



LABORATORY POWER SUPPLIES



P O W E R S U P P L I E S A R O U N D T H E W O R L D

The power supply business has evolved dramatically throughout the 28 years that Powerbox has been in business. Today the majority of power converters are of switch mode design and the difference between an AC/DC and DC/DC converter could be just a few components. Input ranges can be exceptionally wide, 25 to 265 Volts AC or DC depending on model and series. Powerbox has a wide range of power conversion products for virtually all applications. Because there is such an over-lap of power supplies across applications Powerbox has broken with tradition in devising product groups based on mechanical layout. Our product groups comprise Components, Modules, Externals, Open Frame and Enclosed, Cassettes, Laboratory, UPS, Enclosures, and Procurement. Each category includes both AC/DC and DC/DC converters.

Powerbox laboratory power supplies

The Powerbox range of laboratory power supplies detailed in this brochure covers products from 60W to 12kW with single, dual, triple, and quad output voltages ranging from 0 to 600VDC. The lower power units generally use linear technology with switch mode technology being used from 300W onwards. High power units feature "soft" switching for high efficiency and low ripple/noise. All the power supplies are equipped with large easy-to-read digital panel meters and have settings for both voltage and current.

Applications

Powerbox laboratory power supplies are the perfect choice for testing, production and development environments. In the lower power range, the units are designed for both system and bench top applications and they are all designed to be as compact as possible. Many of them can be stacked to save valuable bench top space.

Programmability

Most of our power supplies are programmable, using analogue voltage, GPIB or RS232 interfaces. Please turn to the end of this brochure for further information on all programmable functions.

Reliability

Long term performance and excellent reliability is important in the design of Powerbox laboratory power supplies. With protective circuitry incorporating designs based upon field experience and diverse application history these power supplies are suitable for most applications.

All specifications in this brochure are typical and subject to be changed without notice.

A standard power supply or custom design power solution?

When choosing a power supply you need to establish if a standard unit can be used, but if not we can often make minor modifications. We can also offer a full custom design when required. Below are some helpful hints and guidelines on how to select the most ideal solution.

Standard

The standard products are very often of proven design and are usually available of-the-shelf. The advantage of a standard power supply is standardized mechanical package, proven reliability and that a second source is frequently available, and you can avoid the cost of development and engineering time. Moreover, it is almost always necessary to arrange for re-approval of a modified unit.

Custom Design

If your requirements cannot be met by the use of a standard product, we can work with your engineers to specify and produce a custom design precisely matched to your application's demands. This gives you all the features of a custom design which usually include, but are not restricted to, mechanical dimensions, form factor, thermal design, the number of outputs, power voltage and current requirement, technical performance, and agency approvals related to quality and safety.

For medium or large volume requirements, engineering costs may not add greatly to the cost of the product, but this is something which may need careful consideration where costs are absorbed over shorter production requirements.

Quick Reference Guide



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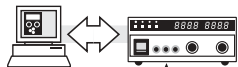


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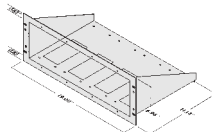
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PB3100 Series

65W AC/DC LINEAR TRIPLE OUTPUT

Features

- 105°C Capacitors
- $\pm 0.05\%$ line and load regulation
- International safety standards
- Floating outputs
- Low output ripple



Specifications

INPUT

Voltage	115V, 230V -10% to +10%.
Frequency	47-63Hz.
Protection	Fuse in power inlet.
Safety isolation	2000VAC rms for 1 minute 500VAC rms, output to ground according to EN 60950, IEC 1010.

OUTPUT

Power	Up to 65W.
Line regulation	Output 1, 2 and 3: +0.05%.
Load regulation	Output 1, 2 and 3: 35mV for 0% to 100% load change.
Transient response	250ms, 0,2V overshoot (10% to 100% step at 0.1A/m).
Ripple	Output 1, 2 and 3: 3mV p-p (at 50% load).
Drift (8h)	Output 1, 2 and 3: 0.05% after 30 minutes warm up time.
Overload protection	Yes, constant current.
Temperature coefficient	Output 1, 2 and 3: 0.02%/°C.
Parallel operation	Yes.
Series operation	Yes, total voltage must not exceed 150V.

ENVIRONMENTAL

Operating temperature	-20°C to +40°C ambient.
Storage temperature	-40°C to +85°C.
Cooling	Convection.

GENERAL

Meters	Four meters, green LED type, 3 digits.
Indicators	LED for constant voltage and constant current mode. Voltage range, over range, over temperature indication.
Dimensions	185 x 132 x 280mm (HxWxD)
Weight	6.5kg

STANDARDS

Safety standard	EN61010-1:1993.
EMC standard	EN50081-1: 1992, EN50082-1: 1992.
CE mark	Yes.

OUTPUT 1	OUTPUT 2	OUTPUT 3
0-20V, 0-2.5A or 0-40V, 0-1.25A	0-20V, 0-2.5A or 0-40V, 0-1.25A	0-7V, 4A

3000/6000 Series

90 - 200 W AC / DC LINEAR SINGLE AND TRIPLE OUTPUT

Features

- Constant voltage/current
- Floating outputs
- Series/parallel available
- Master/Slave selectable
- Linear technology
- Low ripple
- Additional 5V/5A fixed output



Specifications

INPUT		5V FIX OUTPUT (6000 Series)	
Voltage	230 VAC, 50Hz.	Load regulation	<10mV.
OUTPUT		Line regulation	<5mV.
Constant voltage (CV)	Load regulation: $\pm 0.01\% + 2\text{mV}$. Line regulation: $\pm 0.01\% + 2\text{mV}$.	Ripple & noise	<2mVrms.
CV ripple and noise	3000 Series: <1mVrms. 6000 Series: <1mVrms.	Voltage accuracy	5V $\pm 0.25\text{V}$.
Constant current (CC)	Load regulation: 3000 Series: <10mA. 6000 Series: <15mA. Line regulation: $\pm 0.01\% + 2\text{mV}$.	Output current	5A.
CC ripple and noise	3000 Series: <3mArms. 6000 Series: <3mArms.	GENERAL	
Rise time(no load)	<100mS.	Digital display	<0.2% + 2 Dig.
Rise time (load)	<200mS (<6A), <500mS (<10A), <1S (>10A).	Series connection	Different models can be connected in series (<240V).
Fall time (no load)	<2.5S.	Parallel connection	Same model can be connected in parallel (<24A).
Fall time (load)	3000 Series: <250mS. 6000 Series: >250mS.	Master - slave	Yes (for single-set operation). N/A (for multi-set connection).
Output impedance	<2mW + 2uH.	Independent operation mode	Two independent outputs and 5V fixed output. Output from 0 to rating volts and 0 to rating amperes (6000 series).
Recovery time	<100uS to within 0.1% of set voltage (50% to 100% load change).	Series operation mode	Output from 0 to \pm rating volts and rating amperes. Output from 0 to double rating volts at rating amperes (6000 series).
TRACKING OPERATION		Parallel operation mode	Output from 0 to double rating amperes at rating volts (6000 series).
Tracking error	$\pm 0.2\% + 10\text{mV}$ (6000 series).	STANDARDS	
Series regulation	<0.3% + 10mV (6000 series).	Safety standard	IEC-1010-1.
		CE mark	Yes.

MODEL NUMBER	OUTPUT 1	OUTPUT 2	OUTPUT 3	DIMENSIONS (LxWxH)	WEIGHT (kg)
3303DS	0-30V/3A			290 x 120 x 160 mm	5,2
3601DS	0-60V/1A			290 x 120 x 160 mm	5,2
6303DS	5V/5A fix	0-30V/3A	0-30V/3A	366 x 230 x 160 mm	12,0



PBX 40000 Series

60 W SINGLE, DUAL, TRIPLE & QUAD OUTPUT LINEAR BENCHTOP

Features

- Linear topology
- Low ripple and noise
- Excellent line/load regulation
- Fast transient response
- Constant voltage or current mode, automatic crossover, and mode indication
- Current limit
- Optional internal analog programming includes OVP
- Optional internal 16-bit GPIB (IEEE-488) and RS-232 control interface cards
- Remote sense



Specifications

INPUT

AC input voltage	Standard: 230 VAC $\pm 10\%$. 47-63 Hz; Optional: 110/220/230/240 VAC $\pm 10\%$, 47-63 Hz.
AC input current	Single unit: 1.2 A, Dual unit: 2.4 A, Triple unit: 3.6 A, Quad unit: 4.8 A, at 115 VAC.

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Transient response time	< 100 μ s recovery to 0.05% band, $\pm 50\%$ load change in the range of 25% to 100% of the rated load.
Front panel control	10-turn voltage and 1-turn current potentiometers (10-turn current optional).
Front panel resolution	0.02% of maximum voltage.

ENVIRONMENTAL

Operating temperature	0 to 30°C for full rated output. Above 30°C, derate output linearly to zero at 70°C.
Storage temperature	-55 to 85°C.
Humidity	0 to 80% RH, non-condensing.

GENERAL

Dimensions	107.9x141x327.6 mm (WxHxD).
Weight	Approximately 4.3 kg (9.5 lb.).
AC input connector	IEC 320 connector.

STANDARDS

Safety and EMC standards	Units meet EN55011 (Group 1 Class A) 1991, EN50081-1 1992 and EN50082-1 1992, (IEC 1010- 1:1990), CSA certified.
CE mark	Yes.

ANALOG PROGRAMMING WITH OPTIONAL APG INTERFACE INSTALLED

Remote Start/Stop and interlock	2.5-15 V signal or TTL-compatible input, selectable logic.
Remote analog programming	Option 0-10 VDC for 0-100% or rated voltage or current $\pm 0.1\%$, 0-10 k for 0-100% of rated voltage or current $\pm 0.1\%$.
Remote monitoring	0-10 VDC for 0-100% of rated voltage or current $\pm 0.1\%$.
Over voltage protection	Trip range 3 V to full output +10%.
Remote ON/OFF	2 to 25 VDC high; <0.8 VDC low; user-selectable logic.
Tracking accuracy	$\pm 1\%$ for series operation.

OPTIONS

GPIB	GPIB Interface card (16-bit).
RS-232	RS-232 Interface card (16-bit).
APG	Analog programming interface card.
M1 110	110 VAC Input (50/60 Hz).
M2 220	220 VAC Input (50/60 Hz).
M4 240	240 VAC Input (50/60 Hz).
M11	10-turn current potentiometer.
M13	Locking bushings for front panel controls.
M13A	Locking knobs.
M43	Switch Selectable Input 110 VAC or 220 VAC.
RM	19-inch rack mount kit for up to four power supplies.



Four units rack mounted

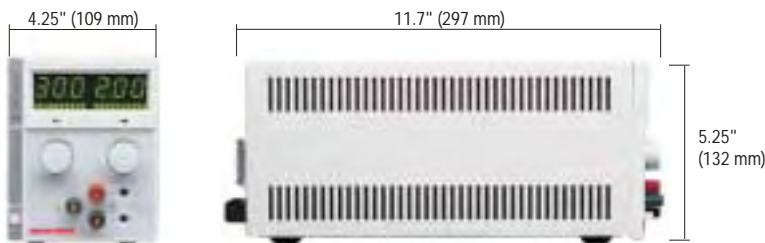
PBX 40000 Series

60 W SINGLE, DUAL, TRIPLE & QUAD OUTPUT LINEAR BENCHTOP

Electrical specifications¹

MODEL NUMBER	PBX 407-6	PBX 4015-4	PBX 4020-3	PBX 4030-2	PBX 4060-1	PBX 40120-0.5	PBX 40250-0.25
Output Ratings:							
Output Voltage	0-7 V	0-15 V	0-20 V	0-30 V	0-60 V	0-120 V	0-250 V
Output Current	0-6 A	0-4 A	0-3 A	0-2 A	0-1 A	0-0.5 A	0-0.25 A
Output Power	42 W	60 W	60 W	60 W	60 W	60 W	60 W
Line Regulation:²							
Voltage (0.01% of Vmax + 2 mV)	2.7 mV	3.5 mV	4 mV	5 mV	8 mV	14 mV	27 mV
Current (0.01% of Imax + 250 µA)	0.85 mA	0.65 mA	0.55 mA	0.45 mA	0.35 mA	0.3 mA	0.275 mA
Load Regulation:³							
Voltage (0.01% of Vmax + 2 mV)	2.7 mV	3.5 mV	4 mV	5 mV	8 mV	14 mV	27 mV
Current (0.01% of Imax + 250 µA)	0.85 mA	0.65 mA	0.55 mA	0.45 mA	0.35 mA	0.3 mA	0.275 mA
Output Noise & Ripple (20 Hz-20 MHz):							
Voltage	<1 mVrms	<1 mVrms	<1 mVrms	<1 mVrms	<1 mVrms	<1 mVrms	<5 mVrms
Current	<2 mArms	<2 mArms	<2 mArms	<2 mArms	<2 mArms	<2 mArms	<1 mArms
Meter Accuracy:							
Voltage (1% of Vmax + 1 count)	0.08 V	0.25 V	0.3 V	0.4 V	0.7 V	2.2 V	3.5 V
Current (1% of Imax + 1 count)	0.07 A	0.05 A	0.04 A	0.03 A	0.02 A	0.006 A	0.003 A
Drift (8 hours):⁴							
Voltage (0.02% of Vmax)	1.4 mV	3 mV	4 mV	6 mV	12 mV	24 mV	50 mV
Current (0.03% of Imax)	1.8 mA	1.2 mA	0.9 mA	0.6 mA	0.3 mA	0.15 mA	0.075 mA
Temperature Coefficient:⁵							
Voltage (0.015% of Vmax/°C)	1.05 mV	2.25 mV	3 mV	4.5 mV	9 mV	18 mV	37.5 mV
Current (0.02% of Imax/°C)	1.2 mA	0.8 mA	0.6 mA	0.4 mA	0.2 mA	0.1 mA	0.05 mA

1. Specifications indicate typical performance at 25 °C ± 5 °C, nominal line input of 115 VAC.
2. For input voltage variation over the AC input voltage range, with constant rated load.
3. For 0-100% load variation, with constant nominal line voltage.
4. Maximum drift over 8 hours with constant line, load, and temperature, after 30-minute warm-up.
5. Change in output per °C change in ambient temperature, with constant line and load.



