Paw-Taw-John Services, Inc.™

S-Series SERVO SENSOR™ CONTROLLER
OPERATION & TECHNICAL DATA MANUAL

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SECTION 1
OVERVIEW AND SPECIFICATIONS

Paw-Taw-John Services, Inc.
18125 N Ramsey Road
Rathdrum, Idaho 83858
(208) 687-1478
Fax (208) 687-4148
www.pawtaw.com

Paw-Taw-John Services, Inc.™ (PTJ) is a designer and manufacturer of semi-custom servo controller systems and associated components. The company brings together individuals with decades of experience in systems and software design, custom electrical and electronic systems manufacturing and technical sales with expertise in system manufacturing. PTJ specializes in systems that provide greater user flexibility, lower maintenance, increased productivity, quicker pay-back and higher yield. Our systems are in use worldwide by companies wanting more intelligence with their controllers.

ABOUT SERVO CONTROLLERS

A servo control system is an electro-mechanical system that knows its position and allows external input, whether from sensors, computers or humans, to produce a change in position. In most applications, the servo system is used to control linear motion.

Each isolated linear motion is referred to as an axis. Servo Sensor™ Controller (S-series) systems are used to control one or more axes. Several of these may be interactive in multi-axis systems such as moving multiple axes simultaneously while still allowing individual axis adjustment.

A simple control system consists of a Servo Sensor™, a hydraulic or pneumatic cylinder, a servo valve and an interface device that allows commands to be given to the Servo Sensor™.

S Series SERVO SENSOR™ CONTROLLER

Produced through an industry synergy, a new generation closed-loop control system offers a more compact package at lower total cost while cutting response time to half that of other industrial closed-loop systems.

The Servo Sensor™ was co-developed by PTJ and MTS ® Sensors Division. Manufactured by PTJ in Idaho, the platform for the unique design is an MTS Temposonics III magnetostrictive linear position sensor.

GENERAL DESCRIPTION

The Servo Sensor™ is a complete servo controller installed and interfaced inside an MTS Temposonics® III sensor platform. It consists of a Servo Controller Module (SCM), driver module (DM) and sensing element (SE) combined inside the sensor head body. MTS® proprietary technology is integrated directly to the SCM. This integration in the SCM provides the Servo Sensor™ with very fast displacement measurements and servo control outputs. Hydraulic cylinders can typically be positioned to .001".

FEATURES

- Operates from single +24 Vdc power supply
- Low supply current- typical 100mA with current controlled devices
- Voltage or current drive output
- Single cable run to Servo Sensor™
- Servo device interfaced at end cap of Servo Sensor™
- ~1 millisecond Servo Loop update time
- Two wire RS-485 network compatible
- Up to 26 units per link
- ASCII 8 bit communications
- User selectable Baud Rates
- 16 bit CRC error checking
- Visible indications for power and status located on end cap
- Same robust design as MTS Temposonics® III sensor
- Four user selectable modes of operation
- Reverse polarity protected
- ESD protected

Set up Program

- Setup software available in DOS/Windows 95/98/NT formats
- Programmable port location

Servo Sensor™ Controller Applications
- Hydraulic cylinders – linear motion
- Pneumatic cylinders
- Linear measure in control of ball screw applications, etc.

Industry Application Areas
- Aerospace
- Automotive
- Food products industry
- Metal manufacturing
- Plastic manufacturing
- Steel manufacturing/production
- Wood products industry

Certifications
- CE Certified
  -EN50082-2 Immunity
  -EN50081-2 Emissions
- FCC Part 15 Subpart B
- Industry Canada ICES-003
- Tested to IP67 Standard

COMPONENT DESCRIPTIONS

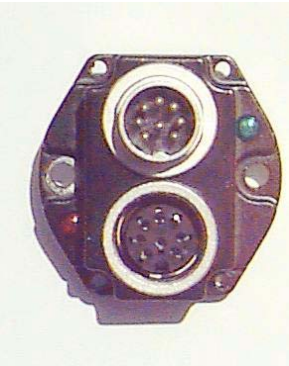
Pressure Housing
- Rod style, hollow stainless steel tube for basic mounting structure
- Inserts into hydraulic/pneumatic cylinders with bored pistons

Sensing Element
- Self-contained magnetostrictive device anchored inside the main body of sensor cartridge

Driver Module
- Provides power conversions for driving the SE
- Supplies power for SCM
- Provides data control interfacing to SCM

Servo Control Module
- Unit consists of MTS proprietary data acquisition technology, high-speed micro controller, RS-485 interface, servo driver and a power conversion device.

End Cap
- Houses one eight pin female connector for servo cable, one eight pin male connector for com cable
- Red and green visual status indicators (LED's)



HARDWARE SPECIFICATIONS

Drive Output
- Output: current, thermal and short circuit protected
- Range: 0 to ± 10 Vdc or 0 to ±50 mA, factory set
- Resolution: 12 bit

Loop Update Time
- ~1millisecond

Servo Sensor™ Update Time
- **~3.2**milliseconds per probe at 115.2kb

Resolution
- In Inches
  0.0005" to 32.0"
  0.001" to 65.0"
  0.002" to 131.0"
- In Millimeters
  0.01mm to 655.35 mm
  0.02 mm to 1310.07 mm
  0.04 mm to 2621.40 mm
- Servo Sensor™ measuring scale for inches or millimeter and resolution are determined at time of ordering

Discrete I/O
- Isolation: 2500 VAC
- Three source 24 Vdc inputs
- One source 24 Vdc output; 25 mA max
- 3 microsecond on/5 microsecond off
- Maximum input voltage: 24.8Vdc

Power Requirements
- Voltage: +24 Vdc, -5 to +5%
- Current: 100 mA typical with ±50 mA drive output
- DC-DC converter isolation: 1000 Vrms

Relay Contact (located in cap)

- 3.6 Amps Max. @24vdc continuous

Temperature
- Range –40 to 75°C

Dimensions
- Servo Sensor™ length: Stroke dependent
- End cap length: 6.5 inches including straight connectors

Communication Interface
- RS-485 two wire
- Eight bit addressing
- 16 bit CRC
- Baud rates: 19.2, 38.4, 57.6, 115.2 kb
- Eight (8) command bytes to Servo Sensor™
  - Byte 1 – Device Address
  - Byte 2 – Command
  - Byte 3 – Master Address
  - Byte 4 – Data
  - Byte 5 – Data
  - Byte 6 – Data
  - Byte 7 – CRC MSB
  - Byte 8 – CRC LSB
- Eight (8) response bytes from Servo Sensor™
  - Byte 1 – Master Address
  - Byte 2 – Command
  - Byte 3 – Device Address
  - Byte 4 – Data
  - Byte 5 – Data
  - Byte 6 – Data
  - Byte 7 – CRC MSB
  - Byte 8 – CRC LSB

Visual Indicators
- Indicators located at end cap of controller
- Red lamp indicates power applied
- Green lamp flashes at rates that equate to operation or faults

SYSTEM INTEGRATION

Single Unit Slave System

During normal operations, the Servo Sensor™ communicates serially with a host computer or PLC in time frames based on the baud rate. The host computer or PLC monitors status and position information sent by the unit.

When a new target is necessary, target and velocity commands are sent one time to the Servo Sensor™. If the target is acknowledged, the system returns to reading position and status.

An operator interface panel allows the user to input new target information to be sent to the Servo Sensor™ via the host computer.

Multi-Unit Slave System
A multiple slave system would be integrated similar to a single slave system, except Servo Sensor ™'s would be installed on an RS-485 two-wire network. Installing multiple port RS-485 interface cards in the computer would expand the slave system. Address loading of the devices on a network would be required and would be accomplished using program software. Operator interfaces again would be organized through the PC, stand alone controllers or PLC's.

Discrete Control Inputs
The Servo Sensor™ has three independent discrete +24 Vdc inputs for control of the servo loop. They are Set Enable, Relay Enable and Trigger.

Discrete Control Output
This discrete output is a 24 Vdc signal that is used to indicate set complete or cycle complete. This output is dependent upon the Servo Sensor™ mode of operation. For further information see Operating Modes.

SECTION 2
DETAILED OPERATION INFORMATION

SERVO SENSOR™ OPERATION

SAFETY FEATURES

The Servo Sensor™ has two independent discrete control input lines that are used for motion control safety. They are Set Enable and Relay Enable. These inputs will **always** be active for motion to occur. When using the serial mode, the device provides a status word that can be used for fault identification and external control of motion. The following information relates to servo loop control for hydraulic and pneumatic cylinders.

Set Enable
The Set Enable is an external discrete input to the Servo Sensor™ provided by a host controller or other switched device that allows the Servo Sensor™ to accept target information and in turn will allow movement. When the Set Enable is low, the Servo Sensor™ will not accept target information and the cylinder will maintain its present position. When the Set Enable is high, the Servo Sensor™ will accept target information and immediately cause the cylinder to move to a new position designated by the host controller.
The Set Enable has two programmable modes:

- In the first mode - when the Set Enable (active high) is applied and a target is sent to the unit, the Set Enable can be removed (active low) and the cylinder will continue and finish its targeted movement. No target information will be accepted until an active high is applied.

- In the second mode - when the Set Enable (active high) is applied and a target is sent to the unit, the cylinder will move to its targeted position. If the Set Enable (active low) is removed at any point during movement, the cylinder will stop moving immediately. To start movement again, the Set Enable (active high) and a new target will be required. So the Set Enable must be active for the duration of movement in this mode.

The Set Enable input can be used in conjunction with external devices, such as a proximity switch, photo eye or limit switch. The user can position these devices in such a way as to prevent movement in danger areas or create zones for movement.

Under all conditions with or without the Set Enable input, the servo controller will maintain or try to maintain its position target.

Relay Enable
The Relay Enable input controls a relay located in the end cap of the Servo Sensor™. A normally open contact controls the power to the servo device or the command lines to the servo device. These options are accomplished by installing pin jumpers within the J3 connector that attaches to P3 of the end cap. The control is designed for 24Vdc.

Generally, when 24Vdc power is removed from proportional valves, the spool inside assumes a "fourth position". This position blocks the pressure and tank ports, thus no pressured oil is applied to the cylinder. With proportional valves the relay contact could be used to power the valve.

All hydraulic systems using servo valves should have a hydraulic lock up valve installed for an external E-stop and should be external to the Servo Sensors™. The valve must be activated for applying hydraulics to the cylinders. When inactive, hydraulic pressure is removed from the cylinder/s.

Status/Fault Control
The Servo Sensor™ sends status bits to the host controller when used. Through software, this word can be used to control hydraulics, provide status of the hardware and fault information. Refer to Appendix B for more details.

Servo Drive Output
Prevention of motion is important when a fault might occur within the Servo Sensor™. The following faults will cause a zero output drive:

Temposonics® Feedback Bad
Bad Control Module

LED VISUAL FAULT INDICATIONS (LOCATED AT PROBE END CAP)

The green LED is pulsed to show the status of the Servo Sensor™. Status indications are described below.

- 1 sec ON, 1 sec OFF
- System OK and position is within IN Position window from target
- ½ sec ON, ½ sec OFF
- System OK, but not within IN Position window
- ½ sec On, 1 ½ sec OFF
  Error – no position data
- Stays on = error, system not running
- Stays off = error, system not running

LED BLINK RATE	.5sec.	.5sec.	.5sec.	.5sec.
BAD SERVO SENSOR™	ON	ON	ON	ON
BAD SERVO SENSOR™	OFF	OFF	OFF	OFF
BAD TEMPO	OFF	OFF	OFF	ON
IN MOTION	OFF	ON	OFF	ON
UNIT OK	OFF	OFF	ON	ON

RUN MODES OVERVIEW

The servo control program located inside the Servo Sensor™ offers four modes of operation. The Cycle, Increment, and Pulse mode use a sixty point set table that is programmed within the Servo Sensor™.

- The first mode is the Serial Mode. Machine control programs are loaded into a host computer, micro controller, or PLC. These programs can access the Servo Sensor™ internal parameters and/or command externally. Communications between the Servo Sensor™ and host is accomplished via a two-wire RS-485 interface. Three discrete inputs and one output provide external control and status.
- The second mode is the Cycle Mode. A set table is stored within the Servo Sensor™. The set table has 60 possible set points, velocities and dwell times available that make an axis perform a motion profile. Discrete inputs called Set Enable and Trigger control the start and continuance of the motion profiles contained in the set table. A discrete output from the Servo Sensor™ is used to monitor the status of the motion profile. Once the axis starts its sequenced motion events, the motion can be reset to a home position or stopped by toggling the Trigger input. The Set Enable can also stop the motion events anytime.
- The third mode is the Incremental Mode. User enters values in the set table within the Servo Sensor™. Each time the Trigger input is enabled the Servo Sensor™ will position incrementally to the next target related to the set table. This is accomplished through the set cable. The Motion Enable Control input must be on before movement can begin.
- The fourth mode is the Pulse Mode. This mode is predominately used by PLC's. Set points loaded within the Servo Sensor™ are accessed by supplying pulses from an output of the PLC. The pulse frequency is ~500 Hertz.

OPERATING (RUN) MODES

The following table designates which controls are used in specific modes:

	Serial	Cycle	Incremental	Pulse
Set Enable	X	X	X	X
Relay Enable	X	X	X	X
Trigger	O	X	X	X
Output-INPOS	X	X	X	X
Output-Cycle Complete	X	X	X	X

X = Used O = Not Used

MODE OPERATION EXAMPLES

The following sections discuss the three different modes of operation that use the internal Set table. By configuring value entries within the table, different motion profiles are obtainable. Use the Servo Sensor™ setup software for programming values in the set table.

The Serial mode is not discussed because it's use is for external controllers such as PC's, PLC's, and Stand alone controllers. All commands from the main controller are sent to the Servo Sensor™ over a serial link.

Rules

All motion starts at Set Point 1.
The Motion Enable input must be on at all times for movement.
The Trigger input starts cycles, is used for pulsing in the Pulse mode and increments through the Set Point table in the Increment Mode.
The set point values must be within the range of the stroke of the Servo Sensor™.

Set Point Column

- If Set point value equals 0 in any location of the desired movement, the end of cycle has been reached.
- If end of cycle is reached, the trigger input must be reset to start cycle again.
- Set point value equals 1-60 the motion will jump to that set point location and continue desired motion.

Velocity Column

- Up to three velocity changes are allowed in a motion direction.

Dwell Column

- If Dwell time = 0, the Set Point is not a set point but a point that the velocity changes in the desired motion.

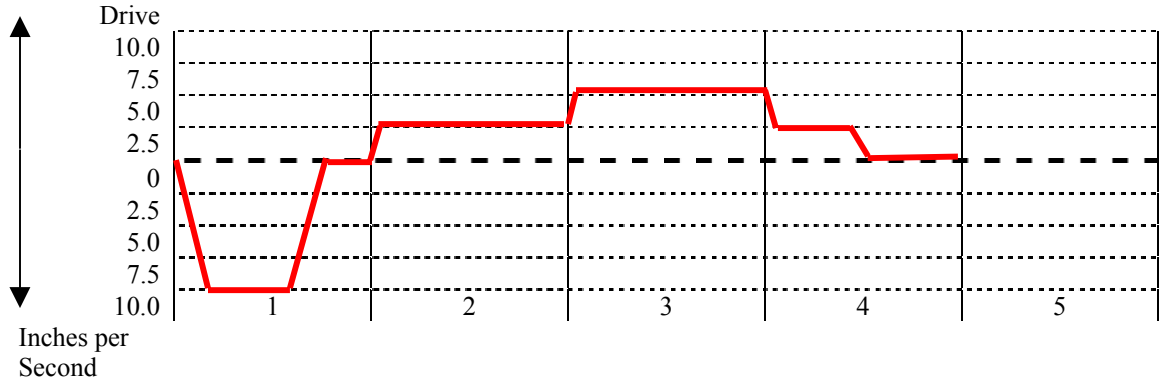
Typical Cycle Mode Program

a) Start at Set point #1
b) Go to Set point #1 at Velocity #1
c) After reaching Set point, remain there until Dwell time expires (timed in 100ths of seconds)
d) Then go to next Set point.
e) If Dwell time = 0, the Set point is not a Set point, but changes Velocity at the Set point. Only up to three (3) Velocity changes can be made to the final Set point.
f) If Set point = 0, the end of the cycle has been reached. System stops until the Trigger Input is on to reset the cycle.
g) If Set point = 1-60, the cycle will skip to Set point 1-60.
h) The Motion Enable input must be on for the cycle to operate. The cycle will stop if Set Enable is turned off.
i) Trigger Input will reset the cycle.
j) The discrete output can be used to indicate "In Position" or Cycle complete. User selectable within the system parameters.

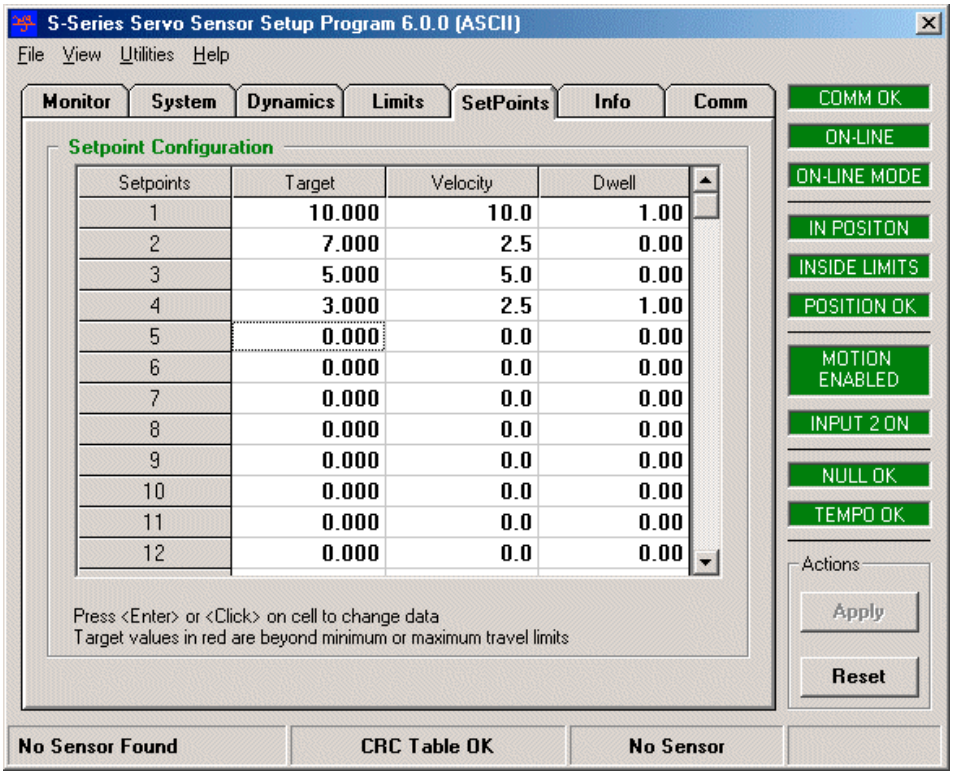
Cycle Mode Descriptive Examples

Example #1: Complex Cycle

Set #	1	2	3	4	5	6
Set Point	10000	07000	05000	03000	00000	
Velocity	100	025	050	025	000	
Dwell Time	00100	00000	00000	00100	00000	



1) Move to 10.000" at 10.0"/second and dwell there for 001.00 seconds.
2) Move to 07.000" at 0.25"/second.
3) Without stopping, accelerate to 05.0"/second and continue moving to 05.000".
4) Without stopping decelerate to 02.5"/second and continue moving to 03.000", dwell there for 001.00 seconds.
5) End Cycle.

