

8 Data Recording

8.1 In Brief

A wide variety of operating modes permit flexible configuration of drive and automation systems by using positioning, speed and current regulation. The built-in EtherCAT interface allows networking to multiple axes drives as well as online commanding by EtherCAT master units.

EPOS3 EtherCAT features a built-in data recorder to debug errors and to monitor motion control parameters and actual values.

8.1.1 Objective

The present Application Note explains the functionality of the built-in data recorder. Features and configuration options are explained.

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8.1.2 Scope

Hardware	Order #	Firmware Version	Reference
EPOS3 EtherCAT		2200h	Firmware Specification
EPOS3 70/10 EtherCAT	411146	2200h or higher	

Table 8-74 Data Recording – covered Hardware and required Documents

8.1.3 Tools

Tools	Description
Software	«EPOS Studio» Version 2.00 or higher

Table 8-75 Data Recording – recommended Tools

8.2 Overview

8.2.1 Launching the Data Recorder

- 1) Start «EPOS Studio».
- 2) Start Data Recorder – either click right «Selected Node» or click «Tools» in Navigation Window.
- 3) Following screen will be displayed:

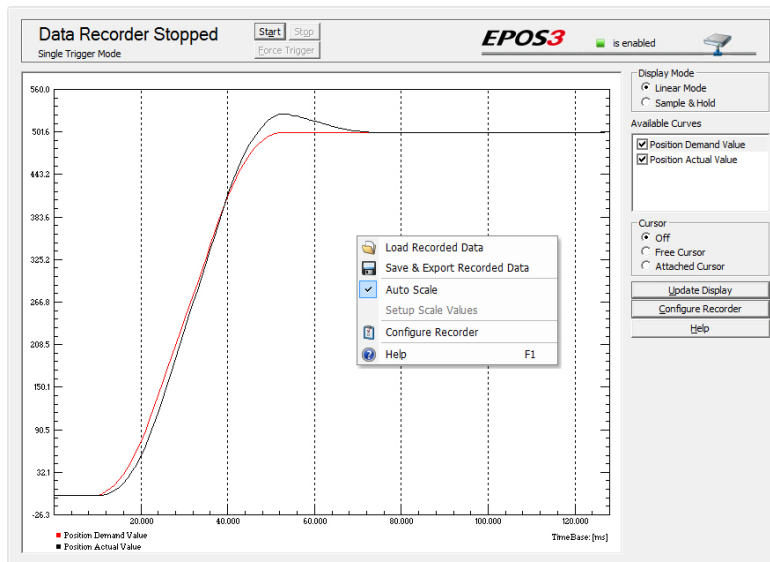


Figure 8-75 Data Recorder Overview

8.2.2 Control Elements and their Function

Title Bar

Control Element	Description / Function	
Status	Displays data recorder's status. The following states are possible:	
	Data Recorder Running Continuous Acquisition Mode	Data are continuously recorded and displayed.
	Data Recorder Waiting Single Trigger Mode	On standby, waiting to receive a trigger to start a single data record (for trigger options → page 8-96).
	Data Recorder Triggered Single Trigger Mode	Sampling in process until data buffer is full.
	Data Recorder Stopped Single Trigger Mode or Continuous Acquisition Mode	Recording completed and stopped, results are being displayed.
Start	Commences sampling. In "Single Trigger Mode", the data recorder is waiting for a trigger. In "Continuous Acquisition Mode", the data recorder is continuously recording and displaying data.	
Stop	Stops sampling. Latest recorded data are being displayed.	
Force trigger	A trigger has been activated.	

Table 8-76 Data Recording – Title Bar

Options Bar

Control Element	Description / Function	
Display Mode	Linear Mode	To display data, linear interpolation will be used.
	Sample & Hold	Between samples, no interpolation will be used.
Available Curves	Available curves will be listed. Tick check box to show/untick to hide a curve in the display.	
Cursor	Off	No curser will be displayed.
	Free Cursor	Curser will appear, as soon as the mouse is moved.
	Attached Cursor	Moving the mouse will attach the cursor to the selected curve. Use "Available Curves" to select another curve.
Update Display	Last sampled data will be loaded and displayed.	
Configure Recorder	To select sampled data and to configure the data recorder (→ "Data Recorder Configuration" on page 8-94).	