Optional GPIB Interface Card



Optional RS-232 Interface Card



Optional APG Interface Card

For programming options (GPIB, RS232), each unit needs its own programming card. See details on page 29.



PBX 41000 Series

300 W SINGLE OUTPUT

Features

- Smallest 300 watt programmable power supply available
- Constant voltage or current operation with automatic crossover and mode indication
- Current Limit
- Optional internal analog programming, isolated analog programming, OVP
- Optional internal 16 Bit GPIB and RS-232 control interface options
- Remote sense
- CE, CSA



Specifications

INPUT

AC input voltage	Standard: 230VAC, 47-63Hz. Optional: Switch selectable 100VAC or 220VAC ±10%, 47-63Hz.
Switching frequency	Nominal 100kHz.

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Transient response time	<500s recovery to 50mV band for ±50% load change in the range of 25% to 100% of the rated load.
Front panel control	10-turn voltage and 1-turn current potentiometers (10-turn current optional).
Front panel resolution	0.02% of maximum voltage.
Max voltage differential	400VDC from output to safety ground.
Over voltage protection	Trip range 3V to full output +10%.

ENVIRONMENTAL

Operating temperature	0 to 30°C for full rated output. Above 30°C, derate output linearly to zero at 70°C.
Storage temperature	-55 to 85°C.
Humidity	0 to 80% RH, non-condensing.

GENERAL

Dimensions	107.9x141x327.6 mm (WxHxD).
Weight	Approximately 4.3kg (9.5 lb).
AC input connector	NEMA 5-15 plug to IEC 320 connector on back panel.

STANDARDS

Safety and EMC standards	Units meet CSA (IEC 61010-1:1990), FCC Part 15, Subpart J, Class A standards for radiated and conducted emissions, EN50011 (Group 1 Class B) 1991, EN50081-1 1992 and EN50082-1 1992.
CE mark	Yes.

PROGRAMMING

Remote Start/Stop and interlock	2.5-15 V signal or TTL-compatible input, selectable logic.
Remote analog programming	Option 0-10VDC for 0-100% or rated voltage or current ±1.0%, 0-10k for 0-100% of rated voltage or current ±1.0%.
Remote monitoring	0-10VDC for 0-100% or rated voltage or current ±1.0%.
Remote ON/OFF	2 to 25VDC high; <0.8VDC low; user-selectable logic.

OPTIONS

GPIB	GPIB Interface Card (16 Bit).
RS-232	RS-232 Interface Card (16 Bit).
APG	APG Interface Card.
M2S	Switch selectable input 110 VAC or 220 VAC.
M11	10-Turn Current Potentiometer.
M13	Locking Bushings for front panel controls.
M13A	Locking knobs.
RM	19' rack mount kit for up to 4 power supplies.



Four units rack mounted

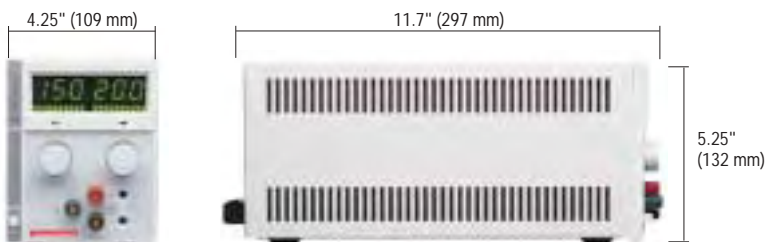
PBX 41000 Series

300 W SINGLE OUTPUT

Electrical specifications¹

MODEL NUMBER	PBX 4115-20	PBX 4130-10	PBX 4160-5
Output Ratings:			
Output Voltage	0-15 V	0-30 V	0-60 V
Output Current	0-20 A	0-10 A	0-5 A
Output Power	300 W	300 W	300 W
Line Regulation:²			
Voltage (0.01% of Vmax + 2mV)	3.5 mV	5 mV	8 mV
Current (0.01% of Imax + 1mA)	3 mA	2 mA	1.5 mA
Load Regulation:³			
Voltage (0.01% of Vmax + 2mV)	3.5 mV	5 mV	8 mV
Current (0.05% of Imax + 1mA)	3 mA	2 mA	1.5 mA
Output Noise & Ripple:			
20Hz-20MHz	5 mVrms 100 mVp-p	5 mVrms 100 mVp-p	5 mVrms 100 mVp-p
Meter Accuracy:			
Voltage (1% of Vmax + 1 count)	0.25 V	0.4 V	0.7 V
Current (1% of Imax + 1 count)	0.3 A	0.2 A	0.06 A
Drift (8 hours):⁴			
Voltage (0.02% of Vmax)	3 mV	6 mV	12 mV
Current (0.03% of Imax)	6 mA	3 mA	1.5 mA
Temperature Coefficient:⁵			
Voltage (0.015% of Vmax/°C)	2.25 mV	4.5 mV	9 mV
Current (0.02% of Imax/°C)	4 mA	2 mA	1 mA

1. Specifications indicate typical performance at 25 °C ± 5 °C, nominal line input of 120VAC.
2. For input voltage variation over the AC input voltage range, with constant rated load.
3. For 0-100% load variation, with constant nominal line voltage.
4. Maximum drift over 8 hours with constant line, load, and temperature, after 30-minute warm-up.
5. Change in output per °C change in ambient temperature, with constant line and load.



Optional GPIB Interface Card



Optional RS-232 Interface Card



Optional APG Interface Card

For programming options (GPIB, RS232), each unit needs its own programming card. See details on page 29.



LBO Series

500W SINGLE & DUAL OUTPUT HIGHEST DENSITY QUARTER RACK

Features

- Smallest 500 watt programmable power supply available
- Extra high power density
- Power factor correction
- Zero voltage "soft" switching for high efficiency, low noise and high reliability
- Front and rear connectors
- Analog programming
- Optional internal 16 Bit GPIB and RS-232 control
- OVP, current limit, thermal protection
- Remote sense



Specifications

INPUT

AC input voltage	84-264VAC, 47-63Hz; power factor corrected. Derate maximum output power to 450W for AC input <95V.
Max current	7A max @100VAC, 6A max @120VAC, 3A max @220VAC.
Power factor	0.98 min for full load at nominal voltage.
Harmonic distortion	Current harmonics meet IEC 1000-3-2.
Switching frequency	≥100kHz.

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Time delay	3s max, from power on to output stable.
Transient response time	1ms for output voltage to recover within 0.5% of its previous level after a step change in load current of up to 50% of rated power.
Max voltage differential	±300VDC from output to safety ground.
Front panel control	10-turn voltage and 1-turn current potentiometers.
Front panel resolution	0.02% of maximum voltage.

ENVIRONMENTAL

Operating temperature	0 to 50°C.
Storage temperature	-40 to 85°C.
Humidity	10 to 95% RH, non-condensing.

GENERAL

Dimensions	107.9x141x327.6 mm (WxHxD).
Weight	3.5kg (7.7 lb).
AC input connector	IEC320, 15A/250V.
Main output connector	Front panel: 5-way binding posts. Max current limit 30A; Rear panel: 7.5-33V models: Bus bars; 60-120V models: wire clamp connectors.

STANDARDS

Safety and EMC standards	Units meet IEC 1010-1 safety standard and EN50081-2 and EN50082-1 EMC standards. Additional standards: CSA C22.2 No 1010-1, UL3101, and FCC part 15, Class A EMI standard.
CE mark	Yes.

PROGRAMMING

Remote Start/Stop and interlock	2.5-15 V signal or TTL-compatible input, selectable logic. TTL input impedance: 2k (in series with one diode drop).
Remote analog programming	Voltage and current programming inputs (source must be floating): 0-5V, 0-10V (default) voltage sources. Input impedance (V and I): 20k.
Remote monitoring	1% of full scale output for the default range.

OPTIONS

GPIB	GPIB Interface Card (16 Bit).
RS-232	RS-232 Interface Card (16 Bit).
RM	19" rack mount kit for up to 4 power supplies.

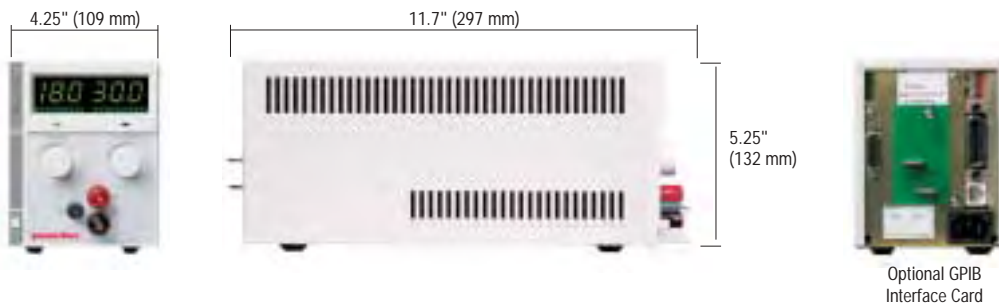


Four units rack mounted

Electrical specifications¹

MODEL NUMBER	LBO 7.5-67	LBO 18-30	LBO 33-16	LBO 60-9	LBO 120-4.5
Output Ratings:					
Output Voltage ²	0-7.5 V	0-18 V	0-33 V	0-60 V	0-120 V
Output Current ³	0-67 A	0-30 A	0-16 A	0-9 A	0-4.5 A
Output Power	502.5 W	540 W	528 W	540 W	540 W
Line Regulation:⁴					
Voltage (0.01% of Vmax + 2mV)	2.8 mV	3.8 mV	5.3 mV	8 mV	14 mV
Current (0.01% of Imax + 1mA)	7.7 mA	4 mA	2.6 mA	1.9 mA	1.5 mA
Load Regulation:⁵					
Voltage (0.01% of Vmax + 2mV)	2.8 mV	3.8 mV	5.3 mV	8 mV	14 mV
Current (0.05% of Imax + 1mA)	11.7 mA	8 mA	6.6 mA	5.9 mA	5.5 mA
Meter Accuracy:					
Voltage (1% of Vmax + 1 count)	0.2 V	0.3 V	0.5 V	0.7 V	2.2 V
Current (1% of Imax + 1 count)	0.8 A	0.4 A	0.3 A	0.2 A	0.2 A
Output Noise (0-20MHz):					
Voltage (p-p)	50 mV	50 mV	75 mV	125 mV	180 mV
Output Ripple (rms):					
Voltage	5 mV	5 mV	7.5 mV	10 mV	20 mV
Current ⁶	250 mA	250 mA	150 mA	150 mA	75 mA
Drift (30minutes):⁷					
Voltage (0.15% of Vmax)	11.5 mV	27 mV	49.5 mV	90 mV	180 mV
Current (0.3% of Imax)	201 mA	90 mA	48 mA	27 mA	13.5 mA
Drift (8 hours):⁸					
Voltage (0.03% of Vmax)	2.3 mV	5.4 mV	9.9 mV	18 mV	36 mV
Current (0.02% of Imax)	34 mA	15 mA	8 mA	4.5 mA	2.3 mA
Temperature Coefficient:⁹					
Voltage (0.015% of Vmax/°C)	1.2 mV	2.7 mV	5 mV	9 mV	18 mV
Current (0.02% of Imax/°C)	13.4 mA	6 mA	3.2 mA	1.8 mA	0.9 mA
OVP Adjustment Range: (5% to 110% of Vmax)					
	0.4-8.3 V	0.9-19.8 V	1.7-36.3 V	3-66 V	6-132 V
Efficiency:¹⁰					
	80%	80%	80%	80%	80%

- All electrical specifications are typical and represented at the full operating temperature range for all models, unless otherwise stated.
- Minimum output voltage is <0.15% of rated voltage at zero output setting.
- Minimum output current is <0.2% of rated current at zero setting when measured with rated load resistance. Front output current limited to 30A max.
- For input voltage variation over the AC input voltage range, with constant rated load.
- For 0-100% load variation, with constant nominal line voltage.
- Current mode noise is measured from 10% to 100% of rated output voltage, full current.
- Maximum drift over 60 minutes with constant line, load, and temperature, after power up.
- Maximum drift over 8 hours with constant line, load, and temperature, after 60 minutes warm-up.
- Change in output per °C change in ambient temperature, with constant line and load.
- Typical efficiency at 120V and full output power.



For programming options (GPIB, RS232), each unit needs its own programming card. See details on page 29.



LCR Series

800W SINGLE OUTPUT HIGH POWER DENSITY

Features

- Telecom and industrial applications
- Small size and light weight
- Power factor correction
- Series and parallel operation
- Built for mobile applications
- Temperature controlled fan



Specifications

INPUT

Input voltage	50-260VAC (50-200VAC reduced power, see curve below).
	50-260VDC/max 600W (50-200VDC reduced power).
Input current	4.5A .
Power factor	>0.99.
Inrush current	<30A, cold start.
Isolation	Input-chassis: 12V models 1500VAC, other models 3750VAC. Input-output: 3750VAC. Output-chassis: 500VAC.

