User Manual

MTCA.4 Shelf

Product Numbers:

11890-119

11890-152

11890-156

11890-170

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The details in this manual have been carefully compiled and checked.

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1 Safety

The intended audience of this User's Manual is system integrators and hardware/software engineers.

1.1 Safety Symbols used in this document

	**Hazardous voltage!** *This is the electrical hazard symbol. It indicates that there are dangerous voltages inside the Shelf.*

	**Caution!** *This is the user caution symbol. It indicates a condition where damage of the equipment or injury of the service personnel could occur. To reduce the risk of damage or injury, follow all steps or procedures as instructed.*

	**Danger of electrostatic discharge!** *The Shelf contains static sensitive devices. To prevent static damage you must wear an ESD wrist strap.*

1.2 General Safety Precautions

	**Warning!** *Voltages over 60 VDC can be present in this equipment. This equipment is intended to be accessed, to be installed and maintained by qualified and trained service personnel only.*

- Service personnel must know the necessary electrical safety, wiring and connection practices for installing this equipment.
- Install this equipment only in compliance with local and national electrical codes.

1.3 References and Architecture Specifications

- PICMG® MTCA.4 Specification
- PICMG® AMC® Base Specification
- PICMG® MicroTCA® Base Specification (*www.picmg.org*)
- CERN - CMS MicroTCA crate concepts & AMC card reqirements

2 Hardware Platform

The Schroff **11890-119** is a **7** U MicroTCA.4 Shelf with rear µRTM area for AMC double full-size modules and RTMs, **bottom to top airflow** and **CERN backplane topology** (Dual star storage interface (Port 2 and 3), clock routing similar to AMC.0 Rev1.0).

The Schroff **11890-152** is a **7** U MicroTCA.4 Shelf with rear µRTM area for AMC double full-size modules and RTMs, **bottom to top airflow** and **MTCA.4 backplane topology** .

The Schroff **11890-156** is a **9** U MicroTCA.4 Shelf with rear µRTM area for AMC double full-size modules and RTMs, **bottom to top airflow** and **CERN backplane topology** (Dual star storage interface (Port 2 and 3), clock routing similar to AMC.0 Rev1.0).

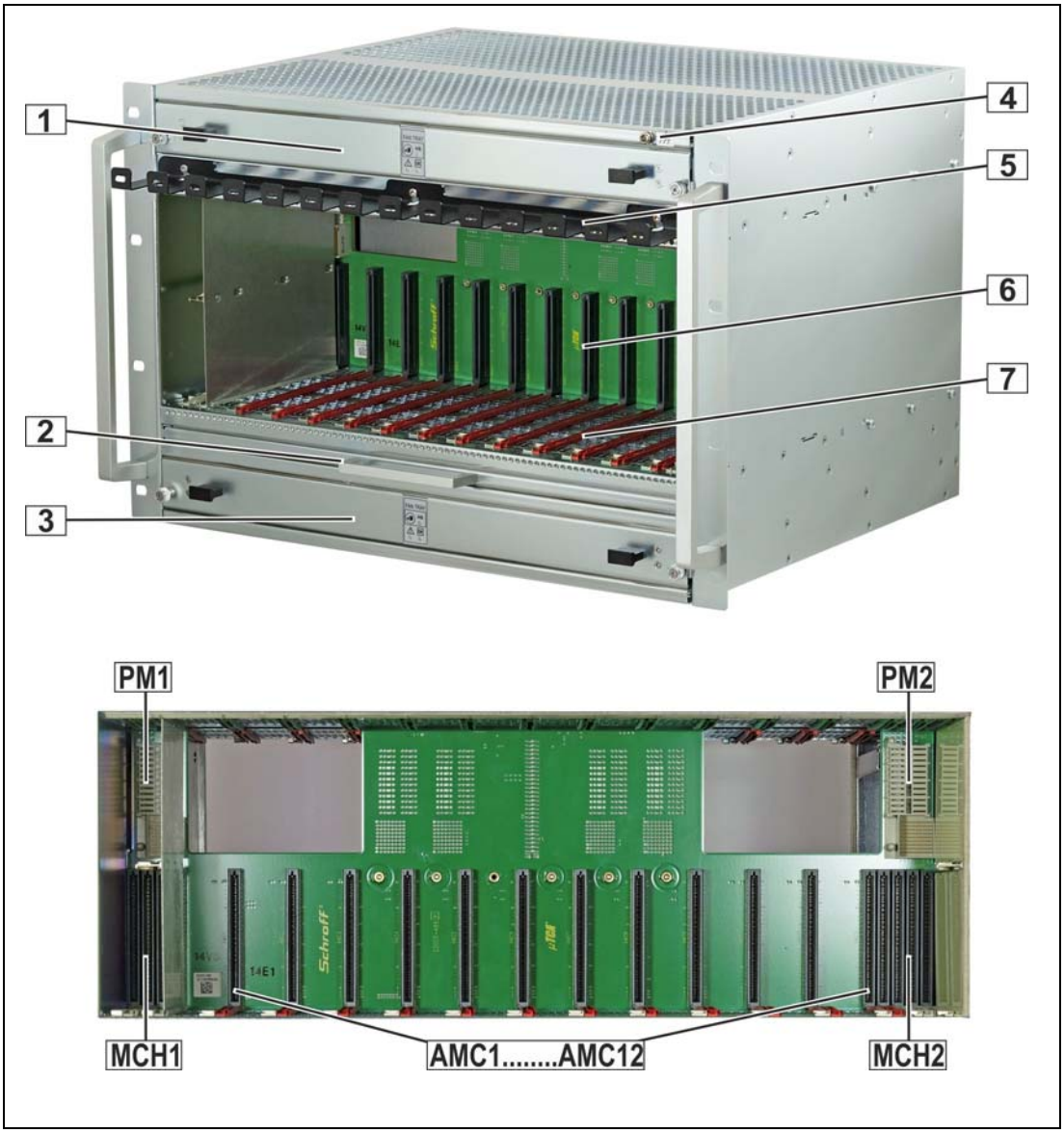
The Schroff **11890-170** is a **9** U MicroTCA.4 Shelf with rear µRTM area for AMC double full-size modules and RTMs, **bottom to top airflow** and **MTCA.4 backplane topology**.

Features:

- Shielded galvanisized steel subrack with 19” rack mounting brackets
- MicroTCA.4 Backplane with radial IPMI-L from both MCH slots to all AMC slots and bused IPMB-0 among MCHs, PMs and CUs.
- The Shelf provides:
  - 12 AMC double full-size slots
  - 2 redundant MicroTCA Carrier Hub (MCH) slots (single full-size)
  - 4+2 Power Module (PM) slots (single full-size)
  - 1 JSM slot
  - 6 RTM double full-size slots
- Active cooling through two hot-swappable Cooling Units (CUs) in push-pull configuration, providing each:
  - 6 speed controlled 12 VDC fans.
  - Cooling Unit Enhanced Module Management Controller (CU EMMC)
  - Display Module
- Front accessible air filter

