

# APPLICATION NOTES

## Advanced Graphical Interface - AGI Internal PLC (CODESYS V3)

- CODESYS V3 logic running on AGI 300/400 series product
- Support of Modbus/TCP and RTU communication
- Use of remote CANopen optional modules



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#### 1. General information

#### Warnings, legal information and safety

#### Warnings and notes

Throughout this document, a number of warnings and notes with helpful user information will be presented. To ensure that these are noticed, they will be highlighted as follows in order to separate them from the general text.

#### Warnings



Warnings indicate a potentially dangerous situation, which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

#### Notes



Notes provide general information, which will be helpful for the reader to bear in mind.

#### Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the unit. If there is any doubt about how to install or operate the unit, the company responsible for the installation or the operation must be contacted.



The unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

#### Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

#### Safety issues

Installation of the unit should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

#### Electrostatic discharge awareness

Sufficient care must be taken to protect the terminal against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

#### About the application notes

#### General purpose

This document includes application notes for DEIF's AGI 300/400 series. It mainly includes general product information, mounting instructions and wiring descriptions.

The general purpose of the application notes is to help the AGI application designer, with the first steps of installing and using the internal PLC (CODESYS V3).



Please make sure to also read the Installation Instructions before starting to work with the AGI 300/400. Failure to do this could result in human injury or damage to the equipment.

#### Intended users

The Application Notes are mainly intended for the AGI application designer.

#### Contents and overall structure

This document is divided into chapters, and in order to make the structure simple and easy to use, each chapter will begin from the top of a new page.

### 2. Internal PLC (CODESYS V3)

This manual describes the AGI control system based on the CODESYS V3 PLC software.

The documentation covers installation and setup of:

- CODESYS V3 logic running on AGI 300/400 series product
- Support of Modbus/TCP and RTU communication
- Use of remote CANopen optional modules



For finding relevant CODESYS programming documentation, please refer to the CODESYS web site <u>www.codesys.com</u> and its online help.

#### 3. Control solutions with AGI 300/400 series and CODESYS V3

AGI products can deliver effective HMI and control solutions based on AGI Creator and CODESYS V3.

The AGI 300/400 series HMI products have been designed to include the CODESYS V3 PLC Runtime. The PLC runtime is automatically transferred to the device, by AGI Creator as part of the AGI Creator Runtime, and it is running with the support of the operating system of the device.

CODESYS V3 Development System is required to develop and debug PLC applications and transfer them to the AGI 300/400 series HMI device. The CODESYS V3 Runtime requires a license activation to be used. CODESYS V3 license is activated within AGI Creator and the license code will then univocally be matched with the operator panel.



License activation is required for the operation of CODESYS V3 Runtime. CODESYS V3 Runtime will not communicate with the CODESYS V3 development system until after license activation.

#### System configuration

The HMI and control solution based on AGI Creator and CODESYS V3 can be applied in different configurations.

#### **Compact stand-alone controller**

The HMI and control system can be used to build very compact stand-alone systems. Input/output is available using the optional I/O module.

HML	CODESYS V3 PLC
	CODESYS V3 License
Platfo	I/O Optional Module
	'

#### Controller with remote I/O

A fieldbus interface (either built-in or with an optional module) is available for the HMI and control solution. Configurations with local and distributed I/Os are possible.



#### **Connectivity in HMI and control systems**

Even when adding the control option with the CODESYS V3 PLC, the HMI still retains its full communication capabilities based on AGI Creator communication drivers.



The communication capabilities over serial network are limited by the amount of serial interfaces available. Each serial interface supports a single communication protocol. Specific optional add-on serial interface modules are available to increment the amount of serial interfaces at disposal.

#### **Requirements and limitations**

The following firmware and software versions are required to work with the CODESYS V3 PLC Runtime:

Version
300 or newer
1.76 or higher
2.0.0.328 or higher
3.5.4 or higher

#### 4. Getting started

This chapter provides the necessary information on how to set up the HMI + CODESYS PLC system. The required operations are listed below and will be explained in the following chapters.

- CODESYS V3 development system installation
- DEIF CODESYS package installation
- AGI Creator Runtime installation in the operator panel
- Activation of the CODESYS V3 license into the operator panel
- Creation of a new PLC project
- Download PLC application
- Symbol file configuration with CODESYS V3 development system
- Communication setup in AGI Creator

#### CODESYS V3 development system installation

The CODESYS V3 development system can be downloaded for free from the CODESYS

website at: <a href="http://www.codesys.com/download.html">www.codesys.com/download.html</a>

You need to register before you can download the software.

#### **DEIF CODESYS packages installation**

A dedicated DEIF CODESYS package is required to allow the official CODESYS V3 development software to integrate with your control systems based on AGI 300/400 series platform.

The DEIF package is only included in the AGI Creator from version 2.0.0.328 (and later) located in the installation folder and  $\rightarrow$  "\CODESYS\V3\". The package is also available for download on the DEIF Extranet.

The CODESYS development system includes a tool called "Package Manager" for the installation of the DEIF CODESYS package. The package manager tool can be launched from the CODESYS development system > Tools > Package Manager. This tool can be used both for checking the installed packages and for installing new ones.

To install the DEIF CODESYS package, open the Package Manager and click the "Install" button and browse for the file with \*.package extension – confirm by pressing "Open".

The installation procedure will start automatically. The system will prompt you with a request for either a complete or typical installation - any of these will install all the required files for support of the CODESYS V3 PLC Runtime features.

The package manager dialogue is visible in the following figure, showing the installed packages.

Refresh				Sort by:	Name	• Instal
Name	Version	Installation date	Update info	License info		Uninstall
👱 AGI 300 Package	3.5.7.0	07-06-2016		No license require	ed	Details
						Updates Search updates
						CODESYS Store
						CODESYS Store

#### Updating old CODESYS packages

When a new version of the DEIF CODESYS package is available, it can be installed to update the currently installed DEIF CODESYS package to the latest. This package will always include the newest CODESYS V3 PLC Runtime features.

