IEC-625

PM 6611 80MHz Universal counter
PM 6612 80MHz Counter timer
PM 6613 250MHz Universal counter
PM 6614 520MHz Universal counter
PM 6615 1GHz Universal counter
PM 6616 1.3GHz Universal counter

Wide frequency ranges from 10Hz up to 80MHz . . . 250MHz . . . 520MHz . . . 1GHz and 1.3GHz

Two different inputs, respectively LF and RF, specially designed for noise-free measurements

The automatic PIN-diode attenuator in the RF channel gives:
— Ease of operation
— Noise suppression
— Overload protection

High sensitivity of 10mV

High time-resolution of 100ns

9 digit planar display ensures the best resolution with overflow

Good portability through battery option and compact lightweight construction

Choice of 4 X-tal oscillators

IF display offset

IEC Bus-line interface

BCD output and digital-to-analog converter output options, for digital print-out or analog recording of measuring data

Ease of operation, thanks to excellent ergonomic lay-out and automated functions, while the very bright planar display ensures the best readability

Type Number	Frequency					Period + Period av.	Multiple Ratio	Totalizing of Counts	Time interval
	80MHz	250MHz	520MHz	1GHz	1.3GHz				
PM 6611	■					■	■	■	
PM 6612	■					■	■	■	■
PM 6613	■	■				■	■	■	
PM 6614	■	■	■			■	■	■	
PM 6615	■	■	■	■		■	■	■	
PM 6616	■	■	■	■	■	■	■	■	

Table 1. Performance survey of PM 6610-series of universal counters

WIDE VERSATILITY AND FLEXIBILITY TO MEET YOUR PARTICULAR REQUIREMENTS

The PM 6610-series forms a family of five universal frequency counters: 80MHz, 250MHz, 520MHz, 1GHz and 1.3GHz plus one 80MHz counter/timer.

All models measure a wide variety of frequency- and time- related parameters such as: FREQUENCY, PERIOD-AVERAGE, MULTIPLE-RATIO, TOTALIZING of counts, SELF-CHECK (and TIME-INTERVAL PM 6612 only). They further offer a facility as stopwatch.

The universal counter PM 6611 and the counter/time PM 6612, both ranging up to 80MHz, are designed for general purpose frequency and time measurements in research and development – production testing – maintenance and repair – and education. The universal counters PM 6613, PM 6614, PM 6615 and PM 6616 have specifically been designed for high frequency measurements, on telecommunication – broadcast- and TV equipment. The rechargeable battery unit plus the compact and lightweight construction make all these units very suitable for portable field use.

Choice of time-base oscillator

There is choice of 5 X-tal oscillators, see table 2. In this way the individual stability requirement can be met economically and also upgraded, if necessary at a later stage. By means of the external reference input, use can be made of a frequency standard.

Instantaneous high stability time base

The PM 6610-series, break new ground in the area of portable counters by extending the instantaneous high stability of laboratory instruments to field applications. This has been achieved by developing oven-contained crystal oscillators with extremely low power consumption.

The high-stability ovenized time-base options therefore can also be used with the internal battery pack. No warm-up times are thus needed when changing locations with a counter having a stability much higher than that of TCXO's (temperature compensated X-tal oscillator). The battery capacity is sufficient for 24 hours stand-by operation. This makes these counters the most suitable for portable field service use currently available.

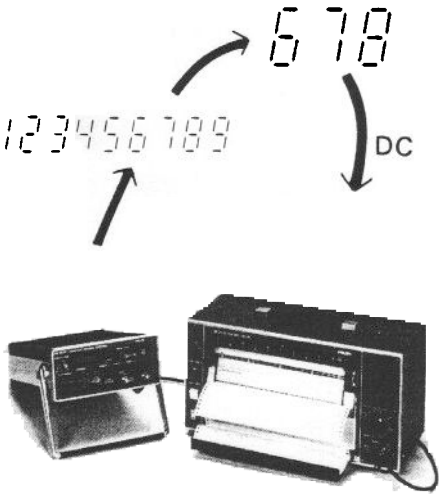


Fig. 1

Mains (line voltage) or battery supply

Each instrument is equipped for the following alternative supply voltages:

Table 2. Choice of time-base oscillators

PM 661./..version Including time-base:		01 version PM 9677	02 version PM 9678	03 version PM 9679	04 version PM 9690	05 version PM 9691
STABILITY against:	Type:	standard	TCXO	proportionally oven controlled	proportionally oven controlled	proportionally oven controlled
Ageing:		$< 5 \times 10^{-7}$ per month	$< 1 \times 10^{-7}$ per month	$< 1 \times 10^{-7}$ per month	$< 1.5 \times 10^{-9}$ per 24h*	$< 5 \times 10^{-10}$ per 24h*
Temperature: 0°C...50°C, ref. to +25°C		$< 1 \times 10^{-6}$	$< 1 \times 10^{-6}$	$< 1 \times 10^{-7}$	$< 3 \times 10^{-8}$	$< 5 \times 10^{-9}$
Change in measuring – and supply mode; line/int. battery/ ext. DC 12V...28V		$< 3 \times 10^{-7}$	$< 5 \times 10^{-8}$	$< 1 \times 10^{-8}$	$< 3 \times 10^{-9}$	$< 3 \times 10^{-9}$
Line voltage; ±10%		$< 1 \times 10^{-8}$	$< 1 \times 10^{-9}$	$< 1 \times 10^{-9}$	$< 5 \times 10^{-10}$	$< 5 \times 10^{-10}$
Warm-up time to reach 1×10^{-7}		—	—	≈10min	< 15min	< 15min

* *after 72 hours of continuous operation*

- Line voltage: 110...240V_{RMS}; 45...440Hz
- External battery: 11.8...28V_{DC} (for mobile use)
- Internal rechargable battery unit (for portable use)

IF (Display) off-set unit PM 9668
The optional circuit board PM 9668 enables the addition or subtraction of a programmable value to the measured value. In this way it allows the 8 most significant digits to be off-set.
This unit offers the external selection between *two* pre-programmable off-set values.

BCD – output PM 9674
The optional circuit board PM 9674 gives BCD-data in a parallel format for connection to a standard printer such as the Philips PM 2466.

Analog output PM 9675
The digital-to-analog converter PM 9675 provides a high resolution analog output for recording frequency stabilities of oscillators, filters and crystals on a Y-t chart recorder. In frequency control systems having analog feed back the DAC serves as an extremely accurate frequency-voltage converter. The PM 9675 permits conversion of any three consecutive digits out of the total of 9, or the two least significant digits. As such it functions as a magnifying glass to focus on just that part of the read-out which is most important (see fig. 1).

The normal mode converts 000 into a zero analog output, and 999 into a full scale output.

The flexibility is boosted by choice of operating mode. In the offset mode, the conversion of 500 produces a zero analog output; whilst 000 gives a mid-scale deflection.

For a display changing between 9.9999999 and 10.0000000MHz it is possible to record the frequency on the center of the strip chart, rather than having the output shifting between zero and full scale.

Bus Interface PM 9676
The serial data output-unit PM 9676 enables data processing by connecting the instrument to a standard bus-line.

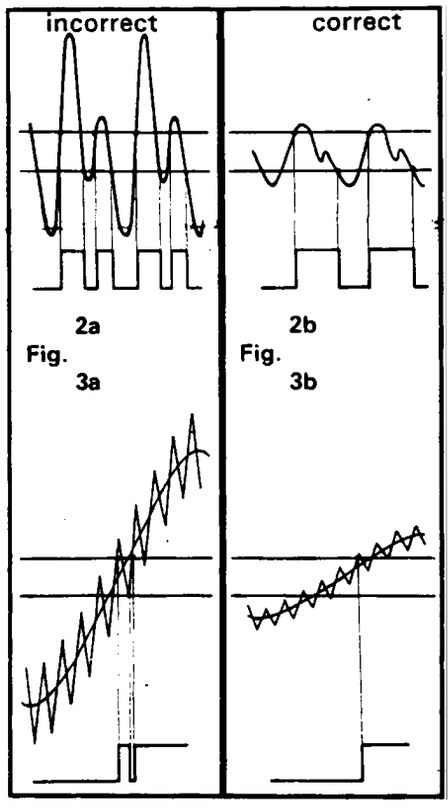
Carrying case PM 9676
To protect the whole instrument during transport or field use, an ever-ready case PM 9672 can be ordered as an optional extra.

Rackmount adapters PM 9669
The counters can easily be fitted in a standard 19" rack by the use of the rack adapter PM 9669/01 or PM 9669/02 for one respectively two counters.