Table 8-77 Data Recording – Option Bar

Display

Control Element	Description / Function
Zoom	Zoom in: Click left and draw a rectangle over desired area – status indication (upper left corner) will change to "Zoomed". Zoom out: Click right – status indication will disappear.
Cursor	If activated, the cursor will appear as small circle. Cursor's actual coordinates are displayed in the upper right corner.
Left / Right Scale	Each data set may be displayed in either left or right pane (→ Data Recorder Configuration).
Time Scale	At bottom border with corresponding time base at lower right corner.
Legend	Currently displayed curves' legend appears in lower left corner.

Table 8-78 Data Recording – Display

Context Menu

Control Element	Description / Function
Load Recorded Data	Load recorded data from file (*.rda).
Save & Export Recorded Data	Save recorded data to file in following file formats:
	*.rda Binary Format (for use with «EPOS Studio»)
	*.txt ASCII Text Format (for import in Microsoft Excel)
	*.csv Comma Separated Values (for import in Microsoft Excel)
	*.bmp Bitmap Format
Auto Scale	Select this option to automatically calculate optimal scale values.
Setup Scale Values	If “Auto Scale” is deselected, left/right pane and time scale can be defined manually.
Manual	Open connected device's online help manual.
Configure Recorder	To select sampled data and to configure data recorder (→Data Recorder Configuration).

Table 8-79 Data Recording – Context Menu

8.3 Data Recorder Configuration

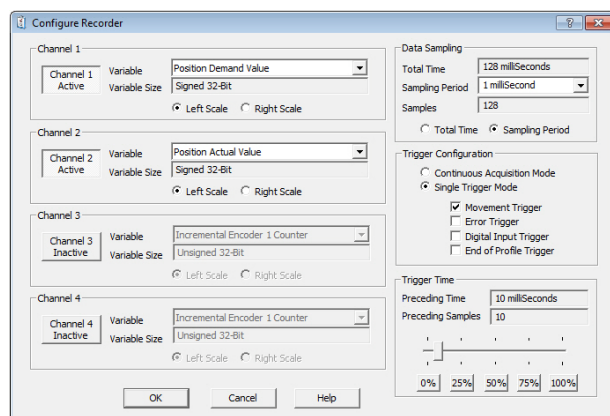


Figure 8-76 Data Recording – “Configure Recorder” Dialog

Channel 1...4

Control Element	Description / Function
Channel Active/Inactive	Activate/deactivate up to four recorder channels.
Variable	Select desired variables to be recorded.
Variable Size	Displays size of selected variable.
Left / Right Scale	Select pane to display the recorded data.

Table 8-80 “Configure Recorder” – Channel

Data Sampling

Control Element	Description / Function
Total Time	Displays total duration.
Sampling Period	Select sampling period.
Samples	Displays number of samples per channel.
Total Time or Sampling Period	Select whether to determine the total time or the sampling period.

Table 8-81 “Configure Recorder” – Data Sampling

Trigger Configuration

Control Element	Description / Function	
Continuous Acquisition Mode	Data will continuously be recorded.	
Single Trigger Mode	Movement Trigger	A trigger is activated upon every start of a movement.
	Error Trigger	A trigger is activated upon an occurring error.
	Digital Input Trigger	A trigger is activated at an edge of a digital input. Note: In “Homing Mode”, also the current threshold will be interpreted as a trigger.
	End of Profile Trigger	A trigger is activated at the end of a movement profile.

Table 8-82 “Configure Recorder” – Trigger Configuration

Trigger Time

Control Element	Description / Function
Preceding Time	The lead time to be displayed prior activation of a trigger. “100%” permits display of data prior the trigger. Best Practice: Use the trigger time in combination with the error trigger to debug errors.
Preceding Samples	Displays the number of samples before the trigger.

Table 8-83 “Configure Recorder” – Trigger Time

8.4 Example: Data Recording in "Profile Position Mode"

8.4.1 Step 1: Configure Data Recorder

- 1) Click "Configure Recorder" in the options bar or select "Configure Recorder" from the context menu.

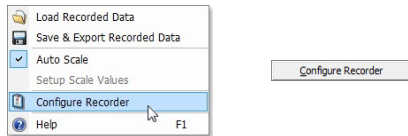


Figure 8-77 Configure Data Recorder

- 2) Select the following variables:
 - Position Demand Value
 - Position Actual Value
 - Velocity Actual Value
 - Current Actual Value
- 3) Select a sampling period of 1 ms.
- 4) Select "Single Trigger Mode" and tick "Movement Trigger".
- 5) Select a preceding time of 0 microseconds.

