

PROTRONIX

數字式功率計
Digital Power Meter
Model: 1201A

Instruction Manual

使用說明書

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Specification

TRMS Power

Range:	19.99W, 199.9W, 1999W
Accuracy:	$\pm(0.3\%+3d)$
Freq. Response:	40Hz ~ 80Hz
Max. Voltage:	299.9V
Max. Current:	200mA for 19.99W 2A for 199.9W 20A for 1999W
Power Factor (Cos Φ):	Zero To Unity Leading Or Lagging
Shunt Resistance:	0.01 Ω (Current Sense)

TRMS AC Voltage

Range:	115V (0 ~ 199.9V), 230V (100 ~ 299.9V) Auto Range, Internal Selection
Accuracy:	$\pm(0.25\%+2d)$
Protection	300V
Impedance	Above 200K Ω

TRMS AC Current

Range:	.1999A, 1.999A, 19.99A
Accuracy:	$\pm(0.3\%+2d)$
Freq. Response:	40Hz ~ 200Hz for .1999A 40Hz ~ 1KHz for 1.999 ~ 19.99A
Peak Over Indication:	2.5 Times Of Range
Shunt Resistance:	0.01 Ω
Crest Factor Response:	50:1 for Minimum RMS Input, Linearly Decreasing To 3:1 For Full Scale RMS RMS input

General

Displays:	Dual 4 Digits High Intensity 7-Segment
Watts/ Ampere Reading:	3 Auto Ranges Up At 2000 Counts Down At 0.180 Counts
Min. Input:	10% Of Range For All True RMS Converter
Dimension:	260(W) x 100(H) x 340(D) mm
Power:	115V/230V \pm 10%, 50/ 60Hz, 10W
Weight:	4 Kgs.

General Description

PROTRONIX 1201A Digital Power Meter is a 2000W with power factor measurement meter. It has both auto ranging and manual operation. It is designed to aid engineering, production test, quality control, quality assurance and service department to decide product power consumption from AC power lines.

Model 1201A provide a fast and convenient method of determining product efficiency, power factor and true RMS current while continuously monitoring the AC line voltage. Phase angle relationships may be accurately calculated through utilization of the displayed digital data.

Model 1201A uses a unique four-quadrant complex waveform analog multiplier to derive a DC voltage level equivalent to the integrated product of the instantaneous value of line voltage and current. The developed DC voltage value is converted for presentation on a 3 1/2 digit display. Automatic ranging provides maximum resolution from 10 milliwatts to 1999 watts. True RMS current from micro amp through 19.99 amperes with a crest factor of 3:1 may be monitored by selecting the current display with the front panel switch.

Model 1201A is designed to operate selectable 115/ 230V AC independent from load power. Load voltage may be varied 0 ~ 300V in 2 ranges; 0 ~ 199.9 & 100.0 ~ 299.9. Both input test voltage and load are connected via a rear panel barrier strip.

Installation

This section contains information for inspection and installation of **Digital Power Meter Model 1201A**.

Before Use

If the external shipping container shows evidence of in-transit damage, such damage should be immediately brought to the attention of the carrier and such damage noted on the bill of lading.

Unpack the instrument and retain the shipping container until the instrument has been inspected for possible damage in the shipment is observed, notify the carrier and obtain his authorization for repairs before returning the instrument to the factory. Where the external shipping container has shown evidence of damage in transit, but the instrument shows no external damage, it may be advisable to perform operation to determine that the instrument has not incurred hidden damage.

Power Requirements

This instrument is shipped from the factory for operation from the power source voltage specified by the purchaser.

The unit operation from 50 – 60Hz input. Units connected for 115V operation will operate at line voltage of 103 to 126 volts. Those connected for 230V operation will operate at line voltages of 207 to 253 volts.

Cautions

- 1) The operation temperature range is within 20 - 50°C .
- 2) Before operate, allow instrument to warm-up more than 10 minutes after power on.
- 3) Do not apply any signal or voltage to output terminal at front panel.

