Fast Switching Synthesizers

AEROFLEX
A passion for performance.

How did Aeroflex fast-switching synthesizers get to be #1? It's no mystery. First, we built the best products. The only ones, in fact, that have it all—high speed, low noise and wide bandwidth—in one package. Even our most basic models are 30 times faster and 10 times cleaner than the closest competitor.

- 2200 - OEM Modular Synthesizer
- 2500 - OEM Modular Synthesizer
- 2106 - Fast Switching Synthesizer
- 2126 - Fast Switching Synthesizer
- MS5000-150 - Airborne Frequency Synthesizer
- FS2000 - OEM Modular Synthesizer

Signal Sources

2023A/B, 2025 Signal Generators

AEROFLEX
A passion for performance.

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.

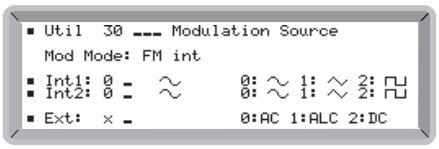
The low weight of the product makes it ideal for portable applications within maintenance environments.

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

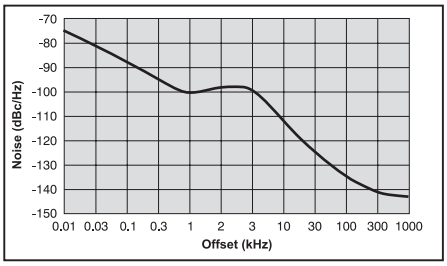
Amplitude modulation with a 1 dB band-width of 30 kHz and modulation depths of up to 99.9% with a resolution of 0.1% ensures the generator is suitable for testing AM systems and undertaking EMC immunity measurements. The standard pulse modulation facility has an on/off ratio of better than 40 dB and 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.

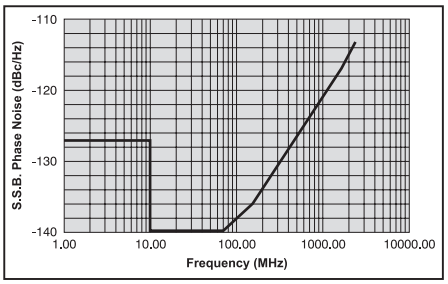
Frequency and Phase Modulation

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

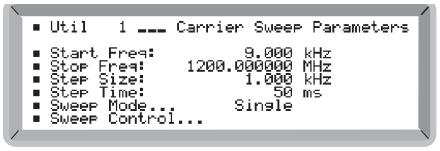
An internal modulation oscillator is provided which is capable of generating one or two tones in the frequency range of 0.01 Hz to 20 kHz. In addition to a sine wave output, a triangular or square wave is provided. Internal and external modulation sources may be combined to produce more complex modulation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

BACK

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

100 to 120 V~, 50 - 400 Hz
(Limit 90 - 132 V~, 45 - 440 Hz
210 - 240 V~, 50 - 60 Hz
(Limit 188 - 264 V~, 45 - 66 Hz)

200 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

100 to 120 V~, 50 - 400 Hz

(Limit 90 - 132 V~, 45 - 440 Hz
210 - 240 V~, 50 - 60 Hz
(Limit 188 - 264 V~, 45 - 66 Hz)

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

46880/088	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)

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

AEROFLEX
A passion for performance.

www.aeroflex.com

info-test@aeroflex.com

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

Part No. 46891/001, Issue 11, 02/04

BACK

Signal Sources

2026A/B 10 kHz to 2.05/2.51 GHz MultiSource Generator

AEROFLEX
A passion for performance.

Up to three fully functional signal generators in one unit offering a unique solution for complex tests on receivers, components and systems.

- Two or three high quality RF signal generators in a space efficient format
- Ideal for intermodulation and receiver characterization
- Wide frequency coverage:-
  10 kHz to 2.05 GHz (2026A)
  10 kHz to 2.51 GHz (2026B)
- +24 dBm RF output for effective component testing
- Support for an external signal generator
- Application specific test modes simplify measurement procedures
- User defined tracking between signal sources
- Adjustable carrier phase to allow peaking of three tone intermodulation
- Built-in switched combiner network improves measurement uncertainty
- Optional GSM modulation for testing multi-carrier power amplifiers
- Optional Bluetooth and GSM modulation

The 2026A/B are multiple source generators which offer two RF signal generators in one box with a third source available as an option. Each source is a fully functional RF signal generator with AM, FM, ØM, 2FSK, 4FSK and pulse modulation capability.

The 2026A/B are ideal for use in R&D and manufacturing where there is a need for two or three combined sources for conducting tests such as intermodulation and selectivity performance of components and receiver assemblies.

To aid the user to undertake difficult test procedures simply and without ambiguity, the 2026A/B family provide application-specific modes of operation. Application modes include amplifier two and three-tone intermodulation, receiver intermodulation and receiver selectivity. A rotary control and up/down keys allow easy modification of the selected parameters.

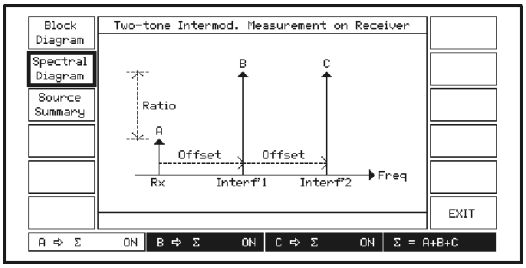
Measurement Accuracy

The use of a built in combiner, switches and cables eliminates many of the measurement uncertainties introduced by connecting together separate signal generators. The 2026A/B family thereby guarantees the level of intermodulation products introduced during amplifier or receiver intermodulation testing.

All alignment processes, including the internal frequency standard and the correction factors for the signal source RF paths, are digitally derived so realignment can be undertaken without removal of external covers. Digital adjustment also eliminates the use of mechanical adjusters, minimizing long term drift and vulnerability to mechanical shock.

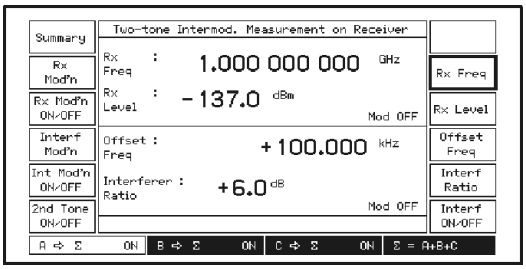
Application Modes

The 2026A/B family has a Set Up Key to enable the applications to be selected. Each Set Up is displayed as a pictorial representation of the internal signal source routing. A spectral diagram is used to show the parameters to be entered in each application in well known engineering terminology.



Spectral diagram of two tone intermodulation on a receiver

For example, selecting 'Intermodulation on a Receiver Test' allows the signal sources to be automatically set by entering the receiver input frequency and level, the ratio of the level of the two interferers (relative to the receiver input level) and the offset frequency (channel spacing).

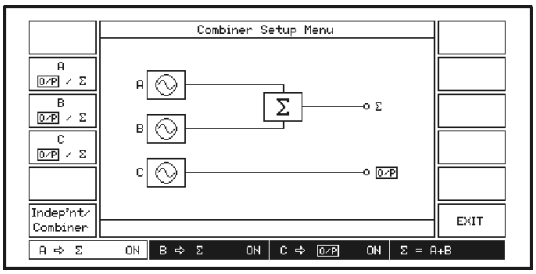


Application mode for intermodulation test on a receiver

Other application modes include 2 and 3 tone intermodulation tests on amplifiers and receiver selectivity.

Flexible Source Routing

Each of the signal sources can either be routed to a separate output connector or switched to the input of an RF combiner network before being fed to the combiner output connector. The combiner routing is set up quickly and effectively using the Combiner Set Up menu. The flexibility of the signal routing allows the 2026A/B family to accept an external signal generator, such as the 2050 Digital and Vector Generator, to enable different forms of carrier signals to be produced. Alternatively the output from a 2029 Vector Modulator, driven from one of the 2026A/B sources can be routed in.

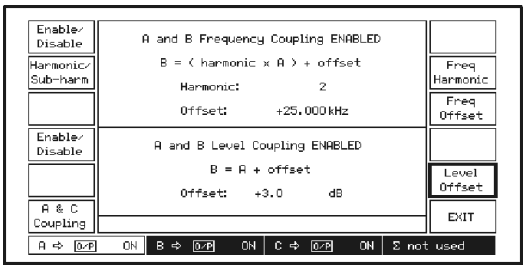


Setting up the source and combiner routing

Automatic Source Coupling

As an alternative to the application modes, the 2026A/B MultiSource Generator family allows the frequency and level of the internal RF sources to be coupled together with a user defined offset. The source frequencies can have an offset with an additional harmonic (or sub-harmonic) relationship to simplify the testing of harmonic converters and divider systems.

The coupling factors are entered by an easily understood format using a dedicated coupling menu.



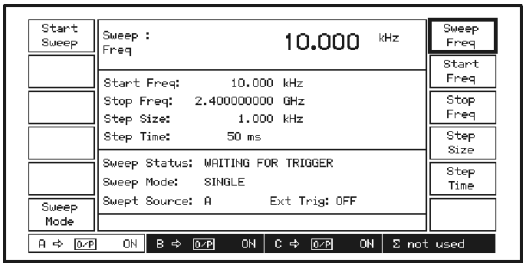
Setting up coupling

The ability to set sources to track each other greatly simplifies the testing of mixers, multipliers and dividers by reducing the number of active controls required.

Sweep

The 2026A/B family allows one of the RF sources to be frequency swept with user defined start, stop, and step values to reduce the amount of operator time or GPIB overhead. By enabling the coupling facility, sweeping one source will simultaneously sweep the other internal RF sources to allow automated swept measurements on frequency conversion devices to be made.

The sweep can be performed with modulation enabled for swept measurements of receiver immunity characteristics.



2026A/B sweep menu

High RF Output

The high RF level of the individual outputs is ideal for testing components and ensures that the 2026A/B family can generate high RF levels at the combiner output while maintaining low levels of intermodulation.

Comprehensive Modulation

Each signal source is capable of being independently modulated from its own fully programmable modulation source to ensure maximum flexibility. The internal modulation sources are each capable of generating sine, triangle or square wave signals.

Amplitude, frequency and phase modulated carriers can be generated from the internal modulation sources or from the independent external inputs. The frequency modulation system provides excellent performance in the DC coupled mode with very low carrier frequency error and stability ensuring that the generator can accurately test

receivers sensitive to small frequency errors.

Pulse Modulation

Each source is capable of being independently pulse modulated to allow the simulation of TDD or TDMA RF signal bursts with pulse on/off ratios of better than 40 dB and a rise time of less than 10 μs.

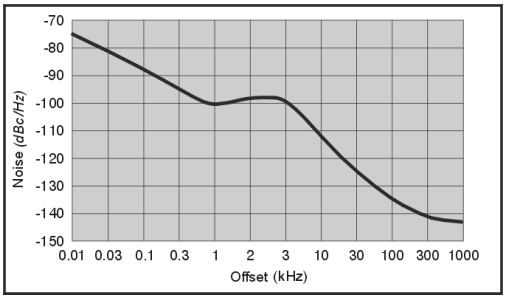
FSK

In addition to the analog FM facilities, the 2026A/B MultiSource Generator family supports 2 and 4-level FSK signals from external logic inputs. The FM deviation generated is set by keyboard entry of the required deviation. The facility is ideal for testing paging receivers and RF modems.

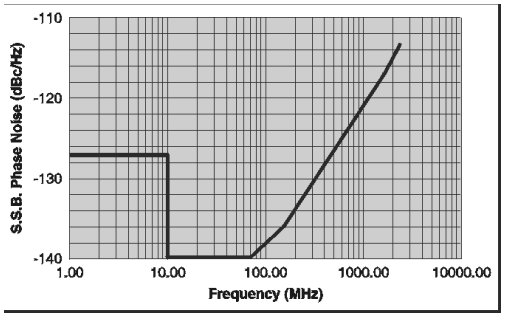
GSM Modulation

Option 116 is available to allow 2026A/B to emulate GSM signals using FM techniques which achieve superior noise floor performance than solutions using IQ systems. The facility is ideal for testing GSM receiver selectivity and for testing the linearity of high performance multi-carrier power amplifiers.

HIGH SPECTRAL PURITY



Typical SSB Phase Noise at 1 GHz



Typical Phase Noise at 20 kHz offset

Measurement of receiver selectivity and ultimate signal-to-noise ratio requires good spectral purity. The 2026A/B family has a low residual FM of typically 3 Hz and typical sideband noise of -121 dBc/Hz at 20 kHz offset from 1 GHz, to allow demanding measurements to be made.

Programming

A GPIB interface is fitted so that all standard signal generator functions are controllable over the bus. The protocol and syntax of GPIB commands has been designed in accordance with IEEE 488.2 standard to facilitate the generation of ATE programs.

Low Cost of Ownership

An electronic trip protects the individual source outputs against the accidental application of reverse power.

Careful attention to the thermal design and the use of well-proven signal generator modules gives high reliability and calibration validity.

The use of flash memory and software download via the RS-232 interface means the 2026A/B family can be upgraded with its covers fitted.

OPTIONS

Option 001 - Third Source

The 2026A/B family as standard is supplied with two RF sources. A version with 3 sources is available as an option to support applications such as intermodulation tests on a receiver.

Option 003 - High Stability Time Base

For applications requiring improved frequency stability and close-in phase noise, the standard TCXO can be replaced by a high performance OCXO.

Option 004 - Rear Panel Connections

The RF connectors for all sources, their associated modulation and pulse inputs and the combiner output connector can be mounted on the rear panel for ease of use within an ATE environment, as a factory option.

Option 116 - GSM PRBS Modulation

This options gives the 2026A/B family the capability for each source to emulate a GSM carrier. This makes the 2026A/B suitable for performing test on GSM multicarrier amplifiers and GSM receivers.

Option 117 - Bluetooth and GSM PRBS Modulation

This option provides modulation facilities for two Bluetooth modulated carriers and a carrier emulating GSM Modulation.

SPECIFICATION

GENERAL DESCRIPTION

The 2026A/B MultiSource Generator family contains synthesized signal generators offering up to three independent RF sources with separate outputs or one or more of the signals routed via a combiner. The 2026B Signal Generator covers the range 10 kHz to 2.51 GHz. 2026A Signal Generators are limited to 2.05 GHz. An external signal generator can be fed into the standard 2-source 2026A or 2026B. Each signal source can be controlled independently in frequency and level and each has its own amplitude, frequency, phase and pulse modulation capability. All parameters can be entered from the front panel keyboard and a rotary control can be used to adjust most settings. The following signal generator specifications apply to all of the sources fitted.

CARRIER FREQUENCY

Range

10 kHz to 2.05 GHz with a resolution of 1 Hz (2026A)

10 kHz to 2.51 GHz with a resolution of 1 Hz (2026B)

Accuracy

As frequency standard

RF OUTPUT

Output Range

Freq Range	Individual	Combiner
10 kHz - 250 kHz	-140 to +13 dBm	Uncalibrated
250 kHz - 1 MHz	-140 to +24 dBm	Uncalibrated
1 MHz - 1.2 GHz	-140 to +24 dBm	-140 to +10 dBm
1.2 GHz - 2.51 GHz	-140 to +20 dBm	-140 to +6 dBm

Maximum output is further reduced by 5 dB when Pulse modulation is selected and/or by up to 6 dB when AM is selected dependant upon AM depth.

Resolution

0.1 dB

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 normalized for 75 Ω operation with an optional external impedance converter (applies to all outputs simultaneously).

RF Output Accuracy (over temp. range 17 to 27°C)

Freq Range	Individual	Combiner
10 kHz - 250 kHz	±0.8 dB from -127 to +13 dBm	Unspecified
250 kHz - 1 MHz	±0.8 dB from -127 to +6 dBm ±1.0 dB from +6 to +24 dBm	Unspecified
1 MHz - 1.2 GHz	±1.0 dB from -127 to -100 dBm ±0.8 dB from -100 to +6 dBm ±1.0 dB from +6 to +24 dBm	±1.0 dB from -127 to +4 dBm
1.2 GHz - 2.51 GHz	±1.6 dB from -127 to +6 dBm ±2.0 dB from +6 to +20 dBm	±2.0 dB from -127 to 0 dBm

Temperature Stability

Freq Range	Drift(dB/°C)
10 kHz - 1.2 GHz	<±0.02
1.2 GHz - 2.51 GHz	<±0.04

RF level tracking (over temp range +17 to +27°C)

Relative level accuracy between any two or more combined signals (of equal amplitude), is typically: [1]

RF level	1 MHz to 1.2 GHz	1.2 GHz to 2.51 GHz
-18 dBm to +4 dBm	±0.3 dB	±0.6 dB
<-18 dBm	±0.6 dB	±1.2 dB

Attenuator hold

Inhibits operation of the step attenuator from the level at which the key is enabled. Useable for a level reduction of at least 10 dB. Typical accuracy ±3 dB.

VSWR

Individual outputs

For output levels less than -5 dBm, output VSWR is less than 1.5:1 for carrier frequencies up to 1.2 GHz and less than 1.7:1 for carrier frequencies up to 2.51 GHz (2.05 GHz for 2026A).

Combined output

Output VSWR is less than 1.22:1 for carrier frequencies between 1 MHz to 1.2 GHz and less than 1.32:1 for carrier frequencies up to 2.51 GHz (2.05 GHz for 2026A).

RF Output connector

50 Ω type N connector to MIL-PRF-39102.

Output protection

Individual outputs

Protected from a source of reverse power up to 25 W from a source VSWR of 5:1. Protection circuit can be reset from the front panel or via the GPIB or RS-232 interface.

Combined output

No reverse power protection. Maximum total safe power 0.5 W.

SPECTRAL PURITY

Harmonics (above 1 MHz)

Individual outputs:

Typically better than -30 dBc for RF level up to +6 dBm, typically better than -25 dBc for RF levels up to +18 dBm (+14 dBm above 1.2 GHz).

Combined output:

Typically better than -30 dBc for RF level up to -18 dBm, typically better than -25 dBc for RF levels up to +4 dBm. (0 dBm above 1.2 GHz).

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.

Isolation

Better than 80 dB between individual outputs in use

Better than 60 dB from a used individual output and the combiner output

Better than 40 dB between the combiner output and an unused individual output

Intermodulation

At an RF output level of 0 dBm on the combiner into a load VSWR of 2.1 or better.

Frequency Range	Two Tone Intermodulation*
10 MHz to 2.51 GHz	<-80 dBc
5 MHz to 10 MHz	<-75 dBc
Useable but unspecified down to 1 MHz	

* Third order intermodulation products. Intermodulation levels reduce with reducing RF Level.

Residual FM (FM off)

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

BACK

Typically <1 Hz at 249 MHz, <2 Hz at 501 MHz <3 Hz at 1001 MHz <6 Hz at 2001 MHz.

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.

MODULATION CAPABILITY

FM, AM or phase modulation can be applied to the carriers generated by each signal source from independent internal or external modulation sources. The internal modulation sources are capable of generating two simultaneous signals into any one of the modulation channels. Each internal and external modulation source can be simultaneously enabled to produce combined amplitude and frequency (or phase) modulation. Pulse modulation can be applied to each of the carriers from external pulse sources. 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 each carrier using data from an external source.

FREQUENCY MODULATION

Deviation

Resolution 3 digits or 1 Hz

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
0.01 - 18.75	100

Accuracy at 1 kHz

±5%

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 then 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 modulation oscillator or external via front panel BNC

FSK

Modes

2 level or 4 level FSK, external data input via a 25 way rear panel D Type connector

Frequency shift

Variable up to ±100 kHz

Accuracy

As FM deviation accuracy, timing jitter ±3.2 µs

Filter

8th order Bessel BW 3.9 kHz

PHASE MODULATION

Deviation

0 to 10 radians, resolution 3 digits or 0.01 radians

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

Individual Outputs

For carrier frequencies <500 MHz useable to 1.5 GHz

Combined Output

Unspecified below 5 MHz useable to 1 MHz, otherwise as individual outputs.

Range

0 to 99.9%, resolution 0.1%

Accuracy(2)

±5% of set depth at 1 kHz, over temperature range 17°C to 27°C 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)

<1.5% at 1 kHz rate for modulation depths up to 30%

<2.5% at 1 kHz rate for modulation depths up to 80%

Modulation source

Internal LF generator or external, via front panel BNC

PM on AM

Typically 0.1 radians at 30% depth at 470 MHz

PULSE MODULATION

Frequency range

32 MHz to 2.51 GHz (2.05 GHz for 2026A), useable to 10 MHz

RF level range

Maximum guaranteed output is reduced by 5 dB when pulse modulation is selected

RF level accuracy

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

Control

Pulse input is on a front panel BNC with 10 kΩ nominal 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, overshoot <1 dB

MODULATION OSCILLATOR

The internal modulation oscillator for each signal source is capable of generating one or two modulation tones simultaneously in one modulation channel.

Frequency range

0.01 Hz to 20 kHz with a resolution of 0.01 Hz, 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 from each source is available on the front panel Modulation Input/Output BNC connector at a nominal level of 2 V RMS EMF from a 600 Ω source impedance.

EXTERNAL MODULATION

Input on the front panel Modulation Input/Output connector. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance is 100 kΩ nominal. Maximum safe input ±15 V.

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 in the display indicate when the input is outside levelling range.

SWEEP MODE

The carrier frequency of one source can be swept. To enable more than one source to be swept the coupling facility must be invoked.

The start/stop values of carrier frequency, frequency step size and time per step can be set.

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 in single, continuous, start/stop or single step mode.

FREQUENCY STANDARD

FREQUENCY STANDARD (TCXO)

Frequency 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/output

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

EXTERNAL RF INPUT

The following applies when an external input is connected at the rear panel.

Insertion loss	15 dB ±1.5 dB
Frequency range	1 MHz to 3 GHz
Return loss	>20 dB to 2.51 GHz
Max input power	0.5 W

GENERAL

GPIB INTERFACE

All signal source parameters except the supply switch are remotely programmable.

Designed in accordance with IEEE 488.2.

RS-232

All signal source parameters except the supply switch are remotely programmable.
Connector is 9 way D type, baud rate 300 to 9600 bits per second. Handshake hardware is DTR, RTS, CTS and DSR and software is XON and XOFF. Electrical interface is to EIA-232-D.

ELECTROMAGNETIC COMPATIBILITY

Conforms with the protection requirements of Council Directive 89/336/EEC. Complies 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 (as amended) and the product safety standard IEC/EN 61010-1 : 2001 + C1 : 2002 + C2 : 2003 for class 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an installation category 2 supply.

RATED RANGE OF USE

(Over which full specification is met unless otherwise indicated.)

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 +71°C, Humidity up to 93% at 40°C
Altitude up to 4600 m (15,000 ft)

POWER REQUIREMENTS

AC SUPPLY

Voltage

100 - 240 V ~(Limit 90 - 264 V~)

Frequency

50 - 60 Hz (Limit 45 - 66 Hz)

Power Consumption

250 VA maximum

CALIBRATION INTERVAL

2 years

DIMENSIONS AND WEIGHT

(over projections but excluding front panel handles)

Height	Width	Depth	Weight
177 mm	419 mm	488 mm	16 kg

OPTIONS

OPTION 001 - 3 SOURCE SIGNAL GENERATOR

Includes 3 signal sources

OPTION 003 - 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, $<\pm 5$ in 10^9 per day after two 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 004 - REAR PANEL INPUTS

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

OPTION 116 - GSM MODULATION

Option 116 is available on 2026Q and 2026A/B signal generators.

Baseband source

Data rate

270.833333 kHz (13 MHz/48).

Data rate accuracy

As 10 MHz frequency standard.

Filter

Gaussian filter approximated by eight-pole RC network.

Number of outputs

3

Data pattern

(2^{15} -1) PRBS sequence.

The outputs are separated in time to ensure that they are not correlated.

ACCURACY

FM deviation

Typically better than 2% when used as described.

SPECTRAL CHARACTERISTIC

Wideband noise

For an output of +10 dBm on the individual output typically -75 dBc measured in a 100 kHz bandwidth relative to the modulated signal measured in a 30 kHz bandwidth at 6 MHz offset, in accordance with ETSI-defined measurement methods on wideband noise.

Option 117 Bluetooth and GSM Modulation

Option 117 is available on the 2026A/B Signal Generators and provides a facility for generating two independant Bluetooth modulated carriers and a simulated GSM carrier. The modulation data source for each channel can be independantly selected as either internal PRBS (Bluetooth PN 9, GSM Bluetooth PN 15) or external data. Refer to separate option 117 application note for further information.

Notes

(1) Does not apply to external RF input signals to combiner.

(2) For RF levels not exceeding +10 dBm (individual output) or -4 dBm (combined output).

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2026A	10 kHz to 2.05 GHz MultiSource Generator (2 internal sources)
2026B	10 kHz to 2.51 GHz MultiSource Generator (2 internal sources)

Options

Option 001	Add third internal source
Option 003	High stability frequency standard
Option 004	Rear panel outputs
Option 116	GSM PRBS modulation (not with Option 117)
Option 117	GSM and Bluetooth Modulation (not with Option 116)

Supplied with

	AC power supply lead
46882/466	Operating Manual

Optional Accessories

46880/100	Service manual
46884/293	Rack mounting kit, depths from 480 mm to 680 mm
46884/294	Rack mounting kit, depths from 680 mm to 840 mm
46884/931	Rack mounting kit containing front panel brackets only
46662/614	Soft carrying case
43129/189	1.5 m GPIB lead
46884/650	RS-232 Cable 9 way female to a 9 way female 1.5 m
46884/649	RS-232 Cable 9 way female to a 25 way female 1.5 m
54112/165	Hard carrying case

CHINA Beijing
Tel: [+86] (10) 6539 1166
Fax: [+86] (10) 6539 1778

CHINA Shanghai
Tel: [+86] (21) 5109 5128
Fax: [+86] (21) 5150 6112

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1628 604455
Fax: [+44] (0) 1628 662017

UK Cambridge
Tel: [+44] (0) 1763 262277
Fax: [+44] (0) 1763 285353

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

AEROFLEX
A passion for performance.

www.aeroflex.com

info-test@aeroflex.com

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

Part No. 46891/119, Issue 11, 06/05

BACK

Signal Sources

2026Q CDMA Interferer Multisource Generator

AEROFLEX
A passion for performance.

The 2026Q is designed to work with a radio test set to provide a fully integrated radio receiver test solution for cellular and PCS systems

- Two tone interference generation for AMPS/CDMA receiver testing in accordance with IS-97-A/IS-98-A
- Option for providing GSM signals for receiver and amplifier testing
- Combiner output frequency range from 800 MHz to 2.0 GHz
- Provides single calibrated point of reference for the transceiver under test
- Excellent phase noise and spectral purity
- Elimination of additional RF combining or signal conditioning
- High internal isolation of returned signals
- Includes two independent, fully featured RF signal generators 10 kHz to 2.4 GHz
- Very low levels of internally generated intermodulation products
- Single unit solution for CDMA interference testing

The 2026Q is a derivative of the popular 2026 MultiSource RF signal generator. It has been designed to work directly with a CDMA radio test set to produce a fully integrated radio receiver test solution for CDMA cellular and PCS systems in accordance with IS-97-A/IS-98-A.

Calibrated and Combined Signal Path

It is designed to produce a fully calibrated combined RF output containing any mix of internally generated interference signals from its two RF sources, together with a calibrated signal path for a radio test set transmit output. A return path from the transceiver back to the radio test set receiver input is also provided through the instrument as illustrated in figure 1.

This allows a CDMA receiver to be tested for sensitivity in the presence of single or dual tone interference. The interfering signals are combined without the need for any RF switching mechanism that would otherwise affect the test result.

Option 116 allows the 2026Q to provide GSM modulated signals for receiver or amplifier testing with low floor noise characteristics.

High Isolation

2026Q is configured to ensure high levels of isolation between each of the transmit and receive paths between the radio test set, the interfering signal sources and the transceiver under test.

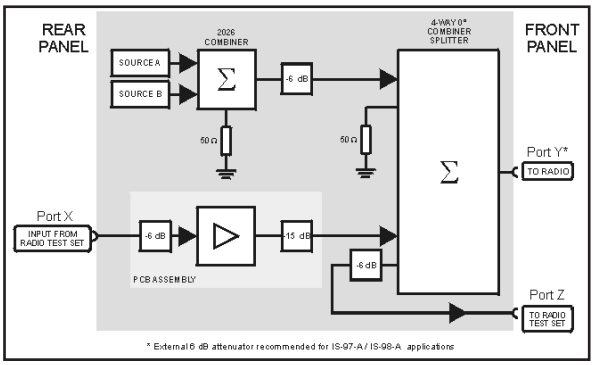


Figure 1 : 2026Q configured for radio testing with a test set

Path loss test data is supplied with each instrument for the frequency bands 865 MHz - 895 MHz, 1750 MHz - 1990 MHz. Drift influences within these bands is minimal ensuring a level accuracy of better than ±0.75 dB. The frequency response across each of these bands is flat to within ±0.1 dB, thus minimizing the need for additional system calibration.

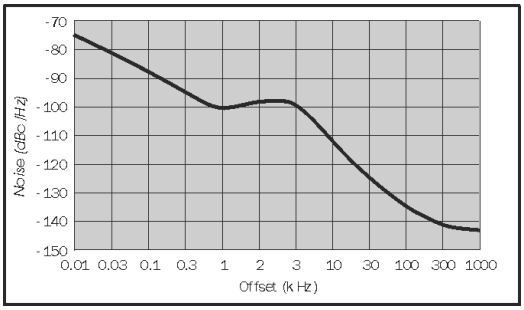
Independent Signal Generators

Each of the RF generators contained within 2026Q may be used independently, routed to their individual RF connectors. In this mode, each generator covers the full frequency range 10 kHz to 2.4 GHz with an output power of between -137 dBm and +24 dBm. Each source may be independently modulated either from an internal or external source(s). Modulation modes include AM, FM, PM, Pulse and 2/4 level FSK. The standard 2026 specification applies when used in this mode.

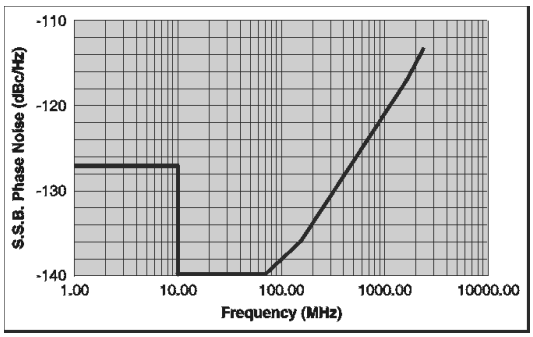
Excellent Spectral Purity

Very low phase noise and spurious responses are achieved making them ideal for CDMA handset interference tests and other general purpose applications. The 2026Q has a low residual FM of typically 3 Hz and typical sideband noise of -121 dBc/Hz at 20 kHz offset from 1 GHz.

The excellent noise floor performance is more than adequate for mobile handset and base station testing.



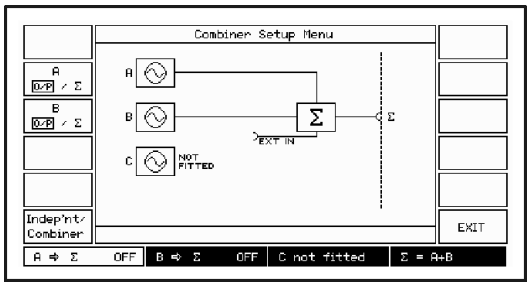
Typical SSB Phase Noise at 1 GHz



Typical Phase Noise at 20 kHz offset

Flexible Source Routing

Each of the signal sources can either be routed to a separate output connector or switched to the input of an RF combiner network before being fed to the combiner output connector. The combiner routing is set up quickly and effectively using the Combiner Set Up menu.

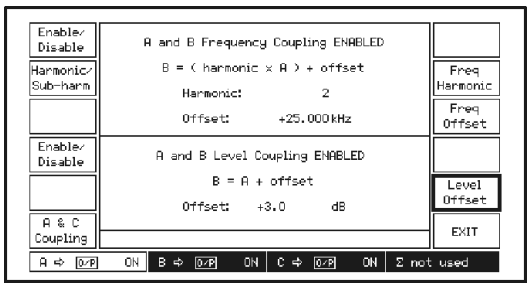


Setting up the source and combiner routing

The flexibility of the signal routing allows the 2026Q to accept an external input from another signal generator, such as the 2050 Digital and Vector Generator producing CDMA modulation or a radio test set.

Automatic Source Coupling

The two internal generators can have their frequency and level 'coupled'. In the case of RF level this coupling can be any fixed offset enabling control of a single parameter to manifest a change in both sources. For RF frequency this coupling can be both a fixed frequency offset or a harmonically related offset and again allow simple programming and control of the instrument.



Setting up coupling

Sweep

The 2026Q allows either of the independent RF sources to be frequency swept with user defined start, stop, and step values to reduce the amount of operator time or GPIB overhead. By enabling the coupling facility, sweeping one source will simultaneously sweep the other internal RF source to allow automated swept measurements on frequency conversion devices to be made.

High RF Output

Each of the RF signal generators is able to deliver up to +24 dBm at their output, making them ideal for testing components such as mixers and amplifiers etc.

Comprehensive Modulation

Each signal source is capable of being independently modulated from its own fully programmable modulation source to ensure maximum flexibility. The internal modulation sources are each capable of generating sine, triangle or square wave signals.

Amplitude, frequency and phase modulated carriers can be generated from the internal modulation sources or from the independent external inputs.

BACK

The frequency modulation system provides excellent performance in the DC coupled mode with very low carrier frequency error and stability ensuring that the generator can accurately test receivers sensitive to small frequency errors.

Programming

A GPIB interface is fitted so that all standard signal generator functions are controllable over the bus. The protocol and syntax of GPIB commands has been designed in accordance with IEEE 488.2 standard to facilitate the generation of ATE programs.

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.

Low Cost of Ownership

An electronic trip protects the individual source outputs against the accidental application of reverse power.

Careful attention to the thermal design and the use of well-proven signal generator modules gives high reliability and calibration validity.

The use of flash memory and software download via the RS-232 interface means the 2026Q can be upgraded with its covers fitted.

Option 116 - GSM Modulation

Option 116 is avaialble to allow 2026A/B to emulate GSM signals using FM techniques which achieves superior noise floor performance than solutions using IQ systems. The facility is ideal for testing GSM receiver selectivity and for testing the linearity of high performance multi-carrier power amplifiers.

SPECIFICATION

GENERAL DESCRIPTION

The 2026Q CDMA Interferer MultiSource Generator is a purpose built instrument for testing CDMA hand-set and base station equipment. It features two synthesized RF signal generators with both independent and combined RF outputs. The combined RF output provides a path to and from the radio under test and an appropriate CDMA radio test set. Each signal source covers the frequency range 10 kHz to 2.4 GHz, whilst the combined path covers the range 800 MHz to 2.0 GHz.

CARRIER FREQUENCY

Independent source frequency range

10 kHz to 2.4 GHz with a resolution of 1 Hz

Combined output frequency range

800 MHz to 2.0 GHz with a resolution of 1 Hz

Accuracy

As frequency standard

RF OUTPUT

Range

Individual outputs
-137 dBm to +24 dBm[1]

Combiner outputs
-137 dBm to -3 dBm[1]

Maximum output is reduced by 5 dB when pulse modulation is selected and/or by up to 6 dB when AM is selected dependent upon AM depth.

Resolution

0.1 dB or 3 digits for linear units

Accuracy (Individual RF outputs)

(over temp range 17 to 27°C)

RF Level	-127 dBm to -100 dBm	-100 dBm to +6 dBm[2]	>+6 dBm to +24 dBm
Up to 1.2 GHz	±1.0 dB	±0.8 dB	±1.0 dB
Above 1.2 GHz	±1.6 dB	±1.6 dB	±2.0 dB

Temperature Stability

Up to 1.2 GHz	<±0.02 dB/°C
Above 1.2 GHz	<±0.04 dB/°C

Accuracy (Combined RF output)

(over temp range 17 to 27°C and level range -20 dBm to -35 dBm)

RF Frequency range	Level Accuracy
865 MHz - 895 MHz	±0.75 dB
1750 MHz - 1990 MHz	±0.75 dB

Attenuator hold

Inhibits operation of the step attenuator from the level at which the key is enabled. Useable for a level reduction of at least 10 dB. Typical accuracy ±3 dB.

VSWR

Individual outputs
For output levels less than -5 dBm, output VSWR is less than 1.5:1 for carrier frequencies up to 1.2 GHz and less than 1.7:1 for carrier frequencies up to 2.4 GHz.

Path Loss

	865 MHz to 895 MHz	1750 MHz to 1990 MHz
(X → Y)*	14 dB typ.	15 dB typ.
(Y → Z)	13.5 dB typ.	13.5 dB typ.
(Y → X)	>40 dB	> 40 dB

** -measured values are supplied with each instrument with a frequency response of <± 0.1 dB across the frequency bands 865 MHz to 895 MHz, 1750 MHz to 1780 MHz and 1930 MHz to 1990 MHz. Measurement uncertainty of ± 0.25 dB applies.*

Options are available providing lower path loss figures - please contact your IFR sales office for further details.

VSWR (refer to Figure 1)

	865 MHz to 895 MHz	1750 MHz to 1990 MHz
Port X	<1.2:1	<1.35:1
Port Y	<1.6:1*	<1.6:1*
Port Z	<1.35:1	<1.35:1

**Typically <1.25:1*

Maximum	Safe Power (matched)
Port X	+19 dBm
Port Y	+33 dBm
Port Z	+33 dBm

RF Output connector

50 Ω type N connector to MIL-PRF-39102.

Output protection

Individual outputs

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 interface.

Combined output

No reverse power protection.

SPECTRAL PURITY

Harmonics

Individual outputs:

Typically better than -30 dBc for RF level up to +6 dBm, typically better than -25 dBc for RF levels up to +18 dBm (+14 dBm above 1.2 GHz).

Combined output:

Typically better than -30 dBc for RF level up to -36 dBm, typically better than -25 dBc for RF levels up to -13 dBm.

Non-Harmonics

Better than -70 dBc to 1 GHz, better than -64 dBc above 1 GHz, better than -60 dBc above 2 GHz.

