SFU 0200

Schnellfrequenzumrichter
High Frequency Converters

HIGH QUALITY

100%

MADE IN
GERMANY

EXCELLENT SERVICE

Content

Issue November 2021 **Rev. 1.2**

1. Type Numbers SFU0200

Typ	Description	Housing
Type 1 / 300VA	SFU0200 / 1A SFU0200 / 1A SSE	Standard in desktop housing for cabinet mounting
Type 2 / 480VA	SFU0200 / 2A SFU0200 / 2A SSE	Standard in desktop housing for cabinet mounting
Type 3 / 620VA	SFU0200 / 3A SFU0200 / 3A SSE	Standard in desktop housing for cabinet mounting
Type 4 / 550VA	SFU0200 / 4A SFU0200 /4A SSE	Standard in desktop housing for cabinet mounting

2. Introduction

Depending on its construction, the speed of a three-phase AC motor is directly dependent on the number of poles and the frequency of the network. In a 3ph 380V/50Hz network, with a 2-pole motor, the rated speed would be 50 U/s * 60 = 3000 Upm.
With d.c. motors (brushless d.c.), the speed is dependent on the voltage applied.

Three-phase AC motors provide numerous benefits in industry, such as brushless operation, freedom from wear and tear, favourable capacity/weight ratio, high-speed capability, and much more. These motors can be used many different application areas, such as milling and grinding spindles, or with drilling machinery, for example.

In the aforementioned applications, three-phase AC motors are operated using special control gear – frequency converters. These frequency converters convert the fixed 50 Hz network into a 3-phase network with variable frequency and voltage. This greatly reduces the start-up problems and the high starting currents that are inevitable when high-capacity three-phase AC motors are connected to a fixed network. The motor is controlled according to a special characteristic curve until its rated speed has increased, or it has been decelerated to a standstill.
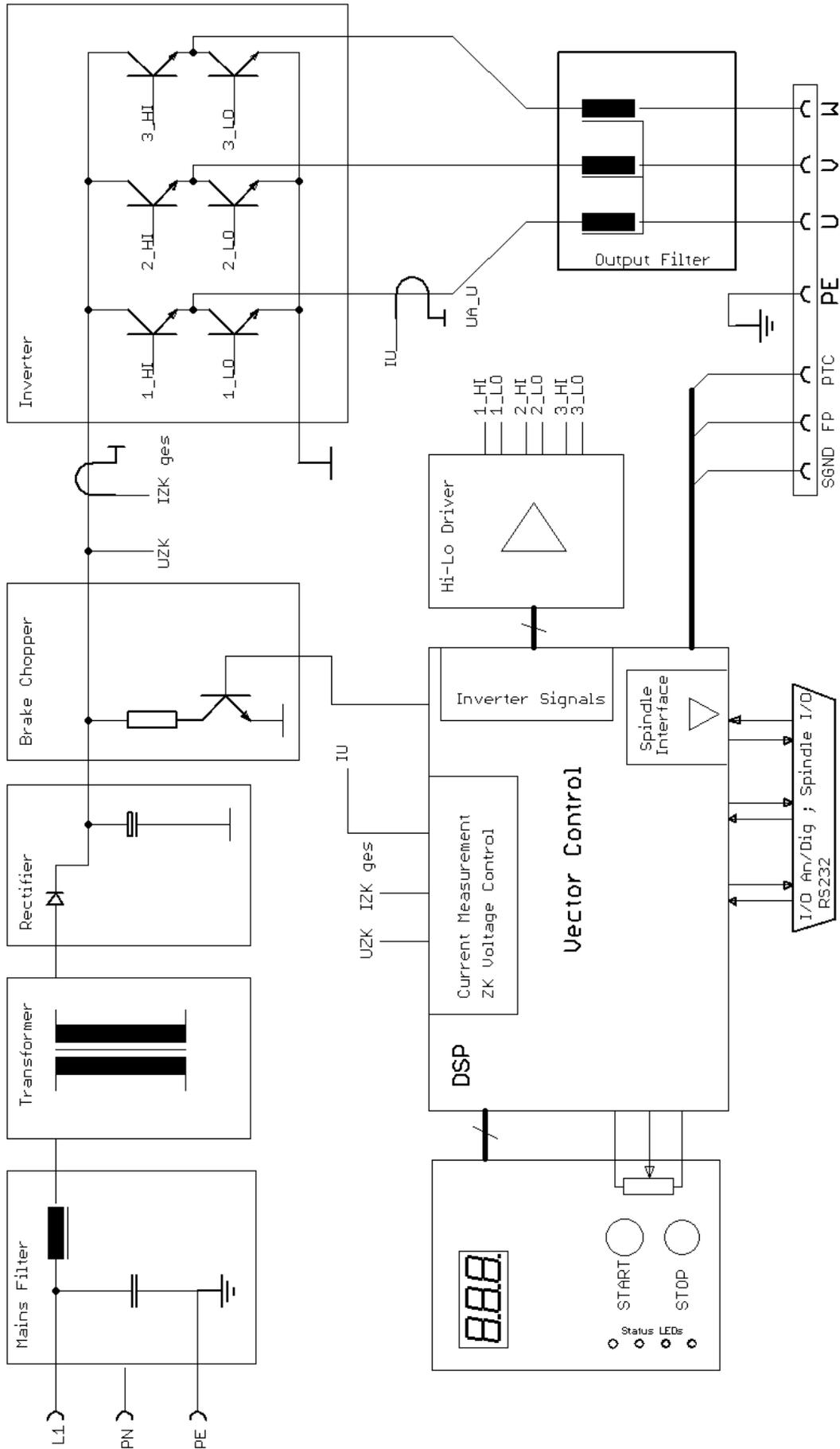
The frequency converter **SFU 0200** -series has been specially designed for use in these high frequency applications, offering excellent safety, performance and reliability, the result of years of experience in the design and construction of frequency converters, together with the use of the latest materials and the most reliable components. It can be used in many different applications and is as equally suitable for use as a replacement device in existing systems with older type series as it is in pre-planned applications as a cost-effective solution. With the outstanding control and regulation algorithm the level of temperature within the spindle is kept very low, helping to prolong life of the bearings and the lifetime of the tools.

