

# American Magnetics

Excellence in Magnetics and Cryogenics Since 1968



112 Flint Rd Oak Ridge, TN 37830

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## Model 430 Power Supply Programmer



and

## Integrated Magnet Power Supply Systems



Shown here: AMI's most popular Magnet Power Supply System, the **Model 4Q06125PS-430**

### Model 430 Programmer

The AMI Model 430 Power Supply Programmer is a sophisticated digital power supply controller that allows an operator to manage a superconducting magnet system with unprecedented accuracy and ease. The Model 430 is designed to control a wide range of single, dual, and four-quadrant linear and switching power supplies. The most frequently used functions are accessible via single keystroke or shift plus keystroke. For other functions, a menu driven format guides the user to enter inputs using the push button front panel interface.

### Integrated Power Supply Systems

AMI Integrated Magnet Power Supply Systems incorporate the digitally based Model 430 Power Supply Programmer which provides simplified, flexible operation with precise low drift magnet current control. Standard systems are mounted in rugged 19" rack-style cabinets. Standard 4-quadrant systems range from 5 A to 250 A, while the standard bipolar current ratings range from 100 A to 500 A. Bipolar systems incorporate the AMI Model 601 Energy Absorber to achieve bipolar operation and allow fast ramp down with a unipolar power supply.

### Multi-axis Systems

Multiple Model 430 Power Supply Programmers can control a multi-axis magnet system for virtual rotation of the magnetic field. An infinite combination of field vectors is possible when the coils of the multi-axis magnet system are energized and controlled independently and simultaneously.

### Model 430 Power Supply Programmer Specifications for AMI's Standard Systems @ 25°C

Magnet Current Control Parameter	Standard Model 430 Configurations: Programmable Limits							
	±5 A	±10 A	+100 A	±125 A	+200 A	±250 A	+300 A	+500 A
Accuracy <sup>a</sup> (A) with Standard Shunt System:	0.002	0.004	0.04	0.05	0.08	0.1	n/a <sup>b</sup>	n/a <sup>b</sup>
Accuracy <sup>c</sup> (A) - High Stability System:	0.00025	0.0005	0.005	0.0063	0.01	0.0125	0.015	0.025
Stability <sup>a</sup> (A) with Standard Shunt System:	0.001 <sup>d</sup>	0.002 <sup>d</sup>	0.02 <sup>d</sup>	0.025 <sup>d</sup>	0.04 <sup>d</sup>	0.05 <sup>d</sup>	n/a <sup>b</sup>	n/a <sup>b</sup>
Stability <sup>c</sup> (A) - High Stability System:	0.00005	0.0001	0.001	0.00125	0.002	0.0025	0.003	0.005
Minimum Ramp Rate (mA/min):	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1
Maximum Ramp Rate (A/sec):	1	1	1	10	20	20	30	30

<sup>a</sup> After 20 minutes; stability and accuracy of systems 250 A and less<sup>b</sup> are improved more than a factor of 10 with the optional high-stability (flux-gate) system.

<sup>b</sup> Systems larger than 250 A include the high stability (flux-gate) option as the standard configuration.

<sup>c</sup> After 10 minutes;

<sup>d</sup> Drift is further reduced to half that shown after 60 minutes.



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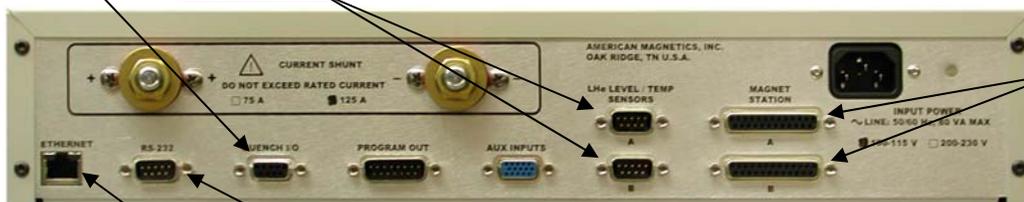
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## Model 430 Features

- Parameter for setting persistent switch cool time<sup>1</sup>
- Ultrahigh resolution and accuracy
- Intuitive user operation and comprehensive manual<sup>2</sup>
- Upper current limit and voltage limit settings
- Easy to read digital  $V_m/V_s$  (magnet and supply voltage) display meter
- Can automatically determine inductance of load
- Drivers for LabView
- User-adjustable threshold quench detection with detection I/O
- Automatic ramp down and quench inputs
- Galvanically isolated Program Output signal to prevent ground loops
- Multifunction vacuum fluorescent display (VFD)
- Menu driven user interface and keypad – logical and intuitive
- One touch Ramp/Pause button
- Digital readout in Field (kilogauss or Tesla) or Current (Amperes)
- Control multiple parallel or series configured supplies
- Front panel indication that current is flowing in magnet leads
- Velocity sensitive encoder dial for fine adjustments
- Programmable piecewise-continuous ramping with 10 current-dependent rates
- Output signals to helium level and temperature instruments via internal wiring from the magnet station connector



