



## PSA Operating Manual

Version 04 Pre-Release

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### 1.0 Specifications

Power Supply Requirements:	22-26 VDC, 2A*
Ambient Temperature Range:	0 to 60°C
Protection Class:	IP40 or IP67
Medium:	Dry, un-lubricated air**
Filtration:	Recommended 5µm
Operating Pressure:	0 – 100 psi gauge***
Exhaust Ports:	3/8" NPT High Flow Exhaust Mufflers Recommended
Supply Port:	3/8" NPT ½" Hose minimum required.
Materials:	Cylinder and valve body: Anodized aluminum Magnet: Double Ni plate Internal valve parts: Anodized aluminum and engineering plastics. Electronic enclosure: Nickel plated aluminum. Seals: Buna N standard
Electromagnetic Compatibility:	The controller has been designed to conform to the EMC standards EN50081-2 (Emission) and EN50082-2 (interference immunity) in accordance with EMC directive 89/336. For this specification, shielded cables are required as described in Section 2.2.

\*If the power supply voltage drops below the above range during operation, subpar or abnormal operation may occur. Voltage values above the maximum rating may result in overheating or overvoltage damage. Since the controller has a bulk capacitance at the power input, a large inrush current flows when the power is turned on. Do not use quick-blow circuit breakers and fuses. Avoid toggling the power on and off in short intervals, as this might lead to deterioration of certain circuit elements. A power supply with isolated output is recommended.

Upon sudden loss of electrical power, the valve spool will center, and the cylinder will tend to slowly drift to a fully retracted, or a fully extended position – dependent upon load and pressure supply conditions. If it is critical that the cylinder maintain position upon electrical power loss, a means of braking – external to the pneumatic servo – must be provided for. An integrated cylinder brake is scheduled for development.

\*\*Use of lubricants can affect valve dynamics and effect service life of the actuator. Cylinder is pre-lubricated with silicone grease, and contains low friction seals and bore liner for long work life.

\*\*\*Actuator is structurally rated for 175psi. However, sensors which measure air pressure have a signal range limited to 100psi.

## **2.0 Hardware**

### **2.1 Electrical Hardware**

Conformance to the CE RFI/EMC susceptibility and emissions regulations requires that the Sunstream servo be properly wired and grounded. Failure to properly ground the cables will result in a compromised performance, if not equipment malfunction, due to electromagnetic noise. A very low impedance connection should be made from the power cable to earth (chassis) ground, and proper wiring practices are required to avoid system ground loops. In some applications it may be necessary to install a low impedance ground strap between the servo and earth to achieve a proper ground.

Use 20-22 gage wire in twisted pairs with a fully shielded cable. For maximum shielding and reliability, use cables with combined shields that utilize both a foil and braided layer. Many potentially effective shields can be destroyed by improper termination of the shields to ground. Don't ground with pigtailed. As a low impedance path to ground is essential in order to realize maximum shielding benefits, the best connection is a 360° contact between the shield and connector or chassis. On the equipment, the metal connector on the cable must complete the grounding of the cable shield. Scrape or mask off any paint between the metal connector and the chassis to ground the connector.

To minimize exposure to RFI/EMC radiation, electronic equipment should be isolated from sources of high-energy electromagnetic radiation such as cables carrying high currents, radio transmitters, electrical load control centers and contactors.

