PL320QMD

Power Supply

Service Manual

Book Part Number 48511-0930

Table of Contents

General	2
Installation	4
Specification	5
Functional Description	7
Circuit Description	8
Calibration	10
Parts List	11
Component Layouts	18
Circuit Diagrams	19

General and Safety

This manual has been prepared to aid the experienced engineer in the maintenance and repair of the PL320QMD power supply. Recalibration or repair should only be attempted by skilled personnel in conjunction with high quality test equipment. If the user is in any doubt as to his competence to carry out the work, the supply should be returned to the manufacturer for the work to be carried out.

This instrument is Safety Class I according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use). It is an Installation Category II instrument intended for operation from a normal single phase supply.

This instrument has been tested in accordance with EN61010-1 and has been supplied in a safe condition. This instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in a safe condition.

This instrument has been designed for indoor use in a Pollution Degree 2 environment in temperature range 5°C to 40°C, 20% - 80% RH (non-condensing). It may occasionally be subjected to temperatures between +5°C and –10°C without degradation of its safety. Do not operate while condensation is present.

Use of this instrument in a manner not specified by these instructions may impair the safety protection provided. Do not operate the instrument outside its rated supply voltages or environmental range.

WARNING! THIS INSTRUMENT MUST BE EARTHED

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited. The protective action must not be negated by the use of an extension cord without a protective conductor.

When the instrument is connected to its supply, terminals may be live and opening the covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts. The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair. Capacitors inside the power supply may still be charged even if the power supply has been disconnected from all voltage sources but will be safely discharged about 1 minute after switching off power.

Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

If the instrument is clearly defective, has been subject to mechanical damage, excessive moisture or chemical corrosion the safety protection may be impaired and the apparatus should be withdrawn from use and returned for checking and repair.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders is prohibited.

Do not wet the instrument when cleaning it.

The following symbols are used on the instrument and in this manual:-


Earth (ground) terminal.


alternating current (ac)


direct current (dc)

Dismantling the Equipment

The cover is removed by removing the two screws through the handle, and the remaining screws on each side and on the top.

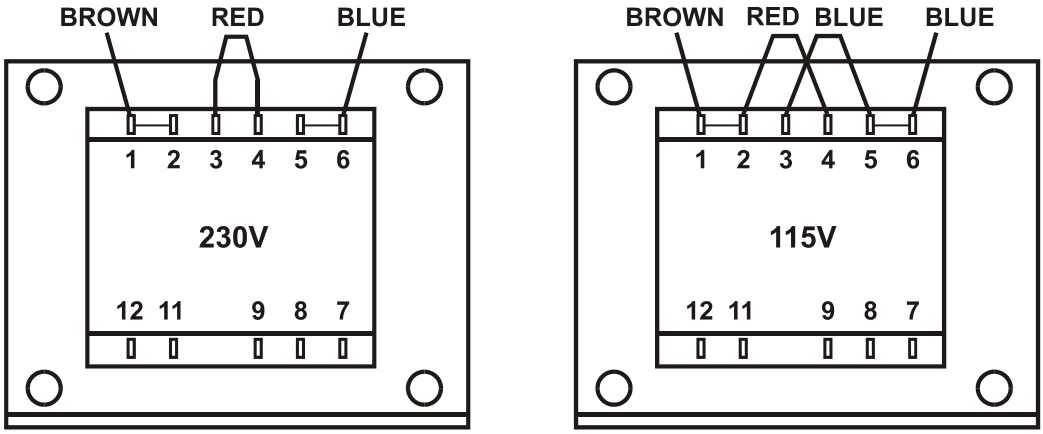
The front panel may be disconnected from the chassis by removing the two front feet and the self-tapping screws directly between them. This allows the front panel to be laid forward giving improved access to the rear of the Main PCB. All preset adjustments are accessible through the Main PCB.

Should it be necessary to gain access to the front of the Main PCB, press in the retaining barb on each corner fixing pillar and lift off the pcb, having first removed the 3 control knobs.

Mains Operating Voltage

Check that the operating voltage of the instrument shown on the rear panel is suitable for the local supply. Should it be necessary to change the operating voltage range proceed as follows:

1. Ensure that the instrument is disconnected from the AC supply.
2. Remove the screws holding the case upper and handle.
3. Lift off the case upper.
4. Change the transformer wiring following the appropriate diagram below:



Note: Units factory set to 230V will have no blue link wire - this must be provided when converting to 115V operation. When converting a 115V unit to 230V the blue link wire should be discarded.

5. Reassemble in the reverse order.
6. Change the fuse type to suit the new operating voltage.

Important Note: Safety regulations state that the AC line voltage to which the apparatus is set must be clearly marked on the outside. If the line voltage setting is changed, it is imperative that the voltage marked on the label close to the power lead entry point is also changed.

Fuse

The AC fuse is located on the back panel; the correct fuse type is 20mm x 5mm 250V HBC time-lag with the following rating:

230V operation:	3.15A(T)
115V operation:	6.3A(T)

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders is prohibited.

