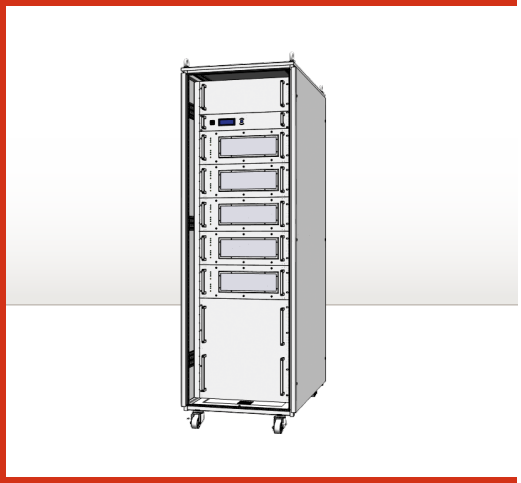
NEWSLETTER Q3.06

www.advanced-energy.com

AE®'s Strong Commitment to Industrial Markets. Over the past several years, we have seen strong growth in industrial markets that previously did not engage in plasma treatment and thin-film coating or that were just not ready for volume production. Examples include the solar, tribological coating, large-area glass and web coating, and packaging markets. With AE®'s strong background and expertise in traditional markets such as semiconductor, data storage, and flat panel display, we were able to develop new product families that specifically address the industrial marketplace. AE's Crystal®, Pulsar™, Pinnacle® Plus+, and source products are examples. AE® will keep and even extend our commitment to these markets. Our promise: There is more to come! Stay tuned and enjoy this release of our newsletter. **Thomas Linz, Director End User Sales & Applications Engineering Europe**

Content:



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POWER-RF: High-Precision Pulse Power Amplifiers for MRI and NMR Applications

MRI/NMR Principle A homogenous, static magnetic field exists in the cavity inside a superconducting coil. Atoms move in both a rotating ("spin") and a tottering ("precession") manner. In a hydrogen atom, an electron circles around a proton. A moving electron by itself generates a magnetic field. Hence, the rotating atom can be considered an elementary magnet that will align in parallel (or anti-parallel) when exposed to a static magnetic field. In addition to rotating, the atom totters with a so-called Larmor frequency, which is proportional to the field strength of the static magnetic field. This frequency varies for the different elements of the periodic table. For hydrogen, the Larmor frequency is approximately 42.5 MHz per 1 T field strength. When a high-frequency magnetic field with the Larmor frequency superimposes the static magnetic field, the atoms can be misaligned with the static field. The atoms "flip" back as soon as the RF field is turned off. By that, they transmit a signal that is called free induction decay (FID). The FID is detected and analyzed to gain information in the form of a spectrum or an image.

RF Pulse Power Amplifier One component in magnetic resonance imaging (MRI) and nuclear magnetic resonance (NMR) systems is the RF linear pulse power amplifier. This amplifier provides RF pulses to misalign the atoms. Both MRI and NMR require a high-precision RF amplifier. Because the systems use shaped pulses, the amplifier has to be very linear. For trustworthy medical diagnostics, the amplifier must be extremely stable in amplitude and phase because instabilities would cause variations in the image's brightness that could be misleading.
In addition, the fall time of an RF pulse is most crucial for the system. As soon as the RF is switched off, RF receivers are employed to detect the FID. In order not to disturb the receiver, the RF power amplifier needs to shut off rapidly and suppress any noise immediately.

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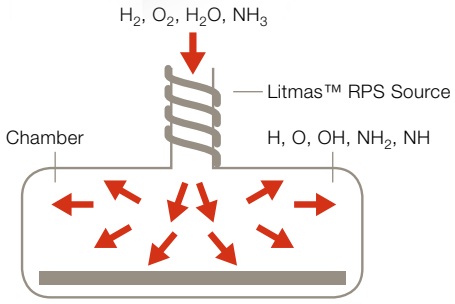
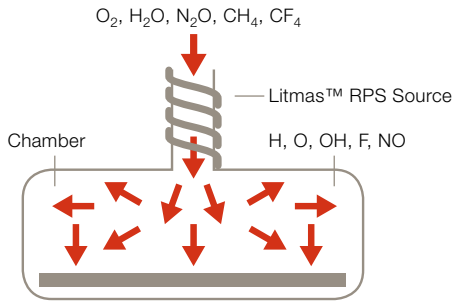
ADVANCED ENERGY®

