

# VOLTCRAFT

## VOLTCRAFT – TOP PERFORMANCE IN EVERY WAY

For more than 40 years, our product range has been dynamically adapting to the constant changes in the industry. We commit to offering first-class quality to our customers while delivering an excellent cost-performance ratio. This philosophy remains the cornerstone of Voltcraft's success.

## FG-1302 / FG-1602 DUAL-CHANNEL ARBITRARY WAVEFORM GENERATOR



Item no. 2616564 (FG-1302)

Item no. 2616563 (FG-1602)

The DDS (Direct Digital Synthesizer) signal generator features include 4-bit vertical resolution with two independent channels. It has precise waveform outputs including sine, square, pulse, ramp, noise, as well as 150 built-in arbitrary waveforms.

### FEATURES

FG-1602 (60 MHz frequency output) / FG-1302 (30 MHz frequency output) // 1  $\mu$ Hz frequency resolution // 2 channels // 9.14 cm (3.6 inch) TFT LCD display (480 x 272 pixels) // Supports SCPI // FG-1602 (300 MSa/s) / FG-1302 (125 MSa/s) maximum sampling rate // 14-bit vertical resolution

### EQUIPMENT

Comprehensive waveform output: sine, square, pulse, ramp, noise, and 150 built-in arbitrary waveforms // Waveform length: 2 pts to 100 k // Modulation waveform: AM, DSB-AM, FM, PM, ASK, FSK, PSK, BPSK, QPSK, 3FSK, 4FSK, OSK, PWM, SUM, SWEEP, BURST // Frequency counter range: 100 mHz - 100 MHz // Frequency counter resolution: 7 digits // Input: Frequency counter input, External modulation input, External trigger input // Output: Sync output // Communication interface: USB host, USB device // Delivery

### PACKAGE CONTENTS

Function generator // Power cord // USB cable // Q9 BNC cable // BNC to alligator cable // 1x spare fuse (250 V. F1AL) // Software + English manual on CD // Safety hint sheet // Quick guide



Model FG-1602 shown above.

## Technical Data

All technical data are guaranteed when the following conditions are met, unless otherwise stated.

- The signal generator must be operated continuously for more than 30 minutes at the specified operating temperature (20°C to 30°C) to meet these specifications;
- The signal generator is in the calibration internal and has performed a self-calibration.

In addition to the specifications marked with the word "Typical", the specifications used are guaranteed.

## Waveforms

| Waveforms           |   |          |
|---------------------|---|----------|
| Bandwidth           | FG-1032   | 30 MHz   |
|                     | FG-1062   | 60 MHz   |
| Sample Rate         | FG-1032   | 125MSa/s |
|                     | FG-1062   | 300MSa/s |
| Vertical Resolution | 14 bits   |          |
| Channel             | 2   |          |
| Standard Waveforms  | Sine wave, square wave, ramp wave, pulse wave, noise  |          |
| Arbitrary Waveforms | Sinc, exponential rise, exponential decline, electrocardiogram, Gaussian, semi-positive, Lorentz, dual audio, DC voltage totaling more than 150 kinds |          |

## Frequency Characteristics

| Frequency Characteristics (Frequency resolution to 1 $\mu$ Hz) |                                     |                    |
|--|-------------------------------------|--------------------|
| Sine wave  | FG-1032                             | 1 $\mu$ Hz ~ 30MHz |
|  | FG-1062                             | 1 $\mu$ Hz ~ 60MHz |
| Square wave  | FG-1032                             | 1 $\mu$ Hz ~ 15MHz |
|  | FG-1062                             | 1 $\mu$ Hz ~ 20MHz |
| Pulse wave   | FG-1032                             | 1 $\mu$ Hz ~ 15MHz |
|  | FG-1062                             | 1 $\mu$ Hz ~ 20MHz |
| Ramp wave  | FG-1032                             | 1 $\mu$ Hz ~ 1 MHz |
|  | FG-1062                             | 1 $\mu$ Hz ~ 2 MHz |
| Noise wave (-3 dB)   | 20 MHz BW (AWGN)                    |                    |
| Arbitrary wave   | 1 $\mu$ Hz - 10 MHz                 |                    |
| Frequency resolution   | 1 $\mu$ Hz or 7 significant figures |                    |

|                      |   |
|----------------------|---|
| Frequency stability  | $\pm 30$ ppm at $0\pm 40^\circ\text{C}$ |
| Frequency aging rate | $\pm 30$ ppm per year                   |