- Integrated DB-25 magnet station connector with wired DB-25 output signals available for other system devices

- Built-in Ethernet and RS-232<sup>3</sup> communication interfaces
- Ethernet port allows access to the Programmer across a local network or via the Internet
- Operating software is stored in flash memory and can easily be updated via the Ethernet or RS-232 ports

<sup>1</sup>Important for conduction-cooled magnets (dry switch) when a relatively long time is required to cool as compared with wet switches.

<sup>2</sup>Manual is conveniently available in the Model 430 firmware (pdf format) - just access the instrument's IP address via a web browser.

<sup>3</sup>An optional external conversion unit is available for interfacing the RS-232 serial port to a GPIB bus.

## Simplified Operation

Most frequently used functions are accessible via single keystroke or shift plus keystroke. The front panel velocity-accelerated rotary encoder dial also allows the operator to make fine adjustments to operating parameters of the magnet system. Magnet system signal wiring, such as magnet voltage/current, helium levels, and temperatures, connect to the rear panel through a single DB-25 connector. Multiple connectors on the rear panel allow the user to route the signals to the appropriate instruments at the control station; the need for complicated wiring between the cryostat and magnet control station is thus eliminated.

## Digital Control

The digitally-based Model 430 incorporates very high resolution analog <-> digital converters and digital signal processing (DSP) to achieve excellent stability, precise control, and superior current resolution of the programmed magnetic field. An internal microcomputer manages all computations, analog data conversion, display/keypad functions, communications I/O, and analog power supply programming signals.

## High Resolution and Stability

Precision instrumentation techniques and potentiometer-free designs are employed throughout the instrument to ensure accurate signal translation for a wide range of conditions. The magnet current is sampled at a resolution of 15.6  $\mu\text{A}$  (for a 125 A supply) and is front-panel programmable in 0.1 mA increments. A further order of magnitude in accuracy and stability can be achieved by choosing the optional fluxgate based current measurement system in place of the standard resistive shunt.

## Magnet Control and Protection

The Model 430 protects the magnet from runaway supply voltage/current or operator error. The quench detect function, with user-adjustable quench sensitivity, is designed to detect a magnet quench and quickly stop power from being delivered to the resistive magnet. The system can optionally incorporate an AMI Liquid Helium (LHe) Level Instrument to prevent magnet quenching due to low LHe level; automatic ramp down of the magnet (even in persistent mode) is initiated if the LHe level drops to a preset level.

A system administrator can program the instrument (from the front panel or remotely) with password protected operational limits or any other parameter(s) which can thereafter not be exceeded or changed without the password. During operation of the system, if the operator inadvertently attempts to take the magnet system to an excessive magnetic field strength or excessive voltage, the Programmer will not accept the parameter and will alert the operator that the value exceed the limits.

The Model 430 automatically determines and sets the proper persistent switch heater current (range: 0 to 100 mA; compliance 13.5 V). The persistent switch heater circuit is continually monitored and the user is notified of circuit problems. The Model 430 Programmer automatically controls the power supply and persistent switch heater to aid the user in safe and quick transitions in and out of persistent mode.



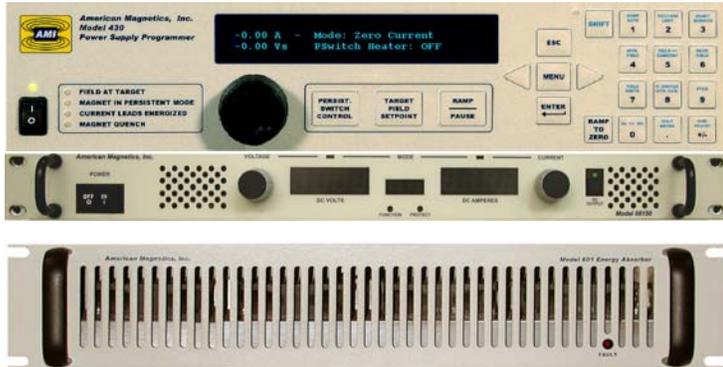
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For **single quadrant operation** (I+, V+) the Model 430 Programmer can control various unipolar **switching or linear supplies**. Shown here is the AMI Model 08150PS-430 1200 watt switching supply combination. This system offers great value, small size, and minimum heat generation. The Model 430 Programmer has also been tested on older supplies such as the HP6260B linear power supply; it can breathe new life into your system by offering state of the art control capability.

