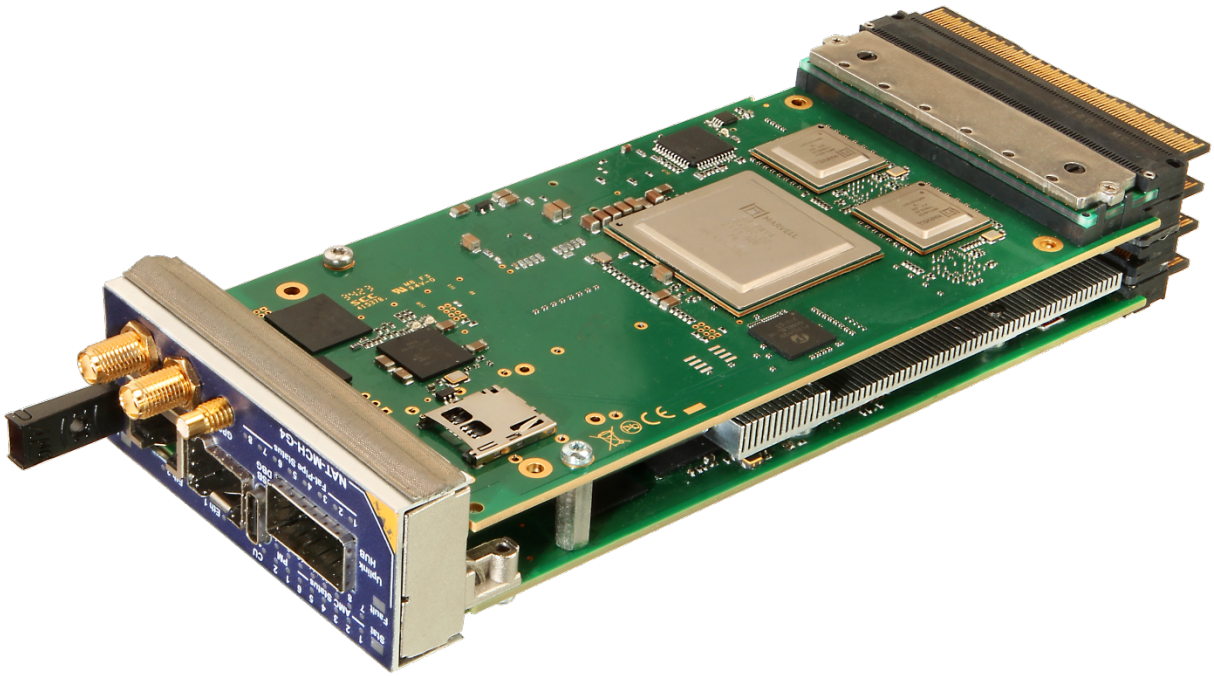
NAT-MCH-G4 - USER GUIDE

4TH GENERATION MTCA CARRIER HUB

DESIGNED BY N.A.T. GMBH



USER GUIDE V1.1

HW REVISION 1.X

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1. PREFACE

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Note:

The release of the Hardware Manual is related to a certain HW board revision given in the document title. For HW revisions earlier than the one given in the document title please contact N.A.T. for the corresponding older Hardware Manual release.

1.2. About the 4th Generation of the NAT-MCH

Throughout the past twenty years MicroTCA has proven to be a solid and mature standard for a lot of applications in many vertical markets.

Many of the MicroTCA systems used in these applications are based on N.A.T.'s 3rd generation NAT-MCH.

Its form, fit and function successor, the 4th generation of the **NAT-MCH-G4** is available now, being one of the market's most sophisticated MCHs.

Designed from scratch, the **NAT-MCH-G4** implements state-of-the art technology in terms of switching and management for MicroTCA system.

The **NAT-MCH-G4** not only incorporates top-of-the edge hardware components as FPGAs and switches, also its installed user interfaces such as the Command Line Interface and the Web Interface are based on leading technology.

The **NAT-MCH-G4** is an easy-to-use and handy management and switching controller for your MicroTCA system.

Team N.A.T. stands fully committed behind one of N.A.T.'s signatory products, which has served MicroTCA base applications for more than 20 years in various generations and variants.

1.3. About this Document

This document serves as a User's Guide for both the single-width **NAT-MCH-G4** and the double-width **NAT-MCH-S4** MicroTCA Carrier Hubs by N.A.T..

For detailed technical information please refer to the respective Technical Reference Manual.

The available Quick Start Guide provides basic start-up guidance.

As this document provides an overview of the functional capabilities of both the single-width **NAT-MCH-G4** and double-width **NAT-MCH-S4** MCHs, it refers to those functionalities common to both MCHs by just referencing the **NAT-MCH-G4** and explicitly references the **NAT-MCH-S4** only where it deviates from the NAT-MCH-G4**.**

This document is organized into the following sections:

Introduction

Abstract on the **NAT-MCH-G4** main functionalies, their components, and fields of applications

MTCA Basics

Short summary of MTCA basic functionality e.g. connectivity and power policy

Access to the NAT-MCH-G4

Quick overview on how to communicate with the **NAT-MCH-G4** and

Command Line Interface (CLI)

Detailed information about the Command Line Interface, the associated script language, and basic functionality

SSH Support

Detailed information on how to establish a secured connection to the **NAT-MCH-G4**

Web Interface

Short introduction to the **NAT-MCH-G4's** web interface

Specifications and Compliances

List of specifications, abbreviations, and datasheets of components referred to in this document, as well as standards, the **NAT-MCH-G4** complies to

Document's History

Revision record

Note:

It is assumed that the **NAT-MCH-G4** is handled by qualified personnel only!

2. INTRODUCTION

The fourth generation of MicroTCA Carrier Hub family is referenced by their base boards, the single-width **NAT-MCH-G4** and the double-width **NAT-MCH-S4.** Any NAT-MCH comprises of

- a base module, providing management, 1/10GbE switching for the so-called Base Fabric including fibre or copper uplinks
- an optional clock mezzanine for central clock distribution, providing optional support for PTP and White Rabbit as well as GPS synchronisation
- various optional so-called hub modules for Fat Pipe connectivity and uplinks. Depending on the chosen hub, it provides either up to 40GbE or PCIe Gen4 or Gen5 x8 links to the AMCs. Various uplink options (up to 100GbE or PCIe Gen4 x16) at the front panel offer a broad and flexible range of possible choices to connect the MCH to external networks.

Unlike the the single-width **NAT-MCH-G4**, the double-width **NAT-MCH-S4** provides optional support for a MCH Rear Transition Module (NAT-MCH-RTM), connected by PCIe x16 link.

2.1. Base Board Variants

Basically, the **NAT-MCH-G4** provides central management and data switching as well as power and system management for any MicroTCA system with up to 12 AMCs. Yet another AMC (aka "AMC #13") can be operated in the second MCH slot without Fat Pipe functionality. The **NAT-MCH-G4** supplies up to two front and two rear Cooling Units as well as up to four Power Modules.

