AC500 PLC and ABB ACS355 Drive via Modbus RTU with ABB Standard Library

1 Description

This application note will take you through the hardware installation and configuration of ABB ACS355 Drives and eCo PLC with Modbus RTU communication. The AC500 ABB-specific ready-made function blocks and visualizations from the PS553- DRIVES library will be used for the control of the drives.

2 Objectives:

The personal computer will connect to PLC via Ethernet port and eCo PLC control drive via Modbus RTU connection. Here is the equipment list for this application note

Description	Quantity
PC with Automation Builder V1.x software installed	1
ABB eCo CPU PM556 ETH CPU	1
CAT5 Ethernet Patch cable	1
ACS355 Drive with FMBA-01 adapter card	1
Twisted pair shielded cable for RS-485 connection	1

3 Connection diagram

PC with Automation Builder



ACS355 Drive



Modbus RTU connection

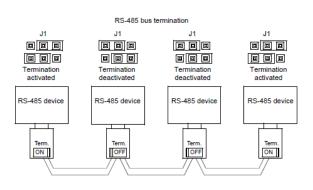
AC500 eCo ETH CPU



4 Wiring diagram:

ACS355 drive's FMBA-01 adapter card

X1			Description
	1	SHLD	Bus cable shield. Connected internally to GND_B via an RC filter and directly to CH_GND (chassis).
ØØØØ	2	DATA_B	Data positive
3 DATA_A		DATA_A	Data negative
	4	GND_B	Isolated signal ground



AC500 eCo CPU's COM2 Modbus RTU wiring diagram:

The pin assignment of the serial interface COM2:

1 [🔘	1	Terminator P
2[⊗	2	TxD/RxD-P
3[⊗	3	TxD/RxD-N
4 [⊗	4	Terminator N
5[\@]	5	Functional earth

- 4.1 Connect ACS355 drive's pin 2 to PLC's pin 2
- 4.2 Connect ACS355 drive's pin3 to PLC's pin 3
- 4.3 Connect ACS355 drive's pin4 to PLC's pin 7
- 4.4 Connect the shield to drive's pin 5
- 4.5 Jumper PLC's pin1 to pin 2
- 4.6 Jumper PLC's pin3 to pin 4
- 4.7 Verify the wiring and terminators are active a. Jumpers on the FMBA-01
- 4.8 Wire terminals 1&2 and 3&4 (optional) Using just the CPU, apply power to the PLC
 - 4.9 Launch Automation Builder and create a new project



5 Create new PLC project in Automation Builder software tool:

5.1 Double click on ABB Automation Builder software tool 🛄 icon on the desktop.

(If Automation Builder icon is not available on your desktop, click **Start**, go to **All Programs**, select **ABB** folder and click on **Automation Builder** software tool.)

- 5.2 The Automation Builder Screen will appear as shown below, if Internet access is available Automation Builder will show the default ABB homepage for PLC products
- 5.3 Create a new project by clicking the New button or selecting the File > New Project
- 5.4 Enter project name as shown in example below: AC500 and ACS355 with Modbus RTU project
- 5.5 Select the location to store the project in PC
- 5.6 Select OK to start the project

6 Specifying the hardware configuration:

To specify the hardware configuration, the I/Os and their symbolic names have to be defined. Configure your I/O by double clicking I/O (Onboard I/Os) and refer to the mapping tab window opened on the right side where you can give variable names to each I/O points.

- 6.1 Double click AC500 (PM564-ETH) on the left to open this hardware menu
- 6.2 Change the value of Check battery from **ON** to **OFF** (if no battery present for this example)

