



The Sign of Quality  
Made in Germany

# SFU 0200

Schnellfrequenzumrichter  
High Frequency Converters





HIGH QUALITY

100%

MADE IN  
GERMANY



EXCELLENT SERVICE

# Content

## Issue May 2017

1	Type numbers	2
2	Introduction	2
3	Description and Features	3
4	Block Diagram	4
5	Technical Data	5
6	Safety Precautions and Warnings	6
7	Connections, Interfaces and Pinout	7
7.1	Digital and Analogue Inputs and Outputs	8
7.2	Spindle Control Interface with round Connector	8
7.3	Spindle connection with screw terminals (SSE-Version)	9
7.4	Spindle connection with screw terminals (Desktop-Version)	9
7.5	Mains Supply and mains network selection	10
8	Functions, Commissioning, Operation	11
8.1	Front Panel	11
8.2	Configuration of the rotational Speed	12
8.3	Configuration of the Direction of Rotation	12
8.4	Selection of the Spindle Characteristics	12
8.5	Starting and Stopping the Frequency Converter	13
8.6	Remote Controlled Configuration of the Direction of Rotation	14
8.7	Error codes	14
8.8	Safety Functions	14
9	Calibration and Configuration using Windows Software	15
10	EMC (Electro-Magnetic Compatibility)	15
11	Mechanics, Views + Dimensions	16
12	Other products of BMR GmbH	18
13	Our Quality Commitment	19

## 1. Type Numbers SFU0200

Typ	Description	Housing
Typ 1 250VA	SFU0200 / 1A	Standard in desktop housing
	SFU0200 / 1A SSE	for cabinet mounting
Typ 2 400VA	SFU0200 / 2A	Standard in desktop housing
	SFU0200 / 2A SSE	for cabinet mounting
Typ 3 500VA	SFU0200 / 3A	Standard in desktop housing
	SFU0200 / 3A SSE	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  $50 \text{ U/s} \cdot 60 = 3000 \text{ Upm}$ .

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.

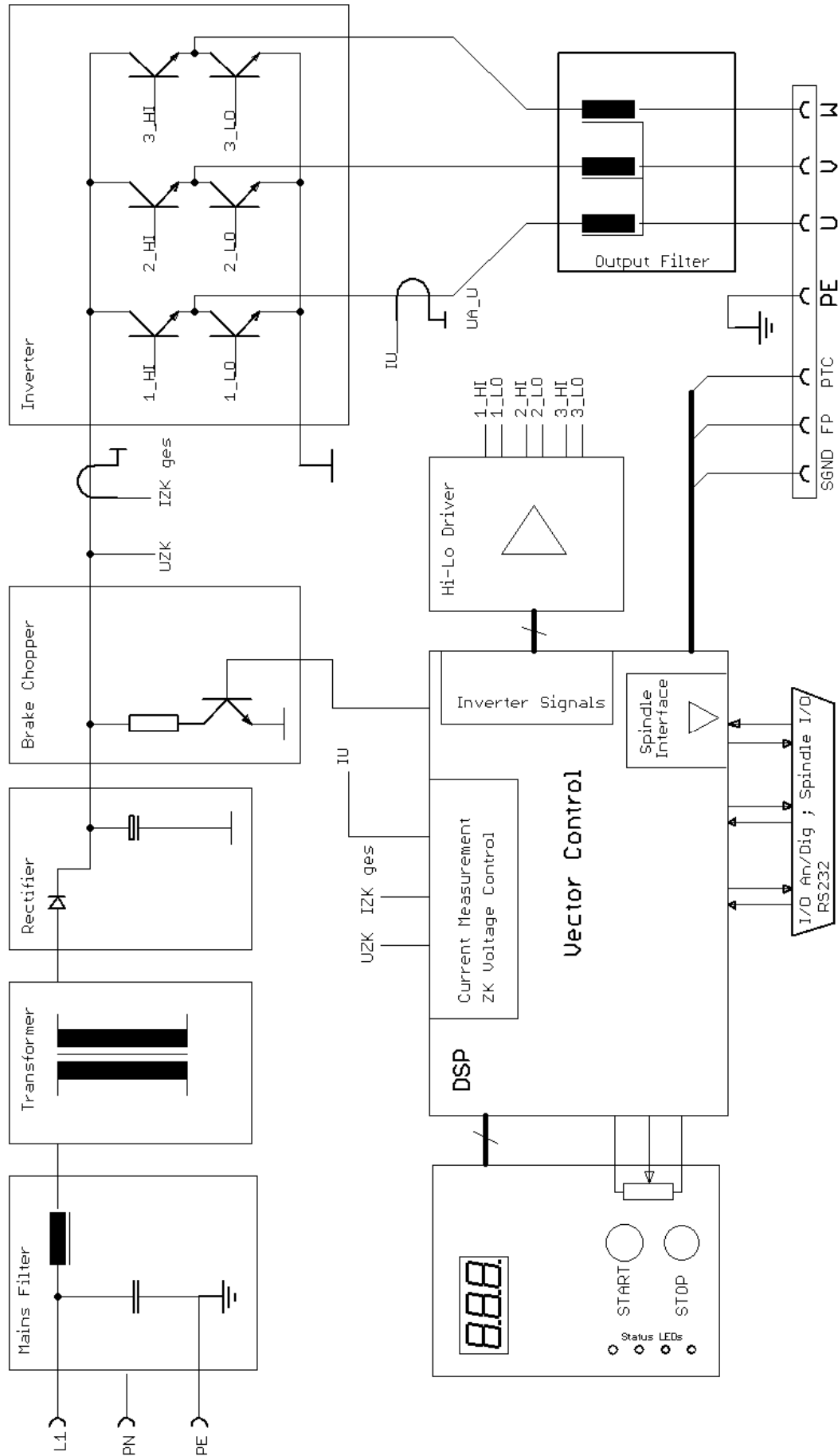
In the aforementioned applications, three-phase AC motors are operated using special control gear – frequency converters. These frequency converters convert the fixed 50 Hz network into a 3-phase network with variable frequency and voltage. This greatly reduces the start-up problems and the high starting 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.

