SFU 0156

Schnellfrequenzumrichter
High Frequency Converters
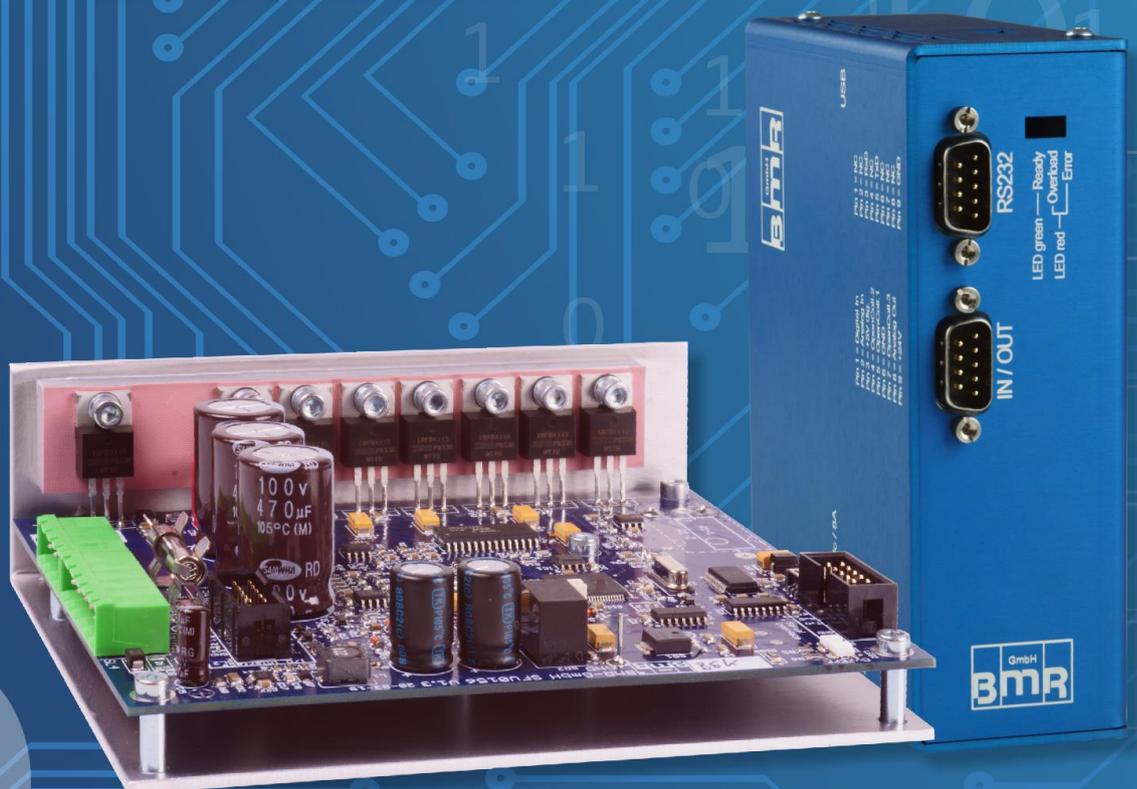
HIGH QUALITY

100%

MADE IN GERMANY

EXCELENT SERVICE

CONTENT
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1. Description and Features

✓ Operation of **AC induction and** and **BLDC spindle motors**
✓ Available as Open Frame or as SSE for cabinet mounting on DIN rail
✓ The frequency converter **SFU 0156** allows **speed frequencies** up to **4000Hz/240.000 rpm** with 2-pole AC induction motor.
✓ The core of SFU-0156 is a **digital signal processor** (DSP) which produces all output parameters and collects signals.
✓ **High-precision sinusoidal** output signals with a low distortion factor and low deformation allow for optimal rotation qualities in AC motors of all operating conditions
✓ All parameters like power, voltage and frequency are collected in **real time** and are regulated by the implemented vector control depending on the load.
✓ High **operating safety:** All operating conditions like acceleration, operation with nominal rotation speed, braking are controlled and critical conditions are intercepted.
✓ **Short circuit protected**
✓ **on board chopper resistor**
✓ **Protection against excess temperature.**
✓ **Integrated intelligent recovery diode** prevents overvoltage at the power supply

2. Technical Data

Power Supply	Logic:	24V / 0,1 A DC (18V…30V)
	Spindle:	max. 85V / 8A DC - pluggable screw terminals 2,5mm²
Fuses	FS2:	T6,3A
		recommendation.: Littlefuse 0477 06.3XP/SIBA 179200 6,3
Continuous output power	640VA / S1 100%	
Spindle Connection	4-pin:	U, V, W, PE - pluggable screw terminals 4mm²
Output Voltage	depending on the spindle characteristic: max. 55V	
Output Current	Continuous phase current 7A/ Phase peak current 9A	
Output Frequency	AC: 4.000 Hz / max. 240.000 rpm	
	DC: 1.667 Hz / max. 100.000 rpm	
Control Inputs	Digital In :	Start / Stop (0 / 24V) "0": 0..7V, "1": 18..24V
	Analogue In:	Set Value Rotational Speed (0…10V)
Sensor Inputs	Temperatur Sensor: PTC, KTY or PT1000	
Control Outputs	Digital out :	free configuration: open collector 45V/0,5A
	Analogue Out:	Output Load (0…10V)
Operating Status Indicators	Converter ready: LED green / Error: LED red	
Interface	RS232 Interface: 115.200Bd, 8 Data, 1 Stop Bit, No Parity	
	USB Interface (USB-Mini)	
Dimensions (L x B x H mm)	open frame 132 x 111 x 42 mm / SSE 123 x 45 x 136	
Chopper Resistor	47Ohm / 10W	
Operating Conditions	5 - 40°C / rel. humidity of air max. 85%	

3. Intended Use / Safety-Precautions and Warnings

✓ This unit is designed for operation in industrial environments only. When used in residential and commercial areas, additional measures may be required to limit emitted interference.

✓ During installation, applicable safety regulations must be observed.

✓ Before switching on the inverter for the first time, ensure that it is fixed and that the connected spindle is also securely fixed and cannot make any uncontrolled movements.

✓ Compliance with EMC (Electro Magnetic Compatibility) limits is the responsibility of the manufacturer of the machine or device. To increase immunity to interference and to reduce emitted interference, the inputs and outputs of this unit are equipped with filters. This makes operation in an industrial environment possible in principle.

✓ The EMC of a machine or a device is influenced by all connected components (motor, cables, wiring, …). Under certain conditions, it may be necessary to connect external filters to ensure compliance with the applicable EMC standards.

✓ This appliance generates dangerous electrical voltages and is used to operate dangerous rotating mechanical tools. For this reason, only professionally qualified, trained personnel may work on this unit and carry out the connection!

✓ Before putting the unit into operation, make sure that it is in perfect condition. If it has been damaged during transport, it must not be connected under any circumstances.

