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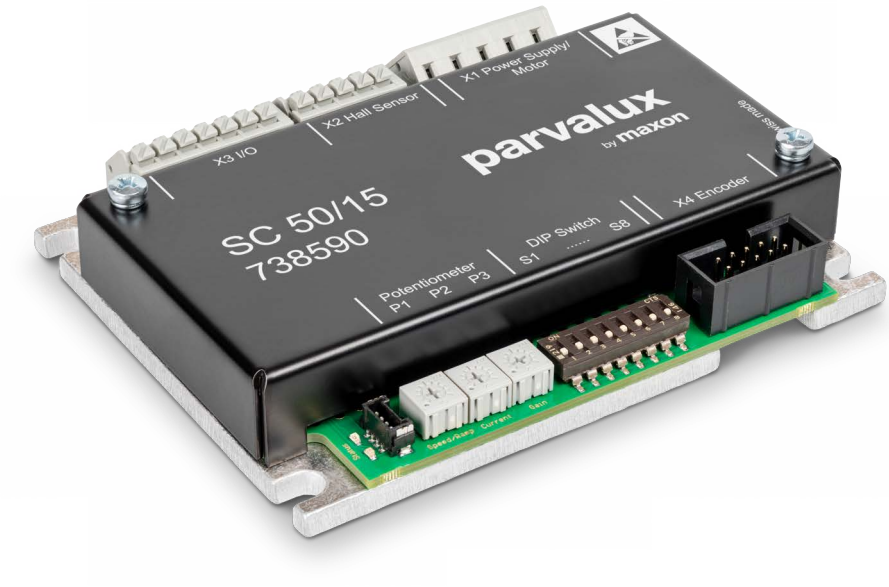
SC 50/15

Hardware Reference



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SC 50/15 Servo Controller | P/N 738590
Hardware Reference
CCMC | Edition 2025-07 | DocID rel13125

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TABLE OF CONTENTS

READ THIS FIRST

These instructions are intended for qualified technical personnel. Prior commencing with any activities…

- *you must carefully read and understand this manual and*
- *you must follow the instructions given therein.*

The SC 50/15 Servo Controller *is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and* ***is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment****.*

Therefore, you must not put the device into service*,…*

- *unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *unless the other machinery fulfills all relevant health and safety aspects!*
- *unless all respective interfaces have been established and fulfill the herein stated requirements!*

1 ABOUT

1.1 About this Document

1.1.1 Intended Purpose

The purpose of the present document is to familiarize you with the SC 50/15 Servo Controller. It will highlight the tasks for safe and adequate installation and/or commissioning. Follow the described instructions …

- to avoid dangerous situations,
- to keep installation and/or commissioning time at a minimum,
- to increase reliability and service life of the described equipment.

1.1.2 Target Audience

The present document is intended for trained and skilled personnel. It conveys information on how to understand and fulfill the respective work and duties.

1.1.3 How to use

Throughout the document, the following notations and codes will be used.

Notation	Meaning
(n)	refers to an item (such as part numbers, list items, etc.)
➔	denotes “see”, “see also”, “take note of” or “go to”

Table 1-1 Notation used

Short	Meaning
AnIN	Analog input
BLDC	Brushless DC motor
CCW	Counterclockwise
CW	Clockwise
DigIN	Digital input
DigOUT	Digital output
PMDC	Permanent magnet DC motor
PWM	Pulse Width Modulation

Table 1-2 Abbreviations & acronyms used

1.1.4 Symbols & Signs

This document uses the following symbols and signs:

Type	Symbol	Meaning
Safety alert DANGER		Indicates an **imminent hazardous situation**. If not avoided, it **will result in death or serious injury.**
WARNING		Indicates a **potential hazardous situation**. If not avoided, it **can result in death or serious injury.**
CAUTION		Indicates a **probable hazardous situation** or calls the attention to unsafe practices. If not avoided, it **may result in injury.**
Prohibited action	 (typical)	Indicates a dangerous action. Hence, **you must not!**
Mandatory action	 (typical)	Indicates a mandatory action. Hence, **you must!**
Requirement, Note, Remark		Indicates an activity you must perform prior to continuing, or gives information on a particular point that must be observed.
Best practice		Indicates an advice or recommendation on the easiest and best way to further proceed.
Material Damage		Indicates information particular to possible damage of the equipment.

Table 1-3 Symbols and signs

1.1.5 Copyright

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1.2 About the Device

The «SC 50/15» is a small-sized, powerful 4-quadrant PWM servo controller for the highly efficient control of permanent magnet DC (PMDC) and brushless DC (BLDC) motors up to approximately 750 Watts with various feedback options, such as Hall sensors or incremental encoders.

The featured operating modes—speed control (closed loop) or speed control (open loop)—meet the highest requirements. The «SC 50/15» is designed being commanded by a PWM input, analog input or an internal potentiometer set value signal and features extensive analog and digital I/O functionality.

The device is designed to be configured via simple DIP switch and potentiometer settings for several functions and feedback options.

1.3 About the Safety Precautions

- Make sure that you have read and understood the note “READ THIS FIRST” on Page A-2!
- Do not engage with any work unless you possess the stated skills (➔Chapter “1.1.2 Target Audience” on Page 1-3)!
- Refer to ➔Chapter “1.1.4 Symbols & Signs” on Page 1-4 to understand the subsequently used indicators!
- You must observe any regulation applicable in the country and/or at the site of implementation with regard to health and safety/accident prevention and/or environmental protection!

DANGER

High voltage and/or electrical shock
Touching live wires causes death or serious injuries!

- *Consider any power cable as connected to live power, unless having proven the opposite!*
- *Make sure that neither end of cable is connected to live power!*
- *Make sure that power source cannot be engaged while work is in process!*
- *Obey lock-out/tag-out procedures!*
- *Make sure to securely lock any power engaging equipment against unintentional engagement and tag it with your name!*

Requirements

- *Make sure that all associated devices and components are installed according to local regulations.*
- *Be aware that, by principle, an electronic apparatus cannot be considered fail-safe. Therefore, you must make sure that any machine/apparatus has been fitted with independent monitoring and safety equipment. If the machine/apparatus should break down, if it is operated incorrectly, if the control unit breaks down or if the cables break or get disconnected, etc., the complete drive system must return—and be kept—in a safe operating mode.*
- *Be aware that you are not entitled to perform any repair on components supplied by Parvalux.*

Electrostatic sensitive device (ESD)

- *Wear working cloth and use equipment in compliance with ESD protective measures.*
- *Handle device with extra care.*

