

## MICROWAVE FREQUENCY COUNTER

## MF2400 series

10 Hz to 20/27/40 GHz

NEW



CE GPIB

The MF2400 series is composed of three frequency counters: the MF2412A (20 GHz), the MF2413A (27 GHz), and the MF2414A (40 GHz).

They are ideal for evaluating mobile radio communications devices and circuits, with the ability to measure the carrier frequency and pulse width of burst signals. In addition to displaying measurement results on a 12-digit LCD, the frequency values can be read using the analog display function, which is ideal for monitoring evaluation and especially for frequency adjustment, etc., as in the case of various types of oscillators.

Furthermore, the template function is useful for assessing quickly whether or not the measurement results fall within the upper and lower frequency limit specifications; the evaluation result is output from the AUX connector on the rear panel as a Go/No-go signal. An easy-to-use automatic measurement system can be configured using the GPIB function.

### Features

- Measures carrier frequency and pulse width of burst signals
- Analog frequency display
- Pass/Fail evaluation for frequency range specified by template function
- Measurement of any burst section using gating function

### Functions

#### • Wide band measurement

The line up of three counters upper frequency limits of 20, 27, and 40 GHz meet every type of usage requirement. In addition, a high-frequency fuse holder and fuse element protects the input circuit from excessively powerful signals, and a variety of adapters are available for coupling each connector.

#### • High-accuracy burst measurement

The carrier frequency, burst width and burst repetition rate of a 100 ns to 0.1 s burst signal input from INPUT 1 can be measured quickly with high accuracy.

#### • Analog display function

Using this function, the entire LCD becomes an analog meter and the measured values are indicated by the position of the meter needle. In addition to grasping changes in the measured frequency, this permits faster frequency adjustment and Go/No-go judgement of oscillators which had to be read as many digits of measured data before. This analog meter also solves problems associated with misreading frequency values.



Moves left/right and indicates frequency value

#### • Template function

After the upper and lower frequency limits have been preset, if the measured frequency is within the preset range, Go is displayed; 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 device Pass/Fail evaluation system (using analog display).

#### • High-speed transient measurement

Frequency counters have an interval when measurement is not performed (sample rate), so that sudden frequency changes during this period cannot be measured.

However, the MF2400 series overcomes this problem by capturing frequency changes at speeds of up to 10  $\mu$ s and saving a maximum of 2000 sampling points. 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.

#### • Gating function

With burst signal measurements, the carrier frequency may be different at the start, middle, and end of the burst. In the MF2400 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.