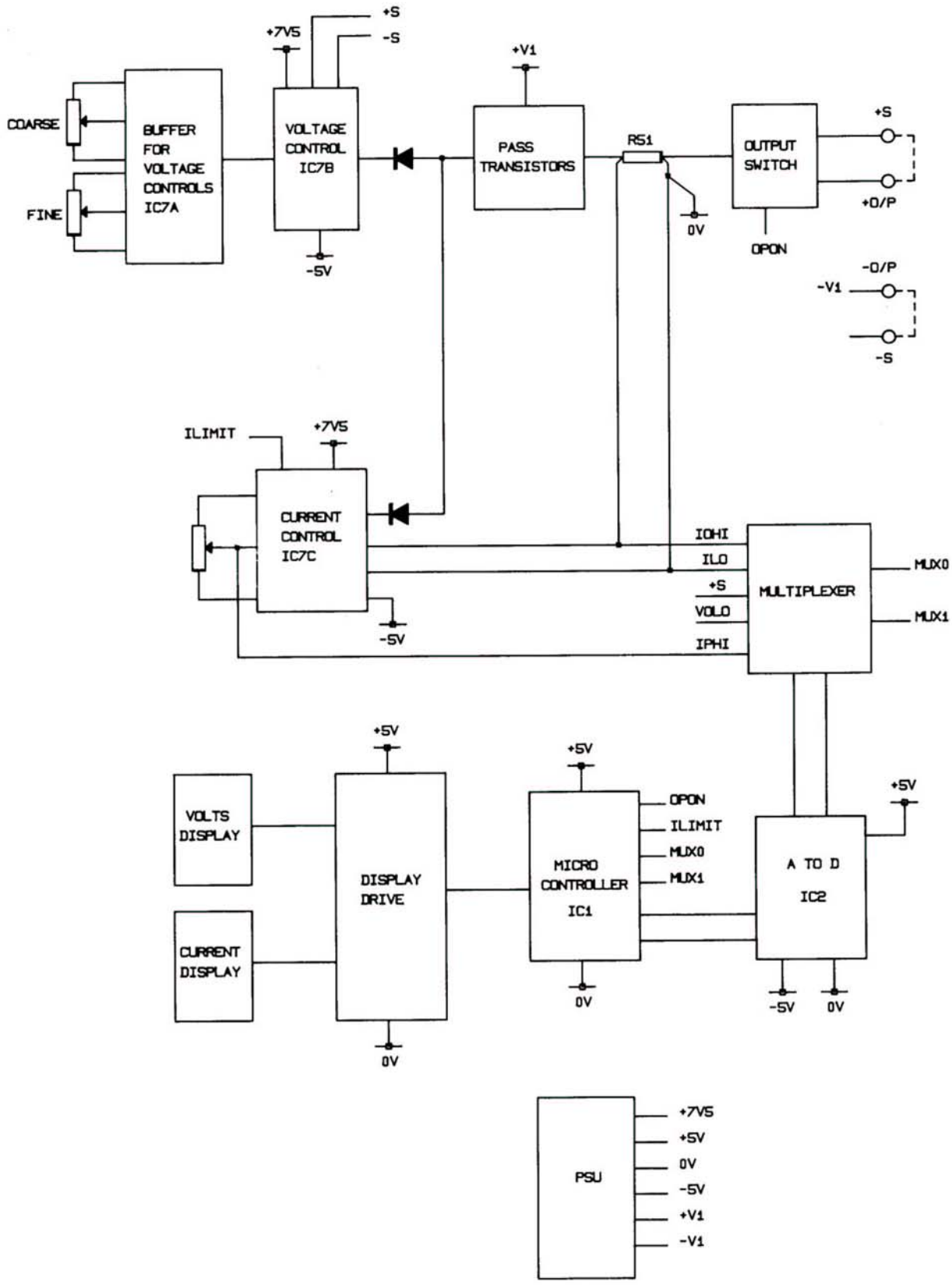
Specification

OUTPUTS

Output Range:	Nominally 0-32V, 0-2.1A.
Output Voltage Setting:	By coarse and fine controls; resolution <5mV across the range.
Output Current Setting:	By single logarithmic control.
Output Mode:	Constant voltage or constant current modes with automatic cross-over. Decimal points flash to indicate constant current mode.
Configuration Selection:	Isolated, True parallel, Series, or Series Tracking via front panel switches.
Output Switch:	Isolates the output and permits voltage and current limits to be set up before connecting the load.
Output Terminals:	4mm terminals on 19mm (0.75") spacing.
Sensing:	Remote via 4mm terminals or direct via shorting links (provided).
Output Impedance:	
Constant Voltage:	<5 mΩ at 1kHz.
Constant Current:	Typically 50 kΩ with voltage limit at maximum.
Output Protection:	Up to maximum output voltage +20 Volts forward; diode clamped for reverse voltages and up to 3A reverse current.
Load & Line Regulation:	< 0.01% of maximum output for 90% load change or 10% line change.
Ripple and Noise:	Typically <1 mV rms.
Transient Response:	< 20 µsec to within 50 mV of setting for 90% load change.
Temperature Coefficient:	Typically < 100 ppm/^{O}C.
Meter Type:	Dual 3.75 digit (4095 count) with 12.5mm (0.5") LEDs. Reading rate 4Hz.
Meter Resolution:	10 mV and 1mA over the entire range.
Meter Accuracy:	Voltage 0.1% of reading + 1 digit, current 0.3% of reading + 1 digit.
Current Meter Damping:	~20 ms, switchable to 2 sec for averaging of rapidly varying loads.

GENERAL

AC Input Voltage:	Internally set for 230VAC or 115VAC 50/60Hz; operating range ±10% of setting. Installation Category II.
Power Consumption:	320VA max
Operating Range:	5^{O}C to 40^{O}C, 20% to 80% RH.
Storage Range:	–20 ^{O}C to +60 ^{O}C.
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2.
Weight:	9.5 kg.
Size:	350mm W x 170mm H x 265mm L
Safety:	Complies with EN61010-1.
EMC:	Complies with EN61326.



Block diagram - Main Outputs

Functional Description

The relationship between the major circuit elements is shown in the block diagram opposite.

The transformer incorporates two secondary windings, one which produces the main supply powering the output, and another which produces an auxiliary supply powering the control and metering circuits.

The series regulator is placed in the positive output of the main supply, but because of the way in which the control and metering circuits operate, it is convenient to label the output of the series regulator as 0 volts, and to regard the negative side of the main supply as being the controlled output voltage (-V out).

The auxiliary supply provides stabilised symmetrical voltage outputs V+ and V- with the common point connected to the +ve output.

The series regulator is controlled by the 'voltage control circuit' until the output current flowing reaches the current limit setting, upon which the 'current control circuit' takes over. The voltage control buffer amplifies and provides low output impedance from the voltage controls.

The input to the voltage control circuit is from the control buffer, or from the master output on the slave side.

The 12 bit A to D measures output voltage and either preset current or output current selected by the multiplexer.

The micro-controller reads the output of the A to D and drives the appropriate display.

Circuit Description

Refer to the appropriate schematic at the back of this manual.

Power Supply - Mains

This consists of a full wave bridge rectifier feeding the reservoir capacitor C31. The full load secondary winding voltage is 36V rms giving approximately 55 volts off load and 40V on full load (30V and 24V on PL154).

Power Supply - Auxiliary

This consists of twin full wave rectified supplies from a 21V centre tapped winding. IC8 generates +5V for the micro-Controller, display and A to D. Q7 and D10 generate +7.5V for the analogue section. D11 generates -5V for the analogue section and A to D. 0V of this supply is connected to the positive output at R51.

Voltage Control

IC7A buffers the voltage control pots and VR3 sets maximum output voltage of the unit. D6 is the reference which is nominally 2.45V.

IC7B is a differential amplifier with a voltage gain of 13.3. For 30V output this means the voltage at PJ2-8 will be 2.25V and for 15V output 1.125V. VR9 trims differential gain and effects voltage regulation. This can be set more accurately by generating a few hundred millivolts between positive output and positive sense, see calibration section.

Current Control

IC7C is the error amplifier and compares the voltage on the wiper of VR5 with the voltage generated across the current sense resistor R51. When this limit is reached IC7C takes control changing the supply output from constant voltage to constant current. Current limit is indicated to the micro-controller by ILIMIT going high. The sense resistor is 100 milli-Ohm, therefore with the current limit set to 2A the voltage on the wiper of VR5 will be typically 188mV when VR7 is set central. VR8 adjusts the output current to be the same as the preset current at low levels. VR4 trims maximum output current.

Series Regulator

Q1 and Q2 form a triple Darlington. On 2 Amp and 4 Amp versions Q2 is in parallel with Q3, Q4 and Q5. On 3 Amp versions Q2 is in parallel with Q3, Q4, Q5, Q8 and Q9. Q1 is a Darlington and is on a heatsink on the driver pcb.

A to D

IC2 is a 12 bit dual slope converter. Its reference is derived from D6 by R27 and R28 and is typically 180mV. XL1 is either a 4MHz crystal or ceramic resonator. The buffered oscillator output is also used by the microcontroller IC1. Analogue multiplexer IC3 selects measurement of output voltage, preset current or output current. R65 and C38 provide the current meter damping facility.

Microcontroller

The measurement system and display is controlled by a microcontroller IC1.

The two 4-digit LED displays are driven by IC1 via the segment latches IC4 and IC9 and the digit latch IC5. Digit current is provided by IC6 and individual segment current is limited to 50mA by the resistors R10 and R17. The digit on-time rate is 2ms and is controlled by IC1 which also provides the inter digit blanking to prevent ghosting segments.

The measurement of output values of voltage and current is performed by the 12 bit analog to digital converter IC2. The measurement rate is controlled by the 4.0MHz ceramic resonator XL1 connected between pins 22 and 23 and the buffered version of this 4MHz signal at pin 25 is used as the clock to the microcontroller IC1. The ADC, IC2, is a dual slope converter and provides a little over 8 readings per second when clocked at 4MHz. The ADC is run in continuous mode and

the status signal on pin 2 is read by the microcontroller every 6ms. When a reading is ready the microcontroller reads the 12 bit binary value and then converts it to 7 segment BCD and stores it ready to be sent to the display. After each reading the microcontroller switches the input multiplexer IC3 to the next required input. In this way it is possible to read and display any of the following:

Output Volts (equal to Preset Volts when the output switch is off)
Output Current
Preset Current

The multiplexer is controlled by IC1. The decision on what to measure and display at any time is taken by the microcontroller and in order to do this correctly a number of status signals and switches are monitored on a regular basis. These are:

ILIMIT true if in current limit
OPON the output on/off switch signal

These signals may be read by the microcontroller as required.

Service Notes

If jitter is experienced on the meters near full scale, this can be overcome by increasing C1 to 330nF. If the integrator capacitor C4 has high dielectric absorption this will cause non-zeroing of the current meter; this can be overcome by simply replacing it with another of the same type.

Poor regulation can be caused by incorrect adjustment of the differential gain or if the output is oscillating.

Quad Mode Switchbank Assembly

The bank of four switches allows four modes of operation to be obtained.

Isolated: SW1 (Release) depressed. All interconnections between the two units is removed.

Parallel: SW2 depressed. The Slave unit pass transistors are driven from Q1 on the Master PCB, and their output is combined with that of the Master unit, thus doubling its current capability. VR5 on the Master unit is disconnected from R47 and connected to a network generating twice the control voltage. The slave unit becomes inoperative.

Series: SW2 depressed. The Slave unit positive terminal is connected to the Master unit negative terminal.

Tracking: SW4 depressed. As for Series, but additionally R36 on the +ve input to the Slave unit voltage control op-amp IC7B is disconnected from IC7A and is instead connected to a potential divider connected between Master unit +ve output and Slave unit -ve output. This maintains the voltageage at the Slave +ve output (and hence the Master -ve output) equal to ½ of the total output voltage, thus producing tracking supplies of ± 30V controlled from VR1 and VR2 on the Master unit. VR1 and VR2 on the Slave unit become inoperative.

