QRP

Number 19 on your Feedback card

Low Power Operation

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Have you been looking for a good analog meter for a project? Have you found out how much they cost? One would think, with the entire world going digital, analog meters would be really, really cheap. The exact opposite has occurred instead. Now, a quality analog meter costs more than the project you're trying to construct. You can still find plenty of surplus analog meters laying around however, provided you don't mind the face printed with some strange industrial scale.

Entering the Digital World

This is a case of "if you can't beat 'em, join 'em" as digital panel modules are now available at a very reasonable price. I've have been working with two different models from two different suppliers.

They're both low power 3-1/2 digit LCD digital panel meters. Their basic input requirement is 200 mV DC. Other input ranges are also possible, by special order. The first module we'll look at is the D1 International DPM5035L. The second module is by Modutec.

Specifications

The DPM5035L is built around a Maxim MAX131CPL analog-to-digital converter chip. Along with some support parts, the Maxim chip does all the work. The LCD is an easy-to-read 0.5" high and shows 3-1/2 digits. Automatic zero and a polarity indicator are part of the DPM5035L. You can select your own decimal point position. A "1" displayed on the left-most side of the DPM5035L is the over-range indication. The conversion rate is about three times per second.

The DPM5035L has a basic DC input of 200 mV. The input is differential. Input impedance is over 11 megohms. You can operate the DPM5035L on a single 9 volt battery. Any power supply from 5 to 9 volts will work just fine. The low battery indication comes on at approximately 4.8 volts. According to the factory, a fresh 9 volt battery should operate the DPM5035L for over one year. If you want, or if you just don't need the LCD display, you can also order the DPM5035L in an LED-readout version. Its number is DPM5135. This LED version requires 5 volts at less than 130 mA. This would be an ideal DPM for a power supply. Both the DPM5035L and the DPM5135 are available from D1 International Inc., 95 East Main Street., Huntington NY 11743; (516) 673-6866. The price for the DPM5035L is about $30, plus shipping.

The Modutec digital panel meter is so very close to these specifications I won't repeat them. The Modutec DPM I used is the BL100101. You can get this meter from Digi-Key for $33. While it has the same LCD, 0.5", and displays 3-1/2 digits, the Modutec DPM is much smaller than the DPM5035L. In fact, you can place the Modutec DPM inside the D1 International DPM.

Differences Between the Two

Both of these DPMs are very much alike electrically; the main difference is in their physical layout. The DPM5035L is the larger of the two and requires much more panel area than the Modutec DPM. This may be of concern if you're wondering about using one of these DPMs in your next QRP project. Although larger, the DPM5035L is much easier to install. The DPM5035L snaps into the panel cutout. No other hardware is required. This bezel allows for some "operator error" when cutting out the panel. The Modutec DPM, on the other hand, requires a very clean-fitting cutout. There is no bezel to hide your mistakes. The Modutec meter also requires you to add a mounting clip and plastic nuts. It's no biggie, but you have to really take your time to do the installation properly with the Modutec DPM. The Modutec meter also requires a connection kit. This kit is a header on 0.100 centers. The input to the Modutec meter is very sensitive to static discharges and you are warned not to solder directly to the DPM pins. Use the connection kit to avoid problems.

