Frequency Converter SFU 0052 SSE

Content

1.   Introduction

The SFU0052 is the successor of the SFU051 and can replace it directly with the exception that the spindle characteristics of the DC version are different and can not be interchanged, but are available at BMR on request. It is implemented an improved DC functions which grants a much better overall performance.

The rotational speed of **BLDC** (brushless direct current) motors is direct depending on the voltage applied. Generally this voltage will be connected to a 3 phase winding on the rotor via a collector, which takes over the proper commutation.

BLDC motors have the windings on the stator and a permanent magnet on the stator. So they don't need a mechanical collector, but the commutation has to be carried out electronically

The precondition for this is the knowledge about the position of rotor at any time. The informations have to be gathered either from encoders or from the back emf voltage of the winding, which is a so called sensorless operation.

The rotation speed of an **AC** motor depends on the revolving field of the stator. The rotor doesn't follow the revolving field of the converter. This difference is called slippage, which is typical for all ac motors.

The motor control is realized by a well proved special BMR speed *vector control.* A speed sensor within the spindle is not necessary.

2.   Description and Features

- **sensorless** Operation of **BLDC** and **AC spindles**
- The frequency converter **SFU 0052** allows **rotational speeds** up to **60,000Upm.**
- The core of **SFU 0052** is a **digital signal processor** (DSP) which produces all output parameters and collects signals.
- Output power up to 250VA within a very compact DIN rail case
- 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 and braking are controlled and critical conditions are intercepted.
- **Easy and flexible integration into new or existing applications with** Input und Output signals for control.

- **Short circuit protected**

3. Block Schematic
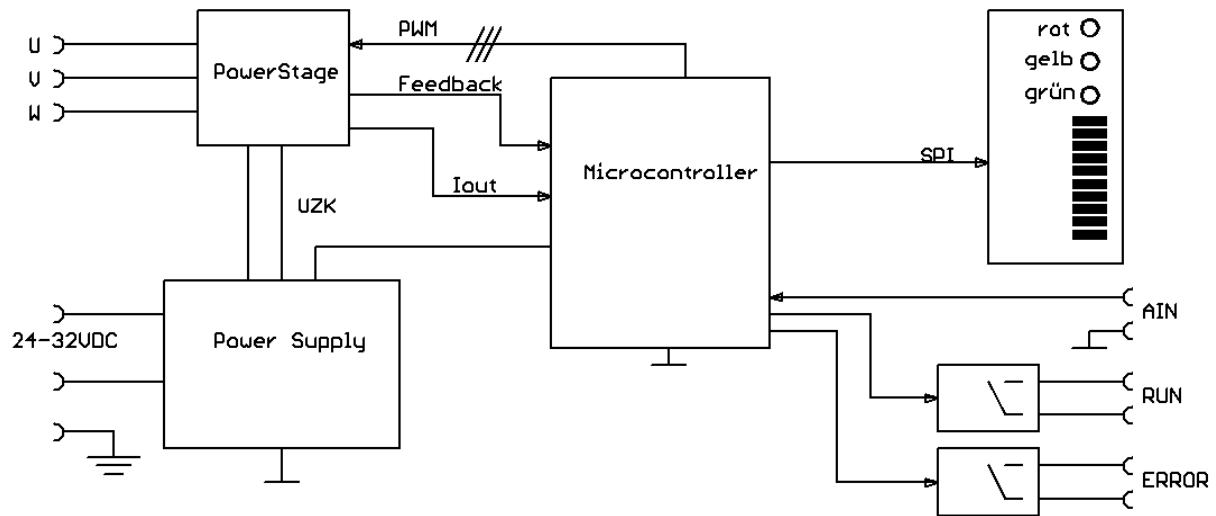
Picture 1

4. Technical Data

Power Supply Voltage	Logic / Digital: +24V / 0,25A DC Umax = 32V! Spindle: +24V…50V DC / Fuse: 6,3AT protected against reverse wiring, but not for permanent duration
Output Power	ca. 250VA
Spindle Connection	3-polig: U, V, W,
Output Voltage	depending on Spindle Voltage Supply
Output Current	6A , electronically limited and matched to the corresponding spindle
Overload	to be set up for max. 10s
Output frequency	max. 100.000 rpm
Control Input	1 Analogue: 0-10V pluggable screw terminal X1 PIN1 Analogue Signal, PIN2 Ground protected to withstand voltages beyond 10V, but not for permanent duration
Control Outputs	2 Digital: Relay at pluggable screw terminal X1 24VDC/1000mA, 125VAC/500mA PIN3-4: normally open – **RUN** / **Spindle has reached set value** PIN5-6: normally open – **ERROR** / **any error, overload**
Interface	USB for setup and remote control
Dimensions B x H x T (mm)	105 x 125 x 55 Mounting at 35mm DIN rail
Weight	ca.300g
Protection	IP20
Ambient. Operationg Temp	40°C

5. 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!

