WAVE STANDARD SERIES

45 YEARS OF INNOVATION

MODELS WS8351/2

350MHz Single/Dual Channel Arbitrary Function Generators

- Single / Dual-channel Arbitrary / Pulse / Function Generator
- Differential outputs configured as separate or synchronized
- 350MHz sine and 250MHz square waves
- 14-Bit, 2GS/s, 512Kpoint arbitrary waveforms
- 4Vp-p into 50Ω (8Vp-p differential), double into open circuit
- 10 built-in waveforms: sine, square, pulse, triangle, ramp, sin(x)/x, gaussian, exponential, noise and DC
- AM, FM, FSK, PSK and Sweep modulations

- Continuous, triggered, gate and burst modes
- Powerful pulse/pattern composer for analog, digital and mixed signals, device tests
- User friendly 4" color LCD display
- Remote control through LAN, USB and GPIB
- Store/recall on memory stick or 1GB internal memory
- Free ArbConnection software, IVI and MATLAB drivers
- LXI Class C compliant

Tabor's WS8351/2 is a 350MHz single/dual channel generator with the functionality of a function, arbitrary, modulation and pulse/pattern generator, all in one easy to use, high performance, compact stand alone bench top, which enables engineers to test analog, digital and mixed signals devices with a single instrument.

Standard Waveforms
The WS8351/2 has 11 built-in functions for quick and easy waveform generation. Front panel operations allows for easy selection and editing of all waveform parameters. All the standard waveforms can reach up to 125MHz with Sine and Square going as high as 350MHz and 250MHz respectively.

User Defined Waveforms
For more advanced users the WS8351/2 with its 14-bit vertical resolution offers a standard 512Kpoint memory depth and a 2GS/s sample clock for designing waveforms. With the ability to control and edit the value of each and every point any wave is possible. The memory can be divided into segments for storing all of the user defined waveforms.

Common or Separate Clocks
Need a dual channel unit, a single channel unit... why choose? With the new WS8352 you can have it both ways. The WS8352 has two differential output channels, which operate either independently, or synchronized. As two separate channels, one has the advantage of having two separate instruments in one box, each having the ability to be programmed to output different function shapes, frequencies, amplitude levels and even in different run modes. Alternatively, the advantage of having two synchronized channels with less than 10ps skew and skew control is very significant in applications that require an accurate and controlled phase between the two channels.

Pulse / Pattern Creation
Generating complex pulse trains has never been easier. The Pulse Composer is a powerful built-in tool that converts the WS8351/2 to a very sophisticated Pulse/Pattern Generator, allowing to create literally any complex pulse train / pattern, whether it's a single pulse, multi-level, linear-points, initialization or preamble pattern definition, arbitrary bit design, user-defined or even standard random patterns with

programmable resolution, so it doesn't matter if your application is radar communications, nanotechnology or serial bus testing, the pulse/pattern composer is the right tool for your application. Moreover, all the WS8351/2 advanced trigger modes are applicable, hence one can choose to use the "step" mode to advance every bit independently or the "once" mode to advance a complete data block in one trigger event, enabling even more applications, such as trigger, clock and data protocols.

Multi-Level and PAM(n) Signals
The WS8351/2's pulse composer enables up to 350Mbit/s data rate generation, utilizing either NRZ and RZ modes (minimum transition times) which is ideal especially for multi level and PAM(n) applications such as, LED (light-emitting diodes), CAN, QPHY, FlexRay or simulating and testing Ethernet environment, whether it's 100Mbit/s (100BASE-T), the later gigabit Ethernet (1000BASE-T) or even the latest 802.3an standard (10GBASE-T), which utilizes PAM-16.

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YEARS OF INNOVATION

Smart Trigger

Until now, you've been forced to trigger on a specific event. Tabor's all-new SmarTrigger feature was designed to enhance the trigger capability and facilitate wider flexibility of a specific pulse event. It allows triggering on either a pulse having a larger pulse width than a programmed time value (<time), a pulse having a smaller pulse width than a programmed time value (>time), or even on a pulse having a pulse width between two limits (<>time). In addition, the SmarTrigger has a hold-off function, in which the output is held idle after the first trigger and starts a waveform cycle only with the first valid trigger after a hold-off interval has lapsed, allowing you to solve endless "negotiation" scenarios.

Modulated Waveforms

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 WS8351/2 can also do standard modulation schemes such as AM, FM, FSK, PSK, sweep and chirp without sacrificing the power of the instrument control and output run modes.

Accuracy and Stability

As standard, the WS8351/2 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 8 digits resolution.

