**HIGH-AVAILABILITY MILITARY ROUTER-SWITCH**

POWERFUL, OPEN AND FLEXIBLE COTS L2/L3 MANAGED SWITCH WITH EDGE-COMPUTING CAPABILITIES

**NVS-MIL2004HSR**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tr>
<td>High-availability for mission-critical applications</td>
<td>HSR and PRP for zero-delay recovery time in case of network failure</td>
</tr>
<tr>
<td>Full IEEE1588 (PTP) support</td>
<td>Nano-second range time accuracy even over redundant networking paths</td>
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<tr>
<td>SW and HW microservices supported</td>
<td>Cutting edge multi-core CPU with FPGA to support user applications</td>
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<tr>
<td>Security-by-design</td>
<td>Multi-layered security to protect the system against heterogeneous threats</td>
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<tr>
<td>MIL-STD</td>
<td>1\textsuperscript{st} class military enclosure MIL-STD-461G MIL-STD-810G</td>
</tr>
<tr>
<td>Multiple media type</td>
<td>Copper and fiber based connections support</td>
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Overview

The NVS-MIL2004HSR is a COTS general purpose 20+5 port managed Gigabit Ethernet L2/L3 Switch that is packaged in a reliable, lightweight and compact MIL-STD-810G certified enclosure. A military compliant dual redundant power supply is fitted in full equipped versions to cover all applications and accept American & European standard AC/DC voltages for immediate worldwide operation.

Latest generation conduction-cooled electronics have been custom designed to fit enclosure mechanics and withstand harsh environments. The Router-Switch is fitted with a complete set of active auxiliary electronics and supervisory systems that are indispensable for next generation programs and provide increased payload safety, greater system control and easy integration.

Main Features

- Managed 20 port GbE L2/L3 Switch
- 4 port fiber optic links
- General purpose service Ethernet port
- Latest generation ARM Cortex hardware
- High-availability Seamless Redundancy (HSR)
- Parallel Redundancy Protocol (PRP)
- Precision Time Protocol (PTP)
- Multilayer management, security & monitoring
- Auxiliary RS232 console port
- Edge computing capabilities for user defined applications
- General purpose, PPS and IRIGb Input and Output available on auxiliary connector
- Sealed military enclosure cold plate cooled
- Dual redundant MIL-STD-704 AC/DC power supply
- System operation front panel LED indicators
- Optimized heat dissipation chassis design
- Real Time High/Low temperature monitoring
- Remote reset, battleshort & standby system control
- Dual oversized in-line EMI/EMC power Input filters
- Tested and certified by independent official laboratories per MIL-STD-810G & MIL-STD-461G
Key Benefits

Reliability

With NVS-MIL2004HSR, the mission reliability is enhanced thanks to the application of interoperable high-availability Ethernet solutions. Specifically, it supports the two only protocols able to ensure zero-delay recovery time in case of a network failure: High-availability Seamless Redundancy (HSR, IEC 62439-3 Clause 5) and Parallel Redundancy Protocol (PRP, IEC 62439-3 Clause 4).

HSR provides redundancy by sending packets in both directions through a ring network. A simple HSR network consists in Doubly Attached Bridging Nodes, each having two Ethernet ports. A HSR node sends the same frame over both ports, therefore even in fault scenario where the fiber optic is broken, no frame lost is ensured and the communication among all the nodes continues.

PRP redundancy is implemented in the nodes rather than in the network. Especially adapted nodes (Dual Attached Nodes – DANs) are connected to two independent and standard Ethernet networks (LAN A and LAN B) and send the same frames over both networks. The PRP operatives ensures the reception of all the information even if one the networks fails.

Cybersecurity

Security is a must for any military system susceptible to be used in field. NVS-MIL2004HSR is an smart router-switch designed following “security-by-design” approach to achieve the highest levels of protection. A multi-layered analysis and protection is required to cover security threats that may arise at integrated circuit, embedded device, network, vehicle and infrastructure levels.

