Application Note





Title	How to connect CMMT to a BECKHOFF IPC in TwinCAT V3 NC
Version	
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Original	en
Last saved	

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1 Components/Software used

Type/Name	Version Software/Firmware	Date of manufacture
CMMT-AS-C4-3A-EC-S1		
CMMT Plug In	1.0.1.10	
Festo Automation Suite	1.0.3.6	
TwinCAT V3	Version 12.0.21005.1 REL	
TwinCAT V3 - IPC	Build 4022.22	

Table 1.1:1Components/Software used

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Information

This AppNote describes the procedure with the CMMT-AS motor controller. The CMMT-AS servo drive controller and CMMT-ST servo drive controller for extra-low voltage are based on the same software platform. Therefore, the described settings can also be used as a reference for its parameterization. It is hereby expressly pointed out, that this has not been explicitly tested and therefore the function cannot be guaranteed!

2 Starting with TwinCAT V3

Start and name a new TwinCAT Project

New Project					?	×
▷ Recent		.NET Framework 4.5	Sort by: Default	- II' 🗉	Search Installed Templates (Ctrl+E	- م (
 Installed Templates Other Project T TwinCAT Meas TwinCAT PLC TwinCAT Project Samples Online 	urement	TwinCAT XAE	Project (XML format)	TwinCAT Projects	Type: TwinCAT Projects TwinCAT XAE System Manager Configuration	
			lick here to go online and find	tempiates.		
Name:	CMMT_NC_TEST		20420 0 1 .			
Location: Solution name:	C:\Users\gbqz\D CMMT_NC_TEST	ocuments\Visual Studio	2013\Projects	-	Browse	
solution name:	CWIWIT_NC_TEST					Cancel

Make a connection to the IPC (Industrial PC) by double clicking on SYSTEM -> Choose Target... -> Search (Ethernet).

→

Note

Make sure that the laptop and the IPC are within the same network through the IP settings.



Choose Target System	×
. In the second	OK Cancel
	Search (Ethernet)
	Search (Fieldbus)
	☐ Set as Default
Connection Timeout (s): 5	

Execute a Broadcast Search and select the Laptop Ethernet Adapter where the IPC is connected to narrow down the search.

Add Route Dialog		×					
Enter Host Name / IP:	Refresh Status	Broadcast Search					
Host Name Connected Address AMS NetId TwinCAT DS Version Comment							
Select Adapter(s) X ITwinCAT-Intel PCI Ethernet Adapter (Gioabit) 10,101.65,124, 255.255.254.0 ASIX AX88179 USB 3.0 to Gigabit Ethernet Adapter 192.168.0.77 255.255.00 VirtualBox Host-Only Ethernet Adapter 192.168.56.1 255.255.255.0							
AmsNel Transport Type: TCP_IP V	ОК	Cancel					
Address Info:	 Static Temporary 	 Static Temporary 					
Connection Timeout (s): 5	Add Route	Close					



Note

If the IPC doesn't appear with the broadcast search, and the network settings have been forgotten, a monitor can be connected to it with the DVI connector, as well as a mouse and keyboard through USB. Running in the IPC is a Windows operating system will be visible in the monitor and the network settings of the IPC can be changed accordingly.



Click on the IPC, change the Address Info to IP Address -> Add Route.

Add Route Dialog × Enter Host Name / IP: Refresh Status Broadcast Search Host Name AMS NetId TwinCAT OS Version Connected Address Comment CX-2A57CE 192.168.0.17 5.42.87.206.1.1 3.1.4020 Windows 7 < CX-2A57CE CDE64375 Route Name (Remote): Route Name (Targe 5.42.87.206.1.1 AmsNetId: Target Route Remote Route O Project 🔘 None Transport Type: TCP_IP Static Static Address Info: 192.168.0.17 Temporary Temporary Host Name
 IP Address Connection Timeout (s): 5 Max Fragment Size (kByte): 0 + Add Route Close Logon Information at is valid for the * Enter a user name and password t remote system. Administrator User name: Password: • Encrypt Password (TwinCAT 3 only) ОК Cancel

The default Password for any IPC is by default 1.

