## XMC4300 EtherCAT APP SSC Slave Example Getting Started V4.2





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#### Overview





This example demonstrates the implementation of a EtherCAT slave node using the Beckhoff SSC tool to generate the slave stack code for "XMC4300 Relax EtherCAT Kit"

While reviewing this example you will see in output direction the EtherCAT

master controlling LED1 on the "XMC4300 Relax EtherCAT Kit". In input direction you will monitor inside the master device the status of BUTTON1. You will observe inside the source code how to modify the mapping of the data structures to the I/Os for your own evaluations and testing. Furthermore you will learn how to modify the data structures and generate a slave stack code which fits to your needs. In this example we will demonstrate how easy it is to setup a proper EtherCAT communication by using the EtherCAT APP.



#### Requirements



#### XMC4300 Relax EtherCAT Kit



RJ45 Ethernet Cable



Windows Laptop installed

- > DAVE v4 (Version 4.1.4 or higher)
- > TwinCAT2 or TwinCAT3 Master PLC
- > Slave Stack Code Tool Version 5.12



Micro USB Cable (Debugger connector)

#### Requirements - free downloads





TwinCAT2 (30 day trial; 32-bit Windows only) Link: <u>Download TwinCAT2</u>

or



TwinCAT3 (no trial period; usability limited; 32-bit and 64-bit Windows) Link: <u>Download TwinCAT3</u>

#### ATTENTION:

According our experience TwinCAT is best compatible with Intel<sup>™</sup> ethernet chipset.

For details on compatibility with your hardware, additional driver and general installation support please get into contact with your local BECKHOFF support.

#### Requirements - free downloads



DAVE (v4.1.4 or higher) Link: <u>Download DAVE<sup>™</sup> (Version 4)</u>



EtherCAT Slave Stack Code tool Version 5.12

(ETG membership obligatory) Link: <u>Slave Stack Code tool</u>



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#### Setup – Hardware







### Setup – Cleanup flash of XMC4300

	J-Link V5.0 Link V5.1 J-Flash J-Flash J-Flash J-Flash J-Link Back	2f Lite SPI Commander	٠ ٩			SEGGEI Target Device Unspec Select a dee	R J-Flash Lite 5.12f		nterface WD	Speed
							4 SEGGER J-Flash File Help Target Device	Lite V5.40	Speed	- ×
						~	4 SEGGER J-Flash File Help Target Device XMC4300-256 Data File (bin / hex /	Lite V6.40	Speed 4000 kHz Prog. addr. (bin file only)	
Target Device	Settings					×	4 SEGGER J-Flash File Help Target Device XMC4300-256 Data File (bin / hex /	Lite V6.40	Prog. addr. (bin file only) 0x0000000	Ersse Chip
a Target Device XI	Settings 4C4300-256			Little F	Core	×	4 SEGGER J-Flash File Help Target Device XMC4300-256 Data File (bin / hex /	Lite V6.40	Prog. addr. (bin file only) 0x0000000 am Device	Erese Chip
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Farget Device: XI Selected Device: XI Manufacturer Infineon	Settings MC4300-256 Device XMC4108-64 XMC4200-256	Core Core Core M4 Cotter-M4 Corter-M4	NumCores 1	Little F Flash Size 150 mi 64 KB 255 KB	AM Size	×	4 SEGGER J-Flash File Help Target Device XMC4300-256 Data File (bin / hex /	Lite V6.40	Prog. addr. (bin file only) Dx0000000 am Device	Erase Chip

Make sure the XMC flash on your XMC4300 Relax EtherCAT Kit is cleaned up





### Setup – Import example project into DAVE™

File	Edit Source Refacto	or Navigate Projec	t
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	Open File		
	Close	Ctrl+V	i.
	Close All	Ctrl+Shift+V	į.
	Save	Ctrl+	5
	Save As		
	Save All	Ctrl+Shift+	5
2	Rename	F	2
8	Refresh	F.	5
	Print	Ctrl+I	0
	Switch Workspace		•
	Restart		
S.	Import		
	Export		
	Properties	Alt+Ente	ŗ
	Exit		

3

1

mport DAVE projects		
Import Existing DAVE Projects		
Select Root Directory	]	Browse
Select Archive File     C:\Users	\Public\Downloads\XMC4300_Relax_EtherCat_APP_Slave_SSC.zip	Browse
Project List:		
XMC4300_Relax_EtherCat_	APP_Slave_SSC(XMC4300_Relax_EtherCat_APP_Slave_SSC)	Select All
	1	D 1 . 411
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Infineon	
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### Setup – Import example project into DAVE™

	Di	AVE C	E - DAVE	<sup>™</sup> - C:\Work	spaces\DA\	/E-4.1\ETI	HERCAT_
	File	Edit	Source	Refactor	Navigate	Search	Project
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1		⊳	🕞 Src				
2			X Infin	eon_XMC_E _ESC.xlsx	CAT_SSC_C	onfig.xml	
T		DB	Startup				
		D .C	main.c				
			linker_sc	ript.ld			
			solver.ba	ik			

After the project import you will find this project folder structure.

<sup>1</sup> The project is nearly complete for building, it only misses the EtherCAT slave stack code. For these files the Src folder has been already prepared.

<sup>2</sup> The EtherCAT slave stack code for the XMC4300 can be generated by configuration files. These configuration files are included in the project already

The following slides show in detail how to define your EtherCAT slave node interface and to generate the slave stack code.

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# The flow to define the EtherCAT<sup>®</sup> slave node interface

![](_page_13_Picture_1.jpeg)

![](_page_13_Picture_2.jpeg)

1 Take the Excel Worksheet provided inside the example project to define your EtherCAT slave node interface.

2 The Beckhoff SSC-tool uses the excel sheet as an input to generate the output-files.

3 The generated EtherCAT slave stack code does apply for the XMC4300.

<sup>4</sup> The generated **E**therCAT **S**lave **I**nformation file (ESI) does apply for the EtherCAT host. There the relevant interface information about the slave is stored.

