

Electronic Counters

10 mHz to 18 GHz

R5372P

- Measurement Range: 10 mHz to 18 GHz
- Unique Method Enables Pulse Modulation Measurements with 50 ns Pulse Width and 10 kHz Resolution
- Pulse-Width Measurement to 10 ns Resolution
- Enhanced Range of Calculation Functions
- Automatic Measurement of Maximum FM Deviation



(Photo is R5372P)

R5372P

Microwave Frequency Counters

R5372P is high-resolution microwave frequency counters capable of pulse modulation measurements up to 18 GHz. Not only are measurements of aircraft, harbor, river and fire prevention radar possible but also, these counters are capable of CW microwave frequency measurements, totalizing functions and PCM error-bit totalizing. Using the A input which makes use of a reciprocal counting technique (10 mHz to 10 MHz), it is possible to perform pulse width or pulse repetition frequency measurements to a resolution of 10 ns. By using an external trigger signal, it is possible to measure a pulse modulated carrier frequency at any desired point (frequency profile measurement).

These counters also provide high basic performance, typified by an input sensitivity of -20 dBm at 18 GHz and 1 Hz resolution with a 1 s gate using a digital TRAHET technique. In addition, plus/minus offset display is possible using keyboard entry of any or all digits, as are digital comparison functions, arithmetic calculation result display and display of maximum values, minimum values, standard deviation and parts per million – all provided as standard.

By building in an optional GPIB or BCD output capability, these counters can be used in automated microwave measurement systems.

■ High-Resolution Measurement of Pulse Modulated Signals

To measure pulse modulated signals, the frequency counter's gate time must be set at or within the pulse width. The result with conventional counters is that the readout accuracy suffers. The R5372P microwave counters on the other hand, with their on-board CPUs and true averaging function can display three additional digits. Only the resolution need to be set manually; gate time and number of averaging operations are automatically set. The minimum measurable pulse width for pulse modulated signals is 100 ns using an internal gate signal or 50 ns using an external gate signal.

■ Frequency Measurement at any Desired Portion of a Pulse Modulated Carrier

By inputting a TTL-level, negative logic, external gate signal at the rear-panel connector; the carrier frequency of a chirp radar can be measured at any desired frequency or pulse width and provide a pulse modulated carrier frequency profile. Pulse widths of 50 ns to 0.1 s can be measured. The resolution of the measured frequency is set using the RESOLUTION keys on the front panel.

■ Reciprocal Method Enables Pulse Width Measurement

Signal input at the A input (10 mHz to 10 MHz) is processed by taking the reciprocal of the frequency to provide rapid, high-resolution measurement of the pulse width and the pulse repetition frequency of a pulse modulated signal. The measurement procedure is simple; just connect the rear-panel signal detection output to input A.

Applications include measurement of the pulse width and repetition frequency of radar signals and of two-way radio pilot signals. DC coupling allows PCM error bit accumulation as well.

■ FM Deviation Measurements Are Simple

FPU and STL testing of TV relay equipment requires measurements of transmitted output and frequencies as well as FM deviation measurements. The ΔF mode of the R5372P can be used to perform easily deviation measurements of FM modulated frequencies and by means of an external trigger signal is also possible.

■ Pulse Modulated Signal Measurement

The R5372P microwave counters feature straightforward operating procedures to measure the important characteristics of radar and other pulse modulated signals. The examples below illustrate measurement of a carrier signal at 9450 MHz with a pulse repetition frequency of 3210 Hz and pulse width of 100 ns.

1. Carrier Frequency Measurement

With the R5372P in the manual mode, set the frequency to 9450.5 MHz, approximating the frequency to be measured (within 9450.5 ± 125 MHz) and set the sample rate to HOLD. Switch the sync mode to internal (rear panel INT. connector) so that if the first gate time value is too short to obtain the required resolution, internal averaging will be performed automatically.

2. Repetition Frequency Measurement

After performing the same procedure as for carrier frequency, use either the detected output from the AUX IN/OUT connector at the rear panel or provide a signal from an external detector. Input this signal to the input A connector of the R5372P. Set the input A to the 10 mHz to 10 MHz measurement band (reciprocal mode) to obtain a measurement result of 3210.2 Hz in approximately 3 ms with high resolution. This mode overrides the hold on the sampling rate.

