OPERATION AND SERVICE MANUAL

BOP 125-1KVA-T

BOP-AC POWER SOURCES

KEPCO INC.
An ISO 9001 Company.

MODEL
BOP 125-1KVA-T
AC POWER SUPPLY
OPERATION AND SERVICE MANUAL

ORDER NO.	REV. NO.

IMPORTANT NOTES:

1) This manual is valid for the following Model and associated serial numbers:

MODEL	SERIAL NO.	REV. NO.

2) A Change Page may be included at the end of the manual. All applicable changes and revision number changes are documented with reference to the equipment serial numbers. Before using this Operation and Service Manual, check your equipment serial number to identify your model. If in doubt, contact your nearest Kepco Representative, or the Kepco Documentation Office in New York, (718) 461-7000, requesting the correct revision for your particular model and serial number.

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KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, NY. 11352 U.S.A. • TEL (718) 461-7000 • FAX (718) 767-1102
email: hq@kepcopower.com • World Wide Web: http://www.kepcopower.com

BOP 125-1KVA

ONE PHASE AND THREE PHASE SERIES

BOP-AC POWER SOURCES

MODEL BOP 125-1KVA-T

SERIAL NO._____

MANUAL REVISION NO._____

OPERATION AND SERVICE MANUAL

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SECTION 1 — GENERAL

1.1 SCOPE

The purpose of this manual is to describe the installation and operation of the BOP 125-1KVA Series Power Source.

The models BOP 125-1KVA-3T and BOP 125-1KVA-T are described in this manual. Section 2 lists the electrical, mechanical and environmental specifications of the equipment. Section 3 describes the installation of a BOP 125-1KVA system while Section 4 describes its operation. Sections 5 through 7 provide maintenance, service and calibration instructions.

1.2 GENERAL DESCRIPTION

The BOP 125-1KVA Series of equipment consists of high performance solid-state power conversion systems. The equipment utilizes advanced direct coupled linear techniques which allow for a compact and lightweight design without sacrificing performance. The equipment also includes Kepco-Pacific field proven fail-safe technology. This along with a conservative design ensures long term reliability.

The BOP 125-1KVA Series presently consists of two models, the model BOP 125-1KVA-3T and model BOP 125-1KVA-T. Both are rated for 1KVA continuous output. Model BOP 125-1KVA-3T is configured for three phase output while the model BOP 125-1KVA-T is configured for single phase output. Both models feature the IEEE–488 interface and are completely programmable.

This manual is an Operation and Service Manual. Maintenance and Calibration requirements for the equipment are also included in the manual. The service instructions in Section 6 describe how to isolate a defective PCB Assembly.

1.3 SAFETY NOTICES

Due to the nature of this equipment, the user must be aware of certain operator and equipment hazards associated with electrical power conversion equipment. Throughout this manual, operator safety notices will be indicated as **WARNINGS** and will be bordered as shown below:

WARNING

WARNING STATEMENT

A warning is issued when the operator can possibly be exposed to lethal voltages or the chance of personal injury exists.

Hazards to equipment will be indicated as **CAUTIONS** and will be bordered as shown below:

CAUTION

CAUTION STATEMENT

A caution is issued when either the Power Source or associated load may be subject to a damaging situation, but the operator is not in jeopardy.

The following warnings and cautions should be noted:

WARNING

1) DO NOT REMOVE THE COVER OF THE BOP 125-1KVA POWER SOURCE WHEN INPUT POWER IS CONNECTED.
2) DO NOT WEAR RINGS OR WATCHES WHEN MAKING CONNECTIONS TO THE BOP 125-1KVA EQUIPMENT.
3) DISCONNECT INPUT POWER FROM THE BOP 125-1KVA POWER SOURCE WHEN MAKING CONNECTIONS TO THE OUTPUT TERMINALS.
4) DO NOT WORK ON POWER EQUIPMENT ALONE. KEEP A BUDDY NEARBY TO ADMINISTER FIRST-AID IN CASE OF SHOCK OR SOME OTHER ACCIDENT.
5) READ THIS MANUAL THOROUGHLY PRIOR TO USING THE BOP 125-1KVA EQUIPMENT.

CAUTION

1) MAKE SURE THE OUTPUT OF THE BOP 125-1KVA SERIES EQUIPMENT IS SET PROPERLY PRIOR TO CLOSING OUTPUT CONTACTOR. (i.e., VOLTAGE, FREQUENCY AND PHASE DISPLACEMENT).
2) DO NOT ATTACH A LOAD TO THE OUTPUT OF THE BOP 125-1KVA POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOURCE ARE FULLY UNDERSTOOD.
3) DO NOT APPLY EXCESSIVE INPUT VOLTAGE TO THE BOP 125-1KVA POWER SOURCE AS EQUIPMENT DAMAGE WILL RESULT.

SECTION 2 - SPECIFICATIONS

2.1 ELECTRICAL SPECIFICATIONS

The following specifications apply to the Models BOP 125-1KVA-T and BOP 125-1KVA-3T. Each specification is assumed to apply to both models unless otherwise noted.

2.1.1 INPUT PERFORMANCE SPECIFICATIONS

Input voltage

NOMINAL	100	120	220	240
TOLERANCE Vac	± 10	± 12	± 22	± 24

All of the above operate at 47 - 63 Hz, Single Phase.

CAUTION

DO NOT APPLY EXCESSIVE INPUT VOLTAGE, AS POWER SOURCE DAMAGE WILL RESULT.

2.1.2 OUTPUT PERFORMANCE SPECIFICATIONS

OUTPUT VOLTAGE RANGE: (Adjustable in 0.1V steps)

Model BOP 125-1KVA-T: 0-136.5 Vac

Model BOP 125-1KVA-3T: 3Ø line to neutral 0-136.5 Vac; 3Ø line to line 0-236 Vac
Split phase 0-273 Vac (phase B set to 180°)

For other output voltages use Stepup/Stepdown Transformers. Consult factory for details.

OUTPUT CURRENT:

Model BOP 125-1KVA-T: 8.3 Amps RMS
18 Amps peak available at crest of sine wave to drive peak type loads such as DC power supplies

Model BOP 125-1KVA-3T: 3 Amps RMS per phase
9 Amps peak per phase available at crest of sine wave to drive peak type loads such as DC power supplies

OUTPUT POWER:

Model BOP 125-1KVA-T:
Model BOP 125-1KVA-3T: Full rated KVA at all power factors

OUTPUT FREQUENCY:

VARIABLE, AUTORANGING

20.00 to 49.99 Hz in 0.01 Hz steps
50.0 to 499.9 Hz in 0.1 Hz steps
500 to 2000 Hz in 1.0 Hz steps

CURRENT LIMIT:

Model BOP 125-1KVA-T: 12.0 Amps maximum
Adjustable in 0.2 Amp steps

Model BOP 125-1KVA-3T: 6.0 Amps per phase maximum
Adjustable in 0.2 Amp steps

PHASE SEPARATION:

Model BOP 125-1KVA-3T only:

Phase A: 0 degrees (Reference Phase)

Phase B: Adjustable 0-360 degrees in 1 degree steps

Phase C: Adjustable 0-360 degrees in 1 degree steps

SOURCE EFFECT:

± 0.1%, Maximum for ± 10% source voltage change

LOAD EFFECT: (0–100%)

Less than 0.5% (0.1% typical)

TEMPERATURE EFFECT: 0–50° C

Frequency 0.25%; Voltage 1.0%

OUTPUT DISTORTION:

Less than 1.0% Total Harmonic Distortion (0.50% Total Harmonic Distortion typical)

RIPPLE (Output Modulation):

Less than 0.8 V p-p @ 120 Vac RMS Output

SMALL SIGNAL BANDWIDTH:

20 to 20,000 Hz

TRANSIENT RESPONSE TIME:

Less than 50 microseconds for a no load to full load step transient.

OUTPUT DC OFFSET:

Less than 10 mVdc

OUTPUT ISOLATION:

Output is completely isolated from chassis ground and the input. Any one leg may be grounded to provide local reference. Maximum float off ground 150 Vac.

METERING:

80 character 2-line LCD display.

OUTPUT VOLTAGES:

Model BOP 125-1KVA-T: Output voltage is displayed on front panel LCD display

Resolution/Accuracy: 0.1 Vac/1% ± 1 digit

Model BOP 125-1KVA-3T: Output line to neutral voltages displayed simultaneously on front panel LCD

Resolution/Accuracy: 0.1 Vac/1% ± 1 digit

OUTPUT FREQUENCY:

Output Frequency is displayed on front panel display

Resolution/Accuracy: 0.1 Hz/1% ± 1 digit

OUTPUT CURRENT:

Model BOP 125-1KVA-T: Output current is displayed on front panel LCD

Resolution/Accuracy: 0.1 A rms/1% ± 1 digit

Model BOP 125-1KVA-3T: Each Phase output displayed on front panel LCD

Resolution/Accuracy: 0.1 A rms/1% ± 1 digit

FAULT INDICATORS:

a) Overtemperature

b) Output device failure – Fail-safe circuit allows Power Source to continue operation at reduced output capability).

c) Overload - If unit is in current limit state for more than 30 seconds, an overload message is displayed.

Programmable Interface:

The BOP 125-1KVA equipment is supplied with an IEEE-488 instrumentation interface. Amplitude, frequency, phase displacement, current limit, and the output contactor maybe controlled over the bus .

The BOP 125-1KVA Power Source can be addressed as a Listener and a Talker. Output frequency, voltages and currents are transmitted back to the IEEE controller upon command.

Programming Accuracy:
Frequency: ± 0.01%
Voltage: ± 0.1% ± 1 count @ 120 Vac output
Phase Displacement: ± 0.1 degree
Current Limit: ± 0.1% ± 1 count @ full scale

2.2 MECHANICAL SPECIFICATIONS

Height: 5.25 inches (133 mm)
Width (Front Panel): 19.00 Inches (482 mm)
(Chassis): 16.75 (425 mm)
Depth: 23.00 inches (584.2 mm)
Weight: 65 pounds (29.5 Kg)

INPUT CONNECTIONS:

The BOP 125-1KVA Series is supplied with an input power cord. A NEMA Type 5-20P plug is attached to the end of the power cord when ordered for the 115 Vac input operation.

OUTPUT CONNECTION:

Output is taken from the BOP 125-1KVA Series equipment via a single row terminal strip supplied with No. 6-32 Binding Head Screws.

CHASSIS SLIDES:

The chassis of the BOP 125-1KVA Series equipment has been designed to accept the following chassis slides: Kepco model number CS 04

2.3 ENVIRONMENTAL SPECIFICATIONS

POWER DISSIPATION:

Power dissipation is directly proportional to the output power produced. Worst case dissipation is at full rated output load and high line input, approximately 500 Watts.

AMBIENT TEMPERATURE:

The BOP 125-1KVA Series equipment is designed to operate in ambient temperatures of 0-55°C.

VENTILATION REQUIREMENTS:

Air intake is along the sides, exhaust is through the rear panel.The BOP 125-1KVA Series equipment contains two 70 CFM fans.

AUDIBLE NOISE:

Audible noise generated by the BOP 125-1KVA series is less than 50 dbA when measured 1 meter from the front panel.

SECTION 3 - INSTALLATION

3.1 INSTALLATION

This section describes the installation requirements of the BOP 125-1KVA Series equipment.

Section 3.2 concerns input power requirements while Section 3.3 provides information on output connections for the BOP 125-1KVA Series.

WARNING

1) DO NOT REMOVE THE COVER OF THE BOP 125-1KVA POWER SOURCE WHEN INPUT POWER IS CONNECTED.
2) DO NOT WEAR RINGS OR WATCHES WHEN MAKING CONNECTIONS TO THE BOP 125-1KVA EQUIPMENT.
3) DISCONNECT INPUT POWER FROM THE BOP 125-1KVA POWER SOURCE WHEN MAKING CONNECTIONS TO THE OUTPUT TERMINALS.
4) DO NOT WORK ON POWER EQUIPMENT ALONE. KEEP A BUDDY NEARBY TO ADMINISTER FIRST-AID IN CASE OF SHOCK OR OTHER ACCIDENT.
5) READ THIS DOCUMENT THOROUGHLY PRIOR TO USING THE BOP 125-1KVA EQUIPMENT.

