simplex motion

Info

The SA series has been developed to meet the demands of industries relying on Autonomous Guided Vehicles (AGVs) and battery-powered robots.

High Torque and Power Density:

A key feature of the SA-series is its exceptional torque and power density. This allows for increased load-carrying capacity and faster acceleration, enabling AGVs and robots to perform complex tasks with agility and speed.
The motor's high power density and high efficiency, contributes to longer operational durations on a single battery charge.

48V battery compatible:

A fully charged 48V lithium-ion battery is above 58V. In the SA-series, this has been addressed by setting the upper limit to above 60V.

Compact Design:

The SA-Series is designed with a focus on space efficiency. Its compact size makes it an ideal choice for AGVs and robots where size constraints are a critical factor.

Integrated features:

-Safe Torque Off (STO) functionality, ensuring a secure and rapid shutdown of torque in emergency situations.
-Brake control, enables the motor to control the release and engagement of the brake directly.
-Energy dump, for dissipating excess energy to prevent potential damage.
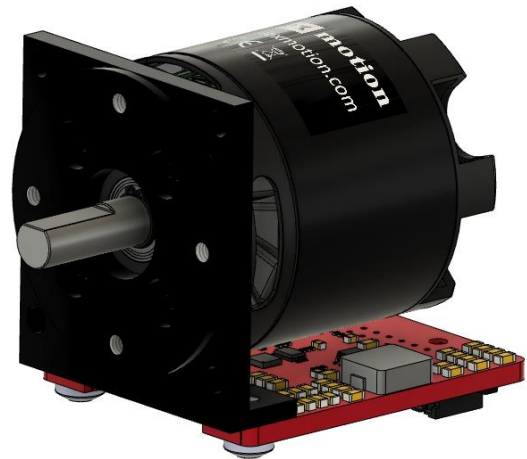
Connectivity:

The SA-Series offers versatility in its connectivity with 24V digital input and output. Additionally, analog input provides customizable control options. The motor further expands its adaptability through CAN and Modbus communication protocols, enabling efficient data exchange with other components in the system.

Silent Operation:

This not only improves the working conditions for operators and nearby personnel but also makes the motor an excellent choice for applications requiring a low-noise environment.

Durability and Reliability:

The brushless outrunner motor design has few wear parts are ideal for demanding conditions, requiring components that can withstand the rigors of continuous use, minimizing maintenance requirements.

Table of contents

1 Technical data

Important characteristics and limits for the Simplex Motion SA100 products.

| Motor specifications		SA100
Torque	At nominal rpm	0.51 Nm (72 oz-in)
	Continuous stall	0.55 Nm (78 oz-in)
	Peak	2.0 Nm (280 oz-in)
Speed	Nominal	3000 rpm
	Peak	6000 rpm
Power	Continuous	160 W (in open air)
	Peak	400 W
Efficiency	Up to	80%
Rotor inertia		$78 * 10^{-6}$ kgm^2
Electrical specifications		
Power Supply voltage	Min	24 V
	Typical	48 V
	Max	60 V (absolute maximum 70V)
Supply Current	Idle	0.05 A (at 48V)
	Continuous	4 A (at 48V)
	Peak	12.5 A (at 48V)
Logic Supply voltage		24-60V
STO voltage		24-60V
Controller specifications		
Integrated incremental encoder solution	Counts per revolution	4096 / 8192 / 16384
	Resolution	0.09° / 0.044° / 0.022°
Switching frequency		32 kHz
Motor commutation	Method	space vector modulation with field orientation control
	Rate	16 kHz
PID controller	Sample rate	2 kHz
	Control	Torque, Position, Speed
Ramping control	Speed	speed limit + controlled acceleration/deceleration
	Position	controlled speed + acceleration/deceleration
Protection		overcurrent, torque, voltage, temperature, locked shaft
Status indicator		green + red light, blink pattern provides status
Interfaces		
	RS485/RS232 TTL	max 115kBit/s, Modbus RTU protocol
	CAN	max 1Mbit/s - SMCAN / CANOpen CiA DS 301
	Step/direction	Step/direction inputs, 24V logic inputs, max 200kHz.
	Quadrature encoder	24V logic inputs, max 200kHz
	Analog control	voltage 0...+10V
Digital Inputs, IN1-2	Maximum voltage	-0.5..+60V
	Low/high threshold	Configurable 0..+10V
	Pull up/down resistor	None
Analog inputs, IN1-2	Maximum voltage	-0.5..+60V
	Input range	0..+10V
	Resolution	16bits
	Accuracy	10bits
	Input impedance	150kOhm
Digital outputs, OUT1-2	Control	Logic, single pulse, PWM, RC servo control
	Output circuit	Open collector, transistor.
	Maximum voltage	-0.5..+60V
	Maximum current	3A
	Pull up/down resistor	None
Mechanical specifications		
Dimensions	Body (L x W x H)	66 x 50 x 64 mm
	Shaft	D8 x 20 mm
Mounting/recommended fastening torque		M4x6mm screws in front / 2.1 Nm
Weight		450 g (15.9 oz)
Shaft loading	Radial load	200 N
	Axial load	100 N
Ambient specifications		
Protection class		IP00, needs external protection
Temperature	Operating	0..+40°C
	Derating of output power	2.7 W/°C above 40°C
	Thermal time constant	340 seconds
	Storage	-40..+85 °C

