MFG-2000 Series
Multi-Channel Function Generator

FEATURES

- Maximum Five Output Channels
  - 2 Equivalent Performance Arbitrary Channels Frequency: 1μHz–10/20/30/60MHz
  - RF Channel Frequency (FG/ARB/MOD): 160/320MHz
  - Pulse Generator Frequency: 25MHz
  - Power Amplifier: Low Frequency, 100kHz, Output 20W
- True Point by Point Output Arbitrary Waveform Function: 200MSa/s, 100MHz Repetition Rate, 14-bit Resolution, 16k Points Memory Depth
- Earth Ground Isolation Design among I/O Terminals and Instrument Chassis
- Frequency Counter: 150MHz, 8 bits
- AM/FM/PM/ASK/FSK/PSK/SUM/PWM Modulation
- USB Host/USB Device/LAN (MFG-22XX only)
- 4.3 Inch TFT Color Display
GW Instek rolls out the MFG-2000 series multi-channel function generator, which has up to 5 simultaneous output channels, including CH1 and CH2 equivalent performance dual channel arbitrary function generator with the maximum 60MHz for both channels; RF signal generator, a standard AFG, which produces the maximum 320MHz sine wave and various modulation RF signals; pulse generator, whose frequency reaches 25MHz; power amplifier, which is ideal for audio range. The above-mentioned five different functionality channels are separately or totally allocated on 10 models, which extend from the basic single-channel AFG with pulse generator models to five-channel models so as to satisfy various educational and industrial applications.

The AFG channel of the MFG-2000 series outputs sine, square, and triangle, etc. The series features true point by point output arbitrary waveform characteristics of 200 MHz sample rate, 100MHz waveform repetition rate, 14-bit resolution, and 16k points memory depth. Some models provide various modulation methods such as AM/FM/PM/FSK/PWM, Sweep, Burst, Trigger, 150MHz Frequency Counter. Synchronized dual channel models provide correlated functions, including synchronization, delay, sum, and coupling. RF signal generator, a complete AFG signal source (including ARB), features various modulations, Sweep, and digital modulations such as ASK and PSK and its sine wave frequency is up to 320MHz. A full-function pulse generator with 25 MHz is equipped to all models and its pulse width, rise edge time, fall edge time are adjustable that can be applied as trigger signals. Independent input/output power amplifier with 20W, 10dB, DC-100KHz bandwidth, and distortion less than 0.1% can be applied to the audio application.

The overall design of the MFG-2000 series is earth ground isolation among output/input terminals and instrument chassis that can only be found in high-level signal sources. The output channels can sustain maximum isolation voltage up to ±42Vpk (DC+ AC peak value) to earth ground that is ideal for floating circuit tests. Multi-unit outputs can be executed without factoring in grounding reference issue. There is no additional isolation requirement for experiments such as “full-wave rectification” and “voltage doubler” which are easy and safe. An external power supply can bring up the DC bias voltage to ±42Vpk to meet the requirements of higher DC bias voltage such as automotive and educational applications.

The AFG of the MFG-2000 series collocating with AWES (Arbitrary Waveform Editing Software) allows users to easily and quickly edit arbitrary waveforms. DWR (Direct Waveform Reconstruction) allows users to collocate with GDS series digital oscilloscopes to retrieve waveforms and upload them to arbitrary generator to achieve direct waveform reconstruction. 66 built-in waveforms allow users to edit arbitrary waveforms and to output the whole segment or divided segments.

