



100 MS/s PXI Arbitrary Waveform Generator

Racal Instruments™ 3155 is a high-performance, single-slot and output, PXI-based Arbitrary Waveform Generator 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.

- ◆ **Sine, Square, Triangle, Ramp, Arbitrary, and FM Modulation Waveform Capability**
- ◆ **Sample Rates Up to 100 MS/s and 2 Mega Samples or Megabytes of Waveform Memory**
- ◆ **14-bit Resolution for High Dynamic Range**
- ◆ **Easy-to-Use WaveCAD 6.0 GUI with C, CVI, C++, and VB Drivers Included**
- ◆ **Sequence Generator of Up to 4096 Waveform Segments**
- ◆ **Internal Linear and Log Sweep, and FM Plus External FSK**

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's performance combined with WaveCAD, so there is no limit to the waveforms created and generated. 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, the user may vary module-to-module phase offsets to create a multi-phase signal source.

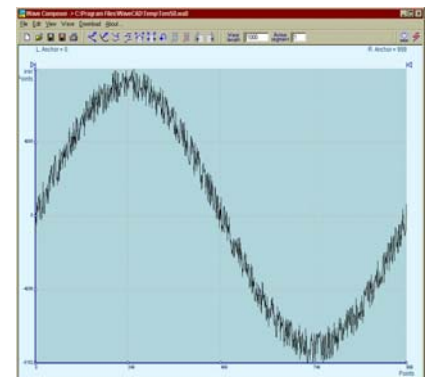
100 MS/s Sample Rate

New technology requirements continue to drive test systems to use increasingly narrow channel width. 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.

2Meg 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 waveform on the right was created using simple elements that are built into the Wave Composer. The waveform is a sine with an added second harmonic and topped with random noise. Downloading this waveform to the 3155 is done in a few milliseconds



WaveCAD Software: Unlimited Source of Arbitrary Waveforms

With the 3155's WaveCAD software, users 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.

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. One 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.

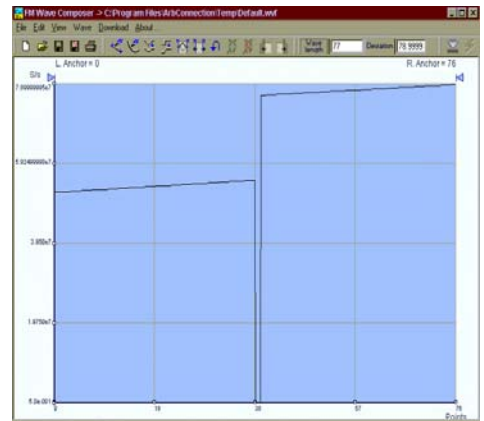
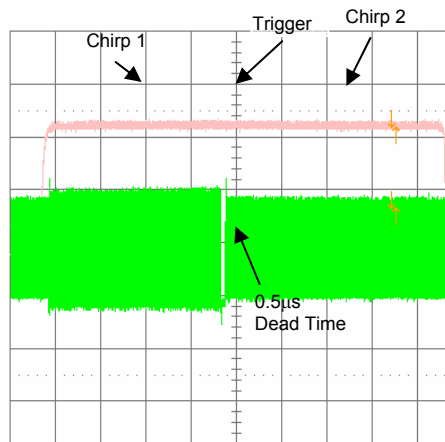
Link #	Loop(s)	Segment #	Adv
1	1	1	0
2	10	2	0
3	5	3	0
4	1	4	0
5	1	5	1
6	3	4	0
7	6	3	0
8	1	2	0
9	2	1	1

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.



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

Flexible Triggering Capability

Combining PXI bus trigger lines with 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.

AMPLITUDE CHARACTERISTICS

Amplitude

160 mV-16 V(p-p), output Hi-Z
80 mV-8V(p-p), into 50 Ω

Resolution

3.5 digits

Accuracy (at 1 kHz)

80 mV - 799.9 mV(p-p): $\pm(1\% + 1 \text{ mV})$
800 mV - 8 V(p-p): $\pm(1\% + 10 \text{ mV})$

DC Offset Range

0 to $\pm 3.6 \text{ V}$

DC Offset Resolution

22 mV

DC Offset Accuracy

$\pm(1\% \text{ of setting} + 1\% \text{ of amplitude} + 2 \text{ mV})$

Output Impedance

50 $\Omega \pm 1\%$

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 5 0MHz

Start Phase Range

0-360°

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%-90%)

<10 ns

Aberration

<5%

Triangle

Frequency Range

100 μHz to 10 MHz

Start Phase Range

0-360°

Pulse and Ramp Functions

Frequency Range

100 μHz to 10 MHz

Double Pulse Spacing

10 ns-1000 s

Delay, Rise/Fall Time, High Time Ranges

0%-99.9% of period (each independently)

Gaussian Pulse Time Constant Range

10-200

Sinc Pulse "Zero Crossings" Range

4-100

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): 1ppm TCXO

External User-Supplied: 10 MHz TTL, 50% DC $\pm 2\%$

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)

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 are downloaded by the user.

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 128k output cycles.

TRIGGER CHARACTERISTICS**Input Sources**

Internal: 100 mHz-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

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 k Ω \pm 5%
 Slope: Positive or Negative (selectable)
 Level: TTL
 Pulse Width (min.): 20 ns

Sine Output

Frequency Range: 50 Hz to 100 MHz (same as sample clock)
 Connector: SMB
 Impedance: 50 Ω , \pm 1%
 Level: 1V 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

External Reference Input

Connector: SMB
 Impedance: 10k Ω \pm 5%
 Level: TTL, 50% Duty Cycle \pm 5%

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

PXIBUS INTERFACE DATA

Software Compliance

SCPI 1993.0, IEEE488.2

Drivers

LabVIEW, LabWindows/CVI, VXIplug&play (WIN95/NT)

Waveform Creation & Control Software

WaveCAD (WIN95/98/NT/2000)

Shared Waveform Memory

DMA block transfer

Backplane Signal Support

TTLTrg0-7: Trigger In, Sync Out
 Star: Trigger In, Sync Out

Current & Power Consumption

	<u>+12</u>	<u>+5</u>	<u>3.3</u>	<u>-12</u>
$I_{DC}(A)$	0.2	.03	1.4	0.2

Total Power: <10Watts

ENVIRONMENTAL

Temperature

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

Humidity (non-condensing)

11°C-30°C: 95% \pm 5%
 31°C-40°C: 75% \pm 5%
 41°C-50°C: 45% \pm 5%

Altitude

Operating: 10,000 ft.
 Storage: 15,000 ft.

Weight

8 oz. (0.23 kg)

Dimensions

PXI Single-width, 3U high

EMC Certification


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

Safety

ENG1010-1:1993 + A2:1995

MTBF

113,535 house per MIL-HDBK-217E, 30° C, Ground Benign

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

ORDERING INFORMATION

MODEL/DESCRIPTION

Racal Instruments 3155, 100 MS/s Agile AWG, 1 M
 Racal Instruments 3155, 1 ppm, 100 MS/s Agile AWG, 1 M, 1 ppm

PART NUMBER

407810-001
 407810-011

The EADS North America Defense Test and Services policy is one of continuous development, consequently the equipment may vary in detail from the description and specification in this publication.



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