Established 1981

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PM1000

AC Power Analyser

Voltech

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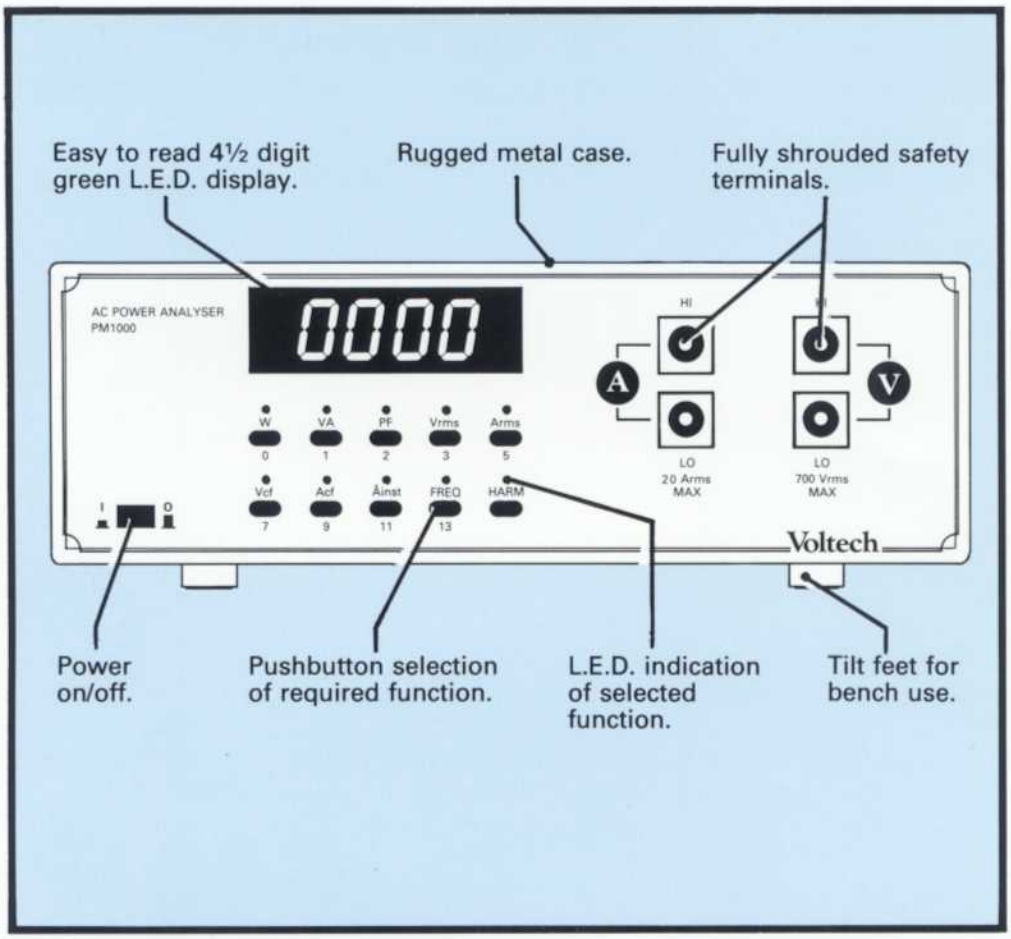
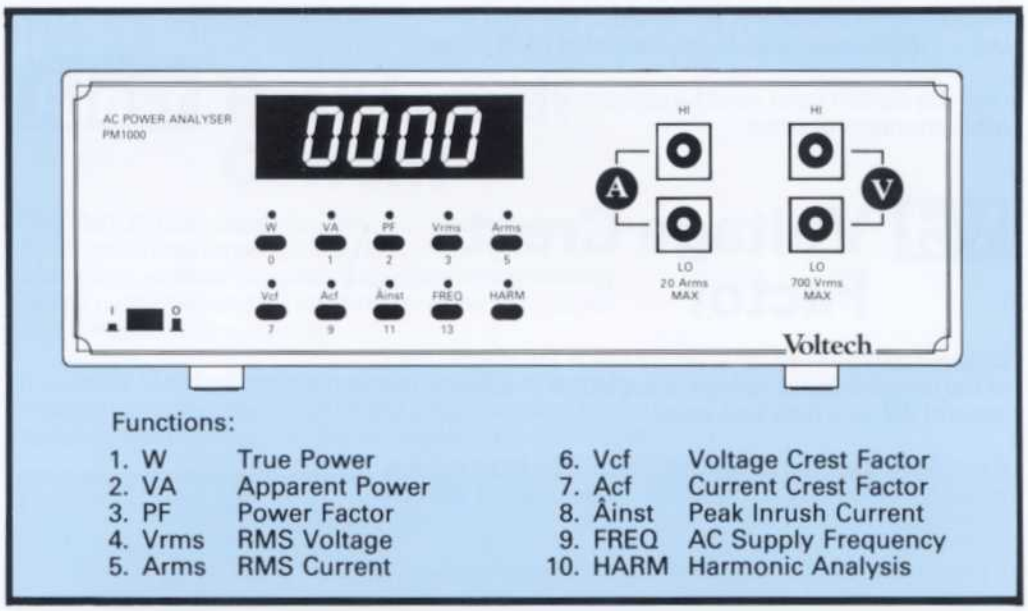