2.1 Front and Rear View

Figure 1: 11890-119/-152 Front View



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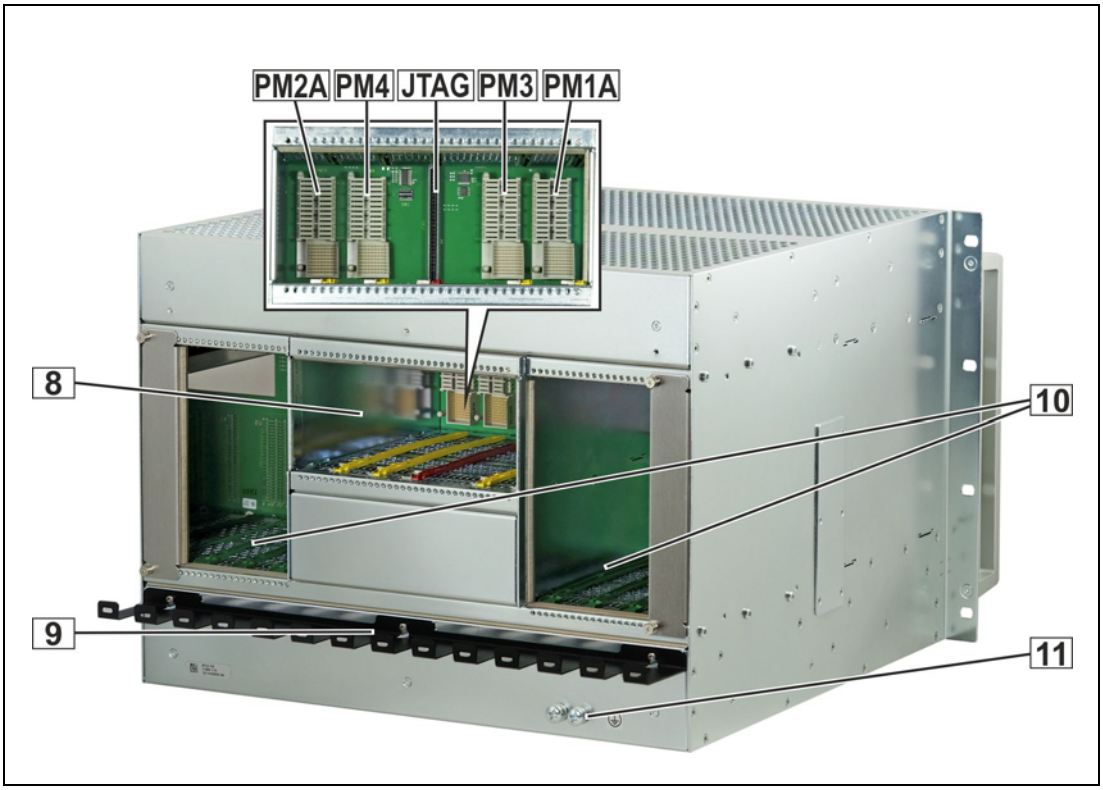
1	Upper Cooling Unit (CU1)	5	Cable Tray
2	Air filter	6	Backplane
3	Lower Cooling Unit (CU2)	7	Card cage
4	ESD Wrist Strap Terminal		

Figure 2: 11890-119/-152 Rear View



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8	Card cage PM and JSM	10	Card Cage RTM
9	Cable Tray (Can be mounted above or below the card cage)	11	Ground Terminal

Figure 3: 11890-156/-170 Front and Rear View

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2.2 ESD Wrist Strap Terminals

	**Danger of electrostatic discharge!** *Static electricity can harm delicate components. You must wear an ESD wrist strap before exchanging any part or electric component!*

The ESD Wrist Strap Terminal (4 mm banana jack) is located at the upper front side.

3 Backplane

The MicroTCA Backplane provides:

- 12 AMC double Full-size slots (6 HP)
- 2 single Full-size MicroTCA Carrier Hub (MCH) slots (6 HP)
- 6 Power Module (PM) slots for Single Full-size Power Modules
- 2 Connectors for Cooling Units
- 1 Full-size slot for a JTAG Switch Module (JSM)

