THURLBY THANDAR INSTRUMENTS

EL-R & EX-R Series



Precision laboratory power supplies - single, dual and triple outputs

EL-R Series - linear regulated - 30 watts to 130 watts

EX-R Series - mixed-mode regulated - 175 watts to 420 watts

compact size, silent cooling, 4 digit meters, remote sense

also covers EL302P, EX355P, EX752M

tti-test.com

EL-R Series - linear regulated precision laboratory power supplies





EL-R Series - Model Range					
Model	O/Ps	Voltage	Current	Power	Aux. O/P
EL301R	One	0 to 30V	0 to 1A	30W	
EL183R	One	0 to 18V	0 to 3.3A	60W	
EL302R	One	0 to 30V	0 to 2A	60W	
EL561R	One	0 to 56V	0 to 1.1A	60W	
EL155R	One	0 to 15V	0 to 5A	75W	
EL303R	One	0 to 30V	0 to 3A	90W	
EL302RD	Two	0 to 30V	0 to 2A	120W	
EL302RT	Three	0 to 30V	0 to 2A	130W	1.5 - 5V @2A
Related Models					
EL302P	30V/2A model with RS-232 interface				

Simplicity in use

EL-R series power supplies use classic analog controls for voltage and current.

The large and bright displays have a fixed resolution to avoid confusion.

Preset voltage and current levels are shown when the DC output switch is turned off.

Remote sense is available when needed but is disabled by setting the switch to Local.

EL-R Series

Simplicity with Precision

The new EL-R series has been developed from the top selling EL series.

By adding four digit meters and switchable remote sensing, the EL-R series offers much higher precision whilst retaining the simplicity of operation which many bench-top power supply users prefer.

Eight models are offered including single, dual and triple outputs and covering a power range of 30 watts up to 130 watts.

Linear regulation

All EL-R series models* use true linear regulation for the best possible performance. Excellent line and load regulation is matched by very low output noise and good transient response.

Four digit meters

The EL-R series incorporates separate voltage and current meters on each main output with a resolution of 10mV and 1mA. The fixed resolution avoids the misinterpretation of readings that can occur with auto-ranging 3 or 3½ digit meters where the decimal point position moves as the reading changes.

Remote Sensing

Each main output incorporates remote sense terminals that can be enabled or disabled at the flick of a switch.

Remote sensing is essential for maintaining precise regulation at the load and true metering of the load voltage. Many other power supplies omit remote sense, and quote regulation figures that could never be achieved in practice.

N.B. A 2 metre length of a 24/0.2 wire pair has a resistance of around 0.1 Ω. For a 5V load drawing 3A the metering error without remote sense would be 0.3V and the effective full current load regulation would be around 6%, against a quoted figure of perhaps 0.01% for the power supply itself.

DC output switches

Each main output has a DC on-off switch. This enables voltage and current settings to be viewed before the load is connected and allows multiple outputs to be controlled individually. Surprisingly, many power supplies omit this essential feature.

Constant voltage or constant current

Each main output can operate in constant voltage or constant current mode with automatic crossover and mode indication. Coarse and fine voltage controls are provided. The current control is logarithmic enabling low current levels to be set accurately.

Silent cooling

All EL-R series models use convection cooling and are entirely free of fan noise.

Safety binding-post terminals

EL-R series power supplies are fitted with the new TTi designed output terminals. These can accept a 4mm safety plug with rigid insulating sleeve, a requirement specified by an increasing number of laboratories for safety reasons.

However, unlike the 4mm safety sockets used on some other products, the new TTi terminals can also accept fork connectors or bare wires, giving maximum connection flexibility.



Single, dual or triple outputs

The EL-R series includes six single output models plus one dual output and one triple output model.

The EL302RD has two independent and isolated outputs each with a 0 to 30V, 0 to 2A capability and its own on-off switch. The outputs can be wired in either series or parallel to provide voltages up to 60 volts or currents up to 4 amps.

All outputs are intrinsically short circuit proof, and are protected against external voltages and reverse currents.

Variable voltage auxiliary output

The EL302RT incorporates a third output fully variable between 1.5V and 5.0V with a fixed current limit of 2A.

The set voltage can be measured at the press of a button using the digital meters.

* Note that this third output uses switch-mode post regulation.

Alternative power supply series

If the EL-R series does not exactly fit your requirements, TTi offers ten other PSU series totalling around 60 models. The closest models to the EL-R series are:

New PL & PL-P series

Advanced linear regulated PSUs of ultra-compact size offering up to 90 watts per output. Features include lockable analog controls, variable voltage span, and 0.1mA current resolution.

