
GENERAL INFORMATION

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Introduction

The 3002 is a C size, message-based VXI signal generator covering the frequency range 9 kHz to 2.4 GHz. The RF output can be modulated in amplitude, frequency or phase using internal or external signal sources. Additionally pulse modulation may be applied externally. An internal AF source is capable of generating simultaneous two-tone modulation. The 3002 is 2-slots wide and conforms to revisions 1.3 and 1.4 of the VXI specification.

Main features

Frequency selection

Carrier frequency resolution is 1 Hz across the band. A series of carrier frequencies can be stored in non-volatile memory for recall when required.

Output

RF output up to +25 dBm (uncalibrated above 1.2 GHz) can be set with a resolution of 0.1 dB over the entire range. Carrier output can be completely disabled.

An electronic trip protects the generator output against reverse power of up to 50 W. This prevents damage to output circuits when RF or DC power is accidentally applied to the RF OUT connector.

To facilitate testing of receiver squelch systems, an attenuator hold function allows control of the RF output without introducing RF level drop-outs from the step attenuator.

The RF output level can be offset by up to ± 5.0 dB to compensate for cable or switching losses, or to standardize a group of instruments.

The maximum RF output level can be set so as to protect sensitive devices connected to the RF OUTPUT socket.

Spectral purity

With an SSB phase noise performance of typically -121 dBc/Hz at 20 kHz offset from a 1 GHz carrier, this instrument can be used for both in-channel and adjacent channel receiver measurements. Harmonically related signals and non-harmonics are better than -25 dBc and -60 dBc respectively.

Modulation

Comprehensive amplitude, frequency and phase modulations are available. Pulse modulation can be applied to the carrier from an external pulse source. The instrument also accepts one or two logic level inputs to produce a 2-level or 4-level FSK modulated output. An internal modulation oscillator is provided, having a frequency range of 0.01 Hz to 20 kHz. The oscillator is capable of generating one or two modulation tones simultaneously in one modulation channel. An independent BNC input on the front panel allows external modulation signals to be combined with

the internal signal(s). These sources can be combined to give a number of modulation modes. The pulse modulation can be used in combination with the other forms of modulation.

The frequency modulation range provides a 1 dB bandwidth of typically 100 kHz and provides FM deviation up to a maximum of 100 kHz. AC or DC coupled FM can be selected. Phase modulation is also available with a 10 kHz bandwidth up to a maximum of 10 radians.

Amplitude modulation with a 1 dB bandwidth of typically 30 kHz and with modulation depths of up to 99.9% is available with a resolution of 0.1%. Pulse modulation is available as standard with typical rise and fall times of less than 10 μ s and 40 dB on/off ratio.

The external input voltage required for 100% modulation is 1 V RMS (1.414 V peak). To accommodate other signal levels, Automatic Level Control (ALC) can be selected which provides correctly calibrated modulation for inputs between 0.75 and 1.25 V RMS. HI and LO indications are reported when the input level is outside the range of the ALC system.

Incrementing

All major parameters can be incremented or decremented in steps. If no step size is programmed for a parameter, the steps are preset to 1 kHz for carrier frequency, 1 kHz for modulation oscillator, 1 kHz for FM deviation, 1% for AM depth, 0.1 rad for Φ M and 1 dB for output level.

Frequency sweep

The sweep capability of the instrument allows comprehensive testing of systems. Sweeps may be logarithmic or linear. Four parameters are used to specify sweep: start, stop, step size and time per step, all of which can be programmed by the user. Sweep triggering can be programmed as single shot or continuous and can be initiated directly or on the detection of a trigger. The triggering signal may be from a back plane trigger, programmed or from a TTL/CMOS signal applied to the front panel TRIGGER INPUT.

Memory

The instrument provides both non-volatile and volatile memory for storing instrument settings. The non-volatile memory provides 100 instrument settings and 100 settings of carrier frequency only. The volatile memory (RAM) also provides 100 instrument settings. Any one of the non-volatile instrument settings can be selected as the power-up setting for the instrument.

Memory sequencing

A software facility allows sequences of stored instrument settings to be defined. The incrementing facilities can then be used to cycle through the settings using the VXI trigger facilities.

Memory protection

To prevent accidental change of the contents of the stored settings, individual memories or ranges of memories can be write-protected.

Triggers

Triggering the 3002 Signal Generator may be via the VXI TTL triggers (0 - 7), the trigger command, *TRG message or front panel input.

Calibration data

All alignment data is digitally derived. Realignment can be undertaken, without removing covers, by protected functions via the VXI interface.

