

## MT Series: 100 kW to 2000 kW+



MT Series 100 kW and 150 kW Module



MT Series 250 kW Module

Product Name:	MT Series
Number of Models:	65
Power Levels:	100 kW to 2000 kW+
Voltage Range:	Models from 0-16 Vdc to 0-4000 Vdc
Current Range:	Models from 0-24 Adc to 0-24000 Adc
Enclosure	Floor Standing Cabinet

### Overview

Magna-Power Electronics MT Series uses the same reliable current-fed power processing technology and controls as the rest of the programmable DC power supply product line, but with larger high-power modules: individual 100 kW, 150 kW and 250 kW power supplies. As an added safety measure, all MT Series units include an input AC breaker rated for full power. The independent IGBT-based MT Series units are among the largest standard switch-mode power supplies on the market, minimizing the number of switching components when comparing to smaller module sizes. Scaling in the multi-megawatts is accomplished using the UID47 device, which provides master/slave control: one power supply takes command over the remaining units, for true system operation.

250 kW modules come standard with an embedded 12-pulse harmonic neutralizer, ensuring low total harmonic distortion (THD). Even higher quality AC waveforms are available with an external additional 500 kW 24-pulse or 1000 kW 48-pulse harmonic neutralizers, designed and manufactured exclusively for Magna-Power Electronics products (Page 29).

All MT Series power supplies come standard with isolated 37-pin external I/O, RS232, Remote Interface Software, IVI drivers for integration into a variety of programming environment Three front panel types are available (Page 22) for maximum application flexibility. The A Version provides front panel control and calibration, start and stop buttons, and a digital display for voltage and current. The D Version front panel adds a 10-key digital front panel entry, memory sequencing, and modulation capabilities for non-linear output profile emulation.

### Available Options and Accessories

- Harmonic Neutralizer
- High Isolation Output (+ISO)
- High Slew Rate Output (+HS)
- IEEE-488 GPIB Interface (+GPIB)
- LXI TCP/IP Ethernet Interface (+LXI)
- Photovoltaic Power Profile Emulation (PPPE)
- RS-485 Converter (RS485)
- UID47: Universal Interface Device (UID)
- USB Edgeport Converter (USB)

# Innovative High-Power Switch-Mode Technology

## MT Series Specifications

### Input Specifications

<b>Nominal Voltage</b> 3 phase, 3 wire + ground	380 Vac, 3 $\Phi$ (operating range 342 - 440 Vac) 415 Vac, 3 $\Phi$ (operating range 373 - 456 Vac) 440 Vac, 3 $\Phi$ (operating range 396 - 484 Vac) 480 Vac, 3 $\Phi$ (operating range 432 - 528 Vac)
<b>Frequency</b>	50 Hz (operating range 45 - 55 Hz) 60 Hz (operating range 54 - 66 Hz)
<b>Power Factor</b>	> 92% at maximum power: 100 kW and 150 kW modules > 96% at maximum power: 250 kW modules

### Output Specifications

<b>Ripple</b>	(See Models Chart)
<b>Line Regulation</b>	Voltage Mode: $\pm 0.004\%$ of full scale Current Mode: $\pm 0.02\%$ of full scale
<b>Load Regulation</b>	Voltage Mode: $\pm 0.01\%$ of full scale Current Mode: $\pm 0.04\%$ of full scale
<b>Load Transient Response</b>	2 ms to recover within $\pm 1\%$ of full scale output, with a 50% to 100% or 100% to 50% step load change
<b>Efficiency</b>	$\geq 90\%$ at full load (See Model Charts)
<b>Stability</b>	$\pm 0.10\%$ for 8 hrs. after 30 min. warmup
<b>Isolation</b>	User inputs and outputs: referenced to earth ground  Maximum input voltage to ground: $\pm 2500$ Vac  Maximum output voltage to ground: $\pm 1000$ Vdc for models less than or equal to 1000 Vdc $\pm 4000$ Vdc for models greater than 1000 Vdc
<b>Maximum Slew Rate</b>	Standard Models: 100 ms for output voltage change from 0 to 63% 100 ms for output current change from 0 to 63%  With High Slew Rate Option (+HS): 4 ms for output voltage change from 0 to 63% 8 ms for output current change from 0 to 63%
<b>Bandwidth</b>	Standard Models: 3 Hz for remote analog voltage programming 2 Hz for remote analog current programming  With High Slew Rate Option (+HS): 60 Hz for remote analog voltage programming 45 Hz for remote analog current programming

**Note:** Specifications are subject to change without notice. For three-phase configurations, input specifications are line-to-line. Unless otherwise noted, input voltages and currents are specified for three-phase configurations.

