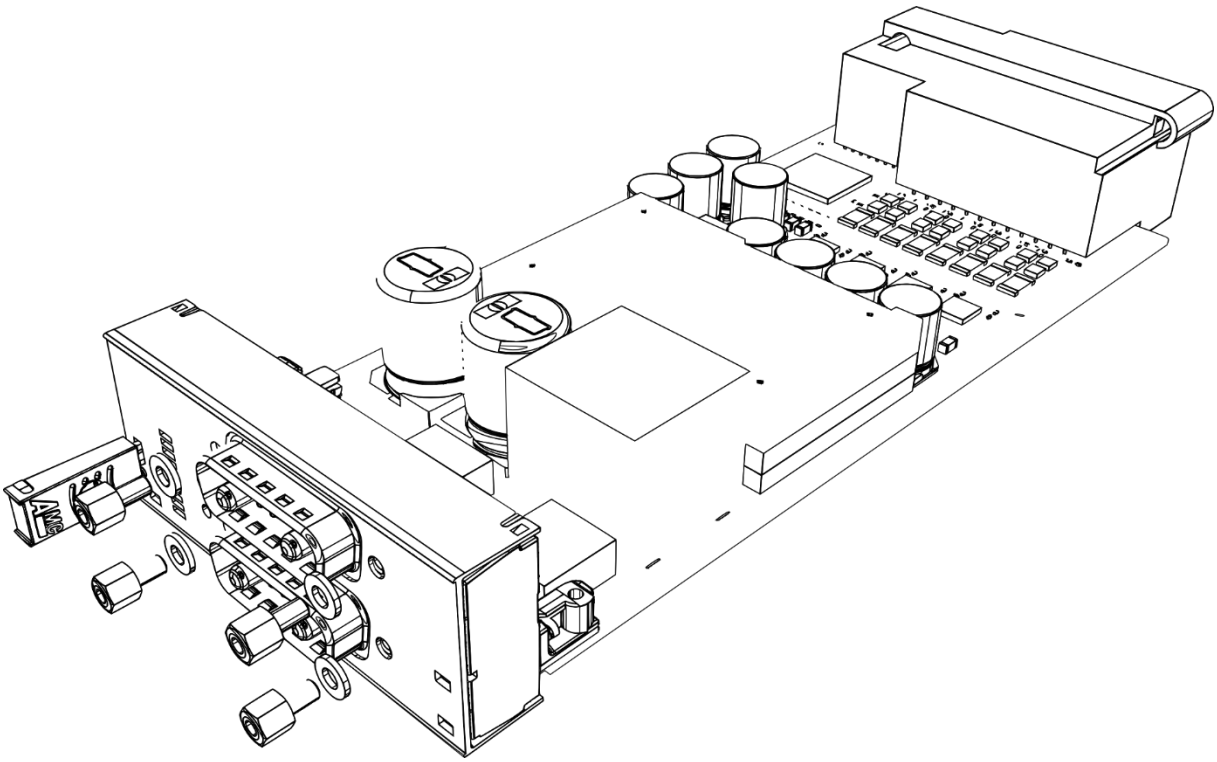
NAT-PM-DC48 / NAT-PM-600LV

DC POWER MODULES

DESIGNED BY N.A.T. GMBH



TECHNICAL REFERENCE MANUAL V2.0

HW REVISION 1.X

N.A.T. Gesellschaft für Netzwerk- und Automatisierungs-Technologie mbH
Konrad-Zuse-Platz 9 | 53227 Bonn, Germany | Phone: +49 228 965 864 - 0
sales@nateurope.com | www.nateurope.com

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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 This Document

This document is intended to give an overview on the **NAT-PM-DC48's** and **NAT-PM-DC600LV's** functional capabilities. Most information is valid for both variants, so – unless otherwise specified – for reasons of clarity it is referred to **NAT-MCH-DC** only.

Preface

General information about this document

Introduction

Abstract on the **NAT-PM-DC'** main functionality and application field

Quick Start

Important information and mandatory requirements to be considered before operating the **NAT-PM-DC** for the first time

Functional Description

Detailed information on the individual devices and the **NAT-PM-DC'** main features

Hardware

Information about LEDs and connectors

Operation

Basic information about operating the **NAT-PM-DC** e.g., airflow, firmware update, Power Module configuration etc.

Specifications and Compliances

Detailed list of specifications, abbreviations, and datasheets of components referred to in this document, as well as standards, the **NAT-PM-DC** complies to

Document's History

Revision record

Note:

It is assumed, that the **NAT-PM-DC** is handled by qualified personnel only!

2. INTRODUCTION

Today's complex communication systems with latest hardware and an increased number of AMCs make high demands regarding power consumption. Otherwise, heat dissipation becomes a problem in densely populated system. Thus, highly efficient Power Modules with excellent performance at the same time are crucial for a MicroTCA system.