The P versions include remote control via analog, RS232, USB and LAN interfaces with LXI support. GPIB is available as an option.

EX-R series

The EX-R series has similar features to the EL-R series but uses mixed-mode regulation to offer power from 175 watts up to 420 watts.

Full details of the EX-R series are included within this brochure.

EL302P - operation via RS-232

The EL302P is a digitally controlled version of the EL302 with an isolated RS-232 interface.



It offers a low-cost solution for a basic programmable PSU and will be sufficient for many applications where the sophistication and complexity of GPIB is not needed.

A simple command set allows remote control of voltage, current and output enable together with read-back of metering values and operational status.

Local control is via three rotary encoders providing rapid and accurate setting of voltage and current during bench use.

EX-R Series - mixed-mode regulated precision laboratory power supplies





EX-R Series - Model Range					
Model	O/Ps	Voltage	Current	Power	Aux. O/P
EX1810R	One	0 to 18V	0 to 10A	180W	
EX355R	One	0 to 35V	0 to 5A	175W	
EX2020R	One	0 to 20V	0 to 20A	400W	
EX4210R	One	0 to 42V	0 to 10A	420W	
EX354RD	Two	0 to 35V	0 to 4A	280W	
EX354RT	Three	0 to 35V	0 to 4A	305W	1.5 - 5V @5A
Related Models					
EX752M	Two*	0 to 75V	0 to 2A	300W	
* or single output of 75V/4A or 150V/2A					
EX355P	35V/5A model with RS-232 interface				

Simplicity in use

EX-R series power supplies use classic analog controls for voltage and current.

The large and bright displays have a fixed resolution to avoid confusion.

Preset voltage and current levels are shown when the DC output switch is turned off.

Remote sense is available when needed but is disabled by setting the switch to Local.

EX-R Series

Power, Precision, Simplicity

The new EX-R series has been extended by incorporating models from the best selling EX series.

By adding four digit meters and switchable remote sensing, the EX-R series offers much higher precision whilst retaining the simplicity of operation which many bench-top power supply users prefer.

Six models are offered including single, dual and triple outputs and covering a power range of 175 watts up to 420 watts.

Mixed-mode regulation

The EX-R series combines high frequency switch-mode pre-regulation with linear post-regulation to provide performance that comes close to that of an all-linear design.

Excellent line and load regulation is matched by low noise and good transient response.

Four digit meters

The EX-R series incorporates separate voltage and current meters on each main output with a resolution of 10mV and 1mA (10mA on higher current models). The fixed resolution avoids the misinterpretation of readings that can occur with auto-ranging 3 or 3½ digit meters where the decimal point position moves as the reading changes.

Remote Sensing

Each main output incorporates remote sense terminals that can be enabled or disabled at the flick of a switch.

Remote sensing is essential for maintaining precise regulation at the load and true metering of the load voltage. Many other power supplies omit remote sense, and quote regulation figures that could never be achieved in a practice.

N.B. A 2 metre length of a 24/0.2 wire pair has a resistance of around 0.1 Ω. For a 5V load drawing 3A the metering error without remote sense would be 0.3V and the effective full current load regulation would be around 6%, against a quoted figure of perhaps 0.01% for the power supply itself.

DC output switches

Each main output has a DC on-off switch. This enables voltage and current settings to be viewed before the load is connected and allows multiple outputs to be controlled individually. Surprisingly, many power supplies omit this essential feature.

Constant voltage or constant current

Each main output can operate in constant voltage or constant current mode with automatic crossover and mode indication. Coarse and fine voltage controls are provided. The current control is logarithmic enabling low current levels to be set accurately.

*Silent cooling**

Most EX-R series models use convection cooling and are entirely free of fan noise. * *The highest power density models, EX2020R and EX4210R, use an intelligent fan for cooling.*

Safety binding-post terminals

EX-R series power supplies are fitted with the new TTi designed output terminals. These can accept a 4mm safety plug with rigid insulating sleeve, a requirement specified by an increasing number of laboratories for safety reasons.

However, unlike the 4mm safety sockets used on some other products, the new TTi terminals can also accept fork connectors or bare wires, giving maximum connection flexibility.



Single, dual or triple outputs

The EX-R series includes four single output models plus one dual output and one triple output model.

The EX354RD has two independent and isolated outputs each with a 0 to 35V, 0 to 4A capability and its own on-off switch. The outputs can be wired in either series or parallel to provide voltages up to 70 volts or currents up to 8 amps.

All outputs are intrinsically short circuit proof, and are protected against external voltages and reverse currents.

Variable voltage auxiliary output

The EX354RT incorporates a third output fully variable between 1.5V and 5.0V with a fixed current limit of 5A.

