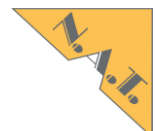


**NAT-AMC-COMEX**  
**AMC CARRIER WITH COMEXPRESS MODULE**  
**DESIGNED BY N.A.T. GMBH**

**TECHNICAL REFERENCE MANUAL V2.0**  
**HW REVISION 2.X**



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## 1. PREFACE

### 1.1. Disclaimer

The following documentation, compiled by N.A.T. GmbH (henceforth called N.A.T.), represents the current status of the product's development. The documentation is updated on a regular basis. Any changes which might ensue, including those necessitated by updated specifications, are considered in the latest version of this documentation. N.A.T. is under no obligation to notify any person, organization, or institution of such changes or to make these changes public in any other way.

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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-AMC-COMex**' functional capabilities.

#### ***Preface***

General information about this document

#### ***Introduction***

Abstract on the **NAT-AMC-COMex**' main functionality and application field

#### ***Quick Start***

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

#### ***Functional Description***

Detailed information on the individual devices and the **NAT-AMC-COMex**' main features

#### ***Hardware***

Information about LEDs and connectors

#### ***Specifications and Compliances***

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

#### ***Document's History***

Revision record

#### **Note:**

It is assumed, that the **NAT-AMC-COMex** is handled by qualified personnel only!



## 2. INTRODUCTION

Generally, the **NAT-AMC-COMex** is an COMExpress (COMex) carrier module in double-width and full-size AMC form factor. In combination with a compliant COMex module, it works as a general-purpose processor (PrAMC), storage, and graphic AMC.

The **NAT-AMC-COMex** supports any COMex module Type7 validated by NAT. It offers PCIe Gen4 x8 at ports 4-11 and 12-20 at the backplane. Moreover, it provides 2x 10G Ethernet via port0/1, 2x 25G Ethernet via SFP28 front uplink, and a 1G Ethernet link via RJ45 at the front panel.

One M.2 PCIe x4 interface is intended for mounting a memory device, a second one can be equipped with a graphic card. If so, the board provides an HDMI interface at the front panel.

Thus, the **NAT-AMC-COMex** offers a wide range of setups from well-priced to high-performing configurations.



### 2.1. Main Features

Table 1 – Main Features

| Form Factor                     |                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | <ul style="list-style-type: none"> <li>• Double-width, full-size AMC</li> <li>• Width: 147 mm, Depth: &lt;180.6 mm</li> </ul>                                                                  |
| Mounting Slot                   |                                                                                                                                                                                                |
|                                 | <ul style="list-style-type: none"> <li>• For any type of COMExpress-Type 7 module validated by N.A.T.</li> </ul>                                                                               |
| On-Board Resources COMex Type-7 |                                                                                                                                                                                                |
| <b>MMC</b>                      | <ul style="list-style-type: none"> <li>• Microchip ATxmega128</li> </ul>                                                                                                                       |
| <b>Ethernet Controller</b>      | <ul style="list-style-type: none"> <li>• Dual 25G Intel Ethernet Controller E810-XXVAM2</li> </ul>                                                                                             |
| <b>Storage</b>                  | <ul style="list-style-type: none"> <li>• MicroSD-Card</li> <li>• M.2 PCIe x4 memory interface for SSD, FLASH</li> </ul>                                                                        |
| <b>Graphic</b>                  | <ul style="list-style-type: none"> <li>• M.2 PCIe x4 graphic module (option)</li> </ul>                                                                                                        |
| <b>Front Panel Connections</b>  | <ul style="list-style-type: none"> <li>• HDMI port (option)</li> <li>• 4x USB 3.0</li> <li>• 1x 1G Ethernet vis RJ45</li> <li>• 2x SFP28 (25G Ethernet)</li> <li>• Debug</li> </ul>            |
| <b>Backplane Interconnect</b>   | <ul style="list-style-type: none"> <li>• IPMI</li> <li>• AMC Port 0/1: 10G-KR</li> <li>• AMC Port 2/3: SAS / SATA</li> <li>• AMC Port 4-11 / 12-20: PCIe x8 Gen4</li> <li>• TCKLA-D</li> </ul> |
| LEDs                            |                                                                                                                                                                                                |
|                                 | <ul style="list-style-type: none"> <li>• Standard AMC LEDs (Status, Fault, Hot-Swap)</li> </ul>                                                                                                |
| Compliance                      |                                                                                                                                                                                                |
|                                 | <ul style="list-style-type: none"> <li>• MTCA.0 / MTCA.4</li> <li>• AMC.0</li> <li>• AMC.1</li> <li>• AMC.2</li> <li>• IMPI V2.0</li> <li>• HPM.1</li> </ul>                                   |
| Environmental                   |                                                                                                                                                                                                |
| <b>Operating Environment</b>    | <ul style="list-style-type: none"> <li>• default: 0 to +50 degrees Celsius</li> <li>• Humidity: 5% to 95% (non-condensing)</li> </ul>                                                          |
| <b>Storage Environment</b>      | <ul style="list-style-type: none"> <li>• default: -40 to +100 degrees Celsius</li> <li>• Humidity: 5% to 95% (non-condensing)</li> </ul>                                                       |

### 3. QUICK START

To ensure proper functioning of the **NAT-AMC-COMex** 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-AMC-COMex** 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, a power supply, and cooling devices.

