AIM & THURLBY THANDAR INSTRUMENTS

QL Series II



Precision linear dc power supplies - single and triple outputs

unrivalled accuracy, resolution, stability and noise performance

advanced user interface gives superior control

multiple output ranges provide greater flexibility

USB, LAN and RS-232 or GPIB interfaces

aimtti.com

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Aim-TTi

Linear regulation with more than 100 watts per output

16-bit precision, 1mV setting resolution

Multiple ranges for increased flexibility

One third or two third rack width, 4U height

Duplicate rear terminals (P versions)

Current resolution down to 0.1mA



Direct numeric setting of voltage or current

Watts display (V x A)

Variable over-voltage and over-current protection trips

Up to 160 memory stores for voltage and current settings

Individual output switches plus master control

Rotary control of voltage and current

Linked mode control for tracking operation or series/parallel wiring

Remote or local sense with keypad selection

Safety binding post terminals can accept fixed-shroud 4mm plugs** as well as normal plugs, bare wires, and fork connectors

Fully bus programmable via USB, LAN, RS232 (P versions) or GPIB(G) interfaces

Auxiliary output, fully variable 1.00V to 6.00V at 3A (bus control and readback on P versions)

Building upon success

The original QL series re-defined the laboratory power supply in terms of precision and performance.

Now the QL Series II builds upon that success and adds new features and models.

Exceptional precision

The QL series offers an unparalleled level of precision. Voltage and current are controlled using instrumentation quality 16 bit DACs enabling voltages to be set to 1mV resolution even at full output voltage.

Indeed, the accuracy is sufficient for the QL to be used as a calibration source for some hand-held DMMs.

Multiple ranges for greater flexibility

The QL series II provides multiple ranges for increased current capability at lower voltages. The QL564, for example, is a 112W PSU with three ranges.

The main range offers 0 to 56 volts at up to 2 amps. The higher current range provides up to 4 amps for voltages up to 25V. A further low current range provides an enhanced current setting and measurement resolution of 0.1mA.

Unrivalled performance

The QL series uses pure linear technology and offers unrivalled performance in terms of regulation, output noise and dynamics.

Line and load regulation are close to the limit of measurement. Recovery time from transient current pulses is better than 50µs.

Differential output noise is less than 350µV rms in CV mode and down to 20µA rms in CI mode.

Of equal importance for critical applications in areas such as telecoms is common mode noise current (the noise current flowing between the output terminals and ground). This is less than 4µA rms on the QL Series - dramatically better than most other PSUs.

- Advanced dc power supply range, single or triple output
- Very high precision, very low noise, excellent dynamics
- Advanced user interface with numeric and rotary control
- Multiple voltage/current ranges for increased flexibility
- Multiple non-volatile memories for power supply set-ups
- Switchable remote sense provides perfect load regulation
- Comprehensive protection including OVP and OCP trips
- Compact bench footprint; modular width for rack mounting
- Auxiliary output fully variable 1.00V to 6.00V at 3A with selectable voltage and current metering (T models)
- Bus programmable via USB, RS232, LAN (P models) or GPIB (G) interface
- Duplicate power and sense terminals at rear (P&G models)



Exceptional facilities and performance

Fast, simple and safe to use

The user interface of the QL series has been painstakingly designed to provide rapid control whilst guarding against any possibility of error.

Unlike other digitally controlled units, the QL series provides both numeric and rotary control.

Illuminated keys and display legends provide instant confirmation of settings and status.

Voltage and current setting can be performed in either of two ways:

Direct numeric entry

Settings can be made by direct numeric entry using the 0 to 9 keypad.

Each new setting is previewed on the display and must be confirmed with the OK key.

Settings recalled from memory are similarly previewed and confirmed.

Numeric setting is very fast requiring only three key presses to set to 5 volts, for example, (V, 5, OK).

To set a more precise level such as 12.725 volts requires more key presses, but can still be done in seconds.

