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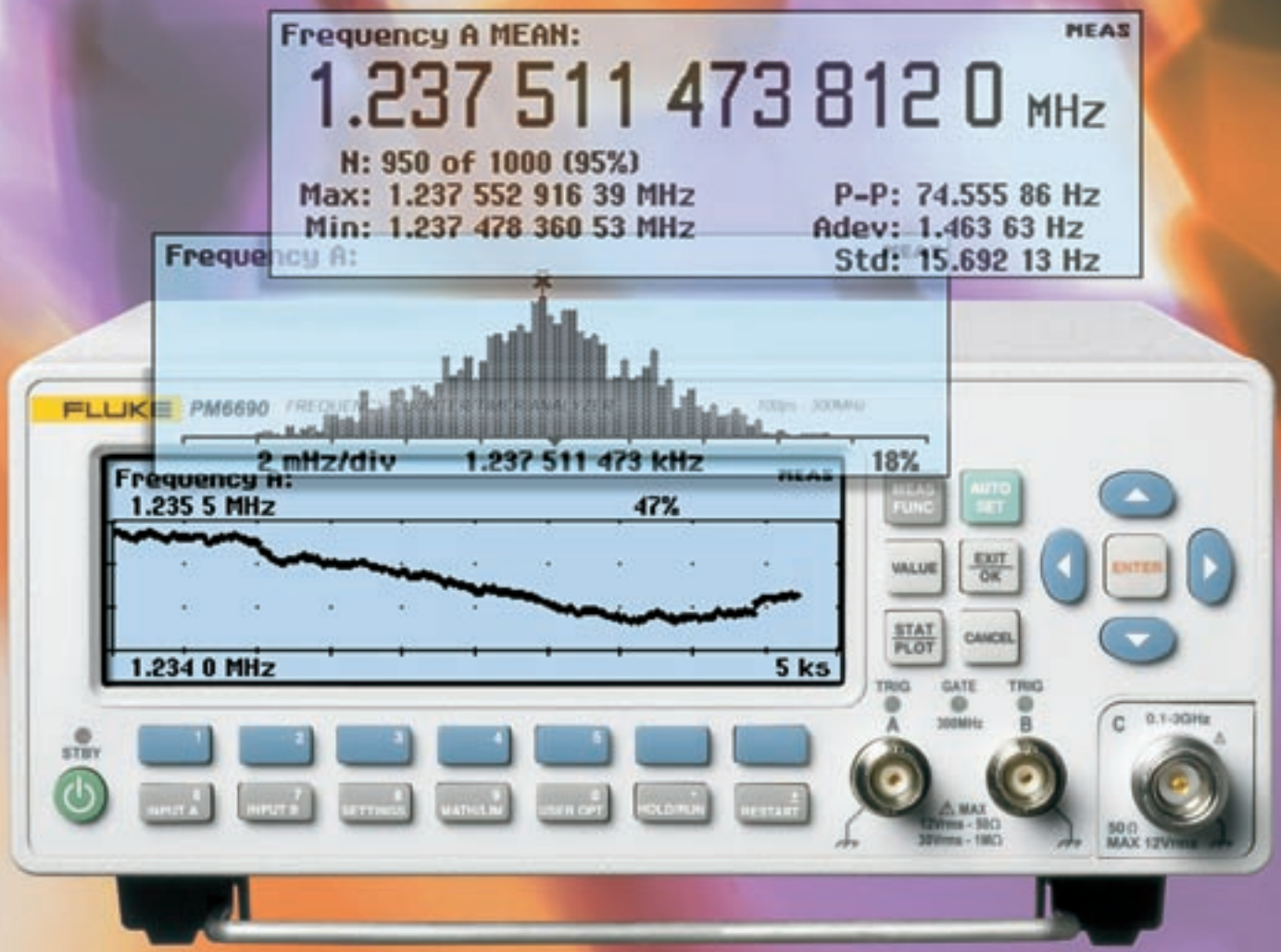
Fluke PM6690

Frequency Counter/Timer/Analyzer



- **High resolution and speed:**
  - 12 digits/s frequency measurements
  - 100 ps single-shot time resolution
  - 0.001° phase resolution
- Frequency range: 300 MHz standard; 3 GHz or 8 GHz input optional
- Built-in statistical analysis
- High speed: 250k measurements/s to internal memory, 2000 measurements/s through GPIB-bus
- 750 000 measurements stored in internal memory
- Graphical display gives up to 14 digits display resolution, TrendPlot and histogram display
- Both USB and GPIB high speed busses as standard

With the new PM6690 Frequency Counter/Timer/Analyzer, Fluke offers the most versatile and accurate tool for measurement, analysis and calibration of frequency, time interval and phase for use in test systems, on the R&D bench, in the calibration lab or in the field.