When a new version of DEIF CODESYS package is released, we always aim for complete compatibility with the previous versions.

If the new package is not fully compatible with the previous version, some changes to adapt the PLC application to the new package may be required. In these cases, the updates to the DEIF package will come with proper instructions for the conversion of existing projects.

The package update procedure is identical to the first installation of the CODESYS package, please refer to the proper chapter for specific information.



CODESYS V3 keeps the older package versions instead of replacing them in order to have all the installed packages at disposal if required.

#### **Creator Runtime installation**

The HMI and control system is composed by two main subsystems - the Creator HMI Runtime and the CODESYS V3 PLC Runtime.

As the CODESYS PLC Runtime is part of the AGI Creator HMI Runtime, it is necessary to install the AGI Creator Runtime on the operator panel in order to have the CODESYS PLC Runtime running. For further information on installing the runtime, please refer to the AGI Creator help file.

#### Activation of CODESYS V3 license on the operator panel

CODESYS V3 PLC Runtime license is activated on the operator panel trough an Ethernet connection using AGI Creator version 2.0.0.328 (or later). Each license can be used on **one** single operator panel, which means that once it has been activated, the license is univocally matched with the MAC-ID of the operator panel.

To activate the license, follow the below steps:

In AGI Creator select, Run > Manage Target

On the License tab > locate the *Panel Info* section > select the IP address of the operator panel where the license will be activated, chosen from the drop-down menu. The drop-down menu will be a list of operator panels available on the network.

Locate the Activation Keys section > type in the license provided from DEIF.

Click the Activate Panel button.

Once the system confirms the license to be successfully activated, reboot the operator panel to complete the activation procedure.



## The CODESYS V3 license activation procedure requires an active internet connection on the PC.

untime Board License	
License folder C: Lisers\ (vorkspace Panal Info Activate Pand 1	
Save License Panel ID 00300 EE23 Activation Keys	
20000X.30000X.30000X.30000X	
	_
	Import Lornet Activate Panel

For testing purposes, it is possible to use a temporary demo license that will activate the CODESYS V3 PLC Runtime for <u>120 minutes</u>. To activate the demo mode, enter the license code: **CODESYS\_DEMO**. The runtime will end itself after this time and reboot will be needed.



## CODESYS V3 licenses, once activated, cannot be paired with a different device nor be deactivated.

In case it is necessary to verify whether a license has been activated on an HMI, it is possible to check this in the system log of the operator panel.

From the context menu on the operator panel, select the option "Log at boot" and then reboot the operator panel. At panel restart, the log window will be displayed on screen, if a valid CODESYS V3 license is found from the system, then the string "CODESYS Module: CODESYS V3 license found: CODESYS V3 is running" will be present among the panel boot logging information.

#### Creation of a new CODESYS PLC project

To create a new CODESYS V3 project select File > New Project or click the line icon from the upper tools bar. A new project dialogue box will be displayed; select "Standard project", and then define project name and location. Confirm with "OK" as shown in the following figure.

Categories Categories Categories Per	nies gebi Poplypojed	Final Province
Name: Location:	UnderS C: User/IMWEDocuments	• 🗔
		OK Canal

#### **Download PLC application**

The selection of the PLC, where to download the project, must be chosen from the device communication settings tab before proceeding with the download operation.

Double-click "Device (AGI 300 or AGI 400)" in the project tree to display the device properties in the work area. Make sure you are located in the "Communication Settings" tab; then click the "Scan Network..." button.

The Select Device dialogue box will be displayed. This dialogue box lists all the compatible devices available in the network (the operator panels are defined as "AGI 300 or AGI 400"). Select your device - then press "OK".

In case more operator panels use CODESYS V3 PLC Runtime and are present in the same network, a different string between the square brackets reported after the device name can recognise each panel.

In the next figure, the string is "0003.0003.A0C6". The last two HEX numbers of the string "C6" correspond to the last byte of the operator panel IP Address. In this case, the corresponding operator panel is the one with IP address xxx.xxx.198 as C6 HEX corresponds to 198 DEC.

elect the network path to the controller:		
🗉 🚜 🗛 Gateway-1 (scanning)	Device Name:	Scan network
- m ACI 300 [0003.0E08.A0C6]	out noy 1	Wink
	IP-Address: localhost	
	Port: 1217	
	Driver: TCP/JP	

The selected device is then listed in the Communication Settings as shown in the next figure. The device properties are listed on screen. A green dot over the device graphical representation informs that the device is correctly recognised and available in the network.

Communication Settings	Scan network Gateway	Device		
oplications				
eles		<u> </u>		
.09		_	•••	
PLC settings		Galeway	- I00061 (active)	· .
NC shell		Praddrest:	Uevice Name:	-
Jsers and Groups		192-100.6-190 Port:	AGI 300 Device Address:	
Access Rights		1217	0006	
interface Parameters			Teryel ID: 1038 0802	
feak deployment			Target Type: 4096	
Retus			Target Vendor: DEIF A/S	
information			Target Version: 3.5.7.20	



Communication with the available devices is established through a gateway. A default gateway is available and it is generally not needed to change the standard gateway settings. For more information about the gateway setup, please refer to the CODESYS V3 documentation.

#### **Upload PLC application**

Uploading the PLC project is possible only if the project source has been previously downloaded to the PLC. To download the project source while online, select Online > Source download to connected device.

To upload a PLC project from the HMI, select the source upload command from the file menu and select the PLC from the device list as shown in the following figure.



#### Symbol file configuration with CODESYS V3 development system

The CODESYS V3 development system can create a list of all the variables available in the PLC programme in the form of a file with \*.xml extension.

The variables to be included in the generated xml file must be selected. To get access to the project variables list, for the selection, it is necessary to add the symbol configuration to the CODESYS project. This project item is not added by default.

To add the symbol configuration, right-click "Application" from the project tree, then in the context menu select Add Object > Symbol configuration. The symbol configuration voice will be added to the project tree, as shown in the following figure.