## Amplitude Characteristics

| Amplitude Characteristics (not specifically labeled, the load defaults to 50 $\Omega$ ) |  |  |
|---|--|--|
| Output amplitude  | FG-1032  | 2mVpp ~ 20Vpp ( $\leq 10\text{MHz}$ ) High Z<br>2mVpp ~ 10Vpp ( $\leq 30\text{MHz}$ ) High Z<br>1mVpp ~ 10Vpp ( $\leq 10\text{MHz}$ ) 50 $\Omega$<br>1mVpp ~ 5Vpp ( $\leq 30\text{MHz}$ ) 50 $\Omega$  |
|   | FG-1062  | 2mVpp ~ 20Vpp ( $\leq 10\text{MHz}$ ) High Z<br>2mVpp ~ 10Vpp ( $\leq 60\text{MHz}$ ) High Z<br>1mVpp ~ 10Vpp ( $\leq 10\text{MHz}$ ) 50 $\Omega$<br>1mVpp ~ 5Vpp ( $\leq 60\text{MHz}$ ) 50 $\Omega$  |
| Amplitude accuracy  | $\pm$ (1% of setting + 1 mVpp) (Typical 1kHz sine, 0V offset)  |  |
| Amplitude resolution  | 1mVpp or 4 digits  |  |
| DC offset range (AC +DC)  | FG-1032  | $\pm(10\text{ Vpk}-\text{Amplitude Vpp}/2)$ High Z ( $\leq 10\text{MHz}$ )<br>$\pm(5\text{Vpk} - \text{Amplitude Vpp}/2)$ High Z ( $\leq 30\text{MHz}$ )<br>$\pm(5\text{ Vpk} - \text{Amplitude Vpp}/2)$ 50 $\Omega$ ( $\leq 10\text{MHz}$ )<br>$\pm(2.5\text{ Vpk} - \text{Amplitude Vpp}/2)$ 50 $\Omega$ ( $\leq 30\text{MHz}$ ) |
|   | FG-1062  | $\pm(10\text{Vpk} - \text{Amplitude Vpp}/2)$ High Z ( $\leq 10\text{MHz}$ )<br>$\pm(5\text{Vpk}-\text{Amplitude Vpp}/2)$ High Z ( $\leq 60\text{MHz}$ )<br>$\pm(5\text{ Vpk} - \text{Amplitude Vpp}/2)$ 50 $\Omega$ ( $\leq 10\text{MHz}$ )<br>$\pm(2.5\text{ Vpk}-\text{Amplitude Vpp}/2)$ 50 $\Omega$ ( $\leq 60\text{MHz}$ )    |
|   | <b>Note:</b><br>Offset > 2.5Vpp, amplitude $\geq 10\text{mV}$ (High Z)<br>Offset > 1.25Vpp, amplitude $\geq 5\text{mV}$ (50 $\Omega$ ) |  |
| DC offset accuracy  | $\pm$ (1 % of  setting  + 1 mV + amplitude Vpp * 0.5%)   |  |
| Offset resolution   | 1 mVpp or 4 digits   |  |
| Output Impedance  | 50 $\Omega$ (Typical)  |  |

