



THURLBY THANDAR INSTRUMENTS

CPX400D & DP

PowerFlex Dual DC Power Supply

SERVICE GUIDE



Table of Contents

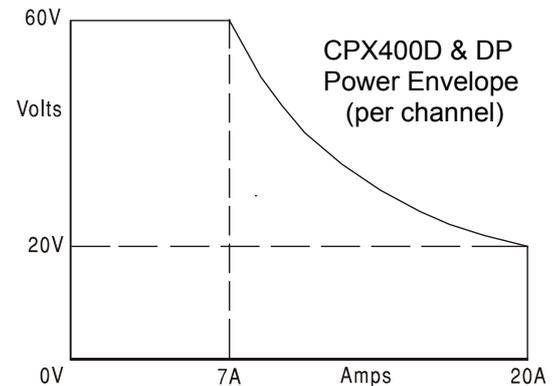
Specification	2
Safety	5
Installation	6
General	7
Calibration	8
Parts List	10

Specification

General specifications apply for the temperature range 5°C to 40°C. Accuracy specifications apply for the temperature range 18°C to 28°C after 1 hour warm-up with no load and calibration at 23°C. Typical specifications are determined by design and are not guaranteed.

OUTPUT SPECIFICATIONS

Voltage Range:	0V to 60V
Current Range:	0A to 20A
Power Range:	Up to 420W
Output Voltage Setting:	By coarse and fine controls.
Output Current Setting:	By single logarithmic control.
Operating Mode:	Constant voltage (CV) or constant current (CC) with automatic cross-over, provided that the power demanded stays within the power envelope, see graph. Outside of this envelope the output becomes unregulated.



Operating Ranges:	Four selectable ranges: 60V/20A, 60V/7A, 20V/20A and Custom Limits. Any V/I setting of the 60V/7A or 20V/20A ranges always falls within the appropriate part of the Power Envelope. The 60V/20A range permits any setting up to 60V and 20A but the output will become unregulated if operated outside of the Power Envelope, see above. The voltage and current limits of the Custom Limits range can be set to any V_{max} between 0.1V & 60V and I_{max} between 0.01A and 20A. This facility is most useful in limiting operation to a particular part of the Power Envelope.
Settings Lock: (S-Lock)	Voltage and current settings can be locked by a single button press. Lock accuracy is equal to meter accuracy (see Meter Specification)
Output Switch:	Electronic. Preset voltage and current displayed when off.
Output Terminals:	Front panel: Universal 4mm safety binding posts on 19mm (0.75") pitch. Rear Panel: Barrier strip connections (CPX400DP only)
Output Sensing:	Switchable between local and remote. Remote connection by spring-loaded push terminals on front panel and barrier strip on rear panel (CPX400DP only).
Output Protection:	Forward protection by Over-Voltage Protection (OVP) and Over-Current Protection (OCP) trips. Reverse protection by diode clamp for reverse currents up to 3A.
OVP Range:	1V to 66V set by front panel screwdriver adjustment or via the remote interfaces. Setting resolution: 100mV. Response time: Typically 1ms. Maximum voltage that should be applied across the terminals is 70V.
OCP Range:	Measure-and-compare over-current protection is implemented in firmware and can only be set via the remote interfaces. Setting resolution: 10mA. Response time: typically 500ms. For manual operation (Local mode) & CPX400D, OCP is fixed at 22A.
Over-temperature Protection:	The output will be tripped off if a fault causes the internal temperature to rise excessively.

Line Regulation: Change in output for a 10% line change:
 Constant voltage: <0.01% of maximum output
 Constant current: <0.01% of maximum output

Load Regulation: Change in output for any load change within PowerFlex envelope, remote sense connected:
 Constant voltage: <0.01% of maximum output
 Constant current: <0.05% of maximum output

Ripple & Noise (20MHz bandwidth): 5mVrms max; typically <3mVrms, <15mV pk-pk, at maximum load, CV mode.

Transient Load Response: <250us to within 50mV of set level for a 5% to 95% load change.