- Any maintenance to the device must be carried out after the supply voltage has been disconnected, only!

- 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.

- Maintaining EMC (electromagnetic compatibility) limits is the responsibility of the manufacturer of the machine or device. The inputs and outputs on this device are fitted with filters, to increase the interference immunity and reduce emitted interference, making it possible to use this device in an industrial environment.

- 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.

- For the reasons listed above, installation and connection of the device should be carried out by qualified personnel, only.
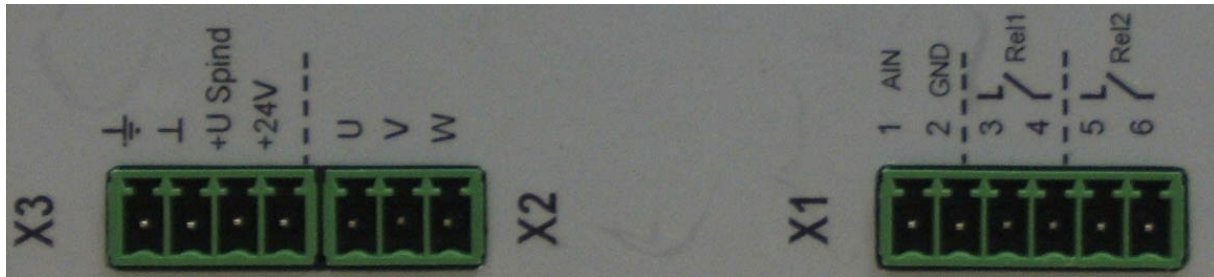
Attention:
Please verify that all power supply voltages are correct in polarity and value

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

6. Connections, Plugs and Pin Assignments

Picture 2

6.1   Analogue Input - Digital Output X1 6 pol. pluggable screw terminal 3,5mm

Pin	Function	Description
1	Analogue Input	**Start/Stop** in combination with **Set Value of rotational speed** see 7.2 / 7.3
2	Ground	Ground for Pin 1
3	Relay1 (NO)	**Spindle RUN (normally open)** Spindle has reached set value
4		
5	Relay2 (NO)	**Overload / Error (normally open)**
6		

6.2 Spindle Connection X2   3 pol. pluggable screw terminal 3,5mm

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

6.3 Mains Connection X3   3 pol pluggable screw terminal 5,0mm – to be locked

Pin	Function	Description
1	PE	Protective Earth
2	0V	GND USpind and +24V
3	+USpind	+ Spindle Voltage Supply -> Fuse 6,3AT protected against voltage reversal and back emf voltage from spindle. Voltages measured here are not buffered by a cap. Umax = 50V 24V Spindles may be operated with a bridge to Pin 4
4	+24V	+ Voltage Supply for Logic -> FUSE FS1 250mAT protected against voltage reversal Umax = 32V!!

6.4 Interface USB
For communication with PC and setup and remote control with the help of SFU-Terminal

7. Description of Functions and Operation

SFU 0052-SSE gets all important operating conditions and parameters.
A selection of two can be output on the digital outputs as messages

All setups described below can easily be carried out with the help of SFU Terminal with a Version higher than V5.9 .

The multi purpose input X1-PIN 1 input can be used for setting up the desired rotational speed and in combination for START-STOP