## Signal Characteristics

| Signal Characteristics                                  |         |  |
|---|---------|--|
| Sine  |         |  |
| Bandwidth flatness (relative to 1 kHz Sine wave, 1 Vpp) | FG-1032 | $\leq 10\text{MHz}$ : $\pm 0.3\text{dB}$<br>$\leq 30\text{MHz}$ : $\pm 0.5\text{dB}$   |
|   | FG-1062 | $\leq 10\text{MHz}$ : $\pm 0.3\text{dB}$<br>$\leq 35\text{MHz}$ : $\pm 0.5\text{dB}$<br>$\leq 60\text{MHz}$ : $\pm 1\text{dB}$ |
| Harmonic distortion                                     | FG-1032 | Typical (0dBm)<br>DC to 1MHz: $< -65\text{dBc}$<br>1MHz to 30MHz: $< -60\text{dBc}$  |

|                                   |  |  |
|-----------------------------------|--|--|
|                                   | FG-1062  | Typical (0dBm)<br>DC to 1MHz: <-65dBc<br>1MHz to 35MHz: <-60dBc<br>35MHz to 60MHz: <-50dBc |
| Total harmonic distortion         | < 0.2 %, 10 Hz to 20 kHz, 1 Vpp  |  |
| Non-harmonic distortion           | Typical (0dBm)<br>≤10MHz: <-70dBc<br>>10MHz: <-70dBc + 6dB/ sound interval |  |
| Phase noise                       | Typical (0dBm, 10kHz offset)<br>10MHz: ≤ -110dBc/Hz                        |  |
| <b>Square</b>                     |  |  |
| Rise/fall time                    | < 20ns   |  |
| Jitter (rms), typical (1Vpp, 50Ω) | 200ps + 30ppm  |  |
| Overshoot                         | < 5%   |  |
| <b>Ramp</b>                       |  |  |
| Linearity                         | < 1% of peak output<br>(typical 1 kHz, 1 Vpp, symmetry 50%)                |  |
| Symmetry                          | 0% to 100%   |  |
| <b>Pulse</b>                      |  |  |
| Period                            | FG-1032  | 67 ns to 1 Ms  |
|                                   | FG-1062  | 50 ns to 1 Ms  |
| Pulse Width                       | ≥ 24ns   |  |
| Rise and fall time                | ≥ 15ns   |  |
| Overshoot                         | < 5%   |  |
| Jitter (rms), typical (1Vpp, 50Ω) | 200ps + 30ppm  |  |
| <b>Noise</b>                      |  |  |
| Types                             | Gaussian white noise   |  |
| Bandwidth (-3dB)                  | 20 M   |  |
| <b>Arbitrary wave</b>             |  |  |
| Bandwidth                         | 10M  |  |
| Waveform length                   | 2 to 100K points   |  |
| Sampling rate                     | FG-1032  | 125Ma/s  |
|                                   | FG-1062  | 300Ma/s  |
| Amplitude accuracy                | 14 bits  |  |

## Modulation Characteristics

| Modulation Characteristics |  |
|----------------------------|--|
| Modulation Type            | AM, DSB-AM, FM, PM, ASK, FSK, PSK, BPSK, QPSK, 3FSK, 4FSK, OSK, PWM, SUM |

|   |  |
|---|--|
| <b>AM</b>                               |  |
| Carrier                                 | Sine wave, square wave, ramp wave, arbitrary wave (except DC)  |
| Modulated signal source                 | Internal or external   |
| Internal modulation waveform            | Sine wave, square wave, ramp wave, white noise                 |
| Internal amplitude modulation frequency | 2 mHz to 100 kHz   |
| Depth                                   | 0.0% to 100.0%   |
| <b>DSB-AM</b>                           |  |
| Carrier                                 | Sine wave, square wave, ramp wave                              |
| Modulated signal source                 | Internal or external   |
| Internal modulation waveform            | Sine wave, square wave, ramp wave                              |
| Internal amplitude modulation frequency | 2 mHz to 100 kHz   |
| Depth                                   | 0.0% to 100.0%   |
| <b>FM</b>                               |  |
| Carrier                                 | Sine wave, square wave, ramp wave, arbitrary wave (except DC)  |
| Modulated signal source                 | Internal or external   |
| Internal modulation waveform            | Sine wave, square wave, ramp wave, white noise                 |
| Internal modulation frequency           | 2 mHz to 100 kHz   |
| Frequency offset                        | $1 \mu\text{Hz} \leq \text{offset} < \text{carrier frequency}$ |
| <b>PM</b>                               |  |
| Carrier                                 | Sine wave, square wave, ramp wave, arbitrary wave (except DC)  |
| Modulated signal source                 | Internal or external   |
| Internal modulation waveform            | Sine wave, square wave, ramp wave, white noise                 |
| Internal phase modulation frequency     | 2 mHz to 100 kHz   |
| Phase deviation range                   | $0^\circ$ to $180^\circ$                                       |
| <b>PWM</b>                              |  |
| Carrier                                 | Pulse wave   |
| Modulated signal source                 | Internal or external   |
| Internal modulation waveform            | Sine wave, square wave, ramp wave, white noise                 |

