



1.0 Overview

This manual describes how a Host laptop or personal computer, operating the Sunstream Scientific Graphical User Interface, can communicate via an asynchronous serial (RS-232) link to the servo controller in order to:

- Set state limits such as velocity, acceleration, and force.
- Tune controller gains and select noise filters.
- Configure communication parameters.
- Write and store custom motion programs.

2.0 Getting Started

2.1 Required Hardware

- Windows Operating System, Version XP or later.
- Laptop or PC with COM port compatible with RS-232 communication.

2.2 Initiate Communication

- Turn off power to the Sunstream Servo.
- Open the GUI software. In the upper right hand corner, you should see:
COM Port: Disconnected **SSI Controller:** Disconnected
- Connect the GUI host computer to the Sunstream Servo programming connector with the programming cable, via an RS-232 (asynchronous serial) port.
- Click on the "Port" pulldown menu and select "Connect". This will connect the GUI workspace to the proper asynchronous port on your computer.
- If this operation is successful, in the upper right hand corner you should see:
COM Port: **Connected** **SSI Controller:** Disconnected
- Apply +24V power to the Sunstream controller, or toggle the RESET pin.
- When communication is established between the GUI host and the Sunstream controller, in the upper right hand corner you should see:
COM Port: **Connected** **SSI Controller:** **Connected**
- You are now ready to exchange data between the GUI host and the Sunstream controller.

2.3 Data Exchange

- Single click on the **Import** icon to transfer data from the Sunstream controller to the GUI environment.

- Single click on the **Flash** icon to transfer data from the GUI environment to the Sunstream icon, and to flash that data into permanent memory.

3.0 Programming Environment

The Sunstream Scientific Graphical User Interface provides an intuitive environment by which a user can access configurable memory and calibrate the servo. Tune gains and filters, set limits for state parameters such as acceleration and velocity, assign position values to points, and write fully featured motion control programs.

3.1 System

Program parameters for the physical system.

Axial Load: Enter the average expected axial load in pounds. A (+) force acts in the direction to extend the actuator rod, and a (-) force acts in the direction to retract the cylinder rod. 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. If you do not know the average axial force, leave this value at 0 lbf.

Maximum Weight: Enter the maximum expected inertia load in pounds.

Minimum Weight: Enter the minimum expected inertia load in pounds.

Inlet 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.

Stiction*: A dimensionless parameter to attenuate the effects of static friction. Consult factory before changing the default setting.

Friction*: A dimensionless parameter to attenuate the effects of running friction. Consult factory before changing the default setting.

3.2 State

Program parameters related to dynamic states.

Positional Resolution: Enter a value for a positional resolution. This is the error window for any Positional Move instruction. For the operation to conclude, the following inequality must be true:

$$\text{Positional Resolution} < |\text{Commanded Position} - \text{Measured Position}|$$

Force Resolution: Enter a value for a force resolution. This is the error window for a Ramp to Force or Step to Force instruction. For the operation to conclude, the following inequality must be true:

$$\text{Force Resolution} < |\text{Commanded Force} - \text{Measured Force}|$$

Force Limit: Enter the force value that triggers the switch from position to force mode during a Soft Touch. A positive force value represents an extending force, and a negative force value represents a retracting force.

Force Rate: Enter the rate at which the servo will ramp to a force setting with a Ramp to Force instruction.

Maximum Velocity: Enter the “not to exceed” velocity for any Move or Move to Point operation. The Sunstream controller will generate an internal position trajectory for this Move operation which respects the velocity limit.

Maximum Acceleration: Enter the “not to exceed” velocity for any Move or Move to Point operation. The Sunstream controller will generate an internal position trajectory for this Move operation which respects the velocity limit.

Maximum Deceleration: Not yet activated. Maximum Deceleration defaults to Max. Acceleration Setting.

3.3 Control

Program motion control modes, tuning gains, and filters.

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.

Acceleration Mode: Choose between a square or trapezoidal acceleration profile. A square acceleration profile results in faster cycle times. A trapezoidal profile yields a smoother acceleration.

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.

Filter A: Not yet activated.

Filter B: Not yet activated.

3.4 CAN2.0B

Program parameters related to CAN 2.0B communication. For further details on CAN 2.0B, refer to the Robert Bosch CAN Specification Version 2.0.

Identifier Extension Bit

Choose between a Standard (11 bit) or Extended (29 bit) Identifier.

Acceptance Mask Enable Bit

Enable or Disable the Acceptance Mask

Bit Configuration Register

SBG *CAN synchronization [0-1]*

- 0 The CAN module resynchronizes on the falling edge only
- 1 The CAN module resynchronizes on both rising and falling edges

SJW *Synchronization Jump Width [1-4]*

SJW indicates by how many units of TQ a bit is allowed to be lengthened or shortened when re-synchronizing with the receive data stream on the CAN bus. The synchronization is performed either with the falling edge (SBG=0) or with both edges (SBG=1) of the bus signal. SJW is programmable from 1 to 4 TQ.

