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Upgrading Industrial Thin Film Coaters Powered by Crystal® with Advanced Energy's Bipolar DC Technologies

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The continuous advancements in power electronics components lead to faster event responses. In turn, the advantages are higher accuracy and lower defects in layer stack and process controls. These are all welcomed in our world as we continuously work toward stability and repeatability in our individual coating competencies. Higher-speed internal components have resulted in faster arc detection, faster arc response time, and lower, adjustable arc energies. Whether you are using DC, pulsed DC, bipolar pulsed DC or RF, we must wrestle with the reality of power supply generational discontinuation. High-power sinewave technologies such as Advanced Energy's Crystal® have become obsolete, presenting the challenge to learn new process parameters for different materials. However, new AE technology advancements and application support can help you plan, test, qualify and integrate the latest power supply technologies in your systems. This presentation highlights our solutions.

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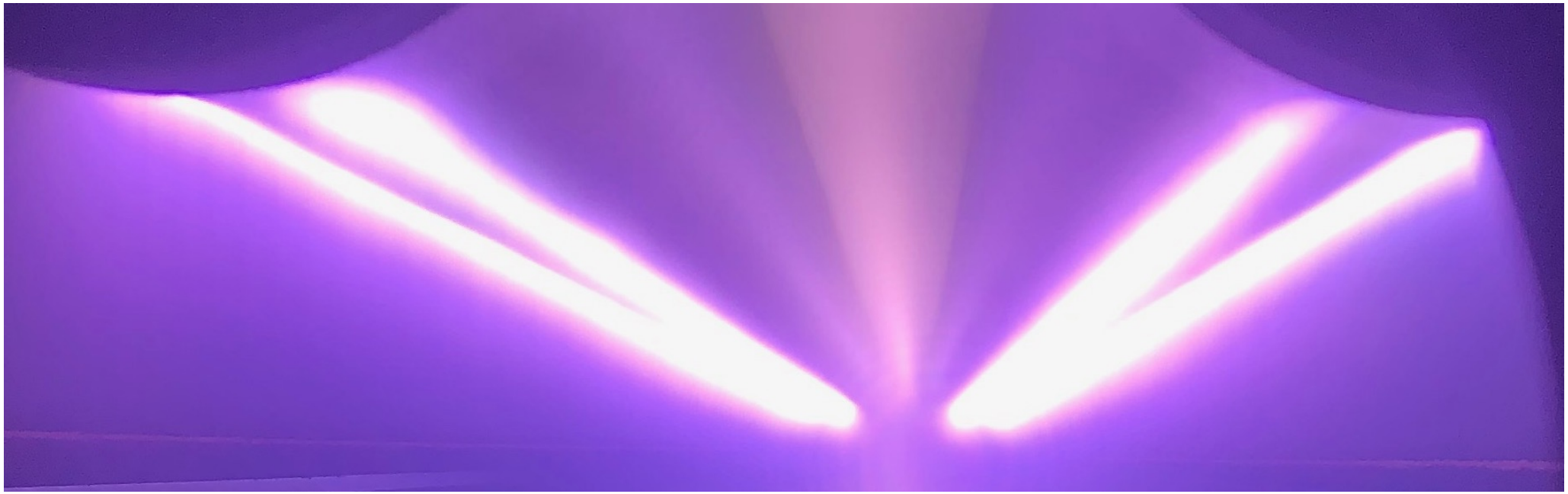


Advanced Energy

Ascent Product line includes AMS/DMS, Ascent AP (Advanced Pulsing)

Crystal Legacy

Technology Advancements

Why Square Wave DC

Features

Ascent AMS

Ascent AMS/DMS

Ascent AP

Output Types

Integration

Crystal Legacy

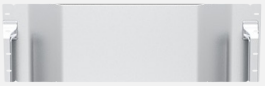
- 20+ year standard
- Parts discontinuation forces obsolescence
- Switching technology and control advancements
- Processes are requiring more precise control
- Parts availability is becoming more difficult

Technology Advancements

- Faster switching IGBTs
- Faster control methods
- Progressive arc management
- Synchronization both pulse and arc
- Higher power densities in smaller space
- FASDAQ™ – arc management tuning
- PowerInsight by Advanced Energy™ for statistical process control and long-term trending.

