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VEROTEC
Electronic Enclosures
A MEMBER OF POLYRACK

RUGGED SOLUTIONS

How electronic systems perform even under the harshest conditions

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INTRODUCTION

Extreme heat, freezing cold, intense vibrations, dust or water exposure—even under extreme conditions, electronic systems are used that people rely on to function smoothly. Furthermore, in these areas of application, operators often entrust their own lives to the systems. It must therefore be ensured that functionality is maintained without interruption.

For these areas of application, suppliers develop so-called **rugged solutions**—extremely robust solutions that are individually developed and produced for the respective application, the required specifications, and standards such as EN9100, RTCA DO-160, or MIL-STDs.

Together with Ahmet Taşseki, Head of Aerospace and Defense at POLYRACK TECH-GROUP and expert in the development of **rugged solutions**, we looked at the key factors that enable an electronic system to withstand extreme conditions.

POLYRACK is one of the leading providers of high-quality, customized system solutions for civil aviation, defense and security, and all fields in which harsh operating conditions require compliance with the most stringent standards.

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AREAS OF APPLICATION

Where are **rugged solutions** used? Anywhere where harsh conditions are expected. Specific main areas of application are:

- Air Transport Racks (ATR)
- Civil and military aviation
- Civil and military maritime transport (naval)
- Military land vehicles (tracked and wheeled vehicles)
- Other civil applications, such as rail transport

The following ATR types are relevant:

- Standard ARINC 404A (defense, partly civil)
- Standard ARINC 600 (civil, partly defense)
- Modified standard ARINC 404A
- Modified standard ARINC 600
- Customized solutions

STANDARDS AND NORMS

Standards and norms are a positive factor, as they ensure the compatibility of different elements or modules on the one hand, and essential features on the other, which are of great significance in the case of **rugged solutions**. The application of leading standards guarantees functionality under the required conditions.

The following are the most common standards for **rugged solutions** and their areas of application:

- **VITA:** Standards for the development and manufacture of embedded computer components in critical areas
- **VPX (VITA46):** Standards for connecting computer components (computer bus) in the military sector
- **ATR:** Standardized platform for complete systems
- **ARINC:** Standards for aircraft avionics, cabin systems, protocols, and interfaces
- **COM Express:** Form factor for integrated computers (Computer-on-Modules)
- **PC/104:** Standards for integrated computers and PC-compatible modules

FOR WHICH REQUIREMENTS IS AN ATR SYSTEM SUITABLE?

SELECTION CRITERIA FOR THE CHASSIS / SYSTEM

Environmental requirements

- MIL-STD-810
- DO-160
- Customer specifications:
  - Shock and vibration
  - Temperature
  - Operating altitude
  - IP rating
  - Corrosion protection
- MIL-STD-461 for EMC

System cooling

- CC conduction cooling → passive
- Active
- CC+active → hybrid cooling
- Liquid cooling

System performance depends on cooling system

- **Low**
  up to approx. 120W – passive
- **Medium**
  up to approx. 350W – active
- **High**
  from 350W – hybrid cooling

Cooling type definition

- CC / passive cooling for low system performance
- AC / active cooling for medium to high system performance
- CC+AC / hybrid cooling for medium to high system performance
- Liquid cooling for high to very high system performance
- Selection of cooling method in accordance with IP protection class

Chassis / System Design Applicable standards

- MIL-STD-810
- MIL-STD-704
- MIL-STD-1275
- MIL-STD-461
- MIL-STD-202
- MIL-STD-464
- VITA 46 / VPX
- VITA 65 / Open VPX
- VITA 48.2 / VPX-REDI
- VITA 62
- DO-160
- MIL-DTL-38999
- ARINC standard
- FED-STD-595B
- TL standards
- VG standards
- STANAG standards
- IPC-A-610
- IPC J-STD-001
- IEC standards
- IEEE standards