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2 SPECIFICATIONS

2.1 Technical Data

SC 50/15 Servo Controller (738590)			
Electrical Rating	Nominal power supply voltage $+V_{CC}$		12…50 VDC
	Absolute supply voltage $+V_{min}$ / $+V_{max}$		10 VDC / 56 VDC
	Output voltage (max.)		0.98 x $+V_{CC}$
	Output current I_{cont} / I_{max} (<10 s)		15 A / 30 A
	Pulse Width Modulation frequency		53.6 kHz
	Sampling rate PI speed controller		5.36 kHz
	Max. efficiency		98% (➔Figure 2-2 on Page 2-9)
	Max. speed	PMDC motor	• Open loop: limited by max. permissible speed (motor) and max. output voltage (controller) • Closed loop: 5'000 or 15'000 rpm, dependent on configuration (➔Chapter 3.5.1 on Page 3-24)
		BLDC motor	2'500…30'000 rpm, dependent on configuration (➔Chapter 3.5.1 on Page 3-24)
	Built-in filter choke		3 x 200 nH; 15 A
Inputs & Outputs	Digital inputs	«Enable»	Logic +2.1…+30 VDC
		«Direction»	
		«Stop»	
	Digital output	«Ready»	Logic signal output, 3.3 VDC, Ri: 2.2 kΩ, Push-Pull
	Analog input	«Speed Set Value»	Analog 0…5.0 VDC
			PWM signal (fixed amplitude 0…5 VDC, 1 kHz…10 kHz)
	Digital Hall sensor signals H1, H2, H3		+2.0…+24 VDC (internal pull-up)
	Digital incremental encoder signals A, A\, B, B\		EIA RS422, max. 1 MHz, max. 100 kHz (single-ended)
Voltage Outputs	Sensor supply voltage V_{Sensor}		+5 VDC / I_L ≤100 mA
Motor Connections	PMDC motor		+ Motor, − Motor
	BLDC motor		Motor winding 1, Motor winding 2, Motor winding 3

Continued on next page.

SC 50/15 Servo Controller (738590)			
Configuration	DIP switch		SMD type, 8 position for the setting of: • Motor Type • Control Mode • Speed Set Value Source • Speed Sensor Selection / Encoder Resolution • Hall Sensor Polarity • Speed Range Selection
	Potentiometers		3 x angular type 210° for the setting of: • Speed Ramp/Speed Set Value • Continuous/Maximum Current Limit • Controller Gain
Status Indicators	Device status	Operation	green LED
		Error	red LED
Physical	Weight		approx. 158 g
	Dimensions (L x W x H)		100 x 80 x 22 mm
	Mounting		Slotted flange for M4 screws
Environment	Temperature	Operation	−30…+30 °C
		Extended range [a]	+30…+84 °C; Derating: −0.278 A/°C (➔Figure 2-1)
		Storage	−30…+85 °C
	Altitude [b]	Operation	0…6’000 m MSL
	Humidity		5…90% (condensation not permitted)

[a] Operation within the extended range is permitted. However, a respective derating (declination of output current I_{cont}) as to the stated values will apply.

[b] Operating altitude in meters above Mean Sea Level, MSL.

Table 2-4 Technical data

2.2 Thermal Data

2.2.1 Derating of Output Current

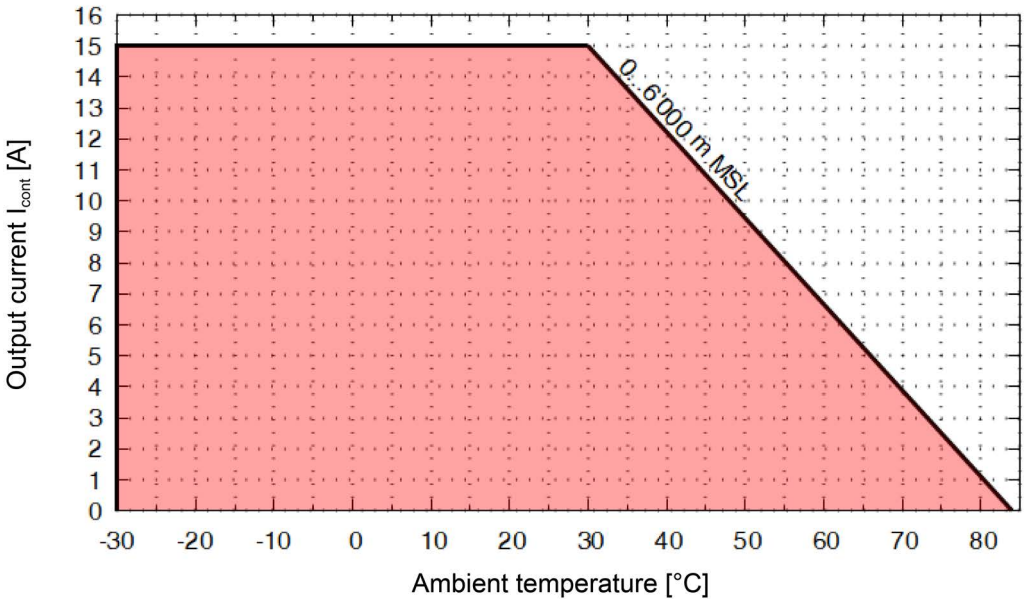

Figure 2-1 Derating of output current

2.2.2 Power Dissipation and Efficiency

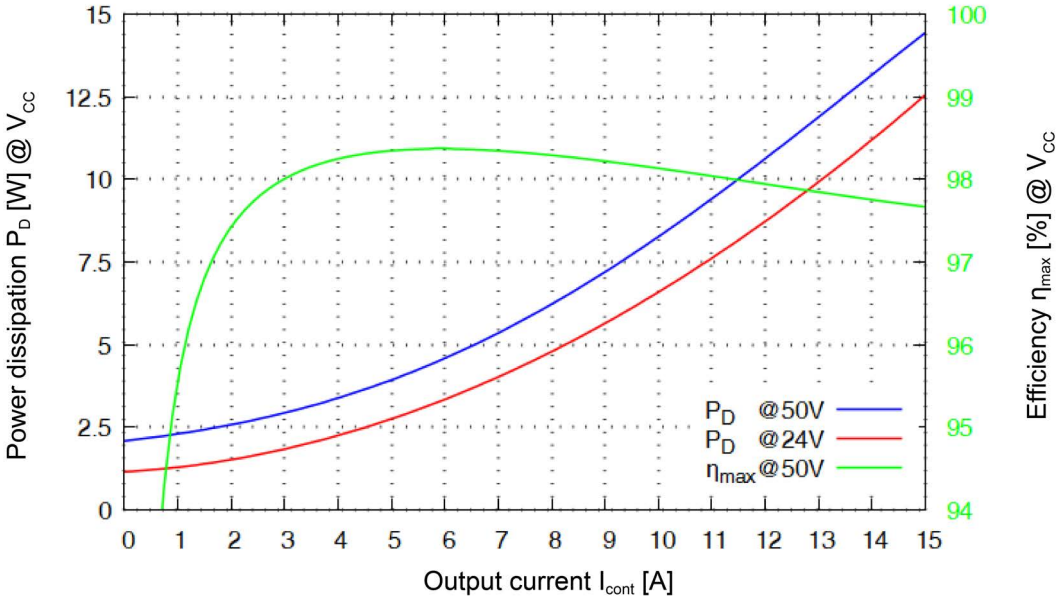

Figure 2-2 Power dissipation and efficiency

2.3 Limitations

Protection functionality	Switch-off threshold	Recovery threshold
Undervoltage	9.0 V	9.5 V
Overvoltage	58 V	56 V
Overcurrent	100 A	—
Thermal overload	95 °C	85 °C