7.1 Frontpanel
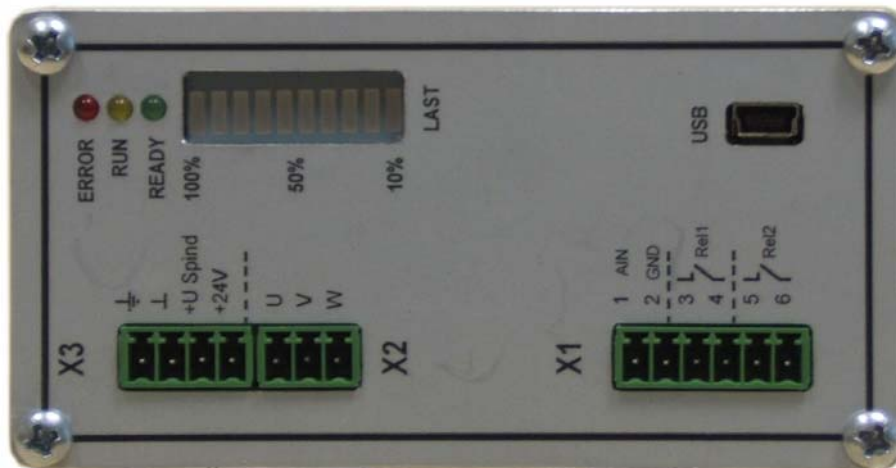
<div align="right">Picture 3</div>

During operation the current status is displayed at the LEDs **ERROR**, **RUN**, **READY**
The LED **ERROR** is additionally a common indication for an error.

7.2 Start and Stop of the converter

An input voltage of 0V at X1-PIN 1 makes the spindle stop, and a voltage higher than 0,29V starts the spindle up to a rotational speed according to the scaling.
As indication for RUN State the yellow LED is switched ON and relay at X1-PIN3-4 is switched.

As soon as an error occurs, the spindle is stopped. A restart is possible after reset and set of the voltage at X1-PIN 1

7.3 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 characteristic
  e.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**.
  As soon as the spindle is started the rotational speed can be increased to maximum

  The analogue input is protected agains voltages beyond 10V for short time and not for permanent duration

7.4 Load Display

At the LED bar the current load condition is displayed as fractions of 100%. As soon as the maximum load is superceded the red LED is lit and the relay at X1-PIN 2-3 is switch. In case that this condition is persisting longer than 10s or longer as the value set up with SFU-Terminal, the spindle is stopped. (see 7.5)

7.5 Status LEDs and Relays

For indication of the current operating status there are 3 LEDs present. Operating conditions listed below are possible:

- **READY**:   Power Supply of 24V has been connected and no error: green LED

- **PowerOn ERROR:**   In case of the presence of an analogue voltage at X1-PIN 1-2 during PowerOn, the red and the green LED are switched on and the Error-Relay at X1-PIN 5-6 is switched. By this an automatic but ununited start of the spindle is prevented
  - ➔ Converter is in Error condition

- **RUN**:   The converter is started and the spindle runs. The green and the yellow LEDs are switched on and the Run-Relay at X1-PIN 3-4 is switched.

- **Output Current < Max Current Limit: In case that the nominal current of the spindle is exceeded, the red** ERROR LED is lit and the ERROR relay is switched. If this is persisting longer than 10s or longer as the value set up, the spindle will be stopped. Now the ERROR LED and the READY and RUN LED and the RUN Relay are off.
  - ➔ The converter is in an Error Condition

- **Output Current > Max Current Limit: In case of the max. current of the spindle is superceded immediately. In this case the** ERROR LED and the READY and RUN LED and the RUN Relay are switched off.
  - ➔ The converter is in an Error Condition

- **Spindle is blocked** (Stall): In case of a blocking of the spindle, it will be switched off **immediately In this case the** ERROR LED and the READY and RUN LED and the RUN Relay are switched off.
  - ➔ The converter is in an Error Condition

- **Accepting an error condition and restore the Ready condition**:
  - ➔ Analogue voltage has been switched off.
  - ➔ ERROR LED off Error-Relay at X1-PIN 5-6 open.
  - ➔ READY LED is on

ERROR RED	RUN YELLOW	READY GREEN	Condition
⚪	⚪	⚪	**OFF**
⚪	⚪	🟢	READY: ready for run , spindle standstill
⚪	🟡	🟢	RUN: Spindle has reached set value
🔴	🟡	🟢	ERROR: Overload and spindle runs, Automatic switch off after max 10 sec. To be set up with SFU-Terminal
🔴	⚪	⚪	ERROR: Spindle standstill Overload Stop or Spindle blocked
🔴	⚪	🟢	Analogueeingang > 0V at PowerOn
◯	◯	⚪	not used

ERROR: X1-PIN 5-6	RUN: X1-PIN 3-4	Status Relay (normally open)
open	open	READY: ready for run , spindle standstill
open	closed	RUN: Spindle has reached set value
closed	closed	ERROR: Overload and spindle runs, Automatic switch off after max 10 sec. To be set up with SFU-Terminal
closed	open	ERROR: Spindle standstill Overload Stop or Spindle blocked

5. 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.

