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Racal Instruments™ 3156C

2-Channel Arbitrary Waveform Generator

Racal Instruments™ 3156C Dual Channel Arbitrary Waveform Generator outputs 16-bit waveforms from 2 channels at up to 225 MS/s. 12-bit digital patterns may be output at rates up to 200 Mbits/s.

Key Features

- **2-channel high-performance Arbitrary Waveform Generator**
- **2 synchronized 16-bit channels with 12-bit emulation**
- **Sample rates up to 250 MS/s and 1 Meg memory per channel**
- **Frequency and amplitude hopping**
- **Internal AM, Sweep, FM and External FSK and PSK**
- **12-bit ECL differential digital pattern and stimulus output**
- **8 standard waveforms plus arbitrary waveforms**

Product Information

High Dynamic Range

The 3156C 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 3156C, 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 ArbConnection software can be used to breadboard custom frequency modulation profiles graphically.

High Sampling Rates

Sample rates up to 225 MS/s are available with memory size of 1 Meg. Channels A and B may be operated independently or in synchronization.

Legacy System Upgrade

The 3156C is a good choice for upgrading legacy ATE systems that use older generation waveform synthesizers. A self-test port is included along with software calibration for upgraded maintainability and accuracy.

ASTRONICS TEST SYSTEMS

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

Resolution
- 1.6 V to 16 V_{pk-pk}: 1 mV
- 160 mV to 1.599 mV_{pk-pk}: 100 µV
- 10 mV to 159.9 mV_{pk-pk}: 10 µV

Accuracy (at 1 kHz into 50 Ω)
- 1.6 V to 16 V_{pk-pk}: ±(1% +50 mV)
- 160 mV to 1.599 V_{pk-pk}: ±(1% +20 mV)
- 10 mV to 159.9 mV_{pk-pk}: ±(1% +5 mV)

Settling Error (5 V Step)
- 50 Ω load 6 ms to 0.5% error
- 500 Ω load 20 ns to 0.5% error

DC Offset Range
- 0 to ±7.995 V

DC Offset Resolution
- 1 mV

DC Offset Accuracy
- ±(1% ±1% from Amplitude ±5 mV)

Output Impedance
- 50 Ω ±1%

Standby (Output Disconnected)
- Output On or Off

Output Protection
- Short circuit (10 sec max.)

Standard Waveforms

Frequency Range
- Sine, square: 100 µHz to 100 MHz
- Others: 100 µHz to 16 MHz

Frequency Resolution
- 11 digits

Accuracy & Stability
- Same as frequency standard

Sine

Phase Range
- 0 to 360° with 0.05° resolution

Selectable Filters
- Channel 1: 60 kHz Bessel, 180 MHz Gaussian, 60 & 120 MHz Elliptic
- Channel 2: 10 kHz Bessel, 60 MHz Gaussian, 60 & 120 MHz Elliptic

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

Harmonics & Spurious

Frequency	<5 V_{pk-pk}	<10 V_{pk-pk}
<25 MHz	36 dBc	34 dBc
<10 MHz	42 dBc	40 dBc
<1 MHz	48 dBc	40 dBc

Flatness

Frequency	Flatness
<100 MHz	15%
<25 MHz	5%
<5 MHz	3%

Triangle

Phase Range
- 0 to 360° with 0.05° resolution

Square

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

Aberration
- <6%: 10 mV_{pk-pk} to 12 V_{pk-pk}
- <8%: 12 V_{pk-pk} to 16 V_{pk-pk}

Duty Cycle Range
- 0.001% to 99.999%

Pulse

Delay, Rise/Fall Time, High Time Ranges
- 0% to 99.999% 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
- -100 to 100

Half-Cycle Waveforms

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

Frequency Range
- 10 mHz to 1 MHz

Phase Start Range (Sine and triangle only)
- 0° to 360°

Start Phase Resolution
- 0.05°

Run Modes
- Continuous, Triggered

Delay Between Half Cycles (Applies to continuous run mode only)
- 200 ns to 21 s

Delay Resolution
- 20 ns

DC Output Function

Range
- -100% to 100% of amplitude

Stroke Video Function

DC Offset Range
- -7.995 V to +7.995 V

Run Modes
- Continuous
- Single

Arbitrary Waveforms

Vertical Resolution
- 12 or 16 bits, user selectable

Waveform Segmentation
- Permits division of waveform memory into smaller segments from 16 to 1 Meg points.

