ABOUT YOUR **6608** DEVICE

The 6608 device is a timing and digital I/O board with a high-stability clock called an oven-controlled crystal oscillator (OCXO). This document describes how to use the OXCO and how to measure frequency deviation.

For information on installation, features, and functions, see the *6601/6602 User Manual*. The 6608 device is based on the NI-TIO counter ASIC that provides counter/timer and digital line functionality. Your 6608 device is a functional superset of the 6602 device with the added OCXO, so all references to the *6602 device* in the user manual also apply to your *6608 device*.

Oven-Controlled Crystal Oscillator (OCXO)

The accuracy of your time measurement and pulse generation is determined by the timing accuracy of your counter clock. Your 6608 device has an OCXO that provides a highly stable 10 MHz clock that you can use as a GATE or SOURCE of a counter. You can also use the OCXO as the PXI backplane clock. Modules phase locked to the PXI backplane clock will acquire the same clock stability as the 6608. For more information, search for *phase lock* in the *Knowledge Base* section of our website, www.ni.com

Using the OCXO as the GATE or SOURCE Counter

You can route the 10 MHz clock to any of the RTSI lines (also referred to as PXI triggers on PXI products), which are available to each counter as GATE or SOURCE. The relationship and mapping between the RTSI lines and PXI triggers is described in Table 1-1, *Pins Used by the PXI-6602 Device*, of the *6601/6602 User Manual*.

Using the OCXO as the 10 MHz PXI Backplane Clock

Your PXI chassis has a built-in 10 MHz backplane clock that is independently routed to each peripheral slot. An independent buffer on the chassis drives the clock signal to each peripheral slot with a skew of less than 1 ns between slots. You can use this common reference clock signal to synchronize multiple modules in a measurement or control system.

Use the OCXO 10 MHz clock to drive the PXI backplane clock so the modules in the other slots can take advantage of the stable timebase.

✒ **Note** For PXI-6602 and PXI-6608 devices, the maximum timebase is phase locked to the PXI backplane clock.

To use the OCXO 10 MHz clock as the PXI backplane clock, simply plug your PXI-6608 device into the Star Trigger Controller slot, slot 2, or the slot immediately to the right of the controller of the PXI chassis.

By default, NI-DAQ software drives the 10 MHz clock from the OCXO onto the PXI Star trigger so that it is used as the PXI backplane clock. When the PXI chassis senses a clock on PXI Star trigger in slot 2, the chassis disables its internal clock, then uses the OCXO clock instead, illustrated below.
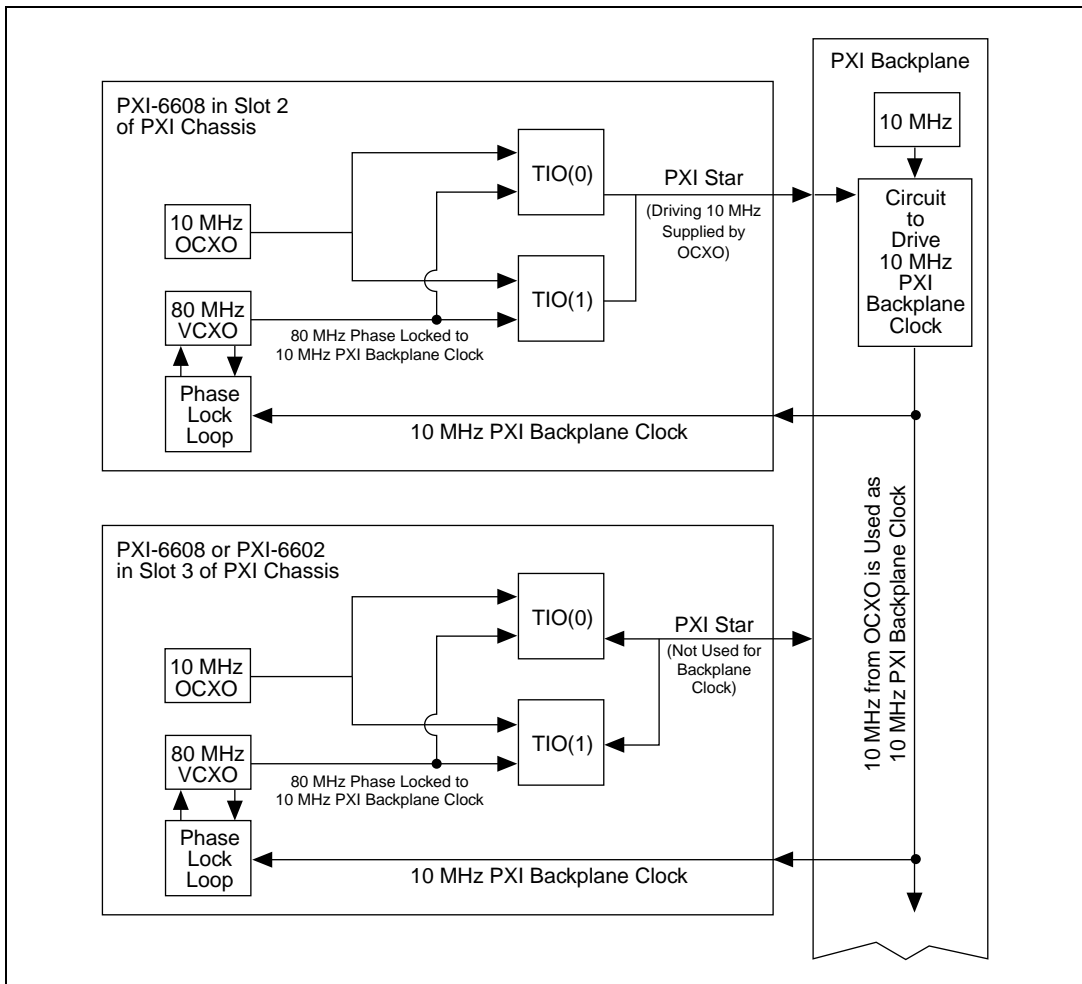
Measuring OCXO Stable Frequency Deviation

