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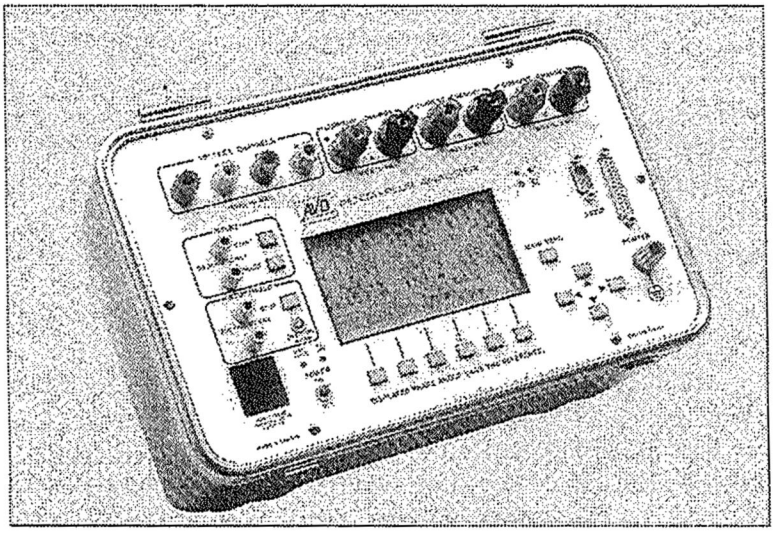
THE MEASURE OF EXCELLENCE IN ELECTRICAL TESTING



MULTI-AMP® PENTA-PLUS™ Analyzer

- **Simultaneous measurement and display of all three-phase system parameters**
- **Accurate phase angle measurement at low current levels**
- **Versatile, menu-driven instrument with a built-in timer and data-logging**
- **High-speed measurement mode**

Multifunction Measuring Instrument

DESCRIPTION

The Multi-Amp® PENTA-PLUS™ Analyzer (Cat. No. 835310) is a next-generation multifunction instrument for measuring ac voltage, ac primary and secondary current, power, reactive power, phase angle and frequency of a single- or three-phase electrical system.

The PENTA-PLUS Analyzer is easily configured to measure the amplitude and phase angle between any two voltage and current inputs. All measured quantities are displayed simultaneously on a large, easy-to-read graphic display.

The unique firmware in the PENTA-PLUS Analyzer, combined with a built-in, microprocessor-based timer, is specifically designed to ease testing and commissioning of protective relay systems, including induction unit pickup and timing tests.

The internal timer responds to a variety of start and stop gates, including the application of ac or dc voltage, and opening or closing of dry contacts.

The PENTA-PLUS Analyzer is a menu-driven instrument equipped with data-retention and data-logging capabilities. These features allow the user to capture and save test results or transmit them to a PC on a pre-programmed time interval.

Other important features include accurate phase angle measurement at very low current levels and the high-speed measurement mode.

This field-portable instrument is battery- and line-operated.

APPLICATIONS

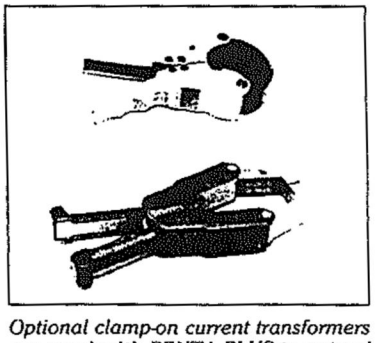
The PENTA-PLUS Analyzer is an ideal instrument for use in general electrical systems maintenance, in electrical machine repairs, in protective relay testing or in monitoring power at the electrical service entrance.

The PENTA-PLUS Analyzer is designed to perform fast, accurate checking and testing of protective relay and meter installations during their commissioning and in routine maintenance.

Combined with a voltage or current source, the PENTA-PLUS Analyzer also becomes an excellent tool for testing and calibrating virtually any type of protective relay.

FEATURES AND BENEFITS

- Battery- and line-operated, with an automatic, built-in charger
- Rugged, ergonomic and lightweight plastic enclosure
- Three independent voltage and current channels with a built-in timer
- Specifically designed to facilitate protective relay testing
- Simultaneously measures and displays voltage, current, phase angle, power, reactive power and frequency of single- or three-phase systems
- Wide current and voltage operating ranges
- High-speed measurement mode, with up to 20 readings per second
- Accurate phase angle measurement at low current levels
- HOLD mode for freezing all readings
- Autoranging to reduce test time, with manual override
- Independent frequency measurement on any two selected inputs
- Measurement of primary currents, using the optional clamp-on CT
- Programmable, timed data transmission for data-logging purposes
- RS-232C data and parallel printer output ports
- Large, easy-to-read, high-resolution LCD display with an available backlight and contrast control



Optional clamp-on current transformers are used with PENTA-PLUS to extend current ranges.

SPECIFICATIONS

Input

Line: 90 to 253 V, 50/60 Hz, 30 VA

Battery

Internal, sealed, lead-acid, rechargeable battery with an internal automatic charger. Safety features include internal battery over-charging and charge exhaustion protection.

