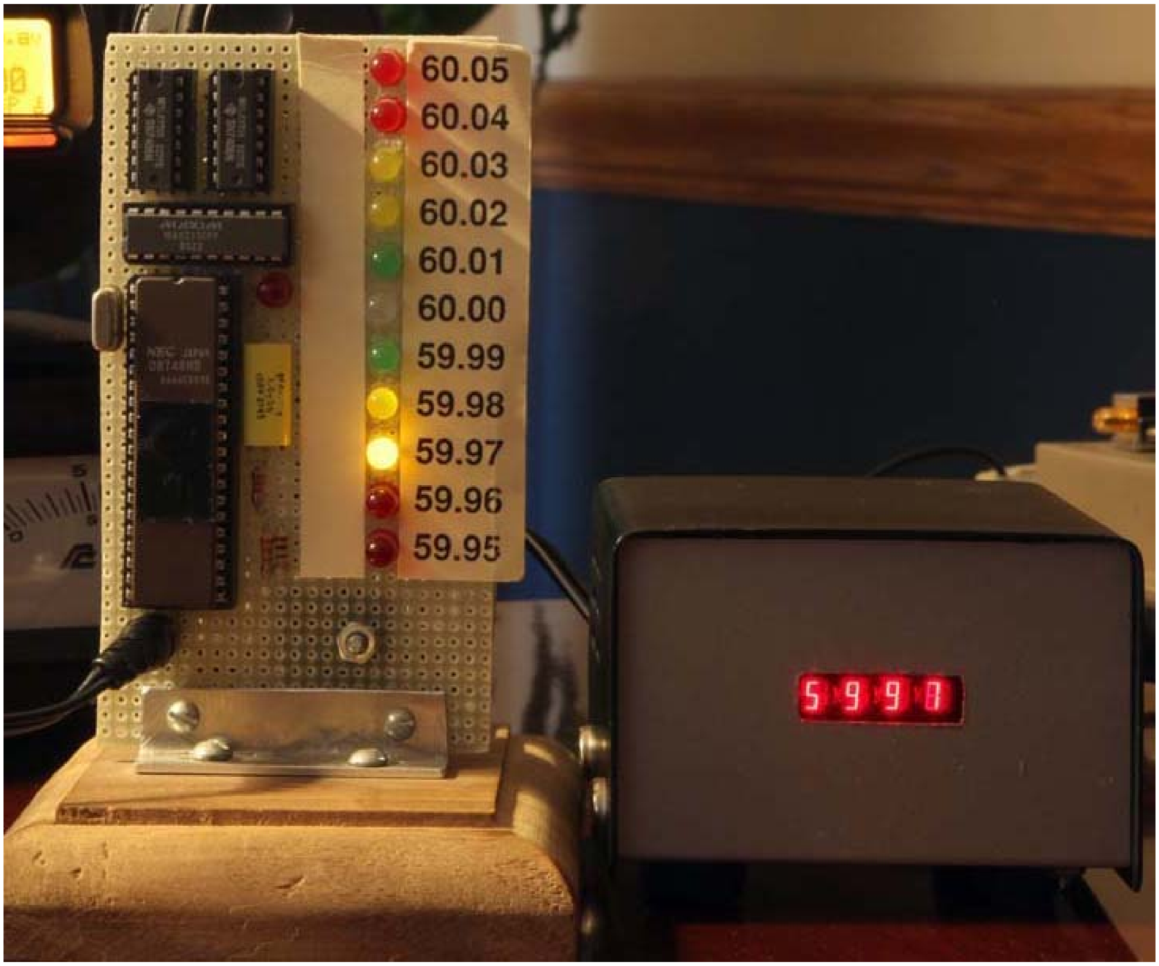
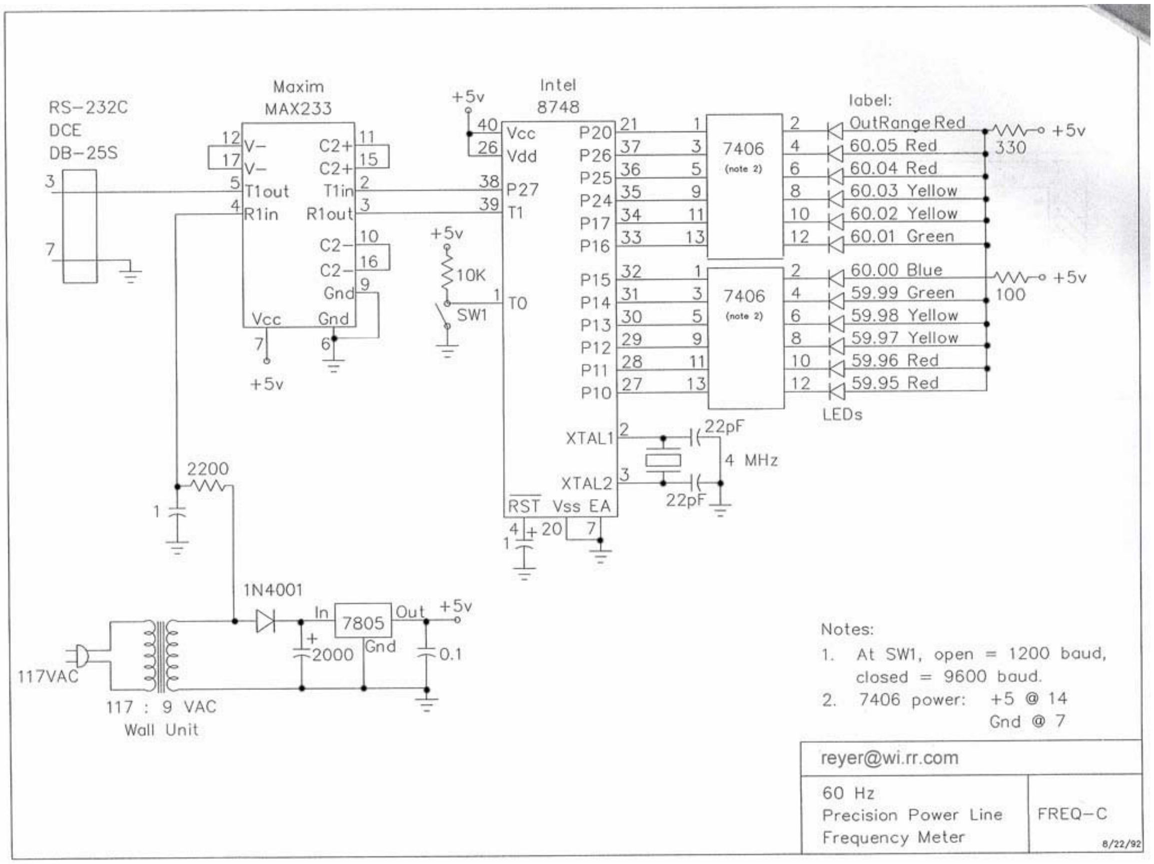
Mains Frequency Monitor – Steven Reyer