Figure 4: Backplane Topology (Cern) 23005-486 for 11890-119/-156

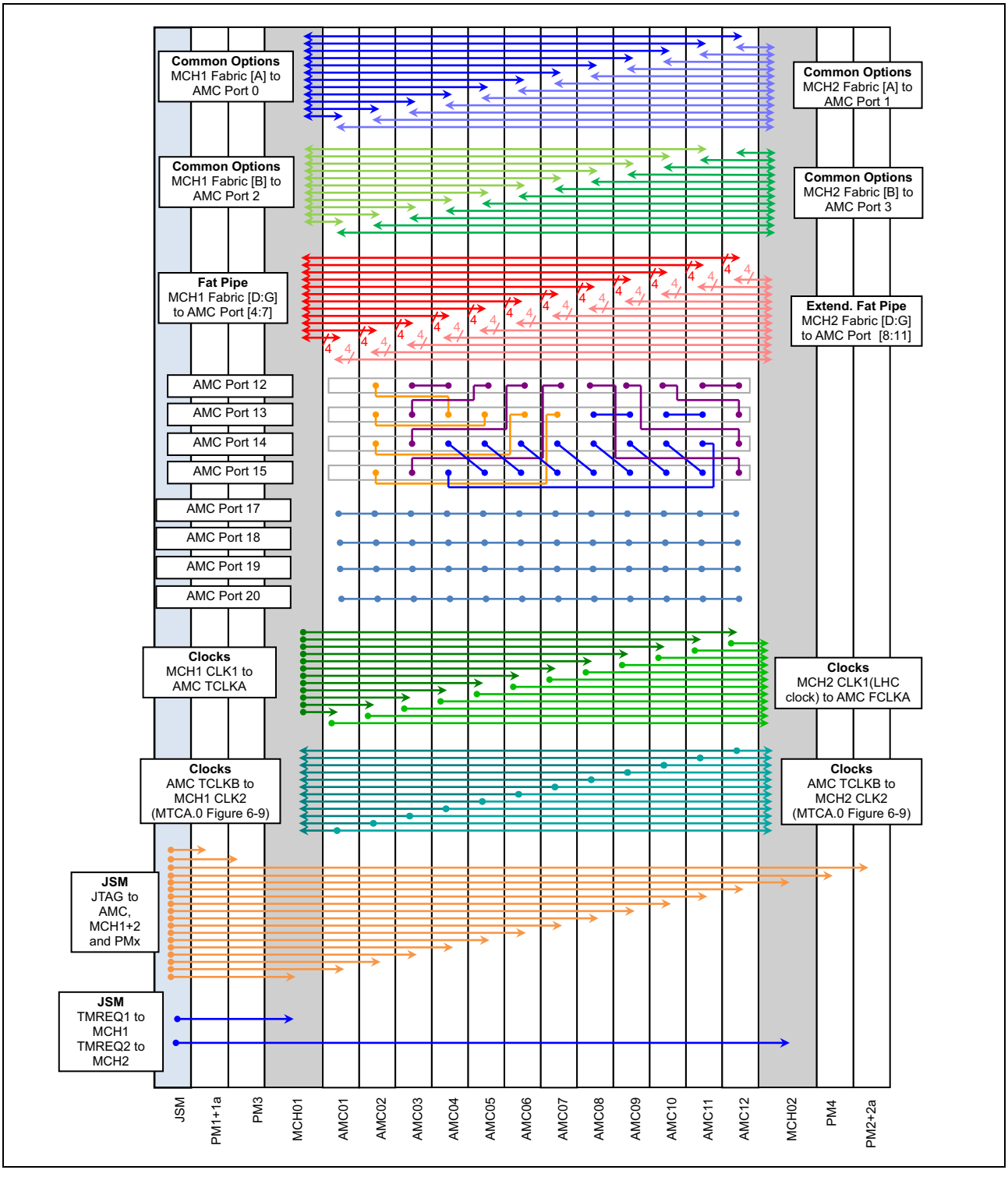

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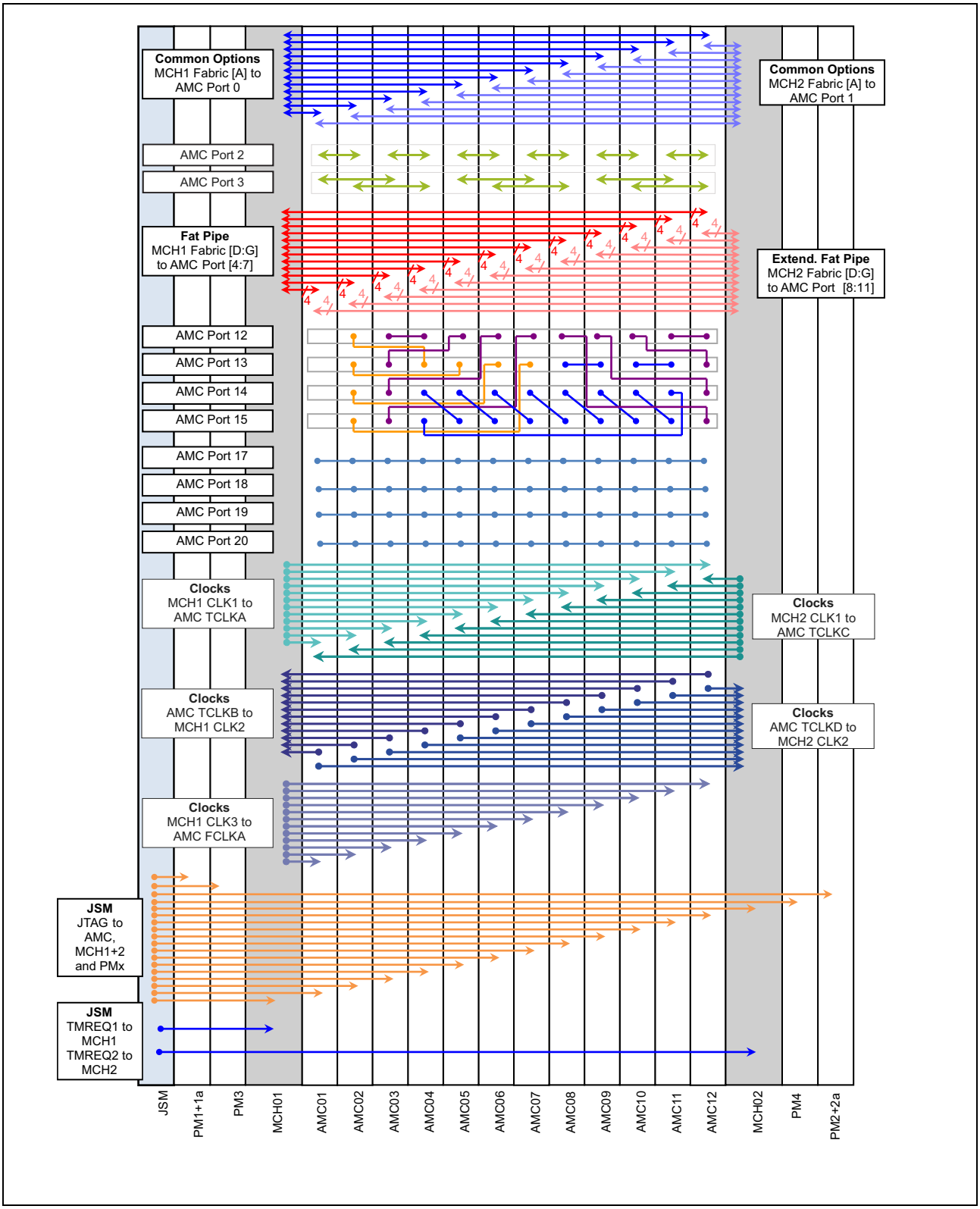
Figure 5: Backplane Topology 23005-496 for 11890-152/-170



3.1 Fabric Interface

3.1.1 Common Options

MCH1 Fabric Port A is routed to all AMC slots Port 0 in a radial configuration.

MCH2 Fabric Port A is routed to all AMC slots Port 1 in a radial configuration.

AMC Ports 2 and 3 are direct slot to slot connections for CPU/HDD configurations. (BP 23005-496)

MCH1 Fabric Port B is routed to all AMC slots Port 2 in a radial configuration. (BP 23005-486)

MCH2 Fabric Port B is routed to all AMC slots Port 3 in a radial configuration. (BP 23005-486)

3.1.2 Fat Pipe

MCH1 Ports [D:G] are routed to all AMC slots Port [4:7] in a radial configuration.

3.1.3 Extended Fat Pipe

MCH2 Ports [D:G] are routed to all AMC slots Port [8:11] in a radial configuration.

3.1.4 Ports 12 to 15

Ports 12 to 15 are point to point connections as proposed in the MTCA.4 specification section 6.7.1.

3.1.5 Ports 17 to 20

Ports 17 to 20 are used as a bus for triggers, clocks and interlock signal distribution.

3.2 Clock Distribution BP 23005-486

MCH1 CLK1 to AMC TCLKA

MCH2 CLK1 to AMC FCLKA

AMC TCLKB to MCH1 CLK2 and MCH2 CLK2

3.3 Clock Distribution BP 23005-496

Synchronisation clock topology in accordance with AMC.0 R2.0, especially for the use of PCIe AMC modules in accordance with AMC0 R2.0 that expect the FabricCLK on FCLKA.

Fully redundant telecom clock architecture with TCLKA, TCLKB, TCLKC, TCLKD.

3.4 Intelligent Platform Management Bus (IPMB)

MicroTCA uses an Intelligent Platform Management Bus (IPMB) for management communications.

3.4.1 IPMB-L

The IPMB among AdvancedMCs and the MCHs is non-redundant and implemented in a radial topology. This IPMB called Local IPMB (IPMP-L)

3.4.2 IPMB-0

The IPMB among the MCH, the PM and the CU is called IPMB-0. The reliability of the IPMB-0 is improved by the addition of a second IPMB, with the two IPMBs referenced as IPMB-A and IPMB-B.

The IPMB-A and IPMB-B are routed in a bused configuration.

IPMB-A and IPMB-B are electrically and logically separate from the Local IPMB (IPMB-L)

3.5 IPMB Addresses

GA[2:0]	IPMB-L address	Module	MicroTCA Carrier Local Address		Carrier Manager FRU Device ID
			Site Number	Site Type	
GGU	72h	AMC01	01	AdvancedMC (07h)	5
GUG	74h	AMC02	02	AdvancedMC (07h)	6
GUU	76h	AMC03	03	AdvancedMC (07h)	7
UGG	78h	AMC04	04	AdvancedMC (07h)	8
UGU	7Ah	AMC05	05	AdvancedMC (07h)	9
UUG	7Ch	AMC06	06	AdvancedMC (07h)	10
UUP	7Eh	AMC07	07	AdvancedMC (07h)	11
UPU	80h	AMC08	08	AdvancedMC (07h)	12
UPP	82h	AMC09	09	AdvancedMC (07h)	13
PUU	84h	AMC10	10	AdvancedMC (07h)	14
PUP	86h	AMC11	11	AdvancedMC (07h)	15
PPU	88h	AMC12	12	AdvancedMC (07h)	16

GA[2:0]	IPMB-0 address	Module	MicroTCA Carrier Local Address		Carrier Manager FRU Device ID
			Site Number	Site Type	
GGU	A8h	CU 1	1	Cooling Unit (04h)	40
GUG	AAh	CU 2	2	Cooling Unit (04h)	41
GGU	C2h	PM1/1A	1	Power Module (0Bh)	50
GUG	C4h	PM2/2A	2	Power Module (0Bh)	51
GUU	C6h	PM3	3	Power Module (0Bh)	52
UGG	C8h	PM4	4	Power Module (0Bh)	53

3.6 JTAG

The sytem provides a single full size slot for a JSM between the PM slots at the rear side.