The set voltage can be measured at the press of a button using the digital meters.

Higher current and higher power

Single output versions of the EX-R series are available with an output current capability up to 20 amps and output power up to 420 watts.

These higher current models have 10mA meter resolution.

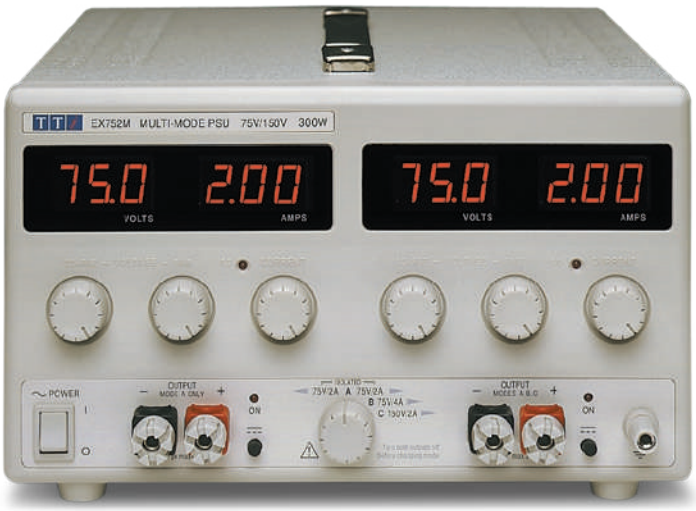
The highest power versions (EX2020R and EX4210R) have fan assisted cooling using a low-noise brushless dc fan with intelligent control.
(All other models use fan-less convection cooling).



EX752M - higher voltage multi-mode dual

Output voltages up to 150V

The EX752M is a dual output 300 watt PSU with Multi-Mode capability. This enables it to operate as a dual power supply with two independent and isolated outputs, or as a single power supply of double the power.



As a dual, each output provides 0 to 75V at 0 to 2A (mode A). As a single, the output can be selected as either 0 to 75V at 0 to 4A (mode B) or 0 to 150V at 0 to 2A (mode C). In single modes, the unused half of the unit becomes completely inoperative and its displays are blanked.

EX355P - operation via RS-232

The EX355P is a digitally controlled version of the EX355 with an isolated RS-232 interface.

It offers a low-cost solution for a basic programmable PSU and will be sufficient for many applications where the sophistication and complexity of GPIB is not needed.



A simple command set allows remote control of voltage, current and output enable together with read-back of metering values and operational status.

Local control is via three rotary encoders providing rapid and accurate setting of voltage and current during bench use.

EL-R MODEL RANGE

Voltage/Current Levels

EL301R	0 to >30V; 0 to >1A	(30W nominal power)
EL183R	0 to >18V; 0 to >3.3A	(60W nominal power)
EL302R	0 to >30V; 0 to >2A	(60W nominal power)
EL561R	0 to >56V; 0 to >1.1A	(60W nominal power)
EL155R	0 to >15V; 0 to >5A	(75W nominal power)
EL303R	0 to >30V; 0 to >3A	(90W nominal power)
EL302RD	2 x (0 to >30V; 0 to >2A)	(120W nominal power)
EL302RT	2 x (0 to >30V; 0 to >2A) plus 1.5 to 5.0V @ 2A	(130W nominal power)

OUTPUT SPECIFICATIONS

Output Setting & Control

Voltage Setting:	By coarse and fine controls.
Current Setting:	By single logarithmic control.
Output Mode:	Constant voltage or constant current with automatic cross-over. CC indicator lit in constant current mode.
Output Switch:	Electronic, non isolating. Preset voltage and current limit displayed when Output is off. On state indicated by LED.

Output Performance

Ripple & Noise:	Typically <1mV rms, (CV mode, 20MHz bandwidth).
Load Regulation:	<0·01% of maximum output for a 90% load change (using remote sense).
Line Regulation:	<0·01% of maximum output for 10% line change.
Transient Response:	<50µs to within 50mV of setting for a 5% to 95% load change.
Temp. Coefficient:	Voltage: typically <100ppm/°C.

Output Protection

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

Output Connections

Output Terminals:	Universal 4mm safety binding posts on 19mm (0·75") spacing.

Terminals can accept fixed shroud 4mm plugs, standard 4mm plugs, fork terminals and bare wires.

Remote Sense

Sense Selection:	Voltage sensing is selected as Local or Remote by front panel switch.
Sense Terminals:	Sprung loaded screw-less terminals.

METER SPECIFICATIONS

Display Type: Dual 4-digit meters, 14mm (0·56") LED.