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evices 🔹 🏚	X PLC_AC500				
My First eCo R.C project	PMS64-ETH Configuration MS64-ETH Hardwa	re Information			
PLC_AC500 (PM564 ETH)	Parameter	Type	Value	Default Value Unit	Description
CEID (501+600+2AI+1A0)	- Brow LED / Falcafe function	Enumeration of BYTE	On	On	Error LED off by error dass
🗐 10_Bus	Check battery	Enumeration of BYTE	Off	On	Check battery state (if Off and no battery then no error message)
a Interfaces	Behaviour of outputs in stop	ENUMERACION OF BYTE	utt in naroware and online	utt in hardware and online	Behaviour of outputs on stop Off in hardware and online Off in hardware and actual state online Act
(COM1_Online_Access (COM1 - Online Access)	Stop on error dass	Enumeration of BYTE	E2	E2	Stop PLC program by error class
C COM2_None (COM2 - None)	🕈 Warnstart	Enumeration of BYTE	Off	off	Warmstart on E2 failure
= 25 Ethernet	Reaction on floating point exception	Enumeration of BYTE	E2 failure	E2 failure	Reaction on floating point exception
्वि ETH1 (ETH1)	Flexible configuration	Enumeration of BYTE	None	None	Flexible configuration
Protocols (Protocols)	Flexible configuration timeout	WORD(0_65535)	1000	1000 s	Flexible configuration timeout
	Free wheeling pause	BYTE(0255)	10	10 ms	Free wheeling pause
	Start PERSISTENT %R80.x	WORD(0.,1023)	0	0	Set start address for PERSISTENT segment in area %R80.x
	End PERSISTENT %R80.x	WORD(01023)	0	0	Set end address for PERSISTENT segment in area %RB0.x

7 Setup the Ethernet communication in Windows:

Before you are able to download the compiled program the first time from the PC to the PLC, you have to setup the communication parameter. There are two options you can use to login to the PLC, either with Ethernet or serial with TK503 USB cable.

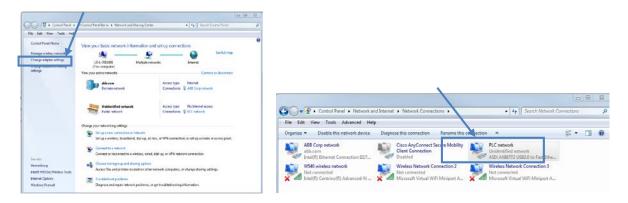
For this exercise, we are using Ethernet connection for online access to this PLC.



Make sure that your PC address is in the same class as the CPU's IP address. The factory setting of the CPU for IP address is **192.168.0.10**. Then the IP of the PC should be **192.168.0.x**, **x** should be different number than **10** so that it will not have an IP conflict with the CPU. Subnet mask should be **255.255.255.0**.

To change the IP address in your PC:

- 7.1 Windows Control Panel > Network and Internet > Network and Sharing Center
- 7.2 Click on Change adapter settings
- 7.3 Select Local Area Connection (in this example is PLC network connection below) and right click it to open the menu.



Choose **Properties** (the status is active when the Ethernet connection between PC and PLC is active)

- 7.4 Select Internet Protocol Version 4 (TCP/IPv4) and double click to see properties.
- 7.5 Type in your desired IP address and subnet mask then click OK.

ſ	PLC network Status	PLC network Properties	ersion 4 (TCP/IPv4) Properties 🛛 💡 🔀
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	IPv6 Connectivity: No network access Media State: Enabled Duration: 01:04:22	This connection uses the following terms	P address automatically wing IP address:
	Speed: 100.0 Mbps	Client for Microsoft Network P address: P address:	192 . 168 . 3 . 249
		☑ ☐ QoS Packet Scheduler Subnet mask: ☑ ☐ File and Printer Sharing for Microsoft Vetworks Default gatew ☑ Internet Protocol Version 4 (TCP/IPv4) Default gatew	255.255.0
	Activity	✓	server address automatically wing DNS server addresses:
	Bytes: 99,128 538,848	Install Uninstall Properties Preferred DNS Description Transmission Control Protocol/Internet Protocol. The default	
	Properties Sizable Diagnose	wide area network protocol that provides communication	ttings upon exit Advanced
l	Close	OK Cancel	OK Cancel

8 Setup the IP address in Automation Builder software:

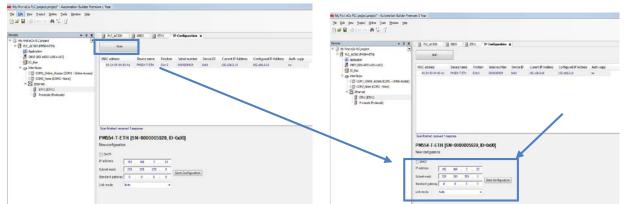
8.1 Make sure the CPU's RUN switch is STOP position

8.2 Click IP-Configuration to access Scan tool

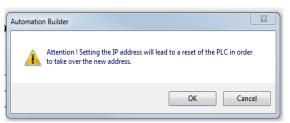


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	Remote configuration
	ABBNetConfig protocolactive

- 8.3 Click on Scan button for searching active PLC on the network
- 8.4 Highlight the active IP address in the search window
- 8.5 Change the IP address to new IP address such as **192.168.3.20**
- 8.6 Click on Send Configuration button to send new IP address to PLC.



