SUBRACKS
REQUIREMENTS, SELECTION CRITERIA AND OPTIONS FOR ADAPTATION

CONTENTS

1. INTRODUCTION: AREAS OF APPLICATION

Horizontal pitch (HP) is a unit of length used to measure the horizontal width of rack mounted electronic equipment with one HP being 0.2 inches wide, so a standard 19-inch rack is 95 HP wide. Subracks conforming to the 19-inch standard IEC 60297-3-101 hold printed circuit boards and plug-in units. 84 HP wide subracks can be built into 19-inch electronics cabinets. Different application areas and environmental conditions will determine requirements such as shock and vibration resistance, heat dissipation and electromagnetic shielding.

Illustration: 19-inch subrack installed in a 19-inch electronics cabinet

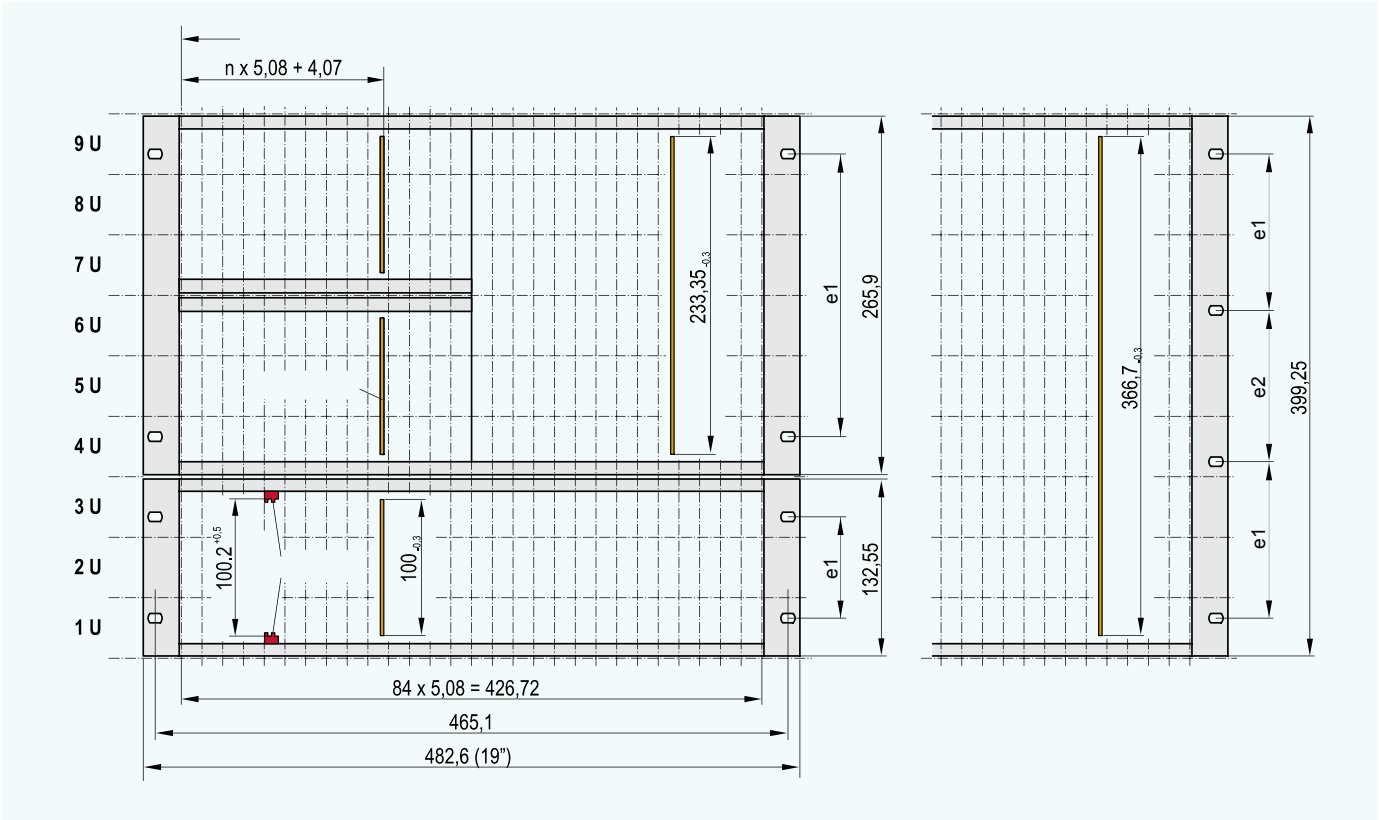

Illustration: Dimensions of a subrack as per IEC60297-3-101 and IEEE1101.1/.10/.11 (1 U = 1¾ inches = 44.45 mm)

2. WHAT DIMENSIONS SHOULD THE SUBRACK HAVE?

The size and type of the electronics assemblies to be housed determine the subrack dimensions, as do the specifications or restrictions determined by the place of operation. Where non-standard electronics components are used, such as custom-built printed circuit boards (PCBs), it is important to ensure that the internal configuration of the subrack can accommodate such components.

If the electronics assemblies are not too large, the use of frame type plug-in units might be appropriate, which in turn can be built into standard subracks or cases. The external dimensions of frame type plug-in units are 19-inch-compatible, and can accommodate both standard and non-standard electronics components internally. If however the components to be fitted are themselves 19-inch-compatible, boards or components can also be affixed to a chassis or mounting plate within the subrack.

In general, standard off-the-shelf products should be used where possible as a wide range of solutions based on the 19-inch standard is available. Making use of off-the-shelf products saves user development time, tooling costs and the need to keep stocks of particular components.

Vertical pitch is expressed in Eurocard format 'U' height units, where 1U measures 1.75 inches. Typical dimensions are 3U and 6U, and today more than 70 percent of standard boards are produced in the 3U format owing to the continued miniaturization of components and ever-greater integration, resulting in a trend to reduced subrack height dimensions. Another trend is the increased use of active cooling using DC or AC fans on boards with high heat dissipation losses. Intelligent fans controlled by system management software are increasingly used to reduce noise during operation.