Before installing or uninstalling the **NAT-AMC-COMex**, read the Installation Guide and the User's Manual of the **NAT-AMC-COMex** and the  $\mu$ TCA 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-AMC-COMex** 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

The power supply for the **NAT-AMC-COMex** must meet the following specifications:

***Carrier Board: +12V / 0.5A max. (without COMex module)***

***Additional power consumption according to attached COM Express module***

### 3.3.2. Hot-Swap

The **NAT-AMC-COMex** 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-AMC-COMex** 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-AMC-COMex** 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-AMC-COMex** 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-AMC-COMex** carefully out of the backplane

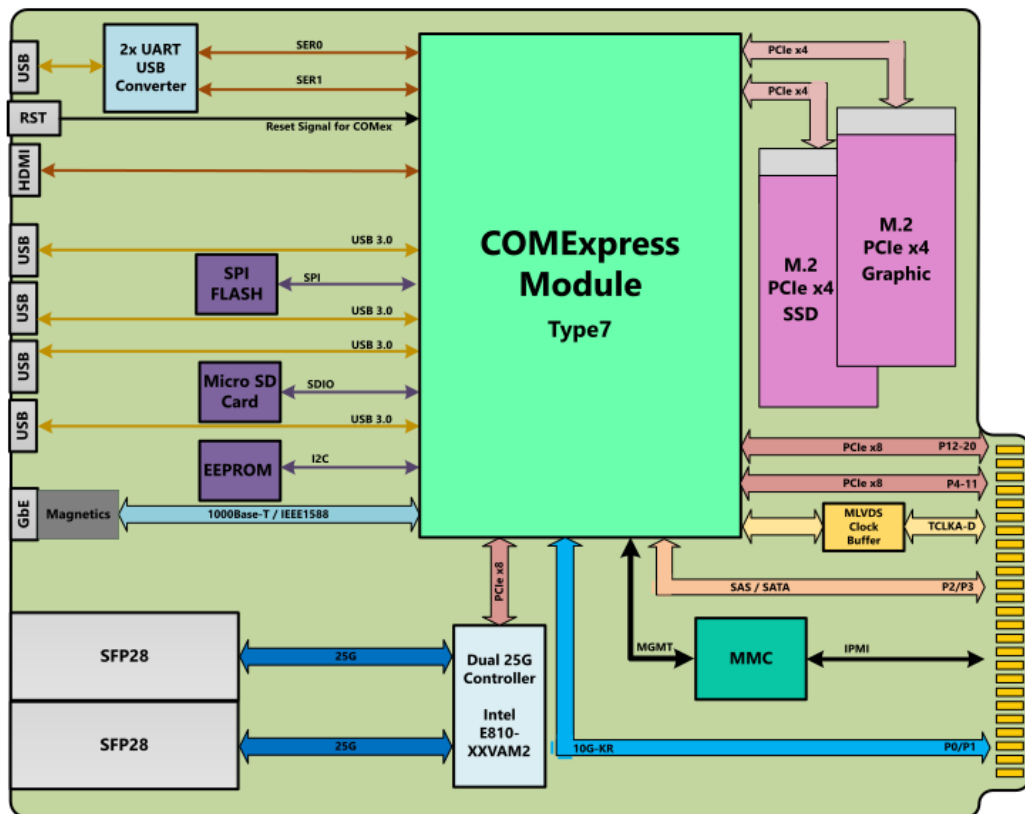


## 4. FUNCTIONAL DESCRIPTION

Essentially, the **NAT-AMC-COMex** works as COMExpress carrier module, so the board itself does not include too many complex functional blocks. Hence the block diagrams below show the interwork with a COMExpress module only.

The following figures give an overview of the functional blocks.

**Figure 1 – Block Diagram NAT-AMC-COMex**



### 4.1. M.2 Interface

Originally, the M.2 interface was intended as pure mass storage interface, but meanwhile also solutions for connecting e.g. an LTE- or WIFI-module are available.

The **NAT-AMC-COMex** owns two M.2 interfaces; one is intended to be used with an SSD or FLASH memory, and a second M.2 interface can be equipped with a graphic module. In this case, the carrier provides an HDMI interface at the front panel.

### 4.2. Memory

SPI FLASH, EEPROM (both for internal use), and a MicroSD-Card are attached to the COMex module.

### 4.3. Gigabit Ethernet Controller and Multiplexing

The **NAT-AMC-COMex** features an Intel E810-XXVAM2 Dual 25G Ethernet Controller. This controller is connected via an PCIe x8 link to the COMex module and provides 25G Ethernet to the SFP28 interfaces at the front panel.

10G Ethernet to Port 0/1 is directly connected to the COMex module as well as the SerDes PCIe Gen4 x8 connections at Port 4-11 and Port 12-20. Moreover, SAS / SATA to Port 2/3 is supported.

### 4.4. MMC

A Microchip ATxmega128 works as Module Management Controller (MMC).

### 4.5. Front Panel Interfaces

#### 4.5.1. Graphical Interface

If an M.2 graphic module is installed, an HDMI connector provides a graphical interface at the front panel.

#### 4.5.2. USB Interface

The **NAT-AMC-COMex** features four USB 3.0 interfaces at the front panel.

#### 4.5.3. Ethernet Port

The **NAT-AMC-COMex** features a 1000Base-T interface at the front panel via an RJ45 connector.



### 4.5.4. SFP28 Interface

The **NAT-AMC-COMex** provides a dual SFP28 interface with up to 25G Ethernet at the front panel.

### 4.5.5. Debug Interface

Per default, both interfaces of the USB-to-UART bridge are connected to the two serial ports of the COMExpress module (CE\_SER1 and CE\_SER0).

The debug interface is accessible via a Micro-USB connector at the front panel.

