The Supply Chain for Magnetics

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Timeline

• Intro
• The process
• Investments
• What things can we do
• Materials
• Conclusions
• When designing magnetics there is certain tendency to focus on the electrical part and forget about the mechanical one

• This approach might be “OK” for simple magnetics but as soon as your “Great Idea” starts to be more complex several things need to be considered

How to get there?
Commercializing a “simple magnetic” is a “quite straightforward” process that could take few months:

- Low risk in the simulations
- Manufacturers have easy access to materials
- No toolings required
- Adjustments are something affordable in time and money

**Specs**
- BOM = 5 to 10 different material
Commercializing a “complex magnetic” could take up to years

- High risk in the simulations
- Custom made materials
- Lot of toolings required
- Adjustments are a pain in time and money

BOM = 10 to 25 different material
How much money are you willing to invest to commercialize your great idea?

<table>
<thead>
<tr>
<th>Material</th>
<th>Sample MOQ</th>
<th>Production MOQ</th>
<th>Tooling Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Dozens</td>
<td>Thousands</td>
<td>3 k€ - 5 k€</td>
</tr>
<tr>
<td>Coil former</td>
<td>Dozens</td>
<td>Thousands</td>
<td>4 k€ - 6 k€</td>
</tr>
<tr>
<td>Litz Wires</td>
<td>5 – 10 kg</td>
<td>100 – 500 kg</td>
<td>0€? (not really)**</td>
</tr>
<tr>
<td>Copper Stamps</td>
<td>10 – 50 kg</td>
<td>100 – 500 kg</td>
<td>1 k€ - 2 k€</td>
</tr>
<tr>
<td>Aluminum Housings</td>
<td>Dozens</td>
<td>Hundreds</td>
<td>3 k€ - 7 k€</td>
</tr>
<tr>
<td>Potting</td>
<td>1 – 6 kg</td>
<td>60 – 100 kg</td>
<td>0€? (not really)**</td>
</tr>
</tbody>
</table>

**These materials might not require tooling but certain special machinery such as hot crimping machines and automatic dispensing equipments**
How much money are you willing to invest to commercialize your great idea?

Certifying your great idea could need a significant investment (10 k€ - 50 k€)
What things can we do to improve the process and reduce the risks?

• Analyzing the project timeline, budget and crucial phases is critical

• Fixed requirements 😃  ----- Flexibility & Adaptability = Easier life 😊

• Understand your supplier and their needs (forecast) --- You are not alone in this business!

• **Understand the limitations of each of the materials you are planning to use**
• Great ideas many times come with latest materials or very specific shapes. This could bring problems during production due to the lack of alternatives.

• Good to know which materials form the core (Ni, Mn, Fe, Molybdenum, rare earth materials...) to understand how nowadays shortage could impact the industrialization of your great idea.
Custom Cores

- Custom shapes can bring major benefits for very challenging requirements, but special attention needs to be care to the production volume.

- Inductance and mechanical tolerances are there. To avoid risks and time communication with your core supplier or magnetic experts is critical.

- Distributed gaps can help to reduced fringing fields up to certain point. Not more is better!

![Cost vs. Nº of Gaps](image1.png)

![Loss vs. Nº of Gaps](image2.png)
• Litz wires clearly improved the high frequency performance but one shall be careful to ensure the availability and feasibility of the litz wire considered.

High frequency inductor @ 700 kHz

Do we really need to go for the smallest?
Winding – Foil / Copper Stamps / Edge Wound

- In high current designs a trade-off needs to be taken between simplicity and high frequency performance

Foil

- Terminations are not straightforward
- High manual labor
- Difficult tolerance control
- Easy prototyping – difficult automation

Copper Stamps

- Tooling needed
- High frequency limitation
- Good repeatability
- Easy scalability

Rectangular wires

- Tooling needed
- High frequency limitation
- Minimum DC losses
- Easy scalability
Coil formers and isolation tapes

- Great ideas many times come with custom coil formers or complex winding structures. The selection/design of the coil former could have a great impact on the automation feasibility of the winding.

- Safety distance and current handling needs to be considered when looking at the coil formers. Special extended rail bobbins or thicker pins might be needed and not available in the market.

When it comes to cost and automation reinforced winding wires are far more preferred than margin tape designs.
Resins – some questions that you should ask yourself

- Which type of resin should I consider for managing the heat of my component?
- Do I need a UL certified material?
- Can I afford a 50€/kg in my resin?
- Can I wait 10 weeks for getting the MOQ of my “sexy” material?
- Is this component going on a bath or am I going to pot it alone?
Conclusions

- Great ideas need time for their industrialization. Understanding this process is critical for decision making.

- Tooling and MOQs are there when developing advanced and complex magnetics.

- Understanding the materials limitations is critical for a successful and rapid go to market.

- Production volume and forecast are needed to go ahead with certain ideas.

- A trade-off between cost, performance and replacements is needed to ensure the long-term manufacturability of the product.
Thank you for your interest.

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PSMA Magnetics Committee/What it Takes to Commercialize
“Great Ideas”

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