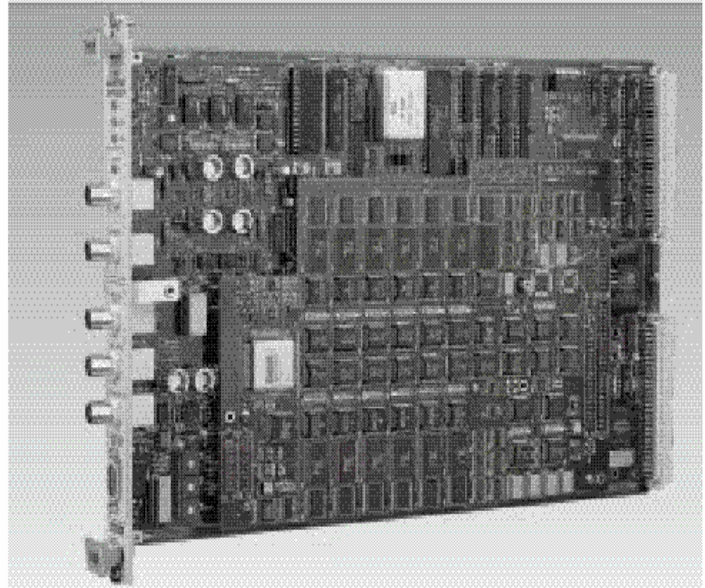


500MS/s Single Channel Waveform Synthesizer Model 3162A



- ◆ Arbitrary Waveform Generator 500MS/s with 12-bit Resolution
- ◆ 1Mbyte Waveform Memory
- ◆ AM, PM and FSK Modulation Inputs and Real-time Frequency Hopping
- ◆ 20ps Feature Placement and Jitter Resolution for Margin Testing
- ◆ Phase Locking to Internal 1ppm Reference or to External Signal
- ◆ Waveform Sequences with Variable Clock Rates to Save Memory

The 3162A Single Channel Frequency Agile Waveform Synthesizer combines industry-leading 500MS/s performance, frequency agility and modulation capability in a single-slot VXIbus module. Signal output in the range of 100mHz to 200MHz with 12-bit resolution supports the test stimulus needs of the information age such as feature placement and jitter injection with 20ps resolution.

500Megasample/Second Performance
As products develop which use increased signal bandwidths, test equipment and systems are needed to keep pace with these trends. The 3162A's 500MS/s sample rate insures the production of test

stimuli with the quality and performance necessary. For example, harmonics are -40dBc for a 10MHz sine wave.

Frequency Agility

Racal met the demand for real-time frequency agility by providing the 3162A with an interface allowing the user to control the output frequency instantaneously. Up to 256 frequency hops are available at clock rates that are integer division ratios of the 3162A's sample clock. Hops are controllable via the front panel D-sub connector or triggered via the front panel or VXIbus.

Modulation Capability

External modulation capability is provided through the front panel inputs for Amplitude and Phase Modulation (AM and PM), as well as Frequency Shift Keying (FSK).

Phase Lock to External Signals

The 3162A automatically locks its output to external analog signals up to 18.75MHz. Phase offset resolution is programmable in 0.01° steps. The frequency of the external signal may be queried since the 3162A has a built-in 6-digit frequency counter.

Arbitrary Waveform Creation Software

WaveCAD waveform creation software is supplied and allows users 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.

Multi-Tone Waveforms

The 3162A can be used together with math software to create multi-tone waveforms. These are commonly used to test the filters and receivers in multi-channel communications systems employing Frequency Division Multiplexing (FDM). This scheme is often used in satellite communication, but is also finding applications in copper and optical transmission. A basic test process involves feeding a signal modulated with test data to one "N" channel at a time, while feeding a tone (unmodulated carrier) to the N-1 unused channels. The data channel and multi-tone channels are typically created separately and then mixed together for up-conversion.

Margin Testing

The 3162A can be used to analyze the sensitivity of a Unit Under Test (UUT) to variations in the time placement of features (i.e., edges, glitches, ripple, etc.). The 3162A simulates these variations using either

Feature Placement or Jitter Injection. These features are useful for simulating anomalies in disk drive read head signals or in digital communications data streams.