Performance data

GENERAL DESCRIPTION	<p>The 3002 is a synthesized VXI signal generator covering the frequency range 9 kHz to 2.4 GHz.</p> <p>The RF output can be amplitude, frequency, phase or pulse modulated. An internal programmable AF source is capable of generating simultaneous two tone modulation. All functions can be controlled by an IEEE 488.2 message based interface.</p>
CARRIER FREQUENCY	
Range	9 kHz to 2.4 GHz.
Resolution	1 Hz.
Accuracy	Equal to the frequency standard accuracy.
RF OUTPUT	
Range	<p>-137 dBm to +25 dBm, (RF power above +19 dBm is uncalibrated for carrier frequencies >1.2 GHz). Maximum output is reduced by 5 dB when pulse modulation is selected and/or by up to 6 dB dependent upon set AM depth.</p>
Resolution	0.1 dB
Accuracy	<p>Over a temperature range of 17°C to 27°C:</p> <p style="padding-left: 20px;">Below +7 dBm:</p> <p style="padding-left: 40px;">±0.8 dB to 1.2 GHz, ±1.6 dB to 2.4 GHz.</p> <p style="padding-left: 20px;">Above +7 dBm:</p> <p style="padding-left: 40px;">±1 dB to 1.2 GHz, ±2 dB to 2.4 GHz.</p> <p>Temperature coefficient <±0.02 dB/°C to 1.2 GHz, and <±0.04 dB/°C to 2.4 GHz.</p>
Attenuator hold	Inhibits operation of the step attenuator from the level at which the function is enabled. Usable for a level reduction of at least 10 dB. Typical accuracy ± 3 dB.
Output impedance	50 Ω SMA female connector to MIL 390123D. 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.
Reverse power	Protected against the application of reverse power to the output connector for levels up to 50 W from 50 Ω or 25 W from a source VSWR of 5:1. Tripping of the reverse power protection circuit illuminates a front panel LED and raises an interrupt. The circuit can be reset either by an explicit command or by a device reset.
SPECTRAL PURITY	
Harmonics	Typically better than -30 dBc for levels up to +7 dBm, typically better than -25 dBc for levels 6 dB below the maximum specified output.
Non-harmonics	Better than -70 dBc for carrier frequencies up to 1 GHz, better than -64 dBc for carrier frequencies above 1 GHz, better than -60 dBc for carrier frequencies above 2 GHz.
Residual FM	<p>Less than 4.5 Hz RMS in a 300 Hz to 3.4 kHz bandwidth at a carrier frequency of 1 GHz.</p> <p style="padding-left: 40px;">Residual FM (typical)</p> <p style="padding-left: 60px;"><1 Hz at 249 MHz <2 Hz at 501 MHz <3 Hz at 1001 MHz <6 Hz at 2001 MHz</p>
SSB phase noise	Better than -124 dBc/Hz at 20 kHz offset from a 470 MHz carrier. Typically -121 dBc/Hz at 20 kHz offset from a 1 GHz carrier.
RF leakage	Complies with VXIbus revision 1.3/1.4 specifications below 1 GHz.
MODULATION	<p>FM, AM or phase modulation can be applied to the carrier from an internal or external modulation source. The internal modulation source is capable of generating two simultaneous signals into any one of the modulation channels. Internal and external modulation can be simultaneously enabled to produce combined amplitude and frequency (or phase) modulation. Pulse modulation can be applied to the carrier from an external pulse source. The pulse modulation can be used in combination with the other forms of modulation. 2 level or 4 level FSK modulation can be applied to the carrier using data from an external source.</p>

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FREQUENCY MODULATION

Deviation range	0 to 100 kHz.
Resolution	3 digits or 1 Hz.
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).
Accuracy	±5% at 1 kHz modulation rate.
Carrier error	Less than 1% of the set frequency deviation when DC coupled.
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.
Group delay:	Less than 5 µs to 100 kHz.

FSK

Modes:	2 level or 4 level FSK.
Data source:	External data connected to TRIGGER INPUT connector (2 level) or TRIGGER INPUT and PULSE INPUT connectors (4 level).
Frequency shift:	Settable up to ±100 kHz.
Accuracy:	As FM deviation accuracy.
Timing jitter:	±3.2 µs
Filter:	8 th order Bessel, -3 dB at 20 kHz.

PHASE MODULATION

Range	0 to 10 radians.
Resolution	3 digits or 0.01 radians.
Bandwidth (3 dB)	100 Hz to 10 kHz.
Accuracy	±5% at 1 kHz modulation rate.
Distortion	Less than 3% at 10 radians at 1 kHz. Typically 0.5% for deviations up to 1 radian at 1 kHz.

AMPLITUDE MODULATION (for carrier frequencies <500 MHz, usable to 1.5 GHz)

Range	0 to 99.9%.
Bandwidth (1 dB)	DC to 30 kHz (DC coupled), 10 Hz to 30 kHz (AC coupled), 20 Hz to 30 kHz (AC coupled with ALC).
Resolution	0.1%.
Accuracy	±5% of set depth at 1 kHz rate at +17°C to 27°C ambient temperature. Temperature coefficient <0.02% per °C.
Distortion	Less than 2.5% at 1 kHz rate for modulation depths up to 80%, Less than 1.5% at 1 kHz rate for modulation depths up to 30%.
ΦM on AM	Typically 0.1 radians at 30% depth at 470 MHz.

