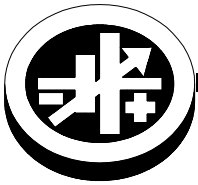


QUICK START GUIDE



KEPCO An ISO 9001 Company.

BOP
100W, 200W,
400W **CE**

BIPOLAR OPERATIONAL POWER SUPPLY

I — INTRODUCTION

1.1. SCOPE OF MANUAL. This Quick Start Guide covers simple installation and local operation of the Kepco 100W, 200W and 400W Series of BOP Bipolar Operational Power Supplies. Full specifications, features and instructions are found in the BOP Operator Manual that can be downloaded free from the Kepco web site at:

www.kepcopower.com/support/opmanls.htm#bop-op

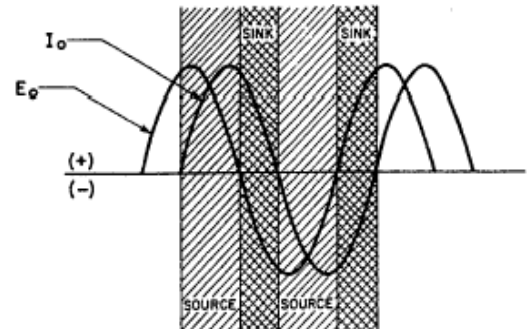
1.2. DESCRIPTION. Kepco's BOP are linear stabilizers with two bipolar control channels (voltage or current mode), selectable and individually controllable either by front panel controls, or by remote signals. These two principal control channels are each protected by bipolar limit circuits. The positive and negative current or voltage limit points can be manually set or remotely programmed simultaneously or Individually. Automatic crossover between each principal control channel and the limit channels is provided. Only one principle channel (voltage or current) can control the output at any one time.

The BOP can operate in all four voltage-current quadrants; it can act as either a source (output voltage is the same direction as output current) or a sink (output voltage is opposite that of output current). An example is shown in Figure 1 where the BOP is programmed to deliver a sine wave output and the load produces a phase shift between the output voltage and current. See applicable BOP Operator Manual (PAR. 1.1) for limits on long-term operation in sink mode.

Remote On-Off Feature. A new remote on-off feature is now included in most BOP models. The front panel REMOTE indicator (Figure 2 or 3) is a dual-function indicator labelled REMOTE (W/ DIG ON)/OUT ON (W/DIG OFF. When digital programming is ON (optional BIT card in use), the indicator is on to show remote mode. When digital programming is OFF the indicator only goes on when the OUTPUT is ON. Isolated remote on-off control of the output and associated flag signal is configured at the PC 15 programming connector. Contact Kepco to retrofit older models. For older models (see Figure 4, 5) there is no remote on/off capability and the REMOTE indicator is only on if an optional BIT card is in use.

Units are shipped for 115V a-c operation (105V to 125V a-c), 57 to 63Hz. For operation at 104V a-c, 208V a-c or 230V a-c refer to the full Operator Manual (PAR 1.1).

1.3. OPTIONS. Standard models (M suffix) include analog voltage and current meters. Models with a D suffix include digital meters. Models optimized to operate in current mode with large inductive loads are identified by suffix L. Models optimized to operate in voltage mode with large capacitive loads are identified by suffix C. Models with digital control via GPIB or RS 232 are identified by suffix 4886. Models with digital control via ethernet/LAN are identified by suffix 802E.



**FIGURE 1. SINK OPERATION PRODUCED BY LOAD
PHASE SHIFT**

1.4. EQUIPMENT SUPPLIED.

- PC 15 programming connector (PC 12 wired for front panel control) **MUST** be installed at rear panel to enable local operation (see NOTE).
- 115V a-c Line Cord

NOTE: The signal allocation of the rear panel programming connector is slightly altered from older models:

- pin 21 was unused, changed to logic selection for isolated on-off.
- pin 48 was shorted to pin 47, is now the return for isolated on-off control and flag (pin 47 unchanged).
- pin 50 was shorted to pin 49, now used as isolated on off control (pin 49 unchanged).
- pins 12, 14 were for class A/AB selection, now for external compensation of voltage mode loop, similar to pins 16 and 18 for current mode loop.

1.5. ACCESSORIES (NOT SUPPLIED)

- Slides (Full rack only)
- Rack adapter RA 24 or RA 37 (mount 3/4 rack unit in 19-inch rack)
- BIT cards for digital interface (RS 422, GPIB, LAN)

II — SAFETY.

