Signal Sources

2023A/B, 2025 Signal Generators

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

- Wide frequency coverage:-
  - 9 kHz to 1.2 GHz (2023A)
  - 9 kHz to 2.05 GHz (2023B)
  - 9 kHz to 2.51 GHz (2025)
- Excellent spectral purity
- Linear and logarithmic sweep mode
- RPP to 50 W
- Sine, triangular and square wave two tone modulation source
- RS-232 and GPIB control
- Comprehensive modulation:- AM, FM, ∅M , Pulse & FSK
- 3.9 kHz Bessel filtered FSK
- Optional +25 dBm RF output
- SINAD Measurement Option

The 2023A/B and 2025 signal generators are portable and lightweight, offering carrier frequencies from 9 kHz to 1.2 GHz (2023A), 9 kHz to 2.05 GHz (2023B) and 9 kHz to 2.51 GHz (2025) with a wide choice of modulation modes.
The instruments are suitable for a wide range of applications in laboratory, production, and maintenance environments.
The GPIB facility allows the unit to be included in ATE systems for faster manufacturing throughput.
An RS-232 interface is provided with a command set in common with the GPIB to simplify remote control of the signal generator in basic test systems or via a modem.

Operation

Front panel control is achieved through a flexible combination of keyboard selection, cursor selection and a rotary control in conjunction with a clear and intuitive menu presentation on a bright panel display. This ensures the instrument can be set up into any desired mode of operation quickly and simply.

Frequency Selection

Frequency resolution of 1 Hz across the complete frequency range of 1.2 GHz, 2.05 GHz or 2.51 GHz ensures adequate resolution to characterize narrow band communication systems and components.

RF Output

Peak RF output levels of between +13 dBm and -140 dBm can be set accurately with a resolution of 0.1 dB. 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, and during EMI investigations. A RF level limit can be set to limit the output power to avoid damage to external, power sensitive devices. RF level offsets up to ±5 dB can be applied to counter the effects of test system losses etc. 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 a source with a VSWR's of up to 5:1, preventing damage to output circuits if a 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.

Size and Weight

The 2023A/B and 2025 occupy a full rack width, but only 2 units high to minimize rack occupancy in manufacturing and test systems and

for instrument stacks in benchtop use.

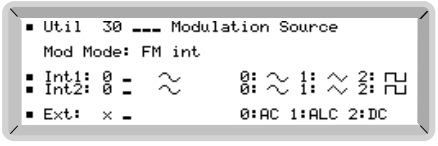
The low weight of the product makes it ideal for portable applications within maintenance environments.

Spectral Purity

Measurement of receiver selectivity and ultimate signal to noise ratio requires good spectral purity. The 2023A/B and 2025 have a low residual FM of typically 3 Hz and a commendable sideband noise of typically -121 dBc/Hz at 1 GHz, (20 kHz offset) to allow demanding measurements to be made at an affordable cost. Good close in phase noise is also achieved with results at 100 Hz offsets typically <-85 dBc.

Modulation

Comprehensive amplitude, frequency, phase, FSK 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.



Amplitude and Pulse Modulation

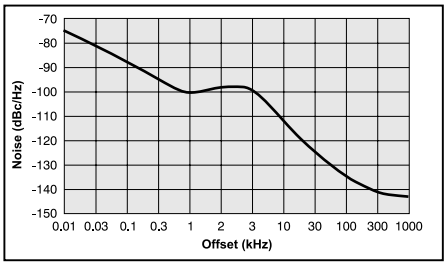
Amplitude modulation with a 1 dB band-width of 30 kHz and modulation depths of up to 99.9% with a resolution of 0.1% ensures the generator is suitable for testing AM systems and undertaking EMC immunity measurements. The standard pulse modulation facility has an on/off ratio of better than 40 dB and a rise/fall time of less than 10 μs enabling characterization of TDMA or TDD bursts in RF amplifiers and modules. The internal square wave modulation source may be used to self pulse modulate the generator for use in EMI applications.

An optional Fast Pulse modulator improves the on/off ratio to typically >80 dB with rise and fall times of <20 ns.

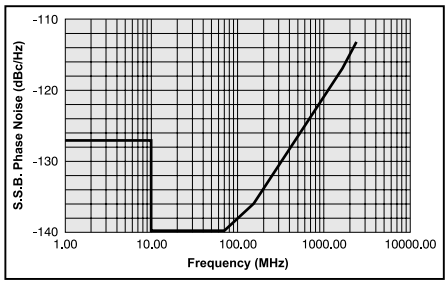
Frequency and Phase Modulation

With a 1 dB FM bandwidth of 275 kHz and a deviation range of 0 to 12.8 MHz, the 2023A/B and 2025 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 ideal for testing paging and DCS (Digitally Coded Squelch) 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.



Typical SSB Phase noise at 1 GHz (OCXO fitted)



Typical SSB Phase noise at 20 kHz offset

FSK

The generation of 2 level and 4 level FSK signals is possible directly from external logic inputs. The TTL data is automatically filtered using a 8th Order 3.9 kHz Bessel filter to reduce spectral spreading, as required by both ERMES and FLEX™ paging systems. The required FM deviation is set from the front panel.

