

AG25, AG26

Beckhoff® TwinCAT® Library

Software description



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1 General notes

The library and its function were tested on a Beckhoff® CX9001-0101. The module was programmed using TwinCAT® v2.11.2226.

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1.1 Requirements

- Basic knowledge of handling and programming TwinCAT® systems.
- Familiarity with EtherCAT®.

1.2 Liability

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1.3 Versions overview

V1.1 valid for library SIKO_AG2X_V300.lib

1.4 List of abbreviations

ETC	EtherCAT®
SW	Status Word
CW	Control Word

2 Hardware configuration

2.1 Register the XML Device Description File for AG2X

Close TwinCAT® System Manager

Copy the file "ESI_SIKO_ECT_V1_00.XML" to folder "...\TwinCAT\IO\EtherCAT"

Open TwinCAT® System Manager

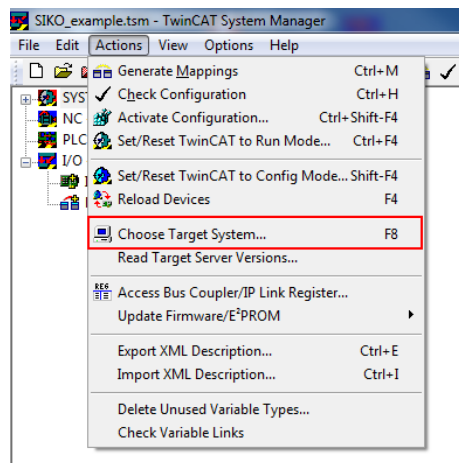
2.2 Create TwinCAT® System Manager hardware configuration

Precondition: The PLC is powered and connected to the programming PC.

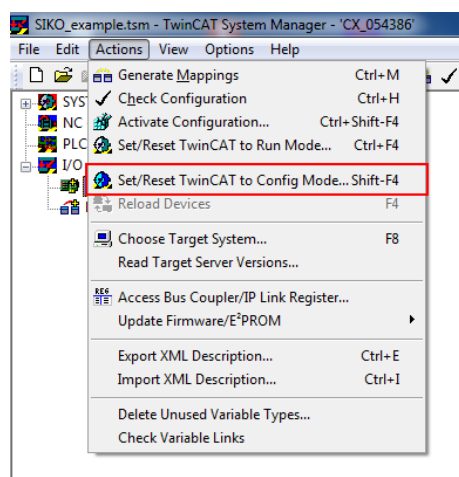
Open a new hardware configuration in TwinCAT® System Manager.

Save file with name "SIKO_example.tsm".

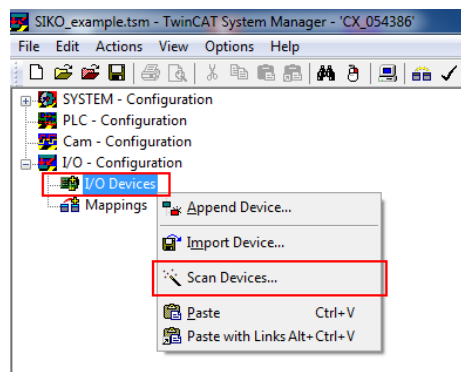
Choose your target system.



Set TwinCAT® to config mode



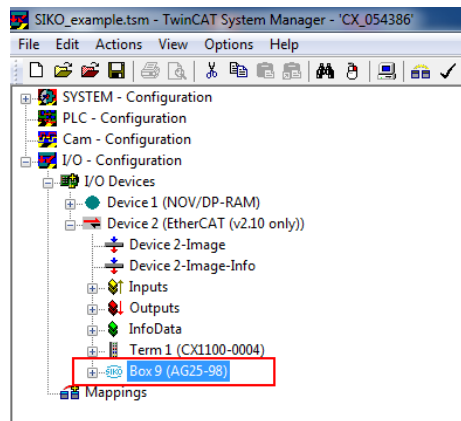
Scan Devices



Confirm Message "Scan for boxes" with "yes".

Confirm Message "Activate Free Run" with "no".

The connected AG25 should be found and attached to the I/O configuration.



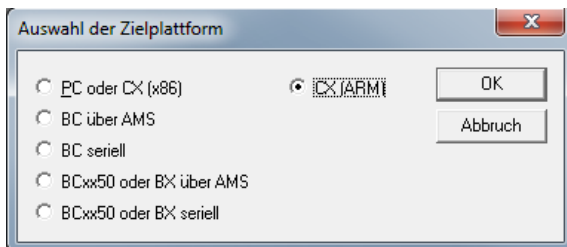
Save the configuration file.

