POCKET CALIBRATOR

The Pocket Calibrator described by Mr. Gary McClellan in the June **Radio-Electronics** ("Pocket Calibrator for Volts and Ohms") holds some traps for the unwary.

First, the DC sources are "relatively" high resistance. For example, the one-volt source has an equivalent internal resistance of 1111 ohms. Thus, when calibrating a 20,000 ohms-per-volt meter (analog) on the three-volt scale, the output voltage will drop two percent; at 10,000 ohms-per-volt four percent, and at 1000 ohms-per-volt, it will drop 25 percent. A few percent accuracy, indeed!

Second, he implies a dependence of measurement accuracy of AC voltages on frequency—not so. The heating ability of an AC wave (that which we are usually trying to measure) is a function of periodicity, amplitude (usually specified as peak or peak-to-peak) and a shape factor (specifically, the root-mean-square of the voltage taken over a period); it depends upon frequency only to the extent of bandpass considerations of the measuring device. Thus crystal frequency stability in his calibrator is wholly unnecessary. The same result could have been obtained much more economically by using, say, a micropower equivalent of the 555 timer circuit in the free-running mode.

It is perhaps of no moment that the vertical scan rate of color TV is not 60 Hz but 59.94 Hz. McClellen can't get 60 Hz out of his circuit, anyway, without pushing (or pulling) the Xtal.

Let me say, however, that **Radio-Electronics** is the only electronics magazine

to which I subscribe, and I enjoy it. I'm pleased to say that I rarely find deficiencies in the material such as the ones mentioned above.

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Reader Smithey makes some interesting points, and ones that are easily cleared up. But, first, I think it would help if I pointed out just what the intended use of the Pocket Calibrator is. It is intended for use in the field (e.g. transmitter site) to spot-check electronic instruments. The project is designed to be

built at low cost by people who may not have access to laboratory instrumentation. As a result, the Pocket Calibrator will not provide absolute long-term accuracy, nor was it intended to. That job is reserved for standards located in a temperature-controlled laboratory. By way of contrast, our low-cost Pocket Calibrator's nearest laboratory equivalent is the Datel-Intersil DVC-5000. That low-cost instrument provides DC voltage calibration traceable to NBS, and sells for only $595.00! There's about a tenfold difference in price; Keep that in mind.

Regarding Smithey's remarks about "relatively" high DC resistance, he is referring to the output resistance on the 10-volt, 1-volt, and 0.1-volt ranges. The 10-volt range is no problem, due to the low impedance of the LM-723 regulator. The other ranges can

cause trouble with low-impedance analog multimeters. But both the text on page 53, **Radio-Electronics,** June 1982 issue, and the assembly manual that comes with the project clear that up. As a reminder, the text points out that if you are using one of those meters, the output will be reduced. It is then suggested that you measure the 1-volt and the 0.1-volt outputs, and write down the readings. Then refer to them later, as necessary. So, as you see, there is no problem here if you follow the instructions under the subhead "Use." Of course, it is easy to calculate the correct output, if you prefer.

Regarding Mr. Smithey's remarks on the frequency dependence of the AC calibration: In that case there is a relation, due to the characteristics of the sine shaper that follows the MM5369. Change the frequency and the sinewave loses its shape, distortion rises, and the meter shows error. Average reading DMM's are especially prone to waveshape error, so the frequency is crystal-controlled. The output, which is 16.67 ms (60.0 Hz), is also handy for scope timebase accuracy-checks. In short, the AC calibration circuitry is no place for an R-C oscillator.

To sum up: The project will give the reader no problems if he uses it for the purpose for which it was intended, and reads and follows the instructions on its use.

By the way: I designed a calibrator with no adjustments, and with a low-resistance DC output. But the cost turned out to be $190.00!—GARY McCLELLAN   **R-E**