CAUTION

1) PRIOR TO CLOSING THE OUTPUT CONTACTOR MAKE SURE THE OUTPUT OF THE BOP 125-1KVA SERIES EQUIPMENT IS SET PROPERLY (i.e., VOLTAGE, FREQUENCY AND PHASE DISPLACEMENT).
2) DO NOT ATTACH A LOAD TO THE OUTPUT OF THE BOP 125-1KVA POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOURCE ARE FULLY UNDERSTOOD.

3.2 INPUT POWER REQUIREMENTS

The BOP 125-1KVA Series of Power Sources described in this manual are normally set for 120 Vac input power. Input power is supplied through an integral power cord. The power cord is fitted with a NEMA type 5-20P plug and can be plugged into any standard 20 Amp outlet.

The BOP 125-1KVA Series may draw as much as 18 Amps input depending on line and load conditions. Input current is proportional to output power. A 20 Amp branch circuit is required to prevent nuisance trips of the branch breaker. Input frequency to the BOP 125-1KVA Series Power Source may be in the range of 47-63 Hz.

To connect the BOP 125-1KVA to the source of input power use the following steps:

1) Verify that 120 Vac is available at the outlet.
2) Plug the input power cord into the power outlet

NOTE: For other than 120 Vac input voltage user must supply appropriate input plug.

CAUTION

DO NOT APPLY EXCESSIVE INPUT VOLTAGE TO THE BOP 125-1KVA EQUIPMENT OTHERWISE POWER SOURCE DAMAGE WILL RESULT.

3.2.1 RECONFIGURING INPUT FORMS

All connections involved in changing input requirements for this unit are located on T10, the main power transformer, the Low-Volt Power Supply, Assembly No. 117173 and on the Low-Volt Transformer Board, Assembly No. 117176 (see Table 3-1 and Figure 3-1).

CONDITION	120 Vac		240 Vac		220 Vac		100 Vac	
Selectable Connection (Jumpers) Transformer T10 and Board 117173	FROM	TO	FROM	TO	FROM	TO	FROM	TO
	T10-1	E6	T10-1	E6	T10-1	E6	T10-1	E6
	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	T10-2	E5
	T10-3	E5	T10-3	E5	T10-3	E5	N.C.	N.C.
	T10-4	E9	T10-4	E4	T10-4	E4	T10-4	E9
	N.C.	N.C.	N.C.	N.C.	T10-5	E3	T10-5	E3
	T10-6	E3	T10-6	E3	T10-6	E8	T10-6	E8
	E10	E8	E10	E8	N.C.	N.C.	N.C.	N.C.
	E4	E2	N.C.	N.C.	N.C.	N.C.	E4	E2
	CB-TOP	E1	CB-TOP	E1	CB-TOP	E1	CB-TOP	E1
	AC-N	E7	AC-N	E7	AC-N	E7	AC-N	E7
Selectable Connections (Jumpers) Board 117176	E1	E4	E1	E3	E1	E3	E1	E4
	E2	E5	E2	E4	E2	E4	E2	E5
N.C. = No Connection, AC-N = Neutral or low side of input								

TABLE 3-1 BOP 125-1KVA JUMPER CONNECTIONS FOR OPERATING WITH 120 Vac, 240Vac, 220 Vac, 100Vac INPUT

The BOP 125-1KVA units (-T, or -3T) are normally setup for 120Vac nominal input. To convert from 120Vac input to other input voltages follow the instructions below.

TO CONVERT FROM 120Vac TO 240Vac

ON ASSEMBLY #117173

1) Remove E2 - E4 Wire Jumper
2) Move QD* from E9 to E4

ON ASSEMBLY #117176

1) Move QD from E4 to E3
2) Move QD from E5 to E4

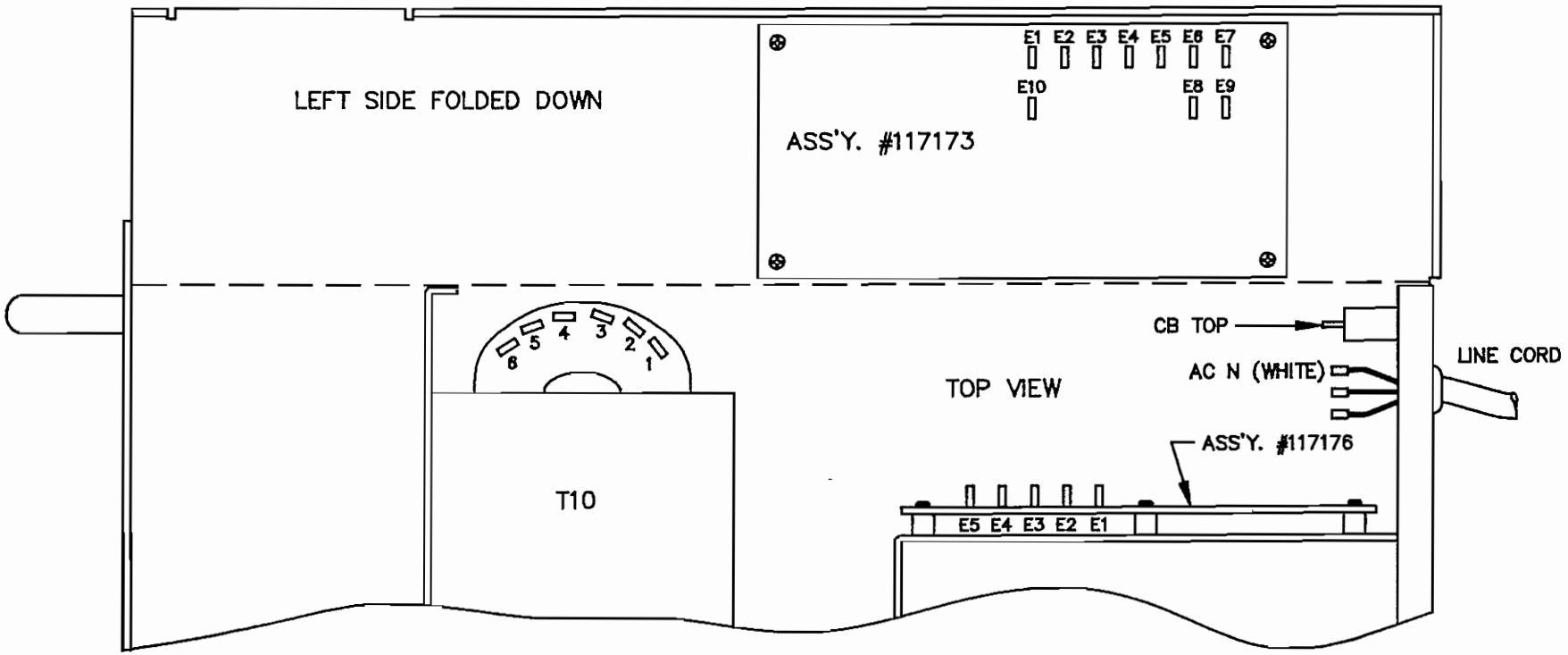

FIGURE 3-1 LOCATION OF THE QUICK CONNECT TERMINALS FOR THE POWER TRANSFORMER T10, ASSEMBLY #117173, ASSEMBLY #117176 AND INPUT POWER CIRCUIT BREAKER CB. SEE TABLE 3-1 FOR CONNECTIONS FOR INPUT VOLTAGE OF EITHER 120, 240, 220 OR 100 Vac.

TO CONVERT FROM 120Vac TO 220Vac

ON ASSEMBLY # 117173

1) Remove E2 - E4 Wire Jumper
2) Remove E8 - E10 Wire Jumper
3) Move QD from E9 to E4
4) Move QD from E3 to E8
5) Add wire (with QDs attached) E3 - T10-5

