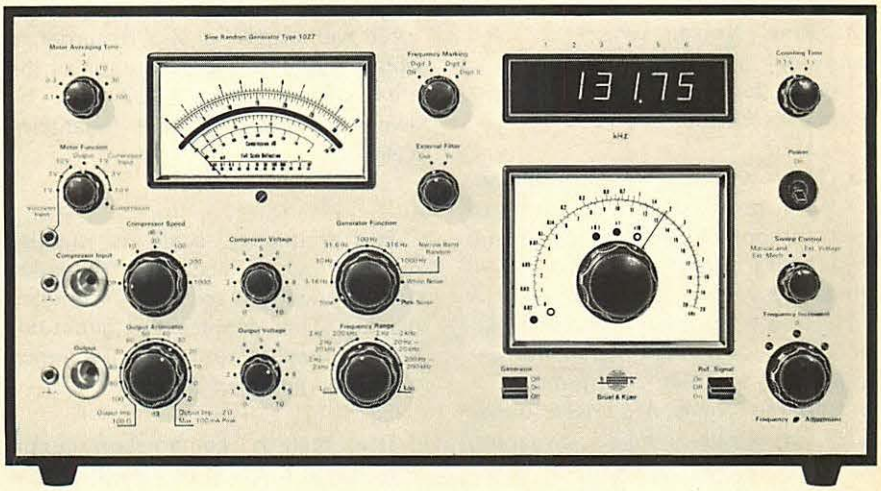
type 1027

Sine Random Generator



FEATURES:

- Output waveforms:
  Sinusoidal
  Narrow band random noise
  White noise
  Pink noise
- Frequency range in all modes 2 Hz to 200 kHz
- Continuous sweep over three decades
- Extremely low distortion
- Six noise bandwidths from 3,16 Hz to 1000 Hz
- High stability, voltage controlled oscillator
- Lin and Log frequency scales
- 6 digit frequency display, 0,1 or 1 s counting time
- Easy frequency calibration
- Compressor circuit usable in all signal modes
- Up to 90 dB dynamic range of compressor
- Six compressor speeds from 3 to 1000 dB/s
- Separate voltmeter input
- Meter indicates:
  Output voltage
  Compressor input voltage
  Compression
  Voltmeter input
- Seven meter averaging times from 0,1 to 100 s
- Frequency marker output for level recorder
- External filter connections
- Tunes Slave Filter 2020 and Heterodyne Analyzer 2010

USES:

Electro-acoustical measurements, such as:

- Frequency response, distortion, and impedance of audio recording and reproduction equipment
- Frequency response and directional characteristics of microphones, loudspeakers, hydrophones, and projectors
- High-accuracy determination of audio filter characteristics
- Phase response
- Hearing aid frequency response calibration
- Automatic recording of harmonics with Tracking Frequency Multiplier 1901 and filter 2020 or 2010

Building Acoustical measurements, such as:

- Sound distribution
- Transmission loss
- Sound insulation
- Reverberation time
- Model investigations

Mechanical Dynamics measurements, such as:

- Mechanical impedance
- Phase
- Vibration testing

Investigations in, for example:

- Psychoacoustic and music research
- Biology (animal sounds etc.)
- Phonetics research
- Anechoic and reverberation rooms

Introduction

The Sine Random Generator Type 1027 is a high accuracy, high stability, and low distortion signal source. In this compact, sophisticated instrument, a high degree of flexibility for connection to other B & K instruments and versatility in a wide range of applications are found.

Four types of output signal are available:

1. **White Noise,** which is used mainly for response measurements in connection with a constant bandwidth analyzer.

2. **Pink Noise,** which is used mainly for response measurements in connection with a constant percentage bandwidth analyzer.

3. **Narrow Band Random Noise,** which is used for direct response measurements to avoid the build-up of standing waves. It is also used where a sweeping random signal is considered a more relevant test signal than a sinusoidal signal, for example the Swedish "Statens Provningsanstalt" uses a 31,6 Hz bandwidth of random noise sweeping from 20 Hz to 20 kHz for loudspeaker testing. Six bandwidths are available with the 1027, from 3,16 to 1000 Hz.

4. **Sinusoidal Signal,** which is used for frequency response, distortion, and phase measurements, and for resonant frequency investigations.

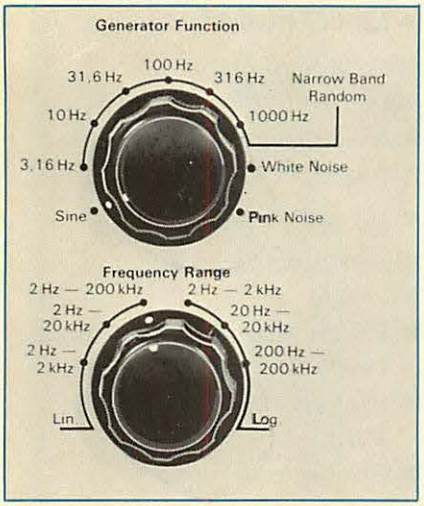


Fig.1. Generator Function and Frequency Range selectors

All four types of signal are available in the full frequency range from 2 Hz to 200 kHz. This makes the 1027 the widest band, noise generator in the B & K instrument programme. Narrower frequency ranges are switch selectable and the upper and lower frequency limits are continuously adjustable within the selected frequency range.

The frequency of the sinusoidal signal, and the centre frequency of the narrow band noise, can be varied over the instrument's full frequency range. Scanning of the frequency range can be made manually, or remotely via a mechanical drive or an electrical signal. Hence, the 1027 can be synchronized with a Level or X-Y Recorder to obtain a graphic representation of the measurement. The 1027 can be swept both linearly and logarithmically.

The frequency scale is supplemented by an accurate frequency counter with a six digit frequency display. This enables the generator to be tuned to an exact frequency within a fraction of a Hz.

The built-in compressor circuit maintains a constant level at the test object when the frequency is swept, even if the load varies. The compressor is of a special construction giving no regulation error for static frequency outputs, and it can be used in all output modes of the generator.

Type 1027 is equipped with an electronic voltmeter, which can monitor the output voltage, the compressor input voltage, or the amount of compression. Seven meter averaging times from 0,1 to 100 seconds are available. The voltmeter has also a separate input so that it can be used alone, independent of the function of the generator.

External filters can be connected to the Sine Random Generator in order to produce an output signal according to a desired weighting function. With a Band Pass Filter Type 1617 or 1618, for example, third-octave or octave bands of random noise can be obtained.