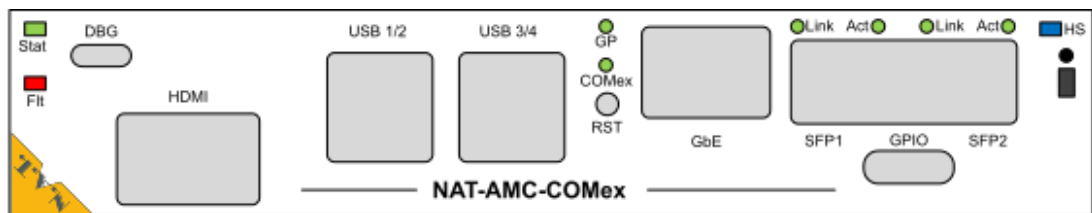


### 5. HARDWARE

#### 5.1. Front Panel and LEDs

The **NAT-AMC-COMex** is equipped with various LEDs described in the following section.

**Figure 2 – NAT-AMC-COMex: Front Panel**



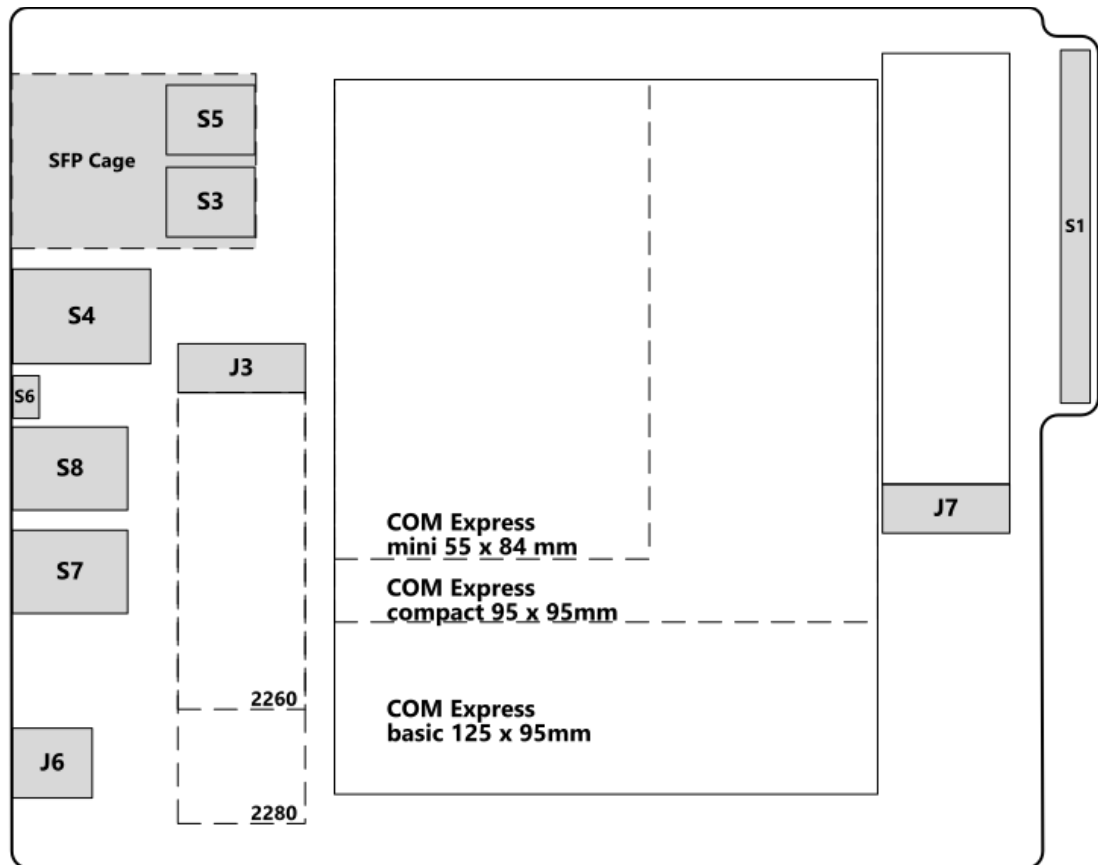
**Table 2 – Front Panel LEDs**

| Label        | Color  | Behaviour  | Description                                     |
|--------------|--------|------------|-------------------------------------------------|
| SFP 1/2 Link | green  | Fast flash | 25G                                             |
|              |        | Slow blink | 10G                                             |
|              |        | OFF        | No link available                               |
| SFP 1/2 Act  | green  | Solid ON   | SFP interface active                            |
|              |        | OFF        | SFP interface inactive                          |
| COMex        | green  | Solid ON   | COMex active                                    |
|              |        | OFF        | COMex inactive                                  |
| GP           | green  | tbd        | controlled by Microcontroller                   |
| Stat         | green  |            | General purpose status LED                      |
|              | orange |            | controlled by Microcontroller                   |
| Flt          | red    | Solid ON   | Fault LED: temperature exceeds range            |
| HS           | blue   |            | Hot-Swap LED<br>refer to chapter 3.3.2 Hot-Swap |

