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APPLICATION NOTE

www.triomotion.com

1. Contents

2. Introduction

The EURO205X Motion Coordinator can be configured to interface directly to Synchronous Serial Interface (SSI) absolute encoders. These encoders respond on a dedicated Clock and Data 200 kHz RS422 serial interface when their position is requested by the controller. When set to the relevant encoder mode, the axis transmits a burst of clock pulses to the encoder on a fixed cycle. The data returned is available to BASIC and can be used to servo a motor.

3. System Requirements

ENDAT Encoders require the FPGA of the Motion Coordinator to be fitted with a revised program. This needs to be fitted by TRIO and is specified with a different order code.

EURO205X Motion Coordinator with system software v1.6688la (special version) and FPGA version SSI 9721. The axis must be feature enabled for servo operation for it to function.

Motion Perfect 2 version 2.4.1.4 is useful although not essential.

4. Wiring Configuration

The encoder connects directly to the "A", "/A", "Z" and "/Z" connections of the EURO205X axis. The following table gives the encoder connections to the EURO205X backplane connector:

Encoder Signal	D-type Pin Number	Axis 0	Axis 1	Axis 2	Axis 3
CLOCK	1	C27	C25	C23	C21
/CLOCK	2	C26	C24	C22	C20
DATA	6	A26	A24	A22	A20
/DATA	7	A25	A23	A21	A19
0V (Signal Gnd)	5	A13 or C13	A13 or C13	A13 or C13	A13 or C13

The encoder must be connected to its power supply. Often this is +24V and separate power wires are contained in the encoder cable for +24V power and 0V power.

The clock and data signals are ALWAYS low voltage (5V) RS422 level. Do not connect signals which are above this level. Most SSI encoders have signals at 5V level, even when powered from 24V dc.

5. Configuring the Motion Coordinator

Using the incremental or absolute encoder ports requires that the relevant "feature enable" codes on the EURO205X Motion Coordinator are installed:

Axis Number	**Feature Code for Encoder Use**
0	4
1	5
2	6
3	7

After setting the feature enable codes the axes will power up as *incremental* encoder inputs. It is necessary to set the configuration by changing the axis ATYPE using a BASIC program:

Axis ATYPE	**Description**
7	SSI Absolute

Example:

```
ATYPE AXIS(2) = 7 ' set up axis 2 as SSI Absolute Servo
```

6. Relevant Trio BASIC Commands

The BASIC implements some new keywords to give the user access to the encoder data.

6.1. ENCODER_BITS

This axis parameter configures the interface for the number of encoder bits. The parameter should be set to the total number of encoder bits. For example: A 24 bit encoder has 12 multi-turn and 12 bits/turn resolution. The BASIC program initialises with:

```
BASE(axis_number)
ATYPE=7
ENCODER_BITS=24
```

Note that the parameter must be set for each axis.

If it is needed to change the number of encoder bits, then first set ENCODER_BITS to zero and after a short delay, set the ENCODER_BITS to the new value.

```
BASE(axis_number)
ENCODER_BITS=0
WA(2)
ENCODER_BITS=13
```

6.2. ENCODER_STATUS

The software has a facility to "ignore" some bits in the SSI data (up to 7) at the bottom of the SSI register. The number of bits to ignore is set in bits 16..18 of the SSI_BITS:

```
SSI_BITS = 24 + (3 * $10000)
```

This will ignore 3 bits of the SSI transfer of 24 total bits. The whole 24 bits are put into ENCODER_STATUS so if you wanted to read the bottom 3 bits you can use this register. The 21 bits without the status can be found in ENCODER.

```
ssi_status = ENCODER_STATUS AND $07
```

See the SSI encoder handbook for the meaning of these status bits.

6.3. ENCODER

This axis register contains the actual absolute value being returned by the encoder. Whereas MPOS can be changed by the DEFPOS, OFFPOS and REP_DIST functions, the ENCODER value will always show the true encoder absolute value.

Note that MPOS is the value used by the servo software to show the axis position. ENCODER is only for service diagnostic use.

7. Error Handling

SSI data packets are sent as plain Gray Code or Binary numbers. There is no checksum or CRC included in the SSI format so error detection is minimal. If incorrect data is sent which results in the position going outside the following error limit (FE_LIMIT) then a servo error will occur. Otherwise the controller will have no knowledge of the error at all.

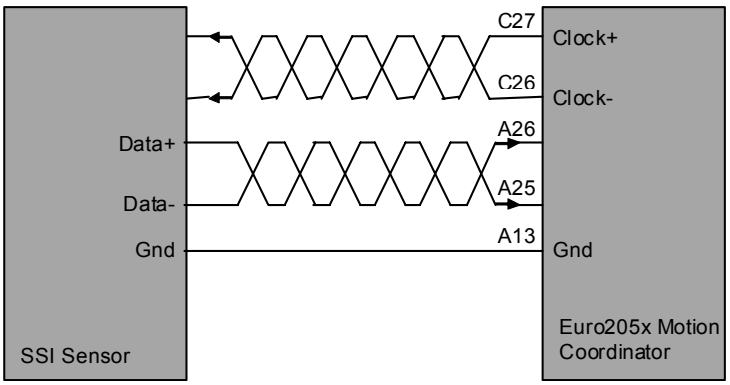
Where a SSI encoder axis is used in a non servo application, it is up to the programmer to ensure that suitable precautions are taken to detect data errors should they occur.

8. SSI Interface

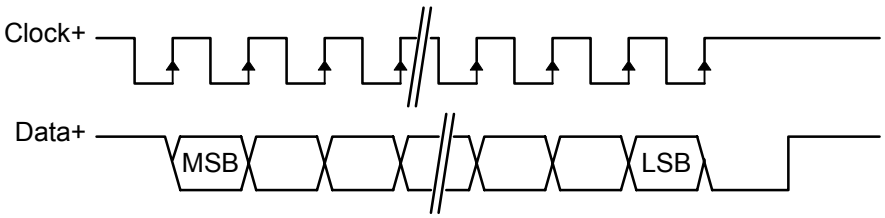
SSI or Synchronous Serial Interface is a digital system for transferring data in serial form and is the most widely used serial interface between absolute sensors and controllers. The SSI convention uses

a pulse train from the controller to clock out the data from the sensor.

Block Diagram



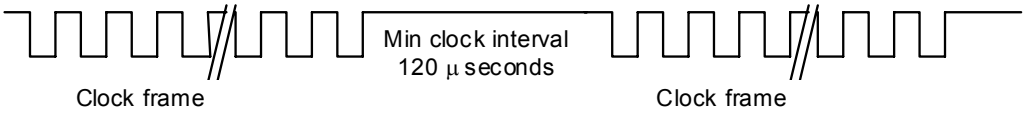
Timing Diagram



8.1. Data Interrogation

Once initialised by the ENCODER_BITS command the Euro205x continually interrogates the sensor by sending clock pulses in "frames" of n+2 pulses where n is the bit count set. One clock frame is sent every 250 μsec and the clock rate is fixed at 200kHz. The clock interval between frames depends on the number of bits and with ENCODER_BITS set to 25 it is 120 μsec. This gives a maximum cable length of 200 metres between the controller and the sensor.

Clock Sequence



8.2. Signal 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 position control loop. ENCODER_BITS must be set to suit the encoder. (Maximum 25 bit)

If ENCODER_BITS is set to **n**, the Euro205x will always produce **n**+1 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.