Calibration

Equipment Required

A 5.5 digit multimeter with better than 0.05% accuracy on voltage and better than 0.1% accuracy on current or use a precision current shunt.

A small switch, 18K resistor and a diode.

Preparation

Preset adjustments are accessible from both sides of the main pcb and their identities are also marked on both sides of the pcb.

Take great care not to touch the mains connections on the transformers during adjustment. Use an insulated trim tool. Allow five minutes warm-up before proceeding.

Calibration

To avoid errors when making voltage measurements the DVM must be connected directly to the **sense** terminals.

Voltage - Differential Gain

Remove the link between + O/P and + sense only and fit a diode, cathode to + sense and anode to + O/P. Connect the small switch across the diode. Connect the 18K resistor between - O/P and + sense. Connect the DVM set to 20V range to the sense terminals.

Close the switch

Set the DC output switch on

Set the output voltage to approximately 14V

Note the reading

Open the switch and adjust VR9 for the same reading +/- 0.5mV

Close and open the switch and check the reading

Voltage - Output and meter

Remove the switch and 18K resistor and refit the link between +O/P and + sense.

Set coarse and fine controls to maximum and adjust VR3 to 32.1V or 15.6 on PL154 on the external DVM.

Adjust VR6 so the internal meter reads the same as the DVM.

Current

Set output switch to OFF

Set the current limit control for a reading of 10mA

Set output switch to ON ON and short the output terminals

Adjust VR8 for a reading of 10mA

Remove the short and connect an ammeter between the output terminals.

Set current limit to approximately 1800mA and adjust VR7 so that the internal and external ammeters read the same.

Set current limit to maximum, output off and adjust VR4 for 2100mA .

Quad Mode Calibration

The above calibration must be carried out first.

Select parallel mode, output switches OFF

Master current limit to maximum

Adjust VR2 on switchbank pcb for 4050mA on the master ammeter.

Select tracking mode, output switches ON

Set master output voltage to approximately 30V

Adjust VR1 on switchbank pcb so that the above voltmeter reads the same as the master voltmeter.

PCB ASSEMBLY – MAIN (44115-1960)

Part Number	Description	Position
10300-0313	PAD P/E S/AD 12 X 15MM	FOR R51
22225-0220	SWITCH PUSH/PUSH SPPH11470B	SW2
22573-0063	HEADER 16WAY STR SIL LONG	FOR DISPLAYS
22573-0205	HEADER 5 WAY STRAIGHT .156P	PJ3
22573-0210	HEADER 10 WAY STRAIGHT .156P	PJ1
23185-0000	RES ZERO OHM	LK3-5
23202-1100	RES 100RF W60 MF 50PPM	R53
23202-3100	RES 10K0F W60 MF 50PPM	R30 ,R46
23202-3105	RES 10K5F W60 MF 50PPM	R47
23202-3620	RES 62K0F W60 MF 50PPM	R4
23202-4226	RES 226KF W60 MF 50PPM	R27
23202-4470	RES 470KF W60 MF 50PPM	R29
23207-2220	RES 2K20J 1W MF 250PPM	R49
23215-5100	RES 1M00B W25 MF 15PPM	R55
23284-0060	RES 2K2J 2W5 WW	R61
23286-0010	RES 0R1J 10W WW ALUMINIUM HSD	R51
23347-0140	POT 10K LIN	VR1-2
23347-0150	POT 10K LOG	VR5
23377-2100	RES PS/H 1K0 CF 10MM	VR4
23377-2220	RES PS/H 2K2 CF 10MM	VR9
23377-2470	RES PS/H 4K7 CF 10MM	VR3
23377-4100	RES PS/H 100K CF 10MM	VR8
23379-1100	RES PS/H 100R CERMET 10MM SKEL	VR7
23379-2100	RES PS/H 1K0 CERMET 10MM SKEL	VR6
23427-0334	CAP 470PK 100V MED K P5	C14
23557-0612	CAP 1U0 100V/50V ELEC RE2 P2	C16, C18 ,C39
23557-0647	CAP 10U 35V ELEC RE2 P2	C7,C25-26 ,C38
23557-0666	CAP 47U 63V ELEC RE2 P3.5	C20
23557-0668	CAP 220U 10V ELEC RE2 P2.5	C37
23620-0246	CAP 100NK 63V P/E P5	C9
23620-0249	CAP 330NK 63V P/E P5	C1, C5 ,C10-11
23620-0256	CAP 1U0K 63V P/E P5	C3
23620-9007	CAP 10NK 100V P/E P5	C13
23685-0007	CAP 100NK 250V P/P MKP4 P10	C4

PCB ASSEMBLY – MAIN (44115-1960) /continued…

Part Number	Description	Position
25061-9505	DISPLAY - 4 DIGIT LED	DISP1-2
25115-0907	DIO 1N4002 B/R	D26
27153-0030	IC 7109 40 PIN	IC2
28502-0010	RESONATOR CER 4MHZ CSA4.00MG	XL1

PCB ASSEMBLY – MAIN – SM STAGE (44115-1941)

Part Number	Description	Position
23105-0220	RES SM0805 22R0F W1	R5
23105-0270	RES SM0805 27R0F W1	R10-17
23105-0510	RES SM0805 51R0F W1	R48A
23105-1240	RES SM0805 240RF W1	R54A
23105-1330	RES SM0805 330RF W1	R52
23105-1470	RES SM0805 470RF W1	R42
23105-2100	RES SM0805 1K00F W1	R8,R43 ,R48
23105-2150	RES SM0805 1K50F W1	R37A
23105-2180	RES SM0805 1K80F W1	R18,28A
23105-2470	RES SM0805 4K70F W1	R1,R34,R40-41,R64,R69
23105-3100	RES SM0805 10K0F W1	R25, R33, R45 ,R62
23105-3130	RES SM0805 13K0F W1	R37
23105-3150	RES SM0805 15K0F W1	R32
23105-3330	RES SM0805 33K0F W1	R9 ,R66-67
23105-3470	RES SM0805 47K0F W1	R2-3 ,R75
23105-3560	RES SM0805 56K0F W1	R31
23105-4100	RES SM0805 100KF W1	R6,R24, R65 ,R70
23105-4200	RES SM0805 200KF W1	R38
23105-4220	RES SM0805 220KF W1	R7
23105-4470	RES SM0805 470KF W1	R39
23105-6100	RES SM0805 10M0F W1	R26,R44
23106-2820	RES SM0805 8K20D W1 25PPM	R54
23106-3150	RES SM0805 15K0D W1 25PPM	R36
23106-3160	RES SM0805 16K0D W1 25PPM	R28
23106-4200	RES SM0805 200KD W1 25PPM	R35
23405-0470	CAP SM0805 47P CER COG	C15 ,C17
23461-0020	CAP SM0805 100NZ 50V CER Y5V	C2,C6,C12,C27-30
23461-0040	CAP SM0805 1N0K 50V CER X7R	C36,C40-41

PCB ASSEMBLY – MAIN – SM STAGE (44115-1941) /continued…

Part Number	Description	Position
25021-0010	DIO SM LL4148 SWITCHING	D1-4, D7,D25
25340-1000	TRAN SM PNP BC859C	Q6
25377-1000	TRAN SM NPN BC849C	Q8
27106-1160	IC SM LM324M OP AMP	IC7
27161-2030	IC SM V/REF ZRC250 2.5V 2%	D6
27164-1060	TRAN SM ULN2803AFW NAN	IC6
27227-0520	IC SM 4052	IC3 ,IC10
27239-2730	IC SM 74HC273	IC5
27244-1573	IC SM 74AC573	IC4,IC9
27250-2150	IC SM PIC16C55A-04/SO	IC28 IC1
35555-4270	PCB - MASTER/MAIN - PLs	

PCB ASSEMBLY – DRIVER (44115-0410)