![](_page_14_Picture_0.jpeg)

### Defining the interface of EtherCAT<sup>®</sup> slave node

SSC Src Infineon\_XMC\_ECAT\_SSC\_Config.xml XMC\_ESC.xlsx

2

-	Index -	ObjectCode ~	SI -	DataType 🖛	Name
	//0x6nnx	Input Data of th	e Module (0x60	00 - 0x6FFF)	
	0x6000	RECORD			IN_GENERIC
			0x01	UINT	IN_GEN_INT1
			0x02	UINT	IN_GEN_INT2
			0x03	UINT	IN_GEN_INT3
			0x04	UINT	IN_GEN_INT4
			0x05	BOOL	IN_GEN_Bit1
			0x06	BOOL	IN_GEN_Bit2
			0x07	BOOL	IN_GEN_Bit3
			0x08	BOOL	IN_GEN_Bit4
			0x09	BOOL	IN_GEN_Bit5
			0x0A	BOOL	IN_GEN_Bit6
			0x0B	BOOL	IN_GEN_Bit7
			0x0C	BOOL	IN_GEN_Bit8

ll0x7nnx	Output Data	of the Module	(0x7000 - 0x7Ff	FF)
0x7000	RECORD			OUT_GENERIC
		0x01	UINT	OUT_GEN_INT1
		0x02	UINT	OUT_GEN_INT2
		0x03	UINT	OUT_GEN_INT3
		0x04	UINT	OUT_GEN_INT4
		0x05	BOOL	OUT_GEN_Bit1
		0x06	BOOL	OUT_GEN_Bit2
		0x07	BOOL	OUT_GEN_Bit3
		0x08	BOOL	OUT_GEN_Bit4
		0x09	BOOL	OUT_GEN_Bit5
		0x0A	BOOL	OUT_GEN_Bit6
		0x0B	BOOL	OUT_GEN_Bit7
		0x0C	BOOL	OUT_GEN_Bit8
1				

1 Double click on the excel file to open it.

<sup>2</sup> Check the content of the file. The data defined in both I/O directions is 4x16-bit integers and 8x1-bit booleans.

3 or further details on how to define your own interface you may want to follow the instructions inside *EtherCAT Slave Design Quick Guide.pdf* inside SSC tool.

![](_page_14_Figure_9.jpeg)

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![](_page_15_Figure_2.jpeg)

![](_page_16_Picture_0.jpeg)

Custom	FI 9800 L 24vis CiA402 Sample
Evaluation H The corresp	araun provides a cineral sample application of the new ELSoop EnterChi Kit. Jonding device description is located in file "\esi\SlaveStackCode.xml" (device:

![](_page_16_Picture_3.jpeg)

## 1 Start the sec tool and create a new project File >> New

![](_page_16_Picture_5.jpeg)

<sup>2</sup> Select the configuration file which you find inside the example project

![](_page_17_Picture_0.jpeg)

Custom	Infineon XMC EtherCAT hardware <infineon technologies=""></infineon>	
Vendor: Infin Version: 2.0.	eon Technologies (0x34E). 0.0	
NOTE: This	configuration is not provided by Beckhoff Automation and files or file fragm	ments m
THE ACTION INTO A		
be added wr	act are no r covered by the license from becknon Automation Gribh.	
De added wr		
Shall be set i	f the Slave code executes on an XMC4800/XMC4300 device.	

<sup>3</sup> Select the Infineon device inside the drop down list and confirm with the OK button. Your project will be created.

![](_page_18_Picture_0.jpeg)

File Project Tool Help		
lave Project Navigation	Slave Settinge	
- EtherCAT SlaveSlaveInformation	Name VENDOR_ID	Value 0x0000034E
Generic Hardware	VENDOR_NAME	Infineon Technologies
EtherCAT State Machine	VENDOR_IMAGE	424D1605000000000000
Synchronisation	GROUP_NAME	Infineon slave
ProcessData	GROUP_IMAGE	424DD802000000000000
···· Mailbox	DEVICE_IMAGE	424DD802000000000000
····· Compiler	PRODUCT_CODE	0x0000000
	REVISION_NUMBER	0x0
	SERIAL_NUMBER	0x0
	DEVICE_PROFILE_TYPE	0x00001389
	DEVICE_NAME	XMC_ESC
	DEVICE_NAME_LEN	0x7
	DEVICE_HW_VERSION	1.0
	DEVICE_HW_VERSION_LEN	Ox3
	DEVICE_SW_VERSION	5.12

- Check the settings inside SlaveInformation: vendor ID, vendor name, product ID and product code are customer specific and are used by the host to identify the slave.
- Define revision number, serial number, device name, HW/SW version according to your needs.
- The vendor ID/name and product code assigned to Infineon may be used for evaluation purpose only. For productive purpose your own vendor ID/name assigned by the EtherCAT Technology Group is obligatory.

![](_page_19_Picture_0.jpeg)

Show Conflict Options EEPROM Prog Application	t Window Jrammer	Create new	Value 0x0000034E
Options EEPROM Prog Application	Irammer	Create new	Value 0x0000034E
EEPROM Prog Application	jrammer	Create new	0x0000034E
Application Grand		Create new	Infinance Tealers
RE			/ Technolog
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	Src.	<b>-</b>	13.06.2016 10:1
<b>F</b>	XMC_ESC.xlsx	J	10.03.2016 15:4
+ 4			•
	ile Relax_EtherCat	ile Relax_EtherCat > SSC > •	ile Relax_EtherCat > SSC > • 47 Search SSC Name Srr E XMC_ESC.xlsx

4 Import the EXCEL-sheet which defines the interface of your EtherCAT node.

5

Select the EXCEL-file provided inside the example project.

![](_page_19_Picture_7.jpeg)

![](_page_20_Picture_0.jpeg)

File	Proj	ect	Tool Help	<b>)</b>		
Slave Pr	0	Proj	ject Update		is	
E Eh		Find	d Setting	Ctrl+F		5.1
		Cre	ate new Slave I	Files F5	ersio	n 1.3
		Cre	ate new Slave I	Files F5	ersio ne ne	n 1

#### 6 Click on Project >> Create new Slave Files to start file generation.

7 In this step the destination folder for the EtherCAT slave Stack Code and the ESI file can be adapted. For this example it is recommended to take the default settings.

Project File	C:\Workspace	s\DAVE-4.1\ETHERCAT_DC\XMC4300_Relax_EtherCat_APP_S	
	Source Folder	C:\Workspaces\DAVE-4.1\ETHERCAT_DC\XMC4300_Relax_E	Change
	ESI File	C:\Workspaces\DAVE-4.1\ETHERCAT_DC\XMC4300_Relax_	Change
	Doc Folder	C:\Workspaces\DAVE-4.1\ETHERCAT_DC\XMC4300_Relax_E	Change

![](_page_21_Picture_0.jpeg)

#### Find and use your result

)		2
4 🕞	SSC	
4	🔁 Src	I
	b applInterface.h	I
	coeappl.c	I
	🔉 🔚 coeappl.h	
	b ecat_def.h	
	c ecatappl.c	I
	b ecatappl.h	I
	ecatcoe.c	I
	b la ecatcoe.h	I
	ecatslv.c	I
	b ecatsly.h	I
	b eeprom.h	I
	⊳ <mark>h</mark> esc.h	I
	D mailbox.c	
	b mailbox.h	I
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	⊳ 🔚 objdef.h	I
	sdoserv.c	I
	b sdoserv.h	I
	XMC_ESC.c	I
	▶ h XMC_ESC.h	I
	M XMC_ESCObjects.h	ノ
	Infineon_XMC_ECAT_SSC_Config.xml	
	MC_ESC.esp	
-		ר
	XI XMC_ESC.xml	J

After the generation process the respective files are inside the project space:

<sup>8</sup>Check the availability of the generated slave stack code

Otheck the availability of the ESI-file and download to the host by these 3 steps:

- 1. Stop TwinCAT System Manager
- 2. Copy the ESI file to resp. destination for TwinCAT2:

*C:\TwinCAT\Io\EtherCAT* for TwinCAT3:

- C:\TwinCAT\3.1\Config\Io\EtherCAT
- 3. Restart TwinCAT System Manager to start re-work of the device description cache.