✓ The inverter must not be operated near heat sources, strong magnets or devices generating strong magnetic fields.

✓ Sufficient air circulation around the inverter must be ensured. The heat sink must not be covered.

✓ No liquid must be allowed to enter the unit. If this appears to be the case, the unit must be switched off and disconnected from the mains.

✓ The ambient air must not contain any aggressive, highly flammable or electrically conductive substances and should be as free of dust as possible.

✓ All work on the inverter and the corresponding accessories may only be carried out when it is switched off and disconnected from the mains. The national accident prevention regulations as well as the general and regional assembly and safety regulations (e.g. VDE) must be observed.

✓ All work in connection with one of our inverters may only be carried out by persons who are professionally qualified and have been instructed accordingly.

⚠ **Attention:**
Please verify that all power supply voltages are correct in polarity and value

⚠ **Attention:**
Please ensure to have the proper characteristic selected, always!
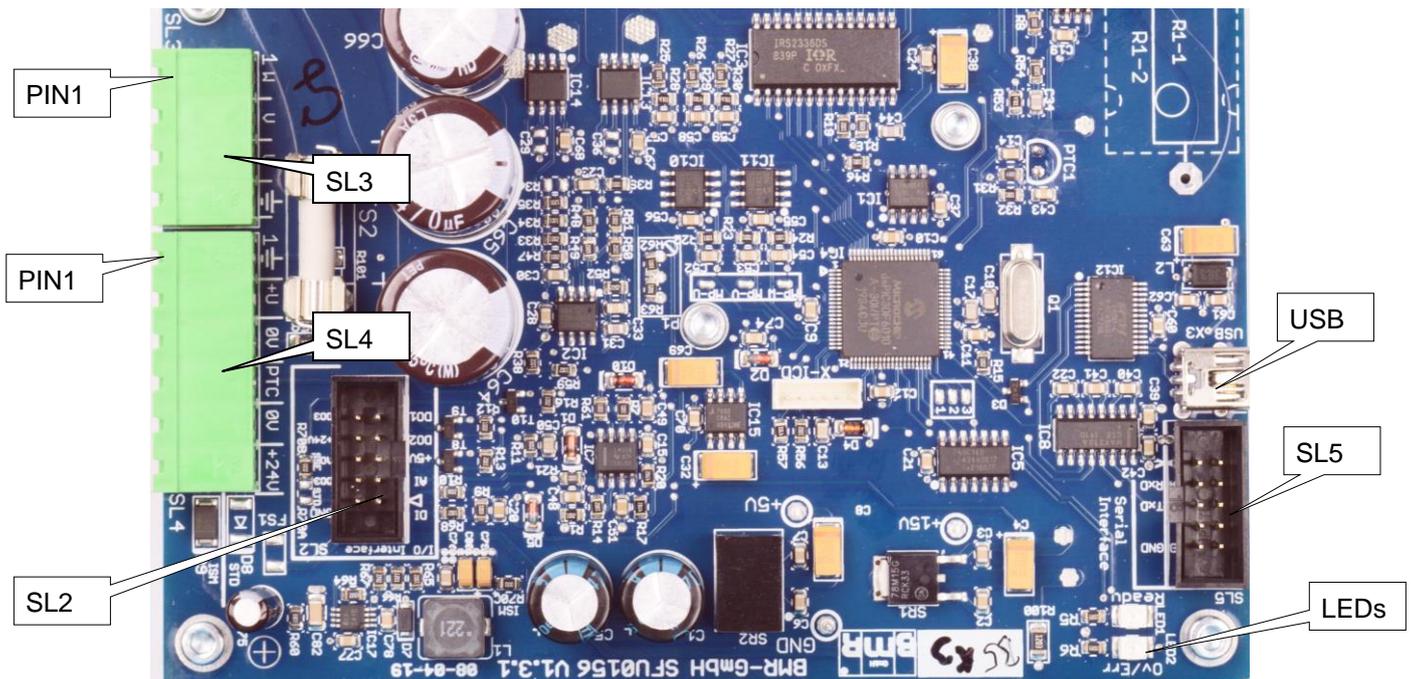**The operation of a spindle with a wrong characteristic may harm the spindle severely!**

⚠ **Attention:**
In case of replacing the fuses, please ensure to use types only, which are mentioned in 'Technical Data'!

4. Connections, Plugs and PIN Assignments   open frame

4.1 Power Supply Connection SL4 (pluggable screw terminals)

Pin	Function	Description
1	PE	Protective Earth, is internally connected to mounting bracket
2	$+80V_{DC}$	+ Supply Voltage for spindle -> Fuse FS2 6,3 AT
3	0V (80V)	Voltage return for spindle supply
4	PTC / KTY / PT1000	Temperature sensor spindle -> available at HW V1.1 and to be configured with SFU-Terminal >V6.25
5	0V (24V) and PTC, KTY, PT1000	Voltage return for logic supply and spindle temperature sensor GND (internally connected with PIN3)
6	+24V (max 30V)	**Standard:** + Supply voltage for control logic (-> 10) protected against voltage reversal
	NC	**Version ISM:** with on board +24V voltage converter. In this version the logic supply voltage is directly generated from the spindle supply voltage (-> 10)

4.2 Spindle Connection SL3 (pluggable screw terminals)

Pin	Function	Description
1	W	Spindle Phase W
2	V	Spindle Phase V
3	U	Spindle Phase U
4	PE	Protective Earth of spindle and cable shield

4.3 Inputs and Outputs - I/O Interface SL2 (2.54mm Header)

Pin	Function	Description
1	DI (Digital Input)	Start / Stop
3	AI (Analog Input)	Set value for rotational speed
2,4	Ground	Ground Ref. for Pin 1, 3, 5, 7, 8, 9, 10 (internally connected withSL4.3/5)
5	+5V / 10mA	auxiliary supply [1] [2]
6	AO (Analog Out)	Output 0…10V (free configuration) **Load Percent**
7	DO2 Open Collector2	Output (for free configuartion) **Overload**
8	+24V / 10mA $_{max.}$	auxiliary supply [1] (internally connected with SL4.6)
9	DO1 Open Collector1	Output (for free configuartion) **Converter Ready**
10	DO3 Open Collector3	Output (for free configuartion) **Duty Speed reached**

The scaling of the analog input can be modified, as well as the function of the open collector outputs can be defined freely. The noted functions are the factory default setup.

On option a remote controller is available which can be connected directly with the I/O interface at SL2. (→11).

(1) Attention, with using and wiring these auxiliary voltages particular care is required and lies under the responsibility of the user! These voltages may be used as auxiliary voltage but are not especially fused. +24V is directly connected to FS1 and +5Vdig is directly connected with the DSP and all other ICs. So, potential errors at the wiring may harm the board severely!

(2) On option a 10V Reference Voltage adapter is available which is connected on SL2 and replaces +5V at Pin 5 with +10V/50mA. This allows an easy connection of a potentiometer for controlling the rotational speed of the converter/spindle. (→12).

