

NEW



## MODELS 5251/5351

### 250MS/s PXIBus / PCIBus Arbitrary Waveform / Function Generators

- 5251: Single Channel PXIBus waveform generator
- 5351: Single Channel PCIBus waveform generator
- Sine waves to 100MHz and Square to 62.5MHz
- 16 Bit amplitude resolution
- 2M waveform memory
- 10Vp-p into 50Ω standard, double into high impedance
- Multiple run modes: trigger, timer and trigger delay
- AM, FM, FSK, PSK, ASK, Freq. & Amp. Hop, sweep
- Powerful sequence generator links and loops segments in user-defined fashion. Stores up to 10 different sequence tables
- Occupies a single slot only
- Ultra fast waveform downloads using DMA
- Multi-Instrument synchronization
- ArbConnection software for easy waveform creation

Model 5251/5351, is a single-channel frequency agile waveform synthesizer that combines industry leading performance, frequency agility and modulation capability in a stand-alone, modular product. Having 1.5Hz to 250MHz clock and 16-bit vertical DAC resolution provides the test stimuli required for the decades to come. It can be used as an arbitrary waveform generator, modulating generator, as well as function and pulse generator.

#### **A Cost Effective Format**

The 5251/5351 is a sensible alternative to a GPIB-based waveform generator when developing a PXI or PCI based test system. The 5251/5351 provides a synergistic combination of a function generator, arbitrary waveform synthesizer, programmable sequencer, pulse generator, and modulation generator in one instrument. The 5251/5351 delivers all this at a lower cost than comparable bench-type, or VXI-based instruments. This versatility ensures that the Model 5251/5351 will adapt to future testing needs as well as current ones.

#### **250MS/s Performance**

Higher performance test equipment and systems are needed as products which use increasing signal bandwidths are developed. The sample rate generator can be programmed from frequencies as low as 1.5Hz to 250MHz with superior waveform quality and purity. For example, phase noise is typically below 120dB/Hz at 10kHz offset for a 10MHz sine wave.

#### **Waveform Memory**

Longer waveform memory minimizes test duration by allowing multiple waveforms to be loaded simultaneously and retrieved as needed for the specific test. The 5251/5351 comes with 2M points of memory as standard for applications requiring longer memory.

#### **Memory Segmentation and Sequencing**

Solving almost every complex application, powerful segmentation and sequencing produce an endless variety of complex waveforms. The waveform memory can be divided into multiple waveform segments and sequenced in user-selectable fashion

to create complex waveforms that have repeatable segments and thus saving precious memory space. Five different advance modes are available for the 5251/5351 series to step through the sequence table, including stepped and mixed advance modes and thus increasing efficiency of the test system. To solve even the toughest application, the products allow generation of up to 10 different sequences, each capable of linking 10k waveform fragments and looping each waveform up to 1M times.

#### **Frequency Agility**

Decrypting radio transmission often employs frequency hopping. Model 5251/5351 provides breakthrough technology that allows simulation of 12-bit decrypted code as easy as writing a simple hop table. The frequency hop mode is fast, coherent and provides a great tool for simulating code transmission without losing speed and integrity.

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## **Accurate Output**

As standard, the instrument is equipped with an internal frequency reference that has 1ppm accuracy and stability over a period of 1 year. An external frequency reference is provided on the rear panel for applications requiring greater accuracy or stability, supported by the instrument's 14 digits resolution.

## **Modulation Capability**

Agility and modulation capabilities open the door to diverse applications. In addition to the capability of generating any shape and style of waveform with the arbitrary waveform generation power, the products can also do standard modulation schemes such as AM, FM, ASK, FSK, PSK, frequency and amplitude hops and sweep without sacrificing the power of the instrument control and output run modes.

## **Multi-Instrument Synchronization**

Multiple 5251/5351 can be synchronized using a Master-Slave arrangement allowing users to benefit from the same high quality performance in their multi-channels needs.

## **Automated External Self-Calibration**

Normal calibration cycles in the industry range from one to three years where instruments are sent to a service center, opened to allow access to trimmers, calibrated and certified for repeated usage. Leading-edge technology was implemented to allow calibration from the PXI/PCI interface. Calibration factors are stored in a flash memory thus eliminating the need to open chassis covers.

## **Multiple Environments to Write Your Code**

Model 5251/5351 comes with a complete set of drivers, allowing you to write your application in various environments such as: Labview, CVI, C++, VB, MATLAB. You may also link the supplied dll to other Windows based API's or, use low level SCPI commands (Standard Commands for Programmable Instruments) to program the instrument, regardless if your application is written for Windows, Linux or Macintosh operating systems.

