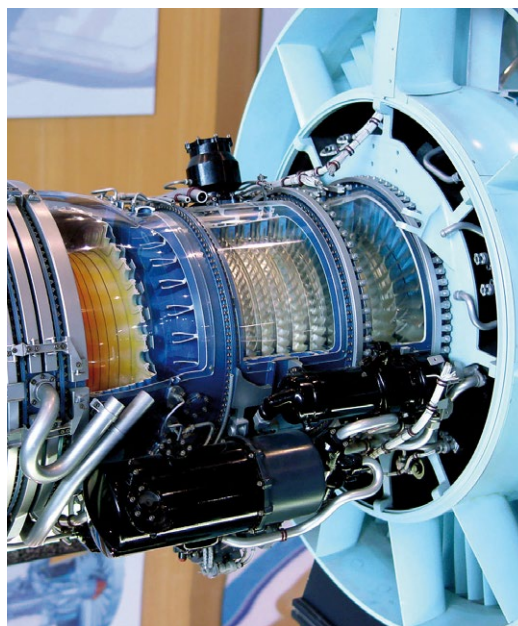
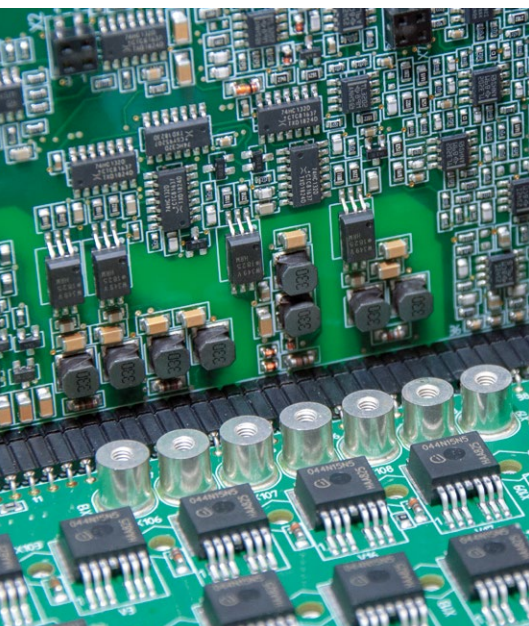




Elektro-Automatik



TECHNICAL NOTE: AUTORANGING: THEORY OF OPERATION

AUTORANGING DC SUPPLIES

ABSTRACT

With the rising penetration of energy-consuming native direct current (DC) loads in commercial and residential applications, and the increasing focus on the adoption of energy-efficient systems to fulfill ambitious national goals, the debate over the relative merits of AC-versus DC-based systems has intensified.

The components include converters (central rectifiers and DC-DC converters), DC circuit breakers, DC power distribution units (PDUs), and DC power management systems (monitoring and control) installed for building-level, floor/room-level, and device-level conversion.

PRINCIPLE OF AUTORANGING

"Autoranging" is a term used when a programmable DC source automatically offers a wide output range of both voltage and current to maintain full power output across a wide operation range. The below diagram depicts both traditional square and Autoranging operating.

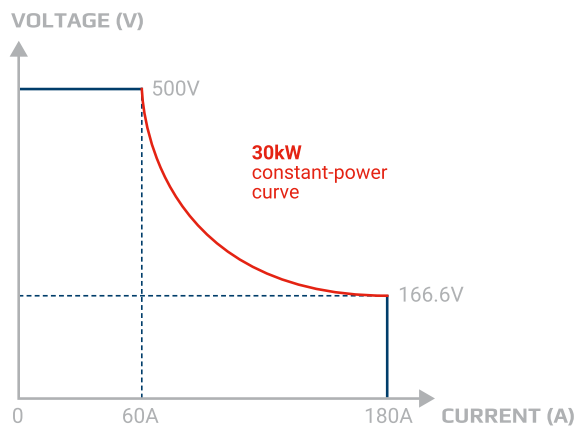


Figure 1
Autoranging Power Profile

The principal of operation is simple. The source automatically offers increased current at lower voltages which maximizes flexibility. This type of solution allows the use of a single source to address multiple voltage and current combinations.

Traditional DC supplies output base on a "square", limited operating curve. Meaning full power is achieved only at full scale voltage since current is limited to a specified value. Applying the programmable DC supplies' full scale voltage to a DUT is rare which means in most cases, the DC source is not utilized to the full power potential.

INTRODUCTION

Programmable DC power sources are an essential tool in product development and production testing of a wide range of electronic devices and systems. In many instances, functional test requires submitting the device-under-test (DUT) to a wide range of operating conditions. In some cases, the DUT draws constant power under variable input conditions. Common examples are DC motor drives and regulated DC/DC supplies. In such circumstances, the ability of the programmable DC source to provide increased current at reduced output voltage is valuable. This ability is known as "Autoranging". DC supplies without Autoranging often require users to oversize or use multiple supplies to test the DUT under varying input voltage conditions.



Picture 1
5-15 kW PSI 9000 3U

Application Example:

The trend of 380VDC power distribution for server farms has been suggested as an efficient method of power delivery within a data centers. Top manufacturers like Cisco and Juniper adopted such technology since it's believed the simplified conversion result in significant energy savings.