SOURCES: Versatile Litmas™ Remote Plasma Sources: Superior Performance and Ease of Use

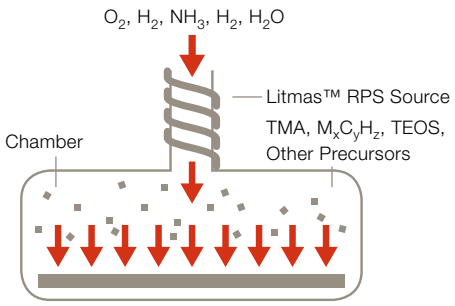
AE®'s compact Litmas™ RPS



Pre-cleaning application



Photoresist strip / etch application



ALD / CVD application

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AE®'s Litmas™ Remote Plasma Source (RPS) with LitmasMatch™ technology combines a plasma source and power-delivery system in a compact design for higher performance and increased reliability in your plasma-based applications.

Benefits Because it integrates all of the components found in a traditional plasma source into a single, compact package, AE®'s Litmas RPS installs easily on new or existing process tools. The patented LitmasMatch solid-state power-delivery system enables faster tuning and precise process control, while sophisticated on-board sensing and communication technology – combined with the LitmasMatch system – delivers unprecedented reliability. A wide range of process gases are accommodated by two plasma chamber material options (ceramic or quartz).

Integrated Remote Plasma Source Design The Litmas product line is designed with higher performance and reduced cost of ownership in mind. Typically, a plasma source consists of four components: an RF generator, coaxial cable, a matching network, and a plasma chamber. By comparison, both the 1.5 and 3.0 kW Litmas RPS units are approximately the same size as a single matching network, mount directly on the process chamber, and require no additional space in an equipment rack. Integration into a single package also allows the use of thermal and electrical sensors, placed in strategic locations throughout the unit, to reduce the risk of damage from inadequate cooling water flow, improper vacuum conditions, or other misuse.

Applications The flexible Litmas RPS can perform in a wide range of process applications, including substrate pre-clean, photoresist strip, thin-film deposition, and etch.

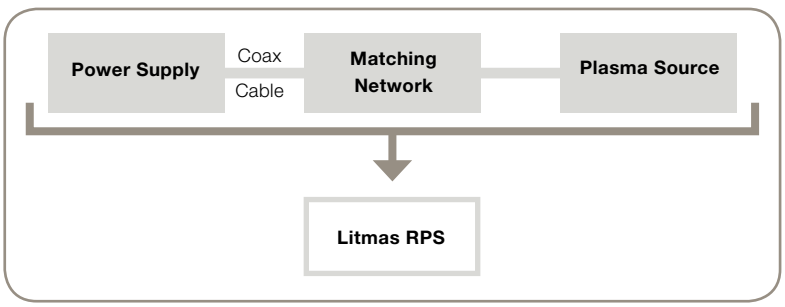
· **Pre-clean** Prior to PVD or CVD steps, flowing dissociated hydrogen gas from the Litmas RPS into the process chamber gently removes native oxides and other residual contamination from the substrate, enabling better adhesion and improved contact resistance.

· **Photoresist Strip** The Litmas RPS is ideally suited for use with traditional O2/N2 and O2/CF4 photoresist chemistries. Recent results have demonstrated strip rates in the range of 10 µm per min, comparable to the best performance in the industry.

· **Thin-film deposition** The Litmas product line is especially well suited for precision deposition processes such as atomic layer deposition (ALD), where high tuning speed and precise process control are required.

· **Etch** Because of the high-speed tuning capability of the LitmasMatch power-delivery system, the Litmas RPS is a perfect candidate for critical etch steps, as found for example in the Bosch process.

For more information, visit the Litmas product page on our website:
http://www.advanced-energy.com/en/Plasma.html



AE®'s Litmas™ RPS integrates a power supply, matching network, plasma source, and cabling into one, compact package.

