HE-SERIES

AC POWER SOURCE

OPERATIONS AND SERVICE MANUAL

PACIFIC

POWER SOURCE CORP.

CERTIFICATION

Pacific Power Source certifies that this instrument was throughly tested and inspected and found to meet or exceed its published specifications when it was shipped from the facility.

WARRANTY

Pacific Power Source warrants each unit to be free from defects in material and workmanship. For the period of one year after purchase, Pacific Power Source will repair or replace any unit returned to our plant in Huntington Beach, California, by the original buyer, with shipping both ways prepaid by the buyer.

Pacific Power Source is not responsible for consequential damage arising from the use of its equipment. This warranty does not include batteries. It does not apply to extensively modified or non-standard units. Debit memos for returned units are not accepted, and will cause return of the unit without repair.

PACIFIC POWER SOURCE

HE-SERIES

AC POWER SOURCE

OPERATOR'S MANUAL

MANUAL #117550-D

PACIFIC POWER SOURCE CORPORATION
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SECTION 1

GENERAL

1.0 GENERAL

1.1 SCOPE

The purpose of this document is to describe installation and operation of the HE-Series Power Source.

The Models 310-HE and 110-HE are described by this manual. Section 2 lists the electrical, mechanical and environmental specifications of the equipment. Section 3 describes the installation of an HE System while Section 4 describes operation. Section 5 thru 7 provide maintenance, service and calibration instructions.

1.2 GENERAL DESCRIPTION

The HE-Series equipment is high performance solid-state power conversion equipment. The equipment utilizes advanced direct coupled linear techniques which allow the HE equipment to be compact and lightweight without sacrificing performance. The HE-Series equipment also includes Pacific's field proven fail-safe technology. This along with a conservative design philosoly insures long term reliability.

The HE-Series presently consists of two models, the Model 310-HE and Model 110-HE. Both are rated for 1kVA continuous output. The Model 310-HE is configured for three phase output while the Model 110-HE is configured for single phase output. Both models feature the IEEE-488 interface and are completely programmable.

This manual is an operator's manual. Service, maintenance and calibration requirements of this equipment are covered by this this document. The service instructions described in Section 5 provide instruction relative to isolating 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 issued as WARNINGS and will be bordered as shown below:

* * * W A R N I N G * * *

WARNING STATEMENT

* * * W A R N I N G * * *

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 stated as CAUTIONS. Cautions will be bordered as shown below:

— — — C A U T I O N — — —

CAUTION STATEMENT

— — — C A U T I O N — — —

A caution is issued when either the Power Source or load attached may be subjected to a damaging situation and the operator is not in jeopardy.

1.3 SAFETY NOTICES (CON'T)

The following warnings and cautions should be noted:

* * * W A R N I N G * * *

1) DO NOT REMOVE THE COVER OF THE HE POWER SOURCE WHILE INPUT POWER IS CONNECTED TO THE HE.

2) DO NOT WEAR RINGS OR WATCHES WHEN MAKING CONNECTIONS TO THE HE EQUIPMENT.

3) DISCONNECT INPUT POWER FROM THE HE POWER SOURCE WHILE 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 ELECTROCUTION OR SOME OTHER ACCIDENT.

5) READ THIS DOCUMENT <u>THOROUGHLY</u> PRIOR TO USING THE HE EQUIPMENT.

* * * W A R N I N G * * *

\- \- \- C A U T I O N - - -

1) MAKE SURE THE OUTPUT OF HE-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 HE POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOUCRE ARE FULLY UNDERSTOOD.

3) DO NOT APPLY EXCESSIVE INPUT VOLTAGE TO THE HE POWER SOURCE. MACHINE DAMAGE WILL RESULT.

\- \- \- C A U T I O N - - -

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SECTION 2

SPECIFICATIONS

2.0 SPECIFICATIONS

The following specifications apply to the Models 110-HE and 310-HE. Each specification is assumed to apply to both models unless noted otherwise.

2.1 ELECTRICAL SPECIFICATIONS

2.1.1 INPUT PERFORMANCE SPECIFICATIONS

INPUT VOLTAGE:

110-132 VAC	47-63 Hz	Single Phase
OR		
200-240 VAC	47-63 Hz	Single Phase

- - - C A U T I O N - - -

DO NOT APPLY EXCESSIVE INPUT VOLTAGE
MACHINE DAMAGE WILL RESULT

- - - C A U T I O N - - -

2.1.2 OUTPUT PERFORMANCE SPECIFICATIONS

OUTPUT VOLTAGE RANGE:

Model 110-HE	0-136.5 VAC
Model 310-HE	0-136.5/236 VAC
	Adjustable in 0.1V steps.

OUTPUT CURRENT:

Model 110-HE	8.3 Amps RMS
	18 Amps peak available at crest of sine wave to drive peak type loads such as DC power supplies.
Model 310-HE	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 FACTOR:

Model 110-HE	Full rated kVA $\pm$ 0.5 to 1.0pf
	derates to 85% @ $\pm$ 0.0pf
Model 310-HE	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 110-HE	12.0 Amps Maximum
	Adjustable in 0.1 Amp steps
Model 310-HE	6.0 Amps per phase Maximum
	Adjustable in 0.1 Amp steps

PHASE SEPARATION: (Model 310-HE only)

Phase A:	0° (Reference Phase)
Phase B:	Adjustable 0-360° in 1 degree steps
Phase C:	Adjustable 0-360° in 1 degree steps

2.1.2 OUTPUT PERFORMANCE SPECIFICATIONS (CON'T)

INPUT LINE REGULATION:

± 0.1%, Maximum for a ± 10% line change

OUTPUT VOLTAGE REGULATION:

Less than 0.5% (0.1% Typical)

OUTPUT DISTORTION:

Less than 1.0% THD (0.50% THD Typical)

OUTPUT MODULATION:

Less than 0.8Vp-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 step transient.

OUTPUT DC OFFSET:

Less than 10mVDC

OUTPUT ISOLATION:

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

METERING:

OUTPUT VOLTAGES:

Model 110-HE: Output voltage is displayed on front panel LCD display.
Resolution: 0.1 VAC
Accuracy: 1% ± 1 count

Model 310-HE: Output line to neutral voltages displayed simultaneously on front panel LCD.
Resolution: 0.1 VAC
Accuracy: 1% ± 1 count

2.1.2 OUTPUT PERFORMANCE SPECIFICATIONS (CON'T)

METERING: (con't)

OUTPUT FREQUENCY:

Output frequency is displayed on front panel display.
Resolution: 0.1 Hz
Accuracy: 1% ± 1 count

OUTPUT CURRENT:

Model 110-HE: Output current displayed on front panel LCD.
Resolution: 0.1 AAC
Accuracy: 1% ± 1 count

Model 310-HE: Each phase output displayed on front panel LCD.
Resolution: 0.1 AAC
Accuracy: 1% ± 1 count

FAULT INDICATORS:

A) Overtemp

B) Output device failure. (Failsafe circuit allows power source to continue operation at reduced output capability).

C) Overload. If unit is in current limit for more than 30 seconds, a overload message is displayed.

PROGRAMMABLE INTERFACE:

The HE equipment is supplied with the IEEE-488 instrumentation interface. The bus is capable of controlling amplitude frequency, phase displacement, current limit and the output contactor.

The HE 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°
Current Limit:	± 0.1% ± 1 count @ full scale

2.2 MECHANICAL SPECIFICATIONS

Height:		5.25 inches
Width:	Front Panel	19.00 inches
	Chassis	16.75 inches
Depth:		23.00 inches
Weight:		65 pounds

Refer to Figure 2.2.1.

INPUT CONNECTION:

The HE is supplied with an input power cord. A NEMA Type 5-15P plug is attached to the end of the power cord when ordered with the 115 VAC input form.

OUTPUT CONNECTION:

Output is taken from the HE equipment via a single row terminal strip supplied with #6-32 binding head screws.

CHASSIS SLIDES:

The chassis of the HE-Series equipment has been designed to accept the following chassis slides:

P/N 310-22 as manufactured by
Jonathan Manufacturing Company
Fullerton, California.

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 HE-Series equipment is designed to operate in ambient temperatures of 0-55 degrees Celsius.

VENTILATION REQUIREMENTS:

The HE-Series equipment contains 2 each 70 CFM fans. Air intake is along the sides. Exhaust is through the rear panel.

AUDIBLE NOISE:

Audible noise generated by the HE-Series is less than 50 dbA when measured 1 meter from the front panel.

SECTION 3

INSTALLATION

3.0 INSTALLATION

This section describes the installation requirements of the HE-Series equipment.

Section 3.2 references input power requirements while section 3.3 provides information relative to output connections to the HE.

3.1 SAFETY NOTICES

* * * W A R N I N G * * *

1) DO NOT REMOVE THE COVER OF THE HE POWER SOURCE WITH INPUT POWER CONNECTED TO THE HE.

2) DO NOT WEAR RINGS OR WATCHES WHEN MAKING CONNECTIONS TO THE HE EQUIPMENT.

3) DISCONNECT INPUT POWER FROM THE HE POWER SOURCE WHILE 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 ELECTROCUTION OR OTHER ACCIDENT.

5) READ THIS DOCUMENT THOROUGHLY PRIOR TO USING THE HE EQUIPMENT.