6. EMC

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.

- 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.

8. Drawing

X3

X2

X1

ERROR
RUN
READY

LAST

USB

103.0mm

53.0mm

125.0mm

133.0mm
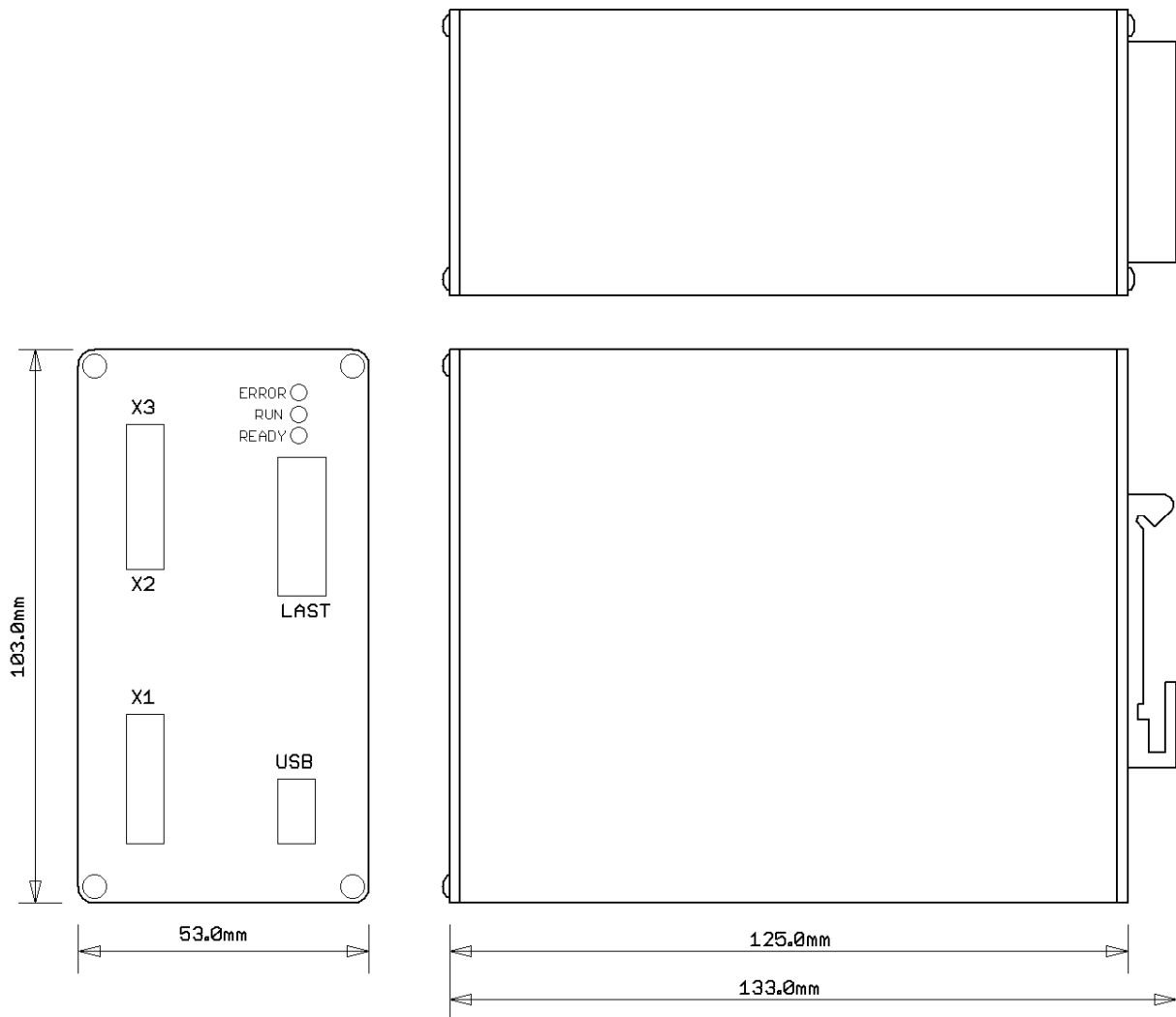
Picture 4
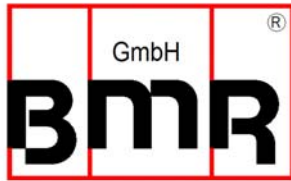
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