An easy-to-use Precision Power Analyser. The touch of a button gives direct readout of true power and a host of other useful measurements.

- Easy to use – fully autoranging for voltage, current and frequency
- Accurate measurements of real power (W) and apparent power (VA) even with distorted waveforms
- Displays real power factor
- True RMS measurement of voltage (2V to 700V AC) and current (20mA to 20A AC)
- Computes the crest factor (Pk/RMS) of input voltage and load current
- Harmonic analysis of current and voltage waveforms for checking conformance to specifications
- Wide frequency range – from DC to 20KHz
- Determines peak inrush current of motors, transformers, power supplies and similar loads

Applications



Functions:

1. W	True Power	6. Vcf	Voltage Crest Factor
2. VA	Apparent Power	7. Acf	Current Crest Factor
3. PF	Power Factor	8. Âinst	Peak Inrush Current
4. Vrms	RMS Voltage	9. FREQ	AC Supply Frequency
5. Arms	RMS Current	10. HARM	Harmonic Analysis

W Real Power

Measures accurately the power absorbed by a load or delivered from an AC power source, even with distorted waveforms. The instrument is (AC + DC) coupled and therefore measures the total real power.

Connect the PM1000 as shown in the appropriate connection diagram and select 'W'. The instrument is fully autoranging and the display will read the actual power in watts.

VA Apparent Power

Determines the apparent power absorbed by a load or delivered from a source. Connect the instrument as for power measurements and select 'VA'.

The apparent power is computed as VA = Vrms × Arms and displayed in volt–amperes.

PF Power Factor

Displays the true power factor of an AC load. Power factor is not cos ϕ except for undistorted waveforms; cos ϕ is merely the displacement factor of the load, a measure of the phase shift between the voltage and current waveforms.

If the current waveform is distorted, the fundamental components of voltage and current may well be in phase, with cos $\phi = 1$, but the true power factor will be less than unity. The PM1000 computes the ratio W/VA, which is the true power factor even for distorted waveforms.

Vrms RMS Voltage

Determines the true rms value of the input voltage, even with distorted waveforms. The input is (AC + DC) coupled, and the instrument will record the rms value of the combined AC and DC components. Only the voltage input leads need be connected for Vrms measurements.

Arms RMS Current

Determines the true rms value of the load current irrespective of waveform. As for Vrms, the input is (AC + DC) coupled, and displays the total RMS value.

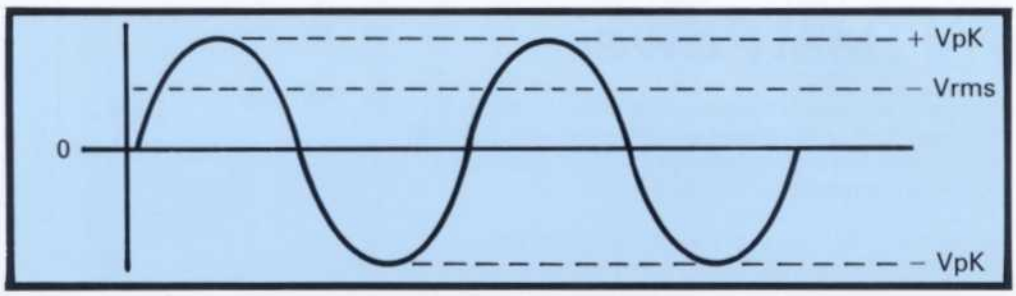
Only the current input need be connected when taking measurements of Arms.

Vcf Voltage Crest Factor

Display the ratio Vpk/Vrms, where Vpk is the magnitude of the repetitive peak voltage, irrespective of polarity. The value of Vcf for a pure sine-wave is 1.41.

A non-linear load will cause distortion of the input voltage waveform, resulting in a reduction in the value of voltage crest factor.

