

AKD1G: Reading an EnDat 2.2 encoder on the secondary feedback (X9) over CANopen and EtherCAT via SDOs and PDOs Revision A 7-22-2020

The ability to read FB2.P and FB3.P over CANopen/EtherCAT was added in firmware release 1-12-00-000. This document is specific to reading FB3.P.

Per the note below for FB3.MODE, Endat 2.2 connected to X9 as the tertiary feedback is only supported in NB hardware models.

Version: 01-12-00-000 Release Date: June 24, 2014

Field Bus Specific Issues New Features

- **Bug 4651 - Add FB3-support to Canopen/EtherCAT (4651,S-12552)**


New Feature Details:

Customers would like to use an object to access FB3.P via CANopen objects.

Solution:

The object 0x60E4 sub 3 is added for the third additional feedback sensor position. It can be scaled via the feed constant 0x60E9 sub 3 and 0x60EE sub 3. It is available via SDO and PDO.

For initial setup the following settings were used.



Terminal

A command line interface to the device. Type a command and press return.

```
-->DRV.EMUEMODE 11
-->FB3.PUNIT 3
-->FB3.PIN 1
-->FB3.POUT 1
-->
```

DRV.EMUEMODE

Setting	Function
11	FB3 Input (Tertiary feedback is reported with FB3.P). Use FB3.MODE to select the feedback type.

FB3.MODE

Description

This parameter selects the type of feedback connected to X9. The position is reported as the tertiary feedback position, by FB3.P.

Value	Feedback
0	Endat 2.2 Feedback Device

This parameter is only supported on drives with model numbers similar to AKD-x-xxxxx-NBxx-xxxx.

In this example, FB3.PUNIT=3 was elected.

FB3.PUNIT

Description

FB3.UNIT sets the position unit for FB3.P.

Value	Description
0	Counts (32.32 format)
3	(FB3.PIN/FB3.POUT) per revolution.

FB3.PIN

Description

Use FB3.PIN with [FB3.POUT](#) to set the user units for [FB3.P](#).

General Information

Type	NV Parameter
Units	N/A
Range	1 to 4,294,967,295
Default Value	100
Data Type	Integer
Start Version	M_01-05-011-000

FB3.POUT

Description

Use FB3.POUT with [FB3.PIN](#) to set the user units for [FB3.P](#).

General Information

Type	NV Parameter
Units	N/A
Range	1 to 4,294,967,295
Default Value	20
Data Type	Integer
Start Version	M_01-05-011-000

It is worth mentioning the settings for FB3.PIN and FB3.POUT affect the value of FB3.P displayed in Workbench but doesn't affect the value over CANopen or EtherCAT. Both were set above in Terminal to 1 (1:1 scaling).

FB3.ENCRECRES

General Information

Type	NV Parameter
Units	None
Range	0 to 4,294,967,295
Default Value	0
Data Type	Integer
Start Version	M_01-11-03-000

The default of zero was used for this application note for native scaling.

FB3.ENCRECRES


Description

Feedback 3 is natively scaled to 4,294,967,296 counts per revolution for rotary motors, and 4,294,967,296 per motor pole pitch ([MOTOR.PITCH](#)) for linear motors. **When FB3.ENCRECRES is non-zero, scaling is applied on top of the native scaling.**

