

# eLoad<sup>®</sup>

## Programmable dc Electronic Loads

AMREL offers the Industry's Widest Selection of Standard Models, as well as Customized COTS and Built-to-Print eLoads

60W-200kW+

up to 1200V and 5000A

High-voltage

High-current

Ultra-low Voltage

Air-cooled

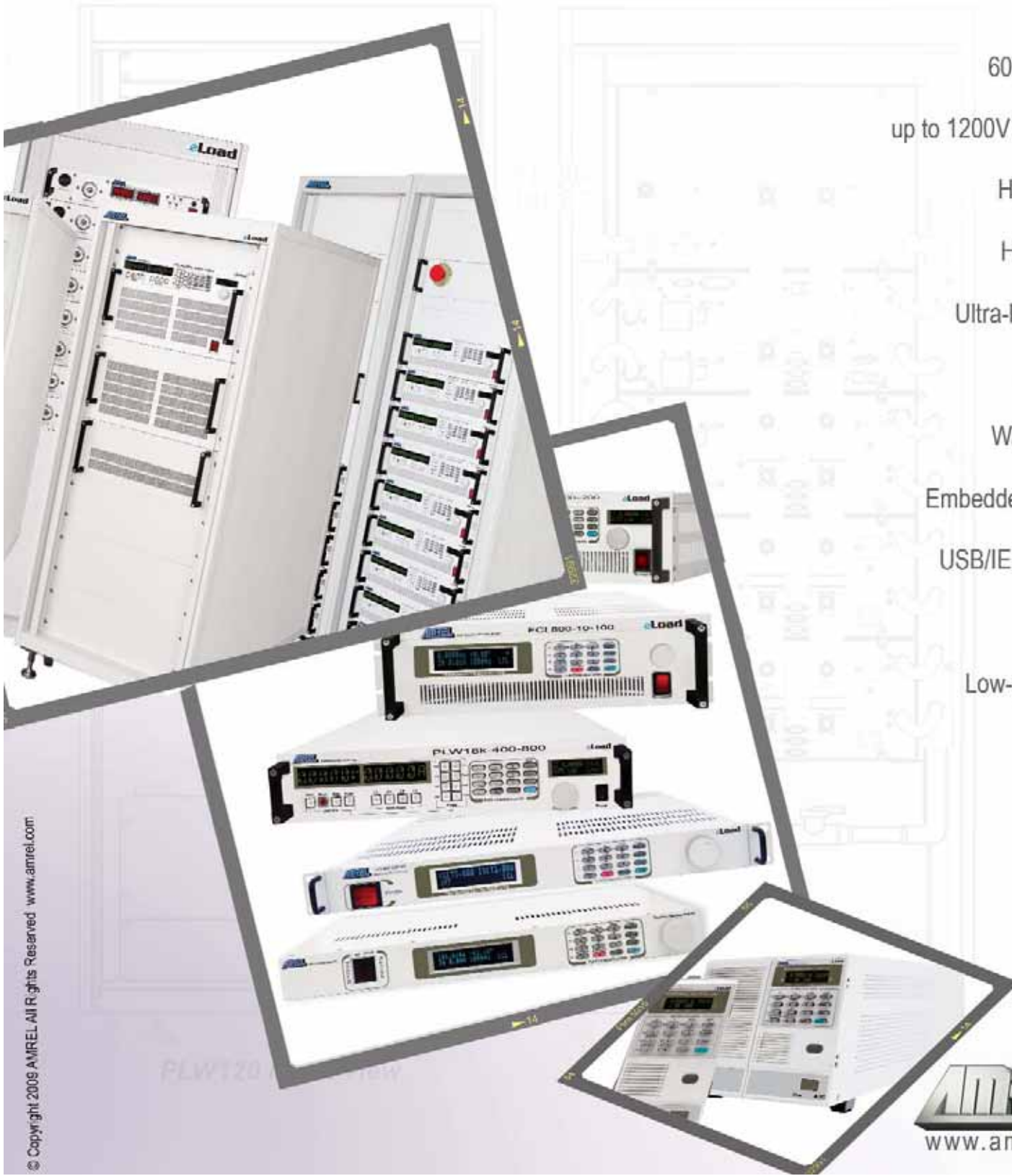
Water-cooled

Embedded Ethernet

USB/IEEE/RS-232

Zero-volt

Low-profile (1U)



# CONTENTS

## 1 AMREL'S eLoad SELECTION GUIDE

### WHY AMREL

- 2 How is AMREL Customer Driven
- 3 AMREL Sets New Standards

## 4-5 eLoad PROGRAMMABLE LOAD BANK SOLUTIONS

### LPL Series of Low-profile 1U Air-cooled eLoad Solutions

300 ~ 800W/60 ~ 800Vdc/3 ~ 100Adc or Custom-tailored Ratings  
Available Interfaces: RS-232, GPIB, Ethernet and USB

## 6-7 PLA Series of Air-cooled eLoad Solutions

800W ~ 100kW+/60 ~ 1200Vdc/50 ~ 5000Adc or Custom-tailored Ratings  
Available Interfaces: RS-232, GPIB, Ethernet and USB

## 8-9 PLW Series of High-power Water-cooled eLoad Solutions

6kW ~ 200kW+/60 ~ 1200Vdc/50 ~ 5000Adc or Custom-tailored Ratings  
Available Interfaces: RS-232, GPIB, Ethernet and USB

## 10-11 BPL Series of Bench-top Air-cooled eLoad Solutions

400W or 800W/60 ~ 800Vdc/15 ~ 200Adc or Custom-tailored Ratings  
Available Interfaces: RS-232, GPIB, Ethernet and USB

## 12-13 FCL Series of Fuel Cell eLoad Solutions

200W or 1.5kW/10Vdc, 20Vdc or 30Vdc/100 ~ 200Adc or  
Custom-tailored Ratings  
Available Interfaces: RS-232, GPIB, Ethernet and USB

## 14-15 ZVL Series of Zero-volt Air-cooled eLoad Solutions

60W, 100W, 150W, 200W or 300W/10Vdc or 20Vdc/10 ~ 100Adc  
Custom-tailored Ratings  
Available Interfaces: RS-232 and GPIB

## 16-17 FEL Series of Ultra-low Voltage eLoads & PEL Series of Low-power eLoads

60W, 150W or 300W/10Vdc or 20Vdc/50 ~ 200Adc or Custom-tailored Ratings  
Available Interfaces: RS-232 and GPIB

## 18 FEL, PEL and ZVL "Rackmount" Solutions

60W, 150W or 300W/10Vdc or 20Vdc/50 ~ 200Adc or Custom-tailored Ratings  
Available Interfaces: RS-232 and GPIB

## 19 OTHER SOLUTIONS

### MCU-1 Master Network Controller

Multi-Channel Control of up to 8 eLoads  
Available Interfaces: RS-232, GPIB, USB and 8-Port Ethernet

### AWG "Waveform Capture/Authoring" Arbitrary Waveform Generator

Generate 12 Arbitrary Waveforms  
Digitize and Record Voltage and Current Load Profiles of DUT  
Author, Edit, Save & Manage Proprietary Load Profiles/Waveforms  
Available Interfaces: RS-232, GPIB, Ethernet and USB

## 20-21 FRA Frequency Response Analyzer

Cost-effective FRA Solution for less than \$5K  
Impedance Measurement Program Included  
0.1Hz Option Available  
Available Interfaces: RS-232, GPIB, Ethernet and USB

## APPLICATIONS

- 22 Battery Testing/Energy Storage & Power Supply/Electronic Components
- 23 PV
- 24 Fuel Cell Testing and EIS/Impedance Measurement
- 25 Military/Defense ATE and Aerospace/Avionics ATE
- 26 Industrial Solutions
- 27 University and Research Laboratory Test Solutions

## eLOAD SYSTEMS AND CUSTOMIZED SOLUTIONS

- 28-31 General Customization/Systems Capabilities and Solutions
- 32-33 Standard and Customized High-voltage Solutions

Please note: Specifications contained in this catalog are subject to change without notification.

# AMREL's eLoad® Selection Guide

1. Choose your maximum power level.
2. Select your required maximum voltage.
3. Find your maximum current requirement.
4. Select the product series from the color legend below.

## How to Order

Power — V-Max — A-Max  
 Ex: PLA 1.5k — 120Vdc — 300Adc

Other standard power, voltage and current ratings are available- please contact AMREL if your required rating is not shown below.

Max Voltage	Maximum Power Level																							
	60 W	100 W	150 W	200 W	300 W	400 W	600 W	800 W	1.5k W	2.0 kW	2.5 kW	3.0 kW	4.0 kW	5.0 kW	6.0 kW	7.5 kW	9.0 kW	12 kW	18 kW	24 kW	36 kW			
10V	50A		100A		200A	100A		100A	100A															
10V	20A	20A		40A	100A			150A	200A															
10V		40A	100A	80A																				
20V	50A		100A	100A	200A	100A		100A	100A															
20V						150A		200A	200A															
30V				100A				100A	100A															
30V						150A		200A	200A															
60V	10A		30A		60A	150A		200A						1000A		1500A	1500A	1500A	1500A	1500A	1500A			
60V			60A		120A			100A																
60V			50A		100A		100A	300A	600A	600A	1000A	1000A	1200A	1200A	1500A									
120V					60A	75A		150A							600A		1000A	1200A	1500A	1500A	1500A			
120V								150A																
120V			25A		50A		60A	80A	300A	400A	600A	800A	1000A	1200A	1500A									
150V		20A		40A	40A																			
300V							120A																	
400V							30A	30A	60A	100A	150A	200A	300A	360A	400A									
400V								50A																
400V			8A		15A			40A							300A	600A	400A	600A	800A	1200A	1500A			
600V							20A	60A	40A						200A		300A	400A	600A	800A	1000A			
600V								20A	30A															
600V								30A	30A															
600V			5A		10A		30A	60A	100A	120A	150A	200A	240A		400A									
800V																								
1000V			3A		6A	15A	15A	30A																
1000V								10A			20A		50A		80A	80A				150A	200A	300A		

PEL SERIES   
 FEL SERIES   
 ZVL SERIES   
 BPL SERIES 

LPL SERIES   
 PLA SERIES   
 PLW SERIES   
 FCL SERIES 

\* Please Note: Custom-tailored ranges are available. All series with the exception of the PLW series are air-cooled. Additional standard models are available



ZVL Zero-volt eLoads (pages 14-15)



LPL Low-profile eLoads (pages 4-5)



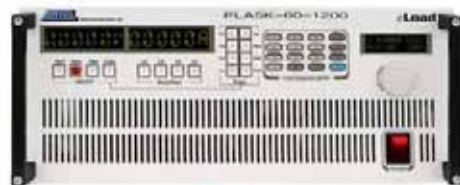
PLW Water-cooled eLoads (pages 8-9)



BPL Bench-top eLoads (pages 10-11)



PEL/FEL eLoads (pages 16-17)



PLA Air-cooled eLoads (pages 6-7)



FCL Fuel Cell eLoads (pages 12-13)

# HOW IS AMREL UNIQUENESS “CUSTOMER DRIVEN”?



**Tailored Solutions** - 80% of AMREL's standard products evolved from our customers built-to-spec requirements, resulting in AMREL developing the widest selection of Programmable Electronic Load Bank Solutions on the market.

Why settle for an “almost” solution? Choose from the broadest selection of standard, tailored and customized Programmable dc Load Bank Solutions!

## Customer Support and Satisfaction:

**We listen to the customer** – to insure your satisfaction. Whether you need a standard eLoad, a “Customized” eLoad, or a full blown built-to-print eLoad –our team will make sure your requirements are met.

**Have a post-sales question?** Tired of electronic phone systems leading you around in circles? Not at AMREL. When you call AMREL, a live person will connect you to a support engineer ready to answer your technical question.

**Replace or upgrade?** When your requirements change, AMREL's team of engineers can recommend the most cost effective, time saving solutions. That may in some cases be just a minor upgrade such as adding our field upgradeable Ethernet or USB interfaces. Be assured, whatever your requirements-AMREL's team of engineers will have the best solution for you.

*“...offering the widest selection of power products on the market is the greatest testimonial to AMREL's ability to design, build and service quality power solutions.”*



AMREL meets your unique application demands with our exclusive custom-tailored dc load bank solutions, including customizable voltage, current and power ratings, while packaged in the industry's smallest foot print.

## One-Stop Shopping with AMREL

Choose AMREL as your sole-source supplier for programmable dc power supplies and programmable dc electronic loads, because you can:

- Find what you need in our wide selection
- Get what you want through our extensive customization capabilities
- Set-up faster and easier, since the compatibility of our programmable dc electronic loads and power supplies are ensured by functional testing
- Take advantage of superior customer service; on average, your support call will be answered by a live person in less than a minute

# AMREL's eLoad® CONTINUES TO SET INDUSTRY STANDARDS

## THE HIGHEST POWER DISSIPATION DENSITY 2U 18kW eLoad



The PLW Series has the highest power dissipation density  
6k-18k 2U (17"Wx3.5"Hx27.5"D) 24k-36k 4U (17"Wx3.5"Hx27.5"D)

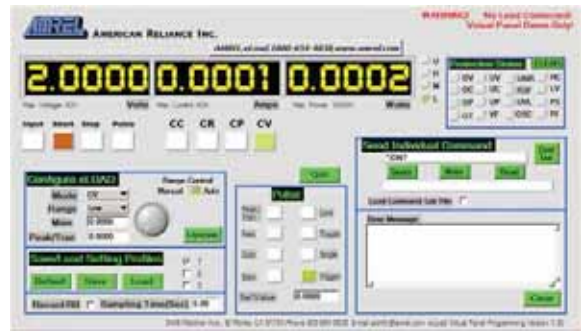
**SAVE RACK SPACE!** eLoad has the industry's smallest footprint with the highest current, voltage & power ratings available.

## eLoad HAS FIELD ENABLED ETHERNET/USB - SAVING TIME AND \$\$\$



As your needs evolve, so will your eLoad. When you're ready to add the Ethernet and/or USB functionality to your eLoad, a simple phone call is all it takes!

## STANDARD WITH eLoad - PC SOFT PANEL & VOLTAGE/CURRENT DATA CAPTURE TO STORE TEST MEASUREMENTS



Includes: • Transient Management • Data Monitor



## AMREL'S eLoad - THE MOST USER FRIENDLY PANEL IN THE INDUSTRY

Major functions are available through a single button. Most secondary functions that may not be used as frequently require only a few key-strokes. System maintenance and setup functions are menu driven via a LCD display.



## eLoad PROVIDES ANTI-CONDENSATION PROTECTION FOR LIGHTS OUT TESTING

A self-decondensation circuit is provided to eliminate internal condensation. The unique design also offers a water system shutdown when power is removed. This eliminates the chance of condensation resulting from continued water flow during emergency shutdown.

## DIGITAL CLOSED-CASE CALIBRATION - SAVES TIME AND \$\$\$

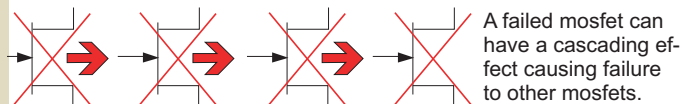


Calibrating an AMREL eLoad

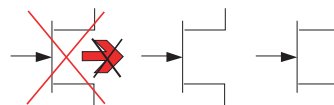


Traditional Method of Calibration

## eLoad's MOSFET PROTECTION DESIGN FOR MAXIMUM UPTIME



A failed mosfet can have a cascading effect causing failure to other mosfets.



AMREL's unique design decreases the possibility of a single failed mosfet causing additional failures.

An electronic load can contain hundreds of FETs paralleled together. With some standard electronic load designs, the failure of a single FET may damage its parallel FETs or even trigger a catastrophic failure. This may leave the unit beyond repair. On the other hand, AMREL's eLoad is designed to isolate failures by individually protecting each FET.

# LPL Series of Low-profile Programmable

## Why Choose the LPL Series?

In ATE System Applications, rack space is a highly coveted asset. Traditional modular loads require at least 3U (5.25") of rack space, additional mainframe cost, and are limited in power rating, typically below 300W. Why spend your rack space and budget when you don't need to?

AMREL's LPL Series of "Low-profile" dc Electronic eLoads occupies only 1U (1.75") of rack space, while offering the industry's highest power density, making it an ideal ATE solution. With the industry's widest model selection, the LPL Series ranges from 150W to 800W without the added cost of a mainframe or sacrificing valuable rack space. For an economical solution with all the necessary ATE capabilities in an ultra-compact package, the LPL eLoad is your clear choice!