The PM6690 is the state-of-the-art Frequency Counter/Timer/ Analyzer that outperforms all existing counters on the market. The PM6690 offers unique ease-of-use with a graphical display and menu-driven control system. All this at an outstanding price!

Outstanding Performance/ Price ratio

The PM6690 outperforms all other counters on the market, regardless of the measurement task. The PM6690 offers unique control of your measurement set-up, and is the ideal choice for every need and budget, offering outstanding performance at the price of a standard counter.

Figure 1: Measurement speed as high as 12 digits/s and a 14-digit display resolution is standard.

World-leading performance

The basic performance of the PM6690 is world-leading:

- **High resolution** is vital for R&D and production testing.
  The PM6690 gives 100 ps single-shot time resolution, or 12 digits/s frequency resolution to detect very small time and frequency changes. This gives 2 more digits of resolution at the same speed as any other interpolating counter. Measurement results can be displayed with a resolution of up to 14 digits.

Figure 2: The main measurement result is further supported by auxiliary readings, e.g. of signal amplitudes.

- **Up to 2000 measurements per second via GPIB.** The high measurement speed of the PM6690 saves you lots of test time and increases throughput in test systems, resulting in big savings.
- **Wide frequency range** of up to 8 GHz, covers all frequency measurement needs from DC to microwave. There is no need to invest in a separate microwave counter.
- **Modulation Domain Analysis** is performed by capturing very fast frequency changes in real time, thanks to the high 250k measurement/s speed and the big memory depth of 750k readings.
- **For calibration purposes,** results are quickly obtained. The PM6690 offers very high accuracy through the high-stability internal OCXO timebase, a very small systematic time interval error and of course the very high resolution.

Ease-of-use

The menu-driven instrument control structure reduces the risk of mistakes. The selected measurement result is supported by auxiliary parameter readings, which means you no longer need other instruments like a DMM or an oscilloscope.

A graphical presentation mode of the results as a histogram or trend curve gives a much better understanding of random signal distribution and system changes over time, from slow drift to fast modulation (TrendPlot).

The intelligent Auto-trigger automatically sets optimum trigger level and hysteresis, matched to the actual input signal.

Figure 3: Measure function selection menu, shown with measured results.

Excellent computer connectivity

The PM6690 is supplied with both USB and GPIB high-speed interfaces as standard. This eliminates the need to invest in an extra GPIB interface for your PC, if used in small systems, yet allows smooth integration in larger GPIB-based test systems.

Figure 4: Input parameter setting menu shown with the acquired result.

Plug & Play in existing test systems

The GPIB interface is standard and supports two modes: native SCPI 1999 and a 53131A emulation mode for easy implementation in test systems originally designed to include timer-counters of other brands. This instant Plug & Play feature allows easy exchange of a timer-counter in a system, and reduces the need to rewrite existing system code.

Improved control over measurement start/stop

The PM6690 maximizes measurement capabilities with features such as:

- arming for full control of both the start and stop of the measurement on complex signals
- trigger hold-off with 10 ns resolution
- automatically detected frequency burst parameters
- limit testing that skips unwanted parameter values, or can help you find an anomaly

With the state-of-the-art PM6690 you have a single, powerful tool that enables you to handle every time and frequency measurement and analysis task.

Unique graphical presentation

The PM6690 offers a unique graphical display, which is also used to present the numerical readings and to support the menu-driven control system. A non-expert can easily make the correct set-up without the risk of costly mistakes.

Auxiliary measurement values such as $V_{max.}$, $V_{min.}$ and V_{p-p} in the display of frequency measurements, and frequency and attenuation read-outs in phase measurements, eliminate the need for extra test instruments and provide you with direct answers to commonly asked questions, like 'What is the attenuation and phase shift of this network?'

Measurement values can be presented both numerically and graphically at the same time. The graphical presentation gives easy insight into for example the nature of jitter. It also makes it easier to find and analyze other changes over time such as slow drift or fast modulation. For these purposes, three statistical presentation modes can be chosen for the same data set: Numerical Statistics, Histogram or Trend.

