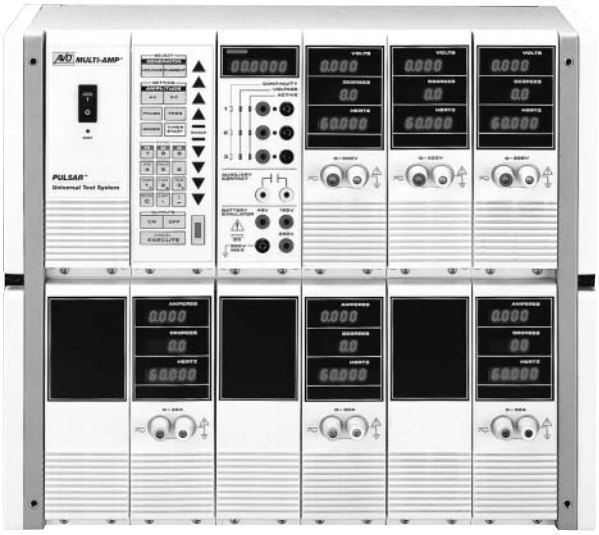
PULSAR®
Universal Protective Relay Test System



- **Complete three-phase test system in one unit**
- **Modular design for system customization**
- **Steady-state and dynamic testing**
- **Transient testing via DFR replay and EMTP/ATP simulation**
- **Capable of GPS satellite synchronized testing**

DESCRIPTION

The PULSAR® Universal Protective Relay Test System represents the next generation in protective relay testing. This one-unit, modular system lets you select the testing capabilities you need now and expand as your requirements change.

The PULSAR base unit includes the chassis, back plane, and input power and control module.

Current and Voltage Amplifier Modules

The system is customized by adding a timer module and the number of current and voltage amplifier modules needed for specific testing applications.

Modules slide out easily so you can configure the system to meet your applications.

For example, adding the timer, one current amplifier module and one voltage amplifier module to the base unit provides a variable ac/dc current and voltage output, adjustable phase angle and frequency settings, and comprehensive control, timing and monitoring circuits. This configuration tests single-phase relays.

Add up to three current and three voltage amplifier modules to create a full, three-phase relay test system in one portable unit.

High-Current Output Units and Interface Module

PULSAR performs computerized tests with IBM, or compatible PCs, even notebooks.

For high-current applications, PULSAR can be connected to the Multi-Amp EPOCH-20, and EPOCH-II, High-Current Output Units. The Multi-Amp High-Current Interface Module provides the control interface between PULSAR and the EPOCH-20 or EPOCH-II to provide high-current, high-volt/ampere output for single-, three- or six-phase testing. For specifications on the Interface Module, the EPOCH-20 and EPOCH-II, refer to catalog entries for these models.

Designed for Convenience

PULSAR is small and lightweight enough to be carried to job sites by one technician. For durability, the unit is housed in a rugged field enclosure for use at substations and power plants. PULSAR is designed for easy setup and operation. A standard wall outlet is the only power source needed.

High-intensity LEDs display all outputs throughout the test, and PULSAR automatically changes output ranges to reduce testing time.

Manual or Computerized Control

PULSAR can be operated manually by simple, front-panel controls or combined with any IBM® or compatible PC and the Megger AVTS™ software package for automated steady-state, dynamic and transient testing.

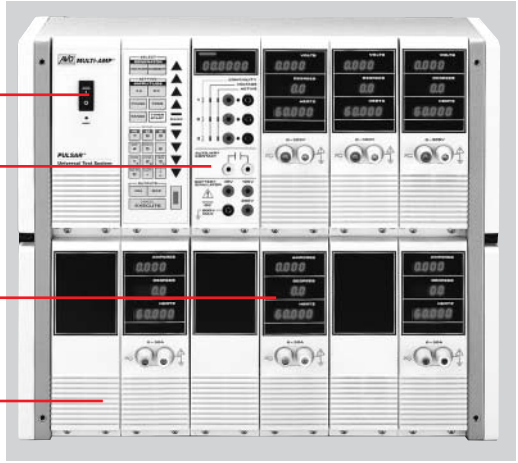
APPLICATIONS

PULSAR is designed to test virtually any relay, from simple overcurrent relays to complex three-phase, microprocessor-based relays requiring phase-shifting capability. This table lists relays by IEEE device number and matches them with the required combination of current and voltage amplifier modules.

IEEE Device Number	Relay Types	Select Modules (Qty) Based on Relay Type
2	Time-Delay Starting Relay	**Pulsar Base Unit plus:**
21	Distance (1ϕ)	1 Voltage Amplifier
24	Volts/Hertz	1 Current Amplifier
27/59	AC/DC Under/Overvoltage Relay	1 Timer, Monitor and Battery Simulator Module
32	Directional Power (1ϕ)	
37/76	DC Under/Overcurrent Relay	
40	Loss of Field	
50	Instantaneous Overcurrent (up to 30 A)*	
51	Overcurrent (up to 30 A at 150 VA)*	
67	Directional Overcurrent	
67N	Ground Directional Overcurrent	
81	Frequency	
82	DC Reclosing Relay	
85	Carrier or Pilot Wire Relay	
86	Lock-out Relay	
94	Tripping Relay	
	All the above relays plus:	**Pulsar Base Unit plus:**
21	Distance (open-delta)	2 Voltage Amplifiers
21G	Distance, Ground	2 Current Amplifiers
25/25A	Synchronizing/Auto-Synch	1 Timer, Monitor and Battery Simulator Module
32	Directional Power (open-delta)	
46	Phase Balance Current	
47	Phase Sequence Voltage (open-delta)	
79	AC Reclosing Relay	
87	Differential	
50/51	Instantaneous (up to 60 A at 300 VA)*	
67	Directional Overcurrent	
	All the above relays plus:	**Pulsar Base Unit plus:**
21	Distance (3ϕ wye) Voltage and Current.	3 Voltage Amplifiers
32	Directional Power (3ϕ)	3 Current Amplifiers
46N	Negative Sequence Overcurrent	1 Timer, Monitor and Battery Simulator Module
50/51	Instantaneous (up to 90 A at 450 VA)*	
67	Directional Overcurrent	

