BK PRECISION®

Instruction Manual

Models:1770/1775/1780
Linear Programmable Power Supplies

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ONE: INTRODUCTION

Congratulations! You have just purchased one of the most advanced professional Programmable Power Supplies available. The innovative ergonomic design and overall high quality will provide years of reliable operation. Therefore, it is very important to completely familiarize yourself with the unit before attempting use. Please read this manual carefully, paying particular attention to the Warning and Caution sections.

1.1 DESCRIPTION

The Programmable Power Supply Series from B+K Precision offers a complete solution to power supply system requirements. These models are indispensable instruments in assisting in the development and testing of new products, as well as being standard instruments for automatic test systems. The wide range of output selection combined with excellent load/line regulation creates a vital instrument in your lab environment.

Each supply comes standard with a GPIB interface and a three-year warranty. Plus, all units feature output voltage and current programming, overvoltage and overcurrent protection, remote sense, reverse polarity protection and output enable/disable. All models of the programmable power supply series are able to be calibrated either in local or remote mode.

1.2 INSPECTION

When you unpack your new programmable power supply from its original packaging, carefully check each item for damage that may have occurred during shipment. If the shipping carton is damaged contact the carrier immediately. If anything is missing, please contact B+K Precision at 714-237-9220 for immediate service.

1.3 INCLUDED ITEMS

Programmable Power Supply
Operation Manual
Power Cord

1.4 CAUTIONS AND WARNINGS

1. The input power requirements for the programmable power supplies are 115/230 VAC ± 10% or 240VAC +5% ~ -15%, 50/60 Hz.
2. Before begin to operate the power supply, set the correct voltage 115 or 230 (240) VAC setting equal to the applied voltage, otherwise damage will result to the power supply .
3. Do not use solvents or aromatic hydrocarbons to clean the module as they may damage the finish. If cleaning is necessary, use only a mild solution of soap and warm water. Be careful not to allow water to enter the unit. Please be sure to always disconnect the power cord before cleaning.
4. Use only specified fuses. Do not use a substitute fuse which is of a different size and rating. Otherwise, damage may result to the unit.
5. Do not substitute or modify any internal circuits.
6. Exercise extreme caution when cables are over four feet in length.
7. Turns off AC power (or disable unit) before disconnecting load or floating voltages.
8. Operates the power supply with properly rated wire sizes.

1.5 LOCATION AND COOLING

1. The proper operating temperature for the power supply are from 0 ℃ to 50 ℃ The unit ventilates by drawing air through the sides and exhausting it through the rear.
2. Proper ventilation area for the power supplies is at least 1 inch of spacing on all sides.
3. The PPS are built to configure into 1/2 rack mount configurations.

1.6 GPIB INTERFACE CONNECTOR

The GPIB connector on the rear panel connects your supply to the computer and other GPIB devices. A GPIB system can be connected in any configuration (star, linear, or both)as long as the following rules are observed:

1) The total number of devices including the computer should not be greater than 15.

2) The total length of all cables used should not be more than 2 meters times the number of devices connected together, or a maximum length of 20 meters.

Please do not stack more than three connector blocks together on any GPIB port. The resulting leverage can exert excessive force on the mounting panels. Make sure that all connectors are fully seated and that the lock screws are firmly **hand tightened**. Use a screwdriver only when removing the screw form the mounting panel.

TWO: GETTING STARTED

2.1 UNIT FAMILIARIZATION

Use the following illustrations of the power supplies in conjunction with the descriptions to familiarize yourself with the unit.

Front Panel : Figure A, B

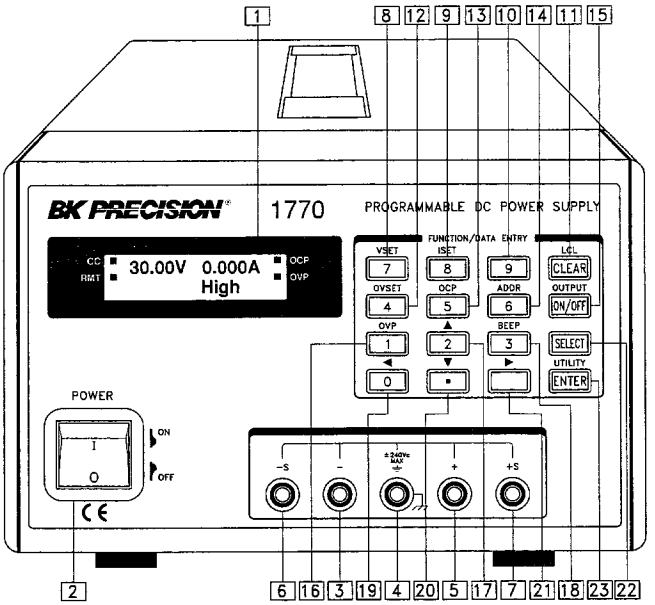


Figure A.Front Panel of Model 1770

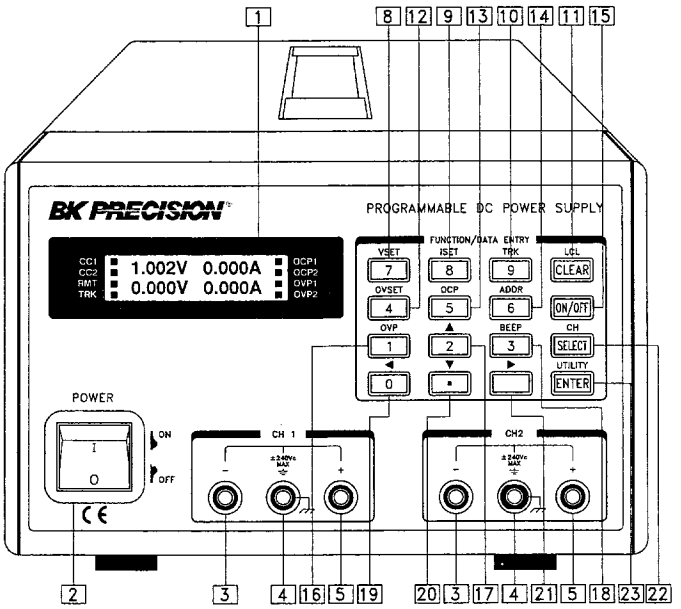


Figure B.Front Panel of Models 1775/1780

2.1.1 FRONT PANEL KEYS

<NOTES:>

Most soft keys have two functions. The first function of the keys is function entry (i. e. VSET,ISET, OCP, etc.). The second function for the soft key is numeric data entry (i, e, 0-9).

1.	LCD Display	Displays alphanumeric information with status annunciators. A detailed listing of descriptions is presented in section **LCD STAUS ANNUNCIATORS**
2.	Power On/Off	Powers on the unit.
3.	Negative Terminal	Negative output terminal.
4.	Ground Terminal	Ground output terminal.
5.	Positive Terminal	Positive output terminal.
6.	-S Terminal	Negative remote sense (Applicable only for model 1770)
7.	+S Terminal	Positive remote sense (Applicable only for model 1770)
8.	VSET (7)	Output control key used to display or alter the present voltage setting. Numeric entry key for number seven.
9.	ISET (8)	Output control key used to display or alter the present current setting. Numeric entry key for number eight.
10.	TRK (9)	Mode control key which activates the tracking mode on or off. (Applicable only for models 1775/1780). Numeric entry key for number nine.
11.	LCL (CLEAR)	Used in conjunction with the numeric entry keys to clear partially set commands and returns unit to the metering mode. Also returns the supply to Local mode when the unit is operating in the Remote mode.
12.	OVSET (4)	Output control key used to display or alter the overvoltage threshold. Numeric entry key for number four.
13.	OCP (5)	Mode control key which activates the " OverCurrent Protection " mode on or off. Numeric entry key for number five.
14.	ADDR (6)	System control key used to view or alter the GPIB address. Addresses available are 0-30. Numeric entry key for number six.
15.	OUTPUT (ON/OFF)	Mode control key which activates the output on or off. When the output is disabled, the LCD displays " OUTPUT OFF ".
16.	OVP (1)	Mode control key which activates the " OverVoltage Protection " mode on or off. Numeric entry key for number one.
17.	↑ (2)	This key increases the value of the digit to be varied. Numeric entry key for number 2.

18.	BEEP (3)	Activates the audible indicator on or off. Numeric entry key for number three.
19.	← (0)	This key moves the cursor one digit left until it comes to the desired digit to be varied. Numeric entry key for "0".
20.	↓ (•)	This key decreases the value of the digit to varied. Decimal point key.
21.	→	This key moves the cursor one digit right until it comes to the digit to be varied.
22.	CH (SELECT)	This key allows you to select channel 1 or channel 2 (Applicable only for models 1775/1780).
23.	UTILITY(ENTER)	Reserved for future use. Enters the values in the setting mode and returns the display to metering mode.