- The warning message window display is shown below for this change.
- This screen shows the progress of IP address settings is sending to CPU. Wait about 30 seconds for CPU to register new IP address (the RUN and ERR lights are flashing during this process).
- Click OK to accept this new IP address for this CPU.



 Press "Scan" button again to verify the IP address of CPU. This window shows the Configured IP address sent to CPU successfully. This IP address will be used in IEC 61131-3 CoDeSys to download your PLC project to CPU.

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9 Modbus RTU setup in Automation Builder software

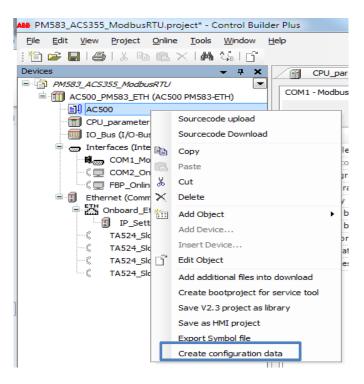
- 9.1 Right click on COM2_None> Add Object
- 9.2 Select COM2-Modbus then click Replace object to accept the changes.

Devices		o FIETH1 Protocols	COM2_None	~
PM564_ACS355_ModbusTCP_Final ACS00_eCo (PM564-ETH) AC500_eCo (PM564-ETH) AC500				^
OBIO (6DI+6DO+2AI+1AO)	Replace object : COM2_No	ne		x
F IO_Bus = → Interfaces - \$ ↓ COM1_Online_Access_1 (COM1 - Online Access)	Object path: AC500_eCo\Interfaces\C	OM2_None		
© COM2_None (COM2 - None)	Object name: COM2	_Modbus		
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	⊞- Serial protocols	Name	Version Order Number	Short Desc
		COM2 - ASCII	2.4.1.0	
		COM2 - Modbus	2.4.1.0	
		COM2 - Multi		
		COM2 - Online Access	2.4.1.0	
		•	III	•
	Close this dialog after ea	ach transactie 🥅 Display all versions		
	Reset filter	Rej	place object 0	Close

9.3 Set the configuration as shown below

COM2 - Modbus Configuration	Modbus Server Settings		_		
Parameter	Туре	Value	Default Value	Unit	Description
🕋 🌵 Enable login	Enumeration of BYTE	Disabled	Disabled		Check for CoDeSys login
RTS control	Enumeration of BYTE	Telegram	None		RTS control must be set to 'telegram' for RS485 !
Telegram ending value	WORD(065535)	3	3		Set the telegram ending value in ms or characters
🔷 🖗 Baudrate	Enumeration of DWORD	19200	19200	Bits/s	Set the baudrate in Bits per seconds
🖤 🖗 Parity	Enumeration of BYTE	None	even		Set the parity Bit type
🔷 Data Bits	Enumeration of BYTE	8	8	Bits/character	Set the character size
🖤 < Stop Bits	Enumeration of BYTE	1	1		Set the number of stop Bits per character 2 means 1,5 when character size is 5
Run on config fault	Enumeration of BYTE	No	No		Start PLC program even on configuration fault
Operation mode	Enumeration of BYTE	Client	None		Set the operating mode
Address	BYTE(0255)	0	0		Set the address of the device (Note: Client requires address 0)

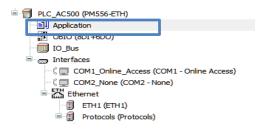
- 9.4 Click File > Save Project to save the configuration settings for this lab.
- 9.5 Right click on AC500.
- 9.6 Click **Create Configuration data** to save the settings before go to CoDeSys window.





