Beta RS-232 Manual V2

1.0 COMMUNICATIONS:

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 Beta OI Terminal Manual) If no connection is present, the software will proceed with initialization.

This manual describes how a Host can communicate with the servo controller via, RS-232 link, to:
- Request information from the Sunstream controller.
- Enable and disable operation of the actuator.
- Change parameter settings, such as maximum acceleration and velocity.
- Command the servo actuator to perform a specific task, such as Move to a Position.

1.1 RS-232

4 pin Binder Series 680 connector: transmit, receive, +5V, GND. This GND pin is an isolated ground reference shared all communication circuits present on a particular actuator. The +5V pin should not be connected to any external source. It's used exclusively to provide power to the handheld Operator Interface Terminal. www.binder-usa.com

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.

All communication pins have peak galvanic isolation of 4kV provided by Texas Instruments series ISO7220 digital isolators. These digital isolators operate off a +5V supply (referenced to the isolated GND) and have TTL input thresholds. Outputs are 4mA CMOS.

Serial transmission from PLC, received by Sunstream Servo

Bit 7, the upper bit of the 8 bit word, when set to 0 designates that the following 7 bits transmitted by the PLC to the servo will define an Input Designation (ID). An ID commands the servo to carry out a specific physical task, such as moving to a specific point; an informational task, such as modifying the maximum permissible acceleration; or a logical task, such as initiating operation after a DSP reset. When the Sunstream Servo has successfully received a transmission from the PLC defining an ID, it responds by acknowledging the reception. The acknowledgement word will have two leading 1's, and the remaining 6 bits will be the address of the received instruction. For example, when the Sunstream controller receives a "Set Position Input" (03h) ID, the acknowledgement transmitted will be C3h.

If two IDs are transmitted sequentially, the servo recognizes only the latter input designation.

When Bit 7 is set to 1, the following 7 bits transmitted by the PLC to the Sunstream Servo will define an Input Value (IV). This word will assign a quantifiable value to a task designated by the preceding PLC transmission. For example, if the PLC transmits 03h (00000011b), the servo will recognize a command to

move to a new position. If the PLC then transmits 8Eh (10001110b), the servo will recognize that it is to move to a position designated by point 14.

When the Sunstream Servo has successfully received an Input Value, it responds by acknowledging the reception by transmitting the word 83h.

If the host sends the Sunstream controller an invalid instruction, the Sunstream controller will inform the host by transmitting the word 82h.

If the host sends the Sunstream controller a new instruction while it's busy executing a present instruction, a word will be transmitted to indicate that the controller is still busy. This word is 80h.

INPUT DESIGNATION DEFINITIONS (0xxxxxxx):

- **(00h) Halt**   **(00000000b)**
  - o When the Sunstream actuator receives a Halt command, it completes execution of the current command, but will ignore any further commands until it receives an Operate signal.
  - o Upon initializing at power up, the Sunstream actuator will be in Halt mode.
  - o This ID does not require a subsequent IV.

- **(01h) Operate**   **(00000001b)**
  - o Unlocks the Sunstream actuator from Halt mode.
  - o The user must provide the Sunstream actuator an Operate command before the servo becomes operational.
  - o This ID does not require a subsequent IV.

- **(02h) Reset**   **(00000010b)**
  - o Sunstream controller is reset and placed in Halt mode.
  - o This ID does not require a subsequent IV.
  - o No acknowledgement is transmitted.

- **(03h) Position Point Input Command**   **(00000011b)**
  - o This commands the servo to move to one of 128 points.
  - o This ID requires a subsequent IV to define a specific point.

- **(04h) Force Input Command**   **(00000100b)**
  - o This commands the servo to output a specific force, regardless of position.
  - o Maximum force of cylinder is assumed to be (100psi)*(Bore Area) lbf.
  - o This ID requires a subsequent IV to assign a numerical value to force.

- **(05h) Set Maximum Acceleration**   **(00000101b)**
  - o Limits the maximum acceleration of the servo.
  - o Setting applies to both extension and retraction.
  - o Acceleration setting may be changed at the completion of any command to the servo.
  - o This ID requires a subsequent IV to assign a numerical value to acceleration.