Table 2-5 Limitations

2.4 Dimensional Drawing

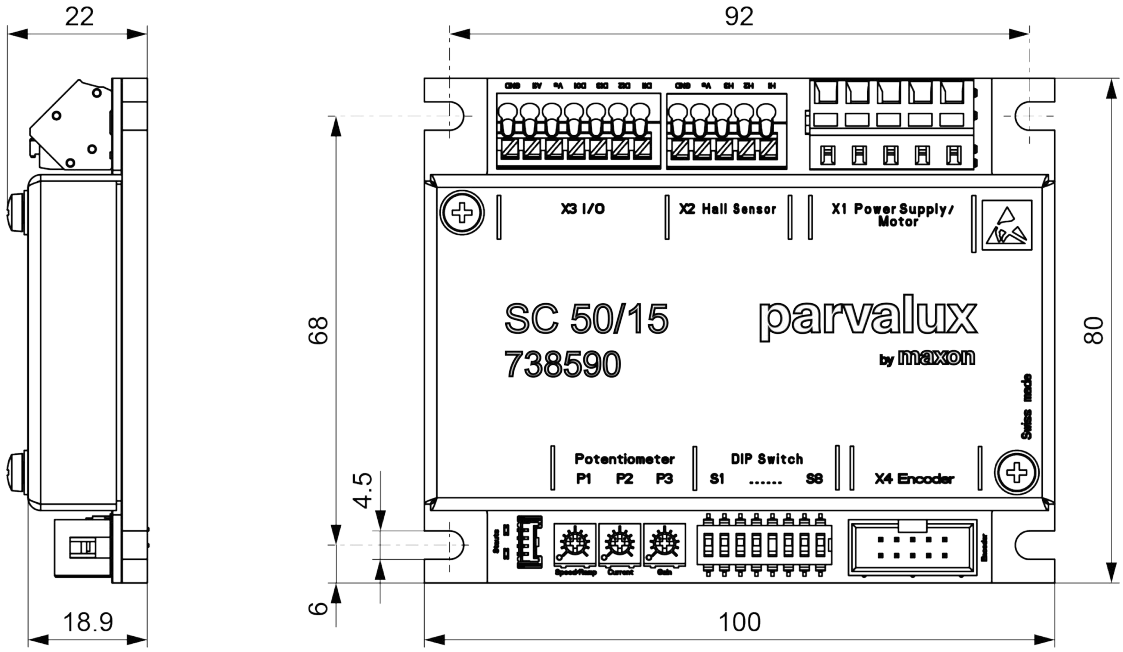

Figure 2-3 Dimensional drawing [mm]

2.5 Standards

The described device has been successfully tested for compliance with the below listed standards. In practical terms, only the complete system (the fully operational equipment comprising all individual components, such as motor, servo controller, power supply unit, EMC filter, cabling etc.) can undergo an EMC test to ensure interference-free operation.

Important Notice
The device's compliance with the mentioned standards does not imply its compliance within the final, ready to operate setup. In order to achieve compliance of your operational system, you must perform EMC testing of the involved equipment as a whole.

Electromagnetic Compatibility		
Generic	IEC/EN 61000-6-2	Immunity for industrial environments
	IEC/EN 61000-6-3	Emission standard for residential, commercial and light-industrial environments
Applied	IEC/EN 55032 (CISPR32)	Radio disturbance characteristics / radio interference
	IEC/EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test >10 V/m
	IEC/EN 61000-4-4	Electrical fast transient/burst immunity test ±2 kV
	IEC/EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields 10 Vrms

Others		
Environment	IEC/EN 60068-2-6	Environmental testing—Test Fc: Vibration (sinusoidal, 10…500 Hz, 20 m/s^2)
	MIL-STD-810F	Random transport (10…500 Hz up to 2.53 g_{rms})
Safety	UL File Number	Unassembled printed circuit board: E251497
Reliability	MIL-HDBK-217F	Reliability prediction of electronic equipment Environment: Ground, benign (GB) Ambient temperature: 298 K (25 °C) Component stress: In accordance with circuit diagram and nominal power Mean Time Between Failures (MTBF) 527'422 hours

Table 2-6 Standards

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3 SETUP

IMPORTANT NOTICE: PREREQUISITES FOR PERMISSION TO COMMENCE INSTALLATION

The SC 50/15 Servo Controller is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and **is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

WARNING

Risk of injury
Operating the device without the full compliance of the surrounding system with the EU Directive 2006/42/EC may cause serious injuries!

- *Do not operate the device, unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *Do not operate the device, unless the other machinery fulfills all relevant health and safety aspects!*
- *Do not operate the device, unless all respective interfaces have been established and fulfill the requirements stated in this document!*

3.1 Generally applicable Rules

Maximal permitted supply voltage

- *Make sure that supply power is between 12…50 VDC.*
- *Supply voltages above 56 VDC, or wrong polarity will destroy the unit.*
- *Note that the necessary output current is depending on the load torque. Yet, the output current limits are as follows:*
  – continuous max. 15 A
  – short-time (acceleration, <10 s) max. 30 A

Electrostatic Sensitive Device (ESD)
Observe ESD protective measures.

3.2 Recommended Tools

Tool	Manufacturer	Part Number
Slotted head screwdriver size 0.4x2.5 mm		
Slotted head screwdriver size 0.6x3.5 mm		

Table 3-7 Recommended tools

3.3 Mechanical Installation

WARNING

Risk of injury
Incorrect installation may cause serious injuries!
Some contacts on the reverse side of the controller are not electrically insulated and—if the controller is not mounted as described—may cause serious injuries, respectively may short-circuit with the mounting structure.

- *When mounting to an electrically conducting surface, you must make sure that the components mounted on the controller's reverse side cannot get in touch with the mounting structure.*
- *Check the mounting structure for protruding items and eliminate them before mounting the controller.*

Mounting on electrically conducting materials
Check the mounting structure for protruding items and eliminate them.
When mounting to an electrically conducting surface, you must make sure that the components mounted on the controller's reverse side cannot get in touch with the mounting structure.

1) Make sure to follow the above mentioned instructions.
2) Use four (4ea) M4 screws to mount the controller. For the drilling pattern see ➔Figure 2-3 on Page 2-10.

