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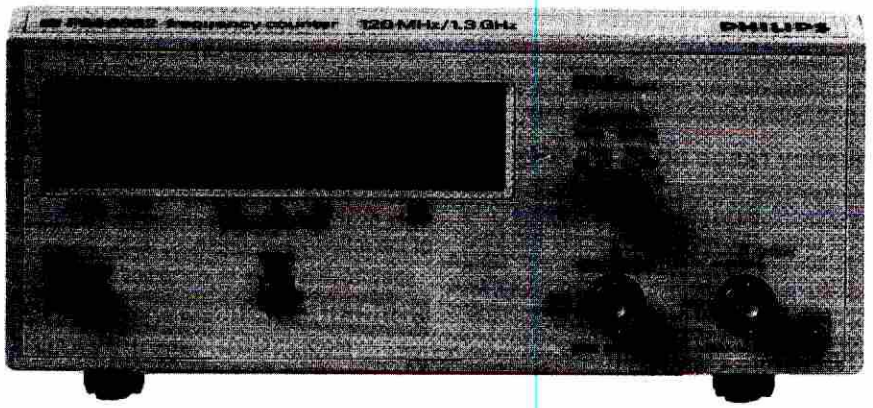
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High Resolution Frequency Counters

PM 6662 & PM 6669



PM6662

PM 6662 & 6669 High Resolution Frequency Counters

- Unrivalled price/performance
- High resolution reciprocal counting
- Error-free triggering
- High stability MTCXO: 2 x 10^{-7} over 0° ...50°C with pushbutton calibration
- Eight measuring modes including PULSE WIDTH
- Versatile use with the GPIB/IEEE-488 interface or battery operation
- 1.3 GHz RF-input

Introduction

The PM 6662 and PM 6669 are economic, easy-to-use counters that meet the most stringent demands for high-precision measurements, reliability and durability.

The PM 6662 handles frequency measurements, while the multi-function PM 6669 offers period, count totalization, ratios, pulsewidth and frequency difference measurements.

Options for further enhancement include a 1.3 GHz input, battery pack and high-stability MTCXO timebase oscillator for both models, and a GPIB/IEEE-488 interface for the multi-function PM 6669.

The built in microprocessor uses the reciprocal frequency counting technique to yield high resolution measuring results under all conditions even on low frequency measurements. Measuring accuracy is improved by the high performance front-end, providing continuous adjustment of sensitivity and noise immunity. Accuracy can be further increased with the optional high-stability time-base PM 960.

The instruments are designed to fullfil a broad range of needs with a full range of options, including GPIB/IEEE-488 bus interface for systems use and a battery pack for independent field use.

These counters are housed in a sturdy, durable all-metal casing providing excellent shielding against RF interference. Both counters, therefore, have the durability and ruggedness to meet the demands of field service applications and severe environmental conditions.

The Versatile Counter - PM 6669

The PM 6669 offers as many as 8 measuring functions, including pulsewidth and relative frequency measurements; functions normally found only in more expensive timer/counters.

A wide range of configurations optimize the counter to meet your specific requirements. The PM 6669 can be used on the testbench, in GPIB/IEEE-488 systems (with the optional GPIB/IEEE-488 interface and rackmount kit), or for field service (using the optional battery pack and carrying case).

For enhanced performance, the 1.3 GHz input option or the high-stability MTCXO timebase oscillator can be ordered. All these options can be retrofitted at any time.

Both counters have a full 9-digit display, to allow complete presentation of measuring results. When less accurate masurements are required, blanking of irrelevant display digits can be made.

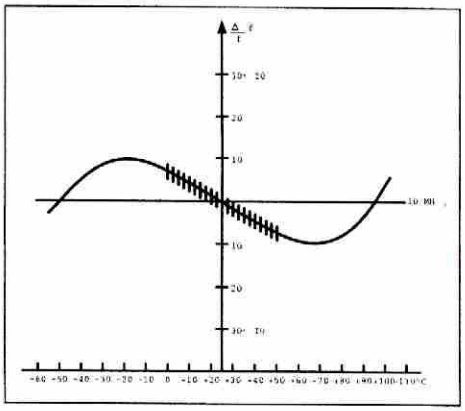
MTCXO timebase

Counter stability and precision have always been limited by the timebase crystal oscillator. Achieving really high stability demanded the use of costly oven-stabilized oscillators, while lower cost instruments use standard crystal oscillators or TCXOs (Temperature Compensated Crystal Oscillator).