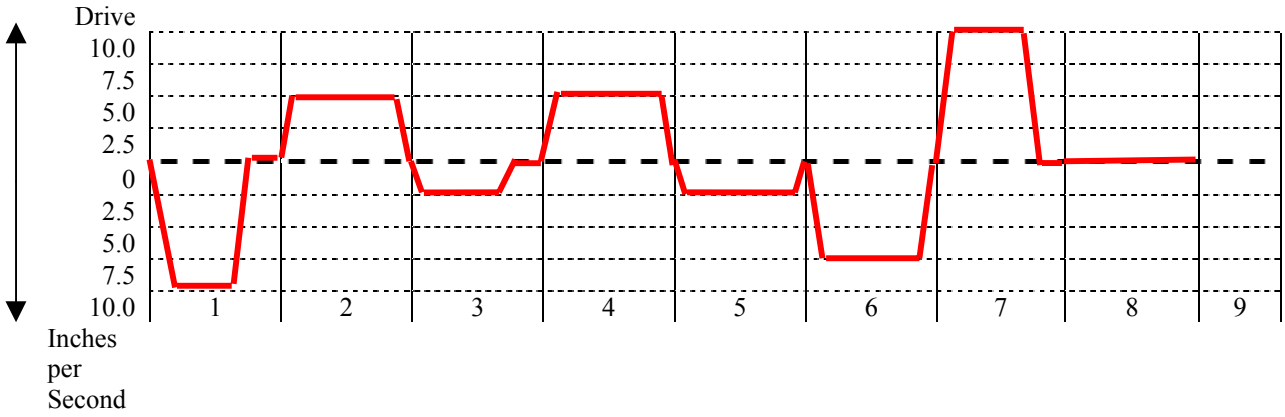


The picture to the left is a screen captured from an actual data entry for the movement described above. The origin is from the S-Series Setup Software for the Servo Sensor™.

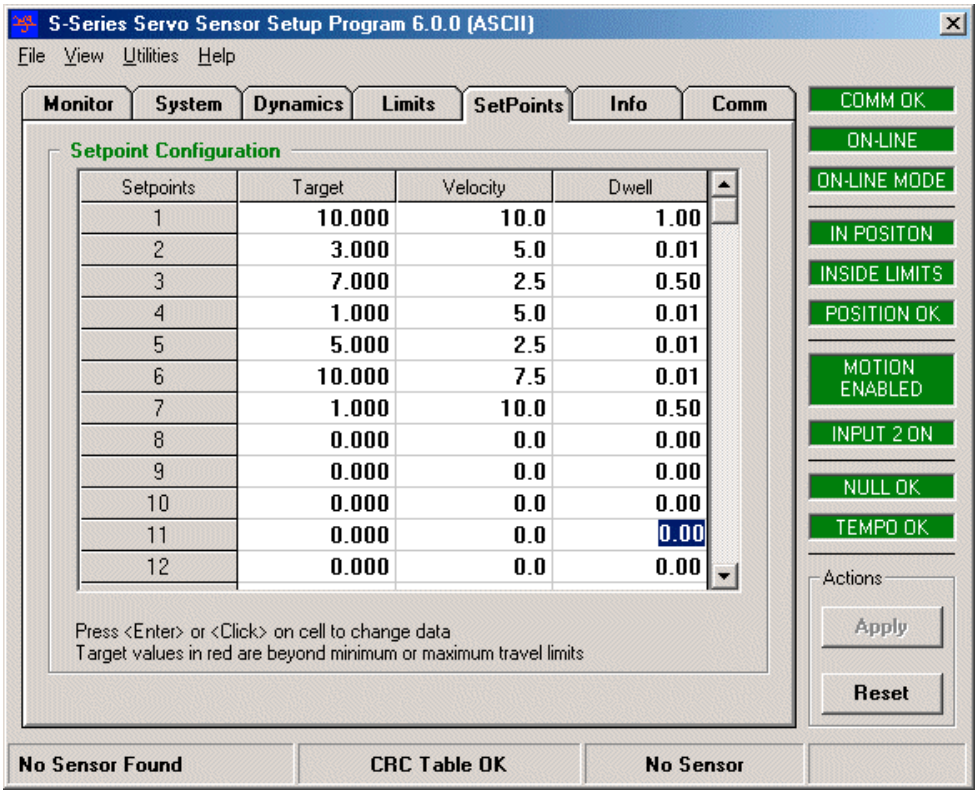
Please note the value entries have decimal places. The Velocity value for set point one is 10”/second. The dwell time is 1 second.

Example #2: Compound Cycle

Set #	1	2	3	4	5	6	7	8
Set Point	10000	03000	07000	01000	05000	10000	01000	00000
Velocity	100	050	025	050	025	075	100	000
Dwell Time	00100	00001	00050	00001	00001	00001	00050	00000



1) Move to 10.000" at 10.0"/second and dwell there for 001.00 seconds.
2) Move to 03.000" at 05.0"/second and dwell there for 000.01 seconds.
3) Move to 07.000" at 02.5"/second and dwell there for 000.50 seconds.
4) Move to 01.000" at 05.0"/second and dwell there for 000.01 seconds.
5) Move to 05.000" at 02.5"/second and dwell there for 000.01 seconds.
6) Move to 10.000" at 07.5"/second and dwell there for 000.01 seconds.
7) Move to 01.000" at 10.0"/second and dwell there for 000.50 seconds.
8) End cycle.

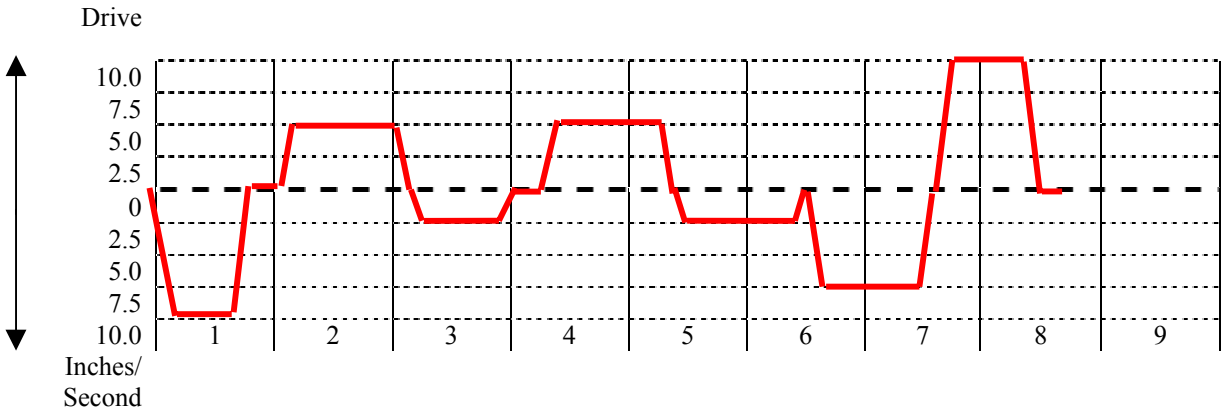


This screen reflects another motion where the stroke must dwell for changing direction. Again the cycle stops due to the zero values loaded in set point eight.

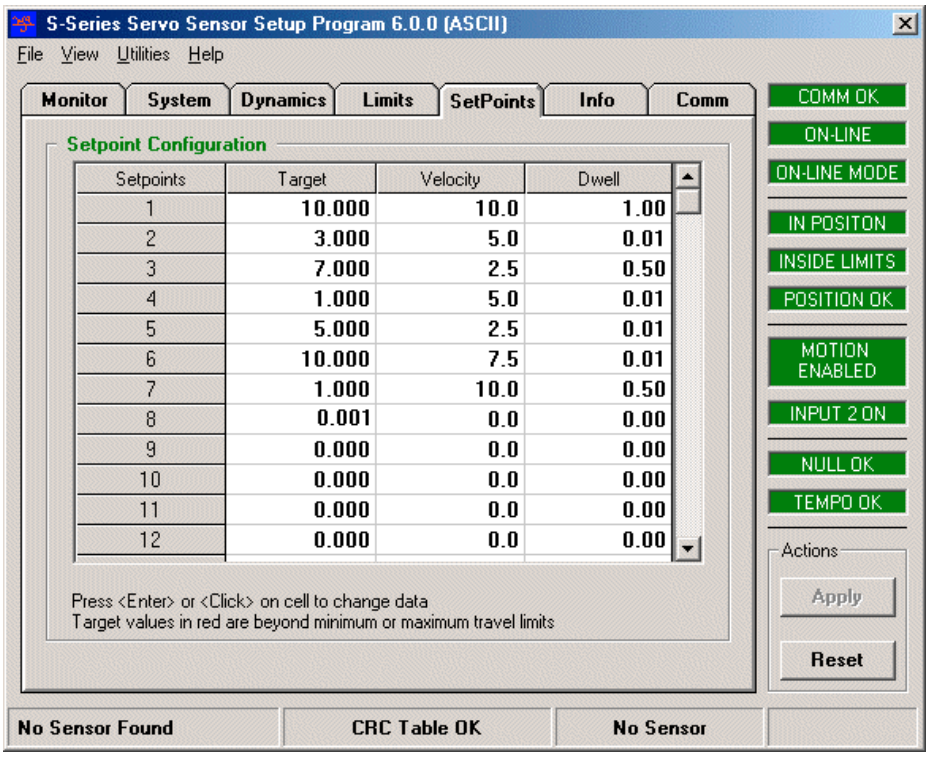
Example #3: Compound Looping Cycle

A compound looping cycle is the same as a compound cycle- Example #2, EXCEPT Set # 8 table entries.

Set #	1	2	3	4	5	6	7	8
Set Point	10000	03000	07000	01000	05000	10000	01000	**00001**
Velocity	100	050	025	050	025	075	100	000
Dwell Time	00100	00001	00050	00001	00001	00001	00050	00000



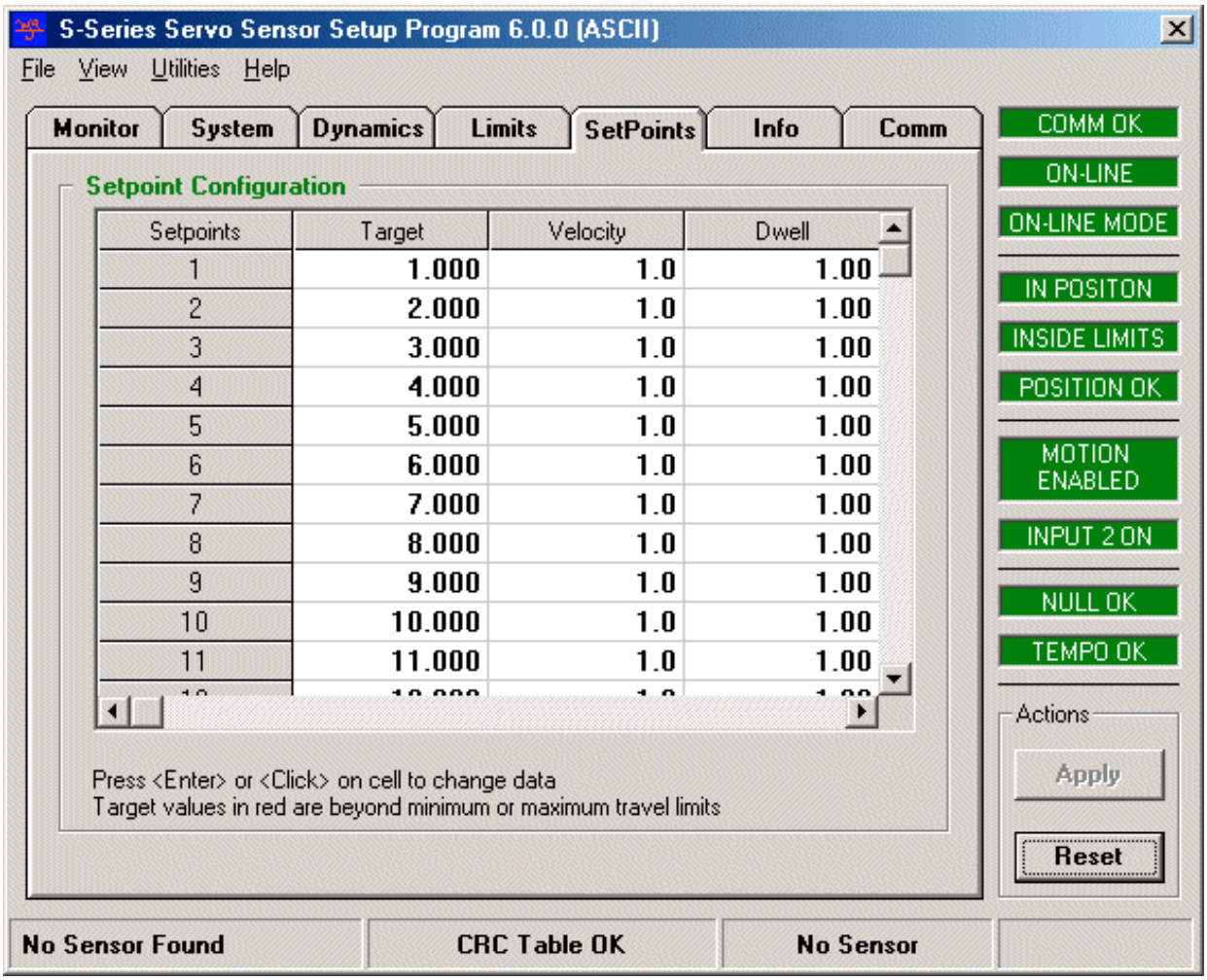
1) Move to 10.000" at 10.0"/second and dwell there for 001.00 seconds.
2) Move to 03.000" at 05.0"/second and dwell there for 000.01 seconds.
3) Move to 07.000" at 02.5"/second and dwell there for 000.50 seconds.
4) Move to 01.000" at 05.0"/second and dwell there for 000.01 seconds.
5) Move to 05.000" at 02.5"/second and dwell there for 000.01 seconds.
6) Move to 10.000" at 07.5"/second and dwell there for 000.01 seconds.
7) Move to 01.000" at 10.0"/second and dwell there for 000.50 seconds.
8) Return to Set point #1 and repeat cycle until Set Enable is removed.



The loaded values shown to the left will cause a continuous motion. Since a 1 is loaded in the set point eight location and zero values are loaded in Velocity and Dwell the motion will return to set point 1. This could have been a 2 or three. Using the rules as described earlier, and knowing the requirements of the move, a very complex move could be obtained.

Incremental Mode:

a) If Enable Input is on, advance 1 Set point each time Trigger is switched on.
b) Set points must have Velocity and Dwell times.
c) Also Velocity change mode can be used.



The screen above shows the set point table layout for the increment mode.

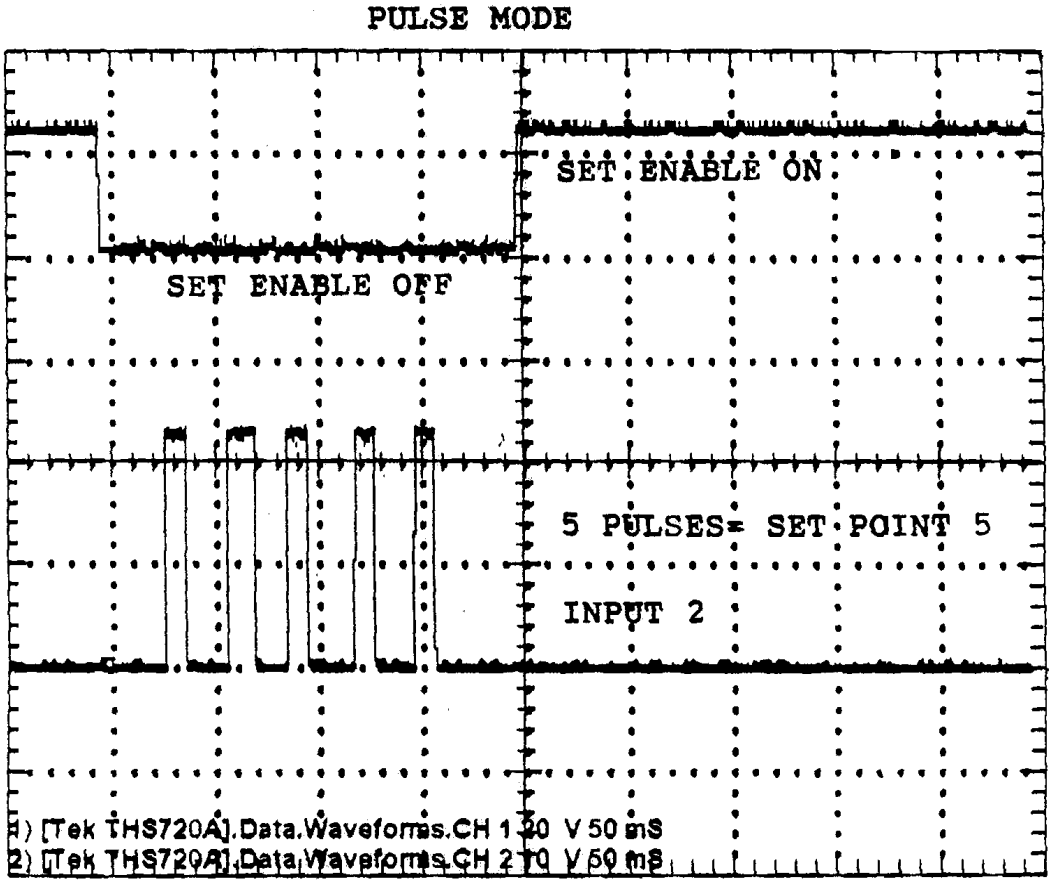
A consideration to remember is the set value must not exceed the stroke length of the Servo Sensor™.

Pulse Mode: -See diagram

a) Selects the desired Set point and Velocity by counting the pulses on the Trigger Input line while the Enable Input is off. When the Enable is turned on, a Set point will be entered per the pulse number. The pulse number equates to the 60 set point loaded in the controller. If a delay of 2 seconds occurs with no activity on the Trigger input and the enable set is off, no Set point will be selected.

b) Multiple Velocity can be selected as in the cycle mode by making dwell time = 0.

c) A valid Set point must have a Velocity and a value other than zero in the Dwell time field.



SECTION 3
INSTALLATION

Installation Considerations

Installations vary with each application of the Servo Sensor™ controller. The following are considerations that the user must consider when installing the Servo Sensor™ controller in a control environment.

- The +24vdc power supply should be regulated and meet the power requirements stated in the Servo Sensor™ controller specification.
- If a proportional valve is the item to be controlled, the power supply must have the current capability for both the valve and the Servo Sensor™.
- Always fuse the AC input side of the power supply with the correct fuse.
- A fuse is desirable for the +24vdc to the SS. It must be sized to accommodate the highest load.
- Proper wire size for the loads should be determined.
- Temperature and wash down environments should be considered that apply to the location of the SS.
- Since the SS is a linear device, the mounting should be parallel with the axis direction.
- When networking the SS for multiple axis systems, the RS-485 should be engineered to prevent data transmission losses. Using short stub lengths from the SS to the transmission link is desired. Consult factory for further info.

INITIAL TURN ON PROCEDURE

WARNING

INSURE ALL LOCAL LOCKOUT PROCEDURES ARE FOLLOWED!!!
CHECK CONTROLLED MEDIUM IS OFF

Power up sequence:

1. Turn **ON** power to SS
   a. Verify Red Power Led on SS is on.
   b. Verify Green Status Led is flashing at a steady on off rate.
   c. Verify controlled device (servo valve, proportional valve) has power
2. Turn **ON** control power (if used),
3. Turn **ON** hydraulic power,

Multiple Axis Network Installation Considerations

Multiple axis networks are possible due to the RS-485 two-wire feature of the SS. The custom cable provided by PTJ has the communications pair inside.

SECTION 4
PROBE
REPLACEMENT

SERVO SENSOR™ CONTROLLER REPLACEMENT

Recommended Servo Sensor™ removal and installation procedures are very important to minimize downtime and prevent further system damage. This chapter covers the steps for replacement of Servo Sensor used with hydraulic cylinders.

