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PM 6669 High-Precision Frequency Counter Specifications

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Measuring functions

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| Measuring Modes | Freq. A, Freq. B, Period A, RPM A, Totalize A. Freq. A/Ao, Freq. A-Ao, Pulse Width A. |
| Frequency A or B (optional) | Range: Freq. A: 0.1 Hz...160 MHz Freq. B: 70 MHz...1.3 GHz (option PM 9608B) Mode: Reciprocal frequency counting. LSD displayed: $2.5 \times 10^{-7} \times \text{FREQ} / \text{Measuring-time}$ |
| Frequent A/Ao | A Frequency-A measurement is performed. The measured frequency is divided by the constant Ao before display. The resolution of the displayed ratio is determined by the FREQ A measurement. At power-on Ao is set to 1 (default). |
| Frequency A-Ao | A Frequency-A measurement is performed. The value of constant Ao is subtracted from the measured frequency before display. The resolution of the displayed difference is determined by the FREQ A measurement. At power-on Ao is set to 0 (default). |
| RPM A | A Frequency-A measurement is done. The measured frequency is multiplied with 60, and shown on the display as revolutions per minute (RPM). Range: 6 RPM...720 x 10 ⁶ RPM |

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| Period A | <p>Range: 8 ns...2 x 10⁸s</p> <p>Mode: Single period measurement (SINGLE) or period average measurement (at 0.2, 1 or 10s Measuring-times).</p> <p>LSD displayed: SINGLE period measurement: (TIME < 100s): 100 ns (TIME > 100s): 5 x PERIOD / 10⁹s</p> <p>Period Average measurement: 2.5 x 10⁻⁷ x PERIOD / Measuring time</p> |
| Totalize A | <p>Event counting is controlled by the START/STOP button. Sequential start-stop counts are accumulated. RESET closes the gate and resets the Frequency Counter to zero.</p> <p>Range: 0... 1 x 10¹⁵ with indication of k or M (kilo-pulses or Mega-pulses). The result is truncated if out of display range.</p> <p>Frequency range: Sine-wave: 10 Hz...16 MHz Pulse: 0 Hz...16 MHz Pulse pair resolution: 80 ns</p> <p>LSD displayed: 1 unit count (counts < 10⁹) 5 x counts/10⁹ (counts 3 10⁹)</p> |
| Width A | <p>A positive Pulse Width measurement is performed. Measuring time selection is not valid (always SINGLE measurements).</p> <p>Range: 100 ns...2 x 10⁸s</p> <p>LSD displayed: (TIME < 100s): 100 ns (TIME 3 100s): 5 x WIDTH / 10⁹s (Triggering on 50% of amplitude will occur only if the duty factor of the signal is 0.5)</p> |

Definitions

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| LSD displayed | <p>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.</p> |
| Resolution | <p>Resolution = smallest increment between two measuring results on the display, due to the 1 count error.</p> <p>Freq. A, B, Period: Resolution can be 1 LSD unit or 2 LSD units. If:</p> <ul style="list-style-type: none"> ● LSD x Measuring time / FREQ or PERIOD < 10⁻⁷ the resolution is 2 LSD units (30% probability). ● Otherwise resolution is 1 LSD unit (70% probability). <p>SINGLE Period A and Width A: Resolution equals 1 LSD unit.</p> |

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| Inaccuracy | Inaccuracy, i.e. the relative error, depends on the following factors: \pm Resolution / FREQ, PERIOD or WIDTH \pm relative trigger error \pm relative time base error |
| Relative trigger error | Freq. A, Period A: \pm noise voltage A (Vpp) / signal slope A (V/s) x meas. time |
| Relative time base error | \pm deviation from 10 MHz / 10 MHz |

Input specifications

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| Input-A | <p>Frequency range: 10 Hz...160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23 °C \pm 5 °C)</p> <p>Sensitivity: Sine: 10 mVrms, 10 Hz to 120 MHz 30 mV rms typically, 120 to 160 MHz at room temperature Pulse: 30 mV rms, 0.1 Hz...120 MHz</p> <p>Coupling: AC</p> <p>Impedance: 1 MΩ // 30 pF</p> <p>Attenuation: Continuously variable in two ranges between x1 and x400</p> <p>Filter: Switchable 50 kHz low pass noise filter with a suppression of 20 dB at 200 kHz.</p> <p>Maximum voltage: 350V (DC + AC peak) between 0 and 440 Hz, falling to 11 Vrms at 1 MHz.</p> |
| Triggering | <p>Trigger levels: 3 different levels for triggering on signals with various duty factors, and AUTO:</p> <ul style="list-style-type: none"> • Symmetrical input signals, should be selected for input signals with a duty factor of 0.25...0.75. • Positive pulses, for input signals with duty factor <0.25. • Negative pulses, for input signals with duty factor >0.75. <p>AUTO trigger level: The counter will make test settings and automatically select the best trig level setting. AUTO requires repetitive signals with a repetition rate > 100 Hz. AUTO is not active in TOTALIZE-A measurements.</p> <p>Trigger slopes (via GPIB only): Positive or negative.</p> |

