



AC20 Series

Modbus RTU– Communication Option

Technical Manual

DOC-0017-11-EN-B
04.04.2023



ENGINEERING **YOUR** SUCCESS.

1 Safety

IMPORTANT: Please read this information BEFORE installing the equipment.

1.1 Intended Users

This manual is to be made available to all persons who are required to install, configure or service equipment described herein, or any other associated operation.

The information given is intended to highlight safety issues, and to enable the user to obtain maximum benefit from the equipment.

Complete the following table for future reference detailing how the unit is to be installed and used.

INSTALLATION DETAILS	
Model Number (see product label)	
Where installed (for your own information)	

1.2 Application Area





The equipment described is intended for industrial motor speed control utilizing AC induction motors or AC permanent magnet synchronous machines.

1.3 Personnel

Installation, operation, and maintenance of the equipment should be carried out by competent personnel. A competent person is someone that is technically qualified and familiar with all safety information and established safety practices; with the installation process, operation, and maintenance of this equipment, and with all the hazards involved.

1.4 Product Warnings

Special attention must be paid to the information presented in warning, caution, and information notices when they appear in this manual. Definitions of caution, warning and information notices are shown below:

 DANGER Risk of electric shock	 WARNING Hot surfaces	 Caution Refer to documentation	 Earth/Ground Protective Conductor Terminal
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Application Risk

The specifications, processes and circuitry described herein are for guidance only and may need to be adapted to the user's specific application. We cannot guarantee the suitability of the equipment described in this Manual for individual applications.

Risk Assessment

Under fault conditions, power loss or unintended operating conditions, the drive may not operate as intended. In particular:



- Stored energy might not discharge to safe levels as quickly as suggested and can still be present even though the drive appears to be switched off.
- The motor's direction of rotation might not be controlled
- The motor speed might not be controlled
- The motor might be energised

A drive is a component within a drive system that may influence its operation or effects under a fault condition. Consideration must be given to:

- Stored energy
- Supply disconnects
- Sequencing logic
- Unintended operation

1.5 Safety Information

Risk of Electric Shock

	DANGER!	
	Ignoring the following may result in injury:	
	<ul style="list-style-type: none"> - This equipment can endanger life by exposure to rotating machinery and high voltages. - The equipment must be permanently earthed due to the high earth leakage current, and the inverter motor must be connected to an appropriate safety earth. - Ensure all incoming supplies are isolated before working on the equipment. Be aware that there may be more than one supply connection to the inverter. - There may still be dangerous voltages present at power terminals (motor output, supply input phases, DC bus and the brake, where fitted) when the motor is at standstill or is stopped. - For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range. CAT I and CAT II meters must not be used on this product. - Allow at least 5 minutes for the inverter's capacitors to discharge to safe voltage levels (<50V). Use the specified meter capable of measuring up to 1000V dc & ac rms to confirm that less than 50V is present between all power terminals and between power terminals and earth. - Unless otherwise stated, this product must NOT be dismantled. In the event of a fault the inverter must be returned. Refer to "Routine Maintenance and Repair". 	

Safety & EMC Requirements

Where there is a conflict between safety and EMC requirements, personnel safety shall always take precedence.



WARNING!

Ignoring the following may result in injury or damage to equipment:



- Never perform high voltage resistance checks on the wiring without first disconnecting the inverter from the circuit being tested.
- Whilst ensuring ventilation is sufficient, provide guarding and /or additional safety systems to prevent injury or damage to equipment.
- When replacing an inverter in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.
- When replacing an inverter in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.
- All control and signal terminals are SELV, i.e. protected by double insulation. Ensure all external wiring is rated for the highest system voltage.
- Thermal sensors contained within the motor must have at least basic insulation.
- All exposed metalwork in the Inverter is protected by basic insulation and bonded to a safety earth.
- RCDs are not recommended for use with this product but, where their use is mandatory, only Type B RCDs should be used.



WARNING!

Ignoring the following may result in injury or damage to equipment:



- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.
- This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.
- This is a product of the restricted sales distribution class according to IEC 61800-3. It is designated as "professional equipment" as defined in EN61000-3-2 for. Permission of the supply authority shall be obtained before connection to the public low voltage supply.

2 Manufacturing Location

Germany

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Parker Hannifin Manufacturing Germany GmbH & Co. KG - Sitz: Bielefeld - Amtsgericht: Bielefeld HRA 15699
persönlich haftende Gesellschafterin: Parker Hannifin GmbH - Sitz: Bielefeld - Amtsgericht Bielefeld HRB 35489
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3 Waste Electrical and Electronic Equipment (WEEE)



Waste Electrical and Electronic Equipment - must not be disposed of with domestic waste. It must be separately collected according to local legislation and applicable laws.

Parker Hannifin Company, together with local distributors and in accordance with EU directive 2002/96/EC, undertakes to withdraw and dispose of its products, fully respecting environmental considerations. For more information about how to recycle your Parker supplied waste equipment, please contact your local Parker Service Centre.

Packaging

During transport our products are protected by suitable packaging. This should be taken for central disposal as secondary raw material.

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5 Introduction

5.1 Product Features


- Galvanically isolated bus electronics via DB9F female connector
- Supports all common baud rates up to 115200bps(bits/s)
- RTU (8bit) and ASCII (7bit) support
- Serial communications over RS485 or RS232
- Modbus message forwarding
- Diagnostic support
- Communication and Device Status LEDs



6 Installation


DANGER!

RISK OF ELECTRIC SHOCK




Terminal covers, main covers, and cover fixings must remain in place while the drive is energized.

These should only be removed once the supply to the unit and/or system has been disconnected, and the residual energy in the DC link capacitors has been discharged.




CAUTION!

ESD SENSITIVE EQUIPMENT



Take ESD precautions when handling the Communication Interface Option Cards to avoid any risk of damaging the equipment.



- All activities covered in this chapter should be carried out when there is no power to the inverter.
- If the drive has been powered up, ensure enough time has elapsed that the inverter has discharged its residual energy.
- Always check that the voltages on the user terminals are at a safe level (<50V) before carrying out any of these activities.

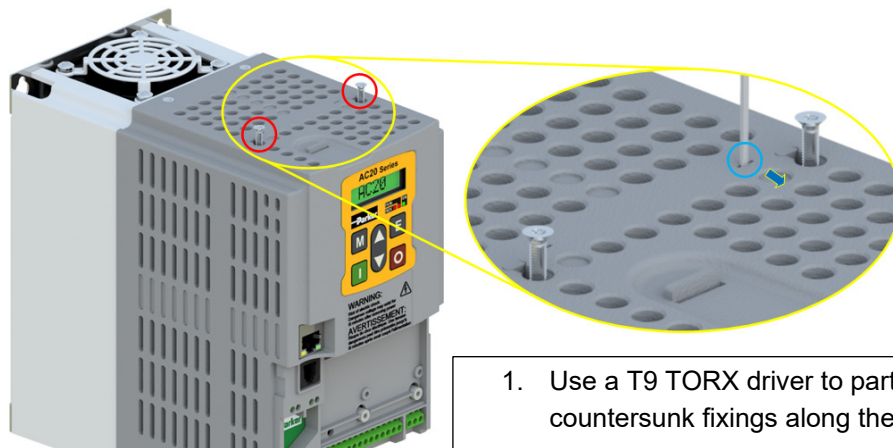
6.1 Order Codes

Order Code	Description
2003-CB-00	CANopen communication interface option card
2003-EC-00	EtherCAT communication interface option card
2003-IP-00	Ethernet IP communication interface option card
2003-PB-00	Profibus DP-V1 communication interface option card
2003-PN-00	PROFINET IO communication interface option card
2003-RS-00	RS485 Modbus RTU communication interface option card

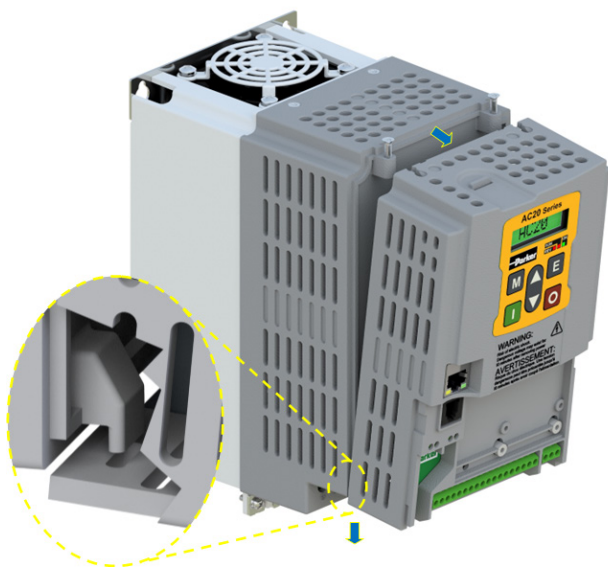
6.2 Fitting the Option

Frames 2 – 5

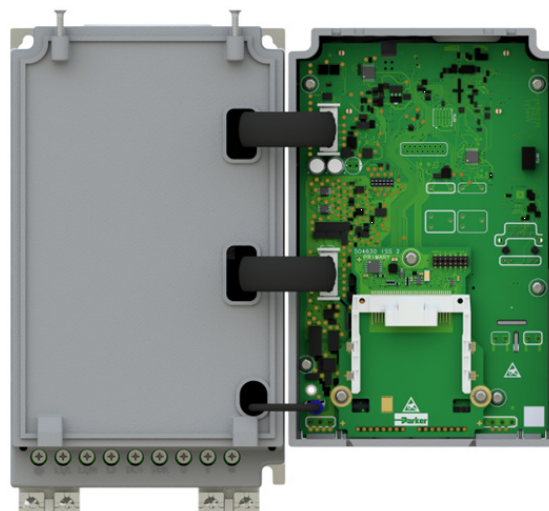
The Communication Interface Option Cards are intended to be customer installed. The control module housing cover will need to be removed prior to option card installation.



