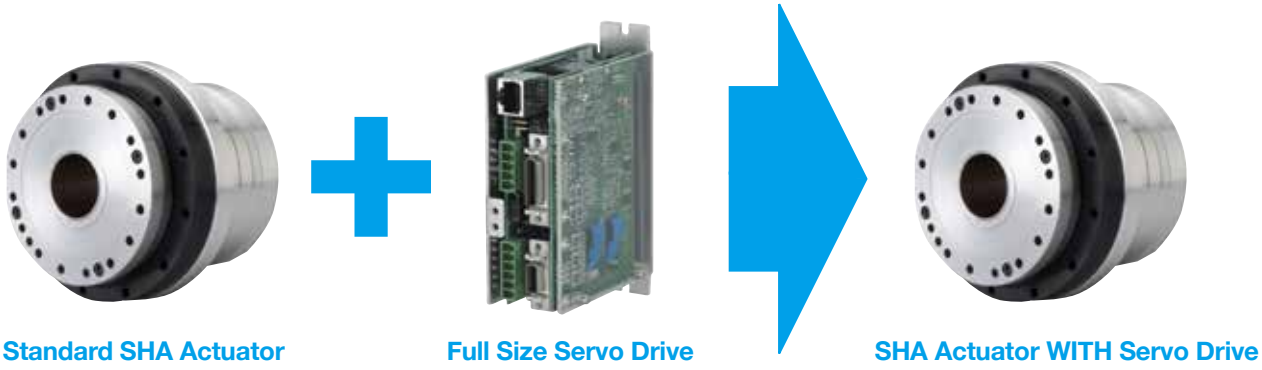
HarmonicDrive®

SHA Rotary Actuator with Integrated Servo Drive

SHA Actuator with Integrated Servo Drive



Standard SHA Actuator | Full Size Servo Drive | SHA Actuator WITH Servo Drive

The Integrated Series is a family of compact actuators that deliver high torque with exceptional accuracy and repeatability. These servo actuators feature high precision Harmonic Drive® gearing combined with a brushless servo motor, a brake option, magnetic dual absolute encoders and an **Integrated Servo Drive with CANopen® or EtherCAT®** communication options. This revolutionary product eliminates the need for an external drive and greatly simplifies cabling yet delivers high-positional accuracy and torsional stiffness in a compact housing.

Features

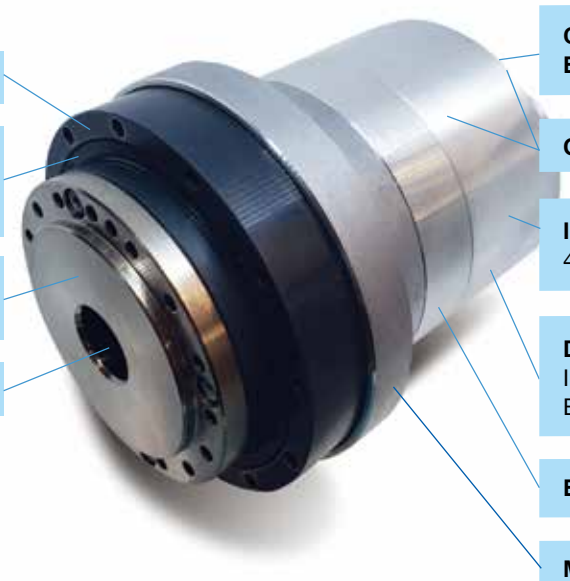
- Actuator + Integrated Servo Drive with CANopen® or EtherCAT® Communication Options
- CANopen Option Features
  - Only a single cable with 4 conductors is needed for power and communication: CANH, CANL, VDC, 0VDC
  - Up to 127 devices can be connected with bus or line topology options
- EtherCAT Option Features
  - Approximately 100x faster compared to CANopen (100Mps vs 1Mps)
  - Up to 200x more deterministic than CANopen (1 μs vs 100μs -200μs)
  - Up to 65,536 devices can be connected with line, star, tree or ring topology options
- 48VDC Nominal Supply Voltage
- Zero Backlash Harmonic Drive® Gearing
- Panel Mount sealed connectors with radial and axial options
- Dual Absolute Encoders
- Control Modes include: Torque, Velocity, and Position Control as well as CSP, CSV, and CST
- Harmonic Drive HDL Commissioning Software

EtherCAT® Coming Soon!