***Ensure that power is turned off when connecting or disconnecting any cables to the Sunstream controller.***

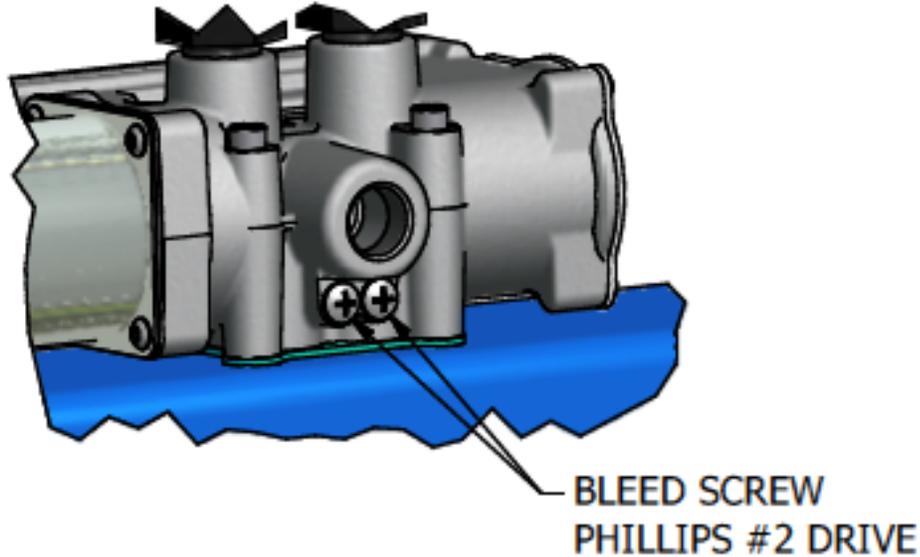
### **2.2 Mechanical**

It is critical that the actuator rod end is coupled to the load with a mechanism that has a high level of axial stiffness. Conventional alignment couplers should be avoided as they are typically compromised by considerable levels of undamped axial play. In systems with high loads, this may result in a "chattering" condition that generates undesirable levels of noise and wear. Sunstream Scientific offers a proprietary anti-backlash alignment coupler. These couplers allow for angular and positional misalignment between the actuator and load, and have zero axial-play.

Machine compliance may also compromise the performance of the pneumatic servo, and in general, the machine or chassis to which the Sunstream servo is integrated should be designed to be as stiff as possible. If the servo is rigidly mounted to a chassis which floats on vibration isolators, the mass of the chassis should be substantially large in comparison to the inertial load driven by the servo.

### 2.2.1 Pressure Vents

Located below the pressure inlet port, find head and rod side bleed screws. The bleed screws can be removed to allow the rod to easily move when manually programming position points. Use caution when removing the screws under pressure, as they will fully back out.



## 3.0 Communication

Presently, there are three (3) digital communication options: an RS-232 serial link, a CAN2.0B serial link, or a 12-bit parallel I/O link. All communication pins have a peak galvanic isolation of 2.5kV.

Upon power up, all Sunstream servos, regardless of communication protocol, will transmit two sequential 8 bit words, #1Bh & #57h, on the RS-232 link – this series is transmitted twice. If a handheld teaching pendant is connected to the RS-232 port, or if a PC is connected to the RS-232 port, with the Sunstream programming software running, the software will enter the programming mode (see Section 4.0). If no connection is present, the software will continue to execute.

*Refer to the GUI or Handheld Interface Manual for further information on setting parameters, points, filters, and gains.*

### 3.1 RS-232

6 pin Binder Series 680 connector. The RS-232 transceiver is a Texas Instruments MAX3221 and meets the requirements of TIA/EIA-232-F. The default RS-232 configuration (in software) is for 8 data bits, 1 stop bit, no parity, and a baud rate of 9600 bits per second. The baud rate can be increased to 19200 bits per second at the factory.

*Refer to the RS232 Manual for further information on operational control of the Sunstream pneumatic servo through the RS-232 serial link.*

### 3.2 DISCRETE I/O 12-bit parallel link

14 pin Binder Series 723 connector. The I/O units comprise 10 input bits and 2 output bits. Each uni-directional pin is galvanically isolated. As the galvanic isolators are uni-directional, the input and output pins cannot be reversed.

*Refer to the I/O Indexer Manual or I/O Positioner Manual for further information on operation control of the Sunstream pneumatic servo through the 12 bit I/O link.*

### 3.3 CAN 2.0B

6 pin Binder Series 680 connector. The CAN2.0B transceiver is a Texas Instruments SN65HVD251, and it meets the requirements of ISO 11896. The default baud rate is set to 1M bits per second at the factory.

