GENCAL™
INSTRUMENTATION

GENCAL POWER METERING

RF power measurement instrumentation designed for production power supplies.

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The advanced GenCal™ system is the only RF power measurment instrumentation package designed for the plasma-based process environment.

BENEFITS

- **Quickly verifies proper operation of generator and tuner**
- **Alerts you to power fluctuations in the generator**
- **Selectssetpoint for input to the power supply**
- **Display the generator's forward and reflected power**
- **Displays the forward and reflected power as measured by the PMH**
- **Has indicator lights for:**
  - *Generator overtemperature*
  - *Generator preset power limit*
- **Has a Generator Power on/off and interlock control switch**

GENERAL DESCRIPTION

GenCal system provides industry-leading measurement accuracy at the discrete frequencies commonly used in the plasma process industry. The GenCal system uses the same stat-of-the-art hybrid power sensor technology used by AE's R&D Award winning plasma impedance sensor. This optimized technology provides measurements in the presence of plasma-generated signals that have high harmonic content and noise with an accuracy not currently available in other power measurement instruments.

The GenCal system is a two-part design, consisting of:

- *A convenient hand-held meter, the control electronics package (CEP)*
- *Different Power Measurement Head (PMHs), each set for a specific frequency and power range.*

Each PMH is an in-line, bi-directional sensor between the power supply and the plasma load (or impedance-matching network in 13.56 MHz and 400 kHz applications). The PMHs provide forward and reflected power measurements to the CEP. The CEP automatically scales the readings from the operating PMH and displays them.

The GenCal system is a complete, compact, easy-to-use RF power supply calibration system. The CEP provides precise analog control of your supply. Through a convenient 25-pin port, the CEP provides:

- *A percentage of full-scale setpoint*
- *On and off signals*
- *Monitoring of power supply readbacks for comparison to the measurements made by the in-line PMH snesor.*

Power supply controls include RF ON, INTERLOCK pushbuttons, and a rotary switch for selecting a precision setpoint input to the power supply.

You may also use the CEP without a PMH for power supply control when you don't need external power measurements.

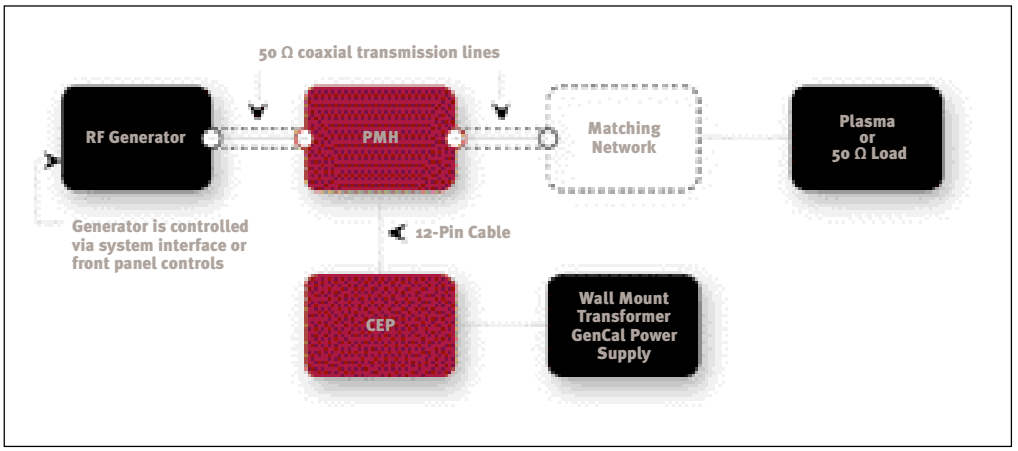
The system is powered by an external 18 V ac output wall plug power pack. A 115 V ac power pack with a standard US plug is shipped with CEP. Versions for use at 100 V ac and 230 V ac are also available. Power (dc) for the circuitry in the PMH is supplied by the CEP.