### Physical Specifications

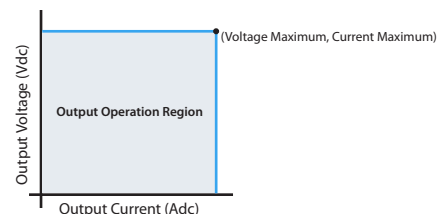
Power	Size (H" x W" x D")	Weight
100 kW	62.5 x 48 x 31.5 in (158.8 x 121.9 x 80.0 cm)	1600 lbs (725.8 kg)
150 kW	62.5 x 48 x 31.5 in (158.8 x 121.9 x 80.0 cm)	2100 lbs (952.5 kg)
250 kW	62.5 x 72 x 31.5 in (158.8 x 182.9 x 80.0 cm)	3300 lbs (1496.9 kg)
500 kW	62.5 x 144 x 31.5 in (158.8 x 365.8 x 80.0 cm)	6600 lbs (2993.7 kg)
750 kW	62.5 x 216 x 31.5 in (158.8 x 548.7 x 80.0 cm)	9900 lbs (4490.6 kg)
1000 kW	62.5 x 288 x 31.5 in (158.8 x 731.6 x 80.0 cm)	13200 lbs (5987.4 kg)

### Control Specifications

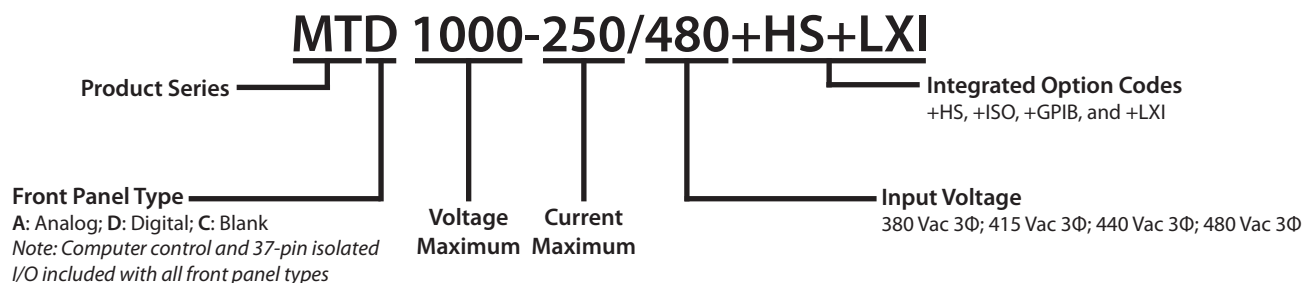
<b>Voltage Programming Accuracy</b>	$\pm 0.075\%$ of full scale voltage
<b>OVT Programming Accuracy</b>	$\pm 0.075\%$ of full scale voltage
<b>Current Programming Accuracy</b>	$\pm 0.075\%$ of full scale current
<b>OCT Programming Accuracy</b>	$\pm 0.075\%$ of full scale current
<b>Voltage Readback Accuracy</b>	$\pm 0.2\%$ of full scale voltage
<b>Current Readback Accuracy</b>	$\pm 0.2\%$ of full scale current
<b>External Analog Programming and Monitoring Levels</b>	0 - 10 Vdc
<b>External Analog Output Impedances</b>	Voltage output monitoring: 100 $\Omega$ Current output monitoring: 100 $\Omega$ +10 Vdc reference: 1 $\Omega$
<b>External Digital Programming and Monitoring Limits</b>	Input: 0 to 5 Vdc, 10k input impedance Output: 0 to 5 Vdc, 5 mA drive capacity
<b>Remote Sense Limits</b>	3% maximum voltage drop from output to load
<b>Period Programming Limits</b>	Minimum period: 10 ms Maximum period: 9997 sec