Advanced Energy

Ascent® DMS



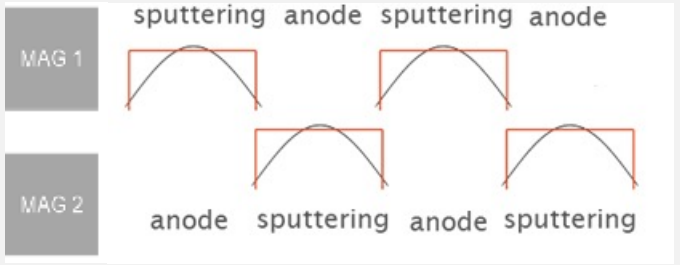
AMS add-on
40, 60, 80, 100, 120 kW

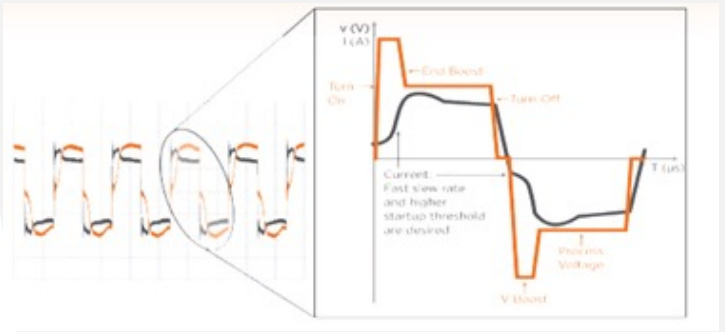
Ascent® DMS AP

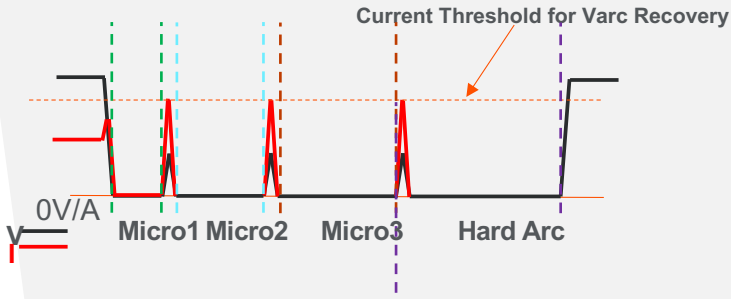
15, 20, 30 kW

Why Square Wave DC?

- Higher deposition rates, work under the curve 8-10% rate increase over sine wave for given process conditions
- Arc response is faster due to stable DC output.
  - Compared with sine wave there needs to be anticipation of the actual arc, total arc energy will be higher.
- Progressive Arc Management







Feature Comparison

	Crystal AC	Ascent AMS/DMS	Ascent AP (Advanced Pulsing)
Output Type	Sine Wave	Programmable Frequency Bipolar	DC, Programmable Frequency Unipolar & Bipolar
Process Frequency	Sine Wave (36-100kHz)	500 Hz – 50 kHz (Programmable)	5 kHz – 150 kHz (Programmable)
Cathode Duty Cycle	50%	5 - 95% Programmable per Cathode Frequency Based	5 - 95% Programmable per Cathode Frequency Based
Arc Management	AC arc management	DC-Style Arc Management (Lower Arc Energy)	DC-style arc management (lower arc energy)
Synchronization Between Positions	No	Yes Frequency and Arc	Yes Frequency and Arc
Cathode Phasing	No	Coming Soon	Yes

