Advanced Energy

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# 3D PRINTING



## SOLUTION OVERVIEW

3D printing of metals and polymers is gaining increasing acceptance in industrial applications. It allows the creation of complex geometries that are difficult to achieve using traditional manufacturing methods. Melting metal powders using lasers or electron beams to produce parts with high strength and durability is commonly used in aerospace, automotive and medical industries. On the other hand, polymer machines allow the cost-effective production of highly customized small volumes, for example as an alternative to injection molding.

In addition to the process-specific energy source, the electric systems of metal and polymer machines include heating elements, actuators, sensors and logic controllers to be able to determine and control important process variables. They require power supply solutions that are reliable and stable in an industrial operating environment and provide a high level of efficiency. These requirements are met from 300 W to 24 kW with the uMP Gen II, LCM, and iHP AC-DC power supply series.

## Target Markets/Customers

Industrial 3D printers that use one of the following processes to create metal or polymer parts from 3D CAD data:

Powder Bed Fusion, Directed Energy Deposition, Binder Jetting, Material Extrusion, Vat Photopolymerization, Material Jetting, Sheet Lamination.

The market is composed of three basic types of OEM:

1. Native manufacturers of 3D printers.
2. Suppliers of traditional manufacturing machines that add 3D printing to their portfolio, including hybrid solutions.
3. Suppliers from related industries such as printing or optics. They are mainly characterized by acquisitions of native manufacturers.

Renowned manufacturers include:

- AMER: Stratasys, 3D Systems, Desktop Metal, Markforged
- EMEA: EOS, SLM Solutions, Additive Industries, Trumpf, Cubicure
- APAC: Titomic, Bright Laser Tech, Farsoon Technologies, InssTek, XYZPrinting

## Where to Avoid

Non-industrial desktop machines that are aimed towards consumers as well as design and art professionals (these machines have ~15% share of the overall 3D printing hardware market.

## Audience – who to engage and when

- Focus on OEMs of industrial 3D metal and/or polymer machines (these machines types have reached an upper level of industry maturity and diffusion, and ~66% share of the overall 3D printing hardware market)
- Not a focus, but not prohibited either: OEMs of industrial ceramic, composite and electronic machines (these machine types have a lower level of industry maturity and diffusion, and a share of ~18% of the overall 3D printing hardware market)
- Functions: Product Management, Engineering, Technical Purchasing
- Seniority levels: VP, Director, Manager
- When to engage: When prospects are in early design stages or have completed their designs, and start to look for the required components.

## Business Benefits

- Prevent unplanned downtimes due to issues related to power, increase uptime
- Ensure consistent quality of printed parts, avoid defects caused by power fluctuations
- Reduce operating costs in terms of power consumption and efficiency

These points improve the competitiveness of the OEM's 3D printer and make it more attractive to industrial end users.

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## Qualifying Questions

- What type of 3D printer do you manufacture?
- What manufacturer/type of power supply do you currently use in that 3D printer?
- What is your annual purchase volume?
- Why did you choose that manufacturer/type? And what are you satisfied with?
- What are you not satisfied with:
  - Product performance/supply performance/quality issues/ technical support/technical documentation/order process/ claims management etc.
  - What implications do those problems have? How much does that cost you? What could you achieve without those problems?
- What are the typical and peak power requirements of your 3D printer?
- What is the input voltage, and what is the most demanding operating environment in terms of temperature, humidity, vibration etc?
- What is the requirement regarding power factor correction?
- Do you need specific approvals/certifications/declarations of conformity?
- Do you need to measure the temperature of a specific point or the temperature distribution across a larger surface?
  - What manufacturer/type of temperature measurement device do you currently use?

## Customer Challenges

Each OEM has unique challenges based on their design choices and components.

1. Efficiency of the power supplies contributes to the operational cost of the 3D printer.
2. Reliability of the process taking place withing the 3D printer affects quality.

For example, Power Bed Fusion (PBF) is a high-power process with many different subsystems that can experience power related disturbances that may cause part defects over the longer manufacturing time.

## Key Features & Specs (high-level differentiators)

Our power supplies meet the requirements of a wide range of applications within 3D printing.

1. Compliance with SEMI F47 Standard
2. Control options and flexibility offered with our configurable power supplies
3. High efficiency decreases operational costs of the printer: iHP is 92%, uMP Gen II is up to 91.5%, LCM3000 is >90% efficiency.
4. Input voltage - range and fluctiations can happen, varying by location/country
5. Output voltage range - different components or subsystems require different levels
6. Output power - to match typical operating power consumptions of the 3D printer, including any additional loads, such as higher peaks when starting up

