Practical Low Resistance Measurements

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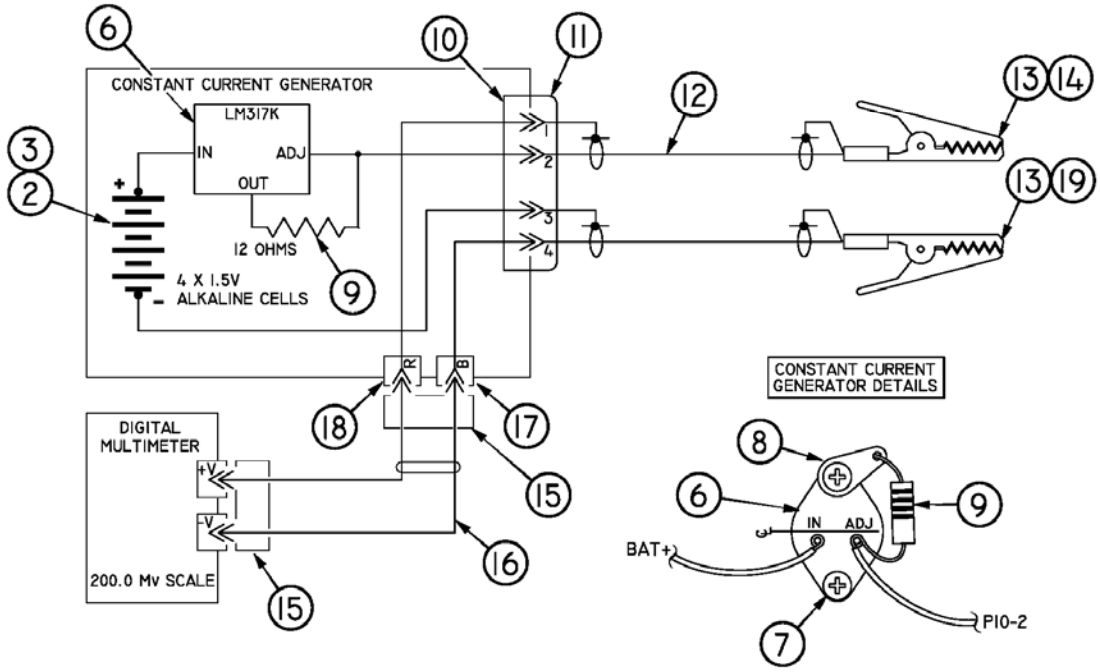
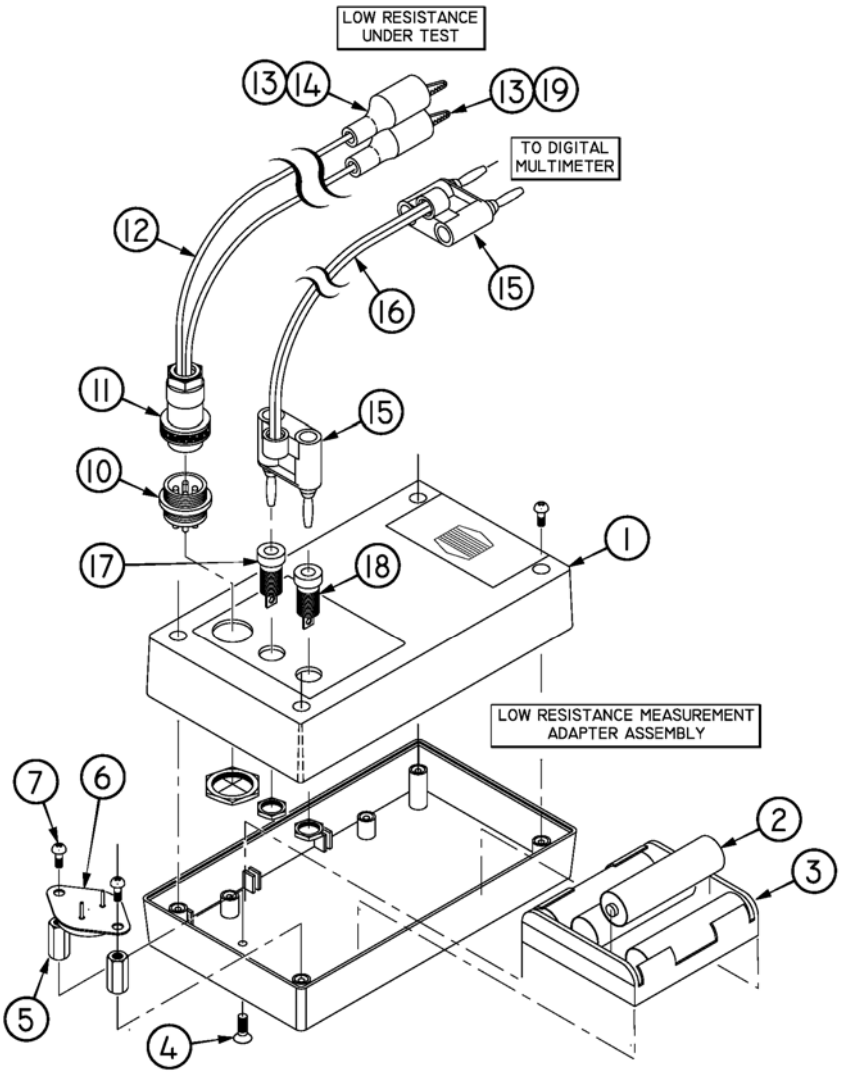
Revision –A– 8/5/4