Number of Memory Segments
- 1 to 16 k

Sampling Clock

Internal Source Range
- 1 Hz to 225 MHz

Resolution
- 11 digits

Accuracy and Stability
- Same as reference

Reference Clock
- CLK10: per VXI
- Internal: 1 ppm, 19° to 29° C; 1 ppm/year aging rate

Modulated Waveforms

Run Modes
- Off (CW output), Continuous, Triggered, Burst, and Gated

Idle Mode
- CW or DC

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

Trigger Delay Range (Enable cmd to modulated O/P)
- 0, 120 ns to 21.47 s + system delay

Re-Trigger Delay Range (Modulated O/P end to modulated O/P restart)
- 140 ns to 21.47 s

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Specifications
continued

Trigger Parameters
- All trigger settings and specifications such as level, slope, jitter, etc. are applicable in modulation mode

Sweep

Swept Waveform
- Sine wave

Type
- Linear or log

Direction
- Up or Down

Sweep Range
- 10 Hz to 100 MHz

Time
- 1.4 µs to 40 s

Marker Output
- Start of Sweep

FM

Modulated Waveform
- Sine wave

Modulating Waveforms
- Sine, square, triangle, ramp

Frequency Range
- 10 Hz to 100 MHz

Modulating Frequency Range
- 10 mHz to 350 kHz (1 MHz typical)

Peak Deviation
- Up to 50 MHz

Marker Output
- Programmable marker at a selected frequency

AM

Modulated Waveform
- Sine wave

Envelope Waveform
- Sine Wave

Carrier Frequency Range
- 10 Hz to 100 MHz

Modulation Depth
- 0% to 200% (software above 100%)

Marker Output
- Not available for AM mode

FSK

Shifted Waveform
- Sine wave

Carrier Frequency Range
- 10 Hz to 100 MHz

Baud Rate Range
- 1 bit/s to 10 Mbits/s

Internal FSK Data Bits
- 2 to 4000

Sweep Time
- 1.4 µs to 40 s

Marker Output
- Programmable marker at a selected frequency

Frequency Hopping

Hopped Waveform
- Sine wave

Hop Table Size
- 2 to 2000

Dwell Time
- 400 ns to 20 s

Dwell Time Resolution
- 20 ns

Hop Frequency Range
- 10 Hz to 100 MHz

Marker Position
- Programmable on a selected frequency step

External Advance
- Advance Rate: 1 MHz (max)

Digital Pattern Output

Pattern Size
- 12-bits, differential ECL, internal source termination

Pattern Rate (PPS)
- 100 µPPS to 160 MPPS

Hold Count Range (Free-Run Mode)
- 1 to 2,100,000,000

Free-Run Minimum Hold Count

$$\text{Total Hold Count} = \sum_{\text{PatNum}=1}^{\text{Pattern Count}} \text{Hold Count[PatNum]}$$

- Up to 40 MS/s: Total Hold Count ≥2
- 40 MS/s to 80 MS/s: Total Hold Count ≥4 and modulo 2
- 80 MS/s to 160 MS/s: Total Hold Count ≥8 and modulo 4

Number of Patterns
- Stimulus: 1 to 64k
- Free-Run: 1 to 3200

Output Mode
- Stimulus: Fixed hold time for all steps
- Free-Run: Programmable hold time for each pattern

Run Modes
(applies to Standard, Arbitrary 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
- 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 1 million, programmable

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

Run Mode Enable Sources
- Software: 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

Trigger Sources
- External: F/P connector or backplane
- Internal: Programmable timer
- Software: Close and Remove commands
- Re-trigger Timer: Programmable delay

External Trigger Characteristics

Input Sources
- Connector: Front Panel SMB, each channel
- Isolation: Relay isolation
- VXI Backplane: TTLTrg0-7

Signal Characteristics
- Pulse Width: 10 ns, min
- Frequency Range: DC to 2 MHz
- Damage Level: 30 V_{rms}
- Sensitivity: 35 mV_{p-p}
- Trigger Level Range: ±5 V
- Trigger Level Resolution: 10 mV
- Slope: Positive or negative
- Trigger Jitter: ±1 SCLK