Part Number	Description	Position
20030-0263	WASHER M3 ZPST	FOR IC8 & Q1
20038-9501	WASHER M3 SPRING	FOR IC8 & Q1
20210-0101	NUT M3 ZPST	FOR IC8 & Q1
20234-0011	SCREW M3 X 10 PNHDPZ ZPST	FOR IC8 & Q1
20611-0003	BUSH POLYESTER TO220	FOR IC8 & Q1
20613-0006	SIL-PAD TO220	FOR IC8 & Q1
20670-0180	HEATSINK PCB MTG 63MM HIGH	FOR IC8 & Q1
22315-0454	FUSE 2.0AT SUBMIN PCB MTG UL	FS1,2
22573-0225	HEADER 5 WAY STR F/LOCK .156	PJ6
22573-0226	HEADER 6 WAY STR F/LOCK .156	PJ7
22573-0210	HEADER 10 WAY STRAIGHT .156P	
23202-3100	RES 10K0F W60 MF 50PPM	R57
23185-0000	RES ZERO OHM	LK2,FS3
23202-0470	RES 47R0F W60 MF 50PPM	R19,56
23202-1100	RES 100RF W60 MF 50PPM	R50
23202-1470	RES 470RF W60 MF 50PPM	R59
23202-2100	RES 1K00F W60 MF 50PPM	R58
23202-0010	RES 1R00F W60 MF 50PPM	R20-23
23557-0647	CAP 10U 35V ELEC RE2 P2	C23,24
23557-0654	CAP 1000U 63V ELEC RE2 P7.5	C31,32,33,34
23557-0664	CAP 1000U 35V ELEC RE2 P5	C21
23557-0667	CAP 220U 25V ELEC RE2 P3.5	C22

PCB ASSEMBLY – DRIVER (44115-0410) /continued…

Part Number	Description	Position
23685-0007	CAP 100NK 250V P/P MKP4 P10	C30
25115-0907	DIO 1N4002 B/R	D8
25117-0020	DIO 1N5401	D16,17,19,21,23
25130-0231	DIO ZEN 8V2 W4	D10
25130-0903	DIO ZEN 5V1 W4	D11
25211-9302	RECTIFIER BRIDGE W02G	BR2
25382-0610	TRAN NPN DARLINGTON TIP120	Q1
25383-0505	TRAN NPN BC338	Q7
27160-0009	IC V/REG 7805 TO220	IC8
35515-1220	PCB - DRIVER - PL	

PCB ASSEMBLY – SWITCHBANK (44115-0630)

Part Number	Description	Position
20010-0205	RIVET ALUM 2.4W X 6L	
20040-9501	NUT No.4 Angle	
22225-0750	SWITCHBANK - PLQMD	
22573-0224	HEADER 4 WAY STR F/LOCK .156	PJ8
22575-0204	SKT 4W .156 20AWG (Yellow)IDT	
22575-0205	SKT 5W .156 20AWG (Yellow)IDT	
23185-0000	RES ZERO OHM	LK1
23202-2536	RES 5K36F W60 MF 50PPM	R4
23202-4180	RES 180KF W60 MF 50PPM	R3
23202-0010	RES 1R00F W60 MF 50PPM	R1A-1D,2A-2D
23377-1470	RES PS/H 470R CF 10MM	VR2
23379-3100	RES PS/H 10K CERMET 10MM SKEL	VR1
35515-1340	PCB - SWITCHBANK - PL (10mm)	
43187-0100	WIRE SET SW/BANK PCB PLQMD	

PCB ASSEMBLY – HEATSINK (46115-0970)

Part Number	Description	Position
20030-0240	WASHER 4BA ZPST	
20038-9503	WASHER M3.5 SPRING	
20100-9201	NUT 4BA Full - Steel	
20134-9007	SCREW 4BA x 1/2in. Pozi Pan	
20611-0007	TRANSISTOR MOUNT – TO3	
20613-0014	SIL-PAD TO3	
20670-9001	HEATSINK KP314	
22451-0200	SOLDER TAG 4BA	
25386-9201	TRAN NPN 2N3055	

CASING AND OTHER ITEMS

Part Number	Description	Position
10232-0304	SLEEVE 30 x20MML BLACK	MAINS SW, FUSEHOLDER, MAINS SWITCH, FUSEHOLDER
10232-0305	SLEEVE 20 x20MML BLACK	TRANSFORMER
10232-0306	SLEEVE 50 x25MML BLACK	HEATSINK
20030-0240	WASHER 4BA ZPST	TERMINALS
20030-0266	WASHER M4 ZPST	1/BR1,1/BR2,4/HEATSINKS
20037-0247	WASHER 4BA SHK/PROOF I/T ZPST	FRONT PANEL, EARTH TERMINAL
20037-0304	WASHER M4 SHK/PROOF I/T ZPST	CHASS/H.S POSTS
20037-0305	WASHER 5/16in.SHK/PRF I/T ZPST	EARTH TERMINALS
20037-0401	SOLDER TAG SHAKEPROOF - M4	EARTH
20038-9502	WASHER M4 SPRING	HEATSINK COVER, EARTH,
20038-9503	WASHER M3.5 SPRING	TERMINALS
20040-9401	NUT No.6 FLAT	FEET
20062-9301	SCREW No.4x3/8in. POZI PAN	SW PCB
20062-9305	SCREW No.6x3/4 PZPNST/B BS4174	FOR FEET
20062-9501	SCREW No.6x3/4in RAISED CKHDPZ	FOR HANDLE
20063-0010	SCREW No.6 x 3/8 NIB HDPZ ST/AB	COVER FIXING, TRANSFORMER/CHASSIS, FRONT PANEL, CASE
20065-0150	SCREW No. 6 x 3/8 TORX T15	DRIVER/SPACERS
20065-0150	SCREW No. 6 x 3/8 TORX T15	DRIVER/SPACER
20134-9005	SCREW 4BA x 1/4in. POZI PAN	TERMINALS
20210-0102	NUT M4 ZPST	HEATSINKS, EARTH
20213-0040	CAPTIVE NUT SPIRE No.6	CHASSIS, TRANSFORMER, FRONT PANEL
20213-0040	CAPTIVE NUT SPIRE No.6	
20234-0023	SCREW M4 x 8 PNHDPZ ZPST	HEATSINK POSTS, HEATSINK COVER, EARTH
20611-9305	TRAN MOUNTING BUSH SK18-4-1	FOR HEATSINKS
20653-0204	CABLE TIE 100 x 2.5MM	
20661-0242	SPACER HEX M4 x 25 NPBR	FOR HEATSINKS
20661-0257	SPACER HEX 4BA x ½ in. NPBR	
20661-0259	SPACER RND 3/8 ODx.175 ID NYL	FOR HEATSINK
20661-0604	SPACER, PCB SUPPORT ½in. NYL	MAIN PCB MOUNTING
20661-0605	SPACER, PCB SUPPORT 7/8in.NYL	DRIVER PCB MTG
20661-9302	SPACER HEX STUD M4 x 25 NPBR	
20662-9101	INSTRUMENT FOOT	
22115-0760	TRANSFORMER MAINS PL320 D5115	
22219-0060	SWITCH PADDLE DPST SOLDER LUGS	MAINS ON/OFF

