250MS/s PCIBus Arbitrary Waveform / Function Generator



MODEL TE5351

- Single-channel 250MS/s waveform generator
- Sine and Square waves generated to 100MHz
- 16 Bit amplitude resolution
- 2M waveform memory
- 10 Vpp into 50Ω, double into open circuit
- Multiple run modes including trigger, re-trigger and trigger delay
- AM, FM, Arbitrary FM, FSK, PSK, Frequency Hop and sweep modulation
- Powerful sequence generator links and loops segments in user-defined fashion. Stores up to 10 different sequence tables
- Occupies a single PCI slot only
- Ultra fast waveform downloads using DMA
- Extremely low phase noise carrier
- Multi-Instrument synchronization
- ArbConnection software for easy waveform creation&control

Model 5351, is a single-channel PCI-based frequency agile waveform synthesizer combine industry leading performance, frequency agility and modulation capability in a stand-alone, bench-type product. Signal output in the range of 1Hz to 250MHz and 16-bit vertical DAC resolution provide 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.

PCIbus: A Cost Effective Format

The 5351 is a sensible alternative to a GPIB-based waveform generator when developing a PCI-based test system. The 5351 provides a synergistic combination of a function generator, arbitrary waveform synthesizer, programmable sequencer, pulse generator, and modulation generator in one instrument. The 5351 delivers all this at a lower cost than comparable bench-type, or VXI-based instruments. This versatility ensures that the Model 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 1Hz to 250MS/s 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 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 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 100 different sequences, each capable of linking 16k waveform fragments and looping each waveform up to 1M times.

Frequency Agility

Decrypting radio transmission often employs frequency hopping. Model 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 loosing 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 FM, AM, FSK, PSK, and frequency hops without sacrificing the power of the instrument control and output run modes.

Multi-Instrument Synchronization
Multiple 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 PCI interface. Calibration factors are stored in a flash memory thus eliminating the need to open instrument covers.

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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Service and Support
Beyond providing precision Test & Measurement instruments, Tabor Electronics provides unparalleled service and support, and is continuously finding new ways to bring added value to its customers.

Our after-sales services are comprehensive. They include all types of repair and calibration, and a single point of contact that you can turn to whenever you need assistance. As part of our extensive support, we offer individualized, personal attention Help Desk, both online and offline, via e-mail, phone or fax.

Tabor Electronics maintains a complete repair and calibration lab as well as a standards laboratory in Israel and USA. Service is also available at regional authorized repair/calibration facilities.

Contact Tabor Electronics for the address of service facilities nearest you.

Applications
For expert technical assistance with your specific needs and objectives, contact your local sales representative or our in-house applications engineers.

Manuals, Drivers, and Software Support
Every instrument comes equipped with a dedicated manual, developer libraries, IVI drivers, and software. However, if your specific manual is lost or outdated, Tabor Electronics makes it possible to log-on to its Download Center and get the latest data “in a click”.

Product Demonstrations
If your application requires that you evaluate an instrument before you purchase it, a hands-on demonstration can be arranged by contacting your local Tabor Electronics representative or the Sales Department at our Corporate Headquarters.

Three-year Warranty
Every Tabor Electronics instrument comes with a three-year warrantee. Each one has full test results, calibration certificate, and CD containing product's manual and complete software package. Our obligation under this warranty is to repair or replace any instrument or part thereof which, within three years after shipment, proves defective upon examination. To exercise this warranty, write or call your local Tabor representative, or contact Tabor Headquarters and you will be given prompt assistance and shipping instructions.

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STANDARD WAVEFORMS

Waveforms: Sine, Triangle, Square, Pulse, Ramp, Sinc (Sine(x)/x), Gaussian, Exponential, Repetitive Noise, DC, Half-Cycle.
Frequency Range: Waveform dependent
Source: Internal synthesizer

SINE

Frequency Range: 700µHz to 100MHz
Start Phase Range: 0-360°
Start Phase Resolution: 0.01°

Harmonics Distortion:

	≤ 3Vpp	≤5Vpp	≤10Vpp
DC to 1MHz	-55dBc	-45dBc	-37dBc
1 to 10MHz	-48dBc	-43dBc	-35dBc
10 to 50MHz	-35dBc	-30dBc	-25dBc
50 to 100MHz	-28dBc	-25dBc	-22dBc

