

## AP SERIES

### Autoranging power supplies for bench or systems use

The AP series power supplies utilise an autoranging concept and can provide a wide and adjustable range of voltage and current combinations within their constant power envelope. This is ideal for bench or systems use because a single unit will often meet future as well as present needs.

#### FEATURES

- 500W, 1kW and 3kW models available
- Manual, IEEE 488.2 bus or LabWindows™ control
- High resolution programming and readback with interface options
- Constant voltage or constant current operation
- Operating modes: local or bus control, remote sensing, remote programming, auto parallel, auto series, auto tracking
- Master/slave operation for more power or higher voltages
- Digital LED panel meters and annunciators
- Easily rack mountable, ideal for systems use
- Active power factor correction on 3kW models



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## AP SERIES AUTORANGING POWER SUPPLIES

## 1kW MODELS

These compact autoranging bench or systems power supplies use a switch-mode topology to provide a wide range of adjustable voltage and current combinations within a 1 kilowatt power envelope.

Output may be controlled manually or via the GPIB (with option /H), or via LabWindows™. Constant voltage or constant current is available and operating modes are local or bus, remote sensing, simple remote programming by voltage or resistance, auto parallel, auto series and auto tracking. Master/slave connections are provided for systems requiring more power or higher voltages. AP units are simple to rack mount.

### See also COMMON SPECIFICATION

#### AC INPUT

230V  $\pm 14\%$  or 115V  $\pm 14\%$  selectable. 48-63Hz.

#### OUTPUT CONTROL

1. Manual using 10-turn controls
2. Voltage or resistance programming
3. High resolution GPIB programming (option /H)

#### LINE REGULATION

For a 10% change  
 $<0.01\% +3mV$  in CV mode  
 $<0.01\% +5mA$  in CI mode

#### LOAD REGULATION

For a zero to 100% change  
 $<0.01\% +5mV$  in CV mode  
( $<0.01\% +5mA$  in CI mode)

#### RIPPLE AND NOISE

( $\Delta f=20Hz$  to 20MHz)  
CV: 4mV rms/40mV pk-pk typical  
Max. 7mV rms/70V pk-pk  
CI: 25mA rms typical 40mA rms max.

#### OUTPUT IMPEDANCE

0.2mΩ at DC typical

#### TRANSIENT RESPONSE

(CV typical)  
<2ms for recovery within 100mV following change in output current of 10% of max. rating at that voltage.

#### PROGRAMMING

Resistance: 0-4k7Ω provides zero to V/I max. Voltage: 0-5V provides zero to V/I max. Response time: up 120ms, down 400ms (full load)

#### REMOTE INHIBIT TERMINAL

2 to 60V input shuts down output

#### REMOTE SENSING

Maintains nominal voltage at the load

#### METERING

Twin 3 digit LED panel meters for volts and amps. Twin 20-segment bargraphs to assess voltage and current capacity within power envelope.

#### LED FLAGS

For mode indication, trips etc

#### PROTECTION

Inherent via CV/CI. Adjustable overvoltage limit (OVL). Overtemperature (OT) protection. Input fuse.

#### OPERATING AMBIENT TEMP. RANGE

0 to 40°C

#### STORAGE TEMPERATURE RANGE

-20 to +60°C

#### COOLING

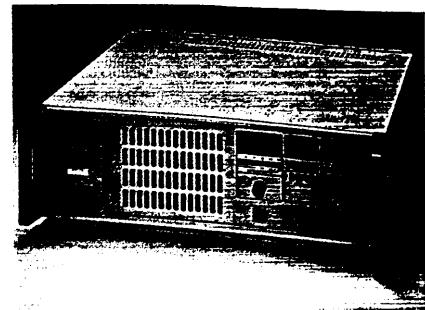
Fan assisted. Draws front, exhausts rear

#### DIMENSIONS/WEIGHT

(3U) H145mm (5 $\frac{3}{4}$ )" x W435mm (17") x D520mm (20 $\frac{1}{2}$ ")  
16kg (35.2lbs)