Voltage Meter

Resolution:	10mV
Accuracy:	0·3% of reading ± 3 digits

Current Meter

Resolution:	1mA
Accuracy:	0·5% of reading ± 3 digits

AUXILIARY OUTPUT (EL302RT only)

Voltage:	Variable <1.5V to >5V by front panel control.
Meter accuracy:	0.3% ± 4 digits.
Current limit:	2A minimum.
Load regulation:	<3% for 90% load change.
Line regulation:	<0.2% for 10% line voltage change.
Ripple & Noise	Typically <5mVrms, <15mVpk-pk (20MHz bandwidth):
Output Protection:	Output will withstand up to 7V forward voltage. Diode clamp reverse protection for currents up to 3A.
Output Terminals:	Universal 4mm safety binding posts on 19mm (0·75") spacing.
Status Indication:	UNREG lamp.

GENERAL SPECIFICATIONS

Input

AC Input:	230V AC or 115V AC ± 10%, 50/60Hz. Installation Category II
VA Ratings:	EL301R - 85 VA; EL302R, EL302P, EL183R, EL561R - 160VA; EL155R, EL303R - 250VA; EL302RD, EL302RT - 320VA

Temperature & Environmental

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.
Cooling:	Silent fan-less convection cooling.

Safety & EMC

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

Physical

Size:	Single output models - 140x160x295 mm (WxHxD). Dual and triple output models - 260x160x295 mm (WxHxD).
Weight:	EL301R - 3.4kg; EL302R, EL302P, EL183R, EL561R - 4.4kg: EL155R, EL303R - 5.0kg; EL302RD, EL302RT - 7.5kg.

Accuracy specifications apply for the temperature range 18°C to 28°C after 1 hour warm-up. Thurlby Thandar Instruments Ltd. operates a policy of continuous development and reserves the right to alter specifications without prior notice.

Specifications - EX-R Series EL302P, EX355P, EX752M

EX-R MODEL RANGE

Voltage/Current Levels

EX355R	0 to >35V; 0 to >5A	(175W nominal power)
EX1810R	0 to >18V; 0 to >10A	(180W nominal power)
EX2020R	0 to >20V; 0 to >20A	(400W nominal power)
EX4210R	0 to >42V; 0 to >10A	(420W nominal power)
EX354RD	2 x (0 to >35V; 0 to >4A)	(280W nominal power)
EX354RT	2 x (0 to >35V; 0 to >4A) plus <1.5 to >5.0V @ 5A	(305W nominal power)

OUTPUT SPECIFICATIONS

Output Setting & Control

Voltage Setting: By coarse and fine controls.
Current Setting: By single logarithmic control.
Output Mode: Constant voltage or constant current with automatic cross-over. CC indicator lit in constant current mode.
Output Switch: Electronic, non isolating. Preset voltage and current limit displayed when Output is off. On state indicated by LED.

Output Performance

Ripple & Noise: Typically <2mV rms, <10mV pk-pk (EX355R, EX354RD, EX354RT) Typically <2mV rms, <20mV pk-pk (EX1810R, EX2020R, EX4210R) (CV mode, 20MHz bandwidth)
Load Regulation: <0·01% of maximum output for a 90% load change (using remote sense).
Line Regulation: <0·01% of maximum output for 10% line change.
Transient Response: <200µs to within 50mV of setting for a 5% to 95% load change.
Temp. Coefficient: Voltage: typically <100ppm /°C.

Output Protection

Output Protection: Outputs will withstand forward voltages up to 40V (EX355R, EX354RD, & EX354RT); 22V (EX1810R); 25V (EX2020R); 48V (EX4210R). Reverse protection by diode clamp for currents to 3A.

Output Connections

Output Terminals: Universal 4mm safety binding posts on 19mm (0·75") spacing.
Terminals can accept fixed shroud 4mm plugs, standard 4mm plugs, fork terminals and bare wires.

Remote Sense

Sense Selection: Voltage sensing is selected as Local or Remote by front panel switch.
Sense Terminals: Sprung loaded screw-less terminals.

METER SPECIFICATIONS

Display Type: Dual 4-digit meters, 14mm (0·56") LED.

Voltage Meter

Resolution: 10mV
Accuracy: 0·3% of reading ± 3 digits

Current Meter (EX355R, EX354RD, EX354RT)

Resolution: 1mA
Accuracy: 0·5% of reading ± 3 digits

Current Meter (EX1810R, EX2020R, EX4210R)

Resolution: 10mA
Accuracy: 0·6% of reading ± 3 digits

AUXILIARY OUTPUT (EX354RT only)

Voltage: Variable <1.5V to >5V by front panel control.
Meter accuracy: 0.3% ± 4 digits.
Current limit: 5A minimum.
Load regulation: <0.5% for 90% load change.
Line regulation: <0.1% for 10% line voltage change.
Ripple & Noise Typically <2mVrms, <10mVpk-pk (20MHz bandwidth):
Output Protection: Output will withstand up to 7V forward voltage. Diode clamp reverse protection for currents up to 3A.
Output Terminals: Universal 4mm safety binding posts on 19mm (0·75") spacing.
Status Indication: UNREG lamp.