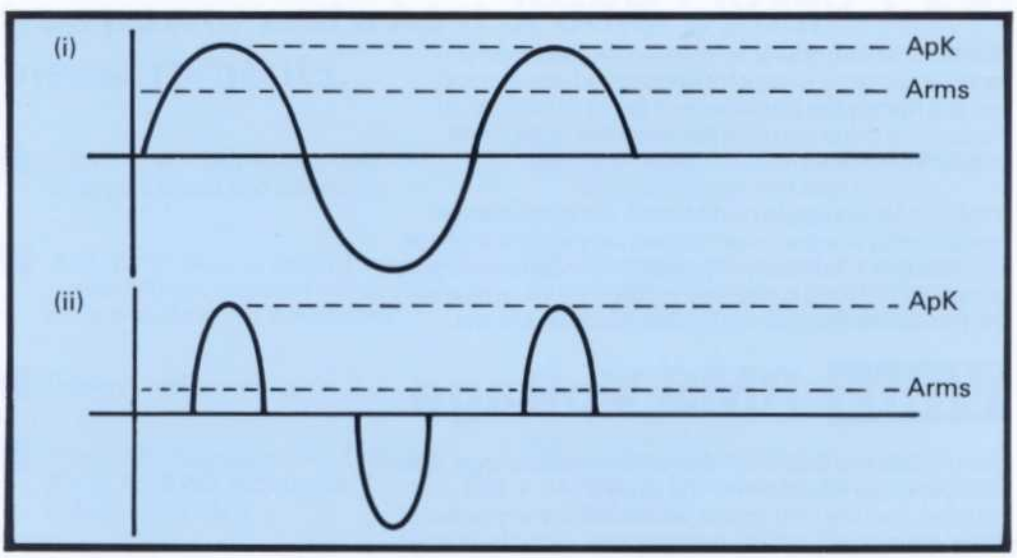
A measurement of voltage crest factor thereby provides a useful indication of the effect of a load on the AC supply.



Acf Current Crest Factor

Displays the ratio Apk/Arms, where Apk is the magnitude of the repetitive peak current, irrespective of polarity.

If the load takes a sinusoidal current, Acf = 1.41 (i)
Many loads, such as a rectifier with capacitor filter produce a distorted current waveform (ii) and Acf will be much greater than 1.41.

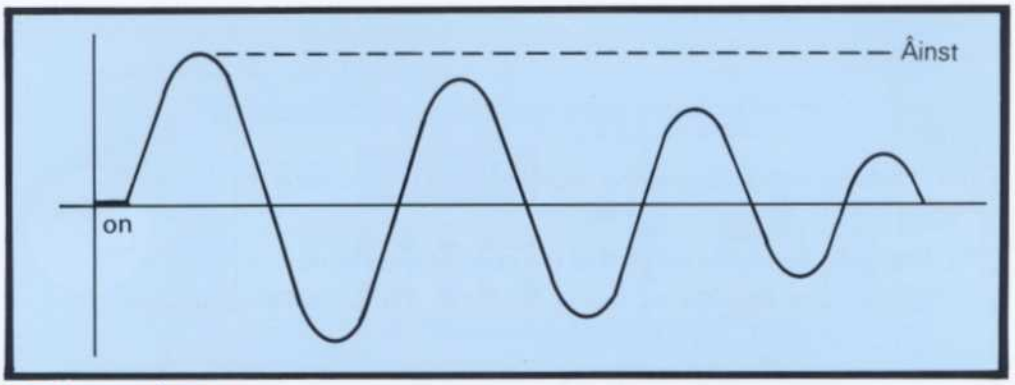


This measurement is useful in determining the repetitive peak current requirement of a power source. For example in a UPS installation the crest factor must be determined to ensure that the system can handle the repetitive peak current without being overloaded.

Âinst Peak Inrush Current

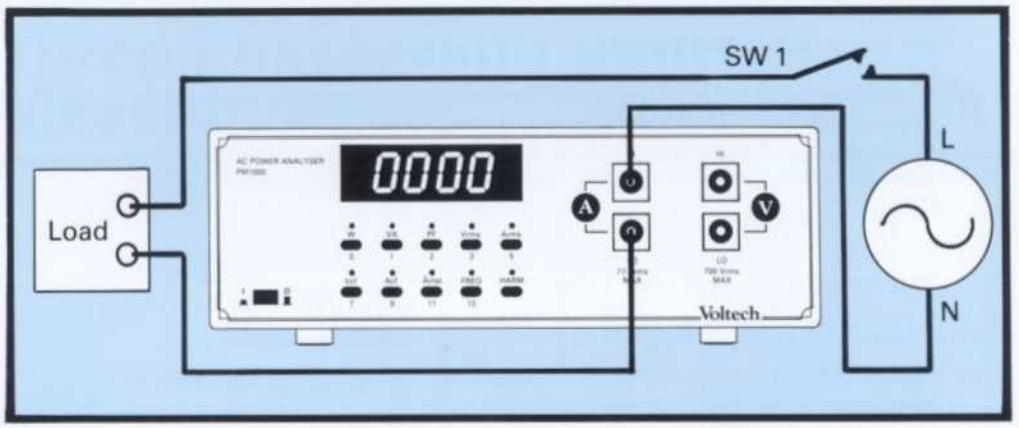
The PM1000 can determine the peak inrush current that flows into a load when the load is first energised. For example an ordinary tungsten lamp passes a significantly higher current when first switched on than the current that flows when it is running.

