

Signal Sources

3002 VXI Signal Generator



AEROFLEX
A passion for performance.

Unique product offering full signal generator functionality with high performance in a VXI module

- Wide frequency coverage
- Sweep mode
- Reverse power protection to 50 W
- Simultaneous two tone generation
- Sine, triangular and square wave modulation source
- Modulation capabilities:
Amplitude, frequency, phase, pulse, FSK
- Fast pulse modulation option
- Soft front panel interface
- VXI plug & play compatible
- LabView and LabWindows drivers
- -137 dBm to +25 dBm RF output

The 3002, with its wide frequency coverage from 9 kHz to 2.4 GHz internal modulation source and built-in attenuator, packs into only 2 C-sized VXI slots. It is not a signal source, but a fully fledged, high functionality signal generator.

To ensure ease of use, the instrument has been designed to be fully compatible with the requirements of the IEEE 1155 specification and those of the VXI plug & play Systems Alliance. Software drivers and a simple 'soft front panel' interface allow the module to be easily programmed, with parameters changed via keyboard and mouse.

The signal generator is suitable for a wide range of applications in the laboratory and production where an alternative to rack and stack systems is advantageous.

Operation

The 3002 is a message-based instrument and can be programmed using software drivers or by direct sending of ASCII strings to the instrument. Settings of frequency only, or of the full instrument, can be stored in memory allowing recall simply by memory number. Features which provide enhanced operation include non-volatile memories, memory sequencing and the use of VXI triggers for progressing test sequences.

Frequency selection

Frequency resolution of 1 Hz across the complete frequency range of 9 kHz to 2.4 GHz ensures adequate resolution to characterize narrow band communication systems and components.

RF Output

Output levels up to +25 dBm (+19 dBm above 1.2 GHz) can be set with a resolution of 0.1 dB over the entire range. An attenuator hold function allows control of the RF output without introducing RF level drop-outs from the step attenuator to facilitate testing of receiver squelch systems. Also included are five RF level offsets which enable the user to calibrate out any path losses or small gains up to 5 dB.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W from source VSWRs of up to 5:1, preventing damage to output circuits if an RF transmitter or DC power supply is accidentally applied to the output connector. This feature contributes to long service life and low cost of ownership.

Modulation

Comprehensive amplitude, frequency, phase, FSK and pulse modulation facilities are provided for testing all types of receivers.

Modulation Oscillator

An internal modulation oscillator is provided which is capable of generating one or two tones in the frequency range of 0.01 Hz to 20 kHz. As an alternative to a sine wave output, a triangular or square wave output is provided. A front panel input enables an external modulation signal to be combined with the internal modulation to simplify the testing of complex receiver systems.

Frequency and Phase Modulation

With a 1 dB FM bandwidth of 100 kHz and a deviation range of 0 to 100 kHz, the 3002 signal generator offers wide frequency modulation capability. AC or DC coupled FM can be selected with very low carrier frequency error and drift in the DC coupled mode. The DC coupled mode is ideal for testing tone and message paging equipment accurately. The phase modulation is ideal for testing narrow band analog radios with a deviation range of 0 to 10 radians and a 3 dB bandwidth up to 10 kHz.

Amplitude and pulse modulation

Amplitude modulation with a 1 dB bandwidth of 30 kHz and modulation depths of up to 99.9% with a resolution of 0.1%, ensures the generator is suitable for testing AM systems and undertaking EMC immunity measurements. The pulse modulation facility has an on/off ratio of better than 45 dB up to 1.2 GHz and a rise time of less than 10 ms enabling characterization of TDMA or TDD bursts in RF amplifiers and modules.

An optional Fast Pulse modulator improves the on/off ratio to typically >80 dB with typically rise and fall times of 15 ns.

2 and 4 level FSK

In addition to the analog FM facilities, the 3002 signal generator allows the generation of 2 and 4 level FSK signals from external logic levels. The FM deviation generated is set by programmed command. The facility is ideal for testing paging receivers and RF modems.

Sweep

When configured as a swept carrier frequency generator, the start and stop frequency, step size and time per step can be programmed along with a choice of linear or logarithmic sweep. The sweep can be set to single or continuous operation and can be initiated by a command, a trigger applied to the front panel input or from the VXI backplane. A single step facility is also provided.

Size and weight

The 3002 occupies only 2 slots in a C-size chassis. This space saving is especially valuable in the testing of FDM links where large numbers of sources are required.