Options:

- Flex-rated mating cables with sealed connectors
- 4 I/O
  - NPN or PNP Opto-Isolated Digital Inputs
  - 2 Programmable Analog/Digital Inputs or Open Drain Outputs

SHA with Integrated Servo Drive Features



Mounting Flange: Fixed

Cross Roller Bearing: High Moment Loading Capacity

Gearhead: Harmonic Drive® SHA

Hollow Shaft: Standard

Connector(s): Panel Mount
Exit Options: PM1, PM4

Optional Connection: I/O & MTO

Integrated Servo Drive: CANopen® 48VDC (24-60VDC)

Dual Absolute Encoders: Motor Input Encoder (17bit), Gear Output Encoder (16bit)

Brake: with or without Brake

Motor: DC Brushless

Ordering Code (with Integrated Drive)

SHA	25	A	101	SG	-	B	09	B	LV	-	IDT17b16b	-	PM1	S	-	SP
1	2	3	4	5		6	7	8	9		10		11	12		13

1.	Model	SHA Integrated Series
2.	Size	20, 25, 32
3.	Design Version	A
4.	Gear Ratio	51, 81, 101, 121, 161
5.	Gearhead	Harmonic Drive® SG Series
6.	Motor Version	B
7.	Motor Size	08: SHA 20 09: SHA 25 12: SHA 32

8.	Brake	A: Without brake B: With brake
9.	Voltage Rating	LV: 48VDC (24-60VDC)
10.	Encoder and Resolution	IDT17b16b - Integrated Drive Motor Input Encoder (17bit) Gear Output Encoder (16bit)
11.	Options	PM1 – Axial Exit PM4 – Radial Exit
12.	I/O Connection Signal	Blank: without I/O and MTO side S: with I/O Panel Mount Connection
13.	Special Specifications	Blank: Standard product SP: Special-specification code

Ultra Compact

Our engineering team incorporated more features and capabilities without greatly impacting the size and mass of the actuator.

Decrease cable and cabinet requirements with a slight increase in weight from the standard. Simplify connections while maintaining the same overall length, with the exception of connector mounting features, reducing overall system needs, including: cables, volume and mass.

Size 20

Only 3.5 mm feature added for connectors plus 0.2 kg

Only 19.25 mm maximum radial protrusion plus 0.2 kg

Size 25

Only 4.6 mm feature added for connectors plus 0.2 kg

Only 25.8 mm maximum radial protrusion plus 0.2 kg

Size 32

Only 6 mm feature added for connectors plus 0.1 kg

Only 22.7 mm maximum radial protrusion plus 0.2 kg

Same overall length as standard versions

Panel Mount Connectors

SHA actuators with an integrated servo drive include standard LEMO® connectors with two exit orientation options. Along with providing the equipment builder the flexibility to choose optimum cables for their specific application, panel mount connectors permit easy replacement of cables. In the event of cable damage, the cables can be replaced without disassembling or replacing the entire actuator.

Exit Options

Key

- **PM1** Panel mount connector(s), rear exit (opposite output)
- **PM4** Panel mount connector(s), top exit (of output side)

PM1 Rear Exit

PM4 Top Exit

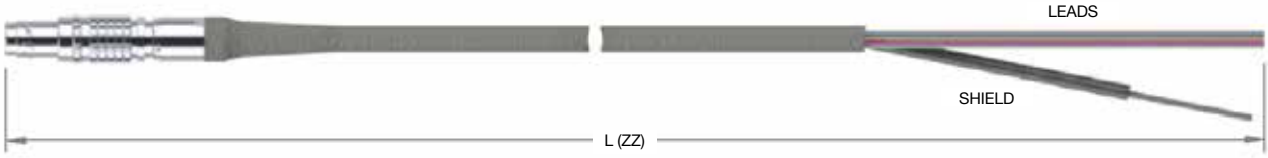
Optional Cables 3 Lengths Available **(ZZ)**: 3m (**03**), 5m (**05**), 10m (**10**)

Power/Connection

Actuator	Description
SHA-20A	CBL-D**ZZ**-L104-N
SHA-25A	CBL-D**ZZ**-L204-N
SHA-32A	CBL-D**ZZ**-L204-N

Input/Output (for use with **'S'** option only)