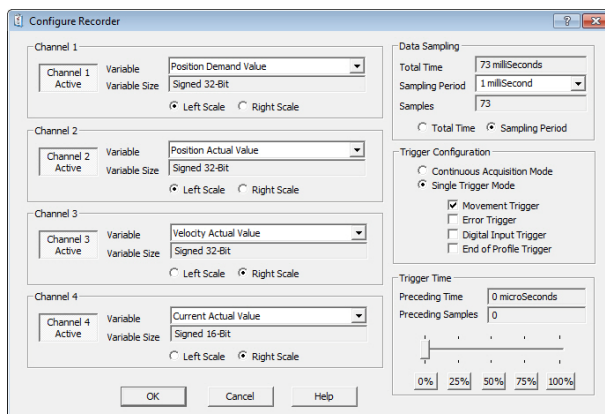


Figure 8-78 Select Configuration Options

- 6) Click "OK" to save settings.

8.4.2 Step 2: Execute Movement

- 1) Change the active view to "Profile Position Mode".
- 2) Activate "Profile Position Mode".
- 3) Enable the EPOS3 70/10 EtherCAT and start a relative movement.

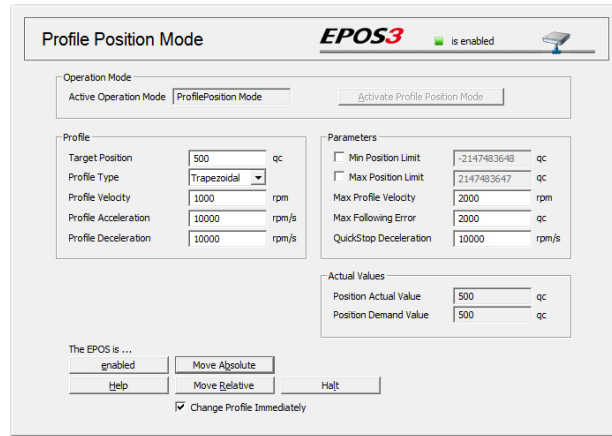


Figure 8-79 Execute Movement

8.4.3 Step 3: Update Display

Change back to the view "Data Recording". If the display does not automatically refresh, press "Update Display" button.

8.4.4 Step 4: Save recorded Data

- 1) Click right "Save & Export Recorded Data" to open context menu.

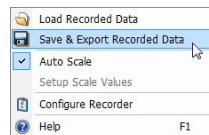


Figure 8-80 Save recorded Data

- 2) Select desired path.
- 3) Enter a file name.
- 4) Press "Save".

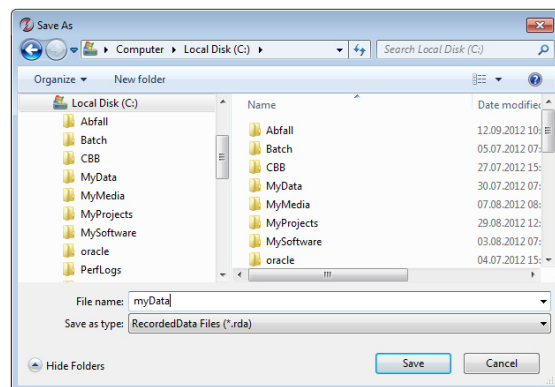


Figure 8-81 Save recorded Data



Best Practice

Save recorded data as ASCII text file or as bitmap!

8.4.5 Step 5: Analyze recorded Data

- 1) Select cursor mode "Attached Cursor".
- 2) Tick "Position Actual Value" in "Available Curves".
- 3) Move cursor over the display and read the attached curve's values.

