# BECKHOFF New Automation Technology

Information Oversampling | EN

AX8000

Multi axis servo system



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The contents of this documentation apply to the AX8000 multi-axis servo system. The chapters contain information on the use of the oversampling function and how to parameterize it via CoE objects.

### Function

Process data are usually transferred exactly once per communication cycle. Conversely, the temporal resolution of a process data directly depends on the communication cycle time. Higher temporal resolution is only possible through a reduction in cycle time - with associated practical limits.

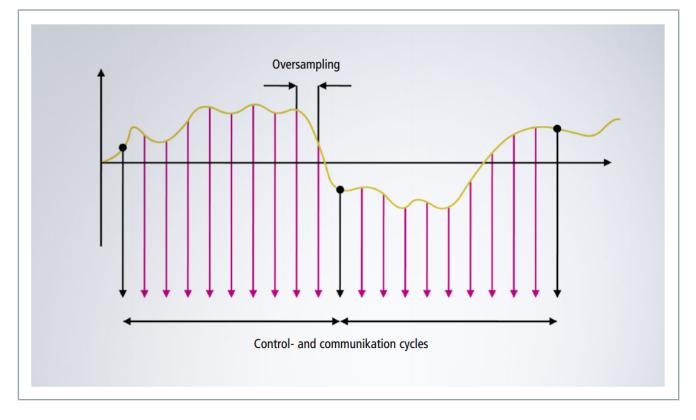
Oversampling enables the multiple sampling of a process data within a communication cycle and the subsequent (inputs) or previous (outputs) transfer of all data in an array. The oversampling factor describes the number of samples within a communication cycle and is therefore a multiple of one.

Triggering of the sampling within the I/O components is controlled by the local clock (or the global system time), which enables associated temporal relationships between distributed signals across the whole network.



#### System prerequisites for the function

You have the possibility to use the oversampling on axis modules from the AX8xxx series from the firmware version v1.03. The function can be used on the device and on the channel.



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### Configuration

You have the possibility to configure the content of a PDO variables multiple times in order to use the oversampling.

A general explanation of PDOs and the Process Data tab can be found here.

Proceed as follows to use the oversampling:

► Select the desired axis module in the I/O tree



Left-click "Process Data"

The dialog box "Process Data" opens

General	EtherCAT	Г DC	Process	Data	Plc	Slots	Startup	CoE - Online	AoE - Online	Diag History	Onlin
Sync M	anager:			PD	D List:						
SM	Size	Туре	Flags	In	dex	Size	Name			Flags	SI
0	512	MbxOut		0	1B03	0.0	Ch A I	nterpolator Dyn	amic Inputs		
1	512	MbxIn		0	1623	4.0	Ch A I	nterpolator Out	outs .		2
2	18	Outputs		0	1703	0.0	Ch A I	nterpolator Dyn	amic Outputs		
3	26	Inputs		0	1A26	4.0	Ch A F	PositionControl I	nputs		3
4	0	DynO		0	1B06	0.0	Ch A F	PositionControl I	Dynamic Inp		
5	0	Dynln		0	1626	0.0	Ch A F	ositionControl (	Dutputs		
				0	1706	0.0	Ch A F	PositionControl I	Dynamic Ou		
				0	1A2A	0.0	Ch A \	/elocityControl	nputs		
				0	1B0A	0.0	Ch A \	/elocityControl	Dynamic Inp		
				0	162A	0.0	Ch A \	/elocityControl (	Outputs		
				0	:170A	0.0	Ch A \	/elocityControl	Ovnamic Ou		
				0	:1A32	0.0	Ch A 1	TorqueControl Ir	nputs		3
				0	1B12	0.0	Ch A T	TorqueControl D	ynamic Inp		
				0	1632	0.0	Ch A 1	TorqueControl C	utputs		

Select "0x1A32 ChA Torque Control Inputs"

The currently configured PDOs can be found in the dialog box "PDO Content" below the "PDO List". These are part of the previously selected PDO.