<sup>10</sup> Rebuild the DAVE project with the new files

File Edit Navigati	e Search	Proj	ject Ru	in DAVE	Window	Help	
25	3 15 10	7	Build A	Active Proj	iect		勃

![](_page_22_Picture_0.jpeg)

#### Patching SSC 5.12

Summary of patches/fixes on known issues of SSC V5.12 are documented by the ETG here: Link: SSC V5.12 Patches

**ATTENTION!** Please check carefully for latest patches you might need.

For CTT conformance as of today, this example here needs to be patched at a minimum with the following patch:

![](_page_22_Picture_5.jpeg)

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![](_page_23_Figure_2.jpeg)

![](_page_23_Picture_4.jpeg)

# Copy data from/to local data to/from ESC memory

![](_page_24_Picture_1.jpeg)

Inside the generated file *XMC\_ESC.c* the link to your application must be implemented. Modify the source code accordingly which copies the application data to/from ESC memory to the local application memory:

![](_page_24_Picture_3.jpeg)

# Implement application specific slave node behaviour

![](_page_25_Picture_1.jpeg)

Inside the generated file *XMC\_ESC.c* file the function APPL\_Application is implemented. This function implements the application specific code to handle input and output... A) ... from mainloop or B) ... if synchronisation is active from ISR Inside main.c of the example, the function *void process\_app(TOBJ7000 \*OUT\_GENERIC, TOBJ6000 \*IN\_GENERIC);* implements the mapping of the input/output data to buttons and LEDs. Therefore please modify the function APPL\_Application to call process\_app in the following way:

### Originally generated code:

![](_page_25_Picture_4.jpeg)

#### Modified code:

![](_page_26_Picture_0.jpeg)

### Description – Process of input and output

![](_page_26_Picture_2.jpeg)

Within the slave stack code the function process\_app is called. This process\_app function process the binary output data (master->slave) to set the LED1 "XMC4300 Relax EtherCAT Kit". The states of the BUTTON1 is checked and propagated to the input data (slave->master).

![](_page_26_Picture_5.jpeg)

![](_page_27_Picture_0.jpeg)

#### Description – Overview on used APPs

![](_page_27_Figure_2.jpeg)

The ECAT\_SSC APP assigns the system resources (automatically done by DAVE by using the respective lower level apps) and pins (by manual configuration) to setup a proper EtherCAT communication. The EVENT\_DETECTOR, EVENT\_GENERATOR and INTERRUPT APPs are used inside this example to connect the sync\_out\_0 and sync\_out\_1 of the ECAT\_SSC APP to the interrupt service routines of the SSC-stack.

# Description – EtherCAT ports and physical connection [1/2]

![](_page_28_Picture_1.jpeg)

ECAT SSC	INT	FRRUPT	
ECAT E	Configure APP Inst	tance	
	Instancel	abal	
// .	tename instance i	abei f	
(4+)	Add New Instance		
	emove		
· · ·	terrior en		
	HW Signal Connec	tions	
<b>O</b> 1	Manual Pin Alloca	tor	
	Manual Resource A	Assignment	
	Come ADD Confirm	ration	
	Lopy APP Configu	iration	
0 1	Paste APP Configu	iration	
I	mport APP Config	guration	
Manual Pin Alloca	ator	1,0000	
Manual Pin Alloca	e APP Pin Name	Pin Number (Port)	
Manual Pin Alloca ilter ECAT_SSC_0 APP Instance Nam	e APP Pin Name	Pin Number (Port)	
Manual Pin Alloce ilter ECAT_SSC_0 APP Instance Nam a ECAT_SSC_0	e APP Pin Name	Pin Number (Port) #73 (P1.10)	
Manual Pin Alloce ilter ECAT_SSC_0 APP Instance Nam a ECAT_SSC_0	APP Pin Name led_err led_link_act_p0	Pin Number (Port) #73 (P1.10) #71 (P1.12)	
Manual Pin Alloca ilter ECAT_SSC_0 APP Instance Nam • ECAT_SSC_0	APP Pin Name  Ied_err Ied_link_act_p0 Ied_link_act_p1	Pin Number (Port) #73 ( P1.10 ) #71 ( P1.12 ) #95 ( P0.11 )	
Manual Pin Alloca lifter ECAT_SSC_0 APP Instance Nam a ECAT_SSC_0	APP Pin Name e APP Pin Name led_err led_link_act_p1 led_run	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11)	
Manual Pin Alloce	APP Pin Name APP Pin Name Ied_err Ied_link_act_p0 Ied_link_act_p1 Ied_run mdc	Pin Number (Port) #73 ( P1.10 ) #71 ( P1.12 ) #95 ( P0.11 ) #72 ( P1.11 ) #93 ( P3.3 ) #14 ( P0.12 )	
Manual Pin Alloce ilter ECAT_SSC_0 APP Instance Nam a ECAT_SSC_0	e APP Pin Name led_err led_link_act_p0 led_link_act_p1 led_run mdc mdio e0 lint	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #88 (P1.15)	
Manual Pin Alloce	e APP Pin Name led_err led_link_act_p0 led_link_act_p1 led_run mdc mdio p0_link p0 pc clk	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #68 (P1.15) #78 (P1.1)	
Manual Pin Alloca ilter ECAT_SSC_0 APP Instance Nam • ECAT_SSC_0	e APP Pin Name led_err led_link_act_p0 led_run mdc mdio p0_link p0_rx_clk p0 rx_dv	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #68 (P1.15) #78 (P1.1) #80 (P1.9)	
Manual Pin Alloca ilter ECAT_SSC_0 APP Instance Nam • ECAT_SSC_0	APP Pin Name  APP Pin Name  Ied_err Ied_link_act_p0 Ied_link_act_p1 Ied_run mdc mdio p0_link p0_rx_clk p0_rx_clk p0_rx_err	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #68 (P1.15) #78 (P1.1) #80 (P1.9) #54 (P2.6)	
Manual Pin Alloca iliter ECAT_SSC_0 APP Instance Nam a ECAT_SSC_0	e APP Pin Name led_err led_link_act_p0 led_link_act_p1 led_run mdc mdio p0_link p0_rx_c1k p0_rx_c1k p0_rx_dv p0_rx_d0	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #68 (P1.15) #78 (P1.1) #80 (P1.9) #54 (P2.6) #75 (P1.4)	
Manual Pin Alloca ilter ECAT_SSC_0 APP Instance Nam • ECAT_SSC_0	APP Pin Name APP Pin Name Ied_err Ied_link_act_p0 Ied_link_act_p1 Ied_run mdc mdio p0_link p0_rx_clk p0_rx_dv p0_rx_dv p0_rx_d0 p0_rxd0 p0_rxd1	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #73 (P1.1) #73 (P1.1) #68 (P1.15) #78 (P1.1) #80 (P1.9) #54 (P2.6) #75 (P1.4) #57 (P5.1)	
Manual Pin Alloca	e APP Pin Name led_err led_link_act_p0 led_link_act_p1 led_run mdic p0_link p0_rx_clk p0_rx_clk p0_rx_dv p0_rxd1 p0_rxd2	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #68 (P1.1) #80 (P1.9) #54 (P2.6) #75 (P1.4) #57 (P5.1) #56 (P5.2)	
Manual Pin Alloca	e APP Pin Name led_err led_link_act_p0 led_link_act_p1 led_link_act_p1 led_link_act_p1 led_rn mdc mdic p0_link p0_rx_clk p0_rx_clv p0_rx_dv p0_rxd1 p0_rxd2 p0_rxd2 p0_rxd2	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #68 (P1.15) #78 (P1.1) #80 (P1.9) #54 (P2.6) #75 (P1.4) #55 (P5.1) #56 (P5.2) #55 (P5.7) #50 (P5.1)	
Manual Pin Alloca	e APP Pin Name led_err led_link_act_p0 led_link_act_p1 led_run mdc mdio p0_link p0_rx_clk p0_rx_clk p0_rx_crr p0_rxd0 p0_rxd1 p0_rxd3 n0 tr_clk m0 tr_clk	Pin Number (Port) #73 (P1.10) #71 (P1.12) #95 (P0.11) #72 (P1.11) #93 (P3.3) #94 (P0.12) #68 (P1.15) #78 (P1.1) #80 (P1.9) #54 (P2.6) #75 (P1.4) #55 (P5.2) #55 (P5.7) #79 (P1.0)	