#### ORDER CODES/DESCRIPTIONS

**11AP3080** AP30-80 Power supply  
**11AP6050** AP60-50 Power supply  
**11AP10030** AP100-30 Power supply



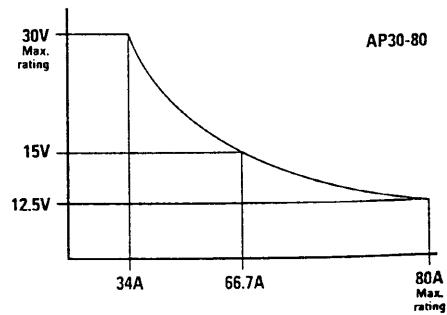
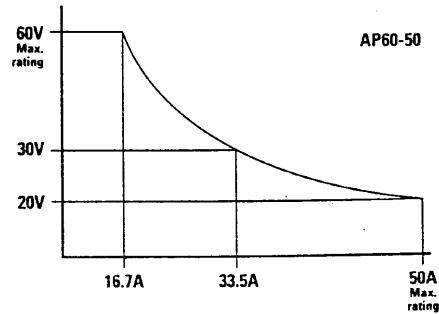
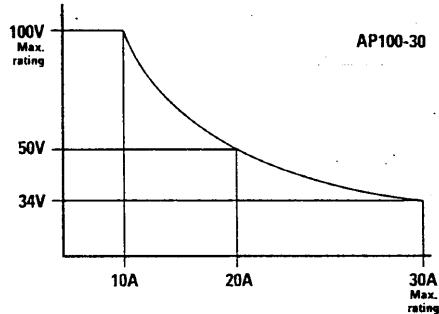
#### 1kW power limit:

**AP30-80** 0-30V/0-80A

**AP60-50** 0-60V/0-50A

**AP100-30** 0-100V/0-30A

#### OUTPUT CHARACTERISTICS



## COMMON SPECIFICATION

See following pages for performance parameters of 500W, 1kW and 3kW units.

### OUTPUT CONTROL

1. Front panel 10-turn potentiometers
2. Remote programming by resistance
3. Remote programming by voltage
4. GPIB control (option /H fitted in chosen AP unit)

### RESOLUTION OF FRONT PANEL CONTROLS

0.07% of maximum output voltage, typical  
0.07% of maximum output current, typical

### STABILITY

Typical drift in output over 8 hours assuming constant line, load and ambient temperature after 30 minutes warm up:  
±0.03% of output ±5mV (CV)  
±0.03% of output ±5mA (CI)

### OVERVOLTAGE LIMIT (OVL)

Multiturn potentiometer adjustable through front panel. Trip level adjustable from approximately 2 volts to 2 volts above rated output voltage. Accuracy of trip setting ±(1%+1.5V)

### CURRENT MONITOR

0V to 5V amplified current monitor output for zero to full output current. Accuracy 1%+10mV. Output impedance 5kΩ nominal.

### REMOTE PROGRAMMING

Referenced to negative sense by voltage: 0 to 5V provides zero to full output voltage or current. Accuracy 0.1% output +0.1% f.s. (CV). 1% output +1% f.s.(CI). By resistance: 0 to 4k7Ω provides zero to full output voltage or current. Accuracy 0.2% output +0.1 f.s. (CV). 1.1% output +0.1% f.s. (CI)

### REMOTE INHIBIT

Inhibit signal of +4V to +60V to rear panel terminals shuts down output

### REMOTE SENSING

Maintains nominal voltage at load by correcting for up to 0.5V in each output lead

### RADIO FREQUENCY INTERFERENCE

Complies with BS800 and is designed to meet VDE0875 level N.