Modern digital multimeters are limited with respect to measurement of low resistance. Off-the-shelf multimeters offer measurement on the order of 200 ohms full scale with a resolution of 100 milliohms. Evaluation of switch and relay contacts requires measurement of resistance on the order of tens of milliohms, well outside the capability of typical test instruments. Further, switch and relay contacts often present a variable resistance due to film or corrosion build-up on contact surfaces. Useful measurements require a substantial current flow to penetrate contaminants. Typical instruments measure resistance with bias currents of 5 milliamperes or less.

A practical 4-wire resistance measurement tool is illustrated in adjacent figures. A battery (3) and voltage regulator wired as a constant current generator (6) causes 100 milliamperes of current to flow in test clips (13) when they are brought together. A second pair of conductors bring voltage impressed between the clips out to a contemporary multimeter set to read millivolts.





Calibration:

The finished fixture can be tested for calibration by plugging it into the multimeter while it is set up to measure current. The fixture should produce a current of 100 ± 2 mA

Using the Fixture:

This device will yield useful resistance measurements up to better than 20 ohms. If your multimeter has a 200 millivolt range, a 100 milliampere test adapter will display 2 ohms full scale. If your instrument displays readings to the nearest 0.1 millivolt, then the least significant digit of the display is 1 milliohm. For example, a reading of 20.5 millivolts translates to a resistance between the clips of 205 milliohms.

This tool is useful in diagnosing system malfunctions that could be attributed to increased contact resistance in switches or relays. Switches outside the pressure vessel on turbojet aircraft are particularly good candidates for environmental effects, especially those under the nacelles or on landing gear struts.

When investigating the condition of a switch or relay, it’s useful to exercise the part and observe variations in contact resistance from one measurement to the next. Unless you are offered baseline resistance values as part of a published test procedure, you’ll have to make comparative measurements between a suspected bad and a known good component.

It’s a certainty that no switch or relay contact producing a measured resistance of more than 100 milliohms is a healthy contact. For some devices, anything over 50 milliohms is cause for further investigation.

SUGGESTED PARTS LIST:
CCS = COMMON COMMERCIAL STOCK

ITEM	QTY	P/N	DESCRIPTION	MFGR
19	1	BU-60-2	INSULATOR BOOT - RED	MUELLER
18	1	J151	BANANA JACK - RED	DIGIKEY
17	1	J152	BANANA JACK - BLACK	DIGIKEY
16	1	CCS	18AWG 2-COND LAMP CORD	CCS
15	2	274-717	DUAL IN-LINE BANANA PLUG	RADIO SHACK
14	1	BU-60-0	INSULATOR BOOT - BLACK	MUELLER
13	2	BU-60CS	ALIGATOR CLIP	MUELLER
12	1	350-223	22AWG SHIELDED WIRE	LMB
11	1	274-001	4-PIN PLUG	RADIO SHACK
10	1	274-002	4-PIN SOCKET	RADIO SHACK
9	1	12.4XBK	12.4-OHM, 1%, 1/4W RESISTOR	DIGIKEY
8	1	CCS	SOLDER LUG	CCS
7	2	CCS	6-32 x .24 RH MACHINE SCREW	CCS
6	1	LM317K-STEEL	3-TERMINAL VOLTAGE REGULATOR	DIGIKEY
5	1	CCS	6-32 x .25 x .50 LONG SPACER	CCS
4	2	CCS	6-32 X .38 FH MACHINE SCREW	CCS
3	1	274-411	4XAA BATTERY HOLDER	RADIO SHACK
2	1	CCS	AA ALKALINE CELL	CCS
1	1	503	PLSTC PRJCT BX 3.3 x 1.5 x 5.6	LMB

INSTRUCTIONS FOR USE

THE LOW RESISTANCE MEASUREMENT ADAPTER GENERATES A 100 MILLIAMPER CONSTANT CURRENT BETWEEN THE MEASUREMENT CLIPS. AN INDEPENDENT PAIR OF WIRES CONNECTS THE DISPLAY MULTIMETER TO THE CLIPS.

SET MULTIMETER TO ITS MOST SENSITIVE SCALE. MOST DIGITAL MULTIMETERS WILL READ 100 MILLIVOLTS WITH 0.1 MILLIVOLT RESOLUTION. THE 100 MILLIAMPER CURRENT SOURCE PRODUCES 0.1 MILLIVOLT OF DROP FOR EVERY MILLIOHM OF RESISTANCE. EXAMPLE: A VOLTAGE READING OF 12.2 MILLIVOLTS WILL BE OBSERVED WHEN 122 MILLIOHMS RESISTANCE PATH EXISTS BETWEEN THE TEST CLIPS.

DISCONNECT TEST LEADS WHEN THE INSTRUMENT IS NOT IN USE TO AVOID ACCIDENTAL DISCHARGE OF THE BATTERY.