OUTPUT

Power	800W.
Efficiency	85-90% @ 230VAC, 10-100% load.
Line regulation	±0.1%.
Load regulation	±0.5%.
Setting accuracy	±0.1%.
Ripple (f>50Hz)	<50mV rms.
Hold up time	>5ms.

ENVIRONMENTAL

Operating temperature	Full power typically: -25 to +50°C. Reduced power: +50 to +70°C.
Cooling	Temperature controlled fan.

GENERAL

Mounting	Bench.
Parallel operation	Yes, by slave unit.
Series operation	Yes, by slave unit.
LED indication	Yellow led power OK.
Protection class	Mechanical: IP21 metal enclosure/handle. Electrical: 12V models/Class I, other models/ClassII.
Connectors	Banana socket.
Dimensions	258x136x89 mm.
Weight	1.6kg with cables.

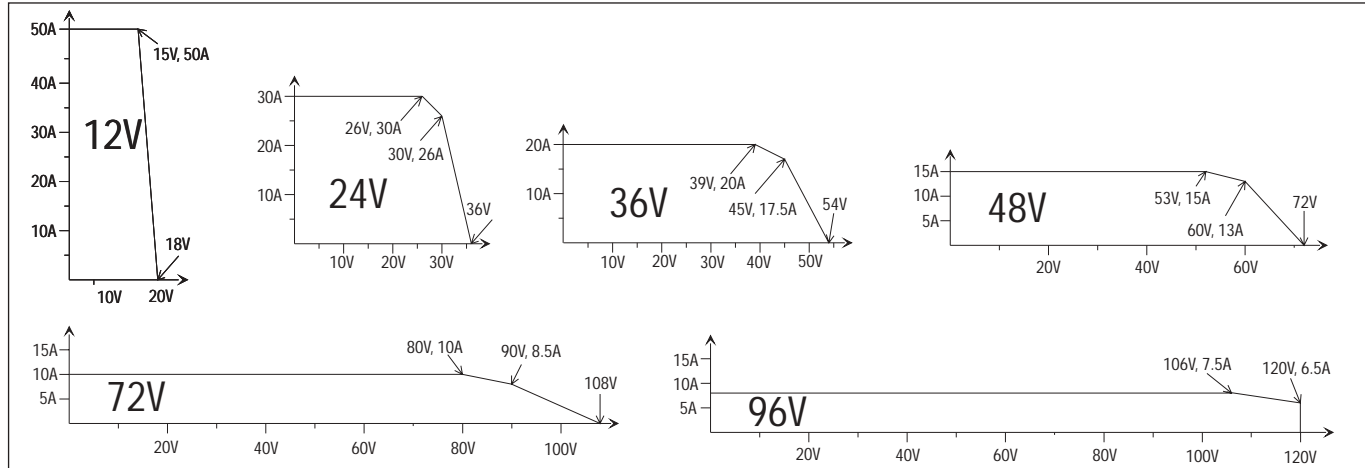
STANDARDS

Safety and EMC standards	EN60335-2-29+A2, EN55022B, EN50081-1, EN50082-2..
CE mark	Yes.

Adjustable power supplies, master and slave units

TYPE MASTER UNIT	TYPE SLAVE UNIT	INPUT VOLTAGE*)	OUTPUT VOLTAGE SETTING RANGE (SEE CURVES)	OUTPUT CURRENT LIMIT SETTING (SEE CURVES)	MAX POWER
LCR7160	LCR7161	50...260 VAC	0-18VDC	0-50A	800W
LCR4610	LCR4611	50...260 VAC	0-36VDC	0-30A	800W
LCR4615	LCR4616	50...260 VAC	0-54VDC	0-20A	800W
LCR4600	LCR4601	50...260 VAC	0-72VDC	0-15A	800W
LCR4605	LCR4606	50...260 VAC	0-100VDC	0-10A	800W
LCR7340	LCR7341	50...260 VAC	0-120VDC	0-7.5A	800W

*) Reduced power at low input 50...200VAC.
Also DC input 50...260VDC, max power 600W, reduced output power at low input.



Nominal output voltage/current characteristics.



PBX 45000 Series

1000W SINGLE OUTPUT SWITCH MODE

Features

- Power factor correction (0.99 minimum)
- Zero voltage “soft” switching for high efficiency and low noise
- Constant voltage or constant current operation
- Stackable half-rack package, benchtop and rack mountable
- Analog programming standard, optional ISOL card
- Optional internal 16-bit GPIB (IEEE-488) and RS-232 control interface cards
- OVP, current limit, thermal protection
- Remote sense, 5 V line loss compensation
- CE



Specifications

INPUT

AC input voltage	85-250 VAC, 47-63 Hz; power factor corrected. Derate maximum output power to 900 W for AC input less than 95 V.
Maximum input current	13 A maximum at 100 VAC, 11 A maximum at 120 VAC, 6 A maximum at 220 VAC.
Power factor	0.99 minimum for full load and 120 VAC input.
Input harmonic distortion	Harmonics distortion complies with EN61000-3-2 limits.
Switching frequency	7.5 V to 300 V models: nominal 125 kHz (250 kHz output ripple); 600 V model: nominal 62.5 kHz (125 kHz output ripple).

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Time delay	4s maximum from power on until output stable.
Transient response time	1 ms for output voltage to recover within 0.5% of its previous level after a step change in load current of up to 50% of rated output.
Max voltage differential	±600 VDC from output to safety ground.
Front panel control	10-turn voltage and current potentiometers.
Front panel resolution	0.02% of maximum voltage.

ENVIRONMENTAL

Operating temperature	0 to 40°C.
Storage temperature	-40 to 85°C.
Humidity	10 to 80% RH, non-condensing.

GENERAL

Dimensions	214.6x94x464.8 mm (WxHxD).
Weight	Approximately 6.4 kg (14 lb.).
AC input connector	IEC 320 connector.
Main output connector	7.5 to 40 V models: nickel-plated copper bus bars; 60 to 600 V models: 4-terminal wire clamp connector for DC output and local sense.

STANDARDS

Safety and EMC standards	Units meet CAN/CSA-22.2 No. 1010.1-92 and EN50081-2 (Class A) and EN50082-1 EMC standards, CSA certified, UL pending.
CE mark	Yes.

PROGRAMMING

Remote Start/Stop and interlock	2.5-15 V signal or TTL-compatible input, selectable logic.
Remote analog programming	Voltage and current programming inputs (source must be isolated): 0-5 k, 0-10 k resistances; 0-5 V (default), 0-10 V voltage sources.
Remote analog monitoring	Voltage and current monitor outputs 0-5 V (default), 0-10 V ranges for 0-100% of output.
Remote programming and monitoring accuracy	<1% of full scale output for the default range.

OPTIONS

GPIB	GPIB Interface card (16-bit).
RS-232	RS-232 Interface card (16-bit).
ISOL	Isolated Interface card provides isolated analog control and readback of output voltage and current.
M13	Locking bushings on front panel controls.
M13A	Locking knobs.
M22A	No front binding posts.
M61	Recessed front panel potentiometers.
RM-XHR	19-inch rack mount kit for two power supplies.

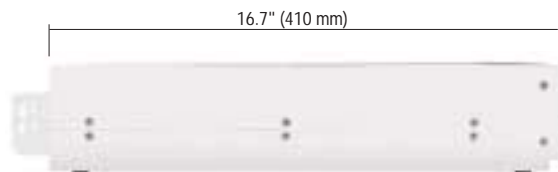
PBX 45000 Series

1 0 0 0 W S I N G L E O U T P U T S W I T C H M O D E

Electrical specifications¹

MODEL NUMBER	PBX 457.5-130	PBX 4520-50	PBX 4533-33	PBX 4540-25	PBX 4560-18	PBX 45100-10	PBX 45150-7	PBX 45300-3.5	PBX 45600-1.7
Output Ratings:									
Output Voltage	0-7.5 V	0-20 V	0-33 V	0-40 V	0-60 V	0-100 V	0-150 V	0-300 V	0-600 V
Output Current	0-130 A	0-50 A	0-33 A	0-25 A	0-18 A	0-10 A	0-7 A	0-3.5 A	0-1.7 A
Output Power	975 W	1000 W	1089 W	1000 W	1080 W	1000 W	1050 W	1050 W	1020 W
At the front panel binding posts:									
Output Current	0-30 A	0-30 A	0-30 A	0-25 A	0-18 A	0-10 A	0-7 A	0-3.5 A	0-1.7 A
Output Power	225 W	600 W	990 W	1000 W	1080 W	1000 W	1050 W	1050 W	1020 W
Line Regulation:²									
Voltage	1 mV	1 mV	1 mV	1 mV	1.5 mV	1.5 mV	3 mV	10 mV	15 mV
Current	5 mA	2 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA
Load Regulation:³									
Voltage	1.5 mV	1.5 mV	1.5 mV	1.5 mV	1.5 mV	2.5 mV	4 mV	10 mV	15 mV
Current	50 mA	10 mA	4 mA	3 mA	3 mA	2 mA	2 mA	2 mA	2 mA
Meter Accuracy:									
Voltage (0.5% of Vmax + 1 count)	0.05 V	0.2 V	0.3 V	0.3 V	0.4 V	0.6 V	0.9 V	1.6 V	4 V
Current (0.5% of Imax + 1 count)	0.8 A	0.4 A	0.3 A	0.3 A	0.1 A	0.06 A	0.05 A	0.03 A	0.01 A
Output Noise & Ripple:									
rms	5 mV	5 mV	5 mV	5 mV	5 mV	5 mV	10 mV	15 mV	50 mV
p-p (0-20 MHz)	50 mV	50 mV	50 mV	50 mV	50 mV	50 mV	75 mV	100 mV	300 mV
Drift (8 hours):⁴									
Voltage (0.05% of Vmax)	3.75 mV	10 mV	16.5 mV	20 mV	30 mV	50 mV	75 mV	150 mV	300 mV
Current (0.1% of Imax)	130 mA	50 mA	33 mA	25 mA	18 mA	10 mA	7 mA	3.5 mA	1.7 mA
Temperature Coefficient:⁵									
Voltage (0.02% of Vmax/°C)	1.5 mV	4 mV	6.6 mV	8 mV	12 mV	20 mV	30 mV	60 mV	120 mV
Current (0.03% of Imax/°C)	39 mA	15 mA	9.9 mA	7.5 mA	5.4 mA	3 mA	2.1 mA	1.1 mA	0.48 mA
Maximum Remote Sense									
Line Drop Compensation ⁶	3 V/line	5 V/line	5 V/line	5 V/line	5 V/line	5 V/line	5 V/line	5 V/line	5 V/line
OVP Adjustment Range:									
(5% to 110% of Vmax)	0.375-8.25 V	1-22 V	1.65-36.3 V	2-44 V	3-66 V	5-110 V	7.5-165 V	15-330 V	30-660 V
Efficiency:⁷									
	81%	83%	83%	83%	84%	84%	85%	85%	85%

- Specifications indicate typical performance at 25 °C ± 5 °C, nominal line input of 120 VAC.
- For input voltage variation over the AC input voltage range, with constant rated load.
- For 0-100% load variation, with constant nominal line voltage. Measured at the rear panel output connector unless stated otherwise.
- Maximum drift over 8 hours with constant line, load, and temperature, after 30-minute warm-up.
- Change in output per °C change in ambient temperature, with constant line and load.
- Line drop is subtracted from total voltage available at supply output.
- Typical efficiency at 115 VAC input and rated output power.



Optional RS-232 Interface Card/
Low Voltage Output Connector

For details on GPIB and RS-232 options, see page 30.



PBX 46000 Series

1 2 0 0 W S I N G L E O U T P U T Z E R O V O L T A G E S O F T S W I T C H I N G

Features

- 1U height
- Zero voltage “soft” switching for high efficiency and low noise
- Analog programming standard, optional ISOL (isolated programming card)
- Optional internal 16-bit GPIB (IEEE-488) and RS-232 control interface cards
- Constant voltage or constant current operation
- OVP, current limit, thermal protection
- Remote/local modes
- Remote sense, 5 V line loss compensation
- CE, CSA, UL approvals



Specifications

INPUT

AC input voltage	85-130 VAC or 190-264 VAC, 1 (17 A @ 120 VAC; 8.8 A @ 230 VAC typical), 47-63 Hz. Automatic range detect.
Switching frequency	Nominal 78 kHz (156 kHz output ripple).

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Time delay	7 s maximum from power on until output stable.
Transient response time	<3 ms for output voltage to recover within 0.5% of its rated voltage after a step change in load current of up to 10% to 90% of rated output.
Max voltage differential	±600 VDC from output to safety ground.
Front panel control	10-turn voltage and current potentiometers.
Front panel resolution	0.02% of maximum voltage.

ENVIRONMENTAL

Operating temperature	0 to 50°C.
Storage temperature	-20 to 70°C.
Humidity	30 to 90% RH, non-condensing.

GENERAL

Dimensions	482.5x43.4x510.5 mm(WxHxD).
Weight	Approximately 8.2 kg (18 lb.).
AC input connector	3-terminal, 34 A/250 V, wire clamp connector with strain relief cover.
Main output connector	7.5 to 40 V models: nickel-plated copper bus bars with bus bar shield; 60 V to 600 V models: 4-terminal wire clamp connector with strain relief.

STANDARDS

Safety and EMC standards	Units meet IEC 1010-1 and EN50081-2 and EN50082-2 EMC standards. Additional standards: CSA C22.2 No. 1010.1, UL 3111-1, and FCC, part 15, class A EMI standard, CSA certified, UL listed.
CE mark	Yes.