1 Right click on the ECAT\_SSC APP. From the context menu select "Manual Pin Allocator" to open the pin allocation for the EtherCAT module.

2 Inside Manual Pin Allocator you can configure the EtherCAT ports for your application. For the example provided, the configuration fits to the XMC4300 Relax EtherCAT Kit.

# Description – EtherCAT ports and physical connection [2/2]

![](_page_29_Picture_1.jpeg)

**Attention:** please check what PHY is integrated on the XMC4300 Relax EtherCAT Kit.

In case of the **TI83848**, please change the PHY address of Port 0 according to the PHY Selection Guide V2.7 from Beckhoff:PHY\_Selection\_Guide to **16**.

	EVENT_DETECTOR ED_SYNC0	EVENT_GENERATOR EG_SYNC0	EVENT_GENERATOR EG_SYNC1	PWM_CCU8 PWM_CCU8_0	EVENT_DETECTOR ED_SYNC1	INTERRUPT INT_SYNC1	ECAT_SSC ECAT_SSC_0			
ſ	TIMER TIMER 0			)					■ ECAT_SSC_0 🛛	
-						000			General Settings Pin Settings	
GLC	DBAL_CCU8_0	GLOBAL_CCU4	_0		-				Enable reset request	Ether
2		<u>a</u>	0	-0-	)			-	Enable output port	
24	CPU CTRI XMC4	F FFPROM XMC4		-				*	PHY Settings	
									Enable PHY management interface	
									PHY address of port 0: 16	
									Port 1 TX shift: Ons	
									Priority Settings	
									Preemption priority 63 Subpriority 0	

![](_page_30_Picture_0.jpeg)

### Description – Distributed clock support

![](_page_30_Figure_2.jpeg)

For distributed clock support, the sync0 and sync1 signals coming from the EtherCAT peripheral are used to trigger interrupts. Inside the interrupt service routines the respective API functions of the SSC protocol stack are called.

![](_page_30_Picture_5.jpeg)

# Description – Overview on propagating the sync0 and sync1 signals to ISR

![](_page_31_Picture_1.jpeg)

![](_page_31_Figure_2.jpeg)

EVENT\_DETECTOR and EVENT\_GENERATOR APPs are instances of the event request unit (ERU) peripheral. Inside this example the ERU is used to propagate the signals sync0 and sync1 to the interrupt service routines.

Please see next slides how to setup this configuration inside DAVE.

ATTENTION: With the same approach sync0 and sync1 signals can also be connected to other resources. For example: ADC, ports and timers.

![](_page_32_Picture_1.jpeg)

ECAI	SSC E	Configu e	APP Instance. stance Label	रा ो 				
2	+ ×	Add New I Remove	nstance		f			
		HW Signal	Connections		-			
	O	Manual Pi	n Allocator					
		Manual Re	source Assign	iment				
		Copy APP	Configuration	n				
	4	Dante ADD	Configuration	20				
	V	Paste APP	configuration		1			
		Import AP	P Configuration	' on				
HW Signal Conn	ections 0	Import AP	P Configuratio	on				
HW Signal Conn Iter ECAT_SSC_ Source	ections 0 APP Inst	Import AP	P Configuration	on	Target APP	Instance Name	Target Sign	al

1 Right click on the ECAT\_SSC APP. From the context menu select "HW Signal Connections" to open the HW Signal Connection dialog of the ECAT\_SSC APP.

2 Connect the sync\_out\_0 and sync\_out\_1 signal to the a/b input of the event detection units .

![](_page_33_Picture_1.jpeg)

![](_page_33_Figure_2.jpeg)

3 Double click on the EVENT\_DETECTOR APP for SYNC0 and EVENT\_DETECTOR APP for SYNC1.

![](_page_33_Figure_4.jpeg)

4 Select the respective source signal ("A" for SYNC0 and "B" for SYNC1) and edge detection "Rising Edge".

![](_page_34_Picture_1.jpeg)

![](_page_34_Figure_2.jpeg)

Filter	ED	SYNC0 -							
_	-								
		Source APP Instance Name	Source Signal		Connect To	Target APP Instance Nam	e	Target Signal	
4	Ð	ED_SYNC0							
			trigger_out	-	>	EG_SYNC0	Ŧ	trigger_in	

<b>1</b>	HW Sig	nal Connections								
Fi	lter EC	_SYNC1 •								
		Source APP Instance Name	Source Signal		Connect To	Target APP Instan	ce Name	Target Signal		
	•	ED_SYNC1								
			trigger_out	-	>	EG_SYNC1		trigger_in	•	
			Not Selected		>	Not Selected	+	Not Selected	Ŧ	

5 Right click on the EVENT\_DETECTOR APP for SYNC0 and SYNC1. From the context menu select "HW Signal Connections " to open the HW Signal Connection dialog of the ECAT\_SSC APP.