Incremental rotary control

For those preferring quasi-analogue control, or for applications where the voltage or current must be gradually changed, the Jog wheel is available. The wheel has a positive stepped action but can be spun rapidly when required.

Output voltage can be incremented or decremented in steps of 0.1V, 10mV or 1mV. Current steps can be selected from 0.1A down to 0.1mA.

The Jog function can be left permanently engaged or can be disabled at the touch of a button.

Instant Limits view

To enable the current limit to be set before connecting the load, the limit setting is displayed when the output is set to Off.

Pressing the Limits key at any time provides a temporary display of the limit values allowing precise adjustment to be made.

Setting memories for added convenience

The QL Series II provided storage of up to 50 power supply sets-up in non-volatile memory (160 set-ups for a triple). Voltage, current, OVP and OCP are all saved.

An further power-down memory is also incorporated. Upon mains switch-off, the set-up of the PSU is saved and is automatically restored at switch-on.

On the triple output models, independent memories are provided for each output, plus an additional set for 'linked' mode where the user may wish to recall settings for both outputs simultaneously.

Remote or local sense

The QL series provides full remote sense capability via dedicated sense terminals. Remote sense is essential to maintain regulation at the load (two 0.01 Ohm connection leads will drop 100mV at 5 amps).

When remote sense is not required, internal local sensing can be selected at the touch of a button.

Safety binding-post terminals

All QL series power supplies are fitted with the new TTi designed output terminals. As well as acting as conventional binding posts for bare wires, spade connectors, or standard 4mm plugs, these can accept a 4mm safety plug with rigid insulating sleeve, a requirement specified by an increasing number of laboratories for safety reasons.



Limited opening length combined with raised insulated shoulders also make these terminals "touch proof" for voltages up to 250V.

OVP and OCP trips with "alarm" output

The QL series provides fully adjustable over-voltage and over-current trips.

These trips can be used both as a fail-safe against accidental mis-setting and as a protection against inappropriate load conditions.

In addition to turning the output off, a trip condition switches the rear panel alarm signal enabling other equipment to be controlled.

For complete protection of the power supply, the trip will also be operated by over-temperature, or excess voltage on the sense terminals.

Instant watts display

The product of voltage and current can be displayed at any time by pressing the V x A button.

The power is displayed with a resolution down to 1 milliwatt.

Further facilities - triple output models

These triple output models have two main outputs plus one auxiliary output.

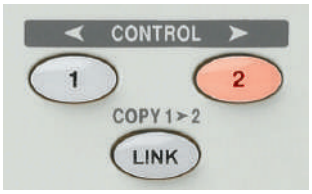
The casing is twice the width of a single output model (two-thirds rack).

Linked mode convenience

The triple output models have two identical outputs which are both independent and isolated.

Illuminated keys selects which output is to be adjusted and provide unambiguous indication.

In situations where the user wishes to set similar voltages or currents on both outputs, "linked" mode is available. When linked, all adjustments are applied to both outputs simultaneously.



Linked mode can provide tracking outputs and is particularly useful when the user wishes to wire the outputs in series or parallel to obtain higher voltages or currents. A "copy" function allows all of the settings of one output to be duplicated on the other prior to linking.

For even greater flexibility, the outputs can be linked when set to different voltages or currents allowing separate settings to be loaded into the linked-mode memories for simultaneous recall.

Auxiliary output for low voltage circuits

The triple output models incorporate a third "auxiliary" output intended for powering logic and other low voltage circuitry.

This output is fully isolated from the main outputs and provides a fully variable voltage of between 1.00 and 6.00 volts at a current of up to 3 amps.



Voltage and current can be read on the main display at the touch of a button. An independent output on/off switch is provided.

On P versions, voltage and on/off status are bus controllable, and output current and status can be read-back.

Note that, unlike the main outputs which are pure linear, the auxiliary output incorporates a switch-mode down converter.

Comprehensive output control

Each output has its own illuminated dc on/off key providing completely independent control.

