

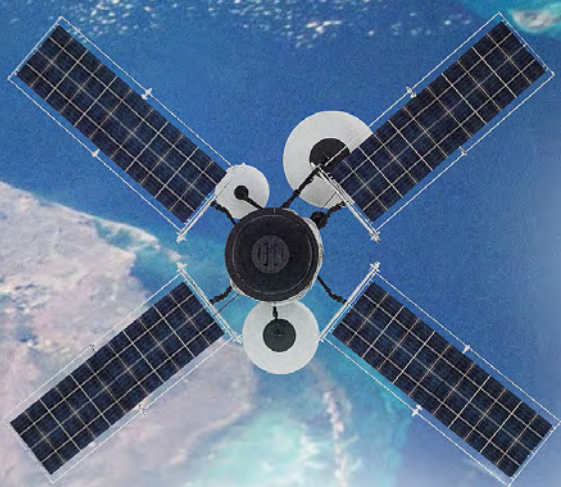


## Programmable Power **Buyer's Guide**





**AMETEK Programmable Power** boasts one of the industry's broadest portfolios of programmable power products under the well-known and respected Sorensen, Elgar, and California Instruments brands.



AMETEK offers programmable AC, DC, and AC plus DC power sources as well as AC and DC electronic loads. Standard products serve a wide range of stimulus, test and measurement (T&M), and process power needs in applications including semiconductor fabrication, commercial and defense automatic test equipment (ATE), oil exploration, avionics, general research and development (R&D), and electromagnetic compatibility (EMC) compliance testing. The company also focuses on the emerging renewable-energy market, offering solutions for photovoltaic-panel (PV) test, PV simulation for both terrestrial and satellite applications, grid simulation, and battery simulation and test.

Key products new to this edition of the Programmable Power Buyer's Guide include the Sorensen Modular intelligent-Bidirectional Energy Amplified (Mi-BEAM) Series, which features full DC source and sink capabilities with power levels from 12kW up to 37kW within a 4U rack height. Also new is a cabinet-mounted floor-standing system—the Sorensen intelligent-Bidirectional Energy Amplified (i-BEAM) Series, which features full DC source and sink capabilities with power levels from 60kW to 1.3MW.



Two additional new products specifically address satellite PV applications. Targeting large satellites, the Elgar Advanced Solar Power Simulator (ASPS) features either two independent, isolated 600W channels or a single 1200W channel and an industry-leading 2 $\mu$ s shunt switching recovery time. And for small satellites, the company offers the new mini-Solar Array Simulator (m-SAS), which provides one 840W channel at 60V, 80V, or 150V. Designed to test the maximum power-point tracker that small satellites typically use, m-SAS features a 250Hz tracking speed.

New to this edition in the AC programmable power-source lineup are the Sequoia and Tahoe Series. Sequoia offers ratings up to 1.08MVA at voltages to 333VAC and currents to 3000A/phase. The fully regenerative Sequoia serves grid-simulation applications. Tahoe offers identical power, voltage, and current specs and serves customers who do not require the regenerative capability.

The company also offers the Asterion DC ASA and ASM Series high-performance three-channel power supplies, the air-cooled PLA and water-cooled PLW programmable electronic loads, the TerraSAS ETS Series standalone terrestrial solar array photovoltaic simulator, and the CTS Series 3,000 to 90,000VA programmable AC and DC immunity compliance testing system.

In addition to rackmount, cabinet, and benchtop models, AMETEK Programmable Power offers a high-density, modular programmable power module system with the ReFlex Power Series that provides DC, AC, and electronic-load assets under the control of a single controller.

Recognizing that a standard product might not be an optimal solution for specialized applications, AMETEK Programmable Power offers custom-engineered solutions, ranging from OEM integration for medical and semiconductor industries to turnkey solar-array simulators for satellites. The company can also modify standard power products to meet specific application requirements.

# Programmable DC Supplies: From 30kW to 650kW

AMETEK Programmable Power offers a wide range of programmable DC power supplies, with maximum power ratings extending from 600W to 650kW (as shown in Table 1). Their power ratings can be extended to even higher power in parallel. These supplies serve key application areas, including industrial automation, materials research, aerospace test, and battery simulation and test.

