Make a DC Voltage Reference for your shack

I was reading the November 2021 issue of Radcom where the author Andrew Barron, ZL3DW, does a nice job of explaining accuracy conventions with the current crop of digital multimeters.

This brought to mind the rather simple DC Voltage Reference I had put together a few years earlier. I had always meant to share what I did in an article, but never seemed to get around to it. So pulled out my notes and the Voltage Reference unit and put this article together.

There is a convenient "High Precision Voltage Reference Module" which is still offered on eBay and the like at reasonable cost. The module utilizes the Pin Programmable Analog Devices AD584L Precision Voltage Reference. The output voltage is chosen by on board jumpers to select one of 4 popular output voltages: 10.000V, 7.500 V, 5.000 V or 2.500 V. The AD584L has a maximum deviation from 10.000 volts of +/- 7.25 mV from 0ºC to +70º. (For those liking % tolerances, that is +/- 0.075% !).

At 25ºC, the maximum deviations for the 4 outputs are +/- 5 mV, 4 mV, 3 mV and 2.5 mV respectively.

The full AD584 specification is available on line at
https://www.analog.com/media/en/technical-documentation/data-sheets/AD584.pdf

Module description

Figure 1 shows the module as I received it from the supplier. For operation, an input voltage of 15-30 Vdc is required. At the top of the pcb there is an opening and 2 battery clips designed to mount a 15V battery, which I think would be hard to find today. Fortunately a DC barrel jack with 2.1 mm pin is provided on the side, which is what I used to connect dc power. The AD584L is the TO-99 device seen in the center of the pcb. Below that, a row of 4 double 2-pin headers are provided to select which of the 4 output voltages is routed to the output terminals. These terminals are provided at the bottom edge of the pcb, allow easy connection of the voltmeter you are testing, either by hook type clips, alligator clips, or the typical 2mm diameter voltmeter test prods. A small spst on/off switch is also provided, and an on-board led indicates when dc power is on.

Calibration table (Fig. 2)

The unit that I purchased came with calibration information printed on a small piece of paper. See Fig. 2. This is a good place to advise caution before purchasing your "High Precision Voltage Reference Module". I am afraid its "Buyer Beware" now more so than a few years ago. There are clones out there. Its worth a query to see if the seller provides the calibration information. You will see in Fig. 2 that in my case the calibration measurements were done on a HP 34401A.

Assembled DC Voltage Reference Test Unit (Fig. 3)

I didn't think it made much sense to do anything elaborate for dc power, as this type of calibration reference is used only occasionally, and spends most of its life either on display, or ignominiously in a drawer somewhere! For the 15 volts dc, I used a simple

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low cost voltage step-up module, the MT3608, which also seems readily available on line. The MT3608 boosts the 3 volts from a pair of AA cells to the 15 volts need by the AD584L. I didn't think that a schematic diagram was necessary, due to the simplicity and that Fig 3 shows all the connections.

Using the DC Voltage Reference (Fig. 4)
Its as simple as turning on both the DMM under test and the DC voltage reference module and connecting the DMM voltmeter test leads to the DC Voltage Reference Module as shown in Fig. 4. Compare the DMM voltmeter reading with the calibration value.

Fig 1 AD584L DC Voltage Reference Module.

Fig. 2 Calibration data supplied

AD584 L   电压基准

标称电压   实际电压
2.5V   2.499, 42V
5V   5.000, 37V
7.5V   7.500, 42V
10V   10.000, 66V

标定设备：Agilent 34401A
环境温度：23度
标定时间：2015-7-27

编号：01

Fig. 3 Assembled DC Voltage Reference

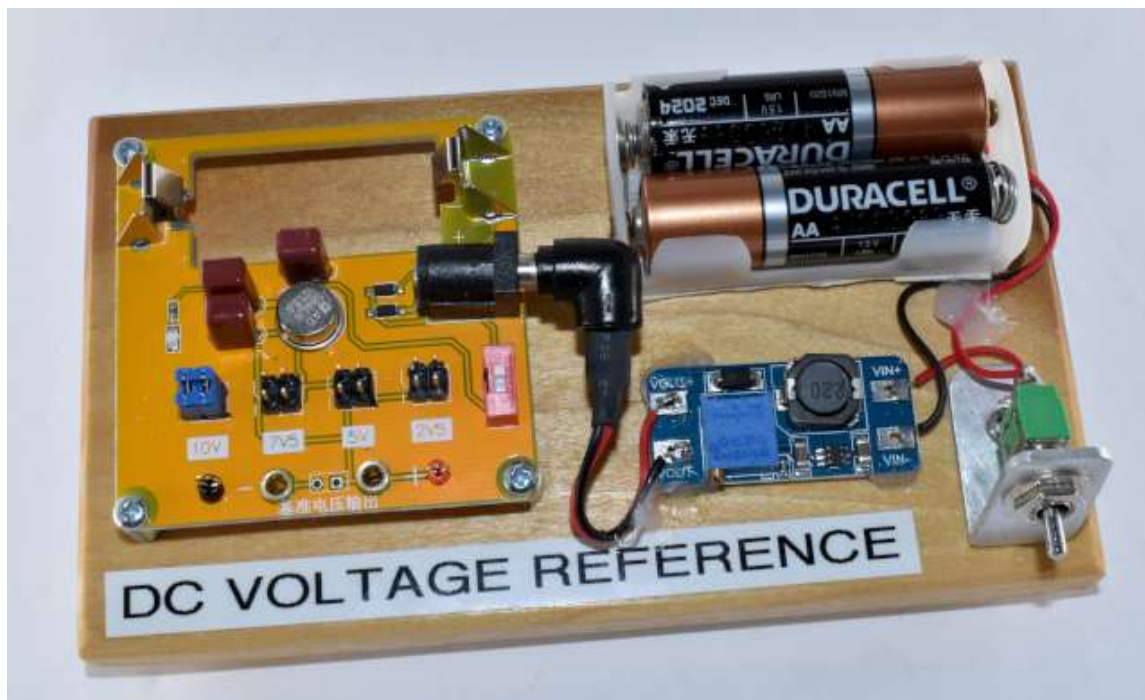
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Fig 4 Use of the Voltage Reference to check the authors 6000 count DMM

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