

**SECONDARY STANDARDS FOR
CHECKING DC METERS
DESCRIPTION AND APPLICATION**

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1. GENERAL

1.01 This practice describes the KS-8039 volt-milliammeter, KS-20599, L4, DMM (digital multimeter), and the KS-22861, L1, DMM.

1.02 Revision arrows are used to emphasize the more significant changes. The Equipment Test List is not affected. This document is reissued for the following reasons:

(a) To rate the KS-20599, L4, DMM Mfr Disc.

(b) To add the KS-22861, L1, DMM.

1.03 These instruments are provided with the necessary voltage and current scales to facilitate their use as secondary standards in checking the accuracy of voltmeters, ammeters, and milliammeters used in telephone plants. The KS-8039 meter is accurate within plus or minus a quarter of 1 percent of full scale deflection. The accuracy of the KS-20599, L4, meter is covered in Practice 100-520-102. The accuracy of the KS-22861, L1, meter is covered in the Instruction Manual KS-22861, L103, supplied with the meter.

2. DESCRIPTION

KS-8039 VOLT-MILLIAMMETER

2.01 The meter and associated equipment are mounted in a bakelite case with a removable hinged cover. Shielding eliminates the effect of external magnetic fields. The overall dimensions of the case with the cover closed are approximately 5 inches (127 millimeters) by 8 inches (203.2 millimeters) by 8 inches (203.2 millimeters). (See Fig. 1.)

2.02 The meter has a knife edge pointer and mirror scale. This scale is 6 inches (152.4 millimeters)

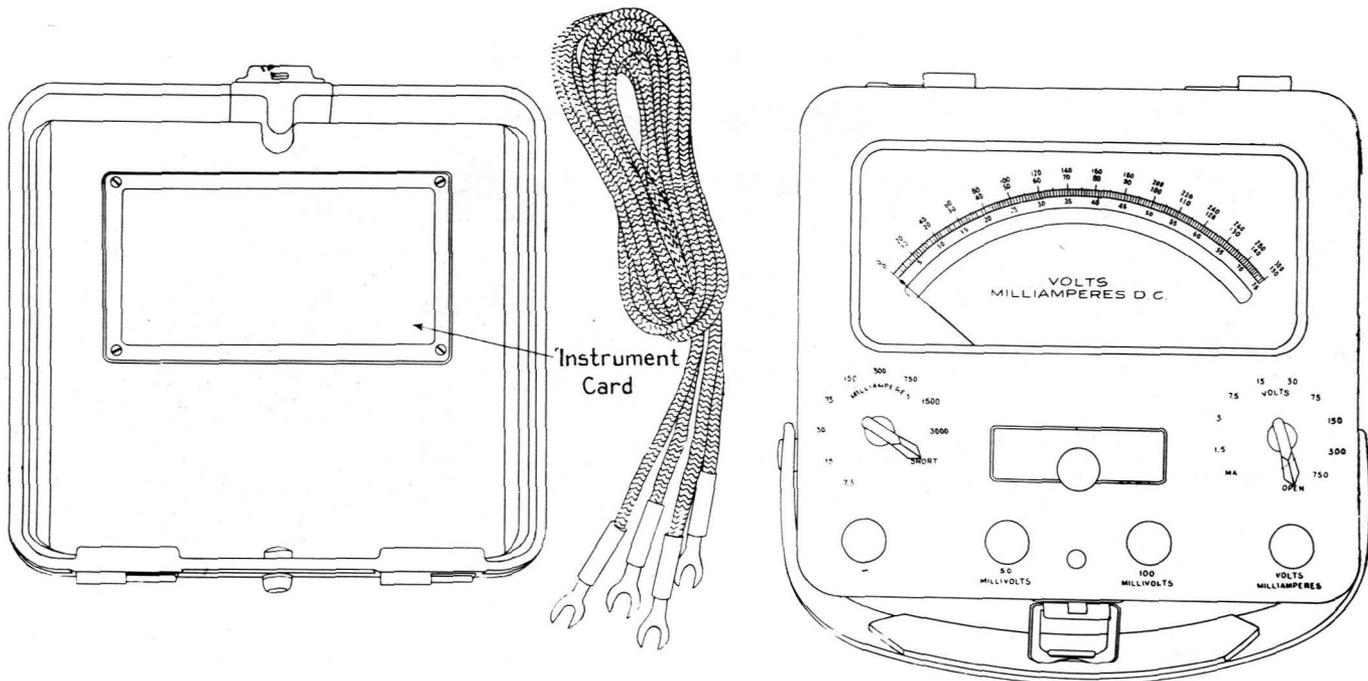


Fig. 1—KS-8039 Volt-Milliammeter

long and has 150 lines with three rows of scale markings. The inner set of markings consists of 0 to 75 in red characters located between the mirror and the graduations. On the outside of the arc formed by the graduations, markings 0 to 150 and 0 to 300 are provided in black characters.

