Measuring functions

Frequency A or C
(Frequency B via GPIB only)

Range,

Freq A: 0.1 Hz...120 MHz
Freq B: 0.1 Hz...12 MHz (only via GPIB)
Freq C: 70 MHz...1.3 GHz (option PM 9608B)

Mode: Reciprocal frequency counting.

LSD displayed: $\frac{2.5 \cdot 10^{-7} \cdot \text{FREQ}}{\text{Measuring-time}}$

Period A

Range: 8 ns...$2 \cdot 10^8$ s

Mode: Single period measurement (SINGLE) or period average measurement (at 0.2, 1 or 10 s Measuring-times).

LSD displayed:

SINGLE period measurement:

100 ns (TIME < 100 s)

$\frac{5 \cdot \text{PERIOD}}{10^9 \text{s}}$ (TIME > 100s)

Period average measurement:

$\frac{2.5 \cdot 10^{-7} \cdot \text{PERIOD}}{\text{Measuring-time}}$

Ratio A/B
(Ratio B/A, C/A or C/B only via GPIB)

Range: 0 and $1 \cdot 10^{-7}$...$2 \cdot 10^9$ (A/B)
0 and $1 \cdot 10^{-8}$...$2 \cdot 10^8$ (B/A)
0...$1 \cdot 10^{15}$ (A/B SINGLE and B/A SINGLE)
8...$6 \cdot 10^{10}$ (C/B) (C/A)

Frequency range:

Input A: 0.1 Hz...120 MHz (A/B)
0 Hz...12 MHz (B/A ,C/A, A/B SINGLE)
Input B: 0 Hz...12 MHz
Input C: 70 MHz...1.3 GHz (option PM 9608B)

LSD displayed (Ratio A/B):

$\frac{25}{\text{meas time} \cdot \text{FREQ B}}$ (0.2, 1 or 10 s Measuring-times)

LSD displayed (Ratio B/A):

$\frac{2.5}{\text{meas time} \cdot \text{FREQ A}}$ (0.2, 1 or 10 s Measuring-times)

LSD displayed (A/B SINGLE, B/A SINGLE):

1 RATIO < 10^9

$\frac{5 \cdot \text{RATIO}}{10^9}$ RATIO ≥ 10^9

LSD displayed (Ratio C/A or C/B):

$\frac{640}{\text{meas time} \cdot \text{FREQ A or B}}$

Time interval A-B
(Time interval B-A via GPIB only)

Range:

100 ns...$2 \cdot 10^8$ s (SINGLE)
0 ns...20 s (average)

Mode: Single time interval (SINGLE) or time interval average measurements (at 0.2, 1 or 10 s Measuring-times)

LSD displayed:

SINGLE Time-interval measurement:

100 ns (TIME < 100 s)

$\frac{5 \cdot \text{TIME}}{10^9 \text{ s}}$ (TIME > 100 s)

Time-interval average measurement:

$\frac{2.5 \cdot 10^{-7} \text{ s}}{\text{N}}$

Number of intervals averaged N:

$\frac{\text{Measuring-time}}{\text{pulse repetition rate}}$

Min dead time from stop to start:

250 ns

Timing difference A-B channels:

4 ns max

NOTE: *Input signals must be repetitive and asynchronous with respect to the time base.*

Totalize A
(Totalize B via GPIB only)

Range:
0...1 • 10^{15} with indication of K or M (Kilo-pulses or Megapulses). The result is truncated if out of display range.

Frequency range: 0 Hz...12 MHz

Pulse pair resolution: 8 ns

LSD displayed:
1 unit count (counts < 10^9)
5 • counts/10^9 (counts ≥ 10^9)

Gated by B (A) mode:
Event counting on input A (B) during the duration of a pulse on input B (A).

Start/stop by B (A) mode:
Event counting on input A (B) between two consecutive pulses on input B (A).

Manual mode:
Event counting is controlled by the START/STOP button. Sequential start-stop counts are accumulated. RESET closes the gate and resets the Timer/Counter to zero.