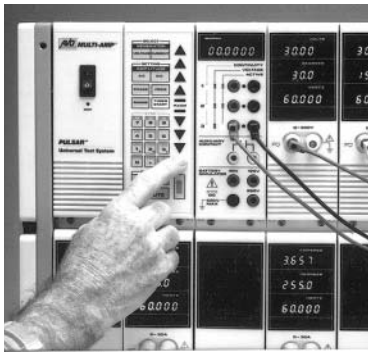
* For higher currents or volt-amperes, refer to catalog entries on these models.

CUSTOMIZE PULSAR FOR SPECIFIC APPLICATIONS



FEATURES AND BENEFITS

- Complete, three-phase test system: PULSAR can be configured to provide complete three-phase variable current, voltage, frequency, phase angle, dc voltage, dc current, control, timing and monitoring functions.
- Unique, modular design: PULSAR modules plug in and slide out easily for system configuration. You can purchase any number of modules for configuration using one or more PULSAR units. This feature also allows for prompt replacement of modules during service.



Under manual control, you can easily change settings with the ramp up-and-down keys.

- Simple, manual control: With the system's multiple-channel outputs, you can easily change amplitude, phase angle or frequency settings by pushing the ramp up-and-down keys.
- Totally automated testing: PULSAR, combined with the advanced software capabilities of AVTS, automates steady-state and dynamic testing, and performs transient testing via DFR replay or EMTP/ATP simulation.
- Steady-state and dynamic testing capability, including dc offset: Either manually through front-panel controls or via computer control, the operator can test virtually any relay.
- Performs transient tests: Acceptance tests or troubleshooting can be accomplished by replaying digitally recorded faults or EMTP simulations in the IEEE COMTRADE Standard C 37.111.
- Performs end-to-end tests: When combined with AVTS software and a portable GPS satellite receiver, PULSAR performs satellite-synchronized, end-to-end dynamic or transient tests for troubleshooting complex protection schemes.
- Continuous LED displays: Large, high-intensity LEDs remain active even when the test set is under computer control so the operator can see all outputs all the time. Amplitudes, phase angle and frequency of all current and voltage outputs are displayed continuously and simultaneously .
- Automatic range changing: PULSAR automatically performs range changes under load to reduce testing time.

- Immediate error indication: Audible and visual alarms signal when amplitude, phase angle or waveform of the outputs is in error.
- Wide-frequency bandwidth: This feature provides the current and potential outputs to second, third and fifth harmonic, or virtually any desired harmonic within the operating range of the unit.
- Creates user-defined waveforms for special test applications: The operator can use any computer to generate square waves, half-waves, sine waves and analytical sine waves. This includes per-unit values of amplitude, selected harmonics at various phase angles and dc offset with exponential decay.
- Built-in RS-232 interface: The interface works with standard communication ports on any IBM or compatible computer, even a notebook PC.
- Tests high instantaneous relays: Output of two or three current amplifier modules can be connected in parallel to increase the maximum current available to 60 amperes (two modules) or 90 amperes (three modules) for testing high instantaneous overcurrent relays.
- Output potential of two voltage amplifier modules can be summed together to increase the maximum potential to 600 volts if the load is not grounded for testing high instantaneous over-voltage relays.

SPECIFICATIONS

Temperature Range
Operating: 32 to 122° F (0 to 50° C)

Storage: -13 to +158° F (-25 to +70° C)

Humidity Range
0 to 90% RH, noncondensing

Environmentally Tested
To simulate the worst field conditions, PULSAR was tested and certified in accordance with Military Standard MIL-STD-810 for temperature, shock and vibration resistance as a Class 3 instrument.

PULSAR in field enclosure

Enclosure
For field use, PULSAR can be ordered housed in a tough, polyethylene-plastic, sealed enclosure.

Rubber-sealed lids protect the test set from water and dust intrusion. Carrying handles are located on the top and sides for convenience.

For laboratory use, PULSAR can be ordered housed in a laboratory style configuration. The unit comes with panels and carrying handles mounted on the side of the chassis.

For protection in transit, the laboratory unit comes with a rugged, retracting-wheel carrying case. As the handle is extended, the sturdy wheels swing out of their recesses, and the case becomes a luggage cart and transit case in one.

The foam-lined case is designed to protect PULSAR from normal shock and vibration in transit.

PULSAR also can be ordered without enclosures for mounting in a standard, 19 in. (483 mm) rack.

Dimensions

Field Enclosure
With lids on

20 H x 22 W x 12.5 D in.
508 H x 558.8 W x 317.5 D mm

With lids off

20 H x 22 W x 10.25 D in.
508 H x 558.8 W x 260.4 D mm

Lab Enclosure
15.75 H x 18.75 W x 8.75 D in.
400 H x 476.3 W x 222.3 D mm

Weight
Weight varies depending on the number of modules in the system. The weight shown below is for a complete three-phase test system, including the timer module, three current amplifier modules and three voltage amplifier modules.