To confirm a successful connection, an "X" will appear under the Connected column

Add Route Dialog						×
Enter Host Name / IP:			F	lefresh Status	Bro	adcast Search
Host Name	Connected	Address	AMS NetId	TwinCAT	OS Version	Comment
CX-2A57CE	Х	192.168.0.17	5.42.87.206.1.1	3.1.4020	Windows 7	
<	CX-2A570		Route	Name (Remot	re): CDE64	375
AmsNetId:	5.42.87.2	00.1.1	-	_		010
Amaneuu.		06.1.1	– Large	et Route	Remo	ite Route
			-	et Route roject	Remo N	ite Route
Transport Type:	TCP_IP	~	() P (● S	roject tatic	() N (● SI	nte Route one tatic
Transport Type: Address Info:		~	() P (● S	roject	() N (● SI	nte Route one
Transport Type: Address Info:	TCP_IP	~	() P (● S	roject tatic	() N (● SI	nte Route one tatic

Close the Add Route Dialog window, select the IPC and click OK

Choose Target System	×
□	OK Cancel
	Search (Ethernet) Search (Fieldbus)
	Set as Default
Connection Timeout (s): 5	

Install the CMMT ESI File

3 Install the CMMT ESI File

Download the EtherCAT ESI file from the support portal for CMMT.

"Install" it in TwinCAT V3 by copying the file into the following folder

C:\TwinCAT\3.1\Config\lo\EtherCAT



Note

This procedure is recommended before TwinCAT has been started, If TwinCAT is already running, the Device Repository can be refreshed/updated by clicking on TwinCAT -> EtherCAT Devices -> Reload Device Descriptions.

	TWI	NCAT TWINSAFE PLC TOOLS SCOPE	WIN	DOW HELP
	>	Activate Configuration		- TwinCAT RT (x64) - 🔎
1.1	*	Restart TwinCAT System		
1	恭	Restart TwinCAT (Config Mode)		
	2	Reload Devices		
	1	Scan		
1	۲	Toggle Free Run State		
	٩	Show Online Data		Choose Target
	₩ 8-00	Show Sub Items		
	æ	Security Management		
	RE6	Access Bus Coupler/IP Link Register		
		Update Firmware/EEPROM	•	ocal v3.1 (Build 4022.22)
		Show Realtime Ethernet Compatible Devices		Version
		File Handling	•	
		Selected Item	•	
		EtherCAT Devices	•	Update Device Descriptions (via ETG Website)
		Target Browser	•	Reload Device Descriptions
		Filter Designer	•	Manage User Defined Whitelist
		About TwinCAT		Manage User Defined Blacklist

4 Scanning the EtherCAT Network

Once chapters 1 & 2 have been done, go to I/O, right click on Devices and execute a SCAN.



From the available interfaces, select the EtherCAT one and click on OK

5 new I/O devices found	×
Device 1 (Profinet Controller CCAT (RT)) Device 2 (EtherCAT) Device 3 [EtherCAT Automation Protocol) [Local Area Connection 2 (TwinCAT-Intel I Device 4 [EtherCAT Automation Protocol) [Local Area Connection (TwinCAT-Intel PC Device 6 (COM Port) [Bus 0 Slot 126 UART 0 (0xD0B1A000)]	OK Cancel Select All Unselect All

Select Yes on Scan for Boxes.



If CMMT is successfully detected, select to Append linked axis to: NC - Configuration -> OK





Note

Free Run can be activated to test communication between BECKHOFF IPC and CMMT.

After a successful SCAN of the network, CMMT should appear under the I/O'S EtherCAT Master and Axis 1 under the MOTION -> NC Task.



Click on the scanned CMMT Driver and enable DC for synchronization.