Volt max/min A
(Volt max/min B via GPIB only)
Range: -51 V... +51 V

Frequency range:
DC and 100 Hz...50 MHz (input A)
DC and 100 Hz...5 MHz (input B)

Resolution:
Input signals within ±5 V: 20 mV
Input signals outside ±5 V: 200 mV

Inaccuracy DC and 100 Hz...12 MHz(A) or ...1 MHz(B):
Input signals within ±5 V:
30 mV ± 1% of reading ± 3% of V_{PP}
Input signals outside ±5 V:
300 mV ± 3% of reading ± 3% of V_{PP}

Inaccuracy 12 MHz...50 MHz(A) or 1 MHz...5 MHz(B):
Input signals within ±5 V:
30 mV ± 10% of reading ± 10% of V_{PP}
Input signals outside ±5 V:
300 mV ± 10% of reading ± 10% of V_{PP}

Definitions

LSD displayed

LSD = Unit value of the least significant digit displayed. All calculated LSD:s (see section Measuring functions) should be rounded to the nearest decade (e.g 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Resolution = smallest increment between two measuring results on the display, due to the 1 count error.

Freq A, C, Period A and Ratio A/B:

Resolution can be 1 LSD unit or 2 LSD units.

If; $\frac{\text{LSD} \cdot \text{Measuring-time}}{\text{FREQ or PERIOD}} < 10^{-7}$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).

Ratio A/B:

Resolution can be 1 LSD unit or 2 LSD units.

If: $\frac{\text{LSD} \cdot \text{Measuring-time}}{\text{RATIO}} < \frac{10}{\text{FREQ A}}$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).

SINGLE Period A and SINGLE Ratio A/B:

Resolution equals 1 LSD unit.

Time A-B:

Resolution (95% confidence level) equals 1 LSD unit or 100 ns/$\sqrt{N}$, whichever is greatest.

Inaccuracy

Inaccuracy, i.e the relative error, depends on the following factors:

$$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD, RATIO or TIME}}$$

± relative trigger error

± relative time base error

± relative systematic error

Relative trigger error:

Freq A, Period A:

$$\pm \frac{\text{noise voltage A } (V_{pp})}{\text{signal slope A (V/s)} \cdot \text{meas time}}$$

Ratio A/B:

$$\pm \frac{\text{noise voltage B } (V_{pp})}{\text{signal slope B (V/s)} \cdot \text{meas time}}$$

Totalize A, gated or start stop by B:

$$\pm \frac{\text{noise voltage B } (V_{pp})}{\text{signal slope B (V/s)} \cdot \text{gate time B}}$$

Time A-B:

$$\pm \frac{\text{noise voltage A } (V_{pp})}{\text{signal slope A (V/s)} \cdot \text{TIME} \cdot \sqrt{N}}$$

$$\pm \frac{\text{noise voltage B } (V_{pp})}{\text{signal slope B (V/s)} \cdot \text{TIME} \cdot \sqrt{N}}$$

Relative time base error:

$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

Relative Time A-B systematic error:

Inaccuracy caused by timing difference between A and B channels < ±4 ns/TIME.

Input specifications

Input-A and Input-B

Frequency range:
0 Hz...120 MHz (Typically up to 160 MHz with 60 mV_{RMS} input signal.)

Sensitivity,
DC coupled;
Sine: 20 mV_{RMS}, 0 Hz...30 MHz
40 mV_{RMS}, 30 MHz...120 MHz
Pulse: 60 mV_{PP}, 0 Hz...30 MHz
110 mV_{PP}, 30 MHz...120 MHz

AC coupled;
Sine: 20 mV_{RMS}; 20 Hz...30 MHz
40 mV_{RMS}; 30 MHz...120 MHz

Sensitivity is selectable in 6 steps; 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1 V_{RMS} (sine); nominal.

The sensitivity is decreasing to 60 mV_{RMS} at 160 MHz typically.

Coupling: AC- or DC- coupled, switch selectable.

Impedance: 1 MΩ // 35 pF, independent of "COM B via A" switch setting.

Attenuation: x1 or x10, switch selectable or AUTO.

Trigger levels:
DC coupled:
+51 V...-51 V, adjustable via up/down control.
AC coupled:
0 V fixed or auto level.

Trigger level resolution:
20 mV; signals within ±5 V
200 mV; signals outside ±5 V

Trigger level setting accuracy: ±10 mV ±1% of setting

AUTO trigger level:
Trigger level on input A (and B when required) is automatically set to 50% of input signal amplitude.

Frequency range: 100 Hz...120 MHz

Trigger indicators: Tri-state LED-indicators;
On: Signal above set trigger level.
Off: Signal below set trigger level.
Blinking: Triggering occurs.

Trigger slopes: Positive or negative.

Channel input: Separate A and B, or A and B common via input-A.

