

# S-Series Sensor ASCII Protocol v8.1.0

**Legend:**

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

| Communications Format |          |
|-----------------------|----------|
| Supported Baud        | **115200 |
| Rates:                | 57600    |
|                       | 38400    |
|                       | 19200    |
| Data Bits:            | 8        |
| Start Bit:            | 1        |
| Stop Bit:             | 1        |
| Parity:               | none     |

\*\*Default

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

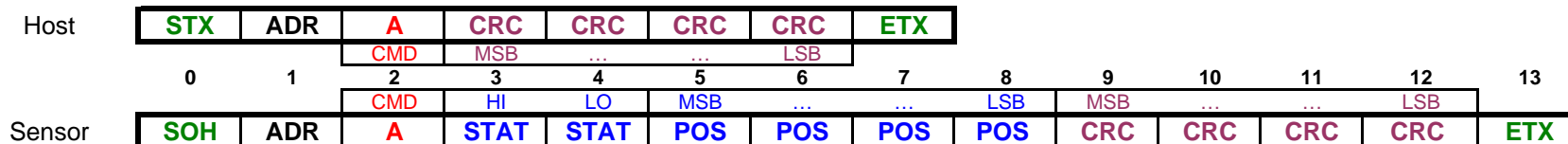
## COMMAND SUMMARY

| Command Summary |     |     |                                       |      |
|-----------------|-----|-----|---------------------------------------|------|
| Dec             | Hex | CMD | Definition                            | Page |
| 65              | 41H | A   | Read Status Byte & Position           | 3    |
| 66              | 42H | B   | Read Control Byte & Target            | 3    |
| 67              | 43H | C   | Read Secure Code & Velocity           | 3    |
| 68              | 44H | D   | Read Parameter                        | 4    |
| 69              | 45H | E   | Read Timestamp & Following Error      | 4    |
| 70              | 46H | F   | Read Sensor Info (Name, Date, Serial) | 4    |
| 71              | 47H | G   | Write Secure Code                     | 6    |
| 72              | 48H | H   | Write Offset Increment                | 6    |
| 73              | 49H | I   | Write Target & return target          | 6    |
| 74              | 4AH | J   | Write Target & return position        | 7    |
| 75              | 4BH | K   | Write Velocity                        | 7    |
| 76              | 4CH | L   | Write Parameter                       | 7    |
| 77              | 4DH | M   | Write Velocity & Target               | 8    |
| 78              | 4EH | N   | Jog +                                 | 8    |
| 79              | 4FH | O   | Read Setpoint Position                | 5    |
| 80              | 50H | P   | Jog -                                 | 8    |
| 81              | 51H | Q   | Write Setpoint Data                   | 9    |
| 82              | 52H | R   | Read Setpoint Data                    | 5    |
| 83              | 53H | S   |                                       |      |
| 84              | 54H | T   | Command Stop                          | 9    |
| 85              | 55H | U   |                                       |      |
| 86              | 56H | V   |                                       |      |
| 87              | 57H | W   |                                       |      |
| 88              | 58H | X   |                                       |      |
| 89              | 59H | Y   |                                       |      |
| 90              | 5AH | Z   |                                       |      |
| 35              | 23H | #   | Read/Set Address (ADR)                | 9    |

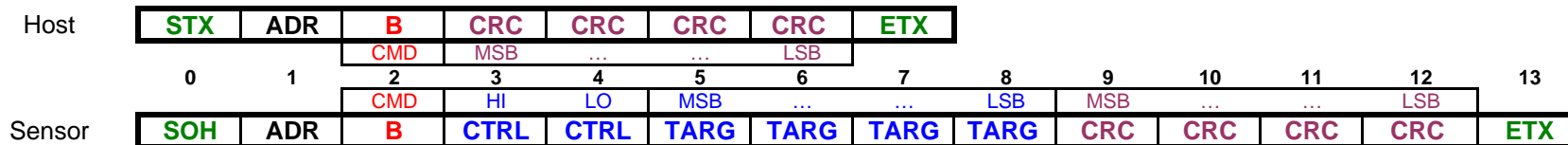
| Sensor Address |     |     |     |
|----------------|-----|-----|-----|
| Sensor         | ADR | Hex | Dec |
| 1              | a   | 61H | 97  |
| 2              | b   | 62H | 98  |
| 3              | c   | 63H | 99  |
| 4              | d   | 64H | 100 |
| 5              | e   | 65H | 101 |
| 6              | 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