Actuator	Description
SHA-20, 25, 32	CBL-E**ZZ**-L012-N



Specifications SHA with Integrated Servo Drive

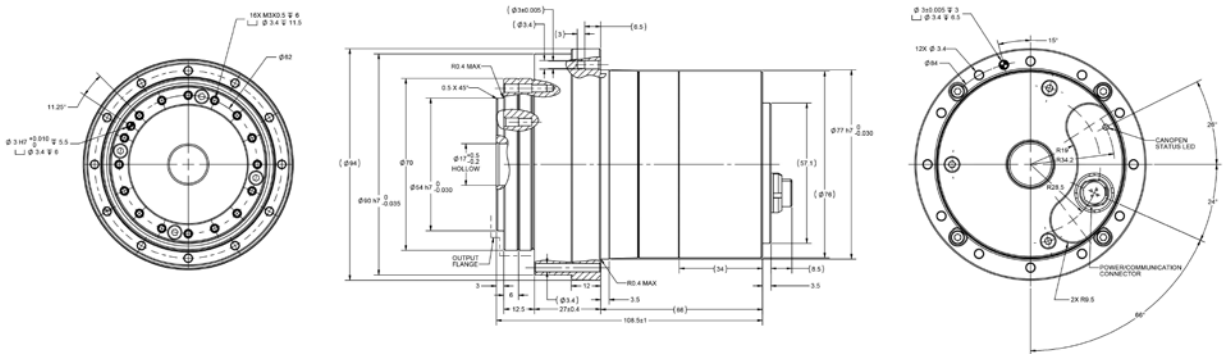
Item \ Size			SHA 20A					SHA 25A					SHA 32A				
			51	81	101	121	161	51	81	101	121	161	51	81	101	121	161
Maximum torque		Nm	68	96	107	113	120	100	163	204	217	229	146	238	298	357	477
Maximum speed		rpm	63	40	32	27	20	75	47	38	32	24	50	31	25	21	16
Maximum current		A_{rms}	14.9	13.2	12	10.8	9.1	25.5	25.5	25.5	23.2	19	25.5	25.5	25.5	25.5	25.5
Continuous torque[1]		Nm	16	26.6	33.4	40.2	48	28	46	57	69	81	37	61	77	93	126
Continuous speed[1]		rpm	49	32.4	26	21.9	17.1	51	35	28.2	23	15	47.2	30	24	20	15
Continuous current		A_{rms}	4.7	4.7	4.7	4.7	4.4	8.5	8.5	8.5	8.5	7.8	8.5	8.5	8.5	8.5	8.5
Torque constant		Nm/A	6.3	10.1	12.7	15.2	20.2	5.3	8.5	10.6	12.7	16.9	7.9	12.8	15	19.1	25.4
Moment of inertia with brake		kgm^2	0.2	0.6	0.9	1.3	2.3	0.6	1.6	2.5	3.6	5.4	2.2	5.6	8.7	12.5	22.2
Moment of inertia without brake		kgm^2	0.2	0.5	0.8	1.2	2.0	0.5	1.4	201	3.0	6.4	1.9	4.8	7.5	10.8	19.1
Allowable moment load			187					258					580				
Moment stiffness			25.2×10^4					39.2×10^4					100×10^4				
Output bearing basic dynamic rated load		kN	14.6					21.8					38.2				
Encoder type		–	Dual magnetic absolute					Dual magnetic absolute					Dual magnetic absolute				
Motor encoder resolution		–	2^{17} (131072)					2^{17} (131072)					2^{17} (131072)				
Gear encoder resolution		–	2^{16} (65536)					2^{16} (65536)					2^{16} (65536)				
Mass		kg	2.1					3.3					PM1: 6.3, PM4: 6.4				
Operating voltage		V	48 (24-60)					48 (24-60)					48 (24-60)				
Communication protocol		–	CANopen® (DS301/DS402), EtherCAT®					CANopen® (DS301/DS402), EtherCAT®					CANopen® (DS301/DS402), EtherCAT®				
Environmental[4]	Ambient operating temp	°C	0-40 (-20-60 storage)					0-40 (-20-60 storage)					0-40 (-20-60 storage)				
	Operating humidity	%RH	20-80 (no condensation)					20-80 (no condensation)					20-80 (no condensation)				
	Vibration resistance[3]	m/s^2	25					25					25				
	Shock resistance[3]	m/s^2	300					300					300				
	Max operating altitude	m	1000 above sea level					1000 above sea level					1000 above sea level				
	No dust, no metal powder, no corrosive gas, no flammable gas, no oil mist, Indoor use only, refer to standard SHA manual for more information																
Motor insulation			Insulation resistance: 100MΩ or more (by DC500V insulation tester), Dielectric strength: AC1500v/1 min Insulation class: A														
Mounting direction			Can be installed in any direction														
Recommended heatsink size [mm][1]			SHA 20: 320 X 320 X 16 mm SHA 25: 350 X 350 X 18 mm SHA 32: 400 X 400 X 20 mm														

1. Value after temperature rise and saturation when the recommended aluminum heatsink is installed.
2. Value of phase induced voltage constant multiplied by 3.
3. For testing conditions, refer to [1-12 Shock resistance] (P1-41) and [1-13 Resistance to vibration] (P1-42) of SHA manual. Motor operation is not guaranteed in applications where vibrations and impacts are continuously applied for a long period of time.
4. For details. refer to [3-3 Location and installation] (P3-6) of SHA manual.

