NATIVE-SERVER-R1

MICROTCA SERVER FOR SERVER APPLICATIONS

WITH NAT-MCH-G4 AND NAT-AMC-COMEX

DESIGNED BY N.A.T. GMBH

TECHNICAL REFERENCE MANUAL V1.0

HW REVISION 1.X

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1. PREFACE

1.1. Disclaimer

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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 This Document

This document is intended to give an overview of the **NATIVE-server-R1's** functional capabilities.

Preface

General information about this document

Introduction

Abstract on the **NATIVE-server-R1's** main functionality and application field

Quick Start

Important information and mandatory requirements to be considered before operating the **NATIVE-server-R1** for the first time

Hardware

Details on the **NATIVE-server-R1** most important components and interfaces

Specifications and Compliances

Detailed list of specifications, abbreviations, and datasheets of components referred to in this document, as well as standards, the **NATIVE-server-R1** complies to

Document's History

Revision record

Note:

It is assumed, that the **NATIVE-server-R1** is handled by qualified personnel only!

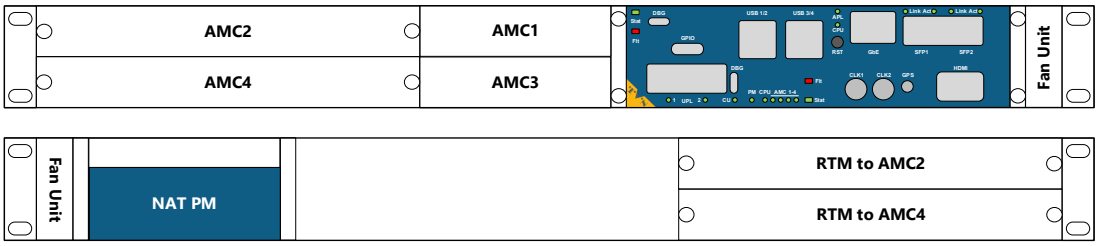
2. INTRODUCTION

The **NATIVE-server-R1** is a compact µTCA chassis designed for server applications. It comprises of a **NAT-MCH-G4** including an optional **NAT-MCH-G4-CLK**, a **NAT-PM**, and an integrated **NAT-AMC-COMex** PrAMC (Processing AMC).

The chassis features four payload slots in total: two slots for double-wide, mid-size AMCs which can be expanded by two RTMs, and two slots for single-width, mid-size AMCs without RTMs.

The following figure shows the chassis design of the **NATIVE-server-R1** front panel.

Figure 1 – NATIVE-server-R1 Front and Rear Panel



2.1. Main Features NAT-MCH-G4

Basically, the **NAT-MCH-G4** is the central management and data switching entity of the **NATIVE-server-R1** and handles power and system management. Although the **NAT-MCH-G4** module is integrated in the system, its functionality is not restricted as it was the case with the former **NAT-eMCH**.

The base Ethernet switch features a 1G / 2.5G / 10G Ethernet connection to the **NAT-AMC-COMex** module and all other AMCs in the system. Beyond that, a 1G-25G Ethernet uplink via SFP28-DD is available at the front panel.

In combination with the optional **NAT-MCH-G4-CLK-P** module, the **NAT-MCH-G4** offers several options of switching and manipulating clock signals. Two low jitter Clock multiplexers provide CLK1 and CLK2 to each AMC, CLK3 is executed as PCIe Reference Clock.

The **NAT-MCH-G4-CLK** module features 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.

As an assembly option, the **NAT-MCH-G4-CLK** module offers an optional GPS receiver with a dedicated SMC connector at the front panel to attach a GPS antenna.

Please note: as essential part of the **NATIVE-server-R1** the combination of the **NAT-MCH-G4** and the **NAT-AMC-COMex** is constantly attached to the chassis and ***not hot-swappable!***

2.2. Main Features NAT-AMC-COMex

The embedded **NAT-AMC-COMex** is an COMExpress (COMex) carrier board for COMExpress Type7 modules. As the name implies, a COMExpress module is a Computer-on-Module, which means it concentrates the core functionality of an x86 processing system on one single PCB. This includes CPU and memory functionality, graphics (option), and the most common interfaces.

For storage demands, the carrier owns an M.2 PCIe x4 interface, which offer various options to connect an SSD, FLASH memory, etc. A second M.2 PCIe x4 interface is intended to be used with a graphics module to provide an HDMI interface at the front plate.