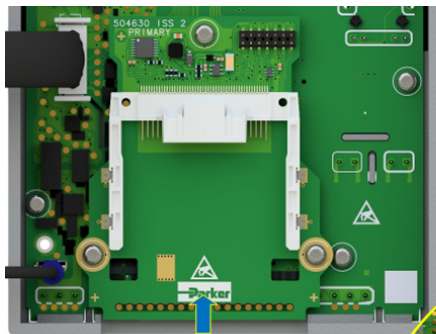
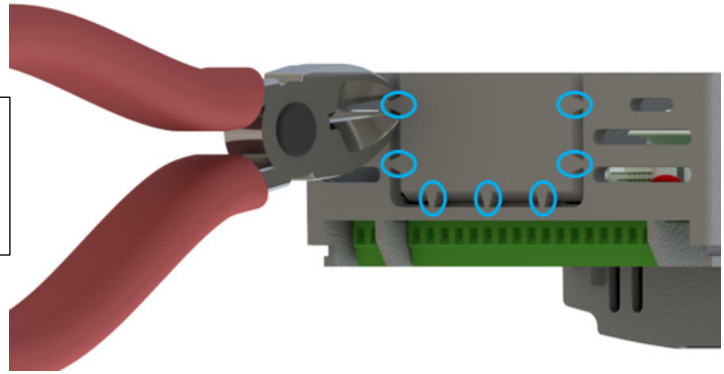
1. Use a T9 TORX driver to partially unscrew the two 3x12 countersunk fixings along the top of the product.
2. Insert a flat head screwdriver into the moulding features and lever the control module housing away from the power



3. Unhook the bottom of the control module housing from the power stack.
4. Gently turn the control module upside down so it rests to the right of the power stack, with the interface cables still connected.



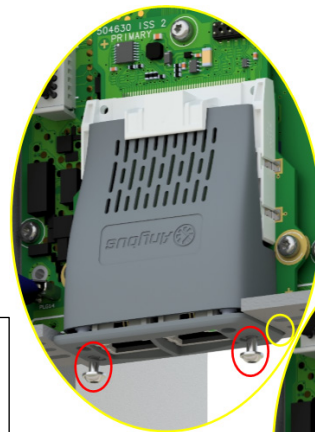
- Remove and discard the Comms Option break-out feature in the control module housing by cutting the 7x bridges using suitable small side cutters.



- Remove the Comms Interface Option card from its packaging.

- Slide the Comms Card along the PCB using the connector features for alignment.

Note: The front facia of the Option should be loose at this point.



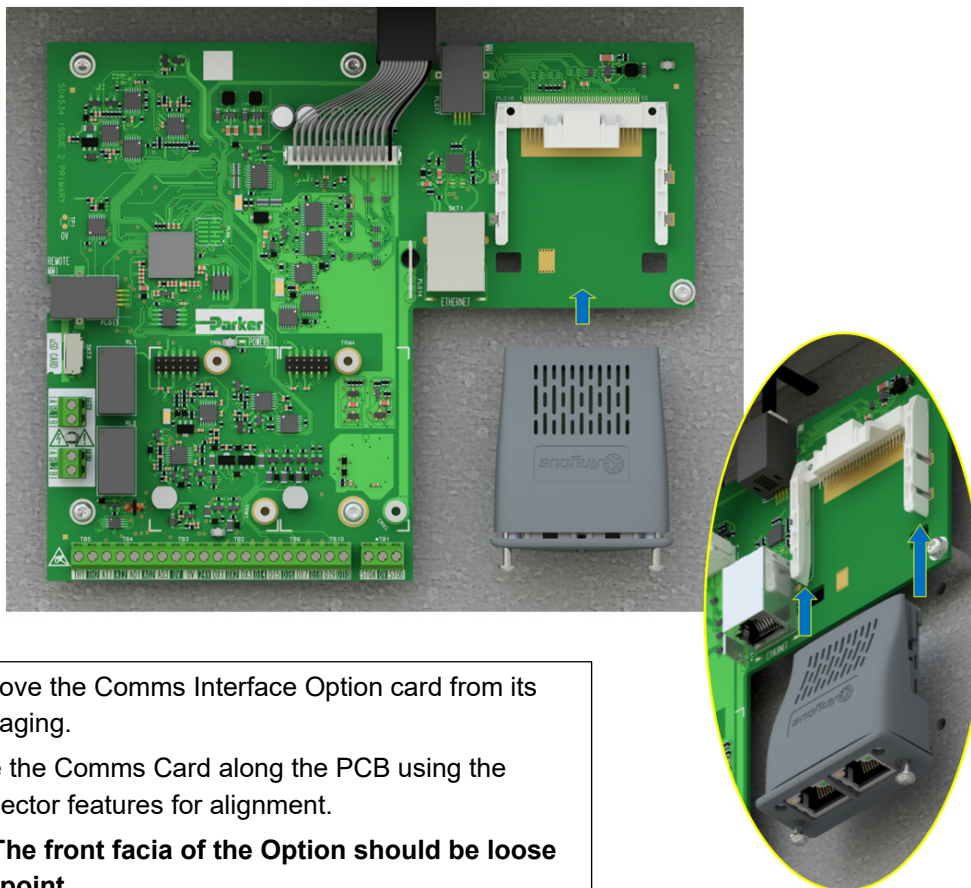
- Now fully tighten the two T8 screws on the front facia of the Communication Interface Option Card.
- Check that the Option Card is secure and that it cannot slide out.
- Reassemble the product by performing the reverse process of steps 1 – 4.



In the event that the Communication Interface Option Card needs to be removed, follow the installation process, but perform steps 7 and 8 in reverse.

Frame 6 – 10

On Frames 6 – 10, the lower terminal cover will need to be removed prior to option card installation.



1. Remove the Comms Interface Option card from its packaging.
2. Slide the Comms Card along the PCB using the connector features for alignment.

Note: The front fascia of the Option should be loose at this point.



3. When the Comms Interface Option Card is fully engaged in the connector and its housing has hooked onto the edge of the PCB, fully tighten the two T8 screws on the front fascia.
4. Check that the Option Card is secure and that it cannot slide out.

In the event that the Communication Interface Option Card needs to be removed, perform steps 2 & 3 in reverse.

7 Network

7.1 Network Connector and Cable Specification

Modbus RTU Connectors

1xD-Sub socket male, 9 pole. The Modbus interface is galvanically isolated and provides both RS-232 and RS-485.

Pin	Direction	Signal	Description
1	-	GND	Bus polarization, ground (isolated)
2	Output*	5V	Bus polarization power +5V DC (isolated)
3	Input	PMC	Connect to pin #2 for RS-232 operation. Leave unconnected for RS-485 operation.
4	-	-	-
5	Bidirectional	B-Line	RS-485 B-Line (+)
6	-	-	-
7	Input	Rx	RS-232 Data Receive
8	Output	Tx	RS-232 Data Transmit
9	Bidirectional	A-Line	RS-485 A-Line (-)
Housing	-	PE	Protective Earth

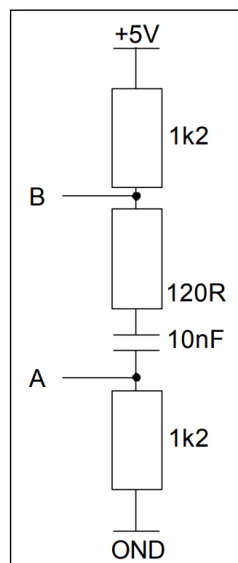
*Any current drawn from this pin will affect the total power consumption.

Cable

Use of CAT5E STP or FTP screened cable is recommended.

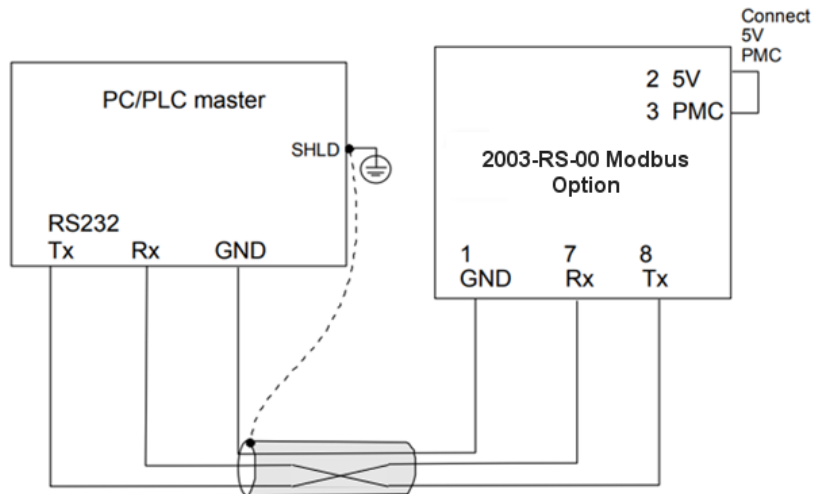
Terminators and Biasing

- The illustrated example assume the Master/PLC has a terminating and biasing network built in.
- Both ends of the network need terminating. 120Ω 1/4W in series with a 10nF (10V min) cap is recommended where an AC20 is at the end of the network. For other devices, check the manual to see if it has internal or switchable terminators.
- The network also needs to be biased. Typically, the Master/PLC will do this. If it does not, use the combined biasing and terminating scheme at one end of the network:

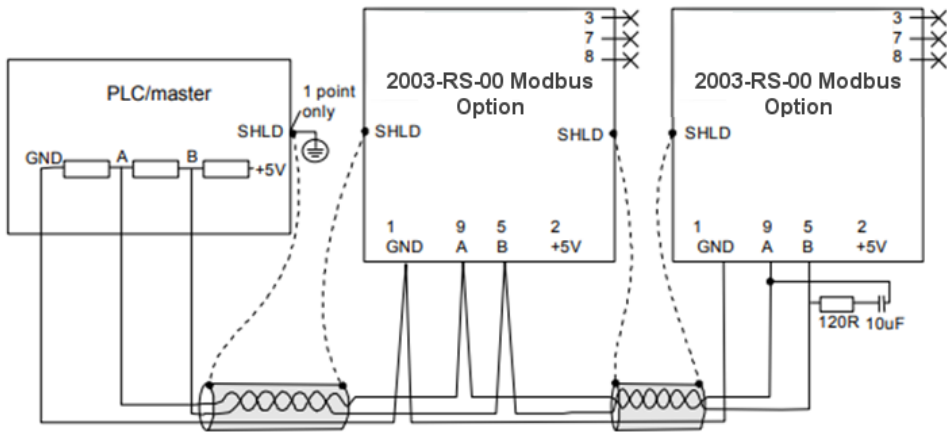


RS-232 Wiring Diagram Example

Suitable for short connections <3m only.



