

## QL and QL-P Series - Description and Specifications

### QL Series - 105W to 215W, High Precision, Linear, Digital Control, Single and Triple Output

- ▶ Single output or triple output models
- ▶ Setting by direct numeric entry or spin wheel
- ▶ 1mV resolution at up to 56 volts
- ▶ Multiple ranges for increased current flexibility
- ▶ Multiple non-volatile setting memories
- ▶ OVP and OCP trips with alarm output
- ▶ Selectable remote sense terminals
- ▶ Linked-mode operation of main outputs (triple)
- ▶ Auxiliary output of 2.7, 3.3 or 5.0V at 1A (triple)
- ▶ GPIB, RS232 and USB interfaces (P versions)
- ▶ Front and rear mounted terminals (P versions)



Picture of single and triple models ◀  
"At a glance" features listing ◀

### Unmatched Precision, Unrivalled Performance

The QL series represents the 'next generation' of laboratory power supplies offering an unparalleled level of precision and performance.

Voltage and current are controlled using 16 bit DACs enabling voltages to be set to 1mV resolution even at full output. Indeed, the accuracy is sufficient for the PSU to be used as a calibration source for some hand-held DMMs.

The QL series uses pure linear technology and offers unrivalled performance in terms of regulation, output noise and dynamics. Line and load regulation are at the limit of measurement. Output noise is less than 350µV rms. Recovery time from transient current pulses is better than 50µs.

The QL series provides full remote sense capability via dedicated sense terminals. Remote sense is essential to maintain precise regulation at the load (two 0.03 Ohm connection leads will drop 300mV at 5 Amps). When remote sense is not required, internal local sensing can be selected at the touch of a button.

### Setting Memories for Added Convenience

The QL series provided storage of up to 30 power supply sets-ups in non-volatile memory. Upon mains switch-off, the set-up of the PSU is saved and is automatically restored at switch-on.

### Multiple Ranges for Greater Flexibility

The QL series provides multiple ranges for increased current capability at lower voltages. The main range offers 0 to 35 volts at up to 3 Amps. The higher

### 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 versatile 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 terminals are provided for system use.

### OVP and OCP Trips with 'Alarm' Output

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

### Auxiliary output for low voltage circuits - QL355T and QL355TP

The QL355T and TP incorporate a third output intended for powering logic and other low voltage circuitry.

This output is fully isolated from the main outputs and provides a switchable voltage of 2.7, 3.3 or 5.0 volts at a current of up to one amp. An independent output

current range provides up to 5 Amps for voltages up to 15V. A further low current range provides enhanced current setting and measurement resolution of 0.1mA. The product of voltage and current can be displayed at any time by pressing the VxA button. The power is displayed to a resolution of 0.01 Watts.

### **Fast, Simple and Safe to use**

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

Voltage and current setting can be performed either by direct numeric entry or, for applications where the voltage or current must be gradually changed, by using the quasi-analogue Jog control.

To enable the current limit to be set before connecting the load, the limit setting is displayed when the output is off. Pressing the View Limits key at any time provides a temporary display of the limit values allowing precise adjustment to also be made with the output on.

### **Triple Output Models QL355T and QL355TP**

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).

The QL355T and TP 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.

### **MODEL RANGE**

QL355 - Single Output, 35V/3A or 15V/5A

QL564 - Single Output, 56V/2A or 25V/4A

QL355T - Triple Outputs, 2 x (35V/3A or 15V/5A)  
plus 2.7/3.3/5.0V at 1A

QL355P - As QL355 with RS232/GPIB/USB interfaces

on/off switch is provided which is bus controllable on the QL355TP.

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.

### **QL-P MODELS**

#### **Fully programmable via GPIB, RS-232 or USB**

Models with a P suffix incorporate a full bus interface enabling remote control and readback via either GPIB (IEEE-488), RS-232 or USB. On T models, the single interface address controls all three outputs. The GPIB interface conforms fully with IEEE-488.2 as well as IEEE-488.1. The serial interface can be used as a conventional RS-232 interface or as part of a multi-instrument ARC system (Addressable RS-232 Chain).

#### **USB support:**

The QL bus interface incorporates a USB connection in addition to RS232 and GPIB.

USB represents the future for medium speed PC connectivity and enables multiple devices to be connected. A Windows device driver is supplied which creates a virtual COM port, enabling USB to be used with applications that do not directly support it.

#### **Fully isolated outputs for maximum flexibility:**

Each output is fully floating and is opto-isolated from the bus interfaces. On triple output models the two main outputs can be linked in series or parallel to produce higher voltages or higher currents as required.

#### **Rear terminals:**

P versions incorporate output power and sense terminals on the rear panel in addition to as the front panel.

#### **Simple and consistent control:**

QL series supplies use simple and consistent command structures which make programming particularly easy regardless of which interface is used. A National Instruments LabWindows\* device driver is available.

#### **High resolution control and readback:**

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

QL564P - As QL564 with RS232/GPIB/USB interfaces  
QL355TP - As QL355T with RS232/GPIB/USB interfaces

supply status. N.B. Control of the auxiliary output on T models is limited to output on-off and monitoring of overload status.