Different types of COMExpress modules have been designed for different applications. Thus, the choice of the type determines the application field of the **NAT-AMC-COMex**. So the carrier board can work as a general purpose processor AMC (PrAMC), storage, or graphics solution if combined with the appropriate COMExpress module.

For a recent list of validated COMExpress Type 7 modules suitable for installation on the **NAT-AMC-COMex**, please contact NAT.

Generally, the **NAT-AMC-COMex** features 2x 25G Ethernet via SFP28 at the front panel and 10G Ethernet to AMC Port 0/1. Via FatPipe, it provides PCIe Gen4 x4 to all AMCs in the system.

2.3. Main Features

Table 1 – Technical Data

Form Factor	
	• 4-slot 1U chassis, mountable in 19'' racks • up to two single-wide, mid-size AMCs and • up to two double-wide, mid-size AMCs and their correspondent RTM
Height	• 1U
Width	• 445mm
Depth	• approx. 373mm
Weight	• approx. 5.8kg
NAT-MCH-G4 with NAT-MCH-G4-CLK-P	
Processing Resources	• Xilinx Zynq MPSoC with FPGA / 2x ARM A9 • 1 GB DDR3 RAM • 256 MB QSPI FLASH
Interfaces	• 10GbE switch for Fabric A • 2x 25GbE Uplink at front panel via SFP28-DD • 10G Ethernet to backplane • CLK I/O via SMA at front panel • GPS IN via SMC at front panel as option • CLK1/CLK2 to each AMC • CLK3 PCIe RefClock • Debug via Micro-USB B
System Management	• Central management and data switching • Power and system management.
Software / Firmware	• FreeRTOS
NAT-PM-AC600 (other PM on request)	
Input Voltage	• 100 – 265VAC
Mains Frequency	• 50/60 Hz
Output (max.)	• 400W
Output Power	• 6.6A @12 VDC • 180mA @3.3V
NAT-AMC-COMex	
Onboard Carrier	• Atmel Microchip ATxmega128 • Intel Ether Controller i810 • 2x M.2 PCIE x4 interface (for memory and graphics) • MicroSD-Card
Backplane Interconnect	• IPMI • AMC PORT 0/1: 1G-KX/10G-KR • AMC PORT 4-7/8-11/12-15/17-20: PCIE Gen4 x4 to all AMCs
Front Panel Interfaces	• 4x USB 3.0 • 2x 25GbE Uplink via SFP28 • GPIO via Micro-D connector • Debug via Micro-USB B
Cooling Units	
	• Integrated Cooling Units including air filter • Cooling concept from right to left • 4 fans for front area, 3 fans for rear area • Cooling power of 400W @ +55°C operating temperature

Compliance	
	• PICMG AMC Base Specification • PICMG MTCA.0 Rev. 3 • PICMG MTCA.4 • CE, RoHS, IP20 • EN 60068-2-6, EN 60068-2-27, EN 62368-1 • IEC 61587-3, EN 61000-6-3, EN 6100-6-2
Environmental	
Ambient Temperature (operation)	• 0°C to +50°C • Humidity: 30% to 80% (non-condensing)
Ambient Temperature (storage)	• -20°C to +70°C • Humidity: 30% to 80% (non-condensing)

3. QUICK START

To ensure proper functioning of the **NATIVE-server-R1** during its usual lifetime, take the following precautions before handling the shelf.

3.1. Unpacking

Electrostatic discharge, incorrect board installation, and uninstallation can damage circuits or shorten their lifetime. Before touching integrated circuits ensure to take all required precautions for handling electrostatic devices.

Avoid touching gold contacts of the AMC-Edge-Connectors to ensure proper contact when inserting the modules into the **NATIVE-server-R1**.

Make sure that the chassis and its attachments are undamaged and complete according to delivery note.

3.2. Mechanical Requirements

Despite its compact design the **NATIVE-server-R1** is compliant to the open µTCA standards MTCA.0/MTCA.4 and therefore every standard-compliant, single or double mid-size AMC module (with corresponding RTM) can be integrated.

Before installing or uninstalling an AMC/RTM, read the Installation Guide and the User's Manual of the module.

Check all modules for steps that you have to take before turning on or off the power. After taking those steps, turn on or off the power if necessary.