RS-485 Wiring Diagram Example



7.2 LED Indications



Communication (COM) LED

LED State	Description
Off	No power - <i>or</i> - no traffic
Yellow	This LED will flash during correct reception and transmission (20 ms on, 40 ms off)
Red	A fatal error has occurred

Device Status (DS) LED

LED State	Description
Off	Initializing - <i>or</i> - no power
Green	Module initialized, no error
Red	Internal error - <i>or</i> - major unrecoverable fault
Red, single flash	Communication fault or configuration error Case 1: Invalid settings in Network Configuration. Case 2: Settings in Network Configuration has been changed during runtime (i.e. the settings do not match the currently used configuration)
Red, double flash	Application diagnostics available

8 Configuration

The option comms configuration is accessible through the keypad under the menu **Option Comms**, through DSE Lite function block **Option Comms Config** or through the webserver following the path **Home > Engineer > Communications > Option Comms**.

The AC20 Modbus option requires configuration of both communication parameters and process data mapping.

8.1 Communication parameters

Keypad Menu Path	DSE-Lite Function Block	Webserver
<pre> graph TD Setup[Setup] --> Communication[Communication] Communication --> Option[Option] </pre>	<p>Option Comms Config</p> <pre> COMMS FITTED NONE COMMS VERSION(0) 0 COMMS VERSION(1) 0 COMMS SERIAL NUM 0x00000000 COMMS STATE NONE DIAGNOSTIC OK EXCEPTION CODE 0x0000 COMMS SUPERVISED FALSE MAPPING CHANGED FALSE STATION NAME IP ADDRESS 0.0.0.0 SUBNET MASK 0.0.0.0 GATEWAY ADDRESS 0.0.0.0 ACTUAL BAUD RATE AUTO NONE EXTERNAL 0.0.0.0 0.0.0.0 0.0.0.0 0x001E 0 AUTO 19200 BPS EVEN 1 STOP FALSE 0 TRUE COMMS REQUIRED ADDR ASSIGNMENT SET IP ADDRESS SET SUBNET MASK SET GATEWAY ADDR ACCESS NODE ADDRESS CANOPEN BAUD MODBUS BAUD RATE PARITY HIGH WORD FIRST ACTIVE TIMEOUT MASTER MAPPING </pre>	<p>Home ► Engineer ► Communications ► Option Comms</p> <pre> 0691: Comms Required NONE 0769: Comms Fitted UNKNOWN 0770: Comms Version + 0773: Comms Serial Num 00000000 0774: Comms State NONE 0775: Diagnostic OK 0776: Exception Code 0000 </pre>

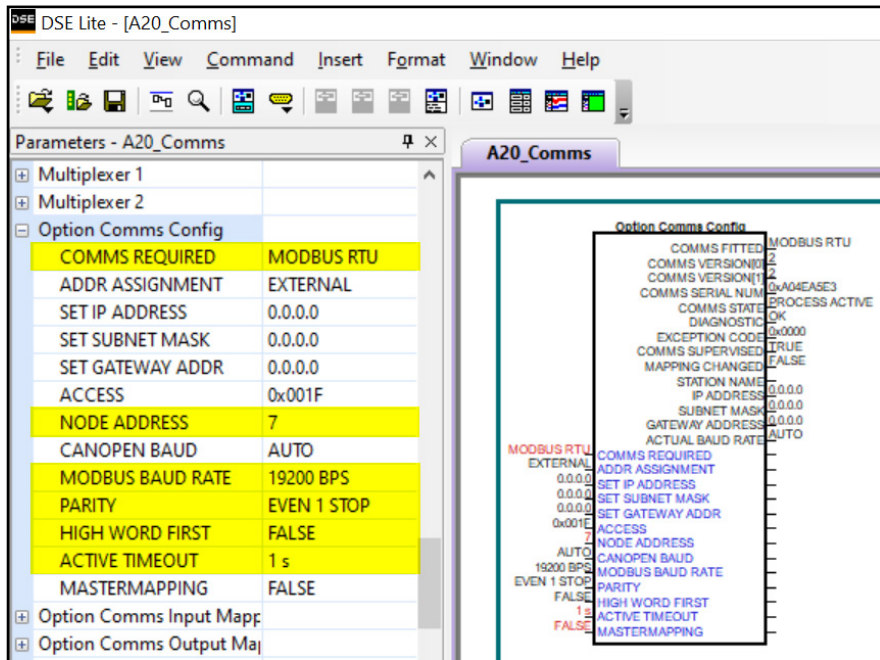
The network parameters of the slave must be set to establish communication with the master.

- The parameter **0691 COMMS REQUIRED** must be set to **MODBUS RTU**.
- On Modbus, each device on the network must be assigned a unique node address, the **0763 NODE ADDRESS** parameter must be set to the required address for the slave. The range is 1 - 247.
- The slave supports all common baud rates up to 115.2kbps, the **0765 MODBUS BAUD RATE** parameter must be set to the required baud rate for the network.
- The slave supports Odd/Even/None parity; 1 or 2 stop bits, the **0766 PARITY** parameter must be set to match of the network.
- The **0767 HIGH WORD FIRST** parameter specifies the network word order of 32-bit parameters. If set TRUE, then the high word (most significant word) will be sent first.
- The **0768 ACTIVE TIMEOUT** parameter specifies how long the module shall stay in the PROCESS ACTIVE state after receiving a Modbus request. If this is set to zero, then the module will remain in the PROCESS ACTIVE state after receiving the first Modbus request.

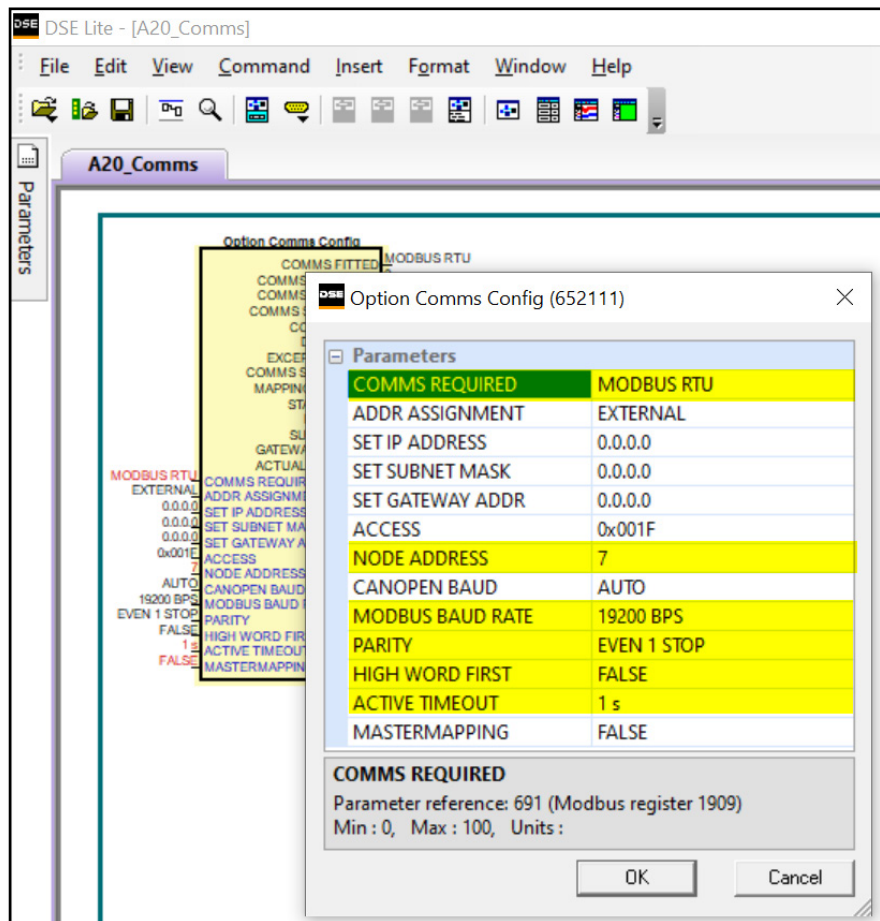
Configuration with DSE Lite

When performing an online configuration, the fitted option card will automatically be selected.

In offline mode, display your configuration page in DSE Lite and click the plus sign [+] at the left of function block **Option Comms Config** to see set communication parameters.



Alternatively, perform the steps described above by double clicking on the function block **Option comms config** to open parameters tab in the configuration interface.



Configuration with the webserver

Access the AC20 webserver by typing the IP-Address of the drive into the web browser.
 The drive must be in configuration state. Set the Modbus Option comms parameters as shown below.

The screenshot shows the Parker AC20 webserver interface. At the top left is the Parker logo. Below it are navigation tabs: Summary, Parameters, and Passwords. A dropdown menu shows 'ENGINEER' and a 'Monitor' button is present. The breadcrumb trail reads: Home ► Engineer ► Communications ► Option Comms. The main configuration area is highlighted in yellow and contains the following parameters:

- 0691: Comms Required: MODBUS RTU (dropdown)
- 0692: Input Mapping +
- 2586: InMappingStatus +
- 0725: Out Mapping +
- 2619: OutMappingStatus +
- 0763: Node Address: 7 (text input)
- 0765: Modbus Baud Rate: 19200 BPS (dropdown)
- 0766: Parity: EVEN 1 STOP (dropdown)
- 0767: High Word First:
- 0768: Active Timeout: 1.0 s (text input)
- 0769: Comms Fitted: UNKNOWN

On the left side of the configuration area, the status is shown as 'State: Configuration' and 'Drive: OK'.

8.2 Process Data

AC20 parameters implementation

The AC20 Modbus RTU option comms allows a selection of parameters to be grouped together during the configuration for fast I/O data exchange.

The cyclic I/O data is configured by using the read and write process data mapping tables in the AC20. String-type parameters cannot be mapped.

Set process data using AC20 input and output mapping tables

These tables are two parameter arrays in which AC20 parameter numbers may be added.

Read Mapping:

The read process data represents cyclic data sent from the PLC to the AC20, this is mapped into the table **Option Comms Input Mapping**. Only writable AC20 parameters that are not configuration parameters may be added to the read process data.