Some cylinders have probe guards attached to the end of the cylinder to prevent Servo Sensor damage. Other cylinders have the probe cap and cable completely enclosed. Use the appropriate wrenches necessary to remove and reinstall the guards.

The Servo Sensor has a connector ensemble located at the head electronics, which gives the user quick- disconnect ability. The Servo Sensor utilizes the Temposonics III platform, so removal and installation is easy.

REMOVAL OF SERVO SENSOR™

WARNING

OBSERVE ALL LOCAL LOCKOUT AND SAFETY PROCEDURES!

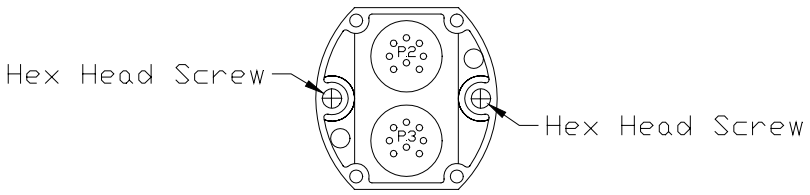
1) Turn off motion system power and control power to hydraulics. Lock Out!!!
2) Insure area around the Servo Sensor is clean and free of dirt, sawdust, and any other foreign material.
3) Survey the area in back of the cylinder to make sure there is sufficient room to withdraw the Servo Sensor without encountering obstructions.
4) Remove all protective covers from the back of the probe and cable.
5) Disconnect cables from Servo Sensor and secure away from work area.
6) Loosen two hex head screws at head electronics.
7) Slide the sensing element/electronics assembly out of the high-pressure tube.
8) Wipe cables clean of any hydraulic oil that might have come in contact with them. (Hydraulic oil can cause deterioration of cable integrity.)
9) Proceed with Servo Sensor replacement immediately.

INSTALLATION OF SERVO SENSOR™

WARNING

OBSERVE ALL LOCAL LOCKOUT AND SAFETY PROCEDURES!

1) Verify the new Servo Sensor is compatible with the old Servo Sensor.
2) Maneuver the Servo Sensor element tip into the hole of the high-pressure tube.
3) Tighten the probe securely with the hex head screws used during removal.
4) Clean and reconnect the cables to the probe.
5) Reinstall guard or protective probe and cable cover. (Note: this step may be required prior to reconnecting cable.)
6) Power may now be re-applied to the motion system.
7) Verify the Servo Sensor is working with the motion system electronics.
8) It is possible the Servo Sensor will need an address change when on a multiple axis system. Consult addressing procedure.
9) Turn on hydraulics power.
10) Proceed with operation of the machine.
11) If problems are still present, consult Troubleshooting chapter of the manual for other possible solutions.



Addendum #1

ABBREVIATIONS

Due to the size of displays used on the host devices, abbreviations are used for field labeling. The following list is provided to assist the user when a question occurs.

Accel	Acceleration
Addr	Address
Car	Carriage
Carr	Carriage
Ctl or Cntrl	Control
Cyl	Cylinder
Decel	Deceleration
Dec.	Decrease
Dir	Direction
Dist.	Distance
Elmt	Extend Limit
Ena	Enable
Ext. or Extnd	Extend
Ewind	Extend window
F	Face
Fract.	Fraction
Fwd	Forward
Grad	Gradient
L	Left
In	Inputs
Inc.	Increase
Incr.	Increment
Min.	Minimum
Out	Outputs
P or Pos	Position
Para	Parameters
Paramtr	Parameters
Pnts	Points
PS	Position
R	Right
Ret or Retct	Retract
Rev	Reverse
Rlmt	Retract limit
Rwind	Retract window
Sel	Select
SS	Servo Sensor™
T or Targ	Target
Vel.	Velocity
Windw	Window
777ss	Old 9-bit Servo Sensor™

Addendum #2

S-SERIES Servo Sensor™ Controller

GLOSSARY OF TERMS

A

ACCEL EXTEND (1 to 255): Defines the servo output on ramp delay to a maximum drive condition. Value 255 is fast.

ACCEL RETRACT (1 to 255): Same as ACCEL EXTEND; except for movement in the opposite direction.

ACCELERATION: Defines the servo output on ramp delay to a maximum drive condition.

ADDRESS (1 to 26): Entry value determines the Servo Sensor™ Address. Multiple axis applications require each unit to have a separate address.

AIR CYL SELECT IF=1: If one is entered, an air motion algorithm is used.

AUTO NULL ENABLE: Integral Gain: An entered value that corrects for position errors when the controlled device is not balanced.

AUTO NULL WINDOW: Integral Window: Value defines a window when integral gain is used in relation to the target position.

B

BAUD RATE: Entry value determines the baud rate for the Servo Sensor™ communications.

C

CYCLE MODE: A mode of operation, including complex, compound and compound looping.

D

DECEL EXTEND (1 to 255): Defines the servo output off ramp delay from a maximum drive condition.

DECEL RETRACT (1to 255): Same as DECEL EXTEND; except for movement in the opposite direction.

DECEL WINDOW EXTEND (1 to 255): Defines an area that deceleration is not used before the positioning device reaches target.

DECEL WINDOW RETRACT: Same as DECEL WINDOW EXTEND; except for movement in the opposite direction.

DECELERATION: Defines the servo output off ramp delay from a maximum drive condition.

DECELERATION MINIMUM POSITION: Defines an area that deceleration is not used before the positioning device reaches target.

DERIVATIVE GAIN: An entered value that determines a rate of movement in relation to the velocity that a positioning device moves. If the value is too small the positioning device will move slowly when making small movements.

DERIVATIVE WINDOW: Determines a window of positioning error in relation to the rate of movement of a positioning device.

DIFFERENTIAL GAIN: An entered value that determines a rate of movement in relation to the velocity that a positioning device moves. If the value is too small the positioning device will move slowly when making small movements.

DIFFERENTIAL WINDOW: Determines a positioning error in relation to the rate of movement of a positioning device.

DRIVE LIMIT EXTEND (1 to 255): Determines the amount of current/voltage output in the forward movement of a positioning device. Value must be greater than or equal to VELOCITY GAIN entry for velocity applications.

DRIVE LIMIT RETRACT (1 to 255): Same as DRIVE LIMIT EXTEND;. Except for movement in the opposite direction.

DRIVER MODULE (DM): The DM provides the power conversions for driving the SE and supply power for the SCM. It also provides data control interfacing to the SCM.

E

END CAP: The end cap contains connector receptacles, visual status indications and ESD protection.

F

FORWARD SERVO DRIVE MAXIMUM: Determines the amount of current/voltage output in the forward movement of a positioning device.

FORWARD VELOCITY MAXIMUM: Value defines the rate of motion of a positioning device.

FREQUENCY: Displayed value entry from the PARAMETERS Mode of the XXXproj.exe program. This value is the crystal frequency used inside the Servo Sensor™.

G

GAIN EXT (1-255) Proportional Gain: An entered value that is multiplied with the position error when a positioning device is moving. If the value is too high, the positioning device will hunt (oscillate) when it reaches a target. If this value is too low, the positioning device will not attain is target position.

GAIN RET (1 to 255): Same as GAIN EXT; except for movement in the opposite direction.

H

I

IN POSITION WINDOW: Position Error Window: A value entered that describes the allowable error between a target position and actual feed back position. The Servo Sensor™ INPOS/Cycle output turns on when target and actual position are within this window.

INCH/METRIC SELECTION: Specifies the type of measurement system used for data position information.

INCREMENTAL MODE: A mode of operation allowing the 777ss to step through pre programmed set points one at a time.

INTEGRAL GAIN: An entered value that corrects for position errors when the controlled device is not balanced.

INTEGRAL WINDOW: Value defines when integral gain is used in relation to the target position.

J

K

L

LOOP CYCLE TIME (1=500microsec, else One milli-sec.): Determines the speed of the update time of the servo loop.

M

MAX. TRAVEL LIMIT: Software limit that defines the maximum position of a linear motion.

MAXIMUM TARGET VALUE: Software limit that defines the maximum position of a linear motion.

MILLIMETER ENABLE IF 1=Inch/Metric Selection: Specifies the type of measurement system used for data position information.

MIN. TRAVEL LIMIT: Software limit that defines the minimum position of a linear motion.

MINIMUM TARGET VALUE: Software limit that defines the minimum position of a linear motion

N

NULL ZERO POINT: Value entry adjusts the output of the servo loop when initialized.

O

OPERATING MODES: One of four operating (or Run) modes: PC/Serial, Cycle, Increment or Pulse.

OUTPUT MODE (1=CYCLE COMPLETE, ELSE INPOS): This entry selects how the discrete output from the 777 Servo Sensor™ Controller will operate. When Cycle Complete is activated, the output only comes on when a programmed cycle is completed. If the entry is other than the Cycle Complete mode, the output will come on when the target and actual position error are within a programmed limit entered in Limits Table.

P

POSITION ERROR WINDOW: A value entered that describes the allowable error between a target position and actual feed back position.

PROBE GRADIENT: Displayed values of 48 and 49 data entries.

PROBE LENGTH: Active stroke length of probe used.

PROBE SCALE CALCULATION: Section title for resolution calculations.

PROPORTIONAL GAIN: An entered value that is multiplied with the position error when a positioning device is moving. If the value is too high, the positioning device will hunt (oscillate) when it reaches a target. If this value is too low, the positioning device will not attain is target position.

PULSE MODE: A mode of operation allowing the 777ss to be controlled by on/off voltage levels such as from a PLC.

Q

R

READOUT DIRECTION (1=EXTEND to 0): Changes the measurement direction.

RELAY ENABLE: Discrete control input that can be used to energize or de-energize an external device through the P3 connector.

RESOLUTION: Customer determined resolution of the sensor portion of the 777 Servo Sensor™ Controller. Entered value determines the resolution. 2”, 1”, or .5” only.

REVERSE SERVO DRIVE MAXIMUM: Determines the amount of current/voltage output in the reverse movement of a positioning device.

REVERSE VELOCITY MAXIMUM: Value defines the rate of motion of a positioning device.

RUN MODE (1=CYCLE, 2=DISCRETE, 3=Incremental, ELSE SERIAL): This entry selects a functional mode of operation for the Servo Sensor.

S

SCALE FACTOR LSB: Entered value determined from PROBE SCALE CALCULATION.

SCALE FACTOR MSB: Entered value determined from PROBE SCALE CALCULATION.

SENSING ELEMENT (SE): The SE is a self-contained magnetostrictive device that is anchored inside the main body of the sensor cartridge. The SE generates raw position data sent to the Driver Module

SENSOR LENGTH: Probe length entered up to 65.000".

SERIAL MODE: A mode of operation allowing the 777ss to receive set information from an external RS-485 source.

SERVO CONTROL MODULE (SCM): The servo control module consist of MTS proprietary data acquisition technology, high speed micro controller, serial interface, servo driver and a power conversion device.

SERVO LOOP: In a control system (particularly a servo amplifier), the output-to-input feedback loop through which automatic control is effected.

SET ENABLE MODE (1=STOP MODE): If the value is one, movement will stop when the set enable input is removed from the 777 Servo Sensor™ Controller. If the value is zero and a set point is entered, movement will continue to set point regardless if the set enable is removed. Input to the 777ss from an external switched device that allows motion when present. Set Enable is used in all modes of operation.

SWAP DRIVE POLARITY IF 1: Value will reverse the drive output polarity. An indication that this value should be changed is if the actuator fully extends or retracts and will not respond to set commands.

T

TEMP GRADIENT SCALE: Calibrated value entry provided by MTS.

TEMPO DIRECTION READOUT: Defines the position feed-back values in relation to the direction of motion.

TRIGGER: Input to the Servo Sensor™ used in cycle, incremental and pulse modes of operation.

U

UNIT ADDRESS: Identifies a servo controller in a multiple axis application.

V

VELOCITY GAIN (0 to 255): Value determines maximum current or voltage out when moving under a velocity application. This value is typically 255. If velocity is not used this value will be 0.

W

X

Y

Z

ZERO ADJUST (COURSE): User defined course adjustment value used for calibrating a positioning device to a reference of a machine

ZERO ADJUST (FINE): User defined fine adjustment value used for calibrating a positioned device to a reference of a machine after the course adjust has been completed.

+/- ZERO ADJUST FINE, 32000 max: User defined fine adjustment value used for calibrating a positioning device to a reference of a machine. Commonly referred to as offset.

Addendum #6
Troubleshooting

Listed below are common problems when installing and making the Servo Sensor work. Systems can be configured differently, so some of the solutions may not apply.

PROBLEMS ENCOUNTERED BEFORE DYNAMIC OPERATION

INDICATION	POSSIBLE SOLUTIONS
1. Red Power LED on SS not lite	Check 24vdc power input has the correct polarity.
2. Green Status LED on SS is steady	SS controller configured incorrectly or bad. Check configuration for desired operation or replace SS controller.
3. No communications	Check RS485 pair for proper TX and RX orientation. Reverse TX and RX lines. Check baud rate value via host control device or programming device. Change baud rate accordingly. Check port addressing is compatable with user program. Check back plane installed communications card is address correctly for program. Check external RS-485 protocol converter is operating and configured correctly.
4. Actual feedback position jittery	Check addressing of all SS controllers on link. If two or more controllers have the same address, change accordingly.

PROBLEMS ENCOUNTERED WHEN CONFIGURING INITIAL MOTION DYNAMICS

5. Motion device moves in one direction and stays there	Change SS program table motion direction field to 1 or 0 from its present state.
6. No motion occurrs when commanded to move	Verify the set enable input to SS is high. (24vdc) Correct. Verify relay enable input to SS is high. (24vdc) Correct.
7. SS feed back direction value needs changed	Change SS program table feedback direction field to 1 or 0 from its present state.
8. Motion device doesn't move to full or retracted position	Review SS program table minimum and maximum travel limits and change to desired limits.

PROBLEMS ENCOUNTERED WHEN IN OPERATION

9. All devices have intermittent feed back readings	Disconnect each Servo Sensor on the network until the readings stabilize. Replace the unit that caused the problem.

S-SERIES Servo Sensor ASCII Protocol

COMMAND SUMMARY

Legend:

ADR	Node/Slave Address	**TIME**	Time Stamp
STAT	Status Byte	**ERR**	Following Error
CTRL	Control Byte	**SP #**	Setpoint Number
POS	Position	**DATA**	Setpoint Data
TARG	Target	**CHAR**	Text Data
VEL	Velocity	**OFF**	Setpoint Offset
SN	Serial Number		
CODE	Security Code	**SOH**	(01H) Master Header
PAR #	Parameter Number	**STX**	(02H) Slave Header
PARM	Parameter Data	**ETX**	(03H) End of packet

Data Shown in Blue
Command & Pad Characters Shown in Red
Control Characters Shown in Green
CRC Shown in Purple
Note: CRC calculated using CITT-1024

Command Summary

Dec	Hex	CMD	Definition	Page
65	41H	A	Read Status Byte & Position	2
66	42H	B	Read Control Byte & Target	2
67	43H	C	Read Secure Code & Velocity	2
68	44H	D	Read Parameter	3
69	45H	E	Read Timestamp & Following Error	3
70	46H	F	Read Sensor Info (Name, Date, Serial)	3
71	47H	G	Write Secure Code	5
72	48H	H	Write Offset Increment	5
73	49H	I	Write Target & return target	5
74	4AH	J	Write Target & return position	6
75	4BH	K	Write Velocity	6
76	4CH	L	Write Parameter	6
77	4DH	M	Write Velocity & Target	7
78	4EH	N	Jog +	7
79	4FH	O		
80	50H	P	Jog -	7
81	51H	Q	Write Setpoint Data	8
82	52H	R	Read Setpoint Data	4
83	53H	S		
84	54H	T		
85	55H	U		
86	56H	V		
87	57H	W		
88	58H	X		
89	59H	Y		
90	5AH	Z		
35	23H	#	Read/Set Address (ADR)	8

Sensor Address

Sensor	ADR	Hex	Dec
1	a	61H	97
2	b	62H	98
3	c	63H	99
4	d	64H	100
5	e	65H	101
6	f	66H	102
7	g	67H	103
8	h	68H	104
9	I	69H	105
10	j	6AH	106
11	k	6BH	107
12	l	6CH	108
13	m	6DH	109
14	n	6EH	110
15	o	6FH	111
16	p	70H	112
17	q	71H	113
18	r	72H	114
19	s	73H	115
20	t	74H	116
21	u	75H	117
22	v	76H	118
23	w	77H	119
24	x	78H	120
25	y	79H	121
26	z	7AH	122

Read Commands

Read Position & Status

A

	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Host	STX	ADR	A	CRC	CRC	CRC	CRC	ETX						
			CMD	MSB	…	…	LSB							
Sensor	SOH	ADR	A	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX
			CMD	HI	LO	MSB	…	…	LSB	MSB	…	…	LSB	

Read Target & Control

B

	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Host	STX	ADR	B	CRC	CRC	CRC	CRC	ETX						
			CMD	MSB	…	…	LSB							
Sensor	SOH	ADR	B	CTRL	CTRL	TARG	TARG	TARG	TARG	CRC	CRC	CRC	CRC	ETX
			CMD	HI	LO	MSB	…	…	LSB	MSB	…	…	LSB	

Read Velocity & Security Code

C

	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Host	STX	ADR	C	CRC	CRC	CRC	CRC	ETX						
			CMD	MSB	…	…	LSB							
Sensor	SOH	ADR	C	0	CODE	0	VEL	VEL	VEL	CRC	CRC	CRC	CRC	ETX
			CMD	PAD	CODE	PAD	MSB	…	LSB	MSB	…	…	LSB	

Read Commands (continued)

Read Parameter

D

See parameter listing and Appendix A for detailed information.

Host	STX	ADR	D	0	0	PAR #	PAR #	CRC	CRC	CRC	CRC	ETX	
			CMD	PAD	PAD	MSB	LSB	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	D	PAR #	PAR #	PARM	PARM	PARM	PARM	CRC	CRC	CRC	CRC	ETX

Read Timestamp & Error

E

Host	STX	ADR	E	0	0	0	0	CRC	CRC	CRC	CRC	ETX	
			CMD	PAD	PAD	PAD	PAD	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	E	TIME	TIME	ERR	ERR	ERR	ERR	CRC	CRC	CRC	CRC	ETX

Read Sensor Information

F

See Appendix B for sensor information offsets and returned data

Host	STX	ADR	F	0	0	OFF	OFF	CRC	CRC	CRC	CRC	ETX	
			CMD	PAD	PAD	MSB	LSB	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	…	…	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	F	CHAR	CHAR	CHAR	CHAR	CHAR	CHAR	CRC	CRC	CRC	CRC	ETX

Read Setpoint Data

R

See Appendix C for Setpoint and offset definitions

Host	STX	ADR	R	OFF*	0	SP#	SP#	CRC	CRC	CRC	CRC	ETX	
			CMD	Offset	PAD	MSB	LSB	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	R	SP#	SP#	DATA	…	…	DATA	CRC	CRC	CRC	CRC	ETX

*OFF	Definitions	DATA			
0	Read SP# Target	TARG	TARG	TARG	TARG
1	Read SP# Velocity (with 0 pad)	0	VEL	VEL	VEL
2	Read SP# Dwell	DWL	DWL	DWL	DWL

Write Commands

Write Security Code

G

Host	STX	ADR	G	0	0	0	CODE	CRC	CRC	CRC	CRC	ETX	
			CMD	PAD	PAD	PAD	DATA	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	PAD	DATA	PAD	PAD	PAD	PAD	MSB	…	…	LSB	
Sensor	SOH	ADR	G	0	CODE	0	0	0	0	CRC	CRC	CRC	CRC	ETX

Write Offset Increment

H

Host	STX	ADR	H	"+ or -"	INC	INC	INC	CRC	CRC	CRC	CRC	ETX	
			CMD	POL	MSB	…	LSB	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	H	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX

Write Target and Return Target

I

Host	STX	ADR	I	TARG	TARG	TARG	TARG	CRC	CRC	CRC	CRC	ETX	
			CMD	MSB	…	…	LSB	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	I	CTRL	CTRL	TARG	TARG	TARG	TARG	CRC	CRC	CRC	CRC	ETX

Write Commands (continued)

Write Target and Return Position

J

Host	STX	ADR	J	TARG	TARG	TARG	TARG	CRC	CRC	CRC	CRC	ETX	
			CMD	MSB	…	…	LSB	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	J	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX

Write Velocity and Return Position

K

Host	STX	ADR	K	0	VEL	VEL	VEL	CRC	CRC	CRC	CRC	ETX	
			CMD	PAD	MSB	…	LSB	MSB	…	…	LSB		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	K	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX

Write Parameter

L

See parameter listing and Appendix A for detailed information.

