ADVICE

AN ISO 9001 COMPANY
KEPCO®
THE POWER SUPPLIER™
SINCE 1946

KEPCO'S BOP FAMILY OF FOUR QUADRANT BIPOLAR POWER SUPPLIES

BOP 200W and 400W (Linear)

M MODELS: Standard - Analog Meter
200W Models: 20V, 36V, 50V, 100V, 200V
400W Models: 20V, 36V, 50V, 72V, 100V

D MODELS: Digital Meter

MODELS: Optimized for Capacitive Loads

-4886 MODELS: GPIB Control

BOP 40W High Voltage (Linear)

500V, 1000V

BOP 1KW (Switch-Mode)

MG MODELS: Standard
6V, 10V, 20V, 25V, 36V, 50V, 72V, 100V

GL MODELS: Optimized for Very Low Ripple and Noise
20V, 36V, 50V

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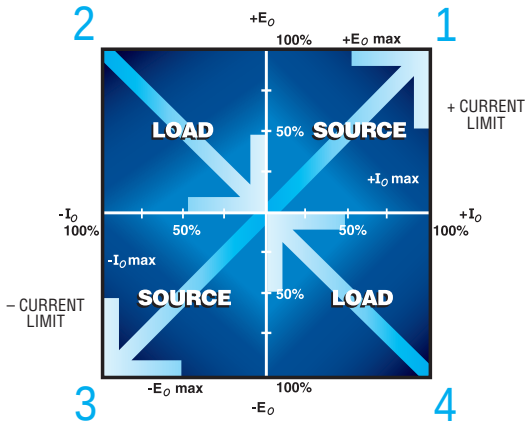
WHAT IS A 4 QUADRANT POWER SUPPLY?

Conventional d-c power supplies operate in a single quadrant of the voltage-current axis, delivering stabilized and adjustable d-c voltage or current to a load. They may be voltage stabilized, meaning that the current varies with the load, or they may be current stabilized, meaning that the voltage varies with the load.

Kepco's BOP operate in all four quadrants of the voltage-current axis, therefore their output may swing seamlessly from negative to positive voltage and the output current may also swing from positive to negative values. The result of this is that BOP will function as a source or a sink, meaning it will either deliver power to a load or absorb power from a load. In order to do that, the BOP is built as a power amplifier with a bipolar output, having a frequency bandwidth much larger than a regular power supply. The frequency bandwidth is model and option dependent.



FOUR-QUADRANT OPERATION FROM A KEPCO BOP POWER SUPPLY

In quadrant 1 of the volt-ampere axis, both voltage and current are positive so the BOP power supply is able to deliver power to a load. In quadrant 3 both are negative and the BOP is also a source. In quadrants 2 and 4, however, the voltage and current are of opposite polarity. In these two quadrants the BOP will act as a sink, absorbing power. **The sinking may be transient in nature as BOP absorbs energy stored in reactive elements or it may be steady state, when for example, BOP controls the discharge of a battery or acting as an electronic load, constant current for an external voltage source, or a constant voltage for an external current source.**

BOP 1KW (Switch-Mode)

Using switch-mode technology for low dissipation when sinking power from an active load, the BOP 1KW recuperate the energy for reuse. The key to this is a bi-directional a-c input power factor correcting (PFC) circuit, which allows transparent energy interchange without dissipative internal sinking.

The BOP 1KW has two primary control channels: voltage or current. Either of these may be controlled from full plus setting to full minus setting. To assure that they will intersect in one of the two source quadrants to form a closed boundary as do conventional unipolar power supplies, four auxiliary limit channels are provided: plus voltage, minus voltage, plus current and minus current. These four are controllable from a very small value to the nominal values. Their control does not pass through zero as do the primary voltage and current channels. The intersection of whichever primary control channel is engaged by the load and the respective limit channel does form a closed boundary, and a variable load automatically crosses over from the primary channel to the limit channel.

