

## FREQUENCY COUNTER

### MF1601A/1602A, MF1603A/1604A

0.1 mHz to 1 GHz

0.1 mHz to 3 GHz

- High resolution/fast measurement time
- Frequency/period/pulse width/totalizing
- Parts per million (ppm) display/processing
- Burst signal measurement



The MF1600 series are compact and easy to operate frequency counters. We are convinced of the world highest level of their performance. The reliability and cost-performance has been upgraded by developing a new custom LSI to reduce the number of logic circuits and by using a microprocessor. Multi-functions, such as 0.1 mHz to quasi-microwave frequency measurement, period measurement, pulse width measurement, and totalizing are provided. High resolution with a fast measurement time (10 digits displayed in 1 second) for a super-wide frequency range has been achieved by using reciprocal plus vernier techniques.

Burst signal measurement and signal masking functions, and low-pass filters expand the measurability of various input waveforms.

A ppm display and arithmetic operation functions are provided to permit display of final data expressed in a most effective numerals such as ratios, deviations or in a converted unit by processing measured results.

In addition, measurement and setting conditions can be easily stored and recalled for repeat measurements.

An optional GP-IB interface enables easy configuration of automatic measurement and monitoring systems.

### Features

#### • High-speed/high-resolution measurement

The reciprocal method, which displays the measured frequency after counting back from the input signal period, plus the vernier technique, give a high resolution with a fast measurement time (10 digits displayed in 1 second).

#### • Burst signal measurement

The gate is opened synchronously after confirming the input signals. Intermittent signals, such as pulse-modulated waves can be accurately measured. A 6-digit display is available even when the gate time is 0.4 ms.



#### • Pulse width measurement

The input signal pulse width can be measured with a 10 ns single-shot resolution. It can also be measured in the average measurement mode with 300 ps resolution. Either a width of positive or negative pulse can be measured easily by the SLOPE setting.

#### • Totalizing

The number of pulses between the start and stop triggers can be totalled for signals up to 100 MHz.

#### • Mask function

It is difficult to eliminate the chattering noise influence on measured results when measuring relay switching time and so on. Using the SIG MASK function permits period measurement irrespective noise for periods from 5  $\mu$ s to 1600 s.

For burst signal measurement, early signal fluctuations should be disregarded. The measurement start can be delayed by 1  $\mu$ s to 16 s using the GATE MASK function.

#### • Processing function

Results can be displayed as required data such as rotation, speed, pressure, etc. after processing by setting a combination of ppm and arithmetic processing functions.