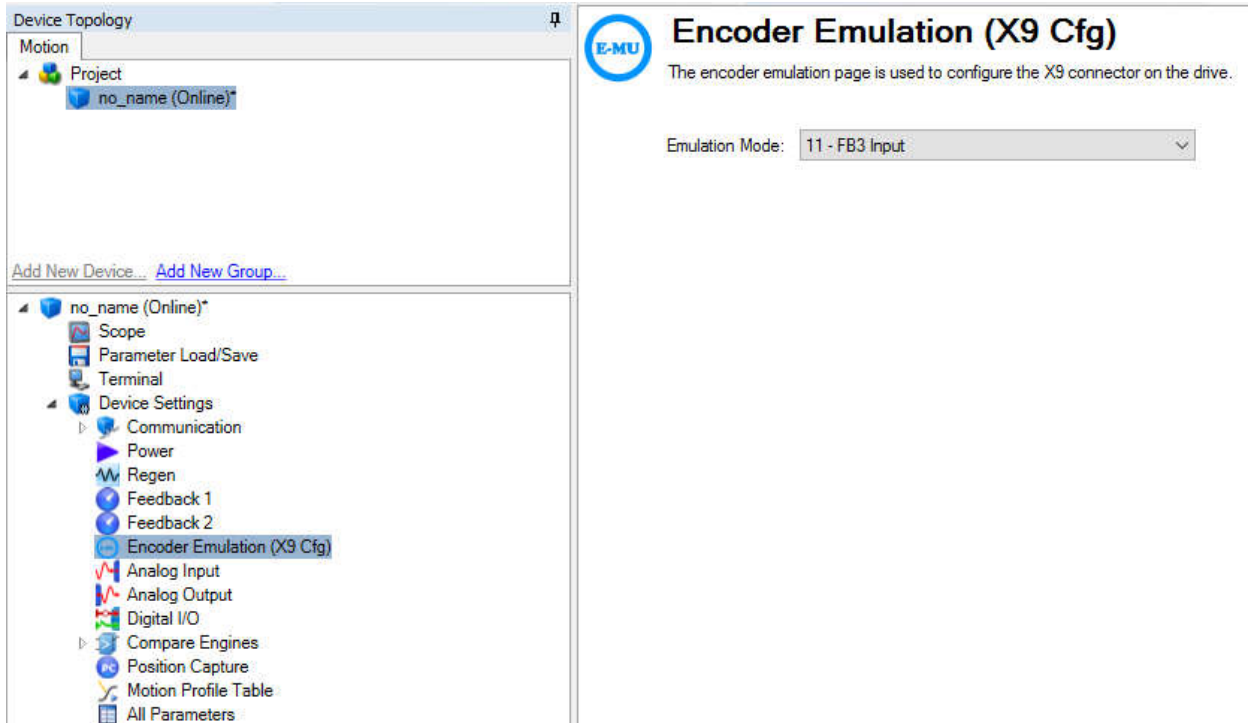
In addition to the setup in terminal you can view the Emulation mode as follows in the Workbench GUI:

Feedback 2 (X9/X7)

Select the Feedback source and mode.

Feedback Source:	1 - Feedback Source X9	 X9 is configured for another usage. Configure
Feedback Mode:	0 - Input - A/B Signals	
Resolution:	0	counts/rev
Feedback Position:	4,294,967,293	counts (32 bits/rev)

On click of the “Configure” link above the Emulation Mode is shown as FB3 Input which is correct for X9 with EnDat 2.2.



The screenshot shows the Workbench GUI with the 'Encoder Emulation (X9 Cfg)' page selected. The left sidebar shows the 'Device Topology' tree with 'no_name (Online)*' expanded to 'Device Settings', where 'Encoder Emulation (X9 Cfg)' is highlighted. The main panel displays the 'Encoder Emulation (X9 Cfg)' configuration page, which includes a description: 'The encoder emulation page is used to configure the X9 connector on the drive.' and an 'Emulation Mode' dropdown menu set to '11 - FB3 Input'.

Watch				
Enab...	Device	Parameter	Value	Units
<input checked="" type="checkbox"/>	no_name (Online)*	FB3.P - Feedback 3 scaled position	44.964	PIN/POUT
<input type="checkbox"/>				

6.5.4.5 Object 60E4h: Additional position actual value

This object provides the additional position actual values. The values are given in user-defined position units. The value is calculated analog to the calculation for the actual position 6064h via object 6091h and 6092h, but for this with the factors given by the objects 60E8h, 60E9h, 60EDh and 60EEh.