Both variants of the **NAT-PM-DC** have managed the balancing act: highly integrated with superior performance of up to 1300W (**NAT-PM-DC48**, depending on assembly option), they are the market's most efficient Power Modules for all MicroTCA applications.

They provide payload and management power for up to 12 Advanced Mezzanine Cards (AMCs), 2 Cooling Units (CUs) and 2 MicroTCA carrier Hub (MCH) modules. So, a total of 16 independent 12V channels for payload power and 3.3V for management power are supplied. Moreover, they ensure backup power for other Power Modules (Shared Management Power, SMP) within the system.

The **NAT-PM-DC48** offers power conversion from two -48VDC input sources, whereas the **NAT-PM-600LV** is sourced from a primary supply of 24V.

The Power Module's software has been developed and debugged using the **NAT-MCH** as a reference tool. It is fully compatible with any cards or modules inserted into a MicroTCA chassis. Application areas are, for instance:

- commercial-, military-, and telecommunication applications
- automation test equipment
- medical or security tasks
- video demand services
- industrial machine control and other clustered computing applications

2.1. Main Features

Table 1 – Main Features

Form Factor		
	• Single-width, full-size Form Factor	
EMMC		
FPGA	• Lattice MachXO2	
Microcontroller	• Atmel ATXMega	
	NAT-PM-DC600LV	**NAT-PM-DC48**
12V Subsystem	• Max. power/channel: 80W / 6.6A@12V • Fast trip current limit: 8.3A • Max. inrush current: 19.4A • Accuracy 12V: +2% / -2% • Max. ripple @ 6.6A: <10mV	
3.3V Subsystem	• Max. channel current: 180mA • Fast trip current limit: 300mA • Accuracy 3.3V: +5% / -0% • Max. ripple @ 180mA: <20mV	
DC IN	• Dual +24V Power Input A/B • Range: +18V – +36V	• Dual -48V Power Input A/B • Range: -38V – -60V
Max. Output power (assembly option)	• 300W / 600W • Conversion efficiency (brick): 92%	• 860 W / 1300W • Conversion efficiency (brick): 97%
Insulation Input/Output	• 1500V	
Redundancy	• N+1 and 2+2	
Safety Standard	• SELV	
LEDs		
	• Standard AMC LEDs (Status, Fault, Hot-Swap) • LEDs for optical load indication	
Compliance		
	• MTCA.0 • MTCA.1 (**NAT-PM-DC48** only) • AMC.0 • IMPI • RoHS • EN55032:2012 +AC :2013 • EN61000-6-2:2005 +AC :2005	
Order Codes NAT-PM-DCxxxLV- [Option]		
600LV-ET	• 600W DC, dual +24VDC input, 12VDC and 3.3VDC output for 16 channels; extended temperature range: -40°C - +85°C	
300LV	• 300W DC, dual +24VDC input, 12VDC and 3.3VDC output for 16 channels	
600LV	• 600W DC, dual +24VDC input, 12VDC and 3.3VDC output for 16 channels	

Order Codes NAT-PM-DC48- [Option]	
1300-0.1SF	• 1300W full size single width, MTCA.1 compliant with retention screws
860-0.0SF	• 860W full size single width, MTCA.0 compliant
860-0.1SF	• 860W full size single width, MTCA.1 compliant with retention screws
1300-0.0SF	• 1300W full size single width, MTCA.0 compliant
Environmental	
Operating Environment	• Default temperature range: 0° to +55° Celsius • Extended temperature range: -40° to +85° Celsius • Humidity: 10% to 90% (non-condensing)
Storage Environment	• Default temperature range: -40° to +85° Celsius • Humidity: 10% to 90% (non-condensing)

3. QUICK START

To ensure proper functioning of the **NAT-PM-DC** during its usual lifetime, take the following precautions before handling the board.

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 connectors to ensure proper contact when connecting the **NAT-PM-DC** to the MTCA-System.

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

3.2. Mechanical Requirements

The installation requires a MicroTCA backplane and cooling devices.

Before installing or uninstalling the **NAT-PM-DC**, read the Installation Guide and the User's Manual of the **NAT-PM-DC** and the µTCA system the board will be plugged into.

Check all installed boards and 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 the **NAT-PM-DC** is connected with the connector(s) completely inserted.

When operating the board in areas of strong electromagnetic radiation, ensure that the module is bolted to the rear panel or rack, and shielded by closed housing.

3.3. Voltage Requirements

3.3.1. Power supply

NAT-PM-DC48: Dual -48V Power Input A/B (Range: -38V – -60V)

NAT-PM-DC600LV: Dual +24V Power Input A/B (Range: +18V – +36V)

3.3.2. Hot-Swap

The **NAT-PM-DC** supports hot-swapping, which means that the board can be inserted or extracted during normal system operation without affecting other modules.

Make sure to follow the procedure ***exactly*** to prevent the **NAT-PM-DC** or the system it is plugged into from damage!