The new PM 6662 and PM 6669 counters are available with the unique Philips MTCXO (Mathematically Temperature Compensated Crystal Oscillator). The temperature dependency curve for each individual crystal oscillator is factory measured, and the frequency deviations across the temperature range (Δf) are stored in a non-volatile memory.

During operation, the Δf value for the operating temperature is looked-up in the memory and used to compensate the measuring result before it is displayed. This automatic temperature compensation also results in highly accurate measurements instantly, without the need for long warm-up times.

The unique MTCXO principle gives a residual temperature stability of 2 x 10^{-7} over the temperature range 0° ...50°C, a value comparable to that of oven-stabilized oscillators, but at much lower cost.

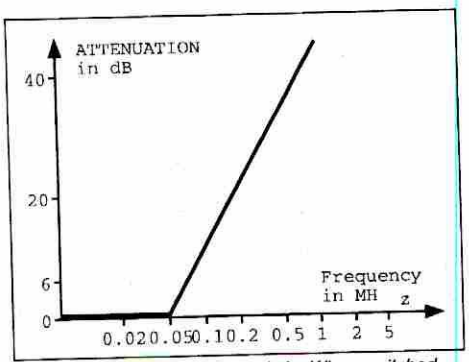


The ΔF characteristics for each MTCXO crystal are factory-measured and stored in a look-up table in a non-volatile memory. The ΔF value for any operating temperature is looked up during operation and used to correct the measured frequency value before display

Unprecedented Counter Value

The precision and stability of the MTCXO oscillator isn't the only way that PM 6669 and PM 6662 set new standards. The high-sensitivity input circuitry, with automatic triggering on all input waveforms, continuously variable attenuation and a switchable low-pass filter for noise reduction all features normally found only in higher priced counters.

The PM 6669 also offers an additional



Noise-rejection filter characteristic. When switched on, all HF noise and interference signals are suppressed as indicated

GPIB/IEEE-488 bus interface that provides full remote control programmability of all major functions, making it probably today's lowest cost programmable precision counter.

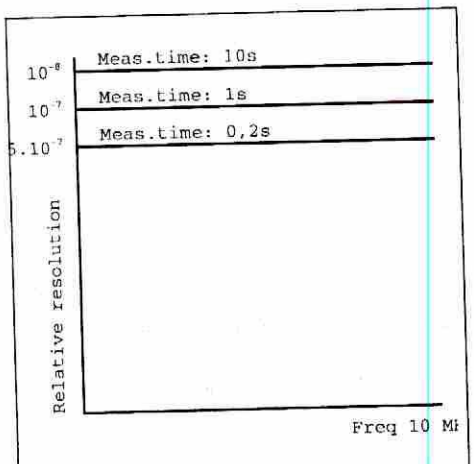
The PM 6669 and PM 6662 use Philips' state-of-the-art electronics technology throughout, including a new LSI single-chip counter which, together with a single-chip microprocessor, forms the complete counter logic. SMD (surface-mounted device) technology is also used for precise, highly automatic assembly.

Our advanced technology results in compact construction, low dissipation and very high reliability. All these benefits, in combination with PM 6662 and PM 6669's very attractive price level, add up to an unprecedented combination of counter performance and value.

High-resolution measurements

Synchronized multiple-period measurements, with computation of the reciprocal value, allow high-resolution measurements on signals of all frequencies. The microprocessor eliminates traditional ±1 input cycle errors, resulting in a measurement result of at least 7 digits per second of measuring time, regardless of the input frequency. This capability eliminates the need for the long gate times or period measurements which are normally required to obtain high resolution.

A full 9-digit display allows complete presentation of the measurement result, while unstable or insignificant display digits can be blanked to avoid erroneous readings of the display.