ON ASSEMBLY #117176

1) Move QD from E4 to E3
2) Move QD from E5 to E4

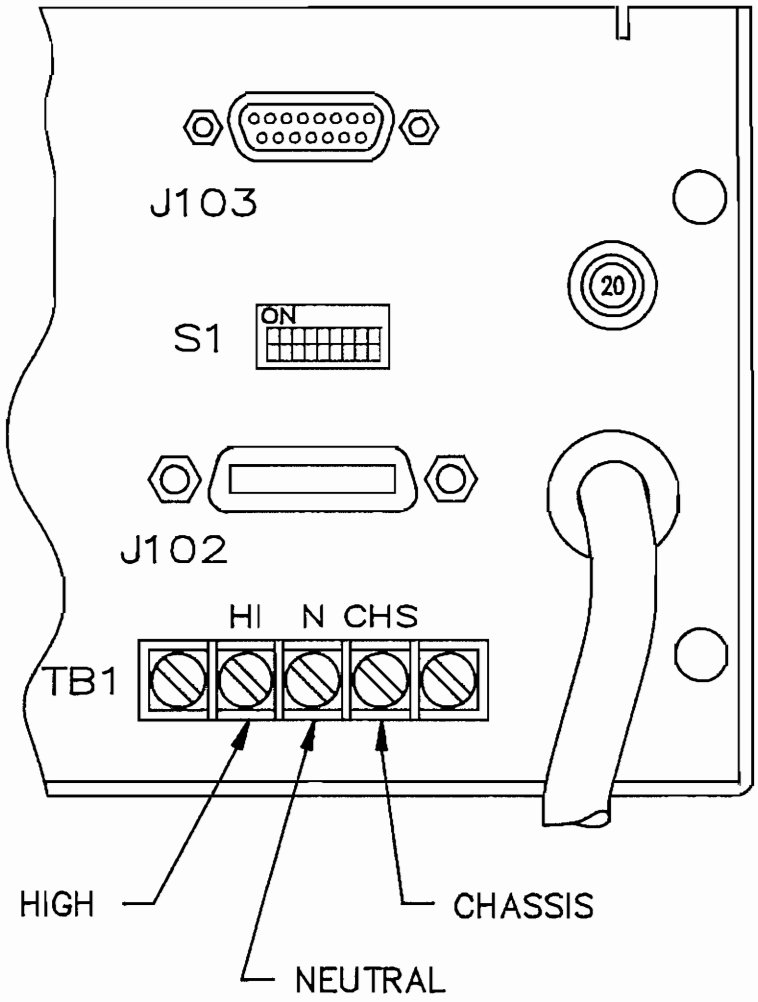

FIGURE 3-2 BOP 125-1KVA-T TYPICAL OUTPUT WIRING

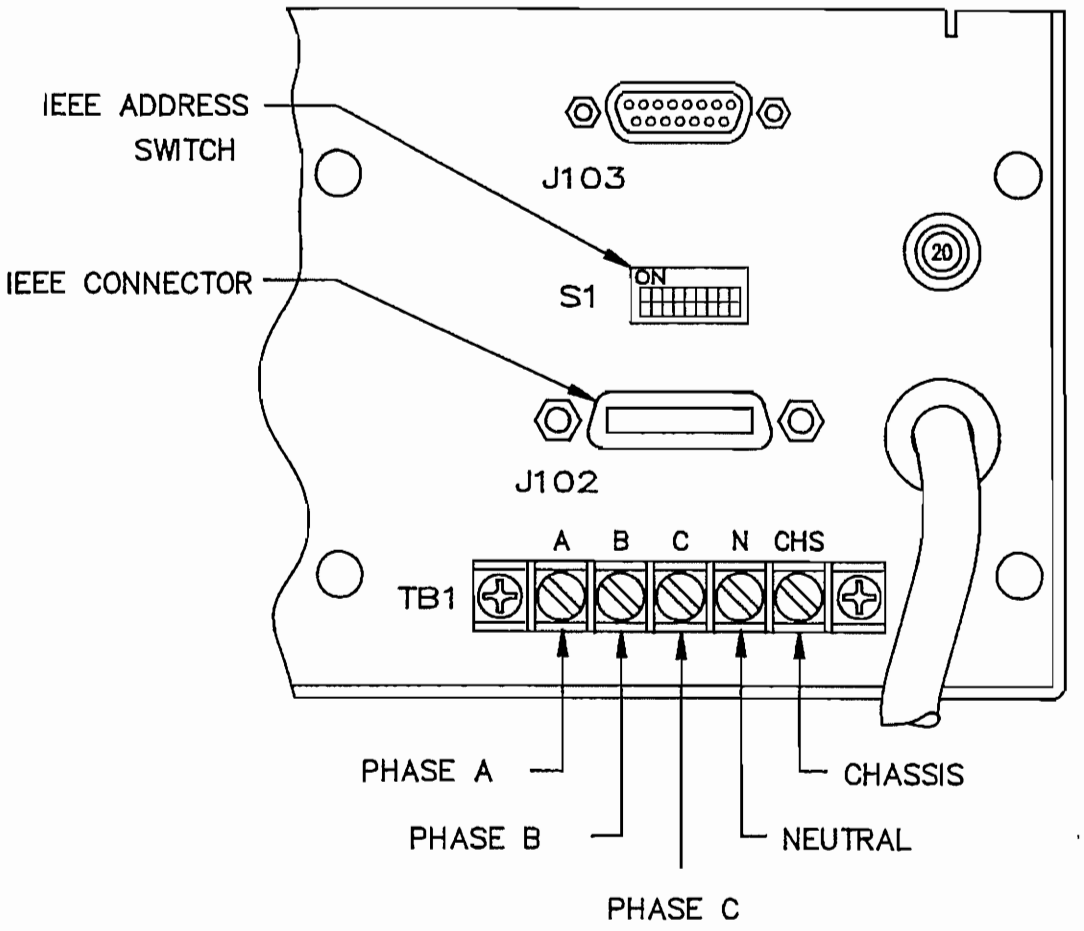

FIGURE 3-3 BOP 125-1KVA-3T TYPICAL OUTPUT WIRING

TO CONVERT FROM 120Vac TO 100Vac

ON ASSEMBLY #117173

1) Remove E8 - E10 Wire Jumper
2) Move QD From E3 To E8
3) Move QD From T10-3 To T10-2
4) Add wire (with QDs attached) E3 - T10-5

ON ASSEMBLY #117176

No Change

*QD – QUICK DISCONNECT

3.3 OUTPUT POWER CONNECTION

The BOP 125-1KVA Series of Power Sources consists of high performance amplifiers with direct-coupled outputs. This provides extremely low output impedance and allows the BOP 125-1KVA system to deliver high pulse currents. To take advantage of this feature, output wiring should be larger than normal and kept as short as possible to minimize impedance.

Output wiring for the model BOP 125-1KVA-3T should be a minimum of AWG No. 16. Output wiring for the BOP 125-1KVA-T should be a minimum of AWG No. 14.

All connections must be electrically and mechanically secure with crimp type ring lugs preferred. This ensures optimum performance.

Output power is available at the rear panel terminal board labeled **OUTPUT POWER**. Make connections to the terminals as labeled.

CAUTION

1) **THE LOW VOLTAGE POWER SUPPLIES ARE ENERGIZED EVEN WHEN THE INPUT POWER SWITCH IS SET TO THE OFF POSITION.**
2) **DO NOT ATTACH A LOAD TO THE OUTPUT OF THE BOP 125-1KVA POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOURCE ARE FULLY UNDERSTOOD.**

The output of the BOP 125-1KVA Power Source is completely isolated from the input power and chassis. When the load is connected one leg of the output should be ground referenced, usually NEUTRAL or LOW.

Figures 3-2 and 3-3 show typical output wiring of the BOP 125-1KVA-T and BOP 125-1KVA-3T systems, respectively.

3.4 IEEE BUS CONNECTIONS

Connection to the IEEE Bus is via J102 (see Figure 3-4). Switch S1 selects the address of the BOP 125-1KVA Power Source. The function of the S1 switch is in accordance with IEEE specifications.Please refer to paragraph 4.5 for determination of the S1 position.

3.5 TRANSFORMER ACCESSORY CONNECTIONS (Stepup/Stepdown Transformer)

Connect the power cable from the transformer accessory to TB1 of the BOP 125-1KVA Power Source (refer to Figure 3-5 for correct connections). Connect the signal cable between J3 on the transformer accessory to J103 on the BOP 125-1KVA Power Source.

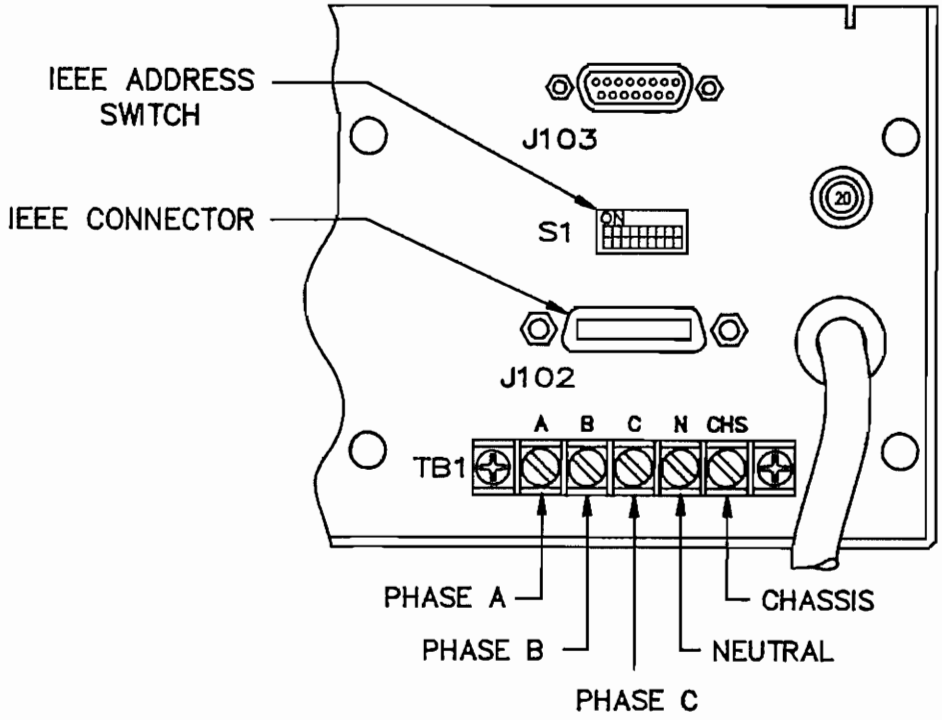

FIGURE 3-4 IEEE-488 GPIB INTERCONNECTION

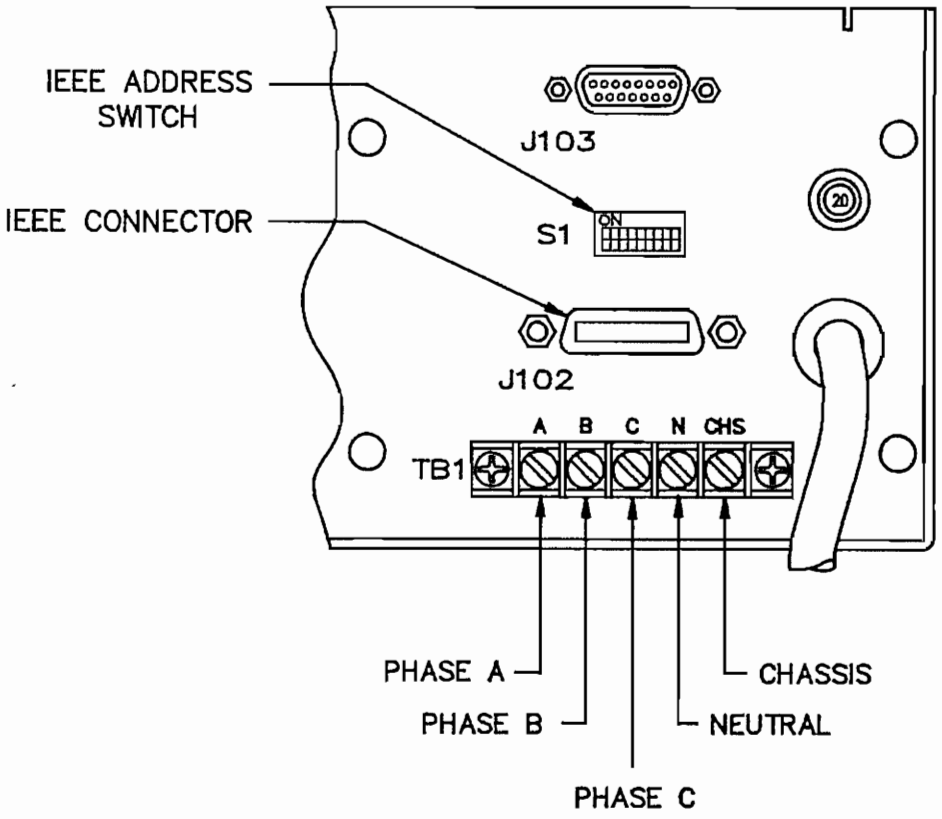

FIGURE 3-5 TRANSFORMER ACCESSORY CONNECTION

SECTION 4 - OPERATION

4.1 SAFETY NOTICES

WARNING

1) DO NOT REMOVE THE COVER OF THE BOP 125-1KVA POWER SOURCE WHEN INPUT POWER IS CONNECTED.
2) DO NOT WEAR RINGS OR WATCHES WHEN MAKING CONNECTIONS TO THE BOP 125-1KVA EQUIPMENT.
3) DISCONNECT INPUT POWER FROM THE BOP 125-1KVA POWER SOURCE WHEN MAKING CONNECTIONS TO THE OUTPUT TERMINALS.
4) DO NOT WORK ON POWER EQUIPMENT ALONE. KEEP A BUDDY NEARBY TO ADMINISTER FIRST-AID IN CASE OF SHOCK OR SOME OTHER ACCIDENT.
5) READ THIS SECTION THOROUGHLY PRIOR TO USING THE BOP 125-1KVA EQUIPMENT.

CAUTION

1) PRIOR TO CLOSING THE OUTPUT CONTACTOR MAKE SURE THE OUTPUT OF BOP 125-1KVA SERIES EQUIPMENT IS SET PROPERLY (i.e., VOLTAGE, FREQUENCY AND PHASE DISPLACEMENT).
2) DO NOT ATTACH A LOAD TO THE OUTPUT OF THE BOP 125-1KVA POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOURCE ARE FULLY UNDERSTOOD.

4.1.1 INTRODUCTION

The BOP 125-1KVA Series equipment features a microprocessor controlled oscillator. This oscillator allows the user to control the following output parameters.

Amplitude, independent or tracking
Frequency
Phase separation (model BOP 125-lKVA-3T)
Current limit

Paragraph 4.2 describes the function of each front panel control. Paragraph 4.3 provides operating instructions of the model BOP 125-1KVA-3T. Paragraph 4.4 describes the model BOP 125-1KVA-T. Paragraph 4.5 describes the operation of the BOP 125-1KVA equipment via the IEEE-488 Instrumentation Bus. Finally paragraph 4.6 explains the transient generation capabilities of this equipment.

4.2 LOCATION AND DESCRIPTION OF CONTROLS

Figure 4-1 is a line drawing of the front panel of the BOP 125-1KVA Series equipment. Each control and indicator is identified and its function defined in the test below:

1 INPUT POWER

This pair of interlocked push-buttons control the input power of the BOP 125-1KVA Power Source. The active state is indicated by a **GREEN** light meaning **ON**; a **RED** light indicates **OFF**.

2 FRONT PANEL DISPLAY

This multiplexed LCD displays system status and provides user information

3 SLEW CONTROLS

These controls are used to slew the voltage and frequency. They are particularly useful for making small changes in the Power Source output.