### SAFETY STANDARDS

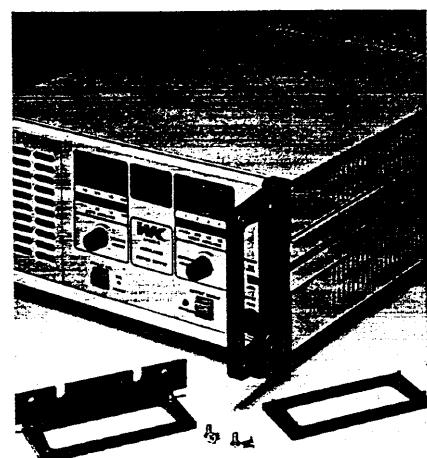
Design to comply with BS4743/IEC348.

### METERING AND STATUS INDICATORS

Twin 3 digit panel meters with red, high efficiency LEDs of 12.5mm character height. Used to display voltage and current simultaneously. The overvoltage limit setting can also be displayed. For meter accuracy see following pages. Twin bar graphs of 20 segments each give approximate indications of voltage and current availability and provide trend indications. Status flags within the panel meters give LED indication of CV and CI operating modes. A central status window (see illustration) announces unregulated condition (UNREG), over temperature (OT), and over voltage (OVL). In addition, if option /H is fitted, BUS indicates when the unit is under GPIB control, LSN indicates receiving data from bus, TLK indicates transmitting data on bus, and SRQ indicates that a 'service request' has been initiated.

### ENVIRONMENTAL

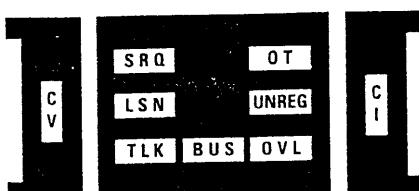
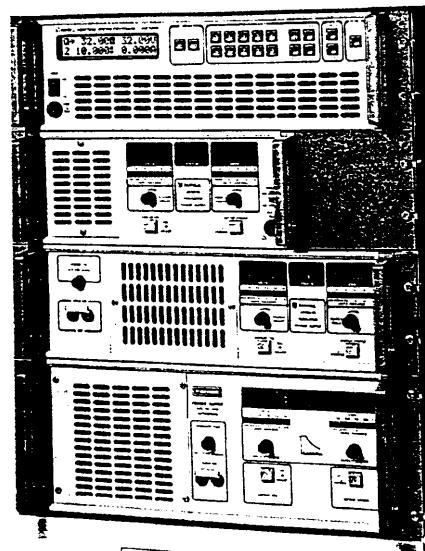
Operating temperature range 0 to 40°C  
Storage temperature range -20 to +60°C  
Cooling by fan. Draws front exhausts rear.  
Over temperature trip protection featured.



### RACK MOUNTING

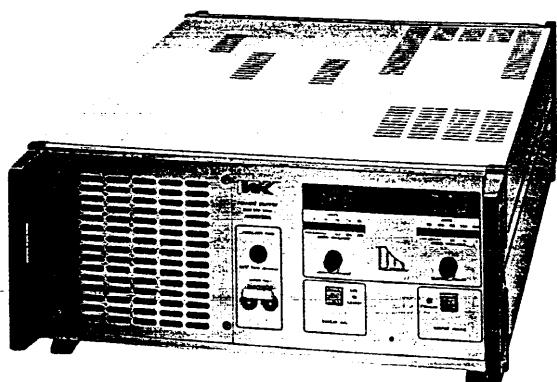
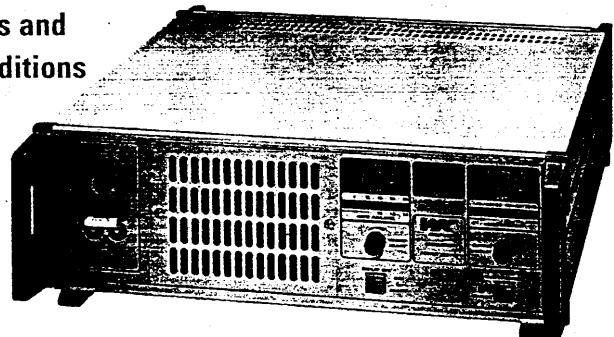
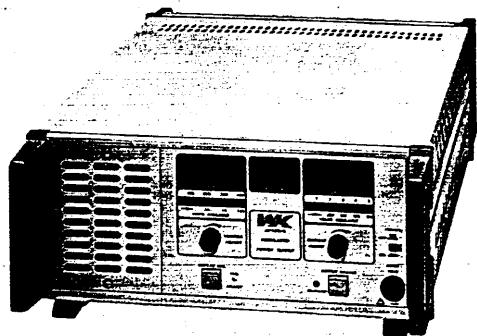
Any AP unit can easily be fitted into a standard 19" rack using the mounting kit provided (see illustration). The rear of the unit must be supported.