For situations where power needs to be connected or disconnected from all three outputs together, master on/off keys are also provided.



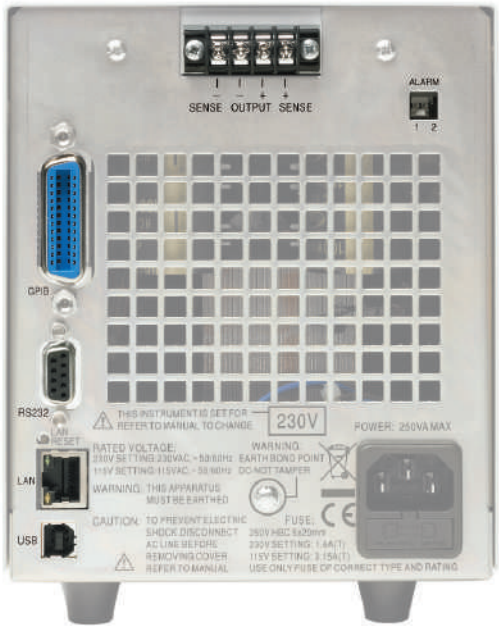
Comprehensive Remote Control (QL-P)

Bench and System use

The QL-P models include all of the manual control features of the standard models plus comprehensive digital interfaces and rear terminals.

All power supply settings can be controlled via the bus. Voltage and current can be set to a resolution of 1mV or 0.1mA for each main output, and to 10mV for the auxiliary output.

Actual voltage and current can be read back along with the power supply status.



Rear output terminals

Power and sense terminals are duplicated on the rear panel for rack mount applications or other situations where rear connection is more appropriate.

Digital remote control

To meet the varying needs of today's engineers, a comprehensive array of interfaces is provided. USB, LAN, RS-232 (P verions) and GPIB (G) are provided as standard. Each of the digital bus interfaces provides full control of voltage, current, and output on/off, plus read-back of voltage, current and status. The interfaces are at ground potential and are opto-isolated from the output terminals.

GPIB (G Version)

The GPIB interface is compliant with IEEE-488.1 and IEEE-488.2. Currently GPIB remains the most widely used interface for system applications.

RS-232

An RS-232/RS-423 interface is provided for use with legacy systems. This type of serial interface remains in common useage and is perfectly satisfactory for the control of power supplies because data speed is not an issue.

USB

USB provides a simple and convenient means of connection to a PC and is particularly appropriate for small system use. A USB driver is provided which supports Windows 2000, XP , Vista and Windows 7. Further versions will be supported as they are released.

LAN (Ethernet)

The LAN interface uses a standard 10/100 base-T Ethernet hardware connection with ICMP and TCP/IP Protocol for connection to a Local Area Network or direct connection to a single PC. This interface supports LXI and is highly appropriate for system use because of its scalable nature and low cost interconnection.

LXI Compliance

The LAN interface is compliant with LXI-C. LXI (LAN eXtensions for Instrumentation) is the next-generation, LAN-based modular architecture standard for automated test systems managed by the LXI Consortium, and is expected to become the successor to GPIB in many systems. For more information on LXI and how it replaces GPIB, or operates along side it, go to: www.aimtti.com/go/lxi

IVI Driver

An IVI driver for Windows is included. This provides support for common high-level applications such as LabView*, LabWindows*, and HP/Agilent VEE*.