Outline Dimensions (SHA with Integrated Servo Drive)

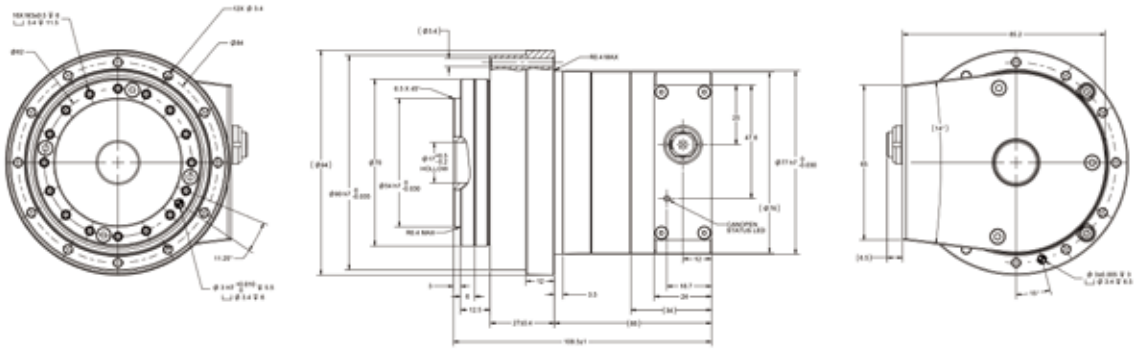
SHA-20A-XXXSG-C08BLV-IDT17b16b-PM1

(Units: mm)



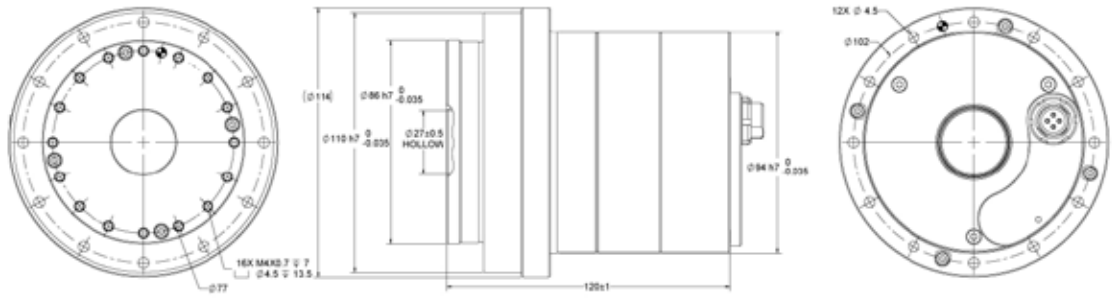
SHA-20A-XXXSG-C08BLV-IDT17b16b-PM4

(Units: mm)



SHA-25A-XXXSG-B09BLV-IDT17b16b-PM1

(Units: mm)