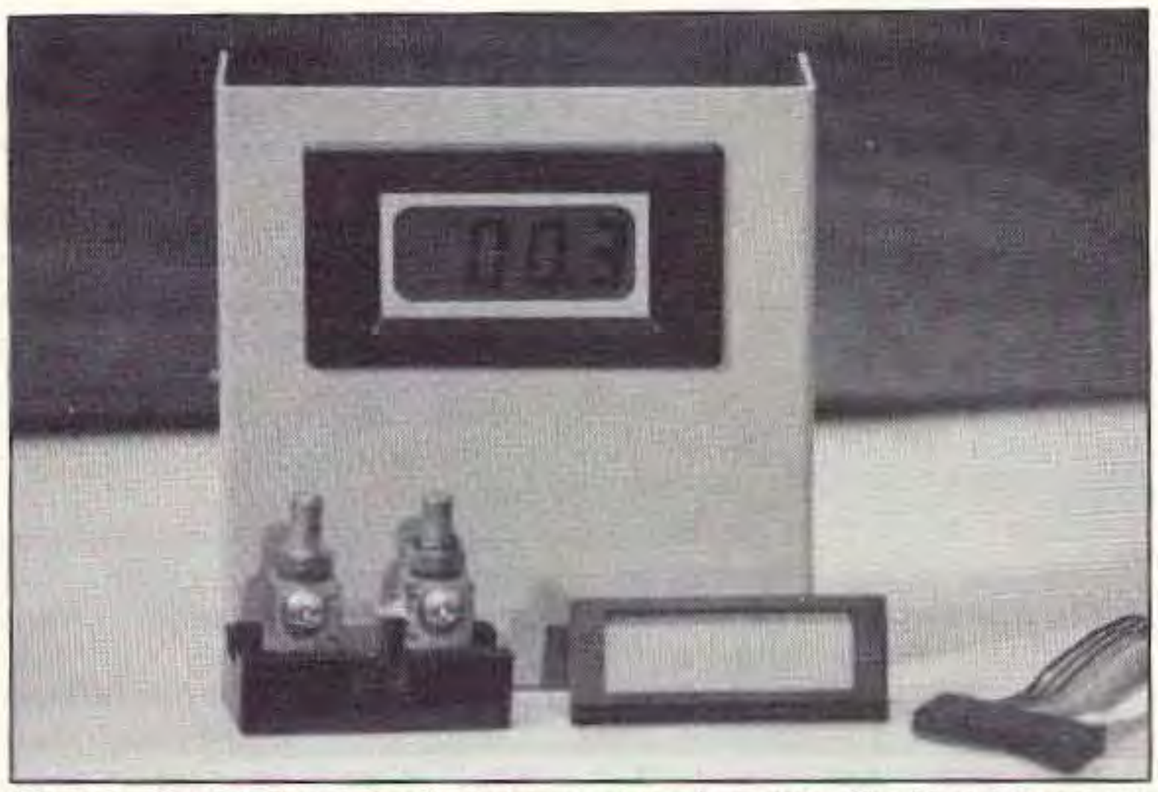

Photo A. The D1 Digital Panel Module mounted in a case. The Modutec meter is in the foreground with its connector. A 100 amp 100 mV shunt is also shown.

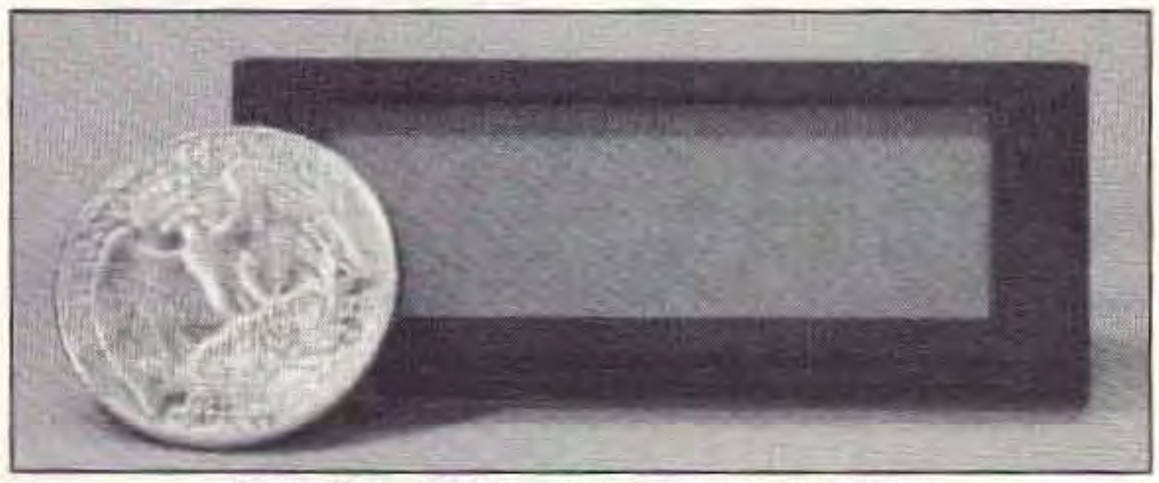

Photo B. The Modutec Digital Panel Module is tiny.

Making Them Work

A very popular use of the DPM is to measure voltage from a power supply or a battery. The first step you need to do is scale the input so the DPM knows what to do with it. With an input of only 200 mV, it becomes quite clear you must keep the proper ratio of signal to input. Take a look at Figure 1. You'll notice that the two resistors scale the input from our power supply down to a value the DPM needs. We have scaled the 200 mV input to 20 volts input. In case you don't have 1% resistors on hand, I added the 10k trimmer to fine-tune the voltage divider. An 8.2k and a 5k trimmer provide an easier adjusting of the DPM.