The 1027 can tune the Heterodyne Slave Filter Type 2020 and the Heterodyne Analyzer Type 2010 so that constant bandwidth analysis can be performed. Automatic harmonic analysis can be made if a Tracking Frequency Multiplier Type 1901 is used with the 2010 or 2020. A linear sweep is normally used for this type of measurement.

For production testing and inspection of amplifiers, record players, tape recorders, filters, loudspeakers and other electroacoustic devices, the 1027 can be connected to an Audio Frequency Response Tracer Type 4712 via a small Sweep Unit WB 0190.

Description

A simplified block diagram of the Sine Random Generator is shown in Fig.2. The instrument contains four main sections, namely a generator section, a compressor section, an output section, and a meter section.

GENERATOR SECTION

The various waveforms available with the 1027 are generated in the following ways: Both white and pink noise are produced in a noise generator. The narrow band random noise is made through modulation, in a beat frequency oscillator (BFO), of a filtered signal from the noise generator with a sine signal from a voltage controlled oscillator (VCO). The sinusoidal output signal is obtained by modulation of the signal from a fixed frequency oscillator with that of the VCO.

Fixed Frequency Oscillator

The crystal controlled fixed frequency oscillator is the master clock for the 1027, and all the various frequencies used in different parts of the instrument are derived from it via frequency converters.

One of these signals has a frequency of 1,2 MHz. When "Sine" is selected on the front panel, this signal is fed through the high frequency (HF) regulation amplifier to the BFO, where it is mixed with the VCO signal.

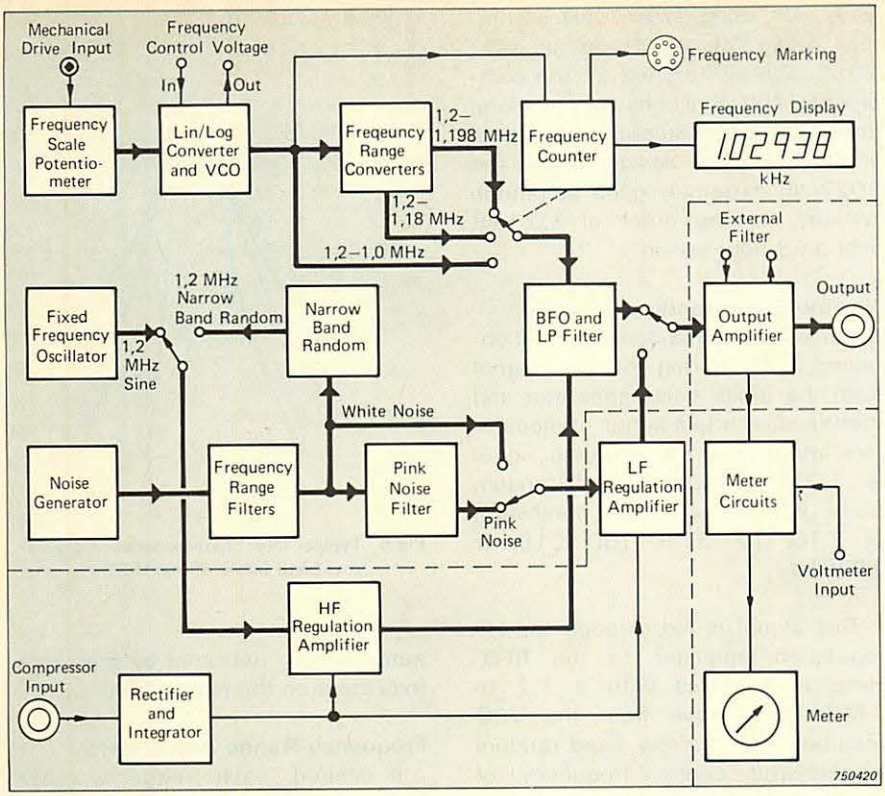


Fig.2. Simplified block diagram of the Sine Random Generator

Voltage Controlled Oscillator

The frequency of the VCO is controlled by a DC voltage, which is supplied either from a high precision, low noise, conductive plastic potentiometer connected to the shaft of the frequency scale dial or from an external source for remote control. The DC voltage is used to perform a linear sweep, while a logarithmic sweep is obtained by transforming the linear voltage ramp into a logarithmic characteristic in the built-in Lin-to-Log converter.

After modulation in the BFO, the VCO's frequency range of 1,2 Hz to 1 MHz corresponds to an output range of 0 Hz to 200 kHz. In order to cover the other available frequency ranges in the 1027, the VCO signal is fed to two frequency converters, each decreasing the range by one decade. In this way the same relative frequency stability is obtained in all ranges.

Sinusoidal Frequency Ranges

Mixing the 1,2 MHz signal from the fixed frequency oscillator with the 1,2 Hz to 1 MHz, the 1,2 Hz to 1,18 MHz, and the 1,2 Hz to 1,198 MHz signals from the VCO produces the three linear sinusoidal frequency ranges:

2 Hz to 2 kHz
2 Hz to 20 kHz
2 Hz to 200 kHz

and utilizing the built-in Lin-to-Log converter the three logarithmic ranges are produced:

2 Hz to 2 kHz
20 Hz to 20 kHz
200 Hz to 200 kHz

Each of these frequency ranges can be swept continuously.

Fig.3. Sweep Control selector

Sweep Control

The sweep control knob has two positions: "Manual and Ext. Mechanical" and "Ext. Voltage". In the first, a friction clutch permits both manual and external control. This is an advantage as it permits easy mechanical synchronization with a Level Recorder Type 2307. In the "Ext. Voltage" mode electrical sweep control using a Level Recorder Type 2307 or 2309, or an X-Y Recorder such as Type 2308 is possible. The sweep can be either linear or logarithmic.

The logarithmic sweep is normally used for frequency response measurements and in connection with constant percentage bandwidth filters, where it gives a uniform resolution.

A linear sweep is preferred for phase response measurements on loudspeakers as the slope gives information about time delays or group delay. The linear sweep is also used together with constant bandwidth filters, since it then gives equal separation and resolution of harmonically related components. This is often very useful for detecting the harmonic relationships. It also allows minimum analysis time when used with a constant bandwidth slave filter such as Type 2020 or the analyzer section in Type 2010.