The base Ethernet switch provides 1G/2.5G/10G Base Fabric connectivity to each AMC. Basically, the **NAT-MCH-G4** features two 1-10G Ethernet uplinks the front panel. Depending on the assembly option, the front uplink even provides up to 4x 25G. Please note, that these four ports cannot be combined to one port.

In a redundant MTCA system the secondary MCH connects to the primary MCH by another 25G Update Fabric. As this Update Fabric is provided by the base switch one can generate redundancy by adding an optional second MCH at any point in time without the need for any hardware modifications.

The **NAT-MCH-G4** comes in the form factor of a single-width, full-size AMC, compliant with the latest revision 3 of the MTCA.0 specification. For MTCA.4 systems, NAT offers the **NAT-MCH-S4**, a double-width, full-size MicroTCA Carrier Hub. Technically, it provides the same functionality as the single-width board but comes with optional RTM support and mounting space for NVMe / SSD memory devices.

Most information in this document is valid for both variants, so – unless otherwise specified – for reasons of clarity it is referred to the notation **"NAT-MCH-G4"** only.

2.2. Clock Distribution

In combination with an optional clock module, the **NAT-MCH-G4** offers several options of switching and manipulating clock signals.

There are two clock modules available:

- **NAT-MCH-G4-CLKP** featuring two low jitter clock multiplexers providing CLK1 and CLK2 to each AMC, whereas CLK3 provides a 100MHz spread spectrum PCIe reference clock.
- **NAT-MCH-G4-CLKT** featuring three low jitter clock multiplexers providing CLK1, CLK2 and CLK3 to each AMC.

Both clock module provide two SMA connectors at the front panel to feed an external CLK signal to the MCH or to extract a CLK generated in the system. The direction of each SMA connector is configurable, the maximum frequency limit (as per MTCA.0 spec) is 100MHz.

An optional GPS receiver with a dedicated SMC connector at the front panel to attach a GPS antenna allows to distribute a 10kHz or 1pps signal via either CLK1, CLK2 or CLK3.

More details are available in the NAT-MCH-G4 Clock Module User Manual.

2.3. Ethernet Fat Pipe Switching

Beyond the base Ethernet, the **NAT-MCH-G4-HUB-EX** module offers Fat Pipe Ethernet connections. It provides 10GbE (12 x4 lanes @ 2.5GbE) or 40GbE (12 x4 lanes @10GbE) per AMC. Alternatively, four x1 ports with 1-10G are available for each AMC. The link width to be used can be independently set for each AMC.

Moreover, the **NAT-MCH-G4-HUB-EX** owns a x4 MCH update channel @ 10G/40G to a secondary MCH in a redundant MTCA system.

A QSFP-DD uplink with 8x 1-25G can be operated as e.g., 2 x4@100GbE or 8 x1@25GbE. Please refer to section 2.5 for more information on the uplinks.

2.4. PCIe Fat Pipe Switching

The **NAT-MCH-G4** MicroTCA Carrier Hub family features two HUB modules for applications requiring PCIe Fat Pipe connectivity:

- The single-width **NAT-MCH-G4-HUB-Px52** can be operated on both base module variants. It provides PCIe Gen4 x4 switching to 12 AMCs as well as a QSFP-based PCIe Gen4 x4 uplink at the front panel. Please refer to section 2.5 for more information on the uplinks.
- The double-width **NAT-MCH-G4-HUB-Px84** module is designed to perform with the **NAT-MCH-S4**, including RTM support as assembly option. The module provides PCIe Gen5 x4 switching to 12 AMCs as well as one PCIe Gen5 x16 connection to an optional

RTM. Moreover, it features two PCIe Gen4 x8 via two QSFP-DD interfaces, which can be combined to one x16 front panel uplink. Please refer to section 2.5 for more information on the uplinks.

If supported by the backplane, both modules offer PCIe x8 links for up to 6 AMCs. The PCIe switches support multiple independent virtual backplane clusters with one PCIe Root Complex each.

2.5. Front panel uplinks

Various uplink options at the front panel offer a wide and flexible range of possible choices to connect the **NAT-MCH-G4** to external networks:

The **NAT-MCH-G4** base board offers Ethernet connections via SFP(-DD), ix, or RJ45 with 1-25G depending on the assembly option.

The **NAT-MCH-G4-HUB-EX** Fat Pipe Ethernet module features an additional QSFP-DD front uplink with 8x 1-25G.

The **NAT-MCH-G4-HUB-Px52** Fat Pipe PCIe module owns a PCIe Gen4 x4 uplink via QSFP, whereas the double-width **NAT-MCH-G4-HUB-Px84** features a PCIe Gen4 x16 (or two x8) uplink(s) via two QSFP-DD interfaces.

The **NAT-MCH-G4-CLK-P** module provides two SMA connectors for input or output of an up to 100MHz clock and an optional SMC connector for input of a GPS signal.

Detailed information about the front uplink functionality of the **NAT-MCH-G4** and important differences to the former third generation of the **NAT-MCH** can be found in the "Uplink Guide" document at our website (please refer to chapter 8.1 Internal Reference Documentation).

2.6. Combo assemblies for usage in Science applications

Especially for the use with science applications, by its special NAT-MCH-SCI assemblies, NAT holds the following product bundles available which are optimized for the special needs within these applications.

- **NAT-MCH-SCIx52**
  - A combination of the **NAT-MCH-S4**, the **NAT-MCH-G4-CLK-P**, and the **NAT-MCH-G4-HUB-Px52** with one PCIe Gen4 x4 front uplink and no RTM support.
- **NAT-MCH-SCIx84**
  - A combination of the **NAT-MCH-S4**, the **NAT-MCH-G4-CLK-P**, and the **NAT-MCH-G4-HUB-Px84** with one PCIe Gen4 x16 (or two x8) front uplinks and RTM support.
- **NAT-MCH-SCIxE**
  - A combination of the **NAT-MCH-S4**, the **NAT-MCH-G4-CLK-P**, and the **NAT-MCH-G4-HUB-Ex** with one 1-25GbE front uplink.

3. MTCA BASICS

The following two figures illustrat possible backplane architectures of an MTCA chassis, one with one MCH and one with two MCHs.