2.03 There is a row of four binding posts across the front of the panel. These are designated from left to right as follows: (-), 50 MILLIVOLTS, 100 MILLIVOLTS, and VOLTS-MILLIAMPERES.

2.04 To the rear of the (-) post is a multiposition dial switch designated MILLIAMPERES which establishes the several ranges for checking milliammeters and ammeters of not more than 3 amperes full scale deflection. A similar switch designated VOLTS and located to the rear of the VOLTS-MILLIAMPERES binding post establishes the several voltage ranges of the instrument. A small knob located in the middle of the panel affords means for setting the pointer accurately at the zero point of the scale.

2.05 A small push button is provided between the two millivolt binding posts to provide electrical damping of oscillations of the movable element and thus protect the instrument from damage due to

mechanical shocks when it is closed and being carried or moved from place to place. This push button is so located that when the cover is closed, it is depressed and operates contacts which short-circuit the winding of the movable element.

♦**Note:** When the KS-8039 is not in use, it is recommended that the MILLIAMPERES and VOLTS range switch be set to the SHORT and OPEN positions, respectively.♦

2.06 Designations, as shown in ♦Table A,♦ are engraved on the panel opposite each position of the pointer of each switch to facilitate setting the dial switches for the various test conditions and full scale ranges corresponding to the different settings.

2.07 The 50 MILLIVOLTS and 100 MILLIVOLTS terminals are for use in checking instruments which, in conjunction with external shunts, are used to measure currents of more than 3 amperes.

KS-20599,L4, DIGITAL MULTIMETER

2.08 ♦The KS-20599, L4, has been rated Mfr Disc. and replaced by the KS-22861, L1, digital multimeter.♦ The KS-20599, L4, meter (Fig. 2) is a bipolar digital multimeter, capable of line or battery

♦TABLE A♦		
METER SWITCH SETTINGS		
MILLIAMPERES	VOLTS	MILLIVOLTS
7.5	MA *	0-50
15	1.5	
30	3	
75	7.5	0-100
150	15	
300	30	
750	75	
1500	150	
3000	300	
Short	750	
	Open	

* When range switch is in this position, CURRENT measurement is enabled.

operation. The meter provides 4-1/2 digit resolution on ac volts, dc volts, and ohms; and 3-1/2 digit resolution on ac and dc current.

2.09 The measured input signal is displayed on 7 segment planar characters. The polarity of dc measurements is automatically displayed. The meter is provided with 21 ranges, by means of a range switch and a function switch. Power for the KS-20599, L4, multimeter is supplied by a module containing 6 NiCd batteries. The KS-20599, L404, line cord (with charger) may also be used. The meter comes equipped with one pair of KS-20599, L403, test leads.

♦KS-22861, L1, DIGITAL MULTIMETER

2.10 The KS-22861, L1, is a bipolar solid state, 4-1/2 digit, handheld, microcomputer-based, liquid crystal display multimeter which operates from a 9-volt battery. The DMM is primarily intended for measurement of voltages on D2 channel banks, A6 channel banks, T2 digital line, and the 140-volt system battery plant. The DMM provides 4-1/2 digit resolution on ac volts, dc volts, ac current, dc current, and ohms. (See Fig. 3.)

2.11 The KS-22861, L1, DMM is capable of making the following measurements:

- True RMS measurement for ac signals up to 100 kilohertz
- Frequency measurements to 200 kilohertz
- Voltage measurements in dBm referenced to 600 ohms or in dB relative to an operator-selected reference voltage.
- Resistance measurements up to 300 megohms
- Ability to store any input signal as an offset or relative reference value.

2.12 The KS-22861, L1, is approximately 3.4 inches wide, 1.8 inches high, 7.1 inches long, and weighs 1 pound.

2.13 The current ranges of the DMM are double fuse protected with a 2-ampere, 250-volt fuse in series with a 3-ampere, 600-volt fuse.

2.14 The ranges for the KS-22861, L1, DMM are as follows:

- DC volts (+dc and -dc): 200 mV/2V/20V/200V/1KV
- AC volts: 200 mV/2V/20V/200V/750V
- DC current (+dc and -dc): 200 μ A/2 mA/20 mA/200 mA/2000 mA
- AC current: 200 μ A/2 mA/20 mA/200 mA/2000 mA
- Resistance (ohms): 200/2K/20K/200K/2M/100M/300M.