Front Panel

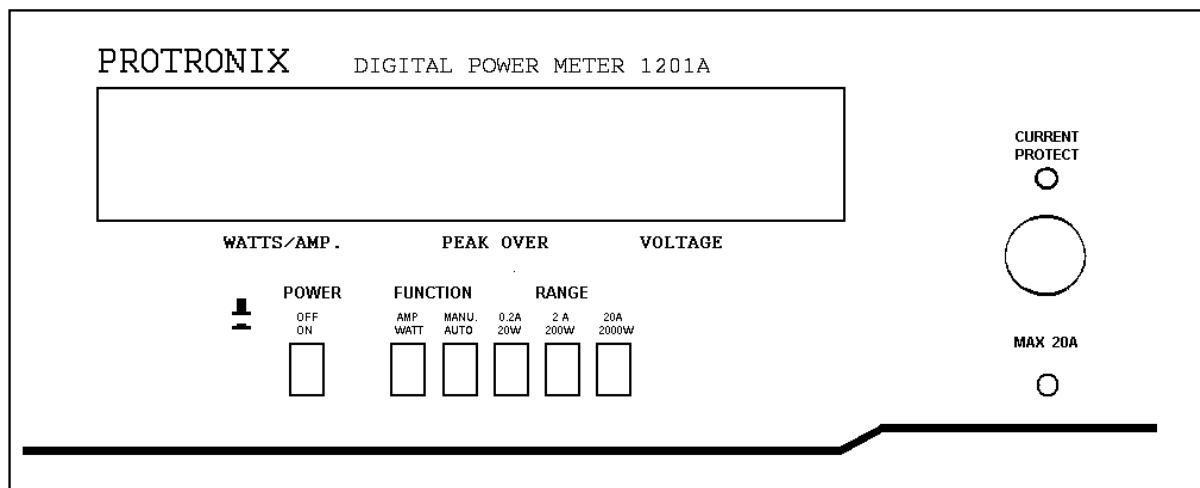
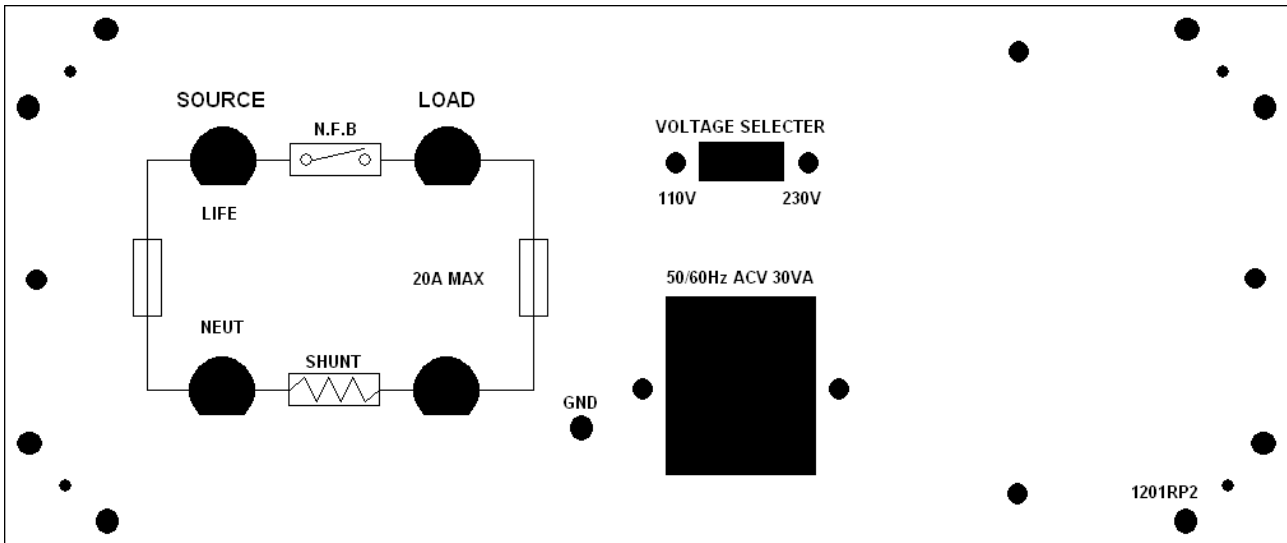


TABLE 2. Front Panel

Rear Panel



When use Power Line, make sure to connect only to indicated line of Life/ Neutral/ Earth.

TABLE 1. Rear Panel Connections

Operation

This section contains complete operating instructions for the **Model 1201A Digital Power Meter**.

