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Astronics Test Systems 3100M

VXI Single/Dual Channel Arbitrary Waveform Generator

The Astronics Test Systems 3100M Waveform Synthesizer Series combines 300 MS/s waveform generation performance, versatility, and compact size into a single-slot VXIbus format.

The 3100M is a greatly improved version of a field-proven instrument ideal for VXI test stimulus generation. It replaces one or two of the popular 3152A Precision PLL Waveform Synthesizers, which are standard on many military and commercial test platforms.

Key Features

- **Phase locks to external analog signals: 500 Hz to 10 MHz, 100 mV to 30 V_{rms}**
- **Sine and square waves up to 100 MHz at amplitudes up to 16 V_{pk-pk} into 50 Ω**
- **Built-in functions: Trianglex, Sinex, Sinc, Square, Ramp, Pulse, DC, Exponential & Gaussian Pulse**
- **Linear/log sweep features (arbitrary and DDS) up to 100 MHz**
- **Ten high-performance modulation modes including AM, FM, PM, PWM, 3D, amplitude/frequency hopping**
- **VXI replacement for legacy pulse and function generators**

Product Information

Compatibility Mode

The 3100M defaults to its highest performance operational mode, but also can be set to operate as though it were a 3151A+ or 3152A for all modes including (and not limited to) PLL, PM, sequenced mode, trigger delay, and multi-module synchronization. The 3100M provides a front panel interface that is different from that of the 3152A. For legacy designs, please refer to literature for the 3151B and 3152B models for more information.

Modulation Modes

The 3100M allows the modulation of a carrier waveform ranging up to 100 MHz with ten modulation types including AM, FM, PM, FSK, PSK, ASK, frequency hopping, amplitude hopping, 3D modulation (a combination of AM, FM, and PM), and Pulse Width Modulation (PWM).

Modulation sources are all internal except for PM (external or internal with 3D mode) and include sine, square, triangle, ramp, and arbitrary (in some cases). PWM is generated using the included waveform creation software and downloaded to the instrument.

Frequency Sweep

The 3100M sweeps sine (now using Direct Digital Synthesis or DDS), square, or triangle waveforms between any two frequencies up to 100 MHz. Sweep may be performed either up or down and linearly or logarithmically.

11-Digit Frequency Resolution

The 3100M DDS frequency synthesizer (CW mode) provides high frequency resolution, high signal-to-noise ratio (70 dB, typical), and the low phase-noise and jitter needed for telecommunications test applications.

Phase-Lock Mode

The 3100M can phase-lock its output to external analog waveforms. In phase-lock mode, the output automatically locks its frequency to an external signal up to 10 MHz and voltage up to 30 V_{rms}. Phase offset is programmable with 0.01° resolution, and the trigger threshold is programmable with 10 mV resolution.

Waveform Creation Software

The 3100M includes waveform creation software for instrument control and waveform creation that lets you interactively program the generator and import, edit, or create waveforms.

Creation tools are provided to help you design function generator or arbitrary waveforms, pulse waveforms, frequency modulated waveforms, 3D waveforms (user-defined combinations of amplitude, frequency and phase modulation), serial waveforms and more.

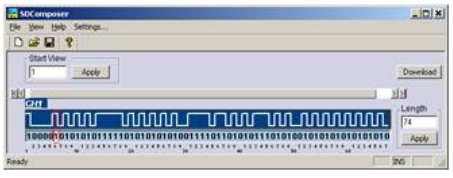


Figure 1: Serial Composer

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Product Information
continued

Highly Configurable Design

The 3100M can be configured with one or two 3152-compatible channels. It can also be configured with a single- or dual-channel amplifier which can be used to increase the output voltage of the waveform generator to 40 V_{pk-pk}.

LAN and USB Compatibility

The 3100M models only are fitted with a front panel LAN port and USB host port. The LAN port can be used as an alternate control port independent of a VXI controller and even in the absence of a VXI controller. The USB port can be used to connect with USB-compatible Flash drives.

Arbitrary Waveform Creation

The Waveform Composer feature is useful for creating test stimuli for the 3100M. The Waveform Composer allows you to import wave-forms from a scope, .csv or text file, choose from a variety of pre-defined



Figure 2: LAN and USB Front Panel Connections

waveforms, or to enter an equation. Any waveform can then be manually edited with a variety of tools.
The instrument drivers are capable of loading these waveforms into the instrument while running a test program.