The equipment supports hardware root-of-trust, firmware encryption, authentication and signature features. Additional security related integrated circuits, like TPM among others, allow secure equipment enrolments, certificates management and security real-time supervision against potential physical attacks.

From the networking point of view, NVS-MIL2004HSR supports state-of-the-art Layer 3 and higher secure communication protocols (like TLS, SSH, etc.) and the platform is ready to implement more specific secure networking solutions like full Layer 2 traffic protection or secure IEEE 1588 solution.

MIL-STD


Connectors: MIL-DTL-38999
AC/DC: MIL-STD-704F
Acoustic: MIL-STD-1474D
HF communications: MIL-STD-110F
Vehicle: MIL-STD-1275D
**Edge-computing**

The raw information collected from the heterogeneous sensors and actuators populated in the new military equipment demands distributed edge-computing capabilities to reduce and to enrich the data information finally communicated through the backbone network.

In order to offer a COTS solution able to support this edge-computing approach, NVS-MIL2004HSR integrates in a long term supply single integrated circuit an impressive computation capacity: 4x ARM Cortex-A53 and 2x Dual-core ARM Cortex-R5 CPUs, 1x Mali-400 MP2 GPU and high-end FPGA to support the advanced networking features offered by this equipment. The RAM memory on-board is a high-speed DDR4 memory while non-volatile memory demands are satisfied through a high-capacity device.

**Synchronization**

The key benefit of implementing Precise Time Protocol (PTP) or IEEE 1588-2008 is a similar accuracy level of synchronization that provides a GPS receiver, in a device connected to an Ethernet network. Being able of sharing the same nanosecond-range time reference in all the embedded systems of the vehicle, it is feasible ensuring sensor synchronization and event time-triggered operations.

NVS-MIL2004HSR implements a comprehensive solution for PTP. Apart from supporting the Transparent Clock operation, required for any 1588-aware switch, this equipment supports PTP over HSR/PRP, Ordinary Clock and Boundary Clock. This means that it is feasible configuring the NVS-MIL2004HSR as the PTP Master or Slave in the vehicle and in addition, using the Pulse-Per-Second output signal to provide a synchronized reference to any non-1588 device.

**Multiple media type support**

Both copper and fiber optic based connectivity are supported under 10/100/1000Base-T and 1000Base-SX Gigabit Ethernet standards.
Panel LED Indicators

<table>
<thead>
<tr>
<th>LED</th>
<th>NAME</th>
<th>COLOR</th>
<th>FUNCTION WHEN LED IS ILLUMINATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>PAYLOAD-POWER ON</td>
<td>GREEN</td>
<td>Indicates PSU output DC power is supplied OK and within voltage tolerances</td>
</tr>
<tr>
<td>BIT</td>
<td>BUILT-IN-TEST</td>
<td>GREEN</td>
<td>Indicates Router-Switch electronics has passed self test successfully (no fault detected)</td>
</tr>
<tr>
<td>PFM</td>
<td>POWER FAIL MONITOR</td>
<td>RED</td>
<td>Indicates Router-Switch external power input voltage falls below the minimum range</td>
</tr>
<tr>
<td>TSPW</td>
<td>TEMP SUPERVISOR ON</td>
<td>GREEN</td>
<td>Indicates the Temperature Supervisor Unit is DC powered (TSU is operational)</td>
</tr>
<tr>
<td>DTR_1</td>
<td>DATA TRAFFIC RING 1</td>
<td>YELLOW</td>
<td>Flashes when data transfer occurs in Communication Ports assigned to Ring 1</td>
</tr>
<tr>
<td>DTR_2</td>
<td>DATA TRAFFIC RING 2</td>
<td>YELLOW</td>
<td>Flashes when data transfer occurs in Communication Ports assigned to Ring 2</td>
</tr>
<tr>
<td>TSLO</td>
<td>LOW TEMP FAIL</td>
<td>RED</td>
<td>TSU indicates the system is operating below the Low Temperature threshold</td>
</tr>
<tr>
<td>TSHI</td>
<td>HIGH TEMP FAIL</td>
<td>RED</td>
<td>TSU indicates the system is operating above the High Temperature threshold</td>
</tr>
</tbody>
</table>

Eight front panel LED indicators inform the user of power input/output status, data transfer activity, payload electronics self test pass/fail, operational temperature compliance and standby mode (when the Router-Switch is remotely operated). This information serves during operation in-the-field, maintenance and software development.
Front Panel I/O

The NVS-MIL2004HSR Router-Switch implements standard MIL-38999 series connectors that are ideally suited for the broad spectrum of military applications.