It is useful to determine the magnitude of this current in order to correctly specify fuses and circuit breakers and to determine the effect on the AC supply feeding the load.



To measure Âinst:–

a) Connect the PM1000 as shown.



b) Select Âinst. The PM1000 is now 'armed'; it is continuously scanning the signal on the current channel and is ready to display the peak value.

c) Energise AC supply by closing SW1, which may be an electro-mechanical or a solid state switch. The peak inrush current will be captured and displayed.

d) To take another reading of peak current reset the PM1000 by pressing Âinst again.

FREQ Frequency

This displays the frequency in Hz of the voltage or current input. If both the voltage and current inputs are connected and they are not the same frequency (e.g. a PWM system) then the PM1000 will choose and display the lower frequency. This feature allows the PM1000 to work in applications where one input is 'chopped' such as variable speed motor drives etc.

HARM Harmonic Analysis

This function is used to determine the magnitude of the fundamental component and harmonics of distorted current or voltage waveforms. Many AC loads, such as DC power supplies, florescent lamps and thyristor convertors draw a distorted current waveform from the AC supply.

There is an increasing awareness of the need to limit the level of harmonics drawn from the supply, and a number of regulatory authorities already specify limits for the harmonic content of certain loads. For example VDE 0712 Part 2 provides a limit for ballast lamps of:

Harmonic	Limit (% of Fundamental)
2	5
3	25 x Power Factor/0.9
5	7
7	4
9	3
11	2
13	1

The PM1000 will measure the harmonics of the voltage or current waveforms.

To determine harmonic content of the current waveform:

a) Connect the PM1000 so that it measures the correct fundamental frequency when 'FREQ' is selected (see page 5).

b) Select 'HARM'. The red L.E.D. will turn on to indicate that the PM1000 is in the harmonic analysis mode. Now press the button marked 'Arms' to select current analysis. All L.E.D.'s above the buttons will light and the display will read the Total Harmonic Distortion (THD) of the current waveform as a percentage.

c) To determine the value of a specific harmonic simply press the pushbutton appropriate to the harmonic required. Harmonic '0' (DC) will be displayed in amps DC, while harmonics 2, 3, 5, 7, 9, 11, 13 will be displayed as a percentage of the fundamental. The fundamental is displayed in amps rms.

d) To exit this function press 'HARM' once again. The red L.E.D. will go out, and the instrument will reset to 'Vrms'.

To determine harmonic content of the voltage waveform:

a) Connect the PM1000 so that it measures the correct fundamental frequency when 'FREQ' is selected (see page 5).

b) Select 'HARM'. The red L.E.D. will turn on to indicate that the PM1000 is in the harmonic analysis mode. Now press the button marked 'Vrms' to select voltage analysis. All L.E.D.'s above the buttons will light and the display will read the Total Harmonic Distortion (THD) of the voltage waveform as a percentage.