4.4 USB Interface (alternative use with RS232)

The SFU 0156 has an USB Mini connector for easy access with "SFU-Terminal" configuration program. You have the options to setup and configure the converter.
Attention: The USB interface is sharing the same interface channel with the RS232 interface (4.5) internally, so that either one of both can be used, only.

4.5 Serial Interface RS232 SL5 (2.54 mm Header) (alternative use with USB)
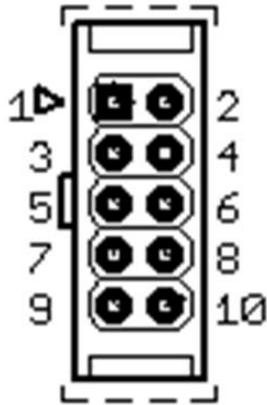
Pin	Funktion
1, 2, 4, 6, 7, 8	NC
3	RxD
5	TxD
9	GND
10	NC

4.6 Adapter-Cable for SL2 and SL5

For easy connection to SL2 and SL5 a standard[3] ribbon cable connector with Dsub9 fem is available as option.

List for Adapter-Cable SL2:

D-Sub-Pin	SL2-Pin	Function SL2
1	1	Digital Input1
2	3	Analog Inpu1
3	5	+5Vdig [1] [2]
4	7	Open Collector 2
5	9	Open Collector 1
6	2	GND
7	4	GND
8	6	Analog Out
9	8	+24V [1]
7	10[3]	Open Collector 3

List for Adapter-Cable SL5:

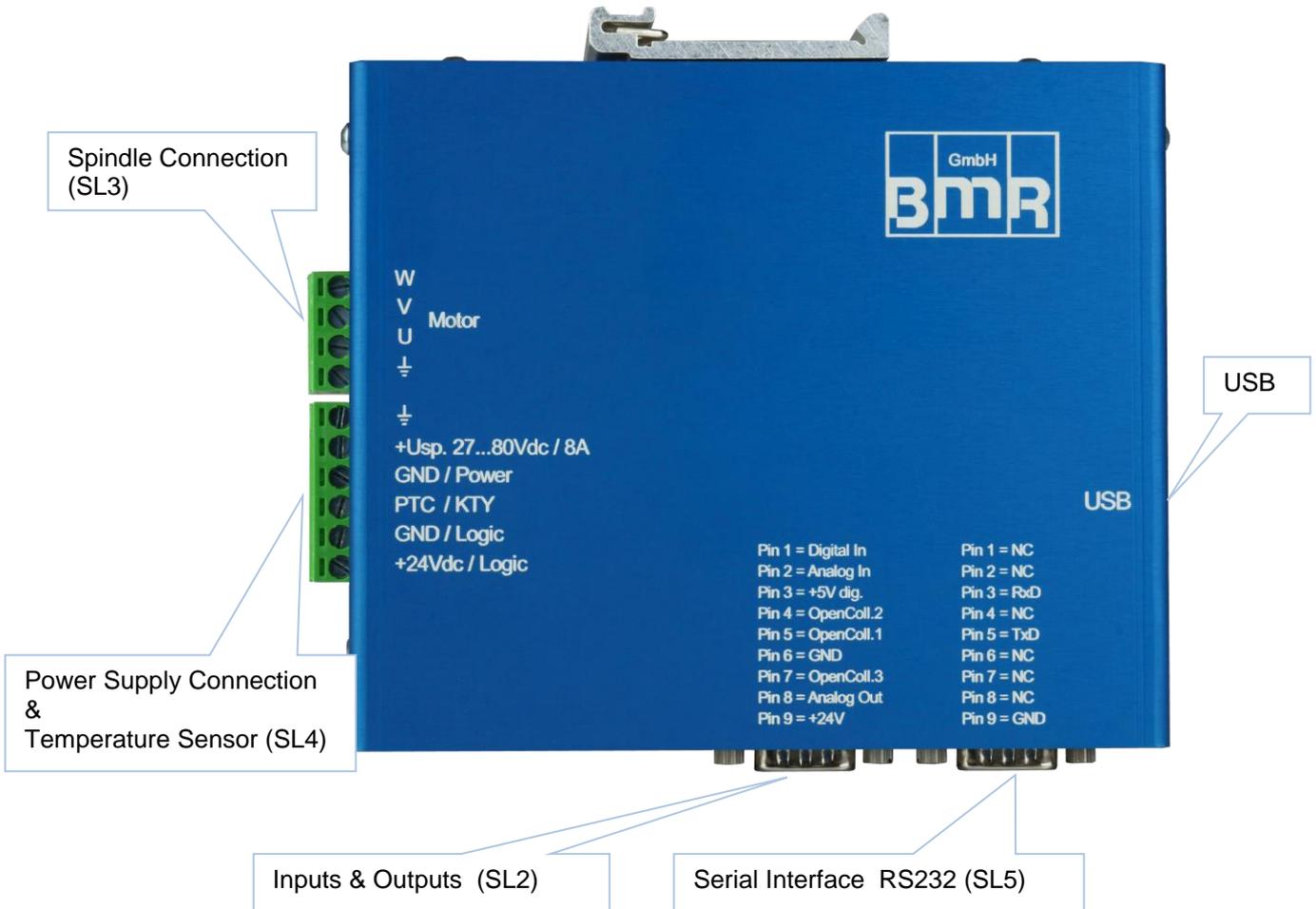| D-Sub-Pin	SL5-Pin	Function SL5
1	1	
2	3	RxD
3	5	TxD
4	7	
5	9	GND
6	2	
7	4	
8	6	
9	8	

(1) Attention, with using and wiring these auxiliary voltages particular care is required and lies under the responsibility of the user! These voltages may be used as auxiliary voltage but are not especially fused. +24V is directly connected to FS1 and +5Vdig is directly connected with the DSP and all other ICs. So, potential errors at the wiring may harm the board severely!

(2) On option a 10V Reference Voltage adapter is available which is connected on SL2 and replaces +5V at Pin 5 with +10V/50mA. This makes possible easy set value generation for rotational speed with connection of Potentiometers (→12).

