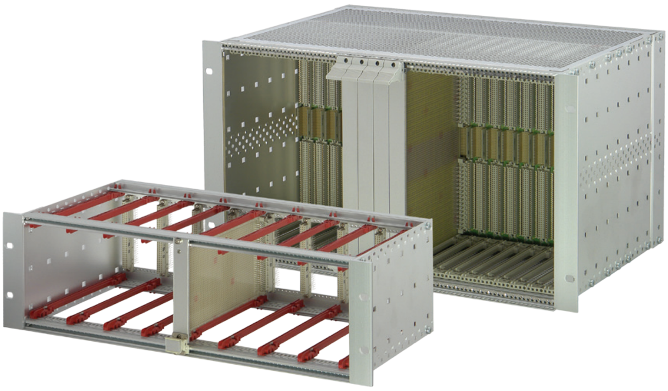
Subracks

REQUIREMENTS, SELECTION CRITERIA
AND OPTIONS FOR ADAPTATION



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1. INTRODUCTION: AREAS OF APPLICATION

Subracks hold printed circuit boards and plug-in units and conform to the 19” standard (IEC 60297 3 101 ff). Versions with a width of 84 HP can be assembled into standard 19” electronics cabinets. Different areas of application and the environmental conditions associated with them place different requirements on these subracks, such as particular shock and vibration resistance levels, optimized heat dissipation, electromagnetic shielding, and many other aspects.

Fig.: 19” subrack installed in a 19” electronics cabinet

2. WHAT DIMENSIONS SHOULD THE SUBRACK HAVE?

The dimensions of subracks are determined by the size and type of the electronics assemblies to be housed. Also, by specifications or restrictions determined by the place of operation. Where ‘non-standardized’ electronics components are concerned, such as non-standardized printed circuit boards (PCBs), etc., it is important to ensure that the internal configuration of the subrack can accommodate such non-standardized components. If the electronics assemblies are not too large, frame type plug-in units can provide relatively compact solutions that can then in turn be built into standardized subracks or cases. The external dimensions of frame type plug-in units are 19”-compatible and internally they can accommodate both standardized and non-standardized electronics components. If, however, the components to be installed are themselves 19”-compatible, the final configuration is simplified . Non-standardized boards or components can also be installed into a chassis or mounting plate within the subrack.

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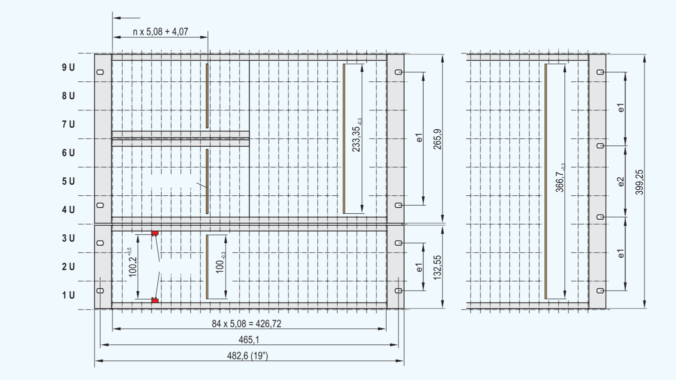

Fig.: Dimensions of a subrack as per IEC 60297-3-101 and IEEE 1101.1/.10/.11 (1 U = 1¾ inches = 44.45 mm)

In general, off-the-shelf, standardized products should be used where possible, e.g., those that conform to the 19” standard, as a wide range of solutions are available based on these standards. Making use of off-the-shelf products saves the user development time, tooling costs, and the need to keep stock of specific components. Typical dimensions are 3 U and 6 U (height units: 1 U = 1¾ inches). Due to the continuing miniaturization of components and the ever greater level of integration, today more than 70% of standardized boards are produced in the 3 U (Euroboard) format. This is resulting in a trend toward reduced heights in subrack dimensions. A further trend is an increased use of active cooling of the boards with high heat dissipation losses using DC or AC blowers. To reduce the noise level during operation, intelligent blowers are in increasing use that are controlled via the system management.