I'm enjoying the discussion of measuring the power line frequency. Nearly 25 years ago I designed a couple hobby-level power line frequency meters. They used an old Intel EPROM-based microcontroller, the 8748. They were a bit old even then, but handy 8-bit processors, and I had a pile of them:



The Time Nuts discussion has addressed the interface question. Here's how I solved it back then — a simple RC filter (necessary to eliminate glitches) and a MAX233 where I fed the AC signal into what's normally the RS-232 input, and got TTL out for the uC. It converted voltage levels and gave me some Schmitt triggering. Worked fine and I had the chip there anyway since I wrote a serial bit-banging routine to output the line frequency and min and max values since reset to a PC.

The reference is just a common quartz crystal.



I wrote the code in assembly language and to avoid division (there was no division instruction) I used the binomial theorem to approximate the reciprocal of the period. Here's some of the explanation from my old notes:

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;The unit computes the frequency by measuring the period
;of 27 cycles of the line.  Using a 4 MHz crystal on the
;8748 yields a processor state time of 3.75 us.
;A counting loop accumulates after 20 such states (75 us)
;thus yielding period measurements nominally equal to
;(27 cycles)*(1000000 us/s)*(1 s/60 cycles) = 450000 us
;where (450000 us)/(3.75 us/state) = 120000 states
;and (120000 states)/(20 states/count) = 6000 counts.