Standard accessories
Operation/service manual
Line cord
Front panel protection cover

MORE ACCURATE AND RELIABLE LF AND RF FREQUENCY MEASUREMENTS

Whilst the basic accuracy of any counter is ±1 digit ±the time base error, it is not always realized that noise or interference can cause false counting and can lead to significant errors



With the PM 6610-series, the superior accuracy for both LF- and RF- measurements is due to the improved triggering with noise- and interference rejection. This break-through in trigger performance has been obtained by two specially designed input- and trigger channels optimized respectively for LF- and RF-signal processing.
The fig. 1a in the introduction indicate how distortion or noise in a conventional counter can cause the signal to pass through the trigger window (hysteresis band) and hence give false counts.
The Philips PM 6610-series of counters feature **continuously** variable input attenuation, which reduces the input signal to an amplitude just above the value of the trigger window. At the same time, noise and interference are suppressed so much that they cannot span the trigger window. False counts from noise, interference, etc. are thus eliminated in these counters. This optimum input matching (which cannot be achieved with conventional counters having decade-step attenuators) ensures that the accuracy as measured is the maximum attainable accuracy of ±1 digit ±the time base error.

LF-input
For the low frequency input (A), the continuous attenuation is set manually by the sensitivity control for universal waveforms up to 80MHz. For accurate LF measurements, the built-in low-pass filter may be switched on. This filter rejects HF noise or interference, having amplitudes much higher than that of the input signal under test (see curve).

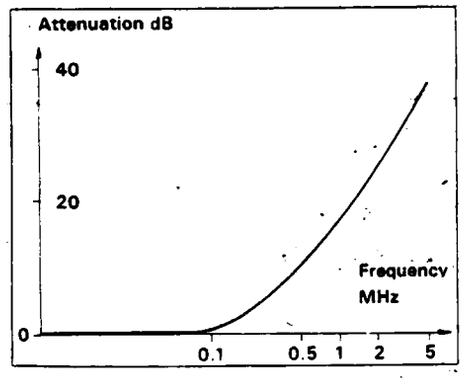


Fig. 4 This filter characteristic shows the attenuation of high frequency signals.

RF-input
The special RF input channel (B) on models PM 6613...PM 6616 features an automatic multistage PIN-Diode attenuator circuit. In addition to the noise suppression this gives the following user benefits:

1. wide dynamic input voltage range
2. ease of operation
3. high overload protection

Wide input voltage range
The use of PIN-diode attenuators and other state of the art components in the RF stages ensures perfect triggering at input levels between −27dBm and +35dBm (10mV_{RMS}...12V_{RMS}).

Automatic triggering
The operator need not concern himself with setting the amplitude for optimum triggering. The AUTOMATIC ATTENUATION of input signals ensures the best triggering without human intervention.

RF-input protection

Unlike conventional AGC-circuits (where the gain is controlled, but where the full input voltage is applied to the amplifier input), the multi-stage PIN-Diode circuit really ATTENUATES the input signal.
This ensures that powerful signals are strongly reduced before they appear at the input of the sensitive amplifier. The attenuator functions as very fast RF INPUT PROTECTION up to a high +35dBm (12V) signal level.
It is evident that an electronic overload protection reacts much faster than the older mechanical methods such as RF-fuses or relays. In addition the latter do not offer protection against modulated- or pulsed RF, since they respond to the average signal value.

Low level RF measurements

In conventional counters, too low an input signal often causes stable and reproduceable yet fully erroneous measurements. Such measurements are eliminated in these counters by a distinct switch-off point.
A built-in level detector permits counting only when the input signal is of sufficient amplitude ($\geqslant$ 10mV).

EASE OF OPERATION

Like other new instruments in the Philips range, these counters have received a lot of attention from ergonomic design specialists to get an uncluttered front panel layout, which is well human engineered. The controls are placed so that operation is easily understood, whilst the clear and very bright 9-digit planar display gives readouts with high last digit resolution. This offers quick and full control over your counter; a convenience not offered by instruments having autoranging and less digits.

Easy to handle in field use

Due to the high degree of integration, all models have the same compact and lightweight construction. For easy operation in the field, a built-in type of battery unit keeps overall dimensions unchanged.

Display blinking is a warming that the battery charge is low. To complete your measurement, 10–15 minutes are left before recharging is needed.

The sealed lead-acid batteries eliminate damage from complete discharge. Recharging is possible from the line or from an external DC souce (at least 18V).

The built-in recharging circuit is fully automatic. For the user, this means no worries about the recharging time. The charging current is automatically controlled to protect the batteries against overcharge.

For mobile field use, the 11.8...28V power receptacle enables supply from external batteries (for instance from the cigarette lighter socket in your car).

