

# GTX22x0 SERIES

## PXI TIME INTERVAL COUNTERS

- 14 measurement functions
- DC to 225 MHz (GTX2210), DC to 1.3 GHz (GTX2220), DC to 2.0 GHz (GTX2230)
- 100 ps resolution without averaging (GTX2220 and GTX2230 only)
- Fast measurement mode: 2300 readings/sec
- External reference clock input
- External arming signal input
- Gate signal output
- Self-calibration feature ensures highest accuracy
- Programmable automatic adjustment of board setting to obtain a stable reading
- Software selectable input impedance (1 M $\Omega$  or 50 $\Omega$ ) and coupling (AC or DC) for each input channel



## DESCRIPTION

The GTX22x0 family of PXI universal time interval counters offer many of the measurement and timing functions of high-end stand-alone frequency counters, including accumulate, auto ratio, frequency, fast frequency (GTX2220 and GTX2230 only), period, ratio, single period, test clock, time interval, time interval delay, totalize, totalize gated, totalize gated once, and width.

There are three models available: the GTX2210, GTX2220 and GTX2230. The GTX2210 frequency range extends to 225 MHz, the GTX2220 covers frequencies up to 1.3 GHz, and the GTX2230 covers frequencies up to 2.0 GHz.

## FEATURES

The GTX22x0 series counters have two signal input channels via BNC connectors, an external timebase input, arm input, and a gate signal output. The separate input signals can be used for arming and gating the circuitry, and controlling the timing of the analysis (start/stop duration) for more meaningful measurements.

The GTX22x0 series counters use an on-board microprocessor with embedded firmware to off-load processing tasks from the main CPU. The counters use high-density, low-power field programmable gate arrays (FPGA) to perform complex logic tasks. Reciprocal counting techniques are used to achieve high resolution measurements on lower frequency signals without sacrificing measurement time. These techniques provide a fixed number of digits of resolution for all frequencies rather than a fixed resolution in Hz for the same gate time.

The GTX2220 and GTX2230 can determine any frequency to 0.1 parts per million (seven digits) in just 1 ms and resolve each time

measurement to 100 ps. This ability to precisely resolve frequency and time allows for increased accuracy as well as reduced measurement time. When combined with 2,300 measurements/sec, one of the fastest rates available, more data can be acquired in a single second than a typical GPIB counter can acquire in one minute.

Additionally, the counters include an on-board accurate timebase - 10 MHz TCXO - for internal frequency reference. An external input is provided for external timebases.

## SOFTWARE

The GTX22x0 series counters are supplied with the GXCNT virtual instrument panel, which includes the 32-bit DLL driver libraries and documentation. The virtual panel can be used to interactively adjust and control the instrument from a window that displays the current instrument settings and measurements.

In addition, various interface files provide access to the library for programming tools and languages such as ATEasy, Microsoft<sup>®</sup> and Borland<sup>®</sup> C/C++, Microsoft Visual Basic<sup>®</sup>, LabVIEW, Borland Delphi, and more.

## APPLICATIONS

- ATE Systems
- Event timing measurements
- Frequency measurements
- Time interval measurements

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## SPECIFICATIONS

INPUT CHARACTERISTICS	
<b>IMPEDANCE</b>	Below 225 MHz: 1 M $\Omega$ or 50 $\Omega$ channel independent and software selectable 225 MHz and above: 50 $\Omega$
<b>COUPLING</b>	DC or AC channel independent and software selectable
<b>TRIGGER</b>	Positive or Negative channel independent and software programmable, automatic level or hold last
<b>MAXIMUM SIGNAL INPUT</b>	50 $\Omega$ : 5 V <sub>RMS</sub> 1 M $\Omega$ : DC to 1 MHz - 15 V <sub>RMS</sub> (GTX2210); 30 V <sub>RMS</sub> (GTX2220/GTX2230) Above 1 MHz - 5 V <sub>RMS</sub>
FREQUENCY RANGE	
<b>GTX2210</b>	Channels A and B: DC to 225 MHz
<b>GTX2220</b> <b>GTX2230</b>	Channel A: Programmable DC to 225 MHz OR 100 MHz to 1.3 GHz (GTX2220) 100 MHz to 2.0 GHz (GTX2230) Channel B: DC to 225 MHz
SENSITIVITY	
<b>SINE</b>	25 mV <sub>RMS</sub> DC – 20 MHz 50 mV <sub>RMS</sub> 20 MHz – 50 MHz 200 mV <sub>RMS</sub> 50 MHz – 225 MHz 250 mV <sub>RMS</sub> 225 MHz – 1.3 GHz (GTX2220 or GTX2230) 500 mV <sub>RMS</sub> 1.3 GHz – 2.0 GHz (GTX2230 only)
<b>PULSE</b>	500 mV <sub>pk-pk</sub> at 5 ns pulse width
TRIGGER (THRESHOLD) LEVEL	
<b>RANGE</b>	$\pm 5.00$ V in 40 mV steps
<b>ACCURACY</b>	$\pm 3\%$ of setting $\pm 0.04$ V
<b>AUTO TRIGGER</b>	Automatic selection of optimum trigger level Signal repetition rate: 100 Hz to 75 MHz
EXTERNAL REFERENCE CLOCK INPUT	
<b>IMPEDANCE</b>	2 K $\Omega$ in series with 47 nF
<b>MAXIMUM INPUT VOLTAGE</b>	5 V <sub>RMS</sub>
<b>COUPLING</b>	AC
<b>SENSITIVITY</b>	150 mV <sub>RMS</sub> sine, 450 mV <sub>pk-pk</sub> pulse
<b>DUTY RATIO</b>	40% to 60%
<b>FREQUENCY</b>	10 MHz only
EXTERNAL ARM INPUT	
<b>INPUT SIGNAL CHARACTERISTICS</b>	DC Coupled, TTL compatible (1.4 V threshold)
<b>MINIMUM PULSE WIDTH</b>	15 ns
<b>IMPEDANCE</b>	2 K $\Omega$
EXTERNAL GATE OUTPUT	
<b>OUTPUT SIGNAL CHARACTERISTICS</b>	DC Coupled, TTL compatible (1.4 V threshold)