This unit is designed exclusively for **operation in an industrial environment**. (Chap. 6 / Chap. 10)

3. Description and Features

✓ Operation of **AC and BLDC** motors/spindles

✓ The high frequency converter SFU-0200 allows **output frequencies** up to
4.000 Hz / 240.000Upm with 2-pole AC and BLDC motors **1.667 Hz / 100.000 rpm**

✓ **High output power 300VA / 480VA / 620VA / 550VA** from a **compact design**

✓ The core of the **SFU 0200** is a **Digital Signal Processor** (DSP), which generates all output variables and captures signals.

✓ All parameters, such as current, voltage and frequency, are captured in **real time**, and adjusted by implementing via the **Vector Control** according to loading

✓ High level of **operational safety**. All operating states such as acceleration, operation at rated speed, and deceleration, are monitored and critical statuses are intercepted and brought under control. This also includes the **controlled deceleration** of the motor / spindle in the event of power failure or Emergency Stop.

✓ **Diverse control and communication possibilities.** 3 types of connection are available to facilitate communication using peripheral devices - PC , PLC (Programmable Logic Control), CNC (Computer Numeric Control).

✓ **Straight-forward and flexible integration** into existing systems by means of open configuration of I/O signals for control and configuration:
Control inputs: 1 analogue, 3 digital
Control outputs: 1 analogue, 2 digital (relay)

✓ **Galvanic separation** of all interfaces from each other and from the network / motor potential

✓ **Short-circuit-protected**

✓ **User-friendly configuration** and control using optional Windows Software for the PC

✓ **Integrated board chopper-resistor** for quick braking even from high speeds

4. Block Diagram

5. Technical Data

Output power	0200/1: 300VA S1-100%	0200/2: 480VA S1-100%	0200/3: 620VA S1-100%	0200/4: 550VA S1-100%
Supply connection	230V, 50Hz / 115V, 60Hz switchable with rotary switch and with exchange of fuse			
Fuse	230V: 2,5AT 115V: 4,0AT	230V: 3,15AT 115V: 5,0AT	230V: 5,0AT 115V: 8,0AT	230V: 5,0AT 115V: 8,0AT
Motor connection	Desktop Case: 19"-Case / SSE Case:	circular jack 3-pin or 7-pin Screw Terminals 2,5mm² 6-pin Screw Terminals 4mm² 9-pin U, V, W, 2*PE, temperature sensor, FP, SGND	Screw	
Output voltage	max. 36V	max. 60V	max. 48V	max. 60V
Continuous current Peak phase current	6,5A 7,5A	6,5A 7,5A	9,8A 11,0A	7,5A 8,5A
Over-current	max. 20s			
Output frequency	AC: 4.000Hz / 240.000 rpm DC: 1.667Hz / 100.000 rpm			
Spindle characteristics	max. 16, stored internally			
Spindle sensor inputs	speed sensor, PTC, KTY, PT1000			
Control inputs	1 analogue: 0-10V 3 digital: 0-24,V			
Control outputs	1 analogue: 0-10V 2 digital: relay outputs, 24VDC/1000mA, 125VAC/500mA			
Interface	RS232			
Housing dimensions w x h x d	desktop 240 x 94 x 268 SSE 90 x 312 x 268		desktop 240 x 94 x 268 SSE 90 x 312 x 268	
Weight	(desktop) ca. 6kg	(SSE) ca. 7kg	(desktop) ca. 8kg	(SSE) ca. 8kg
Protection	IP20			