### Environmental Specifications

<b>Ambient Operating Temperature</b>	0 $^{\circ}$ C to 50 $^{\circ}$ C
<b>Storage Temperature</b>	-25 $^{\circ}$ C to 85 $^{\circ}$ C
<b>Humidity</b>	Relative humidity up to 95% non-condensing
<b>Temperature Coefficient</b>	0.04 % / $^{\circ}$ C of maximum output voltage 0.06 % / $^{\circ}$ C of maximum output current
<b>Air Flow</b>	Front and rear intake, top exhaust



# MT Series Models



## Models Chart

The following chart details the available standard MT Series models. The Current Maximum (A<sub>dc</sub>) column is separated by the available power levels. To determine the appropriate model, first select your output Voltage Maximum (V<sub>dc</sub>) to find appropriate row. Next, select one desired current maximum from the row that contains your desired voltage maximum. Non-standard voltage and current configurations are available. Configurations above 1000 kW are also available. Please contact your local sales partner for more information.

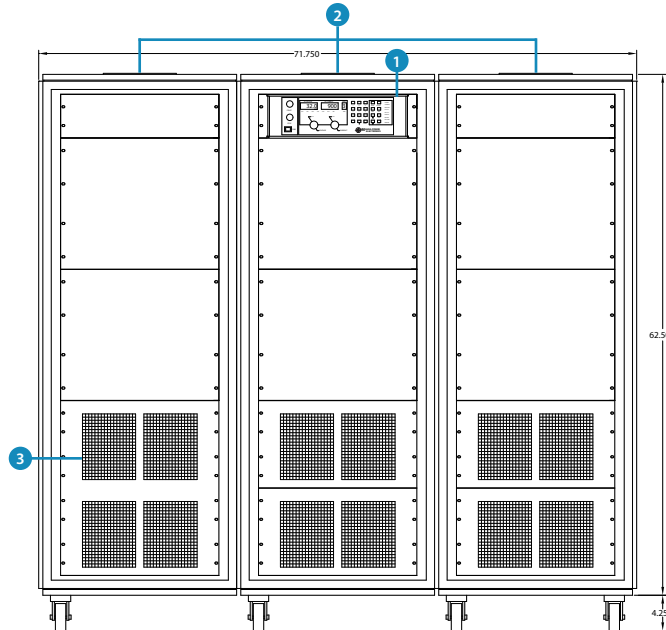
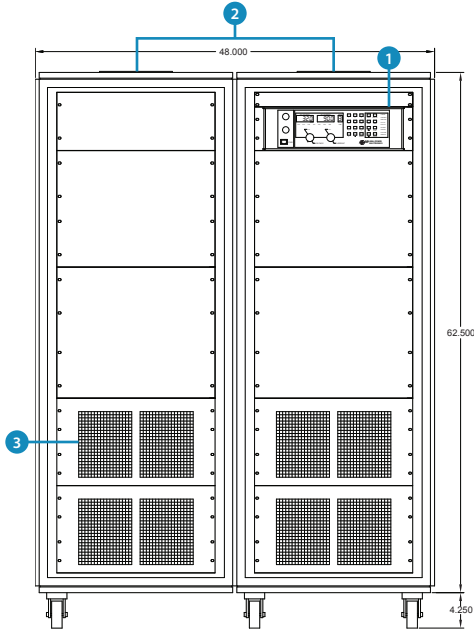
Voltage Maximum (V <sub>dc</sub> )	100 kW	150 kW	250 kW	500 kW*	750 kW*	1000 kW*	Ripple (mV <sub>rms</sub> )	Efficiency (%)	
	Current Maximum (A <sub>dc</sub> )								
16	6000	N/A	N/A	N/A	N/A	N/A	35	90	
20	5000	N/A	N/A	N/A	N/A	N/A	40	90	
25	N/A	6000	N/A	N/A	N/A	N/A	40	90	
32	3000	4500	N/A	N/A	N/A	N/A	40	90	
40	2500	3750	6000	12000	18000	24000	40	91	
50	2000	3000	5000	10000	15000	20000	50	91	
60	1660	2500	4160	8320	12480	16640	60	91	
80	1250	1850	3000	6000	9000	12000	60	91	
100	1000	1500	2500	5000	7500	10000	60	91	
125	800	1200	2000	4000	6000	8000	100	91	
160	620	900	1500	3000	4500	6000	120	91	
200	500	750	1250	2500	3750	5000	125	91	
250	400	600	1000	2000	3000	4000	130	92	
300	333	500	833	1666	2499	3332	160	92	
375	270	400	660	1320	1980	2640	170	92	
400	250	375	625	1250	1875	2500	180	92	
500	200	300	500	1000	1500	2000	220	92	
600	160	240	400	800	1200	1600	250	92	
800	120	180	300	600	900	1200	300	92	
1000	100	150	250	500	750	1000	400	92	
1250	80	120	200	400	600	800	500	92	
1600	62	90	150	300	450	600	600	92	
2000	50	75	125	250	375	500	800	92	
2500	40	60	100	200	300	400	900	92	
3000	32	48	80	160	240	320	1000	92	
4000	24	36	60	120	180	240	1100	92	
	Input Current Per Phase (A <sub>ac</sub> )								
380/415 Vac, 3Φ	191	287	478	956	1434	1912			
440/480 Vac, 3Φ	165	248	413	826	1239	1652			

