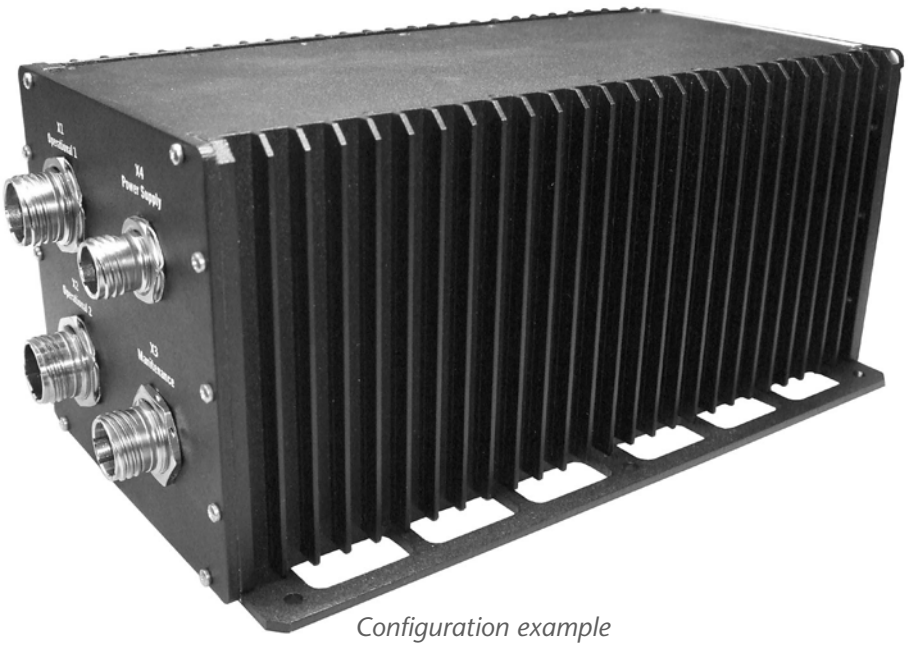
Embedded Solutions

CPCI Rack – Single Euro with Conduction Cooling



Configuration example

User Manual

mikro elektronik
gmbh · nürnberg

CPCI Rack – Single Euro with Conduction Cooling

This enclosure for CompactPCI® cards in 3U format allows to use standard boards that were designed for ventilated systems even in an environment which needs conductive cooling. To do this, all critical components are directly coupled to the housing to divert waste heat to the exterior wall. This reduces the costs involved in the higher overhead of conduction cooling to the housing, and no PCB space is lost on the boards for this cooling method.

This extremely robust enclosure is hermetically sealed against impacts from outside, offers high vibration and shock resistance through the use of wedge locks as well as special connector types such as MIL-C-38999. The standard front connectors of the boards are wired to four MIL-C-38999 connectors (three I/O connectors and one power supply connector) at the rear side of the system inside the housing. Both front and rear I/O can be made available on these connectors, and the pin-out is always customized.

The standard CompactPCI boards are fitted into a special "CCA" frame (conduction cooled assembly) and inserted into the system. The system provides three CompactPCI® slots for one CPU board with a side card and one I/O board, as well as a PSU slot with an H15 connector. The distance between the slots on the backplane is greater than on standard backplanes.

The thermal resistance is 0.4 Kelvin/Watt and the temperature class Tx for 40 W maximum performance (for boards with an operating temperature of -40 to +85°C). The enclosure is compliant with IP65 for protection against dust and humidity.

The system is suited for MEN boards F11S, F12N, F13, F14, F15, F17, F18, F19P and F50C.

Technical Data

General System Characteristics

- 3 slots for 3U Eurocard boards in CCA frame
- Middle slot (right of the system slot) designed for a side card connected to the CPU board
- Conduction-cooled

Mechanical Specifications

- 3U card horizontal
- Dimensions: 200 mm x 350 mm x 145 mm
- Weight: 4500g
- IP65 compliant

Connectors

- 4 MIL-C-38999 connectors X1..X4
- X1..X3 for customized I/O
  - 59 usable I/O pins
- X4 for power supply

CompactPCI® Backplane

- Compliance with CompactPCI® Spec. 2.0 Rev. 2.1 and IEC 61 076-4-101 (connectors)
- 3-slot
  - CPU system slot
  - Side-card slot
  - Peripheral slot
- System slot on the left

Power Supply

- PSU 3U CCA
- Input: 24VDC nominal (18-32V)
- Output 5V, 3.3V/35W
- Robust internal connection to rear-panel outer connector X4
- SMBus
- External I/Os for key function
- Overtemperature shutdown: 50..90°C (adjustable by SMBus command)
- Holdup time according to EN50155 Class S2