<sup>6</sup> Connect the trigger\_out signals of the event detection units to the trigger\_in signals of the event generation units.

![](_page_35_Picture_1.jpeg)

HW Signal	Add New In     Remove     HW Signal (     Manual Pin     Manual Res     Copy APP (     Paste APP (     Import APP     Export APP     (     APP Help	Instance Connections Allocator ource Assignment. Configuration Configuration Configuration				
HW Signal	HW Signal ( Manual Pin Manual Res Copy APP ( Paste APP ( Import APP Export APP ( APP Help	Connections Allocator ource Assignment. Configuration Configuration Configuration				
HW Signal	<ul> <li>Manual Res</li> <li>Copy APP ( Paste APP C)</li> <li>Import APP</li> <li>Export APP</li> <li>APP Help</li> </ul>	ource Assignment. Configuration Configuration Configuration		_		
HW Signal	⑦ APP Help					
	Connections					
Filter EG_SV	NC0	e Source Signal	Conne	Target APP Instanc	ce Name Tar	aet Signa
⊿ 🔂 EG	SYNC0	iout -	>	INT_SYNC0	+ sr_ii + Not	q Selected
?				Save	Reset	Clo
HW Signal	Connections					

7 Right click on EVENT\_GENERATOR for sync0 and sync1. From the context menu select "HW Signal Connections" to open the HW Signal Connection dialog of the EVENT\_GENERATOR APP.

<sup>8</sup> Connect the iout of the EVENT\_GENERATOR APP for sync0 to INTERRUPT APP of sync0. Proceed respectively for sync1.

![](_page_36_Picture_1.jpeg)

![](_page_36_Figure_2.jpeg)

9 Double click on the INTERRUPT APP for sync0 and INTERRUPT for sync1.

Interrupt Settings			
📝 Enable interrupt	it initialization		
Interrupt Priority			
Preemption priorit	v 30 Subpriorit	by 0	
Treemption priori	y 50 Subpriori	.y o	
Interrupt handler:	SYNC0IRQHandler		

Subpriority 0

SYNC1IRQHandler

Interrupt Priority Preemption priority 30

Interrupt handler:

<sup>10</sup> Set the interrupt service routine for sync0 and sync1 inside the configuration of the respective INTERRUPT APP.

![](_page_37_Picture_1.jpeg)

![](_page_37_Picture_2.jpeg)

Inside main() the interrupt handlers for sync0 and sync1 are implemented. The implementation is calling the respective functions of the SSC protocol stack.

Description – SSC specific enabling/disabling of interrupts [1/2]

![](_page_38_Picture_1.jpeg)

Please see ET9300 application note published by the ETG on details about the SSC code structure and interrupt handling (chapter 4).

In v1.8/2017-11-14 of this document inside chapter 5/hardware access it is specified:

", if interrupts are used also two macros shall be defined "ENABLE\_ESC\_INT" and "DISABLE\_ESC\_INT". These shall enable/disable **all four interrupt** sources".

These macros are implemented inside ECAT\_APP. Timer- and PDIinterrupt are handled by the ECAT\_APP. As Sync0 and Sync1 are routed through ERU (see before) these interrupts need to be handled in addition by the user.

For this purpose ECAT\_APP is implementing a callback function for user specific implementation:

ENABLE\_ESC\_INT\_USER and DISABLE\_ESC\_INT\_USER.

# Description – SSC specific enabling/disabling of interrupts [2/2]

![](_page_39_Picture_1.jpeg)

Within this example you find the implementation of ENABLE\_ESC\_INT\_USER and DISABLE\_ESC\_INT\_USER inside main.c:

![](_page_39_Figure_3.jpeg)

![](_page_40_Picture_0.jpeg)

### Description – initialization inside main.c

DAVE CE - XMC4300_Relax_EtherCat_APP_Slave_SSC	/main.c - DAVE <sup>™</sup> - C:\Workspaces\DAVE-4.1\ETHERCA	T_DC
File Edit Source Refactor Navigate Search P	roject DAVE Window Help	
🗑 🕼 🔁 🔀 🤌 🕩 🗉 🖷 🕺 2. († 1. č.	R 🕂 🖄 👫 🕇 🔤 🗖 🖬 🛛 🖻 🖉 🜑	🎄 • 🙆 🛷 • 📝 🖞 • 🖗 • 🗠
C/C++ Proj X Project Expl C XMC4300_Relax_EtherCat_APP_Slave_SSC [. XMC4300_Relax_EtherCat_APP_Slave_SSC [. XMC4300_Relax_EtherCat_APP_Slave_SSC [. Debug Debu	<pre>   main.c    main.c    99@ int main(void)   100 {     101 DAVE_STATUS_t status;     102 uint32_t timer=0;     103 status = DAVE_Init();     104     105 Init_ECAT_Adapt_LED ();     106 Init_Relax_Button();     107     108 if(status == DAVE_STATUS_FAILURE)     109 {     110 /* Placeholder for error handle     111 XMC_DEBUG("DAVE APPs initializa     while(1U)     113 {     114 }     115 }     116     117 /* Placeholder for user applicati     118 while(1U)     119 {         20 MainLoop();         121 }         122 }         122 </pre>	<pre>/* Initialization of DAVE     /* Initialize the ports wh     /* Initialize buttons on X er code. The while loop below can be ation failed\n"); ion code. The while loop below can b</pre>

Inside main() DAVE and its APPs (PWM\_CCU8, ECAT\_SSC) are initialized. InitECAT\_Adapt\_LED() and Init\_Relax-Button() are used to initialize the buttons and LED1 to 8 of the "XMC4300 Relax EtherCAT Kit". Finally the MainLoop is called cyclically to process the state machine of the slave stack code.

![](_page_40_Picture_5.jpeg)

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#### Agenda

![](_page_41_Figure_2.jpeg)

![](_page_41_Picture_4.jpeg)

![](_page_42_Picture_0.jpeg)

#### How to test – start the slave to run

![](_page_42_Picture_2.jpeg)

### ACTIONS

1. Build and download the example application software to the XMC4300 and start the debugger

![](_page_42_Picture_5.jpeg)

#### 2. Start the software by the run button

![](_page_42_Picture_7.jpeg)

OBSERVATIONS The ERR-LED on the "XMC4300 Relax EtherCAT Kit" will turn on and immediately turn off again

# How to test – start the TwinCAT 2 master to run (1/4)

![](_page_43_Picture_1.jpeg)