4 NUMERIC KEYPAD

These keys are used to provide numeric input to the BOP 125-1KVA Power Source

5 ENTER KEY (ENTR)

This key is used to terminate a keyboard input

6 CLEAR KEY (CLR)

This key is used to delete an erroneous data input

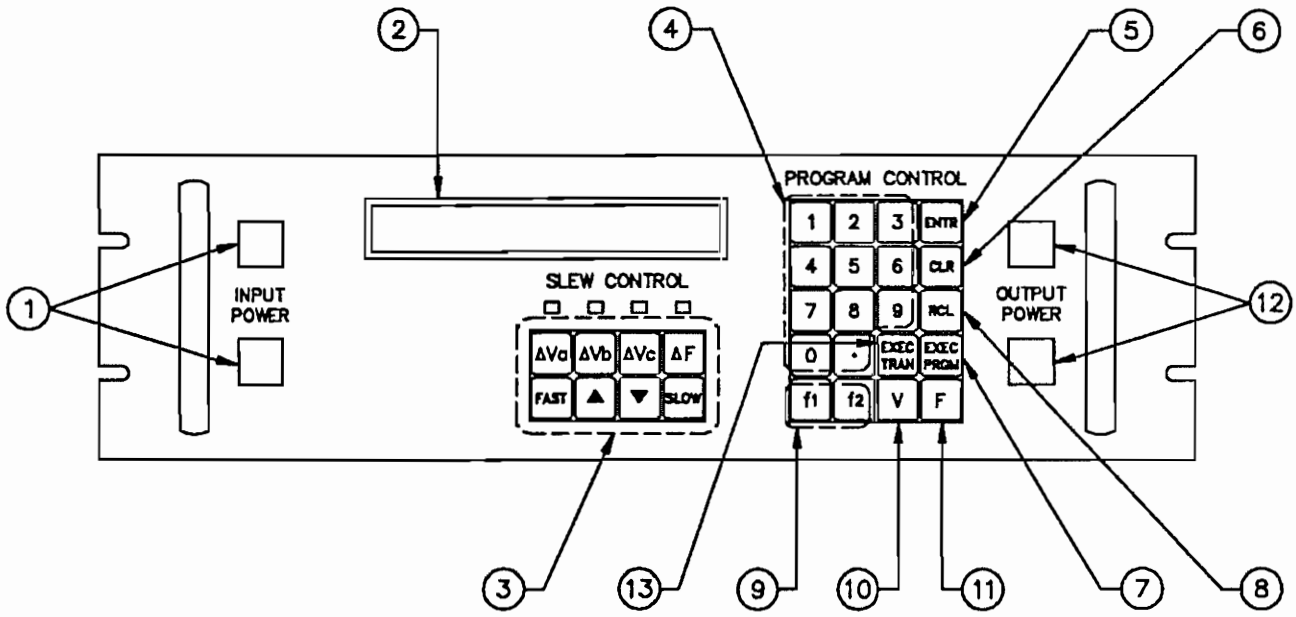

FIGURE 4-1 BOP 125-1KVA FRONT PANEL CONTROL LAYOUT

7 EXECUTE PROGRAM KEY (EXEC PRGM)

This key is used to execute a program which has been recalled

8 RECALL KEY (RCL)

This key is used to access a desired program number

9 SPECIAL FUNCTION KEYS (f1, f2)

The Special Function keys are used to adjust viewing angle and intensity of the LCD display. These keys are also used in the program parameter entry mode.

10 VOLTAGE ADJUSTMENT KEY (V)

This key is used to set output voltage directly without storing the value in a program

11 FREQUENCY ADJUSTMENT KEY (F)

This key is used to set output frequency directly without storing the value in a program

12 OUTPUT POWER ON/OFF

This pair of interlocked push buttons control the output contactor of the BOP 125-1KVA. The active state is indicated by a **GREEN** light meaning **ON**; a **RED** light indicates **OFF**

13 EXECUTE TRANSIENT KEY (EXEC TRAN)

This key is used to start/stop the envelope transient program

4.3 MODEL BOP 125-1KVA-3T OPERATION

This paragraph describes the operation of the model BOP 125-1KVA. Local operation (data entry via the front panel keypad) is discussed in this section. Remote operation (via the IEEE Interface) is discussed in Section 4.5.

Several modes of local operation exist for the model BOP 125-1KVA. The first is the use of preprogrammed output parameters. These may be recalled and executed at anytime. The second mode of operation is direct entry and execution of output voltage or frequency parameters. These values are transferred to the output but not stored in program memory.

The final mode of operation described is the use of the slew controls. These controls allow the user to change the output of the Power Source in small steps. This feature is especially useful when attempting to characterize the load which is attached to the BOP 125-1KVA Power Source.

SYSTEM OPERATION

The first time the unit is turned on a program has to be entered into memory. The BOP 125-1KVA equipment contains battery back up for the memory. This is provided so that once a program is entered, it is retained, even if the input power is cut off.

Turn on the input power switch. The display will light up after a slight delay and show this message:

KEPCO-PACIFIC MODEL BOP 125-1KVA-3T
SMARTSOURCE (C) 1990 v3.04 PRESS "RCL"

This is the opening display. Note that the PROM version is displayed after the year.

4.3.1 ADJUSTMENT OF THE LCD BACKGROUND LIGHTING INTENSITY

At this point the intensity and viewing angle of the LCD display may be adjusted, if desired.

1) Press the **f1** key, a screen prompt will be displayed
2) Press the **UP** or **DOWN** arrow located in the Slew Control section to raise or lower the intensity.

NOTE: The default setting is maximum intensity. When the upper or lower limit of adjustment is reached, the function exits back to the opening display or the active program.

4.3.2 ADJUSTMENT OF THE VIEWING ANGLE

1) Press the **f2** key, a screen prompt will be displayed
2) Press the **UP** or **DOWN** arrow located in the Slew Control section to raise or lower the viewing angle.

NOTE: When the upper or lower limit is reached, the function exits back to the opening display or the active program.

4.3.3 ENTERING OPERATING PARAMETERS INTO PROGRAM MEMORY

Parameter entry is a simple process through which operating parameters are stored in one of the oscillator's 99 program memories. The user is prompted for values of frequency, voltage, phase angle, and current limit (to be stored in program memory). Program memory is non-volatile. Once a program is stored, it may be recalled at any time, power is applied even if input power has been cut off in the interim. Programs which are stored locally (via the keyboard) may be recalled either locally or via the IEEE-488 Bus. Likewise, programs which are stored via the IEEE-488 Bus may also be recalled either locally or via the Bus.

At each prompt, a default value is displayed. Pressing the **ENTR** key will store the default value. Entering a desired value followed by the **ENTR** key will store the new value. Note that for the following examples, program 1 is used. The range of allowed program numbers is 0–99 with 0 being reserved for the transient program (the transient function is explained in Section 4.6).

The following steps are used to enter parameters into a program memory. It is important to realize that this procedure may be started from either the opening menu, or from an active program.

To Enter A Program

1) Press the **RCL** button and the following message will be displayed:

PROGRAM NUMBER

2) Key in program number 1 on the keypad by pressing the **1** and **ENTR** buttons and the display will show one of two responses:

a) If program 1 has not yet been stored:

PROGRAM ENTERED HAS NOT BEEN STORED
PRESS f2 TO ENTER PARAMETERS

b) If the parameters have been stored for program 1:

PGM 01 VA=120.0 VB=120.0 VC=120.0
F=400.0 ILM=6.0 AMPS ØB=120 ØC=240

This display shows all parameter values which have previously been stored for this program.

3) Press **ENTR** to exit this display or **f2** to enter new parameter values.

If **f2** is pressed, the operator is presented with a series of screens, each of which will prompt the operator to enter a different operating parameter. In each case, an existing or default value is already present and a range of allowed values is displayed. Press **ENTR** to accept this value, or enter a new value from the keypad and press **ENTR** to store it.

The screens presented for program entry and their default values are as follows:

NOTE: Pressing **CLR CLR** (clear key twice) will exit the entry mode.

Set Output Frequency

Program Number 1
Frequency (20-2000 Hz) 60.00

Set Output Voltage - Phase A

Program Number 1
Volts Phase A (0-136.5) 120

Set Output Voltage - Phase B

Program Number 1
Volts Phase B (0-136.5) 120.0

Set Output Voltage - Phase C

Program Number 1
Volts Phase C (0-136.5) 120.0

NOTE: The resolution of the voltage value is 0.1 volts. When the transformer option is used, the resolution of the voltage value is 1 volt. Therefore, a 0.1 volt value will not be accepted.

Set Phase Angle For Phase B:

Program Number 1
Phase Angle B (0-360) 120

Set Phase Angle For Phase C:

Program Number 1
Phase Angle C (0-360) 120

Set Current Limit Value

Program Number 1
Current Limit (0 to 6.0A) 6.0

NOTE: The current limit maximum value for the BOP 125-1KVA-3T is 6.0 amps. for example, when the 1 to 2 transformer option is installed, the current limit is cut in half because of the transformer action. Therefore, for the BOP 125-1KVA-3T it will be 3.0 amps.

The parameter entry process is completed and the BOP 125-1KVA displays this screen showing the parameters which have been entered (assuming you have selected the default values):

PGM 01 VA=120.0 VB=120.0 VC=120.0
F=60.0 ILM=6.0 AMPS ØB=120 ØC=240

From this screen, the program may be executed by pressing the **GREEN EXEC PRGM** key. Pressing **ENTR** will exit to the previous screen whether it was the opening one, or one from an active program.

4.3.4 PROGRAM EXECUTION

Stored programs may be recalled and executed from either the opening screen or while another programs is in process.

This is very similar to the parameter entry described in the previous section (program 1 is used in the example)

1) Recall the program with **RCL 1 ENTR**

2) The program contents are displayed on the screen

3) Press **EXEC PRGM** (**GREEN** key) to execute the program

4) At this point the output contactor is in the **OFF** position and the **RED** output power lamp is **ON**. Press the **GREEN** output power key to close the output power contactor (indicated by the illumination of the **GREEN** lamp). Output power is now present at the output terminals of the BOP 125-1KVA Power Source

Once a program is executed, a metering screen is displayed to provide accurate, continously updated operating status information.

LOC PO1 VA=120.0 VB=120.0 VC=120.0
400.1 HZ IA=0.0 IB=0.0 IC=0.0

The metering screen is interpreted as follows:

1 LOCAL/REMOTE INDICATOR

This field indicates whether the Power Source is in local (keyboard entry) or remote (IEEE-488 Bus) control. In the remote mode the keyboard is locked out and the output power controls are also locked out.

2 PROGRAM NUMBERS

This field indicates the program number which is in use. This field will be blank when non- programmed output values are in use.

3 OUTPUT VOLTAGE

These three fields display the output line to neutral voltages of the BOP 125-1KVA Power Source. These voltages are measured ahead of the output contactor so as to allow monitoring of the voltage prior to energizing a connected load.

NOTE: When the transformer option is installed, the display will show.

TA=ACTUAL VOLTAGE FOR PHASE A IN VOLTS RMS
TB=ACTUAL VOLTAGE FOR PHASE B IN VOLTS RMS
TC=ACTUAL VOLTAGE FOR PHASE C IN VOLTS RMS

4 OUTPUT FREQUENCY

This field displays the output frequency of the BOP 125-1KVA Power Source.

5 OUTPUT CURRENT

These three fields display the RMS output current of each phase.

4.3.5 OUTPUT VOLTAGE SETTING (V KEY)

After a program has been entered and recalled the output voltage for all three phases can be adjusted DIRECTLY without programming the Power Source. To adjust the output voltage, press the V key and the following screen will be displayed:

ENTER VOLTAGE VALUE ON KEYPAD
(0-136.5 Vrms) 120.0

The present value is displayed. Enter the new value and press the GREEN EXEC PRGM key. The metering screen will appear and show the new voltage readings without a program number. This function does not affect stored program values.

NOTE: When the transformer option is installed the voltage range that is displayed is 0 to 273 Volts RMS.

4.3.6 FREQUENCY SETTING

In a similar manner, frequency may be changed as well. To adjust the frequency, press the F key and the following screen will be displayed:

ENTER FREQUENCY VALUE ON KEYPAD
(20-2000 Hz) 60.00

The present value of frequency is displayed. Enter the value and press the GREEN EXEC PRGM key. The metering screen will appear showing the new frequency without the program number displayed. This function does not effect stored program values.

4.3.7 SLEW CONTROLS

The slewing control keys are used to make small changes in any or all of the three voltages or the frequency. The changes can be made to the frequency, Phase A, Phase B or Phase C voltages in any combination.

Activate any or all of the slew controls by pressing the (Δ Va), (Δ Vb), (Δ Vc) or (Δ F) keys. The LED's will light up above the selected key(s). Pressing the UP (Δ) or DOWN (∇) key will slew the selected function(s) UP or DOWN.