**Table 1. Standard DC Rack-Mount and Floor-Standing Supplies**

| Series          | Low-end power (kW) | High-end power (kW) | Low-end voltage (V) | High-end voltage (V) | Low-end current (A) | High-end current (A) |
|-----------------|--------------------|---------------------|---------------------|----------------------|---------------------|----------------------|
| i-BEAM          | 60                 | 650*                | 80                  | 1000                 | 200                 | 1000*                |
| ASD FLX         | 10                 | 320                 | 40                  | 160                  | 62                  | 8000                 |
| HPX             | 36                 | 240                 | 10                  | 1000                 | 45                  | 6000                 |
| SGX             | 4                  | 150                 | 10                  | 1000                 | 5                   | 1200                 |
| SGA             | 4                  | 150                 | 10                  | 1000                 | 5                   | 1200                 |
| Mi-BEAM**       | 12                 | 37                  | 600                 | 2000                 | 50                  | 150                  |
| SFA             | 5                  | 30                  | 40                  | 1250                 | 20                  | 500                  |
| Asterion DC     | 1.7                | 10                  | 40                  | 600                  | 2.8                 | 250                  |
| Asterion DC ASA | 0.6                | 1.8***              | 60                  | 600                  | 2.8                 | 42                   |
| Asterion DC ASM | 1.7                | 5.1****             | 40                  | 600                  | 2.8                 | 42                   |
| DLM 3-4kW       | 3                  | 4                   | 5                   | 600                  | 5                   | 450                  |
| ASPS*****       | —                  | 1.2                 | 40                  | 220                  | 2.72                | 20                   |
| DCS             | 1                  | 3                   | 8                   | 600                  | 1.7                 | 350                  |
| XG 850          | 0.67               | 0.85                | 6                   | 600                  | 1.4                 | 110                  |
| m-SAS           |                    | 0.84                | 60                  | 150                  | 5.6                 | 14                   |
| DLM 600         | 0.375              | 0.6                 | 5                   | 300                  | 2                   | 75                   |

\*Two systems in parallel can deliver 1.3MW, \*\*Ratings for single-rack configuration; racks may be paralleled to 1.2MW, \*\*\*Three channels, 600W per channel

\*\*\*\*Three channels, 1700W per channel, \*\*\*\*\*Two 600W channels or one 1200W channel

## Sorensen i-BEAM

The Sorensen intelligent-Bidirectional Energy AMplified (i-BEAM) Series features full DC source and sink capabilities with power levels from 60kW to 650kW and is fully scalable up to 1.3MW with parallel systems. The available voltage ranges of 80V, 300V, 600V, 800V, and 1,000VDC provide full power up to 1,000A within a single system. i-BEAM is available in 1-, 2-, and 4-channel configurations. Multichannel versions share an internal DC bus that can transfer up to 2MW from channel to channel without incurring the rectifier losses accompanying regeneration to the AC grid. i-BEAM serves automotive, energy-storage, aerospace, and industrial applications and has dedicated battery testing and simulation modes.



## ASD FLX Series

The modular water-cooled ASD FLX supplies offer a modular design with front-loading removable, lightweight modules allowing easy one-person installation. An input voltage range of 324VAC to 528VAC provides flexibility. Other features include precise programming of voltage and current slew rate and an industrial field-bus interface (Modbus-TCP and Modbus-RTU as well as Ethernet) to enable real-time digital control.



# Programmable DC Supplies: From 30kW to 650kW

## Sorensen HPX High-Power Extensible Programmable DC Series

The Sorensen HPX High-Power Programmable DC Series delivers reliable low-noise performance and fast and precise programmability in a rack-mount cabinet with casters. A single-bay rack-mount cabinet can deliver up to 150kW; a dual-bay rack can deliver up to 240kW. Modularity allows efficient maintenance. Intelligent controls support sophisticated sequencing while a constant-power mode allows for independent settings of maximum voltage, current, and power. Features include front-panel manual control, an isolated analog input, RS-232, Ethernet (LXI), and optional IEEE-488 interfaces.



## Sorensen SGX, SGA, and SFA Series

The SGX Series offers exceptional load transient response, low noise, and industry-leading power density. At the heart of the SGX Series is a 5kW power module, and one to six modules in a single chassis can deliver 5kW to 30kW. Paralleled chassis combinations can achieve power levels up to 150kW, with paralleled units operating as a single supply providing total system current.