Non-Harmonic Distortion:

DC to 50MHz	-65dBc
50 to 100MHz	-60dBc

Total Harmonic Distortion:

DC to 100kHz	0.15%

Flatness (1kHz):

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

Phase Noise - Internal SCLK

100Hz Offset	-70dBc/Hz
1kHz Offset	-85dBc/Hz
10kHz Offset	-92dBc/Hz
100kHz Offset	-112dBc/Hz
1MHz Offset	-140dBc/Hz

TRIANGLE

Frequency Range: 700µHz to 32MHz
Start Phase Range: 0-360°
Start Phase Resolution: 0.01°

SQUARE

Frequency Range: 700µHz to 100MHz
Duty Cycle Range: 0% to 99.9%
Rise/Fall Time: <4.5ns
Aberration: <5%+10mV

PULSE

Frequency Range: 700µHz to 32MHz
Delay, Rise/Fall Time, High Time Ranges: 0%-99.9% of period (each independently)
Rise/Fall Time: <4.5ns
Aberration: <5%+10mV

RAMP

Frequency Range: 700µHz to 32MHz
Delay, Rise/Fall Time Ranges: 0%-99.9% of period (each independently)

SINC (Sine(x)/x)

Frequency Range: 700µHz to 32MHz
"0 Crossings": 4-100

GAUSSIAN

Frequency Range: 700µHz to 32MHz
Time Constant: 10-200

EXPONENTIAL PULSE

Frequency Range: 700µHz to 32MHz
Time Constant: -100 to 100

REPETITIVE NOISE

Bandwidth: 50MHz

DC

Range: -5V to +5V

HALF-CYCLE WAVEFORMS

Function Shape: Sine, Triangle, Square
Frequency Range: 100Hz to 1MHz
Phase Start Range (Sine/triangle only): 0 to 360°
Start Phase Resolution: 0.01°
Run Modes: Continuous, Triggered
Delay Between Half Cycles (Continuous only): 200ns to 20s
Delay Resolution 20ns

ARBITRARY WAVEFORMS

Sample Rate:
Continuous Mode 1.5S/s to 250MS/s (typically 300MS/s)
All Other Modes 1.5S/s to 225MS/s (typically 250MS/s)
Vertical Resolution: 16 bits
Waveform Memory: 2M points

MEMORY SEGMENTATION

No. of Segments: 1 to 10k
Min. Segment Size: 16 points
Resolution: 4 points size increments from 16 to 2M points

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

ADVANCE MODES

Automatic Sequence Advance: No trigger required to step from one segment to the next. Sequence is repeated continuously per a pre-programmed sequence table.

Stepped Sequence Advance: Current segment is sampled continuously until a trigger advances the sequence to the next programmed segment and sample clock rate.

Single Sequence Advance: Current segment is sampled the specified number of repetitions and then idles at the end of the segment. Next trigger samples the next segment the specified repeat count, and so on.

Mixed Sequence Advance: Each step of a sequence can be programmed to advance either a) automatically (Automatic Sequence Advance), or b) with a trigger (Stepped Sequence Advance).

Sequencer Steps: 1 to 4096
Segment Loops: 1 to 1Meg
Minimum Segment Duration: 600ns
Multi Sequence: 1 to 10, Selectable

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DIGITAL PULSE GENERATOR

Pulse State:	On/Off
Pulse Mode:	Single or double, programmable
Polarity:	Normal, inverted or complemented
Period:	80 ns minimum, programmed with 4 ns increments
Pulse Width:	4 ns minimum
Rise/Fall Time:	<4.5ns
High Time:	0 ns minimum
Delay:	0 ns minimum
Double Pulse Delay:	0 ns minimum
Amplitude Window:	100mVp-p to 10Vp-p
Low Level	-5V to +4.950V
High Level	-4.950V to +5V

NOTES:

1. 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.
2. 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.
3. The sum of all pulse parameters must not exceed the pulse period setting