CE This KEPCO product is backed by a firm 5-YEAR WARRANTY

BOP 1KW MODEL TABLE

MODEL	d-c OUTPUT RANGE		CLOSED LOOP GAIN		OUTPUT IMPEDANCE			
					VOLTAGE MODE		CURRENT MODE	
	VOLTAGE V d-c	CURRENT A d-c	VOLTAGE CHANNEL G_V (V/V)	CURRENT CHANNEL G_I (A/V)	SERIES R mΩ	SERIES L μH	SHUNT R Ω	SHUNT C μF
1000 WATT								
BOP 6-125MG	0 to ±6	0 to ±125	0.6	12.5	0.05	1.5	24	1150
BOP 10-75MG	0 to ±10	0 to ±75	1.0	7.5	0.13	2.0	67	976
BOP 20-50MG	0 to ±20	0 to ±50	2.0	5.0	0.40	8.3	200	371
BOP 25-40MG	0 to ±25	0 to ±40	2.5	4.0	0.63	15.8	313	165
BOP 36-28MG	0 to ±36	0 to ±28	3.6	2.8	1.30	25	640	103
BOP 50-20MG	0 to ±50	0 to ±20	5.0	2.0	2.50	50	1250	55
BOP 72-14MG	0 to ±72	0 to ±14	7.2	1.4	5.14	104	2570	33
BOP 100-10MG	0 to ±100	0 to ±10	10.0	1.0	10.0	163	5000	16

NOTE: When connecting active loads, the steady-state voltage of the active load must not exceed the maximum voltage rating of the BOP. Otherwise the overvoltage protection will shut down the power supply.

BOP 1KW FEATURES

- Full 4-quadrant, 1000 watt, source-sink operation.
- Energy recuperation, during sink-mode, through a patented bi-directional PFC circuit.
- Meets the EN61000-3-2 harmonic limits. A built-in EN55011 Class A input EMI filter is provided.
- High efficiency switch-mode operation.
- Output voltage from ±6V to ±100V.
- Full digital control with built-in standard GPIB. Compatible with IEEE 488.2. Accepts standard SCPI commands. VISA driver provided. Also supports RS 232 bus.
- Large graphic LCD, displays settings and output voltage and current.
- Keypad control from front panel with menu to access functions.
- Calibration adjustments are made via the remote interface or locally from the keypad and are stored in non-volatile memory. Calibration is password protected.
- CE; Complies with the requirements of the Low Voltage Directive 73/23/EEC, the Marking and Declaration Directive 93/28/EEC, and the EMC Directive 89/336/EEC.
- Built-in complex waveform generator.
- Parallel (max. 5 units) or Serial (max. 3 units) connection of identical units. Parallel and Series connecting cables are required; contact factory for pricing.

YOU CAN MODEL MANY REAL-WORLD PHENOMENA IN WHICH POLARITY OR DIRECTION IS AN ISSUE

RIGHT/LEFT UP/DOWN HOT/COLD
CLOCKWISE/COUNTERCLOCKWISE
CHARGE/DISCHARGE FORWARD/REVERSE

APPLICATIONS FOR KEPCO'S BOP 1KW

Automotive
Battery and Motor Simulation and Testing

Wafer Deposition and Electroplating

Magnet Applications
Particle Beam Correctors and Injectors, Medical Imaging, etc.

Solar Panel Research and Testing

BOP 1KW INPUT CHARACTERISTICS

SPECIFICATIONS		RATING/DESCRIPTION	CONDITION
a-c Voltage	nominal	230V a-c	Single phase
	range	176-264V a-c	
Frequency	nominal	50/60 Hz	
	range	47-63 Hz	
Current	176V a-c	9.5A (7.5A)*	Maximum
	264V a-c	6.4A (4.4A)*	Maximum
Power Factor	source	0.99	Nominal output power Complies with EN 61000-3-2
	sink	0.97	
Efficiency		65% (56%)*	Minimum when sourcing
Switching Frequency		70 KHz ±5% (50KHz ±5%)*	Active PFC for source and sink

* BOP 6-125MG and BOP 10-75MG only.

BOP 1KW PROGRAMMING/DISPLAY CHARACTERISTICS

SPECIFICATIONS		RATING/DESCRIPTION	CONDITION
Analog Control	voltage or current main channel	-10V to +10V	Full range output
	± voltage and ± current protection limit channel	+0.05V to +10V	0.5% to 100% of nominal range
Digital Control	local	Panel-mounted keypad	Direct entry
	remote	IEEE 488-2 (GPIB)	SCPI
	remote	RS 232	
	remote	RS 485 (BITBUS)	Used for series and parallel configurations
Display	front panel	4" backlit LCD displays all functions	
	remote	All parameters read back on RS 232 and GPIB buses	

BOP 1KW GENERAL (ENVIRONMENTAL) SPECIFICATIONS

SPECIFICATIONS		RATING/DESCRIPTION	CONDITION
Temperature	operating	0 to +50°C	Full rated load
	storage	-20 to +85°C	
Cooling		Two internal fans	Exhaust to the rear
Humidity		0 to 95% RH	Non-condensing
Shock		20g, 11msec ±50% half sine	Non-operating
Vibration	5 -10 Hz	10mm double amplitude	3-axes, non-operating
	10-55 Hz	2g	3-axes, non-operating
Altitude		Sea level to 10,000 ft.	