Offering similar performance levels, SGA Series high-power DC supplies include basic analog controls. Building on the SGA is the Sorensen SFA high-power current source for laser-diode applications. Providing a constant-current regulation mode only, the SFA's low stored energy output minimizes damage potential for sensitive devices and enables a current slew rate of up to 400 A/ms.



## Sorensen Mi-BEAM

The Sorensen Modular intelligent-Bidirectional Energy AMplified (Mi-BEAM) Series features full DC source and sink capabilities with power levels from 12kW up to 37kW within a 4U rack height. It features voltage ranges of 600V, 1,500V, and 2,000VDC with current ratings from 50A to 150A. It supports regeneration with up to 95% efficiency and can serve as an electronic load. In addition, the Mi-BEAM Series is scalable up to 1.2MW with parallel configurations. Mi-BEAM supports a wide variety of applications, including battery simulation and test, solar-array simulation, fuel-cell test, and electric-vehicle (EV) drivetrain test. It can be operated remotely or from its intuitive front-panel touchscreen.





## CASE STUDY

### SGX Programmable Supplies Help Lab Study Elemental Particles

#### Background

A government-funded particle-physics and accelerator laboratory has asked big questions: What are we made of? How did the universe begin? In pursuit of answers, the lab has been studying elemental particles of matter to uncover their secrets and help us understand the intricacies of space and time. A topic of recent interest is a particular class of short-lived particles.

The lab is engaged in two projects regarding these particles. One experiment is studying how these particles act when subjected to a magnetic field to determine whether their behavior is in accordance with the predictions of the Standard Model, which describes fundamental forces, particles, and their interactions. Initial results indicate that it does not, suggesting that new fundamental particles and forces may be waiting to be found. The second experiment will try to determine whether the particles can convert into other particles.



#### The Challenge

To produce the particles, the lab employs accelerators that smash protons into a target, creating the particles of interest. Magnets steer the particles into a delivery ring and subsequently to a precision storage ring, a large-diameter electromagnet, where their behavior can be studied. To drive the cryogenically cooled steering magnets used in the experiments, scientists required programmable supplies that could deliver bulk DC power and featured isolated analog control inputs.



#### The Solution

*The lab recently chose the Sorensen SGX Series of programmable power supplies from AMETEK Programmable Power to drive the steering magnets used in its experiments. These high-power, fault-tolerant, modular DC supplies offer 10V to 1,000V maximum voltage ranges, 5A to 1,200A maximum current ranges, and 4kW to 150kW maximum power ratings as well as isolated analog control. The lab chose the SGX Series because it has experienced good stability and reliability with the AMETEK Programmable Power products it has purchased over several decades. In addition, the lab appreciates the local long-term support and, when needed, factory support, it has received. The lab also benefits from the modularity of AMETEK Programmable Power products, which facilitates maintenance and simplifies spare inventory. And for the lab's particle experiments, the SGX Series offered value at a competitive price. Favorable relationships across the AMETEK Programmable Power sales channel sealed the deal.*

# Programmable DC Supplies: Less Than 30kW

As Table 1 shows, AMETEK Programmable Power offers a range of DC power supplies that are ideal for power requirements that are less than 30kW. Key application areas extend from the laboratory to the factory in industries ranging from automotive to aerospace. Specific applications include burn-in, compliance testing, production test, quality assurance, materials research, battery-charger test, solar-array simulation, process control, and validation. The supplies also can be integrated into ATE systems.

## Sorensen Asterion DC

The Sorensen Asterion line of DC power supplies combines intelligence and flexibility to create an advanced platform of DC solutions in 1.7, 3.4, 5.0, and 10kW versions, with the Asterion DC ASA model adding 1.8kW capability in the form of three isolated 600W channels, and the Asterion DC ASM model with 5.1kW capability in the form of three isolated 1.7kW channels.



The Asterion DC Series features fixed-range and autoranging models. The fixed-range supplies are economical, traditional rectangular wave output power supplies with all the enhanced advantages standard with the Asterion platform. The autoranging supplies feature expanded current and voltage ranges at full output power, satisfying a wider range of testing needs without requiring the purchase of additional models.

