Programmable Power Supply

PPS-1860/1860G/3635/3635G

PPT-1830/1830G/3615/3615G

USER MANUAL

GW INSTEK PART NO. 82PS-36350MC

ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

Declaration of Conformity

We

GOOD WILL INSTRUMENT CO., LTD.

No. 7-1, Jhongsing Rd., Tucheng City, Taipei County 236, Taiwan

GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.

No.69 Lushan Road, Suzhou New District Jiangsu, China.

declares that the below mentioned product

PPS-1860/1860G/3635/3635G

PPT-1830/1830G/3615/3615G

are herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to Electromagnetic Compatibility (89/336/EEC, 92/31/EEC, 93/68/EEC) and Low Voltage Equipment Directive (73/23/EEC). For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Equipment Directive, the following standards were applied:

◎ EMC

EN 61326-1: Electrical equipment for measurement, control and laboratory use — EMC requirements **(1997+A1: 1998)**			
Conducted and Radiated Emissions	EN 55011: 1991+A1: 1997+A2: 1996	Electrostatic Discharge	EN 61000-4-2: 1995+A1:1998
Current Harmonic	EN 61000-3-2: 1995+A1: 1998+A2: 1998 +A14: 2000	Radiated Immunity	EN 61000-4-3: 19965+A1:1998
Voltage Fluctuation	EN 61000-3-3: 1995	Electrical Fast Transients	EN 61000-4-4: 1995
----------	----------	Surge Immunity	EN 61000-4-5: 1995
----------	----------	Conducted Susceptibility	EN 61000-4-6: 1996
----------	----------	Voltage Dips/ Interrupts	EN 61000-4-11: 1994

◎ **Safety**

Low Voltage Equipment Directive 73/23/EEC & amended by 93/68/EEC
IEC/EN 61010-1 :2001

SAFETY TERMS AND SYMBOLS

These terms may appear in this manual or on the product:

WARNING. Warning statements identify condition or practices that could result in injury or loss of life.

CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

The following symbols may appear in this manual or on the product:

DANGER
High Voltage

ATTENTION
refer to Manual

Protective Conductor
Terminal

DANGER
Hot Surface

Equipotentiality

CONTENTS PAGE

1. INTRODUCTION..... 1
1.1 DESCRIPTION..... 1
1.2 FEATURE..... 2

2. SPECIFICATIONS..... 3~6

3. PANEL CONTROLS AND INDICATORS..... 7~10
3.1 FRONT PANEL..... 11~12
3.2 REAR PANEL..... 12

4. POWER-ON CHECK PROCEDURES AND INITIAL SETUP..... 13
4.1 POWER-ON CHECK PROCEDURES..... 13
4.2 INITIAL SETUP..... 14

5. OPERATING INSTRUCTIONS..... 15
5.1 OUTPUT VOLTAGE SETTING..... 15
5.2 OUTPUT CURRENT SETTING..... 15
5.3 OVER VOLTAGE PROTECTION SETTING..... 15
5.4 VOLTAGE STEP SETTING..... 15~16
5.5 OUTPUT ON OR OFF..... 16
5.6 CURRENT STEP SETTING..... 16
5.7 AUTO RUNNING TIMER SETTING..... 17
5.8 GPIB ADDRESS SETTING..... 17
5.9 STORAGE SETTING VALUE..... 17
5.10 RECALL SETTING VALUE..... 17
5.11 RECALL AUTO RUNNING LOOP..... 18
5.12 ENABLE OR DISABLE AUTO RUNNING STEP..... 18

5.13 ENABLE OR DISABLE PARALLEL MODE..... 18
5.14 ENABLE OR DISABLE TRACKING MODE..... 18
5.15 MAXIMUM SETTING VALUES..... 19

6. DESCRIPTION OF THE PROTECTION FUNCTIONS..... 20
6.1 OVP..... 20
6.2 OCP..... 20

7. DESCRIPTION OF POWER-ON SELF TEST..... 21
7.1 DISPLAY CHECK..... 21
7.2 CPU TEST..... 21
7.3 RAM TEST..... 21
7.4 ROM TEST..... 21
7.5 D/A A/D TEST..... 21

8. CALIBRATION..... 22～26

9. REMOTE PROGRAMMING..... 27
9.1 INTRODUCTION..... 27
9.2 INTERFACE CAPABILITIES..... 27 ～ 28
9.3 IEEE-488.2 BUS RESTRICTIONS..... 28
9.4 GPIB ADDRESS SELECTION..... 28
9.5 BUS COMMANDS..... 29 ～ 30
9.6 DEVICE-DEPENDENT COMMAND SET..... 31
9.7 SERVICE REQUEST..... 31
9.8 SERIAL POLL..... 31

10. MAINTENANCE..... 40
10.1 FUSE REPLACEMENT..... 40
10.2 CLEA NING..... 40

1. INTRODUCTION

1.1 Description

1.1.1 The PPS series and PPT series is a programmable power supply. It uses precision DAC to provide high resolution.

1.1.2 User friendly designed, with full digitized panel operation, easy in setting operation, 3-way data entry, set the output directly by a operation keyboard, change the output by UP/DOWN key with step setting or automatic control through the GPIB interface.

1.1.3 The features of self test, OVP protection and OCP protection, further prevent the sensitive load from unnecessary voltage shocks or current shocks.

1.1.4 The programmable power supply features a versatile preset capability for voltage, current, OVP setting, timer, output, OCP, (tracking, parallel for triple output only) and GPIB address etc. The setting value of voltage, current, OVP protection and enable condition are assorted together and can be stored in memory and recalled when necessary. As the memory device (RAM) is battery backedup the stored data are retained while turning off the instrument.

1.1.5 This manual describes including specifications, panel control and indicators and initial setup,power-on checkout procedures, and operating procedures for output setting and control functions.

1.1.6 GPIB Commands for all PPS/PPT Series are with SCPI. The new language standard for programmable test instruments. This standard means that all instruments performing the same function use the same instruction.

1.2 Feature

* Easy Operation, with UP/DOWN Key
* High Resolution: 10mV (20mV rating voltage > 36V) , 1mA (2mA rating current > 3.5A)
* 4-Digit Display for both voltage and current.
* High Stability, Low Drift
* Over Voltage Protection, Over Current Protection
* Memory store and recall 100 points for PPS series, 50 points for PPT series.
* Memory , Status and Error Code display.
* Self Test Confirm Performance
* Software Calibration
* FRONT/REAR output and sense switch selectable.
* AUTO STEP RUNNING With timer setting.
* IEEE-488.2 & SCPI compatible command.
* Triple Output (for PPT series only).
* Auto Tracking (for PPT series only).
* Auto Series and Parallel Operation (for PPT series only).