Voltage Programming Speed (CPX400DP only): Maximum time required for output to settle within 1% of its total excursion (for resistive load). Excludes command processing time.

<i>Range and Setting</i>		<i>90% Load</i>	<i>No Load</i>		<i>90% Load</i>	<i>No Load</i>
60V 7A	Up	8ms	8ms	Down	80ms	1.5s
20V 20A	Up	8ms	8ms	Down	10ms	1.2s

Temperature Coefficient: Typically <100ppm/°C

Status Indication: Output ON lamp.
 Constant voltage mode lamp.
 Constant current mode lamp.
 Unregulated (power limit) lamp
 Remote lamp (CPX400DP only)
 LAN lamp
 Trip message on display.

METER SPECIFICATIONS

Meter Types: Dual 4 digit meters with 10mm (0.39") LEDs. Reading rate 4 Hz.

Meter Resolutions: 10mV, 10mA

Meter Accuracies: Voltage 0.1% of reading ± 2 digits
 Current 0.3% of reading ± 2 digits

ADDITIONAL SPECIFICATIONS

Independent Mode: Each output is fully independent and isolated. Operation is equivalent to two single power supplies.

VoltageTracking Mode: (V_{TRACK}) With V_{TRACK} selected the voltage controls of Output 1 (the Master) set an identical voltage on Output 2. The outputs remain isolated and the current controls remain independent.
 Locking the Master (S-Lock) also locks the voltage of Output 2.

Tracking Accuracy: Slave voltage = Master voltage ± (0.1% of Master voltage ± 20mV)

Synchronous On/Off: In addition to the independent DC On/Off controls for each output, the outputs can be turned on or off simultaneously using the Synchronous On/Off key. This key operates in all modes.

DIGITAL INTERFACES (CPX400DP only)

Full digital remote control facilities are available through the RS232, USB, LAN and GPIB interfaces.

Voltage Setting:	16-bit, Resolution 10mV, Accuracy $\pm (0.05\% + 10\text{mV})$
Current Setting:	16-bit, Resolution 1mA, Accuracy $\pm (0.3\% + 0.005\text{A})$
RS232:	Standard 9-pin D-connector. Baud rate 9600.
GPIB:	Conforming with IEEE488.1 and IEEE488.2
USB:	Standard USB 2.0 hardware connection. Operates as a virtual COM port.
LAN:	Ethernet 100/10base-T hardware connection. LXI V1.2, Class C compliant.
Remote Command Processing Time:	Typically <25ms between receiving the command terminator for a step voltage change at the instrument and the output voltage beginning to change.

GENERAL

AC Input:	110V – 240V AC $\pm 10\%$, 50/60Hz. Installation Category II.
Power Consumption:	1250VA max.
Operating Range:	+5°C to +40°C, 20% to 80% RH.
Storage Range:	–40°C to + 70°C.
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2.
Safety:	Complies with EN61010-1.
EMC:	Complies with EN61326.
Size:	210 x 130 x 375mm (WxHxD) half rack width x 3U height (optional rack mounting kit available).
Weight:	7.4kg

This power supply is a Safety Class I instrument 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 10 minutes 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.
	Instrument in STAND-BY
	mains supply ON.
	alternating current (ac)

Mains Operating Voltage

This instrument has a universal input range and will operate from a nominal 115V or 230V mains supply without adjustment. Check that the local supply meets the AC Input requirement given in the Specification.

Mains Lead

Connect the instrument to the AC supply using the mains lead provided. Should a mains plug be required for a different mains outlet socket, a suitably rated and approved mains lead set should be used which is fitted with the required wall plug and an IEC60320 C13 connector for the instrument end. To determine the minimum current rating of the lead-set for the intended AC supply, refer to the power rating information on the equipment or in the Specification.

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.

Ventilation

The power supply is cooled by an intelligent multi-speed fan which vents at the rear. Take care not to restrict the air inlets at top, bottom and side panels or the exit at the rear. In rack-mounted situations allow adequate space around the instrument and/or use a fan tray for forced cooling.

