American Magnetics

P.O. Box 2509, 112 Flint Road, Oak Ridge, TN 37831-2509

Phone: 865-482-1056 Fax: 865-482-5472

Web Site: http://www.americanmagnetics.com e-mail: steve.short@americanmagnetics.com

QUOTATION

Address: **Lawrence Berkeley National Laboratory**

Attention: **Steve Virostek**

Date: **Apr 13 2007**

Quotation No: **070413 - QI15716**

Reference: **300A PS**

Please accept this quotation for consideration of your Cat. Code MU1010, Serial # 10246 solicitation for 300A power supply systems. After review of your specification American Magnetics is pleased to submit the attached quotation noting the following comments and exceptions:

2.1.2 Power supplies are rated at +/- 10V Nominal with +/- 9V guaranteed.
2.1.6 Historical maximum inductance ranges are calculated at 100H. AMI expects there to be no deleterious stability issues at the requested inductances. Calculations to verify compliance will be made prior to delivery.
2.2.3 **Exception:** The quoted power supply system temperature coefficient is 100 ppm per degree C temperature change.
2.2.4 Power supply current delta for 10% dips has not been characterized.
2.2.5 The quoted power supply current stability has been characterized as 0.01% Imax drift after 40 minute warmup.
2.2.7 Current resolution accuracy of quoted power supply is 0.1% of 300A or 300 mA.
2.3.1 In the event of a power outage, upon restoration of power, the quoted power supply will reenergize at the decayed rate.
2.3.2 Upon magnet quench, the quoted power supply output will o to approximately -10V.
2.3.3 **Exception:** Upon HTS lead quench, the quoted power supply does not induce a resistance as defined by solicitation.
2.3.4 **Exception:** Upon cooler failure, the quoted power supply does not induce a resistance as defined by solicitation.
2.3.5 **Exception:** Per exceptions to sections 2.3.3 and 2.3.4, outputs for items 3 and 4 are not provided by the quoted power supply.
3.2 Due to proprietary processes, American Magnetics agrees to provide access to the Quality Assurance Manual, Quality Assurance manager and make provisions to allow for the witness of product final inspection and testing.

LBNL solicitation Cat. Code MU1010, Serial # 10247 for 60A power supply systems is beyond the current design of our products. A redesign to our four quadrant system is ongoing and should be available by the third quarter of 2007. The redesigned system is expected to meet your design criteria. At this time we will need to decline bidding on this solicitation.

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ITEM	QUAN.	DESCRIPTION	UNIT PRICE	TOTAL

1 **24** **Model 601 Energy Absorber - Magnetic Field Fast Ramp Down Option** **$2,150** **$51,600**

When used in combination with one of the AMI power supply-programmer systems, the magnetic field fast ramp down option permits the energy stored in large magnets to be discharged more rapidly. The discharge rate is determined by the voltage across the magnet terminal by the equation V = L di/dt. Since the inductance of a typical superconducting magnet may be several henries it can take a very long time to discharge a magnet. The magnetic field fast ramp down option is capable of producing a constant 5 volt discharge. Current is routed from the power supply through the Model 601 and then to the magnet. The end result is at least a 50 fold improvement in the time required for a typical magnet discharge as compared to the typical exponential decay through the small resistance of power lead cables. Up to six (6) units can be connected in parallel to achieve a maximum performance of 5 volts at 780 amperes. The unit will operate safely to ramp down the magnet in the event of a power outage during magnet charging.

The Model 601 has the following specifications:

1. Energy dissipation ..... 5 Volts at 130 amps (650 VA) continuous load at 25°C linearly derated to 5 Volts at 100 amps (500 VA) continuous load at 40 °C
2. Cooling ..... Forced air cooled
3. Operating temperature ..... 0 to 40 °C @ 100 A
   0 to 25 °C @ 130 A
4. Size ..... 3.5" H x 19" W x 19" D
5. Approximate weight ..... 20 lbs
6. Regulatory ..... CE approved