CASING AND OTHER ITEMS /continued…

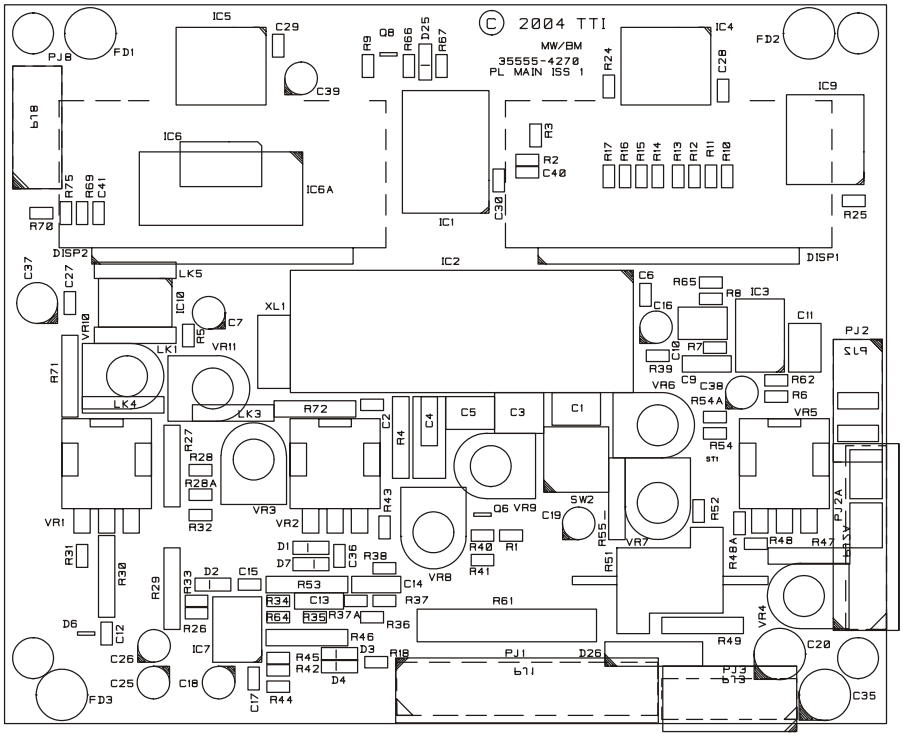
Part Number	Description	Position
22219-0080	SWITCH PADDLE DPDT PCB MTG	DC ON/OFF
22300-9301	FUSEHOLDER PANEL MOUNTING	
22315-0241	FUSE 3.15A ANTI SURGE HRC	
22443-0003	GROMMET - PV93	
22448-0240	BUSH STRAIN RELIEF SR-5N-5	
22451-0200	SOLDER TAG 4BA	
22491-0180	MAINS LD TYPE 2 END/UK PLUG 5A	
22571-0675	TERMINAL TP/2 RED/GREY 12	
22571-0685	TERMINAL TP/2 BLACK/GREY 12	
22571-0691	WASHER ALUMINIUM FOR TP2E TERM	
22571-0696	TERMINAL TP/2 GREY/GREY	
22573-0224	HEADER 4 WAY STR F/LOCK .156	PJ4 DRIVER
22573-0225	HEADER 5 WAY STR F/LOCK .156	
22575-0204	SKT 4W .156 20AWG (YELLOW) IDT	
22575-0205	SKT 5W .156 20AWG (YELLOW) IDT	TRANSFORMERS, FRONT PANEL
22575-0206	SKT 6W .156 20AWG (YELLOW) IDT	HEATSINK
29211-0110	HANDLE EC254-OZ 6in BLACK/NICK	
31512-0360-2	COVER, HEATSINK PL320QMD	
33331-5100-6	FRONT PANEL - PLQMD	
33331-5110	OVERLAY F/PNL - PL320QMD	
33536-3510	COVER - PL320QMD	
33536-3560-5	CHASSIS - PLQMD	
35331-0080	SHORTING BAR - PLATED	
37113-0170	BUTTON, SWITCHBANKS, MID-GREY	
37113-0400	BUTTON, MID-GREY ABS	
37151-0480	KNOB 21MM D-SHAFT L/GREY F/R	
37558-1250	LABEL - PL320QMD (MOD)/NSN	
37558-1260	LABEL MANF DATE PL320QMD (MOD)	
37559-0630	LABEL WARNING 230V/3.15A/320VA	
43171-1520	CONN ASSY 10 WAY - PLs	
43187-0070	WIRE SET CUT CHASSIS - PL320	
43187-0080	WIRE SET CUT H/SINK PL320	
43187-0110	WIRE SET CHASSIS PLQMD	
43187-0560	WIRE SET CUT MAINS - PL	
43187-0580	WIRE SET CONN 10 WAY - PL	
43187-0590	WIRE SET MAINS - PLD	

CASING AND OTHER ITEMS /continued…

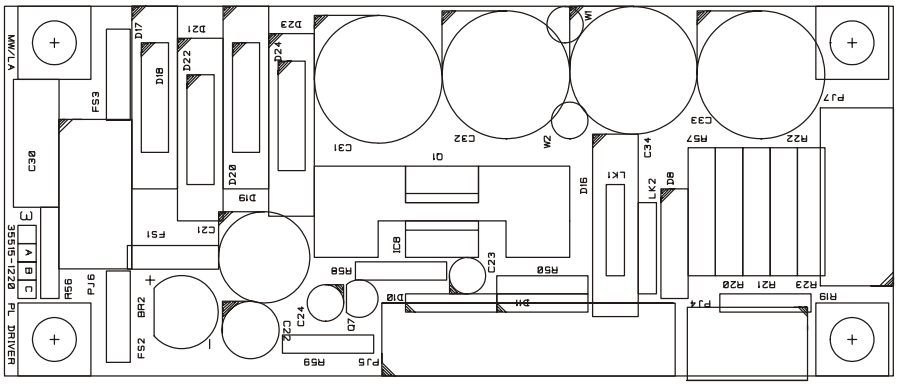
Part Number	Description	Position
43187-1010	WIRE SET CUT TERM PCB PL/TS	
43187-1190	WIRE FUSEHOLDER CONNECTING PL	
44115-0410	PCB ASSY - DRIVER - PL320	
44115-0630	PCB ASSY SW/B PL320QMD	
44115-1960	PCB ASSY - MAIN - PL320	
46115-0440	HEATSINK ASSY PL320/154/EL302	
46115-0970	PCB ASS TERM UNIVERSAL PL/TS	
23620-9007	CAP 10NK 100V P/E P5	
23621-0317	CAP 10NM 250VAC X2 P10/P15	
25117-0020	DIO 1N5401	
35515-1320	PCB TERMINAL UNIVERSAL PL/TS	

