

A MANUFACTURER'S GUIDE TO IN-MOLD STRUCTURAL ELECTRONICS

An introduction to the value of IMSE components



WHAT ARE IN-MOLD STRUCTURAL ELECTRONICS (IMSE)?

Known as the perfect union of form and function, IMSE integrates printed, conductive inks with In-Mold Decorating (IMD). It produces a single finished product that requires a fraction of the space of conventional electronics and eliminates the need for a printed circuit board (PCB).

The graphic and functional inks are printed second surface so they are protected behind the applique substrate. IMSE products are typically printed on polycarbonate and polyester, but DuraTech is not limited to these materials.

IMSE is a low-cost alternative to traditional technologies and requires fewer raw materials and zero assembly while improving product durability and the user experience.

How is IMSE different than IMD?

The two products are similar in appearance and the materials used. The difference is that In-Mold Decorating (IMD) products only include graphics, while IMSE takes it to the next level by incorporating electrically functional components as well.



Industries and applications that use IMSE

- Appliances
- Medical devices
- · HVAC
- Automotive
- EV charging stations
- Commercial food service equipment
- Gas pumps/stations
- · Many more!

THE STRUCTURAL BREAKDOWN OF IMSE

IMSE has multiple structural options, all providing the opportunity for a smaller, sleeker part. Possible structures include:

A-Film Structure

Film on top, injection

molding resin on bottom.

2-Film Structure

Film on top and bottom, injection molding resin in-between.

A-Film Resin





Film on bottom, injection molding resin on top.



The layers of an IMSE part

1. Decorative A Surface Film: The traditional IMD product. All of your decorating, screen printing and forming is here. This is the layer that the user sees.

2. A Surface Electronics: The electrical components. Can be put on the A Surface Film or Functional B Surface Film.

3. Injection Molding Resin

4. B Surface Electronics: The electrical components. Can be put on the A Surface Film or Functional B Surface Film.

5. Functional B Surface Film



So, layer 1 would have all the graphics, and layer 5 would have all the functional electronics. They'd be placed in the injection molding tool and then the resin would be injected in between them, bonding them. The final result would feel like one solid plastic part.



BENEFITS OF IMSE COMPARED TO CONVENTIONAL ELECTRONICS

Conventional electronics are usually made up of multiple pieces which can make the part bulky and heavy while limiting design freedom. IMSE is "Single Part Integrated," which allows for design freedom, ease of integration and reduces complexity of the part. There are many other benefits to IMSE products as well, including:

- Fewer parts: Simplify the bill of materials (BOM) and reduce assembly time
- More durable products: A single, solid part is less prone to damage during use
- Less weight: IMSE can provide up to 70% less weight and 90% thinner parts
- Easier to clean: IMSE doesn't have cracks and crevices around switches or buttons for dirt and bacteria to hide, making it ideal for applications that require frequent cleaning or disinfection
- Maximum weather resistance: IMSE is a solid state replacement for membrane switches, which makes it ideal for outdoor keypads, wet environments and marina environments

- Superior illumination options: IMSE eliminates the need for separate light guides and can include LED indicators, backlighting, large area illumination and more
- Greater design freedom: IMSE can be customized to create the ideal user experience for your application
- More sustainable products: IMSE creates 34-60% less greenhouse gases and 50-75% less plastics, according to independent lifecycle analyses

Reduce and simplify

With conventional electronics, this single product is made up of 64 parts + PCBA, is 35mm thick and weighs 470g — creating a bulky, heavy part with multiple pieces. Using IMSE, the product is composed of one molded part + PCBA, with 4mm part thickness and weighing 140g.

•

CUSTOMIZATION OPTIONS

IMSE brings opportunities for greater design freedom.

HMI control options

IMSE parts can include interactive features such as:

- Touch buttons
- Linear and radial sliders
- Multi-touch control
- Scroll wheels with adjustable detents and infinity scrolling
- Programmable haptics
- Sound and vibration

Superior illumination

IMSE eliminates the need for separate light guides and can include illumination features such as:

- LED indicators
- Smooth icon backlighting
- Functional ambient and large area illumination
- Single point and diffused LED lighting
- Static or dynamic light lines



Other IMSE customization options

Resistive Heating Elements: Ideal for lens defrosting, de-icer for traffic control lights and solar panels, headlamp heater for snowplows, UTVs, locomotives and LiDAR, and lab equipment warming.

Connectivity: IMSE can support Wi-Fi, Bluetooth and Near Field Communication Tags.

Integrated Control Electronics (SIP):

Integration options include control electronics within IMSE parts, IMSE parts connected directly to host systems, digital interference between IMSE parts and host system.

Connector options: Crimp connector or flex tail. There's a digital signal as opposed to an analog signal, so the microcontroller is actually embedded inside the in-mold structural electronics.

TIPS FOR A SUCCESSFUL IMSE PROJECT

If IMSE projects aren't set up correctly, the injected resin can blow away LEDs and circuits and effectively ruin the part. But there are a number of other challenges that many molders and product developers may be unfamiliar with. To minimize fallout rates and achieve the greatest likelihood of success for an IMSE project, consider these tips:

| 1 | | |
|---|--|---|
| | Start working with your printer early on | An experienced printer like DuraTech can offer insights on materials, IMSE production processes and design consideration that can help avoid delays or other costly problems. So, working with a printer early in the project lifecycle is the best way to stay on track. Remember too that circuit design and validation, distortion to graphics, testing printed samples, etc. will add 10-12 weeks prior to mold tool design. |
| 2 | | |
| | Make sure gating is set up correctly | IMSE tooling requirements are similar to that of traditional injection molding tooling, but the gating has to be designed specifically for IMSE. Use one gate whenever possible to reduce knit line effects, use short land lengths to ensure good resin flow, and use impinging gates whenever possible to lock the film into place during fill. |
| 3 | | The design considerations for IMSE closely mirror those |
| | Design for manufacturability | for traditional IMD. However, it is best not to take an existing injection molded part and make it into an IMSE part, as the injection mold tooling will probably have to change. Existing mold tools will generally not work unless they were designed for in-mold decorating or IMSE. DuraTech can validate your design compatibility with IMSE. |

WHY DURATECH OFFERS SUPERIOR IMSE SOLUTIONS

DuraTech is THE choice for IMSE fabrication because we have the technology, technical knowhow and strategic partnerships to create IMSE parts that exceed expectations for performance and durability.

Partnership with TactoTek

DuraTech has a licensing agreement with TactoTek, a deep tech company that specializes in Injection-Molded Structural Electronics (IMSE) with over 170 granted patents around IMSE. The partnership allows DuraTech to use TactoTek's patented processes, expert engineers and intellectual property, thereby enhancing and expanding our IMSE offerings.

TactoTek has a formal process for testing any material or component that can be included within an IMSE part. They study each input individually for desired and undesired properties, including potential contaminants, chemical reactions and anticipated performance through IMSE manufacturing processes. Then they subject parts to automotive interior grade testing to confirm manufacturability and ensure optimal performance.

TactoTek continuously releases technology and product updates that enable newer integrations and optimize cost and manufacturability of IMSE for a wide range of applications.

Work with DuraTech for your next IMSE project!

Let us put our expertise to work for you and experience the value our IMSE services can bring to your business.



www.DuraTech.com

1-800-451-9503

dtwebinquiries@duratech.com