Host	STX	ADR	L	0	PAR #	PAR #	PARM	PARM	PARM	PARM	CRC	CRC	CRC	CRC	ETX
			CMD	PAD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB		
Sensor	SOH	ADR	L	PAR #	PAR #	PARM	PARM	PARM	PARM	CRC	CRC	CRC	CRC	ETX	

Write Commands (continued)

Write Target & Velocity

M

Host	STX	ADR	M	VEL	VEL	VEL	TARG	TARG	TARG	TARG	CRC	CRC	CRC	CRC	ETX
			CMD	MSB	…	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB		
Sensor	SOH	ADR	M	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX	

Jog +

N

Host	STX	ADR	N	0	VEL	VEL	VEL	CRC	CRC	CRC	CRC	ETX		
			CMD	PAD	MSB	…	LSB	MSB	…	…	LSB			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	HI	LO	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	N	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX	

Jog -

P

Host	STX	ADR	P	0	VEL	VEL	VEL	CRC	CRC	CRC	CRC	ETX		
			CMD	PAD	MSB	…	LSB	MSB	…	…	LSB			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
			CMD	HI	LO	MSB	…	…	LSB	MSB	…	…	LSB	
Sensor	SOH	ADR	P	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX	

Write Commands (continued)

Read/Write Address Change

#

Host	STX	#	SN	SN	SN	SN	SN	SN	W/R*	ADR	CRC	CRC	CRC	CRC	ETX
		CMD	MSB	…	…	…	…	LSB	0 or 4	a to z	MSB	…	…	LSB	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
			CMD	HI	LO	MSB	…	…	LSB	MSB	…	…	LSB		
Sensor	SOH	ADR	-	STAT	STAT	POS	POS	POS	POS	CRC	CRC	CRC	CRC	ETX	

Host		Sensor
*W/R	ADR	Response
0	NA	Read Address
4	a - z	Set Address

Write Setpoint Data

Q

See Appendix C for Setpoint and offset definitions

Host	STX	ADR	Q	OFF*	SP #	SP #	DATA	…	…	DATA	CRC	CRC	CRC	CRC	ETX
			CMD	Offset	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
			CMD	MSB	LSB	MSB	…	…	LSB	MSB	…	…	LSB		
Sensor	SOH	ADR	Q	SP #	SP #	DATA	…	…	DATA	CRC	CRC	CRC	CRC	ETX	

*OFF	Definitions	DATA			
0	Write SP# Target	TARG	TARG	TARG	TARG
1	Write SP# Velocity (with 0 pad)	0	VEL	VEL	VEL
2	Write SP# Dwell	DWL	DWL	DWL	DWL
		MSB	…	…	LSB

Control and Status Byte Bit Definitions

Control Byte								
	MSB				LSB			
Range	0-F				0-F			
Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Definition	Air Cyl Select	Sensor Write Enable	Input 2 ON	Jog Active		Power Up		

Status Byte								
	MSB				LSB			
Range	0-F				0-F			
Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Definition	Motion Enable On		Position Negative	Null OK	Over Travel	System OK	In Position	Tempo OK

Data Format Definitions

Data Format					
	MSB	…	…	LSB	Result **
ASCII Byte	B3	B2	B1	B0	**1** - ASCII Data
Convert To Hex Byte					
ASCII 0-9	**B3H = B3 - 30H**	**B2H = B2 - 30H**	**B1H = B1 - 30H**	**B0H = B0 - 30H**	**2** - Hex Data
ASCII A-F	**B3H = B3 - 37H**	**B2H = B2 - 37H**	**B1H = B1 - 37H**	**B0H = B0 - 37H**	
Convert To Decimal Counts					
	(B3H * 4096) +	**(B2H * 256) +**	**(B1H * 16) +**	**(B0H) =**	**3** - Counts

**	*Format*	*MSB*	*…*	*…*	*LSB*	*Result*
1	**ASCII**	**0**	**F**	**3**	**D**	3901
ASCII Hex Value		30	46	33	44	
2	**HEX**	**0**	**F**	**3**	**D**	
Decimal Value		0	15	3	13	
3	**COUNT**	**0**	**3840**	**48**	**13**	**=3901**

MSB	*…*	*…*	*LSB*	*Result*
A	**6**	**D**	**0**	42704
41	36	44	30	
A	**6**	**D**	**0**	
10	6	13	0	
40960	**1536**	**208**	**0**	**=42704**

Notes:

1 Multiply counts by *resolution* to get *true* position and target data

2 *Velocity* is calculated using 3 bytes instead of 4.

Revision History

15-May-01	Added parameter listings Corrected Math Error on Data format page Added parameter 35 - Sensor Length (deleted then restored by GB 05/01)
09-Jul-01	Updated Parameter Min/Max/Default Values
25-Jul-01	Added Velocity Range Parameter (#13) (Added by GB 07/01) Amended Jog Plus/Minus Commands (changed by GB 07/01)

Documentation by: **David Gann**
NightOwl Consulting
5917 N. Alameda Blvd.
Spokane, WA 99205-7607

Sensor Parameters

Notes:

The Parameter Security Code is a value that must be sent to the probe so data entry can proceed. Each table has its own code

	Level of Security
Parameter Security Code 5	All Parameters
Parameter Security Code 4	System Parameters
Parameter Security Code 3	Servo Dynamic Parameters
Parameter Security Code 2	Servo Sensor Limits
Parameter Security Code 1	

The undocumented parameter numbers are not supported and should not be used.

The default values listed are suitable for most applications.

SERVO DYNAMICS TABLE

Access Code: **Parameter Security Code 3**

PARAMETER NUMBER	PARAMETER	DEFINITION	VALUE			
			Min	Max	Default	Units
1	Not Used					
2	**Extend Gain**	Value multiplied by the position error when in positive direction	1	65000	500	Counts
3	**Retract Gain**	Value multiplied by the position error when in negative direction	1	65000	500	Counts
4	**Extend Acceleration**	Acceleration value used for servo output on ramp delay to a maximum drive condition.	1	255	100	Counts
5	**Retract Acceleration**	Same as above except for negative direction.	1	255	100	Counts
6	**Extend Deceleration Window**	Defines an area in movement before the target is reached that the deceleration value will not be used.	1	65000	255	Counts
7	**Retract Deceleration Window**	Same as above except for negative direction.	1	65000	255	Counts
8	**Extend Deceleration**	Deceleration value used for servo output off ramp delay from a maximum drive condition	1	65000	100	Counts
9	**Retract Deceleration**	Same as above except for negative direction	1	65000	100	Counts
10	**Extend Deadband**	Position value used to describe area in positive direction that no servo drive is used.	0	65000	0	Counts
11	**Retract Deadband**	Same as above except in the negative direction	0	65000	0	Counts
12	**Velocity Enable**	0 = Drive limits are used for motion (speed) control 1 = Entry enables the velocity loop control for motion (speed)	0	1	0	Boolean
13	**Velocity Range**	0 = 0.1"/sec 1 = 0.01"/sec	0	1	0	Boolean
14	**Extend Drive Limit**	Determines the amount of current/voltage output in the positive direction. 255 equals maximum drive.	1	255	255	Counts
15	**Retract Drive Limit**	Same as above except in the negative direction	1	255	255	Counts
16	**Auto-Null Enable**	0 = Auto-null Disabled 1 = an integral gain loop is enabled which causes the drive output to counter imbalances in the controlled device when on or near target position.	0	1	0	Boolean
17	**Auto-Null Window**	Value defines a position window around the target position that will enable an integral loop. **- AIR CYLINDER ONLY**	0	65000	0	Counts
18	**Jog Increment**	Defines the minimum move value when jogging the Servo Sensor™	0	65000	0	Counts
19	**Jog Maximum**	Defines the maximum move value when jogging the Servo Sensor™	0	65000	0	Counts
20	**Drive Signal Polarity**	Value will reverse the drive output polarity. Either 1 or 0	0	1	0	Boolean

LIMITS TABLE

Access Code: **Parameter Security Code 2**

PARAMETER NUMBER	PARAMETER	DEFINITION	VALUE			
			Min	Max	Default	Units
30	**Minimum Limit**	Software defined minimum limit for stroke of a linear movement. Entry is usually defined in inches.	0	< Maximum Limit	50	Counts
31	**Maximum Limit**	Software defined maximum limit for stroke of a linear movement. Entry is usually defined in inches.	> Minimum Limit	<= Stroke Length	Stroke Length - 50 counts	Counts
32	**In Position Window**	Entry defines the allowable error between the transducer feedback position and the target position. This value can not be more than half of the MAXIMUM LIMIT value.	1	< ½ Maximum Limit	60	Counts
33	**Zero Adjust**	User defined value used for calibrating a positioned device to a reference of a machine.	-32000	32000	-4300	Number
35	**Sensor Length**	Physical length of sensor in counts. (READ ONLY VALUE)	0	65000		Counts

FEEDBACK CALIBRATION

Access Code: **Parameter Security Code 5**

PARAMETER NUMBER	PARAMETER	DEFINITION	VALUE			
			Min	Max	Default	Units
41	**Readout Direction**	Changes the measurement direction 0 = Retract to 0 1 = Extend to 0	0	1	0	Boolean

SYSTEM SETUP

Access Code: **Parameter Security Code 4**

PARAMETER NUMBER	PARAMETER	DEFINITION	VALUE			
			Min	Max	Default	Units
55	**Sensor Address**	Entry programs the Servo Sensor™ network address. A maximum of 26 Servo Sensors™ can be put on a single multi-drop circuit	1	26	1	Number
56	**Baud Rate**	Value determines the communications data frequency for the Servo Sensor™. Four baud rates can be used: 1 = 19.2kb 2 = 38.4kb 3 = 57.6kb 4 = 115.6kb	1	4	1	Number
57	**Null Zero**	Factory set values that zero the electrical null for the servo drive output. (This is a READ ONLY Value)	0	4096	2047	Counts
58	**Motion/Set Enable**	1 = The Servo Sensor™ will stop motion drive when Motion/Set Enable is removed from the discrete input of the Servo Sensor™. A new target will be needed to continue motion and the Motion/Set Enable must be high. 0 = The Servo Sensor™ will continue motion to target when the Motion/Set Enable is removed. If the Motion/Set Enable is low no motion will occur under any circumstances.	0	1	0	Boolean
59	**Air Cylinder Enable**	0 = a hydraulic algorithm for motion is used 1 = an air algorithm for motion is used.	0	1	0	Boolean
61	**Run Mode**	0 = Serial Mode 1 = Cycle Mode 2 = Pulse Mode 3 = Increment Mode	0	3	0	Number
62	**Output Mode**	0 = In Position. This will cause the In Position Output from the Servo Sensor™ to come on when the target and transducer feedback position are within the **In Position Window** value. 1 = Cycle complete. This will cause the In Position Output from the Servo Sensor™ to come on when a cycle complete has occurred and the Servo Sensor™ is programmed for the cycle mode.	0	1	0	Boolean

PARAMETER LISTING IN NUMERIC ORDER

Parameter Summary

Parameter	PAR # (Hex)		Definition	Parameter	PAR # (Hex)		Definition
	MSB	LSB			MSB	LSB	
0	0	0		**20**	**1**	**4**	**Drive Signal Polarity**
1	0	1		21	1	5	
2	**0**	**2**	**Extend Gain**	22	1	6	
3	**0**	**3**	**Retract Gain**	23	1	7	
4	**0**	**4**	**Extend Acceleration**	24	1	8	
5	**0**	**5**	**Retract Acceleration**	25	1	9	
6	**0**	**6**	**Extend Deceleration Window**	26	1	A	
7	**0**	**7**	**Retract Deceleration Window**	27	1	B	
8	**0**	**8**	**Extend Deceleration**	28	1	C	
9	**0**	**9**	**Retract Deceleration**	29	1	D	
10	**0**	**A**	**Extend Deadband**	**30**	**1**	**E**	**Minimum Limit**
11	**0**	**B**	**Retract Deadband**	**31**	**1**	**F**	**Maximum Limit**
12	**0**	**C**	**Velocity Enable**	**32**	**2**	**0**	**In Position Window**
13	**0**	**D**	**Velocity Range**	**33**	**2**	**1**	**Zero Adjust**
14	**0**	**E**	**Extend Drive Limit**	34	2	2	
15	**0**	**F**	**Retract Drive Limit**	**35**	**2**	**3**	**Sensor Length**
16	**1**	**0**	**Auto-Null Enable**	36	2	4	
17	**1**	**1**	**Auto-Null Window**	37	2	5	
18	**1**	**2**	**Jog Increment**	38	2	6	
19	**1**	**3**	**Jog Maximum**	39	2	7	

Parameter Summary (Continued)

Parameter	PAR # (Hex)		Definition
	MSB	LSB	
40	2	8	
41	**2**	**9**	**Readout Direction**
42	2	A	
43	2	B	
44	2	C	
45	2	D	
46	2	E	
47	2	F	
48	3	0	
49	3	1	
50	3	2	
51	3	3	
52	3	4	
53	3	5	
54	3	6	
55	**3**	**7**	**Sensor Address**
56	**3**	**8**	**Baud Rate**
57	**3**	**9**	**Null Zero**
58	**3**	**A**	**Motion/Set Enable**
59	**3**	**B**	**Air Cylinder Enable**

Parameter	PAR # (Hex)		Definition
	MSB	LSB	
60	3	C	
61	**3**	**D**	**Run Mode**
62	**3**	**E**	**Output Mode**
63	3	F	
64	3	0	
65	3	1	
66	3	2	
67	3	3	
68	3	4	
69	3	5	

SETPOINT REFERENCE

Q & R

The following list of parameters apply only to Commands **Q** (Write Setpoint) and **R** (Read Setpoint)

Target: Target value location. Used with Pulse, Cycle, and Increment mode. Value must be more than Minimum Limit or less than Maximum limit.

Velocity: Motion speed for set point 1 target value. 255=25.5 units/sec

Dwell: Time value that after target is reached before a new position will cause a move. This is used with Cycle, Pulse, and Increment mode.

SETPOINT	SP #		OFF*	DATA
	MSB	LSB	OFFSET	
1	0	1	0	Target
			1	Velocity
			2	Dwell
2	0	2	0	Target
			1	Velocity
			2	Dwell
3	0	3	0	Target
			1	Velocity
			2	Dwell
4	0	4	0	Target
			1	Velocity
			2	Dwell
5	0	5	0	Target
			1	Velocity
			2	Dwell
6	0	6	0	Target
			1	Velocity
			2	Dwell
7	0	7	0	Target
			1	Velocity
			2	Dwell
8	0	8	0	Target
			1	Velocity
			2	Dwell
9	0	9	0	Target
			1	Velocity
			2	Dwell
10	0	A	0	Target
			1	Velocity
			2	Dwell

SETPOINT	SP #		OFF*	DATA
	MSB	LSB	OFFSET	
11	0	B	0	Target
			1	Velocity
			2	Dwell
12	0	C	0	Target
			1	Velocity
			2	Dwell
13	0	D	0	Target
			1	Velocity
			2	Dwell
14	0	E	0	Target
			1	Velocity
			2	Dwell
15	0	F	0	Target
			1	Velocity
			2	Dwell
16	1	0	0	Target
			1	Velocity
			2	Dwell
17	1	1	0	Target
			1	Velocity
			2	Dwell
18	1	2	0	Target
			1	Velocity
			2	Dwell
19	1	3	0	Target
			1	Velocity
			2	Dwell
20	1	4	0	Target
			1	Velocity
			2	Target

SETPOINT	SP #		OFF*	DATA
	MSB	LSB	OFFSET	
21	1	5	0	Velocity
			1	Dwell
			2	Target
22	1	6	0	Velocity
			1	Dwell
			2	Target
23	1	7	0	Velocity
			1	Dwell
			2	Target
24	1	8	0	Velocity
			1	Dwell
			2	Target
25	1	9	0	Velocity
			1	Dwell
			2	Target
26	1	A	0	Velocity
			1	Dwell
			2	Target
27	1	B	0	Velocity
			1	Dwell
			2	Target
28	1	C	0	Velocity
			1	Dwell
			2	Target
29	1	D	0	Velocity
			1	Dwell
			2	Target
30	1	E	0	Velocity
			1	Dwell
			2	Target

SETPOINT	SP #		OFF*	DATA
	MSB	LSB	OFFSET	
31	1	F	0	Target
			1	Velocity
			2	Dwell
32	2	0	0	Target
			1	Velocity
			2	Dwell
33	2	1	0	Target
			1	Velocity
			2	Dwell
34	2	2	0	Target
			1	Velocity
			2	Dwell
35	2	3	0	Target
			1	Velocity
			2	Dwell
36	2	4	0	Target
			1	Velocity
			2	Dwell
37	2	5	0	Target
			1	Velocity
			2	Dwell
38	2	6	0	Target
			1	Velocity
			2	Dwell
39	2	7	0	Target
			1	Velocity
			2	Dwell
40	2	8	0	Target
			1	Velocity
			2	Dwell

SETPOINT	SP #		OFF*	DATA
	MSB	LSB	OFFSET	
41	2	9	0	Target
			1	Velocity
			2	Dwell
42	2	A	0	Target
			1	Velocity
			2	Dwell
43	2	B	0	Target
			1	Velocity
			2	Dwell
44	2	C	0	Target
			1	Velocity
			2	Dwell
45	2	D	0	Target
			1	Velocity
			2	Dwell
46	2	E	0	Target
			1	Velocity
			2	Dwell
47	2	F	0	Target
			1	Velocity
			2	Dwell
48	3	0	0	Target
			1	Velocity
			2	Dwell
49	3	1	0	Target
			1	Velocity
			2	Dwell
50	3	2	0	Target
			1	Velocity
			2	Target

SETPOINT	SP #		OFF*	DATA
	MSB	LSB	OFFSET	
51	3	3	0	Velocity
			1	Dwell
			2	Target
52	3	4	0	Velocity
			1	Dwell
			2	Target
53	3	5	0	Velocity
			1	Dwell
			2	Target
54	3	6	0	Velocity
			1	Dwell
			2	Target
55	3	7	0	Velocity
			1	Dwell
			2	Target
56	3	8	0	Velocity
			1	Dwell
			2	Target
57	3	9	0	Velocity
			1	Dwell
			2	Target
58	3	A	0	Velocity
			1	Dwell
			2	Target
59	3	B	0	Velocity
			1	Dwell
			2	Target
60	3	C	0	Velocity
			1	Dwell
			2	Target

SENSOR INFORMATION DATA AND OFFSETS

The Sensor Information Command (F) requires a offset to access the 54 bytes of sensor information in 6 byte blocks.
The Offset values shown read the entire 54 byte information block, and will require parsing.