Front Panel Controls And Indicators

There are seven switches on the front panel of the **Model 1201A**. The 20 ampere circuit breaker functions as load protection for the model, the **POWER ON/OFF** controls for model 1201A. Application of power to the instrument is indicated by lighting of the LINE VOLTAGE and LOAD current or consumption power. Another 4 switches select the range of current with either AUTO or MANUAL operation.

When in the WATT position, the LED indicator adjacent to the WATTS legend is illuminated and the indication in the LOAD display is the true $EI \cos\Phi$ power to the load. When the switch is in the AMP position, the LED indication adjacent to the LOAD display is the true RMS current flowing to the load. Each display is composed of 3 1/2 seven-segment digits.

TRMS Voltmeter

The testing voltage display will show the voltage across load at all times with 0.1 volt resolution regardless of the mode of the LOAD display. The model 1201A operates from 0 to 199.9V AC and from 100.0 to 299.9 for load testing. The operating range automatically selects suitable range for testing.

TRMS Ammeter

To operate the model 1201A in the AMP mode, place the **AMP/WATT** switch in the **AMP** position. The 3 1/2 digit LOAD display then indicates the current flowing to the load. There are three current ranges, 0.2A, 2A and 20A. Ranging is fully automatic. Whenever the input to the instrument is such that the indication would be 0180, or less (decimal point omitted), the instrument will automatically downrange. Whenever the input is such that the indication would be more than 1999, the instrument automatically up ranges. If the maximum current of 19.99 amperes is exceeded, the display will blink until the load is removed or the current is reduced to within the instrument's range. If the indication is .0180 amperes, or less, the instrument is already operating in its lowest range (0.2A).

Also **Model 1201A** has manual range for peak current over adjustment. The foregoing paragraph was based on sinusoidal or near-sinusoidal waveforms. Under conditions of pulsing of other complex waveforms with large crest factors, the instrument will uprange as necessary to maintain the input signal within the linear operating range of the internal amplifier. This insures that the display indication is in terms of the true RMS value of the measured current. Accuracy is not impaired. However, the reading resolution will be reduced. For example, if the true RMS value of a sinusoidal current is near 1.2 amperes, the display might indicate 1.212 amps. If the current is a high crest factor waveform, and it is necessary to up range, the reading for the same RMS value would be 01.21. This feature is an invaluable aid to the test personnel as the leading zero to the left of the decimal point provides a recognizable indication that the current is other than near-sinusoidal and has high crest factor, in the area of 3:1 or more.

TRMS Wattmeter

To operate the **Model 1201A** in the **WATT** mode, the **AMP/WATT** switch is placed in the **WATT** position. The LED indicator adjacent to the WATTS legend will illuminate to indicate the unit is operating in the WATT mode, the LOAD display will then indicate the power, in watts, being delivered to the load. This is a true $EI \cos\Phi$ indication irrespective of the voltage or current waveforms. There are three power ranges; 20 watts, 200 watts & 2000 watts which has ranges of 0.2, 2.0 and 20 amperes. Ranging in the power mode, as in the current mode, is completely automatic. Whenever the power to the load is such as to provide an indication of 0180, or less, the instrument will automatically downrange. If the load power delivered would produce an indication of 1999, or more, the instrument will up range. If the maximum of 1999 watts is exceeded, the display will blink until the load power is reduced to a value within the range of the instrument or the load is removed. If the indication is 01.80, or less, the instrument is operation in its lowest range.

As in the current mode of operation, the foregoing is applicable only when the current flowing to the load is near-sinusoidal. The auto ranging system operates in an identical manner in the power mode as in the current mode. When the current is of a pulsing or complex, nature, the peak detector will force an up range to maintain the current amplifier in its linear operational region.

Functional Description

General

This section provides a functional description of the model 1201A Digital Power Meter referenced to the block diagram, TABLE 3. The description provided in this section is intended to assist the engineer or technician in gaining a general understanding of the operation of the circuits of the model 1201A without the necessity of a detailed circuit description. With the information provided in this section (and that of 6-2 calibration), routine maintenance during the initial one-year warranty period can be accomplished. Detailed warranty maintenance during this period will be accomplished at the factory.

Power Supplies

Power for the internal logic circuits is obtained from a power transformer, rectifier-filter system and regulators. In addition, a precision reference is obtained from the 5 volt logic supply. The reference supply furnished an input to the voltmeter and current meter circuits to which the line voltage and current are compared.