POWER-DC: AE®'s SUMMIT® DC Power Supply – Critical Technology for Advanced Sputtering Processes

Summit® DC power supply electrical specifications:

Output
- Power: 20 kW (dual), 25 kW (dual), 30 kW (dual), 40kW, 50 kW, 60 kW
- Voltage range: up to 300 to 1300 VDC (full power, single tap)

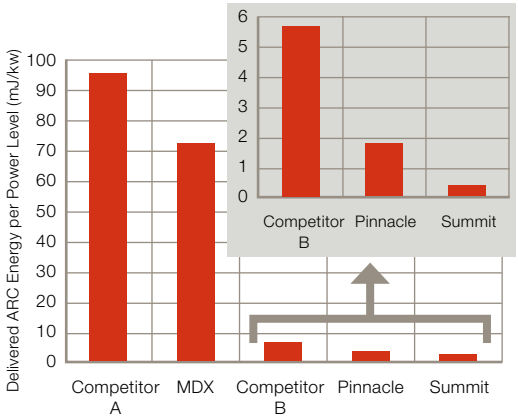
Input
- Voltage Range: up to 380 to 480 VAC (±10%)
- > 0.9 power factor
- > 90% efficiency

Interface Options
- Ethernet, RS-232/485, passive display (standard)
- Profibus
- DeviceNet®
- Isolated analog (0/15 VDC digital, 0 to10 VDC analog, 37-pin)
- Virtual front panel (laptop-based)
- Remote control Panel

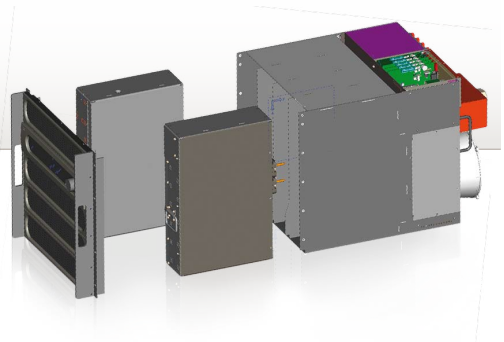
Mechanical
- Packing height: 10 U
- Cooling medium: air

Extreme Arc Handling: < 500 µJ/kW

Figure 2: Summit: The New Industry Standard for the Minimal ARC Energy



Summit® DC power supplies' extreme arc handling capability [AE®]



Lately, when you walk into any electronics store, the coming of affordable LCD (liquid crystal display) technology is staring right back at you. Many people were able to enjoy watching this summer's World Cup action more vividly than ever before. Apple® computers recently announced that it is removing the aging CRT (cathode ray tube) designs from its catalog entirely. In the span of only a few years – with a shorter adoption cycle than the original CD and then the DVD – LCD flat viewing has taken the world by storm. How is this all possible? What helped enable this phenomenon?

Most simply, key to the industry's success was improving system throughput. Manufacturing utilization had to allow worthwhile investment by enabling a rapid rise to sustainable profitability. Throughput can be measured in both the speed of the system and the quality of the product leaving the tool (yield). Advanced Energy's Summit® DC power supply, representing the accumulation of 25 years of power conversion experience, aggressively addresses throughput head on.

Of utmost significance, Summit power supplies' extreme arc handling capabilities deliver the industry's smallest amount of damaging energy to developing arc zones during process runs. Summit power supplies' state-of-the-science technology removes all but 500 µJ/kW of this energy (Figure 2), assuring the operator that all is being done to enable his difficult and valuable process. Because customers' eyes tend to gravitate toward those few malfunctioning pixels across an entire display, the importance of high quality cannot be compromised.

This, then, becomes critical when one is operating a target across its lifetime. Significant arcing can occur any time during the processes due to imbedded impurities; however, they seem most prevalent early into and later on in a target's life. Combined with a wide full-power operating voltage range – which also enables use of a target's required lifetime despite vast impedance changes – Summit power supplies set the stage for effective system utilization.

In addition, damaging arcs affect throughput by limiting the system's ability to raise process power. Because Summit power supplies minimize arc energy, the operator is free to raise process power levels to the extent that the system can support such aggressive sputtering energy levels (cooling capacity, robotic movement limitations, etc.). Enabling system optimization is a leading AE® design goal.

By offering a robust, universal input voltage range, Summit power supplies have demonstrated successful operation in Korea, Taiwan, Japan, China, Europe, and the U.S.A. – all with the same standard mains design. Not only does this improve system uptime, it also enables regional development (one set of system facilities) with rapid cross-regional deployment (separate facility capabilities), all with little or no process variation.

And, as tool process power requirements have approached two megawatts, flat panel display plasma power supplies have never been subjected to such large mains currents. This can lead to power distortions that affect other components within the tool, false tripping that affects the process itself, and significant facility expense put forth in an attempt to address these issues. The Summit design stands out again with as much focus on the robust front end as on the plasma end. By dedicating a section of power conversion just to the mains, Summit system stability and thus system confidence raises the bar of expectations.