With the multi-functionality channels, the MFG-2000 series provides different industrial sectors with special dual channel waveforms, IQ modulation signals, low-frequency vibration simulation, automotive sensors, AM/FM broadcast signals, PWM motor or fan control signals, pulse synchronized signals, pulse noise, audio circuit or devices such as speaker tests. The series is ideal for various fields, including scientific research, education, research and development, production and quality control. The MFG-2000 series can maximally and simultaneously output five functional channels. The functionalities of each channel are as follows:

### PANEL INTRODUCTION

1. TFT LCD Panel
2. Number Panel
3. Scroll Knob & Selection Key
4. Power switch
5. Output Terminal
6. Main Output Switch
7. Function Keys
8. Operation Keys
9. USB Host
10. Trigger & Modulation Input
11. Sync and Counter Input
12. Fan
13. Power Amplifier Input & Output
14. LAN (MFG-22XX only)
15. USB Device
A. CIRCUIT DESIGN FOR GROUND ISOLATION AMONG OUTPUT/INPUT TERMINALS AND INSTRUMENT CHASSIS

Output channels, synchronization and modulation input/output connector grounding are isolated from instrument chassis. These connectors can sustain maximum isolation voltage up to ±42Vpk (DC+ AC peak value) to earth ground that is ideal for floating circuit tests. Multi-unit outputs can be executed without factoring in grounding reference issue.

The built-in DC bias voltage of the MFG-2000 series can be applied on various waveforms. The DC bias voltage is ±5V under 50 ohm load. An external power supply can be used to bring up the DC bias voltage to ±42Vpk (DC+ AC peak value) for higher DC bias applications.

B. PULSE GENERATOR

Each model of the series has a built-in pulse generator and its output frequency reaches 25 MHz. Users can set pulse width, duty cycle, rise edge time, and fall edge time to support trigger signal.

C. RF SIGNAL GENERATOR

RF signal generator is a full function AFG signal source. Identical to CH1/CH2, it can output sine, square, ramp, pulse, noise, etc. Its sine wave frequency reaches 160MHz or 320MHz. And its true point by point output arbitrary waveform function supports 200 MHz sample rate, 100MHz waveform repetition rate, 14 bit resolution, 16k point memory depth, frequency sweep and various modulation methods such as AM/FM/PM/FSK/PWM/PSK/ASK.

RF signal generator can be applied as a high frequency arbitrary waveform generator, simulated signals of analog or digital broadcast stations or carrier signals of local oscillator.

D. POWER AMPLIFIER

20W/20dB power amplifier, which has a bandwidth of DC – 100KHz and less than 0.1% distortion. The low frequency power amplifier can be applied as an audio amplifier or a driver amplifier for piezoelectric components (collocating with an impedance transformer, 20W output) and conducts power component characteristics tests, magnetization characteristics tests(B-H curve) of magnetic materials such as ferrite and amorphous materials (collocating with an impedance transformer, 20W output).

Users can connect a speaker with the low frequency power amplifier of the MFG-2000 series to realize various physics experiments.
E. **VERSATILE OUTPUT WAVEFORM SELECTIONS**

There are standard waveforms for the series such as sine, square, triangle, ramp, pulse, noise, DC voltage. In addition, 66 built-in waveforms allow users to easily select desired waveforms.

F. **VARIOUS MODULATION FUNCTION**

The series supports AM, FM, PM, FSK, PWM and SUM modulation. RF channel not only has the above-mentioned modulation capabilities but also supports advanced modulations such as ASK and PSK Modulation. The most modulation sources can be internal or external. Applications include communications systems’ base band, motor control and light adjustment.

G. **SWEEP FUNCTION**

The series supports frequency sweep and amplitude sweep that can also integrate other functions, including linear/logarithm, one-way (saw tooth)/two-way (triangle) waveforms, continuous/single trigger/gated trigger to meet various application requirements by different sweep methods. Frequency sweep carries out tests on the frequency response of electronic components such as filter and low frequency amplifier.

H. **BURST FUNCTION**

The series supports N-period or gated trigger. Phase angle, duration time, frequency, waveform infinite can be adjusted to meet non-continuous output applications.
J. FOUR METHODS TO OBTAIN ARBITRARY WAVEFORMS

Front Panel Operation
Via single unit’s panel, arbitrary waveforms can be selected, edited, stored, recalled, output, triggered from 66 built-in waveforms.

CSV File Upload
Support CSV file upload produced by MATLAB and Excel.

Direct Waveform Reconstruction
Collocate with GDS series digital oscilloscopes to retrieve waveforms and upload them to arbitrary generator to achieve direct waveform reconstruction.

