MF2400C Series
Microwave Frequency Counter
10 Hz to 20, 27, 40 GHz
Newest Burst Wave Measurements

The MF2400C series lineup is composed of three frequency counters: the MF2412C (20 GHz), the MF2413C (27 GHz), and the MF2414C (40 GHz). This series is ideal for evaluating mobile radio communications devices and circuits, and can also measure the carrier frequency and pulse width of burst signals.

In addition to displaying measurement results on the 12-digit vacuum fluorescent display (VFD), frequency values can be read using the analog display function, which can be used for monitoring and is especially useful for adjusting the frequency of oscillators.

Furthermore, the template function is perfect for assessing whether or not results fall within upper and lower frequency limit specification. Because the evaluation result is output from the AUX connector on the back panel as a Go/No-go signal, an easy-to-use, automatic measurement system can be configured using the GPIB function.
Wide Band Measurement

The lineup of three counters with upper frequency limits of 20, 27, and 40 GHz, satisfies every usage requirement. In addition, a high-frequency fuse protects the input circuit from over-power signals, and a variety of adapters is available for coupling each connector.

High-Accuracy Burst Measurement

The carrier frequency, burst width, and burst repetition rate of burst signals from 100 ns to 0.1 s input to Input 1 can be measured quickly and accurately.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Positive selected</th>
<th>Negative selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burst width</td>
<td>Measurement at Burst ON</td>
<td>Measurement at Burst OFF</td>
</tr>
<tr>
<td>Burst repetition</td>
<td>Measurement of On-On period</td>
<td>Measurement of Off-Off period</td>
</tr>
</tbody>
</table>

Analog Display Function

Using this function, the entire VFD becomes an analog meter and values are indicated by the meter needle. In addition to quickly grasping changes in measured frequency, this permits faster frequency adjustment and Go/No-Go evaluation of oscillators, which previously required reading of many digits. This analog meter also solves problems of misreading frequency values.

Gating Function

At burst signal measurement, the carrier frequency may be different at the burst start, middle, and end. In the MF2400C series, the carrier signal frequency at any position of the signal (delay time from trigger signal leading edge) and at any specified time (gate time) can be measured using a combination of the gating and trigger delay functions.

High-speed Transient Measurement

Frequency counters have an interval (sample rate) when measurement is not performed, so sudden frequency changes during this period cannot be measured. However, the MF2400C series overcomes problems of measuring fast transients by capturing frequency variations at speeds of up to 10 μs and saving a maximum of 2000 sampling points. Saved data can be read by a PC host using GPIB. When it is combined with a host computer, frequency changes can be displayed graphically. This is very effective for measuring VCO start-up characteristics and PLL lock times.

Template Function

When the upper and lower frequency limits have been preset, Go is displayed when the measured frequency is within the preset range; if it is out of range, No-Go is displayed. In addition, the Go/No-Go signal can be output from the AUX connector on the back panel as a TTL signal. This is very useful for configuring an automatic Pass/Fail evaluation system (using analog display).

High-stability Reference Crystal Oscillator

A high-stability reference crystal oscillator is installed as standard in this counter instead of being available as an option in the previous MF2400B series. It supports an order-of-magnitude better measurement stability than previous instruments without additional investment.

Added Save and Recall Functions

Up to 10 setups can be saved in the internal memory and freely recalled. Saving complex setups in advance, such as burst triggers and gate settings, supports immediate recall for measurement, reducing both measurement setup time and malfunctions due to setup mistakes.
VFD display (256 x 64 dot): Measurement results and parameter settings displayed. Excellent visibility compared to LCD due to self-luminescent display method.

Sample Rate: Sets measurement off time

Resolution: At normal measurement, the \(<\) and \(>\) keys switch the frequency measurement resolution. However, when setting parameters, the \(<\) and \(>\) keys select the setting item, which is confirmed by pressing the Enter key.

Menu: Sets measurement functions, such as frequency, level, burst, etc. This menu changes automatically to the parameter setting condition, and changes numeric values and units.

Preset: Returns each parameter to default setting

Hold, Restart: The Hold key holds the measured valued. When Hold is ON, the key lamp is lit. The Restart key starts measurement over. When the Restart key is pressed when Hold is ON, the data is measured and held.

Frequency Acquisition: Used at frequency measurement of Input 1. At Auto, the full frequency band is swept and the frequency of signals exceeding the specified level is measured. At Manual, the frequency in the allowable input frequency range centered on the preset frequency is measured.

Meas Mode: At Burst, the burst signal width, period, and carrier frequency are measured (unrelated to Acquisition key setting, and change to manual measurement condition). Continuous wave measurement is performed in the CW mode.