Make sure the part to be installed/removed is hot-swap-capable, if you don't switch off the power.

Ensure that any module is connected to the **NATIVE-server-R1** with the connector completely inserted.

Maintain ambient airflow to ensure normal operation. If the airflow is blocked or restricted, or if the intake air is too warm, an over temperature condition can occur.

Ensure that cables from other equipment do not obstruct the airflow through the shelf.

Use filler panels which include an airflow baffle that extends to the backplane to cover all empty chassis slots. The filler panel prevents fan air from escaping out of the front of an open slot.

The **NATIVE-server-R1** is intended to be grounded. Ensure that the shelf ground terminals are connected to Protective Earth of the building.

3.3. Voltage Requirements

3.3.1. Power supply

Per default, the **NATIVE-server-R1** comes with an **NAT-PM-AC600** Power Module. Other modules e.g. **NAT-PM-DC48**, are available on request. For detailed information about these modules, please refer to chapter 6.1 Internal Reference Documentation.

3.3.2. Hot-Swap

The **NATIVE-server-R1** supports hot-swapping, which means that an AMC module, which features hot-swap-capability as well, can be inserted or extracted during normal system operation without affecting other modules.

Please note: this is only applicable for the four AMC modules and their RTMs. The combination of the **NAT-MCH-G4** and **NAT-AMC-COMex** is ***not hot-swappable***!

Make sure to follow the procedure ***exactly*** to prevent the AMC module or the system it is plugged into from damage!

Insertion of a hot-swap-capable module

- Ensure the module supports hot-swapping
- Ensure that the hot-swap-handle is in "unlock"-position (pulled out)
- Push the module carefully into the dedicated slot of the **NATIVE-server-R1** until it is completely inserted
- The blue HS-LED turns solid on
- With pushing the hot-swap-handle to "lock"-position, the HS-LED starts blinking and the IPMI-Controller of the backplane/carrier detects the board
- If the information provided by the module is valid, the **NATIVE-server-R1** enables payload power and the blue HS-LED turns off

Extraction of a hot-swap-capable module

- Pull the hot-swap-handle in "unlock"-position
- The blue HS-LED starts blinking
- The IPMI-Controller of the **NATIVE-server-R1** disables payload power
- The HS-LED turns solid on
- Pull the module carefully out of the **NATIVE-server-R1**

4. HARDWARE

The following drawings show the mechanical dimensions of the **NATIVe-server-R1** chassis.