F	File Edit	Actions	View	Options	; He	lр		
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		C - Config	uration					
		- Configu	ration					
		I/O Dev Mappin	🔹 <u>A</u> ppen	d Device	e			
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Inser Typ	rt Device	Beckhoff Light	Paste	with Link	cs Alt+	Ctrl+ Ctrl+	v v	Ok
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- Inser Typ	rt Device e:	D Beckhoff Light 11/0 11/0 Lightb 11/0 11/0 Lightb 11/0 11/0 Lightb 11/0 11/0 Lightb	Dus Paste Paste Paste Paste Paste Paste Paste Paste Paste Paste Paste Paste	with Link	cs Alt+	Ctrl+ Ctrl+	v v	Ok
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Inser Typ	rt Device e:	Beckhoff Light Hvo II/O Lightb Hvo II/O Lightb Hvo II/O Lightb Hvo II/O Lightb Hvo II/O Lightb Hvo II/O Lightb Hvo II/O Lightb Profinet	Dus Paste Paste SFC200x; PCI Is C1220, ISA Is Master EL672 Is C1200 (2 Tele Is Master CX1500 Is Slave CX1500	With Link 0, EtherCAT grams) 0-M200, PC104 I-B200, PC104	cs Alt+	Ctrl+ Ctrl+	v v	Ok Cance
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Typ	rt Device e:	Beckhoff Lighti     I//0 II//0 Lighti     Profibus DP     Profibus DP     Profibus DP     Profibus DP     CANopen     DeviceNet / EI     SERCOS interf     Elympide	Dus Paste Paste Paste S FC200x, PCI Is FC200x, PCI Is C1220, ISA Is Master EL672 Is C1200 (2 Tele Is C1200 (2 T	with Link 0, EtherCAT grams) 0-M200, PC10 -B200, PC104	cs Alt+	Ctrl+ Ctrl+	V	Ok Cance Target Ty © PC or C CX or
Typ	rt Device e: III e: IIII e: IIIII e: IIII e: IIII e: IIIII e: IIII e: IIIII e: IIIII e: IIIII e: IIIIIII e: IIII e: IIIIII E: IIIIII E: IIIIIIIIII E:	Beckhoff Lighth     I//0 Lightb     Profibus DP     Profibus DP     Profibus DP     Profibus DP     CANopen     DeviceNet / EI     SERCOS interf     EI     SERCOS interf     EI     SERCOS interf     EI     SERCOS interf     EI     SERCOS interf	Dus IS FC200x, PCI IS FC200x, PCI IS CT220, ISA IS Master EL672 IS CT220 (2 Tele IS Master CX150 IS Master CX1500 hernet I/P ace	with Link 0, EtherCAT grams) 0-M200, PC104 -B200, PC104	rs Alt+	Ctrl+ Ctrl+	v	Ok Cance Target Ty © PC or © CX or © BX or

![](_page_43_Picture_3.jpeg)

After starting the TwinCAT System Manager from windows start menu:

1 Right Click I/O-Devices and select "Append Device…"

2 Create an EtherCAT master device by double click

# How to test – start the TwinCAT 2 master to run (2/4)

<ul> <li>OS (NDIS) C PCI C DPRAM</li> <li>Description:</li> <li>Local Area Connection (Intel(R) 82579LM Gigabit Netw</li> <li>Device Name:</li> <li>\DEVICE\(03DAE701-02D1-42A0-BCEC-1C1D821BA</li> <li>PCI Bus/Slot:</li> <li>Searc</li> <li>MAC Address:</li> <li>d8 9d 67 d3 11 66</li> <li>Compatible</li> <li>IP Address:</li> <li>0.0.0 (0.0.0)</li> <li>Promiscuous Mode (use with Netmon/Wireshark or</li> <li>Virtual Device Names</li> <li>Adapter Reference</li> <li>Adapter:</li> <li>Freerun Cycle (ms):</li> <li>4</li> <li>SYSTEM - Configuration</li> <li>PLC - Configuration</li> <li>PLC - Configuration</li> <li>PLC - Configuration</li> <li>PLC - Configuration</li> <li>V/O - Configuration</li> <li>V Device1 (Ether A pend Box</li> <li>Celete Device</li> <li>Online Reset</li> <li>Online Reset</li> <li>Online Reload (Config Mode only)</li> <li>Online Delete (Config Mode only)</li> <li>Contine Configuration</li> </ul>	Network Adap	oter	
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![](_page_44_Picture_2.jpeg)

3 Select the network adapter you want to use (search and select); Application hint: In case the device is not found please install the respective device driver by following the instructions given by TwinCAT through the "Compatible Devices…" button

4 Right Click EtherCAT master and select "Scan Boxes..."

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# How to test – start the TwinCAT 2 master to run (3/4)

![](_page_45_Picture_1.jpeg)

![](_page_45_Figure_2.jpeg)

### • OBSERVATIONS

1 The slave appears as a node on the EtherCAT master bus

2 The RUN-LED is flashing indicating PREOP-state

ALC: N

# How to test – start the TwinCAT 2 master to run (4/4)

![](_page_46_Picture_1.jpeg)

![](_page_46_Picture_2.jpeg)

# How to test – Setting slave to operational mode

![](_page_47_Picture_1.jpeg)

![](_page_47_Picture_2.jpeg)

Set master device to free run mode

1 EtherCAT slave view: Online status of slave shows the slave in OP state.

2 EtherCAT master view: Online status of master shows the slave in OP state. Cyclic counter is incrementing.

3 "XMC4300 Relax EtherCAT Kit": RUN-LED is static turned on indicating OP-state.

# How to test – Monitoring slave inputs on master

![](_page_48_Picture_1.jpeg)

![](_page_48_Picture_2.jpeg)

While pushing BUTTON1 on <code>"XMC4300</code> Relax EtherCAT Kit" the button state is updated on the host

![](_page_48_Picture_4.jpeg)

![](_page_48_Picture_5.jpeg)

📴 Untitled - TwinCAT System Manager		State of IN CEN Bit1 change
Datei Bearbeiten Aktionen Ansicht Optionen Hilfe		State of IN_GEN_DILL changes
D 📽 📽 🖬 🍜 🖪   X 🖻 🖻 🙈 🗛 🤌 🔜 📾 🗸 :	# 👧 👧 💱 🔨 🔞 😫 🔍 🖓 🚱 🍢 🔊 🤋	according to the state of
Konfiguration     SPS - Konfiguration	Variable Flags Online	
FA - Konfiguration     Fa - Konfiguratio	Wert: 1 Neuer Wert: Force Aufheben Schreiben	BUITON1

# How to test – Setting slave outputs on master (1/2)

![](_page_49_Picture_1.jpeg)

ACTIONS

Right click on OUT\_GEN\_Bit1 of the slave node and select "Online Write..." inside the context menu; Change the value from 0 to 1 to switch on LED1 from 1 to 0 to switch off LED1

![](_page_49_Picture_4.jpeg)

OBSERVATION LED1 "XMC4300 Relax EtherCAT Kit" is turned on/off according to OUT\_GEN\_Bit1 setting

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#### Agenda

![](_page_50_Figure_2.jpeg)