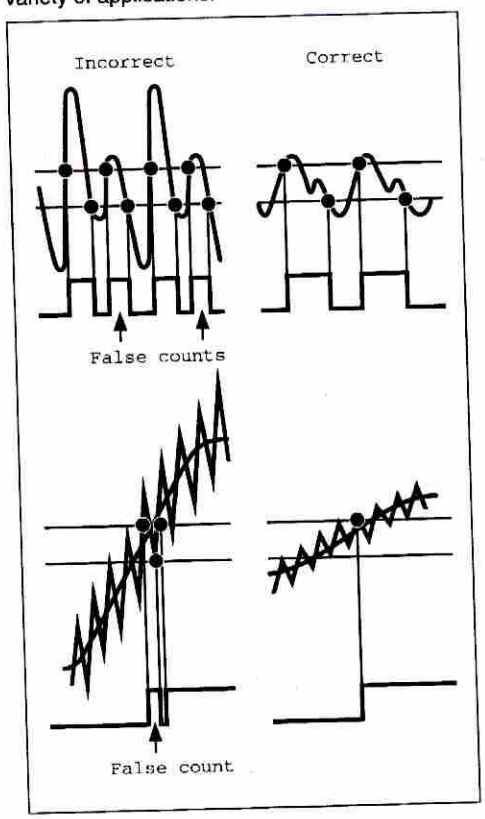


A variable input attenuator enables correct matching of the input signal to the trigger sensitivity of the counter. False counts caused by interference, distortion and noise are thereby prevented.

Frequency range up to 1.3 GHz

As standard, the PM 6662 and PM 6669 counters are guaranteed to measure frequencies up to 120 MHz under all conditions (typically 160 MHz at room temperature). The optional HF input extends the range right up to 1.3 GHz, ideal, for example, for measurements on telecommunications equipment.

The HF input has a very wide operating voltage range, from 10 mVrms to 12Vrms, to suit a wide variety of applications.



Smartandsimple-PM 6662

For frequency measurements, the PM 6662 combines the same high accuracy as the PM 6669 with simple, foolproof operation every time.

The AUTO DISPLAY function always gives the correct range (Hz, kHz or MHz) and resolution for any input frequency and selected measuring time.

AUTOTRIGGER automatically sets the right trigger level to ensure correct triggering, whatever the waveform. A choice of measuring times allows for the optimum selection of measuring speed versus accuracy, and selection of sensitivity over a wide range allows for suppression of the influence of noise.

Specifications

Measuring Functions

Frequency A (standard) or B (optional)

Frequency range:
Freq A: 10 Hz ...120 MHz
(typically...160 MHz)
Freq B: 70 MHz... 1.3 GHz (PM 9608 B)
Mode: Reciprocal frequency measurement
LSD unit displayed:

$$\frac{2.5 \times 10^{-7} \times \text{FREQUENCY}}{\text{measuring time}}$$

Frequency A/A_0 (PM 6669)

The FREQ A measurement is divided by the constant A_0 before display. At power-on, A_0 is set to 1 (default).

Frequency $A-A_0$ (PM 6669)

The FREQ A measurement is subtracted by the constant A_0 before display. At power-on, A_0 is set to 0 (default).

RPM A(PM 6669)

The freq A measurement is multiplied by 60 and displayed as revolutions per minute (RPM).
Range: 6 RPM ... 720 x 10^6 RPM

PeriodA(PM 6669)

Range: 8 ns x 10^8 s
Mode: single period measurement (SINGLE) or period average measurement (at 0.2, 1 or 10s measuring times).
LSD displayed:
SINGLE period measurement:
100 ns (TIME<100s)

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

Period average measurement:

$$\frac{2.5 \times 10^{-7} \times \text{period}}{\text{Measuring time}}$$

Totalize A (PM 6669)

Event count is controlled by the START/STOP button. Sequential start-stop counts are accumulated.
Range: 0...1 x 10^{15} with indication of K or M (kilo-pulses or mega-pulses). The result is truncated to 9 digits
Frequency range:
Sine wave: 10 Hz... 12 MHz
Pulse: 0 Hz... 12 MHz
Pulse pair resolution: 80 ns

Width A (PM 6669)

A positive pulse width measurement is performed. Measuring time selection is not valid (always SINGLE)
Range: 100 ns...2 x 10^8 s
LSD displayed: 100 ns (TIME<100s)
$\frac{5 \times \text{width}}{10^9 \text{s}}$ (TIME ≥ 100s)

Input Specifications

Input A (PM 6662)