By double-clicking the symbol configuration, it will be displayed on page.

anged symbol configuration will be transferre	ed with the next do	which or online change			
Symbols	Access Rights	Maximal Attribute	Туре	Members	Comment
- 🔽 📄 GVL		E.			
V V MYVARGIODAII		~	INT		
V 🌩 MyVARGlobal2			INT		
- IoConfig Globals					
- nIoConfigTaskMapCount			DINT		
ninConfinTaskMan		-	POINTER TO InConfinTasiMan		
E I PIC 1995			, , ,		
V . MyVAR1	-	-	INT		
MyVAR2		-	BOOL		
V A MyVARI	-	-	RT AL		

The symbol configuration contains a list of all the variables available in the CODESYS project. Single variables or groups of variables can be selected by checking the corresponding voice in the list.

The xml symbol file is generated when the application is downloaded to the PLC or when the Build > Generate Code command is executed. The file created is stored in the application folder.

#### Communication setup in AGI Creator 2.0.x.xxx

AGI Creator communicates with the internal CODESYS V3 PLC Runtime using the CODESYS V3 ETH protocol. Local host 127.0.0.1 should be entered in the IP Address parameter. This identifies the PLC as an internal CODESYS V3 Runtime.

		Cancel
A105		
IP address	127 . 0 . 0 . 1	
Timeout (ms)	1000	
Full node address		
Variable list count	255	
PLC Models		
CODES1'S 3		

Additional information regarding the CODESYS V3 ETH driver are available in AGI Creator, F1 help > Communication Drivers section.

#### Import symbol files into AGI Creator 2.0.x.xxx

AGI Creator Tag Editor requires direct import of CODESYS V3 symbol file for defining the tags.

Use the command "Import Tags" in AGI Creator Tag Editor to import the symbols generated by the development system.

Select \*.xml as Import Type in the AGI Creator Tag import dialogue box, as shown in the following figure.

Select Controller	CODESYS V3 ETH	•
Select Import Type	".xml	•

CODESYS V3 Development System generates a new version of the \*.xml file each time the PLC project is built.

CODESYS V3 ETH communication driver supports automatic symbol file (SDB) upload from the PLC; the HMI can upload the symbol table from the PLC using the communication protocol.

Any change in the tag offset information, due to a new compilation of the PLC program, does not require manual re-importing of the symbol file.

However, the symbol file must be imported again when:

- Tags have been renamed
- Tags have changed data format
- New tags have been added.

#### **Communication diagnostic**

The AGI 300/400 series can be configured to report communication diagnostic information - also for the communication with the internal PLC Runtime. To display communication diagnostic information, use the proper System Variables or the System Logger. For further information, please refer to the AGI Creator help file.

#### 5. Modbus TCP

CODESYS V3 PLC Runtime can use the built-in Ethernet interface of the operator panels for the distributed Modbus TCP network. No additional hardware is required.

The system can act as Modbus TCP Master or Slave; both configurations are available at the same time.

To add an Ethernet Modbus TCP interface, two steps are required.

Right-click Device (AGI 300 or AGI 400) in the Project tree and select "Add Device". The Add Device dialogue box is now displayed. The Ethernet device is located under the Fieldbusses > Ethernet Adapter category. Choose the Ethernet device from the list and click "Add Device" to add it to the current PLC configuration.

lame: Lthernet					
lction:					
Append device	) Insert device 🕐 Plug device 🔘	Update device			
Device:					
Vendor: <all vendors=""></all>					
Name	Vendor	Version			
B 🗊 Miscellaneou	n				
B- III Fieldbusses					
- can CANbus					
8- MP Ethernet	Adapter				
(2) mbs	met 35 - Smart Software Solu	tions GmbH 3.4.2.0			
D etne					

Right-click Ethernet (Ethernet) in the project tree and select "Add Device".

Modbus TCP Master and Slave devices are located under the categories Modbus > Modbus TCP Master/Slave; select the required device from the list and click on "Add Device" to add it to the current PLC configuration.

me. I		
inte.		
Append device 💮 Insert (	device 🔿 Plug device 🕥 Update device	
evice:		
endor: <al vendors=""></al>		
Name	Vendor	Version
B- 👔 Fieldbusses		
🕸 - 😝 EtherNet/IP		
B- Modbus		
- Modbus ICPI	Tester 35 - Smart Software Solut	tions GmbH 3.5.6.0
B- ModbusTCP S	lave Device	
1.071	CP Slave Device 35 - Smart Software Solut	tions GmbH 3.5.5.0
ModbusT		

#### Modbus TCP master configuration

Modbus TCP master configuration is displayed in the work area by selecting the Modbus TCP Master Configuration tab after a double-click on Ethernet > Modbus TCP Master in the project tree.

General	Modbus-TDP	MODBUS
ModbusTCPMaster I/O Mapping	Response Timeout (ms) 1000	
ModbusTCPMaster Parameters	auto reconnect	
Status		
Information		

Available parameters are:

Element	Description
Response Timeout (ms)	Timeout for Modbus slaves reply, given in milliseconds.
Socket Timeout (ms)	Timeout for socket reply, given in milliseconds.
Auto-reconnect	If set auto-confirm error and re-establish TCP connection.

#### Add and configure remote Modbus TCP slave devices

To add a remote Modbus TCP Slave device, right-click Ethernet > Modbus TCP Master in the project tree and select "Add Device". The Modbus TCP slave devices are located under the category Modbus > Modbus TCP Slave; choose the device from the list and click "Add Device" to add it to the current PLC configuration.

ame: Poppus_rup_alav	e_i		
Action:			
Append device (*) In	sert device (*) Plug device (*) Update	device	
Devices			
/endor: All vandurs>			
Name	Vendor	Version	
8- 🗿 Fieldbusses			
🗟 🎫 Modbus			
H Modbus	TCP Slave		
Mod Mod	But TCP Slave 35 - Smart Software Sol	utions GmbH 3.5.7.0	

The remote Modbus TCP slave configuration is displayed in the Work area by selecting the Modbus TCP Slave tab after a double click on Ethernet > Modbus TCP Master > Modbus TCP Slave in the project tree.

