



Merlin Systems Corp. Ltd

Servo Air Muscle

Specifications

© Merlin Systems Corp. Ltd 2002-2003

Merlin Systems Corp. Ltd assumes no responsibility for any errors which may appear in this manual, reserves the right to alter the devices, software or specifications detailed herein at any time without notice, and does not make any commitment to update the information contained herein. Merlin Systems Corp. Ltd's products are not authorized for use as critical components in life support devices or systems.

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	$\geq \text{F0}$