Exercise care in making all connections to and from the BOP terminals.



WARNINGS

1. Remove a-c power from the BOP before making any connections.
2. Wires and/or cables, connected from the BOP terminals to external components or programming devices must be properly insulated and securely terminated on both sides to make accidental touch impossible. **DO NOT USE BANANA PLUGS WITH EXPOSED SCREWS OR OTHER EXPOSED METAL PARTS AT THE FRONT PANEL OUTPUT TERMINALS!**
3. The BOP chassis and cover must be safety-grounded to a reliable a-c source ground. A safety-ground may be established by using a grounded a-c power outlet or, if the latter is not available, by means of a separate wire, from the provided GROUND terminal to a reliable a-c source ground point.
4. **THE COMMON OUTPUT TERMINAL OF THE BOP MAY EITHER FLOAT OR BE GROUNDED.** Leave the output terminal floating when an external, grounded device is used at either the programming input or the output. For noise reduction ground a single return terminal on either the programming device, the BOP or the load configuration. See PAR 3.4 for the maximum allowable floating voltage for the COMMON output terminal.

III — INSTALLATION

3.1. UNPACKING. The power supply has been thoroughly inspected and tested prior to packing and is ready for operation. After careful unpacking, inspect for shipping damage before attempting to operate. Perform the Preliminary Checkout (PAR. 3.2). If any indication of damage is found, file an immediate claim with the responsible transport service

3.2. PRELIMINARY CHECKOUT. A simple operating check after unpacking and before permanent installation, is advisable to ascertain whether the BOP has suffered damage in shipment.

1. Install PC15 (supplied) at rear panel. This is required for local control of the unit.
2. Refer to Safety instructions (see Section II) and connect unit to 115V a-c source; see Operator Manual (PAR 1.1) for different source voltage.
3. Set the BOP front panel controls as follows
 - a. Voltage/Current MODE select switch set to VOLTAGE.
 - b. Voltage Control ON/OFF switch to ON, Voltage Control to extreme counterclockwise position.
 - c. A-C POWER circuit breaker/switch to ON.
 - d. The E_O Mode indicator will be on and the REMOTE (W/ DIG ON)/OUT ON (W/DIG OFF) indicator will also be on indicating the output is on.
4. Turn the Voltage Control clockwise through its range, while observing the front panel Voltmeter. The BOP output voltage should respond smoothly, from the maximum negative output voltage, through zero, to the maximum positive output voltage of the BOP.
5. Set Voltage Control ON/OFF switch to OFF.
6. Set A-C POWER circuit breaker/switch OFF.
7. Connect a short circuit between the OUTPUT and COMMON front panel output terminals.
8. Set the BOP front panel controls as follows:
 - a. Voltage/Current MODE select switch set to CURRENT.
 - b. Current Control ON/OFF switch to ON and Current Control to its maximum counterclockwise position.
 - c. A-C POWER circuit breaker/switch to ON.
 - d. The I_O Mode indicator will be "on."
9. Turn the Current Control clockwise through its range, while observing the front panel Ammeter. The BOP output current should respond smoothly, from the maximum positive output current, through zero, to the maximum negative output current of the BOP.
10. Apply voltage (3.5 to 24V) across pins 50 and 48 (return) of the PC 15 programming connector. Verify that front panel VOLTAGE and CURRENT meters show 0V and 0A, respectively, and OUT ON (W/ DIG OFF) indicator goes off.
11. Set A-C POWER circuit breaker/switch OFF. Remove the short circuit from the output terminals. This concludes the preliminary check-out of the BOP.

3.3. INSTALLING THE POWER SUPPLY.

3/4 RACK MODELS. These models are shipped with four plastic feet installed for benchtop operation. The feet must be removed for rack mounting. Kepco's RA 24 or RA 37 can be used to install these models in a standard 19-inch rack (installation instructions supplied with rack adapter). Four plastic mounting inserts on the bottom of the chassis can be used to mount the unit on any flat surface.

FULL RACK MODELS. These models are shipped with fixed angle brackets and chassis slide support bars installed and are ready for mounting in a 19-inch rack.

