TECHNICAL NOTE:
AUTO-RANGING : THEORY OF OPERATION
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.

**ABSTRACT**

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 “Auto-Ranging”. DC supplies without Auto-Ranging often requires users to oversize or use multiple supplies to test the DUT under varying input voltage conditions.

**PRINCIPLE OF AUTO-RANGING**

“Auto-Ranging” is a term 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 Auto-Ranging operating modes.

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.

**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 “Auto-Ranging”. DC supplies without Auto-Ranging often requires users to oversize or use multiple supplies to test the DUT under varying input voltage conditions.

**Application Example:**

The trend of 380 VDC 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 1: 5-15 kW PSI 9000 3U**

**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 192 VDC - 400 VDC. This wide range of operation means the switch pulls considerably more current at low voltage operation.

In the previous example, a 8.2 kW 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 0-500 Vdc and up to 30 Adc.

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

- At 192 Vdc is 5,000W/192Vdc = 26.0 Adc
- At 420 Vdc is 5,000W/420Vdc = 11.9 Adc.

In this case, the Elektro-Automatik Auto-Ranging 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 180 Vdc.

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

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

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

AUTO-RANGING ADVANTAGE

In this case, the square operating source of at least 8.2 kW 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 10 kW solution. Just to test a 3,150 W product... Below is an example that the 8/10 kW supply provides a maximum of 20 Adc.

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<table>
<thead>
<tr>
<th>Power</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>3U</td>
<td>4/5 kW</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>8/10 kW</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>12/15 kW</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 1: Square Operating Power Specifications
Automated Test Systems

ATE Integration is often simplified using Auto-Ranging 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 Auto-Ranging source could provide both cost and valuable space savings in ATE designs.

Digital Remote Interfaces

Most 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

High Power Solutions

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

SUMMARY

Auto-Ranging 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 or give us a call. We’re happy to help!