Feature Placement

Feature Placement provides for movement of any signal section by a precise amount of time, either backward or forward, with 20ps of resolution, a mere fraction of a sample point. Feature placement is used for characterizing a UUT's susceptibility to real-world timing anomalies such as logic race conditions in Field Programmable Gate Arrays (FPGA's) or microcontroller clocks.

Jitter Injection

This important new WaveCAD feature lets users a) select a waveform feature, and b) insert precise amounts of jitter into any user-defined waveform. The jitter may be linear or random with programmable width. Step size resolution can be as low as one thousandth of a sample point. Figure A shows a positive edge selected for jitter injection using WaveCAD. Figure B shows the jitter measured on an oscilloscope. Waveforms like this measure a circuit's susceptibility to digital noise.

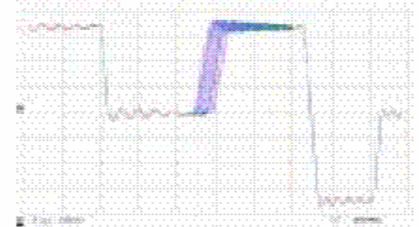


Figure A

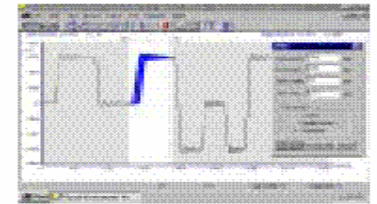


Figure B

VXIplug&play Drivers

Available LabWindows/CVI and LabVIEW drivers simplify test system design and integration. Included on the VXIplug&play install disk is a soft front panel that provides manual instrument control from Windows 3.1, 95 or NT. The VXIplug&play driver also gives C, C++ or Visual Basic programs access to 3162A driver functions directly.

3162A SPECIFICATIONS

AMPLITUDE CHARACTERISTICS

Amplitude

20mV-10V_{pk-pk}, output open circuit
10mV-5V_{pk-pk}, into 50Ω

Resolution

4 digits

Accuracy (at 1kHz)

1V-5V_{pk-pk}: ±(1%+25mV)
100mV-999.9mV_{pk-pk}: ±(1%+5mV)
10mV-99.99mV_{pk-pk}: ±(1%+2mV)

DC Offset Range

0 to ±2.495V, 5mV steps

DC Offset Accuracy

±(2%+10mV)

Output Impedance

50Ω±1%

Low-Pass Filter

150MHz, 7-pole, elliptic

Standby (Output Disconnected)

Output On or Off

Output Protection

Short circuit

Glitch Energy

100pV-s at 5V_{pk-pk}

STANDARD WAVEFORMS

(Sine, Triangle, Square, Pulse [Standard, SINC, Exponential and Gaussian], Noise, DC)

Frequency Resolution

7 digits

Accuracy & Stability

Same as frequency standard

Sine

Frequency Range

100μHz to 200MHz, usable to 250MHz

Total Harmonic Distortion

(4096 points, 500MS/s)

0.5%

Harmonics (4096 points)

Frequency	Harmonic Level
<200MHz	<25dBc
<10MHz	<40dBc
<100kHz	<50dBc

Band Flatness

<100MHz: 10% (0.83dB)
<200MHz: 30% (2.3dB)

Start Phase Range

0-360°

Square

Frequency Range

100μHz to 200MHz; usable to 250MHz

Duty Cycle Range

1% to 99%

Rise/Fall Time (10%-90%)

<2.5ns

Aberration

<5%

Triangle

Frequency Range

100μHz to 5MHz, usable to 50MHz

Start Phase Range

0-360°

Pulse and Ramp Functions

Frequency Range

100μHz to 5MHz, usable to 50MHz

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

Noise Function

Frequency Range

100μHz to 5MHz, usable to 50MHz

DC Output Function

Range

-100%-100% of amplitude

3162A SPECIFICATIONS

ARBITRARY WAVEFORMS

(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, built-in functions, or imported waveforms.

Feature Placement Resolution

20ps

Waveform Memory

1Meg-points

Vertical Resolution

12 bits (4096 levels)

Number of Memory Segments (Max)

4096

Minimum Segment Size

16 points

SEQUENCED ARBITRARY WAVEFORMS

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. Sample clock is selectable for each segment. Sample clock changes coherently between steps.

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

First trigger samples the current segment the number of times specified by the repeat (loop) parameter then idles at the value of the last point output. Next trigger advances to the next segment and the process repeats.