3 Software configuration

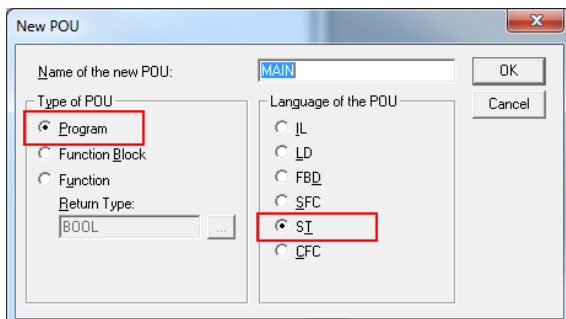
NOTICE	<p>Danger of data loss</p> <p>All drive parameters are organized in a structure of the type T_ParameterAg2x. This data type is declared within the library. To achieve non-volatile storage of the parameters inside the PLC the instances of T_ParameterAg2x must be declared with the keyword PERSISTENT.</p> <p>Variables which are declared as PERSISTENT are stored in a file in the TwinCAT\Boot directory when the TwinCAT system stops (after the last PLC cycle) or a write persistent data command is issued. The next time the system starts, this file is read, and the persistent variables in the runtime system are initialized with the values from the file. If the TwinCAT system is not stopped properly (e.g. power failure) or no write persistent data command is issued the consequence is data loss. In this case at the next startup a backup copy of the file is loaded with default values.</p>
NOTICE	<p>Limited user flash write cycles</p> <p>If the input bEnableWritePersistentData is TRUE, then each time a command bStartRead, bStartWrite or bStartCopy is executed a write access to the user flash of the PLC is performed. In this case do not execute these commands cyclically. To execute commands cyclically set the input bEnableWritePersistentData to FALSE.</p>

3.1 Create TwinCAT® PLC Control project

Open an empty project and choose the target system according to your hardware configuration.



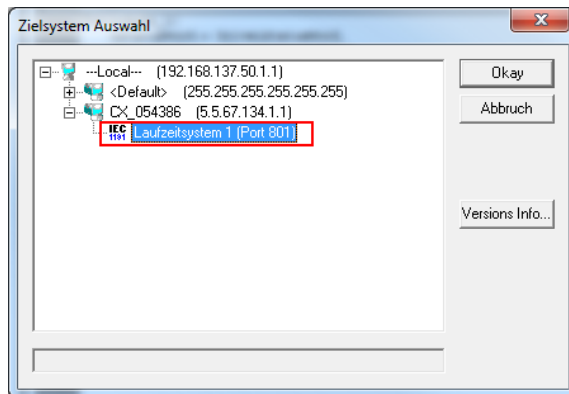
Choose Type of POU "Program" and Language of the POU "ST".



Save the project with name "SIKO_example.pro".

3.2 Choose run time system

Online > Choose Run-Time System...



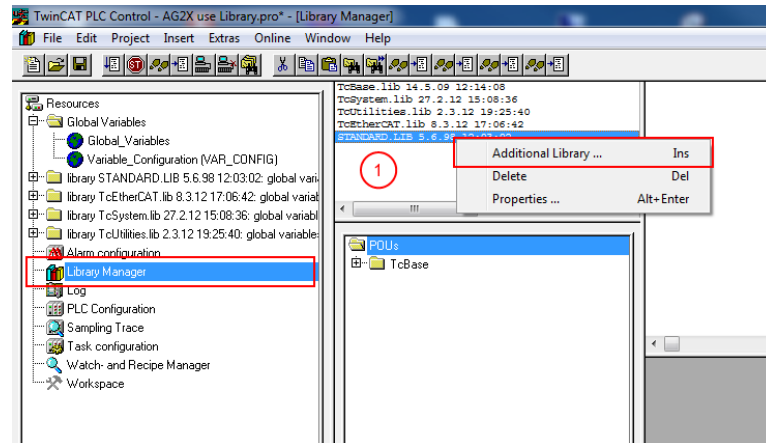
3.3 Library import

Import the library "SIKO_AG2X_Vxxx.lib" to your project using TwinCAT® Library Manager:

Go to tab "Resources"

Double click on folder "Library Manager"

Right click in window ① and choose "Additional Library"



3.4 Declare global variables

NOTICE

Please consider the alignment of your plc.

Go to tab "Resources"

Double click on folder "Global_Variables" and type in the global declarations:

VAR_GLOBAL

```
Drive1StatusWord AT %IB0:UINT;
Drive1ActualValue AT %IB4:DINT;
Drive1DigitalInputsStatus AT %IB8:USINT;
Drive1ControlWord AT %QB0:UINT;
Drive1TargetValue AT %QB4:DINT;
Drive1DigitalOutputsControl AT %QB8:USINT;
```

END_VAR

3.5 Create instances of T_PdInAg2x, T_PdOutAg2x, FB_SikoAg2x, T_ParameterAg2x

Go to tab "POUs"

Double click on program "MAIN" and type in the declarations:

PROGRAM MAIN

VAR

stPdInAg2x_1: T_PdInAg2x;

stPdOutAg2x_1: T_PdOutAg2x;

fbSikoAg2x_1: FB_SikoAg2x;

END_VAR

VAR PERSISTENT

ParameterAg2x_1: T_ParameterAg2x;

END_VAR

3.6 Call the function block

Go to tab "POUs"

Double click on program "MAIN" and type in the function call in the program window.