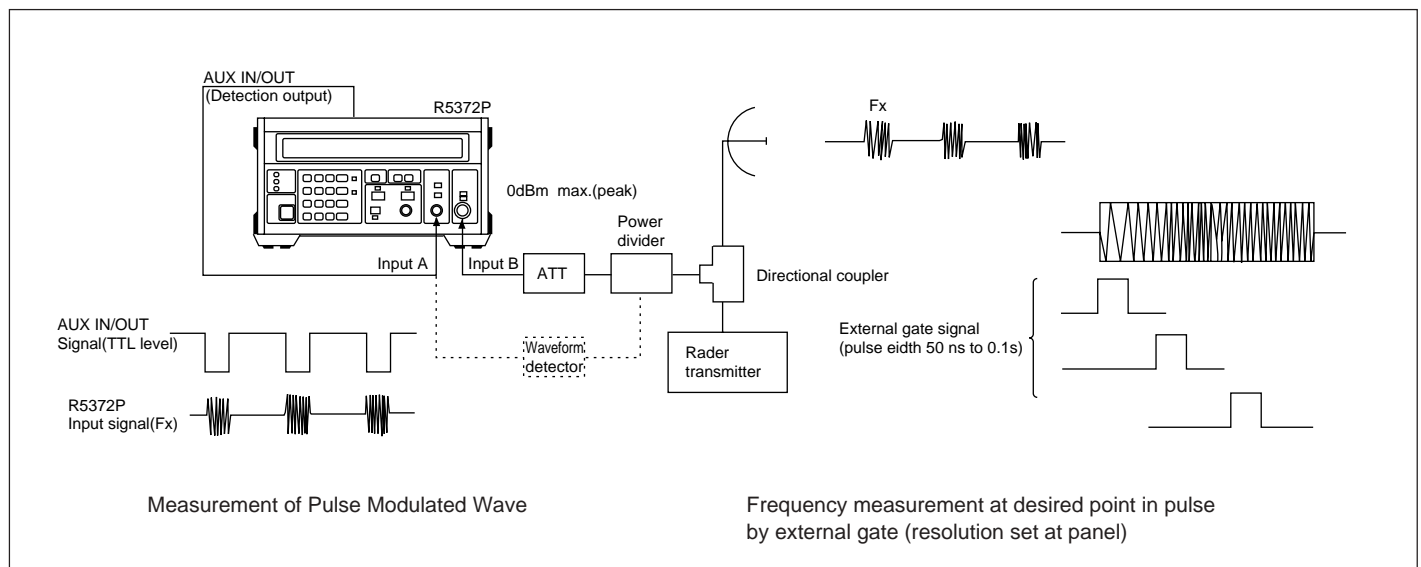
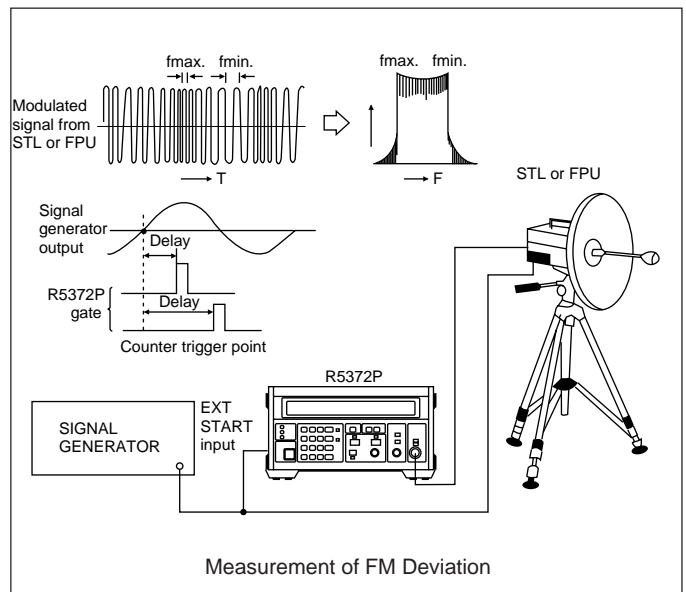
3. Pulse Width Measurement

To measure pulse width, set up the counter as for carrier frequency measurement and press the SHIFT and PW keys to obtain a measurement with 10 ns resolution. When measuring pulse modulated signals having a long rise time, the displayed pulse width may exceed the actual pulse width because the pulse width is measured by measuring the threshold level width of the counter. In such cases, connect the output of a detector to input A and adjust the trigger level to enable measurement of the 50% pulse width.