Isolation

Better than 80 dB between individual outputs in use.
Better than 60 dB from a used individual output and the combiner output.

Intermodulation

<-80 dBc at an RF output level of -22 dBm on the combiner, across the range 800 MHz to 2.0 GHz. Intermodulation levels reduce with reducing RF Level.

Residual FM (FM off)

Less then 4.5 Hz RMS deviation in a 300 Hz to 3.4 kHz un-weighted bandwidth at 1 GHz. Typically <1 Hz at 249 MHz, <3 Hz at 1001 MHz.

Radio Connections

Refer to Figure 1

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.

MODULATION CAPABILITY

FM, AM or phase modulation can be applied to the carriers generated by each signal source from independent internal or external modulation sources.

The internal modulation sources are capable of generating two simultaneous signals into any one of the modulation channels. Each internal and external modulation source can be simultaneously enabled to produce combined amplitude and frequency (or phase) modulation.

Pulse modulation can be applied to each of the carriers from external pulse sources. 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 each carrier using data from an external source.

FREQUENCY MODULATION

Deviation

0 to 100 kHz

Resolution

3 digits or 1 Hz

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 then 5 µs to 100 kHz

Carrier frequency offset (DC coupled)

Less than 1% of the set frequency deviation

Distortion

Less than 1% at 1 kHz rate for deviations up to 100 kHz

Typically ≤0.3% at 1 kHz rate for deviations up to 10 kHz

Less than 3% at 1 kHz rate and deviations upto 100 kHz for carrier frequencies below 50 MHz

Modulation source

Internal modulation oscillator or external via front panel BNC

FSK

Modes

2 level or 4 level FSK

Data source

External data input via a 25 way rear panel D Type connector

Frequency shift

Variable 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

Resolution

3 digits or 0.01 radians

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, useable to 1.5 GHz on the individual outputs

Range

0 to 99.9%

Resolution

0.1%

Accuracy[3]

±5% of set depth at 1 kHz rate

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[3]

<1.5% at 1 kHz rate for modulation depths up to 30%

<2.5% at 1 kHz rate for modulation depths up to 80%

Modulation source

Internal LF generator or external, via front panel BNC

PM on AM

Typically 0.1 radians at 30% depth at 470 MHz

PULSE MODULATION

Frequency range

32 MHz to 2.4 GHz, useable to 10 MHz

RF level range

Maximum guaranteed output is reduced by 5 dB when pulse modulation is selected

RF level accuracy

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

Control

Pulse input is on a front panel BNC with 10 kΩ nominal 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

Overshoot

<1 dB

MODULATION OSCILLATOR

The internal modulation oscillator for each signal source is capable of generating one or two modulation tones simultaneously in one modulation channel.

Frequency range

0.01 Hz to 20 kHz with a resolution of 0.01 Hz

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 from each source is available on the front panel Modulation Input/Output BNC connector at a nominal level of 2 V RMS EMF from a 600 Ω source impedance.

EXTERNAL MODULATION

Input on the front panel Modulation Input/Output connector. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance is 100 kΩ nominal. Maximum safe input ±15 V.

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 in the display indicate when the input is outside levelling range.

SWEEP MODE

The carrier frequency of one source can be swept. To enable more than one source to be swept the coupling facility must be invoked.

Control parameters

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

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 in single, continuous, start/stop or single step mode.

FREQUENCY STANDARD (OCXO)

Frequency

10 MHz

Ageing rate

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

Temperature 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.

External input/output

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

GENERAL

GPIB INTERFACE

All signal source parameters except the supply switch are remotely programmable.

Designed in accordance with IEEE 488.2.

RS-232

All signal source parameters except the supply switch are remotely programmable.
Connector is 9 way D type, baud rate 300 to 9600 bits per second. Handshake hardware is DTR, RTS, CTS and DSR and software is XON and XOFF. Electrical interface is 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 (as amended) and the product safety standard IEC/EN 61010-1 : 2001 + C1 : 2002 + C2 : 2003 for class 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an installation category 2 supply.

RATED RANGE OF USE

(Over which full specification is met unless otherwise indicated.)

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 +71°C, Humidity up to 93% at 40°C
Altitude up to 4600 m (15,000 ft)

POWER REQUIREMENTS

AC SUPPLY

Voltage

100 - 240 V ~(Limit 90 - 264 V~)

Frequency

50 - 60 Hz (Limit 45 - 66 Hz)

Power Consumption

250 VA maximum

CALIBRATION INTERVAL

2 years

DIMENSIONS AND WEIGHT

(over projections but excluding front panel handles)

Height	Width	Depth	Weight
177 mm	419 mm	488 mm	<17kg

OPTIONS

OPTION 116 - GSM MODULATION

Option 116 is available on 2026Q and 2026A/B signal generators.

Baseband source

Data rate

270.833333 kHz (13 MHz/48).

Data rate accuracy

As 10 MHz frequency standard.

Filter

Gaussian filter approximated by eight-pole RC network.

Number of outputs

3

Data pattern

(2^{15} -1) PRBS sequence.

The outputs are separated in time to ensure that they are not correlated.

ACCURACY

FM deviation

Typically better than 2% when used as described.

SPECTRAL CHARACTERISTIC

Wideband noise

For an output of +10 dBm on the individual output typically -83 dBc measured in a 100 kHz bandwidth relative to the modulated signal measured in a 30 kHz bandwidth at 6 MHz offset, in accordance with ETSI-defined measurement methods on wideband noise.

---

(1) Level uncalibrated above +20 dBm for frequencies >1.2 GHz (-7 dBm at combiner output)

(2) Level accuracy is unspecified below 100 kHz for levels >+6 dBm

(3) For RF output levels not exceeding +10 dBm (-22 dBm at combiner output)

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VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2026Q	CDMA Interferer MultiSource Generator

Options

Option 116	GSM PRBS modulation

Supplied with

	AC power supply lead
46882/361	Operating Manual
46880/087	Service Manual

Optional Accessories

46884/293	Rack mounting kit, depths from 480 mm to 680 mm
46884/294	Rack mounting kit, depths from 680 mm to 840 mm
46884/931	Rack mounting kit containing front panel brackets only
46662/614	Soft carrying case
43129/189	1.5 m GPIB lead
46884/650	RS-232 Cable 9 way female to a 9 way female 1.5 m
46884/649	RS-232 Cable 9 way female to a 25 way female 1.5 m

CHINA Beijing
Tel: [+86] (10) 6539 1166
Fax: [+86] (10) 6539 1778

CHINA Shanghai
Tel: [+86] (21) 5109 5128
Fax: [+86] (21) 5150 6112

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1628 604455
Fax: [+44] (0) 1628 662017

UK Cambridge
Tel: [+44] (0) 1763 262277
Fax: [+44] (0) 1763 285353

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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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.

Part No. 46891/004, Issue 9, 06/05

BACK

Signal Sources

2030 Series Signal generators

AEROFLEX
A passion for performance.

A high performance signal generator with programmable modulation sources and LF output, wide modulation bandwidths, sweep capability and excellent accuracy.

- Wideband cover:-
  10 kHz to 1.35 GHz (2030)
  10 kHz to 2.7 GHz (2031)
  10 kHz to 5.4 GHz (2032)
- 0.1 Hz frequency resolution
- 0.1 Hz to 500 kHz modulation oscillator
- Wideband FM with 10 MHz bandwidth
- Single, dual, composite and dual composite modulation modes
- GPIB programming (IEEE 488.2 standard)
- Simple operation through menu selection of modes

The 2030 series of signal generators offers increased flexibility with combinations of frequency, phase, amplitude and pulse modulation over the frequency ranges 10 kHz to 1.35 GHz (2030), 10 kHz to 2.7 GHz (2031) and 10 kHz to 5.4 GHz (2032). These instruments are suitable for a wide variety of applications ranging from RF component characterization to radio communications system testing. Set up time is reduced by recalling previously stored instrument settings from the non-volatile memory. Remote programming via the GPIB is provided as a standard feature, allowing the instruments to be included in automatic test systems.

Operation

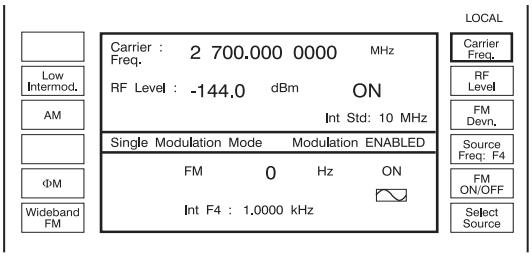
Operation of the instrument is performed by simply selecting the required operating mode and entering parameter values using the numeric keypad. Parameter values may be varied by means of the rotary control knob or by use of the ⇧⇩keys.

The Signal Generator, Sweep, LF, Delta, Memory and Utility displays are selectable at any point of operation using the keys below the screen. Within each display, soft keys are assigned alongside the display to allow parameter entry or to select the relevant functions.

Display

A large screen, dot matrix liquid crystal display, with backlighting, offers excellent clarity and low power consumption. Contrast may be varied using the knob to optimize the viewing angle and differing lighting conditions may be accommodated by adjusting the backlight intensity.

The parameters displayed on the screen depend on the operating mode selected; for example in the Signal Generator mode, carrier frequency, modulation and RF level are shown in separate horizontal regions. Status information is also shown with error messages being displayed in a single line at the top of the screen.



BACK

Frequency selection

Carrier frequency entry is selected via a soft key option on the signal generator screen and data is then entered directly via the keyboard. Frequency is resolved to within 0.1 Hz across the complete range of the instrument. Carrier frequencies can be stored in the non-volatile memory for recall at any time. A CARRIER ON-OFF switch is provided to completely disable the output.

RF Output

RF output up to +13 dBm can be set by direct keyboard entry with a resolution of 0.1 dB or better over the entire range. An extended hysterisis facility allows for extended electronic control of RF output level without introducing mechanical attenuator transients when testing squelch systems and an overrange facility allows the generator to produce RF levels above the normal operating range. A high output option is available to extend the maximum calibrated level to +19 dBm on 2030.

A low intermodulation mode can be selected which freezes the RF levelling system and improves the intermodulation performance when combining the outputs of two signal generators.

Calibration Units

A choice of calibration units is available to the operator and provision is made for the simple conversion of units (for example, dBm to mV). For units without Option 8 the output level can be offset by up to ±2 dB by keyboard entry. Offsets from the calibrated value may be used to compensate for cable or switching losses external to the generator. The operator may also use this facility as a means of deliberately offsetting the output level to ensure that all generators in an area give identical measurements. While using the offset facility, the calibration of the signal generator is not lost and may be returned to at any time.

Units with RF profile and complex sweep option (Option 8) have a much more comprehensive profiling and offsetting capability.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W, preventing damage to output circuits when RF or DC power is accidentally applied. This feature contributes to long unit life and low cost of ownership.

MODULATION

Comprehensive amplitude, frequency (plus Wideband FM), phase and optional pulse generation and modulation are provided for testing all types of receivers.

Modulation Oscillator

An internal modulation oscillator is provided with a frequency range of 0.1 Hz to 500 kHz, resolved to 0.1 Hz. In addition to the normal sine wave output, alternative triangular or square waveforms may be selected. A second oscillator may be added as an option. Two independent BNC inputs on the front panel allow external modulation signals to be mixed with the internal signal(s) allowing a maximum of four modulations channels to be active at one time.

Modulation Modes

Four modulation modes are provided – single, dual, composite and dual composite. In the single mode only one type of modulation can be active at any time. Selecting alternative modulation cancels any other active modulation. In the dual mode two types of modulation may be obtained allowing one form of frequency modulation to be combined with one form of amplitude modulation. In the composite mode, only one type of modulation can be active, and is fed by two independent channels. The dual composite mode combines the facilities of the dual mode with the composite mode and provides two types of modulation each fed from two sources.

Frequency and Phase Modulation

The wide range frequency modulation capability provides a 1 dB bandwidth of 300 kHz and provides FM deviation up to a maximum of 1 MHz for frequencies up to 21 MHz and 1% of carrier frequency else-where. Phase modulation is also available with a 10 kHz bandwidth up to a maximum of 10 radians.

Both AC and DC coupled FM are available and in the DC coupled mode a patented offset correction system eliminates the large carrier frequency offsets that occur with normal signal generators. As a result the 2030 series signal generators can be used confidently for testing tone and message paging equipment.

Wideband FM

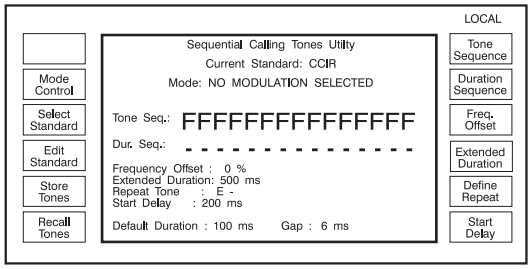
Broadband frequency modulation with a 3 dB bandwidth of 10 MHz is provided via a rear panel BNC socket. This is ideal for tests on equipment using frequency shift keying for high speed digital transmission.

Amplitude and Pulse Modulation

Amplitude modulation with a 1 dB band-width of 30 kHz and with modulation depths of up to 99.9% is available with a resolution of 0.1%. Pulse modulation is available as an option with typical rise and fall times of 5 ns and 70 dB on/off ratio.

Modulation Levelling

An automatic level control facility is provided for both of the external modulation inputs and provides correctly calibrated modulation for input levels varying from 0.7 V to 1.4 V RMS. HI and LO indications show when the input level is outside the range of the ALC system.



Tone Signaling

The signaling facility allows testing of radios with DTMF, sequential and sub-audible tone capability. A wide range of tone system standards are built in and provision is also made for user definable standards to cover special requirements. Tone sequences can be set up with up to 16 tones in length and the complete sequence can be sent from 1 to 9 times or set to repeat on a continuous basis. Sub-audible tones are normally used in the composite modulation mode where the modulation level for the tone and the in-band modulation can be set independently.

INCREMENTING

All major parameters can be incremented or decremented in step sizes entered via the keyboard or the GPIB.

⇧⇩ keys

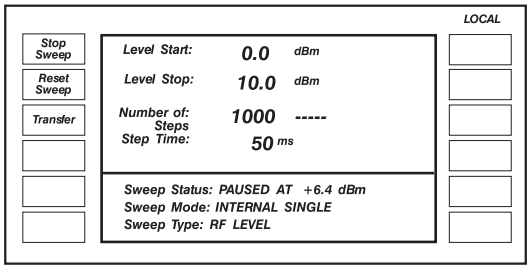
If the knob is disabled, a single touch on either the ⇧ or ⇩ key moves the parameter by a single step and holding the key pressed causes the signal generator to step continuously at a rate of about three steps per second.

Rotary Control

When the rotary control is enabled the parameters can be varied using the knob, whose sensitivity may be altered by factors of ten using the ⇧ and ⇩ keys. The digits affected by the rotary control are indicated on the display by lines above and below the numeric display.

Delta Display

The Delta menu allows the increment for all the parameters to be set and also includes a TOTAL SHIFT key to show the variations in the parameters from their last keyed in value, a RETURN key to reset the selected parameter to its start value and a TRANSFER key to update the parameter value to equal the shifted value.



SWEEP

The digital sweep capability of the 2030 series allows dynamic testing of systems and includes capabilities for sweeping carrier frequency, RF level, LF frequency and LF level. Four parameters are entered to specify the sweep – start value, stop value, number of steps and time per step.

Option 8 provides additional sweep capabilities which allow the step size, step time and RF level to be entered.

Markers and Ramp Output

Six markers may be defined and a marker output is provided on a rear panel socket together with a 0-10 V ramp signal for driving the X axis of an oscilloscope or X-Y plotter.

Start/Stop

A single key press starts the sweep and a horizontal bar graph on the display shows the progress of the sweep. The sweep can be stopped at any time and the ⇧⇩ keys used to step forwards or backwards for search purposes. Transfer of the current sweep value into the signal generator or LF modes for more detailed analysis is also possible. The sweep facility can be used in conjunction with a simple X-Y display unit, an oscilloscope or an X-Y plotter.

NON-VOLATILE MEMORY

True non-volatile memory needing no battery back-up is fitted to the 2030 series and is used to store details of instrument settings and calibration information.

Instrument Settings

Details of instrument settings are stored in four areas of memory. One area stores 50 complete instrument settings (including data on parameters which are not currently active), a second area stores 50 partial settings (consisting of details about the currently active parameters), a third area stores details of 100 carrier frequency values and a fourth area stores details of 20 sweep settings. Facilities are provided to prevent the memories from being accidentally overwritten and for recalling a specified memory at switch-on.

Calibration Data

In addition to storage and recall of measurement settings, the non-volatile memory contains data on instrument status and calibration. All calibration data on RF level, FM accuracy, internal frequency standard adjustment and modulation are retained and may be altered from the front panel or via the GPIB after disabling the software protection. Status information stored includes the identity string (type and serial number), choice of internal/external standard, GPIB address, elapsed time and a date alarm for calibration due reminders.

Memory Content Protection

To prevent accidental interference with the contents of status and calibration data, internal data is protected by a secure key sequence. Two levels of protection are offered, appropriate to the function being accessed. The most secure is reserved for features that alter the calibration data, change the time and date setting or blank the displays when memories are recalled. The first level of protection is less severe, enabling the user to access features which are relevant to normal operation, for example, selection of RF level calibration units, RF level offsets, external standard frequency and switch-on status.

Unprotected features provide a range of additional operating features, such as the ability to display status information, elapsed time, time and date, etc.

PROGRAMMING

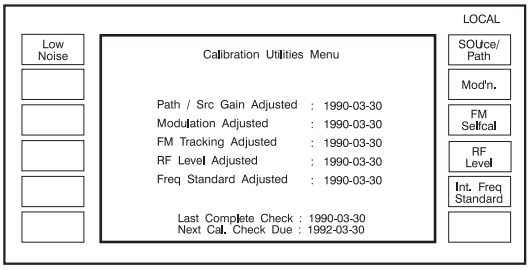
A GPIB interface is fitted as standard so that all functions are controllable over this interface. The instruments function as talkers as well as listeners and the interface has been designed in accordance with the IEEE 488.2 standard.

CALIBRATION

The 2030 series has a two year recommended calibration interval, with the user being able to calibrate some functions. The calibration display is avail-able via soft key selection in the utilities menu.

Software Assisted Calibration

When carrying out calibration manually (via the keyboard), the instrument displays information on the procedure and in the case of FM tracking even carries out the full adjustment process automatically. No internal adjustments are provided, or required, for calibration and even the internal frequency standard can be adjusted from the front panel. Calibration may also be carried out via the GPIB allowing a fully automated recalibration of all parameters to be performed.



Automatic Date Stamping

Having completed a readjustment of a parameter the instrument updates the calibration data and uses the information from the real time clock to record the date of adjustment. The calibration engineer can also set a calibration due date and when this date is reached a message will be displayed advising the operator to return the unit for calibration.

Low Cost of Ownership

In keeping with the IFR philosophy of cost-effectiveness with innovation, the 2030 series has been designed for minimal maintenance and low operating costs. The two year calibration interval combined with the high reliability ensures a low overall cost of ownership.

OPTIONS

The standard features may be supplemented by taking advantage of the various options available. See list below.

Option 1 - Second Modulation Oscillator

An additional modulation oscillator can be fitted to the 2030 series to enable greater flexibility. This second oscillator has the same specification as the first and allows full use of complex modulation modes and is particularly useful where two tone modulation is required.

Option 2 - Pulse Modulation

This optional facility allows radar RF and IF stages to be tested and features rise and fall times of less than 25 ns with an on/off ratio of better than 70 dB.

Option 3 - 19 dBm Output

A high output option is available for 2030 and provides an extra 6 dB of calibrated output level making it ideal for use as a local oscillator or in testing passive components.

Option 9 - Internal Pulse Generator

Provides internal pulses which, when used with pulse modulation, generates pulsed RF outputs to eliminate the need for an external function generator.

Option 5 - GSM PCN Modulation

An option is available for 2030 series which provides GMSK Bt 0.3 modulation at a clock rate of 270.833 kHz in accordance with the GSM specification. The option includes a comprehensive internal data generator.

Option 6 - Avionics & DME

This optional facility provides for the internal generation modulation waveforms suitable for the testing of Instrument Landing Systems (ILS) and VHF Omni Range (VOR) beacons.

Additional modes of operation support the testing of ADF, Marker Beacons and the SELCAL signaling system.

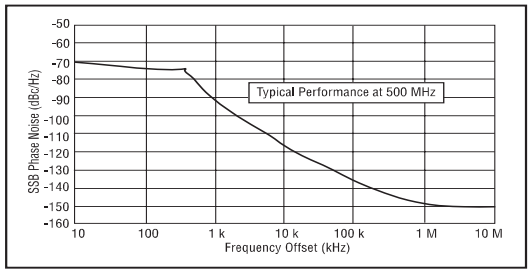
Another additional option creates Gaussian shaped double pulses to produce the correct DME RF signals to test DME receivers.

Option 8 - RF Profiles and Complex Sweep

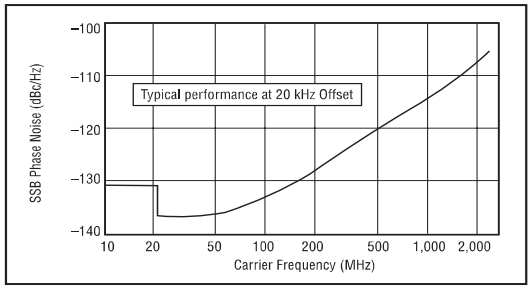
The RF Profile facility allows the signal generator to compensate for frequency dependent level errors introduced by cables, amplifiers and signal combiners. The Complex Sweep facility allows for the generation of sweeps whose step size, step time and RF level change while the sweep is in progress. These features are particularly useful for EMC, Tempest and ATE applications.

Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications.



Variation of SSB Phase Noise with Offset



Variation of SSB Phase Noise with Frequency

SPECIFICATION

GENERAL DESCRIPTION

2030 series signal generators cover the frequency ranges of 10 kHz to 1.35 GHz, 10 kHz to 2.7 GHz and 10 kHz to 5.4 GHz. A large screen dot matrix display with soft key function selection allows flexibility of operation and ease of use. The output may be amplitude, phase or frequency modulated with pulse generation and modulation available as an option. Modulation is available using a combination of an internal synthesized LF oscillator with up to two external signal inputs.

A second internal source is available as an option.

CARRIER FREQUENCY

Range

10 kHz to 1.35 GHz (2030)

10 kHz to 2.7 GHz (2031)

10 kHz to 5.4 GHz (2032)

Selection

By keyboard entry of data

Variation by ⇧⇩ keys and by rotary control

Indication

11 digits with annunciators

Resolution

0.1 Hz

Accuracy

As frequency standard

Phase incrementing

The carrier phase can be advanced or retarded in steps of 1.5° using the rotary control.

RF OUTPUT

Range

-144 dBm to +13 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Overrange

Selectable overrange mode allows uncalibrated levels up to +19 dBm to be generated (typically up to +25 dBm for 2030 with Option 003 fitted).

Selectable extended hysterisis provides for uncalibrated RF level control with up to 24 dB range without level interruption.

Selection

By keyboard entry of data. Variation by UP/DOWN keys and by rotary control. Units may be µV, mV, V EMF or PD; dB relative to 1 µV, 1 mV EMF or PD; dBm. Conversion between dB and voltage units may be achieved by pressing the appropriate units key (dB, or V, µV, mV).

Indication

4 digits with unit annunciators

Resolution

0.1 dB

VSWR

For output levels less than 0 dBm: Less than 1.25:1 to 2.2 GHz, less than 1.4:1 to 2.7 GHz, less than 1.5:1 to 5.4 GHz.

Output Protection

Reverse power of 50 W from a source VSWR of up to 5:1.

Accuracy at 22°C ±5°C

	<1.35 GHz	<2.7 GHz	<5.4 GHz
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>-100 dBm	±0.85 dB	±1 dB	±1.5 dB
>-127 dBm	±0.85 dB	±1 dB	-

Temperature stability dB/°C	<1.35 GHz	<2.7 GHz	<5.4 GHz
	±0.005	±0.01	±0.02

SPECTRAL PURITY

At RF levels up to +7 dBm:-

Harmonics

2030, 2031: Better than -30 dBc to 1 GHz; better than -27 dBc above 1 GHz.

2032: Better than -30 dB to 1 GHz; better than -27 dBc to 1.35 GHz; better than -25 dBc above 1.35 GHz.

Sub-harmonics

Better than -90 dBc to 1.35 GHz; better than -40 dBc to 2.3 GHz; better than -30 dBc to 5.4 GHz.

Non-Harmonics

Better than -70 dBc at offsets from the carrier frequency of 3 kHz or greater.

Residual FM (FM off)

Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB phase noise

Less than -116 dBc/Hz (typically -122 dBc/Hz) at an offset of 20 kHz from a carrier frequency of 470 MHz.

RF Leakage

Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm loop, 25 mm or more from any part of the case.

FM on AM

Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ØM on AM

Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

MODULATION MODES

Four modulation modes are available:

Single

FM, Wideband FM, ØM, AM or pulse (optional)

Dual

Two independent channels of differing modulation type (e.g. AM with FM).

Composite

Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite

A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

FREQUENCY MODULATION

Deviation

Peak deviation from 0 to 1 MHz for carrier frequencies up to 21.09375 MHz. Peak deviation from 0 to 1% of carrier frequency above 21.09375 MHz.

Selection

By keyboard entry of data

Variation by ⇧⇩ keys and by rotary control

Indication

3 digits with annunciators

Displayed Resolution

1 Hz or 1 least significant digit, whichever is greater

Accuracy at 1 kHz

±5% of indication ±10 Hz excluding residual FM

Bandwidth (1 dB)

DC to 300 kHz (DC coupled)

10 Hz to 300 kHz (AC coupled)

Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth is greater than 1 MHz.

Group delay

Less than 1 µs from 3 kHz to 500 kHz

Carrier Frequency Offset

In DC FM less than ±(1 Hz + 0.1% of set deviation) after using DC FM nulling facility.

Distortion

Using external modulation without ALC: Less than 3% at maximum deviation for modulation frequencies up to 20 kHz. Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation source

Internal LF generator or external via front panel sockets.

WIDEBAND FM

Deviation

As FM

Indication

3 digits with annunciators

Selection

By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the value of deviation nearest to the requested value.

Input level

1.414 V peak (1 V RMS sine wave) to achieve indicated deviation.

Accuracy

As FM

3 dB Bandwidth

Typically 10 MHz (DC or AC coupled)

Group Delay

Less than 0.5 µs from 3 kHz to 10 MHz

Modulation Source

External via BNC on rear panel, 50 Ω input impedance

PHASE MODULATION

Deviation

0 to 10 radians

Selection

By keyboard entry of data

Variation by ⇧⇩ keys and by rotary control

Indication

3 digits with annunciators

Resolution

0.01 radians

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 maximum deviation at 1 kHz modulation rate

Modulation Source

Internal LF generator or external via front panel sockets

AMPLITUDE MODULATION

For carrier frequencies up to 1 GHz

Range

0 to 99.9%

Selection

By keyboard entry of data

Variation by ⇧⇩ keys and by rotary control

Indication

3 digits with annunciator

Resolution

0.1%

Accuracy

±4% of setting ±1%

1 dB Bandwidth

With modulation ALC off: DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode

Typical modulation bandwidth exceeds 50 kHz

Distortion

For a modulation rate of 1 kHz: Less than 1% total harmonic distortion for depths up to 30%, less than 3% total harmonic distortion for depths up to 80%.

Modulation source

Internal LF generator or external via front panel sockets

MODULATION OSCILLATOR

Frequency range

0.1 Hz to 500 kHz

Selection

By keyboard entry of data

Variation by ⇧⇩ keys and by rotary control

Indication

7 digits with annunciators

Resolution

0.1 Hz

Frequency accuracy

As frequency standard

Distortion

Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz

Alternative waveforms

A triangular wave is available for frequencies up to 100 kHz

A square wave is available for frequencies up to 2 kHz

BACK

Signaling tones

The modulation oscillator can be used to generate sequential (up to 16 tones) or sub-audible signaling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF standards.*

Facilities are also available for creating and storing user defined tone systems.

** Requires second modulation oscillator (option 001) to be fitted.*

EXTERNAL MODULATION

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied.

Input impedance 100 kΩ nominal

MODULATION ALC

The EXT MOD 1 and EXT MOD 2 modulation inputs can be levelled by an ALC system

Level Range

1 V to 2 V peak (0.7 V RMS to 1.4 V RMS sine wave)

Distortion

Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz)

1 dB Bandwidth

Typically 10 Hz to 500 kHz

LF OUTPUT

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

Selection

By keyboard entry of data

Variation by ⇧⇩ keys and by rotary control

Indication

7 digits with unit annunciators for frequency and 3 digits with unit annunciators for level

Level

100 µV to 5 V RMS with a load impedance of greater than 600 Ω.
100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω

Source impedance

5.6 Ω nominal

Level accuracy at 1 kHz

With a load impedance of greater than 10 kΩ: ±5% for levels above 50 mV and ±10% for levels from 500 µV to 50 mV.

Frequency response

Typically better than ±1 dB, 0.1 Hz to 300 kHz

SWEEP

Control modes

Start/stop values of selected parameter. Number of steps. Time per step.

Step time

1 ms to 10 s per step

Sweep ramp

Synchronized analog ramp with a nominal amplitude of 0 to 10 V peak on rear panel BNC connector

Markers

User selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to +5 V from 600 Ω on rear panel BNC socket.

Trigger

Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep. Socket is internally connected via 10 kΩ pull-up resistor to +5 V.

FREQUENCY STANDARD (OCXO)

Frequency

10 MHz

Temperature stability

Better than ±5 in 10^8 over the operating range of 0 to 50°C

Warm up time

Within 2 in 10^7 of final frequency within

10 minutes from switch on at 20°C ambient

Ageing rate

Better than 2 in 10^7 per year

Output

Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω. This output can be disabled.

External input

Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ.

GENERAL

GPIB INTERFACE

A GPIB interface is fitted as standard. All functions except the supply switch and display contrast are remotely programmable.

Capabilities

Designed in accordance with IEEE 488.2.

Complies with the following subsets as defined in IEEE Std.488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

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 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 2 supply.

RATED RANGE OF USE

(Over which full specification is met)

Temperature

0 to 55°C

Humidity

Up to 93% at 40°C

CONDITIONS OF STORAGE AND TRANSPORT

Temperature

-40 to +71°C

Humidity

Up to 93% relative humidity at 40°C

Altitude

Up to 4600 m (15,000 ft)

POWER REQUIREMENTS

AC supply

Four voltage settings covering:

100 V~ (Limit 90 - 115 V~)
120 V~ (Limit 105 - 132 V~)
220 V~ (Limit 188 - 242 V~)
240 V~ (Limit 216 - 264 V~)

Frequency: 50 - 400 Hz (Limit 45 - 440 Hz) 180 VA max

CALIBRATION INTERVAL

2 years

DIMENSIONS AND WEIGHT

(Over projections but excluding front panel handles)

Height	***Width***	***Depth***	***Weight***
152 mm	425 mm	525 mm	16.5 kg
6 in	16.6 in	20.5 in	36 lb

OPTIONS

OPTION 1 - SECOND MODULATION OSCILLATOR OPTION

Specification as Modulation Oscillator

OPTION 2 - PULSE MODULATION OPTION

Modulation Modes

Pulse modulation may be used alone or in conjunction with FM, ØM or Wideband FM

Rise Time

25 ns (Typically 5 ns)

Control

0 V for carrier off, +5 V for carrier on

Threshold level typically +2.5 V

ON/OFF Ratio

Better than 70 dB

Input impedance

50 Ω

OPTION 105 - SLOWRISETIMEPULSEMODULATION

Modifies pulse modulation option for a typical rise and fall time of 2 µs

OPTION 3 - +19 dBm RF OUTPUT LEVEL OPTION

For 2030 model only

RF Output Range

–144 dBm to +19 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +13 dBm at maximum AM depth.

Harmonics

At RF levels up to +7 dBm: better than –27 dBc

OPTION 5 - GSM/PCN/PCS OPTION

See separate sheet

OPTION 6 - AVIONICS OPTION

See separate sheet

OPTION 8 - RF PROFILE AND COMPLEX SWEEP

See separate sheet

OPTION 9 - INTERNAL PULSE GENERATOR OPTION

See separate sheet

OPTION 10 - DME OPTION

See separate sheet

OPTION 12 - ELECTRONIC ATTENUATOR

Carrier Frequency Range

250 kHz to 1.35 GHz (2030),*

250 kHz to 2.7 GHz (2031).*

** Useable to 10 kHz*

RF Output Range

-138 dBm to +10 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.

Accuracy

±1.2 dB for output levels >-127 dBm at 22°C ±5°C

Temperature Stability

±0.01 dB/°C

VSWR

<1.5:1 for output levels less than 0 dBm

Reverse Power Handling

1 W from a source VSWR of up to 5:1

Amplitude Modulation

Standard specification applies for carrier frequencies above 50 MHz (Above 100 MHz for Option 6).

BACK

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers Versions

2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator

Options

Option 001	Second internal modulation oscillator
Option 002	Pulse Modulation
Option 003	+19 dBm Output Level (2030 only).
Option 005	GSM/PCN/PCS (GMSK Bt 0.3 Modulation).
Option 006	Avionics (requires Option 001, cannot be used with Option 003).
Option 008	RF Profiles and Complex Sweep.
Option 009	Internal Pulse Generator. Needs Option 002.
Option 010	DME (requires Option 001 and 006, cannot be used with Option 003 or Option 005).
Option 012	Electronic Attenuator (2030 and 2031 only). Not available with options 003 or 010
Option 105	Modifies the Pulse Modulation option for slower rise and fall time (order with option 002).
Option 112	External modulation inputs (2) 600 Ω impedance

Supplied with

AC supply lead.

Operating Manual.

Optional Accessories

46880/047	Service manual.
43126/012	RF connector cable, 50 Ω, 1.5 m, BNC.
54311/092	Coaxial adapter N male to BNC female.
59999/163	Precision coaxial adapter N male to SMA female.
54311/095	RF connector cable, 1 m, type N connectors.
43129/189	GPIB Lead assembly.
46883/408	IEEE/IEC Adapter block for GPIB socket.
46884/291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884/292	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884/541	Rack mounting kit containing front mounting brackets only.
46884/444	Maintenance kit for 2030 series.
46662/525	Transit case.
54112/164	Soft carry case.
54499/044	DECT Filter.

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

AEROFLEX
A passion for performance.

www.aeroflex.com
info-test@aeroflex.com

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

Part No. 46891/005, Issue 9, 05/04

BACK

Signal Sources

2040 Series Low Noise Signal Generator

Excellent noise characteristics and low spurious signals for a wide range of critical measurements

- Wide band cover:
  10 kHz to 1.35 GHz (2040)
  10 kHz to 2.7 GHz (2041)
  10 kHz to 5.4 GHz (2042)
- Low residual FM noise: 0.3 Hz RMS at 1 GHz
- Low spurious signals: –90 dBc non-harmonics
- Low phase noise: –140 dBc/Hz at 1 GHz
- Comprehensive modulation modes
- +13 dBm output (+19 dBm optional)
- 0.1 Hz to 500 kHz modulation oscillator
- Comprehensive frequency and amplitude sweep capabilities

The 2040 series of low noise signal generators covers a wide range of frequencies from 10 kHz to 1.35 GHz (2040), 10 kHz to 2.7 GHz (2041) and 10 kHz to 5.4 GHz (2042). With a choice of operating modes, two low noise modes for improved SSB phase noise and normal mode for increased flexibility, the 2040 series can be used in a wide variety of applications. Microprocessor control coupled with a large screen dot matrix display provides ease of use via menu driven displays. Set up time is further reduced by recalling previously stored instrument settings from the non-volatile memory. Remote programming via the GPIB is provided as a standard feature, allowing the instruments to be incorporated in automatic test systems.

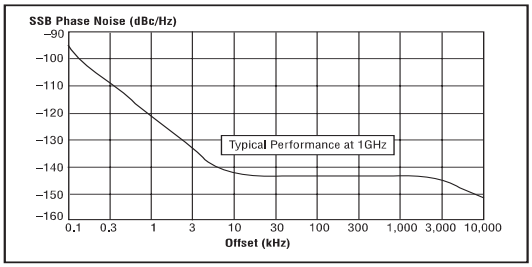
Excellent Spectral Purity

The excellent noise characteristics and the low level of spurious signals of the 2040 series enable the instruments to be used with confidence for a wide range of critical measurements.

Low SSB Phase Noise

With a specified SSB phase noise performance of better than –140 dBc/Hz at 20 kHz offset from a carrier of 1 GHz, the 2040 series of signal generators is easily able to measure UHF receiver selectivities beyond 90 dB.

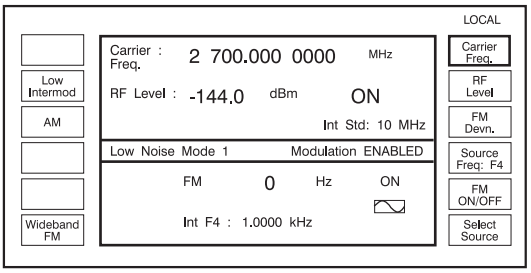
The low residual FM noise figure (less than 0.3 Hz RMS at 1 GHz) gives the 2040 series the capability of measuring UHF receiver signal to noise ratios as high as 80 dB.



Typical phase noise performance at 1 GHz

Low spurious signal content

A specified non-harmonic spurious signal content of –90 dBc ensures the suitability of the 2040 series for the most demanding measurements on modern receivers and RF systems.



Display

A large screen, dot matrix liquid crystal display, with backlighting, offers excellent clarity and low power consumption.

The parameters displayed on the screen depend on the operating mode selected; for example in the Signal Generator mode, carrier frequency, modulation and RF level are shown in separate horizontal regions. Status information is also shown with error messages being displayed in a single line at the top of the screen.

Frequency selection

Carrier frequency entry is selected via a soft key option on the signal generator screen and data is then entered directly via the keyboard. Frequency is resolved to within 0.1 Hz across the complete range of the instrument. Carrier frequencies can be stored in the non-volatile memory for recall at any time. A CARRIER ON-OFF switch is provided to completely disable the output.