Figure 1 – MTCA System with one MCH

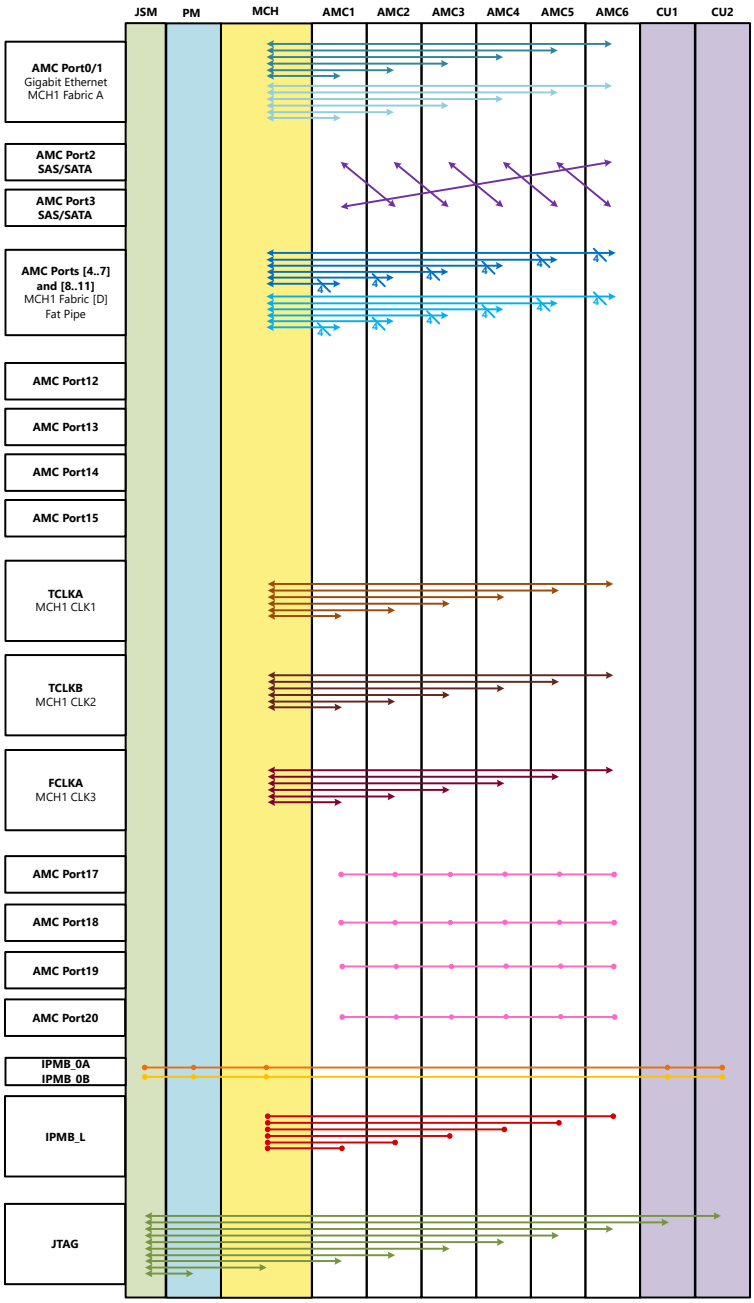
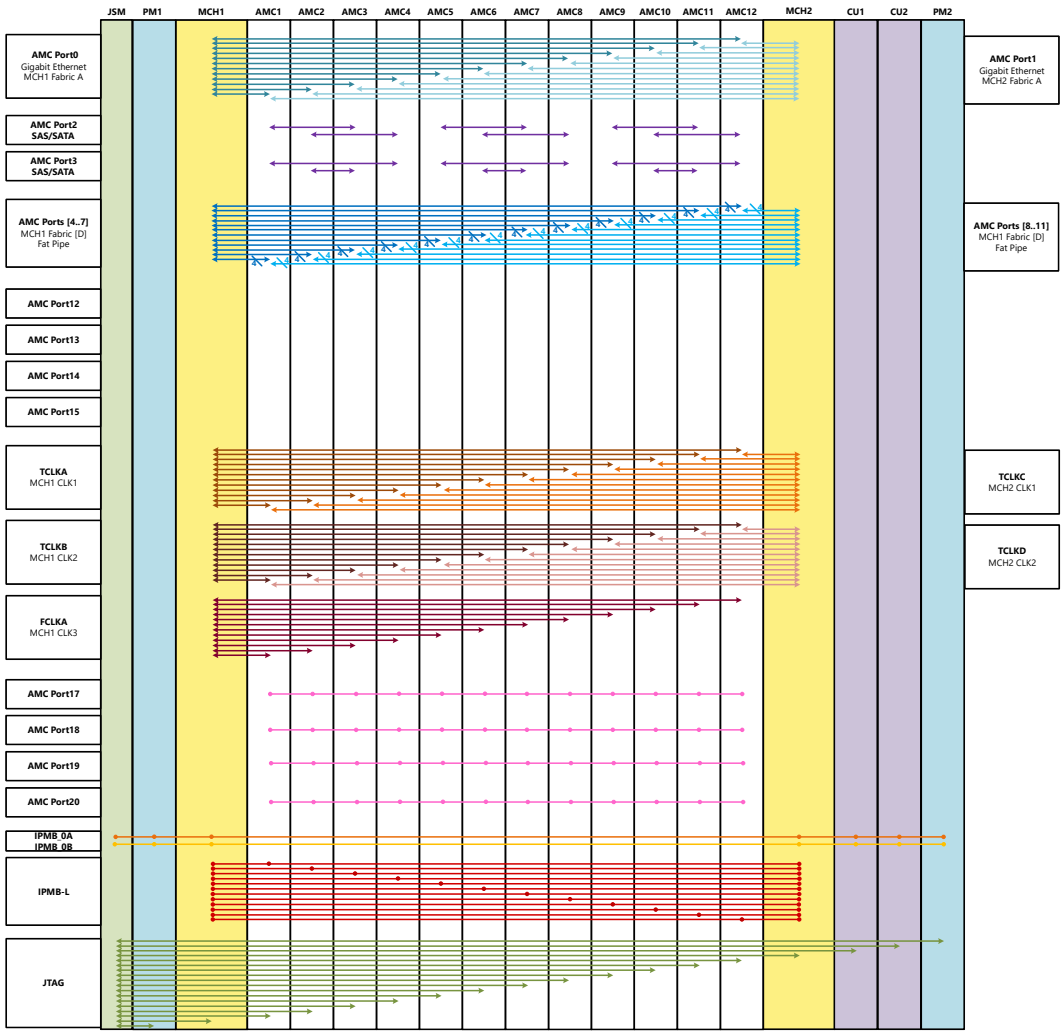


Figure 2 – MTCA System with two MCHs



3.1. Backplane Connections of the MCH base board

The following section introduces to the backplane connections established by the base board of a MCH. Regarding the MCH operation, the following connections are important.

3.1.1. MCH Fabric A to AMC Ports #0/1

In MicroTCA the Base Fabric interface from a MCH to each AMC is implemented by a radial structure where the MCH connect to all AMCs in the system by point-to-point Ethernet (1G – 10G) links. The Fabric A ports of a MCH connect to AMC Ports #0 and #1. As a MCH offers 12 lanes in Fabric A, it can connect to 12 AMCs .