Solution Explorer 🔹 무 🗙	CMMT_NC_TEST ⇒ ×
© ⊃ ☆ [™] o - ฮ ₽ <mark>-</mark>	General EtherCAT DC Process Data Startup CoE - Online Diag History Online
Search Solution Explorer (Ctrl+ü)	Operation Mode
Solution 'CMMT_NC_TEST' (1 project)	
CMMT_NC_TEST SYSTEM	Advanced Settings
kở 🥝 SYSTEM ▶ 🖂 MOTION	
PLC	
SAFETY	
96 C++	
I/O I/O I/O I/O	
 Le Devices Device 2 (EtherCAT) 	
2₽ Image	
🛟 Image-Info	
SyncUnits	
Inputs	
 Outputs InfoData 	
Term 1 (EK1200)	
Drive 3 (CMMT-AS)	

5 PLC Project setup

5.1 Adding the PLC Project

Right click on PLC and select Add New Item...



Choose the Standard PLC Project and select Add

Add New Item - CMMT_NC_TEST			? ×
▲ Installed	Sort by: Default	• # E	Search Installed Templates (Ctrl+E)
Plc Templates	Standard PLC Project	Plc Templates	Type: Plc Templates Creates a new TwinCAT PLC project
	Empty LC Project	Pic Templates	containing a task and a program.
Name: CMMT_MC			
Location: C:\Users\gbqz\	Documents\Visual Studio 2013\Projec	CLEMMENC T -	Browse
			Add Cancel

5.2 Adding PLC I/O Variables

Add a Global Variable List (GVL) and declare 1 USINT Output with initial value 8 and 1 USINT Input.



1	{attribute 'qualified only'}		
2	VAR_GLOBAL		
3	I_usiModesOfOperationDisplay	AT %I*	:USINT;
4	Q_usiModesOfOperation	AT %Q*	:USINT := 8;
5	END_VAR		

→

Modes of Operation 8 means that the Axis will be in "Cyclic Synchronous Position" Mode. In this mode, the CMMT doesn't control the movement to the Target Position by himself. The IPC's NC element is responsible for defining and controlling the trajectory. This is done by sending the in-between positions of the Target Position to the CMMT.

Build the PLC Project.

Note



If the compilation has been done without any error, the variables should be visible at the very bottom of the PLC Project within the PLC Task Inputs/Outputs.



Link the created variables to the **Modes of Operation Display** Input and **Modes of Operation** Output of the CMMT.



<

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over

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□ / □ lar □ / □ Tar

Cancel

>

Attach Variable Modes of operation (Output)	×
Search: MOTION PLC CMMT_MC CMMT_MC Instance GVL.0_usiModesOfOperation > QB 512029.0, USINT [1.0]	Show Variables Unused Used and unused Exclude disabled Exclude same Image Show Tooltips Sort by Address Show Variable Groups Show Variable Types Matching Type Matching Size All Types Array Mode Offsets Continuous Show Dialog Variable Name / Comment / Hand over / Tare over
< >>	Cancel OK



Note

If the variables are not visible in the Variable List, it could be that the PLC project compilation has not been done or there is an error on the PLC program.

5.3 Adding the PLC Open Library

Go to PLC -> References (Double Click) -> Add Library -> Tc2_MC2

Here are the	PLC Open FBs
--------------	--------------





Create in the GVL a variable of Type AXIS_REF, which will be linked to the NC Axis element.



Build/Compile the PLC project without errors



6 MOTION NC Axis configuration

Open the Axis 1 encoder settings by opening the following path:

MOTION -> NC Task -1 1 SVB -> Axes -> Axes 1 -> Enc

Modify the **Scaling Factor Numerator** according to the Fieldbus Settings in the CMMT.