## Markets and Applications:

- Battery/Energy Storage/Ultracapacitor Testing and Validation
- dc Power Supply and Battery Charger Validation and Testing
- Fuel Cell Durability, Lifetime and Performance Characterization
- Single Cell and Short Stack Fuel Cell Characterization
- EIS/Impedance Measurement
- Defense/Aerospace and Avionics ATE, Electronics and Power Sources Testing
- Thin-film, Single- & Poly-silicone PV Design Validation and Testing
- Power Supply, Power Electronics/Components Validation and Testing
- Industrial Applications: Generator/Alternator, UPS/Battery Banks, Datacenter Backup Power, and Automotive Power Electronics & Components
- Lab/Bench-top Applications: Ideal for R&D, Testing and QC Engineers
- Power Electronics/Components, dc Distribution & dc-dc Converters
- Universities
- National Research Labs



### LPL SELECTOR GUIDE

LPL XXX - YY - ZZZ - OPTION\*

I=Isolated Analog Programming Option\*

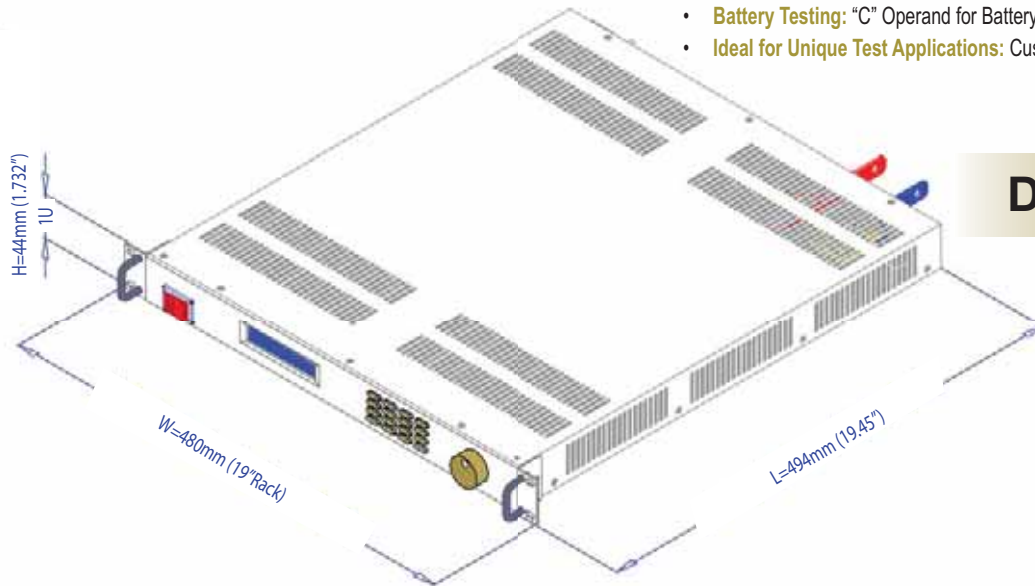
XXX -POWER | YY - VOLTAGE | ZZZ - CURRENT

R=Isolation Relay Option\*

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	V <sub>MIN</sub> at I <sub>MAX</sub>	Size (Height, Depth)	
LPL	LPL150-60-50	150W	60	50	0.5	1U, 21"D	
LPL	LPL150-120-25	150W	120	25	1.75	1U, 21"D	
LPL	LPL150-400-8	150W	400	8	1.6	1U, 21"D	
LPL	LPL150-600-5	150W	600	5	4	1U, 21"D	
LPL	LPL300-60-100	300W	60	100	0.6	1U, 21"D	
LPL	LPL300-120-50	300W	120	50	1	1U, 21"D	
LPL	LPL300-400-15	300W	400	15	1.8	1U, 21"D	
LPL	LPL300-600-10	300W	600	10	5	1U, 21"D	
LPL	LPL600-60-100	600W	60	100	0.5	1U, 21"D	
LPL	LPL600-120-60	600W	120	60	0.72	1U, 21"D	
LPL	LPL600-400-30	600W	400	30	1.8	1U, 21"D	
LPL	LPL600-600-20	600W	600	20	5	1U, 21"D	
LPL	LPL800-60-100	800W	60	100	0.5	1U, 21"D	
LPL	LPL800-120-80	800W	120	80Adc	0.96	1U, 21"D	
LPL	LPL800-400-40	800W	400	40Adc	2.4	1U, 21"D	
LPL	LPL800-600-30	800W	600	30	7.5	1U, 21"D	
		Voltage Range: 10Vdc ~ 800Vdc Rating Current Range: 1Adc ~ 100Adc Rating Power Range: 60W ~ 800W Rating Current-tailored Ranges Available		EFU-L = Field Upgradeable Ethernet & USB Available			

## Key Features and Benefits:

- **Broadest Model Selection:** 150W, 300W, 600W, 800W Models: 60V, 120V, 400V, 600V, 800V
- **Save Rack Space:** All LPL Models are 1U high & "Zero" Stackable
- **Maximize ROI:** In-rack Closed-case Calibration
- **Ultra-low Compliance Voltage:** Ultra-low Voltage Operation
- **Reliable:** Individual FET Protection to Isolate Power Stage Failures
- **Maximized Uptime:** Redundant Over-temperature and Over-power Protection
- **Fast Response:** 25us Independently Programmable Rise/Fall Time
- **Quiet:** Fan Speed Control for Reduced Acoustic Noise Under Light Load Conditions.
- **Flexible Test Platform:** Five Modes of Operation: CC, CR, CV, CP and Pulse Load Shaping
- **Intuitive Front Panel Control:** User-friendly Function Keys, Full Keypad & Digital Encoder
- **Integrated DMM:** 14-bit 5-digit Voltage and Current Measurement Display
- **Two Loads in One:** Ultra-low Current Range Option for Optimized Accuracy
- **More Ranges:** 3 Full Scale Ranges (100%, 50% & 10%)
- **More Protections:** Anti-oscillation & Programmable Protections: OV, UV, OC, UC, OP, & UP
- **More Interfaces:** Co-resident GPIB/RS-232 & Field-enabled Ethernet/USB Option Available
- **ATE Ready:** Standard LabWindows and LabVIEW Drivers and SCPI Command Set
- **Bench-top Test Automation Ready:** Four Step Profiles; 32 Step Points for Each Profile
- **Fuel Cell Application Ready:**
  - Impedance Measurement via Frequency Response Analyzer (FRA)
  - Current Interruption Mode for Fuel Cell Testing
  - Ultra-low Compliance Voltage to Operate at High Current Down to 0.1Vdc
  - Virtual Panel provides Polarization Curve Sweep and Voltage/Current Cycling Capability
- **0 ~ 10Vdc PLC or DAQ Control Ready:**
  - 0~10Vdc External Analog Programming
  - External On/Off Control
  - External Mode Selection Available
  - Front Panel Key Lockout Prevents Unwanted Key Entry
- **More System Integration Features & Options:**
  - Standard Remote Inhibit (RI) for Interlock Capability
  - Standard Dry Contact Fault for Redundant System Protection
  - Isolated Analog Control/Monitor Option
  - External dc Contactor
  - Reverse Polarity/Isolation Relay Option
- **Battery Testing:** "C" Operand for Battery Testing.
- **Ideal for Unique Test Applications:** Custom-tailored Ratings & Features Available



## Dimensions

### LPL SPECIFICATIONS

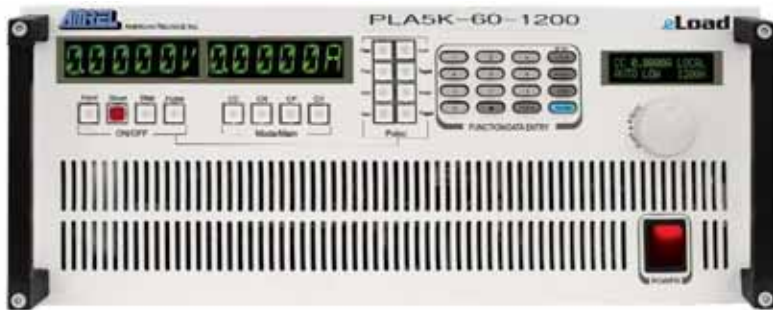
CV MODE SPECIFICATIONS		CC MODE SPECIFICATIONS	
CVL RANGE	0 ~ 10% of Vmax	CCL RANGE	0 ~ 10% of Imax
CVM RANGE	0 ~ 50% of Vmax	CCM RANGE	0 ~ 50% of Imax
CVH RANGE	0 ~ 100% of Vmax	CCH RANGE	0 ~ 100% of Imax
ACCURACY	0.05% of Value ± 0.1% of Rating	ACCURACY	0.05% of Value ± 0.1% of Rating
RESOLUTION	1/16000 of Rated Voltage	RESOLUTION	1/16000 of Rated Voltage
TRANSIENT TIME (SLOW)	0.500~511.9 (ms)	TRANSIENT TIME (SLOW)	0.500~511.9 (ms)
TRANSIENT TIME (FAST)	0.500~51.9 (ms)	TRANSIENT TIME (FAST)	0.050~51.9 (ms)
CR and CP MODE SPECIFICATIONS		PROTECTION	
Please reference website datasheet for details		OVER POWER PROTECTION	110% * Pmax
		OVER VOLTAGE PROTECTION	105% * Vmax
		OVER CURRENT PROTECTION	110% * Imax
		OVER TEMPERATURE PROTECTION	90°C ± 5°C
		REVERSE MAXIMUM CURRENT	110% of Imax
		REMOTE INHIBIT (RI)	Short
		FAULT INDICATOR	SPDT Relay
		Other Programmable Protections: OPP, OVP, OCP, UVL & Anti-Oscillation	
GENERAL SPECIFICATIONS		DIELECTRIC STRENGTH	
REMOTE INTERFACES	RS-232, GPIB & USB/ETHERNET	PRIMARY CIRCUIT TO CHASSIS	1500Vac for 1 Minute
ANALOG PROGRAMMING	0 ~ 10Vdc	PRIMARY CIRCUIT TO LOAD TERMINAL	1500Vac for 1 Minute
ACCURACY	Mode Accuracy ± 0.1% of Rating	LOAD TERMINAL TO CHASSIS	1500Vdc for 1 Minute
VMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
IMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
FREQUENCY RANGE	0.1Hz ~ 10kHz		
ACCURACY	0.10%		
AC INPUT	95~240Vac / 48 ~ 62Hz		
OPERATING TEMPERATURE	5°C ~ 40°C		
DIMENSIONS	21" (L) x 17" (W) x 1.75" (H)		

# PLA Series of Programmable

## Why Choose the PLA Series?

Traditional dc Electronic Load Solutions are bulky and large in size. Most are offered with standard voltage, current and power ratings. In the ATE world, rack space is a highly coveted asset and application demands are constantly diversifying with new technology development.

AMREL's PLA Series of "Air-cooled" dc Electronic eLoads offers the industry's smallest footprint, the highest power density and current rating, along with the broadest selection of high voltage models on the market. PLA models are capable of being custom-tailored to meet your application requirements.



## Markets and Applications:

- Battery/Energy Storage/Ultracapacitor Testing and Validation
- dc Power Supply and Battery Charger Validation and Testing
- Fuel Cell Durability, Lifetime and Performance Characterization
- Single Cell and Short Stack Fuel Cell Characterization
- EIS/Impedance Measurement
- Defense/Aerospace and Avionics ATE, Electronics and Power Sources Testing
- Thin-film, Single- & Poly-silicone PV Design Validation and Testing
- Power Supply, Power Electronics/Components Validation and Testing
- Industrial Applications: Generator/Alternator, UPS/Battery Banks, Datacenter Backup Power, and Automotive Power Electronics & Components
- Lab/Bench-top Applications: Ideal for R&D, Testing and QC Engineers
- Power Electronics/Components, dc Distribution & dc-dc Converters
- Universities
- National Research Labs

### PLA SELECTOR GUIDE

PLA XXX - YY - ZZZ - OPTION\*  
XXX -POWER | YY - VOLTAGE | ZZZ - CURRENT

I=Isolated Analog Programming Option\*

R=Isolation Relay Option\*

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	V <sub>MIN</sub> at I <sub>MAX</sub>	Size (Height, Depth)
PLA	PLA800-60-300	800W	60	300	0.6V	2U, 21"D
PLA	PLA800-120-150	800W	120	150	1.8V	2U, 21"D
PLA	PLA800-400-50	800W	400	50	2.7V	2U, 21"D
PLA	PLA800-600-30	800W	600	30	7.8V	2U, 21"D
PLA	PLA1.5K-60-600	1.5kW	60	600	0.6V	2U, 21"D
PLA	PLA1.5K-120-300	1.5kW	120	300	1.8V	2U, 21"D
PLA	PLA1.5K-400-100	1.5kW	400	100	2.7V	2U, 21"D
PLA	PLA1.5K-600-60	1.5kW	600	60	7.8V	2U, 21"D
PLA	PLA2K-60-600	2kW	60	600	0.6V	3U, 25.5"D
PLA	PLA2K-120-400	2kW	120	400	1.8V	3U, 25.5"D
PLA	PLA2K-400-150	2kW	400	150	2.7V	3U, 25.5"D
PLA	PLA2K-600-100	2kW	600	100	8.4V	3U, 25.5"D
PLA	PLA2.5K-60-1000	2.5kW	60	1000	0.6V	3U, 25.5"D
PLA	PLA2.5K-120-600	2.5kW	120	600	1.8V	3U, 25.5"D
PLA	PLA2.5K-400-200	2.5kW	400	200	2.7V	3U, 25.5"D
PLA	PLA2.5K-600-120	2.5kW	600	120	7.8V	3U, 25.5"D
PLA	PLA3K-60-1000	3kW	60	1000	0.6V	3U, 25.5"D
PLA	PLA3K-120-800	3kW	120	800	1.6V	3U, 25.5"D
PLA	PLA3K-400-300	3kW	400	300	2.7V	3U, 25.5"D
PLA	PLA3K-600-150	3kW	600	150	7.2V	3U, 25.5"D
PLA	PLA4K-60-1200	4kW	60	1200	0.6V	4U, 25.5"D
PLA	PLA4K-120-1000	4kW	120	1000	1.8V	4U, 25.5"D
PLA	PLA4K-400-360	4kW	400	360	2.7V	4U, 25.5"D
PLA	PLA4K-600-200	4kW	600	200	7.8V	4U, 25.5"D
PLA	PLA5K-60-1200	5kW	60	1200	0.6V	4U, 25.5"D
PLA	PLA5K-120-1200	5kW	120	1200	1.8V	4U, 25.5"D
PLA	PLA5K-400-400	5kW	400	400	2.8V	4U, 25.5"D
PLA	PLA5K-600-240	5kW	600	240	7.8V	4U, 25.5"D
PLA	PLA7.5K-60-1500	7.5kW	60	1500	0.6V	6U, 25.5"D
PLA	PLA7.5K-120-1500	7.5kW	120	1500	1.8V	6U, 25.5"D
PLA	PLA7.5K-400-600	7.5kW	400	600	2.7V	6U, 25.5"D
PLA	PLA7.5K-600-400	7.5kW	600	400	8.4V	6U, 25.5"D

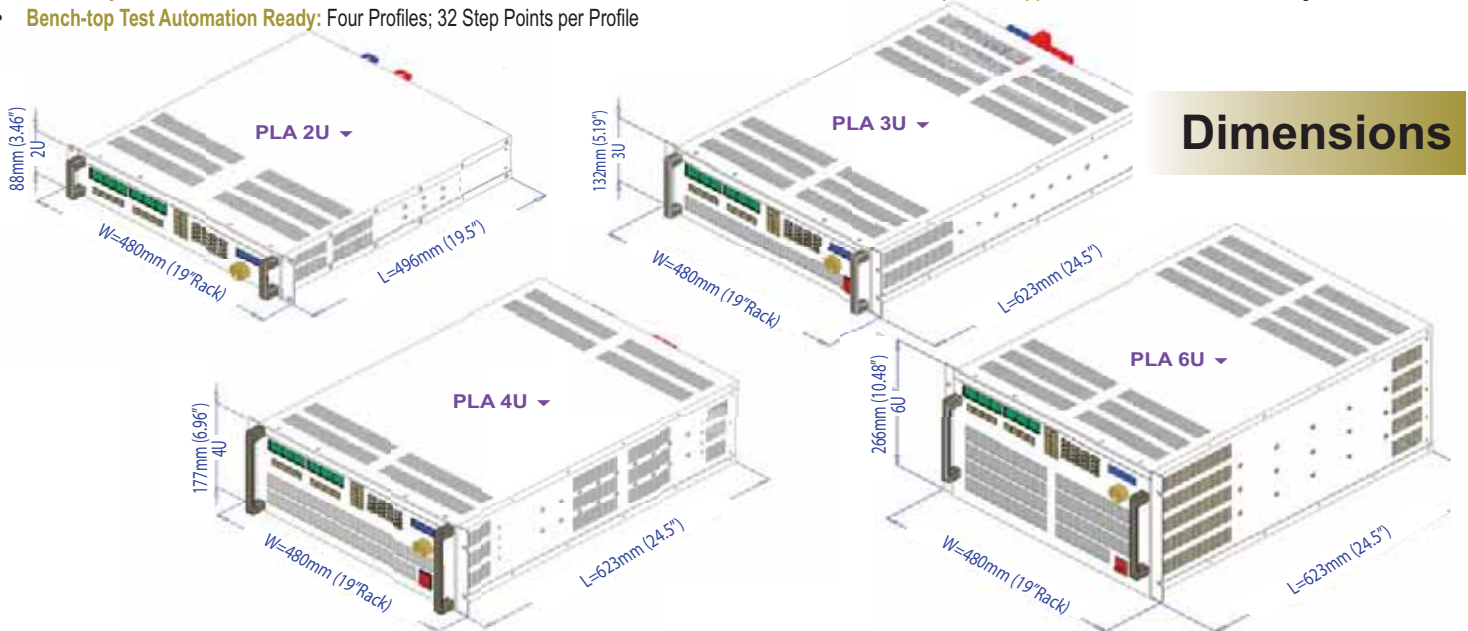
Additional standard models above 7.5kW and up to 250kW+ are available. Please contact AMREL for more details.