Frequency range:
10 Hz...120 MHz (typically...160 MHz)
Coupling: AC
Impedance: 1 MΩ//30 pF
Max. sensitivity:
Sinewave: 30 mV rms; 10 Hz...100 Hz
15 mV rms; 100 Hz...75 MHz
30 mV rms; 75 MHz...120 MHz
60 mV rms; Typically: 120 MHz... 160 MHz
Pulse: 90 mV p-p; 10 Hz...100 Hz
50 mV p-p; 100 Hz...75 MHz
90 mV p-p; 75 MHz...120 MHz
Minimum pulse duration: 4 ns
Attenuation: X1,X3, X10, X30, X100 and X300. The attenuation selector is labelled sensitivity; 15 mV, 50 mV, 150 mV, 500 mV, 1.5V, 5V.
Trigger level: A fixed (+, 0 or -)
Trigger level offset is automatically applied to ensure correct triggering on any waveform and duty cycle (AUTO trigger)
Maximum voltage without damage: 350V (DC+AC peak) DC...440 Hz falling to 12 Vrms at 1 MHz

Input A (PM 6669)

Frequency range:
10 Hz...120 MHz (Typically up to 160 MHz with 30 mVrms input signal).
Sensitivity:
Sine: 10 mVrms 10 Hz...120 MHz
(30 mVrms typically, 120...160 MHz)
Pulse: 30 mVp-p 0 Hz...120 MHz
Coupling: AC
Impedance: 1 MΩ//30 pF
Attenuation: continuously variable in two ranges between x1 and x400.
Filter: Switchable 50 kHz low pass noise filter with a supression of 20 dB at 200 kHz.
Trigger levels: 3 different levels for triggering on signals with various duty factors, and AUTO.


used for symmetrical input signals with a duty factor of 0.25...0.75.


used for input signals with duty factor <0.25.


used for input signals with duty factor >0.75.

AUTO trigger level: The counter selects a suitable trigger level setting automatically (not active in TOT-A measurements)
Input signal repetition rate: >100 Hz
Trigge slopes (via GPIB/IEEE488 only): + or -
Maximum voltage without damage: 350V (DC + AC peak) between DC and 440 Hz, falling to 11 Vrms at 1 MHz.

Input B (Option PM 9608B):

Frequency range: 70 MHz...1.3 GHz
Coupling: AC
Operating input voltage range:
10 mV/rms...12Vrms; 70...900 MHz
15 mV/rms...12Vrms; 900...1100 MHz
40 mV/rms...12Vrms; 1100...1300 MHz
AM tolerance: 94% at max 100 kHz modulation frequency. Minimu signal must exceed minimum operating input voltage requirement.
Input impedance: 50Ω nominal, VSWR <2:1
Max. voltage without damage: 12 V/rms; overload protection with pin diodes

External reference input

The external reference input is automatically selected when an external signal of 9.9...10.1 MHz is connected.
Input Frequency: 10 MHz±0.1 MHz
Coupling: AC
Operating input voltage range: 500 mV/rms ...15 Vrms (sine)
Maximum voltage without damage: 15V/rms
Impedance: approx 300Ω at 10 MHz

Auxiliary Functions

Reset (PM 6669 only)

The RESET-button has three functions
1: **RESET.** Starts a new measurement. The settings are not changed.
2: **LOCAL.** Sets the counter to LOCAL, used when in remote operation (unless Local Lock-out is programmed).
3: **START/STOP.** Opens/closes the gate in TOTALIZE A MAN mode.

Displ Hold/Store A_0 (PM 6669 only)

The Displ Hold/Store A_0 button has two functions:
1: **DISPL HOLD:** The current measuring result is frozen on the display. A new measurement starts when the Reset button is pressed.
2: **STORE A_0:** This function is active in Frequency A measurements only. When the button is pressed for >1s, the result on the display is stored as the constant A_0, which is used for the calculation of frequency difference ($A-A_0$) and ratio (A/A_0).

Blank Digits (PM 6669 only)

This function blanks any number of least significant digits on the display, in order to mask unstable display digits

Definitions

LSD displayed

LSD = Unit value of least significant digit displayed. All calculated LSDs 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, B, Period A:
Resolution can be 1 LSD unit or 2 LSD units.
if: $\frac{\text{LSD} \times \text{measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$
the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
SINGLE Period A and Width A:
Resolution equals 1 LSD unit.