Keypad Menu Path	DSE Lite Function Block	Webserver																						
<pre> graph TD Engineer --> Communications Communications --> OptionComms[Option Comms] OptionComms --> InputMapping[Input Mapping[]] </pre>	<p>Option Comms Input Mapping</p> <p>MAPPING[0] MAPPING[1] MAPPING[2] MAPPING[3] MAPPING[4] MAPPING[5] MAPPING[6] MAPPING[7] MAPPING[8] MAPPING[9] MAPPING[10] MAPPING[11] MAPPING[12] MAPPING[13] MAPPING[14] MAPPING[15] MAPPING[16] MAPPING[17] MAPPING[18] MAPPING[19] MAPPING[20] MAPPING[21] MAPPING[22] MAPPING[23] MAPPING[24] MAPPING[25] MAPPING[26] MAPPING[27] MAPPING[28] MAPPING[29] MAPPING[30] MAPPING[31]</p>	<p>Home ► Engineer ► Communications ► Option Comms</p> <p>0691: Comms Required MODBUS RTU ▼</p> <p>0692: Input Mapping -</p> <table border="1"> <tr><td>000:</td><td>1212 Input</td></tr> <tr><td>001:</td><td>2061 Input B</td></tr> <tr><td>002:</td><td>0584 Digin Invert</td></tr> <tr><td>003:</td><td>0626 Digout Invert</td></tr> <tr><td>004:</td><td>0497 Remote Reverse</td></tr> <tr><td>005:</td><td>0498 Rem Trip Reset</td></tr> <tr><td>006:</td><td>0000</td></tr> <tr><td>007:</td><td>0000</td></tr> <tr><td>008:</td><td>0000</td></tr> <tr><td>009:</td><td>0000</td></tr> <tr><td>010:</td><td>0000</td></tr> </table>	000:	1212 Input	001:	2061 Input B	002:	0584 Digin Invert	003:	0626 Digout Invert	004:	0497 Remote Reverse	005:	0498 Rem Trip Reset	006:	0000	007:	0000	008:	0000	009:	0000	010:	0000
000:	1212 Input																							
001:	2061 Input B																							
002:	0584 Digin Invert																							
003:	0626 Digout Invert																							
004:	0497 Remote Reverse																							
005:	0498 Rem Trip Reset																							
006:	0000																							
007:	0000																							
008:	0000																							
009:	0000																							
010:	0000																							

Write Mapping:

The write process data represents cyclic data sent from the AC20 to the PLC, this is mapped into the table **Option Comms Output Mapping**.



Keypad Menu Path	DSE Lite Function Block	Webserver																						
	<p>Option Comms Output Mapping</p> <p>MAPPING[0] MAPPING[1] MAPPING[2] MAPPING[3] MAPPING[4] MAPPING[5] MAPPING[6] MAPPING[7] MAPPING[8] MAPPING[9] MAPPING[10] MAPPING[11] MAPPING[12] MAPPING[13] MAPPING[14] MAPPING[15] MAPPING[16] MAPPING[17] MAPPING[18] MAPPING[19] MAPPING[20] MAPPING[21] MAPPING[22] MAPPING[23] MAPPING[24] MAPPING[25] MAPPING[26] MAPPING[27] MAPPING[28] MAPPING[29] MAPPING[30] MAPPING[31]</p>	<p>Home ► Engineer ► Communications ► Option Comms</p> <p>0691: Comms Required MODBUS RTU ▼</p> <p>0692: Input Mapping +</p> <p>2586: InMappingStatus +</p> <p>0725: Out Mapping -</p> <table border="1"> <tr><td>000:</td><td>0507 Status Word</td></tr> <tr><td>001:</td><td>0462 Reference</td></tr> <tr><td>002:</td><td>0103 Speed rpm</td></tr> <tr><td>003:</td><td>0534 Anin 1 Value</td></tr> <tr><td>004:</td><td>0540 Anin 2 Value</td></tr> <tr><td>005:</td><td>0558 Anout 1 Value</td></tr> <tr><td>006:</td><td>0563 Anout 2 Value</td></tr> <tr><td>007:</td><td>0610 Digin Word</td></tr> <tr><td>008:</td><td>0625 Digout Word</td></tr> <tr><td>009:</td><td>0000</td></tr> <tr><td>010:</td><td>0000</td></tr> </table>	000:	0507 Status Word	001:	0462 Reference	002:	0103 Speed rpm	003:	0534 Anin 1 Value	004:	0540 Anin 2 Value	005:	0558 Anout 1 Value	006:	0563 Anout 2 Value	007:	0610 Digin Word	008:	0625 Digout Word	009:	0000	010:	0000
000:	0507 Status Word																							
001:	0462 Reference																							
002:	0103 Speed rpm																							
003:	0534 Anin 1 Value																							
004:	0540 Anin 2 Value																							
005:	0558 Anout 1 Value																							
006:	0563 Anout 2 Value																							
007:	0610 Digin Word																							
008:	0625 Digout Word																							
009:	0000																							
010:	0000																							

Note: String-type parameters cannot be mapped.

Register Mapping

The AC20 input and output mapping tables are mapped to **Holding Registers** and **Inputs Registers**.

They are also mapped to **Coils** and **Discrete Inputs**, which use 16-bit entities per Holding Register or Input Registers.

The register mapping is summarized below.

Modbus Registers Access Method	Description	Modbus Address Range (Decimal)
Holding Registers (4x) (Read /Write): 16bit Register wise access	Input mapping	00000 - 00255
	Output mapping	00256 - 00511
Input Registers (3x) (Read Only): 16bit Register wise access	Output mapping	00000 - 00255
Coils (0x) (Read/Write): Bitwise access	Input mapping	00000 - 04095
Discrete Inputs (1x) (Read Only): Bitwise access	Output mapping	00000 - 04095

(See Appendix B for detail on Modbus register implementation)

An 8-bit or 16-bit parameter is mapped to a single register and a 32-bit parameter is mapped to 2 registers. An array parameter is packed to as many registers as needed. For example, an array of 3 elements of type UINT8 is packed into 2 registers.

Process Data Mapping		Modbus Register Mapping		
Parameter	Data Type	Register	High Byte	Low Byte
1	USINT	00000		USINT
2	SINT	00001		SINT
3	INT	00002	INT	
4	BOOL	00003		b 0
5	DINT	00004	DINT	
		00005		
6	BOOL[3]	00006		b 2 b 1 b 0
7	SINT[3]	00007	SINT[1]	SINT[0]
		00008		SINT[3]

Cyclic Data Exchange

Process data exchange will occur when a connection is established. The module will enter the PROCESS ACTIVE state on the first received Modbus request (including acyclic access). It will stay in this state unless a timeout occurs (if specified).

However, the read process data will only update the mapped parameters when in the PROCESS ACTIVE mode. On a transition into the PROCESS ACTIVE state all read process mapped parameters will be updated.

When in the PROCESS ACTIVE state, the read process mapped parameters will all update only when a change in the read process data occurs.

Mapping status

The process data mapping status can be accessed from AC20 via the following parameters:

- Parameter **2586 InMappingStatus**: shows the status of the currently active cyclic data input mapping table (32 entries), value is the Tag ID of the parameter to be cyclic read in.
- Parameters **2619 OutMappingStatus**: Shows the status of the currently active cyclic data output mapping table (32 entries), value is the Tag ID of the parameter to be cyclic sent out.

The parameters **2586 InMappingStatus** and **2619 OutMappingStatus** are visible from webserver and are valid if **Parameter 0774 Comms State** = PROCESS ACTIVE.

Parker

Summary | Parameters | Passwords

ENGINEER ▾ Home ► Engineer ► Communications ► Option Comms

0691: Comms Required MODBUS RTU ▾

0692: Input Mapping +
2586: InMappingStatus +

0725: Out Mapping +
2619: OutMappingStatus +

0763: Node Address 7

State: **Operational**
Drive: **OK**

8.3 Parameter Mapping

The Modbus RTU is acyclic by nature and does not feature a dedicated cyclic data channel in the same sense as many other networks.

The AC20 parameters are mapped to **Holding Registers** starting at register address **0528**.

Access to these registers is slower than using the Process Data Mapping due to it using the Modbus request-response mechanism back to the master.

Each parameter number is mapped on to two registers regardless of the parameter data Type.

If the parameter has a data type that uses one byte, then it will occupy the low-byte of the first register. If the parameter has a data type that uses two bytes, then it will occupy the first register. Unused register locations will read zero; writing to that location will have no effect.

The word-order of 32-bit parameters is determined by the **0767 High Word First** parameter.

The relationship between an AC20 parameter and a Holding Register is given as:

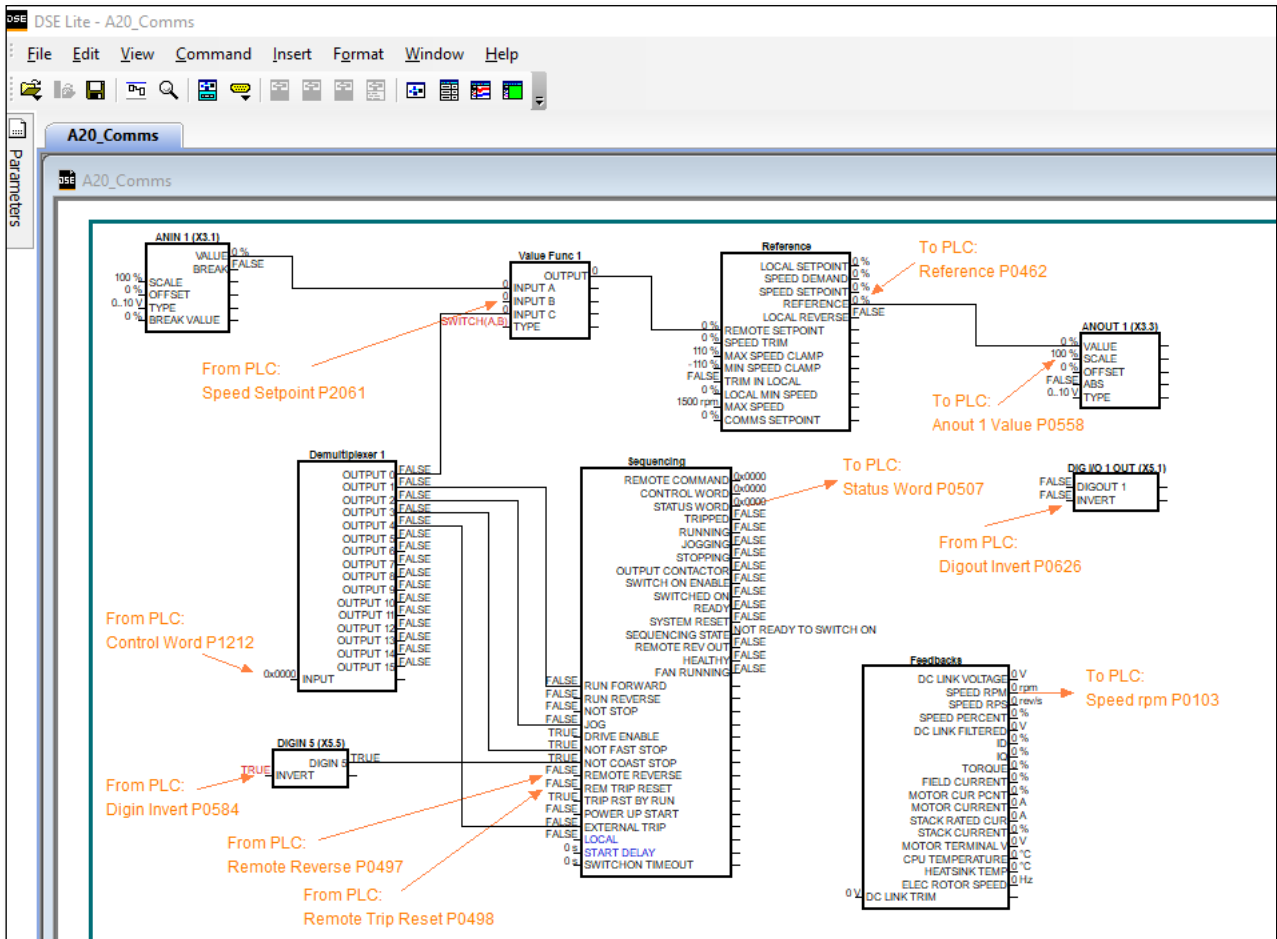
$$\text{Register number} = (\text{parameter number} - 1) * 2 + 0528$$