RF Output

RF output up to +13 dBm can be set by direct keyboard entry with a resolution of 0.1 dB or better over the entire range. An extended hysterisis facility allows for extended electronic control of RF output level without introducing mechanical attenuator transients when testing squelch systems and an overrange facility allows the generator to produce RF levels above the normal operating range. A high output option is available to extend the maximum calibrated level to +19 dBm on 2040.

A low intermodulation mode can be selected which disables the RF levelling system and improves the intermodulation performance when combining the outputs of two signal generators.

50 W Protection

An electronic trip protects the generator output against reverse power of up to 50 W, preventing damage to output circuits when RF or DC power is accidentally applied. This feature contributes to long unit life and low cost of ownership.

VERSATILE MODULATION CAPABILITIES

Comprehensive amplitude, frequency (plus Wideband FM), phase and optional high speed pulse modulation are provided for testing all types of receivers.

Modulation Oscillator

An internal modulation oscillator is provided with a frequency range of 0.1 Hz to 500 kHz, resolved to 0.1 Hz. In addition to the normal sine wave output an alternative triangular or square waveform may be selected for sweep applications. A second oscillator may be added as an option. Two independent BNC inputs on the front panel allow external modulation signals to be mixed with the internal signal(s) allowing a maximum of four modulation channels to be active at one time.

Modulation Modes

Four modulation modes are provided – single, dual, composite and dual composite. In the single mode only one type of modulation can be active at any time. Selecting alternative modulation cancels any other active modulation. In the dual mode two types of modulation may be obtained allowing one form of frequency modulation to be combined with one form of amplitude modulation. In the composite mode, only one type of modulation can be active, and is fed by two independent channels. The dual composite mode combines the facilities of the dual mode with the composite mode and provides two types of modulation each fed from two sources.

Frequency and Phase Modulation

The wide range frequency modulation capability provides a 1 dB bandwidth of 300 kHz and provides FM deviation up to a maximum of 1 MHz for frequencies up to 21 MHz, 1% of carrier frequency elsewhere. Phase modulation is also available with a 10 kHz bandwidth up to a maximum of 10 radians.

Both AC and DC coupled FM are available and in the DC coupled mode a patented offset correction system eliminates the large carrier frequency offsets that occur with normal signal generators. As a result the 2040 series signal generators can be used confidently for testing tone and message paging equipment.

Wideband FM

Broadband frequency modulation with a 3 dB bandwidth of 10 MHz is provided via a rear panel BNC socket. This is ideal for tests on equipment using frequency shift keying for high speed digital transmission.

Amplitude and Pulse Modulation

Amplitude modulation with a 1 dB bandwidth of 30 kHz and with modulation depths of up to 99.9% is available with a resolution of 0.1%. Fast pulse modulation is available as an option with rise and fall times of less than 25 ns and a 70 dB on/off ratio.

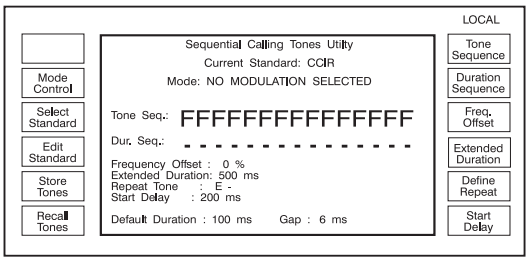
Modulation Levelling

An automatic level control facility is provided for both of the external modulation inputs and provides correctly calibrated modulation for input levels varying from 0.7 to 1.4 V RMS. Hl and LO indications show when the input level is outside the range of the ALC system.

Tone Signaling

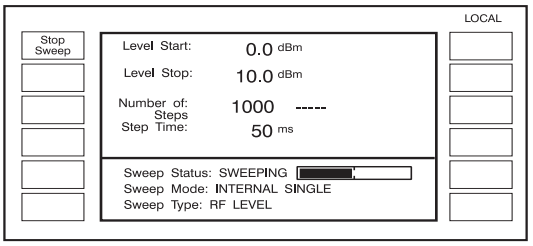
The signaling facility allows testing of radios with DTMF, sequential and sub-audible tone capability. A wide range of tone system standards are built in and provision is also made for user definable standards to cover special requirements. Tone sequences can be set up with up to 16 tones in length and the complete sequence can be sent from 1 to 9 times or set to repeat on a continuous basis. Sub-audible tones are normally used in the composite modulation mode where the modulation level for the tone and the in-band modulation can be set independently.

BACK



Delta Display

The Delta menu allows the increment values for all the parameters to be set and also includes a TOTAL SHIFT key to show the variations in the parameters from their last keyed in value, a RETURN key to reset the selected parameter to its start value and a TRANSFER key to update the parameter value to equal the shifted value.



FREQUENCY AND LEVEL SWEEP

The digital sweep capability of the 2040 series allows dynamic testing of systems and includes capabilities for sweeping carrier frequency, RF level, LF frequency and LF level. Four parameters are entered to specify the sweep – start value, stop value, number of steps and time per step.

Markers and Ramp Output

Five markers may be defined and a marker output is provided on a rear panel socket together with a 0 to 10 V ramp signal for driving the X axis of an oscilloscope or X-Y plotter.

Option 8 provides additional sweep capabilities which allow the step size, step time and RF level to be entered.

Start/Stop

A single key press starts the sweep and a horizontal bar graph on the display shows the progress of the sweep. The sweep can be stopped at any time and the Up/Down keys used to step forwards or backwards for search purposes. Transfer of the current sweep value into the signal generator or LF modes for more detailed analysis is also possible. The sweep facility can be used in conjunction with a simple X-Y display unit, an oscilloscope or an X-Y plotter.

POWERFUL NON-VOLATILE MEMORY

True non-volatile memory needing no battery back-up is fitted to the 2040 series and is used to store details of instrument settings and calibration information.

Instrument Settings

Details of instrument settings are stored in four areas of memory. One area stores 50 complete instrument settings (including data on parameters which are not currently active), a second area stores 50 partial settings (consisting of details about the currently active parameters), a third area stores details of 100 carrier frequency values and a fourth area stores details of 20 sweep settings. Facilities are provided to prevent the memories from being accidentally overwritten and for recalling a specified memory at switch-on.

Calibration Data

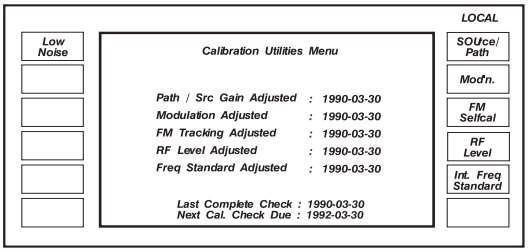
In addition to storage and recall of measurement settings, the non-volatile memory contains data on instrument status and calibration. All calibration data on RF level, FM accuracy, internal frequency standard adjustment and modulation are retained and may be altered from the front panel or via the GPIB after disabling the software protection. Status information stored includes the identity string (type and serial number), choice of internal/external standard, GPIB address, elapsed time and a date alarm for calibration due reminders.

GPIB 488.2 PROGRAMMING

A GPIB interface is fitted as standard so that all functions are controllable over the bus. The instruments function as talkers as well as listeners and the interface has been designed in accordance with the IEEE 488.2 standard.

SIMPLE CALIBRATION

The 2040 has a two year recommended calibration interval, with all routine calibration adjustments carried out without removing the instrument covers. The calibration display is available via soft key selection in the utilities menu.



Low Cost of Ownership

In keeping with the IFR philosophy of cost effectiveness with innovation, the 2040 series has been designed for minimal maintenance and low operating costs. The two year calibration interval combined with the high reliability ensures a low overall cost of ownership.

OPTIONS EXTEND RANGE OF APPLICATIONS

The standard features may be supplemented by taking advantage of the various options available.

Option 1 - Second Modulation Oscillator

An additional modulation oscillator can be fitted to the 2040 series to enable greater flexibility. This second oscillator has the same specification as the first and allows full use of complex modulation modes and is particularly useful where two tone modulation is required.

Option 2 - Pulse Modulation

This optional facility allows radar RF and IF stages to be tested and features rise and fall times of less than 25 ns with an on/off ratio of better than 70 dB.

Option 3 - +19 dBm RF Output Level

A high output option is available for 2040 and provides an extra 6 dB

of output level making it ideal for use as a local oscillator or in testing passive components.

Option 6 - Avionics

This optional facility provides for the internal generation of modulation waveforms suitable for the testing of Instrument Landing Systems (ILS) and VHF Omni Range (VOR) beacons. Additional modes of operation support the testing of ADF, Marker Beacons and the SELCAL signaling system.

Option 8 - RF Profiles and Complex Sweep

The RF Profile facility allows the signal generator to compensate for frequency dependent level errors introduced by cables, amplifiers and signal combiners. The Complex Sweep facility allows for the generation of sweeps whose step size, step time and RF level changes while the sweep is in progress. These features are particularly useful for EMC, Tempest and ATE applications.

Option 11 - Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications

SPECIFICATION

GENERAL DESCRIPTION

2040 series signal generators cover the frequency ranges 10 kHz to 1.35 GHz, 10 kHz to 2.7 GHz and 10 kHz to 5.4 GHz. A large screen dot matrix display with soft key function selection allows flexibility of operation and ease of use. The output may be amplitude, phase or frequency modulated with pulse modulation available as an option. Modulation is available using a combination of an internal synthesized LF oscillator with up to two external signal inputs. A second internal source is available as an option.

CARRIER FREQUENCY

Range

10 kHz to 1.35 GHz (2040).

10 kHz to 2.7 GHz (2041).

10 kHz to 5.4 GHz (2042).

Overrange

Selectable overrange mode allows uncalibrated levels up to +19 dBm to be generated (typically up to +25 dBm for 2030/40 with Option 003 fitted).

Selectable extended hysterisis provides for uncalibrated RF level control with up to 24 dB range without level interruption.

Selection

By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication

11 digits with annunciators.

Resolution

0.1 Hz.

Accuracy

As frequency standard.

Phase Incrementing

The carrier phase can be advanced or retarded in steps of p/128 radians (approximately 1.4°) using the rotary control.

RF OUTPUT

Range

–144 dBm to +13 dBm.

When AM is selected the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Selection

By keyboard entry of data. Variation by UP/DOWN keys and by rotary control. Units may be µV, mV, V EMF or PD; dB relative to 1 µV, 1 mV EMF or PD; dBm.

Conversion between dB and voltage units may be achieved by pressing the appropriate units key (dB, or V, µV, mV).

Indication

4 digits with unit annunciators.

Resolution

0.1 dB.

Accuracy At 22°C ±5°C

	<1.35 GHz	<2.7 GHz	<5.4 GHz
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>-100 dBm	±0.85 dB	±1 dB	±1.5 dB
>-127 dBm	±0.85 dB	±1 dB	-
Temperature stability dB/°C	±0.005	±0.01	±0.02

VSWR

For output levels less than 0 dBm:

Less than 1.25:1 to 2.2 GHz.

Less than 1.4:1 to 2.7 GHz.

Less than 1.5:1 to 5.4 GHz.

Output Protection

Reverse power of 50 W from a source VSWR of up to 5:1.

NOISE MODES

Three noise modes are offered with the following characteristics:

Low Noise Mode 1

Lowest phase noise with a restricted FM deviation capability and reduced AM bandwidth.

Low Noise Mode 2

Low phase noise with restricted FM deviation capability and full AM bandwidth.

Normal Mode

Full FM deviation capability and AM bandwidth.

SPECTRAL PURITY

At RF levels up to +7 dBm:

Harmonics

2040, 2041:

Better than –30 dBc to 1 GHz;

Better than –27 dBc above 1 GHz.

2042:

Better than –30 dBc to 1 GHz;

Better than –27 dBc to 1.35 GHz;

Better than –25 dBc above 1.35 GHz.

Sub-Harmonics

Better than –90 dBc to 1.35 GHz.

Better than –40 dBc to 2.3 GHz.

Better than –30 dBc to 5.4 GHz.

Non-Harmonics (offsets greater than 3 kHz)

In low noise modes:

Better than –70 dBc up to 21.09375 MHz.

Better than –90 dBc from 21.09375 MHz to 2.7 GHz.

Better than –84 dBc above 2.7 GHz.

In normal mode:

Better than –70 dBc.

Residual FM (FM off)

Low noise mode: Less than 0.3 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 1 GHz

Normal mode: Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB Φ Noise

Carrier Frequency Range	SSB Phase Noise in dBc/Hz at offset frequencies of:		
	100 Hz	1 kHz	20 kHz & Above
<1.35 GHz	-75	-115	-140
<675 MHz	-81	-121	-140
<337.5 MHz	-87	-121	-140
<168.7 MHz	-92	-127	-143
<84.3 MHz	-96	-131	-143
<42.1 MHz	-96	-131	-143
<21 MHz	-82	-127	-140

RF Leakage

Less than 0.5 mV PD at the carrier frequency in a two turn 25 mm loop 25 mm or more from any part of the case.

FM on AM

Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ΦM on AM

Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

MODULATION MODES

Four modulation modes are available:

Single

FM, Wideband FM, ΦM, AM or Pulse (optional).

Dual

Two independent channels of differing modulation type (e.g. AM with FM).

Composite

Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite

A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

FREQUENCY MODULATION

Deviation

Peak deviation available varies with carrier frequency and noise mode selected as follows:

	Maximum FM Deviation available:	
Carrier Frequency Range	Normal Mode	Low Noise Modes
2.7 to 5.4 GHz	27-54 MHz*	200 kHz
1.35 to 2.7 GHz	13.5-27 MHz*	100 kHz
675 to 1350 MHz	6.75-13.5 MHz*	50 kHz
337.5 to 675.0 MHz	3.375-6.75 MHz*	25 kHz
168.75 to 337.5 MHz	1.687-3.375 MHz*	12.5 kHz
84.375 to 168.75 MHz	843-1687 kHz*	6.25 kHz
42.1875 to 84.375 MHz	421-843 kHz*	3.125 kHz
21.09375 to 42.1875 MHz	210-421 kHz*	1.56 kHz
10 kHz to 21.09375 MHz	1 MHz	6.25 kHz

*Maximum FM deviation available is 1% of carrier frequency value when in normal noise mode.

Selection

By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication

3 digits with annunciators.

Displayed Resolution

1 Hz or 1 least significant digit, whichever is greater.

Accuracy at 1 kHz

In low noise modes:

±6% of indication ±1 Hz excluding residual FM.

In normal mode:

±5% of indication ±10 Hz excluding residual FM.

Bandwidth (1 dB)

DC to 300 kHz (DC coupled).

10 Hz to 300 kHz (AC coupled).

Bandwidth is limited to 100 kHz in low noise modes.

Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth in normal mode is greater than 1 MHz.

Group delay

Less than 1 µs from 3 kHz to 500 kHz in normal mode.

Less than 3 µs from 3 kHz to 250 kHz in low noise modes.

Carrier Frequency Offset

In DC FM mode less than ±(1 Hz +0.1% of set deviation) after using DC FM nulling facility.

Distortion

Using external modulation without ALC:

Less than 3% at maximum deviation for modulation frequencies up to 20 kHz.

Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation Source

Internal LF generator or external via front panel sockets.

WIDEBAND FM

Deviation

As FM.

Indication

3 digits with annunciators.

Selection

By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the value of deviation nearest to the requested value.

Input level

1 V RMS to achieve indicated deviation.

Accuracy

As FM.

3 dB Bandwidth

In normal noise mode typically 10 MHz (DC or AC coupled).

In low noise modes typically 250 kHz

(DC or AC coupled).

Group delay

Less than 0.5 µs from 3 kHz to 10 MHz in normal modes.

Modulation Source

External via rear panel socket (50 Ω impedance).

PHASE MODULATION

(Normal mode only)

Deviation

0 to 10 radians.

Selection

By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication

3 digits with annunciators.

Resolution

0.01 radians.

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 maximum deviation at 1 kHz modulation rate.

Modulation Source

Internal LF generator or external via front panel sockets.

AMPLITUDE MODULATION

For Carrier Frequencies up to 1 GHz:

Range

0 to 99.9%.

Selection

By keyboard entry of data. Variation by up/down keys and by rotary control.

Indication

3 digits with annunciator.

Resolution

0.1%.

Accuracy

±4% of setting +1%.

1 dB Bandwidth

In normal and low noise mode 2:

With Modulation ALC off; DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode.

Typical modulation bandwidth exceeds 50 kHz.

In low noise mode 1:

With Modulation ALC off; Useable from DC to 1.5 kHz in DC coupled mode and 10 Hz to 1.5 kHz in AC coupled mode.

Distortion

For a modulation rate of 1 kHz:

Less than 1% total harmonic distortion for depths up to 30%.

Less than 3% total harmonic distortion for depths up to 80%.

Modulation Source

Internal LF generator or external via front panel sockets.

MODULATION OSCILLATOR

Frequency Range

0.1 Hz to 500 kHz.

Selection

By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication

7 digits with annunciators.

Resolution

0.1 Hz.

Frequency Accuracy

As frequency standard.

Distortion

Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.

Alternative Waveform

A triangular wave is available for frequencies up to 100 kHz and a square wave up to 2 kHz.

Signaling Tones

The modulation oscillator can be used to generate sub-audible or sequential (up to 16 tones) signaling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF standards. Facilities are also available for creating and storing user defined tone systems.*

** Requires second modulation oscillator (Option 001) to be fitted.*

EXTERNAL MODULATION

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1 V RMS sine wave applied. Input impedance 100 kΩ nominal.

MODULATION ALC

The EXT MOD 1 and EXT MOD 2 modulation inputs can each be levelled by an ALC system.

Level Range

0.7 V RMS to 1.4 V RMS sine wave.

Distortion

Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz).

1 dB Bandwidth

Typically 10 Hz to 500 kHz.

LF OUTPUT

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

Selection

By keyboard entry of data. Variation by UP/DOWN keys and by rotary control.

Indication

7 digits with unit annunciators for frequency and 4 digits with unit annunciators for level.

Level

100 µV to 5 V RMS with a load impedance of greater than 600 Ω.

100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.

Common mode voltage

±0.5 V maximum.

Source impedance

5.6 Ω nominal.

Level Accuracy at 1 kHz

With a load impedance of greater than 10 kΩ:

+5% for levels above 50 mV and ±10% for levels from 500 µV to 50 mV.

Frequency Response

Typically better than ±1 dB from 0.1 Hz to 300 kHz.

SWEEP

Not available in low noise mode.

Control Modes

Start/stop values of selected parameter.

Number of steps.

Time per step.

Step Time

1 ms to 10 s per step.

Sweep Ramp

Synchronized analog ramp with an amplitude of nominally 0 to 10 V peak on rear panel BNC connector.

Markers

Five user selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to + 5 V from 600 Ω on rear panel BNC socket.

Trigger

Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep or steps from point to point on the sweep. Socket is internally connected via 10 kΩ pull-up resistor to +5 V.

FREQUENCY STANDARD (OCXO)

Frequency

10 MHz.

Temperature Stability

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

Warm up time

Within 2 in 10^7 of final frequency within 10 minutes from switch on at 20°C ambient.

Ageing Rate

Better than 2 in 10^7 per year.

Output

Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω.

External input

Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ.

GENERAL

GPIB INTERFACE

A GPIB interface designed in accordance with IEEE 488.2 is fitted as standard.

Capabilities

Complies with the following subsets as defined in IEEE Std.488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

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 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 2 supply.

RATED RANGE OF USE

(Over which full specification is met)

Temperature

0 to 55°C.

Humidity

Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature

–40 to +71°C.

Humidity

Up to 93% relative humidity at 40°C.

Altitude

Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply

Four voltage settings covering:

100 V~ (Limit 90 - 115 V~)
120 V~ (Limit 105 - 132 V~)
220 V~ (Limit 188 - 242 V~)
240 V~ (Limit 216 - 264 V~)

Frequency: 50 - 400 Hz (Limit 45 - 440 Hz) 180 VA max

CALIBRATION INTERVAL

2 years.

DIMENSIONS AND WEIGHT

(Over projections but excluding front panel handles)

Height	Width	Depth	Weight
152 mm	425 mm	525 mm	21 kg
6 in	16.6 in	20.5 in	46 lb

OPTIONS

OPTION 1 - SECOND MODULATION OSCILLATOR OPTION

Specification as Modulation Oscillator.

OPTION 2 - PULSE MODULATION OPTION

Modulation Modes

Pulse modulation may be used alone or in conjunction with FM, ΦM or Wideband FM.

Rise Time

Less than 25 ns.

Control

0 to +1 V for carrier off, +3.5 to +5 V for carrier on.

ON/OFF Ratio

Better than 70 dB, typically exceeds 80 dB.

Additional level error

Less than ±0.5 dB.

Propagation delay

Typically 80 ns from pulse input to RF pulse output.

Input Impedance

50 Ω nominal.

OPTION 105 - SLOW RISE TIME PULSE MODULATION

Modifies pulse modulation option for a typical rise and fall time of 2 µs.

OPTION 3 - +19 dBm RF OUTPUT LEVEL OPTION

For 2040 model only.

RF Output Range

–144 dBm to +19 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +13 dBm at maximum AM depth.

Overrange allows levels up to +25 dBm to be requested.

Harmonics

At RF levels up to +7 dBm: better than –27 dBc.

OPTION 6 - AVIONICS OPTION

See separate sheet.

OPTION 8 - RF PROFILE AND COMPLEX SWEEP

See separate sheet.

OPTION 12 - ELECTRONIC ATTENUATOR

Carrier Frequency Range

250 kHz* to 1.35 GHz (2040),

250 kHz* to 2.7 GHz (2041).

* Useable to 10 kHz

RF Output Range

-138 dBm to +10 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.

Accuracy

±1.2 dB for output levels > -127 dBm at 22°C ±5°C

Temperature Stability

±0.01 dB/°C

VSWR

<1.5:1 for output levels less than 0 dBm.

Reverse Power Handling

1 W from a source VSWR of up to 5:1.

Amplitude Modulation

Standard specification applies for carrier frequencies above 50 MHz (Above 100 MHz for Option6)

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2040	10 kHz to 1.35 GHz Signal Generator
2041	10 kHz to 2.7 GHz Signal Generator
2042	10 kHz to 5.4 GHz Signal Generator

Options

Options are factory fitted only and must be specified at the time of ordering.

Option 001	Second internal modulation oscillator.
Option 002	Pulse Modulation.
Option 003	+19 dBm Output Level (2040 only).
Option 006	Avionics (requires Option 001, not with Option 003).
Option 008	RF Profile and Complex Sweep.
Option 012	Electronic attenuator (2040 and 2041 only). not available with option 003
Option 105	Modifies the pulse modulation option for slower rise and fall time (order with Option 002).
Option 112	External modulation inputs (2) 600 Ω impedance

Supplied with

AC supply lead.

Operating Manual.

Optional Accessories

46880/050	Service manual.
43126/012	RF connector cable, 50 Ω, 1.5 m, BNC.
54311/092	Coaxial adapter N male to BNC female.
59999/163	Precision coaxial adapter N male to SMA female.
54311/095	RF connector cable, 1 m, type N connectors.
43129/189	GPIB Lead assembly.
46883/408	IEEE/IEC Adapter block for GPIB socket.
46884/291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884/292	Rack Mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884/541	Rack mounting kit containing front mounting bracket only.
46884/444	Maintenance kit 2030/40 series.
46662/525	Transit case.
54112/164	Soft carry case.
54499/044	DECT filter.

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

AEROFLEX
A passion for performance.

www.aeroflex.com
info-test@aeroflex.com

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

Part No. 46891/006, Issue 7, 02/04

BACK

Signal Sources

2050 Series Digital & Vector Signal Generator

AEROFLEX
A passion for performance.

Designed to meet the needs of modern digital radio technologies up to 5.4 GHz

- PSK, FSK, QAM, GMSK
- I and Q modulation to 10 MHz (1 dB bw.)
- External digital data input
- Internal PRBS data source
- Excellent accuracy and stability
- Envelope control for RF bursts
- Programmable channel filter characteristics
- Variable data rate control
- NADC, PDC, GSM, TETRA plus others
- Wide band DCFM for fast FSK
- Baseband I & Q outputs
- Electronic attenuator option

The 2050 series of digital and vector signal generators covers the frequency range 10 kHz to 1.35 GHz (2050), 10 kHz to 2.7 GHz (2051) and 10 kHz to 5.4 GHz (2052). These instruments are suitable for a wide range of applications including the testing of new digital communication systems.

Modulation Capability

The 2050 combines comprehensive analog modes, AM, FM, PM and Pulse (optional), with I Q vector modulation. A digital mode using internal DSP (digital signal processing) is provided to convert digital data into complex modulation formats as shown in the following table.

FSK	2 and 4 level
GMSK	
PSK	2, 4 and 8 level
DPSK (Differential)	2, 4 and 8 level
Phase Offset DPSK	2, 4 and 8 level
Time Offset PSK	4 level
QAM	4, 16, 64 and 256 level

Two FM modes are available, wideband FM (>10 MHz) for fast FSK or video applications and a 1 MHz bandwidth mode. Both modes offer FM deviations up to 1% of carrier frequency. FM is available as either DC or AC coupled. A patented FM nulling correction system eliminates carrier frequency offsets that occur with lesser generators when using DCFM, and allows the 2050 to be used confidently with Wireless LAN or paging equipment such as POCSAG, FLEX™ and ERMES.

Vector Modulation

In Vector mode the signal generator accepts I and Q modulation inputs with 10 MHz, 1 dB bandwidth. This precision modulator enables any modulation characteristic to be simulated with a high degree of accuracy, typical vector errors of less than 0.5% are possible. The excellent temperature stability and drift characteristics of the modulator ensure calibrated signals are always available making this the ideal choice for demanding research and development applications as well as in manufacturing of digital communications systems.

The wide IQ bandwidth allows the generation of Direct Sequence Spread Spectrum signals as used in CDMA as well as QAM and OFDM signals as used in new broadcasting formats such as DAB (Digital Audio Broadcast).

Precision radar Chirp signals can be simulated in conjunction with an Arbitrary Waveform Generator to test radar receivers.

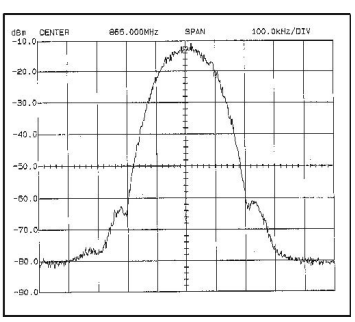
Digital Modulation

In digital mode, the signal generator is able to produce a wide array of digital modulation types and in each case the user is free to modify the data rate and filter characteristics to suit individual application needs. This level of control and flexibility means that the 2050 series is fully prepared today for the digital formats of tomorrow's narrow band digital radio communications equipment.

For common standards, the 2050 is already pre-programmed to generate the required modulation format from a single key press and so aid ease of use. Proprietary schemes can be created and stored into non volatile user memories.

Mod Type	System
π/4 DQPSK	NADC (DAMPS), PDC (JDC), TETRA, TFTS, APCO25
GMSK	GSM, Mobitex, CDPD, MC9, DSRR, MD24-192N/W, Modacom
OQPSK	Inmarsat M
FSK	POCSAG, CITYRUF
4FSK	ERMES, APCO25
8DPSK	VDR (VDL)

Data rates up to 34 ksymbols/sec can either be generated internally from a pseudo random sequence generator or supplied externally as a serial or parallel data stream into a flexible digital interface. A burst control input allows TDMA or TDD bursts to be generated synchronously with the data. A separate analog envelope control input allows linear control of the RF level to simulate bursted modulation conforming to power time template and adjacent channel spectrum requirements.



In digital mode the user can introduce defined errors to the modulation as skew, gain imbalance and carrier leakage, and so aid investigation of design limitations.

Fading Simulation

The built-in Rician and Rayleigh fading simulator with programmable path ratio and Doppler speed allows testing of receivers under 'real life' propagation conditions in which receivers must operate. The availability of fading simulation at the early design stages of new communications equipment simplifies the development of more robust designs and reduces the time taken for full compliance testing.

Software Assisted Calibration

All calibration and re-alignment procedures can be carried out without removal of the instrument covers and can be performed either manually or automatically via the GPIB. No internal adjustments are necessary; even the frequency standard is adjusted via the front panel or GPIB. During manual alignment full instructions are given on the instrument display. In digital and vector modes a self calibration system optimizes the performance of the vector modulator; a warning is displayed when environmental changes or elapsed time warrant a re-calibration of the modulator.

Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications.

SPECIFICATION

GENERAL DESCRIPTION

2050 series signal generators have a large screen dot matrix display with softkey function selection which allows flexibility of operation. Hardkey and data entry key together with a rotary control knob are also provided. The output may be modulated using ΦM, FM, AM, IQ vector or complex digital modulation. Pulse modulation is optional.

CARRIER FREQUENCY

Range

10 kHz to 1.35 GHz (2050)
10 kHz to 2.7 GHz (2051)
10 kHz to 5.4 GHz (2052)

In digital and vector modes the lowest frequency is 10 MHz and for 2052 the highest frequency is reduced to 2.7 GHz.

Selection

By keyboard entry of data. Variation by up/down keys and by rotary control.

Indication

11 digits with annunciators.

Resolution

0.1 Hz.

Accuracy

As frequency standard.

Phase incrementing

The carrier phase can be advanced or retarded in steps of 1.5° using the rotary control.

RF OUTPUT

Range (Analog mode)

–144 dBm to +13 dBm
Max guaranteed output above 2.7 GHz is +11 dBm.

With AM selected, the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Range (Digital or Vector mode)

–138 to +6 dBm peak envelope power.
RF level is defined with a PRBS modulation applied in digital mode or with 0.5 V applied to either the I or Q input in vector mode.

BACK

Selectable Overrange Mode

Uncalibrated levels up to +19 dBm.

Selectable Extended Hysterisis

Uncalibrated RF level control over a range of 24 dB (maximum) without level interruption.

Selection

By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control. Units may be µV, mV, V, EMF or PD; dB relative to 1 µV, 1 mV, EMF or PD; dBm.

Indication

4 digits with unit annunciators.

Resolution

0.1 dB.

Accuracy

At 22°C ±5°C in non Digital or Vector modes:			
	<1.35 GHz	<2.7 GHz	<5.4 GHz
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>–100 dBm	±0.85 dB	±1 dB	±1.5 dB
>–127 dBm	±0.85 dB	±1 dB	–
Temperature stability dB/°C	0.005	0.01	0.02

In Digital or Vector Mode (Auto IF Selection)

At a temperature of 22°C ±5°C

<2 GHz	*±1.5 dB*
<2.7 GHz	*±2 dB*

Temperature coefficient : <0.04 dB/°C

OUTPUT VSWR

For output levels less than 0 dBm:

<2.2 GHz	*<1.25:1 (19.1 dB return loss)*
<2.7 GHz	*<1.4:1 (15.6 dB return loss)*
<5.4 GHz	*<1.5:1 (14 dB return loss)*

SPECTRAL PURITY

At RF levels up to +7 dBm in CW and analog modulation modes:

Harmonics	≤1 GHz	1 GHz to 1.35 GHz	>1.35 GHz
2050 & 2051	<-30 dBc	<-27 dBc	<-27 dBc
2052	<-30 dBc	<-27 dBc	<-25 dBc

Sub-Harmonics

< –90 dBc to 1.35 GHz, < -40 dBc to 2.3 GHz, < –30 dBc to 5.4 GHz.

Non-Harmonics

< –70 dBc at offsets from the carrier frequency of 3 kHz or greater.

Residual FM

Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB phase noise

Less than –116 dBc/Hz (typically –122 dBc/Hz) at an offset of 20 kHz from a carrier frequency of 470 MHz.

RF Leakage

Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm loop, 25 mm or more from any part of the case.

FM on AM

Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ΦM on AM

Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

In digital and vector modes of operation:

Modulation is generated by converting a 120 MHz, 132 MHz, 160 MHz or 176 MHz intermediate frequency (IF) to the required carrier frequency.

Additional signals are present at the local oscillator frequency, image frequency and frequencies equivalent to the harmonics of the IF mixed with the local oscillator.

Phase noise

In vector mode: As analog modulation and CW modes.

In digital mode: As analog modulation modes for offsets >100 kHz; <–108 dBc/Hz at 20 kHz offset from a 1 GHz carrier.

MODULATION MODES

Six modulation modes are available:

Single

FM, Wideband FM, ΦM, AM or pulse (optional).

Dual

Two independent channels of differing modulation type (e.g. AM with FM).

Composite

Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite

A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

Vector

Provides IQ modulation facility.

Digital

Accepts digital inputs and converts the signal to QAM, PSK, GMSK or FSK formats.

FREQUENCY MODULATION

Deviation

Peak deviation from 0 to 1 MHz for carrier frequencies up to 21.09375 MHz. Peak deviation from 0 to 1% of carrier frequency above 21.09375 MHz.

Selection

By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control.

Indication

3 digits with annunciators.

Displayed Resolution

1 Hz or 1 least significant digit, whichever is greater.

Accuracy at 1 kHz

±5% of indication ±10 Hz excluding residual FM.

Bandwidth (1 dB)

DC to 300 kHz (DC coupled).
10 Hz to 300 kHz (AC coupled).

Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth is >1 MHz.

Group delay

Less than 1 µs from 3 kHz to 500 kHz.

Carrier Frequency Offset

In DC FM less than ± (1 Hz + 0.1% of set deviation) after using DC FM nulling facility.

Distortion

Using external modulation without ALC: Less than 3% at maximum deviation for modulation frequencies up to 20 kHz. Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation source

Internal LF generator or external via front panel sockets.

WIDEBAND FM

Deviation

As FM.

Indication

3 digits with annunciators.

Selection

By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the nearest value of deviation to that requested.

Input level

1.414 V peak (1 V RMS sine wave) to achieve indicated deviation.

Accuracy

As FM.

3 dB Bandwidth

Typically 10 MHz (DC or AC coupled).

Group Delay

Less than 0.5 ms from 3 kHz to 10 MHz.

Modulation Source

External via rear panel socket (50 Ω impedance).

PHASE MODULATION

Deviation

0 to 10 radians.

Selection

By keyboard entry of data. Variation by up/down keys (or ⇧⇩) and by rotary control.

Indication

3 digits with annunciators.

Resolution

0.01 radians.

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 maximum deviation at 1 kHz modulation rate.

Modulation Source

Internal LF generator or external via front panel sockets.

AMPLITUDE MODULATION

For carrier frequencies up to 1 GHz.

Range

0 to 99.9%.

Selection

By keyboard entry of data. Variation by up/down keys (or ⇧⇩) and by rotary control.

Indication

3 digits with annunciator.

Resolution

0.1%.

Accuracy

±4% of setting ±1%.

1 dB Bandwidth

With modulation ALC off; DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode.

Typical modulation bandwidth exceeds 50 kHz.

Distortion

For a modulation rate of 1 kHz: Less than 1% total harmonic distortion for depths up to 30%, less than 3% total harmonic distortion for depths up to 80%.

Modulation source

Internal LF generator or external via front panel connectors.

DIGITAL MODULATION

In digital mode the instrument can be used over the carrier frequency range 10 MHz to 1.35/2.7 GHz and accepts internal or external data to modulate the RF output. The modulation can be applied in common digital formats and the channel filter characteristics specified.

Internal Data

All 0's, 1's or selectable PN 2 to 7, 9, 10, 11 or 15 PRBS sequence.

Note with GSM selected PRBS is limited to PN9 & 15. All 0's and all 1's are available.

External data

Accepts data as a serial input or parallel input from a 25 way auxiliary D Type connector on the rear panel. Accepts symbols containing 1 to 8 data bits with internally or externally generated clock sources. All inputs and outputs are TTL/CMOS logic compatible.

Note, in GSM mode, external data must be supplied as 8 bit parallel.

Symbol Rate

Mod Type	min sym/s	max sym/s	Filter
PSK, QAM	1900	34000	Nyquist/Root Nyquist
PSK, QAM	1900	25000	Gaussian
FSK,	1900	25000	Nyquist/Root Nyquist
FSK, GMSK	512	25000	Gaussian
OQPSK	1900	16000	All filters

Symbol source can be internal or external, internal symbol rate is adjustable in steps of 0.1 symbols/s. Symbol rate must be within 2% of external symbol rate to maintain modulation accuracy.

Generic Modulation types

Can select PSK, Differential PSK, Differential Phase Offset PSK (i.e π/4DQPSK), Time Offset QPSK, QAM, GMSK and FSK. The number of bits per symbol can be selected from 2 to 8 for QAM, 1 to 3 for PSK and 1 or 2 for FSK systems.

RF Channel Filters

Root raised cosine, raised cosine or Gaussian. Filter bandwidth can be selected as follows: Raised cosine or root raised cosine for α from 0.2 to 0.8 in 0.01 steps. Gaussian 3 dB bandwidth from 0.4 of the symbol rate (0.2 of symbol rate as IQ baseband filter) up to a maximum of 22.6 kHz.

Pre-defined Modulation Types

The following can be selected:

Mod Type	System
π/4 DQPSK	ADC (DAMPS), PDC (JDC), TETRA, TFTS, APCO25
GMSK	GSM, Mobitex, CDPD, MC9, DSRR, MD24-192N/W, Modacom
OQPSK	Inmarsat M
FSK	POCSAG, CITYRUF
4FSK	ERMES, APCO25
8DPSK	VDR (VDL)

Modulation Accuracy

At the decision points with the envelope input at 1 V or disabled and filter above 0.25 for raised cosine filters and 0.3 for root raised cosine filters:

- *PSK & QAM* — *<1.5% RMS vector error*
- *NADC, PDC* — *<1% RMS vector error (EIA, RCR 27A method)*
- *GSM & CDPD* — *<3° RMS phase error (typical)*

FSK/GMSK

Frequency deviation can be set with 1 Hz resolution across the range 100 Hz to 20 kHz.

Accuracy: <1% of set deviation.

Modulation errors

Modulation errors can be added to simulate:
IQ skew from 0 to ± 20° in 0.1° steps
IQ imbalance from 0 to ±10 dB in 0.1 dB steps
Carrier leak from 0 to 10% in 0.1% steps
Range of errors allowed is limited by the peak envelope power.

Note: modulation errors are not available in either GSM or OQPSK modes.

IQ Outputs

Baseband IQ output signals available on the front panel at a level of 0.5 V p.d. nominal into 50 Ω.

