BALDOR®
MOTORS AND DRIVES

SBSC SERIES 2000 / 3000
SERVO CONTROL
FOR BRUSHLESS AC MOTORS

INSTALLATION & INSTRUCTION MANUAL

Made in Germany

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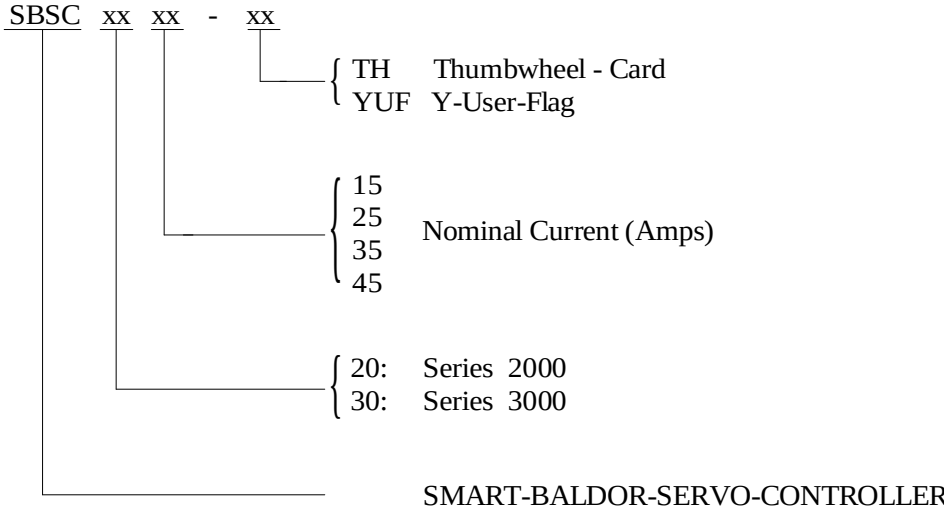
1.0 Specification

1.1 Usage Definitions

The amplifiers of the series SBSC2000/3000 are electrical equipment for industrial power installations. They are designed for machine applications, which need variable speed controlled three-phase A.C. motors.
This product is only for use in industrial applications as described in norms EN 60204 and VDE 0160. This means use
SBSC2000/3000 in stationary groundbased applications only. It is not meant for use in home appliances, medical technics, cars, ships or airplanes.
Before the SBSC is put into operation, please contact your Electric-Supply-Company for special operating conditions.

1.2 Identification



1.3 Features

A SBSC is a 1 axis amplifier with integrated power stage.
It provides the following features:

POWER SECTION:	? Ratio peak : nominal current = 2:1. Both values independently adjustable.
? 3 respectively 4 output current versions (15/25/35/45A) available.	? Brushless-servomotors (1 to 8 poles) can be connected. (Feedback: 1-pole pair resolver)
? All SBSC amplifiers are short circuit proof and require no minimum load.	? Power wiring via terminal screws (max. wiring diameter 10mm²/AWG7)
? Output power up to 30kVA	
CONTROL I/O Section:	
? 3 opto isolated control inputs for dedicated amplifier functions	? Possibility of daisy-chain wiring for amplifier configuration of up to 16 axis (SBSC)
? 1 handwheel (encoder) - input	? Software amplifier tuning capability with graphic program.
? Serial interface (RS232C) for communication and programming	? Wiring of control inputs and outputs via plug type screw connection (max. wiring diameter 1,5mm²/ AWG15) or SUB-D connector
? Diagnostic display on front panel	
? Amplifier configuration adjustable via software	
GENERAL:	? Isolation classification according to DIN 0110 with overvoltage category II
? Protection class IP20 (acc. to DIN40 050 / IEC144)	? Contamination level 2
? Cooling: self-ventilation	

1.4 Declaration of Conformity

Herewith we declare, that our products are components only and not ready for immediate or instant use within the meaning of "Safety law of appliance", "EMC Law" or "Machine directive".

The final mode of operation is defined only by the insertion into the user´s construction.

It is the responsibility of the user to verify that his construction is in accordance with existing regulations.

It is prohibited by law to put the machine into operation before verifying that the machine is in accordance with EC directive 89/392 and 921/368.

The supplier declares product conformity with the following standards:

DIN VDE 0160 / 05.88	Electronic equipment for use in electrical power installations
DIN VDE 0100	Erection of power installations with nominal voltages up to 1000V
DIN IEC 326 Part 1 / 10.90	Design and use of printed boards
DIN VDE 0110 Part 1-2 / 01.89	Dimensioning of clearance and creepage distances
DIN VDE 0110 Part 20 / 08.90	
EN 60529 / 10.91	Degrees of protection provided by enclosures

1.5 EMC - Conformity and CE - Marking

The application of EMC conformal component and partly systems relieves the observance of EMC Guidelines and the guaranty of conformity for the manufacturer of machines. Therefore all standard components and partly systems will be tested according to the requirements of EMC regulation. Those tests will be executed by a competent and independent institution. The conformity of the products will be confirmed by a declaration of conformity from the European Community.
The installation instructions refer to elimination of radio interference as well as to immunity from noise for BALDOR Drive Systems.
Thereby the user is informed about the EMC critical parts. The examples don´t show the complete possibilities of cabinet components or constructions.

Guidelines for EMC Conformity

? ? ? ? **Machine Guideline (89/392/EWG)** **- Machine Safety Law**
Application since 01.01.95

? ? ? ? **EMV Guideline (89/336/EWG)** **- EMC Law**
Applicade 01.01.96 on

? ? ? ? **Low Voltage Guideline (73/23/EWG)** **- Machine Safety Law**
Applicade 01.01.97 on

1.5.1 EMC Installation Instructions

To ensure electromagnetical compatibility (EMC) at hostile environment inside the cabinet following instructions are to be observed for construction. Only the implementation of following provisions enables the reduction of interference down to required values.

For the Drives Technology following key points are to be considered:

- **Grounding**
- **Screening**
- **Filtering**

Furthermore the relevant chapters of the Installation manual for the controllers have to be observed.
For installation of the drives system the starting point is the installation into a cabinet.

For construction of a cabinet the following installation instructions have to be considered:

A) All metal conducting parts of a cabinet are to be connected arealy and conductable.Eventually the connections should be placed with an earthing strap at a central grounding point .[1)]

B) Signal lines and Power Cables are to be connected separately. (Avoid interaction space)

C) The screen connection of the signal lines and the power cables has to be ensued on a screen linequaranteeing enough space. This screen line also has to be conductable and connected to the remaining housing parts.

D) The cable to the regeneration resistor has to be screened. The screen connection should be on both sides.

E) The mounting of the mains filter has to be situated at the input of the cabinet or behind the transformer. The filter is to connect on ground (cabinet housing, mounting plate etc.).

F) Wiring has to be conducted bundled and close to the cabinet housing or at the mounting line. The unused leads of a cable have to be connected on one side with ground. [1)]

G) In case of worse potential balance between the screen connections a compensating leak with at least 10mm2 (AWG) has to be provided parallely in addition to reduction of the screen current.

1) Grounding in general describes all metal parts which can be connected to a protective conductor, e.g. housing of switch cabinet, motor housing, fundament grounder.

1.5.2 Specifications and Additional Components

1.5.2.1 Mains Filter

Following results are desired through the application of mains filters:

The electronic system should be protected from high frequency interferences which could enter via the mains cable (immunity from noise) and vice versa the mains cable may not transmit interferences from the electronic systems to the adjoining components (elimination of radio interference).

In the main line a mains input filter has to be provided between transformer and controller (In case of direct connecton this has to be in front of the controller).

To choose the fitting mains filter types following points have to be considered:

1. The need of power of the connected controller. Thereby the capacity and the ability of peak phase current has to be considered.
2. The required or prevailing mains impedance.

This table shows the corresponding mains filter types for 3 phase input:

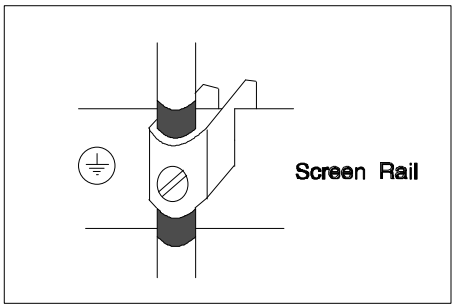
Type	Rated Voltage [V]	Rated Current (at 40°C) [A]	Leakage Current [mA]	Power Losses [W]	Weight [kg]	BALDOR - ID-No
FN 351 - 8 - 29	3x 440	8	16	8.0	1.8	24667
FN 351 - 16	3x 440	16	16	9.0	1.8	24668
FN 351 - 25	3x 440	25	170	9.0	3.0	24669
FN 351 - 36	3x 440	36	170	10.5	3.0	24670
FN 351 - 50 - 29	3x 440	50	190	12.5	3.1	24671
FN 351 - 80 - 29	3x 440	80	210	26.0	9.5	24672
FN 351 - 110 - 29	3x 440	110	210	28.0	9.5	24673

1.5.2.2 Connection Cables

All cables have to be screened.

Motorcable and Signalcable		BALDOR ID - No.
Motorcable	4 x 1.0 mm^2	21599
Motorcable	4 x 2.5 mm^2	21364
Motorcable	4 x 6.0 mm^2	21597
Resolvercable	3 x [2 x 0.14 mm^2]	19413
Regen Resistorcable	3 x 2.5 mm^2	11302

1.5.2.3 Screen Connection



Siemens Clamp		Siemens -No.
5mm Rail	Wiring Diameter 1.5 - 16 mm^2 1.5 - 35 mm^2 16 - 70 mm^2 16 - 120 mm^2	 8US19 21 -2AA00 -2AB00 -2AD00 -2AC00
10mm Rail for T- and double T-profile	Wiring Diameter 95 - 300 mm^2	 8US19 41 -2AA00

1.5.2.4 Connectors

Connection	Designation	BALDOR - ID -No.	
for Motorcable Plug Socket	 CONN SET FEM CONN SET MALE	 2 x 4 pole 2 x 4 pole	 24654A 24656A
for Resolvercable Plug Socket	 CONN SET FEM CONN SET MALE	 12/6 pole 12/6 pole	 24655A 24657A
for SBSC with EMC-Regulation connector X2 with housing			
Connector Housing		25043A 25049A	

1.5.2.5 PG - Cable Glands

PG Cable Gland	Cable Dimensions	Designation	BALDOR ID - No.
PG 9	4 - 8 mm Resolvercable BALDOR ID-No.19413	SCREWING	24658
PG 13.5	6 - 12 mm Motorcable BALDOR ID-No. 21599	SCREWING	24659
PG 21	13 - 18 mm Motorcable BALDOR ID-No. 21364	SCREWING	24660

1.6 Technical Data

All values at T_{amb} = 40 ?C, if not otherwise specified.

