

# TM 11-6625-599-45

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

---

**GS AND DEPOT MAINTENANCE MANUAL**

**INCLUDING REPAIR PARTS**

**AND SPECIAL TOOLS LIST**

**VOLTMETER, ELECTRONIC AN/USM-98A**

This copy is a reprint which includes current pages from Changes 1 through 4. The title was changed by C 2 to read as shown above.

---

**HEADQUARTERS, DEPARTMENT OF THE ARMY**

**5 MAY 1965**

TECHNICAL MANUAL

No. 11-6625-599-45

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D. C., 5 May 1965

**General Support and Depot Maintenance Manual Including Repair  
Parts and Special Tools Lists  
VOLTMETERS, ELECTRONIC AN/USM-98A AND AN/USM-98B  
(NSN 6625-00-753-2115)**

|         |                                                             | Paragraph | Page |
|---------|-------------------------------------------------------------|-----------|------|
| CHAPTER | 1. FUNCTIONING                                              |           |      |
|         | Scope .....                                                 | 1-1       | 3    |
|         | Indexes of publications .....                               | 1-1.1     | 3    |
|         | Reporting equipment improvement recommendations (EIR) ..... | 1-1.2     | 3    |
|         | Block diagram .....                                         | 1-2       | 3    |
|         | Reference power supply, 0- to 500-volt .....                | 1-3       | 4    |
|         | Chopper amplifier, 60-cycle .....                           | 1-4       | 8    |
|         | Low-voltage supply .....                                    | 1-5       | 10   |
| CHAPTER | 2. TROUBLESHOOTING                                          |           |      |
| Section | I. General troubleshooting techniques                       |           |      |
|         | General instructions .....                                  | 2-1       | 13   |
|         | Organization of troubleshooting procedures .....            | 2-2       | 13   |
|         | Test equipment required for troubleshooting .....           | 2-3       | 14   |
|         | II. Troubleshooting Voltmeter, Electronic AN/USM-98A        |           |      |
|         | Troubleshooting sequence .....                              | 2-4       | 23   |
|         | Troubleshooting chart .....                                 | 2-5       | 23   |
|         | III. Decade resistor fault isolation                        |           |      |
|         | Fault indication .....                                      | 2-6       | 25   |
|         | Fault isolation procedure .....                             | 2-7       | 25   |
| CHAPTER | 3. REPAIRS AND CALIBRATION                                  |           |      |
| Section | I. Repairs                                                  |           |      |
|         | General parts replacement techniques .....                  | 3-1       | 27   |
|         | Test equipment required for repairs and calibration .....   | 3-2       | 27   |
|         | Safety features .....                                       | 3-2.1     |      |
|         | Replacement of tubes .....                                  | 3-3       | 27   |
|         | Replacement of decimal point indicator lamp .....           | 3-4       | 27   |
|         | Replacement of printed circuit board components .....       | 3-5       | 28   |
|         | Replacement of standard cell B1 .....                       | 3-5.1     |      |
|         | Cleaning procedure .....                                    | 3-6       | 28   |
|         | II. Calibration                                             |           |      |
|         | Calibration preparation procedure .....                     | 3-7       | 29   |
|         | Calibration test procedure .....                            | 3-8       | 29   |
| CHAPTER | 4. GENERAL SUPPORT TESTING PROCEDURES                       |           |      |
|         | General .....                                               | 4-1       | 33   |
|         | Test equipment, tools, and equipment .....                  | 4-2       | 33   |
|         | Modification work orders .....                              | 4-3       | 33   |
|         | Physical tests and inspections .....                        | 4-4       | 35   |
|         | Calibration standard .....                                  | 4-5       | 37   |
|         | Test data summary .....                                     | 4-6       | 38   |
| CHAPTER | 5. DEPOT INSPECTION STANDARDS                               |           |      |
|         | Applicability of depot inspection standards .....           | 5-1       | 39   |
|         | Applicable references .....                                 | 5-2       | 39   |
|         | Test facilities required .....                              | 5-3       | 39   |