=	AUTOMATION SU New Project*	ITE	# 9,	0	Axis1	×		
	PARAMETERISATI	ON	DIAGNOSIS	CONTRO	L D			
Ф	Axis1 CMMT-AS-C4-3A Path: 192.168.1.20 Disconnected		Connect				a () C	
Param	eter pages	<	Fieldbus					
Driv	e configuration							
Devi	ce settings				F			
Field	bus				Factor group			
Digit	al I/O				Current user unit		Rev [rev, rpm,] (3)	
Ana	ogue I/O			1	Position	0	-6	
Enco	der interface							
▼ Axis	1				Speed	0	-3	-
	Motor				Acceleration	0	-3	-
	Gears				Jerk	0	-3	-
	Axis							

Solution Explorer 🔹 👎 🗙	CMMT_NC_TEST 🗢 🗙	
© ⊙ ☆ °o - ₫ ₽ <mark></mark>	General NC-Encoder Parameter Time Compensation Online	
Search Solution Explorer (Ctrl+ü)		
Solution 'CMMT_NC_TEST' (1 project)	Par meter Offline Value	Onl
CMMT_NC_TEST	- Incoder Evaluation:	
A 🦉 SYSTEM	Invert Encoder Counting Direction FALSE	-
License 🔝	Scaling Factor Numerator 0.000001	
Real-Time	Scaling Factor Denominator (default: 1.0) 1.0	
▲ 🎁 Tasks i PicTask	Position Bias 0.0	
Routes	Modulo Factor (e.g. 360.0°) 360.0	
🚛 Type System	Tolerance Window for Modulo Start 0.0	
TcCOM Objects	Encoder Mask (maximum encoder value) 0xFFFFFFF	
 MOTION MC-Task 1 SAF 	Encoder Sub Mask (absolute range maximum value) 0x000FFFFF	
NC-Task 1 SVB	Reference System 'INCREMENTAL	• 💌
the linage	- Limit Switches:	
Tables	Soft Position Limit Minimum Monitoring FALSE	-
Cbjects	Minimum Position 0.0	
▲ 🚉 Axes ▲ 📑 Axis 1	Soft Position Limit Maximum Monitoring FALSE	-
Aus I	Maximum Position 0.0	
Þ ⇒∐ Drive	+ Filter:	
🗽 Ctrl	+ Homing:	
Inputs	+ Other Settings:	
Outputs		_

 $10^{-6} \ = \ 0.\ 000001$

The Axis settings, CMMT, Motor and Actuator, must also be checked for compatibility between the Festo Automation Suite Settings and the NC Axis settings.

For example: Velocity, Acceleration, Quick stop ramp, maximum velocity, etc.

Solution Explorer	▼ ╄ × CN	IT_NC_TEST 🤹 🗙 PLC_OPEN_FBs Library Manager GVL	MAIN
o o 🕼 'o - 🗊 🗚 🗕		neral Settings Parameter Dynamics Online Functions Coupling Compensation	n
Search Solution Explorer (Ctrl+ü)	ρ-	Parage Ler Offline Value	Online Value Ty Unit
CMMT_NC_TEST SYSTEM	^	- Muximum Dynamics:	
		Reference Velocity 2200.0	F mm/s
A MC-Task 1 SAF		Maximum Velocity 2000.0	F mm/s
Image	X	Maximum Acceleration 15000.0	F mm/s2
Tables		Maximum Deceleration 15000.0	F mm/s2
Objects		+ Default Dynamics:	
Axes	/ 1	+ Manual Motion and Homing:	
Axis T ♦ ₩ Enc		+ Fast Axis Stop:	
🕨 📲 Drive		+ Limit Switches:	
ta Ctrl		+ Monitoring:	
 Inputs Outputs 		+ Setpoint Generator:	
🔺 🛀 Axis 2		+ NCI Parameter:	
Þ ቚ Enc		+ Other Settings:	
Drive Late Ctrl			
Inputs			
Outputs			

These settings are located under the MOTION -> NC -> Axes -> Axis 1 -> Parameters

Double click on Axis one and link the AXIS_REF object by following this path:

Axis 1 -> Settings -> Link To PLC> <select< th=""><th>t FML_REF variable> -> OK</th></select<>	t FML_REF variable> -> OK
--	---------------------------

