

EPOS

Positioning Controller

Application Note "Data Recording"

August 2009 Edition

**EPOS and EPOS2 Devices
Firmware version 2000h or higher**

Introduction

The EPOS positioning controller is a digital positioning system suitable for DC and EC (brushless) motors with incremental encoders in a modular package. The performance range of these compact positioning controllers ranges from a few watts up to 700 watts.

A variety of operating modes allows all kinds of drive and automation systems to be flexibly assembled using positioning, speed and current regulation. The built-in CANopen interface allows networking to multiple axis drives and online commanding by CAN bus master units.

The EPOS supports a built-in data recorder for error debugging and monitoring of motion control parameters and actual values.

Objectives

This application note explains the functionality of the built-in data recorder. Features and configuration options are explained.

References and Required Tool

The latest editions of maxon motor documents and tools are free of charge available under <http://www.maxonmotor.com> category «Service & Downloads» or in the maxon motor e-shop <http://shop.maxonmotor.com>.

Document	Suitable order number for EPOS Positioning Controller
EPOS Firmware Specification	280937, 302267, 302287, 317270, 275512, 300583
EPOS2 Firmware Specification	347717

Tool	
EPOS Studio Version 1.40 or higher	280937, 302267, 302287, 317270, 275512, 347717, 300583

Data Recorder Overview

The Data Recorder can be started in the context menu from selected node in the tool EPOS Studio or in the navigation window 'Tools'. Just click the tool  Data Recording and the following view will be visible.

