9 kHz to 1.2/2.4 GHz Signal Generators 2023/2024

With its level of performance, this small, general purpose signal generator gives outstanding value for money.

- **Wide frequency coverage:- 9 kHz to 1.2 GHz (2023) 9 kHz to 2.4 GHz (2024)**
- **Linear and logarithmic sweep mode**
- **RPP to 50 W**
- **Sine, triangular and square wave two tone modulation source**
- **RS232 and GPIB control**
- **Comprehensive modulation facilities:- Amplitude, Frequency Phase, Pulse, FSK**
- **Excellent rack space efficiency**
- **Simple operation through menu selection of modes**
- **DC operation option**
- **Optional +25 dBm RF output**

2023 and 2024 signal generators are portable and lightweight, offering carrier frequencies from 9 kHz to 1.2 GHz (2023) and 9 kHz to 2.4 GHz (2024).

The instruments are suitable for a wide range of applications in laboratory, production, service and maintenance environments.

The GPIB facility allows the unit to be included in ATE systems for faster manufacturing throughput.

The inclusion of an RS232 interface, with a common command set to the GPIB facility, simplifies remote control of the signal generator in basic test systems and allows control via a modem.

Availability of a large number of non-volatile memory locations reduces the set-up time within ATE systems and can be used to simplify test procedures in manually controlled systems. A memory cloning facility, using the GPIB or RS232, allows the memory settings to be duplicated quickly and efficiently.

Operation

A flexible operating system using keyboard or cursor selection of the main parameters ensures simple and fast operation. A simple menu system can be used to configure the instrument to the user's required mode of operation in a simple and intuitive manner.

A rotary control and up/down keys allow easy modification of the selected parameters.

Frequency selection

Frequency resolution of 1 Hz across the complete frequency range of 1.2 GHz or 2.4 GHz ensures adequate resolution to characterise narrow band communication systems and components.

RF Output

Peak RF output levels up to +13 dBm 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 dropouts from the step attenuator to facilitate testing of receiver squelch systems. An RF level limit can be set to limit the output power to avoid damage to external, power sensitive devices. Also included are five RF level offsets which enable the user to calibrate out any path losses or small gains up to 5 dB over specified frequency ranges. A carrier ON/OFF key is provided to completely disable the output.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W from source VSWR's 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 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 is provided. An input on the front panel enables an external modulation signal to be combined with the internal modulation to simplify the testing of complex receiver systems.

Modulation

Comprehensive amplitude, frequency, phase and pulse modulation facilities are provided for testing all types of receivers. A MOD ON/OFF key simplifies the testing of signal to noise ratio.

Frequency and Phase Modulation

With a 1 dB FM bandwidth of 100 kHz and a deviation range of 0 to 100 kHz, the 2023 and 2024 signal generators offer a wide range 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 facility 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 40 dB and a rise time of less than 10 µs enabling characterisation of TDMA or TDD bursts in RF amplifiers and modules.

FSK

In addition to the analog FM facilities, the 2023 and 2024 signal generators allow the generation of 2 level and 4 level FSK signals from external logic level signals. The FM deviation generated is set by keyboard entry of the required deviation. The facility is ideal for testing paging receivers and RF modems.

Sweep

The sweep facility of the 2023 and 2024 offers linear and logarithmic sweeps, allowing the user to program in start and stop frequency, size of step and time per step and a percentage increment in the case of logarithmic sweep.

The sweep can be paused and the frequency varied by the rotary control to investigate a problem area.

The sweep can be initiated from the keyboard or by a trigger input applied to the rear panel and can be set to single, continuous or start/stop operation. A single step facility is also provided.

The frequency sweep facility is particularly well suited to EMI testing in GTEM cells and screened rooms. Whilst the signal generator is sweeping the RF level can be altered using the rotary control to manually correct the RF level at the output of RF amplifiers. The square wave modulation source allows the generation of square wave amplitude modulation to simulate the effect of TDMA bursts from communication systems on devices being tested for EMC immunity.

The optional high RF output power to +25 dBm can eliminate the need for external amplifiers when using small test cells.

