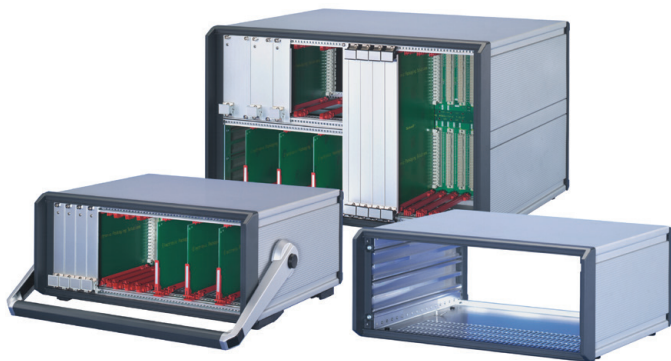


REQUIREMENTS AND SELECTION CRITERIA



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1. DEFINING YOUR AREA OF APPLICATION

Cases are used to contain 19" printed circuit boards and plug-in units in accordance with the 19" standard (IEC 60297-3-101 ff), as well as non-standardized assemblies. They be used as desktop and tabletop cases, or portable cases with a handle, and can also be fitted into 19" cabinets with the corresponding 19" brackets. Depending on the area of application and the prevailing local environmental conditions, they are required to have certain characteristics. When used as a desktop or portable case, they should be made from special light-weight materials, such as aluminum. This material is low in weight, yet at the same time it is incredibly sturdy. For portable usage, special extensions and accessory parts, such as a cable winder for the mains cable or carrying handles, must be available. Design is also a crucial aspect in some areas of application; an optimized EMC concept with high-performance shielding is often indispensable. In other areas of application, the emphasis is on high resistance to shock and vibration or optimized heat dissipation.

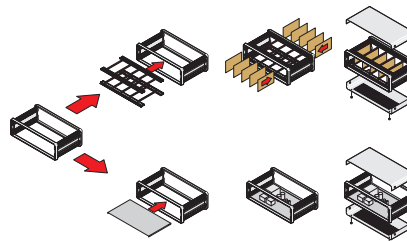


Figure 1: A case for housing euroboards and for customized extension with non-standardized assemblies

2. SPECIFYING DIMENSIONS

The dimensions of the cases are determined both by the size and type of the electronics assemblies to be installed and by the specifications and spatial limitations at the installation site. If the electronic components are not standardized – for example, non-standardized printed circuit boards, heavy transformers, etc. – being able to securely fit these assemblies into the case is essential. In these cases, a chassis or mounting plate, on which the non-standardized components are mounted, is normally put to use.

In an ideal scenario, 19" standardized products are used because they reduce development times, tooling costs, and the need to keep stock of specific components. Typical standardized cases are available on the market in both 3 U and 6 U (unit: 1 U = 1¾ inches). The majority of the printed circuit boards and plug-in units used today are designed with a size of 3 U (euroboard format). This is due to an ongoing trend of miniaturization. This trend is leading to increased use of DC or AC blowers, which is important for actively cooling the boards. Intelligent, speed-controlled blowers controlled by the system management are normally put in place to reduce the noise level during operation.

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The use of cases whose dimensions do not conform to the 19" standard is also on the rise. In these smaller cases, single-board computers according to standards such as embeddedNUC or Mini-ITX are installed. It was not until spring 2015 that SGET (Standardization Group for Embedded Technologies: www.sget.org) published a new case specification for the installation of boards in embeddedNUC format. With these cases, a method of heat dissipation without blowers is generally required.

3. CONSIDERING DESIGN SPECIFICATIONS

The design of a case has become a very important aspect that needs to be considered for many areas of application. Since user applications typically have a service life of up to 10 years, the design of the case should be both modern and timeless. Another key aspect is a customized color scheme, which is tailor-made to suit the corporate design of the customer, enhancing the value of brand recognition. Finding a universal case on the market which caters to both the functionality and design preferences of every customer is almost impossible. It is therefore beneficial when case manufacturers can offer different ranges of cases that can be equipped with the same extension parts, yet can allow variation in design and sometimes even in functionality. This guarantees that users will find precisely the right case for their area of application.



Figure 2: Case ranges to meet various design and functionality requirements

The case front, which is normally always visible, offers a variety of options for customizing the design of cases. As well as functional labeling, front panels made from aluminum or plastic can also be printed with colorful logos and photo-realistic images. Smaller cases, such as for single-board computers, often have printing over the entire surface in order to create a personalized customer design.