# ELECTRONIC COUNTERS, POWER METER, VOLTMETER

## Specifications

| Model                   |  | MF1601A  | MF1602A   | MF1603A  | MF1604A            |
|-------------------------|--|--|---|--|--------------------|
| Measurement Range       |  | 0.1 mHz to 1 GHz   |   | 0.1 mHz to 3 GHz   |                    |
| Frequency measurement   | Range  | FREQ A   | DC-coupled  |  | 0.1 mHz to 100 MHz |
|                         |  |  | AC-coupled  |  | 10 Hz to 100 MHz   |
|                         |  |  | BURST   |  | 50 kHz to 100 MHz  |
|                         | FREQ B   | 10 MHz to 1 GHz  |   | 10 MHz to 1 GHz: (1 GHz)<br>0.5 to 3 GHz: (3 GHz)  |                    |
|                         | Gate time  | <0.4 ms, <2 ms, <20 ms, <0.2 s, <2 s, and <20 s, selectable. If the input signal period exceeds the above value the gate time becomes the same value.  |   |  |                    |
| Display digits          | 5, 6, 7, 8, 9, and 10 digits selectable, one digit added when LSD ON   |  |   |  |                    |
| Measurement accuracy    | ±1 count ± trigger error <sup>1</sup> ± time base accuracy <sup>2</sup> ; (FREQ A)<br>±1 count ± time base accuracy <sup>2</sup> ; (FREQ B)<br>Fraction measurement error <sup>3</sup> added when LSD ON |  |   |  |                    |
| Unit display            | μHz, mHz, Hz, kHz, MHz, and GHz  |  |   |  |                    |
| Period measurement      | Range  | 10 ns to 10,000 s  |   |  |                    |
|                         | Gate time  | <0.4 ms, <2 ms, <20 ms, <0.2 s, <2 s, and <20 s, selectable. If the input signal period exceeds the above value, the gate time becomes the same value. |   |  |                    |
|                         | Measurement error  | ±1 count ± trigger error <sup>1</sup> ± time base accuracy <sup>2</sup><br>Fraction measurement error <sup>3</sup> added when LSD ON                   |   |  |                    |
|                         | Unit display   | ns, μs, ms, s, and ks  |   |  |                    |
| Pulse width measurement | Range  | 20 ns to 10,000 s  |   |  |                    |
|                         | Magnifying power (N)   | 1, 10, 10 <sup>2</sup> , and 10 <sup>3</sup>   |   |  |                    |
|                         | Time unit  | 10 ns  |   |  |                    |
|                         | Measurement error  | ±1 count ± (trigger error <sup>1</sup> /√N) ± time base accuracy <sup>2</sup>  |   |  |                    |
|                         | Unit display   | ns, μs, ms, s, and ks  |   |  |                    |
| Totalizing              | Range  | DC to 100 MHz  |   |  |                    |
|                         | Counting capacity  | 0 to (10 <sup>11</sup> - 1)  |   |  |                    |
| Input                   | Input A  | Sensitivity  | 10 mVrms (sinusoidal wave)<br>30 mVp-p (minimum pulse width: 5 ns)  |  |                    |
|                         |  | Maximum allowable level  | (ATT 20 dB) OFF: 10 Vrms (≤ 10 kHz), 1 Vrms (≤ 100 MHz), 0.5 Vrms (BURST)<br>(ATT 20 dB) ON: 100 Vrms (≤ 10 kHz), 10 Vrms (≤ 100 MHz), 5 Vrms (BURST) |  |                    |
|                         |  | Trigger level  | Approx. -1.5 to +1.5 V continuously adjustable, PRESET: Approx. 0 V,<br>(ATT 20 dB) ON: Approx. -15 to +15 V continuously adjustable                  |  |                    |
|                         |  | Coupling   | AC/DC switchable  |  |                    |
|                         |  | Trigger slope  | +/- switchable  |  |                    |
|                         |  | Low-pass filter  | Cut-off frequency: 10 kHz, ON/OFF switchable  |  |                    |
|                         |  | Connector/impedance  | BNC-type, ≥ 1 MΩ ≤ 25 pF  |  |                    |
|                         | Input B  | Voltage range  | 10 mVrms to 5 Vrms<br>(BURST): Max. 0.5 Vrms  | 10 mVrms to 5 Vrms (≤ 2.8 GHz)<br>30 mVrms to 5 Vrms (≤ 3 GHz)<br>(BURST): Max. 0.5 Vrms |                    |
|                         |  | Coupling   | AC  | AC   |                    |
|                         |  | Connector/impedance  | BNC-type, 50 Ω  | N-type, 50 Ω   |                    |
| Common                  | Reference oscillator   | Frequency  | 10 MHz  |  |                    |
|                         |  | Starting Characteristics   | ≤ 5 × 10 <sup>-8</sup> /day (30 min. after power-on)  |  |                    |
|                         |  | Aging rate <sup>4</sup>  | ≤ 2 × 10 <sup>-8</sup> /day (after 24-hour operation)   |  |                    |
|                         |  | Temperature characteristics  | ± 5 × 10 <sup>-8</sup> (25° ± 25°C)   |  |                    |
|                         |  | External output  | 10 MHz, ≥ 2 Vp-p (open), BNC connector on rear, Internal impedance: ≤ 400 Ω   |  |                    |
|                         |  | External input   | 1, 2, 5 or 10 MHz, 2 to 5 Vp-p, BNC connector on rear, Input impedance: ≥ 100 Ω   |  |                    |
|                         | Calculation function   | Sum, difference, product, and quotient of measured and set values, and ppm display   |   |  |                    |
|                         | Mask function  | Signal rejection within set period and measurement start delay settings  |   |  |                    |
|                         | Memory function  | Save/recall nine panel setting conditions  |   |  |                    |
|                         | Display  | 11 digits, seven-segment green LED   |   |  |                    |
| Sample rate             | Approx. 80 ms, 0.2 s, 2 s, and HOLD, selectable<br>Approx. 20 ms to 9999 minutes setting available   |  |   |  |                    |
| Power                   | AC85 to 132 V or AC170 to 250 V, 50/60 Hz, ≤ 45 VA (at starting: ≤ 50 VA)  |  |   |  |                    |
|                         |  | DC +10 to 30 V   |   | DC +10 to 30 V   |                    |
| Dimensions and weight   | 88H × 213W × 351D mm, <5 kg  |  |   |  |                    |

