KS-20599, L4, DIGITAL MULTIMETER
DESCRIPTION AND APPLICATION

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1. GENERAL

1.01 This section describes the KS-20599, L4, portable digital multimeter and includes instructions for its use. It also describes the accessories available for use with this meter.

1.02 Whenever this section is reissued, the reasons for reissue will be listed in this paragraph. The Equipment Test List is affected.

1.03 The KS-20599, L4, digital multimeter is a miniature battery-powered (or line charged battery), 4-1/2 digit multimeter, which will measure AC or DC voltage, AC or DC current, or resistance. The meter is primarily used to test voltages on the D2 channel bank, A6 channel bank, T2 digital line, and the 140-volt system battery plant.

1.04 The KS-20599, L1, digital voltmeter; the KS-20599, L2, test lead; and the KS-20599, L3, digital multimeter are all rated Mfr Disc. The KS-20599, L1, L2, and L3, are replaced by the KS-20599, L4, digital multimeter.

1.05 The KS-20599, L4, multimeter is provided by the Data Precision Corporation, and is a modified version of the Data Precision Corporation's Model 245 DMM.

2. EQUIPMENT FEATURES

2.01 The KS-20599, L4, meter (Fig. 1) is a bipolar digital multimeter, capable of line or battery operation. The meter provides 4-1/2 digit resolution on ac and dc volts, and ohms; and 3-1/2 digit resolution on ac and dc current.

Fig. 1—KS-20599, L4, Digital Multimeter

2.02 The standard equipment furnished with the meter includes:

- One rechargable battery module
- KS-20599, L402, maintenance manual
- KS-20599, L403, test leads with in-line fuse holder (See Fig. 2)
- KS-20599, L404, charger and cord (See Fig. 3)
- KS-20599, L405, carrying case
- Operators manual
- Factory-test data sheets
- Certificate of Conformance
- One-year warranty.

2.03 The measured input signal is displayed on 7 segment planar characters. The polarity of DC measurements is automatically displayed, while the decimal point tracks the manual selection of the full scale range. Overload signals are automatically sensed, leaving visible the polarity sign and decimal indication, while blanking all the decimal digits. This is a signal to shift to a higher full scale range.

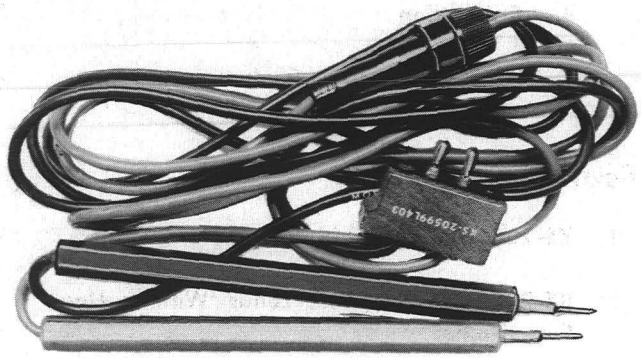

Fig. 2—KS-20599, L403, Test Leads With In-Line Fuse Holder

2.04 The meter is provided with 21 ranges, by means of a range switch and a function switch. Information on the individual ranges is given in Table A.

2.05 Power for the KS-20599, L4, multimeter is supplied by a module containing 6 NiCd batteries, capable of providing up to 6 hours of reliable operation between charges. The KS-20599, L404, line cord (with charger) may also be used to supply power to the meter, when plugged into a 120V/60 Hz source. Recharging the batteries requires approximately 12 hours using the KS-20599, L404, charging unit. When using the meter with

Fig. 3—KS-20599, L404, Charger and Cord

the charger, the batteries will recharge whether the meter is on or off.

> *Note:* For extended field use without access to charging power, extra battery modules are available.

2.06 The meter comes equipped with one pair of KS-20599, L403 test leads, (see Fig. 2). Each lead (one red and one black) is 5 feet long, including the test probes and terminating plugs. A 2-ampere fuse is contained in the fuse holder in the Hi (red) lead.

2.07 The KS-20599, L405, leather carrying case is also provided with the meter. The inside dimensions of the case are 8 inches wide, by 5-3/8 inches high, by 2-1/2 inches deep and has a 48 inch adjustable carrying strap. It is designed to hold all the accessories when being stored. The meter is operable inside the case, with holes for plugging-in the line cord and test leads.

3. OPERATION OF METER

A. Precautions

3.01 The KS-20599, L4, multimeter is a precision instrument and, although ruggedly constructed, may be seriously damaged or burned out if improperly used.

3.02 When making resistance measurements, the operator should make sure that the unit or circuit being measured does not include a source of either ac or dc power which might damage the meter.