Voltage Range: 10Vdc ~ 1200Vdc Rating  
Current Range: 10Adc ~ 5000Adc Rating  
Power Range: 600W ~ 100KW+ Rating  
Custom-tailored Ranges Available

EFU-L = Field Upgradeable Ethernet & USB Available

## Key Features and Benefits:

- **Broadest Model Selection:** 800W, 1.5kW, 2kW, 2.5kW, 3kW, 4kW, 5kW, 7.5kW, 10kW, 15kW, 20kW Models and Higher-power PLA Systems Over 100kW
- **Exclusive High Voltage Models:** Standard 60V, 120V, 400V & 600V Voltage Ratings and widest selection of exclusive 800Vdc and 1200Vdc PLA Models
- **Save Rack Space:** PLA Models Offer Ultra-compact air-cooled Footprint and are "Zero" Stackable
- **Maximize ROI:** In-rack Closed-case Calibration Without an "Outside" Calibration Lab
- **Ultra-low Compliance Voltage:** Ultra-low Voltage Operation @ 1000's of Amps
- **Reliable:** Individual FET Protection to Isolate Power Stage Failures
- **Maximized Uptime:** Redundant Over-temperature and Over-power Protection
- **Fast Response:** 50µs Independently Programmable Rise/Fall Time
- **Ultra-quiet Operation:** Fan Speed Control for Reduced Acoustic Noise Under Light Load Conditions.
- **Flexible Test Platform:** Five Modes of Operation: CC, CR, CV, CP and Pulse Load Shaping
- **Intuitive Front Panel Control:** User-friendly Function Hot Keys, Full Keypad & Digital Encoder
- **Integrated DMM:** 14-bit Five digit Voltage and Current Measurement Display
- **Two Loads in One:** Ultra-low Current Range Option for Optimized Accuracy
- **More Ranges:** Three Full Scale Ranges (100%, 50% & 10%)
- **More Protections:** Anti-oscillation & Programmable Protections: OV, UV, OC, UC, OP, & UP
- **More Interfaces:** Co-resident GPIB/RS-232 and Optional Field-upgradeable Ethernet/USB
- **ATE Ready:** Standard LabWindows and LabVIEW Drivers and SCPI Command Set
- **Bench-top Test Automation Ready:** Four Profiles; 32 Step Points per Profile
- **Fuel Cell Application Ready:**
  - Impedance Measurement via Frequency Response Analyzer (FRA)
  - Current Interruption Mode for Fuel Cell Testing
  - Ultra-low Compliance (0.1Vdc) Voltage to Operate at High-current
  - Virtual Panel provides Polarization Curve Sweep and Voltage/Current Cycling Capability
- **0 ~ 10Vdc PLC or DAQ Control Ready:**
  - External Analog Programming
  - External On/Off Control
  - External Mode Selection
  - Front Panel Key Lockout Prevents Unwanted Key Entry
- **More System Integration Features & Options:**
  - Standard Remote Inhibit (RI) for Interlock Capability
  - Standard Dry Contact Fault for Redundant System Protection
  - Isolated Analog Control/Monitor Option
  - External dc Contactor Option
  - Reverse Polarity/Isolation Relay Option
- **Battery Testing:** "C" Operand for Battery Testing.
- **Ideal for Unique Test Applications:** Custom-tailored Ratings & Features Available



## PLA SPECIFICATIONS

CV MODE SPECIFICATIONS		CC MODE SPECIFICATIONS	
CVL RANGE	0 ~ 10% of Vmax	CCL RANGE	0 ~ 10% of Imax
CVM RANGE	0 ~ 50% of Vmax	CCM RANGE	0 ~ 50% of Imax
CVH RANGE	0 ~ 100% of Vmax	CCH RANGE	0 ~ 100% of Imax
ACCURACY	0.05% of Value ± 0.1% of Rating	ACCURACY	0.05% of Value ± 0.1% of Rating
RESOLUTION	1/16000 of Rated Voltage	RESOLUTION	1/16000 of Rated Voltage
TRANSIENT TIME (SLOW)	0.500 ~ 511.9 (ms)	TRANSIENT TIME (SLOW)	0.500 ~ 511.9 (ms)
TRANSIENT TIME (FAST)	0.500 ~ 51.19 (ms)	TRANSIENT TIME (FAST)	0.050 ~ 51.19 (ms)
CR and CP MODE SPECIFICATIONS		PROTECTION	
PLEASE REFERENCE WEBSITE DATASHEET FOR DETAILS		OVER POWER PROTECTION	110% * Pmax
		OVER VOLTAGE PROTECTION	105% * Vmax
		OVER CURRENT PROTECTION	110% * Imax
		OVER TEMPERATURE PROTECTION	90°C ± 5°C
		REVERSE MAXIMUM CURRENT	110% of Imax
		REMOTE INHIBIT (RI)	Short
		FAULT INDICATOR	SPDT Relay
		OTHER PROGRAMMABLE PROTECTIONS: OPP, OVP, OCP, UVL & ANTI-OSCILLATION	
GENERAL SPECIFICATIONS		DIELECTRIC STRENGTH	
REMOTE INTERFACES	RS-232, GPIB & USB/ETHERNET	PRIMARY CIRCUIT TO CHASSIS	1500Vac for 1 Minute
ANALOG PROGRAMMING	0 ~ 10Vdc	PRIMARY CIRCUIT TO LOAD TERMINAL	1500Vac for 1 Minute
ACCURACY	Mode Accuracy ± 0.1% of Rating	LOAD TERMINAL TO CHASSIS	1500Vdc for 1 Minute
VMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
IMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
FREQUENCY RANGE	0.1Hz ~ 10kHz		
DUTY RANGE	1.000 ~ 100.0%		
FREQUENCY & DUTY ACCURACY	0.1% of Setting		
AC INPUT	95~240Vac 48 ~ 62Hz		
OPERATING TEMPERATURE	5°C ~ 40°C		

# PLW Series of High-power Programmable

## Why Choose the PLW Series?

Traditional Water-cooled dc Electronic Load Solutions are bulky, have limited power handling capability, and are prone to water cooling issues such as condensation and external water valve considerations. Furthermore, only standard voltage, current and power ratings are offered. Rack space, reliability, and the right-solution fit are key parameters for lights-out burn-in of power components, fuel cells, batteries, power supplies, alternators and other electronics.

AMREL's PLW Series of "Water-cooled" dc Electronic eLoads are capable of being custom-tailored to meet your specific application requirements. The PLW Series also offers a unique condensation protection design, the highest power density and current rating, as well as the widest selection of high-voltage models on the market.

## Markets and Applications:

- Battery/Energy Storage/Ultra Capacitor Testing and Validation
- Fuel Cell Durability, Lifetime and Performance Characterization
- dc Power Supply and Battery Charger Validation and Testing
- Single Cell and Short Stack Fuel Cell Characterization
- EIS/Impedance Measurement
- Defense/Aerospace and Avionics ATE, Electronics and Power Sources Testing
- Thin-film, Single- & Poly-silicone PV Design Validation and Testing
- Power Supply, Power Electronics/Components Validation and Testing
- Industrial Applications: Generator/Alternator, UPS/Battery Banks, Datacenter Backup Power, and Automotive Power Electronics & Components
- Lab/Bench-top Applications: Ideal for R&D, Testing and QC Engineers
- Power Electronics/Components, dc Distribution & dc-dc Converters
- Universities
- National Research Labs



### PLW SELECTOR GUIDE

PLW XXX - YY - ZZZ - OPTION\*  
XXX - POWER | YY - VOLTAGE | ZZZ - CURRENT

I=Isolated Analog Programming Option\*  
R=Isolation Relay Option\*

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	V <sub>MIN</sub> at I <sub>MAX</sub>	Size (Height, Depth)
PLW	PLW6K-60-1000	6kW	60	1000	0.6V	2U, 27.5"D
PLW	PLW6K-120-600	6kW	120	600	1.5V	2U, 27.5"D
PLW	PLW6K-400-300	6kW	400	300	3.6V	2U, 27.5"D
PLW	PLW6K-600-200	6kW	600	200	12V	2U, 27.5"D
PLW	PLW9K-60-1500	9kW	60	1500	0.6V	2U, 27.5"D
PLW	PLW9K-120-1000	9kW	120	1000	1.5V	2U, 27.5"D
PLW	PLW9K-400-400	9kW	400	400	3.6V	2U, 27.5"D
PLW	PLW9K-600-300	9kW	600	300	12V	2U, 27.5"D
PLW	PLW12K-60-1500	12kW	60	1500	0.6V	2U, 27.5"D
PLW	PLW12K-120-1200	12kW	120	1200	1.5V	2U, 27.5"D
PLW	PLW12K-400-600	12kW	400	600	3.6V	2U, 27.5"D
PLW	PLW12K-600-400	12kW	600	400	12V	2U, 27.5"D
PLW	PLW18K-60-1500	18kW	60	1500	0.6V	2U, 27.5"D
PLW	PLW18K-120-1500	18kW	120	1500	1.5V	2U, 27.5"D
PLW	PLW18K-400-800	18kW	400	800	3.6V	2U, 27.5"D
PLW	PLW18K-600-600	18kW	600	600	12V	4U, 27.5"D
PLW	PLW24K-60-1500	24kW	60	1500	0.45V	4U, 27.5"D
PLW	PLW24K-120-1500	24kW	120	1500	1.2V	4U, 27.5"D
PLW	PLW24K-400-1200	24kW	400	1200	3.6V	4U, 27.5"D
PLW	PLW24K-600-800	24kW	600	800	12V	4U, 27.5"D
PLW	PLW36K-60-1500	36kW	60	1500	0.45V	4U, 27.5"D
PLW	PLW36K-120-1500	36kW	120	1500	0.9V	4U, 27.5"D
PLW	PLW36K-400-1500	36kW	400	1500	3.3V	4U, 27.5"D
PLW	PLW36K-600-1000	36kW	600	1000	10V	6U, 27.5"D

Additional standard models above 36kW and up to 250kW+ are available. Please contact AMREL for more details.

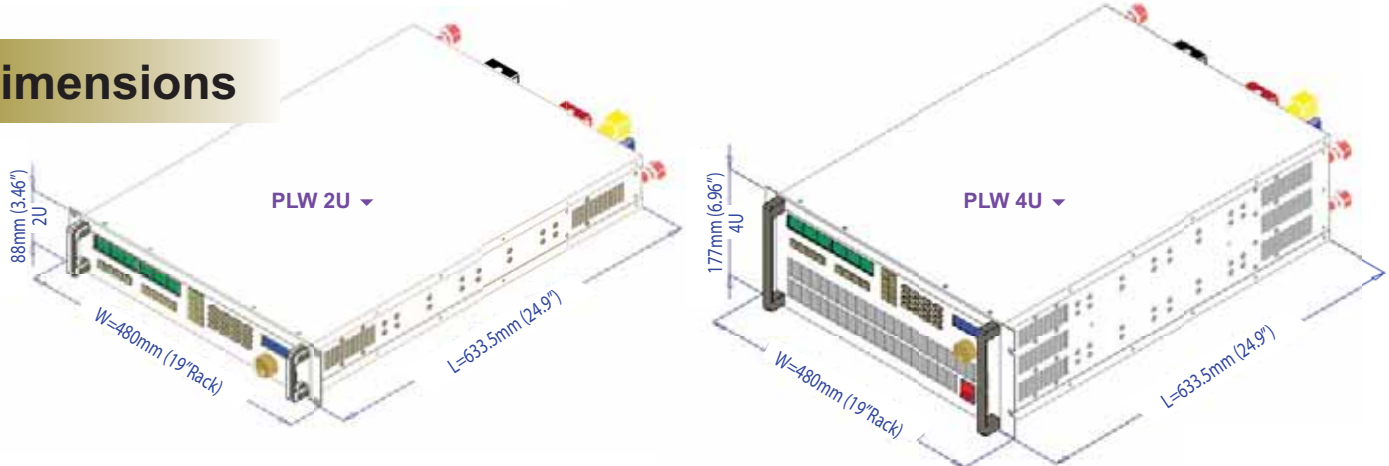
Voltage Range: 10Vdc~1200Vdc Rating  
Current Range: 10Adc ~ 5000Adc Rating  
Power Range: 6kW ~ 100kW+ Rating  
Custom-tailored Ranges Available

EFU-L = Field Upgradeable Ethernet & USB Available

## Key Features and Benefits:

- **Broadest Model Selection:** 6kW, 9kW, 12kW, 18kW, 24kW, 36kW, 48kW, 60kW, 75kW, 100kW, 120kW Models and Higher Power PLW Systems in Excess of 250kW
- **Exclusive High-voltage Models:** Standard 60V, 120V, 400V & 600V Voltage Ratings and Widest Selection of Exclusive 800Vdc and 1200Vdc PLW Models
- **Save Rack Space:** PLW Models Offer Ultra-Compact Footprint and Boasts the Industry's Highest Power Density
- **Maximize ROI:** In-rack Closed-case Calibration Without "Outside" Calibration Lab
- **Ultra-low Compliance Voltage:** Ultra-low Voltage Operation @ 1000's of Amps (5000Adc)
- **Reliable:** Individual FET Protection to Isolate Power Stage Failures
- **Maximized Uptime:** Redundant Over-temperature and Over-power Protection
- **Anti-condensation:** Intelligent Fully-Integrated Temperature Control Circuit and Solenoid Valve Control Prevent Condensation
- **Fast Response:** 50µs Independently Programmable Rise/Fall Time
- **Flexible Test Platform:** Five Modes of Operation: CC, CR, CV, CP and Pulse Load Shaping
- **Intuitive Front Panel Control:** User-friendly Function Hot Keys, Full Keypad & Digital Encoder
- **Integrated DMM:** 14-bit 5-digit Voltage and Current Measurement Display
- **Two Loads in One:** Ultra-low Current Range Option for Optimized Accuracy
- **More Ranges:** Three Full Scale Ranges (100%, 50% & 10%)
- **More Protections:** Anti-oscillation & Programmable Protections: OV, UV, OC, UC, OP, & UP
- **More Interfaces:** Co-resident GPIB/RS-232 and Optional Field-upgradeable Ethernet/USB
- **ATE Ready:** Standard LabWindows and LabVIEW Drivers and SCPI Command Set
- **Test Automation Ready:** Four Profiles; 32 Step Points per Profile
- **Fuel Cell Application Ready:**
  - Impedance Measurement via Frequency Response Analyzer (FRA)
  - Current Interruption Mode for Fuel Cell Testing
  - Ultra-low Compliance (0.1Vdc) Voltage to Operate at High Current
  - Virtual Panel provides Polarization Curve Sweep and Voltage/Current Cycling Capability
- **0 ~ 10Vdc PLC or DAQ Control Ready:**
  - 0~10Vdc External Analog Programming
  - External On/Off Control
  - External Mode Selection
  - Front Panel Key Lockout Prevents Unwanted Key Entry
- **More System Integration Features & Options:**
  - Standard Remote Inhibit (RI) for Interlock Capability
  - Standard Dry Contact Fault for Redundant System Protection
  - Isolated Analog Control/Monitor Option
  - External dc Contactor Option
  - Reverse Polarity/Isolation Relay Option
- **Battery Testing:** "C" Operand for Battery Testing.
- **Ideal for Unique Test Applications:** Custom-tailored Ratings & Features Available