2. SPECIFICATIONS

LOAD EFFECT	Voltage	≤ 3mV Rear output(≤ 6mV front output)
	Current	≤ 3mA (≤ 6mA rating current > 3.5A)
SOURCE EFFECT	Voltage	≤ 3mV
	Current	≤ 3mA
RESOLUTION	Voltage	10mV (20mV rating voltage > 36V)
	Current	1mA (2mA rating current > 3.5A)
	OVP	10mV (20mV rating voltage > 36V)
PROGRAM ACCURACY (25+/-5℃)	Voltage	≤ 0.05%+25mV(+50mV rating voltage >36V)
	Current	≤ 0.2%+10mA
	OVP	≤ 2%+0.6V
RIPPLE & NOISE (20Hz-20MHz)	Voltage	Ripple 1mVrms/3mVp-p
		Noise 2mVrms/30mVp-p
	Current	≤ 3mArms (≤ 5mArms rating current >3.5A)
TEMPERATURE (0-40℃) COEFFICIENT	Voltage	≤ 100ppm +3mV
	Current	≤ 150ppm +3mA
READBACK RESOLUTION	Voltage	10mV (20mV rating voltage > 36V)
	Current	1mA (2mA rating current > 3.5A)
READBACK ACCURACY (25+/-5℃)	Voltage	≤ 0.05%+25mV(+50mV rating voltage >36V)
	Current	≤ 0.2%+10mA

RESPONSE TIME		
10%-90%	UP	≤ 100ms
90%-10%	DOWN	≤ 100ms(≥ 10% rating load)
READBACK TEMPERATURE COEFFICIENT	Voltage	≤ 100ppm+10mV(+20mV rating voltage >36V)
	Current	≤ 150ppm+10mA
DRIFT (NOTE 1)	Voltage	≤ 0.03%+6mV
	Current	≤ 0.1%+6mA
TRACK OPERATION (triple output only)		
tracking error	Voltage	≤ 0.1%+50mV
load effect	Voltage	≤ 50mV
source effect	Voltage	≤ 3mV
PARALLEL OPERATION (triple output only)		
program accuracy (25+/-5℃)	Voltage	≤ 0.05%+25mV(+50mV rating voltage >36V)
	Current	≤ 0.2%+20mA
	OVP	≤ 2%+0.6V
load effect	Voltage	≤ 3mV Rear output (≤ 6mV front output)
	Current	≤ 6mA (≤ 12mA rating current > 3.5A)
source effect	Voltage	≤ 3mV
	Current	≤ 6mA

GPIB CAPABILITY IEEE-488.2 (OPTIONAL)	SH1 , AH1 , T6 , L4 , SR1 , RL1 , PP0 , DC1 , DT0 , C0 , E1
TEMPERATURE & HUMIDITY RATINGS	Operating 0 to 40°C, ≤ 80% Storage -10 to 70°C, ≤ 70%
MEMORY	Store 0-99 (triple output 0-49) Recall 0-99 (triple output 0-49)
TIMER	Setting time 1 sec - 255 min(MAX 255min×99 single) (MAX 255min×49 triple) Resolution 1 sec Function for output working loop
POWER SOURCE	AC 100V, 120V, 220V, 240V, +/-10% 50/60Hz
ACCRSSORIES	Test Lead GTL-104*1,Instruction Manual*1(single output) Test Lead GTL-104*3,Instruction Manual*1(triple output)
OPERATION EVNIRONMENT	Indoor use, Altitude up to 2000m, Installation Category II, Pollution degree 2

NOTE : Change in output over 8-hour interval under constant line, load, and ambient following 30-minute warm-up.

CAUTION. To avoid damaging the power supply, don't use it in a place where ambient temperature exceeds 40°C.

STANDARD PRODUCTS

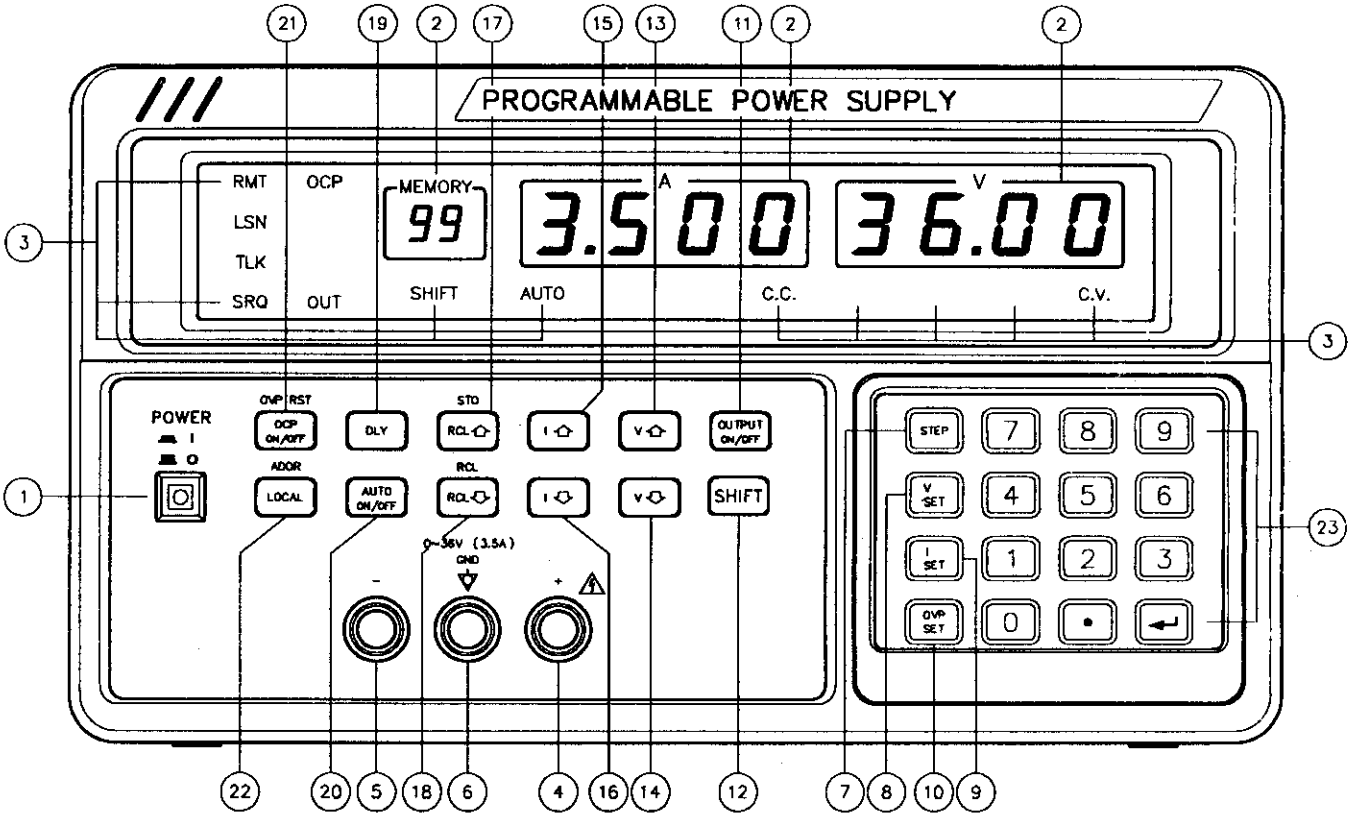
MODEL	INDEPENDENT	OVP	SERIES	PARALLEL	WEIGHT (KG)	WATTS	VA
PPS-1860	0-18V, 0-6.0A	20.0V	-	-	10.0	250	350
PPS-3635	0-36V, 0-3.5A	38.5V	-	-	10.0	250	350
PPS-6020	0-60V, 0-2.0A	63.0V	-	-	10.0	250	350
PPT-1830	0-18V, 0-3.0Ax2 0-6V, 0-5.0Ax1	20.0V 7.0V	36V 3A	18V 6A	10.0	250	350
PPT-3615	0-36V, 0-1.5Ax2 0-6V, 0-3.0Ax1	38.5V 7.0V	72V 1.5A	36V 3A	10.0	250	350