(3) Attention, on request a non standard cable is available with a special wiring making OC3 accessible at PIN7 of the 9PIN D-Sub.
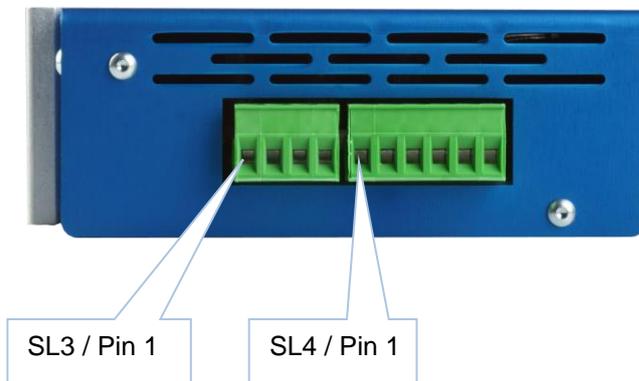
5. Connections, Plugs and Pin Assignments (SSE)

Side view

Spindle Connection (SL3)

Power Supply Connection & Temperature Sensor (SL4)

Motor
W
V
U
⏚

⏚
+Usp. 27...80Vdc / 8A
GND / Power
PTC / KTY
GND / Logic
+24Vdc / Logic

Pin 1 = Digital In
Pin 2 = Analog In
Pin 3 = +5V dig.
Pin 4 = OpenColl.2
Pin 5 = OpenColl.1
Pin 6 = GND
Pin 7 = OpenColl.3
Pin 8 = Analog Out
Pin 9 = +24V

Pin 1 = NC
Pin 2 = NC
Pin 3 = RxD
Pin 4 = NC
Pin 5 = TxD
Pin 6 = NC
Pin 7 = NC
Pin 8 = NC
Pin 9 = GND

USB

Inputs & Outputs (SL2)

Serial Interface RS232 (SL5)

5.1 Spindle Connection and Power Supply

Bottom view

SL3 / Pin 1

SL4 / Pin 1

Pinout for Spindle Connection see   see 4.2 (Table).

Pinout for Power Supply Connection see 4.1 (Table).

5.2   Inputs and Outputs / I/O Interface (SL2)

Pinout for I/Os see 4.6 (Table)

Front view

5.3   Serial Interface RS232 (SL5) and USB Connection

Pinout for serial Interface RS232 (SL5)   see 4.6 (Table)

The USB interface shares the functionality with the serial interface (4.5). For that reason it can be used **alternatively**, only**.**

The converter can be controlled via both interfaces. The control commands is available on the BMR website

For communication via USB a Mini-USB cable can be used

For communication via the RS232 Interface a zero modem cable (crossed RXD-TXD) can be used in conjunction with the ribbon cable adapter

Note:

The setup and parameterization software **SFU-Terminal** is free available on the BMR website. It is very helpful for testing and setup purpose.

6. Funktionsbeschreibung, Inbetriebnahme, Bedienung

6.1 Start / Stop

There are two possibilities to start the spindle:

digitally with a digital control signal at digital input1 **Start/Stop** at SL2.1.
The switching levels for "OFF=0" are 0...7V and for "ON=1" 18...24V,
voltages between 7V and 18V are undefined.
➔ As soon as this is initiated, the spindle will be accelerated to the set value of the
rotational speed which is pre-selected as voltage at analogue input1 **Set Value of
Rotational Speed** at SL2.2.

analogue with a voltage at analogue input1
Precondition is a valid "ON" signal at digital input1 **Start/Stop**
➔ An input voltage of 0V makes the spindle stop, and a voltage higher than 0,29V
starts the spindle up to a rotational speed according to the scaling.

6.2 Set Value of Rotational Speed

There are two possibilities for scaling the rotational speed:

0-10V / Min-Max: The default scaling for the analogue value is according the Min/Max
values of the rotational speed from the spindle characteristice.g.: set values are
Min: 5.000rpm, Max: 60.000
This results in a formula for the control voltage u: u = set value * 10V/60.000rpm
A voltage of u<0,8V realizes standstill, a voltage of 0,8V sets the minimum speed
of 5.000rpm and 10V sets the maximum rotational speed of 60.000rpm.

Another option of the input scaling
is **1V/10.000rpm**.

Analogue input circuit
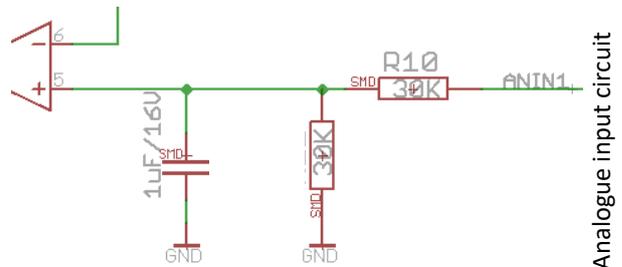
6.3 Outputs

Digital Outputs:

As feedback signals to a PLC or another control there are 3 open collector outputs available.
They indicate the current operational status of the converter. (➔ 6.)
The functions can be setup freely, factory default is listed below
DO1 / SL2.9   default **Converter Ready**   In this case, the PIN is drawn to ground
DO2 / SL2.7   default **Overload**   In this case, the PIN is drawn to ground
DO3 / SL2.10   default **Duty speed reached** In this case, the PIN is drawn to ground

Analogue Output:

As a default function the output load condition is output as a voltage between 0..10V at the
analogue output AO / SL2.6. with a scaling of 1V/10% . Other function values are available
and can be setup with SFU-Terminal.

6.4 LEDs

Likewise the open collector outputs, there are LEDs indicating the current operational status of the converter.

Green	Red	Function
Off	Off	Converter not ready
On	Off	Converter ready
On	On	Overload or Error Warning
Off	On	Converter not ready, switch off because of Error
Off	blinking	internal Error
ON	blinking	STALL Error in startup procedure or load case