Burst control

Available on the rear panel D Type connector. A logic 1 on the burst control turns the RF on over a time interval corresponding to 3 data symbols. Propagation delay is matched to the data path delay. Can be used with the Envelope input.

Burst control is not available with GMSK and FSK modulation types.

ON/OFF Ratio

Greater than 80 dB.

VECTOR MODULATION

Provides for IQ modulation of the carrier output from an external source for carrier frequencies of 10 MHz to 1.35/2.7 GHz.

Carrier Leakage and SSB Image Rejection

Following self-calibration, the RF carrier leakage and SSB image rejection are typically 50 dB.

Vector inputs

IQ inputs on the front panel. The RF level requested is obtained with 0.5 V DC applied to one of the inputs. Input impedance is selectable between 50 Ω and 300 Ω.

DC Vector accuracy

For carrier frequencies up to 2 GHz:
±1% amplitude of FS.
±1° at FS.

For carrier frequencies above 2 GHz:
±1.5% amplitude of FS.
±1.5° at FS.

Vector bandwidth

±0.5 dB wrt DC for modulation frequencies up to 3 MHz.

±1 dB wrt DC for modulation frequencies up to 10 MHz and carrier frequencies up to 2 GHz. ±1.3 dB wrt DC for carrier frequencies up to 2.7 GHz.

IQ MODULATION CALIBRATION

The signal generator can calibrate the IQ modulator automatically. After a 0.5 hour warm up period the calibration remains valid for at least 3 hours over a temperature range of ±5°C. The instrument displays a warning if the calibration validity time or temperature range has been exceeded. Calibration is valid for both digital and vector modes.

FADING SIMULATION

Rayleigh and Rician fading can be simulated in both Vector and Digital modulation modes. Doppler speed can be entered from 0 to 200 Hz with a maximum ratio of 2:1 between direct and scattered speed. Path ratio can be set to ±50 dB.

Note: Fading is not available in either GSM or OQPSK modes.

ENVELOPE CONTROL

The RF level can be varied by applying a control voltage to the envelope input in digital and vector modes. The input may be used to shape the rise and fall of an RF burst and simulate the effect of varying RF levels being received from mobiles in TDMA systems. Applying 1 V gives the set RF level and 0 V suppresses the carrier.

Linear range

Greater than 30 dB.

Linearity typically better than 0.5 dB at –20 dBV (100 mV input).

ON/OFF ratio

Greater than 80 dB.

Envelope delay

< 10 µs, typically 6 µs.

Rise/fall time

Less than 13 µs to –70 dBc.

IF OUTPUT

An IF output is available on the rear panel which is modulated by the selected digital or vector modulation. The IF output can be inhibited by software control. The IF output can be used to provide modulated carriers at higher frequencies by external frequency conversion. The RF output from the front panel connector can be used as an LO for external frequency conversion.

MODULATION OSCILLATOR

Frequency range

0.1 Hz to 500 kHz.

Selection

By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control.

Indication

7 digits with annunciators.

Resolution

0.1 Hz.

Frequency accuracy

As frequency standard.

Distortion

Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.

Alternative waveform

A triangular wave is available in addition to the sine wave for frequencies up to 100 kHz.

Signaling tones

The modulation oscillator can be used to generate sequential (up to 16 tones) or sub-audible signaling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF standards.*

Facilities are also available for creating and storing user defined tone systems.

** Requires second modulation oscillator (option 001) to be fitted.*

EXTERNAL MODULATION

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance 100 kΩ nominal.

MODULATION ALC

The EXT MOD 1 and EXT MOD 2 modulation inputs can be levelled by an ALC system.

Level Range

1 V to 2 V peak (0.7 to 1.4 V RMS sine wave).

Distortion

Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz).

1 dB Bandwidth

Typically 10 Hz to 500 kHz.

LF OUTPUT

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

Selection

By keyboard entry of data.

Variation by ⇧⇩ keys and by rotary control.

Indication

7 digits with unit annunciators for frequency and 4 digits with unit annunciators for level.

Level

100 µV to 5 V RMS with a load impedance of greater than 600 Ω.
100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.

Source impedance

5.6 Ω nominal.

Level accuracy at 1 kHz

With a load impedance of greater than 10 kW: LF ±5% for levels above 50 mV LF ±10% for levels from 500 µV to 50 mV.

Frequency Response

Typically <±1 dB from 0.1 Hz to 300 kHz.

SWEEP

Control modes

Start/stop values of selected parameter. Number of steps. Time per step.

Step time

1 ms to 20 s per step.

Sweep ramp

Synchronized analog ramp with a nominal amplitude of 0 to 10 V peak on rear panel BNC connector.

Markers

User selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to +5 V from 600 Ω on rear panel BNC socket.

Trigger

Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep. Connector is internally connected via 10 kΩ pull-up resistor to +5 V.

FREQUENCY STANDARD (OCXO)

Frequency

10 MHz.

Temperature stability

Better than ±5 in 10^8 in the operating range of 0 to 50°C.

Warm up time

Within 2 in 10^7 final frequency within 10 minutes from switch on at 20°C ambient.

Ageing rate

Better than 2 in 10^7 per year.

Output

Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω. Output can be dis-

abled.

External input

Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ

GENERAL

GPIB INTERFACE

A GPIB interface is fitted. All functions except the supply switch and display contrast are remotely programmable.

Capabilities

Designed in accordance with IEEE488.2.
Complies with the following subsets as defined in IEEE Std. 488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

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 1 portable equipment, for use in a Pollution Degree 2 environmen. The instrument is designed to be operated from an Installation Category 2 supply.

RATED RANGE OF USE *(Over which full specification is met)*

Temperature

0 to 55°C.

Humidity

Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature

–40°C to +71°C.

Humidity

Up to 93% relative humidity at 40°C.

Altitude

Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply

Four voltage settings covering:

100 V~ (Limit 90 - 115 V~)
120 V~ (Limit 105 - 132 V~)
220 V~ (Limit 188 - 242 V~)
240 V~ (Limit 216 - 264 V~)

Frequency: 50 - 400 Hz (Limit 45 - 440 Hz) 180 VA max

CALIBRATION INTERVAL

2 years.

DIMENSIONS AND WEIGHT

(Over projections but excluding handles)

Height	Width	Depth	Weight
152 mm	425 mm	525 mm	21 kg

OPTIONS

OPTION 1 - SECOND MODULATION OSCILLATOR OPTION

Specification as Modulation Oscillator.

OPTION 2 - PULSE MODULATION OPTION

Modulation Modes

Pulse modulation may be used alone or in conjunction with ΦM, FM, Wideband FM, Vector or Digital Modulation.

Rise/Fall Time

25 ns.

Control

0 V for carrier off, +5 V for carrier on.
Threshold level is typically +2.5 V.

ON/OFF Ratio

Better than 70 dB. Input impedance 50 Ω.

OPTION 105 - SLOW RISE TIME PULSE MODULATION

Modifies pulse modulation option for a typical rise and fall time of 1 µs.

OPTION 6 - AVIONICS OPTION

See separate sheet.

OPTION 8 - RF PROFILE AND COMPLEX SWEEP

See separate sheet.

OPTION 12 - ELECTRONIC ATTENUATOR

Carrier Frequency Range

250 kHz to 1.35 GHz (2050),*
250 kHz to 2.7 GHz (2051).*

** Useable to 10 kHz (50 MHz in Digital or Vector modes, useable to 10 MHz)*

RF Output

Range (Analog mode)

-138 dBm to +10 dBm When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.

Range (Digital or Vector mode)

-132 dBm to +3 dBm peak envelope power.

Accuracy

±1.2 dB in non Digital or Vector modes for output levels > -127 dBm at 22°C ±5°C

Temperature Stability

±0.01 dB/°C

VSWR

< 1.5:1 for output levels less than 0 dBm.

Reverse Power Handling

1 W from a source VSWR of up to 5:1.

Amplitude Modulation

Standard specification applies for carrier frequencies above 50 MHz (Above 100 MHz for Option 6).

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2050	10 kHz to 1.35 GHz Digital and Vector Signal Generator
2051	10 kHz to 2.7 GHz Digital and Vector Signal Generator
2052	10 kHz to 5.4 GHz Digital and Vector Signal Generator

Supplied with

AC supply lead

Operating Manual

Options

Option 001	Second modulation oscillator
Option 002	Pulse modulation
Option 006	Avionics (must be ordered with Option 001)
Option 008	RF Profiles and complex sweep
Option 012	Electronic attenuator (2050 and 2051 only)
Option 105	Increased pulse modulation rise and fall time (must be ordered with Option 002)
Option 112	External modulation inputs (2) 600 Ω impedance

Optional Accessories

44991/144	Break out box. Converts auxiliary D type -connector to 8 data, 1 burst line, and a it/symbol clocks on BNC connectors. Daisy chain connection allows the monitoring of the signals (on BNC connectors).
43126/012	RF connector cable, 50 Ω, 1.5 m, BNC
54311/092	Coaxial adapter N male to BNC female
59999/163	Precision coaxial adapter N male to SMA female
54311/095	RF connector cable, 1 m, type N connectors
43129/189	GPIB Lead assembly
46883/408	IEEE/IEC Adapter block for GPIB socket
46884/291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm
46884/292	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm
46884/541	Rack mounting kit containing front mounting brackets only
46884/444	Maintenance kit 2030/40/50 series
46662/525	Transit case
54112/164	Soft carry case
54499/044	DECT Filter
46880/062	Service manual

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

AEROFLEX
A passion for performance.

www.aeroflex.com

info-test@aeroflex.com

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

Part No. 46891/007, Issue 11, 02/04

BACK

Signal Sources

2050T Series Signal Generators

AEROFLEX
A passion for performance.

Setting the standard for low adjacent channel power for TETRA modulation

- <-70 dBc Adjacent Channel Power TETRA modulation
- Excellent vector accuracy
- Rayleigh & Rician fading
- Burst control
- Internal PRBS data source
- Baseband IQ outputs
- IQ vector modulation

The new 2050T series are variants of the successful 2050 series of digital and vector signal generators. They have been designed to satisfy the challenging needs of TETRA radio development and production but without compromizing any of the 2050's original features.

Adjacent Channel Power

For TETRA radio development and production, a new level of signal generator performance is demanded. For selectivity testing of TETRA radio receivers, the level of adjacent channel power from the interfering source (TETRA T2) must be lower than -70 dBc.

Throughout all areas of TETRA development, the problem of adjacent channel power is a key issue which the 2050T series have been specifically designed to address.

The 2050T series offer better than -70 dBc adjacent channel power across the RF frequency range 100 MHz to 490 MHz and throughout their RF level range whilst maintaining a RMS vector error of better than 1.5%.

TETRA Modulation

The modulation characteristics of TETRA are faithfully reproduced within the 2050T series. π/4 Differential QPSK is only one of many modulation types provided. In Advanced Digital Mode the modulation parameters are fixed to those demanded by TETRA. In Normal Digital Mode it is possible to modify subtle aspects of the modulation such as filter alpha coefficients or modulation data rates.

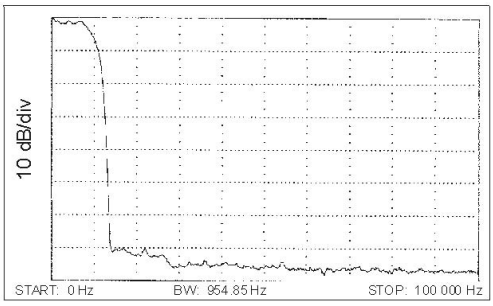


Figure 1 : TETRA ACP Spectrum

Rayleigh and Rician Fading

It is easy to introduce Rayleigh or Rician fading together with modulation impairments, such as IQ imbalance, skew and carrier leakage to each of the baseband, IF and RF outputs.

Burst Control

The TDMA characteristics of TETRA can be readily simulated. Using the 2050T series Envelope Control, bursts of modulation with

over 80 dB dynamic range are possible. The Envelope Control features a linear modulator allowing careful definition of burst ramps. Alternatively if the 2050T series are used with an external data source, RF bursts may be defined digitally by a simple TTL or CMOS control which produces controlled ramp profiles.

Digital Data Source

The 2050T series feature an internal data generator able to produce various PRBS sequences as per CCITT V.52 recommendations. Alternatively, it is possible to input serial or parallel TTL/CMOS data sequences in real time from an external data source. External data may be clocked in using Bit and Symbol clocks supplied internally from the 2050T series or from external sources.

IQ Outputs

The 2050T series feature an IQ vector modulator which may be driven from external I and Q analog drives or from internally DSP generated signals. The internally generated I and Q filtered signals, together with any fading and selected impairments, are available as I and Q analog outputs. They may then be used to drive external modulators or used as test signals in cartesian feedback designs.

Electronic Attenuator

An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications.

SPECIFICATION

GENERAL DESCRIPTION

2050T series signal generators have a large screen dot matrix display with softkey function selection which allows flexibility of operation. Hardkey and data entry key together with a rotary control knob are also provided. The output may be modulated using ΦM, FM, AM, IQ vector or complex digital modulation. Pulse modulation is optional.

CARRIER FREQUENCY

Range

10 kHz to 1.35 GHz (2050T)
10 kHz to 2.7 GHz (2051T)
10 kHz to 5.4 GHz (2052T)

In digital and vector modes the lowest frequency is 10 MHz and for 2052T the highest frequency is reduced to 2.7 GHz.

Selection

By keyboard entry of data. Variation by up/down keys and by rotary control.

Indication

11 digits with annunciators.

Resolution

0.1 Hz.

Accuracy

As frequency standard.

Phase incrementing

The carrier phase can be advanced or retarded in steps of 1.5° using the rotary control.

RF OUTPUT

Range (Analog mode)

–144 dBm to +13 dBm. Max guaranteed output above 2.7 GHz is +11 dBm.

With AM selected, the maximum output level reduces linearly with AM depth to +7 dBm at maximum AM depth.

Range (Digital or Vector mode)

–138 to +6 dBm peak envelope power.*

RF level is defined with a PRBS modulation applied in digital mode or with 0.5 V applied to either the I or Q input in vector mode.

**Maximum level is reduced to -6 dBm PEP when in advanced digital mode*

Selectable Overrange Mode

Uncalibrated levels up to +19 dBm in analog mode.

Selectable Extended Hysterisis

Uncalibrated RF level control over a range of 24 dB (maximum) without level interruption.

Selection

By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control. Units may be µV, mV, V, EMF or PD; dB relative to 1 µV, 1 mV, EMF or PD; dBm.

Indication

4 digits with unit annunciators.

Resolution

0.1 dB.

Accuracy

At 22°C ±5°C in non Digital or Vector modes:

<1.35 GHz	<2.7 GHz	<5.4 GHz	
>0 dBm	±0.5 dB	±0.7 dB	±1 dB
>–50 dBm	±0.85 dB	±1 dB	±1.5 dB
>–127 dBm	±0.85 dB	±1 dB	–
Temperature stability dB/°C	0.005	0.01	0.02

In Digital or Vector Mode:

At a temperature of 22°C ±5°C
<2 GHz ±1.5 dB
<2.7 GHz ±2 dB
Temperature coefficient : < 0.04 dB/°C

VSWR

For output levels less than 0 dBm:

<2.2 GHz <1.25:1 (19.1 dB return loss)
<2.7 GHz <1.4:1 (15.6 dB return loss)
<5.4 GHz <1.5:1 (14 dB return loss)

Output Protection

Reverse power of 50 W from a source VSWR of upto 5:1

SPECTRAL PURITY (ANALOG MODE)

At RF levels up to +7 dBm in CW and analog modulation modes:

Harmonics

	≤1 GHz	1 GHz to 1.35 GHz	>1.35 GHz
2050T & 2051T	<-30 dBc	<-27 dBc	<-27 dBc
2052T	<-30 dBc	<-27 dBc	<-25 dBc

Sub-harmonics

<–90 dBc to 1.35 GHz, < -40 dBc to 2.3 GHz,
<–30 dBc to 5.4 GHz.

Non-harmonics

<–70 dBc at offsets from the carrier frequency of 3 kHz or greater.

Residual FM

Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.

SSB phase noise

Less than –116 dBc/Hz (typically –122 dBc/Hz) at an offset of 20 kHz from a carrier frequency of 470 MHz.

RF Leakage

Less than 0.5 µV PD at the carrier frequency in a two turn 25 mm loop, 25 mm or more from any part of the case.

FM on AM

Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.

ΦM on AM

Typically less than 0.1 radians at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

SPECTRAL PURITY (DIGITAL AND VECTOR MODES)

Modulation is generated by converting a 120 MHz, 132 MHz, 160 MHz or 176 MHz intermediate frequency (IF) to the required carrier frequency.

Additional signals are present at the local oscillator frequency, image frequency and frequencies equivalent to the harmonics of the IF mixed with the local oscillator.

Phase noise

In vector mode: As analog modulation and CW modes.

In digital mode: As analog modulation modes for offsets >100 kHz; < –108 dBc/Hz at 20 kHz offset from a 1 GHz carrier.

MODULATION MODES

Seven modulation modes are available:

Single

FM, Wideband FM, ΦM, AM or pulse (optional).

Dual

Two independent channels of differing modulation type (e.g. AM with FM).

Composite

Two independent channels of the same modulation type (e.g. FM1 with FM2).

Dual composite

A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

Vector

Provides IQ modulation facility.

Digital

Accepts digital inputs and converts the signal to QAM, PSK , GMSK or FSK formats.

Advanced Digital

Accepts digital inputs and converts the signal to accurate TETRA modulation with low levels of adjacent channel power.

FREQUENCY MODULATION

Deviation

Peak deviation from 0 to 1 MHz for carrier frequencies up to 21.09375 MHz. Peak deviation from 0 to 1% of carrier frequency above 21.09375 MHz.

Selection

By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control.

Indication

3 digits with annunciators.

Displayed Resolution

1 Hz or 1 least significant digit, whichever is greater.

Accuracy at 1 kHz

±5% of indication ±10 Hz excluding residual FM.

Bandwidth (1 dB)

DC to 300 kHz (DC coupled).
10 Hz to 300 kHz (AC coupled).
Input is capable of accepting external sources of FSK signals. Typical 3 dB bandwidth is >1 MHz.

Group delay

Less than 1 µs from 3 kHz to 500 kHz.

Carrier Frequency Offset

In DC FM less than ± (1 Hz + 0.1% of set deviation) after using DC FM nulling facility.

Distortion

Using external modulation without ALC: Less than 3% at maximum deviation for modulation frequencies up to 20 kHz. Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.

Modulation source

Internal LF generator or external via front panel sockets.

WIDEBAND FM

Deviation

As FM.

Indication

3 digits with annunciators.

Selection

By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the nearest value of deviation to that requested.

Input level

1.414 V peak (1 V RMS sine wave) to achieve indicated deviation.

Accuracy

As FM.

3 dB Bandwidth

Typically 10 MHz (DC or AC coupled).

Group Delay

Less than 0.5 µs from 3 kHz to 10 MHz.

Modulation Source

External via rear panel socket (50 Ω impedance).

PHASE MODULATION

Deviation

0 to 10 radians.

Selection

By keyboard entry of data. Variation by up/down keys (or ⇧⇩) and by rotary control.

Indication

3 digits with annunciators.

Resolution

0.01 radians.

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 maximum deviation at 1 kHz modulation rate.

Modulation Source

Internal LF generator or external via front panel sockets.

AMPLITUDE MODULATION

For carrier frequencies up to 1 GHz.

Range

0 to 99.9%.

Selection

By keyboard entry of data. Variation by up/down keys (or ⇧⇩) and by rotary control.

Indication

3 digits with annunciator.

Resolution

0.1%.

Accuracy

±4% of setting ±1%.

1 dB Bandwidth

With modulation ALC off; DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode.

Typical modulation bandwidth exceeds 50 kHz.

Distortion

For a modulation rate of 1 kHz: Less than 1% total harmonic distortion for depths up to 30%, less than 3% total harmonic distortion for depths up to 80%.

Modulation source

Internal LF generator or external via front panel connectors.

DIGITAL MODULATION

In digital mode the instrument can be used over the carrier frequency range 10 MHz to 1.35/2.7 GHz and accepts internal or external data to modulate the RF output. The modulation can be applied in common digital formats and the channel filter characteristics specified.

Internal Data

All 0's, 1's or selectable PN 2 to 7, 9, 10, 11 or 15 PRBS sequence.

Note with GSM selected PRBS is limited to PN9 & 15. All 0's and all 1's are available.

External data

Accepts data as a serial input or parallel input from a 25 way auxiliary D Type connector on the rear panel. Accepts symbols containing 1 to 8 data bits with internally or externally generated clock sources. All inputs and outputs are TTL/CMOS logic compatible.

Note, in GSM mode, external data must be supplied as 8 bit parallel.

Symbol Rate

Mod Type	min sym/s	max sym/s	Filter
PSK, QAM	1900	34000	Nyquist/Root Nyquist
PSK, QAM	1900	25000	Gaussian
FSK,	1900	25000	Nyquist/Root Nyquist
FSK, GMSK	512	25000	Gaussian
OQPSK	1900	16000	All filters

Symbol source can be internal or external, internal symbol rate is adjustable in steps of 0.1 symbols/s. Symbol rate must be within 2% of external symbol rate to maintain modulation accuracy.

Generic Modulation types

Can select PSK, Differential PSK, Differential Phase Offset PSK (i.e π/4 DQPSK), Time Offset QPSK, QAM, GMSK and FSK. The number of bits per symbol can be selected from 2 to 8 for QAM, 1 to 3 for PSK and 1 or 2 for FSK systems.

RF Channel Filters

Root raised cosine, raised cosine or Gaussian. Filter bandwidth can be selected as follows: Raised cosine or root raised cosine for a from 0.2 to 0.8 in 0.01 steps. Gaussian 3 dB bandwidth from 0.4 of the symbol rate (0.2 of symbol rate as IQ baseband filter) up to a maximum of 22.6 kHz.

Pre-defined Modulation Types

The following can be selected:

Type	***System***
π/4 DQPSK	NADC (DAMPS), PDC (JDC), TETRA, TFTS, APCO25
GMSK	GSM, Mobitex, CDPD, MC9, DSRR, MD24-192N/W, Modacom
OQPSK	Inmarsat M
FSK	POCSAG, CITYRUF
4FSK	ERMES, APCO25
8DPSK	VDR (VDL)

BACK

Modulation Accuracy

At the decision points with the envelope input at 1 V or disabled and filter above 0.25 for raised cosine filters and 0.3 for root raised cosine filters:

- *PSK & QAM* — *<1.5% RMS vector error*
- *NADC, PDC* — *<1% RMS vector error (EIA, RCR 27A method)*
- *GSM & CDPD* — *<3° RMS phase error (typical)*

FSK/GMSK

Frequency deviation can be set with 1 Hz resolution across the range 100 Hz to 20 kHz.
Accuracy : <1% of set deviation .

Modulation errors

Modulation errors can be added to simulate:
IQ skew from 0 to ± 20° in 0.1° steps
IQ imbalance from 0 to ±10 dB in 0.1 dB steps
Carrier leak from 0 to 10% in 0.1% steps
Range of errors allowed is limited by the peak envelope power.

Note: modulation errors are not available in either GSM or OQPSK modes.

IQ Outputs

Baseband IQ output signals available on the front panel at a level of 0.5 V p.d. nominal into 50 Ω.

Levels are reduced by 12 dB in advanced digital mode.

Burst control

Available on the rear panel D Type connector. A logic 1 on the burst control turns the RF on over a time interval corresponding to 3 data symbols. Propagation delay is matched to the data path delay. Can be used with the Envelope input.

Burst control is not available with GMSK and FSK modulation types.

ON/OFF Ratio

Greater than 80 dB.

ADVANCED DIGITAL MODULATION

In advanced digital mode the instrument will produce TETRA modulation, π/4 DQPSK at 18 ksymbols/s through a Root Raised Cosine Filter with α of 0.35.

Adjacent Channel Power

Adjacent Channel Power across RF frequency range 100 MHz to 490 MHz and temperature range +25° ±5°C with IQ errors and fading disabled <70 dBc at +25 kHz offset

Carrier Leak

Better than -35 dBc (typically <-38 dBc)

VECTOR MODULATION

Provides for IQ modulation of the carrier output from an external source for carrier frequencies of 10 MHz to 1.35/2.7 GHz.

Carrier Leakage and SSB Image Rejection

Following self-calibration, the RF carrier leakage and SSB image rejection are typically 50 dB.

Vector inputs

IQ inputs on the front panel. The RF level requested is obtained with 0.5 V DC applied to one of the inputs. Input impedance is selectable between 50 Ω and 300 Ω.

DC Vector accuracy

For carrier frequencies up to 2 GHz:
±1% amplitude of FS.
±1° angle at FS.

For carrier frequencies above 2 GHz:
±1.5% amplitude of FS.
±1.5° at FS.

Vector bandwidth

±0.5 dB wrt DC for modulation frequencies up to 3 MHz.

±1 dB wrt DC for modulation frequencies up to 10 MHz and carrier frequencies up to 2 GHz. ±1.3 dB wrt DC for carrier frequencies up to 2.7 GHz.

IQ MODULATION CALIBRATION

The signal generator can calibrate the IQ modulator automatically. After a 0.5 hour warm up period the calibration remains valid for at least 3 hours over a temperature range of ±5°C. The instrument displays a warning if the calibration validity time or temperature range has been exceeded. Calibration is valid for both digital and vector modes.

FADING SIMULATION

Rayleigh and Rician fading can be simulated in both Vector and Digital modulation modes. Doppler speed can be entered from 0 to 200 Hz with a maximum ratio of 2:1 between direct and scattered speed. Path ratio can be set to ±50 dB.

Note: Fading is not available in either GSM or OQPSK modes.

ENVELOPE CONTROL

The RF level can be varied by applying a control voltage to the envelope input in digital and vector modes. The input may be used to shape the rise and fall of an RF burst and simulate the effect of varying RF levels being received from mobiles in TDMA systems. Applying 1 V gives the set RF level and 0 V suppresses the carrier.

Linear range

Greater than 30 dB.
Linearity typically better than 0.5 dB at –20 dBV (100 mV input).

ON/OFF ratio

Greater than 80 dB.

Envelope delay

<10 µs, typically 6 µs.

Rise/fall time

Less than 13 µs to –70 dBc.

IF OUTPUT

An IF output is available on the rear panel which is modulated by the selected digital or vector modulation. The IF output can be inhibited by software control. The IF output can be used to provide modulated carriers at higher frequencies by external frequency conversion. The RF output from the front panel connector can be used as an LO for external frequency conversion.

MODULATION OSCILLATOR

Frequency range

0.1 Hz to 500 kHz.

Selection

By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control.

Indication

7 digits with annunciators.

Resolution

0.1 Hz.

Frequency accuracy

As frequency standard.

Distortion

Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.

Alternative waveform

A triangular wave is available in addition to the sine wave for frequencies up to 100 kHz.

Signalling tones

The modulation oscillator can be used to generate sequential (up to 16 tones) or sub-audible signalling tones in accordance with EIA, ZVEI, DZVEI, CCIR, EURO 1, EEA, NATAL and DTMF standards.*

Facilities are also available for creating and storing user defined tone systems.

** Requires second modulation oscillator (option 001) to be fitted.*

EXTERNAL MODULATION

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance 100 kΩ nominal.

MODULATION ALC

The EXT MOD 1 and EXT MOD 2 modulation inputs can be levelled by an ALC system.

Level Range

1 V to 2 V peak (0.7 to 1.4 V RMS sine wave).

Distortion

Less than 0.1% additional distortion for frequencies up to 20 kHz (typically less than 0.1% up to 50 kHz).

1 dB Bandwidth

Typically 10 Hz to 500 kHz.

LF OUTPUT

Front panel BNC connector. The output may be configured in the LF Generator Mode to give an output from the internal modulation oscillator and in the LF Monitor Mode to give an output from the internal modulation signal paths.

Selection

By keyboard entry of data. Variation by ⇧⇩ keys and by rotary control.

Indication

7 digits with unit annunciators for frequency and 4 digits with unit annunciators for level.

Level

100 µV to 5 V RMS with a load impedance of greater than 600 Ω.
100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.

Source impedance

5.6 Ω nominal.

Level accuracy at 1 kHz

With a load impedance of greater than 10 kΩ: LF ±5% for levels above 50 mV LF ±10% for levels from 500 µV to 50 mV.

Frequency response

Typically < ±1 dB from 0.1 Hz to 300 kHz.

SWEEP

Control modes

Start/stop values of selected parameter. Number of steps. Time per step.

Step time

1 ms to 20 s per step.

Sweep ramp

Synchronized analog ramp with a nominal amplitude of 0 to 10 V peak on rear panel BNC connector.

Markers

User selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to +5 V from 600 Ω on rear panel BNC socket.

Trigger

Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep. Connector is internally connected via 10 kΩ pull-up resistor to +5 V.

FREQUENCY STANDARD

Frequency

10 MHz.

Temperature stability

Better than ±5 in 10^8 in the operating range of 0 to 50°C.

Warm up time

Within 2 in 10^7 final frequency within 10 minutes from switch on at 20°C ambient.

Ageing rate

Better than 2 in 10^7 per year.

Output

Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω. Output can be disabled.

External input

Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with an input level in the range 220 mV to 1.8 V RMS into 1 kΩ.

GENERAL

GPIB INTERFACE

A GPIB interface is fitted. All functions except the supply switch and display contrast are remotely programmable.

Capabilities

Designed in accordance with IEEE488.2.
Complies with the following subsets as defined in IEEE Std. 488.1. SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

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

BACK

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 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 2 supply.

RATED RANGE OF USE *(Over which full specification is met unless otherwise stated)*

Temperature

0 to 55°C.

Humidity

Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature

–40°C to +71°C.

Humidity

Up to 93% relative humidity at 40°C.

Altitude

Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply

Four voltage settings covering:

100 V~ (Limit 90 - 115 V~)
120 V~ (Limit 105 - 132 V~)
220 V~ (Limit 188 - 242 V~)
240 V~ (Limit 216 - 264 V~)

Frequency: 50 - 400 Hz (Limit 45 - 440 Hz) 180 VA max

CALIBRATION INTERVAL

2 years.

DIMENSIONS AND WEIGHT

(Over projections but excluding handles)

Height	Width	Depth	Weight
152 mm	425 mm	525 mm	21 kg
6 in	16.6 in	20.5 in	46 lb

OPTIONS

OPTION 1 - SECOND MODULATION OSCILLATOR OPTION

Specification as Modulation Oscillator.

OPTION 2 - PULSE MODULATION OPTION

Modulation Modes

Pulse modulation may be used alone or in conjunction with FM, ΦM, Wideband FM, Vector or Digital Modulation.

Rise / Fall Time

25 ns.

Control

0 V for carrier off, +5 V for carrier on. Threshold level is typically +2.5 V.

ON/OFF Ratio

Better than 70 dB.
Input impedance 50 Ω.

OPTION 105 - SLOW RISE TIME PULSE MODULATION

Modifies pulse modulation option for a typical rise and fall time of 1 µs.

OPTION 6 - AVIONICS

See separate sheet.

OPTION 8 - RF PROFILE AND COMPLEX SWEEP

See separate sheet.

OPTION 12 - ELECTRONIC ATTENUATOR

Carrier Frequency Range

250 kHz to 1.35 GHz (2050T),*
250 kHz to 2.7 GHz (2051T).*

** Useable to 10 kHz (50 MHz in Digital, Advanced Digital or Vector modes, useable to 10 MHz)*

RF Output

Range (Analog mode)
-138 dBm to +10 dBm When AM is selected the maximum output level reduces linearly with AM depth to +4 dBm at maximum AM depth.

Range (Digital or Vector mode)
-132 dBm to +3 dBm peak envelope power.

Range (Advanced digital mode)
-144 dBm to -9 dBm

Accuracy

±1.2 dB in non Digital or Vector modes for output levels >-127 dBm at 22°C ±5°C

Temperature Stability

±0.01 dB/°C

VSWR

< 1.5:1 for output levels less than 0 dBm.

Reverse Power Handling

1 W from a source VSWR of up to 5:1.

Amplitude Modulation

Standard specification applies for carrier frequencies above 50 MHz (Above 100 MHz for Option 6)

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2050T	10 kHz to 1.35 GHz Digital and Vector Signal Generator.
2051T	10 kHz to 2.7 GHz Digital and Vector Signal Generator.
2052T	10 kHz to 5.4 GHz Digital and Vector Signal Generator.

Supplied with

AC supply lead.

Operating Manual.

Options

Option 001	Second modulation oscillator
Option 002	Pulse modulation.
Option 006	Avionics (must be ordered with Option 001).
Option 008	RF Profiles and complex sweep
Option 012	Electronic attenuator (2050T and 2051T only).
Option 105	Increased pulse modulation rise and fall time (must be ordered with Option 002).
Option 112	External modulation inputs (2) 600 Ω impedance

Optional Accessories

44991/144	Break out box. Converts auxiliary D type connector to 8 data, 1 burst line, and a it/symbol clocks on BNC connectors. Daisy chain connection allows the monitoring of the signals (on BNC connectors).
43139/042	RF connector cable, 50 Ω, 1.5 m, BNC.
54311/092	Coaxial adapter N male to BNC female.
59999/163	Precision coaxial adapter N male to SMA female.
54311/095	RF connector cable, 1 m, type N connectors.
43129/189	GPIB Lead assembly.
46883/408	IEEE/IEC Adapter block for GPIB socket.
46884/291	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884/292	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884/541	Rack mounting kit containing front mounting brackets only.
46884/444	Maintenance kit 2030/40/50 Series.
46662/525	Transit case.
54112/164	Soft carry case.
54499/044	DECT Filter.
46880/062	Service manual.

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

AEROFLEX
A passion for performance.

www.aeroflex.com

info-test@aeroflex.com

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

Part No. 46891/008, Issue 9, 02/04

Signal Sources

IFR 3410 Series Digital RF Signal Generators

AEROFLEX
A passion for performance.

An agile signal generator that combines wide frequency cover and high performance vector modulation in a small package, making it ideal for testing wireless communication systems and components

- Wide frequency coverage

  250 kHz to 2 GHz (3412)
  250 kHz to 3 GHz (3413)
  250 kHz to 4 GHz (3414)
  250 kHz to 6 GHz (3416)
- Fast RF frequency and level settling for high speed testing
- High performance vector modulation for improved component test
- Optional dual channel arbitrary waveform generator (ARB)
- Low adjacent channel power for receiver selectivity and amplifier linearity testing
- Fast GPIB response to maximize ATE system performance
- ***IQCreator*** ® RF waveform creation software
- Wide bandwidth FM and AM modulation capability
- Optional Differential I/Q outputs for simplified component test interfacing
- Optional high speed pulse modulation capability
- Compact and lightweight package
- Simple to use touch panel interface
- RF optimization modes - Auto, Low Noise, Low ACP and Higher Power

The IFR 3410 series are portable, lightweight signal generators covering a wide range of carrier frequencies to 6 GHz. High quality analog and vector modulation capabilities make these signal generators ideal for research, development and manufacturing applications.

Careful attention to the design of the modulators and the RF system ensures that these signal generators exhibit low levels of adjacent channel power, making them suitable for the most demanding amplifier linearity and receiver selectivity measurements.

The use of Aeroflex fractional N synthesis techniques, combined with fast level control and an electronic attenuator, ensures the 3410 series signal generators are both frequency and level agile for high speed ATE testing.

Operation

A flexible but intuitive user interface based on a touch panel display system ensures that the signal generator meets the needs of unskilled as well as skilled operators. The instrument can be configured to the required mode of operation very simply, with numerical data being entered by the keyboard or via a rotary control. The display shows the primary parameters in a clear and unambiguous format, minimizing the risk of operator error.

RF Output

The 3410 series signal generators provide peak output power of up to +16 dBm. With a level resolution of 0.01 dB, repeatable and accurate testing of wireless components can be performed.

The electronic attenuator is ideal for high volume applications where attenuator life is critical. A user defined RF level limit can be entered to ensure that the signal generator cannot provide damaging signal levels when testing less robust components. Careful attention to the level control system guarantees that positive level transients cannot be generated. The fast responding electronic reverse power protection system helps ensure long life and high reliability when testing high power systems.

Spectral Purity

Receiver measurements require good spectral purity from a signal generator. The 3410 series has excellent performance with typically 1.5 Hz residual FM at 1 GHz and a floor noise of typically better than -148 dBc / Hz.

Frequency and Level Setting Times

Fast frequency and RF level setting times are key parameters in achieving minimum test execution times and therefore maximum throughput, in production environments. The 3410 series with typical frequency setting times of 2 ms and level setting times of 2.5 ms provide outstanding performance.

In addition to comprehensive sweep functions for carrier frequency, RF level and modulation oscillator 3410 series provides an extremely fast optional sweep mode for frequency and level settings through the use of user stored lists. Option 010, List Mode has a setting time of less than 500 μs and is ideal for frequency hopping and semi-conductor production applications.

Modulation

Comprehensive modulation facilities are provided for supporting the testing of analog or digital RF systems. A single key press turns the modulation on and off, providing a fast method for signal to noise checking.

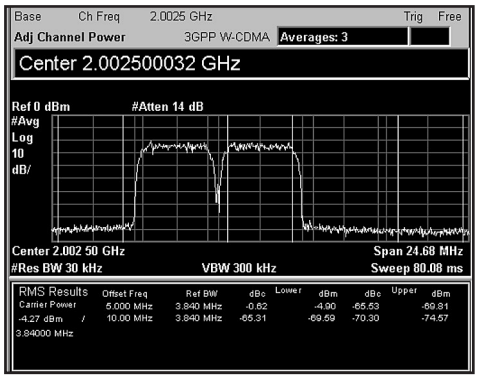
	Int Am1	Int (AM1 + AM2)	Ext AM1	Int FM1	Int (FM1 + FM2)	Ext FM1	Int PM1	Int (PM1 + PM2)	Ext PM1	Internal IQ	External IQ	Pulse	Burst
Int AM1				✓	✓	✓	✓	✓	✓			✓	
Int (AM1 + AM2)				✓		✓	✓		✓			✓	
Ext AM1				✓	✓	✓	✓	✓	✓			✓	
Int FM1	✓	✓	✓									✓	
Int (FM1 + FM2)	✓		✓									✓	
Ext FM1	✓	✓	✓									✓	
Int PM1	✓	✓	✓									✓	
Int (PM1 + PM2)	✓		✓									✓	
Ext PM1	✓	✓	✓									✓	
Internal IQ												✓	✓
External IQ												✓	✓
Pulse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Burst										✓	✓		

Modulation Modes

Vector Modulation

The built-in IQ modulator provides state-of-the-art vector modulated signals with excellent level linearity, low vector error and low noise. With a typical vector bandwidth up to 55 MHz, the modulator is able to support wideband as well as narrow-band wireless standards. Internal calibration systems ensure the modulator performance can be quickly optimized to reduce vector errors and ensure low carrier leak at all operating frequencies.

