



2-Channel Arbitrary Waveform Generator

- ◆ **2-Channel High-Performance Arbitrary Waveform Generator**
- ◆ **2 Synchronized 16-bit Channels**
- ◆ **Sample Rates Up to 200 MS/s and 1 Meg Memory per Channel**
- ◆ **Frequency Hopping**
- ◆ **Internal AM**
- ◆ **Internal Sweep, FM and External FSK**
- ◆ **12-bit ECL Differential Digital Pattern Output, each channel**
- ◆ **8 Standard Waveforms, Arbitrary Waveforms, and Video Stroke Output**

Racal Instruments Model 3156B Dual Channel Arbitrary Waveform Generator outputs 16-bit waveforms from 2 channels at up to 200MS/s. 12-bit digital patterns may be output at rates up to 200Mbits/s.

High Dynamic Range

The 3156B provides improved dynamic range over 12-bit designs providing increased dynamic range and lower "noise floor" making it ideal for the generation of multi-tone signals and I&Q modulation.

Frequency Agility

Direct Digital Synthesis (DDS) technology, utilized in the design of the 3156B, allows flexibility in use of features like FM, FSK, sweep, and frequency hopping. For example, the FM feature can be stimulated by an internal source or an arbitrary FM waveform allowing the production of customized chirp signals. Included WaveCAD software can be used to breadboard custom frequency modulation profiles graphically.

High Sampling Rates

Sample rates up to 200 MS/s are available with memory size up to 1 Meg. Channels A and B are both synchronized to the same sampling clock however, each channel can output a different waveform shape and length.

DUAL CHANNEL CHARACTERISTICS

CHANNEL DEPENDENCIES

Function Modes

Common to both channels except when in modulation and half cycle, where second channel, if not set to the same function, outputs continuous AC signal

Run modes

Common to both channels

Common parameters

Sample clock frequency, reference source, trigger source

Separate parameters

Amplitude, offset, waveform shape and its parameters, SYNC output and output disable

SKEW BETWEEN CHANNELS

Sample Clock Mode 100MS/s

1 MS/s to 25 MS/s: 3 ns
25 MS/s to 75 MS/s: ½ SCLK +3 ns
75 MS/s to 100 MS/s: 1 SCLK +3 ns

Sample Clock Mode 200MS/s

1 S/s to 50 MS/s: 3 ns
50 MS/s to 150 MS/s: 1 SCLK +3 ns
150 MS/s to 200 MS/s: 2 SCLK+3 ns

AMPLITUDE CHARACTERISTICS

Amplitude

20 mV-20 V_{pk-pk} , output open circuit
10 mV-10 V_{pk-pk} , into 50 Ω

Resolution

4 digits

Accuracy (at 1kHz)

1 V-10 V_{pk-pk} : $\pm (1\% + 25 \text{ mV})$
100 mV-1 V_{pk-pk} : $\pm (1\% + 5 \text{ mV})$
10 mV-100 mV V_{pk-pk} : $\pm (1\% + 2 \text{ mV})$

DC Offset Range

0 to $\pm 4.995 \text{ V}$

DC Offset Resolution

1 mV

DC Offset Accuracy

$\pm (1\% \pm 1\% \text{ from Amplitude } \pm 5 \text{ mV})$

Output Impedance

50 $\Omega \pm 1\%$

Standby (Output Disconnected)

Output On or Off

Output Protection

Short circuit (10 sec max.)

STANDARD WAVEFORMS

Frequency Range

100 μHz to 25 MHz

Frequency Resolution

10 digits

Accuracy & Stability

Same as frequency standard

SINE

Offset Phase Range

0-359.95°

Start Resolution Range

0.05°

Total Harmonic Distortion

0.3% to 100 KHz

Harmonics and Spurious

Frequency	Harmonics & Spurious
<25 MHz	30 dBc
<10 MHz	40 dBc
<5 MHz	45 dBc
<1 MHz	55 dBc

Flatness

5% to 10 MHz
10% to 25 MHz

SQUARE

Duty Cycle Range

0% to 99.9%

Rise/Fall Time (10%-90%)

<8 ns

Aberration

<5%+10 mV

TRIANGLE

Frequency Range

100 μHz to 25 MHz

Offset Phase Range

0-359.95°

Start Resolution Range

0.05°

PULSE AND RAMP FUNCTIONS

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

HALF-CYCLE WAVEFORMS

Function Shape (other channel either in half-cycle mode or AC continuous signal)

Sine, Triangle, Square

Frequency Range

100 μHz to 2 MHz

Phase Start Range (Sine and triangle only)

0° to 359.95°

Start Phase Resolution

0.05°

Run Modes

Continuous, Triggered

Delay Between Half Cycles (Applies to continuous run mode only)