Pressing the FAST or SLOW keys while holding the UP or DOWN key increases or decreases the rate of change of selected functions.

The selected function can be observed changing on the metering screen. These new settings are not stored in a program and cannot be recalled. Note that the program number on the display disappears, as a parameter is slewed away from its programmed value. This lets the user know that the parameters are not programmed.

4.3.8 POWER SOURCE STATUS INDICATORS

The BOP 125-1KVA Series Power Source monitors critical parameters of its operation.

a) OVERTEMPERATURE

If the safe operating temperature of the heatsinks is exceeded, the following message is displayed:

"WARNING TEMPERATURE LIMIT HAS BEEN EXCEEDED. REMOVE LOAD AND PRESS ENTER"

b) OVERLOAD CONDITION

If a decrease in the output voltage occurs for more than 30 seconds, the following message is displayed:

OVERLOAD! PRESS ENTER TO CONTINUE

c) DEVICE FAILURE

The third Status Indicator is a device failure signal. The device will automatically disconnect and the Power Source will remain in service at reduced capacity. The following message is displayed:

SERVICE REQUEST SEE MANUAL

If this message is displayed, press "ENTER" to resume the metering function. If a device is disconnected, an LED on the power amplifier board can be seen through the grill at the rear of the equipment.

If any problems occur, contact the factory.

4.4 MODEL BOP 125-1KVA-T OPERATION

The model BOP 125-1KVA-T is a 1KVA Single Phase AC Power Source. It is constructed with many of the same subassemblies used in the model BOP 125-1KVA-3T. The main difference between the two models is the absence of the Phase B and C circuits in the case of the model BOP 125-1KVA-T.

Operation of the model BOP 125-1KVA-T proceeds exactly as that of the model BOP 125-1KVA-3T. See paragraph 4.3 on operating procedures, and omit any instruction relating to Phases B and C; Also, note the current limit range of the model BOP 125-1KVA-T is 0–12 Amps.

4.5 IEEE GPIB CONNECTION

The BOP 125-1KVA Power Source is connected to the IEEE 488 Bus via J102. The signals on this connector are in accordance with the IEEE-488-1978 Standard. switch S1 is used to select the Device Address of the BOP 125-1KVA Power Source. Figure 4-2 shows each section of the switch S1.

The interface is optically isolated from the power circuits of the BOP 125-1KVA Power Source. This allows the user to establish a ground reference (for the BOP 125-1KVA output) at any desired potential up to 150 Vac. Connecting the Power Source to the IEEE-488 Bus involves three steps:

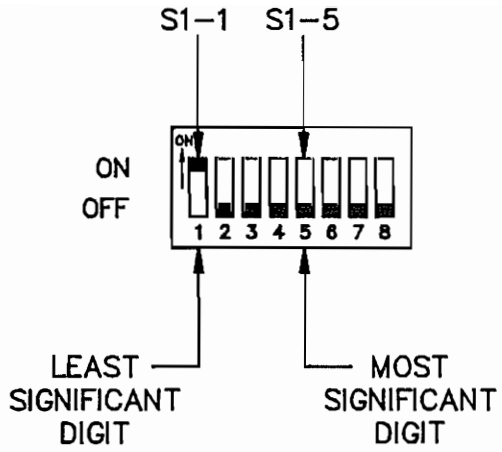

FIGURE 4-2 IEEE GPIB ADDRESS SWITCH SET TO ADDRESS 1

1) Attach the BOP 125-1KVA Power Source to the Bus via the IEEE connector J102
2) Select the Device Address with S1 (located on the rear panel).
3) **Device Address**

   The Device Address is set by using the DIP switch labeled S1 on the rear panel. **OFF** is down and **ON** is up. Set the Device Address using a binary count, S1 is the LSB and S5 is the MSB.

For example:

Switch 1 ON all others OFF = address 1
Switch 2 ON all the others OFF = address 2
Switch 1 and 2 ON all the others OFF = address 3
Switch 3 ON all the others OFF = address 4

4.5.1 REMOTE OPERATION (VIA IEEE GPIB)

The Kepco-Pacific BOP 125-1KVA Series AC Power Source is programmable over the IEEE-488 GPIB. The commands that the BOP 125-1KVA Series Power Source responds to are listed below.

Initialization:

There are two IEEE-488 initializing functions available.

Interface Clear (IFC) - Resets the GPIB Bus status
Device Clear (DCL) - Terminates current program and turns output OFF.

FUNCTION	VALID MNEMONICS
Volts (Three Phases Simultaneously)	V Volt AMP AXXXX VXXXXXX X = Any upper or lower case letter up to 15 letters long including blanks
Volts Phase A only	VA VXXXXA AXXXA volta ama.
Volts Phase B only	VB VXXXXB AXXXB voltb
Volts Phase C only	VC VXXXXC AXXXC amc
Frequency	F FXXXXXX FREQ frequency
Program	PRXX POXX PGXX PR PO PG
Phase Angle B	PB PHB PXXXXXB
Phase Angle C	PC PHC PXXXXC PHASE C
Programmable Current Limit	ILM CLM
Execute A Program	"EXECUTE n, En, Ex, xn"
Execute A Program and Wait For A Trigger (GET)	"EXECUTE n TRG, EnTRG"
Output Contactor ON	ON on
Output Contactor OFF	OFF off
Return to Local	LOC loc local
Sound the Buzzer	B OR b for one beep bbbb or BBBB for multiple beeps

TABLE 4-1 COMMANDS FOR THE BOP 125-1KVA POWER SOURCE

NUMERICAL VALUE ENTRY

Each function is followed by a numerical value except the following; **ON, OFF, LOCAL,** and **TRIGGER.** The numerical value may contain a decimal point. The value entered should not exceed the range of the parameter. The accepted forms of numerical values are the digits 0 1 2 3 4 5 6 7 8 9 and a decimal point. For example, frequency 21.5 or voltage 117.5 Phase B 122 Phase C 240 current 4.2 etc. Exponential notation is also accepted. Voltage 1.365e+02 for 136.5 and frequency 2000e-1 for 200.0.

TERMINATORS

The accepted message terminators are the line feed **(OA) Hex,** the carriage return **(OD) Hex** and the comma **(2C) Hex.** The BOP 125-1KVA Series also terminates on the **END** or **Identify <EOI>** GPIB command received over the Bus.

Note: The memory is common for the Local mode and the Remote mode - Programs stored in either mode can be recalled from either mode.

The commands along with values can be sent in any order with or without embedded spaces between numbers and characters. An end of string **(<EOS>)** character will terminate each transmission. The end of string terminator can be;

a comma **(2C) Hex,** a line feed **(OA) Hex** or a carriage return **(OD) Hex.**

For example:

VOLT136.5 FREQ60.0 <EOS>

Sets the power source for 136.5 Vac on all phases and the frequency to 60.0 Hz.

In the case of the model BOP 125-1KVA-3T the voltages for the three phases can be changed independently.

For example:

VOLTA110.5 VOLTB125.5 VOLTC60.5 <EOS>

Sets the voltage of phase A to 110.5 Vac, voltage Phase B to 125.5 Vac and voltage Phase C to 60.5 Vac

The phase angle can be changed by sending:

PHB90 PHC355 <EOS>

The current limit (0 to 6.0, model BOP 125-1KVA-3T; 0-12.0 model BOP 125-1KVA-T may be adjusted by sending;

clm4.3 <EOS>

The command line may contain one or more parameters must be terminated with one of the end of string characters.

The **PROGRAM** command stores the values in memory until a **TRIGGER** or **EX** command is received. Up to 99 programs can be stored and recalled at any time. Programs that are stored must have all parameters listed when sent over the IEEE-488 GPIB. For example:

PRG03 F400 V120 PHB120 PHC240 ILM6.0 <EOS>

When the Power Source receives this command, it decodes the data and stores it in program location 3. The frequency will be 400 Hz. The Voltage will be 120Vac. The Phase Angle of Phase B will be 120° and the Phase Angle of Phase C will be 240°. The Current Limit will be 6.0 Amps.

or

PGM15F59.99AMA110AMB115AMC120PHB60PHC90ILM3.6<EOS>

Programs stored over the IEEE-488 GPIB can be recalled locally after the Bus transfers control back to the keyboard. In order to recall a program already stored send:

EX03 <EOS>

Program 3 will be executed.

If a **GROUP EXECUTE TRIGGER <GET>** command is used to execute the program on command send the following:

EX03TRG <EOS>

4.5.2 ERROR CODES

When the **GET** command is received, the program is executed.

If an error is detected an error code is returned to the controller.

The error code is one of the following;

ERROR	61Hex	INCORRECT DATA WAS RECEIVED
ERROR	62Hex	DATA RECEIVED WAS OUTSIDE THE LIMITS OF THE POWER SOURCE
ERROR	63Hex	PROGRAM RECALLED WAS NOT STORED
ERROR	64Hex	DEVICE FAILURE
ERROR	65Hex	OVERTEMPERATURE PHASE A
ERROR	66Hex	OVERTEMPERATURE PHASE B
ERROR	67Hex	OVERTEMPERATURE PHASE C
ERROR	68Hex	OVERLOAD PHASE A
ERROR	69Hex	OVERLOAD PHASE B
ERROR	6AHex	OVERLOAD PHASE C
ERROR	6BHex	ILLEGAL TRANSIENT PARAMETERS

TABLE 4-2 ERROR CODES FOR THE BOP 125-1KVA POWER SOURCE

The Power Source will send the **Service Request <SRQ>** bit.
At this point the Bus controller can obtain the error code via a **Serial Poll.**

When finished with the Power Source send a **LOCAL <EOS>** and the system returns to the local mode.

4.5.3 RECEIVING METERED VALUES OVER IEEE GPIB.

If the BOP 125-1KVA Series Power Source is addressed as a Talker, it sends the operating frequency, the voltage for all three phases, and the current for all three phases.

4.6 TRANSIENT PROGRAM EXECUTION

The BOP 125-1KVA Series Power Source is equipped with transient generation routines. The transients produced are of the envelope type. Changes in voltage or frequency are also possible (see paragraph 4.6.1)

4.6.1 TRANSIENT DEFINITIONS

This paragraph defines the various transient parameters that are stored in memory as well as the limits of these parameters (see Figure 4.3 for a typical transient envelope).

The programmable transient parameters are as follows:

1) **RISE TIME (tr)**

   This is the time required for the voltage or frequency to go from nominal value to full transient excursion. Zero rise time is used for step transients. Valid values range from 30 ms to 60 seconds.

2) **DWELL TIME (td)**

   This is the time that the output remains or dwells at full transient excursion. Valid values range from 10 ms to 60 seconds.

3) **FALL TIME (tf)**

   This is the time required for the voltage or frequency to go from full transient value to its nominal steady state value. Zero time is interpreted as a step transient. Valid values for TF range from 30 ms to 60 seconds.

4) **STEADY STATE TIME (To)**

This is the time between transient envelope patterns. Values range from 0 to 60 seconds with a 10 ms resolution. The transient can also be programmed as a single event. In that case, the parameter is not used.

5) **DELTA FREQUENCY (dF)**

This is the change in frequency from steady state or nominal, to full transient excursion values. Valid values are those for which the full excursion value fall within the range of 20-500 Hz.

6) **DELTA VOLTAGE (dV)**

This is the change in voltage from steady state to full excursion value. The valid range of values for this function are those for which the full excursion value falls within the range of 0-136.5 Vac. The **dV** command changes all phases identically. An individual phase can be programmed with one of the following commands:

dVA - Voltage Transient for Phase A
dVB - Voltage Transient for Phase B
dVC - Voltage transient for Phase C

4.6.2 TRANSIENT PROGRAM ACCESS

The transient program is stored in program 0. A transient program must be stored before it can be executed. If the attempt is made to execute before it is stored, the following message is displayed:

"ILLEGAL TRANSIENT PARAMETERS"

Due to the fact that a transient acts on current running parameters, the Power Source must be in a normal operating mode before the transient can occur.