Offset	0						6						12						18						24						30	
Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Data	NAME						DATE						VERSION						SN PREFIX															
Example	7	7	7	V	7				0	7	M	A	Y	0	1		-	V	2	0	A				-	-	-	-	-	-	S	N

Offset	30				36						42						48					
Byte	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Data	SN 1						SN 2						PAD		RESOLUTION						UNITS	
Example	0	1	2	3	4	5	0	0	0	0	0	0	+	+	0	.	0	0	1	0	I	N

	OFFSET								
Name	0	7	7	7	V	7			
Date	8	0	7	M	A	Y	0	1	
Version	16	-	V	2	0	A			
SN Prefix	24	-	-	-	-	-	-	S	N

SN 1	32	0	1	2	3	4	5
SN 2	38	0	0	0	0	0	0
Pad	44	+	+				
Resolution	46	0	.	0	0	1	0
Units	52	I	N				

ASCII CHART

Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char
0	00	NUL	32	20	space	64	40	@	96	60	`
1	01	SOH	33	21	!	65	41	A	97	61	a
2	02	STX	34	22	"	66	42	B	98	62	b
3	03	ETX	35	23	#	67	43	C	99	63	c
4	04	EOT	36	24	$	68	44	D	100	64	d
5	05	ENQ	37	25	%	69	45	E	101	65	e
6	06	ACK	38	26	&	70	46	F	102	66	f
7	07	BEL	39	27	" ' "	71	47	G	103	67	g
8	08	BS	40	28	(	72	48	H	104	68	h
9	09	HT	41	29	)	73	49	I	105	69	I
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	" / "	79	4F	O	111	6F	o
16	10	DLE	48	30	0	80	50	P	112	70	p
17	11	DC1	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	DC3	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	NAK	53	35	5	85	55	U	117	75	u
22	16	SYN	54	36	6	86	56	V	118	76	v
23	17	ETB	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	89	59	Y	121	79	y
26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	62	3E	>	94	5E	^	126	7E	~
31	1F	US	63	3F	?	95	5F	<	127	7F	delete

ASCII CONTROL CODES

Decimal	Hex	Standard Ascii		Alternate		Terminal Codes
		Code	Definition	Code	Definition	
0	00	NUL	Null			^@
1	01	SOH	Start of Heading			^A
2	02	STX	Start Text			^B
3	03	ETX	End Text			^C
4	04	EOT	End of Transmission			^D
5	05	ENQ	Enquiry			^E
6	06	ACK	Acknowledge			^F
7	07	BEL	Bell			^G
8	08	BS	Backspace			^H
9	09	HT	Horizontal Tab			^I
10	0A	LF	Line Feed			^J
11	0B	VT	Vertical Tab			^K
12	0C	FF	Form Feed			^L
13	0D	CR	Carriage Return			^M
14	0E	SO	Shift Out			^N
15	0F	SI	Shift In			^O
16	10	DLE	Data Link Escape			^P
17	11	DC1	Direct Control 1	WACK	Wait Acknowledge	^Q
18	12	DC2	Direct Control 2	STAK	Start Session	^R
19	13	DC3	Direct Control 3	TACK	End Session	^S
20	14	DC4	Direct Control 4			^T
21	15	NAK	Negative Acknowledge			^U
22	16	SYN	Synchronous Idle			^V
23	17	ETB	End Transmission Block	EOB	End of Block	^W
24	18	CAN	Cancel			^X
25	19	EM	End of Medium			^Y
26	1A	SUB	Substitute			^Z
27	1B	ESC	Escape			^[
28	1C	FS	Form Separator			^/
29	1D	GS	Group Separator			^]
30	1E	RS	Record Separator			^^
31	1F	US	Unit Separator	ITB	End of Imtermediate Transmission Block	^-

ASCII WINDOWS VERSION 6.0 OPERATION INFORMATION

SERVO SENSOR™ VISUAL BASIC SETUP SOFTWARE VERSION 6.0

NEW FEATURES

- **Monitor has a jog field added with selectable velocity entry.**
- **Can view the set point table before activating.**
- **Servo Sensor™ field shows how many Servo Sensors™ on active on the link.**
- **Status bar indicates loop communication status of the PC.**
- **Status field indicates Servo Sensor™ status.**
- **Improved communication routine between PC/Host device and the Servo Sensor™.**
- **Display feature that allows viewing target, actual position, and velocity in large format.**
- **Actual name of axis can be entered for monitoring use.**
- **60 point set table displayed.**
- **Expanded Servo Dynamic Control.**
- **Jogging capability.**
- **4 modes of operation control.**
- **Will display Servo Sensor™ resolutions in .0005", .001", and .002".**

Minimum System Requirements ASCII Servo Sensor™ Program

- **Windows 95 (OSR 2 only) and Windows 98**
- **Intel Pentium, 133 MHz processor**
- **Windows ME, Windows 2000 Professional, Windows NT 4.0**
- **Intel Pentium II, 350 MHz processor**
- **64Mb Ram for all Windows platforms**
- **Five programs incorporated in the software package:**
- **InstMsiW**
- **InstMsiW**
- **Setup.exe**
- **Setup**

ASCII Servo Sensor™ Configuration

Loading Considerations

Before loading the software all applications should be turned off.

Some notebook computers will have problems running this software due to shared IRQ and communications ports. To check if a conflict exists enter System info in the Accessories folder on your computer and check if IRQ'S are the same for communication port 1. If so, disable the program that is sharing the interrupt. SMC devices usually cause this problem.

Another way of determining if a program is running in the Windows background is using the Control, Alt, Delete method. Windows will display the programs that are running. Programs can be disabled from this screen.

Palm pilot software has caused problems with the software. It must be disabled for the communication port to operate.

If no results, call for technical assistance.

Running the program

The following information assumes that the user has a basic understanding of computers and software and has key boarding skills.

The laptop or desktop must be running before the power is applied to the communications converter. Generally, the Servo Sensor™ and converter have power applied at the same time. This will cause the Setup software to start properly.

Initial Launch of the software

A splash screen will appear showing a search for the Servo Sensors™. The screen shows the name and version of the software. When the splash screen is finished, the screen changes to a visual basic screen with the COMM tab displayed.

The title of the program is shown at the top of the screen. At the bottom of the Comm tab are fields that show status of the program.

Seven Tab labels are shown on the screen. They are:

Monitor
System
Dynamics
Limits
Set Points
Info
Comm

The menu bar above the tabs shows the following:

File
View
Utilities
Help

Comm Tab

The Comm Tab screen is divided into the following fields (Refer to Figure 1):

- Communications Status
- Select Comm Port and Speed
- Speed
- Packet Interval and Apply and Test Settings Bar
- Actions
- Servo Sensor™ Status column

Communications Status

This field monitors the communications between the PC and the Servo Sensor™/s. Red indicates a fault and green indicates okay. The labels are self-explanatory.

Select Comm Port and Speed

From this field, highlighted labels and option buttons show the Comm ports that are available. Comm port 1 is most often selected and is identified by a black dot.

Speed

The speed selection field identifies the baud rate at which the Comm port is operating. This is the baud speed that the PC is communicating to the Servo Sensor™. The Servo Sensor™ baud rate must match this speed. If "Communications Error" and/or "Sensor Not Responding" are red, then the baud rate needs to be changed and the "Apply and Test Settings" activated to reinitialize the communications. This procedure is used to adapt the program for communications to Servo Sensors™ with different baud rates. It is possible to have Servo Sensors™ with different baud rates on the RS-485 link.

Packet Interval and Apply and Test Settings

The packet interval will be used with PC's that have different operating speeds. A scroll down list is available with values that can be selected.

When a change is made in the Comm tab fields, the Apply and Test Settings command bar is used to change to the new settings.. Pointing the cursor to this bar and clicking the right mouse button activates this function to activate.

Initializing a change causes "Searching" to appear in the "On Line" box and a command code, such as "No Response from Sensor" will appear below the bar.

Actions

The Reset and Apply command buttons are not used.

Servo Sensor™ Status Column

Comm Ok, Online and Online Mode bars are active and all others are inactive in the Status Column screen.

Monitor Tab (Refer to Figure 2)

The Monitor Tab is divided into the following fields:

- Setpoint Information
- Immediate Setpoint Execute
- Servo Position
- Sensor Select
- Jog Controls
- Actions
- Servo Sensor™ Status Column

Setpoint Information

This field works in conjunction with the Immediate Setpoint Execute field. It displays the Target, Velocity and Dwell values stored in the Servo Sensor™ Setpoint Table. It will change when a set point is selected in the Immediate Setpoint Execute field.

Immediate Setpoint Execution

The Setpoint Table stored within the Servo Sensor™ is accessed through this field. The View Only box below the

sixty boxes allows the user to preview the set points, velocities, and dwells before sending the motion commands to the Servo Sensor™. The View Only box must be checked for the set points to be active.

When a set point is activated via the mouse, the program requests the values from that set point and then sends the values back to the Servo Sensor™.

Servo Position

Three labeled fields are shown. Position is the actual position of the magnet in relation to the Servo Sensor™ including offsets.

The Target is the selected set point position or jog position that the user requested.

The Velocity is the velocity value loaded in the set point table associated with the target set point.

The Target and Velocity fields are not active in all other modes of operation other than the serial mode.

Sensor Select

The Sensor Select field shows the Servo Sensor™ addresses that are actively responding. The pull down window will show the addresses. Highlighting the address will cause the program to scan for that Servo Sensor™ and load all values for view or change within the different tabs.

If a name was assigned to each address (using the Info tab) that assigned name will appear below in bold black letters.

Jog Controls

The ASCII Servo Sensor™ has provisions and code for jogging. This field is used to program locations established within the Servo Sensor™ for jogging.

The Maximum window equates to the maximum error allowed between the target and position value. This entry is limited to 2.000 inches and is most often set to .500.

The Increment window establishes the minimum start value for the error between the target and position value. As movement occurs, this value is doubled until the Maximum entered value is achieved. This feature gives more finite control of the position of the device under control. This entry is limited to half of the value entered in the Maximum window and is most often set to .060.

The Velocity is not associated with any values stored in the Servo Sensor™ and is an external value that is sent in code with the jog commands to the Servo Sensor™. A typical entry will be 5.0.

Actions

The Reset and Apply bar are not used.

Servo Sensor™ Status Column

All status bars are active in this field. It is developed from the Status and Control bytes received from the Servo Sensor™. Green indicates okay or inputs on and outputs on. Red indicated problems or that inputs are not on.

System Tab (Refer to Figure 3)

The System Tab is divided into the following sub fields:

- Servo Sensor™ Configuration
  - Servo Number
  - Baud Rate
- Operational Configuration
  - Cylinder Type
  - Output Function
  - Enable Mode
  - Run Mode
- Actions
- Servo Sensor™ Status Column

Servo Sensor™ Configuration

All fields represent the values that are received from the Servo Sensor™. In essence, this tab is used to configure the Servo Sensor™ for system operation. Communications must be established before any configurations can be changed.

Servo Number

This field has a pull down column that shows all Servo Sensors™ communicating on the RS485 link. After a Server Sensor is selected, the baud rate can be changed. The screen will immediately show a screen describing that power must be cycled for the new selection to take effect.

The Comm Tab must be selected and the baud rate changed for the program to match the baud rate of the Servo Sensor™. Apply and Test Settings bar is activated so the program will conduct a search for the Servo Sensor™.

Operational Configuration

The sub fields allow the user to program the special functions of the Servo Sensor™. As written at the bottom of the tab, labels shown in blue will require power to be recycled to the Servo Sensor™.

Also, a short help window will be shown when the cursor/pointer is placed on the sub field to be changed.

Actions

When a change is implemented the Apply bar will highlight. Activate using the mouse button. A screen will appear explaining that the power must be recycled for the changes to be entered.

The Reset is used to reset the System Tab screen.

Servo Sensor™ Status Column

All status bars are inactive in this tab.

Dynamics Tab (Refer to Figure 4)

This tab relates to the motion performance of the Servo Sensor™. It's divided into the following fields:

- Extend
  - Gain
  - Acceleration
  - Deceleration
  - Deceleration Window
  - Drive Limit
  - Dead Band
- Retract
  - Gain
  - Acceleration
  - Deceleration
  - Deceleration Window
  - Drive Limit
  - Dead Band
- AutoNull
- Enabled
- Window
- Velocity Loop Enable
- Reverse Drive Polarity
- Actions
- Servo Sensor™ Status Column

Extend

These sub fields show the present values stored in the Servo Sensor™ for extend dynamics. Refer to the Servo Sensor™ manual for detailed information. When the cursor/pointer is positioned on the field an information window will appear with the range values.

Retract

These sub fields follow the same format of the Extend field.

AutoNull

Auto Null is a modified integration algorithm used to keep the actual feedback and target positions equal. It over comes mechanical null errors in control valves.

As described in the writing below the Auto Null field, the Window is used only when with pneumatic cylinders. In the System tab, the cylinder type must have pneumatic enabled. This changes the over all motion algorithm for air control.

Velocity Loop Enable

Activating this field selects the velocity algorithm with the Servo Sensor™. This should be enabled for most cases. Large cylinder bores (10" and above) may required this feature be disabled.

Reverse Drive Polarity

This field will cause the command signal to a control valve to change polarity when activating or deactivating this field.

Actions

When a change is implemented the Apply bar will highlight. Activate using the mouse button. A screen will appear explaining that the power must be recycled for the changes to be entered.

The Reset is used to reset the System Tab screen.

Servo Sensor™ Status Column

All status bars are inactive in this tab.

Limits Tab (Refer to Figure 5)

The Limits Tab layout screen shows the following fields:

Feedback
Readout Direction
Travel Limits
In Position Window
Zero Offset Adjust
Probe Drawing
Actions
Servo Sensor™ Status Column

Feedback

This field is for display of the programmed values loaded in flash memory of the Servo Sensor™. They are set at the factory and cannot be changed. These values are specified at the time of order and they are read-only.

Readout Direction

The direction that the Servo Sensor™ will read the position data is changed from this field.

Travel Limits

These are user-defined values and must be within the reading range of the Servo Sensor™. The actual values will turn red if they exceed the stroke. The values might not exactly equal the stroke value. This is due to mathematical functions and should not be a cause for alarm.

In Position Window

This value determines whether the in motion bit changes and also is responsible for the signal from discrete output of the Servo Sensor™. If the actual position and target position are within this window the entry encompasses the plus and minus error of the actual and target position.

Zero Offset Adjust

For calibration purposes this sub field is used. The Servo Sensor™ readout range can be moved to accommodate mechanical installation errors. The allowable range is shown when the cursor is put on the field. An example would be if the readout exceeds 0 or the length of the probe. This is indicated by the readout reading 65000.

Probe Drawing

The probe drawing offers a visual display of the different value adjustments and their relationships. When changes are made in the sub fields above, the information boxes change so the user can visualize the change.

Actions

When a change is implemented the Apply command bar will highlight. Activate using the mouse button.

The Reset command bar is used to reset the Limits Tab screen.

Servo Sensor™ Status Column

All status bars are inactive in this tab.

Set Points Tab (Refer to Figure 6)

This tab is used for the cycle, pulse, and increment modes. Sixty set points are available with velocity and dwell entries attached to each point. The tab is divided into the following fields:

- Set Points
- Target
- Velocity
- Dwell
- Actions
- Servo Sensor™ Status Column

Set Points

The set points column is a label box for the actual values loaded. The positioning bars on the right and bottom side of the box can expand the window portion. Also, the field columns can be expanded or retracted by moving the cursor to the lines that separate the column labels. These features allow the user to accommodate the different screen resolutions that users may have.

Target

The target column displays target points loaded in the Servo Sensor™ and can be changed by highlighting the field and entering new values. The actual numbers will change to red if the values exceed the limits of the Servo Sensor™.

Velocity

The velocity values shown under the velocity column are values that are stored in the Servo Sensor™. Entries equate to units per sec. For 25”/sec would be entered as 25.00. These values will only be possible in the dynamics of movement if the controlled medium, such as hydraulics, has the ability to use the entered velocity.

Dwell

The dwell column shows values stored within the Servo Sensor™ memory. Entries are in tenths of seconds. These entries are used when the Servo Sensors™ modes are cycle and pulse modes.

Actions

When a change is implemented the Apply command bar will highlight. Activate using the mouse button.

The Reset command bar is used to reset the Limits Tab screen.

Servo Sensor™ Status Column

All status bars are inactive in this tab.

Info Tab (Refer to Figure 7)

The Info Tab is an informational screen that exhibits the Servo Sensor™ leading particulars and active status words breakdown. The Status and Control bytes are actually a 16 bit

word with the Status and Control as 8 bit nibbles. It is divided into the following fields:

- Servo Sensor™ Program Data
- Servo Sensor™ Status
- Servo Sensor™ Control
- Actions
- Servo Sensor™ Status Column

Servo Sensor™ Program Data

This field shows the probe characteristics and program loaded in the flash memory of the Servo Sensor™.

The last six digits of the serial number are displayed. All of the values and information shown are used to ID (identify) the probe.

A sub field for labeling the Servo Sensor™ is provided. It is only used by the Visual Basic software and is not an item that is loaded in the Servo Sensor™.

Servo Sensor™ Status and Servo Sensor™ Control

These fields provide a row of blocks that equate to each bit in the status word. Green indicates ok or enabled while red indicates bad or disabled. All of these bits are discussed in the Servo Sensor™ manual.

Actions

When a change is implemented the Apply command bar will highlight. Activate using the mouse button.

The Reset command bar is used to reset the Limits Tab screen.

Servo Sensor™ Status Column

All status bars are inactive in this tab.

Menu Bar

The menu bar has four supplements to the program. They are:

- File
- View
- Utilities
- Help

File

The file menu has four sub functions:

- Save Sensor Data
- Load Sensor Data
- Print Sensor Data
- Exit

Save Sensor Data

The User can save the programmed data stored in each Servo Sensor™ under different .dat labels. This is a useful function if different set point table and modes of operation are used for a Servo Sensor™.

Load Sensor Data

This function allows the user to change a configuration of a Servo Sensor™ by loading a previous data file.

Print Sensor Data

Data files can be printed for the Servo Sensor™ that is being looked at in the Monitor screen.

View

A large visual display is accessible from this menu function which shows actual position, target, and velocity. This is useful when cycle, pulse, or increment mode is used. Note that the target and velocity portions of the screen only work when serial mode is used.

Utilities

This function can be used to load a set of generic preprogrammed values to the Servo Sensor™. This function should be used as a last resort and if the Servo Sensor™ is not operating as desired. If used, all parameters and tabs must be reviewed and changed if necessary for operational functions to resume.

Help

The Help menu has three informational sub menus stated as follows:

- Contents
- Paw-Taw-John Homepage
- About

Contents

An informational manual in the form of a ServoSensor.HTM file is accessible via this function and Internet Explorer. The contents document explains how this program is organized and used. It also contains valuable information about the Servo Sensor™.

Paw-Taw-John Homepage

This is a hot key to Paw-Taw-John's homepage. Valuable information about the Servo Sensor™ is available through this page.

About

This is a page that shows the Version of this program and can access your computers system operating characteristics.

SERVO SENSOR™ OPERATION

SAFETY FEATURES

The Servo Sensor™ has two independent discrete control input lines that are used for motion control safety. They are Set Enable and Relay Enable. These inputs will **always** be active for motion to occur. When using the serial mode, the device provides a status word that can be used for fault identification and external control of motion. The following information relates to servo loop control for hydraulic and pneumatic cylinders.

Set Enable
The Set Enable is an external discrete input to the Servo Sensor™ provided by a host controller or other switched device that allows the Servo Sensor™ to accept target information and in turn will allow movement. When the Set Enable is low, the Servo Sensor™ will not accept target information and the cylinder will maintain its present position. When the Set Enable is high, the Servo Sensor™ will accept target information and immediately cause the cylinder to move to a new position designated by the host controller.
The Set Enable has two programmable modes:

- In the first mode - when the Set Enable (active high) is applied and a target is sent to the unit, the Set Enable can be removed (active low) and the cylinder will continue and finish its targeted movement. No target information will be accepted until an active high is applied.

- In the second mode - when the Set Enable (active high) is applied and a target is sent to the unit, the cylinder will move to its targeted position. If the Set Enable (active low) is removed at any point during movement, the cylinder will stop moving immediately. To start movement again, the Set Enable (active high) and a new target will be required. So the Set Enable must be active for the duration of movement in this mode.

