Trimming the PicoPak Microprocessor Clock Frequency

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The PicoPak Clock Measurement Module uses a Microchip PIC16F1847 as its main microprocessor. That device is internally clocked by a 32 MHz RC oscillator that is factory calibrated to a tolerance of ±2% over a 0°C to +60°C operating temperature range. All critical timing for the PicoPak is provided by an external 10 MHz reference, but the microprocessor clock determines the duration a delay of about 575 μs in the 1 s gate interval used to coarsely measure the RF signal frequency. That potentially contributes an error of up to 2% of 575 μs = 11.5 μs = 1.15×10^{-5} s/s or up to 115 Hz out of 10 MHz. Fortunately, the actual error is much less than that, especially at room temperature, typically less than ±10 Hz including measurement scatter and other factors, which is adequate accuracy to establish a 100 Hz nominal beat note for a precise signal period determination. Nevertheless, it is advantageous to trim the PicoPak microprocessor frequency.

The PicoPak firmware includes undocumented ">" and "<" commands to increment and decrement the PIC16F1847 clock frequency. The firmware also includes an "L" command that flashes its monitor LED for 1 second as determined by the microprocessor clock. Thus the LED can be used as a way to calibrate the PIC clock rate by measuring the LED flash duration and trimming the PIC clock frequency.

While a phototransistor or other electro-optic device could be used to detect the LED output, the most practical method of measuring the flash duration is to probe the LED connection on the PicoPak circuit board (the LED pin closest to the front panel on the bottom of the board). The waveform at the anode of the LED goes high when it is on, and can be measured with a universal counter in its period or time interval mode. A 2-channel common time interval measurement set up for a 2.5 volt DC threshold with start=positive slope and stop=negative slope settings works well. With the PicoPak communicating via an ASCII terminal program, the ">" and ">" commands are then used to adjust the period to exactly 1 second. It can be set to a tolerance of about 1 ms (0.1%).

In all cases so far where this adjustment has been made, the proper setting for OSCTUNE has been the factor default of 00 hex, so it is likely that it is not needed.

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