REAR PANEL: Figure E-1, E-2

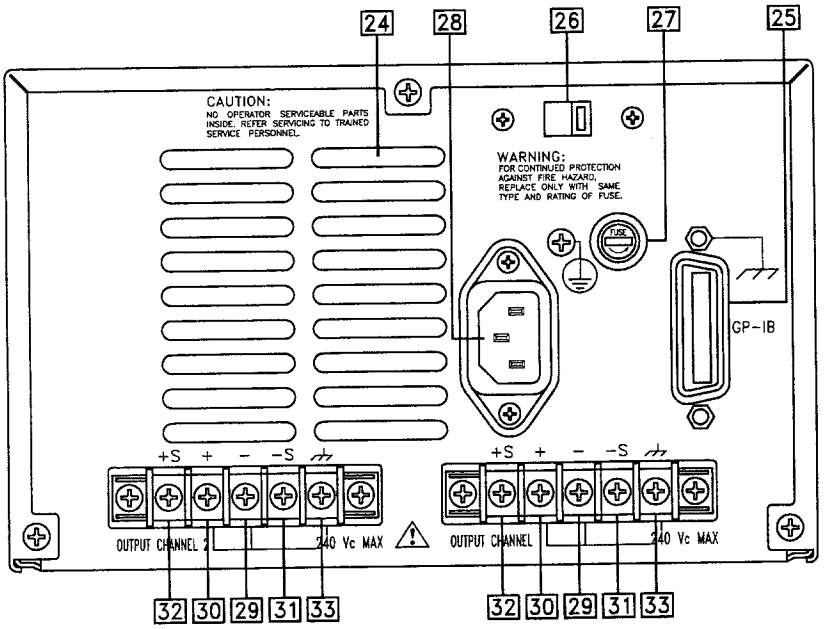


Figure E-1. Rear Panel of models 1775/1780

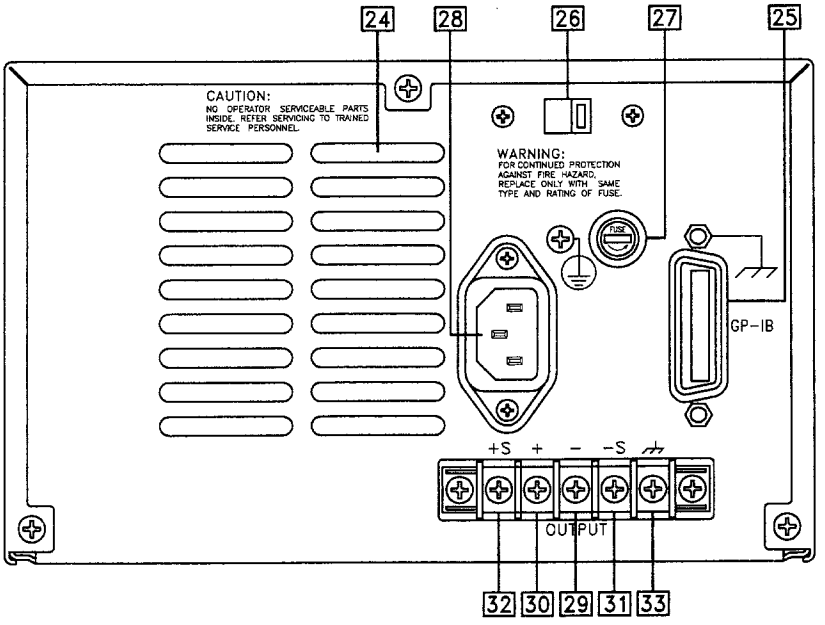


Figure E-2. Rear Panel of model 1770

2.1.2 REAR PANEL

24. Ventilation ports - Exhausts warm air from the unit.

25. GPIB Interface - 24 pin parallel GPIB interface connector.

26. Voltage Selector - Selects voltage of either 115VAC or 230(240)VAC, -10% ~ +10%, 50/60Hz.

27. Fuseholder - Fuseholder for AC line.

28. AC receptacle - AC plug for power cord.

29. Negative Terminal - Negative rear screw terminal output for hard wring.

30. Positive Terminal - Positive rear screw terminal output for hard wring.

31. -S - Negative rear screw terminal for remote sense output. Enables hard wiring.

32. +S - Positive rear screw terminal for remote sense output. Enabled hard wiring.

33. Ground Terminal - Ground rear screw terminal.

34. External analog input voltage for programming output voltage. Input voltage ranges from 0 Volts to 10 Volts.

35. Voltage external programming reference point.

36. External analog input voltage for programming output current. Input voltage ranges from 0 Volts to 10 Volts.

37. Current external programming reference point.

<NOTES:>

1. **The rear panel configuration is identical on all power supplies. However, models 1775/1780 have an additional terminal strip for hard wiring the second channel.**

2. 2 LCD STATUS ANNUNCIATORS

LIQUID CRYSTAL DISPLAY: Figure F-1, F-2,

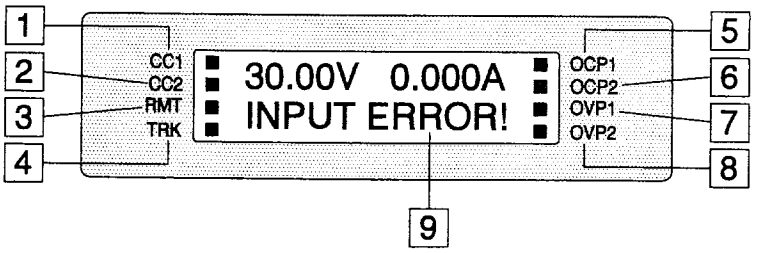


Figure F -1. LCD of models 1775/1780

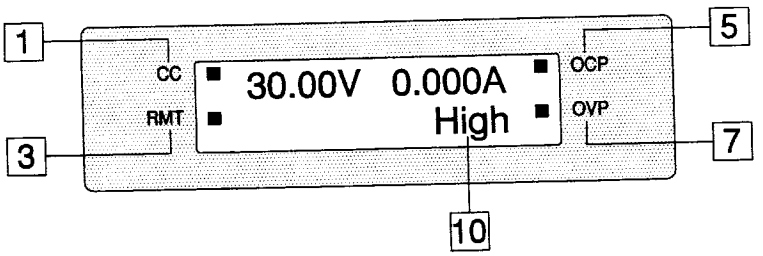


Figure F-2. LCD of model 1770

<NOTE:>

The LCD display real time output Voltage/Current & mode status. There are no status indicators for CV mode. These messages are viewed in either local or remote mode.

1. CC1 - Channel 1 is operating under constant constant current mode. When the indicator is off the supply is operating in constant voltage mode.

2. CC2 - Channel 2 is operating under constant current mode. When the indicator is off the supply is operating in constant voltage mode.(Applicable only for models 1775/1780)

3. RMT - The supply is operating in remote mode.

4. TRK - The supply is operating in tracking mode. (Applicable only for models 1775/1780)

5. OCP1 - Overcurrent protection on channel 1 is enabled. When blinking, the overcurrent circuit has been activated and disabled the output.

6. OCP2 - Overcurrent protection on channel 2 is enabled. When blinking, the overcurrent circuit has been activated and disabled the output. (Applicable only for models 1775/1780)

7. OVP1 - Overcurrent protection on channel 1 is enabled. When blinking, the overcurrent circuit has been activated and disabled the output.

8. OVP2 - Overcurrent protection on channel 2 is enabled. When blinking, the overcurrent circuit has been activated and disabled the output. (Applicable only for models 1775/1780)

9. INPUT ERROR! The numeric value entered is out of range. (Applies to all models)

10. High or Low The supply is operating in either the high or low range. (Applicable only to model 1770)

2.3 OUTPUT TERMINALS AND WIRES

All models have terminal blocks on the rear panel which include positive and negative outputs, positive and negative remote sense outputs, and earth ground.

<NOTE:>

The power supply is set at the factory local sense operation (i.e. the +S and -S terminals are strapped to the " + " and " - " terminals by a shorting plate at the rear terminal block).When operating in remote sense mode, remove the shorting plate and refer to section 3.3 for remote sense operation.

Additionally, all models have positive, negative and earth ground terminals in the front of the unit. Remote sense capability is discussed detail in section 3.3. A brief definition of remote sense is a measurement of voltage at the load rather than at the output terminals.

When local connections are made to the " + " and " - " terminals of the power supply, Wrap and bundle wires to reduce coupling effect.

In order to safely and sufficiently handle electric current, the proper wire size must be selected. Select a wire size with sufficient rating to carry the current without overheating. Other factors to be taken into consideration are voltage drop and conductor temperature.

The following table lists current carrying capacity of various wire sizes. For further information please refer to the NEC 1987 Handbook.

TABLE 1: Stranded Copper wire Ampacity and Resistivity.

	Ampacity Per Wire (Amps)		
Wire Size (AWG)	2 Wire Bundle (Amps)	4 Wire Bundle (Amps)	Resistivity (Ohm/ft)
20	7.8	6.9	0.0102
18	14.5	12.8	0.0064
16	18.2	16.1	0.0040
14	29.3	25.9	0.0025
12	37.6	33.2	0.0016

THREE: OPERATING CHARACTERISITCS AND CONFIGURATIONS

3.1 INTRODUCTION

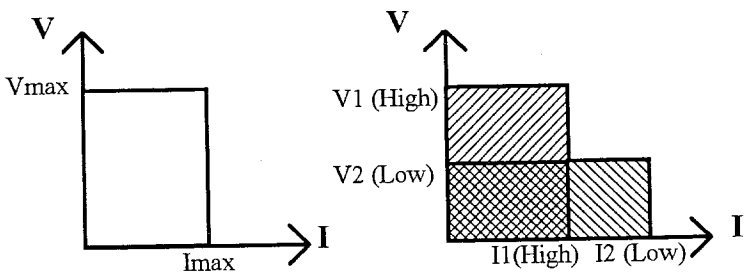
These sections contain information on operating characteristics and how to configure a Power Supply. Sections 3.2 through 3.4 consider the power supplies operating ranges, remote sense operation and considerations when connecting loads.

The latter half of the chapter deals with connecting power supplies in parallel and series configuration for CC and CV operation.

3.2 OPERATING RANGES

All power supplies operate in either constant voltage (CV) or constant current (CC) mode over the rated output . Their respective voltage and current operating locus (figure F) are found in operating quadrants for all models. The power supply acts as a constant voltage source for comparatively large values of load resistance and as a current source for comparatively small values of load resistance, The automatic crossover or transition between these two modes of operations occurs at a critical stage or "crossover " value of load resistance; $R_C = E_S/I_S$, where E_S is the front panel voltage setting and I_S the front panel current setting.

The followings are the operating quadrants (current -vs- voltage) of the power supplies.



Models 1775/1780 **Model 1770**

Figure G. Operating Quadrants

3.3 REMOTE SENSE

When the supply is locally strapped for local sensing (normal operation), an unavoidable voltage drop is incurred in the load leads and this adds to its voltage regulation. By connecting the supply for voltage remote sensing, as shown in figure G, voltage is sensed at the load rather than at the output terminals. This allows the supply to automatically compensate for voltage drop in the load leads and improve regulation. In remote sensing, the VOUT? query and the front panel meter monitor load voltage at the sensing points.

When the supply is connected for remote sensing, the OVP circuit senses at the main output terminal and not at the sense points. The voltage sensed by the OVP circuit could be significantly higher than the voltage bring regulated at the load. Therefore, set OVP threshold voltage accordingly.

3.3.1 REMOTE SENSE CONFIGURATION

Turn off the power supply before modifying any connections on the rear panel terminal block. Configure the unit for remote sensing by first disconnecting the shorting plugs between the sense and load terminals. Connect the load and sense leads to the load as in figure G. Bear in mind that sense and load leads should be as short as possible. Additionally, the sense leads resistance should be no greater than 0.5 ohm/lead, and the voltage drop over the load leads should be no greater than 0.5V/lead.

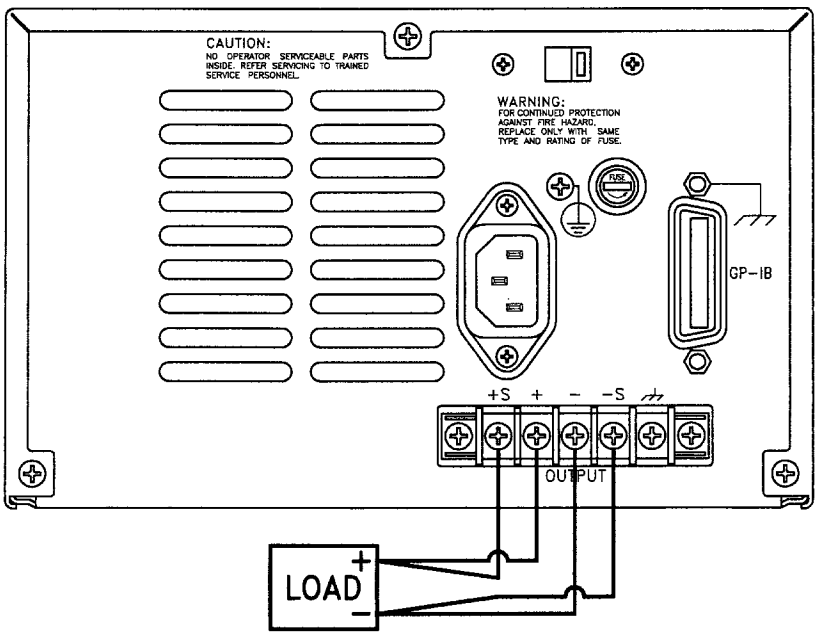


Figure G. Remote Sense Configuration

3.3.2 REMOTE SENSE CHARACTERISTICS

OUTPUT NOISE: Any noise picked up on the sense leads will appear at the supply's output and may adversely affect CV load regulation. Twist the sense leads to minimize external noise pickup and run then parallel and close to the load leads. In noisy environments, it may be necessary to shield the sense leads. Ground the shield at the power supply end only. Do not use the shield as one of the sensing conductors.