Voltmeter

The line voltage is sampled by a precision operational rectifier. The resulted DC voltage is passed through a true RMS converter before being applied to the DC voltmeter circuit. The VOLTS display is driven by a large scale integrated (LSI) circuit that compares the input DC to a precision reference voltage and develops the drive signals for the digit display selector and decoder/ driver. The reading on the 3 1/2 digit display has a resolution of 0.1 volt. The displayed voltage is the average value of the line voltage calibrated in TRMS.

The 115V AC model of the **Digital Power Meter** will operate with line voltages between 103 and 126. The 230V AC model will operate from 207 to 253 volts and line voltages between those limits will be displayed. As show in the block diagram, the VOLTS voltmeter and its display do not enter into the power computations, but provide information on line voltage conditions to the operator. The displayed voltage is necessary to the calculation of phase angle and power factor.

Ammeter

A 0.01 ohm current shunt resistor in series with the power line neutral, provides the current sense input to the variable gain operation amplifier. The gain of the amplifier has three ranges that are controlled by the auto ranging system. The output amplitude of the amplifier is maintained within the input limits of the true RMS converter. The converter develops a DC voltage proportional to the true RMS value of the amplifier output which is in direct relationship to the line current. In the AMPS mode, the output of the true RMS converter is applied to the LOAD display through the **AMP/ WATT** selector. The IC and display circuit of the ammeter are similar to those employed in the VOLTS display and use a reference from the same source as that for the VOLTS display.

The ammeter circuit employs auto ranging so that operation of the wattmeter is completely automatic. The LOAD display voltmeter IC used in the ammeter circuit has an overflow output that indicates that the applied input is beyond the measuring range of the IC. This output is used to command the auto ranging system to up range one step. The auto ranging system output then reduces the gain of the variable gain amplifier to bring the output of the true RMS converter within range of the IC input. Current input so that would cause a reading of 0180, or less, cause the auto ranging system to downrange. There are three ranges of current 0.2, 2 and 20 amperes. If the current exceeds 19.99 amperes, the system cannot up range further. The display will read 19.99, but it will be blinking to indicate the over range condition.

The **Model 1201A** is designed to provide true RMS current and true wattage ($EI \cos\Phi$) readings with current and voltage waveforms that may be distorted severely compared to sinusoidal waveform. In cases where peak currents are several times greater than the true RMS value, the input to the LOAD display may be within range, but the variable gain amplifier will be operating in its non-linear region. Therefore, the peak detector provides an input to the auto ranging system that forces an up range whenever the peak current is greater than 3.5 times the range. At the same time, it inhibits a downrange from being forced by the LOAD display input. Such a condition is indicated by a display reading of 01.00, for example, rather than 1.000, which would be the normal indication for a sinusoidal current.