Modulation Oscillator

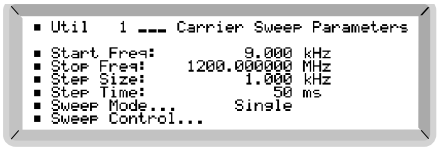
An internal modulation oscillator is provided which is capable of generating one or two tones in the frequency range of 0.01 Hz to 20 kHz. In addition to a sine wave output, a triangular or square wave is provided. Internal and external modulation sources may be combined to produce more complex modulation types.

Sweep

The sweep facility of the 2023A/B and 2025 offers linear and logarithmic sweeps. The user can program all sweep parameters including start and stop frequency, size of step, 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 external trigger input and can be set to single, continuous, stepped or start/stop operation.



The frequency sweep facility is particularly well suited to EMI testing. During a frequency sweep, the RF level can be altered using the rotary control to manually correct the level at the output of 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 EMI.

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

Instrument Stores

The 2023A/B and 2025 signal generators provide extensive storage facilities for simplifying repetitive tests. Up to 100 carrier frequency values and 100 complete instrument settings can be saved to non-volatile stores. Storage is achieved without the need for batteries and so avoids problems of periodic replacement.

A software protection system ensures that individual stored settings cannot be accidentally overwritten.

A further 100 volatile stores are available for complete instrument settings. Their contents can be downloaded over GPIB and then recalled by store number to reduce 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 an external 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 minimize 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 are 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.

A RS-232 interface is fitted as standard with a common command set to GPIB commands. RS-232 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 direct interconnection of GPIB or RS-232 interfaces. 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.

Option 1 - No Attenuator

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.

Option 2 - 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.

Option 3 - High Power

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

Option 4 - High Stability Frequency Standard

An OCXO internal reference can replace the standard TCXO where improved frequency stability is required.

Option 5 - Rear Panel Connectors

All front panel connectors may be removed and fitted to the rear panel for use in production racks.

Option 7 and 11 - Fast Pulse Modulator

A pulse modulator suitable for generating fast pulses with high isolation for applications in radar and EMI.

Option 12 - SINAD Measurement

A fully independent high performance SINAD meter with selectable weighting filters can be fitted for receiver sensitivity measurements.

SPECIFICATION

GENERAL DESCRIPTION

The 2023A/B and 2025 cover the frequency range 9 kHz to 1.2 GHz, 2.05 GHz and 2.51 GHz respectively.

The RF output can be amplitude, frequency, phase or pulse modulated. An internal synthesized programmable AF source is capable of generating single or simultaneous two tone modulation.

GPIB and RS-232 are included as standard to enable remote control of all functions except the supply switch.

CARRIER FREQUENCY

Range

9 kHz to 1.2 GHz (2023A)

9 kHz to 2.05 GHz (2023B)

9 kHz to 2.51 GHz (2025)

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

-140 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, μV, mV.) The output level can be normalized for 75 Ω operation with an impedance converter.

Level Accuracy [1]

Frequency	>-127 dBm	>-100 dBm	Temp Coefficient
9 kHz to 1.2 GHz	±0.8	±0.8	±0.02 dB/°C
1.2 GHz to 2.05 GHz	±1.4	±1.2	±0.03 dB/°C
2.05 GHz to 2.51 GHz	±1.6	±1.6	±0.03 dB/°C

(1) Over range +17°C to +27°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 2.51 GHz.

For output levels greater than -5 dBm output VSWR is less than 1.5:1 for all carrier frequencies.

RF Output Connector

50 Ω type N connector to MIL-PRF-39012

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 from the front panel or via the GPIB/RS-232 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.

Non-Harmonics (for offsets >3 kHz)

Better than -70 dBc to 1 GHz, better than -64 dBc between 1 and 2.05 GHz better than -60 dBc above 2.05 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 μV 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

Resolution

1 Hz

Deviation

CW Range (MHz)	Max Deviation (kHz)
1200 - 2510	12800
600 - 1200	6400
300 - 600	3200
150 - 300	1600
75 - 150	800
37.5 - 75	400
18.75 - 37.5	200
0.009 - 18.75	100

Accuracy at 1 kHz

±4%

Bandwidth (1 dB)

DC to 275 kHz (DC coupled)

10 Hz to 275 kHz (AC coupled)

20 Hz to 275 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

<1% at 1 kHz rate for deviations up to 20% of max available deviation, typically 0.1% for deviations of 2% of max available deviation and <3% at max available deviation

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 connector (2 level) or TRIGGER and PULSE connectors (4 level)

Note with option 7 fitted, rear panel PULSE input is labelled FSK2

Frequency shift

Settable up to ±100 kHz

Accuracy

As FM deviation accuracy

Timing jitter

±3.2 µs

Filter

8th order Bessel, -3 dB at 3.9 kHz

PHASE MODULATION

Deviation

0 to 10 radians, 3 digits or 0.01 resolution

Accuracy at 1 kHz

±4% 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 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%*