The Set Enable input can be used in conjunction with external devices, such as a proximity switch, photo eye or limit switch. The user can position these devices in such a way as to prevent movement in danger areas or create zones for movement.

Under all conditions with or without the Set Enable input, the servo controller will maintain or try to maintain its position target.

Relay Enable
The Relay Enable input controls a relay located in the end cap of the Servo Sensor™. A normally open contact controls the power to the servo device or the command lines to the servo device. These options are accomplished by installing pin jumpers within the J3 connector that attaches to P3 of the end cap. The control is designed for 24Vdc.

Generally, when 24Vdc power is removed from proportional valves, the spool inside assumes a "fourth position". This position blocks the pressure and tank ports, thus no pressured oil is applied to the cylinder. With proportional valves the relay contact could be used to power the valve.

All hydraulic systems using servo valves should have a hydraulic lock up valve installed for an external E-stop and should be external to the Servo Sensors™. The valve must be activated for applying hydraulics to the cylinders. When inactive, hydraulic pressure is removed from the cylinder/s.

Status/Fault Control
The Servo Sensor™ sends status bits to the host controller when used. Through software, this word can be used to control hydraulics, provide status of the hardware and fault information. Refer to Appendix B for more details.

Servo Drive Output
Prevention of motion is important when a fault might occur within the Servo Sensor™. The following faults will cause a zero output drive:

Temposonics® Feedback Bad
Bad Control Module

LED VISUAL FAULT INDICATIONS (LOCATED AT PROBE END CAP)

The green LED is pulsed to show the status of the Servo Sensor™. Status indications are described below.

- 1 sec ON, 1 sec OFF
- System OK and position is within IN Position window from target
- ½ sec ON, ½ sec OFF
- System OK, but not within IN Position window
- ½ sec On, 1 ½ sec OFF
  Error – no position data
- Stays on = error, system not running
- Stays off = error, system not running

LED BLINK RATE	.5sec.	.5sec.	.5sec.	.5sec.
BAD SERVO SENSOR™	ON	ON	ON	ON
BAD SERVO SENSOR™	OFF	OFF	OFF	OFF
BAD TEMPO	OFF	OFF	OFF	ON
IN MOTION	OFF	ON	OFF	ON
UNIT OK	OFF	OFF	ON	ON

RUN MODES OVERVIEW

The servo control program located inside the Servo Sensor™ offers four modes of operation. The Cycle, Increment, and Pulse mode use a sixty point set table that is programmed within the Servo Sensor™.

- The first mode is the Serial Mode. Machine control programs are loaded into a host computer, micro controller, or PLC. These programs can access the Servo Sensor™ internal parameters and/or command externally. Communications between the Servo Sensor™ and host is accomplished via a two-wire RS-485 interface. Three discrete inputs and one output provide external control and status.
- The second mode is the Cycle Mode. A set table is stored within the Servo Sensor™. The set table has 60 possible set points, velocities and dwell times available that make an axis perform a motion profile. Discrete inputs called Set Enable and Trigger control the start and continuance of the motion profiles contained in the set table. A discrete output from the Servo Sensor™ is used to monitor the status of the motion profile. Once the axis starts its sequenced motion events, the motion can be reset to a home position or stopped by toggling the Trigger input. The Set Enable can also stop the motion events anytime.
- The third mode is the Incremental Mode. User enters values in the set table within the Servo Sensor™. Each time the Trigger input is enabled the Servo Sensor™ will position incrementally to the next target related to the set table. This is accomplished through the set cable. The Motion Enable
  Control input must be on before movement can begin.
- The fourth mode is the Pulse Mode. This mode is predominately used by PLC's. Set points loaded within the Servo Sensor™ are accessed by supplying pulses from an output of the PLC. The pulse frequency is ~500 Hertz.

OPERATING (RUN) MODES

The following table designates which controls are used in specific modes:

	Serial	Cycle	Incremental	Pulse
Set Enable	X	X	X	X
Relay Enable	X	X	X	X
Trigger	O	X	X	X
Output-INPOS	X	X	X	X
Output-Cycle Complete	X	X	X	X

X = Used O = Not Used

MODE OPERATION EXAMPLES

The following sections discuss the three different modes of operation that use the internal Set table. By configuring value entries within the table, different motion profiles are obtainable. Use the Servo Sensor™ setup software for programming values in the set table.

The Serial mode is not discussed because it's use is for external controllers such as PC's, PLC's, and Stand alone controllers. All commands from the main controller are sent to the Servo Sensor™ over a serial link.

Rules

All motion starts at Set Point 1.
The Motion Enable input must be on at all times for movement.
The Trigger input starts cycles, is used for pulsing in the Pulse mode and increments through the Set Point table in the Increment Mode.
The set point values must be within the range of the stroke of the Servo Sensor™.

Set Point Column

- If Set point value equals 0 in any location of the desired movement, the end of cycle has been reached.
- If end of cycle is reached, the trigger input must be reset to start cycle again.
- Set point value equals 1-60 the motion will jump to that set point location and continue desired motion.

Velocity Column

- Up to three velocity changes are allowed in a motion direction.

Dwell Column

- If Dwell time = 0, the Set Point is not a set point but a point that the velocity changes in the desired motion.

Typical Cycle Mode Program

a) Start at Set point #1
b) Go to Set point #1 at Velocity #1
c) After reaching Set point, remain there until Dwell time expires (timed in 100ths of seconds)
d) Then go to next Set point.
e) If Dwell time = 0, the Set point is not a Set point, but changes Velocity at the Set point. Only up to three (3) Velocity changes can be made to the final Set point.
f) If Set point = 0, the end of the cycle has been reached. System stops until the Trigger Input is on to reset the cycle.
g) If Set point = 1-60, the cycle will skip to Set point 1-60.
h) The Motion Enable input must be on for the cycle to operate. The cycle will stop if Set Enable is turned off.
i) Trigger Input will reset the cycle.
j) The discrete output can be used to indicate "In Position" or Cycle complete. User selectable within the system parameters.

