



# Modular DC High Power System for 90kW Requirements

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To understand the need for DC power, we need to take a look back to the late 1880s “War of the Currents”. This historical event took place between two of the greatest engineers of our time - Thomas Edison and Nikola Tesla. Edison was the inventor supporting DC power, while Tesla was the engineer behind AC power. DC power was believed to be more reliable. However, at that time, DC power could not be easily converted to higher power requirements and then down again to be safely handled. Tesla was able to overcome this up/down conversion problem by perfecting the AC motor. The AC motor is why today 110VAC/60Hz is the most common electrical power used in the United States today.

Even with the power conversion solved through the AC motor, the need for DC power never went away. All battery devices use DC power. Also, even though we plug devices like TVs, computers, and appliances into our wall outlets, they all use internal electronics to convert the 110VAC/60Hz into DC current to power the device.

This whitePAPER is focused on DC high-power, which is commonly used in industrial and military applications, such as:

- Aerospace/Defense ATE
- Battery Development/Solar Cells
- Electrical Component Validation
- Electroplating of Metals
- Electronic Warfare (EW)
- Magnets
- R&D
- RF Amplifiers
- Satellite Testing
- RF Amplifiers
- SIGINT

Specifically, this paper will show an alternative, better means of selecting a DC power supply up to 90kW.



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## SELECTING A BETTER 90kW DC POWER SUPPLY

In this instance, the highest rated DC power supply offered by Keysight Technologies today is 15kW. However, Keysight makes it easy to tie multiple DC power supplies together in parallel to create systems of much higher power – up to 90kW.

Why choose a parallel DC high-power system over conventional single box DC high-power unit?

COMPARISON	SINGLE BOX	KEYSIGHT PARALLEL SYSTEM
Availability	Custom built, longer lead times	Commercial-off-the-Shelf (COTS), shorter lead times
Reconfigurable	<b>NO</b> , at least not at the customer's site. Some manufacturers may allow the units to be sent back for modification.	<b>YES</b> , modular units can either be added for additional power or subtracted. The subtracted units can be redeployed as standalone units for other applications.
Remote Interfaces	Typical Optional: <ul style="list-style-type: none"> <li>• Add LAN / LXI</li> <li>• Add USB</li> <li>• Add GPIB IEEE-488</li> </ul>	<b>ALL</b> are Standard: <ul style="list-style-type: none"> <li>• 10/100 Base-T Ethernet/LAN/ LXI</li> <li>• USB 2.0</li> <li>• GPIB IEEE-488</li> </ul>
Spare	Need to maintain another exact single box unit if operating unit failed. This is both costly, and requires a large area for storage.	Need just one modular unit to get back to full operation. Even without maintaining a spare, customers would only have reduced capability since the other units would still be able to operate. (ex: 90kW -> 75kW )  Being a COTS instrument, availability can be found from rental companies for short term needs.
SWaP	Because the single box is required to handle the full 90kW, they tend to be very large and heavy units – typically well over 1,500 LBS.	Each modular unit typically weighs about 70 LBS, making it easy for the customer to move units about.  The rack system weighs approximately 300 LBS empty.  Combined weight for 6 units + rack = 720 LBS.

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COMPARISON	SINGLE BOX	KEYSIGHT PARALLEL SYSTEM
Safety	Single box units are difficult to cool, difficult to move due to their size, and some do not offer the Over protections listed in the Keysight Parallel System.	The Keysight Parallel System solution offers: <ul style="list-style-type: none"> <li>• Over-Voltage protection</li> <li>• Over-Current protection</li> <li>• Over-Temperature protection</li> <li>• Pre-configured/pre-wired rack to safely tie together all units, ensure proper cooling, and distribute weight evenly of all units.</li> </ul>
Warranty	2 years	3 years

## KEYSIGHT N8900 SERIES

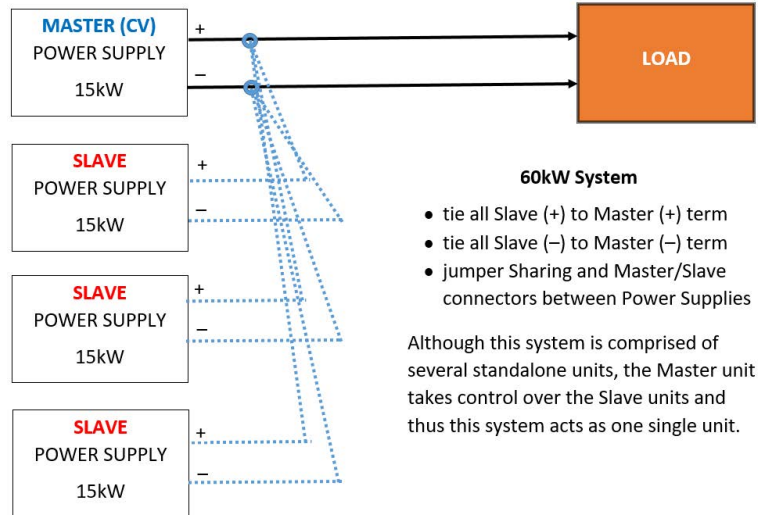
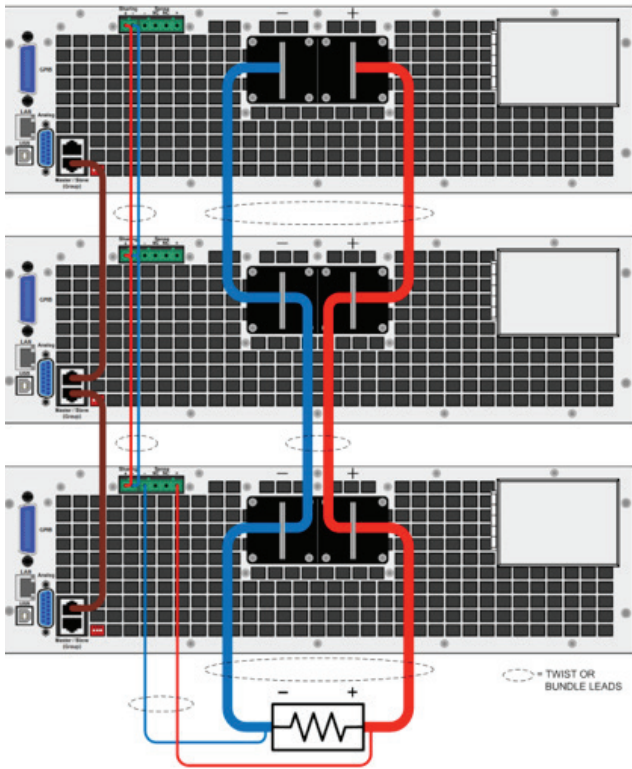
### N8900 Series Rack System for DC High-Power