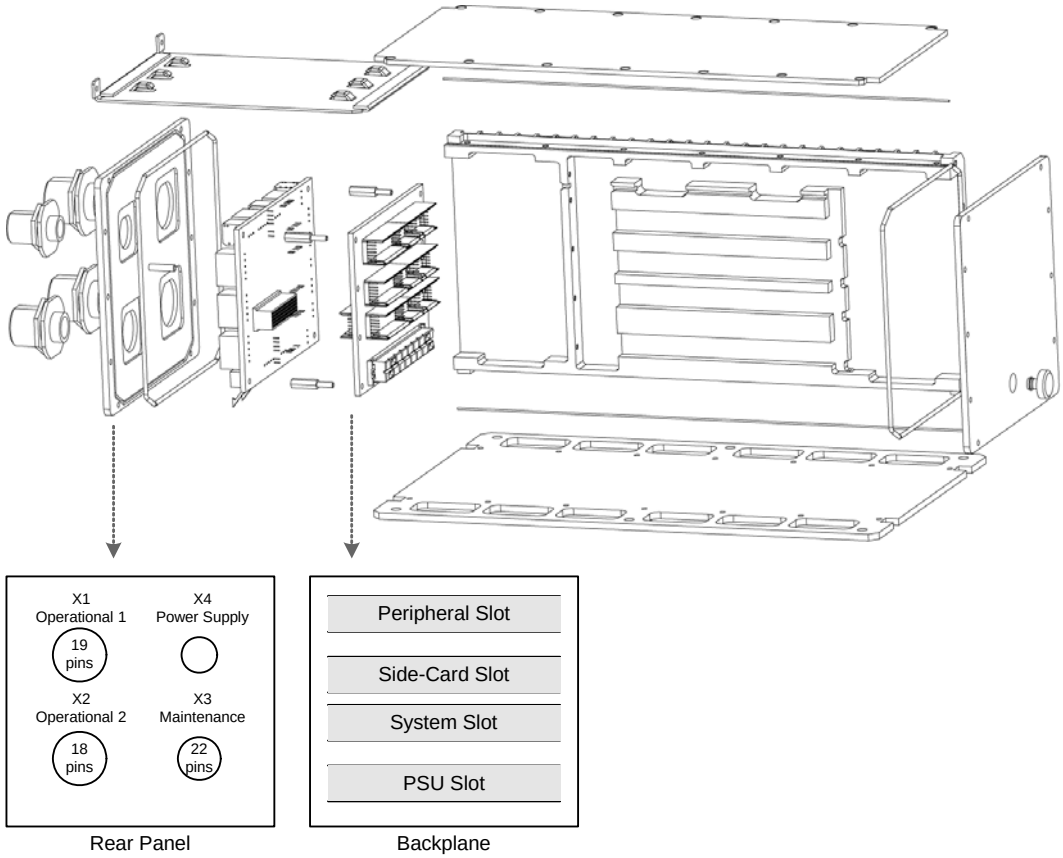
Environmental Specifications

- Temperature range (operation):
  - -40°C to +70°C, with up to +85°C for 10 minutes according to class Tx (EN50155)
  - Thermal resistance 0.4 K/W
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Shock: according to EN 61373, Class B
- Vibration: according to EN 61373, Class B

Suited for MEN Boards ...

- F50C
- F11S (in a special CCA version)
- F12N (in a special CCA version)
- F13 (in a special CCA version)
- F14 (in a special CCA version)
- F15 (in a special CCA version)
- F17 (in a special CCA version)
- F18 (in a special CCA version)
- F19P (in a special CCA version)

Diagram


X1
Operational 1
19
pins
X4
Power Supply
X2
Operational 2
18
pins
X3
Maintenance
22
pins
Rear Panel
Peripheral Slot
Side-Card Slot
System Slot
PSU Slot
Backplane

Configuration Options

Slots

- Different number/type of slots (requires change of mechanical dimensions)

I/O

- Individual signal routing to outer connectors
- Individual CCA frame

Connectors

- Different outer connectors (e.g. M12)

PSU

- Input voltage range 9..154V

Mechanical

- Wall-mounting

Please note that some of these options may only be available for large volumes. Please ask our sales staff for more information.

For available standard configurations see online data sheet.

Product Safety

Electrostatic Discharge (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

About this Document

This user manual describes the hardware functions of the rack, connection of peripheral devices and integration into a system. It also provides additional information for special applications and configurations of the rack.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
P1	Preliminary issue	2009-12-23
E1	First released issue	2010-01-12

Conventions

This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics — Folder, file and function names are printed in *italics*.

bold — **Bold** type is used for emphasis.

`monospace` — A `monospaced` font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".

hyperlink — Hyperlinks are printed in blue color.

The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.

IRQ# /IRQ — Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is either active low or that it becomes active at a falling edge.

in/out — Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".

Vertical lines on the outer margin signal technical changes to the previous issue of the document.

Legal Information

MEN Mikro Elektronik reserves the right to make changes without further notice to any products herein. MEN makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does MEN assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages.
"Typical" parameters can and do vary in different applications. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts.
MEN does not convey any license under its patent rights nor the rights of others.
Unless agreed otherwise, MEN products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the MEN product could create a situation where personal injury or death may occur. Should Buyer purchase or use MEN products for any such unintended or unauthorized application, Buyer shall indemnify and hold MEN and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that MEN was negligent regarding the design or manufacture of the part.

Unless agreed otherwise, the products of MEN Mikro Elektronik are not suited for use in nuclear reactors or for application in medical appliances used for therapeutical purposes. Application of MEN products in such plants is only possible after the user has precisely specified the operation environment and after MEN Mikro Elektronik has consequently adapted and released the product.

ESM™, ESMini™, MDIS™, MDIS4™, MENMON™, M-Module™, M-Modules™, SA-Adapter™, SA-Adapters™, UBox™, USM™ and the MBIOS logo are trademarks of MEN Mikro Elektronik GmbH. PC-MIP® is a registered trademark of MEN Micro, Inc. and SBS Technologies, Inc. MEN Mikro Elektronik®, ESMexpress®, MIPIOS® and the MEN logo are registered trademarks of MEN Mikro Elektronik GmbH.

All other products or services mentioned in this publication are identified by the trademarks, service marks, or product names as designated by the companies who market those products. The trademarks and registered trademarks are held by the companies producing them. Inquiries concerning such trademarks should be made directly to those companies. All other brand or product names are trademarks or registered trademarks of their respective holders.

Information in this document has been carefully checked and is believed to be accurate as of the date of publication; however, no responsibility is assumed for inaccuracies. MEN Mikro Elektronik accepts no liability for consequential or incidental damages arising from the use of its products and reserves the right to make changes on the products herein without notice to improve reliability, function or design. MEN Mikro Elektronik does not assume any liability arising out of the application or use of the products described in this document.