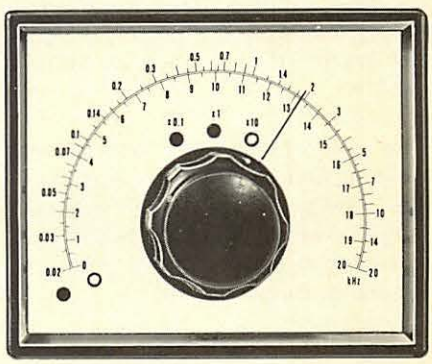


Fig.4. Main frequency scale

Main Frequency Scale

The black knob in the centre of the scale sets the generator to the frequency indicated by the scale. The outer scale is logarithmic while the inner is linear. Five indicator lamps show which scale is used as well as the appropriate multiplication factor to give the frequency in kHz. The lamps are controlled from the frequency range switch.

Frequency Increment Facility

The output frequency can be fine adjusted by the ten-turn "Frequency Increment" potentiometer. This enables a frequency deviation from the setting of the main frequency scale to be selected. Three lights in-

dicate whether the actual frequency is at, below, or above the frequency dial setting. The increment facility may also be used as a fine control to obtain an accurate frequency within a fraction of a Hz, the digital frequency read-out being used for frequency identification.

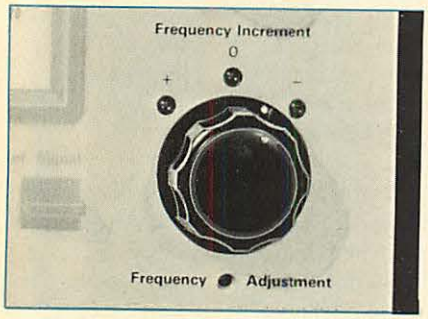


Fig.5. Frequency increment facility

White and Pink Noise

Wide Band Random Noise of very uniform spectral density is generated by two zener diodes with a DC potential applied to them. It has a true symmetrical Gaussian amplitude distribution up to 4,5 σ. The noise is amplified and fed through a 2 Hz high pass filter, giving a well defined lower limiting frequency for the noise. The filter has an 18 dB/octave roll-off below 2 Hz.

By selection of the appropriate combinations of low pass and high pass filters using the "Frequency Range" switch, five bandwidths of white noise (wide band random noise) may be generated:

2 Hz to 2 kHz
2 Hz to 20 kHz
2 Hz to 200 kHz
20 Hz to 20 kHz
200 Hz to 200 kHz

The filter characteristics all have an 18 dB/octave roll-off. With the selection of the various filter combinations, appropriate attenuation is introduced so that the output voltage is the same in all ranges.

By feeding the white noise signal through a —3 dB/octave filter, pink noise is generated covering the same five bandwidths as for the white noise.

The white or pink noise signal level is controlled by the low frequency (LF) regulation amplifier. With the compressor switched-in, the range of regulation is over 70 dB. When switched-off the compressor still functions with a long time constant regulating the signal amplitude. This design gives the 1027 an extremely good amplitude stability, of the order of ± 0,1 dB over an 8 hour period.

Narrow Band Random Noise

Narrow Band Random Noise is obtained via filtering of the signal from the white noise generator and then feeding it to a series of modulators and filters. The resulting signal is 1,2 MHz narrow band random noise with a selectable bandwidth of 3,16; 10; 31,6; 100; 316; or 1000 Hz.

This signal is fed through the HF regulation amplifier to the BFO. Here it is mixed with a 1,2 to 1 MHz sine wave from the VCO resulting in a narrow band random signal, the centre frequency of which can be varied from 2 Hz to 200 kHz. Other frequency ranges are available from the VCO (see Fig.2), and these are used to make the three linear ranges:

2 Hz to 2 kHz
2 Hz to 20 kHz
2 Hz to 200 kHz

and via the built-in Lin-to-Log converter the three logarithmic ranges are produced:

2 Hz to 2 kHz
20 Hz to 20 kHz
200 Hz to 200 kHz

The centre frequency is continuously variable within each range.

The technique of narrow band noise generation used in the 1027 gives extremely stable and well defined filter characteristics independent of the centre frequency. Typical filter characteristics are shown in Fig.6.

Noise Modes

In the white and pink noise modes, and in the narrow band random modes, an attenuation of 10 dB relative to the sinusoidal mode is introduced in the output stage. This ensures adequate crest factor capability in the output amplifier. The change in output voltage is automatically indicated by the range indicators on the meter scale.

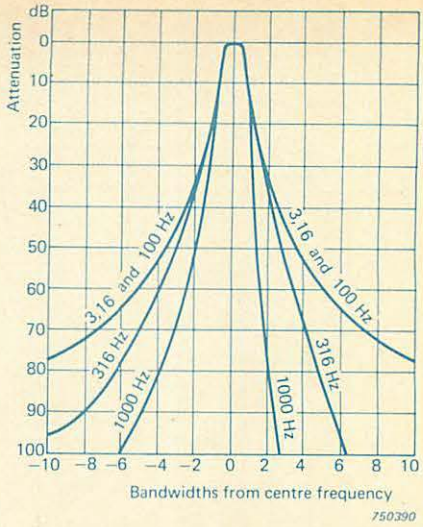


Fig.6. Typical filter characteristics of the narrow band filters of the 1027

Frequency Range Adjustment

If desired, each frequency range in the sinusoidal and narrow band random modes can be narrowed by means of a frequency comparator circuit. This is controlled separately for the high and low ends of the scale by rear panel, screwdriver-operated potentiometers.

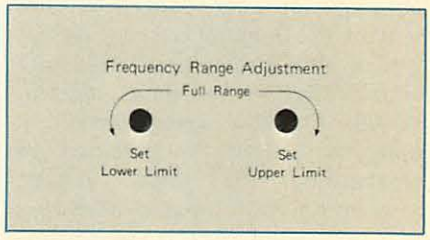


Fig.7. Frequency range adjustment facility on the rear panel

Digital Frequency Display

A counter circuit measures the frequency of the VCO signals, and the 6 digit frequency display is calibrated to read the output frequency of the generator. The counting time is selectable to be either 0,1 or 1 second, and the resolution in the various frequency ranges is:

Resolution of Frequency Display		
Frequency Range	Counting Time	
	0,1 s	1 s
2 kHz	0,1 Hz	0,01 Hz
20 kHz	1 Hz	0,1 Hz
200 kHz	10 Hz	1 Hz