3.4. CONNECTIONS. Connections to the load can be made using either the front or rear panel terminations, but not both.

LOAD CONNECTIONS. Connect the load between OUTPUT and COMMON terminals. Connections may be made at either the front or rear panel. ***Sense connections are required; either local or remote must be used. Otherwise the unit will not operate.***

LOCAL SENSE CONNECTIONS. For local sensing the OUTPUT and COMMON terminals are connected to the adjacent SENSE terminals. The unit is shipped with local sensing links in place at the rear panel. If load connections are made at the front panel, remove the installed links from the rear panel. At the front panel install jumpers between COMMON and the adjacent SENSE terminal and between OUTPUT and the adjacent SENSE terminal.

GROUNDING NETWORK. The unit is shipped with a link installed between terminals 5 and 6 at the rear panel to enable the Grounding Network. This network reduces noise/ripple that may be present at the output.

REMOTE SENSE CONNECTIONS. Remote sensing (connecting the corresponding SENSE terminals to the OUTPUT and COMMON terminations at the load instead of at the BOP) can compensate for load wire losses up to 0.5V per wire (0.25V per wire on models with rated output less than 20V). Remote sensing is recommended for minimum load effect for a remote load. Use twisted pairs: #22 AWG for output sense lines and wires rated for the nominal output current of the power supply for power leads. See full Operator Manual (see PAR. 1.1) for remote sensing requirements.

INPUT A-C CONNECTIONS. Install the line cord (supplied) at the rear panel and connect to 115V a-c, 60Hz (105V to 125V a-c, 47 to 63Hz) mains. Refer to the full Operator Manual (see PAR. 1.1). For operation at 104V a-c, 208V a-c or 230V a-c refer to the full Operator Manual (PAR 1.1).

A-C GROUND. The 3-wire line cord with 3-prong safety plug (supplied), in combination with a properly grounded a-c power outlet, automatically grounds the BOP case. If an adapter for a non-grounded outlet is used, the case must be grounded separately using a separate GROUND terminal at either the front or rear panel. The ground wire must be rated for at least the BOP input current (as noted on nameplate at rear of unit).

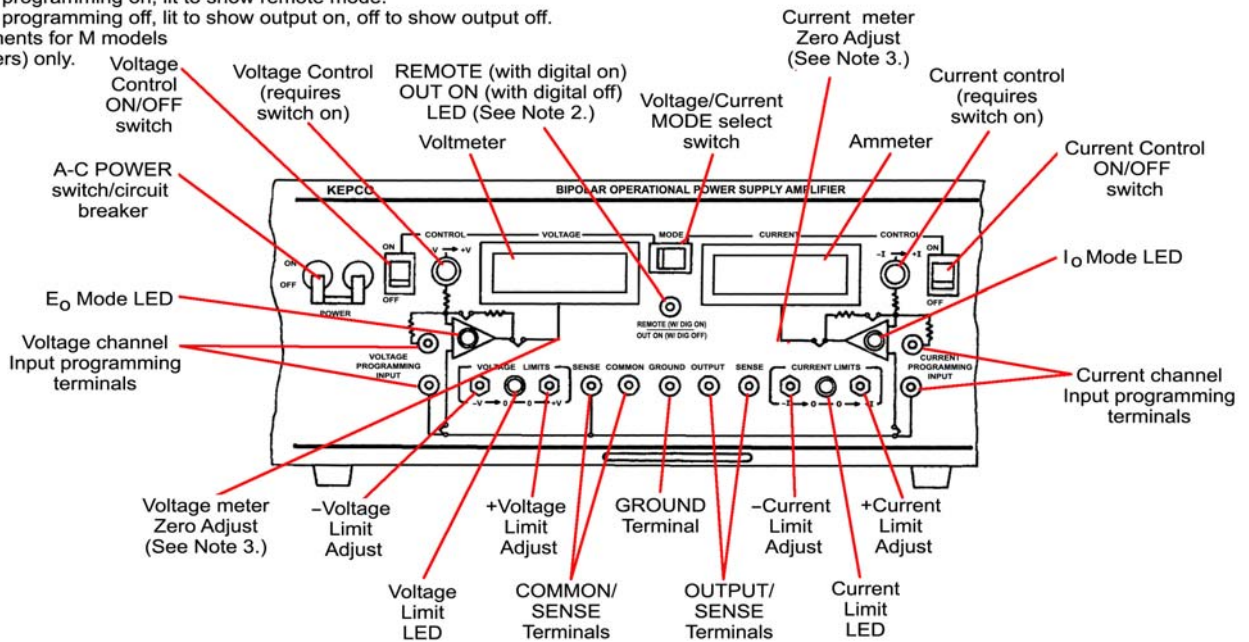
D-C SIGNAL GROUND. Specified ripple and noise figures for BOP power supplies are valid only with the COMMON side of the output load circuit returned to a ground point. The BOP circuits, including output and programming terminals, have no d-c connection to the chassis.