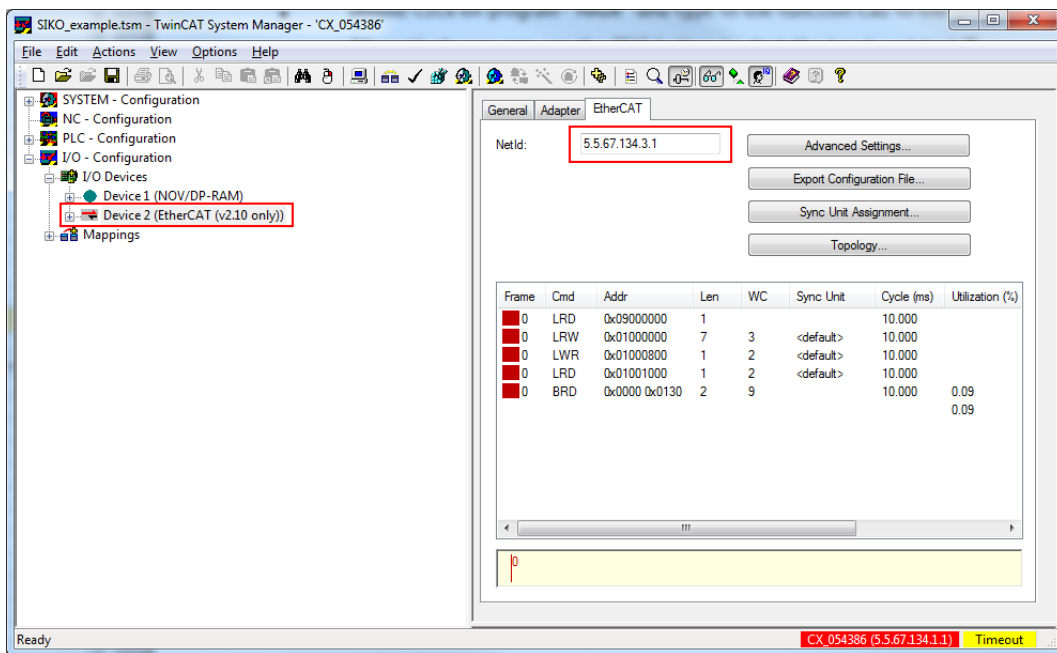
Alternatively you can use the "F2" button to start the input assistant.

Connect the inputs and outputs of the function block according to your configuration.

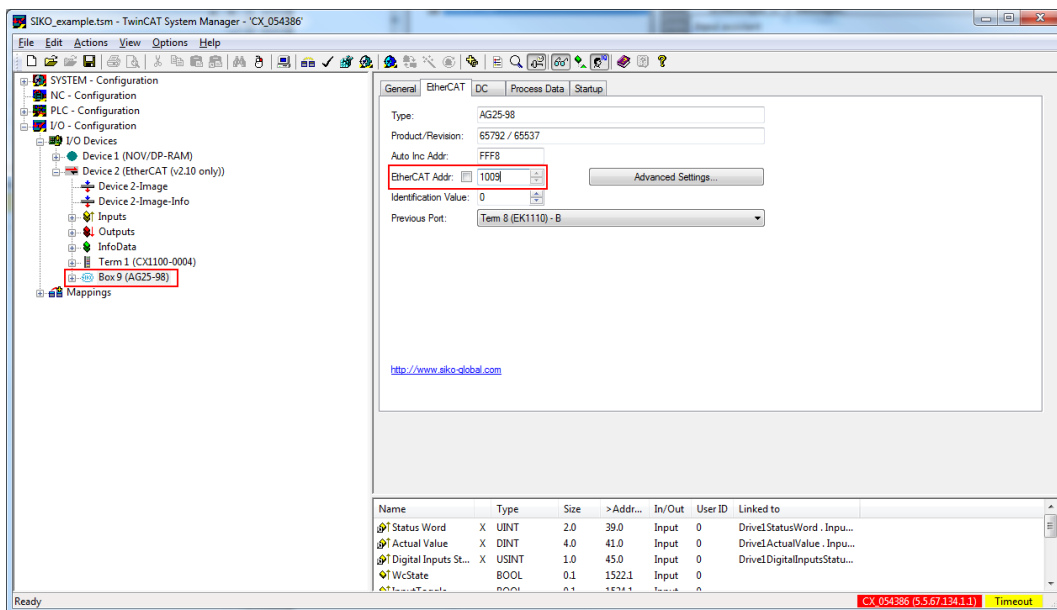
The inputs "sNetId", "nSlaveAddr" and "nPort" must be set according to your hardware configuration.

```
fbSikoAg2x_1(
  nStatusWord:= Drive1StatusWord,
  nActualValue:= Drive1ActualValue,
  nDigitalInputsStatus:= Drive1DigitalInputsStatus,
  stPdOutAg2x:= stPdOutAg2x_1,
  sNetId:= '5.5.67.134.3.1',
  nSlaveAddr:= 1009,
  nPort:= 801,
  tTimeoutEcCoeSdo:= T#4s,
  tTimeoutWps:= T#4s,
  bStartRead:= ,
  bStartWrite:= ,
  bStartCopy:= ,
  bEnableWritePersistentData:= TRUE,
  ParameterAg2x:= ParameterAg2x_1,
  nControlWord=> Drive1ControlWord,
  nTargetValue=> Drive1TargetValue,
  nDigitalOutputControl=> Drive1DigitalOutputsControl,
  stPdInAg2x=> stPdInAg2x_1,
  nCntRead=> ,
  nCntWrite=> ,
  nCntCopy=> ,
  bDone=> ,
  bBusy=> ,
  bError=> ,
  nErrId=> );
```