DIMENSIONS: 255 (W) X 145 (H) X 346 (D) mm

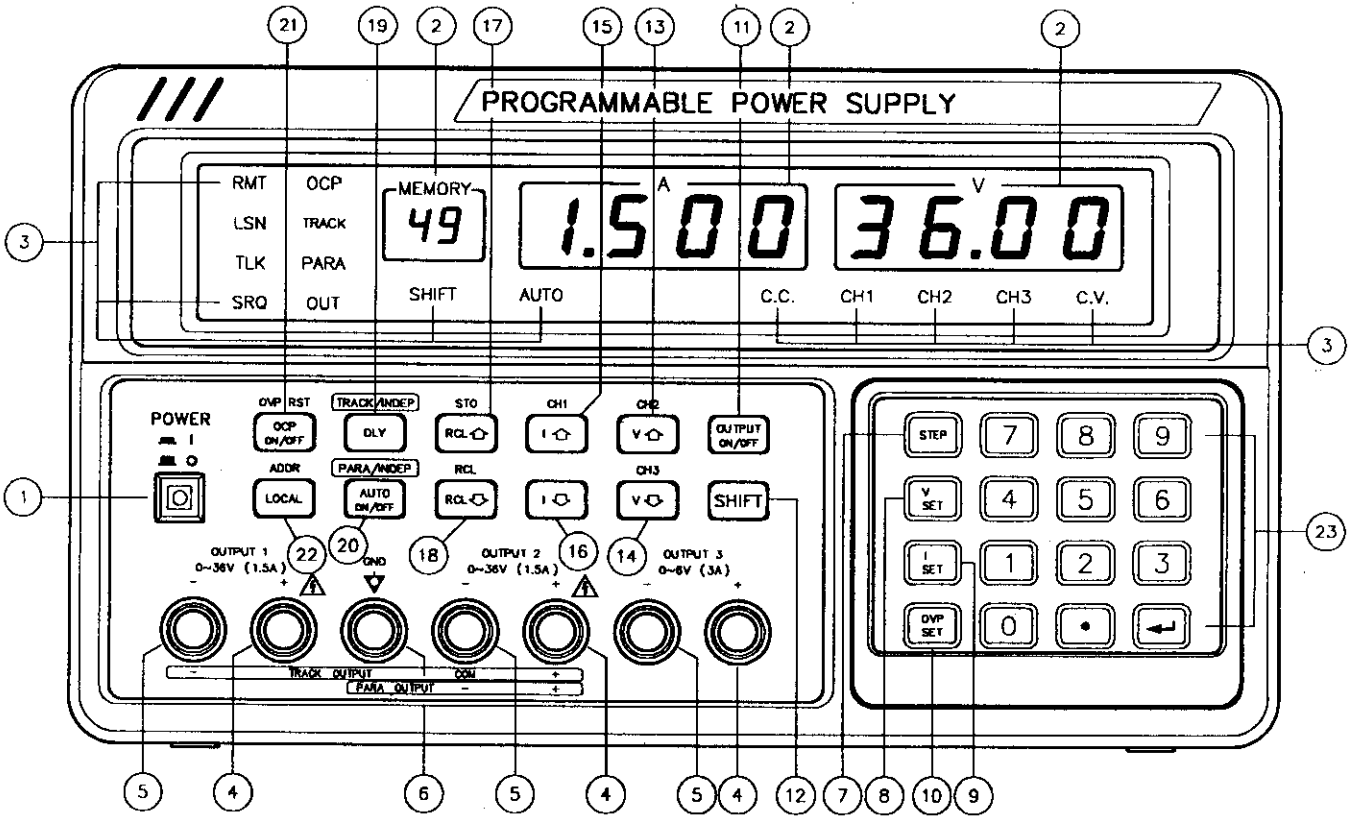
TABLE 2.1

WARNING. Voltages more than 60V DC are a lethal shock hazard to the user.
Be careful when connecting power suplies in series to achieve voltages
higher than 60V DC total or 60V DC between any connection and earth ground.