In systems with just one MCH, these 12 lanes are commonly connected to AMC Port #0, while in a redundant system with two MCHs, MCH_1 commonly connects it 12 lanes to AMC Port #0 and MCH_2 commonly connects it 12 lanes to AMC Port #1.

Another possible setup in a non-redundant system with just one MCH – if supported by the backplane – is to have the MCH connect it 12 lanes to just 6 AMCs but tot both the AMC Ports #0 and #1.

The NAT-MCH-G4 family of products supports these variants.

3.1.2. MCH Management Connections to AMCs via IPMB-L

In MicroTCA the IPMB-L management interface from the MCH to each AMC is implemented by a radial structure, where the MCMC(s) of the MCH(s) and the MMCs of all AMCs are connected by a point-tp-point I^2C bus.

3.1.3. MCH Management Connections to Power Modules and Cooling Units via IPMB-0

In MicroTCA the IPMB-L management interface from the MCH to each power module and each cooling unit is implemented by a redundant bus, named IPMB-A and -B. Each of the busses individually connects the MCMC of the MCH(s) to the EMMCs of every power module and cooling unit in the system.

3.2. Backplane Connections of the MCH Clock Module

In MicroTCA a MCH provides the three clock signals CLK1, CLK2 and CLK3 to all AMCs in a system. However, an AMC may have up to five clock ports labeled TCLKA, TCLKB, TCLKC, TCLKD and FCLKA.

The letter "T" refers to "Telecom Clock", whereas "F" relates to "Fabric Clock". TCLKA-D are universal clocks for the AMCs with M-LVDS signaling standard, whereas FCLKA serves as the PCIe Reference Clock for PCIe connections, based on HCSL signaling standard.

All clocks are frequency limited to 100MHz max by the MicroTCA specification.

The backplane determines how the three clock ports of a MCH are connected to the AMC clock ports. The following table serving as an example, listing a common mapping used by many backplane manufacturers:

Table 1 – MCH to AMC Clock Assignment

MTCA System with one MCH	
MCH1 CLK1	TCLKA
MCH1 CLK2	TCKLB
MCH1 CLK3	FCLKA
MTCA System with two MCHs	
MCH1 CLK1	TCLKA
MCH1 CLK2	TCLKB
MCH1 CLK3	FCLKA

MCH2 CLK1	TCKLC
MCH2 CLK2	TCLKD

3.3. Backplane Connections of the MCH Fat Pipe hub

In MicroTCA the Fat Pipe fabric interface from a MCH to each AMC is implemented by a radial structure where the MCH connect to all AMCs in the system by a point-to-point links.

The Fat Pipe Fabric D-G ports of a MCH connect to AMC Ports #4 to #7. As a MCH offers 4 lanes per Fat Pipe fabric port, it can connect to 12 AMCs by a x4 link.

In systems with just one MCH, the Fat Pipe Fabric D-G ports of the MCH connect to AMC ports #4 to #7, while in a redundant system with two MCHs, MCH_1 commonly connects its Fabric D-G ports to AMC Port #4 to #7 and MCH_2 commonly connects its Fabric D-G ports to AMC ports #8 to #11.

Another possible setup in a non-redundant system with just one MCH – if supported by the backplane – is to have the MCH connect its Fabric D-G ports to 6 AMCs at AMC ports #4 to #11.

The Fat Pipe switch on the MCH hub module determines the protocol used with the Fat Pipe:

- The **NAT-MCH-G4-HUB-EX** hub provides Ethernet with up to 40G to all AMCs.
- The **NAT-MCH-G4-HUB-PCIex52** and **-PCIex84** hub provides PCIe at Gen4/Gen5 speed to all AMCs.

3.4. Power Policy

In MicroTCA up to four power modules can be used per system. Each MCH, each AMC and each colling unit has its own power channel driven by either one or more power modules.

In case of more power modules in the system one power modules becomes the primary power module for a power channel, while one of the other power modules becomes the backup power module for that channel.

Primary power channels may be assigned to different power modules and so may backup power channels.

The MCH knows which power module is a primary and which is a backup power module for a given power channel.

Thus, depending on the number of power modules in the system, the MCH supports several redundancy configurations, i.e. 1+1, 2+1, 2+2, 3+1.

The NAT-MCH-G4 family of products supports these variants.

4. CONNECTING TO A NAT-MCH-G4

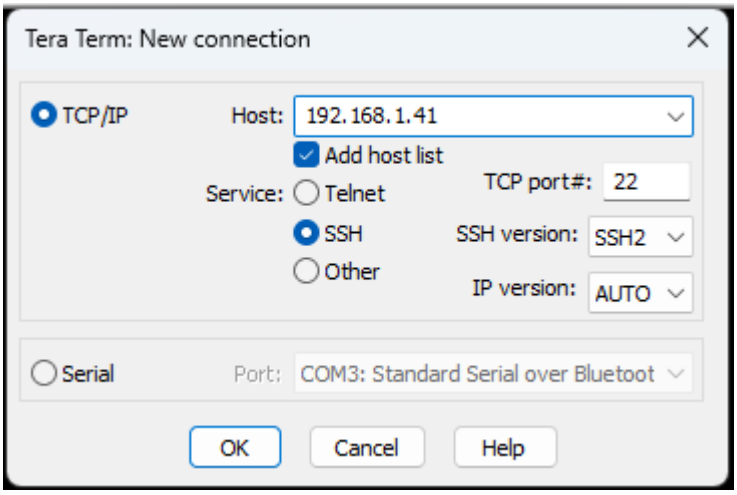
The **NAT-MCH-G4** provides a modern Linux style **C**ommand **L**ine **I**nterface for monitoring and configuring the MCH via a serial console interface. An introduction to the CLI is given in section 5 Command Line Interface (CLI).

The CLI can be accessed either through the Live Log function of the Web Interface using a standard web browser (please refer to section 7 Web Interface) or through a terminal program.

Apart from a network-based access, a terminal program also allows access to the CLI via serial cable. With regards to the choice of a terminal program it is recommended that Microsoft Windows users install a separate tool (e.g. Tera Term, PuTTy, Powershell), while Linux users may use the standard Linux terminal tool.

Using Tera Term as an example, after start-up, the terminal program offers three different options to connect to the **NAT-MCH-G4**.

Figure 3 – Terminal Connection



- USB-Console (serial; direct USB connection between **NAT-MCH-G4** and PC required)
- Telnet (unsecure via network)
- SSH (secured via network)

5. COMMAND LINE INTERFACE (CLI)

This section provides a short introduction to the CLI, the associated script language and explains its basic functionality.