Connectors J1-J5 support four 10/100/1000 BaseT Ethernet links each. Connectors OP1 and OP2 support two fiber optical links each.

A panel circular RJ45 rugged connector has been selected for the service Ethernet port.

A miscellaneous connector groups RS232 serial lines, GPIO signals, PPS and IRIGb timing outputs, Temperature Supervisory Unit standby control, system reset and battleshort functions.

A 5-pin power connector provides input voltage to the Router-Switch.

Connector Pinout Map
Router-Switch Versions & Features

The NVS-MIL2004HSR Router-Switch is precision engineered to satisfy the most demanding military programs. An ‘STANDARD’ version incorporates all the features that are common in the military rugged Switch market. A ‘PLUS’ improved version fits a wide set of extras that make it ideal for new generation critical systems.

When reliability and performance matter, version ‘PLUS’ includes a Dual Redundant PSU, Temperature Supervisory Unit, Cold Start-up Heaters, Double Capacitor Bank for extended hold up time, Front Panel LED Indicators, Remote Operation capability & Power Fail Monitor. This version is delivered within an extended fins enclosure that provides 30% greater self-dissipation capability.

Oversized in-line EMI/EMC filters
Low and High frequency filters are fitted for full MIL-STD-461G compliance. These filters have been selected-on-test (matched) in official labs for performance.

PSU Input protection
The Router-Switch dual PSU are reverse polarity protected, also fitting an inrush current and over voltage limiter.

DC/DC converters
Installed DC/DC converters provide over current and short circuit protection, input/output galvanic isolation, thermal protection and military temperature range.

Extended hold-up
An oversized set of hold-up capacitors are fitted to maintain Router-Switch circuitry DC voltages in the event of momentary power loss of the PSU input voltage.

Time delay fuses
Six military PCB fuses are fitted across the dual PSU modules in order to provide protection to the front end stage, DC/DC converters and TSU power electronics.

Power fail monitor
A power supervisory device continuously monitor the primary AC or DC Router-Switch PSU input power voltage and notifies the payload when power failure is imminent.

DC supervisor
The PSU DC output voltage is monitored via a micropower chip to ensure voltage level is within a specified tolerance. The monitor chip illuminates the panel ON green LED when payload voltage is in range.

PSU Faraday cavity
The internal Router-Switch layout incorporates an independent metallic partition for housing the PSU modules and in-line filters. This greatly reduces PSU heat and avoids electrical noise on payload electronics.

Dual Input diode
A dual diode with common cathode is installed on the rear of the front panel when the STD Router-Switch is ordered for redundant operation with two external batteries.

Router-Switch PSU specifications
- PSU operating temperature: -40° to +90°C
- PSU storage temperature: -50° to +120°C
- PSU DC/DC converter average efficiency: 89%
- PSU front-end module average efficiency: 99%
- DC/DC converter in-to-out galvanic isolation: 3000 Vrms
- DC/DC converter baseplate-to-out galvanic isolation: 500 Vrms
- DC PSU over-voltage transient suppression: 2.5x nominal 12.5 ms
- AC PSU over-voltage output surge suppression: 1Kv during 50 μs
- PSU DC power output ripple and noise: less than 30 mV RMS
Temperature Supervisor

A Temperature Supervisory Unit (TSU) is fitted in the NVS-MIL2004HSR ‘PLUS’ version. This device protects Router-Switch electronics against extreme climatic conditions, switching the power supplies OFF (standby) when the internal temperature is under or over the established limits. Users may set HI & LO temperature trip-points to regulate and optimize the system safety operational temperature range.