1.6.1 Power Section

General	**Unit**	**SBSC 2015**	**SBSC 2025**	**SBSC 2035**	**SBSC 2045**	**SBSC 3015**	**SBSC 3025**	**SBSC 3035**
Nominal DC-Bus-Voltage U_{in} (BPS) = 230V	V_{DC}	320				-		
Nominal DC-Bus-Voltage U_{in} (BPS) = 400V	V_{DC}	-				560		
Nominal DC-Bus-Voltage U_{in} (BPS) = 460V	V_{DC}	-				650		
DC-Bus-Voltage absolute min./max.	V_{DC}	0 ... 350				0 ... 740		
Output Voltage Line/Line fundamental wave; @$V_{DC\text{-}Bus}$ (nom.)	V_{RMS}	0 ... 250				0 ... 500		
Nominal Phase Current (?10%)	A_{RMS}	15	25	35	45	15	25	35
Peak Phase Current (?10%) 3s ?0.5s	A_{RMS}	30	50	70	90	30	50	70
Nominal Output Power	kVA	6.5	10.8	15.1	19.5	13.0	21.6	30.3
Efficiency	%	> 95						
Min. Load Inductance	?H	200						
Output Frequency	Hz	0 ... 500						
Nominal Switching Frequency	kHz	8.5						

1.6.2 24V$_{DC}$ Input

24V-Input	Unit	SBSC2000	SBSC3000
Input Voltage Range absolute min./max. max. V_{Ripple} = ?10%	V_{DC}	20 ... 29	
Input Current; @ 28V_{DC}	A_{RMS}	1.6	
Surge Current at Power On @ 28V_{DC}; @ 100ms	A_{RMS}	2.5	

1.6.3 Positioning - and Velocity Control Section

Servo Performance	Unit	SBSC2000	SBSC3000
Normal Position and Velocity Mode	µs	976	
Handwheel Mode	µs	500	
Execution Rate		typical 50 Blocks/Sec..	

Positioning	Unit	SBSC2000	SBSC3000
Range		± 67 Mio. Encoder Counts	
Accuracy		± 1 Encoder Count	

Velocity		Unit	SBSC2000	SBSC3000
Range			0.005 to 400000 Encoder Counts/ Sec. (6000 rpm)	
Accuracy 3)	Long Term	%	0.002	
	Short Term	%	0.5 to 1.0	
Repeatability 3)		%	0.001	

3) Current loop, motor and load influences not taken into account !

Position - Feedback	Unit	SBSC2000	SBSC3000
Resolution		4096 Counts / rev.	
Accuracy		± 14 arcmin (typical)	
Max. Input Frequency	MHz	1	

1.6.4 Encoder - Input

Encoder Input	Unit	SBSC2000	SBSC3000
Signal	-	5V TTL; Differential	
Max. Input Frequency	kHz	500	

1.6.5 Serial Interface (RS232)

RS232 - Interface	Unit	SBSC2000	SBSC3000
Control In- and Outputs		opto isolated 12 ... 29 V_{DC}	
Programmable In- and Outputs		opto isolated 12 ... 29 V_{DC}	
Communication		RS 232 C	

1.6.6 Memory Specification

Memory Capacity	Unit	SBSC2000	SBSC3000
ROM	kByte	32	
RAM	kByte	8	
EEROM	kByte	8	

1.6.7 Mechanical Section

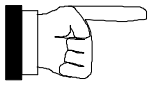
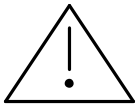
Mechanical	Unit	SBSC2000	SBSC3000
Mounting	-	Bookstyle or Thru the Wall	
Dimensions	mm	105 x 357 x 328 / 140 x 357 x 328 1)	
Weight	kg	8.5 / 9.5 1)	

1) : SBSC2045/3035

1.6.8 Environmental Section

Environmental	Unit	SBSC2000	SBSC3000
Operating Temperature Range	°C	+0 ... +40	
Storage Temperature Range	°C	-25 ... +70	
Humidity	%	10 ... 90; not condensating; according to DIN40 040, Class F	
Class of Protection (Enclosure)	-	IP20	
Max. Installation Altitude / M.S.L.	m	1000	
Shock	-	10G; according to DIN IEC 68-2-6/29	
Vibration	-	1G; 10 ... 150 Hz; according to DIN IEC 68-2-6/29	

Legend:

	This is an *INFORMATION* sign. If this information is read, installation and / or amplifier operating problems can be avoided in advance.
	This sign means *ATTENTION*. In all cases it must be read and taken into account. Non-observance can cause dangerous situations for equipment and personnel.

2.0 Installation Recommendations

2.1 Mechanical Installation

- For installation of your system use a cabinet with a protection class that suits your environmental conditions.

- As cooling air freely enters the unit, the environment must be free from corrosive chemical substances, oil, vapour, steam, metal particles and dust.

- Make sure that cooling is provided.

- Make sure that the top of the unit is covered during installation to prevent particles from falling into the unit.

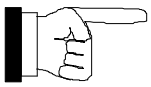
- Keep DC-bus links as short as possible. Therefore always mount SBSC2000/3000-combinations side by side.

- Mount all SBSC vertical (Terminal blocks to the top).

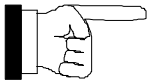
- Use SBSC2000/3000 in stationary groundbased applications only.

2.2 Electrical Installation

Qualified or trained personnel only should install the machine. Electrical rotating equipment can result in property damage, serious injury, or death, when improperly installed. Equipment should be installed in accordance with the local codes and safety standards for construction and guide for selection, installation and use of electric motors and generators.



The wiring, fusing, and grounding must be in accordance to the national electrical code and any local codes.



Use of motor Thermo switch:
It is recommended to survey the status of this protective device in the position control (i.e. NC/CNC/PMAC).
Since the leads can carry high voltage-spikes, isolation by means of a relais should be installed.

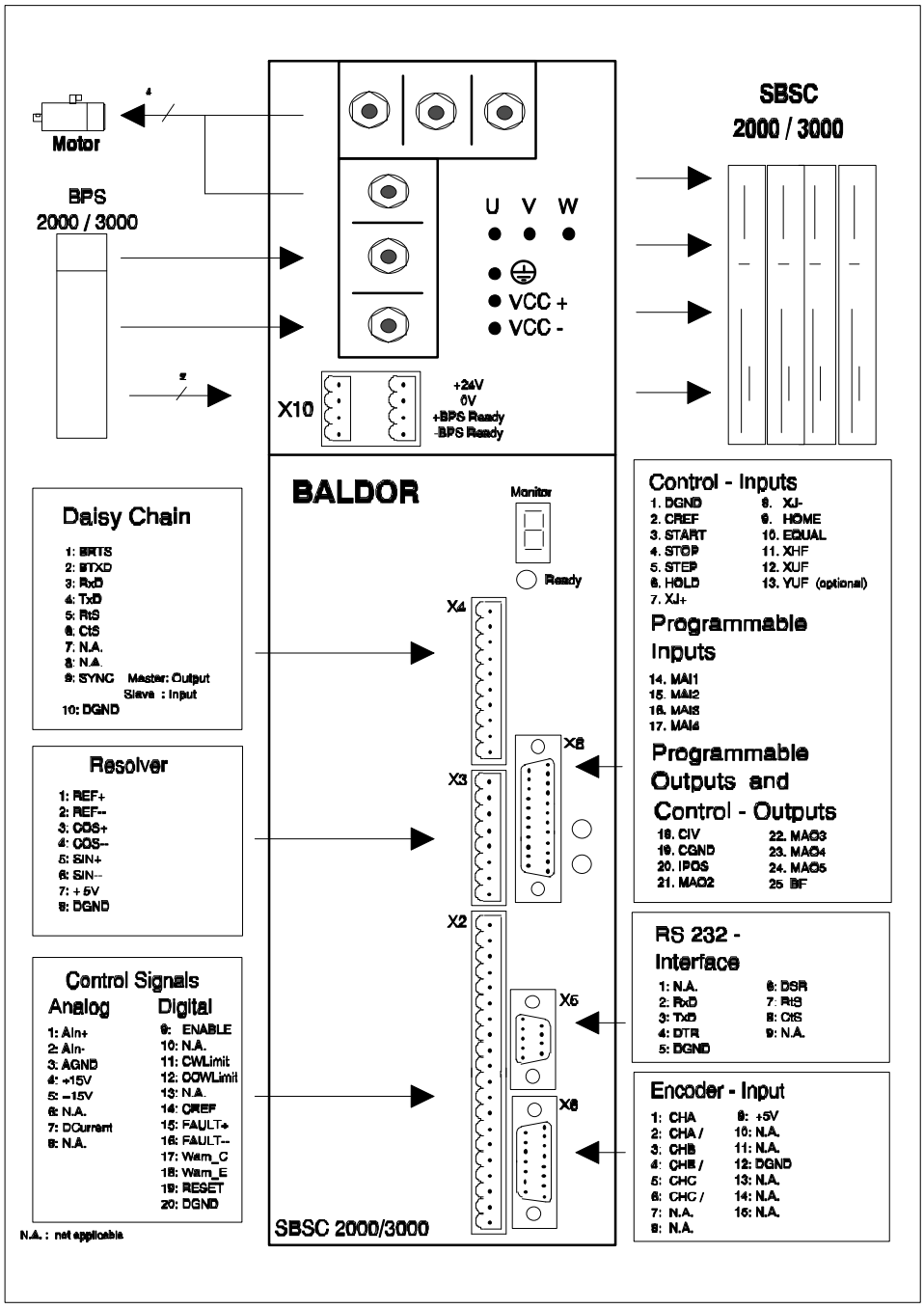
Electrical and/or mechanical alterations are permitted only when power is removed!

Sudden blocking of the rotating motorshaft can cause serious damage to motor and amplifier. It is strongly recommended to install elastic stoppers in the driven machine.

SBSC amplifiers have a 24V input to supply the control circuits. If the 24V supply is off, the power connectors can have dangerous voltage levels without any indication.
The Monitor and the LED "READY " illuminate only if 24V is switched on.