By changing the values in the voltage divider, while keeping the ratio the same, you can scale the input to just about any value you require. The only precaution would be to increase the number of resistors in series when measuring very high voltages. This would prevent flash over of a single resistor. Of course, you QRPers don't need to worry about measuring kV in our amplifiers—unless you happen to smoke cigars!

Trouble with the Input

If you look close at Figure 1, you'll see there is a second power supply running the DPM. That's because you can't have the Lo REF tied to ground. This causes the A-to-D converter chip inside the DPM to become confused and display a false reading. There is only one way around this problem. You must have a separate power source to operate the DPM. Luckily for us, we have three choices. The first is to use a 9 volt battery. It's simple, cheap, and sure is easy. The second is to operate the DPM from a separate power source such as a wall wart power supply. Or, we can use a DC-to-DC converter.

You can buy commercial DC-to-DC converters just about anywhere. But, hold onto your hats, they're not cheap! The one D1 International sells to operate their DPM runs about $20. It generates a +9 volt supply which is totally isolated. I've seen DC-to-DC

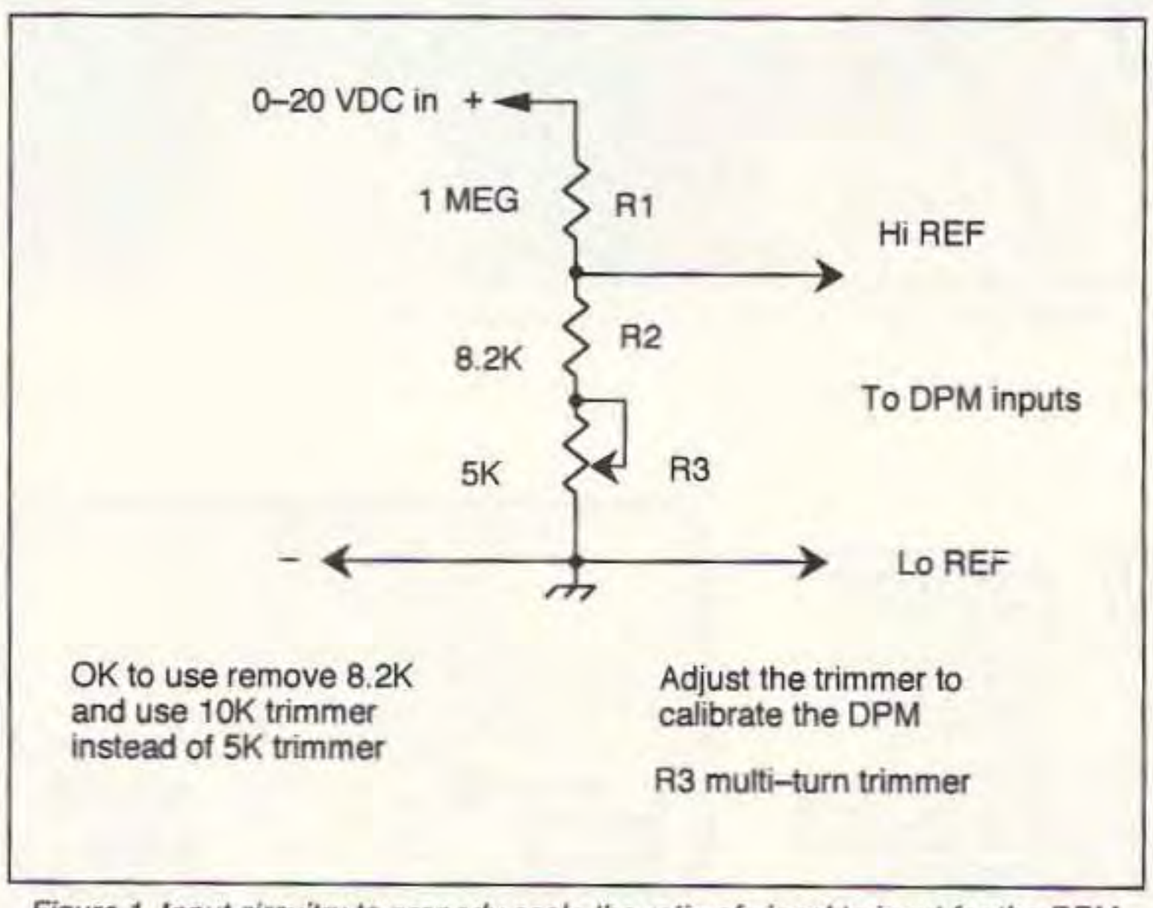

Figure 1. Input circuitry to properly scale the ratio of signal to input for the DPM.