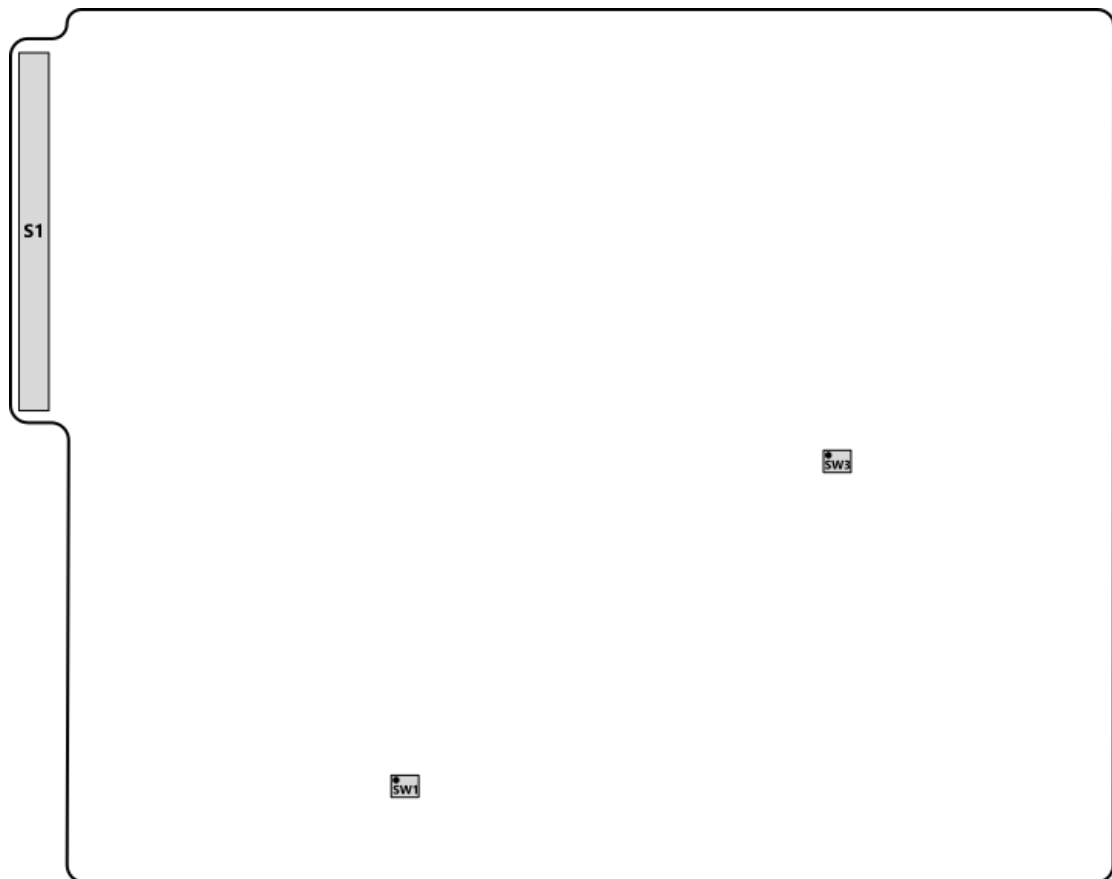
Two LEDs integrated in the RJ45 Ethernet jack are driven directly by the COMExpress GBE0\_LINK#, GBE0\_LINK100#, GBE0\_LINK1000n, and GBE0\_ACT# signals.

## 5.2. Connector- and Switch-Location

Figure 3 – NAT-AMC-COMex – Location Diagram – Top



**Figure 4 - NAT-AMC-COMex – Location Diagram – Bottom**



Assignments from connector labelling to function can be found in the table below.

**Table 3 – Connector Labelling and Function**

| Label                | Description                                                                         |
|----------------------|-------------------------------------------------------------------------------------|
| J2 A-D (below COMex) | Connectors to COMex Module                                                          |
| J3                   | M.2 Interface for mass storage device via NVME-PCIe bus with a length of 60 or 80mm |
| J6                   | Debug Interface via Micro-USB B                                                     |
| J7                   | M.2 Interface for graphic module                                                    |
| S1                   | Standard AMC-Edge Connector                                                         |
| S3 + S5              | SFP28 Interfaces                                                                    |
| S4                   | RJ45 Connector                                                                      |
| S6                   | Reset Switch                                                                        |
| S7 + S8              | 2x 2 USB 3.0 Type A Recepts                                                         |
| SW1                  | Dual Dip Switch, connected to MMC                                                   |
| SW3                  | Dual Dip Switch for Boot Select                                                     |

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 AMC connector to the *right* side

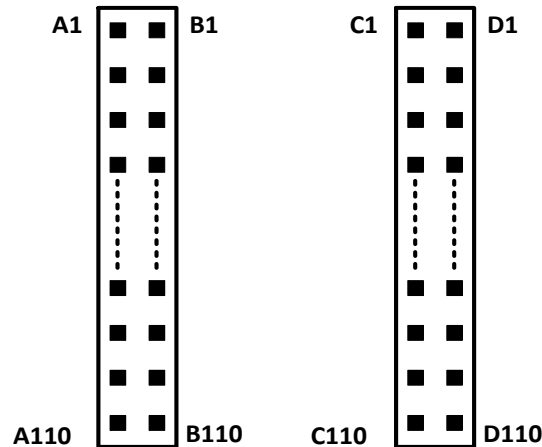
**Connectors on bottom side:** drawings imply the board is orientated with the AMC connector to the *left* side



### 5.2.1. J2 A/B and J2 C/D: COMExpress Module Connectors

Connectors J2 A/B and J1 C/D connect the COMExpress module to the carrier board.

**Figure 5 – J2 A/B and J2 C/D: COMExpress Module Connectors**



**Table 4 – J2 A/B: COMExpress Module Connector – Pin Assignment**

| Pin # | Signal         | Signal       | Pin # |
|-------|----------------|--------------|-------|
| A1    | GND            | GND          | B1    |
| A2    | GBE0_MDI3_N    | GBE0_ACTn    | B2    |
| A3    | GBE0_MDI3_P    | nc           | B3    |
| A4    | GBE0_LINK100n  | nc           | B4    |
| A5    | GBE0_LINK1000n | nc           | B5    |
| A6    | GBE0_MDI2_N    | nc           | B6    |
| A7    | GBE0_MDI2_P    | nc           | B7    |
| A8    | GBE0_LINKn     | nc           | B8    |
| A9    | GBE0_MDI1_N    | nc           | B9    |
| A10   | GBE0_MDI1_P    | nc           | B10   |
| A11   | GND            | GND          | B11   |
| A12   | GBE0_MDI0_N    | CE_PWRBTN#   | B12   |
| A13   | GBE0_MDI0_P    | CE_SMB_CLK   | B13   |
| A14   | GBE0_CTREF     | CE_SMB_DAT   | B14   |
| A15   | CE_SUS_S3#     | SMB_ALERTn   | B15   |
| A16   | nc             | nc           | B16   |
| A17   | nc             | nc           | B17   |
| A18   | CE_SUS_S4#     | CE_SUS_STAT# | B18   |
| A19   | nc             | nc           | B19   |
| A20   | nc             | nc           | B20   |
| A21   | GND            | GND          | B21   |
| A22   | nc             | nc           | B22   |
| A23   | nc             | nc           | B23   |
| A24   | CE_SUS_S5#     | CE_PWR_OK    | B24   |
| A25   | nc             | nc           | B25   |
| A26   | nc             | nc           | B26   |

