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.
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
- 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)
- 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

**Selectible 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**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>&lt;5 V_{pk-pk}</th>
<th>&lt;10 V_{pk-pk}</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25 MHz</td>
<td>36 dBc</td>
<td>34 dBc</td>
</tr>
<tr>
<td>&lt;10 MHz</td>
<td>42 dBc</td>
<td>40 dBc</td>
</tr>
<tr>
<td>&lt;1 MHz</td>
<td>48 dBc</td>
<td>40 dBc</td>
</tr>
</tbody>
</table>

**Flatness**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Flatness</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 MHz</td>
<td>15%</td>
</tr>
<tr>
<td>&lt;25 MHz</td>
<td>5%</td>
</tr>
<tr>
<td>&lt;5 MHz</td>
<td>3%</td>
</tr>
</tbody>
</table>

**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

**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
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

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 Vrms
- Sensitivity: 35 mVpp
- Trigger Level Range: ±5 V
- Trigger Level Resolution: 10 mV
- Slope: Positive or negative
- Trigger Jitter: ±1 SCLK
Specifications

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 Outputs
- Zero Crossing
  - Frequency: 4 to 64 points, programmable
  - Level: TTL, 50 Ω output impedance

Marker (modulation mode only)
- Width: 4 to 64 points, programmable
- Frequency (modulation mode only)
- 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

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)
- 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

Hardware

Digital Logic
- 288 Channels
- 5 MHz maximum frequency
- 256 samples per channel

Software

Drivers
- LabWindows™/CVI, VXIplug&play supported 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 H₂O
Ordering Information

408208 : Racal Instruments™ 3156C
Dual Channel Arbitrary Waveform Generator, 1M