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Specifications
continued

Internal Trigger Characteristics

Internal Trigger Timer
- Range: 1 µs to 21.47 s
- Resolution: 20 ns

Software Trigger
- SCPI or API call

Trigger Delay and Retrigger

Delay Types
- Trigger Delay: Programmable delay from either a software command or an external trigger to the start of waveform output
- Retrigger Delay: Programmable delay from the completion of a waveform cycle until the beginning of the next cycle. The delay repeats for each cycle

Trigger Delay Characteristics
- Range: 0, 120 ns to 21.47 s + system delay
- Resolution: 20 ns
- System Delay (inherent delay from trigger to output): 6 SCLK + 150 ns

Retrigger Delay Characteristics
- Range: 140 ns to 21.47 s
- Resolution: 20 ns
- Retrigger Delay Error
  - < 10 µs: 3 SCLK + 35 ns + 2% of set
  - ≥10 µs: 3 SCLK + 35 ns + 1% of set

SYNC/MARKER CHARACTERISTICS

Sync/Marker Output Destinations
- Front Panel: SMB, each channel
- Isolation: Relay isolation
- VXI Backplane: TTLTrg0-7

Sync Types
- Zero Crossing
- Trigger
  - Pulse: Programmable width and position
  - Internal Trigger: Internal trigger generator is output
  - External Trigger: External trigger is output. Note: Trigger must be provided at TRIG IN connector
- Marker (modulation mode only)

Sync/Marker Characteristics
- Level: TTL, 50 Ω output impedance
- Width: 4 to 64 points, programmable
- Marker Position: Programmable
- frequency (modulation mode only)
- Sync Position: 0 to maximum segment size with 4 point resolution

Interface
(Single slot, Message-Based, VXIbus 1.4 Compliant)

Waveform Memory Block Transfer
- D16/A24/A32

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

Peak Current & Power Consumption
- Total Power: <30 W

	I_{Pm}(A)	I_{Dm}(A)
+24	0.2	0.3
+12	0.7	0.11
+5	1.8	0.15
–2	0	0
-5.2	1.8	0.15
-12	0.1	0.1
-24	0.2	0.15

Front Panel I/O

Arb Outputs
- Main: SMB (2), 50 Ω ±1%
- Self-Test: SMB (1), 50 Ω ±1%
- Protection: Short Circuit to Case Ground, 10 sec
- Standby: Output On or Off (Output Disconnected)

Digital Word Output
- Connector: 50-pin HD50 (SCSI compatible pinout)
- Source: Channel 1 Waveform Memory
- Word Size: 12-bits
- Update Frequency: to 200 MHz
- 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
- Isolation: Relay
- Sync Type
  - Zero Crossing: High when waveform >0, otherwise low.
  - Pulse: Programmable position and width (in Arbitrary and Standard Waveform modes)
  - LCOM: Synchronous with the completion of each burst cycle (available in all Burst Modes)
  - Marker: Synchronous with a selected FSK, FM, or hop frequency, or at the start of a sweep

Trigger Input
- Connector: SMB (2)
- Impedance: 50 Ω ±1%
- Slope: Positive or Negative (selectable)
- Sensitivity: 35 mV_{pk-pk}
- Programmable Threshold: ±5 V
- Damage Level: 30 V_{rms}
- Nominal Level: 0 dBm sine
- Isolation: Relay

External Sample Clock Input
- Connector: SMB (2)
- Frequency Range: 0.1 Hz to 200 MHz
- Impedance: 50 Ω ±1%

Software

Drivers
- LabWindows™/CVI, VXI*plug&play* support for frameworks based on Microsoft Win32® and Win64® application programming interfaces

Interactive Control
- ArbConnection 4.2: A WIN32 graphical application for interactive control of the instrument and the creation of waveforms and digital patterns

Environmental

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

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: 0 to 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-217 FN2, GB GC, 25°)
- 42,935 hours

Mechanical

Weight
- 3 lbs 8 oz (1.6 kg)

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

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Ordering Information

408208 : Racal Instruments™ 3156C

Dual Channel Arbitrary Waveform Generator, 1M

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