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# ELECTRONIC COUNTERS, POWER METER, VOLTMETER

\*1 On sinusoidal wave input of: Where, signal period is T (s), signal amplitude is Es (Vo-p), and noise peak value at 100 MHz bandwidth is En (Vo-p)

$$T_x = \frac{(1.75 \times 10^{-4} + 0.32 \times E_n)}{E_s} \text{ (s)}$$

\*2 Calibration is made after 24-hour operation, at 23° ± 5°C; the time base accuracy becomes (2 × 10<sup>-8</sup> /day) × input signal frequency.

\*3 At frequency measurement: (1 ns/real gate time) × input signal frequency

At period measurement: (1 ns/real gate time) × input signal period

The real gate time is varied by the input signal and 20 to 85% of the panel display.

\*4 The standard model aging rate is ≤ 4 × 10<sup>-8</sup> /week, ≤ 8 × 10<sup>-8</sup> /month, and ≤ 1 × 10<sup>-7</sup> /year.

## Options

|                                      |   |
|--------------------------------------|---|
| Option 01<br>Reference<br>Oscillator | Aging rate: After 24-hour operation, ≤ 5 × 10 <sup>-9</sup> /day (≤ 5 × 10 <sup>-8</sup> /month and ≤ 7.5 × 10 <sup>-8</sup> /year)<br>Temperature characteristics: ± 5 × 10 <sup>-8</sup> (25° ± 25°C)   |
| Option 02<br>Reference<br>Oscillator | Aging rate: After 24-hour operation, ≤ 2 × 10 <sup>-9</sup> /day (≤ 3 × 10 <sup>-8</sup> /month and ≤ 4.5 × 10 <sup>-8</sup> /year)<br>Temperature characteristics: ± 1.5 × 10 <sup>-8</sup> (25° ± 25°C) |
| Option 03<br>Reference<br>Oscillator | Aging rate: After 48-hour operation, ≤ 5 × 10 <sup>-10</sup> /day (≤ 1 × 10 <sup>-8</sup> /month and ≤ 1.5 × 10 <sup>-8</sup> /year)<br>Temperature characteristics: ± 5 × 10 <sup>-9</sup> (25° ± 25°C)  |
| Option 06<br>GP-IB<br>Interface      | IEEE STD 488<br>Interface functions: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, and C0  |

## Ordering information

Please specify model/order number, name and quantity when ordering.