Compact design for bench or rack

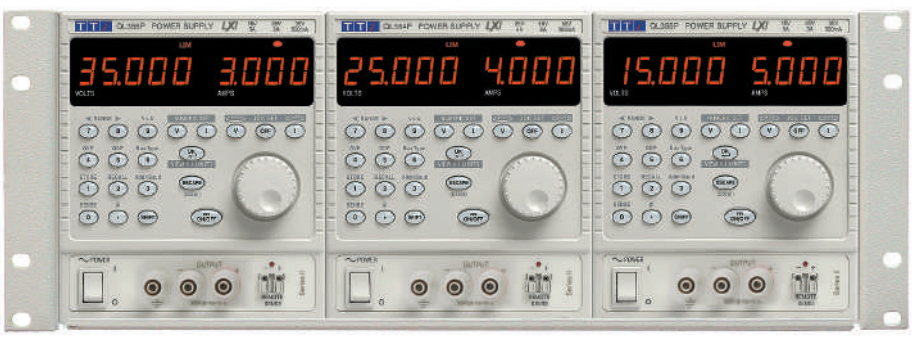
The QL series are highly compact with a small footprint for bench use. Fold-away feet are incorporated which can be used to angle the front panel upwards.

Single output models are one-third rack width, whilst triple output models are two thirds rack width.

A universal rack mount tray is available which will mount one, two or three singles, one triple, or one triple plus one single.

On P versions, rear output terminals are provided for system use.





Technical Specifications

Model Table

Model	O/Ps	Main Output(s)	Aux Output	Max. Power	Interfaces	Terminals	Input V/A	Size W x H x D (mm)	Weight (kg)
QL355	1	0-35V/0-3A or 0-15V/0-5A	-	105W	-	Front only	250 max.	140 x 160 x 290	5.4
QL564	1	0-56V/0-2A or 0-25V/0-4A	-	112W	-	Front only	250 max.	140 x 160 x 290	5.4
QL355T	3	2 x 0-35V/0-3A or 0-15V/0-5A	1-6V/3A	228W	-	Front only	500 max.	280 x 160 x 290	10.5
QL564T	3	2 x 0-56V/0-2A or 0-25V/0-4A	1-6V/3A	242W	-	Front only	500 max.	280 x 160 x 290	10.5
QL355P(G*)	1	0-35V/0-3A or 0-15V/0-5A	-	105W	RS232/USB/GPIB*/LAN	Front/Rear	250 max.	140 x 160 x 290	5.5
QL564P(G*)	1	0-56V/0-2A or 0-25V/0-4A	-	112W	RS232/USB/GPIB*/LAN	Front/Rear	250 max.	140 x 160 x 290	5.5
QL355TP(G*)	3	2 x 0-35V/0-3A or 0-15V/0-5A	1-6V/3A	228W	RS232/USB/GPIB*/LAN	Front/Rear	500 max.	280 x 160 x 290	10.6
QL564TP(G*)	3	2 x 0-56V/0-2A or 0-25V/0-4A	1-6V/3A	242W	RS232/USB/GPIB*/LAN	Front/Rear	500 max.	280 x 160 x 290	10.6

* GPIB optional, factory fit only.

MAIN OUTPUT(S)

QL355, QL355P, QL355T, QL355TP

Max. Output Power: 105 watts
Output Ranges: Range 1 - 0 to 35V, 0 to 3A
Range 2 - 0 to 15V, 0 to 5A
Range 3 - 0 to 35V, 0 to 500.0mA

QL564, QL564P, QL564T, QL564TP

Max. Output Power: 112 watts
Output Ranges: Range 1 - 0 to 56V, 0 to 2A
Range 2 - 0 to 25V, 0 to 4A
Range 3 - 0 to 56V, 0 to 500.0mA

