Switching Unit SU 600

Datasheet v1_00

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DOCUMENT OVERVIEW

Project: Switching Unit SU 600

Author: BOLAB Systems GmbH (info@bolab-systems.de)

Filename: Datasheet SU 600 v1_00.docx

Product: 126684 SU 600 Switching Platform Mainframe 4 slot

Hardware Version: 1.0

Firmware Version: 1.6.5 (SPC-64)

Revision History

Document version: **1.0**

Version	Date	Author	Description
v 1.00	06.10.2023	Franz Bosch	Initial version

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1. General Description

In general the SU 600 switch matrix system is a specific configuration of the BOLAB Switching Platform SP-400 mainframe, a 4HU 19‘‘-Rack that controls the switching states of up to 4 Plug-In modules with size 6HU and 6HP standard width. With a portfolio of more than 15 different module types it is a modular and scalable multi-channel switching solution for currents from 2A up to 70A based on TCP/IP communication.

The SU 600 Switching Unit rack is populated with 3x SPM-023206-MX matrix cards, one unused spare slot and specific internal wiring to a connector interface. It provides in total a 6x96 channel topology with max. 2A per channel, each channel has a 2A fuse integrated.

For cooling purposes 1 fan inside the mainframe provides air circulation, a temperature sensor activates the fan at >40°C. The matrix cards have a self-diagnostic feature “switching state readback”.

An internal 4x2 channel dual wire sense bus provides measurement signals over all module slots with connectivity to external measurement devices. The mainframes Error State output is a normally closed contact that opens in case of SW freeze, exceeding current and temperature limitations depending on card population.

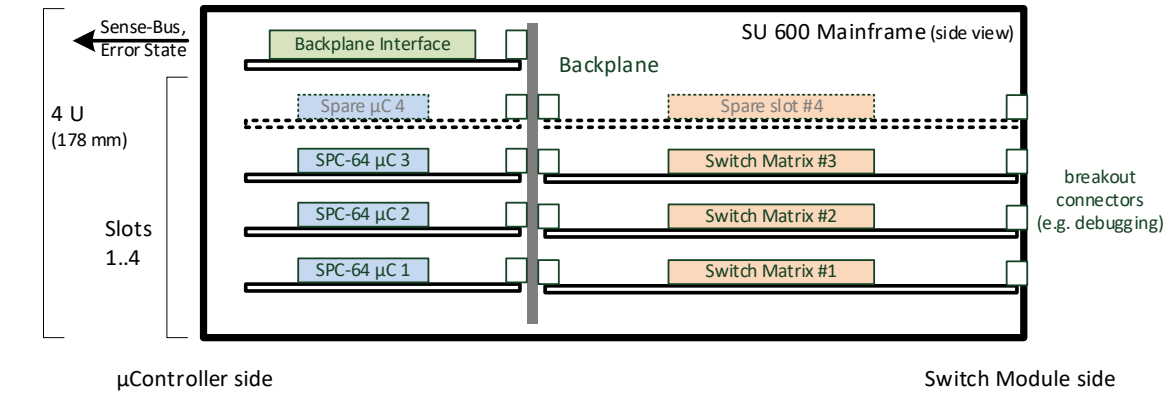
The SU 600 mainframe is controlled via TCP/IP connection and up to 15 mainframes can be linked together on one TCP/IP port to increase the total capacity of switching channels.

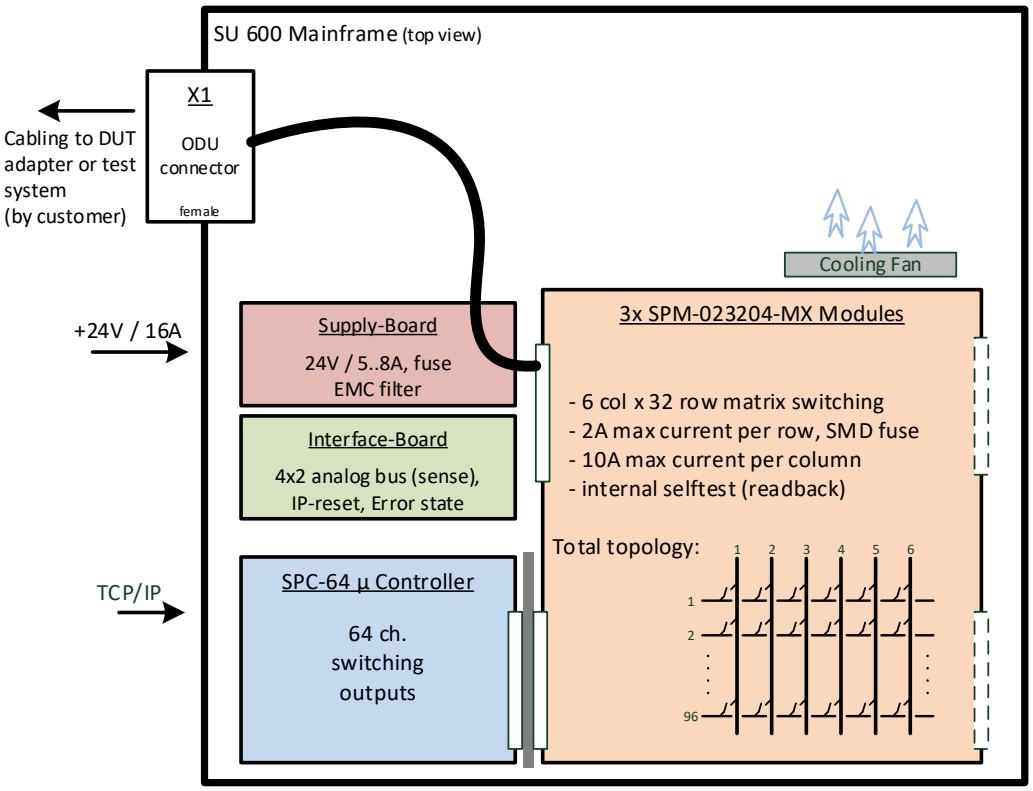
2. Safety Instructions

- Only for use in the specified DC Input Range of 24Vdc supply voltage and in electrical networks providing protection earth (PE)
- Use only inside suitable 19‘‘-Cabinets and not for applications to humans or animals.
- Use modules (SPM) only within specified current and voltage ratings

  acc. modules Datasheet: 60Vdc, 2A (SPM-023206-MX)
- Outputs need sufficient isolation and protection against contact

3. Schematic Overview & Pictures





SU 600 µController side

SU 600 Switch Module side

4. Delivery Content of SU 600 Switching Unit

The SU 600 includes following components:

- 19‘‘-Rack 4HU, 475mm depth, color RAL7035, ON/OFF switch, 1x cooling fans
- 4-slot horizontal backplane for µC and Switch Module population
- Backplane Interface card incl. Error State cable side connector
- SPB Supply card incl. cable side supply input connector
- 3x SPM-023206-MX (Matrix card 6x32 channel, 2A)
- 3x SPC-64 µController card
- Interface connector female side, protection cover, incl. internal wiring
- Interface connector male side (housing, modules, pins, protection cover)
- Filler panels 6HU and 3HU for unused slots (front and rear side closed)
- Switching Platform Software for setup and configuration

5. Certification & Compliance

Certification of conformity:	CE mark by BOLAB
RoHS Compliance:	EU RoHS directive 2011/65/EU Directive (EU) 2015/863 Annex II

6. Used Abbreviations

SP:	Switching Platform	as general term for all Switching Platform products
SPC:	Switching Platform Controller	3HU µC card that controls a Switching Platform Module
SPM:	Switching Platform Module	6HU pcb with relays and other circuits controlled by a SPC
SPW:	Switching Platform Wiring	standardized cable to connect a SPM to system interface
HU:	Height Unit = 44,45 mm	
HP:	Horizontal Pitch = 5,04 mm	
DUT:	Device Under Test	same as UUT (unit under test)

7. Electrical

Supply Voltage	24 Vdc	
Supply Current	typ. <2A max. 16 A	up to 150 closed relays and fan on Fused via rack supply card
Power Consumption	typ. 10..50 W max. 200 W	depending on modules and switching states internal power for all µC, modules and fans
PE Connection	Required	to test systems cabinet

Note:

For SU 600 mainframe a supply of 24Vdc, 5A is recommended.