FUNCTIONALITY

The GenCal system provides precise RF power measurement at discrete frequencies as well as control interface for AE's and other manufacturers' power supplies. This versatile instrument may be used in three configurations:

- *Power meter only*
- *Combined power meter and power supply control*
- *Power supply control only*

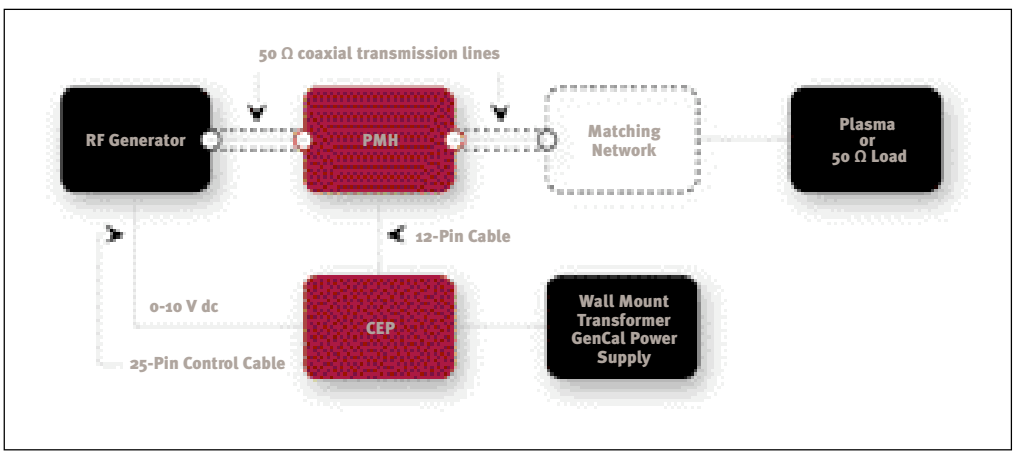
THE GENCAL SYSTEM INSTALLED AS A POWER METER



POWER METERING

When used as a power meter, the GenCal system's accuracy exceeds that of general purpose power meters because it is optimized for a single frequency. For metering without control, no control connections are required between it and the power supply.

SIMULTANEOUS POWER METERING AND POWER-SUPPLY CONTROL USING THE GENCAL SYSTEM



COMBINED METERING AND CONTROL

The GenCal system lets you use both power metering snf power supply control capabilities at the same time. In this case, the CEP is connected to both the power supply under test and the PMH. The RF output of the power supply is connected to the RF In port of the PMH and the RF Out port is connected to an appropriate 50 load. The CEP delivers precise setpoints to the power supply through an 11-position switch. The power supply's forward and reflected power readbacks are monitored along with measured output power as reported by the PMH. Thus, the power supply is stepped though its power range and checked for compliance to its output power accuracy specifications.

POWER MEASUREMENT HEADS (PMHs)

	PMH Model 13/1250	PMH Model 13/2000	PMH Model 13/3000	PMH Model 400/2200
Power	1250 W full-rated forward power	2000 W full-rated forward power	3000 W full-rated forward power	2200 W full-rated forward power
	1375 W maximum forward power	2200 W maximum forward power	3300 W maximum forward power	2420 W maximum forward power
	250 W full-rated reflected power	400 W full-rated reflected power	600 W full-rated reflected power	440 W full-ratedreflected power
	275 W maximum reflected power	440 W maximum reflected power	660 W maximum reflected power	480 W maximum reflected power
Power Scaling	Forward power = 125 W per volt	Forward power = 200 W per volt	Forward power = 300 W per volt	Forward power = 220 W per volt
	Reflected power = 25 W per volt	Reflected power = 40 W per volt	Reflected power = 60 W per volt	Reflected power = 44 W per volt
Frequency	13.56 MHz ± 5 kHz	13.56 MHz ± 5 kHz	13.56 MHz ± 5 kHz	400 kHz ± 50 kHz
Impedance Range	3:1 VSWR referenced to 50	3:1 VSWR referenced to 50	3:1 VSWR referenced to 50	3:1 VSWR referenced to 50
System Accuracy	±1% or 0.2 W (whichever is greater) into a 50 load when used with the CEP (calibrated to AE's internal standard, and recalibrated every 6 months, maximum)	±1% or 0.4 W (whichever is greater) into a 50 load when used with the CEP (calibrated to AE's internal standard, and recalibrated every 6 months, maximum)	±1% or 0.5 W (whichever is greater) into a 50 load when used with the CEP (calibrated to AE's internal standard, and recalibrated every 6 months, maximum)	±1% or 3 W (whichever is greater) into a 50 load when used with the CEP (calibrated to AE's internal standard, and recalibrated every 6 months, maximum)