BOP 1KW PHYSICAL CHARACTERISTICS

SPECIFICATIONS		RATING/DESCRIPTION	CONDITION
Dimensions	English	5.25" x 19" x 21.5"	H x W x D
	metric	133.3 x 482.6 x 546.1 mm	
Weight	English	53 lbs	
	metric	24.1kg	

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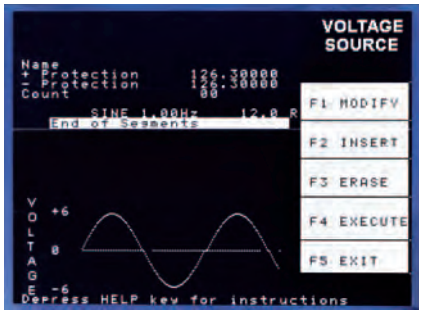
BOP 1KW OUTPUT CHARACTERISTICS

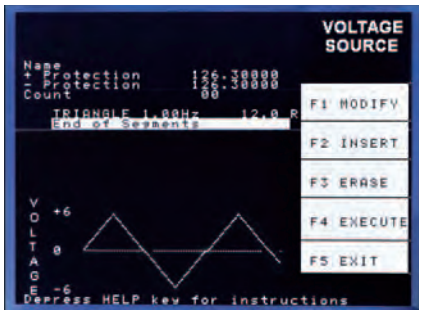
SPECIFICATIONS		RATING/DESCRIPTION	CONDITION
Type of Stabilizer		Voltage/Current 4-quadrant	Switch mode
Switching Frequency		100KHz ±5%	Output stage
Source Adjustment Range	voltage	-100% to +100% of rating	0-50°C
	current	-100% to +100% of rating	
Sink Adjustment Range	voltage	-100% to +100% of rating	0-50°C, recuperated energy is sent back into line for general reuse
	current	-100% to +100% of rating	
Voltage Stabilization in Voltage Mode	source effect	0.05% of rating	min-max input voltage
	load effect	0.1% of rating	0-100% load current
	time effect (drift)	0.02% of rating	0.5 - 8 hours
	temperature effect	0.02%/°C of rating	0-50°C
	ripple	2% $E_o$max p-p	Includes switching noise
	noise	0.2% $E_o$max rms	
Current Stabilization in Current Mode	source effect	0.05% of rating	min-max input voltage
	load effect	0.2% of rating	0-100% load current
	time effect (drift)	0.02% of rating	0.5 - 8 hours
	temperature effect	0.02%/°C of rating	0-50°C
	ripple	2% $I_o$max p-p	Includes switching noise
	noise	0.2% $I_o$max rms	
Error Sensing		0.25 volts per wire	Above rated output
Transient Recovery in Voltage Mode	maximum excursion	5% of nominal output	nominal voltage, 50% load step
	recovery time	200 µsec	Return within 0.1% of set voltage
Output Common Mode Voltage		300V	Output to chassis ground
Series Operation		Master/slave	Maximum of 3 identical units, up to 300V max.
Parallel Operation		Master/slave	Maximum of 5 identical units
Output Protection Limiting		Voltage and current limited in four quadrants	
Output Stage Protection		Output overvoltage/ overcurrent, heat sink overtemperature, switchers overcurrent	Triggers latched shutdown protection of the output module and PFC stage. Recover by cycling power off, then on or by pressing **RESET** at the front panel
Input Stage Protection (PFC)		Internal overvoltage, undervoltage, overcurrent, heat sink overtemperature, fan inoperative	
		Input circuit breaker overcurrent	Trips circuit breaker to shut off unit
Small Signal Bandwidth	voltage channel	2 KHz maximum	Into nominal resistive load
	current channel	800 Hz maximum (600 Hz Maximum) (1)	Into short circuit
Rise/Fall Time	voltage channel	250/200 µsec	Into nominal resistive load
	current channel	0.7/1.2 mSec	Into short circuit