7.   Example for I/O Wiring

Example for wiring the I/O Interface
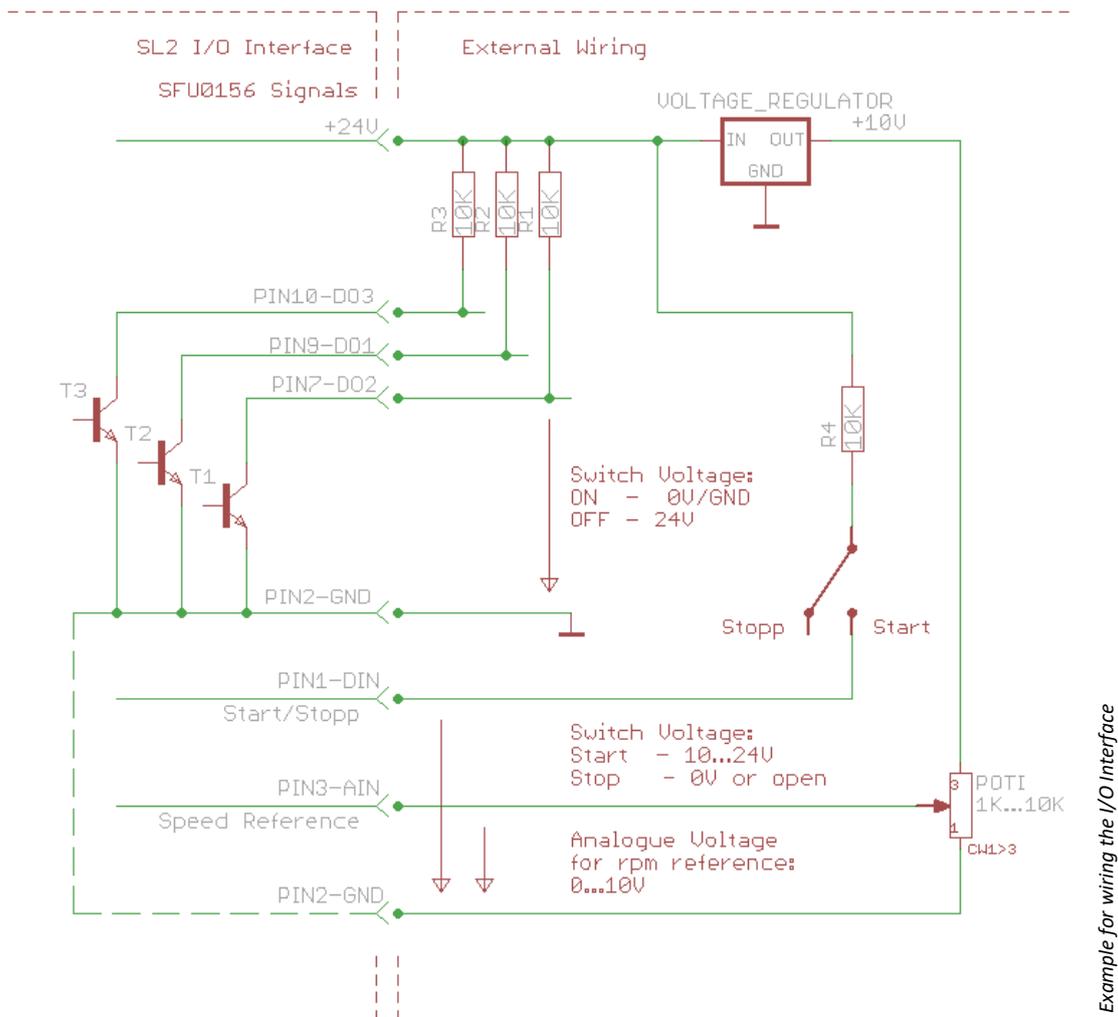
A successful start of the spindle the analogue voltage at PIN3 as reference for the duty speed hast be higher than the minimum voltage (→ 5.2).
With using a potentiometer for dialing the rotational speed it should be wired to 10V, so that the required range from 0...10V can be covered, representing the speed range.

8. Safety Functions

The following safety functions bring about controlled stop of the spindle according predefined deceleration times:

✓ Safety stop because of converter excess temperature after delay-time of 10s is exceeded

✓ Safety stop by overload and time delay exceeded (default 10sec)

✓ Safety stop will occur immediately by exceeding the maximum admissible spindle current.

9. EMC (electromagnetic compatibility)

✓ The compliance with the limit values of EMC is the responsibility of the manufacturer of the machine or device.

✓ This unit is designed for operation in industrial environments only. When used in residential and commercial areas, additional measures may be required to limit emitted interference.

✓ The EMC of a machine or device is affected by all connected components (motor spindle, length and type of cables, wiring, etc..). Under certain conditions the use of additional filters can be necessary to maintain the current laws.

✓ The earth and shield connections of all those devices used in conjunction with the frequency converter should be as short as possible and have as large a cross-section as possible.

✓ Control devices used with the frequency converter (PLC, CNC, IPC, ...) should be connected to a common earth/earth terminal bar

✓ All connections both to and from the frequency converter should be via shielded cable.

✓ Supply cables, motor cables and control cables must be completely isolated from each other. Where crossing cannot be avoided, cables should be laid at 90° to each other.

✓ The control cable should be laid as far away as possible from the load cable.
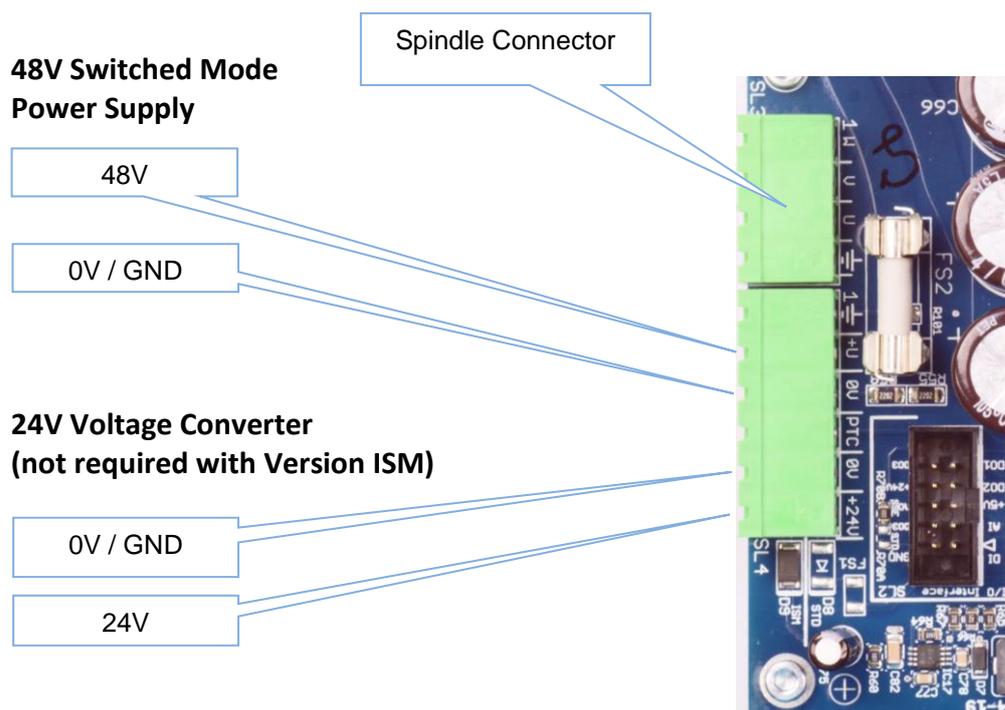
10. Power Supply Set (as Option)

As option a power supply set is available, consisting of a switched mode power supply for the 48V and a DCDC voltage converter for the 24V supply. With the help of this set it is possible, to generate the required DC-supply voltages for the SFU0156.