Please recycle

Germany
MEN Mikro Elektronik GmbH
Neuwieder Straße 5-7
90411 Nuremberg
Phone +49-911-99 33 5-0
Fax +49-911-99 33 5-901
E-mail info@men.de
www.men.de

France
MEN Mikro Elektronik SA
18, rue René Cassin
ZA de la Châtelaine
74240 Gaillard
Phone +33 (0) 450-955-312
Fax +33 (0) 450-955-211
E-mail info@men-france.fr
www.men-france.fr

USA
MEN Micro, Inc.
24 North Main Street
Ambler, PA 19002
Phone (215) 542-9575
Fax (215) 542-9577
E-mail sales@menmicro.com
www.menmicro.com

Contents

Figures

Tables

1 System Overview

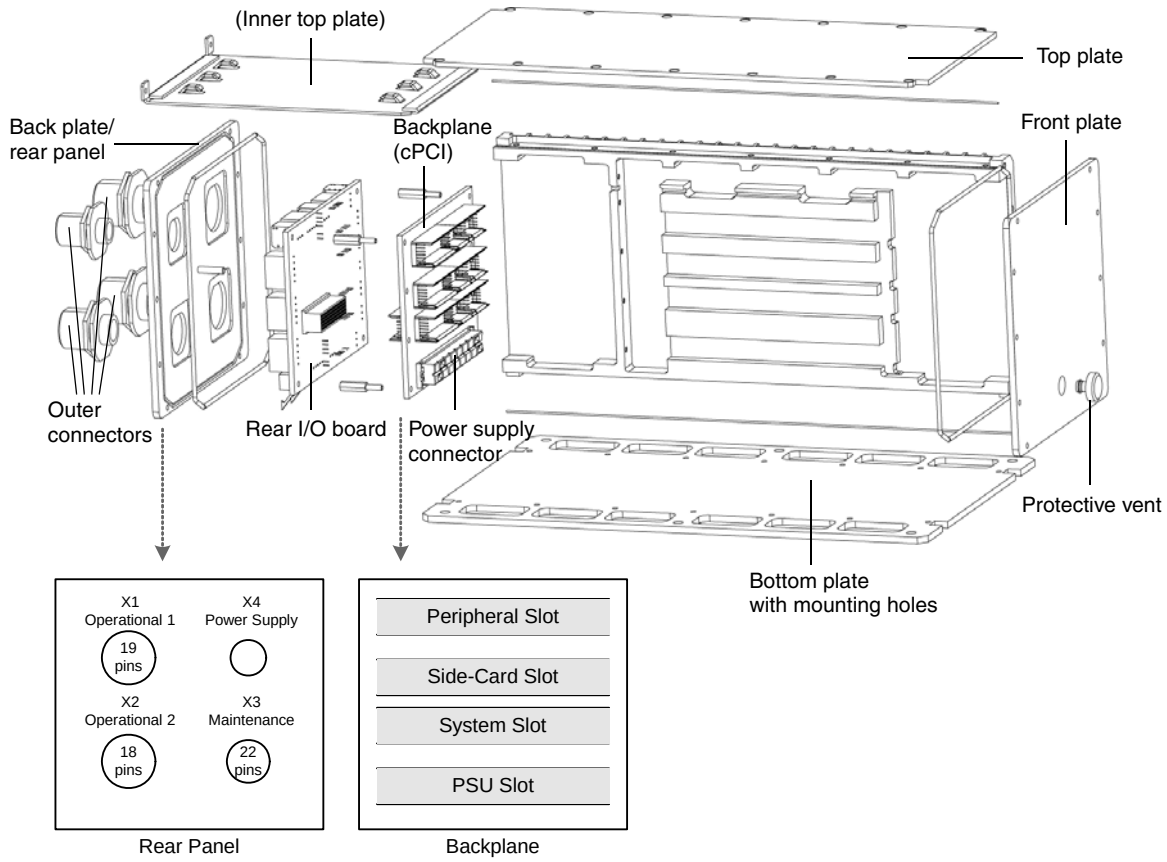
1.1 Basic Principle

The CCA rack is designed to support single-board computers (SBCs) in normal 3U CompactPCI format. The rack's backplane connectors adhere to the CompactPCI standard, but the mounting spacing between these connectors is adjusted to accommodate the added thickness of so-called CCA frames. These Conduction-Cooled Assembly frames can make a conduction-cooled board out of almost any standard, off-the-shelf CPU or I/O board. Each unique board/processor combination is matched to a customized frame system with a tailor-made heat sink designed to transfer heat efficiently from the CPU to the frame and housing of the convection-cooled rack enclosure. This has cost and availability benefits, and there is no need to sacrifice board space for conduction cooling.

Ask our sales team for tailor-made, CCA-frame boards based on standard 3U CompactPCI.

1.2 Layout of the Rack

Figure 1. *Diagram of the CCA rack (excluding power supply unit)*



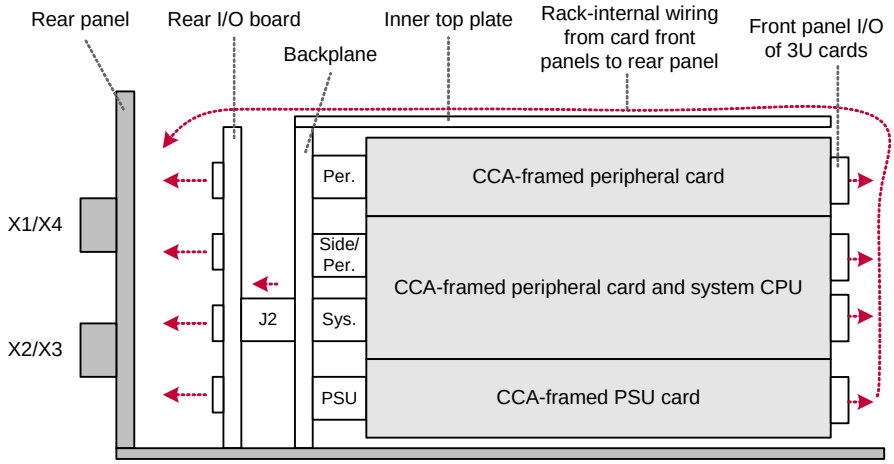
1.3 Signal Routing and Wiring

The following figure – by means of the red arrows – shows how signals are routed and can be wired inside the CCA rack.