1.1 SA100 Technical data

1.1.1 SA100 Motor output power

The SA100 handles up to 160W continuous mechanical output power in normal conditions (mounted with free flowing air around the unit, ambient temperature below 40°C). But it is possible to extract several times more power during short intervals. These higher power ratings are limited by:

- Total power limited to 400W (4 times nominal continuous operating limits)
- The maximum provided torque from the motor (2.0Nm)
- The maximum rotational speed, dependent on supply voltage.

The diagram below shows the operating region of the unit.
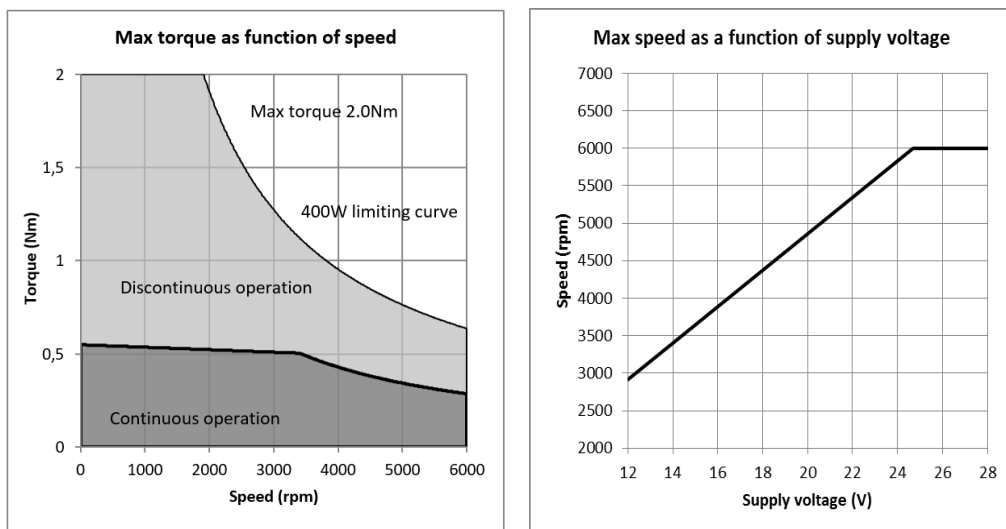
It is possible to extract higher continuous output power levels if the cooling is optimized, for example by fixing the unit to a large metallic structure that can conduct heat away from the unit.

1.1.2   SA100 Physical dimensions

The mechanical implementation utilizes an aluminum extrusion that holds the motor and electronics and allows mounting of the unit. Mounting should be done to facilitate free air moving around the unit to allow sufficient cooling. Thermal properties can also be enhanced by mounting the unit onto a large metallic structure that can conduct heat away from the drive. Specified technical data has been verified with minimal heat conduction and free air flowing around the drive. With efficient conduction of heat from the drive it is possible to extract higher output power ratings.

Make sure to use the thermal protection feature to not damage the drive when running close to its limits.
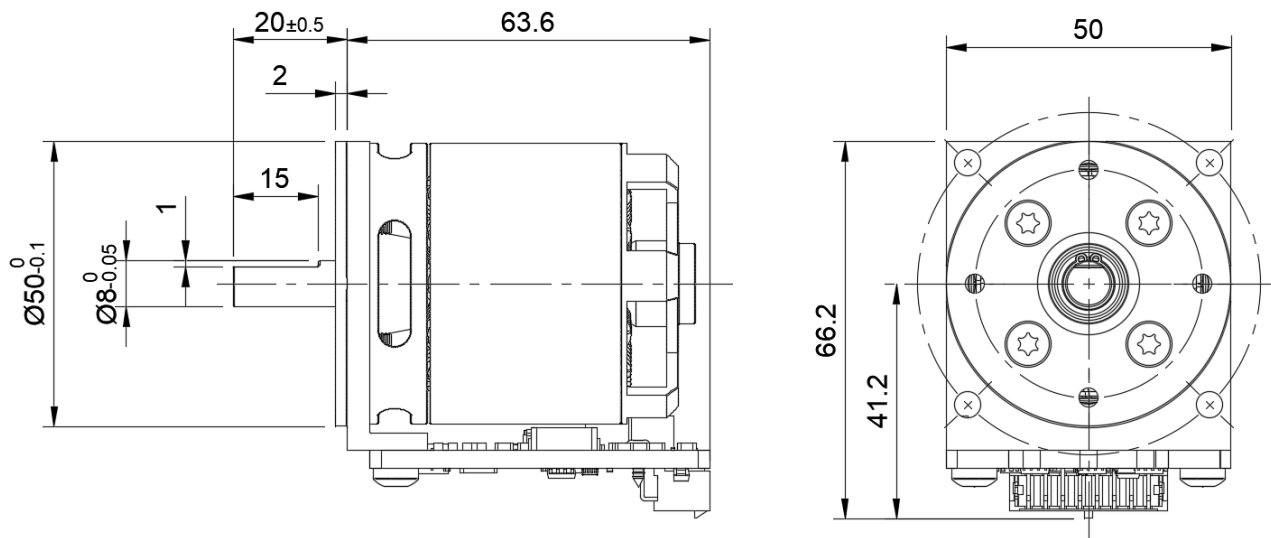
Positive rotational direction is clockwise rotation when looking at the motor front plate (as shown above in the left picture).