➢ **48V Power Supply for Spindle Voltage Supply**

+48VDC Output

0V / GND

Mains connection
88-264 VAC
124-370 VDC
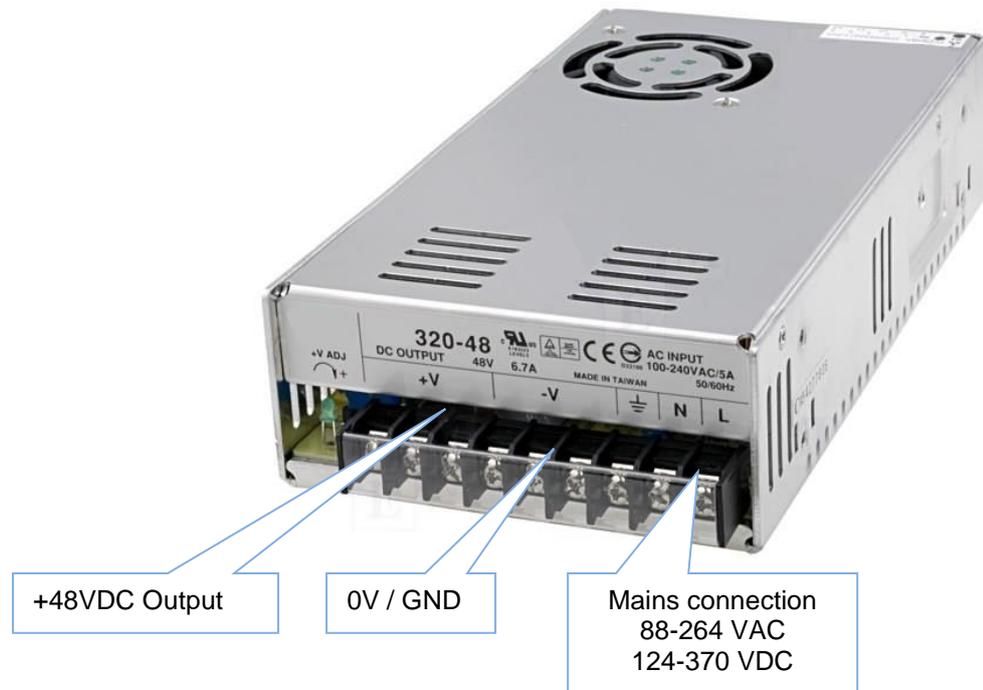
Dimension (WxHxD in mm):   115x50x216

➢ **Connection Diagram of Power Supply with 48V Power Supply**

Spindle Connector

48V Switched Mode Power Supply

48V

0V / GND

24V Voltage Converter (not required with Version ISM)

0V / GND

24V

➢ Version ISM with onboard +24V logic supply

As a further option, a version SFU0156-ISM is available, in which a 24V voltage converter for generating the auxiliary voltage is integrated. With this, all necessary voltages for the processor and control of the output stage are generated directly from the spindle voltage.
In contrast to the standard version, an additional external supply is therefore not necessary and only a power supply unit is required as the main voltage supply for the spindle.
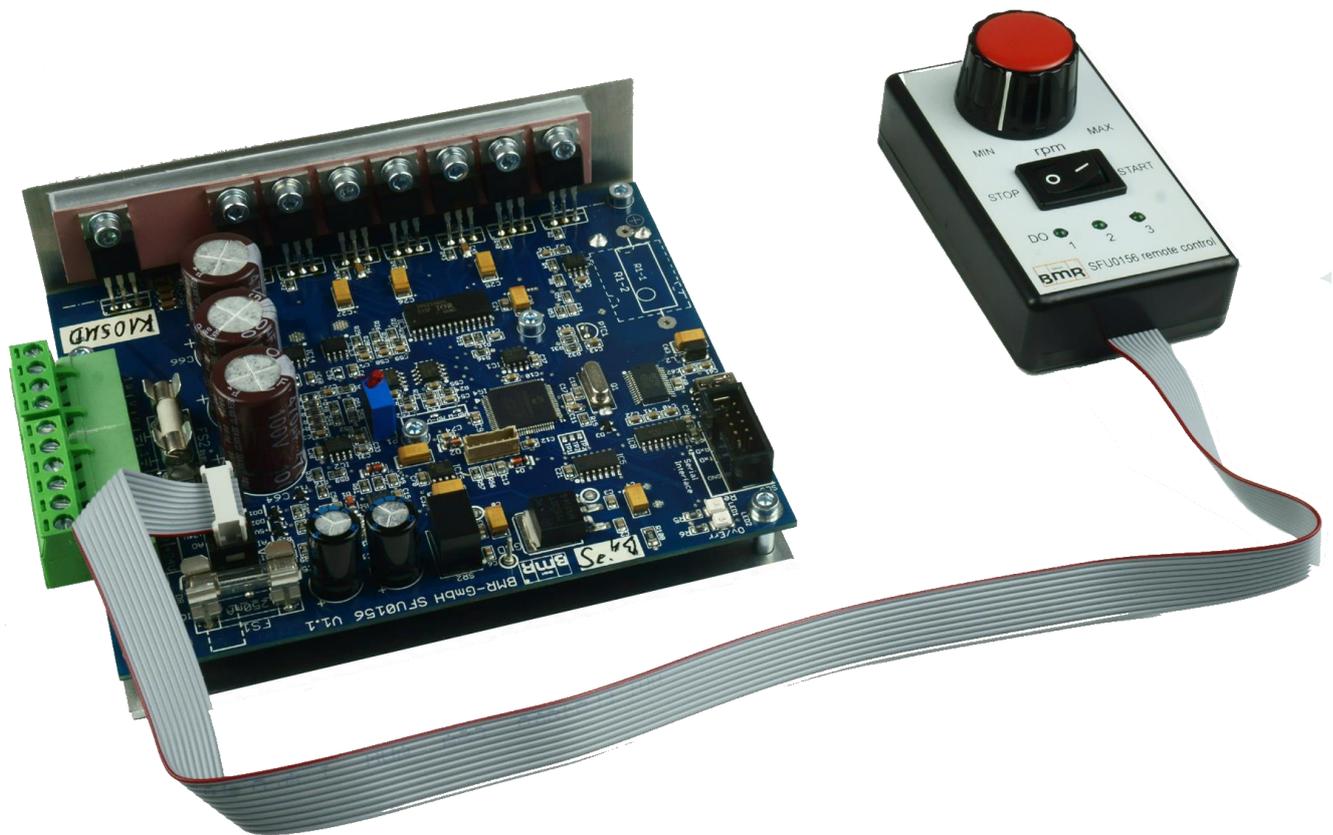