The COMMON terminal of the BOP can be "floated" up to 500 volts (d-c or peak) off chassis ground. The common mode current (leakage from output to ground) is less than 50 μ A (rms) or 5 mA (p-p) at 115V a-c power input, 60 Hz. To avoid common mode current from affecting the BOP output, the system (including the programming device, if used, load, and BOP) must have a single connection to ground (earth ground). The d-c ground wire must be rated for the nominal output current of the BOP (e.g, for BOP 20-10M, use rating of 10A).

Multiple signal grounds in the system may cause "ground-loop" and instability problems, since noise signals develop across the impedances between the multiple ground points. The exact physical location of the "best" single ground point must be carefully selected for minimum ripple/noise output and to avoid the possibility of output current flowing through the return path of an external programming signal.

NOTES:

1. D suffix (digital meters) shown.
2. Dual function indicator REM (WDIG ON)/OUT ON(W DIG OFF)
With digital programming on, lit to show remote mode.
With digital programming off, lit to show output on, off to show output off.
3. Zero adjustments for M models (analog meters) only.

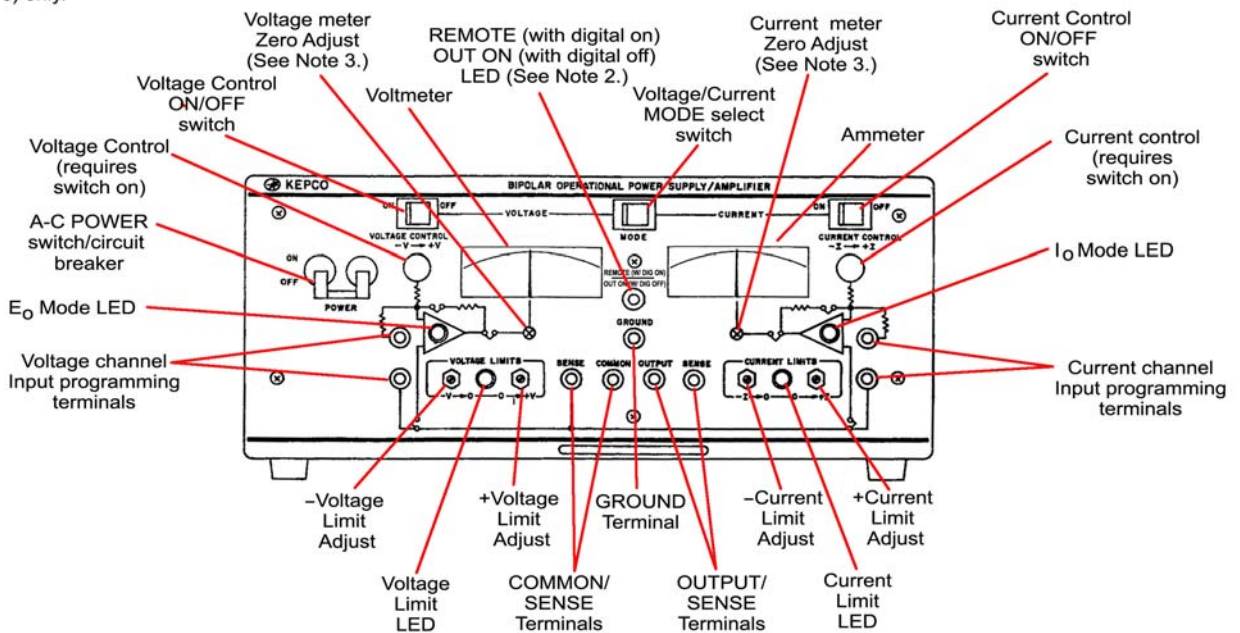


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FIGURE 2. BOP FULL RACK, FRONT PANEL CONTROLS, INDICATORS AND TERMINATIONS

NOTES:

1. M suffix (analog meters) shown.
2. Dual function indicator REM (WDIG ON)/OUT ON(W DIG OFF)
With digital programming on, lit to show remote mode.
With digital programming off, lit to show output on, off to show output off.
3. Zero adjustments for M models (analog meters) only.