Return to Meas: Pressing this key after setting parameters returns to the normal measurement status (measurement screen).
Ext Trig Input:
Measures frequency using external timing signal

AUX Output:
Outputs control signal for measurement function and set parameters

Reference Input:
Inputs external reference clock (1, 2, 5, 10 MHz)

Reference Output:
Outputs reference clock

GPIB Connector:
Connects GPIB cable
**Specifications**

- **MF2400C Series Microwave Frequency Counter**

<table>
<thead>
<tr>
<th>Input</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF2412C: 600 MHz to 20 GHz</td>
<td>| MF2413C: 600 MHz to 27 GHz</td>
</tr>
</tbody>
</table>

**Input Level Range (Sine Wave Input)**

<table>
<thead>
<tr>
<th>Input 1</th>
<th>| Input 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>–33 to 10 dBm (&lt;12.4 GHz), –28 to 10 dBm (&lt;20 GHz), –25 to 10 dBm (&lt;27 GHz), ([-44.6 + 0.741 \times \text{frequency (GHz)}]) to 10 dBm (&lt;40 GHz)</td>
<td>25 mVrms to 2 Vrms (50 Ω), 25 mVrms to 10 Vrms (1 MΩ)</td>
</tr>
</tbody>
</table>

**Impedance, Coupling**

<table>
<thead>
<tr>
<th>Input 1</th>
<th>Input 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Ω, AC coupled</td>
<td>50 Ω or ≥1 MΩ (≤35 pF), AC coupled</td>
</tr>
</tbody>
</table>

**Connector**

<table>
<thead>
<tr>
<th>Input 1</th>
<th>Input 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF2412C: N-type, MF2413C: SMA-type, MF2414C: K-type</td>
<td>BNC-type</td>
</tr>
</tbody>
</table>

**Trigger Mode**

- **Int**: Triggered by measurement signal
- **Ext**: Triggered by external signal
  - *Trigger level*: 1.5 V ± (2 to 10 Vp-p), Trigger pulse width: ≥1 μs, Impedance: ≥100 Ω, Coupling: DC
- **LINE**: Triggered by AC line signal

**Trigger Delay**

20 ns to 0.1 s, Off

(s≤320 ns in 20 ns steps, and <1 μs in 40 ns steps variable; ≥1 μs in continuously variable as effective two digits)

**Gate Width**

100 ns to 0.1 s (pulse off time: ≥240 ns)

**Carrier Frequency Measurement**

<table>
<thead>
<tr>
<th>Resolution</th>
<th>1 Hz</th>
<th>10 Hz</th>
<th>100 Hz</th>
<th>1 kHz</th>
<th>10 kHz</th>
<th>100 kHz</th>
<th>1 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement time</td>
<td>200 s</td>
<td>20 s</td>
<td>2 s</td>
<td>200 ms</td>
<td>20 ms</td>
<td>5 ms</td>
<td>5 ms</td>
</tr>
</tbody>
</table>

*Example of measurement time when measurement carrier frequency = 1 GHz, T = 2/fR, and To<sub>W</sub> = 0.1fR*

Accuracy: ±2 count ± time base accuracy x measurement frequency ± trigger accuracy ± residual error

**Pulse Width Measurement**

Resolution: 1 ns
Accuracy: ±20 ns ± time base accuracy x measurement pulse width ± trigger accuracy (time)

Unit: μs (fixed)

**Pulse Period Measurement**

Resolution: 1 ns
Accuracy: ±20 ns ± time base accuracy x measurement period ± trigger accuracy (time)

Unit: μs (fixed)

**Carrier Wave Frequency Measurement**

<table>
<thead>
<tr>
<th>Resolution, Measurement Time</th>
<th>Measurement period (times)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 1</td>
<td>Input frequency (Hz)</td>
</tr>
<tr>
<td>NORMAL: 1 MHz/1 μs to 0.1 Hz/10 s</td>
<td>Frequency resolution</td>
</tr>
<tr>
<td>FAST: 1 MHz/0.18 μs to 0.1 Hz/1.8 s (typ.)</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Input 2</td>
<td>10 Hz to 10 MHz (50 Ω): 1 MHz/1 μs to 0.1 Hz/10 s</td>
</tr>
<tr>
<td>10 Hz to 10 MHz (1 MΩ): 1 MHz to 0.001 Hz</td>
<td></td>
</tr>
<tr>
<td>Measurement time shown on right</td>
<td></td>
</tr>
</tbody>
</table>

**Measurement Accuracy**

<table>
<thead>
<tr>
<th>Measurement Accuracy</th>
<th>Input 1</th>
<th>Input 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL: ±1 count ± time base accuracy x measurement frequency ± residual error</td>
<td>10 MHz to 1 GHz: ±1 count ± time base accuracy x measurement frequency</td>
<td></td>
</tr>
<tr>
<td>FAST: ±1 count ± time base accuracy x measurement frequency ± trigger accuracy ± residual error</td>
<td>10 Hz to 10 MHz: ±1 count ± time base accuracy x measurement frequency ± trigger accuracy</td>
<td></td>
</tr>
</tbody>
</table>
### Auto/Manual Measurement