STABILITY: When the supply is connected for remote sensing, it is possible for the impedance of the load wires and the capacitance of the load to form a filter, which will become part of the supply's CV feedback loop. The extra phase shift created by this filter can degrade the supply's stability and can result in poor transient response performance. In extreme cases, it can cause oscillation.
It is difficult to state simple rules defining the conditions under which this can occur, and which corrective action to take. A certain amount of trial and error may be called for. Two guidelines which are almost always valid are:

a. Keep the leads short as possible.
b. Twist the load leads together to minimize inductance.

In most circumstances, once these two guidelines are followed, problems associated with the load lead inductance are eliminated. This leaves the load lead resistance and load capacitance as the major cause of the reduced stability. In this case, you may obtain further improvement to the stability by:

a. Keeping the load capacitance as small as possible.
b. Increasing the diameter of the load lead to reduce resistance.

If heavier gauge load lead (# 10 or greater) are used, circumstances may arise when the load lead inductance and the load capacitance can form an underdamped filter. This filter occasionally has the effect of destabilizing phase response. In this case, the above steps can worsen stability since they will reduce damping in the system.

3.4 LOAD CONSIDERATION AND MULTIPLE LOADS CONNECTION

When the supply is in local sensing mode and you are connecting multiple loads to the output, connect each load to the output terminal using separate load leads. This minimizes mutual coupling effects and takes full advantages of the supply's low output resistance. Each pair of wires should be as short as possible and twisted or bundled to reduce lead inductance and noise pickup.

If cabling considerations require the use of distribution terminals that are located remotely from the supply, connect the power supply output terminals to the remote distribution terminals by a pair of twisted or bundled wires. Connect each load to the distribution terminals separately. Remote voltage sensing is recommended in these circumstances. Sense either at the remote distribution terminals or, if one load is more sensitive than the others, directly at the critical load.

OUTPUT ISOLATION: The output of the power supply is isolated form earth ground. Either output terminal may be grounded, or an external source of voltage may be connected between either output and ground. However, both output terminals must be kept within +/-240Vdc of ground. This includes the output voltage. An earth ground terminal is provided on the rear panel terminal block.

Each of the power supplies will operate accordingly to the various types of loads connected to the output .

CAPACITANCE LOADING: In normal conditions, the supply will be stable for almost any size load capacitance (for remote sense stability considerations). However, large load capacitance may cause ringing in the supply's transient response. It is even possible that certain combinations of capacitance and ESR (equivalent series resistance) will result in instability. If this is the case, the solution is to increase or decrease total load capacitance. In addition, the overvoltage protection SCR crowbar circuit has been designed to discharge capacitance up to a certain limit. These limits are:

1. For models of which maximum output voltage is below 18 Volts, Capacitance should not exceed 5000uF.

2. For models of which maximum output voltage is below 35 Volts, Capacitance should not exceed 5000uF.
3. For models of which maximum output voltage is below 60 Volts, Capacitance should not exceed 3000uF.
4. For models of which maximum output voltage is below 128 Volts, Capacitance should not exceed 470uF.
5. For models of which maximum output voltage is below 250 Volts, Capacitance should not exceed 220uF.

<NOTE:>

If load capacitance approaches these limits, it is recommended to not intentionally activate the OVP circuit and discharge the capacitance through the SCR crowbar as part of standard testing procedure.

3.5 PARALLEL CONNECTION OPERATION

<NOTE:>

Power supplies equipped with SCR crowbars should not be used in series or parallel with each other unless a master-slave interconnection is employed and their crowbars interlock .

Greater current capability can be achieved by connecting output in parallel. **However, only power supplies which have equivalent voltage and current output ratings may be connected in parallel. Otherwise, damage to the unit may result.**

A typical connection is shown in figure H through the back of models 1775/1780 in local sensing. All leads are kept as short as possible and are bundled together. Second, connect remote sense terminals to compensate for the voltage drop in the interconnecting load leads. Lastly, the CV and CC operations have identical setups.

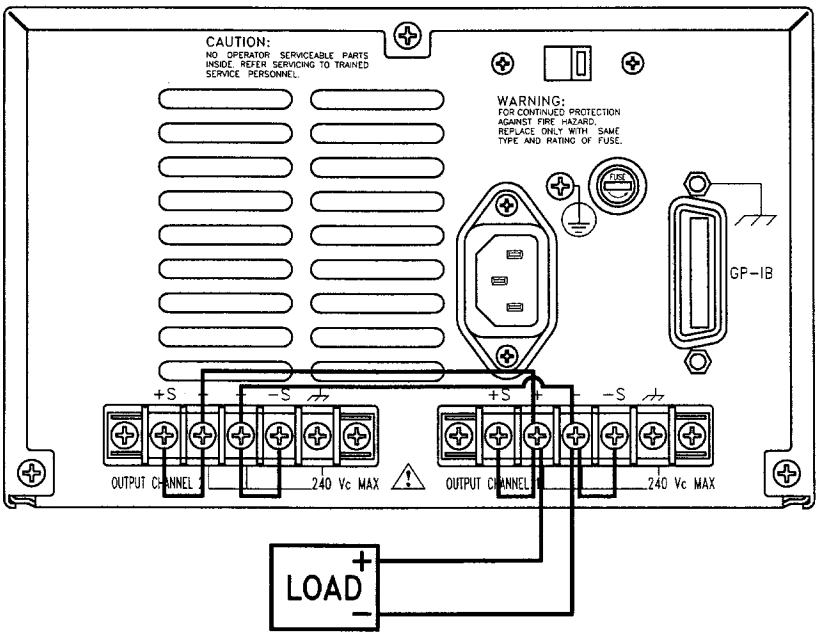


Figure H. Parallel Configuration

3.5.1 CV OPERATION

Although both outputs operate independently of each other in CV operation, one of the outputs must dominate (control) over the other. Additionally, the dominant output must operate in CV mode, while the other output may operate in CC mode.
As an example of this operation, let's assume in figure H. that output channel two operates in CC mode and output channel one operates in CV mode. Perform the following steps:

1. Set output channel two to the maximum output voltage of desired range.
2. Set output channel one to the desired operating voltage.

The voltage of output channel one controls the voltage across the load. The output currents are algebraic sums of the individual outputs.

3.5.2 CC OPERATION

The CC operation is similar in many ways to the CV operation, except that the output current must also be set. To obtain CC operation, perform the following steps:

1. Program output voltage of the two channels to the desired operating voltage.
2. Program output channel one to one-half the desired operating current.
3. Program output channel two to one -half the desired operating current.

Both output operate in CC mode.

3.5.3 REMOTE SENSING CONFIGURATION (Parallel Connection Mode)

The following figure I illustrated the configuration for Remote Sensing in Parallel Operation.

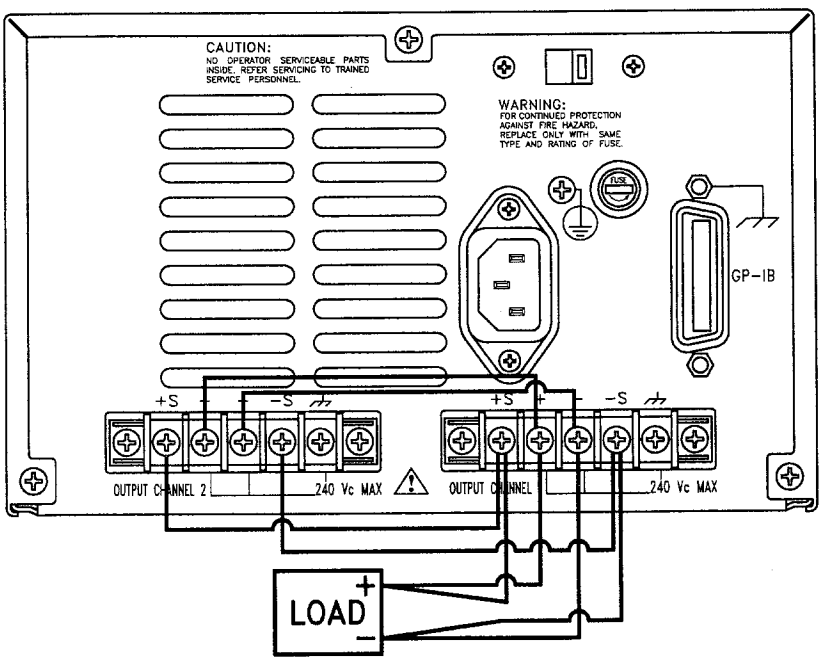


Figure I. Remote Sense, Parallel Mode

3.6 SERIES CONNECTION OPERATION

<NOTE:>

Power supplies equipped with SCR crowbars should not be used in series or parallel with each other unless a master-slave interconnection is employed and their crowbars interlock.

Greater output voltage capability can be obtained by connecting output in series. **A note of caution, since current the same in each element of a series circuit, both output need identical rated currents. If this is not followed, excessive current may be forced into one of the output and cause a failure.**

Figure J illustrates the Series configuration on Models 1775/1780.

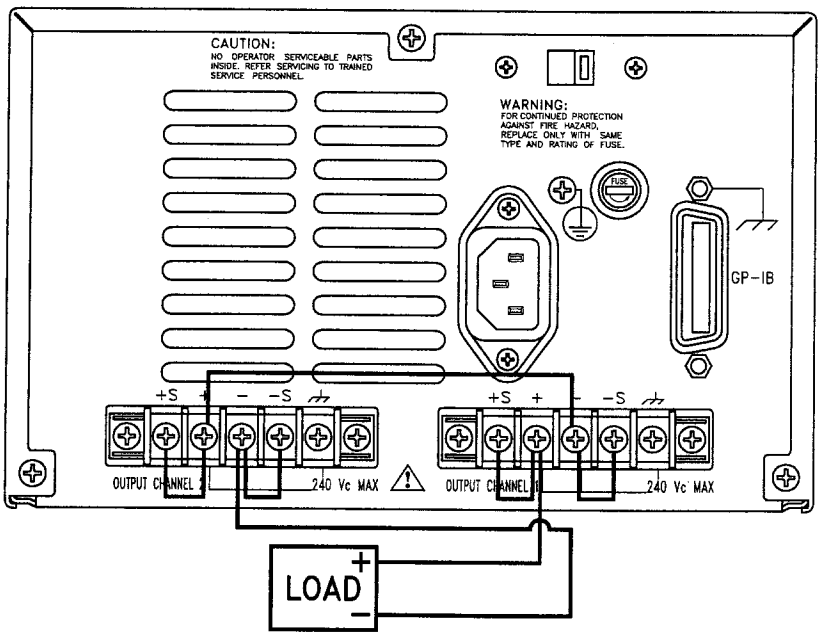


Figure J. Series Configuration

3.6.1 CV OPERATION

In CV operation, first program the current of both output to the desired value. Secondly, program the desired operating voltage to equal the sum of the output voltages.

