Racal Instruments
http://www.racalinstruments.com

PRODUCT INFORMATION

100 MS/s PXI Arbitrary Waveform Generator, Model 3155

- **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**

The Model 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.

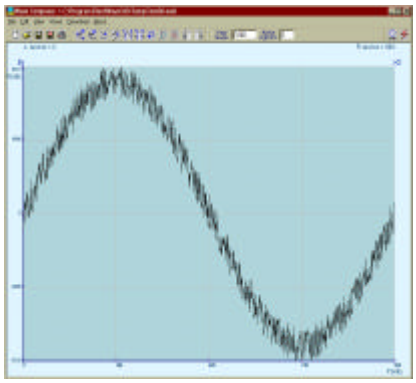
Cost Effective
The 3155 is a cost effective alternative to a GPIB-based waveform generator for use in a PXI-based test system.

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 Model 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 Model 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.

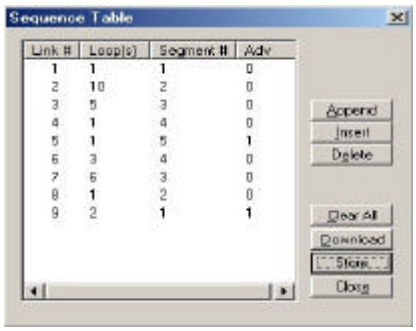
2 Meg Waveform Memory
The 3155 provides 2 Meg of segmentable waveform memory accessible via a high-speed interface, and a storage capacity of up to 4096 different waveforms of variable size. This allows test software to rapidly switch between several different waveforms without multiple downloads.



The above waveform 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.

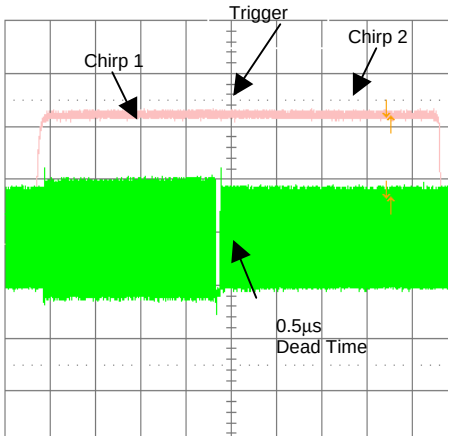
Sequences of up to 4096 Waveforms
Powerful sequencing capability allows linkage of up to 4096 waveform segments and/or bursts (repeated segments) into strings. Each segment can be repeated up to 128 k times in burst mode. Sequenced functions can run continuously or be initiated by a trigger. Also, one 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.

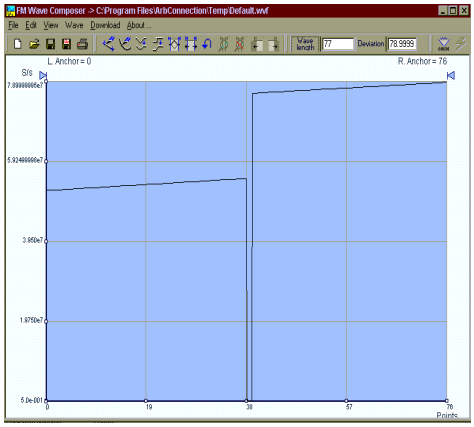


The above sequence table definition was created using WaveCAD software. For this table, segments 1 through 5 run continuously then wait for a trigger to continue and another trigger to initiate the sequence.

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 Model 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.

3155 Specifications

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): ± (1% + 1 mV)
800 mV - 8 V(p-p): ±(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 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 ±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 kΩ ±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, ±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 ±5%
Level: TTL, 50% Duty Cycle ±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, VXI*plug&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

	+12	+5	3.3	-12
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% ±5%
31° C-40° C: 75% ±5%
41° C-50° C: 45% ±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, 30º C, Ground Benign

ORDERING INFORMATION		
Model	**Description**	**Part Number**
3155	100 MS/s Agile AWG, 1 M	407810-001
3155, 1 ppm	100 MS/s Agile AWG, 1 M, 1 ppm	407810-011

CE 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.

Racal Instruments Inc., 4 Goodyear St., Irvine, CA 92618-2002. Tel: (800) 722 2528, (949) 859 8999; FAX: (949) 859 7139
Racal Instruments Group Ltd., 29-31 Cobham Road, Wimborne, Dorset, BH21 7PF, United Kingdom. Tel: +44 (0) 1202872800; FAX: +44 (0) 1202870810
Racal Instruments France , 18 Avenue Dutartre, 78150 LeChesnay, France. Tel: +33 (1) 3923 2222; FAX: +33 (1) 3923 2225
Racal Instruments Srl, Via Milazzo 25, 20092 Cinisello Balsamo, Milan, ITALY. Tel 00-3902-612 3901, Fax 00-3902-612 93606
Racal Instruments GmbH, Technologiepark Bergisch Gladbach, Friedrich-Ebert-Strasse, D-51429 Bergisch Gladbach, Germany. Tel: +49 2204 8442 00; FAX: +49 2204 8442 19