<table>
<thead>
<tr>
<th>Mode</th>
<th>Auto</th>
<th>Manual (CW measurement)</th>
<th>Manual (Burst measurement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM tolerance</td>
<td>35 MHzp-p, Acquisition time: ≤50 ms</td>
<td>±30 MHz (600 MHz to 1 GHz), ±40 MHz (≥1 GHz)</td>
<td>±30 MHz (600 MHz to 1 GHz, pulse width mode: WIDE)</td>
</tr>
<tr>
<td>Acquisition time</td>
<td>≤50 ms</td>
<td>≤15 ms</td>
<td>≤15 ms</td>
</tr>
<tr>
<td>Input frequency range</td>
<td>±30 MHz (600 MHz to 1 GHz, pulse width mode: WIDE)</td>
<td>±40 MHz (≥1 GHz, pulse width mode: NARROW)</td>
<td>±40 MHz (≥1 GHz, pulse width mode: WIDE)</td>
</tr>
</tbody>
</table>

### Functions
- **Template:** Inputs at upper/lower limit of frequency, judged Go/No-Go
- **Frequency offset:** +offset, –offset, ppm
- **Statistical processing:** mean, maximum, minimum, p-p
- **Save/recall:** 10 panel settings (max)

### AUX Output
- Output for Go/No-Go, count end, input level detection, internal gating, restart, and acquisition signal

### Sample Rate
- 1 ms to 10 s (1-2-5 steps), hold

### High-Speed Sample
- **Period/Frequency Resolution**: Input 1: 10 μs/10 kHz, 100 μs/1 kHz, 1 ms/100 Hz  
  Input 2: 10 μs/100 kHz, 100 μs/10 kHz, 1 ms/1 kHz
- **Measurement frequency:** 100 MHz

### Memory Backup
- Saved in backup memory at power off

### Display
- Display digits: 12 digits and 1 digit (– mark)
- VFD: 256 x 64 dots

### Reference Crystal Oscillator
- **Frequency:** 10 MHz
- **Warm-up:** ±5 x 10^{-9}/10 minutes
- **Aging rate:** ±5 x 10^{-9}/day, ±8 x 10^{-9}/year (after 24 h warm-up)
- **Temperature characteristics:** ±5 x 10^{-9} (0° to 50°C)

### External Reference Input
- 1, 2, 5, 10 MHz, Input voltage: 1 to 5 Vp-p (AC coupled), Input impedance: ≥1 kΩ

### External Reference Output
- 1, 2, 5, 10 MHz, Output voltage: ≥2 Vp-p (open end, AC coupled), Output impedance: ≤400 Ω

### External Control
- GPIB (conforms to IEEE488.2 standards): SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2

### Power
- 100 to 120 V/200 to 240 V (auto-switching), 50 to 60 Hz, ≤90 VA, ≤80 VA

### Dimensions and Mass
- 213 (W) x 88 (H) x 350 (D) mm, ≤5 kg

### EMC
- EN61326
- EN61000-3-2
- EN61010-1
- EN61010-1

### LVD
- EN61326
- EN61000-3-2
- EN61010-1

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*1 Delay time until counter started by trigger detection  
*2 MANUAL measurement mode  
*3 fs: frequency resolution, TGW: gate width, Ts: processing time (50 μs), T: Pulse repetition cycle  
*4 Measurement frequency (GHz)/10 count (rms), 5 GHz Measurement example: 5/10 = 0.5 count (rms)  
*5 Measurement frequency (GHz)/2 count (rms), 5 GHz Measurement example: 5/10 = 0.5 count (rms)  
*6 10 MHz when using internal reference signal; outputs signal based on this signal (1, 2, 5, 10 MHz) when using external reference signal

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### Options: Crystal Oscillator

<table>
<thead>
<tr>
<th>Option Number</th>
<th>MF2412C-003</th>
<th>MF2413C-003</th>
<th>MF2414C-003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>10 MHz</td>
<td>10 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td><strong>Aging Rate</strong></td>
<td>±5 x 10^{-10}/day, ±2 x 10^{-9}/year</td>
<td>±5 x 10^{-10}/day, ±2 x 10^{-9}/year</td>
<td>±5 x 10^{-10}/day, ±2 x 10^{-9}/year</td>
</tr>
<tr>
<td><strong>Temperature Characteristics</strong></td>
<td>±10° to 60°C (with reference to 25°C)</td>
<td>±10° to 60°C (with reference to 25°C)</td>
<td>±10° to 60°C (with reference to 25°C)</td>
</tr>
</tbody>
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Specifications are subject to change without notice.