Mounting

This instrument is suitable both for bench use and rack mounting. It is delivered with feet for bench mounting. The front feet include a tilt mechanism for optimal panel angle.

A rack kit for mounting one or two of these Half-width 3U high units in a 19" rack is available from the Manufacturers or their overseas agents.

Service Handling Precautions

Service work or calibration should only be carried out by skilled engineers using high quality test equipment. If the user is in any doubt as to his competence to carry out the work, the instrument should be returned to the manufacturer or their agent overseas for the work to be carried out.

The tracks on the printed circuit boards are very fine and may lift if subjected to excessive heat. Use only a miniature temperature-controlled soldering iron and remove all solder with solder wick or suction before attempting to remove a component.

Dismantling the Instrument

WARNING!

Disconnect the power supply from all voltage sources before it is opened for adjustment or repair. Capacitors inside the supply may still be charged even if the supply has been disconnected from all voltage sources but will be safely discharged about 10 minutes after removing power.

If any adjustment or repair of the opened supply under voltage is inevitable it shall be carried out only by a skilled person who is aware of the hazard involved. The incoming AC supply to the unit under test should be isolated for safety by means of a 1:1 isolation transformer of at least 1500VA. High voltages (up to 400V) are always present in the primary-side circuitry, which lies in a clearly defined area at the rear of the main printed circuit boards.

1. Remove the 6 side screws to release the top cover.
2. First remove the LAN/USB/RS232 Interface PCB (CPX400DP only) by undoing the two RS232 screw-jacks securing the assembly to the rear panel and sliding it forward until the front edge support is clear of the grooves in the Power PCB heatsinks. Unplug the 3-way power connector (PJ9), the two 4-way cable assemblies to the Control PCB and the flat cable to the GPIB Interface assembly (at the GPIB end) and lift the assembly clear. Remove the GPIB Interface by undoing the screw-jacks which secure it to the rear panel.
3. To remove a Power PCB assembly, undo the two nuts securing the orange and black wires to the Main PCB studs and disconnect wires. Unplug the cable assembly between Power PCB assembly and Control PCB noting the orientation (brown wire to pin 1 corner marker). Undo the two M4 nut and bolts securing the top edge of the PCB to the chassis sides, taking care not to lose the spacers, remove the two M3 screws towards the centre of the PCB and lift the board assembly out.
4. Remove the other Power PCB assembly in the same way.
5. Disconnect the cable assemblies between the Control and the Main board.
6. The front panel assembly can be removed by disconnecting all wires between Main PCB and front panel and undoing the 4 screws that secure the front panel to the chassis. The Control board may then be removed by undoing the 5 screws that secure it to the front panel and gently lifting it out.
7. To remove the Main board disconnect the chassis earth connection and undo the 8 screws that secure the Main PCB support pillars to the chassis (i.e. the screws accessible underneath the chassis) and lift out the PCB assembly with its mounting pillars attached.
8. Reassemble in the reverse order taking great care to ensure that all connections are exactly as before dismantling and that no insulation creepage and clearance distances have been compromised. Ensure that only the correct fasteners have been used otherwise earthing, and hence EMC and safety performance, may be impaired.

Calibration

Refer to the General section for dismantling instructions and safety precautions. All adjustments are on the front panel Control board.

Allow 5-minute warm-up before commencing calibration.

Equipment Required

A 5½ digit multimeter with better than 0.05% accuracy on dc Volts and better than 0.12% accuracy on dc current to 10 Amps; alternatively use a precision shunt for current measurement.

Rheostat or other high power load arrangement to provide up to full load.

To enter calibration, hold down the 60V/20A, 60V/7A and 20V/20A buttons at power-on.

60V/7A button is increment, 60V/20A is decrement and 20V/20A is enable adjustment.