9 Example Configuration and Programming

9.1 AC20 Motor Control Application

Use DSE Lite to create, parameterize and configure user defined applications or parameterize and connect fixed motor control blocks in the application. Download the application into the drive then connect to the PLC to read/write the value of the parameters.

In the example below the PLC is used to set motor speed and control, then to read the speed feedback, status of the control and speed reference.



The data highlighted will be mapped into the AC20 process data mapping table in the example below.

9.2 List of process data

Read / Write Process Data mapping list for master/PLC

AC20 Input Mapping	Data Type	Comments	PLC Module
1212 Input Demultiplexer 1	WORD	Control Word	Output
2061 Input B Value Func 1	REAL	Speed Setpoint	
0584 Digin Invert	WORD	Invert digital input	
0626 Digout Invert	WORD	Invert digital Output	
0497 Remote reverse	BOOL	Invert motor Rotation	
0498 Rem Trip Reset	BOOL	Trip Reset	

AC20 Output Mapping	Data Type	Comments	PLC Module
0507 Status Word	WORD	Status Word	Input
0462 Reference	REAL	Speed Reference	
0103 Speed rpm	REAL	Speed Feedback	
0534 Anin1 Value	REAL	Analog In1 Value	
0540 Anin2 Value	REAL	Analog In2 Value	
0558 Anout1 Value	REAL	Analog Out1 Value	
0563 Anout2 Value	REAL	Analog Out2 Value	
0610 Digin Word	WORD	Digital Input state	
0625 Digout Word	WORD	Digital Output state	

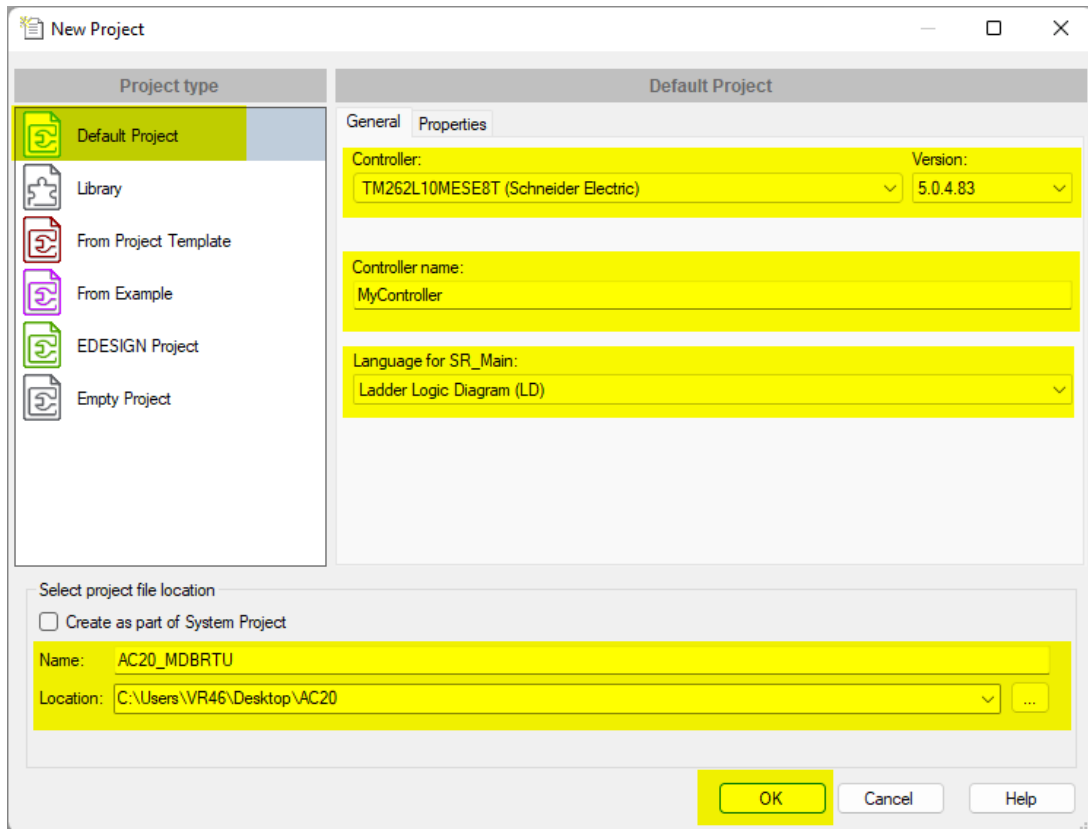
9.3 Programming using Schneider PLC

This example uses Schneider M262 as controller PLC and Machine Expert Logic Builder V1.2.6 as the programming Environment.

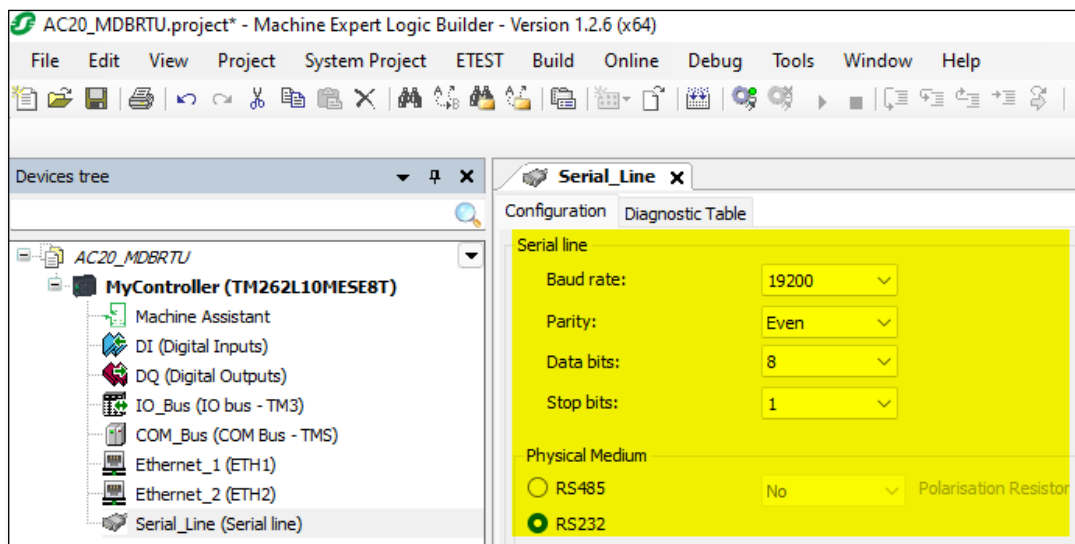
Prior knowledge of Machine Expert software is assumed.

Create a project

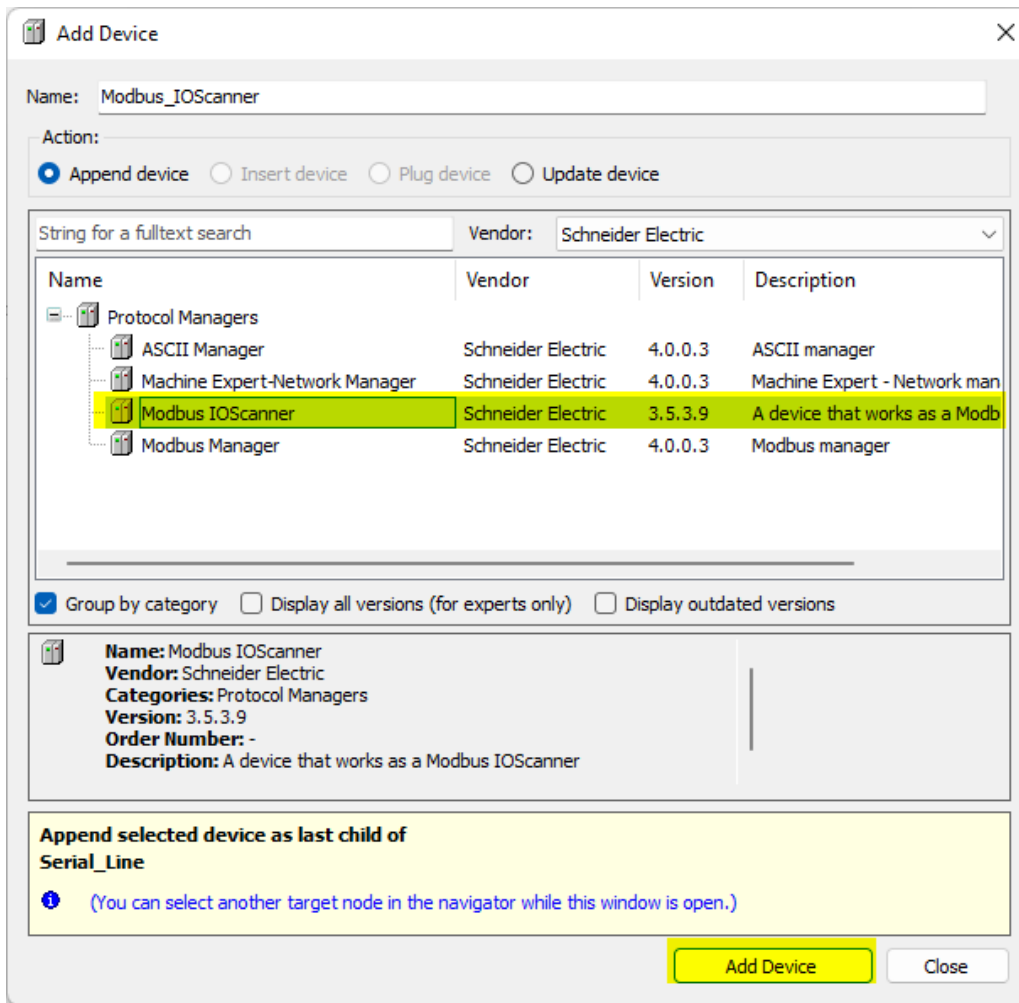
- Launch **Machine expert** from desktop and select **New Project** from start page, in the **New Project** Tab select project type and define properties, then click on **OK**.