## **ArbConnection**

ArbConnection is a graphical tool that provides an unlimited source of Arbitrary Waveforms. With the ArbConnection software you can control instruments functions, modes and features. You can also create a virtually infinite amount of test waveforms. Freehand sketch allows you to draw your own custom waveform for quick analysis of analog signals. You can use the built-in equation editor to create your own exotic functions. Add or subtract components of a Fourier series to characterize digital or analog filters or inject random noise into a signal to test immunity to auxiliary noise.

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**ТАБОР ЭЛЕКТРОНИКС**  
**TABOR ELECTRONICS Inc.**  
Синце 1977  
ГРУППА КОМПАНИЙ

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## Specification

### CONFIGURATION

**Output Channels** 1

**Interface:**

5251	PXIBus
5351	PCIBus

### STANDARD WAVEFORMS

**Waveforms:** Sine, Triangle, Square, Pulse, Ramp, Sine(x)/x, Gaussian, Exponential, Repetitive Noise and DC

**Frequency Range:**

Sine	100µHz to 100MHz
Square, Pulse	100µHz to 62.5MHz
All others	100µHz to 31.25MHz

### SINE

**Start Phase:** 0-360°

**Phase Resolution:** 0.01°

**Harmonics Distortion, 3Vp-p (typ.):**

DC to 2.5MHz	<-55dBc
2.5MHz to 25MHz	<-50dBc
25MHz to 40MHz	<-40dBc
40MHz to 50MHz	<-35dBc
50MHz to 100MHz	<-28dBc

**Non-Harmonic Distortion:**

DC to 50MHz	<-70dBc
50MHz to 100MHz	<-65dBc

**Total Harmonic Distortion:**

DC to 100kHz	0.1%
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**Flatness (1kHz):**

DC to 1MHz	1%
1MHz to 10MHz	3%
10MHz to 25MHz	5%
25MHz to 80MHz	10%
80MHz to 100MHz	15%

**Phase Noise (8 points Sine, Max. SCLK)**

100Hz Offset	-80dBc/Hz
1kHz Offset	-89dBc/Hz
10kHz Offset	-92dBc/Hz
100kHz Offset	-112dBc/Hz
1MHz Offset	-140dBc/Hz

### TRIANGLE

**Start Phase Range:** 0-360°

**Phase Resolution:** 0.01°

**Timing Ranges:** 0%-99.9% of period

### SQUARE

**Duty Cycle Range:** 0% to 99.9%

**Timing Ranges:** 0%-99.9% of period

**Rise/Fall Time:** <4ns (typ.)

**Aberration:** <5%+10mV

**SINC (Sine(x)/x)**

**"0 Crossings":** 4-100

### GAUSSIAN

**Time Constant:** 10-200

### EXPONENTIAL PULSE

**Time Constant:** -100 to 100

### DC

**Range:** -5V to 5V, standard

### PULSE

**Pulse Mode:** Single or double, programmable

**Polarity:** Normal, inverted or complement

**Period:** 16ns to 1000s

**Resolution:** 4ns

**Pulse Width:** 8ns to 1000s

**Rise/Fall Time:**

Fast	<4ns (typ.)
Linear	4ns to 1000s

**High Time, Delay &**

**Double Pulse Delay:** 4ns to 1000s

**Impedance:** 50Ω

**Amplitude Window:** 100mVp-p to 10Vp-p<sup>(1)</sup>

Low Level -5V to +4.950V<sup>(1)</sup>

High Level -4.950V to +5V<sup>(1)</sup>

<sup>(1)</sup> Double into high impedance

### NOTES:

- All pulse parameters, except rise and fall times, may be freely programmed within the selected pulse period provided that the ratio between the period and the smallest incremental unit does not exceed the ratio of 2,000,000 to 1.
- Rise and fall times, may be freely programmed provided that the ratio between the rise/fall time and the smallest incremental unit does not exceed the ratio of 100,000 to 1.
- The sum of all pulse parameters must not exceed the pulse period setting

### HALF-CYCLE WAVEFORMS

**Function Shape:** Sine, Triangle, Square

**Frequency Range:** 0.01Hz to 1MHz

**Phase (Sine/triangle):** 0 to 360°

**Phase Resolution:** 0.01°

**Duty Cycle Range:** 0% to 99.9%

**Run Modes:** Continuous, Triggered

**Delay Between Half Cycles**

**(Continuous only):** 200ns to 20s

Delay Resolution 20ns

### ARBITRARY WAVEFORMS

**Sample Rate:** 1.5S/s to 250MS/s

**Vertical Resolution:** 16 Bits

**Waveform Memory:** 2M points

**Min. Segment Size:** 16 points

**Resolution:** 4 points

**No. of Segments:** 1 to 10k

### SEQUENCED WAVEFORMS

**Operation:** Segments may be linked and repeated in a user-selectable order to generate extremely long waveforms. Segments are advanced using either a command or a trigger