ORDERING PROCEDURE

PM 661./01: 80/250/520/1000/1300 MHz Counter, including time base oscillator PM 9677
PM 661./02: idem, but including PM 9678
PM 661./03: idem, but including PM 9679
PM 661./04: idem, but including PM 9690
PM 661./05: idem, but including PM 9691
PM 9668: If off-set unit
PM 9669/01: 19-in rack mount adapter to fit one unit
PM 9669/02: 19-in rack mount adapter to fit two units
PM 9672: Carrying case
PM 9673: Battery/recharging unit
PM 9674: BCD-output unit
PM 9675: Digital-to-Analog converter
PM 9676: Bus-line interface (IEC TC66)
The time base oscillators, PM 9678, PM 9679, PM 9690 and PM 9691 can be ordered also separately, to upgrade the counter afterwards.

It should be noted that the options PM 9673, PM 9674, PM 9675 and PM 9676 CANNOT be combined.

TECHNICAL SPECIFICATION

FREQUENCY

Range
10Hz...80MHz (PM 6611)
10Hz...80MHz (PM 6612)
10Hz...250MHz (PM 6613)
10Hz...520MHz (PM 6614)
10Hz...1GHz (PM 6615)
10Hz...1.3GHz (PM 6616)

Gate times
10ms...10s (PM 6611, PM 6613...PM 6616)
100ms...10s (PM 6612)

Gate times selectable in decade steps. If the RF-input on models PM 6613...PM 6616 is used, the gate time is automatically multiplied with the prescaling factor.

Accuracy
±1 count ±time base error.

Inputs
LF channel (A) 10Hz...80MHz (all models)
RF channel (B) >80MHz (PM 6613...PM 6616)

SINGLE PERIOD (ALL MODELS)

Range
100ns...100s

Resolution
100ns

Accuracy
±1 count ±time base error ±trigger error*

Input
channel A

PERIOD AVERAGE (ALL MODELS)

Range
1Hz...10MHz
10Hz...10MHz (for sinewaves)

Periods averaged (N)
10^2 and 10^4

Resolution
100ns/N

Accuracy
±1 count ±time base error.
$\pm \frac{\text{trigger error}^*}{N}$

Input
channel A

COUNT (ALL MODELS)

Range
1...10^9

Count accumulation
during manual start/stop interval

Pulse pair resolution
12ns

Input
channel A

Note
In the Count Mode the memory is automatically switched off

TIME INTERVAL (PM 6612 ONLY)

Range
1µs...10^8s

Resolution
100ns or 100µs

Accuracy
±1 count ±time base error ±trigger error**

Inputs
channels A and B

CHECK (ALL MODELS)

10MHz clock frequency interconnected to input A. Any measuring function may be selected.

By using this mode, the COUNT function provides a stop-watch facility.

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* trigger error is $\leqslant \pm 3 \times 10^{-3}$ for sinewaves with signal to noise ratio of $\geqslant$ 40dB

** trigger error for any waveshape is
$\leqslant \pm \frac{2.5 \times 10^{-3}}{\text{signal slope (V/ns)}}$ ns

MULTIPLE RATIO

Ratio fA/fC:
$\frac{10Hz...80MHz}{1kHz...10MHz}$ (PM 6611)

Ratio fA/fB:
$\frac{10Hz...80MHz}{10Hz...10MHz}$ (PM 6612)

Ratio fA or B/fC:
$\frac{10Hz...250MHz}{1kHz...10MHz}$ (PM 6613)
$\frac{10Hz...520MHz}{1kHz...10MHz}$ (PM 6614)
$\frac{10Hz...1GHz}{1kHz...10MHz}$ (PM 6615)
$\frac{10Hz...1.3GHz}{1kHz...10MHz}$ (PM 6616)

Multiplier (N)
10^2 and 10^4 with correct decimal point positioning

Accuracy
± 1 count
$\pm \frac{\text{trigger error}^* \text{ of the lower frequency}}{N}$

Ratio measurements with a multiplier factor
$N = 10^6, 10^8, 10^7$ and 10^8 (PM 6611, PM 6613...PM 6616) and $N = 10^6, 10^7$ and 10^8 (PM 6612) are obtained in the FREQUENCY mode, using the external reference input as lower frequency input. This arrangement, however, does not give correct decimal point positioning.

INPUT CHARACTERISTICS

Input A (all models)
Frequency range: 10Hz...80MHz, limited to 100kHz if internal low-pass filter is switched in
Pulse resolution: 6ns minimum pulse width
Sensitivity: $10mV_{RMS}$ (20Hz...80MHz) $30mV_{RMS}$ (10Hz...20Hz)
Impedance: $1M\Omega//25pF$
Coupling: AC
Attenuation: continuously variable between $\times 1 ... \times 400$
Trigger mode: ~ for signals having a duty factor $> 25\% ... < 75\%$
⊓ for signals having a duty factor $< 25\%$
⊔ for signals having a duty factor $> 75\%$

Overload voltage without damage: $250V_{DC}$
$220V_{RMS}$; up to 400Hz
$12V_{RMS}$; $> 1MHz$

Input B
(Not available on PM 6611)
Input B serves in the PM 6612 as stop channel in time-interval measurements and as lower frequency input for ratio measurements.