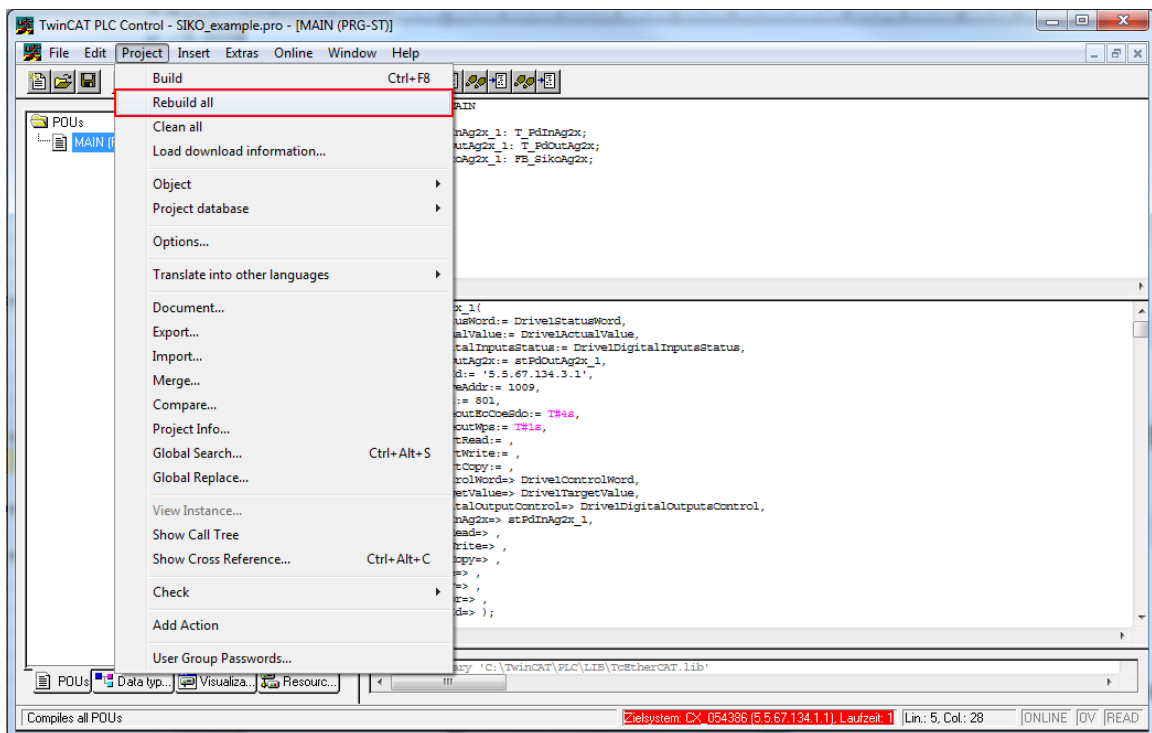
Where to find the sNetId?



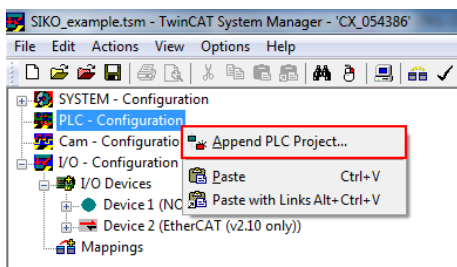
Where to find the nSlaveAddr?



3.7 Build the project

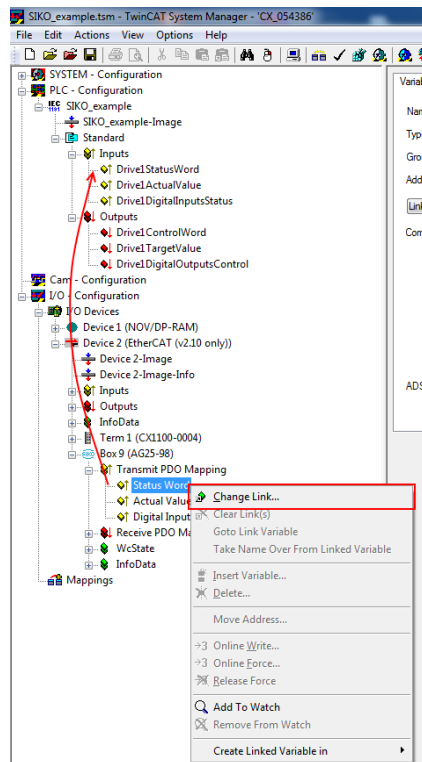


3.8 Append the PLC project to TwinCAT® System Manager hardware configuration

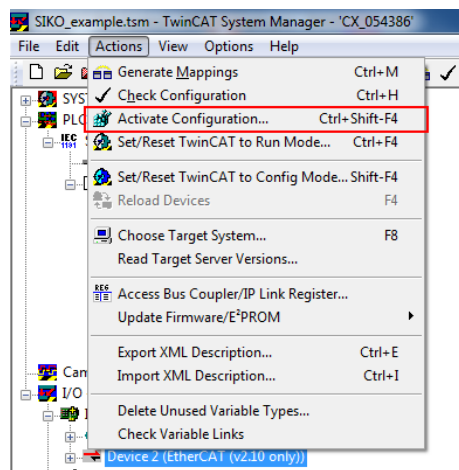


3.9 Setup variable links in TwinCAT® System Manager

Repeat this step for all drive variables.