Component Layouts

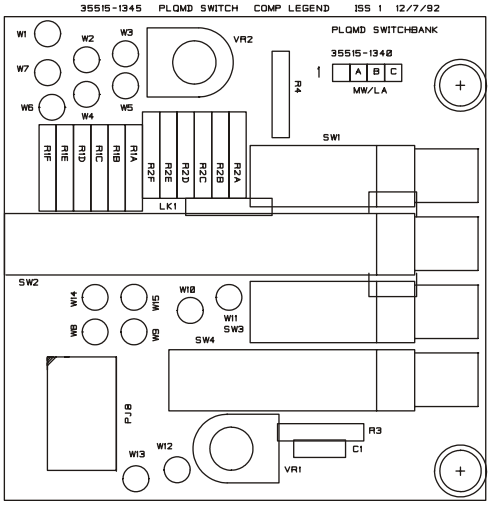
Main Pcb



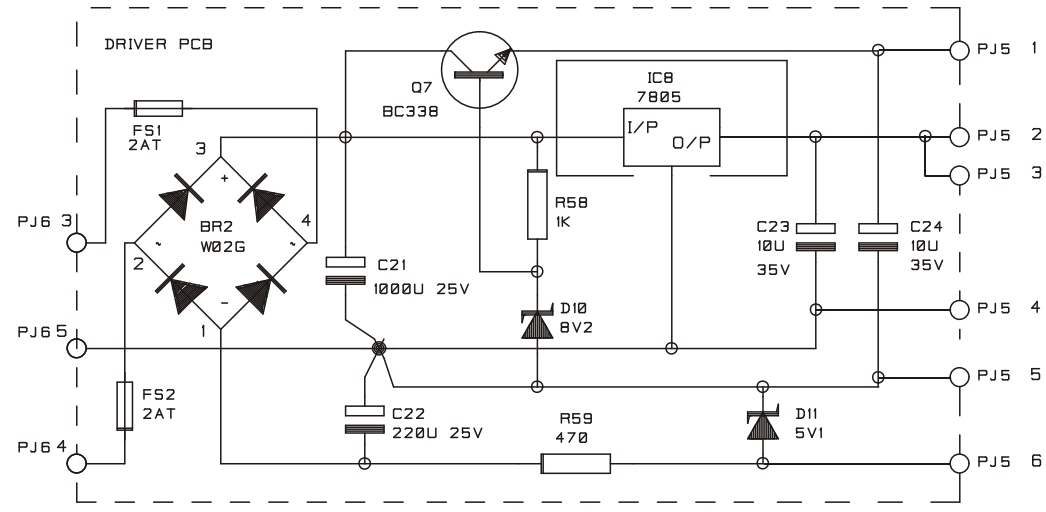
Driver Pcb

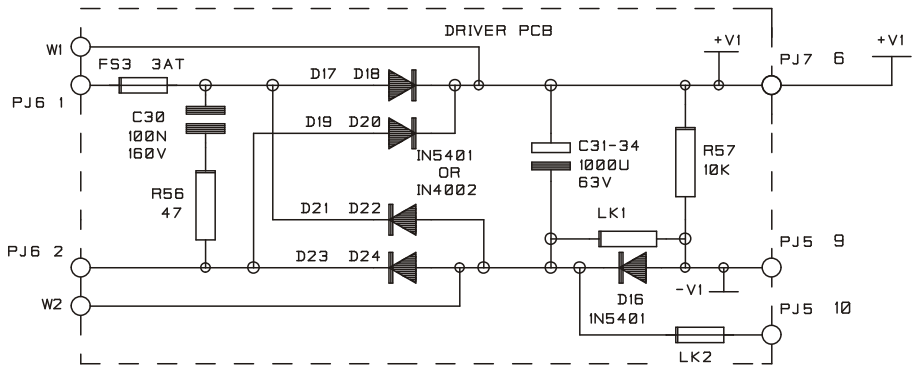


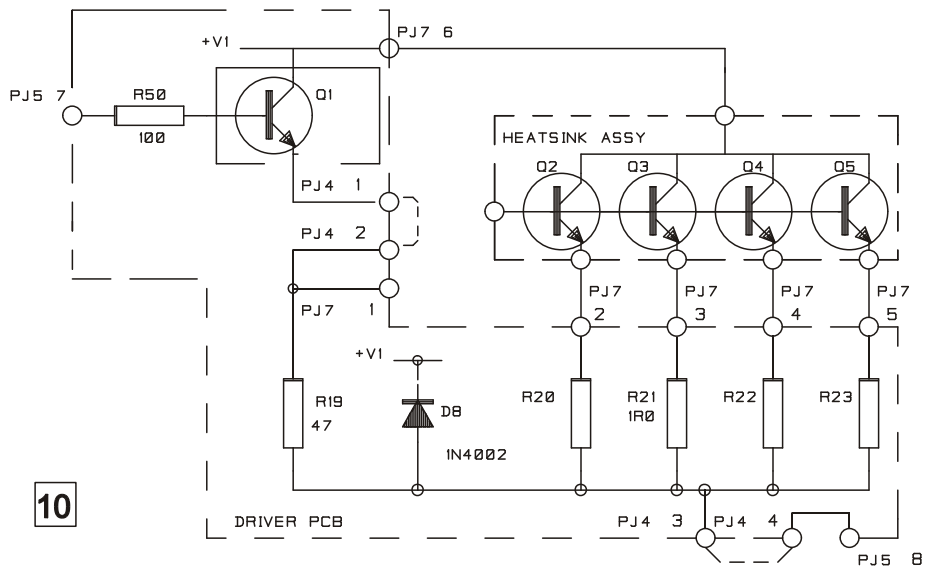
Switchbank Pcb



Circuit Diagrams







10

PL320 Driver and Heatsink

NOTE
1. R51 IS FITTED SOLDER SIDE ON OMD MASTER

PL320 Main pcb, Driver pcb and Heatsink assembly

SLAVE

HEATSINK ASSY
46115-0440

PJ7

DRIVER PCB ASSY
46115-0410

PJ4
1 W11
2 W10
3 W4
4 W5

PJ5

PJ1

PJ2A
1
2
3
4
5
6 W13
7 W12

MAIN PCB ASSY
46115-1960

OUTPUT TERMINALS

PJ3

1 2 3 4 5 6 7 8 9 10

2

SLAVE PJ4 1 W11
MASTER PJ4 1 W9
MASTER PJ4 2 W8
SLAVE PJ4 4 W5
MASTER PJ4 4 W7
W6

SW2-C
SW2-G
LK1
SW2-F
R1A
R1B
R1C
R1D
R1E *
R1F *
6 X 1R
* NOT FITTED
R2A
R2B
R2C
R2D
R2E *
R2F *
6 X 1R
W4 SLAVE PJ4 3
W10 SLAVE PJ4 2

SW4-C
SW4-D
SW3-B
SW4-A
SW3-A
SW2-D
SW2-A
MASTER -O/P PJ8 2
SLAVE +O/P PJ8 3
PJ8 1 SLAVE -O/P

SLAVE PJ2A 6 W13
W12 SLAVE PJ2A 7
SW4-B
C1
MASTER +O/P PJ8 4
VR1 10K
R3 180K

MASTER PJ2A 4 W1
W2 MASTER PJ2A 5
SW2-E
MASTER PJ2A 3 W3
VR2 470
R4 5k36

SW2-B
MASTER PJ2A 1 W14
W15 MASTER PJ2A 2

FUSE
L
MAINS INPUT
N
E
SW1

MASTER

HEATSINK ASSY
46115-0440

PJ7

PJ4
W9 1
W8 2
W6 3
W7 4

DRIVER PCB ASSY
46115-0410

PJ5

PJ1

PJ2A
W14 1
W15 2
W3 3
W1 4
W2 5
6
7

MAIN PCB ASSY
46115-1960

PJ2
1 2 3 4 5 6 7 8 9 10

PJ3

OUTPUT TERMINALS

PL320QMD Switchbank Pcb Assembly and Connection Diagram

THURLBY THANDAR INSTRUMENTS

PL SERIES

PRECISION LINEAR POWER SUPPLIES

INSTRUCTION MANUAL

EC Declaration of Conformity

We Thurlby Thandar Instruments Ltd
Glebe Road
Huntingdon
Cambridgeshire PE29 7DR
England

declare that the following power supplies:

PL154, PL320, PL320QMD, PL320QMT
PL330, PL330QMD, PL330QMT

meet the intent of the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC. Compliance was demonstrated by conformance to the following specifications which have been listed in the Official Journal of the European Communities.

EMC

Emissions:

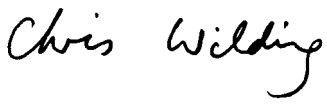
a) EN61326 (1998) Radiated, Class B
b) EN61326 (1998) Conducted, Class B
c) EN61326 (1998) Harmonics, referring to EN61000-3-2 (2000)

Immunity: EN61326 (1998) Immunity Table 1, Performance B, referring to:

a) EN61000-4-2 (1995) Electrostatic Discharge
b) EN61000-4-3 (1997) Electromagnetic Field
c) EN61000-4-11 (1994) Voltage Interrupt
d) EN61000-4-4 (1995) Fast Transient
e) EN61000-4-5 (1995) Surge
f) EN61000-4-6 (1996) Conducted RF

Safety

EN61010-1 Installation Category II, Pollution Degree 2.



CHRIS WILDING
TECHNICAL DIRECTOR

2 July 2004

MAIN OUTPUT(S)

Output Range:	Nominally 0-32V, (PL320/330); 0-15.5V (PL154). Nominally 0-2·1A (PL320); 0-3·1A (PL330); 0-4A (PL154).
Output Voltage Setting:	By coarse and fine controls; resolution <5mV across the range.
Output Current Setting:	By single logarithmic control.
Output Mode:	Constant voltage or constant current modes with automatic cross-over. Decimal points flash to indicate constant current mode.
Configuration Selection: (QMD and QMT only)	Isolated, True parallel, Series, or Series Tracking via front panel switches.
Output Switch:	Isolates the output and permits voltage and current limits to be set up before connecting the load.
Output Terminals:	4mm terminals on 19mm (0·75") spacing.
Sensing:	Remote via 4mm terminals or direct via shorting links (provided).
Output Impedance:	
Constant Voltage:	<5 mΩ at 1kHz.
Constant Current:	Typically 50 kΩ with voltage limit at maximum.
Output Protection:	Up to maximum output voltage +20 Volts forward; diode clamped for reverse voltages and up to 3A reverse current.
Load & Line Regulation:	< 0·01% of maximum output for 90% load change or 10% line change.
Ripple and Noise:	Typically <1 mV rms.
Transient Response:	< 20 µsec to within 50 mV of setting for 90% load change.
Temperature Coefficient:	Typically < 100 ppm/^{O}C.
Meter Type:	Dual 3·75 digit (4095 count) with 12·5mm (0·5") LEDs. Reading rate 4Hz.
Meter Resolution:	10 mV and 1mA over the entire range.
Meter Accuracy:	Voltage 0·1% of reading + 1 digit, current 0·3% of reading + 1 digit.
Current Meter Damping:	~20 ms, switchable to 2 sec for averaging of rapidly varying loads.

LOGIC OUTPUT (PL320QMT & PL330QMT)

Output Voltage Range:	4 to 6 Volts.
Output Current:	0·1 to 4 Amps (PL320QMT); 0·1 to 7 Amps (PL330QMT).
Output Switch:	Electronic.
Output Terminals:	4mm terminals on 19mm (0·75") spacing.
Over-Voltage Protection:	Above 7 Volts.
Output Protection:	Clamped by the over-voltage protection circuit for forward voltages over 7 Volts and up to 1 Amp forward current. Diode clamped for reverse voltages and up to 3 Amps reverse current.
Load & Line Regulation:	< 0·01% of maximum output for 90% load change or 10% line change.
Ripple and Noise:	Typically <1 mV rms.

Transient Response:	< 20 µsec to within 50 mV of setting for 90% load change.
Temperature Coefficient:	Typically < 100 ppm/^{o}C.
Metering *(PL330QMT only)*:	
Meter Type:	3·75 digit (4095 count) with 12·5mm (0·5") LEDs. Reading rate 4Hz.
Meter Resolution:	10 mV and 10 mA
Meter Accuracy:	0·5% of reading + 1 digit.

GENERAL

AC Input Voltage:	Internally set for 110, 120, 220, 230 or 240VAC 50/60 Hz; operating range ±10% of setting. Installation Category II.

