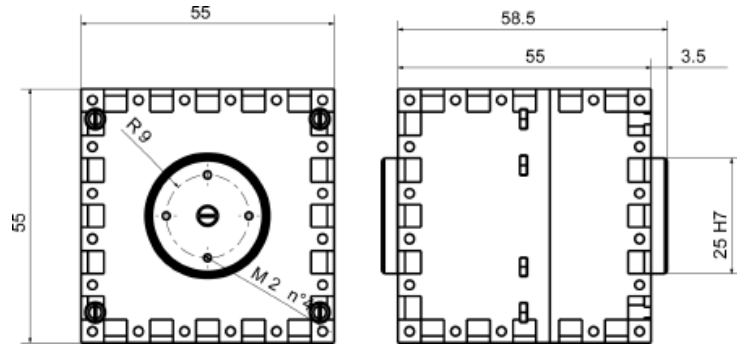
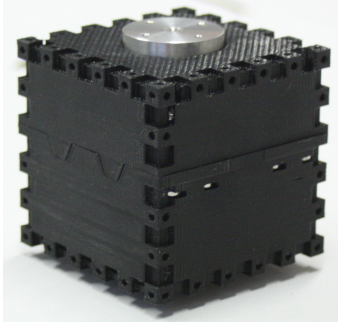


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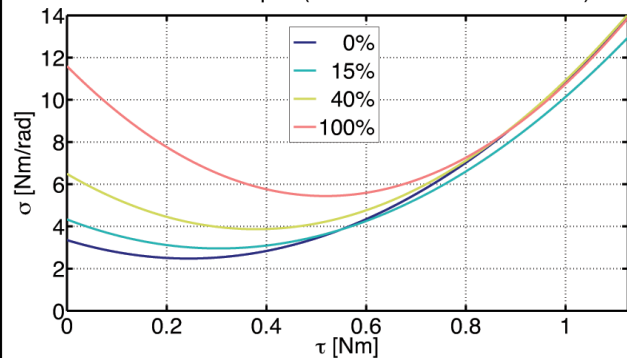
Bidirectional Agonistic - Antagonistic



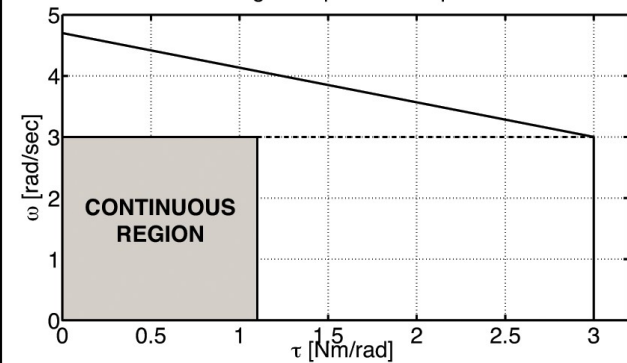
Operating Data

#	(quantity)	(unit)	(value)
Mechanical			
1	Continuous Output Power	[W]	3.3
2	Nominal Torque	[Nm]	1.1
3	Nominal Speed	[rad/s]	3
4	Nominal Stiffness Variation Time	with no load	[s] 0.18
5		with nominal torque	[s] 0.32
6	Peak (Maximum) Torque	[Nm]	3
7	Maximum Speed	[rad/s]	4.7
8	Maximum Stiffness	[Nm/rad]	14
9	Minimum Stiffness	[Nm/rad]	3
10	Maximum Elastic Energy	[J]	0.047
11	Maximum Hysteresis	[°]	2.5
12	Maximum deflection	with max. stiffness	[°] 8.6
13		with min. stiffness	[°] 15.8
14	Active Rotation Angle	[°]	120
15	Angular Resolution	[°]	0.175
16	Weight	[Kg]	0.260
Electrical			
17	Nominal Voltage	[V]	7.4
18	Nominal Current	[A]	2
19	Maximum Current	[A]	6
Control			
20	Voltage Supply	[V]	5
21	Nominal Current	[A]	0.2
22	I/O protocol		I ² C

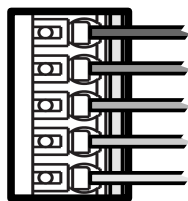
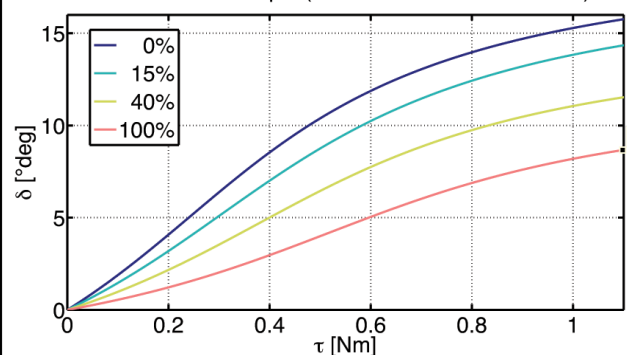
Stiffness – Torque (for different Stiffness Preset)