![](_page_51_Picture_0.jpeg)

#### How to test – start the slave to run

![](_page_51_Picture_2.jpeg)

### ACTIONS

1. Build and download the example application software to the XMC4300 and start the debugger

![](_page_51_Picture_5.jpeg)

#### 2. Start the software by the run button

![](_page_51_Picture_7.jpeg)

![](_page_51_Picture_8.jpeg)

# How to test – start the TwinCAT 3 master to run (1/4)

![](_page_52_Picture_1.jpeg)

1	CO File Edit View Project Build Debug TwinCAT P 	PLC Tc
2	XMCProject      Add New Item      Ctrl+Shift      Add Existing item      Shift+Attem      Scan	+A
	Type:	OK Cancel Target Type © PC only © CX only BX only All
	Name: Device 1	

![](_page_52_Picture_3.jpeg)

After starting the TwinCAT System Manager from windows start menu:

1 Right Click I/O-Devices and select "Add New Item…"

2 Create an EtherCAT master device by double click

# How to test – start the TwinCAT 3 master to run (2/4)

General Adapter Ethe	erCAT Online CoE - Online		
Network Adapte	r		
	OS (NDIS)     OPCI		ODPRAM
Description:	LAN-Verbindung (TwinCAT-Inte	I PCI Ether	rnet Adapter (Gigabit))
Device Name:	\DEVICE\{44658C39-F4B6-49D	B-98AE-61	6E0DC68EE9}
PCI Bus/Slot			Search
MAC Address:	38 63 bb b6 04 60		Compatible Device
IP Address:	169.254.115.19 (255.255.0.0)		L
	Promiscuous Mode (use with	Wireshar	k only)
	Virtual Device Names		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Adapter Referen			
Adapter Referent Adapter:			
Adapter Referen Adapter:	Add New Item		
Adapter Referen Adapter:	Add New Item Add Existing Item		
Adapter Referen Adapter:	Add New Item Add Existing Item Remove		
Adapter Referen Adapter:	Add New Item Add Existing Item Remove Change NetId		
Adapter Referen Adapter:	Add New Item Add Existing Item Remove Change NetId Save Device 1 (EtherCAT) A:		
Adapter Referen Adapter:	Add New Item Add Existing Item Remove Change NetId Save Device 1 (EtherCAT) A: Append EtherCAT Cmd		
Adapter Referen Adapter: Adapter:	Add New Item Add Existing Item Add Existing Item Remove Change NetId Save Device 1 (EtherCAT) A: Append EtherCAT Cmd Append Dynamic Container		
Adapter Referen Adapter:	Add New Item Add Existing Item Add Existing Item Remove Change NetId Save Device 1 (EtherCAT) A: Append EtherCAT Cmd Append Dynamic Container Online Reset		
<ul> <li>Adapter Referent Adapter:</li> <li>▲ Weither Devices</li> <li>▲ Weither</li></ul>	Add New Item Add New Item Add Existing Item Remove Change NetId Save Device 1 (EtherCAT) A: Append EtherCAT Cmd Append Dynamic Container Online Reset Online Reload		
Adapter Referen Adapter:	Add New Item Add Existing Item Change NetId Save Device 1 (EtherCAT) A: Append EtherCAT Cmd Append Dynamic Container Online Reset Online Reload Chaine Delate		

![](_page_53_Picture_2.jpeg)

3 Select the network adapter you want to use (search and select); Application hint: In case the device is not found please install the respective device driver by following the instructions given by TwinCAT through the "Compatible Devices..." button

4 Right Click EtherCAT master and select "Scan Boxes..."

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# How to test – start the TwinCAT 3 master to run (3/4)

![](_page_54_Picture_1.jpeg)

![](_page_54_Picture_2.jpeg)

![](_page_54_Picture_3.jpeg)

1 The slave appears as a node on the EtherCAT master bus

2 The RUN-LED is flashing indicating PREOP-state

# How to test – start the TwinCAT 3 master to run (4/4)

![](_page_55_Picture_1.jpeg)