2 **4** **Model 20300PS-420 Power Supply System** **$16,500** **$66,000**

The Model 420 Programmer is equipped with an internal shunt for measuring the current supplied to the magnet. AMI will also provide system integration and testing of the complete 20300PS-420 combination at our facility to ensure trouble free operation and simple installation at the customer's location. The Model 420 will program and read currents up to 300 amperes. Typical current resolution is approximately 0.6 mA and the accuracy is typically 300 mA over the 0-300 ampere range. AMI will also provide a protective rectifier to prevent damage to the power supply in the event that line input power is lost while the magnet is being charged in non-persistent mode. Magnet ramp down will be very slow and only achieved by the voltage drop in the customer provided power cables to the magnet via the equation V=L di/dt by exponential decay where V=IR at any point in time.

The Model 420 Digital Power Supply Programmer is available as a stand alone unit to be used with existing power supplies. When a power supply is used manually to increase or decrease the magnet current, the high inductance of the magnet may interact with the power supply and cause current oscillations. The Model 420 insures smooth,

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consistent charge and discharge of magnet current which eliminates oscillations and stabilizes the superconducting magnet system. A menu driven format guides the user to make inputs from the push button front panel interface. Parameters for several commonly used magnet power supplies come pre-programmed into the system which allows the user to simply select the correct supply from the menu and begin operation.

The Model 420 provides user programmable ramp rate, current, and voltage limit settings. The ramp rate is continuously adjustable from 0.1 mA/min. to 30 amps/sec. Along with charging and discharging the magnet current, the user can also select the pause feature to temporarily hold at the prevailing magnetic field. An analog voltmeter provides a clear visual indication of both positive and negative magnet voltage. Front panel keypad and digital display allows direct and accurate entry of instrument settings. In addition to displaying the magnet voltage, either the magnet current or field in kilogauss or tesla is also displayed. The magnetic field readout is based on a user input coil constant. The Model 420 includes a regulated persistent switch heater current supply; the persistent switch is push-button activated. Power supply/programmer interface cable is provided. Power lead cable connects conveniently to the vapor cooled current leads of the magnet system. The Model 420 Programmer commands the power supply via an analog signal with a maximum range of -10V to +10V. The 20300PS Power Supply is operated in a remote voltage-voltage programming mode when using the Model 420.

Quench protection provides visual and optoisolated electrical indication of a magnet quench and automatically sets the power supply output voltage to zero. The programmer prevents the power supply from initiating a recharge of the magnet current until the quench detection function is reset. A rear panel input is also provided for users who have a remote quench detection system. Another unique feature is a 25 pin rear panel connector on the Model 420 that allows the customer to connect signals such as cryogen level signals, temperature signals, experimental inputs, etc. directly from the cryostat. This means that all these signals can be easily combined into one standard shielded cable and eliminates the messy wiring which often exists on experimental systems. Three separate output connectors are provided on the rear panel to route these signals to the appropriate devices. Overvoltage, overcurrent, and overtemperature protection are built-in features of the power supply.

Standard communications features include the IEEE-488 and RS-232 (optional RS-422) computer interfaces. AMI recommends a Communications Isolation Module when using either the GPIB or RS232 communications to minimize signal interference. The computer interface allows computer control of all power supply system features including ramp rate, current limit, voltage limit, pause and persistent switch heater operations. Controlling the Model 20300PS-420 via computer allows complex piecewise linear field profiles to be easily executed. LabVIEW drivers for Version 6.1 and higher are included at no charge with each unit. Also provided are GPIB drivers for an integrated panel which displays the Magnet status (PS/420 information), Liquid Helium Level (using Model 135), and Temperature Control Features (using the Lake Shore 332S or Neocera LTC-21). This allows the user to monitor and control both the temperature and magnetic field of their system from one single interface screen. As an added feature, the Model 420 will automatically ramp the magnet down if the liquid helium level falls below the helium Low level setpoint when using this combination of GPIB drivers. When purchasing a Model 420 for use on an

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existing superconducting magnet, please supply the following information: room temperature persistent switch resistance, magnet inductance, switch heater resistance and switch current required.