## Dimensions



### PLW SPECIFICATIONS

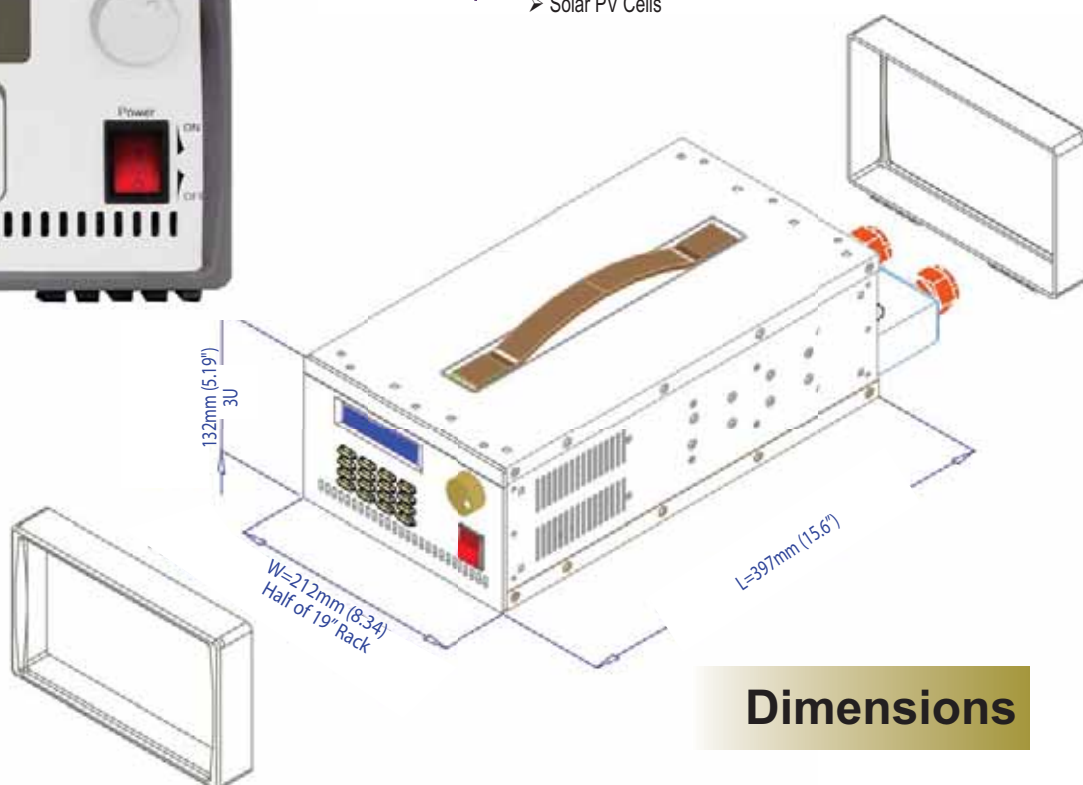
CV MODE SPECIFICATIONS		CC MODE SPECIFICATIONS	
CVL RANGE	0 ~ 10% of Vmax	CCL RANGE	0 ~ 10% of Imax
CVM RANGE	0 ~ 50% of Vmax	CCM RANGE	0 ~ 50% of Imax
CVH RANGE	0 ~ 100% of Vmax	CCH RANGE	0 ~ 100% of Imax
ACCURACY	0.05% of Value ± 0.1% of Rating	ACCURACY	0.05% of Value ± 0.1% of Rating
RESOLUTION	1/16000 of Rated Voltage	RESOLUTION	1/16000 of Rated Voltage
TRANSIENT TIME (SLOW)	0.500 ~ 511.9 (ms)	TRANSIENT TIME (SLOW)	0.500 ~ 511.9 (ms)
TRANSIENT TIME (FAST)	0.500 ~ 51.19 (ms)	TRANSIENT TIME (FAST)	0.050 ~ 51.19 (ms)
CR and CP MODE SPECIFICATIONS		PROTECTION	
Please reference website datasheet for details		OVER POWER PROTECTION	105% * Pmax
		OVER VOLTAGE PROTECTION	105% * Vmax
		OVER CURRENT PROTECTION	110% * Imax
		OVER TEMPERATURE PROTECTION	50°C ± 5°C
		REVERSE MAXIMUM CURRENT	110% of Imax
		REMOTE INHIBIT (RI)	Short
		FAULT INDICATOR	SPDT Relay
		Other Programmable Protections: OPP, OVP, OCP, UVL & Anti-Oscillation	
GENERAL SPECIFICATIONS		DIELECTRIC STRENGTH	
REMOTE INTERFACES	RS-232, GPIB & USB/Ethernet	PRIMARY CIRCUIT TO CHASSIS	1500Vac for 1 Minute
ANALOG PROGRAMMING	0 ~ 10Vdc	PRIMARY CIRCUIT TO LOAD TERMINAL	1500Vac for 1 Minute
ACCURACY	Mode Accuracy ± 0.1% of Rating	LOAD TERMINAL TO CHASSIS	1500Vdc for 1 Minute
VMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
IMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
FREQUENCY RANGE	0.1Hz ~ 10kHz		
DUTY RANGE	1.000 ~ 100.0%		
FREQUENCY & DUTY ACCURACY	0.1% of Setting		
AC INPUT	95 ~ 240Vac / 48 ~ 62Hz		
OPERATING TEMPERATURE	5°C ~ 40°C		

# BPL Series of Bench-top Programmable

## Why Choose the BPL Series?

The BPL Bench-top eLoad strikes the perfect balance between value, features, and ROI. Built on dual current shunt architecture, the BPL provides accurate current readings for high-currents up to 200Adc and low-current readings down to the micro-amps.

AMREL's BPL Series of "Bench-top" dc Electronic eLoads offers high-end performance, the industry's highest power-density and current-rating, fast response time and unparalleled current measurement accuracy in a 3U 1/2 rack package. The BPL is a full-featured, powerful, ultra-compact, and user-friendly bench-top eLoad.



## Dimensions

## Markets and Applications:

- Power Electronics Testing
  - dc-dc Converters
  - ac-dc Power Supplies
  - Switching Power Supplies
  - POL (Point of Load)
- Power Electronic Components Testing
- Battery Chargers & Load Profile Simulation
- Battery Testing and Characterization
- Laboratories, Universities and R&D
- Defense/Aerospace/Avionics/Industrial ATE and Integrated Test Systems
- Portable Applications
- dc Power Sources/Energy Storage
  - Batteries
  - Fuel Cells
  - Ultracapacitors
  - Solar PV Cells

### BPL SELECTOR GUIDE

BPL XXX - YY - ZZZ - AA  
 XXX - POWER | YY - VOLTAGE | ZZZ - CURRENT

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	V <sub>MIN</sub> at I <sub>MAX</sub>	Size (Height, Depth)
BPL	BPL400-60-150	400W	60	150	0.75V	3U, 17.2"D
BPL	BPL400-120-75	400W	120	75	1.5V	3U, 17.2"D
BPL	BPL400-400-30	400W	400	30	3V	3U, 17.2"D
BPL	BPL400-600-20	400W	600	20	8.4V	3U, 17.2"D
BPL	BPL400-800-15	400W	800	15	7.2V	3U, 17.2"D
BPL	BPL800-60-200	800W	60	200	0.75V	3U, 17.2"D
BPL	BPL800-120-150	800W	120	150	1.5V	3U, 17.2"D
BPL	BPL800-400-60	800W	400	60	3V	3U, 17.2"D
BPL	BPL800-600-40	800W	600	40	8.4V	3U, 17.2"D
BPL	BPL800-600-30	800W	800	30	7.2V	3U, 17.2"D
		Voltage Range: 10Vdc ~ 800Vdc Rating Current Range: 1Adc ~ 200Adc Rating Power Range: 150W ~ 800W Rating Custom-tailored Ranges Available		EFU-L = Field Upgradeable Ethernet & USB Available		

## Key Features and Benefits:

- **Broadest Model Selection:** 400W, 800W, or Custom-tailored Power Rating
  - **Exclusive High-voltage Models:** Standard 60V, 120V, 400V & 600V Voltage Ratings and Widest Selection of Exclusive 800Vdc Models
  - **Ideal for Unique Test Applications:** Custom-tailored Ratings & Features Available
  - **Ultra-current Precision & Accuracy:** Dual-current Shunt Architecture Provides Ultra-accurate Current Measurements and Essentially Two eLoads in a Single Package
  - **Save Bench Space:** BPL Models Offer Ultra-compact Footprint [15.65"(L) x 8.35"(W) x 5.20"(H)] and Boasts the Industry's Highest Power Density
  - **Maximize ROI:** On-bench Closed-case Calibration without 3rd Calibration Lab
  - **Ultra-low Compliance Voltage:** Ultra-low Voltage Operation @ Up to 200 Amps
  - **Reliable:** Individual FET Protection to Isolate Power Stage Failures
  - **Maximized Uptime:** Redundant Over-temperature and Over-power Protection
  - **Ultra-quiet Operation:** Fan Speed Control for Reduced Acoustic Noise Under Light Load Conditions.
  - **Fast Response:** 25µs independently Programmable Rise/Fall Time
  - **Flexible Test Platform:** Five Modes of Operation: CC, CR, CV, CP and Pulse Load Shaping
  - **Intuitive Front Panel Control:** User-friendly Function Hot Keys, Full Keypad & Digital Encoder
  - **Integrated DMM:** 14-bit Five Digit Voltage and Current Measurement Display
  - **Two Loads in One:** Ultra-low Current Range Option for Optimized Accuracy
  - **More Ranges:** Three Full Scale Ranges (100%, 50% & 10%)
  - **More Protections:** Anti-oscillation & Programmable Protections: OV, UV, OC, UC, OP, & UP
  - **More Interfaces:** Co-resident GPIB/RS-232 and Optional Field-upgradeable Ethernet/USB
  - **ATE Ready:** Standard LabWindows and LabVIEW Drivers and SCPI Command Set
  - **Test Automation Ready:** Four Profiles; 32 Step Points per Profile
- **Fuel Cell Application Ready:**
    - Impedance Measurement via Frequency Response Analyzer (FRA)
    - Current Interruption Mode for Fuel Cell Testing
    - Ultra-low Compliance (0.1Vdc) Voltage to Operate at High-current
    - Virtual Panel Provides Polarization Curve Sweep and Voltage/Current Cycling Capability
  - **0 ~ 10Vdc PLC or DAQ Control Ready:**
    - 0~10Vdc External Analog Programming
    - External On/Off Control
    - External Mode Selection
    - Front Panel Key Lockout Prevents Unwanted Key Entry
  - **More System Integration Features & Options:**
    - Standard Remote Inhibit (RI) for Interlock Capability
    - Standard Dry Contact Fault for Redundant System Protection
    - Isolated Analog Control/Monitor Option
    - External dc Contactor Option
    - Reverse Polarity/Isolation Relay Option
  - **Battery Testing:** "C" Operand for Battery Testing.

### BPL SPECIFICATIONS

CV MODE SPECIFICATIONS		CC MODE SPECIFICATIONS	
CVL RANGE	0 ~ 10% of V <sub>MAX</sub>	CCL RANGE	0 ~ 10% of I <sub>MAX</sub>
CVM RANGE	0 ~ 50% of V <sub>MAX</sub>	CCM RANGE	0 ~ 50% of I <sub>MAX</sub>
CVH RANGE	0 ~ 100% of V <sub>MAX</sub>	CCH RANGE	0 ~ 100% of I <sub>MAX</sub>
ACCURACY	0.05% of Value ± 0.1% of Rating	ACCURACY	0.05% of Value ± 0.1% of Rating
RESOLUTION	1/16000 of Rated Voltage	CCUL RANGE	0 ~ 10% of I <sub>MAX</sub>
TRANSIENT TIME (SLOW)	0.250 ~ 255.9 (ms)	CCUL ACCURACY	0.05% of Value ± 0.05% of Range
TRANSIENT TIME (FAST)	0.250 ~ 25.59 (ms)	RESOLUTION	1/16000 of Rated Current
		TRANSIENT TIME (SLOW)	0.250 ~ 255.9 (ms)
		TRANSIENT TIME (FAST)	0.025 ~ 25.59 (ms)
CR and CP MODE SPECIFICATIONS		PROTECTION	
Please reference website datasheet for details		OVER POWER PROTECTION	110% * P <sub>MAX</sub>
GENERAL SPECIFICATIONS		OVER VOLTAGE PROTECTION	105% * V <sub>MAX</sub>
REMOTE INTERFACES	RS-232, GPIB & USB/ETHERNET	OVER CURRENT PROTECTION	110% * I <sub>MAX</sub>
ANALOG PROGRAMMING	0 ~ 10Vdc	OVER TEMPERATURE PROTECTION	90°C ± 5°C
ACCURACY	Mode Accuracy ± 0.1% of Rating	REMOTE INHIBIT (RI)	Short
VMON ACCURACY	0.10% of RDG ± 0.1% of Rating	FAULT INDICATOR	SPDT Relay
IMON ACCURACY	0.10% of RDG ± 0.1% of Rating	Other Programmable Protections: OPP, OVP, OCP, UVL & Anti-Oscillation	
IMON (CCUL) ACCURACY	CCUL Mode Accuracy ± 0.1% of Rating	DIELECTRIC STRENGTH	
FREQUENCY RANGE	0.1Hz ~ 20kHz	Primary Circuit to Chassis	1500Vac for 1 Minute
ACCURACY	0.10%	Primary Circuit to Load Terminal	1500Vac for 1 Minute
AC INPUT	95~240Vac 48 ~ 62Hz	Load Terminal to Chassis	1500Vdc for 1 Minute
OPERATING TEMPERATURE	5°C ~ 40°C		
DIMENSIONS	15.65" (L) x 8.35" (W) x 5.20" (H)		
WEIGHT	22 lbs		

# FCL Series of Air-cooled Programmable

## Why Choose the FCL Series?

AMREL's Integrated Fuel Cell Load "FCL" Series is the ideal all-in-one solution that packages a booster supply for true "0-volt at high-current" operations. The FCL also has an embedded FRA for impedance measurement/EIS, and a full featured high-speed dynamic dc load in an ultra-compact 3U (5.25") air-cooled package. AMREL's FCL offers the industry's highest current rating of 200Adc, as well as custom-tailored voltage, current and power ratings.

## Markets and Applications:

- Fuel Cells
  - Single Cell and Short Stack Fuel Cell Characterization, Break-in and Testing Applications
  - Gstat Impedance Measurement (EIS & AC Modulation)
  - Polarization Curve Data Capture (CV & CC Control)
  - Durability
  - Lifetime Tests
  - Performance/Design Characterization



### FCL SELECTOR GUIDE

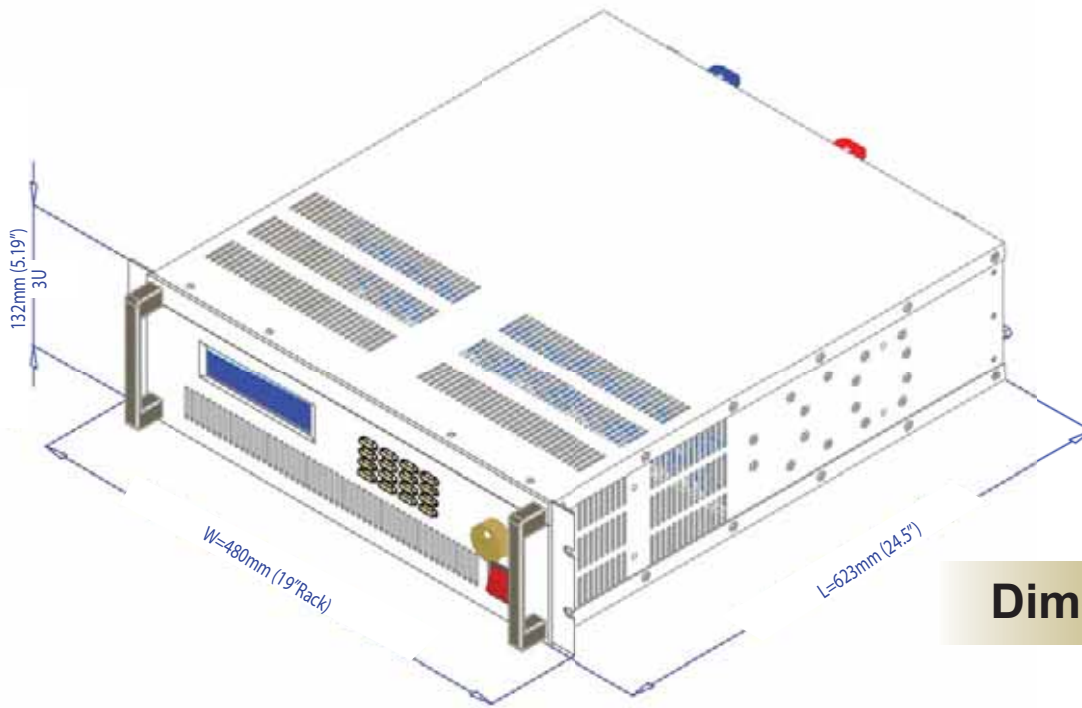
FCL XXX - YY - ZZZ - OPTION  
 XXX - POWER | YY - VOLTAGE | ZZZ - CURRENT

L=Low Frequency Option

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	V <sub>MIN</sub> at I <sub>MAX</sub>	Size (Height, Depth)
FCL	FCL200-10-100	200W	10	100	0Vdc	(5.25", 19.5")
FCL	FCL200-20-100	200W	20	100	0Vdc	(5.25", 19.5")
FCL	FCL200-30-100	200W	30	100	0Vdc	(5.25", 19.5")
FCL	FCL400-10-100	400W	10	100	0Vdc	(5.25", 19.5")
FCL	FCL400-20-100	400W	20	100	0Vdc	(5.25", 19.5")
FCL	FCL400-30-100	400W	30	100	0Vdc	(5.25", 19.5")
FCL	FCL400-10-150	400W	10	150	0Vdc	(5.25", 19.5")
FCL	FCL400-20-150	400W	20	150	0Vdc	(5.25", 19.5")
FCL	FCL400-30-150	400W	30	150	0Vdc	(5.25", 19.5")
FCL	FCL800-10-100	800W	10	100	0Vdc	(5.25", 19.5")
FCL	FCL800-20-100	800W	20	100	0Vdc	(5.25", 19.5")
FCL	FCL800-30-100	800W	30	100	0Vdc	(5.25", 19.5")
FCL	FCL800-10-200	800W	10	200	0Vdc	(5.25", 19.5")
FCL	FCL800-20-200	800W	20	200	0Vdc	(5.25", 19.5")
FCL	FCL800-30-200	800W	30	200	0Vdc	(5.25", 19.5")
FCL	FCL1.5K-10-100	1.5kW	10	100	0Vdc	(5.25", 19.5")
FCL	FCL1.5K-20-100	1.5kW	20	100	0Vdc	(5.25", 19.5")
FCL	FCL1.5K-30-100	1.5kW	30	100	0Vdc	(5.25", 19.5")
FCL	FCL1.5K-10-200	1.5kW	10	200	0Vdc	(5.25", 19.5")
FCL	FCL1.5K-20-200	1.5kW	20	200	0Vdc	(5.25", 19.5")
FCL	FCL1.5K-30-200	1.5kW	30	200	0Vdc	(5.25", 19.5")
Custom-tailored Ranges Available		Voltage Range:10Vdc ~ 800Vdc Rating Current Range:1Adc ~ 200Adc Rating Power Range:60W ~ 800W Rating		EFU-L = Field Upgradeable Ethernet & USB Available		