2.15 The following accessories are supplied with each digital multimeter:

- Leads, Test, KS-22861, L101
- Case, Carrying, KS-22861, L102
- Manual, Instruction, KS-22861, L103
- Sheet Instruction, KS-22861, L104.♦



Fig. 2—KS-20599, L4, Digital Multimeter

3. METHOD OF OPERATION

KS-8039 VOLT-MILLIAMMETER

A. Checking Voltmeters

3.01 *Warning: The VOLTS switch should be set to the position marked OPEN, and the MILLIAMPERES switch should be set to the position marked SHORT before any connections are made. (This is to minimize the danger of damaging the checking instrument by passing too much current through it when a lower range is selected).* When checking voltmeters, the checking meter is connected in parallel with the meter being checked. This is accomplished by connecting a lead from the binding post of the checking meter to the terminal of the meter under check and connecting the VOLTS-MILLIAMPERES binding post to the other terminal of the meter under check.

3.02 The VOLTS switch is then turned in a counter-clockwise direction until obtaining the greatest pointer deflection for a given voltage input.

B. Checking Milliammeters

3.03 *Caution: If it is necessary to avoid service interruption, there should be a closed path through the meter before the*

short-circuit path which is bridging the meter (or meters) is opened. This admonishment applies to paragraphs 3.05 and 3.06.

3.04 *Warning: The VOLTS switch should be set to the position marked OPEN and the MILLIAMPERES switch should be set to the position marked SHORT before any connections are made. (This is to minimize the danger of damaging the checking instrument by passing too much current through it when a lower range is selected). This admonishment applies to paragraphs 3.05 and 3.06.*

3.05 When checking milliammeters, the checking meter is connected in series with the meter being checked. The VOLTS switch is set on MA. If it is necessary to avoid interrupting the circuit, a bridging path is provided to shunt out temporarily that portion of the circuit which must be opened to interpose the checking meter. In these tests, connections are made to the (-) and VOLTS-MILLIAMPERES binding posts of the checking meter and it is so poled that the current will flow through it in the same direction as through the meter being checked.

3.06 After verifying that the VOLTS switch has been set on MA and the MILLIAMPERES switch on SHORT, the temporary bridge, if provided, is opened. The MILLIAMPERES switch is then

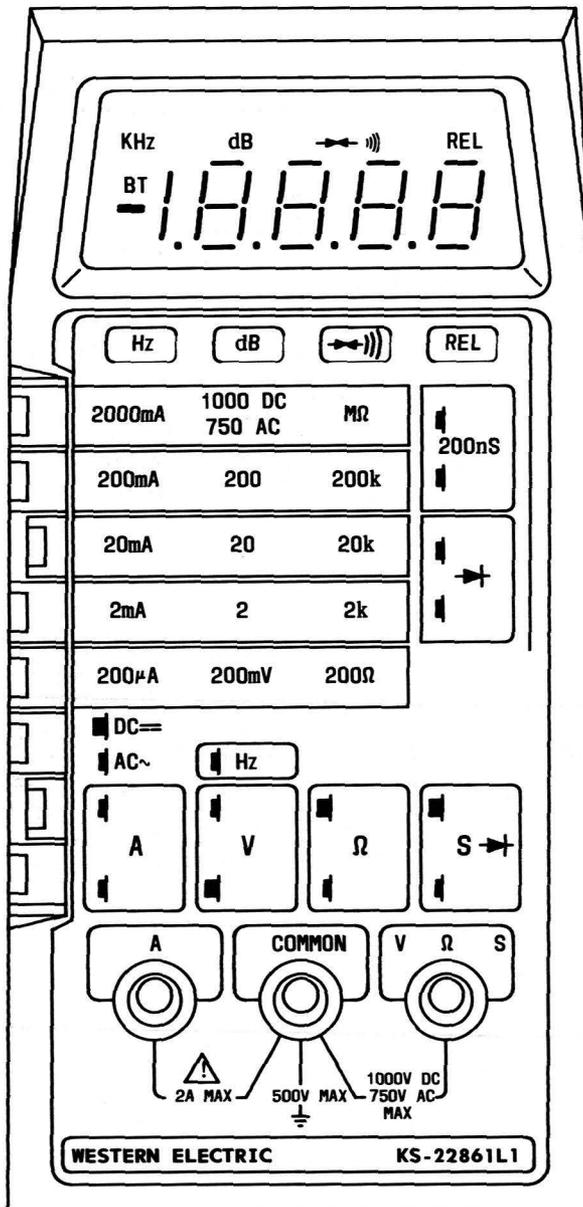


Fig. 3—KS-22861, L1, Digital Multimeter

turned in a counterclockwise direction until the setting for the desired scale range is reached.

C. Checking Ammeters

Ammeters With Full Scale Deflection Up to 3 Amperes

3.07 For ammeters up to a range of 3 amperes without external shunt, the checking meter is connected in series with the meter to be checked.

When a meter of such range with an external shunt is to be checked, the checking meter is interposed into the circuit in series with the shunt. The dial switches are then set for the proper range, as covered in paragraph 3.04.

