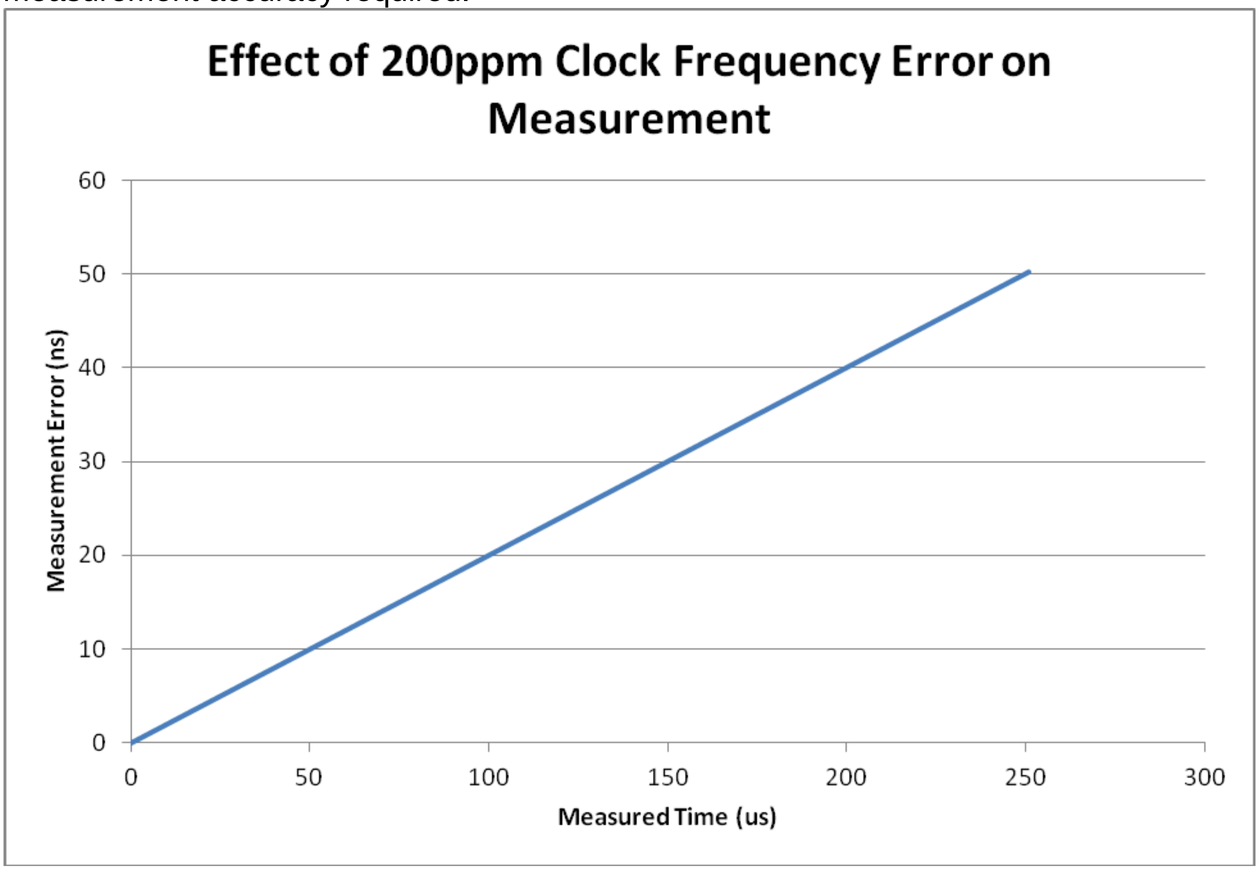
1. Mode 1 and Mode2

The reference clock has a large effect on the performance of the TDC7200, both in terms of accuracy and jitter but these depend largely on the time to be measured. For example, if the nominal clock frequency is 8MHz but the real value has a 200ppm error the real clock value is 7998400 Hz. This error translates directly into a time measurement error.

If the clock is not externally calibrated, then each measurement will have a 200ppm error. If the time to be measured is 20ns, the measurement error is 4ps. However, if the measured time is 200us, the measurement error is 40ns. As shown in the plot below, the quality of the clock required depends on the time to be measured and the measurement accuracy required.



The effect above is true in mode 1 as well as mode 2 because the calibration stage uses the external clock as its reference to determine the internal LSB of the TDC7200 so **both modes rely on both the internal and external clocks.**

It is also worth noting that the noise performance of mode 2 is considerably better for longer time measurements. Please note the Figure below from the TDC7200 datasheet, which shows the effect of measured time on the RMS noise.

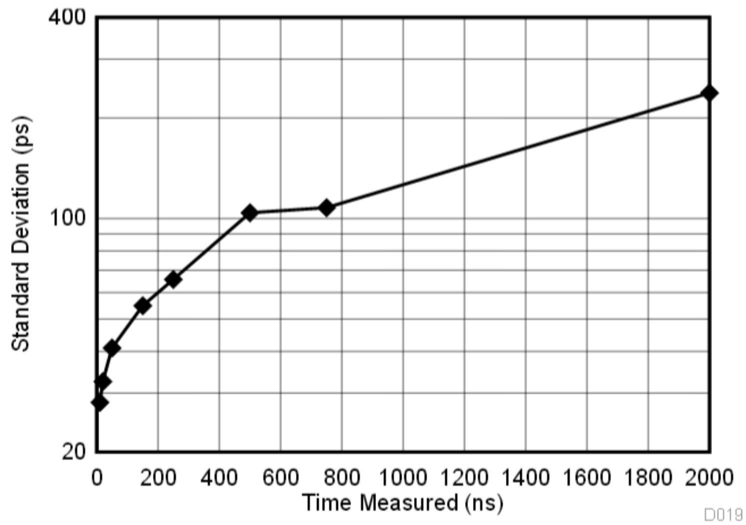


Figure 17. Measurement Mode 1 Standard Deviation vs. Measured Time-of-Flight

It may be possible to calibrate the measured time using a known reference time in the periodic pulse, as shown below. If the pulse “known reference time” can be generated very precisely, the time can be measured using TDC7200 and the known value can be compared against the measured value to deterime the clock error. The measured phase can be scaled by “measured reference time”/ “known reference time” to remove the absolute error in clock frequency, if it is expected to be large. For example, if the pulse is known to be 1us but measured to be 0.998 ns, the measured phase can be multiplied by 1/0.998.