COMMON CHARACTERISTICS

FREQUENCY

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

10MHz 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% duty cycle or 50Ω ±5% 0dBm

AMPLITUDE

Amplitude:	100mV to 10Vp-p into 50Ω; Double into open circuit
Resolution:	1mV
Accuracy (1kHz):	
1V to 8Vp-p	±(1% + 70mV)
80mV to 1Vp-p	±(1% + 10mV)

OFFSET

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

FILTERS

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

OUTPUTS

MAIN OUTPUT

Connector:	Front panel BNC, each channel
Impedance:	50Ω ±1%
Protection:	Short Circuit to Case Ground, 10s max
Standby:	Output On or Off (Output Disconnected)

SYNC OUTPUT

Connector:	Front panel BNC
Level:	TTL into open circuit
Sync Type:	Pulse with Arbitrary and Standard Waves; LCOM in Sequence and Burst Modes (including Burst Modulation); Marker with Modulation Mode only, programmable position

SAMPLE CLOCK OUTPUT

Connector:	Through J7 connector
Level:	400mVp-p
Impedance:	50Ω

COUPLE OUTPUT

Connector:	Through J7 connector
Level:	LVPECL
Impedance:	50Ω, terminated to +1.3V

INPUTS

TRIGGER INPUT

Connector:	Front panel SMB
Impedance:	10kΩ
Slope:	Positive or Negative (selectable)
Programmable Level:	±5V
Sensitivity:	200mV
Damage Level:	±12V
Pulse Width:	>10ns minimum

EXTERNAL REFERENCE INPUT

Connector:	Front panel SMB
Frequency:	10MHz
Impedance:	10kΩ ±5% or 50Ω ±5%
Level:	TTL, 50% ±2% duty cycle

SAMPLE CLOCK INPUT

Connector:	Front panel SMB
Frequency:	DC to 250MHz
Input Level:	300mVp-p to 1Vp-p
Impedance:	50Ω ±5%, PECL
Minimum Pulse Width:	4 ns

COUPLE INPUT

Connector:	Through J7 connector
Input Level:	LVPECL
Impedance:	50Ω, terminated to +1.3V
Minimum Pulse Width:	4 ns

MODULATION

Carrier Waveform:	Sinewave
Modulation Source:	Internal
Run Modes:	Off (Outputs CW), Continuous, Triggered, Delayed Trigger, Burst, Re-trgger and Gated
Advance Source:	Front panel TRIG IN or commands
Carrier Idle Mode:	On or Off, programmable
Marker Position:	TTL, Programmable at selectable frequency

FM

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Modulating Waveforms:	Sine, square, triangle, ramp
Modulating Frequency:	10mHz to 100kHz
Peak Deviation:	Up to 50MHz

ARBITRARY FM

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Modulating Waveform:	Arbitrary waveform
Modulating Waveform Sample Clock:	1S/s to 2.5MS/s
Frequency Array Size:	4 to 10,000 frequencies

AM

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Envelop Waveform:	Sine, square, triangle, ramp
Envelop Frequency:	10mHz to 100kHz
Modulation Depth:	0% to 100%

FSK

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Baud Rate Range:	1bits/sec to 10Mbits/sec
FSK Data Bits Length:	2 to 4,000

PSK

Carrier Waveform:	Sine wave
Carrier Frequency:	100µHz to 100MHz
Carrier phase:	0 to 360°
Baud Rate Range:	1bits/sec to 10Mbits/sec
FSK Data Bits Length:	2 to 4,000

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ASK

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Start/Shift Amplitude:	10mVpp to 10Vpp into 50Ω
Resolution:	Maximum amplitude/4096
Baud Rate Range:	1bit/s to 10Mbit/s
ASK Data Bits Length:	2 to 4000

FREQUENCY HOPPING

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Hop Table Size:	2 to 1000
Dwell Time Mode:	Fixed or Programmable for each step
Dwell Time:	200 ns to 20 s
Dwell Time Resolution:	20 ns
Hop Frequency:	100µHz to 100MHz

AMPLITUDE HOPPING

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Range:	10mVpp to 10Vpp into 50Ω
Dwell Time Mode:	Fixed or Programmable for each step
Dwell Time:	200 ns to 20 s
Dwell Time Resolution:	20 ns
Resolution:	Maximum amplitude/4096