Rack mounting components provided free of charge.



## FEATURES

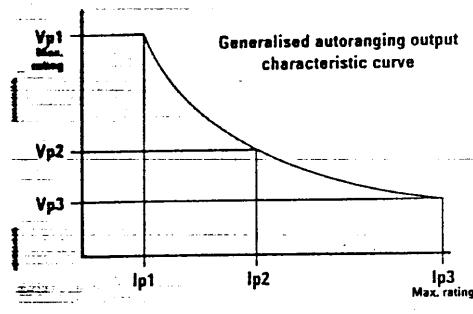
- Compact, efficient switch-mode power supplies
- For bench or systems use
- 500W, 1kW and 3kW models available
- Autoranging, continuously variable stabilised DC output in a wide variety of voltage/current combinations
- Operating modes:
  - constant voltage or constant current
  - auto-parallel
  - auto-series
  - auto-tracking
  - remote sensing
  - remote programming (by resistance or voltage)
  - via GPIB (option /H must be fitted to chosen AP unit)
- Ten-turn voltage and current controls for precise settings
- Twin digital LED display panels. Display voltage and current simultaneously. Display overvoltage setting. Bar graph indication of voltage/current capacity. Status indicators and warning flags for CV/CI mode, OVL, OT and UNREG conditions
- Front panel adjustable overvoltage limit (remotely programmable if /H fitted)
- Front panel output ENABLE switch
- Current monitoring output
- Simple rack mounting system provided
- Option /H will allow an AP unit to be controlled by a computer on the GPIB
  - Programmable functions (listen) with resolution up to 1:4000:
    - Set voltage
    - Set current
    - Set OVL (overrides manual setting)
    - Enable/shut down
    - Inhibit manual OVL
    - Control SRQ
    - Changing mode (bus/local)
  - Readback functions (talk) with resolution up to 1:4000:
    - Actual voltage at load
    - Actual current at load
    - Present status (CV or DI, OVL, OT, UNREG, SRQ)



## AP SERIES AUTORANGING POWER SUPPLIES

### AUTORANGING – the single unit solution to a variety of power needs

The AP series power supplies utilise an autoranging concept and can provide a wide and adjustable range of voltage and current combinations within their constant power envelope. This is ideal for bench or systems use because a single unit will often meet your future as well as present needs.



#### Compact and efficient

Because they utilise an efficient switch-mode topology AP Series units are compact and relatively lightweight for their considerable power outputs. They are suitable for stand-alone bench use or for integrating into systems.

#### Powerful outputs

The voltage and current capability of the units is shown graphically in the SPECIFICATION section and can be determined when in use from two front panel bar graphs which show volts with available current, and current with available volts.

Output can be constant voltage or constant current and the mode in use is shown by LED status indicators (flags) on the front panel. Twin digital LED panel meters are provided to monitor both voltage and current. Output is adjustable from near zero to maximum volts and from near zero to maximum current by 10-turn front panel controls.

Alternatively, the output can be controlled from the rear panel using a variable voltage or resistance, or can be remotely programmed by a computer on the GPIB if option /H is fitted.