ile Edit View Project Build Debug Twin	CAT PLC Tools Sco	ope Window Help	Annen Toject_T	The observe that
腔 💶 🥩 🌂 🌀 🚳 🐾		데 내 -		
- <u>-</u>				Frame Selection
olution Explorer • $+$ × XMCPro	oject_1 × Start Page			
Gener	al Adapter EtherCAT 0	Inline CoE - Online		
▲     MMCProject_1     No       ▷     ▲ SYSTEM     ■       ■     MOTION     ■       ■     PLC     ■       □     SAFETY     ■       ■     C++     ■       ■     Image-Info       ■     ■       ■	Ad. Name 1 1001 Box1 (VMC_E 1 1001 Box1 (VMC	P Counter Send Frame Frames / set	CRC 0 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	
nappings		Lost Frames Tx/Rx Errors	0 + 0 0 / 17	
Solution 'XMCProject_1' (1 project)     XMCProject_1	State Machin	e	0 + 0 0 / 17	
Solution 'XMCProject_1' (1 project)  XMCProject_1  XMCProject_1  SYSTEM	State Machin	e Bootstrap	0 + 0 0 / 17	
Solution 'XMCProject_1' (1 project)  XMCProject_1  XMCProject_1  MOTION  Of C	State Machin Init Pre-Op	e Bootstrap Safe-Op	0 + 0 0 / 17	PREOP
Solution :XMCProject_1: (1 project)  XMCProject_1  XMCProject_1  XMCProject_1  MOTION  PLC  SAFETY	State Machin Init Pre-Op Op	e Bootstrap Safe-Op Clear Error	0 + 0 0 / 17	PREOP
<ul> <li>Mappings</li> <li>Solution 'XMCProject_1' (1 project)</li> <li>XMCProject_1</li> <li>XMCProject_1</li> <li>SYSTEM</li> <li>MOTION</li> <li>PLC</li> <li>SAFETY</li> <li>C++</li> </ul>	State Machin Init Pre-Op Op	e Bootstrap Safe-Op Clear Error	0 + 0 0 / 17	PREOP
<ul> <li>Mappings</li> <li>Solution 'XMLProject_1' (1 project)</li> <li>XMCProject_1</li> <li>XMCProject_1</li> <li>SYSTEM</li> <li>MOTION</li> <li>PLC</li> <li>SAFETY</li> <li>C++</li> <li>I/O</li> <li>Participe</li> </ul>	State Machin Init Pre-Op Op DLL Status	e Bootstrap Safe-Op Clear Error	0 + 0 0 / 17	PREOP
<ul> <li>Mappings</li> <li>Solution 'XMCProject_1' (1 project)</li> <li>XMCProject_1</li> <li>XMCProject_1</li> <li>SYSTEM</li> <li>MOTION</li> <li>PLC</li> <li>SAFETY</li> <li>C++</li> <li>I/O</li> <li>The Devices</li> <li>The Device 1 (EtherCAT)</li> </ul>	State Machin Init Pre-Op Op DLL Status Port A:	e Bootstrap Safe-Op Clear Error	0 + 0 0 / 17 Current State: Requested State:	PREOP
<ul> <li>Mappings</li> <li>Solution 'XMCProject_1' (1 project)</li> <li>XMCProject_1</li> <li>XMCProject_1</li> <li>SYSTEM</li> <li>MOTION</li> <li>PLC</li> <li>SAFETY</li> <li>C++</li> <li>I/O</li> <li>"E Devices</li> <li>E Device 1 (EtherCAT)</li> <li>Image</li> </ul>	State Machin Init Pre-Op Op DLL Status Port A: Port B:	e Bootstrap Safe-Op Clear Error Carrier / Open No Carrier / Closed	0 + 0 0 / 17	PREOP
<ul> <li>Mappings</li> <li>Solution 'XMCProject_1' (1 project)</li> <li>XMCProject_1</li> <li>XMCProject_1</li> <li>SYSTEM</li> <li>MOTION</li> <li>PLC</li> <li>SAFETY</li> <li>C++</li> <li>I/O</li> <li>* Devices</li> <li>* Devices 1 (EtherCAT)</li> <li>* Image</li> <li>* Image</li> <li>* Image</li> </ul>	State Machin Init Pre-Op Op DLL Status Port A: Port B: Port C:	e Bootstrap Safe-Op Clear Error Carrier / Open No Carrier / Closed	0 + 0 0 / 17	PREOP
<ul> <li>Mappings</li> <li>Solution 'XMCProject_1' (1 project)</li> <li>XMCProject_1</li> <li>SYSTEM</li> <li>MOTION</li> <li>PLC</li> <li>SAFETY</li> <li>C++</li> <li>I/O</li> <li>* Devices</li> <li>* Devices</li> <li>* Devices 1 (EtherCAT)</li> <li>* Image</li> <li>* Image</li> <li>* Image</li> <li>* Image</li> <li>* Image</li> </ul>	State Machin Init Pre-Op Op DLL Status Port A: Port B: Port C: Port D:	e Bootstrap Safe-Op Clear Error Carrier / Open No Carrier / Closed No Carrier / Closed	0 + 0 0 / 17	PREOP
<ul> <li>Mappings</li> <li>Solution 'XMCProject_1' (1 project)</li> <li>XMCProject_1</li> <li>SYSTEM</li> <li>MOTION</li> <li>PLC</li> <li>SAFETY</li> <li>C++</li> <li>I/O</li> <li>* Devices</li> <li>* Devices</li> <li>* Device 1 (EtherCAT)</li> <li>* Image</li> <li>*</li></ul>	State Machin Init Pre-Op Op DLL Status Port A: Port B: Port C: Port D:	e Bootstrap Safe-Op Clear Error Carrier / Open No Carrier / Closed No Carrier / Closed	0 + 0 0 / 17	PREOP

2

![](_page_55_Picture_3.jpeg)

3 EtherCAT master view: Inside the EtherCAT master online state you see the queued frames counting up, the connected slave and its PREOP state

4 EtherCAT slave view: The PREOP-state of the slave is indicated within the TwinCAT system manager

# How to test – Setting slave to operational mode

![](_page_56_Picture_1.jpeg)

![](_page_56_Picture_2.jpeg)

Set master device to free run mode

### OBSERVATIONS

0				XMCProje	ct_1 - Microsoft Visua
File Edit View Project Build Debu	ug TwinCAT PLC Too	ls Scope Wind	dow Help		
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- <u>-</u> ∃ ► •	🖸   🖅 🗊 🖕 🖯		00.00		🖏 Frame Selection 🛛
Solution Explorer 🔹 👎 🗙	XMCProject_1 × Start	Page			
<u> </u>	General EtherCAT DC	Process Data	Startup CoE - Online O	nline	^
Solution 'XMCProject_1' (1 project) MCProject 1	State Machine				
SYSTEM	Init	Bootstrap			_
MOTION	Pre-Op	Safe-Op	Current State:	OP	_
SAFETY	Op	Clear Error	Requested State:	OP	-
ETT C					

Solution 'XMCProject_1' (1 project)	General	Adapter	EtherCAT Online CoE	E - Online		
XMCProject_1	No	Ad	Name	State	CRC	
MOTION MOTION PLC SAFETY C++ ZI/O C++ ZI/O MOTION MOTION MOTION MOTION MOTION MOTION MOTION MOTION MOTION MOTION	s== 1	1001	Box 1 (XMC_ESC)	OP	0	
<ul> <li>SyncUnits</li> <li>Inputs</li> </ul>						
Outputs	Actual S	tate:	OP	Counter	Gyclic	Queue

1 EtherCAT slave view: Online status of slave shows the slave in OP state

2 EtherCAT master view: Online status of master shows the slave in OP state; Frames are no more queued; Cyclic counter is incrementing

3 "XMC4300 Relax EtherCAT Kit": RUN-LED is static turned on indicating OP-state

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# How to test – Monitoring slave inputs on master

![](_page_57_Picture_1.jpeg)

![](_page_57_Picture_2.jpeg)

While pushing BUTTON1 on <code>"XMC4300</code> Relax EtherCAT Kit" the button state is updated on the host

![](_page_57_Picture_4.jpeg)

![](_page_57_Picture_5.jpeg)

<b>G</b>	Variable Flags	Online				
Solution 'XMCProject_1' (1 project)  XMCProject_1  XMCProject_1  MOTION	Value: New Value:	1 Force	Relea	se		Write
III PLC SAFETY III C++ III III C++ IIII IIII C++	Comment					~
<ul> <li>Devices</li> <li>Device 1 (EtherCAT)</li> </ul>						~
Image						
SyncUnits					200	
Inputs						
Outputs						▋₩₽ͺ┨┨╴┣╸╶╴╸
A See Box 1 (XMC ESC)						
<ul> <li>IN_GENERIC proces</li> </ul>	5					
IN_GEN_INT1						
✓ IN_GEN_INT2						
✓ IN_GEN_INT3						
IN GEN Bit1						

# State of IN\_GEN\_Bit1 changes according to the state of BUTTON1

# How to test – Setting slave outputs on master (1/2)

![](_page_58_Picture_1.jpeg)

AC

ACTIONS

Right click on OUT\_GEN\_Bit1 of the slave node and select "Online Write..." inside the context menu. Change the value from 0 to 1 to switch on LED1 from 1 to 0 to switch off LED1

![](_page_58_Picture_5.jpeg)

OBSERVATION LED1 "XMC4300 Relax EtherCAT Kit" is turned on/off according to OUT\_GEN\_Bit1 setting

![](_page_59_Picture_0.jpeg)

### Part of your life. Part of tomorrow.

![](_page_59_Picture_2.jpeg)