3-Channel Arbitrary Waveform Generator

- **Three High-Performance Arbitrary Generators in a Single Slot Module**

- **Fully Independent or Synchronized Operation**

- **Outputs Up to 100MS/s (Ch.1) and 50MS/s (Ch's. 2,3)**

- **Ideal Modulation for Microwave Signal Generators**

- **AM/FM/Pulse Modulation or I/Q Modulation Source**

- **Eight Standard Waveforms plus Arbitrary Waveforms**

Racal Instruments™ 3153 Arbitrary Waveform Generator module packs three complete high-performance arbitrary waveform generators into a single-slot VXI module. The module provides eight standard waveforms plus arbitrary waveforms. Extensive synchronizing, sequencing, and triggering capabilities combine to make this the most versatile multi-channel source available for the VXIbus.

Applications

The 3153 is ideal for a wide range of applications requiring multiple signal generators. Typical applications include modulating RF and microwave synthesizers with AM/FM/Pulse or I/Q (In-phase & Quadrature) signals, testing medical devices, and testing military transponders.

High Performance

Each channel of the 3153 delivers precise waveforms with twelve bits of amplitude resolution and nine digits of frequency resolution with extremely low phase noise. Exceptional electrical performance includes up to $10V_{pk\text{-}pk}$ into 50Ω (on all channels) over the full frequency range and $1V_{pk\text{-}pk}$ (on channels 2 and 3 only) from special low-distortion output channels. Selectable high-performance output filters ensure clean stimulus waveforms that give the 3153 the ability to simulate modulation waveforms.

Deep Memory

Deep memory minimizes test time by allowing multiple waveforms to be loaded at once and recalled as needed. Channel 1 includes 512k points of memory with up to 2Meg points as an option. Channels 2 and 3 include 1Meg points each, with up to 8Meg points as an option.

Powerful Segmentation and Sequencing

The 3153 won't back you into a corner. Powerful segmentation and sequencing produce a nearly endless variety of complex waveforms. The waveform memory of each channel can be divided up into ≤4096 waveform segments. Each channel also has a sequencer to link and repeat these segments in a user-selectable fashion. Five different advance modes (including "Mixed"), 4096 segments, and 1M loops are selectable for sequence on each channel.

Multi-Channel Synchronization

Each channel has an independent clock to support asynchronous applications. For synchronous applications, channel two and/or channel three can be synchronized to the channel one clock. When used in this mode, channels two and/or three can be clocked at the full rate of channel one, or be clocked at a slower rate that is divided down from it. In addition, a phase offset can be programmed for each of the slaved channels.

Multi-Module Synchronization

Multiple 3153 modules can be synchronized within a VXI chassis using a Master-Slave arrangement that utilizes the VXI Local Bus.

Synchronization with Other Equipment

The 3153 includes extensive trigger and sync capabilities so that you can be confident that the unit will be able to synchronize with your other instrumentation and unit under test. Six different trigger modes can be set under program control. In addition, a Sync output with programmable characteristics and delay makes it easy to synchronize with your other VXI instruments and switching.

Arbitrary Waveform Creation Software

WaveCAD waveform creation software allows you to create sophisticated test waveforms using equations, freehand drawing, and built-in functions or combinations of all three. Waveforms may also be imported from spreadsheets, math programs or waveform digitizers.

VXI*plug&play* Drivers

LabWindows/CVI and LabVIEW drivers simplify test system design and integration. Included on the VXI*plug&play* install disk is a soft front panel that provides manual instrument control from Windows 95 and NT. The VXI*plug&play* install disk also adds C, C++ or Visual Basic programs access to 3153 driver functions directly.