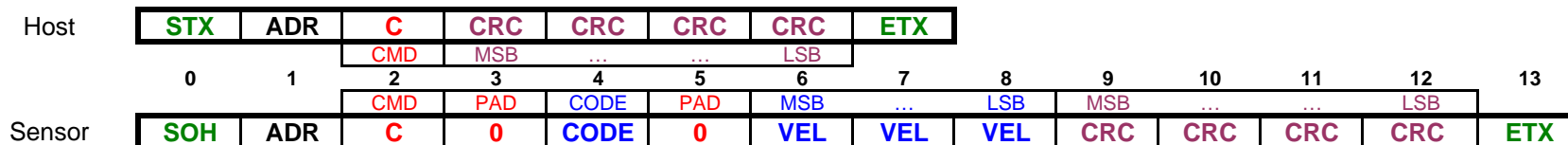
### Read Position & Status

A


### Read Target & Control

B


### Read Velocity & Security Code

C


## Read Commands (continued)

### Read Parameter

See parameter listing and Appendix A for detailed information.

D

|        |            |            |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |            |
|--------|------------|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|
|        | <b>STX</b> | <b>ADR</b> | <b>D</b>           | <b>0</b>           | <b>0</b>           | <b>PAR #</b>       | <b>PAR #</b>       | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b>         |                    |            |
| Host   |            |            | <small>CMD</small> | <small>PAD</small> | <small>PAD</small> | <small>MSB</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |                    |                    |            |
|        | 0          | 1          | 2                  | 3                  | 4                  | 5                  | 6                  | 7                  | 8                  | 9                  | 10                 | 11                 | 12                 | 13         |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>D</b>           | <b>PAR #</b>       | <b>PAR #</b>       | <b>PARM</b>        | <b>PARM</b>        | <b>PARM</b>        | <b>PARM</b>        | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b> |
|        |            |            | <small>CMD</small> | <small>MSB</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |            |

### Read Timestamp & Following Error

E

|        |            |            |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |            |
|--------|------------|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|
|        | <b>STX</b> | <b>ADR</b> | <b>E</b>           | <b>0</b>           | <b>0</b>           | <b>0</b>           | <b>0</b>           | <b>0</b>           | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b>         |            |
| Host   |            |            | <small>CMD</small> | <small>PAD</small> | <small>PAD</small> | <small>PAD</small> | <small>PAD</small> | <small>PAD</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |                    |            |
|        | 0          | 1          | 2                  | 3                  | 4                  | 5                  | 6                  | 7                  | 8                  | 9                  | 10                 | 11                 | 12                 | 13         |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>E</b>           | <b>TIME</b>        | <b>TIME</b>        | <b>ERR</b>         | <b>ERR</b>         | <b>ERR</b>         | <b>ERR</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b> |
|        |            |            | <small>CMD</small> | <small>MSB</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |            |

### Read Sensor Information

See Appendix B for sensor information offsets and returned data

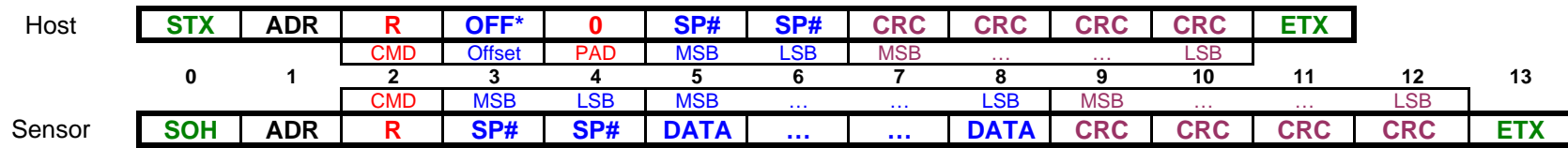
F

|        |            |            |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |            |            |
|--------|------------|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|------------|
|        | <b>STX</b> | <b>ADR</b> | <b>F</b>           | <b>0</b>           | <b>0</b>           | <b>OFF</b>         | <b>OFF</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b>         |                    |            |            |
| Host   |            |            | <small>CMD</small> | <small>PAD</small> | <small>PAD</small> | <small>MSB</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |                    |                    |            |            |
|        | 0          | 1          | 2                  | 3                  | 4                  | 5                  | 6                  | 7                  | 8                  | 9                  | 10                 | 11                 | 12                 | 13         |            |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>F</b>           | <b>CHAR</b>        | <b>CHAR</b>        | <b>CHAR</b>        | <b>CHAR</b>        | <b>CHAR</b>        | <b>CHAR</b>        | <b>CHAR</b>        | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b> | <b>ETX</b> |
|        |            |            | <small>CMD</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>...</small> | <small>...</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |            |            |