The 1U Asterion DC ASA features five extremely wide-range autoranging 600W output channel options optimized for ATE applications. The 1U Asterion DC ASM features nine traditional rectangular 1.7kW output channel options. All the Asterion DC supplies feature an intuitive color touch panel control and standard Ethernet LXI, USB, and RS-232 control interfaces. GPIB control interface and analog programming are optional.

## Sorensen DLM 3-4kW

The Sorensen DLM 3kW and 4kW Series programmable DC power supplies provide stable, continuously variable output voltage (5VDC to 600VDC) and current (5A to 450A) for a broad range of applications in a compact 2U chassis. Displays and indicators show programmed set points and operational control status. Two 3½-digit LED displays indicate programmed voltage, current, and overvoltage set points. Operational status LEDs indicate power on, shutdown, over-temperature, overvoltage, and current- and voltage-mode status. Control status LEDs indicate front panel lockout, remote control, and standby status. IEEE-488 and RS-232 interfaces are optional.



## Elgar ASPS

Specifically for satellite PV applications, the Elgar Advanced Solar Power Simulator (ASPS) features two independent, isolated 600W channels or a single 1200W channel. ASPS features industry-leading 2μs shunt switching recovery time to test the fast PWM shunt switching regulators typically used by large satellites' power-conditioning and distribution units, and it can also test series switching and peak power tracking satellites. ASPS offers extensive protection features to prevent damage to expensive satellites under test, including primary and redundant overvoltage and overcurrent protection and a fast (10μs) electronic circuit breaker.



# Programmable DC Supplies: Less Than 30kW

## Sorensen DCS

The DCS family of 1kW, 1.2kW, and 3kW programmable power supplies achieve continuous full output power in any volt/amp combination within the rated output voltage and current limits in a low-profile chassis. DCS power supplies have an easy-to-use front panel with 10-turn potentiometers to adjust voltage and current settings displayed simultaneously. LEDs indicate conditions such as overtemperature, overvoltage, and constant-voltage/current mode operation. The Sorensen DCS family can be controlled remotely via four standard analog control modes as well as an optional isolated analog control. Other options include an IEEE-488.2 or LXI-compliant Ethernet interface.



## Sorensen XG

The Sorensen XG Series includes three 1U DC power supplies: the 850W half-rack XG 850 version as well as the full-rack 1500W XG 1500 and 1700W XG 1700 models. All are designed for test, production, laboratory, OEM, and quality assurance applications, providing a wealth of features to ensure accuracy and greater efficiency. They provide clean, reliable power and deliver stable, variable output voltage and current for a broad range of development, test, and system requirements.

Up to 30 XG Series units can be connected easily via an RS-485 bus to provide the ultimate flexibility in remote programming, thereby eliminating the cost and complexity of requiring GPIB cards in each unit. Once connected, multiple power supplies can be controlled via a single LAN, USB 2.0, GPIB, RS-232, or RS-485 interface.



## Elgar m-SAS

The Elgar mini-Solar Array Simulator (m-SAS), which targets small satellites, provides one 840W channel at 60V, 80V, or 150V. Designed to test the maximum power-point tracker that small satellites typically use, m-SAS features a 250Hz tracking speed. The system can simulate a variety of eclipse profiles, running them at actual speed or up to 100 times the actual speed for accelerated tests. m-SAS is controlled by a digital signal processor and can be operated using AMETEK Programmable Power's m-SAS software GUI. Other features include low output capacitance, active power-factor correction, and a standard LAN interface.



## Sorensen DLM 600

The Sorensen DLM 600 Series programmable power supplies provide continuously variable output voltage and current for a range of applications in a compact 1U half-rack-wide chassis. Zero Voltage Switching (ZVS) technology enables these supplies to achieve low ripple and noise rivaling larger and more expensive linear power supplies. The supplies also offer high efficiency and fast load transient response. The DLM 600 power-supply series is ideal for high-density-multiple output rackmount requirements or low-profile benchtop applications. The supplies offer output voltages from 0 to 5VDC to 0 to 300VDC and currents from 0 to 2A to 0 to 75A.





