

*PROGRAMMABLE
POWER SUPPLY
PPS SERIES*



SERVICE MANUAL

Release Date: 09/24/03

Revision 1.0

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Table of Contents

1.	PRINCIPLES OF OPERATION	1
1-1	INTRODUCTION	1
1-2	AC INPUT CIRCUIT	1
1-3	PRIMARY INTERFACE.....	1
1-4	ISOLATION	1
1-5	SECONDARY INTERFACE	1
1-6	POWER MESH AND CONTROL	2
1-7	CONSTANT VOLTAGE (CV) DAC	2
1-8	CONSTANT CURRENT (CC) DAC.....	2
1-9	OVERVOLTAGE DAC	2
1-10	OUTPUT VOLTAGE / CURRENT READBACK.....	2
1-11	OVERVOLTAGE READBACK	3
1-12	VOLTAGE CONTROL CIRCUIT.....	3
1-13	CURRENT CONTROL CIRCUIT	3
1-14	OPERATING MODE READBACK	3
1-15	VOLTAGE GAIN STAGE.....	3
1-16	SPIKE PROTECTION CIRCUIT	4
1-17	CALIBRATION MODE.....	4
1-18	EXTERNAL PROGRAM	5
2.	SCHEMATICS.....	6
3.	PARTS LOCATIONS	16
4.	BILL OF MATERIALS	21

1. PRINCIPLES OF OPERATION

1-1 INTRODUCTION

The following descriptions provide a basic understanding of circuit operation and are intended as an aid in troubleshooting.

1-2 AC INPUT CIRCUIT

The AC input circuit consists of line fuse (F301) in the rear of the supply, front panel ON / OFF switch (SW31), power transformer (T301) and line voltage select switch (SW32) select the applicable AC input line voltage 115V / 230V (120V / 240V).

The AC input to the power mesh is rectified by full-wave rectifier circuit (DB31 ~ DB34) and filter capacitors (C304 ~ C305).

Q301, Q304 are the triacs to control the High / Low range of the output in the model of 1020 series.

1-3 PRIMARY INTERFACE

This circuit provides the interface between the user and the power supply. It allows the user to control the power supply from a GPIB controller or from the power supply's front panel keypad.

GPIB interface consist of U210, U212, U213 and keyboard consist of U1, U2.

The primary microcomputer circuit consist of microcomputer chip (U201), ROM (U205), RAM (U206), EEPROM (U204) and data latch (U203), I / O (U209), decoder (U211).

The start up circuit (U202) generates the reset signal at power on and power off to protect against accident EEPROM data writes.

1-4 ISOLATION

Data is transferred serially between the primary interface and secondary interface via optical isolators (U123, U124, U116 ~ U119, U107 ~ U110).

The primary interface circuits are referenced to earth ground, the secondary interface circuits are referenced to power supply "+" terminal. Either power supply output terminal (+ or -) may be floated up to ± 240 Vdc from earth ground.

1-5 SECONDARY INTERFACE

The secondary interface circuits receive digital signals from the primary interface circuits and convert them to analog signals, which are sent to the power control circuits in order to program. The supply's output voltage current and overvoltage.

The supply can also be commanded to send measurement and status data back to the primary interface.

1-6 POWER MESH AND CONTROL

The power control circuits contain voltage and current control circuit which allow the supply to operate in either the constant voltage (CV) or constant current (CC) mode. Transfer between these two modes is accomplished automatically at a value of load resistance equal to the ratio of the programmed current value. The voltage control circuit compares the supply's output voltage with the programmed voltage value and generates a control signal which varies the conduction of the output stage in the power mesh to raise or lower the output voltage as required current control circuit same as voltage control circuit.

1-7 CONSTANT VOLTAGE (CV) DAC

The 12-bit DAC (U128) and amplifier (U125A) convert the digital input on data bus lines (B1 ~ B12) into an analog signal JO.

CVP (TP2) is selected to receive data JO when the control signal CONV is LOW. The JO signal through the analog switch (U121B) and SAMPLE / HOLD by R165, C140 and U127B. It's range is (0 ~ +10V). This signal is sent to the voltage control circuit to set the output voltage to the programmed value.

1-8 CONSTANT CURRENT (CC) DAC

The 12-bit DAC (U128) and amplifier (U125A) convert the digital input on data bus lines (B1 ~ B12) into an analog signal JO.

