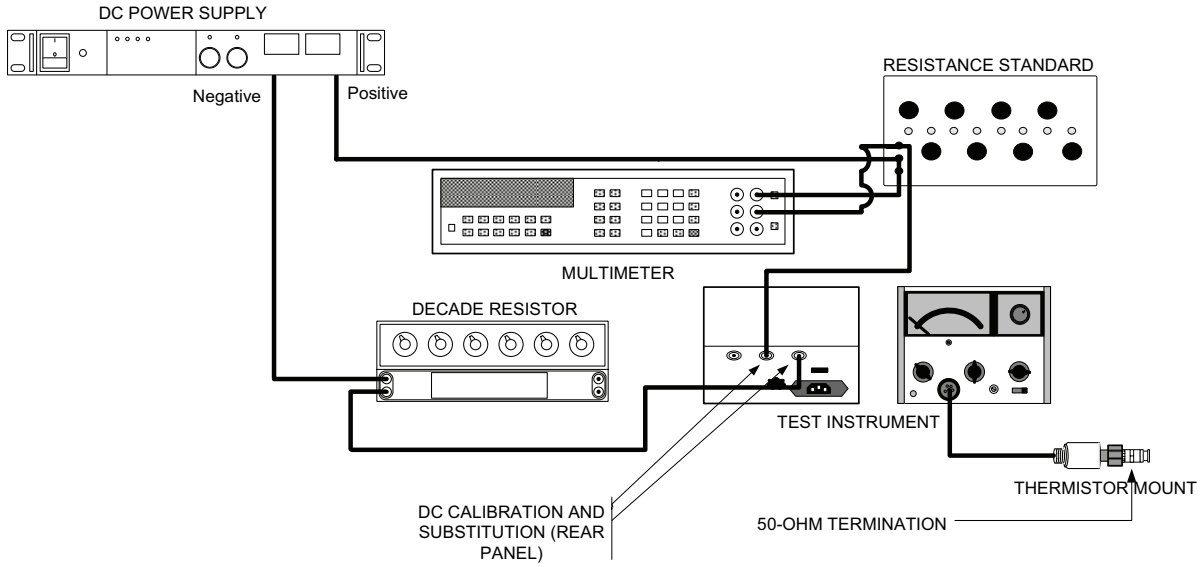


Figure 3. Range and tracking check without power meter calibrator.

(2) Set decade resistor to 10 kΩ. This 10 kΩ value can be decreased as necessary to obtain full scale indication on TI.

(3) Set resistance standard to 1000 ohms.

(4) Set the TI **MOUNT RES** switch to agree with the thermistor mount being used.

(5) Set the TI **RANGE** switch to **.01 MW** and null and zero the meter.

(6) Adjust dc power supply for a full-scale (0.01 mw) indication on the TI. If multimeter indication is not within the limits specified in table 4, perform **b** below.

Table 4. Range and tracking Performance Check (Without Power Meter Calibrator)

Test instrument switch settings	Test instrument indication	Multimeter indications (Vdc)				Adjustments (fig. 3)	
		200 ohm mount		100 ohm mount		200 ohm mount	100 ohm mount
		Min	Max	Min	Max		
.01	**.01**	.438	.456	.619	.645	R14	R1
.03	**.03**	.763	.787	1.08	1.12	R13	R2
.1	**.1**	1.40	1.42	1.98	2.02	R12	R3
.3	**.3**	2.43	2.47	3.43	3.49	R11	R4
1	**1**	4.43	4.51	6.26	6.38	R10	R5

Table 4. Range and tracking Performance Check (Without Power Meter Calibrator) - Continued

Test instrument switch settings	Test instrument indication	Multimeter indications (Vdc)				Adjustments (fig. 3)	
		200 ohm mount		100 ohm mount		200 ohm mount	100 ohm mount
		Min	Max	Min	Max		
3	**3**	7.67	7.83	10.84	11.06	R9	R6
10	**10**	14.00	14.28	19.80	20.20	R8	R7
10	**8**	12.52	12.78	17.71	18.07		
10	**6**	10.84	11.06	15.34	15.64		
10	**4**	8.85	9.03	12.52	12.78		
10	**2**	6.26	6.38	8.85	9.03		

NOTE

Each time the TI **RANGE** switch is changed, turn the dc power supply off and zero the TI meter.