GENERAL SPECIFICATIONS

Input

AC Input: EX354RD, EX354RT - 110V to 240V 50/60Hz (universal input); Other Models - 230V AC ± 10% 50/60Hz; 115V to order. Installation Category II
VA Ratings: EX810R, EX355R - 400VA; EX354RD, EX354RT - 500VA EX2020R, EX4210R - 800VA.

Temperature & Environmental

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.
Cooling: EX1810R, EX355R, EX354RD, EX354RT - fan-less convection cooling; EX2020R, EX4210R - fan assisted using low-noise brushless dc fan.

Safety & EMC

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

Physical

Size: Single output models - 140x160x320 mm (WxHxD). Dual and triple output models - 260x160x320 mm (WxHxD).
Weight: EX810R, EX355R - 3.0kg; EX2020R, EX4210R - 3.6kg EX354RD, EX354RT - 4.3kg.

EL302P & EX355P

Electronic and mechanical specifications are as per EL302R and EX355R except as follows:

Voltage/Current Levels

EL302P	0 to 30V; 0 to 2A	(60W nominal power)
EX355P	0 to 35V; 0 to 5A	(175W nominal power)

Output Setting & Control

Voltage Setting: By coarse and fine rotary encoders or RS-232 interface. Resolution 10mV
Current Setting: By single rotary encoder or RS-232 interface. Resolution 10mA

Metering

Display Type: 4 digit meter for voltage and 3 digit meter for current.
Resolutions: 100mV; 10mA
Accuracy: Voltage - 0·3% of reading ± 1 digit, Current - 0·6% of reading ± 1 digits

Note that in constant voltage mode the meter will show the set voltage to a resolution of 10mV. However the metering resolution is limited to 100mV when in constant current mode, and the last digit will be set to zero.

Voltage Sensing

Voltage sensing is local only (i.e. no remote sense).

Power-down Memory

The power supply saves the voltage, current and output-enable status at power down and restores the settings at power up.

RS-232 Control

Isolation: Fully opto-isolated from power supply output.
Connector: 9-pin D connector.
Baud Rate: Variable from 600 baud to 9,600 baud.
Remote Functions: Set Voltage, Set Current, Set Output On/Off, Read Voltage, Read Current, Read On/Off, Read Mode (CV or CC).
Setting Accuracy: Voltage 0.3% ±20mV. Current 0.6% ±20mA.
Setting Resolution: Voltage 10mV. Current 10mA.
Readback Accuracy: Voltage 0.3% ±100mV. Current 0.6% ±20 mA.
Readback Resolution: Voltage 100mV. Current 10mA.

EX752M

Electronic and mechanical specifications are as per EX354RD except as follows:

Voltage/Current Levels

EX752M	2 x (0 to >75V; 0 to >2A)	(300W nominal power)

Multi-Mode Operation

Three modes of operation can be selected via a rotary switch:
Mode A: Two independent and isolated outputs (75V/2A each).
Mode B: One output of double the current capability (75V/4A). (Unused output is disabled and its displays are blanked).
Mode C: One output of double the voltage capability (150V/2A). (Unused output is disabled and its displays are blanked).

Metering

Display Type: 3 digit meters for voltage and current; (4 digit on second voltmeter to maintain resolution above 100V).
Resolutions: 100mV; 10mA
Accuracy: Voltage - 0·3% of reading ± 1 digit, Current - 0·6% of reading ± 1 digits

Output Performance

Ripple & Noise: Typically <2mV rms, <15mV pk-pk (CV mode, 20MHz bandwidth)
Load Regulation: Modes A and B - <0·01%; Mode C - <0·1% + 2mV (90% load change)

Voltage Sensing

Voltage sensing is local only (i.e. no remote sense).

Output Protection

Output Protection: Outputs will withstand forward voltages up to 85V/170V. Over-voltage trip operates above these levels. Reverse protection by diode clamp for currents to 3A.

Output Terminals

High voltage touch-proof terminals.

Accuracy specifications apply for the temperature range 18°C to 28°C after 1 hour warm-up. Thurlby Thandar Instruments Ltd. operates a policy of continuous development and reserves the right to alter specifications without prior notice.

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