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| RF Input 1.3 GHz (Option PM 9608B) | PM 6666 Input C PM 6669 Input B Frequency range: 70 MHz to 1.3 GHz Coupling: AC Operating input voltage range: 10 mV rms to 12 V rms, 70 MHz to 900 MHz 15 mV rms to 12 V rms, 900 MHz to 1.1 GHz 40 mV rms to 12 V rms, 1.1 to 1.3 GHz AM tolerance: 98 %, minimum signal must exceed minimum operating input voltage requirement Impedance: 50Ω nominal, VSWR < 2:1 Maximum voltage without damage: 12 V rms, overload protection with PIN diodes. |
| External reference input D | 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 |

Auxiliary functions

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| 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: 0.2s Trigger level Offset: AUTO |
| Reset | The RESET-button has three functions: RESET Starts a new measurement. The settings are not changed. LOCAL Makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed). START/STOP Opens/closes the gate in TOTALIZE A. |
| Measuring-time | A Measuring-time of 0.2s, 1s, 10s or SINGLE can be selected. (When SINGLE is selected together with PERIOD or WIDTH, the result is a single cycle measurement, but SINGLE together with FREQUENCY or RPM results in a fixed 3 ms Measuring-time.) |
| Measuring rate | Approx. 5 measurements/s. |
| Display time | Normally the display time equals the set Measuring-time. When SINGLE is selected, a display time of 0.1 seconds is used. |

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| Displ. Hold/Store A ₀ | The DISPL HOLD/STORE A ₀ button has two functions: DISPL HOLD: The current measurement result is frozen on the display. A new measurement starts when RESET button is pressed. STORE A ₀ : This function is active in FREQ 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 | This function blanks any number of least significant digits on the display, in order to hide unstable digits on the display. |

TimeBase Crystal Oscillators

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| Standard Crystal Oscillator (order no. PM 666-/-1-) | <p>Uncertainty due to:</p> <p>Calibration adjustment tolerance, at +23°C ± 3°C: < 1 x 10⁻⁶</p> <p>Aging: per 24 hr.: N/A. per month: < 5 x 10⁻⁷ (5 Hz) per year: < 5 x 10⁻⁶ (50 Hz)</p> <p>Temperature variation: 0 to 50°C: < 1 x 10⁻⁵ (100 Hz) 20 °C - 26 °C: < 3 x 10⁻⁶ (typical value)</p> <p>Power voltage variation 10 % : < 1 x 10⁻⁸ (0.1 Hz)</p> <p>Power-on stability: Deviation versus final value after 24 hr on time: N/A. after a warm-up time of: 30 min</p> <p>Total uncertainty, for operating temperature 0°C to 50 °C, at 2σ (95 %) confidence interval: 1 year after calibration < 1.2 x 10⁻⁵ 2 year after calibration < 1.5 x 10⁻⁵</p> <p>Typical total uncertainty, for operating temperature 20°C to 26°C, at 2σ (95 %) confidence interval: 1 year after calibration < 7 x 10⁻⁶ 2 years after calibration < 1.2 x 10⁻⁵</p> |
| MTCXO: Mathematically Temperature Compensated Crystal Oscillator (order no PM 666x/.3.) | <p>Uncertainty due to:</p> <p>Calibration adjustment tolerance, at +23°C ± 3°C: < 1 x 10⁻⁷</p> <p>Aging: per 24 hr.: N/A. per month: < 1 x 10⁻⁷ (5 Hz) per year: < 5 x 10⁻⁷ (50 Hz)</p> <p>Temperature variation: 0 to 50°C: < 2 x 10⁻⁷ (100 Hz) 20 °C - 26 °C: < 5 x 10⁻⁸ (typical value)</p> <p>Power voltage variation 10% : < 1 x 10⁻⁹ (0.1 Hz),</p> <p>Power-on stability: Deviation versus final value after 24hr on time: N/A after a warm-up time of: 30 min</p> <p>Total uncertainty, for operating temperature 0°C to 50 °C, at 2σ (95 %) confidence interval: 1 year after calibration: < 6 x 10⁻⁷ 2 year after calibration: < 1 x 10⁻⁶</p> <p>Typical total uncertainty, for operating temperature 20°C to 26°C, at 2σ (95 %) confidence interval: 1 year after calibration: < 6 x 10⁻⁷ 2 years after calibration: < 1 x 10⁻⁶</p> |