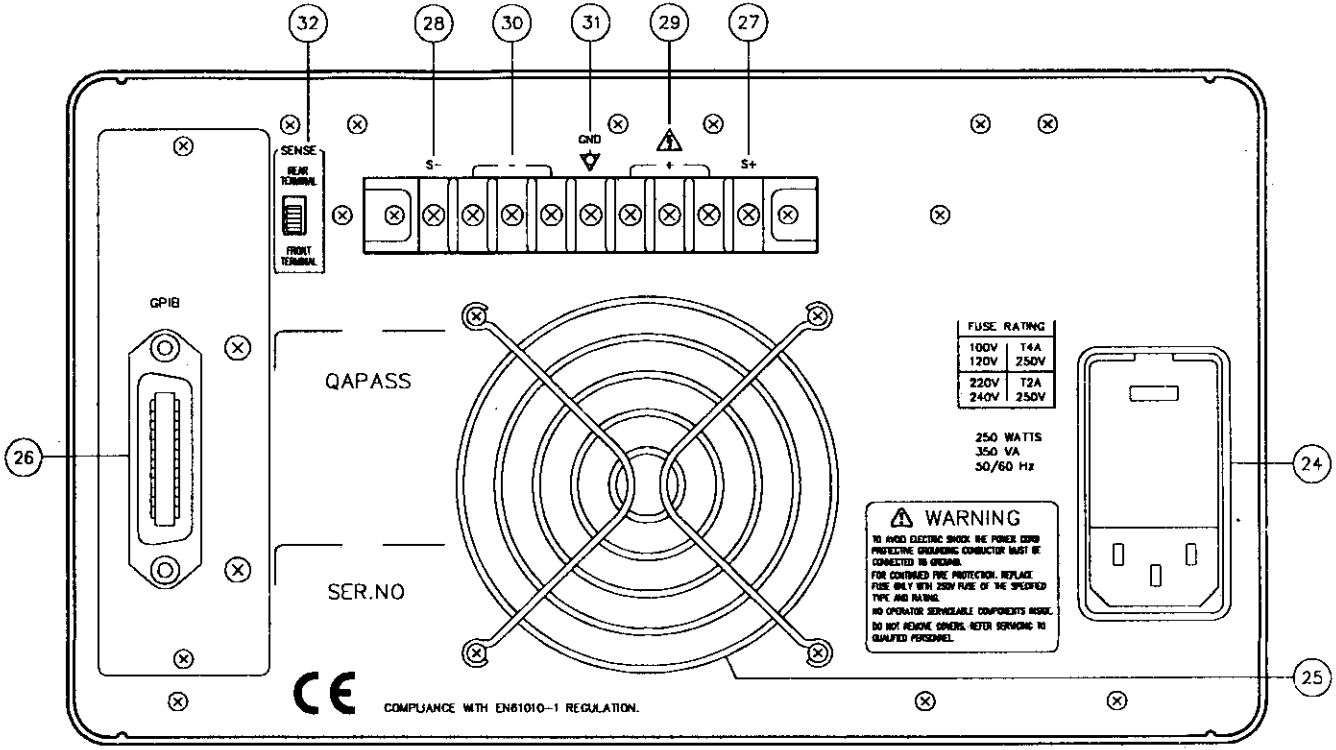
3. PANEL CONTROLS AND INDICATORS



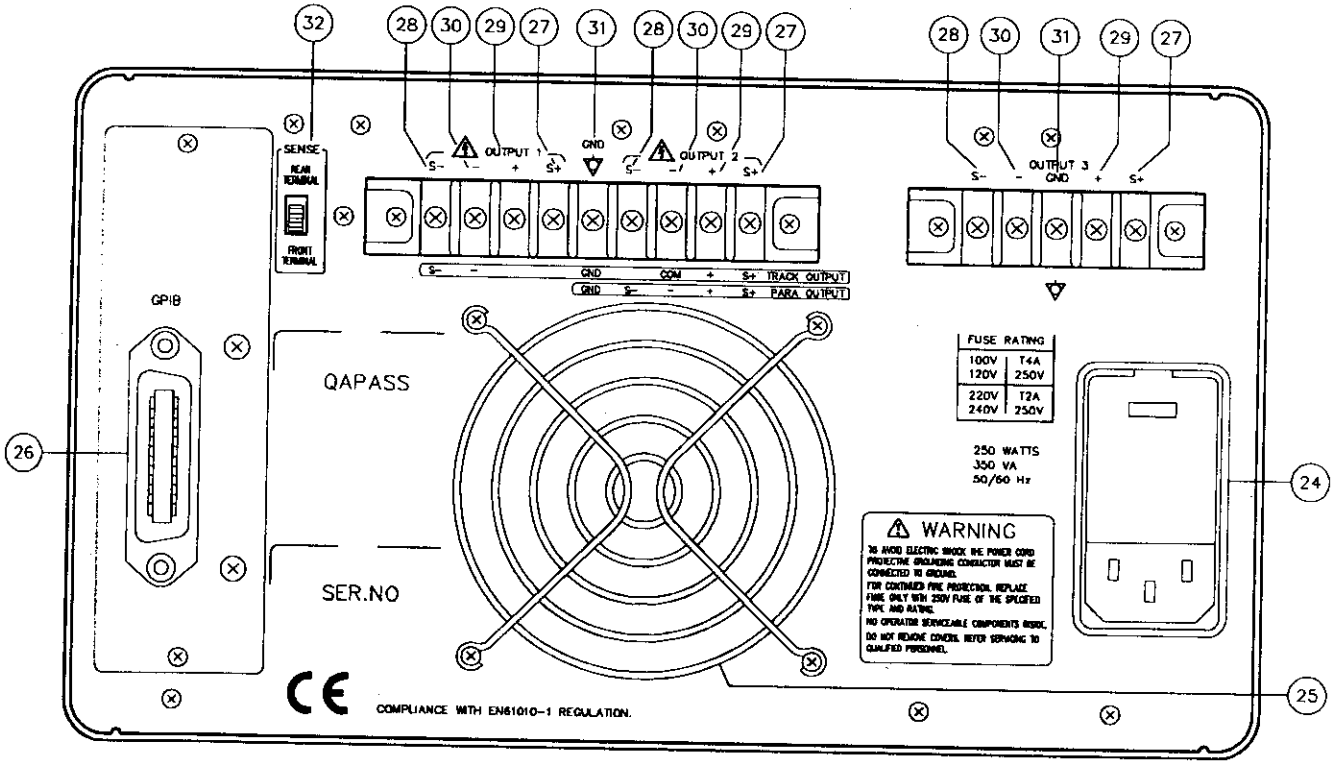
3. PANEL CONTROLS AND INDICATORS



3. PANEL CONTROLS AND INDICATORS



3. PANEL CONTROLS AND INDICATORS



3.1 FRONT PANEL

(1)	Power switch	turn power ON and OFF
(2)	value indicator	4-digit display for both voltage and current 2-digit display for memory address.
(3)	status indicator	include GPIB status, function and status.
(4)	+ output terminal	positive output terminal
(5)	- output terminal	negative output terminal
(6)	ground terminal	ground terminal, connected to case chassis.
(7)	STEP	for setting step voltage and current.
(8)	V SET	used with the numeric keys to set voltage.
(9)	I SET	used with the numeric keys to set current.
(10)	OVP SET	used with the numeric keys to set over voltage potection.
(11)	OUTPUT	turn output ON or OFF.
(12)	SHIFT	SHIFT function key.
(13)	V ▲ (CH2)	used to increase voltage (select channel 2 display, used SHIFT key).
(14)	V ▼ (CH3)	used to decrease voltage (select channel 3 display, used SHIFT key).
(15)	I ▲ (CH1)	used to increase current.(select channel 1 display. used SHIFT key).
(16)	I ▼	used to decrease current.
(17)	RCL ▲ (STO)	used to increase address (store data,used SHIFT and numeric keys)
(18)	RCL ▼ (RCL)	used to decrease address (recall data,used SHIFT and numeric keys)
(19)	DLY (TRACK/INDEP)	used with the numeric keys to set timer (tracking mode enable and disable,used SHIFT key)

(20) AUTO ON/OFF (PARA/INDEP)	turn auto running ON and OFF (turn parallel mode enable and disable,used SHIFT key).
(21) OCP ON/OFF (OVPRST)	turn OCP ON or OFF (reset OVP protection mode used SHIFT key).
(22) LOCAL (ADDR)	used with the numeric keys to set GPIB address or return local from remote mode , (display GPIB address used SHIFT key).
(23) 0-9 ENTRY	used to set data.