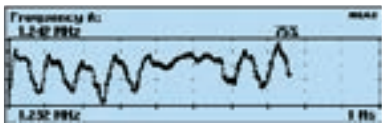


Figure 5: Display showing the trend of a measurement over time.

The user can toggle between these modes to get different views of the same set of measurement results (see also Figures 5, 6 and 7).

When a system needs adjustment to get the frequency within predefined limits, a graphical representation of the actual value provides fast and accurate visual guidance, which is more easily understood than a numerical reading.

Figure 6: The Numerical Statistics mode shows different statistical parameters at the same time.

Additional technical features

The PM6690 not only offers world-leading basic performance, it is also the ultimate tool for more specialized measurements.
Some more unique features of the PM6690 are:

- 'Zero dead-time' technique, giving 250k measurements/s using fast time-stamping of trigger events. This enables the measurement of all successive cycles, without any dead-time, at a speed up to 250k measurements/s. 'Zero dead-time' is most valuable in mechanical testing, e.g. rotational encoders, and in medical systems, e.g. measuring nerve impulse/respiratory cycles.

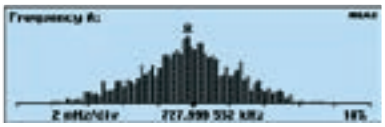


Figure 7: Statistical analysis displayed as a histogram.

- SMART Time interval measurements. Unlike traditional methods in which you need to predefine the start and stop channel (e.g. Time A-B), you can now let the PM6690 detect the start and stop moments automatically. That means no more false results as a result of the stop signal occurring before the start signal – the PM6690 automatically recognizes and compensates for this.

Figure 8: Display showing phase value and auxiliary parameters frequency and attenuation V_A/V_B.

True phase and duty cycle measurements, thanks to a 'single-pass' technique. The traditional methods calculate these parameters using multiple cycles of the input signal. The single-pass phase and duty cycle measurement with the PM6690 enables true phase measurements within a single cycle, given rock-stable results also when the signals under test have a varying frequency. This feature is valuable for example to verify the relative phase between quadrature output pulses (nominal 90°) from rotational encoders, even when the rotation speed varies during the measurement.

- Limit qualifying lets the user accept or reject measurement values based on predefined limits. This provides a valuable ability to make a correct calculation of statistical parameters in complex signals, such as in verification of the RMS jitter of digital pulses in discrete clusters (e.g. in CD players or HDB3-coded data). By setting limits you can isolate an individual cluster in the calculation.
- Measurement pacing sets an accurate sample rate for the measurement, ensuring that samples are taken at exact and equidistant intervals. For example, setting the pacing time to 600 s (= one measurement every 10 minutes) in a 24 hour frequency monitoring session will ensure that the amount of data is reduced to 144 measurement samples, spread equally over the day.

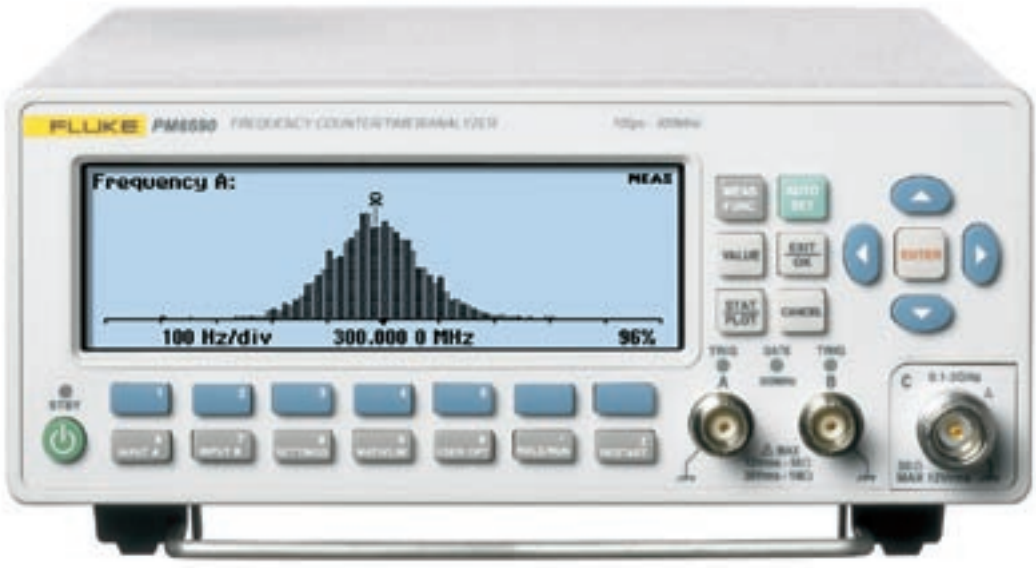
Conclusion

If you have any questions relating to frequency or timing, the Fluke PM6690 gives you the answers you need – quickly, easily and with exceptional accuracy.