Figure 6: JSM Slot Pinout

PIN	JSM slot pin assignement	slot #	PIN	JSM slot pin assignement	slot #	PIN	JSM slot pin assignement	slot #	PIN	JSM slot pin assignement	slot #
1	GND		44	STCK4	AMC4	87	STDO8	AMC8	130	PMTDI4	PM4
2	PP_MCH2		45	STMS4	AMC4	88	STDI8	AMC8	131	GND	
3			46	GND		89	GND		132	PMTMS4	PM4
4			47	STDI4	AMC4	90	STMS8	AMC8	133	PMTCK4	PM4
5			48	STDO4	AMC4	91	STCK8	AMC8	134	GND	
6			49	GND		92	GND		135	PMTCK2	PM2
7	GND		50	STCK5	AMC5	93	STDO9	AMC9	136	PMTMS2	PM2
8			51	STMS5	AMC5	94	STDI9	AMC9	137	GND	
9	PP_MCH2		52	GND		95	GND		138	PMTDO2	PM2
10	GND		53	STDI5	AMC5	96	STMS9	AMC9	139	PMTDI2	PM2
11	TCK1	MCH1	54	STDO5	AMC5	97	STCK9	AMC9	140	GND	
12	TMS1	MCH1	55	GND		98	GND		141	TRST1	
13	GND		56			99	STDO10	AMC10	142	TRST2	
14	TDI1	MCH1	57	PP_MCH1		100	STDI10	AMC10	143	GND	
15	TDO1	MCH1	58	GND		101	GND		144	STRST1	
16	GND		59	STCK6	AMC6	102	STMS10	AMC10	145	STRST2	
17			60	STMS6	AMC6	103	STCK10	AMC10	146	GND	
18	PP_MCH2		61	GND		104	GND		147	STRST3	
19	GND		62	STDI6	AMC6	105	STDO11	AMC11	148	STRST4	
20	STCK1	AMC1	63	STDO6	AMC6	106	STDI11	AMC11	149	GND	
21	STMS1	AMC1	64	GND		107	GND		150	STRST5	
22	GND		65	STCK7	AMC7	108	STMS11	AMC11	151	STRST6	
23	STDI1	AMC1	66	STMS7	AMC7	109	STCK11	AMC11	152	GND	
24	STDO1	AMC1	67	GND		110	GND		153	STRST7	
25	GND		68	STDI7	AMC7	111	STDO12	AMC12	154	STRST8	
26			69	STDO7	AMC7	112	STDI12	AMC12	155	GND	
27	PP_MCH2		70	GND		113	GND		156	STRST9	
28	GND		71			114	STMS12	AMC12	157	STRST10	
29	STCK2	AMC2	72	PP_MCH1		115	STCK12	AMC12	158	GND	
30	STMS2	AMC2	73	GND		116	GND		159	STRST11	
31	GND		74	PMTCK1	PM1 & 5	117	TDO2	MCH2	160	STRST12	
32	STDI2	AMC2	75	PMTMS1	PM1 & 5	118	TDI2	MCH2	161	GND	
33	STDO2	AMC2	76	GND		119	GND		162	PMTRST1	
34	GND		77	PMTDI1	PM1 & 5	120	TMS2	MCH2	163	PMTRST2	
35	STCK3	AMC3	78	PMTDO1	PM1 & 5	121	TCK2	MCH2	164	GND	
36	STMS3	AMC3	79	GND		122	GND		165		
37	GND		80	PMTRST3		123	PMTDI3	PM3 & 6	166		
38	STDI3	AMC3	81	PMTRST4		124	PMTDO3	PM3 & 6	167		
39	STDO3	AMC3	82	GND		125	GND		168	TMREQ2	
40	GND		83			126	PMTMS3	PM3 & 6	169	TMREQ1	
41			84	PP_MCH1		127	PMTCK3	PM3 & 6	170	GND	
42	PP_MCH1		85	GND		128	GND				
43	GND		86	GND		129	PMTDO4	PM4			

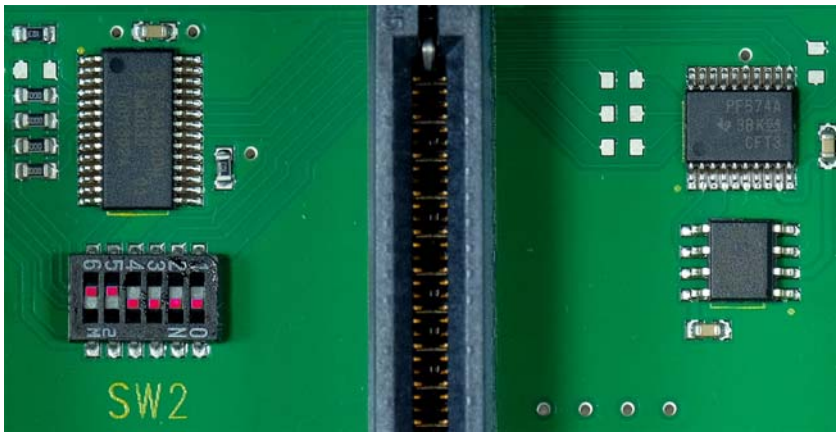
3.7 Carrier FRU SEEPROM

The Carrier FRU SEEPROM is located at the backside of the Backplane. The SEEPROM is connected to both MCHs through I²C-busses.

The I²C-addresses of the SEEPROM is 0xa4.

3.8 Carrier Number

Figure 7: Electronic and mechanical DIP Switch



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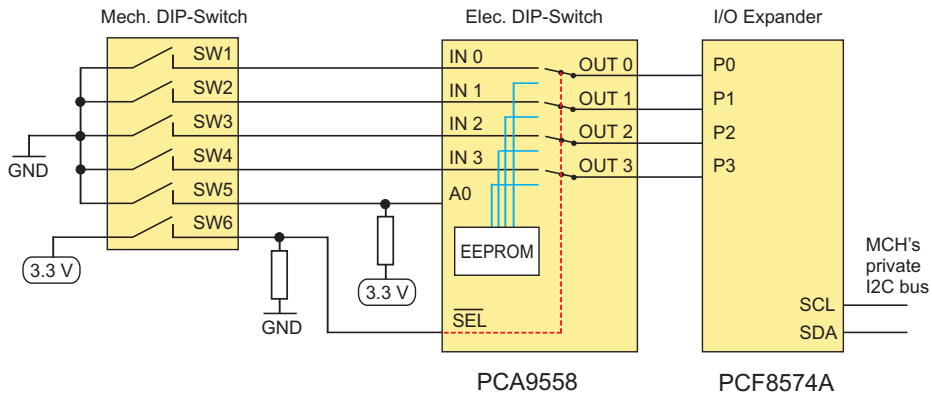
Each MicroTCA Carrier shall have a unique Carrier Number, ranging from 1 to 16 in its MicroTCA Shelf. To provide the Carrier Number, a mechanical and electronic (PCA9558) DIP switch and a PCF8574A I²C I/O expander is located on the Backplane.

Figure 8: Carrier Number Switches



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The customer can use either the mechanical or the electronic DIP switch to set the carrier number.

3.8.1 Mechanical DIP Switch

The mechanical DIP switch is a 6-position switch.

- Switch 1 to 4 are used to set the carrier number (Switch 1 = Bit 0).
- Switch 5 is used to change the I2C-address of the electronic DIP switch.
  - Switch 5 ON: address = 9C
  - Switch 5 OFF: address = 9E
- With switch 6 you can select between mechanical or electronic DIP switch to set the carrier number.
  - Switch 6 ON: Mechanical DIP switch active
  - Switch 6 OFF: Electronic DIP switch active

The DIP Switch is located on the Backplane. It is user-accessible after removing the JSM.

*When setting the carrier number with the **mechanical** DIP switch please note:*

Switch ON = logic 0
Switch OFF = logic 1

The mechanical DIP switch is connected to the input of the electronic DIP switch.
When the SEL signal is a logic 0, the electronic DIP switch will select the data from the internal EEPROM to drive the output pins, when the SEL signal is a logic 1, the electronic DIP switch will select the signal from the mechanical DIP switch to drive on the output pins.