General	Modbus-TCP		
Modbus Save Channel	Slave IP Address:	. 168 . 0 . 1	MUDBO2
Nodbus Slave Init	UNE-ID [1247]	1000	
Modbus ICPslave Parameters	Part	502	
ModbusTCPSlave I/O Mapping			
Status			
Information			

Element	Description
Slave IP Address	IP Address of the Modbus TCP slave device.
Unit-ID	Modbus Node ID of the Modbus TCP slave device
Response Timeout (ms)	Timeout for Modbus slaves reply, given in milliseconds.
Port	TCP port used for the communication with the Modbus TCP slave device.

#### **Configuring Modbus data exchange**

The Modbus data exchange configuration with the Modbus TCP slave can be done in the work area by selecting the Modbus Slave Channel tab after a double click on Ethernet > Modbus TCP Master > Modbus TCP Slave in the project tree.

The configuration is based on channels. For each channel, you can configure a Modbus command that will be sent to the slave. To add a new channel, click the Add Channel button as shown in the following figure. The ModbusChannel dialogue box will now be displayed.

Lanard	Rena AssesType Tripper RUROMuk Longh DnarRanding WIELOMuk Longh Cannack
Alter Dave Channel	
dos Brecht.	
COLUMN REPORT	
thus TOPCaux 10 Harming	
	(mentani
president	Claime
	A DOWN TUPE That Hold and An Dearther Durates Calls 22 a
	Theore Evaluation Conductioned and
	Connect
	Num register
	0ffbe 0x0000 -
	Langh I
	Ever Handbay Sergina alar -
	WAT'T Rejular
	0%x
	Length 1
	OK Caud
	L
	Add Ohennd Dodet

<u>Element</u>	Description
Name	Channel name
Access Type	Selection of the Modbus command.
Trigger	Specifies if the command should be cyclic or rising edge. If cyclic is chosen, then the cycle time (ms) must be specified between each command. If rising edge is chosen, then a command is launched on the rising edge event of a bit variable defined in the Modbus TCP slave I/O mapping.
Comment	User comment if required.
Offset	The starting Modbus address
Length	Number of registers to be read/written

The mapping configuration of the Modbus TCP Slave I/O is displayed in the work area by selecting the Modbus TCP slave I/O mapping tab after a double-click on Ethernet > Modbus TCP Master > Modbus TCP Slave in the project tree. The mapping shows a list of all the Modbus resources read/write in the configured channels. In case the configured channel uses a rising edge triggered command, the trigger bit is listed in the mapping.

General	channels												
	Verlable		Mapping	Channel	Address	Type	Extent Value	Unit	Description				
tothus view channel	1.9			Chernel 8	121/50	ADDAY_		1	Reed Holding				
	5.5	•		Channel 8	10130	WORD		1	00000:				
TENDED Dericans		*		810	5000	8005	FALSE						
tother CPGest Parameters				841	5200	800.	PALTE						
		*		842	767.20	800.	FALSE						
Autors TOPPing Stormourg				813	9,330	800.	PALSE						
				804	1010-	800.	PALSE						
hitus .		*		8.0	50.0	ROG	F0110						
		*		515	363.20	800	PALSE						
formation		*		867	1/2/18	000	TALSE						
		*		0.02	5(5)0	800.	TALSE						
		<b>*</b>		81.0	9,000	8005	FILM						
	-	- <b>`</b> *		5100	5200	800.	PALSE						
		- <b>*</b> *		8411	7627.20	800.	FALSE						
		*		8612	9,310	800.	FALSE						
		- <b>*</b>		0123	92510	800.	PALSE						
		*		8401	500	800	F0119						
		*		Rept.	767.20	800	P11-02						
										Sent maps	<ul> <li>Normal and descent with</li> </ul>	161. The parent desire writing	
	SIC Object	in .											
	Variable		Mapping	Type									
	- 0 H	obut_10_Res	-	Hodbus TCR	Gre								

#### Modbus TCP slave configuration

Modbus TCP slave configuration is displayed in the work area by selecting the Modbus TCP tab after a double-click on Ethernet > Modbus TCP Slave Device in the project tree.



When programmed as explained in this chapter, the CODESYS V3 PLC will act as a Modbus TCP slave device. To configure the device for communication with remote Modbus TCP I/O modules, please refer to the chapter about Modbus TCP master configuration.

Sereral	Configured Parameters			
todhus TCP Slave Device 1/0	V TimeOut:	2000	-	(ms)
Topping	Slave Port:	502	-	
Information	Unit ID:		_	
	Holding Registers (%DV):	10	1	
		10	14	
	- Dela Model			
	- Dala Mudei Start Addresses:			
	Dela Model Start Addresses: Colls:	0	A.	
	Dela Model Start Addrasses: Colls: Discrete Inputs:	0 U	1	
	Dela Model Start Addrasses: Colls: Discrete Inputs: HoldingRegister:	0 U	10 A	
	Dela Model Start Addrasses: Colls: Discrete Inputs: HoldingRegister: Input Register:	0 U 0		

Element	Description
Timeout	If selected, timeout for Modbus Master queries, given in milliseconds.
Slave port	TCP port used for the communication with the Modbus TCP Slave device
Unit-ID	Modbus Node ID of the Modbus TCP slave device
Holding Registers (%IW)	Number of holding registers available in PLC memory
Input Registers (%QW)	Number of input registers available in PLC memory
Start address	Starting address for Modbus resources in PLC

The Mapping configuration of the Modbus TCP slave device is displayed in the work area by selecting the Modbus TCP Slave Device I/O Mapping tab after a double-click on Ethernet > Modbus TCP Slave Device in the project tree.