Field Enclosure
With lids on

73 lb (33.2 kg) approx

With lids off

64 lb (29.1 kg) approx

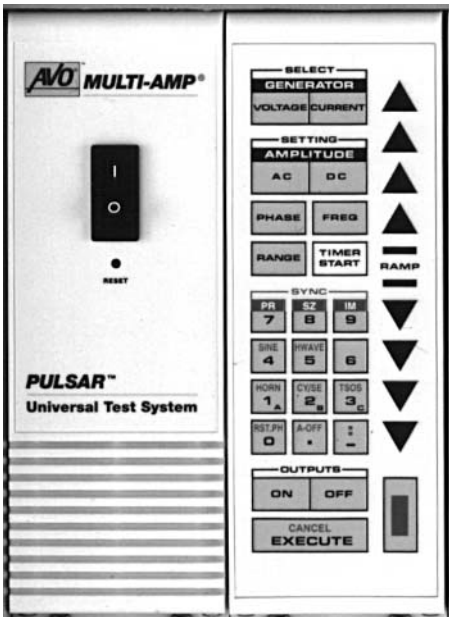
Lab Enclosure
57.5 lb (26.1 kg) approx

The laboratory-style unit comes with a retracting-wheel carrying case for easy transport.

One technician can easily carry PULSAR.

FOR ORDERING INFORMATION, REFER TO PAGES 14-15.

PULSAR®
Input Power and Control Module



- **RS-232 interface port**
- **Optional IEEE-488 GPIB**
- **Manual control keypad**

DESCRIPTION

This module is always located in the top-left corner of the unit. The module is divided into two sections: the power on-section (left half) and the control section (right half).

The power-on section performs the POWER ON and SYSTEM RESET operation. The control section via the keypad allows for the manual entry and control of the voltage, current, amplitudes, phase angle, frequency and range, as well as control of the TIMER START/STOP mechanism.

Also located in this module are the OPERATING SYSTEM WITH SYSTEM RESET button and the primary ac-to-dc power supply/power factor corrector.

FEATURES AND BENEFITS

- Modular, plug-in design: easy to replace or upgrade, thus minimizes downtime.
- Keypad: provides front-panel programmability for steady-state and dynamic testing.
- Sealed-membrane switches: prevent dust/dirt and moisture contamination —maintenance-free.
- Auto-selectable input voltage: Test system will operate on virtually any standard input voltage. No need to worry about connecting to the wrong input source.
- Built-in RS-232 interface: Unit can be used with any standard computer communication port. No need to purchase extra hardware to perform computerized testing.
- Built-in expansion slot: may be used for higher speed communication boards and future expansion applications.

SPECIFICATIONS

Input Power Requirements

Line Voltage: Auto-selectable from 95 to 265 Vac

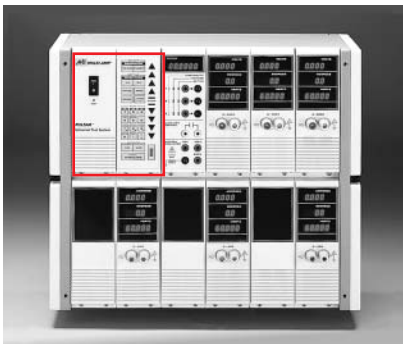
Line Frequency: 47 to 63 Hz

Power Consumption: Depends on configuration and input voltage

Maximum: At 120 V OR 240 V, 1500 W, 50/60 Hz

Communication and Control Ports

RS-232 Interface: Standard baud rates available are 2400, 4800, and 9600 (switch-selectable).



Expansion Slot: For other control and communication boards. An optional IEEE-488 GPIB is available. (Refer to Ordering Information.)

Clock-In/Clock-Out and Sync-In/Sync-Out Ports: BNC connectors connect PULSAR with remote trigger pulse for external initiation (for GPS satellite synchronized testing applications).

Also allows two PULSAR units to be synchronized for "back-to-back" testing or six-phase applications.

Keypad: A 32-key, sealed-membrane keypad is provided for manual control of all test parameters.

These keys allow the operator to select voltage and/or current generators; select ac, dc or ac with dc offset amplitudes, phase angles and frequency; set ranges and start the timer.

Below the SETTING/AMPLITUDE keys are the alphanumeric keys. These can be used to enter numeric data or other functions.

The function keys are selected by the shift key located under the RAMP keys.

Control Functions Available

SYNC/PR: Denotes the PHASE REFERENCE key. Indicates that subsequent procedures will be executed at the master generator's positive-going zero-crossing phase reference.

SYNC/SZ: Denotes the SELF ZERO key. Indicates that subsequent procedures will be executed synchronous with each generator's own positive-going zero crossing.

SYNC/IM: Denotes the IMMEDIATE key. Indicates that subsequent procedures will be executed immediately (point-on-waveform).

LINE SYNCHRONIZATION: PULSAR was designed to be completely independent of the line voltage and frequency. However, there may be applications where synchronizing to the line frequency may be desirable. With Line Synchronization activated, the output voltages and currents will be in phase with the input power line (±2 degrees) if the phase setting on the PULSAR outputs is zero degrees. Output settings other than 0 degrees will Lag the input power line by the value displayed on the channel. The outputs will stay synchronized as long as the line frequency does not change more than ±1 Hertz.

HWAVE: Denotes the HALF-WAVE key. Indicates that a half-wave sine wave is to be generated by the selected generator(s). Used to simulate the half-wave rectified output of a diode for harmonic restraint tests.

SINE: Used to change selected output(s) back to a full sine wave.

HORN: Used to turn the tone generator on/off, which is associated with the monitor (CONTINUITY) mode of the Timer Module.

CY/SE: Used to toggle the timer display between seconds and cycles. In the cycles mode, an automatic division of seconds by the period is performed. The period is normally 50 or 60 Hz (set by internal jumper).

TSOS: Denotes timer stop on synchronization. Normally used when testing auto-synchronizing relays.