Maximum voltage:
350 V ($DC + AC_{peak}$) between 0 and 440 Hz, falling to 8 V_{RMS} at 1 MHz.

Input-C
(option PM 9608,-08B or PM 9615)

Frequency range:

PM 9608B:	70 MHz ... 1.3 GHz
PM 9608:	100 MHz ... 1.1 GHz
PM 9615:	70 MHz ... 1.0 GHz

Coupling: AC

Operating input voltage range:

PM 9608B:
10 mV_{RMS}...12 V_{RMS}, 70 MHz...900 MHz
15 mV_{RMS}...12 V_{RMS}, 900 MHz...1.1 GHz
40 mV_{RMS}...12 V_{RMS}, 1.1 ... 1.3 MHz

PM 9608:
10 mV_{RMS}...12 V_{RMS}, 100 MHz...900 MHz
15 mV_{RMS}...12 V_{RMS}, 900 MHz...1.1 GHz

PM 9615:
15 mV_{RMS}...12 V_{RMS}, 70 MHz...100 MHz
10 mV_{RMS}...12 V_{RMS}, 100 MHz...1.0 GHz

AM tolerance:
98%, minimum signal must exceed minimum operating input voltage requirement

Impedance: 50 Ω nominal, VSWR < 2

Maximum voltage without damage:
12 V_{RMS}, overload protection with PIN diodes.

Ext reference input

The input automatically detects when a suitable external reference signal is connected. The use of an external reference signal is indicated on the display.

Input frequency: 10 MHz ±0.1 MHz

Coupling: AC

Sensitivity: 500 mV_{RMS}

Input impedance: approx. 300 Ω at 10 MHz

Max input voltage: 15 V_{RMS}

General information

Power requirements

Line voltage:
115 or 230 V_{RMS} ±15%;
46...440 Hz, (<24 VA incl. all options).

Safety:
in accordance with IEC 348 CLASS I and CSA 556B.

Line interference:
below VDE 0871 B and MIL STD 461.

Battery unit: See PM 9605 option.

Dimensions and weight

Width: 186 mm
Height: 88 mm
Depth: 270 mm
Weight,
net: 2.4 kg
shipping: 3.2 kg

Cabinet:
The counter is housed in a metal cabinet, to minimize electro-magnetic interference and achieve good mechanical stability.

Environmental conditions

Temperature,
Operating: 0°C...+50°C
Storing: -40°C...+70°C

Altitude,
Operating: 5000 m (53.3 kN/m^2)
Storing: 15000 m (15.2 kN/m^2)

Humidity,
Operating: 10%...90% RH, no condensation
Storing: 5%...95% RH

Vibration test: According to IEC 68Fc

Bump test: According to IEC 68Eb

Handling test: According to IEC 68Ec

Display

Read out:
9 digit LCD display with unit indication.

Unit indication:
MHz, kHz, Hz, mHz, ks, s, ms, s, ns, M, k, m, μ and n.

GATE indicator:
Indicates that the counter is busy measuring.

REMOTE indicator:
Indicates when control over the counter is taken over by an installed GPIB interface PM 9604.

Cursor:
Indicates selected measuring function, selected Measuring-time, input triggering, display hold and whether an external reference frequency is in use.

Time base (Crystal oscillator)

Choice of:
- Uncompensated crystal oscillator (order no PM 6666/.1.)
- MTCXO, i.e. Mathematically Temperature Compensated Crystal Oscillator (order no PM 6666/.3.). The MTCXO can be ordered separately for later upgrading of the counter (option PM 9607).

MTCXO working principle:
The temperature of the crystal is measured. The built-in microprocessor calculates the frequency deviation for that particular temperature from a stored table. The measuring result is mathematically corrected for the time-base frequency temperature error, before being displayed. The correction is switched off when SINGLE is selected to increase the number of measurements/second. This may introduce an additional time base error of $< 1 \cdot 10^{-5}$.

Oscillator version:

	Uncompensated	MTCXO
Stability against:		
Ageing per month	$<5 \cdot 10^{-7}$	$<1 \cdot 10^{-7}$
per year	$<5 \cdot 10^{-6}$	$<5 \cdot 10^{-7}$
Temperature changes 0...50°C	$<1 \cdot 10^{-5}$	$<2 \cdot 10^{-7}$
Line voltage changes 10%	$<1 \cdot 10^{-8}$	$<1 \cdot 10^{-9}$

Auxiliary functions

Power on/off

Switches counter power on/off. At power up a self-test is made and the counter is set to default settings.