Spindle connector

Spindle- and logic supply connector

on board +24V logic-supply module
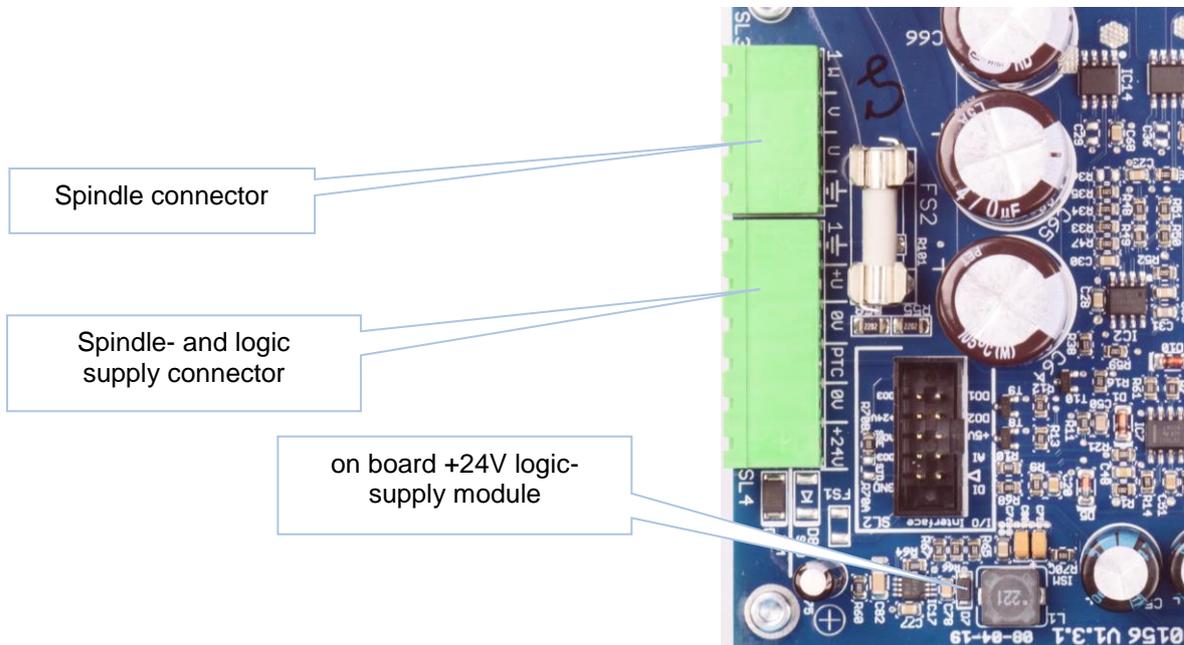
> ⚠️ **Attention:**
>
> **All these works handle with dangerous voltage and have to be carried out by skilled persons only.**
>
> **Please verify before connecting that the supply voltage is switched off!**

11. SFU 0156 with Remote Controller

On option a remote controller is available which can directly be connected with the I/O interface at SL2

✓ By this, the required duty speed can be adjusted with a potentiometer and the converter can be started and stopped with a rocker switch.
The status of the digital outputs is indicated on LEDs.

✓ All required voltages are generated within this adapter, so the converter can be controlled and tested very easily.
A quick test and setting into action of the converter becomes possible even without external control signals.

12.   10V Reference Adapter

An adapter for the SL2 header is available for direct connection of potentiometers for simple generation of set value for rotational speed (duty speed reference value) at Analog Input AI.
It is mounted directly on the SL2 and takes over exactly its function, with the difference that +10V are now available at pin 5 instead of +5V.
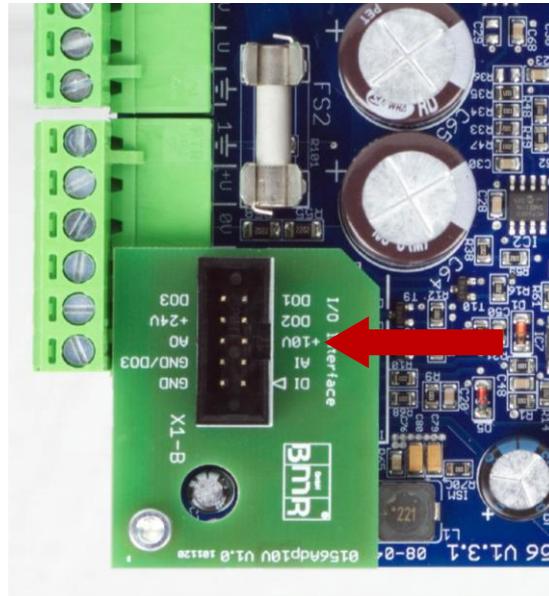
If a potentiometer (1-10KOhm) is connected between +10V and GND, a variable voltage can be set at the slider pin. If the slider is connected to AI (Pin3), the set value for the speed can be adjusted very easily according to the scaling of the analog input.

The +10V output is short-circuit proof and rated for a maximum current of 50mA.
A permanent short circuit is not allowed and will damage the adapter. To prevent this is the responsibility of the user.

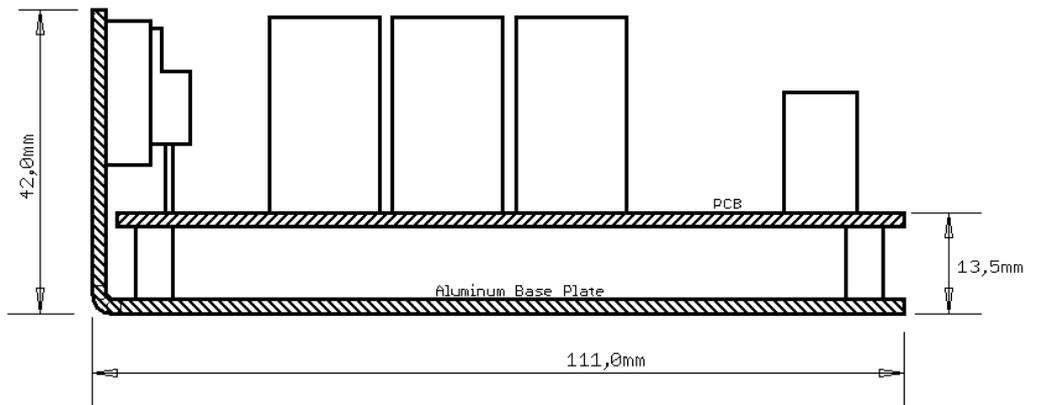The function of the Remote Controller is possible as before.