Custom Pulse Waveform Creation

The Pulse Composer feature is used for the creation of arbitrary pulse trains. You

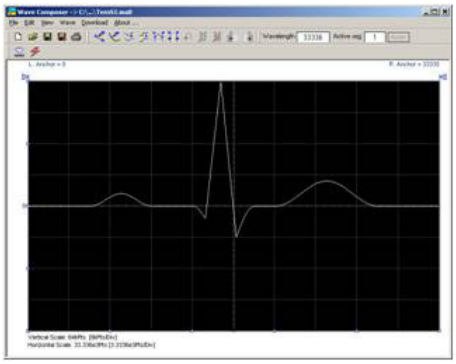


Figure 3: Cardiac Waveform in the Waveform Composer

can specify the characteristics of each pulse in terms of time, amplitude and repetitions.

The ArbConnection™ software then "programs" the instrument to create exactly the pulse that you need, saving you valuable time. In addition, pulses may be programmed by specifying timing parameters directly so that the firmware automatically can build single or double pulses with programmable rise/fall time, width, and delay.

Creating Sequenced Waveforms

The Waveform Studio feature allows

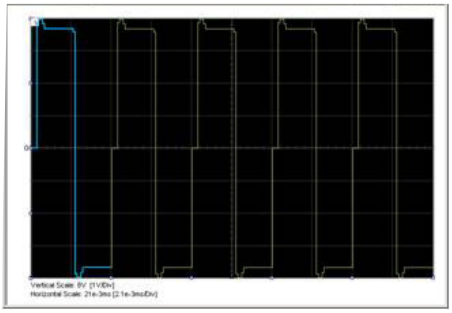


Figure 4: Custom Pulse Waveforms in the Pulse Composer

pre-defined waveforms to be "linked" and looped as one of 10 waveform sequences that may be stored in sequencer memory.

Sequences are useful when complex waveforms are required and portions of the waveform can repeat themselves. They can simplify waveform creation while they preserve waveform memory.

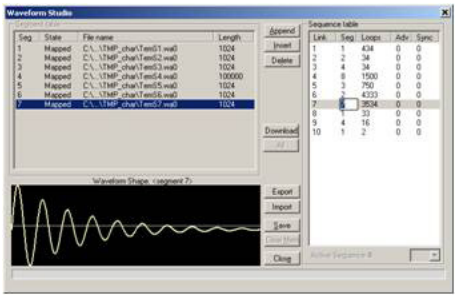


Figure 5: Sequence Definition in Waveform Studio

Combining AM, FM, and PM

The 3D Waveform Composer feature allows you to define any combination of amplitude, frequency, and/or phase modulation into your signal. The composer then calculates the signal for loading into the instrument's 3D modulation memory.

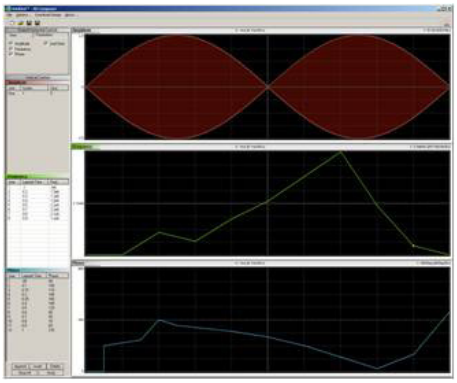


Figure 6: Combined AM, FM, and Phase Modulation in the 3D Composer

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Specifications

Note: The Astronics Test Systems policy is one of continuous development and improvement. Consequently, the equipment may vary in detail from the description and specifications in this publication.

Amplitude Characteristics

Amplitude (direct)
- 20 mV to 32 V_{pk-pk}, output open circuit
- 10 mV to 16 V_{pk-pk}, into 50 Ω

Amplitude (3201A/3202A in series)
- 32 mV to 40 V_{pk-pk}, output open circuit
- 16 mV to 20 V_{pk-pk}, into 50 Ω

Resolution
- 4 digits

Accuracy (at 1 kHz into 50 Ω)
- 1.6 V to 16 V_{pk-pk}: ±(1% + 25 mV)
- 160 mV to 1.59 V_{pk-pk}: ±(1% + 5 mV)
- 10 mV to 159.9 mV_{pk-pk}k: ±(1% + 2 mV)

DC Offset
- Range: 0 to ±7.995 V
- Resolution: 1 mV
- Accuracy: ±(1% ±1% of Amp. ±5 mV)

Output Impedance
- 50 Ω ±1%

Low-Pass Filters (selectable)
- 25 MHz: Bessel
- 50 MHz: Bessel
- 60 MHz: Elliptic
- 120 MHz: Elliptic

Standby (Output disconnected)
- Output On or Off

Output Protection
- Short circuit to case (10 s max)

Standard Waveforms

(Sine, Triangle, Square, Pulse, Ramp, Noise, DC.)