Figure 2 – Front View

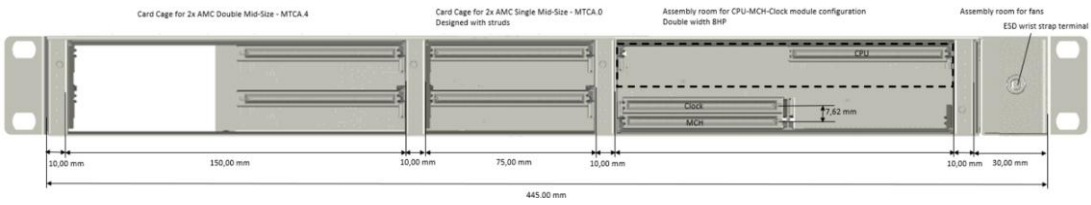
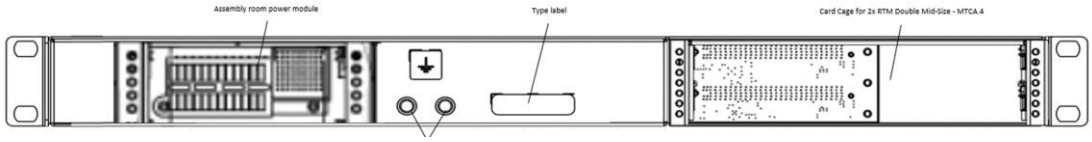
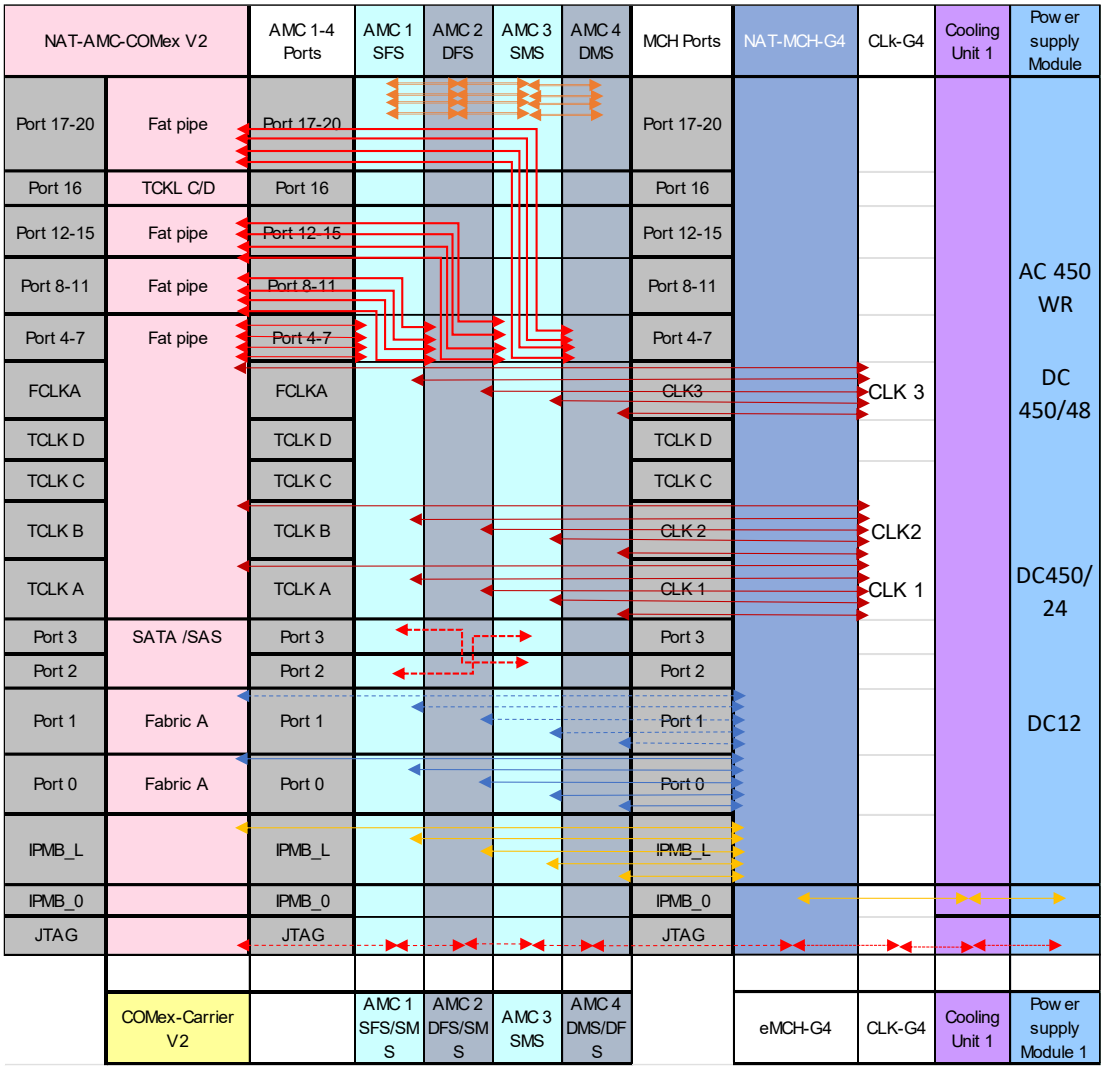


Figure 3 – Rear View



The backplane and slot assignment of the **NATIVE-server-R1** is shown below.