3.2 REAR PANEL

(24) AC POWER SOCKET	line input through this socket to be transfer to this power supply, there are circuits built in the socket including a fuse, a ranging switch, and a filter.
(25) COOLING FAN	ventilates the hot air out, to prevent output stage from thermo shock, and also improves the temperature coefficient.
(26) GPIB INTERFACE	GPIB interface module is sited here, if there is no option installed, covered by a blank panel in turn.
(27) + sence terminal	screw type + sence input terminal.
(28) - sence terminal	screw type - sence input terminal.
(29) + output terminal	screw type + output terminal.
(30) - output terminal	screw type - output terminal.
(31) ground terminal	screw type ground terminal. (connected to case chassis).
(32) REAR OR FRONT SWITCH	select the output sense connected to rear or front output terminals.

4. POWER-ON CHECK PROCEDURES AND INITIAL SETUP

4.1 POWER-ON CHECK PROCEDURES

4.1.1 Line input voltage range setting, check the read-out on power socket matches to local AC line voltage specification. if not, use minus screw drive to open the cover of power socket, then rotate the wheel-type switch till the readout meet the AC line voltage specification.

WARNING. To avoid electrical shock. The power cord protective grounding conductor must be connected to ground.

4.1.2 If there is a range change at last step,then changes with correct type of fuse as shown in table 4.1, this table is also shown the rear panel neer the power socket.

LINE VOLTAGE		FUSE
100V	90V-110V	T 4A 250V
120V	108V-132V	
220V	198V-242V	T 2A 250V
240V	216V-250V	

TABLE 4.1

WARNING. For continued fire protection. Replace fuse only with 250V fuse of the specified type and rating, and disconnect the power cord before replacing fuse.

4.2 INITIAL SETUP

4.2.1 Connect an AC line cord to power socket firmly, then power on.

4.2.2 A sequences of self test is going on, check any errors found, detailed scription about power-on self test is described in section 7 and refer TABLE 9.4.

4.2.3 Check OVP setting.

4.2.4 Toggle OCP protection on if necessary.

4.2.5 Toggle tracking operation on if necessary.(triple output only)

4.2.6 Toggle parallel operation on if necessary.(triple output only)

4.2.7 Setting voltage and current value to the necessary when you need.

4.2.8 Connect a load to the output terminals, then turn output on.

4.2.9 This power supply now READY GO; further operating procedures refer to the pagegraphs described below.

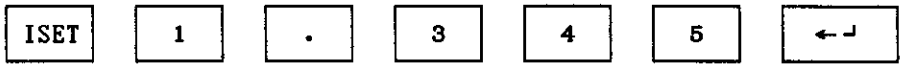
5. OPERATING INSTRUCTIONS

5.1 Output voltage setting : as the example shown below. notice the indicate channel for triple output only.

setting 5.25V

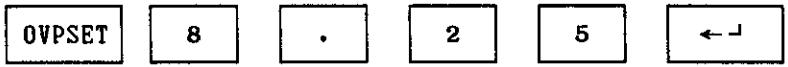
5.2 Output current setting : as the example shown below. notice the indicate channel for triple output only.

setting 1.345A



5.3 Over voltage protection setting : as the example shown below. notice the indicate channel for triple output only.

setting OVP 8.25V



5.4 Voltage step setting: as the example shown below. notice the indicate channel for triple output only.

5.4.1 For example: setting the voltage step is 0.2V

then used UP/DOWN key for change the output voltage.

5.4.2 Used the UP key to increase output voltage as the example shown below.

5.4.3 Used the DOWN key to decrease output voltage as the example shown below.

5.5 Output on or off : as the example shown below.

press one is on ,next is off one by one.

5.6 Current step setting: as the example shown below. notice the indicate channel for triple output only.

5.6.1 For example: setting the current step is 0.04A

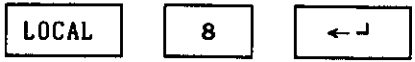
then used UP/DOWN key for change the output current.

5.6.2 Used the UP key to increase output current, the example shown below.

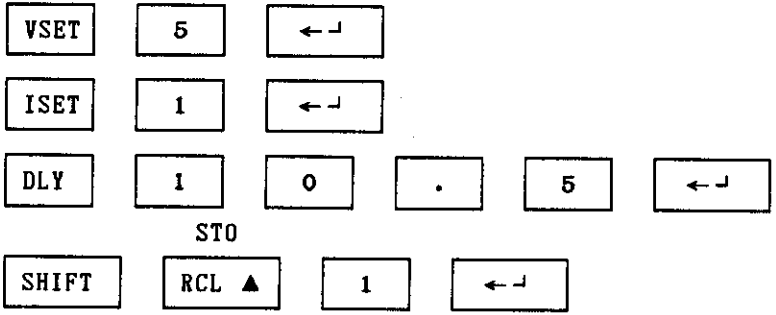
5.6.3 Used the DOWN key to decrease output current, the example shown below.

5.7 Auto running timer setting: as the example shown below.
For example: setting timer is 10 minute and 5 second.

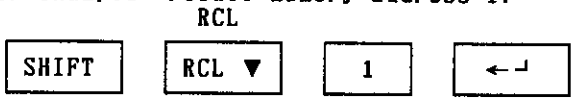
5.8 GPIB address setting: as the example shown below.
For example: setting address is 8.



5.9 Storage setting value: as the example shown below.
For example: voltage 5V, current 1A, timer 10 minute and 5 second storage in memory address 1. notice the indicate channel for triple output only.