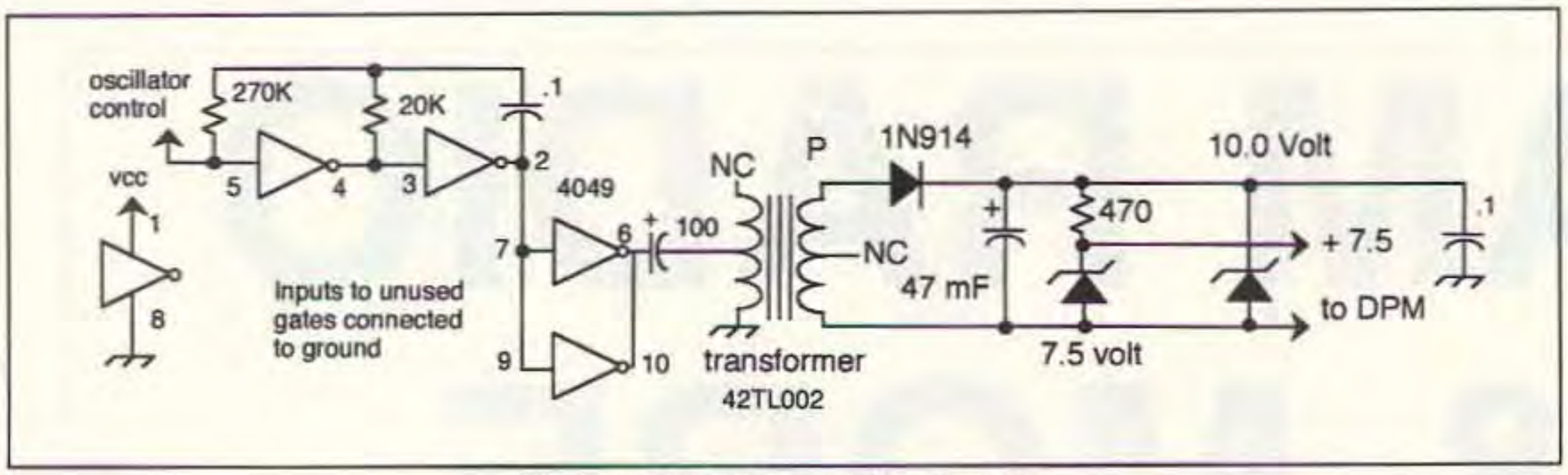

Figure 2. DC to DC converter for the DPM.

converters listed in surplus catalogs. One had a converter that would fill the requirements for under two bucks. It is important when shopping for a converter to get one that supplies an isolated +9 (or +5) volts. Some voltage converters generate a different voltage than the supply. This is not what you want for the DPM.

You can roll your own DC-to-DC converter without too much trouble. In fact, all you need is just a spoonful of parts. Figure 2 shows the DC-to-DC converter I built up using some junk box parts. The output from the oscillator is coupled to a small transformer. The output is then rectified, filtered and regulated to 7.5 volts with a zener diode and a resistor. A second zener diode is also across the output of the converter. This diode acts as a safety valve in case the 7.5 volt zener opens up. If that happens, the 10 volt zener will short the output together, protecting the DPM from overvoltage. In my DC-to-DC converter there is very little current developed. Although I've never measured it, I would guess the total amount of current generated would be less than 10 mA.

Just about any type of oscillator can be used in this circuit. I've used a single gate of an LM324, a 555 timer, a 4049, and at least several others, too. In fact, nothing is really critical. The driver transformer is available from Mouser Electronics.

Notice how the output is separated from the supply ground. This gives us the required isolation. The 0.1 μF capacitor from the output to system ground was required to keep a nasty spike from confusing the DPM.

I built this converter on a hunk of perf board. There is no PC board layout for it. Since the converter uses an oscillator, it may be possible to hear this oscillator in your receiver. Some careful shielding of the converter will keep all the noise inside and out of the receiver.

If you suffer from inductorphopia, you might be able to come up with a suitable DC-to-DC converter without the transformer. Perhaps some types of capacitance-coupled diodes may work.

Measuring Current with the DPM

There is one more task the DPM is capable of doing: It has the ability to measure current. All you need is a shunt in the negative lead and you're ready to go. If you use a calibrated shunt the display will be accurate; if you use a homemade shunt you'll need to calibrate the meter.