Note: Power levels marked with an asterisk (\*) and above 1000 kW are achieved by master/slave paralleling 250 kW modules. Ripple specified for standard models. For models with the High Slew Rate Output Option (+HS), refer to the table on the option page.

# MT Series VI Models

Front View\* (100 kW and 150 kW)

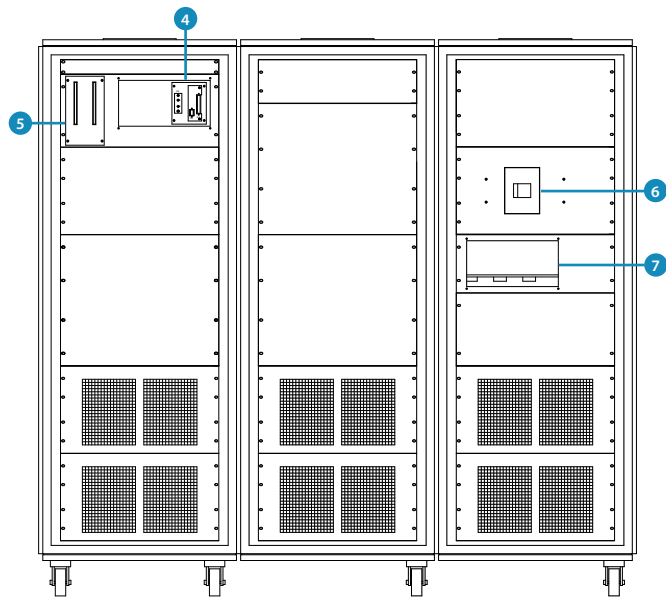
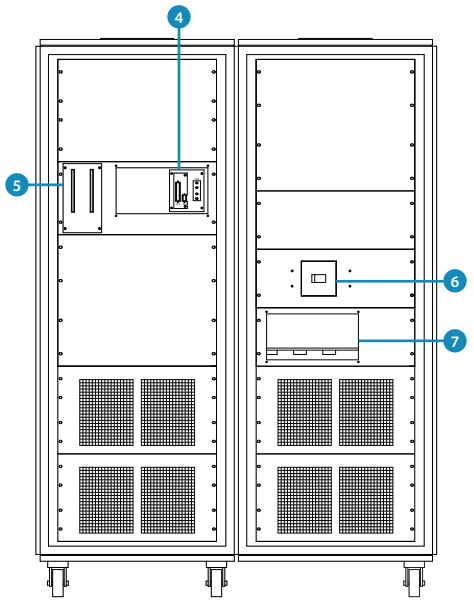
Front View (250 kW)



- 1 Front Panel Controller
- 2 Air Exhaust Fans
- 3 Air Intake
- 4 Connections for External Control
- 5 DC Output Bus (See Details Below)
- 6 Input AC Breaker
- 7 Input AC Power Entry Qty (4) 3/8-16 1.5" Studs

Rear View (100 kW and 150 kW)

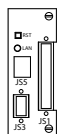
Rear View (250 kW)



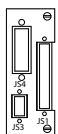
\* Note: 150 kW model pictured in diagram. 100 kW models will have the front panel on the left side.