PROGRAMMING

Remote Start/Stop and interlock	2.5-15 V signal or TTL-compatible input, selectable logic.
Remote analog programming	Voltage and current programming inputs (source must be isolated): 0-5 k, 0-10 k resistances; 0-5 V, 0-10 V (default) voltage sources.
Remote analog monitoring	Voltage and current monitor outputs 0-5 V, 0-10 V (default) ranges for 0-100% of output.
Remote programming and monitoring accuracy	<1% of full scale output for the default range.
Maximum remote sense	5 V/line (Line drop is subtracted from total voltage. Line drop compensation available at supply output.).

OPTIONS

GPIB	GPIB Interface card (16-bit).
RS-232	RS-232 Interface card (16-bit).
ISOL	Isolated Interface card provides isolated analog control and readback of output voltage and current.
M13	Locking bushings on front panel controls.
M13A	Locking knobs.

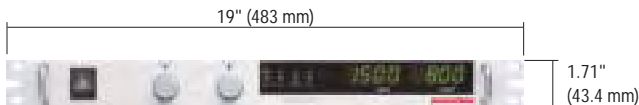
PBX 46000 Series

1 2 0 0 W S I N G L E O U T P U T Z E R O V O L T A G E S O F T S W I T C H I N G

Electrical specifications¹

MODEL NUMBER	PBX 467.5-140	PBX 4612-100	PBX 4620-60	PBX 4635-35	PBX 4640-30	PBX 4660-20	PBX 46100-12	PBX 46150-8	PBX 46300-4	PBX 46600-2
Output Ratings:										
Output Voltage	0-7.5 V	0-12 V	0-20 V	0-35 V	0-40 V	0-60 V	0-100 V	0-150 V	0-300 V	0-600 V
Output Current	0-140 A	0-100 A	0-60 A	0-35 A	0-30 A	0-20 A	0-12 A	0-8 A	0-4 A	0-2 A
Output Power	1050 W	1200 W	1200 W	1225 W	1200 W	1200 W	1200 W	1200 W	1200 W	1200 W
Line Regulation:²										
Voltage <small>(0.01% of Vmax+2 mV)</small>	2.75 mV	3.2 mV	4 mV	5.5 mV	6 mV	8 mV	12 mV	17 mV	32 mV	62 mV
Current <small>(0.01% of Imax+2 mA)</small>	16 mA	12 mA	8 mA	5.5 mA	5 mA	4 mA	3.2 mA	2.8 mA	2.4 mA	2.2 mA
Load Regulation:³										
Voltage <small>(0.02% of Vmax+5 mV)</small>	6.5 mV	7.4 mV	9 mV	12 mV	13 mV	17 mV	27 mV	35 mV	65 mV	125 mV
Current <small>(0.02% of Imax+5 mA)</small>	33 mA	25 mA	17 mA	12 mA	11 mA	9 mA	7.4 mA	6.6 mA	5.8 mA	5.4 mA
Meter Accuracy:										
Voltage <small>(0.5% of Vmax+1 count)</small>	0.05 V	0.07 V	0.2 V	0.3 V	0.3 V	0.4 V	0.6 V	0.9 V	3 V	4 V
Current <small>(0.5% of Imax+1 count)</small>	0.8 A	0.6 A	0.4 A	0.3 A	0.3 A	0.2 A	0.07 A	0.05 A	0.03 A	0.02 A
Output Noise & Ripple:										
Voltage rms	5 mV	5 mV	5 mV	5 mV	5 mV	5 mV	5 mV	7 mV	10 mV	25 mV
Voltage p-p <small>(0-20 MHz)</small>	40 mV	40 mV	60 mV	60 mV	60 mV	60 mV	60 mV	60 mV	80 mV	140 mV
Current rms	175 mA	100 mA	85 mA	25 mA	25 mA	10 mA	5 mA	3 mA	2 mA	1 mA
Drift (8 hours):⁵										
Voltage <small>(0.05% of Vmax)</small>	3.8 mV	6 mV	10 mV	17.5 mV	20 mV	30 mV	50 mV	75 mV	150 mV	300 mV
Current <small>(0.05% of Imax)</small>	70 mA	50 mA	30 mA	17.5 mA	15 mA	10 mA	6 mA	4 mA	2 mA	1 mA
Temperature Coefficient:⁶										
Voltage <small>(0.02% of Vmax/°C)</small>	1.5 mV	2.4 mV	4 mV	7 mV	8 mV	12 mV	20 mV	30 mV	60 mV	120 mV
Current <small>(0.03% of Imax/°C)</small>	42 mA	30 mA	18 mA	10.5 mA	9 mA	6 mA	3.6 mA	2.4 mA	1.2 mA	0.6 mA
Program Slew Rate:⁷										
Rise Time	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms	170 ms	170 ms	170 ms	170 ms
Fall Time	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms	170 ms	170 ms	170 ms	170 ms
OVP Adjustment Range:										
(5% to 110% of Vmax)	0.375-8.25 V	0.6-13.2 V	1-22 V	1.75-38.5 V	2-44 V	3-66 V	5-110 V	7.5-165 V	15-330 V	30-660 V
Efficiency:⁸										
	80%	82%	84%	84%	84%	84%	84%	87%	86%	85%

- Specifications indicate typical performance at 25 °C ± 5 °C, nominal line input of 120 VAC.
- For input voltage variation over the AC input voltage range, with constant rated load.
- For 0-100% load variation, with constant nominal line voltage.
- Measured at full rated output with a resistive load.
- Maximum drift over 8 hours with constant line, load, and temperature, after 30-minute warm-up.
- Change in output per °C change in ambient temperature, with constant line and load.
- Measured with stepped 0-10 V analog programming source and a resistive load.
- Typical efficiency at 100 VAC input and rated output power.



Optional GPIB Interface Card



Optional RS-232 Interface Card

For details on GPIB and RS-232 options, see page 30.



PBX 47000 Series

2800W SINGLE OUTPUT ZERO VOLTAGE SOFT SWITCHING

Features

- Zero voltage “soft” switching for high efficiency and low noise
- Analog programming standard, optional ISOL (isolated programming card)
- Optional internal 16-bit GPIB (IEEE-488) and RS-232 control interface cards
- Constant voltage or constant current operation
- OVP, current limit, thermal protection
- Front panel button preview of voltage, current, OVP
- Remote/local modes
- Remote sense, 5 V line loss compensation
- CE, CSA, UL approvals



Specifications

INPUT

AC input voltage	190-264 VAC, 1 (22.6 A @ 208 VAC; 20.5 A @ 230 VAC typical), 47-63 Hz.
Switching frequency	Nominal 31 kHz (62 kHz output ripple).

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Time delay	7 s maximum from power on until output stable.
Transient response time	<3 ms for output voltage to recover within 0.5% of its rated voltage after a step change in load current of up to 10% to 90% of rated output.
Max voltage differential	±600 VDC from output to safety ground.
Front panel control	10-turn voltage and current potentiometers.
Front panel resolution	0.02% of maximum voltage.

ENVIRONMENTAL

Operating temperature	0 to 50°C.
Storage temperature	-20 to 70°C.
Humidity	30 to 90% RH, non-condensing.

GENERAL

Dimensions	482.5x87.6x510.5 mm(WxHxD).
Weight	Approximately 15 kg (33 lb.).
AC input connector	3-terminal, 34 A/25 0V, wire clamp connector with strain relief cover.
Main output connector	7.5 to 100 V models: nickel-plated copper bus bars with bus bar cover and strain relief; 150V to 600 V models: 4-terminal, wire clamp connector with cover and strain relief.

STANDARDS

Safety and EMC standards	Units meet IEC 1010-1 safety standard and EN50081-2 and EN50082-2 EMC standards. Additional standards: CSA C22.2 No. 1010.1, UL 3111-1, and FCC, part 15, class A EMI standard, CSA certified, UL listed.
CE mark	Yes.

PROGRAMMING

Remote Start/Stop and interlock	2.5-15 V signal or TTL-compatible input, selectable logic.
Remote analog programming	Voltage and current programming inputs (source must be isolated): 0-5 k, 0-10 k resistances; 0-5 V, 0-10 V (default) voltage sources.
Remote analog monitoring	Voltage and current monitor outputs 0-5 V, 0-1 0V (default) ranges for 0-100% of output.
Remote programming and monitoring accuracy	<1% of full scale output for the default range.
Maximum remote sense	5 V/line (Line drop is subtracted from total voltage Line drop compensation available at supply output.).

OPTIONS

GPIB	GPIB Interface card (16-bit).
HFS	Fiber Optic Serial Interface card (16-bit).
RS-232	RS-232 Interface card (16-bit).
ISOL	Interface card provides isolated analog control and readback of output voltage and current
M2	208 VAC three-phase input.
M13	Locking bushings on front panel controls.
M13A	Locking knobs.

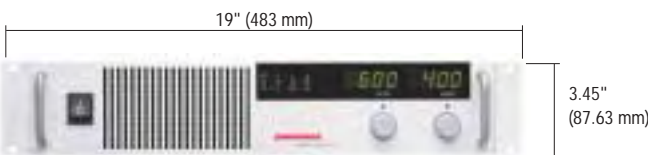
PBX 47000 Series

2 8 0 0 W S I N G L E O U T P U T Z E R O V O L T A G E S O F T S W I T C H I N G

Electrical specifications¹

MODEL NUMBER	PBX 477.5-300	PBX 4712-220	PBX 4720-130	PBX 4740-70	PBX 4760-46	PBX 47100-28	PBX 47150-18	PBX 47300-9	PBX 47600-4
Output Ratings:									
Output Voltage	0-7.5 V	0-12 V	0-20 V	0-40 V	0-60 V	0-100 V	0-150 V	0-300 V	0-600 V
Output Current	0-300 A	0-220 A	0-130 A	0-70 A	0-46 A	0-28 A	0-18 A	0-9 A	0-4 A
Output Power	2250 W	2640 W	2600 W	2800 W	2760 W	2800 W	2700 W	2700 W	2400 W
Line Regulation: ²									
Voltage (0.01% of Vmax + 2 mV)	2.75 mV	3.2 mV	4 mV	6 mV	8 mV	12 mV	17 mV	32 mV	62 mV
Current (0.01% of Imax + 2 mA)	32 mA	24 mA	15 mA	9 mA	6.6 mA	4.8 mA	3.8 mA	2.9 mA	2.4 mA
Load Regulation: ³									
Voltage (0.02% of Vmax + 5 mV)	6.5 mV	7.4 mV	9 mV	13 mV	17 mV	27 mV	35 mV	65 mV	125 mV
Current (0.02% of Imax + 5 mA)	65 mA	49 mA	31 mA	19 mA	14.2 mA	10.6 mA	8.6 mA	6.8 mA	5.8 mA
Meter Accuracy:									
Voltage (0.5% of Vmax + 1 count)	0.05 V	0.07 V	0.2 V	0.3 V	0.4 V	0.6 V	0.9 V	3 V	4 V
Current (0.5% of Imax + 1 count)	3 A	2 A	0.8 A	0.5 A	0.3 A	0.2 A	0.1 A	0.06 A	0.03 A
Output Noise & Ripple:									
Voltage rms	4 mV	5 mV	6 mV	6 mV	6 mV	12 mV	15 mV	20 mV	35 mV
Voltage p-p (0-20 MHz)	50 mV	50 mV	60 mV	60 mV	60 mV	75 mV	100 mV	120 mV	200 mV
Current rms	400 mA	200 mA	100 mA	50 mA	30 mA	10 mA	5 mA	5 mA	0.7 mA
Drift (8 hours): ⁴									
Voltage (0.05% of Vmax)	3.8 mV	6 mV	10 mV	20 mV	30 mV	50 mV	75 mV	150 mV	300 mV
Current (0.05% of Imax)	150 mA	110 mA	65 mA	35 mA	23 mA	14 mA	9 mA	4.5 mA	2 mA
Temperature Coefficient: ⁵									
Voltage (0.02% of Vmax/°C)	1.5 mV	2.4 mV	4 mV	8 mV	12 mV	20 mV	30 mV	60 mV	120 mV
Current (0.03% of Imax/°C)	90 mA	70 mA	40 mA	25 mA	15 mA	9 mA	5.5 mA	2.7 mA	1.2 mA
Program Slew Rate: ⁶									
Rise Time	100 ms	100 ms	100 ms	100 ms	100 ms	170 ms	170 ms	170 ms	170 ms
Fall Time	100 ms	100 ms	100 ms	100 ms	100 ms	170 ms	170 ms	170 ms	170 ms
OVP Adjustment Range: (5% to 110% of Vmax)	0.375-8.25 V	0.6-13.2 V	1-22 V	2-44 V	3-66 V	5-110 V	7.5-165 V	15-330 V	30-660 V
Efficiency: ⁷	81%	84%	87%	86%	88%	89%	90%	90%	90%

- Specifications indicate typical performance at 25 °C ± 5 °C, nominal line input of 208 VAC.
- For input voltage variation over the AC input voltage range, with constant rated load.
- For 0-100% load variation, with constant nominal line voltage.
- Maximum drift over 8 hours with constant line, load, and temperature, after 30-minute warm-up.
- Change in output per °C change in ambient temperature, with constant line and load.
- Measured at full rated output with a resistive load.
- Typical efficiency at 200 VAC input and rated output power.



Optional GPIB Interface Card/
Low Voltage Output Connector



Optional RS-232 Interface Card/
High Voltage Output Connector

For details on GPIB
and RS-232 options,
see page 30.