Default settings,

Function:	FREQ A
Measuring-Time:	0.2 s
Coupling:	AC on Input-A DC on Input-B
Trigger level:	Auto
Trigger slope:	Positive on A and B.

Reset

The RESET-button has three functions:

1.	RESET	Starts a new measurement. The settings are not changed.
2.	LOCAL	Makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
3.	START/ STOP	Opens/closes the gate in TOTALIZE A or B manual mode.

Measuring-time

A Measuring-time of 0.2 s, 1 s, 10 s or SINGLE can be selected.

NOTE: When SINGLE is selected together with PERIOD, RATIO or TIME, the result is a single cycle measurement, but SINGLE together with FREQUENCY results in a fixed 3 ms Measuring-time.

Measuring rate:
Approx. 5 measurements/s. Approx. 2 measurements/s when AUTO trigger level is switched on.

Display time:
Normally the display time equals the set Measuring-time. When SINGLE is selected, a display time of 0.1 seconds is used.

Displ hold

The result of the current measurement will be frozen on the display. A new measurement starts when RESET button is pressed.

Optional accessories

GPIB-interface, PM 9604

Mounting:
Inside counter cabinet.

Interface functions:
SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2

Address setting:
Switch selectable at rear panel between 0 and 30. Factory preset at 10.

Programmable device functions:
Measuring functions
Measuring-time
Trig level offset selection
Trigger slope
Manual Totalize gate control
Output separator selection
Device clear
Device trigger
High-speed dump
MTCXO on/off
Short output format
Free run/Triggered measurements
Set SRQ-mask
Program data out queries
Device identity query

Programming code format:
7-bit ISO code (ASCII) characters. Both upper and lower case characters are accepted.

Input separator:
The counter accepts the following characters as separators:
ETX, ETB, CR, LF, ' '(space) ','(comma), ':'(colon) ';'(semicolon).

Output data separator:
Default separator at power-on is LF. The separator can be programmed to be any non printable ASCII--code with decimal equivalent 0-31, except 27 (ESC).

In addition the combination 13+10 (CR+LF) can be programmed. The EOI-line can be programmed to be active together with the last output byte sent.

Output format:

Measuring result is sent as:

FFFFFFOXXXXXXXXXXE±XS(S) 21(22) characters.

FFFFFF	=	Function code 3...6 characters
O	=	Normally space. O on overflow
X...X	=	Measuring result
E	=	Exponent pointer
±	=	Exponent sign (+ or -)
X	=	Exponent value 0...9
S	=	Selected separator
(S)	=	Second separator LF only if output separator CR+LF has been selected.

When you select 'Short output format' FFFFFF and leading zeroes are omitted.

High-speed dump
The contents of the counting registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead. Max output rate is approximately 100 readings/s.
The output format is FMXXXXXXXXXXXXS(S) where F is calculation formula, M is multiplier, X..X = 12 hex-digits representing the register contents, and S(S) is the set output separator.

Ranges:
Same as for normal operation, with the following exceptions:

Frequency;	Max measuring time: 1 s
Period, average;	Max measuring time: 1.4 s
Time interval, average;	0 ns...1.6 s Max measuring time: 4 s
Ratio A/B:	0 and $6 \cdot 10^{-7}$ ... $1.6 \cdot 10^{8}$
Ratio B/A:	0 and $6 \cdot 10^{-8}$ ... $1.6 \cdot 10^{7}$
Ratio C/A, C/B:	$8...4 \cdot 10^{9}$

Max data output rate:
Normal mode gives >5 readings/s. High-speed dump gives > 100 readings/second,. The highest output rate is obtained at SINGLE Measuring-time.

Output time for measuring data;
Normal operation: Approx. 10 ms (21 bytes)
High-speed dump: Approx. 4 ms (15 bytes)

Response time for addressing:
Approx. 5 µs

Response time for trigger command (GET):
Normal operation: Approx. 10 ms
High-speed dump: Approx. 2 ms

Response time for serial poll:
Approx. 1.5 ms

Input buffer size: 28 bytes

Typical read time for programming data:
Approx. 1 ms/byte (unless input buffer is full)

Battery unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6 V sealed lead-acid battery and an automatic battery charger.

Battery capacity (20°C):
Approx 15 Wh

Operating time when battery powered:
2 hours of continuous operation.