Arbitrary Waveform Editing PC Software
Use AWES to edit complex waveforms. The software supports waveform mathematical operation. The waveform series includes Uniform Noise, Gaussian Noise, Rayleigh Noise, various digital codes such as non zero code, Manchester and RS-232, etc.

K. FLEXIBLE ARBITRARY EDITING

Other Brand’s ARB Operation
The Operation Mode Of “user-defined Retrieval Of Segmented Output” Increases Arbitrary Efficiency!

GW Instek ARB Operation
User only want to output this segment.
## SPECIFICATIONS

<table>
<thead>
<tr>
<th>MFG-2110</th>
<th>CH1 (Function With ARB)</th>
<th>CH2 (Function With ARB)</th>
<th>25MHz Pulse Generator</th>
<th>RF Generator (Function With ARB)</th>
<th>Power Amplifier</th>
<th>Modulation/Sweep/ Burst/Frequency Counter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>● 10MHz</td>
<td>●</td>
<td></td>
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<tr>
<td>MFG-2120</td>
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<td>MFG-2160MF</td>
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<td>160MHz</td>
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<tr>
<td>MFG-2160MR</td>
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<td>MFG-2260MF</td>
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<tr>
<td>MFG-2260MRA</td>
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<td>320MHz</td>
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</table>

### CH1/CH2

#### WAVEFORMS

| Standard | Sine, Square, Ramp, Pulse, Noise
| Arb Function | Built-in
| Sample Rate | 200 MSa/s
| Repetition Rate | 100MHz
| Waveform Length | 16k points
| Amplitude Resolution | 14 bits
| Non-volatile Memory | 10sets
| User-defined Output Markers | 16K points
| User-defined Output Section | From point 2 ~ 16384 (user-defined)
| Output Mode | From point 2 ~ 16384 (user-defined)
| Output Mode | 1~1048576 cycles or infinite mode

#### FREQUENCY CHARACTERISTICS

| Range | Sine 60MHz (max)
| Square 25MHz (max)
| Triangle, Ramp 1MHz
| Accuracy Stability | ±20 ppm
| Aging Tolerance | ±1 ppm, per 1 year
| Tolerance | <1 μHz

#### OUTPUT CHARACTERISTICS (2)

| Amplitude Range | 1 mVpp to 10 Vpp (into 50Ω)
| 2mVpp to 20 Vpp (open-circuit)
| Resolution | ±2% of setting ±1 mVpp
| Flatness | ±0.1 dB at 1 kHz
| Units | ±10% of setting ±160MHz
| ±30% of setting ±320MHz
| (sinewave relative to 1 kHz into 50Ω)
| Impedance | ±5 Vpk AC + DC (into 50Ω)
| ±10 Vpk AC + DC (open circuit)
| Protection | TTL-compatible into >1kΩ
| Ground isolation | Short-circuit protected;
| Overload relay automatically disables main output
| 42Vpk max.

### OFFSET

| Range | ±3 Vpk AC + DC (into 50Ω)
| ±10 Vpk AC + DC (open circuit)
| Accuracy | ±1% of setting ±5 mV + 0.5% of amplitude

### WAVEFORM OUTPUT

| Impedance | 50Ω typical (fixed); >10MΩ (output disabled)
| Protection | Overload relay automatically disables main output
| Ground isolation | Short-circuit protected;
| Overload relay automatically disables main output

### SYNC OUTPUT

| Range | TTL-compatible into >1kΩ
| Impedance | 42Vpk max.