Spectral Purity

Measurement of receiver selectivity and ultimate signal to noise ratio requires good spectral purity. The 3002 has a low residual FM of typically 3 Hz and sideband noise of -121 dBc/Hz at 1 GHz to allow demanding measurements to be made at an affordable cost.

Instrument stores

The 3002 signal generator provides extensive storage facilities for simplifying repetitive test scenarios. Up to 100 carrier frequency values and 100 complete instrument settings can be stored. All of these stores are non-volatile. A software protection system ensures that the

stored settings cannot be accidentally overwritten. The use of an electronic storage medium without back-up batteries ensures long storage life and avoids periodic replacement of batteries. A large volatile storage system capable of storing 100 instrument settings is also provided for use by automatic test systems. The values can be downloaded and then recalled by stored number to avoid the time overhead introduced by the handling of the message based protocol of full instrument settings.

Sequencing

A software facility allows sequences of stored instrument settings to be defined. The trigger commands, front panel or backplane triggers, can then be used to cycle through the sequence of settings to give the highest throughput rates in automatic test systems.

Calibration Data

All alignment data, including the internal frequency standard adjustment, is digitally derived and realignment can be undertaken by protected functions and does not require the removal of instrument covers. Status information stored includes model type and serial number. An elapsed time facility allows the monitoring of the number of users' hours the product has been in use. With a recommended calibration interval of 2 years, ownership costs are kept low.

Programming

The protocol and syntax of the standard commands have been designed in accordance with the IEEE 488.2 standard to simplify the generation of test programs.

To further assist in test program generation and debug, the current instrument setting and status can be read back.

Specification

General Description

The 3002 covers the frequency range 9 kHz to 2.4 GHz. The RF output can be amplitude, frequency, phase or pulse modulated. An internal synthesized programmable AF source is capable of generating single or two tone modulation.

Carrier Frequency

Range

9 kHz to 2.4 GHz

Resolution

1 Hz

Accuracy

As frequency standard

RF Output

Range

-137 dBm to +25 dBm (+19 dBm above 1.2 GHz) 0.1 dB resolution. When AM is selected the maximum RF output level decreases linearly with increasing AM depths to +19 dBm (+13 dBm above 1.2 GHz) at 99.9% depth.

RF Level Units

Units may be programmed in μ V, mV, EMF or PD, dB relative to 1 μ V, 1 mV EMF or PD, or dBm. The output level can be normalized for

75 Ω operation with an impedance converter

Level Accuracy

(over temp. range 17°C to 27°C)

Frequency	Accuracy	Temp Coeff.
9 kHz to 1.2 GHz	± 1 dB <23 dBm ± 1.5 dB <25 dBm	< ± 0.02 dB/°C
1.2 GHz to 2.4 GHz	± 2 dB	< ± 0.04 dB/°C

Attenuator Hold

Selection of Attenuator Hold provides for uncalibrated level reduction of at least 10 dB without the Mechanical Attenuator operating

VSWR

For output levels less than -5 dBm, output VSWR is less than 1.3:1 for carrier frequencies up to 1.2 GHz and less than 1.5:1 for carrier frequencies up to 2.4 GHz

Output Impedance

50 Ω SMA female connector to MIL 390123D

Output Protection

Protected from a source of reverse power up to 50 W from 50 Ω or 25 W from a source VSWR of 5:1. Protection circuit can be reset remotely. Tripping the reverse power protection illuminates a front panel LED and causes an interrupt

Spectral Purity

Harmonics

Typically better than -30 dBc for RF levels up to $+7$ dBm

Typically better than -25 dBc for RF levels up to 6 dBm below maximum specified output

Non-Harmonics (offsets > 3 kHz)

Better than -70 dBc to 1 GHz

Better than -64 dBc above 1 GHz

Better than -60 dBc above 2 GHz

Residual FM (FM off)

Less than 4.5 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 1 GHz

SSB Phase Noise

Better than -124 dBc/Hz at 20 kHz offset from a carrier frequency of 470 MHz, typically -121 dBc/Hz at 20 kHz offset from a carrier frequency of 1 GHz

Φ M on AM

Typically 0.1 radians at 30% depth at 470 MHz

Modulation Modes

Internal and external modulation can be simultaneously enabled to allow combined amplitude and frequency (or phase) modulation. Pulse modulation can be used in combination with the other forms of modulation.