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FIGURE 3. BOP 3/4 RACK, FRONT PANEL CONTROLS, INDICATORS AND TERMINATIONS

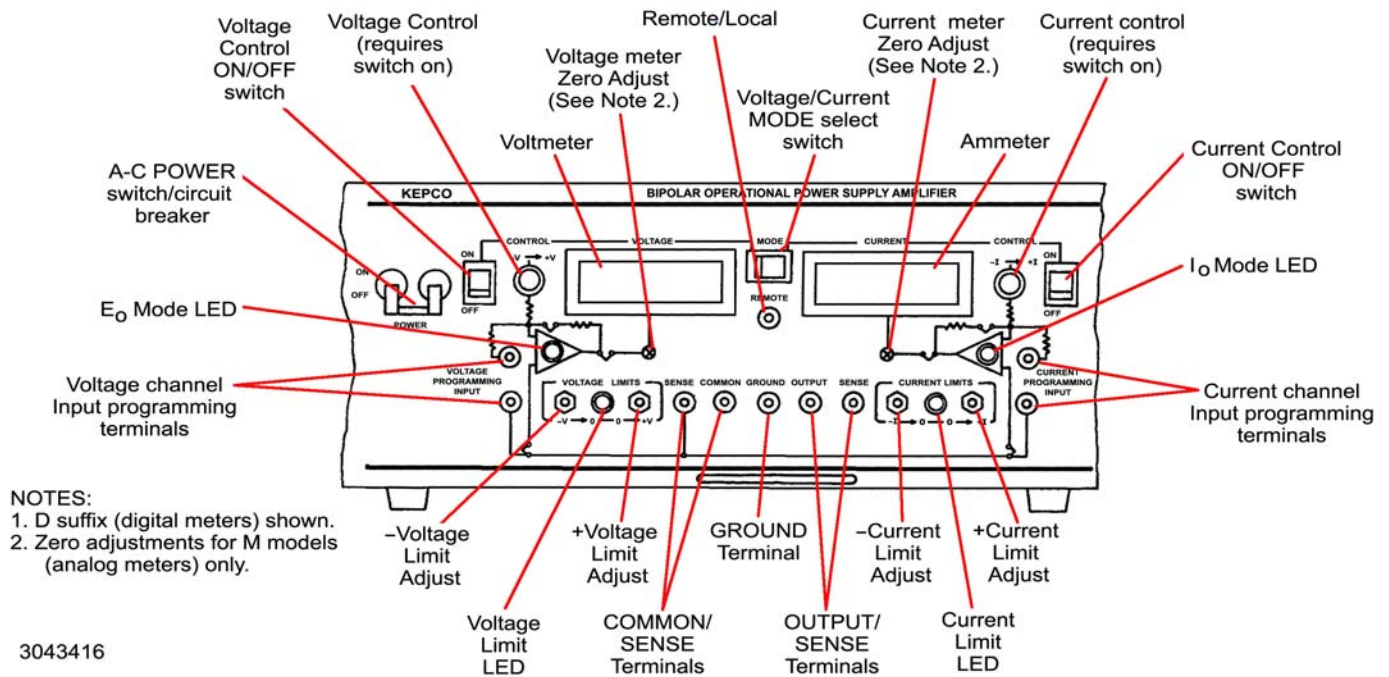