Compared to the CLI of the 3rd generation **NAT-MCH**, the new CLI of the 4th generation **NAT-MCH-G4** provides:

- A reduced number of first level key words
- A help functionality at any command level
- A flexible and adaptable support of parameters and options

5.1. CLI Syntax

The syntax of all CLI commands is as follows:

```
command [parameter 1] … [parameter n] -[option 1] … -[option n]
```

with the following basic commands:

`set` – manipulates the value described in parameter section

`get` – retrieves the value described in parameter section

`print` – prints information and/or values described in parameter section

`help` – the basic CLI help command

`ifconfig` - TCP/IP interface configuration

`script` – script support

`ping` – pings another network node in the network

The CLI supports mandatory and optional parameters. Optional parameters are shown in square brackets i.e.: [site_number]. Options must be placed at the end of the command string.

Example:

```
Nat> set debug ipmi min -p
```

Sets the debug level for the IPMI interface to minimum and persistently stores the value.

Persistently stored values are safe against power cycles and re-boots.

A good starting point for using the CLI always is invoking the <help> command at the CLI prompt:

```
nat> help
```

The <help> command will display all commands with their respective parameters.

More detailed information about a specific function can be obtained by the sub level help system by adding the <-help> option:

Example:

```
nat> set fan level -help
```

Output:

```
usage: set fan level [<params>]
params:
        [<site_number>]
        [<dev_id>]
        <level>
Set fan speed level of cooling units
```

5.2. Script Support

The script support of the **NAT-MCH-G4** uses the available CLI commands. Thus, a script consists of several CLI commands and can be edited and stored. The configuration scripts are divided into so-called domains which can be individually edited, stored, and deleted. Any individual script is loaded during the start-up phase of the **NAT-MCH-G4**, respectively the start-up of its submodules. i.e., the clock configuration is loaded when the clock module is recognized and initialized.

Table 2 – CLI Configuration Domains

Domain	Description
system	basic system configuration: executed during start-up
user	user space configuration: executing immediately after start-up
base1	Base configuration: Ethernet switch initialization of the Base-MCH (side 1)
base2	Base configuration: Ethernet switch initialization of the Base-MCH (side 2)
hub1	Switch configuration: Ethernet switch initialization of the hub module (side 1)
hub2	Switch configuration: Ethernet switch initialization of the hub module (side 2)
clk1	Clock configuration: Initialization of the clock module (side 1)
clk2	Clock configuration: Initialization of the clock module (side 2)

5.2.1. Script Commands

The **NAT-MCH-G4** supports the following CLI commands to create and clear a script configuration:

- script start <domain>
- script end
- script clear <domain | all>

The console interface can be used to enter a new script line-by-line. It is best practice to create/edit the script on a remote host and then upload it to the **NAT-MCH-G4** via the web-interface.

5.2.2. Show Configuration / Aggregated Configuration

The **NAT-MCH-G4** supports the CLI command "print config <domain>" to display the possible configurations available for a particular domain:

Example:

```
nat> print config base1
```

Output:

```
set switchport state AMC1/0 ena
set switchport state AMC2/0 ena
set switchport state U1 ena
set switchport state CPU_1 ena
```

Use "print config all" instead of the ""print config <domain>" to show the aggregated configurations of the **NAT-MCH-G4**:

```
Nat> print config all
```

Output:

```
script start system
ifconfig te0 192.168.1.41 255.255.255.0 0.0.0.0
set ekey ignore false xaui
script end

script start user
script end

script start base1
set switchport state AMC1/0 ena
set switchport state AMC2/0 ena
set switchport state U1 ena
set switchport state CPU_1 ena
script end

script start base2
script end

script start hub1
script end

script start hub2
```

```
script end

script start clk1
script end

script start clk2
script end
```

The *aggregated configuration* consists of all available configurations, concatenated by special *script commands*. It is best practice again to use the aggregated configuration for configuring your **NAT-MCH-G4** line-by-line and to store the respective configuration.

5.2.3. Creating a New Configuration

A new script configuration can be created by two ways:

- Entering respective commands directly via the CLI
- Use the WEB interface to import a script being edited offline.
  (see Chapter 7.2)

In both cases the workflow will be:

Step 1 - Open a script configuration for writing: enter "script start <domain>" to open an particular script for writing mode.

Step 2 - add command to a script: all following commands will be added to <domain>.

Please note: The commands are in the script only, they are not executed at this point. The script configuration is applied after the next restart!

Step 3 - close and store the script: use CLI command "script end" to close a script configuration for writing and to store it to non-volatile memory.

6. SSH SUPPORT

In general, the Secure Shell (SSH) protocol is a cryptographic network protocol for connecting to remote network devices over an unsecured network. Its most notable applications are remote login and command line execution.

6.1. Overview

The **NAT-MCH-G4** incorporates an embedded SSH daemon that offers encrypted remote shell access as a secure alternative to the existing Telnet interface.

The cryptographic foundation is provided by a commercial off-the-shelf library.

The default parameters of the SSH access to the **NAT-MCH-G4** are:

Table 3 – SSH Default Configuration

Parameter	Value	Description
Protocol Version	SSH-2.0	
Port	22	
Login Credentials - USR	root	Default factory setting
Login Credentials - PWD	nat	Default factory setting
Host Key	RSA-2048	
Max Sessions	2	Maximum number of simultaneous SSH connections
Session Inactivity Timeout	n/a	not yet configurable, Idle sessions are automatically closed after 120 minutes
Emulated Terminal Type	VT100	80 columns × 25 lines

6.2. Host Keys

The Host Key is generated according to the Rivest-Shamir-Adleman (RSA) family of public-key cryptosystems, widely used for secure data transmission. The RSA-2048 key has 617 decimal digits (2.048 bits) and is the largest of the RSA numbers.

Known Restrictions with NAT-MCH-G4 running firmware versions <= V3.1.0:

- Up to firmware version 3.1.0, the SSH server on the NAT-MCH-G4 uses pre-built RSA-2048 host keys that are compiled into the firmware image. Because of the pre-built RSA keys, the SSH host key fingerprint will be identical across all **NAT-MCH-G4** units running the same firmware. When connecting for the first time, your SSH client will display a host key fingerprint prompt. You must accept it to proceed.

Firmware versions 3.1.1 or higher support on per-device key generation or key provisioning.

.

6.3. Authentication: Mechanism

User authentication is handled by the user-auth callback during the SSH handshake. Both password and public-key authentication types are supported at protocol level.

6.4. User Accounts

A user account must exist before SSH based communication can be established. For security reasons a user account can be created via an USB connection only as long as no valid SSH account exists.

Depending on the security level, two types of user accounts are supported:

- Host key only verification, i.e. with user name / password
- Public /private key authentication

To create a host key only account:

nat> set user <user name> <password>

To create a public/private key account:

nat> set user <user name> <password> <"RSA public key">

Import note: the RSA public key must be surrounded by double quotes.

User accounts can be removed at any time by:

nat> set user <user name> -rem

The public/private key pair needs to be created on your host machine. The public key can be copied into the command line above by copy/paste.