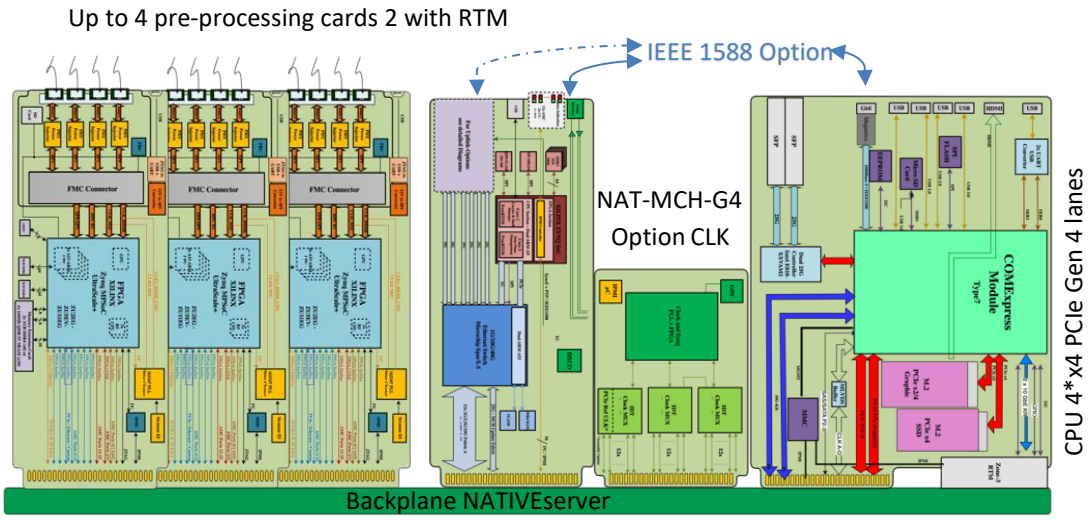
Figure 4 – Backplane Topology



4.1. Sample Setup

A possible setup for a typical **NATIVE-server-R1** application is shown in the following figure.

Figure 5 – Sample Setup



4.2. Front Panel, LEDs, and Connectors

The **NATIVE-server-R1** has a common front panel for the **NAT-MCH-G4** and the **NAT-AMC-COMex**. Due to mechanical restrictions, the MCH and therefore its front panel interfaces are rotated by 180°.

The front panel layout is shown in the following drawing, the assignment is described in the table below.

Figure 6 – Front Panel and LEDs

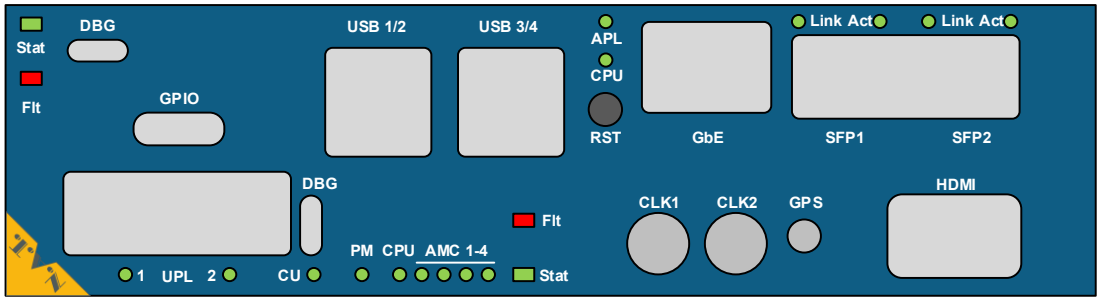


Table 2 – LED Functionality

Label	Color	Behaviour	Description
SFP1 + SFP2 Link	green	Fast flash	25G
		Slow blink	10G
		OFF	No link available
SFP1 + SFP2 Act	green	Solid ON	SFP interface active
		OFF	SFP interface inactive
CPU	green	Solid ON	COMex active
		OFF	COMex inactive
APL	green	tbd	Customer APL controlled by Microcontroller
Stat (COMex + MCH)	green		General purpose status LED
	orange		controlled by Microcontroller
Flt (COMex + MCH)	red	Solid ON	Fault LED: temperature exceeds range
CU Status	green	ON / OFF	Green ON: Unit OK Red ON: Unit Fails OFF: Unit not available controlled by MPSoC
PM Status			
CPU Status	red		
AMC Status 1-4			
UPL1 + UPL2	green	tbd	controlled by MPSoC
	orange		

Two LEDs integrated in the RJ45 Ethernet jack are driven directly by the COMExpress GBE0_LINK#, GBE0_LINK100#, GBE0_LINK1000n, and GBE0_ACT# signals.

