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Application Note

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Subject: SSI Absolute Encoders

Scope

This document is designed to:

1. Help with understanding how SSI transfers the absolute position.
2. Detail any special features a system designer needs to consider when selecting an encoder.
3. Suggest program settings for REP_DIST, REP_OPTION and OFFPOS.

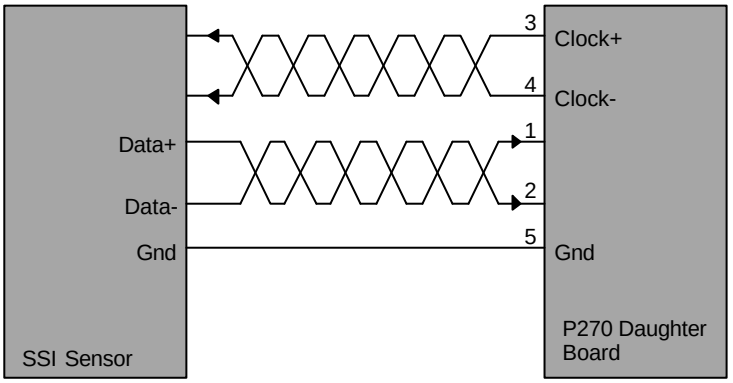
P270 SSI Servo Daughter Board

The SSI daughter board will accept absolute values from an encoder provided that the data is in Gray Code format and the resolution is 24 bits or less. The number of bits, and hence the number of clock pulses sent to the transducer in each frame is programmable and is set by the BASIC instruction SSI_BITS=n.

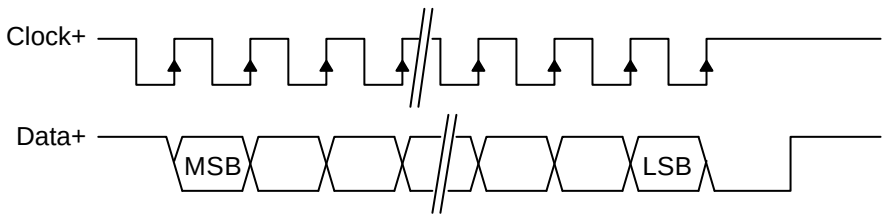
SSI Interface

SSI or Synchronous Serial Interface is a digital system for transferring data in serial form and is the most widely used serial interface between absolute sensors and controllers. The SSI convention uses a pulse train from the controller to clock out the data from the sensor.

Block Diagram



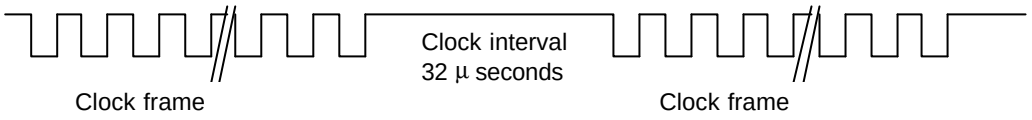
Timing Diagram



Data Interrogation

Once initialised by the SSI_BITS command the P270 daughter board continually interrogates the sensor by sending clock pulses in “frames” of n+2 pulses where n is the bit count set. The clock rate is fixed at 200kHz and the clock interval between frames is 32µsec. This gives a maximum cable length of 200 metres between the controller and the sensor.

Clock Sequence



Data Format

When the data has been clocked in to the Trio *Motion Coordinator*, the firmware interprets the position value to produce a value for MPOS and hence a position error that is used to close the control loop. SSI_BITS must be set to suit the encoder. (Maximum 24 bit)

If SSI_BITS is set to **n**, the P270 daughter board will always produce **n**+2 clock pulses in each frame. The first clock pulse is the start signal and this is followed by **n** pulses which clock in the data. One extra clock pulse is provided to allow for sensors which transmit a parity bit at the end. This extra data bit, if sent, is discarded by the *Motion Coordinator*.

Modification of the Absolute Value

In order to allow full use of the position modifiers in TRIO BASIC, (DEFPOS, OFFPOS etc.) the absolute position value is stored into MPOS on the first sensor reading only. Subsequent absolute readings from the sensor are used to calculate the delta and update the MPOS value based on the change in position from the starting point.

This technique of taking the first reading as absolute and then treating the system as an incremental one means that MPOS can be modified according to the repeat distance (**REP_DIST**) set or changed by the BASIC program using **DEFPOS(new_position)** or **OFFPOS = offset_value.**

To re-establish the absolute position after it has been changed in this way, it is necessary to set the SSI_BITS parameter to zero and then set SSI_BITS back to the correct bit count for the encoder. Note: While this process takes place, **the control loop will temporarily be broken and random unpredictable movements may occur**. For safe operation, set **SERVO=OFF** first.

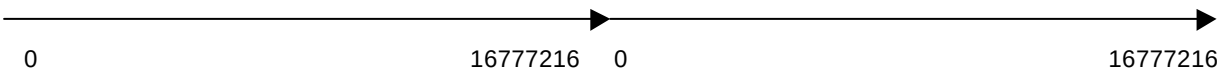
```
' re-intialise the absolute
position
SERVO = OFF
SSI_BITS = 0
WA(5)
SSI_BITS = 24
WA(5)
SERVO=ON
```

Tracking Absolute Position

When an absolute encoder reaches it's maximum count, any further rotation in the forward direction will make the value return to zero and then count up again. To make MPOS track the absolute value as it changes from max to zero, you must set the repeat distance to the same value as the encoder's count range.

For example for a 24 bit encoder set repeat distance to 2^24 and rep_option ON.

```
REP_OPTION = ON
REP_DIST = 16777216
WA(2)
SSI_BITS = 24
```

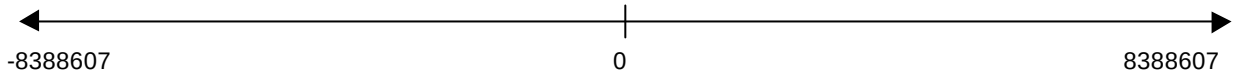


It is also possible to make the encoder absolute position a signed value. Set the repeat distance to half the count range and rep_option OFF.

```
REP_OPTION = OFF
REP_DIST = 8388608
```

```
WA(2)
SSI_BITS = 24
```

The absolute value will now operate correctly between –8388607 and +8388607. This is ideal when the axis needs to move to positions either side of zero.



Similarly, with a 16 bit encoder the values would be:

```
REP_OPTION = OFF
REP_DIST = 32768
WA(2)
SSI_BITS = 16
```

Note:

The default value for REP_DIST is 20000000 for an axis with SSI daughter board fitted to allow the absolute position to initialise correctly. However with this value the MPOS does not follow the absolute position read from the encoder as it wraps around from maximum to zero.

Setting Zero Datum Position

Sometimes it is necessary to use a fixed offset from the absolute zero position of the encoder so that the axis zero can be changed without needing to undo the encoder and move it physically. If the encoder is programmable then this can be achieved within the encoder itself, for example some encoders have a “set zero” button on the encoder body.

If the encoder zero is not settable, the TrioBasic OFFPOS command provides the answer. Add these lines to the program during initialisation of the axis.

```
SSI_BITS = 0
WA(10)
SSI_BITS = 24
WA(10)
OFFPOS = axis_offset_value
```