### 3. Description and Features

- ✓ Operation of **AC and BLDC** motors/spindles
- ✓ The high frequency converter SFU-0200 allows **output frequencies** up to **2 kHz / 120.000Upm** with 2-pole AC and BLDC motors
- ✓ **High output power 250VA / 400VA / 500VA** 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

## 4. Block Diagram



## 5. Technical Data

Output power	0200/1: 250VA	0200/2: 400VA	0200/3: 500VA
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
Motor connection	Desktop Case:  19"-Case / SSE Case:	circular jack 3-pin or 7-pin Screw Terminals 2,5mm <sup>2</sup> 6-pin  Screw Terminals 4mm <sup>2</sup> 9-pin U, V, W, 2*PE, PTC, FP, SGND	
Output voltage	max. 36V	max. 60V	max. 48V
Output current	limited electronically		
Over-current	max. 20s		
Output frequency	AC: 2.000Hz / 120.000 rpm DC: 1.666Hz / 100.000 rpm		
Spindle characteristics	max. 16, stored internally, freely definable		
Control inputs	1 analogue: 0-10V, galvanically separated (located on D-Sub 15-female) 3 digital: 0-24V, galvanically separated (located on D-Sub 15-female)		
Control outputs	1 analogue: 0-10V, galvanically separated (located on D-Sub 15-female) 2 digital: relay outputs, 24VDC/1000mA, 125VAC/500mA		
Interface	RS232 galvanically separated, 115.200 Bd (located on D-Sub 15-female)		
Housing dimensions w x h x d	(desktop) 240 x 94 x 268	(SSE) 90 x 312 x 268	(desktop) 265 x 90 x 292
Weight	(desktop) ca. 6kg	(SSE) ca. 7kg	(desktop) ca. 8kg
Protection	IP20		
Operating conditions	5 - 40°C / rel. humidity of air max. 85 %		