Heating elements are also fitted for mitigating against cold startups. An ‘early warning’ signal advises the digital electronics prior to shutdown-to-standby, allowing critical data to be orderly stored and saved. Router-Switch power is restored once internal temperatures are within operational limits. All functions can be user enabled or disabled by soldered bridges.

| Remote switches | External switches can control system PSU & TSU operation. Lines can be wired to a cockpit or to a master system. | Thermal monitoring | The High and Low TSU temperature trip points are user-adjustable through two multi-turn trimming resistors located in the power supply PCB. Factory presets fitted with fixed resistors can be installed in production series. |

### Battle Remote

| Switch OFF | Switch OFF | NORMAL OPERATION. Both PSU and TSU operate normally. |
| Switch OFF | Switch ON | PSU in STANDBY MODE. The PSU converters are forced to stand-by. No DC power is available to the digital payload. The TSU operates normally. |
| Switch ON | Switch OFF | BATTLE MODE (TSU DISABLED). The PSU is operating normally. The TSU is not allowed to shut down the system power regardless of temperature. |
| Switch ON | Switch ON | PSU in STANDBY MODE. The PSU converters are forced to stand-by. No DC power is available to the digital payload. The TSU is disabled. |

### Thermal heating elements

Resistive heating elements powered by the TSU are bolted to the enclosure frame in order raise internal temperatures during cold startups.

### Battle short switch

Ability to disable the TSU during an emergency or battle situations via the remote ‘Battle short’ switch. This bypasses and overrides all critical TSU functionalities despite the risk of payload temperature over-stress.

### Reset push button

A remote push button allows to RESET the Router-Switch digital payload without switching off the mains breaker. TSU remote operations can be manually activated by an operator or via a master computer.

### Delayed shut-down

An AC/DC FAIL* signal advises the Router-Switch CPU when power failure is imminent prior to power shut-down. Ethernet communications and critical data in memory, etc may be orderly stopped or saved.

### Front panel LEDs

TSU status and operations can be visualized in real time via three chassis front panel LEDs: TSPW (TSU power on), TSHI (system over temperature) and TSLO (system under temperature).

### TSU power supply

TSU circuitry is powered by an independent +5VTSU @ 2 Watt PSU. This module is permanently connected to the Router-Switch primary power input & remains operational during Standby.

### TSU power supply specifications

Provides +5VTSU DC output voltage, up to 2 Watts. Autorange input 80-265 VAC 20-1000 Hz. 7 mA typical. 28VDC 32mA, 48VDC 18mA, 270VDC 4mA typical (±40%). Output current short circuit protection in +5V_TSU: 400mA.

### TSU heater elements

- DC 12 VDC @ 3,3 Amps.
- DC 28 VDC @ 1,5 Amps.
- DC 48 VDC @ 0,8 Amps.
- DC 270 VDC @ 0,15 Amps.
- AC 115 VAC @ 0,3 Amps.
- AC 220 VAC @ 0,18 Amps.
Military PSU Input Options

The NVS-MIL2004HSR Router-Switch power supply unit is extremely versatile in order to cover the full range of system applications regardless of the available end platform primary (main) and secondary power voltage.

The three integrated high performance PSU blocks incorporate a range of features that are only available in latest generation advanced military systems.

When Router-Switch reliability is mission critical and faults are not tolerated, the ‘PLUS’ dual redundant PSU version ensures low stress load sharing for the twin DC/DC converters and mitigates the risk of an output power failure.

A wide variety of single or redundant AC/DC power input combinations are supported as standard to guarantee flawless operation in worst case scenarios.
1. - 1SDC
Suited for UAVs, light armored vehicles and mobile ground weapon or communication systems equipped with DC batteries.

2. - 1SAC
Ideal for Navy and Aircraft platforms fitted with 115 or 220VAC generators. This configuration is also suitable for laboratory and maintenance facilities.

3. - 2SDC
Ideal for military UAVs, mobile ground weapon systems and heavy armored vehicles fitting multiple DC battery banks that share a common ground.