| Model/Order No. | Name                            | Remarks  |
|-----------------|---------------------------------|--|
|                 | <b>Main frame</b>               |  |
| MF1601A         | Frequency Counter               | 0.1 mHz to 1 GHz                               |
| MF1602A         | Frequency Counter               | 0.1 mHz to 1 GHz                               |
| MF1603A         | Frequency Counter               | 0.1 mHz to 3 GHz                               |
| MF1604A         | Frequency Counter               | 0.1 mHz to 3 GHz                               |
|                 | <b>Standard accessories</b>     |  |
| J0127A          | Coaxial Cable, 1 m:             | 1 pc BNC-P•RG-58A/U•BNC-P                      |
| J0017           | Power Cord, 2.5 m:              | 1 pc   |
| J0266           | Adaptor:                        | 1 pc 3-pole to 2-pole                          |
| J0474           | Power Cord (for DC Operation):  | 1 pc MF1602A/1604A only                        |
| F0010           | Fuse, 1.6 A:                    | 2 pcs T1.6A250V                                |
| F0042           | Fuse, 0.8 A:                    | 1 pc MF51NN250V0.8ADC01 (MF1601A/1603A only)   |
| F0043           | Fuse, 1 A:                      | 1 pc MF51NN250V1ADC01                          |
| F0046           | Fuse, 3.15 A:                   | 2 pcs MF51NN250V3.15ADC01 (MF1602A/1604A only) |
| W0458AE         | MF1601A/1602A Operation Manual: | 1 copy For MF1601A/1602A                       |
| W0458BE         | MF1601A/1602A Service Manual:   | 1 copy For MF1601A/1602A                       |
| W0459AE         | MF1603A/1604A Operation Manual: | 1 copy For MF1603A/1604A                       |
| W0459BE         | MF1603A/1604A Service Manual:   | 1 copy For MF1603A/1604A                       |
|                 | <b>Options</b>                  |  |
| MF160□A-01      | Reference Oscillator            | Aging rate: ≤ 5 × 10 <sup>-9</sup> /day        |
| MF160□A-02      | Reference Oscillator            | Aging rate: ≤ 2 × 10 <sup>-9</sup> /day        |
| MF160□A-03      | Reference Oscillator            | Aging rate: ≤ 5 × 10 <sup>-10</sup> /day       |
| MF160□A-06      | GP-IB Interface                 |  |
|                 | <b>Peripheral instruments</b>   |  |
| MH648A          | Pre-Amplifier                   | 100 kHz to 1200 MHz                            |
| MZ5004A         | Battery Pack/Charger            | For MF1602A/1604A                              |
|                 | <b>Optional accessories</b>     |  |
| J0025A          | Coaxial Cable, 1 m              | S-5DWP•5D2W•S-5DWP                             |
| J0025C          | Coaxial Cable, 2 m              | S-5DWP•5D2W•S-5DWP                             |
| J0054A          | Coaxial Cable, 1 m              | 3CA-P2•RG-58A/U•Alligator clips                |
| J0104A          | Coaxial Cable, 1 m              | BNC-P•RG-55/U•N-P                              |
| J0001           | Probe                           | For transmitter, 10 kHz to 30 MHz              |
| J0040           | Coaxial Adaptor                 | N-P•BNC-J                                      |
| J0395           | High-Power Fixed Attenuator     | 30 dB, 30 W, N-type, DC to 9 GHz               |
| MP613A          | RF Fuse Element                 | 5 pcs/pack                                     |
| MP526C          | High-Pass Filter                | For 250 MHz band                               |
| MP526D          | High-Pass Filter                | For 400 MHz band                               |
| J0007           | GP-IB Cable, 1 m                | 408JE-101                                      |
| J0008           | GP-IB Cable, 2 m                | 408JE-102                                      |
| Z0140           | Battery                         | For MZ5004A, 2 pcs/set                         |
| B0270           | Carrying Bag (small)            | For frequency counter only                     |
| B0271           | Carrying Bag (big)              | With battery pack/charger                      |
| B0272           | Carrying Case (small)           | For frequency counter only                     |
| B0273           | Carrying Case (big)             | With battery pack/charger                      |
| B0274A          | Rack Mount Kit                  | IEC3U (with handles)                           |
| B0274C          | Rack Mount Kit                  | JIS, 149H mm (without handles)                 |
| B0026           | Protective Cover                |  |
| Z0152           | Service Kit                     |  |