### **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. Safety-Precautions and Warnings

- ✓ This device produces dangerous electrical voltages and is used for the operation of fast spinning tools. Because of their high rotational speed, it may be dangerous in case of improper handling. For this reason, only professionally trained and qualified personnel should be allowed to work with and setup this device!
- ✓ Before the first commissioning can be carried out, it should be ensured that the spindle and the tool are fixed properly, to eliminate all dangers because of uncontrolled movement of the spindle.
- ✓ Safety regulations being valid for the country where the device is used, have to be adhered to where any work is carried out on the device.
- ✓ Before the device is turned on for the first time, it should be verified, that the connected parts cannot carry out uncontrolled movements.
- ✓ The frequency converter must not be operated close to heating devices or magnets or devices generating strong magnetic fields.
- ✓ Sufficient air circulation around the converter should be ensured.
- ✓ Fluids should be prevented from intruding into the housing. If it seems to be happened, the converter has to be switched off immediately.
- ✓ The ambient air must not use aggressive, flammable or electrically conductive substances and should be as free of dust as possible.
- ✓ All repairs and maintenance on the converter and the relating accessories must be carried out by skilled personal and with powered off, only. To ensure this, the mains plug should be pulled out. In doing this, both the terms of regulations for preventing accidents and the general and national rules for mounting and safety have to be applied.
- ✓ Do not open this device while it is connected to power supply. There is danger of life! With opening this unit the period of warranty will be ended.
- ✓ All people who work with this device should be trained and instructed by their line advanced technician.



### **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**.

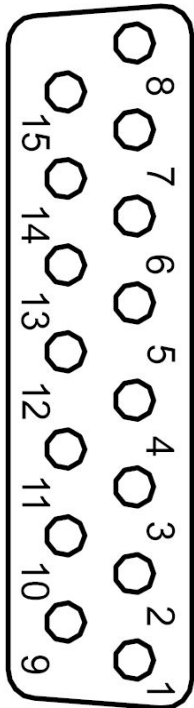
These assignments can be freely configured. Using the optional Windows PC software **SFU-Terminal** the above assignments can be easily achieved, providing exceptional flexibility with each application.

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.

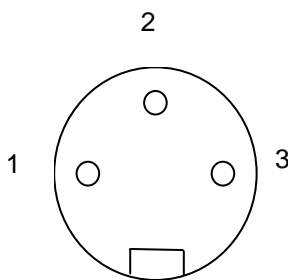
## 7.1 Digital and Analog I/Os (D-Sub 15pin fem.)



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)

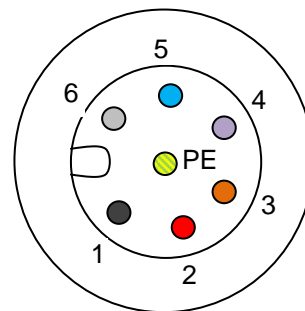
## 7.2 Spindle Connector with circular Jacks

with 3 pin female jack

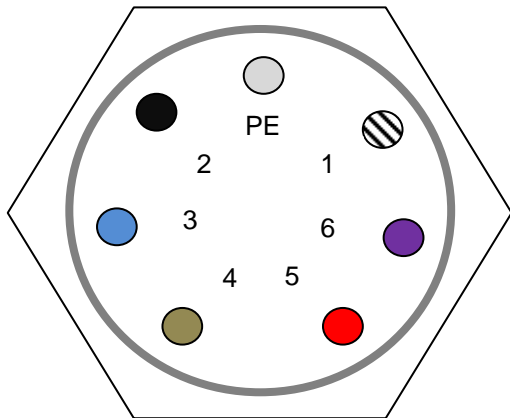


Pin	Function	Description
1	U	Spindle Phase 1
2	V	Spindle Phase 2
3	W	Spindle Phase 3

with 7 pin female jack (Amphenol C16-1 / Binder 693)



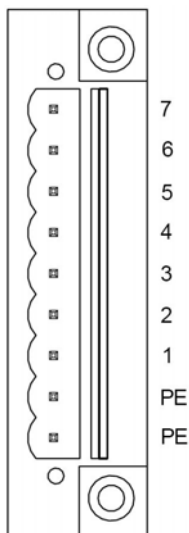
Pin	Function	Description
1	U	Spindle Phase 1
2	PTC	PTC-Signal / Spindle Temperature
3	V	Spindle Phase 2
4	FP	FP-Signal / Speed Sensor
5	W	Spindle Phase 3
6	SGND	Signal-Ground pf PTC-Signal
7	PE	Protective Earth