Size and weight

The 2023 and 2024 occupy a full rack width, 2 units high, to minimise rack occupancy in manufacturing and test systems. This is especially important in the testing of FDM links where large numbers of sources are required.

The low weight of the product makes it ideal for portable applications within service and maintenance environments.

The shallow depth and full width of the instrument is convenient for operation on the bench, particularly where instruments need to be stacked.

Spectral Purity

Measurement of receiver selectivity and ultimate signal to noise ratio requires good spectral purity. The 2023 and 2024 have a low residual FM of typically 3 Hz and sideband noise of typically −121 dBc/Hz at 1 GHz to allow demanding measurements to be made at an affordable cost.

Instrument stores

The 2023 and 2024 signal generators provide extensive storage facilities for simplifying repetitive test scenarios. Up to 100 carrier frequency values and 100 complete instrument settings. All of these stores are non-volatile.

A software protection system ensures that individual stored settings cannot be accidentally overwritten. The use of an electronic storage medium without back up batteries ensures long storage lifetime 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 store number to avoid the time overhead introduced by the handling of the GPIB protocol.

Sequencing

A software facility allows 9 sequences of stored instrument settings to be defined. The incrementing facilities can then be used to cycle through the settings in manually operated test systems or be operated via a trigger.

Calibration Data

All alignment data, including the internal frequency standard adjustment, is digitally derived and realignment can be undertaken without removal of external covers, by protected front panel functions or via the GPIB. Use of digitally stored realignment eliminates the use of mechanical adjusters to minimise long term drift and vulnerability to mechanical shock.

Status information is stored, including an identity string (type and serial number), choice of internal or external standard and GPIB address.

An elapsed time facility allows the monitoring of the number of hours the product has been in use. A recommended calibration interval of 2 years helps towards low cost of ownership.

Programming

A GPIB interface is fitted as standard with all functions controllable over the bus. The protocol and syntax of GPIB commands has been designed in accordance with IEEE 488.2 standard to simplify the generation of ATE programs.

In talk mode, the current settings, instrument status and the identity string can be read.

An RS232 interface is fitted as standard with a common command set to GPIB commands. RS232 control is particularly suitable for use with simple external controllers or RF modems when the instrument is being used in a remote location.

Memory Cloning

The stored settings in one signal generator can be transferred to others without the use of an external controller using the GPIB or RS232 interface. This facility is particularly useful for duplicating test set ups on manual production lines.

OPTIONS

The standard features of the signal generator can be enhanced by taking advantage of the various options available.

No attenuator option

This option reduces the instrument cost by deleting the internal attenuator. An RF output range from −2 dBm to +15 dBm is provided and is a very economic solution for applications requiring a local oscillator.

DC Operation

The DC supply option allows the signal generator to be used in vehicles, remote areas or where the integrity of the AC supply is not guaranteed.

High power

A high power option is available which provides an RF output up to +25 dBm ideal for use as a local oscillator or testing passive and active components.

Rear panel connectors

To facilitate the incorporation of the signal generator in a production rack, the connectors can all be on the rear panel.

2023/2024

SPECIFICATION

GENERAL DESCRIPTION

2023 and 2024 cover the frequency range 9 kHz to 1.2 GHz and 9 kHz to 2.4 GHz respectively.
The RF output can be amplitude, frequency, phase or pulse modulated. An internal synthesised programmable AF source is capable of generating single or simultaneous two tone modulation.
GPIB and RS232 are included as standard to enable remote control of all functions except the supply switch.

CARRIER FREQUENCY

Range
9 kHz to 1.2 GHz (2023)
9 kHz to 2.4 GHz (2024)

Resolution
1 Hz

Accuracy
As frequency standard.

Phase incrementing
The carrier phase can be advanced or retarded in steps as low as 0.09° using the rotary control.

RF OUTPUT

Range
–137 dBm to +13 dBm, 0.1 dB resolution. When AM is selected, the maximum RF output level decreases linearly with increasing AM depth to +7 dBm at 99.9% depth.

RF Level Units
Units may be set to µV, mV, EMF or PD; dB relative to 1 µV 1 mV EMF or PD; or dBm. Conversion between dB and linear units may be achieved by pressing the appropriate units key (dB or V, mV, µV.)
The output level can be normalised for 75 Ω operation with an impedance converter.