A rear I/O board is located behind the backplane and is connected to the J2 connector of the system slot. It brings the J2 I/O signals to the outer connectors (X1 to X3) at the rear panel. The rear I/O board can also contain interface circuits necessary to connect the rack to the application environment. It is always customized to the application's requirements.

I/O from the 3U boards' front panels can be wired directly to the rear panel.

Figure 2. *Signal routing and wiring of interfaces inside the CCA rack*



2 Getting Started

This chapter gives some hints for first installation in a system.

2.1 Configuring the Rack

The configuration of the CCA rack needs some advance planning. Being very compact, the rack provides only three CompactPCI card slots. Because they are located behind the backplane, the signals of the J2 rear I/O connector of the system-slot card can more or less directly be led to the rear-panel outer connectors, which support 59 customizable pins on three connectors (X1 to X3).

The two additional peripheral/side cards normally have only front-panel I/O. This can also be led to the rack's outer connectors by wiring. The rack's interior leaves enough space to safely lead wires between the inner and outer top plate.

Having led all necessary signals to the rear side of the rack, you also need a rear I/O board in between the CompactPCI backplane and back plate to adapt the signals to the outer connectors. This is typically done by MEN according to the customer's requirements.

Other issues that you should consider in advance are the mechanical and thermal situation of your application. Because of its cooling fins, the standard rack can only be installed in horizontal orientation. On the other hand, not all board combinations may be possible because of the cards' thermal performance.

For details on...

- rack-internal wiring see Chapter 1.3 Signal Routing and Wiring on page 13.
- I/O outer connectors see Chapter 3.2 I/O Outer Connectors on page 24.
- rack orientation see Chapter 2.2 Installing the Rack into an Application Environment on page 19.
- thermal considerations see Chapter 2.2.3 Thermal Considerations on page 21.

Ask our sales team for tailor-made, custom assembly and configuration options.

When you have your customized rack, boards and software, you can start implementing your system. The following chapters give you the typical steps that are necessary. Some or all of these steps may be taken by MEN, depending on the customer's requirements.

2.1.1 Installing Boards in the Rack

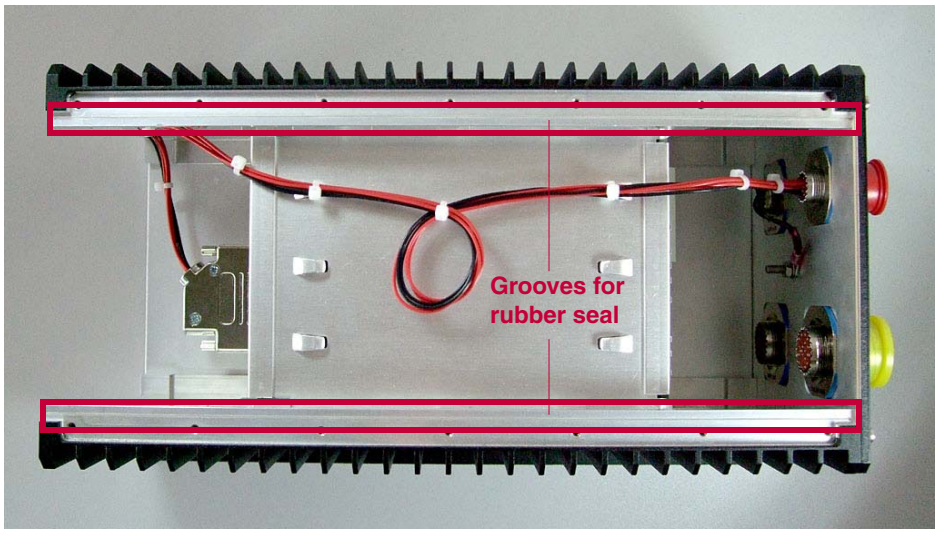
Perform the following steps to install a CompactPCI CCA board:

Open the housing:

☑ Remove the front plate by unscrewing the 10 screws highlighted in the picture:

☑ If you need to do some rack-internal wiring with your boards, you should also remove the top plate by unscrewing the 14 screws highlighted in the picture:

☑ There are sealing rubber bands in grooves below the top plate. Take care not to damage or loose them, and to put them back in place when you re-mount the top plate.



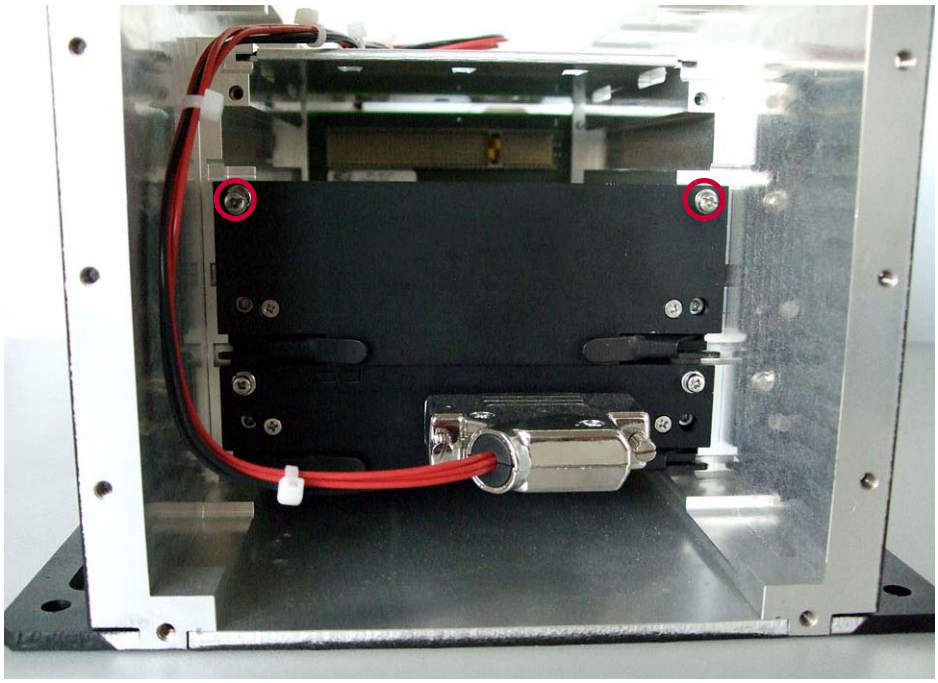
Insert CCA-compatible CompactPCI boards:

☑ Insert your CPU board into the system slot of the CCA rack. Take care not to damage the power supply wires, and make sure to properly align the CompactPCI connectors.