Insertion of a hot-swap-capable module

- Ensure the module and the backplane support hot-swapping
- Ensure that the hot-swap-handle is in "unlock"-position (pulled out)
- Push the **NAT-PM-DC** carefully into the dedicated connector 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 detects the board
- If the information provided by the **NAT-PM-DC** is valid, the backplane enables payload power and the blue HS-LED turns off

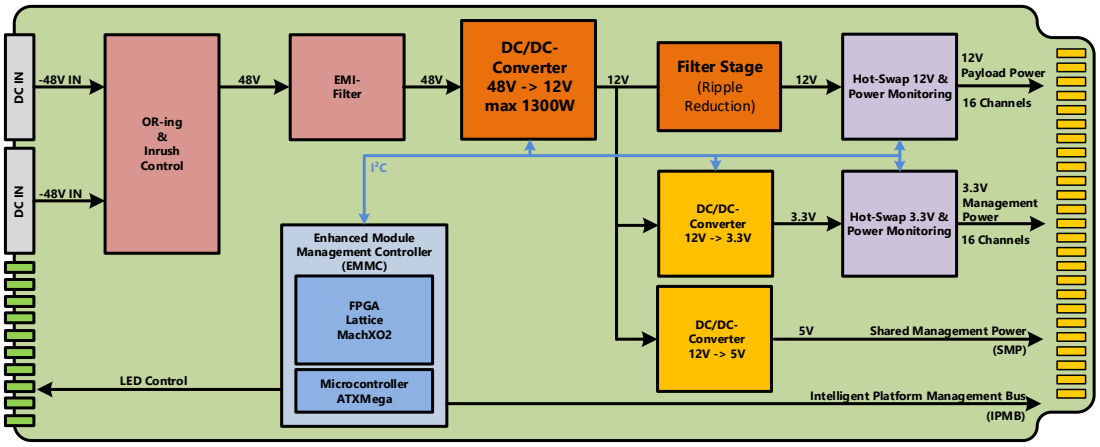
Extraction of a hot-swap-capable module

- Pull the hot-swap-handle in "unlock"-position
- The blue HS-LED starts blinking
- The IPMI-Controller of the backplane disables payload power
- The HS-LED turns solid on
- Pull the **NAT-PM-DC** carefully out of the backplane

4. FUNCTIONAL DESCRIPTION

Apart from the different input voltages, both variants of the **NAT-PM-DC** have basically the same design. Using the example of the **NAT-PM-DC48**, the following figures give an overview of the functional blocks.

Figure 1 – Block Diagram NAT-PM-DC48



4.1. EMMC

The **NAT-PM-DC** includes a robust Enhanced Module Management Controller (EMMC). It interfaces the power functionality via IPMB to the MCH.

4.2. Redundancy and Load Sharing

The **NAT-PM-DC** supports redundancy as well as load sharing modes in accordance with the MTCA specifications. Detailed information can be found in chapter 6.5 Power Channels and Power Module Configurations.

In case of an input power supply failure, the on-board EMMC can be supplied with SMP power by other power modules, so that the System/Carrier Manager is able to analyze root cause failure.

4.3. LED Indicators

The LED light bar at the front panel of the **NAT-PM-DC** shows the total power load of the module on a scale from 0 – 100% in real time.

4.4. Sensors

The **NAT-PM-DC** features several sensors to capture and monitor temperature-, voltage-, and current-conditions of the module. Details are shown in the following table:

Table 2 – Sensor Overview

Sensor #	Sensor Type	Name	Description
1	Temp	TBrick-A	Temperature of 24V/48V Converter Brick A
2	Temp	TBrick-B	Temperature of 24/48V Converter Brick B
3	Temp	T-Base	Temperature of Base Board
4	Voltage	VIN	Input Voltage
5	Voltage	VOUT-A	Output Voltage Channel A
6	Voltage	VOUT-B	Output Voltage Channel B
7	Voltage	12V	12V Monitoring
8	Voltage	3.3V	3.3V Monitoring
9	Current	I-Sum	Sum of all Power Channels
10	Current	Ch01 Current	Power Channel 1 – MCH1
11	Current	Ch02 Current	Power Channel 2 – MCH2
12	Current	Ch03 Current	Power Channel 3 – CU1
13	Current	Ch04 Current	Power Channel 4 – CU2
14	Current	Ch05 Current	Power Channel 5 – AMC1
15	Current	Ch06 Current	Power Channel 6 – AMC2
16	Current	Ch07 Current	Power Channel 7 – AMC3
17	Current	Ch08 Current	Power Channel 8 – AMC4
18	Current	Ch09 Current	Power Channel 9 – AMC5
19	Current	Ch10 Current	Power Channel 10 – AMC6
20	Current	Ch11 Current	Power Channel 11 – AMC7
21	Current	Ch12 Current	Power Channel 12 – AMC8
22	Current	Ch13 Current	Power Channel 13 – AMC9
23	Current	Ch14 Current	Power Channel 14 – AMC10
24	Current	Ch15 Current	Power Channel 15 – AMC11
25	Current	Ch16 Current	Power Channel 16 – AMC12

5. HARDWARE

5.1. Front Panel and LEDs

The **NAT-PM-DC** is equipped with various LEDs described in the following section.