The timer is started by an action from the relay and stopped when the selected outputs come into synchronization.

RST PH: Used to restore the phase relationship between all generators. This is normally used when output frequency is changed, which can alter the phase relationship.

A-OFF: Allows the operator to have selected outputs turned off whenever the timer stop gate or monitor changes state.

Below the alphanumeric keypad are the **ON, OFF** and **EXECUTE** keys. These are used to turn outputs on and off, and to execute a string of commands immediately.

The EXECUTE key makes three-phase, manually operated, dynamic testing possible. The CANCEL key is used to cancel any previously selected function prior to pressing the EXECUTE key.

RAMP: The RAMP keys are located to the right side of the control section. The keys allow the operator to ramp up or down any selected output(s) including ac/dc voltage, current, phase angle and frequency.

Up arrows increment up, and down arrows increment down. The size of the increment varies depending on what is being ramped and the range.

The top-most and bottom-most arrows change the most significant digit. The arrows closest to the center increment the least-significant digit.

Temperature Range

Operating: 32 to 122° F (0 to 50° C)
Storage: -13 to +158° F (-25 to +70° C)

Humidity Range

0 to 90% RH, noncondensing

Dimensions

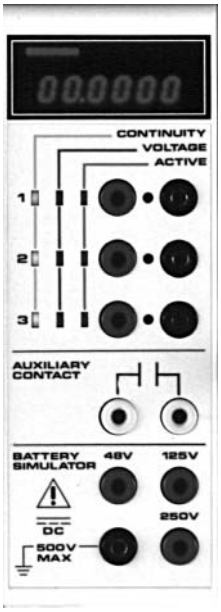
7.8 H x 5.3 W x 8.2 D in.
198.6 H x 134.6 W x 207.7 D mm

Net Weight

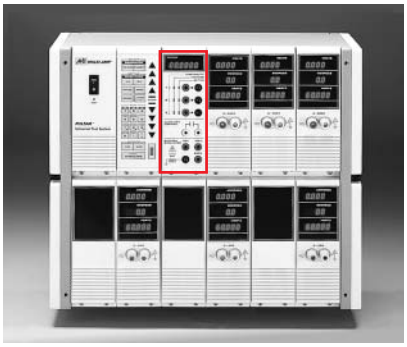
6.15 lb (2.8 kg)

FOR ORDERING INFORMATION, REFER TO PAGES 14-15.

PULSAR®
Timer, Monitor and Battery Simulator Module



- **Times high-speed relays**
- **Multiple continuity monitors**
- **Eliminates need for dc voltage source**



DESCRIPTION

The Timer, Monitor and Battery Simulator Module is designed to slide into one slot of the PULSAR® unit.

The timer is specifically designed to measure high-speed operation of electromechanical, solid-state and microprocessor-based protective relays.

It incorporates three sets of banana-plug receptacles. These receptacles can be programmed as: start gates, stop gates, monitor; all stop gates; or all contact continuity monitors.

The programmable auxiliary contact can be opened or closed by software command. One application for this contact is to simulate breaker failure contact closure.

The battery simulator has four terminals providing three voltages: 48, 125 and 250 volts dc. The primary application is to provide logic voltage to solid-state and microprocessor-based relays.

FEATURES AND BENEFITS

- **Modular, plug-in design:** operator can easily reconfigure test systems to meet changing test requirements.
- **High resolution and accuracy:** provides capability to accurately time high-speed relays.
- **Multiple continuity monitors:** provides multiple contact monitoring without moving test leads.
- **Continuity light and audible tone generator:** monitor operation of the trip contact or trip SCR in the relay under test. The monitor circuit can be reprogrammed easily to be voltage-sensing and can monitor solid-state logic signals.
- This circuit senses a positive-going signal of 1 to 300 volts ac or dc. In addition, the lower threshold voltage is adjustable from 1 to 4 volts to eliminate false triggering due to noisy environments.
- **Programmable de-bounce:** used in eliminating false triggering and contact bounce errors.
- **Programmable contacts:** used to simulate the A/B contacts of a breaker for automatic testing of breaker failure relays.
- **Adjustable voltage thresholds:** Lower threshold may be used to start and stop the timer from TTL voltage signals.
- **Battery simulator:** eliminates need for additional dc voltage source.

SPECIFICATIONS

Display

The 6-digit, 0.3-in. (7.62-mm), high-intensity LED display ensures readability even in high-ambient light conditions.

Range and Resolution

Timer will display in either seconds or cycles, and will autodecade up with the following range and resolution:

Seconds
00.0001 to 99,999.9

Cycles
00.006 to 99,999.9 (at 60 Hz)
00.005 to 99,999.9 (at 50 Hz)

Accuracy
At 23° ± 2° C, ±1 least-significant digit of resolution or ±0.002% of reading

At 0 to 50° C, ±0.005% of reading maximum

Initiation is by a dry contact or dc potential of 5 Vdc or by ac potential above 115 V*.

***Note:** AC voltage accuracy is different at lower voltages. Worst case is ±8 ms (1 to 4 Vac rms adjustable threshold, just following wave shape peak).

Selectable Time Base
The time base used by the timer comes set from the factory at either 60 Hz or 50 Hz, depending on desired operating frequency.

By computer control, the time base can be any frequency from 0.1 Hz to 10 kHz. The typical programmable time base frequencies are 25, 50, 60 or 400 Hz.

Start/Stop/Monitor Gates
Three identical, independent, programmable start, stop or monitor gate circuits permit simple selection of the desired mode of operation.

To monitor operation of the contacts or trip SCR in the device under test, a continuity light is provided for each gate. The gate circuit is isolated for voltage-sensing and can monitor solid-state logic signals.