The location in which the system is finally installed also has an influence on the subrack dimensions. Often the space available for installation – e.g., on ships or other vehicles or in data centers – may be very limited, so the relevant specifications must be observed. These are the framework conditions from which the initial decisions and options can be obtained with regard to the subrack to be used.

3.WHICH STANDARDS AND SPECIFICATIONS MUST BE OBSERVED?

Depending on the area of application, certain international and/or market-specific standards and specifications must be adhered to. 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).

The ETS standards were created by ETSI (the European Telecommunication Standardization Institute). ETS standards are closely related to IEC standards, particularly in respect of European telecommunications systems.

In addition to IEC standards, there are specifications for applications that are required for special market sectors. Examples are VME from VITA (VME International Trade Association) and CompactPCI, MicroTCA, and AdvancedTCA from PICMG (PCI International Computer Manufacturing Group). In addition, there are special standards and guidelines for applications in railroad or military technology, such as special welding certifications (EN 15085), environmental tests (EN 50155) for railroad systems and shock and vibration testing (MIL 901D) for the navy, etc.

Additionally, special protection and safety standards must be taken into consideration. All conductive elements of a mechanical subrack that are capable of coming into contact with dangerous voltages must be grounded and tested to IEC 61010-1. The mechanical components of an assembly system should be free of sharp edges to prevent injury. Assemblies that generate heat and that are accessible to the user must be built into an enclosure or shielded. The design and materials used for a subrack 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 exterior of an assembly system must be designed in such a way that no flammable materials can seep into other areas such as a cabinet. IEC 60950 specifies, for example, the design requirements for ventilation holes on the cladding underside.

IEC 60529 determines the IP protection classes against the ingress of dust or water and for the protection of persons from hazards inside the subrack. 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.

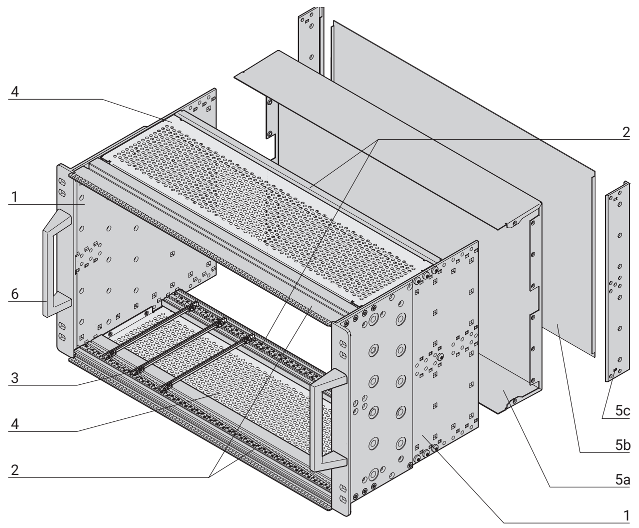

Fig.: Assembled from off-the-shelf components:
1 – Side panel, 2 – Horizontal rail, 3 – Guide rails, 4 – Cover plates, 5 – Front/rear, 6 – Handles

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4. WHAT ENVIRONMENTAL CONDITIONS ARE PRESENT AT THE INSTALLATION SITE?

Since subracks are usually installed into suitable electronics or electrical cabinets, this normally protects them from environmental influences such as dirt, dust, and water. Other important criteria in selecting a subrack are the physical forces acting on it and the level of electromagnetic shielding required.

In measurement, instrumentation, and control systems the requirements for shock and vibration resistance are generally not particularly high (up to 0 or 3 g). For applications that range from traffic light control and industrial machine control systems right through to measurement systems for research or in ring accelerators, simple subracks are usually sufficient. Often no EMC shielding is required, as this is provided, for example, by the cabinet in which the subrack is installed . If high deflection forces are expected due to the width of the unit and due to heavy installed components, more robust designs are required.