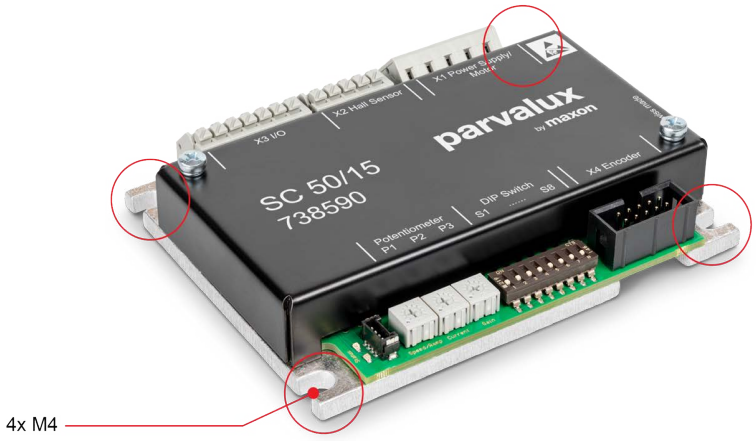
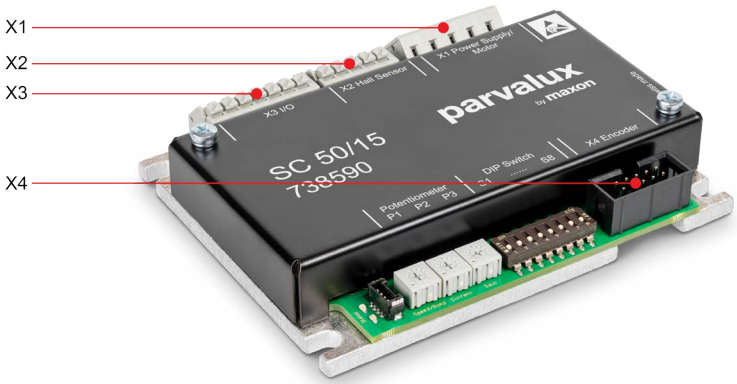


Figure 3-4 Fixation points

3.4 Electrical Installation



X1 Power Supply & Motor ➔Page 3-15

X2 Hall Sensor ➔Page 3-17

X3 I/O ➔Page 3-18

X4 Encoder ➔Page 3-21

Figure 3-5 Connectors

3.4.1 Power Supply & Motor (X1)

Basically, any power supply may be used provided that it meets the stated minimum requirements.

Best practice
Keep the motor mechanically disconnected during the setup and adjustment phase.

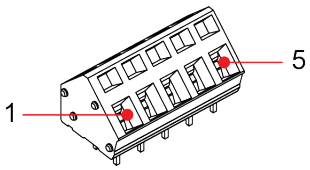


Figure 3-6 Power supply & motor connector X1

Connector X1		
On board	PCB terminal block	5 poles, single-row, spring clamp connection, THT, pitch 5.00 mm
Suitable cables	Solid or stranded	Conductor cross section 0.20…2.5 mm^2
	Flexible	Conductor cross section 0.25…1.5 mm^2, with cable ferrule
		2 conductors with same cross section, with twin ferrules with plastic sleeve 0.50… 1.0 mm^2
	Stripping length	5…6 mm
Recommended tools	Slotted head screwdriver size 0.6x3.5 mm	

Table 3-8 Power supply & motor connector X1 – Specifications

Continued on next page.

X1 Pin	Signal	Description
1	$+V_{CC}$	Power supply voltage (+12…+50 VDC)
2	GND	Ground
3	Motor (+M)	Motor +
4	Motor (−M)	Motor −
5	—	not connected

Table 3-9 Power supply & motor connector X1 – Pin assignment for PMDC motor

X1 Pin	Signal	Description
1	$+V_{CC}$	Power supply voltage (+12…+50 VDC)
2	GND	Ground
3	W1	Motor winding 1
4	W2	Motor winding 2
5	W3	Motor winding 3

Table 3-10 Power supply & motor connector X1 – Pin assignment for BLDC motor

Power supply requirements	
Output voltage	$+V_{CC}$ 12…50 VDC
Absolute output voltage	min. 10 VDC; max. 56 VDC
Output current	Depending on load • continuous max. 15 A • short-time (acceleration, <10 s) max. 30 A

Table 3-11 Power supply requirements

1) Use the formula below to calculate the required voltage under load.
2) Choose a power supply according to the calculated voltage. Thereby consider:
   a) During braking of the load, the power supply must be capable of buffering the recovered kinetic energy (for example, in a capacitor).
   b) If you are using an electronically stabilized power supply, make sure that the overcurrent protection circuit is configured inoperative within the operating range.

The formula already takes the following into account:
- *Maximum PWM duty cycle of 98%*
- *Controller's max. voltage drop of 1 V @ 15 A*

KNOWN VALUES:
- Operating torque M [mNm]
- Operating speed n [rpm]
- Nominal motor voltage U_N [Volt]
- Motor no-load speed at U_N; n_O [rpm]
- Speed/torque gradient of the motor $\Delta n/\Delta M$ [rpm/mNm]

Continued on next page.

SOUGHT VALUE:

- Supply voltage +V_{CC} [Volt]

SOLUTION:

$$V_{CC} \geq \left[\frac{U_N}{n_O} \cdot \left(n + \frac{\Delta n}{\Delta M} \cdot M\right) \cdot \frac{1}{0.98}\right] + 1[V]$$

3.4.2 Hall Sensor (X2)

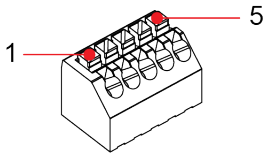


Figure 3-7 Hall sensor connector X2

Connector X2		
On board	PCB terminal block	5 poles, single-row, spring clamp connection, THT, pitch 3.50 mm
Suitable cables	Solid	Conductor cross section 0.20…0.75 mm^2
	Stranded	Conductor cross section 0.50…0.75 mm^2
	Flexible	Conductor cross section 0.25…0.75 mm^2, with cable ferrule without plastic sleeve
		Conductor cross section 0.25…0.5 mm^2, with cable ferrule with plastic sleeve
	Stripping length	8…9 mm
Recommended tools	Slotted head screwdriver size 0.4x2.5 mm	

Table 3-12 Hall sensor connector X2 – Specifications

X2 Pin	Signal	Description
1	H1	Hall sensor 1 input
2	H2	Hall sensor 2 input
3	H3	Hall sensor 3 input
4	V_{Sensor}	Sensor supply voltage (+5 VDC; I_L ≤100 mA)
5	GND	Ground

Table 3-13 Hall sensor connector X2 – Pin assignment

Continued on next page.