3.10 Activate configuration in TwinCAT® System Manager

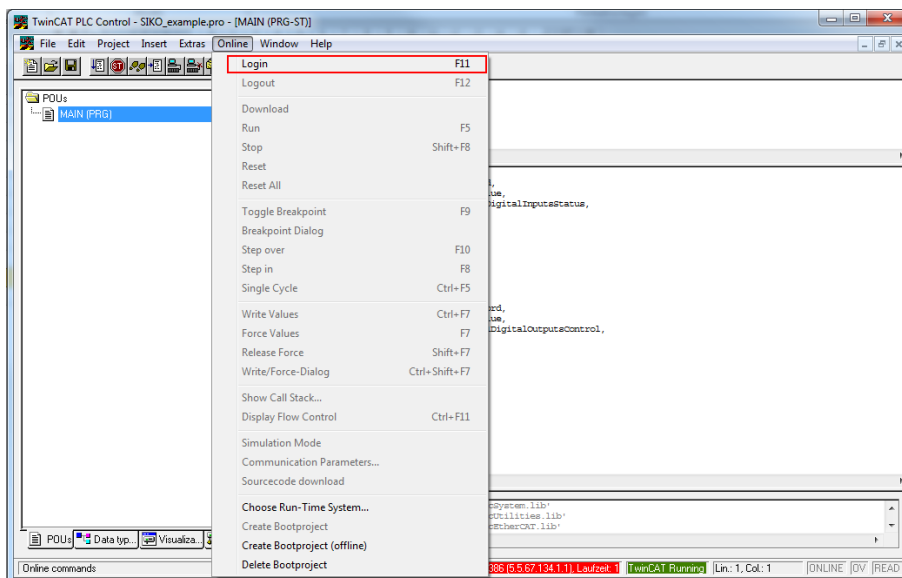


3.11 Program download via TwinCAT® PLC Control

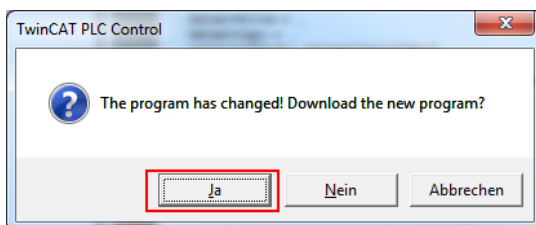
NOTICE

If after the download of the program and creation of the bootproject the Error LED of the drive is blinking red and a error appears in the message window of TwinCAT® message window because of a Sync Manager Timeout a reset is necessary.
To reset the error a online reset must be performed via TwinCAT® System Manager.

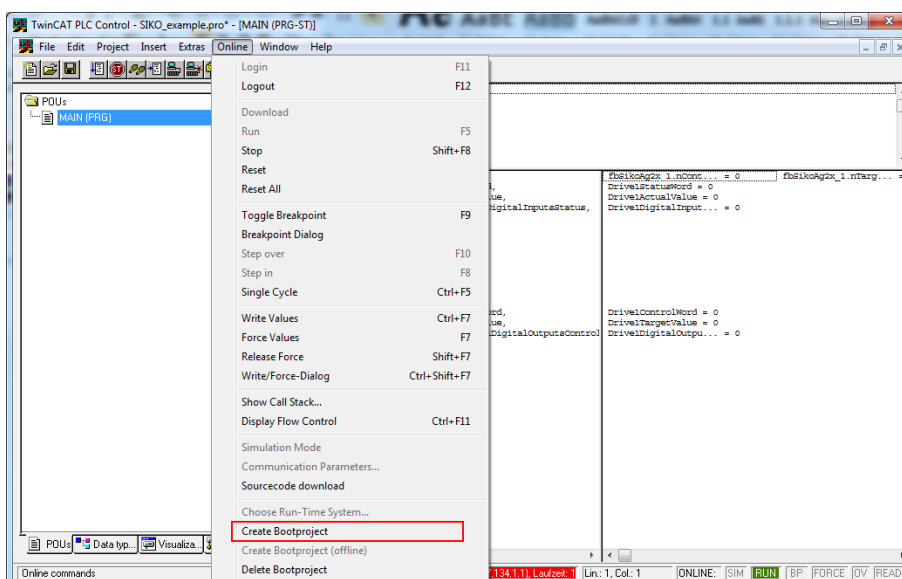
Login



Confirm message



Create Bootproject

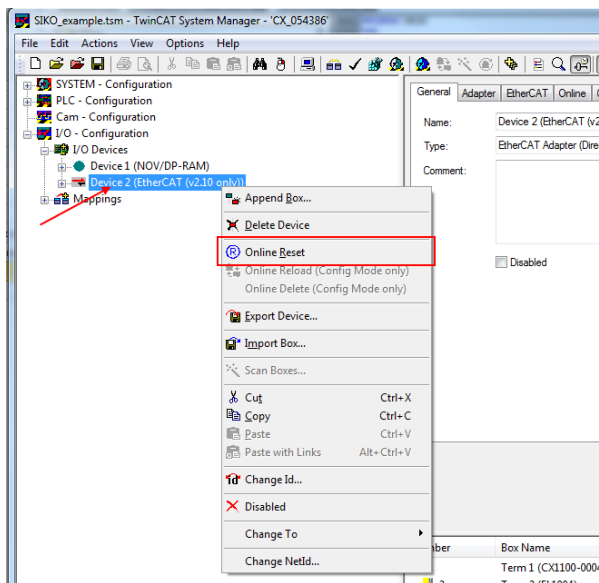


TwinCAT® System Manager Error message after program download and creation of the bootproject.