3.8.2 Electronic DIP Switch (factory default)

The electronic DIP switch is connected to the lower four bits of the I/O lines of the PCF8574A I²C I/O expander. The I/O expander connects to the MCMC's private I²C bus. The MCMC reads the DIP switch setting from the I/O expander, **adds one**, and uses the result as its Carrier Number.

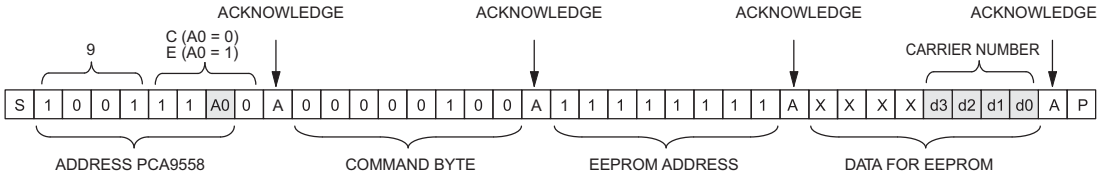
In the default factory setting the electronic DIP switch is active at the address 0x9E (SW5 and SW6 at the mechanical DIP switch = OFF)

Default carrier address = 1 (Data content EEPROM = 0000)

Table 1: I²C Addresses

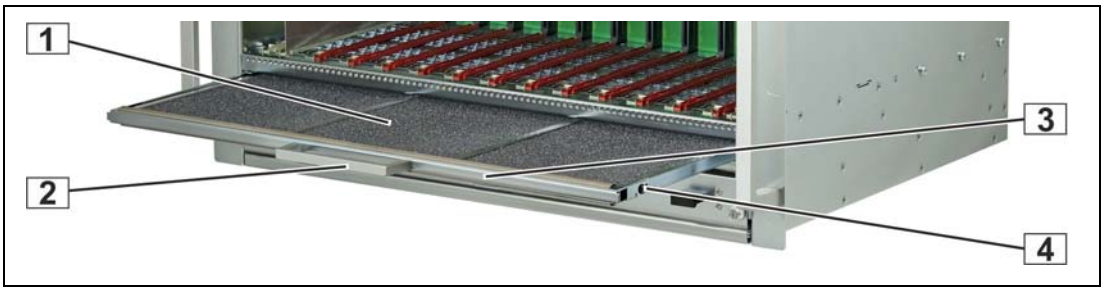
PCA 9558 DIP switch	0x9e or 0x9c	0x9e or 0x9c = 8 bit address write (bit 0 = 0)
PCF8574A I/O expander	0x7c	0x3e = 7 bit address (8 bit address read = 0x7d)

To change the carrier number with the electronic DIP switch you have to send the following I2C command to the electronic DIP switch's EEPROM:



4 Air Filter

Figure 9: Air Filter



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1	Filter Element	3	Filter Tray
2	Handle	4	Spring mounted ball lock

4.1 Introduction

The MicroTCA Shelf provides a front replaceable air filter.

The filter meets the following standards and classifications:

- UL 900 Class 2, UL94 HF-1
- Telcordia NEBS GR-78-CORE
- Telcordia NEBS GR-63-CORE

4.2 Air Filter Replacement

The air filter can be removed by pulling the air filter's handle. To re-install, push the air filter into the guide rails at each side of the shelf until the spring mounted ball lock engage.

When installing the air filter, the filter element must be in top position

4.3 Air Filter Presence Sensor

The air filter presence is detected by a switch located on the Backplane. The signal of the air filter presence sensor is hosted by the Cooling Units.

The presence sensor is defined as a digital sensor (present/not present) in the Cooling Unit‘s Sensor Data Record (SDR). When the air filter is pulled or re-inserted, the CU sends an SDR event message to the MCH.

5 Cooling Units

The MicroTCA Shelf provides two front-pluggable Cooling Units.
Each Cooling Unit contains three 12 VDC fans (290 m³/h (171 cfm) each) for the AMC section, three 12 VDC fans (190 m³/h (111 cfm) each) for the µRTM section and a Schroff Cooling Unit Enhanced Module Management Controller (CU EMMC). The speed level of the AMC and the µRTM fans can be controlled independently as an option. The CU EMMC has an Enhanced Module Management Controller (EMMC) onboard that communicate with the Carrier Manager over IPMB-0. The CU EMMC controls the fan speed, monitors the air filter sensor and provides hot-swap functionality.

During operation of the chassis, the fans are controlled by the MCH.

For further informations about the cooling strategy and behaviour contact the MCH manufacturer.

Figure 10: Cooling Unit

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1	Fan 1	6	Fan 6
2	Fan 2	7	Hot Swap push button
3	Fan 3	8	CU 1
4	Fan 4	9	CU 2
5	Fan 5		

5.1 Cooling Unit Behaviour

After power-on, both cooling units will be in autonomous mode with fan level = 2. After the MCH takes over the shelf management, the fan level is determined by the MCH.

The CU has an intergrated filter and increases the fan speed slowly (soft start) so that the current ripple is limited to < 0.8 A.

The CU firmware can be updated over the IPMB-0 by the MCH.

5.2 Fan Levels

Fan Level	Front Fans [rpm]	Rear Fans [rpm]
0	1800	1380
1	1920	1500
2	2160	1680
3	2400	1860
4	2700	1980
5	2940	2160
6	3120	2280
7	3360	2360
8	3540	2520
9	3780	2700
10	3960	2760
11	4140	2820
12	4320	2940
13	4500	3060
14	4620	3180
15	4800	3360

5.3 Cooling Unit Connectors and Indicators

The display module at the cooling unit provides:

- A green LED – “In-Service”
- A red LED – “Out of Service”
- A blue LED – “Hot-Swap”
- A hot-swap push button

The hot-swap push button indicates to the MCH that the Cooling Unit is about to be removed. Once the operator pushes the hot-swap switch, the MCH is informed of the pending extraction. When the MCH feels it is “safe“ to remove the Fan Tray, the blue Hot-Swap LED illuminates solid.

Table 2: LEDs on Fan Tray front panel

Color	Description	Status	Condition
Green	In-Service LED	Off Solid green	No Power to the Fan Tray Normal Operation
Red	Alarm LED	Solid red	Attention Status (error condition)
Blue	Hot Swap LED	Off Short blink Solid blue	In use Preparing for extraction Ready to remove

5.4 Emergency Cooling

If a fan fails or the connection to the MCH is lost, the EMMC increases the fan speed to the maximum. To check the connection to the MCH, the EMMC sends every 20 seconds the IPMI command GET_DEVICE_ID to the MCH and waits for an acknowledge. After 5 consecutive attempts, the EMMC sets the Cooling Unit to Local Mode and increases the fan speed to the maximum.

5.5 Firmware Update

The actual firmware can be found at **www.pentairprotect.com**. Go to the product page by entering the product number in the search box and download the firmware.