Connect the PE of all systems to a central point. The diameter of the cablelead must be AWG7(10qmm) min.

3.0 Interconnection Diagram "SBSC20xx / SBSC30xx"



Content of delivery: mating connector to X2, 3, 4 and X10.
Order-no´s for mating connectors (spare part or completion):
X5: #16215 (9 pole, male) **X6**: #20739 (15 pole, female) **X8**: #21742 (25 pole, female)

4.0 SBSC Wiring

In chapter 4.3 you will find the typical (minimum) wiring of the system . The following pages show some special applications and the typical wiring in more detail.
This chapter is valid for all SBSC versions.

ATTENTION: For the system set up (chapter 6) it is nessesary to wire the system step by step. It is recommended to follow the system set up procedure, especiallly for users who are not very familar with the SBSC amplifier series.

4.1 Power Wiring

4.1.1 Power Supply

The SBSC amplifier will be supplied from a BPS with the DC-bus voltage. The connection between SBSC and BPS must be as short as possible. The wiring can be done with copper bars (#23176).

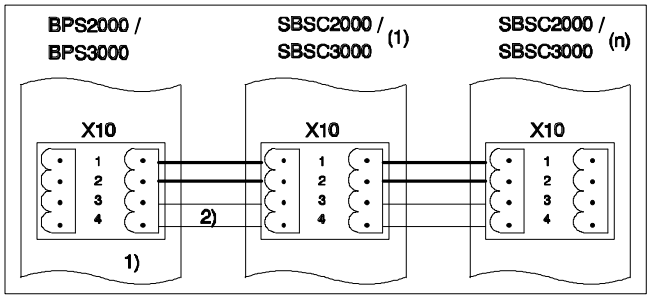
Wiring Power Supply:

Chapter 4.3 shows the wiring in detail

4.1.2 24V$_{DC}$ - Connection

A SBSC2000/3000 needs an external 24V control supply. This voltage supplies the amplifiers control circuits. The advantage is, if main power is switched off, control circuits are still supplied and position information gets not lost.
This supply must be linked to SBSC connector X10 (Pin 1 and 2). The BPS2000/3000 provide the needed 24V output. This output is for that purpose and has the same denotation on BPS.
If the SBSC is not supplied with the BPS, an external power supply must be connected to connector X10.
The external power supply must fullfil certain specifications (see chapter 1.6.2).

Wiring 24V$_{DC}$-option:



1) The shown BPS, can be replaced by an external 24V-power-supply.
   The amount of connected SBSC´s (n) which can be connected to one BPS, depends on the BPS version (refer to BPS2000/3000 manual)
2) The wiring of X10 pin 3 and 4 is nessesary for proper SBSC operation. For details please refer to chapter 4.2.1.

4.1.3 Motor Wiring

The motor must be connected to the following terminals:

U	**Phase U**
V	**Phase V**
W	**Phase W**

A wiring example is shown in chapter 4.3.

The sequence of the motor leads is not arbitrary. Therefore the motor leads must be wired in the right sequence to avoid uncontrolled motor function.

4.2 Control- and Signal Wiring

This chapter is valid for all SBSC versions.

The wiring of the control in- and outputs can be achieved with *one* cable only unlike shown in the pictures below. The outputs *can be* wired. But there is no need for SBSC operation.

4.2.1 Control Inputs

The control inputs below are optoisolated. The ground return for all inputs is "CREF", connector X2.14 or X8.2.

Control Input Function:

Signalname	Connector Pin	Switch Position / Function	
		closed	open
ENABLE	X2.9	Amplifier enabled	Amplifier disabled
CWLimit	X2.11	Clockwise direction of rotation enabled; active braking and position hold	Clockwise direction of rotation disabled; active braking and position hold
CCWLimit	X2.12	Counterclockwise direction of rotation enabled; active braking and position hold	Counterclockwise direction of rotation disabled; active braking and position hold
Machine Input	X8.14 .. 17	Input active	Input not active
Start, Stop etc	X8.3 .. 13	The selected function will be executed	The selected function won´t be executed

A wiring proposal for the control inputs above you will find in chapter 4.3. The hardware description of the optoisolated input is show in chapter 10.1.

Functional example of control inputs:

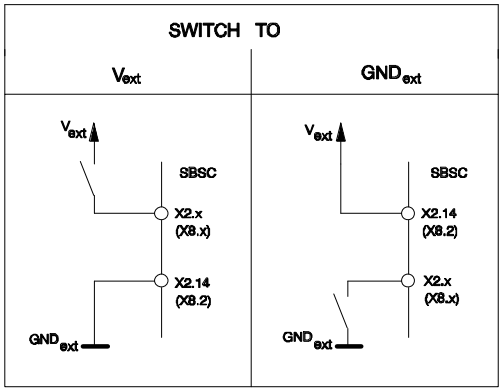
The wiring of the control inputs is also shown in chapter 4.3.

The picture by-stander shows the function and the two wiring principles of the control inputs:

The two wiring versions are:

1) Switching to the external control input power supply. The switch will be linked between the control input (X2.x) and the external power supply (V_{ext}). The ground return (GND_{ext}) is permanetly wired with CREF (X2.14 or X8.2).

2) Switch to the ground return of the external power supply. The switch will be linked between the control input and the external ground return (GND_{ext}). The external power supply (V_{ext}) is permanently wired with CREF (X2.14 or X8.2).

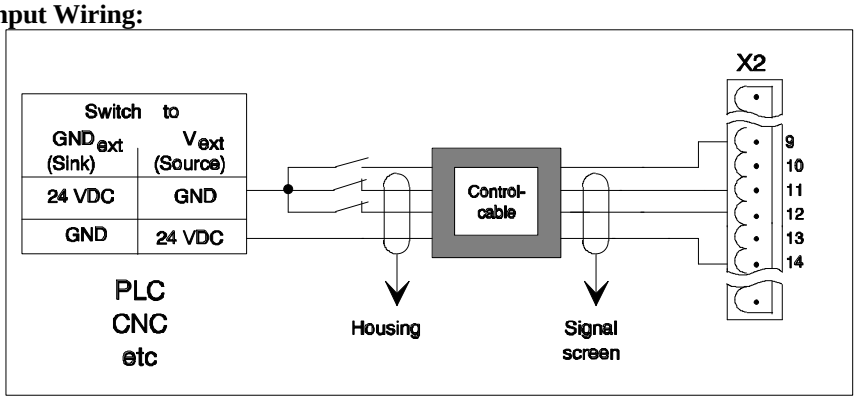


X2.x: "x" for connector pin,
e.g. x=2 ? X2.9 = Enable-Input

Voltage range of V_{ext} : +12 ... 29V_{DC}

The control inputs only work properly, if they are supplied with an external voltage.

Control Input Wiring:



Control Input "±BPS Ready"

a) SBSC with BPS2000/3000:

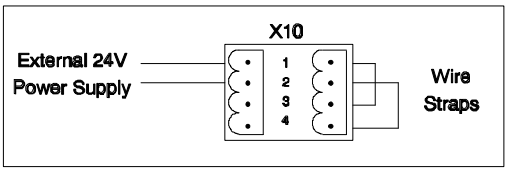
The SBSC provide as default a control input "BPS Ready". If the BPS2000/3000 has an internal malfunction, the BPS will disable the connected SBSC amplifiers. The input is on connector X10 pin 3 and 4.
Under BPS fault condition, this input will be deactivated and the SBSC will show the following state:

LED Ready = *RED*
Monitor-Indication = *2* (Undervoltage)

With this fault indication the SBSC will be disabled.

b) SBSC with external 24V Power Supply:

If the SBSC is not operated with the BPS, an external power supply must be connected to connector X10 as shown below. In that case, the control input "±BPS Ready" has no more function. Nevertheless the input *must* be wired. Without the wiring below, the SBSC will indicate fault condition like above (see a)).



4.2.2 Control Outputs

The SBSC is equipped with a fault relais. The relais contact can be used to observe the amplifier status. The wiring of the fault relais contact is optional and not nessesary for proper amplifier operation.

Control Output Function:

Signalname	Connector Pin	Switch Position / Function	
		closed	open
FAULT+	X2.15	SBSC happy	SBSC not happy
FAULT -	X2.16	no fault indication	fault indication / monitor

Control Output Wiring:

see chapter 4.3

4.2.3 Resolver

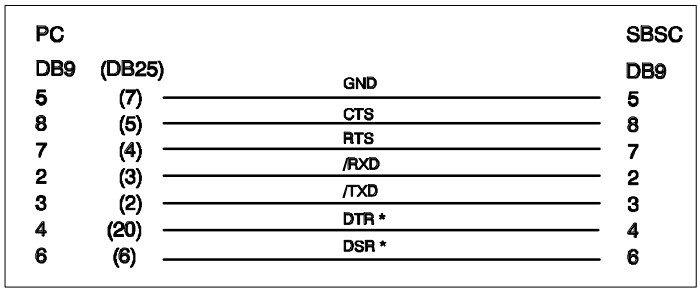
The resolver must be connected to connector X3.

Wiring of the resolver in- and outputs:

The wiring is shown in chapter 4.3.
We recommend the use of the special BALDOR resolver cable #19413.

4.2.4 Interface Cable (RS232)

The wiring from PC to SBSC connector X5 for RS232 interface must be as shown below:



* These signals are not supported by SBSC

The general rule on communication distance is 1 m for 9600 baud.
If there is a very high noise level it may be nesessary to change the baud rate to 4800 or 2400 baud.
Shielding RS232 cables is highly recommended. It is also advised, not to run the RS232 cable next to high power or AC signals such as the servo amplifier, line voltage etc.

4.2.5 Encoder Input

The encoder input (X6) can have the following functions:

Handwheel - Mode

The ratio between incoming encoder signals and the motor speed is configurable via software. For details refer to the SMCC-Software-Manual.

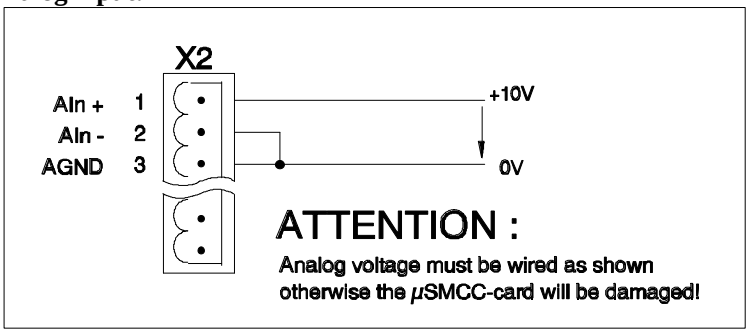
Wiring of the encoder input:

The connector X6 must be wired according to the interconnection diagram (see chapter 3.0).
It is strongly recommended to make the wire connection with twisted pairs and screened cable.
We recommend the use of the BALDOR encoder cable #13036.