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

6. 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 unit 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'!

7. Connections, Interfaces and Pinouts

Operational parameters and outputs:
The **SFU 0200** covers all current important operational parameters and operating data. Up to 6 digital outputs can be used for signalling and up to 2 analogue values can be output to the analogue outputs (0-10V) .

Remote Control and Outputs:
3 digital inputs (24V) and 1 analogue input (0-10V) are available for remote control of the **SFU 0200**.

These assignments can be freely configured. Using the optional Windows PC software *SFU-Terminal* the above assignments can be easily achieved, providing exceptional flexibility with each application.
Each operating parameter can be assigned as a signal and each control signal can be allocated the required I/O pin. In addition, the logic level (high or low active) can be individually defined.
The same assignment is also possible for the analogue measured data and control data at the analogue I/O pin.

The standard allocations of operational parameters, their outputs, control signals and inputs, are listed in the following table.

USB-Adapter
Moreover a RS232-USB Dongle is available, which fits to the Dsub-15 socket and realizes an USB-port here, too. This will be an easy solution with other housing versions, where a USB is required

7.1 Digital and Analog I/Os (D-Sub 15pin fem.)
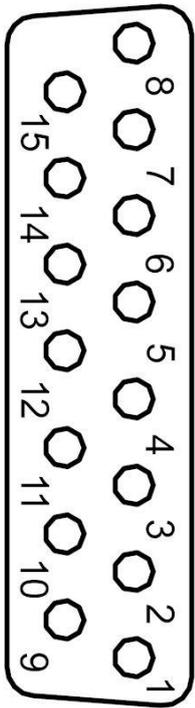
Pin	Function	Description
1	Common Relay	
2	Relay 1 (normally closed)	"Set Value Rotational Speed Reached"
3	Relay 1 (normally open)	"Set Value Rotational Speed Reached"
9	Relay 2 (normally closed)	"Overload Spindle"
10	Relay 2 (normally open)	"Overload Spindle"
6	+24V	Auxillary voltage +24V to PIN8 on option: contact of Relay 3 n.o.
4	Analogue Output	Effektive Load Condition 1V = 10%
11	Analogue Input	Set Calue Rotational Speed
12	Digital Input 1	Start/Stop
8	Ground	
7	Speed Sensor Output	
5	Digital Input 3	Direction of Rotation
13	RxD	(RS232)
14	TxD	(RS232)
15	Digital Input 2	Locking (Emergency Stop)

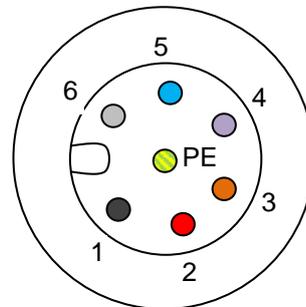**For configuration via USB with the fore mentioned USB-adapter**

7.2 Spindle Connector with circular Jacks

with 3 pin female jack

with 7 pin female jack (Amphenol C16-1 / Binder 693)
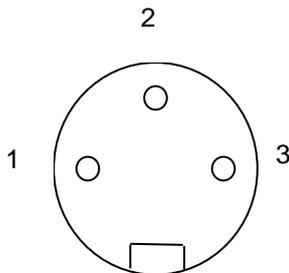
Pin	Function	Description
1	U	Spindle Phase 1
2	V	Spindle Phase 2
3	W	Spindle Phase 3