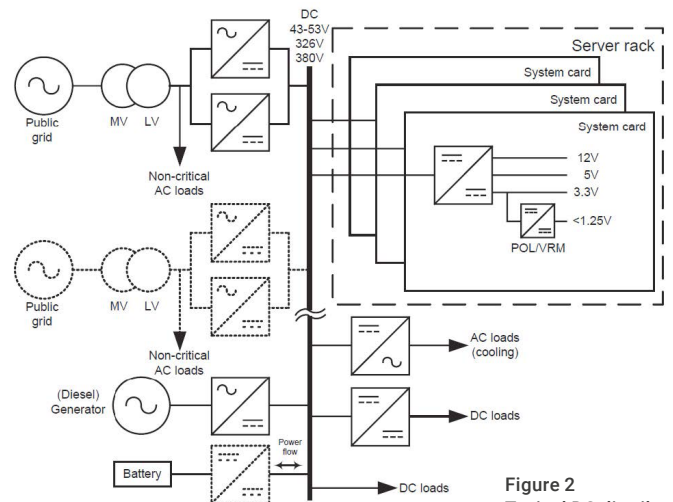


Figure 2
Typical DC distribution architecture

APPLICATION EXAMPLE

For the purposes of this example, the Cisco Nexus 9500 Platform of Series Switches power specifications is a total of 3,000W with an input voltage range of 192VDC - 400VDC. This wide range of operation means the switch pulls considerably more current at low voltage operation.

AC/DC POWER-SUPPLY PROPERTIES	CISCO NEXUS 9500 PLATFORM
Power	3150W
Input voltage	200 to 277VAC or 240 to 380VDC (nominal) 192 to 400VDC (min - max)
Frequency	47 to 63Hz
Efficiency	90% or greater (20 to 100% load)

Figure 3 Nexus 9500 Power Specifications

Input current is:

AT 192VDC IS $3,150\text{W}/192\text{VDC} = 16.4\text{ADC}$

AT 420VDC IS $3,150\text{W}/420\text{VDC} = 7.5\text{ADC}$

When selecting an appropriate programmable power source for test, Engineers must account for both the worst case voltage of 400VDC and current of 16.4ADC. Keep in mind that most design verification test is more extreme and could test down to a low as 180VDC. In that case, current would increase to 17.5ADC. Let's look at a square or dare we say, legacy Programmable DC Supply. Most manufacturers offer a 500VDC output model. For sizing a to the application would mean:

$500\text{VDC} \times 16.4\text{ADC} = 8,200\text{W}$

In this case, a square operating source of at least 8.2kW is required to serve both corner cases of test. Most manufacturers offer a 5, 10, 15 kW solution so Engineers would be forced to select a 10kW solution. Just to test a 3,150W product... Below is an example that the 8/10kW supply provides a maximum of 20ADC.

OUTPUT: VOLTAGE AND CURRENT RANGES			
	3U		
POWER	4/5kW	8/10kW	12/15kW
Voltage	Current		
500	10	20	30

Table 1 Square Operating Power Specifications

AUTORANGING ADVANTAGE

In the previous example, a 8.2kW minimum supply is required to test the corner cases of the DUT requirements.

The EA-PSI 9500-30 3U is rated at 5,000W and provides 0-500VDC and up to 30ADC.

TECHNICAL DATA	PSI 9500-30 3U
Rated voltage & range	0...500V
Rated current & range	0...30A
Rated power & range	0...500W

Table 2 PSI 9500-30 3U Autoranging Power Specifications

With a power rating of 5,000W, the source is capable of providing:

AT 192VDC IS $5,000\text{W}/192\text{VDC} = 26.0\text{ADC}$

AT 420VDC IS $5,000\text{W}/420\text{VDC} = 11.9\text{ADC}$

In this case, the EA Elektro-Automatik Autoranging supply is rated at just half the power of the legacy square supply, yet provides more current and allows ample headroom, even the DVT case down to 180VDC.

In general, power supplies are \$X / Watt. The higher the power, the higher the cost. An Autoranging power supply could be as much as half the cost of the legacy supply.

One thing to consider when selecting an Autoranging power supply is to plan for the future or leverage into other applications. What if instead of 400VDC, the input voltage increased to say 600VDC? Why not use a 750VDC source?

The PSI 9750-20 3U is again rated at 5,000W and provides 750VDC and up to 20ADC. The source still meets application requirements, yet offers the benefit of higher voltage output. In the Autoranging diagram, that's the "Extra Range".

AUTOMATED TEST SYSTEMS



Example of
Intepro System ATE

ATE Integration is often simplified using Autoranging DC supplies. ATE designs usually contain multiple DC supplies to address various DUT requirements or a single oversized supply to meet high power, voltage and current requirements. Using an Autoranging source could provide both cost and valuable space savings in ATE designs.

DIGITAL REMOTE INTERFACES

Most EA Elektro-Automatik's solutions offer industry leading selection of digital remote interfaces called "Anybus". The modules simply plug into the rear panel for play-and-play operation. The vast selection of interfaces avoids the need for unstable and costly digital converters.

Available Interfaces

- RS232
- CAN Open
- Profibus
- ProfiNet I/O 1-2 Port
- Ethernet (1/2 Port)
- ModBus TCP
- CAN
- EtherCAT



Picture 2
Anybus Modules

HIGH POWER SOLUTIONS

EA Elektro-Automatik's Autoranging solutions start at just 160W and extend through 480kW. We offer complete turn-key integrated solutions that can be customized to your requirements.



Picture 3
30kW to 480kW
Pre-Racked Solutions

SUMMARY

Autoranging can be a valuable feature in today's test environment. The benefits are easy to see.

If you have questions or need assistance in specifying a solution, please contact us at:

sales@elektroautomatik.com

or give us a call. We're happy to help!



SERVICE FOR YOU WORLDWIDE.

At the headquarter in Germany in the industrial centre of North Rhine Westphalia more than 200 qualified associates, in a facility of 18000 m², research, develop and manufacture high-tech equipment for laboratory power supply, high power mains adaptors and electronic loads with or without power feedback. The sales network includes branches in China and USA, sales office in Spain and an extensive partner network.

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