Random Sequence Advance

Active segment is controlled in real-time via the front panel D-sub connector. An 8-bit binary word at this connector controls the next segment to advance to.

Jitter Sequence

A portion (such as an edge) of a user-defined waveform is selected and jitter is defined for the specified area. Requires WaveCAD.

Sequencer Steps

1 to 4096

Segment Loops

1 to 1Meg

Segment Duration (min)

100ns, for >1 loop

SAMPLING CLOCK

Internal Source Range

100mHz to 500MHz

Resolution

7 digits

Accuracy and Stability

Same as reference

10MHz Reference Sources

Internal: 1ppm accuracy (19°C-29°C)
1ppm/°C, (<19°C/>29°C)
1ppm/year aging rate
External: Front panel BNC (10MHz, nominal)

SYNTHESIZER AGILITY

Frequency Hopping

Permits the selection of the sampling clock dividing ratio in real time. Sample clock hops (coherently) between up to 256 pre-defined rates.

Hop Control Source

Frequency: Front panel D-sub connector (8-bit binary word)
Trigger: Front panel BNC, TTLTrg0-3 or ECLTrg0

Sampling Clock Range

100MHz to 300MHz: Sampling Clock
Division Available
300MHz to 55MHz: Sampling Clock
Division Not Available

Ratio Between Carrier and Hop Frequencies

1 to 64k

Hop Table

256 hop frequencies

Hop Delay

Last cycle complete + 150ns

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.

Delayed Trigger Mode

Trigger takes effect after a pre-defined delay ranging from 1 to 8Meg clock cycles.

TRIGGER CHARACTERISTICS

Input Sources

Internal: 1mHz-50kHz timer
Accuracy: $\pm(1\%+.5\mu\text{s})$
External: Front Panel BNC
VXI Backplane: TTLTrg0-3, ECLTrg0
Software: *TRG

Trigger Programmed Delay

Accuracy: $\pm(2 \text{ clock cycles} + \text{system delay})$

Resolution: 1 clock cycle

Jitter: 1 clock cycle

Trigger Level Range

Range: $\pm 10\text{V}$

Resolution: 50mV

Sensitivity: $200\text{mV}_{\text{pk-pk}}$

Input Frequency Range

DC to 18.75MHz

Sync Out

Front Panel: BNC

VXI Backplane: TTLTrg0-3, ECLTrg0

Sync Out Sources

BIT: Selected point in segment.

LCOM: Loop complete.

SSYN: Scope sync. Eliminates ± 1 clock jitter.

SYSTEM DELAY

(trigger I/P to waveform O/P)

Trigger Delay Mode OFF

1 sample clock cycle+150ns

Trigger Delay Mode ON

2 sample clock cycle+150ns

PLL CHARACTERISTICS

Operation

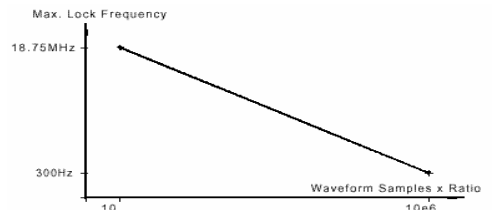
Automatically locks output to external signal.

Input Frequency Range

100Hz to 18.75MHz

PLL Input Characteristics

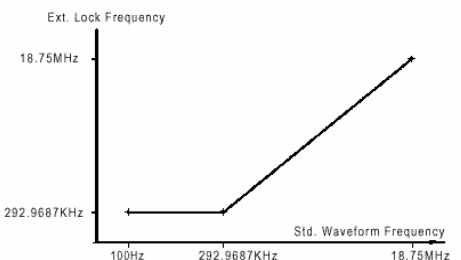
Same as TRIG IN



External Lock Frequency Range

Standard Waveforms: See curve above.

Arbitrary Waveforms: See curve above.



Phase Offset Range

0°-360°

Resolution

2880°/Number of points in waveform

FREQUENCY COUNTER

Operation

Made available to the user in PLL mode only. Frequency reading is valid only when PLL ON LED is lit.

Range

100Hz to 18.75MHz.

Resolution

6 digits

3162A SPECIFICATIONS

AM CHARACTERISTICS

Input Source

Front Panel BNC

Bandwidth

DC to 1MHz

Modulation Range

0 to 200%

Modulation Sensitivity

0 to -2V generates 100% modulation
0 to -4V generates 200% modulation

PM CHARACTERISTICS

Operation

External signal offsets phase. PM input works in PLL mode only.