;That is, at the 4 MHz xtal frequency, 6000 counts will
;be accumulated in 27 cycles of a nominal 60 Hz wave.
;This is the period measurement, and the frequency is
;the reciprocal of this.  However, it can be shown, that
;for frequencies near (within 1 or 2 Hz) of 60 Hz, the
;difference in period away from a nominal 6000 counts
;is the same as the negative of the difference in frequency
;away from 6000 frequency units (60.00 Hz).  For example,
;if the period is determined to be 5995 counts, the
;approximate frequency is 6005 (*.01) Hz.
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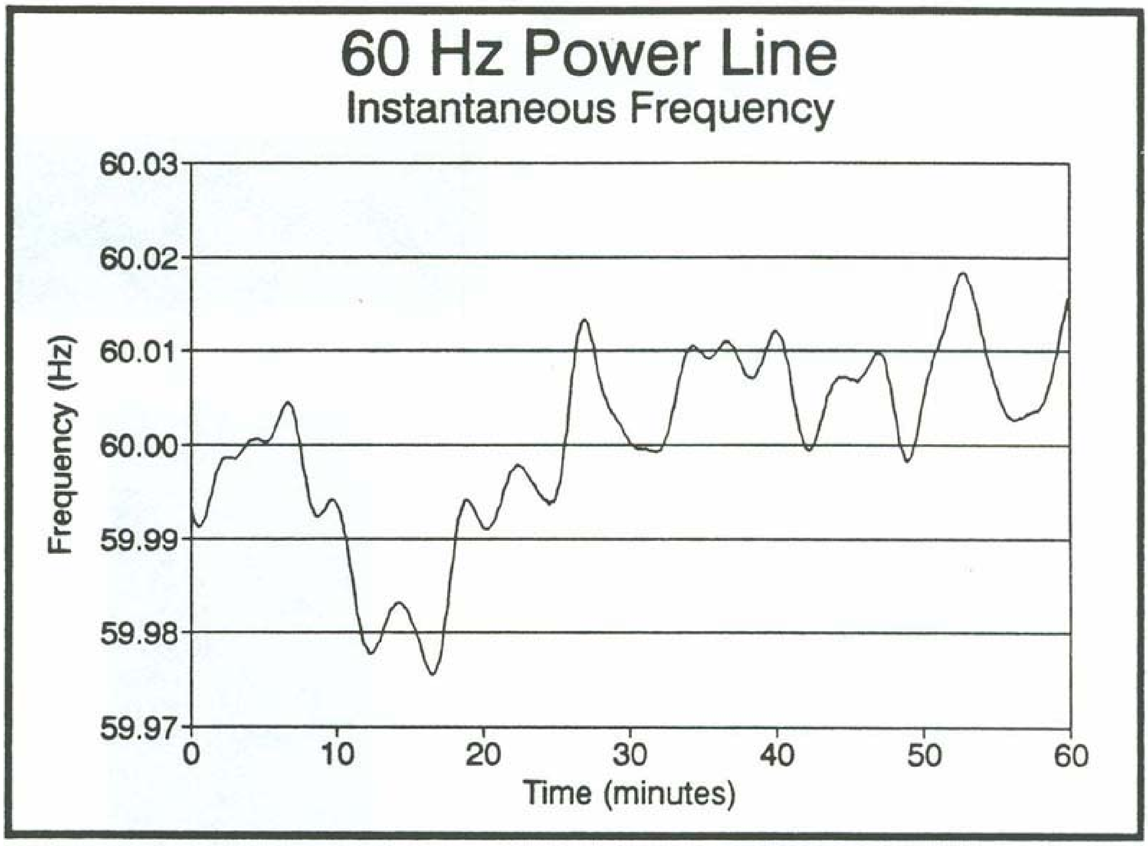
The frequency readout jumps between the 0.01 Hz steps, but after the fact (in a PC) a digital filter smooths it out nicely since it is pretty heavily oversampled — 2 samples per second, roughly:



I thought you might find this interesting, and feel free to share with the group. It's not at the time-nuts level of precision, but fun.

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