The linearity of the modulator and the RF output system is reflected in the excellent adjacent channel power when generating multi-carrier non-constant envelope signals such as cellular CDMA and TETRA.



Typical 3GPP 2 carrier test model 1 (64 channels)

Analog Modulation

With typical AM bandwidth to 30 MHz and typical FM bandwidth to 20 MHz, the 3410 series signal generators are ideal tools for testing broadcast systems. The wide bandwidths allow video signals to modulate the carrier with minimal distortion.

The wideband FM facilities allow the generation of fast-swept signals, while the use of a patented DC FM system ensures that carrier frequency errors when the FM is DC coupled are minimal.

The specifications for AM are maintained to high carrier frequencies to support the use in modern EMC testing applications. The signal generator maintains excellent phase noise performance even when generating wideband modulated signals.

Modulation Oscillator

An internal modulation oscillator is provided which can be used to generate two tones in the frequency range 0.1 Hz to 50 kHz (16 MHz with Option 005 ARB Waveform Generator). In addition to sine waves, the modulation oscillator can provide square waves, triangular and sawtooth waveforms for narrow band sweeping.

Digital Modulation

The user has a choice of either a Dual Arbitrary Waveform Generator or a Real Time Baseband Generator for producing digitally modulated output signals.

Dual Arbitrary Waveform Generator

Fitted internally, the optional Dual Channel Arbitrary Waveform Generator allows the user to select from a library of pre-stored IQ modulator drive waveforms to provide accurately modulated carriers simulating the characteristics of digitally modulated communication systems. Burst modulation and alternate level rf attenuation facilities are provided for TDMA signal simulation. Marker output signals can be placed within the waveform to simplify triggering and synchronization with external test equipment. Using a patented technique, the dual channel ARB is able to take waveform files typically four times oversampled and run them through a real time interpolation

BACK

system to raise the sampling rate of the file. This ensures the generation of low adjacent channel power and low spectral noise density. The dual channel ARB is suited for the generation of both narrow band and wideband signals, including WCDMA signals, without the use of switched reconstruction filters. Combining a large ARB memory with the smaller file size required to define a waveform allows the ARB to store up to 180 waveforms. Alternatively the whole of the memory can be devoted to a single file. One such file would store over 1.5 seconds of a 3GPP WCDMA waveform signal. The use of interpolation techniques ensures that when narrow band systems are simulated the waveform generator can still operate at a high sample rate without requiring excessively large amounts of data to be loaded or restricting the repetition time. The library waveforms are structured in a directory form to ease their selection and the optimization of the user's generator. The modulation waveforms can be simply changed by selection from a file list with the changeover between waveforms occurring in a few milliseconds rather than the many seconds required in more traditional waveform generators. The file name can be determined by the user to convey a useful description of the contents of the file.

Real Time Baseband Generator

Fitted internally, the optional Real Time Baseband, RTBB, generates baseband signals (I and Q) that modulate an RF source in real time to produce generic FSK, PSK and QAM signals at rates up to 2 Msymbols/sec. The RTBB generates or inputs a set of modulation symbols, modulates them with the chosen scheme, filters them using an appropriate channel filter, and then converts the digital stream to analogue I and Q for the I/Q vector modulator. The source of the symbol data is very flexible. The symbol data can originate from a variety of internal or external sources. Internal data source choices include a PRBS generator, an internal pattern generator or internal memory storage of user downloaded symbols. External real-time symbol data can be input in serial or parallel format via an industry standard Low Voltage Differential Signalling (LVDS) interface.

Digitized I/Q data, available from sources such as basestation simulators, can be input via the LVDS interface as an alternative to external parallel or serial symbol data. Streaming digitized I/Q data samples are available as an output via the LVDS interface from internally generated symbols for testing D/A convertors.

Synchronized clock, RF Burst, RF Burst Attenuation control and marker output signal facilities are available for both internal and external data generation.

An important feature necessary to support GSM signal generation is the ability to frequency hop between channels. The RTBB option provides frequency hopping by re-mixing the I and Q data at baseband. The resultant I and Q vectors then modulate the core synthesizer frequency thus producing a new RF frequency at the output of the signal generator. This method ensures that synchronization is maintained between the IQ data and the hop trigger. In addition, because the main synthesizer hardware remains unchanged, frequency stabilization is nearly instantaneous.

IQCreator®

The 3410 series is supplied with a free copy of ***IQCreator***®, a software package to aid the creation and download of files to the ARB and RTBB options.

IQCreator® is a Windows based software utility that enables a user to set up a modulation scheme and then create an ARB file using modulation templates. The resulting file may be saved on a PC or downloaded into the ARB. User-defined configurations can also be saved. Consequently, it is possible to load previously saved setups to regenerate the ARB files quickly and easily. The capabilities of ***IQCreator***® include:-

Generic Modulation Types

PSK, FSK, MSK, QAM modulation types
Nyquist, Root Nyquist and Gaussian filters
PRBS, fixed pattern and user defined data sources
IQ errors - residual carrier, IQ imbalance, quadrature offset
Multi-carrier

Also included are 2G, 2.5G and 3G cellular TDMA and CDMA digital standards along with WLAN and other cordless phone standards.

In addition, ***IQCreator***® includes a utility that allows user-defined waveforms, created using software simulation tools such as MATLAB, to be converted and packaged into a form that can be downloaded into the 3410 Series ARB.

IQCreator® is continually updated to include new modulation capabilities and facilities. The latest version is available for download at www.aeroflex.com.

Options to have an instrument's ARB pre-loaded with a suite of example waveform files are available. A selection of waveforms from each of the standards, or just waveforms relevant to the user's applications, can be chosen. Although only available at the time of order, all the waveforms are available within IQCreator should any of the files be deleted then required in the future.

I/Q Outputs

Single ended baseband I/Q outputs are available as standard. Differential I/Q outputs, combined with comprehensive voltage bias and offset facilities, are optionally available to simplify component and module testing.

Pulse Modulator

An optional pulse modulator allows the generation of fast rise time RF signals with on/off ratios that meet the most demanding radar and ECM/ECCM test applications.

Remote Control

The 3410 series include both fast GPIB and Ethernet remote control interfaces for flexibility in production environments. RS-232 control is also provided for use in legacy ATE systems.

The protocol and syntax of the GPIB commands have been designed in accordance with IEEE 488.2 to simplify program generation. Plug and play drivers are available that include a virtual front panel for remote instrument supervision and debug.

Frequency Standard

The 3410 series includes a high stability OCXO as standard. The inclusion of a main input power standby mode maintains the oscillator at working temperature while the rest of the instrument is powered down. Time to full specification working is thereby minimized for equipment facilities held on standby.

Size

The 2U rack height ensures the 3410 series occupies minimal space in a manufacturing rack or on the engineer's bench, allowing the provision of more compact test systems. The full rack width ensures easy stacking of instruments while the light weight allows for easy carrying in the laboratory or the field.

SPECIFICATIONS

CARRIER FREQUENCY

Range

250 kHz - 2 GHz (3412)
250 kHz - 3 GHz (3413)
250 kHz - 4 GHz (3414)
250 kHz - 6 GHz (3416)

Resolution

1 Hz, accuracy as frequency standard
The carrier output phase can be advanced or retarded in increments of 0.036°.

FREQUENCY SETTING TIME (NON-LIST MODE)

After receipt of the GPIB interface deliminator (terminator), 23°C ± 5°C

Phase Noise Mode Optimized >10 kHz

<5.5 ms, typically 4 ms, ≤375 MHz, to be within ≤200 Hz
>375 MHz, to be within ≤0.1 ppm

Phase Noise Mode Optimized <10 kHz

<3 ms, typically 2.5 ms, ≤375 MHz, to be within ≤200 Hz
<2.5 ms, typically 2 ms, >375 MHz, to be within ≤0.1 ppm

FREQUENCY SETTING TIME (OPTION 010 LIST MODE)

After external trigger in List Mode, 23°C ± 5°C

Phase Noise Mode Optimized >10 kHz

<4 ms, typically 3 ms, ≤375 MHz, to be within <200 Hz
>375 MHz, to be within <0.1 ppm

Phase Noise Mode Optimized <10 kHz

<600 µs, typically 500 µs, ≤375 MHz, to be within <200 Hz
<500 µs, typically 450 µs, >375 MHz, to be within <0.1 ppm

RF OUTPUT

The RF output is controlled by an ALC system in normal operation. When IQ modulation is enabled alternative control modes are available to optimize the performance of the signal generator.

Range

Electronic Attenuator

≤10 MHz	-140 to +13 dBm
≤2 GHz	-140 to +16 dBm
≤3 GHz	-140 to +16 dBm
≤3.75 GHz	-140 to +13 dBm
≤4 GHz	-140 to +10 dBm
≤6 GHz	-140 to +8 dBm

Mechanical Attenuator

≤10 MHz	-140 to +16 dBm
≤2 GHz	-140 to +19 dBm
≤3 GHz	-140 to +16 dBm

No Attenuator

≤10 MHz	0 to +21 dBm
≤3 GHz	0 to +22 dBm
≤3.75 GHz	0 to +20 dBm
≤4 GHz	0 to +17 dBm
≤6 GHz	0 to +18 dBm

When AM is selected the maximum RF output is linearly reduced by up to 6 dB depending on the requested AM depth.

When IQ modulation is selected maximum output is reduced by 6 dB below 100 MHz.

Resolution

0.01 dB

RF Level Units

Units can be set to µV, mV, V EMF or PD; dB relative 1 µV, 1 mV, 1 V EMF or PD; or dBm. Conversion between dB and linear units may be achieved by pressing the appropriate units key (dB or V, mV or µV).

RF Output Accuracy (@ 23°C ± 5°C)

Electronic Attenuator

RF Mode		-127 to -30 dBm	>-30 dBm
Auto	≤2 GHz	±0.75 dB	± 0.50 dB
	≤3 GHz	±1.00 dB	±0.75 dB
		-110 to -30 dBm	**>-30 dBm**
	≤6 GHz	±1.25 dB	±1.00 dB

Mechanical Attenuator

RF Mode		-127 to -28 dBm	>-28 dBm
Auto	≤2 GHz	±0.75 dB	± 0.50 dB
	≤3 GHz	±1.00 dB	±0.75 dB

No Attenuator

RF Mode		>0 dBm
Auto	≤ 2 GHz	±0.50 dB
	≤ 3 GHz	±0.75 dB
	≤ 6 GHz	±1.00 dB

Level Accuracy With IQ Modulation

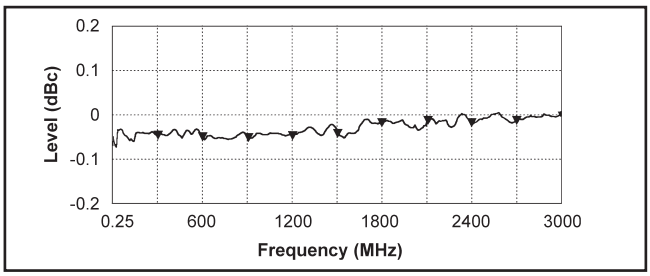
For constant envelope modulation systems: typical standard level error ±0.15 dB

For non-constant envelope modulation systems: typical standard level error ±0.25 dB

Temperature Stability

±0.01 dB/°C, ≤3 GHz
±0.02 dB/°C, ≤4 GHz, ±0.02 dB/°C typical, ≤6 GHz

RF Flatness



Typical flatness at 0 dBm

LEVEL SETTING TIME

Electronic attenuator, Option 003 is assumed in all cases.
ALC loop bandwidth 'Moderate' or 'Broad', to be within ≤0.3 dB

Level Setting Time (Non-List Mode)

After receipt of the GPIB interface deliminator (terminator), 23°C ± 5°C

<4.5 ms, typically 2.5 ms

Level Setting Time (Option 010 List Mode)

After external trigger in List Mode, 23°C ± 5°C

<3 ms, typically 1.5 ms

Output VSWR

Electronic Attenuator

For output levels <0 dBm

Frequency	***Output VSWR***
≤2 GHz	<1.25:1
≤3 GHz	<1.40:1
≤4 GHz	<1.50:1
≤6 GHz	<1.60:1

For output levels >0 dBm VSWR is <1.5:1 ≤4 GHz, <1.8:1 ≤6 GHz

Mechanical Attenuator

For output levels <0 dBm

Frequency	***Output VSWR***
≤3 GHz	1.33:1

For output levels >0 dBm VSWR is <1.5:1, ≤3 GHz

No Attenuator

Frequency	***Output VSWR***
≤4 GHz	<1.5:1
≤6 GHz	<1.8:1

Attenuator Repeatability

Mechanical attenuator typically 0.1 dB

Output Connector

Front panel 50 Ω type N female to MIL-PRF-39012 class 2

Output Protection

Protects the instrument from externally applied RF power (from a 50 Ω source) of 50 W up to 3 GHz and 25 W up to 4 GHz

The RPP trip may be reset from the front panel or via the remote interface. For safety, the protection is also provided when the instrument is switched off.

3416 damage level 0.5 W (+27 dBm) from a max 5:1 VSWR, all frequencies

SPECTRAL PURITY

All parameters stated at RF level ≤+7 dBm in Noise and ACP RF modes

Harmonics

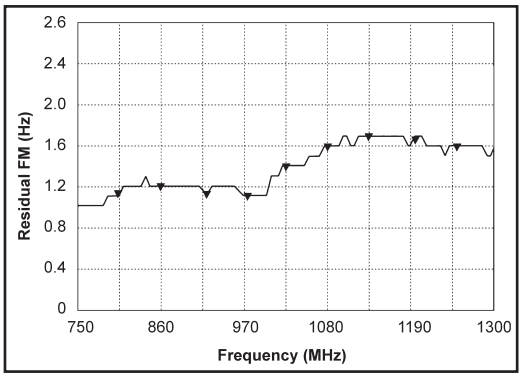
<-30 dBc, typically <-40 dBc

Sub- and Non-Harmonics

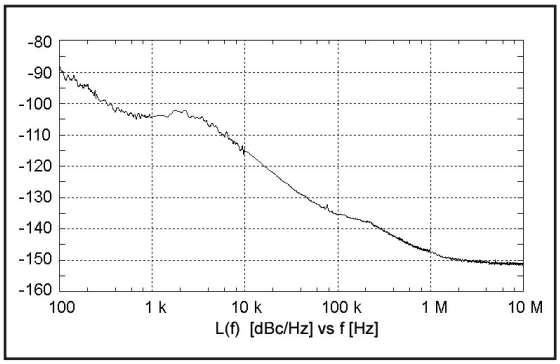
For offsets >10 kHz
<-70 dBc for carrier frequencies ≤3 GHz
<-60 dBc for carrier frequencies ≤6 GHz

Residual FM (FM on CW)

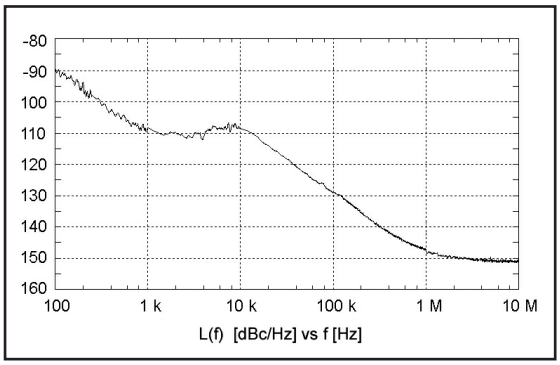
<2.5 Hz RMS (typically 1.5 Hz) at 1 GHz in a 300 Hz to 3.4 kHz unweighted bandwidth



Typical Residual FM



Typical SSB Phase Noise at 1 GHz, phase noise optimized >10 kHz offset

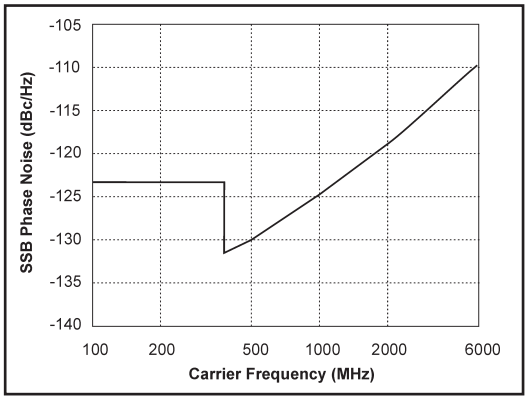


Typical SSB Phase Noise at 1 GHz, phase noise optimized <10 kHz offset

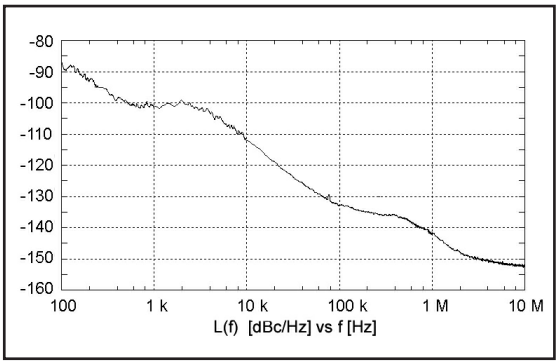
SSB Phase Noise

For 20 kHz offset, Noise Optimized mode

	CW/IQ
≤375 MHz	<-115 dBc/Hz
500 MHz	<-124 dBc/Hz
1 GHz	<-118 dBc/Hz
2 GHz	<-112 dBc/Hz
3 GHz	<-108 dBc/Hz
4 GHz	<-106 dBc/Hz
6 GHz	<-102 dBc/Hz



Typical SSB Phase Noise Performance at 20 kHz Offset, phase noise optimized >10 kHz offset

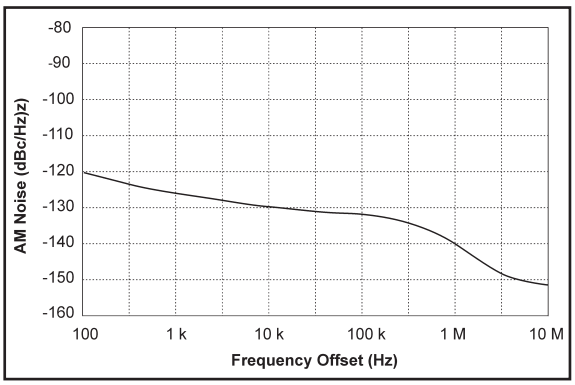


Typical Phase Noise at 2.1 GHz

SSB AM Noise

SSB AM noise at 20 kHz offset (Typical values) measured at levels >0 dBm

Frequency MHz	***CW/IQ (dBc/Hz)***
≤ 3 GHz	*-130*
≤ 6 GHz	*-125*



Typical AM Noise at 1 GHz

RF Leakage

<0.5 µV PD at the carrier frequency into a single turn 25 mm loop 25 mm or more from the case of the signal generator, for carrier frequencies <3 GHz

Wideband Noise

Applicable for all carrier levels at offsets >5 MHz and <50 MHz excluding thermal noise (23°C ±5°C)

RF Mode	***≤375 MHz (dBc/Hz)***	***≤3 GHz (dBc/Hz)***	***≤6 GHz (dBc/Hz)***
Power	*<-138*	*<-142 (-148 typ)*	*<-136*
Noise	*<-138*	*<-142 (-148 typ)*	*<-136*
ACP	*<-135*	*<-140*	*<-134*

MODULATION

FM, AM and ΦM can be applied to the carrier using internal or external modulation sources. The internal modulation source is capable of generating two simultaneous signals into any one of the modulation channels. The internal and external modulation sources can be simultaneously enabled in order to produce combined amplitude and frequency (or phase) modulation.

Internal and external IQ modulation can be applied. In this mode, FM, AM and ΦM are not permitted.

Optional Pulse modulation can be used in combination with FM, AM, ΦM and IQ from an external pulse source.

FREQUENCY MODULATION

Peak Deviation

Frequency	***Maximum Peak Deviation***
250 kHz to 375 MHz	*7.5 MHz*
375 MHz to 750 MHz	*3.75 MHz*
750 MHz to 1.5 GHz	*7.5 MHz*
1.5 GHz to 3 GHz	*15 MHz*
3 GHz to 6 GHz	*30 MHz*

Displayed resolution is 4 digits or 1 Hz.

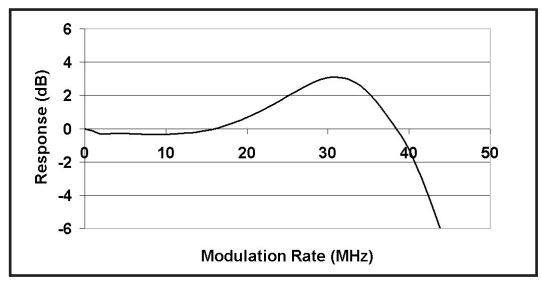
FM Accuracy

At 1 kHz rate
±3% of set deviation excluding residual FM

FM Bandwidth

0.5 dB DC to 200 kHz (DC coupled, 100 kΩ)
10 Hz to 200 kHz (AC coupled, 100 kΩ)

3 dB Typically 20 MHz (DC or AC coupled, 50 Ω)



Typical FM Bandwidth

Carrier Frequency Offset

For DC coupled FM ±(1 Hz + 0.1% of set deviation) after performing a DCFM null operation

Total Harmonic Distortion

At 1 kHz rate
<0.15% for deviations up to 2% of maximum allowed deviation
<0.6% for deviations up to 20% of maximum allowed deviation
<1.5% at maximum deviation

PHASE MODULATION

Phase Deviation

0 to 10 radians
Displayed resolution is 4 digits or 0.01 radians.

Accuracy

At 1 kHz rate
±4% of set deviation excluding residual phase modulation

Bandwidth

0.5 dB 100 Hz to 10 kHz (AC coupled, 100 kΩ)

Total Harmonic Distortion

At 1 kHz rate
<0.5% at 10 radians deviation
Typically <0.1% at 1 radian deviation

AMPLITUDE MODULATION

Specifications apply for carrier frequencies from 2 MHz up to 2 GHz, usable to 4 GHz and 'Noise' or 'ACP' RF modes.

Maximum specified output power is reduced by 2 dB, ≤10 MHz for 'No attenuator' Option 001 with AM selected.

Modulation Depth

0 to 99.9%, Displayed resolution is 3 digits or 0.1%

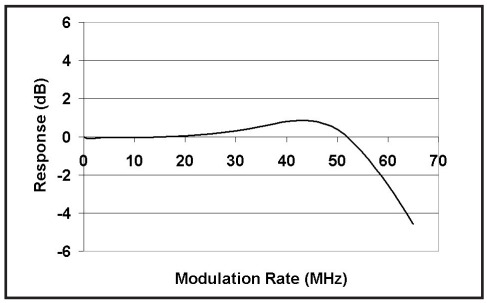
Accuracy

At 1 kHz rate
±4% of set depth ±1% excluding residual AM

AM Bandwidth

1 dB DC to 200 kHz (DC coupled, 100 kΩ)
10 Hz to 200 kHz (AC coupled, 100 kΩ)

3 dB Typically 30 MHz (DC or AC coupled, 50 Ω)



Typical AM Bandwidth

Total Harmonic Distortion

For 1 kHz modulation rate
<1% for depths ≤30%
<2% for depths ≤80%

FM on AM

Typically <20 Hz for 30% AM depth at a modulation rate of 1 kHz and carrier frequency of 500 MHz

ΦM on AM

Typically <0.02 radian for 30% AM depth at a modulation rate of 1 kHz and carrier frequency of 500 MHz

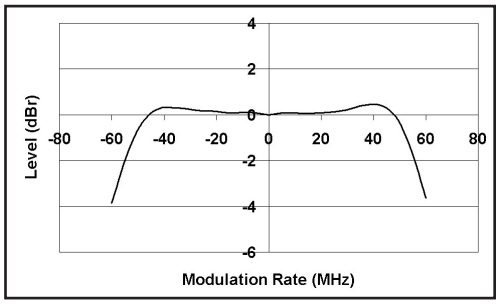
IQ MODULATION

Performance applicable in ACP and Noise modes only

IQ Inputs

BNC connector inputs, selectable 50 Ω/100 kΩ input impedance

Full scale input $(I^2+Q^2)^{0.5}$ occurs for 0.5 V rms (The level requested is obtained by applying 0.5 VDC to either the I or Q input)



Typical IQ Bandwidth

Modulation Bandwidth Relative to DC

At 23°C ± 5°C:
±0.5 dB for frequencies DC up to 5 MHz
1 dB for frequencies DC up to 10 MHz

3 dB:

RF Mode	***≤2.8 GHz***	***≤6 GHz***
Noise	>42 MHz, 50 MHz typ	>35 MHz, 45 MHz typ
ACP	>48 MHz, 55 MHz typ	>40 MHz, 50 MHz typ

DC Vector Accuracy

Relative to Full Scale (0.5 V RMS)

Static Error Vector Magnitude (EVM)	*<1% RMS at full scale*
Magnitude error	*<0.5% RMS at full scale*
Phase error	*<0.5° RMS at full scale*

Residual Carrier Magnitude:

For 0 V input voltage, relative to full scale

RF Mode

Noise <-45 dBc, typically <-55 dBc
ACP <-40 dBc, typically <-50 dBc

Valid for 12 hours after executing an IQ self-calibration and within ±5°C of the calibration temperature. The instrument displays a warning if the time or temperature limits are exceeded.

Static EVM and phase error measured with residual carrier magnitude removed.

IQ Image Suppression

At 10 kHz modulation frequency
Typically <-50 dBc @ 10 kHz

Linearity (See linearity chart over page)

Adjacent Channel Power (ACP), in ACP mode for continuous and discontinuous signals at RF output levels ≤ 0 dBm, over the temperature range 23°C ± 5°C

RF BURST CONTROL

A digital control bit is used to generate an analog ramp (up or down) of the RF output. The Burst Gate control signal can either be generated internally as part of the optional internal base-band source, or provided externally by the user on the rear panel connector. When internally generated, the Burst Gate control signal appears on the rear panel auxiliary connector that then serves as an output.

On/Off Ratio

For the temperature range 23°C ± 5°C
>90 dB for carriers ≤ 3 GHz
>80 dB for carriers ≤ 4 GHz
>65 dB for carriers ≤ 6 GHz

Ramp Profile

Rise and fall time after the L-H and H-L transitions of the burst control bit respectively can be defined by the user from 10 µs to 999 µs in 0.1 µs steps.

Burst Gate control input is a TTL level (HCT), 50 Ω impedance BNC input on the rear panel.

RF ramp can be adjusted in time by ±50 µs in increments of 0.1 µs with respect to the trigger event.

RF BURST ATTENUATION CONTROL

A digital attenuation control bit (in conjunction with the ramp control bit) is used to decrease the RF level from the set level to an alternative level during burst modulation. The Burst Attenuation Trigger signal can be provided internally as part of the optional dual arbitrary waveform generator (ARB), or externally on a rear panel connector. When internally generated, the Burst Attenuation Trigger control signal appears on the rear panel auxiliary connector that then serves as an output.

Attenuation range available is 0 to 70 dB.

Burst Attenuation Trigger control is a TTL level (HCT), 50 Ω impedance

LINEARITY CHART

	TETRA	***GSM 900 / 1800 / 1900 GSM EDGE (Enhanced Data rate for GSM Evolution)***	***802.11a** Wireless LAN (Spectral Mask)***	***IS-95 (CDMAone)***
Frequency Range(s)	*130 MHz - 1 GHz*	*850 MHz - 1 GHz* *1700 - 1900 MHz*	*5.15 - 5.825 GHz*	*824 - 894 MHz* *1850 - 2000 MHz*
ACLR (Continuous & Discontinuous)	*<-70 dBc @ 25 kHz offset* *<-80 dBc* @ 50 kHz offset* *<-80 dBc* @ 75 kHz offset*	*<-35 dBc @ 200 kHz offset* *<-70 dBc @ 400 kHz offset* *<-80 dBc @ 600 kHz offset*	*<-25 dBr @ 11 MHz offset* *<-45 dBr @ 20 MHz offset* *<-60 dBr* @ 30 MHz offset*	*<-65 dBc @ 885 kHz offset* *<-75 dBc @ 1.25 MHz offset* *<-80 dBc @ 1.98 MHz offset*
	3GPP/WCDMA	***NADC (IS - 54, IS - 136)***	***JDC/PDC***	***PHP/PHS***
Frequency Range(s)	*1855 - 2200 MHz*	*824 - 894 MHz* *1850 - 2000 MHz*	*810 - 826 MHz* *940 - 956 MHz* *1429 - 1513 MHz*	*1895 - 1918 MHz*
ACLR (Continuous & Discontinuous)	*<-70 dBc @ 5 MHz offset* *<-72 dBc* @ 5 MHz offset*	*<-40 dBc @ 30 kHz offset* *<-78 dBc* @ 60 kHz offset* *<-80 dBc* @ 90 kHz offset*	*<-65 dBc @ 50 kHz offset* *<-80 dBc* @ 100 kHz offset*	*<-75 dBc @ 600 kHz offset* *<-80 dBc @ 900 kHz offset*

* denotes typical value ** At RF o/p level ≤-4 dBm

signal available on the rear panel Auxiliary connector.

RF burst attenuation requires Electronic Attenuator Opt 003.

INTERNAL MODULATION OSCILLATOR

The internal modulation source is capable of generating up to two simultaneous signals into any one of the modulation systems.

Frequency Range

0.1 Hz to 50 kHz (16 MHz with Option 005) with 0.1 Hz or 5 digits of resolution

Accuracy

As frequency standard

Distortion

<0.1 % for a sine wave at 1 kHz

In addition to a sine wave the following waveforms can be generated:

Triangle 0.1 Hz to 10 kHz (2 MHz with Option 005)
Ramp 0.1 Hz to 10 kHz (2 MHz with Option 005)
Square 0.1 Hz to 5 kHz (1 MHz with Option 005)

(Note: modulation frequency can be set to 50 kHz irrespective of waveform type)

Level

Modulation source signals are available on the rear panel I/AM OUT and Q/FM OUT at nominal level of 1 V peak EMF from 50 Ω source impedance.

EXTERNAL MODULATION SOURCE

External inputs are available with a selectable input impedance of 50 Ω or 100 kΩ (default setting), AC or DC coupled.

Apply 1 V RMS (default) or 1 V peak for the set modulation.

A HI/LO indicator when the applied signal is greater than ±6% from nominal

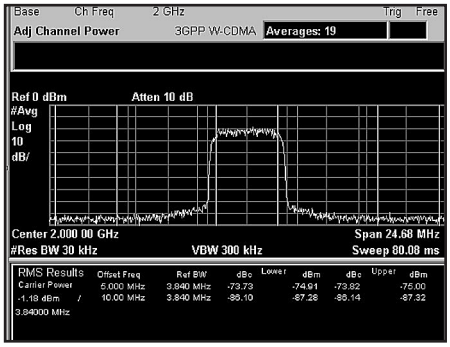
External AM is input to EXT I/EXT AM front panel BNC connector.

External FM is input to EXT Q/EXT FM front panel BNC connector.

INTERNAL DUAL CHANNEL ARB SOURCE (OPTION 005)

A high performance Dual Arbitrary (ARB) Waveform Generator that provides IQ signals for the IQ modulator

The ARB enables files to be downloaded with sample rates from 17 kHz to 66 MHz. The ARB uses an interpolation system to increase the digital to analog converter sample rate and avoid the use of reconstruction filters.



Typical 3GPP test model 1 (64 channels)

ARB CHARACTERISTICS

Flash Memory Size

23,592,960 sample pairs

Maximum Number of Files

180

Sample Format

32 bits of data - 14 bits I, 14 bits Q, 3 associated marker bits

Sample Rate Tuning

± 20 ppm, 0.1 ppm step resolution

D-A Converter Resolution

14 bits

D-A Sample Rate

44 to 66 Msamples/s

BACK

Interpolation Factor

Automatically selected

Reconstruction Filter Stop Band Attenuation

>70 dB

ARB Spectral Purity

Spurious free dynamic range	*>70 dB, typically >80 dB*
20 kHz offset phase noise	*<-120 dBc/Hz*
Floor noise	*<-140 dBc/Hz*

IQCreator™ *Windows based software package is provided for the creation, formatting and downloading of ARB waveform files to the 3410 series.*

A waveform library is provided on a CD containing a selection of files for testing 2G, 2.5G and 3G systems. Files can be downloaded from www.aeroflex.com.

Marker Control Bits

Up to 3 marker bits (1-3) can be attached to each sample of IQ data. These can be used to indicate significant points in the waveform and are available as HC CMOS outputs via the rear panel Aux IN/OUT connector. Marker bit 1 can be used as RF Burst Control signal. Marker bit 2 can be used as Burst Attenuation Trigger signal to decrease (attenuate) the RF level from its nominal value.

Control Mode

Continuous, single or triggered operation of the ARB

An external TTL trigger input signal is available on the AUX IN/OUT rear panel connector.

IQ Outputs (Not applicable with Option 009 fitted)

The IQ signals produced by the ARB are available on the rear panel I/AM OUT and Q/FM OUT BNC connectors. Output level is 0.5 V RMS EMF (vector sum) from a source impedance of 50 Ω.

REAL TIME BASEBAND (OPTION 008)

Allows the creation of digitally modulated signals using generic modulation formats. An internal data source provides PRBS or fixed patterns. External real-time data in the form of symbol data, or digital IQ data may be applied via an LVDS interface.

Generic Modulation Formats

PSK	*BPSK, QPSK, 8PSK, 16PSK* *8PSK EDGE (8PSK with 3π/8 rotation)* *π/2 DBPSK, π/4 DQPSK, π/8 D8PSK* *DBPSK, DQPSK, D8PSK* *OQPSK (time offset)*
MSK	*GMSK*
FSK/GFSK	*2 and 4 level symmetric*
QAM	*16, 32, 64, 128, 256 levels*

For data bit to symbol mapping information refer to Technical Note "IFR 3410 Option 8 RTBB Ancillary Information"

SYMBOL RATE

Range

5 kHz to 2 MHz. Resolution 1 Hz

BASEBAND CHANNEL FILTERS

Filter Types

Nyquist	*a = 0.1 to 0.8, resolution 0.01*
Root Nyquist	*a = 0.1 to 0.8, resolution 0.01*
Gaussian	*Bt 0.1 to 1.0, resolution 0.1*
EDGE	*"Linearized Gaussian" as defined in GSM 05.04*

DATA SOURCE

Formats

Internal Data *PRBS - PN9, PN11, PN15, PN16, PN20, PN21, PN23.*

Fixed Pattern consisting of -
0, 0, 0, 0, 0, 0 ....
0, 1, 0, 1, 0, 1 ....
1, 0, 1, 0, 1, 0 ....
1, 1, 1, 1, 1, 1 ....
User-defined symbol file stored in non-volatile memory (Max size 256 kB)

External Serial Data

A single bit stream representing symbol information can be applied. The bit to symbol conversion is determined from the selected modulation type.

External Parallel Data

Symbol information consisting of 1 to 8 data bits can be applied. External parallel and serial data is input via the LVDS connector on the rear panel.

DATA ENCODING

None, Differential, GSM Differential, Inverted

TIMING/SYNCHRONIZATION

All clock and synchronization signals are provided internally by Option 8 RTBB and made available to the user on the rear panel LVDS connector. An external clock may be phase aligned to the internal clock via a "sync" operation.

External Serial Data Clock

Eight times the symbol rate, for all modulation types.

External Parallel Data Clock

Nominal symbol rate

FREQUENCY HOPPING

Frequency Hop List

Up to 32 frequency values. The frequency values entered represent offset values from the current RF frequency.

Frequency Offset Values

Offset values range ±10 MHz

MODES

Linear

On receipt of a hop trigger, the next frequency in the list is indexed.

Random

On receipt of a hop trigger, an internal PRBS generator indexes through the frequency list. PN length and polynomial initial seed value are user selectable. PN values selectable from - 9, 11, 15, 16, 20, 21, and 23.

External

On receipt of a hop trigger, the 5-bit hop address lines applied to the LVDS connector are used to index the frequency list.

Hop Rate

Max hop rate (hops/sec) is half symbol rate. Hopping is synchronized to symbol transition.

DIGITAL IQ DATA

Digital IQ data is available via the LVDS connector on the rear panel.

EXTERNAL IQ DATA IN

External 16-bit IQ data can be applied to an LVDS interface. The data can then be filtered or not, depending on the application, by the baseband board and fed to the DACs. All clock and sync signals are located

on the LVDS connector. These can be used to synchronize to an externally applied clock.

INTERNAL IQ DATA OUT

16-bit IQ data is available on the LVDS interface when the modulation is generated internally. Outputs can be disabled.

TONES

A tone (CW) only mode is available. Up to 2 tones may be selected. Each tone may be independently enabled and disabled.

Frequency Range	carrier frequency ± 10 MHz
Relative Level	60 dB

DIFFERENTIAL I/Q OUTPUT (OPTION 009)

When differential I/Q outputs are enabled signal generator RF carrier output is CW only.

Output Impedance

Can be used with single ended 50 Ω loads or differential 100 Ω loads. Delivered bias voltages are halved with single ended loads.

I/Q Bias Voltages

Independent I and Q channel bias voltages settable within the range of ±3 V

Bias Voltage

Resolution	1.0 mV nominal
Accuracy	±2% ±4 mV max, ±1% ±2 mV typical
Offset	See Bias Voltage above.