3.6.2 CC OPERATION

In CC operation, one output will operate in CV mode, the other in CC mode. To obtain this operation, perform the following:

1. Program the output current of the two channels to the desired operating current.
2. Program output channel one to one-half the desired operating voltage.
3. Program output channel two to one-half the desired operating voltage.

At load levels less then one half the total voltage limit, the output that was originally in CC mode, stays in CC mode.

At load voltages greater than one-half the total voltage limit, the output that was originally in CC mode, changes to CV mode. The secondary output will regulate the current in CC mode and provide the necessary voltage.

REMOTE SENSE CONFIGURATION (Series Connection Mode)

The following figure K illustrates the configuration for Remote Sensing in Series Operation.

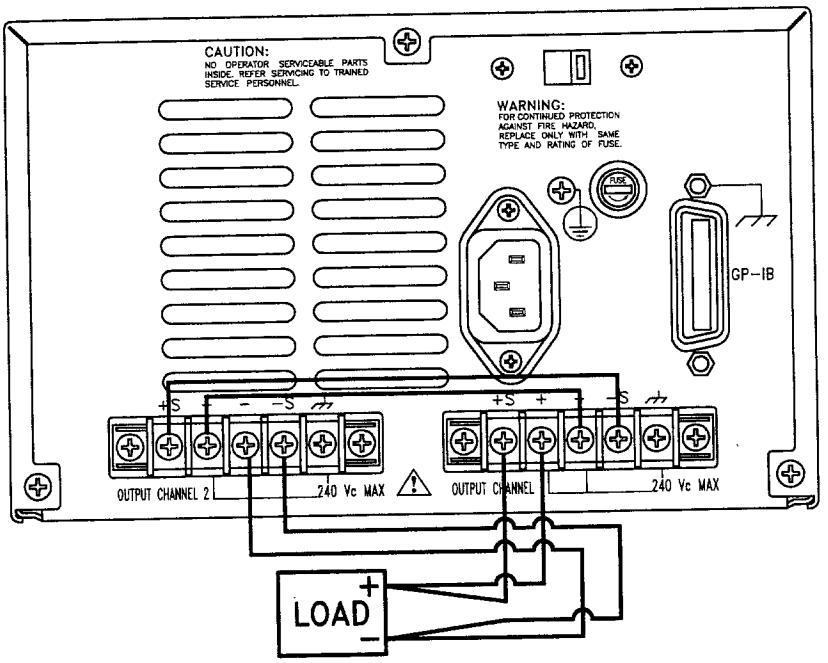


Figure K. Series Configuration with Remote Sense

FOUR: LOCAL OPERATION

4.1 INTRODUCTION

These sections contain information on how to locally program the PPS Series. Upon power up, the power supplies default to local mode operation. All front panel keys may be used to control the power supply.

<NOTES:>

The PPS series power supply models and their operations are essentially identical. However, two of the supplies provide more functions (i.e. models 1775/1780 have dual output and model 1770 has two output operating ranges) which may slightly alter or add to programming procedures. Therefore, please refer to the appropriate sections for these operation.

All operations performed in local mode, may also be performed in remote mode. The unit indicates remote operation when the " **RMT**" annunciation on the display is on.

4.2 GENERAL INFORMATION

1. The power supplies are able to directly accept programming values of voltage, current and overvoltage. **" When a valid input is made, the unit will round off the value to the nearest multiple of the resolution". If a nonvalid input is made, the unit will display "INPUT ERROR! " and return to previous set values.**

2. The actual operation of programming the voltage and current values is simple. Simply, press any of the functional keys and the display shows the present value. **To change this value, simply use the numeric keys to enter a value. If an error is made, press the " CLEAR" key and then reselect the parameter that was to be modified. Once the final value is set, press the " ENTER" key.** LCD module will display the actual value, initiate the function, and return the unit to metering mode. If a user wishes to recall a setting, press the function key pertaining to the operation. For example, to recall a set voltage, press " **VSET**" and then press "**ENTER**"or "**CLEAR**" key to return unit to metering mode.

3. To reset any of the output parameters (i.e. VSET, ISET, OVSET) simply press the desired function key, enter the new value and press "**ENTER**". The Programming steps are identical to steps are identical to steps described in sections 4.3-4.5.

4. Models 1775/1780 have two output (channels) and these may be alternately viewed via the **'CH/SELECT'** key. In order to program the output parameters for each output channel, first toggle the **'CH/SELECT'** key to the desired channel and then observe the following guidelines.

4.3 SETTING VOLTAGE

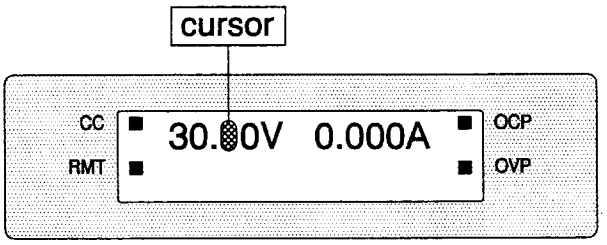
To locally program the voltage (VSET), press **'VSET'**, enter the value and press **'ENTER'** For example, if one wished to set a voltage of 3.99, press:

VSET					UTILITY
7	3	.	9	9	ENTER

the LCD display 3.99 and the unit returns to metering mode.

▲VSET description:

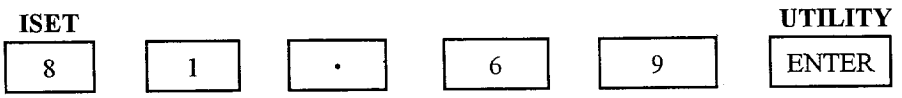
For all models, VSET can be altered by pressing '▲' or '▼' key instead of 'VSET' and entry keys. When the power supply is in the CV mode, pressing '▲' key will increase output voltage per step. The increment step is determined by either pressing the '←' or '→' key until the cursor comes to the digit to be varied. The LCD module would show the following:



The operation of '▼' key is similar to '▲' key for decreasing the output when power supply is in CV mode.

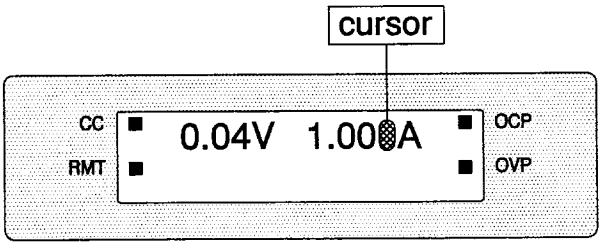
4.4 SETTING CURRENT

To locally program the current (ISET), press "**ISET**" and enter the value and then press"**ENTER**". For example, if one wishes to set a current of 1.69 amps, press:



the LCD displays 1.69 and the unit returns to metering mode.

For all models, ISET can be altered by pressing '▲' or '▼' key instead of 'ISET' and entry keys. When the power supply is in the CC mode, pressing '▲' key will increase output current per step. The increment step is determined by either pressing '←' or '→' key until the cursor comes to the digit to be varied. The LCD module would show the following:



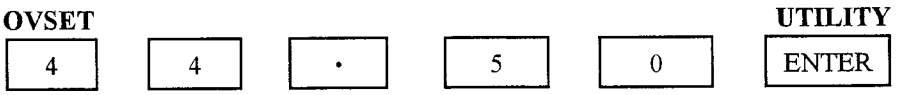
The operation of '▼' key is similar to '▲' key for decreasing the output when power supply is in CC mode.

4.5 SETTING THE PROTECTION MODES

The power supplies have overvoltage protection (**OVP**) and overcurrent protection (**OCP**) features to guard against abnormal operating conditions. When either of these two functions are activated, the unit disables the output. The LCD annunciation will indicate the condition and an audible signal will sound.

4.5.1 SETTING THE OVERVOLTAGE THRESHOLD

To locally program the threshold voltage press "**OVSET**", enter the value and press "**ENTER**". For example, to program an overvoltage value of 4.50V, press:



4.5.2 ENABLING / DISABLING OVERVOLTAGE PROTECTION

In all models, the user can enable or disable the OVP circuit by pressing the "**OVP/4**" key. When enable the OVP annunciation is on.

When the OVP annunciation is blinking, the overvoltage protection circuit has been activated and disabled the output. An audible signal will also sound. To reset, Press the "**OVP/4**" key and the annunciation will stop blinking. Turn the output on and press the "**OVP/4**" key again.

<NOTES:>

When remote sensing, take into consideration the voltage drop across the load leads since the threshold measurement is taken at the output terminals.
In inductive load applications, a high-surge voltage would enable the OVP circuit and disable the output.
Also note the programming resolution and programming accuracy specifications.
When the OVP circuit is disabled, the threshold voltage becomes invalid.

4.5.3 ENABLING / DISABLING OVERCURRENT PROTECTION

To enable the overcurrent protection circuit, press the "**OCP/5**" key and the OCP annunciation is turned on. To disable the overcurrent protection, press the "**OCP/5**" key again and the annunciation is turned off.

When the OCP annunciation is blinking, the overcurrent protection circuit has been activated and disabled the output. An audible signal will also sound. To reset, Press the "**OCP/5**" key and the annunciation will stop blinking. Turn the output on and press the "**OCP/5**" key again.

<NOTE:>

If OCP is on and the constant current mode (CC) is activated, the power supply output is disabled.

4.6 ENABLING / DISABLING OUTPUTS

All modes have the capability of disabling their output to have their setting parameters modified.
Once the modification has been completed, one can enable the power supply to operate at the new values.

The output is enabled or disabled by pressing the "**OUTPUT (ON/OFF)**" key. Models 1775/1780 output is enabled or disabled by selecting the channel/s and pressing the "**OUTPUT (ON/OFF)**" key.

4.7 TRACKING OPERATION (Models 1775/1780)

Models 1775/1780 have the ability of tracking since it has two outputs. When the tracking mode is enabled, the annunciation is on. The output of channel two is identical (in sync. with) to channel one and is controlled by channel one. For instance, a voltage increase in channel one would also cause a voltage increase in channel two.

4.8 RANGE OPERATION (Model 1770)

Model 1770 has two operating ranges, "**High**" or "**Low**". These ranges are controlled by adjusting the voltage and current values to the appropriate programming settings (refer to fig. G section three & appendix A). The LCD displays "**Low**" when the low range is active or "**High**", when the high range is active. For more information on operating range characteristics, please refer to section 3.2.

4.9 AUDIBLE SIGNAL

The power supplies have an audible indicator, which allow monitoring of operating conditions. When functions are activated or parameters set, the audible signal will sound. Should the protection modes be activated an audible signal will sound, indicating a change in an operating mode has occurred. The LCD and annunciators will indicate the condition. This feature can also be disable or enabled by pressing the "**BEEP**" key.