## Key Features and Benefits:

- **Embedded FRA** (Frequency Response Analyzer) Without the Hassles of External Cables
- **Built-in Booster Power Supply** to Test Down to 0Vdc at Full Operating Current
- **Fully Integrated** 200W, 400W, 800W and 1.5kW Air-cooled Electronic eLoad
- **Impedance Measurement Software** Without the Costs of Purchasing Additional Software
- **CC/CV/CR/CP Operating Modes** to Meet Demanding Application Specific Requirements
- **Dynamic Operation Up to 20kHz** Provides Accurate Impedance Measurements
- **Dynamic Profile Loading Via Voltage and Current Sweeps** for Polarization Curves, Durability/Lifetime Tests, Simulate Real-world Applications and Other Dynamic Test Requirements
- **LabVIEW & LabWindows Drivers, Virtual Panel & SCPI Commands** for Simple ATE Integration
- **The One-box Solution** for Testing Electrical Specs, Validating Performance Targets and Evaluating the Impedance Losses for Fuel Cells
- **Widest Model Selection**-10Vdc/20Vdc/30Vdc FCL Rated at 100 or 200Amps and Custom-tailored Models Available



**Dimensions**

### FCL SPECIFICATIONS

CV MODE SPECIFICATIONS		CC MODE SPECIFICATIONS	
CVL RANGE	0 ~ 10% of Vmax	CCL RANGE	0 ~ 10% of Imax
CVM RANGE	0 ~ 50% of Vmax	CCM RANGE	0 ~ 50% of Imax
CVH RANGE	0 ~ 100% of Vmax	CCH RANGE	0 ~ 100% of Imax
ACCURACY	0.05% of Value ± 0.1% of Rating	ACCURACY	0.05% of Value ± 0.1% of Rating
RESOLUTION	1/16000 of Rated Voltage	RESOLUTION	1/16000 of Rated Voltage
TRANSIENT TIME (SLOW)	0.150 ~ 153.6 (ms)	TRANSIENT TIME (SLOW)	0.150 ~ 153.6 (ms)
TRANSIENT TIME (FAST)	0.150 ~ 15.36 (ms)	TRANSIENT TIME (FAST)	0.015 ~ 15.36 (ms)
CR and CP MODE SPECIFICATIONS		PROTECTION	
Please reference website datasheet for details		OVER POWER PROTECTION	110% * Pmax
		OVER VOLTAGE PROTECTION	105% * Vmax
		OVER CURRENT PROTECTION	110% * Imax
		OVER TEMPERATURE PROTECTION	90°C ± 5°C
		REVERSE MAXIMUM CURRENT	110% of Imax
		REMOTE INHIBIT (RI)	Short
		FAULT INDICATOR	SPDT Relay
		Other Programmable Protections: OPP, OVP, OCP, UVL & Anti-Oscillation	
GENERAL SPECIFICATIONS		DIELECTRIC STRENGTH	
REMOTE INTERFACES	RS-232, GPIB & USB/ETHERNET	PRIMARY CIRCUIT TO CHASSIS	1500Vac for 1 Minute
ANALOG PROGRAMMING	0 ~ 10Vdc	PRIMARY CIRCUIT TO LOAD TERMINAL	1500Vac for 1 Minute
ACCURACY	Mode Accuracy ± 0.1% of Rating	LOAD TERMINAL TO CHASSIS	1500Vdc for 1 Minute
VMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
IMON ACCURACY	0.10% of RDG ± 0.1% of Rating		
FREQUENCY RANGE	0.1Hz ~ 20kHz		
ACCURACY	0.10%		
AC INPUT	95-240Vac / 48 ~ 62Hz		
OPERATING TEMPERATURE	5°C ~ 40°C		
DIMENSIONS	19.5" (L) x 17" (W) x 5.25" (H)		

# ZVL Series of Zero-volt Programmable

## Why Choose the ZVL Series?

Traditional dc Electronic Load Solutions have inherent limitations for testing single cell fuel cells and PV cells/modules. DC electronic loads use power dissipating components that require a minimum compliance voltage of 0.6Vdc ~ 1.5Vdc for operation. However, single cell fuel cell and PV cells often require the dc electronic load to operate at below 0.1Vdc. To achieve this, an external booster supply connected in series is required. The drawbacks of using an external booster supply are twofold: cost and cumbersome hardware. This is especially the case for single cell fuel cells. Single cells, depending on the active cell area, can range from 10Adc up to 200Adc. The additional cabling can be troublesome and costly. In addition, booster supplies range between \$500 ~ \$1K+ in cost.

AMREL's ZVL Series of Zero-volt dc Electronic eLoads was designed for Fuel Cell and PV Testing, offering the industry's highest current rating for "0-Volt" operation along with custom-tailored voltage and current ratings to meet diverse applications. All this in a compact fully-integrated rackmount-ready package!

## Markets and Applications:

- Fuel Cells
  - Single Cell and Short Stack Fuel Cell Characterization, Break-in and Testing Applications
  - Gstat Impedance Measurement (EIS & AC Modulation)
  - Polarization Curve Data Capture (CV & CC Control)
  - Durability
  - Lifetime Tests
  - Performance/Design Characterization
- Battery Testing
  - Dynamic Profiling
  - Battery Characterization
  - Charge/Discharge and Lifetime/Cycle Tests
- Power Electronics Testing
  - dc-dc Converters
  - ac-dc Power Supplies
  - Switching Power Supplies
  - POL (Point of Load)
- Power Electronic Components Testing
- Battery Chargers & Load Profile Simulation
- Battery Testing and Characterization
- Laboratories, Universities and R&D
- Defense/Aerospace/Avionics/Industrial ATE and Integrated Test Systems
- Portable Applications



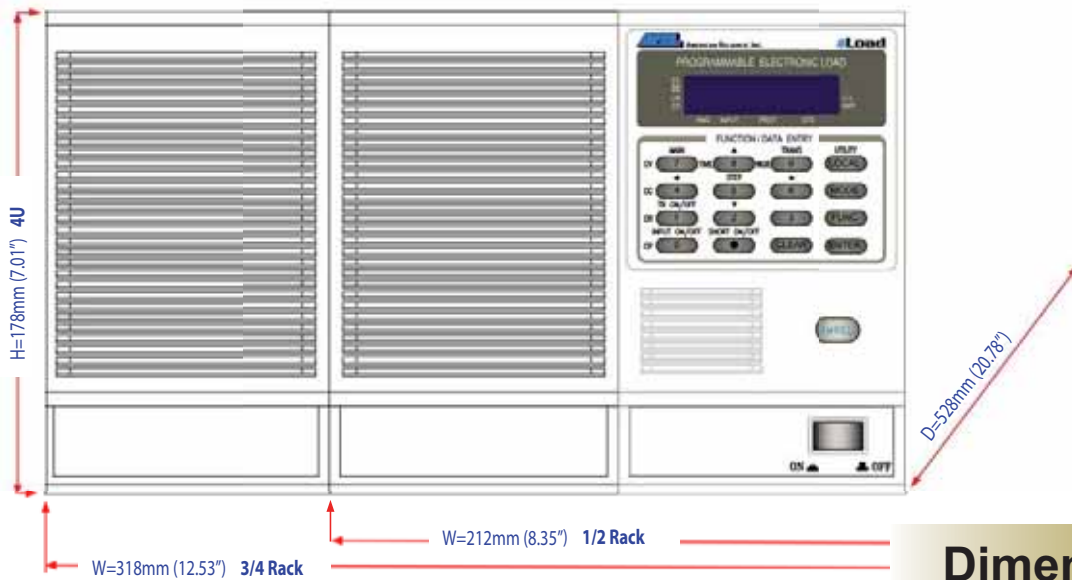
### ZVL SELECTOR GUIDE

ZVL XXX - YY - ZZZ  
 XXX - POWER | YY - VOLTAGE | ZZZ - CURRENT

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	VMIN at IMAX	Size (Height, Width)
ZVL	ZVL60-10-20L	60	10	20	0V	4U, ½Rack
ZVL	ZVL100-10-20L	100	10	40	0V	4U, ½Rack
ZVL	ZVL100-10-40L	100	10	40	0V	4U, ¾Rack
ZVL	ZVL100-10-80L	100	10	80	0V	4U, ½Rack
ZVL	ZVL100-150-20L	100	150	20	0V	4U, ½Rack
ZVL	ZVL150-10-100L	150	10	100	0V	4U, ½Rack
ZVL	ZVL200-10-40L	200	10	40	0V	4U, ½Rack
ZVL	ZVL200-150-40L	200	150	40	0V	4U, ½Rack
ZVL	ZVL300-10-100L	300	10	100	0V	4U, ¾Rack
ZVL	ZVL300-150-40L	300	150	40	0V	4U, ¾Rack
Custom-tailored Ranges Available		Voltage Range: 10Vdc ~ 150Vdc Rating Current Range: 5Adc ~ 100Adc Rating Power Range: 60W ~ 300W Rating				

## Key Features and Benefits:

- **Broadest Model Selection:** 60W, 100W, 150W, 200W, 300W or Custom-tailored Power Ratings
- **Exclusive Voltage Models:** Standard 10V, 20V, 150V and Custom-tailored Voltage Ratings
- **Ideal for Unique Test Applications:** Custom-tailored Ratings & Features Available
- **Exclusive Ethernet Models Available:** 400W, 800W and 1.5kW Ethernet-based ZVL Models
- **True Zero volt Operation:** Fully Integrated Booster Supply and dc Electronic Load
- **Rackmount and Bench Ready:** Rackmount Kits Available
- **Maximize ROI:** On-bench Closed-case Calibration Without Outside Calibration Lab
- **Reliable:** Individual FET Protection to Isolate Power Stage Failures
- **Maximized Uptime:** Redundant Over-temperature and Over-power Protection
- **Ultra-Quiet Operation:** Fan Speed Control for Reduced Acoustic Noise Under Light Load Conditions.
- **Flexible Test Platform:** Five Modes of Operation: CC, CR, CV, CP and Pulse Load Shaping
- **More Interfaces:** Co-resident GPIB/RS-232
- **ATE Ready:** Standard LabWindows and LabVIEW Drivers and SCPI Command Set
- **Test Automation Ready:** 99-point Dynamic Profile Simulation in CV or CC Mode
- **Fuel Cell Application Ready:**
  - Impedance Measurement via Frequency Response Analyzer (FRA)
  - 0-volt Operation for Generating Polarization Curves Down to 0-volts
  - Virtual Panel provides Polarization Curve Sweep and Voltage/Current Cycling Capability
  - CSV V-I Data-logging Feature to Store and Organize Important Test Data
- **0 ~ 10Vdc PLC or DAQ Control Ready:**
  - 0~10Vdc External Analog Programming
  - External On/Off Control
  - External Mode Selection
  - Front Panel Key Lockout Prevents Unwanted Key Entry
- **The Smart Solution:** The ZVL is a Fully-integrated Zero-volt eLoad Designed to Maximize Return on Investment with Minimal or Zero Maintenance Costs, Quality High Performance, and Other Useful Features to Jumpstart Your Important Testing Applications Today



ZVL SPECIFICATIONS			
<b>CV MODE SPECIFICATIONS</b>		<b>CC MODE SPECIFICATIONS</b>	
CVL RANGE	0 ~ 100% of Vmax	CCL RANGE	0 ~ 10% of Imax
ACCURACY	0.2% of Value ± 0.1% of Rating	CCM RANGE	0 ~ 100% of Imax
RESOLUTION	1/3600 of Rated Voltage	ACCURACY	0.2% of Value ± 0.1% of Rating
CV TRANSIENT TIME	1ms ~ 273ms for 0Vdc to Vmax	RESOLUTION	1/3600 of Rated Current
		CC TRANSIENT TIME	27ms ~ 0.100ms for 0Adc to Imax
<b>CR and CP MODE SPECIFICATIONS</b>		<b>PROTECTION</b>	
Please reference website datasheet for details		OVER POWER PROTECTION (OPP)	110% * Pmax
<b>GENERAL SPECIFICATIONS</b>		RESOLUTION	1/4000 of Rated Power
REMOTE INTERFACES	RS-232 & GPIB	ACCURACY	1% of Setting ± 0.5% of Rating
CC MODE ANALOG PROGRAMMING	0 ~ 10Vdc corresponds to 0 ~ Imax	OVER VOLTAGE PROTECTION (OVP)	110% * Vmax
ACCURACY	Mode Accuracy ± 0.1% of Rating	OVP RESOLUTION	1/4000 of Rated Voltage
VMON ACCURACY	0.10% of RDG ± 0.1% of Rating	OVP ACCURACY	0.20% of Setting ± 0.25% of Rating
IMON ACCURACY	0.10% of RDG ± 0.1% of Rating	OVER CURRENT PROTECTION (OCP)	110% * Imax
AC INPUT	115/230Vac   50/60Hz	OCP RESOLUTION	1/4000 of Rated Current
OPERATING TEMPERATURE	5°C ~ 40°C	OCP ACCURACY	0.20% of Setting ± 0.25% of Rating

# PEL & FEL Series of Low-power and Ultra-low Voltage Programmable

## Why Choose the PEL Series?

For years the test and measurement industry was in need of a portable, general-purpose dc electronic load. The available load solutions were either rackmount or multi-channel mainframe-based. The form factor aside, trim pots were the standard calibration method. Users in the Test and Measurement Industry demanded a load bank solution that was compact and portable, embedded with GPIB/RS-232, capable of bench-top closed-case calibration, offered dynamic operability such as profile simulation and could easily be calibrated on a bench without removing the cover.

AMREL's PEL Series of "Low-power" dc Electronic eLoads, designed for your daily testing needs, offers affordable value, dynamic pulse shaping, auto-sequencing, embedded GPIB/RS-232 and closed-case calibration in a portable rackmount-ready package.

## Why Choose the FEL Series?

Traditional load bank solutions were limited by the minimum compliance voltage of internal power dissipating components and the lack of high-current handling capability. The markets for power electronics/components, emerging fuel cell applications and energy storage sources (batteries, ultra capacitors and others) were demanding a dc electronic load solution that was compact enough for simple portability with a voltage/current performance that allowed low-voltage operation at currents exceeding the standard current ratings.

AMREL's FEL Series of "Low-voltage" dc Electronic eLoads offer affordable, compact rackmount-ready programmable loads for high-current dissipation at ultra-low compliance voltage. High current ratings go up to 200Adc.

