2040 series
10 kHz to 5.4 GHz 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
- 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.

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 hysteresis 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 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 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 signal generator 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 0 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 the external modulation inputs and provides correctly calibrated level for input levels varying from 0.7 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 subaudible tone carriers. 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. Subaudible tones are normally used in the composite modulation mode where the modulation level for the tone and the inband modulation can be set independently.

**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.

**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.

**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.

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.

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.

+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.

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.

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.

Electronic Attenuator
An electronic attenuator option is available to meet demanding extended life requirements for repetitive switching, found in high volume production applications.
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 carrier frequency of 500 MHz.

Φ 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.

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:

<table>
<thead>
<tr>
<th>Maximum FM Deviation available:</th>
<th>Carrier Frequency</th>
<th>Normal</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Mode</td>
<td>Noise</td>
<td>Modes</td>
</tr>
<tr>
<td>2.7 to 5.4 GHz</td>
<td>6.75 to 13.5 MHz*</td>
<td>50 kHz</td>
<td></td>
</tr>
<tr>
<td>1.35 to 2.7 GHz</td>
<td>13.5-27 MHz*</td>
<td>100 kHz</td>
<td></td>
</tr>
<tr>
<td>0.75 to 1350 kHz</td>
<td>6.75-13.5 MHz*</td>
<td>50 kHz</td>
<td></td>
</tr>
<tr>
<td>0.375 to 675.0 MHz</td>
<td>3.375-6.75 MHz*</td>
<td>25 kHz</td>
<td></td>
</tr>
<tr>
<td>0.1875 to 337.5 MHz</td>
<td>1.687-3.375 MHz*</td>
<td>12.5 kHz</td>
<td></td>
</tr>
<tr>
<td>0.084375 to 678.75 MHz</td>
<td>0.843-1687 kHz*</td>
<td>6.25 kHz</td>
<td></td>
</tr>
<tr>
<td>0.0421875 to 843.75 MHz</td>
<td>421-843 kHz*</td>
<td>3.125 kHz</td>
<td></td>
</tr>
<tr>
<td>0.02109375 to 4218.75 MHz</td>
<td>42.1-421 kHz*</td>
<td>1.56 kHz</td>
<td></td>
</tr>
<tr>
<td>0.010546875 to 10200 MHz</td>
<td>10 Hz to 10 kHz</td>
<td>6.25 kHz</td>
<td></td>
</tr>
</tbody>
</table>

*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:

\[ \pm 6\% \text{ of indication} \pm 1 \text{ Hz excluding residual FM.} \]

In normal mode:

\[ \pm 5\% \text{ of indication} \pm 10 \text{ Hz excluding residual FM.} \]

**Carrier Frequency**

For Carrier Frequencies up to 1 GHz:

- **Range**: 0 Hz to 99.9 Hz.
- **Selection**
  - By keyboard entry of data. Variation by up/down keys and by rotary control.

**Modulation Source**

Internal LF generator or external via front panel sockets.

**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**
  - \( \pm 5\% \) 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 Hz to 99.9 Hz.
- **Selection**
  - By keyboard entry of data. Variation by up/down keys and by rotary control.

**Indication**

3 digits with annunciator.

**Resolution**: 0.1 Hz.

**Accuracy**

\( \pm 4\% \) 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.

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2040 series

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 or +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.

GENERAL

GBIP 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, TL, L4, SR1, RLL, PPO, DC1, D11, C9, E2.

ELECTROMAGNETIC COMPATIBILITY:
Conforms with the protection requirements of Council Directive 89/336/EEC. Complies with the limits specified in the following standards:
EN55011 Class B CSIR 11
EN50562-2 IEC 801-2,3,4
EN60555-2 IEC 555-2

SAFETY
Complies with IEC 348, HD401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 2 supply. Approved to UL 1244.

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.

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

Amplitude Modulation
Standard specification applies for carrier frequencies above 50 MHz.

Versions and Accessories
When ordering please quote the full ordering number information.

Ordering Numbers

<table>
<thead>
<tr>
<th>Versions</th>
<th>Numbers</th>
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<tr>
<td>2040</td>
<td>10 kHz to 1.35 GHz Signal Generator</td>
</tr>
<tr>
<td>2041</td>
<td>10 kHz to 2.7 GHz Signal Generator</td>
</tr>
<tr>
<td>2042</td>
<td>10 kHz to 5.4 GHz Signal Generator</td>
</tr>
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</table>

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
Ari DCS (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
Finesse of the modulation option for slower rise and fall time (order with Option 002).

Option 112
Ext, 2 In 0 Input 600 Ω Supplied with AC supply lead. Operating Manual.

Optional Accessories

46880-050
Service manual.

43106-012
RF connector cable, TM 4969/3, 50 Ω, 1.5 m, BNC.

54311-092
Coaxial adapter N male to BNC female.

55999-163
Precision coaxial adapter N male to SMA female.

54411-051
Impedance adapter, 50 to 75 Ω, BNC connectors.

54311-095
RF connector cable, 1 m, type N connectors.

43129-189
GBP Lead assembly.

46884-408
IEE/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 2040/40 series.

46662-525
Transit case.

46662-559
Soft carry case.

54499-044
DECT filter.