Upon sensing continuity or a voltage signal, the continuity lamp will glow, and a tone generator will sound if desired.

The following modes are provided for the Start/Stop/Monitor Gates:

- Dry Contact Opens: A change of state starts or stops the timer or continuity is indicated at the opening of normally closed contacts or when conduction through a semiconductor device such as a triac or transistor is interrupted.
- Dry Contacts Close: A change of state starts or stops the timer or continuity is indicated at the closing of normally open contacts or upon conduction through a semiconductor device such as a triac or transistor.
- Application or Removal of AC or DC Voltage: The timer starts, stops or continuity is indicated upon the application or removal of either an ac or dc voltage.
- The voltage threshold is adjustable from 1 to 4 V, ac or dc. A higher threshold voltage helps to eliminate false triggers due to a noisy source. Lower thresholds allow starting and stopping of timer from TTL voltage signals.
- The maximum allowable voltage applied is 300 Vac or 300 Vdc, limited by MOV transient protection.
- Start or stop with any selected generator module: The timer can be started or stopped when turning on or off any (or all) selected generators.
- The timer can be started simultaneously with a change in frequency, phase angle, amplitude or a waveform step.
- The timer can be stopped upon phase synchronization between two voltage channels (normally used to time autosynchronizing relays).

Start Latch
When LATCHED is selected, the start latch allows timing to be initiated by a start gate and to be stopped only by the selected stop gate.

When UNLATCHED, the start latch allows timing to be stopped when the start gate is reversed, such as when timing the closing and opening of a single contact, as in measuring the trip-free operating time of a circuit breaker.

Stop Latch
When LATCHED, the stop latch allows timing to be stopped at the first operation of any stop Gate, thus ignoring contact bounce.

When UNLATCHED, the stop latch allows timing to be stopped by any stop gate and then restarted if the stop gate reverses, provided a start gate is still energized, then stopped again when the gate reverses (total time including contact bounce).

Start/Stop Gate De-Bounce
The timer can be programmed to ignore temporary state changes that are less than a set duration. This is useful for eliminating false triggering and contact bounce errors.

De-Bounce Period: 0.1 to 999 ms
Resolution: 0.1 ms

Auxiliary Contact
A pair of banana-plug receptacles provides access to the programmable dry contact. The contact may be opened or closed by software command.

Maximum Switching Voltages: 110 Vac or 30 Vdc
Maximum Switching Currents: 0.3 A ac or 1.0 A dc
Closing Time: 1 ms typical
Opening Time: 0.5 ms typical

Battery Simulator
Output Voltages: Four banana-plug receptacles will provide the following voltages: 48, 125 and 250 Vdc. Only one output voltage may be used at a time.
Output Power: 60 W
Accuracy: ±20% max
Ripple: ±10% max

Temperature Range
Operating: 32 to 122° F (0 to 50° C)
Storage: –13 to +158° F (–25 to +70° C)

Humidity Range
0 to 90% RH, noncondensing

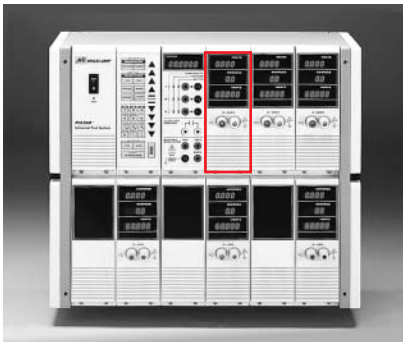
Dimensions
7.8 H x 2.7 W x 8.2 D in
(198.6 H x 67.3 W x 207.7 D mm)

Net Weight
2.93 lb (1.3 kg)

FOR ORDERING INFORMATION, REFER TO PAGES 14-15.

PULSAR®
Voltage Amplifier Module

- **Test potential to 600 V rms**
- **Tests high-instantaneous and direct-connected overvoltage relays**



DESCRIPTION

The Voltage Amplifier Module is designed to slide into one slot of the PULSAR® unit. One module can provide either ac or dc voltage output, 0 to 300 volts rms, or ac with dc offset, 425 volts peak.

Two modules will provide a three-phase, open-delta test source. Three modules will provide a complete three-phase, four-wire test source.

For higher test voltages (greater than 300 volts rms), two modules can be connected in series to double the test potential to 600 volts rms.

For special applications, the voltage amplifier module can provide a sine wave with varying percentage of harmonics and exponential decay or periodic arbitrary waveforms from Digital Fault Recorders or EMTP/ATP (Electro-Magnetic Transients Program) programs.

Other special application waveforms also are available.

FEATURES AND BENEFITS

- **Modular plug-in design:** provides flexibility to add to or reconfigure test system to meet changing test requirements.
- **High resolution and accuracy:** needed to test relays with higher sensitivity and accuracy requirements.
- **0 to 300 volts rms:** provides capability to test relays with high potential requirements such as directly connected or highly instantaneous overvoltage.
- **DC to 20 kHz bandwidth:** provides flexibility to test ac or dc relays, either steady-state, dynamic or transient.
- **User-defined waveforms:** The operator can use a computer to create specific waveforms for special test applications.

SPECIFICATIONS

Output Frequency and Displayed Resolution

The Voltage Amplifier Module provides a variable frequency output featuring automatic decading.