**Bipolar operation** (I+, V-/+) is obtained by adding a Model 601 Energy Absorber unit to take full advantage of programmed magnetic field profiles, and other situations requiring fast ramp down rates.

AMI's lowest-power standard bipolar power supply system, designated 05100PS-430-601, has the Model 08150PS configured at 100 A/ 10 V, and in conjunction with the Model 601, supplies 100 A at 5 V to the load. The system comes mounted in a 19" rack style cabinet. Specifications for this and other standard AMI bipolar systems are outlined below. AMI's highest-power standard bipolar power supply system, the Model 05500PS-430-601, is pictured on the last page of this brochure. Other ratings and configurations are available.

System	Specifications – Standard Cabinet Mounted Bipolar Power Supply Systems						
	Maximum Current	Maximum Voltage	Output Power	Maximum Input Power <sup>a</sup>	Typical Noise	Dimensions <sup>b</sup> h x w x d	Approximate Weight <sup>c</sup>
05100PS-430-601:	+100 A	±5 Vdc	500 VA	1500 VA	75 mV p-p	12.5" x 21.0" x 24.5"	70 lb (32 kg)
05200PS-430-601:	+200 A	±5 Vdc	1000 VA	3000 VA	75 mV p-p	25.0" x 23.6" x 23.6"	165 lb (75 kg)
05300PS-430-601:	+300 A	±5 Vdc	1500 VA	4500 VA	75 mV p-p	30.3" x 23.6" x 23.6"	215 lb (98 kg)
05500PS-430-601:	+500 A	±5 Vdc	2500 VA	7250 VA	75 mV p-p	47.2" x 21.3" x 24.5"	330 lb (150 kg)

<sup>a</sup> Includes Model 430 and Model 601

<sup>b</sup> Rack/cabinet dimensions; h = height; w = width; d = depth

<sup>c</sup> Includes rack/cabinet

For true high-current **four-quadrant operation** (I+/-, V+/-) the Model 430 is configured with the Model 4Q06125PS Power Supply to provide smooth, linear sweeps through zero current with constant ramp rates across the entire operating range. The magnet system can easily be fine tuned by making precise adjustments to the current through the use of the convenient velocity sensitive encoder dial. This system, designated 4Q06125PS-430, comes standard in a 19" rack style cabinet, and is depicted on the cover page of this brochure.

For higher voltage or current, series and parallel configurations of the 4Q06125PS are available (designated 4Q12125PS-430 and 4Q06250PS-430). For smaller magnets, four quadrant power supply systems (designated 4Q1005PS-430 and 4Q1010PS-430) incorporate the smaller Kepco BOP supplies and are offered for smaller magnet requirements. Specifications for standard AMI four quadrant systems are outlined below.



Other ratings and configurations are available.

System	Specifications – Standard Cabinet Mounted Four Quadrant Power Supply Systems						
	Maximum Current	Maximum Voltage	Output Power	Maximum Input Power <sup>a</sup>	Typical Noise	Dimensions <sup>b</sup> h x w x d	Approximate Weight <sup>c</sup>
4Q06125PS-430:	±125 A	±6 Vdc	750 VA	2000 VA	120 mV p-p	12.5" x 21.0" x 24.5"	100 lb (46 kg)
4Q06250PS-430:	±250 A	±6 Vdc	1500 VA	3800 VA	120 mV p-p	19.5" x 21.0" x 24.5"	200 lb (91 kg)
4Q12125PS-430:	±125 A	±12 Vdc	1500 VA	3800 VA	240 mV p-p	19.5" x 21.0" x 24.5"	200 lb (91 kg)
4Q1005PS-430:	±5 A	±10 Vdc	50 VA	700 VA	10 mV p-p	12.5" x 21.0" x 24.5"	85 lb (39 kg)
4Q1010PS-430:	±10 A	±10 Vdc	100 VA	1200 VA	10 mV p-p	12.5" x 21.0" x 24.5"	85 lb (39 kg)