PHYSICAL SPECIFICATIONS

	Control Electronic Package (CEP)
Size	178mm H x 92mm W x 35mm D; 7" H x 3.61" W x 1.38 D, excluding knobs
Weight	0.54 kg (1.2 lb)
Connectors	
Input Power	2-pin, low-voltage power pack connector
Power Supply	25-pin subminiature D, shielded, female
PMH Port	12-pin modular, shielded, male
Display Type	4-digit LCD
Cables	
CEP-to-Power Supply	Length–2.7 m (9 ft); Type–Shielded, twistedpair cable with 25-pin, male, subminiature D connectors on both ends (supplied with the CEP)
CEP-to-PMH	Lenght–2.3 m (7.5 ft); Type–Shielded, twisted-pair cable with 12-pin, male, modular subminiature connectors on both ends (supplied with the CEP)

	Power Measurement Heads (PMHs)
Size	113mm H x 96mm W x 65mm D; 4.45" H x 3.78" W x 2.54 D, excluding connectors
Weight	1250 W = 0.86 kg (1.9 lb); 220 W = 0.68 kg (1.5 lb); 3000 W = 0.91 kg (2 lb)
Connectors	
Input (from RF power supply)	1250 W, 2000 W, and 2200 W = type N coaxial, female 3000 W = type HN coaxial, female
Output (load)	1250 W, 2000 W, and 2200 W = type N coaxial, female 3000 W = type HN coaxial, female
CEP Port	12-pin modular, male

APPLICATION BENEFITS

The GenCal system is the plasma-process industry's most reliable power measurement instrument for power supplies. It operates where other wide-frequency instruments can't–in a plasma environment with high harmonics and noise.

For fast hook-up with the portable CEP, you can install the rugged PMH permanently between the power supply and the tuner. Continuous power passing through the PMH does not harm it. If portability is important for you, an optional carrying case accommodates the CEP, up to three PMHs, and I/O cables.

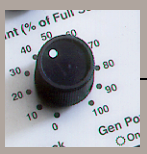
GenCal™ RF Measurement System
Barely affected by amplitude modulation (AM); effect limited to a percent increase in peak of waveform.
Not affected by harmonic (input filtered at 13.56 MHz).
Reads directly from the power supply as well as from forward and reflected power on the line.
Provides precision control setpoint to the power supply.
Works only at specific frequencies.
Low, displayed flicker is ± 1 digit maximum.
Accuracy is ± 1%.

Measurement System B
Strongly affected by AM (different models display different sensitivities).
Strongly affected by harmonics.
Reads only forward and reflected power.
Does not provide a control setpoint.
Broadband.
Short-term flicker is high (several digits).
Accuracy is ± 5%.

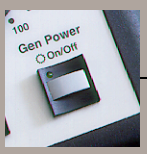
GENCAL FEATURES

Digital Meter and Parameter LEDS
Indicates the present status of the system. A meter displays the value of the parameter indicated by the LEDS.

Display Select Switch
Selects the display parameter: PMH forward power, power supply forward power, PMH reflected power, and power supply reflected power.



Setpoint Knob
Selects the setpoint in 10% increments for control functions.



On/Off Switch
Turns generator power on and off.

Interlock
Lights when interlocks are satisfied.