Frequency Modulation

Deviation

0 to 100 kHz, 3 digits or 1 Hz resolution

Accuracy at 1 kHz

$\pm 5\%$

Bandwidth (1 dB)

DC to 100 kHz (DC coupled)

10 Hz to 100 kHz (AC coupled)

20 Hz to 100 kHz (AC coupled with ALC)

Group delay

Less than 5 μ s to 100 kHz

Carrier frequency offset

(DC coupled)

Less than 1% of the set frequency deviation

Distortion

Less than 3% at 1 kHz rate for deviations up to 100 kHz. Typically < 0.5% at 1 kHz rate for deviations up to 10 kHz

Modulation source

Internal LF generator or external via front panel BNC

FSK

Modes

2 level or 4 level FSK

Data Source

External data connected to Trigger input connector (2 level) or Trigger and Pulse input connectors (4 level)

Frequency Shift

Settable up to ± 100 kHz

Accuracy

As FM deviation accuracy

Timing Jitter

± 3.2 μ s

Filter

8th order Bessel, -3 dB at 20 kHz

Phase Modulation

Deviation

0 to 10 radians, 3 digits or 0.01 resolution

Accuracy at 1 kHz

$\pm 5\%$ of indicated deviation excluding residual phase modulation

3 dB Bandwidth

100 Hz to 10 kHz

Distortion

Less than 3% at 10 radians at 1 kHz modulation rate. Typically < 0.5% for deviations up to 1 radian at 1 kHz

Modulation source

Internal LF generator or external via front panel BNC

Amplitude Modulation

For carrier frequencies below 2 GHz

For RF levels below $+18$ dBm

Range

0 to 99.9%, 0.1% resolution

Accuracy

At 1 kHz modulation rate in the temperature range 17°C to 27°C

Temperature coefficient <0.02%/°C

For carrier frequencies <500 MHz

±5% of set depth

For carrier frequencies <2 GHz

±7.5% of set depth

1 dB Bandwidth

DC to 30 kHz (DC coupled)

10 Hz to 30 kHz (AC coupled)

20 Hz to 30 kHz (AC coupled with ALC)

Distortion

At 1 kHz modulation rate

For carrier frequencies below 500 MHz

<2.5% up to 80% depth

<1.5% up to 30% depth

For carrier frequencies between 500 MHz and 2 GHz

RF level < +7 dBm

<3.5% up to 80% depth

<1.5% up to 30% depth

RF levels +7 dBm to +18 dBm

<5% up to 80% depth

<2.5% up to 30% depth

Modulation source

Internal LF generator or external, via front panel BNC

Pulse Modulation

Frequency Range

32 MHz to 2.4 GHz, useable down to 10 MHz

RF Level Range

Maximum guaranteed output is reduced to +20 dBm, +14 dBm above 1.2 GHz

RF Level Accuracy

When pulse modulation is enabled, adds ±0.5 dB to the RF level accuracy

Control

TTL/CMOS compatible pulse input is on front panel BNC with 10 kΩ input impedance

A logic 0 turns the carrier off, a logic 1 turns the carrier on. Maximum input is ±15 V

On/Off Ratio

Better than 45 dB below 1.2 GHz, better than 40 dB above 1.2 GHz

Rise And Fall Times

Less than 10 μs

Internal LF Generator

Frequency Range

0.01 Hz to 20 kHz

Resolution

0.01 Hz for frequencies up to 100 Hz

0.1 Hz for frequencies up to 1 kHz

1 Hz for frequencies up to 20 kHz

Frequency Accuracy

As frequency standard

Distortion

Less than 0.1% THD at 1 kHz

Waveforms

Sine wave to 20 kHz and triangular or square wave to 3 kHz

Audio Output

The modulation oscillator signal is available on a front panel BNC connector at a level of 2 V RMS EMF from a 600 Ω source impedance

External Modulation

Input on the front panel via BNC connector. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance is 100 kΩ nominal.

Modulation ALC

The external modulation input can be levelled by a peak levelling ALC system over the input voltage range of 0.75 V to 1.25 V RMS sine wave. High and low indications are reported as part of the instrument status when the input is outside the levelling range.