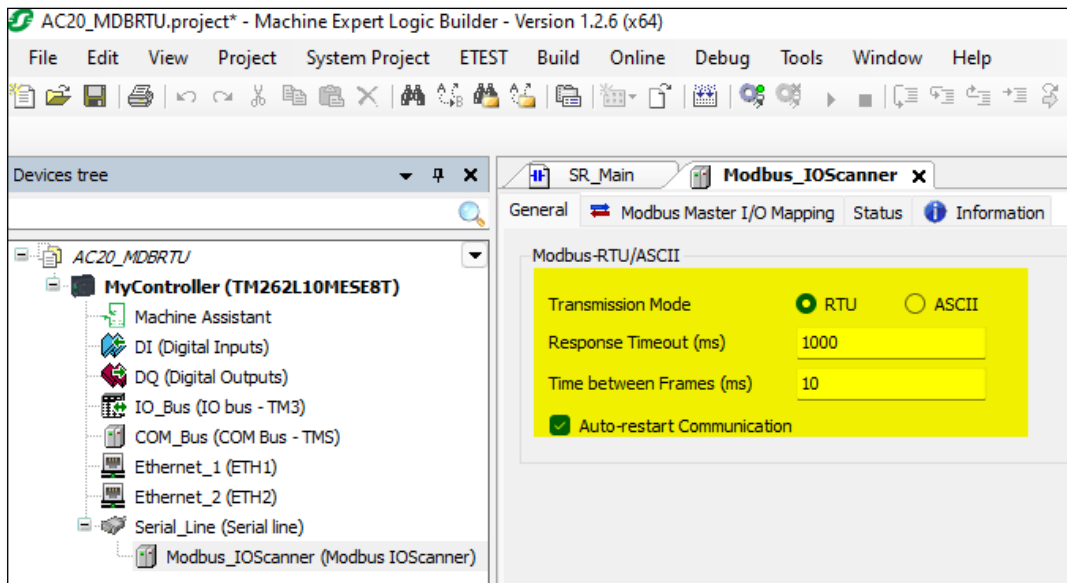
- Serial communication settings: From **Project tree > Devices tree**, double click **Serial_Line** and set the communication parameters to match AC20 Modbus RTU parameters (see *chapter Configuration > Communication parameters for config value*).



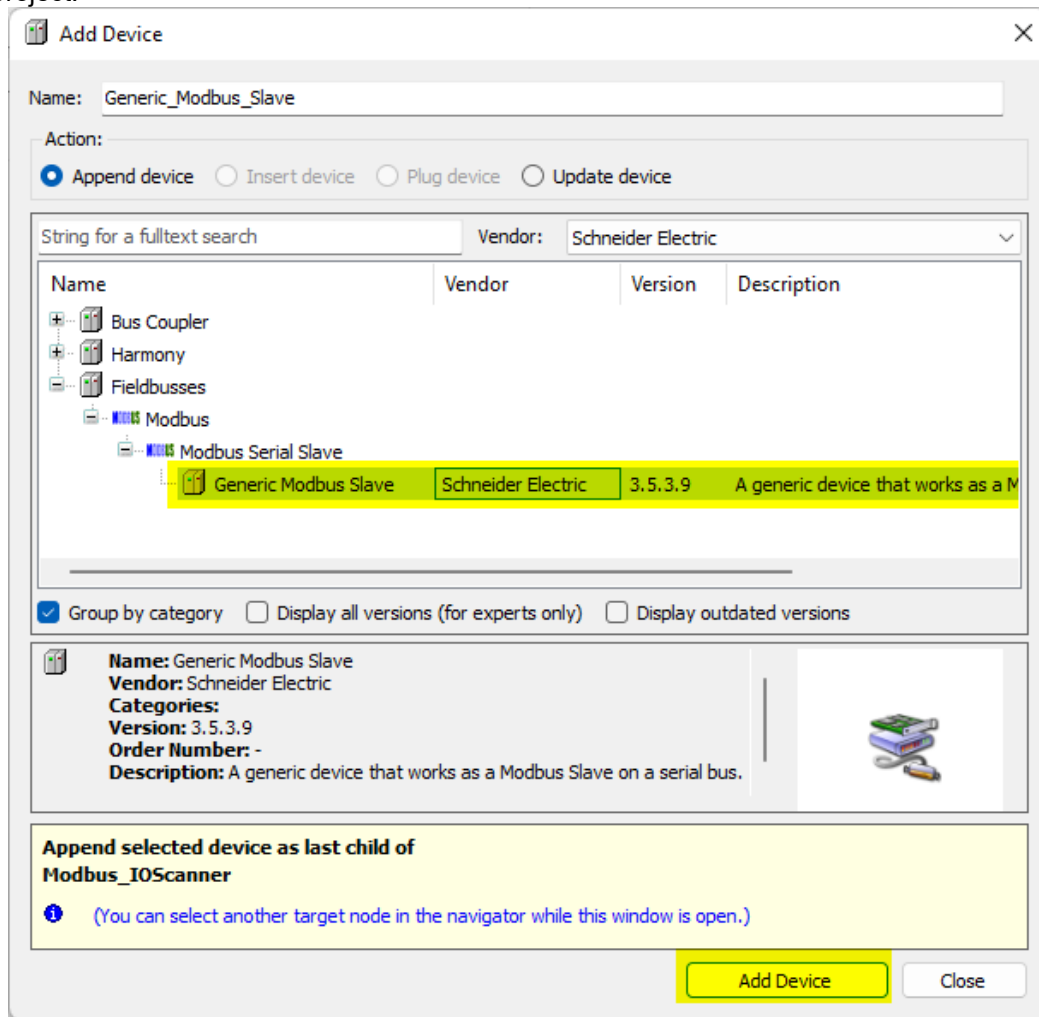
- Add Modbus IO Scanner and settings: From the **Device tree** pane, click on the green + which appears next to **Serial_Line** or right-click serial line and select **Add device**.



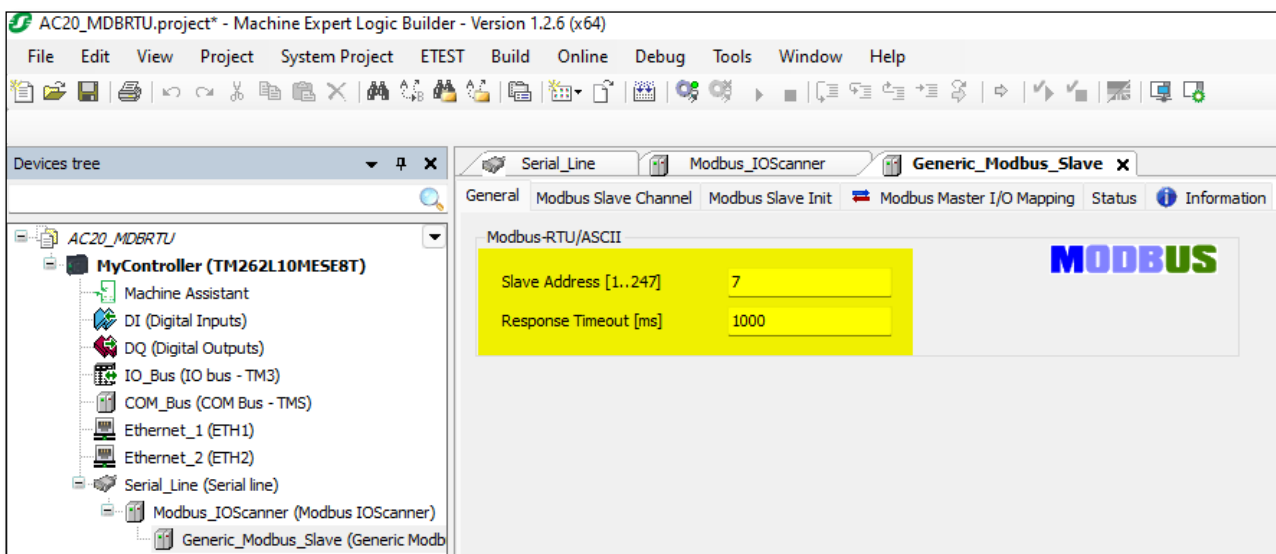
- Set Modbus scanner RTU/ASCII properties



- Add Modbus slave and set device properties: Click on the green + which appear next to the Modbus IO scanner just added or right-click and select **Add device** to add the slave into the project.



- Set Slave address and Response Timeout to match the physical device.