ARBITRARY 3D

Carrier Waveform:	Sine wave
Carrier Frequency:	10Hz to 100MHz
Modulating Waveform:	Arbitrary waveform
Modulating Type:	Amplitude, Frequency and Phase
Modulating Waveform	
Sample Clock:	1S/s to 2.5MS/s
Memory Size:	2 to 30,000

SWEEP

Carrier Waveform:	Sine wave
Sweep Step:	Linear or log
Sweep Direction:	Up or Down
Sweep Range:	10Hz to 100MHz
Sweep Time:	1.4s to 40s

TRIGGER CHARACTERISTICS

EXTERNAL

Source:	Front panel BNC
Trigger Level:	±5V
Resolution:	1mV
Input Frequency:	DC to 2MHz
Min. Pulse Width:	>10ns
Slope:	Positive/Negative, selectable
Trigger Jitter:	±1 sample clock period

DELAYS (Trigger input to waveform output)

System Delay:	6 sample clock cycles+150ns
Trigger Delay:	[(0; 200ns to 20s) + system delay]
Trigger Resolution:	20ns
Trigger Delay Error:	6 sample clock cycles+150ns +5% of setting

INTERNAL / RETRRIGER (BUS)

Delay:	200ns to 20s, Waveform end to waveform restart
Delay Error:	3 sample clock cycles+20ns +5% of setting
Delay Resolution:	20ns

MANUAL

Source:	Soft trigger command through external interface

GATED MODE External signal enables generator. First output cyclesynchronous with the active slope of the triggering signal. Last cycle of output waveform always comple

BURST

Waveforms:	Sine, Triangle, Square, Pulse, Ramp, Sinc (Sine(x)/x), Gaussian Pulse, Exponential Fall, Rising Pulse, Noise, DC.
Counted Burst Cycles:	1 to 1Meg, programmable
Source:	Software, Internal or External

FREQUENCY COUNTER / TIMER

Measurements:	Frequency, Period, Avaraged Period, Pulse Width and Totalize
Source:	Trigger Input
Range:	20Hz to 100MHz (typically 120MHz)
Sensitivity:	500mVpp
Accurcay:	1ppm
Slope:	Positive/Negative transitions
Gate Time:	100µSec to 1 Sec
Input Range:	±5V
Trigger Modes:	Continious, Hold and Gated
Period Avaraged	
Range	10ns to 50ms
Resolution	7 digits / Sec
Period and Pulse Width	
Range	500ns to 50ms
Resolution	100ns
Totalize	
Range	10^{12}-1
Overflow	Led indication

MULTI-INSTRUMENT SYNCHRONIZATION

Description:	Multiple instruments can be daisy-chained together and synchronized to provide multi-channel synchronization.
Initial Skew:	<25 ns + 1 sample clock cycle.
Waveform Types:	Standard, Arbitrary and Sequenced using the automatic sequence advance mode only
Run Modes:	Continuous, Triggered, Gated and Counted Burst

LEADING EDGE OFFSET

Description:	Leading edge offset is programmable for master and slave units.
Run Mode:	Continuous run mode only
Offset Range:	200 ns to 20 s
Resolution&Accuracy:	20 ns

GENERAL

Power Consumption:	22W
Current Consumption:	+5V - 185mA +12V - 900mA +3.3V - 2.6A
Operating temperature:	0ºC - 40ºC
Humidity (non-condensing)	11ºC to 30ºC: 85 % 31ºC to 40ºC: 75 %
Storage temperature:	-40ºC to + 70ºC.
Dimensions:	Single width, 3U high
Weight:	Approx 0.5kg
Safety:	EN61010-1, 2nd revision
EMC:	CE marked. Designed to meet IEC1010-1, UL 3111-1 and CSA 22.2 #1010
Reliability:	MTBF per MIL-HDBK-217E, 25°C, Ground Benign
Workmanship Standards:	Conform to IPC-A-610D
Supplied Accessories:	CD containing Operating Manual, ArbConnection software and developer libraries.
Warranty:	3 years standard

ORDERING INFORMATION

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