## External Controls and DC Output Bus Connections

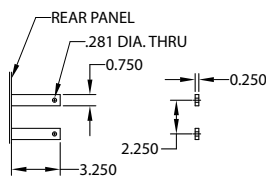
Optional (+LXI) Interface



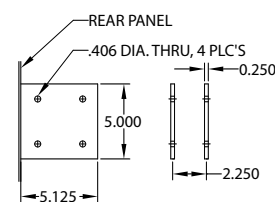
Optional (+GPIB) Interface



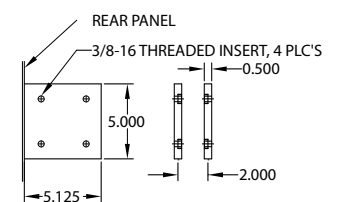
High Voltage Output Bus: Models 1250 Vdc+



Medium Voltage Output Bus: Models 80 Vdc to 1000 Vdc



Low Voltage Output Bus: Models 50 Vdc and below

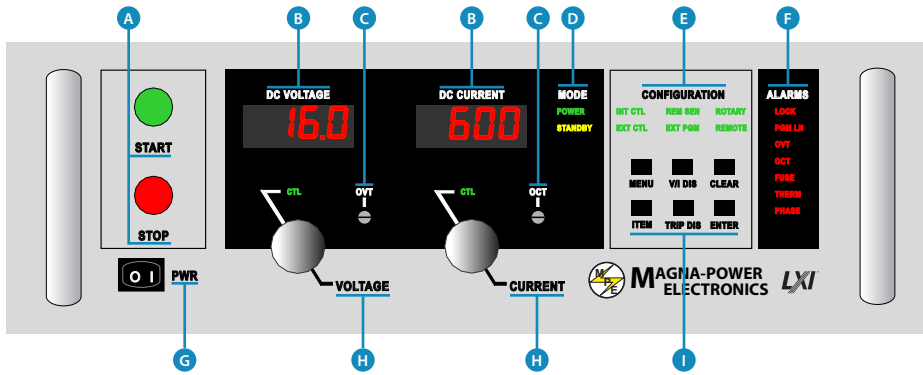


# Front Panel Types (TS/MS/MT Series)

This section details the various front panel types available for the TS Series, MS Series, and MT Series power supplies. For the XR Series front panels, refer to its diagram page.

## A Version Front Panel

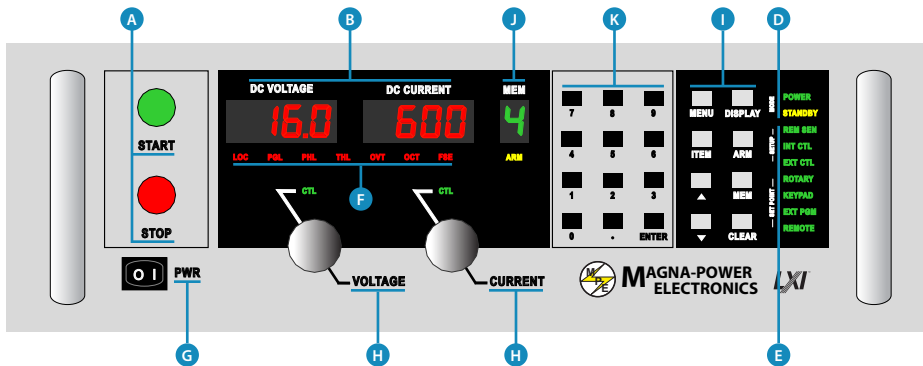
The A Version front panel provides a digital display with rotary front panel input, isolated 37-pin analog/digital I/O, and a RS232 computer interface.



- A** Engages and disengages main power
- B** Meters display output voltage, output current, voltage set point, current set point, over voltage trip, and over current trip
- C** Over voltage trip and over current trip setting potentiometers
- D** MODE  
POWER: Indicates power output  
STANDBY: Indicates control power only
- E** CONFIGURATION  
REM SEN: Remote sense enabled  
INT CTL: Front panel start/stop/clear enabled  
EXT CTL: External start/stop/clear enabled  
ROTARY: Front panel control  
KEYPAD: 10-digit numeric keypad control  
EXT PGM: External voltage/current control  
REMOTE: Computer control
- F** DIAGNOSTIC ALARMS  
LOCK: Interlock  
PGM LN: External input voltage beyond limits  
OVT: Over-voltage protection has tripped  
OCT: Over-current protection has tripped  
THERM: Indicates over-temperature condition  
PHASE: Indicates under-voltage AC input  
FSE: Warns that a fuse has cleared  
ARM: Indicates power supply is ready for or operating in auto-sequencing