* * * W A R N I N G * * *

\- \- \- C A U T I O N - - -

1) MAKE SURE THE OUTPUT OF HE-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 HE POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOURCE ARE FULLY UNDERSTOOD.

\- \- \- C A U T I O N - - -

3.2 INPUT POWER REQUIREMENTS

The HE-Series Power Source described by this document is normally configured with the 115 VAC input power form. Input power is brought in through the integral power cord. The power cord is fitted with a NEMA Type 5-15P plug and can be plugged into any standard 15 or 20A outlet.

The HE-Series may draw as much as 18A 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 HE-Series Power Source may be in the range of 47-63 Hz.

To connect the HE to the source of input power use the following steps:

1) Verify that 115 VAC is available at the outlet.

2) Plug in the input power cord to the power outlet.

— — — C A U T I O N — — —

DO NOT APPLY EXCESSIVE INPUT VOLTAGE TO HE EQUIPMENT. MACHINE DAMAGE WILL RESULT.

— — — C A U T I O N — — —

3.2 INPUT POWER REQUIREMENTS (CONT'D)

3.2.1 RECONFIGURING INPUT FORMS

All connections involved in changing input forms for this unit are located on T10, the main power transformer, the lo-volt power supply, Assembly No. 117173 and on the lo-volt transformer board, Assembly No. 117176.

JUMPER CONNECTION

120 VAC OPERATION

ASSEMBLY NO. 117173

FROM	TO
E1	CB-H1
E3	T10-6
E9	T10-4
E5	T10-3
E6	T10-1
E7	120V LO
E8	E10
E2	E4

ASSEMBLY NO. 117176

FROM	TO
E1	E4
E2	E5

220 VAC OPERATION

ASSEMBLY NO. 117173

FROM	TO
E1	CB-H1
E3	T10-5
E4	T10-4
E5	T10-3
E6	T10-1
E7	220V LO
E8	T10-6
E2 -REMOVE-	E4

ASSEMBLY NO. 117176

FROM	TO
E1	E3
E2	E4

3.3 OUTPUT POWER CONNECTION

The HE-Series Power Source consists of high performance amplifiers with direct-coupled outputs. This provides extremely low output impedance and allows the HE-system to deliver high pulse currents. In order to take advantage of this feature, output wiring should be larger than normal and kept as short as possible to minimize impedances. Output wiring for the Model 310-HE should be a minimum of 16 Awg. Output wiring for the 110-HE should be 14 Awg, minimum.

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.

- - - C A U T I O N - - -

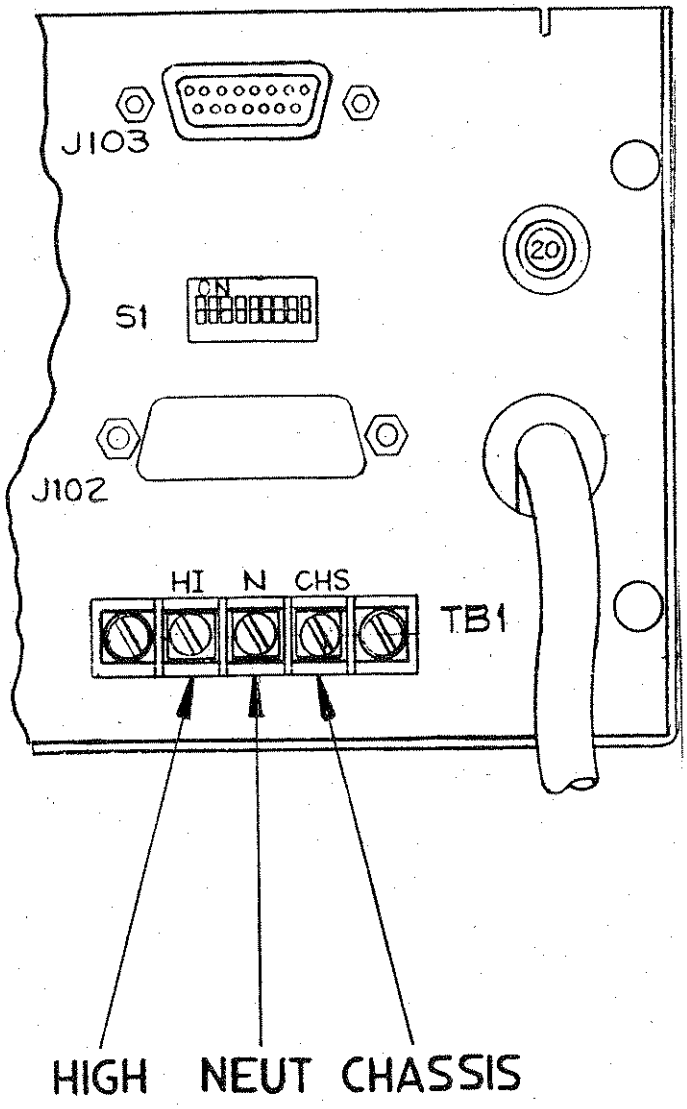
1) THE LOW VOLTAGE POWER SUPPLIES ARE ENERGIZED EVEN WHEN THE INPUT POWER SWITCH IS SET TO THE OFF POSITION.

2) DO NOT ATTACH A LOAD TO THE OUTPUT OF THE HE POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOURCE ARE FULLY UNDERSTOOD.

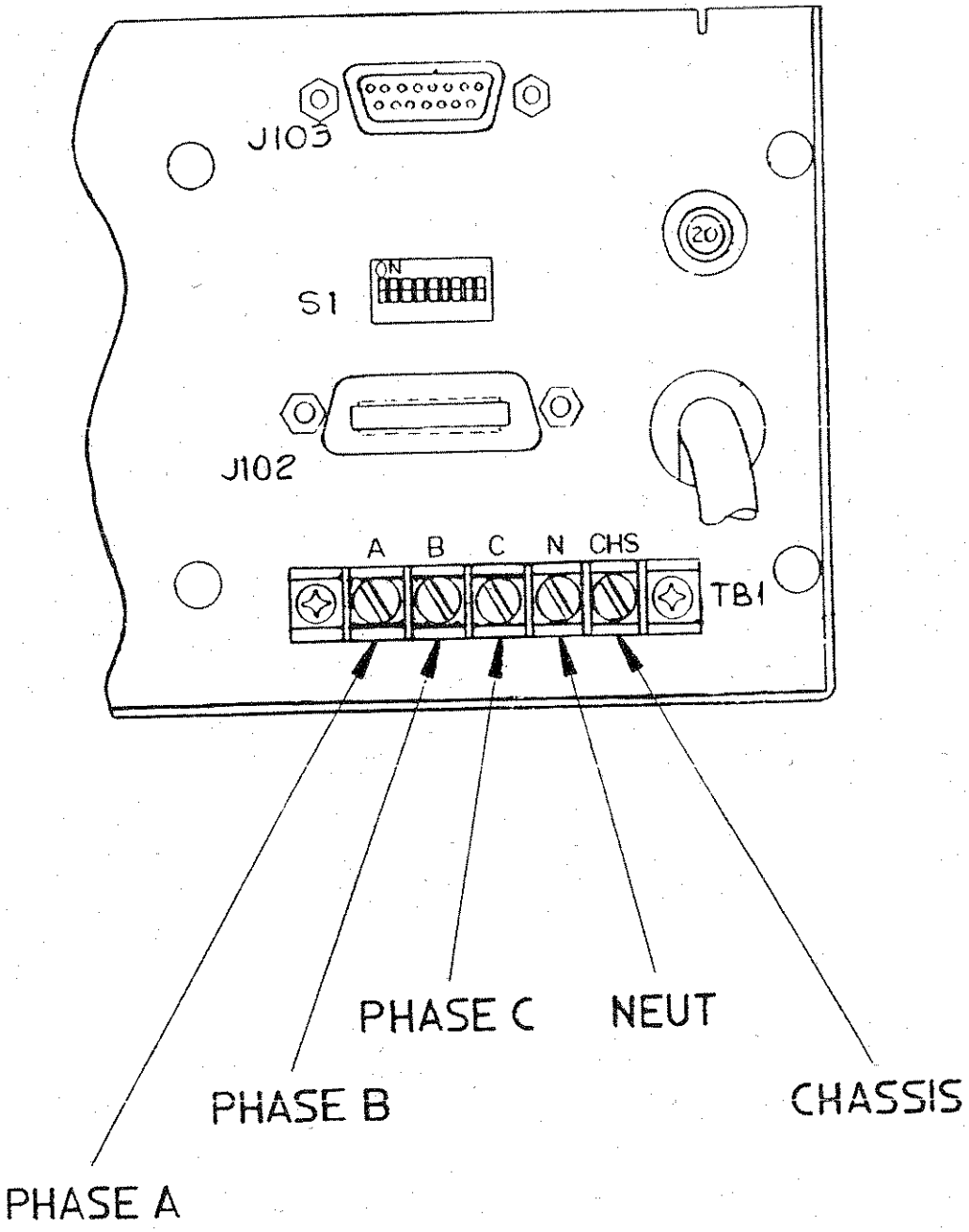
- - - C A U T I O N - - -

The output of the HE 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 LO.

Figures 3.3.1 and 3.3.2 shows typical output wiring of the 110-HE and 310-HE systems, respectively.