### SINE WAVE CHARACTERISTICS (3)

| Harmonic Distortion | –60 dBc DC ~ 20kHz, Ampl > 0.1 Vpp
| –55 dBc 200kHz ~ 1 MHz, Ampl > 0.1 Vpp
| –45 dBc 1MHz ~ 10 MHz, Ampl > 0.1 Vpp
| Total Harmonic Distortion | –20ppm + 200ps
| Units | ±0.1% (Ampl>1Vpp) DC ~ 100 kHz

### SQUARE WAVE CHARACTERISTICS

| Rise/Fall Time | <35ns
| Overshoot | <5%
| Asymmetry | 1% of period ± 5 ns
| Variable duty Cycle | 0.01% to 99.99% (limited by the current frequency setting)
| Jitter | 20ppm +500ps

### RAMP CHARACTERISTICS

| Linearly | < 0.1% of peak output
| Tolerance | 0% ~ 100%

### PULSE CHARACTERISTICS

| Frequency | 1μHz ~ 25MHz
| Pulse Width | ≤20ns (limited by the current frequency setting)
| Variable duty Cycle | 0.01% ~ 99.99% (limited by the current frequency setting)
| Overshoot | <5%
| Jitter | 20ppm +500ps

### PULSE GENERATOR

| Amplitude | 1mVpp ~ 2.5 Vpp (into 50Ω)
| Offset | 2mVpp ~ 5 Vpp (open-circuit)
| Frequency | ±1 Vpk AC + DC (into 50Ω)
| Pulse Width | ±2Vpk AC + DC (open circuit)
| Leading and Trailing Edge Time | 1μHz ~ 25MHz
| Voltage | 20ns ~ 999.9ks (limited by the current frequency setting)
| Variable duty Cycle | 0.01% ~ 99.99% (limited by the current frequency setting)
| Overshoot | 10ns ~ 205ns resolution (limited by the current frequency and pulse width settings)
| Jitter | <5%
| 100ppm +500ps

### MODULATION/SWEEP/BURST FREQUENCY COUNTER

| Power Amplifier |
| Modulation/Sweep/Burst/Frequency Counter |
### SPECIFICATIONS

#### RF GENERATOR

**Waveforms**
- Sine, Square, Ramp, Pulse, Noise, ARB
- Modulating Waveforms: Sine, Square, Triangle, Ramp, Pulse

**AM MODULATION**
- Frequency: 5Hz ~ 100kHz

**FM MODULATION**
- Frequency: 1~1000000 Cycles or infinite

**PM**
- Frequency: 1~1000000 Cycles or infinite

**SUM**
- Frequency: 1~1000000 Cycles or infinite

**PWM**
- Frequency: 1~1000000 Cycles or infinite

**FSK**
- Frequency: 1~1000000 Cycles or infinite

**SWEEP**
- Frequency: 1~1000000 Cycles or infinite

**BURST**
- Frequency: 1~1000000 Cycles or infinite

#### MODULATION/SWEEP

**Modulation Type**
- AM, FM, PM, FSK, PWM (The detail same as CH1 modulation specification)

**Sweep Type**
- INT/EXT (INT only for AM, FM, PM, PWM)

**PSK**
- Carrier Waveforms
- Modulating Waveforms
- Phase Range

**ASK**
- Carrier Waveforms
- Modulating Waveforms
- Source

**ARB function**
- Sample Rate
- Waveform Length
- User-defined output section
- Jitter

#### POWER AMPLIFIER

**Input Impedance**
- 10kΩ

**Input Voltage**
- 1.23Vpmax

**Gain**
- Constant Voltage: 20dB

**Output Power (RL=8Ω)**
- 20W (Square)

**Output Voltage**
- 12.5Vpmax

**Output Current**
- 1.6Amax

**Rise/Fall Time**
- <2.5μS

**Full Power Bandwidth**
- 1Hz ~ 10kHz

**Overshoot**
- 5%

**Total Harmonic Distortion**
- < 0.1% (Ampl >1Vpp)

**Ground Isolation**
- 20ppm +5ns

#### ADVANCED FUNCTIONS

**AM MODULATION**
- Carrier Waveforms
- Modulating Waveforms
- Modulating Frequency

**FM MODULATION**
- Carrier Waveforms
- Modulating Waveforms
- Modulation Frequency

**PM**
- Carrier Waveforms
- Modulating Waveforms
- Modulation Frequency

**SUM**
- Carrier Waveforms
- Modulating Waveforms
- MODULATION Depth

**PWM**
- Carrier Waveforms
- Modulating Waveforms
- Phase Deviation

**FSK**
- Carrier Waveforms
- Modulating Waveforms

**SWEEP**
- Type
- Sweep Direction
- Start/Stop Freq

**BURST**
- Waveforms
- Frequency
- Pulse Count
- Start/Stop Phase

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**Input Voltage**
- 1.25Vpmax