Note: The system slot of the CCA rack is marked by a △ triangle on the backplane (slot "1").

Note: If you have an MEN CPU, the board may already include a side card directly connected to the CPU. The slot to the right of the system slot (slot "2") is specially designed for side cards.

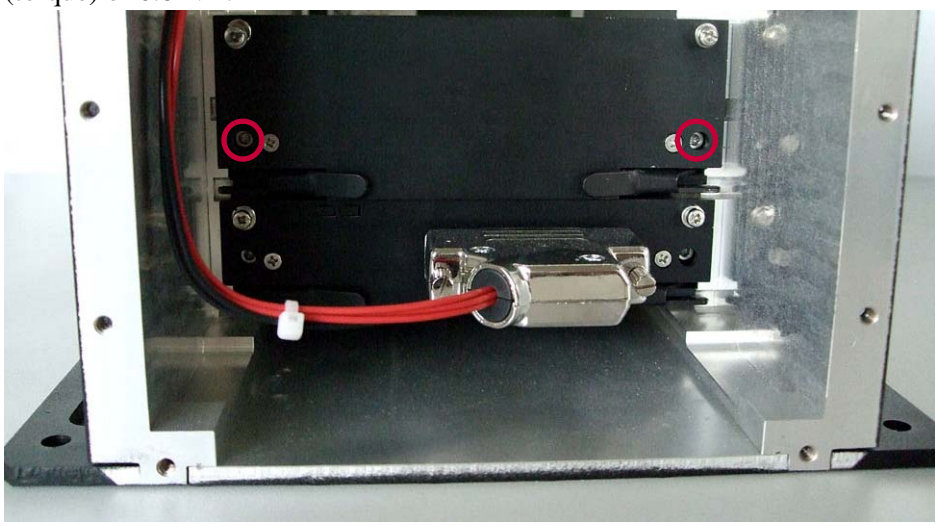
☑ Push the board firmly into the rack until the front plate of the board's CCA frame evenly aligns with the front plate of the PSU unit. To do this, you need to fasten the front-panel screws of the board to the guide rails.



☑ If applicable, insert a peripheral card into the peripheral-card slot (slot "3") of the CCA rack.

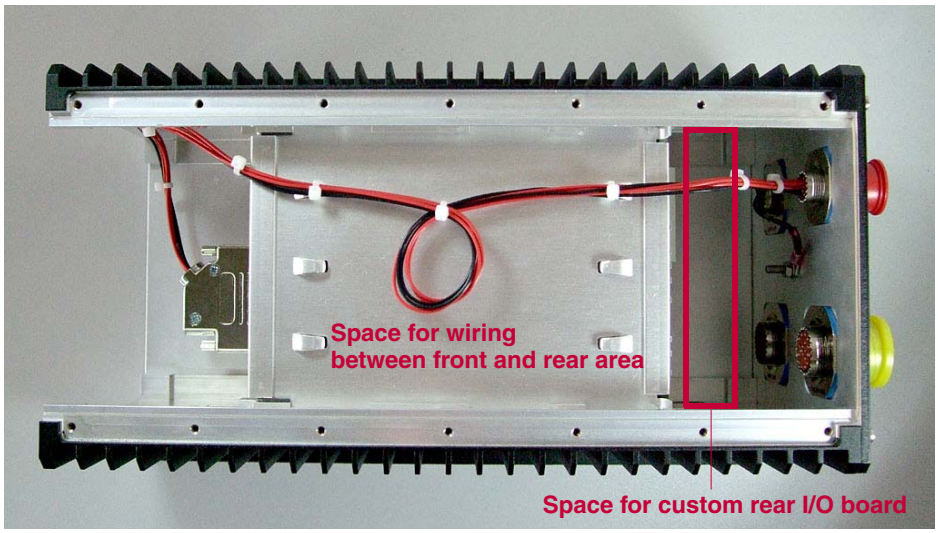
Note: The peripheral slot of the CCA rack is marked by a circle ○ on the back-plane (slot "3").

☑ Use a 2.5-mm hexagon torque wrench to fasten the two wedge locks of every card that you have inserted into the rack. You need to apply a turning moment (torque) of 0.8 Nm.



Connect special board interfaces:

☑ If you need to wire, e.g., front-panel interfaces of the CCA-framed boards to the rear panel and outer connectors of the rack, you should do this now. The rack leaves some space in between the outer and inner top plate to lead wires between the front and back areas, like the power supply connection:



The above picture shows the view inside the rack from the top. For a better view, this example shows a placeholder for the rear I/O board, which is necessary to make the connection from the CompactPCI backplane to the outer connectors.

☑ For better access to the outer connectors, you can remove the back plate in the same way as the front plate. The ten screws are arranged in the same way. (See page 15.)

When everything is connected, you can power up the system to install and configure the software. The user manuals of the individual boards usually include useful hints on first operation.

2.1.2 Installing Operating System Software

By standard, no operating system is installed on the boards. Please refer to the respective manufacturer's documentation on how to install operating system software!

You can find any software available on MEN's website.

2.1.3 Installing Driver Software

For a detailed description on how to install driver software please refer to the respective documentation.

You can find driver software for the PSU (power supply unit) for download on MEN's website.