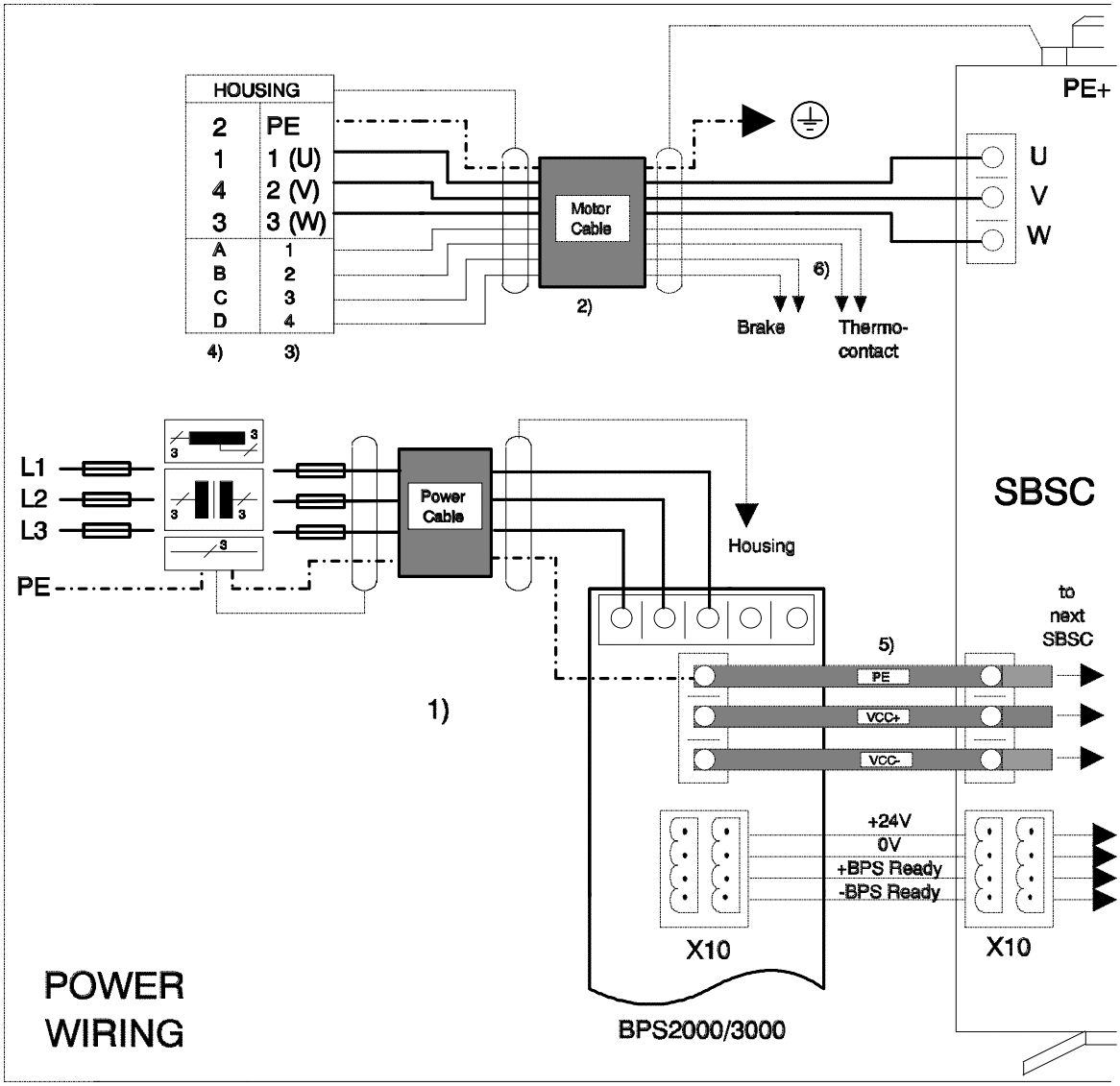
4.2.6 Analog Input

The SBSC has an analog input for general purpose. It is a *polarized* input with an voltage range of **+10V**.
The input has a resolution of 8bit and can be used by software (for details refer to the SMCC-Software-Manual).

Wiring of the analog input:



4.3 Minimum Wiring Diagram "The wiring proposal gives no warranty for



1) The power supply must be wired according to the BPS2000/3000 manual (#22705A)

2) Motorcable:
- # 21599: Wire diameter: 1.0mm² / AWG17 Cable outer diameter: (11.6 ±0.4)mm
- # 21364: Wire diameter: 2.5mm² / AWG13 Cable outer diameter: (14.5 ±0.5)mm
- # 21597: Wire diameter: 6.0mm² / AWG9 Cable outer diameter: (18.5 ±0.6)mm
- # 21598: Wire diameter: 10mm² / AWG7 Cable outer diameter: (22.8 ±0.4)mm

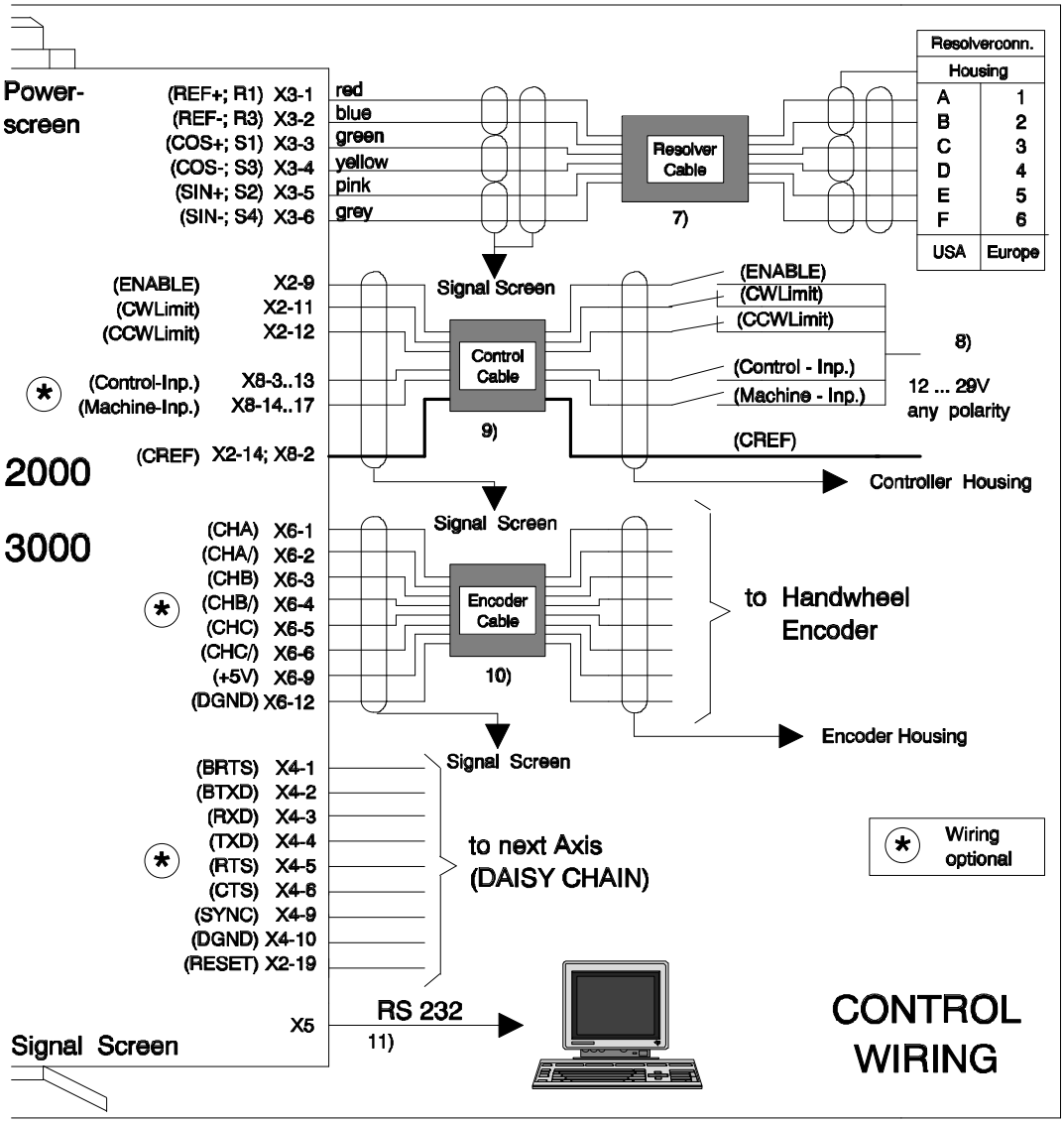
3) Terminal box BSM 6R, BSM90A/90B/100A/100B

4) Connector BSM 63/80 Europe

5) The wiring diameter must fit to nominal BPS output current. The connection between BPS and the SBSC amplifiers must be as short as possible.
The wiring between BPS and SBSC can be done with copper bars (ID-No.: #23176). Also wiring between SBSC´s can be done with copper bars. ID-No´s.: #23177 (105mm housing) #23179 (140mm housing)

6) *Brake output* and *Thermo switch:* The SBSC is not capable to control and supply a motor brake. Furthermore it is not permitted to connect the motor thermo switch to the SBSC.