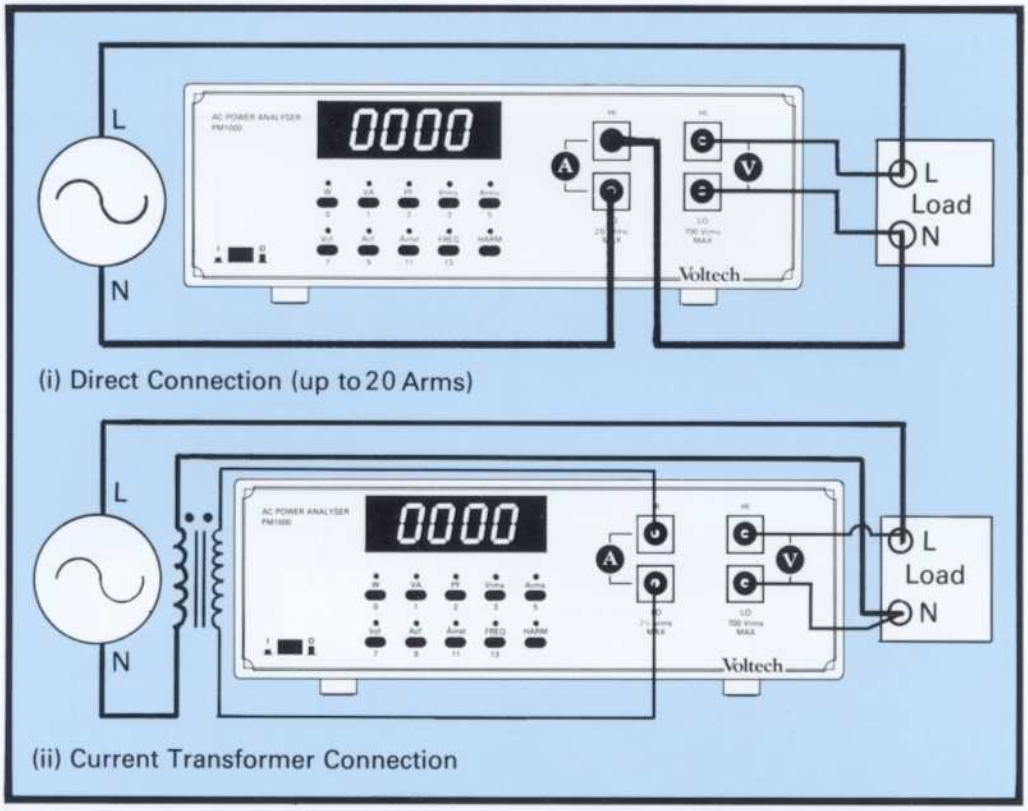
c) To determine the value of a specific harmonic simply press the pushbutton appropriate to the harmonic required. Harmonic '0' (DC) will be displayed in volts DC, while harmonics 2, 3, 5, 7, 9, 11, 13, will be displayed as a percentage of the fundamental. The fundamental is displayed in volts rms.

d) To exit this function press 'HARM' once again. The red L.E.D. will go out, and the instrument will reset to 'Vrms'.

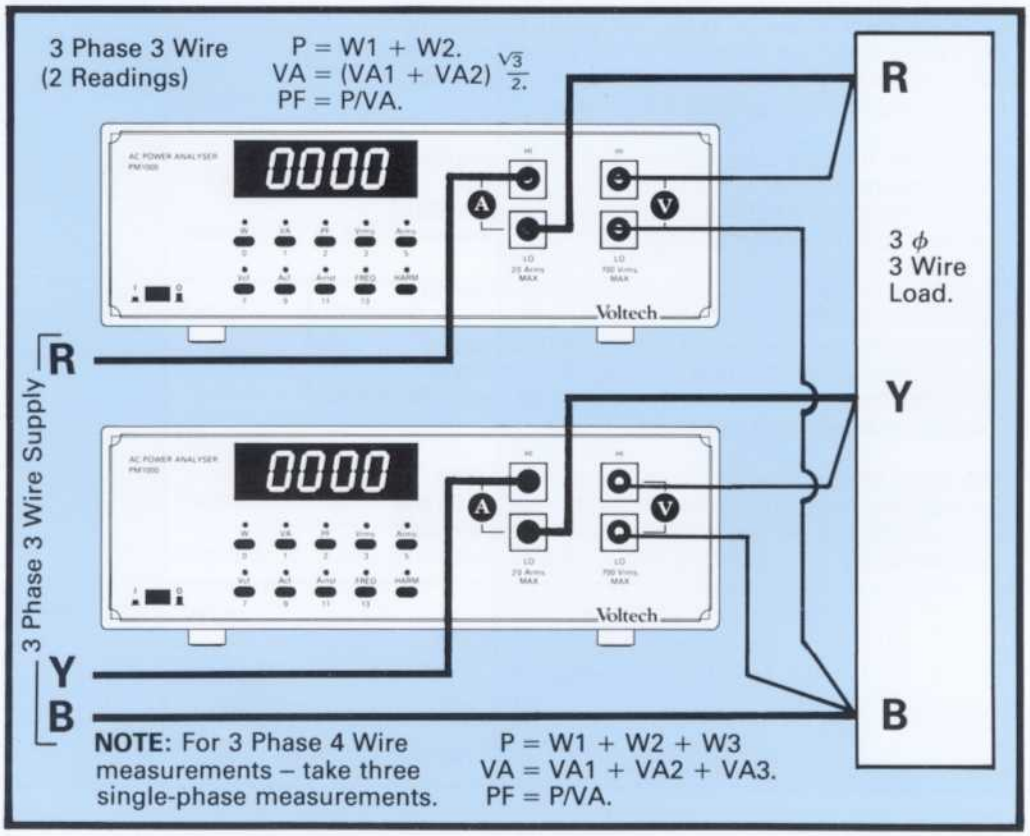
Note
In the harmonic analysis mode the frequency of the fundamental is taken as the frequency which is displayed when 'FREQ' is selected.