Mounting of the unit can be done in 2 ways:
1. Mounting by M4 screws in the front. There are 4pcs of M4 threaded holes of depth 6mm for this purpose.
2. Mounting with M4 screws through the front, there are 4pcs holes with Ø4.5mm in the outer corners.

1.2 Electrical connections

The electrical connections to the SA100-Series is a 16 pol pluggable terminal, (2x8, 3mm pitch)

As mating connector, either Würth WR-MPC3 series (e.g. art. no. 662016113322) or Molex Minifit 3 series (0430251600) is recommended.

Pin	Name	SA100
1	GND	Power supply ground
2	GND	Power supply ground
3	GND	Power supply ground
4	GND	Power supply ground
5	RS485A	RS485 Modbus signal A
6	CAN L	CAN L
7	OUT2	Digital output, up to 60V/3A
8	IN2	Digital/Analog input 0-10V
9	+60V	Power supply input +24...+60V
10	+60V	Power supply input +24...+60V
11	+12-60V	Logic supply +12...+60V
12	STO	Safe Torque Off (Apply >15V for operation)
13	RS485B	RS485 Modbus signal B
14	CAN H	CAN H
15	OUT1	Digital output, up to 60V/3A
16	IN1	Digital/Analog input 0-10V

2 Functionality

The following text describes software related features unique to this motor model.

2.1 Safe Torque Off

This motor has an external input STO that requires an active signal to allow the motor to produce torque. Typically, a 24V input signal should be connected to the STO input to allow motion. When this signal is held low (<10V) the hardware is prohibited to apply current to the motor windings. This function is purely handled by hardware and no software is involved.

However, software is utilized to monitor this feature and asserts a fatal error if a fault is detected. This will cause the motor operation to stop. The following error codes are defined for fault conditions:

Error code (hexadecimal)	Description
0xB100	STO input not active when commanding motor operation.
0xB101	Internal hardware error, 12V supply missing.
0xB102	Internal hardware error, STO switch failure

There is also a register <SafeTorqueOff> that will be used for additional STO settings. At the moment only 3 status bits are present:

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved									FB-DRV	FB-STO	FB-10V	STO Mode Currently not used			

The status bits have the following interpretation

Status bit	Description
FB10V	True when the 12V supply is present.
FBSTO	True when the STO input is active (>15V).
FBDRV	True when the motor power electronics has supply. This supply is turned on/off by the STO input.

For very high demands on safety it is also possible to use an external safety relay to switch off the main power supply to the motor unit. The motor controller can still be active by the separate logic supply input, allowing the motor position and other settings to be maintained.

- Please note that the STO functionality is not certified. For more information regarding the functionality and implementation, please contact Simplex Motion.
- Please note that while the loss of the STO circuit stops the motor, there system might still be in motion due to high inertia.

2.2 Inputs and outputs

This motor model differs from previous SM/SH/SC series when it comes to digital and analog inputs and outputs.

There are 2 dedicated inputs configured for analog 0-10V inputs. These can also be used for digital signals, where the threshold value can be configured in the span 0-10V.

There is a weak pulldown present to keep non connected signals low, but no feature to enable pullup resistors.

Besides the two inputs there are also 2 outputs, intended to drive external loads up to 60V/3A. These outputs are open drain without pullup resistors. Examples of use for these outputs include brake control and brake resistor power dump. There are internal diodes for recirculating current when inductive loads are used. Besides connections on the main connector there are also 2-pole connectors for these outputs using the JST EH type of connectors.

3 Change history

Revision	Note
01a	First release