System Timer/Counters

PM 6654C & PM 6652C

PM 6654C & PM 6652C System Timer/Counters
High accuracy FREQUENCY and PERIOD measurements of 9 digits in one second
High sensitivity 1.5 or 2.3 GHz inputs with wide 10 mV rms to 12V rms dynamic range
TIME-INTERVAL resolution down to 0.5 ps averaged and 2 ns single shot
Measuring modes incl.: Phase, Rise/Fall Time, Duty Factor, V max/min/pp of input
8 pre-programmable front panel menus: digital readout of trigger levels
Mathematical functions
Trigger facilities include Arming, Hold-Off, External Gating and Auto Triggering Level

Introduction
PM 6652C and PM 6654C high performance, fully programmable timer/counters satisfy virtually all frequency and time measurement requirements, especially in R & D laboratories and automatic test systems applications.

The measuring functions and appearance of both instruments are the same. The difference is found in resolution, accuracy and measuring speed. The PM 6652C has a 10 MHz (100 ns) clock frequency, whereas the extra high resolution PM 6654C features a 500 MHz (2 ns) real-time clock resolution. Thanks to its short measuring cycle times, the extra high resolution PM 6654C is particularly well suited to high-speed automatic test systems. Both the PM 6652C & PM 6654C timer/counters offer 14 frequency, time and voltage measuring modes, 100% GPIB/IEEE-488* bus programmability, over 400 readings/second bus speed, 2 ns single shot resolution and 2.3 GHz frequency range.

High Time Interval Measuring Accuracy
A unique combination of high resolution, high trigger accuracy and special trigger control facilities puts these instruments among the most powerful timers on the market.

The high technology PM 6654C with its 2 ns single shot resolution allows time interval measurements to be made to an accuracy and resolution well beyond those of normal timer/counters.

Repetitive signals allow significantly improved resolution by averaging of measuring results. Time intervals, pulse widths, rise and fall times can be measured this way down to sub-picosecond resolution with the PM 6654C and down to 10 ps resolution with the PM 6652C.

Powerful FREQUENCY Measuring Capabilities
High accuracy FREQUENCY and PERIOD measurements can be made in a one second measuring time with resolution of 9 digits in the PM 6654C and 7 digits in the economy version PM 6652C. Both models perform advanced frequency measurements, including externally gated frequency measurements, burst frequency and multiple burst frequency average measurements on down to 200 ns narrow bursts (500 ns for PM 6652C).

Trigger HOLD-OFF, when activated in the FREQUENCY and PERIOD modes, acts as a digital low-pass filter to ignore noise and interference, thereby preventing erroneous measurements.

Complete Triggering Capability
Ultimately, no timer measures more accurately than its trigger accuracy. The PM 6652C’s and PM 6654C’s inputs therefore feature very fast 1 ns rise time and 20 mV rms sensitivity over a 5 V dynamic range. Trigger level accuracy is assured by digital setting and display with 10 mV resolution.

The trigger level may be set by knob controls, keyboard entry, or automatically, in the AUTO mode the counters automatically set A and B trigger levels to 50% of input signal amplitude or 10% and 50% for rise/fall time measurements.

Automatic hysteresis compensation ensures that the actual triggering occurs at the set trigger level and is not delayed by the input hysteresis. Arming and trigger hold-off enable unwanted signals to be ignored.

Mathematics
The MATH (mathematics) facility allows scaling and/or off-setting of measured results before display. This significantly extends the range of application by enabling calibration or unit conversion.

Powerful IEEE-488 Bus Capabilities
Both the PM 6652C and PM 6654C are fully programmable, including all front-end controls and trigger level voltages. Advanced software features are available, including bus learn mode and programmable delimiters. In addition, the high-speed dump mode allows the user to fully exploit the high resolution/high-measuring speed of the PM 6654C, allowing up to 400-500 measurements per second. Pre-set limit monitoring is another useful feature, allowing the counter to send an SRQ when low or high limits are exceeded.