Fluke TimeView 90W for the PM6690

Fluke TimeView 90W further extends the measurement and analysis capabilities of the PM6690 Frequency Counter/Timer/Analyzer. The software package runs on your Windows-based PC and enables remote control of the instrument using either an IEEE-488 (GPIB) or USB interface.

TimeView 90W gives you extensive data analysis capabilities, ranging from storage of a sequence of measurement results directly to FFT processing and histogram calculation of a series of measured results. It is even possible to 'scan' the counter's input signal as if it were an oscilloscope! Or you can find and analyze AM and FM modulation using only the PM6690 and TimeView 90W on your PC!



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Measuring Functions

All measurements are displayed with a large main parameter value and smaller auxiliary parameter values (with reduced resolution). Some measurements are available only as auxiliary parameters.

Frequency A, B, C

Range:
- Input A, B: 0.001 Hz to 300 MHz
- Input C (optional): 100 MHz to 3 GHz (PM6690/6xx), 200 MHz to 8 GHz (PM6690/7xx).

Resolution: 12 digits in 1 s measuring time using 'multiple time-stamp averaging'.

Aux parameters: $V_{max.}$, $V_{min.}$, V_{p-p}

Frequency Burst A, B, C

Frequency and PRF of repetitive burst signals can be measured without external control signal and with selectable start arming delay.

Functions: Frequency in burst (in Hz), PRF (in Hz), Number of cycles in burst.

Range:
- Input A, B, C: See Frequency spec.

Minimum burst duration: 40 ns, 80 ns above 160 MHz

Minimum number of pulses in burst:
- Input A or B: 3 (6 above 160 MHz)
- Input C: Prescaler factor x 3

PRF range: 0.5 Hz to 1 MHz

Start Delay Range: 10 ns to 2 s, 10 ns resolution

Aux parameters: PRF, number of cycles in burst

Period A, B, C Average

Range:
- Input A, B: 3.3 ns to 1000 s
- Input C: 330 ps to 10 ns (PM6690/6xx), 125 ps to 5 ns (PM6690/7xx).

Resolution: 100 ps (single), 12 digits/s (average)

Aux parameters: Vmax., Vmin., Vp-p

Frequency Ratio A/B, B/A, C/A, C/B

Range: 10^{-9} to 10^{11}

Input Frequency:
- Input A, B: 0.1 Hz to 300 MHz
- Input C (optional): Up to 3 GHz, Up to 8 GHz.

Aux. parameters: Freq. 1, Freq. 2

Time Interval A to B, B to A, A to A, B to B

Range:
- Normal calculation: 0 to $+10^6$ s
- Smart calculation: -10^6 s to $+10^6$ s

Resolution: 100 ps (single-shot)

Min. Pulse Width: 1.6 ns

Smart Calculation: Smart Time Interval to determine sign (A before B or B before A)

Positive and Negative Pulse Width A, B

Range: 1.6 ns to 10^6 s

Min. Pulse Width: 1.6 ns

Aux parameters: $V_{max.}$, $V_{min.}$, V_{p-p}

Rise and Fall Time A, B

Range: 700 ps to 1000 s (max. frequency 160 MHz)

Trigger levels: 10% and 90% of signal amplitude, or manual in % of amplitude or in volts

Min. Pulse Width: 1.6 ns

Aux. parameters: Slew rate, $V_{max.}$, $V_{min.}$

Phase A Relative to B, B relative to A

Range: -180° to +360°

Resolution: 0.001° to 10 kHz, decreasing to 1° at >10 MHz. Resolution can be improved using averaging (Statistics)

Frequency Range: up to 160 MHz

Aux. parameters: Freq. A, V_a/V_b (in dB)

