

Every Millimeter Counts: Right-Sizing for Instrument Cases

Space is a premium in the markets for instrument cases. Whether it's a lab, hospital, industrial setting, or on a naval ship, instruments need to be smaller and smaller. In designing instrument cases, it's important to design to exact measurements to maximize density and performance. But, how can this be done without the high costs of tooling from scratch? How can costs be kept low for prototypes or low volumes?

Modularity

There are virtually limitless design possibilities for electronic enclosure design. For various types of instrument cases, it can be difficult to find the appropriate size and configuration for an application. Often, the engineer will have to incorporate a fully customized design or settle on a size that is not quite ideal. This can be expensive, time-consuming, and result in an inferior design solution. A "right-sized" modular design approach for enclosures can help solve these problems. Extrusions help make modular enclosures possible. An extrusion-based design allows the frame of the chassis to be easily cut in different lengths for various size and configuration requirements. The piece parts are easy to incorporate in various sizes for an instrument case or system platform enclosure frame. If the enclosure has a card cage, injection molded card guides can then be popped in at regular intervals into the extrusion holes. As there is flexibility in where the card guides are placed, various card widths and types can be placed inside the enclosure. When talking about modular design for a backplane-based system platform or a cabinet enclosure, the extrusions are typically cut in 1U measurements. The modular format allows various configurations of backplanes, drives, power supplies, shock isolators, etc, can be incorporated into the same base chassis. However, instrument cases need to have more precise sizes in many cases – saving every bit of space. Finding the right enclosure for your application can be very challenging. Often, the designer is forced to develop a highly customized design. Not only are the costs much higher, particularly during prototyping, but the time to market can be lengthy. There is also inherently more risk, as you are relying on custom parts and potential problems with single sourcing, obsolescence, etc.

Right-sized Modular Design

A “right-sized” modular design can help alleviate these problems. For instrument cases, this process starts with the aluminum extrusion, which are cut to any specified length. In many Eurocard system platforms, the extrusion has a radius for sealing and gasketing purposes. This flexibility saves a few manufacturing processes, keeping costs low. Further, the extrusion shape allows the extrusion and panels to be directly mated together. This prevents drilling and tapping the extrusion, again saving costs. With a simple design and only a few pieces, the assembly can be quick and easy. These cost advantages far exceed the extra cost of a super-functional extrusion. The benefit to the designer is he can have an exact-sized case that is customized with a low cost – and in small volumes. Typically, this kind of customization would only be cost-effective in high volumes. Now, it can be done for prototypes and small volumes. The extrusions do more than just allow a modular enclosure frame to be put together. An extrusion solution can be designed symmetrically, so parts cannot be mounted incorrectly. The sidewalls, mounting panels, or even PCB can be mounted directly into the extrusions, greatly reducing labor. Even nuts/bolts, grounding terminals, etc can fit right into a carefully crafted extrusion design.

EMC Considerations

EMC is an important consideration in enclosure design. It is an important part of a packaging designer’s responsibility to ensure that the system does not interfere with, and is not susceptible to interference from, other electronics equipment. Depending on the item’s usage, electronics equipment must meet compliance standards like FCC and CE. The goal is to create ground continuity over the outer skin of the enclosure and to block given wavelengths from passing through any openings. In order to ensure compliance a wide range of issues must be considered. These include material type and thickness, conductive plating, vent hole size, seam length, gasketing, power filtering, access panels and AC cable routing. To provide a solid basis-point, the extrusions for the instrument case can be designed with 90-degree angles to cover any open seams. Further, the shape of the extrusion can allow the insertion of EMC sealing cords.

Adding Aesthetics

Aesthetics can be important in instrument case design. An attractive unit can set an OEM’s medical device apart. There are several ways to enhance the appearance of a case including:

- bezels
- paint
- silkscreen

- swivel handle
- rounded corners
- aesthetic construction

Aesthetic construction means design to minimize unsightly parts of the enclosure. For example, screws can be placed in hard-to-see locations, or the enclosure can be indented where the screws are placed to maintain a flat surface. Also, cover panels and bezels can hide these areas as well as add to the appearance of the chassis in their own right.

Assembly – Saving time

One very important area of packaging for instrument cases is the assembly time. Assembly is a variable cost – and not something that should be overlooked. There are many ways to save time. First, a mounting panel can be used to attach the PCB. This prevents the OEM from having to drill into the bottom of the enclosure. The mounting panel easily mounts into the bottom of the enclosure and sits up about ¼ inch off of the enclosure floor – allowing clearance for nuts, bolts, etc. For quick assembly time, the PCB can be mounted to the mounting panel outside of the enclosure. Assembled outside of the case, the solution provides easy access and less assembly time. Once complete, the case has sidewalls with grooves, so boards can slide directly into the enclosure, without further mounting or customization. Further, the PCB can be mounted to the front panel during assembly. This provides an extra secure mount and saves even more time. Therefore, all types of components (fans, power supplies, tubes, etc) can be mounted without customization and with less assembly time. Further, the T-shaped grooves can allow grounding terminals to be placed. This provides a quick and convenient way to have a secure connection to ground.

Less Effort, Cost, and Risk

An extrusion-based solution will typically be a much more attractive enclosure. The finely machined parts and aesthetics of the design often have a cleaner, more professional look than simple stamped sheet metal. Overall, these modular design techniques limit the effort, cost and risk of customization. In high volumes, many of these costs can be overcome. However, a modular design allows customization to be more cost-effective during prototyping and lower volumes.