**Multi Sequence:** 1 to 10, Selectable

**Sequencer Steps:** 1 to 4k

**Segment Duration:** 600ns min.

**Segment Loops:** 1 to 1M

### ADVANCE MODES

**Automatic:** No triggers required to step from one segment to the next. Sequence is repeated continuously through a pre-programmed sequence table

**Stepped:** Current segment is sampled continuously, external trigger advances to next programmed segment.

**Single:** Current segment is sampled to the end of the segment including repeats and idles there. Next trigger advances to next segment

**Mixed:** Each step of a sequence can be programmed to advance either: a) automatic (Automatic mode), or b) with a trigger (Stepped mode)

**Advance Source:** External (TRIG IN), Internal or software

### MODULATION

#### COMMON CHARACTERISTICS

**Carrier Waveform:** Sinewave

**Carrier Frequency:** 10Hz to 100MHz

**Modulation Source:** Internal

**Run Modes:** Off (Outputs CW), Continuous, Triggered, Delayed Trigger, Burst, Timer and Gated

**Advance Source:** Front panel button, Software commands, TRIG IN

**Carrier Idle Mode:** On or Off, programmable

**Marker Position:** TTL, Programmable at selectable frequency

### FM

**Modulating Shape:** Sine, square, triangle, ramp

**Modulation Freq.:** 10mHz to 100kHz

**Deviation Range:** Up to 50MHz

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## Specification

### ARBITRARY FM

**Modulating Shape:** Arbitrary waveform  
**Modulating SCLK:** 1S/s to 2.5MS/s  
**Freq. Array Size:** 4 to 10,000 frequencies

### AM

**Envelope Freq.:** 10mHz to 100kHz  
**Envelope Shape:** Sine, square, triangle, ramp  
**Modulation Depth:** 0% to 100%

### FSK

**Baud Rate Range:** 1bits/sec to 10Mbits/sec  
**Data Bits Length:** 2 to 4,000

### PSK

**Carrier Phase:** 0 to 360°  
**Baud Rate Range:** 1bits/sec to 10Mbits/sec  
**Data Bits Length:** 2 to 4,000

### FREQUENCY HOPPING

**Hop Table Size:** 2 to 1,000  
**Dwell Time Mode:** Fixed / Programmable per step  
**Dwell Time:** 200ns to 20s  
**Time Resolution:** 20ns

### ASK

**Start/Shift Amp.:** 16mVp-p to 16Vpp into 50Ω  
**Resolution:** Maximum amplitude/4096  
**Baud Rate Range:** 1Bits/s to 10Mbits/s  
**Data Bits Length:** 2 to 4,000

### AMPLITUDE HOPPING

**Range:** 16mVp-p to 16Vpp into 50Ω  
**Resolution:** Maximum amplitude/4096  
**Dwell Time Mode:** Fixed / Programmable per step  
**Dwell Time:** 200ns to 20s  
**Time Resolution:** 20ns

### ARBITRARY 3D

**Modulating Shape:** Arbitrary waveform  
**Modulating Type:** Amplitude CH1, Amplitude CH2, Frequency and Phase  
**Modulating SCLK:** 1S/s to 2.5MS/s  
**Memory Size:** 4 to 30,000

### SWEEP

**Sweep Step:** Linear or log  
**Sweep Direction:** Up or Down  
**Sweep Range:** 10Hz to 100MHz  
**Sweep Time:** 1.4s to 40s

### COMMON CHARACTERISTICS

#### FREQUENCY

**Resolution:** 14 digits (limited by 1μHz)  
**Accuracy/Stability:** Same as reference

### ACCURACY REFERENCE CLOCK

**Internal** 0.0001% (1 ppm TCXO) initial tolerance over a 19°C to 29°C temperature range; 1ppm/°C below 19°C and above 29°C; 1ppm/year aging rate  
**External** 10MHz TTL, 50% ±2%, or 50Ω ±5% 0dBm (jumper)

### AMPLITUDE

**Range:** 100mV to 10Vpp, into 50Ω; 200mV to 20Vpp, into open Z  
**Resolution:** 4 digits

**Accuracy (1kHz):** 100mV to 1Vp-p ±(1% + 10mV)  
1V to 10Vp-p ±(1% + 70mV)

### OFFSET

**Range:** 0 to ±4.950V, into 50Ω  
**Resolution:** 1mV  
**Accuracy:** ±(1%+1% of Amplitude +5mV)

### FILTERS

**Type:** Bessel 25MHz or 50MHz  
Elliptic 60MHz or 120MHz

### OUTPUTS

#### MAIN OUTPUT

**Coupling:** DC coupled  
**Connector:** Front panel BNC  
**Impedance:** 50Ω ±1%  
**Protection:** Short Circuit to Case Ground, 10s max

#### SYNC OUTPUT

**Connector:** Front panel BNC  
**Level:** TTL  
**Sync Type:** Pulse Arbitrary and Standard waves  
LCOM Sequence and Burst modes  
**Position:** 0 to 2M  
**Resolution:** 4 points