0x162A	0.0	Ch A V	elocityControl Outputs	
0x170A	0.0	Ch A V	elocityControl Dynamic Ou	
0x1A32	0.0	Ch A T	orqueControl Inputs	
0x1B12	0.0	Ch A T	orqueControl Dynamic Inp	
0x1632	0.0	Ch A T	orqueControl Outputs	
0x1712	0.0	Ch A T	orqueControl Dynamic Out	
> 0v1A36	0.0	Ch A S	vnc Serva Matar Innuts	

Right-click "PDO Content"

A new dialog box opens.

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# Oversampling

*ם	Add New Item	2	Ctrl+Shift+A
X	Delete	-0	Del
	Edit		
•	Print		Ctrl+P
	Move Up		
	Move Down		

► Left-click "Add New Item"

### A new dialog box "Edit PDO Entry" opens

Edit Pdo Entry			×
Name:	TorCtrl torque/force	actual value	ОК
Index (hex):	3241	12865	2 Cancel
Sub Index:	9		
Data Type:	REAL	~	
Bit Lentgh:	32 🔹		
From Dictionary	bjects from related m : :loCtrl torque/force di		
0x3241:02 - Fe 0x3241:03 - Lir 0x3241:04 - Fill 0x3241:05 - Re 0x3241:06 - To 0x3241:07 - Po	ed forward torque/fo nited torque/force de tered torque/force de	rce demand value mand value emand value ffective	1
0x3241:0A - De 0x3241:0B - Ac 0x3241:0C - Co 0x3242:01 - Ig		rce limit actual ue/force demand valu torque demand value	

- ▶ Select "0x3241:09 TorCtrl Torque/Force actual value" [1]
- ► Confirm with "OK" [2]

AX8000

In the "PDO Assignment", check whether the checkbox for the PDO "0x1A32" is active

## If the checkbox is not active, the PDOs in the process image are not ready:

activate the TwinCAT configuration in order to accept changes

Repeat the above actions in order to add further PDOs to the process image. The oversampling is now active for all PDOs that exist multiple times in the process image.

If you list a variable twice in order to use oversampling than these variables need to be configured directly one after another. It's not allowed to have another variable in between. Same applies when doing oversampling with a higher oversampling factor.

PDO Assignment (0x1C12):	
✓ 0×1600	~
0x16E0	
✓ 0×1620	
0×1700	
✓ 0×1623	
0x1703	
0x1626	
0×1706	
0x162A	
0x170A	
0x1632	
0x1712	
🔽 0x1640	
0x1720	
√0x1643	
0x1723	
0x1646	Υ.

**Oversampling factor** Oversampling enables the multiple sampling of a process data within a communication cycle. The oversampling factor describes the number of samples within a communication cycle and is therefore a multiple of one.

The AX8000 has an internal cycle time of 62.5  $\mu s.$  A process data can't be updated faster than that.

Maximum oversampling

The highest oversampling factor results from:

- Cycle time of the AX8000
- · Cycle time of the task to be synchronized; e.g. the NC task SAF



#### Calculation

max\_over\_factor = cycle time of sync task / cycle time AX8000 = cycle time of sync task / 62.5 µs

Possible values of the oversampling factor If the oversampling is to be implemented with less than the maximum oversampling factor, the number of samples cannot be selected arbitrarily. Otherwise, the values would not match the timing of the controller cycle time.



### Calculation

possible\_over\_factor = max\_over\_factor / 2<sup>n</sup>

Note that the oversampling function does not work if a PDO is only transferred once per cycle. Select an appropriate value for "n".