Pin	Function	Description
1	U	Spindle Phase 1
2	PTC	Temperature Sensor-Signal / Spindle Temperature
3	V	Spindle Phase 2
4	FP	FP-Signal / Speed Sensor
5	W	Spindle Phase 3
6	SGND	Signal-Ground for Temperature Sensor-Signal
7	PE	Protective Earth

with 7 pin Connector C164   for A. Jaeger-Spindles
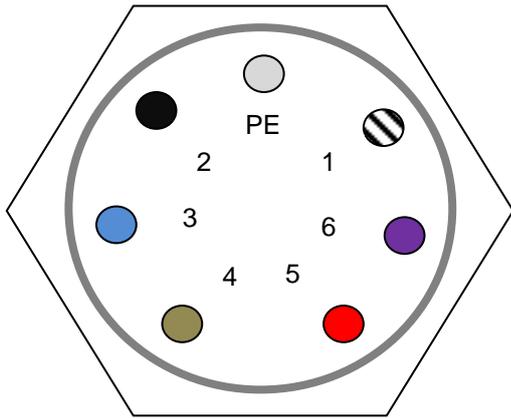
Pin	Color	Description
1	NC	not connected
2	black	Spindle Phase 1
3	blue	Spindle Phase 2
4	brown	Spindle Phase 3
5	red	Temperature Sensor-Signal / Spindle Temperature
6	violett	FP-Signal / Speed Sensor
PE	grey	SGND

View from the backside !

7.3 Spindle Connection with pluggable screw terminals used at SSE
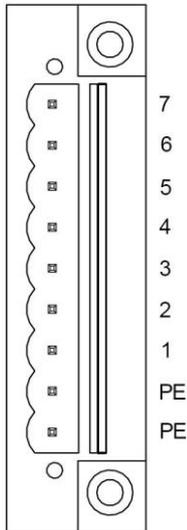
Pin	Description
PE	Protective Earth
PE	Protective Earth
1	Spindle Phase 1 (U)
2	Spindle Phase 2 (V)
3	Spindle Phase 3 (W)
4	Temperature Sensor-Signal (Spindle temperature)
5	Hall-Sensor-Signal (Spindle speed sensor
6	SGND / GND for FP- and Temperature Sensor Signals
7	UH +15V for active hall sensor supply

7.4 Spindle Connection with pluggable screw terminals used at Desktop Housing
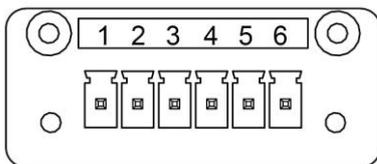
Pin	Description
1	Spindle Phase 1 (U)
2	Spindle Phase 2 (V)
3	Spindle Phase 3 (W)
4	PE
5	Temperature Sensor-Signal (Spindle temperature)
6	SGND Signal-Ground for Temperature Sensor

7.5   Mains Connector

Desktop: 3 pin. mains jack for detachable mains cord
SSE   3 pin. pluggable screw terminals

On default the SFU0200 is setup to 230V mains networks.
On Option a selector switch is available to adapt the mains supply voltage to 230V
and 115V networks.

⚠️ **Attention:**
It is important to select the appropriate mains fuse ! The required value is listed under 5.
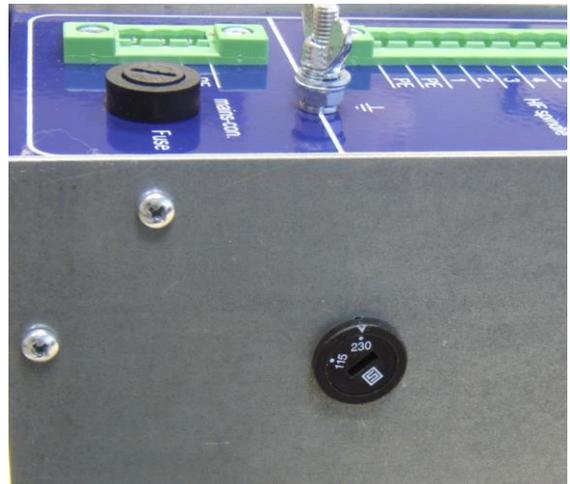
⚠️ **Attention:**
This setting has to be carried out by qualified personal, only!
A wrong setup will cause immediate destructions of the device after power on.

1.

at the bottom of SFU0200   fig 2A

at the side of SFU0200-SSE   fig 2B

8. Functions, Setup, Operation

3 operational possibilities:

✓ Control and configuration manually via front keys
✓ Automatic control and configuration via PLC / IPC
✓ Automatic control and configuration via PC (RS232 interface)

8.1 Front Panel

With the **START** **STOP** -key the spindle is started and stopped. The rotational speed is adjusted with the radio knob. The actual rotational speed is displayed on a 3digit LED.