Connection Diagrams

Single Phase Measurements

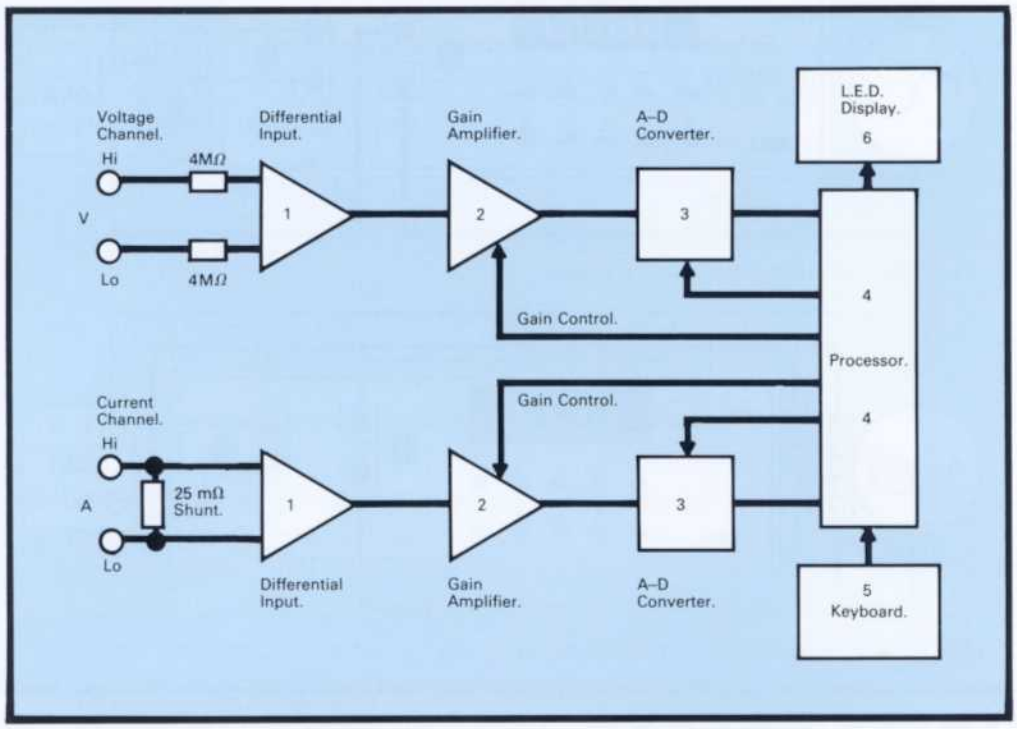


Three Phase Measurements



Functional Description

The PM1000 is a micro-processor based instrument that effects measurements by sampling and digitizing the voltage and current waveforms and computing the value of the required measurement in the processor.



Operation is as follows:
An input attenuator (8MΩ impedance) generates a low level voltage signal and a 25mΩ current shunt generates a low level current signal. These signals are buffered by differential amplifiers (1), which permit the inputs to float with respect to each other and with respect to ground, greatly simplifying accurate measurements.

The signals from the differential amplifiers are amplified by programmable-gain amplifiers (2), the gain being selected by the processor according to the magnitude of the input voltage and current signals.

The outputs from the gain amplifiers are converted to digital information by fast A–D converters (3), which effect simultaneous scanning of the signals on the voltage and current channels. The rate of scanning is controlled by the processor (4) depending on the frequency of the voltage signals.

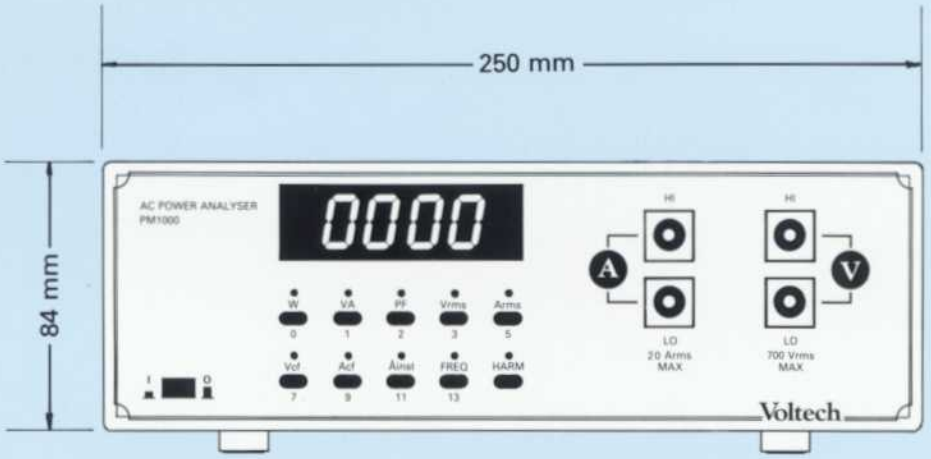
The digital data captured by the processor is used to compute the value of the measurement selected by the keyboard (5), and the result is presented on the 4½ digit LED display (6).