4. CONSIDERING STANDARDS AND SPECIFICATIONS

Depending on the area of application, certain international and/or market-specific standards and specifications must be observed. Current standards contain additional dimension specifications (IEC 60297-1, IEC 60297-2, IEC 60297-3-101, IEC 60297-3-102, IEC 60297-3-103, IEC 61969-2-1, IEC 61969-2-2, IEC 60917-2-X) and – at a higher level – criteria for physical integration (IEC 61587-1, IEC 61969-3), earthquake resistance (IEC 61587-2), electromagnetic compatibility (IEC 61587-3), and thermal management (IEC 62194 Ed.1).

In addition, certain applications require consideration of specifications from various organizations, such as VME from VITA (VME International Trade Association) or CompactPCI, CompactPCI Serial, MicroTCA, and AdvancedTCA from PICMG

(PCI- International Computer Manufacturing Group), as well as embeddedNUC™ version 1 from SGET (Standardization Group for Embedded Technologies). The fields of rail or military technology also require compliance with particular standards and directives; for example, special welding certifications (EN 15085), environmental tests (EN 50155) for rail technology, and shock/vibration tests (MIL 901D) for the navy.

Special protection and safety standards also apply to all cases equally. All conductive elements of a case that come into contact with dangerous voltages must be grounded and tested to IEC 61010-1. There must be no sharp edges on which you could injure yourself. The design and materials used for the case must also be properly selected to avoid the risk of fire. Plastics should conform to the self-extinguishing class as per UL 94 V 0 to V 2, tested to IEC 60707. Owing to toxic additives that are found in materials of the higher self-extinguishing classes, ISO 14000 should also be observed. The base and top cover of the case must be designed in such a way that prevents burning material from seeping into other areas. IEC 60950 specifies, for example, the design requirements for ventilation holes on the bottom side of the case. The specifications for the appropriate IP protection class of the case (protection against ingress of dust and water, and for the protection of persons) are laid out in IEC 60529. The IP protection class designation contains two digits. The first of these specifies the protection level against foreign bodies (from contact by fingers to the ingress of dust) and the second indicates the protection against the ingress of water.

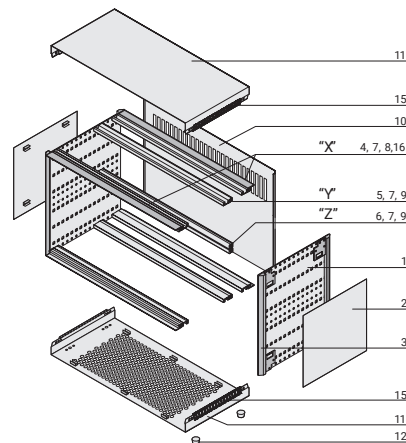


Figure 3: RatiopacPRO case assembled from standard components: 1 – top cover and base plate, 2 – rear panel, 3 – horizontal rail, 4 – side panel, 5 – side plate

5. DEFINING STATIC AND DYNAMIC LOADS

Cases are subjected to various loads. Whether it is a tabletop/desktop case or fitted into a cabinet, the static loads applied are mainly a result of the weight of the installed components. The material of the case is of paramount importance here, and the results will vary depending on whether it is glued, welded, or bolted together, or exists as a one-piece unit. It may also be necessary to fit additional reinforcements or stiffening elements.

If the case is intended for portable use, varying dynamic loads should also generally be taken into account. In measurement, instrumentation, and control applications, where these cases are

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the preferred choice, the requirements for shock and vibration resistance are generally not particularly high (up to 0 or 3 g). Moreover, there are installation locations, e.g., close to rotating machines, in rail applications or traffic technology, or on ships and airplanes, where the effects of shock and vibration are significantly greater. If the installation site is in an earthquake zone, appropriate seismic tests must be carried out in all cases prior to installation.

6. CLARIFYING THE NEED FOR ELECTROMAGNETIC SHIELDING

Depending on the application and environment, electronic devices may need to be equipped with EMC shielding. Due to the increased use of microprocessors with high clock frequencies, the importance of EMC protection is rising steadily. The possibility of retrofitting this EMC protection is therefore ideal.

Shielding does not only concern high-frequency factors; it is also designed to cover electrostatic discharge issues and include low-frequency capacitive or inductive coupling and cable-related faults, as well as high-frequency electromagnetic interference. Side, top, and base elements and the rear and front panels of cases should therefore be finished with a conductive surface (passivated, etc.) and linked conductively to one another by means of contacts such as stainless-steel spring or textile EMC gaskets. Particularly in the front area of the case, if many plug-in units with separate front panels are used, narrow slots will appear, which must be sealed appropriately to achieve optimum EMC shielding. Depending on the shape of the front panels, stainless-steel spring or textile EMC gaskets are also used for this purpose.