BOP 1KW ALLOW FOR AUTOMATIC CREATION AND DISPLAY OF VARIOUS WAVEFORMS AND COMPLEX PATTERNS

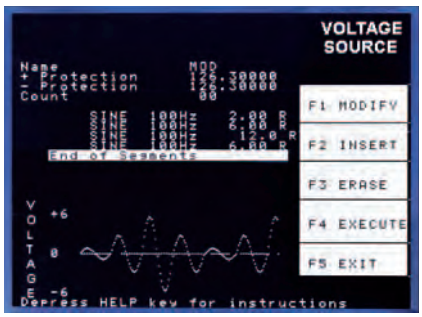
The 1000-watt models have an internal waveform generator that allows a user to combine segments of a sinusoidal waveform, triangular waveform, a ramp, a saw tooth waveform and a square 50% duty cycle pulse, plus d-c to create a variety of arbitrary waveforms. 3,933 of points per basic waveform can be programmed with arbitrary phase relationships. The resulting waveshape can be repeated from 1 to 255 times. The waveshape can also be executed indefinitely until a stop command is received. The waveshape graphics are displayed on the front panel-mounted LCD display, which also shows both settings and actual d-c output values. The programmed waveshapes can be used to control either voltage or current with both positive and negative values. It is possible to reproduce an a-c sinusoid with differing degrees of distortion or dropouts for test purposes. Alternatively, varying amounts of "noise" can be added to a d-c output to gauge the effect on a test subject.



Sine Waveform



Triangle Waveform



Complex Sine Waveform

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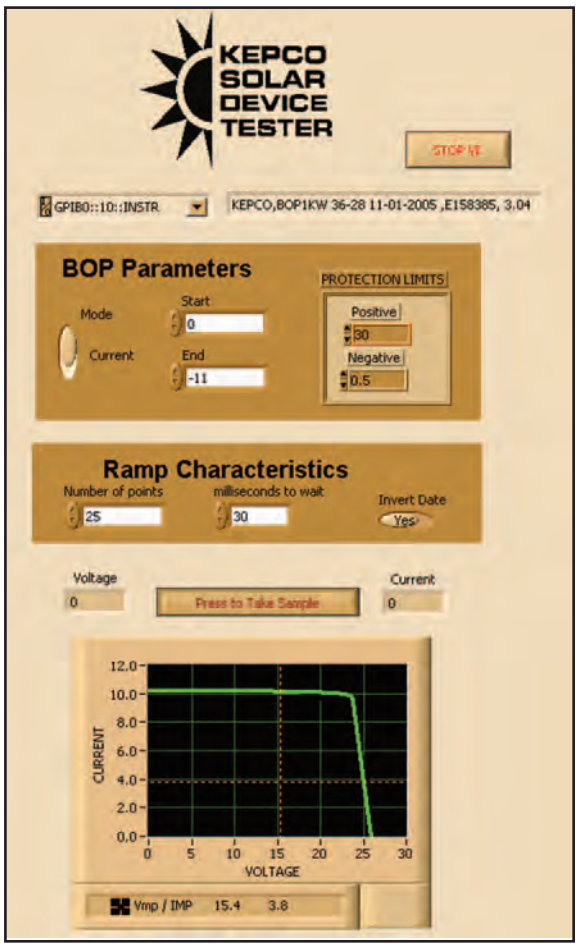
USING KEPCO BOP 1KW FOR SOLAR DEVICE TESTING

The Kepco BOP 1KW provides a one-step solution for test and characterization of solar cells and solar panels. A free LabView subvi allows rapid characterization of the solar device using only the BOP 1KW, eliminating the need for separate DVMs to measure voltage and current. The subvi is designed for both I-V Trace and Dark I-V testing, and can be plugged in or easily adapted to existing LabView test applications, even those previously using two DVMs. This solution offers lower cost, greater throughput and increased ROI when testing solar devices.

BOP 1KW SOLAR DEVICE TESTING FEATURES AND BENEFITS

- SOLAR DEVICE TESTING - Both I-V Trace and Dark I-V Tests supported.
- FLEXIBILITY - KEPCO BOP 1KW LabView Driver allows Solar Device testing while maintaining full functionality of the BOP 1KW Instrument Power Supply features.
- FASTER THROUGHPUT - 20mS per point.
- ROI - Test setups are quick and easy, require no special programming for synchronization, require no dedicated engineering resources to design and/or maintain components comprising a custom solution.
- LOWER COST AND SIMPLICITY - No need to purchase, maintain and calibrate two DVMs - Simplifies calibration, test setup and operation; no trigger connections needed.
- RELIABILITY - With all triggering and measurements done within BOP 1KW there are no synchronization or noise issues.
- PROVEN TECHNOLOGY - Enhancement of proven BOP 1KW technology.
- ENERGY CONSERVATION - Employs energy recuperation as well as active Power Factor Correction (PFC).