The Status LEDs *READY*, *RPM 0*, *RPM OK*, *>100%* give information on the actual spindle status:
The red LED *>100%* indicates generally an error or as an indicator for an overload condition.

With firmware versions from V2.0 on the errors are displayed as an error code in the display. see chap 8.7.

Additionally these states were signalized on the relay out outputs:
At overload relay 2 **Rotational Speed Reached** is deenergized and will be opened.
At an general error relay 3 **Ready** is deenergized and will be opened.

The errors can be evaluated with the help of the windows software *SFU-Terminal*, which is available on the website. The documentation of this software shows how evaluation of these errors is possible.

⚠️ **ATTENTION:**
Where several spindles are in use within one system, the user must ensure that these are of the same type and that the correct spindle characteristic is used.
Otherwise this could cause severe damages of one or more spindles, because the driving voltage may be different!

8.2 Configuration of the rotational speed

The preset of revolutions per minute of the spindle can be achieved by three ways:

- ✓ **Preset manually with the radio knob on the front panel**
- ✓ **Preset via analogue input** Set Value Rotational Speed
  The default scaling for this input is set up to 1V/10.000rpm
- ✓ **Preset via RS232 interface**
  Refer to help in the menu bar of windows software *SFU-Terminal*.

8.3 Configuration of the direction of rotation

The direction of rotation can be set up before start. For this the key STOP has to be pressed approx. 4sec. In the setup mode it can be switched with the START STOP -keys alternating between Right and Left. Right means clockwise rotation with view to the back side of the spindle and Left means counter clockwise respectively. This is stored within the converter, so that this selection is maintained even after power off.
It will be returned to the operating mode if the keys are not pressed for a while.

clockwise figure 4a

counter clockwise figure 4b

8.4 Selection of the Spindle Characteristics

For selecting an other characteristic the STOP START – key has to be pressed together for about 4 sec. In the selection mode, the next higher characteristic can be selected with the START – key and the next lower with the STOP – key.

Up to 16 different characteristics can be stored. In case of selecting a characteristic place where no data have been stored it will be displayed for example **E 0 3** "for missing characteristic No.3". The display stays in this state, unless a used place is selected. If a characteristic is available it will be the respective place number using **0 1** or **0 2** an so on.
It will be returned to the operating mode if the keys are not pressed for a while.
The configuration of the characteristic places can be carried out with the PC-software *SFUTerminal*.
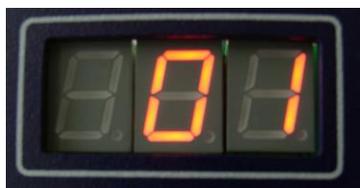

figure 5a

figure 5b

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

8.5 Starting and Stopping the Frequency Converter

Due to many different requirements, there are several possibilities for starting and stopping the **SFU 0200** frequency converter.
- ✓ Manually with the panel keys
- ✓ controlled remotely via a digital input
- ✓ controlled remotely via an analogue input
- ✓ controlled remotely via serial interface

In every case, with the exception of analogue start, the start of the converter is only possible, if a preset of the rotational speed is set up.

✓ Manually via panel keys
Activation of spindle start via the green START key.
Spindle-stop is activated by the red STOP key on the operator panel.

✓ Remote control via digital input Start/Stop by external PLC or CNC
Digital Input 1 is the default. If necessary, this can be changed to another input with the help of *SFU-Terminal* software in the menu "Digital Inputs".

According to safety requirements all signals can be set up individually for ACTIVE-LO or ACTIVE-HI. In combination with a plc the configuration ACTIVE-LO is to be preferred, because in case of spindle cable defect or plc fault an automatic stop can be carried out.

✓ Remotely via the analogue input Rotational Speed Duty .
This is possible, if the start-function is assigned to an analogue input and valid signal at the digital input Start/Stop is present.
This setup can made with the *SFU-Terminal* software in the menu "Analogue Inputs":

In the according edit-field for the preset of Rotational Speed Duty a selection of the scaling can be selected (for example: 1V/10.000UpM or 0-10V min/max).

An input voltage of 0V makes the converter stop, and a voltage higher than 0V starts the converter to a rotational speed according to the scaling.
The above mentioned scaling makes the converter run 40.000rpm at 4V.

✓ Remotely via the RS232 serial interface from a PC or PLC
The rotational speed can be changed with commands via interface. (refer to help in the menu bar of windows software *SFU-Terminal* (as option).

If necessary, a documentation of the serial interface commands can be ordered at BMR GmbH or the responsible representation.