### INPUTS

#### TRIGGER INPUT

**Connector:** Rear panel BNC  
**Input Impedance:** 10kΩ  
**Polarity:** Positive or negative, selectable  
**Level:** ±5V  
**Sensitivity:** 100mV  
**Damage Level:** ±12V  
**Min. Pulse Width:** 10ns

### EXTERNAL REFERENCE INPUT

**Connector:** Rear panel SMB  
**Frequency:** 10MHz  
**Impedance & Level:** Default 10kΩ ±5%, TTL, 50% ±2%  
Option 50Ω ±5%, 0dBm Sinewave

### SAMPLE CLOCK INPUT

**Connector:** Rear panel SMB  
**Input Level:** 300mVp-p to 1Vp-p  
**Impedance:** 50kΩ  
**Range:** 1.5Hz to 250MHz  
**Min. Pulse Width:** 4 ns

### RUN MODES

**Continuous:** Free-run output of a waveform.  
**Triggered:** Upon trigger, outputs one waveform cycle. Last cycle always completed.

**Gated:** External signal transition enables or disables generator output. Last cycle always completed

**Burst:** Upon trigger, outputs a Dual or multiple pre-programmed number of waveform cycles from 1 through 1M.

**Mixed:** First output cycle is initiated by a software trigger. Consequent output requires external triggers through the rear panel TRIG IN

### TRIGGER CHARACTERISTICS

**System Delay:** 6 SCLK+150ns  
**Trigger Delay:** [(0; 200ns to 20s)+system delay]  
**Trigger Resolution:** 20ns  
**Trigger Delay Error:** 6 SCLK+150ns

### EXTERNAL

**Source:** Rear panel BNC  
**Trigger Level:** ±5V  
**Resolution:** 1mV  
**Input Frequency:** DC to 2.5MHz  
**Min. Pulse Width:** 10ns  
**Slope:** Positive/Negative, selectable  
**Trigger Jitter:** ±1 sample clock period

### INTERNAL / TIMER

**Range:** 200ns to 20s  
**Resolution:** 20ns  
**Error:** 3 sample clock cycles+20ns

### MANUAL

**Source:** Soft trigger command from the front panel or remote

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## Specification

### FREQUENCY COUNTER / TIMER

<b>Measurements:</b>	Frequency, Period, Averaged Period, Pulse Width & Totalize Trigger Input
<b>Source:</b>	Trigger Input
<b>Range:</b>	10Hz to 100MHz (typ.120MHz)
<b>Sensitivity:</b>	500mVpp
<b>Accuracy:</b>	1ppm
<b>Slope:</b>	Positive/Negative transitions
<b>Gate Time:</b>	100µSec to 1 Sec
<b>Input Range:</b>	±5V
<b>Trigger Modes:</b>	Continuous, Hold and Gated
<b>Period Averaged:</b>	
Range	10ns to 50ms
Resolution	7 digits / Sec
<b>Period and Pulse Width:</b>	
Range	500ns to 50ms
Resolution	100ns
<b>Totalize:</b>	
Range	10 <sup>12</sup> -1
Overflow	Led indication

### MULTI-INSTRUMENT SYNCHRONIZATION

<b>Initial Skew:</b>	<25 ns + 1 SCLK
<b>Waveform Types:</b>	Standard, Arbitrary and Sequenced using the automatic sequence advance mode only
<b>Run Modes:</b>	Continuous, Triggered, Gated and Counted Burst

### LEADING EDGE OFFSET

<b>Run Mode:</b>	Continuous run mode only
<b>Offset Range:</b>	200 ns to 20 s
<b>Resolution:</b>	20 ns

### GENERAL

<b>Power Consumption:</b>	10W max
<b>Current Consumption:</b>	
+3.3V	2.6A max.
+5V	185mA max.
+12V	900mA max.
<b>Interfaces:</b>	
5251	PXIBus
5351	PCIBus
<b>Dimensions:</b>	Single Slot
<b>Weight:</b>	
Without Package	0.5Kg
Shipping Weight	1Kg
<b>Temperature:</b>	
Operating	0°C - 50°C
Storage	-40°C to + 70°C.
<b>Humidity:</b>	
11°C - 30°C	85%
31°C - 40°C	75%
41°C - 50°C	45%
<b>Safety:</b>	EN61010-1, 2nd revision
<b>Calibration:</b>	1 year
<b>Warranty <sup>(1)</sup>:</b>	3 years standard

### ORDERING INFORMATION

MODEL	DESCRIPTION
5251	250MS/s Single Channel PXIBus Arbitrary Waveform Generator
5351	250MS/s Single Channel PCIBus Arbitrary Waveform Generator

<sup>(1)</sup> Standard warranty in India is 1 year.