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## COMPETITIVE ANALYSIS

### Configurable AC-DC Power Supplies

| Competitor Type | Competitor Strengths | Competitor Weakness | AE Strategy |
|---|---|---|---|
| Leader A | ▪ Robust and quality products<br>▪ High power density<br>▪ Can go direct quickly to win on price | ▪ Complex configurable assembly<br>▪ No high power configurable product >3000 Watts<br>▪ New to digital control | ▪ ConfigPro<br>▪ Defend high power<br>▪ Field configurable (iHP) |
| Leader B | ▪ Extensive medical portfolio<br>▪ Organic and inorganic growth of product offerings | ▪ No high power configurable product >3000 Watts<br>▪ New to digital control | ▪ Attack on SEMI<br>▪ Value Add |
| Emerging A | ▪ Over 10,000 PSU models<br>▪ Low cost<br>▪ R&D focus for new products | ▪ Weak channel<br>▪ Minimal mod capacity<br>▪ Lack software capabilities | ▪ Modification capabilities<br>▪ Software |
| Emerging B | ▪ Heavy investments in R&D<br>▪ Low Cost<br>▪ High production capacity | ▪ Weak channel<br>▪ Limited portfolio<br>▪ New configurable has design issues | ▪ Defend high power |
| Emerging C | ▪ Diverse AC-DC and DC-DC<br>▪ Multiple applications<br>▪ Strong in Japanese market | ▪ Limited portfolio | ▪ Modification capabililities<br>▪ Software |

### Bulk High Power AC-DC Power Supplies

| Competitor Type | Competitor Strengths | Competitor Weakness | AE Strategy |
|---|---|---|---|
| Broad Line A | ▪ Robust and quality products<br>▪ Limited lifetime warranty<br>▪ Can go direct quickly to win on price | ▪ Only 9.5KW in 1U rack<br>▪ Monitor only with comms | ▪ Latest comms<br>▪ LCM10K |
| Broad Line B | ▪ R&D focus for new products | ▪ Parallel up to 4 units, limited to 40KW limit<br>▪ 1 U rack mount power, limited to 8KW | ▪ Add system solutions |
| Broad Line C | ▪ Diverse AC-DC and DC-DC<br>▪ Strong in Japanese market | ▪ Weak channel<br>▪ Minimal mod capacity<br>▪ No high voltage | ▪ Accelterate mod capabilities |
| Hi Power Niche A | ▪ System customization | ▪ Expensive<br>▪ Low power density | ▪ Add system solutions |
| Hi Power Niche B | ▪ Specialize in liquid-cooled power | ▪ Limited portfolio | ▪ New LQM Series |

uMP Gen II Series

iHP Series

LCM Series

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## ADDITIONAL REFERENCES


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INTERNAL CONTACTS

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## Cross-Selling Opportunities

Power supplies are the basic entry into this market. That said, the quality of the parts produced by 3D printers depends on many parameters. Depending on the process, ambient and process temperatures or the atmosphere in the chamber have a decisive influence. Their measurement and control opens up further possibilities for the AE product portfolio.

In addition to power supplies, we can offer some process control and temperature measurement products.

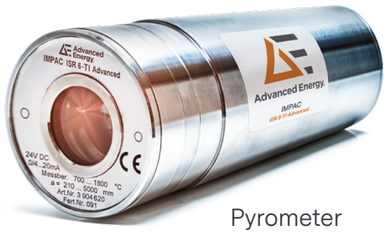
For machines that are using Powder Bed Fusion (PBF) or Directed Energy Deposition (DED) techniques, we can also offer **Pyrometers** for spot measurement and **Thermal Imagers** for temperature distribution across a surface.

For machines that are using Binder Jetting, we can also offer **Piezo Drivers** for precise control of the printhead.

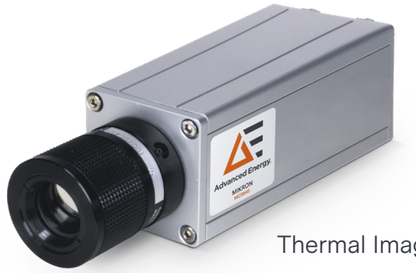
Powder Bed Fusion techniques in industrial 3D printers use fiber- or CO2-laser or electron beam units to bond raw material that is spread over a powder bed. The printer chamber is preheated to a temperature below the phase transition temperature of the raw material, before the beam melts or fuses the powder into the desired layer geometry. Monitoring the temperature of the powder bed and the temperature distribution on the heated area that absorbs the beam's thermal energy are crucial. The process setup makes a more sophisticated non-contact solution necessary.

Directed Energy Deposition is also confronted with temperature measurement challenges, whereby here material is fed to the laser/electron beam via nozzles.

- PBF metal machines that use selective laser melting (for example in AMER: Velo3D or in EMEA: Renishaw or in APAC: Bright Laser Tech)
- PBF metal machines that use electron beam melting (for example in AMER: Sciaky Inc. or in EMEA: Arcam AB (part of GE Additive) or in APAC: QBEAM)
- PBF polymer machines that use selective laser sintering (for example in AMER: Formlabs or in EMEA: EOS or in APAC: Protofab)
- DED metal machines that use a laser/electron beam (for example in AMER: Optomec or in EMEA: DMG Mori or in APAC: Yamazaki Mazak)



Pyrometer



Thermal Imager

Piezo Driver

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## ADDITIONAL REFERENCES

### What We Power