Differential Offset Voltage

Range	±300 mV
Resolution	100 µV nominal
Accuracy	±2% ±3.3 mV max, ±1% ±0.7 mV typical

Level Mode

Variable IQ signal level over 45 dB range

Differential Signal Balance

typ 0.15 dB @10 MHz

I/Q Channel Balance

±0.2 dB @1 MHz

I/Q Level Imbalance Adjust

±4 dB nominal continuously variable

I/Q Signal Amplitude

22.4 mV to 4 V pk-pk per channel

I/Q Signal Amplitude Accuracy

<2% at 20 kHz, typ 1.5%, excludes termination errors

Baseband Purity (2 V p-p set voltage at 1 MHz)

2nd Harm -70 dBc
3rd Harm -65 dBc
IMD -70 dBc (100 kHz tone spacing, at 1 MHz)

SWEEP FACILITY

Provides a digital sweep of RF frequency, RF level and Analog Modulation Sources in discrete steps

Start, stop, step size, number and step time can be controlled. Step time may be set from 2.5 ms to 10 s with 0.1 ms resolution. (20 ms for mechanical attenuator Option 002)

The sweep can be set to be continuous, single or externally triggered from the rear panel. TTL BNC Female rear panel.

Frequency Sweep

Linear step size: 1 Hz minimum step

Logarithmic: 0.01% to 50%, 0.01% step

Level Sweep

0.01 dB minimum step

Modulation Oscillator

0.1 Hz minimum frequency step

LIST MODE

Up to 500 frequencies and levels can be entered in the list. Start address, stop address and dwell time can be controlled. Dwell time can be set from 500 µs to 10 s. Requires Option 003 Electronic Attenuator

FAST PULSE MODULATOR (OPTION 006)

This option requires Electronic Attenuator Option 003 to be fitted.

On/Off Ratio

>80 dB for carrier levels ≥ -60 dBm

Rise/Fall Time

<20 ns typical (10 to 90%)

Pulse Delay

Typically <50 ns

RF Level Accuracy

RF mode = 'auto', as standard ±0.2 dB

The above specification is met for all power levels above 150 MHz.

AM Depth and Distortion

AM operation is unspecified below 10 MHz.
AM depth and distortion specification is degraded for operation above 0 dBm at carrier frequencies <150 MHz.

Video Breakthrough

RF Mode

Power	<±50 mV for RF levels >+10 dBm <±25 mV for RF levels in the range -10 dBm to +10 dBm <±10 mV for RF levels ≤-10 dBm
Noise	<±50 mV for RF levels >+4 dBm <±25 mV for RF levels in the range -16 dBm to +4 dBm <±10 mV for RF levels ≤-16 dBm
ACP	<±50 mV for RF levels >-6 dBm <±25 mV for RF levels in the range -26 dBm to -6 dBm <±10 mV for RF levels ≤-26 dBm

Modulation Source

PULSE IN BNC (female) connector rear panel

Input Impedance

50 Ω

Input Level

TTL level (HCT)

Control Voltage

A HCT logic 0 (0 V to 0.8 V) turns the carrier OFF
A HCT logic 1 (2 V to 5 V) turns the carrier ON

Max. Safe Input Level

±10 V

NON-VOLATILE MEMORY STORES

Full instrument configurations can be saved to 100 memory stores (0 - 99).

FREQUENCY STANDARD

10 MHz OCXO fitted as standard

Ageing Rate

$< \pm 0.8 \times 10^{-7}$ per year after 30 days continuous use

Temperature Coefficient

$< \pm 5 \times 10^{-8}$ over the temperature range 0°C to 50°C

Output Frequency

Within 2×10^{-7} of final frequency after 10 minutes from connecting supply power and switching on at a temperature of 20°C

Standby power is provided while the instrument is off but connected to the supply.

Output of 2 V pk-pk from 50 Ω is provided on a rear panel BNC connector.

EXTERNAL STANDARD INPUT

1 MHz or 10 MHz at a level of 300 mV RMS to 1.8 V RMS into 1 kΩ on the rear panel BNC connector

REAR PANEL OUTPUTS (OPTION 007)

With this option fitted RF output, EXT I/EXT AM input and EXT Q/EXT FM input connectors are transferred to the rear panel. When Option 009 is fitted only RF output connector is transfered to the rear panel. The standard signal generator specification remains unaltered.

GENERAL

WARRANTY

2 years with options for 3, 4 and 5 years

CALIBRATION INTERVAL

Recommended at 2 years

REMOTE CONTROL INTERFACES

Ethernet

All signal generator parameters except the supply switch are remotely programmable. The following LAN protocols supported:

VXI-11
Telephone Network (TELNET)
File Transfer Protocol (FTP) (instrument firmware upgrades only)

GPIB

All signal generator parameters except the supply switch are remotely programmable. The GPIB is designed in accordance with the IEEE 488.2.

RS-232

All functions except the supply switch are remotely programmable. Can be used for upgrading the instrument firmware without removal of the instrument covers.

Interface Functions

SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2

DIMENSIONS AND WEIGHT

	Height	Width	Depth
Overall	107 mm	468 mm (19")	545 mm max
Rackmount *	89 mm	425 mm	545 mm max

** Occupies 2U of rack height excluding removable feet bottom feet and front handles*

Weight

3412/13/14	10.5 kg
3416	11.5 kg

RATED RANGE OF USE

MIL-T-28800E Class 5

Temperature

0°C to 50°C

Humidity

45%, 0°C to 50°C
95%, 30°C to 40°C

Altitude

700 mbars (3050 m, 10,000 feet)

CONDITIONS OF STORAGE AND TRANSPORT

MIL-T-28800E Class 5
Temperature -40°C to +71°C
Altitude 570 mbar (4570 m, 15,000 feet)

POWER REQUIREMENTS

AC Supply

100 - 240 V ~ (Limit 90 - 264 V)
50 - 60 Hz ~ (Limit 45 -66 Hz)
185 VA Max

ELECTROMAGNETIC COMPATIBILITY

Conforms to EC directives 89/336/EEC and standard IEC/EN 61326-1:1997;RF emission class B, immunity table 1 and performance criterion B

SAFETY

Conforms with the requirements of EEC Council Directive 73/23/EEC (as amended) and the product safety standard IEC / EN61010-1 : 2001 + C1 : 2002 + C2 : 2003 for class 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 2 supply.

VERSIONS, OPTIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers	Versions
3412	250 kHz to 2 GHz Digital RF Signal Generator
3413	250 kHz to 3 GHz Digital RF Signal Generator
3414	250 kHz to 4 GHz Digital RF Signal Generator
3416	250 kHz to 6 GHz Digital RF Signal Generator

Supplied with AC power supply lead and CD-ROM containing:

Operating Manual

Data Sheet

Factory Test Results (for the unit supplied) and Certificate of Calibration

IQCreator ® ARB data file creation and download software

VISA Plug 'n' Play driver software

Library of common data files for dual ARB option

Attenuator Options

3410 must be ordered with one of the following attenuator options. Refer to main specification for details.

Option 001	No attenuator
Option 002	Mechanical attenuator (Not available on 3414/3416)
Option 003	Electronic attenuator

Further Instrument Options

Option 005	ARB waveform generator (Not available with Option 008)
Option 006	Pulse Modulation (Requires Option 003, not available with Option 009)
Option 007	Rear panel outputs (RF Output only with Option 009)
Option 008	Real Time Baseband (Not available with Option 005 or 009)
Option 009	Differential I/Q output (Requires Option 005, not available with Option 006)
Option 010	List Mode (Requires Option 003)
Option 020	2G CDMA software license
Option 021	3G CDMA software license

Warranty Options

Option 203	3 year warranty
Option 204	4 year warranty
Option 205	5 year warranty

Pre-Loaded Example Waveforms Options

(Requires Option 005 ARB Waveform Generator)

Option 300	Example waveforms - a selection from each of the standards (Requires Option 021)
Option 301	CDMA example waveforms; 3GPP; CDMA2000; IS-95 (Requires Option 021)
Option 302	Cellular example waveforms; GSM; EDGE; IS136; PDC
Option 303	PMR example waveforms; TETRA, P25
Option 304	Avionics example waveforms; VDL
Option 305	WLAN example waveforms; 802.11; Bluetooth
Option 306	Satellite/Cable example waveforms; Various QAM formats
Option 307	Digital cordless example waveforms; DECT; PHS

For details on each waveform included in option 300 series, refer to Technical Note 3410 Option 300 waveform information, Part Number 46891/942

Optional Accessories

46882/499	Operating manual (paper format)
46880/111	Service manual (includes semi-automatic adjustment software)
82542	Breakout box (for Auxilliary connector)
43129/189	1.5 m GPIB lead
46662/745	Soft carry case
46884/650	RS-232 cable, 9 way female to female, 1.5 m
46884/649	RS-232 cable, 9 way to 25 way female, 1.5 m
46885/138	Rack mounting kit (front panel brackets)
43139/042	RF double screened connector cable 50 Ω, 1.5 m, BNC (m)
54311/095	RF double screened connector cable 50 Ω, 1 m, type N connectors
54311/092	Coaxial adapter N male to BNC female
59999/163	Precision coaxial adapter N male to SMA female

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

AEROFLEX
A passion for performance.

www.aeroflex.com

info-test@aeroflex.com

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

Part No. 46891/133, Issue 15, 03/05

Signal Sources

3002 VXI Signal Generator

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 µV, mV, EMF or PD, dB relative to 1 µV, 1 mV EMF or PD, or dBm. The output level can be normalized for

BACK

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	<±0.02 dB/°C
	±1.5 dB <25 dBm	
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

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.

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 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 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 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 10^7 over the operating range of 0 to 55°C

Ageing Rate

Less than ±1 in 10^6 per year

BACK

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 kΩ.

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
Idm	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 H_2O 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 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

46882/226	Operating manual
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

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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www.aeroflex.com
info-test@aeroflex.com

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

Part No. 46891/009, Issue 10, 02/04

BACK

Signal Sources 2030 Series

Option 5 GSM PCN PCS

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Generates GMSK modulation to the GSM, DCS1800 standards and PCS standards, allowing internal data to be easily entered and edited for mobile phone, base station and component testing.

- Wideband cover:
  10 MHz to 1.35 GHz (2030)
  10 MHz to 2.7 GHz (2031)
  10 MHz to 5.4 GHz (2032)
- GMSK Bt 0.3 Modulation
- Internal data generator
- Data editor
- External data / clock modulation
- Excellent phase accuracy
- Wideband FM

Option 5 GSM PCN PCS for 2030, 2031 and 2032 Signal Generators provide a signal modulated with GMSK Bt 0.3 modulation at a clock rate of 270.833 kHz. The wideband frequency cover enables the generator to be used for testing Global System for Mobile Communications (GSM) and Personal Communications Network/Service (PCN/PCS) receivers. The carrier can be modulated from an internal data generator or from an external data and clock source. Excellent phase accuracy and stability are ensured by the use of a precision modulator.

Internal Modulation

An internal data generator can be used to modulate the carrier. The data can be entered and edited at bit level within a slot and the stored slots assembled into frames, multiframes and superframes either from the keyboard or from an external GPIB controller. Null and pseudo random data slots are also available.

External Modulation

An external source of data and 270.833 kHz clock can be used. The data is internally filtered to provide GMSK Bt 0.3 modulation and the RF envelope can be set to be externally controlled. In this mode the generator frequency standard is phase locked to the external clock signal.

Store and Recall

The availability of non-volatile stores ensures that internal data can be stored for future use and simplifies stand alone operation. The internal data can be edited to bit level within a slot and slots can be assembled into frames, multiframes and superframes.

SPECIFICATION

GENERAL DESCRIPTION

This option adds GMSK (Gaussian Minimum Shift Keying) modulation at a bit rate of 270.833 kHz to the 2030 series. This modulation is used by the GSM and UK PCN systems.

Front panel connectors provide external modulation inputs for Clock, Data and Envelope control.

Facilities are provided for internal modulation by data sequences which can be internally edited and stored. The front panel connectors provide outputs for Clock and Data.

Instruments may be connected using the SYNC connectors to provide multiple RF Outputs with synchronized slot and frame structures.

2030, 2031 or 2032 Signal Generators fitted with the GMSK option conform to the 2030 series specification in the GMSK mode except as follows:

CARRIER FREQUENCY RANGE

Range

2030: 10 MHz to 1.34675 GHz

2031: 10 MHz to 2.69675 GHz

*2032: 10 MHz to 5.4 GHz**

**(GMSK modulation limited to 10 MHz - 2.7 GHz)*

RF OUTPUT

Range

0 dBm to –144 dBm

(-3 dBm max with Option 12 Electronic Attenuator)

Accuracy

2 dB

Output VSWR

As for 2030 series for levels below –6 dBm

SPECTRAL PURITY

Non-Harmonic Output

GMSK signals are generated by mixing a local oscillator with a 3.25 MHz IF signal carrying the GMSK signal. Additional signals are present at the local oscillator frequency, image frequency and frequencies equivalent to the harmonics of the IF mixed with the local oscillator.

FREQUENCY STANDARD

In GMSK mode an input or output at 13 MHz, 10 MHz, 5 MHz or 1 MHz is available.

GMSK MODULATION

Modulation Type

GMSK Bt 0.3 to GSM recommendation 0.5.04.

Modulation Accuracy

Phase accuracy as defined by GSM 05.05 – 4.6 is 1° RMS, 3° peak for carrier frequencies up to 1 GHz.

A second Bt is available which gives an RMS phase error of 5°.

DATA CODING

Selectable as uncoded, or differentially coded to GSM rec 05.04 – 2.3 for internal or external modulation.

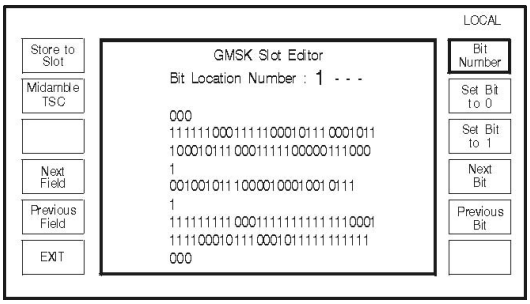
INTERNAL MODULATION

An internal data source provides a Traffic Channel format superframe hierarchy.

Individual slots may be null data, fixed data, or contain (229–1) PRBS data as defined in CCITT rec V.52. Successive slots contain 156, 156, 156, 157 bits. The internal data source provides data and clock output. Internal data can be edited from the front panel and stored or can be entered using the GPIB.

The RF envelope may be ramped up and down to GSM 05.05 annex 2 and GSM 05.05 – 4.2.2.

The internal data generator can be used with an external clock as in 'External Modulation'.



Data Storage

Data in the data generator can be stored and edited from the front panel or via the GPIB.

Store sizes are:

100 slots of which 2 are defined as null (S0) and PRBS (S99).

100 Frames containing any of the stored slots in any order.

100 multiframes containing any of the stored frames in any order.

40 superframes containing any of the stored multiframes in any order.

Internal Modulation Output

Data Output

TTL compatible

Clock Output

TTL compatible

EXTERNAL MODULATION

Clock and Data input at TTL compatible levels. Data must be valid on the falling edge of the clock input.

Data Input level

TTL compatible

Clock Input level

TTL compatible

Clock Input frequency

270.833 kHz ±25 ppm or a clock of the same bit rate but including one clock period of 1¼ bits per slot.

Envelope Input Impedance

15 kΩ nominal

Doppler FM Input Impedance

50 Ω

ENVELOPE CONTROL

Selectable constant level, internal level control, or controlled from the external envelope input: External envelope control voltages are 0 V for off, +1 V for specified RF level. The RF output voltage varies linearly with applied voltage.

External Input risetime

Less than 4 µs.

Off Slot Suppression

Better than –70 dBc.

BACK

MODULATION SENSE

Output can be set to use upper or lower sideband. Modulation sense can be inverted.

SYNCHRONIZATION

Instruments may be synchronized by use of the Sync Input/Output. One instrument in MASTER mode sources a bit clock and the SYNC signal. The SYNC signal goes active low for one bit during the transition of the internal data from slot 7, bit 156 to slot 0, bit 0. Instruments in SLAVE mode use Clock and SYNC signals to maintain a synchronized data structure.

Synchronization input/output

Open collector TTL, 2 mA pull-up, active low, bidirectional.

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2030	10 kHz to 1.35 GHz Signal Generator.
2031	10 kHz to 2.7 GHz Signal Generator.
2032	10 kHz to 5.4 GHz Signal Generator.
Option 005	GSM PCN PCS (GMSK Bt 0.3).

Supplied with

AC power lead

Operating Manual

Options

Option 001	Second internal modulation oscillator.
Option 002	Pulse Modulation.
Option 003	19 dBm Output (2030 only).
Option 006	Avionics (requires Option 001, cannot be ordered with Option 003).
Option 008	RF Profiles and complex sweep.
Option 012	Electronic Attenuator (2030 and 2031 only). Not available with options 003 or 010.
Option 105	Modifies the pulse modulation option for slower rise and fall times (order with Option 002).
Option 112	External modulation inputs (2) 600 Ω impedance

Note

Option 5 is not available with option 9 or option 10 or on 2040 and 2050 series

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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info-test@aeroflex.com

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Part No. 46891/010, Issue 4, 07/03

BACK

Signal Sources

Option 6 Avionics Signal Generator (2030/40/50 series)

AEROFLEX
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Setting the standard in avionics testing. Option provides accurate ILS, VOR, ADF, marker beacon and SELCAL signals for testing avionics receivers

- Accurate ILS and VOR RF waveforms
- Wide frequency coverage
- SELCAL calling tones
- Internal ILS and VOR waveform generators
- 0.0001 DDM resolution
- 0.01% bearing resolution
- Marker beacon
- Optional pulse modulation
- Automatic direction finder testing
- Comprehensive memory facilities

The Aeroflex family of Avionics Signal Generators provides internal generation of waveforms suitable for testing Instrument Landing Systems (ILS), VHF Omni-directional Radio Range (VOR) systems, Marker Beacons and SELCAL radio receivers. Avionics parameters are presented in the same form as described in the ICAO standards. The family offers an ideal single instrument solution for the testing of avionics receivers and airfield alarm monitors. The use of Direct Digital Synthesis techniques ensures excellent accuracy and stable performance under all operating conditions.

Option 6 is available for all 2030, 2031, 2032, 2040, 2041, 2042, 2050, 2051 and 2052 signal generators have become the solution of choice for testing avionics receivers. It offers a range of high performance signal generators for the testing of ILS, VOR and aircraft communications systems. For bench testing of navigation receivers the 2030 series provides exeptional accuracy, allowing even high performance receivers used for airfield alarm monitors to be tested with confidence. The 2040 series signal generators offer the same high levels of performance with the added advantage of exceptionally low carrier phase noise to allow the rigorous testing of the receiver selectivity and intermodulation, an important factor in today's crowded spectrum for a safety critical industry.

The 2050 series has the same performance as the 2030 series but with the additional benefit of being able to provide digitally modulated carriers.

All models can be supplied with a fast pulse modulator and the 2030 series can be supplied with an internal pulse generator to aid radar testing. A further option for 2030 series is a DME option which allows the signal generator to provide Gaussian shaped double pulse for DME testing.

ILS

In ILS mode, the Sum of Depth of Modulation (SDM) of the 90 Hz and 150 Hz tones can be entered to a resolution of 0.1% AM depth. The Difference in Depth of Modulation (DDM) is entered to a resolution of 0.01% depth for a DDM up to 20% and 0.1% for higher DDM settings. A choice of which tone is dominant is available to the user.

The 30 Hz repetition frequency of the ILS waveform can be adjusted in 0.1 Hz steps. For 0% DDM, additional modulation signals can be added to the ILS waveform.

Changing between localizer and glide-slope operation is accomplished with a single key stroke.

Marker Beacons

In the Marker Beacon mode, signals are generated simulating the outer, middle and inner marker beacons. A single key press selects which marker beacon is simulated. Carrier frequency, modulation depth and modulation frequency can be varied from the default settings. Using the normal calling tones menu enables pulsed marker beacon modulation signals to be generated.

VOR

In VOR mode, the AM depth of the subcarrier and 30 Hz tone can be independently set and the relative phase of the 30 Hz tone and the modulation tone on the subcarrier is set by directly entering the bearing information in degrees. The VOR repetition rate of 30 Hz can be adjusted in 0.1 Hz steps. For a fixed bearing, additional modulation can be applied to simulate voice/identity signal. A To/From Beacon key provides a rapid means of reversing a bearing entry and accounting for different bearing conventions.

SELCAL

SELCAL selective calling tone signals are used on the radios providing communication between the aircraft operator and the flight crew. The Avionics Signal Generator provides facilities for generating the SELCAL codes and the modulation signals to test the radio receiver.

Simple Operation

Major parameters can be adjusted by keyboard entry of data, using the UP/DOWN keys or using the rotary control. The use of a large screen dot matrix display ensures clear and unambiguous readout of the avionics parameters.

Instrument settings can be stored in nonvolatile memories. A sequence of test settings can be stored and, using the external trigger facility, the currently recalled memory can be incremented to step through the stored test sequence.

The power up sequence of the generator can be defined such that it always switches on in avionics mode.

SPECIFICATION

Specifications are as 2030, 2031, 2032, 2040, 2041, 2042, 2050, 2051 or 2052 with the following additions

ILS MODE

Tone Frequencies

90 Hz, 150 Hz nominal. Tone frequency may be changed by varying the ILS repetition rate of 30 Hz in 0.1 Hz steps. Tone frequencies maintain 3:1 and 5:1 relationships with the ILS rate.

Frequency Accuracy

As frequency standard

Tone Suppression

Either tone can be suppressed

Additional Modulation

Available for 0% DDM from an internal or external modulation source

Sum of Depth of Modulation (SDM)

SDM Range

0 to 99.9% in 0.1% steps representing the arithmetic sum of each tone depth

SDM Selection

By keyboard entry of data and variation by UP/DOWN keys or rotary control

RF Accuracy of SDM

±2% of SDM setting for carrier frequencies up to 400 MHz (from 100 MHz to 400 MHz with Option 12)

At 40% SDM accuracy is ±0.8% depth

At 80% SDM accuracy is ±1.6% depth

Difference in Depth of Modulation (DDM)

DDM Range

0 to 20% in 0.01% steps

20 to 99.9% in 0.1% steps

DDM Selection

By keyboard entry of depth in %, mA or index and variation by UP/DOWN keys or rotary control

RF Accuracy of DDM

±0.02 of DDM setting ±0.0003 DDM (0.03% depth)

At 0 DDM (on course) accuracy is ±0.0003 DDM (0.03% depth)

At 0.155 DDM accuracy is ±0.0034 DDM (0.34% depth)

LF Output

Available from the LF Output connector

LF Accuracy of DDM

Equivalent to ±0.0003 DDM ±0.005 of setting

At 0 DDM (on course) accuracy is ±0.0003 DDM

MARKER BEACON MODE

Provides default carrier of 75 MHz, 95% AM depth and a modulation frequency of 400 Hz, 1.3 kHz or 3 kHz corresponding to Outer, Middle and Inner Markers. Carrier frequencies, AM depth and modulation frequency can be adjusted from the default values.

VOR MODE

Selection

By keyboard entry of depth and variable by UP/DOWN keys and rotary control

Bearing Control

Relative phase of 30 Hz tone and subcarrier modulation adjustable from 0° to 359.9° in 0.01° steps by entering VOR bearing. Bearing can be entered as TO or FROM the beacon.

Bearing Accuracy

±0.05°

Additional modulation

Available on 0° bearing from an internal or external modulation source

AM Depth Accuracy

±3% of setting ±0.5% for carrier frequencies up to 400 MHz (from 100 MHz to 400 MHz with Option 12)

Frequency

The VOR repetition frequency of 30 Hz may be varied in 0.1 Hz steps. The subcarrier frequency and deviation maintain a fixed relationship with the VOR repetition rate

Frequency Accuracy

As frequency standard

9.96 kHz subcarrier

AM Range

0 to 49.9% depth in 0.1% steps

Modulation

Frequency modulated by a 30 Hz tone with settable

deviations of 420 Hz, 450 Hz, 480 Hz, 510 Hz and 540 Hz

30 Hz Tone

AM Range

0 to 49.9% depth in 0.1% steps

Arithmetic sum of 30 Hz tone and sub carrier limited to 99.8%

ADF MODE

(Does not apply with Option 12 fitted)

Provides default carrier of 190 kHz with 30% AM depth at 1 kHz rate. Carrier frequency, AM depth, modulation rate and RF level can be varied from the default values.

SELCAL MODE

Provides a facility for modulating the RF carrier with sequential calling tones defined by the SELCAL protocol. Allows the entry of two character pairs to define the SELCAL code generated to open the audio path of aircraft radios. Default tone duration and gap are 1 s and 250 ms respectively and can be varied from nominal values.

VERSIONS AND ACCESSORIES

For the full Signal Generator performance specifications please refer to the 2030/40/50 signal generator datasheets. When ordering please quote the full ordering number information.

The NAV-750C is functionally identical to 2030 1.35 GHz Signal Generator fitted with Option 1 and 6.

Option 6 Avionics Signal Generator

Ordering Numbers

To order an avionics signal generator specify which model is required and order with Option 1 and Option 6 fitted.

Versions

2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
2040	10 kHz to 1.35 GHz Low Noise Signal Generator
2041	10 kHz to 2.7 GHz Low Noise Signal Generator
2042	10 kHz to 5.4 GHz Low Noise Signal Generator
2050	10 kHz to 1.35 GHz Digital and Vector Signal Generator
2051	10 kHz to 2.7 GHz Digital and Vector Signal Generator
2052	10 kHz to 5.4 GHz Digital and Vector Signal Generator
Option 001	Second Internal Modulation Oscillator
Option 006	Avionics (must be ordered with Option 001)

Supplied with

AC Power Lead and Operating Manual

Other Options

Option 002	Pulse Modulation
Option 008	RF Profile and complex sweep
Option 009	Internal Pulse Generator (cannot be used with Option 005) only available on 2030, 2031, 2032
Option 010	DME avionics (only available on 2030, 2031, 2032)
Option 012	Electronic Attenuator (not available on 2032, 2042, 2052, 2052T, not available with Options 03 or 010)
Option 105	Modifies the pulse modulation Option for slower rise time (order with Option 002)
Option 112	External modulation inputs (2) 600 Ω impedance
NAV-750C	VOR/LOC/GS/COMM/MKR Bench Test Equipment

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

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Tel: [+33] 1 60 79 96 00
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Tel: [+49] 8131 2926-0
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Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
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KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

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Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
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Part No. 46891/040, Issue 4, 10/03

BACK

Signal Sources 2030/40/50 Series

Option 8 RF Profile & Complex Sweep

Ability to offset for insertion loss or gain of external devices, and provides complex carrier sweeps. Particularly useful for EMC testing and for ATE applications.

- Calibration of RF power at a remote connector
- Frequency dependent RF output power
- Complex sweep capability
- 20 ms to 20 s step time
- Sine, triangle and square wave modulation

Option 8 RF Profile and Complex Sweep provides additional software features which are particularly well suited for Electromagnetic Immunity, Tempest testing and other applications using signal generators with external devices which introduce frequency dependent RF level errors.

Careful attention to transient states ensures that positive overshoots that could damage power amplifiers are not generated.

RF Profile and Offset

The RF Profile and Offset facility allows the user to reduce RF level errors introduced by using external amplifiers, attenuators or signal combiners. The signal generator accepts and displays RF level requests for the power referred to the output of the external device. The facility reduces the calibration effort required in ATE systems and minimizes the probability of operator induced errors when performing manual tests. The RF Profile facility allows the entry of 10 profiles containing up to 100 correction points with linear interpolation to minimize the RF level frequency response errors introduced by the external device.

The use of a large LCD panel and a flexible menu driven user interface provides a simple means of rapidly generating, selecting and editing profiles in an intuitive way whilst minimizing any ambiguity in the setting of the generator.

Segmented Sweep

The Segmented Sweep facility allows the generation of sweeps with up to 10 segments, each of which can have independent sweep parameter settings. The ability of each segment to have a different RF level permits swept immunity tests to be undertaken which follow the frequency dependent immunity limits specified in EMC standards. The independent frequency step size allows the sweep speed to be increased at higher carrier frequencies to minimize the test time.

The independent stop and start frequencies for adjacent segments also allows the generation of sweeps which deliberately omit sections of the RF spectrum to test systems with on-line signals or to speed up tests on multiband systems.

The sweep can be halted at any time if a device response is obtained and the signal generator settings can then be varied to explore the

device response before then continuing with the sweep from the point where the sweep was halted.

Programmable frequency step times between 20 ms and 10 s combined with frequency step sizes down to 0.1 Hz allow the generation of fast swept signals or the slow sweeps associated with EMC testing.

Complex Sweeps

The segmented sweep can be combined with the RF Offset and RF Profile facility to produce complex sweeps which manipulate the RF output level of the signal generator to correct for the frequency response of amplifiers, cables, combiners and antenna characteristics. The ability to include correction factors in sweep mode allows the signal generator to be used in computer controlled test system which allow for manual intervention of the test without losing the system calibration information.

The use of the extended hysterisis facility with the sweep facility to minimize the number of attenuator level transients during a swept test is particularly useful for testing devices which are susceptible to large rapid changes in RF level.

Options

The Option 8 software is available on all versions of the 2030/40/50/50T series signal generators and can be combined with the second modulation oscillator, pulse modulation and generation, GSM PCN and Avionics options to provide a flexible signal generator capable of undertaking tests on most RF and receiver systems.

SPECIFICATION

GENERAL DESCRIPTION

Option 8 software provides additional sweep, RF offset and RF level profiling facilities to support the use of 2030, 2040A 2050 and 2050T series Signal Generators with external amplifiers and attenuators. The RF output from the external device can be calibrated and displayed on the front panel of the signal generator using the RF Offset and RF Profile facilities.

RF OFFSETS

Displayed signal generator output level can be offset by +80 dB to –40 dB from the actual RF output level.

RF Offsets may be used in normal signal generator modes or combined with segmented sweeps.

RF PROFILE

RF output level can be adjusted by ±40 dB from its nominal value without changing the displayed RF output level. Ten profiles can be created each containing up to 100 correction points and the RF output level is linearly interpolated between correction points.

RF Profiles can be used in normal signal generator modes or combined with the segmented sweep.

SEGMENTED SWEEP

Carrier frequency sweeps can be generated which contain defined segments each of which can have a different step size, start and stop frequency, step time and RF level.

Sweep facility is available for 2030 and 2050(T) series in analog modes and for 2040 series in Normal Noise mode.

Start and Stop

Start and stop frequency for each segment can be freely defined within the frequency capability of the signal generator.

Step Size

Minimum step size is 0.1 Hz.

Number of steps is implied by the step size and the start and stop frequencies.

Step Time

20 ms to 20 seconds per step.

Segments

Up to 10 segments may be freely combined together in any order.

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
2040	10 kHz to 1.35 GHz Low Noise Signal Generator
2041	10 kHz to 2.7 GHz Low Noise Signal Generator
2042	10 kHz to 5.4 GHz Low Noise Signal Generator
2050	10 kHz to 1.35 GHz Digital and Vector Signal Generator
2051	10 kHz to 2.7 GHz Digital and Vector Signal Generator
2052	10 kHz to 5.4 GHz Digital and Vector Signal Generator
2050T	10 kHz to 1.35 GHz Digital and Vector Signal Generator.
2051T	10 kHz to 2.7 GHz Digital and Vector Signal Generator.
2052T	10 kHz to 5.4 GHz Digital and Vector Signal Generator.
Option 008	RF Profile and Complex Sweep

Supplied with

AC power lead

Operating manual

Options

Option 001	Second internal modulation oscillator
Option 002	Pulse Modulation
Option 003	+19 dBm Output (2030 and 2040 only)
Option 005	GSM PCN PCS (GMSK Bt 0.3) (2030 series only)
Option 006	Avionics Option (must be ordered with Option 001)
Option 009	Internal Pulse Generator (cannot be used with Option 005) only available on 2030 series
Option 010	DME (requires Option 001 and 006, only available on 2030 series, cannot be fitted with Option 005)
Option 105	Modifies the pulse modulation for slower rise and fall time (order with Option 002)

CHINA Beijing
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Fax: [+86] (10) 6467 2821

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Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

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Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

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Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

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Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

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Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

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Fax: [+45] 9614 0047

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Fax: [+34] (91) 640 06 40

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Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

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Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
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Part No. 46891/011, Issue 4, 07/03

BACK

Signal Sources 2030 Series

Option 9 Internal Pulse Generator

Internal pulse generator producing single or double pulse RF carriers for testing radar RF and IF stages

- Programmable pulse parameters
- External trigger function
- Single and double pulse
- Variable pulse repetition frequency
- Variable pulse delay
- Variable pulse pair spacing
- Variable pulse width
- Wide carrier frequency range
- On/Off ratio of 80 dB
- Eliminates need for external pulse generator

Option 9 Pulse Generator provides the user with internally generated single or double pulses. When combined with Option 2, Pulse Modulation, a solution is provided to aid the testing of radars, EMC or TDMA systems.

The pulse generator can be used with FM, PM and wideband FM or with unmodulated carriers.

With the Pulse Generator allowing variable control of the pulse parameters, many different types of systems can be efficiently and easily evaluated.

Simple Interface

Parameters can be adjusted by keyboard entry of data or by using the ⇧⇩ keys. The use of a large screen dot matrix display ensures clear and unambiguous readout. Within each display, soft keys are assigned alongside the display to allow parameter entry or to select the relevant functions.

Pulse Generator

With Options 2 and 9 combined, single and double pulsed RF carrier outputs can be generated. Pulse width can be varied from 50 ns to 100 ms. Pulse delays can be set from 1 μs to 100 ms in single trigger mode and pulse pair spacing can varied from 100 ns to 100 ms. Triggering can be continuous or via an external source. See Figures 1 and 2 for more details.

The pulse generator with Option 2 can be used over the entire frequency range of the 2030 series, with the level range of -144 dBm to +13 dBm.

Output Control

Synchronization and video outputs are available on rear panel BNC connectors. SYNC provides a 400 ns pulse indicating the start of the pulse. VIDEO provides square waves with fixed rise and fall times and variable parameters such as pulse delay, width and repetition rate.

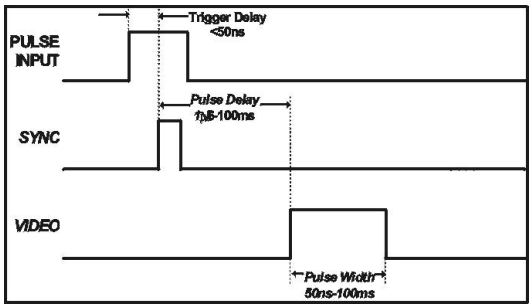

Figure 1 - single pulse, external trigger

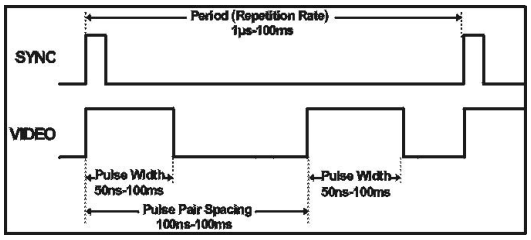

Figure 2 - double pulse, internal trigger

SPECIFICATION

Specifications remain as standard 2030 series with the following additions.

OPTION 9 INTERNAL PULSE GENERATOR

VIDEO OUTPUT (REAR PANEL BNC)

Pulse Width(s)

50 ns to 100 ms, resolution 50 ns

Repetition Rate/ Period (internal trigger)

1 µs to 100 ms, resolution 50 ns

Pulse Delay (Single or Double pulse)

1 µs to 100 ms, resolution 50 ns

Double Pulse Pair Spacing

100 ns to 100 ms, resolution 50 ns

Level

Pseudo TTL (Typ. 0 to 4.5 V, 0 to 2.5 V into 50 Ω)

Rise/Fall Time

Less than 5 ns

SYNC OUTPUT (REAR PANEL BNC)

Pulse Width

Typically 400 ns

Level

Pseudo TTL (Typ. 0 to 4.5 V, 0 to 2.5 V into 50 Ω)

Rise/Fall Time

Less than 5 ns

EXTERNAL TRIGGER ('PULSE INPUT')

Characteristics

Rising edge, TTL level into 50 Ω

Min. Pulse Width 10 ns

Trigger to SYNC Delay

Less than 50 ns

Trigger to SYNC Jitter

Typically 25 ns

RF OUTPUT (WITH OPTION 2 FITTED)

Level Range

-144 dBm to +13 dBm overrange to +19 dBm uncalibrated

Accuracy

Additional level error of ±0.5 dB

Modulation Modes

Pulse modulation may be used at the same time as FM, PM or wide-band FM.

Pulse Characteristics

As above, except;

Rise/Fall Time

Typically <25 ns

ON/OFF Ratio

Better than 70 dB, typically better than 80 dB

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
Option 009	Pulse generator (cannot be used with Option 005)

Options

Option 001	Second internal modulation oscillator
Option 002	Pulse modulation
Option 003	19 dBm Output (2030 only)
Option 006	Avionics (requires Option 001, cannot be used with Option 003)
Option 008	RF Profiles and complex sweep
Option 010	DME (requires Option 001 & 006, cannot be used with Option 005)
Option 112	External modulation inputs (2) 600 Ω impedance

Note

Option 9 is not available with Option 5 or on 2040 and 2050 series.

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

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Fax: [+33] 1 60 77 69 22

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Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

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Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

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Tel: [+1] (316) 522 4981
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Part No. 46891/012, Issue 4, 07/03

BACK

Signal Sources

Option 10 DME Avionics

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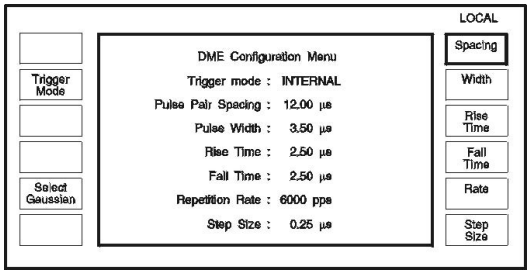
Ideal for testing the receiver stages of DME transponders using Gaussian shaped pulses used under operational conditions

- Generates DME Gaussian shaped double pulses
- Variable pulse parameters
- Gaussian pulse spectrum
- Sync and Video outputs
- External trigger input
- Simple user interface with large screen
- GPIB programmable
- VOR/ILS/Marker Beacons with option 6

DME (Distance Measuring Equipment) provides aircraft with accurate and continuous information of their slant range distance from a ground reference point. Option 10 on the 2030 series signal generators produce the necessary signals required to test DME transponders. The option consists of two parts - an internal pulse generator to produce double pulses, and a linear RF modulator which produces the required Gaussian shaping with 90% of the transmitted energy within a bandwidth of 0.5 MHz in accordance with EUROCAE ED57. Front and rear panel connectors provide External Trigger input and Synchronization and Video outputs.