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An OUTPUT ENABLE button is provided on the front panel. When not pressed in, the panel meters and bargraphs display the prospective output settings. This is done without having to open circuit the load to set the voltage, or short circuit the output to set the current. When the OUTPUT ENABLE button is pressed in, the meters and bargraphs display the actual voltage and current being delivered to the load.

#### Protected

CV/CL power supplies are inherently safe as both output voltage and current will be automatically limited to the preset values. However, to enable the user to protect the load from inadvertent application of an excessive voltage, the units incorporate an overvoltage limit (OVL) which causes the supply to down program when the preset level is exceeded. It can be adjusted by rotating the 'adjust OVL' control through the front panel. The OVL level can be monitored on the voltmeter by depressing the 'display OVL' button. When the OUTPUT ENABLE button is not pressed in, the trip level can be accurately set without activating shutdown or disconnecting the load. A tripped OVL can be reset manually or via a GPIB shutdown/enable command. When used with option /H the OVL may be set remotely overriding the local setting. If the power supply overheats, due to restricted airflow for example, the output shuts down automatically and the overtemperature flag 'OT' in the status window lights up. When the unit has cooled sufficiently, the output returns and the flag turns off. Both 'OVL' and 'OT' conditions can be reset using the OUTPUT ENABLE switch.

Protection is also provided against severe reductions in AC power line input (brownout) which could cause overheating or unreliable operation. The

output will shut down until the AC power line returns within operating tolerances. An undervoltage condition can be recognised by 'UNREG' and 'ENABLED' lamps being illuminated, together with near zero readings on the panel meters. Should the terminal cover be removed whilst the unit is operating a microswitch inhibits the output circuitry and the panel meters indicate zero.

#### Remote sensing

When supplying a load which is some distance from the output, the remote sensing terminals should be used to maintain regulation at the load rather than at the unit's output terminals. Up to 0.5 volts drop per load lead can be allowed for without degrading the specified CV performance.

#### Multiple unit operation

Up to four units can be connected for auto-parallel (master/slave) operation to increase total output current. Control can be maintained from one master unit whether the units are used under local or GPIB control (option /H needed for GPIB). Several units can be connected for auto-series (master/slave) operation, the floating voltage limitation being 200V DC maximum between output and ground. Positive or negative tracking outputs can be achieved by grounding the centre of the series combination, or at any unit in the chain if an unbalanced positive and negative supply is required. Neither rail should exceed 200V DC with respect to ground.

#### Current monitoring

An amplified current monitor output signal of 0 to 5 volts for zero to full current is provided. This is useful for the remote display of output current. It also provides the capability for auto parallelling power supplies should this be a requirement.

#### GPIB interfacing

A GPIB interface card is available as a factory fitted option (/H). When fitted this allows high resolution (up to 1:4000) control and readback of output. The option also activates LEDs which indicate if the power supply is 'talking' or 'listening' or whether a 'service request' signal has been sent.

## AP SERIES AUTORANGING POWER SUPPLIES

## 500W MODELS

These compact autoranging bench or systems power supplies use a switch-mode topology to provide a wide range of adjustable voltage and current combinations within a 500 watt power envelope.

Output may be controlled manually or via the GPIB (with option /H), or via LabWindows™. Constant voltage or constant current is available and operating modes are local or bus, remote sensing, simple remote programming by voltage or resistance, auto parallel, auto series and auto tracking. Master/slave connections are provided for systems requiring more power or higher voltages. AP units are simple to rack mount.

### See also COMMON SPECIFICATION

#### AC INPUT

230V  $\pm 14\%$  or 115V  $\pm 14\%$   
selectable. 48-63Hz.