500 ns to 21 s

Delay Resolution

20 ns

DC OUTPUT FUNCTION

Range

-100% to 100% of amplitude

VIDEO STROKE GENERATION

Video Stroke Patterns

Cross-Locator
Cross-Hair
Positioned-Square
Vertical-Marker-Line
Horizontal-Marker-Line
Right-Hand-Arrow
Left-Hand-Arrow
Diamond-Overlay
Inverted-Triangle
Upright-Triangle

DC Offset Range

-4.995 V to +4.995 V

Step Size

$\pm 9 \text{ mV}$ to $\pm 9.99 \text{ V}$

Step Rate

1 step per trigger

Run Modes

Continuous
Single

Pattern Generation Period

167 ns to 100 s

Minimum Trigger Period

Pattern period + 8 clock cycles

ARBITRARY WAVEFORMS**Vertical Resolution**

12 or 16 bits, user selectable

Waveform Segmentation

Permits division of waveform memory into smaller segments. Segments shorter than 8 points occupy location of 4 segments (32 points)

Number of Memory Segments

1 to 16 k, if all segments are longer than 8 points; 1 to 4096, if all segments are less than 8 points

Waveform Segments, size and resolution (each channel)

Clk Mode – 1 S/s to 100 MS/s:

1 point size increments from 1 to 512 k points

Clk Mode – 1 S/s to 20 OMS/s:

2 point size increments from 2 to 1 Meg points

Custom Waveform Creation Software

WaveCAD software allows instrument control and creation of custom waveforms either freehand, with equations or built-in functions or with imported waveforms.

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

8-points

SAMPLING CLOCK**Internal Source Range**

1 Hz to 200 MHz

Resolution

10 digits

Accuracy and Stability

Same as reference

Reference Clock

CLK10: 100ppm

Internal: 1 ppm, 0 to 50° (with optional TCXO)

External: Front Panel SMB

MODULATED WAVEFORMS**Run Modes**

Continuous, Triggered, Burst and Gated

Run Mode Advance Source

Software commands, Front panel TRIG IN, Backplane TTLTrg0-7

Trigger Delay Range (Enable cmd to modulated O/P)

0, 500 ns to 21 s

Re-trigger Delay Range (Modulated O/P end to modulated O/P restart)

500 ns to 21 s

Trigger Parameters

All trigger parameters such as level, slope, jitter, etc. apply

SWEEP**Swept Waveform**

Sine wave

Type

Linear or log

Direction

Up or Down

Sweep Range

100 μ Hz to 25 MHz

Time

1.4 μ s to 40 s

Marker Output

Programmable marker at a selected frequency

FM**Modulated Waveform**

Sine wave

Modulating Waveforms

Sine, square, triangle

Frequency Range

1 Hz to 25 MHz

Modulating Frequency Range

10 MHz to 100 kHz

Peak Deviation

Up to 25 MHz

Marker Output

Programmable marker at a selected frequency

ARBITRARY FM (operated from an external utility only such as WaveCAD)

Modulated Waveform

Sine wave

Carrier Frequency Range

1 Hz to 25 MHz

Modulating Waveform

Arbitrary waveform

Modulating Waveform Sampling Clock

1 S/s to 5 MS/s

Frequency Array Size

4 to 20 k frequencies

Marker Output

Programmable at selected frequencies

AM**Modulated Waveform**

Sine wave

Envelope Waveform

Sine Wave

Envelope Frequency

10 MHz to 100 kHz

Carrier Frequency Range

1 Hz to 25 MHz

Modulation Depth

0% to 100%

FSK**Shifted Waveform**

Sine wave

Carrier Frequency Range

100 μ Hz to 25 MHz

Baud Rate Range

1bits/sec to 10 Mbits/sec

Internal FSK Data Bits

1-4096

Marker Output

Programmable marker at a selected frequency

FREQUENCY HOPPING**Hopped Waveform**

Sine wave

Hop Table Size

1 to 4096

Dwell Time

500 ns to 21 s

Dwell Time Resolution

20 ns

Hop Frequency Range100 μ Hz to 25 MHz**Resolution**

10 digits

Marker Position

Programmable on a selected frequency step

Step Size ± 1 mV to ± 9.99 V**Step Rate**

1 step per trigger

Run Mode

Continuous, Single

Pattern Generation Period

167 ns to 100 s

Minimum Trigger Period

Pattern Period + 8 clock cycles

DIGITAL PATTERN OUTPUT**Pattern Size**

12-bits, ECL levels differential, each channel

Hold Range1 to 1,000,000,000 to 50 MS/s (hold time >1080 ns and <21 s)
54 to 2,000,000,000 to 100 MS/s**Number of Patterns**

1 to 512 k

Output ModeFree-Run: Programmable hold time for each pattern
Stimulus: Fixed hold time for all steps**Update Frequency**100 μ Hz to 100 MHz**RUN MODES** (applies to Standard, Arbitrary, Sequenced and Modulated waveforms)**Continuous Mode**

Continuous output of a waveform after a software or hardware Enable ON command. Continuous mode disabled with software only Enable OFF command

Triggered Mode

Output of one waveform cycle following an Enable ON command. Last cycle always completed

Burst Mode (Not with Sequenced Mode)

Output of a single or multiple pre-programmed number of waveform cycles (burst) starting after a software or hardware Enable ON command.