Figure 1 Communication Tab

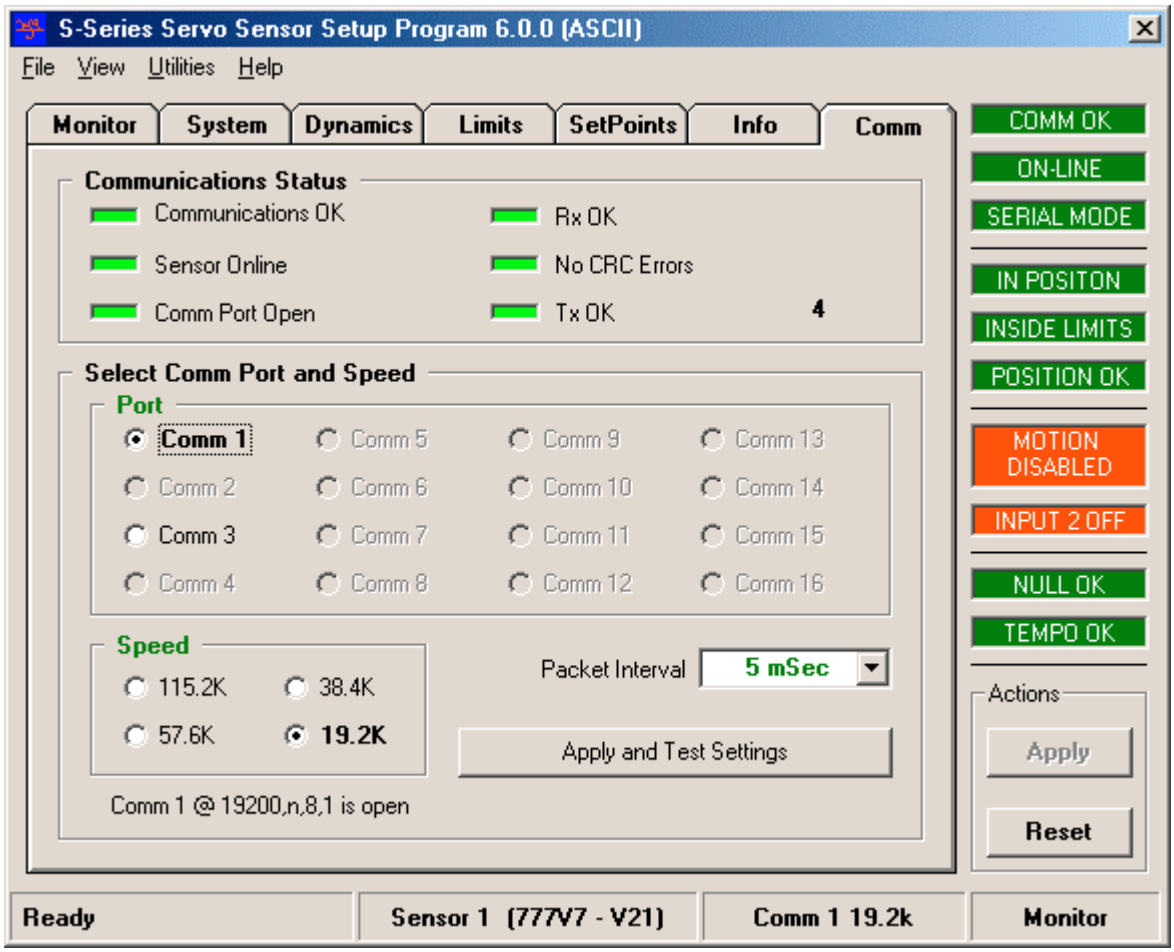


Figure 2 Monitor Tab

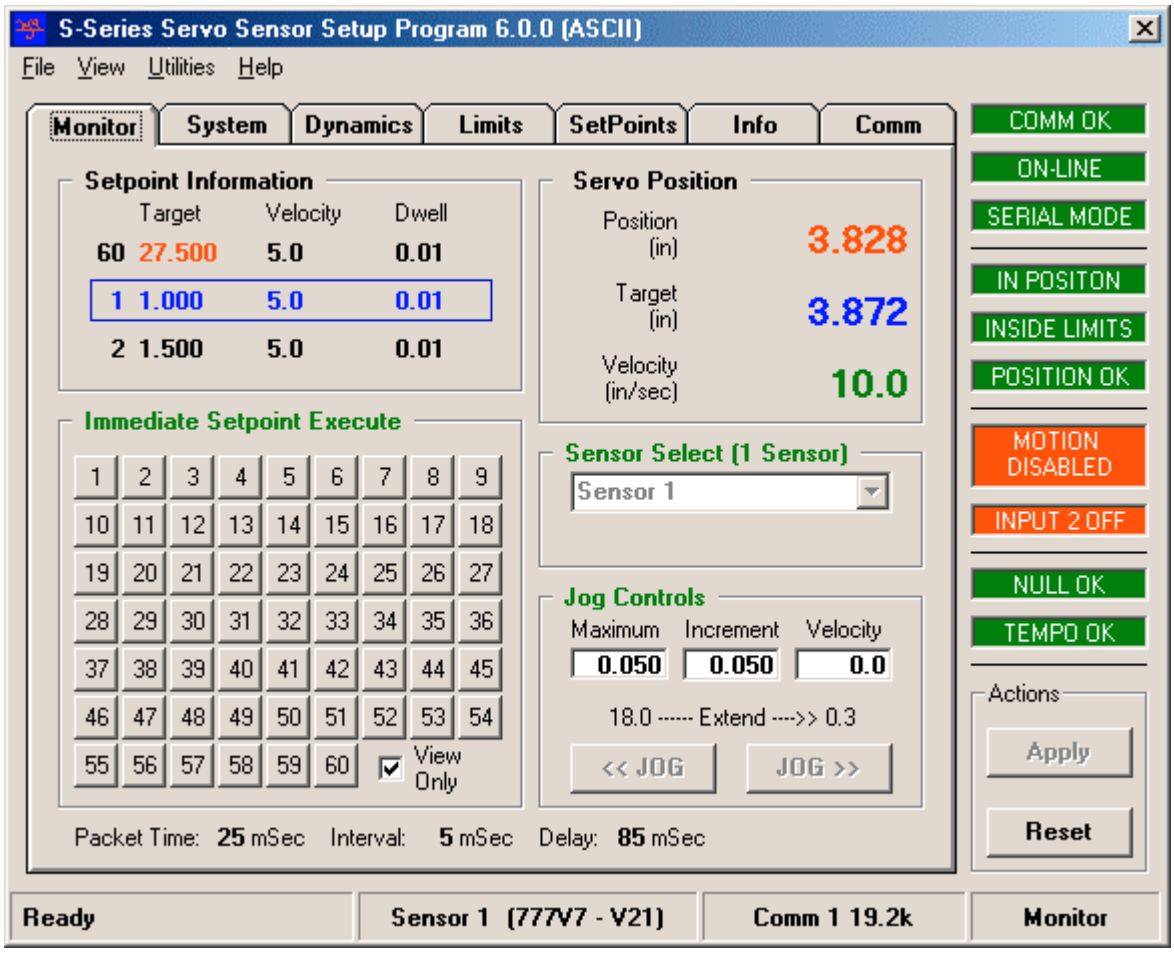


Figure 3 System Tab

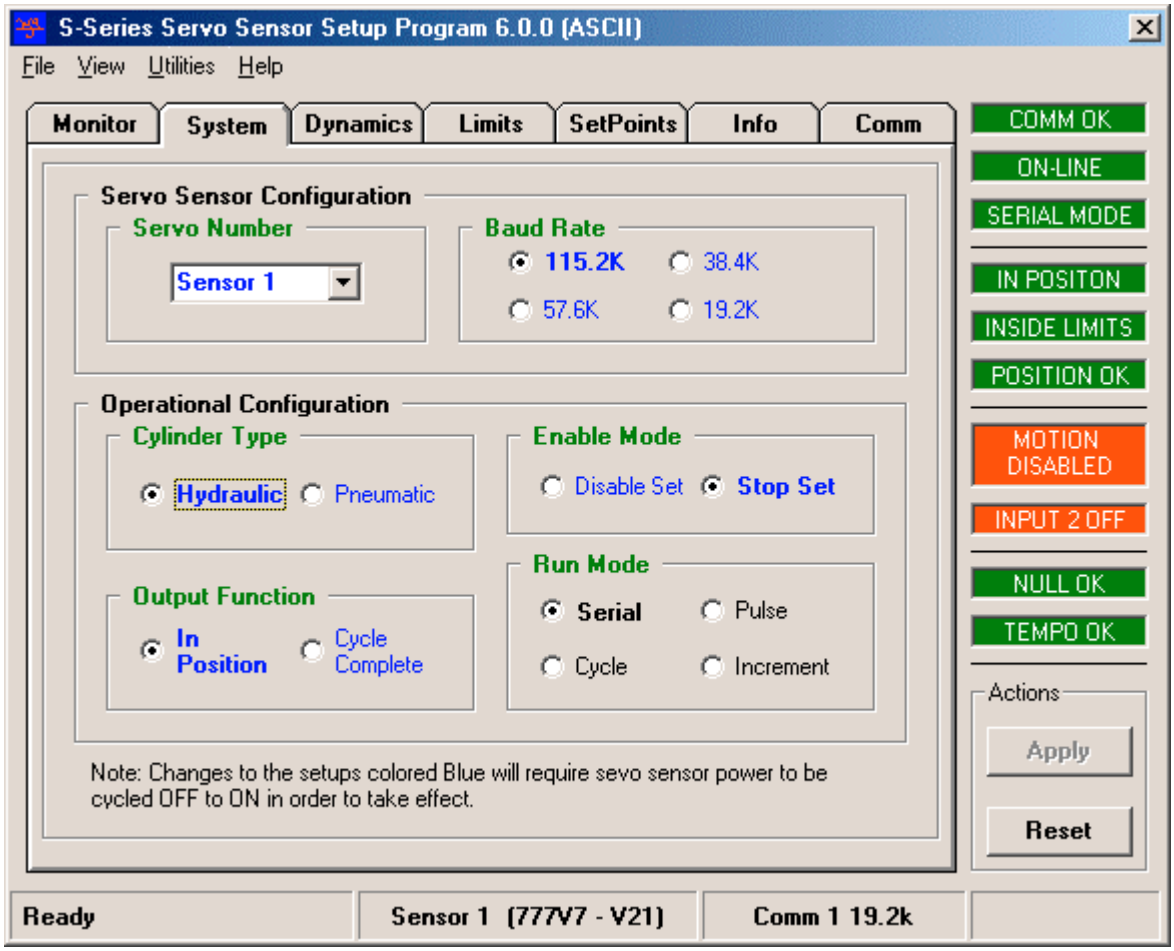


Figure 4 Dynamics Tab

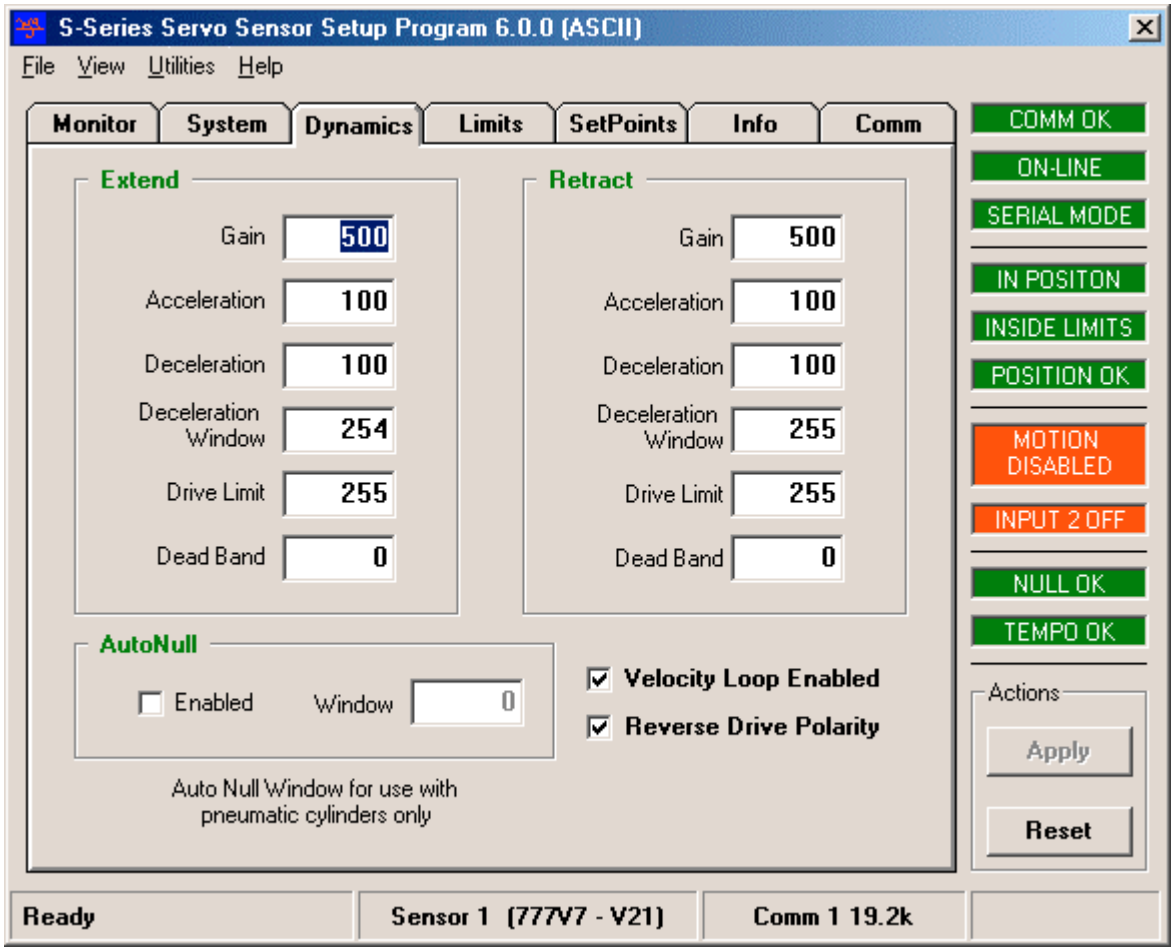


Figure 5 Limits Tab

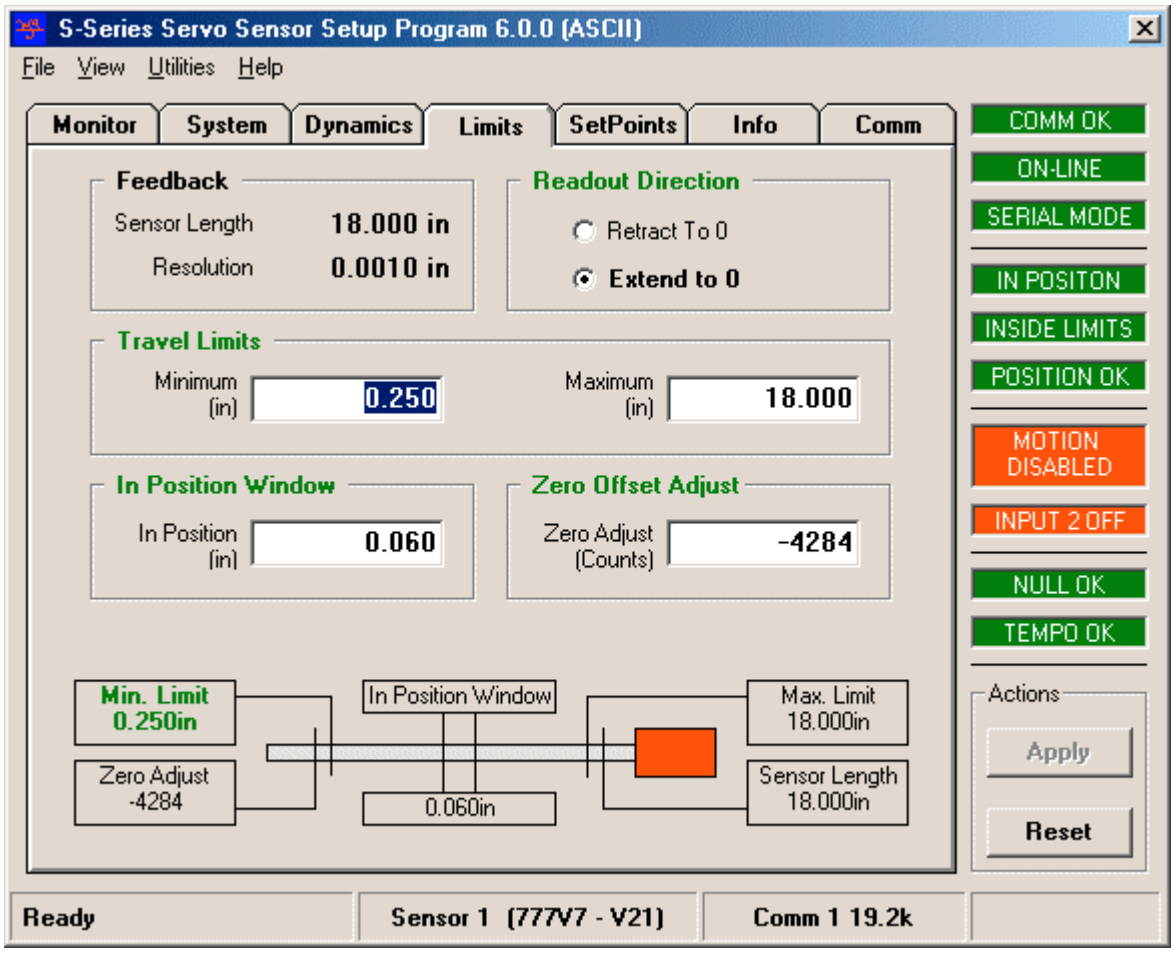


Figure 6 Set Points Tab

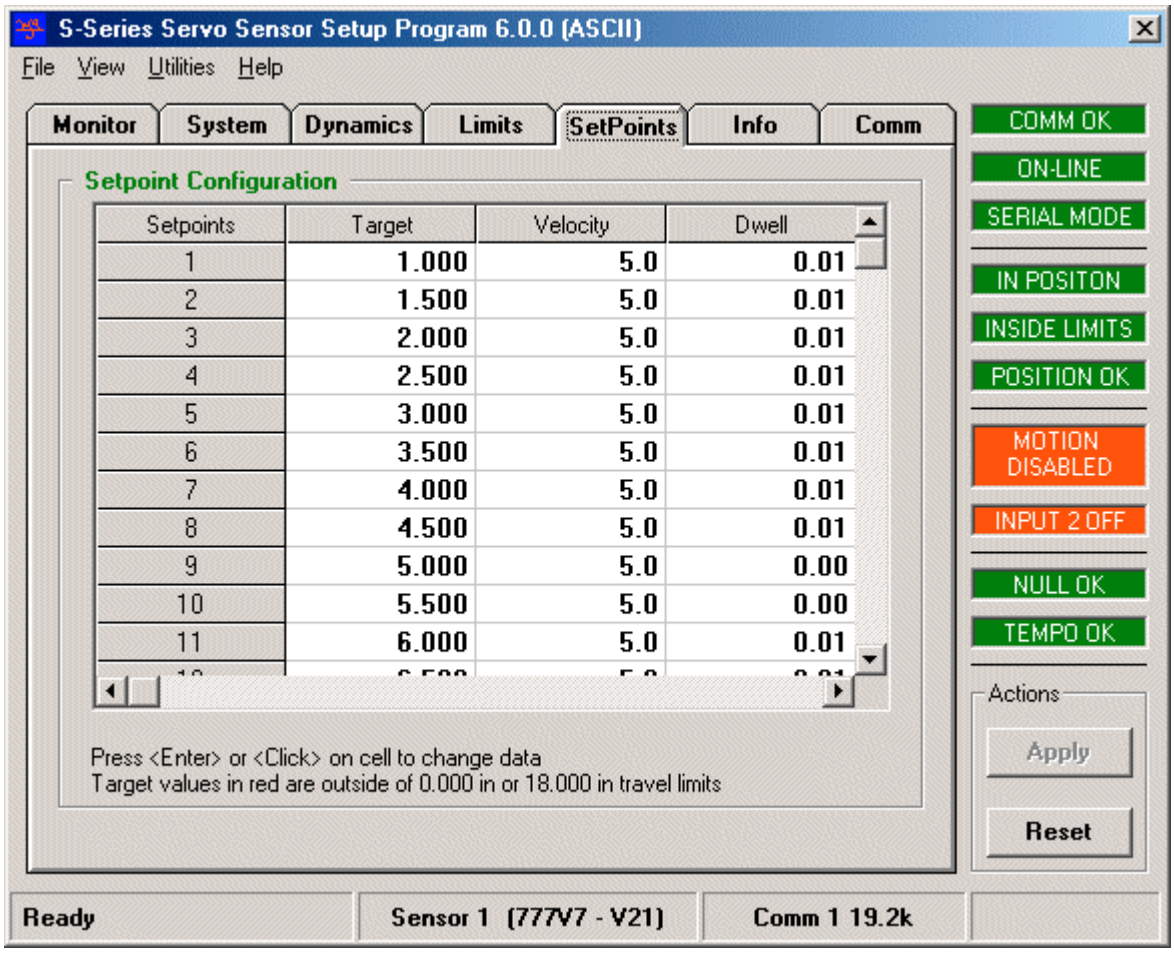
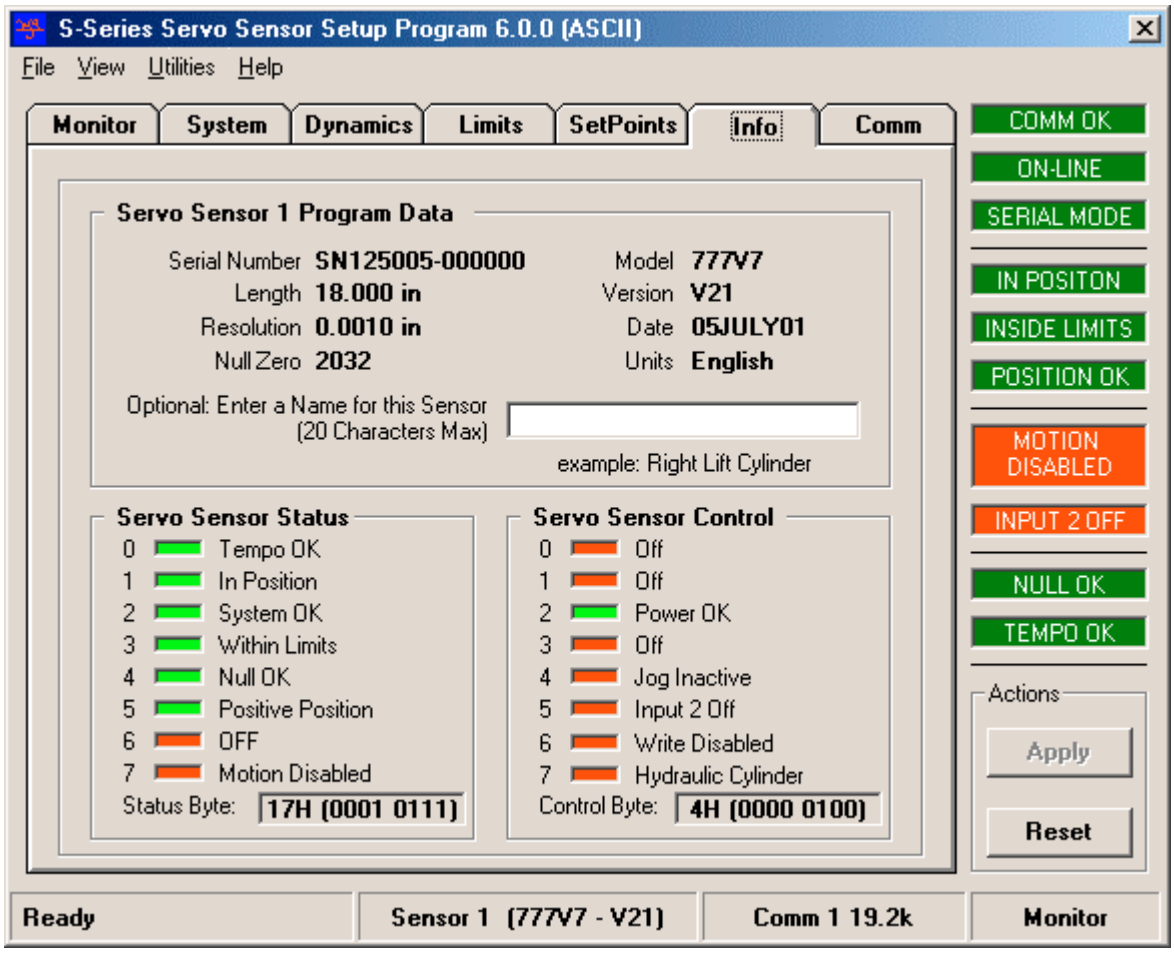
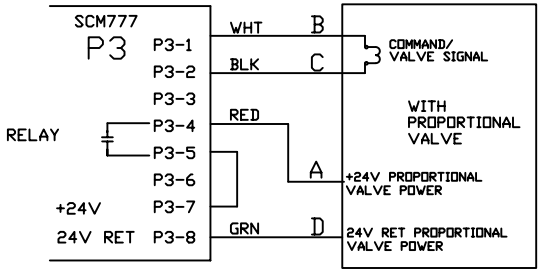
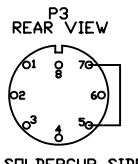


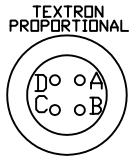
Figure 7 Info Tab



TEXTRON PROPORTIONAL







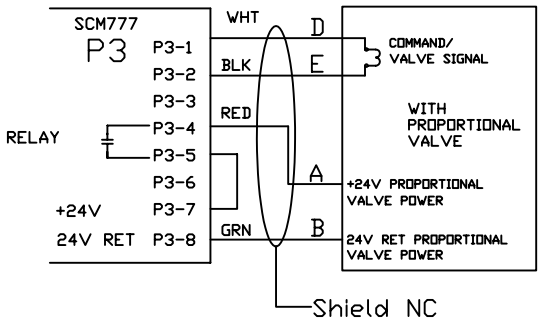
MANHATTAN CABLE M13244

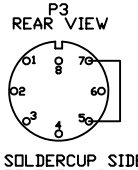
P3-1	WHT	INPUT (+/- 10 VDC)
P3-2	BLK	INPUT (RET)
P3-3		
P3-4	RED	+24V
P3-5		
P3-6		
P3-7		
P3-8	GRN	+24V RET

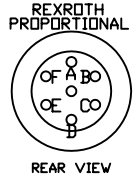
PAIRED

PAIRED

REXROTH PROPORTIONAL
CM 06 EA 14S-61S







MANHATTAN CABLE M13244

P3-1	WHT	INPUT (+/- 10 VDC)
P3-2	BLK	INPUT (RET)
P3-3		
P3-4	RED	+24V
P3-5		
P3-6		
P3-7		
P3-8	GRN	+24V RET

PAIRED

PAIRED

Paw-Taw-John Services, Inc. Rathdrum, ID 83858 (208) 687-1478	Filename: PROPORTIONAL2	Sheets Of: 1 1	REV 8
Drawn By: JRJ Date: 02-19-99 / Approved: JRJ Date: 02-22-01	777 SERVO SENSOR PROPORTIONAL VALVE CONNECTORS		

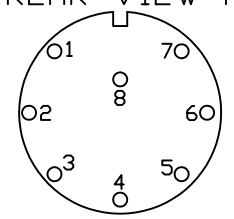
CABLE/CONNECTOR WIRING DIAGRAMS

CABLE COLOR TABLE

PTJ	MTS	MANHATTAN SBZ9811972	FUNCTIONS
P2-1	P2-6	RED (22AWG)	SET/MOTION ENABLE (+24V SOURCE INPUT)
P2-2	P2-1	GRN (22AWG)	RELAY ENABLE (+24V SOURCE INPUT)
P2-3	P2-4	BLK (28AWG)	COM-
P2-4	P2-2	WHT (28AWG)	COM+
P2-5	P2-5	YEL (22AWG)	TRIGGER/INPUT 2 (+24V SOURCE INPUT)
P2-6	P2-3	BLK (18AWG)	P.S. GROUND
P2-7	P2-7	ORG (18AWG)	+24 VDC
P2-8	P2-8	BLU (22AWG)	+24V SOURCE OUTPUT IN POSITION WINDOW VELOCITY WINDOW CYCLE COMPLETE

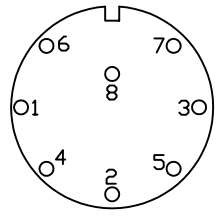
SOLDERCUP SIDE OF
THE CABLE CONNECTOR

PTJ
REAR VIEW P2



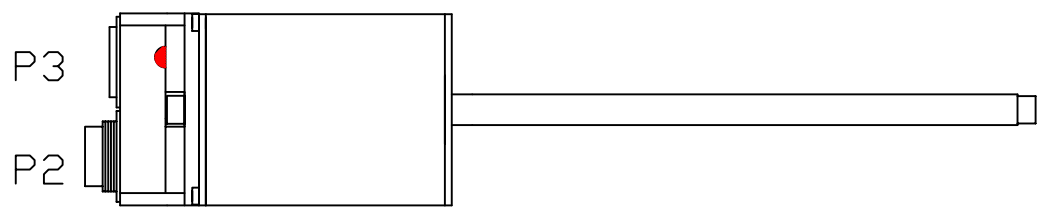
NOTE:
This pin readout was established since different connector manufacturers have thier own readout.

MTS
REAR VIEW P2



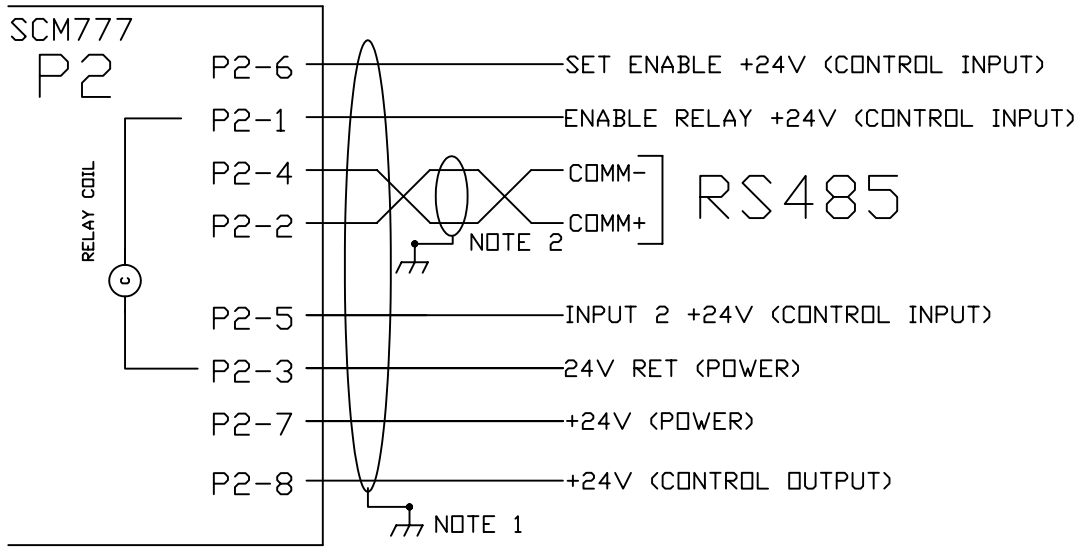
NOTE:
The pin readout is per MTS drawings. The wire color/orientation is the same as PTJ assigned numbers.

REV. 8 NEW CABLE



IT IS HIGHLY RECOMMENDED THAT THE USER USE THE PRESCRIBED CABLE SUPPLIED BY MTS OR PTJ. THE CABLE WAS CUSTOM DESIGNED FOR THE BEST PERFORMANCE OF THE SERVO SENSOR. SUBSTITUITON CABLE IS NOT RECOMMENDED.

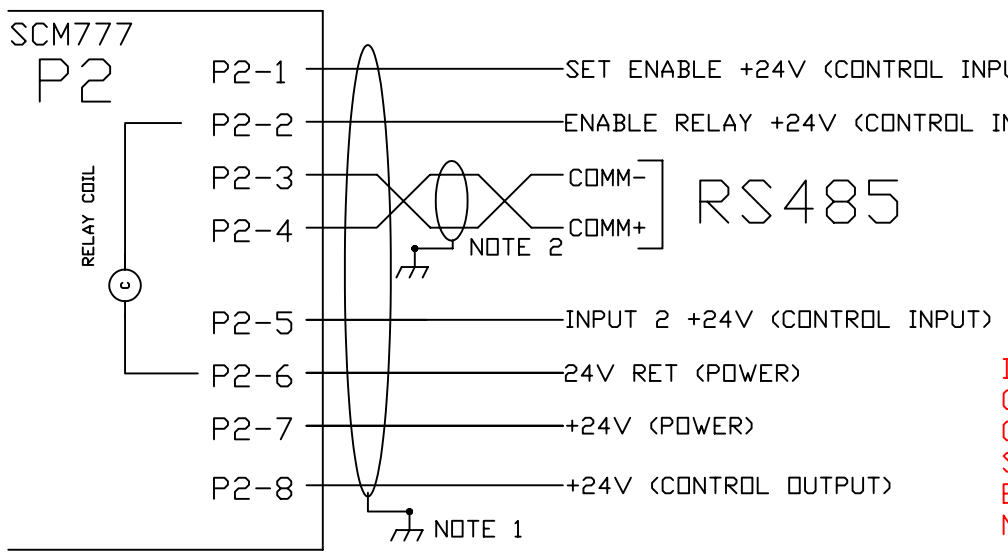
CONTROL CABLE (MTS)



NOTE 1: OVERALL CABLE SHIELD IS CONNECTED AT CONNECTOR GROUND LOCATION AND OTHER END OF CABLE HOOKED TO SYSTEM EARTH GROUND.