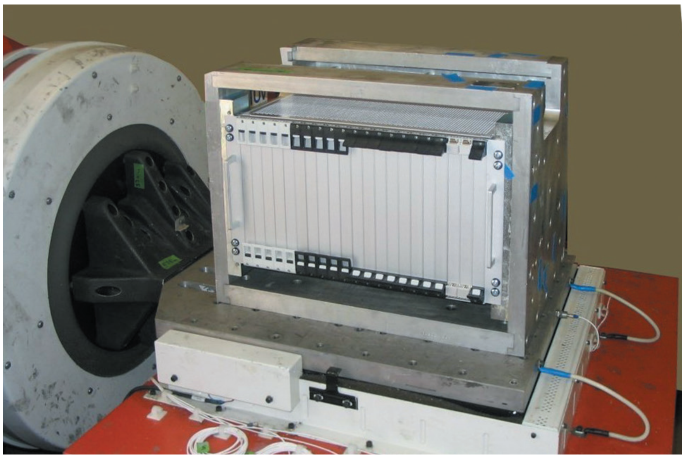

Fig.: Shock and vibration test to MIL 810G and IEC 61587-1, requirement classes DL2 and DL3

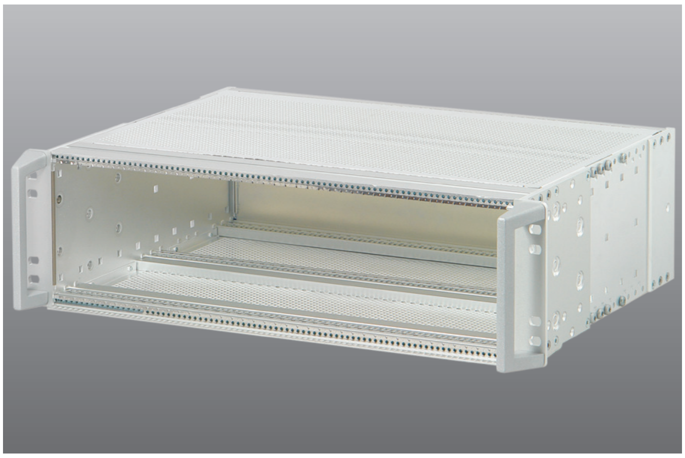

Fig.: SCHROFF europacPRO subrack type R, 'Rugged', offering shock and vibration resistance up to 25g

Subracks for infrastructure applications, e.g., in passenger information or entertainment systems in railroad systems, on buses or aircrafts, or as controllers for loading ramps, etc., must in some situations offer shock and vibration resistances of > 5 up to 25g. Loads of this kind also occur predominantly in defense systems, e.g., in controllers for target acquisition devices on ships. This type of particularly robust subrack is also used in the field of power generation for wind turbine control systems. In this application, the subrack is mounted in the gondola of the windmill and is subjected to similarly high shock and vibration effects. For these applications, the PCBs mounted in the subracks are additionally secured using Card-Loks or Wedge-Loks.

5. WHAT STATIC AND DYNAMIC LOADS ARE PRESENT?

Static loads occur primarily as a result of the weight of the installed components. This determines the choice of, firstly, the materials used for the assembly system, and secondly, the method of construction – glued, welded, or as a one-piece unit. Depending on the application, it may also be necessary to fit additional reinforcements or stiffening elements. An important factor here is also whether the subrack will be moved or subjected to displacement or is designed specifically for mobile use. In such cases, it will also generally be subjected to varying dynamic loads. Such shock and vibration effects should also be taken into account for certain installation locations such as close to rotating machines, in railway or traffic installations, and on ships or aircrafts. If the installation site is in an earthquake zone, appropriate seismic tests must be carried out in all cases prior to installation.

6. IS ELECTROMAGNETIC SHIELDING REQUIRED?

The requirements for electromagnetic shielding of electronic devices varies with the application and the environment in which they are operated. This is not only in respect of high-frequency factors. Shielding is 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 subracks are therefore 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. Each point of cable entry must also be appropriately protected. Standardized EMC tests (VG95373 part 15) are used to establish whether the EMC shielding measures satisfy the requirements of a given application and to assure the reproducibility of this performance level.

The IEC 61587 environmental standard also defines tests for the EMC behavior of subracks. Section 3 of IEC 61587 defines the test conditions for subracks in respect of their EMC shielding properties in the frequency range from 30 MHz to 21 GHz and the attenuation values required. In this respect, the standard is based primarily on IEC 60297 and on IEC 60917. The defining of various shielding efficiencies should further aid the user in selecting the appropriate assembly system on the basis of reference values. To determine a given required level of shielding, the critical interference frequencies must be determined. These may either be generated by the electronics within, or may be outside influences that act on them.