Ascent AMS

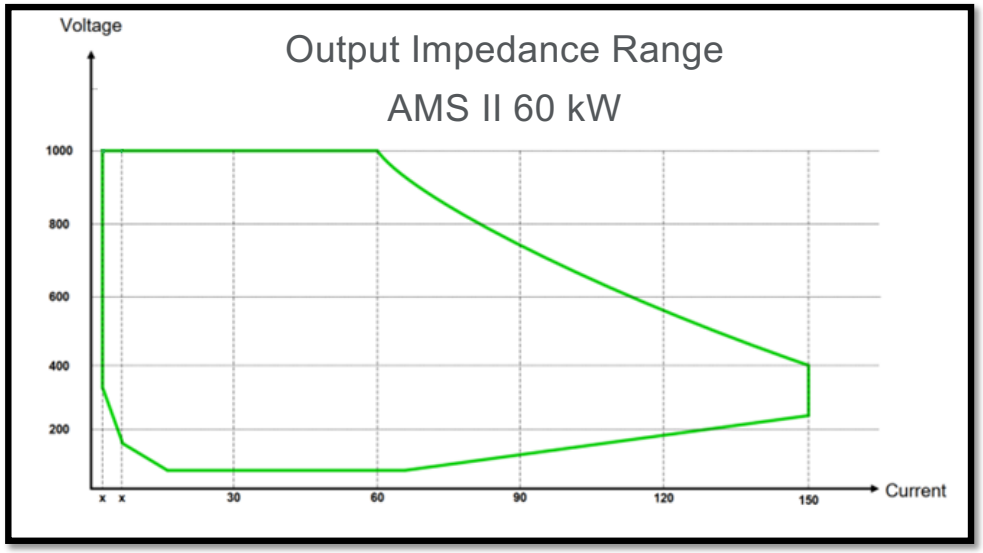
- DC output for single cathode sputtering
- Adjustable progressive arc management
- Stackable (to 13 units)
- LAPP
  - Low average power pulsing
- Pulsing to 5 kHz
- Setpoint compensation

Ascent® AMS II

Wide Range Input

360-528 VAC

Single, expanded Operating Area



Ascent® AMS II

Fully Water Cooled

- Noise reduction
- No external air exchange
- Same water supply needs as AMS

Simplified, Expanded Operating Range

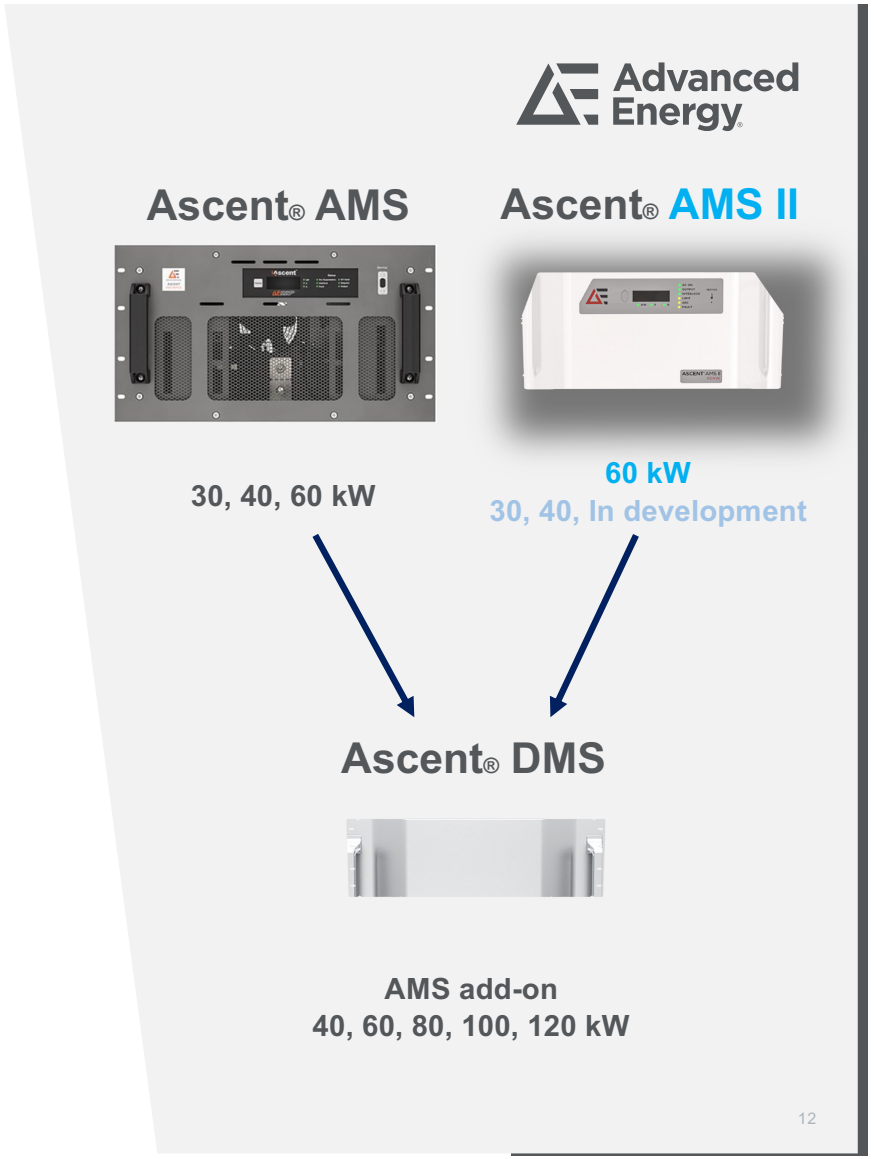
- Wide range input – 360-528 VAC
- Single, expanded SOA