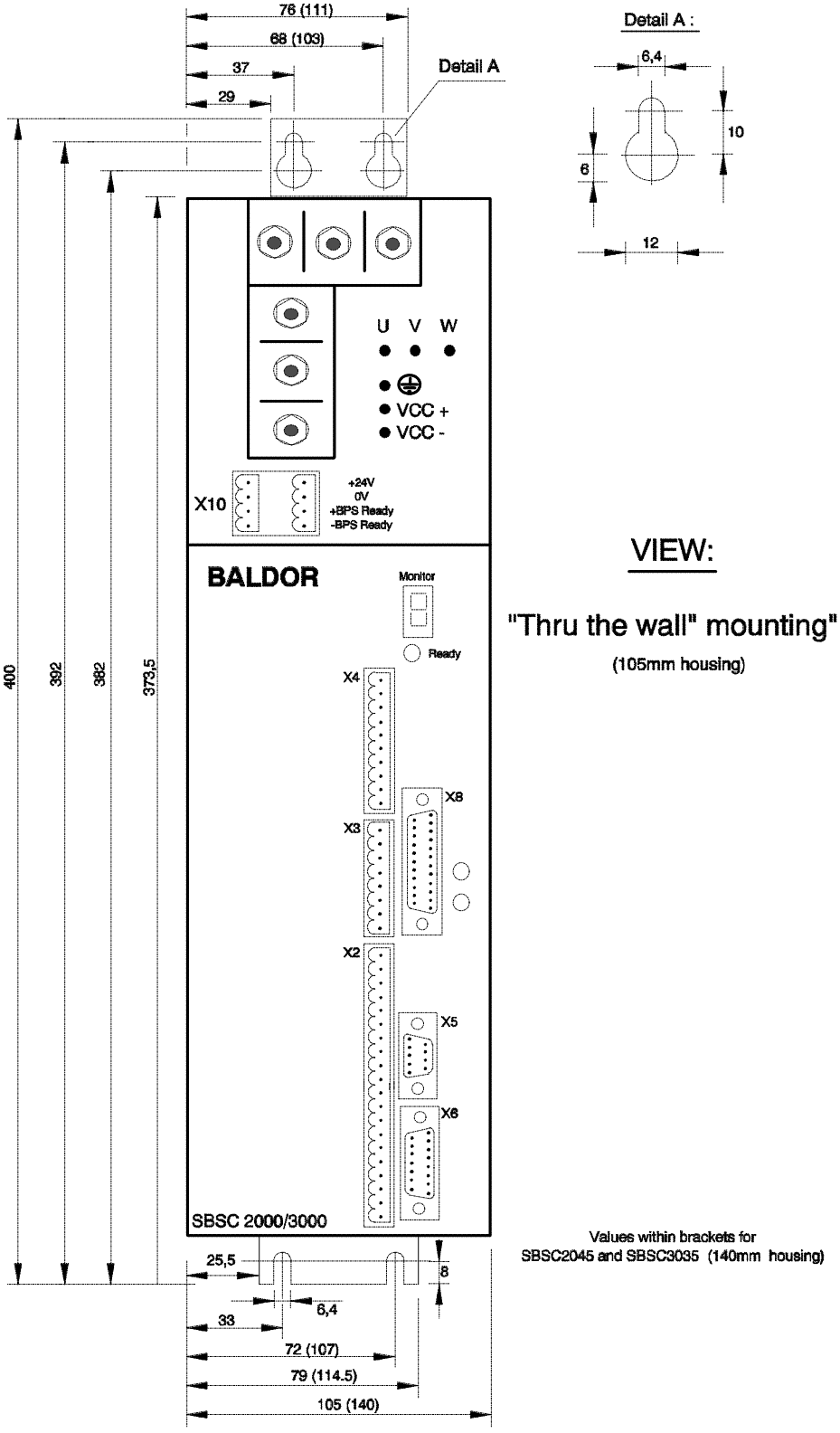
observance of valid EMI - standards"



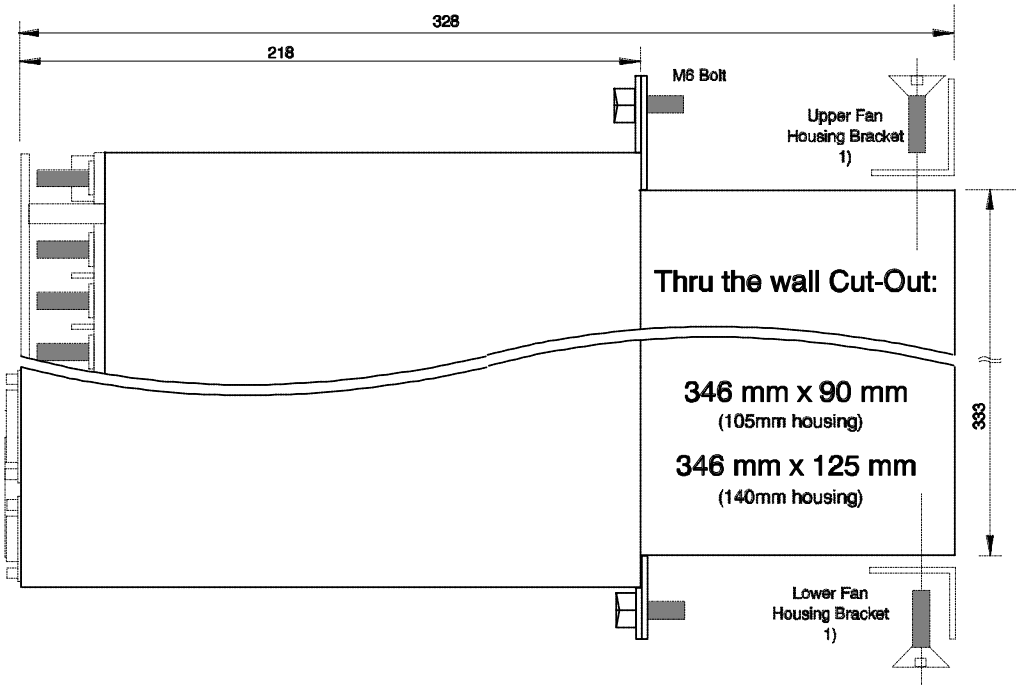
7) Resolvercable: #19413
8) Functional description of the control inputs see chapter 4.2.1. The control inputs must be supplied with an external voltage source.
9) Control cable not available from BALDOR. Drawing shows the wiring principle only. Can be one or more cables
10) Encodercable #13036, twisted and screened
11) Interface cable wiring for one axis refer to chapter 4.2.4.

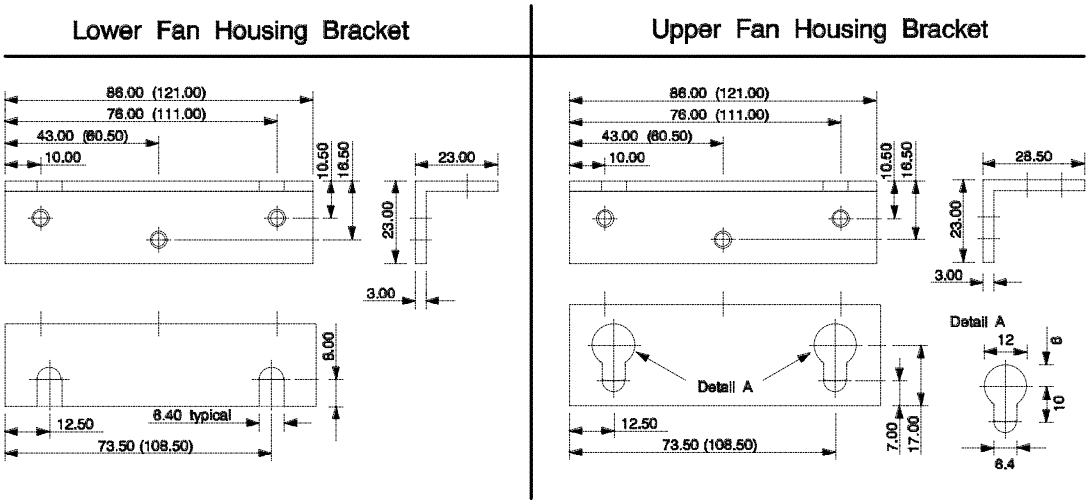
ATTENTION: Please note also chapters 4.0. to 4.2.

5.0 Dimensions



not scaled (dimensions in mm)





Values within brackets for SBSC2045 and SBSC3035 (140mm housing)

not scaled (dimensions in mm)

1) Upper and lower fan housing brackets are not contents of delivery. They must be ordered seperately according table below. The sets below contain both brackets and the screws.

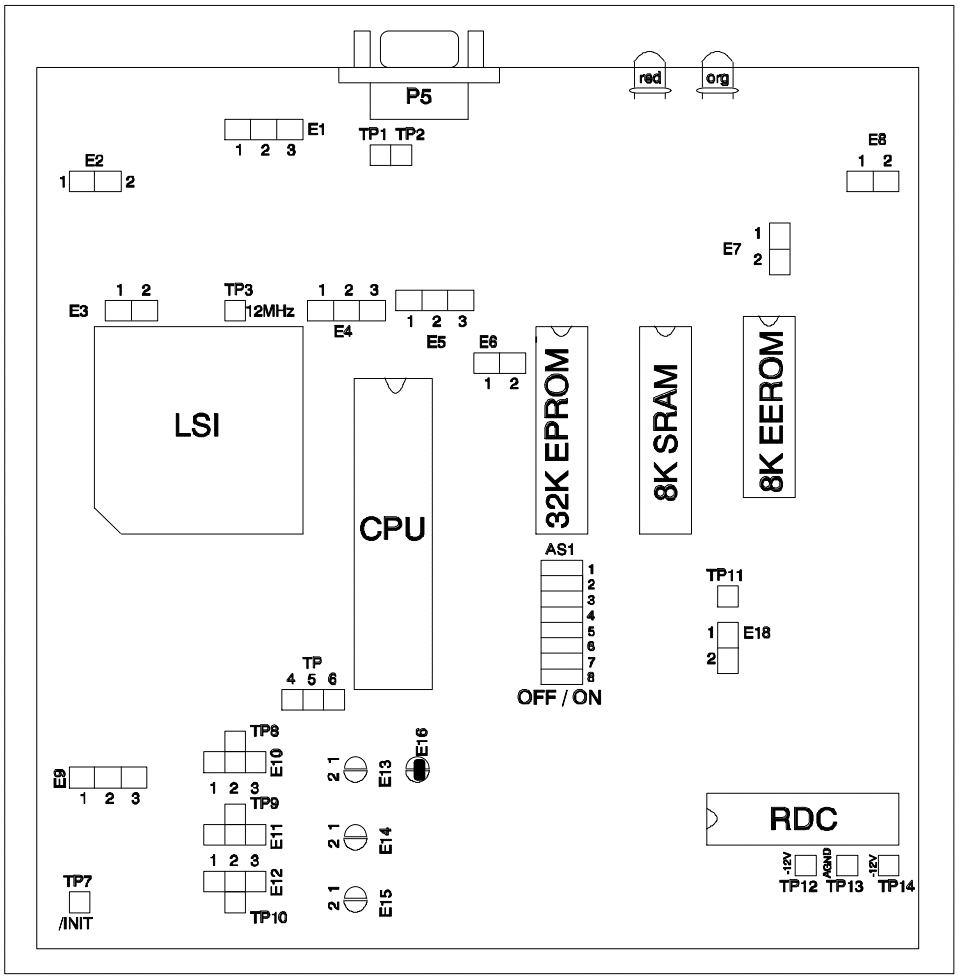
BALDOR ID - Numbers for Fan Housing Bracket Sets	
SBSC2015 / 2025 / 2035 SBSC3015 / 3025	**SBSC2045 SBSC3035**
22570A	23098A

6.0 System Set Up Procedure

6.1 Presets

The following presets must be done at first before starting the system. In order to get access to the SBSC it is necessary to perform some settings on the µSMCC-board.
To get access to this board you must open the front plate and slide out the control card together with the SMCC-board.
The location of the DIP-switches and the jumpers can be found on the component layout below.