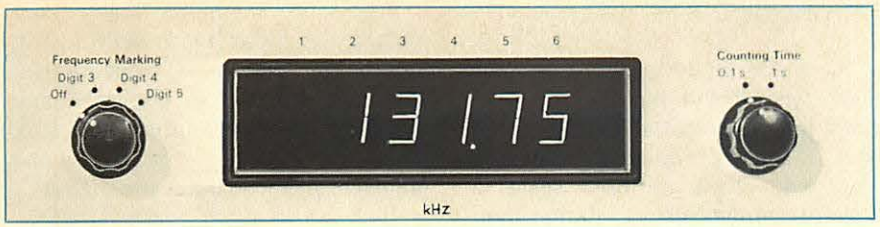


Fig.8. Digital frequency display and the frequency marking and counting time selectors

A special output from the counter is available for controlling the event marker on a connected level recorder. When uncalibrated chart paper is used with a linear sweep of the generator, for example, this facility ensures exact frequency calibration of the chart. The frequency marking is switchable to mark for shift of digit 3, 4, or 5 of the frequency display.

The digital frequency display is blacked out in the White and Pink Noise modes. In the Sine and Narrow Band Random modes it is blacked out when the frequency pointer is in the blank zone of the main frequency scale or outside the limits of the frequency range set by the Frequency Range Adjustment facility. If desired, it is possible to avoid the blacking out by simply inserting a jumper wire inside the instrument.

Reference Signal

A toggle switch with positions "On", "Off", and "On" with self return, can provide a reference signal at the output terminals independent of the generator frequency setting. The reference frequency is 100 Hz, 1 kHz, and 10 kHz in the ranges 2 kHz, 20 kHz, and 200 kHz respectively. This is useful when automatic recordings are being made, as it checks whether the Level Recorder will be inside the recording paper calibration at the middle frequencies where the highest amplitudes are most often found. It may also be used for easy recording of the reference signal preceding frequency recordings to be used in conjunction with the Response Test Unit Type 4416.

The signal waveform is sinusoidal and narrow band random noise in the respective modes, and the output level is controlled from the output section. On/Off switching of the reference signal can also be remotely controlled.

Generator On/Off

The generator output can be shut down with a toggle switch which has the positions "Off", "On", and "Off" with self return. It suppresses the output signal level more than 90 dB (60 dB in 30 ms), and it is very useful for reverberation time measurements, for example. The On/Off function can also be remotely controlled which enables reverberation decay curves to be automatically recorded on a level recorder.

COMPRESSOR SECTION

The output signal from the Sine Random Generator is regulated automatically by means of the built-in regulation (compressor) circuits. These are of a special construction giving no regulation error when dwelling at a single frequency. The compressor can be used with all the types of output signal available from the generator.

A low frequency (LF) regulation amplifier is used for the white and pink noise modes as these are filtered signals from the noise generator. The sine and narrow band random signals are results of high frequency modulation, and therefore a HF regulation amplifier is used in these modes as indicated in the block diagram in Fig.2.

Compressor On

The dynamic range of regulation is 90 dB in the sinusoidal mode and 70 dB in the random noise modes. There are six compressor speeds to choose from: 3, 10, 30, 100, 300, and 1000 dB/s. The amount of compression is continuously adjustable over a wide range and either the compressor input level or the amount of compression can be monitored on the built-in electronic voltmeter.

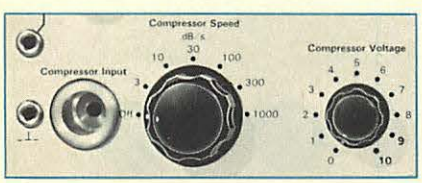


Fig.9. Compressor input and the compressor control knobs

Compressor Off

Even with the compressor switched off, the compressor circuit still regulates the signal amplitude which results in the extremely high amplitude stability of the 1027. A compressor speed of 1 dB/s is selected in the noise modes of the instrument and 500 dB/s in the sine mode. This high compressor speed does not result in low frequency distortion since the signal being processed in the sine mode is always 1,2 MHz.

OUTPUT SECTION

The Generator Function switch determines which of the four available signals is fed to the output amplifier.

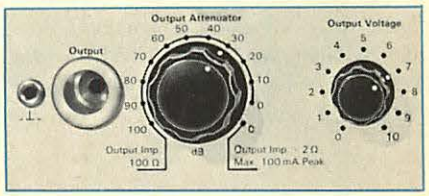


Fig.10. Generator output and the output control knobs

Output Attenuator

The output signal may be attenuated by up to 100 dB in accurate steps of 10 dB, and the level is continuously adjustable within each step. All attenuator positions have an output impedance of 100 Ω.

Direct Output

A direct output is also available from the output amplifier. It has an output impedance of less than 2 Ω and the output level is continuously variable. This output can provide a maximum power of 0,75 W into a 140 Ω load in the sinusoidal mode, 0,075 W in the random noise modes.

External Filter

An external filter can be inserted before the output and meter sections in order to produce an output signal according to a desired weighting function, for example third-oc-

tave or octave for building acoustic measurements (B & K Band Pass Filter Type 1617 or 1618).

Constant Level Output

The output level at the attenuator output or direct output varies considerably when controlled by the compressor section. These outputs are therefore not suited to provide control signals to connected instruments.

A constant level output socket is provided at the rear panel for this purpose. Independent of variations of the generator output voltage, this socket provides a constant sinusoidal output signal as the frequency is swept. It follows the frequency of the generator in sine mode, and the centre frequency of the noise band in narrow band random mode. The signal is also present in the wide band random modes even though the digital frequency display is blacked out. If it is desired to see the display in these modes, a jumper wire can be simply inserted inside the instrument.

The constant level output is well suited for controlling a Tracking Frequency Multiplier Type 1901 or the Digital Stroboscopes Type 4912 and 4913, for example.

METER SECTION

The meter circuitry is of the quasi RMS type giving the correct RMS value for sinusoidal and random signals. The precision meter is equipped with a mirrored scale to prevent parallax errors. Range indicator lamps on the meter are interconnected with the Meter Function, Output Attenuator, and Generator Function switches so that the appropriate range, corresponding to full scale deflection, is indicated directly. The meter has two voltage scales, a dB scale, and a compression scale (see Fig.11.).