Sweep Mode

Control Parameters

Start/stop values of carrier frequency, size of step and time per step

Sweep Time

50 ms to 10 s per step

Linear Sweep

Frequency step size of 1 Hz minimum

Logarithmic Sweep

Percentage increment of 0.01% to 50% in 0.01% steps

Sweep Mode

Single, continuous or external trigger

Trigger

A trigger input is available on a front panel BNC. A step or the complete sweep may be triggered by the front panel input, VXI backplane trigger or VXI command.

Frequency Standard

TCXO

10 MHz

Temperature Stability

Better than ±7 in 10⁷ over the operating range of 0 to 55°C

Ageing Rate

Less than ±1 in 10⁶ per year

External input

Front panel BNC connector accepts an input of 1 MHz or 10 MHz at 220 mV RMS to 1.8 V RMS into 1 k Ω .

General

VXI-bus INTERFACE CAPABILITIES

Complies with revisions 1.3 and 1.4 of the VXIBus specification for message based instruments

Logical address

Manual selection (1-254)

Device type

A16 D16 message based servant, programmable interrupter

Protocol

Word serial IEEE 488.2

Fast Handshake not supported

Connectors

P1, P2 (highest slot of a 2 slot allocation)

TTLTRG

Used to trigger sweep mode and step memory sequences

CLK10

Not used

Local Bus

Not used

ECLTRG

Not used

Peak Current & Power Consumption

	+24 V	+12 V	+5 V	-12 V
Ipm	1.2 A	1.0 A	2.0 A	0.6 A
I _{dm}	0.1 A	0.1 A	1.3 A	0.1 A

Total Power 60 W max

Cooling (per slot): 2.4 litre/s at 1 mm H₂O back pressure for 10°C maximum temperature rise

BITE (built-in test equipment)

LEDs or modules front panel indicate Power OK (green), System Failure (red) and Reverse Power Protection Tripped (red)

RFI COMPATIBILITY

Complies with VXIBus revision 1.3/1.4 specifications below 1 GHz

ELECTROMAGNETIC COMPATIBILITY

Conforms with the protection requirements of the EEC Council Directive 89/336/EEC. Conforms with the limits specified in the following standards:

IEC/EN61326-1 : 1997, RF Emission Class B, Immunity Table 1, Performance Criteria B

SAFETY

Conforms with the requirements of EEC Council Directive 73/23/EEC (as amended) and the product safety standard IEC/EN 61010-1 : 2001 + C1 : 2002 + C2 : 2003 for class 3 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 1 supply.

RATED RANGE OF USE

(Over which full specification is met)

Temperature

0 to 55°C

Humidity

Up to 93% at 40°C

Altitude

Up to 3050 m (10,000 ft)

CONDITIONS OF STORAGE AND TRANSPORT

Temperature

-40 to +70°C

Humidity

Up to 93% at 40°C

Altitude

Up to 4600 m (15,000 ft)

CALIBRATION INTERVAL

2 years

DIMENSIONS AND WEIGHT

Dimensions 2 slot, C Size

Weight Less than 4 kg

OPTION 11 - FAST PULSE MODULATOR

Specification as standard instrument with the following exceptions.

Frequency Range

100 kHz to 2.4 GHz (useable to 9 kHz)

RF Output Range

As standard instrument with the exception that maximum output level is reduced by 3 dB when Pulse is selected.

RF Level Accuracy

Additional ± 0.01 dB/°C temperature coefficient when pulse enabled

Adds ± 0.25 dB for carrier frequencies below 10 MHz

On/Off Ratio

>80 dB below 1.2 GHz

>70 dB up to 2.05 GHz (typically >80 dB)

>65 dB up to 2.4 GHz (typically >70 dB at 2.4 GHz)

Rise & Fall Times

<20 ns (typically 15 ns)

Maximum Repetition Frequency

10 MHz

Control

50 Ω input impedance. A logic 0 (0 V to 0.8 V) turns the carrier off, Maximum input is ± 10 V

FSK Modulation

Only 2 level FSK available when Option 11 specified.

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

3002 9 kHz to 2.4 GHz Signal Generator

Options

Option 11 Fast Pulse

Supplied with

Operating manual on CD ROM

59000/285 LabWindows/CVI® driver

59000/286 VXI plug & play soft front panel (available as a download
from www.ifrsys.com)

Optional Accessories

46880/069 Service manual

46882/226 Operating manual (paper copy)

For the very latest specifications visit www.aeroflex.com

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.