Power Consumption:

	Single	Dual	Triple
15V / 4A or 30V / 2A:	160VA	320VA	400VA
30V / 3A:	250VA	500VA	600VA

Operating Range:	5^{O} C to 40 ^{O}C, 20% to 80% RH.
Storage Range:	-20 ^{O}C to +60 ^{O}C.
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2.

Weight:

	Single	Dual	Triple
15V / 4A or 30V / 2A:	5.0kg	9.5kg	12.5kg
30V / 3A:	6.0kg	12.0kg	15.0kg

Size:

Single	Dual	Triple.
155 mm wide	350 mm wide	425 mm wide

All units 170mm high and 265mm deep, except PL330 versions 300mm deep.

Safety:	Complies with EN61010-1.
EMC:	Complies with EN61326.

Safety

This instrument is Safety Class I according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use). It is an Installation Category II instrument intended for operation from a normal single phase supply.

This instrument has been tested in accordance with EN61010-1 and has been supplied in a safe condition. This instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in a safe condition.

This instrument has been designed for indoor use in a Pollution Degree 2 environment in the temperature range 5°C to 40°C, 20% - 80% RH (non-condensing). It may occasionally be subjected to temperatures between +5°C and –10°C without degradation of its safety. Do not operate while condensation is present.

Use of this instrument in a manner not specified by these instructions may impair the safety protection provided. Do not operate the instrument outside its rated supply voltages or environmental range.

WARNING! THIS INSTRUMENT MUST BE EARTHED

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited. The protective action must not be negated by the use of an extension cord without a protective conductor.

When the instrument is connected to its supply, terminals may be live and opening the covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts. The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair. Capacitors inside the power supply may still be charged even if the power supply has been disconnected from all voltage sources but will be safely discharged about 1 minute after switching off power.

Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

If the instrument is clearly defective, has been subject to mechanical damage, excessive moisture or chemical corrosion the safety protection may be impaired and the apparatus should be withdrawn from use and returned for checking and repair.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders is prohibited.

Do not wet the instrument when cleaning it.

The following symbols are used on the instrument and in this manual:-

Earth (ground) terminal.

alternating current (ac)

direct current (dc)

This instrument has been designed to meet the requirements of the EMC Directive 89/336/EEC.

Compliance was demonstrated by meeting the test limits of the following standards:

Emissions

EN61326 (1998) EMC product standard for Electrical Equipment for Measurement, Control and Laboratory Use. Test limits used were:

a) Radiated : Class B

b) Conducted : Class B

c) Harmonics: EN61000-3-2 (2000) Class A; the instrument is Class A by product category.

Immunity

EN61326 (1998) EMC product standard for Electrical Equipment for Measurement, Control and Laboratory Use.

Test methods, limits and performance achieved were:

a) EN61000-4-2 (1995) Electrostatic Discharge : 4kV air, 4kV contact, Performance A.

b) EN61000-4-3 (1997) Electromagnetic Field, 3V/m, 80% AM at 1kHz, Performance B.

c) EN61000-4-11 (1994) Voltage Interrupt, 1 cycle, 100%, Performance B.

d) EN61000-4-4 (1995) Fast Transient, 1kV peak (AC line), 0.5kV peak (DC Outputs), Performance B.

e) EN61000-4-5 (1995) Surge, 0.5kV (line to line), 1kV (line to ground), Performance A.

f) EN61000-4-6 (1996) Conducted RF, 3V, 80% AM at 1kHz (AC line only; DC Output connections <3m not tested), Performance A.

According to EN61326 the definitions of performance criteria are:

Performance criterion A: 'During test normal performance within the specification limits.'

Performance criterion B: 'During test, temporary degradation, or loss of function or performance which is self-recovering'.

Performance criterion C: 'During test, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.'

Where Performance B is stated it is because DC Output regulation may deviate beyond Specification limits under the test conditions. However, the possible deviations are still small and unlikely to be a problem in practice.

Note that if operation in a high RF field is unavoidable it is good practice to connect the PSU to the target system using screened leads which have been passed (together) through an absorbing ferrite sleeve fitted close to the PSU terminals.

Cautions

To ensure continued compliance with the EMC directive observe the following precautions:

a) after opening the case for any reason ensure that all signal and ground connections are remade correctly and that case screws are correctly refitted and tightened.

b) In the event of part replacement becoming necessary, only use components of an identical type, see the Service Manual.

Mains Operating Voltage

Check that the operating voltage of the instrument shown on the rear panel is suitable for the local supply. Should it be necessary to change the operating voltage range proceed as follows:

1. Ensure that the instrument is disconnected from the AC supply.
2. Remove the screws holding the case upper and handle.
3. Lift off the case upper.
4. If the transformer primary taps are marked: A 0-110-120 B 0-110-120, rewire as follows:

240V operation:	Neutral (blue) wire to A0; Link (red) wire from A120 to B0; Live (brown) wire to B120.
230V operation:	Neutral (blue) wire to A0; Link (red) wire from A110 to B0; Live (brown) wire to B120.
220V operation:	Neutral (blue) wire to A0; Link (red) wire from A110 to B0; Live (brown) wire to B110.
120V operation:	Neutral (blue) wire to A0; Link (blue) wire from A0 to B0; Link (brown) wire from A120 to B120; Live (brown) wire to B120.
110V operation:	Neutral (blue) wire to A0; Link (blue) wire from A0 to B0; Link (brown) wire from A110 to B110; Live (brown) wire to B110.

Alternatively, if the transformer primary taps are numbered 1 to 6, rewire as follows:

230V operation:	Neutral (blue) wire to 6; Link (red) wire from 3 to 4; Live (brown) wire to 1.
115V operation:	Neutral (blue) wire to 6; Link (blue) wire from 3 to 5; Link (red) wire from 2 to 4; Live (brown) wire to 1.

Note: Units factory set to 220, 230 or 240V will have no blue link wire - this must be provided when converting to 110/115/120V operation. When converting a 110/115/120V unit to 220/230V/240V the blue link wire should be discarded.

5. Reassemble in the reverse order.
6. Change the fuse type if necessary.

Important Note: Safety regulations state that the AC line voltage to which the apparatus is set must be clearly marked on the outside. If the line voltage setting is changed, it is imperative that the voltage marked on the label close to the power lead entry point is also changed.

Fuse

The AC fuse is located on the back panel; note that the PL320QMT and PL330QMT have an additional AC fuse for their logic output sections. The correct fuse type is 20mm x 5mm 250V HBC time-lag with the following rating:

Model	**220/230/240V**	**110/115/120V**
PL320 / PL154 (single)	1·6A (T)	3.15A (T)
PL330 (single)	2A (T)	4A (T)
PL320QMD / PL320QMT	3.15A (T)	6.3A (T)
PL330QMD	4A (T)	8A (T)
PL330QMT	5A (T)	10A (T)
PL320QMT & PL330QMT Logic 0utput:	1.6A (T)	3.15A (T)

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders is prohibited.

Mains Lead

When a three core mains lead with bare ends is provided this should be connected as follows:

BROWN	-	MAINS LIVE
BLUE	-	MAINS NEUTRAL
GREEN/YELLOW	-	EARTH

Safety Earth Symbol

As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals in your plug proceed as follows:

The wire which is coloured green-and-yellow must be connected to the terminal in the plug which is marked by the letter E or by the safety earth symbol or coloured green or green-and-yellow.

The wire which is coloured blue must be connected to the terminal which is marked with the letter N or coloured blue or black.

The wire which is coloured brown must be connected to the terminal which is marked with the letter L or coloured brown or red.

If the unit is to be connected to the main supply by fixed wiring, rather than via an AC line plug, then the protective earth (ground) wire in the 3 core mains lead shall be connected to a protective conductor before any other connection is made.

WARNING! THIS APPARATUS MUST BE EARTHED

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited. The protective action must not be negated by the use of an extension cord without a protective conductor.

Mounting

This instrument is suitable both for bench use and rack mounting. It is delivered with feet for bench mounting.

Rack kits for mounting supplies in a 19” rack are available from the Manufacturers or their overseas agents.

Connections

All connections are made from the front panel.

The load(s) should be connected to the positive (red) and negative (black) terminals marked OUTPUT.

Remote sense connections to the load, if required, are made from the positive (red) and negative (black) SENSE terminals. The shorting links between OUPTUT and SENSE terminals should be removed when remote sensing is required. Replace the shorting links (red SENSE to red OUTPUT, black SENSE to black OUTPUT) when remote sensing is not in use.

The green terminal marked  is connected to the chassis and safety earth ground.