Hall sensor	
Sensor supply voltage (V_{Sensor})	+5 VDC
Max. Hall sensor supply current	30 mA
Input voltage	0…24 VDC
Max. input voltage	+24 VDC
Logic 0	<1.0 V
Logic 1	>2.4 V
Internal pull-up resistor	2.7 kΩ (referenced to +5.45 V - 0.6 V)

Table 3-14 Hall sensor – Specifications

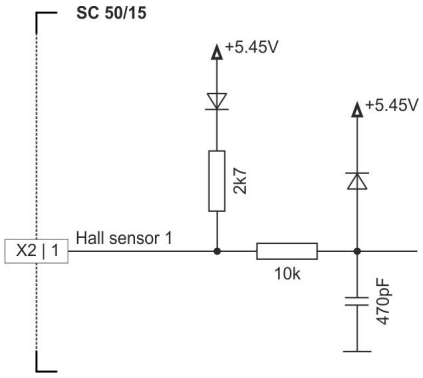


Figure 3-8 H1 input circuit (analogously valid for H2 & H3)

3.4.3 I/O (X3)

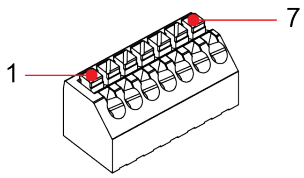


Figure 3-9 I/O connector X3

Connector X3		
On board	PCB terminal block	7 poles, single-row, spring clamp connection, THT, pitch 3.50 mm
Suitable cables	Solid	Conductor cross section 0.20…0.75 mm^2
	Stranded	Conductor cross section 0.50…0.75 mm^2
	Flexible	Conductor cross section 0.25…0.75 mm^2 with cable ferrule without plastic sleeve
		Conductor cross section 0.25…0.5 mm^2, with cable ferrule with plastic sleeve
	Stripping length	8…9 mm
Recommended tools	Slotted head screwdriver size 0.4x2.5 mm	

Table 3-15 I/O connector X3 – Specifications

X3 Pin	Signal	Description
1	DigIN1	Digital input «Enable»
2	DigIN2	Digital input «Direction»
3	DigIN3	Digital input «Stop»
4	DigOUT1	Digital output «Ready»
5	V_{Sensor}	Sensor supply voltage (+5 VDC; I_L ≤100 mA)
6	AnIN1	Analog input «Speed Set Value»
7	GND	Ground

Table 3-16 I/O connector X3 – Pin assignment

Digital Inputs 1…3

Digital inputs 1…3	
Input voltage	0…24 VDC
Max. input voltage	±30 VDC
Logic 0	<1.0 V
Logic 1	>2.4 V
Input resistance	typically 130 kΩ (0…4.4 VDC) typically 10 kΩ (4.4…24.0 VDC)

Table 3-17 Digital inputs 1…3 – Specifications

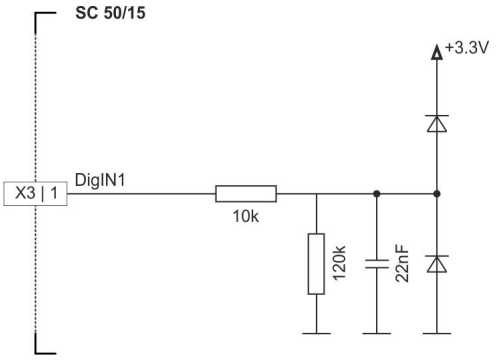


Figure 3-10 DigIN1 input circuit (analogously valid for DigIN2 & DigIN3)

Signal	Function	Logic 0 (open)	Logic 1
DigIN1	Enable	Disabled	Enabled
DigIN2	Direction	CCW	CW
DigIN3	Stop	Running	Stopped

Table 3-18 Digital input functionality

Continued on next page.

Digital Output 1

Digital output 1	
Output voltage	0…3.3 VDC
Max. input voltage	±30 VDC
Logic 0 (no-load)	<0.5 V
Logic 1 (no-load)	>2.8 V
Output resistance	typically 2.2 kΩ

Table 3-19 Digital output 1 – Specifications

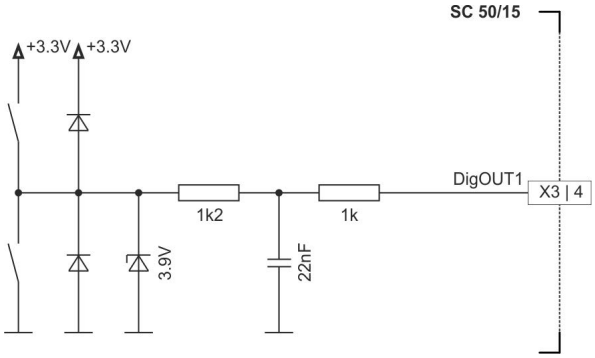


Figure 3-11 DigOUT1 output circuit

Signal	Function	Logic 0	Logic 1
DigOUT1	Ready	Fault	Ready

Table 3-20 Digital output functionality

Analog Input 1

Analog input 1	
Input voltage	0…5.0 VDC
Max. input voltage	±30 VDC
Input resistance	typically 87 kΩ (0…6.0 VDC) typically 31 kΩ (6.0…30.0 VDC)
A/D converter	12 bit
Resolution	1.3 mV
Bandwidth	8 Hz

Table 3-21 Analog input 1 – Specifications

Continued on next page.

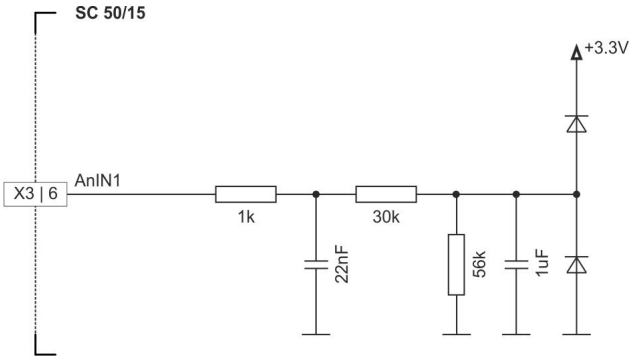


Figure 3-12 AnIN1 input circuit

Best practice in case of use of external potentiometer
When using an external potentiometer, the signals V_{Sensor} and GND (connector X3, pins 5 and 7) may be used as supply. The recommended resistance of the potentiometer is 10 kΩ.

Instead of an analog voltage, a PWM signal with fixed frequency and amplitude can be used to adjust the speed set value.

The desired change in the set value is achieved by variation of the duty cycle in the range 0…100%. Both the amplitude and the duty cycle have an influence on the resulting speed. The mean value of the applied PWM voltage corresponds to the analog input signal «Speed Set Value».

The specified upper limit frequency only applies to a PWM signal with a low-resistance push-pull output. If the signal is generated with an open collector or open drain output and pull-up resistor, the upper limit frequency drops quickly.

Analog input 1 (PWM)	
Nominal PWM amplitude	0…5.0 VDC
Max. PWM amplitude	±30 VDC
PWM frequency (push-pull)	1…10 kHz
Duty cycle	0…100%

Table 3-22 Analog input 1 (PWM) – Specifications

3.4.4 Encoder (X4)

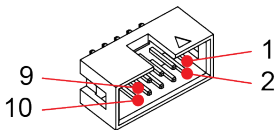


Figure 3-13 Encoder connector X4

Continued on next page.