Demonstration Application Interface Showing User Inputs and Rendered I-V Curve Output

BOP 1KW GL SERIES OPTIMIZED FOR VERY LOW RIPPLE AND NOISE

The BOP-GL series models are a standard modification of the 1KW that have been optimized for exceptionally low current ripple and noise and improved stability (drift and temperature), making them ideal for driving inductive loads such as large magnets or motors. These bipolar power supplies pass smoothly through zero without switching to provide true ± voltage and ± current.

BOP-GL 1000 WATT MODEL TABLE

MODEL	d-c OUTPUT RANGE		CLOSED LOOP GAIN		RIPPLE AND NOISE	
	E_O MAX V d-c	I_O MAX A d-c	VOLTAGE CHANNEL	CURRENT CHANNEL	VOLTAGE rms	CURRENT rms
1000 WATT						
BOP 20-50GL	0 to ±20	0 to ±50	2.0	5.0	0.02%	0.01%
BOP 36-28GL	0 to ±36	0 to ±28	3.6	2.8	0.02%	0.01%
BOP 50-20GL	0 to ±50	0 to ±20	5.0	2.0	0.02%	0.01%

NOTE: When connecting active loads, the steady-state voltage of the active load must not exceed the maximum voltage rating of the BOP. Otherwise the overvoltage protection will shut down the power supply.

For other volt-ampere combinations, consult factory.

BOP 40W HIGH VOLTAGE (Linear)

The Kepco Model BOP 500M and BOP 1000M are high voltage power sources, up to ±500V or ±1000V, respectively.

For full specs, visit our Web site at www.kepcopower.com/bophv.htm.

These combine the capabilities of fast programmable power supplies with a Class A output stage, which can respond bi-directionally from zero. They can be operated in either a "voltage stabilizing" or "current stabilizing" mode. To realize the full high speed potential of the BOP HV, the load characteristics should be mainly resistive. Load capacitance and inductance up to 0.01µF and 0.5mH can be tolerated without performance deterioration.

CE This KEPCO product is backed by a firm 5-YEAR WARRANTY

BOP HIGH VOLTAGE MODEL TABLE

MODEL[3]	d-c OUTPUT RANGE E_o max.	d-c OUTPUT RANGE I_o max.	CLOSE LOOP GAIN VOLTAGE CHANNEL G_V (V/V)	CLOSE LOOP GAIN CURRENT CHANNEL G_I (mA/V)	OUTPUT IMPEDANCE VOLTAGE MODE SERIES R	OUTPUT IMPEDANCE VOLTAGE MODE SERIES L[1]	OUTPUT IMPEDANCE CURRENT MODE SHUNT R	OUTPUT IMPEDANCE CURRENT MODE SHUNT C[2]
BOP 500M	±500V	±80mA	50	8.0	0.05Ω	5mH	100MΩ	0.3µF
BOP 1000M	±1000V	±40mA	100	4.0	0.2Ω	50mH	400MΩ	0.4µF

(1) For determining dynamic impedance in voltage mode.
(2) For determining dynamic impedance in current mode.
(3) To specify digital display, substitute the suffix "DM" for "M."

BOP 200W AND 400W (Linear)

The BOP 200W and 400W are high-speed operational amplifiers with full 4-quadrant, bipolar operation.

Their output is capable of both sustained d-c and the replication of arbitrary a-c waveforms. Voltage and current outputs can be controlled smoothly and linearly through the entire rated plus and minus ranges, passing smoothly through zero with no polarity switching.