6.1.1 Component Layout µSMCC Card



not scaled

6.1.2 DIP Switch Settings

6.1.2.1 Card Addressing Setting

Each card´s address can be set-up by setting the DIP switch on the card as follows:

AS1-1	AS1-2	AS1-3	AS1-4	Card-Address
ON	ON	ON	ON	0 *)
OFF	ON	ON	ON	1
ON	OFF	ON	ON	2
OFF	OFF	ON	ON	3
ON	ON	OFF	ON	4
OFF	ON	OFF	ON	5
ON	OFF	OFF	ON	6
OFF	OFF	OFF	ON	7
ON	ON	ON	OFF	8
OFF	ON	ON	OFF	9
ON	OFF	ON	OFF	10 (hex a)
OFF	OFF	ON	OFF	11 (hex b)
ON	ON	OFF	OFF	12 (hex c)
OFF	ON	OFF	OFF	13 (hex d)
ON	OFF	OFF	OFF	14 (hex e)
OFF	OFF	OFF	OFF	15 (hex f)

*) ex factory

6.1.2.2 Baud Rate Setting

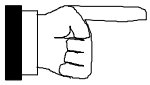
The DIP switch is used to select the communication mode and the baud rate as follows:

AS1-6	AS1-7	AS1-8	BAUD-RATE
ON	ON	ON	9600 *)
OFF	ON	ON	4800
ON	OFF	ON	2400
OFF	OFF	ON	1200
ON	ON	OFF	n.a. (disables RS 232)
OFF	ON	OFF	300
ON	OFF	OFF	38400
OFF	OFF	OFF	19200

*) ex factory

- DIP Switch AS1-5

AS1-5 of the DIP switch is used to enable (*OFF*) or disable (*ON*) saving programs and parameters into EAROM memory. Regardless of the switch position, the contents of the EAROM are always uploaded upon power turn on or reset.



When the DIP switch settings are changed, it is necessary to reset the SBSC or cycle power, in order to activate the new set-up.

6.1.2.3. E - Points

E-Point	Position	Description	Ex-Factory
E1	* * * 1 2 3	1)	1-2
E2	* * 1 2	1)	no Jumper
E3	* * 1 2	1)	1-2
E4	* * * 1 2 3	1)	2-3
E5	* * * 1 2 3	1)	1-2
E6	1 * 2 *	1)	no Jumper
E7	* * 1 2	Jumper pin 1-2 to activate SYNC-Output on Card A0, Make sure if jumper pin 1-2 is installed, E18 must be removed (see E18 also)	1-2
E8	* * 1 2	1)	no Jumper
E9	* * * 1 2 3	Jumper pin 2-3 to obtain non-differential encoder input mode, this will bias encoder negative inputs to ½ Vcc = 2,5 V	1-2
E10;11;12	* * * 1 2 3	With Resolverfeedback, jumper pin 2-3 installed With Encoderfeedback, jumper pin 1-2 installed	2-3
E13;14;15	Solder-Pad	1)	open
E16	Solder-Pad	1)	closed
E18	1 * 2 *	Jumper pin 1-2 for input SYNC (use on all cards other then A0). See E7 also.	no Jumper

1) For test purpose only, no other settings allowed.

6.1.2.4 Single Axis Application

Without any notice all SBSC are delivered for single-axis applications. E7 is installed, E18 is removed.

6.1.2.5 Multi Axis Application

Most multi-axis applications need a synchronized motion control. On the SBSC amplifier this can be achieved by using axis A0 as a master. Up to 15 slaves can be connected.

To synchronize SBSC follow the instructions below:

- On axis A0 install jumper **E7** and remove **E18**
- On all other axis install jumper **E18** and remove jumper **E7**
- Connect the SYNC-line (X4.9) from A0 to all other SYNC-inputs
- Tie all RESET-inputs (X2.19) together
- Connect the RS 232-interface like shown in chapter 4.2.4 and 4.3

Since X5-1 and X5-9 are now used for BRTS and BTXD make sure that these pins are free on the interface cable to your PC or terminal.

6.2 System Set Up Step by Step

With all initial presets completed, the set-up procedure can begin.

Please perform the initial set-up of the system with no load applied to avoid damaging your equipment due to erraneous handling.

1. Before you connect the SBSC amplifier to the BPS, the BPS must be wired and checked according to the manual

After the output voltage of the power supply (BPS2000/ 3000) has been tested, switch off the main supply.

The SBSC has no internal fuse for the DC-bus voltage. Make sure, that the BPS power supply is fused primary. Fuse ratings see BPS2000/3000 manual.

2. Now you can wire the system as shown in drawing chapter 4.3, **except** motor wiring.

3. Install the connection between PC and SBSC with the RS 232 interface cable.
Now switch *ON* the main power. The LED´s and the "MONITOR" must show the following:

LED "READY"	=	GREEN
LED "REG. LOAD"	=	OFF
LED "IPOS"	=	ON
LED "FERR"	=	OFF
MONITOR	=	Decimal point on the right side illuminating (amplifier enabled)

Now invoke the terminal program SMCC V3.xx from the floppy disc. The program will come up with communication information:

9600 baud, COM1, X1 clock.

Enter "*NO*" and card polling will start. The next response should be the number of the cards found. Now step through all cards and verify the I-parameters using F1-key (see also chapter 6.5). Using F10-key and then F1 you can load the default I-parameters also from floppy disc. The file name is:

ipblparb **(parabolic version; stored ex factory on SBSC)**

With the F6-key you can download the default parameters and a small test program into the EAROM on the ? SMCC-card. Enter "*s*" to save these parameters. If you have a multi axis system, check all the parameters from card A0 upto card An. Enter "*An*" for changing the card address.

Especially check parameter i39, i40 and i50 to be set correctly:

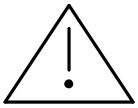
i39 = 3 (4096 Counts / rev.)

a.) **i40 = 2048** for 4 pole motor (BSM 63A/80A/80B)
b.) **i40 = 1024** for 8 pole motor (BSM 90A/90B, 100A/100B)
c.) **i40 = 4096** for 6 pole motor (BSM 6R)

i50 = 0 for a.) and b.)
i50 = 1 for c.)

Furthermore check position control parameter (see chapter 6.3).

If one or more parameters changed, this must be saved. now switch *OFF* main power.



After turning off the power supply, wait about 5 min. to allow discharging the capacitors inside the main power supply.

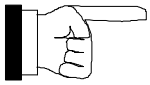
4. Now connect the motorcable. Activate the enable input (X2.9); close the switch (see chapter 4).

During initial set-up the motor shaft must be without load to allow proper phasing.

Switch *ON* the main power again.
After that the monitor will show the following operating state:

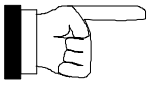
MONITOR = **".; DP"** decimal point lower right corner must be *ON*.

The motor will do a jump in both directions then comes to rest. When turning the motorshaft, torque will be developped. The standard gain parameters should ensure stable but not perfect operation. Fine tuning of the different gains should be done later. If the motorshaft *oscillates*, the proportional gain "*i20*" (s. chapter 6.3) must be decreased.

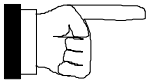


Random power on sequence for 24V resp. bus supply.

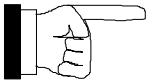
Do not try to power-up with the ENABLE input deactivated. The motor cannot do it´s phasing. After enabling, the motor will speed-up and the amplifier will switch off with fault indication "6".



If the motor has no torque, check the wiring of CW- and CCW-limits (X2-11;X2-12) and the ENABLE input (X2-9).



If the motor shaft accelerates, remove power immediately and check resolver and motor wiring.



If the motor shaft accelerates, remove power immediately and check resolver and motor wiring.

5. Now the SBSC is ready to go. For demonstration and test purposes every SBSC has a small program in EAROM. This program can be started by entering "*R*" on your PC. The motor will move 100000 counts, stop for 1 second and go back to zero again. After 1 second delay this will be repeated for ever. The program can be stopped by entering "*Q*" (quit).

6.3 Stepresponse Optimization

The stepresponse can be optimized with the following I-parameters. For details please refer to SMCC-Software-Manual.
The **Start-Up Values** below will provide a stable motor behavior. This set-up is not the optimum for the position control loop.

Parameter	Meaning	Start-Up Value	
		BSM63/80	all other
i09	Position Integration Mode	1	1
i20	Proportional-Gain Constant	500	1000
i21	Differential-Gain Constant	10	10
i22	Velocity Feedforward Gain	10	10
i23	Integral-Gain Constant	0	0
i30	Acceleration Feedforward Gain	0	0

In order to achieve proper adjustment it is necessary to observe the current waveform on X2-7 (DCurrent) with an oscilloscope. The SBSC is adjusted when the current waveform shows a single overshoot on applying a step command. At constant velocity the AC-component on X2-7 should be kept as low as possible but should not exceed 2Vpp to avoid excessive motor heating. additional servo performance analysis can be done by using the tuning feature. Please refer to SMCC manual.

6.4 Preventing Start - Up Phasing Jump

The SBSC is designed to function with resolvers or encoders and to perform automatic phase finding. The phase finding procedure requires that the motor shaft moves a maximum of one half electrical motor revolution (90° for a 4 pole motor) in order to precisely locate correct motor phasing. Even though the phase finding time and the torque level are both definable, it is sometimes undesirable to have a "phase finding" cycle on a machine, especially since full torque cannot be guaranteed during phasing and motion occurs bidirectionally.
The start-up phasing jump can be eliminated if you set I-parameters as follow.