## Markets and Applications:

- Fuel Cells
  - Single Cell and Short Stack Fuel Cell Characterization, Break-in and Testing Applications
  - Gstat Impedance Measurement (EIS & AC Modulation)
  - Polarization Curve Data Capture (CV & CC Control)
  - Durability
  - Lifetime Tests
  - Performance/Design Characterization
- Battery Testing
  - Dynamic Profiling
  - Battery Characterization
  - Charge/Discharge and Lifetime/Cycle Tests
- Power Electronics Testing
  - dc-dc Converters
  - ac-dc Power Supplies
  - Switching Power Supplies
  - POL (Point of Load)
- Power Electronic Components Testing
- Battery Chargers & Load Profile Simulation
- Laboratories, Universities and R&D
- Defense/Aerospace/Avionics/Industrial ATE and Integrated Test Systems
- Portable Applications

### PEL SELECTOR GUIDE

PEL XXX - YY - ZZZ  
XXX - POWER | YY - VOLTAGE | ZZZ - CURRENT

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	VMIN at IMAX	Size (Height, Width)
PEL	PEL60-60-10	60W	60	10	1V	4U, 1/4Rack
PEL	PEL150-60-30	150W	60	30	1V	4U, 1/4Rack
PEL	PEL150-60-60	150W	60	60	1V	4U, 1/4Rack
PEL	PEL300-60-60	300W	60	60	1V	4U, 1/4Rack
PEL	PEL300-60-120	300W	60	120	1V	4U, 1/4Rack
PEL	PEL300-120-60	300W	120	60	1V	4U, 1/4Rack
PEL	PEL600-120-120	600W	120	120	1V	4U, 1/4Rack
PEL	PEL600-300-120	600W	300	120	1V	4U, 1/4Rack
PEL	PEL600-600-60	600W	600	60	1V	4U, 1/4Rack
Custom-tailored Ranges Available		Voltage Range: 10Vdc ~ 600Vdc Rating Current Range: 1Adc ~ 100Adc Rating Power Range: 60W ~ 800W Rating				

### FEL SELECTOR GUIDE

FEL XXX - YY - ZZZ  
XXX - POWER | YY - VOLTAGE | ZZZ - CURRENT

Series	Model #	Power (W)	Voltage (Vdc)	Current (Adc)	Current (Adc @ 0.4Vdc)	Size (Height, Width)
FEL	FEL60-1	60W	10	50	50	4U, 1/4rack
FEL	FEL60-2	60W	20	50	50	4U, 1/4rack
FEL	FEL150-1	150W	10	100	75	4U, 1/4rack
FEL	FEL150-2	150W	20	100	75	4U, 1/4rack
FEL	FEL300-1	300W	10	200	100	4U, 1/4rack
FEL	FEL300-2	300W	20	200	100	4U, 1/4rack
Custom-tailored Ranges Available		Voltage Range: 10Vdc ~ 800Vdc Rating Current Range: 1Adc ~ 100Adc Rating Power Range: 60W ~ 800W Rating				

## PEL Key Features and Benefits:

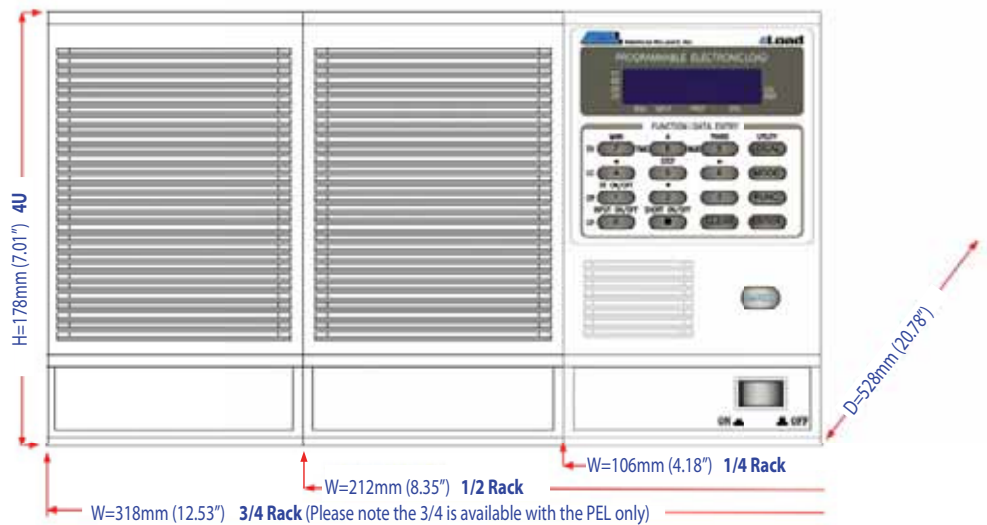
- **Broadest Model Selection:** 60W, 150W, 300W, 600W or Custom-tailored Power Ratings
- **Exclusive Voltage Models:** Standard 60V, 120V, 300V, 600V & Custom-tailored Voltage Ratings
- **Ideal for Unique Test Applications:** Custom-tailored Ratings & Features Available
- **Low-voltage Operation:** Up to 120Adc at 1Vdc and Operable Down to 0.1Vdc

## FEL Key Features and Benefits:

- **Broadest Model Selection:** 60W, 150W, 300W or Custom-tailored Power Ratings
- **Exclusive Voltage Models:** Standard 10V, 20V and Custom-tailored Voltage Ratings
- **Ideal for Unique Test Applications:** Custom-tailored Ratings & Features Available
- **Ultra Low-voltage Operation:** Up to 200Adc at 0.8Vdc and Operable Down to 0.1Vdc



## Dimensions

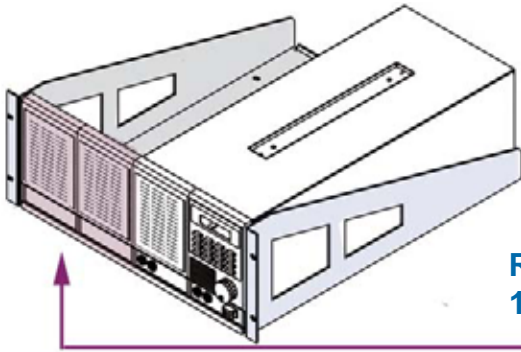


## PEL & FEL SPECIFICATIONS

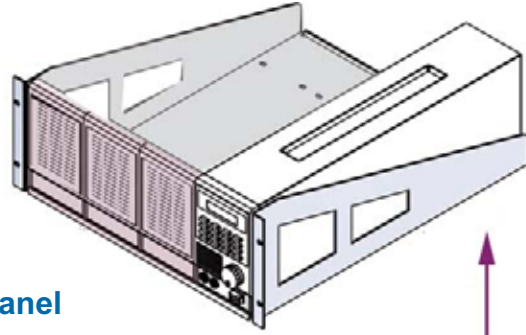
CV MODE SPECIFICATIONS	
CVL RANGE	0 ~ 100% of Vmax
ACCURACY	0.2% of Value ± 0.1% of Rating
RESOLUTION	1/3600 of Rated Voltage
CV TRANSIENT TIME	1ms ~ 270ms for 0Vdc to Vmax
CR and CP MODE SPECIFICATIONS	
Please reference website datasheet for details	
GENERAL SPECIFICATIONS	
REMOTE INTERFACES	RS-232 & GPIB
CC MODE ANALOG PROGRAMMING	0 ~ 10Vdc corresponds to 0 ~ Imax
ACCURACY	Mode Accuracy ± 0.1% of Rating
VMON ACCURACY	0.10% of RDG ± 0.1% of Rating
IMON ACCURACY	0.10% of RDG ± 0.1% of Rating
AC INPUT	115/230Vac   50/60Hz
OPERATING TEMPERATURE	5°C ~ 40°C

CC MODE SPECIFICATIONS	
CCL RANGE	0 ~ 10% of Imax
CCM RANGE	0 ~ 100% of Imax
ACCURACY	0.2% of Value ± 0.1% of Rating
RESOLUTION	1/3600 of Rated Current
PEL CC TRANSIENT TIME	27ms ~ 0.100ms for 0Adc to Imax
FEL CC TRANSIENT TIME	54ms ~ 0.200ms for 0Adc to Imax
PROTECTION	
OVER POWER PROTECTION (OPP)	110% * Pmax
RESOLUTION	1/4000 of Rated Power
ACCURACY	1% of Setting ± 0.5% of Rating
OVER VOLTAGE PROTECTION (OVP)	110% * Vmax
OVP RESOLUTION	1/4000 of Rated Voltage
OVP ACCURACY	0.20% of Setting ± 0.25% of Rating
OVER CURRENT PROTECTION (OCP)	110% * Imax
OCP RESOLUTION	1/4000 of Rated Current
OCP ACCURACY	0.20% of Setting ± 0.25% of Rating

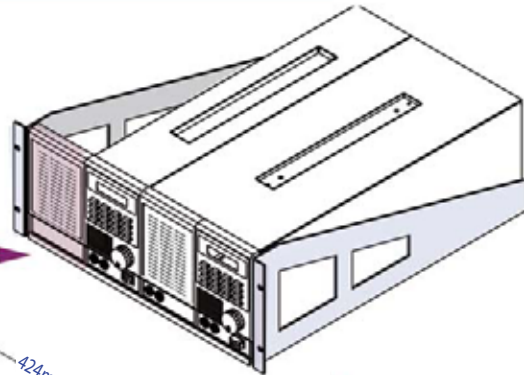
# PEL & FEL Series of Rackmount



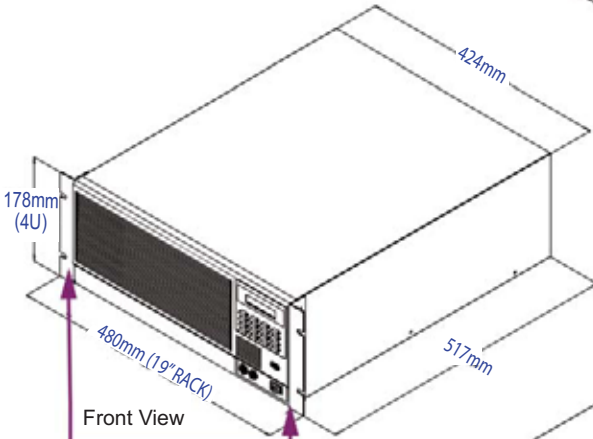
**RMP-02A**  
1/2 Rack Filler Panel



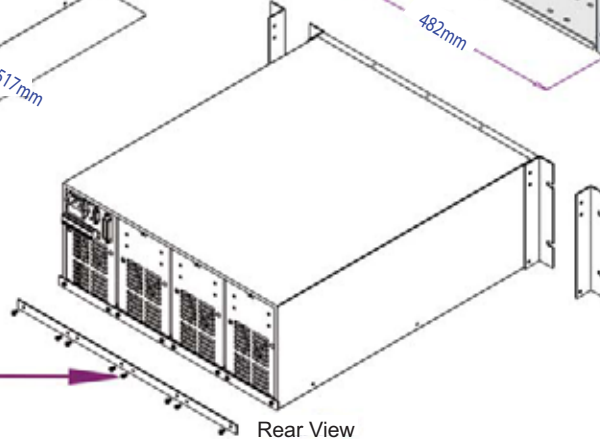
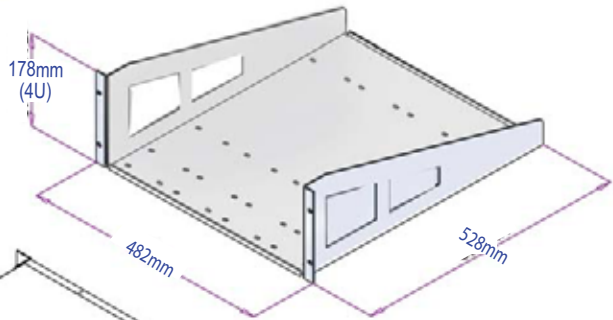
**RMP-03A**  
3/4 Rack Filler Panel



**RMP-01A**  
1/4 Rack Filler Panel

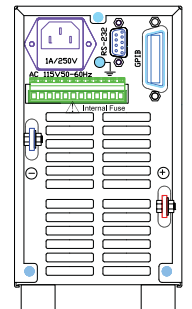
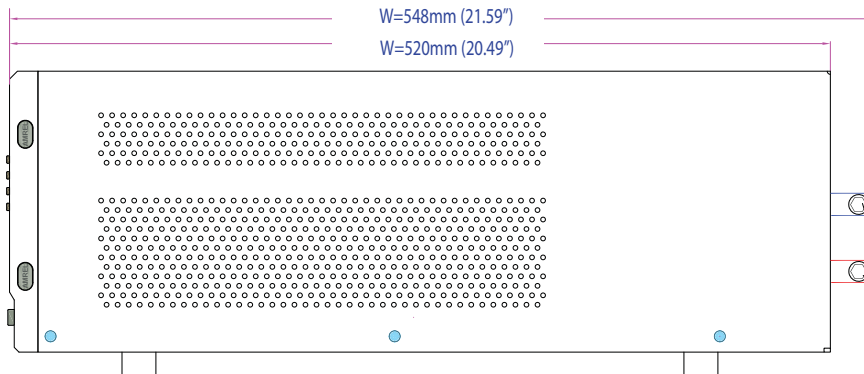
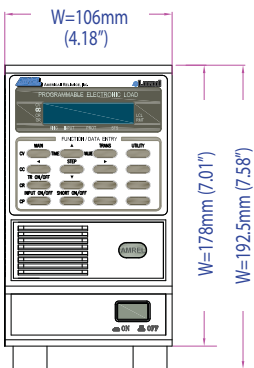


Front View  
**\*\*RMP-04 Full Rack  
Rear Mount**



**\*RM-03 19"  
Rackmount Shelf**

\*Please note that when assembled the shelf adds approximately 5mm to the 4U height.

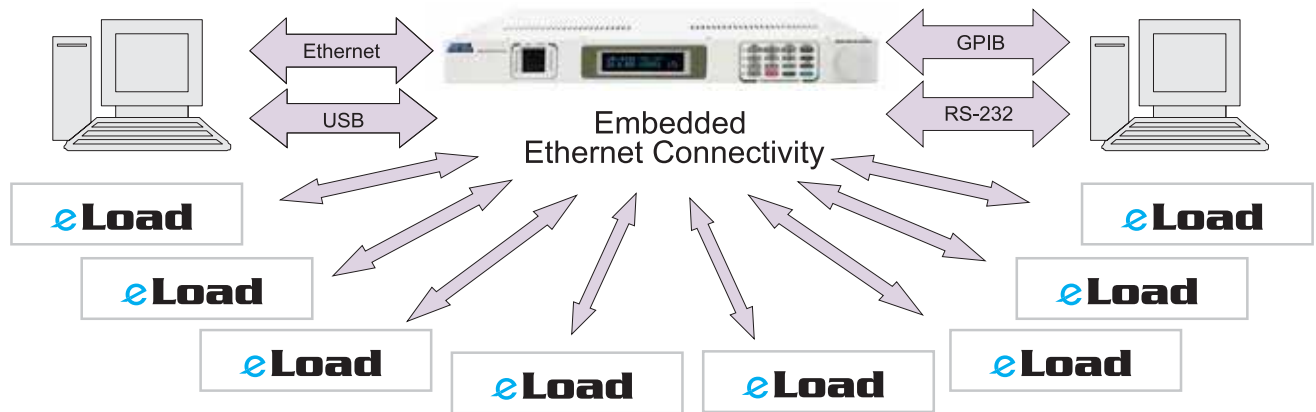


### Why Choose the MCU Series?

AMREL's MCU-1 Solution provides complete remote access and control of AMREL's eLoad. This is accomplished via the optional embedded Ethernet Interface available with the eLoad. The user can easily connect, initialize, and configure the eLoad to AMREL's MCU-1 Controller as shown in the diagram below.

### eTools Software Support Package:

The eTools Software Support Package facilitates the integration of eLoads into an ATE environment. It provides full management control for the devices on either an Ethernet or closed-loop network. eTools also provides portability to test and measurement software platforms such as National Instruments' LabWindows/CVI and LabVIEW, as well as proprietary C/C++ test applications running on Windows.



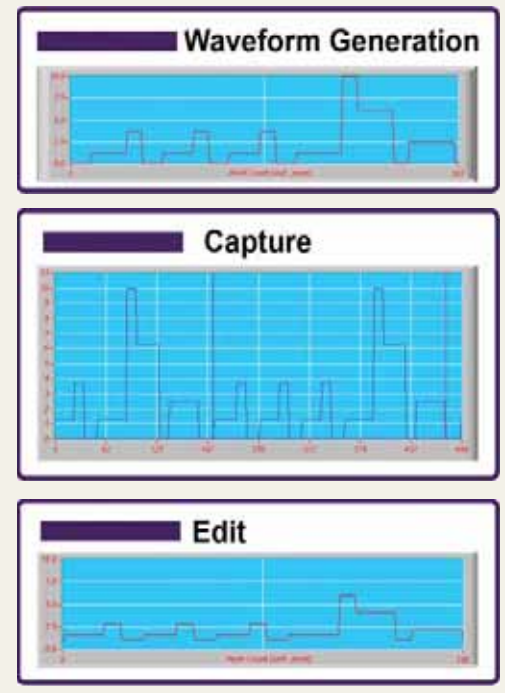
### MCU-1 Key Features and Benefits:

- Integrated Keypad, Digital Encoder and VFD screen
- Compatible with AMREL eLoad and ePower Devices
- Access Up to Eight Ethernet Devices - Expandable to Access Unlimited Devices, via Additional MCU Controllers
- Provides GPIB, USB, RS-232 or Optional Ethernet/USB Interface Connectivity to the Computer via One Single Connection.
- Supports TCP/IP and a Proprietary UDP (User Datagram Protocol) for High Throughput
- Triggering Capability Allows Synchronized Activation of All Connected AMREL Devices
- Faulty Connected Devices are Automatically Isolated from the System and LED Indication Displayed on the Front Panel.