Index	60E4h
Name	Additional position actual value
Object code	ARRAY
Data type	INTEGER32
Category	optional
Subindex	0
Description	highest sub-index supported
Category	mandatory
Access	R/O
PDO mapping	not possible
Value range	3
Default value	3
Subindex	1
Description	1st additional position actual value
Category	mandatory
Access	R/W
PDO mapping	not possible
Value range	INTEGER32
Default value	1
Subindex	2
Description	2nd additional position actual value
Category	
Access	R/W
PDO mapping	not possible
Value range	INTEGER32
Default value	1
Subindex	3
Description	3rd additional position actual value
Category	optional
Access	R/W
PDO mapping	not possible
Value range	INTEGER32
Default value	0

Index	Sub-index	Data Type	Float Scale	Access	PDO map.	Description	ASCII object
60E4h	3	INT32		RW	no	3rd additional position actual value	—
60E8h	3	U32		RW	no	3rd additional gear ratio - motor shaft revolutions	DS402.3ADDPOSGEARMOTORREV
60E9h	3	U32		RW	no	3rd additional feed constant - feed	DS402.3ADDPOSFCFEED
60EDh	3	U32		RW	no	3rd additional gear ratio - driving shaft revolutions	DS402.3ADDPOSGEARSHAFTREV
60EEh	3	U32		RW	no	3rd additional feed constant - driving shaft revolutions	DS402.3ADDPOSFCFSHAFTREV

DS402.3ADDPOSFCFEED DS402: feed (numerator) of position scaling (third additional feed constant)
DS402.3ADDPOSFCSHAFTREV DS402: shaft revolutions of position scaling (third additional feed constant)
DS402.3ADDPOSGEARMOTORREV DS402: motor revolutions (numerator) of position scaling (third additional gear ratio)
DS402.3ADDPOSGEARSHAFTREV DS402: shaft revolutions of position scaling (third additional gear ratio)

$$fieldbus\ position = physical\ position * \left[\frac{DS402.3ADDPOSFCFEED}{DS402.3ADDPOSFCSHAFTREV} \cdot \frac{DS402.3POSGEARMOTORREV}{DS402.3POSGEARSHAFTREV} \right]$$

$$fieldbus\ position = physical\ position * \left[\frac{60E9h\ sub\ 3}{60EEh\ sub\ 3} \cdot \frac{60E8\ sub\ 3}{60ED\ sub\ 3} \right]$$

$$physical\ Position = fieldbus\ Position * \left[\frac{DS402.3ADDPOSGEARMOTORREV}{\frac{DS402.ADDPOSGEARSHAFTREV}{\frac{DS402.3ADDPOSFCFEED}{DS402.3ADDPOSFCSHAFTREV}}} \right]$$

$$physical\ Position = fieldbus\ Position * \left[\frac{60E8\ sub\ 3}{\frac{60ED\ sub\ 3}{\frac{60E9h\ sub\ 3}{60EEh\ sub\ 3}}} \right]$$

Example 1: SDO Read with 1 to 1 scaling

DS402.3ADDPOSGEARMOTORREV=1

DS402.3ADDPOSGEARSHAFTREV=1

DS402.3ADDPOSFCFEED=1

DS402.3ADDPOSFCSHAFTREV=1

SDO Message:

ID: (Hex)	DLC:	Data: (Hex)
601	8	43 E4 60 03 00 00 00 00 ...
		0 1 2 3 4 5 6 7

Value read over CANopen=5Dh or 93 (decimal)

1	581h	8	43 E4 60 03 5D 00 00 00
---	------	---	-------------------------

Using the formula:

Physical position=93

Watch				
Enab...	Device	Parameter	Value	Units
<input checked="" type="checkbox"/>	no_name (Online)*	FB3.P - Feedback 3 scaled position		93.316 PIN/POUT
<input type="checkbox"/>				