All Models

Voltage Setting: By floating point numeric entry or rotary jog wheel; resolution 1mV.
Current Setting: By floating point numeric entry or rotary jog wheel; resolution 1mA or 0.1mA depending on range.
Setting Accuracy: Voltage - 0.03% ±5mV. Current 0.2% ±5mA/0.5mA
Output Mode: Operation in constant voltage or constant current modes with automatic cross-over and mode indication by LEDs.
DC Output Switch: Sets output voltage and current levels to zero when Off.
Output Terminals: 4mm safety binding post terminals on 19mm (0.75") spacing. Duplicated on rear terminal block (P versions only)
Load Regulation: For any load change, at the output terminals, using remote sense. Voltage <0·01% + 2mV. Current <0·01% + 250µA; <0.01% +50µA on 500mA range. Add typically 2·5mV for a 0·5V drop in the positive output lead.
Line Regulation: Voltage <0·01% + 2mV for 10% line change. Current <0·01% + 250µA; <0.01%+ 50µA on 500mA range
Ripple and Noise: Typically <0.35mV rms CV mode, and <0.2mA rms CI mode (<20µA rms on 500mA range)
Common Mode Noise: <4uA rms at 20MHz bandwidth.
Transient Response: <20usec to within 15mV of setting for 90% load change
Temperature Coeff.: <(50ppm+0.5mV)/ oC (voltage), <(100ppm+1mA/0.1mA)/oC (current)
Remote Sense: Eliminates up to 0.5V drop per lead. Remote sense operation selected from front panel and indicated by LED
Sense Terminals: Recessed sprung sockets for direct insertion of wires Duplicated on rear terminal block (P versions only)

OUTPUT PROTECTION

Output Protection: Output will withstand forward voltages of up to 20V above rated output voltage. Reverse protection by diode clamp for currents up to 3A.
Fault Condition Trip: The output will be shut down if any of the four trip conditions listed below occur. In addition to the output being set to Off, an isolated rear panel signal is also activated.
Over Voltage (OVP): Settable 1V to 40V (QL355) or 60V (QL564) in 0.1V steps
Over Current (OCP): Settable 0.1A to 5.5A (QL355) or 4.5A (QL564) in 0.01A steps
Over Temperature: Monitors internal temperature rise to protect against excess ambient temperature or blocked ventilation slots.
Sense Error: Monitors the voltage between the remote sense terminals and output terminals to protect against mis-wiring.
Trip Output Signal: Isolated open-collector output signal on rear panel.

METERING

Display Type: Dual digital displays per output using 14mm (0.56") high brightness LEDs. 5 digits for voltage, 4 digits for current. Update rate 4 per second.
Meter Function: Voltage meter shows set voltage when in CV mode and measured voltage when in CI mode. Current meter shows measured current when in CV mode and set current when in CI mode.
Limits Display: With the dc output switch set to Off, both meters show the set values (i.e. the limits). With the output On, either the voltage meter or current meter will show a measured value (depending on the CV/CI mode). Pressing the Limits button will provide a temporary display of the set values.
Watts (VxA) Display: The voltage meter can be made to show the instantaneous calculated product of voltage and current.
Meter Resolution: Voltage: 1mV (CV mode) or 10mV (CI mode) Current: 1mA or 0.1mA depending on range Power: 0.01W or 0.001W depending on range
Meter Accuracy: Voltage: 0.1% of reading ±10 mV (CI mode) Current: 0.2% of reading ± 0.005A or 0.5mA (CV mode) Power: 0.3% of reading ± 0.05W or 0.005W

SETTINGS MEMORIES

Main Output(s): Up to 50 set-ups per output can be saved and recalled via the keyboard or remote interfaces.
Parameters Stored: Range, Set volts, Set current, OVP, OCP.
Recall system: Settings are previewed onto the displays before being actioned.
Linked Mode: On triple output models when in Linked mode, a further set of 50 memories stores and recalls values for both outputs simultaneously.
Auxiliary Output: Up to 10 voltage settings can be saved and recalled via the keyboard or remote interfaces.

ALARM OUTPUT

Isolated rear-panel open-collector output signal. User can select output to be activated for either OVP, OCP, Overtemperature or Sense miswiring, or for any of those four faults.

LINK & COPY - Triple Output Models

Each output can be controlled independently or can be linked. When linked, keyboard and jog wheel control operates on both outputs simultaneously.
Linked mode can be used to create tracking outputs, or for convenient series or parallel operation of the two outputs.
A Copy function is available which copies all of the settings for output 1 to output 2 (Range, Set volts, Set current, OVP, OCP).
Linked mode can also be used to store the settings for both outputs to a group of common memory stores when simultaneous recall is required.
(Note: Linked mode can be selected with differing voltage and current settings on the two outputs. However both outputs must be set to the same range.)