2 C C C C C C C C C C C C C C C C C C C	and the second s										
	Tatalate	Mapping	Channel	Address	1294	Default Table	Unit.	Desception			
Madeual ICP Calls Church (CC	0.5		20070	101/30	ARRAY DUST OF WORD			Modula reliding Aspirtut			
	* *		Syste(2)	52450	WOND .						
phormation	* *		Inputs[1]	40451	W040						
	* *		ine-mG2	16132	w040						
	* *		Instal 3	76732	w040						
	**		2 pula [4]	925/14	9090						
	8-9		Spate[5]	92048	W080						
	* *		Instances.	767726	w000						
	* *		2646(2)	52427	10/0100						
	1 m		20/02(9)	52018	1002						
	8-9		Devia (P)	100099	WORD						
	1 m		Outputs	50450	TWATA (274) ON MOVE			Masilian Input Registers			
								Sec 6 manying	Durys optim calabire	UN DAVIT SHIDS HETTO	
	IEC Objection							Tau of manying	Dury cyclotracial contractor	un anno Arra Maria	
	IX Opens	Maging	Tree					Zau di manjing	) Durge update undet for	an awar fe-ta mare	
	IX Opens Takan - 9 Robust77,50	Magging Mc.Tr. 🍞	Туря	us107Sae				fas 6 misorra	) Durps quintr casialize	an awar fe-ta mare	
	20 Objects Tables —	Mapping 14_7z - <sup>15</sup> g 14 - <sup>1</sup> g + 10	Type hOverbolk	us 1095ae usadis				Ta d aver	] Burge option satisfier	(JH 24475 ÅH 3 H 375	
	Zi Olyms Yalaba 	Mapping Hatter Tig D Tig + Hi	Type bith with age	us1095ee usabis				fas 6 macmy	) itaya galar analara	נאן באיזיד לאיים אולדים	
	ECOlymes Facilita — 9 Robustles — 1 Robustle	Maping nette 🍃	Type MC-Mode and exchange	ist095ee usalib				Ten of majoring	a baye getter satisfies	(JH 24497 34-93 H 37-5	

#### 6. Modbus RTU

CODESYS V3 Runtime can use the built-in serial interface of the HMI device for the distributed Modbus RTU network. One single serial interface is available as built-in option for the AGI 300/400 series HMI. With the use of optional plug-in modules, it is possible to have up to three serial interfaces on the device.

The system can act as Modbus RTU master or slave; both configurations are available at the same time.

To add a Modbus RTU interface, two steps are required.

Right-click on Device (AGI 300 or AGI 400) in the project tree and select "Add Device". The Add Device dialogue box is now displayed. The Modbus COM device is located under the Fieldbusses > Modbus > Modbus Serial port category, choose the Modbus COM device from the list and click on "Add Device" to add it to the current PLC configuration.



Right-click on Modbus COM in the project tree and select "Add Device". Modbus RTU Master and Slave devices are located under the Fieldbusses > Modbus > Modbus Serial Master/Device categories. Choose the required device from the list and click "Add Device" to add it to the current PLC configuration.

Add Device		
Name: Modbus_COM		
Action:		
Append device 💮 Insert device 🔿 Pagin	renor 🕐 Update device	
Device:		
Vendor: <a>All venders&gt;</a>		3
Name	Vendor	Version
🗟 🎯 Fieldbusses		
🖹 🛤 Modbus		
🗃 🛤 Modbus Serial Device.		
Modbus Serial Device	35 - Smart Software Solutions GmbH	3.5.5.0
🖷 💷 Modbus Serial Master		
- 🗐 Modbus Master, COM Port	35 - Smart Software Solutions GmbH	3.5.5.0

#### Modbus RTU serial port configuration

Modbus RTU serial port configuration is displayed in the work area by selecting the Modbus Serial Port Configuration tab after a double click on Modbus COM in the project tree.

General	Serial Port Configuration	
Status	COM Port	1
Marca and	Baud Rate	1200 ·
Information	Parity	EVEN -
	Data Bits	8
	Stop Bits	1

Available parameters are:

Element	Description
COM Port	Serial COM Port number (1-4).
Baud Rate	Communication Baud Rate.
Parity	Communication Parity.
Data Bits	Communication Data Bits.
Stop Bits	Communication Stop Bits.

The communication mode for the selected serial port is displayed in the work area by selecting the Interface Parameters tab after a double-click on Device (AGI 300 or AGI 400) in the project tree. The mode of the serial interface parameter is RS-232, RS-485, RS-422.

Communication Settings	Parameter	Туре	Value	Default Value	Unit	Description
	Serial Interfaces					
Applications	Mode COM1	Enumeration of INT	R5232	R5232		Mode of COM1
Files	Mode COM2	Enumeration of INT	RS232	RS232		Mode of COM2
r iies	Mode COM3	Enumeration of INT	R5232	R5232		Mode of COM3
Log	- 🌒 Mode COM4	Enumeration of INT	R5232	R5232		Mode of COM4
PLC settings						
PLC shell						
Users and Groups						
Users and Groups Access Rights						
Users and Groups Access Rights Interface Parameters						
Users and Groups Access Rights Interface Parameters Task deployment						
Users and Groups Access Rights Interface Parameters Task deployment Status						
Users and Groups Access Rights Interface Parameters Task deployment Status						

#### Modbus RTU master configuration

Modbus RTU master configuration is displayed in the work area by selecting the Modbus Master Configuration tab after a double-click on Modbus COM > Modbus Master COM in the project tree.

General	Modbus-RTU/ASCII		
ModbusGenericSerialMaster I/O Mapping	TransmissionMode	@ RTU 💿 ASCII	MUDROS
Data a	Response Timeout (ms)	1000	
status	Time between Frames (ms)	10	
Information	auto restart communicatio	an	
	L		

Available parameters are:

Element	Description
Response Timeout (ms)	Timeout for Modbus slaves reply, given in milliseconds.
Time between frames (ms)	Waiting time between slave reply and next master query.
Auto-restart communication	If set, auto-confirm error and re-establish communication.

#### Add and configure remote Modbus RTU slave devices

To add a remote Modbus RTU slave device, right click on Modbus COM > Modbus Master COM in the project tree and select "Add Device". Modbus RTU slave devices are located under the category Fieldbusses > Modbus > Modbus Serial Slave. Choose the device from the list and click "Add Device" to add it to the current PLC configuration.