# DC Bench Power Supplies

## AMETEK Programmable Power Bench Supply Lineup

Whereas supplies such as the DLM 600 and XG 850 can serve in both rack and bench applications, AMETEK Programmable Power offers programmable supplies with ratings from 30 to 840W designed to operate primarily as standalone benchtop units often used in circuit testing and development applications (**Table 2**).

The supply in this category with the highest power rating is the XPF, which features dual 420W outputs for a total of 840W. The XPF incorporates AMETEK Programmable Power's PowerFlex™ design to enable higher currents to be generated at lower voltages within the supply's overall power-limit envelope. The fully independent outputs can be wired in series or parallel to achieve up to double the maximum voltage or current rating. While the XPF employs switch-mode technologies, the 175W to 420W XPH Series combines switch-mode pre-regulation with linear post-regulation. It is available in single, dual, and triple-output configurations.

Other bench supplies from AMETEK Programmable Power incorporate pure linear technology. These supplies include the 105W to 215W XDL Series, which can store 10 power-supply setups in nonvolatile memory (30 setups for a triple-output version); the 75W to 180W XEL Series, which offers the ease of use of analog controls yet also offers advanced digital-control features; and the 30W to 125W XPL Series, which is available in single, dual, and triple-output configurations.

Table 2. Standard DC bench supplies (arranged by total max power, highest to lowest)

| Series | Low-end Power (W) | High-end Power (W) | Low-end Voltage (V) | High-end Voltage (V) | Low-end Current (A) | High-end Current (A) |
|--------|-------------------|--------------------|---------------------|----------------------|---------------------|----------------------|
| XPF    | 175               | 840                | -                   | 60                   | 10                  | 20                   |
| XPH    | 175               | 420                | 18                  | 75                   | 2                   | 20                   |
| XDL    | 105               | 242                | 35                  | 56                   | 0.5                 | 5                    |
| XEL    | 48                | 180                | 6                   | 250                  | 0.37                | 8                    |
| XPL    | 30                | 125                | 18                  | 56                   | 1                   | 3                    |



# High-Power AC Supplies: 500VA to 1MVA

AMETEK Programmable Power offers a wide range of programmable AC/DC and AC + DC power sources, from the 1U 500VA Asterion AC source to the 1MVA Sequoia Grid Simulator (Table 3). Key application areas include avionics and inverter test, power conditioning, grid simulation, and bulk power generation across a wide variety of industrial segments. Products at the high end of this range include the California Instruments Sequoia and Tahoe Series.

## CASE STUDY

### *Oil-field Services Company Chooses New AC Programmable Sources to Upgrade Legacy Equipment*

#### ► Background

The oil and gas industry is a dynamic and unpredictable market, constantly influenced by factors like geopolitical events, technological advancements, and fluctuating demand and prices.

The Permian Basin in Texas and New Mexico perfectly exemplifies this volatility. Oil production in the region declined significantly when prices dropped below profitability thresholds. However, equipment upgrades have become crucial with a renewed focus on increasing production.

#### ► The Challenge

One oil-field services company faced a challenge: Its aging AC sources used in downhole tooling for drilling operations were outdated and needed replacing.

#### ► The Solution

*The company partnered with AMETEK Programmable Power to address this challenge. Here's how our solutions helped:*



- **Seamless Transition Planning:** AMETEK Programmable Power collaborated closely with the company's engineering team for several years to ensure a smooth transition to newer AC source models.
- **Advanced Features of Asterion AC Sources:** The sales team highlighted the advantages of the Asterion AC programmable sources, including:
  - Higher power density
  - Improved user interfaces
  - Enhanced software flexibility
- **Specific Models Chosen:** The company opted for the Asterion AC models AST 1501 and AST 3003, offering superior performance compared to their legacy equipment.
- **Benefits of New Models:**
  - Touchscreen and encoder interfaces provide easy access for programming, control, and measurement.
  - The Asterion AC Virtual Panels graphical user interface enables remote control from a host computer.
  - AMETEK Programmable Power's iX2 current-doubling constant-power technology ensures consistent output power across various operating conditions.
- **Expansion Plans:** To support its production expansion, the company plans to upgrade approximately 500 systems across various locations.