LBX Series

6 KW PROGRAMMABLE DIGITAL DC POWER SUPPLY

Features

- Power factor correction
- Zero voltage “soft” switching for low noise, high efficiency and high reliability
- Constant power mode
- Digital processing with 16-bit control for high accuracy
- Ten 99-step Auto Sequence programs for easy benchtop programming of complex test routines
- Ten store/recall setup locations
- Isolated analog programming and readback standard
- Front panel soft calibration
- Remote sense with 5V line loss compensation



Specifications

INPUT

AC input voltage	Standard: 3-phase 342-500VAC, 47-63Hz. 3-wire and safety ground.
Switching frequency	Nominal 35 kHz (70 kHz output ripple).

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Time delay	5 s maximum from power on until output stable.
Transient response time	<3 ms for output voltage to recover within 0.75% of its rated voltage after a step change in load current from 50% to 100% of rated output or from 100 to 50%.
Max voltage differential	±600 VDC from output to safety ground.
Front panel control	Rotary encoder knobs or keypad entry.
Front panel resolution	0.002% with keypad.

ENVIRONMENTAL

Operating temperature	0 to 50°C.
Storage temperature	-40 to 85°C.
Humidity	30 to 90% RH, non-condensing.

GENERAL

Dimensions	482.5x132.5x463.0 mm(WxHxD).
Weight	Approximately 34 kg (70 lb.).
AC input connector	4-terminal, wire clamp connector with strain relief cover.
Main output connector	10 to 100 V models: nickel-plated copper bus bars with bus bar shield; 150V to 600 V models: 4-terminal, wire clamp connector with strain relief.

STANDARDS

Safety and EMC standards	Units meet IEC 1010-1 safety standard and EN50081-2 and EN50082-2 EMC standards. Additional standards: CSA C22.2 No. 1010.1, UL 3111-1, and FCC, part 15, class A EMI standard.
CE mark	Yes.

PROGRAMMING

Remote Start/Stop and interlock	4-15 V signal or TTL-compatible input.
Remote analog programming	Voltage and current programming inputs: 0-5V, 0-10V (default) voltage sources. Inputs galvanically isolated from supply output.
Remote analog monitoring	Voltage and current monitor outputs 0-5 V, 0-10V (default) ranges for 0-100% of output. Galvanically isolated from supply output.
Remote programming and monitoring accuracy	<±0.3% of full scale output.
Maximum remote sense	5 V/line (Line drop is subtracted from total voltage. Line drop compensation available at supply output.).

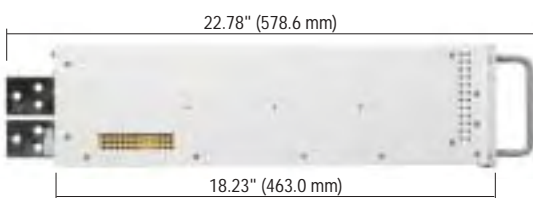
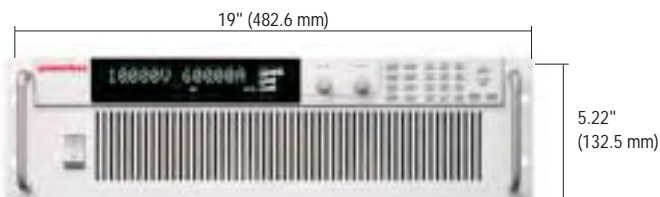
OPTIONS

GPIB	Multi-channel GPIB Interface card (16-bit).
CAN	Multi-channel CANbus interface.
LV-Input	3-phase 190-242VAC, 47-63Hz.

Electrical specifications¹

MODEL NUMBER	LBX 10-600	LBX 20-300	LBX 30-200	LBX 40-150	LBX 60-100	LBX 80-75	LBX 100-60	LBX 150-40	LBX 300-20	LBX 600-10
Output Ratings:										
Output Voltage ²	0-10 V	0-20 V	0-30 V	0-40 V	0-60 V	0-80 V	0-100 V	0-150 V	0-300 V	0-600 V
Output Current ³	0-600 A	0-300 A	0-200 A	0-150 A	0-100 A	0-75 A	0-60 A	0-40 A	0-20 A	0-10 A
Output Power	6000 W	6000 W	6000 W	6000 W	6000 W	6000 W	6000 W	6000 W	6000 W	6000 W
Line Regulation: ⁴										
Voltage (0.01% of Vmax)	1 mV	2 mV	3 mV	4 mV	6 mV	8 mV	10 mV	15 mV	30 mV	60 mV
Current (0.01% of Imax)	305 mA	155 mA	100 mA	80 mA	55 mA	42.5 mA	35 mA	25 mA	15 mA	10 mA
Load Regulation: ⁵										
Voltage (0.05% of Vmax + 5 mV)	10 mV	15 mV	20 mV	25 mV	35 mV	45 mV	55 mV	80 mV	155 mV	305 mV
Current (0.2% of Imax + 40 mA)	620 mA	320 mA	220 mA	170 mA	120 mA	95 mA	80 mA	60 mA	40 mA	30 mA
Meter Accuracy:										
Voltage (0.15% of Vmax)	15 mV	30 mV	45 mV	60 mV	90 mV	120 mV	150 mV	225 mV	450 mV	900 mV
Current (0.5% of Imax)	900 mA	450 mA	220 mA	225 mA	150 mA	113 mA	90 mA	60 mA	30 mA	15 mA
Output Noise (0-20MHz):										
Voltage (p-p)	75 mV	75 mV	75 mV	75 mV	100 mV	100 mV	100 mV	150 mV	250 mV	350 mV
Output Ripple (rms):										
Voltage	10 mV	10 mV	12 mV	15 mV	15 mV	15 mV	20 mV	20 mV	30 mV	80 mV
Current ⁶	3100 mA	1600 mA	1000 mA	750 mA	450 mA	320 mA	230 mA	120 mA	50 mA	25 mA
Drift (30 minutes):⁷										
Voltage (0.04% of Vmax)	4 mV	8 mV	12 mV	16 mV	24 mV	32 mV	40 mV	60 mV	120 mV	240 mV
Current (0.6% of Imax)	3600 mA	1800 mA	1200 mA	900 mA	600 mA	450 mA	360 mA	240 mA	120 mA	60 mA
Drift (8 hours):⁸										
Voltage (0.02% of Vmax)	2 mV	4 mV	6 mV	8 mV	12 mV	16 mV	20 mV	30 mV	60 mV	120 mV
Current (0.4% of Imax)	240 mA	120 mA	80 mA	60 mA	40 mA	30 mA	24 mA	16 mA	8 mA	4 mA
Temperature Coefficient:⁹										
Voltage (0.04% of Vmax/°C)	4 mV	8 mV	12 mV	16 mV	24 mV	32 mV	40 mV	60 mV	120 mV	240 mV
Current (0.06% of Imax/°C)	360 mA	180 mA	120 mA	90 mA	60 mA	45 mA	36 mA	24 mA	12 mA	6 mA
OVP Adjustment Range:										
(5% to 103% of Vmax)	0.5-10.3 V	1-20.6 V	1.5-30.9 V	2-41.2 V	3-61.8 V	4-82.4 V	5-103 V	7.5-154.5 V	15-309 V	30-618 V
Efficiency:¹⁰										
	85%	87%	87%	87%	89%	89%	90%	90%	91%	91%

- All electrical specifications are typical and represented at the full operating temperature range for all models, unless otherwise stated.
- Minimum output voltage is <0.15% of rated voltage at zero output setting for 10V, 20V, 40V, 60V, 80V, and 100V models and <0.3% for 150V, 300V, and 600V models.
- Minimum output current is <0.2% of rated current at zero setting when measured with rated load resistance.
- For input voltage variation over the AC input voltage range, with constant rated load.
- For 0-100% load variation, with constant nominal line voltage.
- Current mode noise is measured from 10% to 100% of rated output voltage, full current, unit in current mode.
- Maximum drift over 30 minutes with constant line, load, and temperature, after power up.
- Maximum drift over 8 hours with constant line, load, and temperature, after 30 minutes warm-up.
- Change in output per °C change in ambient temperature, with constant line and load.
- Typical efficiency at nominal input voltage and full output power.



For details on GPIB and RS-232 options, see page 31.



LBZ Series

12 KW PROGRAMMABLE DIGITAL DC POWER SUPPLY

Features

- Power factor correction
- Zero voltage “soft” switching for low noise, high efficiency and high reliability
- Constant power mode
- Digital processing with 16-bit control for high accuracy
- Ten 99-step Auto Sequence programs for easy benchtop programming of complex test routines
- Ten store/recall setup locations
- Isolated analog programming and readback standard
- Front panel soft calibration
- Remote sense with 5V line loss compensation



Specifications

INPUT

AC input voltage	Standard: 3-phase 342-500VAC, 47-63Hz. 3-wire and safety ground.
Switching frequency	Typical 31 kHz (62 kHz output ripple).

OUTPUT

Power	See table.
Regulation	See table.
Ripple and noise	See table.
Time delay	5 s maximum from power on until output stable.
Transient response time	<20 ms for output voltage to recover within 0.75% of its rated voltage after a step change in load current from 50% to 100% of rated output or from 100 to 50%.
Max voltage differential	±600 VDC from output to safety ground.
Front panel control	Rotary encoder knobs or keypad entry.
Front panel resolution	0.002% with keypad.

ENVIRONMENTAL

Operating temperature	0 to 50°C.
Storage temperature	-40 to 85°C.
Humidity	30 to 90% RH, non-condensing.

GENERAL

Dimensions	482.5x263.4x564.6 mm(WxHxD).
Weight	Approximately 77 kg (170 lb.).
AC input connector	4-terminal, wire clamp connector with strain relief cover.
Main output connector	10 to 100 V models: nickel-plated copper bus bars with bus bar shield; 150V to 600 V models: 4-terminal, wire clamp connector with strain relief.

STANDARDS

Safety and EMC standards	Units meet IEC 1010-1 safety standard and EN50081-2 and EN50082-2 EMC standards. Additional standards: CSA C22.2 No. 1010.1, UL 3111-1, and FCC, part 15, class A EMI standard.
CE mark	Yes.

PROGRAMMING

Remote Start/Stop and interlock	4-15 V signal or TTL-compatible input.
Remote analog programming	Voltage and current programming inputs: 0-5V, 0-10V (default) voltage sources. Inputs galvanically isolated from supply output.
Remote analog monitoring	Voltage and current monitor outputs 0-5 V, 0-10V (default) ranges for 0-100% of output. Galvanically isolated from supply output.
Remote programming and monitoring accuracy	< ±0.3% of full scale output.
Maximum remote sense	5 V/line (Line drop is subtracted from total voltage. Line drop compensation available at supply output.).

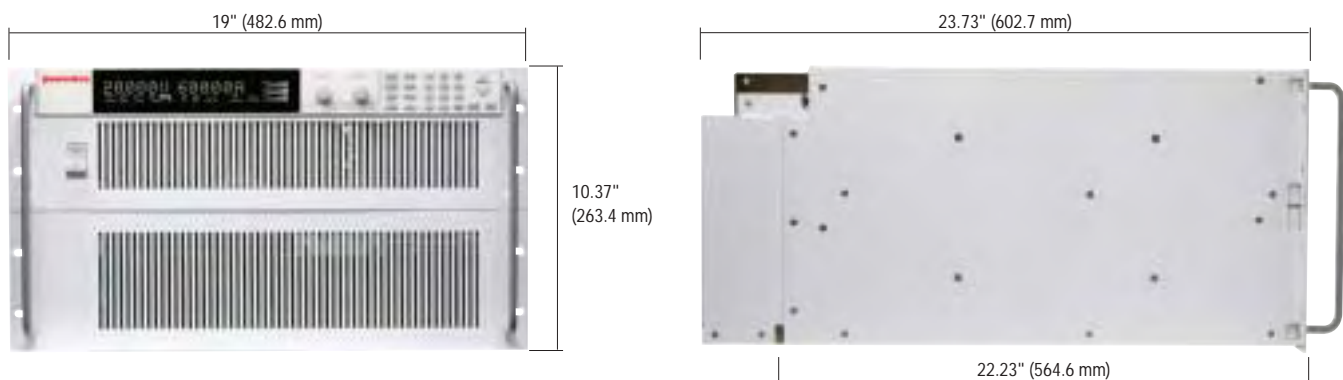
OPTIONS

GPIB	Multi-channel GPIB Interface card (16-bit).
CAN	Multi-channel CANbus interface.
LV-Input	3-phase 190-242VAC, 47-63Hz.