Example 2: SDO Read with scaling

DS402.3ADDPOSGEARMOTORREV=5

DS402.3ADDPOSGEARSHAFTREV=1

DS402.3ADDPOSFCFEED=1000

DS402.3ADDPOSFCSHAFTREV=1



Terminal

A command line interface to the device. Type a command and press return.

```
-->  
-->DS402.3ADDPOSGEARMOTORREV 5  
-->DS402.3ADDPOSGEARSHAFTREV 1  
-->DS402.3ADDPOSFCFEED 1000  
-->DS402.3ADDPOSFCSHAFTREV 1  
-->
```

$$\text{physical Position} = \text{fieldbus Position} * \left[\frac{\frac{DS402.3ADDPOSGEARMOTORREV}{DS402.ADDPOSGEARSHAFTREV}}{\frac{DS402.3ADDPOSFCFEED}{DS402.3ADDPOSFCSHAFTREV}} \right]$$

$$\text{physical Position} = \text{fieldbus Position} * \left[\frac{\frac{5}{1}}{\frac{1000}{1}} \right]$$

$$\text{fieldbus position} = \text{physical position} * \left[\frac{\frac{DS402.3ADDPOSFCFEED}{DS402.3ADDPOSFCSHAFTREV}}{\frac{DS402.3ADDPOSGEARMOTORREV}{DS402.3ADDPOSGEARSHAFTREV}} \right]$$

$$\text{fieldbus position} = \text{physical position} * \left[\frac{\frac{1000}{1}}{\frac{5}{1}} \right]$$

SDO read value=48E7h or 18663 (decimal)

1	581h	8	43 E4 60 03 E7 48 00 00
---	------	---	-------------------------

$$\text{physical Position} = \text{fieldbus Position} * \left[\begin{array}{c} 5 \\ 1 \\ \hline 1000 \\ \hline 1 \end{array} \right]$$

Physical Position= 18663*5/100=93.15

Watch					
Enab...	Device	Parameter	Value	Units	
<input checked="" type="checkbox"/>	no_name (Online)*	FB3.P - Feedback 3 scaled position		93.316	PIN/POUT
<input type="checkbox"/>					

Note these objects or keywords scale the value read over fieldbus but the value of FB3.P remained the same (in Workbench).

Example 3: PDO Read using TPDO4 setup by PCAN macro

```
// PCAN-Explorer Macro File
// First edited: 7/7/2020 11:11:16 AM
FormatVersion=5.0

//setup and run TPDO4 to read FB3.P using object 60E4h subindex 3 "3rd additional position actual
value"

//this macro doesn't erase, setup, or change other existing TPDOs or RPDOs

Send 1 000h 2 02h 01h          //stop network

Wait 500

Send 1 000h 2 80h 00h          //reset network

Wait 1000

WaitID 1 15 581h

//Setup TX PDO4

//*****

//disable TX PDO4

Send 1 601h 8 23h 03h 18h 01h 81h 04h 00h 80h //PDO disabled

WaitID 1 15 581h

//STEP 2: delete actual mapping

Send 1 601h 8 2Fh 03h 1Ah 00h 00h 00h 00h //clear mapping

WaitID 1 15 581h

//STEP 3: Build the mapping...the first entry desired is 60E4h subindex 3

Send 1 601h 8 23h 03h 1Ah 01h 20h 03h E4h 60h //set up

WaitID 1 15 581h

//STEP 4: Write the number of entries to subindex 0 of the mapping object

Send 1 601h 8 2Fh 03h 1Ah 00h 01h 00h 00h //number of entries

WaitID 1 15 581h
```

//STEP 5: Enable TXPDO4

Send 1 601h 8 23h 03h 18h 01h 81h 04h 00h 00h //PDO enabled

WaitID 1 15 581h

//*** Start PDOs ***

Wait 500

waitkey

Send 1 000h 2 01h 01h //enable NMT

WaitID 1 15 581h

Waitkey

Value Read in PDO (481h)= 48E7h or 18663 (decimal)

1	481h	4	E7 48 00 00
---	------	---	-------------

$$physical\ Position = fieldbus\ Position * \left[\frac{5}{\frac{1}{1000}} \right]$$

Physical Position= 18663*5/100=93.15

Watch				
Enab...	Device	Parameter	Value	Units
<input checked="" type="checkbox"/>	no_name (Online)*	FB3.P - Feedback 3 scaled position	93.316	PIN/POUT
<input type="checkbox"/>				

Example 4: PDO Read over Ethercat using TwinCAT3:

Object 60E4h subindex 3 was added to the PDO Content of 0x1A00.