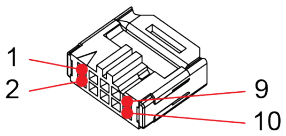
Connector X4		
On board	DIN 41651 male	10 poles, pitch 2.54 mm
Suitable plug	DIN 41651 female	 10 poles, pitch 2.54 mm
Suitable strain relief	Retainer clip, height 13.5 mm, 3M (3505-8110), for plugs with strain relief Retainer clip, height 7.9 mm, 3M (3505-8010), for plugs without strain relief Latch, 3M (3505-33B)	
Suitable cables	10 x AWG28, round-jacket, flat cable, pitch 1.27 mm	

Table 3-23 Encoder connector X4 – Specifications

X4 Pin	Signal	Description
1	—	not connected
2	V_{Sensor}	Sensor supply voltage (+5 VDC; I_L ≤100 mA)
3	GND	Ground
4	—	not connected
5	Ch A\	Channel A complement
6	Ch A	Channel A
7	Ch B\	Channel B complement
8	Ch B	Channel B
9	—	not connected
10	—	not connected

Table 3-24 Encoder connector X4 – Pin assignment

Best practice for encoder selection
A differential encoder (mounted on the motor shaft) with 500 cpt. should be used for velocity control down to approx. 5 rpm.

Encoder (differential)

Encoder (differential)	
Sensor supply voltage (V_{Sensor})	+5 VDC
Max. encoder supply current	70 mA
Min. differential input voltage	±200 mV
Max. input voltage	±12 VDC
Line receiver (internal)	EIA RS422
Max. input frequency	1 MHz

Table 3-25 Differential encoder – Specifications

Continued on next page.

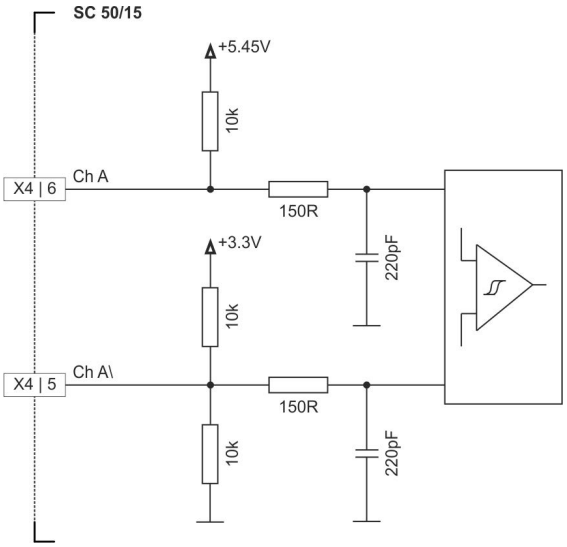


Figure 3-14 Ch A differential input circuit (analogously valid for Ch B)

Encoder (single-ended)

Encoder (single-ended)	
Sensor supply voltage (V_{Sensor})	+5 VDC
Max. encoder supply current	70 mA
Input voltage	0…5 VDC
Max. input voltage	±12 VDC
Logic 0	<1.0 V
Logic 1	>2.4 V
Input high current	I_{IH} = typically −50 µA @ 5 V
Input low current	I_{IL} = typically −550 µA @ 0 V
Max. input frequency	100 kHz

Table 3-26 Single-ended encoder – Specifications

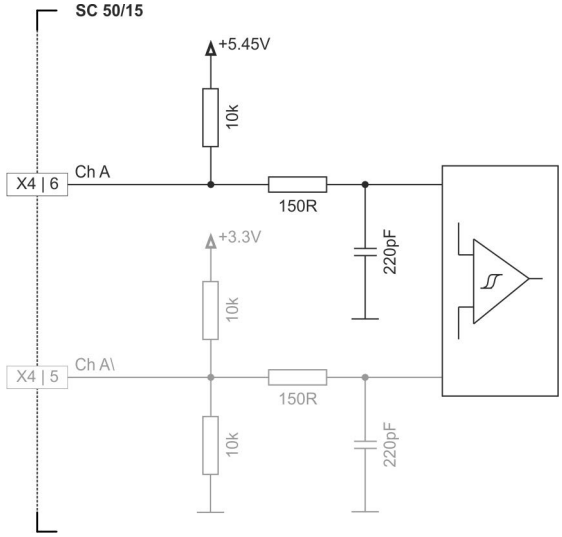
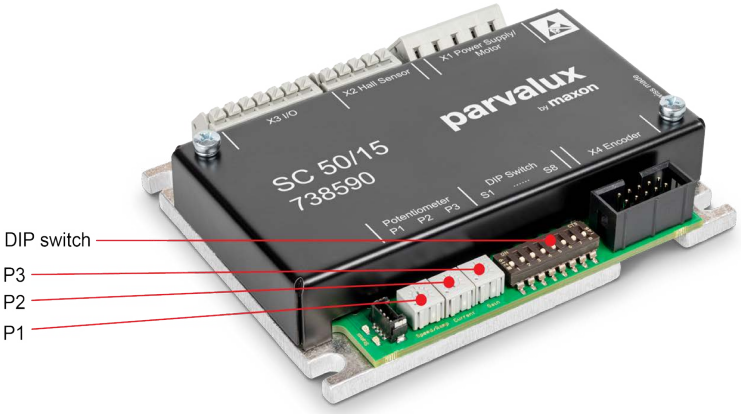


Figure 3-15 Ch A single-ended input circuit (analogously valid for Ch B)

3.5 Configuration



DIP switch ➔Page 3-24 Potentiometer P1…P3 ➔Page 3-26

Figure 3-16 DIP switch and potentiometers – Location

3.5.1 DIP Switch

The device's functionality is set by DIP switches #1 through #8. The default factory setting is "OFF". The state of the DIP switches—and the resulting configuration of the controller—is recognized during power-up. While the controller is powered, the state of the DIP switches must not be changed.

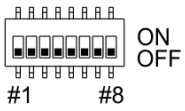


Figure 3-17 DIP switch – Default factory setting

Switch	Functionality	OFF (default)	ON
#1	Motor type	BLDC motor	PMDC motor
#2	Control mode	Closed loop speed control	Open loop speed control with IxR compensation
#3	Speed set value source	Analog Input «Speed Set Value»	Potentiometer 1
#4	Speed sensor and Encoder resolution	See ➔Table 3-28	
#5			
#6			
#7	Hall sensor polarity	Standard	Inverted
		See ➔note on Page 4-29	
#8	Speed range	See ➔Table 3-29	

Table 3-27 DIP switch settings – Functionality

Continued on next page.

IMPORTANT: DIP switch settings during «closed loop speed control»
In control mode «closed loop speed control» (DIP switch #2 "OFF"), the configurations «PMDC motor» (DIP switch #1 "ON") and «Hall sensor only» (DIP switches #4…#6 "OFF") are not valid and the controller will report an error.