A transient program can be entered and executed with the following procedure:

1) Recall an operating program and execute it so that the Power Source is active (it is not necessary to store parameters in the transient program, but it is necessary to execute the transient).
2) Press **RCL O ENTR** the following screen is displayed:

T'PGM dF=+000 dVA=+000 dVB=+000 dVC=+000
tr=00.00 td=00.00 tf=00.00 To=00.00 REP

The **dF** will be blinking. Enter a value for Delta Frequency from the keypad and press **ENTR** or just press **ENTR** to leave the value as it is. Do the same for each value on the screen. Positive and negative numbers for Delta values are entered with the arrow keys on the **SLEW CONTROL** keypad.

3) When you come to the **To=00.00 REP** parameter, (this parameter may also be displayed as **To=f1 SINGLE**) enter a value for the time duration between transient envelopes in continuous repetition. Press **f1** to set this parameter for single shot execution.
4) When the last parameter is entered, the screen displays all the transient values. Press **ENTR** again to return to the active operating program (or opening screen if you have just turned on the equipment).

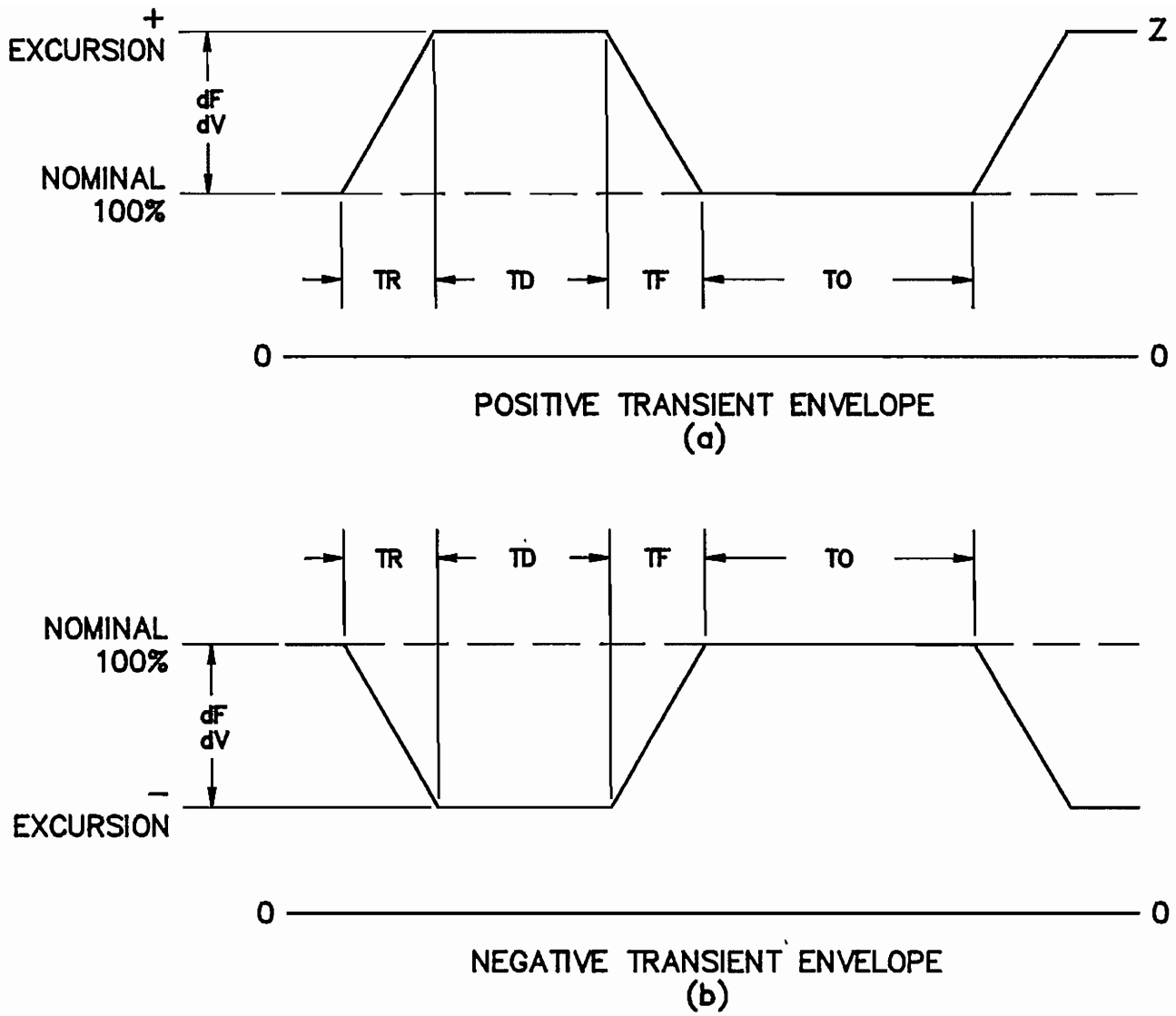

FIGURE 4-3 BOP 125-1KVA TRANSIENT ENVELOPE DEFINITION

5) With an operating program active, press the RED EXEC TRAN key. The transient will execute and the screen will display TRANSIENT IN PROGRESS.

6) Press EXEC TRAN again to stop the transient if it is repetitive. Pressing it once will cause it to stop when it finishes its cycle. Pressing twice will cause it to stop immediately.

The transient program restricts the values of the parameters entered. For tr, and tf the values that fall between 00.01 and 00.03 are not valid. Also, tr, tf td may not be zero simultaneously. The latter represents a nonsense transient envelope pattern and the Power Source will not allow it to be executed. For the delta values, there are no restrictions, but the transient will stop at the operating limit of the Power Source. For instance, if your operating program voltage is 120 volts and the transient program is set for dVA+100, the transient will stop at 136.5 volts not 220 volts.

4.6.3 TRANSIENT OPERATION (VIA IEEE-488 GPIB)

Use these commands as previously described in the IEEE GPIB operation section. Send your Setup parameters first, then recall an operating program, then initiate your transient. You may use the **TRG** function with transient execution.

Do not send Setup commands, or any other command during repetitive transient operation. Always stop a command first with a **TS** or **TN** command.

FUNCTIONS	VALID MNEMONICS
Set Rise Time	tr 00.00 (use this numeric format)
Set Fall Time	tf 00.00
Set Dwell Time	td 00.00
Set Rep Interval	To 00.00
Delta Frequency	dF ± 000
Delta Voltage (all Phases)	dV ± 000
Delta Voltage A	dVA or dA ± 000
Delta Voltage B	dVB or dB ± 000
Delta Voltage C	dVC or dC ± 000
Initiate Transient	TI
Initiate Transient When Group Execute Trigger <GET> Is Issued	TITRG
Stop Repetitive Transient At End Of Cycle	TS
Stop Repetitive Transient Immediately	TN

TABLE 4-3 VALID MNEMONICS FOR THE BOP 125-1KVA POWER SOURCE TRANSIENT PROGRAM

SECTION 5 — MAINTENANCE

5.1 PURPOSE

The purpose of this section is to cover the maintenance requirements of the BOP 125-1KVA Series equipment.

5.2 MAINTENANCE REQUIREMENTS

The BOP 125-1KVA Series equipment has been designed for a minimum of maintenance. Generally, maintenance is limited to a periodic exterior cleaning and regular calibration (refer to Section 7 for calibration).

The BOP 125-1KVA Series equipment is constructed of durable materials. The chassis is made of anodized aluminum. The surface can be cleaned with a cloth dampened with water, and detergent or denatured alcohol.

The front panel has an overlay of a polycarbonate material, and the keys of a thermoplastic material. These surfaces are best cleaned with either water and a mild detergent or a window cleaner as Windex™. Do not use harsh detergent or solvents on plastic surfaces, surface damage may occur.

When cleaning the BOP 125-1KVA equipment, **NEVER** allow liquids to drip onto the chassis. Always moisten the cloth first then wipe the unit down to prevent liquids from getting inside.

Cleaning the interior of the Power Source is required only at the time of calibration. Remove any dust or dirt with a vacuum cleaner or blow it away with an air hose.

WARNING

DO NOT ATTEMPT TO CLEAN THE POWER SOURCE WHILE INPUT POWER IS CONNECTED TO THE BOP 125-1KVA

SECTION 6 - SERVICE

6.1 SERVICE

The purpose of this section is to instruct the user in servicing the BOP 125-1KVA equipment. The recommended service method consists of isolating a defective PCB assembly and replacing the suspected assembly with a known good spare. Suspected defective assemblies should be returned to the factory for repair.

6.2 SAFETY NOTICES

WARNING

1) DISCONNECT INPUT POWER FROM THE BOP 125-1KVA POWER SOURCE PRIOR TO REMOVING THE INPUT COVER.
2) LETHAL VOLTAGE POTENTIALS ARE PRESENT INSIDE THE BOP 125-1KVA EQUIPMENT, USE EXTREME CAUTION WHEN MAKING TEST CONNECTIONS TO CIRCUITS.
3) DO NOT WEAR RINGS OR WATCHES WHEN SERVICING THE BOP 125-1KVA EQUIPMENT.
4) DISCONNECT INPUT POWER FROM THE BOP 125-1KVA POWER SOURCE WHILE MAKING CONNECTIONS TO THE OUTPUT TERMINALS.
5) DO NOT WORK ON POWER EQUIPMENT ALONE. KEEP A TECHNICIAN NEARBY TO ADMINISTER FIRST-AID IN CASE OF SHOCK OR SOME OTHER ACCIDENT.
6) READ SECTIONS 3,4 AND 6 OF THIS MANUAL THOROUGHLY PRIOR TO ATTEMPTING SERVICE TO THIS EQUIPMENT.

CAUTION

USE CARE IN ATTACHING TEST EQUIPMENT TO THE BOP 125-1KVA POWER SOURCE EQUIPMENT. THE POSSIBILITY OF CREATING HIGH CURRENT GROUND LOOPS EXISTS IF EQUIPMENT IS CONNECTED IMPROPERLY.

6.3 SERVICING TECHNIQUE

The BOP 125-1KVA Series equipment is designed with a modular concept. All active electronic components are placed on removable printed circuit board (PCB) assemblies. This allows for service by PCB exchange. The exception is replacement of the input power transformer and DC bridges. If an assembly is found to be defective, it should be returned to the factory for repair.

Paragraph 6.4 is the Theory of Operation of the BOP 125-1KVA Series equipment, and presents the information required to understand the BOP 125-1KVA Power Source operation. It is important that this entire section be read thoroughly prior to attempting to service the BOP 125-1KVA equipment.

Paragraph 6.5 is a recommended troubleshooting procedure for the BOP 125-1KVA Power Source. The procedure is designed to isolate a problem down to the PCB level. Once a problem is isolated, a specific action (usually replacement of a PCB assembly) is suggested.

6.4 OPERATION THEORY

The information presented below is written to aid the service technician in locating malfunctions down to the PCB level.

Refer to Figure 6-1 for a block diagram of the model BOP 125-1KVA-3T and Figure 6-2 for the block diagram of the model BOP 125-1KVA-T.

6.4.1 BOP 125-1KVA-3T THEORY OF OPERATION

The model BOP 125-1KVA-3T consists of three major sub-assemblies; the chassis, the front panel oscillator, and the power amplifiers.

The chassis contains the DC power supply, power and signal harness and input/output terminals. It also provides mounting for the power amplifiers (3 each) and the three phase oscillator assembly.

The model BOP 125-1KVA-3T contains 3 identical power amplifiers. Each amplifier is used to power one of the output phases. The amplifiers are configured for a voltage gain of 17.3, nominally. The power amplifiers receive their input signal from the oscillator assembly. A contactor which is controlled by the output power switch (located on the front panel) is included on the power amplifier PCB. Also included are voltage and current monitoring and a fault detection circuit.

The oscillator assembly generates and processes all signals within the BOP 125-1KVA Power Source. It contains five PCB assemblies; 1) the CPU, 2) Phase A oscillator, 3) Phase B and C oscillators, 4) Display, and 5) IEEE assemblies.

The CPU assembly contains the microprocessor, memory, and oscillator clock circuits. This PCB assembly controls the entire system and generates a variable time base required by the oscillator (PCB assemblies) for frequency generation.

The memory circuits store all user programmed data and use a battery back-up to maintain the information even when the system is de-energized.

The display PCB assembly contains the keypad switches, the input and output contactor drivers, and the LCD. This assembly communicates system Status to and from the user.