> ⚠️ **Attention:**
> **Where one of the above options has been selected to operate the converter, only that pre- selected option can then be used to stop the converter! Only one of the safety functions can override the operation**

8.6 Remote-Controlled Configuration of Direction of Rotation via Digital Inputs

This can be achieved via the digital input Direction of Rotation . The setup can be done with *SFU-Terminal* software in the menu "Digital Inputs":

This is necessary, if the direction of rotation has to be controlled , for example, via a PLC. Reversal can only take place once the spindle / motor has come to a complete stop. If the direction pre-selection setting is changed whilst the spindle / motor is running, the spindle / motor will not turn in the new direction until it has been brought to a complete standstill and then restarted.

8.7 Error codes

With firmware versions from V2.0 on, errors which lead to a switch off of the converter are displayed as error code in the display. If there are more than one errors present, the error codes are displayed sequentially.
They are coded as listed below:

E30: Overload switch off (after delay run out)
E31: Over-temperatur of Converter
E32: Over-temperatur of Spindle
E33: Over-temperatur of Converter or Spindle
E34: DC-Link Over voltage
E35: DC-Link Under voltage Off
E36: DC-Link Under voltage Stop
E37: Over-current Trip -> Power stage Off
E38: Emergency-Stop input locked
E39: No spindle or spindle cable defective (with activated spindle test)
E40: TimeOut serial interface
E41: Spindle characteristic invalid or corrupted
E42: Error back energy -> power stage off
E43: reserved
E44: reserved
E45: Error of speed sensor / encoder

8.8 List of errors indicated with red LED

The following errors are signalled on the red LED:

The following faults lead to an immediate stop without delay

- Overload converter
- Overvoltage intermediate circuit
- Undervoltage intermediate circuit
- Reverse energy too high

The following faults lead to a shutdown with selectable delay

- Overtemperature SFU
- Spindle overtemperature (with connected PTC and activation in characteristic curve)
- Power stage shutdown
- Emergency stop locked

The following errors are displayed after switching on

- Without spindle (with activated spindle test)
- Characteristic error
- EEprom error

8.9 Safety Functions

The following safety functions bring about controlled stopping of the machine, pre-defined by the deceleration times selected within the spindle characteristics,

✓   Safety stop by spindle overtemperature, if this function is activated and it's delay-time exceeded.

✓   Safety stop by converter overtemperature and delay-time exceeded

✓   Safety stop by overload and time delay exceeded

✓   Safety stop by exceeding the maximum admissable spindle current.