4. - 2DRAC
Suitable for mission critical AC applications aboard Navy and Aircraft platforms that require dual redundancy, greater reliability and extended MTBF.

5. - 2DRACDC
Ideal for multi-role mission critical applications that require both AC and DC dual redundancy, greater reliability and extended MTBF.

6. - 2DRDC
For mission critical UAVs, ground systems and heavy armored vehicles that require full dual DC redundancy, greater reliability and extended MTBF.

7. - 1DRDC
For single battery mission critical UAVs, mobile weapon systems & light armored vehicles requiring dual redundancy, greater reliability & extended MTBF.

8. - 1DRAC
For single AC generator mission critical UAVs, Navy and Aircraft platforms requiring dual redundancy, greater reliability and extended MTBF.

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**PSU PART NUMBER EXAMPLES**

- 1 S 12VDC A-50W
- 1 S 115VAC B-75W
- 1 DR 12VDC C-100W
- 1 DR 28VDC D-150W
- 2 DR 12VDC 12VDC C-100W
- 2 DR 28VDC 220VAC D-150W
- 2 DR 115VAC 220VAC D-150W
- 2 DR 270VDC 48VDC D-150W
- 2 DR 115VAC 12VDC C-100W
- 2 DR 115VAC 28VDC D-150W
**Functional Overview**

**Ports Configuration**
- 4x 1000Base-SX fiber optic HSR/PRP port (other media options optional)
- 20x 10/100/1000Base-T copper ports

**Xilinx Zynq UltraScale + EG**
EG devices feature a quad-core ARM® Cortex-A53 platform running up to 1.5GHz. Combined with dual-core Cortex-R5 real-time processors, a Mali-400 MP2 graphics processing unit, and 16nm FinFET+ IEC 62439-3. EG devices have the specialized processing elements needed to excel in next generation Aerospace and Defense applications.

**RAM Memory**
- 16Gb DDR4 - 64-bit attached to processor subsystem

**HSR / PRP Technology**
- Reconfigurable Switch Architecture: flexible combination of low-latency HSR/PRP, L2 and L3 blocks

**Redundancy**
- IEC 62439-3 Clause 4 PRP "Parallel Redundancy Protocol"
- IEC 62439-3 Clause 5 HSR “High availability Seamless Redundancy”
- Optional IEC 62439-2 Media Redundancy Protocol (MRP)
- Optional Device Level Ring (DLR) Redundancy
- Optional IEEE 802.1w for RSTP (Rapid Spanning Tree Protocol)

**Layer 3 Functionalities (not applies to HSR/PRP ports)**
- IPv4/IPv6
- Multicast IP Routing
- IGMP Snooping
- DSCP TOS
- Dynamic Routing: BGPv4, BGPv6, OSPFv2, RIPv2
- Static routing

**Security**
- IEEE 802.1X access control: port & MAC based authentication
- MAC port binding & authentication for login security
- TACACS+, and RADIUS authentication
- Secure Shell (SSH) Protocol v2
- Internal Gyroscope and Accelerometer for security purposes
- TPM IC for identity authentication
- AES 256/HMAC/RSA 2048 encryption/authentication & signature for firmware and bitstream

**Telecontrol**
- Protocol SNMP V1/V2/V3

**Deterministic Ethernet**
- IEEE 1588 AS profile - TSN- supported (station & switches)

**Gateway**
- Optional CAN 2.0 integrated ports
- Optional RS-232/422/485 buses with Modbus / Profibus / Serial console

**Layer 2 General Functionalities**
- IEEE 802.3-2000
- Automatic MAC address learning and aging
- Static MAC Table
- Port-Based Virtual LANs (VLANs)
- IEEE 802.1Q for VLAN tagging
- IEEE 802.1Q for VLAN based Ethernet priorities
- Ethertype based switching
- IEEE 802.1p for Class of Service (CoS)
- IEEE 802.1ab for Link Layer Discovery Protocol (LLDP)
- Priority Modes: PCP (802.1p), Ethertype (Up to 16)
- Broadcast protection configurable via register
- Layer 2 multicast filtering
- Jumbo frame support
- IEEE 1588 StateLess TC (Transparent Clock)