- **(06h) Set Maximum Velocity**   **(00000110b)**
  - o Limits the maximum velocity of the servo.
  - o Setting applies to both extension and retraction.
  - o Velocity setting may be changed at the completion of any command to the servo.
  - o This ID requires a subsequent IV to assign a numerical value to velocity.

- **(07h) Set Force Offset**   **(00000111b)**

- o This input informs the servo to expect a disturbance force which either acts to extend or retract the cylinder. This information increases the accuracy with which the servo can move to a specific point by zeroing out the force offset error.
  - o A force which will cause extension of the cylinder is a positive disturbance force, and a force which will cause retraction of the cylinder is a negative disturbance force.
  - o For example, an actuator disposed in a vertical orientation which extends against gravity will be considered to have a negative force disturbance equal to the weight of the load.
  - o This ID requires a subsequent IV to assign a numerical value to force outset.

- **(08h) Set Positional Resolution**   **(00001000b)**
  - o Sets the window of accuracy within which the servo is considered to be in position.
  - o This ID requires a subsequent IV to assign a numerical value to positional resolution.

- **(09h) Set Force Resolution**   **(00001001b)**
  - o Not yet available

- **(0Ah) Soft Touch Input Command**   **(00001010b)**
  - o Not yet available

- **(0Bh) Override**   **(00001011b)**
  - o Allows an external override of the program sequence. If a command is presently in execution, such as a move to a new Position Point, the servo controller will ignore any new commands until the present command has completed. By transmitting an Override signal to the servo controller, this feature is temporarily disabled.
  - o This ID does not require a subsequent IV.

- **(0Ch) Query Status**   **(00001100b)**
  - o If the servo is busy executing an instruction, it will transmit the word 80h.
  - o If the servo is ready to accept a new instruction, it will transmit the word 81h.
  - o No separate acknowledgement is transmitted

- **(0Dh) Query Position**   **(00001101b)**
  - o To obtain a 15 bit representation of cylinder position, two sequential "Query Position" commands must be sent.
  - o The resolution of the position signal is stroke (in.) / 32768.
  - o Upon receiving the first "Query Position" ID, the Sunstream controller will store the current position as two 8-bit words, and transmit the first word. The MSB of this first word will always be 0.
  - o Upon receiving the second "Query Position" ID, the Sunstream controller will transmit the 2nd 8 bits of the cylinder position.
  - o No separate acknowledgement is transmitted.

INPUT VALUE DEFINITIONS (1xxxxxxx):

- **Assign Position Point Value**
  - o Select point 0 through 127
  - o Each point can be programmed to a position with 0.001" resolution.
  - o 80h (1000 0000b) commands the servo to move to Point 000
  - o FFh (1111 1111b) commands the servo to move to Point 127
  - o Must be preceded by ID of 03h.

- **Assign Force Input Value**
  - o Maximum force of cylinder is assumed to be (100psi)*(Bore Area) lbf.

- o The leading bit is a sign bit: a leading 1 indicates a negative force command
  - o The trailing 6 bits represent magnitude (2^6 = 64 divisions)
  - o Force Setting = (RS-232 input)*(100psi)*(Bore Area)/(64)
  - o 00h represents Force Input Command of 0.0 lbf.
  - o C0h (1100 0000b) represents Force Input Command of -(100psi)*(Bore Area) lbf.
    - ▪ C0h > -123 lbf. For 1.25" bore actuator
    - ▪ C0h > -314 lbf. For 2.00" bore actuator
    - ▪ C0h > -830 lbf. For 3.25" bore actuator
  - o BFh (1011 1111b) represents Force Input Command of +(100psi)*(Bore Area) lbf
  - o A positive force extends the cylinder, and a negative force retracts the cylinder
  - o Must be preceded by ID of 04h.