## D Version Front Panel

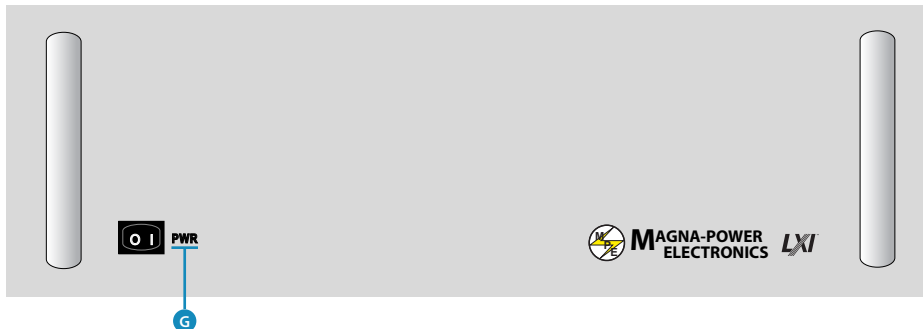
In addition to the features of the A Version front panel, the D Version front panel provides digital 10-key entry, auto-sequencing with memory capability, and modulation for non-linear power profile emulation.



- G** Power switch energizes control circuits without engaging main power
- H** Stepless rotary knob to set voltage/current
- I** FUNCTION KEYS  
MENU: Selects function  
ITEM: Selects item within function  
V/I DIS: Displays voltage/current settings  
TRIP DIS: Displays OVT and OCT settings  
CLEAR: Clears setting or resets fault  
ENTER: Selects item  
MEM: Sets the memory location
- J** Memory location indicator, used for auto-sequencing applications
- K** Digital input keypad

## C Version Front Panel

The C Version front panel is blank, providing on a switch to enable control power. All control must be performed by the provided isolated 37-pin analog/digital I/O or through a computer interface.



## Low Voltage High Current Units

Magna-Power Electronics offers a range of standard low voltage high current units based on TS Series IV and MS Series IV that do not fit in these series' standard power envelopes. All of the product options are available for these models.

Model	Voltage Maximum (Vdc)	Current Maximum (Adc)	Power (kW)	Ripple (mVrms)	Efficiency (%)	Size	Input Current (Aac)		
							208/240 Vac	380/415 Vac	440/480 Vac
TS5-1800	5	1800	9.0	50	86	6U	38	22	18
TS8-1200	8	1200	9.6	40	86	6U	38	22	18
TS5-2700	5	2700	13.5	50	86	9U	57	33	27
TSA10-1800	10	1800	18.0	40	86	6U	72	42	36
TSA10-2700	10	2700	27.0	40	86	9U	108	63	48
MS5-2700	5	2700	13.5	50	86	18U Cabinet	57	30	27
MS5-3600	5	3600	18.0	50	86	18U Cabinet	76	40	36
MS5-4500	5	4500	22.5	50	86	30U Cabinet	95	50	45
MS10-2700	10	2700	27.0	40	86	18U Cabinet	108	62	54
MS10-3600	10	3600	36.0	40	86	18U Cabinet	144	84	72
MS10-4500	10	4500	45.0	40	86	30U Cabinet	180	106	90

# Product Options

## Performance and Packaging Options

Magna-Power Electronics programmable DC power supplies are designed to be as versatile and expandable as possible. A variety of options are available allowing the product to deviate from its standard specifications. This section provides an overview of the available performance and packaging options and products supported.

### Cabinet and Integration

Option Code:	CAB1, CAB2, CAB3, CAB4, CAB3x2, CAB4x2
Products Supported:	SL Series, XR Series, TS Series

Cabinet and integration services are offered for the rack-mount programmable DC power supply products. Cabinets are supplied with fans rated to installed products. Key features of the cabinet and integration option are as follows:

- Hoffman® cabinet frames
- Casters installed, including (2) locking casters
- Special circuitry for product integration with cabinet fans
- Installation and testing as a complete system

#### Cabinet and Integration Specifications

Cabinet Name	Dimensions (H" x W" x D")	Rack Units
CAB1	32" x 24" x 31.5"	12U
CAB2	51.5" x 24" x 31.5"	24U
CAB3	67" x 24" x 31.5"	30U
CAB4	75" x 24" x 31.5"	36U
CAB3x2	67" x 48" x 31.5"	60U
CAB4x2	75" x 48" x 31.5"	72U

### High Slew Rate Output

Option Code:	+HS
Products Supported:	SL Series, XR Series, TS Series, MS Series, MT Series

The high slew rate option solves several limitations inherent in switching power supply design. Rapid voltage transitions require internal electronics to supply the energy to charge and discharge output capacitors. Peak currents internal to the power supply define slew rate; utilizing less capacitance enables voltage transitions in shorter time periods. Additionally, less capacitance reduces requirements for discharge demands during open circuit conditions.