| Pin # | Signal        | Signal        | Pin # |
|-------|---------------|---------------|-------|
| A27   | CE_BATLOW#    | nc            | B27   |
| A28   | ATA_ACT#      | nc            | B28   |
| A29   | nc            | nc            | B29   |
| A30   | nc            | nc            | B30   |
| A31   | GND           | GND           | B31   |
| A32   | nc            | SPEAKER       | B32   |
| A33   | nc            | CE_I2C_CK     | B33   |
| A34   | CE_BIOS_DIS0n | CE_I2C_DAT    | B34   |
| A35   | CE_THRMTRIP#  | CE_THRM#      | B35   |
| A36   | nc            | nc            | B36   |
| A37   | nc            | nc            | B37   |
| A38   | nc            | nc            | B38   |
| A39   | nc            | nc            | B39   |
| A40   | nc            | nc            | B40   |
| A41   | GND           | GND           | B41   |
| A42   | USB2_N        | USB3_N        | B42   |
| A43   | USB2_P        | USB3_P        | B43   |
| A44   | USB_2_3_OCn   | USB_0_1_OCn   | B44   |
| A45   | USB0_N        | USB1_N        | B45   |
| A46   | USB0_P        | USB1_P        | B46   |
| A47   | VCC_RTC       | nc            | B47   |
| A48   | nc            | nc            | B48   |
| A49   | nc            | CE_SYS_RESET# | B49   |
| A50   | nc            | CE_CB_RESET#  | B50   |
| A51   | GND           | GND           | B51   |
| A52   | nc            | nc            | B52   |
| A53   | nc            | nc            | B53   |
| A54   | SD_DATA0      | SD_CMD        | B54   |
| A55   | PCIE1-TX0_P   | PCIE1-RX0_P   | B55   |
| A56   | PCIE1-TX0_N   | PCIE1-RX0_N   | B56   |
| A57   | GND           | SD_WP         | B57   |
| A58   | PCIE0-TX3_P   | PCIE0-RX3_P   | B58   |
| A59   | PCIE0-TX3_N   | PCIE0-RX3_N   | B59   |
| A60   | GND           | GND           | B60   |
| A61   | PCIE0-TX2_P   | PCIE0-RX2_P   | B61   |
| A62   | PCIE0-TX2_N   | PCIE0-RX2_N   | B62   |
| A63   | SD_DATA1      | SD_CDn        | B63   |
| A64   | PCIE0-TX1_P   | PCIE1-Rx+     | B64   |
| A65   | PCIE0-TX1_N   | PCIE1-Rx-     | B65   |
| A66   | GND           | WAKE0#        | B66   |
| A67   | SD_DATA2      | WAKE1#        | B67   |
| A68   | PCIE0-TX0_P   | PCIE0-RX0_P   | B68   |
| A69   | PCIE0-TX0_N   | PCIE0-RX0_N   | B69   |
| A70   | GND           | GND           | B70   |
| A71   | nc            | nc            | B71   |
| A72   | nc            | nc            | B72   |
| A73   | nc            | nc            | B73   |
| A74   | nc            | nc            | B74   |
| A75   | nc            | nc            | B75   |
| A76   | nc            | nc            | B76   |



| Pin # | Signal         | Signal        | Pin # |
|-------|----------------|---------------|-------|
| A77   | nc             | nc            | B77   |
| A78   | nc             | nc            | B78   |
| A79   | nc             | nc            | B79   |
| A80   | GND            | GND           | B80   |
| A81   | nc             | nc            | B81   |
| A82   | nc             | nc            | B82   |
| A83   | nc             | nc            | B83   |
| A84   | nc             | +5V           | B84   |
| A85   | SD_DATA3       | +5V           | B85   |
| A86   | nc             | +5V           | B86   |
| A87   | nc             | +5V           | B87   |
| A88   | PCIE_CLK_REF_P | CE_BIOS_DIS1n | B88   |
| A89   | PCIE_CLK_REF_N | nc            | B89   |
| A90   | GND            | GND           | B90   |
| A91   | SPI_PWR        | nc            | B91   |
| A92   | CE_SPI_MISO    | nc            | B92   |
| A93   | SD_CLK         | nc            | B93   |
| A94   | CE_SPI_CLK     | nc            | B94   |
| A95   | CE_SPI_MOSI    | nc            | B95   |
| A96   | nc             | nc            | B96   |
| A97   | CE_TYPE10n     | CE_SPI_CSn    | B97   |
| A98   | CE_SER0_TX     | nc            | B98   |
| A99   | CE_SER0_RX     | nc            | B99   |
| A100  | GND            | GND           | B100  |
| A101  | CE_SER1_TX     | nc            | B101  |
| A102  | CE_SER1_RX     | nc            | B102  |
| A103  | nc             | #SLEEP        | B103  |
| A104  | +12V_CE        | +12V_CE       | B104  |
| A105  | +12V_CE        | +12V_CE       | B105  |
| A106  | +12V_CE        | +12V_CE       | B106  |
| A107  | +12V_CE        | +12V_CE       | B107  |
| A108  | +12V_CE        | +12V_CE       | B108  |
| A109  | +12V_CE        | +12V_CE       | B109  |
| A110  | GND            | GND           | B110  |