(7) Repeat the technique in (5) and (6) above for the remaining positions of the TI **RANGE** switch. If both the 200 ohm and 100 ohm thermistor mount are available, perform (1) through (6) above for both mounts.

b. Adjustments. Adjust R1 through R14 (fig. 2) as appropriate.

12. Oscillator Frequency

a. Performance Check

NOTE

Do not perform the oscillator frequency check if all parameters in paragraphs **8** through **11** above are within tolerance.

(1) Connect frequency counter to the positive end of C18 (fig. 1) and ground.

(2) Connect the 200-ohm thermistor mount to the TI and terminate the mount with a 50-ohm termination.

(3) Set the TI **MOUNT RES** switch to **200Ω**.

(4) If the frequency counter does not indicate between 9.990 and 10.010 kHz, perform **b** below.

NOTE

Perform (5) through (7) below if the TI is to be used with a 100-ohm thermistor mount.

(5) Disconnect the 200 ohm thermistor mount from the TI.

(6) Connect the 100 ohm thermistor mount to the TI and turn the **MOUNT RES** switch to **100Ω**.

(7) The frequency counter will indicate between 9.950 and 10.050 kHz.

b. **Adjustments.** Adjust L2 (fig. 1) for 10.000 kHz.

13. Power Supply

a. Performance Check

NOTE

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

(1) Connect multimeter to pin W of terminal board XA2 (fig. 4) and ground.

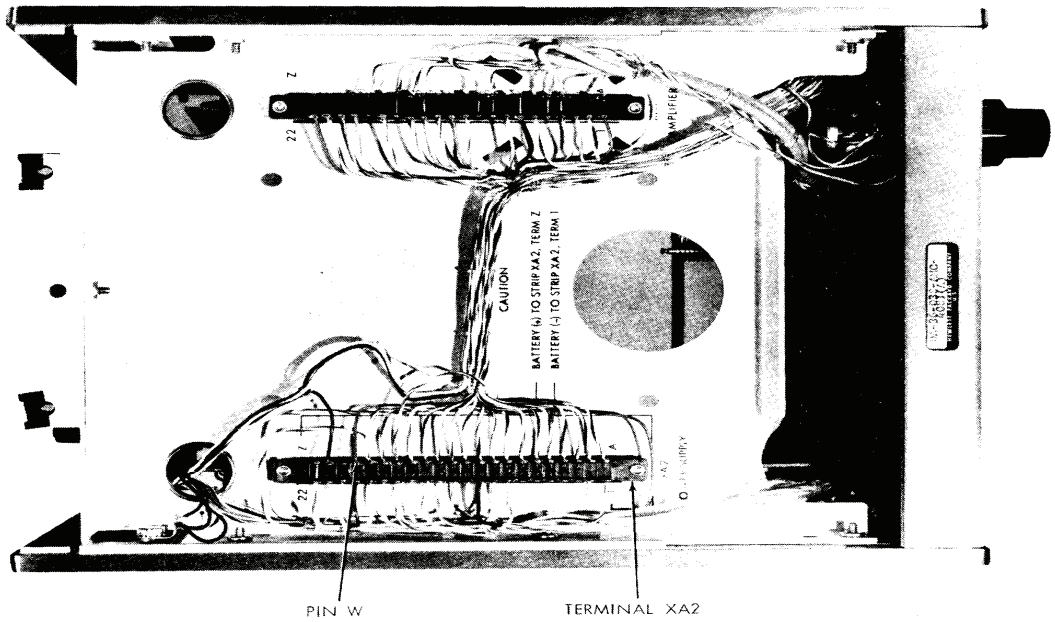


Figure 4. Top internal view.

(2) If the multimeter does not indicate between -17.98 and -18.02 volts dc, perform **b** below.

(3) Vary the output of autotransformer between 105 and 125 volts ac. The multimeter indication will remain within the limits specified in (2) above.

(4) Adjust the autotransformer for a 115 volt ac output.

b. Adjustments. Adjust R36 (fig. 2).

14. Final Procedure

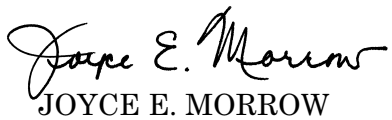
a. Deenergize and disconnect all equipment and replace TI protective cover.

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:



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Distribution:

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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.