When you power your 6608 device, the OCXO requires adequate warm-up time to reach stable frequency. Five minutes is adequate warm-up time for a power-off duration of less than one hour, with maximum deviation within 20 ppb, or parts per billion, while four hours of operation is adequate for a power-off duration of up to 90 days.

Tip For best performance, minimize power-off periods for the OCXO.

The OCXO is calibrated to within 0.1 Hz of 10.000000 MHz prior to shipment. The following table shows additional change in stable frequency that occurs over time. A change in stable frequency of approximately 45 ppb occurs after the first year of normal use.

Days of Operation	Additional Change in Stable Frequency (ppb)
0–10	11.25
11–60	11.25
61–200	11.25
201–365	11.25
366–375	5.63
376–425	5.63
426–565	5.63
566–730	5.63
731–740	2.82
741–790	2.82

For example, if your OCXO has a perfect stable frequency of 10 MHz after warm-up, after the first 10 days of operation, the stable frequency drifts 11.25 ppb. During the next 50 days of operation, this frequency will drift an additional 11.25 ppb, thus making the total drift caused by aging to be 22.5 ppb. After 365 days, drift will be 45 ppb. If you calibrate the OCXO after 365 days of operation to restore the stable frequency to a perfect 10 MHz, the drift during the first 10 days following calibration (days 366–375) will now be 5.63 ppb—the stable frequency in this case will be 10 MHz ± 5.63 ppb after 375 days of operation. Calibration does not affect the drift in frequency; it only changes the stable frequency.

Calibrating Your 6608 Device

When you are ready to calibrate your device to correct for drift in frequency, refer to the *6608 Calibration Procedure* available at www.ni.com/support/calibrat

Note Use an external clock with a short-term stability (over a period of 100 s) of better than 5×10^{-11} to calibrate your device; otherwise, the OCXO will be improperly calibrated. A typical rubidium time standard will meet the required stability.

6608 Specifications

Specifications for the 6602 devices in the *6601/6602 User Manual* apply to the 6608 devices with the following modifications.

Power

Device requirement................................. +5 VDC (±5%)
1–2.5 A (with 1 m shielded cable as load) varies with application and OCXO warm-up period, does not include I/O power supplied through I/O connector

Available at I/O connector......................4.65 to 5.25 VDC, 1 A (maximum)

OCXO Specification

Frequency ....10.000000 MHz

Warm-up time (to within 20 ppb of operating frequency, power-off duration < 1 hour)...................................5 minutes

Frequency stability versus supply voltage change (±5%) ....± 5 ppb

Temperature stability (0 to 50 °C)..........± 5 ppb, reference to 25 °C

Drift in frequency ....± 0.45 ppb/day
± 45 ppb/year

Allowed frequency adjustment (to correct for drift in frequency)............± 500 ppb, typical