✓   Emergency stop via digital input locking

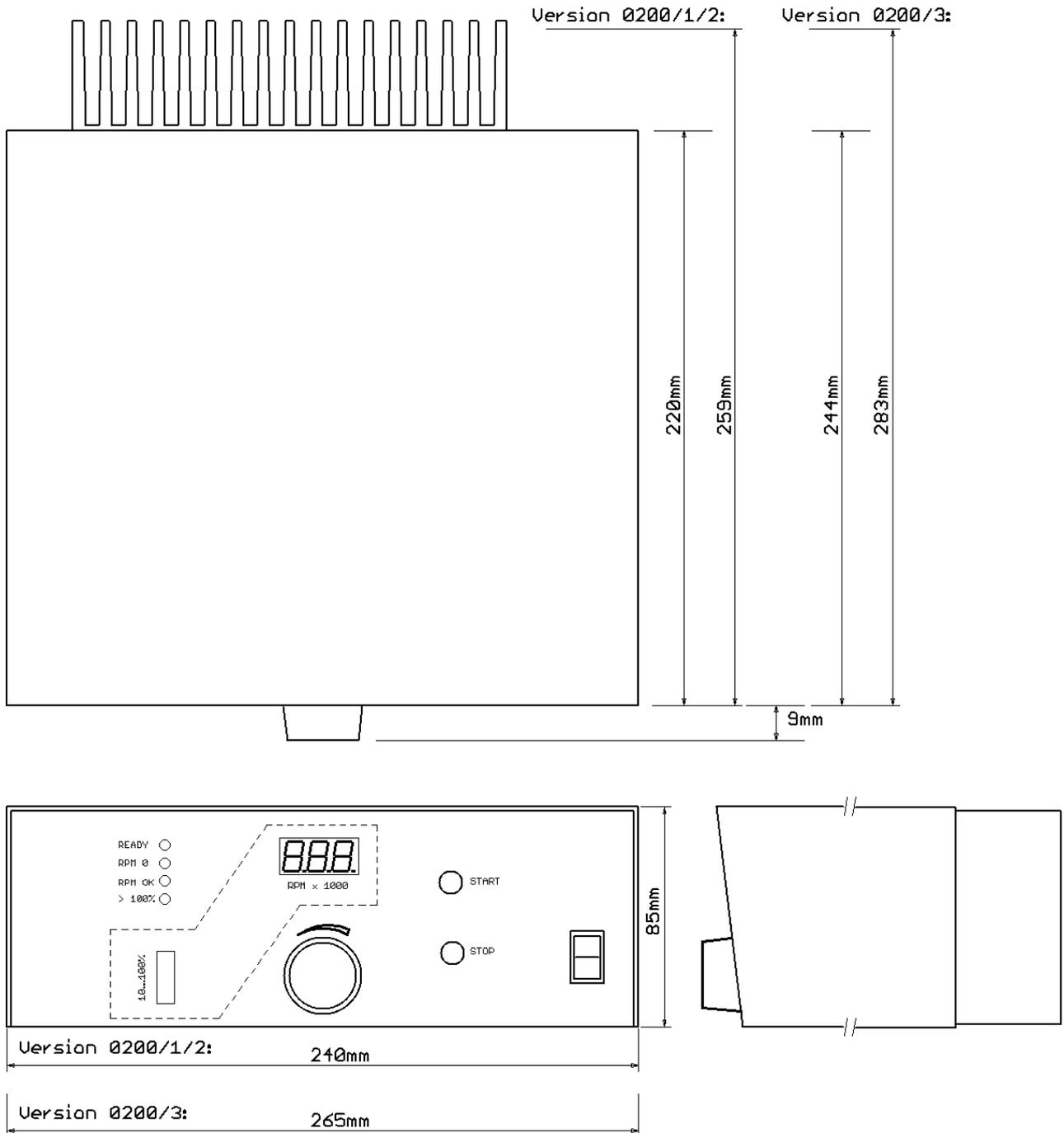# 9. Calibration and Configuration using Windows-Software

The setup of this device can be done in a very flexible and comfortable way with the help of our Windows PC-Software software **SFU-Terminal.** It is available on CD or on our website *www.bmr-gmbh.de/html/british/dokumente/bediensoftware.htm* for free. It is possible to administrate spindle characteristics or to configure the functions of inputs and outputs. Moreover there are further functions and useful tools available
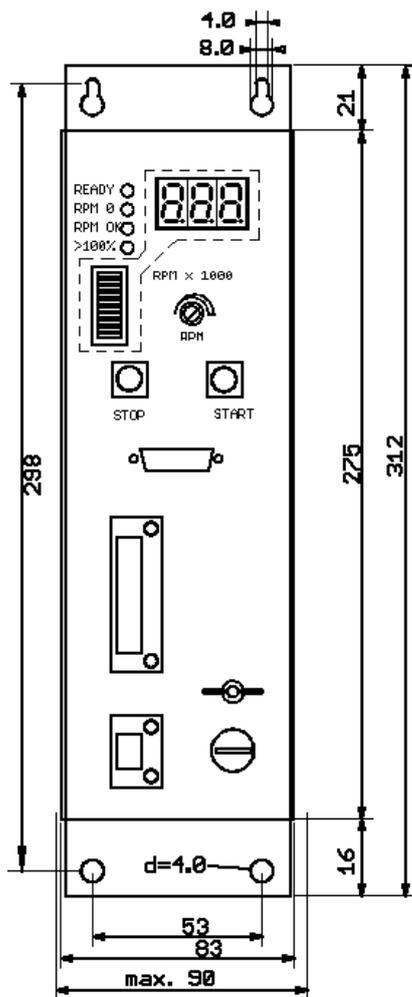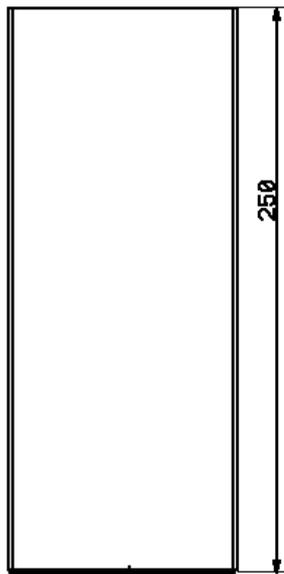
10. EMC

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

✓ Compliance with EMC (Electro Magnetic Compatibility) limits is the responsibility of the machine or device manufacturer. The inputs and outputs of this unit are equipped with filters to increase immunity to interference and reduce emitted interference. 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.