|                                     |  |
|-------------------------------------|--|
| Internal phase modulation frequency | 2 mHz to 1 MHz   |
| Offset                              | 0% to Carrier pulse duty cycle   |
| <b>ASK</b>                          |  |
| Carrier                             | Sine wave, square wave, ramp wave, arbitrary wave                                      |
| Modulated signal source             | Internal or external   |
| Internal modulation waveform        | 50% square wave  |
| Internal modulation amplitude       | $0m V_{pp} \leq \text{amplitude} < \text{carrier amplitude}$                           |
| ASK frequency                       | 2 mHz to 1MHz  |
| <b>PSK</b>                          |  |
| Carrier                             | Sine wave, square wave, ramp wave, arbitrary wave                                      |
| Modulated signal source             | Internal or external   |
| Internal modulation waveform        | 50% square wave  |
| PSK frequency                       | 2 mHz to 1MHz  |
| Phase deviation range               | $0^{\circ}$ to $360^{\circ}$   |
| <b>FSK</b>                          |  |
| Carrier                             | Sine wave, square wave, ramp wave, arbitrary wave                                      |
| Modulated signal source             | Internal or external   |
| Internal modulation waveform        | 50% square wave  |
| FSK rate                            | 2 mHz to 1MHz  |
| FSK hopfreq                         | $2 \text{ mHz} \leq \text{offset} < \text{maximum frequency of corresponding carrier}$ |
| <b>3FSK</b>                         |  |
| Carrier                             | Sine wave, square wave, ramp wave, arbitrary wave                                      |
| Modulated signal source             | Internal   |
| Internal modulation waveform        | 50% square wave  |
| FSK rate                            | 2 mHz to 1MHz  |
| <b>4FSK</b>                         |  |
| Carrier                             | Sine wave, square wave, ramp wave, arbitrary wave                                      |
| Modulated signal source             | Internal   |
| Internal modulation waveform        | 50% square wave  |
| FSK rate                            | 2 mHz to 1MHz  |

| <b>BPSK</b>                             |   |
|---|---|
| Carrier                                 | Sine wave, square wave, ramp wave, arbitrary wave |
| Modulated signal source                 | Internal  |
| Internal modulation waveform            | 50% square wave                                   |
| BPSK rate                               | 2 mHz to 1MHz                                     |
| Phase deviation range                   | 0°~360°   |
| Data source                             | 01patt, 10 patt, PN15,PN21                        |
| <b>QPSK</b>                             |   |
| Carrier                                 | Sine wave, square wave, ramp wave                 |
| Modulated signal source                 | Internal  |
| QPSK frequency                          | 2 mHz to 1MHz                                     |
| <b>OSK</b>                              |   |
| Carrier                                 | Sine wave   |
| Modulated signal source                 | Internal  |
| Internal modulation waveform            | 50% square wave                                   |
| Oscillation time                        | 8ns to 499.75μs                                   |
| OSK frequency                           | 2 mHz to 1MHz                                     |
| <b>SUM</b>                              |   |
| Carrier                                 | Sine wave, square wave, ramp wave                 |
| Modulated signal source                 | Internal or external                              |
| Internal amplitude modulation frequency | 2 mHz to 100kHz                                   |
| Depth                                   | 0.0% to 100.0%                                    |

