

# MODELS WS8351/2

## 350MHz Single/Dual Channel Arbitrary Function Generators

### 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  
 200MHz to 350MHz<sup>(1)</sup>  
 < -50dBc<sup>(1)</sup>

<sup>(1)</sup> 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:

- 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.
- 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.
- 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:** 512kpointsstandard

**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

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### Specification

<b>Hop Table Size:</b>	2 to 256
<b>Hop Type:</b>	Fast or Linear
<b>Dwell Time Mode:</b>	Fixed or programmable per step
<b>Dwell Time:</b>	2ns to 10s
Resolution	2ns

#### COMMON CHARACTERISTICS

##### FREQUENCY

<b>Resolution:</b>	8 digits
<b>Accuracy/Stability:</b>	Same as reference

##### 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

<b>Range:</b>	
Single-ended	50mVp-p to 4Vp-p*
Differential	100mVp-p to 8Vp-p*
* Double into high impedance	
<b>Resolution:</b>	4 digits
<b>Accuracy:</b>	±(3% +5mV)
<b>Rise/Fall Time:</b>	1ns (<900ps typ.)
<b>Overshoot:</b>	5%, typ.

##### OFFSET

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

##### OUTPUTS

###### MAIN OUTPUTS

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

###### SYNC OUTPUT

<b>Connector:</b>	Front panel SMA
<b>Source:</b>	Channel 1 or channel 2
<b>Type:</b>	Single ended
<b>Waveform Type:</b>	
Pulse	16 points width
WCOM	Waveform complete
<b>Impedance:</b>	50Ω
<b>Amplitude:</b>	1V; doubles into high impedance
<b>Variable Position Control:</b>	
Range	0 to segment length
Resolution	16 points

<b>Rise/Fall Time</b>	2ns, typical
<b>Variable Width control:</b>	
Range	16 points to segment length
Resolution	16 points

##### INPUTS

###### TRIGGER INPUT

<b>Connector:</b>	Rear panel SMA
<b>Input Impedance:</b>	10kΩ
<b>Polarity:</b>	Positive, negative, or both
<b>Damage Level:</b>	±20Vdc
<b>Frequency Range:</b>	0 to 15MHz
<b>Trigger Level Control:</b>	
Range	-5V to 5V
Resolution	12 bit (2.5mV)
Accuracy	±(5% of setting + 2.5mV)
Sensitivity	0.2Vp-p
<b>Min. Pulse Width:</b>	10 ns

###### EVENT INPUT

<b>Connector:</b>	Rear panel BNC
<b>Input Impedance:</b>	10kΩ
<b>Polarity:</b>	Positive, negative or either
<b>Damage Level:</b>	±20Vdc
<b>Frequency Range:</b>	0 to 15MHz
<b>Trigger Level Control:</b>	
Range	-5V to 5V
Resolution	12 bit (2.5mV)
Accuracy	±(5% of setting + 2.5mV)
Sensitivity	0.2Vp-p minimum
<b>Min. Pulse Width:</b>	10ns

###### EXTERNAL REFERENCE INPUT

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

###### EXTERNAL SAMPLE CLOCK INPUT

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

##### RUN MODES

<b>Continuous:</b>	A selected output function shape is output continuously.
<b>Self Armed:</b>	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 programmed number of waveform cycles from 1 through 1M.

##### TRIGGER CHARACTERISTICS

###### EXTERNAL

<b>Source:</b>	Channel 1, channel 2, or both
<b>Connector:</b>	SMA
<b>Input Impedance:</b>	10kΩ
<b>Polarity:</b>	Positive, negative, or both
<b>Damage Level:</b>	±20VDC
<b>Frequency Range:</b>	0 to 15MHz
<b>Trigger Level Control:</b>	
Range	-5V to 5V
Resolution	12 bit (2.5mV)
Accuracy	±(5% of setting + 2.5mV)
Sensitivity	0.2Vp-p
<b>Pulse Width:</b>	10 ns, minimum
<b>System Delay:</b>	200 SCLK periods + 50ns
<b>Trigger Delay:</b>	Separate for each channel
Range	0 to 8,000,000 SCLK periods
Resolution	4 points
Accuracy	Same as SCLK accuracy
<b>Smart Trigger:</b>	Detects a unique pulse width
<b>Conditioned Trigger:</b>	<pulsewidth,>pulse width or <>pulse width
Pulse Width Range	50ns to 2s

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## 350MHz Single/Dual Channel Arbitrary Function Generators

### Specification

Resolution	2ns
Accuracy	±(5% of setting +20ns)
<b>Trigger Hold-off:</b>	Ignores triggers for a hold-off
Hold-off range	100ns to 2s
Resolution	2ns
Accuracy	±(5% of setting +20ns)
<b>Trigger jitter:</b>	2ns at max. SCLK (4 SCLK)

#### INTERNAL

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

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

#### FINE TUNING

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

#### GENERAL

<b>Voltage Range:</b>	100VAC to 240VAC
<b>Frequency Range:</b>	50Hz to 60Hz
<b>Power Consumption:</b>	150VA
<b>Display Type:</b>	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
GPIOB interface	IEEE 488.2 standard

#### Dimensions:

With Feet (WxHxD)	315 x 102 x 395 mm
Without Feet (WxHxD)	315 x 88 x 395 mm

#### 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 <sup>(1)</sup>:

3 years standard

#### ORDERING INFORMATION

MODEL	DESCRIPTION
<b>WS8351</b>	350MHz Single Channel Arbitrary Function Generator
<b>WS8352</b>	350MHz Dual Channel Arbitrary Function Generator

#### ACCESSORIES

<b>Sync Cable:</b>	Multi-instrument synchronization
<b>S-Rack Mount:</b>	19" Single Rack Mounting Kit
<b>Case Kit:</b>	Professional Carrying Bag

**Note:** Options and Accessories must be specified at the time of your purchase.

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