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Figure 3: Summit® DC power supplies demonstrate rapid mean-time-to-repair (MTTR) [AE®]

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POWER-DC (continued from page 3):

These supplies demonstrate solid field performance, with nearly 1000 units shipped (most coating high-tech glass today!). In the rare case of an issue, however, imbeded sensors and information displays rapidly warn or notify the operator, which can lead to a process change or a field repair. By incorporating fab-replaceable power modules, often Summit power supplies do not even have to be removed from the rack to address an issue (Figure 3). This not only reduces exchange times from hours to minutes because neither the AC or DC lines are touched, but, in the majority of cases, this also reduces service exchange cost from the price of an entire power supply to the price of a fab-stocked module. The Summit design combines the performance of a high-powered, high-technology, process-enabling power supply with the reliability and serviceability found in smaller units. It will endear designers, operators, and financial operatives with its multi-facetted approach to improving tool profitability.

UPCOMING EVENTS:

04.09. – 08.09.06: 21st European Photovoltaic Solar Energy Conference and Exhibition 2006
Exhibition & Convention Centre Dresden
www.photovoltaic-conference.com
Booth # 85, Hall 5

11.09. – 13.09.06: SEMICON Taiwan 2006
Taipei World Trade Center, Hall 1, Taipei
www.semi.org
Booth # 2222

11.09. – 15.09.06: PSE 2006 – 10th International Conference on Plasma Surface Engineering
Garmisch-Partenkirchen Congress Center
www.pse2006.net
Booth # 2

Paper:
RF-superimposed DC and Pulsed DC sputtering for Deposition of ITO and ZnO, T. Linz, M. Lutz, Advanced Energy Industries GmbH, Filderstadt, Germany, M. Stowell, Applied Films Corporation, Longmont, CO and M. Ruske, Julian Schwenzel, Dr. Joachim Müller, Applied Films GmbH & Co. KG, Alzenau, Germany

13.09. – 14.09.06: DISKCON USA 2006
Hyatt Regency Hotel & Santa Clara Convention Center, www.idema.org
Booth # 417

26.09. – 27.09.06: vaQum International Trade Fair for Vacuum Technology and Vacuum Applications
Exhibition & Convention Center Magdeburg
www.vaqum.de
Booth # 160

Paper:
Integrated Plasma Sources for Cleaning, Ashing, Deposition and Abatement Applications
T. Linz, R. Huber, D. Shaw, M. Lutz, Advanced Energy Industries GmbH, Filderstadt

12.11. – 16.11.06: AVS 53rd International Symposium & Exhibition
Moscone West Convention Center, San Francisco, CA, USA, www.avs.org
Booth # 1211

13.11. – 17.11.06: Matériaux 2006
Exhibition & Convention Center Dijon
www.materiaux2006.net
Booth # 22

06.12. – 08.12.06: SEMICON Japan 2006
Makuhari Messe, Chiba (Tokyo), Japan
www.semi.org
Booth # not available yet

POWER-RF (continued from page 1):

LPPA Advanced Energy®/Dressler® offers a substantial line of RF linear pulse power amplifiers (LPPA) that are optimized for challenging MRI and NMR applications. All of our amplifiers have an extremely short RF fall time of typically 70 nsec and pulse-to-pulse stability of 0.05 dB. These amplifiers cover an overall bandwidth from 200 kHz to 400 MHz with an output power of up to 8000 W. Narrowband amplifiers are used to excite hydrogen and flourine that are approximately 127 MHz and 120 MHz respectively in a 3 T system. Broadband amplifiers are designed to excite different elements of the periodic table down to oxygen with its Larmor frequency of approximately 17 MHz in a 3 T field.

High Field System While in systems up to 3 T, the static magnetic field may be considered homogenous, that may not hold true for high field systems, such as 7 T and 9.4 T systems. In order to cope with a non-homogenous field, it is advantageous to employ a number of RF coils instead of using only one RF coil as is common for up to 3 T applications. Dressler has designed a multi-channel amplifier as the newest member of the LPPA product line. The user may choose to run it with a combined output of 7500 W or to run up to 8 channels separately with maximum 1000 W each. This brand new technology is employed for the LPPA 30080 W (300 MHz for 7 T systems) and the LPPA 40080 W (400MHz for 9.4 T systems). Due to their state-of-the-art architecture, these amplifiers meet the needs of cutting-edge MRI and NMR applications.

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