5.10 Recall setting value: as the example shown below.
For example: recall memory address 1.



5.11 Recall auto running loop : as the example shown below.
For example: the loop from 2 to 5.

RCL

SHIFT	RCL ▼	2	.	5	←┘

5.12 enable or disable AUTO RUNNING STEP
notice: running time is depend on every step setting value and continue the single step from RCL start to endding.

AUTO ON/OFF

(AUTO LED is on, off is blanked)

5.13 enable or disable parallel mode (triple output only)
notice the output terminal is channel 2.

PARA/INDEP

SHIFT	AUTO

(PARA LED is on, INDEP is blanked)

5.14 enable or disable tracking mode (triple output only)
notice: the output terminal is CH2 "+" and CH1 "-".

TRACK/INDEP

SHIFT	DLY

(TRACK LED is on, INDEP is blanked)

5.15 Maximum setting values, is shown as table 5.1

model	PPS-1860	PPS-3635	PPS-6020	PPT-1830	PPT-3615
voltage	19.00V	37.00V	61.00V	19V/6.5V	37V/6.5V
current	6.100A	3.600A	2.100A	3.10A/5.1A	1.55A/3.1A
OVP	20.00V	38.50V	63.50V	20.0V/7V	38.5V/7V
voltage step	2.00V				
current step	0.20A				
timer	255 Min*99	255 Min*99	255 Min*99	255 Min*49	255 Min*49
memory	99	99	99	49	49

TABLE 5.1 MAXIMUM VALUE

6. DESCRIPTION OF THE PROTECTION FUNCTIONS

6.1 OVP : over voltage protection

6.1.1 This over voltage protection feature protects the sensitive load from over voltage shock due to misoperation or output control circuit fail to control, and let output voltage to raise higher than output voltage setting.

6.1.2 Once a over voltage condition is detected by OVP circuit, then output is disable, with an error message displayed.

6.1.3 Press OVPRST key will clear the OVP error, if OVP trips caused by misoperation to let output voltage much higher than OVP trip point.

6.1.4 The OVP trip point is set by keyboard on the front panel.

6.1.5 Over voltage trip point must be set to +2% +0.6V higher than output voltage setting, as an example,always protects sensitive load enough from over voltage shock.

6.2 OCP : over current protection

6.2.1 This over current protection feature protects the load from excessive output current. the OCP mode can not be used while the power supply is operating in CC mode.

6.2.2 Once a over current condition is detected by OCP circuit, then output is disable, with an error message displayed.

6.2.3 Press OCP key will clear the OCP error.

7. DESCRIPTION OF POWER-ON SELF TEST

7.1 DISPLAY CHECK:Check off all digit are lighted properly.
Check off all LED are lighted properly.

7.2 CPU TEST:Test CPU function include registers read/write and flags on/off and branch functions.

7.3 RAM TEST:Test internal RAM and external RAM by read/write funtion.

7.4 ROM TEST:Test ROM with total checksum.

7.5 D/A A/D TEST:Test D/A and A/D converter function properly.

7.5.1 If any error code display, check to TABLE 9.4.

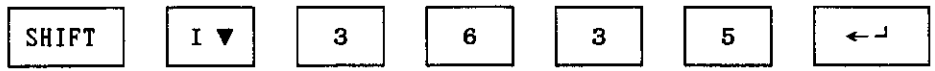
8. CALIBRATION

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

CAUTION: In these procedures, voltages and currents may exceed. then indicated error code, please check TABLE 9.4.

CL10 VOLTAGE OFFSET CALIBRATION
CL11 VOLTAGE FULLSCALE CALIBRATION
CL20 CURRENT OFFSET CALIBRATION
CL21 CURRENT FULLSCALE CALIBRATION
CL30 OVER VOLTAGE PROTECTION OFFSET CALIBRATION
CL31 OVER VOLTAGE PROTECTION FULLSCALE CALIBRATION
CL40 PARALLEL CURRENT OFFSET CALIBRATION (for PPT series only)
CL41 PARALLEL CURRENT FULLSCALE CALIBRATION (for PPT series only)

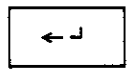
8.1 Key in calibration pass code.
for example:PPS-3635 Key-in (SHIFT I ▼ 3 6 3 5)
PPT-3615 Key-in (SHIFT I ▼ 3 6 1 5) and so on.



| ←——— model number ———→ |

then display indicated CL00

8.2 Connect DMM to power supply output, set DMM in DCV 2V range and push the enter key.



then display indicated CL10

8.2.1 Start voltage offset calibration

8.2.2 Reading the DMM voltage value and key-in to power supply.
For example: DMM reading voltage is 0.26V then key-in 0.26 and enter.

0	.	2	6	←┘

then display indicated CL2F,finished the voltage offset calibration.

8.3 DMM set in DCV 200V range and push the enter key.

←┘

then display indicated CL11

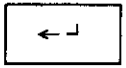
8.3.1 Adjusting VR401 (VR501 ,VR601),reading the DMM value equal to calibration voltage refer to TABLE 8.1 and enter.

model	VR401	VR501	VR601	
PPS-1860	19.00V	-	-	
PPS-3635	37.00V	-	-	
PPS-6020	61.00V	-	-	
PPT-1830	6.50V	19.00V	19.00V	
PPT-3615	6.50V	37.00V	37.00V	

TABLE 8.1

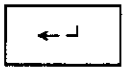
For example 1: IN PPS-3635, DMM reading voltage is 37.00V then key-in 37.00 and enter.

For example 2: IN PPS-3635, DMM reading voltage is 37.00V then enter.



then display indicated CL2F, finished the voltage fullscale calibration.

8.4 DMM set in DC 2A range and connect to output terminal and push the enter key.



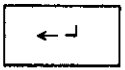
then display indicated CL20

8.4.1 Start current offset calibration

8.4.2 Reading the DMM current value then key-in to power supply.
For example: reading current is 0.021A then key-in 0.021 and enter.

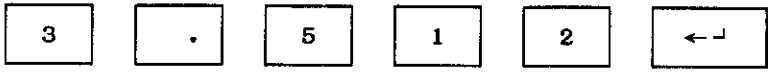
then display indicated CL2F, finished the current offset calibration.

8.5 DMM set in DC 20A range and push the enter key.



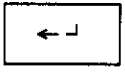
then display indicated CL21

8.5.1 Start current fullscale calibration.
Reading the DMM current value then key-in to power supply and enter.
For example: reading current is 3.512A then key-in 3.512 and enter.



then display indicated CL2F, finished the current fullscale calibration.

