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Doc No.: TN20-67
Version: 1.1
Date: 22nd July 2004
Subject: PCI208 Absolute Encoder Interfaces

Application Information

Contents:

Introduction:

The PCI208 Motion Coordinator can interface directly to Tamagawa "Smart Abs" absolute encoders and Heidenhain EnDat 2.1 absolute encoders. These encoders respond on a dedicated RS485 serial interface when their position is requested by the controller. When set to the relevant encoder mode, the axis transmits an information request to the encoder on a fixed 250usec cycle. The data returned is available to BASIC and can be used to servo control a motor.

System Requirements:

PCI208 Motion Coordinator with system software v1.6325 or higher and FPGA version 01_01_27 (Tamag) or 01_01_27 (EnDAT).
Tamagawa Seiki Co. Ltd. SA35-17/33bit-LPS-5V or SA48-17/33bit-LPS-5V or similar.
Heidenhain EQN425 EnDat encoder or similar.
Motion Perfect 2 version 2.2.2.2 is useful although not essential

Tamagawa Wiring Configuration:

The encoder connects directly to the "Z" and "/Z" connections of the PCI208 axis. The "A", "/A", "B" and "/B" connections are not used and must be left unconnected. The following tables give the encoder connections to the PCI208 100 way connector, if the Trio P181 PCI Breakout Board is not being used:

Encoder Signal	Wire Colour	Axis 0	Axis 1	Axis 2	Axis 3
SD	Blue	71	25	77	31
/SD	Blue/Black	72	26	78	32
GND	Black + Brown/Black	45 or 95	45 or 95	45 or 95	45 or 95
Case GND	Grey	Shell	Shell	Shell	Shell

Encoder Signal	Wire Colour	Axis 4	Axis 5	Axis 6	Axis 7
SD	Blue	83	37	89	43
/SD	Blue/Black	84	38	90	44
GND	Black + Brown/Black	45 or 95	45 or 95	45 or 95	45 or 95
Case GND	Grey	Shell	Shell	Shell	Shell

The encoder must be connected to its 5V supply and optional battery supply if that is required.

If the Trio P181 PCI Breakout Board is being used the connections are made to the 9 way D-Type for each axis as per the following tables:

Encoder Signal	Wire Colour	Axis 0	Axis 1	Axis 2	Axis 3
SD	Blue	6	6	6	6
/SD	Blue/Black	7	7	7	7
+5V	Red	8	8	8	8
Vbat	Brown	-	-	-	-
GND	Black + Brown/Black	5	5	5	5
Case GND	Grey	Shell	Shell	Shell	Shell

Encoder Signal	Wire Colour	Axis 4	Axis 5	Axis 6	Axis 7
SD	Blue	6	6	6	6
/SD	Blue/Black	7	7	7	7
+5V	Red	8	8	8	8
Vbat	Brown	-	-	-	-
GND	Black + Brown/Black	5	5	5	5
Case GND	Grey	Shell	Shell	Shell	Shell

The encoder must be connected to its 5V supply and optional battery supply if that is required. Connection to the 5V supply can be made conveniently via the connector X14 by connecting the encoder supply to the GND and Encoder 5V pins of X14 (see PCI208 Manual for more details). The battery supply (if required) has to be brought out of each D-Type connector on a flying lead. The 0V for the battery supply can be connected to the GND on pin 5, giving easy access to this on X14.

EnDat Wiring Configuration:

The encoder connects directly to the "A", "/A", "Z" and "/Z" connections of the PCI208 axis. The "B" and "/B" connections are not used and must be left unconnected. The following tables give the encoder connections to the PCI208 100 way connector:

Encoder Signal	Encoder Pin Number	Wire Colour	Axis 0	Axis 1	Axis 2	Axis 3
CLOCK	8	Violet	69	71	75	77
/CLOCK	9	Yellow	70	72	76	78
DATA	14	Grey	23	25	29	31
/DATA	17	Pink	24	26	30	32
Up (+5V)	7	Brown/Green	-	-	-	-
Un (GND)	10	White/Green	45 or 95	45 or 95	45 or 95	45 or 95

Encoder Signal	Encoder Pin Number	Wire Colour	Axis 4	Axis 5	Axis 6	Axis 7
CLOCK	8	Violet	81	83	87	89
/CLOCK	9	Yellow	82	84	88	90
DATA	14	Grey	35	37	41	43
/DATA	17	Pink	36	38	42	44
Up (+5V)	7	Brown/Green	-	-	-	-
Un (GND)	10	White/Green	45 or 95	45 or 95	45 or 95	45 or 95

The encoder must be connected to its 5V supply.

If the Trio P181 PCI Breakout Board is being used the connections are made to the 9 way D-Type for each axis as per the following tables:

Encoder Signal	Encoder Pin Number	Wire Colour	Axis 0	Axis 1	Axis 2	Axis 3
CLOCK	8	Violet	X1-1	X1-6	X2-1	X2-6
/CLOCK	9	Yellow	X1-2	X1-7	X2-2	X2-7
DATA	14	Grey	X5-1	X5-6	X6-1	X6-6
/DATA	17	Pink	X5-2	X5-7	X6-2	X6-7
Up (+5V)	7	Brown/Green	X1-8	X5-8	X2-8	X6-8
Un (GND)	10	White/Green	X1-5	X5-5	X2-5	X6-5

Encoder Signal	Encoder Pin Number	Wire Colour	Axis 4	Axis 5	Axis 6	Axis 7
CLOCK	8	Violet	X3-1	X3-6	X4-1	X4-6
/CLOCK	9	Yellow	X3-2	X3-7	X4-2	X4-7
DATA	14	Grey	X7-1	X7-6	X8-1	X8-6
/DATA	17	Pink	X7-2	X7-7	X8-2	X8-7
Up (+5V)	7	Brown/Green	X3-8	X7-8	X4-8	X8-8
Un (GND)	10	White/Green	X3-5	X7-5	X4-5	X8-5

The encoder must be connected to its 5V supply. Connection to the 5V supply can be made conveniently via the connector X14 by connecting the encoder supply to the GND and Encoder 5V pins of X14 (see PCI208 Manual for more details).