## MEASUREMENT FUNCTIONS

MAXIMUM MEASUREMENT RATE	
<b>GTX2210</b>	200/Sec for all modes
<b>GTX2220</b> <b>GTX2230</b>	2300 readings per sec for Fast Frequency and all time modes 1400 reading per sec for Frequency and Period modes
FREQUENCY	
<b>RANGE</b>	DC to 225 MHz (GTX2210) DC to 1.3 GHz (GTX2220) DC to 2.0 GHz (GTX2230)
<b>GATE TIME</b>	GTX2210: 1 ms to 5000 s (plus up to one signal period) GTX2220 and GTX2230: 250 $\mu$ s to 3200 s (plus up to one signal period)
<b>NUMBER OF SIGNIFICANT DIGITS</b>	GTX2210: 8 per second of gate time, e.g., 5 digits in 1 ms GTX2220 and GTX2230: 10 per second of gate time, e.g., 7 digits in 1 ms
<b>LEAST SIGNIFICANT DIGIT (LSD)</b>	GTX2210: Freq x (10 ns/Gate Time) GTX2220: Freq x (100 ps/Gate Time) GTX2230: Freq x (100 ps/Gate Time)
<b>RESOLUTION(HZ)</b>	$\pm$ LSD $\pm$ $\frac{\text{Freq} \times (300 \text{ pS RMS} + (1.4 \times \text{Trigger Error}))}{\text{Gate Time}}$
<b>ACCURACY (HZ)</b>	$\pm$ Resolution $\pm$ TimeBaseError
FAST FREQUENCY (GTX2220 AND GTX2230)	
<b>RANGE</b>	DC to 225 MHz
<b>GATE TIME</b>	4 signal periods, fixed
<b>ACCURACY (HZ)</b>	$\pm$ $\frac{\text{Freq} \times (500 \text{ pS} + 300 \text{ pS RMS} + (1.4 \times \text{Trigger Error}))}{\text{Gate Time}}$ $\pm$ Time Base Error
TIME INTERVAL	
<b>RANGE</b>	-1 ns to 100,000 seconds (> 25 hr)
<b>LEAST SIGNIFICANT DIGIT (LSD):</b>	GTX2210: 10 ns GTX2220: 100 ps GTX2230: 100 ps
<b>RESOLUTION</b>	$\pm$ LSD $\pm$ 300 ps RMS $\pm$ StartTriggerError $\pm$ StopTrigger Error
<b>ACCURACY</b>	$\pm$ Resolution $\pm$ TimeBaseError $\pm$ TriggerLevelTimingError $\pm$ 2 ns
<b>MIN. PULSE WIDTH</b>	8 ns
<b>DELAY</b>	Recognition of stop events is inhibited for a set time GTX2210 range: 30 $\mu$ s to 5000 seconds GTX2220 range: 20 $\mu$ s to 3200 seconds GTX2230 range: 20 $\mu$ s to 3200 seconds
TOTALIZE AND GATED TOTALIZE	
<b>CONTROL</b>	Count gate can be controlled by software, or by events on the second input channel (Gated Totalize). In Gated Totalize, start and stop event slopes are selectable
<b>COUNT RATE</b>	DC to 50 MHz, 10 ns min. pulse width
<b>MODES</b>	Software gate: Gate and count reset are controlled by software Hardware gate: Count is reset before every gate Accumulative: Count is totalized over multiple gates
<b>RANGE</b>	0 to $2.8 \times 10^{11}$ counts
<b>ACCURACY</b>	$\pm 1$ count, reading allowed while counting

Note: Specifications subject to change without notice.