Block Diagram

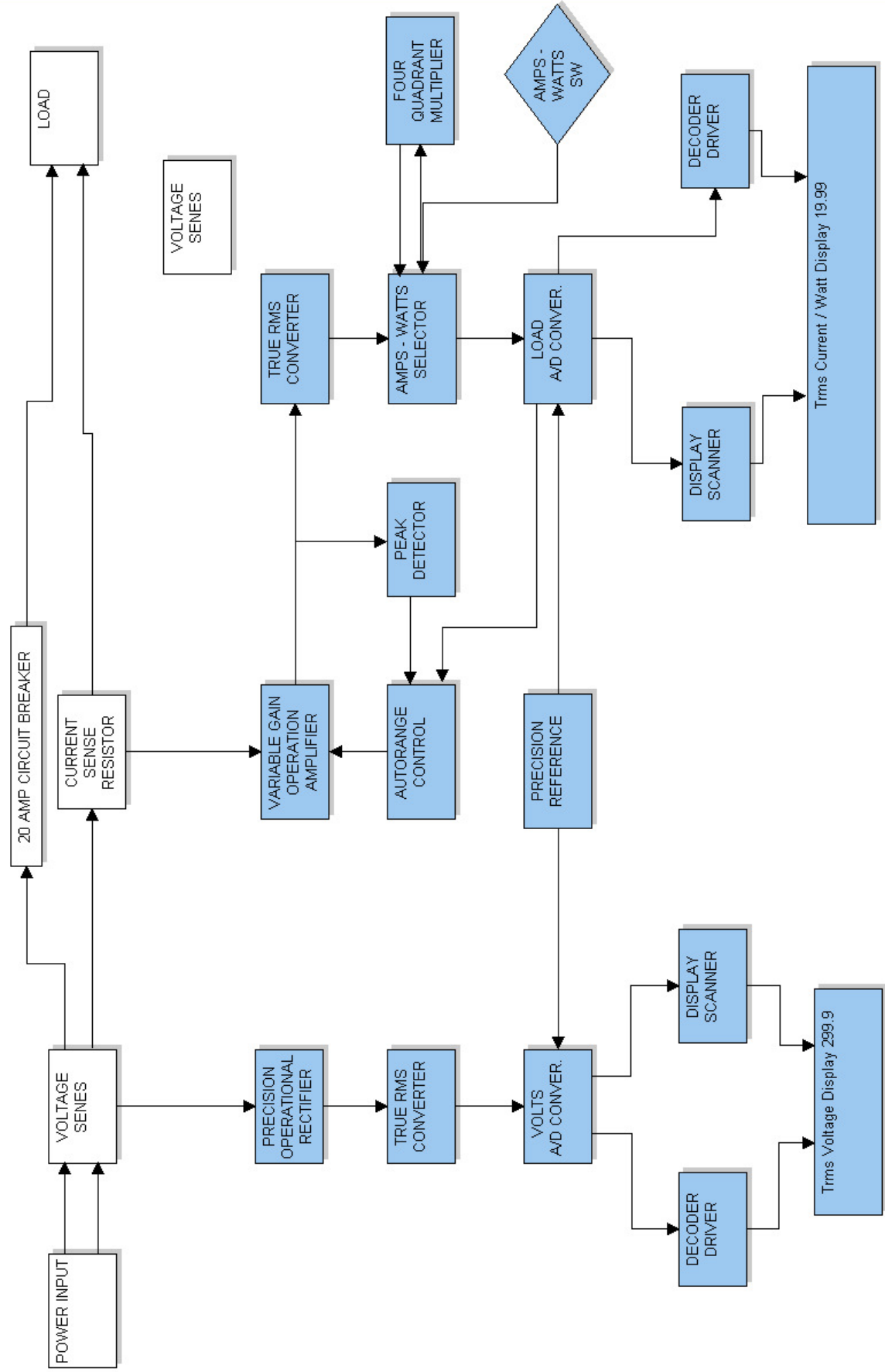


TABLE 3. Block Diagram

Wattmeter

In the wattmeter mode, the DC output of the true RMS converter is removed from the LOAD display input and the output of the four-quadrant analog multiplier is connected to the LOAD display input. The analog multiplier multiplies the current input times the voltage input and provides a DC voltage output proportional to $EI \cos\Phi$. This DC voltage is then applied to the LOAD display IC to produce the wattage reading. The analog multiplier is an integrated circuit configuration that permits the connection of non-linearly and auto-zero functions, thereby providing the high accuracy of the instrument in the wattmeter mode. The multiplier circuitry consists of U209 (bilateral switch), U210 (quad op amp), U211 (quad NAND gate) and associated components. The individual sections of the multiple circuit devices are identified by the device designator and a digit suffix which corresponds to the output pin number, U210-214, for example.

The circuit functions as follows (refer to TABLE 4) The output voltage across the shunt is amplified by U204. This is connected to one of the switch sections (SW1) of the bilateral switch (U209). When the switch is closed, this voltage is applied to U210-U214, along with its associated components, to form a low pass filter. The output of the voltage at its input if switch SW1 remains closed. If the switch is opened periodically, the output of the filter will be the input voltage times the mark/ space ratio of the switch. For example, if the switch is closed 70 percent of the time and opened 30 percent of the time, with this sequence occurring at a rapid rate, the output of the filter will be 70 percent of the input voltage.

The ratio of the switch closed time to opened time is controlled by U210-1, U210-7, U210-11 and U211-10. The input of U210-1 is connected to the voltage at the load that is to be measured. As this voltage varies, U210 and U211 control the time that switch SW1 is closed.

U211-11 is used as a buffer amplifier and drives switch section SW1 of the bilateral switch. Since switch section SW2 of the switch is driven by U211-10, it is the complement of U211-11. This causes switch SW1 to be closed when switch SW2 is open and versa. The purpose of switch SW2 is to connect U210-8 to the input of the low pass filter whenever switch SW1 is open. During this time a correction voltage is applied to the filter to compensate for DC offset drift in the multiplier circuitry.