Electrical specifications

MODEL NUMBER	LBZ 10-1200	LBZ 20-600	LBZ 30-400	LBZ 40-300	LBZ 60-200	LBZ 80-150	LBZ 100-120	LBZ 150-80	LBZ 300-40	LBZ 600-20
Output Ratings:										
Output Voltage ¹	0-10 V	0-20 V	0-30 V	0-40 V	0-60 V	0-80 V	0-100 V	0-150 V	0-300 V	0-600 V
Output Current ²	0-1200 A	0-600 A	0-400 A	0-300 A	0-200 A	0-150 A	0-120 A	0-80 A	0-40 A	0-20 A
Output Power	12000 W	12000 W	12000 W	12000 W	12000 W	12000 W	12000 W	12000 W	12000 W	12000 W
Line Regulation: ³										
Voltage (0.01% of Vmax)	1 mV	2 mV	3 mV	4 mV	6 mV	8 mV	10 mV	15 mV	30 mV	60 mV
Current (0.05% of Imax + 5 mA)	1200 mA	600 mA	400 mA	300 mA	200 mA	150 mA	120 mA	80 mA	40 mA	20 mA
Load Regulation: ⁴										
Voltage (0.05% of Vmax + 5 mV)	10 mV	15 mV	20mV	25 mV	35 mV	45 mV	55 mV	80 mV	155 mV	305 mV
Current (0.1% of Imax + 20 mA)	2440 mA	1240 mA	840 mA	640 mA	440 mA	340 mA	280 mA	120 mA	100 mA	60 mA
Meter Accuracy:										
Voltage (0.15% of Vmax)	15 mV	30 mV	45 mV	60 mV	90 mV	120 mV	150 mV	225 mV	450 mV	900 mV
Current (0.15% of Imax)	6 A	3 A	2 A	1.5 A	1 A	750 mA	600 mA	400 mA	200 mA	100 mA
Output Noise (0-20MHz):										
Voltage (p-p)	75 mV	75 mV	75 mV	75 mV	100 mV	100 mV	100 mV	150 mV	250 mV	350 mV
Output Ripple (rms):										
Voltage	10 mV	10 mV	12 mV	15 mV	15 mV	15 mV	20 mV	20 mV	30 mV	80 mV
Current ⁵	6200 mA	3200 mA	2000 mA	1500 mA	900 mA	640 mA	460 mA	240 mA	100 mA	50 mA
Drift (30 minutes): ⁶										
Voltage (0.04% of Vmax)	4 mV	8 mV	12 mV	16 mV	24 mV	32 mV	40 mV	60 mV	120 mV	240 mV
Current (0.6% of Imax)	7200 mA	3600 mA	2400 mA	1800 mA	1200 mA	900 mA	720 mA	480 mA	240 mA	120 mA
Drift (8 hours): ⁷										
Voltage (0.02% of Vmax)	2 mV	4 mV	6 mV	8 mV	12 mV	16 mV	20 mV	30 mV	60 mV	120 mV
Current (0.04% of Imax)	480 mA	240 mA	160 mA	120 mA	80 mA	60 mA	48 mA	32 mA	16 mA	8 mA
Temperature Coefficient: ⁸										
Voltage (0.04% of Vmax/°C)	4 mV	8 mV	12 mV	16 mV	24 mV	32 mV	40 mV	60 mV	120 mV	240 mV
Current (0.06% of Imax/°C)	720 mA	360 mA	240 mA	180 mA	120 mA	90 mA	72 mA	48 mA	24 mA	12 mA
OVP Adjustment Range:										
(5% to 103% of Vmax)	0.5-10.3 V	1-20.6 V	1.5-30.9 V	2-41.2 V	3-61.8 V	4-88 V	5-110 V	7.5-165 V	15-330 V	30-660 V
Efficiency: ⁹										
	85%	87%	87%	87%	87%	89%	89%	90%	91%	91%

1. All electrical specifications are typical and represented at the full operating temperature range for all models, unless otherwise stated.
2. Minimum output voltage is <0.15% of rated voltage at zero output setting for 10V, 20V, 40V, 60V, 80V, and 100V models and <0.3% for 150V, 300V, and 600V models.
3. Minimum output current is <0.2% of rated current at zero setting when measured with rated load resistance.
4. For input voltage variation over the AC input voltage range, with constant rated load.
5. For 0-100% load variation, with constant nominal line voltage.
6. Current mode noise is measured from 10% to 100% of rated output voltage, full current, unit in current mode.
7. Maximum drift over 30 minutes with constant line, load, and temperature, after power up.
8. Maximum drift over 8 hours with constant line, load, and temperature, after 30 minutes warm-up.
9. Change in output per °C change in ambient temperature, with constant line and load.
10. Typical efficiency at nominal input voltage and full output power.



Features & Options LBX/LBZ Series

Standard features

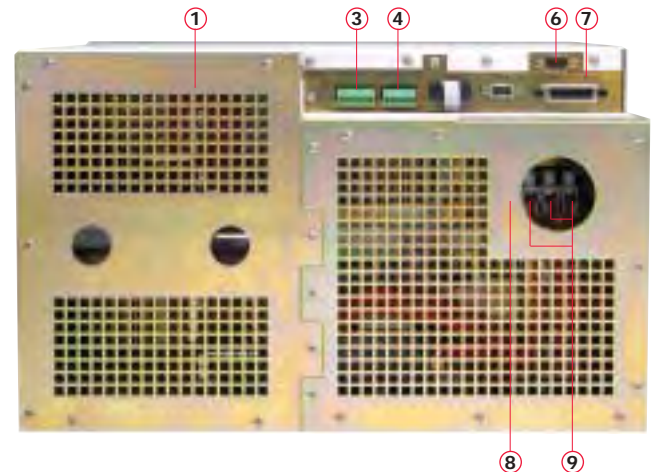
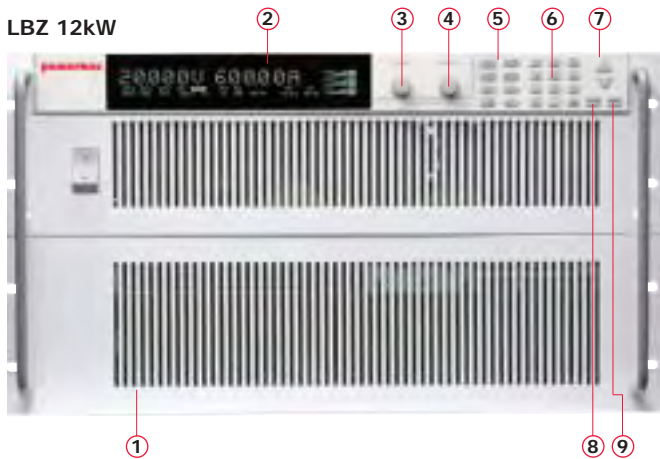
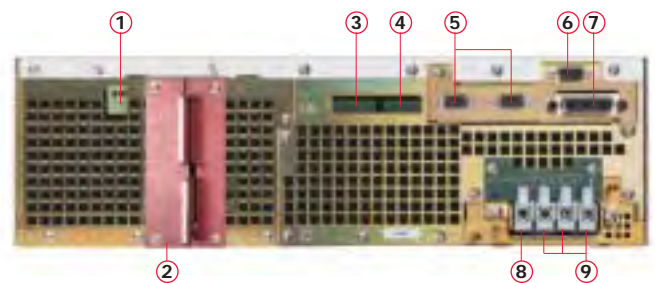
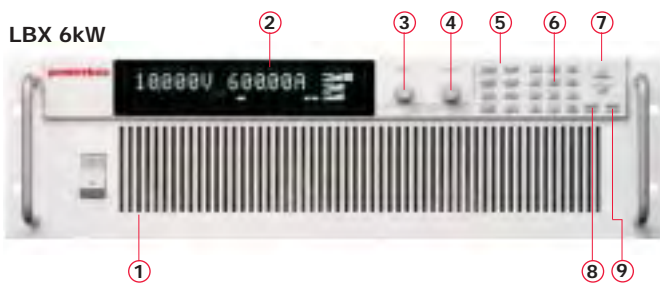
- 3Ø 208 VAC input
- Power Factor Correction (PFC)
- Zero voltage “soft” switching”
- Constant power mode
- 16-bit digital processing
- Ten store/recall setup locations
- 99-step, menu-driven auto sequencing
- Advanced internal programming
- Nine self-protection mechanisms
- Isolated analog programming
- RS-232 interface

- LabView® drivers
- Bright vacuum fluorescent display
- Front panel software-based calibration
- Remote sense with 5V line loss compensation
- UL, CSA, CE approvals; FCC compliant

Options

- GPIB interface card (488.2 with SCPI)
- CANbus communication link*
- High voltage input: 3Ø 342-500VAC HV input
- GPIB-multichannel*

* 6kW only



Front View

- 1 Large air intake area for maximum ventilation and cool operation
- 2 Vacuum fluorescent display
- 3 Precision digital encoded voltage knob
- 4 Precision digital encoded current knob
- 5 Control keys
- 6 Numeric keypad
- 7 Arrow keys
- 8 Enter key
- 9 Menu key

Back View

- 1 Remote sense ports
- 2 DC output (bus bars shown, terminal blocks for higher voltages)
- 3 Status lines, external interblock, and trigger input connectors
- 4 Isolated analog programming and readbacks
- 5 CANbus ports for master/slave or multi-channel operation (option for 6kW only)
- 6 RS-232 connector
- 7 GPIB (IEEE 488.2) connector (optional)
- 8 Safety ground connector
- 9 AC input connectors

Accessories & Interfaces

Analog Controlled Power Supplies

Analog Programming Interface (APG)

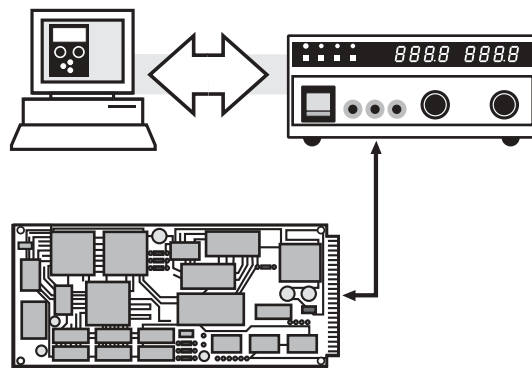
This internal analog programming card includes analog signal control of voltage and current, overvoltage protection (OVP), remote on/off, and master/slave tracking. Option to PBX40000 and PBX41000. Standard on all other series.

Isolated Interface (ISOL)

This interface allows for complete remote programming control of either the unit's output voltage or its current using analog program signals. These signals may be biased at any potential relative to the supply's return line within its maximum voltage differential specification. This card is suitable for the PBX44000, PBX45000, PBX46000 and PBX47000 Series power supplies.

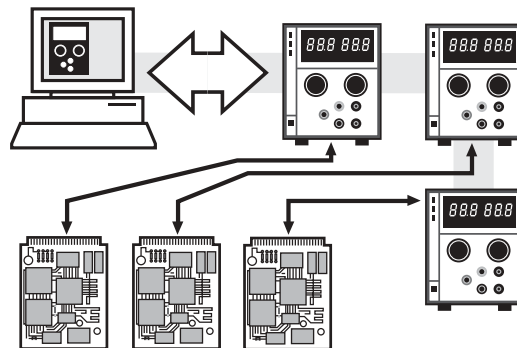
RS232 Controlled Power Supplies

Our RS232 Interface is useful for educators, researchers or independent electronics designers. It was created to control simple test systems, typically with one or two instruments, from your computer. No computer interface is required. You can use one of several software packages available for the RS232 port found on every personal computer today. This interface features fast, 16-bit resolution for programming and readback. It uses the command set and most of the user-programmable features employed by all our other interfaces. In addition, the RS232 protocol operates over longer cable distances than IEEE-488. For remote power supply control in simple applications, this is the best interface to use. Samples of the easy-to-read and operate computer program available to operate power supply controls.



GPIB Interface

This interface makes building test systems easy. It is a single channel interface using IEEE-488 communications. Each power supply using the interface resides at one port on the communications bus and responds to a complete set of computer commands for all remote programming applications. The GPIB Interface features the same fast, 16-bit resolution for programming and readback, as well as the complete, easy-to-use command set employed by our other interfaces. In addition, this interface gives you the IEEE-488 Service Request and Local Lockout capabilities. Choose the GPIB interface for complete remote control of all of our programmable power supplies.

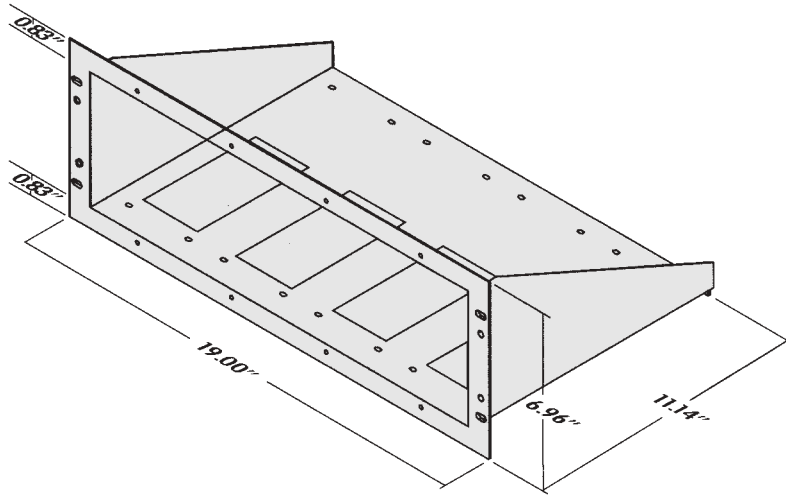


Rackmount Kit

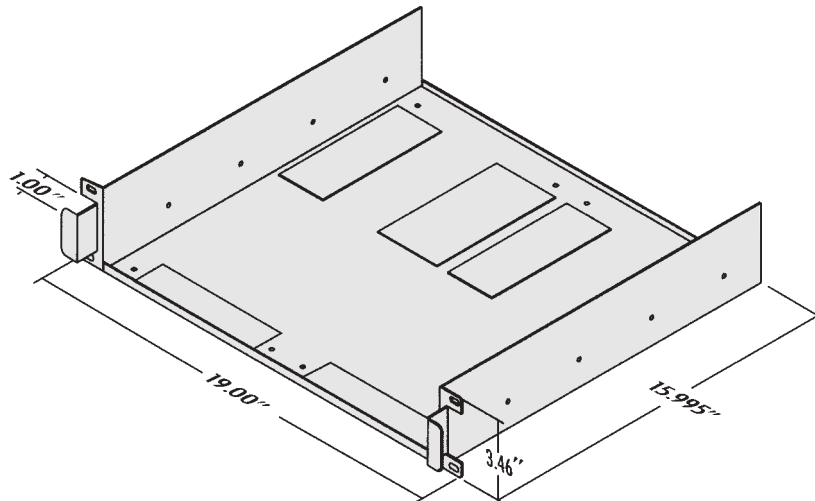
Rackmounts give your power supplies extra stability

You can also choose how you want to set up your system. Our power supplies can be stacked or mounted on racks. We have 2 kits available. See the drawings below.