Recharging time:
7 hours to approx 75% of full capacity.

Battery protection:
Overcharge protection and auto-shut-off total discharge protection.

Temperature,
Operating: 0...+40°C
Storage: -40...+50°C

Weight: 0.8 kg

Rack-mount kit PM 9606

The PM 6666 can be installed in a standard 19" rack using the rack-mount kit PM 9606. One counter PM 6666 can be installed together with a second instrument with a half 19-inch width.

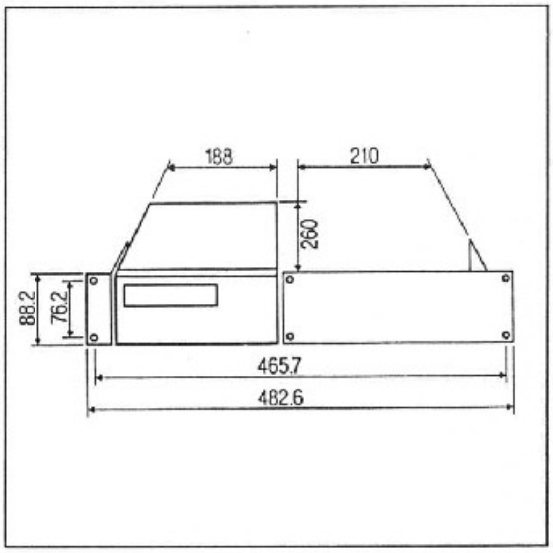


Figure 16. Size of the Rack-mount kit.

High stability time-base PM 9607

See specifications for optional MTCXO time-base.

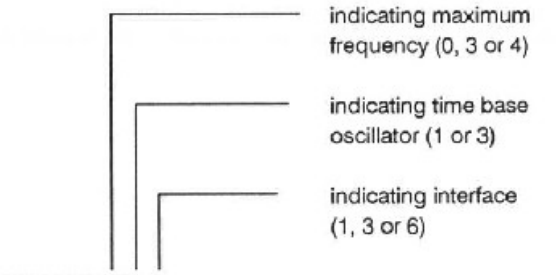
HF-input PM 9608, -08B, -15

See specifications for optional Input-C.

Ordering information

Versions

The PM 6666 ordering number consists of the basic type number and a 3 digit XYZ suffix, specifying the required con-figuration.



Type No.	Description
PM 6666/011	Universal frequency counter, 120 MHz frequency range, uncompensated oscillator $5 \cdot 10^{-7}$/month, incl operators' manual.
PM 6666/3..	As above, but including 1.0 GHz HF-input PM 9615.
PM 6666/4..	As above, but including 1.3 GHz HF-input PM 9608B.
PM 6666/.3.	As above, but including crystal oscillator PM 9607 (MTCXO).
PM 6666/..3	As above, but including battery unit PM 9605.
PM 6666/..6	As above, but including GPIB interface PM 9604.

Example: PM 6666/416 means a PM 6666 frequency counter, including both an 120 MHz and an 1.3 GHz input channel, an uncompensated oscillator and a GPIB interface.

Options and accessories

PM 9604	GPIB-interface
PM 9605	Battery unit
PM 9606	Rack-mount kit
PM 9607	MTCXO time-base
PM 9608	1.1 GHz HF-input (replaced by PM 9608B)
PM 9608B	1.3 GHz HF-input
PM 9609	Carrying case
PM 9615	1.0 GHz HF-input (Only available in some contries)

PM 2296/50	IEEE to IEC adapter
PM 2295/05	IEEE cable, 0.5 m
PM 2295/10	IEEE cable, 1 m
PM 2295/20	IEEE cable, 2 m

PM 8911	1.5 GHz, 500 Ω probe set, 1:10
PM 8922	120 MHz, 1 MΩ probe set, 1:1 and 1:10
PM 8943	650 MHz, 1 MΩ FET probe set
PM 9581	50 Ω termination, 3 W
PM 9585	50 Ω termination, 1 W

All options mentioned above can be installed by the customer.

NOTE: The GPIB interface PM 9604 and the battery unit PM 9605 can not be installed together in a PM 6666 counter.

Manuals

9499 460 12611	Operators' Manual
9499 460 12618	Operators' Manual (German)
9499 460 12632	Operators' Manual (French)
9499 465 01011	Service Manual
9499 460 12711	GPIB Pocket Guide