Frequency Resolution
- 11 digits

Accuracy & Stability
- Same as frequency standard

Sine

Frequency Range
- 100 µHz to 100 MHz

Phase Adjustment
- Range: 0 to 359.95º
- Resolution: 0.05º

Power Range (sine raised to a power)
- 1 to 9

Total Harmonic Distortion
- <0.1% to 100 kHz, STD & CW

Harmonics & Spurious

Frequency	<5 V_{pk-pk}	<10 V_{pk-pk}
<100 MHz	-35 dBc	-30 dBc
<10 MHz	-50 dBc	-35 dBc
<1 MHz	-50 dBc	-40 dBc

Flatness

Frequency	<5 V_{pk-pk}	<10 V_{pk-pk}
<50 MHz	10%	15%
<10 MHz	5%	5%
<1 MHz	1%	-

Square

Frequency Range
- 100 µHz to 100 MHz

Duty Cycle Range
- 0% to 99.99%

Rise/Fall Time (10%-90%)
- <5 ns

Aberration
- <6%

Triangle

Frequency Range
- 100 µHz to 16 MHz

Phase Adjustment
- Range: 0 to 359.95º
- Resolution: 0.05º

Power Range (triangle raised to a power)
- 1 to 9

Pulse and Ramp Functions

Frequency Range
- 100 µHz to 16 MHz

Delay, Rise/Fall Time, High Time Ranges
- 0% to 99.99% of period (each independently)

Gaussian Pulse Time Constant Range
- 1 to 200

Sinc Pulse "Zero Crossings" Range
- 4 to 100

Exponential Pulse Time Constant Range
- -200 to 200

DC Output Function

Range
- -100% to 100% of amplitude

Arbitrary Waveforms

Waveform Creation Software
- Included waveform software allows instrument control and creation of custom waveforms and sequences using freehand mode, equations, and built-in functions; or they can be imported from a spreadsheet, scope or text file.

Waveform Memory
- Legacy Mode: 512 k points
- Modern Mode: 1 Meg points

Vertical Resolution
- Legacy Mode: 12-bits
- Enhanced Mode: 16-bits

Number of Memory Segments
- 1 to 16 k

Minimum Segment Size
- Legacy Mode: 10 points
- Enhanced Mode: 16 points

Sequenced Waveforms

Operation
- Segments may be linked and repeated in a user-selectable fashion 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.

Sequencer Steps
- 1 to 4096

Segment Loops
- 1 to 1 Meg

Minimum Segment Duration
- 500 ns

Minimum Segment Size in a Sequence
- 10 points

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Specifications
continued

Sweep Waveforms

Sweep Range
- 10 Hz to 100 MHz

Swept Waveform
- Sine, square or triangle

Spacing
- Linear or logarithmic

Direction
- Up or Down

Sweep Duration
- 1.4 µs to 40 s

Marker Output
- Selectable frequency

Modulated Waveforms

Carrier Frequency Range
- 10 Hz to 100 MHz

Baseline (pre-trigger state)
- DC or Carrier Frequency, selectable

Modulated Waveform
- AM, FM: Sine, triangle, square, or ramp

Arbitrary FM: Arbitrary Waveform
- Others: Sine

Run Modes
- Continuous, Triggered, Burst and Gated

Run Mode Advance Source
- Software commands, Front panel TRIG IN, Backplane TTLTrg0-7

Trigger Delay Range
- 0, 100 ns to 20 s

Re-trigger Delay Range
- Range: 100 ns to 20 s
- Resolution: 20 ns

Trigger Jitter
- ±1 sample clock period

FM

Modulating Frequency Range
- 10 mHz to 350 kHz

Peak Deviation
- Up to 50 MHz

Modulating Waveform Sampling Clock (Arbitrary FM Mode)
- 1 S/s to 5 MS/s

Frequency Array Size (Arbitrary FM Mode)
- 4 to 20 k frequencies

Marker Output
- Programmable at selected frequencies

AM

Modulated Waveform
- Sine, triangle, square, or ramp

Envelope Frequency
- 10 mHz to 1 MHz

AM Depth
- 0% to 100%

FSK, PSK, ASK

Baud Rate Range
- FSK, PSK: 1 bit/sec to 10 Mbits/sec
- ASK: 1 bit/sec to 2.5 Mbits/sec