Accuracy over temperature range 17°C to 27°C		
	<1.2 GHz	<2.4 GHz
>–127 dBm	±0.8 dB	±1.6 dB
Temperature Stability dB/°C	<±0.02	<±0.04

Attenuator hold
Inhibits operation of the step attenuator from the level at which the key is enabled. Usable for a level change of up to 28 dB.

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.

RF Output connector
50 Ω type N connector to MIL 390123D.

Output protection
Protected from a source of reverse power up to 50 W from 50 W or 25 W from a source VSWR of 5:1. Protection circuit can be reset from the front panel or via the GPIB/RS232 interfaces.

SPECTRAL PURITY

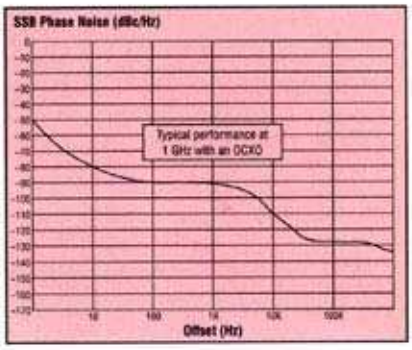
At RF levels up to +7 dBm:

Harmonics
Typically better than –30 dBc for RF levels up to +7 dBm.
Typically better than –25 dBc for RF levels up to +13 dBm.

Sub and Non harmonics (for 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.



Carrier Leakage
Less than 0.5 mV PD at the carrier frequency in a two turn 25 mm diameter loop, 25 mm from the surface of the signal generator.

ΦM 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 from an external pulse source.

FREQUENCY MODULATION

Deviation
0 to 100 kHz, 3 digits or 1 Hz resolution

Accuracy at 1 kHz
±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 µs 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 modulation oscillator or external via front panel BNC.

FSK

Modes
2 level or 4 level FSK

Data source
External data connected to TRIGGER connector (2 level) or TRIGGER and PULSE connectors (4 level).

Frequency shift
Settable up to ±100 kHz

Accuracy
As FM deviation accuracy.

Timing jitter
±3.2 µs

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
±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 <500 MHz, usable to 2 GHz.

Range
0 to 99.9%, 0.1% resolution.

Accuracy
±5% of set depth at 1 kHz (at +17°C to 27°C ambient temperature), temperature coefficient <±0.02%/°C.

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
<2.5% at 1 kHz rate for modulation depths up to 80% and <1.5% at 1 kHz rate for modulation depths up to 30%.

Modulation source
Internal LF generator or external, via front panel BNC.

PULSE MODULATION

Frequency range
32 MHz to 2.4 GHz, usable to 10 MHz

RF level range
Maximum guaranteed output is reduced to +8 dBm.

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

Control
Pulse input is on a rear panel BNC with 10 kΩ input impedance.
A logic 0 (0 V to 1 V) turns the carrier off, a logic 1 (3.5 V to 5 V) 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

MODULATION OSCILLATOR

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 a triangular or square wave to 3 kHz

Square Wave Jitter
<6.4 µs on any edge

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 indicators on the display indicate when the input is outside the levelling range.

2023/2024

SWEEP MODE

Control parameters
Start and stop values of carrier frequency.

Linear sweep
Frequency step size of 1 Hz minimum.

Logarithmic sweep
Percentage increment of 0.01% to 50% in 0.01% steps.

Step time
50 µs to 10 s per step.

Trigger
A trigger input is available on a rear panel BNC connector and can be set to for single, continuous, start/stop or single step mode.

FREQUENCY STANDARD

TCXO
10 MHz

Temperature Stability
Better than ±5 in 10^7 over the operating range of 0 to 55°C.

Ageing rate
Less than ±1 in 10^6 per year.

External Input
Rear panel BNC connector accepts an external input of 1 MHz or 10 MHz at a level of 220 mV RMS to 1.8 V RMS into 1 kΩ.

Output
Rear panel BNC connector provides an output of 10 MHz at a nominal level of 2 V p-p into 50 Ω.