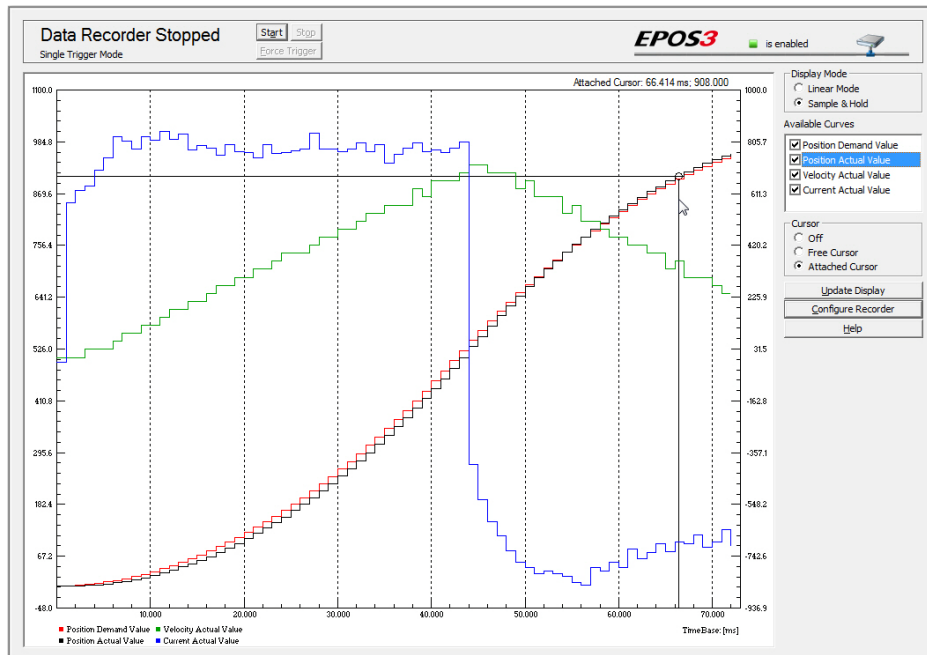


Figure 8-82 Analyze recorded Data

8.4.6 Step 6: Restart Data Recorder

Click "Start" to restart and prepare the data recorder for the next recording.



Figure 8-83 Restart Data Recorder

8.5 Data Recorder Specifications

8.5.1 Functionalities

Recorder

- Executed in current regulator (max 10 kHz sampling rate)
- Configurable sampling rate
- Total buffer size: 512 words

While the data recorder is running, data are sampled to a ring buffer until a trigger is set. After a trigger, data will be recorded until the buffer is full.

Variables

- Max. four variables of the Object Dictionary
- 16-bit and 32-bit variables are allowed (one word)
- 8-bit variables need 16-bits in the data recorder memory

Trigger

Following automatic trigger modes are supported:

- Manuel Trigger – set by communication
- Movement Trigger – set at movement start
- Error Trigger – set by error
- Digital Input Trigger – set by digital input
- End of Profile Trigger – set at movement stop

8.5.2 Object Description

8.5.2.1 Data Recorder Control

Description

The data recorder is controlled by write access.

Name	Data Recorder Control	
Index	0x2010	
Subindex	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value Range	0	3

Bit	Description
15...2	reserved
1	0 = no trigger 1 = force trigger
0	0 = stop recorder 1 = start recorder

Table 8-84 Data Recorder Control – Bits

8.5.2.2 Data Recorder Configuration**Description**

Configures the auto trigger functions.

Name	Data Recorder Configuration
Index	0x2011
Subindex	0x00
Type	UNSIGNED16
Access	RW
Default Value	0
Value Range	→ Table 8-85

Bit	Description
15...4	reserved
3	1 = trigger at end of profile
2	1 = trigger upon digital input
1	1 = trigger by error state
0	1 = trigger at movement start

Table 8-85 Data Recorder Configuration – Bits

8.5.2.3 Data Recorder Sampling Period**Description**

Sampling period as a multiple of the current regulator cycle (n multiplied by 0.1ms).

Name	Data Recorder Sampling Period
Index	0x2012
Subindex	0x00
Type	UNSIGNED16
Access	RW
Default Value	10
Value Range	0 65535

8.5.2.4 Data Recorder Number of Preceding Samples**Description**

Number of preceding samples defines the trigger position in the data recorder buffer.

Name	Data Recorder Number of Preceding Samples
Index	0x2013
Subindex	0x00
Type	UNSIGNED16
Access	RW
Default Value	0
Value Range	0 65535

8.5.2.5 Data Recorder Number of Sampling Variables**Description**

Number of variables (max. 4) to be recorded.

Name	Data Recorder Number of Sampling Variables	
Index	0x2014	
Subindex	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value Range	0	4

8.5.2.6 Data Recorder Index of Variables**Description**

Index of Object Dictionary.