FIVE: REMOTE OPERATION

The programmable Power Supply Series from B+K Precision compatible with **ANSI/IEEE 488.1**. This is the "Standard Digital Interface for Programmable Instrumentation". This standard provides a means for an electrical mechanical system to interconnect measurement devices.

Several key specifications of IEEE 488.1 are:

- Interconnect Devices - Up to 15 devices on one bus.
- Interconnection Path - The total transmission path for a star or linear bused networks is up to 20 meters.
- Signal Lines - Sixteen active lines; 8 data lines, and 8 interface and communication management lines.
- Message Transfer Scheme - Byte-serial, bit-parallel, asynchronous data transfer using interlocking three wire handshake technique.
- Maximum Data Rate - One megabyte per second over limited distances. Typical transmission rate is 250 kilobytes per second. The actual data transmission rate is usually determined by the slowest device in communication at that time.
- Address Capability - There can be a maximum of one talker and up to 14 listeners at one time.
- Pass Control - If a system has more than one controller, only one controller may be active at a time. The active controller may pass control to one of the other passive controllers. Only the controller designated as system controller can demand control. However, a non-active controller may request control.
- Interface Circuits - Driver circuits are TTL and Schottky compatible.

5.1 INTRODUCTION

This section contains information on controlling the power supply via a computer. This material is presented in a normal manner in which a majority of programmers may benefit. Main topics of operation to be covered are:

GPIB Operation
Programming Syntax
Programming the Power Supply

The GPIB sections discuss the interface functions, settings and interface. The Programming Syntax section lists all available programming commands. Last, "Programming the Power Supply" includes a variety of conditions, commands and samples useful for controlling the power supply via the computer.

5.2 GPIB OPERATION

The GPIB (General Purpose Interface Bus) operation allows for constant talk and listen between systems. The PPS series are able to act as both talkers and listeners. The computer is able to act as a talker, listener, and controller.

LISTENER: A device capable of accepting data over an interface.

TALKER: A device capable of transmitting data over an interface.

CONTROLLER: A device capable of specifying the talker and listener for an information transfer.

5.2.1 GPIB INTERFACE FUNCTIONS:

Even though the GPIB control is implemented in the power supply, instructions are only enabled when a computer is equipped with a GPIB interface controller card. A controller manages the operation of the bus system by designating which devices to send and receive data. The controller also provides command specifications within other devices.

The PPS series supply the following IEEE-488 interface functions:

L4	- Basic Listener, Unaddressable if MTA
T6	- Basic Talker, Serial Poll, Unaddressed if MTA
SH1	- Full Source Handshake
AH1	- Full Acceptor Handshake
RL1	- Remote & Local Lockout
DC1	- Device Clear
E1	- Open Collector Driver Electronics (250kb/s max)
C0	- Non-system controller
SR0	- Omitted Service Request Function
TE0	- Omitted extended talker function
LE0	- Omitted extended listener function
PP0	- Omitted parallel poll function
DT0	- Omitted device trigger

5.2.2 ADDRESS SETTING OF GPIB INTERFACE

The main purpose of address setting is for specifying unit identification between the instruments and controller in a GPIB connection system. The PPS Series has 31 addresses (0-30) available. If a number higher than 30 is selected, the display shows " **INPUT ERROR!**" and defaults to previous values. The power supplies are preset at the address 12 by the factory. To view the present address, press the "ADDRESS" key. If the present value is incorrect, enter in a new value with numeric keys and press " ENTER" key. In remote mode, the "ADDRESS" command is available to modify the address.

5.3 PROGRAMMING SYNTAX

The following table lists programming commands available with the PPS Series. These standard GPIB commands readily interface with programming languages. Note that this portion of the manual only deals with GPIB commands. No programming language commands are presented here. Appendix A gives a summary of the command definitions.

5.3.1 GPIB DEVICE COMMANDS LIST

Command	Model 1770	Models 1775/1780	Type	Input / Output
CALCHNL	[0,1]	[0,3]	I	Input
OCP	[0,1]	[0,1]	I	Input
OUT	[0,1]	-	I	Input
OUT1		[0,1]	I	Input
OUT2		[0,1]	I	Input
TRACK		[0,1]	I	Input
OVP	[0,1]	[0,1]	I	Input
PROGRAMMING COMMANDS				
VSET	*		R	Input
ISET	*		R	Input
OVSET	*		R	Input
VSET1		*	R	Input
VSET2		*	R	Input
ISET1		*	R	Input
ISET2		*	R	Input
OVSET1		*	R	Input
OVSET2		*	R	Input
ADDRESS	*	*	I	Input
QUERY COMMANDS				
VOUT?	*		R	Output
IOUT?	*		R	Output
VSET?	*		R	Output
ISET?	*		R	Output
OVSET?	*		R	Output
VOUT1?		*	R	Output
VOUT2?		*	R	Output
IOUT1?		*	R	Output
IOUT2?		*	R	Output
VSET1?		*	I	Output
VSET2?		*	R	Output
ISET1?		*	R	Output
ISET2?		*	R	Output
OVSET1?		*	R	Output
OVSET2?		*	R	Output
STATUS?	*	*	A	Output
ERROR?	*	*	A	Output

5.3.2 CALIBRATION COMMANDS

Command	Model 1770	Models 1775/1780	Type	Input/Output
VOFF	*	*	R	Input
VFS	*	*	R	Input
IOFF	*	*	R	Input
IFS		*	R	Input

NOTE: 1. Types of data entry: I: Integer
R: Real
A: ASCII code

2. Types of input/output: INPUT: Input to the PPS
OUTPUT: Output to the PPS

3. The " CALCHNL" commands for Models 1775/1780 are: 0 -disable calibration, 1-calibrate channel one, 2-calibrate channel two, 3-calibrate both channels.

4. * = > Command available to the model.

5.4 STATUS REPORTING

All models include a status register for reporting the operating conditions of the power supply. Each output channel has an 8 bit register which signifies a true condition as "1" and a false condition as "0". There bit conditions stay true as long as the condition is true.

The status word received is in ASCII code format, and needs to be converted to binary code. Each bit is assigned a particular condition and one nibble is converted to one ASCII code. The single channel PPS send two ASCII Bytes and two Terminator Bytes to the GPIB. The terminator bytes are " line feed" & "carriage return". The deal channel PPS send four bytes of ASCII and two terminator bytes to the GPIB.

STATUS?

DEFINITION OF STATUS WORD:

		NIBBLE 1				NIBBLE 1			
Byte	value	bit 7	b6	b5	b4	b3	b2	b1	b0
0	0	BEEP OFF	HIGH RNG	CV MODE	0	0	OCP OFF	OUT ON	No Error
	1	BEEP OFF	LOW RNG	CC MODE	OV	OC	OCP ON	OUT OFF	Error
1	0	0	0	CV2 MODE	0	0	OCP OFF	OUT ON	CH1
	1	0	TRACK	CC2 MODE	OV2	OC2	OCP ON	OUT OFF	CH2
		NIBBLE 3				NIBBLE 4			

<NOTE:>

Byte 0 is available for all PPS models. However, byte 1 is only applicable for the dual channel models.

An explanation of these bytes/bits is as follows:

1. bit 7 (Byte 0) - Audible indictor is off (0) or on (1).
2. b6 (Byte 0) - Signifies the high range (0) or low range (1). Applicable to Model 1770.
3. b6 (Byte 1) - Signifies whether or not Models 1775/1780 are in tracking mode.
4. b5 - Signifies which mode the power supply is operating in, constant current constant voltage.
5. b4 - Overvoltage has toggled on (1).
6. b3 - Overcurrent has toggled on (1).
7. b2 - Overcurrent protection mode is on or off.
8. b1 - The output is on or off.
9. b0 - error has occurred.
10. b0 (Byte 1)- CH1 or CH2 is selected (cursor).

Example: Reading the Status (dual channel)

After the " **STATUS?** " command is entered is entered, the following ASCII code will be read from the PPS:

ASCII CODE	**30**	**31**	**31**	**35**	**36**
convert to decimal form					
DECIMAL CODE	**0**	**1**	**1**	**5**	**6**
convert to hex form					
HEX CODE			**0484**		
convert to binary form					

	Byte 1		**Byte 0**	
	Nibble 3	**Nibble 4**	**Nibble 1**	**Nibble 2**
BINARY CODE	**0000**	**0100**	**1000**	**0100**

EXPLANATION OF STATUS BITS:
BYTE 0b7 = BEEP on, b5 = CH1 in CV mode, b2 = CH1 OCP on, b1 -CH1 OUTPUT on.
BYTE 1b5 = CH2 in CV mode, b2 = CH2 OCP on, b1 = CH2 OUTPUT on, b0 = Cursor at CH1.

5.5 PROGRAMMING THE POWER SUPPLY

This section provides more detailed requirements of the programming commands available. Upon powering up, the PPS Series undergo self test and default to the factory settings.

INITIAL DEFAULT SETTINGS OF PPS:

COMMAND	Model 1770	Models 1775/1780
OUT	1	-
OUT1	-	1
OUT2	-	1
VSET	0/0	-
ISET	0.0140/0.0140	-
OVSET	maximum	-
VSET1	-	0

VSET2	-	0
ISET1	-	0.0140
ISET2	-	0.0140
OVSET1	-	maximum
OVEST2	-	maximum
ADDRESS	12	12

5.5.1 OUTPUT ON/OFF

All power supplies have their outputs off upon powering up. The command "OUT" is to enable/disable the outputs. To enable the power supply, designate the channel (Models 1775/1780 only) and condition (1=on; 0=off). For example to disable an output, Enter:

OUT0

To view if an output is on or off, query the status of the power supply.

5.5.2 VOLTAGE PROGRAMMING

To program a voltage, specify an output channel (Models 1775/1780 only) and voltage.

<NOTE:> The default output condition of a power supply is " OFF " at startup.

All values of voltage must be in volts (i.e. no millivolts). This operation hold true for voltage settings in CV mode. Thus, actual voltage is the programmed voltage and the programmed current is the current limit. In addition, the specified voltage value will be rounded off to the nearest multiple of resolution.

For example, to program a channel for 16 volts. Enter:

VSET 16

To readback the programmed value, send the query:

VEST?

and address the power supply to talk.

To read back the voltage output of the channel, send the query:

VOUT?

Once again, the power supply should be addressed to talk and the results displayed (i.e. shown on CRT, printed, or saved).

Models 1775/1780 have two outputs, please refer to the programming syntax commands for proper nomenclature of commands.

5.5.3 OVERVOLTAGE PROGRAMMING (OVSET)

In order to protect loads against excessive voltages, an overvoltage protection circuit (SCR crowbar) has been added. When a voltage exceeds the set overvoltage value the power supply output is disabled.

To program overvoltage, specify the output channel (Models 1775/1780 only) and overvoltage value. For example. to program one channel of the Model 1775 for 18V, Enter:

OVSET1 18

To readback the programmed value for channel one, send the query:

OVSET1?

and address the power supply to talk. When specifying the queries, only one command may be issued at a time. The power supply can access only one query at a time.