Simple Interface

Major parameters can be adjusted by keyboard entry of data, using the UP/DOWN keys or the rotary control. The use of a large screen dot matrix display ensures clear and unambiguous readout of the avionics and DME parameters.



DME Pulse Generator

This provides Gaussian shaped double pulses with variable control of pulse width, rise and fall times, pulse pair spacing and pulse repetition rate thus giving complete flexibility when defining the pulse profile. Continuous internally or externally triggered modes of operation are available with all parameters adjustable in both cases.

DME Pulse Modulator

The Gaussian shaped double pulses from the generator can be used to modulate an RF carrier over the DME transmitter range of 960 MHz to 1215 MHz. Unlike a standard pulse modulator where the carrier is enabled or disabled by the modulating signal, the DME modulator is able to control the level of the RF signal at any particular time and thus produces a constrained spectrum corresponding to various standards including EUROCAE ED57 for DME. The Gaussian shaped pulses are identical in amplitude and shape with

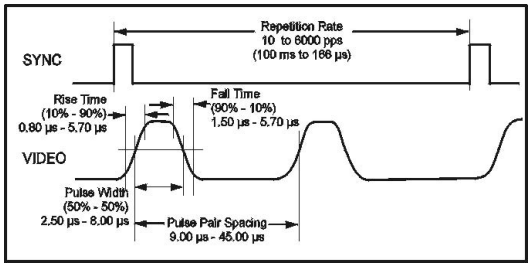
level accuracy of ±0.5 dB over the range -110 dBm to +10 dBm.

Memory

All the instrument configuration settings can be stored within non-volatile memory locations. These memories can be triggered via an external input or manually from the front panel in order that a test sequence may be quickly recalled.

Output Control

There are two additional outputs provided, SYNC and VIDEO. The SYNC output is available either with internally generated pulses or external trigger. The VIDEO output is the same Gaussian shaped signal that is applied to the RF modulator.



GPIB Programmable

All functions can be controlled over the interface bus and are GPIB IEEE 488.2 compatible.

Option 6 - Avionics

DME Option 10 is a natural complement to existing Avionics option 06 which includes VOR, ILS, Marker Beacons, ADF and SELCAL.

The Avionics option offers a complete test solution for the maintenance of avionics radio receivers by providing modes of operations suitable for testing ILS and VOR systems. In addition, it provides efficient testing of marker beacons, SELCAL receivers and ADF (Automatic Direction Finders).

In conjunction with the Avionics option, the 2030 series offers a simple solution which is particularly well suited for testing the complete avionics system - surveillance, alarm monitors and receivers. Direct digital synthesis techniques ensure excellent precision and stability.

SPECIFICATION

Specifications remain as standard 2030 series with the following additions.

RF OUTPUT

Frequency Range

960 MHz to 1215 MHz

Level Range

-110 dBm to +10 dBm

Absolute Level Accuracy

Standard level error ±0.5 dB

Pulse Pair level Accuracy

±0.5 dB

ON-OFF Ratio

>80 dB

VIDEO OUTPUT (REAR PANEL BNC)

Pulse Characteristics

Double pulses, Gaussian shaped

Pulse Width

2.50 µs to 8.00 µs, resolution 50 ns

Rise Time

0.80 µs to 5.75 µs, resolution 50 ns

Fall Time

1.50 µs to 5.75 µs, resolution 50 ns

Pulse Pair Spacing

9.00 µs to 45.00 µs, resolution 50 ns

Repetition Rate

10 pp/s to 6000 pp/s

Level

Pseudo TTL (Typically 0 to 4.5 V, 0 to 2.5 V into 50 Ω)

SYNC OUTPUT (REAR PANEL BNC)

Pulse Width

Typically 400 ns

Level

TTL (Typically 0 to 4.5 V, 0 to 2.5 V into 50 Ω)

Rise/Fall Time

Typically 5 ns

EXTERNAL TRIGGER ('PULSE INPUT')

Characteristics

Rising-edge, TTL level into 50 Ω

Min. pulse width 2 ns

Trigger to SYNC Delay

Typically 60 ns

Jitter

Typically 25 ns

BACK

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers

To order select which model is required and order with Option 1, 6 and 10 fitted.

Versions

2030	10 kHz to 1.35 GHz Signal Generator
2031	10 kHz to 2.7 GHz Signal Generator
2032	10 kHz to 5.4 GHz Signal Generator
Option 001	Second internal modulation oscillator
Option 006	Avionics, requires option 001, cannot use with 003
Option 010	DME requires option 001 & 006, cannot be used with option 005

Supplied with

AC Power Lead

Operating Manual

Options

Option 002	Pulse Modulation
Option 003	19 dBm output (2030 only)
Option 008	RF Profiles and Complex Sweep
Option 009	Internal Pulse Generator cannot be used with option 005
Option 112	External modulation inputs (2) 600 Ω impedance

Please note that Option 5 is not available with DME. DME is not available on 2040 or 2050 series signal generators.

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

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Tel: [+33] 1 60 79 96 00
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Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

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Tel: [+852] 2832 7988
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Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

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Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

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Tel: [+34] (91) 640 11 34
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Tel: [+44] (0) 1682 604455
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Tel: [+44] (0) 1438 742200
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USA
Tel: [+1] (316) 522 4981
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BACK

Signal Sources

Option 12 SINAD Measurement (2023A/B, 2025)

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Option 12 further enhances the versatility of the 2023A/B, 2025 range providing a complete receiver sensitivity test solution in an economical, space saving package.

- High performance SINAD measurement
- 50 dB measurement range
- Accurate DSP based CMESS, CCITT P53 and un-weighted filters
- RS-232 and GPIB control
- User selectable measurement averaging
- Simple menu set up
- Over/under range indication

Option 12 provides the user with a high performance SINAD measurement function which can be used for receiver testing in development, production and servicing.

The SINAD function can be used independently of the signal source as a genuine second instrument. Alternatively the SINAD measurement can be operated with the source in manual or automatic control of RF level mode.

Simple Operation

Set up of the measurement selections from a utility menu ensures simple and fast operation.

```
■ Util 49  ___ SINAD Measurement
■ Average:  22 ___        (1 - 127)
■ Weighting Filter: 2 _ C-MESS
   0: Unweighted  1: CCITT  2: C-MESS
■ SINAD: 1 _  Enabled
   0: Disable  1: Enable  2: AUTO
```

2023A/B and 2025 simultaneously displays the signal RF source parameters and the SINAD measurement result. The user is able to manually control the source amplitude and frequency and see at a glance the resulting SINAD. Input level over range and under range warning messages confirm valid measurement values.

```
Carr Freq   850.000 000 MHz
RF Levl     -115 .0 dBm  ON      FM1 ~ ON
                                 FM2 ~ OFF
SINAD C-MESS  20.0 dB
```

Automatic RF Level Coupled Operation

An automatic RF level adjustment mode to achieve a user defined SINAD value for a receiver under test is available for even simpler bench operation. In this mode the RF level is automatically reduced from a pre-set level until the measured SINAD value matches the user input value.

Weighting Filters

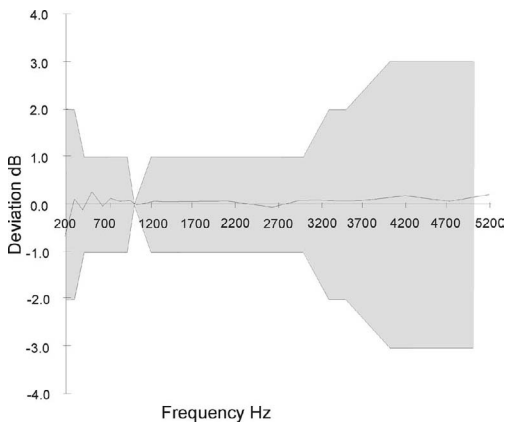
SINAD measurements can be made un-weighted or through accurate and stable DSP based CMESSAGE or CCITT P53 psophometric weighting filters.

Result Averaging

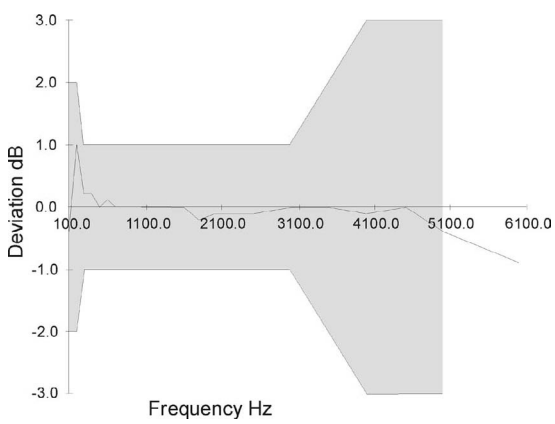
A user selectable result averaging function in the range 1-127 can be applied to the displayed SINAD result.

Instrument Stores

The extensive volatile and non-volatile storage facilities on 2023A/B and 2025 are available for use with Option 12 SINAD to simplify repetitive test sequences for manual or GPIB operation.



Filter response compared to CMESSAGE standard error band



Filter response compared to CCITT standard error band

SPECIFICATION

GENERAL DESCRIPTION

This option provides an independent high performance SINAD measurement function featuring 50 dB SINAD measurement range, with automatic over/under range indication, user selectable weighting filters and result averaging. An automatic generator level seek mode from a user SINAD input value is included. Available with all existing 2023A/B and 2025 family options.

MEASUREMENT RANGE

50 dB

ACCURACY

±0.5 dB

DISPLAY

Resolution

0.01 dB

Averaging

User selectable result averaging from

1-127 measurements - Default setting is 5 measurements.

Over/under range indication

Automatic display warning when input signal level is out of range.

INPUT SIGNAL

Weighting Filters

Selectable CMESS, CCITT P53 weighted measurement filters or un-weighted measurement (50 Hz - 7.0 kHz 3 dB bandwidth)

Modulation Frequency

1 kHz ±20 Hz notch filter range

Sensitivity

50 mV RMS - 3.0 V RMS (250 mV RMS for 50 dB SINAD). Max. safe input level ± 15 V

Input impedance

100 kΩ (nominal)

Input Connectivity

SINAD baseband input is via front panel Ext Mod Input connector, (MOD I/O connector when option 7 or 11 are fitted).

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 Modulator 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

46880/088	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, 1.5m
43129/189	1m GPIB lead
59000/317	VISA Plug ‘n’ Play driver software (also available as a download from www.ifrsys.com)

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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A passion for performance.

www.aeroflex.com
info-test@aeroflex.com

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

Part No. 46891/039, Issue 4, 10/03

BACK

Signal Sources

Option 118 Fast Pulse Modulator 2026A

AEROFLEX
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Option 118 Fast Pulse Modulator extends the application of 2026A 2 and 3 source signal generators to the testing of IFF radar and ECM receivers

- Two or three high quality RF signal generators in a space efficient format
- Fast pulse capability, typically 15 ns rise and fall times
- Wide frequency coverage: 10 kHz to 2.05 GHz (2026A)
- +24 dBm RF output for effective component testing
- Support for an external signal generator
- User defined tracking between signal sources
- Adjustable carrier phase
- Built-in switched combiner network improves measurement uncertainty

The 2026A with Option 118 retains all the functionality of standard 2026A/B family including application modes. For a full product description refer to the 2026A/B family datasheet

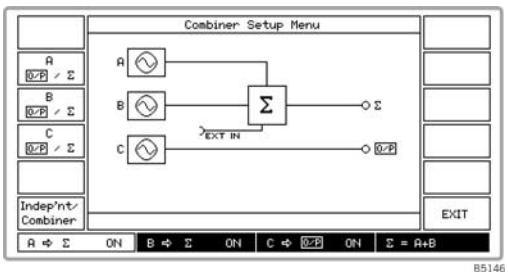
Measurement Accuracy

The use of a built in combiner, switches and cables eliminates many of the measurement uncertainties introduced by connecting together separate signal generators.

All alignment processes, including the internal frequency standard and the correction factors for the signal source RF paths, are digitally derived so realignment can be undertaken without removal of external covers. Digital adjustment also eliminates the use of mechanical adjusters, minimizing long term drift and vulnerability to mechanical shock.

Flexible Source Routing

Each of the signal sources can either be routed to a separate output connector or switched to the input of an RF combiner network before being fed to the combiner output connector. The combiner routing is set up quickly and effectively using the Combiner Set Up menu. The flexibility of the signal routing allows the 2026A/B family to accept an external signal generator, such as the 2050 Digital and Vector Generator, to enable different forms of carrier signals to be produced. Alternatively the output from a 2029 Vector Modulator, driven from one of the 2026A/B sources, can be routed in.

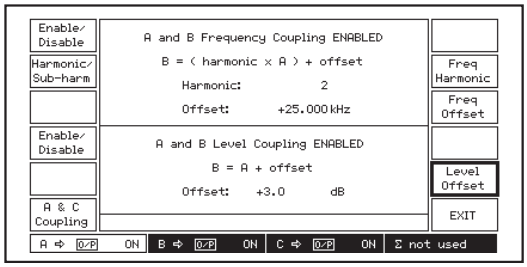


Setting up the source and combiner routing

Automatic Source Coupling

The 2026A with Option 118 allows the frequency and level of the internal RF sources to be coupled together with a user defined offset. The source frequencies can have an offset with an additional harmonic (or sub-harmonic) relationship to simplify the testing of harmonic converters and divider systems.

The coupling factors are entered by an easily understood format using a dedicated coupling menu.



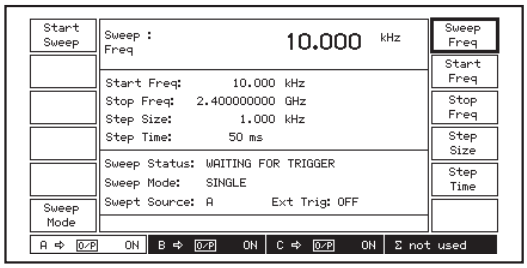
Setting up coupling

The ability to set sources to track each other greatly simplifies the testing of mixers, multipliers and dividers by reducing the number of active controls required.

Sweep

The 2026A with Option 118 allows one of the RF sources to be frequency swept with user defined start, stop and step values to reduce the amount of operator time or GPIB overhead. By enabling the coupling facility, sweeping one source will simultaneously sweep the other internal RF sources to allow automated swept measurements on frequency conversion devices to be made.

The sweep can be performed with modulation enabled for swept measurements of receiver immunity characteristics.



2026A sweep menu

High RF Output

The high RF level of the individual outputs is ideal for testing components and ensures that the 2026A with Option 118 can generate high RF levels at the combiner output.

Comprehensive Modulation

Each signal source is capable of being independently modulated from its own fully programmable modulation source to ensure maximum flexibility. The internal modulation sources are each capable of generating sine, triangle or square wave signals.

Amplitude, frequency and phase modulated carriers can be generated from the internal modulation sources or from the independent external inputs. The frequency modulation system provides excellent performance in the DC coupled mode with very low carrier frequency error and stability ensuring that the generator can accurately test receivers sensitive to small frequency errors.

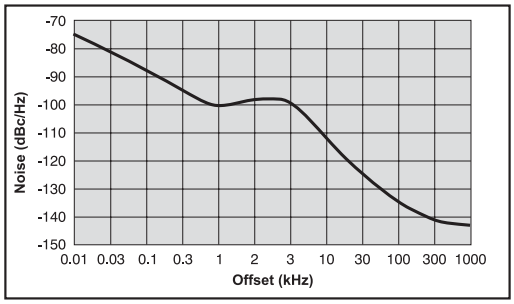
Pulse Modulation

With Option 118 Fast Pulse Modulator fitted the pulse modulation performance is greatly enhanced compared to the standard 2026A/B. This option configuration offers higher on/off ratios of typically >80 dB with faster rise and fall times of 20 ns, typically 15 ns.

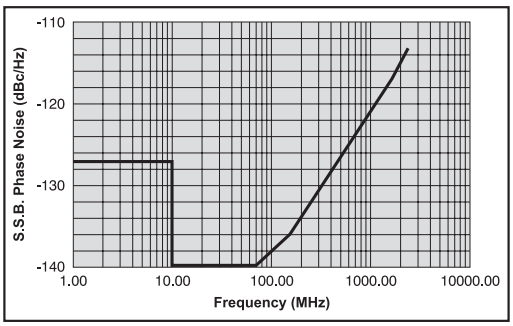
FSK

In addition to the analog FM facilities, the 2026A with Option 118 supports 2 and 4-level FSK signals from external logic inputs. The FM deviation generated is set by keyboard entry of the required deviation. The facility is ideal for testing paging receivers and RF modems.

HIGH SPECTRAL PURITY



Typical SSB Phase Noise at 1 GHz



Typical Phase Noise at 20 kHz offset

Measurement of receiver selectivity and ultimate signal-to-noise ratio requires good spectral purity. The 2026A with Option 118 has a low residual FM of typically 3 Hz and typical sideband noise of -121 dBc/Hz at 20 kHz offset from 1 GHz, to allow demanding measurements to be made.

Programming

A GPIB interface is fitted so that all standard signal generator functions are controllable over the bus. The protocol and syntax of GPIB commands has been designed in accordance with IEEE 488.2 standard to facilitate the generation of ATE programs.

Low Cost of Ownership

An electronic trip protects the individual source outputs against the accidental application of reverse power.

BACK

Careful attention to the thermal design and the use of well-proven signal generator modules gives high reliability and calibration validity.

The use of flash memory and software download via the RS-232 interface means the 2026A with Option 118 can be upgraded with its covers fitted.

OPTIONS

Option 001 - Third Source

The 2026A as standard is supplied with two RF sources. A version with 3 sources is available as an option.

Option 003 - High Stability Time Base

For applications requiring improved frequency stability and close-in phase noise, the standard TCXO can be replaced by a high performance OCXO.

Option 004 - Rear Panel Connections

The RF connectors for all sources, their associated modulation and pulse inputs and the combiner output connector can be mounted on the rear panel for ease of use within an ATE environment, as a factory option.

Option 118 - Fast Pulse Modulator

This option when fitted replaces the standard 2026A pulse modulator with a high performance modulator with much enhanced carrier on/off ratio and improved pulse rise and fall times.

SPECIFICATION

GENERAL DESCRIPTION

The 2026A MultiSource Generator with Option 118 contains synthesized signal generators offering up to three independent RF sources with separate outputs or one or more of the signals routed via a combiner. 2026A Signal Generators cover the frequency range 10 kHz to 2.05 GHz. Each signal source can be controlled independently in frequency and level and each has its own amplitude, frequency, phase and pulse modulation capability. All parameters can be entered from the front panel keyboard and a rotary control can be used to adjust most settings. The following signal generator specifications apply to all of the sources fitted.

CARRIER FREQUENCY

Range

10 kHz to 2.05 GHz with a resolution of 1 Hz (2026A)

Accuracy

As frequency standard

RF OUTPUT

Output Range

Freq Range	Individual	Combiner
10 kHz - 1 MHz	-140 to +24 dBm	Uncalibrated
1 MHz - 1.2 GHz	-140 to +24 dBm	-140 to +10 dBm
1.2 GHz - 2.05 GHz	-140 to +18 dBm*	-140 to +4 dBm**

Maximum output is further reduced by 3 dB when Pulse modulation is selected and/or by up to 6 dB when AM is selected dependant upon AM depth.

* Uncalibrated above +18 dBm - settable to +24 dBm

** Uncalibrated above +4 dBm - settable to +10 dBm

Resolution

0.1 dB

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 normalized for 75 Ω operation with an optional external impedance converter (applies to all outputs simultaneously).

RF Output Accuracy (over temp. range 17 to 27°C)

Freq Range	Individual	Combiner
10 kHz - 1 MHz	±0.8 dB from -127 to +6 dBm ±1.0 dB from +6 to +24 dBm	Unspecified
1 MHz - 1.2 GHz	±1.0 dB from -127 to -100 dBm ±0.8 dB from -100 to +6 dBm ±1.0 dB from +6 to +24 dBm	±1.0 dB from -127 to +4 dBm
1.2 GHz - 2.05 GHz	±1.6 dB from -127 to +6 dBm ±2.0 dB from +6 to +18 dBm	±2.0 dB from -127 to 0 dBm

Temperature Stability

Freq Range	Drift(dB/°C)
10 kHz - 1.2 GHz	<±0.02
1.2 GHz - 2.05 GHz	<±0.04

RF level tracking (over temp range +18 to +28°C)

Relative level accuracy between any two or more combined signals (of equal amplitude) is typically: (1)

RF level	1 MHz to 1.2 GHz	1.2 GHz to 2.05 GHz
-18 dBm to +4 dBm	±0.3 dB	±0.6 dB
<-18 dBm	±0.6 dB	±1.2 dB

Attenuator hold

Inhibits operation of the step attenuator from the level at which the key is enabled. Useable for a level reduction of at least 10 dB. Typical accuracy ±3 dB.

VSWR

Individual outputs

For output levels less than -5 dBm, output VSWR is less than 1.5:1 for carrier frequencies up to 1.2 GHz and less than 1.7:1 for carrier frequencies up to 2.05 GHz.

Combined output

Output VSWR is less than 1.22:1 for carrier frequencies between 1 MHz to 1.2 GHz and less than 1.32:1 for carrier frequencies up to 2.05 GHz.

RF Output connector

50 Ω type N connector to MIL 390123D

Output protection

Individual outputs

Protected from a source of reverse power up to 50 W from a source VSWR of 5:1. Protection circuit can be reset from the front panel or via the GPIB or RS-232 interface.

Combined output

No reverse power protection. Maximum total safe power 0.5 W.

SPECTRAL PURITY

Harmonics (above 1 MHz)

Individual outputs:

Typically better than -30 dBc for RF level up to +6 dBm, typically better than -25 dBc for RF levels up to +18 dBm (+12 dBm above 1.2 GHz).

Combined output:

Typically better than -30 dBc for RF level up to -18 dBm, typically better than -25 dBc for RF levels up to +4 dBm. (-2 dBm above 1.2 GHz).

Non-Harmonics (for offsets >3 kHz)

Better than -70 dBc to 1 GHz, better than -64 dBc above 1 GHz

Isolation

Better than 80 dB between individual outputs in use

Better than 60 dB from a used individual output and the combiner output

Better than 40 dB between the combiner output and an unused individual output

Intermodulation

At an RF output level of 0 dBm on the combiner into a load VSWR of 2.1 or better.

Frequency Range	Two Tone Intermodulation*
10 MHz to 2.05 GHz	<-80 dBc
5 MHz to 10 MHz	<-75 dBc
Useable but unspecified down to 1 MHz	

* Third order intermodulation products for tone spacings ≥30 kHz

Residual FM (FM off)

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

Typically <1 Hz at 249 MHz, <2 Hz at 501 MHz, <3 Hz at 1001 MHz, <6 Hz at 2001 MHz

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.

MODULATION CAPABILITY

FM, AM or phase modulation can be applied to the carriers generated by each signal source from independent internal or external modulation sources. The internal modulation sources are capable of generating two simultaneous signals into any one of the modulation channels. Each internal and external modulation source can be simultaneously enabled to produce combined amplitude and frequency (or phase) modulation. Pulse modulation can be applied to each of the carriers from external pulse sources. 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 each carrier using data from an external source.

FREQUENCY MODULATION

Deviation

Resolution 3 digits or 1 Hz

CW Range (MHz)	Max Deviation (kHz)
1200 - 2050	12800
600 - 1200	6400
300 - 600	3200
150 - 300	1600
75 - 150	800
37.5 - 75	400
18.75 - 37.5	200
0.01 - 18.75	100

Accuracy at 1 kHz

±5%

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 then 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 modulation oscillator or external via front panel BNC

FSK

Modes

2 level or 4 level FSK, external data input via a 25 way rear panel D Type connector

Frequency shift

Variable up to ±100 kHz

Accuracy

As FM deviation accuracy, timing jitter ±3.2 µs

Filter

8th order Bessel BW 3.9 kHz

PHASE MODULATION

Deviation

0 to 10 radians, resolution 3 digits or 0.01 radians

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

Individual Outputs

For carrier frequencies <500 MHz useable to 2.05 GHz

Combined Output

Unspecified below 5 MHz useable to 1 MHz, otherwise as individual outputs

Range

0 to 99.9%, resolution 0.1%

Accuracy[2]

±5% of set depth at 1 kHz, over temperature range 17°C to 27°C
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]

<1.5% at 1 kHz rate for modulation depths up to 30%

<2.5% at 1 kHz rate for modulation depths up to 80%

Modulation source

Internal LF generator or external, via front panel BNC

PM on AM

Typically 0.1 radians at 30% depth at 470 MHz

PULSE MODULATION

With Option 118 fitted the pulse modulation performance of 2026A is as follows:

Frequency range

100 kHz to 2.05 GHz (useable to 10 kHz)

RF level accuracy

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

When pulse modulation is enabled, adds ±0.25 dB to the RF level accuracy specification 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)

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, a logic 1 (2.0 V to 5 V) turns the carrier on.
Maximum input is ±10 V.

RF output range

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

MODULATION OSCILLATOR

The internal modulation oscillator for each signal source is capable of generating one or two modulation tones simultaneously in one modulation channel.

Frequency range

0.01 Hz to 20 kHz with a resolution of 0.01 Hz, 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 from each source is available on the front panel Modulation Input/Output BNC connector at a nominal level of 2 V RMS EMF from a 600 Ω source impedance.

EXTERNAL MODULATION

Input on the front panel Modulation Input/Output connector. The modulation is calibrated with 1.414 V peak (1 V RMS sine wave) applied. Input impedance is 100 kΩ nominal. Maximum safe input ±15 V.

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 in the display indicate when the input is outside levelling range.

SWEEP MODE

The carrier frequency of one source can be swept. To enable more than one source to be swept the coupling facility must be invoked.

The start/stop values of carrier frequency, frequency step size and time per step can be set.

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 in single, continuous, start/stop or single step mode.

FREQUENCY STANDARD

FREQUENCY STANDARD (TCXO)

Frequency 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/output

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

EXTERNAL RF INPUT

The following applies when an external input is connected at the rear panel.

Insertion loss	15 dB ±1.5 dB
Frequency range	1 MHz to 3 GHz
Return loss	>20 dB to 2.05 GHz
Max input power	0.5 W

GENERAL

GPIB INTERFACE

All signal source parameters except the supply switch are remotely programmable.

Designed in accordance with IEEE 488.2.

RS-232

All signal source parameters except the supply switch are remotely programmable.
Connector is 9 way D type, baud rate 300 to 9600 bits per second. Handshake hardware is DTR, RTS, CTS and DSR and software is XON and XOFF. Electrical interface is to EIA-232-D.

ELECTROMAGNETIC COMPATIBILITY

Conforms with the protection requirements of Council Directive 89/336/EEC. Complies 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 EWEC Council Directive 73/23/EEC and Standard IEC/EN 61010-1 : 1993

RATED RANGE OF USE

(Over which full specification is met unless otherwise indicated.)

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 +71°C, Humidity up to 93% at 40°C
Altitude up to 4600 m (15,000 ft)

POWER REQUIREMENTS

AC Supply

90 to 132 V or 188 to 255 V, 47 Hz to 63 Hz, 250 VA maximum

CALIBRATION INTERVAL

2 years

DIMENSIONS AND WEIGHT

(over projections but excluding front panel handles)

Height	Width	Depth	Weight
177 mm	419 mm	488 mm	16 kg

OPTIONS

OPTION 001 - 3 Source Signal Generator

Includes 3 signal sources

OPTION 003 - 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 two 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 004 - REAR PANEL INPUTS

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

OPTION 118 - Fast Pulse Modulator

See pulse modulation section.

Notes

(1) Does not apply to external RF input signals to combiner.

(2) For RF levels not exceeding +15 dBm (individual output) or +1 dBm (combined output).

VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers	Versions
2026A	10 kHz to 2.05 GHz MultiSource Generator (2 internal sources)
	Options
Option 001	Add third internal source
Option 003	High stability frequency standard
Option 004	Rear panel outputs
Option 118	Fast Pulse Modulator
	Supplied with
	AC power supply lead
46882/466	Operating Manual
	Optional Accessories
46880/100	Service manual
46884/293	Rack mounting kit, depths from 480 mm to 680 mm
46884/294	Rack mounting kit, depths from 680 mm to 840 mm
46884/931	Rack mounting kit containing front panel brackets only
46662/614	Soft carrying case
43129/189	1.5 m GPIB lead
46884/650	RS-232 Cable 9 way female to a 9 way female 1.5 m
46884/649	RS-232 Cable 9 way female to a 25 way female 1.5 m
54112/165	Hard carrying case

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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www.aeroflex.com

info-test@aeroflex.com

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

Part No. 46891/123, Issue 3, 04/04

BACK

Synthesizers

2200 OEM Modular Synthesizer

AEROFLEX
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The 2200 family of OEM Modular frequency synthesizers operates in the frequency of 10 MHz to 18.4 GHz and offers sub-microsecond frequency switching speed and sub-microsecond level correction, coupled with superb spectral purity.

The 2200 family of OEM Modular frequency synthesizers operates in the frequency of 10 MHz to 18.4 GHz and offers sub-microsecond frequency switching speed and sub-microsecond level correction, coupled with superb spectral purity. With an installed base of more than a thousand units supporting hundreds of sub-microsecond switching and high spectral purity applications, the 2200 family is a proven performer for a diverse range of stringent applications. Extensive work has been undertaken to improve the reliability of the 2200 as a result of reducing component count and increasing automated production techniques.

The 2200 is based on an iterative, modular direct analog architecture with a central reference generator that synthesizes 50, 100, 150, 200 and 800 MHz signals from a 100 MHz reference derived by multiplying a 5 or 10 MHz reference oscillator appropriately and improving far-out noise by judicious filtering. All frequencies are derived in an iterative frequency generation architecture. Frequencies are generated as a decade of frequency steps over an octave from 500 MHz inputs to the next stage. Final outputs are produced by a scaling module which provides for doubling, dividing or heterodyning to achieve a range of 10 MHz to 2.3 GHz. Units which have extended frequency ranges use an additional scaling module which doubles to 4.6 GHz, and then to 18.4 GHz. The architecture also provides the additional benefit of simplifying the user interface programming in Binary Coded Decimal (BCD). Naturally, a variety of interfaces are optionally provided, including IEEE-488 and a user-friendly keyboard.

This unique, interactive, modular architecture also allows for easy configurations of OEM or specialized products.

The Best of Both Worlds

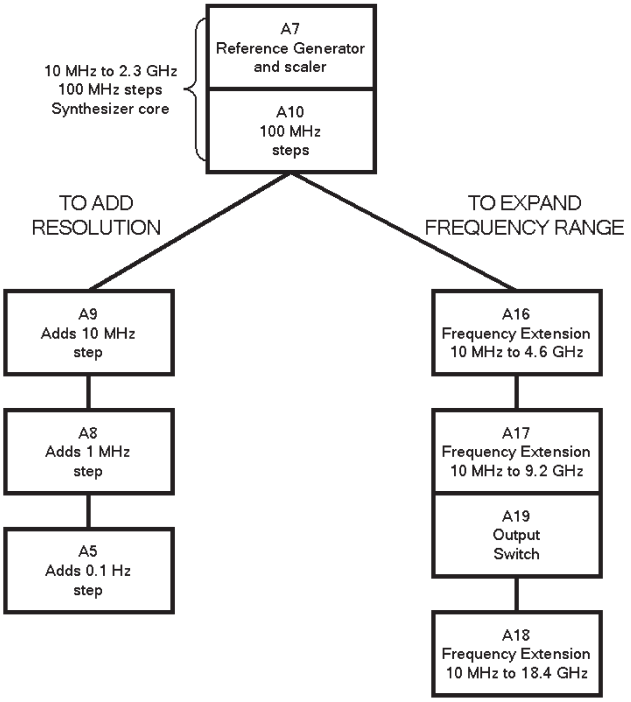
A keyboard-controlled version is available where manual control makes sense. The 2200 provides all the performance of the sub-microsecond System Synthesizer and easy to use, incredibly clean, bench synthesizers. The 2200 is like two synthesizers in one; a microsecond switching computer controlled system synthesizer and an IEEE-488 programmable keyboard entry bench synthesizer with extensive sweep and synchronization capability.

You can conveniently use the 2200 for system development with the convenience of keyboard entry of frequency increments and sweeps, as well as IEEE-488 programming. With the flip of a switch, the 2200 becomes a BCD programmable microsecond frequency switching synthesizer. Even if you do not need fast switching, the 2200 is one of the lowest phase noise 18 GHz synthesizers available.

The 2200 provides programmable and keyboard controlled modulation of AM and FM and 1 μsec frequency switching up to 4 GHz.

OEM Configuration Guide

Aeroflex's modular architecture and iterative frequency plan makes it ideally suited for custom OEM applications. Just two standard modules make up a 10 MHz - 2.3 GHz, 100 MHz resolution OEM synthesizer with the same specifications as the standard family, needing only DC power and Frequency Reference. To obtain finer resolution and/or wider frequency coverage, just add the appropriate standard modules. Factory assistance is available to help you configure an OEM synthesizer which best meets your electrical or environmental specifications.



SPECIFICATIONS

STANDARD 19 " RACK CHASSIS CONFIGURATIONS

Frequency Range	2200 Model	Available Options FM	Pulse	Attenuation SLOW	FAST	Standard Interface
10 MHz to 2.299 999 GHz	2202	O	O	O	O	IEEE-488/BCD
10 MHz to 3.999 999 GHz *	2204	O	O	O	O	IEEE-488/BCD
10 MHz to 18.399 999 GHz	2218	O	O	O	O	IEEE-488/BCD

O : Optional
* : Option 112 extends the frequency coverage to 4.599 999 GHz

RF OUTPUT

Level

+10 dBm

Leveling

± 2 dB (± 5° C of Calibration Temperature)

Impedance

50 Ohm

Settling time

2 µsec maximum (1 µsec typ); to be within +/-2 dB of final amplitude

FREQUENCY ACCURACY AND STABILITY

Same as Reference Oscillator

REFERENCE OSCILLATOR

Internal

10 MHz quartz oscillator aging rate 5 x 10^{-9}/day after 24 hours (in normal operating environment)

External

Any 5 MHz or 10 MHz Frequency Standard at a level of 0 dBm +/- 2dB

SWITCHING SPEED

The 2200 switches between any two frequencies 50 MHz-18 GHz in less than 1 µsec with 1 MHz resolution and 1.2 µsec with 0.1 Hz resolution. The switching time is measured from the time the 2200 receives a strobe command to switch until the phase detector output shows arrival at new frequency. The 2200 is unique: the larger the resolution, the faster the switching speed with 1 GHz resolution or more typically switching in less than 250 nsec.

PHASE NOISE

The 2200 provides sub-microsecond switching and superior phase noise performance simultaneously.

Offset from carrier	Carrier Frequency 100 MHz	600 MHz	1.2 GHz	2.4 GHz	4.6 GHz	9.2 GHz	18.4 GHz
10 Hz	-100	-85	-79	-73	-67	-61	-55
100 Hz	-113	-98	-92	-86	-80	-74	-68
1 kHz	-128	-113	-107	-101	-95	-89	-83
20 kHz	-145	-138	-132	-126	-120	-114	-108
100 kHz	-147	-140	-134	-128	-122	-116	-110
10 MHz	-147	-140	-134	-128	-122	-116	-110
40 MHz	-147	-140	-134	-128	-122	-116	-110

Includes internal reference phase noise

SPURIOUS SIGNALS

dBc	Frequency Range (GHz) 0.05 to 2.3	2.3 to 4.6	4.6 to 9.2	9.2 to 18
Non-Harmonic	-70	-62	-56	-50
Sub-Harmonic **	-40	-40	-30	-30
Harmonic ***	-25 *	-25	-25	-25

* 560 to 800 MHz: -20 dBc ** Option 123: -55 dBc *** FA 4000-1: -50 dBc

FREQUENCY SWEEP MODES

Auto: Sweep repeats automatically

Single: Single sweep activated by front panel keyboard

Sweep Speed: Sweep repeats automatically 1 ms, 10 ms and 100 ms per step external

Synchronized variable to 700 µsec per step

In conjunction with above:

Sweep Up: Frequency sweeps from lower frequency to upper frequency, then returns back to lower frequency.

Sweep Down: Frequency sweeps from upper frequency to lower frequency, then returns back to upper frequency.

Sweep Up/Down: Frequency sweeps from lower frequency to upper frequency, then from upper frequency to lower frequency.

Number of Steps: Selectable from 1 to 10,000 steps

Step Size: Selectable, any size consistent with resolution of unit

Stop Sweep: Causes internal sweep to halt immediately. Return control to command level.

MODULATION

FM

Frequency Range GHz	Peak Deviation MHz	3 dB Bandwidth
0.01 - 3.999	0 to 1	10 Hz to 300 kHz
1.15 - 3.999	0 to 10	10 Hz to 300 kHz

AM

Frequency Range MHz	Depth %	3 dB Bandwidth
10 - 180	0 to 90	10 Hz to 50 kHz

REMOTE PROGRAMMING CONTROL INTERFACE

44 Bits Parallel BCD TTL Compatible; Positive True with Strobe. Mating Connector: 3M P/n 3564-1000. In addition to standard Interface IEEE-488-1978, all functions controlled from the front panel, with the exception of the power line switch, are programmable with the same accuracy and resolution as in manual mode.

GENERAL

Operating temperature range

0° to 50°C

Power Requirements

120/250 VAC 48 to 440 Hz, 250 Watts

Weight

50 lbs. (22.7 kg)

Dimensions

16.75" W x 5.22" H x 23.88" D (42.55 x 13.26 x 60.66 cm)

OPTIONS

OPTION 101, ADDED DDS FOR ENHANCED FREQUENCY RESOLUTION, MODULE A5

Frequency Range MHz	Opt 101 Hertz
10 MHz to 2.3 GHz	0.1
2.3 to 4 GHz	0.1
4.6 to 9.2 GHz	0.2
9.2 to 18.4 GHz	0.4

The option 101 limits the switching speed to 1.2 µsec.