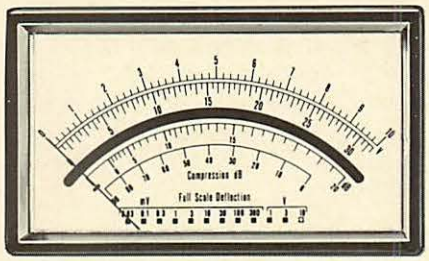


Fig.11. Meter scale

The meter section can be switched to measure four different signals:

1. Output

The meter indicates emf (electromotive force) when the Output Attenuator is in any of the attenuator positions, and output voltage when in position Direct.

With the Voltmeter Input connected directly to the output socket, the output voltage is measured instead of the emf in the attenuator positions of the Output Attenuator. This may be a help in discovering an excessive loading of the output.

2. Compressor Input

The meter indicates the compressor input voltage in three ranges with full scale deflection 1, 3 and 10 V respectively.

3. Compression

In this position the amount of compression is measured from 0 to 90 dB.

4. Voltmeter Input

The electronic voltmeter can be used separately, independent of the generator function.

There is a special voltmeter input with an input impedance of 146 kΩ in parallel with 100 pF, and there are three ranges with full scale deflection 1, 3, and 10 V respectively.

Meter Averaging Time

A wide range of meter averaging times is provided, namely 0,1; 0,3; 1; 3; 10; 30; and 100 seconds. The longer averaging times are especially useful with the narrower bandwidths of random noise.

Connection to External Equipment

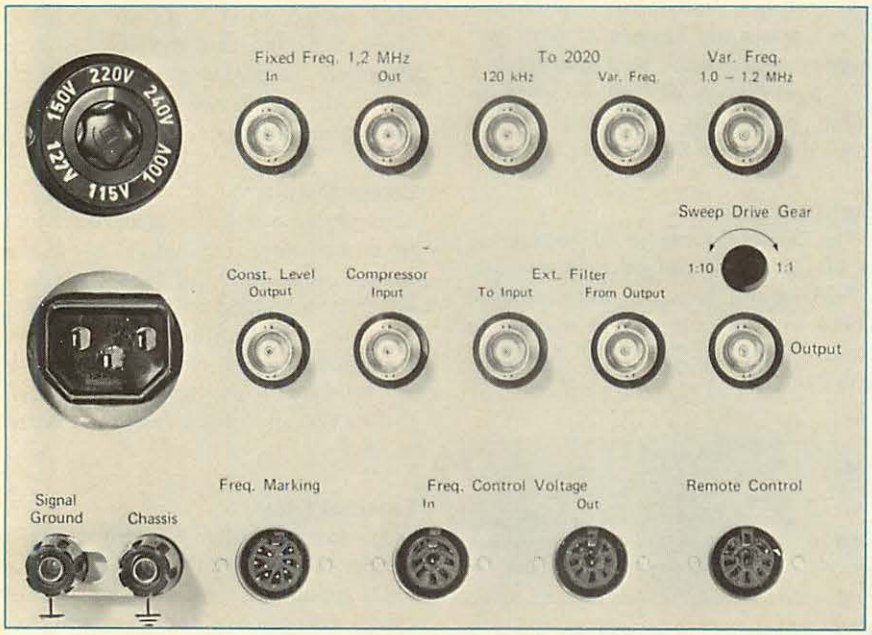


Fig.12. Detail of 1027 rear panel showing sockets for connection to external equipment

The Sine Random Generator has a high degree of flexibility for connection to other B & K instruments.

Signal Ground

The signal ground may be floating or connected to chassis. This is an important feature for avoiding ground loops in measuring set-ups.

Automatic Scanning

Automatic scanning of the 1027 frequency range can be performed using either an external mechanical or electrical source. Both linear and logarithmic sweeps can be achieved in this way.

A mechanical drive shaft socket is located on each side of the 1027. The Flexible Drive Shaft UB 0041, which is a standard accessory with the 1027, transmits the drive from

a Level Recorder Type 2307. The other drive socket may be connected to another B & K instrument to obtain frequency synchronization.

The built-in sweep drive gear with ratios 1:1 and 1:10 is used for externally driven mechanical sweeps. The gear is screwdriver selectable from the rear panel. For normal application the 1:1 ratio is used, but when very slow sweep speeds are required the 1:10 ratio ensures a smooth sweep.

Electrical control of the 1027 output frequency can be obtained from the Level Recorder Type 2307 or 2309, or from the ramp generator of the X-Y Recorder Type 2308.

Alternatively an output voltage proportional to frequency from the 1027 may control the paper throw of the 2307 or the horizontal X deflection of the 2308. This voltage is always available independent of the sweep method being used.

Tuning the Heterodyne Slave Filter Type 2020

High frequency outputs are provided for controlling the frequency tuning of this filter in synchronism with the 1027 output frequency. The control signals are present in all output modes, but the digital frequency display will be blacked out in the wide band random modes unless a jumper wire is inserted inside the instrument. The tuning signals are only provided in the 2 kHz and 20 kHz frequency ranges of the 1027.

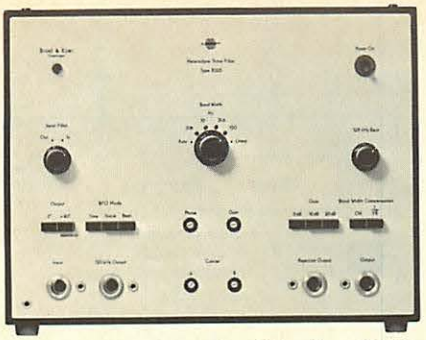


Fig.13. Heterodyne Slave Filter Type 2020

Tuning the Heterodyne Analyzer Type 2010

High frequency input and output are also provided for controlling the frequency of the analyzer section of the 2010 in synchronism with the 1027 output frequency. These signals are available in all modes and in all frequency ranges. The remark on the digital frequency display is the same as with the 2020.

Fig.14. Heterodyne Analyzer Type 2010

Operation with Frequency Response Tracer Type 4712

The Tracer can be used for automatic frequency response plotting together with the 1027. Instead of the motor control used with earlier B & K generators, the 4712/1027 synchronization is obtained via a Sweep Unit WB 0190, which must be ordered separately. The 4712 contains all the controls necessary for automatically starting, stopping, and reversing the sweep so that any part of the frequency range 20 Hz to 20 kHz can be scanned continuously and repeatedly with sweep speeds variable over a wide range.

