Model 648 Bipolar Magnet Power Supply

**Model 648 features**
- Low noise
- CE mark certification
- ±135 A/±75 V, 9.1 kW
- Built-in fault protection
- Bipolar, linear, 4-quadrant output
- 1 mA of programmed current resolution
- Analog programming and IEEE-488 and USB interfaces
Introduction
The Model 648 electromagnet power supply is a robust, fault-tolerant 9 kW supply optimized for powering large 7 or 10 in research electromagnets. It is specifically designed for high precision laboratory use requiring extremely low electrical noise. The linear design removes undesirable higher frequency noise typical of switch mode power supplies. Eliminating the need for external switching or operator intervention to reverse current polarity, the Model 648 uses convenient bipolar, 4-quadrant operation. It is capable of supplying ±135 A/±75 V to a nominal 0.5 Ω, 0.5 H load. The Model 648 is built to last with a rugged design, integrated fault protection, and a simple, clean interior electronic design.

This robust power supply is developed to minimize downtime. It uses worry-free water cooling for quiet efficient operation compared to air-cooled power supplies. The seamless water lines only have external junctions, eliminating internal water leaks. In addition, safety interlocks ensure that cooling water is always flowing to the supply while operating. Magnet water can also be interlocked into the power supply if desired. Internal software controls manage water usage intelligently.

Output architecture
The low electrical noise design of the Model 648 makes it the ideal power supply for use with large electromagnets in high precision laboratory settings, ensuring greater resolution and finer detail in data taken during highly sensitive measurements. Because low noise is critical to measurement systems, the Model 648 implements both a linear design and bipolar architecture. Linear magnet power supplies have several advantages over switch mode power supplies, primarily smooth field generation that is nearly free from offending electromagnetic signatures. The bipolar, 4-quadrant operation required to safely operate an inductive load provides clean transitions through zero without discontinuities.

Output programming
The Model 648 output current is programmed internally via the keypad or the computer interface, externally by analog programming input, or by the sum of the external and internal settings. External programming via analog input signal provides analog resolution. The Model 648 generates extremely smooth and continuous ramps — the digitally generated constant current ramp rate is variable between 0.1 mA/s and 50.000 A/s. To ensure a smooth ramp rate, the power supply updates the high-resolution DAC 12.3 times per second.

Output reading
The Model 648 provides high-resolution output current readings that reflect the actual current in the magnet, and have a resolution of 1 mA. The output voltage reading reports the voltage at the output terminals with a resolution of 1 mV. All output readings can be prominently displayed on the front panel and read over the computer interface.

Protection
The Model 648 provides built-in protection against short circuit, open circuit, line loss, low line voltage, high line voltage, output over voltage, output over current, over temperature, and abrupt change of the external programming input. A proprietary circuit limits the power dissipated in the water-cooled cold plate should low resistance and high line conditions exist. The Model 648 protects itself if operated into resistances outside of nominal limits. By limiting current output, it will safely operate into a shorted load, and operate safely into high resistance loads by limiting voltage output. The Model 648 is also protected against power loss under full operation and nominal magnet load. Both low and high power line conditions are reported on the front panel display.
Introduction

Field Control and Power

Connector:

Limits:

Attenuation:

resistive load, <0.02% THD; ≤10 Hz at ±10 A sine wave into nominal load

Settling time:

load
to chassis to prevent ground loops

Stability (1 h):

Line regulation:

Temperature coefficient:

frequency and its harmonics

Isolation:

Differential output is optically isolated from internal water temperature

Current ripple frequency:

10 mA RMS (0.007%) at 135 A into minimum load resistance

Minimum load resistance:

0.5 Ω, 0.5 H

Nominal load:

9.1 kW nominal

Current range:

Resolution:

Output programming

Internal current setting

Resolution: 1.0 mA (20-bit)

Settling time: 600 ms for 1% step to within 1 mA of output into nominal load

Harmonic distortion: <0.1 Hz at ±135 A sine wave into resistive load, <0.02% THD; <10 Hz at ±10 A sine wave into resistive load, <0.30% THD

Attenuation: -0.5 dB at 10 Hz (external programming input)

Protection: Short circuit, line loss, low line voltage, high line voltage, output over voltage, output over current, and temperature

connector: Two lugs with 8.64 mm (0.34 in) holes for M8 screws into +10% to -5% line voltage

Maximum load resistance:

0.5 Ω, 0.5 H

Nominal load:

9.1 kW nominal

Current range:

Resolution:

Output programming

Internal current setting

Resolution: 1.0 mA (20-bit)

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connector: Two lugs with 8.64 mm (0.34 in) holes for M8 screws

Output current

Resolution: 1.0 mA

Accuracy: ±20 mA ±0.05% of rdg

Update rate: 2.5 rdg/s display, 10 rdg/s interface

Output voltage (at supply terminals)

Resolution: 1.0 mV

Accuracy: ±10 mV ±0.05% of rdg

Update rate: 2.5 rdg/s display, 5 rdg/s interface

Front panel

Display type: 8-line by 40-character graphic vacuum fluorescent display module

Display readings: Output current and ramp rate

Display annunciators: Status and errors

LED annunciators: Fault, Compliance, Power Limit, Ramp, Remote

Audible annunciator: Errors and faults

Keypad type: 20 full-travel keys

Keypad functions: Direct access to common operations, menu-driven setup

Power: Green flush ON and red extended OFF push buttons

Interface

IEEE-488.2 interface

Features:

SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT0, C0, E1

Reading rate:

To 10 rdg/s

Software support: National Instruments LabVIEW™ driver

USB interface

Function:

Emulates a standard RS-232 serial port

Baud rate:

57,600

Reading rate:

To 10 rdg/s

Connector: Type B USB connector

Software support:

National Instruments LabVIEW™ driver

(consult Lake Shore for availability)

Output current monitor

Sensitivity: 7 V/135 A

Accuracy: ±1.5% of full scale

Noise: 5 mV RMS

Source impedance: 20 Ω

Connector: Shared 15-pin sub

Output voltage monitor

Sensitivity: 7 V/0 V

Accuracy: ±1% of full scale

Noise: 2 mV RMS

Source impedance: 20 Ω

Connector: Shared 15-pin sub

Power supply cooling water

Remote enable input: TTL low or contact closure to enable output; jumper required if used

Valve power output:

24 VAC at 1.5 A maximum, automatic or manual control

Magnet cooling water

Remote enable input: TTL low or contact closure to enable output; jumper required if used

Valve power output: 24 VAC at 1.5 A maximum, automatic or manual control

Ordering information

Part number

Description

648

Model 648—specify 200 VAC, 208 VAC, 220 VAC, 230 VAC, 380 VAC, 400 VAC, or 415 VAC

All specifications are subject to change without notice