PULSE MODULATION

Carrier frequency range	32 MHz to 2.4 GHz, usable to 10 MHz.
RF level range	Maximum guaranteed output is reduced to +20 dBm up to 1.2 GHz or +14 dBm above 1.2 GHz when pulse modulation is selected.
RF level accuracy	Maximum additional uncertainty is ±0.5 dB.
Input	Front panel BNC connector with an input impedance of 10 kΩ nominal. A logical '1' (3.5 V to 5 V) turns the carrier on, a logical '0' (0 V to 1 V) turns the carrier off. Maximum safe input is ±15 V.
ON/OFF ratio	Better than 40 dB, better than 45 dB below 1.2 GHz.
Rise and fall time	Less than 10 µs.
Overshoot	Less than 1 dB.

MODULATION OSCILLATOR	The internal modulation oscillator is capable of generating one or two modulation tones simultaneously in one modulation channel.
Frequency range	0.01 Hz to 20 kHz.
Resolution	0.01 Hz to 100 Hz, 0.1 Hz to 1 kHz, and 1 Hz to 20 kHz.
Distortion	Less than 0.1% at 1 kHz.
Sine wave frequency response	Typically 1 dB DC to 20 kHz.
Waveforms	Sine to 20 kHz, triangle or square wave to 3 kHz. Square wave jitter <6.4 μ s on any edge.
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	A front panel BNC connector is provided for external modulation input.
Input level	1 V RMS (1.414 V peak) sine wave for set deviation. Maximum safe input is \pm 15 V.
Input impedance	100 k Ω nominal.
Modulation ALC	Levels the applied external modulation over the range 0.75 to 1.25 V RMS.

SWEEP MODE A carrier frequency sweep mode is provided. The sweep is defined by setting the start, stop and frequency step size. The sweep step size may be specified linearly or logarithmically. The step time can be set from 50 ms to 10 s per step. A step or the complete sweep may be triggered by the trigger input on the front panel, VXI backplane trigger, message or VXI command. Sweep can be set to continuous.

FREQUENCY STANDARD	The carrier frequency and internal modulation frequency are synthesized from either an internal reference oscillator or to an external reference.
Internal standard	10 MHz TCXO.
Aging rate	Less than \pm 1 in 10^6 per year.
Temperature stability	Better than \pm 5 in 10^7 over the temperature range 0 to 55°C.
External standard	Input: Requires an input of 220 mV RMS to 1.8 V RMS into 1 k Ω on front panel BNC connector. Input frequency can be 1 MHz or 10 MHz. Output: Front panel BNC socket provides an output of 10 MHz at a nominal level of 2 V pk-pk into 50 Ω .

CALIBRATION INTERVAL Recommended 2 years. Realignment is accomplished by remote control. There are no mechanical adjustments required for realignment.

VXIbus INTERFACE CAPABILITIES	Complies with revision 1.3/1.4 of VXIbus specification for message based instruments.
Logical address	Manual selection (1 - 254).
Device type	Message based servant, programmable interrupter.
Protocol	Word serial IEEE 488.2. Fast handshake is not supported.
Address/Data	A16/D16.
Connectors	P1, P2 (highest slot of a 2 slot allocation).
TTLTRG	Can be used to trigger sweep.
CLK10	Not used.
Local bus	Not used.
ECLTRG	Not used.

Peak current & power consumption	+24 V:	+12 V:	+5 V:	-12 V:	Total power:	
	lpm	1.2 A	1.0 A	2.0 A	0.6 A	58 W max.
	ldm	0.1 A	0.1 A	1.3 A	0.1 A	

Cooling (per slot) 2.4 liter/s at 0.5 mm H₂O backpressure for 10°C maximum temperature rise.

Front panel indicators LEDs on module's front panel indicate POWER OK (green), SYSTEM FAIL (red) and RPP TRIP - Reverse Power Protection Tripped (red).

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MTBF	Greater than 10,000 hours to MIL 217F.
ELECTROMAGNETIC COMPATIBILITY	Complies with VXIbus revision 1.3/1.4 for specifications below 1 GHz. Conforms to the protection requirements of Council Directive 89/336/EEC. Complies with the limits specified in the following standards: EN55011 Class B CISPR 11 EN50082-1 IEC 801-2, 3, 4
SAFETY	This instrument is designed to comply with the requirements of IEC/EN61010-1, for Class III portable equipment and is for use in a pollution degree 2 environment. The equipment is designed to operate from an installation category 1 supply.
RATED RANGE OF USE	Specification is met over the temperature range 0 to +55°C, humidity up to 93% at 40°C and elevation up to 3050 m (10,000 ft).
CONDITIONS OF STORAGE AND TRANSPORT	The instrument can be stored at temperatures from -40°C to +71°C, elevations up to 4600 m and humidities up to 95% at 40°C.
DIMENSIONS AND WEIGHT	
Dimensions	2 slot, C size.
Weight	Less than 4 kg.

Versions, options and accessories

When ordering please quote the full ordering number information.

Ordering numbers

3002

46882-226
59000/285
59000/286

Versions

9 kHz to 2.4 GHz Signal Generator.

Supplied accessories

Operating manual (this manual).
LabWindows/CVI driver.
VXI Plug & Play soft front panel.