|          | <i>Paragraph</i>                                                                        | <i>Page</i> |
|----------|-----------------------------------------------------------------------------------------|-------------|
|          | General test requirements . . . . .                                                     | 5-4 39      |
|          | Calibration test . . . . .                                                              | 5-5 39      |
|          | Vtvm accuracy test . . . . .                                                            | 5-6 39      |
|          | Accuracy and stability tests, 500-volt divider . . . . .                                | 5-7 40      |
|          | Accuracy test, 50-, 5-, 0.5-volt dividers. . . . .                                      | 5-8 40      |
|          | Attenuator accuracy test . . . . .                                                      | 5-9 40      |
| APPENDIX | A. REFERENCES . . . . .                                                                 | A-1         |
|          | B. GENERAL SUPPORT AND DEPOT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LISTS . . . . . | B-1         |

### LIST OF ILLUSTRATIONS

| <i>Figure No.</i> | <i>Caption</i>                                                                         | <i>Page</i> |
|-------------------|----------------------------------------------------------------------------------------|-------------|
| 1-1               | Voltmeter, Electronic AN/USM-98(*), block diagram.                                     | 4           |
| 1-2               | Reference power supply, 0-500 volt, block diagram.                                     | 5           |
| 1-3               | Chopper amplifier, 60 cycle, block diagram.                                            | 6           |
| 1-4               | Low-voltage power supply, block diagram.                                               | 6           |
| 1-5.1             | Low voltage power supply, AN/USM-98B, schematic diagram.                               | 11          |
| 1-5               | Low voltage power supply, schematic diagram AN/USM-98A.                                | 12          |
| 2-1               | Power transformer T1, voltage and resistance data, AN/USM-98A.                         | 14          |
| 2-1.1             | Power transformer T1, voltage and resistance data, AN/USM-98B.                         | 14.1        |
| 2-2               | Voltmeter, Electronic AN/USM-98A, rear view, showing component location.               | 15          |
| 2-3               | Voltmeter, Electronic AN/USM-98A, left side view, showing component location.          | 16          |
| 2-2.1             | Voltmeter, Electronic AN/USM-98B, rear view, showing component location.               | 16.1        |
| 2-3.1             | Voltmeter, Electronic AN/USM-98B, left side view, showing component location.          | 16.2        |
| 2-4               | Reference power supply 500-volt printed circuit board.                                 | 17          |
| 2-5               | Five-decade attenuator printed circuit board.                                          | 18          |
| 2-4.1             | Reference power supply 500-volt printed circuit board.                                 | 18.1        |
| 2-5.1             | Five-decade attenuator printed circuit board.                                          | 18.2        |
| 2-6               | Voltmeter, Electronic AN/USM-98A, right side view, showing components.                 | 19          |
| 2-7               | Chopper amplifier, printed circuit board.                                              | 20          |
| 2-6.1             | Voltmeter, Electronic AN/USM-98B, right side view, showing components.                 | 20.1        |
| 2-7.1             | Chopper amplifier, printed circuit board.                                              | 20.2        |
| 2-8               | Range resistor printed circuit board.                                                  | 21          |
| 2-9               | Voltmeter, Electronic AN/USM-98A, front panel, rear view, showing component locations. | 22          |
| 3-1               | Voltmeter, Electronic AN/USM-98B.                                                      | 31          |
| 3-2               | Bracket assembly, AN/USM-98B.                                                          | 32          |
| 3-3               | Chassis, electrical equipment.                                                         | 33          |
| 3-4               | Circuit card assembly TB1                                                              | 34          |
| 3-5               | Voltmeter, Electronic AN/USM-98, calibration test.                                     | 35          |
| 4-1               | Calibration accuracy test.                                                             | 38          |
| 5-1               | Depot test setup.                                                                      | 40.2        |
| 5-2               | MIL-STD resistor color code markings.                                                  | 41          |
| 5-3               | MIL-STD capacitor color code markings.                                                 | Foldout     |
| 5-4               | Power supply, 0 to 500 volts, schematic diagram, AN/USM-98A.                           | Foldout     |
| 5-4.1             | Power supply, 0 to 500 volts, schematic diagram, AN/USM-98B.                           | Foldout     |
| 5-5               | Vacuum tube voltmeter mode of operation, simplified schematic diagram, AN/USM-98A.     | Foldout     |
| 5-5.1             | Vacuum tube voltmeter mode of operation, simplified schematic diagram AN/USM-98B.      | Foldout     |
| 5-6               | Differential voltmeter mode of operation, simplified schematic diagram.                | Foldout     |
| 5-7               | Tube socket voltage and resistance diagram.                                            | Foldout     |
| 5-8               | Voltmeter, Electronic AN/USM-98A, schematic diagram.                                   | Foldout     |
| 5-8.1             | Voltmeter, Electronic AN/USM-98B, schematic diagram.                                   | Foldout     |
| 5-9               | Voltmeter, Electronic AN/USM-98B (contract DAAB07-74-C-0622), schematic diagram.       | Foldout     |