#### OUTPUT CONTROL

1. Manual using 10-turn controls
2. Voltage or resistance programming
3. High resolution GPIB programming (option /H)

#### LINE REGULATION

For a 10% change  
 $<0.01\% +3mV$  in CV mode  
(+20mV model AP400-5)  
 $<0.01\% +5mA$  in CI mode

#### LOAD REGULATION

For a zero to 100% change  
 $<0.01\% +5mV$  in CV mode  
(+40mV model AP400-5)  
 $<0.01\% +5mA$  in CI mode

#### RIPPLE AND NOISE typical

( $\Delta f=20Hz$  to 20MHz)  
CV: 4mV rms/40mV pk-pk  
Max. 7mV rms/70V pk-pk  
CI: 25mA rms/40mA pk-pk max.  
AP400-5: 20mV rms/100mV pk-pk  
Max. 40mV rms/200mV pk-pk

#### OUTPUT IMPEDANCE

0.2m $\Omega$  at DC typical

#### TRANSIENT RESPONSE

(CV typical) <2ms for recovery within 100mV following change in output current of 10% of max. rating at that voltage.

#### PROGRAMMING

Resistance: 0-4k7 $\Omega$  provides zero to V/I max.  
Voltage: 0-5V provides zero to V/I max. Response time: up 120ms, down 400ms (full load)

#### REMOTE INHIBIT TERMINAL

2 to 60V input shuts down output

#### REMOTE SENSING

Maintains nominal voltage at the load

#### METERING

Twin 3 digit LED panel meters for volts and amps. Twin 20-segment bargraphs to assess voltage and current capacity within power envelope.

#### LED FLAGS

For mode indication, trips etc

#### PROTECTION

Inherent via CV/CI. Adjustable overvoltage limit (OVL). Overtemperature (OT) protection. Input fuse.

#### OPERATING AMBIENT TEMP. RANGE

0 to 40°C

#### STORAGE TEMPERATURE RANGE

-20 to +60°C

#### COOLING

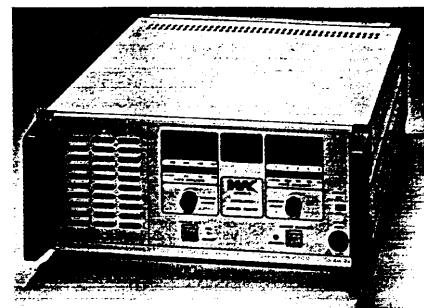
Fan assisted. Draws front, exhausts rear

#### DIMENSIONS/WEIGHT

(3U) H145mm (53/4") x W327mm (123/4") x D520mm (201/2")  
11kg (24.4lbs)

#### ORDER CODES/DESCRIPTIONS

**11AP2080** AP20-80 Power supply  
**11AP7030** AP70-30 Power supply  
**11AP4005** AP400-5 Power supply



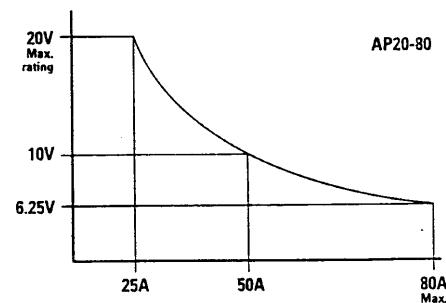
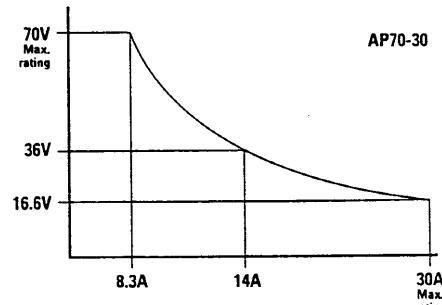
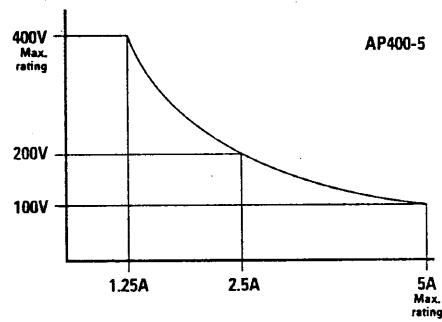
**500W power limit:**

**AP20-80 0-20V/0-80A**

**AP70-30 0-70V/0-30A**

**AP400-5 0-400V/0-5A**

#### OUTPUT CHARACTERISTICS



## AP SERIES AUTORANGING POWER SUPPLIES

## 3kW MODELS

These compact autoranging bench or systems power supplies use a switch-mode topology to provide a wide range of adjustable voltage and current combinations within a 3 kilowatt power envelope.