Frequency is continuously displayed for each channel with large, high-intensity LEDs with these ranges:

DC
00.001 to 99.999 Hz
100.01 to 999.99 Hz
1000.1 to 9999.9 Hz
10,000 to 20,000 Hz

Frequency Accuracy: ±10 ppm or ±0.0006 Hz at 60 Hz at 23° ±2° C

Output Power

Output (continuous)	RMS	Peak
50/60 Hz (sine wave)		
At 300 V		
(300-V range)	100 VA	200 VA
At 30 V		
(30-V range)	75 VA	150 VA
DC	100 W	——

Ranges (automatic range-switching) and Displayed Resolution

Volts RMS			Amperes RMS
0.0	to 300.0	at	0.33
0.000	to 30.00	at	2.5

Peak Output: 425 V

Resolution

Upper Range: 0.1 V
Low Range: 0.001 up to 9.999
10.01 to 99.99
Duty Cycle: Continuous

Amplitude Accuracy

At 50 to 60 Hz:
10 to 100% of range
±0.5% of reading at 23° ±2° C
±1.0% of reading at 0 to 50° C

Total Harmonic Distortion

Less than 0.2% typical, 2% max, at 50/60 Hz

Phase Angle

Range: 0 to 359.9°

Resolution: 0.1°

Accuracy: less than ±0.2° typical, ±0.5° max at 50 or 60 Hz, full-scale voltage

Small-Signal Frequency Range

DC to 20 kHz into 10-kΩ load

Display

Each Voltage Amplifier Module contains a dedicated display to continuously show the output voltage (four digits), phase angle (four digits), frequency (five most-significant digits), output status (on or off) and dc offset when applicable.

Waveforms

DC; sine wave; sine wave with various percent of harmonics at various phases; periodic arbitrary waveforms from Digital Fault Recorders or EMTP/ATP programs; square waves with variable duty cycle, half wave, exponential decay. Arbitrary, nonperiodic waveforms from external analog inputs.

Waveform Storage

Each Voltage Amplifier Module has dedicated RAM storage for waveforms and/or transient waveform events.

Either 32 waveforms and/or events that are 4 k samples long, one waveform event that is 64 k samples long, or one waveform event up to 128 k samples long may be stored per channel and played back on command.

Temperature Range

Operating: 32 to 122° F (0 to 50° C)
Storage: -13 to +158° F (-25 to +70° C)

Humidity Range

0 to 90% RH, noncondensing

Dimensions

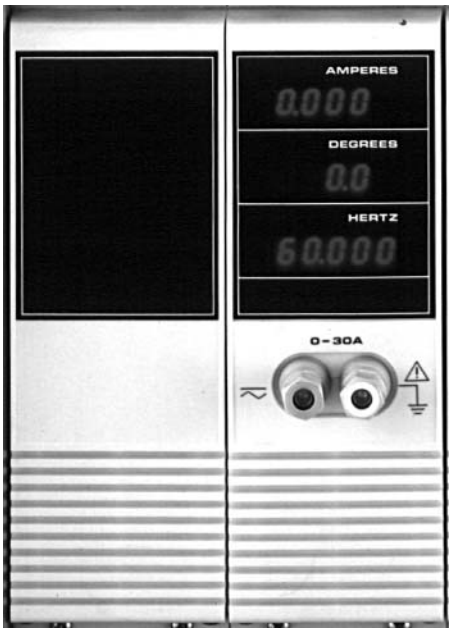
7.8 H x 2.7 W x 8.2 D in.
(198.6 H x 67.3 W x 207.7 D mm)

Net Weight

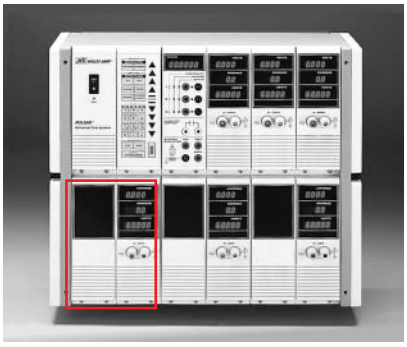
4.4 lb (2 kg)

FOR ORDERING INFORMATION, REFER TO PAGES 14-15.

PULSAR®
Current Amplifier Module



- **Parallel operation to 90 A @ 450 VA**
- **DC to 20 kHz bandwidth**
- **High resolution, high accuracy**
- **150 VA rms power per phase**



DESCRIPTION

The Current Amplifier Module is designed to slide into two slots of the PULSAR® unit. One module can provide either 0 to 30 amperes ac or dc, or ac with dc offset, 42.5 amperes peak.

Two channels can be paralleled to provide 60 amperes ac at 300 VA, or three paralleled to provide 90 amperes ac at 450 VA.

For special applications, the Current Amplifier Module can provide a sine wave with varying percentages of harmonics and exponential decay or periodic arbitrary waveforms from Digital Fault Recorders or EMTP (Electro-Magnetic Transients Program) programs.

Other special application waveforms also are available.

FEATURES AND BENEFITS

- **Modular, plug-in design:** provides flexibility to add to or reconfigure test system to meet changing test requirements.
- **High resolution and accuracy:** provides capability to test relays with higher sensitivity or accuracy requirements.
- **Parallel operation up to 90 amperes:** Three current channels may be paralleled to test high instantaneous overcurrent elements.
- **DC to 20 kHz bandwidth:** provides flexibility to test ac or dc relays, either steady-state, dynamic or transient.
- **User-defined waveforms:** The operator can use a computer to create specific waveforms for special test applications.

SPECIFICATIONS

Output Frequency and Displayed Resolution

The Current Amplifier Module provides a variable frequency output featuring automatic decading. Frequency is continuously displayed for each channel with large, high-intensity LEDs with these ranges:

DC
00.001 to 99.999 Hz
100.01 to 999.99 Hz
1000.1 to 9999.9 Hz
10,000 to 20,000 Hz

Frequency Accuracy: ±10 ppm or ±0.0006 Hz at 60 Hz at 23° ± 2° C

Output Power

Output (continuous)

50/60 Hz (sine wave)	**RMS**	**Peak**
At 30 A		
(30-A range)	150 VA	300 VA
At 15 A		
(15-A range)	150 VA	300 VA
At 3 A		
(3-A range)	150 VA	300 VA
DC	150 W	

Ranges and Displayed Resolution

To meet a variety of test-circuit impedances, three output ranges are provided. Only a single pair of output terminals is needed because impedance is automatically matched to the load by the microprocessor.