8.6 Opened the power supply output terminal and enter.

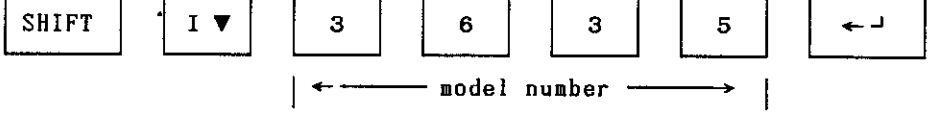


then display indicated CL30

8.6.1 then display indicated CL31
finished all calibration procedure.

8.7 SELECT CALIBRATION FUNCTION

8.7.1 Key-in calibration pass code.
for example:PPS-3635 Key-in (SHIFT I ▼ 3 6 3 5)
PPT-3615 Key-in (SHIFT I ▼ 3 6 1 5) and so on.



then display indicated CL00

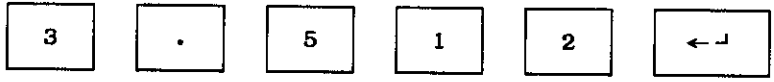
8.7.2 Choice one when you went to calibration
Key-in the calibration item(1:voltage, 2:current, 3:OVP 4:parallel current).
For example: if you went to calibrate current fullscale.
first DMM set in DC 20A range and connect to power supply output second key-in 2.

then display indicated CL20

8.7.3 Use V▲ and V▼ to select.
push V▲ key.

then display indicated CL21
push enter key then start current fullscale calibration.

Reading the DMM current value and key-in it to power supply.
For example: reading current is 3.512A then key-in 3.512 and enter.



Finished current fullscale calibration if have no error.

9. REMOTE PROGRAMMING (option)

9.1 INTRODUCTION

The IEEE-488.2 interface option turns the power supply into a fully programmable instrument for the use with ANSI/IEEE Std 488.2-1987 interface bus(IEEE-488.2 bus). With IEEE-488.2 interface,the power supply can become part of an automated instrumentation system.The power supply can be under complete,interactive control from a remote bus controller;and dedicated to a single task. This manual assumes you know the basics of the IEEE-488.2 interface bus and SCPI. For more information about the IEEE-488.2, please refer to:

. ANSI/IEEE Std 488.2-1987.
. SCPI

9.2 INTERFACE CAPABILITIES

The power supply implements the following GPIB (General Purpose Interface Bus) interface functions, which are defined by IEEE Std.

488.2:
. SH1 (Source Handshake)
. AH1 (Acceptor Handshake)
. T6 (Talker)

. TE0 (No Extended Talker)
. L4 (Listener)
. LE0 (No Extended Listener)
. SR1 (Service Request)
. RL1 (No Capability)
. PP0 (No Parallel Poll)
. DC1 (Device Clear)
. DT1 (Device Trigger)
. E1 (Open collector)
. C0 (No Controller)

9.3 IEEE-488.2 BUS RESTRICTIONS

The following restrictions apply to all IEEE-488.2 systems:
1. A maximum of 15 devices can be connected to a single IEEE-488.2 bus system.
2. The maximum length of IEEE-488.2 cable used in one IEEE-488.2 system is the lesser of either 20 meters or 2 meters times the number of devices in the system.

9.4 GPIB ADDRESS SELECTION

The GPIB address is setting for front panel keyboard. Any address from 00 to 30 decimal is a valid GP-IB address.The power supply will operate on whatever valid address is set on the address.
The GP-IB address switches are readable only upon power up. If the address is changed, the power supply must be turned off and then powered up again before the new address can be used.

9.5 BUS COMMANDS

The Bus commands understood by the power supply can be separated into the three main classes described in the IEEE-488.2 standard: Universal, Uniline, Addressed.

9.5-1 UNIVERSAL MULTI-LINE COMMANDS

My Listen Address (MLA) - The MLA command addresses the power supply to listen.
My Talk Address (MTA) - The MTA command addresses the power supply to talk.
Unlisten (UNL) - The UNL command unaddresses all current listeners.
Untalk (UNT) - The UNT command unaddresses the current talker.

Device Clear (DCL) - The DCL command may be used to clear the power supply setting to a known state. Please note that all devices on the bus equipped to respond to a DCL simultaneously. When the power supply receives a DCL command, it will return to the default conditions listed in table 9.1.

Serial Poll Enable (SPE) -The SPE command establishes the serial poll mode for the power supply. When addressed to talk, it will return a single eight-bit of status.
Serial Poll Disable (SPD) -The SPD command terminates the serial poll mode for the power supply returning it to the normal talker state where the power supply outputs device-dependent data rather than status information.

9.5-2 UNI-LINE COMMANDS

Attention (ATN) - The power supply monitors ATN at all times. When true, ATN places the interface in the "Command Mode" where the power supply accepts (handshakes) data on the Data lines and interpret it as Commands or Addresses. When false, ATN places the interface in the "Data Mode" where the active talker sources device-dependent Data to all active listeners.

Interface Clear (IFC) - The IFC line is used only by the System Controller to halt current operations (communications) on the bus (i.e. unaddress all talkers and listeners and disable Serial Poll). The Uni-line Command clears only the interface by placing it in a known quiescent state.

Remote Enable (REN) - The REN line is used only by the System Controller to enable the power supply to be subsequently placed in the remote programming mode. When true, the power supply capable of remote operation are placed in remote when addressed to listen. When false, the power supply return to local operation.

9.5-3 ADDRESSED COMMANDS

Remote/Local
The remote/local function allows the power supply to operate in either local (front panel) or remote (via GPIB control). The user can send Local Lockout to the power supply via GP-IB to disable the front-panel LOCAL switch only. With Local Lockout, the controller determines whether the unit operates in local or remote control; this enables the controller to prevent anyone else from returning the power supply to local control. Selected Device Clear (SDC) - The SDC command performs the same function as

the DCL command except that only the addressed device responds. This command is useful for clearing only a selected instrument instead of all instruments at once. The power supply returns to the default conditions listed in table 9.1 when responding to a SDC command.

Go To Local (GTL) - This command causes the power supply currently addressed to listen to return and to local control(exit the Remote state).

9.6 DEVICE-DEPENDENT COMMAND SET

Device-dependent commands are the heart of power supply remote control. They tell the power supply how and when to make measurements, when to put data on the bus,when to make service requests, etc. The complete set of device-dependent commands is listed in table 9.1. The commands may be entered using either upper- or lower-case letters. Device-dependent commands are device-dependent messages. For the power supply to receive them, they must be sent over the IEEE-488.2 bus when the power supply is in the remote and has been addressed as a listener. The following paragraphs describe devicedependent commands in alphabetical order.

9.7 SERVICE REQUEST

Service request is a unline message that can be asserted by the power supply to interrupt the controller. Service request can be generated by a power supply fault condition.