■ FM Deviation Measurement

The R5372P's powerful arithmetic functions make it a simple task to measure FM deviation. Connect the counter as shown in the figure below and select the ΔF mode. It is then possible to simply turn the delay knob to determine the maximum and minimum values from the start of measurement and internally calculate the differences later.

An external gate signal (50 ns to 0.1 s) synced at any desired amplitude with the modulated signal can also be used for high-accuracy measurement of FM deviation (the frequency change vs amplitude in frequency modulated signals). Specifically, when the required resolution cannot be obtained due to reduced external gate time (50 ns min.), the averaging mode can be used to obtain high-resolution measurements. This is another application of the enhanced arithmetic functions of these counters.



Electronic Counters

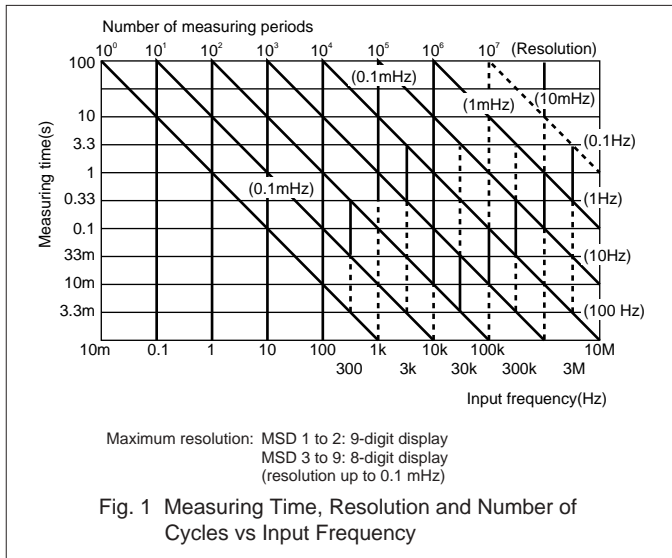
10 MHz to 18 GHz

R5372P (Continued From Previous Page)

Specifications

Input	Input A	Input B
Frequency measurement range	10 mHz to 10 MHz (DC coupled), 10 Hz to 10 MHz (AC coupled)	10 MHz to 550 MHz 500 MHz to 18 GHz
Input impedance	Approx. 1 M Ω /60 pF max.	Approx. 50 Ω Approx. 50 Ω
Input sensitivity	25 mVrms	25 mVrms -20 dBm (500 MHz to 18 GHz)
Input attenuator	0 dB, 20 dB	ANS AUTO, 20 dB
Maximum measurement input	500 mVrms/ATT.0 dB 5 Vrms/ATT.20 dB	500 mVrms/ANS OFF 5 Vrms/ANS ON 0 dBm (ATT.AUTO) +10 dBm (ATT. 20 dB)
Damage level input	6 Vrms (1 MHz to 10 MHz) 10 Vrms (400 Hz to 1 MHz) 100 Vrms (DC to 400 Hz)	6 Vrms +10 dBm/ATT. AUTO +20 dBm/ATT.20 dB
Coupling	DC and AC	AC AC
Trigger level	Approx. -1 V to 1V continuously variable (when -10 V to +10 V/ATT. 20 dB)	- -
Resolution / counting time	See Fig. 1	10 MHz/0.1 μ s to 0.1 Hz/10 s decade switched 10 MHz/0.1 μ s to 0.1 Hz/10 s decade switched
Measurement accuracy	\pm Trigger error*/no. of measurement cycles \pm 1 count \pm time base accuracy (See Fig. 1 for measurement cycles)	\pm 1 count \pm time base accuracy \pm 1 count \pm time base accuracy \pm residual stability Residual stability: 1/10 Y Measured frequency (GHz) (counts rms)
Measurement method	Reciprocal	Direct counting Digital TRAHET Heterodyne converted direct counting
Input connector	BNC N-type	

* Trigger error: \pm 0.3% with respect to sinewave input of 40 dB or higher S/N



Totalize: (Input A 10 mHz to 10 MHz)