11. 11. A 11.				
lame: Modbus_Slave	ECON Port 1			
Action:				
Append device	Treat device (1) Plug d	invite 🔿 Update device		
Device:				
and the second sec				
Vendor: <al th="" vende<=""><th>ers&gt;</th><th></th><th></th><th></th></al>	ers>			
Vendor: <all vend<br="">Name</all>	945	Vendor	Version	
Vendor: <all vend<br="">Name = ) Fieldbusses</all>	975>	Vendor	Version	
Vendor: All vend Name = I Fieldbusses = Int Modbus	dia	Vendor	Version	
Vendor: All vend Name Fieldbusses int Modbus int Modbus	ors> I Ibus Serial Save	Vendor	Version	

Remote Modbus RTU slave configuration is displayed in the work area by selecting the Modbus Slave Configuration tab after a double-click on Modbus COM > Modbus Master COM > Modbus Slave COM Port in the project tree.

			MODBUS
fodbus Slave Channel	Slave Address [1247]	þ.	Muubua
fodbus Slave Init	Response Timeout [ms]	1000	
fodbusGenericSerialSlave1/0 fapping			
Ratus			
nformation			

Element	Description
Slave Address	Modbus Node ID of the Modbus RTU slave device
Response Timeout (ms)	Timeout for Modbus slaves' reply, given in milliseconds.

#### **Configuring Modbus data exchange**

Modbus data exchange configuration with the Modbus RTU slave can be done in the work area by selecting the Modbus slave channel tab after a double-click on Modbus COM > Modbus Master COM > Modbus Slave COM Port in the project tree.

The configuration is based on channels. For each channel, you can configure a Modbus command that will be sent to the slave. To add a new channel, click the Add Channel button, as shown in the following figure. The ModbusChannel dialogue box will be displayed in the page, allowing you to set up the channel.

	Res to a level severe of the severe langer of the severe set
General	Name Longs Type Trippe MichOfusi Longh Res-Konding WRTEDRot Longh Consumi
Perios Bare Cranel	
Nodes Reality	
Repling	
Satura	Modeu:Danvel miciae
Monston	Ourest
	Xas Zand
	Access Tros usual sealers expertents (-surantee cade a) •
	Theore Cade  Orde Time Imp 200
	Connect
	KONONY .
	0fme br000 •
	leash 1
	Ensymptotic device +
	And Long
	DR CHON
	Add Chemel. Delde. DR.

Available parameters are:

<u>Element</u>	Description
Name	Channel name
Access Type	Selection of the Modbus command.
Trigger	Specifies if the command should be cyclic or rising edge. If cyclic is chosen, then the cycle time (ms) must be specified between each command. If rising edge is chosen, then a command is launched on the rising edge event of a bit variable defined in the Modbus TCP slave I/O mapping.
Comment	User comment if required
Offset	The starting Modbus address
Length	Number of registers to be read/written

Mapping configuration of the Modbus RTU slave is displayed in the work area by selecting the Modbus Generic Serial Slave I/O Mapping tab after a double click on Modbus COM > Modbus Master COM > Modbus Slave COM Port in the project tree. Mapping shows a list of all the Modbus resources read/write in the configured channels. In case the configured channel uses a rising edge triggered command, the trigger bit is listed in the mapping.

General	channels			_				
	Variable	Mapping	Channel	Address	Туре	Default Value	Unit	Description
Modbus Slave Channel	8- 🍫		Channel 0	%IW50	ARRAY			Read Holding
	🚊 🔧		Channel 0	%IW50	WORD			0000
Modbus Slave Init	- *		Bito	%EX10	BOOL	FALSE		
ModbusGenericSenalSlave1/0	- *>		Bit1	%DX10	BOOL	FALSE		
Mapping	- <b>*</b> >		882	%EX10	8001	FALSE		
9 alux	- 🍫		Bit3	95DX10	BOOL	FALSE		
	- *		Bit4	%DX10	BOOL	FALSE		
Information	- *>		DHS	%DX10	BOOL	FALSE		
	- *		Bit6	%EX10	800L	FALSE		
	- 🍫		Bit7	95DX10	BOOL	FALSE		
	- *		Bit8	%DX10	BOOL	FALSE		
	- *>		Dit9	%DX10	BOOL	FALSE		
	- *>		Bit10	%EX10	B00L	FALSE		
	- *>		Bit11	96DX10	BOOL	FALSE		
	- *>		Bit12	%DX10	BOOL	FALSE		
	- *>		0(t13	%DX10	BOOL	FALSE		
	- *>		Bit14	%EX10	BOOL	FALSE		
	- 🍤		Bit15	%DX10	800L	FALSE		

#### Modbus RTU slave configuration

Modbus RTU slave configuration is displayed in the work area by selecting the Modbus Serial Device tab after a double-click on Modbus COM > Modbus Serial Device in the project tree.



When programmed as explained in this chapter, the CODESYS V3 PLC will act as a Modbus RTU slave device. To configure the device for the communication with remote Modbus RTU I/O modules, please refer to the chapter Modbus RTU master configuration.

General	Unit ID:	1
Modbus Serial Device I/O Mapping	✓ Time Out:	2000
Information	Holding Registers (%IW):	: 10
	Input Registers (%QW):	10

Available parameters are:

Element	Description			
Unit-ID	Modbus Node ID of the Modbus TCP slave device			
Timeout	If selected, timeout for Modbus Master queries, given in milli- seconds			
Holding Registers (%IW)	Number of holding registers available in PLC memory			
Input Registers (%QW)	Number of input registers available in PLC memory			

Mapping configuration of the Modbus RTU Slave device is displayed in the work area by selecting the Modbus Serial Device I/O Mapping tab after a double-click on Modbus COM > Modbus Serial Device in the project tree.

fame.	Channelli .									
	truke.	Mapping	Channel	Abben	free	Orlink Inter Unit	Designan			
Hudiya briel beine (Cheering	* *		jepute	1010	AREA (\$1.0) (F with)		Photos mining Pagetee			
Mundae	**		54646	4048	4601 (1.10) / with .		Notice (generations			
							And reading	-	International sectors	
	AC Intentio									
	a hone, brief, brief, bri		labornut.	a fan de s						
		1.1.1		10.00						
	A - page to result.									