MODEL 110-HE TYPICAL OUTPUT WIRING
FIGURE 3.3.1



MODEL 310-HE TYPICAL OUTPUT WIRING
FIGURE 3.3.2

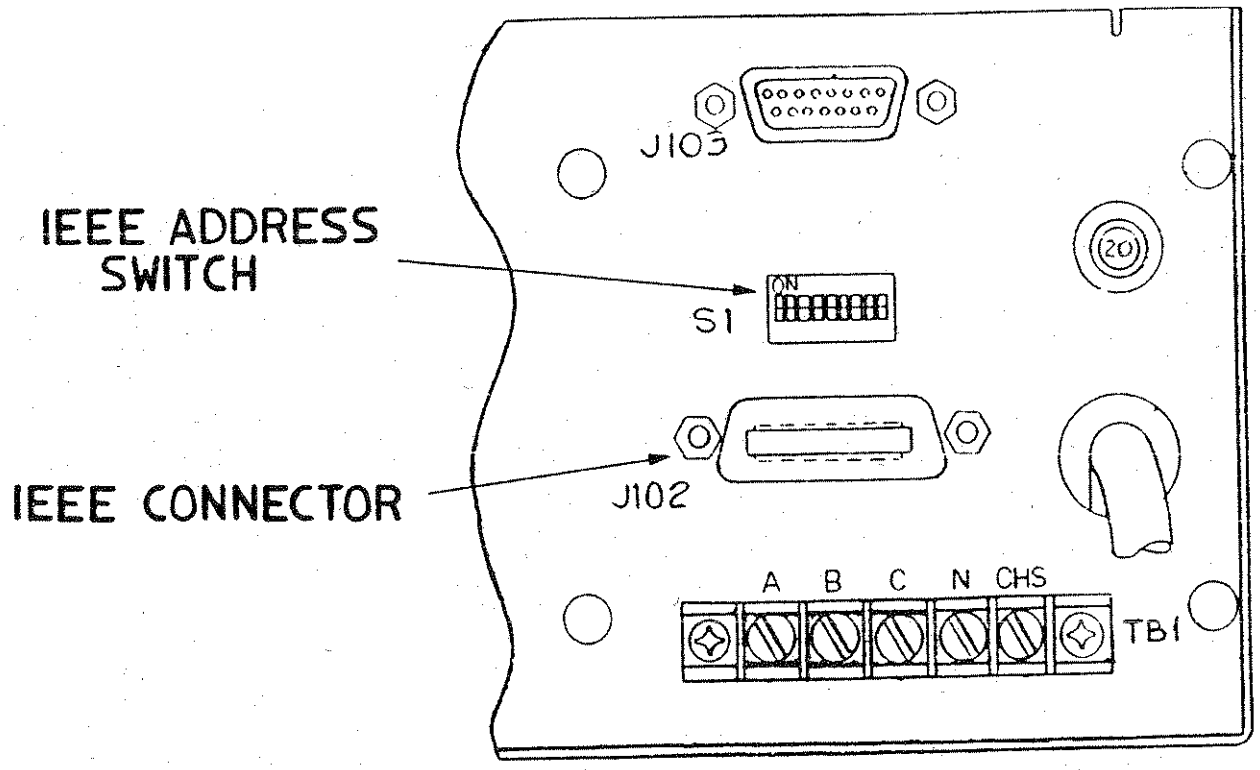
3.4 CONNECTION TO THE IEEE BUS

Connection to the IEEE Bus is via J102. Switch S1 selects the address of the HE Power Source. The function of the S1 switch is in accordance with IEEE specifications.

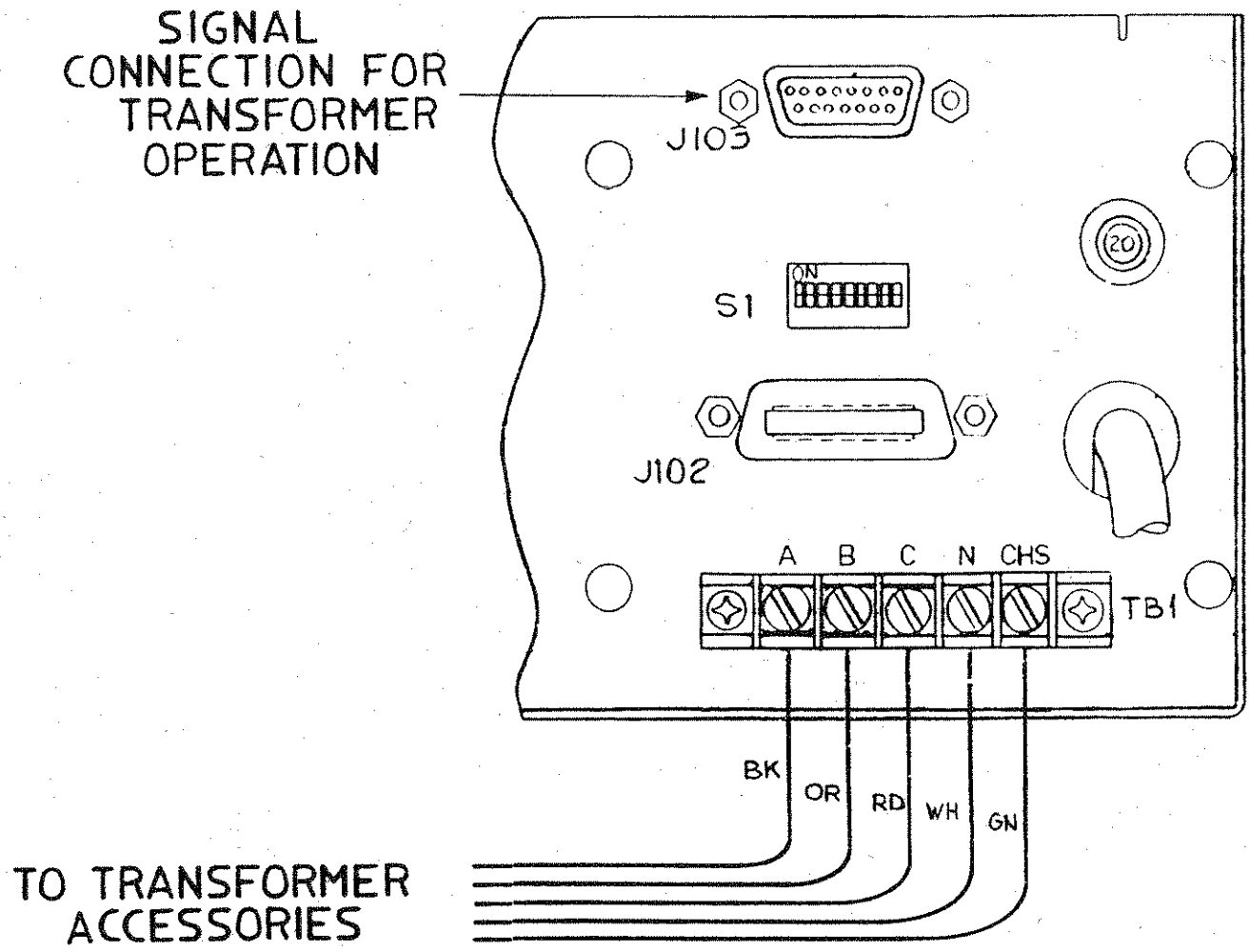
Figure 3.4.1 shows the location of J102. Please refer to paragraph 4.3 for determination of the S1 positions.

3.5 CONNECTION TO THE TRANSFORMER ACCESSORY

Connect the power cable from the transformer accessory to TB1 of the HE Power Source. Refer to Figure 3.4.2 for correct connections. Connect the signal cable between J3 on the transformer accessory to J103 on the HE Power Source.



IEEE BUS INTERCONNECTION
FIGURE 3.4.1



CONNECTION TO THE TRANSFORMER ACCESSORY
FIGURE 3.4.2

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SECTION 4

OPERATION

4.0 OPERATION

This section describes the operation of the HE-Series Power Source.

4.0.1 SAFETY NOTICES

* * * * W A R N I N G * * * *

1) DO NOT REMOVE THE COVER OF THE HE POWER SOURCE WHILE INPUT POWER IS CONNECTED TO THE HE.

2) DO NOT WEAR RINGS OR WATCHES WHEN MAKING CONNECTIONS TO THE HE EQUIPMENT.

3) DISCONNECT INPUT POWER FROM THE HE POWER SOURCE WHILE 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 ELECTROCUTION OR SOME OTHER ACCIDENT.

5) READ THIS SECTION THOROUGHLY PRIOR TO USING THE HE EQUIPMENT.

* * * * W A R N I N G * * * *

\- \- \- \- C A U T I O N - - - -

1) MAKE SURE THE OUTPUT OF HE-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 HE POWER SOURCE UNTIL THE CHARACTERISTICS OF THE POWER SOURCE ARE FULLY UNDERSTOOD.

\- \- \- \- C A U T I O N - - - -

4.0.2 INTRODUCTION

The HE-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 310-HE only)
Current Limit:

Paragraph 4.1 describes the function of each front panel control. Paragraph 4.2 provides operating instructions of the Model 310-HE. Paragraph 4.3 describes the Model 110-HE. Paragraph 4.4 describes the operation of the HE equipment via the IEEE-488 Instrumentation Bus. Finally paragraph 4.5 explains the transient generation capabilities of this equipment.