AUXILIARY OUTPUT - Triple Output Models

Output Voltage: 1.00 to 6.00V
Output Current: >3.0 A maximum. LED indication of over-current.
DC Output Switch: Sets output voltage level to zero when Off.
Setting Accuracy: ±0.5% ±10mV
Ripple and Noise: <2mV rms, 10mVp-p
Load Regulation: < 1% for 90% load change.
Line Regulation: < 0.1% for 10% line change.
Output Regulation: Switch-mode down converter.
Meter Accuracy: Voltage ±0.5% ±10mV, Resolution 10mV Current ±0.5% ±10mA, Resolution 10mA
Output Protection: Output will withstand up to 16 V forward voltage. Diode clamped for reverse voltages and 1 Amps reverse current.
Output Terminals: 4mm safety binding post terminals on 19mm (0.75") spacing. Duplicate screwless terminals at rear (P versions only)

DIGITAL BUS INTERFACES (P & G suffix versions only)

Full remote control and read-back using USB, RS-232, LAN (P) or GPIB(G). All interfaces are at ground potential and opto-isolated from the output terminals.

RS-232

Standard 9-pin D connector. Baud rate variable 600 to 19,200.

USB

USB 2.0 connection (backwards compatible with USB 1.x). Operates as a virtual COM port.

GPIB (IEEE-488)(option G)

The interface conforms with IEEE-488.1 and IEEE-488.2.

Ethernet (LAN)

Standard 10/100 base-T hardware connection. ICMP and TCP/IP Protocol for connection to Local Area Network or direct connection to a single PC.

LXI Compliance

LAN interface is compliant with LXI class C. (LXI is the abbreviation for Lan eXtensions

DRIVER SOFTWARE SUPPLIED

IVI Driver

An IVI driver for Windows is supplied. This provides support for common applications such as LabView*, LabWindows*, HPVEE* etc.

USB Driver

An installation file is supplied which calls a standard Windows* USB driver.

** LabView and LabWindows are trademarks of National Instruments.*
HPVEE (now Agilent VEE) is a trademark of Agilent Technologies.
** USB interface is supported for Windows 2000, XP, Vista and Windows 7. Further versions will be supported as they are released.*
Windows is a trademark of Microsoft.

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Specifications (Continued)

DIGITAL PROGRAMMING PERFORMANCE (P versions only)

Voltage Setting - Main Output(s)
Resolution/Accuracy: 1mV / ± (0.03% +5mV)

Current Setting - Main Output(s)
Resolution/Accuracy: 0.1mA / ± (0.2% +5mA) or 0.01mA / ± (0.2% +0.5mA) on 500mA range

Voltage Setting - Auxiliary Output (Triple Output Models)
Resolution/Accuracy: 10mV / ± (0.5% +10mV)

Programming Speed

Command Delay:	Typically <25ms (this must be added to any of the figures below)
Voltage Up Time:	<10ms* to 1%
Voltage Down Time:	<40ms* to 1% (full load); <0.6s* to 1% (no load)

* The up and down times vary with range and voltage step size. More information is contained in the operating manual which can be downloaded from our web site.

KEYBOARD & ROTARY CONTROL

All functions, including the selection and set-up of the remote control interfaces, can be set from the keyboard. The rotary jog control can be used to adjust output voltage and current settings in a quasi-analogue mode.

GENERAL SPECIFICATIONS

Input

AC Input:	230V AC or 115V AC ± 10%, 50/60HzInstallation Category II.
Input Power:	Single - 250VA max., Triple - 500VA max.

Temperature & Environmental

Operating Range:	+5ºC to +40ºC, 20% to 80% RH
Storage Range:	-40ºC to + 70ºC
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2.
Cooling:	Intelligent variable-speed fan. Over-temperature trip shuts down output if internal temperatures exceed predetermined thresholds..