PM Input

Impedance: 1M Ω , \pm 5%
Sensitivity: 24 $^{\circ}$ /V, typical
Accuracy: \pm 10%

FSK CHARACTERISTICS

Operation

Current segment is sampled continuously. External low level (<trigger level) selects sampling clock, external high level (>trigger level) programs shifted frequency. Clock frequency changes coherently.

Carrier Sampling Clock Range

100mHz to 300MHz

FSK Input

Front Panel BNC

Bandwidth

DC to 10MHz

Delay (min)

1 Waveform Cycle

FREQUENCY HOPPING

Operation

Permits the selection of the sampling clock dividing ratio from a hop table with up to 256 entries.

Hop Control Source

Data: Front Panel D-sub
Trigger: Front Panel Trig, TTLTrg0-3, ECLTrg0

Sample Clock Selection

Data: Binary combination of 8 data lines determines frequency divider.
Trigger: Trigger advances to the next of the hop table.

Carrier Sampling Clock Range

100mHz to 300MHz

Hop Table

256 Hop Frequencies

Hop Delay

Last Waveform Complete + 100ns

FRONT PANEL I/O

Main Output

Connector/Zout : BNC/ 50 Ω \pm 1%
Protection: Short Circuit to Case

Sync Output

Connector/Zout : BNC/50 Ω \pm 1%
Level: >2V into 50 Ω , 5V into 10k Ω
Protection: Short Circuit to Case

Trigger/FSK/PLL Input

Connector/Zin : BNC/10k Ω \pm 5%
Slope: Positive or Negative (selectable)
Input Voltage: \pm 12V
Pulse Width (min.): 20ns

AM/PM Input

Connector/Zin : BNC/1M Ω \pm 5%
Protection: \pm 12V
AM Input Range: 0 to -4V
PM Input Range: 24 $^{\circ}$ /V, typical

External Reference Input

Connector/Zin : BNC/10k Ω \pm 5%
Threshold Level: TTL
Pulse Width (Min.): 20ns

Frequency/Segment Hop Data Input

Connector: 9-pin D-sub, Male
Threshold Level: TTL

VXibus INTERFACE DATA

(Single-slot, Message-based, VXibus 1.4 Compliant)

Software Compliance

SCPI 1993.0, IEEE488.2

Drivers

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

Waveform Creation & Control

Software

WaveCAD (WIN, WIN95, WIN NT)

Shared Waveform Memory

A32 VME block transfer

Backplane Signal Support

TTLTrg0-3: Trigger In, Sync Out
ECLTrg0: Trigger In, Sync Out

Status Lights

Red: Power-On Self-Test Failure
Green: Module accessed on VXibus
Yellow: Phase Lock is engaged
Green: Output on

Cooling (10 $^{\circ}$ C Rise)

3.7 l/s@0.5mm H₂O

Peak Current & Power Consumption

	+24	+12	+5	-2	-5.2	-12	-24
I_{Pm} (A)	0.1	0.5	5.0	0.7	7.0	0.5	0.1
I_{Dm} (A)	0.025	0.25	1.0	0.25	2.0	0.25	0.025

Total Power: 75Watts

ENVIRONMENTAL

Temperature

Operating: 0 $^{\circ}$ C-50 $^{\circ}$ C
Storage: -40 $^{\circ}$ C-70 $^{\circ}$ C
Spec Compliance: 20 $^{\circ}$ C-30 $^{\circ}$ C, 30min. warm-up

Humidity (non-condensing)

11 $^{\circ}$ C-30 $^{\circ}$ C: 95% \pm 5%
31 $^{\circ}$ C-40 $^{\circ}$ C: 75% \pm 5%
41 $^{\circ}$ C-50 $^{\circ}$ C: 45% \pm 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

ORDERING INFORMATION

Model	Description	Part Number
3162A	500MS/s Freq. Agile Waveform Synthesizer 1MEG	407627-012
3162A, 4MEG	500MS/s Freq. Agile Waveform Synthesizer, 4MEG	407627-013
3162A, 8 MEG	500MS/s Freq. Agile Waveform Synthesizer, 8MEG	407627-014

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.

The Racal policy is one of continuous development; consequently, the equipment may vary in detail from the description and specification in this publication.

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 Dutarte, 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