Internal Data Bits
- 1 to 4000

Marker Output
- Programmable at selected bits

Frequency, Amplitude Hopping

Hopping Function
- Frequency or amplitude

Hop Table Size
- 1 to 5000

Advance Source
- External, internal, backplane

Dwell Time Range
- 200 ns to 20 s

Dwell Time Resolution
- 20 ns

Dwell Time Mode
- Fixed or variable

Hop Frequency Range
- 10 Hz to 100 MHz

Amplitude Hopping Range
- 10 mV to 16 $V_{pk\text{-}pk}$

Amplitude Hopping Resolution
- $Ampl_{max}/4096$

Marker Position
- Programmable on a selected hop table index

Sampling Clock

Internal Source Range (worst case)
- Continuous Mode: 100 mS/S to 250 MS/s
- Other Modes: 100 mS/S to 225 MS/s

Internal Source Range (typical 25º C)
- Continuous Mode: 300 MS/s
- Other Modes: 240 MS/s

Resolution
- 11 digits

Accuracy and Stability
- Same as reference

Reference Clock
- CLK10: 100 ppm (typical)
- Internal TCXO: 1 ppm, 19° C to 29° C
- Drift: 1 ppm/year

Operating Modes

Normal Mode
- Continuous output of a single waveform segment

Sequenced Mode
- Continuous or triggered output of a sequence of waveform segments (see Sequenced Waveforms)

Sweep Mode
- Continuous output of a swept waveform

Triggered Mode
- One waveform cycle or sequence or sweep is output

Delayed Triggered Mode
- Delays any trigger by up to 2 million waveform points

Gated Mode
- Generator is enabled when an external gate signal is active. The first gated output cycle is synchronous with the active slope of the gate signal. The last output cycle is always completed.

Burst Mode
- A segment is repeated up to 1 million times. In External Burst Mode, each burst begins with a trigger. In Internal Burst Mode, an internal timer is used to repeat the burst at a programmed interval.

Phase Lock Mode
- Phase locks a standard or arbitrary waveform to an external signal to 30 V_{rms}

Modulation Mode
- CW or AM, FM, FSK, PSK, ASK, Sweep, Frequency or Amplitude Hopping

Phase Modulation (external)
- PM Modulation Rate: 0 to 10 kHz

Counter/Timer
- Measures frequency, period, period averaged, pulse width and events

Triggering Characteristics

Sources
- Internal: 1 µs to 20 s, programmable
- External

  Input Impedance: 10 kΩ

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Specifications
continued

Damage Level: 30 V_{rms}
Level (Programmable): ±10 V
Resolution: 10 mV
Sensitivity: 100 mV_{rms}

- VXI Backplane: TTLTRG0-7

Maximum Trigger Frequency
- Internal Timer: 50 mHz to 1 MHz
- External: DC to 5 MHz

External Trigger Pulse Width
- 10 ns, minimum

Trigger Slope
- Positive or negative

System Delay (Trig I/P to Waveform O/P)
- 150 ns + 6 clock periods

Trigger Delay (Trig I/P to Waveform O/P)
- Legacy Mode: 10 to 2 Meg points
- Modern Mode: 100 ns to 20 s + system delay
- Resolution: 20 ns
- Accuracy: 150 ns +6 clock period

Re-trigger Delay (Waveform end to re-start)
- Resolution: 20 ns
- Accuracy: 20 ns + 3 clock periods

Sync Output
- Front Panel BNC: TTL
- VXI Backplane: TTLTRG0-7

Sync Pulse
- Width Range: 4 to n-8 clock periods
- Position Range: 0 to n (Where n is the number of points in the selected memory segment.)
- Resolution: 4 points

Sync Sources
- Any point, sequence complete, ½ clock period

PLL Characteristics

Operation
- Automatically locks to external signal

PLL Input Characteristics
- Same as TRIG IN

External Lock Frequency Range
- STD Waveforms: 500 Hz to 10 MHz
- ARB Waveforms: 500 Hz to 100 MHz divided by # of points in segment

Coarse Phase Offset Range
- ±180°

Fine Phase Offset Control
- Range: ±36°
- Resolution: 0.01°

Phase Control Accuracy
- 2% ±sample clock period

Counter Characteristics

Operation
- Counter/timer mode, when enabled, disables waveform generation

Measurement Functions
- Frequency, period, period averaged, pulse width and totalize