10 IEC61131-3 Application (CoDeSys):

10.1 Double-click "Application" from the Device tree in the Automation Builder project to open CODESYS.

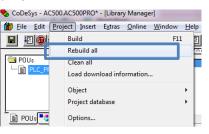


- 10.2 Create the variables in Global variables tab
 - Double-click "Global Variables" in the "Resources" tab (1)
 - a. Create a global variable for the Modbus token handling of type
 - "ACS_MOD_TOKEN_TYPE" (2). This variable will be used for passing a token to all drives on the Modbus RTU line

ScoDeSys - AC500.AC500PRO* - [Global_Variables]	
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1	ONLINE OV READ

11 Create PLC logic

11.1 Compile your project, choose "Rebuild all" from the "Project" menu



11.2 Right-click "PLC_PRG" in the "POUs" tab and choose "Convert Object"
11.3 Choose Target Language "FBD" and click "OK"

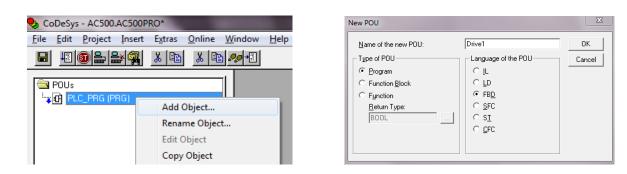
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TOU:	Loading	library 'C:\Program Files\Common	Files\CAA-Targets\ABB_ACS
	Add Object Rename Object		
🖹 POUs 🃲 Data 📰 V	Edit Object Copy Object		ь
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Convert Object				×
Converting POU:	PLO	_PRG		OK
New POU name:	PLO	PLC_PRG		
Target Langua	je			
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- 11.4 Right-click in the POUs field and choose "Add Object"
- 11.5 Set Type of POU to "Program" and Language of the POU to "FBD"



11.6 Give the new Program a suitable name 11.7 Click "OK"

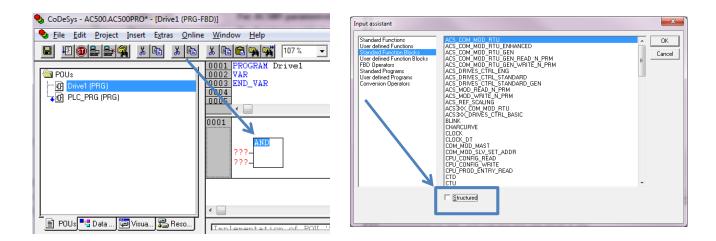


- 11.8 Double-click "PLC_PRG" (1) to open the main program
- 11.9 Select the dotted box (2) in Network 0001 and insert a box(3)
- 11.10 Naming of your new Program : Drive1 (PRG) in to call for it from the main program

-		G-FBD)]
ScoDeSys - AC500.AC500PRO* - [PLC_PRG (PF	G-FBD)]	e <u>W</u> indow <u>H</u> elp
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POUs Drive1 (PRG) PLC_PRG (PRG)	0002 VAR 3 0003 END_VAR 0004 0004	0003 END_VAR 0004 0005
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- 12 Create ACS_COM_MOD_RTU Function Block
 - 12.1 Double-click your new program and add a box as described previously
 - 12.2 Press F2 while the block title is selected and choose "ACS_COM_MOD_RTU" from "Standard Function Blocks"
 - 12.3 Click "OK"

(Tip: uncheck the "Structured" box in the Input assistant).





- 12.4 Give the instance of the drive access block a suitable name (1)
- 12.5 Declare the variable of type "ACS_COM_MOD_RTU" (2)

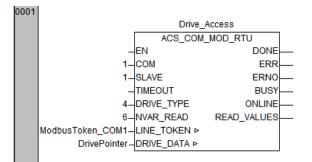
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13 ACS_COM_MOD_RTU Function Block's parameter setup

- 13.1 Set EN to TRUE
- 13.2 Set the com port to 1
- 13.3 Set the slave ID to 1
- 13.4 Set the drive type to 4 (ACS355)
- 13.5 Set "ACS_COM_MOD_RTU" block input "NVAR_READ" according to number of parameters

to be read

- 13.6 Connect the global token (created earlier) to LINE_TOKEN
- 13.7 Connect the variable **DrivePointer** to DRIVE_DATA
 - a. Define DrivePointer: ACS_DRIVE_DATA_TYPE