4.1 LOCATION AND DESCRIPTION OF CONTROLS

Figure 4.1 is a line drawing of the front panel of the HE-Series equipment. Each control and indicator is identified and its function defined in the text below:

1 INPUT POWER

A pair of interlocked push-buttons which control the input power to the HE-Power Source. The active states illuminated with green meaning "ON" and red "OFF".

2 FRONT PANEL DISPLAY

A multiplexed LCD display which displays system status and provides user information.

3 SLEW CONTROLS

Controls which are used to slew the voltage and frequency. Particularly useful for making small changes to the power source output.

4 NUMERIC KEYPAD

Keys used to provide numeric input to the HE-Power Source.

5 ENTER KEY (ENTR)

Key used to terminate a keyboard input.

6 CLEAR KEY (CLR)

Key used to delete an erroneous data input.

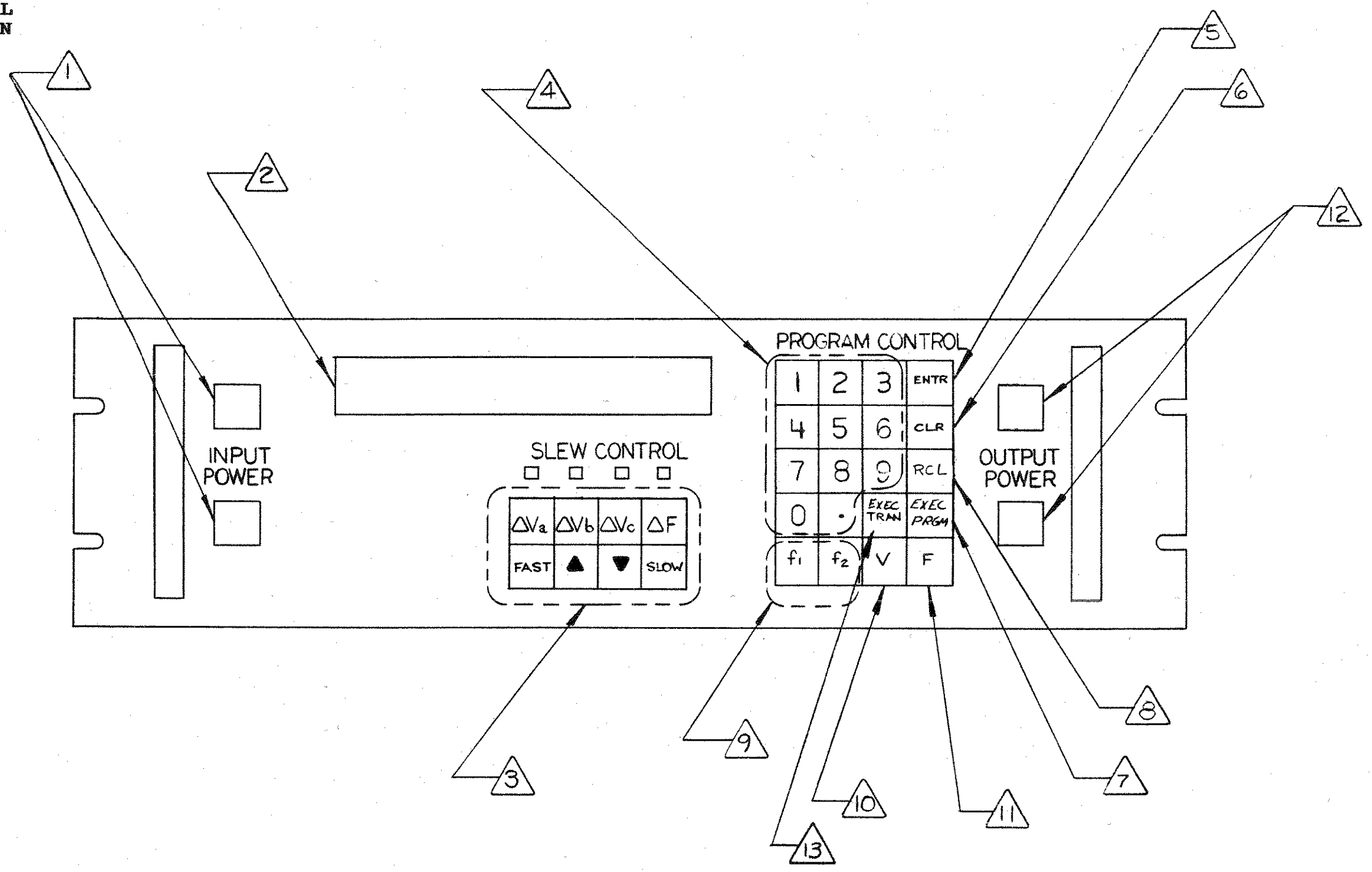


FIGURE 4.1
HE FRONT PANEL CONTROL LAYOUT

4.1 LOCATION AND DESCRIPTION OF CONTROLS (CONT)

7 EXECUTE PROGRAM KEY (EXEC PRGM)

Key used to execute a program which has been recalled.

8 RECALL KEY (RCL)

Key used to access a desired program number.

9 SPECIAL FUNCTION KEYS

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

10 VOLTAGE ADJUSTMENT KEY (V)

Key used to set output voltage directly without storing the value in a program.

11 FREQUENCY ADJUSTMENT KEY (F)

Key used to set output frequency directly without storing the value in a program.

12 OUTPUT POWER ON/OFF

A pair of interlocked push-buttons which control the output contactor of the HE. The active state is illuminated with green meaning "ON" and red "OFF".

13 EXECUTE TRANSIENT KEY (EXEC TRAN)

Key used to start/stop envelope transient program.

4.2 MODEL 310-HE OPERATION

This paragraph describes the operation of the Model 310-HE. Local operation (data entry via the front panel keypad) is discussed in this section. Remote operation (via the IEEE Interface) is discussed in section 4.4.

Several modes of local operation exist for the Model 310-HE. The first is 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 "bump" 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 HE Power Source.

SYSTEM OPERATION

The first time the unit is turned on a program has to be entered into memory. The HE equipment contains battery back-up on the memory. This is provided so that once a program is installed, it is retained, even when input power is removed.

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

```
|MODEL X10-HE SmartSource (c) 1990  v 3.02|
|PACIFIC POWER SOURCE       Press "RCL" Key|
```

This is the opening display. Note that the ROM version is displayed in the upper right corner.

4.2.1 TO ADJUST THE INTENSITY OF THE LCD BACK LIGHTING:

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 upper or lower limit of adjustment is reached, this function exits back to the opening display or active program.

4.2.2 TO ADJUST 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, this function exits back to opening display

4.2.3 ENTERING OPERATING PARAMETERS INTO PROGRAM MEMORY:

Parameter entry is the simple process by which operating parameters are stored in one of the oscillator's 99 program memories. In this process, the user is prompted for values to be stored in program memory for frequency, voltage, phase angle, and current limit. Program memory is non-volatile. Once a program is stored, it may be recalled at any time, even if input power has been removed. Programs which are stored locally (via the keyboard) may be recalled either locally or via the IEEE Bus. Likewise, programs which are stored via the IEEE 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" will store the new value. Note that for the following examples, program "1" is used. The range of legal program numbers is 0-99 with 0 being reserved for the transient program (the transient function is explained in section 4.5).

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

TO ENTER A PROGRAM:

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

| PROGRAM NUMBER _ |

4.2.3 ENTERING OPERATING PARAMETERS INTO PROGRAM MEMORY: (cont)

2) Key in program number 1 on the keypad by pressing the "1" and "ENTR" buttons and the screen will display one of two things:

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 o/B=120   o/C= 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 prompt the operator to enter a different operating parameter. In each case, an existing or default value is already present and a range of legal values is displayed. Press ENTR to accept this value, or enter a new value from the keypad and press ENTR to store it.

Following is the screens presented for program entry and their default values:

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

SET OUTPUT FREQUENCY:

```
|   PROGRAM NUMBER 1
|FREQUENCY (20-2000Hz)                60.00 |
```

4.2.3 ENTERING OPERATING PARAMETERS INTO PROGRAM MEMORY: (cont)

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 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)	240

SET CURRENT LIMIT VALUE:

PROGRAM NUMBER 1	
CURRENT-LIMIT (0 TO 6.0A)	6.0

4.2.3 ENTERING OPERATING PARAMETERS INTO PROGRAM MEMORY: (cont)

NOTE: The current limit maximum value for the 310-HE is 6.0 amps. When the transformer option is installed, the current limit is cut in half because of transformer action. Therefore, the 310-HE is 3.0 amps.

The parameter entry process is complete and the HE 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 o/B=120   o/C= 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 screen, or an active program.

4.2.4 EXECUTING A PROGRAM:

Stored programs may be recalled and executed from either the opening screen, or while another program is running.

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 will be in the OFF position and the RED Output Power lamp should be lit. 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 HE Power Source.