CE This KEPCO product is backed by a firm 5-YEAR WARRANTY

BOP 200W AND 400W MODEL TABLE

MODEL (1) (5)	d-c OUTPUT RANGE VOLTAGE V d-c	d-c OUTPUT RANGE CURRENT A d-c	CLOSED LOOP GAIN VOLTAGE CHANNEL G_V (V/V)	CLOSED LOOP GAIN CURRENT CHANNEL G_I (A/V)	OUTPUT IMPEDANCE VOLTAGE MODE SERIES R mΩ	OUTPUT IMPEDANCE VOLTAGE MODE SERIES L µH (2)	OUTPUT IMPEDANCE CURRENT MODE SHUNT R KΩ	OUTPUT IMPEDANCE CURRENT MODE SHUNT C µF (3)
200 WATT								
BOP 20-10M	0 to ±20	0 to ±10	2.0	1.0	0.04	40	20	0.05
BOP 36-6M	0 to ±36	0 to ±6	3.6	0.6	0.12	20	36	0.03
BOP 50-4M	0 to ±50	0 to ±4	5.0	0.4	0.25	50	50	0.02
BOP 100-2M	0 to ±100	0 to ±2	10.0	0.2	1.0	60	100	0.03
BOP 200-1M (4)	0 to ±200	0 to ±1	20.0	0.1	4.0	1200	200	0.03
400 WATT								
BOP 20-20M	0 to ±20	0 to ±20	2.0	2.0	0.02	10	20	0.5
BOP 36-12M	0 to ±36	0 to ±12	3.6	1.2	0.06	50	36	0.4
BOP 50-8M	0 to ±50	0 to ±8	5.0	0.8	0.125	100	50	0.15
BOP 72-6M	0 to ±72	0 to ±6	7.2	0.6	0.24	200	72	0.1
BOP 100-4M	0 to ±100	0 to ±4	10.0	0.4	0.5	200	100	0.1

(1) Optional digital control va GPIB or RS232. Add suffix -4886.
(2) For determining dynamic impedance in voltage mode.
(3) For determining dynamic impedance in current mode. (4) Same size as 400W models.
(5) To specify digital display, substitute the suffix letter "D" for the suffix letter "M."

BOP 200W AND 400W FEATURES

- Source 100% and sink 50% of the output power rating.
- Separate control circuits for voltage and current with automatic crossover between main channel and limit channel.
- Controls and flag signals accessible through a 50-terminal port at the rear.
- Zeroable preamplifier available for scaling and summing external signals.
- Optional digital control via GPIB or RS 232. Add suffix -4886.
- Parallel and Series connection of identical models.
- Mounting in standard 19" racks
  RA 37: 3/4 rack size
  Mounting "ears" supplied: full rack size

APPLICATIONS FOR KEPCO'S BOP 200W AND 400W

Automotive
Battery and Motor Simulation and Testing

Wafer Deposition and Electroplating

Magnet Applications
Beam Steering, Medical Imaging, etc.

Solar Panel Research and Testing

For full specs, visit our Web site at www.kepcopower.com/bop.htm.

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OPTIMIZE BOP 200W AND 400W FOR DRIVING INDUCTIVE LOADS TO 1 HENRY

As an option (L suffix), Kepco's 200W (except BOP 200-1M) and 400W BOP models may be optimized for driving inductive loads. These BOP units are designed to operate in a stable manner in Current or Current Limit Mode for loads up to 1 Henry. They are also stable with any R-L series load combination.

To prevent voltage limit operation, the equivalent impedance of the R-L series load at the working frequency, must be lower than the nominal resistive load value (nominal output voltage/nominal output current).

All specifications of the unit in voltage mode are unchanged from the standard model. The specifications listed in the table to the right are for inductive load models in Current Mode. All other specifications are identical to the standard BOP.

In current mode the bandwidth of the BOP is reduced when operating with a resistive load. Correspondingly, the rise and fall time of the unit is increased (model dependent). Further, it is possible to reduce the bandwidth in current mode in a predictable way, using one customer installed component on the rear programming connector of the BOP (see Bandwidth Correction Chart).

APPLICATIONS FOR KEPCO'S BOP INDUCTIVE LOAD MODELS

Motor Testing

Testing of Magnetic Components Coils, Speakers, etc.

Industrial Applications with Inductive Loads

Driving CRT Coils

Cryogenic Applications

Correcting Magnets for Medical Imaging or Particle Accelerators

For more information on the BOP Inductive Load Models visit www.kepcopower.com/bop-ind.htm