6.5. Connecting to the NAT-MCH-G4 using SSH

From **Linux** Terminal:

`ssh <user name>@<MCH-IP-ADDRESS>`

When prompted, enter the password.

From **Windows** (PuTTY)

- Open PuTTY.
- Set Host Name to the IP address of the MCH module.
- Set Port to 22.
- Set Connection type to SSH.
- Click Open.

- When prompted, log in with username root and password nat.

6.6. Host Key Verification

On the first connection, your SSH client will display a warning about an unknown host key. This is expected behaviour.

Example:

```
The authenticity of host '192.168.1.100 (192.168.1.100)' can't
be established.

RSA key fingerprint is
SHA256:xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Are you sure you want to continue connecting (yes/no)?
```

Type "yes" to accept and continue. Since all units currently share the same pre-built RSA key, the fingerprint will be consistent across boards running the same firmware version.

6.7. Shell Session

After successful authentication, you will be greeted by:

```
Welcome to N.A.T. MCH GEN4 SSH server.

Your ip address is: <your-ip>

Session will be closed after 120 min of inactivity

nat>
```

The nat> prompt provides the same command shell as the Telnet interface. All standard MCH management commands are available.

6.8. Known Limitations

Known limitations of the current implementation are listed below.

Table 4 – SSH Limitations

Limitation	Description
No SCP / SFTP support	File transfer protocols are not enabled.
Maximum 2 concurrent sessions	The session pool is limited to 2 simultaneous connections.
No SSH banner customization	The welcome banner is hard-coded in firmware.
Only 1 public key per user	Per user only one public key can be stored, thus login from one host computer only is permitted.

7. WEB INTERFACE

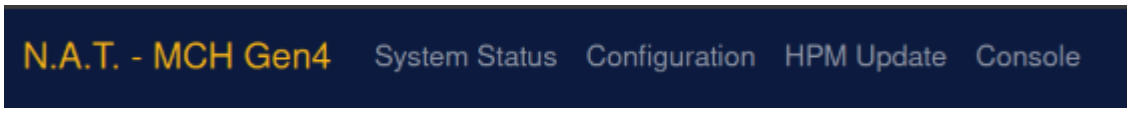
The **NAT-MCH-G4** has been equipped with a new, reactive and intuitive web interface.

It supports the user in diagnosis, configuration, and monitoring of the **NAT-MCH-G4** and the MTCA Chassis. Additionally, it provides a way for firmware updates for every component.

- System Status – real-time status of all system components
- HPM Update – easy update of all components in the system supporting HPM updates
- Script Support – importing and exporting scripts
- General configuration of the **NAT-MCH-G4**.
- Configuration of the Base Board Ethernet Switch,
- Configuration of the **NAT-MCH-G4-HUB-EX/-PCIEx52/-PCIex80** hub modules
- Console – direct access to MCH CLI in an own shell

Access to the web interface can be established using any standard browser connecting to the IP address of the MCH.

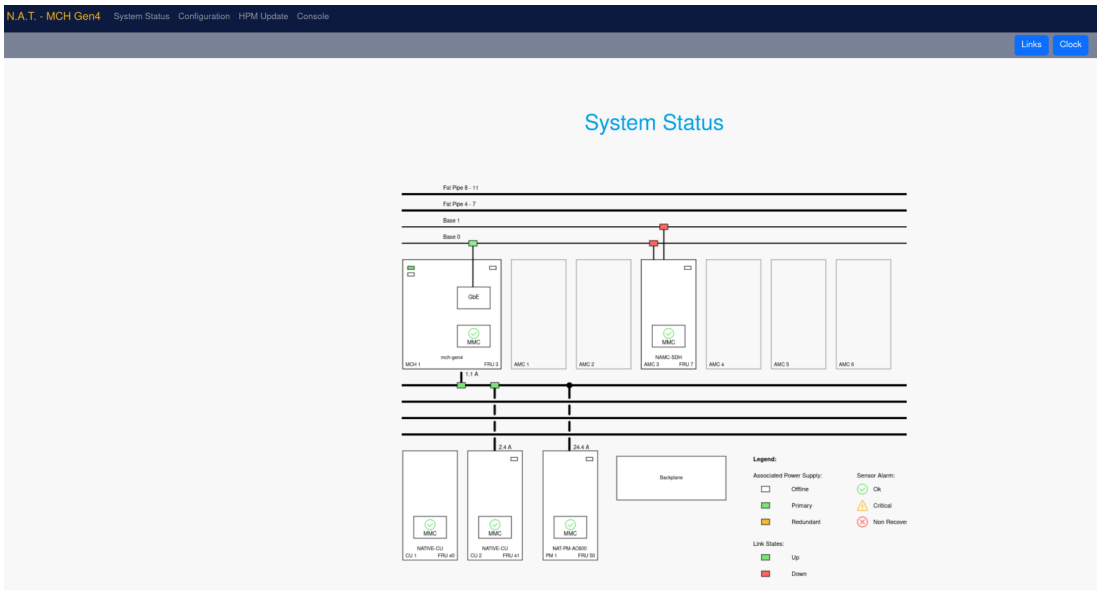
After the home screen is loaded, the menu bar at the top of the page offers several options for accessing the **NAT-MCH-G4** and adapting it to personal needs.



7.1. System Status

The real time status offers advanced monitoring of the system. Beyond basic information like sensor values and FRU data, it provides the state of all backplane links and debug information from every MCH, AMC, Cooling Unit, and Power Module in the MTCA system.

Figure 4 – System Status

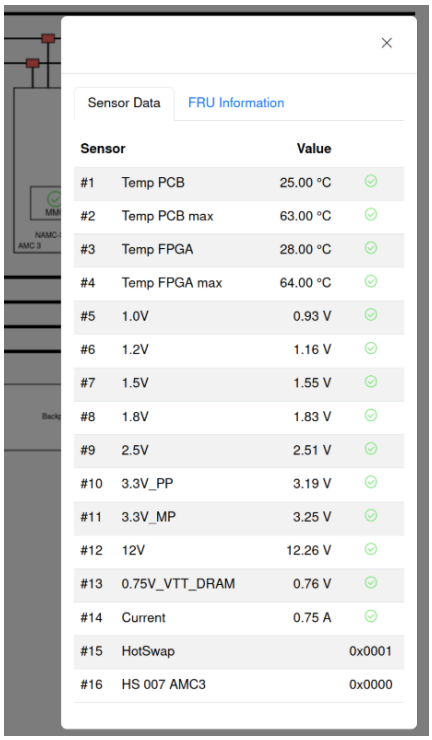


All labeled boxes (MMC boxes) within the FRU module rectangles (for example: MMC, CU, PM, AMC, but also the **NAT-MCH-G4** HUB modules) are clickable. A click leads to an overlay with all FRU information and real-time updates from all sensors.