# GTX22x0 SERIES

## MEASUREMENT FUNCTIONS (CONT'D)

PERIOD (SINGLE PERIOD)	
<b>RANGE</b>	25 ns to 100,000 seconds. See Time Interval for resolution and accuracy
PERIOD (MULTIPLE PERIOD AVERAGE)	
<b>RANGE</b>	See Frequency
<b>GATE TIME</b>	See Frequency
<b>LEAST SIGNIFICANT DIGIT (LSD)</b>	GTX2210: Period x $\frac{10 \text{ ps}}{\text{Gate Time}}$ GTX2220: Period x $\frac{100 \text{ ps}}{\text{Gate Time}}$ GTX2230: Period x $\frac{100 \text{ ps}}{\text{Gate Time}}$
<b>RESOLUTION</b>	$\pm \text{LSD} \pm \frac{\text{Period} \times (300 \text{ ps} + (1.4 \times \text{Trigger Error}))}{\text{Gate Time}}$
<b>ACCURACY</b>	$\pm \text{Resolution} \pm \text{TimeBaseError}$
GATE TIME	
<b>GATE TIME</b>	GTX2230: 250 $\mu$ s to 3200 seconds GTX2220: 250 $\mu$ s to 3200 seconds GTX2210: 1 ms to 5000 seconds
<b>RANGE</b>	DC - 225 MHz on either input. DC - 25 MHz on second input
<b>LEAST SIGNIFICANT DIGIT (LSD):</b>	$\frac{\text{Ratio}}{\text{FREQ}_{\text{hi}} \times \text{Gate Time}}$ , FREQ <sub>hi</sub> = higher frequency input
<b>RESOLUTION AND ACCURACY</b>	$\pm \text{LSD} \pm \frac{\text{Ratio} \times \text{FREQ}_{\text{low}} \times \text{Trigger Error}}{\text{Gate Time}}$ , FREQ <sub>low</sub> = lower frequency input
WIDTH	
<b>ACCURACY</b>	Same as Time Interval, plus 3 ns
PACER	
<b>TIME CONTROLLED</b>	0.8 ms to 3200 seconds
ARMING	
Available on all modes except Totalize	
Arm setup time: Min. 40 ns before selected event	
TIME BASE	
<b>STANDARD</b>	10 MHz TCXO
<b>ACCURACY</b>	Temperature: $\pm 5$ ppm, 0° C to 50° C Aging: < 2 ppm/year Supply voltage: < $1 \times 10^{-8}$ for 10% change Short term: < $5 \times 10^{-10}$ RMS with a 1 second averaging time
<b>EXTERNAL REFERENCE INPUT</b>	External Reference Input (all modes). Alternate signal channel when making single-channel measurements

SUPPLEMENTAL DEFINITIONS	
<b>TRIGGER ERROR</b>	Error due to noise superimposed on the input signal from both internal and external sources  $\text{Trigger Error} = \frac{\sqrt{500 \mu\text{N}^2 + E_n^2}}{(\text{input signal slew rate})} \text{ seconds RMS}$ E <sub>n</sub> = RMS noise of input signal (225 MHz bandwidth)
<b>TRIGGER LEVEL TIMING ERROR</b>	Time error due to threshold uncertainty $\text{Trigger Level Timing Error} = \frac{<250 \text{ mV}}{(\text{input signal slew rate})}$
<b>TIME BASE ERROR</b>	Fractional frequency error of time-base reference, times the measurement result
<b>POWER REQUIREMENTS (TYPICAL)</b>	+5 V @ 0.3 Amp -3.3 V @ 0.05 Amp +12 V @ 0.1 Amp -12 V @ 0.05 Amp
<b>STORAGE TEMPERATURE</b>	-20° C to +70° C
<b>SIZE</b>	3U PXI
<b>WEIGHT</b>	12 oz.

Note: Specifications subject to change without notice.

## ORDERING INFORMATION

<b>GTX2210</b>	225 MHz Time Interval Counter
<b>GTX2220</b>	1.3 GHz Time Interval Counter
<b>GTX2230</b>	2.0 GHz Time Interval Counter
<b>GTX22xx-CAL</b>	GTX2210/GTX2220/GTX2230 Calibration
<b>GTX22xx-NCAL</b>	GTX2210/GTX2220/GTX2230 NIST Calibration
<b>GX92005</b>	DIN Mating Connector for GTX22xx and SMX204x
<b>GX92006</b>	3' Harness for GTX22xx and SMX204x DIN connector (DIN to Header)
<b>GX92012</b>	Cable, BNC male to BNC male, 50 Ohm, 2'
<b>GX92015</b>	Cable, BNC male to BNC male, 50 Ohm, 5'

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