Switch			Speed sensor setting and encoder resolution
#4	#5	#6	
OFF	OFF	OFF	Hall sensor only (default)
ON	OFF	OFF	Encoder 12 cpt
OFF	**ON**	OFF	Encoder 16 cpt
ON	**ON**	OFF	Encoder 100 cpt
OFF	OFF	**ON**	Encoder 256 cpt
ON	OFF	**ON**	Encoder 500 cpt
OFF	**ON**	**ON**	Encoder 512 cpt
ON	**ON**	**ON**	Encoder 1'024 cpt

Table 3-28 DIP switch settings – Speed sensor setting and encoder resolution

Switch	Speed range setting	
#8	Hall sensor only	Encoder
OFF (default)	500…10'000 rpm (2-pole motor)	250…5'000 rpm
	250…5'000 rpm (4-pole motor)	
	125…2'500 rpm (8-pole motor)	
ON	500…30'000 rpm (2-pole motor)	250…15'000 rpm
	250…15'000 rpm (4-pole motor)	
	125…7'500 rpm (8-pole motor)	

Table 3-29 DIP switch settings – Speed range setting

3.5.2 Potentiometer

The potentiometers have a linear range of 0…100% over a rotational angle of 210 degrees.

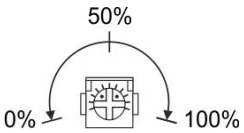


Figure 3-18 Potentiometers

P1	Functionality	DIP switch #3 («Speed Set Value» source)	
		"OFF" (default) Analog input	"ON" Potentiometer P1
50% (default)	Speed ramp	The speed ramp can be adjusted in the range of 20 ms…5 s [c] in relation to the maximum speed selected using DIP switch #8	The speed ramp is fixed to the factory-setting of 1 s in relation to the maximum speed selected using DIP switch #8
	«Speed Set Value»	The «Speed Set Value» is set via analog input and depends on the speed range selected using DIP switch #8	The «Speed Set Value» can be adjusted depending on the speed range selected using DIP switch #8

P2	Functionality	Range
50% (default)	Output current	I_{cont} = 1…15 A I_{max} = 2…30 A

P3	Functionality	DIP switch #2 (Control mode)	
		"OFF" (default)	"ON"
10% (default)	Gain	Closed loop: Controller gain setting	Open loop: IxR gain setting

[c] The selected time with potentiometer P1 is independent of DIP switch #8 but the slope of the speed ramp is dependent on the motor's speed range which is set using DIP switch #8.

Table 3-30 Potentiometers – Functionality

3.6 Status Indicators

The SC 50/15 features a set of LED indicators to display the device status.

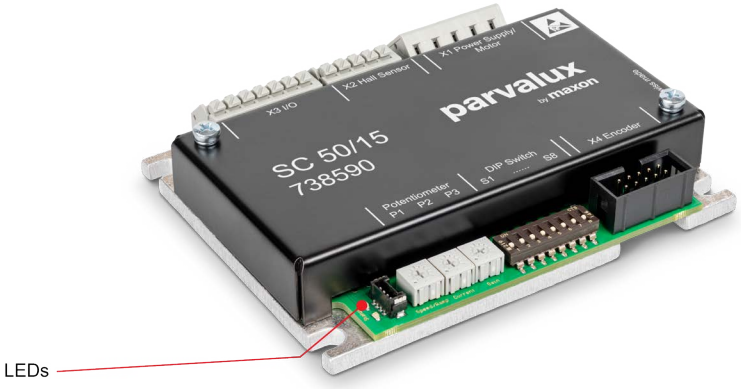


Figure 3-19 LEDs – Location

- Green LED shows the operating status
- Red LED indicates errors

LED		Description	
Green	Red		
OFF	OFF	INIT	
SLOW	OFF	DISABLED	
ON	OFF	ENABLED	
2x	OFF	STOPPING; STOP STANDSTILL	
OFF	**1x**	ERROR	• $+V_{cc}$ overvoltage error • $+V_{cc}$ undervoltage error • V_{Sensor} undervoltage error
OFF	**2x**	ERROR	• Thermal overload error • Overcurrent error • Power stage error
OFF	**3x**	ERROR	• Speed sensor/encoder configuration error
OFF	**4x**	ERROR	Reserved
OFF	**5x**	ERROR	• Hall sensor pattern error • Hall sensor sequence error • Hall sensor frequency too high error

Continued on next page.

LED		Description	
Green	Red		
OFF	**ON**	ERROR	Internal error

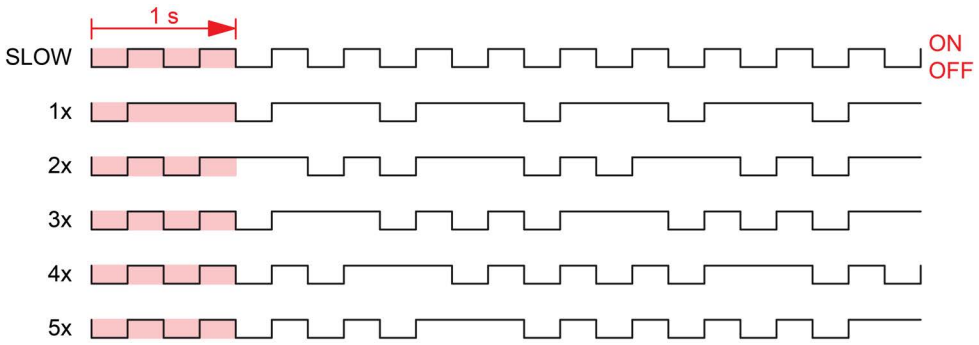


Table 3-31 LEDs – Interpretation of Condition

3.7 Wiring

Ground safety earth connection (optional)