Figure 2 – NAT-PM-DC48: Front Panel

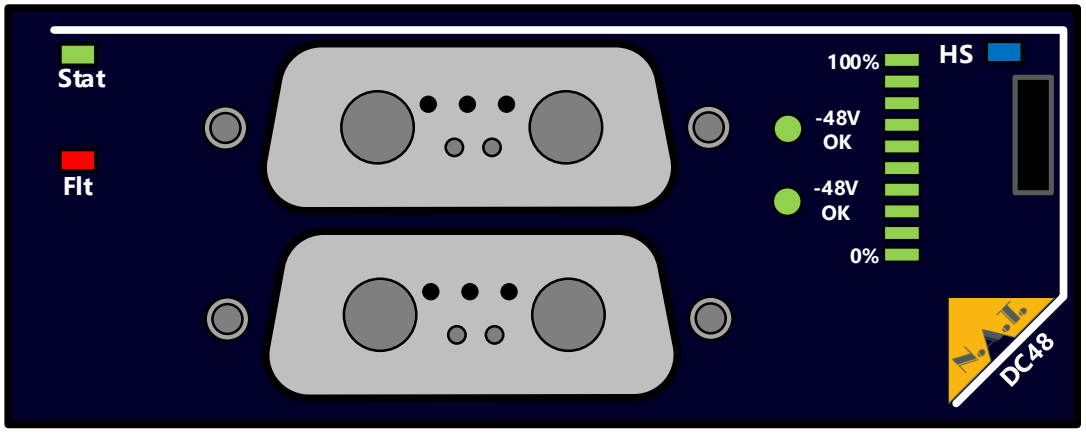
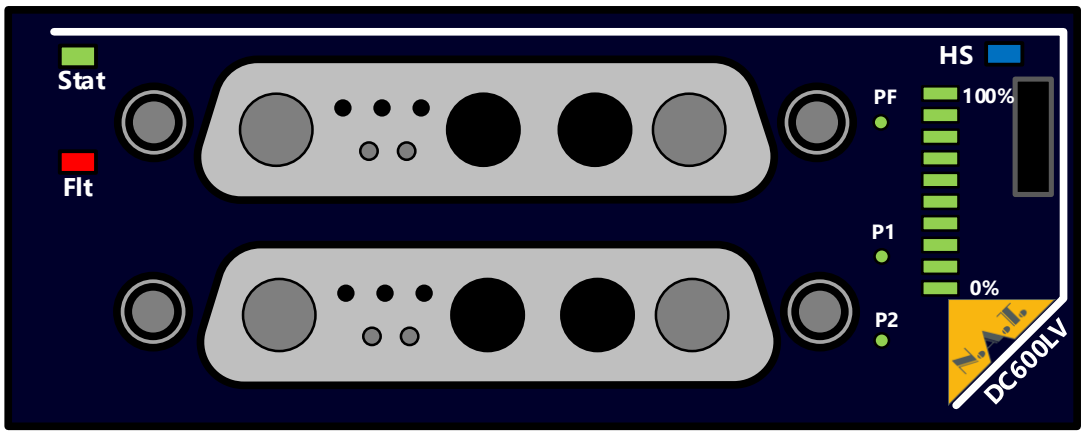


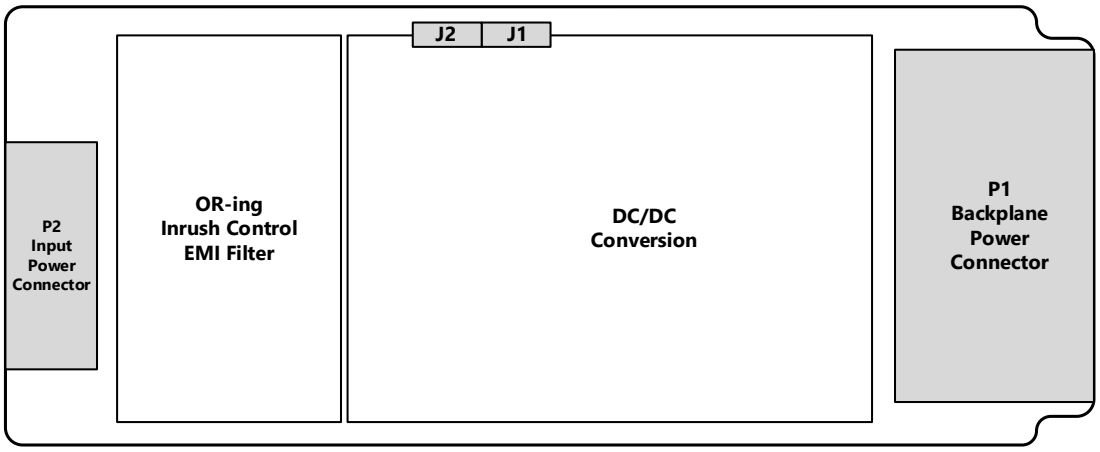
Figure 3 – NAT-PM-DC600LV: Front Panel



The module contains the standard LEDs consisting of a blue hot-swap LED, a red fault indication LED and an orange/green general purpose status LED controlled by the MMC. The fault indication LED turns to ***"On"*** if the temperature sensor registers a temperature value falling below or exceeding a threshold level. If the temperature returns to normal value, the LED is switched to ***"Off"*** again. For detailed information on the behavior of the HS-LED, please refer to chapter 3.3.2 Hot-Swap.