Easy to Use

Large and user-friendly 4" backlit color LCD display facilitates browsing through menus, updating parameters and displaying detailed and critical information for your waveform output. Combined with numeric keypad, cursor position control and a dial, the front panel controls simplify the often complex operation of an arbitrary function generator.

Remote Control

Model WS8351/2 comes standard with a variety of interfaces: Ethernet, USB and GPIB allowing the user to freely select the interface best suited to his individual requirements. The included ArbConnection software is a powerful editorial tool for designing waveforms and provides the user with full control of instrument functions, modes and features.

Multiple Environments to Write Your Code

In addition to the included ArbConnection software, the WS8351/2 comes with a complete set of drivers, allowing you to write your application in various environments such as: Labview, CVI, C++, VB, and 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.

Automated External Calibration

Leading-edge technology is implemented to allow calibration from any interface, USB, GPIB or LAN and calibration factors are stored in a flash memory thus eliminating the need to open instrument covers.

ArbConnection

The ArbConnection software provides you with full control of instrument functions, modes and features. ArbConnection is a powerful editorial tool that allows you to easily design any type of waveform. Whether it is the built in wave, pulse or serial data composers, or the built in equation editor with which you can create your own exotic functions, ArbConnection makes virtually any application possible.

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Specification

CONFIGURATION

Output Channels	1/2, Synchronized/fully separated

STANDARD WAVEFORMS

Type:	Sine, triangle, square, ramp, pulse, sin(x)/x, exponential rise, exponential decay, gaussian, noise and DC.
Frequency Range:	
Sine, Pulse	1µHz to 350MHz
Square	1µHz to 250MHz
All others	1µHz to 125MHz

SINE

Start Phase:	0 to 360°
Harmonics Distortion (typ.):	
5MHz to 200MHz	<-40dBc[1]
200MHz to 350MHz[1]	<-50dBc[1]
[1] Measured with 500MHz lowpass filter	
Non-Harmonics Distortion (typ.):	
1MHz to 100MHz	<-80dBc
100MHz to 250MHz	<-75dBc
250MHz to 350MHz	<-70dBc
SSB Phase Noise (10kHz offset):	
1MHz Carrier	<-120dBc/Hz
10MHz Carrier	<-118dBc/Hz
100MHz Carrier	<-115dBc/Hz
250MHz Carrier	<-108dBc/Hz
350MHz Carrier	<-100dBc/Hz

TRIANGLE / RAMP (SAW-TOOTH)

Start Phase:	0 to 360°
Phase Resolution:	0.1°
Timing Range:	1.0% to 99.9%

SQUARE

Duty cycle Range:	1.0% to 99.9%
Rise/Fall time:	1ns (typically <900ps)
Overshoot:	<5%, typ.
Jitter (rms):	<10ps

SINC (Sine(x)/x)

"0 Crossings"	4 to 100 cycles

GAUSSIAN

Time Constant	10 to 200

EXPONENTIAL PULSE

Type:	Rise or Decay, selectable
Time Constant:	-100 to 100

NOISE

Bandwidth:	125MHz

DC

Range:	-2V to +2V

PULSE

Pulse Mode:	Single or double, programmable
Polarity:	Normal, inverted or complement
Period:	4ns to 1.6s
Resolution:	1ns
Pulse Width:	2ns to 1.6s
Rise/Fall Time:	
Fast	1ns (typical < 900ps)
Linear	1ns to 1.6s
Delay & Double	
Pulse Delay:	1ns to 1.6s
Amplitude Window:	100mVp-p to 4Vp-p into 50Ω
Levels	
Low Level	-2V to +1.95V
High Level	-1.95V to +2V

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 512,000 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 1,000,000 to 1.
3. The sum of all pulse parameters must not exceed the pulse period setting.

PULSE / PATTERN COMPOSER

MULTI-LEVEL / LINEAR-POINTS

Number of Levels:	1 to 1000
Dwell Time:	500ps to 10s
Transition type:	Fast or Linear
Memory:	100k
Amp. Resolution:	4 digits
Time Resolution:	500ps to 100ns (auto or user)

PATTERN

Pattern Source:	PRBS or user-defined
PRBS Type:	PRBS7, PRBS9, PRBS11, PRBS15, PRBS23, PRBS31, USER
Data Rate:	10Bit/s to 350MBit/s
Number of Levels:	2, 3, 4, 5
High/Low Levels:	±2.5V
Resolution:	4 digits
Loops:	1 to 1e6
Preamble:	1 to 512e3
Length:	1 to 512e3

PAM (PULSE AMPLITUDE MODULATION)