## Specifications

### ● MF2400 series

Input	Frequency range	INPUT 1 MF2412A: 600 MHz to 20 GHz, MF2413A: 600 MHz to 27 GHz, MF2414A: 600 MHz to 40 GHz INPUT 2 10 MHz to 1 GHz (50 Ω), 10 Hz to 10 MHz (1 MΩ)																
	Input level range (sine wave input)	INPUT 1 -33 to +10 dBm (<12.4 GHz), -28 to +10 dBm (<20 GHz), -25 to +10 dBm (<26.5 GHz), [-44.6 + 0.741 x frequency (GHz)] to +10 dBm (≤40 GHz) INPUT 2 25 mVrms to 2 Vrms (50 Ω), 25 mVrms to 10 Vrms (1 MΩ)																
	Impedance, coupling	INPUT 1: 50 Ω, AC couple INPUT 2: 50 Ω or ≥1 MΩ (≤35 pF), AC couple																
	Connector	INPUT 1 MF2412A: N-type, MF2413A: SMA-type, MF2414A: K-type INPUT 2: BNC-type																
Gating function	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*1, off (≤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 (<1 μs in 20 ns steps variable; ≥1 μs in continuously variable as effective two digits)																
Pulse modulation wave measurement	Frequency range	MF2412A: 600 MHz to 20 GHz, MF2413A: 600 MHz to 27 GHz, MF2414A: 600 MHz to 40 GHz																
	Pulse width	100 ns to 0.1 s (NARROW), 1 μs to 0.1 s (WIDE)																
	Pulse repetition frequency	10 Hz to 4 MHz (pulse off time: ≥240 ns)																
	Carrier frequency measurement*2	Max. resolution: 10 kHz (pulse width: 100 ns to 1 μs), 1 kHz (pulse width: 1 to 10 μs), 100 Hz (pulse width: 10 to 100 μs), 10 Hz (pulse width: 0.1 to 1 ms), 1 Hz (pulse width: 1 to 10 ms), 0.1 Hz (pulse width: 10 to 100 ms) Measurement time: (T or Ts whichever is greater) x {1/(f <sub>R</sub> x TGW)} <sup>2</sup> *3 <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Resolution</td> <td>1 Hz</td> <td>10 Hz</td> <td>100 Hz</td> <td>1 kHz</td> <td>10 kHz</td> <td>100 kHz</td> <td>1 MHz</td> </tr> <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> </table> <p style="text-align: center;">*Measurement carrier frequency: 1 GHz (TGW*3 = 0.1/f<sub>R</sub>) Accuracy: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy ±residual error*5 ±1/TGW*3</p>	Resolution	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	Measurement time	200 s	20 s	2 s	200 ms	20 ms	5 ms	5 ms
	Resolution	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz										
Measurement time	200 s	20 s	2 s	200 ms	20 ms	5 ms	5 ms											
Pulse width measurement	Resolution: 1 ns Accuracy: ±20 ns ±time base accuracy x measurement pulse width ±trigger accuracy Unit indication: μs (fixed)																	
Pulse period measurement	Resolution: 1 ns Accuracy: ±20 ns ±time base accuracy x measurement period ±trigger accuracy Unit indication: μs (fixed)																	
Carrier wave frequency measurement	Resolution, gate time	INPUT 1 NORMAL: 1 MHz/1 μs to 0.1 Hz/10 s FAST: 1 MHz/0.18 μs to 0.1 Hz/1.8 s (typical) INPUT 2 10 MHz to 1 GHz (50 Ω): 1 MHz/1 μs to 0.1 Hz/10 s 10 Hz to 10 MHz (1 MΩ): Shown below 																
	Measurement accuracy	INPUT 1 NORMAL: ±1 count ±time base accuracy x measurement frequency ±residual error*4 FAST: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy ±residual error*5 INPUT 2 10 MHz to 1 GHz: ±1 count ±time base accuracy x measurement frequency 10 Hz to 10 MHz: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy																
Auto/manual measurement	Auto FM tolerance: 35 MHzp-p, Acquisition time: ≤50 ms Manual (CW measurement) Input allowable frequency range: ±30 MHz (600 MHz to 1 GHz), ±40 MHz (≥1 GHz) Acquisition time: ≤15 ms Manual (Burst measurement) Input allowable frequency range: ±30 MHz (600 MHz to 1 GHz, pulse width mode: WIDE), ±20 MHz (≥1 GHz, pulse width mode: NARROW), ±40 MHz (≥1 GHz, pulse width mode: WIDE) Acquisition time: ≤15 ms																	

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Functions	Template: Inputs in upper/lower limit of frequency, judged on GO/NO-GO Frequency offset: +offset, -offset, ppm Statistical processing: mean, maximum, minimum, p-p
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
Memory back up	Store in non-volatile memory at instrument power-down
Display	Display digits: 12 digits and 1 digit (- mark) LCD: 248 x 60 dots (with back light)
Reference crystal oscillator	Frequency: 10 MHz Warm-up: $\leq \pm 5 \times 10^{-8}$ /day (after 30 min. warm-up) Aging rate: $\leq \pm 2 \times 10^{-8}$ /day (after 24 h warm-up) Temperature characteristics: $\pm 5 \times 10^{-8}$ (0° to 50 °C)
External reference input	1/2/5/10 MHz, Input voltage: 2 to 5 Vp-p (AC coupling), Input impedance: $\geq 1$ k $\Omega$
External reference output	1/2/5/10 MHz*6, Output voltage: $\geq 2$ Vp-p (open end, AC coupling), Output impedance: $\leq 400$ $\Omega$
External control	GPIB (conforms to IEEE488.2 standards): SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Power	85 to 132/170 to 250 V (auto switch), 47.5 to 63 Hz, $\leq 80$ VA
Operating temperature	0° to 50 °C
Dimensions and mass	213 (W) x 88 (H) x 350 (D) mm, $\leq 5$ kg
EMC	EN55011: 1991, Group 1, Class A EN50082-1: 1992
Safety	EN61010-1: 1993 (Installation Category II, Pollution Degree II)