ELECTRICAL SPECIFICATIONS

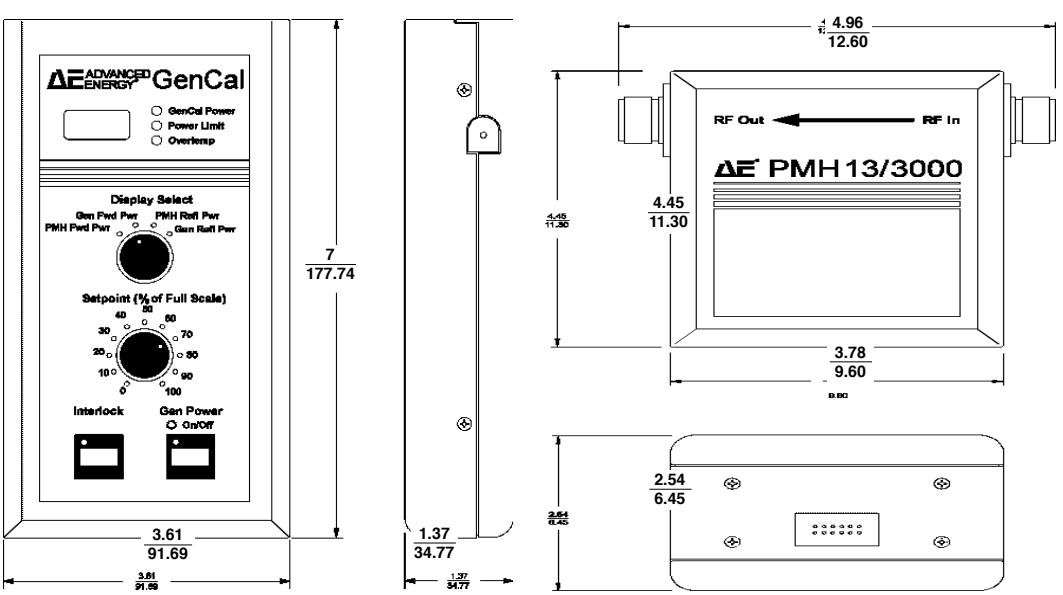
GenCal System Input Power	
Voltag	18 V ac, supplied by a power pack that plugs into the wall. The power pack requires 50/60 Hz ac power in one of three voltage ranges; 87 to 115 V; 100 to 132 V; 200 to 265 V.
Current	400 mA maximum at 18 V ac (includes CEP and PMH)

Control Electronics Package (CEP)	
Input Signal Amplitude (power supply or PMH)	0 to 10 V dc typical, 11 V maximum; 0 to 10 V represents the relative range of zero to full-rated power as scaled by the CEP. 11 V represents 110% of full-rated power.
Display Format	Displays power with 0.1 W resolution for levels below 10% of full rated output; otherwise, displays in whole-integer watts.
Display Resolution	System accuracy is ± 1 least significant display digit.

ENVIRONMENTAL SPECIFICATIONS

Ambient Temperature Operating	Minimum 18°C (64°F), maximum 32°C (90°F); If the units are enclosed in cabinets, do not exceed the maximum ambient temperature.
Storage	Minimum -25°C (-13°F), maximum 55°C (131°F)
Transportation	Minimum -25°C (131°F), maximum 55°C (131°F); For short periods of up to 24 hr, the maximum is 70°C (158°F)
Humidity	15 to 85% relative humidity – no condensation or icing
Atmospheric Pressure Operating	745 mbar minimum (2500 m (8,203 ft) above sea level)
Storage	585 mbar minimum (4000 m (13,124 ft) above sea level)
Transportation	480 mbar minimum (5000 m (16,405 ft) above sea level)

CEP AND PMH DIMENSIONS



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Advanced Energy Industries, Inc.
1625 Sharp Point Drive
Fort Collins, Colorado 80525
800.446.9167
970.221.4670
970.221.5583 (fax)
support@aei.com
www.advanced-energy.com

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