Data Rate:	10Mbit/s to 2Gbit/s
PAM Range:	2 to 1000
Pattern Memory:	16Mbit
Resolution:	1 bit (TBD)

ARBITRARY WAVEFORMS

Sample Rate:	10MS/s to 2GS/s
Vertical Resolution:	14 bits
Waveform Memory:	512k points standard
Min. Segment Size:	192 points
Resolution:	16 points
No. of Segments:	1 to 16k
Waveform Granularity:	1 point

MODULATION

COMMON CHARACTERISTICS

Carrier Waveform:	Sine, square, triangle
Carrier Frequency:	10kHz to 350MHz
Modulation Source:	Internal

FM

Modulation Shape:	Sine, square, triangle, ramp
Modulation Freq.:	100Hz to 35MHz
Deviation Range:	10mHz to 175MHz

FSK / FREQUENCY HOPPING

FSK Baud Rate:	10mbps to 350Mbps
Hop Table Size:	2 to 256
Hop Type:	Fast or Linear
Dwell Time Mode:	Fixed or programmable per step
Dwell Time:	2ns to 10s
Dwell Time Res.:	2ns

SWEEP / CHIRP

Sweep Type:	Linear or log
Sweep Direction:	Up or down
Sweep Time:	1.4 µs to 10ms
Modulation Shape:	Pulse
Pulse Repetition:	
Range	200ns to 20s
Resolution	3 digits
Accuracy	100ppm

AM

Modulation Shape:	Sine, square, triangle, ramp
Modulation Freq.:	100Hz to 1MHz
Modulation Depth:	0.1 to 200%

ASK / AMPLITUDE HOPPING

Hop Table Size:	10mbps to 350Mbps
Hop Table Size:	2 to 256
Hop Type:	Fast or Linear
Dwell Time Mode:	Fixed or programmable per step
Dwell Time:	2ns to 10s
Resolution	2ns

COMMON CHARACTERISTICS

FREQUENCY

Resolution:	8 digits
Accuracy/Stability:	Same as reference

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Specification

ACCURACY REFERENCE CLOCK:

Internal	1 ppm from 19°C to 29°C; 1ppm/°C below 19°C or above 29°C; 1 ppm/year aging rate
External	-5dBm to 5dBm, 50Ω

AMPLITUDE

Range:

Single-ended	50mVp-p to 4Vp-p*
Differential	100mVp-p to 8Vp-p*

*Double into high impedance

Resolution:	4 digits
Accuracy:	±(3% +5mV)
Rise/Fall Time:	1ns (<900ps typ.)
Overshoot:	5%, typ.

OFFSET

Offset Range:	-1.5V to + 1.5V into 50Ω
Offset Resolution:	4 digits
Offset Accuracy:	±(5% +5mV)

OUTPUTS

MAIN OUTPUTS

Coupling:	DC-coupled
Type:	Single ended or differential
Connectors:	Front panel SMAs
Impedance:	50Ω ±1%
Protection:	Protected against temporary short to case ground

SYNC OUTPUT

Connector:	Front panel SMA
Source:	Channel 1 or channel 2
Type:	Single ended
Waveform Type:	
Pulse	16 points width
WCOM	Waveform complete
Impedance:	50Ω
Amplitude:	1V; doubles into high impedance
Variable Position Control:	
Range	0 to segment length
Resolution	16 points
Rise/Fall Time	2ns, typical
Variable Width control:	
Range	16 points to segment length
Resolution	16 points

INPUTS

TRIGGER INPUT

Connector:	Rear panel SMA
Input Impedance:	10kΩ
Polarity:	Positive, negative, or both
Damage Level:	±20Vdc
Frequency Range:	0 to 15MHz

Trigger Level Control:

Range	-5V to 5V
Resolution	12 bit (2.5mV)
Accuracy	±(5% of setting + 2.5mV)
Sensitivity	0.2Vp-p
Min. Pulse Width:	10 ns

EVENT INPUT

Connector:	Rear panel BNC
Input Impedance:	10kΩ
Polarity:	Positive, negative or either
Damage Level:	±20Vdc
Frequency Range:	0 to 15MHz

Trigger Level Control:

Range	-5V to 5V
Resolution	12 bit (2.5mV)
Accuracy	±(5% of setting + 2.5mV)
Sensitivity	0.2Vp-p minimum
Min. Pulse Width:	10ns

EXTERNAL REFERENCE INPUT

Connector:	Rear panel BNC
Input Frequency:	10MHz to 100MHz
Input Impedance:	50Ω
Voltage Swing:	-5dBm to 5dBm
Damage Level:	10dBm