**<3.5% for carrier freqs above 500 MHz*

Modulation source

Internal LF generator or external via front panel BNC

PULSE MODULATION

FOR FAST PULSE MODULATOR SEE OPTIONS

Frequency range

32 MHz to 2.51 GHz, useable to 10 MHz

RF output range

Maximum guaranteed output is reduced to +8 dBm

(+20 dBm or +14 dBm with high power option when pulse modulation is selected)

RF level accuracy

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

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

Control

Pulse input is on a rear panel BNC with 10 kΩ nominal input impedance. A HCT logic 0 (0 V to 0.8 V) turns the carrier off, a HCT logic 1 (2.0 V to 5 V) turns the carrier on. Max safe input is ±15 V

INTERNAL LF GENERATOR

Frequency range

0.01 Hz to 20 kHz

Resolution

5 digit

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. 1 V RMS (1.414 V pk) sine wave for set deviation. Input sensitivity may be optionally specified for 1 V pk (option 10). 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 0.5 V to 1.25 V RMS sine wave.

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

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 ms to 10 s per step

Trigger

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

FREQUENCY STANDARD

TCXO

10 MHz

Temperature Stability

Better than ±7 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 pk-pk 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, TE∅, L4, LE∅ SR1, RL1, PP0, DC1, DT1, C0, E2

RS-232

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 EIA-232-D

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 73/72/EEC and Standard IEC/EN 61010-1 : 1993
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, 47 - 440 Hz

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

OPTION 1 - NO ATTENUATOR

(cannot be specified with option 7 or option 3)

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 with option 1

Output protection

Reverse power protection is not provided

OPTION 2 - 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.

Rated Range of Use

Temperature

0 to 45°c

OPTION 3 - HIGH POWER

If fast pulse modulation is needed see Option 11

Specifications as standard instrument with the following exceptions:

RF output range

-140 dBm to +25 dBm (Output power is uncalibrated above +19 dBm for carrier frequencies above 1.2 GHz and above +14 dBm above 2.4 GHz). Maximum output is reduced by 5 dB when standard pulse modulation is selected and/or by up to 6 dB dependent upon set AM depth.

RF Level Accuracy Above +7 dBm (over temperature 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 2.5 GHz	±2 dB	<±0.03 dB/°C

Harmonics

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

Amplitude Modulation (for RF levels from +7 dBm to +18 dBm)

Carrier frequency <500 MHz

Standard depth and distortion spec applies

Carrier frequency 500 MHz to 2 GHz

Accuracy (from +17°C to +27°C ambient, temperature coefficient <±0.02%/°C)

±7.5% of set depth at 1 kHz mod rate

Distortion (at 1 kHz mod rate)

<5% up to 80% depth

<2.5% up to 30% depth

OPTION 4 - 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

OPTION 5 - REAR PANEL CONNECTORS

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

OPTION 7 - FAST PULSE MODULATOR

With option 7 fitted, a BNC Pulse input connector is fitted to the front panel and the existing front panel LF output connector becomes a combined modulation input/output connector. Specification as standard instrument with the following exceptions.

Frequency range

100 kHz to 2.51 GHz (useable to 9 kHz)

RF output range

-140 dBm to +10 dBm (useable to +13 dBm) when pulse enabled

RF level accuracy

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

On/Off ratio

>80 dB below 1.2 GHz

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

>65 dB up to 2.51 GHz (typically >70 dB at 2.51 GHz)

Rise & fall times

<20 ns (typically 10 ns)

Maximum repetition frequency

10 MHz

Control

TTL levels into 50 Ω input impedance. A HCT logic 0 (0 V to 0.8 V) turns the carrier off, a HCT logic 1 (2.0 V to 5 V) turns the carrier on. Maximum input is ±10 V.

OPTION 11 - FAST PULSE MODULATOR WITH HIGH POWER

Pulse operation as Option 7. RF output as Option 3 with the following exception.

RF output range

Maximum output level is reduced by 3 dB when Pulse is selected

OPTION 12 - SINAD MEASUREMENT

See separate SINAD Measurement data sheet 46891-002

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2023A	9 kHz to 1.2 GHz Signal Generator
2023B	9 kHz to 2.05 GHz Signal Generator
2025	9 kHz to 2.51 GHz Signal Generator

Options

Option 1	No attenuator (not available with option 3, 7 or 11)
Option 2	DC operation
Option 3	High power (not available with option 1, 7 or 11)
Option 4	High stability frequency standard
Option 5	Rear panel outputs
Option 7	Fast Pulse Modulator (not available with option 1, 3 or 11)
Option 10	Mod input sensitivity 1 V pk
Option 11	Fast Pulse with High Power (not available with options 1, 3 or 7)
Option 12	SINAD Measurement

Supplied with

	AC power supply lead
46882/373	Operating Manual
43130/119	DC supply lead (option 2 only)

Accessories

46880/068	Service manual
46884/792	Front bracket handle mounting kit
46662/601	Transit case
46662/602	Soft carry case
46884/650	RS-232 cable, 9-way female to 9-way female, 1.5 m
43129/189	1 m GPIB lead
59000/317	VISA Plug 'n' Play driver software (also available as a download from www.ifrsys.com)

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AEROFLEX
A passion for performance.

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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.

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