## Read Commands (continued)

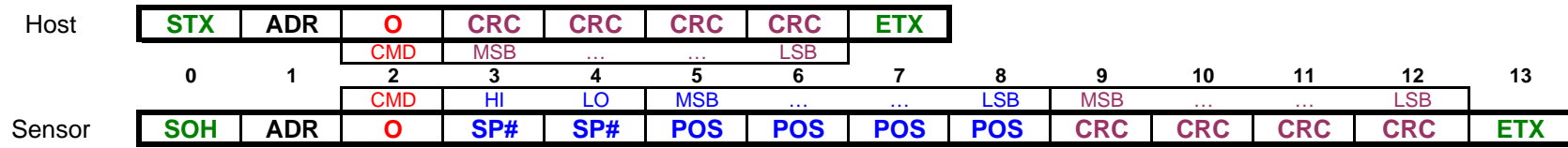
### Read Setpoint Data

See Appendix C for Setpoint and offset definitions

R


| *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  |

### Read Position & Setpoint

O


## Write Commands

### Write Security Code

G

|        |            |            |                    |                    |                     |                    |                     |                    |                    |                    |                    |                    |                    |            |
|--------|------------|------------|--------------------|--------------------|---------------------|--------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|
|        | <b>STX</b> | <b>ADR</b> | <b>G</b>           | <b>0</b>           | <b>0</b>            | <b>0</b>           | <b>CODE</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b>         |                    |            |
| Host   |            |            | <small>CMD</small> | <small>PAD</small> | <small>PAD</small>  | <small>PAD</small> | <small>DATA</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |                    |                    |            |
|        | 0          | 1          | 2                  | 3                  | 4                   | 5                  | 6                   | 7                  | 8                  | 9                  | 10                 | 11                 | 12                 | 13         |
|        |            |            | <small>CMD</small> | <small>PAD</small> | <small>DATA</small> | <small>PAD</small> | <small>PAD</small>  | <small>PAD</small> | <small>PAD</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |            |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>G</b>           | <b>0</b>           | <b>CODE</b>         | <b>0</b>           | <b>0</b>            | <b>0</b>           | <b>0</b>           | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b> |

### Write Zero Adjust Offset Increment

H

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

### Write Target and Return Target

I

|        |            |            |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |            |
|--------|------------|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|
|        | <b>STX</b> | <b>ADR</b> | <b>I</b>           | <b>TARG</b>        | <b>TARG</b>        | <b>TARG</b>        | <b>TARG</b>        | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b>         |                    |            |
| Host   |            |            | <small>CMD</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |                    |                    |            |
|        | 0          | 1          | 2                  | 3                  | 4                  | 5                  | 6                  | 7                  | 8                  | 9                  | 10                 | 11                 | 12                 | 13         |
|        |            |            | <small>CMD</small> | <small>MSB</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> | <small>MSB</small> | <small>...</small> | <small>...</small> | <small>LSB</small> |            |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>I</b>           | <b>CTRL</b>        | <b>CTRL</b>        | <b>TARG</b>        | <b>TARG</b>        | <b>TARG</b>        | <b>TARG</b>        | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>CRC</b>         | <b>ETX</b> |

## Write Commands (continued)

### Write Target and Return Position

J

|        |     |     |   |      |      |      |      |     |     |     |     |     |     |     |
|--------|-----|-----|---|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|
| Host   | STX | ADR | J | TARG | TARG | TARG | TARG | CRC | CRC | CRC | CRC | ETX |     |     |
|        | 0   | 1   |   | CMD  | MSB  | ...  | ...  | LSB | MSB | ... | ... | LSB |     |     |
| Sensor | SOH | ADR | J | STAT | STAT | POS  | POS  | POS | POS | CRC | CRC | CRC | CRC | ETX |
|        |     |     |   | CMD  | MSB  | LSB  | MSB  | ... | ... | LSB | MSB | ... | ... | LSB |