Amplitude is continuously displayed with large, high-intensity LEDs.

Amperes RMS		Volts RMS
0.00 to 30	at	5
0.00 to 15	at	10
0.000 to 3	at	50

Peak Output: 42.5 A

Resolution

Upper two ranges: 0.01 A
Low range: 0.001 A
Duty Cycle: Continuous

Amplitude Accuracy

At 50 or 60 Hz
10 to 100% of range
±0.5% of reading at 23° ± 2° C
±1.0% of reading at 0 to 50° C

Total Harmonic Distortion

Less than 0.2% typical, 2% max, at 50/60 Hz

Phase Angle

Range: 0 to 359.9°

Resolution: 0.1°

Accuracy: less than ±0.2° typical, ±0.5° max at 50 or 60 Hz, full-scale current

Small-Signal Frequency Range

Dc to 20 kHz into 0.02 Ω load

Display

Each Current Amplifier Module contains a dedicated display to continuously show the output current (four digits), phase angle (four digits), frequency (five most significant digits), output status (on or off) and dc offset when applicable.

Waveforms

DC; sine wave; sine wave with various percent of harmonics at various phases; periodic arbitrary waveforms from Digital Fault Recorders or EMTP/ATP programs; square waves with variable duty cycles, half-wave and exponential decay. Arbitrary nonperiodic waveforms from external analog inputs.

Waveform Storage

Each Current Amplifier Module has dedicated RAM storage for waveforms and/or transient waveform events.

Either 32 waveforms and/or events that are each 4 k samples long, one waveform event that is 64 k samples long, or one waveform event 128 k samples long may be stored per channel and played back on command.

Temperature Range

Operating: 32 to 122° F (0 to 50° C)

Storage: -13 to +158° F (-25 to +70° C)

Humidity Range

0 to 90% RH, noncondensing

Dimensions

7.8 H x 5.3 W x 8.2 D in.
198.6 H x 134.6 W x 207.7 D mm

Net Weight

8.9 lb (4 kg)

FOR ORDERING INFORMATION, REFER TO PAGES 14-15.

PULSAR®
High-Current Interface Module

- **Connects PULSAR® to EPOCH-20® or EPOCH-II®**
- **Provides high-current, high-power testing capability**
- **High resolution, high accuracy**
- **Slides easily into PULSAR module slot**

DESCRIPTION

The PULSAR® High-Current Interface Module is a control interface between the PULSAR Universal Test System and EPOCH-20® or EPOCH-II® High-Current Output Units.

It adds high-current, high volt-ampere output to PULSAR's relay testing capability and "one-box" convenience for single-phase, three-phase or six-phase testing.

The interface module is lightweight and is designed to slide easily into one slot of the PULSAR system.

APPLICATIONS

Typically, the interconnected PULSAR system and EPOCH high-current units would be used for testing instantaneous overcurrent and high-impedance ground overcurrent relays.

Other applications would include high-current, high volt-ampere uses such as testing short-reach distance relays or overcurrent relays with high multiples of tap.

For special testing applications, two or more EPOCH-20s or EPOCH-IIs can be operated in parallel with PULSAR to increase test current or volt-amperes.

For example, panel testing can be performed, which requires high volt-amperes to overcome high burdens due to several relays being connected in series.

The EPOCH-20 can provide an output up to 170 amperes at 600 volt-amperes rms. The EPOCH-II can provide 170 amperes at 1000 volt-amperes rms.

FEATURES AND BENEFITS

- Modular, plug-in design provides flexibility to add to or reconfigure test system to meet changing test requirements.
- High resolution, high accuracy provides capability to test relays with higher sensitivity or accuracy requirements.
- Only a minimal investment is required to interface PULSAR and the high-current EPOCH units.
- Up to nine interface modules can be installed in a PULSAR to control up to nine EPOCH-20 or EPOCH-II units. This feature allows for special applications, such as testing multi-terminal current differential relays.

SPECIFICATIONS

Output Ranges and Displayed Resolution

The EPOCH-20 and EPOCH-II have six output taps providing currents up to 170 amperes rms. The displayed resolution depends on which output tap is used and the desired output current.

EPOCH-20 Output

High Ranges: 600 VA rms
2 to 10.00 A at 60 V max
3 to 15.00 A at 40 V max
8 to 40.00 A at 15 V max
10 to 50.00 A at 12 V max
20 to 100.0 A at 6 V max
34 to 170.0 A at 3.5 V max

Low Ranges: 300 VA rms
2 to 10.00 A at 30 V max
3 to 15.00 A at 20 V max
8 to 40.00 A at 7.5 V max
10 to 50.00 A at 6 V max
20 to 100.0 A at 3 V max
34 to 170.0 A at 1.75 V max

Resolution

Four Ranges: 0.01 A
Two Ranges: 0.1 A

EPOCH-II Output

High Range

2.00 to 10.00 A at 100 V max
3.00 to 15.00 A at 66.6 V max
8.00 to 40.00 A at 25 V max
10.00 to 50.00 A at 20 V max
20.00 to 100.0 A at 10 V max
34.00 to 170.0 A at 5.9 V max

Output Power: 1000 VA

Low Range

2.00 to 10.00 A at 50 V max
3.00 to 1 5.00 A at 33.3 V max
8.00 to 40.00 A at 12.5 V max
10.00 to 50.00 A at 10 V max
20.00 to 100.0 A at 5 V max
34.00 to 170.0 A at 2.95 V max

Output Power: 500 VA

Resolution

Four ranges: 0.01 A
Two ranges: 0.1 A

Output Frequency and Displayed Resolution

The interface module provides a variable frequency signal to the EPOCH-20/EPOCH-II High-Current Output Unit. Output frequency is continuously displayed for each channel with large, high-intensity LEDs with the following ranges:
5.000 to 99.999 Hz
100.01 to 999.99 Hz

Frequency Accuracy: ±10 ppm at 23° ±2° C

Amplitude Accuracy

At 23° ±2° C, typical amplitude accuracy at 50 or 60 Hz will be ±0.5% of setting throughout range of load, 10 to 100% of range and range of input voltage.