## Sweep Characteristics

| <b>Sweep Characteristics</b>          |  |
|---------------------------------------|--|
| Carrier                               | Sine, square wave, ramp wave, arbitrary wave (Except DC)     |
| Minimum/maximum starting frequency    | 1 μHz (minimum) / maximum frequency of corresponding carrier |
| Minimum/maximum termination frequency | 1 μHz (minimum) / maximum frequency of corresponding carrier |
| Types                                 | Linear, logarithmic  |
| Sweep time                            | 1 ms to 500 s ± 0.1%   |
| Trigger source                        | Internal, external, manual                                   |

## Burst Characteristics

| Burst Characteristics  |  |                                      |
|------------------------|--|--------------------------------------|
| Waveform               | Sine wave, square wave, ramp wave, pulse wave and arbitrary wave (Except DC)                   |                                      |
| Types                  | N-cycle, Gated   |                                      |
| N-cycle trigger source | Internal, external, manual   |                                      |
| Carrier frequency      | $1 \mu\text{Hz} \leq \text{Offset} \leq \text{Maximum frequency of corresponding carrier} / 2$ |                                      |
| N-cycle trigger cycle  | FG-1032  | 67 ns ~ 1 Ms (Min = Cycles * Period) |
|                        | FG-1062  | 34 ns ~ 1 Ms (Min = Cycles * Period) |
| periodicity            | $1 \sim 60000$ (Max = Burst Period / Period) /infinite   |                                      |
| Gated source           | External trigger   |                                      |

## Counter Specifications

| Counter Specifications |                                   |
|------------------------|-----------------------------------|
| Measurement function   | Frequency, period                 |
| Frequency Range        | Single channel :100 mHz - 200 MHz |
| Frequency resolution   | 7 digits                          |
| Input resistance       | 1 M $\Omega$                      |

## Input/Output Characteristics

| Input/Output Characteristics     |                                |
|----------------------------------|--------------------------------|
| Communication Interface          | USB Host, USB Device           |
| <b>External modulation input</b> |                                |
| Input frequency range            | DC - 20 kHz                    |
| Input level range                | $\pm 1\text{V}$ full scale     |
| Input impedance                  | 10 k $\Omega$ (typical)        |
| <b>External trigger input</b>    |                                |
| Level                            | TTL-compatible                 |
| Slope                            | Rising or falling (selectable) |
| Pulse Width                      | >100ns                         |
| <b>Sync Output</b>               |                                |
| Level                            | TTL-compatible                 |
| Maximum frequency                | 1MHz                           |

## General Specifications

| Display            |   |
|--------------------|---|
| Display type       | 3.6-inch color LCD display                  |
| Display resolution | 480 Horizontal $\times$ 272 Vertical pixels |



|                                 |  |
|---------------------------------|--|
| Display color                   | 65536 colors, 16 bits, TFT   |
| <b>Power</b>                    |  |
| Voltage                         | 100- 240 VAC, 50/60 Hz, CAT II   |
| Power consumption               | Less than 20W  |
| Fuse                            | 250V, F1AL   |
| <b>Environment</b>              |  |
| Temperature                     | Working temperature: 0 °C to 40 °C   |
|                                 | Storage temperature: -20 °C to 60 °C   |
| Relative humidity               | Less than 35°C: ≤ 90% relative humidity<br>35°C to 40°C: ≤ 60% relative humidity |
| Height                          | Operating 3,000 meters<br>Non-operation 12,000 meters                            |
| <b>Mechanical Specification</b> |  |
| Dimension                       | 200mm (Length) × 92.1 mm (Height) × 147.5mm (Width)                              |
| Weight                          | Approx. 0.8 kg   |
| <b>Others</b>                   |  |
| Adjustment interval             | The recommended calibration interval is one year                                 |

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