8. Mechanical

Width	19‘‘	app. 483 mm
Height	4 HU	app. 178 mm
Depth	475 mm ~ 550 mm ~ 600 mm ~650 mm	rack depth incl. connectors & sockets incl. 90° ODU connector applied incl. straight ODU connector applied
Weight	app. 11,2 kg	SU 600 mainframe without cable side interface connector

9. Environment

Operating Temperature Range	0..55 °C 32..131 °F	
Operating Humidity Range	10-80 %	non condensing

10. Mainframe Cooling

1 fan in the center of the mainframe provides an internal air stream of app. 150m^3 per hour.

They will be activated (switched ON):

- By Backplane Interface card if the mainframe temperature sensor (located in top middle of mainframe) exceeds 40°C
- By any µController (SPC) that detects a temperature of >40°C on its ADC (depending on module population or external sensors).

They will be de-activated (switched OFF):

- If no µControllers (SPC) and Backplane Interfaces temperature sensor is measuring >35°C

There is a 5°C temperature difference to avoid a fast switching ON/OFF situation for the fans. If e.g. 5 µControllers are requesting the “Fan ON State”, then they will be switched to OFF if none of them is requesting “Fans ON” any more.

In case of cooling is not sufficient and temperature still raises, any temperature sensor exceeding the value of +80°C leads mainframes Error State set to “1” and opens the output contact.

Note:
Customer is responsible to integrate this contact in the test systems interlock loop to interrupt the power supply. This contact provides no safety level!

11. Basic Topology & Design

BOLAB Switching Platform design and topology issues:

- Modular concept: switch module side (6HU) for switching execution and load placement. µC side (3HU) of mainframe for communication and switching control.
- The SP Modules basically focus on switching execution and do not contain any control components. Switching control is provided exclusively by seperate µController card.
- Each slot with a populated 6HU Switch Module (SPM) requires a 3HU µController card (SPC) connected to the µController side of the slot.
- Communication to test system controller via TCP/IP protocol, cable connected to one of the µControllers (SPC) in the mainframe.
- Firmware 100% supports multithreading down to module level. Means each module can be controlled by different thread.
- Most modules provide internal diagnostic circuits and features.

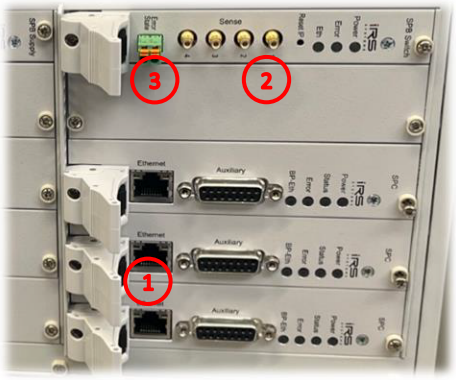
12. Supply & Integration

Mechanical integration in 19''-Cabinet via standard L-profile rails. Alternatively a C-profile rail integration is possible.

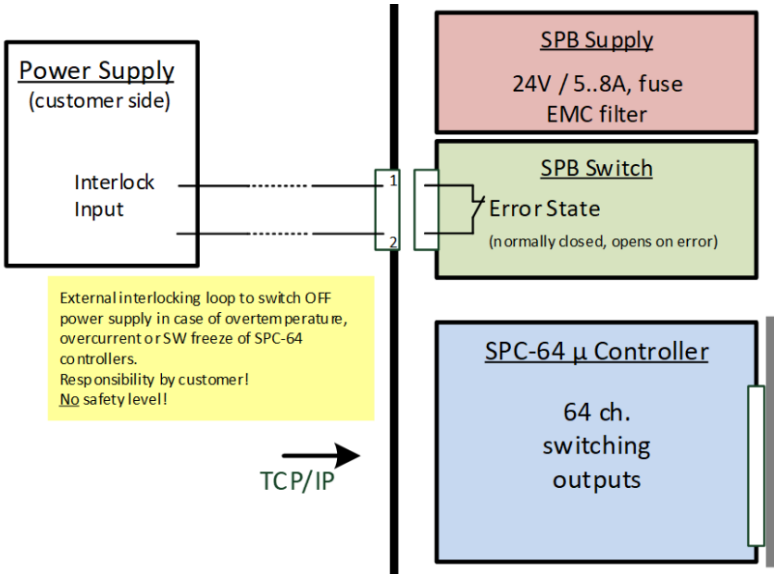
For customer manufactured supply wiring, the SU 600 mainframe provides a green Phoenix quick lock 3 pin connector for 24Vdc, GND and PE of test systems cabinet on the SPB Supply card.

1: For TCP/IP communication the test system's controller has to be connected to one of the SPC-64 µController cards "Ethernet" socket. No matter which one is connected, the SPB Switch card distributes the TCP/IP to all 4 slots. Unused sockets can be used for other devices TCP/IP in the test system.

2: This 4 SMB sockets "Sense" are the access to the 4 dual wire analog signal bus in the mainframe. The SU 600 has just matrix cards populated, this analog signals are <u>not</u> used in this configuration.