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The standard applies solely to the mechanical structure for the electronic devices and not to the electronic devices themselves. Other standards apply to the end products. In most cases, the required test procedures for these differ significantly from those described in the standards mentioned above. Such tests are normally performed by the manufacturer of the finished system or are contracted to independent outside testing agencies.

7. SHOULD VISUAL FACTORS BE TAKEN INTO ACCOUNT?

The appearance of a subrack is determined primarily by its function and by the fact that it is generally installed in a cabinet. In such situations, the emphasis is clearly on functionality. The one part of the subrack for which visual design factors can and do also play a role is its front panel.

The front panels of a 19” subrack are individually designed and manufactured for each application. Standard blank panels are available on the market in various sizes and versions. But few users today have the facilities necessary to efficiently carry out the user specific machining and printing these panels typically require. For prototypes, pre-production, or small production runs, however, it is often essential to carry out the machining in just a few days so that any corrections or modifications can be made quickly. Some subrack manufacturers such as nVent offer this complete service with a wide range of front panels and plug-in units, mechanical modifications, a wide selection of accessories and the options of painting or multicolor printing (including digital) for front panels. This makes it simple for the customer to obtain an individual design for the front panel, e.g., by including a logo.

8. SHOULD COMPONENTS SUCH AS CABLING, BACKPLANE, AND PSU BE READY INTEGRATED?

In addition to the basic mechanical unit, customers are increasingly asking for further components to be integrated. At nVent, system integration includes electromechanical and electronic components such as EMC elements, cabling, switches, backplanes, power supply units, monitoring units, and cooling solutions, all in one subrack. As a result, users get a type of plug-and-play product for their 19” technology. nVent undertakes the entire project management and advises the customer from the initial specification and design, purchasing, prototype manufacture, testing, and checking right through to the actual product manufacture, including logistics and after-sales service.

Fig.: Front panel design to customer specifications: Single or multiple color (including digital) printing

9. IS THE SUBRACK EASY TO ASSEMBLE OR DOES IT COME FULLY ASSEMBLED?

Ease of construction should also not be overlooked in an assembly system. Normally, assembly systems can be supplied either in parts, i.e., as a kit, or fully assembled. In particular when supplied as individual parts, it must be ensured that the subrack is simple to assemble, without the need for costly special tools or large time investments because of instructions that are unclear or difficult to understand. It is desirable that the assembly of the entire mechanical structure of the subrack be carried out using a single tool.

10. SUMMARY

There are many factors to take into consideration when selecting a subrack for a given application. 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. Modular subracks of this type allow different products to be created on a unified basis and with different standardized components. They can be configured for varying requirements in respect of dimensions, static and dynamic loads such as shock and vibration resistance, electromagnetic interference shielding, and individual internal mounting options.

11. COMPANY PORTRAIT AND AUTHOR INFORMATION

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.

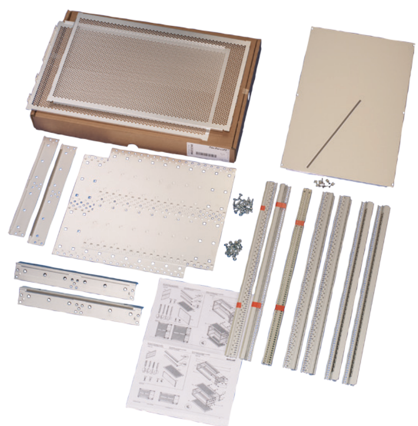

Fig.: Subrack kit supplied as a flatpack to save space during delivery and storage

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ABOUT ENCLOSURES

Electrical systems come in all shapes and sizes, from massive industrial controls to single components. nVent offers a comprehensive range of enclosures that house these vital assets. Marketed under the nVent HOFFMAN and SCHROFF brands, our enclosures offer two-pronged protection: safeguarding electrical equipment from the operating environment and people from electrical hazards. The nVent SCHROFF brand includes server cabinets, data center cooling solutions, power supplies and subracks and cases.

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 SCHROFF 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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