Related Objects

➔ Data Recorder Subindex of Variables

Name	Data Recorder Index of Variables	
Index	0x2015	
Number of entries	0x05	

Names	Data Recorder Index of Variable 1 Data Recorder Index of Variable 2	Data Recorder Index of Variable 3 Data Recorder Index of Variable 4
Index	0x2015	
Subindex	0x01...0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value Range	➔ Object Dictionary	

8.5.2.7 Data Recorder Subindex of Variables**Description**

Subindex of Object Dictionary.

Related Objects

➔Data Recorder Index of Variables

Name	Data Recorder Subindex of Variables
Index	0x2016
Number of entries	0x05

Names	Data Rec... Subindex of Variable 1 Data Rec... Subindex of Variable 2	Data Rec... Subindex of Variable 3 Data Rec... Subindex of Variable 4
Index	0x2016	
Subindex	0x01...0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value Range	➔Object Dictionary	

8.5.2.8 Data Recorder Status**Description**

Data recorder's status.

Name	Data Recorder Status
Index	0x2017
Subindex	0x00
Type	UNSIGNED16
Access	RO
Default Value	0
Value Range	➔Table 8-86

Bit	Description
15...2	reserved
1	0 = not triggered 1 = triggered
0	0 = stopped 1 = running

Table 8-86 Data Recorder Status – Bits

8.5.2.9 Data Recorder Max. Number of Samples**Description**

Defines maximal number of samples per variable. The parameter is dynamically calculated by the data recorder.

The maximal number of samples is the memory size (512 words) divided by the sum of the variable size (in words) of all configured variables.

Name	Data Recorder max. Number of Samples	
Index	0x2018	
Subindex	0x00	
Type	UNSIGNED16	
Access	RO	
Default Value	0	
Value Range	–	–

Example:

Sum of Variable Size [word]	Example	Number of Samples
1	1 x 16-bit variable or 1 x 8-bit variable	512
2	1 x 32-bit variable	256
3	1 x 16-bit and 1 x 32-bit variable	170
...	...	...
8	4 x 32-bit variables	64

Table 8-87 Data Recorder Max. Number of Samples – Example

8.5.2.10 Data Recorder Number of recorded Samples**Description**

Offset to the start of the recorded data vector within the ring buffer.

Name	Data Recorder Number of recorded Samples	
Index	0x2019	
Subindex	0x00	
Type	UNSIGNED16	
Access	RO	
Default Value	0	
Value Range	–	–

8.5.2.11 Data Recorder Data Buffer

Description

Memory for the different data recorder's ring buffers. Memory allocation is dynamically calculated when the recorder is started.

Name	Data Recorder Data Buffer
Index	0x201B
Subindex	0x00
Type	Domain
Access	RO
Default Value	0
Value Range	–

Data Buffer Segmentation (Example: 2 x 16-bit variables, 1 x 32-bit variable)

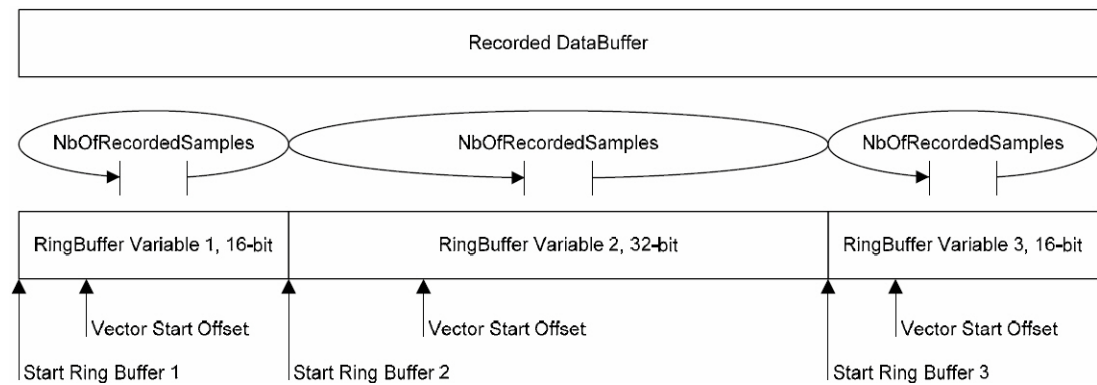


Figure 8-84 Data Recorder Data Buffer – Segmentation

StartRingBuffer1 = 0

StartRingBuffer2 = MaxNbOfSamples * nbOfWords(Variable1)

StartRingBuffer3 = MaxNbOfSamples * (nbOfWords(Variable1) + nbOfWords(Variable2))