#### 7. CAN master

CODESYS V3 Runtime can act as a CAN master to allow the use of distributed CANopen I/O points. To interface the operator panel with CAN network, one of the available CAN optional modules must be installed.

The following figure shows AGI 304 and AGI 307 with the optional CANopen module mounted.



To add a CANopen master interface, two steps are required.

Right-click Device (AGI 300) in the project tree and select "Add Device". The Add Device dialogue box is now displayed. The CAN bus device is located under the category Fieldbusses > CANbus. Choose the CAN bus device from the list and click "Add Device" to add it to the current PLC configuration.

Action:			
Append device	🗇 Inset device 🔘 Plug device 🔘	Update device	
Device:			
Vendor: <all th="" vend<=""><th>iors&gt;</th><th></th><th></th></all>	iors>		
Name	Vendor	Version	
	us		
Miscellanec			
Miscellaneo     Fieldbusser			
Fieldbusses	the Dr. Court Collinea Cal		

Right-click CANbus in the project tree and select "Add Device". The CANopen manager device is located under the category Fieldbusses > CiA CANopen > CiA CANopen Manager. Choose the CANopen Manager device from the list and click "Add Device" to add it to the current PLC configuration.



The parameters of the CAN interface are grouped in three tabs accessible on the right part of the PLC configuration tool when the CAN master element has been added to the configuration tree.



A complete and detailed description of the configuration of CAN controllers and the configuration of CAN slave devices is included in the CODESYS user manual.

#### CAN bus network configuration

The CAN bus configuration is displayed in the work area by selecting the CANbus tab after a double-click on CANbus in the project tree.

All operator panel models of type AGI 315x (1GHz ARM CPU) can support two CAN networks.

CANbus	Status (	Information	
Netwo	ork:	0 💠	CON
Baudr	rate (bit/s):	250000	СНИ

Available parameters are:

Element	Description
Network	CAN network number 0 is default, in case double CAN network configuration Network 1 is used for the second CAN network.
Baud rate (bit/s)	CAN network Baud rate.

#### CANopen master configuration

The CANopen master configuration is displayed in the work area by selecting the CANopen Manager tab after a double-click on CANbus > CANopen Manager in the project tree.

Cillipen Hanager 🗰 CA	Name LO	Hatery Status 0	Interneted		
Germal					
Node ID: 127		Deck and fix to	ellipiration	CAI	noqo
SZ Admitet CAluped	inge:	[2] Participal reptions	1912-00		
E Start Stares		ANT Ever Behaviour	Restart Save		•
NHT SHITA I (*)	(eldine				
les:					
E Brabla Sync Product	4				
008-ID (Hex) 354	201				
Cycle Period (jul)	1000	141			
Window Length (jul)	12200	10			
E Braine Sure Carave	10				
Harbert		124	ē.		
2 Dable Heatbeat P	dana)	1	Enable T2HE A	hiducig	
Node III	127	16	(xer) G-803	10.0 (10)	
Producer Time (ms):	200	183	Paduce Deal	0%43: 0000	

<u>Element</u>	Description			
Node ID	CAN node number assigned to the CAN master.			
Autostart CANopen manager	If selected, the CANopen manager starts automatically if all mandatory slaves are ready. If not selected, the manager must be started by the application, using the CiA405 NMT function block for this purpose.			
Polling of optional slaves	If an optional slave does not respond during start-up sequent the system polls the slave every second until the slave respon- successfully.			
Start slaves	If selected, the CAN master starts the slaves automatically. Otherwise, the start operation must be done in the application.			
NMT Start All	If the start slaves option is selected, it is possible to enable NM <sup>-</sup> Start All function. This function will start all the slaves at the same time when all the slaves are ready. If not enabled, each slave is started separately.			
NMT error behaviour	This option allows you to determine the behaviour on a guard event; the available options are Restart Slave or Stop Slave.			
Enable sync producing	Enable the sending of sync telegrams on the CAN bus.			
COB-ID (Hex)	COB-ID of the sync message, standard ID is 128 (80 Hex).			
Cycle Period (µs)	Time interval between two sync messages, given in microseconds.			
Window length (µs)	Length of the time window for synchronous PDOs, given in microseconds.			
Enable sync consuming	If selected, the sync messages are supposed to be produced by a different device on the CAN network; the CANopen manager will receive such messages.			
Enable heartbeat producing	If selected, the master sends heartbeat messages on the CAN network.			
Node ID	CAN identifier of the heartbeat messages producer (1-127).			
Producer time (ms)	Time interval between two heartbeat messages, given in milliseconds.			
Enable TIME producing	If selected, the master sends TIME messages on the CAN network.			
COB-ID (Hex)	COB-ID of the TIME messages, default value is 256 (100 Hex).			
Producer time (ms)	Time between two time messages, given in milliseconds. Must be a multiple of the task cycle time.			

#### **Diagnostic mapping**

When a CAN master device is added to the PLC configuration, the system automatically creates a variable of the type CANOpenManager in the project. This variable contains the diagnostic information about the CAN master.

The variable name is assigned by default but can be changed by changing the I/O module name in the PLC configuration. The variable is reported in the CANopen I/O mapping tab, displayed in the work area by double-clicking the CANbus > CANopen Manager in the project tree, as shown in the following figure.

General	IEC Objects	IEC Objects			
	Variable	Mapping	Туре		
CANopen I/O Mapping	@ CANopen_Manager	**	CANOpenManager		
Status					
Information					
	-				
	11				

#### Definition of CAN I/O slaves in the PLC configuration

After the setup of the CAN master, the structure of available CAN I/O slaves can be defined.