Server (Port)	Timestamp	Message
TCPLC (801)	21.07.2007 09:42:50 462 ms	PLC Download: 725 Symbols, 422 DataTypes
(65535)	21.07.2007 09:42:49 718 ms	'Box 9 (AG25-98)' (1009): state change aborted (requested 'OP', back to 'SAFEOP').
(65535)	21.07.2007 09:42:49 718 ms	'Box 9 (AG25-98)' (1009): 'SAFEOP to OP' failed! Error: 'check device state for OP', AL Status '0x0014' read and '0x0008' expected. AL Status Code '0x001b - Sync manager watchdog'
(65535)	21.07.2007 09:42:49 692 ms	'Box 9 (AG25-98)' (1009): abnormal state change (from 'OP' to 'SAFEOP') with code 0x14. 'Sync manager watchdog'. Try to go back to 'OP'...

3.12 Perform Online Reset via TwinCAT® System Manager

Right click on the EtherCAT® Adapter > Online Reset



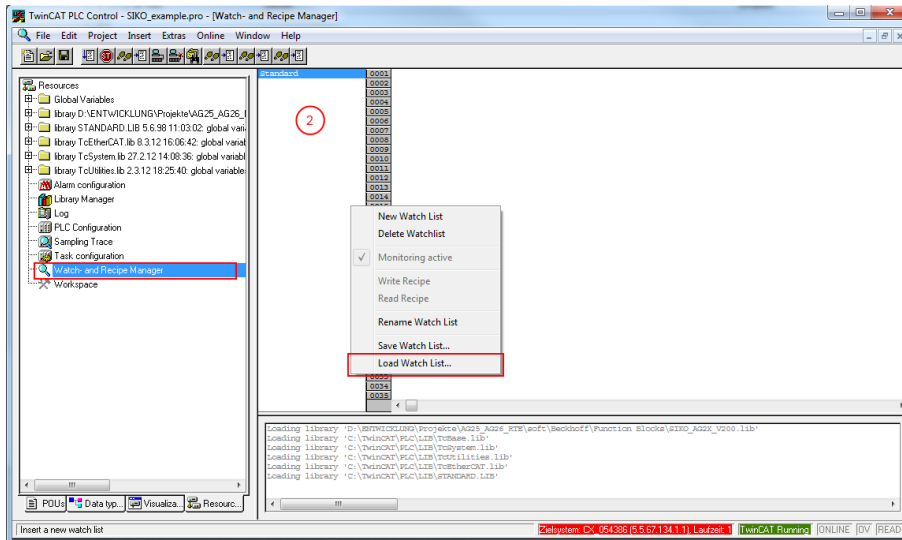
3.13 Import Watchlist

Open TwinCAT® PLC Control

Goto tab "Resources" and double click on folder "Watch- and Recipe Manager"

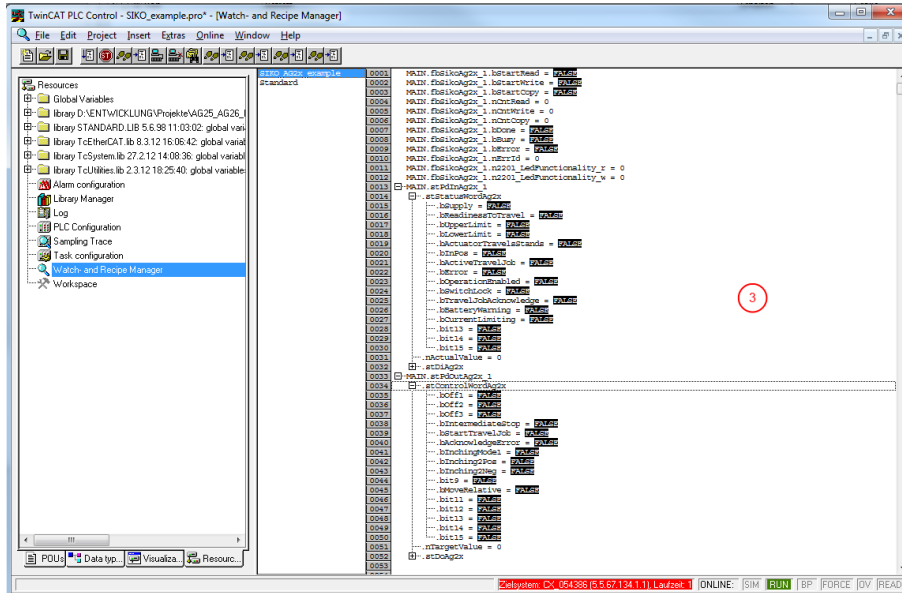
Right click in window ② and choose "Load Watch List..."

Import watch list "SIK0_AG2x_example.wtc"



3.14 Use the watch list

The watch list contains the structures for process data input and output. In addition the watch list contains the control bits for parameter access and the parameter "n2201_LedFunctionality_r" and "n2201_LedFunctionality_w" for example. To expand the watch list logout via Online > Logout. Then right click into window ③ and use the input assistant to add more parameters.