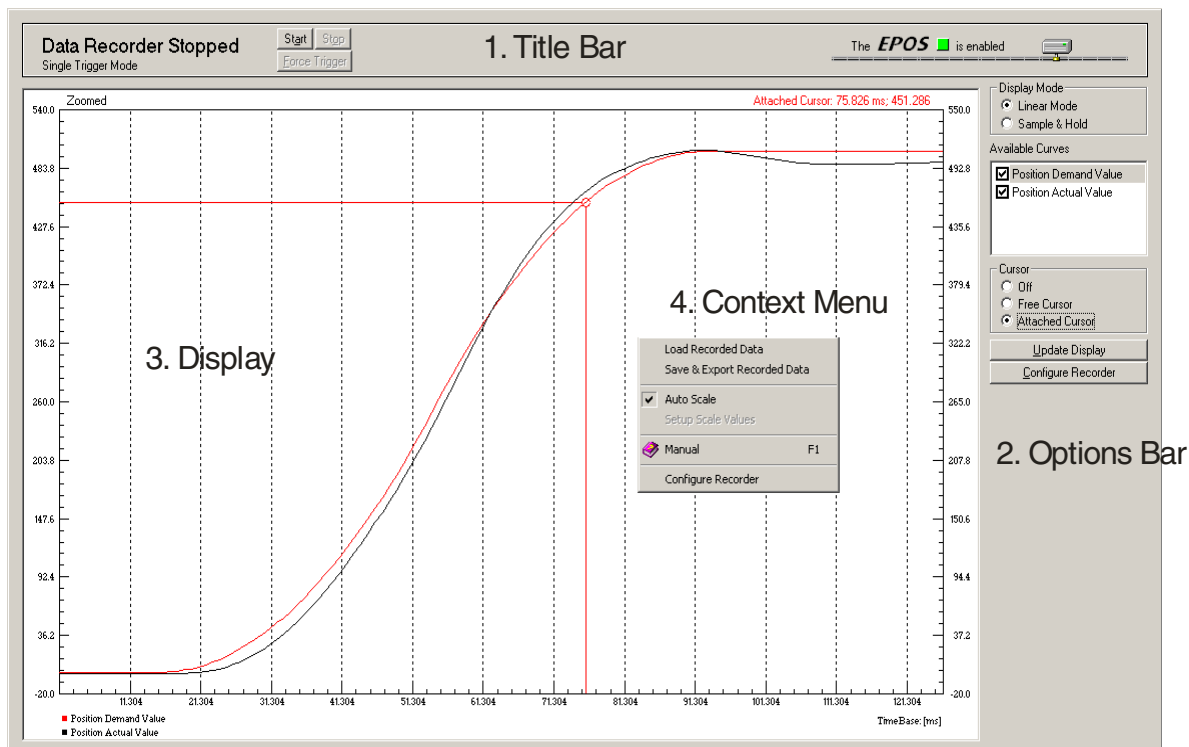


Figure 1: Data Recorder Overview

1. Title Bar

Status	Displays the status of the data recorder. The following states are possible: Data Recorder Running: Continuous Acquisition Mode The data recorder is continuously recording and displaying data. Data Recorder Waiting: Single Trigger Mode The data recorder is waiting for a trigger to start a single data recording (see 'Configure Recorder' for trigger options). Data Recorder Triggered: Single Trigger Mode A trigger is activated. The data recorder keeps sampling until the data buffer is full and then stops. Data Recorder Stopped: Single Trigger Mode or Continuous Acquisition Mode The data recording is finished and stopped. The recorded data is displayed.
Button 'Start'	The data recorder is started. In the 'Single Trigger Mode' the data recorder is waiting for a trigger. In the 'Continuous Acquisition Mode' the data recorder is continuously recording and displaying data.
Button 'Stop'	The data recorder is stopped. The last recorded data is displayed.
Button 'Force Trigger'	A trigger is activated by the user.

2. Options Bar

Display Mode	Linear Mode: A linear interpolation is used for displaying the data. Sample & Hold: No interpolation is used between two samples.
Available Curves	All available curves are listed. Select or deselect the checkbox to show or hide the curves in the display.
Cursor	Off: No cursor is displayed Free Cursor: Moving the mouse over the display a cursor is displayed. Attached Cursor: Moving the mouse over the display a cursor attached to the selected curve is displayed. Click on an item in the list 'Available Curves' to select another curve.
Update Display	The last sampled data is loaded and displayed.
Configure Recorder	Open the dialog 'Configure Recorder' to select the sampled data and to configure the data recorder options. (See section <i>Dialog 'Configure Recorder'</i>)

3. Display

Zooming	Press the left mouse button and draw a zooming rectangle to select the new view of the display. If the scale is zoomed the information 'Zoomed' is displayed in the left upper corner. Click the right mouse button to zoom out.
Cursor	If a cursor is activated a small circle is displayed moving the mouse over the display. In the upper right corner the actual values of the cursor position is displayed.
Left / Right Scale	Two different scales can be selected. Each data can be configured to be displayed in the left scale or in the right scale. (See section <i>Dialog 'Configure Recorder'</i>)
Time Scale	The time scale is displayed at the bottom border of the display. The time base is shown in the lower right corner.
Legend	In the lower left corner the legend of the displayed curves is shown.

4. Context Menu

Load Recorded Data	Recorded Data can be loaded from a file (*.rda).
Save & Export Recorded Data	Recorded Data can be saved to a file. (*.csv, *.txt, *.bmp, *.rda) '*.rda' File Format: Binary Format (can only be loaded by EPOS Studio) '*.txt' File Format: ASCII Text Format (can be imported to Microsoft Excel) '*.csv' File Format: Comma separated values (can be imported to Microsoft Excel) '*.bmp' File Format: Bitmap Format
Auto Scale	Select this option to calculate automatically the optimal scale values.
Setup Scale Values	If the option 'Auto Scale' is deselected, the left, right and time scale values can be defined manually.
Manual	Open the online manual according to the connected device.
Configure Recorder	Open the dialog 'Configure Recorder' to select the sampled data and to configure the data recorder options. (See section <i>Dialog 'Configure Recorder'</i>)

Dialog 'Configure Recorder'