To add a CANopen I/O slave, right-click CANopen Manager in the Project tree and select "Add Device". The Add Device dialogue box is now displayed. The list of available CANopen I/O slaves is located under the Fieldbusses > CiA CANopen > CiA Remote Device category. Choose the device from the list and click "Add Device" to add it to the current PLC configuration.

Add Dev	ce		
eme: E	MF AS CZ 3A 1		
Actions			
Appen	d device (*) International (*) Prop device (*) 60	Jpdate device	
-			
landor	(All senders)		
renuori	CALIFORDIST	100 100 100	2.00
Name		Vendor	Ver
= (3) r	ieldbusset		1
= 0	A CANopen		
	Cin Remote Device		
	AR52102_SoftMotion	Metronix GmbH	3.5.
	AR52105MOL_SoftMotion	Metronix GmbH	3.5.
	ARS2107_SoftMotion	Metronix GmbH	3.5.
	AR52302_SoftMotion	Metronix GmbH	3.5.
	the second s		



Installation of third part CAN slaves in CODESYS V3 requires a specific EDS descriptor file, provided by the CAN slave manufacturer. Please refer to the CODESYS manual for detailed information regarding the installation of the EDS files.

#### **Settings for CAN slaves**

The configuration for the CAN slaves has a common part, which is independent of the EDS file. The next figure shows the CANopen Remote Device tab of a CAN slave displayed in the work area, after a double-click on CANbus > CANopen Manager > CAN SLAVE NAME in the project tree. The parameters shown in the figure can be shown by selecting the Enable Expert Settings option.



For specific information regarding the setup of the CAN slaves, please refer to the documentation provided by the CAN slave manufacturer.

PDOs	General Node ID: 1	SD0 Channels	(1/1 active)	CANopen
500s	🖉 Enable Expert Settin	gs 📄 Optional Device		
ANopen I/O Mapping	Enable Sync Produc	ing 📄 No initialisation	Reset Node:	Sub:001 •
tatus	A Nodeguarding			
	Enable Nodeguardin	na	Enable Heartbeat	Producing
nrormation	Guard Time (ms):	ů 👘	Producer Time (ms):	0 .
	Ufe Time Factor:	0	Heartbeat Con	suming (0/0 active)
	.⊿ Emergency		A TIME	
	Enable Emergency		Enable TIME Prod	ucing
	COB-ID:	\$NODEID+16#80	COB-ID (Hex):	100
			Enable TIME Cons	uming
	.∉ Checks at Startup			
	Check Vendor ID	Check Product Number	Check Revision N	lumber

Parameters available differ, depending on the chosen slave:

<u>Element</u> Node ID	<b>Description</b> CAN node number of the CAN slave device $(1 - 127)$ .
Create all SDOs	When selected, the SDO messages for the slave configuration, depending on the PDO mapping, are created for all objects. When selected, the SDO messages for the slave configuration, depending on the PDO mapping, are created for all objects. When not selected, the SDO messages for the slave configuration are created only for the modified objects. In this latter case, please make sure that the EDS file loaded in CODESYS V3 matches the hardware device features. Otherwise, some required SDO messages will be erroneously skipped.
Enable sync producing	If selected, this device sends sync messages on the CAN network. This option is selectable only if the sync messages production at the CANopen master side is disabled.
No initialisation	If selected, the sequence of SDO messages required for the device initialisation (PDO mapping) will not be created.
Optional device	If selected, the current device is considered as optional in the bus. At start-up, the CAN controller will check if it is at present applying the following rules:
	If the device has been present since start-up and correctly replies to the CANopen mandatory object "Device Type" query (matching the EDS file specification), then it is started. The master will continue with the next device.
	If the device has been present since start-up and it does not reply as expected to the "Device type" query, it is not started. The master then stops, reporting a mismatching error in the CAN configuration; if the "Optional device" with not-matching "Device Type" is inserted in the bus after start-up, the master will skip it and continue to scan the other devices.
	If the device is not present since start-up, it is simply skipped. The master will continue with the next device.

#### 8. Internal controller hardware

This chapter describes some implementation-specific issues in the CODESYS V3 PLC Runtime developed for use with the AGI 300/400 series HMI products.

#### The CAN interface

The optional CANopen module includes a CAN bus interface implemented according to the CAN protocol specifications 2.0 A.

This CAN controller only supports standard frame format (2.0 A) with bit rates up to 1 Mbit/s.

The following transfer functions have been implemented:

- Transfer rate and timing
- Message framing (Part A)
- Arbitration accordingly to Part A specifications
- Automatic retransmission in case of lost arbitration or error detection
- Acknowledgement
- Message validation
- Error detection and error signalling
- Global identifier masking (for 11-bit and 29-bit long identifiers)
- Interrupt or data polling-driven software supported
- Automatic transfer of data frame (prepared in SDRAM buffer) triggered by one bit setting
- Automatic receipt of data packets with the allowed frame identifier
- 32 separated SDRAM memory buffers for data packets having the node corresponding ID
- Fully implemented CAN error fault confinement
- Automatic detection of bus off state
- Detection of the heavily disturbed CAN bus and warning

Programming the parameter BaudRateKbps at the value 0 enables the use of custom timing.

The resulting Baud rate is calculated using the formula: Bit frequency = 8 MHz/(Prescaler \* (1 + Tsetup + Thold))

Valid values for parameters are:

- Prescaler: 1 to 64
- Tsetup: 1 to 8
- Thold: 1 to 4

Other two parameters can affect the behaviour of the CAN controller:

- SyncJumpWidth: defines the number of time quanta (8 MHz/Prescaler) allowed to accept a SYNC pulse. Valid values are 1 to 4.
- SampleMode: defines the number of times the bit is sampled before it is considered valid. Valid values are 0 (1 sample) and 1 (3 samples).

#### **Timer resolution**

The resolution of CODESYS V3 timers is 1 millisecond. When a timer value is defined, it is internally translated to the corresponding number of milliseconds.

The resolution of the internal real time clock is 1 millisecond allowing the maximum resolution of timers. Note that the execution time of the PLC programme may apparently affect the resolution of timers.