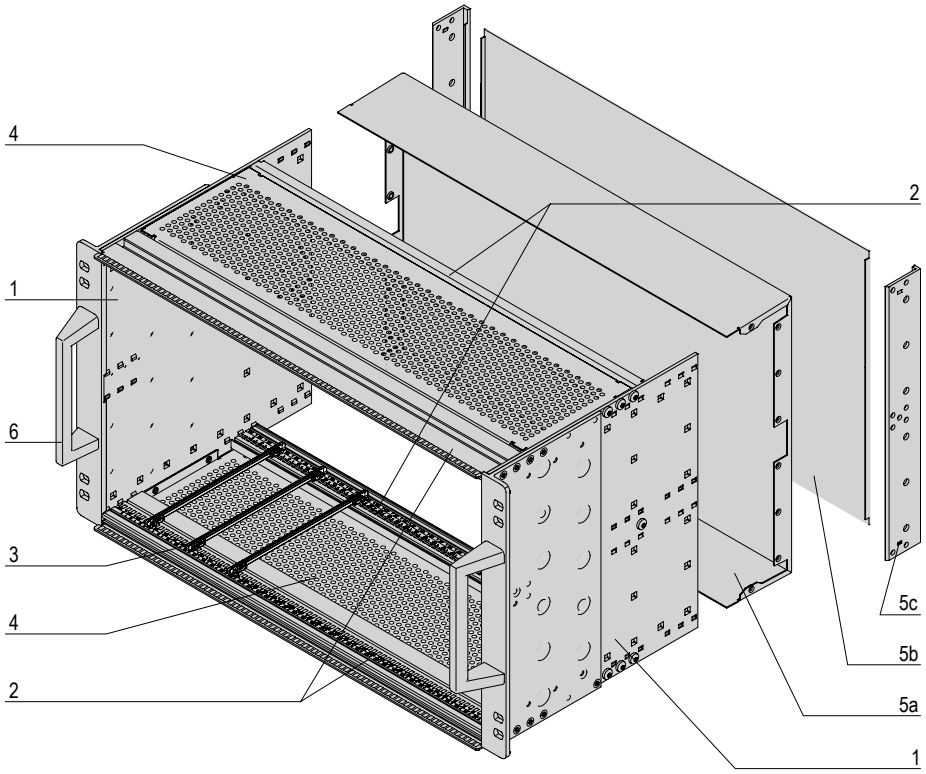

Illustration: Assembled from off-the-shelf components: 1 – Side panel, 2 – Horizontal rail, 3 – Guide rails, 4 – Cover plates, 5 – Front/rear, 6 – Handles

3. WHICH STANDARDS AND SPECIFICATIONS MUST BE OBSERVED?

Certain international and/or market-specific standards and specifications must be adhered to depending on the application area. Current standards such as 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, and IEC 60917-2-X contain additional dimension specifications, 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 issued by the European Telecommunications Standards Institute (ETSI) closely relate to IEC standards, particularly with respect to European telecommunications systems.

In addition to IEC standards there are specifications for applications that are required for special market sectors. Examples are the legacy VMEbus computer bus standard from the VME International Trade Association (VITA), as well as Peripheral Component Interconnect (PCI) from PCI International Computer Manufacturing Group (PICMG) and its contemporary variants: CompactPCI, Advanced Telecommunications Computing Architecture (AdvancedTCA) and MicroTCA.

There are also special standards and guidelines for railroad or military applications, such as special welding certifications (EN 15085), environmental tests (EN 50155) for rail systems and shock and vibration testing (MIL 901D) for marine applications.

Furthermore, special protection and safety standards must be taken into consideration. All conductive elements of a mechanical subrack that may come into contact with dangerous voltage 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 are accessible to users must be shielded or built into an enclosure. The materials used in a subrack design must also be selected in such a way that the risk of fire spreading is avoided. Plastics should conform to the self-extinguishing class as per UL 94 V-0 to V-2, tested to IEC 60707. The ISO 14000 Environmental Management Standard should also be observed owing to toxic additives that are found in materials of the higher self-extinguishing classes.

Assembly system cladding must be designed so that no flammable material can seep into other areas such as a cabinet. For example, the IEC 60950 standard for safety of information technology equipment specifies the design requirements for ventilation holes on the bottom of an enclosure.

IEC 60529 determines the ingress protection (IP) classes against dust or water ingress and for the protection of persons from hazards inside the subrack. The IP class designation contains two digits. The first of these specifies the protection level against foreign bodies from contact by fingers through to ingress of dust and the second indicates the protection against ingress of water. For example the number 6 in IP68 means that there is no dust ingress, while the number 8 means that the unit is protected against submersion under conditions specified by the manufacturer.

4. ENVIRONMENTAL CONDITIONS ARE PRESENT AT THE INSTALLATION SITE?

Since subracks are usually fitted into suitable electronics or electrical cabinets, this normally protects them from environmental conditions 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, typically up to 3g. Simple subracks are usually sufficient for applications ranging from traffic light control to industrial machine control systems, through to measurement systems for research or in particle ring accelerators.

Often no EMC shielding is required as this is provided by the cabinet in which the subrack is fitted. More robust designs are required if high deflection forces are expected owing to the width of the unit and due to the heavy weight of installed components.

Subracks must in some situations offer shock and vibration resistance up to 25g for infrastructure applications, for example in passenger information or entertainment systems, in railroad systems, on buses or aircraft, or in controllers for loading ramps. Loadings of this kind also occur predominantly in defense systems, in controllers for target acquisition devices on ships for example.

This type of particularly robust subrack is also used for wind turbine control systems in power generation, where the subrack is mounted in the gondola at the top of a wind turbine tower and is subjected to similarly high shock and vibration effects. For these uses the PCBs mounted in the subracks are additionally secured using proprietary locking mechanisms such as Card-Loks or Wedge-Loks.