### Write Velocity and Return Position

K

|        |     |     |   |      |      |     |     |     |     |     |     |     |     |     |
|--------|-----|-----|---|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Host   | STX | ADR | K | 0    | VEL  | VEL | VEL | CRC | CRC | CRC | CRC | ETX |     |     |
|        | 0   | 1   |   | CMD  | PAD  | MSB | ... | ... | LSB | MSB | ... | ... | LSB |     |
| Sensor | SOH | ADR | K | STAT | STAT | POS | POS | POS | POS | CRC | CRC | CRC | CRC | ETX |
|        |     |     |   | CMD  | MSB  | LSB | MSB | ... | ... | LSB | MSB | ... | ... | LSB |

### Write Parameter

See parameter listing and Appendix A for detailed information.

L

|        |     |     |   |       |       |       |      |      |      |      |     |     |     |     |     |
|--------|-----|-----|---|-------|-------|-------|------|------|------|------|-----|-----|-----|-----|-----|
| Host   | STX | ADR | L | 0     | PAR # | PAR # | PARM | PARM | PARM | PARM | CRC | CRC | CRC | CRC | ETX |
|        | 0   | 1   |   | CMD   | PAD   | MSB   | LSB  | MSB  | ...  | ...  | LSB | MSB | ... | ... | LSB |
| Sensor | SOH | ADR | L | PAR # | PAR # | PARM  | PARM | PARM | PARM | CRC  | CRC | CRC | CRC | ETX |     |
|        |     |     |   | CMD   | MSB   | LSB   | MSB  | ...  | ...  | LSB  | MSB | ... | ... | LSB |     |

## Write Commands (continued)

### Write Target & Velocity

M

|        |            |            |          |             |             |            |             |             |             |             |            |            |            |            |            |
|--------|------------|------------|----------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|------------|------------|------------|------------|
| Host   | <b>STX</b> | <b>ADR</b> | <b>M</b> | <b>VEL</b>  | <b>VEL</b>  | <b>VEL</b> | <b>TARG</b> | <b>TARG</b> | <b>TARG</b> | <b>TARG</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>ETX</b> |
|        | 0          | 1          | CMD      | MSB         | ...         | LSB        | MSB         | ...         | ...         | LSB         | MSB        | ...        | ...        | LSB        | 14         |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>M</b> | <b>STAT</b> | <b>STAT</b> | <b>POS</b> | <b>POS</b>  | <b>POS</b>  | <b>POS</b>  | <b>CRC</b>  | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>ETX</b> |            |

### Jog +

N

|        |            |            |          |             |             |            |            |            |            |            |            |            |            |            |  |
|--------|------------|------------|----------|-------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--|
| Host   | <b>STX</b> | <b>ADR</b> | <b>N</b> | <b>0</b>    | <b>VEL</b>  | <b>VEL</b> | <b>VEL</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>ETX</b> |            |            |  |
|        | 0          | 1          | CMD      | PAD         | MSB         | ...        | LSB        | MSB        | ...        | ...        | LSB        | 13         |            |            |  |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>N</b> | <b>STAT</b> | <b>STAT</b> | <b>POS</b> | <b>POS</b> | <b>POS</b> | <b>POS</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>ETX</b> |  |

### Jog -

P

|        |            |            |          |             |             |            |            |            |            |            |            |            |            |            |  |
|--------|------------|------------|----------|-------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--|
| Host   | <b>STX</b> | <b>ADR</b> | <b>P</b> | <b>0</b>    | <b>VEL</b>  | <b>VEL</b> | <b>VEL</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>ETX</b> |            |            |  |
|        | 0          | 1          | CMD      | PAD         | MSB         | ...        | LSB        | MSB        | ...        | ...        | LSB        | 13         |            |            |  |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>P</b> | <b>STAT</b> | <b>STAT</b> | <b>POS</b> | <b>POS</b> | <b>POS</b> | <b>POS</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> | <b>ETX</b> |  |



## Write Commands (continued)

### Read/Write Address Change

#

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

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

To use this command, obtain the Servo Sensor™ serial number. The serial number is located on the label on the sensor body. Only the last six digits are relevant. Set enable must be *off*.