Angular Speed – Torque



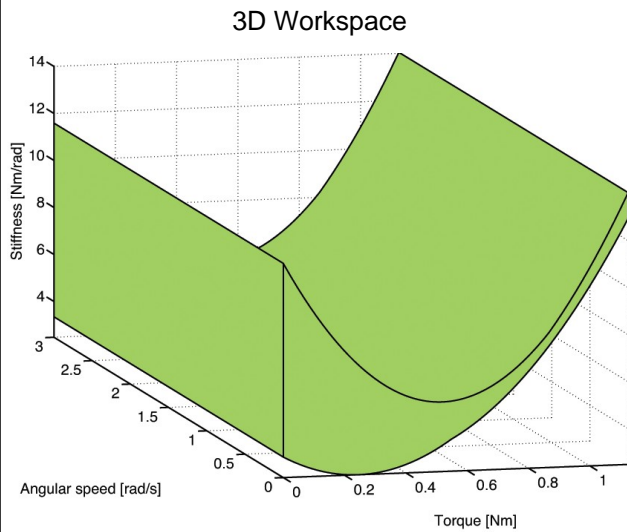
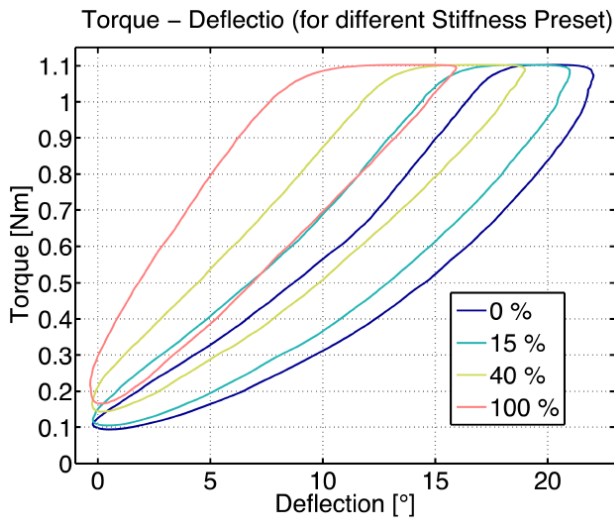
Deflection – Torque (for different Stiffness Preset)



	+5 V (logic)
	I ² C SDA
	I ² C SCL
	GND
	+7.4 V (power)

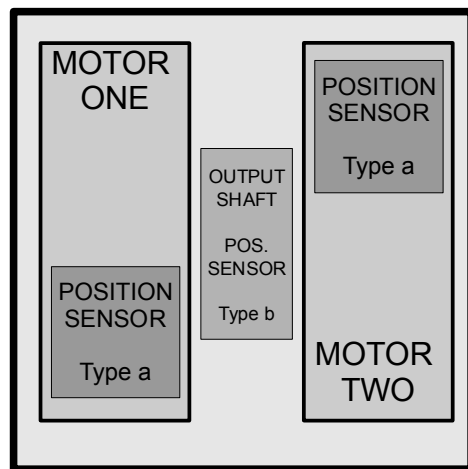
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Additional Characteristics