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Integration	The values transferred by oversampling can be used in the higher- level controller or generated there. An array can be used to group several process data together for this.	
Solution Explorer	► Right-click "Task"	
○ ○ ☆ ☆ - '○ - ♂ / ⊁	► Left-click "Add New Item"	
Search Solution Explorer (Ctrl+ū)		
Solution 'TwinCAT Project12' (1 project)		
SYSTEM		
License     Aeal-Time		
Add New Item Ins		
👪 Type Syster 🛍 Add Existing Item. 😒 Shift+Alt+A		
TcCOM Objects     MOTION		
PLC		
Untitled1     Difference     Di		
Insert Task X	Select "Task with image" [1], give it a name and confirm with	
Name: Task 3 2 OK N	"OK" [2]	
Type Cancel		
O TwinCAT Task		
TwinCAT Task With Image		
O TwinCAT Job Task (Worker Task)		
TwinCAT Fast Cyclic Task		
O TwinCAT Virtual Task		
Solution Explorer       ▼       ₽         ○	<ul> <li>Right-click "Input"</li> <li>Left-click "Add New Item"</li> </ul>	-
Solution 'TwinCAT Project12' (1 project)     IwinCAT Project12	Insert Variable	
A SYSTEM		
License	General OK	
<ul> <li>Real-Time</li> <li>Tasks</li> </ul>	Name: Var 1 Multiple: 1 Cancel	
🔺 🚺 Task 3	Start Address: Byte: 0 🖨 Bit: 0 🖨	
Image	Show All	
Add New Item Ins	Data Type >Size Name Space	
Task Recalc Addresses	OTCID 4	
▶ 📑 Task <del>5</del>	PTCGP 4	
	PTCID 4 REAL 4	
	ST_AX5000_P_0150_FeedBackOption 4 AX5000	
	ST_AX5000_P_0401 4 AX5000 TcFileFindHandle 4	
	TcFileHandle 4	
	TCOM_STATE 4	
	TCPIP_EVENT 4 TcSourceInfoType 4	
	TaTmai aul	
	Search Type:	

► Select a variable type from the list and click "Create Array Type"

8-

Create Array Type	Define "Array" size [1] and confirm with "OK" [2]
Base Type: REAL	
1 0 0 New OF	
2 0 🗘 0 🗘 New OF	
3 0 🔺 0 🔺 New OF	
New Type:	
ARRAY [03] OF REAL	
OK Cancel	
sert Variable	<ul> <li>Select the created "Array Type" and issue a name [1]</li> </ul>
General Autoria Multiple: 1	► Confirm with "OK" [2]
Name: Torque Control Multiple 1 Cancel Start Address: Byte: 16 Bit: 0  Show Al	

Name Sp TcLine AX5000 AX5000 AX5000 AX5000

Safety

Create Array Type...

v

>Size

**BECKHOFF** Version: 1.1

Data Type UINESTRUCT\_OVENCOUT ST\_AX5000\_P\_0150\_HwardschurerUmtSettings ST\_AX5000\_P\_02150\_PowerSettings ST\_AX5000\_P\_0225 T\_AX5000\_P\_0222 T\_Lison\_LevelInfo TComIniDataHdr TCSeniatzedSourceInfoType STRING(15) FSOE\_15 ARRAY [0.5] OF REAL cucch

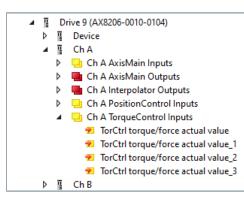
Search Type:

Solution Explorer 👻	Ψ×
○ ○ 🏠 🖽 · │ šo · @ │ 🔑 💻 🚽 ·	
Search Solution Explorer (Ctrl+ü)	ρ.
<ul> <li>Solution 'TwinCAT Project12' (1 project)</li> <li>TwinCAT Project12</li> <li>SYSTEM</li> <li>License</li> <li>Real-Time</li> <li>Tasks</li> <li>Task 3</li> <li>Image</li> <li>Inputs</li> </ul>	
🔺 🌮 Torque Array	
Torque Array[0]	
<ul> <li>Torque Array[1]</li> <li>Torque Array[2]</li> <li>Torque Array[3]</li> </ul>	
Uutputs	
🔺 🝺 Task 4	

► In the Solution Explorer, left-click "Array" element

Variable Flag	s Online			
Name:	Torque Array[0]			
Type:	REAL ({18071995-0	0000-0000-0000-00000000	00000D})	
Group:	Inputs	Size:	4.0	
Address:	0 (0x0)	User ID:	0	
ADS Info:	Port: 301, IGrp: 0x3	040010, IOffs: 0x8000000	00, Len: 4	_

► Left-click "Linked to"



- ► Select "Sample" and confirm with "OK"

Repeat this step for all "Array" elements.

You can now use the "Array" in a "Scope", for example.

More Information: www.beckhoff.com/ax8000

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