Motortype	Number of Polpairs	i41	i54	i72
BSM 63A / 80A / 80B	2	12	180	3
BSM 6R	3	8	780	3
BSM 90A / 90B / 100A / 100B	4	5	80	3

to i41: This parameter is for torque optimization. With the parameter value above, motor current will be reduced to a minimum.

6.5 I - Parameter

i00 Following Error Limit	0	
i01 In-Position Band	100	
i02 Manual Data Input	0	
i03 Hand Shake Enable	100	
i04 Home Feed Rate	100000	
i05 Servo Time	100	
i06 Reference Feed Rate	1000	
i07 Time Scale	40	*1)
i08 Accel/Decel Time	0	
i09 Pos Integration Mode	0	*3)
i10 Following Error Limit	0	
i11 Feed Hold Slew Control	3	
i12 Move Delay Time	1000	
i13 Brushless Motor Enable	10	
i14 Processor A/D Converter Mode	0	
i15 Select Lookup Table	5	
i16 Handwheel Mode 1 Control	4096	
i17 Velocity Display Time Base	3	
i18 Display Formats	0	
i19 Address of Last Card	128	*2) *3)
i20 Proportional Gain Constant	-1	
i21 Differential Gain Constant	-1	
i22 Velocity Feedforward Gain	0	
i23 Integral Gain Constant	1:1.0	
i24 Home Direction	3	*3)
i25 Home Offset	2048 (4 Pole)	***4)**
i26 Home Flag Control	12	***4)**
i27 Handwheel Scale Factor	0	*3)
i28 Handwheel Mode Control 2	130	
i29 Handwheel Encoder Control	1	*3)
i30 Feedforward Gain	0 or 1 (6 Pole)	***4)**
i31 Jog Feed Rate	200	*3)
i32 PWM Limit	40	
i33 Protective PWM Limit	0	***4)**
i34 Set Backlash	-1	*3)
i35 Software Positive Pos. Limit	-1	*3)
i36 Software Negative Pos. Limit		
i37 Position Range		

i57	0	*3)
n/a.....	1:1.0	*3)
i58	3	*3)
n/a.....	0	
i59	0	*2)
n/a.....	0	
i60 Deadband	0	
X.....	65464	*3)
i61 Deadband	0	*2)
Y.....	0	
i62 PLC	0	*2)
Enable.....	0	
i63 Parabolic Mode	0	*2)
Control.....	0	
i64 X Encoder/Resolver Base	0	*2)
Add.....	0	***4)**
i65 Y Encoder/Resolver Base	0	*2)
Add.....	0	
i66 Speed of Second X	0	*2)
Resolver.....	1	*3)
i67 Speed of Second Y	0	*2)
Resolver.....	0	
i68 Second X Resolver Base	0	*2)
Address.....		
i69 Second Y Resolver Base		
Address.....		
i70 X Encoder/Resolver		
Bias.....		
i71 Y Encoder/Resolver		
Bias.....		
i72 X Encoder/Resolver		
Size.....		
i73 Y Encoder/Resolver		
Size.....		
i74 Second X Resolver		
Size.....		
i75 Second Y Resolver		
Size.....		
i76 X Enc. Data/Strobe Logic Level.....		
i77 Y Enc. Data/Strobe Logic Level.....		
i78 X Range Mode Control.....		
i79 Y Range Mode Control.....		

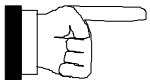
NOTE: *1) i12 ? 100 for BSM 6R or 6-pole motors
*2) not applicable
*3) no other values allowed
***4)** Parameter value depends on motor type (refer to chapter 6.2 and 6.4)

7.0 Status Monitor

To make it easy to monitor the performance of the SBSC, there is a status monitor available. The indicated numbers 1 to 7, as well as the LED Ready have the following meaning:

LED Ready	Monitor	Status	Cause
Green	OFF	Amplifier disabled	no fault
Green	.	Amplifier enabled	no fault
Red	1	Overvoltage	Missing, damaged or wrong designed regeneration resistor.

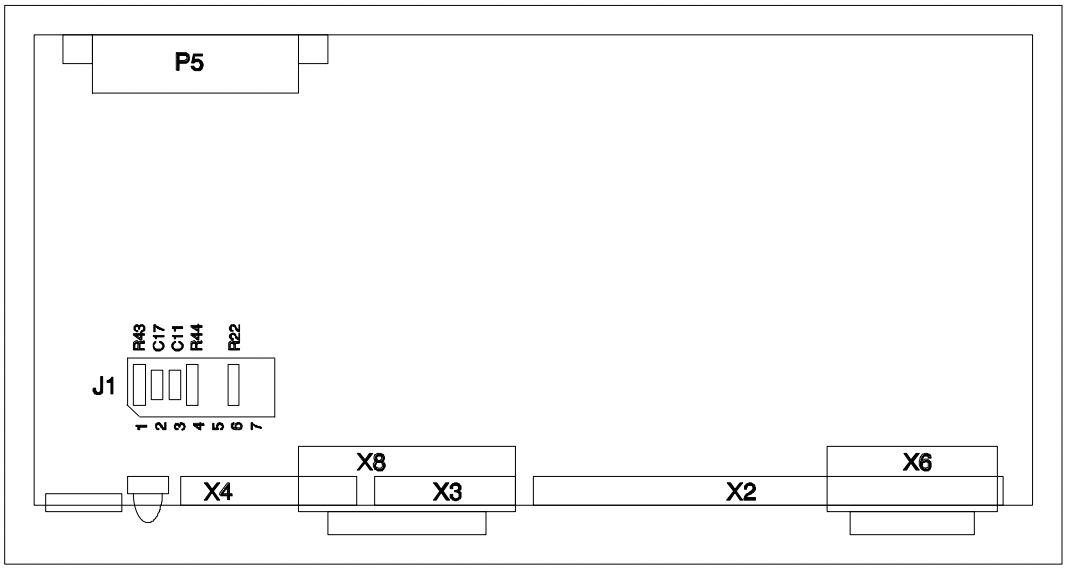
Red	2	Undervoltage	Missing wiring of X10 or problems with BPS2000/3000; see also chapter 4.2.1
Red	3	Overcurrent	Power stage fault or motor leads short circiut
Red	4	Overtemperature	Amplifier oversized; active motor torque to high. Ambient temperature to high
Red	5	Resolver Fault	Parting of the cable or resolver leads short circuit or missing plug-in connection
Red	6	Electronic Fusing (see also Fault 7)	Amplifier or motor active current overload.
Green	7	If It-limit is reached, amplifier will reduce output current to it´s nominal value. After 1,5s ? 0,5s SBSC switches off (amplifier disable) with fault "6; electronic fusing".	Cycle time between motor acceleration and deceleration is too short.



With main power OFF and 24V-supply ON (X10), status monitor works for fault diagnostic.

8.0 Control Card

8.1 Component Layout



8.2 Component Functions

Components	Function	Value *)
R22	It-switching threshold (nom.current)	-
R43	P-gain for current loop phase U	150k?
C17	I-gain for current loop phase U	4.7nF
R44	P-gain for current loop phase V	150k?
C11	I-gain for current loop phase V	4.7nF

*) Standard values

- Maximum Motor Speed:
The maximum speed with the SBSC is 6000 rpm. Higher speeds are available on request.

- It-Switching Threshold Adjustment:
The function of resistor R22 (location see control card layout) is for nominal current threshold (It-Limit) adjustment. The threshold can be changed from 0% upto 100%. The table below shows the ratio between nominal and peak current for different values of R22:

R22	SBSC x015 I_{peak} = 30A	SBSC x025 I_{peak} = 50A	SBSC x035 I_{peak} = 70A	SBSC 2045 I_{peak} = 90A
-	$I_{nominal}$ = 15,0A	$I_{nominal}$ = 25,0A	$I_{nominal}$ = 35,0A	$I_{nominal}$ = 45,0A
20k?	$I_{nominal}$ = 12,0A	$I_{nominal}$ = 20,0A	$I_{nominal}$ = 28,0A	$I_{nominal}$ = 36,0A
10k?	$I_{nominal}$ = 10,0A	$I_{nominal}$ = 16,7A	$I_{nominal}$ = 23,3A	$I_{nominal}$ = 30,0A
5k?	$I_{nominal}$ = 7,5A	$I_{nominal}$ = 12,5A	$I_{nominal}$ = 17,5A	$I_{nominal}$ = 22,5A

x: 2 or 3; e.g. SBSCx015 stands for SBSC2015 and SBSC3015

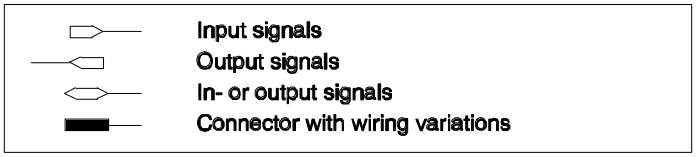
9.0 Testsignals

For current monitoring purpose a testsignal is available on terminal X2-7. The signal level indicates the magnitude of the actual output current and can be directly refered to motor torque by multipling with the torque constant.