EXTERNAL SAMPLE CLOCK INPUT

Connector:	Rear panel SMA
Input Impedance:	50Ω
Voltage Swing:	0dBm to 10dBm
Input Frequency:	1GHz to 4GHz (Double the internal clock)
Clock Divider:	1/1, 1/2, 1/4, 1/256, separate for each channel
Damage Level:	15dBm

RUN MODES

Continuous:	A selected output function shape is output continuously.
Self Armed:	No start commands are required to generate waveforms.
Armed:	The output dwells on a DC level and waits for an enable command and then the output waveform is output continuously; An abort command turns off the waveform.
Triggered:	A trigger signal activates a single-shot or counted burst of output waveforms and then the instrument waits for the next trigger signal.
Normal Mode:	The first trigger signal activates the output; consecutive triggers are ignored for the duration of the output waveform.
Override Mode:	The first trigger signal activates the output; consecutive triggers restart the output waveform regardless if the current waveform has been completed or not.
Gated:	A waveform is output when a gate signal is asserted. The waveform is repeated until the gate signal is de-asserted. Last period is always completed.
Burst:	Upon trigger, outputs a Dual or multiple pre-programmed number of waveform cycles from 1 through 1M.

TRIGGER CHARACTERISTICS

EXTERNAL

Source:	Channel 1, channel 2, or both
Connector:	SMA
Input Impedance:	10kΩ
Polarity:	Positive, negative, or both
Damage Level:	±20VDC
Frequency Range:	0 to 15MHz

Trigger Level Control:

Range	-5V to 5V
Resolution	12 bit (2.5mV)
Accuracy	±(5% of setting + 2.5mV)
Sensitivity	0.2Vp-p
Pulse Width:	10 ns, minimum
System Delay:	200 SCLK periods + 50ns
Trigger Delay:	Separate for each channel
Range	0 to 8,000,000 SCLK periods
Resolution	4 points
Accuracy	Same as SCLK accuracy
Smart Trigger:	Detects a unique pulse width
Conditioned Trigger:	< pulse width, > pulse width or <>pulse width
Pulse Width Range	50ns to 2s
Resolution	2ns
Accuracy	±(5% of setting +20ns)
Trigger Hold-off:	Ignores triggers for a hold-off
Hold-off range	100ns to 2s
Resolution	2ns
Accuracy	±(5% of setting +20ns)
Trigger jitter:	2ns at max. SCLK (4 SCLK)

INTERNAL

Source:	Common or separate
Modes:	
Timer	Waveform start to waveform start
Delayed	Waveform stop to waveform start
Timer:	
Range	200ns to 2s
Resolution	3 digits
Accuracy	100ppm

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Delay

Range	152 to 8,000,000 SCLK periods
Resolution	Even numbers, divisible by 4

MANUAL

Source:	Soft trigger command from the front panel or remote

INTER-CHANNEL SKEW CONTROL

COURSE TUNING

Initial skew:	200ps
Control:	
Range	0 to waveform-length points
Resolution	4 points
Accuracy:	Same as SCLK accuracy

FINE TUNING

Initial skew:	200ps
Control:	
Range	-3ns to +3ns
Resolution	10ps
Accuracy:	(10% of setting + 20ps)

GENERAL

Voltage Range:	100VAC to 240VAC
Frequency Range:	50Hz to 60Hz
Power Consumption:	150VA
Display Type:	TFT LCD, back-lit
Size	4 "
Resolution	320 x 240 pixels
Interfaces:	
USB 2.0	
Host	1 x front, USB host, (A type);
Device	1 x rear, USB device, (B type)
LAN	1000/100/10 BASE-T
GPIB	IEEE 488.2 standard interface
Dimensions:	
With Feet	315 x 102 x 395 mm (WxHxD)
Without Feet	315 x 88 x 395 mm (WxHxD)
Weight:	
Without Package	4.5kg
Shipping Weight	6kg
Temperature:	
Operating	0°C to 40°C
Storage	-40°C to 70°C
Humidity:	85% RH, non condensing
Safety:	CE Marked, IEC61010-1
EMC:	IEC 61326-1:2006
Calibration:	2 years
Warranty [1]:	3 years standard

ORDERING INFORMATION

MODEL	DESCRIPTION
WS8351	350MHz Single Channel Arbitrary Function Generator
WS8352	350MHz Dual Channel Arbitrary Function Generator

ACCESSORIES

Sync Cable:	Multi-instrument synchronization
S-Rack Mount:	19" Single Rack Mounting Kit
Case Kit:	Professional Carrying Bag
Note:	Options and Accessories must be specified at the time of your purchase.

[1] Standard warranty in India is 1 year.

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