BOP INDUCTIVE LOAD SPECIFICATIONS

MODEL / SPECIFICATION (1)	BANDWIDTH (DC TO F-3dB)		RISE/FALL TIME (2)	RECOVERY TIME CONSTANT AT STEP LOAD (3)	LOAD EFFECT RESISTIVE LOAD, NOMINAL (4)
	RESISTIVE LOAD, NOMINAL	INDUCTIVE LOAD, 2mH			
200 WATT					
BOP 20-10ML 0 to ±20V, 0 to ±10A	11.2 KHz	4.1 KHz	35µS	220µS	12 ppm/Hz
BOP 36-6ML 0 to ±36V, 0 to ±6A	12 KHz	5 KHz	30µS	210µS	4 ppm/Hz
BOP 50-4ML 0 to ±50V, 0 to ±4A	1.43 KHz	1.8 KHz	245µS	280µS	20 ppm/Hz
BOP 100-2ML 0 to ±100V, 0 to ±2A	3.5 KHz	5.0 KHz	84µS	250µS	47 ppm/Hz
400 WATT					
BOP 20-20ML 0 to ±20V, 0 to ±20A	12 KHz	2.5 KHz	33µS	180µS	3 ppm/Hz
BOP 36-12ML 0 to ±36V, 0 to ±12A	12.7 KHz	6.8 KHz	28µS	100µS	3 ppm/Hz
BOP 50-8ML 0 to ±50V, 0 to ±8A	10.6 KHz	4.9 KHz	31µS	200µS	7 ppm/Hz
BOP 72-6ML 0 to ±72V, 0 to ±6A	2.6 KHz	2.7 KHz	125µS	200µS	50 ppm/Hz
BOP 100-4ML 0 to ±100V, 0 to ±4A	1.2 KHz	1.7 KHz	220µS	280µS	70 ppm/Hz

For digital meters, substitute the letter D for M when ordering - example: BOP 20-10DL.

For GPIB control of the BOP, add the suffix 4886 after the letter L in the model name - example: BOP 20-10ML4886.

(1) All specifications listed are for inductive load models in Current Mode. All other specifications are identical to the standard BOP.
(2) 10% - 90%, nominal resistive load.
(3) Short-circuit, nominal resistive load.
(4) Load effect increases nonlinearly with frequency from the typical 0.5 mA in DC full scale (same as the standard unit) at the average rate listed.

BOP INDUCTIVE LOAD - BANDWIDTH CORRECTION

MODEL	EXTERNAL CAPACITOR (ACROSS PINS 16 AND 18 OF PC 12 PROGRAMMING CONNECTOR)						
	0.01 µF	0.02 µF	0.05 µF	0.1 µF	0.2 µF	0.5 µF	1 µF
200 WATT							
BOP 20-10ML	4.1 KHz	2.3 KHz	1.0 KHz	0.57 KHz	0.27 KHz	0.11 KHz	0.06 KHz
BOP 36-6ML	4.0 KHz	2.5 KHz	1.0 KHz	0.55 KHz	0.25 KHz	0.12 KHz	0.06 KHz
BOP 50-4ML	1.4 KHz	1.2 KHz	0.7 KHz	0.47 KHz	0.25 KHz	0.11 KHz	0.06 KHz
BOP 100-2ML	1.8 KHz	1.4 KHz	0.8 KHz	0.51 KHz	0.27 KHz	0.11 KHz	0.06 KHz
400 WATT							
BOP 20-20ML	4.0 KHz	2.4 KHz	1.0 KHz	0.57 KHz	0.30 KHz	0.12 KHz	0.07 KHz
BOP 36-12ML	4 KHz	2.4 KHz	1 KHz	0.57 KHz	0.27 KHz	0.11 KHz	0.06 KHz
BOP 50-8ML	3.6 KHz	2.1 KHz	0.93 KHz	0.54 KHz	0.29 KHz	0.12 KHz	0.06 KHz
BOP 72-6ML	1.75 KHz	1.3 KHz	0.75 KHz	0.47 KHz	0.26 KHz	0.11 KHz	0.06 KHz
BOP 100-4ML	1.0 KHz	0.8 KHz	0.6 KHz	0.4 KHz	0.23 KHz	0.11 KHz	0.06 KHz

OPTIMIZE BOP 200W AND 400W FOR DRIVING CAPACITIVE LOADS TO 10 MILLI-FARADS

As an option (C suffix), Kepco's 200 Watt (except BOP 200-1M) and 400 Watt BOP models may be optimized for driving capacitive loads.

These BOP units are designed to operate in a stable manner in voltage or voltage limit mode for capacitive loads up to 10mF. They are also stable when driving any R-C parallel combination where load R is ≥ nominal value and C is ≤10mF. Load R (nominal value) = nominal output Voltage/nominal output Current (e.g., BOP 36-6MC, R = 36/6 = 6 Ohms). To prevent current limit operation, the equivalent impedance of the R-C parallel load circuit at the working frequency must be greater than the nominal R value.

Static specifications representing accuracy for various influence parameters are identical to the standard BOP models. Ripple and noise specifications are better (approximately 50% lower) for the C option units compared to the standard BOP.