## CHAPTER 1 FUNCTIONING

### 1-1. Scope

a. This manual covers general support and depot maintenance for Voltmeter, Electronic AN/USM-98(\*). It includes instructions appropriate to general support and depot maintenance personnel for troubleshooting, testing, aligning, and repairing the equipment, and replacing maintenance parts. It also lists tools, materials, and test equipment for general support and depot maintenance. Detailed functions of the equipment are covered in paragraphs 1-2 through 1-5.

b. Official nomenclature followed by (\*) represents all models of the equipment. Thus, Voltmeter, Electronic AN/USM-98(\*) represents Voltmeters, Electronic AN/USM-98A and AN/USM-98B. The AN/USM-98B has been manufactured under several orders with minor differences in repair parts; appendix B covers the earlier units; TM 11-6625-599-40P-2 covers units manufactured under Contract DAAB07-74-C-0622.

c. The complete technical manual for this equipment includes TM 11-6625-599-12 and TM 11-6625-599-40P-2.

d. Report of errors, omissions, and recommendations for improving this publication by the individual user is authorized and encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703.

#### 1-1.1 Indexes of Publications

a. *DA Pam 310-4*. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, Changes, or additional publications pertaining to the equipment.

b. *DA Pam 310-7*. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

#### 1-1.2 Reporting Equipment Improvement Recommendations (EIR)

EIR's will be prepared using DA Form 2407 (Maintenance Request). Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed directly to Commander, US Army Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be furnished directly to you.

#### NOTE

For other applicable forms and records, refer to TM 11-6625-599-12.

### 1-2. Block Diagram

(fig. 1-1)

Voltmeter, Electronic AN/USM-98A (vtvm) is a precision voltmeter used to measure accurately direct current (dc) potentials from 0 to 500 volts. The vtm contains a 0- to 500- volt reference power supply (*a* below), a 60-Hz chopper amplifier (*b* below), and a low voltage power supply (*c* below). The vtm functions as a vacuum-tube voltmeter when the NULL switch is set to VTVM, and as a differential voltmeter when the NULL switch is set to 10, 1, .1 or .01.

a. *Reference Power Supply 0- to 500- Volt* (fig. 1-1 and 1-2). The 0- to 500- volt reference voltage is obtained from a +700 volt power supply and a voltage regulator and divider. A part of power transformer T1 and power rectifiers CR101, CR102, and CR103 provide an unregulated +700 volts to the voltage regulator. Series regulator tube V102, differential amplifiers V106 and V105, and voltage reference tube V104 provide a regulated + 500 volts. The reference range voltage divider, the RANGE switch, and the five-decade attenuator provide the desired voltage (0 to 500 volts). This voltage is applied to meter M1 through a voltage divider.

b. *Chopper Amplifier 60-Hz* (fig. 1-1 and 1-3).

(1) The 60-Hz chopper amplifier is a stable, drift-free dc amplifier. The input voltage to the 60-Hz chopper amplifier is the difference between the 0-to 500- volt reference power supply output and the unknown voltage when the NULL switch is set to 10, 1, .1, or .01. The input voltage is applied directly to the 60- Hz chopper amplifier when the NULL switch