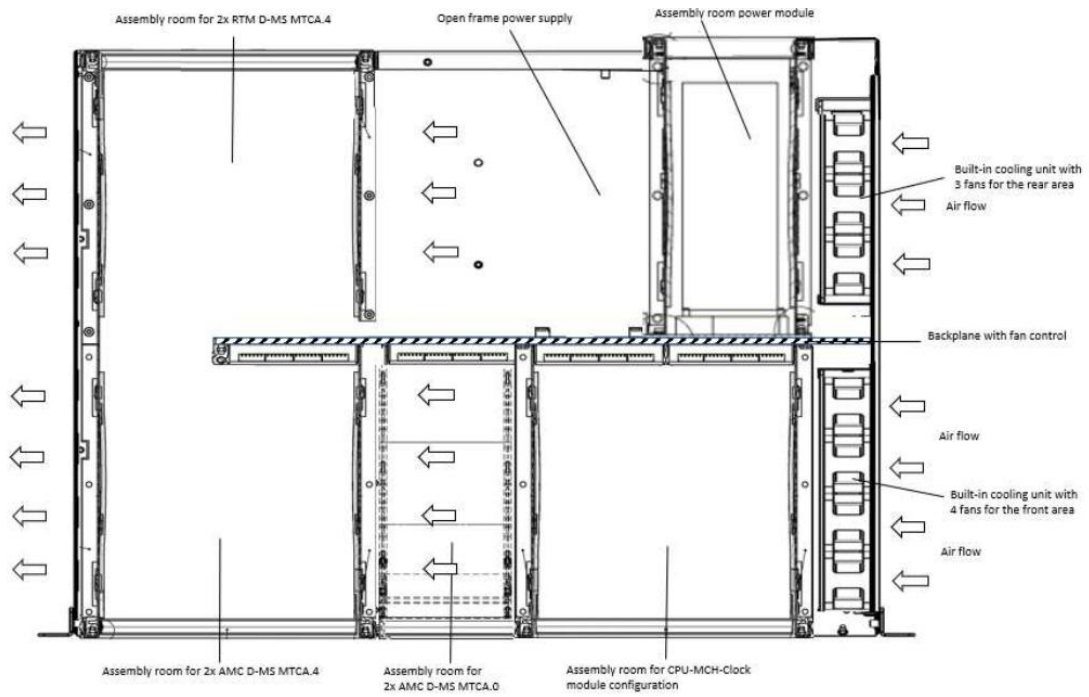
Table 3 – Front Panel Interfaces

Label	Description
DBG	COMex Debug Interface via Micro-USB B
GPIO	General Purpose I/O via Micro-D Connector
USB 1/2 + USB 3/4	2x 2 USB 3.0 Type A Recepts
RST	Reset Button
GbE	RJ45 Ethernet Jack
SFP1 + SFP2	SFP28 Interfaces to COMex
UPL1 + UPL2	2x MCH Front Uplink via SFP28-DD
DBG	MCH Debug Interface via Micro-USB B
CLK1 + CLK2	2x Clock I/O via SMA
GPS	GPS IN via SMC
HDMI	Graphics port via HDMI

4.3. Cooling Unit and Fans

The **NATIVE-server-R1** is equipped with seven 12 VDC fans in pull configuration. They are controlled by a temperature sensor and managed by a fan controller on the backplane. Cold air is taken from the right side and led through the system. Thus, a cooling power of 400W at an operating temperature of +55°C (short term) is ensured.

Figure 7 – Air Flow Direction



Air volume calculation:

Air volume:	V	
Heat dissipation:	P_v	= max. 400 W
Air constant:	f	= 3,3 m^3K/Wh
Temperature difference:	dT	= 10K or 15K (internal to ambient temperature)
Calculation formula:	V	= (f x P_v) / dT
Air volume @ dT = 10 K:	V	= 132,0 m^3/h (77,70 cfm)
Air volume @ dT = 15 K:	V	= 88,0 m^3/h (51,80 cfm)

Please note: These numbers are for orientation only. Due to varying assembly positions of the modules higher flow resistances must be considered which may influence the temperature behaviour in a negative way.

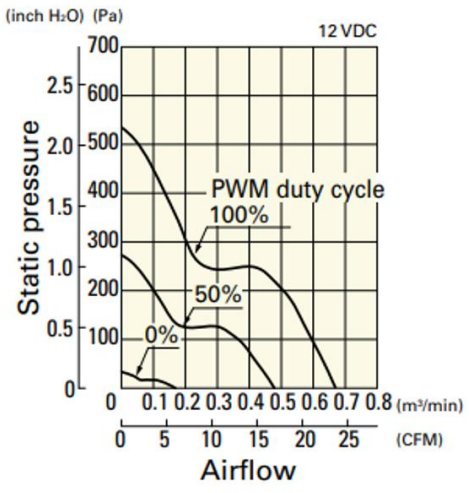
Fan Unit:

Six fans (four for the front area, two for the rear) are grouped as a unit which is controlled by a fan controller located on the backplane.