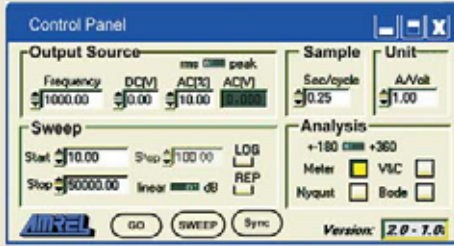
### AWG - Arbitrary Waveform Generator & Waveform Capture/ Edit

- **Waveform Capture** to Store Dynamic Loading Profiles Required for Fuel Cell Design Validation, Durability, Accelerated Life-Time, Conditioning, Performance Verification and Fuel Cell Power Electronics Test Applications
- **Waveform Generator** Simulates Diverse Loading Profiles, Real Life Applications or Drive Cycles via Stored Loading Profiles or Standard Waveforms
- **Ideal for ATE Environments** With Unique and Diverse Control Loading Algorithms
- **Digitize Voltage and Current Operating Behavior** of the DUT, Store Them as Different Load Profiles and Simulate the DUT Test Criteria Anytime and Hassle-free
- **Select from Over 10 Standard Waveforms** to Meet Unique Application Demands
- **Edit, and Combine Captured Waveform** to Create Automatic Test Sequences or Extremely Long Patterns to Simulate DUT Operating Characteristics
- **Self Authoring Software** to Precisely Generate and Edit Waveform Profile Sequences to Meet Dynamic Test Application Requirements
- **External and Internal Triggering**, Adjustable Sampling Size and Window for Full Control of Digitizing Analog Data

### Arbitrary Waveform Generation/ Capture/Edit Demo



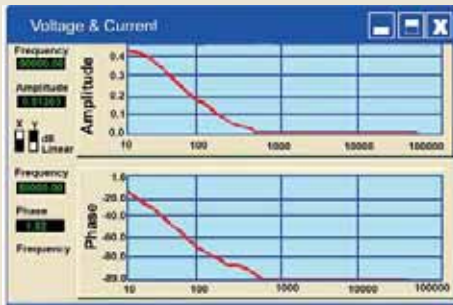
## TECHNICAL FEATURES:



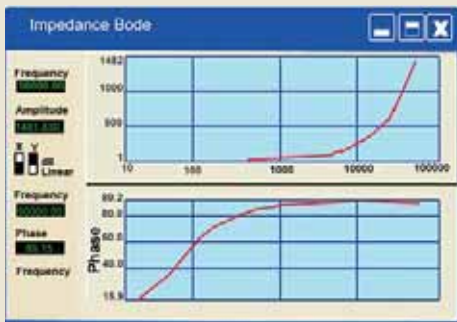
CONTROL PANEL



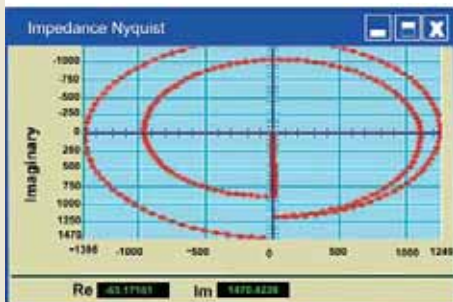
REAL TIME MONITORING



V/I GRAPH



BODE PLOTS



NYQUIST PLOTS

- **Digital Sine Correlation** to Remove Harmonics for Accurate Measurements
- **Programmable Integration (Sampling) Time** will Allow Measurement of Micro-ohm Signals Buried Under Noise Without the Need for Auxiliary Equipment
- **Simultaneous V/I Measurement** to Ensure Exact Impedance and Phase Information
- **DDS Sine-wave Generation**, Yielding Frequency Errors Less than 0.02Hz
- **Floating Dual Independent Signal Analyzers** Provide Single-channel Impedance Measurements or Both Channels to Measure Transfer Functions, Transconductance, Impedance, Signal Analysis (FRA) Data and Other Important Parameters in Polar/Rectangular Format
- **User-friendly Features Include:** Auto-gain, Quick-set ac Amplitude, Signal Overload (Signal Saturation) Protection, and Adjustable Sample Interval Without the Complicated Calculations - the Above Features Allow the User to Start Measuring Impedance Without Hassles.
- **Auto-Gain Control and Flexible Ranges** for Measuring Small Signals in Noisy Environments with  $1\mu\text{V}$  Sensitivity while Maximizing Resolution and Precision to Obtain an Accurate Measurement
- **Universal ac + dc Output Signals** Critical for Impedance Measurement/AC Modulation Applications in the Battery/Fuel Cell/Electronic Components and Devices R&D, Testing and Production Sectors
- **GPIO/RS-232 and Optional USB/Ethernet** Provide State-of-the-art Connectivity while Satisfying Diverse Throughput/Network Security Requirements
- **System-level Multi-channel Impedance Measurement** can be Achieved Using the Integrated MCU-1 Capability and a Switch Matrix
- **Impedance Measurement Application Program** Included to Save Costs Associated with Existing Expensive Impedance Measurement Software
- **Comprehensive Application Program** with Premium Features - Nyquist, Bode, V/I, Real-time Display of Impedance Measurements and Operating Conditions, Frequency Sweeps with Adjustable Amplitude in Log/Linear Form and Auto-save for Logged Data to Establish AMREL's FRA as the Ultimate Diagnostic Tool
- **0.1Hz Models** Available

## FREQUENCY RESPONSE ANALYZER SPECIFICATIONS<sup>1</sup>

### GENERATOR

Waveform:	Sine Wave
Programmable Frequency Range:	1 Hz ~ 20 KHz
Frequency Resolution:	0.01Hz
Amplitude:	Up to 20% of dc Bias Setting or 1Vrms
Amplitude Resolution:	5mVPP
Distortion:	< 0.2%
Sweep Types:	Frequency – Logarithmic and Linear Amplitude – Logarithmic and Linear

### AMPLITUDE ACCURACY

Frequency Range	Amplitude Range	AC Amplitude Accuracy <sup>2</sup>
10Hz ~ 20kHz	0.05Vrms ~ 0.1999Vrms	± 2% * 0.1999Vrms
	0.2Vrms ~ 0.8Vrms	± 0.50% * 0.8Vrms
	Output Amplitude > 0.8	± 2% * 1Vrms

\*1: Amplitude Accuracy are specified to % of Max Range Value

### dc BIAS

Range:	10mVdc ~ 10Vdc
Resolution:	10mV
Accuracy:	0.1% ± 50mVdc
Output Impedance:	50Ω
Maximum Output:	0V < Vdc + Vpk-pk(ac) ≤ 10V



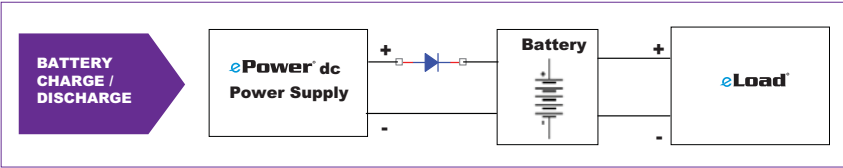
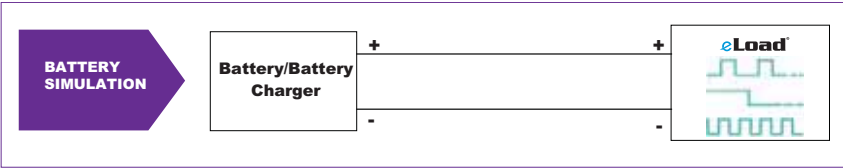
### ANALYZERS (Two Independent Analyzers Operate in Parallel)

Range:	Auto
Sensitivity:	1μV
Dynamic Range:	90dB
Common Mode Rejection:	>80dB @ 100Hz
Cross Channel Isolation:	>90dB @ 10kHz
Coupling:	ac (- 3dB @ 2Hz)
dc Blocking Voltage:	250Vdc Common Mode/500Vdc Differential Mode
Differential Input Impedance:	> 200KΩ
Maximum Input:	1Vp-p (approx. 350mVrms)
Adc (Per Channel):	16 bit, 400K samples/second
Sample Interval:	10ms ~ 10s; Default Setting: 0.25s
Phase Accuracy:	1.0 degree

### MAGNITUDE ACCURACY

Amplitude			
160mV < Input ≤ 350mV	± 0.2% * 350mV	± 0.2% * 350mV	± 0.5% * 350mV
54mV < Input ≤ 160mV	± 0.2% * 160mV	± 0.2% * 160mV	± 0.5% * 160mV
27mV < Input ≤ 54mV	± 0.2% * 54mV	± 0.2% * 54mV	± 0.5% * 54mV
18mV < Input ≤ 27mV	± 0.2% * 27mV	± 0.2% * 27mV	± 0.5% * 27mV
11mV < Input ≤ 18mV	± 0.2% * 18mV	± 0.2% * 18mV	± 0.5% * 18mV
5.4mV < Input ≤ 11mV	± 0.2% * 11mV	± 0.2% * 11mV	± 0.5% * 11mV
3.6mV < Input ≤ 5.4mV	± 1.0% * 5.4mV	± 0.2% * 5.4mV	± 0.5% * 5.4mV
1μV < Input ≤ 3.6mV	± 1.0% * 3.6mV	± 1.0% * 3.6mV	± 1.0% * 3.6mV
Frequency	10Hz ~ 999.99Hz	1kHz ~ 9999.99Hz	10kHz ~ 20kHz

# BATTERY TESTING/ENERGY STORAGE APPLICATIONS



## CAPABILITIES

- **Determine Battery Characterization Parameters**
  - Internal Resistance/Impedance
  - Charge/Discharge Rates
  - Discharge Curves
  - Depth of Discharge (DOD)
  - Temperature Effects
  - Charge Efficiency
  - Cycle Life
  - Capacity Retention & Characteristics
- **Constant Charge/Discharge Loading**
- **Pulsed Mode Testing**
- **Complex Dynamic Load Profile Simulation**
- **Cycle Testing - Charge/Discharge Profiles**
- **Qualification & Lifetime Testing**
- **Constant Current/Constant Power Testing**
- **Battery Charger Validation**
- **High-voltage Battery Characterization**
- **High-current Battery Characterization**
- **High-current Discharge Tests**

## RELATED PRODUCTS-BATTERY/ENERGY/POWER SUPPLY/ELECTRONICS

- **High-power, Rackmount & System Solutions**
  - PLA (page 6-7)
  - PLW (page 8-9)
  - System Solutions (page 28-33)
- **Bench-top & Multi-channel Solutions**
  - BPL (page 10-11)
  - LPL (page 4-5)
  - FEL (page 16-17)
  - PEL (page 16-17)
- **Resistance & Impedance Measurement**
  - FRA - Frequency Response Analyzer Battery/Energy Storage (page 20-21)
- **dc Power Supply/Battery Charger Solutions**
  - Dual-channel SPD
  - Low-power SPS
  - Medium-power SPS
  - HPS

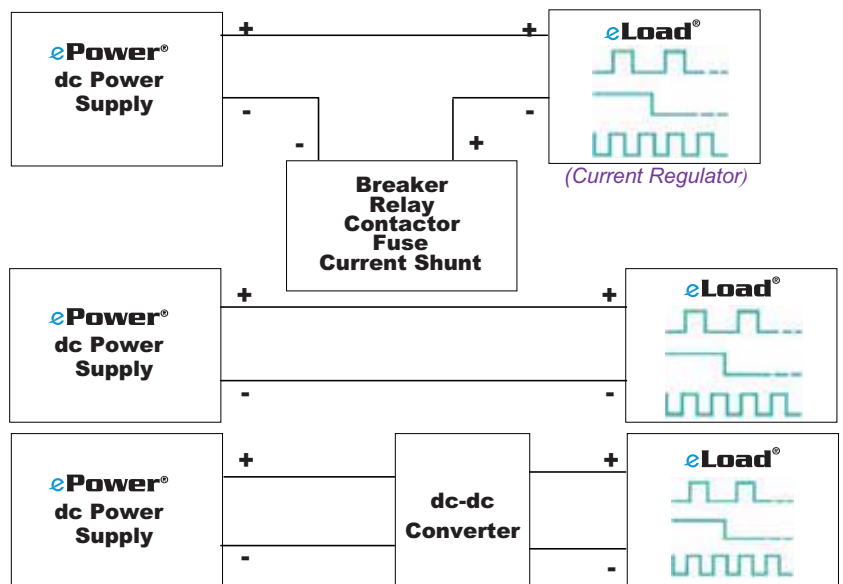
## PERFORMANCE MONITOR PARAMETERS

- **State of Charge (SOC)**
- **State of Health (SOH)**
- **Open Circuit Voltage (OCV)**
- **Internal Resistance/Impedance**
- **Voltage/Current/Power**

# POWER SUPPLY & ELECTRONIC COMPONENTS

## CAPABILITIES

- **Validate dc Power Supply & dc-dc Converter Design and Performance Specifications**
  - Load Transient Recovery & Dynamic Load Regulation
  - Programming Response Time
  - Loop Response
  - Overshoot and Undershoot Characteristics
  - Static Load Regulation
  - Efficiency
  - Start up Time
  - Source Effect (line regulation)
  - PARD
  - Power Factor
  - Drift
  - Voltage Latch-up
  - Over-voltage Protection Validation
  - Short Circuit Current Protection Validation
  - Over-current Protection Validation
- **Dynamic Operating Modes**
  - Auto-sequence Voltage, Current, Resistance & Power Profile
  - Pulse Mode and Continuous Pulse Shaping
  - Program Frequency, Duty Cycle & Rise/Fall Times
- **Exclusive High-voltage, Current and Power Ratings**

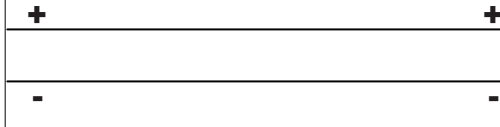
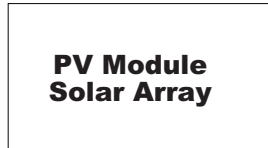
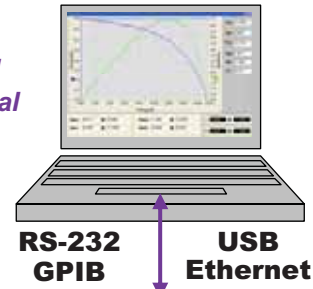


# PV Applications

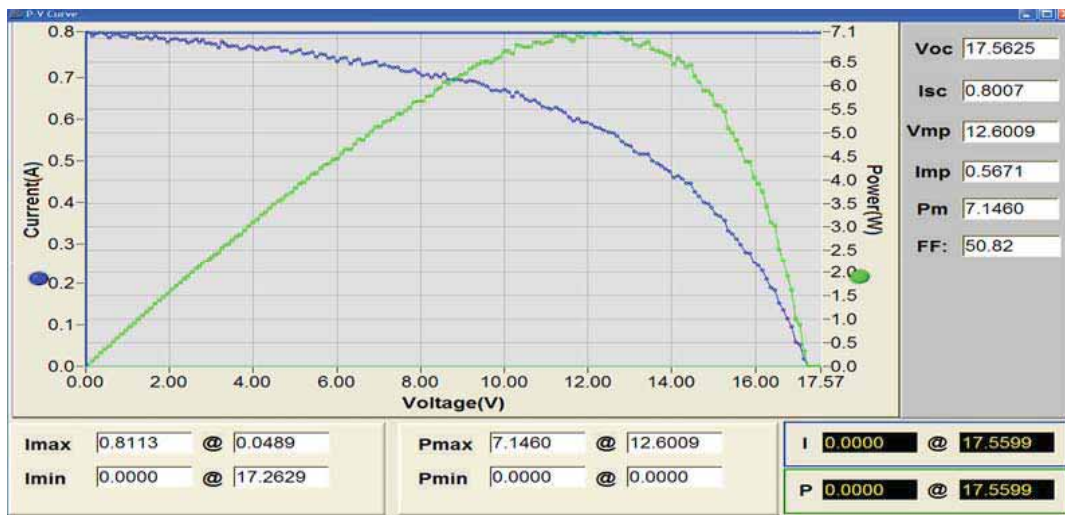
# APPLICATIONS



PC Program provides the graphical display of the I-V Curve and numerical data for VMP, IMP, FF, ISC and VOC