Input Characteristics
- Input BNC: Front panel TRIG/PLL IN
- Trigger Level Range: ±10 V
- Sensitivity: 500 mV_{pk-pk}
- Damage Level: ±12 V
- Slope: Positive or negative
- Minimum Pulse Width: 10 ns

Frequency, Period Averaged
- Frequency: 10 Hz to 100 MHz
- Period: 10 ns to 50 ms
- Resolution: 7 digits/s

Period, Pulse Width
- Range: 500 ns to 50 ms
- Resolution: 100 ns

Totalize
- Frequency: 20 Hz to 100 MHz
- Event Counting Range: 1 to 10^{12}-1

Gate Time
- Frequency: 100 µs to 1 s

Reading Modes
- Repetitive: Continuous measurements when signal is present
- Hold: Single measurement on command
- Gated: Active in Gated Totalize mode

PM Characteristics

Operation
- External signal offsets phase. The PM input is operational in PLL mode.

PM Input
- Impedance: 100 kΩ, ±5%
- Phase Range: ±130°
- Input Bandwidth: 100 Hz to 10 kHz
- External Lock Range: Same as PLL
- Sensitivity: 20°/V
- Accuracy: ±10%

Multiple-Module Synchronization

(Multiple modules can be daisy-chained and synchronized to provide multi-channel systems. Master/slave phase is programmable.)

Initial Skew
- <±75 ns + 4 sample periods

Synchronization Modes
- Waveform: STD, ARB, SEQ (auto advance only)
- Run: Continuous, triggered, gated, burst

Inter-Module Phase Offsets
- Availability: Continuous run mode only
- Resolution & Accuracy: 20 ns
- Range: <100 ns to 20 s

Synchronization Mechanism
- VXI LOCAL BUS

Frequency Range for Operation
- STD Waveforms: 1.5 kHz to 100 MHz
- ARB/SEQ Waveforms: 2.5 MS/s to
- 150 MS/s (subject to backplane limits)

Interface

(Single slot, Message Based, VXIbus 3.0 Compliant)

Front Panel I/O

Outputs (1 per 3152B)
- MAIN (BNC): 50 Ω, 5.7 V_{rms} (28 dBm)
- SYNC (BNC): TTL

Inputs (1 per 3152B)
- TRIG/PLL IN (BNC): 10 kΩ, ±10V
- SCLK IN (SMB): NECL, 50 Ω, ±5%
- Lower SMB Options:
  1. W1/W4: 10 MHz IN, 100 kΩ, LVTTL
  2. W3/W5: PM IN, 50Ω (3152x-compatible)

  Also available: 0 dBM sine



Lower SMB Options

I/O Ports
- LAN: RJ45
- USB 2.0: Type A jack



General

Status Lights
- Red: Fail
- Amber: Link
- Amber: Module accessed on VXIbus
- Amber: PLL Locked
- Green: Output on

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Specifications
continued

Peak Current & Power Consumption
- Total Power: <25 W

	I_{Pm}(A)	I_{Dm}(A)
+24	0.116	0.03
+12	0.07	0.011
+5	1.74	0.014
–2	0	0
-5.2	1.8	0.15
-12	0.06	0.01
-24	0.112	0.01

Software

Native Language
- SCPI 1993.0, IEEE 488.2

Firmware Upgrades
- Stored in Flash using VXI utility

Drivers
- LabVIEW™, LabWindows™/CVI, VXI*plug&play* support for frameworks based on Microsoft Win32® application programming interface

Waveform & Control Software
- ArbConnection™ 4.2

Shared Waveform Memory
- D16/A24/A32 block transfer

3201A/3202A Amplifiers

Input Characteristics
- Channels: 3201A (1), 3202A (2)
- Channel 1: Input SMB, BNC
- Channel 2: Input SMB (2)
- Input Impedance: 50 Ω
- Coupling: DC
- Frequency Range: DC to 15 MHz
- Damage Level: 12 V_{pk-pk} (6 V_{pk})

Output Characteristics
- Channel 1: Output BNC
- Channel 2: Output SMB
- Coupling: DC
- Protection: Short Circuit, 10 seconds
- Gain: 10 (other values available)
- Polarity: Non-inverting
- Output Impedance: 50 Ω (75 Ω and 600 Ω are also available)

Pulse Characteristics
- Transition Time: <22 ns
- Aberration: <7%

Sine Characteristics
- Bandwidth: 15 MHz @ 20 V_{pk-pk}
- Accuracy: ±(3% of full-scale amplitude range + 25 mV), Square wave at 1 kHz
- THD: 0.2%, 10 Hz to 100 kHz