13. Drawing and Mounting

For mounting purpose there are 6 nuts with a 3mm thread provided, being pressed into the at the bottom side of mounting bracket.
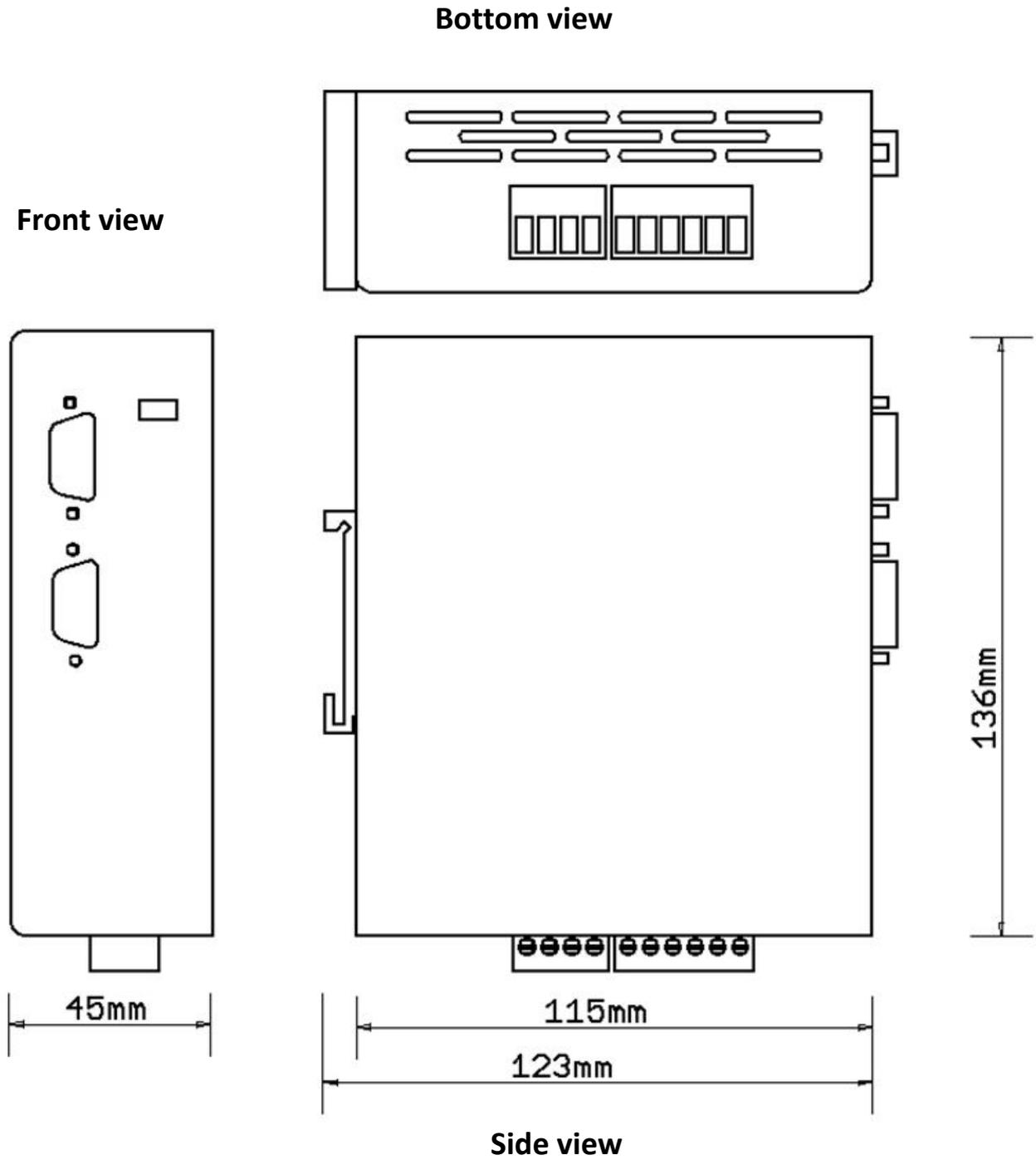
Top view
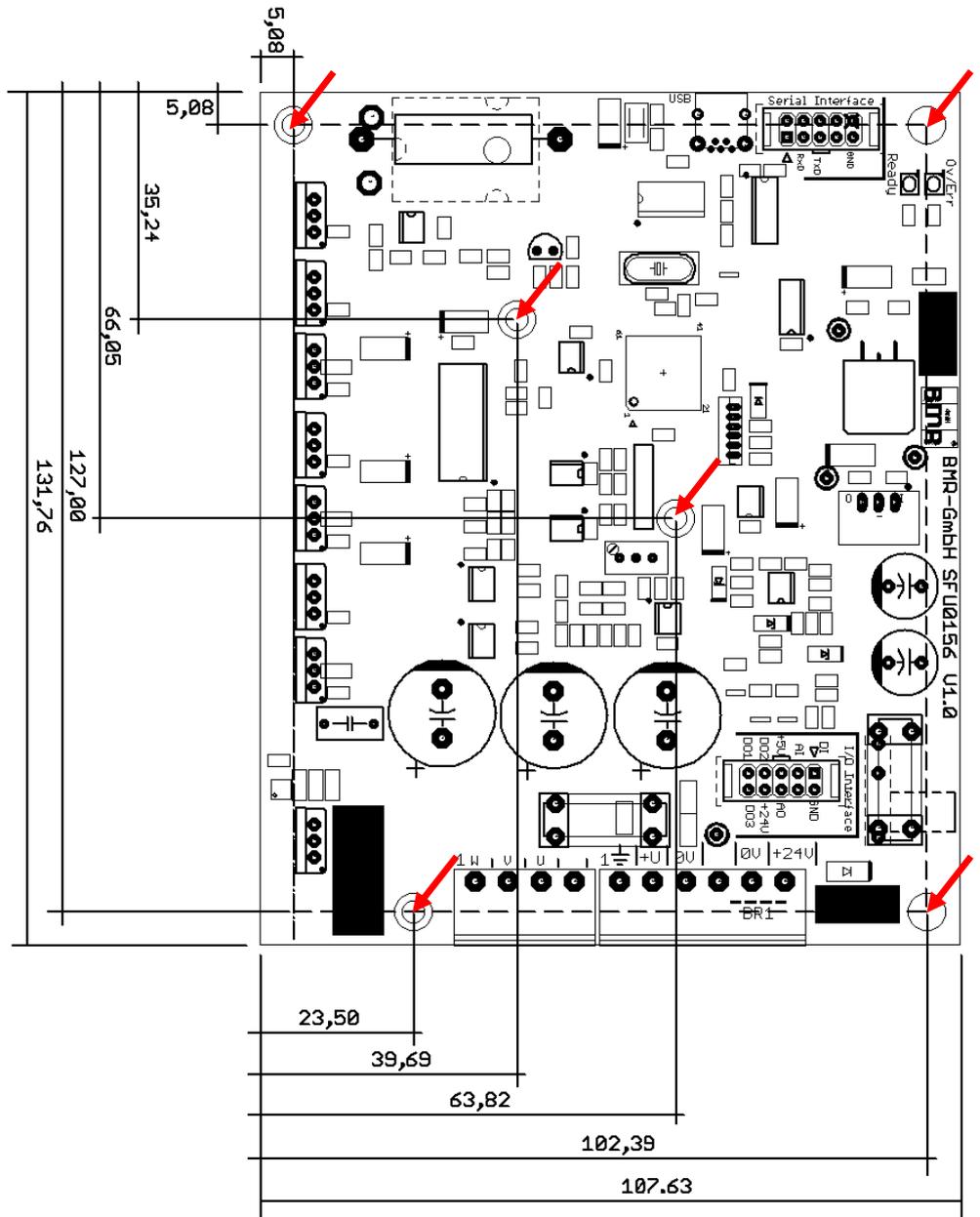
Side view

A DIN rail mounting according to EN 50022 (35mm x 7.5mm)
is provided for mounting of the SSE version.

Bottom view

Front view

136mm

45mm

115mm

123mm

Side view

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