5.5.4 CURRENT PROGRAMMING

To program a current, specify an output channel (Models 1775/1780) and current. All values of current must be in amps. Additionally, the unit rounds off ISET to the nearest multiple of resolution. For example, to specify a current of 1.6 amps. Enter:

ISET 1.6

This operation holds true for current settings in CC mode. When the supply operates in CC mode, the actual current is the programmed current and programmed voltage is the voltage limit.

To readback the programmed value, send the query:

ISET?

and address the power supply to talk.

To readback the current output of the channel, send the query:

IOUT?

Once again, the power supply should be addressed to talk and the results displayed (i.e. shown on CRT, printed, or saved).

Models 1775/1780 series have two outputs, please refer to the programming syntax commands for proper nomenclature of commands.

5.5.5 OVERCURRENT PROTECTION (OCP)

The overcurrent programming feature protects the load from excessive output currents. The OCP mode cannot be used while the power supply is operating in CC mode, since OCP would disable the output. The OCP command is enabled by a logic " 1" and disabled by a logic " 0". For example, to enable a channel for overcurrent protection. Enter:

OCP1

to disable a channel form OCP, Enter:

OCP0

5.5.6 TRACK COMMAND

This command may be controlled by a true "1" or false "0" command. The "TRACK" command is only applicable to Models 1775/1780. The ensuing example will assist in clarifying the command.

To set the tracking mode in Models 1775/1780, send " TRACK 1"

Refer to section 4.7 for more information on Models 1775/1780 tracking mode.

5.6 FUNDAMENTALS OF PROGRAMMING

The following section explains fundamental operations of programming the supply in remote mode. Before beginning operation, have your system completely installed and set up accepted, **do not** have a load applied at the outputs. Be aware at all times of power supply ' s voltage and current limits. If data greater than the range of the power supply is programmed, data is disregarded and a error occurs. Due to the extent of programming languages available, only common programming commands will be discussed.

ADDRESS SELECTION: The first step involved in remote programming is to select the power supply's address. The present power supply address may be viewed via the front panel address key or in the Default Conditions List. To alter this address, press the address key, select a new address (0-30) and press " ENTER" key. The data is stored in an EEPROM.

COMMON COMMANDS: There is a wide variety of commands available to program the power supply. However. the commands which pertain to voltage and current are of most use. These commands are: VSET, ISET, OVSET, VOUT?, IOUT?, OVSET? and COP.

Secondary commands of prime importance pertain to the actual programming language. Some of these commands are: OUTPUT, ENTER, DELAY, SEND, PRINT, and CLEAR. The definitions and uses of these commands are as follows:

OUTPUT: Addresses the power supply to listen and sends command to power supply.

ENTER: Addresses the power supply to talk and receive data from the power supply.

DELAY: Introduces a time delay to the power supply.

<NOTE:> This command is extremely important since the power supplies occasionally require time delays in order to execute operations. Otherwise, error messages occur.

CLEAR: Clears the power supply.

<NOTE:> The PPS series does not have a CLR command. Therefore, the user must initially specify a hardware clear before beginning programming.

SEND: Sends GPIB management commands.

PRINT: Writes data to the screen or to a file.

All commands may be accepted in either upper or lower case letters in ASCII code. The PPS series accepts integer or numeric data as input. Plus (+) and minus (-) signs are also numeric characters. Remember not to program too large a value since the power supply rounds off data to suit the power supplies resolution.

SENDING DATA: The steps involved in sending data to the power supply are setting the address (power supply & computer), function and sending the command (Qbasic). For example, to turn on the output of a power supply (single output), send:

```
PRINT #1, "OUTPUT 12; out 1"
```

where:

PRINT	Qbasic command. Writes data to the screen or to a file
#1	File number
OUTPUT	Qbasic command . Specifies that the file is opened for sequential output
12	GPIB device address
OUT	GPIB command
1	Enable output (0 disables output)

Continuing on with this example we will set the output voltage to 11V and output current to 1.7 amps, therefore send:

```
PRINT #1, "OUTPUT 12; out 11"
PRINT #1, "OUTPUT 12; out 1.7"
```

<NOTE:> The voltage and current values are given in volts and amps.

OBTAINING DATA: The steps involved in obtaining data from the power supply follow a similar formats as in sending data. However, additional commands (Enter and Print) are necessary to view the data. For example, to query the programmed voltage of the previous example, send:

```
PRINT #1, "OUTPUT 12; VSET?"
```

Although a query has been sent to the power supply, there has been no command given to view the data. At this moment the power supply holds the VSET value in a sample/hold circuit till the proper command has been executed. Therefore, to retrieve data onto the screen, send:

```
PRINT #1, "ENTER12"
INPUT #2, VOLTAGE$
PRINT " VOLTAGE SETTING =" ;VOLTAGE$
```

The PPS series are capable of output voltage and current to the bus. Therefore, one may send queries to read in the values from the supply. In our example we set an output voltage of 11V and current of 1.7A. Let us recall these actual output values.

To query the voltage output of the power supply, send:

```
PRINT #1, "OUTPUT 12; VOUT?"
```

Now, proceed to obtain the voltage output value:

```
PRINT #1, "ENTER 12"
INPUT #2, V$
PRINT "VOUTPUT =" ;V$
```

The screen now shows a value of approximately 11V.

To query the current of the power supply, send:

```
PRINT #1, "OUTPUT 12; IOUT?"
```

Now, proceed to obtain the current output value:

```
PRINT #1, "ENTER 12"
INPUT #2, I$
PRINT "IOUTPUT =" ;I$
```

Now, simply short the output terminals, and the LCD screen will now display a value of approximately 1.7 amps.

The same methods presented here hold true for programming overvoltage and overcurrent protection as well as other GPIB commands.

In order to return the supply to local mode, press the **" LCL"** key on the front panel.

<NOTE:>

Attempting to modify values/conditions via the front panel display during remote operation is not possible.However, values/conditions may be monitored operation.

SIX: CALIBRATION

6.1 INTRODUCTION

This addendum describes calibration procedures for the B+K Precision Programmable DC Power Supply. The supply is calibrated either through local or remote control. The following information provides calibration procedures in local mode.

NO hardware adjustment is necessary since all calibration is accomplished by software. The software sends calibration constants to the supply via the front panel keys. Calibration should be performed at least annually.

The four parameters that must be calibrated are output voltage, output current, readback voltage and readback current. After all the power supply parameters are calibrated, the supply returns to normal operating condition. If there are any errors in the calibration, cycle the power and recalibrate. All constants are saved in a non-volatile EEPROM.

6.2 CALIBRATION CONFIGURATION

There are two configurations for calibration of power supplies. One of which would be for voltage and the second for current.

The two pieces of equipment necessary for calibration are:

1. Precision Shunt Resistor -0.1 ohm/10 Amp, 0.001% accuracy (for smaller current) or 0.05% accuracy (for larger current), 20ppm, 10 watts.
2. DMM (DC voltage and current) -5 digit, 0.005% accuracy.

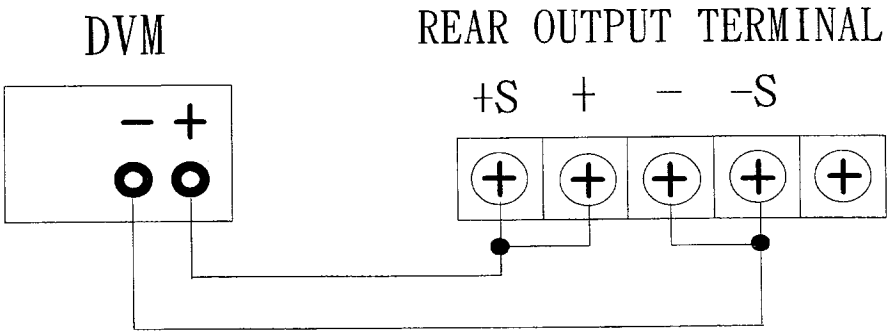


Figure M. Voltage Calibration Configuration

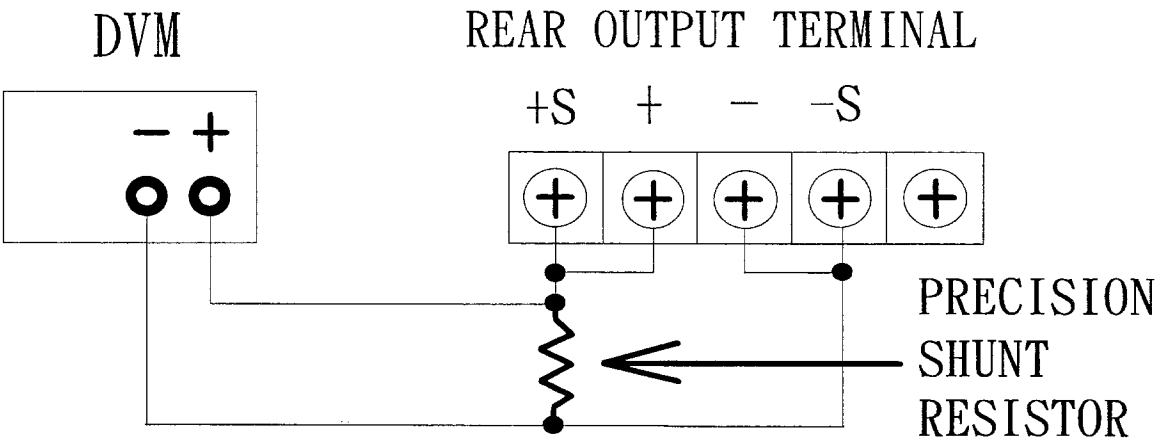


Figure N. Current Calibration Configuration

6.3 LOCAL CALIBRATION

The following steps describe the calibration procedure of the supply via front panel keypads in mode.

CAUTION: **In these procedures, voltages and currents may exceed full scale value. Take all necessary precautions.**

STEPS:

1. Disconnect all loads from the supply.
2. Strap the supply for local sensing.
3. Connect the voltmeter to the +S and -S rear terminals as in figure M. for Voltage calibration.
4. Turn on the power supply and press **" 8" &" ON/OFF"** simultaneously.
5. The supply will begin the voltage and current calibration process.

VOLTAGE CALIBRATION

1. The supply initially sends an offset voltage to the output. This offset voltage is measured on the DMM.

2. Enter the " V Lo= " value to the power supply by the front panel keys, and press "ENTER" once. For example, if the DMM reads 4.662 V, press:

4	.	6	6	2	ENTER

3. After calibrating the voltage offset, the supply sends full scale voltage to the output. This value is measured on the DMM.

4. Enter in the " V Hi = " value to the power supply by the front panel keys and press" ENTER" once. For example, if the full scale is 14.369 V as measured by the DMM, press:

1	4	.	3	6	9	ENTER

The voltage calibration is now complete!