Counting range: DC to 10 MHz

Counting capacity: 0 to 9,999,999,999

Pulse width measurement: (Input A 10 mHz to 10 MHz band)

Range: 50 ns to 1 s (resolution 10 ns, average of 10 pulses)

Units: μ s (fixed display)

Accuracy: \pm trigger error $\sqrt{10} \pm 1$ count \pm time base accuracy

$$\text{Trigger error; } \frac{0.0025}{\text{Signal slope (V}/\mu\text{s)}} (\mu\text{s})$$

$$\pm \frac{2 \times \text{Peak noise voltage}}{\text{Signal slope}} (\mu\text{s})$$

Pulse Modulation Measurement (MANUAL mode)

Measurement ranges:

10 MHz to 550 MHz (INPUT A)

500 MHz to 18 GHz (INPUT B)

Pulse width: 100 ns to 0.1 s (internal syncing)

50 ns to 0.1 s (external syncing)

Pulse repetition frequency (f_r): 10 Hz to 5 MHz

Syncing trigger modes:

INT. Internal syncing. Gate is opened and closed in sync with a pulse modulation of the input.

EXT. START Gate is opened when an external start signal is received.

Triggering is only possible when an internal detector output is on.

Trigger input signal (sinewave also usable):

1.5V \pm (2 to 10) Vp-p

Pulse width; 1 μ s min.

EXT. GATE Gate opens and closes when an external gate signal is received.

Gate input signal level: TTL, negative logic

Pulse width: 50 ns to 0.1 s

LINE Gate opens in sync with power-line frequency. Triggering is only possible when an internal detector output is on.

Carrier frequency measurement:

Maximum resolution See Fig. 2.

Accuracy $GW < 200 \mu\text{s};$

± 1 count \pm time base accuracy $\pm \frac{0.04}{GW}$ (Hz rms) ± 5 kHz

$GW \geq 200 \mu\text{s};$

± 1 count \pm time base accuracy $\pm \frac{1}{GW}$ (Hz rms)

Measurement time $(50 \mu\text{s} + \frac{1}{f_r}) \times (\frac{1}{\text{RESOLUTION}} \times \frac{1}{GW})^2$

GW; Gate width (for internal syncing, this is the modulation pulse width minus approx. 50 ns)

f_r ; Pulse repetition frequency

Units display GHz, MHz, kHz, Hz, fixed display

Modulation pulse width measurement:

Pulse width display at the counter input sensitivity level

Resolution: 10 ns

Accuracy: ± 30 ns \pm time base accuracy

Units: μ s fixed display

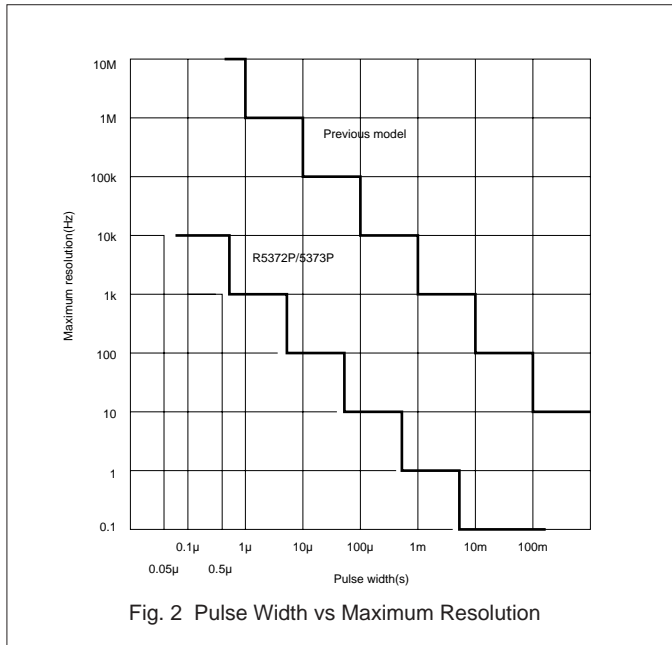


Fig. 2 Pulse Width vs Maximum Resolution

Time Bases

Time base stability:

	Standard	Option 21	Option 22	Option 23
Aging rate	$2 \times 10^{-9}/\text{day}$	$5 \times 10^{-9}/\text{day}$	$2 \times 10^{-9}/\text{day}$	$5 \times 10^{-10}/\text{day}$
	$8 \times 10^{-9}/\text{mo.}$	$5 \times 10^{-9}/\text{mo.}$	$2 \times 10^{-9}/\text{mo.}$	$1 \times 10^{-9}/\text{mo.}$
Long-term stability	$1 \times 10^{-7}/\text{yr}$	$8 \times 10^{-8}/\text{yr}$	$5 \times 10^{-8}/\text{yr}$	$2 \times 10^{-8}/\text{yr}$
Temperature characteristic ($+25 \pm 25^\circ\text{C}$)	$\pm 5 \times 10^{-8}$	$\pm 5 \times 10^{-8}$	$\pm 1 \times 10^{-8}$	$\pm 5 \times 10^{-9}$

Time base output: Frequency 10 MHz

Voltage 1 Vp-p (minimum)

Output impedance Approx. 50 Ω, BNC connector

External frequency standard input: 1, 2, 2.5, 5 or 10 MHz

Voltage 1 to 10 Vp-p

Input impedance Approx. 500 Ω, BNC connector

Calculation Functions

- Digital comparator function (limits set using keyboard)
- Maximum & minimum value hold
- Deviation measurement (deviation, maximum, minimum)
- Standard deviation
- Averaging
- PPM
- Offset display, drift display
- Scaling display
- Sum and difference display by automatic measurement of Inputs A and B
- Harmonic frequency display
- Arithmetic functions

General Specifications

Measuring modes (Input B):

AUTO: Automatic mode with capture time of approx. 300 ms (from reset until count begins)

FM tolerance 10 MHzp-p (minimum)

MANUAL: Manual key settings of fixed frequency band; no capture action

Bandwidth (FM tolerance)

± 125 MHz or more (1.4 GHz to 18 GHz)

± 25 MHz or more (0.5 GHz to 1.4 GHz)

Sample rate: 50 ms to 5 s continuously variable or HOLD

Delay time: 25 μs to 30 ms continuously variable or OFF (from INT/EXT/LINE trigger until count begins)

Memory backup: Backup is provided when power is supplied from AC line. When power cable is disconnected, approximately two weeks' backup is available from built-in Ni-Cd batteries. Full charging of batteries requires 2 to 3 days.

Auxiliary input/output: Supports gate signal output, wave detection output, external reset signal input and measurement completed signal output; input/output level, 14-pin TTL connector equivalent to Amphenol 57-40140.

Display: 12-digit fixed-point, 7-segment green LED decimal display with memory; character height approx. 11 mm

Operating conditions: 0 to 40°C, 85% relative humidity (maximum)

Storage temperature range: -20 to +60°C

Power requirement: Specified at time of ordering

Option No.	Standard	Option 32	Option 42	Option 44
Power supply voltage	90 to 110 V	108 to 132 V	198 to 242 V	216 to 250 V

48 to 66 Hz

Power consumption: 120 VA (maximum)

External dimensions: Approx. 255 (W) × 132 (H) × 420 (D) mm

Mass: 10 kg (maximum)

Accessories

Item	Model	Product code	Remarks
Power cable	A01402		
Input cable	A01036-1500		BNC-BNC
Input cable	MI-04		N-N

Options

(These options may be added after delivery of the unit by factory retrofitting.)

(Either Option 01 or option 02 (not both) can be selected.)

Option 01: GPIB interface (IEEE 488-1978)

Function Output of displayed data and remote control of front panel key settings

Option 02: BCD data output

Function Parallel output of the nine least significant digits in binary-coded-decimal form; can be connected to Digital Recorder with 50-pin connector equivalent to Amphenol 57-40500

Specifications common to Options 01 and 02:

D/A converter analog output: (From AUX IN/OUT connector)

Digits converted: 3 least significant digits

Output voltage: -4.995 V to +4.995 V ± 20 mV ($+23^\circ \pm 5^\circ\text{C}$)

Output impedance: 100 Ω (maximum)

Digital comparator output: (From AUX INPUT/OUTPUT connector) TTL negative logic, open collector

Option 21, 22 and 23: Time base oscillator

(See Time Base Stability chart above left)

Accessories (Sold separately)

R16058	Transit Case
A02448	EIA Rack Mount Set
A02248	JIS Rack Mount Set