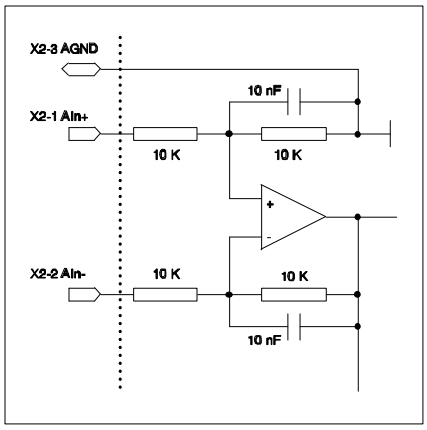
Testpoint		Function and Normalization
X2 - 7	DCurrent	Actual Output Current; 0.. +10V; +10V equal peak current

10 I / O Hardware Description

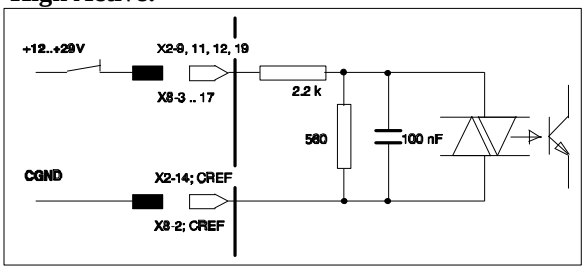
- Legend

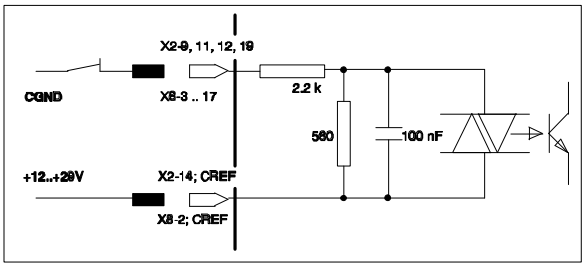


10.1 Input Signals

Analog Input Signal Connector X2			
Function	Signal	PIN	Hardware
Analog-Input	AIn+	1	U_{in}(max) = +10V 
	AIn-	2	
	AGND	3	

Digital Input Connector X2 / X8			
Function	Signal	PIN	Hardware
	X2		
Amplifier Enable	ENABLE	9	**- High Active:**
CW-Limit (pos. rotation)	CWLimit	11	
CCW-Limit (neg. rotation)	CCWLimit	12	
RESET-Input (INIT)	RESET	20	
Ground Return	CREF	14	
	X8		
Program - Start	START	3	
Program - Stop	STOP	4	**- Low Active:**
Progr. - Step	STEP	5	
Program - Hold	HOLD	6	
JOG+	XJ+	7	
JOG-	XJ-	8	
Activate Home	HOME	9	
Pre - JOG	EQUAL	10	
X-Home-Flag	XHF	11	min. Input resistor R_{IN} = 2,2k? ; opto isolated ;
X-User-Flag	XUF	12	U_{IN}=12 ... 29V_{DC}; max. current at 24V; I = 10mA
Y-User-Flag **1)**	YUF	13	
Machine Input 1	MAI1	14	
Machine Input 2	MAI2	15	
Machine Input 3	MAI3	16	
Machine Input 4	MAI4	17	
Ground Return	CREF	2	



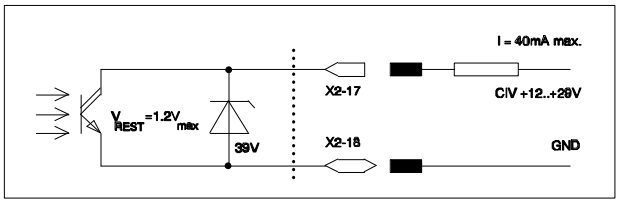


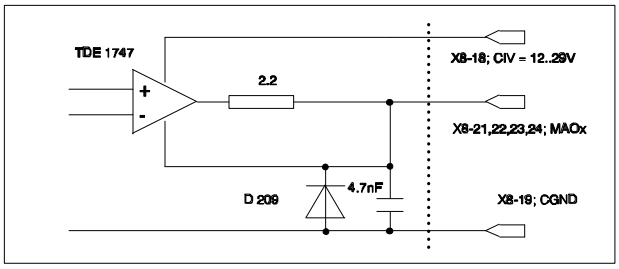
RESET-Input can restore the following faults:

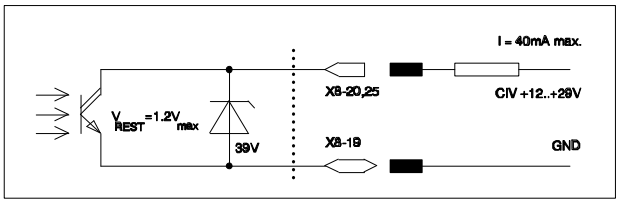
Overvoltage
Undervoltage
Resolver Fault
Electronic Fusing
µSMCC-Card ? Hard Reset

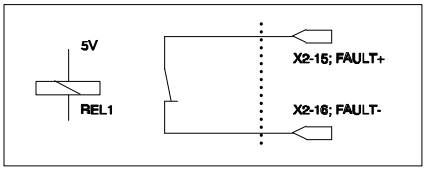
1) optional

10.2 Output Signals

Digital Output Connector X2			
Function	Signal	PIN	Hardware
It-Warning	Warn_C Warn_E	17 18	 Warning before amplifier switches off with It- Limit or Overtemperature.

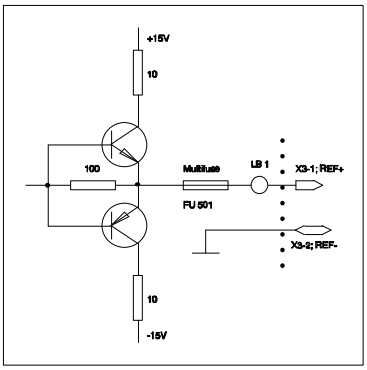
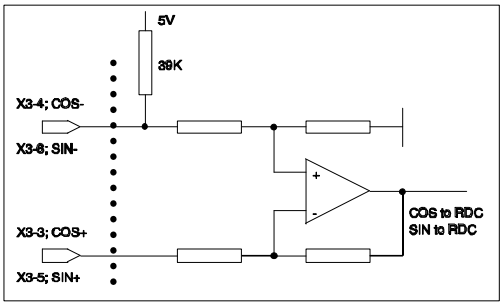
Digital Machine - Output Connector X8			
Function	Signal	PIN	Hardware
Reference-Voltage	CIV	18	
Machine-Output 2	MAO2	21	
Machine-Output 3	MAO3	22	
Machine-Output 4	MAO4	23	
Machine-Output 5	MAO5	24	
Ground Return	CGND	19	Current limiting to 0.3A opto isolated; U_{IN}=12 ... 29V_{DC}; max. Current at 24V; I = 200mA

Digital Control-Output Connector X8			
Function	Signal	PIN	Hardware
In_Position	IPOS	20	
Buffer Full	BF	25	
Ground Return	CGND	19	

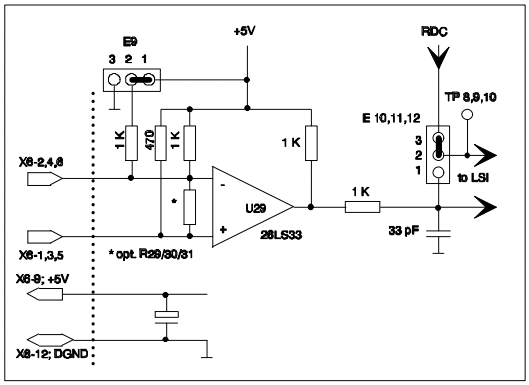
Digital Output Connector X2			
Function	Signal	PIN	Hardware
Fault Relay	Fault+ Fault-	15 16	 Contact is closed, if amplifier works correct U_{AC} = 110V I_{max} = 0.3A / U_{DC} = 22V I_{max} = 0.8A

Analog Output Signal Connector X2			
Function	Signal	PIN	Hardware
Testsignal see Chapter 9	DCurrent	7	The Testsignal is terminated with R = 4.7k? and normalized to 10V. Load resistor R ? 100k?

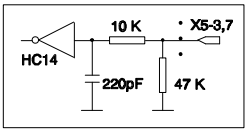
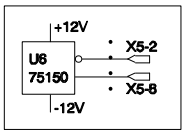
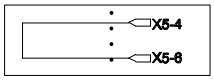
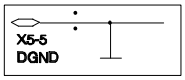
10.3 Resolver

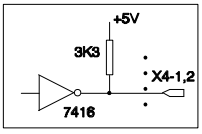
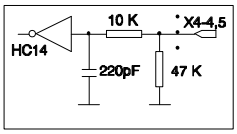
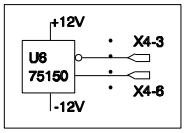
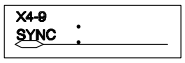
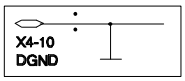
Resolver - Signals Connector X3			
Function	Signal	PIN	Hardware
Reference-Signal	REF+ REF-	1 2	 Signal waveform sinusoidal; f = 7.2 ... 8.0 kHz; U_{OUT} = 21V_{pp} ?10%; short circuit proof
COSINUS - Input SINUS - Input	Cos+ Cos- Sin+ Sin-	3 4 5 6	 Input impedance about 17k? ; Signal waveform sinusoidal; U_{IN} = 10V_{pp} ?10%; 7.2 ... 8.0kHz

10.4 Encoder Input

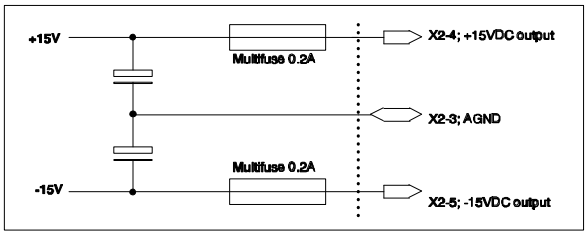
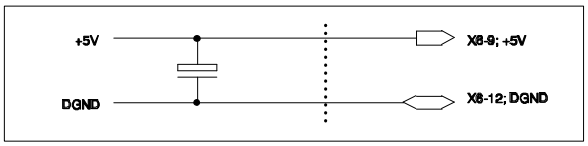
Encoder - Signals Connector X6			
Function	Signal	PIN	Hardware
Encoder Channel_A	CHA CHA/	1 2	
Encoder Channel_B	CHB CHB/	3 4	
Encoder- Channel_C	CHC CHC/	5 6	
+5V-Output	+5V	9	
Ground Return	DGND	12	5V-Output; I_{max} = 250mA

10.5 RS232 - Interface

RS232 Signal Connector X5			
Function	Signal	PIN	Hardware
TXD RTS	TXD RTS	3 7	
RXD CTS	RXD CTS	2 8	
DTR DSR	DTR DSR	4 6	
DGND	DGND	5	
Data Format: - 1 Start Bit - 8 Data Bits - 1 Stop Bit - no Parity			

Daisy Chain Signal Connector X4			
Function	Signal	PIN	Hardware
BRTS BTXD	BRTS BTXD	1 2	
TXD RTS	TXD RTS	4 5	
RXD CTS	RXD CTS	3 6	
SYNC	SYNC	9	
DGND	DGND	10	

10.6 Auxiliary Voltage Outputs

Auxiliary Voltage Outputs Connector X2 / X6			
Function	Signal	PIN	Hardware
?15 V_{DC} Auxiliary-voltage-output	$+15V_{DC}$ AGND $-15V_{DC}$	**X2** 4 3 5	 **Attention:** A short circuit will generate a "RESET" Short circuit proof; I_{max} = 100mA
+ 5V Auxiliary-voltage-output	+ 5V DGND	**X6** 9 12	 **not** short circuit proof; I_{max} = 250mA