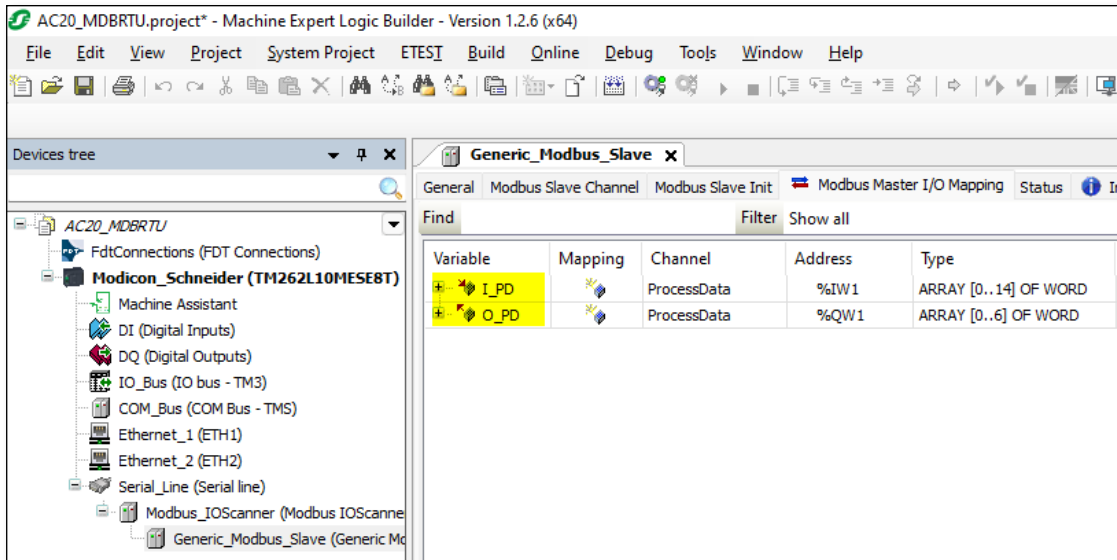


- I/O mapping and variable name: The table below will be used for process data config to the PLC.

Process Data	Data Type	N° of Registers	Comments	PLC Module
0507 Status Word	WORD	1	Status Word	Input
0462 Reference	REAL	2	Speed Reference	Input
0103 Speed rpm	REAL	2	Speed Feedback	Input
0534 Anin1 Value	REAL	2	Analog In1 Value	Input
0540 Anin2 Value	REAL	2	Analog In2 Value	Input
0558 Anout1 Value	REAL	2	Analog Out1 Value	Input
0563 Anout2 Value	REAL	2	Analog Out2 Value	Input
0610 Digin Word	WORD	1	Digital Input state	Input
0625 Digout Word	WORD	1	Digital Output state	Input
Input Register Size		15	Register access (00256 ... 00270)	
1212 Input Demultiplexer 1	WORD	1	Control Word	Output
2061 Input B Value Func 1	REAL	2	Speed Setpoint	Output
0584 Digin Invert	WORD	1	Invert digital input	Output
0626 Digout Invert	WORD	1	Invert digital Output	Output
0497 Remote reverse	BOOL	1	Invert motor Rotation	Output
0498 Rem Trip Reset	BOOL	1	Trip Reset	Output
Output Register Size		7	Register access (00000 ... 00006)	

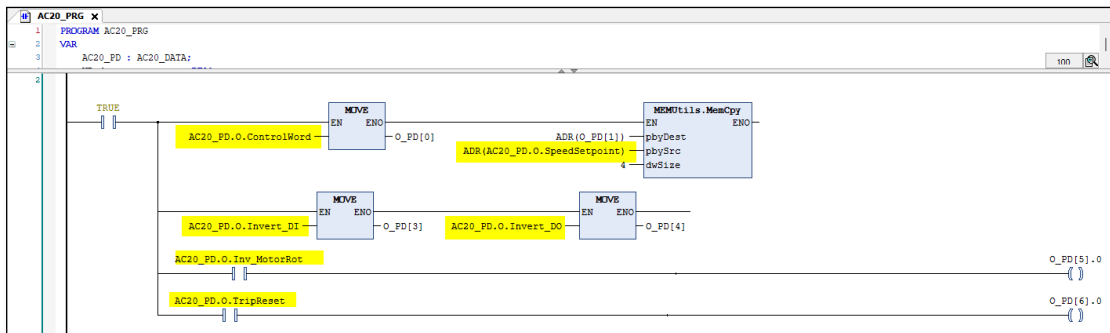
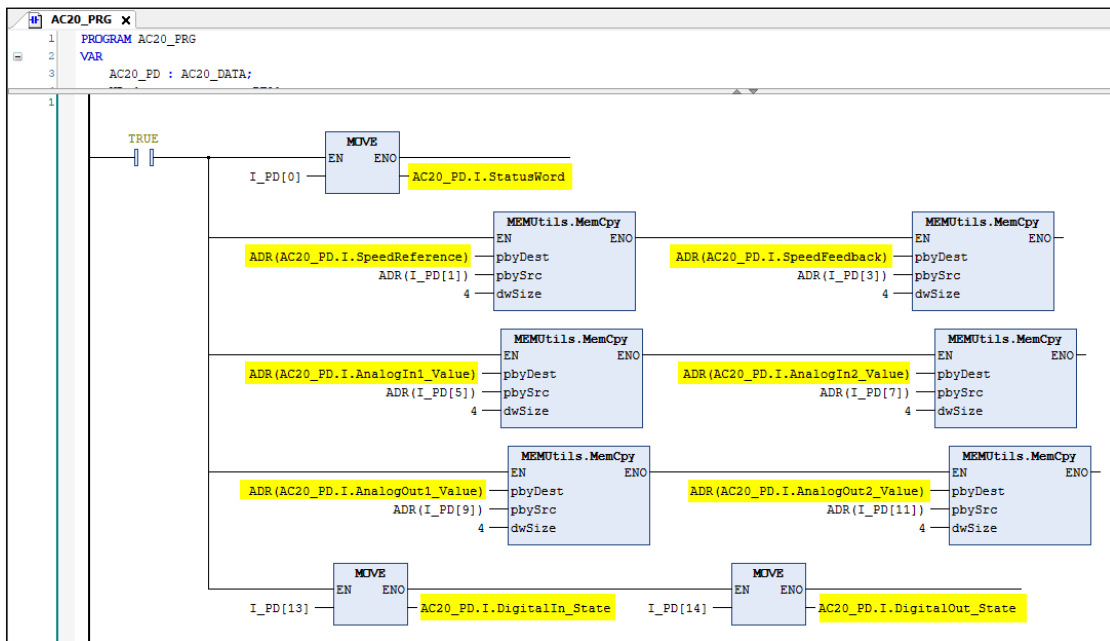
- Add process data channel to Modbus slave: double click **Modbus slave** from device tree, select **Modbus Slave Channel** then click on **Add channel**.

- Define variable name, double click **Modbus slave** from device tree, select **Modbus Master I/O Mapping** then assign a name to the variable list.



Create a program to transfer data

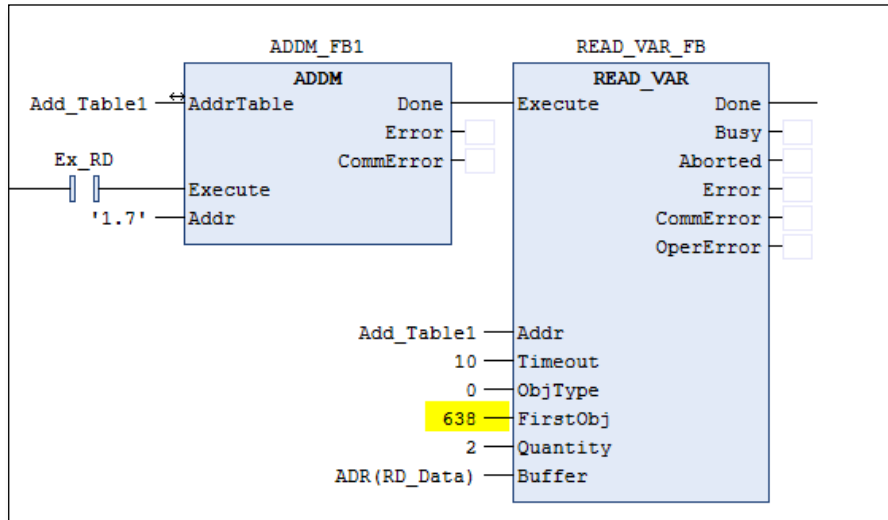
In the example ladder code below, in Network 1 the data is read from drive to PLC and in Network 2 the PLC writes data to the drive.



Read / Write parameters Acyclically

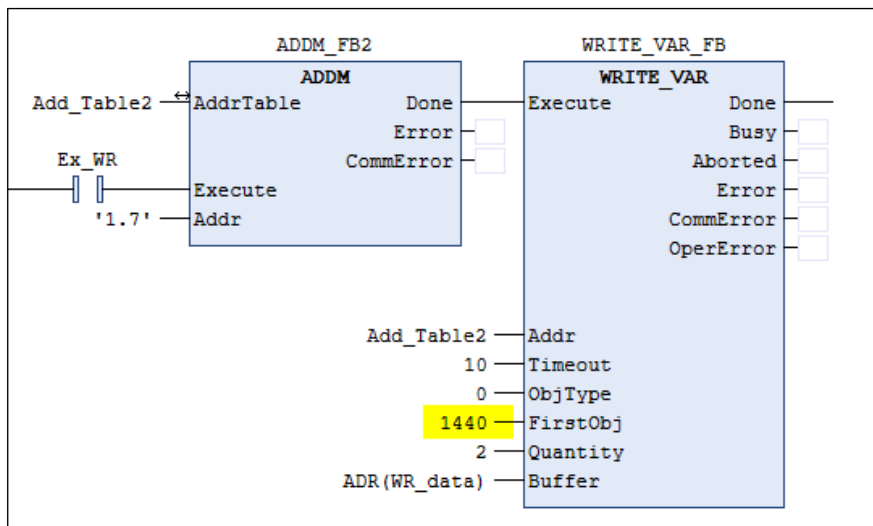
The acyclic read and write services may be achieved using functions block “**READ_VAR**” and “**WRITE_VAR**”.

- Example: Read parameter **0056 Current Limit Out** (2038h).



Parameter	Type	Description
Addr	ADDRESS	Slave address in the rack
ObjType	ObjectType	Type of object to be read (MW, I, IW, Q).
FirstObj	DINT	Index of the first object to be read.
Quantity	UINT	number of objects to be read
Buffer	POINTER TO BYTE	array that holds the received data

- Example: Write parameter **0457 Motor Max Speed** (21C9h).



Parameter	Type	Description
ObjType	ObjectType	type of object to write (MW, I, IW, Q).
FirstObj	DINT	Index of the first object to write.
Quantity	UINT	number of objects to be read
Buffer	POINTER TO BYTE	Array that holds the data that shall be written to the target

- Save the project, compile, and download to the PLC.

10 Lost Communication Trip

Supervised Parameter:

The **0777 Comms Supervised** parameter indicates a master has made a connection to the Modbus RTU device.