3.15 Software example

3.15.1 Parameter access

The present module contains the parameter data in addition to the process data (CW/SW). Parameters that can be changed (read/write) exist in programming as actual value (r) and as target value (w) as well. Furthermore, it is differentiated between pure read parameters (only indicated as actual value) and pure write parameters (only indicated as target value).

A rising edge must be applied either to the "bStartRead" or to the "bStartWrite" input on the module described here in order to enable a read or write process of one of the variables.

3.15.2 Read parameters

If a rising edge is applied to the "bStartRead" input, then all parameters will be read and can be used for further programming.

3.15.3 Diagnosis reading "nCntRead"

If counter value is not reset to "0" the read cycle was interrupted by read failure. This indicates to a communication failure. For detailed information about the cause of failure there is an error code available at the output "nErrId".

3.15.4 Write parameters

If a rising edge is applied to the "bStartWrite" input of the module, then all parameters (target and actual values) will be transferred to the drive.

3.15.5 Diagnosis reading "nCntWrite"

If counter value is not reset to "0" the write cycle was interrupted by write failure. This indicates to a communication failure or a parameter value is beyond range of value accepted by drive. For detailed information about the cause of failure there is an error code available at the output "nErrId".

3.15.6 Copy parameters from read to write

If a rising edge is applied to the "bStartCopy" input of the module, then all actual values (r) are copied to their corresponding target values (w).

3.15.7 Counter value

nCnt Read value	nCnt Write value	Name	Value range (dec)	Default
1	1	LED Functionality	0 ... 1	0
2	2	Service Interface Baud Rate	0 ... 3	1
3	3	Digital Output 1 Functionality	0 ... 3	0
4		Digital Output Functionalities State		-
5	4	Digital Outputs Polarity	0 ... 15	0
6	5	Digital Input 1 Functionality	0 ... 11	0
7	6	Digital Input 2 Functionality	0 ... 11	0
8	7	Digital Input 3 Functionality	0 ... 11	0
9	8	Digital Input 4 Functionality	0 ... 11	0
10		Digital Input Functionalities State		-
11	9	Digital Inputs Polarity	0 ... 15	0
12	10	Controller Parameter P	1 ... 500	300
13	11	Controller Parameter I	0 ... 500	2
14	12	Controller Parameter D	0 ... 500	0
15	13	A-Pos	1 ... 100	50
16	14	V-Pos	Gear 66:1 \Rightarrow 1 ... 75 rpm 98:1 \Rightarrow 1 ... 50 rpm 188:1 \Rightarrow 1 ... 30 rpm 368:1 \Rightarrow 1 ... 15 rpm	10
17	15	D-Pos	1 ... 101	101
18	16	A-Rot	1 ... 100	50
19	17	A-Inch	1 ... 100	50
20	18	V-Inch	Gear 66:1 \Rightarrow 1 ... 75 rpm 98:1 \Rightarrow 1 ... 50 rpm 188:1 \Rightarrow 1 ... 30 rpm 368:1 \Rightarrow 1 ... 15 rpm	10
21	19	Pos Window	0 ... 1000	10
22	20	Gear Ratio Numerator	1 ... 10000	1
23	21	Gear Ratio Denominator	1 ... 10000	1
24	22	Spindle Pitch	0 ... 1000000	0
25	23	Calibration Value	-999999 ... 999999	0
26	24	Software Limit 1	-9999999 ... 9999999	99999
27	25	Software Limit 2	-9999999 ... 9999999	-19999
28	26	Delta Inch	-1000000 ... 1000000	720
29	27	Sense of Rotation	0 ... 1	0
30	28	Pos Type	0 ... 2	0
31	29	Operating Mode	0 ... 1	0
32	30	Inching 2 Stop Mode	0 ... 1	0

nCnt Read value	nCnt Write value	Name	Value range (dec)	Default
33	31	Inpos Mode	0 ... 2	0
34	32	Loop Length	0 ... 30000	360
35	33	Contouring Error Limit	1 ... 30000	400
36	34	Current Limiting	25 ... 110	110
37	35	Inching 2 Offset	10 ... 100	100
38	36	Inching 2 Acceleration Type	0 ... 1	0
39	37	Offset Value	-999999 ... 999999	0
40	38	PCM Position 1	DINT	0
41	39	PCM Position 2	DINT	0
42	40	PCM Position 3	DINT	0
43	41	PCM Position 4	DINT	0
44	42	PCM Position 5	DINT	0
45	43	PCM Position 6	DINT	0
46	44	PCM Position 7	DINT	0
47	45	PCM Acceleration 1	1 ... 100	50
48	46	PCM Acceleration 2	1 ... 100	50
49	47	PCM Acceleration 3	1 ... 100	50
50	48	PCM Acceleration 4	1 ... 100	50
51	49	PCM Acceleration 5	1 ... 100	50
52	50	PCM Acceleration 6	1 ... 100	50
53	51	PCM Acceleration 7	1 ... 100	50
54	52	PCM Velocity 1	Gear 66:1 \Rightarrow 1 ... 75 rpm 98:1 \Rightarrow 1 ... 50 rpm 188:1 \Rightarrow 1 ... 30 rpm 368:1 \Rightarrow 1 ... 15 rpm	10
55	53	PCM Velocity 2	see PCM Velocity 1	10
56	54	PCM Velocity 3	see PCM Velocity 1	10
57	55	PCM Velocity 4	see PCM Velocity 1	10
58	56	PCM Velocity 5	see PCM Velocity 1	10
59	57	PCM Velocity 6	see PCM Velocity 1	10
60	58	PCM Velocity 7	see PCM Velocity 1	10
61	59	PCM Deceleration 1	1 ... 101	101
62	60	PCM Deceleration 2	1 ... 101	101
63	61	PCM Deceleration 3	1 ... 101	101
64	62	PCM Deceleration 4	1 ... 101	101
65	63	PCM Deceleration 5	1 ... 101	101
66	64	PCM Deceleration 6	1 ... 101	101
67	65	PCM Deceleration 7	1 ... 101	101
68		Output Stage Temperature		-
69		Voltage of Control		-