FIGURE 4. BOP FULL RACK (OLDER MODELS), FRONT PANEL CONTROLS, INDICATORS AND TERMINATIONS

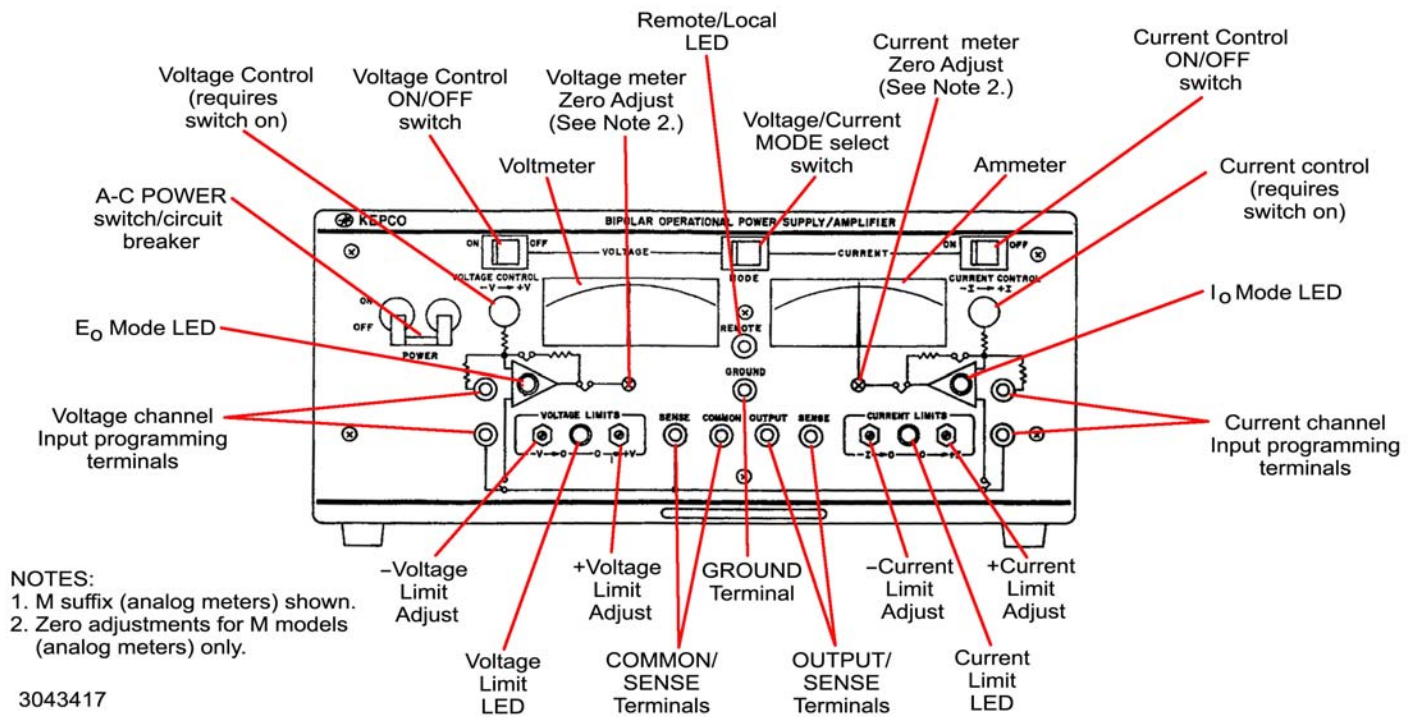
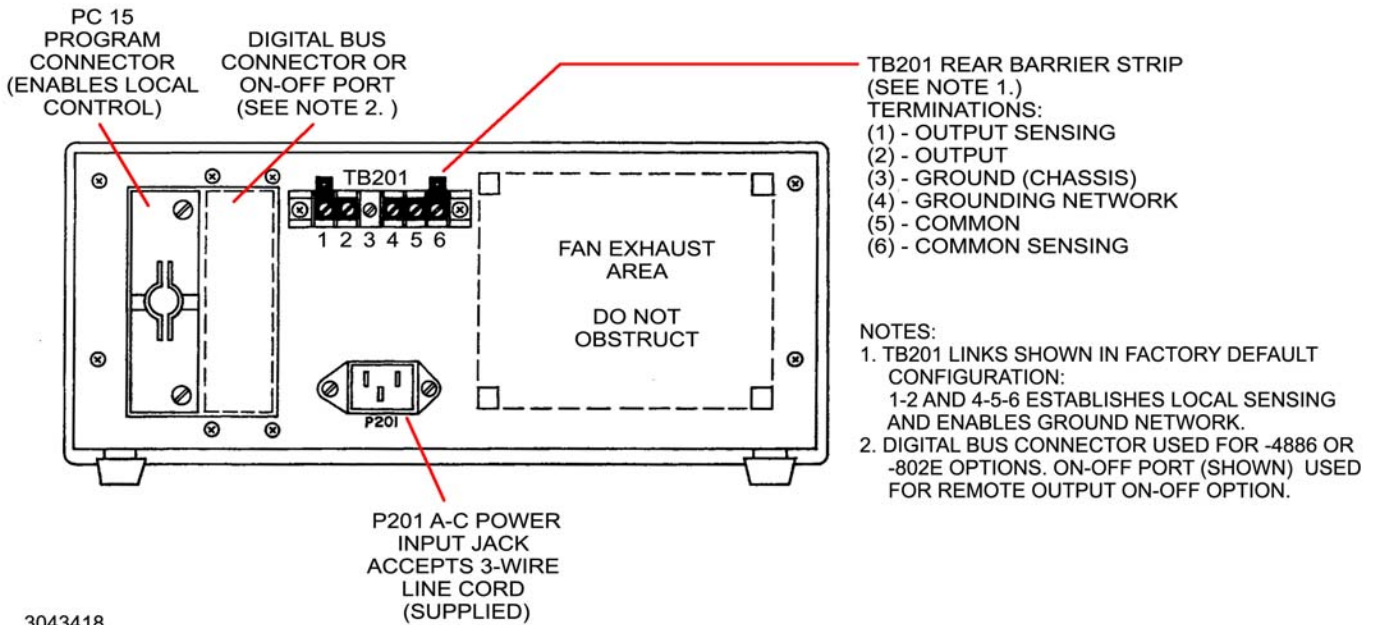