Pin	Color	Description
1	NC	not connected
2	black	Spindle Phase 1
3	blue	Spindle Phase 2
4	brown	Spindle Phase 3
5	red	PTC-Signal / Spindle Temperature
6	violett	FP-Signal / Speed Sensor
PE	grey	GND

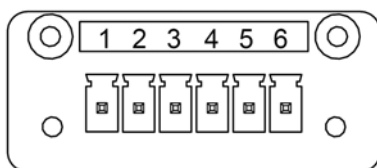
View from backside

### 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	PTC-Signal (Spindle temperature)
5	Hall-Sensor-Signal (Spindle speed sensor)
6	SGND / GND for FP- and PTC 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	PTC-Signal (Spindle temperature)
6	SGND Signal-Ground PTC

## 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.



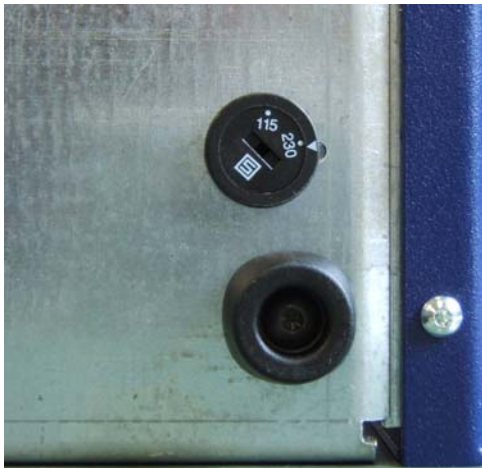
### **Attention:**

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.



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 **E03** "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 **01** or **02** 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 be 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 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](http://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

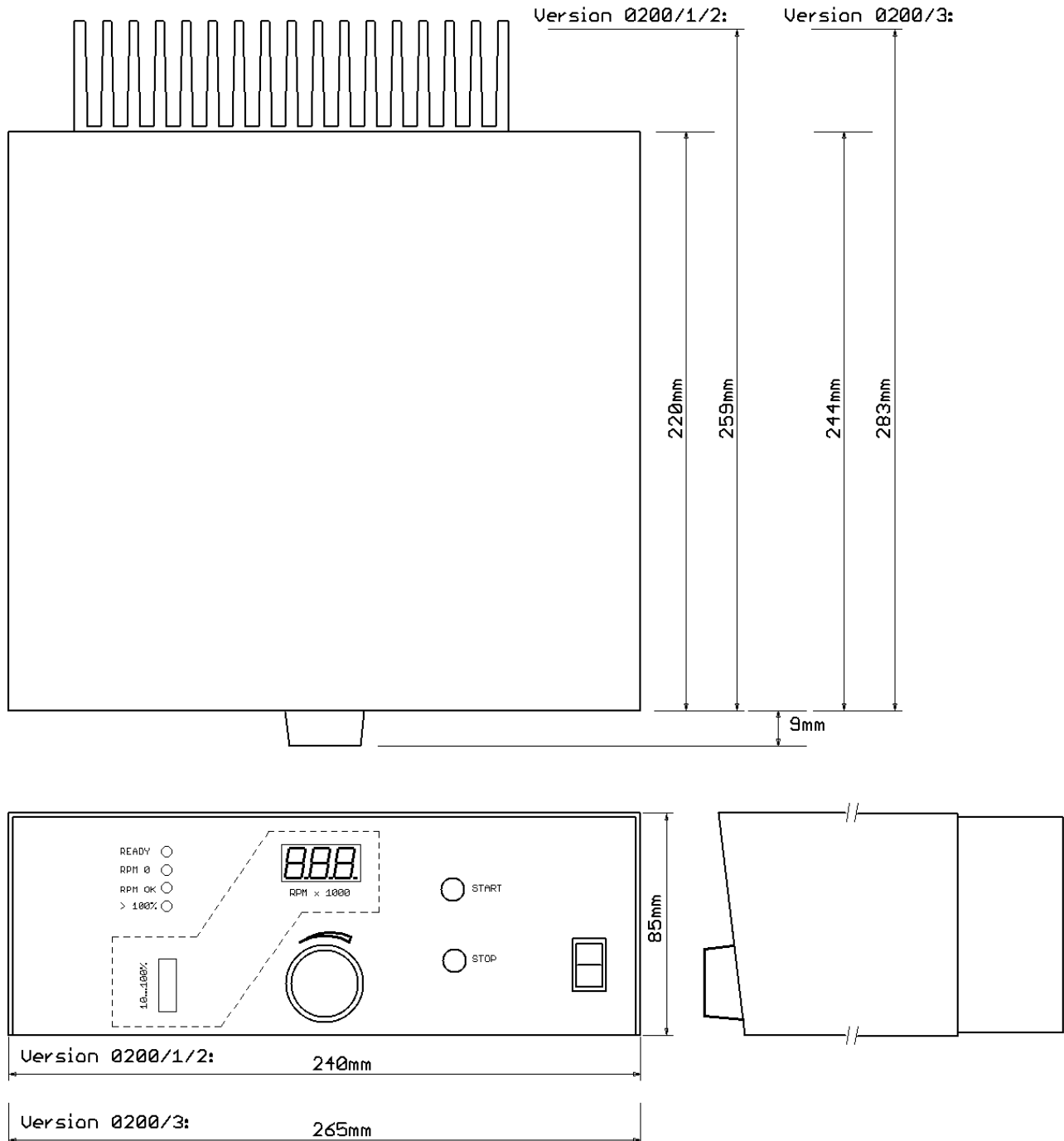
The compliance with the limit values of EMC is the responsibility of the manufacturer of the machine or device.