Step/Settings	Display	Adjust for	Load	Detail
1. O/P off	Cal count	-5mV ± 2mV	DVM	O/P off volts
2. 0V	Cal count	0V ± 2mV	DVM	V DAC zero
3. Max V, 1A	Cal count	60V ±2mV	DVM	V DAC scale
4. Max V, 1A	O/P volts	Display = DVM	DVM	V metering scale
5.		Display = DVM	DVM	OVP
6. I pot at 0	I pot	Display = 0	-	I pot ADC zero
7. 4V, 0A	Cal count	0mA ± 2mA	milli-ammeter	I DAC zero
8. 4V, 0A	O/P amps	Display = milli-ammeter ±2mA	milli-ammeter	I metering zero
		Change load		
9. 4V, 10A	Cal count	10A ±10mA	Ammeter	I DAC scale
10. 4V, 10A	O/P amps	Display = ammeter	Ammeter	I metering scale
11. O/P off	'End'	-	-	Stores and exits

The final step in the sequence step 11 adjusts nothing. The volts display shows 'End'. Pressing the 20V/20A button for 2.5 seconds stores the new calibration and reboots in normal operating mode. Until this is done no changes at all are made to the EEPROM contents.

Note: the OVP step will jitter because the display shows more resolution than is available for this function.

Powerflex Adjustments

This is factory set and would not normally need to be done during routine calibration. However if a component has been changed proceed as follows. These adjustments are more easily done using an electronic load.

Set the PSU to maximum volts and current.

Set the load to 7.35A and switch on.

Adjust VR13/113 so that the **UNREG** led just comes on.

Set psu voltage to 22V.

Set the load to 20.00A.

Adjust VR15/115 for 21.1X volts (**UNREG** led should be on).

Warning: Take great care when making these adjustments as the large heatsink in the centre of the Main pcb is at a hazardous voltage.

Main Board Adjustments

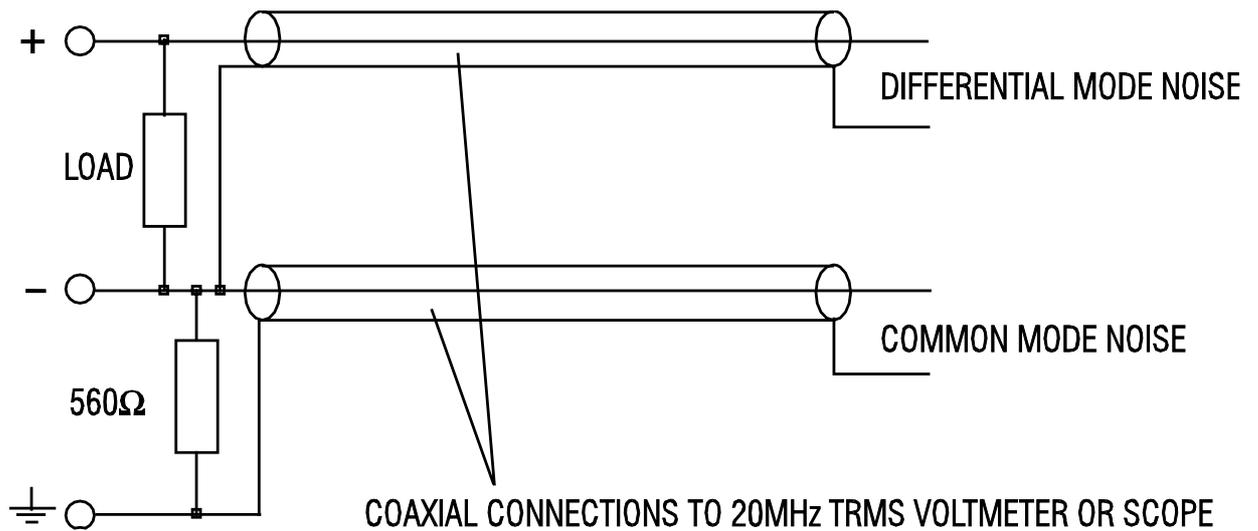
These are factory set and do not require re-adjustment unless a component in that part of the circuit is changed.

VR1 is adjusted to give $390V \pm 0.5V$ HT with 100VAC input.

Adjust VR2 for 72kHz at TP1.