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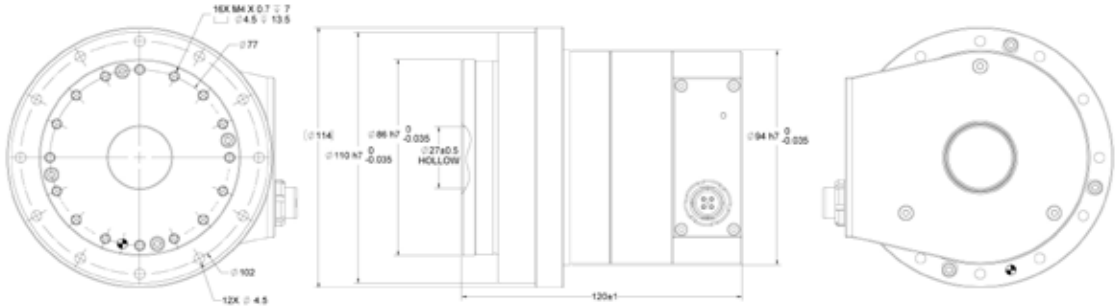
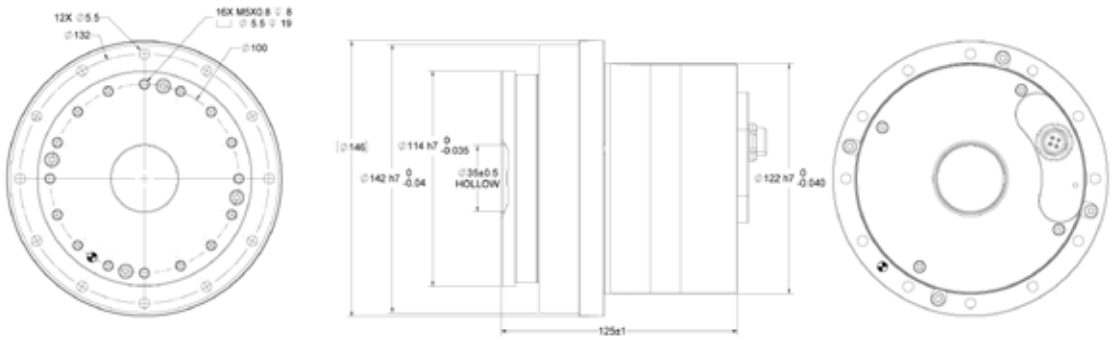
(Units: mm)



Outline Dimensions (SHA with Integrated Servo Drive)

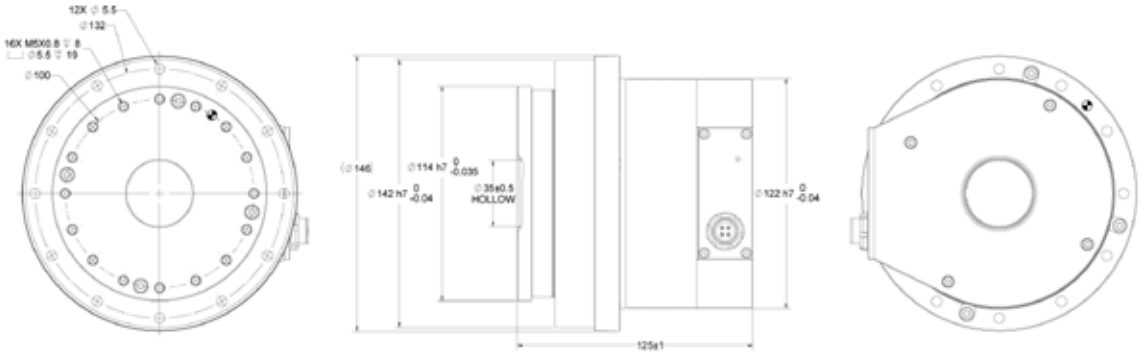
SHA-32A-XXXSG-B12BLV-IDT17b16b-PM1

(Units: mm)



SHA-32A-XXXSG-B12BLV-IDT17b16b-PM4

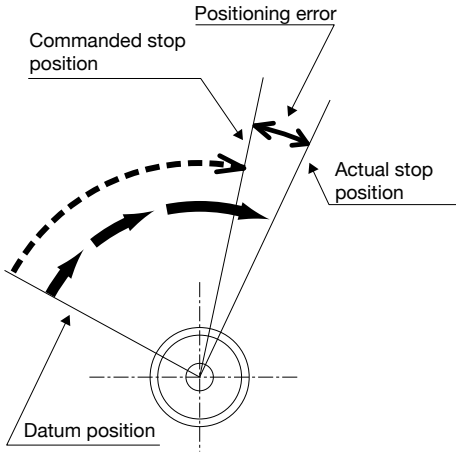
(Units: mm)



One-Way Positional Accuracy

The one-way positioning accuracy is defined as the maximum positional difference between the commanded position and the actual stop position when a series of positioning moves are performed in the same rotation direction. (Refer to JIS B-6201-1987).

The SHA series incorporates a Harmonic Drive® gear which inherently has high-rotational position accuracy. Because of the gearing's high ratio, any rotational error at the input (i.e. motor shaft position error or motor feedback error) is reduced by a factor of the ratio (1/ratio) and typically becomes negligible at the output. Therefore, most of the error is represented by the transmission error of the gear itself.