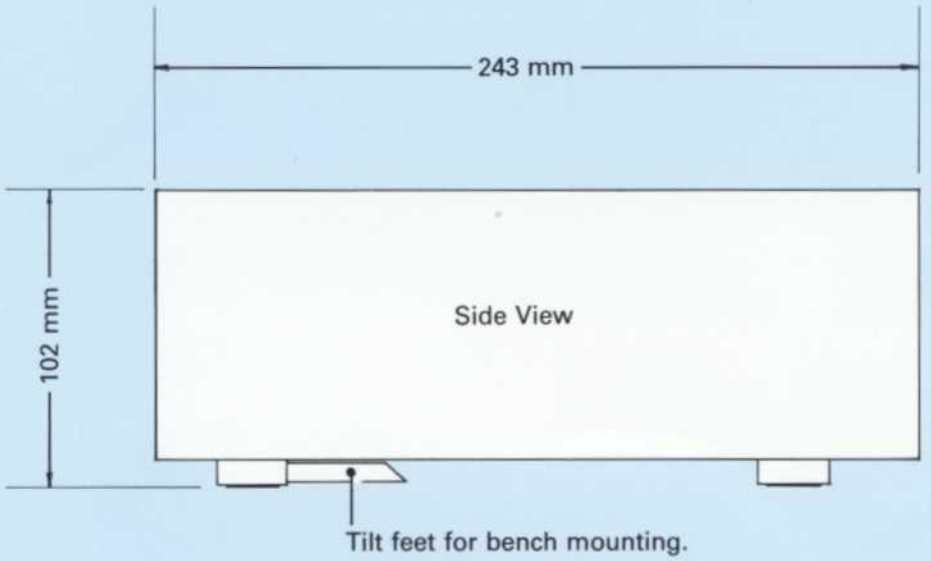
Specifications

RMS Voltage (Vrms)	Range		2V to 700V rms (autoranging) in 4 ranges: 8V, 35V, 140V and 700V rms
	Display		4½ digits
	Frequency range		DC and 5Hz to 20kHz
	Crest Factor		Up to 19.9 (limit 1000V Pk)
	Accuracy 23 ± 5°C Sinewave		± 0.20% ± 0.02%/kHz ± 0.10% of range
	Input Impedance		8MΩ
	Peak Input Voltage	Continuous	1000V
		< 1 second	2500V
RMS Current (Arms)	Range	Standard	20mA to 20A rms (autoranging) in 4 ranges:– 0.2A, 1A, 5A, and 20A rms
		Option 001	50mA to 20A rms (autoranging) in 4 ranges:– 0.5A, 2.5A, 12.5A and 20A rms
	Display		4½ digits
	Frequency range		DC and 5Hz to 20kHz
	Crest Factor		Up to 19.9 (Limit 40A Pk) (Limit 110A Pk on option 001)
	Accuracy 23 ± 5°C Sinewave		± 0.20% ± 0.10%/kHz ± 0.10% of range
	Input Resistance		0.05Ω max inc. fuse circuit
Power (W)	Range	Standard	40mW to 14kW (autoranging) in 16 ranges corresponding to V and A
		Option 001	100mW to 14kW
	Display		4½ digits with polarity according to direction of power flow
	Frequency range		DC and 5Hz to 20kHz
	Accuracy 23 ± 5°C Sinewave		± 0.40% ± (0.25 ÷ PF)%/kHz ± (0.1 × PF)% of range
Apparent Power (VA)	Range	Standard	40mVA to 14kVA (autoranging) in 16 ranges corresponding to V and A
		Option 001	100mVA to 14kVA
	Display		4½ digits
	Frequency range		DC and 5Hz to 20kHz
	Accuracy 23 ± 5°C Sinewave		± 0.40% ± 0.25%/kHz ± 0.10% of range
Power Factor (PF)	Range		0.000 ± 1.000
	Display		4½ digits (+ = leading PF, – = lagging PF)
	Accuracy 23 ± 5°C Sinewave		± 0.002 ± 0.0025/kHz