**Working Mode**
- Constant Voltage

**Gain**
- 20dB

**Output Voltage**
- 12.5Vpmax

**Output Current**
- 1.6Amax

**Rise/Fall Time**
- < 2.5μS

**Full Power Bandwidth**
- 1Hz ~ 10kHz

**Overshoot**
- 5%

**Total Harmonic Distortion**
- < 0.1% (Ampl >1Vpp)

**Ground Isolation**
- 20ppm +5ns

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**Input Impedance**
- 10kΩ

**Input Voltage**
- 12.5Vpmax

**Gain**
- Constant Voltage: 20dB

**Output Power (RL=8Ω)**
- 20W (Square)

**Output Voltage**
- 12.5Vpmax

**Output Current**
- 1.6Amax

**Rise/Fall Time**
- <2.5μS

**Full Power Bandwidth**
- 1Hz ~ 10kHz

**Overshoot**
- 5%

**Total Harmonic Distortion**
- < 0.1% (Ampl >1Vpp)

**Ground Isolation**
- 20ppm +5ns

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**Input Voltage**
- 1.25Vpmax

**Working Mode**
- Constant Voltage

**Gain**
- 20dB

**Output Voltage**
- 12.5Vpmax

**Output Current**
- 1.6Amax

**Rise/Fall Time**
- <2.5μS

**Full Power Bandwidth**
- 1Hz ~ 10kHz

**Overshoot**
- 5%

**Total Harmonic Distortion**
- < 0.1% (Ampl >1Vpp)

**Ground Isolation**
- 20ppm +5ns
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>NChannel, Infinite</th>
<th>0s ~ 100 s</th>
</tr>
</thead>
</table>

#### EXTERNAL TRIGGER INPUT

<table>
<thead>
<tr>
<th>Type</th>
<th>For FSK, Burst, Sweep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Level</td>
<td>TTL Compatibility</td>
</tr>
<tr>
<td>Slope</td>
<td>Rising or Falling(Selectables)</td>
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<tr>
<td>Pulse Width</td>
<td>&gt;100ns</td>
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<tr>
<td>Input Impedance</td>
<td>10kΩ, DC coupled</td>
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</tbody>
</table>

#### EXTERNAL MODULATION INPUT

<table>
<thead>
<tr>
<th>Type</th>
<th>For AM, FM, PM, SUM, PWM</th>
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</thead>
<tbody>
<tr>
<td>Voltage Range</td>
<td>±5V full scale</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>10kΩ</td>
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<tr>
<td>Frequency</td>
<td>DC to 20kHz</td>
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<tr>
<td>Ground Isolation</td>
<td>42Vpmax</td>
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</tbody>
</table>

#### TRIGGER OUTPUT

<table>
<thead>
<tr>
<th>Type</th>
<th>For FSK, Burst, Sweep</th>
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<tbody>
<tr>
<td>Level</td>
<td>TTL Compatible into 50Ω</td>
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<tr>
<td>Pulse Width</td>
<td>&gt;450ns</td>
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<tr>
<td>Maximum Rate</td>
<td>1MHz</td>
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<tr>
<td>Fan-out Impedance</td>
<td>50Ω, Typical</td>
</tr>
</tbody>
</table>

#### FREQUENCY COUNTER

| Range | 5Hz ~ 150MHz |
| Accuracy | Time Base accuracy±1count |
| Resolution | Input Impedance Sensitivity |
| Ground Isolation | 42Vpmax |
| Dual Channel Function (CH1/CH2) | -180 ~ 180° | Synchronize phase |
| Phase | CH2=CH1 |
| Track | 30MHz Single Channel Arbitrary Function Generator with Pulse Generator, Modulation, Power Amplifier |
| Coupling | Frequency (Ratio or Difference) |
| DsoLink | Amplitude & DC Offset |