Harmonics

Frequency	<10 V_{pk-pk}
<15 MHz	-30 dBc
<10 MHz	-38 dBc
<1 MHz	-47 dBc

Flatness

Frequency	<10 V_{pk-pk}
<15 MHz	25%
<7.5 MHz	10%
<1 MHz	5%

Environmental

Temperature
- Operating: 0º C to 55º C
- Storage: -40º C to 71º C

Humidity (non-condensing)
- 11º C to 30º C: 95% ±5%
- 31º C to 40º C: 75% ±5%
- 41º C to 50º C: 45% ±5%

Altitude
- Operating: 10,000 ft
- Storage: 15,000 ft

Vibration (non-operating)
- 2 g at 55 Hz

Shock (non-operating)
- 30 g, 11 ms, half sine pulse

MTBF (MIL-HDBK-217F 25C, GB, GC)
- 3100M-3152B: 76,104 hrs
- 3100M-3152B-3152B: 43,088 hrs

Vibration (non-operating)
- 2 g at 55 Hz

Shock (non-operating)
- 30 g, 11 ms, half sine pulse

MTBF (MIL-HDBK-217F 25C, GB, GC)
- 3100M-3152B: 76,104 hrs
- 3100M-3152B-3152B: 43,088 hrs

Mechanical

Weight
- 3 lbs 1 oz (1.40 kg)

Cooling (10º C Rise)
- 3.7 l/s @ 0.5 mm H_2O

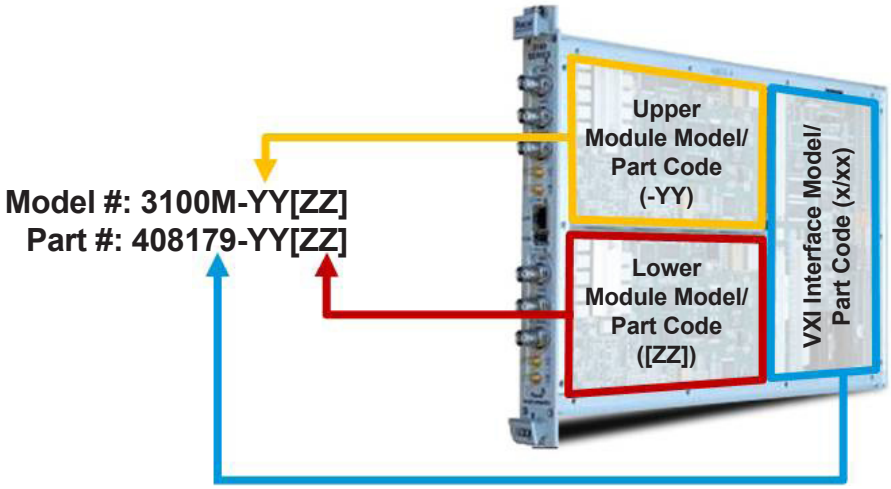
CE The CE Mark indicates that the product has completed and passed rigorous testing in the area of RF Emissions and Immunity to Electromagnetic Disturbances, and complies with European electrical safety standards.

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Ordering Information

408179-YY[ZZ] : Racal Instruments™ 3100M-YY[ZZ]
VXI Single/Dual Channel Arbitrary Waveform Generator

Model/Part # Configurator:
Substitute "YY" with the upper internal module code chosen, and substitute "[ZZ]" with the optional lower internal module code.



To create the optional sections of the model/part #, substitute the "-YY" and "[ZZ]" in the part # configurator with the correct Internal Module Code from the table below.

Internal Module Model Code (-YY), ([ZZ])	Internal Module P/N Code (-YY), ([ZZ])	Internal Module Description
W1	W1	1 MB, External Reference Input Port
W3	W3	1 MB, 3152-compatible pinout module
W4	W4	4 MB, External Reference Input Port
W5	W5	4 MB, 3152-compatible pinout module
A1	A1	Amplifier, 20 MHz, 20 V_{pk-pk}
A2	A2	Dual Amplifier, 20 MHz, 20 V_{pk-pk}


3100M-W3


3100M-W3W3


3100M-W3A2

Part Number Ordering Examples:

408179-W3W3	3100M-W3W3: 3100M AWG with a 1 MB 3152B-compatible pinout module (W3) in the upper module position and the same unit in the lower module position (W3)
408179-W4A1	3100M-W4A1: 3100M AWG with a 4 MB 3152B Ext Ref module (W4) in the upper module position and an amplifier (A1) in the lower module position

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