Create ACS_DRIVES_CTRL_STANDARD Function Block

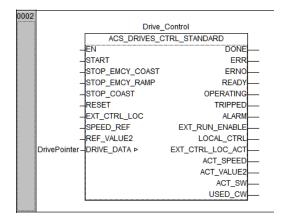
- Create a second network (Ctrl +T) in the same program and add the block "ACS_DRIVES_CTRL_STANDARD" in the same way as for "ACS_COM_MOD_RTU"
- Setup the block as shown below.



14 ACS_DRIVES_CTRL_STANDARD Parameter setup

- Connect the variable **DrivePointer** to DRIVE_DATA
- Select DrivePointer: ACS_DRIVE_DATA_TYPE

Note! The variable connected to "ACS_DRIVES_CTRL_STANDARD" \rightarrow "DRIVE_DATA" must be the same as the one connected to "ACS_COM_MOD_RTU" \rightarrow "DRIVE_DATA" and must be of type "ACS_DRIVE_DATA_TYPE"



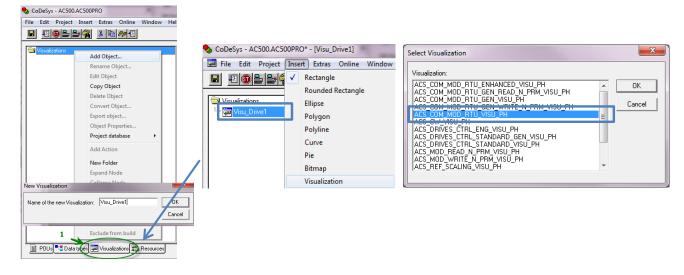
Here is the complete PLC codes for this project:

💊 CoDeSys - AC500.AC500PRO - [Drive1	(PRG-FBD)]	
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15 Create the ACS_COM_MOD_RTU Visualization screen:

- 15.1 Right-click "Visualizations" in the "Visualizations" tab (1)
- 15.2 Choose "Add Object", give the visualization page a suitable name
 - a. E.g. Visu_Drive1
- 15.3 From the new page, choose "Visualization" from the "Insert" menu and draw a box
- 15.4 Select Visualization "ACS_COM_MOD_RTU_VISU_PH"

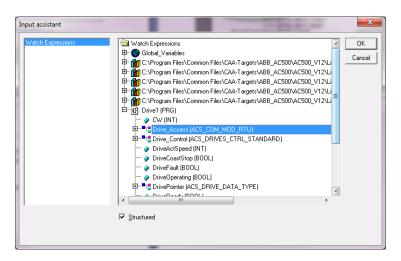


- 15.5 Double-click the new visualization object for Settings and click "Placeholder"
- 15.6 Select the "Replacement" field and press F2

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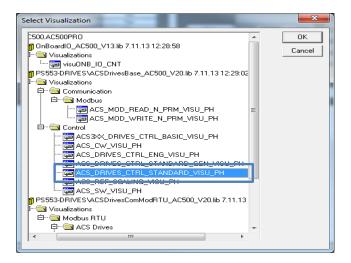
15.7 Select the function block as shown below





16 The ACS_DRIVES_CTRL_STANDARD Visualization

- 16.1 On the same page, create a visualization window for the drive control
- 16.2 Repeat the previous steps to insert a visualization object
- 16.3 Select Visualization "ACS_DRIVES_CTRL_STANDARD_VISU_PH"

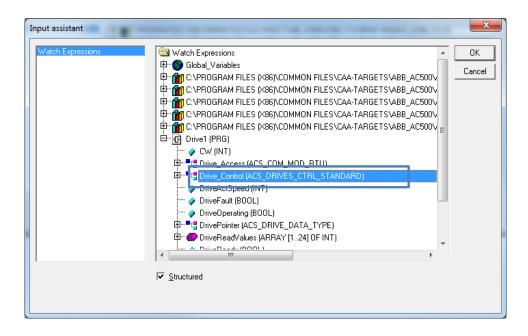


16.4 Double-click the new visualization object for Settings and click "Placeholder".16.5 Select the "Replacement" field and press F2.