- **Define Maximum Acceleration**
  - o The maximum programmable acceleration through RS-232 is 5.25 g's
  - o No sign bit. Magnitude applies to both acceleration and deceleration.
  - o Acceleration magnitude is represented by 7 bits (2^7 = 128 divisions)
  - o FFh (1111 1111b) represents a maximum acceleration magnitude of 5.25 g's
  - o 9Ah (1001 1010b) represents a maximum acceleration magnitude of 1.05 g's
  - o 1.0g = 386 in/s^2
  - o Must be preceded by ID of 05h.

- **Define Maximum Velocity**
  - o The maximum programmable velocity through RS-232 is 64 in/s
  - o No sign bit. Value limits the velocity magnitude during both extension and retraction.
  - o Velocity magnitude is represented by 7 bits (27 = 128 divisions)
  - o FFh (1111 1111b) represents a maximum velocity magnitude of 64 in/s.
  - o 9Ah (1001 1010b) represents a maximum velocity magnitude of 13 in/s.
  - o Must be preceded by ID of 06h.

- **Define Force Offset**
  - o Maximum allowable force offset will be (50psi)*(Bore Area) lbf. If the system is expected to be subject to a disturbance greater than this value, then a servo actuator with a larger bore size needs to be selected.
  - o The leading bit is a sign bit: a leading 1 indicates a negative force command
  - o The trailing 6 bits represent magnitude (2^6 = 64 divisions)
  - o Force Setting = (RS-232 input)*(50psi)*(Bore Area)/(64)
  - o A disturbance force which extends the cylinder should be assigned a positive sign.
  - o A disturbance force which retracts the cylinder should be assigned a negative sign.
  - o The default software setting assumes there to be no disturbance force.
  - o C0h (1100 0000b) represents Force Input Command of -(50psi)*(Bore Area) lbf.
  - o BFh (1011 1111b) represents Force Input Command of +(50psi)*(Bore Area) lbf.
  - o Example: Consider a 2.0" bore servo actuator disposed in a vertical orientation, such that the rod extends against gravity to lift a 40 pound weight. Physically this represents a static load disturbance of -40 lbf to the servo control system, and will compromise the servo performance to a degree. When this disturbance load is known, it can be zeroed out to improve servo performance. To zero out the disturbance in this example:
    - ▪ (RS-232 input) = 64*(-40 lbs) / (50psi*3.14in^2)
    - ▪ (RS-232 input) = -16.305
    - ▪ (RS-232 input) = 1111 0000b (remember that leading bit designates IV, and that the 2nd leading bit is a sign bit)
  - o Must be preceded by ID of 07h.

- **Define Positional Resolution**
  - o When the servo has settled within the value specified by Positional Resolution,
  - o No sign bit. Resolution is considered to be a value higher or lower than target position.
  - o Position resolution is represented by 7 bits for a range of 128

- o Position resolution (in.) = (0.004)*(RS-232 input)
- o For example: an RS-232 input of 8Bh sets the position resolution to 0.044 in.
- o Must be preceded by ID of 08h.

- **Define Force Resolution**
  - o Not yet available

- **Assign Soft Touch Value**
  - o Not yet available

Serial transmission from Sunstream Servo, received by PLC

The servo transmits three basic types of information to the PLC: State Feedback, such as the position of the servo actuator; and acknowledgement to reception of information from the PLC; or a logic/status feedback which provides the PLC with miscellaneous information on the operational status.

POSITION FEEDBACK:

When queued, the servo transmits the position of the cylinder in two bytes, with the first bit of each byte designating the transmission as a position signal, and the second bit of each byte designating the subsequent 8 data bits to be either the upper or lower half of a 15bit word. The programmer must concatenate these two words to form a single word with 15 bit resolution. The positional resolution of this serial feedback can be calculated by:

Resolution (in.) = (Maximum cylinder stroke) / 32768

0xxxxxxx   First 7 bits of present position
xxxxxxxx   Second 8 bits of present position

LOGIC/STATUS FEEDBACK:

- **(80h) Busy**
  - o Servo is busy with a present command.

- **(81h) Ready**
  - o Servo is ready to accept a new input from PLC

- **(82h) Invalid Argument**
  - o An invalid ID or IV has been received by the Sunstream Controller.

- **(83h) Acknowledgement of Value**
  - o A valid IV has been received by the Sunstream Controller.