The standard output stage Magna-Power Electronics power supplies has been designed to provide the lowest possible output ripple voltage within the constraints of available components, size, and cost. Part of the output stage consists of a bank of aluminum electrolytic capacitors which has the desired electrical properties to provide this function. These components require bleed resistors to discharge any voltage when the power supply has no load and is disabled. While the presence of these components and the resulting performance are normally industry accepted, there are applications where lower output capacitance is extremely desirable and higher ripple voltage is acceptable. To meet this need, a high-slew rate option is available which has an output stage consisting of low capacitance film and aluminum electrolytic capacitors. Applications for the high-slew rate option include battery charging, photovoltaic emulation, power waveform generation, and medium speed power pulsing. These applications all benefit from higher bandwidth and in many cases, can tolerate the increased ripple voltage of this option.

#### Slew Rate Specifications

	Slew rate standard	Slew rate with +HS option
Voltage	100 ms	4 ms
Current	100 ms	8 ms

### High Isolation Output

Option Code:	+ISO
Products Supported:	TS Series, MS Series, MT Series

Certain applications require floating the output voltage to values beyond the power supply's standard isolation rating. Magna-Power Electronics High Isolation Output option (+ISO) enables any TS Series, MS Series, or MT Series model with a peak output voltage rating of 250 Vdc through 1000 Vdc to be rated for a higher voltage output isolation. Improved isolation is achieved by a novel output stage with improved controller isolation. In addition to being able to float the power supply to a higher output voltage, this option also enables lower voltage units to connected series up to the higher isolation rating.

The table below provides the output isolation rating for all available configurations, where  $V_o$  is the unit's rated maximum output voltage.

Output Isolation Specifications			
Product	Isolation, models 1000 Vdc and below	Isolation, models 1000 Vdc and below with +ISO option	Isolation, model above 1000 Vdc
SL Series	1000 Vdc	N/A	N/A
XR Series	1000 Vdc	N/A	N/A
TS Series	1000 Vdc	$\pm (2000 \text{ Vdc} + V_o/2)$	$\pm (2000 \text{ Vdc} + V_o/2)$
MS Series	1000 Vdc	$\pm (2000 \text{ Vdc} + V_o/2)$	$\pm (2000 \text{ Vdc} + V_o/2)$
MT Series	1000 Vdc	4000 Vdc	4000 Vdc

## UID47: Universal Interface Device

Option Code:	UID47
Products Supported:	SL Series, XR Series, TS Series, MS Series, MT Series

Magna-Power Electronics UID47 is a general purpose device for connection to Magna-Power Electronics' power supplies. The device contains the necessary circuitry for configuring power supplies for master/slave parallel or series operation.

Master/slave parallel operation allows two or more power supplies to equally share output current when connected together. Master/slave series operation allows two or more power supplies to equally share output voltage when connected together. In either operation mode, the master unit will command the slave units to the proper voltage and current. Each unit will display its own individual voltage and current. Installation requires setting jumpers, placing included 37-conductor cables between the UID47 and power supplies, and wiring the power supply outputs in either parallel or series.

The UID47 can be used as an interface for connecting control and monitoring lines to external circuitry. It also contains an area on the printed circuit board for interconnecting wires and placing components for specific user applications.

Key features of the UID47 option are as follows:

- Compatible with all Magna-Power Electronics power supplies
- Interface for series and parallel master/slave operation
- User configurable screw terminal connector
- Pad area for custom circuitry
- (2) 6-foot 37-pin cables included



## Water Cooling

Option Code:	+WC
Products Supported:	TS Series, MS Series

Water cooling is available for Magna-Power Electronics TS Series and MS Series power supplies typically for use in corrosive environments, such as electroplating applications or in densely packaged system cabinets, where heat removal by air cooling presents a problem.