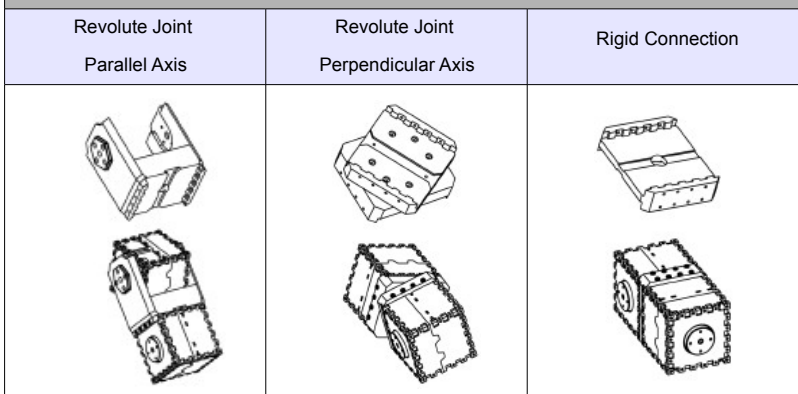


Sensor Map

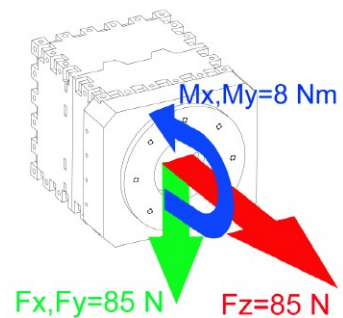
Additional sensors data			
#	(quantity)	(unit)	(value)
Sensor a			
a1	Resolution	[°]	0,175
a2	Range	[°]	0 - 270
a3	I/O protocol	[]	Analog
ax	Voltage Supply	[V]	5
Sensor b			
b1	Resolution	[°]	0,175
b2	Range	[°]	0 - 360
b3	I/O protocol	[]	Analog
b4	Voltage Supply	[V]	5



Mechanical Connections

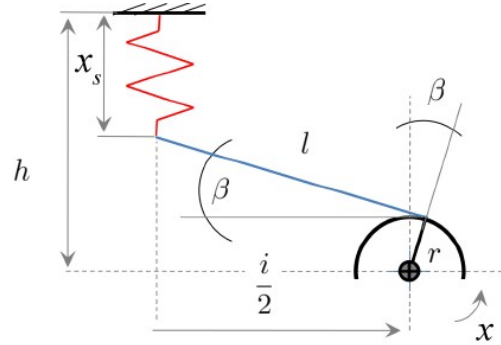
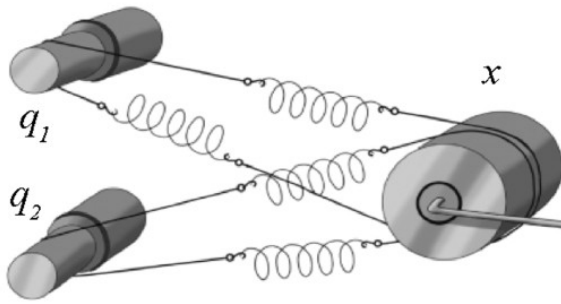


Structural Load



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Model



Mathematical model

101	Recoil Point Function	$x_e(q) = \frac{q_1 + q_2}{2}$
102	Energy Function	$H(q, x) = 0.00973 \left(\arcsin(2 q_1 - x)^{2.1} + \arcsin(2 q_2 - x)^{2.1} \right)$
103	Output Torque Function	$\tau(q, x) = 0.0407 \left(\frac{\arcsin(2(q_1 - x))^{1.09}}{\sqrt{1 - 4(q_1 - x)^2}} + \frac{\arcsin(2(q_2 - x))^{1.09}}{\sqrt{1 - 4(q_2 - x)^2}} \right)$
104	Output Stiffness Function	$\sigma(q, x) = 0.00973 \left(\left(\frac{9.11 \arcsin(2 x - q_1)^{0.0896}}{1 - 4(x - q_1)^2} + \frac{16.7 x - q_1 \arcsin(2 x - q_1)^{1.09}}{(1 - 4(x - q_1)^2)^{\frac{3}{2}}} \right) + \left(\frac{9.11 \arcsin(2 x - q_2)^{0.0896}}{1 - 4(x - q_2)^2} + \frac{16.7 x - q_2 \arcsin(2 x - q_2)^{1.09}}{(1 - 4(x - q_2)^2)^{\frac{3}{2}}} \right) \right)$
105	Spring Torque Function	$e_s(q, x) = \begin{bmatrix} \frac{0.0407 \arcsin(2(q_1 - x))^{1.09}}{\sqrt{1 - 4(q_1 - x)^2}} \\ \frac{0.0407 \arcsin(2(q_2 - x))^{1.09}}{\sqrt{1 - 4(q_2 - x)^2}} \end{bmatrix}$
106	Springs to Motors Transmission Ratio	$A(q, x) = \begin{bmatrix} \frac{0.00652 \arcsin(2(q_1 - x))^{0.0448}}{\sqrt{1 - 4(q_1 - x)^2}} & 0 \\ 0 & \frac{0.00652 \arcsin(2(q_2 - x))^{0.0448}}{\sqrt{1 - 4(q_2 - x)^2}} \end{bmatrix}$
107	Springs to Output Transmission Ratio	$B(q, x) = \begin{bmatrix} \frac{0.00652 \arcsin(2(q_1 - x))^{0.0448}}{\sqrt{1 - 4(q_1 - x)^2}} \\ \frac{0.00652 \arcsin(2(q_2 - x))^{0.0448}}{\sqrt{1 - 4(q_2 - x)^2}} \end{bmatrix}$