Inaccuracy

Inaccuracy, i.e. the relative error, depends on the following factors:
$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD or WIDTH}}$
± relative trigger error
± relative timebase error

Relative trigger error:

Freq A, Period A:
$\pm \frac{\text{noise voltage A (Vp-p)}}{\text{signal slope A (V/s)} \times \text{meas. time}}$
Relative timebase error:
$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$

Note: For WIDTH measurements, triggering on 50% of amplitude will occur only if the duty factor is 0.5. In other cases the timing error caused by wrong trigger level setting should be added to inaccuracy.

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PM 6662 & PM 6669

General Specifications

Power requirements

Line voltage: 115 or 230V ± 15%, 45...440 Hz, less than 20 VA
Fuse: Internal thermal fuse in mains transformer
Line interference: Below VDE 0871 B

Time Base

Alternatives:
Standard built-in crystal oscillator. Order no. PM 6662/.1. or PM 6669/.1.
MTCXO. Mathematically Temperature Compensated Crystal Oscillator. Order no. PM 6662/.3. or PM 6669/.3. The MTCXO can be separately ordered (option PM 9607) for later upgrading of the counter.

Osc version:	Standard	MTCXO
Stability against:		
Ageing /month	$<5 \times 10^{-7}$	$<1 \times 10^{-7}$
/year	$<5 \times 10^{-6}$	$<5 \times 10^{-7}$
Temperature 0...50°C	$<1 \times 10^{-5}$	$<2 \times 10^{-7}$
Line voltage change 10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$
Change in supply line/battery	$<5 \times 10^{-7}$	$<1 \times 10^{-8}$

Environmental

Warming up time to reach specification: 5 minutes
Temperatures:
storage: -40°C...+70°C
Operating: 0°C...+50°C
Altitude: Operating and non-operating; 4600m (15000 ft)
Humidity: 95% R.H.; 0°C...40°C
Vibration: Operating; 15 min along each of the 3 major axis, 10 Hz...150 Hz, 0.3 mmp-p displacement and 2g max. acceleration.
Shock: Operating; 3 shocks along each of the 3 major axis, half sinewave, 6 ms duration and 40g acceleration pulses
Bench handling: MIL-STD-810D method 516.3, procedure VI
EMC: Meets VDE 0871 (B) and FCC part 15J
Safety: CSA bulletin 556B certified and Philips certification to comply with IEC 348 Class 1

Display

Read out: 9-digit LCD with unit indication
Gate indicator: Indicates gate open,i.e. measurement activity.
Cursors:
PM 6662: indicate used input (A or B), measuring time and use of ext. reference frequency
PM6669: Indicate selected measuring function, measuring time, input triggering, display hold and use of ext. reference frequency

Measuring Time/Rate

Measuring time:
PM 6662: 0.2, 1 and 10s
PM 6669: 0.2, 1, 10s and SINGLE
Note: SINGLE selected in PERIOD or WIDTH, results in a single cycle measurement. SINGLE in FREQUENCY or RPM, results in a fixed measuring time of 3 ms.
Display time: The display time equals measuring time plus approx 100 ms.
Max. measuring rate: Approx 5 measurements/s (standard osc). or 2 measurements/s (MTCXO)

Mechanical Specifications

Width x Height x Depth:
PM 6662: 186 x 88 x 220 mm (7.3 x 3.5 x 8.7 inches)
PM 6669: 186 x 88 x 270 mm (7.3 x 3.5 x 10.7 inches)
Net weight: PM 6662: 1.6 kg (3.6 pounds)
PM 6669: 2.1 kg (4.6 pounds)
Shipping weight:
PM 6662: 2.6 kg (5.7 pounds)
PM 6669: 3.1 kg (6.8 pounds)
Cabinet: All-metal cabinet with fold-down tilting support that also acts as a handle.

Optional Accessories

GPIB/IEEE-488 Interface, PM 9604

(PM 6669 only)

Mounting: Inside counter cabinet.
Interface functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Address setting: Switch selectable between 0 and 30.
Programmable device functions: All front panel settings except Power on/St by, sensitivity and filter on/off; plus Trigger Slope (pos/neg).
Special bus functions:
Output separator selection
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. Upper or lower case characters.
Input separator: The counter accepts the following separators:
EXT, ETB, CR, LF, '(space)', '(comma)', '(colon)', '(semicolon)'.
Output data separator: Default separator at power on is LF. The separator can be programmed to any non-printable ASCII code with decimal equivalent 0-31, except 27 (ESC). The combination 13 + 10 (CR + LF) can be programmed. The EOI line can be programmed to be active together with the last sound output byte sent.