This device was developed for use in industrial environments. For trouble-free operation and to reduce emitted interference, the following should be observed during wiring of the equipment:

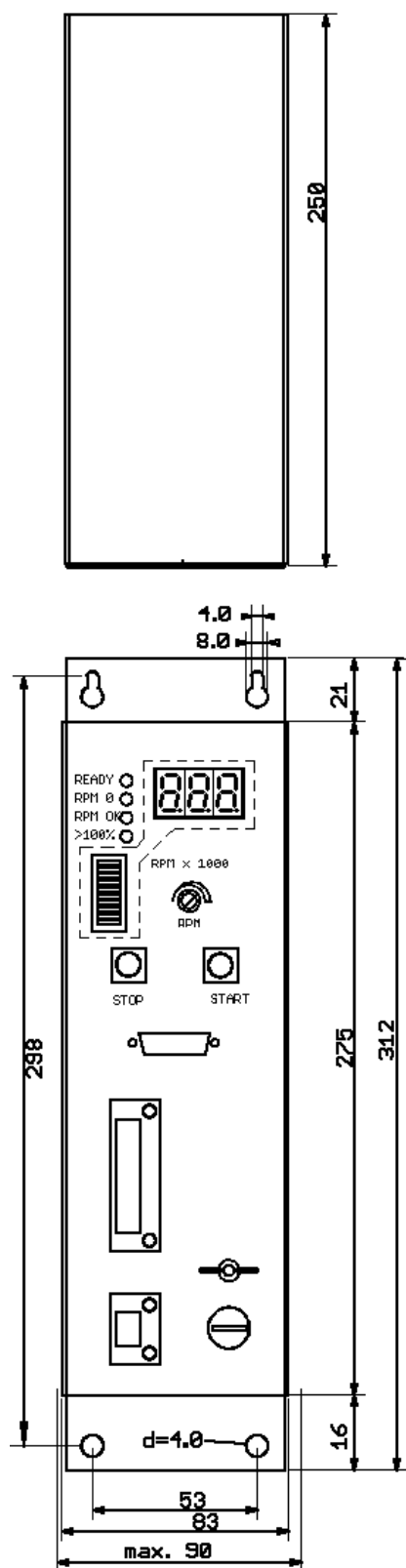
- ✓ The EMC of a machine or device is affected by all connected components (motor spindle, length and type of cables, wiring, etc..). Under certain conditions the use of additional filters can be necessary to maintain the current laws.
- ✓ The earth and shield connections of all those devices used in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