GENERAL

REMOTE CONTROL

GPIB
All functions except the supply switch are remotely programmable.

Capabilities
Designed in accordance with IEEE 488.2.
The GPIB interface complies with the following subsets as defined in IEEE standard 488.1:
SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2

RS232
All functions except the supply switch are remotely programmable.

Connector
9 way male D-type.

Bit rate
300 to 9600 bits/s.

Handshake
Hardware: DTR, RTS, CTS and DSR
Software: XON and XOFF

Electrical
Interface to RS232D

ELECTRO-MAGNETIC COMPATIBILITY
Conforms with European Directive 89/336/EEC and associated International Standards. Complies with the limits specified in the following standards:

EN55011	Class B CISPR II
EN50082-1	IEC 801-2,3,4
EN60555-2	IEC 555-2

SAFETY
Complies with IEC 1010-1, BS EN61010-1 class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 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°C to +71°C.

Humidity
Up to 95% at 40°C

Altitude
Up to 4600 m (15,000 ft)

POWER REQUIREMENTS

AC Supply
90 to 132 V or 188 to 264 V
47 Hz to 63 Hz 175 VA maximum

CALIBRATION INTERVAL
2 years

DIMENSIONS AND WEIGHT
(over projections but excluding front panel handles)

Height	Width	Depth	Weight
107 mm	419 mm	440 mm	<8 kg

OPTIONS

NO ATTENUATOR
Omits the internal step attenuator. Specification as standard instrument with following exceptions:

RF output range
From -2 dBm to +15 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +9 dBm at maximum AM depth.

Pulse modulation
Not available

Output protection
Reverse power protection is not provided.

DC OPERATION
Allows for operation from an external DC power source in addition to an AC power source. Specification as standard instrument with the following additions:

DC supply range
11 V to 32 V.

AC Supply Frequency
47 Hz to 440 Hz at 90 to 132 V
47 Hz to 63 Hz at 188 to 264 V
200 VA maximum

DC consumption
70 W with Option 3 not fitted. 95 W with option 3 and 4 fitted.

HIGH POWER
Specifications as standard instrument with the following exceptions:

RF output range
-137 dBm to +25 dBm for carrier frequencies up to 1.2 GHz. Uncalibrated to 2.4 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.

RF level accuracy Accuracy over 17°C to 27°C		
	<1.2 GHz	<2.4 GHz
	±1 dB	±2 dB
Temp Stability dB/ °C	±0.02	±0.04

Harmonics
Typically better than -25 dBc for levels 6 dB below the maximum specified output.

HIGH STABILITY FREQUENCY STANDARD
Replaces the internal TCXO with a high stability OCXO. Specification as standard instrument with the following exceptions:

Ageing rate
±2.5 in 10^7 per year, ±5 in 10^9 per day after 2 months continuous use.

Stability
Better than ±5 in 10^8 over the temperature range 0 to 50°C.

Warm up time
Within 2 in 10^7 of final frequency 10 minutes after switch on at a temperature of 20°C.

REAR PANEL CONNECTORS
RF output, modulation input and audio output connectors are transferred to the rear panel. The signal generator specification is not altered.

VERSIONS AND ACCESSORIES
When ordering please quote the full ordering number information.

Ordering Numbers	Versions
2023	9 kHz to 1.2 GHz Signal Generator
2024	9 kHz to 2.4 GHz Signal Generator
	Options
Option 1	No attenuator (not available with option 3)
Option 2	DC operation
Option 3	High power (not available with option 1)
Option 4	High stability frequency standard
Option 5	Rear panel outputs
	Supplied with
	AC power supply lead
46882-225U	Operating Manual
43130-119U	DC supply lead (option 2 only)
	Accessories
54311-208Z	50/75 Ω adapter. N type (m) to BNC (f). 5.7 dB loss dc to 1 GHz.
46880-068C	Service manual
46884-792D	Front bracket handle mounting kit
46662-601J	Transit case
46662-602F	Soft carry case
46884-650F	RS232 cable, 9-way female to 9-way female, 1.5m
43129-189U	1m GPIB lead
59999-724N	TC5010 TEM Cell (see separate sheet)