The phase A oscillator PCB assembly provides three major functions, namely, the generation of the Phase A vector, the output frequency counter, and the analog to digital conversion of the output voltages and currents. The oscillator section produces an analog sinusoidal waveform that drives the input of the Phase A power amplifier.

The Phase B and Phase C oscillator PCB assembly contains two oscillator circuits. These circuits drive the Phase B and C power amplifiers and are identical to the oscillator circuit of the Phase A oscillator.

The fifth PCB assembly is the IEEE Interface PCB assembly. This assembly contains IEEE Interface control circuits. The inputs to the IEEE Interface are optically isolated from the power circuits of the BOP 125-1KVA equipment. This PCB functions as a transparent latch and level

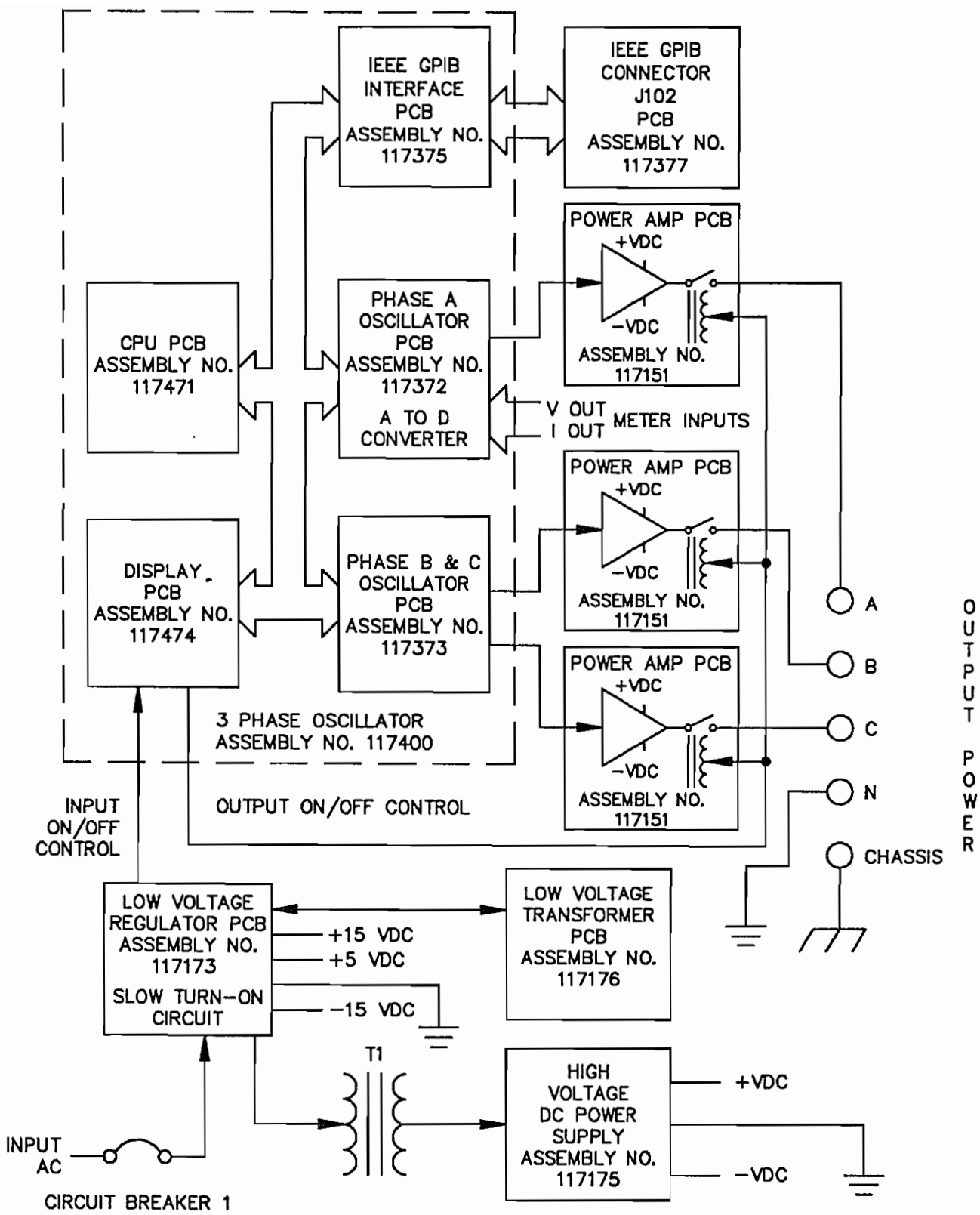

FIGURE 6-1 BOP 125-1KVA-3T BLOCK DIAGRAM

shifter necessary for IEEE-488 operation. All input and output to this PCB assembly is controlled by the CPU.

6.4.2 MODEL BOP 125-1KVA-T THEORY OF OPERATION

The operation of the Model BOP 125-1KVA is similar to that of Model BOP 125-1KVA-3T. The main differences are a result of the absence of the Phase B and Phase C Output Circuits (refer to Figure 6-2 for the Block Diagram of the BOP 125-1KVA-T).

As in the case of the Model BOP 125-1KVA-3T, the Model BOP 125-1KVA-T consists of 3 major assemblies; 1) chassis, 2) power amplifiers and 3) oscillator. The single phase chassis is similar to the three phase, the difference is due to the number of output terminals available and the number power amplifiers assemblies which are supported.

The Model BOP 125-1KVA-T contains two power amplifier assemblies. The power amplifiers are connected in parallel to form one output vector with a combined power rating of 1KVA. The power amplifiers used in the Model BOP 125-1KVA-T are identical to those used in the Model BOP 125-1KVA-3T.

The oscillator assembly of the BOP 125-1KVA-T contains four PCB assemblies; 1) CPU, 2) display, 3) Phase A oscillator, and 4) IEEE Interface.

The Phase A oscillator and IEEE Interface PCB's are identical to that of the BOP 125-1KVA-3T. The CPU and display PCB assemblies are similar but not identical to those of the BOP 125-1KVA-3T. The differences again are due to the absence of the Phase B and C control circuits.

The reader is encouraged to compare Figure 6-1 and Figure 6-2 to note the similarities and differences between model BOP 125-1KVA-T and BOP 125-1KVA-3T.

In summary, the model BOP 125-1KVA-T is quite similar to the Model BOP 125-1KVA-3T. The model BOP 125-1KVA-T is basically a BOP 125-1KVA-3T with the Phase B and C drive cirucits removed.

6.5 TROUBLESHOOTING PROCEDURE

These instruction direct the technician in troubleshooting the BOP 125-1KVA. If there are questions, please call Kepco-Pacific at 1-718-461-7000 in New York for assistance.

6.6 TEST EQUIPMENT REQUIREMENTS

6.6.1 HANDTOOLS

Screwdriver, No. 2 Phillips
Screwdriver, Straight blade

6.6.2 TEST EQUIPMENT

1) Oscilloscope, 2-channel,triggered sweep Tektronix model 2213 or equivalent.
2) Digital Multimeter Fluke model 8050A or equivalent
3) Frequency Counter Fluke model 7250A or equivalent
4) 1kW resistive load (three 333 Watt loads for the BOP125-1KVA-3T)

6.7 TROUBLESHOOTING HINTS

No Power

If the red input power lamp does not light up, the unit is dead. Is power applied to the

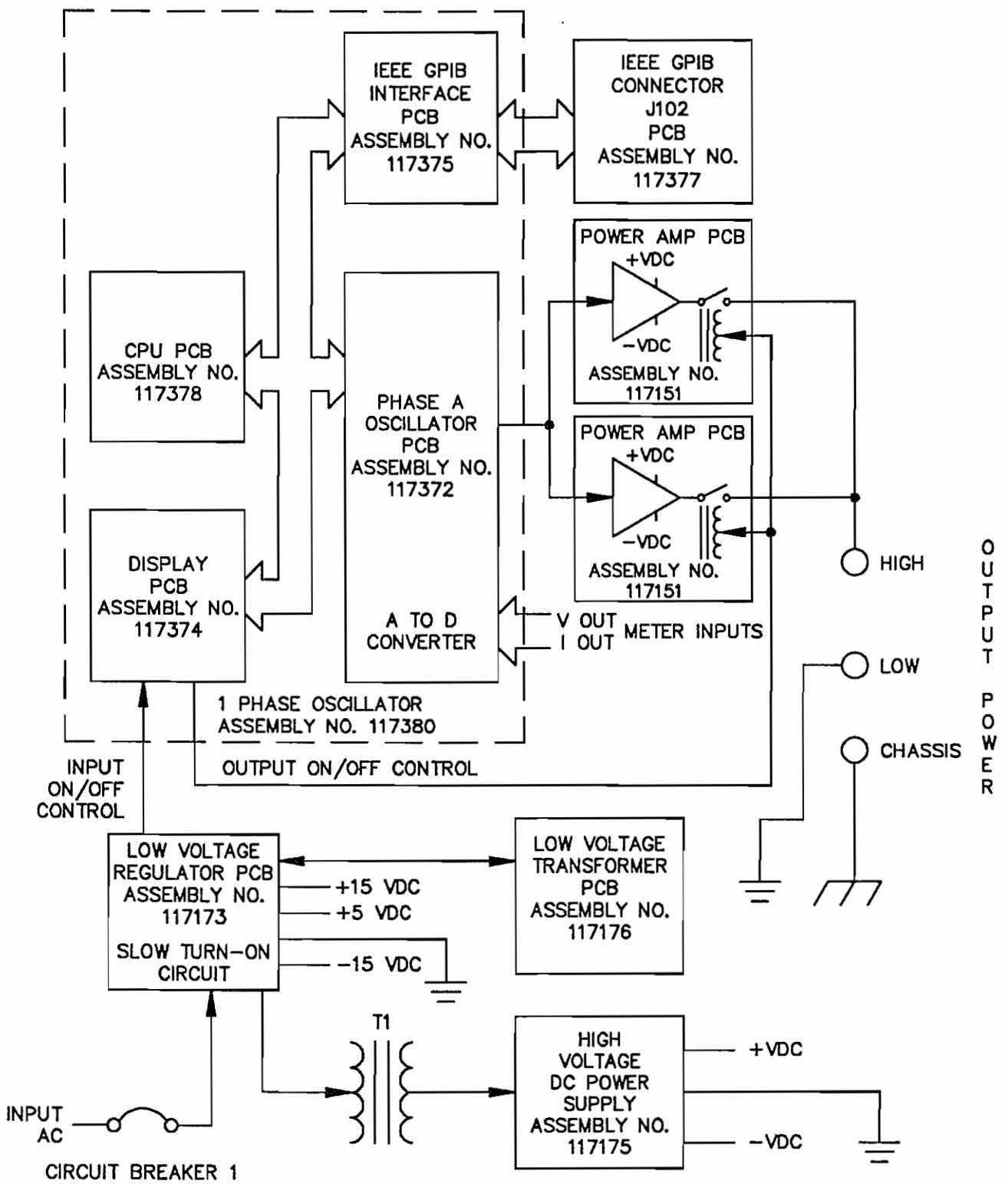

FIGURE 6-2 BOP 125-1KVA-T BLOCK DIAGRAM

unit? Check the input fuse. Is the lamp burnt out? Check the voltages on the front panel display PCB assembly from J21-12 to J21-11 +5.7 Vdc, J21-12 to J21-9 about +10 Vdc, J21-6 to J21-5 +15 Vdc,J21-6 to J21-7 –15 Vdc. If the voltages are not OK, check for shorts. If there are no shorts replace the Low Voltage power supply assembly. If the voltages are OK replace the front panel display assembly.

Unit Dead

The RED input power lamp lights up but the unit is dead and the GREEN input power lamp does not light. Replace the front panel display assembly.

No Display

The GREEN input power lamp is on. If one of the output lamps is **ON** and there is no beep, check for disconnected cables. If all cables are connected and still nothing happens, replace the CPU PCB assembly. If the output lamps are **OFF** replace the front panel display assembly. If you hear a beep then the CPU is working, check the view angle and backlight settings (see Sections 4.3.1 and 4.3.2).