## 11. Views and Dimensions

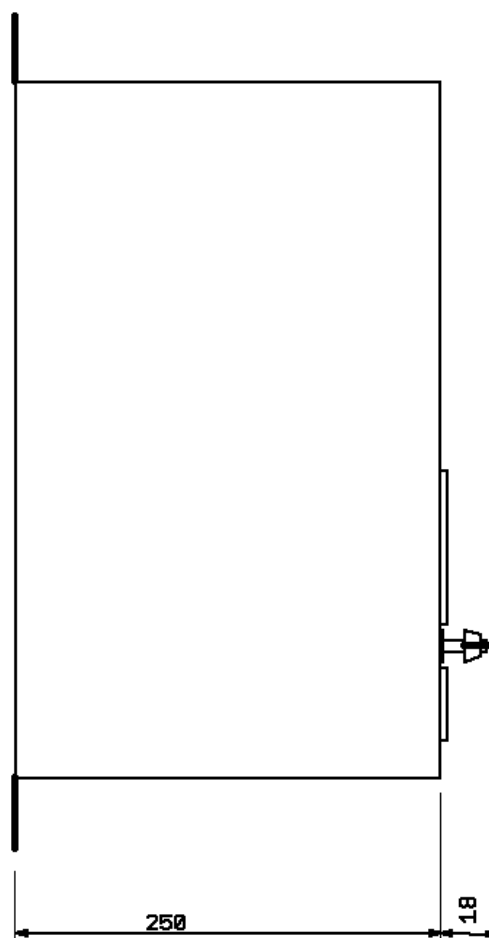
### 11.1 SFU 0200/x A in desktop housing with LED-Display



## 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

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



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

**DR. KAISER**  
präzision durch diamant

**Henninger**  
PRÄZISIONSTECHNIK

....and many more!

# OUR QUALITY COMMITMENT

100%	„Made in Germany“
100%	precision
100%	reliability
100%	support
100%	flexibility



Subject to technical alterations.  
May 2017





# ANSPRECHPARTNER CONTACT

FON 09122 / 631 48 - 0  
FAX 09122 / 631 48 - 29

## **BMR GmbH** elektrischer & elektronischer Gerätebau

Walpersdorfer Straße 38  
91126 Schwabach

E-Mail [info@bmr-gmbh.de](mailto:info@bmr-gmbh.de)  
Homepage [www.bmr-gmbh.de](http://www.bmr-gmbh.de)

## **GESCHÄFTSFÜHRUNG MANAGEMENT**

Susanne Brittling  
[s.brittling@bmr-gmbh.de](mailto:s.brittling@bmr-gmbh.de)

## **ENTWICKLUNGSABTEILUNG DEVELOPMENT DEPARTMENT**

Franz Lebski  
[f.lebski@bmr-gmbh.de](mailto:f.lebski@bmr-gmbh.de)

Frank Buchholz  
[f.buchholz@bmr-gmbh.de](mailto:f.buchholz@bmr-gmbh.de)

Markus Neidert-Loy  
[m.neidert-loy@bmr-gmbh.de](mailto:m.neidert-loy@bmr-gmbh.de)

Stephan Brittling  
[stephan.brittling@bmr-gmbh.de](mailto:stephan.brittling@bmr-gmbh.de)

## **EINKAUF/REPARATURSERVICE PURCHASE / REPAIR-SERVICE**

Vera Wallert  
[v.wallert@bmr-gmbh.de](mailto:v.wallert@bmr-gmbh.de)

## **VERTRIEB SALES**

Michael Lämmermann  
[m.laemmermann@bmr-gmbh.de](mailto:m.laemmermann@bmr-gmbh.de)

Annette Farbulleh  
[a.farbulleh@bmr-gmbh.de](mailto:a.farbulleh@bmr-gmbh.de)

Rudolf M. Brittling  
[r.brittling@bmr-gmbh.de](mailto:r.brittling@bmr-gmbh.de)