Ammeters With Full Scale Deflection Greater Than 3 Amperes

3.08 Ammeters With Internal Shunt: For checking ammeters of this size which are equipped with internal shunts, a 60 ampere, 100 millivolt portable testing shunt is used in conjunction with the checking meter. This portable shunt is not covered by the KS specification for the instrument. The portable shunt is needed only when it becomes necessary to check meters as covered in this paragraph. This shunt is connected in series with the ammeter to be checked, observing the precautions again interrupting the current, as covered in paragraph 3.03. The meter terminals of the shunt are connected to the (-) binding post and to the 50 MILLIVOLTS or 100 MILLIVOLTS binding post of the checking instrument, using the leads provided with this instrument. When the 50 MILLIVOLTS binding post is used, a full scale deflection of the checking meter indicates a current of 30 amperes. In this case, the deflections are read on the 0 to 300 scale and each line represents 0.2 ampere. When the 100 MILLIVOLTS binding post is used, a full scale deflection indicates a current of 60 amperes. Under this condition, deflections as read on the 0 to 300 scale, should be multiplied by 2 and the decimal point moved one place to the left in order to determine the value of current in amperes.

3.09 Ammeters With External Shunt: When ammeters are associated with external shunts they are checked as millivoltmeters. In this case the checking meter is connected, by means of its shunt leads, across the shunt of the meter being checked. In making the connections, the negative instrument terminal of this shunt is connected to the (-) binding post of the checking meter and the positive instrument terminal of the shunt is connected either to the 50 MILLIVOLTS or to the 100 MILLIVOLTS terminal of the checking meter, depending upon whether the shunt associated with the meter being checked is rated 50 or 100 millivolts.

D. Use of Dry Cell and Variable Resistance

3.10 In cases where it is desired to check several points on the scale of an ammeter with an external shunt and it is not convenient to vary the current, an alternate procedure may be followed. This consists in disconnecting the meter leads from their shunt, and then connecting them in parallel with the shunt leads of the checking meter as in paragraph 3.07. A dry cell is used as a source of current and this is connected in series with a variable resistance such as a 35-type test set. The dry cell, with the variable resistance in series with it, is bridged across the two pairs of shunt leads, taking the place normally occupied by the associated external shunt of the meter being tested.

Note: When a dry cell is used, it is essential to exercise care that there is always sufficient series resistance so that the current flow through the instruments will not exceed the value for a full scale deflection. When a millivoltmeter is disconnected from its shunt, the voltage of a single dry cell imposed directly across its terminals may easily burn out the winding. About 300 ohms is needed to keep the current from 1 dry cell down to the capacity of the 50 millivolts scale. About 600 ohms is required for half scale and about 1200 ohms for a quarter-scale reading. Half these values would be sufficient for the 100 millivolts scale.

3.11 **Warning:** Before operating the **KS-20599, L4, digital multimeter, check Practice 100-520-102 for complete details.** To operate the KS-20599, L4, digital multimeter, proceed as follows:

- (1) Plug the test leads into the side of the meter. If necessary, plug in the line cord to power the meter.
- (2) Set the function switch to the proper position for the type of measurement to be made.

- (3) Set the range switch to read as close to full scale as possible.
- (4) Contact the Hi (red) probe to the higher potential and the COM (black) probe to the lower potential (or ground).
- (5) Read the measured value on the display, and, if necessary, adjust the range for a near full scale reading.

◆KS-22861, L1, DIGITAL MULTIMETER

3.12 For voltage operation of the KS-22861, L1, digital multimeter, proceed as follows:

- (1) Using the range switches, select a range.
- (2) Set AC/DC function switch out for DC, in for AC.
- (3) Press A, V, Ω , / function switch in to select voltage function.
- (4) Ensure all other switches are out.
- (5) Connect the test leads Low (-) to common input connector, HIGH () to v, Ω s input connector.
- (6) Refer to Table B, input overload limits and connect the leads to the circuit being measured.
- (7) Read the measured value on the display.

3.13 To operate the KS-22861, L1, digital multimeter in other functions, check the Instruction Manual KS-22861, L103, supplied with the meter for complete details.◆

TABLE B		
INPUT OVERLOAD LIMITS		
FUNCTION	INPUT TERMINALS	MAXIMUM INPUT LIMIT
AC Voltage, AC dB, Frequency	VΩS and COMMON	750V rms or 1000V peak continuous except 20 seconds maximum on the 200 mV range above 300V dc or ac rms.
DC Voltage, DC dB	VΩS and COMMON	1000V dc or peak ac continuous except 20 seconds maximum on the 200 mV and 2V ranges above 300V dc or ac rms.
AC or DC Current	A and COMMON	2A maximum, fuse protected to 600V dc or ac rms.
Resistance Conductance, Diode Test, and Continuity	VΩS and COMMON	500V dc or ac rms