In voltage mode, with a resistive load, the bandwidth of the BOP Capacitive Load is reduced versus the standard model, while the response time is increased (except the 20V model: see Specifications Chart). The frequency response variations can be practically eliminated by reducing the bandwidth in voltage mode in a predictable manner using an internal user-installed component to increase the internal compensation capacitance (see Bandwidth Correction Chart).

In Current Mode the dynamic specifications are almost identical for all BOP C option models: 3-dB bandwidth of 4.9kHz and rise/fall time of 72µsec (lower bandwidth and higher rise/fall time than the standard BOP models).

APPLICATIONS FOR KEPCO'S BOP CAPACITIVE LOAD MODELS

Solar Cell/Panel Research and Testing

Driving and Testing Piezo-Electric Devices

Capacitor Testing

Driving and Testing Capacitive Transducers

Industrial or Lab Applications with Capacitive or Capacitive-Resistive Loads

BOP CAPACITIVE LOAD SPECIFICATIONS

MODEL / SPECIFICATION (1)	BANDWIDTH (DC TO F-3dB)		RISE/FALL TIME (4)	RECOVERY TIME AT STEP LOAD (5)
	RESISTIVE LOAD, NOMINAL (2)	CAPACITIVE LOAD, 10uF (3)		
200 WATT				
BOP 20-10MC 0 to ±20V, 0 to ±10A	12 KHz	14 KHz	32µS	100µS
BOP 36-6MC 0 to ±36V, 0 to ±6A	13.5 KHz	16.3 KHz	32µS	95µS
BOP 50-4MC 0 to ±50V, 0 to ±4A	11.5 KHz	15 KHz	35µS	100µS
400 WATT				
BOP 20-20MC 0 to ±20V, 0 to ±20A	4.8 KHz	5.3 KHz	75µS	225µS
BOP 36-12MC 0 to ±36V, 0 to ±12A	13.5 KHz	16 KHz	30µS	95µS
BOP 50-8MC 0 to ±50V, 0 to ±8A	9 KHz	11 KHz	38µS	160µS
BOP 72-6MC 0 to ±72V, 0 to ±6A	6.5 KHz	8.3 KHz	60µS	184µS
BOP 100-4MC 0 to ±100V, 0 to ±4A	6.0 KHz	8.0 KHz	66µS	190µS

For digital meters, substitute the letter D for M when ordering - example: BOP 20-20DC.

For GPIB control of the BOP, add the suffix 4886 after the letter C in the model name - example: BOP 20-20MC4886.

(1) All specifications listed are for capacitive load models in Voltage Mode.
(2) For BOP 20-20MC, DC: nonuniformities of the frequency response creates a larger 3-dB bandwidth for the resistive load than for the standard BOP.
(3) Nonuniformities of the frequency response for the standard 10µF load create a larger 3-dB bandwidth than for the resistive load.
(4) 10% - 90%, with nominal resistive load.
(5) Load between infinity and nominal resistive values.

BOP CAPACITIVE LOAD - BANDWIDTH CORRECTION

MODEL	INTERNAL USER-INSTALLED CAPACITOR						
	1 nF	2.2 nF	4.7 nF	15 nF	33 nF	47 nF	100 nF
200 WATT							
BOP 20-10MC	11.5 KHz	9 KHz	7.5 KHz	3.5 KHz	2.2 KHz	1.3 KHz	0.5 KHz
BOP 36-6MC	12.1 KHz	10 KHz	7.8 KHz	3.5 KHz	2.2 KHz	1.4 KHz	0.5 KHz
BOP 50-4MC	11 KHz	9 KHz	7 KHz	3 KHz	1.5 KHz	1 KHz	0.5 KHz
400 WATT							
BOP 20-20MC	4.6 KHz	4.4 KHz	3.2 KHz	1.3 KHz	0.7 KHz	0.6 KHz	0.5 KHz
BOP 36-12MC	12 KHz	10 KHz	7.6 KHz	3.5 KHz	2.2 KHz	1.4 KHz	0.5 KHz
BOP 50-8MC	8.5 KHz	8 KHz	6.5 KHz	4.5 KHz	3 KHz	1.5 KHz	0.5 KHz
BOP 72-6MC	6.5 KHz	6.0 KHz	5.3 KHz	2.7 KHz	1.4 KHz	0.9 KHz	0.5 KHz
BOP 100-4MC	6.0 KHz	5.4 KHz	4.2 KHz	2.5 KHz	1.5 KHz	1.1 KHz	0.5 KHz

The listed bandwidth values are for C option units in Voltage Mode, nominal resistive load.