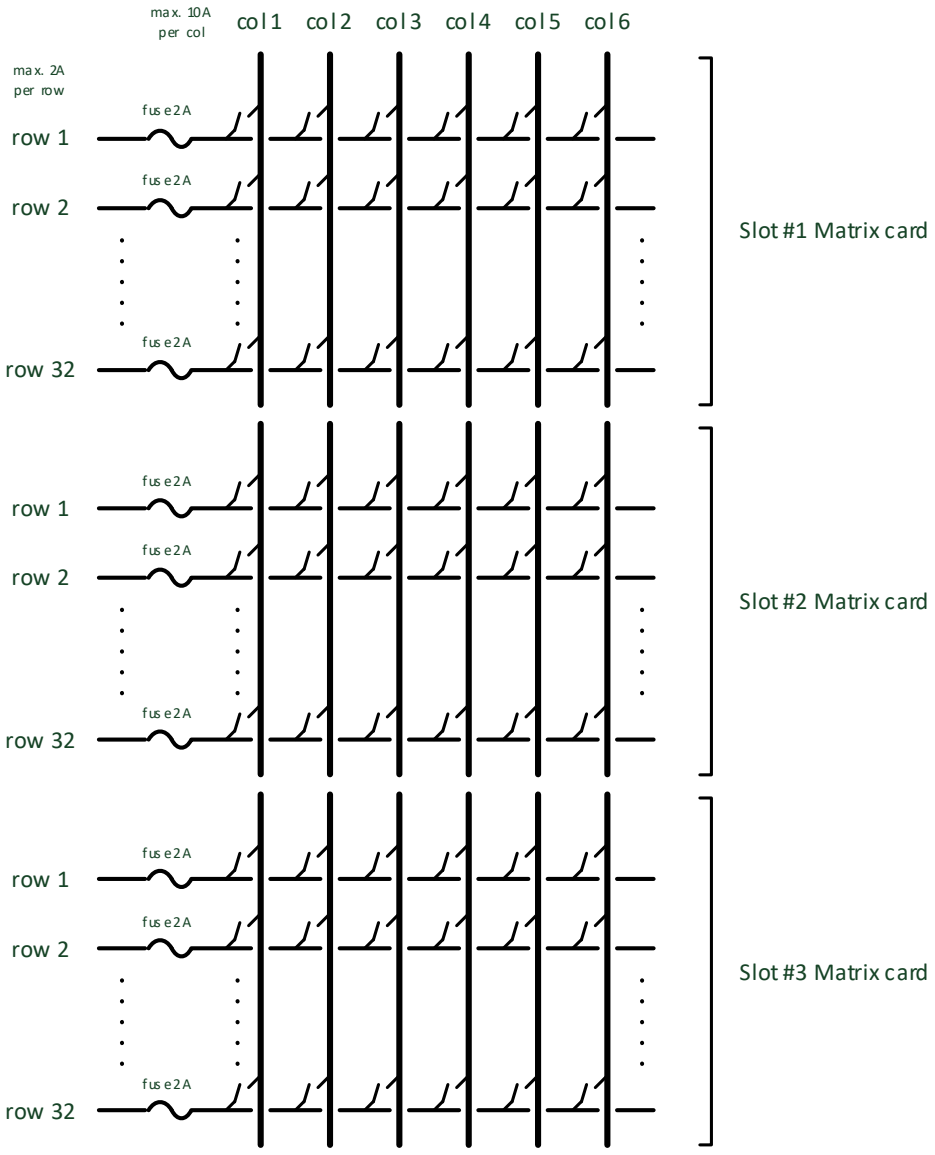


3: Error State output for external power supply interlocking loop:



13. SU 600 Topology

- 2x SPM-023206-MX matrix cards combined in total to a 6 x 96 matrix topology
- Max. 2A per row, max. 10A per column current limitation, rows fused

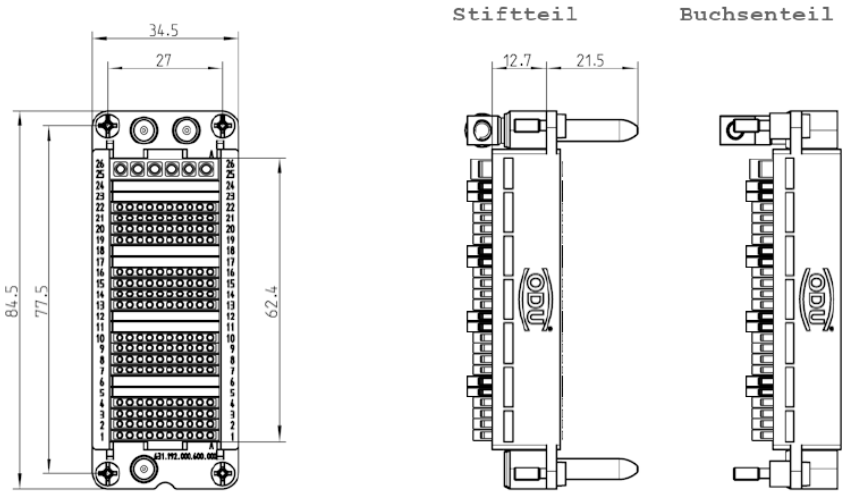


Schematic of SU 600 matrix topology

14. ODU Interface Connector

		a	b	c	d	e	f				
26	M 1	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6				Bus
25											
24											
23											
22	M 2										Matrix #4 spare
21	M 3										
20	M 4										
19	M 5										
18											
17											
16	M 6	Row 01	Row 02	Row 03	Row 04	Row 05	Row 06	Row 07	Row 08	Row 09	Row 10
15	M 7	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20
14	M 8	Row 21	Row 22	Row 23	Row 24	Row 25	Row 26	Row 27	Row 28	Row 29	Row 30
13	M 9	Row 31	Row 32								
12											
11											
10	M 10	Row 01	Row 02	Row 03	Row 04	Row 05	Row 06	Row 07	Row 08	Row 09	Row 10
9	M 11	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20
8	M 12	Row 21	Row 22	Row 23	Row 24	Row 25	Row 26	Row 27	Row 28	Row 29	Row 30
7	M 13	Row 31	Row 32								
6											
5											
4	M 14	Row 01	Row 02	Row 03	Row 04	Row 05	Row 06	Row 07	Row 08	Row 09	Row 10
3	M 15	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20
2	M 16	Row 21	Row 22	Row 23	Row 24	Row 25	Row 26	Row 27	Row 28	Row 29	Row 30
1	M 17	Row 31	Row 32								
		a	b	c	d	e	f	g	h	i	k

ODU ID: 26746



Gesamtsteckkraft (Mittelwert): 136 N / Gesamtabzugskraft (Mittelwert): 103 N

656.631.2XX.XXX.XXX Stiftteil

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  1x 631.192.000.600.000 ODU-MAC Sti-Rahmen, Gr.3
  1x 492.420.650.908.000 Tülleng. Gr. 3, Kunststoff, Querbügel
 16x 631.118.110.922.000 Isolierkörper 10-pol.
160x 185.710.000.270.000 Stift 0,7 mm, kurz
  1x 631.111.106.923.000 Isolierkörper 6-pol.
  6x 185.432.000.270.000 Stift 1,3 mm, kurz
  8x 631.151.000.923.000 Leermodul 1 Einheit
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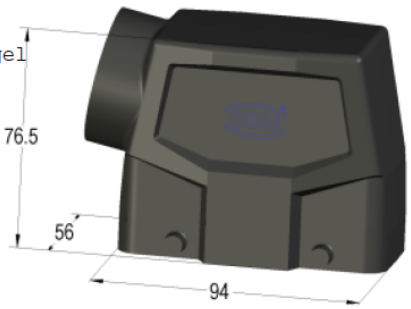