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													- H	%5	EN	DONE		%	5
		÷.											- III	%5	START	ERR		%	s
														%S	EMCY_COAST	ERNO		%	s
													- III	%S	EMCY_RAMP	READY		%	s
													- II	%5	STOP_COAST	OPERA	TING	%	s
													- II	%5	RESET	TRIPPE	D	%	s
													· 💾			ALARN	1	%	s
			-				-	-	-	-	-	-	·Π			EXT_R	UN_EN	%	s
							-	-	-	-	<u> </u>	-	· .			LOCAL	CTRL	%	s
Vi	sual	lizati	ion											100	\$100 (1778), 1.00	- 23	RL_LOC	%	s
,	Cate																EED	%	ŝ
	Visu			_	_	_										ок	. UE 2	%	8
IP.	Text		ables					/isu	alizat	tion:	_ /	ACS.	DRIV	ES_CTRL_S	TAN		1	%	s
Шı	Colo	rvari	ables	5			1		Pla	ceho	der					Cancel	w	%	s
l li		on at	bsolu				~	-					~				_		
	Moti Varia		lativ	e				7	Drav	,	_	_		Cold	1				
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Ŀ	Secu	uity							Anis	otron	in			Alarm o					
	Pilog	ramn	nabili	ŵ					Isotr					Augurn C					
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							L		- see	1 and	1 50	ollat	24						

16.6 Select the function block as shown below





16.7 The screen should look as shown below

		I_MOD_RTU FBS		.		ACS_DRIVES_C	TRL_STANDARD				
%s	EN	DONE	%s	\$FB\$							
%s	COM	ERR	%s	ŀ	%s	EN	DONE	%s			
%s	SLAVE	ERNO	%s		705		DONE	705			
%s	TIMEOUT	BUSY	%5		%s	START	ERR	%s			
%s	DRIVE_TYPE	ONLINE	%5		%s	EMCY COAST	ERNO	%s			
%s	NVA R_READ	WriteErrCnt	%5					/05			
		La stW rite Err	%5		%s	EMCY_RAMP	READY	%s			
		ReadErrCnt	%s		%s	STOP COAST	OPERATING	%s			
		LastReadErr	%5			_	OFERATING	/03			
%s	MCW	MSW	%s		%s	RESET	TRIPPED	%s			
%s	RefValue1	ActValue1	%s				ALARM	%s			
%s	RefValue2	ActValue2	%s								
	-	r embedded modbus					EXT_RUN_EN	%s			
%s	DATA_ IN1	DATA_IN13	%5				LOCAL CTRL	%s			
%s	DATA_IN2	DATA_IN14	%5		_						
%s	DATA_IN3	DATA_IN15	%5		%s	EXT_CTRL_LOC	EXT_CTRL_LOC	%s			
%s	DATA_IN4	DATA_IN16	%s		%s	SPEED REF	ACT SPEED	%s			
%s	DATA_ IN5	DATA_IN17	%s								
%s	DATA_ IN6	DATA_IN18	%s		%s	REF_VALUE2	ACT_VALUE 2	%s			
%s	DATA_IN7	DATA_IN19	%s				ACT SW	%s			
%s	DATA_IN8	DATA_IN20	%s				-				
%s %s	DATA_IN9	DATA_IN21	%s %s				USED_CW	%s			
%5	DATA_IN1 0	DATA_IN22	%5								
	DATA_IN1 1	DATA_IN23	%5		MESSAG	E	%s				
%s	DATA_IN1 2	DATA_IN24	765								

17 Download program to PLC

- 17.1 Save the program and choose "Communication Parameters" from the "Online"
 - menu.
- 17.2 Set communication Parameters according to your online connection
- 17.3 The CPU's IP address will be assigned per user's choice.