Example: To set the network address: if the serial number on the label is "100000734" and the desired address is 2 then the command is:

<STX> # 0 0 0 7 3 4 4 b x x x x <ETX> (where x x x x is the calculated CRC)

### Write Setpoint Data

See Appendix C for Setpoint and offset definitions

Q

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

| *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  |

### Stop Command

T

|        |            |            |            |             |             |            |            |            |
|--------|------------|------------|------------|-------------|-------------|------------|------------|------------|
| Host   | <b>STX</b> | <b>ADR</b> | <b>T</b>   | <b>CRC</b>  | <b>CRC</b>  | <b>CRC</b> | <b>CRC</b> | <b>ETX</b> |
|        |            | <b>CMD</b> | <b>MSB</b> | ...         | ...         | <b>LSB</b> |            |            |
|        | 0          | 1          | 2          | 3           | 4           | 5          | 6          | 7          |
|        |            | <b>CMD</b> | <b>HI</b>  | <b>LO</b>   | <b>MSB</b>  | ...        | ...        | <b>LSB</b> |
|        |            |            |            |             | <b>MSB</b>  | ...        | ...        | <b>LSB</b> |
| Sensor | <b>SOH</b> | <b>ADR</b> | <b>T</b>   | <b>STAT</b> | <b>STAT</b> | <b>POS</b> | <b>POS</b> | <b>POS</b> |
|        |            |            |            |             |             | <b>POS</b> | <b>POS</b> | <b>POS</b> |
|        |            |            |            |             |             | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> |
|        |            |            |            |             |             | <b>CRC</b> | <b>CRC</b> | <b>CRC</b> |
|        |            |            |            |             |             | <b>ETX</b> |            |            |

## Control and Status Byte Bit Definitions

Control and  
Status Bytes

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

| Status Byte |                     |   |                      |         |                |              |             |             |
|-------------|---------------------|---|----------------------|---------|----------------|--------------|-------------|-------------|
| Range       | MSB                 |   |                      |         | LSB            |              |             |             |
|             | 0-F                 |   |                      |         | 0-F            |              |             |             |
| Bit         | 7                   | 6 | 5                    | 4       | 3              | 2            | 1           | 0           |
| Definition  | Motion<br>Enable On |   | Position<br>Negative | Null OK | Over<br>Travel | System<br>OK | In Position | Tempo<br>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                 | <b>B3H = B3 - 30H</b> | <b>B2H = B2 - 30H</b> | <b>B1H = B1 - 30H</b> | <b>B0H = B0 - 30H</b> | 2 - Hex Data   |
| ASCII A-F                 | <b>B3H = B3 - 37H</b> | <b>B2H = B2 - 37H</b> | <b>B1H = B1 - 37H</b> | <b>B0H = B0 - 37H</b> |                |
| Convert To Decimal Counts |                       |                       |                       |                       |                |
|                           | <b>(B3H * 4096) +</b> | <b>(B2H * 256) +</b>  | <b>(B1H * 16) +</b>   | <b>(B0H) =</b>        | 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)
- 2-Feb-03 Updated expanded parameters for Velocity Enable and Output mode
- 19-Nov-03 Added Set Enable changes for v23E
- 25-Mar-04 Changed extend / retract acceleration from 8-bit value to 16-bit value
- 13-Apr-04 Added "O" and "T"