In applications that require an extended temperature range from -40 °C to +85 °C, only stainless-steel spring gaskets could be used for EMC shielding previously. However, the first high temperature-resistant, textile EMC gasket has now become available on the market. Compared to stainless-steel gaskets, textile gaskets are considerably cheaper and easier to use.

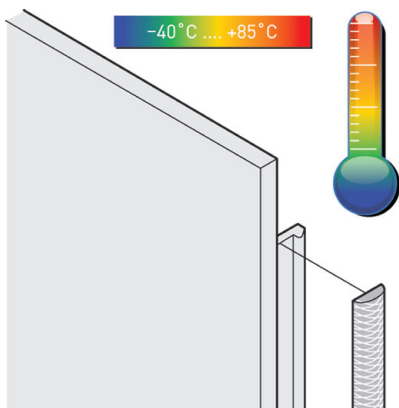


Figure 4: Textile EMC gasket for temperatures from -40 °C to +85 °C

Standardized EMC tests (VG 95373-15) are applied to determine whether the EMC measures adopted are sufficient for the desired application. The IEC 61587 environmental standard also defines tests for the EMC behavior of cases. Section 3 of IEC 61587 defines the test conditions for cases with respect to their EMC shielding properties in the frequency range from 30 MHz to 2 GHz and the attenuation values required. In this respect,

the standard is based primarily on IEC 60297 and IEC 60917. Defining various shielding efficiencies should further aid the user in selecting the appropriate case on the basis of reference values. Importantly, the standard is limited to the mechanics of the electronic devices only. Other standards apply to the end products – the complete, fully functioning devices. The appropriate tests are carried out by the device manufacturer and at commissioned testing facilities.

7. CONSIDERING TEMPERATURE CONDITIONS AT THE INSTALLATION SITE

Since cases are installed into suitable electronics or electrical cabinets in some applications, they are normally protected from environmental influences such as dirt, dust, and water. Even high-end ambient temperatures do not present a critical problem because the components installed into the case can be cooled either by heat dissipation or by air-conditioning the entire cabinet.

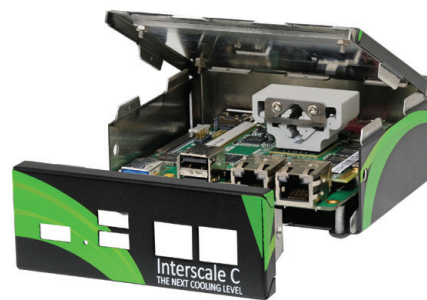


Figure 5: SCHROFF FHC (Flexible Heat Conductor)

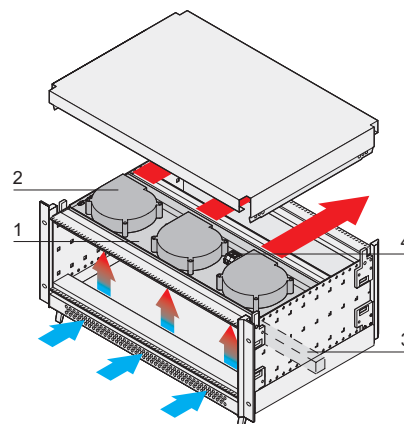


Figure 6: RatiopacPRO Air – heat dissipation already integrated

If the cases are used portably, or as desktop or tabletop cases, optimum heat dissipation must be ensured if the ambient temperatures are higher. In most cases, the type of cooling is selected on two key criteria: the rate of dissipation loss by the installed components, and the ambient temperatures at the installation site. Optimized air cooling is generally sufficient. Depending on the heat dissipation rate, the components' own built-in fans may be supplemented by external blowers or integrated with entire fan trays. Some cases can also be equipped with special blower front or rear panels, or are available in special heat-dissipation models. For more complex VMEbus, CompactPCI, MicroTCA, and advanced systems, guidelines for cooling are also supplied in the relevant specifications.

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For smaller cases not designed to the 19" standard, such as those used for single-board computers, heat dissipation without blowers is either preferred or required. For this purpose, there are various products on the market which can dissipate the heat from the processor to the case via solid metal bodies, attached heat pads, or thermal paste. Components known as FHCs (Flexible Heat Conductors) have also recently become available. These are made from aluminum, which boasts superior heat conductivity properties, and have a height-adjustable design. They ensure that processors of various heights can be kept in continuous contact, meaning that height tolerances are no longer significant. This is made possible by a heat conductor consisting of two interlocking sections – one of which is in contact with the heat-emitting component (the processor) and the other is adjusted vertically in relation to the first section. Between the two sections is a spring, which presses the upper section up against the interior of the case cover. The dissipated heat is reliably transferred away from the source and into the environment through the case surface by means of thermal radiation.