**Table 5 – J2 C/D: COMExpress Module Connector – Pin Assignment**

| Pin # | Signal      | Signal      | Pin # |
|-------|-------------|-------------|-------|
| C1    | GND         | GND         | D1    |
| C2    | GND         | GND         | D2    |
| C3    | USB0_SSRX_N | USB0_SSTX_N | D3    |
| C4    | USB0_SSRX_P | USB0_SSTX_P | D4    |
| C5    | GND         | GND         | D5    |
| C6    | USB1_SSRX_N | USB1_SSTX_N | D6    |
| C7    | USB1_SSRX_P | USB1_SSTX_P | D7    |
| C8    | GND         | GND         | D8    |
| C9    | USB2_SSRX_N | USB2_SSTX_N | D9    |
| C10   | USB2_SSRX_P | USB2_SSTX_P | D10   |
| C11   | GND         | GND         | D11   |



| Pin # | Signal          | Signal             | Pin # |
|-------|-----------------|--------------------|-------|
| C12   | USB3_SSRX_N     | USB3_SSTX_N        | D12   |
| C13   | USB3_SSRX_P     | USB3_SSTX_P        | D13   |
| C14   | GND             | GND                | D14   |
| C15   | nc              | DDI1_AUX_P         | D15   |
| C16   | nc              | DDI1_AUX_N         | D16   |
| C17   | nc              | nc                 | D17   |
| C18   | nc              | nc                 | D18   |
| C19   | PCIE1-RX2_P     | PCIE1-TX2_P        | D19   |
| C20   | PCIE1-RX2_N     | PCIE1-TX2_N        | D20   |
| C21   | GND             | GND                | D21   |
| C22   | PCIE1-RX3_P     | PCIE1-TX3_P        | D22   |
| C23   | PCIE1-RX3_N     | PCIE1-TX3_N        | D23   |
| C24   | DDI1_HPD        | nc                 | D24   |
| C25   | nc              | nc                 | D25   |
| C26   | 10G_KR3_RX_P    | DDI1_PAIR0_P       | D26   |
| C27   | 10G_KR3_RX_N    | DDI1_PAIR0_N       | D27   |
| C28   | nc              | nc                 | D28   |
| C29   | 10G_KR2_RX_P    | DDI1_PAIR1_P       | D29   |
| C30   | 10G_KR2_RX_N    | DDI1_PAIR1_N       | D30   |
| C31   | GND             | GND                | D31   |
| C32   | nc              | DDI1_PAIR2_P       | D32   |
| C33   | nc              | DDI1_PAIR2_N       | D33   |
| C34   | nc              | DDI1_DDC_AUX_SEL_R | D34   |
| C35   | nc              | 10G_PHY_CAP01      | D35   |
| C36   | nc              | DDI1_PAIR3_P       | D36   |
| C37   | nc              | DDI1_PAIR3_N       | D37   |
| C38   | 10G_KR1_SFP_SDA | 10G_KR1_SFP_SCL    | D38   |
| C39   | 10G_KR0_SFP_SDA | 10G_KR0_SFP_SCL    | D39   |
| C40   | nc              | nc                 | D40   |
| C41   | GND             | GND                | D41   |
| C42   | 10G_KR1_RX_P    | 10G_KR1_TX_P       | D42   |
| C43   | 10G_KR1_RX_N    | 10G_KR1_TX_N       | D43   |
| C44   | nc              | nc                 | D44   |
| C45   | nc              | nc                 | D45   |
| C46   | nc              | nc                 | D46   |
| C47   | nc              | nc                 | D47   |
| C48   | nc              | nc                 | D48   |
| C49   | 10G_KR0_RX_P    | 10G_KR0_TX_P       | D49   |
| C50   | 10G_KR0_RX_N    | 10G_KR0_TX_N       | D50   |
| C51   | GND             | GND                | D51   |
| C52   | PORT4-Rx_P      | PORT4-Tx_P         | D52   |
| C53   | PORT4-Rx_N      | PORT4-Tx_N         | D53   |
| C54   | CE_TYPE0n       | GND                | D54   |
| C55   | PORT5-Rx_P      | PORT5-Tx_P         | D55   |
| C56   | PORT5-Rx_N      | PORT5-Tx_N         | D56   |
| C57   | CE_TYPE1n       | CE_TYPE2n          | D57   |
| C58   | PORT6-Rx_P      | PORT6-Tx_P         | D58   |
| C59   | PORT6-Rx_N      | PORT6-Tx_N         | D59   |
| C60   | GND             | GND                | D60   |
| C61   | PORT7-Rx_P      | PORT7-Tx_P         | D61   |