4.2.4 EXECUTING A PROGRAM (CONT)

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

```
LOC  P01    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 Bus) control. In the remote mode the keyboard is locked out. Output power controls are also locked out.

2 PROGRAM NUMBERS

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

4.2.4 EXECUTING A PROGRAM (CONT)

3 OUTPUT VOLTAGE

These three fields display the output line to neutral voltage of the HE 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 HE Power Source.

5 OUTPUT CURRENT

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

4.2.5 SETTING OUTPUT VOLTAGE: ("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 will be displayed. Enter the new value and press the green EXEC PRGM key. The metering screen will appear and display the new voltage readings without the program number. This function does not effect any stored program values.

NOTE: When the transformer option is installed the voltage range that will be displayed is 0 to 273 Vrms.

4.2.6 SETTING THE FREQUENCY ("F" KEY):

In the same manner just described, 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 - 2000Hz                        60.00    |
```

The present value of frequency will be 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 any stored program values.

4.2.7 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 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 above the selected key(s). Pressing the UP (▲) or the DOWN (▼) key will slew the selected function(s) up or down.

Pressing the FAST or SLOW keys while holding the UP or DOWN key will increase or decrease the rate of change of the selected function(s).

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

4.2.8 POWER SOURCE STATUS INDICATORS

The HE-Series Power Source monitors critical parameters of its operation.

A) OVER TEMPERATURE
If the safe operating temperature of the heatsinks is exceeded, the following message will be 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 will be 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 will be displayed:

SERVICE REQUEST SEE MANUAL

If this message is displayed, press "Enter" to resume the metering function. If a device has disconnected a LED on the power amplifier board can be seen then the grill at the rear of the machine.

If any problems occur, contact the factory.

4.3 MODEL 110-HE OPERATION

The Model 110-HE is a 1kVA Single Phase AC Power Source. It is constructed from many of the same subassemblies used in the Model 310-HE. The main difference between the two models is the absence of the phase B and C circuits in the case of the Model 110-HE.

Operation of the Model 110-HE proceeds exactly as that of the Model 310-HE. Refer to paragraph 4.2 for operating procedures. Omit any instructions relating to Phases B and C. Also, the current limit range of the Model 110-HE is 0-12 Amps.

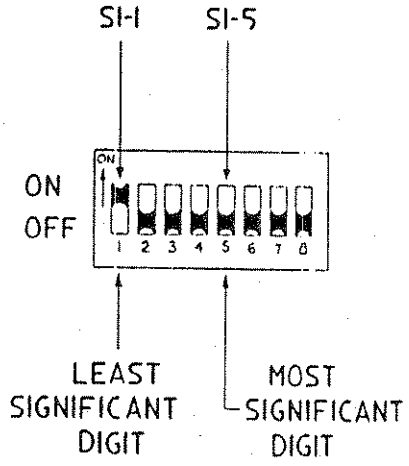
4.4 CONNECTING THE IEEE GPIB BUS:

The HE Power Source is connected to the IEEE 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 HE Power Source. Figure 4.4.1, below, shows S1 to relative to the function of each section of the switch.

The interface is optically isolated from the power circuits of the HE Power Source. This allows the user to establish the ground reference of the HE output to be any desired potential within 150 VAC of earth ground. Connection of the HE Power Source to the IEEE Bus involves two basic steps which are:

1) Attach the HE Power Source to the Bus via the IEEE connector J102.

2) Select the device address with S1 (located on the rear panel).



SHOWN FOR ADDRESS 1

IEEE ADDRESSING SWITCH
FIGURE 4.4.1

4.4 CONNECTING THE IEEE GPIB BUS: (CONT)

3) DEVICE ADDRESS
The device address is set by using the dip switch on the rear panel labeled S1. 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:

S1 ON all others OFF = address 1

Switch 2 ON all the others OFF = address 2

Switch 1 and 2 ON all others OFF = address 3

Switch 3 ON all others OFF = address 4

4.4.1 REMOTE OPERATION (via IEEE GPIB BUS)

Pacific's HE-Series AC Power Source is programmable over the IEEE-488 GPIB Bus. The commands that the HE-Series Power Source responds to are listed below:

FUNCTION	VALID MNEMONICS
VOLTS (3 PHASES SIMULTANEOUSLY)	V VOLT AMP AXXXX VXXXXXX 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	En, EXECn, EXECUTEn
RECALL A PROGRAM AND WAIT FOR A TRIGGER (G.E.T.) BEFORE EXECUTING	EnTRG, EXECUTE n TRG
OUTPUT CONTRACTOR 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

4.4.1 REMOTE OPERATION via IEEE GPIB BUS (CONT)

NUMERICAL VALUE ENTRY

Each function will be 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 numeric 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 (0A)hex, the carriage return (0d)hex and the comma (2c)hex. The HE-Series also terminates on the End or Identify <EOI> GPIB command received over the bus.

4.4.2 REMOTE OPERATION

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 imbedded spaces between numbers and characters. An end of string (<EOS>) character will terminate each transmission. The end of string terminator can be:

a comma (2Ch), a line feed (OAh) or a carriage return (ODh).

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 310-HE, the voltages for the three phases can be changed independently.

For example:

va110.5 VB125.5 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 60.5VAC.

The phase angle can be changed by sending:

PHB90 PHC355 <EOS>

The current limit (0 to 6.0,MODEL 310-HE; 0-12.0 MODEL 110-HE) may be adjusted by sending:

clm4.3 <EOS>

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

4.4.2 REMOTE OPERATION (CONT)

The PROGRAM command stores the values in memory until a trigger or RCL command is received. Programs that are to be stored need to have all the parameters listed when sent over the GPIB bus. 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. Up to 99 programs can be stored and recalled at any time.

OR

PGM15F59.99AMA110AMB115AMC120PHB60PHC90ILM3.6<EOS>

Programs stored over the GPIB Bus may be recalled locally after the Bus has relinquished control back to the keyboard. In order to recall a program already stored send:

RCL03 <EOS>

Program 3 will be executed.

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

RCL03TRG <EOS>

And when the <GET> command is received, the program is executed.

4.4.2 REMOTE OPERATION (CONT)

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

The error code will be one of the following:

ERROR	61hex	INCORRECT DATA WAS RECEIVED
ERROR	62hex	DATA RECEIVED WAS OUTSIDE THE LIMITS OF THE MACHINE
ERROR	63hex	PROGRAM RECALLED WAS NOT STORED
ERROR	64hex	DEVICE FAILURE
ERROR	65hex	OVER TEMP PHASE A
ERROR	66hex	OVER TEMP PHASE B
ERROR	67hex	OVER TEMP PHASE C
ERROR	68hex	OVERLOAD PHASE A
ERROR	69hex	OVERLOAD PHASE B
ERROR	6Ahex	OVERLOAD PHASE C
ERROR	6Bhex	ILLEGAL TRANSIENT PARAMETERS

The power source will set the service request <SRQ> bit. At this point the Bus controller may obtain the error code via a serial poll.

When finished with the power source send a "LOCAL <EOS>" and the system will return to the local mode

4.4.2 REMOTE OPERATION (CONT)

Receiving metered values over IEEE GPIB Bus.

If the HE-Series Power Source is addressed as a talker it will send the operating frequency, the voltage for all three phases and the current for all three phases.

4.4.3 GPIB PROGRAMMING NOTES

Note that the Group Execute Trigger (GET) command is an IEEE-488 Std. function as opposed to a 110/310-HE mnemonic.

Always begin using the GPIB bus with one of the following commands...

```
PROGRAM nn etc...
DISPLAY nn
EXECUTE nn
```

4.5 EXECUTING TRANSIENT PROGRAMS:

The HE-Series Power Source is equipped with transient generation routines. The transients produced are the envelope type. Changes in voltage or frequency are possible. The transients are fully defined in paragraph 4.5.1.

4.5.1 TRANSIENT DEFINITIONS

This paragraph defines the various transient parameters which are stored in memory. The limits of these parameters are also stated. Refer to Figure 4.5.1 for a representation of a typical transient envelope.

This programmable transient parameters are listed below:

1) RISE TIME (TR)

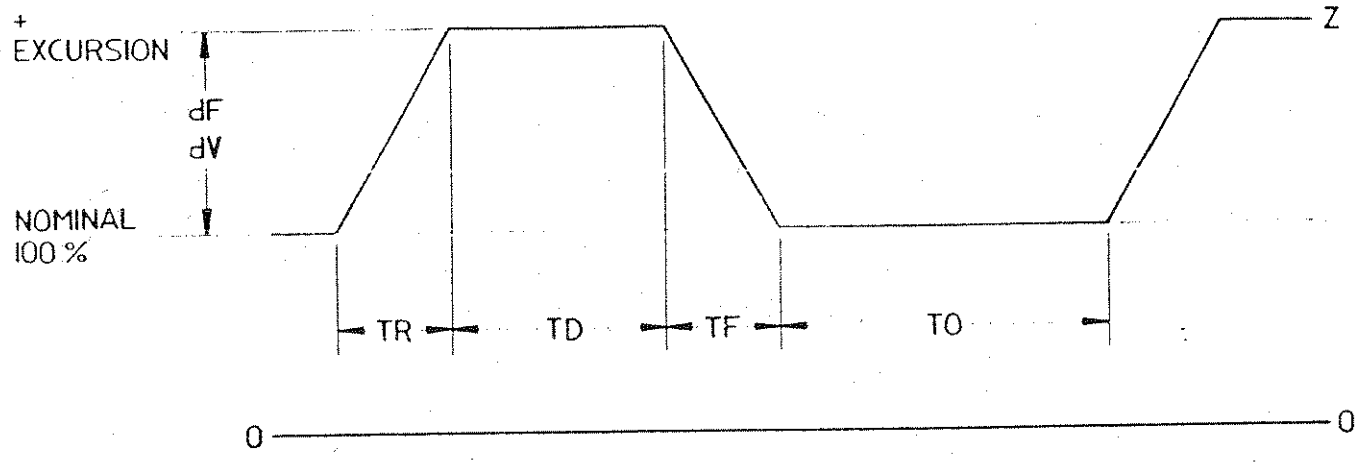
This is the time required for the voltage or frequency to go from nominal value to full transient excursion. Zero rise time is used for step transients. Valid values for TR range from 30mS to 60 seconds.

