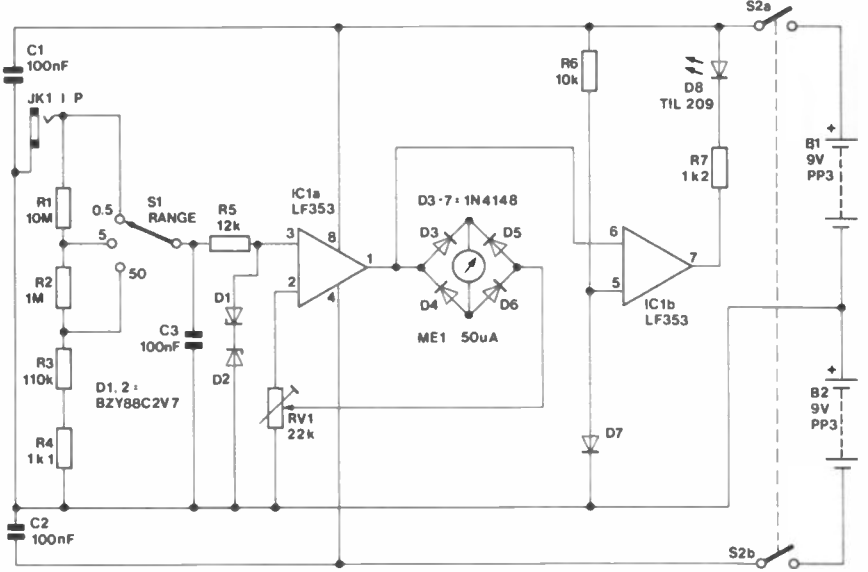
High Z Voltmeter

DC voltage measurements made using an ordinary analogue multimeter can sometimes be misleadingly low. This problem occurs when checking low current circuits. A normal (20k/volt) multimeter has a 50 microamp meter movement, and therefore draws a current of around 10 to 50 microamps from the circuit under test. This is obviously not possible in a low current part of a circuit where perhaps a current flow of only one or two microamps is present, and connecting the multimeter to the circuit has the effect of greatly reducing the voltage at the test point. Strictly speaking the voltage reading on the multimeter is correct, but the registered voltage is only present while the multimeter is connected to the circuit and is of little practical value.



The classic solution to this problem is to use a high impedance voltmeter when making voltage checks on low current circuits. A unit of this type has an amplifier to drive the meter and substantially reduce the input current requirement. This high impedance voltmeter design, in common with most units of this type, has a constant input resistance of over 11 megohms. Three voltage ranges having full scale values of 0.5, 5, and 50 volts are provided. In terms of ohms per volt sensitivity this gives over 22 megohms, 2.2 megohms, and 220k respectively, which is vastly superior to a normal analogue multimeter.

The first stage of the unit is a three stage attenuator which gives the three measuring ranges. R5, D1, and D2 are an overload protection circuit which prevents an excessive input voltage of either polarity from reaching IC1a, and also eliminates the possibility of an excessive input voltage causing a severe overload of the meter. IC1a, together with RV1 and D2 to D6, forms a precision full wave rectifier circuit which drives the meter. RV1 is adjusted to give the unit the correct level of sensitivity. The point of using a precision rectifier rather than a simple buffer stage is that it is then not essential to connect the input signal with the correct polarity. ME1 will register the correct input voltage regardless of its polarity. Note that IC1 is a type having a JFET input stage so that it does not significantly load the high resistance attenuator and impair the accuracy of the unit. C3 helps to filter out any noise picked up at the input, which (due to the fact the unit will respond to input signals of either polarity) could otherwise produce a strong deflection of ME1.

One problem with this basic voltmeter circuit is that it does not enable the polarity of the input signal to be determined. This is overcome by including voltage comparator IC1b and its associated circuitry. Under quiescent conditions or with a positive input signal (i.e. the non-earth input positive of the earth input) the output of IC1b goes high and LED indicator D8 is switched off. However, with a negative input signal the output of IC1b goes low and D8 is switched on to indicate that the input voltage is negative in polarity.

In order to calibrate the unit a suitable and accurately known voltage is required. For example, a 4.5 volt battery could be used to provide the calibration voltage. A multimeter would be used to measure the precise battery voltage, the high impedance voltmeter would be set to the 5 volt range, the battery would then be connected to the input of the unit, and finally RV1 would be carefully adjusted for precisely the correct reading on ME1.

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HIGH Z VOLTMETER PARTS LIST

RESISTORS – All 0.4W 1% Metal Film			
R1	10M	1	(M10M)
R2	1M	1	(M1M)
R3	110k	1	(M110K)
R4	1k1	1	(M1K1)
R5	12k	1	(M12K)
R6	10k	1	(M10K)
R7	1k2	1	(M1K2)
RV1	22k Hor S-Min Preset	1	(WR59P)
CAPACITORS			
C1,2,3	100nF Polyester	3	(BX76H)
SEMICONDUCTORS			
IC1	LF353	1	(WQ31J)
D1,2	BZY88C2V7	2	(QH00A)
D3-7	1N4148	5	(QL80B)
D8	Red LED	1	(WL32K)
MISCELLANEOUS			
ME1	50μA Panel Meter	1	(RW91Y)
S1	Rotary Sw 4-pole 3-way	1	(FH45Y)
S2	DPST Rotary	1	(FH57M)
JK1	3.5mm Jack	1	(HF82D)
B1,2	Battery 9V PP3	2	FK62S
	Battery Connector	2	(HF28F)