Output format:
Normal: 20 characters plus separator(s)
7 characters alphabetic header plus 13 characters numeric value
Short output: Alphabetic header and leading zeros are omitted.
High-speed dump:
The contents of internal registers are transferred to the controller without being processed by the counter. The processing must be done in the controller instead.
Max. output rate: approx 100 readings/s
Output format: A 2 character header, followed by 12 Hex-digits plus separator(s)
Max. data output rate:
Normal mode: Approx 5 readings/s
High-speed dump: Aprox 100 readings/s
Output time for measuring data:
Normal mode: Approx. 15 ms (20 bytes)
High speed mode: Approx. 6 ms (15 bytes)
Response time for addressing:
Approx. 600 µs
Response time for trigger command (GET):
Approx. 10 ms
Typical readtime for programming data:
Approx 1 ms/byte

Battery unti PM 9605

The PM 1905 is a rechargeable battery unit for mounting inside the counter. The unit cantains a standard 6V sealed lead-acid battery and an automatic battery charger.

Battery capacity (20°C): Approx 15 WH
Operating time when battery powered: Approx 3 hours of continuous operation.
Recharing time: 7 hours to apprix 75% of full ecpacity.
Battery protection: Overchary protection and deep discharge (auot-shut-off) protection.
Low battery indication: All display indications will blink when apprix 15 minites operation time is left
Temperature:
Operating: 0...+40°C
Storage: -40...+50°C
Weight: 0,8 kg

Rack-mount kit PM 9606

PM 6662 or PM 6669 can be installed in a standard 19" rack using the rack -mount kit PM 9606.
One counter PM662/69 can be installed together with a second instrument with a half 19-ich width, e.g. Philips PM 2534/35 DMMS.

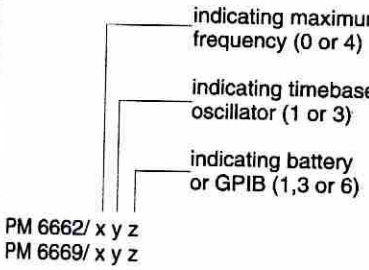
Carrying case PM 9609

The PM 9609 is a leather-lock case to protect the PM 6662/69 counters during transportation.

Ordering information

Versions

The PM 6662/69 ordering numbers consists of the basic type number and a 3 digit XYZ suffix specifying the reqiured cinfiguration.



Type No **Description**

PM 6662/011 Basic frequency counter, 120 MHz frequency range, standard oscillator 5 x 10^{-7}/ month, incl. operation's manual.
PM 6669/011 Basic frequency counter, 120 MHz frequency range, standard oscillator 5 x 10^{-7}/ month, incl. operations manual
PM 666./4.. As above, but including 1.3 GHZ input PM 9608B.
PM 666./3. As above, but including crystal oscilator PM 9607 (MTCXO)
PM 666./..3 As above but including battery unit PM 9605.
PM 6669/..6 As above but including GPIB interface PM 9604,

Example: PM 6669/413 means a PM 6669 freqeuncy counter, including both a 120 MHz and a 1.3 GHz input channel a standard oscillator and a battery pack.

Options and accessories

PM 9604 GPIB interface
PM 9605 Battery unit
PM 9606 Rack mount adapter
PM 9607 MTCXO time-base
PM 9608B 1.3 GHz HF-input
PM 9609 Carrying care
PM 9665B 50 KHz Low-pass filter, BNC-BNC
PM 8911/091 1.5 GHz 500 Ω probe set 1:10-
PM 8922/501 120 MHz , 1 M Ω probe set 1:1 and 1:10
PM 8943 650 NHz, 1 M Ω FET probe set
PM 9581 50 Ω termination 3 W
PM 9581 50 Ω termination 1 W

All options can be field-installed by the user

NOTE: The GPIB int erface PM 9604 and the battery unit PM 9605 cannot be installed together n a PM 6669 counter

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