2.2 Installing the Rack into an Application Environment

2.2.1 Dimensions and Mounting Holes

The rack's total dimensions are 200 mm x 350 mm x 145 mm. The housing is made for sturdy screw mounting and provides six mounting holes at its bottom plate.

Figure 3. *Mounting holes at the bottom plate of the CCA rack*

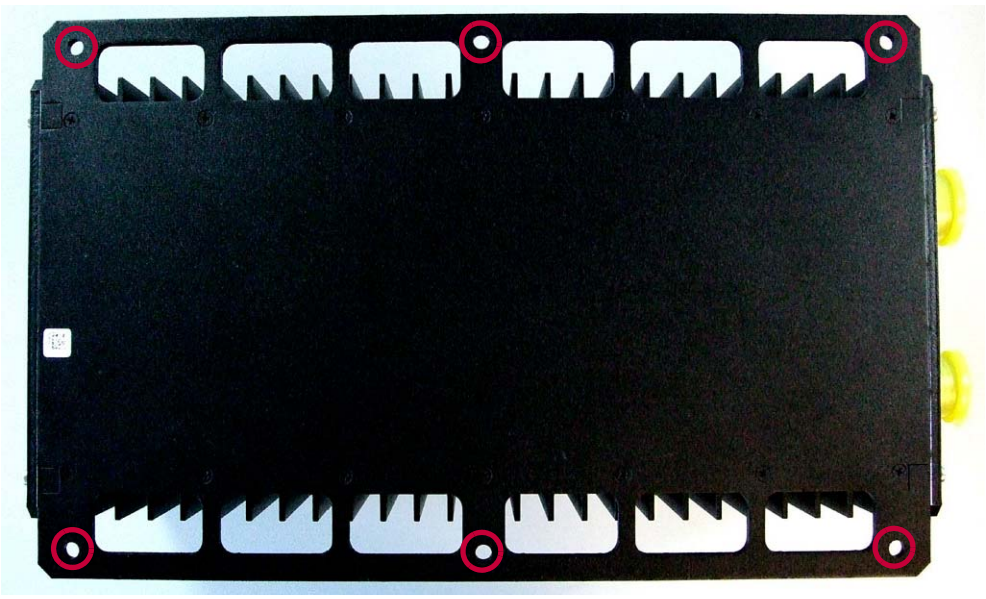
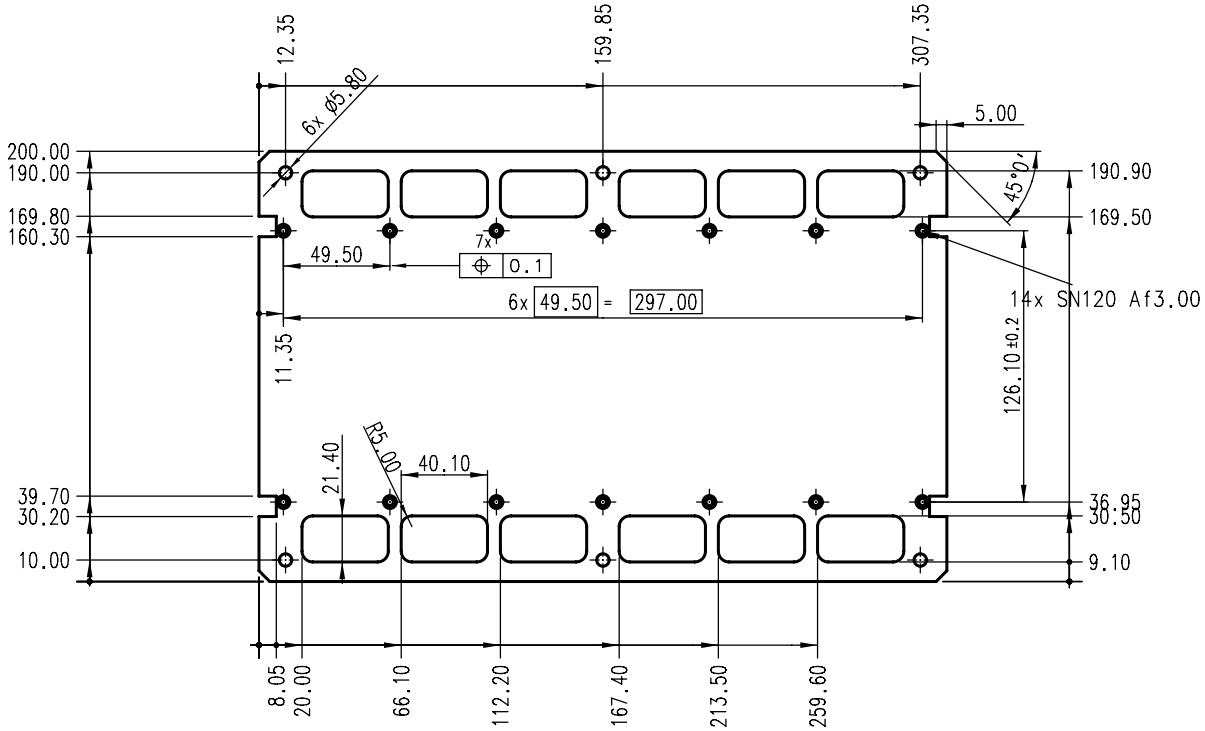