Additionally, small icons in the FRU module display the FRU's overall health status. A green checkmark indicates good health, meaning all sensors are in a healthy area. A yellow checkmark indicates critical sensor values and a red checkmark indicates non-recoverable situations.

As an example, the list below shows all sensor values (here: AMC3) that are critical or non-recoverable.

Figure 5 – Sensor Data



The second tab contains the FRU information of the selected FRU module (here: MCH1).

Figure 6 – FRU Information

Note: Alarming sensors are always shown in the top part of the tab.

7.2. Configuration

The configuration page allows basic configuration settings of the MCH:

Figure 7 – Network Configuration

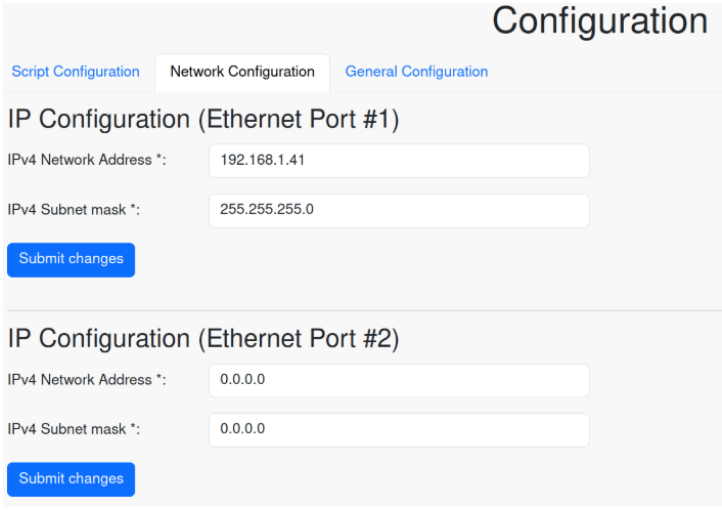
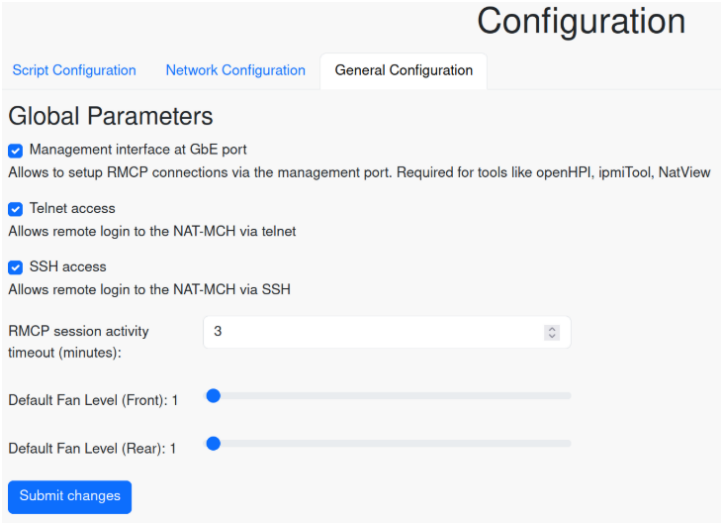


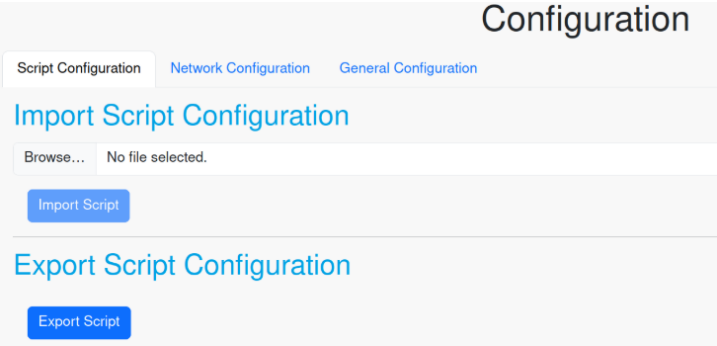
Figure 8 – General Configuration



Most of the more specific MCH configurations are implemented through the MCH script support, for example setting the configuration of the uplink ports, clock configurations, etc.

These scripts are divided into domains according to the respective sub module, i.e. hub, clock, base (please refer to section 5.2. An active script configuration can be exported to any host and edited offline. A modified or new configuration can be imported to the MCH.

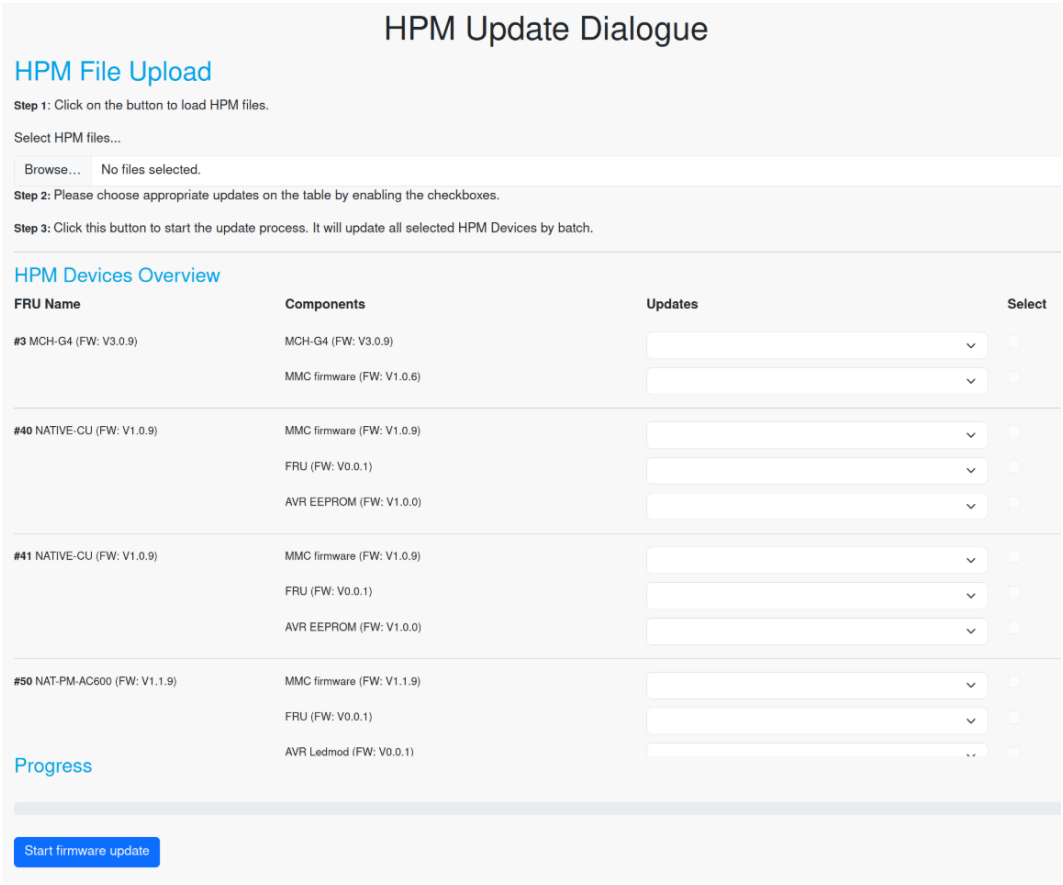
Figure 9 – Script Configuration



7.3. HPM Update

The HPM update page provides a convenient method to update all FRU devices in a system. Users may update specific components of a FRU by an appropriate HPM files. Updates are applicable to subcomponents, for example: FRU Information, AVR MMC, or FPGA firmware.