* The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.
Specifications

Measuring Functions

Frequency A

Range
PM 6652C: 0.1 Hz to 120 MHz
PM 6654C: 0.01 Hz to 120 MHz

Frequency C Optional

Range: 100 Hz to 1.5 GHz (Option PM 6610)

Period A

Range
PM 6652C: 100 ns to 10¹⁰ s, resolution 100 ns
PM 6654C: 8 ns to 10¹⁰ s, resolution 2 ns

Time Interval A to B, Pulse Width A, Rise/Fall A, Single

Range
PM 6652C: 8 ns to 10¹⁰ s, resolution 100 ns
PM 6654C: 8 ns to 10¹⁰ s, resolution 2 ns

Time Interval A to B, Pulse Width A, Rise/Fall A, Averaged

Range
Time Interval: 0 ns to 100 s
Pulse Width: 4 ns to 100 s
Rise/Fall Time: 0 ns to 100 s
Resolution
PM 6652C: 100 ns/N
PM 6654C: 10 ns/N

Duty Factor A

Range: 0 to 1 - 250 ns x Pulse rep. rate
Frequency Range: 0.03 Hz to 2 MHz

Totalize A

Range: 1 to 10¹⁰
Frequency Range: 0 to 120 MHz
Mode: Manual or external

Ratio A/B

Range: 10⁻¹⁰ to 10¹³
Frequency Range: 0.1 Hz to 120 MHz/0.01 Hz to 10 MHz

Ratio C/B

Range: 10 to 10³
Frequency Range: Input C range/0.01 Hz to 10 MHz

Phase A-B

Range: 0° to 360°/ (1 - 250 ns x FREQ)
Frequency Range: 0.03 Hz to 2 MHz

V Max, V Min, V p-p

Range: -50V to +50V
Frequency Range: DC, 100 Hz to 120 MHz

Input and Output Specifications

Inputs A and B

Frequency Range: DC-coupled: 0 to 120 MHz;
AC-coupled: 20 Hz to 120 MHz
Rise Time: Approx 1 ns
Sensitivity: 20 mV rms sine wave or 60 mV p-p (0 to 60 MHz); 30 mV rms sine wave or 90 mV p-p (60 MHz to 120 MHz)
Min. Pulse Duration: 4 ns
Attenuation: x 1, x 10 (fixed)

Hysteresis Band: Approx 40 mV p-p
Hysteresis compensation is automatically performed in TIME A-B, P A, Width A, RISE/FALL A, PHASE A-B and DUTY FACTOR measuring modes, resulting in a residual hysteresis band which is virtually 10 mV p-p.

Dynamic Input Voltage Range: 60 mV p-p within ±5V p-p/±5V dc (x 1); 600 mV p-p within ±50V p-p/±50V dc (x 10)

Trigger Level Selection: Manually via keyboard (10 MV steps); Manually via potentiometers; Auto trigger

Trigger Level Range: -5V to +5V (x 1); -50V to +50V (x 10)

Trigger Slopes: Positive or negative

Trigger Level Readout: Set trigger levels for channel A and B are displayed with a resolution of 10 mV (x 1) or 100 mV (x 10)

Trigger Indicators: Tri-state LED indication

AUTO Trigger: The AUTO trigger will automatically set A and B trigger levels to 50% of input signal amplitude (10% and 90% for risefall time measurements)

Min. Amplitude: 120 mV p-p

Frequency Range: 100 Hz to 120 MHz

Coupling: DC/AC

Channel Input: Separate A and B or common via A

Impedance

Separate A and B: 1 MΩ/35 pF or 50Ω nominal (A and B)

Common A: 0.5 MΩ/70 pF nominal or 50Ω nominal (A). Open input (B)

Input C (Option/PM 6610)

Frequency: 100 Hz to 1.5 GHz

Operating Input Voltage Range: [10 mV rms to 12 mV rms (100 MHz to 1 GHz); [30 mV rms to 12 mV rms (1 to 1.5 GHz)

Coupling: AC

Impedance: 50Ω nominal; VSWR ≤2

AM Tolerance: 96%; minimum signal must exceed minimum operating input voltage

Max Voltage Without Damage: 12 V rms overload protection with PIN diodes

Input C (Option PM 6619)

Frequency Range: 0.1 to 2.3 GHz

Coupling: AC

Operating Input Voltage Range: 20 mV rms to 12 V rms; 100 to 500 MHz
10 mV rms to 12 V rms; 0.3 to 2 GHz
15 mV rms to 12 V rms; 2 to 2.1 GHz
25 mV rms to 12 V rms; 2.1 to 2.3 GHz

AM Tolerance: 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement.