3.03 When making either current or voltage measurements, the range switch should be placed in the proper position before making contact with the test probe or ground lead to the circuit to be measured. If there is any doubt as to the approximate value of the voltage or current to be measured, the range switch should be set to the highest value for the initial test and then decreased step-by-step until the proper scale range is reached.

> ***Warning: When making high voltage measurements, it is extremely important that the red and black test leads are not reversed. The red lead (which contains an inline fuse) must contact the higher potential point and the black lead must contact the lower potential point (or ground). If the leads are reversed, the meter could be seriously damaged.***

3.04 If the battery charger/line cord is connected, a potential difference may exist between the "ground" of the power source and the "ground" of the measured circuit. This difference of ground potentials may set up ground-loop currents and affect the measured values although the instrument will reduce their effects significantly. The ground-loop effects can be avoided almost completely by operating the meter on batteries.

B. Operating Instructions

3.05 Check the battery charge level by using the meter on DCV function and the 10 range. With the KS-20599, L403, leads plugged into the meter, place the Hi (red) probe on the metal ring of the battery charger jack (see Fig. 4). A negative measurement with a value in excess of 7.2 indicates a charged battery. If the reading is less than 7.2, the line cord and charger must be used to recharge the battery pack.

3.06 ***To operate the meter:***

(1) Plug the test leads into the side of the meter. If necessary, plug in the line cord to power the meter (see paragraph 3.05).

TABLE A

KS-20599, L4 MULTIMETER SPECIFICATIONS

FUNCTION	RANGE	MINIMUM RESOLUTION	OVER-RANGE CAPABILITY	FREQUENCY	ACCURACY (18C-28C) READ	ACCURACY (18C-28C) RANGE	OVERLOAD CAPABILITY	INPUT IMPED. MILLIVOLT DROP OR ISC & VOC	TEMPERATURE INFLUENCE (8C-18C) (28C-38C) READ	TEMPERATURE INFLUENCE (8C-18C) (28C-38C) RANGE	LONG TERM STAB. 6 MONTHS READ	LONG TERM STAB. 6 MONTHS RANGE
DC VOLTS	±100 mV	10 UV	100%	N/A	STD.		1 KV DC PLUS PEAK AC	10 MEG MIN.	STD.		STD.	
	± 1 V	100 UV	100%		±.02%	±.01%			±.02%	±.01%	±.01%	±.01%
	± 10 V ±100 V ± 1 KV	1 mV 10 mV 100 mV	100% 100% —		±.03%	±.01%			±.03%	±.01%	±.03%	NONE
AC VOLTS	100 mV	10 UV	100%	STD.	STD.		500 VDC PLUS PEAK AC	1 MEG MIN.// 100 PFD MAX.	STD.		STD.	
	1 V 10 V 100 V 500 V	100 UV 1 mV 10 mV 100 mV	100% 100% 100% —	50 HZ-1K HZ	±.20%	±.10%			±.40%	±.10%	±.10%	NONE
				1K HZ-25K HZ	±.70%	±.10%			±.70%	±.10%	±.10%	NONE
DC CURRENT	±100 UA	100 NA	100%	N/A	STD.		2A FUSED	200 mV	STD.		STD.	
	± 1 mA ± 10 mA ±100 mA ± 1 A	1 UA 10 UA 100 UA 1 mA	100% 100% 100% 100%		±.20%	±.10%			±.20%	±.10%	NO CHANGE	
AC CURRENT	100 UA	100 NA	100%	STD.	STD.		2A FUSED	200 mV	STD.		STD.	
	1 mA 10 mA 100 mA 1 A	1 UA 10 UA 100 UA 1 mA	100% 100% 100% 100%	50 HZ-1K HZ	±.30%	±.10%			±.30%	±.10%	±.50%	NONE
				1K HZ-25K HZ	±1.1%	±.10%			±1.1%	±.10%		
RESISTANCE	100 Ω	.01 Ω	100%	N/A	STD.		115 VDC OR AC (RMS)	—	STD.		STD.	
	1 KΩ 10 KΩ 100 KΩ 1 MΩ	.1 Ω 1 Ω 10 Ω 100 Ω	100% 100% 100% 100%		±.10%	±.02%			±.10%	±.02%	NO CHANGE	
	10 MΩ	1 KΩ	100%		±.25%	±.02%			±.20%	±.05%		