The screenshot shows the TwinCAT3 ADS Symbol Watch interface. The 'PDO List' table is as follows:

Index	Size	Name	Flags	SM	SU
0x1A00	6.0	Inputs		3	0
0x1A01	0.0	Inputs			0
0x1A02	0.0	Inputs			0
0x1A03	0.0	Inputs			0
0x1B01	6.0	Inputs	F		0
0x1B20	32.0	Inputs	F		0
0x1B21	6.0	Inputs	F		0

The 'PDO Content (0x1A00):' table is as follows:

Index	Size	Offs	Name	Type	Default (hex)
0x6041:00	2.0	0.0	Statusword	UINT	
0x60E4:03	4.0	2.0	3rd additional position actual value	DINT	
		6.0			

The 'PDO Assignment (0x1C12):' section shows a list of addresses with checkboxes. The 'Download' section has 'PDO Assignment' and 'PDO Configuration' checked.

The Solution Explorer shows the following tree structure:

- I/O
 - Devices
 - Device 2 (EtherCAT)
 - Image
 - Image-Info
 - SyncUnits
 - Inputs
 - Outputs
 - InfoData
 - Drive 1 (AKD)
 - Inputs
 - Statusword
 - 3rd additional position actual value
 - Outputs
 - 1st set-point
 - Controlword

After Activating the Configuration and switching to Run Mode the value read over EtherCAT in the PDO was shown as 18663 (decimal) which is consistent with the value read over CANopen.

Symbol	Value	Type	Path
3rd additional position actual value	18663	DINT	I/O.Devices.Device 2 (EtherCAT).Drive 1 (AKD).Inputs

Note the values set by the DS402 keywords in Workbench Terminal can also be read over CoE.

Index	Name	Flags	Value	Unit
60C2:0	Interpolation time period	RW	> 2 <	
60D0:0	Touch probe source	RW	> 2 <	
60E0	Positive torque limit value	RW P	0x01F4 (500)	
60E1	Negative torque limit value	RW P	0x01F4 (500)	
60E4:0	Additional position actual value	RO P	> 3 <	
60E6:0	Additional position encoder resolution ...	RO	> 3 <	
60E8:0	Additional gear ratio - motor shaft revo...	RW	> 3 <	
60E8:01	1st additional gear ratio - motor shaft r...	RW	0x00000001 (1)	
60E8:02	2nd additional gear ratio - motor shaft ...	RW	0x00000001 (1)	
60E8:03	3rd additional gear ratio - motor shaft r...	RW	0x00000005 (5)	
60E9:0	Additional feed constant - feed	RW	> 3 <	
60E9:01	1st additional feed constant - feed	RW	0x00000001 (1)	
60E9:02	2nd additional feed constant - feed	RW	0x00000001 (1)	
60E9:03	3rd additional feed constant - feed	RW	0x000003E8 (1000)	
60EB:0	Additional position encoder resolution ...	RW	> 3 <	
60ED:0	Additional gear ratio - driving shaft rev...	RW	> 3 <	
60ED:01	1st additional gear ratio - motor shaft r...	RW	0x00000001 (1)	
60ED:02	2nd additional gear ratio - motor shaft ...	RW	0x00000001 (1)	
60ED:03	3rd additional gear ratio - motor shaft r...	RW	0x00000001 (1)	
60EE:0	Additional feed constant - driving shaf...	RW	> 3 <	
60EE:01	1st additional feed constant - driving s...	RW	0x00000001 (1)	
60EE:02	2nd additional feed constant - driving ...	RW	0x00000001 (1)	
60EE:03	3rd additional feed constant - driving s...	RW	0x00000001 (1)	
60F4	Following error actual value	RO P	0	
60FC	Position demand internal value	RO P	0	