😍 CoDeSys - AC500.AC500PRO - [Drive1 ([PRG-FBD)]		
CoDeSys - AC500AC500PRO - Drive1 (File Edit Project Inset Extras	and the second s	Communication Parameters Channels Channels Coal AC500_Default_TC Name Value Comment Address 192168.0.10 IP address or hostname Port 201 Motorola byteorder Yes	OK Cancel New Remove
	Step over Step in Single Cycle Write Values Force Values Release Force Write/Force-Dialog Show Call Stack Display Flow Control Simulation Mode Communication Parameters		Gateway

17.4 Choose "Login" from the "Online" menu and in the following pop-up window, click "Yes"
17.5 Choose "Run" from the "Online" menu to start the PLC

17.6 Check that the PLC goes to "RUN" mode

Note! If the PLC does not go to "RUN" mode, you might have some PLC errors that you need to reset. You can do that either by pressing the "DIAG" button on the PLC itself (not in the eCo series) followed by the "OK" button until all errors are reset. You can also do it in online mode by using the "diagreset" command from the "PLC Browser" in the CODESYS "Resources" tab.

18 Create boot project

In "online" mode (Login), choose "Create boot project" from the "Online" menu. With this command, the compiled project is stored to the flash in such a way that the PLC will load it automatically when restarted

CoDeSys - AC500.AC500PRO - [Drive]	. (PRG-FBD)]	
🎭 Eile Edit Project Insert Extras	Online Window Help	
🖬 📲 🗊 🛷 + 🖩 🚔 🙀 👗	Login	Alt+F8
	Logout	Ctrl+F8
	Download	
Drive1 (PRG)	Run	F5
	Stop	Shift+F8
	Reset	
	Reset (cold)	
	Reset (original)	
	Ta unia Paralua sint	F9
	Toggle Breakpoint Breakpoint Dialog	19
	Step over	F10
	Step in	F8
	Single Cycle	Ctrl+F5
	Write Values	Ctrl+F7
	Force Values	F7
	Release Force	Shift+F7
	Write/Force-Dialog	Ctrl+Shift+F7
	Show Call Stack	
	Display Flow Control	
	Simulation Mode	
	Communication Parameters	
	Write file to PLC	
	Read file from PLC	
	Send marked text to RemoteControl Master (e.g. as parameter)	
	Create boot project	
	Show file information	



19 Run The Program

- 19.1 Go online
- 19.2 verify the PLC is in run mode
- 19.3 reset the Drive if needed
 - a. Click on the start button on ACS_DRIVES_CTRL_STANDARD block
 - b. Enter a SPEED_REF on ACS_DRIVES_CTRL_STANDARD block
 - c. The speed ref is in counts (+/- 20,000)
 - d. Refer to drive parameters 11.05 for scaling
- 19.4 Verify the motor running status.

20 ACS355 drive's parameters setup:

- 20.1 Power up the drive
- 20.2 Enter/verify the parameters as shown below
- 20.3 Drive power down and power up for the new fieldbus settings to take effect!

Parameter	Description	Value	Comment
98.02	COMM PROT SEL	STD MODBUS	Activates fieldbus module
53.02	EFB STATION ID	1	Modbus RTU node address of the drive
53.03	EFB BAUD RATE	19.2 kbit/s	Transfer rate of the link. Same baud rate must
53.04	EFB PARITY	8 NONE 1	Parity and stop bits. Same parity and stop bits
53.05	PROFILE	ABB DRV FULL	Communication profile "ABB Drives"
53.10	EFB PAR 10	101	Actual speed feedback
53.11	EFB PAR 11	303	Status Word
10.01	EXT 1 COMMANDS	COMM	Fieldbus interface as source for start and
11.02	EXT1/EXT2 SEL	COMM	Fieldbus interface as source to switch to
11.03	REF1 SELECT	COMM	Fieldbus interface as source for speed reference
11.05	REF1 MAX	1500rpm	Max speed/frequency scaling value (used in function block/visualization input "SPEED_REF_MAX"). Must be less or equal to drive parameter max speed/frequency.
16.04	FAULT RESET SEL	COMM	Fieldbus interface as source for fault reset
53.12	Bus Voltage (107)	107	Actual value
53.13	Temp Deg C (110)	110	Actual value
53.14	Al-1 % (120)	120	Actual value
53.15	Frequency (103)	103	Actual value
53.16	Current (104)	104	Actual value
53.17	Torque (105)	105	Actual value

NOTE: These parameter must be filled in or communications will not work correctly!

- 20.4 Cycle the drive power
- 20.5 Test the PLC codes with these parameters.