Illustration: Schroff europacPRO subrack type R, 'Rugged', offering shock and vibration resistance up to 25 g

5. STATIC AND DYNAMIC LOADINGS ARE PRESENT?

Static loads occur primarily as a result of the weight of the installed components. This determines firstly the choice of materials used for the assembly system and secondly, the assembly method - glued, welded or one-piece unit. Depending on the application, it may also be necessary to fit additional reinforcement or stiffening elements.

An important factor here is also whether the subrack will be moved or displaced, or indeed if it 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 proximity to rotating machines, in railway or traffic installations and on ships or aircraft. If the system is to be located in an earthquake zone, appropriate seismic tests must be carried out prior to installation.

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

6. IS ELECTROMAGNETIC SHIELDING REQUIRED?

The requirement for electromagnetic shielding of electronic devices varies with the application and the environment in which they are operated. This is not only with respect to high-frequency emissions - 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 'passivated' conductive surface 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. Standard EMC tests (VG95373 part 15) are used to establish whether the EMC shielding measures satisfy the requirements of a given application and to assure reproducibility in performance.

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 with respect to their EMC shielding properties in the frequency range from 30MHz to 2GHz and the attenuation values required. In this respect the standard is based primarily on IEC 60297 and on IEC 60917.

The definition 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 that may either be generated by the electronics within or from outside influences that act on them.

It should be borne in mind that the standard applies solely to the mechanical structure for the electronic devices and not to the electronic devices themselves. Other standards apply to 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 out to testing bodies.

Illustration: Front panel design to customer specifications: single or multiple color (including digital) printing

7. SHOULD VISUAL FACTORS BE TAKEN INTO ACCOUNT?

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

The front panels of a 19-inch 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 machining and overprinting that these require.
Meanwhile for prototypes, pre-production, or small production runs it is often essential to carry out the machining in just a few days, so that any corrections or modifications can be made quickly.
Subrack manufacturers such as Pentair offer an all-round 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, for example by including a logo.

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

In addition to the basic mechanical unit, customers are increasingly asking for further components to be integrated. With Pentair, system integration includes electromechanical and electronic components such as EMC elements, cabling, switches, backplanes, power supply units, monitoring units and cooling solutions, all within the subrack.

The user thus obtains a form of 19-inch plug-and-play unit. Pentair undertakes the entire project management and advises the customer from the initial specification and design through purchase, prototype manufacture, testing and checking through to actual product manufacture, including logistics and after-sales service.

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

Ease of construction should not be overlooked in a system that requires assembly. Normally, packaging systems can be supplied either in parts as a kit or fully assembled. In particular when supplied as individual parts, the system must not need costly special tools or demand a large investment in time because instructions are unclear or difficult to understand. The assembly of the entire mechanical structure of the subrack should be carried out using a single tool.

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

10. SUMMARY

There are many factors to take into consideration when selecting a subrack for a given application. Selection is made easier by opting for a flexible product platform that can be modified to suit customer requirements, the application and the environmental conditions at the point of use. Modular subracks of this type allow different products to be created on a unified basis and with standard components. They can be configured for various requirements in respect of dimensions, static and dynamic loading levels such as shock and vibration resistance, electromagnetic interference shielding and individual internal mounting options.

11. COMPANY PORTRAIT AND AUTHOR INFORMATION

About Pentair Electronics Protection
Pentair's Electronics Protection platform offers worldwide standards-based solutions for housing and protecting electronics systems for the general electronics, infrastructure, communications, industrial, defense and medical markets. The Schroff brand offers a broad portfolio of products from basic printed circuit board (PCB) accessories, such as card retainers, conduction cooled frames, front panels and handles to subracks, cases, backplanes, power supplies, cabinets and pre-assembled chassis for embedded computing systems. For more information, visit **www.schroff.biz**.

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LINKS

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