9.8 SERIAL POLL

In a serial poll the controller polls each device on the bus, one at a time. The power supply responds by placing the contents of the eight-bit serial poll register on the GPIB data lines. Table 9.3 defines each of the bits in the serial poll register and defines what causes each bit to be set and reset. Bit positions 0 through 7 are placed on DIO lines 1 through 8.Note that the serial poll register represents only the power supply connected to the GPIB, not other power supplies that may be slaved to the GP-IB connected unit.

COMMAND	RANGE	DESCRIPTION
[VOURce:] VOLTage	EFER TABLE 2.1	
[SOURce:] VOLTage?		
[SOURce:] VOLTage:PROTection	EFER TABLE 2.1	
[SOURce:] VOLTage:PROTection?		
[SOURce:] VOLTage:PROTection [:LEVel] ?		
[SOURce:] CURRent	EFER TABLE 2.1	
[SOURce:] CURRent?		
[SOURce:] CURRent:PROTection:STATe	1/0(on/off)	
[SOURce:] CURRent:PROTection:STATe?		
[SOURce:] CHANnel	1-3	triple output only
[SOURce:] CHANnel?		triple output only
[SOURce:] DTIMe?		
[SOURce:] DTIMe	0.0-255.59	(minute.second)
SYSTem:ERRor?		
SYSTem:VERSion?		
SYSTem:MEMory?		
SYSTem:AUTo	1/0(on/off)	
SYSTem:AUTo?		
SYSTem:TRAcking	1/0(on/off)	triple output only
SYSTem:PARAllel	1/0(on/off)	triple output only
STATus:OPERation?		
STATus:OPERation [:EVENt] ?		
STATus:OPERation:CONDition?		
STATus:OPERation:ENABle?		
STATus:OPERation:ENABle	0-65535	
STATus:QUEStionable?		
STATus:QUEStionable [:EVENT] ?		
STATus:QUEStionable:CONDition?		
STATus:QUEStionable:ENABle	0-65535	

Table 9.1 GP-IB Command

STATus:QUEStionable:ENABle? STATus:PRESet STATus:QUEUe:ENABle		
OUTPut:STATe OUTPut:STATe? OUTPut:PROTection:CLEar	1/0(on/off)	
MEASure:VOLTage? :CURRent?		

COMMON COMMANDS		
*CLS		REFER TO TABLE 9.2
*RST		
*TST?		
*OPC		
*OPC?		
*IDN?		
*WAI		
*ESE	0-255	
*ESE?		
*ESR?		
*SRE	0-255	
*SRE?		
*STB?		
*RCL	0-99/0-49	
*RCL?		
*SAV	0-99/0-49	
*SAV?		

Table 9.1 GP-IB Command (Continue)

NOTE :Lower-case alpha characters sent to the power supply are treated as Upper-case alpha characters.

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
POWER ON	USER REQUEST	COMMAND ERROR	EXECUTION ERROR	DEVICE DEPENDENT ERROR	QUERY ERROR	0	OPERATION COMPLETE
128	64	32	16	8	4	2	1

Table 9.2 Event Status Register

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
	NU	NU	CV 1	CC 1	CV 2	CC 2	CV 3
32768	16384	8192	4096	2048	1024	512	256

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
CC 3	NU	NU	NU	NU	NU	SETTING	NU
128	64	32	16	8	4	2	1

Operation Condition NU: NOT USED

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
OPER	RQS	ESB	MAV	QUES	0	0	0
128	64	32	16	8	4	2	1

Table 9.3 Status Byte Register

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
	NU	NU	NU	NU	NU	NU	NU
32768	16384	8192	4096	2048	1024	512	256

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
NU	NU	NU	NU	NU	NU	OC1	OV1
128	64	32	16	8	4	2	1

Question Condition NU: NOT USED

Error code	SCPI code / description
0	0," NO error"
-001	-330,"Self-test failed;CPU test error"
-002	-330,"Self-test failed;RAM test error"
-003	-330,"Self-test failed;ROM test error"
-005	-330,"Self-test failed;DAC/ADC test error"
-012	-300,"Device-specific error;Overcurrent protection error"
-013	-300,"Device-specific error;Overvoltage protection error"
-016	-222,"Data out of range;Voltage Too Large
-017	-222,"Data out of range;Current Too Large
-018	-222,"Data out of range;Voltage Too Small
-019	-222,"Data out of range;Current Too Small

Table 9.4 Error Code

-064	-221,"Setting confict;Timer setting error"
-065	-221,"Setting confict;Overvoltage protection setting error"
-066	-221,"Setting confict;Address setting error"
-067	-221,"Setting confict;Voltage setting error"
-068	-221,"Setting confict;Current setting error"
-069	-221,"Setting confict;Recall setting error"
-070	-221,"Setting confict;Store setting error"
-091	-300,"Device-specific error;Calibration current full-scale error"
-092	-300,"Device-specific error;Calibration voltage full-scale error"
-093	-300,"Device-specific error;Calibration overvoltage protection full-scale error"
-094	-300,"Device-specific error;Calibration overvoltage protection offset error"

Table 9.4 Error Code (Continue I)

-096	-300,"Device-specific error;Calibration current offset error"
-098	-300,"Device-specific error;Calibration voltage offset error"
-099	-300,"Device-specific error;Calibration error"
	-100,"Command error"
	-108,"Parameter not allowed"
	-109,"Missing parameter"
	-200,"Execution error"
	-200,"Execution error;STEP error"
	-221,"Setting confict;STEP voltage or current setting error"
	-222,"Data out of range"
	-240,"Hardware error"
	-310,"System error"

Table 9.4 Error Code (Continue II)

	-313,"Calibration memory lost"
	-330,"Self-test failed"
	-350,"Queue overflow"
	-410,"Query INTERRUPTED"
	-420,"Query UNTERMINATED"
	-430,"Query DEADLOCKED"

Table 9.4 Error Code (Continue Ⅲ)

10. MAINTENANCE

WARNING

The following instructions are for use by qualified personal only. To avoid electrical shock, do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

10.1 Fuse Replacement

If the fuse blows, the LED display will not light and the power supply will not operate. The fuse should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse, then replace only with a fuse of the correct rating and type (see Page.13). And, disconnect the power cord before replacing fuse. The fuse is located on the rear panel (see Page.9).

10.2 Cleaning

To clean the power supply,use a soft cloth dampened in a solution of mild detergent and water. Do not spray cleaner directly onto the instrument, since it may leak into the cabinet and cause damage.

Do not use chemicals containing benzine,benzene,toluene,xylene,acetone , or similar solvents.

Do not use abrasive cleaners on any portion of the instrument