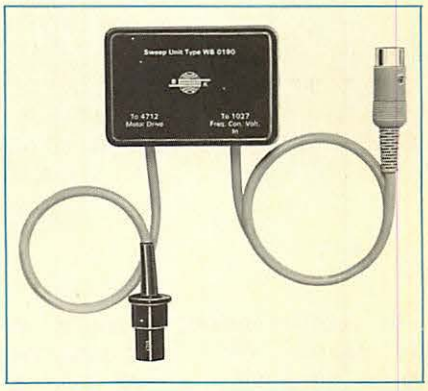


Fig.15. Sweep Unit WB 0190

Examples of Use

Due to its high performance capability and flexibility of operation with other B & K instruments, the Sine Random Generator Type 1027 can be used for an unusually wide range of applications.

Primarily, the 1027 is designed as a high quality, low distortion, electro-acoustical generator with a very wide frequency range. Thus it will find application in acoustical and electrical frequency response, phase response, distortion and directivity measurements using either a sine or a noise signal. In addition, it will find application in various building acoustic measurements, such as the measurement of sound distribution, sound insulation, sound absorption, and reverberation time.

With the greatly expanded capabilities of the instrument, however, several new application areas arise. The high frequency capability of the instrument makes it ideal for model acoustics and hydrophone investigations. In addition, the wide frequency range of the random noise signal makes it useful in noise and vibration simulation. In this area, the external filter capability is of special importance, as any desired shaping of the frequency response can be made.

Fig.16 indicates some practical measuring set-ups using the 1027 as the high precision signal generator.

If the object to be investigated is a Hi-Fi amplifier, for example, the 1027 output signal is fed directly to the object. Loudspeakers, projectors (underwater loudspeakers) and vibration exciters require the use of a power amplifier, as the 1027 has a limited power output capability.

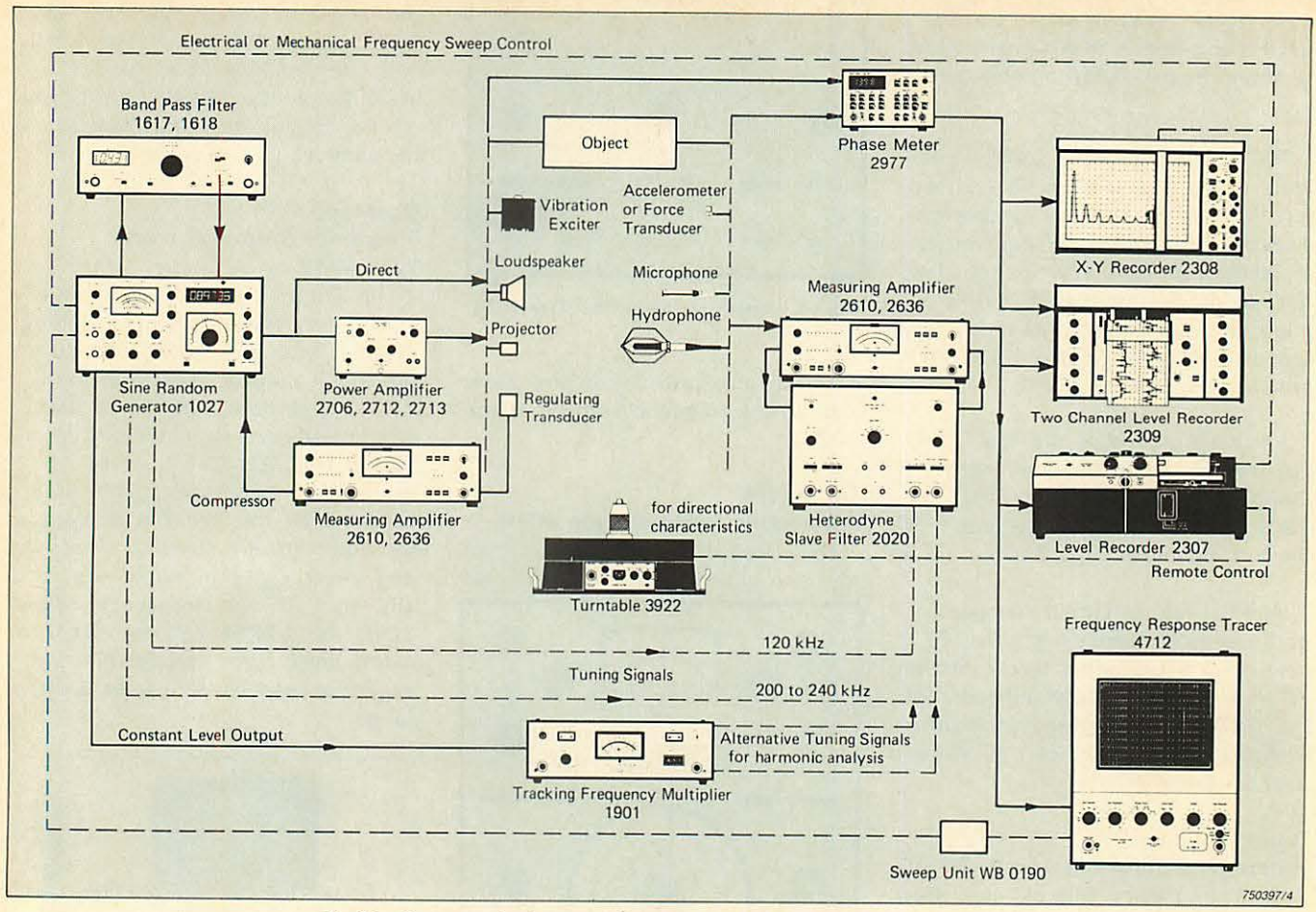


Fig.16. Some practical measuring set-ups for a wide range of applications

To obtain compressor control of the signal level, a transducer senses the level and feeds back a regulating signal through a measuring amplifier to the compressor section of the 1027. In this way the level at the regulating transducer position is kept constant when the frequency is swept.

The 1027 provides the necessary high frequency signals for tuning the Heterodyne Slave Filter Type 2020 over the frequency range 10 Hz to 20 kHz. These tuning signals are provided in all modes of operation, including the pink and white noise modes, so that the 1027 may be used simultaneously as a white or pink noise generator and the tuning master for the 2020. The analyzer section in the Heterodyne Analyzer Type 2010 also can be tuned from the 1027, and the tuning range for this combination is very wide; from 2 Hz to 200 kHz.

With the input of the Tracking Frequency Multiplier Type 1901 connected to the constant level output of the 1027, the 2020 can be tuned to submultiples and multiples of the 1027 output frequency. Hence, it is possible to make automatic subharmonic and harmonic analysis from 0,1 × f to 99,9 × f, where f is the 1027 output frequency. The 2010 can also be tuned in this way and then harmonic analysis can be made from 1 × f to 999 × f.