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# 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 |                          |
|  | <b>Level of Security</b> |
| 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                    | <b>Extend Gain</b>                 | Value multiplied by the position error when in positive direction  | 1                         | 65000  | 500     | Counts            |
| 3                    | <b>Retract Gain</b>                | Value multiplied by the position error when in negative direction  | 1                         | 65000  | 500     | Counts            |
| 4                    | <b>Extend Acceleration</b>         | Acceleration value used for servo output on ramp delay to a maximum drive condition.   | 1                         | 65.534 | 30.000  | Number in/sec/sec |
| 5                    | <b>Retract Acceleration</b>        | Same as above except for negative direction.   | 1                         | 65.534 | 30.000  | Number in/sec/sec |
| 6                    | <b>Extend Deceleration Window</b>  | Defines an area in movement before the target is reached that the deceleration value will not be used.   | 1                         | 65000  | 255     | Counts            |
| 7                    | <b>Retract Deceleration Window</b> | Same as above except for negative direction.   | 1                         | 65000  | 255     | Counts            |
| 8                    | <b>Extend Deceleration</b>         | Deceleration value used for servo output off ramp delay from a maximum drive condition   | 1                         | 65000  | 100     | Counts            |
| 9                    | <b>Retract Deceleration</b>        | Same as above except for negative direction  | 1                         | 65000  | 100     | Counts            |
| 10                   | <b>Extend Deadband</b>             | Position value used to describe area in positive direction that no servo drive is used.  | 0                         | 65000  | 0       | Counts            |
| 11                   | <b>Retract Deadband</b>            | Same as above except in the negative direction   | 0                         | 65000  | 0       | Counts            |
| 12                   | <b>Velocity Enable ***</b>         | 0 = Drive limits are used for motion (speed) control   | 0                         | 2      | 2       | Number            |
|                      |                                    | 1 = Enables the <i>slow</i> velocity control for motion (0 to 40.00 in/sec/sec)  |                           |        |         |                   |
|                      |                                    | 2 = Enables the <i>fast</i> velocity control for motion (0 to 400.0 in/sec/sec)  |                           |        |         |                   |
| 13                   | <b>Velocity Range</b>              | 0 = 0.1"/sec<br>1 = 0.01"/sec  | 0                         | 1      | 0       | Boolean           |
| 14                   | <b>Extend Drive Limit</b>          | Determines the amount of current/voltage output in the positive direction. 255 equals maximum drive.   | 1                         | 255    | 255     | Counts            |
| 15                   | <b>Retract Drive Limit</b>         | Same as above except in the negative direction   | 1                         | 255    | 255     | Counts            |
| 16                   | <b>Auto-Null Enable</b>            | 0 = Auto-null Disabled<br>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                   | <b>Auto-Null Window</b>            | Value defines a position window around the target position that will enable an integral loop. - <b>AIR CYLINDER ONLY</b>   | 0                         | 65000  | 0       | Counts            |
| 18                   | <b>Jog Increment</b>               | Defines the minimum move value when jogging the Servo Sensor™  | 0                         | 65000  | 0       | Counts            |
| 19                   | <b>Jog Maximum</b>                 | Defines the maximum move value when jogging the Servo Sensor™  | 0                         | 65000  | 0       | Counts            |
| 20                   | <b>Drive Signal Polarity</b>       | Value will reverse the drive output polarity. Either 1 or 0  | 0                         | 1      | 0       | Boolean           |

\*\*\* Requires power to be cycled before the new parameter data takes effect.

| <b>LIMITS TABLE</b> |                           | Access Code:   | <b>Parameter Security Code 2</b> |                      |                           |        |
|---------------------|---------------------------|--|----------------------------------|----------------------|---------------------------|--------|
| PARAMETER NUMBER    | PARAMETER                 | DEFINITION   | VALUE                            |                      |                           |        |
|                     |                           |  | Min                              | Max                  | Default                   | Units  |
| 30                  | <b>Minimum Limit</b>      | Software defined minimum limit for stroke of a linear movement. Entry is usually defined in inches.  | 0                                | <<br>Maximum Limit   | 50                        | Counts |
| 31                  | <b>Maximum Limit</b>      | Software defined maximum limit for stroke of a linear movement. Entry is usually defined in inches.  | ><br>Minimum Limit               | <= Stroke Length     | Stroke Length - 50 counts | Counts |
| 32                  | <b>In Position Window</b> | 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<br>Maximum Limit | 60                        | Counts |
| 33                  | <b>Zero Adjust</b>        | User defined value used for calibrating a positioned device to a reference of a machine.   | -32000                           | 32000                | -4300                     | Number |
| 35                  | <b>Sensor Length</b>      | Physical length of sensor in counts. (READ ONLY VALUE)   | 0                                | 65000                |                           | Counts |