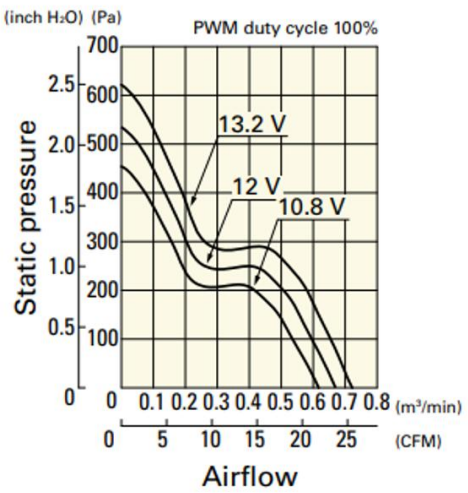
Nominal voltage	VDC	12	
Voltage range	VDC	10,8 .. 13,2	
Speed	min-1	max. 18.000 ± 10%	
Power consumption	W	5,88	
Min. ambient temperature	°C	-20	(operation)
	°C	-30	(storage)
Max. ambient temperature	°C	+70	(operation)
	°C	+70	(storage)
Air flow	m3/h	40,2	(23,7 cfm)
Sound pressure level	dB(A)	54	
Service life time L10 at 60°C	h	40.000	
Dimension	mm	40x40x28	
Weight	g	53	

Figure 8 – Technical Data Fans

PWM duty cycle



Operating voltage range



5. OPERATION AND CONFIGURATION

As the operation and configuration of the **NAT-MCH-G4** and the **NAT-AMC-COMex** correspond to the functionality of the stand-alone modules, please refer to the according documentation. The latest version can be found on our WEBSITE.

6. SPECIFICATIONS AND COMPLIANCES

6.1. Internal Reference Documentation

- **NATIVE-SERVER-R1**
- **NAT-MCH-G4**
- **NAT-AMC-COMEX**
- **NAT POWER MODULES**

6.2. Standards Compliance

- PICMG AMC Base Specification
- PICMG MTCA.0 Rev. 3
- PICMG MTCA.4
- CE, RoHS, IP20
- EN 60068-2-6, EN 60068-2-27, EN 62368-1
- IEC 61587-3, EN 61000-6-3, EN 6100-6-2

6.3. 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.

6.4. 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 relationships. 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.

6.5. Compliance to CE Directive

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

6.6. 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.

6.7. Abbreviation List

Table 4 – Abbreviation List

Abbreviation	Description
AC	Alternating Current
AMC	Advanced Mezzanine Card
BIOS	Basic Input/Output System
BMC	Base Management Controller
CLI	Commend Line Interface
CPU	Central Processing Unit
COM	Communication Port
EEPROM	Electrically Erasable Programmable Read Only Memory
eMCH	Embedded MCH
FLASH	Non-Volatile Memory
FRU	Field Replaceable Unit
FTP	File Transfer Protocol
GbE	Gigabit Ethernet
GUI	Graphical User Interface
HS	Hot-Swap
I^2C	Inter-Integrated Circuit
IP	Internet Protocol
IPMB	Intelligent Platform Management Bus
IPMI	Intelligent Platform Management Interface
JRE	Java Runtime Environment
LAN	Local Area Network
µC/MCU	Microcontroller (Unit)
MCH	µTCA Carrier Hub
µTCA	Micro Telecommunications Computing Architecture
OS	Operating System
RMCP	Remote Management Control Protocol
RTM	Rear Transition Module
SATA	Serial Advanced Technology Attachment
SDR	Sensor Data Repository
SEL	System Event Log
SMS	System Management Software
SNMP	Simple Network Management Protocol
SRAM	Static Random Access Memory
UDP	User Datagram Protocol
VAC	Volt Alternating Current
TCKL	Telecom Clock
USB	Universal Serial Bus

7. DOCUMENT'S HISTORY

Table 5 – Document's History

Rev	Date	Description	Author
1.0	27.10.2025	• initial release	se