2) DWELL TIME (TD)

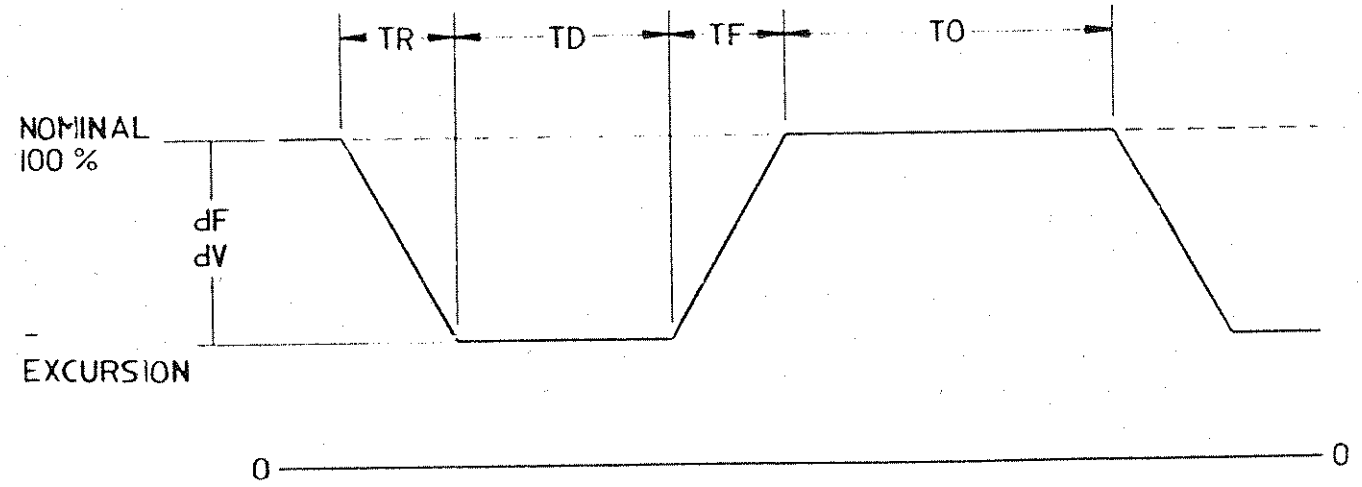
This is the time that the output remains or "dwell" at full transient excursion. Valid values ranges from 10mS to 60 seconds.

3) FALL TIME (TF)

This is the time required for the voltage or frequency to go from the full transient value back to its nominal steady state value. Zero time is in
Valid values for TF range from 30mS to 60 seconds.



POSITIVE TRANSIENT ENVELOPE
(a)



NEGATIVE TRANSIENT ENVELOPE
(b)

TRANSIENT ENVELOPE DEFINITION
FIGURE 4.5.1

4.5.1 TRANSIENT DEFINITIONS (cont)

4) STEADY STATE TIME (TO)

This is the time between transient envelope patterns. Values from this parameter range from 0 to 60 seconds with a 10mS resolution. The transient may also be programmed as a single event. In this case, this 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 lies within the 20-500Hz range.

6) DELTA VOLTAGE (dV)

This is the change in voltage from steady to full excursion values. Valid range of values for this function are those for which the full excursion value lies in the range of 0-136.5 VAC. The dV command changes all phases identically. An individual phase may 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.

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4.5.2 ENTERING A TRANSIENT PROGRAM

The transient program is stored in program 0. Naturally, a transient program must be stored before it can be executed. If this is attempted, the following message will be 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 may entered and executed with the following procedure:

1) Recall an operating program and execute it so that the power source is active (this is not necessary to store parameters in the transient program, but it is necessary to execute the transient).

2) Press RCL 0 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 once more to return to active operating program (or opening screen if you happen to have done this after just turning on the machine).

4.5.2 ENTERING A TRANSIENT PROGRAM (cont)

5) Now 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 imposes few restrictions on the values of the parameters you enter. For Tr, & Tf it will not allow values between 00.01 and 00.03. Also, TR, TF, TD may not be zero at the same time. This is a nonsense transient envelope pattern and the power source will not allow this to be executed. For the delta values, no restrictions are imposed, but the transient will stop at the operating limit of the machine. 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.

4.5.3 TRANSIENT OPERATION OVER IEEE BUS:

Valid mnemonics for IEEE operation of the transient program:

FUNCTION	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 tran at end of cycle	TS
Stop repetitive tran immediately.	TN

Use these commands as previously described in the "Operation Over the Bus" 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 command for that matter, while a repetitive transient is operating. Always stop it with the TS or TN command first.

SECTION 5

MAINTENANCE

5.0 MAINTENANCE

5.1 PURPOSE

The purpose of this section is to state the maintenance requirements of the HE-Series equipment.

5.2 MAINTENANCE REQUIREMENTS

The HE-Series equipment has been designed so that it requires a minimum of maintenance. Generally speaking, maintenance is limited to a periodic exterior cleaning and regular calibration. Refer to Section 7 of this manual for calibration of this equipment.

The HE-Series equipment is constructed of durable materials. The chassis is constructed of anodized aluminum. This surface can be cleaned by wiping with a cloth that has been dampened with water and detergent or denatured alcohol.

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

When cleaning the HE equipment, NEVER allow liquids to enter the chassis. Always moisten the cloth first then wipe down the unit to prevent accidental introduction of liquid to the interior of the power source.

Cleaning of the interior of the power source is only required at time of calibration. Simply remove any dust or dirt with a vacuum cleaner or blow it away with an air hose.

* * * * W A R N I N G * * * *

DO NOT ATTEMPT TO CLEAN THE POWER SOURCE WHILE INPUT POWER IS CONNECTED TO THE HE.

* * * * W A R N I N G * * * *

SECTION 6

SERVICE

6.1 SERVICE

The purpose of this section is to instruct user in servicing the HE equipment. The recommended service method consists of isolating a defective PCB assembly and then replacing the suspected assembly with a known good spare. Suspected defective assemblies are then returned to the factory for repair.

6.2 SAFETY NOTICES

* * * * W A R N I N G * * * *

1) DISCONNECT INPUT POWER FROM THE HE POWER SOURCE PRIOR TO REMOVING THE INPUT COVER.

2) LETHAL VOLTAGE POTENTIALS ARE PRESENT INSIDE HE EQUIPMENT, USE EXTREME CAUTION WHEN MAKING TEST CONNECTIONS TO CIRCUITS.

3) DO NOT WEAR RINGS OR WATCHES WHEN SERVICING THE HE EQUIPMENT.

4) DISCONNECT INPUT POWER FROM THE HE 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 ELECTROCUTION OR SOME OTHER ACCIDENT.

6) READ SECTIONS 3, 4 AND 6 OF THIS MANUAL THOROUGHLY PRIOR TO ATTEMPTING SERVICE TO THIS EQUIPMENT.

* * * * W A R N I N G * * * *

\- \- \- \- C A U T I O N - - - -

1) USE CARE IN ATTACHING TEST EQUIPMENT TO THE HE EQUIPMENT. THE POSSIBILITY OF CREATING HIGH CURRENT GROUND LOOPS EXIST IF EQUIPMENT IS CONNECTED IMPROPERLY.

\- \- \- \- C A U T I O N - - - -

SECTION 6

SERVICE

6.3 SERVICE METHOD

The HE-Series equipment has been designed using a modular concept. All active electronic components have been placed on removable printed circuit board (PCB) assemblies. This allows for service by PCB exchange. The exception to this is replacement of the input power transformer and DC bridges. If an assembly is determined to be defective, it should be returned to the factory for repair.

Paragraph 6.4 is the theory of operation of the HE-Series equipment. This paragraph presents the information required to understand the operation of the HE Power Source. It is important that this entire section be read thoroughly prior to attempting service of any kind to the HE equipment.

Paragraph 6.5 is a recommended troubleshooting procedure for the HE Power Source. This procedure is designed to isolate a problem to the PCB level. Once the problem is isolated, the procedure will recommend a specific action (usually replacement of a PCB assembly).

6.4 THEORY OF OPERATION

This paragraph describes the operation of the HE-Series Power Source. The information presented below is written to aid the service technician in locating malfunctions to the PCB level.

Refer to Figure 6.2.1 for a block diagram of the Model 310-HE and Figure 6.2.2 for the block diagram of the Model 110-HE.

6.4.1 MODEL 310-HE THEORY OF OPERATION

The Model 310-HE consists of three major subassemblies. These include the chassis, the front panel oscillator, and 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 3 phase oscillator assembly.

The Model 310-HE contains 3 identical power amplifiers. Each amplifier is used to power one to an 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 along with voltage and current monitoring and fault detection circuit.