FIGURE 5. BOP 3/4 RACK (OLDER MODELS), FRONT PANEL CONTROLS, INDICATORS AND TERMINATIONS

3.5. COOLING. The components in the BOP power supply rely on forced air cooling. SIDE PANEL OPENINGS AND THE TOP OF THE CASE **MUST** BE KEPT CLEAR FROM ALL OBSTRUCTIONS TO ENSURE AIR CIRCULATION. Periodic cleaning of the interior of the

power supply is recommended. If the BOP is rack-mounted or installed into confined spaces, care must be taken that the ambient temperature (the temperature immediately surrounding the power supply) does not rise above 55°C (~131°F).



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FIGURE 6. BOP REAR PANEL TERMINATIONS, TYPICAL FOR 3/4 RACK AND FULL RACK MODELS

IV — OPERATION

Turn the unit on using the front panel POWER switch/circuit breaker (see Figure 2 or 3). **CAUTION: DO NOT repeatedly toggle the POWER on/off switch as this may cause unit to fault.** If actuator does not lock when released, wait a few seconds before trying again. The circuit breaker is “trip-free;” if overload exists, contacts cannot be held closed by actuator.

NOTE: PC 15 rear programming connector must be installed to enable local control of the unit.

4.1. VOLTAGE MODE OPERATION WITH CURRENT LIMITING. The BOP may be used as a stabilized (d-c) source of positive or negative voltage with output current limiting (for either polarity) when pre-selected for the application at hand. Always monitor the front panel meters while adjusting output voltage/current.

1. Determine the output voltage and current requirements of your load. Disconnect the load and set the BOP MODE switch to CURRENT and the CURRENT CONTROL switch to ON.
2. Voltage limits are recommended to be greater than the maximum voltage required for the load by 10% of the rated voltage of the unit (e.g., for a 72V BOP and a load that requires 30V, set voltage limits to $\pm 37.2V$).

If specific \pm voltage limits are not needed, use a screwdriver to adjust the $+V$ VOLTAGE LIMIT potentiometer to full clockwise position and $-V$ VOLTAGE LIMIT potentiometer to full counterclockwise position.

If specific \pm voltage limits are needed, proceed as follows.

- a. Turn CURRENT CONTROL fully counterclockwise. Use a screwdriver to adjust the $-V$ VOLTAGE LIMIT potentiometer as desired (recommended to be 10% greater than the maximum negative voltage required for the load), monitoring the VOLTAGE meter for the correct limiting value.
 - b. Turn CURRENT CONTROL fully clockwise. Use a screwdriver to adjust the $+V$ VOLTAGE LIMIT potentiometer as desired, monitoring the VOLTAGE meter for the correct limiting value.
3. With the a-c POWER circuit breaker/switch set to OFF, connect a short circuit across the OUTPUT and COMMON terminals.

