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Racal Instruments™ 3155

100 MS/s PXI Arbitrary Waveform Generator

The Racal Instruments™ 3155 is a high-performance, single-slot and output, PXI-based Arbitrary Waveform Generator (AWG) that combines many powerful functions into one small package. The 3155 includes WaveCAD 6.0 software for controlling, generating, editing, and downloading waveforms from a remote computer.

Key Features

- **Sine, square, triangle, ramp, arbitrary, and FM modulation waveform capability**
- **Sample rates up to 100 MS/s and 2 MS or megabytes of waveform memory**
- **14-bit resolution for high dynamic range**
- **Easy-to-use Wavecad 6.0 GUI with drivers that support frameworks based on Microsoft Win32® application programming interface**
- **Sequence generator of up to 4096 waveform segments**
- **Internal linear and log sweep, and FM plus external FSK**

Product Information

Cost Effective

The 3155 is a cost effective alternative to a GPIB-based waveform generator for use in a PXI-based test system. It provides a synergistic combination of a function generator, arbitrary waveform synthesizer, programmable sequencer, pulse generator, and modulation generator in one instrument. This versatility ensures that the 3155 will adapt to future testing needs as well as current ones.

Arbitrary Waveforms

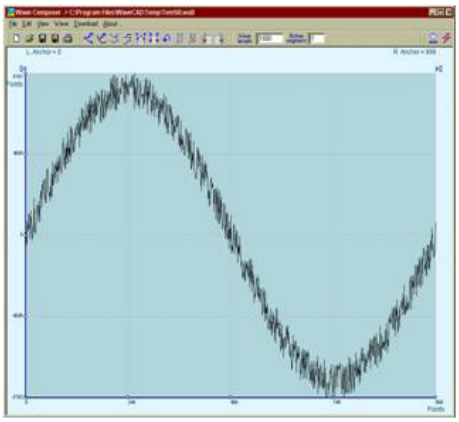
The 3155 comes with WaveCAD for designing arbitrary waveforms. Waveform coordinates can be imported from a variety of sources such as Matlab, Excel, ASCII files, etc. Also, multiple 3155 units can be placed in a PXI chassis such as the Racal Instruments™ 1461-14 for multi-instrument synchronization to create multiple, phase-controlled output channels. Then, you may vary module-to-module phase offsets to create a multi-phase signal source.

100 MS/s Sample Rate

New technology requirements continue to drive test systems to use increasingly narrow channel widths. A high sample rate of 100 MS/s makes the 3155 an ideal modulation source for troubleshooting new encoding schemes. The 3155 also provides high-speed waveforms to simulate signal distortion, power line cycle dropouts, video signals, component failures, and power supply transients.

2 Meg Waveform Memory

The 3155 provides 2 Meg of segmentable waveform memory accessible via a high-speed interface, and a storage capacity of up to 4096 different waveforms of variable size. This allows test software to rapidly switch between several different waveforms without multiple downloads.



The above waveform uses two of the simple elements built into the Wave Composer: a sine wave summed with random noise. This waveform downloads to the 3155 in just a few ms.

WaveCAD Software: Design Source for Arbitrary Waveforms

With the 3155's WaveCAD software, you control the instrument's functions, modes, and features. In addition, one can create a virtually unlimited variety of test waveforms: Freehand sketch and the built-in equation editor allow custom waveform design for quick analysis of analog signals. A typical application is to add or subtract components of a Fourier series for digital or analog filter characterization, or to inject random noise into a signal to test immunity to auxiliary noise.

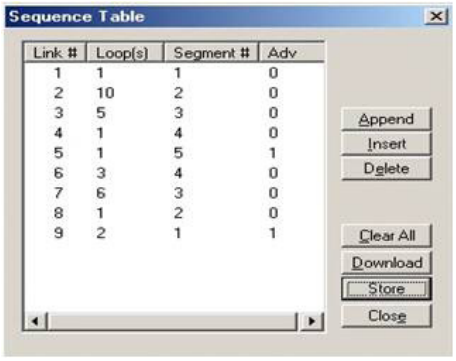
ECO# 2011-EADSTS-02-01-11-11-MU. Uncontrolled Unclassified Information ("UUI"). This documentation does not contain ITAR-controlled data within the definition of the ITAR and has been reviewed and approved for release to non-US persons. EADS North America Proprietary Copyright © 2011

Product Information
continued

Another unique and valuable feature of WaveCAD is the FM Composer. The FM composer is similar to the Wave Composer screen except that the vertical axis is given in units of frequency also. You can create any arbitrary waveform shape or even use the equation editor to generate exotic shapes to frequency modulate the output.