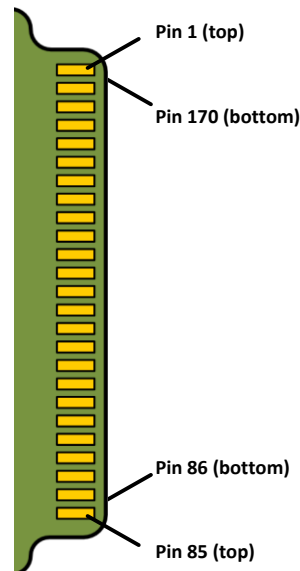
| Pin # | Signal         | Signal      | Pin # |
|-------|----------------|-------------|-------|
| C62   | PORT7-Rx_N     | PORT7-Tx_N  | D62   |
| C63   | nc             | nc          | D63   |
| C64   | nc             | nc          | D64   |
| C65   | PORT8-Rx_P     | PORT8-Tx_P  | D65   |
| C66   | PORT8-Rx_N     | PORT8-Tx_N  | D66   |
| C67   | RAPID_SHUTDOWN | GND         | D67   |
| C68   | PORT9-Rx_P     | PORT9-Tx_P  | D68   |
| C69   | PORT9-Rx_N     | PORT9-Tx_N  | D69   |
| C70   | GND            | GND         | D70   |
| C71   | PORT10-Rx_P    | PORT10-Tx_P | D71   |
| C72   | PORT10-Rx_N    | PORT10-Tx_N | D72   |
| C73   | GND            | GND         | D73   |
| C74   | PORT11-Rx_P    | PORT11-Tx_P | D74   |
| C75   | PORT11-Rx_N    | PORT11-Tx_N | D75   |
| C76   | GND            | GND         | D76   |
| C77   | nc             | nc          | D77   |
| C78   | PORT12-Rx_P    | PORT12-Tx_P | D78   |
| C79   | PORT12-Rx_N    | PORT12-Tx_N | D79   |
| C80   | GND            | GND         | D80   |
| C81   | PORT13-Rx_P    | PORT13-Tx_P | D81   |
| C82   | PORT13-Rx_N    | PORT13-Tx_N | D82   |
| C83   | nc             | nc          | D83   |
| C84   | GND            | GND         | D84   |
| C85   | PORT14-Rx_P    | PORT14-Tx_P | D85   |
| C86   | PORT14-Rx_N    | PORT14-Tx_N | D86   |
| C87   | GND            | GND         | D87   |
| C88   | PORT15-Rx_P    | PORT15-Tx_P | D88   |
| C89   | PORT15-Rx_N    | PORT15-Tx_N | D89   |
| C90   | GND            | GND         | D90   |
| C91   | PORT17-Rx_P    | PORT17-Tx_P | D91   |
| C92   | PORT17-Rx_N    | PORT17-Tx_N | D92   |
| C93   | GND            | GND         | D93   |
| C94   | PORT18-Rx_P    | PORT18-Tx_P | D94   |
| C95   | PORT18-Rx_N    | PORT18-Tx_N | D95   |
| C96   | GND            | GND         | D96   |
| C97   | nc             | nc          | D97   |
| C98   | PORT19-Rx_P    | PORT19-Tx_P | D98   |
| C99   | PORT19-Rx_N    | PORT19-Tx_N | D99   |
| C100  | GND            | GND         | D100  |
| C101  | PORT20-Rx_P    | PORT20-Rx_P | D101  |
| C102  | PORT20-Rx_N    | PORT20-Rx_N | D102  |
| C103  | GND            | GND         | D103  |
| C104  | +12V_CE        | +12V_CE     | D104  |
| C105  | +12V_CE        | +12V_CE     | D105  |
| C106  | +12V_CE        | +12V_CE     | D106  |
| C107  | +12V_CE        | +12V_CE     | D107  |
| C108  | +12V_CE        | +12V_CE     | D108  |
| C109  | +12V_CE        | +12V_CE     | D109  |
| C110  | GND            | GND         | D110  |



### 5.2.2. S1: AMC Edge Connector

The **NAT-AMC-COMex** connects to the backplane via S1.

**Figure 6 – S1: AMC Edge Connector (top view)**



**Table 6 – S1: AMC Edge Connector – Pin Assignment**

| Pin # | Signal     | Signal        | Pin # |
|-------|------------|---------------|-------|
| 1     | GND        | GND           | 170   |
| 2     | +12V_PP    | nc            | 169   |
| 3     | /AMC_PS1   | nc            | 168   |
| 4     | +3.3V_MP   | nc            | 167   |
| 5     | AMC_GA0    | nc            | 166   |
| 6     | nc         | nc            | 165   |
| 7     | GND        | GND           | 164   |
| 8     | nc         | PORT20-Tx_R_P | 163   |
| 9     | +12V_PP    | PORT20-Tx_R_N | 162   |
| 10    | GND        | GND           | 161   |
| 11    | PORT0-Tx_P | PORT20-Rx_R_P | 160   |
| 12    | PORT0-Tx_N | PORT20-Rx_R_N | 159   |
| 13    | GND        | GND           | 158   |
| 14    | PORT0-Rx_P | PORT19-Tx_R_P | 157   |
| 15    | PORT0-Rx_N | PORT19-Tx_R_N | 156   |
| 16    | GND        | GND           | 155   |
| 17    | AMC_GA1    | PORT19-Rx_R_P | 154   |
| 18    | +12V_PP    | PORT19-Rx_R_N | 153   |
| 19    | GND        | GND           | 152   |
| 20    | PORT1-Tx_P | PORT18-Tx_R_P | 151   |
| 21    | PORT1-Tx_N | PORT18-Tx_R_N | 150   |
| 22    | GND        | GND           | 149   |
| 23    | PORT1-Rx_P | PORT18-Rx_R_P | 148   |