CCP (TP3) is selected to receive data JO when the control signal CONI is LOW. The JO signal through the analog switch (U121A) and SAMPLE / HOLD by R164, C139, U127A. It's range is (0 ~ +10V).

This signal is sent to the current control circuit to set the output current to the programmed value.

1-9 OVERVOLTAGE DAC

The 12-bit DAC (U128) and amplifier (U125A) convert the digital input on data bus lines (B1 ~ B12) into an analog signal JO.

OVP (TP1) is selected to receive data JO when the control signal CON – OVP is LOW. The JO signal through the analog switch (U121C) and SAMPLE / HOLD by R113, C136 and U111A. It's range is (0 ~ +5.9V). The OVP signal is applied to the overvoltage detection and control circuit.

1-10 OUTPUT VOLTAGE / CURRENT READBACK

The current readback signal is amplified by (U111B) and compared with JO. The signal CMPI is sent to microprocessor successively approximates the value of the monitored signal to a 12 – bit resolution.

1-11 OVERVOLTAGE READBACK

The overvoltage ($\overline{OV}$) signal from the overvoltage detection circuit (U103A) is normally a HIGH LEVEL indicating that no OV condition exists. When an OV condition is detected a LOW LEVEL ($\overline{OV}$) signal is sent to U108. The microprocessor read the OV status on data bus line OVP.

If OVP is occurred, the microprocessor will let output off and OVP cursor blink and crowbar SCR (Q405) is fired it is connected across the output. When the output voltage exceeds the programmed overvoltage value the output will OFF, Q109 will on and the SCR short the output soon.

1-12 VOLTAGE CONTROL CIRCUIT

The output voltage (VMON is 0 to -10V) and the CVP signal (CVP is 0 to +10V) are summing at R127 of CV error amplifier (U105B). If the output voltage is less than the programmed voltage, the summing junction goes negative causing U105B to produce a more positive going CV signal D102 is conducting. This action drives the output of the voltage gain stage higher causing the output state to increase the output voltage.

If the output voltage exceeds the programmed voltage, the summing junction goes positive causing U105B to produce a more negative going CV signal. This reduces the input voltage to the voltage gain stage and hence lowers the output voltage.

1-13 CURRENT CONTROL CIRCUIT

The current monitors the voltage (RMO) across current monitoring resistor (R410 ~ R413). It's voltage (0 to -0.2V) comparing the signal from CCP (U102A). When output current is greater than programmed current the compared (U102B) output is higher and D109 is conducted, which controls the conduction of the output state in the same way as described previously for the voltage control circuit. During CC mode, D109 is forward biased and diverts current away from the base of Q107 in the voltage gain stage.

1-14 OPERATING MODE READBACK

The operating mode status signal is TO7. In CV mode, the signal TO7 is high. In CC mode, It goes to low. The microprocessor will periodically read the data bus CV level (U110 pin5). When this level occurs low, the LCD will indicate CC mode and limit the output current.

1-15 VOLTAGE GAIN STAGE

The voltage gain stage includes Q101, Q107 and Q404. Transistor Q101 provides a current sink for Q107 and Q404. Q101 is a constant current about 10mA. A positive control signal at the base of Q107 will cause Q107 conduct more and Q404 conducts less, then the output voltage will increase.

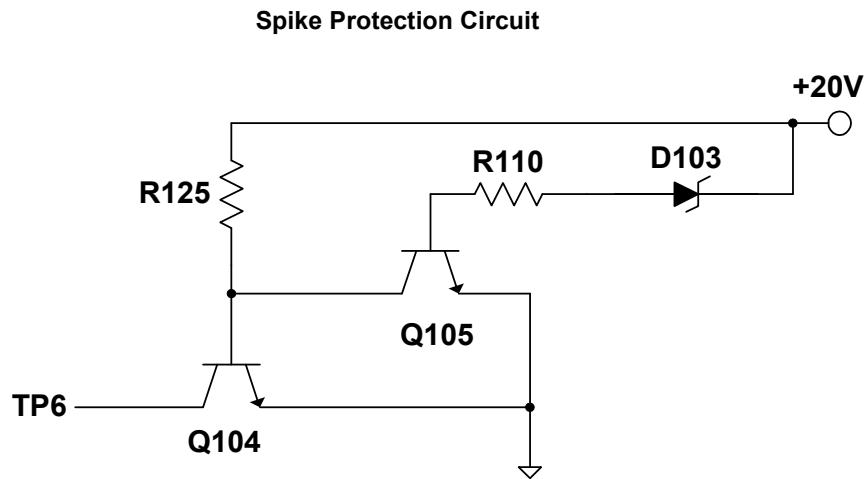
The output stage transistors Q401, Q402, Q403, Q404, Q407 and Q408 are common collect configurations that provide low output impedance. D403 protect the reverse current into the Q404.