Main Outputs

Setting Up the Output

With the power switch ON and the output switch OFF the output voltage and current limit may be accurately set using the three output controls prior to connection to the load. The left hand meter indicates voltage and the right hand meter indicates current.

With the output switch in the OFF (set) position, the current meter shows the value of the current limit setting (indicated by all the decimal points coming on); with the output switch ON, it shows the value of load current flowing.

Unless remote sensing is required the shorting bars should be placed from + sense to + output and from - sense to - output. Ensure that the terminals are properly tightened before use.

Constant Voltage

The voltage output is set using the coarse and fine voltage controls; the current control sets the maximum current that can be supplied.

Constant Current

If the load resistance is low enough such that, at the set level of output voltage, a current greater than the current limit setting would flow, the supply will automatically move into constant current operation.

The current output is set using the current limit control; the voltage controls set the maximum voltage that can be generated.

Constant Current Indication

When the unit is operating in constant current mode, either by intention or because the current limit point has been reached, the decimal points on the current meter will flash to indicate constant current rather than constant voltage operation.

Instantaneous Current Output

The current limit control can be set to limit the continuous output current to levels down to 1 mA. However, in common with all precision bench power supplies, a capacitor is connected across the output (isolated by the output switch) to maintain stability and good transient response. This capacitor charges to the output voltage, and short circuiting of the output will produce a short current pulse as the capacitor discharges which is independent of the current limit setting.

Current Meter Damping

The digital meters have a reading rate of about four readings per second and a damping time constant of 20 ms, thus providing virtually instantaneous response to reading changes.

If the unit is used to supply a load varying at a rate faster than about 0·5Hz, difficulty may be experienced in interpreting the current meter readings. This problem can be alleviated by pressing the button marked DAMPING. This increases the current meter damping time constant to 2 seconds with the result that the meter will tend to read the average current flowing rather than following the variations. This facility should only be used when necessary since it greatly increases settling time and reduces absolute accuracy.

Series or Parallel connection with other units

The output of the power supply unit is fully floating and may be used in series with other power supply units to generate high DC voltages up to 300V DC.

WARNING! Such voltages are exceedingly hazardous and great care should be taken to shield the output terminals for such use. On no account should the output terminals be touched when the unit is switched on under such use. All connections to the terminals must be made with the power switched off on all units.

It should be noted that the unit can only source current and cannot sink it, thus units cannot be series connected in anti-phase.

The unit can be connected in parallel with others to produce higher currents.Where several units are connected in parallel, the output voltage will be equal to that of the unit with the highest output voltage setting until the current drawn exceeds its current limit setting, upon which the output will fall to that of the next highest setting, and so on. In constant current mode, units can be connected in parallel to provide a current equal to the sum of the current limit settings.

Application of an external voltage source to the output

In common with all series regulated single-ended power supplies, the unit is not capable of sinking current provided from an external source.

If a voltage greater than the set output voltage of the unit is applied from an external source, the internal regulator will turn off, no current will flow, and the voltage meter will read the applied voltage. No damage will result providing the applied voltage does not exceed the maximum output voltage of the power supply by more than 20 Volts. Application of a voltage greater than this is prohibited.

If a reverse voltage is applied, this will be clamped by an internal reverse protection diode. The reverse current should not exceed 3 Amp.

Additional Instructions for Quad Mode Dual Versions

Quad-Mode Dual versions of the power supplies incorporate a bank of four interlocked push-button switches which enable any one of four different modes of operation to be selected. These are as follows:

1. Isolated

Each power supply operates as a completely separate and independent unit, electrically isolated from the other.

2. Parallel

The output from both units is channelled into the Master unit (right hand side), increasing its current output capability accordingly. The Master unit then behaves exactly as a single power supply of increased current capability. The Slave unit (left hand side) becomes inoperative. The resolution of the current meter is 2mA on the PL330QMD in parallel mode.

3. Series

Operation is as in Isolated mode, except that the Slave positive output terminal is internally connected to the Master negative output terminal.

4. Tracking

Operation is as for Series mode, except that the Master voltage controls operate on the Master and Slave units simultaneously. The current limit controls on each unit continue to operate individually. Tracking accuracy is better than ±0·3% of setting ± 0·1% of full range.

The Slave output switch should always be on. Both outputs are then switched from the Master output switch.

Remote sensing cannot be used in either Series or Tracking modes, therefore the shorting bars should be left in place.

Additional Instructions for Quad Mode Triple Versions

The Quad-Mode Triple consists of a Quad-Mode Dual as described in the previous section, plus a logic supply.

P310QMT Logic Supply

This has a fixed 5V 1·5A output which is isolated from the other supplies.

The logic supply is protected against short circuits. It is protected against external forward voltages up to 16 Volts and reverse voltages by a diode: the reverse current must not exceed 3 Amps.

PL320QMT & PL330QMT Logic Supply

Setting the Output

Set the output with the calibrated control. With the output switch OFF the meter (PL330 only) displays voltage; with the switch ON it displays load current. Unless remote sensing is required the shorting bars should be placed from + sense to + output and from - sense to - output.

Current Limit (PL320QMT)

Current limit is indicated by lighting the CURRENT LIMIT LED and is set by a calibrated control with a range of 0·1A to 4A. The power supply is not designed to operate in constant current mode as a current source.

Current Limit (PL330QMT)

Current limit is indicated by all the decimal points flashing and is set by a calibrated control with a range of 0·1A to 7A. The power supply is not designed to operate in constant current mode as a current source.

Protection

Over-voltage protection is fitted to this supply and will be triggered if the voltage across the output terminals exceeds 7 Volts. If this occurs the power supply output is crowbared by a thyristor; the power supply will then shut down and TRIP will be shown in the display. The power supply can be reset by turning off the DC output switch or by turning the supply off.

The power supply is protected from reverse voltages by a diode; the reverse current must not exceed 3 Amps.

General

Connection to the Load

The load should be connected to the positive (red) and negative (black) terminals marked OUTPUT. Both are fully floating and either can be connected to ground. The negative terminals are permanently connected to the power supply output, whilst the positive ones are switched electromechanically (main outputs) or electronically (logic outputs). The green terminal is connected to chassis and to the earth (ground) of the AC input cable.

If the unit is to be used with live measuring or load circuits which have protective earth terminals, ensure that all protective earth terminals are connected to a protective conductor prior to switching on (the green front panel terminal may be used for this purpose).

If the unit is to be used with live measuring or load circuits which do not have protective earth terminals, ensure that the unit AC line plug is inserted before making connections between the unit output terminals and such circuits.

Remote Sensing

The unit has a very low output impedance, but this is inevitably increased by the resistance of the connecting leads. At high currents, this can result in significant differences between the indicated source voltage and the actual load voltage, (two 50mΩ connecting leads will drop 0·2V at 2 Amps, for instance). This problem can be minimised by using short, thick, connecting leads, but where necessary it can be completely overcome by using the remote sense facility.

This requires the sense terminals to be connected to the output at the load instead of at the source; remove the two shorting bars and connect the sense terminals directly to the load. To avoid instability and transient response problems, care must be taken to ensure good coupling between each output and sense lead. This can be done either by twisting the leads together or by using coaxially screened cable (sense through the inner). An electrolytic capacitor directly across the load connection point may also be beneficial.

The voltage drop in each output lead must not exceed 0·5 Volts.

The shorting bars must be re-fitted if the remote sensing facility is not being used. Remote sensing cannot be used in the tracking or series modes on either output.

Other Considerations

The power supplies generate considerable heat and require a full air cooling flow for correct operation. Do not obstruct any of the cooling slots in the cover, or block the inflow of air at the bottom.

Avoid allowing the supply to get damp, and keep away from corrosive fluids.

Maintenance

The Manufacturers or their agents overseas will provide repair for any unit developing a fault. Where owners wish to undertake their own maintenance work, this should only be done by skilled personnel in conjunction with the service manual which may be purchased directly from the Manufacturers or their agents overseas.

Cleaning

If the PSU requires cleaning use a cloth that is only lightly dampened with water or a mild detergent. Polish the display window with a soft dry cloth.

WARNING! TO AVOID ELECTRIC SHOCK, OR DAMAGE TO THE PSU, NEVER ALLOW WATER TO GET INSIDE THE CASE. TO AVOID DAMAGE TO THE CASE OR DISPLAY WINDOW NEVER CLEAN WITH SOLVENTS.

Thurlby Thandar Instruments Ltd
Glebe Road, Huntingdon, Cambridgeshire PE29 7DR, England
Telephone: (44) 01480 412451 Fax: (44) 01480 450409
e mail: sales@tti-test.com web site: www.tti-test.com

Book Part No. 48511-0170 Issue 10