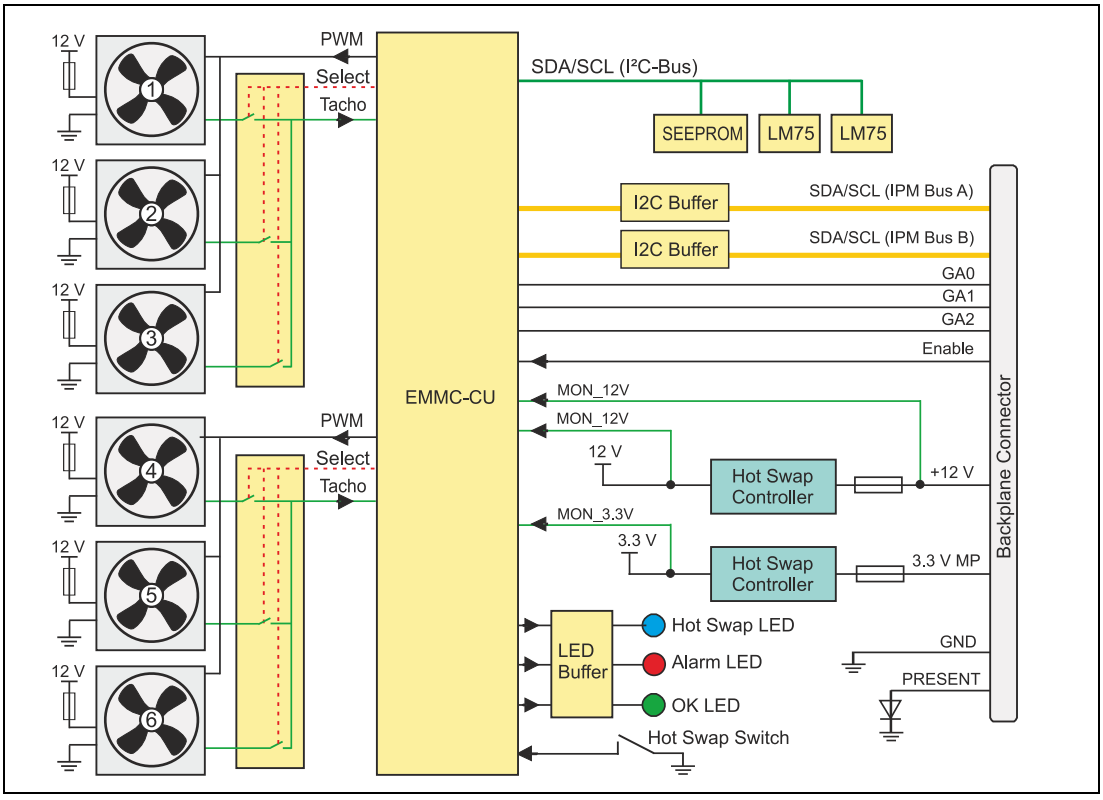
5.6 Cooling Unit IPMB Addresses

Table 3: Cooling Unit IPMB Addresses

Cooling Unit 1	0xA8
Cooling Unit 2	0xAA

5.7 Fan Controller Block Diagram

Figure 11: Fan Controller Block Diagram



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5.8 Cooling Capacity

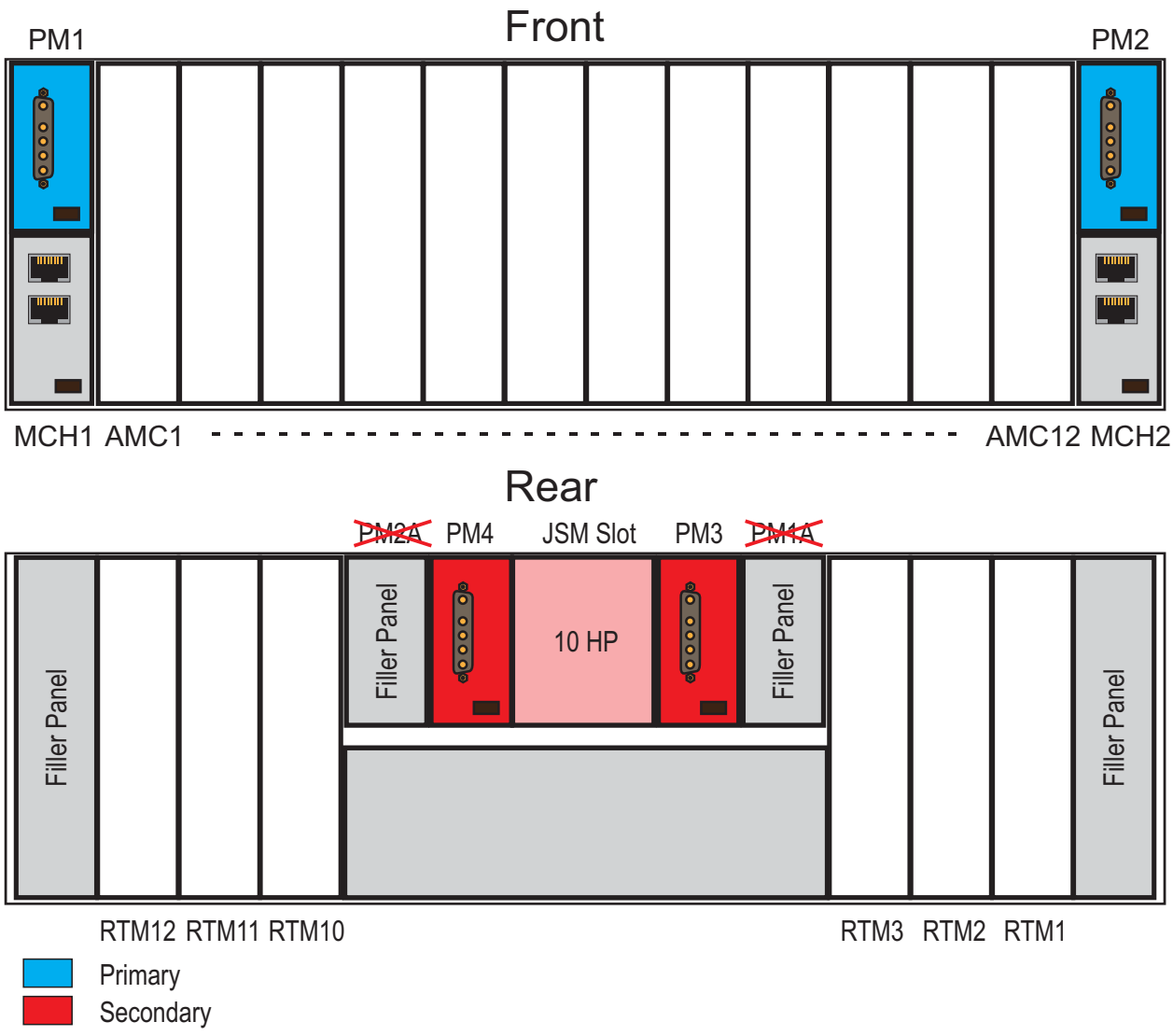
The Schroff MTCA.4 Shelf provides airflow using two Cooling Units, one below and one above the card cage subrack. Each Cooling Unit has 6 fans moving air from the lower side to the upper side of the Shelf in a push-pull arrangement. This arrangement provides excellent airflow as well as fault tolerance in the unlikely event of a fan failure. The maximum power available to an AMC/µRTM combination is 80 W, the average power on the µRTM shall not exceed 30 W. The shelf cooling capacity for the AMC front boards is 80 W/board, the cooling capacity for the µRTM boards is 30 W/board ($\Delta t \approx 10$ K).