The oscillator assembly generates and processes all signal within the HE Power Source. This assembly contains five PCB assemblies which are 1) the CPU, 2) Phase A oscillator, 3) Phase B and C oscillator, 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 the 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 this information even when the system is de-energized.

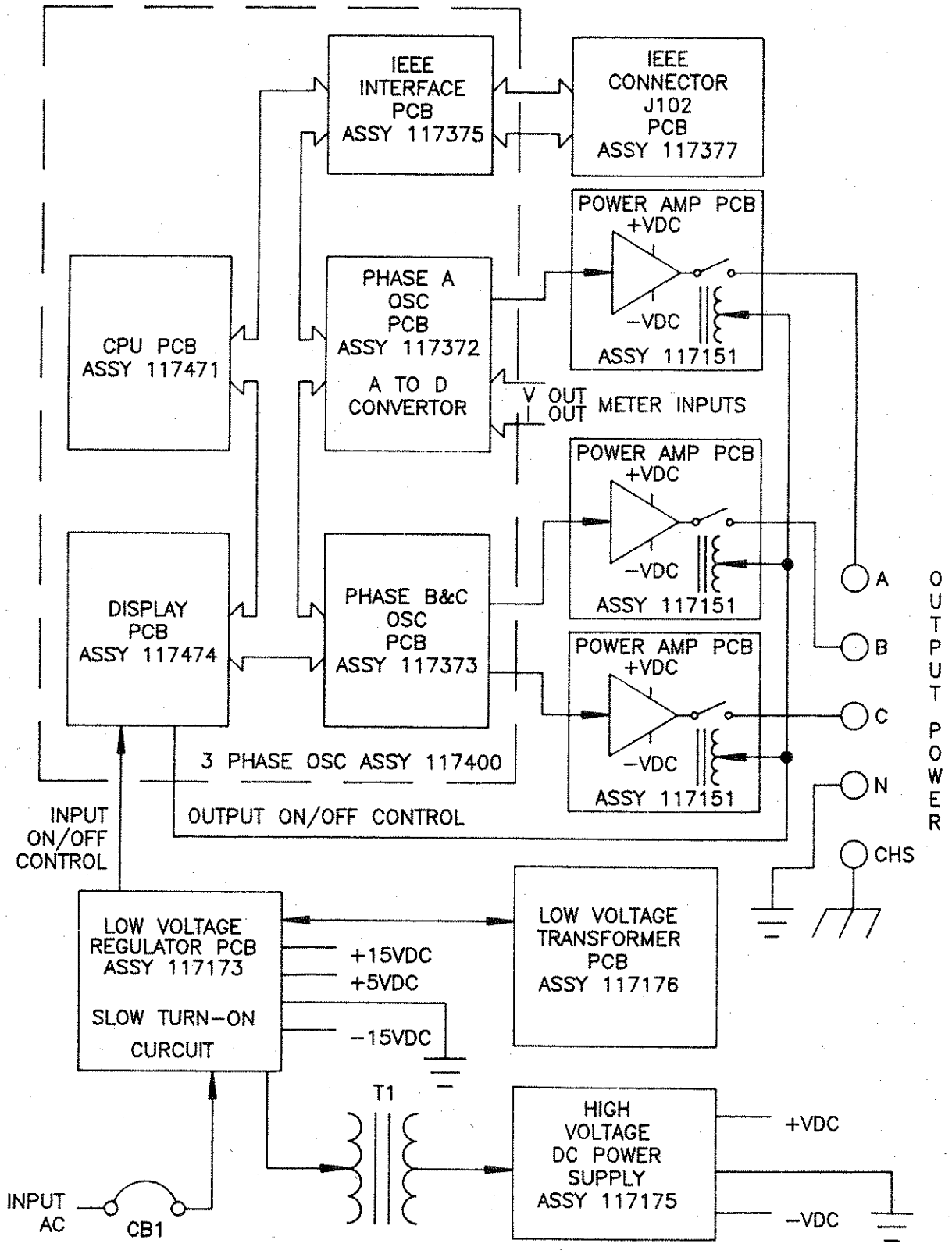
The Display PCB assembly contains the keypad switches, the input and output contactor drivers and the LCD display. This assembly communicates system status to and from the user.

6.4.1 MODEL 310-HE THEORY OF OPERATION (cont)

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 of this PCB produces an analog sinusoidal wave-form which drives the input of the Phase A power amplifier PCB assembly.

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 PCB.

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 HE equipment. This PCB functions as a transparent latch and level shifter necessary for IEEE-488 operation. All input and output to this PCB assembly is controlled by the CPU.



MODEL 310-HE BLOCK DIAGRAM
FIGURE 6.2.1

6.4.2 MODEL 110-HE THEORY OF OPERATION

The operation of the Model 110-HE in many ways is quite to that of that of the Model 310-HE. The main differences are a result of the absence of the Phase B and Phase C output circuits. Refer to Figure 6.2.2 for the block diagram of the 110-HE.

As in the case of the Model 310-HE, the Model 110-HE is comprised 3 major assemblies; 1) chassis, 2) power amplifiers and 3) oscillator. The single phase chassis is similar to the three phase, the difference lie in the number of output terminals available and the number power amplifier assemblies which are supported.

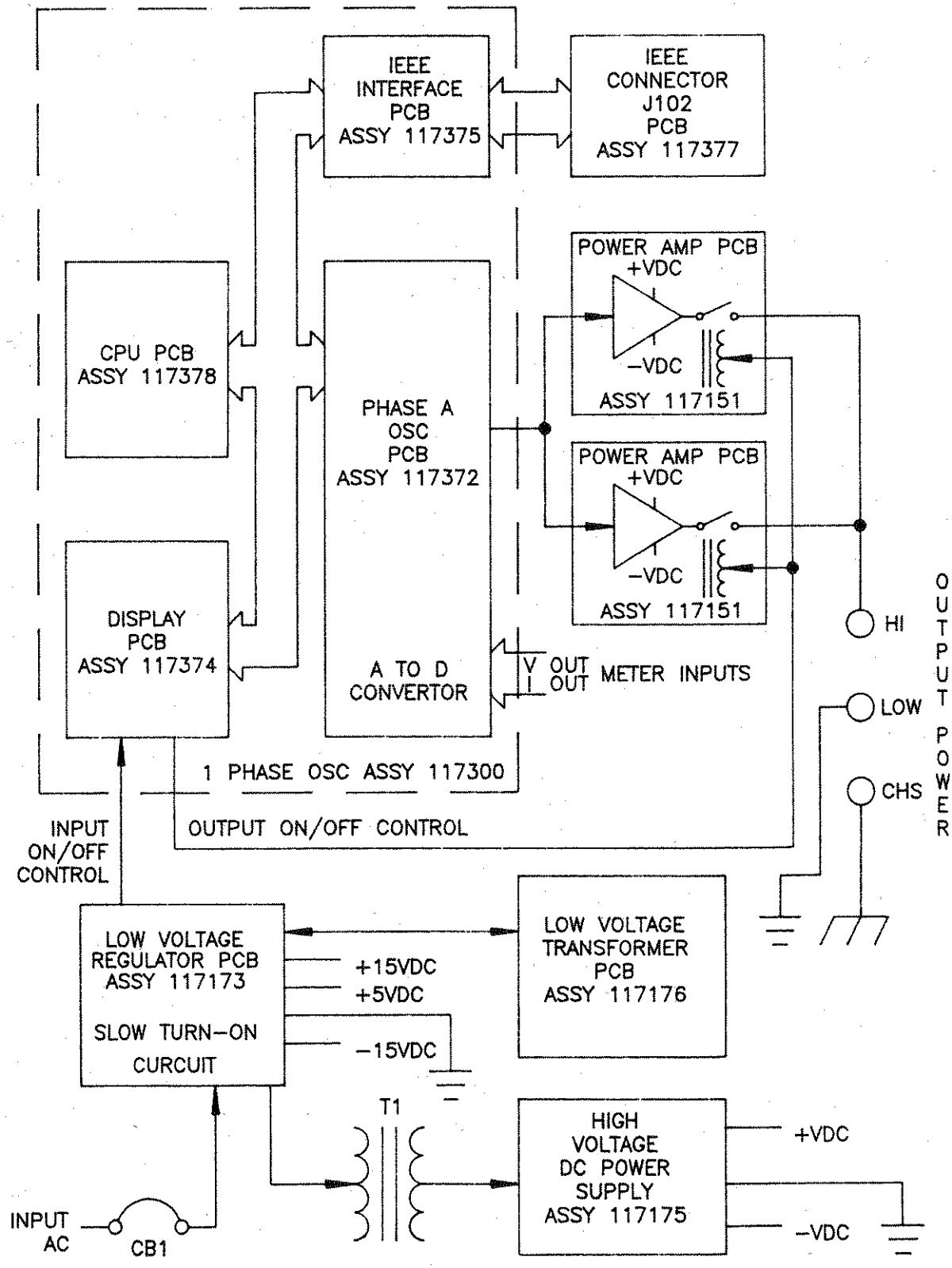
The Model 110-HE contains two power amplifier assemblies. The power amplifiers are connected in parallel to form one output vector with a combined power rating of 1kVA. The power amplifiers used in the Model 110-HE are identical to those used in the Model 310-HE.