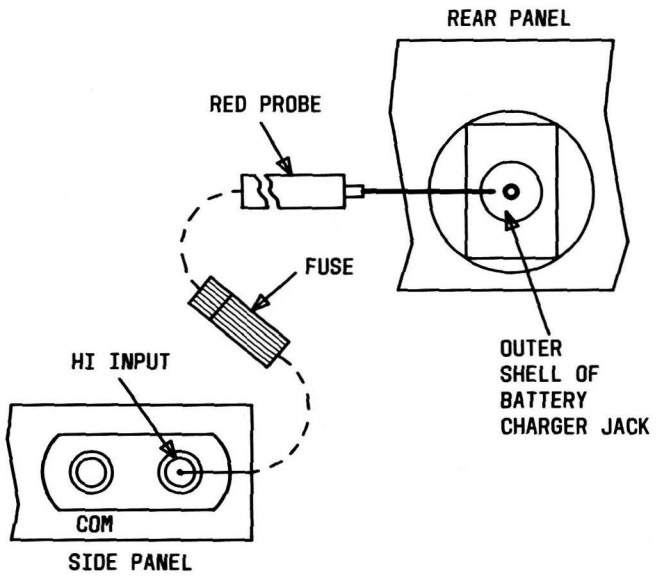

Fig. 4—Battery Check Diagram

(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.

Note 1: If the expected measurement value is unknown, set the range scale to the highest position (10MΩ for resistance and 1K for all others) and graduate down until a near full scale reading is obtained.

Note 2: No zero adjustment is ever required on any measurement function or range scale and none is provided.

(4) Contact the Hi (red) probe to the higher potential and the COM (black) probe to the lower potential (or ground).

Warning: When making high voltage measurements, it is extremely important that the red and black test leads are not reversed. The red lead (which contains an inline fuse) must contact the higher potential point and the black lead contact the lower potential point (or ground). If the leads are reversed, the meter could be seriously damaged.

(5) Read the measured value on the display and if necessary, adjust the range for a near full scale reading.

4. MAINTENANCE

A. General

4.01 The KS-20599, L4, multimeter should be free from all dirt and grease. When cleaning is required, moisten a KS-2423 twill cloth (or equivalent) with denatured alcohol and wipe off the meter. Do not pour the alcohol directly on the meter.

Danger: Use denatured alcohol only in a well ventilated area. Exercise care when using alcohol to avoid inhaling fumes.

4.02 The banana plugs on the KS-20599, L403, test leads should fit snugly into the side of the multimeter. Should they become loose, there are two approved methods of repair.

(1) Using a miniature screwdriver or other implement, slightly spread the blades on each banana plug.

Gauge by feel.

(2) Carefully apply a smooth, thin coating of solder to each blade on the banana plug. Do not leave any excess on the plug which could fall off in the terminal.

Gauge by feel.

B. Calibration

4.03 The KS-20599, L4, multimeter is factory calibrated and burned-in prior to shipment. The L4 is designed to remain in calibration for a minimum of 6 months before recalibration is required. When calibrations are made, only the rear panel should be removed (see Fig. 5). ***The meter itself should not be opened.***