656.630.2XX.XXX.XXX Buchsenteil

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  1x 492.120.600.908.000 Anbaug. Gr. 3, Kunststoff, Querbügel
 16x 630.118.110.922.000 Isolierkörper 10-pol.
160x 175.581.000.270.000 Buchse 0,7 mm
  1x 631.111.106.923.000 Isolierkörper 6-pol.
  6x 175.535.000.270.000 Buchse 1,3 mm
  8x 631.151.000.923.000 Leermodul 1 Einheit
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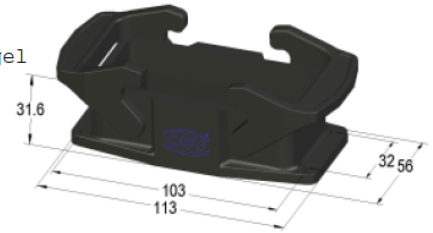
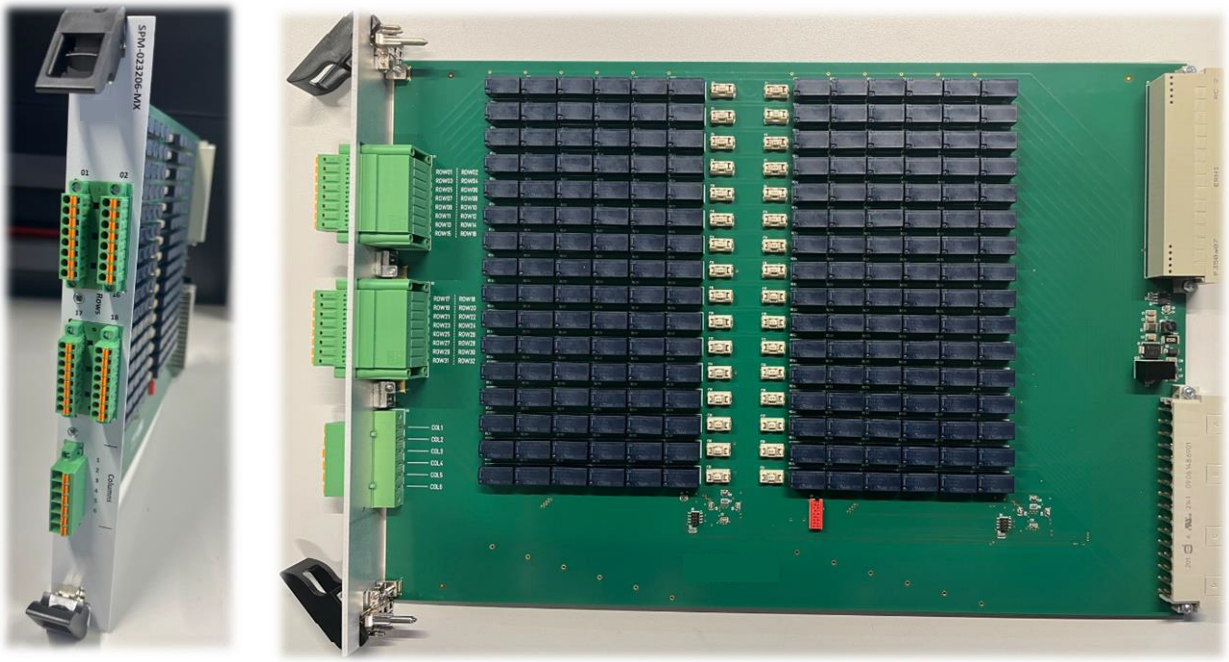


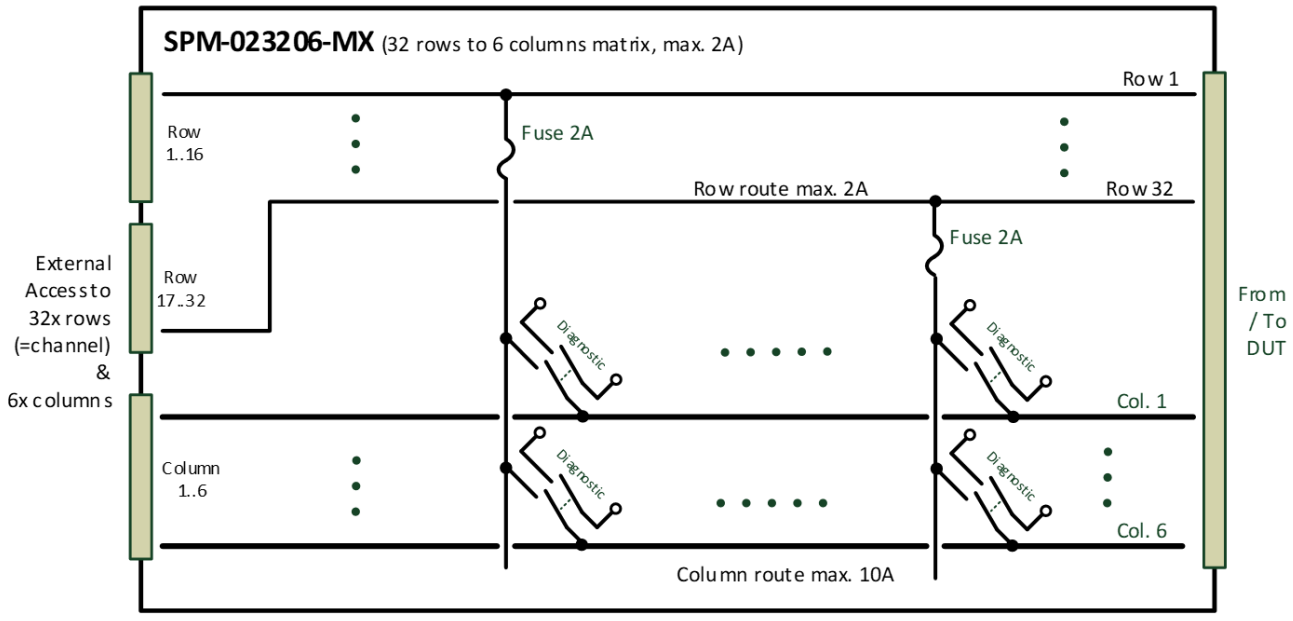
Werkzeuge

```
080.000.051.000.000 Crimpzange 0,05 - 1,0 qmm
080.000.051.101.000 Positionierer 0,05 - 1,0 qmm
087.7CC.070.005.000 Demontagewerkzeug 0,7 mm
087.7CC.130.004.000 Demontagewerkzeug 1,3 mm
```