Counted Burst Cycles

1 to 1Meg, programmable

Burst LimitationsFor segments below 8 points: Segment duration must be >500 ns
For segments Above 8 points: Segment duration must be >40 ns**Gated Mode**

Hardware or backplane transition enables or disables generator output. Last cycle always completed

Run Modes Enable SourceSoftware: Enable ON/OFF command
Hardware: Front panel TRIG IN
VXI Backplane: TTLTrg0-7
Mixed: Output of one cycle following a software Enable ON command. Subsequent outputs enabled by hardware, or backplane triggers**TRIGGER CHARACTERISTICS****Input Sources**External: Front Panel SMB
VXI Backplane: TTLTrg0-7
Software: Close and Remove commands**Pulse Width**

10 ns, min.

Slope

+ or -, selectable

Trigger LevelRange: ± 5 V
Resolution: 1 mV**Input Frequency Range**

DC to 5 MHz

Sync Out

Front Panel: SMB, each channel

Sync TypeZero Cross A/B or Pulse
Marker, in modulated mode only**Sync Level**

TTL

Marker Position

Programmable

Trigger Out

VXI Backplane: TTLTrg0-7

Sync/Trigger Out Sources (Pulse only mode)BIT: Selected point in segment.
LCOM: Loop complete.**System Delay** (trigger I/P to waveform O/P)

1 sample clock cycles+100 ns

Trigger Delay (close cmd to event O/P)

0; 500 ns to 21 s

Retrigger Delay (event O/P end to event O/P restart):

500 ns to 21 s

Trigger Delay Error3 SCLK + 150 ns $\pm 5\%$ of delay setting**Trigger/Retrigger Delay Resolution**

20 ns

Retrigger Delay Error3 SCLK + 150 ns $\pm 5\%$ of retrigger delay setting**Trigger Jitter**Delay=0: ± 1 SCLK
Delay \neq 0: 20 ns ± 1 SCLK**FRONT PANEL I/O****Main Outputs**Connector: SMB (2)
Impedance: 50 Ω $\pm 1\%$
Protection: Short Circuit to Case Ground, 10 sec
Standby: Output On or Off (Output Disconnected)**Digital Word Output**Connector: 50-pin VHDCI
Source: Channels 1 and 2 Waveform Memory
Word Size: 12-bits
Update Frequency: to 100MHz
Level: Differential ECL internally terminated with 510 Ω to -5.2 V**Sync Outputs** (with channel 2 sync routable to channel 1)Connector: SMB (2)
Level: TTL
Sync Type: Zero Cross A/B or Pulse with Arbitrary and Standard Waveforms.
LCOM in Sequence and Burst Modes (including Burst Modulation). Marker with Modulation Modes only, programmable position.

3156B PRODUCT SPECIFICATIONS

Trigger Input

Connector: SMB
Impedance: 50 Ω \pm 1%
Slope: Positive or Negative (selectable)
Sensitivity: 10 mVp-p
Programmable Level: \pm 5 V
Damage Level: 1 V rms
Level: 0 dBm sine

External Reference Input

Connector: SMB
Frequency: 10 MHz
Impedance: 50 Ω \pm 5%
Level: 0dBm, sine
Damage Level: 1 V rms

VXIBUS INTERFACE DATA

(Single slot, Register Based, VXIbus 1.4 Compliant)

Drivers

LabVIEW, LabWindows/CVI,
VXIplug&play (WIN2000/XP)

Waveform Creation & Control

Software

WaveCAD (WIN2000/XP)

Waveform Memory Block Transfer

D16/A24/A32

Status Lights

Red: Fail
Yellow: Module accessed on VXIbus
Green (2): Channel on

Cooling (10°C Rise)

3.7l/s @ 0.5mm H₂O

Peak Current & Power Consumption

	+24	+12	+5	-2	-5.2	-12	-24
$I_{Pm}(A)$	0.2	0.1	3.0	0	2.0	0.1	0.2
$I_{Dm}(A)$	0.25	0.1	0.15	0	0.15	0.1	0.15

Total Power: <50 Watts

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.

Vibration (non-operating)

2 g at 55 Hz

Shock (non-operating)

30 g, 11 ms, half sine pulse

Weight

3 lbs. 8oz. (1.6 kg)

ENVIRONMENTAL

Temperature

Operating: 0° C-50° C
Storage: -40° C-70° C
Spec Compliance: 20° C - 30° C

RELIABILITY

MTBF

27,201 hours

ORDERING INFORMATION

MODEL/DESCRIPTION

Racal Instruments 3156B, Dual Channel Arbitrary Waveform Generator
Racal Instruments 3156B w/ 1ppm, Dual Channel Arbitrary Waveform Generator with TCXO

PART NUMBER

407862-001
407862-011

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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