Configuring the Motion Coordinator:

Using the absolute encoder ports requires that the relevant "feature enable" codes on the PCI208 Motion Coordinator are installed:

Axis Number	Feature Code for Encoder Use
0	8
1	9
2	10
3	11
4	12
5	13
6	14
7	15

After setting the feature enable codes it is necessary to set the configuration by changing the axis ATYPE using a BASIC program:

Before the ATYPE is set for EnDAT it is essential to set the "ENCODER_BITS" parameter for the axis.

Axis ATYPE	Description
31	NOT AVAILABLE ON PCI208
32	Tamagawa absolute encoder with servo control
33	NOT AVAILABLE ON PCI208
34	EnDAT absolute encoder with servo control

The +/-10volt DAC's may be used from BASIC when the servo is off.

Tamagawa Relevant BASIC Commands:

The BASIC implements some new keywords to give the user access to the encoder data. Please refer to the Smart Abs specification for information on the encoder fields.

ENCODER_ID

This axis parameter returns the ENID parameter from the encoder (fixed at 17 decimal).

ENCODER_TURNS

This axis parameter returns the number of multi-turn counts from fields ABM0/ABM1/AMB2 of the encoder. The multi-turn data is not automatically applied to the axis MPOS after initialisation. The application programmer must apply this from BASIC using OFFPOS or DEFPOS as required.

ENCODER_STATUS

This axis parameter returns both the status field SF and the ALMC encoder error field. The ALMC field is in bits 8..15. The SF field is in bits 0..7.

ENCODER

This axis parameter returns the position within one turn of the encoder. The axis measured position MPOS will be set to this value automatically when the ATYPE is set to 31 or 32.

EnDAT Relevant BASIC Commands:

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

ENCODER_BITS

This axis parameter configures the interface for the number of encoder bits. Bits 0..7 of the parameter should be set to the total number of encoder bits. Bits 8..14 should be set to the number of multi-turn bits to be used.

For example: A 25 bit encoder has 12 multi-turn and 13 bits/turn resolution. The BASIC program initialises with:

```
ENCODER_BITS AXIS(0)=25 + (256 * 12)
ATYPE AXIS(0)=34
```

Note that the parameter must be set for each axis.

ENCODER_ID

Unused on the EnDat encoder.

ENCODER_TURNS

This axis parameter returns the number of multi-turn counts from the encoder.

ENCODER_STATUS

Unused on the EnDat encoder.

ENCODER

This axis parameter returns the position within one turn of the encoder.

ENCODER_CONTROL

Endat encoders can be set to either cyclically return their position, or they can be set to a parameter read/write mode. The mode is controlled with the parameter ENCODER_CONTROL.

ENCODER_CONTROL = 1 ' sets parameter read/write mode
ENCODER_CONTROL = 0 ' sets cyclic position return mode

ENCODER_CONTROL is set to 0 on power up or reset. Using the ENCODER_READ or ENCODER_WRITE functions will set the parameter to 1 automatically.

On the PCI 208 the ENCODER_CONTROL should be set for the axis pairs 0/1, 2/3, 4/5 or 6/7 at the same time due to the configuration of the interface transceivers.

ENCODER_READ(address)

Returns a 16 bit encoder parameter. Bits 8..15 of the "address" are the "MRS" setting (see EnDat interface data) and bits 0..7 are the offset within the MRS block. If a CRC error occurs the function will return -1. ENCODER_READ is an axis function and can use the axis modifier within the Trio BASIC language:

Example:

```
' Set axes to parameter mode in a pair (PCI 208)
ENCODER_CONTROL AXIS(6)=1
ENCODER_CONTROL AXIS(7)=1

ENCODER_READ($A10D) AXIS(7) ' read the number of encoder bits
```

ENCODER_WRITE(address, value)

Writes to an encoder parameter. Bits 8..15 of the "address" are the "MRS" setting (see EnDat interface data) and bits 0..7 are the offset within the MRS block. If an error occurs the function will return 0 otherwise it will return -1. Writing to address 0 performs an encoder reset function which is used as part of a position shift function:

Example:

```
' Set axes to parameter mode in a pair (PCI 208)
ENCODER_CONTROL AXIS(0)=1
ENCODER_CONTROL AXIS(1)=1

' Set value to shift by and perform reset:
ENCODER_WRITE($A700,$2000) AXIS(0)
ENCODER_WRITE($A701,0) AXIS(0)
ENCODER_WRITE(0,0) AXIS(0)
```

Error Handling:

When the axis receives a data packet from the encoder with a CRC error, or fails to receive a data packet from the encoder, it will set bit 2 of the AXISSTATUS axis parameter. If subsequent packets are received successfully the bit will be cleared.

If bit 2 of the ERRORMASK axis parameter is set the encoder data error will trip the WDOG enable relay.