The phase characteristic of the object can be measured with the Phase Meter Type 2927. The frequency range capability is from 2 Hz to 200 kHz, and this range can be swept continuously with a linear sweep of the 1027.

Frequency response curves, distortion contours, phase characteristics, etc. can be recorded on a Level Recorder Type 2307 or 2309, or X-Y Recorder Type 2308. The frequency synchronization between the 1027 and the preprinted chart in the recorder is obtained via an electrical or mechanical sweep control connection. For recording of directional characteristics the Level Recorder Type 2307 can be employed and the test object mounted on a Turntable Type 3922. The rotation of the object is then synchronized exactly with the polar chart paper of the recorder.

The result of the analysis can also be seen on a Frequency Response Tracer Type 4712. With the Sweep Unit WB 0190 connected between the 1027 and the 4712, frequency response curves can be traced automatically on the screen. Production limits can be drawn on the interchangeable scale in front of the screen enabling fast, accurate production testing to be performed.

Specifications 1027

GENERATOR SECTION

Output Waveform: (switchable)
1. Sinusoidal
2. Narrow Band Random Noise
3. White Noise (wide band random noise)
4. Pink Noise (wide band random noise —3 dB/oct.)

Output Amplitude Stability (all modes):
Typically ± 0,1 dB from 15 to 35°C (59 to 95°F) over an 8 hour period

SINUSOIDAL AND NARROW BAND RANDOM NOISE

Frequency Ranges:
3 linear ranges:
2 Hz to 2 kHz
2 Hz to 20 kHz
2 Hz to 200 kHz

3 logarithmic ranges:
2 Hz to 2 kHz
20 Hz to 20 kHz
200 Hz to 200 kHz

Amplitude Linearity:
± 0,2 dB re 1 kHz, 2 Hz to 200 kHz

Harmonic Distortion (Each harmonic):
Range 2 kHz (× 0,1):
< 0,015% (20 Hz to 2 kHz)
< 0,03% (2 Hz to 20 Hz)

Range 20 kHz (× 1):
< 0,015% (20 Hz to 20 kHz)

Range 200 kHz (× 10):
< 0,015% (200 Hz to 50 kHz)
< 0,03% (50 kHz to 100 kHz)

Frequency Counter:
6-digit, 7-segment display
Accuracy: ± 1 on last digit + 20 ppm of tuning frequency
Counting Time: 0,1 s and 1 s, switch selectable

Frequency Scale:
Linear and logaritmic scales
Lamp indication of selected lin or log ranges (5 lamps)

External Frequency Control:
Sensitivity of VCO with external voltage control:
Full Scale Sweep: 0 to 10 V DC
Lin Scale × 0,1: 0,2 kHz/V
Lin Scale × 1: 2 kHz/V
Lin Scale × 10: 20 kHz/V
Log Scales: 0,3 decade/V corresponding to 1 octave/V

Sensitivity of VCO with external mechanical drive:
Full Scale Sweep: 30 rotations with built-in sweep drive gear in 1:1, 300 rotations in 1:10

Frequency Accuracy:
Lin Ranges: 0,3% of frequency range
Log Ranges: 3% of reading + 25 ppm of frequency range

Voltage to Frequency Conversion:
Linearity 0,03% of scale range (lin scale)

Frequency Increment Range:
Lin Ranges: ± 1% of frequency range
Log Ranges: ± 7% of frequency reading or 0,1 octave

Frequency Marker:
Output for controlling event marker on Level Recorder for exact chart calibration. Switchable to mark for shift of digit 3, 4 or 5

Frequency Stability of BFO:
Measured over 8 hours after 1 hour warm-up time

Low end of scale			
Scale	2 Hz	20 Hz	200 Hz
Lin	0,15 Hz	1,5 Hz	15 Hz
Log	0,15 Hz	1,5 Hz	15 Hz
High end of scale			
Scale	2 kHz	20 kHz	200 kHz
Lin	1 Hz	10 Hz	100 Hz
Log	4 Hz	40 Hz	400 Hz

SINUSOIDAL MODE

Attenuator Output:
Output Voltage: 100 μV to 10 V, variable in 10 dB steps, continuously variable within each step. Accuracy of steps ± 0,1 dB re 0 dB position (10 V)
Output Impedance: 100 Ω in all attenuator positions

Direct Output (direct coupled):
DC Offset: < ± 50 mV
Output Voltage: 0 to 10 V continuously variable
Max. Output Current: 100 mA peak
Output Impedance: < 2 Ω
Max. Output Power: 0,75 W into 140 Ω load
Min. Load Impedance at FSD: 140 Ω

Inherent Noise:
< 70 dB

Hum and Spurious Signals:
< 80 dB

NARROW BAND RANDOM NOISE MODE

Bandwidths (effective noise bandwidths):
3,16; 10; 31,6; 100; 316; 1000 Hz

Filter Type:
3 pole Butterworth

Distribution:
Symmetrical Gaussian amplitude distribution up to 4,5 σ

Attenuator Output:
Output Voltage: 30 μV to 3 V, variable in 10 dB steps, continuously variable within each step. Accuracy of steps: ± 0,1 dB re 0 dB position (3 V)
Output Impedance: 100 Ω in all attenuator positions

Direct Output (Direct coupled):
DC Offset: < ± 50 mV
Output Voltage: 0 to 3 V continuously variable
Max. Output Current: 100 mA peak
Output Impedance: < 2 Ω
Max. Output Power: 75 mW into 140 Ω load
Min. Load Impedance at FSD: 140 Ω

Inherent Noise:
< 60 dB

Hum and Spurious Signals:
< 70 dB

WHITE AND PINK NOISE MODES

Frequency Ranges: (switchable)
2 Hz to 2 kHz
2 Hz to 20 kHz
2 Hz to 200 kHz
20 Hz to 20 kHz
200 Hz to 200 kHz
18 dB/oct. roll-off outside these frequencies

Distribution:
Symmetrical Gaussian amplitude distribution up to 4,5 σ

Frequency Response:
White Noise:
± 1 dB, 20 Hz to 200 kHz
± 2 dB, 2 Hz to 20 Hz
Pink Noise:
± 1,5 dB, 20 Hz to 200 kHz
± 2,5 dB, 2 Hz to 20 Hz