PV APPLICATION PROGRAM SCREENSHOT



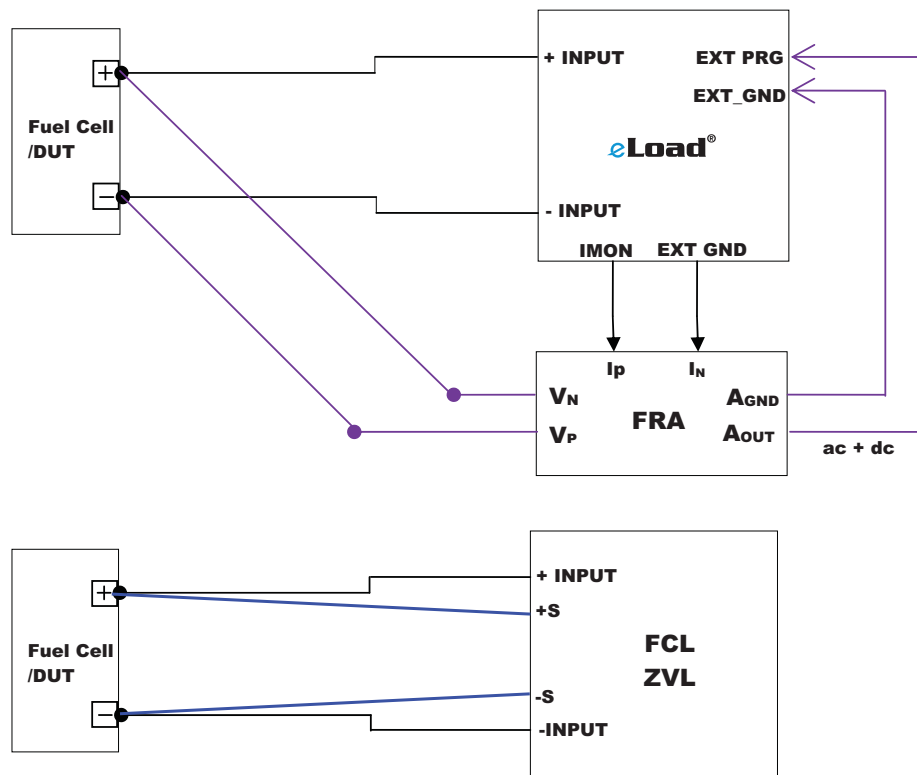
## CAPABILITIES

- **Determine PV Performance Parameters**
  - Open Circuit Voltage (Voc)
  - Short Circuit Current (Isc)
  - Voltage at Max Power (Vmp)
  - Current at Max Power (Imp)
  - Power at Max Power (Pmp)
  - Fill Factor
- **Generate I-V Curves**
  - Determine Pmp and Power Curve
  - Auto-loading at Pmp Point
  - Save and Organize Captured Data
- **Validate PV Cell/Module down to 0Vdc**
- **Validate Thin-film, Single and Poly- silicone PV Design & Materials**
- **Validate Solar Concentrator PV Design**

## RELATED PRODUCTS

- **High-power, Rackmount & System Solutions**
  - PLA (page 6-7)
  - PLW (page 8-9)
  - System Solutions (page 28-33)
- **Bench-top & Multi-channel Solutions**
  - BPL (page 10-11)
  - LPL (page 4-5)
  - FEL (page 16-17)
  - PEL (page 16-17)
- **Zero Volt Load Solutions**
  - ZVL (page 14-15)
- **MPPT Inverter Test Solutions**
  - Dual-channel SPD
  - Low-power SPS
  - Medium-power SPS
  - HPS

# FUEL CELL TESTING AND EIS/IMPEDANCE MEASUREMENT APPLICATIONS



## CAPABILITIES

- **Determine Fuel Cell Operating Parameters**
  - Internal Resistance/Impedance
  - Fuel/Oxidant Utilization
  - Gas Concentration
  - Temperature Effects
  - Pressure Effects
  - Validate Balance of System/Plant
- **Impedance Measurement**
  - EIS/AC Modulation
  - Current Interruption
- **Polarization Curves**
- **Single Cell Characterization down to 0Vdc**
- **Short Stack & Full Stack Test**
- **Durability Test**
- **Voltage/Current Cycling**
- **Accelerated Lifetime Test**
- **dc-dc Converter Validation**
- **Electrical Test and Characterization**

## RELATED PRODUCTS

- **High-power, Rackmount & System Solutions**
  - PLA (page 6-7)
  - PLW (page 8-9)
  - System Solutions (page 28-33)
- **Bench-top & Multi-channel Solutions**
  - BPL (page 10-11)
  - LPL (page 4-5)
  - FEL (page 16-17)
  - PEL (page 16-17)
- **Zero Volt Load Solutions**
  - ZVL (page 14-15)
  - FCL (page 12-13)
- **EIS/Impedance Measurement**
  - FRA - Frequency Response Analyzer (page 20-21)
  - FCL - Fuel Cell Load Solution (page 12-13)
- **dc Power Supply Solutions**
  - Dual-channel SPD
  - Low-power SPS
  - Medium-power SPS
  - HPS

# MILITARY/DEFENSE AND AEROSPACE/AVIONICS ATE APPLICATIONS

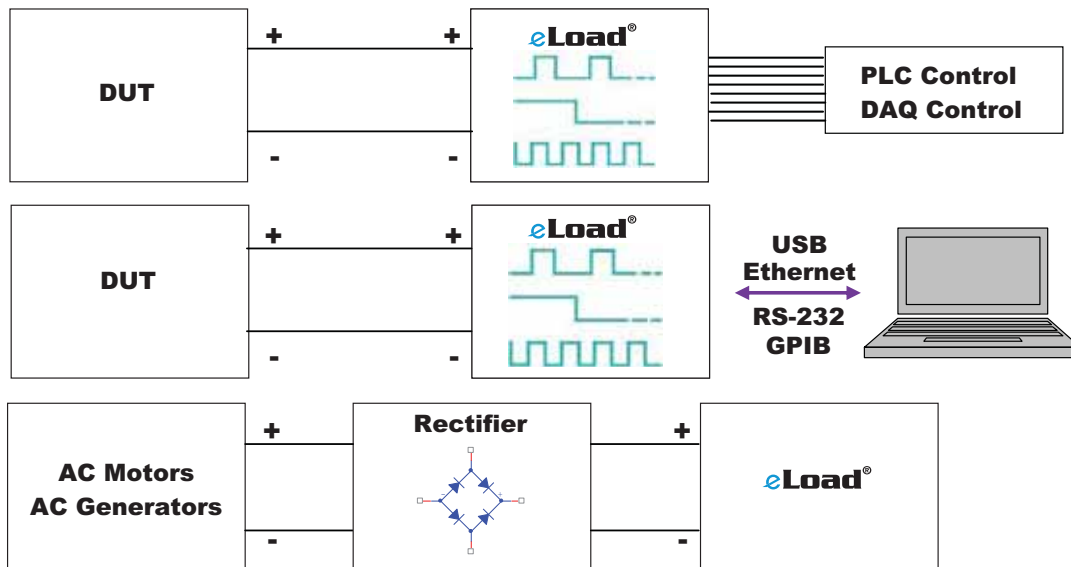


## CAPABILITIES

- **Customization**
  - Build-to-Print (design, prototyping, testing, manufacturing & tech support)
  - Pre-sales Consultation & Post-sales Service/Tech Support
  - Hardware Design and Modification
  - Mechanical Design and Modification
  - Design and PCB Layout
  - Custom Software and Firmware Modifications
  - Full Testing Capabilities
  - Custom-tailor Existing Product Ratings and Specs to Meet Unique Application Demands
- **Exclusive System Capabilities and Options**
  - dc Contactor and Emergency Shutdown Panel
  - System Integration of ac and dc Connectors, Power Distribution, and System Wiring
  - AMREL's Exclusive "Anti-condensation" Water Manifold Distribution System
  - Customized System Hardware, Software, Firmware and Mechanical Design
  - NEMA Enclosures Available
  - Full System-level Testing Capabilities
- **Exclusive High-voltage, High-current and High-power Ratings Available**

## RELATED PRODUCTS

- **High-power, Rackmount & System Solutions**
  - PLA (page 6-7)
  - PLW (page 8-9)
  - System Solutions (page 28-33)
- **Bench-top & Multi-channel Solutions**
  - BPL (page 10-11)
  - LPL (page 4-5)
  - FEL (page 16-17)
  - PEL (page 16-17)
- **Fuel Cell/Battery Impedance Measurement**
  - FRA - Frequency Response Analyzer (page 20-21)
  - FCL - Fuel Cell Load Solution (page 12-13)
- **dc Power Supply Solutions**
  - Linear Power Supply
  - Dual-channel SPD
  - Low-power SPS
  - Medium-power SPS



## CAPABILITIES

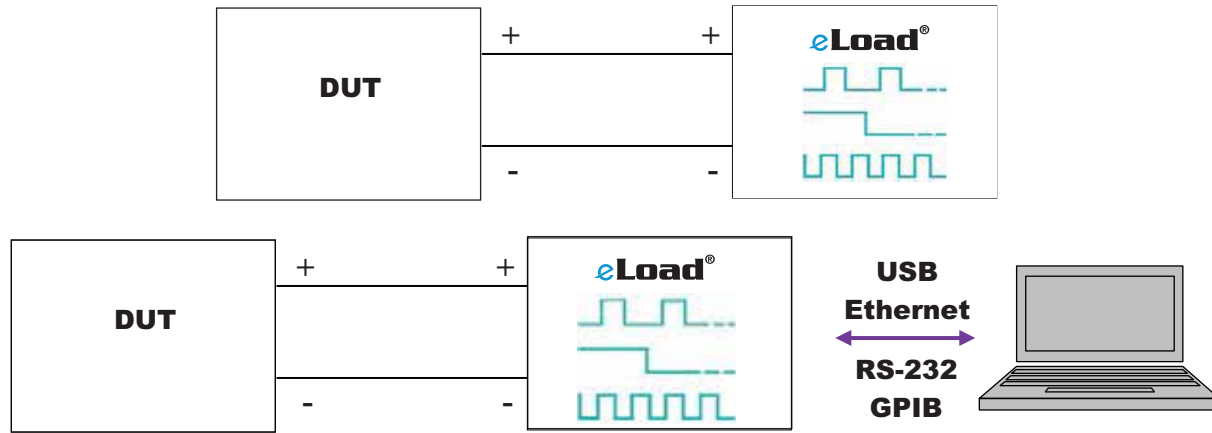
- **Industrial Applications:** AMREL offers the unique capability to tailor dc electronic loads for many diverse industries, including telecommunications, data center, transportation, oil/gas, utility, automotive power electronics and components production sectors. AMREL provides a solution for the specific needs of a wide range of applications, such as generator/alternator testing, UPS/battery back-up discharge tests, and quality testing. In addition, AMREL provides personalized service and post-sales support to ensure that you are running 24/7. Contact AMREL today to discuss your application needs.
- **Customization & Exclusive Options**
  - Isolated Analog Programming, Voltage/Current Monitor
  - TTL CV/CC Mode Selection
  - TTL On/Off Control & Remote Inhibit for Interlock Protection
  - Solid State Reverse Polarity/Isolation Relays
  - Build-to-print Solutions - from Requirements to Product
  - Custom-tailor Existing Products to Meet Unique Demands
  - Pre-sales Consultation & Post-sales Service/Tech Support
  - Special Custom Feature Development & Hardware Design
  - LabVIEW, LabWindows & SCPI Command Set
  - Custom Software/Firmware Modifications Available
- **Widest Line of dc Test Solutions**
  - High Current/Voltage Rated Switch-mode Supplies (1.2kW to 900kW+)
  - Customized Multi-channel Linear Supplies (10W to 2kW)
  - Low-profile (1.75" Rackmount) dc Electronic eLoad
  - Ultra-compact Air-Cooled eLoad (800W to 100kW+)
  - Smallest Footprint Water-cooled eLoad (6kW to 200kW+)
- **Exclusive High-voltage, Current and Power Ratings**
- **Ask about how to Custom-tailor a Cost-effective Solution Today**

## RELATED PRODUCTS

- **High-power, Rackmount & System Solutions**
  - PLA (page 6-7)
  - PLW (page 8-9)
  - System Solutions (page 28-33)
- **Bench-top & Multi-channel Solutions**
  - BPL (page 10-11)
  - LPL (page 4-5)
  - FEL (page 16-17)
  - PEL (page 16-17)
- **dc Power Supply Solutions**
  - Linear Power Supply
  - Dual-channel SPD
  - Low-power SPS
  - Medium-power SPS
  - HPS
- **Customized Solutions**
  - Customization Page (page 29-33)

# University and Research Laboratory Test Solutions

# APPLICATIONS



## CAPABILITIES

- **Exclusive Options and Services**
  - Ultra-low Current Range Option for Optimized Precision
  - 3rd Party NIST Calibration Service
  - Solid State Reverse Polarity/Isolation Relays
  - Isolated Analog Programming, Voltage/Current Monitor
  - Pre-sales Consultation & Post-sales Service/Tech Support
  - Custom-tailor an Existing Product to Meet Unique Requirements
- **Exclusive Features and Functionality**
  - Auto-sequencing Voltage, Current, Resistance & Power Profile
  - Pulse Mode and Continuous Pulse Shaping
  - Program Frequency, Duty Cycle & Rise/Fall Times
  - LabVIEW, LabWindows & SCPI Command Set
  - Simple Closed-case Calibration for Internal Metrology Lab
- **Widest Line of dc Test Solutions**
- **Ultra-portable Bench-top Solutions**
  - Customized Precision Multi-channel Linear Supplies (10W to 2kW)
  - Widest Selection of 1.2kW to 3kW Switch-mode Supplies to fit your budget
    - LPL - Low-profile (1.75" Rackmount) dc Electronic **eLoad**
    - BPL - Smallest Footprint Bench-top **eLoad** (400W & 800W)
    - FEL/PEL - Cost-effective Bench-top **eLoad** (60W to 600W)
- **High-power Solutions**
  - High-current/Voltage Rated Switching Supplies (6kW to 900kW+)
  - Ultra-compact Air-cooled **eLoad** (800W to 100kW+)
  - Smallest Footprint Water-cooled **eLoad** (6kW to 200kW+)
  - System Solutions Available
- **Exclusive High-voltage, Current and Power Ratings**
- **Custom-tailored and Customized Solutions Available**

## RELATED PRODUCTS

- **High-power, Rackmount & System Solutions**
  - PLA (page 6-7)
  - PLW (page 8-9)
  - System Solutions (page 28-33)
- **Bench-top & Multi-channel Solutions**
  - BPL (page 10-11)
  - LPL (page 4-5)
  - FEL (page 16-17)
  - PEL (page 16-17)
- **dc Power Supply Solutions**
  - Linear Power Supply
  - Dual-channel SPD
  - Low-power SPS
  - Medium-power SPS
  - HPS
- **Fuel Cell/Battery Impedance Measurement**
  - Frequency Response Analyzer (page 20-21)
  - Fuel Cell Load Solution (page 12-13)

# ePower<sup>®</sup> Programmable dc Switch Mode & Linear Power Supplies

AMREL's ePower<sup>®</sup> line includes three series and over 200 models of programmable switch mode & linear power supplies:

## SPS Series of Mid-power Rackmount Switch Mode Power Supplies

- Wide Ranges 1.2kW to 45kW, Up to 1000Vdc and 2700Adc
- Low-profile, High-power Density 1U (1.2kW and 1.5kW)
- GPIB/SCPI, RS-232, RS-485, USB & Ethernet Interfaces Available
- Built-in Output Isolation & Polarity Reversal Relays Available
- Master Slave Capability Up to 31 Channels
- Available with Full Function Keypad Control, LED Indicators, and/or Encoder Knob Controls, Auto Sequencing and Triggering
- External Analog Programming
- Dual-channel (SPD) Models Available (360W/Channel Mix and Match)
- Closed-case Calibration
- Isolated Analog Programming/Vmon/Imon Available



## HPS Series of High-power Cabinet Mounted Switch Mode Power Supplies

- Wide Ranges 20kW to 900kW+, up to 2500Vdc and 7500Adc
- Digital Closed-case Calibration
- Co-existent GPIB/SCPI & RS-232 Interfaces Standard
- Ethernet and USB Interfaces Available (Field Upgradeable)
- External Analog Programming
- Provides High Efficiency & High Power Factor (~0.9) Operation
- Available in Standard 22" to 48" Wide Cabinet Mount Enclosures
- NEMA Weatherized Enclosure Available



## PD Series of Low Noise Linear Power Supplies

- Output Ranges 20W to 2000W, 5 to 350Vdc and 0.1 to 50Amps
- Single & Dual Outputs
- CV/CC Crossover
- Co-existent GPIB/SCPI & RS-232 Interfaces Standard
- Ethernet Interface Available
- Low Ripple and Noise (PARD) Output
- Multi-channel Systems, Up to 8 Channels Per Chassis (PDS) Available
- Bench-top Models (BPD) Available W 8.5"x H 7"(4U)x D 15.6"
- Closed-case Calibration
- Customer Defined Rackmount Configuration Available



## PDS Series of Customizable "Multi-channel" Linear Power Supplies

- Up to 8 Channels per System: Customize Single, Dual, 4-Channel or 8-Channel PDS Solution According to Your Application Needs
- Choose from Over 200+ Configurations: Custom-tailored Voltage, Current and Power Ratings for Each Channel or Mix and Match
- Master/Slave Multiple 8-Channel Systems: Expandable System via RS-485 Connection & Master/Slave Configuration Saves System Costs

## MFP Series of Modified COTS "Military-grade" Fixed-output Power Supplies

- Available Models: 300W and 1.2kW @ 28Vdc
- Sealed & Condensation-proof: Encapsulated Epoxy Coating Ensures Reliability and Long-term Operation
- Wide Operating Temperature: Continuous Operation from -40°C ~ 70°C
- Universal ac Input: 95% PFC; 45Hz - 440Hz @ 95~250Vac
- Convection Cooled: Silent Operation with No Fans to Replace



AMREL Provides Tailored Solutions to Meet Your Specific Requirements  
**Customization and Modification Available.**

*Please Note: Specifications subject to change without notification.*

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pdinfo@amrel.com [www.amrel.com](http://www.amrel.com)

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