nCnt Read value	nCnt Write value	Name	Value range (dec)	Default
70		Voltage of Output Stage		-
71		Voltage of Battery		-
72		Motor Current		-
73		Actual Position		-
74		Actual Rotational Speed		-
75		Serial Number		-
76		Production Date		-
77		SW Motor Controller		-
78		Gear Reduction		-
79		System Status Word		-
80		Encoder Resolution		-
81		Device ID		-
82		Number of Errors		-
83		Error Number 1		-
84		Error Number 2		-
85		Error Number 3		-
86		Error Number 4		-
87		Error Number 5		-
88		Error Number 6		-
89		Error Number 7		-
90		Error Number 8		-
91		Error Number 9		-
92		Error Number 10		-
93	66	S Command	0 ... 8	0

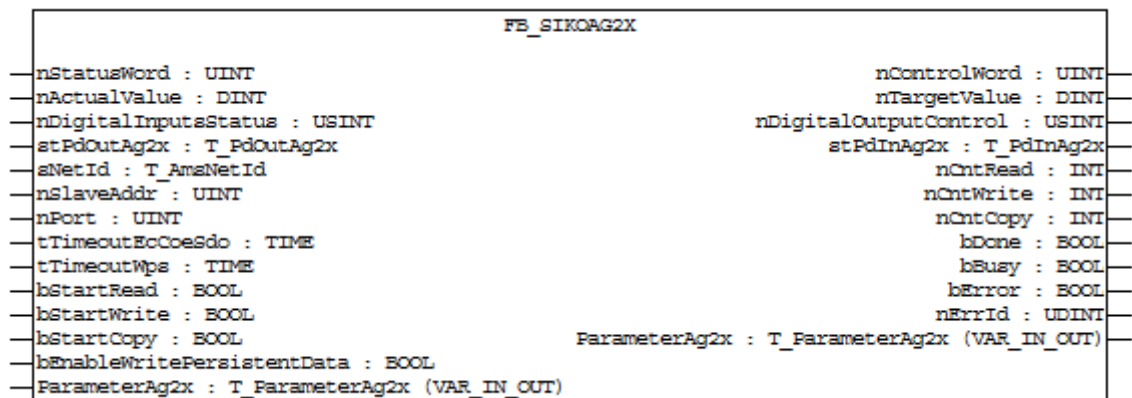
3.15.8 Error codes

If a communication error occurs, there is an ADS error code present at the output nErrId.

4 Function block description

The inputs nStatusWord, nActualValue and nDigitalInputsStatus are mapped by the function block to a structure of type T_PdInAg2x. This structure is available at output stPdInAg2x for further programming.

The function block expects a structure of type T_PdOutAg2x at input stPdOutAg2x. The function block maps the structure to the the outputs nControlWord, nTargetValue and nDigitalOutputControl.



4.1 Function block inputs

Input	Data type	Description
nStatusWord	UINT	Connect to global input variable.
nActualValue	DINT	Connect to global input variable.
nDigitalInputsStatus	USINT	Connect to global input variable.
stPdOutAg2x	T_PdOutAg2x	Process data output.
sNetId	T_AmsNetId	This is a string that contains the AMS network identifier of the EtherCAT® master device.
nSlaveAddr	UINT	Fixed address of the EtherCAT® slave to which the SDO commands should be sent.
nPort	T_AmsPort	The PORT parameter specifies the runtime system whose persistent data is to be stored.
tTimeoutEcCoeSdo	TIME	Maximum time allowed for the execution of the function blocks FB_EcCoeSdoRead and FB_EcCoeSdoWrite.
tTimeoutWps	TIME	States the length of the timeout that may not be exceeded by execution of the ADS command.
bStartRead	BOOL	Start command read.
bStartWrite	BOOL	Start command write.
bStartCopy	BOOL	Start command copy.
bEnableWritePersistentData	BOOL	Write persistent data after a read, write or copy command.
ParameterAg2x	T_ParameterAg2x	Structure that contains the drive parameters.

4.2 Function block outputs

Output	Data type	Description
nControlWord	UINT	Connect to global output variable.
nTargetValue	DINT	Connect to global output variable.
nDigitalOutputControl	USINT	Connect to global output variable.
stPdInAg2x	T_PdInAg2x	Process data input mapped to a structure.
nCntRead	INT	Counter value of read cycle.
nCntWrite	INT	Counter value of write cycle.
nCntCopy	INT	Counter value of copy cycle.
bDone	BOOL	Command executed successfully.
bBusy	BOOL	Command in processing.
bError	BOOL	Command terminated with error.
nErrId	UDINT	In the event of an error the ADS error number will be returned.