OPTION 120, FM MODULATION

Frequency Range MHz	Peak Deviation Wide	+/- MHz Narrow
50-69	1.5	0.15
70-139	0.75	0.075
140-279	1.5	0.15
280-559	3	0.3
560-1149	6	0.6
1150-2299	12	1.2
2300-4599	24	2.4
4600-9199	48	4.8
9200-18399	96	9.6

OPTION 121, PROGRAMMABLE FM, MAINTAINS CONSTANT DEVIATION ACROSS FREQUENCY RANGE

Frequency Range MHz	Peak Deviation MHz
50-1149	0.01, 0.1, 1
1150-18399	0.1, 1, 10

External only FM coupling mode	3 dB Bandwidth
DC	DC to 5 MHz
AC	50 Hz to 5 MHz

OPTION 122, PULSE MODULATION

On/OFF ratio

60 dB

Rise/Fall time

10 nsec

OPTION 125, FAST ATTENUATOR, SOLID STATE

Frequency Range

0.5 to 18 GHz

Attenuation Range

0 to 60 dB

Attenuation Increment

0.25 dB

Switching Time

1 µsec max

OPTION 128, SLOW ATTENUATOR, MECHANICAL

Frequency Range

10 MHz to 18.4 GHz

Attenuation Range

0 to 120 dB

Attenuation Increment

1 dB

Switching Time

20 msec max

Contact the factory for non-standard options such as phase modulation or requirements not satisfied by standard options.

VERSIONS, OPTIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers	Versions
2202	10 MHz to 2.3 GHz (1 Hz Resolution) Keyboard Main Frame (includes GPIB)
2204	10 MHz to 4.6 GHz (1 Hz Resolution) Keyboard Main Frame (includes GPIB)
2218	10 MHz to 18.4 GHz (4 Hz Resolution) Keyboard Main Frame (includes GPIB)
	Options
101	(Up to 4 GHz, 0.1 Hz Resolution) (4.6 to 9.2 GHz, 0.2 Hz Resolution) (9.2 to 18.4 GHz, 0.4 Hz Resolution)
112	Extends Upper Frequency of 2204 to 4.6 GHz
116	100 MHz Reference
117	Reversed fan for increased air flow with Filter
120	Non-programmable Wideband FM
122	Pulse Modulation 500 MHz to 4, 9, 18 GHz, 60 dB ON/OFF, 40 nsec R/F
123	Low Sub-harmonics at -66 dBC
125	Fast Attenuator
126	High Speed Memory/HP 8510 Interface (separate unit)
128	Slow Attenuator
129	Differential BCD
904	Extra Manual
905	Slides for Full Rack

CHINA
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 6282 8002

EUROPE
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UNITED KINGDOM
Tel: [+44] (0) 1438 742200
Toll Free: [+44] (0800) 282 388 (UK only)
Fax: [+44] (0) 1438 727601

USA
Tel: [+1] (316) 522 4981
Toll Free: [+1] (800) 835 2352 (US only)
Fax: [+1] (316) 522 1360

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www.aeroflex.com
info-test@aeroflex.com

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Part No. 46891/154, Issue 2, 06/04

Synthesizers

2500 OEM Modular Synthesizer

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Supports hundreds of fast switching, high spectral purity applications

- Truly modular construction
- Wide frequency range from a single unit
- Amplitude levelling
- Hop states faster than 1 Megahop/sec
- Wide variety of standard and custom interface options
- High performance modulation: chirp, pulse, AM and FM
- Highest spectral purity

The Aeroflex 2500 series synthesizers feature superior performance never available before. They stand at the pinnacle of a family of frequency synthesizers that exemplify cutting edge performance. The 2500 series synthesizers are more reliable, ultra-fast, exceptionally clean, and low cost. They are an ideal source for agile radar, radar simulators, radar upgrades, fast antenna, RCS measurements, electronic warfare systems, and ultra-fast ATE. The high-speed source is based on direct-synthesis techniques with generous use of sharp-rolloff bandpass filters for low-spurious performance. The instrument realization is housed in a 3U rack mountable chassis with display, keyboard, IEEE-488 interface, and parallel BCD interface for ultra- fast switching control. The 2500 series technology has been developed to support the most stringent airborne requirements. The architecture as well as the implementation has been specifically geared to furnishing military qualified, high reliable units. The architecture developed around direct analog frequency synthesis is inherently insensitive to vibration - there are no VCOs or sensitive phase lock loops. The components and modules supporting the architecture have also been selected for their rugged and temperature stable qualities. The architecture has been implemented using the most advanced technology presently available.

SPECIFICATION

Frequency Range and Resolution

Model Number	Frequency Range (GHz)	Frequency Resolution
2513	0.3 to 13.5	0.5 MHz
2518	0.3 to 18	1 MHz
2520	0.3 to 20	1 MHz
2526	0.3 to 26.5	1 MHz

Switching Speed

<200 ns

Output Power

+10 dBm (50 Ω) nominal

Flatness

±2 dB (±5°C of calibration temperature)

Amplitude setting

Within 2 dB of final level <200 ns

Reference Oscillator

Internal: 100 MHz Quartz Oscillator, 5 x 10^{-8} per day after 30 days in normal operating environment

External Tuning Input

±2 VDC, pull range ± 100 Hz per volt nominal at 1 GHz

Frequency and Accuracy Stability

Same as reference oscillator

Remote Programming Control Interfaces

20 bits parallel BCD 1, 2, 4, 8 (1 MHz resolution)

Optional 44 bits parallel BCD 1, 2, 4, 8 (1 Hz resolution)

IEEE-488-1978

Phase Coherence

Frequency steps of 50 MHz from 4.8 to 13.5 GHz

100 MHz steps from 13.5 GHz and 26.5 GHz (Finer steps possible as a special option - contact factory)

Spectral Purity

Phase Noise

Absolute SSB Phase Noise in dBc/Hz (includes noise of internal reference)

Frequency Offset	Carrier Frequency (GHz) 0.5	1.0	3.0	8.0	18.0
10 Hz	-86	-80	-71	-60	-55
100 Hz	-105	-85	-99	-90	-84
1 kHz	-110	-95	-110	-110	-102
10 kHz	-130	-120	-124	-120	-113
100 kHz	-140	-132	-128	-122	-115
1 MHz	-142	-139	-132	-123	-116
10 MHz	-143	-148	-140	-136	-130
100 MHz	-143	-150	-150	-138	-132

Spurious and Harmonic Signals

Frequency Range (GHz)	Spurious (dBc)	Sub-Harmonics (dBc)	Harmonics (dBc)
0.3 - 2.4	-80	None	-50
2.4 - 4.8	-76	None	-50
4.8 - 13.5	-70	None	-50
13.5 - 20	-64	-60	-50
20 - 26.5	-64	-50	-50

Operating Temperature

0°C to 50°C

Storage temperature

-20°C to 85°C

Power Requirements

18:120/220/240 VAC ±10%, 48 to 440 Hz, 320 W, 380 VA

Dimensions

16.75" W x 5.22" H x 23.88" D

(42.55 x 13.66 x 60.66)

Weight

55 lbs (24.9 kg)

AVAILABLE OPTIONS

1 Hz frequency resolution

(Limits switching speed to 1 microsecond for steps less than 500 MHz - Does not affect spectral purity or phase noise)

FM Chirp (Wideband FM)

FM Normalized

40 GHz Frequency doubler, +10 dBm, SMA (F) Input, K (F) Output, Rack Mount Unit

(Dimensions: 2.2" H x 19" W x 6" D, weight: <2 lbs)

10 MHz Phase Lock Capability. Internal reference can be phase locked to 10 MHz Signal at 0 dBm ±2 dB.

19 inch standard equipment rack mount slides

FREQUENCY MODULATION OPTION

SENSITIVITY

1.0 V peak for full scale deviation

The amplitude of the FM input signal must be adjusted to obtain the desired deviation according to the output frequency range.

Source

External Only
Input impedance: 50 Ω
Modes: DC and AC

Frequency Stability

AC Mode - The FM Oscillator is phase locked to the synthesizer reference. Consequently the carrier has the same stability as in CW Mode.

DC Mode - The FM Oscillator Phase Lock is unlocked to introduce the DC or very low frequency FM signal. The oscillator is thus free running.

Linearity

<10% for maximum deviation

FM Deviation

Frequency (MHz)	Deviation (MHz)(min.)	Rate (MHz/ms)
300-600	±8.0	22.0
600-1200	±15.0	44.0
1200-2400	±30.0	88.0
2400-4800	±60.0	175.0
4800-13500	±120.0	350.0
13500-18000	±240.0	700.0
20000-26500	±240.0	700.0

BACK

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1628 604455
Fax: [+44] (0) 1628 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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www.aeroflex.com
info-test@aeroflex.com

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Part No. 46891/215, Issue a, 06/05

BACK

Synthesizers

2106 Fast Switching Synthesizer

- <100 Microsecond Switching
- Low Phase Noise -130 dBc/Hz
- 2 Hz Resolution
- Low Spurious
- Dual Configuration Available

The Aeroflex 2106 RF source represents a milestone in Synthesizer development and reflects years of design experience in Fast Switching Synthesis. Designed specifically to meet the needs of today's Telecommunications industry, this high speed source offers a cost effective solution without sacrificing performance. The source covers a frequency range of 4.5 MHz to 6.0 GHz with a switching speed of 100 Microseconds. Spurious levels are greater than -65 dBc and Phase Noise at 1.0 GHz is greater than -130 dBc/Hz at 10 KHz offset.

SPECIFICATIONS

Frequency Range

4.5 to 6010 MHz

Step Size

2 Hz to 2000 MHz

2 Hz from 2000 to 4000 MHz

4 Hz from 4000 to 6010 MHz

Power Output

+7 dBm

Flatness

±1.5 dB

Output Isolation

25 dB minimum between ports

<5 µseconds switching time between ports

VSWR

1.8:1

External Reference

10 MHz, 3 dBm ±4 db, 50 Ohms

Frequency Stability

Same as Reference Oscillator

Reference Output

10 MHz, +3 dBm ±2 db, 50 Ohms

Phase Noise of External Reference

-130 dBc/Hz 100 Hz offset

-140 dBc/Hz 1 KHz offset

-143 dBc/Hz 10 KHz offset

-145 dBc/Hz 50 KHz offset

Switching Time

<100 µseconds to within 1.0 radian of final phase

Output Phase Noise

OFFSET	<250 MHz		25 to <5GHz		0.5 to <1.0 GHz		1.0 to <2.0 GHz		2.0 to <4.0 GHz		4.0 to <6.0 GHz	
	Typ.	Guar	Typ.	Guar	Typ.	Guar	Typ.	Guar	Typ.	Guar	Typ.	Guar.
10 KHZ	-125	-122	-135	-132	-131	-127	-125	-122	-119	-116	-113	-110
20 KHZ	-127	-124	-137	-133	-133	-129	-127	-124	-121	-118	-115	-112
100 KHZ	-128	-125	-138	-134	-134	-130	-128	-123	-122	-118	-116	-113

Noise Floor (10 MHz Offset):

-140 dBc/Hz 4.5 to 180 MHz

-145 dBc/Hz 180 to 1000 MHz

-147 dBc/Hz 1000 to 2000 MHz

-138 dBc/Hz 2000 to 4000 MHz

-134 dBc/Hz 4000 to 6010 MHz

Harmonics

-25 dBc maximum 4.5 to 6010 MHz

Subharmonics

-60 dBc, Typical

-50 dBc Max except for components at FC noted below

@ FC=4.0 to 4.25, 5F/2 may be -45 dBc

@ Offsets =± 2.8 MHz from the carrier, spurs will be as follows:

FC < 180 MHz: -60 dBc

180 MHz<FC<1.0 GHz: -66 dBc

1.0 GHz<FC<2.0 GHz: -60 dBc

2.0 GHz<FC<4.0 GHz: -54 dBc

4.0 GHz<FC<6.01 GHz: -48 dBc

For 1.0 GHz<FC <2 GHz, fixed spurs at the following frequencies may be -60 dBc:

1175, 1225, 1275, 1325, 1375, 1425, 1475, 1525, 1575 & 1625 MHz

Spurious

-65 dBc maximum 4 to 2000 MHz

-60 dBc maximum 2000 to 4000 MHz

-55 dBc maximum 4000 to 6010 MHz

For FC less than 180 MHz a spur may exist between 1609 MHz and 1960 MHz at -35 dBc

A fixed 800 MHz spur may exist at -60 dBc all carrier frequencies

Residual FM

<7 Hz 4.5 to 2000 MHz

<16 Hz 2000 to 4000 MHz

<32 Hz 4000 MHz to 6010 MHz

Frequency Control

Parallel BCD negative true with strobe. Strobe normally low, trigger on trailing edge

OUTPUT FAULT TTL level logic, "1" normal operation

Remote On/Off (RF)

O MHz = Off

On/Off ratio

< 25 dBc

Logic Connector

50 Pin receptacle, AMP 554216-3

Initialization

Unit will initialize with RF Off

RANDOM VIBRATION 10 Hz to 300 Hz @ 1.2G RMS

POWER: 105 TO 125 VAC, 50-60 Hz

Dimensions

16.75" W X 5.22" H X 23.86" D

Temperature Range

+10 ^{o}C to +45 ^{o}C

CONFIGURATION S = Single Synthesizer,

D = Dual, Two independent synthesizers in a common chassis

PROGRAMMING INPUT

(BCD CONNECTOR)

SIGNAL	PIN	PIN	SIGNAL
Logic Ground	50	25	NC
400 MHz	49	24	Strobe
NC	48	23	NC
NC	47	22	NC
NC	46	21	Chassis Ground
Fault	45	20	8 MHz
200 MHz	44	19	4 MHz
100 MHz	43	18	2 MHz
NC	42	17	1 MHz
80 MHz	41	16	20 MHz
40 MHz	40	15	10 MHz
MUX	39	14	2 GHz
800 MHz	38	13	1 GHz
8 Hz	37	12	2 Hz
4 Hz	36	11	4 GHz
80 Hz	35	10	20 Hz
40 Hz	34	9	10 Hz
800 Hz	33	8	200 Hz
400 Hz	32	7	100 Hz
8 kHz	31	6	2 kHz
4 kHz	30	5	1 kHz
80 kHz	29	4	20 kHz
40 kHz	28	3	10 kHz
800 kHz	27	2	200 kHz
400 kHz	26	1	100 kHz

Note: Mating Connector is 3M P/N 3564-1001 (50 Pin Ribbon. Bail mount, Plug)

Note- Specifications subject to change without notice

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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www.aeroflex.com
info-test@aeroflex.com

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Part No. 46891/177, Issue 1, 06/04

BACK

Synthesizers

2126 Fast Switching Synthesizer

- <100 microsecond switching
- Low phase noise -130 dBc/Hz
- 1 Hz resolution
- Low spurious
- BCD/GPIB programming available

The Aeroflex 2126 RF source represents a milestone in Synthesizer development and reflects years of design experience in Fast Switching Synthesis. Designed specifically to meet the needs of todays Telecommunications industry, this high speed source offers a cost effective solution without sacrificing performance. The source covers a frequency range of 4.5 MHz to 6.0 GHz with a switching speed of 100 Microseconds. Spurious levels are greater than -65 dBc and Phase noise at 1.0 GHz is greater than -130 dBc/Hz at 10 KHz offset.

SPECIFICATIONS

Frequency Range

4.5 to 6010 MHz

Step size

1 Hz - 4.5 to 1999 MHz

2 Hz - 2000 to 3999 MHz

4 Hz - 4000 to 6010 MHz

Power Output

+7 dBm

Flatness

±1.5 dB

Output Isolation

25 dB minimum between ports

<5 µs switching time between ports

VSWR

1.8:1

External Reference

10 MHz, 3 dBm ±4 dB, 50 Ohms

Frequency Stability

Same as Reference Oscillator

Reference Output

10 MHz, +3 dBm ±2 dB, 50 Ohms

Phase Noise of External Reference

-130 dBc/Hz 100 Hz offset

-140 dBc/Hz 1 kHz offset

-143 dBc/Hz 10 kHz offset

-145 dBc/Hz 50 kHz offset

Switching Time

<100 µs to within 1.0 radian of final phase

Output Phase Noise

OFFSET	<250 MHz	25 to <.5 GHz	0.5 to <1.0 GHz	1.0 to <2.0 GHz	2.0 to <4.0 GHz	4.0 to <6.0 GHz
	Typ. Guar.	Typ. Guar.	Typ. Guar.	Typ. Guar.	Typ. Guar.	Typ. Guar.
10 KHZ	-125 -122	-135 -132	-131 -127	-125 -122	-119 -116	-113 -110
20 KHZ	-127-124	-137-133	-133 -129	-127 -124	-121 -118	-115 -112
100 KHZ	-128 -125	-138 -134	-134 -130	-128 -123	-122 -118	-116 -113

Noise Floor (10 MHz Offset

-140 dBc/Hz 4.5 to 180 MHz

-145 dBc/Hz 180 to 1000 MHz

-147 dBc/Hz 1000 to 2000 MHz

-138 dBc/Hz 2000 to 4000 MHz

-134 dBc/Hz 4000 to 6010 MHz

Harmonics

-25 dBc maximum 4.5 to 6010 MHz

Subharmonics

-60 dBc, Typical

-50 dBc Max except for components at FC noted below

@ FC=4.0 to 4.25, 5F/2 may be -45 dBc

@ Offsets =± 2.8 MHz from the carrier, spurs will be as follows:

FC <180 MHz: -60 dBc

180 MHz<FC<1.0 GHz: -66 dBc

1.0 GHz<FC<2.0 GHz: -60 dBc

2.0 GHz<FC<4.0 GHz: -54 dBc

4.0 GHz<FC<6.01 GHz: -48 dBc

For 1.0 GHz<FC<2 GHz, fixed spurs at the following frequencies may be -60 dBc: 1175, 1225, 1275, 1325, 1375, 1425, 1475, 1525, 1575 & 1625 MHz

Spurious

-65 dBc maximum 4.5 to 2000 MHz

-60 dBc maximum 2000 to 4000 MHz

-55 dBc maximum 4000 to 6010 MHz

For FC less than 180 MHz a spur may exist between 1609 MHz and 1960 MHz at -35 dBc:

A fixed 800 MHz spur may exist at -60 dBc all carrier frequencies

Residual FM

<7 Hz 4.5 to 2000 MHz

<16 Hz 2000 to 4000 MHz

<32 Hz 4000 to 6010 MHz

Frequency Control

Parallel BCD positive or negative true with strobe. Strobe normally low, trigger on trailing edge

GPIB (IEEE-488)

Output Fault

TTL level logic, "1" normal operation

Remote on/off (RF)

0 MHz = Off

On/Off ratio < 25 dBc

Logic Connector

50 Pin receptacle, AMP 554216-3

Initialization

Unit will initialize with RF Off

Random Vibration

10 to 300 Hz @ 1.2G RMS

Power

Autoranging: 50-60 Hz , 100 to 130, 180 to 250 VAC

Dimensions

19.0" W X 3.5" H X 22.28" D (Chassis Width 16.72")

Temperature Range

+10 to +45 °C

PROGRAMMING INPUT (BCD CONNECTOR)

SIGNAL	***PIN***	***PIN***	***SIGNAL***
Logic Ground	50	25	NC
400 MHz	49	24	Strobe
NC	48	23	NC
NC	47	22	NC
NC	46	21	Chassis Ground
Fault	45	20	8 MHz
200 MHz	44	19	4 MHz
100 MHz	43	18	2 MHz
1 Hz	42	17	1 MHz
80 MHz	41	16	20 MHz
40 MHz	40	15	10 MHz
MUX	39	14	2 GHz
800 MHz	38	13	1 GHz
8 Hz	37	12	2 Hz
4 Hz	36	11	4 GHz
80 Hz	35	10	20 Hz
40 Hz	34	9	10 Hz
800 Hz	33	8	200 Hz
400 Hz	32	7	100 Hz
8 kHz	31	6	2 kHz
4 kHz	30	5	1 kHz
80 kHz	29	4	20 kHz
40 kHz	28	3	10 kHz
800 kHz	27	2	200 kHz
400 kHz	26	1	100 kHz

Note: Mating Connector is 3M P/N 3564-1001 (50 Pin Ribbon. Bail mount, Plug)

CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1682 604455
Fax: [+44] (0) 1682 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: 800 835 2352

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www.aeroflex.com
info-test@aeroflex.com

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Part No. 46891/175, Issue 1, 05/04

BACK

Synthesizers

MS5000-150 Airborne Frequency Synthesizer

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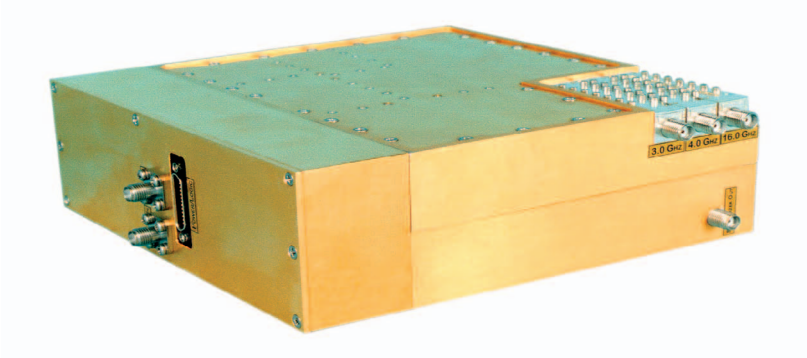


- Nanosecond Tuning
- Low Phase Noise
- Phase Coherent
- Low Harmonics
- Small Size
- Fighter Environment
- Optional Fixed Outputs
- Other Frequencies Available

The MS5000-150 features superior performance never before available in a synthesizer designed for use in Airborne Fighter Environments. The high-speed source is based on direct-synthesis techniques with generous use of sharp-rolloff bandpass filters for low-spurious performance. The synthe-sizer covers a range of 9 to 15 GHz with a fre-quency switching speed of better than 30 ns. Harmonic levels are better than -50 dBc while spurious levels are no worse than -40 dBc. Phase noise at 14 GHz is -120 dBc/Hz offset 10 kHz from the carrier. Compact size, ruggedized construction and light weight make this unit ideal for EW, RWR, ESM, and other military applications.

Frequency Range

9.0 to 15.0 GHz

Output Step Size

50 MHz , 5 MHz Optional

Power Output

+10 dBm ± 2 dB

Tuning Speed

50 nSec

VSWR

2:1

Phase Coherency

When tuned to a multiple of 100 MHz, the unit will be phase coherent from F1 to F2 and back to F1

Harmonics and Sub-Harmonics

-50 dBc

Spurious

-40 dBc

SSB Phase Noise, Static

See Plot

Fixed Outputs

Optional fixed output frequencies are available if derived from multiples of internal 100 MHz reference.

Tuning Data Input

11 Bit TTL for 5 MHz resolution

Power Supply

+5.0V @ 3.5A, -6V @0.35A, +15V @ 1.4A

Operating Temperature

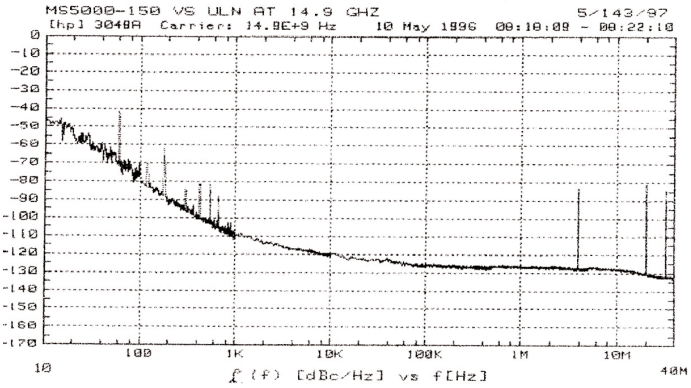
-40 °C to +85 °C

Dimensions

6.0" X 6.0" X 2.0"

Environmental

Airborne Fighter



CHINA Beijing
Tel: [+86] (10) 6467 2761 2716
Fax: [+86] (10) 6467 2821

CHINA Shanghai
Tel: [+86] (21) 6282 8001
Fax: [+86] (21) 62828 8002

FINLAND
Tel: [+358] (9) 2709 5541
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Tel: [+33] 1 60 79 96 00
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BACK

Synthesizers

FS2000 OEM Modular Synthesizer

The FS-2000 family of OEM Modular frequency synthesizers operates in the frequency of 10 MHz to 18.4 GHz and offers sub-microsecond frequency switching speed, and sub-microsecond level correction, coupled with superb spectral purity.

The FS-2000 family of OEM Modular frequency synthesizers operates in the frequency of 10 MHz to 18.4 GHz and offer sub-microsecond frequency switching speed, and sub-microsecond level correction, coupled with superb spectral purity. With an installed base of more than a thousand units, supporting hundreds of sub-microsecond switching and high spectral purity applications, the FS-2000 family is a proven performer for a diverse range of stringent applications.

The FS-2000 is based on an iterative, modular direct analog architecture with a central reference generator that synthesizes 50, 100, 150, 200 and 800 MHz signals from a 100 MHz reference derived by multiplying a 5 or 10 MHz reference oscillator appropriately and improving far-out noise by judicious filtering. All frequencies are derived in an iterative frequency generation architecture. Frequencies are generated as a decade of frequency steps over an octave from 500 MHz inputs to the next stage. Final outputs are produced by a scaling module which provides for doubling, dividing, or heterodyning to achieve a range of 10 MHz to 2.3 GHz. Units which have extended frequency ranges use an additional scaling module which doubles to 4.6 GHz, and again to 9.2 and 18.4 GHz. The architecture also provides the additional benefit of simplifying the user interface programming in Binary Coded Decimal (BCD). Naturally, a variety of interfaces are optionally provided, including IEEE-488 and a user-friendly keyboard.

This unique, interactive, modular architecture also allows for easy configurations of OEM or specialized products.

The Best of Both Worlds

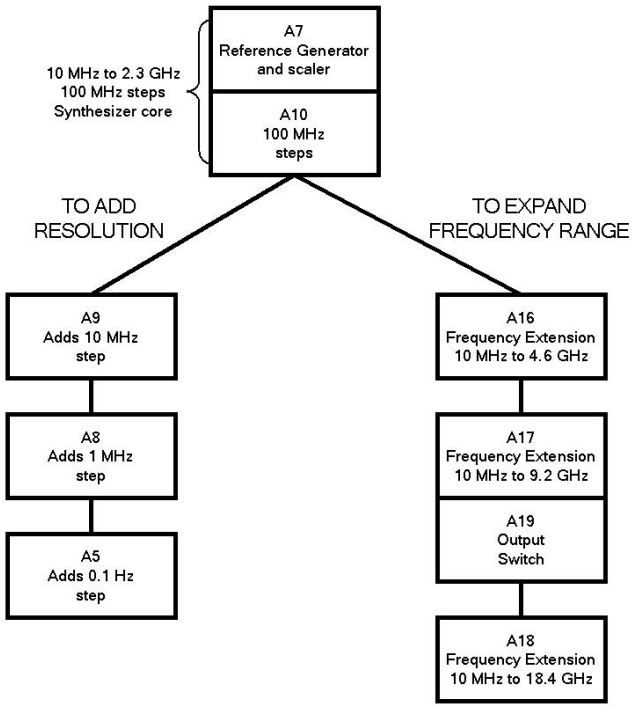
A keyboard-controlled version is available where manual control makes sense. The FS-2000B or FS2000C still provide all the performance of the sub-microsecond System Synthesizer and easy to use, incredibly clean, bench synthesizers. The FS-2000B is like two synthesizers in one; a microsecond switching computer controlled system synthesizer and an IEEE-488 programmable keyboard entry bench synthesizer with extensive sweep and synchronization capability.

You can conveniently use the FS-2000 for system development with the convenience of keyboard entry of frequency increments and sweeps, as well as IEEE-488 programming. With the flip of a switch, the FS-2000B becomes a BCD programmable microsecond frequency switching synthesizer. Even if you do not need fast switching, the FS-2000B-18 is one of the lowest phase noise 18 GHz synthesizers available.

The FS-2000 provides programmable and keyboard controlled modulation of AM and FM and 1 μsec frequency switching up to 4 GHz.

OEM Configuration Guide

Aeroflex's modular architecture and iterative frequency plan makes it ideally suited for custom OEM applications. Just two standard modules make up a 10 MHz - 2.3 GHz, 100 MHz resolution OEM synthesizer with the same specifications as the standard family, needing only DC power and Frequency Reference. To obtain finer resolution and/or wider frequency coverage, just add the appropriate standard modules. Factory assistance is available to help you configure an OEM synthesizer which best meets your electrical or environmental specifications.



SPECIFICATIONS

STANDARD 19 " RACK CHASSIS CONFIGURATIONS

Frequency Range	FS-2000 Model	Available Options: AM	FM	Pulse	Attenuation SLOW	FAST	Standard Interface
10 MHz to	A-2		O		O		BCD
2.299 999 GHz	B-2						IEEE-488/BCD
10 MHz to	A-4		O		O	O	BCD
3.999 999 GHz *	B-4		O				IEEE-488/BCD
10 MHz to	A-9			O			BCD
9.199 999 GHz	B-9			O			IEEE-488/BCD
10 MHz to	A-18			O			BCD
18.399 999 GHz	B-18			O			IEEE-488/BCD
	MMS-18	O	O		O		MSIB/IEEE-488

O : Optional
* : Option 112 extends the frequency coverage to 4.599 999 GHz

RF OUTPUT

Level

+10 dBm

Leveling

± 2 dB (± 5° C of Calibration Temperature)

Impedance

50 Ohm

Settling time

2 µsec maximum (1 µsec typ); to be within +/-2 dB of final amplitude

FREQUENCY ACCURACY AND STABILITY

Same as Reference Oscillator

REFERENCE OSCILLATOR

Internal

10 MHz Quartz Oscillator Aging rate 5 x 10^{-9}/day after 24 hours (in normal operating environment)

External

Any 5 MHz or 10 MHz Frequency Standard at a level of 0 dBm +/- 2dB

SWITCHING SPEED

The FS-2000 switches between any two frequencies 50 MHz-18 GHz in less than 1 µsec with 1 MHz resolution and 1.2 µsec with 0.1 Hz resolution. the switching time is measured: From the time the FS-2000 receives a strobe command to switch until the phase detector output shows arrival at new frequency. The FS-2000 is unique: the larger the resolution, the faster the switching speed with 1 GHz resolution or more, typically switching in less than 250 nsec.

PHASE NOISE

The FS-2000 provides sub-microsecond switching and superior phase noise performance simultaneously.

Offset from carrier	Carrier Frequency 100 MHz	600 MHz	1.2 GHz	2.4 GHz	4.6 GHz	9.2 GHz	18.4 GHz
10 Hz	-100	-85	-79	-73	-67	-61	-55
100 Hz	-113	-98	-92	-86	-80	-74	-68
1 kHz	-128	-113	-107	-101	-95	-89	-83
20 kHz	-145	-138	-132	-126	-120	-114	-108
100 kHz	-147	-140	-134	-128	-122	-116	-110
10 MHz	-147	-140	-134	-128	-122	-116	-110
40 MHz	-147	-140	-134	-128	-122	-116	-110

Includes internal reference phase noise

SPURIOUS SIGNALS

dBc	Frequency Range (GHz) 0.05 to 2.3	2.3 to 4.6	4.6 to 9.2	9.2 to 18
Non-Harmonic	-70	-62	-56	-50
Sub-Harmonic **	-40	-40	-30	-30
Harmonic ***	-25 *	-25	-25	-25

* 560 to 800 MHz: -20 dBc ** Option 123: -55 dBc *** FA 4000-1: -50 dBc

FREQUENCY SWEEP MODES

Auto: Sweep repeats automatically

Single: Single sweep activated by front panel keyboard

Sweep Speed: Sweep repeats automatically 1 ms, 10 ms and 100 ms per step external

Synchronized variable to 700 µsec per step

In conjunction with above:

Sweep Up: Frequency sweeps from lower frequency to upper frequency, then return back to lower frequency.

Sweep Down: Frequency sweeps from upper frequency to lower frequency, then returns back to upper frequency.

Sweep Up/Down: Frequency sweeps from lower frequency to upper frequency, then from upper frequency to lower frequency.

BACK

Number of Steps: Selectable from 1 to 10,000 steps.

Step Size: Selectable, any size consistent with resolution of unit.

Stop Sweep: Causes internal sweep to halt immediately. Return control to command level.

MODULATION (C CHASSIS ONLY)

FM

Frequency Range GHz	Peak Deviation MHz	3 dB Bandwidth
0.01 - 3.999	0 to 1	10 Hz to 300 kHz
1.15 - 3.999	0 to 10	10 Hz to 300 kHz

AM

Frequency Range MHz	Depth %	3 dB Bandwidth
10 - 180	0 to 90	10 Hz to 50 kHz

REMOTE PROGRAMMING CONTROL INTERFACE

A chassis

44 Bits Parallel BCD TTL Compatible; Positive True with Strobe. Mating Connector: 3M P/n 3564-1000

B and C chassis

In addition to standard Interface IEEE-488-1978, all functions controlled from the front panel, with the exception of the power line switch, are programmable with the same accuracy and resolution as in manual mode.

GENERAL

Operating temperature range

0° to 50°C

Power Requirements

120/250 VAC 48 to 440 Hz, 250 Watts

Weight

FS-2000: 46 lbs. (20.9 kg)

Fs-2000A, FS-2000B or FS-2000C: 50 lbs. (22.7 kg)

Dimensions

FS-2000: 8.37" W x 5.22" H x 25.0" D (21.26 x 13.26 x 63.5 cm)

FS-2000A: 16.75" W x 5.22" H x 23.88" D (42.55 x 13.26 x 60.66 cm)
FS-2000B
FS-2000C

OPTIONS

OPTION 101, ADDED DDS FOR ENHANCED FREQUENCY RESOLUTION, MODULE A5

Frequency Range MHz	Opt 101 Hertz
10 MHz to 2.3 GHz	0.1
2.3 to 4 GHz	0.1
4.6 to 9.2 GHz	0.2
9.2 to 18.4 GHz	0.4

The option 101 limits the switching speed to 1.2 µsec.

OPTION 120, FM MODULATION

Frequency Range MHz	Peak Deviation Wide	+/- MHz Narrow
50-69	1.5	0.15
70-139	0.75	0.075
140-279	1.5	0.15
280-559	3	0.3
560-1149	6	0.6
1150-2299	12	1.2
2300-4599	24	2.4
4600-9199	48	4.8
9200-18399	96	9.6

OPTION 121, PROGRAMMABLE FM, MAINTAINS CONSTANT DEVIATION ACROSS FREQUENCY RANGE

Frequency Range MHz	Peak Deviation MHz
50-1149	0.01, 0.1, 1
1150-18399	0.1, 1, 10

External only FM coupling mode	3 dB Bandwidth
DC	DC to 5 MHz
AC	50 Hz to 5 MHz

OPTION 122, PULSE MODULATION

On / OFF ratio

60 dB

Rise / Fall time

10 nsec

OPTION 125, FAST ATTENUATOR, SOLID STATE

Frequency Range

0.5 to 18 GHz

Attenuation Range

0 to 60 dB

Attenuation Increment

0.25 dB

Switching Time

1 µsec max

OPTION 128, SLOW ATTENUATOR, MECHANICAL

Frequency Range

10 MHz to 18.4 GHz

Attenuation Range

0 to 120 dB

Attenuation Increment

1 dB

Switching Time

20 msec max

Contact the factory for non-standard options such as phase modulation or requirements not satisfied by standard options.

VERSIONS, OPTIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers	Versions
FS-2000A-2	10 MHz to 2.3 GHz (1 MHz Resolution)
FS-2000B-2	10 MHz to 2.3 GHz (1 Hz Resolution) Keyboard Main Frame (includes GPIB)
FS-2000A-4	10 MHz to 4.0 GHz (1 Hz Resolution)
FS-2000B-4	10 MHz to 4.0 GHz (1 Hz Resolution) Keyboard Main Frame (includes GPIB)
FS-2000A-9	10 MHz to 9.2 GHz (2 Hz Resolution)
FS-2000B-9	10 MHz to 9.2 GHz (2 Hz Resolution) Keyboard Main Frame (includes GPIB)
FS-2000A-18	10 MHz to 18.4 GHz (4 Hz Resolution)
FS-2000B-18	10 MHz to 18.4 GHz (4 Hz Resolution) Keyboard Main Frame (includes GPIB)
FS-2000-MMS-18**	10 MHz to 18.4 GHz (0.4 Hz Resolution) includes Frequency Modulation Output Level Control +10 to -110 dBm in 1 dB Steps: Two 4-Slot MMs Modules

** MMS does not include 70001A Main Frame

OPTIONS

101	*(Up to 4 GHz, 0.1 Hz Resolution)* *(4.6 to 9.2 GHz, 0.2 Hz Resolution)* *(9.2 to 18.4 GHz, 0.4 Hz Resolution)*
112	*Extends Upper Frequency of -4 to 4.6 GHz*
116	*100 MHz Reference*
117	*Reversed fan for increased air flow with Filter*
**120*	*Non-programmable Wideband FM*
**122*	*Pulse Modulation 500 MHz to 4, 9, 18 GHz, 60 dB ON/OFF, 40 nsec R/F*
**123*	*Low Subharmonics at -66 dBC*
125	*Fast Attenuator*
126	*High Speed Memory/HP 8510 Interface (separate unit)*
128	*Slow Attenuator*
129	*Differential BCD*
904	*Extra Manual*
905	*Slides for Full Rack*

** These options available in A and B chassis only*

CHINA
Tel: [+86] (10) 6467 2823
Fax: [+86] (10) 6467 2821

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Fax: [+44] (0) 1438 727601

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Tel: [+33] 1 60 79 96 00
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Tel: [+34] (91) 640 11 34
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UNITED KINGDOM
Tel: [+44] (0) 1438 742200
Toll Free: [+44] (0800) 282 388 (UK only)
Fax: [+44] (0) 1438 727601

USA
Tel: [+1] (316) 522 4981
Toll Free: [+1] (800) 835 2352 (US only)
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