Sequences of Up To 4096 Waveforms

Powerful sequencing capability allows linkage of up to 4096 waveform segments and/or bursts (repeated segments) into strings. Each segment can be repeated up to 128 k times in burst mode. Sequenced functions can run continuously or be initiated by a trigger. Also, one can mix continuous and triggered segments within one sequence. These sequencing features allow the creation of complex waveforms or pulse patterns using minimal amounts of memory.



The above sequence table definition was created using WaveCAD software. For this table, segments 1 through 5 run continuously then wait for a trigger to continue and another trigger to initiate the sequence.

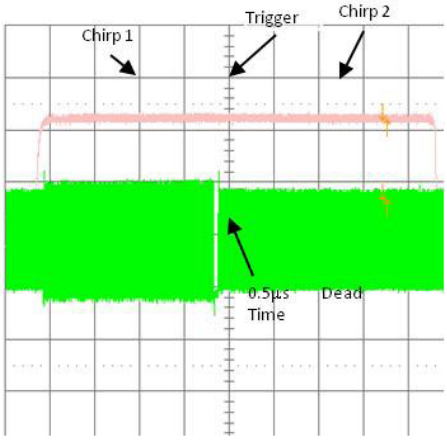
Using WaveCAD, sequences are created via a sequence table. Sequence table download is extremely fast as the program writes directly to waveform and sequencer memory, thus bypassing the embedded controller.

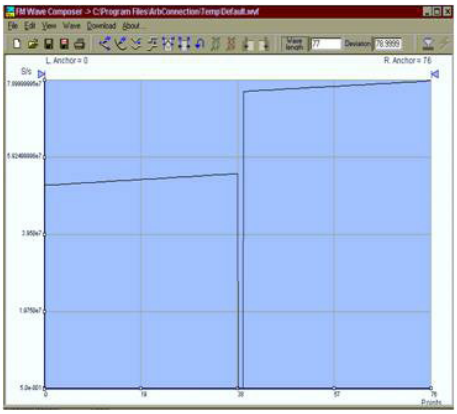
Sample Clock Agility

The 3155 has outstanding low phase noise and carrier stability, requirements for telecommunication and channel separation applications. The output of the 3155 is also highly agile for applications needing sweep, FSK, and FM. Direct Digital Synthesis (DDS) supports applications such as wide-band FM, and wander with arbitrary chirp profiles.

Flexible Triggering Capability

Combining PXI bus trigger lines with





The FM profile in WaveCAD's Wave Composer produces the dual chirped waveform shown in the scope plot above

the 3155 sync capability transforms the 3155 into an Arbitrary Trigger Generator. In addition to continuous output, the instrument can also wait for a trigger to initiate a single waveform, a burst of waveforms, or a sequence of waveforms. Triggers can also be used to advance a sequence of waveforms, one segment at a time. The 3155 accepts the triggers for multiple sources: eight backplane trigger lines plus the STAR trigger, front panel trigger input, and manual commands such as *TRG.

Specifications

Note: The EADS North America Test and Services 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
- 160 mV to 16 V_{pk-pk}, output Hi-Z
- 80 mV to 8 V_{pk-pk}, into 50 Ω

Resolution
- 3.5 digits

Accuracy (at 1 kHz)
- 80 mV to 799.9 mV_{pk-pk}: ±(1% + 1 mV)
- 800 mV to 8 V_{pk-pk}: ±(1% + 10 mV)

DC Offset Range
- 0 to ±3.6 V

DC Offset Resolution
- 22 mV

DC Offset Accuracy
- ±(1% of setting + 1% of amplitude + 2 mV)

Output Impedance
- 50 Ω ±1%

Low-Pass Filters (selectable)
- 25 MHz, 7-pole, elliptic
- 50 MHz, 7-pole, elliptic

Standby (Output Disconnected)
- Output On or Off

Output Protection
- Short circuit

Standard Waveforms (Func:mode Fix)

(Sine, Triangle, Square, Pulse [Standard, SINC, Exponential and Gaussian], Noise and DC)

Frequency Resolution
- 10 digits

Accuracy & Stability
- Same as frequency standard

Sine

Frequency Range
- 100 µHz to 50 MHz

Start Phase Range
- 0 to 360°

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Specifications
continued

Total Harmonic Distortion (max vertical and horizontal resolution)
- 0.05% to 100 kHz

Harmonics and Spurious (max vertical and horizontal resolution)