NOTE 2: COMMUNICATIONS PAIR DRAINLINE IS CONNECTED AT SYSTEM EARTH GROUND ONLY.

CONTROL CABLE (PTJ)



NOTE 1: OVERALL CABLE SHIELD IS CONNECTED AT CONNECTOR GROUND LOCATION AND OTHER END OF CABLE HOOKED TO SYSTEM EARTH GROUND.

NOTE 2: COMMUNICATIONS PAIR DRAINLINE IS CONNECTED AT SYSTEM EARTH GROUND ONLY.

IT IS NOT RECOMMENDED THAT THE USER CONNECT THE +24VDC RETURN TO EARTH GROUND. GROUND LOOPING CAN OCCUR. THE SHIELDS MUST BE CONNECTED TO EARTH/CHASSIS GROUND TO PROVIDE THE BEST NOISE IMMUNITY AS SHOWN.

Paw-Taw-John Services, Inc.
Rathdrum, ID 83858 (208) 687-1478

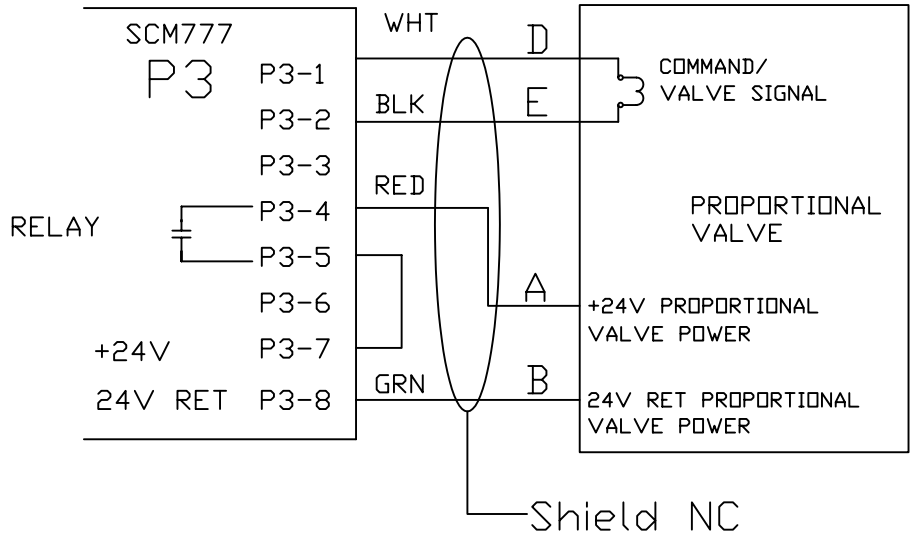
Filename:	Sheet:	Of:	REV
POWER_COM P2 .DWG	1	1	8

S-SERIES SERVO SENSOR
CABLE INTERFACE
POWER/ COM CABLE

Drawn By: JRJ
Date: 08/25/03

Approved:
Date:

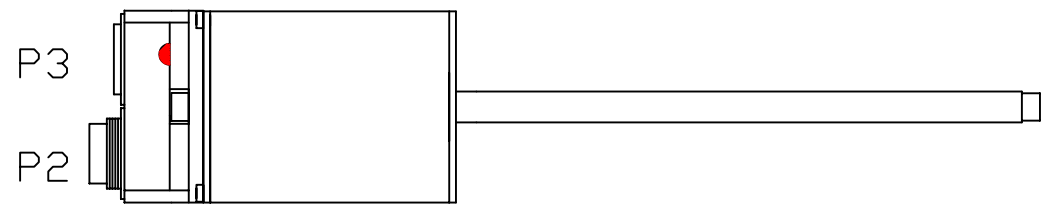
TYPICAL PROPORTIONAL VALVE WIRING



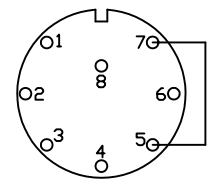
MANHATTAN CABLE
M13244

PTJ	MTS	WIRE	FUNCTION	
P3-1	P3-7	WHT	INPUT (+/- 10 VDC)	PAIR
P3-2	P3-3	BLK	INPUT (RET)	
P3-3	P3-5			
P3-4	P3-2	RED	+24V	
P3-5	P3-4	JUMP	JUMPER FOR PROP. VALVE POWER	PAIR
P3-6	P3-1			
P3-7	P3-6	JUMP		
P3-8	P3-8	GRN	+24V RET	

REV. 8 NEW CABLE

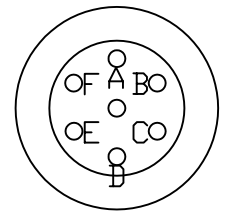


PTJ
P3
REAR VIEW



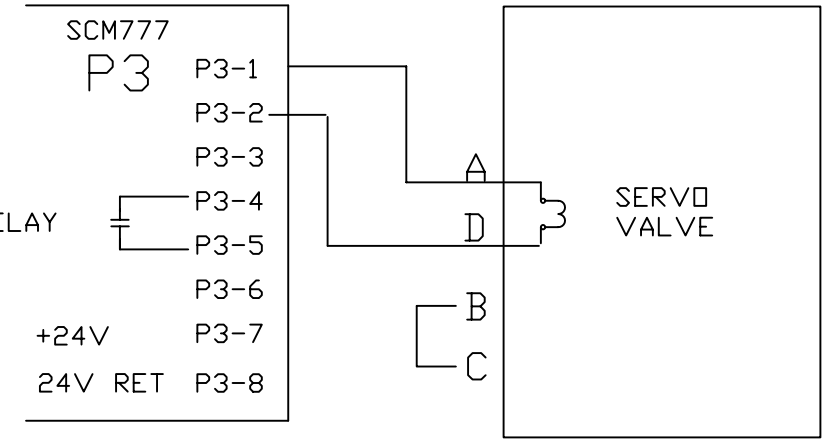
SOLDERCUP SIDE
OF THE CABLE
CONNECTOR

CM 06 EA 14S-61S
TYPICAL PROP. CONNECTOR



REAR VIEW
SOLDER CUP SIDE
OF THE CABLE

TYPICAL SERVO VALVE WIRING

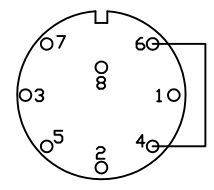


SOLDERCUP SIDE OF
THE CABLE CONNECTOR

MANHATTAN CABLE M39249

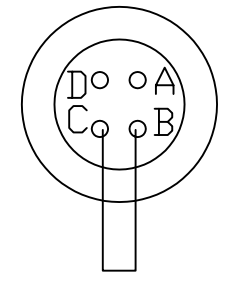
PTJ	MTS	WIRE	FUNCTION	
P3-1	P3-7	WHT	D VALVE+	PAIR
P3-2	P3-3			
P3-3	P3-5			
P3-4	P3-2			
P3-5	P3-4	BLK	A VALVE-	
P3-6	P3-1			
P3-7	P3-6			
P3-8	P3-8			

MTS
P3
REAR VIEW



SOLDERCUP SIDE
OF THE CABLE
CONNECTOR

MS3106A14S-2S
TYPICAL SERVO CONNECTOR



REAR VIEW
SOLDER CUP SIDE
OF THE CABLE

SERVO CABLE PART NO.

□□ □□□ □□□

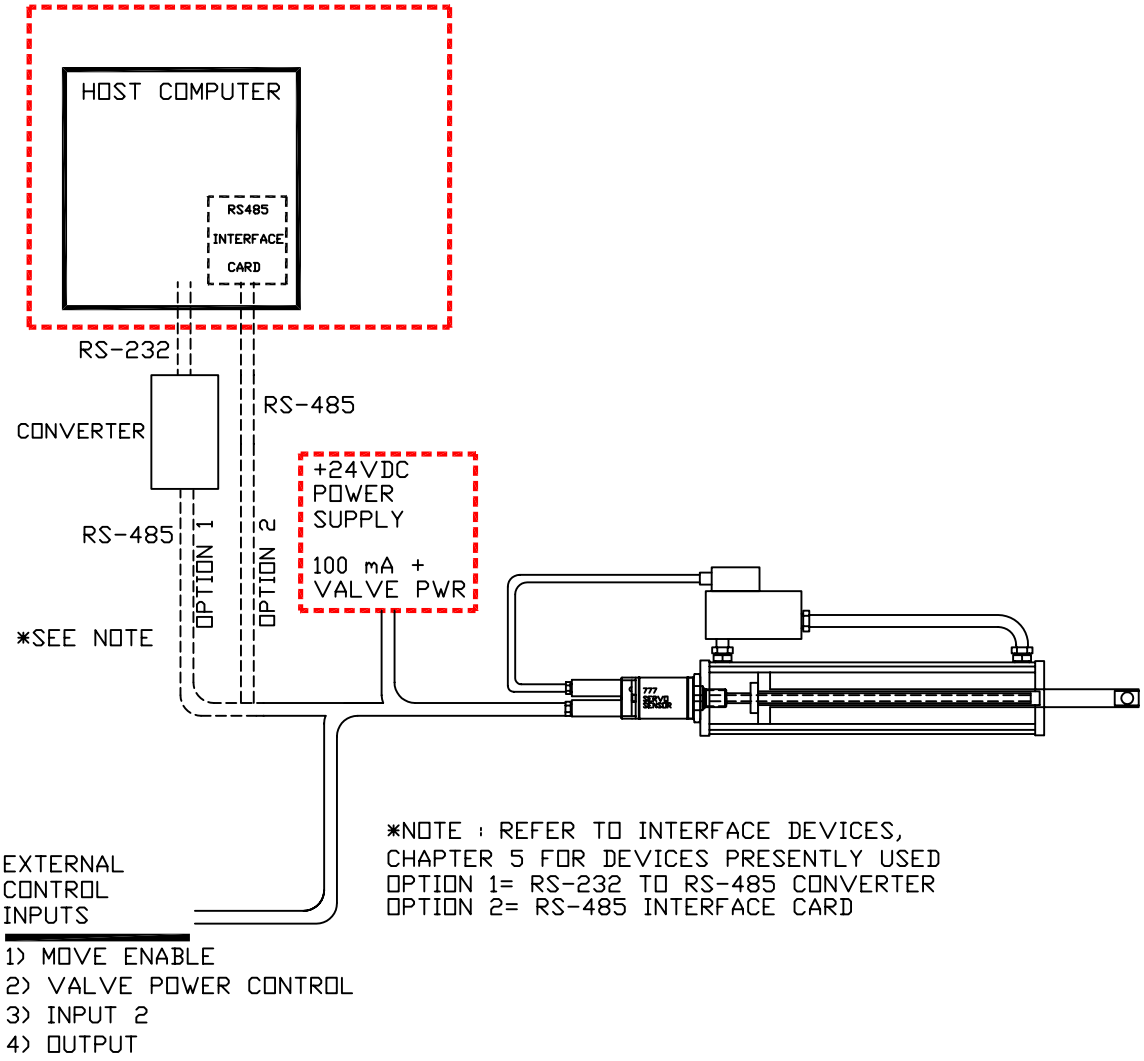
SERVO CABLE CONNECTION TYPE
SS=8 PIN STRAIGHT CONNECTOR
SR=8 PIN RIGHT ANGLE CONNECTOR

CABLE LENGTHS
001 TO 005
OVER 5FT SPECIAL ORDER

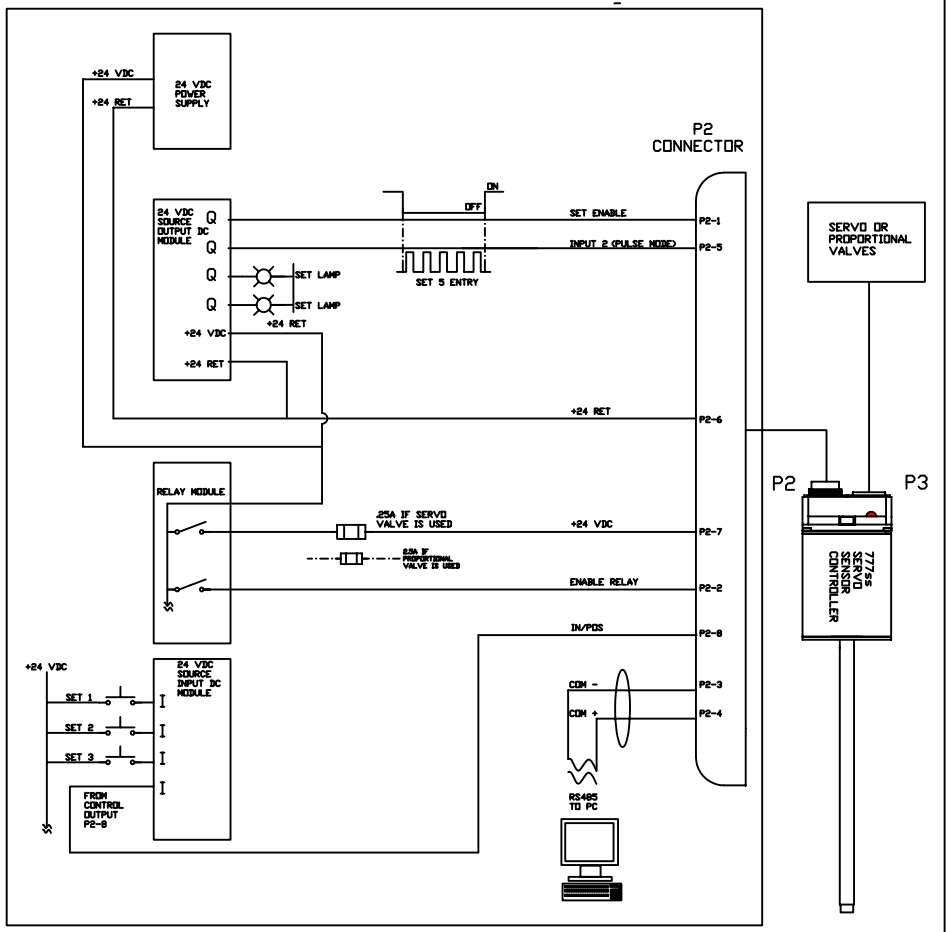
SERVO CABLE TERMINATION
P0=PIG TAIL
Q1_=4 PIN MS SERVO VALVE CONNECTOR
Q2_=PROPORTIONAL VALVE CONNECTOR(FILL IN THE BLANK)
A=ATCHLEY SERVO VALVE
B=MOOG SERVO VALVE
C=REXROTH PROPORTIONAL VALVE
D=TEXTRON DIRECT DRIVE VALVE
E=VICKERS PROPORTIONAL VALVE
F=BOSCH PROPORTIONAL VALVE=6 PIN CONNECTOR

Paw-Taw-John Services, Inc.		Filename: SERVO_PROP P3	Sheet: DWG 1	Of: 1	REV 8
Rathdrum, ID 83858 (208) 687-1478		S-SERIES SERVO SENSOR CABLE INTERFACE SERVO/PROP CABLE			
Drawn By: JRJ Date: 08/25/03	Approved: Date:				

PC MODE
TYPICAL INTERFACE

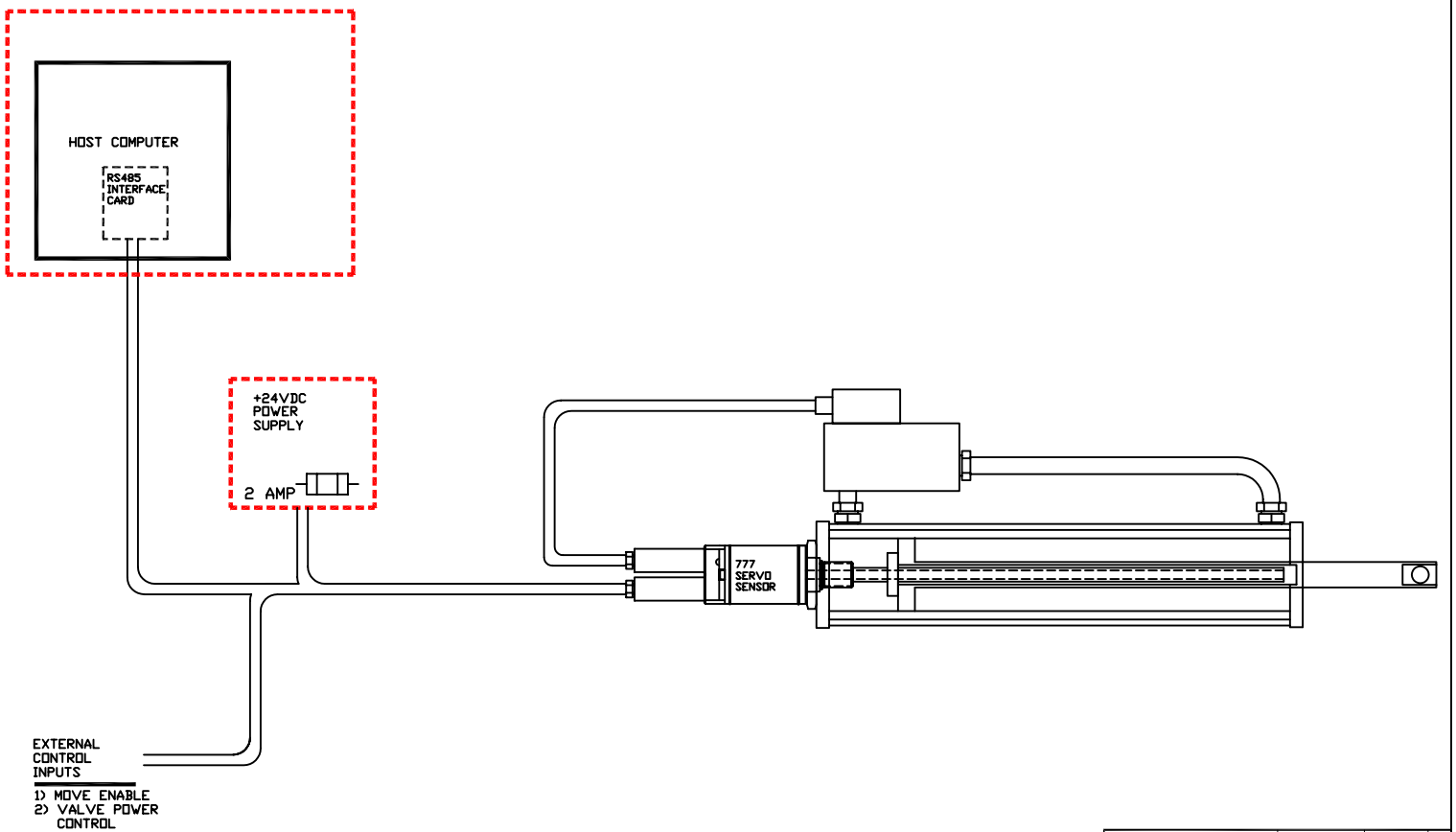


TYPICAL PLC INTERFACE
USING PULSE MODE



Pow-Tow-John Services, Inc.	Filename: PLCINTFACE	Sheet: 1 of 1	REV: 1
	777 SERVO SENSOR CONTROLLER PLC PULSE MODE INTERFACE		
Drawn By: JL Date: 02-25-09	Approved: JJ Date: 04-06-09		

TYPICAL INTERFACE



Paw-Taw-John Services, Inc.	Filename: TYP INTERFACE	Sheet: 1	Of: 1	REV: 1
Rathdrum, ID 83858 (208) 687-1478	PAW-TAW-JOHN SERVICES 777 SERVO SENSOR™ TYPICAL INTERFACE			
Drawn By: MW Date: 11-20-98	Approved: JJ Date: 11-20-98			