4. Set the CURRENT CONTROL switch to OFF. Set the MODE switch to VOLTAGE and the VOLTAGE CONTROL switch to ON, then set BOP POWER a-c circuit breaker/switch to ON.
5. Adjust the $+I$ and $-I$ CURRENT LIMIT potentiometers for both polarities as required, monitoring the CURRENT meter for the correct limiting value. Proceed as follows:
 - a. Turn VOLTAGE CONTROL fully counterclockwise. Use a screwdriver to adjust the $-I$ CURRENT LIMIT potentiometer as desired.
 - b. Turn VOLTAGE CONTROL fully clockwise. Use a screwdriver to adjust the $+I$ CURRENT LIMIT potentiometer as desired.
 - c. Set a-c POWER circuit breaker/switch to OFF, then remove the short circuit from the output.
 - d. Set a-c POWER circuit breaker/switch to ON and adjust the output voltage to zero using the VOLTAGE CONTROL.
 - e. Set a-c POWER circuit breaker/switch to OFF, then connect the load to the BOP output.
6. Set a-c POWER switch/circuit breaker to ON, and adjust the operating voltage by means of the VOLTAGE CONTROL to the value required.

NOTE: If the output current exceeds the pre-adjusted value at any time the VOLTAGE MODE indicator will go out and the CURRENT LIMIT indicator will go on. After the cause of the overcurrent is eliminated, the indicator lights will return to their initial status.

4.2. CURRENT MODE OPERATION WITH VOLTAGE LIMITING. The BOP may be used as a stabilized d-c source of positive or negative current, with output voltage limiting (for either polarity), pre-selected for the application at hand. Always monitor the front panel meters while adjusting output voltage/current

1. Determine the output current and voltage requirement of your load.
2. With the a-c POWER circuit breaker/switch set to OFF, disconnect the load and connect a short circuit across the OUTPUT and COMMON terminals.

3. Set the BOP MODE switch to VOLTAGE and the VOLTAGE CONTROL switch to ON, then set a-c POWER circuit breaker/switch to ON.
4. Current limits are recommended to be greater than the maximum current required for the load by 10% of the rated current of the unit (e.g., for a 6A BOP and a load that requires 3A, set current limits to $\pm 3.6A$).
If specific \pm current limits are not needed, use a screwdriver to adjust the +I CURRENT LIMIT potentiometer to full clockwise position and -I CURRENT LIMIT potentiometer to full counterclockwise position.

If specific \pm current limits are needed, proceed as follows:
 - a. Turn VOLTAGE CONTROL fully counterclockwise. Use a screwdriver to adjust the -I CURRENT LIMIT potentiometer as desired (recommended to be 10% greater than the maximum negative current required for the load), monitoring the CURRENT meter for the correct limiting value.
 - b. Turn VOLTAGE CONTROL fully clockwise. Use a screwdriver to adjust the +I CURRENT LIMIT potentiometer as desired (recommended to be 10% greater than the maximum positive current required for the load) monitoring the CURRENT meter for the correct limiting value.
 - c. Set the VOLTAGE CONTROL switch to OFF. Set a-c POWER switch/circuit breaker to OFF, then remove the short circuit from the output but leave the load disconnected.
5. Set the BOP MODE switch to CURRENT, CURRENT CONTROL switch to ON and set a-c POWER switch/circuit breaker to ON.
6. Adjust the +V and -V VOLTAGE LIMIT potentiometers to the required output (compliance) values. Proceed as follows:
 - a. Turn CURRENT CONTROL fully counterclockwise. Use a screwdriver to adjust the -V VOLTAGE LIMIT potentiometer as desired.
 - b. Turn CURRENT CONTROL fully clockwise. Use a screwdriver to adjust the +V VOLTAGE LIMIT potentiometer as desired.
 - c. Set a-c POWER switch/circuit breaker to OFF, then connect a short circuit across the OUTPUT and COMMON terminals.
- d. Set a-c POWER switch/circuit breaker to ON and use the CURRENT CONTROL to adjust the output current to zero.
- e. Set a-c POWER switch/circuit breaker to OFF and remove short across OUTPUT and COMMON terminals.
7. Connect the load to the BOP OUTPUT and COMMON terminals.
8. Set a-c POWER switch/circuit breaker to ON and use the CURRENT CONTROL to adjust output current through the load to the required value.

4.3. ADDITIONAL FEATURES. The following features of the BOP power supply are covered in the full Operator Manual (see PAR. 1.1).

- BOP Operation with Remote Control of the Voltage Control Channel
- BOP Operation with Remote Control of the Current Control Channel
- Using the BOP as an Amplifier
- Remote Control of the BOP Current Limit
- Remote Control of the BOP Voltage Limit
- Series and Parallel Connection of BOP Power Supplies
- Remote On-Off Control