Input Impedance: 50Ω nominal

VSWR: <2:1; 50 to 1500 MHz
<2.5:1; 1.5 to 2 GHz
<3.5:1; >2 GHz

Max Voltage Without Damage: 12 V rms overload protection with pin diodes; Roar Panel inputs and outputs

Rear Panel Inputs and Outputs

Input D: 100 kHz to 10 MHz external reference frequency

Input E: External reset

Input F: External arm, external gate or average

Output G: 10 MHz internal reference frequency

Output H: Gate open/closed output signal

Output I and J: Channels A and B trigger levels

Crystal Oscillator Summery

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<td>Warm-up time to reach 10°c of final value</td>
<td>N/A</td>
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<td>&lt;15 min</td>
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*After 48 hours of continuous operation
**System Timer/Counters**

**PM 6654C & PM 6652C**

**GPIB/IEEE-488 Bus**
All front panel accessible functions are programmable through the option PM 9696B.

**Date Output Rate:** 30 to 50 readings/s in normal mode, approx. 450 readings/s in high-speed dump mode.

**General Specifications**
- **Measuring Time:** 0.1 ms to 95 s, down to approx. 2 µs for single-event measurements or external gate
- **Display Hold:** Freezes measuring results
- **Trigger Hold Off Range:** 5 µs to 200 ms (manual setting)
- **Time Interval Delay:** 100 µs to 999 s; bus programmable Hold-off active in single-shot Time Interval, Pulse width or Rise/Fall Time measurement.
- **Mathematics:** Mathematics makes it possible to offset a measuring value or to change scale factor as follows: \( K x \)
- **Check:** Applies 10 MHz Time Base Frequency to the measuring logic
- **Reset:** Manual via push-button or electrical via input E
- **Power On/Stand By:** In "ST BY" position, power is available to maintain an ovenized crystal oscillator
- **Test Function:** Performs internal self test
- **Program Memory:** 8 complete instrument settings can be saved and recalled from internal non-volatile memory
- **Display:** 10 digits LED display, sign and exponents
- **Unit Indicators:** 3 LEDs indicating Hz, s or V
- **Operating Temperature:** -5°C to 50°C
- **Power Requirements:** 115/230V ± 15%, 45 to 440 Hz; 60 VA. The PM 6654C and PM 6652C can also be powered by an external dc voltage; 17V to 28V.
- **Size:** 440 mm W x 89 mm H x 440 mm L (17.3 in W x 3.5 in H x 17.3 in L)
- **Weight:** Net, 8 kg (17.5 lb); shipping, 10 kg (22 lb)

**Ordering Information**

**Models**
- PM 6652C 120 MHz, 100 ns Timer/Counter
- PM 6654C Plus 2 ns resolution

**Included with Instrument**
- One-year product warranty, line cord, rack mounting brackets, Operating manual, and Certificate of Calibration Practices.

**Optional Configurations**
- When ordering, select basic "PM" Model desired from above, plus construct a 3-digit suffix by selecting 1 digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.
- **Input Frequency Option**
  - 0/0: Standard 120 MHz
  - 1/1: 5.5 MHz (PM 9696D/01)
  - 1/2: 3.0 MHz (PM 9696D/01)
- **Reference Oscillator Option**
  - 1/1: Standard Crystal
  - 2/1: TCXO (PM 9697B/01)
- **IF, Very High Stability Ovenized Crystal (PM 9696D/01)**
- **IF, Ultra High Stability Ovenized Crystal (PM 9691/01)**
- **IF, Standard Crystal plus Externally Referenced Frequency Multiplier (PM 9697/00)**

**Ordering Configuration**
To order the 120 MHz, 100 ns resolution version with TCXO oscillator and standard front panel with GPIB IEEE-488 I/F, select:

- **Model:** PM 6652C
- **Option Suffix:** Input, Oscillator, Interface
- **Yields Complete Model Number:** PM 6652C026

**Options and Accessories**
- PM 9595/10 50Ω Feedthrough Termination; 1W
- PM 9610/01 1.5 GHz Option (input C)
- PM 9611/01 Built-in Rear Panel Input
- **Wiring Option:** PM 9612/01 Fan
- PM 9613/01 Rack Mount Slide Kit
- PM 9619/01 2.3 GHz Option (input C)
- PM 9665B/01 50 kHz Low Pass Filter
- PM 9666/01 Trigger Level Output Cable
- PM 9678/01 TCXO Time Base Oscillator (version 2.1)
- PM 9690/01 Overized Time Base Oscillator (version 3.0)
- PM 9691/01 Overized Time Base Oscillator (version 4.0)
- PM 9692/01 Overized Time Base Oscillator (version 5.0)
- PM 9693D/08 Analog Recorder Output
- PM 9698B/00 IEEE-488 Bus Interface
- PM 9697/00 External Reference Frequency Multiplier

**Customer Support Services**

- Also see Section 20.
- **Factory Warranty:** One-year product warranty.