Solution Explorer	• 4 ×	Library Manager 🛱	GVL	MAIN	CMMT_NC_1	rest ⇒ ×
🕹 o 🖓 To - II 🖊 🗕		General Settings	Parameter D	ynamics Online	Functions Coupli	ng Compensation
Search Solution Explorer (Ctrl+ü)	<u>ہ</u> م	unk To I/O		Drive E (CMMT /	(2)	
Solution 'CMMT_NC_TEST' (1 project)				Drive 5 (CMMT-A	(5)	
CMMT_NC_TEST		Link To PLC				
SYSTEM		Axis Type: CA		(D81- MDD 742 (Driver)
		Aus Type.	INOPER D3 UZ/	Profile MDF 742 (e.g. EtherCAT CoE	Drive) V
 Image: A constraint of the second seco				- Dieplay (Ophy) -		
thage		Select Axis Pl	LC Referen <mark>e</mark> e (('Axis 1')		×
III T bles		(reserve)				
🔚 Orjects		(none) GVL.CMMT_Axis	1_Ref (CMMT_	MC Instance)		ок
⊿ ⊒a Ales				_		Cancel
Axis 1						
▷ 🐳 Enc ▷ ≕]] Drive						Unused
tw Ctrl						⊖ All
Inputs						
Outputs						
PLC						
SAFETY						
‰ C++ ▷ 🔽 I/O						
V 🔤 VO						
1						

General	Settings	Parameter	Dynamics	Online	Functions	Coupling	Compensation	
Link To	o I/O		Drive 5	(CMMT-/	AS)			
Link To	PLC		GVL.CI	MMT_Axi	s1_Ref (CMI	MT_MC Inst	tance)	

Click on **Activate Configuration** to download the scanned network + Settings to the IPC.





Note

If the IPC is missing some licenses required for the NC application, a window will pop up, mentioning that the licenses are missing. For testing purposes, TwinCAT V3 allows to generate Trial Licenses, which will expire after a certain period. The license can be bought from BECKHOFF at any time once the tests have been successful.



License codes can be viewed at the SYSTEM -> License -> Online Licenses Tab.

Solution Explorer 👻	Ψ×	CMMT_NC_TES	T ⊕ ×						
0 0 G 10 - II / P		Order Information (Runtime) Manage Licenses Project Licenses Online Licenses							
Search Solution Explorer (Ctrl+ü)	ρ.								
Solution 'CMMT_NC_TEST' (1 project)		Order No	License	Instances	Platform Type	Status			
✓ ☐ CMMT_NC_TEST			TC3 NC PTP Axis	10 instances (0 in use)	Runtime	expires on Oct 3, 2018 (trial license)			
SYSTEM		TC1000	TC3 ADS	cpu license	Runtime	expires on Oct 3, 2018 (trial license)			
License			TC1100	TC3 IO	cpu license	Runtime	expires on Oct 3, 2018 (trial license)		
Real-Time Tasks		TC1200	TC3 PLC	cpu license	Runtime	expires on Oct 3, 2018 (trial license)			
Routes		TF5000	TC3 NC PTP	cpu license	Runtime	expires on Oct 3, 2018 (trial license)			
Type System									
TcCOM Objects									

After the configuration has been done, click on the RUN Mode symbol to bring the IPC into Run Mode.

CMMT_NC_TEST - Microsoft Vis	ual Studio	
FILE EDIT VIEW PROJECT E	BUILD DEBUG TWI	NCAT TWINSAFE PLC TOOLS SCO
🕴 G + O 🔞 + 🛅 + 🏜 🕍	¥∂∂)••	C - Attach
🛛 🖉 Build 4022.22 (Loaded) 🔹 🚽	P 🔤 🧧 🎘 🎯	😧 🐾 CX-2A57CE 🔹 🖕 🗌
Solution Explorer	• # ×	CMMT_NC_TEST 👳 🗙
G O 🟠 To - 🗊 🖌 🗕		Order Information (Runtime) Manage Licenses

Note

HW changes or Network changes must be done with the system in Configuration mode, which is triggered by clicking on the Blue Icon. Once configurations have been done, the PLC code can only be downloaded once the IPC is in RUN Mode.

7 PLC Programming

Now the that the complete configuration has been done, the PLC Open Function Blocks for Softmotion can be integrated as done in CODESYS.



They must be linked to the AXIS_REF element that we have created for the Axis.