Water cooling is accomplished with chill plates and an integrated central heat exchanger. The chill plates provides a thermal conduction path for heat sensitive components and the central heat exchanger removes heat from air internal to the enclosure. Water cooled TS Series models have enclosures without vent holes and are basically sealed the unit from the environment. An internal solenoid valve enables water flow when the chill plate reaches 60 degrees celcius. Operation of the solenoid prevents internal condensation.

	Water Cooling Specifications		
	5 kW - 15 kW Models	20 kW to 30 kW Models	45 kW to 75 kW Models
Inlet Coolant Temperature	25°C	25°C max	25°C max
Flow Rate (Min)	1.5 GPM	3.0 GPM	4.5 GPM
Pressure (Max)	80 psi	80 psi	80 psi
Inlet/Outlet Pipe Size	1/4" NPT male	1/2" NPT male	1/2" NPT male

Each 15 kW module has a 1/4" NPT female inlet and outlet for water flow. For models greater than 15 kW, external plumbing interconnects power supply modules. A minimum of 2.50" is recommended behind the enclosure for this hardware and user connections. For systems requiring more than one power supply, plumbing connections must be paralleled; that is, water should not flow from one power supply into another.



# Product Options

## Communication Interface Options

All Magna-Power Electronics programmable DC power supplies come standard with RS232 serial interface and 37-pin isolated analog/digital I/O. Additional available interface options are available, as detailed in this section.

### IEEE-488 GPIB

Option Code:	+GPIB
Products Supported:	SL Series, XR Series, TS Series, MS Series, MT Series

The IEEE-488 interface, sometimes called the General Purpose Interface Bus (GPIB), is a general purpose digital interface system that can be used to transfer data between two or more devices. It is particularly well-suited for interconnecting computers and instruments. Some of its key features are:

- Up to 15 devices may be connected to one bus
- Total bus length may be up to 20 m and the distance between devices may be up to 2 m
- Communication is digital (as opposed to analog) and messages are sent one byte (8 bits) at a time
- Message transactions are hardware handshaked
- Data rates may be up to 1 Mbyte/sec

### LXI TCP/IP Ethernet

Option Code:	+LXI
Products Supported:	SL Series, XR Series, TS Series, MS Series, MT Series

Certified to the LXI Standard (Class C), the TCP/IP Ethernet option includes an embedded web-server, allowing web browser power supply control and monitoring from virtually anywhere. LXI is an instrumentation platform based on industry standard Ethernet technology designed to provide modularity, flexibility, and performance to small- and medium-sized systems.

LXI's advantages are exemplified in its compact, flexible package providing high-speed I/O and reliable measurements. The Magna-Power Electronics LXI TCP/IP Ethernet option includes an embedded web-server, allowing web browser power supply control and monitoring from virtually anywhere.

### USB Edgeport (Adapter)

Option Code:	USB
Products Supported:	SL Series, XR Series, TS Series, MS Series, MT Series

Edgeport USB-to-serial converters offer instant I/O expansion for peripheral device connectivity. An out-of-the-box (external) alternative to PCI cards, Edgeport makes it easy to add serial port to a PC, server or thin client in minutes without opening the chassis, reconfiguring or rebooting the system.

The USB Edgeport device plugs directly into the back of the power supply, creating a seamless USB interface. Feature-rich design, reliability and unmatched operating system support make Edgeport USB-to-serial converters ideal for mission-critical enterprise applications. USB cable included along with associated drivers on the Magna-Power Electronics software CD.

### RS-485 (Adapter)

Option Code:	RS485
Products Supported:	SL Series, XR Series, TS Series, MS Series, MT Series

The RS-485 allows non-addressable, “dumb” RS-232 devices to be connected on an addressable RS-485 network. The master node controls all communications to connected devices. By distributing the switching intelligence along the RS-485 network, wiring cost savings are substantial compared to a single switched “star” configuration.

Devices can either be polled by the master node or request access to the bus through a RS-232 handshake line. This provides a versatile system for interconnecting devices that are designed for point to point communications. Because the units communicate using standard RS-485 signals, RS-232 devices can form their own network or be added to an existing system. Up to 32 nodes at up to 4000 feet can be on one bus without a repeater, and the 485DSS's addressing scheme allows up to 256 units on a single network with repeaters.