## SPECIFICATIONS

### MAIN OUTPUT(S)

Max. Output Power:

Output Ranges:

### QL355, QL355P, QL355T, QL355TP

105 watts

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

### MAIN OUTPUT

Max. Output Power:

Output Ranges:

### QL564, QL564P

112 watts

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

### MAIN OUTPUT(S)

Voltage Setting:

Current Setting:

Setting Accuracy:

Output Mode:

DC Output Switch:

Output Terminals:

Load Regulation:

Line Regulation:

Ripple and Noise:

Transient Response:

TempCo:

Remote Sense:

Sense Terminals:

By floating point numeric entry or rotary jog wheel; resolution 1mV.

By floating point numeric entry or rotary jog wheel; resolution 1mA or 0.1mA depending on range.

Voltage - 0.03%  $\pm$ 5mV. Current 0.2%  $\pm$ 5mA/0.5mA

Operation in constant voltage or constant current modes with automatic cross-over and mode indication by LEDs.

Sets output voltage and current levels to zero when Off.

4mm terminals on 19mm (0.75") spacing. Duplicate terminals on rear tag strip (P versions only)

<0.01% of maximum output for 50% load change

<0.01% of maximum output for 10% line voltage change

Typically <0.35mV rms

<20usec to within 15mV of setting for 90% load change

< $\pm$ (50ppm+0.5mV)/ degreeC (voltage)

Eliminates up to 0.5V drop per lead. Remote sense operation selected from front panel and indicated by LED.

Recessed sprung sockets for direct insertion of wires. Duplicate terminals on rear tag strip (P versions only).

### OUTPUT PROTECTION

Fault Condition Trip:

Over Voltage (OVP):

Over Current (OCP):

Over Temperature:

Sense Error:

Trip Output Signal:

Output will withstand forward voltages of up to 20V above rated output voltage. Reverse protection by diode clamp for currents up to 3A.

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.

Settable 1V to 40V (QL355) or 62V (QL564) in 0.1V steps

Settable 0.1A to 5.5A (QL355) or 4.4A (QL564) in 0.01A steps

Monitors internal temperature rise to protect against excess ambient temperature or blocked ventilation slots.

Monitors the voltage between the remote sense terminals and output terminals to protect against mis-wiring.

Isolated open-collector output signal on rear panel.

### METERING

Display Type:	Dual digital meters per output using 14mm (0.56") high brightness LEDs. 5 digit voltmeter, 4 digit current meter. Reading 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. The value displayed is equal to the equivalent power at the moment when the button is pressed and remains whilst the button is held.
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: 0.05% of reading $\pm 10$ mV (CI mode) Current: 0.2% of reading $\pm 0.005$ A or 0.5mA (CV mode) Power: 0.3% of reading $\pm 0.05$ W or 0.005W

### SETTING MEMORIES

Number of Stores:	10 (30 total on QL355T and TP) plus power-down store.
Memory Type:	Non-volatile using EEPROM.
Parameters Stored:	Range, Set volts, Set current, OVP, OCP.
Recall system:	Settings are previewed onto the displays before being actioned.

### LINK & COPY

#### QL355T & QL355TP Only

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 one to output two (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

#### QL355T & QL355 TP Only

Output Voltage:	Switchable as 2.7V, 3.3V or 5.0V. Accuracy $\pm 1\%$ .
Output Current:	>1.0 A maximum. LED indication of over-current.
DC Output Switch:	Sets output voltage level to zero when Off.
Output Terminals:	4mm terminals on 19mm (0.75") spacing. Duplicate terminals at rear (P versions only)
Output Protection:	Output will withstand up to 16 V forward voltage. Diode clamped for reverse voltages and 3 Amps reverse current.
Load Regulation:	< 0.2% for 50% load change.
Line Regulation:	< 0.1% for 10% line change.

### BUS INTERFACES

#### P Suffix versions only

USB:	Supplied with device driver for Win98 or above. Operates as a virtual COM port.
RS-232:	Variable baud rate 19,200 max. Single instrument or Addressable RS232 Chain (ARC) system.
GPIB:	Conforming with IEEE-488.1 and IEEE-488.2

N.B. All three interfaces incorporate full control, readback and status reporting.

Bus Type Selection: From front panel (GPIB/RS232/USB).  
Address Selection: From front panel (1 to 31).  
Baud Selection: RS-232 only. From front panel (600 to 19200 baud).  
Setting Resolution: Voltage - 1mV, Current 0.1mA (0.01mA on 500mA range).  
Readback Resolution: Voltage - 10mV, Current 1mA (0.1mA on 500mA range).  
Accuracy: See specifications under Outputs and Metering above.  
Remote Command Response Time: Interface: <80 ms (command processing time). Output Voltage : Response time varies with range and load conditions. Typical time to settle to within 1% of the total excursion on a 35V/3A range with full load is <25ms. With no load it is <7 ms for an upward change and <600ms for a downward change.

## GENERAL

Power Requirements: 230V or 115V  $\pm$  14% (internally adjustable). Installation category 11.  
Environmental: Operating Range: 5oC to 40oC, 20% to 80% RH  
Storage Range: -20oC to +60oC  
Size: 141 x 171 x 300 mm (single); 282 x 171 x 300 mm (triple)  
Weight: 5 kg (single); 10 kg (triple)  
Electrical Safety: Designed and manufactured to comply with IEC1010-1. Full safety sockets available to special order.  
EMC: Designed and manufactured to comply with EN61326.  
Benchtop Operation: Folding legs are incorporated that can be used to angle the front panel upwards when required.  
Rack Mount Option: 19 inch 4U mount for up to three single output units or one triple plus one single. Blanking plates are available for unused sections.

Thurlby Thandar Instruments Ltd. operates a policy of continuous development and reserves the right to alter specifications without prior notice.