**Synchronization**
- IEEE 1588v2 PTP "Precision Time Protocol" profiles with E2E mode and P2P mode of operation
- IEEE 1588v2 PTP "Precision Time Protocol" over HSR & PRP
- Optional Ordinary Clock & Boundary Clock mode of operation
- S(NTP) & Client

**Management and Monitoring**
- HTTPS WEB interface with secure firmware/bitstream update
- Graphic representation of Network status (HSR DANs & VDANs)
- Statistics independent per port
- SNMP RFC 1157/RFC 3411
- DHCP (Client and Server)
- ANSI C Low Level library
- System Syslog
- MIB support
- Console port

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**Diagram of Zynq UltraScale + EG**
- 4x ARM CORTEX –A53 (64BIT) Mail 400 MP2 GPU
- 2x ARM CORTEX-R5 Mail 1000 Base-T (other media options optional)
- 20x 10/100/1000Base-T copper ports
- HSR LOW-LATENCY BLOCK
- NON-BLOCKING L2 Switching Matrix & L3 Switching Device
- Nx Ultra-Low Latency VLAN L2 Switching port
- ZYNQ ULTRASCALE+ MPSOC
- Front Panel

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**Diagram of Reconfigurable Switch Architecture (RSA)**
- + Switch / Router Design
- Nx L2/L3 ports

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**Diagram of Functionalities**
- Interfaces and Protocols
- Security Features
- Management and Monitoring
- Telecontrol
Ordering Information

NVS-MIL2004HSR / PLUS / 2DR 28VDC 220VAC D-150W / B / E

System Version (STD or PLUS)
Primary Input Power
Secondary Input Power
PSU Output Power
Mounting (Base or Side or NAS622 or Legs)
Color (Black or Earth)

System Dimmensions

The NVS-MIL2004HSR Router-Switch is mounted as standard via six M4 bottom cover threads that provide secure attachment to the application vehicle base plate. Other mounting options are available upon request. These include side or rear panel fixings, protruding bottom cover legs, front NAS-622 hooks and self-clinching pilot pins, or other.

The enclosure has a self dissipation capacity up to 50W and is not dependent upon cold plate mounting. Cold plate installation is recommended to significantly improve thermal performance and decrease payload Delta-T by approximately 12-15°C. This will double the MTBF of the enclosed electronics.
About Us

We offer rugged computers in different form factors for all types of military applications, both standard and custom-designed. Our military systems and enclosures are designed for enduring high temperatures, shocks, vibrations and EMI standards, with architectures such as VPX, VME, CompactPCI, microTCA, Rack-mount or ATR. Our technical department offers additional services of consultancy, post-sale support and repair management. HPEC architectures (High Performance Embedded Computing) and System Certifications: MIL-810 F/G, MIL-STD-461E, MIL-STD-1275D, MIL-STD-704, DO-254, DO-178.

Certified solutions for military systems integrators:

- Last Generation Combat Systems
- Missile Control Systems
- Tactical Radar and Sonar for the Battlefield
- Military Router / Switch
- Mission Management Systems
- Military GPS
- UAVs
- C4ISR
- Marine Consoles
- Simulators

UNE EN ISO 9001 Certified

This international standard promotes the adoption of a process-based approach when a quality management system is developed, implemented and its effectiveness is improved, which is in turn based on the continuous improvement cycle PDCA (Plan, Do, Check, Act).

Benefits related to the market:

- Improve the image of the products and/or services offered.
- Promote its development and strengthen its position.
- Gain market share and access foreign markets thanks to the trust it generates among clients and consumers.

Benefits related to clients:

- Increased client satisfaction.
- Eliminate multiple audits with the corresponding costs saving.
- Access quality agreements reached with clients.

Benefits for the company’s management:

- Serve as a means for maintaining and improving the effectiveness and adaptation of the quality management system, when highlighting the points of improvement.
- Lay the foundations of quality management and encourage the company to implement a process of ongoing improvement.
- Increase the staff’s motivation and participation, as well as improve resource management.