Operation Time
3-hour continuous on full charge

Voltage

0 to 650 Vac in nine ranges, with 0.1% resolution

Accuracy
±0.5% of reading, from 3 to 650 V

Input impedance: 10 MΩ

Maximum input: 1000 V, from inputs to the chassis or between inputs

Current

0 to 100 A ac in 11 ranges, with 0.1% resolution

Accuracy: ±0.5% of reading, from 0.05 to 100 A

Burden at 5 A: 0.1 VA.

Phase Angle

±0 to 360°, with 0.1° resolution

Accuracy at 50/60 Hz
±0.4° for input levels above 3 V and 0.05 A (100 mA range); ±2° for lower input levels down to 0.5 V or 0.002 A

Power

±0 to 100 kW in six ranges, with 0.1% resolution. Highest resolution is 0.001 W.

Accuracy at 50/60 Hz: ±0.6% of VA

Reactive Power

±0 to 100 kvar in six ranges, with 0.1% resolution. Highest resolution is 0.001 var.

Accuracy at 50/60 Hz: ±1% of VA

Frequency

45 to 65 Hz, with 0.01-Hz resolution

Accuracy: ±0.01 Hz

Time

0.000 to 999.999 s

Accuracy: ±0.001 s; ±0.005%

Start/Stop Inputs

10 to 300 V (dc or ac), or dry contacts closure or opening

Input resistance: 1000 Ω minimum

Response Time

Regular single-phase mode
Two readings per second

High-speed single-phase mode
20 readings per second

Three-phase mode
One set of readings every 2.5 seconds

Operating Modes

The instrument has the following operating modes:

Continuous Mode: The voltage, current, power, reactive power, phase angle and frequency of single- or three-phase systems are continuously measured and displayed.

High-speed Capture Mode: In this mode, the PENTA-PLUS Analyzer can take up to 20 single-phase voltage, current and phase angle readings per second. Up to 60 test results can be captured and viewed.

Max-hold Mode: In this mode, the maximum rms value of the single-phase current or voltage is held and displayed.

Timer Mode: The internal timer is triggered using the external START/STOP gates. AC or DC applied and DC removed. The timer also holds the value of current and voltage when it is stopped.

Data-logging Mode: A transmission interval (from 1 to 99 min) can be selected for downloading the measurements to an external PC or printer.

Environmental

Operating Temperature
32 to 104° F (0 to 40° C)

Storage Temperature
–4 to +158° F (–20 to +70° C)

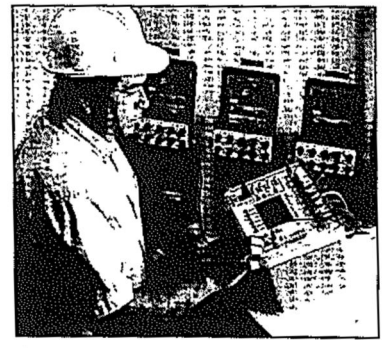
Relative Humidity
To 90%, noncondensing

Dimensions

10.5 H x 14 W x 9 D in.
267 H x 56 W x 229 D mm

Weight

18.7 lb (8.4 kg)



The portable Multi-Amp PENTA-PLUS is battery- and line-operated.

ORDERING INFORMATION

Item (Qty)	Cat. No.
PENTA-PLUS Analyzer	835310
Included Accessories	
Line cord, ac	1495
Instruction manual	835311
Optional Accessories	
Leads	
Standard potential 6.6 ft [2 m] (set of 4)	835312
Fused potential 6.6 ft [2 m] (set of 4)	830213
Current, 20-A, STATES® plugs	
3.3 ft [1 m] (set of 3)	835313
Current, 20-A, clips 3.3 ft [1 m] (set of 3)	835314
Current, 100-A 3.3 ft [1 m] (set of 3)	835315

Item	Cat. No.
Calibration Report [must be ordered with the instrument]	CAL-835310
Clamp-on current transformers	
1000:1	830312
1000:5	835318
3000:1	835319
3000:5	835320
Carrying case, soft, padded	835316

AVO INTERNATIONAL

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2. GENERAL INFORMATION

2.1. DESCRIPTION

The Multi-Amp® PENTA-PLUS ANALYZER (Model 835310) is a next generation portable battery/line operated multifunction instrument for measuring AC voltage, AC primary and secondary current, power, reactive power, phase angle and frequency of a single or three phase electrical system. PENTA-PLUS ANALYZER is easily configured to measure the amplitude and phase angle between any two voltage and current inputs. All measured quantities are displayed simultaneously on a large, easy-to-read graphic display.

The unique firmware in the PENTA-PLUS ANALYZER, combined with a built-in microprocessor-based timer, is designed specifically to facilitate the testing and commissioning of protective relay systems, including performing induction unit pick-up and timing tests. The internal timer responds to a variety of start and stop gates, including the application of AC or DC voltage, and opening or closing of dry contacts.