Frequency	Harmonics & Spurious
<25 MHz	<-25 dBc
<5 MHz	<-40 dBc
<1 MHz	<-55 dBc

Square

Frequency Range
- 100 µHz to 50 MHz

Duty Cycle Range
- 0% to 99.9%

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

Aberration
- <5%

Triangle

Frequency Range
- 100 µHz to 10 MHz

Start Phase Range
- 0 to 360°

Pulse and Ramp Functions

Frequency Range
- 100 µHz to 10 MHz

Double Pulse Spacing
- 10 ns to 1000 s

Delay, Rise/Fall Time, High Time Ranges
- 0% to 99.9% of period (each independently)

Gaussian Pulse Time Constant Range
- 10 to 200

Sinc Pulse "Zero Crossings" Range
- 4 to 100

Exponential Pulse Time Constant Range
- -100 to 100

DC Output Function

Range
- -100% to 100% of amplitude

Arbitrary Waveforms (Func:mode User)

(Waveform memory may be segmented allowing storage of multiple waveforms.)

Custom Waveform Creation Software
- WaveCAD software allows instrument control and creation of custom waveforms freehand, with equations, in the built-in functions, or with imported waveforms.

Waveform Memory
- 2 Meg

Vertical Resolution
- 14 bits (16384 levels)

Number of Memory Segments (Max.)
- 4096

Minimum Segment Size
- 16 points

Segment Size Resolution
- 4 points

Download Rate
- 5 Meg points per second

Sequenced Arbitrary Waveforms (Func:mode Seq)

Operation
- Permits division of waveform memory into smaller segments. Segments may be linked and repeated in a user-selectable fashion to generate extremely long waveforms. The sequencer may be started and stopped 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)

Advance Source
- External, internal, or soft trigger

Sequencer Steps
- 1 to 4,096

Step (Segment) Loops
- 1 to 128 k

Sample Clock

Internal Source Range
- 50 S/s to 100 MS/s

Resolution
- 10 digits in 1 µHz increments

Accuracy and Stability
- Same as reference

Reference Clock
- Standard: Clk10
- Internal (Optional): 1 ppm TCXO
- External User-Supplied: 10 MHz TTL, 50% DC ±2%

Sample Clock Modulation

(Sample Clock sweeps continuously from start to stop, at a rate defined by the sweep time. More complex sweep modes and types can be generated using the FM mode in conjunction with the FM composer program.)

Type
- Linear or log

Direction
- Up or Down

Sample Clock Range
- 50 S/s to 100 MS/S (Freq = SCLK/Npoints)

Time
- 1 ms to 1000 s

Time Resolution
- 7 digits

Time Accuracy
- ±0.1%

Advance
- Automatic, triggered, gated, or software command

Marker Level
- >2 V into 50 Ω
- 4 V nominal into 10 kΩ

Marker Position
- Programmable for selected frequency within the sweep

FM – Built-In Standard Waveforms

- Sample clock can be frequency modulated by internal waveforms that are resident in internal memory (fixed waveforms)

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Specifications
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Modulation Source
- Internal sine, square, triangle, and ramp

Modulation Frequency Range
- 2 mHz to 100 kHz

Resolution
- 10 digits

Accuracy
- 0.1%

Peak Frequency Deviation
- DC to 50 MHz

Advance
- Automatic, triggered, gated or software command

Marker Output and Level
- Same as SYNC output

Position
- Fixed at carrier frequency

FM – Downloaded Arbitrary Waveforms
- Sample clock can be frequency modulated by arbitrary waveforms that you download

Modulation Source
- User waveform, any shape, 10 to 10,000 waveform points

Modulation Sample Clock Range
- 1 mS/s to 2 MS/s

Resolution
- 7 digits

Accuracy
- 0.1%

Peak Sample Clock Deviation
- DC to 100 MHz

Advance
- Automatic, triggered, gated or software command

Marker Output and Level
- Same as SYNC output

Position
- Programmable for selected sample clock frequency

Waveform Download Rate
- 5 Meg samples per second

Frequency Shift Keying
(Sample clock is shift keyed or ramped to new frequency and back)

Type
- Standard or Ramped

Sample Clock Range
- 50 S/s to 100 MS/s

External Level Range
- 0 Level: Sample Clock
- 1 Level: Hop Frequency

FSK Frequency Range
- DC to 10 MHz

FSK System Delay
- 1 Waveform Cycle + 50 ns

FSK Ramp Time Range
- 10 µs to 1 s

FSK Ramp Time Resolution
- 3 digits

FSK Ramp Time Accuracy
- ±0.1%

Operating Modes

Normal Mode
- Continuous output of a waveform

External Triggered Mode
- An external signal triggers one output cycle

Internally Triggered Mode
- An internal timer repetitively triggers one output cycle at a fixed interval

Gated Mode
- External signal enables generator output. First gated output cycle is synchronous with the active slope of the triggering signal. Last output cycle is always completed.