<sup>a</sup> Includes Model 430

<sup>b</sup> Rack/cabinet dimensions; h = height; w = width; d = depth

<sup>c</sup> Includes rack/cabinet



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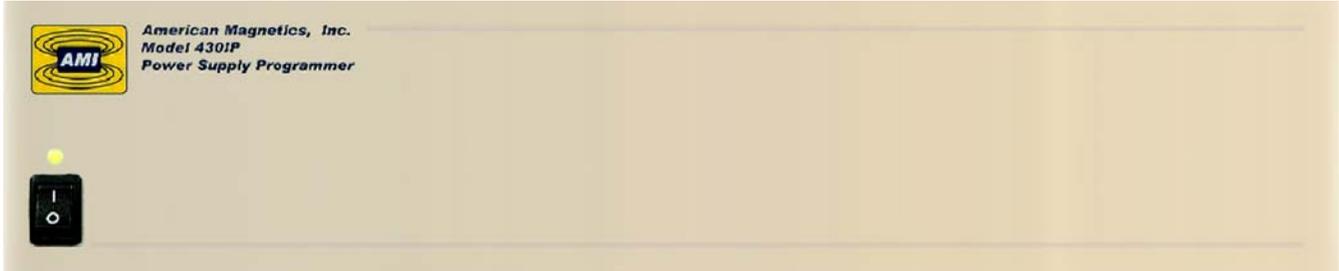
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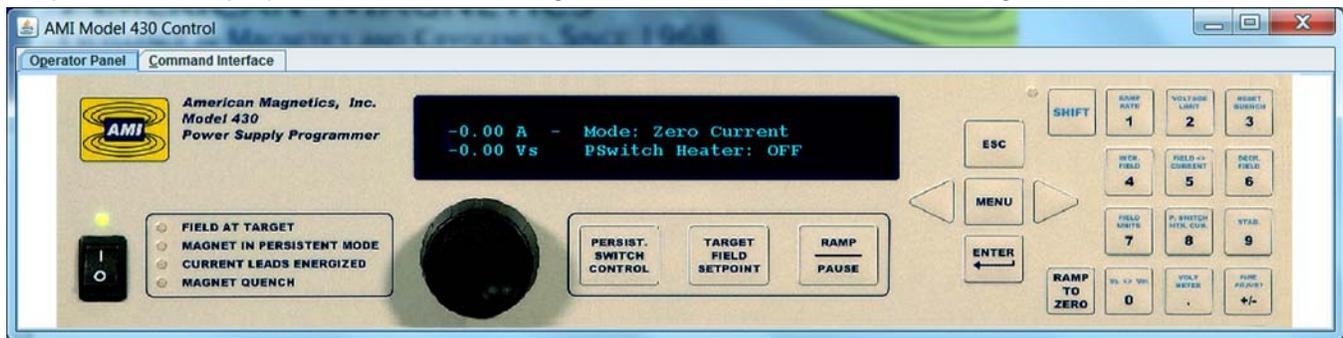
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## The Internet Protocol Model 430IP Power Supply Programmer

With **no front panel controls** except the power On/Off switch, the Model 430IP is designed for fully functional magnet system control via the rear panel Ethernet connection using TCP/IP with a web browser.



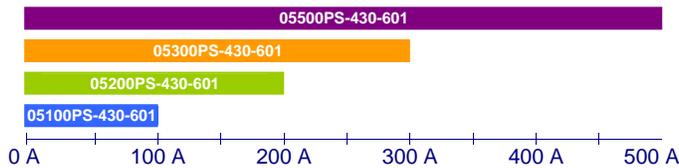
Control can be established through a locally connected computer or remotely through a network or even the Internet; the human/machine interface is a web browser depiction of the Model 430. This is especially useful for multi-axis systems where a computer is an inherent part of the system. The IP-capable firmware can also be applied to the standard Model 430 with front panel controls – in this case the computer-displayed Model 430 mirrors and controls all hardware front panel devices with the exception of the ac input power switch. The following is a screen-shot of the Model 430IP being controlled with a web browser.



### Selecting an AMI Power Supply System

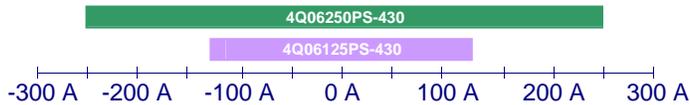
### Model 05500PS-430-601 System

#### Bipolar (Magnet Voltage -5 V<sup>1</sup> to +5 V)

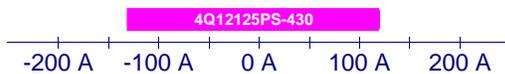


<sup>1</sup> Available for fast discharge of magnet.

#### Four Quadrant High Current (Magnet Voltage -6 V to +6 V)



#### Four Quadrant High Current (Magnet Voltage -12 V to +12 V)



#### Four Quadrant Low Current (Magnet Voltage -10 V to +10 V)