PENTA-PLUS ANALYZER is a menu driven instrument equipped with data-retention and data-logging capabilities, which allow the user to capture and save test results or transmit them to a PC on a pre-programmed time interval.

Other important features include accurate phase angle measurement at very low current levels and the high speed measurement mode.

2.2. APPLICATIONS

PENTA-PLUS ANALYZER is an ideal instrument for use in general electrical systems maintenance, in electrical machine repairs, in protective relay testing, or in monitoring power at the electrical service entrance

In the protective relay application area, PENTA-PLUS ANALYZER is designed to perform fast, accurate checking and testing of relay and meter installations, during their commissioning and for performing regular maintenance.

Also, combined with a source of voltage and/or current, PENTA-PLUS ANALYZER becomes an excellent tool for testing and calibrating virtually any type of protective relay.

2.3. FEATURES

- Battery and line operated, with an automatic built-in charger.
- Rugged, ergonomic and light plastic enclosure.
- 3 independent voltage and current channels, with a built-in timer.
- Specifically designed to facilitate protective relay testing.
- Simultaneously measures and displays voltage, current, phase angle, power, reactive power and frequency of single or three phase systems.
- Wide current and voltage operating ranges.
- Fast measurement mode, with up to 20 readings per second.
- Accurate phase angle measurement at low current levels.
- HOLD mode for freezing all readings.
- Auto-ranging to reduce test time, with manual over-ride.
- Independent frequency measurement on any two selected inputs.
- RS232 Data and parallel printer output ports.

2.4. ELECTRICAL SPECIFICATIONS

SPECIFICATIONS	
Input:	Line: 90-253 V, 50/60 Hz, 30 VA
Battery:	Internal, sealed lead-acid, rechargeable battery with an internal automatic charger. Safety features include Internal battery over-charging and charge exhaustion protection. Operation Time: 3-Hour continuous on full charge.
Voltage:	0 - 650 Volts (AC or DC) in 9 ranges, with 0.1% resolution. Accuracy: ±0.5% of reading, from 3-650 Volts. Input impedance: 10 MΩ. Max input: 1000 Volts, from inputs to the chassis or between inputs.
Current:	0 - 100 Amperes (AC) in 11 ranges, with 0.1% resolution. Accuracy: ±0.5% of reading, from 0.05-100 Amperes. Burden at 5A: 0.1VA.
Phase Angle:	± 0 - 360.0 Degrees, with 0.1 degree resolution. Accuracy at 50/60 Hz: ±0.4 Deg. for input levels above 3 Volts and 0.05 (100 MA Range) Amps, ±2 deg. for input levels above 3 Volts or 0.002 Amps
Power:	± 0 - 100 KW in 6 ranges, with 0.1% resolution. Highest resolution is 0.001 Watt. Accuracy at 50/60 Hz: ±0.6% of VA.
Reactive Power:	± 0 - 100 KVAR in 6 ranges, with 0.1% resolution. Highest resolution is 0.001 VAR Accuracy at 50/60 Hz: ±1% of VA.
Frequency:	45 - 65 Hz, with 0.01 Hz resolution. Accuracy: ± 0.01 Hz
Time:	0.000 to 999.999 Seconds. Accuracy: ±0.001 Seconds +/- 0.005%.
Start/Stop Inputs:	10 - 300 Volts (DC or AC), or dry contacts closure or opening. Input resistance: 1000 Ω Minimum.

Response Time:	Regular single-phase mode: 2 reading per second High Speed single-phase Mode: 20 readings per second Three-phase mode: 1 set of readings every 2.5 seconds.

2.5. MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

Case Material:	High density Polyethylene
Dimensions:	356W x 267H x 229D millimetres (14W x 10.5H x 9D inches)
Weight	8.5 Kg (18.7 Lbs), approximately
Operating Temperature:	0°C to 40°C (32°F to 104°F)
Storage Temperature:	-20°C to 70°C (-4°F to 158°F)
Relative Humidity:	0 to 90%, NON-CONDENSING

2.6. ORDERING INFORMATION

	Cat. No.
PENTA-PLUS	835310

The instrument is shipped complete with:

Line cord, three wire, 120V	MC1495
Instruction Manual	835311

The following optional accessories are available:

Calibration Report	CAL-835310
Standard Potential Leads [set of 4, 2m]	835312
Fused Potential Leads [set of 4, 2m]	830213
20-Amps Current Leads, States Plugs [set of 3, 1m]	835313
20-Amp Current Leads, clips [set of 3, 1m]	835314
100-Amp Current Leads [set of 3, 1m]	835315
1000:1 Clamp-On Current Transformer	830312
1000:5 Clamp-On Current Transformer	835318
3000:1 Clamp-On Current Transformer	835319
3000:5 Clamp-On Current Transformer	835320
Padded Soft Carrying Case	835316
Kodak Diconix 180si, Portable Ink-Jet Printer	K32099