\*1: Delay time until counter started by trigger detection

\*2: MANUAL measurement mode

\*3:  $f_R$ : frequency resolution, TGW: gate width, Ts: processing time (50  $\mu$ s),  
T: period (2/ $f_R$ )

\*4: Measurement frequency (GHz)/10 count (rms)

\*5: Measurement frequency (GHz)/2 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

### • Options 01/02/03: Crystal oscillator

Option number	01	02	03
Frequency	10 MHz		
Aging rate	5 x 10 <sup>-9</sup> /day, 5 x 10 <sup>-8</sup> /month, 7.5 x 10 <sup>-8</sup> /year *After power on, with reference to frequency after 24 h	2 x 10 <sup>-9</sup> /day, 3 x 10 <sup>-8</sup> /month, 4.5 x 10 <sup>-8</sup> /year *After power on, with reference to frequency after 24 h	5 x 10 <sup>-10</sup> /day, 1 x 10 <sup>-9</sup> /month, 1.5 x 10 <sup>-8</sup> /year *After power on, with reference to frequency after 48 h
Temperature characteristics	$\pm 5 \times 10^{-8}$ -10° to 60°C (with reference to 25°C)	$\pm 1.5 \times 10^{-8}$	$\pm 1 \times 10^{-9}$

### Ordering information

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

Model/order No.	Name
<b>Main frame</b>	
MF2412A	Microwave Frequency Counter
MF2413A	Microwave Frequency Counter
MF2414A	Microwave Frequency Counter
<b>Standard accessories</b>	
J0017	Power cord, 2.5 m: 1 pc
F0012	Fuse, 3.15 A: 2 pcs
W1227AE	MF2412A/2413A/2414A operation manual: 1 copy
<b>Options</b>	
MF2412A-01	Crystal oscillator (5 x 10 <sup>-9</sup> /day)
MF2413A-01	Crystal oscillator (5 x 10 <sup>-9</sup> /day)
MF2414A-01	Crystal oscillator (5 x 10 <sup>-9</sup> /day)
MF2412A-02	Crystal oscillator (2 x 10 <sup>-9</sup> /day)
MF2413A-02	Crystal oscillator (2 x 10 <sup>-9</sup> /day)
MF2414A-02	Crystal oscillator (2 x 10 <sup>-9</sup> /day)
MF2412A-03	Crystal oscillator (5 x 10 <sup>-10</sup> /day)
MF2413A-03	Crystal oscillator (5 x 10 <sup>-10</sup> /day)
MF2414A-03	Crystal oscillator (5 x 10 <sup>-10</sup> /day)

Model/order No.	Name
<b>Optional accessories</b>	
K224*1	Coaxial adapter (K-P•K-J, SMA compatible, DC to 40 GHz, SWR: 1.2)
J0004	Coaxial adapter (SMA-J•N-P)
34RKNF50	Coaxial adapter (ruggedized K-P•N-J, DC to 20 GHz, SWR: 1.25)
J0060	Coaxial adapter (N-J•SMA-P)
J0527	Coaxial cord (K-P•K-P), 2 ft
J0127A	Coaxial cord (BNC-P•RG-58A/U•BNC-P), 1 m
J0837	Coaxial cord (N-P•N-P), 2 m
MP612A*2	Fuse Holder (N-P•N-J, DC to 1 GHz)
MP613A*2	Fuse Element (DC to 1 GHz, Power rating: +17 dBm, Blow rating: $\geq +35$ dBm)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0409	Carrying case (with B0329L protection cover)
B0329L	Protection cover
B0390G	Rack mount kit (19 inch type, one unit)
B0411A	Rack mount kit (19 inch type, two units, side by side)

\*1: The K224 adapter is used to prevent damage to the input connector.

\*2: The MF2400 series has the MP612A Fuse Holder (with MP613A Fuse Element) to prevent input of excessive power. In addition, the MP612A Fuse Holder has an N-type connector, so an adapter is required according to the coupled connector type.