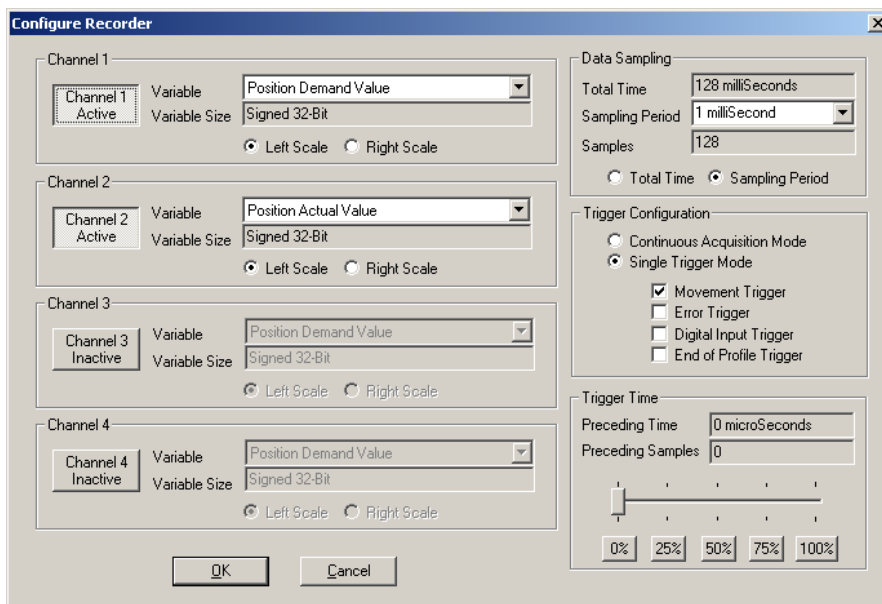


Figure 2: Dialog 'Configure Recorder'

Channel 1 - 4

Channel Active/Inactive	Activate or deactivate recorder channels. There are for channels available for data recording.
Variable	Select one of the variables to be recorded in the corresponding channel.
Variable Size	The size of the selected variable is shown.
Left / Right Scale	Select whether to display the recorded data at the left or at the right scale.

Data Sampling

Total Time	The total time can be selected or is displayed.
Sampling Period	The sampling period can be selected or is displayed.
Samples	Number of samples per channel is shown.
Options Total Time/ Sampling Period	Select whether to determine the total time or the sampling period.

Trigger Configuration

Continuous Acquisition Mode	Select this option to do a continuous data recording.
Single Trigger Mode	Movement Trigger: A trigger is activated at each start of a movement. Error Trigger: A trigger is activated at the occurrence of an error. Digital Input Trigger: A trigger is activated at an edge of a digital input. End of Profile Trigger: A trigger is activated at the end of a movement profile. Remark: Also the current threshold in the homing mode is handled as a trigger.

Trigger Time

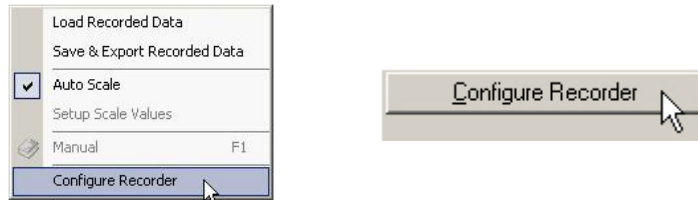
Preceding Time	The time to be displayed before the trigger is activated. Configuring the trigger time to 100% the data before the trigger event can be displayed. Remark: Use the trigger time in combination with the error trigger to debug errors.
Preceding Samples	Shows the number of samples before the trigger.

Data Recording Example 'Profile Position Mode'

Follow the instructions step by step to do a data recording of a relative position movement.

Step 1: Configure Data Recorder

Click on the button 'Configure Recorder' in the options bar or select the command in the context menu to open the dialog 'Configure Recorder'.



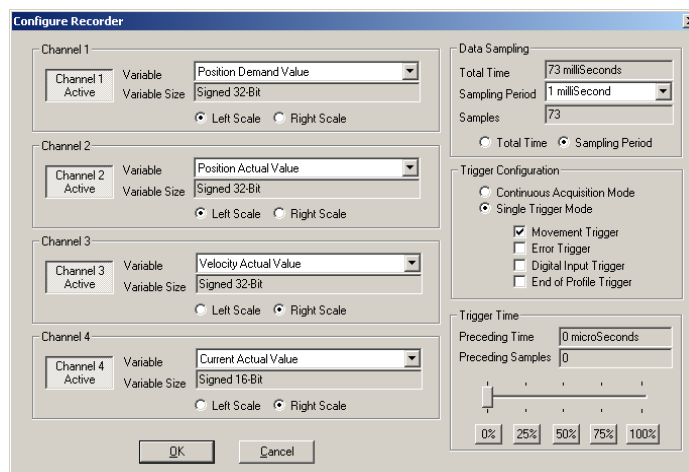
Variable Selection: Select the following variables

- Position Demand Value
- Position Actual Value
- Velocity Actual Value
- Current Actual Value