4.04 When recalibration is required, test standards of the following range and accuracy should be used:

DC Volts: 0 to 1.0000V ±0.01%

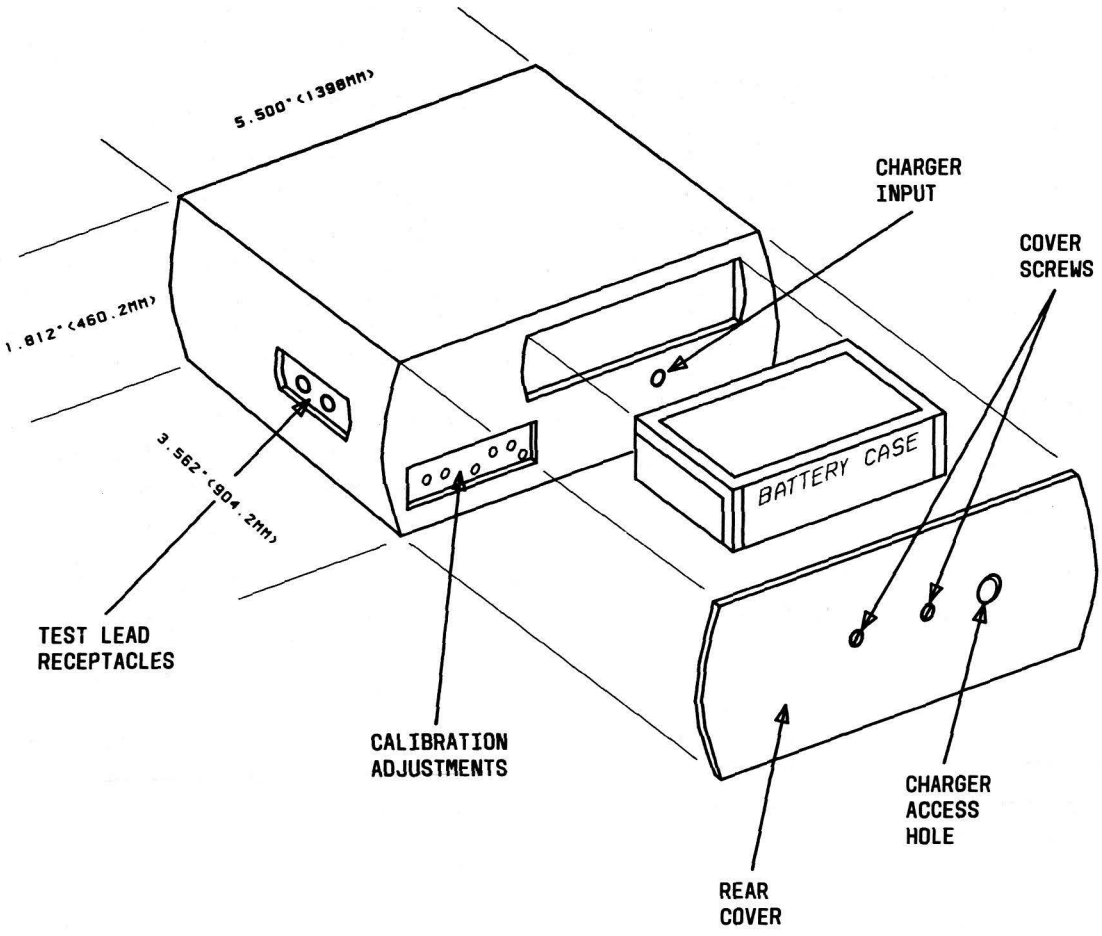

Fig. 5—KS-20599, L4, Multimeter With Rear Panel Removed

AC Volts: at 100 Hz 0 to 1.0000V ±0.05%
at 20 KHz 0 to 1,000.0V +0.10%

All the calibration equipment should be allowed to warm up for at least 15 minutes before using to ensure these values are stable.

4.05 Before trying to calibrate the KS-20599, L4 meter, check the battery charge level as described in paragraph 3.05.

4.06 When calibrating the meter, it is extremely important that all of the adjustments in Table B be made in the order they are given.

Note: If the available test standards do not provide the full scale values specified, the closest value to the specified input should be used. Input signals of at least 50% of full scale should be used.

Danger: Always use an insulated calibration tool because high voltage may be present at the calibration point.

4.07 To calibrate the meter, it is first necessary to remove the rear panel shown in Fig. 5. Using a 3-inch C screwdriver, remove the two panel mounting screws. Then, insert the screwdriver in one of the screw holes and lift out.

4.08 Connect the meter to the calibration equipment and check the meter reading against the test standard. If the values are different, take an insulated, narrow bladed, calibration tool of appropriate dimension and ***very slowly*** adjust the meter until the readings are equal. Continue calibrating the meter, following the order given in Table B, until all the adjustments have been made.

4.09 When all the adjustments are complete, check all the values again to see if calibrations are still correct. If the values are off ***repeat the entire procedure.***

4.10 If the meter will not calibrate after the second attempt, return the meter for repair in accordance with local instructions.

Warning: Do not attempt to open the meter and adjust or replace any parts. Any change could seriously affect the accuracy of the meter.

C. Fuse and Battery Replacement

4.11 If the KS-20599, L4, multimeter does not respond when a measurement is taken, plug-in the KS-20599, L404, charger and take the measurement again.

4.12 If there is still no response, remove power from the meter. Open the in-line fuse holder and replace the 2-ampere fuse. Return power to the meter and test the meter by taking another measurement. If the meter responds, resume intended use.

4.13 If the fuse is good, but the meter will not respond, the battery module should be replaced. Proceed as follows:

(1) Turn the function switch to off and remove the line cord

(2) Using a 3-inch C screwdriver, remove the rear panel of the meter. (See Fig. 5)

(3) Snap out the old battery module and replace with a new one

TABLE B

CALIBRATION ADJUSTMENTS

FUNCTION SELECT	FSR RANGE SELECT	TEST SIGNAL	ADJUSTMENT MARKING
DCV	1.0	+ 1.9000 VDC	R10
ACV	1.0	100 Hz, 1.9000 V RMS	R4
ACV	1000	20 KHz, 200.00 V RMS	C7
ACV	100	20 KHz, 100.00 V RMS	C3
ACV	10	20 KHz, 19.000 V RMS	C2
ACV	1.0	20 KHz, 1.9000 V RMS	C1

(4) Check to see that the replacement battery pack is fully charged using the procedures given in paragraph 3.05

(5) If charged, replace the rear panel. Return power to the meter and take a measurement to check the meter.

4.14 If the meter does not respond, return the meter for maintenance in accordance with local instructions.