A laser trimmer 100 mV shunt is what I use. This shunt will drop one millivolt for every amp of current. So, at 100 amps, we have 100 mV across the shunt. If this is applied to the DPM, the display will be 100. You can select the display decimal point by using a switch. At 10 amps, the display would read 010 and so on. It is important that the shunt be in the negative lead. And again, the DPM must be running on either a battery or the DC-to-DC converter described above. I have a source of laser trimmer 100 mV shunts. They're not cheap, about $35 each, but if you're interested, drop me a note.

Depending on the amount of current you want to measure, you can build your own shunt. A six-inch piece of solid #14 copper wire wound on an AA battery works great. Use the battery as a form only; remove it before you use the shunt. You have to calibrate this shunt with a 100k-to-470k trimmer as shown in the schematic. Either value will work. To calibrate the shunt, first connect a load of several amps in series with a source of power and the shunt. A headlight makes a cheap and dirty load. Now install your own current meter, say your multimeter, in series, too. Turn on the supply and note the current on your multimeter. Adjust the trimmer so the DPM displays the same value. Place a drop of paint or nail polish on the trimmer to prevent its movement and you're all done. By using a shunt and the DPM, you have a great way to measure a large amount of current safely. A multi-pole switch would be ideal for a combination voltage and current display.

Other Uses

Although the DPM is really at home with current and voltage, it can be made to do other tasks. If you want to display frequency, for example, all you have to do is add a frequency to voltage chip and display the results on the DPM. Measuring SWR or RF power would be easier yet. Two of the DPMs, one to measure forward power and a second to measure reflected power, would be easy to build. In fact, the Kanga power bridge would be a good test bed for a project like this. Right now, I'm working on my own version of a field-strength meter using the DPM from D1 International. Should be an interesting project to build.

Field Day

Next month is Field Day, a traditional outing for QRP stations. How about getting those Field Day photos together and sending some in? Other QPRers would like to see what the guy's station looks like after the smoke clears.

While life may be too short for QRP, intense levels of RF and those cigars will do you in quicker! 73

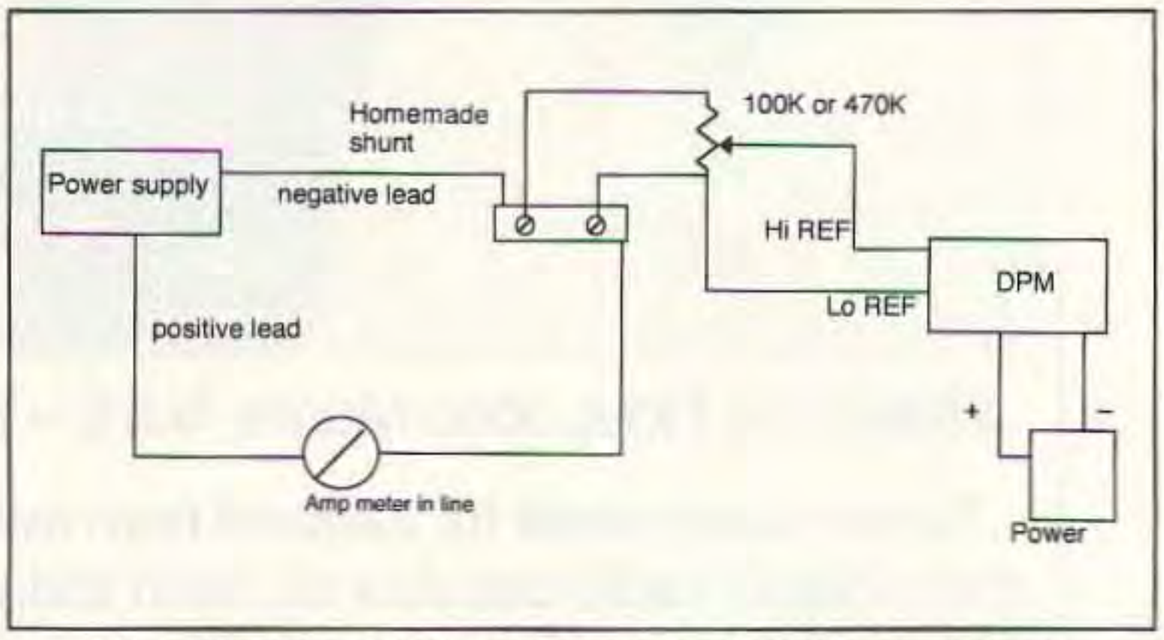

Figure 3. Using a power supply to calibrate the DPM to read current.