Noise Measurements

Differential and common-mode noise checks can be made using the arrangement below. Keep all unshielded connections as short as possible.



Make measurements with the output fully loaded. Measure differential and common-mode noise one at a time on a 20MHz TRMS voltmeter or use a 20MHz bandwidth-limited scope for peak-to-peak measurements.

Parts List

PCB ASSEMBLIES

Part Number	Description	Position
44115-2070	PCB ASSY POWER L/R	
44115-3620	PCB ASSY FRONT PANEL	FRONT PANEL
44115-3630	PCB ASSY CONTROL	CONTROL ASSY
44115-3640	PCB ASSY TERMINAL	TERMINAL PCB
44115-3650	PCB ASSY MAIN	MAIN PCB
44115-3660	PCB ASS LAN/USB/RS232	
44912-0250	PCB - ASSY - GPIB I/F	

MECHANICAL ITEMS

Part Number	Description	Position
10232-0360	TUBING PVC CLEAR 9.5ID UL	SLEEVE PINK WIRES FROM ON/OFF SWITCH (90MM)
20500-0010	FAN GUARD 80MM	
20662-0570	FOOT SELF ADHESIVE GREY	FRONT FEET
20662-9101	INSTRUMENT FOOT	BACK FEET
22040-0030	FERRITE SLEEVE APPX 9/16/17L	QTY 1 EARTH REAR PANEL (3 PASSES, 2 TURNS),
22219-0130	SWITCH ROCKER GOLD SPST UL SP	
22467-0170	TERMINAL BARRIER BLOCK 4W 20A	REAR PANEL CPX400DP
22571-1150	TERMINAL PSU SAFETY: REAR INS YELLOW	
22571-1211	TERMINAL PSU SAFETY 24L SPINDLE GREY	
22571-1220	TERMINAL PSU SAFETY:TOP INS RED	
22571-1230	TERMINAL PSU SAFETY:TOP INS BLACK	
22571-1240	TERMINAL PSU SAFETY:TOP INS GREY	
22575-0077	SKT 2 WAY IDT .1P	FAN (1), FRONT PANEL (2)
22575-0079	SKT 4 WAY IDT .1P	LAN to CNTL
22575-0081	SKT 6 WAY IDT .1P	LAN to CNTL
22575-0202	SKT 2W .156 20AWG YELLOW IDT	PJ5 ON MAIN (PINS 1 & 2 LINKED), PJ6, 7 ON MAIN, PJ7, 207 ON CONTROL, REAR TERMINALS
22575-0203	SKT 3W .156 20AWG Yellow IDT	LK1 ON MAIN
22575-0204	SKT 4W .156 20AWG Yellow IDT	PJ8 on MAIN
22575-0209	SKT 9W .156 20AWG Yellow IDT	CONTROL/POWER PCBs
23557-0731	CAP 100U 100V ELEC LOW ESR	MOUNTED ACROSS REAR TERMINALS CPX400DP
28522-0030	FAN 80MM 24VDC 3000RPM UL SP	

MECHANICAL ITEMS continued/...

Part Number	Description	Position
31346-0260	INSULATOR MAX505x180MM UL	LARGE HEATSINK ON MAIN
31346-0300	INSULATOR - LAN PCB - CPX400DP	REAR OF LAN PCB
31346-0310	INSULATOR - GPIB PCB- CPX400DP	REAR OF GPIB PCB
31547-1150	SCREEN REAR PANEL CABLE CPX400DP	FIT TO REAR PANEL
31547-1160	SCREEN CHASSIS CABLE CPX400DP	FIT TO CHASSIS BASE
31711-0183	BEZEL - HALF RACK 3U - GREY3	
33143-0293	FOOT - TILT - HOUSING GREY3	
33143-0303	FOOT - TILT - SUPPORT - GREY3	
33331-9840	FRONT PANEL	FRONT PANEL
33331-9850	REAR PANEL PRINTED CPX400DP	REAR PANEL
33331-9990	REAR PANEL PRINTED CPX400D	
33331-9860	OVERLAY FRONT PANEL - CPX400DP	FRONT PANEL OVERLAY
33537-0990	CASE LOWER	
33537-1003	CASE UPPER - GREY3	
37113-2033	KEYCAP 8X3MM GREY3	SYNCHRONOUS ON/OFF AND VTRACK BUTTONS ONLY
37113-2093	KEYCAP 8X4.5MM GREY3	FRONT PANEL OUTPUT 1 / OUTPUT 2
37113-2190	KEYCAP 8X3MM MID GREY	FRONT PANEL KEYS (14)
37151-0443	KNOB 16MM D-SHAFT GREY3	FRONT PANEL
37541-1230	LABEL SAFETY EARTH GREEN/WHITE	FIT INSIDE REAR PANEL
48511-1480	INSTRUCTION MANUAL	