#### AMETEK Programmable Power's Commitment

AMETEK Programmable Power is dedicated to providing reliable, high-performance solutions for the oil and gas industry's evolving needs. The company offers support to help companies expand production capacity and upgrade equipment, ensuring system reliability and performance as market conditions fluctuate.

**Table 3. Standard AC Sources**

| Series       | Low-end power (kVA) | High-end power (kVA) | Low-end voltage (Vac) | High-end voltage (Vac) | Low-end current (Arms) | High-end current (Arms) |
|--------------|---------------------|----------------------|-----------------------|------------------------|------------------------|-------------------------|
| Sequoia      | 15                  | 1000                 | 166                   | 333                    | 31.25                  | 3,000                   |
| Tahoe        | 15                  | 1000                 | 166                   | 166                    | 31.25                  | 3,000                   |
| Asterion 1U  | 0.5                 | 1.5                  | 200                   | 400                    | 2.5                    | 15                      |
| Asterion 2U  | 2.25                | 3                    | 200                   | 400                    | 3.75                   | 10                      |
| Asterion 4U  | 4.5                 | 24                   | 200                   | 400                    | 7.5                    | 80                      |
| Asterion 14U | 12                  | 36                   | 200                   | 400                    | 20                     | 120                     |

## California Instruments Sequoia Series

The Sequoia Series offers grid simulation, with automatic crossover between source and grid-simulation power modes in AC, DC, and AC+DC configurations. The Sequoia Series can regenerate up to 96% of the rated output power back to the utility. In the grid-simulation mode, the Sequoia Series can accept and sink power returning from any connected equipment to the utility grid. This power return can be a short-term event or a semi-permanent condition.

Using a state-of-the-art SiC power-switching architecture, this full four-quadrant product combines compactness, robustness, and functionality in a floor-standing chassis. This easy-to-configure power product covers a wide range of single-phase and multi-phase AC or single-channel and multi-channel DC power applications at an affordable cost. With the addition of an optional electronic load option, the Sequoia Series can easily handle your advanced renewable energy simulation and test requirements.



## California Instruments Tahoe Series

The Tahoe Series covers a wide range of single-phase and multi-phase AC or single-channel and multi-channel DC power applications at an affordable cost. With add-on test application routines for avionics and compliance testing, the Tahoe Series can fulfill a variety of your power test requirements.

Using a state-of-the-art SiC power switching architecture and Digital Signal Processing, the Tahoe Series combines a robust, high-power AC/DC source with an advanced power analyzer in a single-floor standing chassis. With five base configurations, the Tahoe Series offers Reflex capability, allowing flexible power expansion as needed. This ability to reconfigure into multi-chassis systems greatly expands your test coverage.



# AC Sources: Up to 36kVA

## California Instruments Asterion AC

California Instruments Asterion AC power sources combine intelligence and flexibility to deliver high-performance, programmable AC and DC power.

The supplies offer high power density and a low-profile form factor with an intuitive touchscreen interface. The sources employ AMETEK's iX2™ current-doubling technology, which enables output current to increase linearly up to two times the full-voltage current as the voltage decreases from the maximum rated voltage to one-half of the maximum rated voltage.



## CASE STUDY

# Programmable Sources and Loads Boost Manufacturer's Micro Inverter, Electric Vehicle Projects

### Background

The global market for microinverters is expected to reach \$13.5 billion by 2030, while the solar EV charging market is forecasted to reach \$330.9 million by 2031. However, testing these renewable energy technologies presents unique challenges.



### The Challenge

Testing PV inverters requires specialized equipment to simulate real-world conditions accurately. Here's a breakdown of the specific challenges:

- **Simulating Solar Cell Output:** A programmable DC power supply is needed to mimic the output characteristics of solar panels.
- **Maximum Power Point Tracking (MPPT) Testing:** A solar array simulator is necessary to exercise the inverter's ability to track the maximum power point.
- **Grid Simulation:** The inverter test system needs a regenerative programmable AC power source to simulate a real grid.