CURRENT CALIBRATION:

1. When the voltage calibration is complete, connect the voltmeter to the Precision Shunt Resistor as in figure N.
2. The supply initially sends an offset current to the output. This offset current is measured on the DMM.
3. Enter the " I Lo = " value to the power supply by the front panel keys, and press " ENTER" once. For example, if the DMM reads 103 mV, press:

1	.	0	3	ENTER

4. After calibrating the current offset value, the supply sends full scale current to the output. This value is measured on the DMM.
5. Enter the " I Hi = " value to the power supply by the front panel keys, and press " ENTER" once. For example, if the DMM reads .3301 V press:

3	.	3	0	1	ENTER

6. The current calibration is now complete!

<NOTE:>

For Models **1775/1780, Ch.1 and Ch.2 can only be calibrated in sequence (applies only in local mode).**

6.4 REMOTE CALIBRATION

The PPS series are able to be calibrated via computer commands. Therefore it is not necessary to remove the power supply from the system. There are several commands available for calibration. These are; CALCHNL,VOFF,VFS, IOFF, IFS. A definition of these commands is presented in appendix A. The equipment necessary for calibration is identical to the equipment used in local mode. Refer to figures M and N for voltage and current calibration configurations.

6.5 CALIBRATION PROGRAM EXAMPLE

Please refer to Appendix D.

SEVEN: USER MAINTENANCE/SERVICE

7.1 FUSE REPLACEMENT

If the fuse is suspected to be defective, it should be inspected and, if necessary, replaced. To inspect or replace the fuse, please perform the following steps:

(1) Disconnect the AC line cord from the unit to reduce electrical shock hazard.
(2) Remove the fuse by sliding out the fuse holder. The fuseholder is beneath the AC Receptacle. Test the fuse for electrical continuity with an ohmmeter.
(3) If the fuse us found to be defective, replace it with a replacement fuse as specified in the following table:

Models	Fuse Rating	
Model 1770	230V~/2AT, 250V	115V/4AT,250V
Models 1775/1780	230V~/2AT, 250V	115V/4AT,250V

(4) Replace the fuse in the fuseholder and re-install.
(5) Reconnect the AC power cord.

<NOTE:>

USE OF ANY FUSE OTHER THAN THE ONE SPECIFIED MAY CAUSE DAMAGE TO THE UNIT, POSE A SEVERE FIRE HAZARD, AND WILL VOID THE WARRANTY.

7.2 IN CASE OF DIFFICULTIES

This programmable power supply has been designed to be accurate, reliable, and easy-to -use. However, it is possible that you may experience difficulties during operation. If there appears to be any kind of problem during the use of the unit, please perform the following steps to help determine the cause:

(1) Re-read the operating instructions. It is very easy to inadvertently make mistakes in operating procedure.
(2) Remove and test the fuse. The power supply will not function with an open fuse.

If the preceding two steps fail to resolve the problem, please call your local distributors.

<NOTE:>

ATTEMPTED REPAIR, MODIFICATIONS, OR TAMPERING BY UNAUTHORIZED PERSONNEL WILL VOID THE WARRANTY.

7.3 LIMITED THREE YEAR WARRANTY

B+K Precision warrants to the original purchaser that its product and the component parts thereof, will be free from defects in workmanship and materials for a period of three years from the date of purchase.

B+K Precision will, without charge, repair or replace, at its' option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty card to B+K precision, 1031 Segovia Circle, Placentia, CA 92870 within fifteen (15) days from proof of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alternations or repairs. it is void if the serial number is alternated, defaced or removed.

B+K Precision shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to -state.

Model Number: _____ Date Purchased : _____

7.4 SERVICE INFORMATION

Warranty Service: Please return the product in the original packaging with proof of purchase to the below address. Clearly state in writing the performance problem and return any leads, connectors and accessories that you are using with the device.

Non-Warranty Service: Please return the product in the original packaging to the below address. Clearly state in writing the performance performance problem and return any leads, connectors and accessories that you are using with the device. Customers not on open account must include payment in the form of a money order or credit card. For the most current repair charges contact the factory before shipping the product.

Return all merchandise to B+K Precision with per-paid shipping. The flat-rate repair charge includes return shipping to locations in North America. For overnight shipments and non-North America shipping fees contact B+K Precision.

B+K Precision
1031 Segovia Circle
Placentia, CA 92870
Phone: 714-237-9220
Facsimile: 714-237-9214

Include with the instrument your complete return shipping address, contact name, phone number and description of problem.

APPENDIX A: SPECIFICATIONS

The following lists the performance specifications for the B+K Precision. Linear Programmable DC Power Supply Series. **All specifications are at rear terminals with a resistive load, and local sensing unless otherwise stated.** All specifications apply over the full operating temperature range of 0 ℃ to 50 ℃ unless otherwise specified.

MODEL	**Model 1770**
AC INPUT	One rear panel mounted switch permits of 115 or 230(240)Vac line voltage.
Input Current	
115VAC	1.92A
230VAC	0.96A
Fuse Rating	
115VAC	4A
230VAC	2A
Amplitude	115/230Vac 10% or 240Vac 10%
Frequency	50 to 60 Hz
Maximum VA	221VA
Maximum Power	192W
Peak Inrush Current	30A
DC OUTPUT MAXIMUM RATINGS	
Voltage	0~17.5V ; 0~35V
Current	0~6A ; 0~3A
DC OUTPUT PROGRAMMING RANGE	
Voltage	0~17.5V ; 0~35V
Current	0~6A ; 0~3A
PROGRAMMING RESOLUTION (LSB)	Voltage and current programming are monatonic over full temperature range.
Voltage	10mV
Current	2mA
OVP	200mV
PROGRAMMING ACCURACY	If the unit is recalibrated at a temperature other than 25 ℃,these specifications apply over a temperature band of ± 5 ℃ around calibration temperature.
Voltage	0.05% +2 LSB
Current	0.15% +5 LSB
OVP	2.4% +0.3V
LOAD EFFECT	Load effect is defined as the maximum change in output due to a load change up to the maximum voltage or current rating.
Voltage	0.001% +1mV
Current	1mA
Remote sense operation is possible with up to 0.5V drop for positive and negative output load leads.	

Specifications are subject to change without notice

APPENDIX A: SPECIFICATIONS (continued)

MODEL	Model 1770
SOURCE EFFECT	Maximum output change for a line voltage change within rating.
Voltage	1mV
Current	1mA
PARD (PERIODIC AND RANDOM DEVIATION AND NOISE)	
RMS/PK-PK (20Hz - 20Mhz) with output ungrounded.	
Voltage	1mVrms/10mVp-p
Current	1mArms
TEMPERATURE COEFFICIENT	The temperature coefficient is defined as the change in output per degree Celsius; after a 30 minute warm-up period.
Voltage	100ppm/°C
Current	200ppm/°C
DRIFT (STABILITY)	The drift is defined as the change in output over an eight hour interal under constant line, load, and ambient temperature after a 30 minute warm-up period.
Voltage	0.01% + 1mV
Current	0.1% +6mA
LOAD TRANSIENT RESPONSE	The time required for the output voltage to recover within a band of 0.1% of rated voltage around the nominal voltage, within a 50% variation in load current.
Recovery Time	50us
PROGRAMMING UP/DOWN SPEED	The total programming UP/DOWN time is the sum of output voltage response time and the programming command processing time. LSB is the maximum time for the output voltage to vary within .025% of a final value. UP and DOWN times are the maximum times for the output from 10% to 90% or to 10% of its total excursion value.
Tup/Tdn	10ms/15ms
LSB	20ms/30ms
READBACK RESOLUTION (LSB)	
Voltage	10mV
Current	1mA(Low);2mV(High)
READBACK ACCURACY	If the unit is recalibrated at a temperature other than 25 °C,these specifications apply over a temperature band of ± 5 °C around calibration temperature.
Voltage	0.1% +2LSB
Current	0.2% +5LSB
READBACK TEMPERATURE COEFFICIENT	The readback temperature coefficient is defined as the variation in reading per degree Celsius after a 30 minute warm-up.
Voltage	100ppm+10mV
Current	200ppm+4mA
OUTPUT ISOLATION	Neither output terminal may be more than 40Vdc from chassis ground.
	240Vdc
TEMPERATURE RATINGS	
Operating	0 °C to 50 °C
Storage	-40 °C to 70 °C
GPIB INTERFACE CAPABILITY	SH1,AH1,T6,TE0,L4,LE0,RL1,SR0,PP0,DC1,DT0,C0,E1
WEIGHT	18 lbs
DIMENSIONS 8.4" x5.2" x15.7" for all models	

Specifications are subject to change without notice

APPENDIX A: SPECIFICATIONS (continued)

MODEL	Model 1780	Model 1775
AC INPUT	One rear panel mounted switch permits operation of 115 or 230(240)Vac line voltage.	
Input Current		
115VAC	2.7A	2.6A
230VAC	1.35A	1.3A
Fuse Rating	AC input is protected by a rear panel mounted fuse.	
115VAC	4A	4A
230VAC	2A	2A
Amplitude	115/230 Vac 10% or 240 Vac 10%	
Frequency	50 to 60 Hz	
Maximum VA	315VA	299VA
Maximum Power	240W	232W
Peak Inrush Current	30A	30A
DC OUTPUT MAXIMUM RATINGS		
Voltage	18V	35V
Current	4A	2A
DC OUTPUT PROGRAMMING RANGE		
Voltage	0-18V	0-35V
Current	0-4A	0-2A
PROGRAMMING RESOLUTION (LSB)	Voltage and current programming are monotonic over full temperature range.	
Voltage	5mV	10mV
Current	1.5mA	0.6mA
OVP	100mV	200mV
PROGRAMMING ACCURACY	If the unit is recalibraed at a temperature other than 25 °C, the specifications apply over a temperature band of ± 5 °C around calibration temperature.	
Voltage	0.05%+2LSB	0.05%+2LSB
Current	0.15%+5LSB	0.15%+5LSB
OVP	2.4%+0.6V	2.4%+1.3V
LOAD EFFECT	Load effect is defined as the maximum change in output due to a load change up to the maximum voltage or current rating.	
Voltage	0.001%+1mV	0.001%+1mV
Current	1mA	1mA
Remote sense operation is possible with up to 0.5V drop for positive and negative output load leads.		