Safety & EMC

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

Physical

Size:	Single - 140 x 160 (1/3 rack, 4U) x 290mm Triple - 280 x 160 (2/3 rack, 4U) x 290mm (size excludes feet, knobs and terminals).
Weight:	Single - 5.5kg (12lb), Triple - 10.5kg (23lb)

OPTIONS

Rack Mount
RM410 19 inch 4U mount for up to three single output units or one triple plus one single. Blanking plates are supplied for unused sections.

Accuracy specifications apply for the temperature range 18ºC to 28ºC after one hour warm-up. Thurlby Thandar Instruments Ltd. operate s a policy of continuous development and reserves the right to alter specifications without prior notice.

Other TTi Power Supply Series

EL-R series

Compact linear regulated power supply series with analog controls. Single, dual and triple outputs. 30 to 130 watts. Up to 56V or up to 5A.

PL & PL-P series

Advanced linear regulated power supply series with analog controls combined with digital functions. Ultra compact. Single and dual outputs. 75 to 180 watts. Up to 60V or up to 5A.
Models with RS-232, USB, LAN, and optional GPIB (PL-P).

PLH & PLH-P series

Higher voltage versions of the New PL and PL-P series offering output voltages up to 250V. Single output, 90 watts.
Models with RS-232, USB, LAN and optional GPIB (PLH-P).

EX-R series

Compact mixed-mode regulated power supply series with analog controls. Single, dual and triple outputs. 175 to 420 watts. Up to 150V or up to 20A.

TSX & TSX-P series

High performance mixed-mode regulated single output power supply series with analog or digital controls. 360 watts. Up to 35V or up to 20A.
RS-232 and GPIB controlled models (TSX-P).

MX & MX-P series

Multi-output multi-range power supplies using mixed-mode regulation. Digital control with large graphic LCD. Up to 70V and up to 10A
Models with RS-232, USB, GPIB and LAN interfaces (MX-P).

CPX series

Compact 'PowerFlex' regulated series, single and dual output with analog controls. 350 to 840 watts. Up to 60V or up to 20A.
Models with RS-232, USB, GPIB and LAN interfaces (CPX-P).

QPX series

High power PowerFlex and PowerFlex+ regulated units, digital controls. Single and dual outputs, 750 to 1200 watts. Up to 80V or up to 50A.
Analog, RS-232, USB, GPIB & LAN (LXI) interfaces (QPX-P).

Designed and built in Europe by:

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Brochure Part No. 82100-1190 Iss. 2b

AIM & THURLBY THANDAR INSTRUMENTS

Aim-TTi

Product Summary

Laboratory Power Supplies

Bench and system power supplies from 30 watts up to 1200 watts using linear, mixed-mode and PowerFlex regulation technologies.



Waveform Generators

Analog and digital (DDS) function generators, true arbitrary generators, arbitrary/function generators and pulse generators.



Precision Measurement Instructments

Benchtop DMMs, frequency counters, component measurement instruments (LCR), electronic dc loads, current probes.



RF and EMC Test Equipment

Spectrum analyzers, signal generators, frequency counters, power meters, emc measurement instruments.



Company name and product brands

Thurlby Thandar Instruments Ltd. (TTi) is one of Europe's leading manufacturers of test and measurement instruments.

Products have been sold under two brand names: TTi and Aim.

In the future, however, the full product range will be branded Aim-TTi.

This changeover will be gradual and many products will continue to carry the TTi or Aim brands for some time to come.

Web Addresses (URLs)

The preferred URL for obtaining information concerning Aim-TTi products is:

www.aimtti.com (international customers)

Customers in the UK should use the URL:
www.aimtti.co.uk

Customers in the USA should use the URL:
www.aimtti.us

Note that previous URLs such as www.tti-test.com will continue to operate for the time being.

Designed and built in Europe by:

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