Options available for the Model 20300PS-420 include:
1. Magnetic field fast ramp down ..... Model 601 Energy Absorber
2. Magnet power lead cables ..... Specify length required
3. 420-magnet station cable ..... 19 conductor cable x 25 feet (optional 25 conductor)
4. 420-helium level or temperature cable ..... 4 conductor cable x 6 feet
5. Stabilizing Resistor ..... Needed for systems without a persistent switch

The Model 20300PS-420 has the following specifications:
1. DC output ..... 0 to +300 A; 0 to +20V; 6000 VA
2. Primary power ..... 208 (190-242) VAC, 3 phase, 50-60 Hz
3. Programming ramp rate ..... 0.1 mA/min. - 30 A/sec.
4. Programming accuracy ..... 0.1% of Imax
5. Voltage resolution ..... 10 mV display, 0.02mV internal
6. Current resolution ..... 10 mA display, 0.6 mA internal
7. Current stability (Drift) @ 25 oC ..... < 0.01% of Imax
8. Voltage stability ..... 20 mV P-P a
9. Standard persistent switch heater output ..... 0.1-100 mA DC
10. Current control ..... Up-Pause-Down
11. Computer interface ..... IEEE-488 and RS-232
12. Cooling ..... Forced air cooled
13. Output noise (typical) ..... 60 mV p-p
14. Approximate dimensions: ..... 8.72" H x 19" W x 25" D
15. Load inductance range ..... 0.2 to 150 H
16. Mounting ..... 19" Rack mounted
17. Approximate weight ..... 90 lbs
18. Regulatory ..... CE approved

When paused or at the programmed current limit with inductive load.

Warranty
American Magnetics warranties its products to conform to the specifications described in its quotation for a period of fifteen months from the date of shipment. AMI makes no other warranty of any kind, expressed or implied. In the event of failure occurring during normal use, AMI, at its option, will repair or replace all products or components that fail under warranty and such repair or replacement

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shall constitute a fulfillment of all AMI liabilities with respect to its products. Since, however, AMI does not have control over the installation conditions or the use to which its products are put, no warranty can be made of fitness for a particular purpose, and AMI cannot be liable for special or consequential damages. All repairs are F.O.B. Oak Ridge, Tennessee, USA. If the repairs are covered under this warranty then standard shipping for return to the customer is paid for by AMI within the USA. Before shipping any item to AMI for repair, the customer must first obtain an RMA number from an authorized AMI representative. Do not attempt to repair or replace any items without first speaking to an authorized AMI representative. Doing so may expose the customer to hazards and will void this warranty. Customers requiring a more comprehensive warranty program may purchase additional coverage, the price of which may vary by product type.

Proprietary Information
The information disclosed herein, with the exception of information supplied by the customer, was originated by and is the property of American Magnetics, Inc. This information shall not be disclosed outside the organization to which it is submitted without the written consent of American Magnetics, Inc. or as required by law. If this is a firm fixed price quotation the pricing is valid for no more than 120 days and may be subject to change or withdrawal without notice due to raw material supply variations, etc. American Magnetics, Inc. reserves the right to decline any purchase order placed against this quotation.

System Training
On-site or factory operational training services are available in many cases. We highly recommend our factory system training for inexperienced users. Ask your AMI sales representative for further information about our training services.

Order Cancellation Policy
In the event that a customer desires to cancel an order after it has been accepted by American Magnetics there may be a cancellation charge for services provided prior to the cancellation. This charge may be for work/engineering performed and/or for material commitments already made by AMI for the purposes of fulfilling the order. The amount of the charge may vary and will be at the discretion of AMI. AMI reserves the right not to ship or sell merchandise that has not been completed, due to order cancellation, and reserves the right to retain ownership of all such materials upon order cancellation. In the unlikely event that AMI must cancel an order all money previously received will be refunded unless other arrangements have been agreed to. This will be the extent of AMI's liability and obligation

Ship Date: 90 Days After Receipt of Order
Terms: Net 30 Days
FOB: Oak Ridge, TN

Sincerely,

_____
Steve Short - Technical Sales Rep
AMERICAN MAGNETICS, INC.