Specifications are subject to change without notice

APPENDIX A: SPECIFICATIONS (continued)

MODEL	Model 1780	Model 1775
SOURCE EFFECT	Maximum output change for a line voltage change within rating.	
Voltage	1mV	1mV
Current	1mA	1mA
PARD(PERIODIC AND RANDOM DEVIATION AND NOISE) RMS/PK-PK(20Hz -20MHz)with output ungrounded.		
Voltage	1mVrms/10mVp-p	1mVrms/10mVp-p
Current	1mArms	1mArms
TEMPERATURE COEFFICIENT	The temperature coefficient is defined as the change in output per degree Celsius; after a 30 minute warm-up period.	
Voltage	100ppm/°C	100ppm/°C
Current	200ppm/°C	200ppm/°C
DRIFT (STABILITY)	The drift is defined as the change in output over an eight hour interal under constant line, load, and ambient temperature after a 30 minute warm-up period.	
Voltage	0.01%+1mV	0.01%+3mV
Current	0.1%+5mA	0.1%+2mA
LOAD TRANSIENT RESPONSE	The time required for the output voltage to recover within a band of 0.1% of rated voltage around the nominal voltage, within a 50% variation in load current.	
Recovery Time	50us	50us
PROGRAMMING UP/DOWN SPEED	The total programming UP/DOWN time is the sum of output voltage response time and the programming command processing time. LSB is the maximum time for the output voltage to vary within .025% of a final value. UP and DOWN times are the maximum times for the output from 10% to 90% or to 10% of its total excursion value.	
Tup/Tdn	10ms/15ms	10ms/15ms
LSB	20ms/30ms	20ms/30ms
READBACK RESOLUTION		
Voltage	5mV	10mV
Current	2mA	1mA
READBACK ACCURACY	If the unit is recalibrated at a temperature other 25 °C,these specifications apply over a temperature band of ± 5 °C around calibration temperature.	
Voltage	0.1% +2LSB	0.1% +2LSB
Current	0.2% +5LSB	0.2% +5LSB
READBACK TEMPERATURE COEFFICIENT	The readback temperature coefficient is defined as the variation in reading per degree Celsius after a 30 minute warm-up.	
Voltage	100ppm+4mV	100ppm+8mV
Current	200ppm+4mA	200ppm+2mA
OUTPUT ISOLATION	Neither output terminal may be more than 40Vdc from chassis ground.	
	240Vdc	240Vdc
TEMPERATURE RATINGS		
	Operating	0 °C to 50 °C
	Storage	-40 °C to 70 °C
GPIB INTERFACE CAPABILITY	SH1,AH1,T6,TE0,L4,LE0,RL1,SR0,PP0,DC1,DT0,C0,E1	
WEIGHT	18 lbs	20 lbs
DIMENSIONS	8.4" x5.2" x15.7" for all models	

Specifications are subject to change without notice

APPENDIX B: COMMAND SUMMARIES

COMMAND	DEFINITION
ADDRESS	Sets the address of the PPS
CALCHNL	0 = end calibration 1 = calibrated channel 1 2 = calibrated channel 2 3 = calibrated all channels
IFS	Sets the fullscale current for calibration.
IOFF	Sets the current offset value in calibration.
ISET	Sets the current
ISET1	Sets the current to channel one (Models 1775/1780 only)
ISET2	Sets the current to channel two (Models 1775/1780 only)
OCP	Set the overcurrent protection.
OUT	Set the output on or off.
OUT1	Sets the output of channel one on or off (Models 1775/1780 only)
OUT2	Sets the output of channel two on or off (Models 1775/1780 only)
OVSET	Set the overvoltage protection
OVSET1	Set the overvoltage protection value for channel one (Models 1775/1780 only)
OVSET2	Set the overvoltage protection value for channel two (Models 1775/1780 only)
TRACK	Sets the tracking mode of Models 1775/1780.
VFS	Sets the fullscale voltage for calibration.
VOFF	Sets the offset voltage for calibration.
VSET	Sets the voltage
VSET1	Sets the voltage to channel one (Models 1775/1780 only)
VSET2	Sets the voltage to channel two (Models 1775/1780 only)
VERSION	Display version no.
HELP	Display command list

APPENDIX B: COMMAND SUMMARIES

COMMAND	DEFINITION
ERROR	Queries for command or numeric errors
IOUT	Queries the current output.
IOUT1	Queries the current output of channel one (Models 1775/1780 only)
IOUT2	Queries the current output channel two (Models 1775/1780 only)
ISET?	Queries the set current output.
ISET1?	Queries the set current output of channel one (Models 1775/1780 only)
ISET2?	Queries the set current output of channel two (Models 1775/1780 only)
OVSET?	Queries the overvoltage value.
OVSET1?	Queries the overvoltage value for channel one (Models 1775/1780 only)
OVSET2?	Queries the overvoltage value for channel two (Models 1775/1780 only)
STATUS	Queries the status of the power supply.(see note 3)
VOUT	Queries the output voltage.
VOUT1	Queries the output voltage of channel one (Models 1775/1780 only)
VOUT2	Queries the output voltage of channel two (Models 1775/1780 only)
VSET?	Queries the set voltage value
VSET1?	Queries the set voltage value of channel one (Models 1775/1780 only)
VSET2?	Queries the set voltage value of channel two (Models 1775/1780 only)
RANGE	0 = low current 1 = high current
OVP	Set the overvoltage protection
MODEL	Queries the model no. of the power supply.
BEEP	0 = beeper function disable 1 = beeper function disable 2 = force beeper alarm 3 = beeper alarm off

APPENDIX C: QUERY MESSAGES

ERROR CODE MESSAGE	DEFINITION
ERROR 0	No Errors
ERROR 1	Command String Error
ERROR 2	Numeric String out of Range
ERROR 3	Numeric String Over Length
ERROR 4	Command Sequence Error
ERROR 5	
ERROR 6	

NOTE : 1. All GPIB commands are case-nonsensitivity ASCII codes.
2. Allow many command string
3. STATUS operation explanation:
After " STATUS" command accepted, PPS will display a decimal number in ASCII, convert this decimal this decimal number to binary form. Each bit indicated a action/status:

(Channel 1 ------> CH 1, Channel 2 ------> CH 2)

bit 0:	0	NO ERROR
	1	ERROR
bit 1:	0	CH1 OUTPUT OFF
	1	CH1 OUTPUT ON
bit 2:	0	CH1 OCP ON
	1	CH1 OCP OFF
bit 3:	0	CH1 OC NOT OCCUR
	1	CH1 OC OCCUR
bit 4:	0	CH1 OV NOT OCCUR
	1	CH1 OV OCCUR
bit 5:	0	CH1 CV MODE
	1	CH1 CC MODE
bit 6:	0	LOW RANGE
	1	HIGH RANGE
bit 7:	0	BEEPER ON
	1	BEEPER OFF
bit 8:	0	ARROW IN CHANNEL 1
	1	ARROW IN CHANNEL 2
bit 9:	0	CH2 OUTPUT OFF
	1	CH2 OUTPUT ON
bit 10:	0	CH2 OCP ON
	1	CH2 OCP OFF
bit 11:	0	CH2 OC NOT OCCUR
	1	CH2 OC OCCUR
bit 12:	0	CH2 OV NOT OCCUR
	1	CH2 OV OCCUR
bit 13:	0	CH2 CV MODE
	1	CH2 CC MODE
bit 14:	0	INDEPENDENT
	1	TRACKING TO CHANNEL 1
bit 15:	0	RESERVED

APPENDIX D: QUERY MESSAGES

The following is a software calibration program written in QBASIC for an one channel PROGRAMMABLE DC POWER SUPPLY. The equipment necessary to calibrated the unit included a PPS series (relay control), a FLUKE 8842A digital multimeter (GPIB interface), and a controller card from National Instruments (AT-GPIB). A shunt resistor used for local calibration may be utilized in remote calibration.

```
' ***program and variable declaration ***
DECLARE SUB DELAY (SECONDS)
MULTIPLIER = 10
dmm$ = " 20" :CH$= " "
' *** program initialization ***
RANDOMIZE TIMER
OPEN " gpib0" FOR OUTPUT AS #1
OPEN " gpib0" FOR INPUT AS #2
PRINT #1, " ABORT"
PRINT #1, " REMOTE"
PRINT #1, "clear"
PRINT #1, " output" ; dmm$;" ;* "
PRINT #1, " OUTPUT1,OUTO ; VEST 6; ISET 0.125 "
CLS
INPUT " Enter GPIB address of PPS unit under test (default = 12) = " ;pps$
IF VAL(pps$)<0 OR VAL (pps$)>31 OR pps$ = " " THEN pps$ = " 12 "
PRINT #1, "output"; pps$; " ;model?"
PRINT #1, " enter " ;pps$
INPUT #2, model$
PRINT : print "        " ; model$ " found at GPIB address " ;pps$
PRINT
DO
INPUT "     Enter channel for calibration/testing (1/2) = > " ;CH$
LOOP UNTIL CH$ = " 1" OR CH$ = " 2 "
PRINT
' ***** VOLTAGE CALIBRATION *****
PRINT #1, " output " ; pps$ ; " ; calchnl1"
CALL DELAY(3)
PRINT#1, " enter " ;dmm$: INPUT #2, rd$
voff = VAL(rd$)
PRINT #1, " output " ; pps$; " ;voff "; STR$(voff)
CALL DELAY(3)
PRINT#1, " enter " ;dmm$: INPUT #2, rd$
vfs = VAL(rd$)
PRINT#1, " output " ; pps$; " ;vfs " ;STR$(vfs)
PRINT USING " Offset Voltage = ##.### V        Fullscale Voltage = ##.### V " ; voff; vfs
' ***** CURRENT CALIBRATION *****
PRINT#1, " output1 ; out 1 "
CALL DELAY(3)
PRINT#1, " enter " ;dmm$: INPUT #2, rd$
ioff = VAL(rd$)* MULTIPLIER
PRINT#1, " output " ;pps$; " ;ioff " ; STR$ (ioff)
CALL DELAY (3)
PRINT#1, " enter " ;dmm$: INPUT #2, rd$
ifs = VAL(rd$) * MULTIPLIER
PRINT#1, " output " ;pps$; " ; ifs " ; STR$(ifs)
PRINT USING " Offset Current = ##.### V        Fullscale Counter = #.#### A " ; ioff; ifs
CALL DELAY (5)
PRINT#1, " enter "
PRINT#1, " LOCAL"
END
SUB DELAY(SECONDS)
  FOR count = 1 TO 5000 * SECONDS
  NEXT count
END SUB
```

SAFETY PRECAUTIONS

SAFETY PRECAUTIONS

The B+K Precision Programmable Power Supply have been designed and tested according to EN-61010-1, Safety requirement for Electronic Measuring Apparatus.

SAFETY NOTES

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. The manufacturer assumes no liability for the customer' s failure to comply with these requirements.

BEFORE APPLYING POWER ⚠

Verify that the product is set to match the available line voltage and the correct fuse is installed.

GROUND THE INSTRUMENT

This product is provided with a protective earth terminal. To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument must be connected to the AC power supply mains through a three-conductor power cable, with the third wire firmly connected to an electrical ground (safety ground) at the power outlet. For instruments designed to be hard-wired to the ac power lines (supply mains), connect the protective earth terminal to a protective conductor before any other connection is made. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury. If the instrument is to be energized via an external autotransformer for voltage reduction, be certain that the autotransformer common terminal is connected to the neutral (earthed pole) of the ac power lines (supply mains).
The GPIB (option) Ground is connected with chassis ground, and therefore the operator must take care if the computer is also connected with other measuring devices prevent a short cut.

FUSES

Only fuses with the required current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustment must be made by qualified service personnel. Do not replace components with power cable connected.

Under certain conditions, dangerous voltage may exist even with the power cable removed. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT EXCEED INPUT RATINGS

This instrument must be connected to a properly grounded receptacle to minimize electric shock hazard. Operation at line voltage or frequencies in excess of those stated on the data plate may cause leakage currents in excess of 5.0mA peak.