Rackmount Kit for PBX 40000, PBX 41000 and LBQ Series



Rackmount Kit for PBX 45000 Series



Programming Interfaces

SPECIFICATION

Interface Specifications for the PBX 40000 Series with RS-232 or GPIB Interface Installed¹

MODEL NUMBER	PBX 407-6	PBX 4015-4	PBX 4020-3	PBX 4030-2	PBX 4060-1	PBX 40120-0.5	PBX 40250-0.25
Program Resolution (16-bit)							
Voltage	0.12 mV	0.25 mV	0.34 mV	0.5 mV	1.01 mV	2.01 mV	4.2 mV
Current	0.1 mA	0.07 mA	0.05 mA	0.03 mA	0.02 mA	0.01 mA	0.01 mA
OVP	0.12 mV	0.25 mV	0.34 mV	0.5 mV	1.01 mV	2.01 mV	4.2 mV
Program Accuracy							
Voltage (0.2%+10 mV)	24 mV	40 mV	50 mV	70 mV	130 mV	250 mV	510 mV
Current (0.3%+10 mA)	28 mA	22 mA	19 mA	16 mA	13 mA	11.5 mA	10.8 mA
OVP (0.5%+100 mV)	135 mV	175 mV	200 mV	250 mV	400 mV	700 mV	1350 mV
Readback Resolution (16-bit)							
Voltage	0.12 mV	0.25 mV	0.34 mV	0.5 mV	1.01 mV	2.01 mV	4.2 mV
Current	0.1 mA	0.07 mA	0.05 mA	0.03 mA	0.02 mA	0.01 mA	0.01 mA
Readback Accuracy							
Voltage (0.2%+20 mV)	34 mV	50 mV	60 mV	80 mV	140 mV	260 mV	520 mV
Current (0.3%+20 mA)	38 mA	32 mA	29 mA	26 mA	23 mA	21.5 mA	21 mA

Interface Specifications for the PBX 41000 Series with RS-232 or GPIB Interface Installed¹

MODEL NUMBER	PBX 4115-20	PBX 4130-10	PBX 4160-5
Program Resolution (16-bit)			
Voltage	0.25 mV	0.5 mV	1.01 mV
Current	0.34 mA	0.17 mA	0.08 mA
OVP	0.25 mV	0.5 mV	1.01 mV
Program Accuracy			
Voltage (0.2%+10 mV)	40 mV	70 mV	130 mV
Current (0.3%+10 mA)	70 mA	40 mA	25 mA
OVP (0.5%+100 mV)	175 mV	250 mV	400 mV
Readback Resolution (16-bit)			
Voltage	0.25 mV	0.5 mV	1.01 mV
Current	0.34 mA	0.17 mA	0.08 mA
Readback Accuracy			
Voltage (0.2%+20 mV)	50 mV	80 mV	140 mV
Current (0.3%+20 mA)	80 mA	50 mA	35 mA

Interface Specifications for the LBQ Series with RS-232 or GPIB Interface Installed²

MODEL NUMBER	LBQ 7.5-67	LBQ 18-30	LBQ 33-16	LBQ 60-9	LBQ 120-4.5
Program Resolution (16-bit)					
Voltage	0.13 mV	0.30 mV	0.55 mV	1.01 mV	2.01 mV
Current	1.12 mA	0.50 mA	0.27 mA	0.15 mA	0.08 mA
OVP	0.13 mV	0.30 mV	0.55 mV	1.01 mV	2.01 mV
Program Accuracy					
Voltage (0.2%+10 mV)	25 mV	46 mV	76 mV	130 mV	250 mV
Current (0.3%+10 mA)	211 mA	100 mA	58 mA	37 mA	23.5 mA
OVP (0.5%+100 mV)	138 mV	190 mV	265 mV	400 mV	700 mV
Readback Resolution (16-bit)					
Voltage	0.13 mV	0.30 mV	0.55 mV	1.01 mV	2.01 mV
Current	1.12 mA	0.50 mA	0.27 mA	0.15 mA	0.08 mA
Readback Accuracy					
Voltage (0.2%+20 mV)	35 mV	56 mV	86 mV	140 mV	260 mV
Current (0.3%+20 mA)	221 mA	110 mA	68 mA	47 mA	33.5 mA



Programming Interfaces

SPECIFICATION

Interface Specifications for the PBX 45000 Series with RS-232 or GPIB Interface Installed²

MODEL NUMBER	PBX 457.5130	PBX 4520-50	PBX 4533-33	PBX 4540-25	PBX 4560-18	PBX 45100-10	PBX 45150-7	PBX 45300-3.5	PBX 45600-1.7
Program Resolution (16 Bit)									
Voltage	0.13 mV	0.34 mV	0.55 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Current	2.18 mA	0.84 mA	0.55 mA	0.42 mA	0.3 mA	0.17 mA	0.12 mA	0.06 mA	0.03 mA
OVP	0.13 mV	0.34 mV	0.55 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Program Accuracy									
Voltage (0.2%+10 mV)	25 mV	50 mV	76 mV	90 mV	130 mV	210 mV	310 mV	610 mV	1210 mV
Current (0.3%+10 mA)	400 mA	160 mA	109 mA	85 mA	64 mA	40 mA	31 mA	21 mA	15 mA
OVP (0.5%+100 mV)	138 mV	200 mV	265mV	300 mV	400 mV	600 mV	850 mV	1600 mV	3100 mV
Readback Resolution (16 Bit)									
Voltage	0.13 mV	0.34 mV	0.55 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Current	2.18 mA	0.84 mA	0.55 mA	0.42 mA	0.3 mA	0.17 mA	0.12 mA	0.06 mA	0.03 mA
Readback Accuracy									
Voltage (0.2%+20 mV)	35 mV	60 mV	86 mV	100 mV	140 mV	220 mV	320 mV	620 mV	1220 mV
Current (0.3%+20 mA)	410 mA	170 mA	119 mA	95 mA	74 mA	50 mA	41 mA	31 mA	25 mA

Interface Specifications for the PBX 46000 Series with RS-232 or GPIB Interface Installed²

MODEL NUMBER	PBX 467.5-140	PBX 4612-100	PBX 4620-60	PBX 4635-35	PBX 4640-30	PBX 4660-20	PBX 46100-12	PBX 46150-8	PBX 46300-4	PBX 46600-2
Program Resolution (16-bit)										
Voltage	0.13 mV	0.2 mV	0.34 mV	0.59 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Current	2.35 mA	1.68 mA	1.01 mA	0.59 mA	0.5 mA	0.34 mA	0.2 mA	0.13 mA	0.07 mA	0.03 mA
OVP	0.13 mV	0.2 mV	0.34 mV	0.59 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Program Accuracy										
Voltage (0.2%+10 mV)	25 mV	34 mV	50 mV	80 mV	90 mV	130 mV	210 mV	310 mV	610 mV	1210 mV
Current (0.3%+10 mA)	430 mA	310 mA	190 mA	115 mA	100 mA	70 mA	46 mA	34 mA	22 mA	16 mA
OVP (0.5%+100 mV)	138 mV	160 mV	200 mV	275 mV	300 mV	400 mV	600 mV	850 mV	1600 mV	3100 mV
Readback Resolution (16-bit)										
Voltage	0.13 mV	0.2 mV	0.34 mV	0.59 mV	0.67 mV	1.01 mV	1.68 mV	2.52mV	5.04 mV	10.1 mV
Current	2.35 mA	1.68 mA	1.01 mA	0.59 mA	0.5 mA	0.34 mA	0.2 mA	0.13 mA	0.07 mA	0.03 mA
Readback Accuracy										
Voltage (0.2%+20 mV)	35 mV	44 mV	60mV	90 mV	100 mV	140 mV	220 mV	320 mV	620 mV	1220 mV
Current (0.3%+20 mA)	440 mA	320 mA	200 mA	125 mA	110 mA	80 mA	56 mA	44 mA	32 mA	26 mA

Interface Specifications for the PBX 47000 Series with RS-232 or GPIB Interface Installed¹

MODEL NUMBER	PBX 477.5-300	PBX 4712-220	PBX 4720-130	PBX 4740-70	PBX 4760-46	PBX 47100-28	PBX 47150-18	PBX 47300-9	PBX 47600-4
Program Resolution (16-bit)									
Voltage	0.13 mV	0.2 mV	0.34 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Current	5.04 mA	3.69 mA	2.18 mA	1.17 mA	0.77 mA	0.47 mA	0.3 mA	0.15 mA	0.07 mA
OVP	0.13 mV	0.2 mV	0.34 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Program Accuracy									
Voltage (0.2%+10 mV)	25 mV	34 mV	50 mV	90 mV	130 mV	210 mV	310 mV	610 mV	1210 mV
Current (0.3%+10 mA)	910 mA	670 mA	400 mA	220 mA	148 mA	94 mA	64 mA	37 mA	22 mA
OVP (0.5%+100 mV)	138 mV	160 mV	200mV	300 mV	400 mV	600 mV	850 mV	1600 mV	3100 mV
Readback Resolution (16-bit)									
Voltage	0.13 mV	0.2 mV	0.34 mV	0.67 mV	1.01 mV	1.68 mV	2.52 mV	5.04 mV	10.1 mV
Current	5.04 mA	3.69 mA	2.18 mA	1.17 mA	0.77 mA	0.47 mA	0.3 mA	0.15 mA	0.07 mA
Readback Accuracy									
Voltage (0.2%+20 mV)	35 mV	44 mV	60 mV	100 mV	140 mV	220 mV	320 mV	620 mV	1220 mV
Current (0.3%+20 mA)	920 mA	680 mA	410 mA	230 mA	158 mA	104 mA	74 mA	47 mA	32 mA

Programming Interfaces

SPECIFICATION

Interface Specifications for the LBX Series with RS-232 or GPIB Interface Installed²

MODEL NUMBER	LBX 10V/600A	LBX 20V/300A	LBX 30V/200A	LBX 40V/150A	LBX 60V/100A	LBX 80V/75A	LBX 100V/60A	LBX 150V/40A	LBX 300V/20A	LBX 600V/10A
Program Resolution (16 Bit)										
Voltage (0.002%)	0.2 mV	0.4 mV	0.6 mV	0.8 mV	1.2 mV	1.6 mV	2 mV	3 mV	6 mV	12 mV
Current (0.002%)	12 mA	6 mA	4 mA	3 mA	2 mA	1.5 mA	1.2 mA	0.8 mA	0.4 mA	0.2 mA
Program Accuracy										
Voltage (0.10%)	10 mV	20 mV	30 mV	40 mV	60 mV	80 mV	100 mV	150 mV	300 mV	600 mV
Current (0.15)	900 mA	450 mA	300 mA	225 mA	150 mA	112.5 mA	90 mA	60 mA	30 mA	15 mA
Readback Resolution (16 Bit)										
Voltage (0.002%)	0.2 mV	0.4 mV	0.6 mV	0.8 mV	1.2 mV	1.6 mV	2 mV	3 mV	6 mV	12 mV
Current (0.002%)	12 mA	6 mA	4 mA	3 mA	2 mA	1.5 mA	1.2 mA	0.8 mA	0.4 mA	0.2 mA
Readback Accuracy										
Voltage (0.15%)	15 mV	30 mV	45 mV	60 mV	90 mV	120 mV	150 mV	225 mV	450 mV	900 mV
Current (0.30%)	1800 mA	900 mA	600 mA	450 mA	300 mA	225 mA	180 mA	120 mA	60 mA	30 mA

Interface Specifications for the LBZ Series with RS-232 or GPIB Interface Installed²

MODEL NUMBER	LBZ 10V/1200A	LBZ 20V/600A	LBZ 30V/400A	LBZ 40V/300A	LBZ 60V/200A	LBZ 80V/150A	LBZ 100V/120A	LBZ 150V/80A	LBZ 300V/40A	LBZ 600V/20A
Program Resolution (16 Bit)										
Voltage (0.002%)	0.2 mV	0.4 mV	0.6 mV	0.8 mV	1.2 mV	1.6 mV	2 mV	3 mV	6 mV	12 mV
Current (0.002%)	24 mA	12 mA	8 mA	6 mA	4 mA	3 mA	2.4 mA	1.6 mA	0.8 mA	0.4 mA
Program Accuracy										
Voltage (0.10%)	10 mV	20 mV	30 mV	40 mV	60 mV	80 mV	100 mV	150 mV	300 mV	600 mV
Current (0.15)	1800 mA	900 mA	600 mA	450 mA	300 mA	225 mA	180 mA	120 mA	60 mA	30 mA
Readback Resolution (16 Bit)										
Voltage (0.002%)	0.2 mV	0.4 mV	0.6 mV	0.8 mV	1.2 mV	1.6 mV	2 mV	3 mV	6 mV	12 mV
Current (0.002%)	24 mA	12 mA	8 mA	6 mA	4 mA	3 mA	2.4 mA	1.6 mA	0.8 mA	0.4 mA
Readback Accuracy										
Voltage (0.15%)	15 mV	30 mV	45 mV	60 mV	90 mV	120 mV	150 mV	225 mV	450 mV	900 mV
Current (0.30%)	3600 mA	1800 mA	1200 mA	900 mA	600 mA	450 mA	360 mA	240 mA	120 mA	60 mA

1. Interface specifications are typical at 25°C \leq 5°C, nominal line input of 120VAC.

2. Interface specifications are typical and represented at the full operating temperature range for all models, unless otherwise stated.