FIXINGS AND FASTENINGS

Part Number	Description	Position
20010-0255	RIVET SNAP-LOCK 4.1Dx7.5TH	
20010-0258	RIVET SNAP-LOCK 3.6Dx2.7-3.6/GREY	
20010-0262	RIVET SNAP-LOCK 4.1D X 3.5T	LAN PCB (2), GPIB BLANKING PLATE (REAR PANEL)
20010-0266	RIVET SNAP-LOCK 3.6Dx2-3H F/HD	CONTROL PCB/FRONT PANEL PCB
20030-0263	WASHER M3 ZPST	
20030-0271	WASHER M4x12x1 ZPST	TERMINALS
20037-0304	WASHER M4 SHK/PROOF I/T ZPST	FRONT FEET (2), EARTH (1), REAR PANEL SCREEN (2)
20037-0401	SOLDER TAG PLAIN - M4	EARTH
20063-0010	SCREW NO6 X 3/8 NIBHDPZ ST/AB	CASE UPPER
20065-0070	SCREW M2.5 X 6 PLAS PNHDPZ	BEZEL FIXING
20065-0150	SCREW N0 6 X 3/8 TORX T15	REAR PANEL TO CHASSIS

FIXINGS AND FASTENINGS continued/...

Part Number	Description	Position
20210-0102	NUT M4 ZPST	TERMINALS
20210-0110	NUT M4 BARB	TERMINALS (5), POWER PCB (4), FRONT PANEL WIRES
20210-0112	NUT M3 BARB	CHASSIS SCREEN/CHASSIS
20213-0040	CAPTIVE NUT SPIRE NO.6	
20234-0016	SCREW M4 X 16 PNHDPZ ZPST	BACK FEET (2), REAR PANEL TERMINAL BLOCKS (4)
20234-0027	SCREW M3 X 6 PNHDPZ ZPST	CHASSIS
20234-0028	SCREW M4 X 10 PNHDPZ ZPST	FRONT FEET
20234-0029	SCREW M4 X 12 PNHDPZ ZPST	POWER PCB
20234-0034	SCREW M4 X 6 PNHDPZ ZPST	SCREEN REAR PANEL (2)
20234-0100	SCREW M3x6PNHDPZ C/W EXT SH/P	PCB SPACERS (8), POWER PCB TO CHASSIS (4)
20236-0010	SCREW M4 X 12 TAMPERPROOF	EARTH
20653-0204	CABLE TIE 100 X 2.5MM	POWER (4), F/PANEL (4)
20661-0275	SPACER HEX M4 X 20 NPBR	TERMINAL BLOCK/REAR PANEL
20661-0293	SPACER Rnd M4 Cl x 4 NYLON	POWER PCBs/CHASSIS
20661-0609	SPACER PCB SUPPORT 1 INCH NYLON	PCB SUPPORT GPIB CABLE
20661-0613	SPACER PCB SUPPORT 7/16L NYLON	



Thurlby Thandar Instruments Ltd.

Glebe Road • Huntingdon • Cambridgeshire • PE29 7DR • England (United Kingdom)

Telephone: +44 (0)1480 412451 • Fax: +44 (0)1480 450409

International web site: www.tti-test.com • UK web site: www.tti.co.uk

Email: info@tti-test.com