Figure 7 – HPM Update Dialogue



The left column shows all devices supported by the HPM update procedure. Every device offers updates for at least one component (See column: "Components"). The **NAT-MCH-G4** FRU for example has the overall firmware (v3.0.9) and consists of the components "MCH-G4" (FPGA/Linux firmware) V3.0.9 and "MMC firmware" (firmware for management controller) V1.0.6.

After uploading a valid HPM file, the dropdown box gets filled.

If multiple HPM files match the component, the most current firmware gets preselected. Now the component update must be enqueued by clicking on the checkmark 'Select'. After clicking on 'Start firmware update' the batch processing begins.

Green checkmarks besides the components indicate successful uploads and the button reports 'Updates completed'. In case of an error it reports 'Updates failed'.

7.4. Console

This page features a full-functional console to the **NAT-MCH-G4** for accessing the CLI and a list of debug flags.

Figure 8 – Console and Debug Flags in the Web Interface

8. SPECIFICATIONS AND COMPLIANCES

8.1. Internal Reference Documentation

- **NAT-MCH-G4 – Product Website**
- **NAT-MCH-G4 – Collaterals**

Please visit our website for the latest documentation

8.2. Standards Compliance

- MTCA.0
- MTCA.4
- MTCA.4.1
- AMC.0
- AMC.1
- AMC.2
- AMC.3
- AMC.4
- IMPI V1.5
- HPM.1
- RoHS
- REACH
- CE

8.3. Compliance to RoHS Directive

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the "Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS) predicts that all electrical and electronic equipment being put on the European market after June 30th, 2006 must contain lead, mercury, hexavalent chromium, poly-brominated biphenyls (PBB) and poly-brominated diphenyl ethers (PBDE) and cadmium in maximum concentration values of 0.1% respective 0.01% by weight in homogenous materials only.

As these hazardous substances are currently used with semiconductors, plastics (i.e. semi-conductor packages, connectors) and soldering tin any hardware product is affected by the RoHS directive if it does not belong to one of the groups of products exempted from the RoHS directive.

Although many of hardware products of N.A.T. are exempted from the RoHS directive it is a declared policy of N.A.T. to provide all products fully compliant to the RoHS directive as soon as possible. For this purpose since January 31st, 2005 N.A.T. is requesting RoHS compliant deliveries from its suppliers. Special attention and care has been paid to the production cycle, so that wherever and whenever possible RoHS components are used with N.A.T. hardware products already.

8.4. Compliance to WEEE Directive

Directive 2002/95/EC of the European Commission on "Waste Electrical and Electronic Equipment" (WEEE) predicts that every manufacturer of electrical and electronical equipment which is put on the European market has to contribute to the reuse, recycling and other forms of recovery of such waste so as to reduce disposal. Moreover this directive refers to the Directive 2002/95/EC of the European Commission on the "Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS).

Having its main focus on private persons and households using such electrical and electronic equipment the directive also affects business-to-business relationships. The directive is quite restrictive on how such waste of private persons and households has to be handled by the supplier/manufacturer; however, it allows a greater flexibility in business-to-business relation-ships. This pays tribute to the fact with industrial use electrical and electronical products are commonly integrated into larger and more complex environments or systems that cannot easily be split up again when it comes to their disposal at the end of their life cycles.

As N.A.T. products are solely sold to industrial customers, by special arrangement at time of purchase the customer agreed to take the responsibility for a WEEE compliant disposal of the used N.A.T. product. Moreover, all N.A.T. products are marked according to the directive with a crossed out bin to indicate that these products within the European Community must not be disposed with regular waste.

If you have any questions on the policy of N.A.T. regarding the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the "Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS) or the Directive 2002/95/EC of the European Commission on "Waste Electrical and Electronic Equipment" (WEEE) please contact N.A.T. by phone or e-mail.

8.5. Compliance to CE Directive

Compliance to the CE directive is declared. A 'CE' sign can be found on the PCB.

8.6. Compliance to REACH

The REACH EU regulation (Regulation (EC) No 1907/2006) is known to N.A.T. GmbH. N.A.T. did not receive information from their European suppliers of substances of very high concern of the ECHA candidate list. Article 7(2) of REACH is notable as no substances are intentionally being released by NAT products and as no hazardous substances are contained. Information remains in effect or will be otherwise stated immediately to our customers.

8.7. Abbreviation List

Table 5 – Abbreviation List

Abbreviation	Description
AMC	Advanced Mezzanine Card
BIOS	Basic Input/Output System
COM Express	Computer-On-Module Express
DDI	Dual Display Interface
EEPROM	Electrically Erasable PROM
EMC	Electromagnetic Compatibility
FLASH	Non-Volatile Memory
GbE	Gigabit Ethernet
HCSL	High Speed Current Steering Logic
HS	Hot Swap
I^2C	Inter-Integrated Circuit
I/O	Input/Output
IPMB	Intelligent Platform Management Bus
IPMI	Intelligent Platform Management Interface
LTE	Long Term Evolution
µC	Microcontroller
µTCA/MTCA/MicroTCA	Micro Telecommunications Computing Architecture
MCH	µTCA/MTCA Carrier Hub
MMC	Module Management Controller
NVMe	Non-Volatile Memory Express
PCI(e)	Peripheral Component Interconnect (Express)
PrAMC	Processor AMC
(P)ROM	(Programmable) Read Only Memory
SATA	Serial Advanced Technology Attachment
SD-Card	Secure Digital Memory Card
SerDes	Serializer/Deserializer
SGMII	Serial Gigabit Media Independent Interface
SPI (FLASH)	Serial Peripheral Interface (FLASH)
SSD	Solid State Drive
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
WiFi	Wireless Fidelity – wireless network

9. DOCUMENT'S HISTORY

Table 6 – Document's History

Rev	Date	Description	Author
1.0	08.12.2025	Initial Release	SE
	02.03.2026	Added chapter 4.3 SSH Support	AL
	30.03.2026	Reworked Document	SE
	10.04.2026	Changes applied to all sections	HL, HK
1.1	25.07.26	Added chapter User Accounts to SSH	HL