In the PM 6613...PM 6616 input B is the RF input channel with automatic attenuation.

Time Interval STOP-channel B (PM 6612 only)
Frequency range: 10Hz...10MHz
Pulse resolution: 50ns minimum pulse width
Sensitivity: $20mV_{RMS}$
Impedance: $1M\Omega//25pF$
Coupling: AC
Attenuation: continuously variable between $\times 1 ... \times 20$
Trigger mode: ~ for signals having a duty factor $> 25\% ... < 75\%$
⊓ for signals having a duty factor $< 25\%$
⊔ for signals having a duty factor $> 75\%$

Overload voltage without damage: $250V_{DC}$
$220V_{RMS}$; up to 400Hz
$12V_{RMS}$; $> 1MHz$

RF Input (B)
Frequency range: 5MHz...250MHz (PM 6613; $4 \times$ prescaled)
50MHz...520MHz (PM 6614; $8 \times$ prescaled)
50MHz...1000MHz (PM 6615; $16 \times$ prescaled)
80MHz...1300MHz (PM 6616; $16 \times$ prescaled)
Dynamic input voltage range: $10mV^*_{RMS} ... 12V_{RMS}$ ($-27dBm ... +35dBm$)
Impedance: 50Ω
Attenuation: Continuous by automatic PIN-diode attenuation circuit; max 62dB
Coupling: AC
VSWR: always < 2
AM tolerance: 98% at $\leq 5kHz$ modulation frequency
30% at $\geq 1MHz$ modulation frequency
Overload voltage without damage: $12V_{RMS}$

* Above 960MHz, the sensitivity of the PM 6615 might drop to $-24dBm$ ($14mV_{RMS}$) at 1GHz. For PM 6616 dynamic range is $10mV_{RMS} ... 12V_{RMS}$ for frequencies 150MHz...1GHz and $20mV_{RMS} ... 12V_{RMS}$ for frequencies 80MHz...1.3GHz.

Input C (Ext. ref. oscillator)
Frequency range: $1kHz ... 10MHz_{RMS}$
Sensitivity: $500mV_{RMS}$
Impedance: approx. $10k\Omega$
Counting: AC
Overload voltage without damage: $50V_{RMS}$

OUTPUT CHARACTERISTICS

Oscillator output (rear)
X-tal frequency: 10MHz
Amplitude: approx. $1V_{RMS}$; open circuit
Output impedance: approx. 200Ω
Coupling: AC
Overload protection: short-circuit proof

GENERAL

Display
Read out: Planar, 9 digits; 7 segments gas discharge display with automatic decimal point positioning
Display time: 0.2...5s and ∞
Reset: Pushing 'Reset' resets the counter. Releasing 'Reset' starts new measurement.
Gate lamp: Indicates that main-gate is opened and counting takes place
Memory: Switchable by push-button. In the Count Mode, the memory is switched off and the button is used for 'start/stop' operation

Power requirements
Line voltage: 110/220V ±15%; 45...440Hz
Consumption: depending on type no. crystal oscillator and options: approx. 15VA
Mains interference: below CISPR: 22/3, 29/2 and 40/1
or via Internal battery PM 9673
or via External DC source:
voltage: between +11.8V and +28V
consumption: approx 8W.
Approx. 100mA in STANDBY position if an oven-stabilized oscillator is mounted.
Connector: 4 mm banana

Environmental
Temperature: Storage: $-40°C ... +70°C$
Operating: $0°C ... +50°C$
Altitude/barometer pressure:
Storage: 15000m (50000ft)/15.2kN/m²
Operating: 5000m (15000ft)/53.3kN/m²
Humidity: 10...90% RH (26°C dewpoint)
Vibration test: According to IEC 68 Fc
Bump test: According to IEC 68 Eb
Handling test: According to IEC 68 Ec
Transport test: According to NLN-L88

Dimensions and weight
(w × h × d) 210 × 89 × 325mm
(8.25 × 3.5 × 12.8-in)
2.8kg (6.2lb)

Optional accessories
A complete list of optional accessories for both the PM 6620-Series and the PM 6610-Series appears one page 198.