Space requirements

- Weight
- Specified ICD (Interface Control Documents)
  - Electrical
  - Mechanical

Definition of the platform

- Standard VITA
  - VPX
  - OpenVPX
  - SOSA™ - Sensors Open System Architecture (Definition of the platform)
- Customized

Board type

- CC – Conduction Cooled
- Customized

Chassis material

Milled individual plates made of aluminum alloy
- Screw solution
- Salt bath soldered
  - ALU 6061-T651
  - ALU 6082-T651

Sheet metal solution
- Screw solution
- Salt bath soldered
  - ALU 6061-T651
  - ALU 6082-T651
  - 5052-H32

ISO standards EN/AS 9100

Areas of application

- Land
- Air
- Water

IP protection class up to IP68

Surface treatment

- Powder coating
- Painting

ATR SYSTEM
with hybrid cooling for high heat dissipation requirements

ROBUST ¾-ATR TALL
High Power VME / ARINC 404A System

CONDUCTION-COOLED ½-ATR SYSTEM
for direct mounting

CUSTOMIZATION

As a rule, **rugged solutions** require a well-thought-out combination of a basis of standards and individual adaptation to the requirements of the specific application. However, completely customized developments are also possible.

Electronics integration

- High-speed signals
- High-power signals
- Wireless setup
- Cable connections (fiber optic, coax)

- Selection of connectors
  - External connectors
  - Internal connectors (BP, BP-IO board)

- PSU selection
  - Input voltage
  - Output voltages (board voltages)
  - Total power
  - Interface (VITA 62, customized)

- Selection of BP platform (VPX, OpenVPX, SOSA, customized)
- Fan control

- Fan selection
  - MIL-Spec fans
    - Altitude suitability
    - Certification (MIL-STD-810, DO-160)
    - Fan performance (volume flow)
- Chassis sealing
  - IP protection class
  - EMC protection

→ Use of conductive seals for external connectors and removable case parts (e.g., front panel, cover, and base plate, etc.)

Backplane design

- VPX
- OpenVPX
- SOSA
- Customized

IO-board design

- Selection of external connectors / round connectors
- Pluggable on the backplane
- Connectors for connection to the backplane

Thermal simulation

- Verification of cooling performance
- Calculation of system temperature / edge temperature
- Calculation of board temperatures
  - Optimization of heat sinks / system cooling

ATR tray design

- Selection of size
- Selection of front and rear hold-downs
- Selection of shock absorbers

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INTEGRATED CONCEPTS

Case, backplane, I/O board, cooling, display—all of the initially separate components of a **rugged solution** only become functional and powerful when they are combined into an integrated overall system. There are numerous interactions here that must be taken into account in the design process.

The built-in component not only serves a functional purpose, but also places demands on the backplane. This configuration defines, for example, the cooling design, and different cooling concepts require different amounts of space in the case. Even this simplified example shows that all components of the final overall solution must be included in the planning and design from the start in order to achieve a high-performance end product.

Individual panel solutions can be used to provide maximum ease of use even under the toughest conditions.

Production should also be planned from the very beginning.

It is therefore advisable to bring a holistic, full-service provider on board for projects where seamless integration is essential, so that you don't end up with individual solutions that are functional in themselves but do not work well together.

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CONCLUSION

In the area of rugged solutions, virtually anything that the application requires is technically possible. To ensure that the project is truly successful and that the end result is a high-performance end product that works in practice, well-thought-out, comprehensive planning and a great deal of experience are required.

The cooling concept in particular is often a key component that has a major impact not only on the success of the overall project, but also on the design of other components and production planning.

In addition, the project requirements must be met and the relevant standards implemented.

In this context, it is advisable to cooperate with a development and manufacturing partner who is open to solutions and technologies and who can support the entire project and all related sub-disciplines.

Do you have a new project, and would you like to discuss a possible production concept in person? The POLYRACK TECH-GROUP team of experts will be happy to provide you with a non-binding initial consultation.

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