Positive and Negative Duty Factor A, B

Range: 0.000001 to 0.999999

Frequency Range: 0.1 Hz to 300 MHz

Aux parameters: Period, Pulse Width

$V_{max.}$, $V_{min.}$, V_{p-p} A, B

Range: -50 V to +50 V, -5 V to +5 V. Range is limited by the specification for max. input voltage without damage (see 'Inputs A and B')

Frequency Range: DC, 1 Hz to 300 MHz

Mode: $V_{max.}$, $V_{min.}$, V_{p-p}

Resolution: 2.5 mV

Uncertainty:
- DC, 1 Hz to 1 kHz: 1% + 15 mV
- 1 kHz to 20 MHz: 3% + 15 mV
- 20 MHz to 100 MHz: 10% + 15 mV
- 100 MHz to 300 MHz: 30% + 15 mV

Auxiliary parameters: $V_{max.}$, $V_{min.}$, V_{p-p}

Time stamping A, B

Raw time stamp data together with pulse counts on input A or B, accessible via GPIB or USB only.

Max. sample speed: See GPIB specifications

Max. frequency: 160 MHz

Timestamp resolution: 100 ps

Input and Output Specifications

Inputs A and B

Frequency Range:
- DC-Coupled: DC to 300 MHz
- AC-Coupled: 10 Hz to 300 MHz

Impedance: 1 MΩ // 20 pF or 50 Ω (VSWR ≤ 2:1)

Trigger Slope: Positive or negative

Max. channel timing difference: 500 ps

Sensitivity: (at x1 input attenuation)
- DC–200 MHz: 15 mV_{rms}
- 200–300 MHz: 25 mV_{rms}

Attenuation: x1, x10

Dynamic Range (x1): 30 mV_{p-p} to 10 V_{p-p} within ±5 V window

Trigger Level: (with read-out on display)
- **Resolution:** 2.5 mV
- **Uncertainty (x1):** ± (15 mV + 1% of trigger level)
- **AUTO Trigger Level:** Trigger level is default set to 50% point of input signal (10% and 90% for Rise/Fall Time).

AUTO Hysteresis:
- **Time:** Min. hysteresis window (hysteresis compensation)
- **Frequency:** one third of input signal amplitude

Analog noise reduction filter: Nominal 100 kHz, RC-type filter.

Digital Low Pass Filter: Variable 1 Hz to 50 MHz low-pass filter using trigger hold-off

Max. Input Voltage Without Damage:
- 1 MΩ: 350 V (DC + AC_{pk}) at DC up to 440 Hz, falling to 12 V_{rms} (att. = x1) at 1 MHz
- 50 Ω: 12 V_{rms}

Input Connector: BNC

3 GHz RF Input option (PM6690/6xx)

Operating Input Voltage Range:
- 100 to 300 MHz: 20 mV_{rms} to 12 V_{rms}
- 0.3 to 2.5 GHz: 10 mV_{rms} to 12 V_{rms}
- 2.5 to 2.7 GHz: 20 mV_{rms} to 12 V_{rms}
- 2.7 to 3.0 GHz: 40 mV_{rms} to 12 V_{rms}

Prescaler Factor: 16

Input Impedance: 50Ω nominal, AC-coupled, VSWR < 2.5:1

Max. input voltage without damage: 12 V_{rms}, pin-diode protected

Connector: Type N female

8 GHz RF Input option (PM6690/7xx)

Operating Input Voltage Range:
- 200 to 500 MHz: 20 mV_{rms} to 7 V_{rms}
- 0.5 to 3.0 GHz: 10 mV_{rms} to 7 V_{rms}
- 3.0 to 4.5 GHz: 20 mV_{rms} to 7 V_{rms}
- 4.5 to 6.0 GHz: 40 mV_{rms} to 7 V_{rms}
- 6.0 to 8 GHz: 80 mV_{rms} to 7 V_{rms}

Prescaler Factor: 256

Input Impedance: 50 Ω nominal, VSWR <2.5:1

Max. Voltage Without Damage: 7 V_{rms}

Connector: Type N female

Rear Panel Inputs and Outputs

Reference Input: 1, 5, or 10 MHz, 0.1 to 5 V_{rms} sinewave
- Input impedance: > 1 kΩ (AC coupled)

Reference Output: 10 MHz; >1 V_{rms} sinewave into 50Ω

Arming Input: Arming of all measuring functions
- Frequency Range: DC to 80 MHz
- Input impedance: Approx. 1 kΩ.