5.2. Connector- and Switch-Location NAT-PM-DC48

Figure 4 – NAT-PM-DC48 – Location Diagram



For standard interfaces, no further explanation is given. Please refer to the particular standards for more information.

Pin assignments and drawings of non-standard interfaces are described in the following paragraphs.

Connectors on top side: drawings imply the board is orientated with the PM connector to the ***right*** side

Connectors on bottom side: drawings imply the board is orientated with the PM connector to the ***left*** side

5.2.1. J1: Microcontroller Programming Header

J1 functions as microcontroller programming interface of the **NAT-PM-DC48**.

Figure 5 – J1: Microcontroller Programming Header

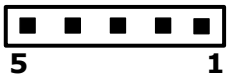


Table 3 – J1: Microcontroller Programming Header – Pin Assignment

Pin #	Signal	Signal	Pin #
1	PDI_DATA	+3.3V_EMMC	2
3	PDI_CLOCK	GND	4
5	Test		

5.2.2. J2: USB/Debug Interface

J2 is the USB / Debug interface of the **NAT-PM-DC48**.

Figure 6 – J2: USB / Debug Interface

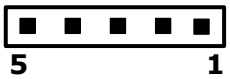


Table 4 – J2: Programming Header – Pin Assignment

Pin #	Signal	Signal	Pin #
1	Test	GND	2
3	DP	DN	4
5	VBUS		

5.2.3. P1 – Backplane Power Connector

The Backplane Power Connector is made up of two sections: high power pins (part A) and control signal and management power.

Table 5 – P1A: High Power Pins

Pin #	Signal	Signal	Pin #
1	PP_M1	PP_AMC1	13
2	PP_CU1	PP_AMC2	14
3	PP_CU2	PP_AMC3	15
4	GND	PP_AMC4	16
5	GND	PP_AMC5	17
6	GND	PP_AMC6	18
7	GND	PP_AMC7	19
8	GND	PP_AMC8	20
9	GND	PP_AMC9	21
10	GND	PP_AMC10	22
11	GND	PP_AMC11	23
12	PP_M2	PP_AMC12	24

Table 6 – 1B – Control Signal and Management Power

Pin #	A	B	C	D	E	F	G	H
1	PS_PM#	PM_OK#	PS1_M1#	PS1_CU1#	EN_M1#	EN_CU1#	MP_M1	MP_CU1
2	TCK	PMP_A#	PS1_2#	PS1_1#	EN_2#	EN_1#	MP_2	MP_1
3	TMS	PMP_B#	PS1_4#	PS1_3#	EN_4#	EN_3#	MP_4	MP_3
4	TRST#	PMP_C#	PS1_6#	PS1_5#	EN_6#	EN_5#	MP_6	MP_5
5	TDO	RST_PM_IN#	PS1_8#	PS1_7#	EN_8#	EN_7#	MP_8	MP_7
6	TDI	RST_PM_A#	PS1_10#	PS1_9#	EN_10#	EN_9#	MP_10	MP_9
7	GA0	RST_PM_B#	PS1_12#	PS1_11#	EN_12#	EN_11#	MP_12	MP_11
8	GA1	RST_PM_C#	PS1_M2#	PS1_CU2#	EN_M2#	EN_CU2#	MP_M2	MP_CU2
9	GA2	SMP	SCL_B	SDA_B	SCL_A	SDA_A	PWR_ON_M2	PWR_ON_M1

5.2.4. P2 A/B – Input Power Connectors

P2 A/B are the input power connectors of the **NAT-PM-DC48**.

Figure 7 – P2 A/B: Input Power Connectors

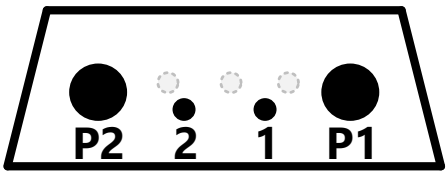


Table 7 – P2 A/B: Input Power Connectors

Pin #	Signal	Comment
P1	-48V Return	Input Power (+)
1	Control *	Control
2	Control Return*	Control
P2	-48V	Input Power (-)