Integrated Support and Diagnostics

- Integrated Virtual Front Panel
- FastDAQ™ and Embedded POWERINSIGHT
- File over EtherCAT (FoE)

Ascent AMS, AMS II/DMS

- Ascent AMS or AMS II provides the DC bus
- Ascent DMS accessory shapes the output waveform to bipolar pulsed DC
- Ascent DMS contains arc management functionality
  - Progressive arc management
- Adjustable Duty Cycle
- Boost voltage
- Power balance
- DMS stackable – 2 units (up to 240 kW)



Ascent AP (Advanced Pulsing)

- 3 Modes of operation
  - Single cathode DC
- Single cathode unipolar pulsed DC
  - Boost voltage
  - Reverse voltage to 300V
  - Off times when crossing 0
- Dual cathode bipolar pulsed DC
  - Adjustable duty cycle
  - Boost voltage
  - Power balance

Advanced Energy

Ascent® SMS AP

10, 15, 20, 30 kW

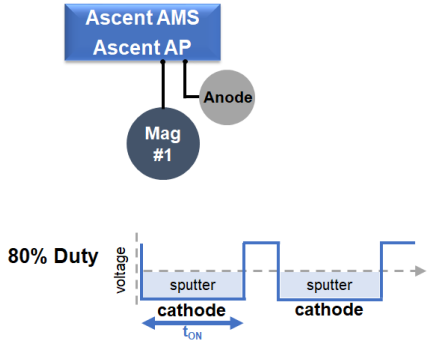
Ascent® DMS AP

15, 20, 30 kW

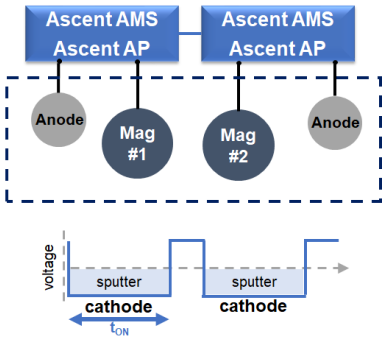
Multiple Output Configurations

- Single cathode DC
- Single cathode unipolar DC
- Dual cathode DC – arc synchronized
- Dual cathode bipolar pulsed DC
- Dynamic Reverse Pulsing
  - Patented by AE
  - Higher rate
  - Lower temps
  - Lower film stress

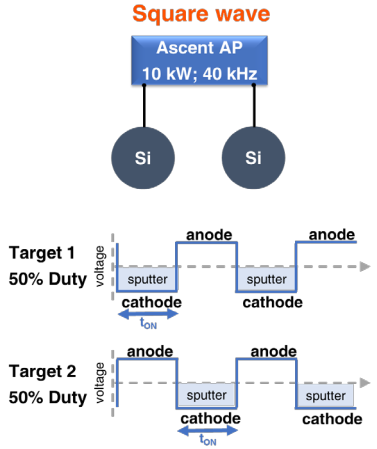
Single magnetron sputtering



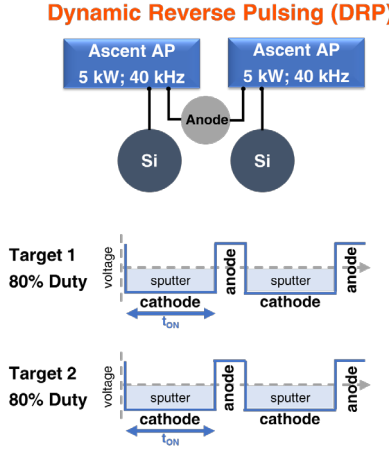
Single magnetron sputtering
Dual lid Synchronized



Square wave



Dynamic Reverse Pulsing (DRP)



Integration

- Cabinets
  - Drop-in cabinet for Crystal
    - Water
    - Input and output power
    - Machine interface
  - Multiple configurations from AE
  - Your design
  - Experienced 3rd party cabinet shop