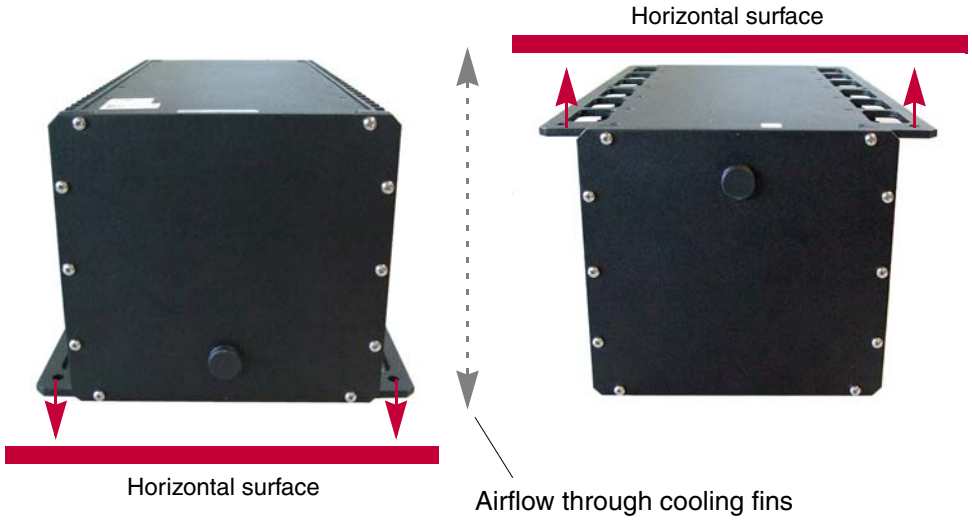
Figure 4. *Dimensions of the bottom plate of the CCA rack*

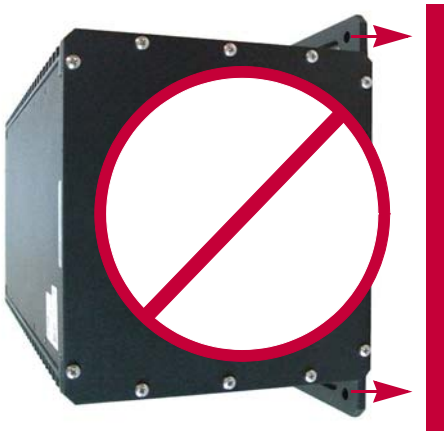


2.2.2 Rack Orientation

It generally depends on the application environment on how and where the CCA rack is mounted. Because of the orientation of its cooling fins, the standard rack can only be mounted on a horizontal surface, as shown in the following figure.

Figure 5. *Mounting orientations of standard CCA rack version*





Mounting to vertical surfaces is only possible with a special rack configuration!

As an option, MEN can also provide the rack for wall mounting, i.e. on a vertical surface. The cooling fins will then fit the mounting orientation. Please contact MEN's sales team for further information.

In any case, the surface where the rack is mounted on must provide for sufficient airflow to the cooling fins. Mounting the rack onto a closed surface, e.g., a table, will not be sufficient.

2.2.3 Thermal Considerations

The inner shape of each CCA-framed board inside the rack is unique to the cooling requirements of this board, accommodating specific hot spots that need thermal contact with the CCA frame. Those frames are mounted with wedge-lock connectors for reliable thermal coupling, transferring heat efficiently from the CPU to the frame and housing of the CCA rack.

The maximum temperature inside the rack is +85 °C. The maximum operating temperature of the entire rack (i.e. the temperature on the rack's surface) is +70 °C, with an allowed +85 °C for maximum 10 minutes. This specification conforms with the EN 50155 railway standard.

The total thermal resistance (R_{th}) of the CCA rack is 0.4 °C/W, allowing system designers to calculate the performance of their applications according to the following formula:

$$\Delta T = T_{internal} - T_{ambient} = P_v * R_{th}$$

As an example, this formula would dictate a maximum electrical power of 37.5 W to be installed in a CCA frame with a maximum allowable temperature of +85 °C and an ambient temperature of +70 °C:

$$P_{vmax} = \Delta T / R_{th} = 15\ °C / 0.4\ °C/W = 37.5\ W$$

Likewise, given an installed electrical power of 22 W and an outside temperature of 60 °C, the component operating temperature could be calculated as 68.8 °C:

$$T_{internal} = P_v * R_{th} + T_{ambient} = 22\ W * 0.4\ °C/W + 60\ °C = 68.8\ °C$$

It heavily depends on the thermal performance of your boards on whether you can implement the desired configuration with MEN's CCA rack. If you have any questions or problems regarding thermal behavior, please contact MEN.

3 Functional Description

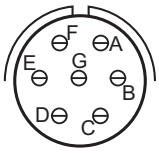
3.1 Power Supply

The CCA rack has its own power supply unit (PSU). The PSU supports a voltage range of 18-32 V and 35 W.

You can find driver software for the PSU (power supply unit) for download on MEN's website.

3.1.1 Outer Connector

Table 1. *Pin assignment of X4 Power Supply outer connector*



A	VCC
B	VCC
C	-
D	GND
E	GND
F	-
G	PS_Enable

Table 2. *Signal mnemonics of X4 Power Supply outer connector*

Signal	Direction	Function
GND	-	Isolated ground
PS_Enable	in	Power Supply enable
VCC	in	+24V nom. supply voltage Minimum: +18V (-25%) Maximum: +32V (+33%) Protected against input voltage reversal by a fuse.

Connector types:

- D38999/24FB99PN plug
- Mating connector:
  D38999/26FB99SN receptacle

MEN offers a set of suitable mating connectors for all four outer connectors of the CCA rack. Please see MEN's website for ordering information.

3.1.2 Temperature Sensor

The power supply provides an integrated temperature sensor for the detection of overtemperature conditions that could cause a destruction of the power supply. The temperature sensor is configurable within an overtemperature range of +50°C to +90°C. The temperature limit can be set using the PSU driver software available for download on MEN's website.

3.1.3 Digital Input and Standby

The power supply provides one digital input (*PS_Enable*) to enable/disable the output voltages. The digital input is connected to a control line that provides a controlled shut-down of the CCA rack system.

The power supply generates a maximum standby power of 0.5 W.

The standby condition is defined as follows:

- Input voltage U_{in} = +24 V
- Digital input = "low" (0 V)
- Output voltage +5 V = 0 V (disabled)
- Output voltage +3.3 V = 0 V (disabled)

The power supply provides a programmable delay time between the falling edge of the digital input and the output voltages being switched off. The mode can be set using the PSU driver software available for download on MEN's website.