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| | The MTCXO can be ordered separately for later upgrading of the counter (option PM 9607). |
| MTCXO working principle: (Mathematically Temperature Compensated Crystal Oscillator) | 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 $< 1 \times 10^{-5}$. |
| Explanation | <p>Calibration Adjustment Tolerance: Is the maximal tolerated deviation from the true 10 MHz frequency after a calibration. When the reference frequency does not exceed the tolerance limits at the moment of calibration, an adjustment is not needed.</p> <p>Total uncertainty: Is the total possible deviation from the true 10 MHz value under influence from frequency drift due to aging and ambient temperature variations versus the reference temperature. The operating temperature range and the calibration interval are part of this specification.</p> |

Interface and Battery Unit Specifications

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| GPIB-interface, Option PM 9604 | <p>Mounting: Inside counter cabinet.</p> <p>Interface functions: SH1, AH1, T5, L4, SRI, RL1, DC1, DT1, E2</p> <p>Address setting: Switch selectable at rear panel between 0 and 30. Factory Preset at 10.</p> <p>Programmable device Functions for: PM 6666: Full GPIB programmability, Auto trigger, Voltage Measurements. PM 6669: All front panel settings plus trigger Slope (Pos/Neg), excluding Power On/Standby, Sensitivity and Filter On/Off.</p> |
| Max Data Output Rate | <p>Normal Mode: Approx. 5 readings/s</p> <p>High-Speed Dump: Approx. 100 readings/s. The highest output rate is obtained for PM6666 at SINGLE measuring time. The content of the counting registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead.</p> |
| Output Time for measuring Data | <p>Normal Mode: Approx. 10 ms (21 bytes)</p> <p>High-Speed Mode: Approx. 4 ms (15 bytes)</p> <p>Response time for Addressing: Approx. 5 's</p> <p>Response Time for Trigger Command (GET): Approx. 10 ms</p> <p>Typical Read Time for Programming Data: Approx. 1 ms/byte</p> |

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| Battery unit PM 9605 | <p>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.</p> <p>Battery capacity (20 °C): Approx. 15 Wh</p> <p>Operating time when battery powered for: PM 6666: 2 hours of continuous operation. PM 6669: 3 hours of continuous operation.</p> <p>Recharging time: 7 hours to approx. 75 % of full capacity.</p> <p>Battery protection: Overcharge protection and auto-shut-off total discharge protection.</p> <p>Temperature: Operating: 0 ...+ 40 °C Storage: -40 ... + 50 °C</p> <p>Weight: 0.8 kg</p> |
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General Specifications

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| Power requirements | <p>Line voltage: 115 or 230 V rms \pm 15 %; 46 to 440 Hz, (<24 VA incl. all options).</p> <p>Safety: According to CE-regulation 73/23 EN61010-1 CAT II, Pollution Degree 2</p> <p>EMC: According to CE regulation 89/336: Emission according to EN 50081-1, EN 55011 Immunity according to EN 50082-1, inclusive IEC 801-2, -3, -4</p> <p>Battery unit: See PM 9605 option.</p> |
| Dimensions and weight | <p>Dimensions: Width: 186 mm Height: 88 mm Depth: 270 mm</p> <p>Weight: PM 6666: Net: 2.4 kg Shipping: 3.2 kg</p> <p>PM 6669 Net: 2.1 kg Shipping: 3.0 kg</p> <p>Cabinet: The counter is housed in a metal cabinet, to minimize electromagnetic interference and achieve good mechanical stability</p> |

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| Environmental conditions | <p>Temperature: Operating: 0 °C to +50 °C Storing: -40 °C to +70 °C</p> <p>Altitude: Operating: 5000 m (53.3 kN/m²) Storing: 15000 m (15.2 kN/m²)</p> <p>Humidity: Operating: 10 % to 90 % RH, no condensation Storing: 5 % to 95 % RH</p> |
| Display | <p>Read out: 9 digit LCD display with unit indication.</p> <p>Unit indication: MHz, kHz, Hz, mHz, ks, s, ms, s, ns, M, k, m, μ and n.</p> <p>GATE indicator: Indicates that the counter is busy measuring.</p> <p>REMOTE indicator: indicates when control over the counter is taken over by an installed GPIB interface PM 9604.</p> <p>Cursor: Indicates selected measuring function, selected Measuring-time, input triggering, display hold and whether an external reference frequency is in use.</p> |