| <b>FEEDBACK CALIBRATION</b> |                          | Access Code:   | <b>Parameter Security Code 5</b> |     |         |         |
|-----------------------------|--------------------------|--|----------------------------------|-----|---------|---------|
| PARAMETER NUMBER            | PARAMETER                | DEFINITION   | VALUE                            |     |         |         |
|                             |                          |  | Min                              | Max | Default | Units   |
| 41                          | <b>Readout Direction</b> | Changes the measurement direction<br>0 = Retract to 0<br>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               | <b>Sensor Address ***</b>  | 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               | <b>Baud Rate ***</b>       | Value determines the communications data frequency for the Servo Sensor™. Four baud rates can be used:<br>1 = 19.2kb<br>2 = 38.4kb<br>3 = 57.6kb<br>4 = 115.6kb  | 1                         | 4    | 4       | Number  |
| 57               | <b>Null Zero</b>           | Factory set values that zero the electrical null for the servo drive output. (This is a READ ONLY Value)   | 0                         | 4096 | 2047    | Counts  |
| 58               | <b>Motion/Set Enable</b>   | 0 = The Servo Sensor™ will continue motion to target when the Motion/Set Enable is removed (OFF). Motion/Set Enable must be high (ON) to set a new target and enable motion.   | 0                         | 3    | 0       | Number  |
|                  |                            | 1 = The Servo Sensor™ will stop motion when Motion/Set Enable is removed (OFF). Motion/Set Enable must be high (ON) to set a new target and enable motion.   |                           |      |         |         |
|                  |                            | 2* = The Servo Sensor™ will continue motion to target when the Motion/Set Enable is removed (OFF). The Servo Sensor™ will accept a new target when Motion/Set Enable is low(OFF) but will not move until Motion/Set Enable goes high (ON). |                           |      |         |         |
|                  |                            | 3* = The Servo Sensor™ will stop motion when Motion/Set Enable is removed (OFF). The Servo Sensor™ will accept a new target when Motion/Set Enable is low(OFF) but will not move until Motion/Set Enable goes high (ON).                   |                           |      |         |         |
| 59               | <b>Air Cylinder Enable</b> | 0 = a hydraulic algorithm for motion is used   | 0                         | 1    | 0       | Boolean |
|                  |                            | 1 = an air algorithm for motion is used.   |                           |      |         |         |
| 61               | <b>Run Mode</b>            | 0 = Serial Mode<br>1 = Cycle Mode<br>2 = Pulse Mode<br>3 = Increment Mode  | 0                         | 3    | 0       | Number  |

\*\*\* Requires power to be cycled before the new parameter data takes effect. \* New for v23E



| SYSTEM SETUP     |                 | Access Code:  | Parameter Security Code 4 |     |         |        |
|------------------|-----------------|---|---------------------------|-----|---------|--------|
| PARAMETER NUMBER | PARAMETER       | DEFINITION  | VALUE                     |     |         |        |
|                  |                 |   | Min                       | Max | Default | Units  |
| 62               | Output Mode *** | 0 = In Position. This will cause the <b>In Position Output</b> from the Servo Sensor™ to come on when the target and transducer feedback position are within the <b>In Position Window</b> value. | 0                         | 3   | 0       | Number |
|                  |                 | 1 = In Track. This will cause the <b>In Position Output</b> from the Servo Sensor™ to come on when the <i>following error</i> becomes larger than the <i>In Position window</i> .                 |                           |     |         |        |
|                  |                 | 2 = Cycle complete. This will cause the <b>In Position Output</b> from the Servo Sensor™ to come on when a cycle complete has occurred and the Servo Sensor™ is programmed for the cycle mode.    |                           |     |         |        |
|                  |                 | 3 = Open Loop Enable. Enables open loop mode.   |                           |     |         |        |

\*\*\* Requires power to be cycled before the new parameter data takes effect.

## 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          | Parameter | PAR # (Hex) |     | Definition      |
|                               | MSB         | LSB |                     |           | MSB         | LSB |                 |
| 40                            | 2           | 8   |                     | 60        | 3           | C   |                 |
| 41                            | 2           | 9   | Readout Direction   | 61        | 3           | D   | Run Mode        |
| 42                            | 2           | A   |                     | 62        | 3           | E   | Output Mode *** |
| 43                            | 2           | B   |                     | 63        | 3           | F   |                 |
| 44                            | 2           | C   |                     | 64        | 3           | 0   |                 |
| 45                            | 2           | D   |                     | 65        | 3           | 1   |                 |
| 46                            | 2           | E   |                     | 66        | 3           | 2   |                 |
| 47                            | 2           | F   |                     | 67        | 3           | 3   |                 |
| 48                            | 3           | 0   |                     | 68        | 3           | 4   |                 |
| 49                            | 3           | 1   |                     | 69        | 3           | 5   |                 |
| 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 |           |             |     |                 |

# 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 |   |   |   |   |

## SETPOINT REFERENCE

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

Q & R

- 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   |

## 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 Intermediate Transmission Block | ^_             |