6 Power

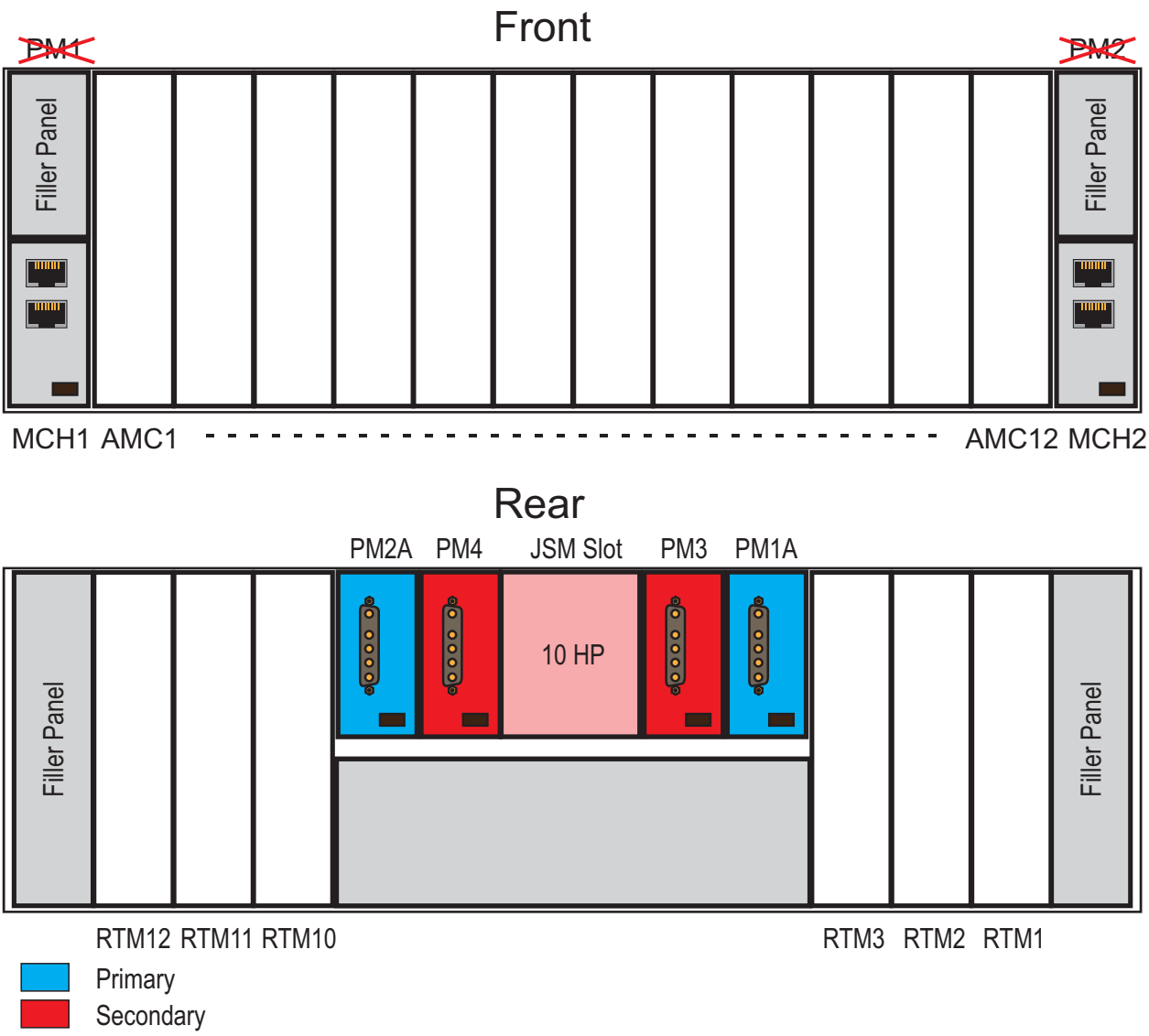
The MTCA.4 system provides 6 Power Module (PM) slots for Single Full-size Power Modules
PM1/1A and PM2/2A are defined as primary Power Modules, PM3 and PM4 are the secondary (backup) Power Modules.

It is not possible to use the slots for PM1/2 and PM1A/2A at the same time!

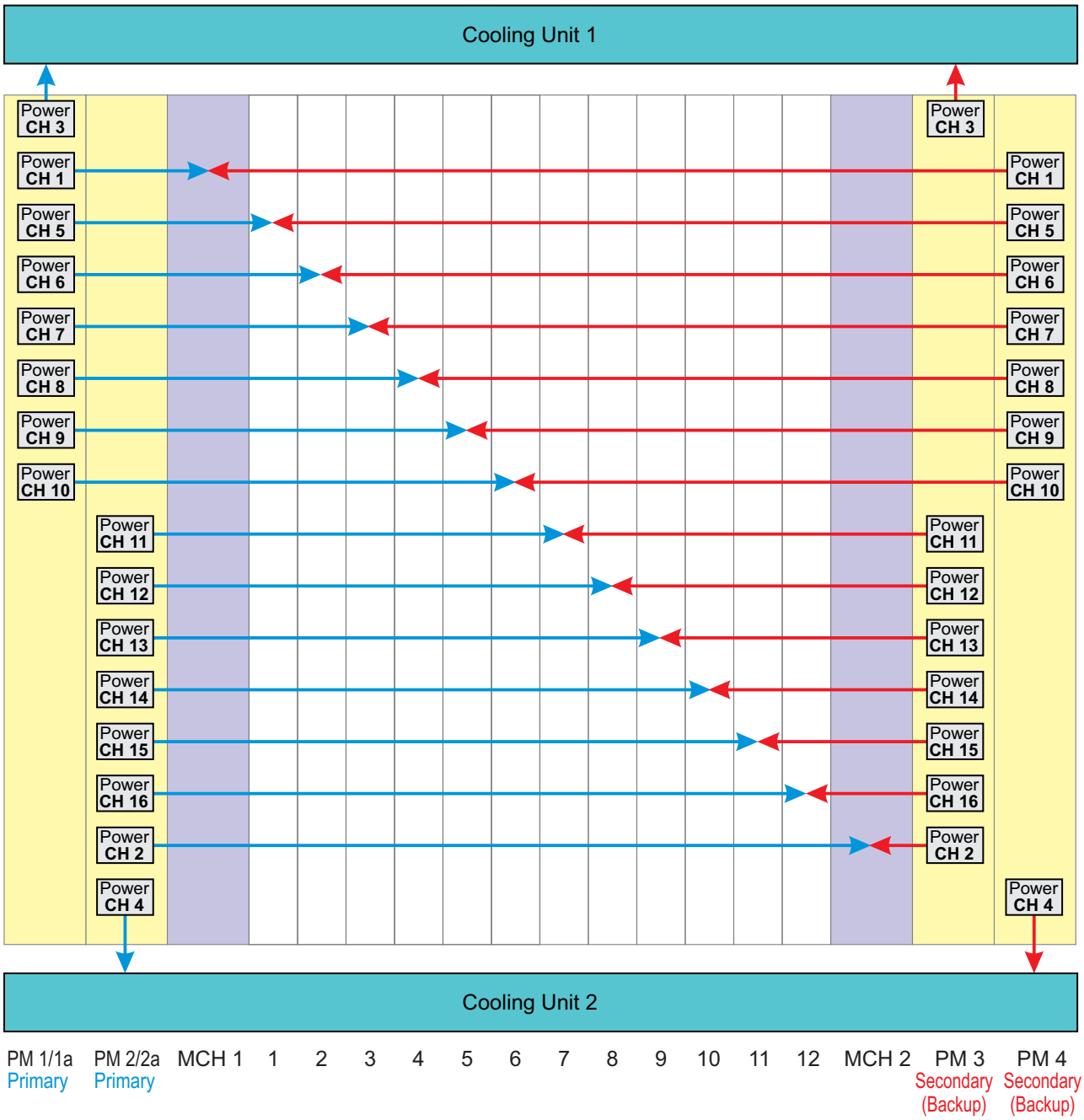
Power Module Kombination 1



Power Module Kombination 2



Power Distribution



7 Technical Data

Table 4: Technical Data

Physical Dimensions	
Height (11890-119/-152)	308,35 mm (7 U)
Height (11890-156/-170)	397,25 mm (9 U)
Width (with mounting brackets)	482,60 mm
Depth	373,3 mm
Depth (with front and rear cable trays)	473,3 mm
Weight	
Weight completely assembled (11890-119/-152)	approx. 18 Kg
Weight completely assembled (11890-156/-170)	approx. 21 Kg
Environmental	
Ambient temperature	+5°C…+50°C
Humidity	+5%...+85%, non-condensing