SAM *Sample Point Setting [0-1]*

This parameter sets the number of samples used by the CAN module to determine the actual level of the CAN bus. When the SAM bit is set, the level determined by the CAN bus corresponds to the result from the majority decision of the last three (3) values. The sample points occur at the sample point and twice before with a distance of ½ TQ.

- 0 The CAN module samples only once
- 1 The CAN module samples 3x and makes a majority decision.

TSEG1 *Time Segment 1 [3-16]*

This parameter specifies the length of the TSEG1 segment in TQ units. The value of TSEG1 is programmable from 3 to 16 TQ, and must be greater than or equal to TSEG2.

TSEG2 *Time Segment 2 [2-8]*

This parameter specifies the length of the TSEG2 segment in TQ units. The value of TSEG2 is programmable from 2 to 8 TQ, in compliance with the formula:

$$(SJW + SBG + 1) \leq TSEG2 \leq 8$$

Baud Rate Register

Select a value 000 – 255 for the Baud Rate Prescaler (BRP)

Data Byte Order

- 0 The data is received & transmitted in the following order: Data byte 3, 2, 1, 0, 7, 6, 5, 4.
- 1 The data is received & transmitted in the following order: Data byte 0, 1, 2, 3, 4, 5, 6, 7.

Message Length

The value from the pulldown menu determines how many data bytes are used for transmission or reception.

- 2 bytes (One 16 bit word)
- 4 bytes (Two 16 bit words)
- 6 bytes (Three 16 bit words)

8 bytes (Four 16 bit words)

Receive Mailbox ID

Enter a standard 11bit or extended 29 bit address identifier for the Sunstream Receive Mailbox.

Receive Mailbox Acceptance Mask

If the Acceptance Mask is enabled, enter the desired standard or extended acceptance mask.

Transmit Mailbox ID

Enter a standard 11bit or extended 29 bit address identifier for the Transmit Mailbox. The Sunstream controller will transmit with this ID.

3.4.1 Baud Rate Calculations

Time Quantum (TQ) = (BRP + 1) / 40MHz

Bit time = (TSEG1 + 1) + (TSEG2 + 1) + 1

Baud rate is calculated as follows (in bits per second):

$$\text{Baud Rate} = \frac{40 \text{ MHz}}{(\text{BRP} + 1) \times \text{Bit Time}}$$

3.4.2 CAN Bit Timing

CAN Bit Timing Examples:

<u>TSEG1</u>	<u>TSEG2</u>	<u>Bit Time</u>	<u>BRP</u>	<u>Sampling Pt.</u>	<u>Baud Rate</u>
4	3	10	3	60%	1 Mbps
10	7	20	3	60%	500 Kbps
9	4	16	9	68.8%	250 Kbps
14	8	25	15	64%	100 Kbps
11	6	20	39	65%	50 Kbps

3.5 Program

Write your own fully featured custom motion program.

Create up to three (3) programs with a 64 line limit. Programs can be concatenated to create a single 192 line program.

3.6 Edit Points

Real-Time communication with the Sunstream servo enables direct programming or teaching up to 128 position points.

Under the Edit Points tab, click **START EDIT** to initiate real time communication with the Sunstream controller. You will see the following information written to the GUI screen. Select from the appropriate menu items.

EDIT POINT:	–
PROGRAM POINT	1
TEACH POINT	2

The Sunstream controller has memory allocated for 128 position points. These points are pre-programmed at increments of 0.2 inches. For example, POINT 000 is pre-programmed to correspond to a position of 00.000 in., POINT 001 is pre-programmed to correspond to a position of 00.200 in, POINT 050 is pre-programmed to correspond to a position of 10.000 in. etc.

Press (1) to modify internal points by using the keypad to enter a numerical value for the selected point.

Press (2) to modify internal points by manually moving the cylinder rod to the desired location for the selected point.

EDIT POINT > PROGRAM POINT

PROGRAM POINT:	–
POINT(0-127)	011
DIST	02.200

Use keypad to select the desired point to be modified, and press Enter. Type in numerical value for position in inches. Hit Enter to select another point.

EDIT POINT > TEACH POINT

TEACH POINT	
POINT	000
DIST	05.203

Use keypad to select the desired point to be modified, and press Enter. The current position of the piston will be written to the screen, and is continuously updated as the rod is pulled to its desired location. Hit Enter to lock in the desired point.

3.7 Operate

Real-Time communication with the Sunstream servo enables the operation of a Program through the GUI host, or setting the software (electrical) null position of the spool.

Operating the servo continuously through GUI is not recommended, and should be restricted to basic tuning and performance assessment.

Under the Operate tab, click **OPERATE** to initiate real time communication with the Sunstream controller. You will see the following information written to the GUI screen. Select from the appropriate menu items.

EXTERNAL	F4
PROGRAM 1-3	F1-F3
NULL SPOOL	S
TUNE SERVO	T

Press (F4) to run Servo with an external device (CAN, I/O, RS-232)

Press (F1) to run Internal Program #1

Press (F2) to run Internal Program #2

Press (F3) to run Internal Program #3

Press (S) to null spool

Press (T) to tune servo (not yet available)