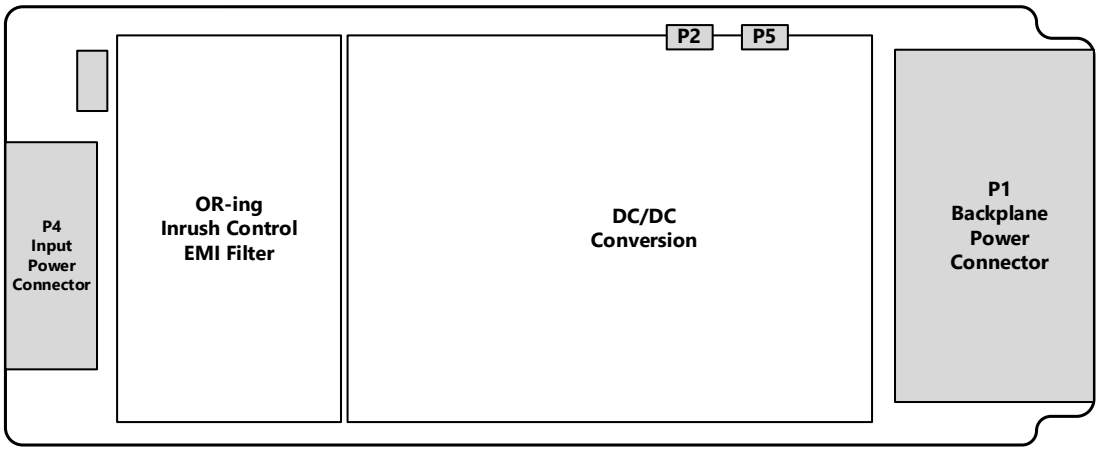
Note: the Control and Control Return pins shall be tied together in the external connector.

5.2.5. SW1: Hot-Swap-Switch

Switch SW1 is used to support hot-swapping of the module. It conforms to PICMG AMC.0.

5.3. Connector- and Switch-Location NAT-PM-DC600LV

Figure 8 – NAT-PM-DC600LV – Location Diagram



For standard interfaces, no further explanation is given. Please refer to the particular standards for more information.

Pin assignments and drawings of non-standard interfaces are described in the following paragraphs.

Connectors on top side: drawings imply the board is orientated with the PM connector to the ***right*** side

Connectors on bottom side: drawings imply the board is orientated with the PM connector to the ***left*** side

5.3.1. P2: USB/Debug Interface

P2 is the USB / Debug interface of the **NAT-PM- DC600LV**.

Figure 9 – P2: USB / Debug Interface

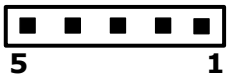


Table 8 – P2: Programming Header – Pin Assignment

Pin #	Signal	Signal	Pin #
1	Test	GND	2
3	DP	DN	4
5	VBUS		

5.3.2. P5: Microcontroller Programming Header

P5 functions as microcontroller programming interface of the **NAT-PM-DC600LV**.

Figure 10 – P5: Microcontroller Programming Header

Table 9 – P5: Microcontroller Programming Header – Pin Assignment

Pin #	Signal	Signal	Pin #
1	PDI_DATA	+3.3V_EMMC	2
3	PDI_CLOCK	GND	4
5	Test		

5.3.3. P1 – Backplane Power Connector

The Backplane Power Connector is made up of two sections: high power pins (part A) and control signal and management power.

Table 10 – P1A: High Power Pins

Pin #	Signal	Signal	Pin #
1	PP_M1	PP_AMC1	13
2	PP_CU1	PP_AMC2	14
3	PP_CU2	PP_AMC3	15
4	GND	PP_AMC4	16
5	GND	PP_AMC5	17
6	GND	PP_AMC6	18
7	GND	PP_AMC7	19
8	GND	PP_AMC8	20
9	GND	PP_AMC9	21
10	GND	PP_AMC10	22
11	GND	PP_AMC11	23
12	PP_M2	PP_AMC12	24

Table 11 – 1B – Control Signal and Management Power

Pin #	A	B	C	D	E	F	G	H
1	PS_PM#	PM_OK#	PS1_M1#	PS1_CU1#	EN_M1#	EN_CU1#	MP_M1	MP_CU1
2	TCK	PMP_A#	PS1_2#	PS1_1#	EN_2#	EN_1#	MP_2	MP_1
3	TMS	PMP_B#	PS1_4#	PS1_3#	EN_4#	EN_3#	MP_4	MP_3
4	TRST#	PMP_C#	PS1_6#	PS1_5#	EN_6#	EN_5#	MP_6	MP_5
5	TDO	RST_PM_IN#	PS1_8#	PS1_7#	EN_8#	EN_7#	MP_8	MP_7
6	TDI	RST_PM_A#	PS1_10#	PS1_9#	EN_10#	EN_9#	MP_10	MP_9
7	GA0	RST_PM_B#	PS1_12#	PS1_11#	EN_12#	EN_11#	MP_12	MP_11
8	GA1	RST_PM_C#	PS1_M2#	PS1_CU2#	EN_M2#	EN_CU2#	MP_M2	MP_CU2
9	GA2	SMP	SCL_B	SDA_B	SCL_A	SDA_A	PWR_ON_M2	PWR_ON_M1

5.3.4. P4 A/B – Input Power Connectors

P4 A/B are the input power connectors of the **NAT-PM-DC600LV**.

