



Merlin Systems Corp. Ltd

Servo Air Muscle

Specifications

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Absolute Limits

Environmental

Temperature 0 to +50 °C
Humidity 0-90%RH, non-condensing.
Intermittent shocks should not exceed 10g

Electrical

Absolute maximum allowed voltage on all pins is -3.0 to +15.0 with respect to GND pin.

Pneumatic

Maximum withstand pressure 6bar. No more than 5bar for extended periods.
Muscles must never be operated without an air supply.

Physical

Maximum end-loading is 20Kg. The muscle can produce forces greater than this, and therefore must not be prevented from contracting.
Muscles must never be subjected to end-compression (always keep in tension).

Operating Conditions

Electrical and Pneumatic Supplies

Electrical supply must be from a voltage-stabilised source at $5.0 \pm 0.25V$ (over temperature), delivering a minimum of 2.0A current.

Air supply should be 3-5 bar (normally 4 bar) at up to 20l/min. Air must be moisture- and oil-free.

Several muscles on a single supply will require extra electrical or pneumatic capacity, according to usage (i.e. how many may be moving at once).

Connections

Air supply is via a push-fit connector that accepts 4mm plastic air-line.

Electrical connection is via a miniature pluggable 4-way circular connector (provided).

End-blocks are mounted via 4×M3 bolt fixings on 20.5×22.5mm centres.
At the 'free' end (without connectors) there is also a mounting point for a flexible cord: If this is used, the free end can be self-supporting.

Mechanical

The end-blocks must not exceed 5° out of line with the tension axis.
 For reading accuracy, muscles must always be operated under positive tension.
 To achieve full extension, a minimum tension of 2Kgf must always be present.

Performance

Electrical

Quiescent current varies between models, but is always <60mA.
 When moving, current is ≤2.0A peak, or 0.75A averaged over 100mSec.

Force Levels and Movement Range

‘Muscle length’ is the length of the active section, measured between the inner faces of the end-blocks.

Muscles are specified in terms of the ‘relaxed length’, under no tension.

In use, a muscle stretches by approximately 15% of its length when fully extended (under tension), and reduces by about 15% when fully contracted.

Thus, the relaxed length is at approximately the centre position, and maximum movement range is about 30% of the nominal length.

The maximum force available is approximately 30Kgf at 4bar. It is proportional to the supply pressure, and also (very approximately) to ‘extension’ beyond the minimum fully-contracted length.

The maximum compression achieved therefore depends considerably on the applied load: If load is L and max-force is F, then a fraction approximately L/F of contraction is lost.

Control Interfaces

Three different control interfaces are provided –

VOLTAGE

The Voltage interface accepts a nominal control voltage of 0.0-3.30V relative to the supply ground

SERVO

The Servo interface accepts a positive-going pulse of 1.0-2.0mSecs.
 The high-level control voltage must be at least 3.0V and low-level at most 0.5V.
 Repetition rate is unimportant, but off-time should be at least 1mSec.

ASCII

The ASCII interface supports unit-addressed multi-drop control operation (several muscles on the same bus), position interrogation and optional checksum security.
 The protocol is described in a separate document.

The serial interface operates at 4800baud, with 8 data bits, one start bit, one stop bit, and no parity. No handshake signals are used.

Communication is direct to RS-232 bus.

Up to 50 muscles can be connected in parallel to the same bus wires.

Movement and Positioning

Positional accuracy is $\leq 3\%$ of movement range.

Within the centre range of movement (approx 20-80% position), achievable movement speed is $\geq 20\text{cm/sec}$, and response to control/load changes is $\leq 500\text{mSec}$.

(Movement can be substantially slower near the limits of movement).

Calibration and Control

Muscles are normally controlled over a specified 'calibrated range' of movement, which is slightly less than the full movement range.

Depending on the interface type, the control value is provided by a voltage, the length of a pulse, or a coded number. These values have the following ranges:-

<u>Interface</u>	<u>control type</u>	<u>value range 0%-100%</u>
VOLTAGE	voltage	0.0 – 3.30 Volts
PULSE	pulse-width	1.0 – 2.0 mSecs
ASCII	hexadecimal number	00 – FF

The relationship of muscle position to the control value extends somewhat beyond the calibrated range, as follows –

<u>Control %</u>	<u>position</u>	<u>Voltage/V</u>	<u>Pulse/mSecs</u>	<u>hex value</u>
<15%	max. contraction	<0.2	<1.05	≤ 10
15-25%	below min-cal	0.2 – 0.825	1.06 – 1.25	11 – 3F
25%	0% cal-range	0.825	1.25	40
50%	50% cal-range	1.650	1.5	80
75%	100% cal-range	2.475	1.75	C0
75-85%	above max-cal	2.475 – 3.1	1.75 – 1.94	C1 – EF
>85%	max. expansion	>3.1	>1.95	$\geq \text{F0}$