Data Sampling: Select a sampling period of 1 ms

Trigger Configuration: Select the single trigger mode. Movement Trigger only

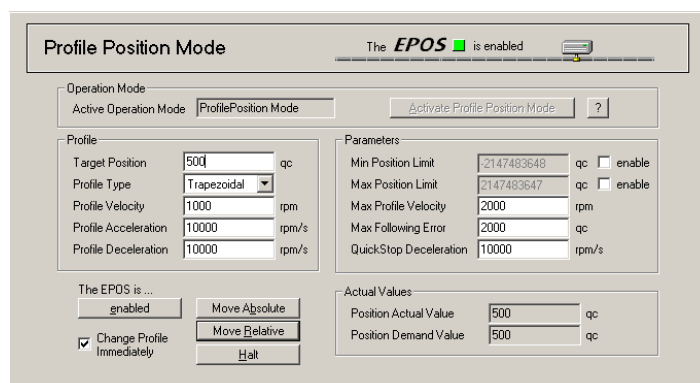
Trigger Time: Select a preceding time of 0 microseconds

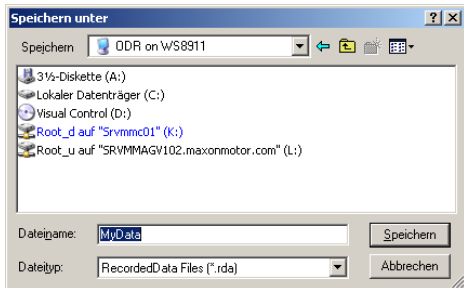
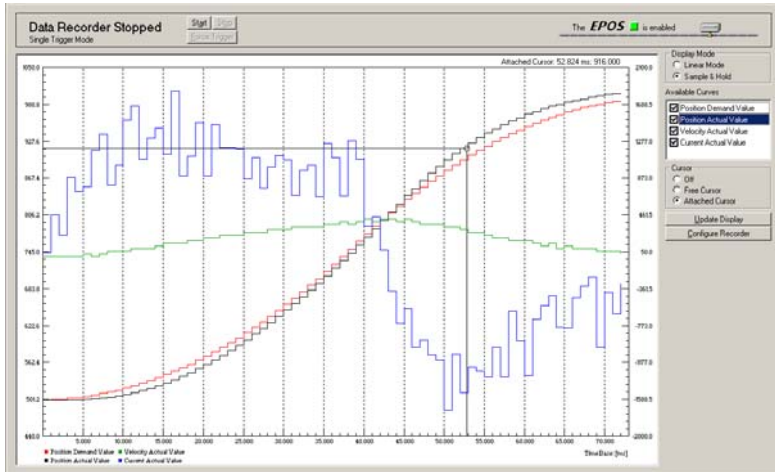


Click OK to save and configure the data recorder!

Step 2: Execute Movement

Change the active view to the 'Profile Position Mode'. Activate the profile position mode, enable the EPOS and start a relative movement.



Step 3: Update Display	Change back to the view 'Data Recording'. Press the button 'Update Display', if the display is not automatically updated.
Step 4: Save Recorded Data	Click the right mouse button to open the context menu and select the command 'Save & Export Recorded Data'.  Enter a file name to store the recorded data.  Remark: Change the file type to save the recorded data as an ASCII text file or as a bitmap!
Step 5: Analyze the recorded data	Select the cursor mode 'Attached cursor'. Click on the item 'Position Actual Value' in the list 'Available Curves'. Move the mouse over the display and read the values of the attached curve. 
Step 6: Restart the data recorder	Restart the data recorder for a new data recording by clicking on the button 'Start' in the title bar. 

Specification Data Recorder

Functionalities

Recorder

- Executed in current regulator (max 10 kHz sampling rate)
- Sampling rate can be configured
- Total buffer size: 512 words

When the data recorder is running, data is sampled to the ring buffer until a trigger is set. After a trigger the data recorder is running 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

Various automatic trigger modes are supported. These trigger modes can be activated or deactivated.

- 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

Object description

Data Recorder Control

Name	data recorder control	
Index	0x2010	
Subindex	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	3

Description

The data recorder is controlled by write access.

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

Table 1: Configuration data recorder control bits

Data Recorder Configuration

Name	data recorder configuration	
Index	0x2011	
Subindex	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	see table below	

Description

Configuration of auto trigger functions.

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

Table 2: Configuration data recorder trigger bits

Data Recorder Sampling Period

Name	data recorder sampling period	
Index	0x2012	
Subindex	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	10	
Value range	0	65535

Description

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

Data Recorder Number of Preceding samples

Name	data recorder number of preceding samples	
Index	0x2013	
Subindex	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	65535

Description

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

Data Recorder Number of Sampling Variables

Name	data recorder number of sampling variables	
Index	0x2014	
Subindex	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	4

Description

Number of variables to be recorded (max. four variables are supported).

