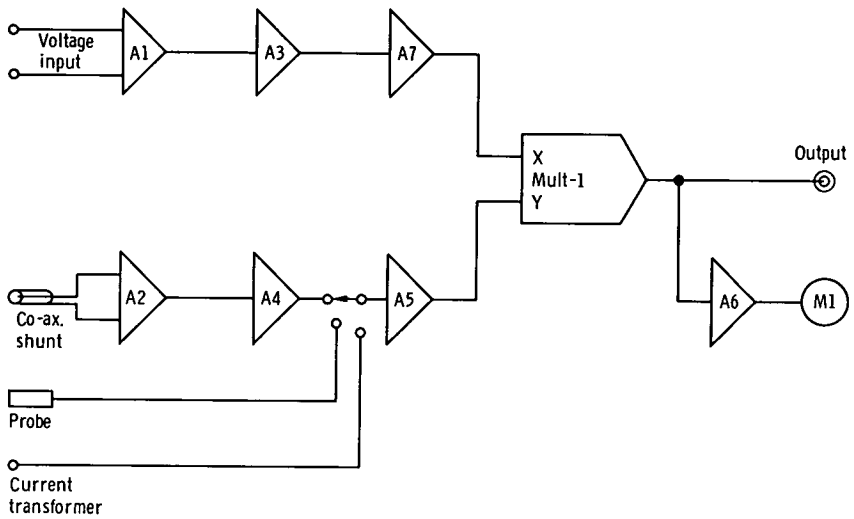
NASA TECH BRIEF

Lewis Research Center

WIDEBAND WATTMETER FOR INSTANT MEASUREMENT OF REAL POWER



Simplified block diagram of wideband wattmeter

The Problem:

The necessity to obtain information on the flow of electric power in nonlinear and time-varying systems had led to a number of attempts to devise wide-band wattmeters. Many switching and pulse circuits generate power spikes during their transition or switching time. This transient power may be of great significance and should be taken into account to avoid catastrophic failures in the active devices. Conventional sine wave or low frequency wattmeters are inadequate for this purpose.

The Solution:

A portable, solid state wattmeter with a wideband (dc to 1 MHz) linear multiplier which provides true four quadrant operation permitting instantaneous indication of real power as an oscilloscope display.

How It's Done:

As shown in the figure, amplifier A1 is a differential voltage amplifier and with suitable range switching covers the 1 to 1000 volt range. A3 and A7 amplify the output of A1 to the desired 1 to 10 volt range and drive the multiplier X input. Amplifier A2 is a differential amplifier for the current shunt signal. It is followed by two single ended amplifiers, A4 and A5, which raise the signal level to the desired 1 to 10 volts for the multiplier Y input. When either the current sensing probe or the current transformer is used, only amplifier A5 is needed. Current input may be from the probe (0-10 amps), a shunt assembly, or a current transformer. One of the latter two items is necessary for the 10-100 ampere range.

Accidental overvoltage or overrange protection is provided by fast recovery diodes and zener clamps. This facilitates measuring repetitive pulse waveforms where a portion of the signal is overrange. The portion of the signal which is within range will be accurately reproduced.

Average power indication is provided by meter, M1, and its associated driver, A6. The use of this meter in conjunction with external meters reading true rms voltage and current permits the determination of power factor for repetitive non-sinusoidal power waveforms.

(continued overleaf)

Notes:

1. This wattmeter should be of use to manufacturers and users of semiconductors, transformers, inductors and capacitors which carry currents with abruptly changing waveforms.
2. Performance specifications are: frequency band width dc to 1 MHz; current range 10 mA to 100 amperes peak; voltage range 1 volt to 1000 volts peak; accuracy ±2% of full scale reading.
3. The unit can be assembled in a volume no larger than 20.3 cm x 25.4 cm x 20.3 cm (8 x 10 x 8 inches), and weighs no more than 4.5 kg (10 pounds).
4. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)
   Reference: NASA CR-72752 (N72-14420), Development of a Wideband Wattmeter as a Laboratory Instrument
5. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B72-10737

Patent Status:

NASA has decided not to apply for a patent.

Source: L.G. Landes and Y.Y. Liu
Barnes & Reinecke, Inc.
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