Output may be controlled manually or via the GPIB (with option /H), or via LabWindows™. Constant voltage or constant current is available and operating modes are local or bus, remote sensing, simple remote programming by voltage or resistance, auto parallel, auto series and auto tracking. Master/slave connections are provided for systems requiring more power or higher voltages. AP units are simple to rack mount.

### See also COMMON SPECIFICATION

#### AC INPUT

230V  $\pm 14\%$ . 48-63Hz.  
115V versions not available.  
Max rms input current 22A

#### POWER FACTOR CORRECTION

Reconstructs sinusoidal current waveform. Reduces harmonics and lowers rms input current. For a given load this increases power that may be drawn from AC supply socket without overheating AC supply wiring. Active switching frequency 20kHz.

Typical PF is 0.997. Example.  
Max. power from a 13A socket at 230V is 2.2kW from  
Power consumption = 0.997 x supply volts x supply current  
Max. output power = Power consumption x % efficiency/100  
Max. supply =  $\frac{\text{Max. output power}}{0.997 \times \text{supply volts} \times \% \text{ efficiency}/100}$

#### OUTPUT CONTROL

1. Manual using 10-turn controls
2. Voltage or resistance programming
3. High resolution GPIB programming (option /H)

#### LINE REGULATION

For a 10% change  
<0.01% +3mV in CV mode  
<0.01% +15mA in CI mode

#### LOAD REGULATION

For a zero to 100% change  
<0.01% +5mV in CV mode  
<0.01% +15mA in CI mode

#### RIPPLE AND NOISE

( $\Delta f=20\text{Hz}$  to 20MHz)  
CV: 4mV rms/40mV pk-pk typical  
Max. 7mV rms/70mV pk-pk  
CI: 75mA rms typical, 120mA rms max.

#### OUTPUT IMPEDANCE

0.1m $\Omega$  at DC typical

#### TRANSIENT RESPONSE

(CV typical)<2ms for recovery within 100mV following change in output current of 10% of max. rating at that voltage.

#### PROGRAMMING

Resistance: 0-4k7 $\Omega$  provides zero to V/I max. Voltage: 0-5V provides zero to V/I max.  
Response time: up 120ms, down 400ms (full load)

#### REMOTE INHIBIT TERMINAL

2 to 60V input shuts down output

#### REMOTE SENSING

Maintains nominal voltage at the load

#### METERING

Twin 3 digit LED panel meters for volts and amps. Twin 20-segment bargraphs to assess voltage and current capacity within power envelope.

#### LED FLAGS

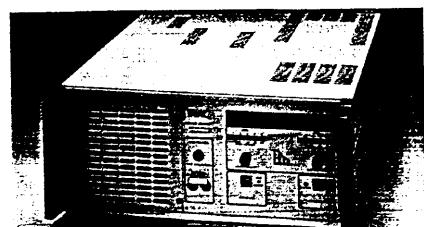
For mode indication, trips etc

#### PROTECTION

Inherent via CV/CI. Adjustable overvoltage limit (OVL). Overtemperature (OT) protection. Input fuse.