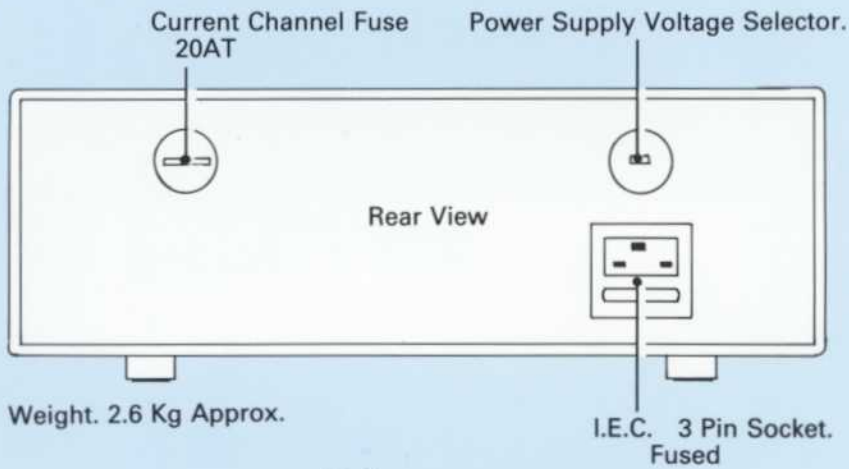
Voltage Crest Factor (Vcf)	Range		1.00 to 19.9
	Display		3 digits
	Accuracy 23 ± 5°C Sinewave		± 0.05
Current Crest Factor (Acf)	Range		1.00 to 19.9
	Display		3 digits
	Accuracy 23 ± 5°C Sinewave		± 0.05
Instantaneous Peak Current (Âinst)	Range	Standard	0.1A to 44A Pk (autoranging in 3 ranges 1.5, 7.5 and 44 A Pk)
		Option 001	0.2A to 110A Pk (autoranging in 3 ranges 3.8, 19 and 110A Pk)
	Display		3 digits with polarity
	Accuracy 23 ± 5°C Sinewave		± 2.0% of range
	Aperture time		100 µs
AC supply Frequency (FREQ)	Range		5Hz to 20 kHz
	Display		4½ digits
	Accuracy 23 ± 5°C Sinewave		± 0.2% of reading
Harmonic Analysis (HARM)	RMS current	Standard	20mA to 20A rms in 4 ranges 0.2, 1, 5 and 20A rms)
		Option 001	50mA to 20A rms in 4 ranges 0.5, 2.5, 12.5 and 20A rms
	RMS voltage		2 to 700V rms (autoranging) in 4 ranges: 8, 35, 140 and 700V rms
	Frequency range		DC, 5Hz to 20kHz
	Display		4½ digits
	Accuracy 23 ± 5°C Triangular Wave		Fundamental: ± 0.5% ± 0.2%/kHz ± 0.1% of range Harmonics: (± 0.25 ± 0.01/kHz)% of fundamental
Input Terminal			4mm Safety Sockets ⚠ max. 1000V to ⏚
Operating Temperature and Humidity			0–50°C, 10–90% RH
Overcurrent Protection			Fuse HRC 1¼" (32mm) 20AT
Dielectric Strength	Input – Case Input – Power Supply Power Supply – Case		4kV AC 50/60 Hz 1 minute
Power Supply	AC Input Voltage Frequency Protection Consumption		110V ± 20% (110V position) 220V ± 20% (220V position) 48 to 65 Hz Fuse 20mm 315mAT 15W, 20VA max.

Dimensions





Tilt feet for bench mounting.



Weight. 2.6 Kg Approx.

I.E.C. 3 Pin Socket.
Fused

Accessories Supplied:

1 x User Manual
4 x Test leads with moulded safety plugs
4 x Safety crocodile clips
1 x AC supply lead (3 core) 1 m long.

Options:

CT1000 Precision AC Current Transformer Dual Ratio 100A:1A 1000A:1A

CL1000 AC clamp on current transformer 1000A:1A

PS1000 SCR Switch module for precise switch-on of AC Supply when measuring inrush current (Âinst).

Safety Considerations

This test equipment is constructed and tested to the requirements of IEC 348 'Safety requirements for electronic measuring apparatus'. The instruction manual and the notes below should be read and followed to ensure the safety of the instrument and the user. Their safety is not assured if the instrument is misused or carelessly handled.

1. This equipment is constructed to IEC348 Safety class 1 and the A.C. line plug should be inserted in a socket with a protective ground contact.

2. The line plug should be inserted before connections are made to measuring or control circuits.

3. Do not attempt to remove outer cover without first disconnecting auxiliary and test power supplies.

Warranty

This Voltech Instruments product is warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Voltech Instruments will, at its option, either repair or replace products which prove to be defective.

For repair or service under warranty, this instrument must be returned to a service center designated by Voltech. Purchaser shall pre-pay shipment charges to service center and Voltech shall pay shipment charges to return the instrument to purchaser.

Limitation of Warranty

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