3153 SPECIFICATIONS

AMPLITUDE CHARACTERISTICS

Amplitude (Hi outputs, chs. 1-3)

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

Amplitude (Lo outputs, chs. 2&3)

$1V_{pk-pk}$, into 50Ω

Resolution

3.5 digits

Accuracy (at 1kHz)

±1%

DC Offset Range

0 to ± 4.5V

DC Offset Accuracy

±1%

Output Impedance

$50\Omega\pm1\%$

Low-Pass Filters (selectable)

Chan. 1: 25MHz, 50MHz, 7-pole
Chan. 2: 12.5MHz, 25MHz, 7-pole
Chan. 3: 250kHz, 25MHz, 7-pole

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] and DC)

Frequency Resolution

9 digits

Accuracy & Stability

Same as frequency standard

Sine

Frequency Range

Ch. 1: 10mHz to 50MHz
Chs. 2&3: 10mHz to 6.25MHz, usable to 25MHz

Start Phase Range

0-360°

Total Harmonic Distortion (max vertical and horizontal resolution)

0.3%

Harmonics and Spurious

(max vertical and horizontal resolution)

Frequency	High Output	Low-Level Output
<10MHz	<-35dBc	N/A
<5MHz	<-40dBc	<-45dBc
<1MHz	<-55dBc	<-60dBc

In-Band Spurious and Non-Harmonic

(Ch. 1 @ 40MHz, Chs. 2&3 @ 20MHz)

Amplitude	Ch. 1	Chs. 2&3
$\leq5V_{pk-pk}$	<-22dBc	<-25dBc
$\leq10V_{pk-pk}$	-8dBc	<-15dBc

Two Tone Intermodulation

(Ch. 1 @ 23.1 & 24.1MHz, Chs. 2&3 @ 12.1 & 13.1MHz)

Amplitude	Ch. 1	Chs. 2&3
$\leq5V_{pk-pk}$	<-35dBc	<-35dBc
$\leq10V_{pk-pk}$	<-25dBc	<-30dBc

Square

Frequency Range

Ch. 1: 10mHz to 50MHz
Chs. 2&3: 10mHz to 25MHz

Duty Cycle Range

0% to 99.9%

Rise/Fall Time (10%-90%)

<17ns

Aberration

<7%+10mV

Triangle

Frequency Range

10mHz to 1MHz, usable >1MHz

Start Phase Range

0-360°

Pulse and Ramp Functions

Frequency Range

10mHz to 1MHz, usable >1MHz

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 either freehand, with equations or built-in functions or with imported waveforms.

Waveform Memory

Standard: 512k/1Meg/1Meg
Optional: 2Meg/4Meg/4Meg
2Meg/8Meg/8Meg

Vertical Resolution

12 bits (4096 levels)

Number of Memory Segments (Max.)

4096

Minimum Segment Size

8 points

Segment Size Resolution

4 points

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.

Single1 Sequence Advance

Current segment is sampled once and then idles at the end of the segment. The next trigger advances to the next repeat count of the segment, if any. When all repeats have completed, the next trigger advances to the next segment.

Mixed Sequence Advance

Each step of a sequence can be programmed to advance either automatically or with a trigger as in Single Sequence Advance.

Sequence Table Download

Mode 1: SCPI Commands
Mode 2: High Speed Binary Download

Sequencer Steps

1 to 4096

Segment Loops

1 to 1Meg

Segment Duration

1μs, minimum (points x SCLK $\geq$ 1 μs)

SAMPLING CLOCK

Internal Source Range

Ch. 1: 1Hz to 100MHz
Chs. 2&3: 1Hz to 50MHz

Resolution

9 digits

Accuracy and Stability

Same as reference

External Sample Clock Inputs

Ch. 1: Front panel SMB (>0dBm sine)
Chs. 2&3: Front panel SMB (>0dBm sine)

External Sample Clock Frequency Range

10MHz to 100MHz

Sample Clock Dividers

Chs. 2&3 only: 1 to 64k

Reference Clock

Standard: Clk10
External: Front Panel BNC (>0dBm sine)

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 1Meg output cycles.

External Burst Mode (FUNC:MODE FIX, FUNC:MODE USER only)

An external signal triggers a burst of up to 1Meg output cycles.

Breakpoint Mode

Trigger starts waveform and stop signal or SCPI command stops it. START signal or SCPI command re-starts the waveform.

TRIGGER CHARACTERISTICS

Input Sources

Internal: 1mHz-50kHz timer (1)
Accuracy: ±(1%+1μs)
External: Front Panel SMB (3)
VXI Backplane: TTLTrg0-3, ECLTrg0
Software: *TRG, WS Trigger Cmd.

Trigger Start Phase

Range: 0 to Number of points (0° to 360°)
Resolution: 4 points
Jitter: 1 clock cycle

Pulse Width

20ns, min.