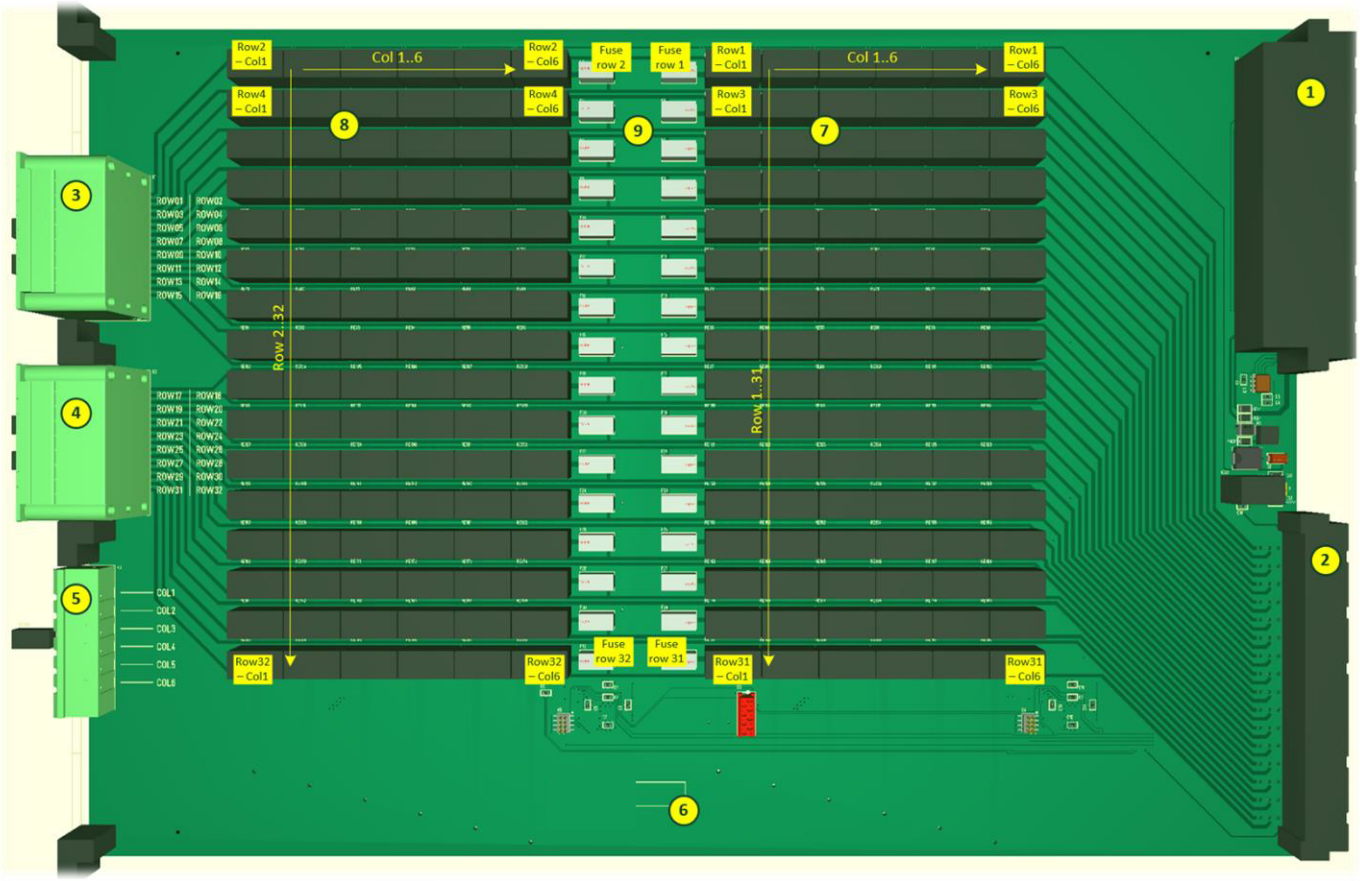
15. SPM-023206-MX Matrix card

15.1 Topology & Components





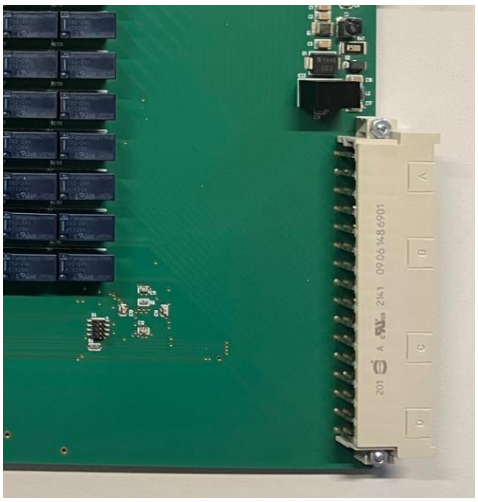
Topology of SPM-023206-MX



Component location of SPM-023206

1 Backplane interface connector (to SPC-64)
2 DUT interface connector (to ODU connector)
3 Breakout connector Rows 1-16 (parallel to DUT interface connector)
4 Breakout connector Rows 17-32 (parallel to DUT interface connector)
5 Breakout connector Columns 1-6 (parallel to DUT interface connector)
6 Cards type and serial number label
7 Crosspoint relays for row 1 – 31 (odd) & column 1 – 6
8 Crosspoint relays for row 2 – 32 (even) & column 1 – 6
9 Fuses for row 1 – 31 (right side), row 2 – 32 (left side)

15.2 DUT Interface Connector Pinout



X2 connector layout for cable to DUT/Adapter

	d	b	z	
2	Row 01	Row 02	PE	2
4	Row 03	Row 04		4
6	Row 05	Row 06		6
8	Row 07	Row 08		8
10	Row 09	Row 10	Col 1	10
12	Row 11	Row 12		12
14	Row 13	Row 14	Col 2	14
16	Row 15	Row 16		16
18	Row 17	Row 18	Col 3	18
20	Row 19	Row 20		20
22	Row 21	Row 22	Col 4	22
24	Row 23	Row 24		24
26	Row 25	Row 26	Col 5	26
28	Row 27	Row 28		28
30	Row 29	Row 30	Col 6	30
32	Row 31	Row 32		32

For cabling to system's receiver interface or to DUT Adapter following data needs to be considered:

Max. current	6 A	per connector pin (crosspoints limited to 2A!)
Used pins	1 2	pins used per row pins used per column
Wire cross sections	AWG 20 / 0,5 mm^2 AWG 16 / 1,5 mm^2	per row wire per column wire

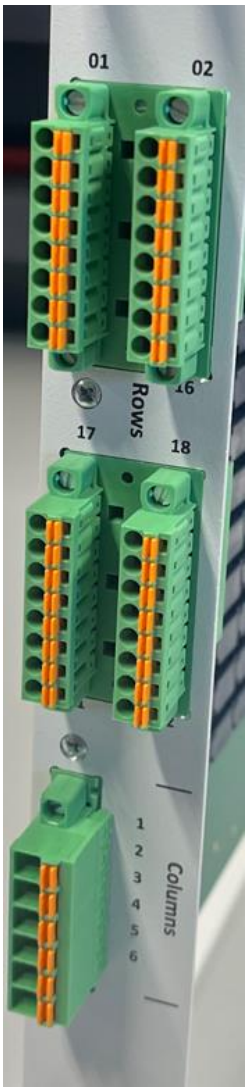
*note:

For SU 600 internal wiring to DUT interface connector female side (socket) is already integrated.

15.3 Breakout Connector Pinout

	Breakout
1	Row 1
2	Row 3
3	Row 5
4	Row 7
5	Row 9
6	Row 11
7	Row 13
8	Row 15

	Breakout
1	Row 2
2	Row 4
3	Row 6
4	Row 8
5	Row 10
6	Row 12
7	Row 14
8	Row 16



	Breakout
1	Row 17
2	Row 19
3	Row 21
4	Row 23
5	Row 25
6	Row 27
7	Row 29
8	Row 31

	Breakout
1	Row 18
2	Row 20
3	Row 22
4	Row 24
5	Row 26
6	Row 28
7	Row 30
8	Row 32

	Breakout
1	Col 1
2	Col 2
3	Col 3
4	Col 4
5	Col 5
6	Col 6

The breakout connector can easily be used as parallel matrix crosspoints access e.g. for debugging purposes, additional instruments access, DUT access from cards front side.

For cabling to breakout interface following data needs to be considered:

Max. current	8 A 12 A	per Row pin (8pin conn., crosspoints max. 2A!) per Col pin (6pin conn., Col routes max. 10A!)
Used pins	1	pins used per Row and per Col
Wire cross sections	AWG 20 / 0,5 mm^2 AWG 16 / 1,5 mm^2	per Row wire per Column wire

16. Features & Functions

Note:
Some functions depend on card types and population of the mainframe.
The SU 600 with matrix configuration does not support: Module Current Monitoring
Module Temperature Monitoring
Analog Sense Bus access

Module Capacity	Up to 4 SP-Modules (SPM) with standard width 6HP (app. 30mm) can be populated in one mainframe
Communication	Via TCP/IP connection, e.g. 192.168.111.240 cable connected to one of the µControllers (no matter which one) cascading of max. 15 mainframes on one TCP/IP port
Current Range	Switch Modules classification (max. current): 2A for SU 600
Voltage Range	max. 60Vdc (SPM-023206-MX)
Load Cooling	1 cooling fan in center of rack, air stream app. 150m^3 per hour activation via API command and on module request (temp.-sensors)
Digital I/O (per SPC)	2 bit digital IN, 2 bit dig. OUT per µController card max. 2mA TTL 3.3V read/set via SW command
Error State Contact	Form A relay contact on backplane interface card for internal error state. Contact is closed when no internal error is detected and opens in case of error. Error reasons are: - SW freeze (firmware inside SP-1200) - Over-Current detected on any high current load channel - Over-Temperature in mainframe or on any high current load channel
Module Current Monitoring	High current modules (>30A) provide internal current monitoring incl. channel switching OFF function: Load channel will be switched OFF by firmware, if current exceeds limit
Module Temperature Monitoring	High current modules (>30A) provide internal temperature monitoring incl. channel switching OFF function: Load channel will be switched OFF by firmware, if temperature exceeds limit
Mainframe Temperature Monitoring	The mainframe has a PT1000 temperature sensor located typically on top of the 19''-Rack in the middle. Fan(s) will be activated by firmware at >40°C and deactivated at < 35°C Error state contact will be opened at >80°C