✓ For trouble-free operation and to reduce emitted interference, the following instructions should be observed when wiring:

✓ Make the earth and shield connections of all devices working in conjunction with the inverter as short as possible and with the largest possible cross-section.

✓ Connect control devices (PLC, CNC, IPC, ...) connected to the inverter to a common earth connection or busbar.

✓ Use toothed lock washers for mechanical installation to ensure good electrical contact with the enclosure.

✓ Use shielded cables for all connections to and from the inverter. Earth the screen at both ends

✓ Always route the mains, motor and control cables separately from each other. If crossings are unavoidable, they should be laid at a 90° angle.

✓ Lay the control cable as far away as possible from the load cables.

11. Views and Dimensions

11.1 SFU 0200/x A in desktop housing with LED-Display

Version 0200/1/2:

Version 0200/3:

220mm

259mm

244mm

283mm

9mm

READY

RPM 0

RPM OK

> 100%

RPM x 1000

START

STOP

10...100%

85mm

Version 0200/1/2: 240mm

Version 0200/3: 265mm

11.2 SFU 0200/x in SSE Housing

Masse in / Measures in [mm]
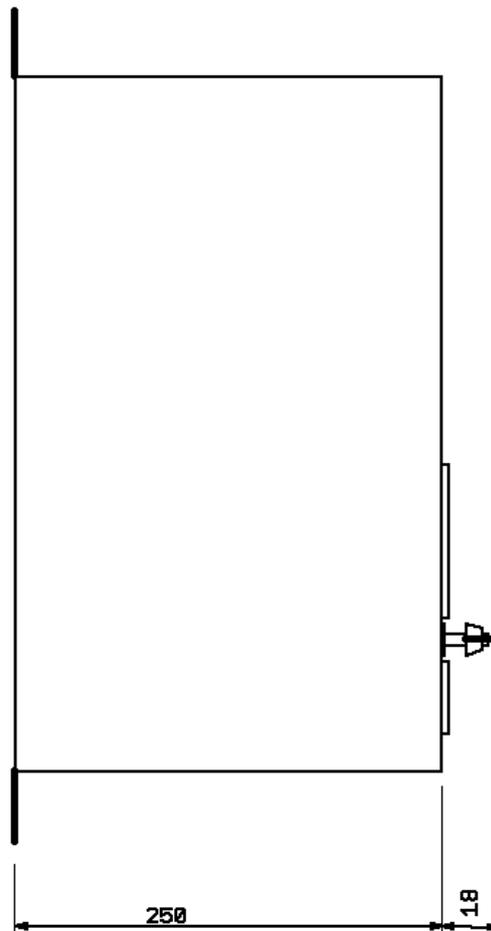
ONE PRODUCT IS NOT ENOUGH
MORE PRODUCTS OF BMR GMBH

Cooling Unit KG-T 500

Nominal Voltage:	100 - 250 V_{AC} / f=50Hz
Start Input Voltage:	max. 24 V_{DC}
Max. power input:	max. 80W
Max. cooling power:	max. 500W (by ambient temperature<23°C)
Relais details:	max. 30W (30V_{DC} / 1A)
Fuses:	2 A

The cooling unit KG-T 500 is controlled by an internal microprocessor. It has been designed to run high speed spindles like in cool ambience conditions. You are able to use it nearly for all types of spindles and cooling blocks. The maximum range of spindle power is 2000W.

SFU 0156 „Remote-Control"

Als Option ist ein Fernsteuer-Adapter zum direkten Anschluss an das I/O Interface an der Stiftleiste SL2 verfügbar.

✓ 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 RS232-USB 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.

Spindle-Illumination-Ring

Don't you know the problem, that despite of lighting systems, exactly at the point where you need to see something, a shadow appears or there is too less light?

Optionales Zubehör:

With the new spindle illumination ring of **BMR GmbH** this problem belongs to the past!

Spindles

High - frequency spindles are essential in today's adaption technology.
Each application requires a specific solution.

Jäger High Performance Spindles

IMT

SycoTec

IBAG

precise - FRANCE ELECTROBROCHES - U.G.V. www.precise.fr

ZWANZIG HSC-DRIVE-SYSTEMS

Henninger PRÄZISIONSTECHNIK

….and many more!

OUR QUALITY COMMITMENT

100%	**„Made in Germany"**
100%	**precision**
100%	**reliability**
100%	**support**
100%	**flexibility**

Subject to technical alterations.
November 2021

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