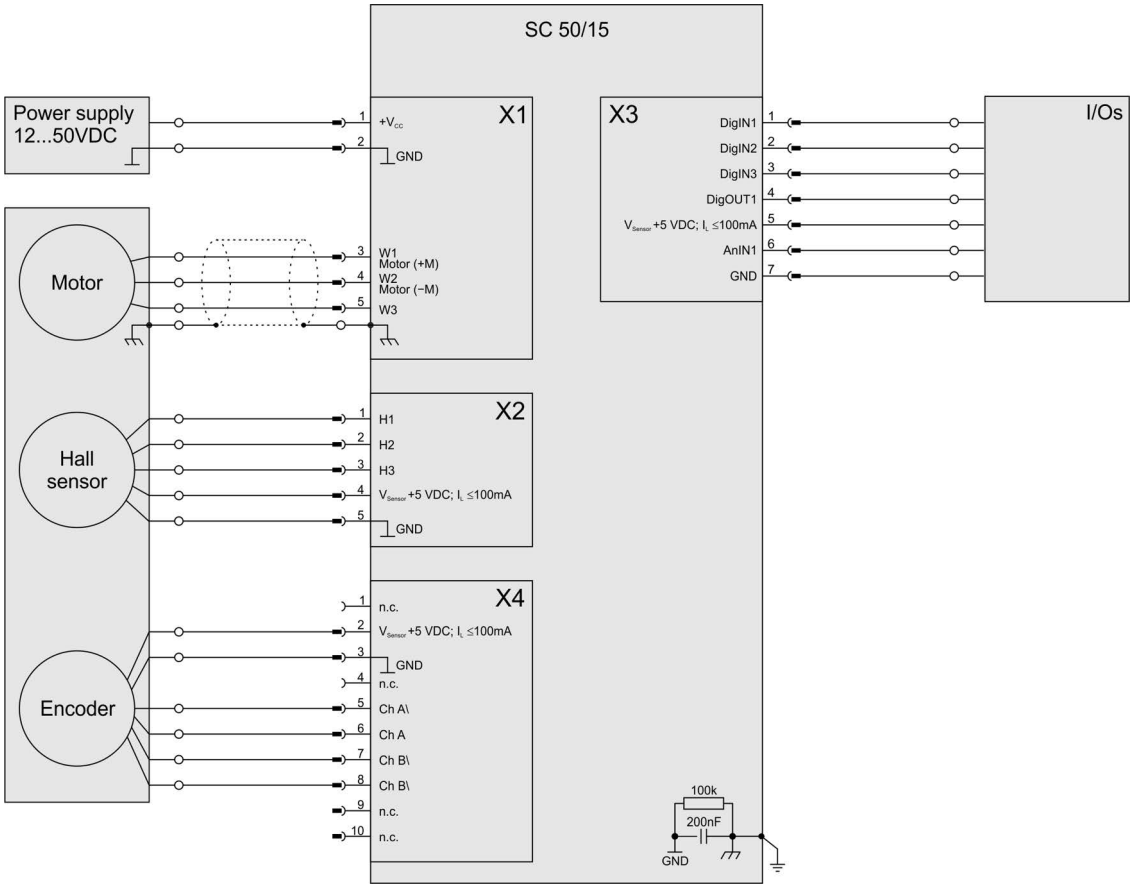


Figure 3-20 Main wiring diagram

4 OPERATION

The «SC 50/15» can operate in two modes:

- **Closed loop speed control** compares the actual speed signal with the applied set value. In case of deviation, the speed is dynamically readjusted.
- **Open loop speed control** feeds the motor with a voltage proportional to the applied speed set value. Changes in load are compensated using the IxR methodology.

The below graphs (➔Figure 4-21) illustrate the relationship between the speed set value input and the controlled/commanded motor parameters with no load connected to the motor.

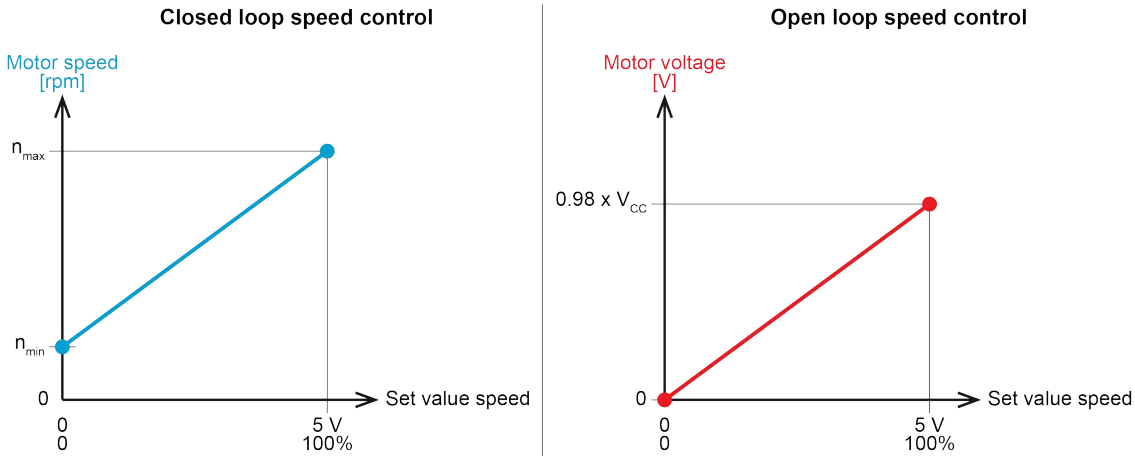


Figure 4-21 Operation modes – Closed loop speed control vs. open loop speed control

The DIP switches **#1**, **#2**, and **#3** (see ➔Table 3-27 on Page 3-24) define the main components of your application—the **type of motor**, the **control mode**, and the **speed set value's source**.

IMPORTANT: DIP switch settings during «closed loop speed control»
In control mode «closed loop speed control» (DIP switch #2 "OFF"), the configurations «PMDC motor» (DIP switch #1 "ON") and «Hall sensor only» (DIP switches #4…#6 "OFF") are not valid and the controller will report an error.

In «open loop speed control», the SC 50/15 operates as a voltage controller
A «Speed Set Value» of 0 (zero) VDC is equal to a motor voltage of 0 (zero) VDC and thus a speed of 0 (zero) rpm or standstill. Independent of the position of DIP switch #8 (see ➔Table 3-29 on Page 3-25), the maximum speed is given by the SC 50/15's supply voltage and the motor's speed constant.

In case of abnormal motor behavior: Changing the Hall sensor polarity using DIP switch #7
The Hall sensor polarity cannot be determined from the outside nor can it be retrieved from the motor's data sheet. If, after the completed controller setup procedure, the motor is not running as expected—for example if the motor speed is fluctuating or if the motor speed is not changing in line with the speed set value input—the Hall sensor pola-rity might not be according to the standard configuration. If the case, set DIP switch #7 (see ➔Table 3-27 on Page 3-24) to "ON" to invert the Hall sensor polarity.

Continued on next page.

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HOW TO SETUP THE CONTROLLER

1) **For closed loop speed control:**
Use the DIP switch #3 to select the input source of the speed set value—either analog input AnIN1 or potentiometer P1.
The set value range (0…+5.0 VDC, respectively 0%…100% PWM) is equal to a motor speed range as selected with DIP switch #8 (in correlation with DIP switches #4 through #6). The set value changes in linear fashion.

   For open loop speed control:
Use the DIP switch #3 to select the input source of the speed set value—either analog input AnIN1 or potentiometer P1.
The set value range (0…+5.0 VDC, respectively 0%…100% PWM) is equal to a motor voltage range of 0 VDC … 0.98 x V_{CC}. The maximum speed is determined by the controller's supply voltage and the motor's speed constant and is independent on the DIP switches #4 through #8 positions. The set value changes in linear fashion.

2) If you are using the analog input AnIN1 to set the «Speed Set Value», the potentiometer P1 will adjust the speed ramp (in the range of 5 s…20 ms) in linear fashion.

3) Adjust the potentiometer P2 to the required limiting values of I_{cont} (in the range of 1…15 A) and I_{max} (in the range of 2…30 A). Both ranges are adjusted at the same time, the limiting values change in linear fashion.

   IMPORTANT: The limiting value I_{cont} should be below the motor's nominal current (max. continuous current, refer to the ➔motor data sheet).

4) Slowly increase the potentiometer P3 to the required gain. The SC 50/15 will thereby use this value for thermal motor protection according to the I2t method and will limit the output current to I_{cont} if necessary.

   IMPORTANT: If the motor starts to rattle, vibrate, or making noises, the set gain is too high. If so the case, turn the potentiometer P3 in CCW direction to lower the gain.

LIST OF FIGURES

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