Rear panel measurement inputs (option PM6690/xx2): A, B, C input through rear panel
- Impedance: Channels A and B: 1 MΩ // 50 pF or 50 Ω (VSWR ≤ 2:1); channel C: 50 Ω
- Connectors: Type SMA female for rear input C, BNC for all other inputs/outputs

Auxiliary Functions

Trigger Hold-Off

Time Delay Range: 20 ns to 2 s, 10 ns resolution

External Start and Stop Arming

Modes: Start, Stop, Start and Stop Arming

Input channels: A, B or E (Ext. Arming)

Max. rep. Rate for Arming signal:
- Channel A, B: 160 MHz
- Channel E: 80 MHz

Start Time Delay Range: 20 ns to 2 s, 10 ns resolution

Statistics

Functions: Maximum, Minimum, Mean, ΔMax.–Min., Standard Deviation and Allan Deviation

Display: Numeric, histograms or trendplots

Sample Size: 2 to $2*10^9$ samples

Limit qualifier: OFF or Capture and store values above/below/inside or outside limits

Measurement pacing
- Pacing time range: 2 µs to 1000 s

Mathematics
- Functions: (K*X+L)/M and (K/X+L)/M X is current reading; K, L and M are constants which can be set via keyboard or as frozen reference value (X_0) obtained through earlier measurement

Other Functions

Measuring Time: 20 ns to 1000 s for Frequency, Burst and Period Average, Single cycle for other measuring functions.

Timebase Reference: Internal, External or Automatic

Display Hold: Freezes result, until a new measurement is initiated via Restart

Limit alarm: Indication on front panel and/or SRQ via GPIB
- Limit values: Lower limit (limit1) Upper limit (limit2)
- Settings: OFF or Alarm if value is above/below/inside or outside limits.
- On alarm: STOP or CONTINUE
- Display: Numerical + Graphical

Stored instrument set-ups: 20 instrument setups can be saved/recalled from internal non-volatile memory; 10 can be user protected

Display: Backlit LCD for menu control, 14 digit numerical read-out, graphical read-out and status information
- Number of digits: 14 digits maximum in numerical mode.
- Resolution: 320 * 97 pixels

GPIB Interface

Compatibility: IEEE 488.2-1987, SCPI 1999, Model 53131A compatible mode.

Interface Functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2

Max. measurement Rate
Via GPIB: 2k readings/s (block) or 350 readings/s (individually triggered)
To Internal Memory: 250k readings/s (100 k readings/s with cal. on)

Internal Memory Size: Up to 750k readings.

Data output Format: ASCII, IEEE double precision floating point

USB Interface

standard

USB version: 2.0 Full Speed (11 Mbit/s)

General Specifications

Environmental Data

Class of Product: MIL-PRF-28800F, Class 3.

Operating Temp.: 0°C to +50°C

Storage Temp.: -40°C to +71°C

Humidity: 5% to 95% (10°C to 30°C); 5% to 75% (30°C to 40°C); 5% to 45% (40°C to 50°C).

Altitude: 4600 m

Vibration: Random and sinusoidal according to MIL-PRF-28800F, Class 3

Shock: Half-sine 30G per MIL-PRF-28800F, Bench handling

Transit drop test: The optional heavy-duty transport case and the soft carrying case have been tested according to MIL-PRF-28800F

Reliability: MTBF 30 000 h (calculated value)

Safety: Designed and tested for Measurement Category I, Pollution Degree 2 in accordance with EN/IEC 61010-1:2001; CAN/CSA-C22.2 No 61010.1-04 (incl. approval).

EMC: EN 61326 (1997) A1 (1998), increased test levels according to EN 50082-2, Group 1, Class B.

Power Requirements

Basic version: 90 to 265 V_{rms}, 45 to 440 Hz, < 40 W

Dimensions and Weight

Dimensions (WxHxD): 210 x 90 x 395 mm (8.25 x 3.6 x 15.6 in)

Rack size: 1/2 * 19 inch wide, 2HE, less than 400 mm deep

Weight: Net 2.7 kg (5.9 lb), Shipping approx. 4.5 kg (9.9 lb).