### The Solution

*A renewable energy provider partnered with AMETEK Programmable Power to address these challenges and establish efficient testing procedures. Here's how our solutions helped:*

- **Pre-Compliance Testing and Production Facility Setup:** AMETEK Programmable Power provided equipment for pre-compliance testing of a solar microinverter and battery storage infrastructure and also helped set up a functional and production test facility for microinverters.
- **Specific Equipment Used:**
  - TerraSAS PV Simulators for accurate solar panel output simulation.
  - Asterion programmable DC power supplies, specifically the ASM three-channel power supplies.
  - Sequoia regenerative programmable AC power sources for grid simulation with advanced features.
- **Benefits:** The solutions met the company's needs and helped them transition from outdated equipment. In particular:
  - The Sequoia source offered key benefits like higher voltage ratings, RLC load emulation, and external drive capabilities.
  - The Asterion power supplies saved the company 67% of its equipment rack space over typical single-channel designs. Each factory required 80 DC channels. The ASM three-channel power supply in a 1U rack height would require only 27 (26 ⅔) units (or 27U) of total rack height. Therefore, 28 lbs. max each x 27 = 756 lbs. total. The use of the ASM models yielded a 67% space and weight savings of 53U and 1,484 lbs.
- **EV Service Equipment (EVSE) Testing:** Additionally, Sequoia sources were chosen for their flexibility in testing various components and subsystems within the EVSE energy ecosystem. They can function as both EV emulators and grid simulators, adapting to evolving testing requirements.

With its focus on product quality and application expertise, AMETEK Programmable Power is a strong partner for companies developing renewable energy products. They offer a range of standard products and can also create customized solutions to address specific power supply needs.



# Compliance

Equipment today often must meet international regulatory requirements promulgated by organizations such as the International Electrotechnical Commission (IEC). To help, AMETEK Programmable Power offers two lines of compliance test systems (CTS). The CTS Series features ratings of 150 to 300V at 0 to 37A with power levels from 3,000 to 15,000VA. The **Sequoia** or **Tahoe** CTSHL option offers 166 to 333V ratings but at current levels of 0 to 62.5A/phase and power levels from 30 to 90kVA. Both include measurement systems compliant with IEC 61000-4-15, AC sources compliant with IEC 61000-4-5, and reference impedances according to IEC 60725. These systems fully support testing in accordance with relevant international standards, including EN IEC 61000-3-2 or 3-12 (harmonics) and EN IEC 61000-3-3 or 3-11 (flicker) as well as various EN IEC 61000-4 standards (AC immunity tests).

The CTS Series consists of an AC power source, a power-analysis conditioning system (PACS), a PC-based data acquisition system, and Windows-based CTS software. The systems perform the IEC tests, generate detailed test reports, and store comprehensive data files on disk to allow post-test analysis.

Designed to be used in conjunction with the Sequoia or Tahoe Series power source, the CTSHL adds support for EN IEC 61000-3-12 (harmonics, < 75 Arms/phase) and EN IEC 61000-3-11 (flicker, <75 Arms/phase). Key features include a direct PC-bus-access data-acquisition system, which provides the required sampling rate and resolution to meet IEC 61000-4-7 measurement requirements.



**Sequoia**



**Tahoe**

# Modular Power Supplies and Loads

## Elgar ReFlex Power™ (RFP™) Module Series

### Applications and Product Feature Overview

The Elgar ReFlex Power™ (RFP™) Module Series high-density, programmable-power module system provides DC, AC, and electronic-load assets under the control of a single controller. RFP™ provides a reconfigurable, flexible platform ideal for ATE and production test environments where RFP™ can provide programmable stimulus and bias power as well as programmable loads for the device(s) under test.

*Specific modules include:*



**Elgar RFP AC Power**, a 140 to 280V module that delivers 3.5 to 7A at 875VA



**Elgar RFP DC High Power**, which delivers 33 to 450V at 2.3 to 30A with a 1,000W power rating



**Elgar RFP DC Low Power**, which provides 16 to 65V at 5.1 to 20.6A with a power rating of 330W



**Elgar RFP DC Load**, rated at 500V, 5 to 30A, and 375 to 750W



Rounding out the modular lineup is the 12-slot RFP chassis, which operates on 115 to 400V inputs, and the Ethernet-enabled **RFP Controller Module**, which can control up to eight mainframes — potentially up to 95 modules.

# Programmable Electronic Loads

AMETEK Programmable Power offers a full lineup of programmable AC and DC electronic loads for applications such as fuel-cell test, solar-panel test, and battery test (Table 4).