Analog Sense Bus	SP backplane provides 4 ch. dual wire analog sense bus; via 4x SMB connectors on backplane interface connecting e.g. a DMM allows measuring the voltage drop of a integrated shunt or output voltage of current transducer on the load channels Basically 4 currents could be measured in parallel. Note: - Not all SP-Modules and load channels support current measurement and access to the sense bus - Load channels may be switched to dedicated sense busses, see module specification
SP-Editor SW	The topology and population of BOLAB Switching Platform products can be configured with a SW tool, the Switching Platform Editor: - SP project definition and handling - Mainframes, modules and µC configuration - Auto-Setup function and configuration report file - Module dependent parameters (e.g. relay bouncing time) - Alias names for channels (easy understandable switching) - Current and temperature limits (high current cards 30A, 70A) - Access levels Operator, Developer, Administrator password protected - Firmware and database update - Debug windows for manual control - Integrated command request builder and documentation - …

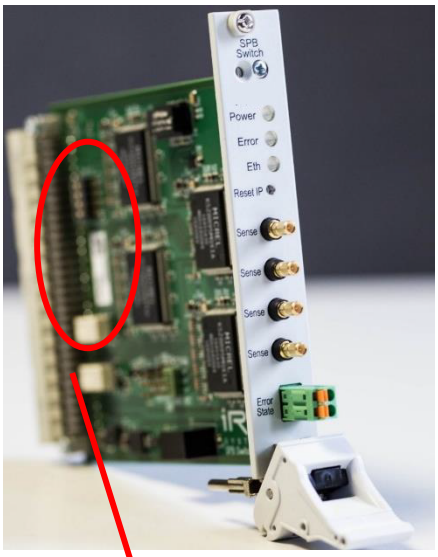
17. Backplane Interface – SPB Switch

17.1 Connectivity & Status

The backplane interface “SPB Switch” card provides access to SU 600 mainframe’s analog sense bus (8ch.) and the Error State output. The card shows mainframes status conditions via the LEDs Power, Error and Ethernet and allows an IP reset.

The interface also works as a switch for internal TCP/IP distribution to each slot (each slot has own IP address).

For each SP mainframe the IP Address has to be set in this interface card.



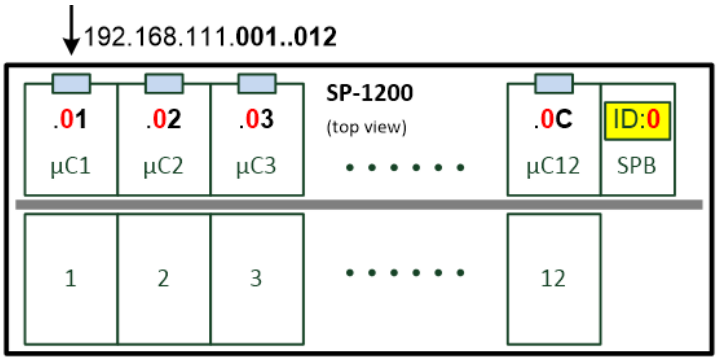
17.2 IP Address Setting

Default value of each SP mainframes IP Address is:

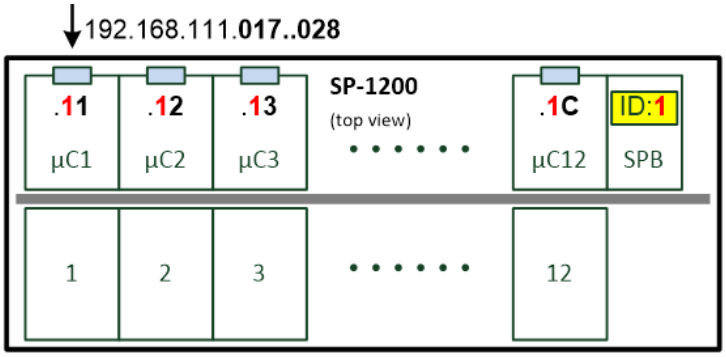
192.168.111.0

With a 4pin DIP switch on the backplane interface card (right side next to the SNr. Label) the Rack-ID can be set from “0x0” to ”0xE”. This also sets the high nibble of last part of the IP Address. The low nibble is defined by hardware from “0x1” to “0x4” for each slot in a 4 slot mainframe and to “0xC” for a 12 slot mainframe.

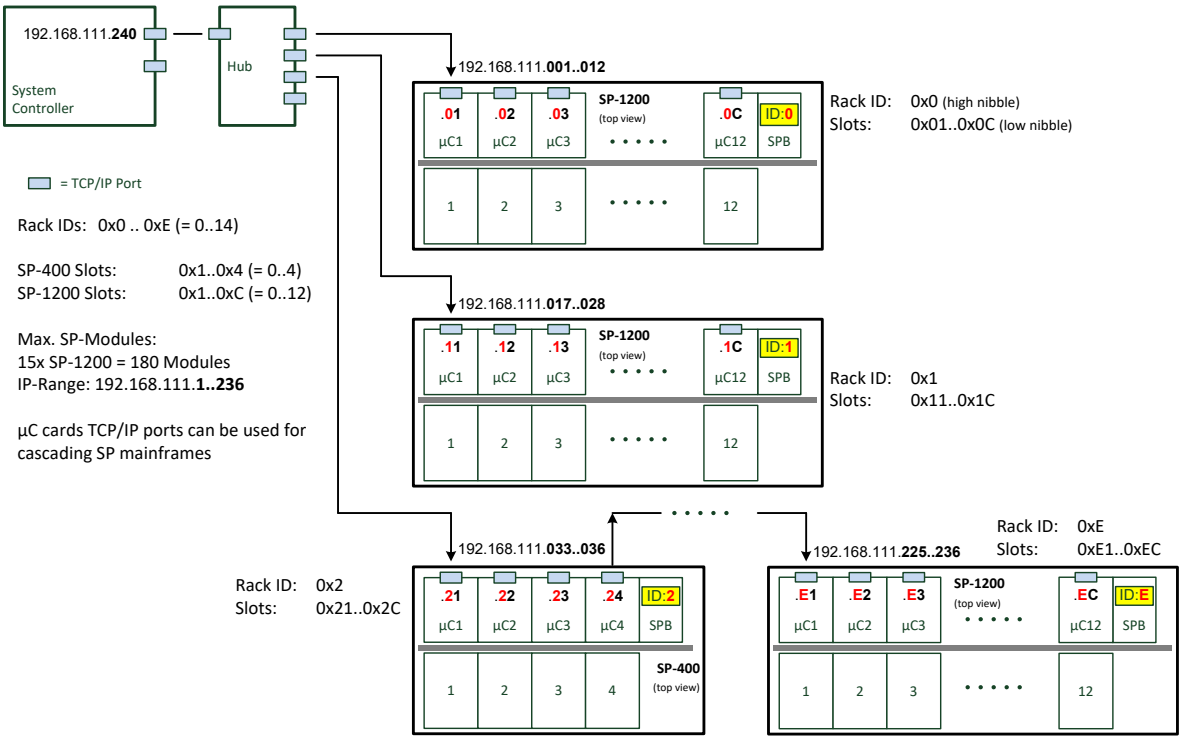
This defines following default IP Address structure (based on a 12 slot mainframe):



