

Variable Stiffness Actuators: the user's point of view.

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“vsaUT-2 datasheet”

Multimedia Extension #8

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vsaUT-2

Variable Transmission Ratio

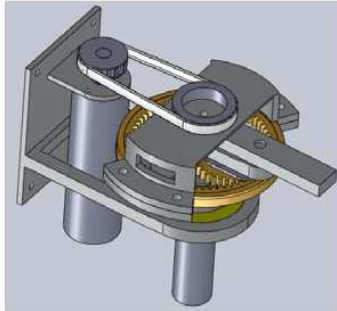
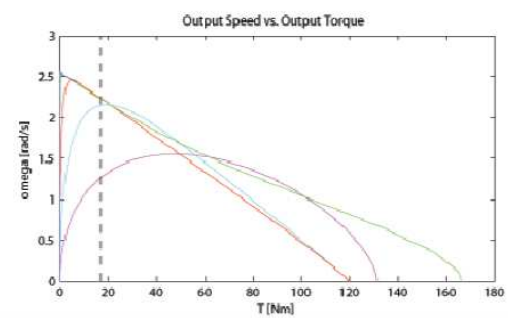
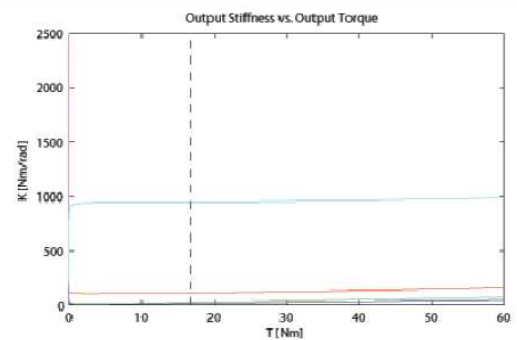


Fig.2
Mechanical interface
drawings

| Operating Data | | | |
|----------------|----------------------------------|---------------------|---------|
| # | (quantity) | (unit) | (value) |
| Mechanical | | | |
| 1 | Continuous Output Power | [W] | 37 |
| 2 | Nominal Torque | [Nm] | 16.8 |
| 3 | Nominal Speed | [rad/s] | 2.2 |
| 4 | Nominal Stiffness Variation Time | with no load | [s] 0.4 |
| 5 | | with nominal torque | [s] 0.5 |
| 6 | Peak (Maximum) Torque | [Nm] | 60 |
| 7 | Maximum Speed | [rad/s] | 2.6 |
| 8 | Maximum Stiffness | [Nm/rad] | inf |
| 9 | Minimum Stiffness | [Nm/rad] | 0 |
| 10 | Maximum Elastic Energy | [J] | 1.6 |
| 11 | Maximum Torque Hysteresis | [%] | n/a |
| 12 | Maximum deflection | with max. stiffness | [°] 0 |
| 13 | | with min. stiffness | [°] n/a |
| 14 | Active Rotation Angle | [°] | ± 60 |
| 15 | Angular Resolution | [°] | n/a |
| 16 | Weight | [Kg] | 2 |
| Electrical | | | |



vsaUT-2

Additional Characteristics

Fig.7
Measured
Torque
vs
Deflection

Fig.8
3D workspace

| Additional sensors data | | | |
|-------------------------|------------------------------|--------|---------|
| # | (quantity) | (unit) | (value) |
| a0 | Sensor a | | |
| a1 | Resolution | [yyy] | xxx |
| a2 | Range | [yyy] | xxx |
| a3 | I/O protocol | [yyy] | xxx |
| ax | (specific sensor properties) | [yyy] | xxx |
| b0 | Sensor b | | |
| bx | (specific sensor properties) | [yyy] | xxx |
| by | (specific sensor properties) | [yyy] | xxx |
| bz | (specific sensor properties) | [yyy] | xxx |
| n0 | Sensor n | | |
| ... | ... | ... | ... |

Fig.9
Sensor Map

This space is left blank for any integrative information at the compiler's discretion. Examples may include:

- additional system images
- max. structural load values
 - accessories
 - software details

| vsaUT-2 | | |
|--|--------------------------------------|--|
| Model | | |
| <div>Fig.10a Actuator Internals Layout</div> | | <div>Fig.10b Actuator Internals Working Principle</div> |
| Mathematical model | | |
| 101 | Recoil Point Function | $x_e = q_2$ |
| 102 | Energy Function | $H = \frac{1}{2} \frac{(L - q_1)^2}{q_1^2} k L^2 \sin^2(x - q_2)$ |
| 103 | Output Torque Function | $\tau = \frac{-k}{2} \frac{(L - q_1)^2}{q_1^2} L^2 \sin(2(x - q_2))$ |
| 104 | Output Stiffness Function | $\sigma = k L^2 \frac{(L - q_1)^2}{q_1^2} \cos(2(x - q_2))$ |
| 105 | Spring Torque Function | $e_s = \frac{(L - q_1)}{q_1} k L \sin(x - q_2)$ |
| 106 | Springs to Motors Transmission Ratio | $A = \begin{bmatrix} \frac{-L^2}{q_1^2} \cdot \sin(x - q_2) \\ \frac{-(L - q_1)}{q_1} L \cos(x - q_2) \end{bmatrix}^T$ |
| 107 | Springs to Output Transmission Ratio | $B = \frac{(L - q_1)}{q_1} L \cos(x - q_2)$ |