The oscillator assembly of the 110-HE 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 310-HE. The CPU and display PCB assemblies are similar but not identical to those of the 310-HE. The differences again lie in the absence of the Phase B and C control circuits.

The reader is encouraged to compare Figure 6.2.1 and 6.2.2 to note the similarities and differences between Models 110-HE and 310-HE.

In summary, the Model 110-HE is quite similar to the Model 310-HE. The Model 110-HE is basically a 310-HE with the Phase B and C drive circuits removed.



MODEL 110-HE BLOCK DIAGRAM
FIGURE 6.2.2

SECTION 6

SERVICE

6.5 TROUBLESHOOTING PROCEDURE

This paragraph recommends a procedure to troubleshoot the HE-Series equipment. These instructions will direct the technician through the troubleshooting procedure. If questions arise while attempting service, please call Pacific @ 1-800-854-2433, 1-800-472-8465 in California for answers to questions.

6.6 TEST EQUIPMENT REQUIREMENTS

6.6.1 HANDTOOLS

Screwdriver, #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 (3-333 watt loads for the 310-HE)

6.7 TROUBLE SHOOTING HINTS

NO POWER. The red input power lamp will not light, the unit is dead. Is power applied to the unit? Check the input fuse. Is the lamp burned out? Check the voltages on the Front Panel Display PCB Assembly from J21-12 to J21-11 +5.7VDC, J21-12 to J21-9 about +10VDC, J21-6 to J21-5 +15VDC, J21-6 to J21-7 -15VDC. 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 but the unit is dead and the green input power lamp will not light. Replace the Front Panel Display Assembly.

6.7 TROUBLE SHOOTING HINTS (cont)

NO DISPLAY. The green input power lamp will light. 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 no output lamp is lit replace the Front Panel Display Assembly. If you hear a beep then the CPU is working. Check the view angle and backlight settings. See section 4.2.2.

NO OUTPUT SIGNAL. No sinewaves 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, if no signal is present replace Phase A Oscillator PCB Assembly. If Phase B and/or C output is not operating correctly, check for signals at TP11 and TP8 of Phase B&C Oscillator PCB Assembly, if no signals replace Phase B & C Oscillator PCB Assembly. If the oscillator signals are ok check the Power Amplifiers.

NO OUTPUT POWER. Check for a failure light on any of the Power Amplifiers, if lit replace the Power Amplifier. If voltage is present at the output with no load but collapses with a 333 watt load per phase on a 310-HE or a 1 killowatt load on a 110-HE, replace the associated Power Amplifier's.

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.

6.7 TROUBLE SHOOTING HINTS (cont)

VOLTAGE AND CURRENT DISPLAY. If all of the voltage and current displays are not working correctly, replace the Phase A Oscillator PCB Assembly. 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 & 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&C Oscillator PCB Assembly. Note the D to A converter for all three phases's voltage and current metering is on Phase A Oscillator PCB Assembly.

IEEE. No communication over the IEEE bus. Verify the IEEE address switch is set correctly. Check for +5VDC from J61 pin 14 to J61 pin 13 on the IEEE PCB Assembly. If no voltage check for shorts or a bad Low Voltage Power supply Assembly. If the voltage is ok and there is no communication replace the IEEE PCB Assembly.

6.8 ROSTER OF SUBASSEMBLIES

The following is a list of the replaceable subassemblies contained within the HE series. When ordering replacement items, be sure to use the assembly numbers listed below. Also be prepared to state model and serial numbers of the power source requiring repair.

310-HE Hi Voltage Power Supply Assy 117172
110-HE Hi Voltage Power Supply Assy 117175
AC Power Harness 117130
Low Voltage Power Supply Assy 117173
Low Voltage Transformer Assy 117176
Low Voltage Cable Assy 117133
Transformer Voltage Sense Harness 117136
310-HE Signal Cable Assy 117134
110-HE Signal Cable Assy 117144
IEEE Cable Assy 117145
Power Supply Interconnect Cable 117132
Power Amplifier Assy 117177
Phase A Oscillator Assy 117372
Phase B&C Oscillator Assy 117373
110-HE Front Panel PCB Assy 117374
310-HE Front Panel PCB Assy 117474
CPU PCB Assy 117378
IEEE GPIB PCB Assy 117375
IEEE Connector PCB 117377
CPU Battery, PPSC Part Number 706005
Key Switch Light Bulb, PPSC Part Number 701026

SECTION 6

SERVICE

6.9 RETURNING EQUIPMENT FOR REPAIR

Equipment requiring service or repair must be returned to the Huntington Beach, California factory or to a Pacific Power Source Corporation 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 that can be contacted.

2) Attach the instrument 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 resistent container with adequate room for the instrument and ample surrounding shock absorbing material. PACK CAREFULLY TO AVOID EQUIPMENT DAMAGE IN TRANSIT. PACIFIC POWER SOURCE CORPORATION SHALL NOT BE RESPONSIBLE FOR REPAIR OF DAMAGE DUE TO IMPROPER PACKAGING AND HANDLING.

If the equipment to be serviced is under warranty, Pacific Power Source Corporation will repair and return the equipment, freight collect, to the original purchaser.

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

SECTION 6

SERVICE

6.10 WARRANTY PROVISIONS

Pacific Power Source Corporation warrants each unit to be free of defects in material and workmanship for a period of one year beginning with the date of shipment to the original purchaser.

Excepted from this warranty are fuses and batteries which carry the warranty of their original manufacturer if applicable. Within this warranty period Pacific Power Source Corporation will service, repair, or replace any defective part when examination shows that fault has not occurred because of misuse, abnormal operation, or user modification. The unit must be returned by the original purchaser to the Huntington Beach, California factory or to a Pacific Power Source Corporation authorized service location. Freight must be prepaid both ways by the original purchaser. Pacific Power Source Corporation is not responsible for consequential damage arising from the use of its equipment.

SECTION 7

CALIBRATION

7.0 CALIBRATION

7.1 SCOPE

This section describes the calibration interval and calibration procedure of the HE.

7.2 SAFETY NOTICES

* * * * W A R N I N G * * * *

1) DISCONNECT INPUT POWER FROM THE HE 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 WHILE MAKING CONNECTIONS TO TERMINALS.

5) DO NOT WORK ON POWER EQUIPMENT ALONE. KEEP A "TECHNICIAN" NEARBY TO ADMINISTER FIRST-AID IN CASE OF ELECTROCUTION OR SOME OTHER ACCIDENT.

6) READ SECTIONS 3, 4 AND 6 OF THIS MANUAL THOROUGHLY PRIOR TO ATTEMPTING SERVICE TO THIS EQUIPMENT.

* * * * W A R N I N G * * * *

\- \- \- \- C A U T I O N - - - -

1) USE CARE IN ATTACHING TEST EQUIPMENT TO THE EQUIPMENT. THE POSSIBILITY OF MACHINE DAMAGE EXIST IF EQUIPMENT IS CONNECTED IMPROPERLY.

\- \- \- \- C A U T I O N - - - -

SECTION 7

CALIBRATION

7.3 CALIBRATION INTERVAL

The HE Power Source requires calibration once every twelve months.

7.4 CALIBRATION PROCEDURE

This procedure assumes the HE Power Source is operating correctly. Power up the HE and enter a the following program, 60Hz and 136.5 volts in each of the three phases along with default values of 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 110-HE.

NOTE: If the External Transformer Option is connected, it's power and signal cables must be disconnected until called for in section 7.4.8.

7.4.1 TEST EQUIPMENT REQUIREMENTS

The following test equipment is required:

1) Digital Voltmeter (DVM) - 4 1/2 digit, Fluke model 8050A or equal.

2) Digital Clamp On Ammeter - Amprobe model ADC-1 or equal.

3) Frequency Counter, Fluke 7250A or equal.

7.4.2 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&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&C Oscillator PCB. Adjust R64 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 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&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&C Oscillator PCB until the voltmeter reads 136.5 VAC. This is the Phase B 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&C Oscillator PCB to calibrate the Phase B voltage display.

Connect a voltmeter to the Phase C Output. Adjust R65 on the Phase B&C Oscillator PCB to calibrate the Phase C voltage display.

7.4.5 310-HE CURRENT LIMIT

Enter though the keyboard a current limit of 3.0 amps. On Phase A Oscillator PCB adjust R59 (current limit) for 1.760 VDC as read on TP8 to TP12. Next enter a current limit of 2.0 amps. Verify CURRENT LIMIT by applying a 333 watt load per phase and observing the voltage reducing and 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.

7.4.6 110-HE CURRENT LIMIT

Enter through the keyboard a current limit of 3.0 amps. On Phase A Oscillator PCB adjust R59 (current limit) for 1.760 VDC as read on TP8 to TP12. Next enter a current limit of 4.0 amps. Verify CURRENT LIMIT by applying a 1KW load and observing the voltage reducing and 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.

7.4.7 METERED CURRENT ADJUSTMENT

Connect a full load to the output of the Power Source. 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&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 HE. Verify the frequency reading is $\pm$ 0.1% $\pm$ 1 count. The frequency display cannot be adjusted, if out of tolerance replace the Phase A Oscillator PCB Assembly.

SECTION 8

NOTES & REFERENCES

SECTION 9

MODIFICATIONS AND CHANGE INFORMATION

9.0 MODIFICATIONS

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

9.1 MANUAL CHANGE INFORMATION

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

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