*Refer to the Beta CAN 2.0B Manual for further information on operational control of the Sunstream pneumatic servo through the CAN 2.0B serial link.*

### 3.4 PLC 12-bit parallel link

14 pin Binder Series 723 connector. The I/O units comprise 10 input bits and 2 output bits. Each uni-directional pin is galvanically isolated. As the galvanic isolators are uni-directional, the input and output pins cannot be reversed.

*Refer to the PLC Manual for further information on operation control of the Sunstream pneumatic servo through the 12 bit I/O link.*

## 4.0 Parameter Programming

By means of Windows based GUI or a handheld controller, operators have access to the pneumatic servo's memory to configure the following general parameters in software:

**CONTROL MODE:** The default Control Mode of the servo actuator is the *Soft Mode*. In *Soft Mode*, the actuator has maximum robustness to unknown machine frame compliance, and will operate more quietly. In *Stiff Mode*, the actuator will generate more noise - but will better reject external disturbances.

**MAXIMUM WEIGHT:** Enter the maximum inertial weight, in pounds, that the pneumatic servo will drive over its entire operational envelope.

**MINIMUM WEIGHT:** Enter the minimum inertial weight, in pounds, that the pneumatic servo will drive over its entire operational envelope.

**AIR PRESSURE:** Enter the minimum expected gage pressure, in psi, at valve inlet. This parameter is utilized to diagnose a pressure loss. The factory default setting is 70 psi.

**MAXIMUM ACCELERATION:** Program the maximum allowable acceleration in g's. This parameter limits the maximum acceleration rate as the servo accelerates from rest to peak velocity.

**MAXIMUM DECELERATION:** Program the maximum allowable acceleration in g's. This parameter limits the maximum rate of the servo as it decelerates from peak velocity to rest. This feature is not yet available. Deceleration presently assumes the same value as maximum acceleration.

**MAXIMUM VELOCITY:** Program the maximum allowable velocity in units of inches per second. This parameter limits the maximum velocity for both extension and retraction strokes.

**MINIMUM POSITIONAL RESOLUTION:** This is the positional window required for a valid final position.

**AXIAL LOAD:** Enter the average steady state load the pneumatic servo will be expected to drive. Loads which result in cylinder extension will have a positive sign, and those which cause retraction of the cylinder have a negative sign. For example, if the pneumatic servo is disposed in a vertical application, where the cylinder extends, against gravity, to drive a 20 lbfm weight upward, the load input to the controller should be -20. The default value is 0.

**P GAIN:** P Gain is a parameter that scales the loop gain autonomously calculated by the servo controller. Increasing Proportional Gain results in a higher system bandwidth, and a smaller positional error. However, a value which is too high will result in overshoot and possible instability. Choose a value between 1 and 200 for P Gain. The default value is 100.

**S GAIN:** S Gain is a parameter which will smooth the effects of the high frequency noise. Higher values of S Gain will also improve tracking in systems with low inertia and external disturbance forces. Incrementally increase this value until noise levels are undesirable. The default value is 100.

**D GAIN:** The D Gain parameter is a non-dimensional feed forward setting. Increasing D Gain accelerates the servo's response to an input command, and reduces following error. However, D Gain values which are too high may result in undesirable overshoot. Choose a value between 0 and 100 for D Gain. The default value is 01.

**FRC GAIN:** This parameter is a non-dimensional value which sets the loop gain for the actuator in Thrust mode. When the actuator is operating in a positional mode, this value has no effect. Choose a value between 1 and 999 for Frc Gain. The default value is 350.

**FILTERS:** Filter A and Filter B are not yet activated.

**POINTS:** Up to 127 positional points, stored in the Sunstream controller's data memory, can be accessed and configured through the hand held teaching pendant or Windows interface. Each point has a resolution up to 0.001". Points can be either pre-programmed or "taught" by pulling the actuator to a desired position and locking that position, through the keypad, to a specific point.

## **5.0 Operational Guidelines**

- i) Is the servo actuator rigidly secured to a chassis with a mass that is substantially higher than the mass of the load?
- ii) Has all axial backlash between the cylinder push rod and inertia load been removed? Check all coupling mechanisms and mounting points for play.
- iii) Do the software settings for air pressure, maximum inertial weight, and minimum inertial weight accurately reflect the physical system?