Amplitude accuracy of ±1.0% of setting maximum 0 to 50° C.

Phase Angle

Range: 0 to 359.9°
Resolution: 0.1°
Accuracy: less than ± 0.2° typical, ±0.5° maximum at 50 or 60 Hz, full-scale current

Total Harmonic Distortion

Less than 1% typical, 2% maximum, at 50/60 Hz

Display

The current channel contains a dedicated display to continuously show the output current (four digits); phase angle (four digits); frequency (five most significant digits) and output status (on or off).

Temperature Range

Operating: 32 to 122° F (0 to 50° C)
Storage: -13 to 158° F (-25 to 70° C)

Humidity Range

0 to 90% RH, noncondensing

Dimensions

7.8 H x 2.7 W x 8.2 D in.
(198.6 H x 67.3 W x 207.7 D mm)

Net Weight

1.96 lbs (.89 kg)

FOR ORDERING INFORMATION, REFER TO PAGES 14-15.

PULSAR Universal Relay Test System

Order PULSAR configured to your specific application requirements. To determine the catalog number, fill in the blanks below with corresponding number or letter from the detailed information boxes.

ORDERING EXAMPLE:

To order PULSAR Base Unit (1) with: one High-Current Interface Module (1); in the field enclosure (E); two Current Amplifier Modules (2); the Timer, Monitor and Battery Simulator Module (T); three Voltage Amplifier Modules (3); an optional GPIB Interface (G); for North America (1/60), request the following catalog number: **11E2T3G-1/60**.

1 1 E 2 T 3 G – 1 / 60

Fill in these blanks with the corresponding number or letter.

1 ____ ____ ____ ____ ____ ____ – ____ / ____

PULSAR Base Unit

1 = Includes chassis, back plane, and Input Power and Control Module.

High-Current Interface Module

Enter **0**, **1**, **2** or **3** for the number of High-Current Interface Modules required.

Enclosure Options

Enter **E** = Enclosure. Unit comes installed in a rugged field enclosure.

Enter **L** = Unit comes with enclosure for laboratory/benchtop use, includes rugged, reuseable transit case.

Enter **R** = Rack-mountable. Unit is ready for mounting in a 19-inch rack.

Current Amplifier Modules

Enter **0**, **1**, **2** or **3** for the number of Current Amplifier Modules required.

Operating Frequency

Enter **50** = 50-Hz system

Enter **60** = 60-Hz system

Power Cord Option

Enter **1** = North America

Enter **2** = International

Enter **3** = Continental Europe

Expansion Slot Option

Enter **N** = None

Enter **G** = GPIB

Voltage Amplifier Modules

Enter **0**, **1**, **2** or **3** for the number of Voltage Amplifier Modules required.

Timer, Monitor and Battery Simulator Module

Enter **T** = Unit comes with Timer, Monitor and Battery Simulator.

NOTE: This module is required for timing tests and to monitor contacts.

Enter **N** = No Timer, Monitor and Battery Simulator is desired.

ORDERING INFORMATION

Item (Qty)	Cat. No.
Included Accessories	
Test leads	
The appropriate number of test leads is included depending on the PULSAR system ordered. Refer to next page for ordering information on test leads for additional modules.	
Accessory kit includes:	
Carrying case for leads (1)	14573
Instruction manual (1)	14849
Power Cord Options	
North America line cord	14460
International line cord	14525
Continental Europe line cord	15021
Laboratory Unit	
Reusable transit case	15867
Additional PULSAR Modules	
Voltage Amplifier Module Included Accessories	15073
Test leads (1 pr)	1282
Installation instructions	13748
Carrying case	15105
Current Amplifier Module Included Accessories	**16942**
Test leads (1 pr)	15922
Installation instructions	13760
Carrying case	14574
Timer, Monitor and Battery Simulator Module Included Accessories	**15075**
Test leads (5 pr)	1282
Installation instructions	14774
Carrying case	15105
High-Current Interface Module Included Accessories	**15820**
EPOCH-20 Interface cable (1)	15821
EPOCH-II Interface adapter (1)	15833
Blank module (1)	14327
Carrying case	14574
AVTS™ Software	
AVTSTM Software Program Included Accessory	**10091**
Instruction manual (1) (Additional manuals available at quantity discounts)	51906
Extended Software Support Program	
1 to 2 users	10098
1 to 5 additional users	10097
6 or more additional users	10096
Expansion Slot Option	
IEEE-488 General Purpose Interface Board	14539-1

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F 1 214 331 7399

OTHER TECHNICAL SALES OFFICES
Norristown USA, Toronto CANADA, Mumbai INDIA, Le Raincy FRANCE, Cherrybrook AUSTRALIA, Guadalajara SPAIN and The Kingdom of BAHRAIN.

ISO STATEMENT
Registered to ISO 9001:1994 Reg no. Q 09250
Registered to ISO 14001 Reg no. EMS 61597

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