Setting the Rack-ID switch from “0” to “1” changes the mainframes IP Address range:



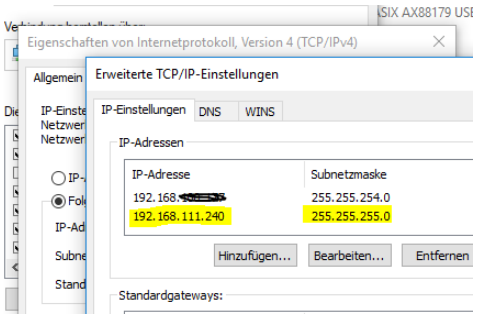
Example topology with multiple SP Mainframes:



17.3 Controller PC - IP Setting

The IP Address range for a Switching Platform topology with 15 SP-1200 mainframes is from **192.168.111.1** up to **192.168.111.236**. To avoid collisions, a good IP Address for an external controller (PC, Laptop, PXI-Controller, ..) would be e.g.:

192.168.111.240

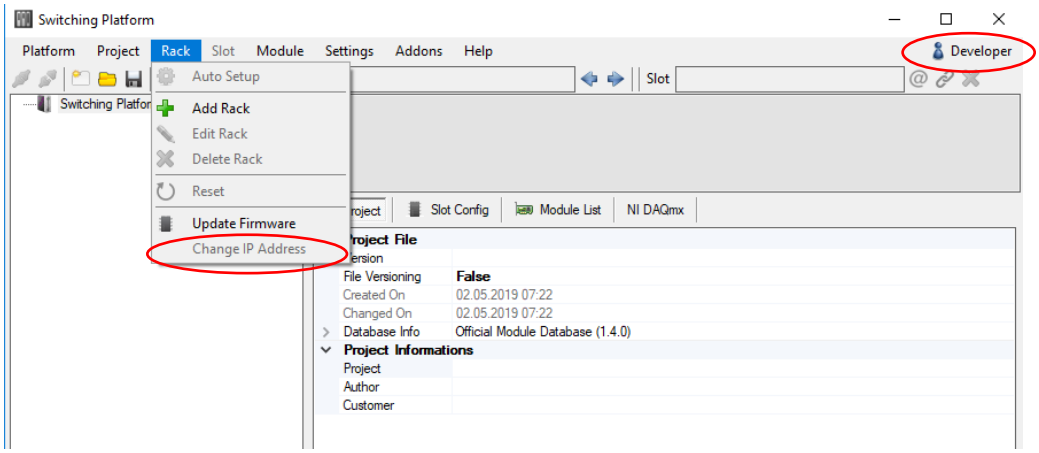


17.4 Change Mainframes IP Address

The mainframes IP address can be changed via the SP Software: *Rack – Change IP Address*. This requires developer login.

Note:

A change of IP address immediately disconnects the mainframe connection. To re-connect, the systems controller IP-Port setting must be changed accordingly.



18. Rack Supply Card – SPB Supply

The 24Vdc supply voltage for each SP mainframe is applied via the green 3pin Quick Lock connector. For removal both locking springs need to be pressed to unplug the connector.

+24Vdc, GND and test systems PE need to be connected, the cable side connector is included in delivery. The input is fused with 16A.

All wires need minimum width AWG14 or equivalent 2,5mm^2.

+24Vdc	1	Top pin
GND (24V)	2	Middle pin
PE	3	Bottom pin

SBP Supply card and SPB Switch

19. Error State Output

The Error State output reflects mainframe internal errors to devices outside of the mainframe in order to react on critical conditions. Via ADC inputs, each µC card (SPC-64) is monitoring the current and temperature sensors on the module in the corresponding backplane slot. In case of limit exceeding, the SPC sets the Error State to “1” for the whole mainframe.

Main purpose is to connect the Error State output to the Interlock input of a power supply, so in case of an error the PS will switch off and remove potentially dangerous voltage and current from test system and DUT.

The error state can also be connected to e.g. dig. I/O devices read by test systems controller to react inside test sequence on error state condition.

The Error State is set to “1” (means relay contact opens):

- Over current condition:

  Any load channels current monitoring detected a current exceeding the set limits (set in SP-Editor by default or custom specific).

- Over temperature condition:

  Any load channels or modules temperature monitoring detected a temperature exceeding the set limits (set in SP-Editor by default or custom specific).

  Some modules also provide external temperature sensors. This sensors can be used also outside oft he SP mainframe e.g. in the test systems cabinet.
  Indemendent from SP-Modules the mainframe has a temperature sensor located on top middle of the rack. Via the backplane interface this sensor will activate the fans when >40°C and also raise overtemperature condition when >80°C.

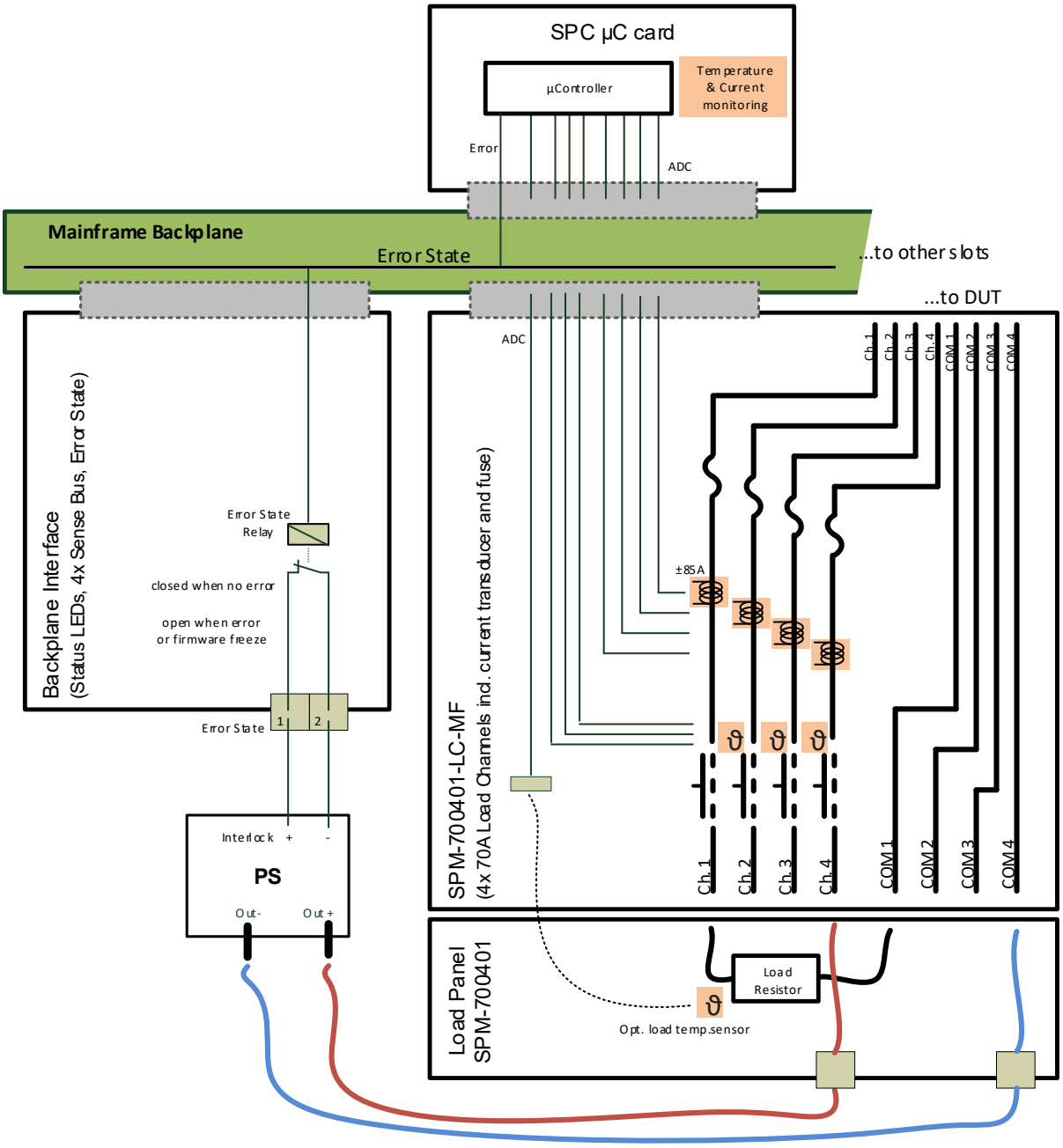
- Firmware freeze:

  Internal running firmware is re-setting the error state permanently to „0“. If this function is not executed, the error state will switch to „1“ by HW circuits.

In case of Error State is “1”, each API command sent to mainframe will receive a corresponding error message and the command will not be executed.

The Error State can be reset by API function.

Functional schematic example with 70A high current module:



21. Population & Removal of Modules

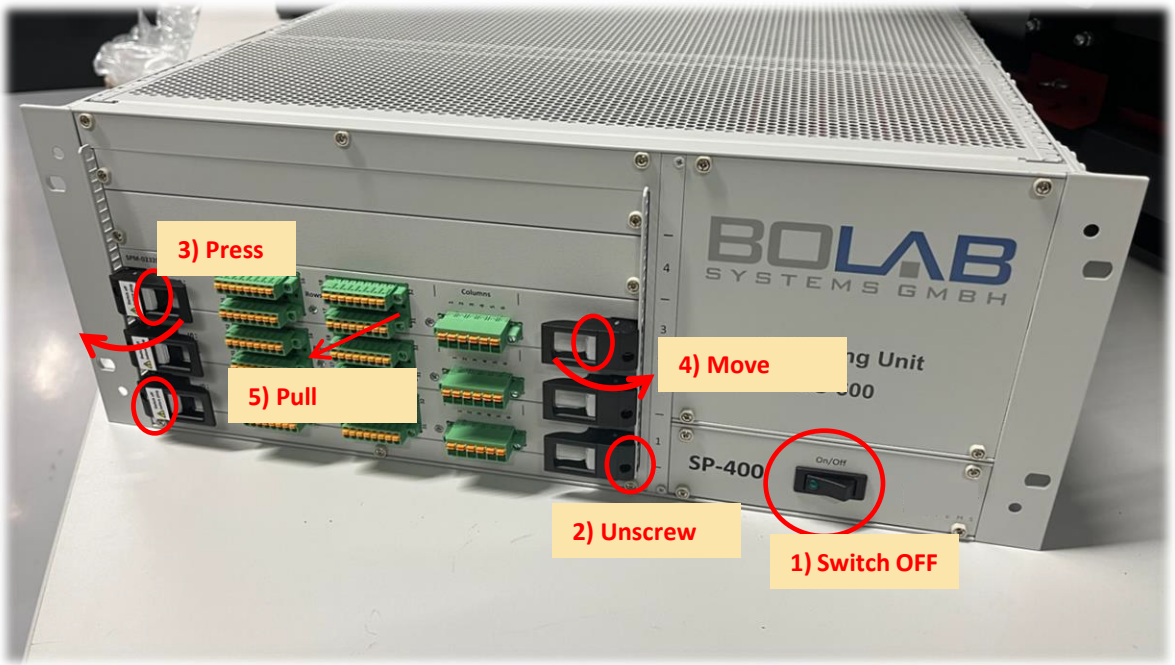
! Use only SP-Modules that are designed for BOLAB Switching Platform. Using other cards can damage the mainframe or other system hardware components.

Attention:

Always switch SP-xxx mainframe to OFF or remove 24Vdc supply when removing or plugging cards (modules & controllers)!

1) Disconnect 24V supply or switch off the mainframe before plugging/removing cards.
2) To remove modules, first unscrew the panels on top and bottom of SPM holder
3) Then press grey locks at the same time and
4) Move the holders to unplug the cards from backplane and modules cabling connectors
5) Pull the module carefully out of the slot
6) Some modules have components mounted on pcb bottom side (left side).
   To avoid collision with panels of neighbor modules and damage the module the movement must be done very sensitive.

For plugging of modules perform the reverse procedure from 5. to 2. with unpowered or switched OFF mainframe.



22. List of Available Switching Platform Components

ID	Type	Description
SP-1200	Mainframe 7 HU, 12 slots	Max. 12 modules (vertical)
SP-400	Mainframe 4 HU, 4 slots	Max. 4 modules (horizontal)
SPM-300801-FS	Fault Simulation 8 Ch. 30A	Connect DUT pins to short busses
SPM-014002-HV	High Voltage Matrix 1kV	40 ch. 1A configurable High Voltage Matrix
SPM-021604-MX	Matrix 16x4 ch. 2A	16 rows (2A) to 4 columns (10A), selftest: relay readback
SPM-023206-MX	Matrix 32x6 ch. 2A	32 rows (2A) to 2 columns (10A), selftest: relay readback
SPM-026401-LC	Loadcard 64 ch. 2A	64x form A contacts 2A, selftest: relay readback, load breakout pcb
SPM-100802-LC	Loadcard 8x2 ch. 10A	8x2 form A contacts 10A, current measurement by shunt or current transducer, mounting panel or load breakout pcb
SPM-300602-LC	Loadcard 6x2 ch. 30A	6x2 form A contacts 30A, selftest: test current loop, mounting panel or load breakout pcb
SPM-700401-LC	Loadcard 4 ch. 70A	4x form A contacts 70A, selftest: test current loop, mounting panel or load breakout pcb
SPM-700401-LC-MF	Loadcard 4 ch. 70A	4x MOS-FET switches 70A, selftest: test current loop, mounting panel or load breakout pcb
SPM-SYS-001	System Module	System Module; 8x diff. signal switching, auxiliary DC power supply, monitoring (5V, 12V, 24V), 16x Dig. IN, 12x Dig. OUT
SPM-1000201-ME-CMM	Measurement Module current µA – 100A	2x CMM-III autoranging current measurement devices, incl. factory- or DakkS-calibration, selftest: current loop

23. Sparepart List

Manufacturer /Supplier	Part Nr.	BOLAB Part Nr.	Component Description
BOLAB Systems GmbH	SU 600	126684	Mainframe SP-400 in SU 600 configuration
BOLAB Systems GmbH	SPB Switch	121467	SP Backplane Interface card v1.3
BOLAB Systems GmbH	SPB Supply	122051	SP Supply card v2.0
BOLAB Systems GmbH	SPC-64	122970	SP µController card v2.3
Würth Elektronik	691304530003	121013	Supply connector 3pin
Phoenix Contact	FMC 1,5/ 2-ST-3,81	109439	Error State Output connector 2pin
Phoenix Contact	FMC 1,5/ 8-STF-3,81	120337	8 pin breakout connector for Rows
Phoenix Contact	FKCN 2,5/ 6-STF-5,08	120338	6 pin breakout connector for Columns
Littelfuse	0154002.DR	119358	SMD Fuse 2A incl. socket

24. Product Support

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