| Pin # | Signal      | Signal        | Pin # |
|-------|-------------|---------------|-------|
| 24    | PORT1-Rx_N  | PORT18-Rx_R_N | 147   |
| 25    | GND         | GND           | 146   |
| 26    | AMC_GA2     | PORT17-Tx_R_P | 145   |
| 27    | +12V_PP     | PORT17-Tx_R_N | 144   |
| 28    | GND         | GND           | 143   |
| 29    | PORT2-Tx_P  | PORT17-Rx_R_P | 142   |
| 30    | PORT2-Tx_N  | PORT17-Rx_R_N | 141   |
| 31    | GND         | GND           | 140   |
| 32    | PORT2-Rx_P  | nc            | 139   |
| 33    | PORT2-Rx_N  | nc            | 138   |
| 34    | GND         | GND           | 137   |
| 35    | PORT3-Tx_P  | nc            | 136   |
| 36    | PORT3-Tx_N  | nc            | 135   |
| 37    | GND         | GND           | 134   |
| 38    | PORT3-Rx_P  | PORT15-Tx_R_P | 133   |
| 39    | PORT3-Rx_N  | PORT15-Tx_R_N | 132   |
| 40    | GND         | GND           | 131   |
| 41    | AMC_ENABLEn | PORT15-Rx_R_P | 130   |
| 42    | +12V_PP     | PORT15-Rx_R_N | 129   |
| 43    | GND         | GND           | 128   |
| 44    | PORT4-Tx_P  | PORT14-Tx_R_P | 127   |
| 45    | PORT4-Tx_N  | PORT14-Tx_R_N | 126   |
| 46    | GND         | GND           | 125   |
| 47    | PORT4-Rx_P  | PORT14-Rx_R_P | 124   |
| 48    | PORT4-Rx_N  | PORT14-Rx_R_N | 123   |
| 49    | GND         | GND           | 122   |
| 50    | PORT5-Tx_P  | PORT13-Tx_R_P | 121   |
| 51    | PORT5-Tx_N  | PORT13-Tx_R_N | 120   |
| 52    | GND         | GND           | 119   |
| 53    | PORT5-Rx_P  | PORT13-Rx_R_P | 118   |
| 54    | PORT5-Rx_N  | PORT13-Rx_R_N | 117   |
| 55    | GND         | GND           | 116   |
| 56    | AMC_SCL     | PORT12-Tx_R_P | 115   |
| 57    | +12V_PP     | PORT12-Tx_R_N | 114   |
| 58    | GND         | GND           | 113   |
| 59    | PORT6-Tx_P  | PORT12-Rx_R_P | 112   |
| 60    | PORT6-Tx_N  | PORT12-Rx_R_N | 111   |
| 61    | GND         | GND           | 110   |
| 62    | PORT6-Rx_P  | PORT11-Tx_P   | 109   |
| 63    | PORT6-Rx_N  | PORT11-Tx_N   | 108   |
| 64    | GND         | GND           | 107   |
| 65    | PORT7-Tx_P  | PORT11-Rx_P   | 106   |
| 66    | PORT7-Tx_N  | PORT11-Rx_N   | 105   |
| 67    | GND         | GND           | 104   |
| 68    | PORT7-Rx_P  | PORT10-Tx_P   | 103   |
| 69    | PORT7-Rx_N  | PORT10-Tx_N   | 102   |
| 70    | GND         | GND           | 101   |
| 71    | AMC_SDA     | PORT10-Rx_P   | 100   |
| 72    | +12V_PP     | PORT10-Rx_N   | 99    |
| 73    | GND         | GND           | 98    |

| Pin # | Signal      | Signal     | Pin # |
|-------|-------------|------------|-------|
| 74    | AMC_TCLKA_P | PORT9-Tx_P | 97    |
| 75    | AMC_TCKLA_N | PORT9-Tx_N | 96    |
| 76    | GND         | GND        | 95    |
| 77    | AMC_TCLKB_P | PORT9-Rx_P | 94    |
| 78    | AMC_TCKLB_N | PORT9-Rx_N | 93    |
| 79    | GND         | GND        | 92    |
| 80    | AMC_FCLKA_P | PORT8-Tx_P | 91    |
| 81    | AMC_FCKLA_N | PORT8-Tx_N | 90    |
| 82    | GND         | GND        | 89    |
| 83    | /AMC_PS0    | PORT8-Rx_P | 88    |
| 84    | +12V_PP     | PORT8-Rx_N | 87    |
| 85    | GND         | GND        | 86    |



### 5.2.3. SW1: Switch

SW1 is connected to the MMC, the function of SW1 is tbd

Figure 7 – SW1: Switch



Table 7 – SW1: Switch– Operating Parameters

| SW1-1 | SW1-2 | Function |
|-------|-------|----------|
| OFF   | OFF   | tbd      |
| ON    | OFF   | tbd      |
| OFF   | ON    | tbd      |
| OFF   | OFF   | tbd      |

### 5.2.4. SW2: Hot-Swap-Switch

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

### 5.2.5. SW3: Boot Mode Select Switch

By setting SW3, the boot source can be selected according to the table below.

Figure 8 – SW500: Boot Mode Select Switch



Table 8 – SW3: Boot Mode Select Switch– Operating Parameters

| SW3-1      | SW3-2      | Function                                   |
|------------|------------|--------------------------------------------|
| <b>OFF</b> | <b>OFF</b> | <b><i>Boot from COMex BIOS</i></b>         |
| ON         | OFF        | not supported                              |
| OFF        | ON         | Boot from <b>NAT-AMC-COMex</b> carrier SPI |
| OFF        | OFF        | bot supported                              |

**Note:**

Default configuration is labelled with ***bold, italic letters***.

## 6. SPECIFICATIONS AND COMPLIANCES

### 6.1. Internal Reference Documentation

- NAT-AMC-COMex

### 6.2. Standards Compliance

- MTCA.0
- MTCA.4
- AMC.0
- AMC.1
- AMC.2
- IMPI V2.0
- HPM.1



### 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. semiconductor 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 electronic 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 electronic 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 9 – 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 <sup>2</sup> C   | 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            |

### 7. DOCUMENT'S HISTORY

**Table 10 – Document's History**

| Rev | Date       | Description                                                                     | Author |
|-----|------------|---------------------------------------------------------------------------------|--------|
| 1.0 | 21.09.2021 | <ul style="list-style-type: none"><li>initial release</li></ul>                 | Se     |
| 2.0 | 27.10.2025 | <ul style="list-style-type: none"><li>update to hardware revision 2.x</li></ul> | se     |