Slope

+ or -, selectable

Trigger Level (Ch. 1)

Range: ±10V
Resolution: 50mV

Trigger Level (Chs. 2&3)

TTL

Input Frequency Range

DC to 12.5MHz

Sync Out

Front Panel: BNC
VXI Backplane: TTLTrg0-3, ECLTrg0

Trigger Out

VXI Backplane: TTLTrg4-6 (Chs. 1-3)

Sync/Trigger Width

4 to 800 points, programmable

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)

Separate: 1 sample clock cycle+150ns
Synchronized: 2 slowest sample clock cycles+150ns

SYNCHRONIZATION

Types

Channel 1 to 2
Channel 1 to 3
Channel 1 to 2 and 3
Multiple module: Using the VXI Local Bus (LBUS)

Inter-Channel Skew (Channels Synchronized)

Ch. 1 to 2 or 3: ±10ns, max.
Ch. 2 to 3: ±5ns, max.

FRONT PANEL I/O

Main Outputs
Connector: SMB (3), Lo (2)
Impedance: 50Ω ±1%
Protection: Short Circuit to Case Ground

Sync Outputs
Connector: SMB (3)
Impedance: 50Ω ± 1%
Level: >2V into 50Ω, 5V into 10kΩ
Protection: Short Circuit to Case Ground

Trigger Inputs
Connector: SMB (3)
Impedance: 10kΩ ±5%
Slope: Positive or Negative (selectable)
Level (Ch. 1): Programmable threshold
Level (Chs. 2&3: TTL
Voltage: ±12V, max.
Pulse Width (min.): 20ns

Start/Stop Inputs
Connector: SMB (2)
Impedance: 10kΩ ±5%
Slope: Positive or Negative (selectable)
Level: TTL
Voltage: ±12V, max.
Pulse Width (min.): 20ns

External Reference Input
Connector/Impedance: BNC/10kΩ ±5%
Level: 0dBm, sine, 50Ω

External Sample Clock Input
Connector: SMB (2)
Level: 0dBm, sine, 50Ω

VXIBUS INTERFACE DATA
(Single slot, Message Based, VXIbus 1.4 Compliant)

Software Compliance
SCPI 1993.0, IEEE488.2

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

Waveform Creation & Control Software
WaveCAD (WIN95/NT)

Shared Waveform Memory
A24 or A32 VME block transfer

Backplane Signal Support
TTLTrg0-3: Trigger In, Sync Out
ECLTrg0: Trigger In, Sync Out
TTLTrg4-6: Trigger Out
LBUS: Multi-module synchronization

Status Lights
Red: Power-On Self-Test failure
Yellow: Module accessed on VXIbus
Green: Output on (3)
Green: External Clock on

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

Peak Current & Power Consumption

	+24	+12	+5	–2	-5.2	-12	-24
I_{Pm}(A)	0.2	0.1	3.0	0.0	2.0	0.1	0.2
I_{Dm}(A)	0.15	0.1	0.15	0.0	0.15	0.1	0.15

Total Power: <50Watts

ENVIRONMENTAL

Temperature
Operating: 0°C-50°C
Storage: -40°C-70°C
Spec Compliance: 20°C-30°C, 30min. 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: 10,000ft.
Storage: 15,000ft.

Vibration (non-operating)
2g at 55Hz

Shock (non-operating)
30g, 11ms, half sine pulse

Weight
3lbs. 8oz. (1.6kg)

EMC (Council Directive 89/336/EEC)
EN55011, Group1, Class A, EN50082-1, IEC 801-2,3,4

Safety (Low Voltage Directive 73/23/EEC)
EN61010-1, IEC1010-1, UL3111-1, CSA 22.2#1010

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.**

ORDERING INFORMATION

MODEL/DESCRIPTION	PART NUMBER
Racal Instruments 3153, 1Meg, 100/50/50MS/s 3 Channel Waveform Generator, 512k/1M/1M	407677-001
Racal Instruments 3153, 4Meg, 100/50/50MS/s 3 Channel Waveform Generator, 2M/4M/4M	407677-002
Racal Instruments 3153, 8Meg, 100/50/50MS/s 3 Channel Waveform Generator, 2M/8M/8M	407677-003