Table 3. *Power supply standby delay timing values*

Mode	Standby Delay
0	No standby delay (default)
1	1 min
2	2 min
3	4 min
4	8 min
5	16 min

3.1.4 Fuse Protection

The DC/DC converter of the PSU is protected by a fuse. **This fuse is not intended to be exchanged by the customer. Your warranty for the CCA rack will cease if you exchange the fuse on your own.** Please send your rack and PSU to MEN for repair if a fuse blows.

- Current rating: 5 A
- Type: fast
- Size: 4.5 x 12.1 mm
- MEN part number: 5675-0009

3.2 I/O Outer Connectors

Both the front and rear I/O of the boards inside the CCA rack can be made available on three MIL-C-38999 connectors located at the back plate. Since the CCA rack is completely closed during operation, these connectors are the only way of linking up peripherals.

The connectors all have different types and pin counts, totaling 59 user I/O pins.

Figure 6. *Outer connectors at rear panel of CCA rack*

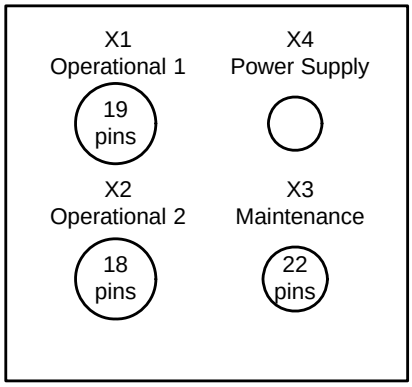
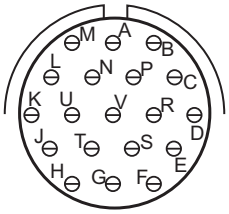
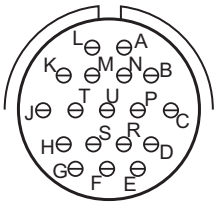


Table 4. *Pin layout and types of outer connectors X1..X3*

 X1 Operational 1 19 pins	 X2 Operational 2 18 pins	 X3 Maintenance 22 pins

The exact functional pin-out depends on the cards implemented in the CCA rack. It is completely customizable. See also Chapter 1.3 Signal Routing and Wiring on page 13.

Connector types:

X1, 19-pin:

- D38999/24FD19PN plug
- Mating connector: D38999/26FD19SN receptacle

X2, 18-pin:

- D38999/24FD18PA plug
- Mating connector: D38999/26FD18SA receptacle

X3, 22-pin:

- D38999/24FC35PN plug
- Mating connector: D38999/26FC35SN receptacle

MEN offers a set of suitable mating connectors for all four outer connectors of the CCA rack. Please see MEN's website for ordering information.

Ask our sales team for tailor-made, custom configuration options.

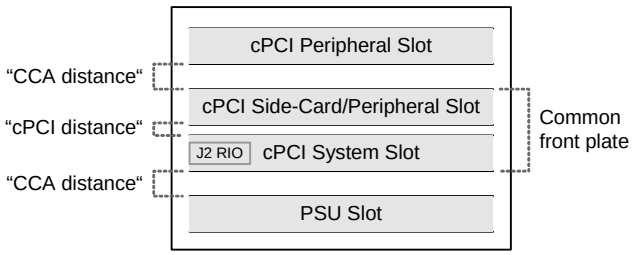
3.3 Backplane

The backplane basically includes one CompactPCI system slot and two peripheral slots. The peripheral slot next to the system slot is designed to support also side cards for the CPU. The card plugged into this slot must share the front plate with the CPU. The distance between the two slots complies with a standard CompactPCI backplane (4-HP slot), whereas the distance between the other slots is greater to accommodate 3U cards with an individual CCA frame (5-HP slots).

The backplane also provides a slot for a 3U-card power supply unit, using a standard H15 receptacle connector.

Only the CompactPCI system slot has a J2 connection to route rear I/O signals to the rear I/O board and – from there – to the outer connectors. The peripheral slots do not support rear I/O.

Figure 7. *Backplane connectors*



3.3.1 CompactPCI Bus

The CCA rack supports 32-bit 33-MHz CompactPCI compliant with CompactPCI specification PICMG 2.0 Rev. 3.0. The backplane provides a CompactPCI reset.

3.3.2 Side-Card Slot and Peripheral Slot

Both the side-card slot (slot "2") and the peripheral slot (slot "3") are ordinary CompactPCI peripheral slots. However, the distance between the system slot and side-card slot is smaller than usual. A side-card is a normal CompactPCI form-factor board but is directly coupled to the system slot and shares a front-panel with the CPU. This means in turn that it is mechanically and electrically possible to plug any 4-HP peripheral card into slot 2 of the CCA rack, as long as it forms a unit with the CPU board, with a common front-panel. MEN can provide a suitable CPU-and-peripheral-board solution together with the CCA adaption on request. Please contact MEN's sales team for further information.

3.3.3 Connection between CompactPCI and Power Supply

The backplane provides an SMB connection between the CompactPCI slots and the power supply slot. This allows the driver software to access and configure the PSU.

3.4 Protective Vent

The protective vent at the side of the enclosure provides an effective barrier from dust and dirt and still allows the sealed housing to breathe with changing environmental conditions. This prevents pressure from building up and damaging enclosure seals, exposing sensitive components to water and debris.

Figure 8. *Protective vent on the front plate of the CCA rack*

4 Appendix

4.1 Literature and Web Resources

- CCA rack data sheet with up-to-date information and documentation: www.men.de/products/0701-0054.html

4.2 Finding out the Product's Article Number, Revision and Serial Number

MEN user documentation may describe several different models and/or design revisions of the CCA rack. You can find information on the article number, the design revision and the serial number on a label attached to the chassis.

- **Article number:** Gives the product's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the design revision of the product.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 9. *Label giving the board's article number, revision and serial number*