Data Recorder Index of Variables

Name	data recorder index of variables
Index	0x2015
number of entries	0x05

Name	data recorder index of variable 1 - 4
Index	0x2015
Subindex	0x01 - 0x04
Type	UNSIGNED16
Access	RW
Default Value	0
Value range	see object dictionary

Description

Variable configuration: index of object dictionary.

Related Objects

- Data Recorder SubIndex of Variables

Data Recorder SubIndex of Variables

Name	data recorder sub index of variables
Index	0x2016
number of entries	0x05

Name	data recorder sub index of variable 1 - 4
Index	0x2016
Subindex	0x01 - 0x04
Type	UNSIGNED16
Access	RW
Default Value	0
Value range	see object dictionary

Description

Variable configuration: sub index of object dictionary.

Related Objects

- Data Recorder Index of Variables

Data Recorder Status

Name	data recorder status
Index	0x2017
Subindex	0x00
Type	UNSIGNED16
Access	RO
Default Value	0
Value range	see table below

Description

State of data recorder.

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

Table 3: Status control bits

Data Recorder Max. Number of Samples

Name	data recorder max. number of samples
Index	0x2018
Subindex	0x00
Type	UNSIGNED16
Access	RO
Default Value	0
Value range	- -

Description

Maximal number of samples per variable. This 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.

Examples:

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 4: Examples max. number of samples

Data Recorder Number of Recorded Samples

Name	data recorder number of recorded samples	
Index	0x2019	
Subindex	0x00	
Type	UNSIGNED16	
Access	RO	
Default Value	0	
Value range	-	-

Description

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

Data Recorder Data Buffer

Name	data recorder data buffer	
Index	0x201B	
Subindex	0x00	
Type	Domain	
Access	RO	
Default Value	0	
Value range	-	-

Description

Memory for the different ring buffers of the data recorder. The memory allocation is calculated dynamically when the recorder is started.

Data Buffer Segmentation

Sample: 2 x 16-bit variables, 1 x 32-bit variable

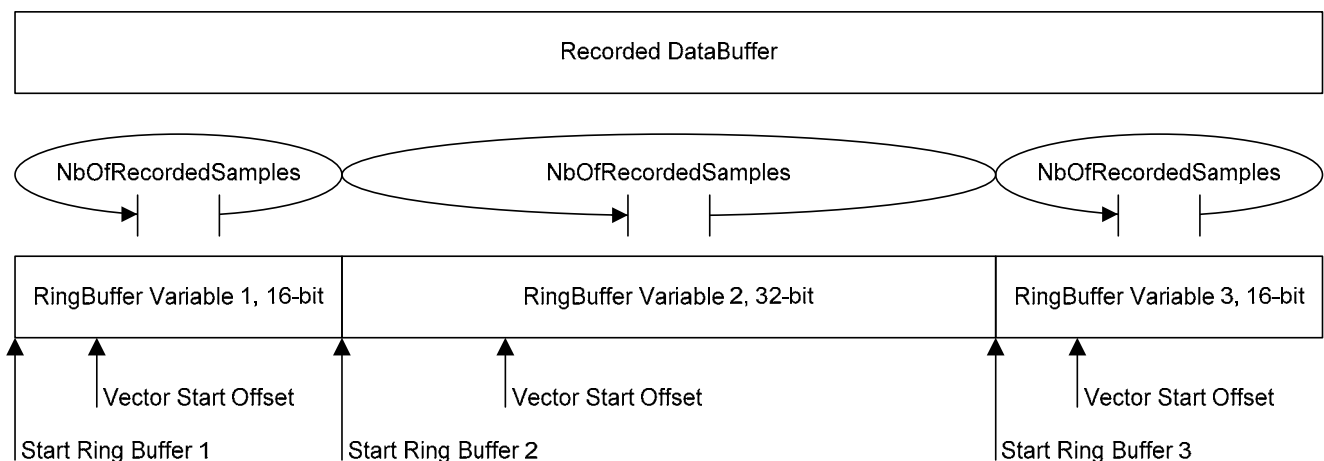


Figure 3: Data buffer segmentation

StartRingBuffer1 = 0

StartRingBuffer2 = MaxNbOfSamples * nbOfWords(Variable1)

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