#### OPERATING AMBIENT TEMP. RANGE

0 to 40°C



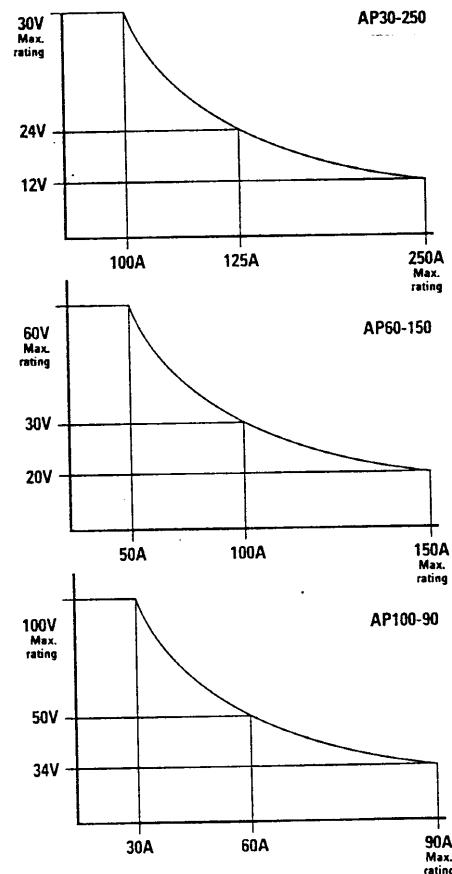
#### 3kW power limit:

**AP30-250 0-30V/0-250A**

**AP60-150 0-60V/0-150A**

**AP100-90 0-100V/0-90A**

#### OUTPUT CHARACTERISTICS



#### STORAGE TEMPERATURE RANGE

-20 to +60°C

#### COOLING

Fan assisted. Draws front, exhausts rear

#### DIMENSIONS/WEIGHT

(4U) H177mm (7 $\frac{3}{4}$ ") x W435mm (17") x D673mm (26 $\frac{1}{2}$ ")  
23kg (50.6lbs)

#### ORDER CODES/DESCRIPTIONS

1EBAP30250A AP30-250 Power supply

11AP60150 AP60-150 Power supply

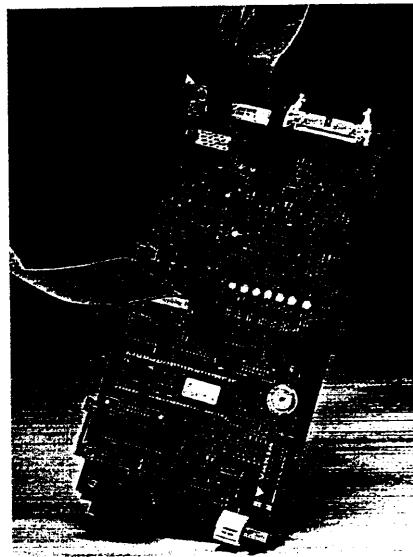
11AP10090 AP100-90 Power supply

## AP SERIES AUTORANGING POWER SUPPLIES

## OPTIONS

### HIGH RESOLUTION IEEE 488.2 PROGRAMMING (OPTION /H)

GPIB card to interface AP unit with bus controller  
IEEE 488.2 protocol  
High resolution programming and readback of up to 1:4000  
Commands: remote/local operation, set voltage, current, overvoltage trip and enable/disable output  
Reads back voltage, current, CV or CI status, overvoltage setting and trip, enabled/disabled status, overpower, sink mode, over temperature trip  
220 stores for all set commands  
Self-test function  
Interface opto-isolated from power supply output  
LabWindows™ software driver available  
Switchable to operate as an improved version of earlier generation (option /B) interface



### ORDER CODE

Add /H to AP model number

### SPECIFICATION

#### Programming resolution

AP model	V step	I step
AP20-80	5mV	20mA
AP70-30	20mV	10mA
AP400-5	100mV	1.25mA
AP30-80	10mV	20mA
AP60-50	20mV	12.50mA
AP100-30	25mV	10mA
AP30-250	10mV	100mA
AP60-150	20mV	50mA
AP100-90	25mV	25mA

#### Programming accuracy

Voltage: 0.2% of output +0.13% f.s.  
Current: 1.1% of output +0.13% f.s.  
Overvoltage trip: 1% of output +0.16% f.s.

#### Readback accuracy

Voltage: 0.2% of output +0.13% f.s.  
Current: 1.1% of output +0.16% f.s.

Design developments may result in specification changes

Publication Ref. AP Series Q2.96

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