Table 4. Standard Electronic loads

| Series | AC power | DC power  | Voltage range | Current    |
|--------|----------|-----------|---------------|------------|
| PLA    | -        | 0.8-7.5kW | 10-1200Vdc    | 10-1500Adc |
| PLW    | -        | 6-250kW   | 60-1200Vdc    | 10-5000Adc |

## Sorensen PLW

PLW Series water-cooled DC electronic eLoads offer a unique condensation protection design as well as the highest power density and current ratings plus the widest selection of high-voltage models on the market. Specific features and benefits include closed calibration, making it unnecessary to send the load back to the factory for calibration; individual FET protection, which eliminates cascading failures should a single FET fail, and ultralow voltage operation, which enables them to dissipate full rated current at 1% of their maximum rated voltage (typical).



## Sorensen PLA

The PLA Series air-cooled DC electronic eLoads offer the industry’s smallest footprint, the highest power density and current rating, and the broadest selection of high-voltage models on the market for an air-cooled load. PLA models can be custom-tailored to meet your application requirements. Like the PLW models, they feature closed-case calibration, individual FET protection, and ultralow voltage operation.





# Programmable Electronic Loads

## CASE STUDY

### Automotive Parts Manufacturer Chooses PLW Series of Electronic Loads for Fuel-Cell Test

#### Background

An automotive parts manufacturer based in Asia anticipates a future of fuel-cell electric vehicles (FCEVs) that emit zero toxic pollution—only water. The company is even looking beyond the automobile. In addition to making automotive modules, core parts, and aftermarket service parts as well as converters for battery-electric automobiles, the company is investigating hydrogen fuel-cell technology for trains, vessels, logistics equipment, and even emergency power generators.



#### The Challenge

The company's key product in the fuel-cell area is the membrane electrode assembly (MEA), which can be stacked and combined with other components and systems including a hydrogen tank, frame, fuel-processing system, power junction box, DC/DC converter, high-voltage battery, thermal-management system, and air-processing system to form a complete fuel-cell power pack. Target applications range from a fuel-cell forklift that can be recharged in five minutes to a hydrogen emergency power generator with a modular design that can operate in extreme conditions. The manufacturer requires programmable electronic loads to pursue these applications.



#### The Solution

The manufacturer chose the water-cooled PLW Series programmable electronic loads from AMETEK Programmable Power, including a PLW6K-60-1000 unit (with a rating of 6kW, 60V, 1,000A), a PLW6K-120-600 model (6kW, 120V, 600A), and a PLW12K-60-1500 unit (12kW, 60V, 1,500A). Through the efforts of AMETEK Programmable Power's distributor network to maintain excellent relationships in the region, AMETEK Programmable Power has emerged as the preferred choice for electronic loads and other programmable power products. The customer uses many AMETEK Programmable Power supplies in addition to the PLW electronic loads and has experienced strong after-sales support. AMETEK Programmable Power's PLW Series electronic loads offered two key selling points that drove the sales win: product reliability, with features like Individual FET protection minimizing mean time to repair (MTTR), and power density, with the 6kW and 12kW models that the customer chose fitting into 2U, 27.5-in.-deep chassis.



# Custom Engineering

AMETEK Programmable Power realizes that standard catalog products cannot completely satisfy every application requirement—even flexible, modular products. Consequently, the company's Solutions Business provides custom power-supply and load systems and integrations, ranging from OEM integration for the medical and semiconductor industries to modular avionics ATE power subsystems. The company can also modify its standard products to meet your application requirements.



AMETEK Programmable Power is especially skilled at providing custom power solutions based on previously developed custom systems. This approach maximizes functionality, minimizes lead times, and maximizes value.

Examples include OEM power supplies for heating or burn-in, AC stimulus for current-transformer and circuit breaker-testing, solar-array simulation for satellites, solar-array simulation for terrestrial PV inverter test, PV emulation for inverter verification, radar power-bus simulation, and battery-string simulation. The company has also developed power racks for high-energy solid-state lasers and a DC power source and regenerative load for avionics actuator and motor testing.





*Whether you need a standard benchtop power supply or a fully custom energy-absorber test system, contact your AMETEK Programmable Power sales representative.*





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