One-Way Positioning Accuracy

Item \ Size		SHA 20A					SHA 25A					SHA 32A				
		51	81	101	121	161	51	81	101	121	161	51	81	101	121	161
One-Way Positional Accuracy	arc sec	60	50	50	50	50	50	40	40	40	40	50	40	40	40	40

Cross Roller Bearing Specifications

Item / Size	Circular pitch of the roller (dp)	Offset amount (R)	Basic dynamic rated load (C)	Basic static rated load (Co)	Permissible moment load (Mc)	Moment stiffness (Km)
	mm	mm	kN	kN	Nm	×10⁴ Nm/rad
SHA-20A	70	23.5	14.6	22	187	25.2
SHA-25A	85	27.6	21.8	35.8	258	39.2
SHA-32A	111	34.9	38.2	65.4	580	100

Calculating the Maximum Load

Calculate the maximum load (Mmax, Frmax, Famax) with the following formula and verify that they are less than their allowances.

$$M_{max}=Fr_{max}(Lr+R)+Fa_{max}\cdot La$$

Where, the variables of the formula are:
M*max*: Maximum torsional moment in N•m(kg•m)
Fr*max*: Maximum radial load in N(kgf); See Fig.1.
Fa*max*: Maximum axial load in N(kgf); See Fig.1.
Lr, La: Loading point in mm; See Fig.1.
R: Offset: See Fig.1 and Table 1.

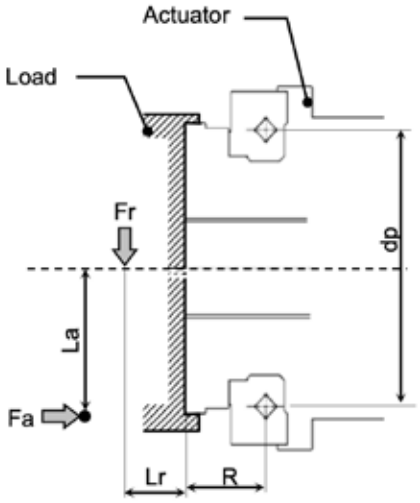


Fig. 1: External load action

Operating Range

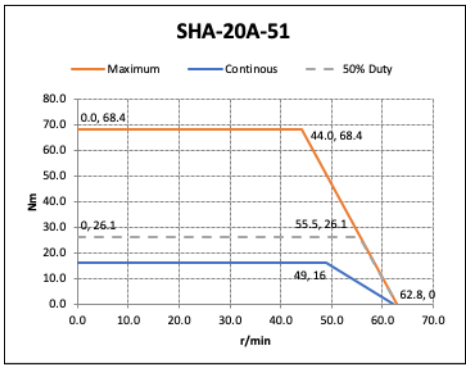
The following graphs show the operating range for an SHA series actuator with an integrated drive.

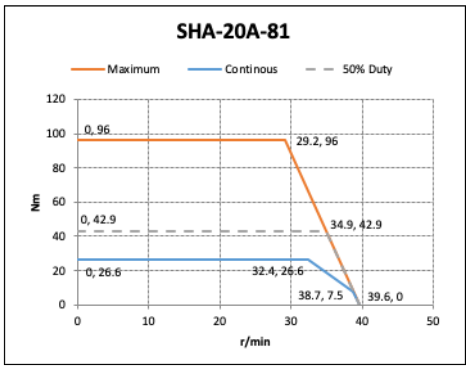
(1) **Continuous Motion Range**
The range allows continuous operation of the actuator.

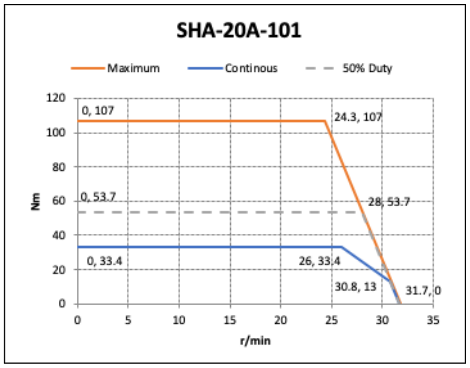
(2) **50% Duty Motion Range**
This range indicates the torque/speed where 50% duty cycle operation is permitted (the ratio of operating time and delay time is 50:50).

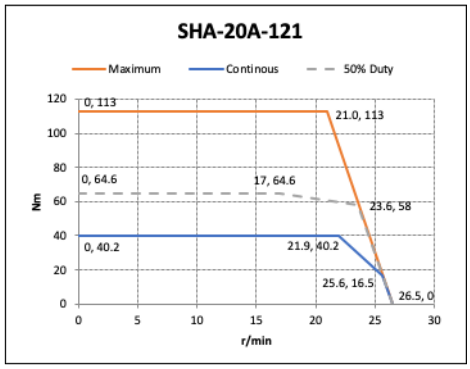
(3) **Motion Range During Acceleration and Deceleration**
This range indicates the torque/speed which the actuator can be operated momentarily. The range allows instantaneous operation like acceleration and deceleration.