No Output Signal

Sinewaves are not present at the output. Verify that a valid program has been recalled. If Phase A output is not operating correctly, check for a signal at TP1 on Phase A oscillator PCB assembly use TP1 of CPU Board as common. If there is no signal replace Phase A oscillator PCB assembly. If Phase B and/or Phase C output is not operating correctly, check for signals at TP11 and TP8 of Phase B and C oscillator PCB assembly. If there are no signals replace the Phase B and C oscillator PCB assembly. If the oscillator signals are OK check the power amplifiers.

No Output Power

Check for a failure indication light on the power amplifiers. If it is on replace the power amplifiers. If voltage is present at the output with no load, but collapses with a 333 Watt load per phase on a BOP 125-1KVA-3T or a 1 killowatt load on a BOP 125-1KVA-T, replace the associated power amplifers.

Incorrect Frequency Display

If the frequency display is incorrect and the output is OK, replace Phase A oscillator PCB assembly. Note, the frequency counter is on Phase A oscillator PCB assembly.

No Voltage and Current Display

If all of the voltage and current displays are not working correctly, replace the Phase A oscillator PCB asembly. If a signal is present at TP1 of Phase A oscillator PCB assembly and the VA voltage display is incorrect, replace Phase A oscillator PCB assembly. VB is TP2 and VC is TP5 of Phase B and C oscillator PCB assembly. Transformer output VA is TP4, VB is TP5, and VC is TP2 of Phase A oscillator PCB assembly. Current output IA is TP3 of Phase A oscillator PCB assembly. IB is TP3 and IC is TP6 of Phase B and C oscillator PCB assembly. Note the D to A converter for metering all three phases (voltage and current) is on phase A oscillator PCB assembly.

No IEEE GPIB FUNCTION

No communication over the IEEE Bus. Verify that the IEEE address switch is set correctly. Check for +5 Vdc from J61 pin 14 to J61 pin 13 on the IEEE PCB assembly. If there is no volt-

age check for shorts or a defective Low Voltage power supply assembly. If the voltage is OK and there is no communications replace the IEEE PCB assembly.

6.8 SUBASSEMBLY ROSTER

The following is a list of the replaceable subasemblies contained in the BOP 125-1KVA Series. When ordering replacements, be sure to use the subassembly numbers listed below. Also be prepaired to state Model and Serial Numbers of the Power Source requiring repair.

BOP 125-1KVA-3T High Voltage Power Supply Assembly No.	117172
BOP 125-1KVA-T High Voltage Power Supply Assembly No.	117175
AC Power Harness Assembly No.	117130
Low Voltage Power Supply Assembly No.	117173
Low Voltage Transformer Assembly No.	117176
Low Voltage Cable Assembly No.	117133
Transformer Voltage Sense Harness Assembly No.	117136
BOP 125-1KVA-3T Signal Cable Assembly No.	117134
BOP 125-1KVA-T Signal Cable Assembly No.	117144
IEEE Cable Assembly No.	117145
Power Supply Interconnect Cable Assembly No.	117132
Power Amplifier Assembly No.	117177
Phase A Oscillator Assembly No.	117372
Phase B and C Oscillator Assembly No.	117373
BOP 125-1KVA-T Front Panel PCB Assembly No.	117374
BOP 125-1KVA-3T Front Panel PCB Assembly No.	117474
CPU PCB Assembly No.	117378
IEEE GPIB PCB Assembly No.	117375
IEEE Connector PCB Assembly No.	117377
CPU Battery, Part No.	706005
Key Switch Light Bulb, Part No.	701026

TABLE 6-1 BOP 125-1KVA SUBASSEMBLIES

6.9 EQUIPMENT RETURN AND REPAIR

Equipment requiring service or repair must be returned to Kepco, Flushing, New York factory or to a Kepco authorized service center. Freight must be prepaid both ways by the shipper. Important instructions are:

1) Attach a tag to the equipment identifying the owner's name and address and the name and phone number of an individual who can be a contact.
2) Attach the Power Source Serial Number and a description of the service required.
3) Pack the equipment in the original carton or crate if available. If not, use a rigid water resistant container with adequate room for the equipment and with sufficient shock absorbing material.

PACK CAREFULLY TO AVOID EQUIPMENT DAMAGE IN TRANSIT. KEPCO WILL NOT BE RESPONSIBLE FOR REPAIR OF DAMAGE DUE TO IMPROPER PACKAGING AND HANDLING.

If the equipment to be serviced is under warranty, Kepco will repair and return the equipment, freight collect, to the original purchaser.

If the equipment to be serviced is out of warranty, Kepco will inspect the equipment and will contact the owner regarding and estimate of repairs. Upon issuance by the owner of a purchase order, Kepco will proceed with the repairs, and will return the equipment, freight collect to the owner.

6.10 WARRANTY PROVISIONS

Kepco guarantees each unit to be free of defects in material and workmanship for a period of one year starting from the date of shipment to the original purchaser.

Excluded from this warranty are fuses and batteries which carry a warranty from their own manufacturers. During the warranty period Kepco will service, repair or replace any defective part where examination shows that the fault was not attributable to misuse, abnormal operation, or user modification. The unit must be returned by the original purchaser to Kepco, Flushing, New York factory or to a Kepco authorized service location. Freight must be prepaid both ways by the original purchaser. Kepco is not responsible for consequential damage arising from the misuse of its equipment.

SECTION 7 — CALIBRATION

7.1 SCOPE

This section describes the calibration interval and calibration procedure of the BOP 125-1KVA.

7.2 SAFETY NOTICES

WARNING

1) DISCONNECT INPUT POWER FROM THE BOP 125-1KVA PRIOR TO REMOVING THE INPUT COVER.
2) LETHAL VOLTAGE POTENTIALS ARE PRESENT INSIDE THE EQUIPMENT, USE EXTREME CAUTION WHEN MAKING TEST CONNECTIONS TO CIRCUITS.
3) DO NOT WEAR RINGS OR WATCHES WHEN SERVICING THE EQUIPMENT.
4) DISCONNECT INPUT POWER FROM THE UNIT WHEN MAKING CONNECTIONS TO TERMINALS.
5) DO NOT WORK ON POWER EQUIPMENT ALONE. KEEP A TECHNICIAN NEARBY TO ADMINISTER FIRST-AID IN CASE OF SHOCK OR SOME OTHER ACCIDENT.
6) READ SECTIONS 3,4, AND 6 OF THIS MANUAL THOROUGHLY PRIOR TO ATTEMPTING TO SERVICE THIS EQUIPMENT.

CAUTION

USE CARE IN ATTACHING TEST EQUIPMENT TO THE POWER SOURCE. THE POSSIBILITY OF POWER SOURCE DAMAGE EXITS IF EQUIPMENT IS CONNECTED IMPROPERLY

7.3 CALIBRATION INTERVAL

The BOP 125-1KVA Power Source may require calibration once every twelve months depending on use.

7.4 CALIBRATION PROCEDURE

This procedure assumes the BOP 125-1KVA Power Source is operating correctly. Power up the BOP 125-1KVA and enter the following program commands, 60 Hz and 136.5 volts for each of the three phases along with default values for the phase and current limit. Refer to Section 4 for instructions on entering parameters. Execute the program entered. Ignore references to Phase B and C on the BOP 125-1KVA-T.

7.4.1 TEST EQUIPMENT REQUIREMENTS

The following test equipment is required:

1) Digital Voltmeter (DVM) - 4 ½ digit, Fluke model 8050A or equal
2) Digital Clamp On Ammeter - Amprobe model ADC-1 or equal
3) Frequency Counter, Fluke model 7250A or equal

DAC REFERENCE ADJUSTMENT

Connect the voltmeter to TP9 and TP12 of the Phase A Oscillator PCB. Adjust R60 for 10.000 ± 0.005 Vdc. This is the Phase A digital to analog reference voltage.

Connect the voltmeter to TP1 and TP7 of the Phase B and C oscillator PCB. Adjust R60 for 10.000 ± 0.005 Vdc. This is the Phase B digital to analog reference voltage.

Connect the voltmeter to TP4 and TP7 of the Phase B and C oscillator PCB. Adjust R63 for 10.000 ± 0.005 Vdc. This is the Phase C digital to analog reference voltage

7.4.3 OUTPUT VOLTAGE ADJUSTMENT

Connect the voltmeter to the Phase A output. Adjust R61 on the Phase A oscillator PCB until the voltmeter reads 136.5 Vac. This is the Phase A oscillator output.

Connect the voltmeter to the Phase B output. Adjust R59 on the Phase B and C oscillator PCB until the voltmeter reads 136.5 Vac. This is the Phase B oscillator output.

Connect the voltmeter to the Phase C output. Adjust R63 on the Phase B and C oscillator PCB until the voltmeter reads 136.5 Vac. This is the Phase C oscillator output.

7.4.4 A/D REFERENCE ADJUSTMENT

Connect a voltmeter to TP6 and TP7 on Phase A oscillator PCB. Adjust R53 for a meter reading of 2.048 ± 0.002 Vdc. This is the reference voltage for the metering analog to digital converter.

Connect a voltmeter to the Phase A output. Adjust R54 on the Phase A oscillator PCB to calibrate the Phase A voltage display

Connect a voltmeter to the Phase B output. Adjust R61 on the Phase B and C oscillator PCB to calibrate the Phase B voltage display

Connect a voltmeter to the Phase C output. Adjust R65 on the Phase B and C oscillator PCB to calibrate the Phase C voltage display

7.4.5 BOP 125-1KVA-3T CURRENT LIMIT

Enter (through the keyboard) a current limit of 3.0 Amps. Adjust R59 (current limit) on the Phase A oscillator PCB for 1.760 Vdc as read on TP8 to TP12. Next enter a current limit of 2.0 Amps. Verify **CURRENT LIMIT:** First apply a 333 Watt load per phase, then observe the voltage decrease; also note the current reads 2 Amps on the display for all three phases. Verify that after approximately 35 to 40 seconds the **Overload** warning is displayed. Press the **ENTR** button to continue. Return the current limit back to 6.0 Amps.

7.4.6 BOP 125-1KVA-T CURRENT LIMIT

Enter (through the keyboard) a current limit of 3.0 Amps. Adjust R59 (current limit) on the Phase A oscillator PCB for 1.760 Vdc as read on TP8 to TP12. Next enter a current limit of 4.0 Amps. Verify **CURRENT LIMIT:** First apply a 1KW load per phase, then observe the voltage decrease; also note the current reads 4 Amps on the display. Verify that after approximately 35 to 40 seconds the **Overload** warning is displayed. Press the **ENTR** button to continue. Return the current limit back to 18 Amps.

NOTE: Overload lamps are located at rear of unit. Visable through ventilation slots.

7.4.7 METERED CURRENT ADJUSTMENT

Connect the full load to the output of the Power Souce. Connect the clamp on ammeter to Phase A output. Adjust R56 on Phase A oscillator PCB until the metered value reads the same as the clamp on ammeter for Phase A. On the Phase B and C PCB, adjust R62 for Phase B and R66 for Phase C. Disconnect the load.

7.4.8 TRANSFORMER OUTPUT TEST

If you do not have a transformer output skip this section.

Connect the transformer box and enter 273.0 Volts RMS for all three phases. Connect the voltmeter to the Phase A transformer output. On Phase A oscillator PCB adjust R57 to calibrate the Phase A voltage display. On phase A oscillator PCB adjust R58 to calibrate the Phase B voltage display. On Phase A oscillator PCB adjust R55 to calibrate the Phase C voltage display.

7.4.9 FREQUENCY METER

Connect the frequency meter to any active output of the BOP 125-1KVA. Verify the frequency reading is $\pm 0.1\%$ ± 1 count. The frequency display cannot be adjusted, therefore if out of tolerance, replace the Phase A oscillator PCB assembly.

SECTION 8 — NOTES AND REFERENCES

8.1 NOTES AND REFERENCES

SECTION 9 — MODIFICATIONS AND CHANGE INFORMATION

9.1 MODIFICATIONS

In cases where customer specified modifications have been installed in the equipment, the modifications will be described on the following pages.

9.2 MANUAL CHANGE INFORMATION

Kepco strives to keep up with the latest electronic developments by adding circuit and component improvements to the products as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, these changes may not be reflected in the printed manuals. In that case, the following pages will contain the new change information.