#### OTHER

- Store/Recall Interface: 10 Groups of Setting Memories
- Display: 4.3 inch TFT LCD, 480 × 3 (RGB) × 272

#### GENERAL SPECIFICATIONS

- Power Source: AC 100-240V, 50-60Hz or AC 100-120V, AC 220-240V, 50-60Hz
- Power Amplifier Source: DIP switch, AC 100-120V/AC 220-240V, 50-60Hz (MFG-2120MA, MFG-2260MFA, MFG-2260MRA only)
- Power Consumption: 30W or 80W (With power amplifier)
- Temperature to satisfy the specification: 18 ~ 28°C ; Operating temperature: 0 ~ 40°C ; Relative humidity: < 80%, 0 ~ 40°C, <= 70%, 35 ~ 40°C ; Installation category: CAT II
- Dimensions & Weight: 266(W) x 107(H) x 293(D) mm ; Approx. 2.5kg
- Storage Temperature: -10 ~ 70˚C, Humidity: 70%
- Operating Environment: IEC 61010 degree 2, Indoor use
- Operating Altitude: 2000 Meters
- Power Source: AC 100-240V, 50-60Hz or AC 100-120V, AC 220-240V, 50-60Hz
- Storage Temperature: 5Hz ~ 150MHz
- Operating Environment: 10 Groups of Setting Memories
- Display: 4.3 inch TFT LCD, 480 × 3 (RGB) × 272
- Power Source: AC 100-240V, 50-60Hz or AC 100-120V, AC 220-240V, 50-60Hz
- Storage Temperature: 5Hz ~ 150MHz
- Operating Environment: 10 Groups of Setting Memories
- Display: 4.3 inch TFT LCD, 480 × 3 (RGB) × 272

#### ACCESSORIES

- Quick Start Guide x 1, CD-ROM with MFG Software and User Manual x 1
- GTL-110 BNC Cable x 1 (MFG-2120/2120MA/2120MRA) or 2 (MFG-2260MFA, MFG-2260MRA)

#### OPTIONAL ASSESSORIES

- GTL-246 USB Type A to Type B cable
- FREE DOWNLODES:
  - Arbitrary Waveform Editing Software
- GTL-246 USB Type A to Type B cable
- FREE DOWNLODES:
  - Arbitrary Waveform Editing Software

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**Specifications subject to change without notice.**

MFG-2000GD1BH

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**ORDERING INFORMATION**

MFG-2110 10MHz Single Channel Arbitrary Function Generator with Pulse Generator
MFG-2120 20MHz Single Channel Arbitrary Function Generator with Pulse Generator
MFG-2120MA 20MHz Single Channel Arbitrary Function Generator with Pulse Generator, Modulation, Power Amplifier
MFG-2130M 60MHz Single Channel Arbitrary Function Generator with Pulse Generator, Modulation, 160MHz RF Signal Generator
MFG-2160MF 60MHz Single Channel Arbitrary Function Generator with Pulse Generator, Modulation, 320MHz RF Signal Generator
MFG-2160MR 60MHz Single Channel Arbitrary Function Generator with Pulse Generator, Modulation, 320MHz RF Signal Generator
MFG-2230M 30MHz Dual Channel Arbitrary Function Generator with Pulse Generator, Modulation
MFG-2260M 60MHz Dual Channel Arbitrary Function Generator with Pulse Generator, Modulation, 160MHz RF Signal Generator
MFG-2260MFA 60MHz Dual Channel Arbitrary Function Generator with Pulse Generator, Modulation, Power Amplifier, 160MHz RF Signal Generator
MFG-2260MRA 60MHz Dual Channel Arbitrary Function Generator with Pulse Generator, Modulation, 320MHz RF Signal Generator, Power Amplifier

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**OPTIONAL ASSESSORIES**

- GTL-246 USB Type A to Type B cable
- FREE DOWNLODES:
  - Arbitrary Waveform Editing Software