It is often helpful – and unavoidable nowadays – to use special software to simulate heat generation and heat flow through an electronics case or cabinet. In the capable hands of an experienced specialist, the simulation software delivers results which not only guarantee optimum heat dissipation, but also allow you to use the space efficiently. For an electronics system to be developed to a professional standard, it is essential that the calculations specialist meets with and advises the developers during the planning phase and performs all necessary calculations.

8. OTHER SERVICES FOR SUPPORT DURING PRODUCT CONFIGURATION AND SELECTION

In addition to their products, many manufacturers offer their customers a diverse array of accompanying services. Interactive configurators enable customers to assemble customized cases online. A continuous compatibility checker prevents errors when selecting components. Individual parts, for example, can also be modified with cutouts or drill holes. You can download 3D CAD data from the TraceParts online platform for this purpose. Hardware developers can choose from 32 different native CAD data formats, which can then be used directly in their CAD programs. Additionally, the 3D perspectives of the products can also be downloaded as PDF files, either for user documentation or simply even for visual reference if they do not yet have a CAD system or CAD viewer. Using this platform, users can also get an instant request for quote on a selected product and request the products they are interested in from the manufacturer's download basket.



Figure 7: Downloading 3D CAD data free of charge from TraceParts

Additional services such as the provision of digital user manuals and test reports free of charge, the delivery of fully assembled cases, and the option of modifying standard products to customer requirements without the huge costs, are factors which should be taken into account when choosing a product. Some manufacturers support and offer guidance to their customers throughout the entire product lifecycle: from configuration and ordering, to delivery, and eventually recycling. This also includes services such as free delivery to the point of use in environmentally friendly cardboard packaging, commissioning, warranty extensions, maintenance, repair, replacement parts, and upgrading. An environmentally sustainable recycling process at the end of a product's lifecycle rounds off the possible services.

9. INTEGRATING ADDITIONAL COMPONENTS, SUCH AS CABLING, BACKPLANES, PSU

Customers are increasingly asking not just for the standard case mechanics, but also for the integration of additional components. This also includes the installation of electromechanical and electronic components such as cabling, switches, backplanes, power supply units, monitoring units, and the like. These components can either be supplied by the customers themselves or purchased and assembled via the case manufacturer according to the specifications submitted. Some case manufacturers are also developers and manufacturers of backplanes and power supply units, so they are able to offer multiple products which are fine-tuned to each other, and which are tested by in-house laboratories.

10. EASY TO ASSEMBLE OR FULLY ASSEMBLED ALREADY

Another important aspect when choosing a case is ease of assembly. Customers can generally have their selected case delivered either in kit form – that is, in parts – or fully assembled. When being delivered in parts, it is important that the case is easy to assemble. This should be possible without the need for a costly, specialized tool. Ideally, only one assembly tool should be necessary to assemble the entire mechanics system. Assembly instructions that are clear and easy to understand help to make the assembly process as short as possible.



Figure 8: Case kit supplied as a flatpack to save space during delivery and storage

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11. SUMMARY

Depending on the application, certain conditions must be considered before selecting a case. If these are clearly defined, you can begin searching for a case with the appropriate features. The selection is made easier by opting for a flexible platform product that can be modified to suit the requirements of the customer, the application, and the environmental conditions at the installation site. Thanks to the modular structure of these products, customized cases can be configured which will meet your requirements in terms of dimensions, static/dynamic loads, or internal configuration.

12. ABOUT NVENT

At nVent, we believe that safer systems ensure a more secure world. We connect and protect our customers with inventive electrical solutions. nVent is a \$2.1 billion global company that provides enclosures, electric heat tracing solutions, complete heat management systems, and electrical and fastening solutions. nVent employs 9,000 people worldwide.

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AUTHOR

Dipl. Wirt. Ing. (FH) Martin Traut studied industrial engineering at the Karlsruhe University of Applied Sciences. Since 1990, he has acted as product manager for various nVent products at its Straubenhardt facility. In 2000, he took over as project manager for the Subracks / Chassis division.

In 2004, his remit was expanded to include the Integrated Systems (CompactPCI, VME, AdvancedTCA) product division, where he had a significant impact on the design of the product platforms. In the middle of 2013, he assumed the role of global Product Lifecycle Manager, in which he provided support for product launches and phase-outs across all product divisions.

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