1-16 SPIKE PROTECTION CIRCUIT

Spike protection circuit consists of D103, R110, R125, Q104 and Q105. It is to avoid generating spike when the power supply is switched on and off continuously.

Principles:

1. When power is switched on, the input power 20V has not risen to 18.7V. Q105 is in off status and Q104 is on. Point TP6 is 0 volt. When the input power 20V has risen and exceeded 18.7V, Q105 turns on and Q104 turns off. Point TP6 is in stand by status and its voltage is about 1.8V.
2. When power is switched off, the input power 20V hasn't fallen down to 18.7V. Q105 turns on and Q104 turns off. Point TP6 is in stand by status. When the input power 20V has fallen down to 18.7V below, Q104 turns on and Q105 turns off. Point TP6 is 0 volt.

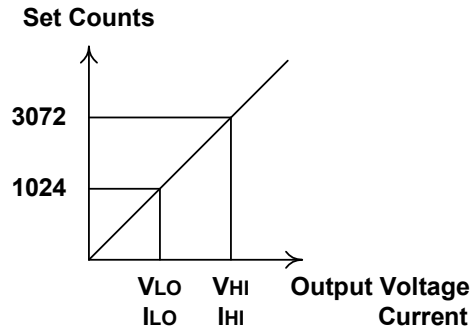


1-17 CALIBRATION MODE

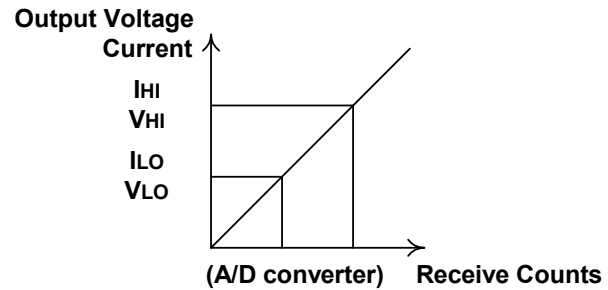
If the PPS is calibrated well, the accuracy is close to 4096 bits. To enter the calibration mode, press 8 and ON/OFF key simultaneously. To calibrate the linearity of the output, we use high and low points to calculate the slope. When calibrating the low point, it sends 1/4 full counts (1024) to D/A converter IC7541 (U128). The D/A converter IC7541 receives, and generates the corresponding voltage. Then, enter the measured value (V_{lo} or I_{Lo}), which is the low point of the linearity, into the PPS. The PPS will know what the exact voltage it outputs at 1024 counts. When calibrating the high point, it will send 3/4 full counts (3072) to the D/A converter IC7541, and generates corresponding voltage. Also, enter this measured value (V_{Hi} or I_{Hi}) to the PPS and it will know what voltage it outputs at 3072 counts. Thus, forming a proportional linearity between output value and CPU counts, and storing it in EEPROM 93C46 (U204). Then, the internal

controlling input voltage is followed by the proportional linearity when pressing the keypad.

The readback curve is done internally. It will use the VLo, ILo, VHi and IHi values to determine the received counts that correspond to the voltage or current the PPS outputs. After the user enters the VLo, ILo, VHi and IHi, the readback counts will appear on the LCD screen.



OUTPUT CURVE



READBACK CURVE

1-18 EXTERNAL PROGRAM

The power supply can be controlled by external. Analog signal from J101 (OVH – OVL, OIH – OIL). It's level is 0 ~ 10V. The current signal through the U101A amplifier is summed with CCP signal. The voltage signal through the U101B is summed with the CVP signal. For instance, sets the programmed voltage to 0V and add another +2V at OVH and OVL will generate 2/10 of full output voltage. When the external program is not used, short OVL and OVH as well as OIL and OIH to avoid noise interference.

Block Diagram