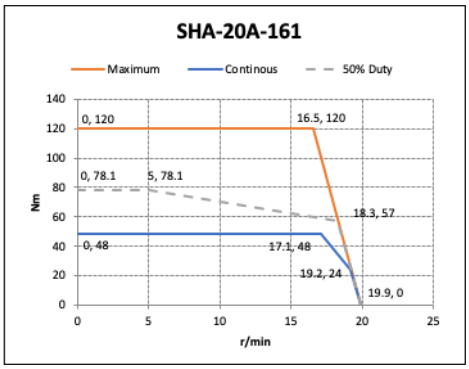
The continuous and 50% duty motion ranges shown on each graph are measured when the actuator is mounted to an aluminum heatsink as specified on page 6.



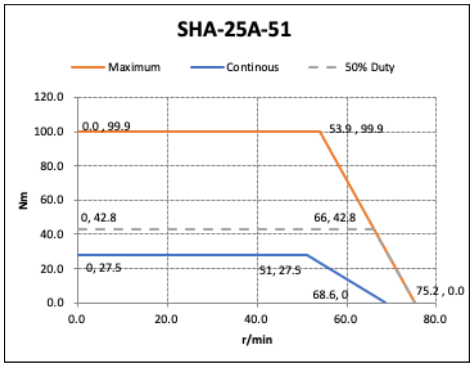


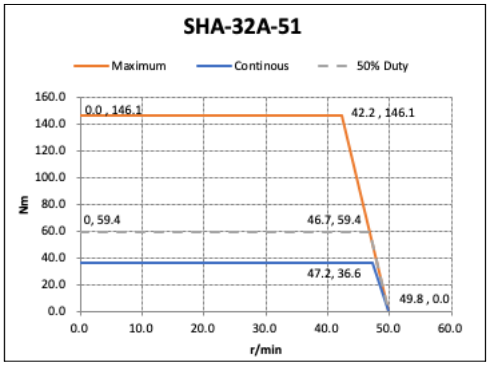


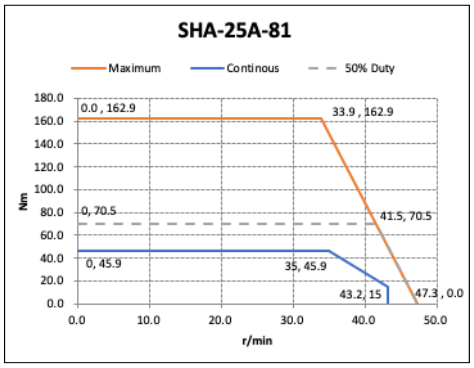


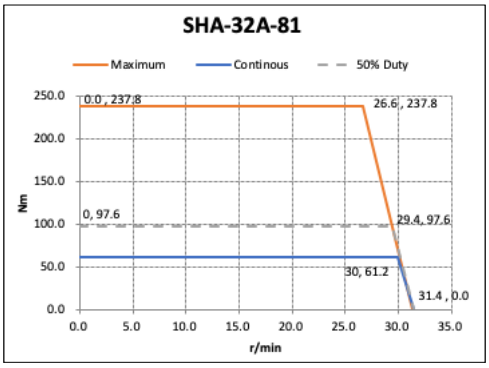


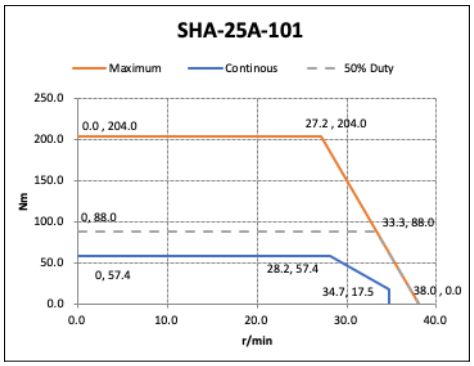
Operating Range

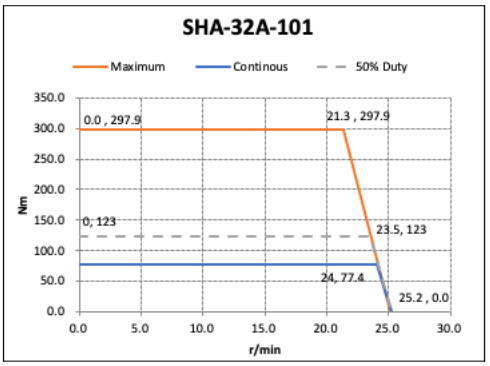


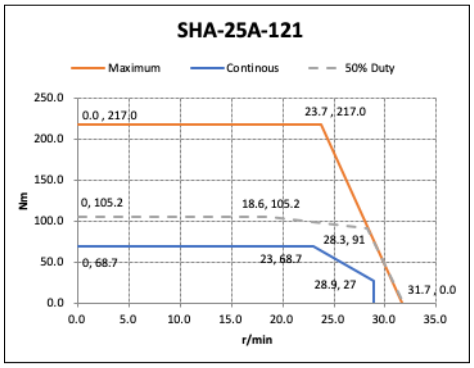


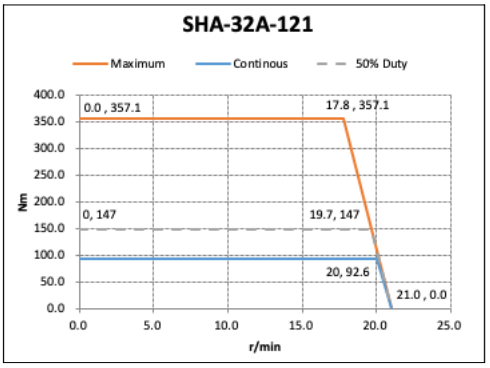


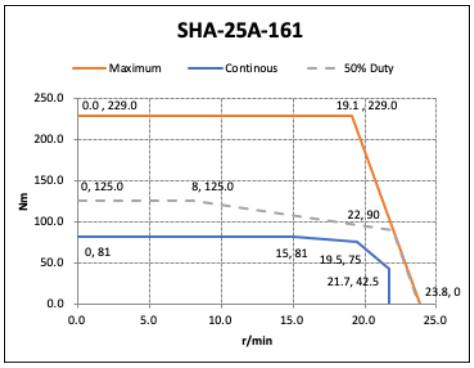


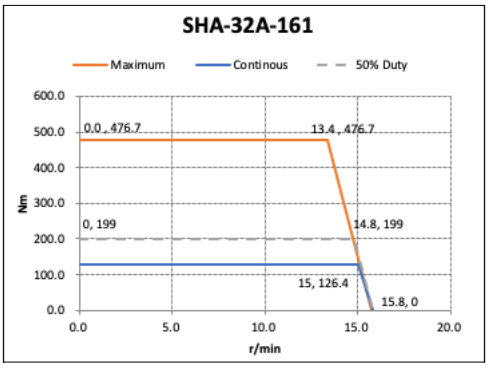












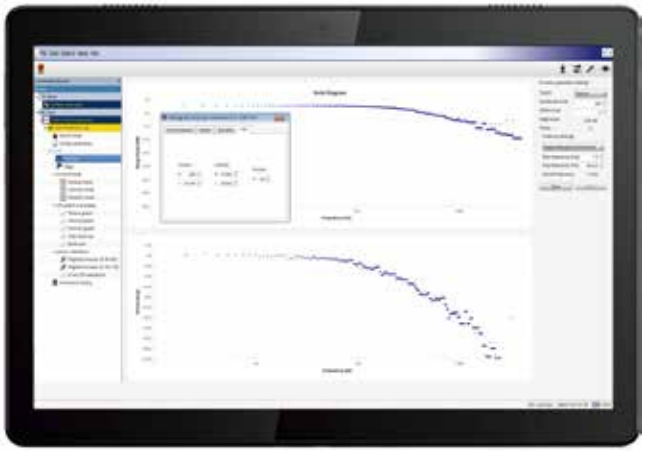
HDL-IDE 3.0 Software:

HDL-IDE 3.0 software provides the ability to setup or commission the SHA Integrated actuators without connecting to a CANopen or EtherCAT master controller. A single actuator can connect to a personal computer or laptop with a CAN communication converter and a power supply. All 256 parameters, including the tuning parameters and 256 general user variables can be set and stored to be recognized by the master controller operating the specific application. The following are some of the features included in HDL-IDE 3.0 software:

Features

- Torque Mode and Graph
- Velocity Mode and Graph
- Position Mode and Graph
- Homing Mode
  - Limit Switch
  - Current Position
  - Hardstop Homing
- Step Response
- Bode Plot
- Parameter List
- Virtual Mode
- Common Features for all Actuators

Position Mode and Graph



Bode Plot and Settings

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