“Soft” Switching

“Hard” Switching

Traditional high frequency switch-mode supplies, which rely on generating an AC waveform in the range of 100 kHz to 200 kHz to drive the main power transformer, have used power transistors to “hard-switch” the unregulated input voltage at this rate. This means that a transistor turning on will have the whole raw input voltage, typically in the range of 350 V, across it as it changes state. During the actual switching interval (less than 0.5 microsecond) there is a finite period as the transistor begins to conduct where the voltage begins to fall at the same time as current begins to flow. This simultaneous presence of voltage across the transistor and current through it means that, during this period, power is being dissipated within the device. A similar event occurs as the transistor turns off, with the full current flowing through it. (See Figure 1.)

Designers that use a hard-switching topology are in a no-win situation when they try to reduce wasted power, and still meet the EMC directive. As the switching period is reduced through the use of improved driving circuitry, the faster rise and fall times generate more high frequency energy that is radiated and conducted out of the unit as unacceptable radio frequency interference (RFI). If the rise and fall times are intentionally slowed to reduce the radio frequency interference, the power losses in the transistor increase proportionally, increasing the thermal stress on the part thus reducing its lifespan. In this way, older hard switching topologies are a compromise between electrical efficiency reduction and EMC “noise” trade-offs.

“Soft” Switching

More recently, new power conversion topologies have been developed which dramatically reduce the power dissipated by the main power transistors during the switching interval, while at the same time nearly eliminating much of the generated radio frequency energy, or high frequency “noise”. The most common technique employed has been a constant frequency resonant switching scheme, which ensures that the actual energy being dissipated by the active device is reduced to nearly zero. This method, commonly called “Zero Voltage Switching” (ZVS) or “Soft” Switching uses the parasitic output capacitance of the power transistors (typically MOSFETs) and the parasitic leakage inductance of the power transformer as a resonant circuit. Using this resonant circuit, the output inductance, the parasitic drain-source body diodes of the MOSFETs, and an appropriate switching sequence allows the voltage across each transistor to swing to zero before the device turns on and current flows. Likewise, at turn-off, the voltage differential across the transistor swings to zero before it is driven to a non-conductive state. With this scheme, current is only flowing through the transistors when they are fully “on”, and doing useful work transferring energy to the output of the supply. The power dissipation within the transistor that would normally occur during the switching interval has effectively been eliminated. (See Figure 2.) Unwanted high-frequency voltage and current transients during the switching period – the culprits that supply much of the RF noise radiated and conducted out of the power supply – are also dramatically reduced due to the smooth resonant transition. With the noise effectively reduced at its source, enhancing filtering at the input and output of the unit ensures that the unit is well within the noise limits set by international standards.

With “Soft” Switching techniques, reduction in wasted power will often improve the efficiency of a unit by more than 2%. While this does not sound significant, it can account for a saving of more than 20 W in a 1000W power supply. This 20 W is power that would have been dissipated by the main power transistors, the most critical and most heavily stressed semiconductors in any switch-mode power supply. Reducing the power here lowers their junction temperature, giving increased thermal operating margins and, hence, a longer life for the power supply. Not only does a “soft” switching power supply generate significantly less electrical noise, it achieves greater efficiency, longer mean time between failure (MTBF), and higher immunity to the effects of other equipment operating nearby. Both the LBO6000, LBO12000, PBX46000, PBX47000, PBX45000 and LBO 500 Series products use “Soft” Switching technology.

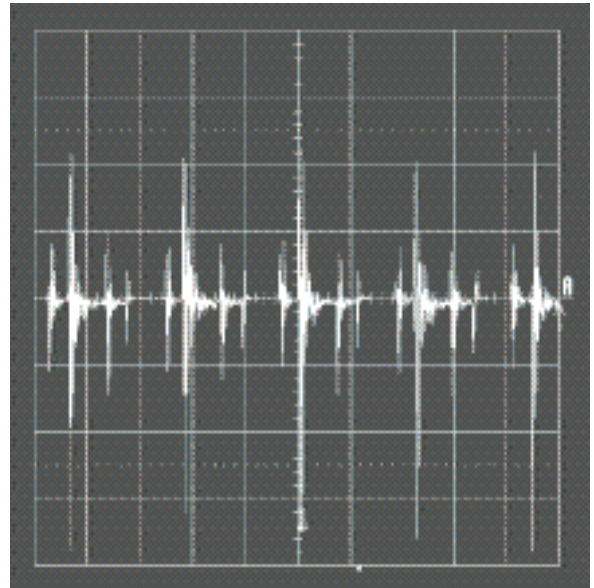


Figure 1. “Hard” switching topology power loss waveform for a bridge MOSFET (320 W/div) showing high instantaneous peak power loss during each switching cycle.

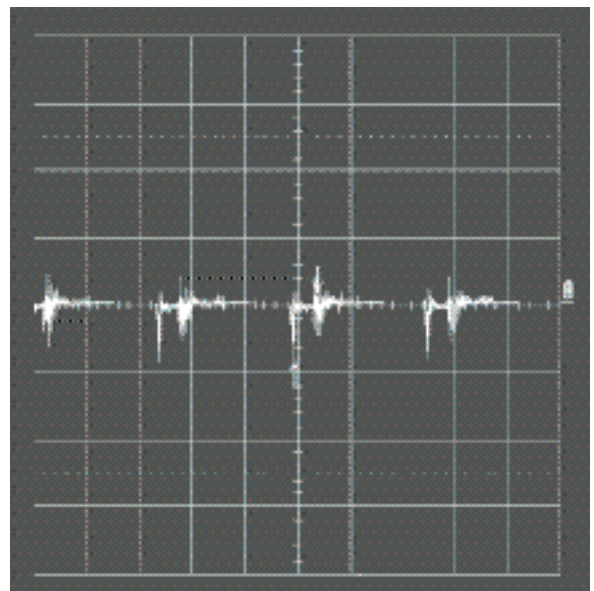


Figure 2. “Soft” switching topology power supply with the same rating as that in Figure 1. Power loss waveform for a bridge MOSFET (320 W/div). Instantaneous peak power is now reduced to less than one-quarter the level in the “hard” switching version.

Glossary of Terms

For ease of use, Powerbox use a standard format for power conversion product specifications. The following terms and related definitions are listed in the same order as they appear in a typical product specification.

INPUT	
Voltage	Nominal RMS value(s) of AC sinewave mains voltage(s) for which the converter is designed.
Nominal voltage	Typical frequently used input AC or DC voltages for which the converter is suitable.
Voltage range	The range(s) of input AC or DC voltage(s) over which the converter(s) operates within specification.
Frequency	The range of mains frequency over which the converter operates within specification.
Current at no load	The current drawn by the converter from the supply when the load current is zero and the input supply voltage is at the low end of the specified range.
Current at full load	The current drawn by the converter from the supply when the load current is at maximum rating and the input supply voltage is at the low end of the specified range.
Reflected ripple	The AC current generated at the input of a converter by the switching action of the converter.
Protection	Indicates if the converter is protected internally. The recommended fuse rating for the power supply may be given.
Reverse voltage protection	Protection circuit built into the input of the converter to prevent damage if a reverse polarity voltage is applied to the input.
Isolation	The electrical separation between the input and output expressed as a DC test voltage, and a resistance with parallel capacitance.
Safety isolation	The electrical separation between the primary and secondary circuits and the safety standards to which the converter conforms in this respect.
Filter	Indicates built in line input filter to attenuate reflected ripple current.
OUTPUT	
Power	The maximum continuous power measured in watts that can be taken from the output (s) of the converter.
Turn on delay	The time in seconds after switch on for the output(s) to reach their nominal voltage(s) within regulation limits.
Overshoot	A transient change in output voltage in excess of specified regulation limits.
Line regulation	The percentage change in output voltage caused by the input voltage varying over the specified range. This range is either mentioned, or is the actual input voltage range.
Load regulation	The percentage change in output voltage caused by a specified load variation.
Cross regulation	The percentage change in output voltage of one output caused by a specified load variation on another output of a multi-output converter.
Transient response	The maximum time for the output voltage to return within regulation limits following a specific load step change.
Setting accuracy	The percentage difference between the actual voltage setting and the nominal output voltage at rated load and nominal line input voltage.
Voltage balance	The difference, expressed as a percentage between the voltage magnitudes of a twin output converter, where the outputs have the same nominal voltage but the opposite polarity.
Voltage adjustment	The range over which the output voltage can be adjusted (and the means of adjustment).
Current adjustment	The range over which the output current can be adjusted (and the means of adjustment).
Resolution	The smallest incremental step adjustment possible by use of built-in controls.
Ripple and noise	The sum of all the voltage noise components expressed as a peak to peak amplitude over a specified band width.
Drift	A change of output voltage over a period of time, independent of input, load and temperature variations.
Overvoltage protection	A circuit which detects output overvoltages above a specified level and shuts down the converter to protect load circuits.
Reverse voltage protection	A built-in circuit (or element) that protects the converter from a reverse polarity applied across the output terminals.
Short circuit protection	Automatic output current limiting to prevent damage to the converter when a short circuit is applied across the output terminals.
Overload protection	A protective feature that limits output power or current demands to prevent damage to the converter.
Current limit adjustment	The range over which the protective current limit can be adjusted (and the means of adjustment).
Thermal protection	An internal temperature trip that shuts down the converter if the internal temperature exceeds a predetermined limit.
Temperature coefficient	The percentage change in output voltage per °C change in external ambient temperature averaged over the specified full rating operating temperature range.
Impedance	The apparent impedance presented by the converter to its output terminals.
Efficiency	The ratio of total output power to total true input power expressed as a percentage.
Hold up time	The minimum time the converter output(s) remain in regulation after loss of input power under full rated load and nominal input voltage conditions.
Power fail	A logic compatible signal warning that the outputs will fall outside regulation limits due to the loss of input power.
Minimum load	The minimum load current that should be taken from a converter output. Below regulation is not guaranteed.
Parallel operation	The ability of two or more converter outputs set to the same voltage to be connected in parallel to provide increased output current.
Series operation	The ability of two or more converter outputs to be wired in series to provide a higher output voltage.
Remote sense	A method of compensating the deterioration of regulation caused by the resistance of load connection lead. Accomplished by sensing the output voltage at the load and using the difference between this voltage and the internal reference to regulate the output voltage.



Glossary of Terms

Programming	The control of converter output voltage and/or current by varying an external parameter (voltage, current or resistance).
Remote adjustment	The ability to vary output voltage and/or current over a specified range by an external control.
Remote inhibit	Converter shutdown into a standby or idle mode by application of an external signal to the inhibit terminal.
Input common	Normally referenced to the negative side of the converter input.
Logic compatibility	Type of logic signal that can be used without level change or impedance transforms.
On control input voltage	Logic "hi" threshold.
Offcontrol input voltage	Logic "lo" threshold.
Shutdown idle current	Current drawn by the converter from the supply in standby.

ENVIRONMENTAL

Operating temperature	The range of ambient or baseplate temperature in °C over which a converter can be operated safely at either rated or derated output power.
Derating	The output power reduction required for safe operation above a specified temperature, usually expressed as a % reduction per °C up to the maximum operating temperature.
Storage temperature	The range of ambient temperatures over which a converter may be stored long term without damage. Expressed in °C.
Cooling	The process of removing heat dissipated internally within the power converter during normal operation. This may be by natural convection, or conduction to a baseplate, or by forced air.
Humidity	The maximum moisture content in the surrounding air for operation of the converter over the specified operating temperature range. Expressed as a percentage, it is the ratio of the actual mass of water vapour present to the mass of water vapour in the same volume of saturated air at the same temperature and pressure.
Altitude	The maximum altitude at which the converter can be used without derating.

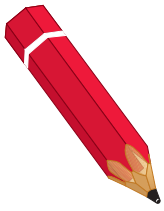
GENERAL

MTBF	The predicted average length of time (Mean time between failure) between failures exclusive of infant mortality and end of rated life.
MTTR	The predicted average length of time to (Mean time to repair) repair a faulty unit with the specified spares kit.
Safety standards	Standards laid down by various national and international regulatory agencies.
Approved	Approval, listing or certification of the converter has been obtained for the standards specified.
Designed to meet	Provided the converter is correctly installed it will not prevent the host equipment from obtaining official recognition to the standards specified.
Safety leakage current	When the input voltage is at nominal, the current flowing from the input lines to the protective earth conductor.

RFI standards	Limits laid down by various national and international regulatory agencies for radio frequency interference generated by electrical and electronic equipment.
Shock standards	Definition of the mechanical "bump" tests that can be applied to the converter without damage.
Vibration standards	Definition of the amplitude and frequency of mechanical vibration that can be applied to the converter without damage.
Design topology	The conversion principle employed (eg. linear, switched mode flyback, half bridge etc).
Switching frequency	The typical frequency of the converter switch at full rated load.
External synchronisation	The ability to synchronise the converter switching frequency to an external oscillator.
Ventilated case	Enclosed in a metal case with ventilation slots for cooling by convected or forced air.
Case grounding	Metal enclosures around converters will normally be connected to ground internally. Some converters have insulated cases.

If you would like to read about any other topics relating to power conversion technology in future editions, please contact the national Powerbox office with your suggestions.

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