Timebase Options

Timebase Option:		Standard (-/x1x)	High Stability (-/x5x)	Ultra High Stability (-/x6x)
Timebase Type:		X-tal based	OCXO	OCXO
Uncertainty due to:				
- Calibration adjustment tolerance	at 23°C ± 3 °C	< 1×10^{-6}	< 1×10^{-8}	< 3×10^{-9}
- Aging	per 24 hours (1)	n.a.	< 5×10^{-10}	< 3×10^{-10}
	per month	< 5×10^{-7}	< 1×10^{-8}	< 3×10^{-9}
	per year	< 5×10^{-6}	< 5×10^{-8}	< 1.5×10^{-8}
- Temperature variation:	0°C ... 50°C	< 1×10^{-5}	< 5×10^{-9}	< 2.5×10^{-9}
	20°C ... 26°C (2)	< 3×10^{-6}	< 1×10^{-9}	< 4×10^{-10}
- Power voltage variations	± 10%	< 1×10^{-8}	< 5×10^{-10}	< 5×10^{-10}
Short Term Stability	$\tau = 1$ s	not specified	< 1×10^{-11}	< 5×10^{-12}
(root Allan Variance)	$\tau = 10$ s	not specified	< 1×10^{-11}	< 5×10^{-12}
Power-on Stability: deviation vs. final value after 24 h 'on' time, after a warm-up time of 10 minutes		n.a.	< 1×10^{-8}	< 5×10^{-9}
Total uncertainty, for operating temperature 0°C ... 50°C, at 2 σ (95%) confidence interval:				
- 1 year after calibration		< 1.2×10^{-5}	< 6×10^{-8}	< 1.8×10^{-8}
- 2 years after calibration		< 1.5×10^{-5}	< 1.2×10^{-7}	< 3.6×10^{-8}
Typical total uncertainty, for operating temperature 20°C ... 26°C, at 2 σ (95%) confidence interval				
- 1 year after calibration		< 7×10^{-6}	< 6×10^{-8}	< 1.7×10^{-8}
- 2 years after calibration		< 1.2×10^{-5}	< 1.2×10^{-7}	< 3.5×10^{-8}

Notes: n.a. not discernible, negligible versus 1°C temperature variation
(1) after 1 month of continuous operation
(2) typical values

Explanation

Calibration adjustment tolerance	This is the maximum 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.
Total uncertainty	This is the total possible deviation from the true 10 MHz value under influence of 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.

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Ordering Information

Basic Model

PM6690/xxx	300 MHz, 100 ps Frequency Counter/Timer/Analyzer

Included with the Instrument are:
One year product warranty,
Line cord in local version,
User documentation on CD-ROM,
Getting Started booklet (English, French or German),
Certificate of Calibration Practices.

If requested with the order, a calibration report including the test data can be included at a nominal fee.

Input Options (factory installed only)

PM6690/0xx	300 MHz frequency coverage, no C input installed
PM6690/6xx	3 GHz Channel C input option installed
PM6690/7xx	8 GHz Channel C input option installed
PM6690/xx1	Standard inputs (= front panel mounted)
PM6690/xx2	Rear panel inputs (factory installed only)

Timebase Options (factory installed only)
(see table for details of individual timebases)

PM6690/x1x	Standard timebase
PM6690/x5x	Very High Stability Oven Timebase; 0.01 ppm/month
PM6690/x6x	Ultra High Stability Oven Timebase; 0.003 ppm/month

Configuration example:

The type number PM6690/661 identifies a PM6690 300 MHz / 100 ps Frequency Counter/Timer/Analyzer that has the 3 GHz C-input option installed, an Ultra High Stability OCXO timebase installed, and is equipped with all front-panel mounted inputs.

Optional Accessories

PM 9622/021	Rack Mount Kit, 2 HE, 19 inch wide
PM 9627/001	Leather-look carrying case
PM 9627H	Heavy-duty aluminum transport case
TimeView 90W*	TimeView for Windows®, for PM6690 series (IEEE-488 / USB)
PM 9581	Feedthrough terminator (BNC, 50 Ω, 3W)
PM 9585	Feedthrough terminator (BNC, 50 Ω, 1W)
PM 9584	Signal Splitter (BNC, 50 Ω, 3W)
PM 9639/011	Wide bandwidth Probe (1 GHz, 500 Ω, 10:1) for use with 50 Ω input
Calibration Certificate	Calibration Certificate for PM6690, incl. test data. Available on request

Fluke. *Keeping your world up and running.*

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