Attenuator Output:
As for Narrow Band Random Noise

Direct Output:
As for Narrow Band Random Noise

GENERAL

Frequency Range Adjustment:
Upper and lower frequency limit adjustable by rear panel screwdriver-operated potentiometers

Reference Signal:
Three position toggle switch, "On", "Off", and "On" with self return. Independent of generator frequency setting, the reference frequency is:
100 Hz in 2 kHz ranges
1 kHz in 20 kHz ranges
10 kHz in 200 kHz ranges
Accuracy: ± 2%
May be remotely controlled
Output level is controlled by "Output Attenuator" and "Output Voltage" knobs
Signal waveform is sinusoidal or narrow band random in the respective modes

Generator On/Off:
Three position toggle switch, "Off", "On", and "Off" with self return. Suppresses the output signal 60 dB in 30 ms. May be remotely controlled

METER SECTION

Meter Function:
Meter can be switched to read four different signals:

1. Output:
Indicates EMF (electromotive force) in attenuator positions and output voltage in position "Direct"

2. Compressor Input:
Three ranges, full scale deflection 1; 3; 10 V

3. Compression:
Indicates 0 to 90 dB compression
Accuracy ± 5 dB within compressor dynamic range (see under COMPRESSOR SECTION)

4. Voltmeter Input:
Separate input,
Input impedance 146 kΩ//100 pF
Three ranges, full scale deflection 1; 3; 10 V

Meter Scales:
Voltage Scales: linear 0 to 10 and 0 to 31,5
dB Scale: 0 to 20 dB
Range settings displayed on meter scale
Compression Scale: 0 to 90 dB

Rectifier:
Quasi RMS, gives true RMS value for sine and random signals

Averaging Times:
0,1; 0,3; 1; 3; 10; 30; 100 s

Accuracy of Meter Rectifier + Meter:
1% of scale reading + 1% of full scale deflection

COMPRESSOR SECTION

Amplitude Linearity:
± 0,2 dB re 1 kHz, 2 Hz to 200 kHz

Compressor Input Voltage:
Min. 0,5 V RMS

Input Impedance:
25 kΩ//100 pF

Compressor Speed:
3; 10; 30; 100; 300; 1000 dB/s

Dynamic Range:
Sinusoidal Mode: 90 dB
Random Noise Modes: 70 dB

Compressor Rectifier:
Average

Regulation Characteristic:
0 dB static error

CONNECTION TO EXTERNAL EQUIPMENT

Frequency Control Voltage IN:
Sensitivity: see under GENERATOR SECTION, "External Frequency Control"
Input Impedance: > 10 MΩ
Max. Input Current: 0,25 μA
Input Voltage: Min. −10 V, max. + 15 V
Voltages Available: + 15,4 V and −1,35 V (max. current 10 mA) for Level Recorder Types 2307 and 2309

Frequency Control Voltage Out:
Voltage follows frequency control voltage ± 1 mV whether supplied internally or externally
Output Impedance: < 1 Ω
Minimum Load Impedance: 10 kΩ

Fixed Frequency:
"In": 0,13 to 1 V peak-to-peak 1,2 MHz sine wave, input impedance 130 pF
"Out": 1,2 MHz triangular wave
0,3 to 1,5 V peak-to-peak
Min Load impedance 5 kΩ//500 pF

Variable Frequency:
1,0 to 1,2 MHz sine wave
1,5 to 3 V peak-to-peak
Min. load impedance 5 kΩ//500 pF

To 2020:
Control signals for Heterodyne Slave Filter Type 2020, present in 2 kHz and 20 kHz ranges, and in all output modes
Fixed Frequency: 120 kHz sine wave
1 to 4 V peak-to-peak
Min. load impedance 5 kΩ//500 pF
Variable Frequency: 200 to 240 kHz triangular wave
0,3 to 1,5 V peak-to-peak
Min. load impedance 5 kΩ//500 pF

Remote Control:
"Generator On/Off" and "Reference Signal" may be remotely controlled

Signal Ground:
May be floating or connected to chassis. Detachable bar connection on rear panel

External Filter:
"To Input":
Output Impedance: < 10 Ω
Min. Load Impedance: 5 kΩ//2 nF in sine and narrow band random modes, 500 Ω//2 nF in white and pink noise modes
Output Voltage: 450 mV RMS sine 140 mV RMS narrow band noise 1 V RMS white and pink noise
"From Output":
Input Impedance: 150 kΩ//100 pF
Max. Input Voltage: 15 V peak

Constant Level Output:
0,5 to 1 V RMS sine wave following the frequency of the generator (follows centre frequency in narrow band random mode). Also operative in white and pink noise modes
Min. Load Impedance: 5 kΩ// 2 nF

GENERAL

Warm-up Time:
Approx. 15 s

Electromagnetic Compatibility
Complies with Class B computing device of American FCC (Federal Communication Commission) Rules

Operating Temperature:
5 to 40°C (41 to 104°F)

Storage Temperature
−25°C to +70°C (−13°F to +150°F)

Humidity:
0 to 90% RH at 30°C, non-condensing

Power Supply:
100, 115, 127, 220, 240 V
(± 10%), 50 to 400 Hz, 50 VA
Complies with safety class I of IEC 348

Cabinet:
Supplied as model A (light-weight metal cabinet), B (model A in mahogany cabinet), or C (as A but with flanges for standard 19" racks)

Dimensions (model A):
(Excluding feet, knobs, etc.)
Height: 222 mm (8,7 in)
Width: 430 mm (16,9 in)
Depth: 200 mm (7,9 in)

Weight (model A):
11 kg (24 lb)

Accessories Includes:
1 Coaxial Connection Cable..... AO 0013
1 Coaxial Connection Cable ..... AO 0127
1 Control Cable ..... AQ 0035
1 B & K Coaxial Plug..... JP 0101
2 BNC Coaxial Plugs ..... JP 0035
1 7-pin DIN Plug ..... JP 0703
2 8-pin DIN Plugs..... JP 0802
2 Banana Plugs..... JP 0002
1 Flexible Shaft..... UB 0041
1 Power Cable..... AN 0010
1 630 mA fuse..... VF 0032
1 315 mA fuse..... VF 0042

Accessories Available
Sweep Unit WB 0190 (for use with Frequency Response Tracer Type 4712)
Frequency Control Cable AQ 0034 (for use with Level Recorder Type 2307 and X-Y Recorder Type 2308)