Figure 11 – P4 A/B: Input Power Connectors

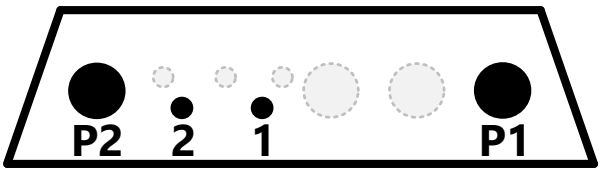


Table 12 – P4 A/B: Input Power Connectors

Pin #	Signal	Comment
P1	+24V Input	Input Power (+)
1	Control *	Control
2	Control Return*	Control
P2	+24V Return	Input Power (-)

Note: the Control and Control Return pins shall be tied together in the external connector.

5.3.5. SW1: Hot-Swap-Switch

Switch SW1 is used to support hot-swapping of the module. It conforms to PICMG AMC.0.

6. OPERATION

6.1. Insertion / Power up

After placing the **NAT-PM-DC** in a MTCA Rack the system is powered up as soon as the primary DC power source is available. The Cooling Unit(s) and MCH(s) are powered up in autonomous mode. As soon as the MCH has taken control over the system, the green WD LED starts to blink. From this time on the power module is under control of the MCH. The MCH is responsible for directing the power module to power up further AMCs in the system.

For detailed information about the Hot-Swap process, please refer to chapter 3.3.2 Hot-Swap.

6.2. Power down / Extraction

The power down / hot swap process is started by pulling the module's hot swap handle. In a non-redundant system the MCH will switch off payload and management power channels for the AMCs, Cooling Units, and the MCH itself. In a redundant system, finally the system remains powered by the second Power Module.

As soon as the power module's blue LED is solid on the module is ready for extraction.

For detailed information about the Hot-Swap process, please refer to chapter 3.3.2 Hot-Swap.

6.3. Airflow Requirements

All N.A.T. power modules do have very good conversion efficiencies. Nevertheless, still a certain amount of heat dissipation must be disposed by the airflow, in which a higher ambient temperature requires a higher airflow.

For detailed advice on your particular system, please contact NAT.

6.4. Firmware Update

The **NAT-PM-DC** supports firmware updates by the HPM (Hardware Platform Management) upgrade mechanism. Update files usually are provided in compressed format (.zip) and need to be un-compressed before the update can be executed. To get the latest firmware update, please contact N.A.T.

The update can be executed by **NATview** or any other IPMI /RMCP front end tool.

Please use the following ipmitool command to upgrade the power supply firmware:

ipmitool -H <MCH-IP Addr.> -P "" -B 0 -b 7 -T 0x82 -t 0xc2 hpm upgrade pm_ac1000_V112.hpm activate

To verify the installed version (after a power cycle), please use the following:

ipmitool -H <MCH-IP Addr.> -P "" -B 0 -b 7 -T 0x82 -t 0xc2 hpm check

where

0xc2 is the IP address of power module PM1

0xc4 is the IP address of power module PM2

0xc6 is the IP address of power module PM3

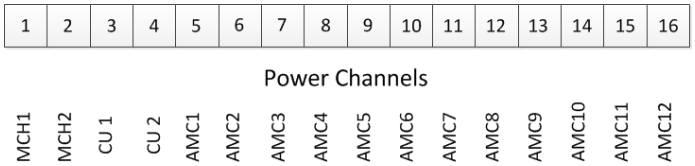
0xc8 is the IP address of power module PM4

More information regarding firmware updates can be found in the **NAT-MCH** User's Manual, chapter ***Ipmitool***.

6.5. Power Channels and Power Module Configurations

Up to16 power channels are available in an MTCA system, one power channel for every FRU (MCHs, CUs, and AMCs) in the system.

Figure 12 – Power Channels



To every power channel up to two Power Modules can be assigned, one primary and one secondary. The **NAT-MCH** firmware supports up to four Power Modules. With three or four Power Modules, it is possible to realize a N+1 redundancy or redundant load sharing configuration.

The most common setup scenarios are described in the following paragraphs.

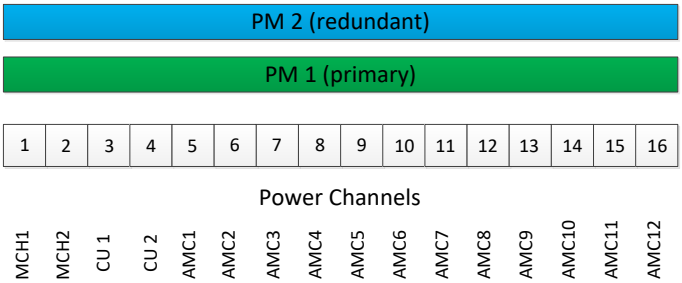
Information about the assignment and configuration of the Power Modules is stored in the backplane FRU, which can be configured via. **NATView**.