Internal Burst Mode (FUNC:MODE FIX, FUNC:MODE USER only)
- An internal timer repetitively triggers a burst of up to 128 k output cycles.

External Burst Mode (FUNC:MODE FIX, FUNC:MODE USER only)
- An external signal triggers a burst of up to 128 k output cycles.

Trigger Characteristics

Input Sources
- Internal: 100 mHz to 2 MHz timer
- Accuracy: 0.1%
- Resolution: 7 digits
- External: Front Panel BNC
- PXI Backplane: TTLTrg0-7, Star
- Software: *TRG, WS Trigger Cmd.

Trigger Start Phase
- Range: 0 to Number of samples (0° to 360°)
- Resolution: 4 point
- Jitter: 1 clock cycle

Pulse Width
- 20 ns, min

Slope
- + or -, selectable

Trigger Level
- TTL

Input Frequency Range
- DC to 5 MHz

Sync Out
- Front Panel: BNC
- PXI Backplane: TTLTrg0-7, Star

Sync/Trigger Out Sources
- BIT: Selected point in segment.
- LCOM: Loop complete.
- SREP: Start of each segment repetition within a sequence.
- SEG: Start of each segment within a sequence.

Sync Delay
- Programmable in points
- System Delay (trigger I/P to waveform O/P)
- 1 sample clock cycle + 120 ns

Multiple Instrument Synchronization

Sample Clock Source
- Master card to slave boards via the local bus

Sample Clock Range
- 50 S/s to 50 MS/s

Initial Skew
- First Slave: <15 ns
- Other Slaves: 15 ns cumulative

Phase Offset Range
- 0 to # of points in segment

Phase Offset Resolution
- 4 points

Interface

Backplane Signal Support
- TTLTrg0-7: Trigger In, Sync Out
- Star: Trigger In, Sync Out

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Specifications
continued

Current & Power Consumption
- Total Power: <10 W

	+12	+5	3.3	-12
I_{DC}(A)	0.2	.03	1.4	0.2

Front Panel I/O

Main Output
- Connector: BNC
- Impedance: 50 Ω ±1%
- Protection: Short Circuit to Case Ground

Sync Output
- Connector: BNC
- Impedance: 50 Ω ±1%
- Level: >2 V into 50 Ω, 4 V into 10 kΩ
- Protection: Short Circuit to Case Ground

Trigger Input
- Connector: BNC
- Impedance: 10 kΩ ±5%
- Slope: Positive or Negative (selectable)
- Level: TTL
- Pulse Width (min.): 20 ns

External Reference Input
- Connector: SMB
- Impedance: 10 kΩ ±5%
- Level: TTL, 50% Duty Cycle ±5%

Sine Output
- Frequency Range: 50 Hz to 100 MHz (same as sample clock)
- Connector: SMB
- Impedance: 50 Ω, ±1%
- Level: 1 V into 50 Ω
- Flatness: -3 dB at 100 MHz
- Protection: Temporary short, case to ground
- Total Harmonic Distortion: 0.3% to 100 kHz, -55 dBc to 1 MHz
- Harmonics & Non-Related Spurious: -45 dBc to 10 MHz, -35 dBc to 100 MHz

Software

Software Compliance
- SCPI 1993.0, IEEE488.2

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

Waveform Creation & Control Software
- WaveCAD (based on Microsoft Win32® application programming interface)

Shared Waveform Memory
- DMA block transfer

Environmental

Temperature
- Operating: 0° C to 50° C
- Storage: -40° C to 71° C
- Spec Compliance: 20° C to 30° C, 30-min warm-up

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

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

EMC Certification
- ENG1326:1997 + A1:1998
- FCC Part 15, Class A

Safety
- ENG1010-1:1993 + A2:1995

MTBF (MIL-HDBK-217E)
- 113,535 hrs, 30º C, Ground Benign

Mechanical

Weight
- 8 oz (0.23 kg)

Dimensions
- PXI Single-width, 3U high

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.

Ordering Information

407810-001 : Racal Instruments™ 3155
100 MS/s Agile AWG, 1 M

407810-011 : Racal Instruments™ 3155
1 ppm, 100 MS/s Agile AWG, 1 M, 1 ppm

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