7.1 Shelf Dimensions

Figure 12: Shelf Dimensions 11890-156/-170

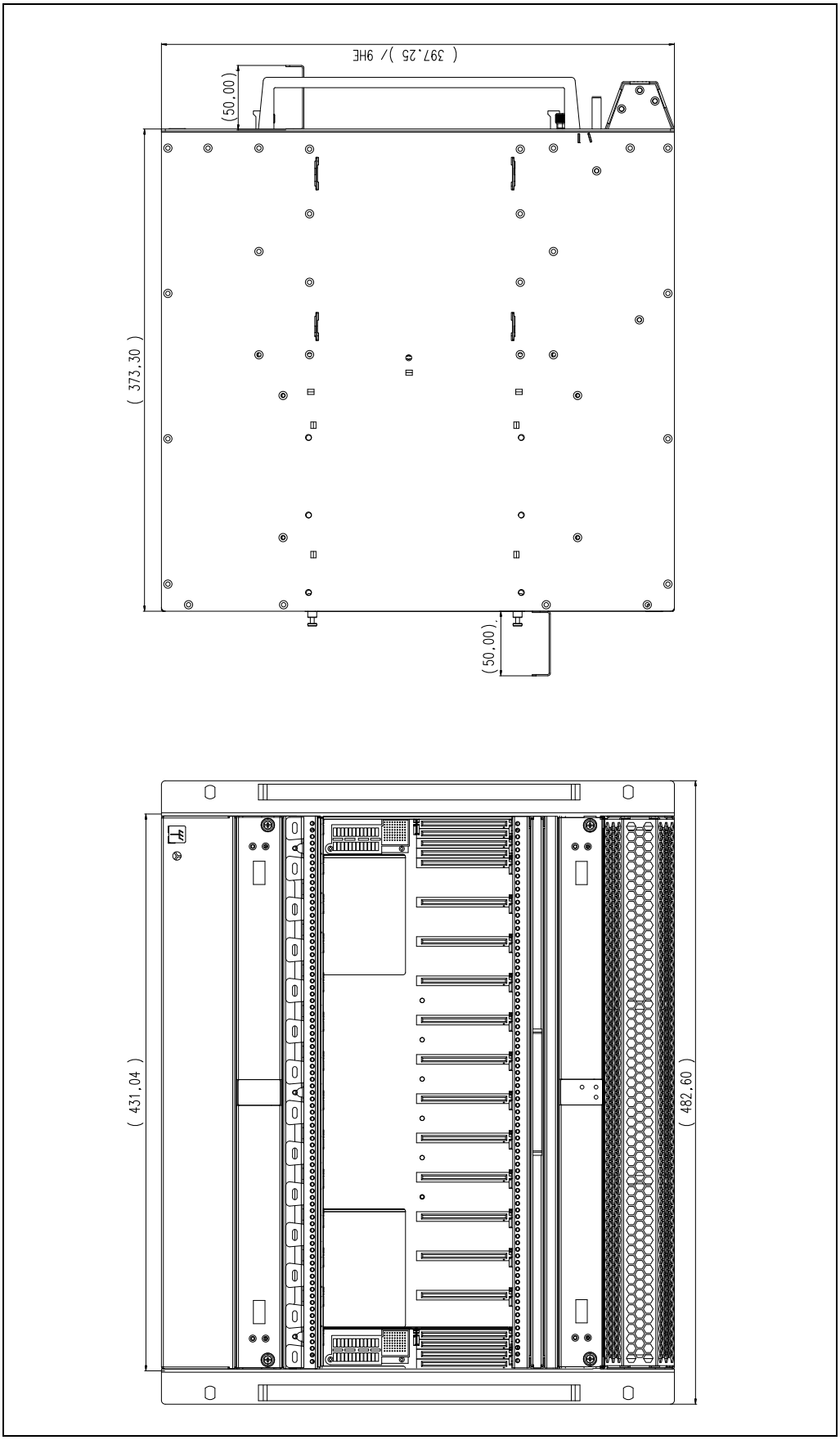


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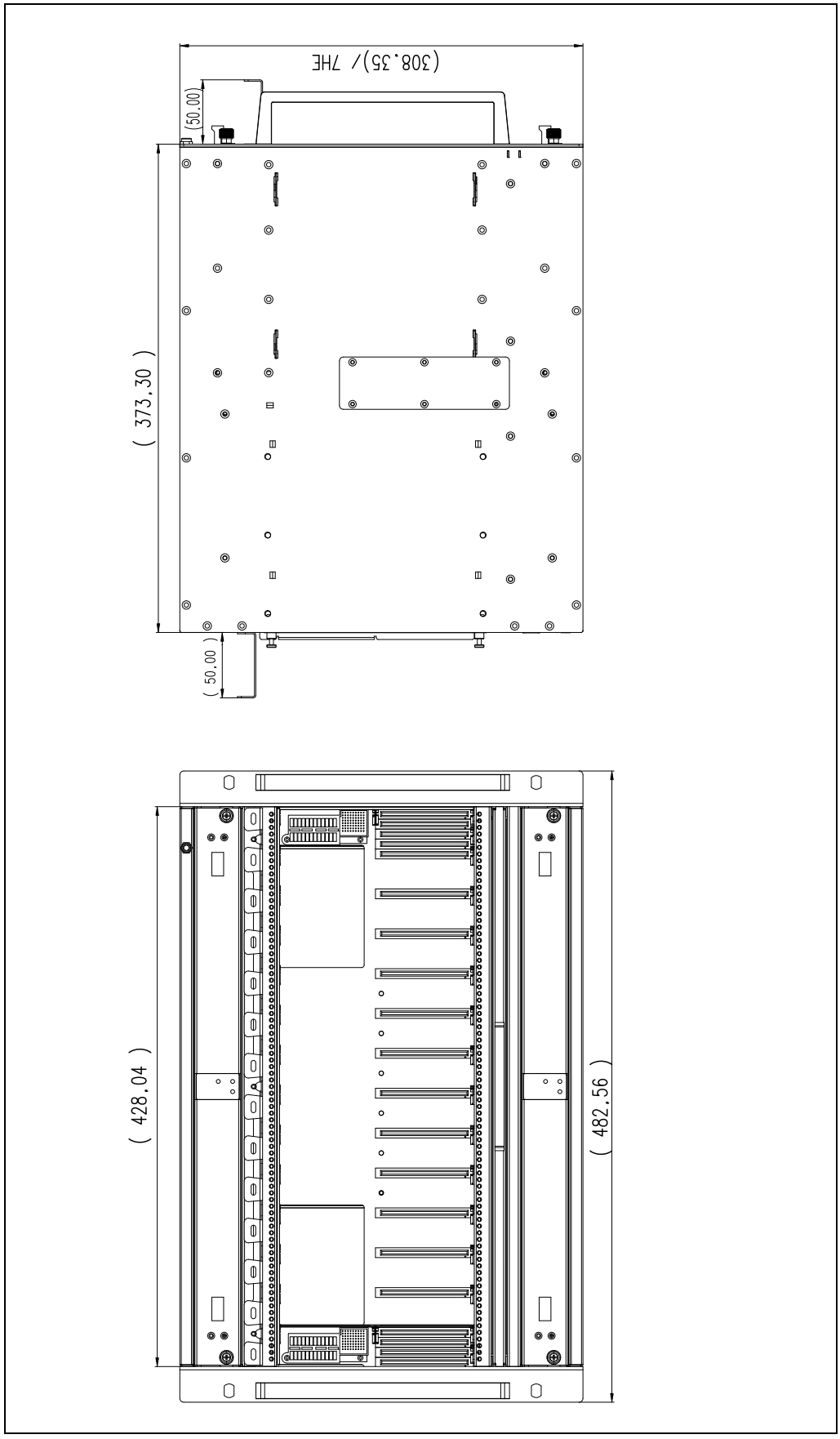
Figure 13: Shelf Dimensions 11890-119/-152



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