6.5.1. Power Module Setup #1: Redundancy (2 PMs)

A traditional redundant setup features two Power Modules, with every one of them assigned to every power channel. When the primary Power Module fails, the secondary Power Module will take over and the system will work further without interruption.

In a redundancy setup, only the power of one Power Module is available.

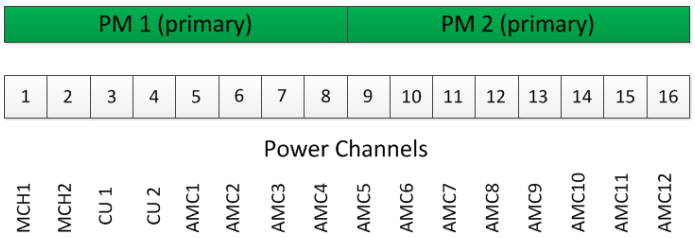
Figure 13 – Power Module Setup #1: Redundancy



6.5.2. Power Module Setup #2: Load Sharing (2 PMs)

In a load sharing configuration, only one Power Module is assigned to a power channel. The total power of all Power Modules can be used for the system, but when a Power Module fails, every FRU assigned to this Power Module also fails due to missing power.

Figure 14 – Power Module Setup #2: Load Sharing

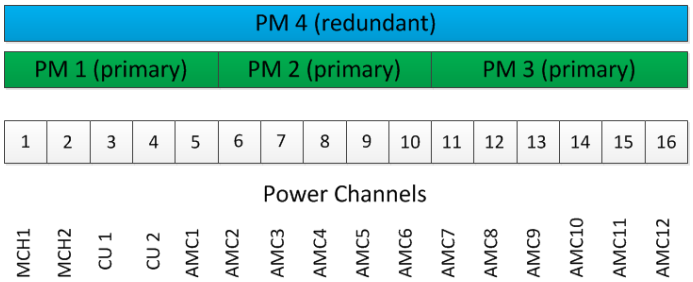


6.5.3. Power Module Setup #3: N+1 Redundancy (3/4 PMs)

An N+1 redundant configuration provides two or three primary Power Modules and one secondary Power Module. The power budget for the complete system is the sum of the primary Power Modules.

When one of the primary Power Modules fails, the secondary Power Module will take over immediately.

Figure 15 - Power Module Setup #3: N+1 Redundancy



7. SPECIFICATIONS AND COMPLIANCES

7.1. Internal Reference Documentation

- **NAT-MCH** User's Manual: https://nateurope.com/product/nat-mch/

7.2. External Reference Documentation

- Microchip ATxmega128 Microcontroller Datasheet, DS40002058A, Rev. A – 08/2018
- Lattice MachXO2 Family Datasheet, DS1035, V. 3.3 – 03/2017

7.3. Standards Compliance

- MTCA.0
- MTCA.1 (**NAT-PM-DC48** only)
- AMC.0
- IMPI
- EN55032:2012 +AC :2013
- EN61000-6-2:2005 +AC :2005

7.4. 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.

7.5. 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.

7.6. Compliance to CE Directive

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

7.7. 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.

7.8. Abbreviation List

Table 13 – 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
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
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

8. DOCUMENT'S HISTORY

Table 14 – Document's History

Rev	Date	Description	Author
1.0	20.06.2012	• Initial Release	hl
1.1	21.06.2012	• Added operating chapter and air flow requirements	hl
1.2	28.02.2013	• Added remark concerning dependency of output power on input voltage	hl
1.3	06.05.2013	• Added ripple voltage information, minor corrections	te
1.4	15.10.2013	• Added reference to **NAT-PM-DC840**	hl
1.5	15.10.2014 26.02.2015	• Adapted to new layout incl. new arrangement of chapters • Changed document's name from "User's Manual" to "Technical Reference Manual" • Removed information about **NAT-PM-DC780** due to end of life • Updated "List of used abbreviations" • Added Figure 1 (photo of the module) • Chapter 2: Corrected current value of max. channel current • Added chapter 3.5: "Sensors" • Added chapter 8: "Statement on Environmental Protection" • Added chapter 9: "Known Bugs and Restrictions" • Added Appendix A: "Reference Documentation" • Minor changes, such as typo correction etc. • Clarification of input power labelling	Se HL
1.6	05.08.2015	• Swapped Chapter Sensors and Application • Added remark that Output Power adaption has been removed with FW 1.13	HL
1.7	30.09.2015	• Removed statement for output power adaption	HL
1.8	14.7.2016	• Added reference to NAT-PM-DC600LV	HL
1.9	8.10.2020	• Removed reference to UL60950	HL
2.0	16.05.2023	• Complete rework of document • Added information about **NAT-PM-DC48** • Removed information about **NAT-PM-DC420** and **-DC840** due to end of life	se