Keysight provides a pre-wired rack system that overcomes most challenges associated with DC high-power (safety, cooling, wiring, etc.)

- N89201A – DC power up to 90kW, high current system:
  - o Up to 3,060A DC output
  - o Up to 200V DC output
  - o 208VAC (3Φ) input
- N89202A – DC power up to 90kW, low current system:
  - o Up to 540A DC output
  - o Up to 1,500V DC output
  - o 208VAC (3Φ) input
- N89401A – DC power up to 90kW, high current system:
  - o Up to 3,060A DC output
  - o Up to 200V DC output
  - o 400V AC (3Φ) input
- N89402A – DC power up to 90kW, low current system:
  - o Up to 540A DC output
  - o Up to 1,500V DC output
  - o 400V AC (3Φ) input



## CONNECTING UNITS IN PARALLEL



## AVAILABLE KEYSIGHT DC HIGH-POWER SUPPLIES FOR THIS APPLICATION

208VAC INPUT	400VAC INPUT
N8931A - 80VDC/510A/15,000W	N8951A - 80VDC/510A/15,000W
N8932A - 200VDC/210A/15,000W	N8952A - 200VDC/210A/15,000W
N8934A - 500VDC/90A/15,000W	N8954A - 500VDC/90A/15,000W
N8935A - 750VDC/60A/15,000W	N8955A - 750VDC/60A/15,000W
N8937A - 1,500VDC/30A/15,000W	N8957A - 1,500VDC/30A/15,000W

With multiple models to choose from, customers have the flexibility to design either a high-voltage system (up to 1,500VDC) or high-current system (up to 3,060A). The rack is pre-wired for this application. The only other item necessary is the correct model selection for the customer's application.

**Rule of Thumb:** Always ensure that units connected in parallel are of the same model in order to avoid the risk of mismatch power sharing of the load.

### OTHER KEY FEATURES

- Auto-ranging units ensure that units distribute the load evenly across all parallel units.
- LXI provides graphical user interface via web browser.
- Master unit has full control over slave units. End user only needs to interact with master unit.

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## COMPETITIVE COMPARISON TABLE – KEYSIGHT MODULAR vs SINGLE BOX

	KEYSIGHT	MAGNA POWER	TDK LAMBDA
Model	N8951A x 6 units 80VDC/1,125A/90kW	MTD-80-1250 80VDC/1,250A/100kW	EMHP-80-1125 80VDC/1,125A/90kW
Remote Interfaces	<b>ALL</b> are Standard LXI/LAN, GPIB, USB	Option +LAN/LXI Option +GPIB Option +USB	Option +GPIB Option +RS232
Weight	70 LBS/ea x 6 units for 420 LBS Subtotal + 300 LBS Rack = 720 LBS Total	1,600 LBS Total	1,500 LBS Total
Rack Dimensions	60.6" x 41.7" x 23.6"	62.5" x 48" x 31.5"	44.5" x 27.5 x 39" (standalone unit/no rack)
AC Input Configuration	208VAC (3Φ) 400VAC (3Φ)	380VAC (3Φ) 415VAC (3Φ) 440VAC (3Φ) 480VAC (3Φ)	440VAC (3Φ) 480VAC (3Φ)
Cooling	Forced Air	Forced Air	Forced Air
Warranty	3 Years	2 Years	2 Years

*Claude Sweeton is a Sr. Sales Engineer at TEVET, LLC. He has been with TEVET for over seven years, and has over thirty-nine years of combined experience in Test & Measurement. His experience began back in 1978 when he joined the US Navy; while serving he attended many technical schools including Basic Electronics & Electricity School, Advanced Electronics (A School) – Radar, Calibration & Precision Metrology (PMEL) at Lowry AFB, and C-7 EE & Supervisory Level School. His primary responsibility was to maintain the advanced communications, radar, sonar, and weapons systems on SSNs and SSBNs. Upon his honorable discharge in 1986 he was hired by Texas Instruments Avionics Division (now part of Raytheon) where he provided technical support on the AGM-88 High-speed Anti-Radiation Missile (HARM) and AN/AAQ-13 & AN/AAQ-14 LANTIRN Missile Systems, and Emitter Locating System (ELS). In addition to his experience in Aerospace & Defense he has worked at Sandia National Labs, Saudi Ordnance & Maintenance Company, Hewlett Packard, Anritsu, and Gnubi Communications (now part of EXFO).*

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