The Supervised parameter value is set to TRUE when one or more IO connections are established. The Supervised parameter will subsequently change to FALSE if the connection is closed or the wrong communication parameters is set.

Comms Break Trip

The drive will trip when there is a loss of communications between the master and the drive.

A COMMS BREAK trip will occur if the **0777 Comms Supervised** parameter transitions from TRUE to FALSE and the drive is in the operational state.

The trip may be disabled by clearing the respective bit in the parameter **0870 Enable Trips Lo**. The parameter Enable Trip Lo is a 32-bit word, the bit number 27 is used to disable or to enable the trip.

Comms state

The **0774 Comms State** parameter indicates 'PROCESS_ACTIVE' as long as the Modbus RTU communication takes place within a specified timeout period, after which the module shifts to 'WAIT_PROCESS'. By default, this timeout is disabled, causing the module to stay in 'PROCESS_ACTIVE' after the first received Modbus request.

11 Diagnostic Event

Configuration problems can often be identified by looking at the Communication Status and device Status LEDs and from the Comms Diagnostic **0775 parameters**.

Hardware Mismatch

Diagnostic = HARDWARE MISMATCH:

The required option does not match the actual fitted option.

No option is fitted but one is required.

Invalid Configuration

Diagnostic = INVALID CONFIGURATION:

Invalid read or write process data mapping

Invalid communication settings

Diagnostic = MAPPING FAILED:

Attempting to map a parameter that does not exist.

Attempting to map a configuration parameter.

Attempting to map a read-only parameter to the read process data.

Other Diagnostics

Diagnostic = EXCEPTION :

Module has gone into an unrecoverable exception state

Diagnostic = UNSUPPORTED OPTION:

The fitted option is not supported by the drive

Diagnostic = NOT RESPONDING:

no initial response from the option

APPENDIX A: Data types

The AC20 parameter data type and size and number of registers used for process data mapping are given in the table below.

Note for acyclic access all parameters map to two registers regardless of data type.

AC20 Parameter			
Data Type	Description	No of Registers	Bytes
BOOL	Boolean	1	1
SINT	Short integer	1	1
INT	Integer	1	2
DINT	Double integer	2	4
USINT	Unsigned short integer	1	1
UINT	Unsigned integer	1	2
UDINT	Unsigned double integer	2	4
REAL	Floating point	2	4
TIME	Duration	2	4
DATE	Date	2	4
TIME_OF_DAY	Time of day	2	4
DATE_AND_TIME	Date and time of day	2	4
STRING	String	<i>not permitted</i>	<i>n</i>
BYTE	Bit string length 8	1	1
WORD	Bit string length 16	1	2
DWORD	Bit string length 32	2	4

Arrays

Some parameters have multiple elements and are classified as parameter arrays. A parameter array has a parameter number that accesses the *whole* of the array. It also has parameter numbers that represent each *element* of the array.

Array Example: A parameter array called **VHZ_USER_FREQ** has 11 elements.

Parameter Number	Parameter - VHZ_USER_FREQ
0145	whole array
0146	index 0
0147	index 1
...	...
0157	index 10

If the parameter number of the whole array is 0145, then the parameter number of the element index 0 of the array will be 0146, the parameter number of the element index 01 will be 0147, etc.

String

A string parameter may be accessed via its parameter number.

APPENDIX B: Parameters

Function Block Inputs

Parameter Name	No.	Default Value	Range	Units	Type	Writable
COMMS REQUIRED	691	1: None	0: Unknown 1: None 2: CANopen 3: EtherCAT 4: Ethernet IP 5: Modbus RTU 6: Profibus 7: Profinet		ENUM	CONFIG
Communications option required.						
ADDR ASSIGNMENT	758	0: External	0: External 1: Fixed 2: DHCP		ENUM	CONFIG
Method for assigning the IP address.						
SET IP ADDRESS	759	0			ADDR	CONFIG
Ethernet option IP address						
SET SUBNET MASK	760	0			ADDR	CONFIG
Ethernet option subnet mask.						
SET GATEWAY ADDR	761	0			ADDR	CONFIG
Ethernet option gateway address.						
ACCESS	762	31: 31	0: IP Config Enable 1: Web Enable 2: Web Parameters Enable 3: FTP Enable 4: FTP Admin Mode		WORD	CONFIG
Ethernet access using comms option (bitwise)						
NODE ADDRESS	763	0			USINT	CONFIG
Communications node address.						
CANOPEN BAUD	764	9: Auto	0: 10 kbps 1: 20 kbps 2: 50 kbps 3: 100 kbps 4: 125 kbps 5: 250 kbps 6: 500 kbps 7: 800 kbps 8: 1000 kbps 9: Auto 10: Lss		ENUM	CONFIG
Required baud Rate for CANopen.						
MODBUS BAUD RATE	765	4: 19200 BPS	0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps 5: 38400 bps 6: 57600 bps 7: 76800 bps 8: 115200 bps		ENUM	CONFIG
Required baud Rate for Modbus RTU						
PARITY	766	0: Even 1 Stop	0: Even 1 Stop 1: Odd 1 Stop 2: None 2 Stop 3: None 1 Stop		ENUM	CONFIG
Modbus parity and stop bits						
HIGH WORD FIRST	767	FALSE			BOOL	CONFIG
For 32-bit values high word comes first if set to TRUE.						
ACTIVE TIMEOUT	768	0	0 to 65		TIME	CONFIG
Process active timeout period.						

Parameter Name	No.	Default Value	Range	Units	Type	Writable
MASTERMAPPING	2566	TRUE			BOOL	CONFIG
Switch to choose how the PROFINet, EtherCAT, PROFibus and CanOpen PDO mapping is defined: If TRUE the bus master sets/configures the PDO mapping. The drive mapping parameters 692...757 are cleared (set to zero) and made invisible (GKP and website) as this the required condition. If FALSE the mapping parameters 692...757 are visible (Keypad and webserver) can be used to define the PDO mapping from drive side (which the bus master then can upload). The switch is considered during drive startup (stopped -> operational transition).						

Function Block Outputs

Parameter Name	No.	Default Value	Range	Units	Type	Writable
COMMS FITTED	769	0: Unknown	0: Unknown 1: None 2: CANopen 3: EtherCAT 4: Ethernet IP 5: Modbus RTU 6: Profibus 7: Profinet		ENUM	NOT
Communications option fitted.						
COMMS VERSION[0]	770	0			USINT	NOT
Firmware version of the comms module.						
COMMS VERSION[1]	770	0			USINT	NOT
Firmware version of the comms module.						
COMMS SERIAL NUM	773	0			DWORD	NOT
Serial number of the comms module.						
COMMS STATE	774	8: None	0: Setup 1: NW Init 2: Wait Process 3: Idle 4: Process Active 5: Error 6: Reserved 7: Exception 8: None		ENUM	NOT
State of the option comms.						
DIAGNOSTIC	775	0: Ok	0: Ok 1: Hardware Mismatch 2: Invalid Configuration 3: Mapping Failed 4: Exception 5: Unsupported Option 6: Not Responding		ENUM	NOT
Diagnostic for the comms option.						
EXCEPTION CODE	776	0			WORD	NOT
Diagnostic code on option entering exception state. The MSB is the exception code and the LSB is the exception info.						
COMMS SUPERVISED	777	FALSE			BOOL	NOT
Indicates a master has made a connection to the device.						
MAPPING CHANGED	778	FALSE			BOOL	NOT
The PLC has changed the process data mapping from that set by the drive.						
STATION NAME	779				STRING	NOT
Current PROFINET station name.						
IP ADDRESS	787	0			ADDR	NOT
Current Ethernet option IP address.						
SUBNET MASK	788	0			ADDR	NOT
Current Ethernet option subnet mask.						
GATEWAY ADDRESS	789	0			ADDR	NOT
Current Ethernet option gateway address.						

Parameter Name	No.	Default Value	Range	Units	Type	Writable
ACTUAL BAUD RATE	790	0: 10 kbps	0: 10 kbps 1: 20 kbps 2: 50 kbps 3: 100 kbps 4: 125 kbps 5: 250 kbps 6: 500 kbps 7: 800 kbps 8: 1000 kbps 9: Auto 10: lss		ENUM	NOT
Actual CANopen baud rate.						

APPENDIX C: MODBUS RTU

Modbus is a request-reply protocol and offers services specified by function codes.

Modbus Registers

Holding Registers

Registers	Contents	Comment	Type
00000 – 00255	Input mapping	Read	Process Data
00256 – 00511	Output mapping	Write	
00512	Node Address	Do not modify	Network Settings (Some of these settings will have no effect when modified as these will be overwritten by the AC20 when the option starts)
00513	Communication Settings	Do not modify	
00514	RTU/ASCII Mode	Do not modify	
00515	Process Active Timeout	Process Active Timeout in milliseconds	
00516	Enter/Exit Idle Mode	0: Not idle >0 Idle - the Modbus option will change to the IDLE state.	
00517 – 00527	Reserved	-	-
00528 - 65534	Parameter mapping	Parameter N° 1 ... nn	All AC20 parameters

Input Registers

Registers	Contents	Comment
00000 – 00255	Output mapping	Process Data

Coils

Registers	Contents	Comment
00000 – 04095	Input mapping	Process Data

Discrete Inputs

Registers	Contents	Comment
00000 – 04095	Output mapping	Process Data

Modbus functions

The following Modbus functions are supported by AC20 Modbus RTU option

Function#	Modbus Function
1	Read Coils
2	Read Discrete Inputs
3	Read Holding Registers
4	Read Input Registers
5	Write Single Coil
6	Write Single Register
8	Diagnostics
15	Write Multiple Coils
16	Write Multiple Registers
17	Report Slave ID (<i>not supported</i>)
23	Read/Write Multiple Registers
43	Read Device Identification (Subcode 14)
68	Exchange Process Data
69	<i>Reserved</i>

Note: The Exchange Process Data (Function 68) uses a user-defined function code 68. This can be used for efficient process data exchange. The 'Process Data Read' and 'Process Data Write' fields can be up to 252 bytes long.

Request format:

Addr	68	Process Data Read	CRC
------	----	-------------------	-----

Response format:

Addr	68	Process Data Write	CRC
------	----	--------------------	-----

The following Modbus exception codes may be transmitted by the AC20 Modbus option during an error response:

Code	Name	Description
0x01	Illegal function	The function code in the query is not supported
0x02	Illegal data address	The data address received in the query is outside the initialized memory area
0x03	Illegal data value	The data in the request is illegal

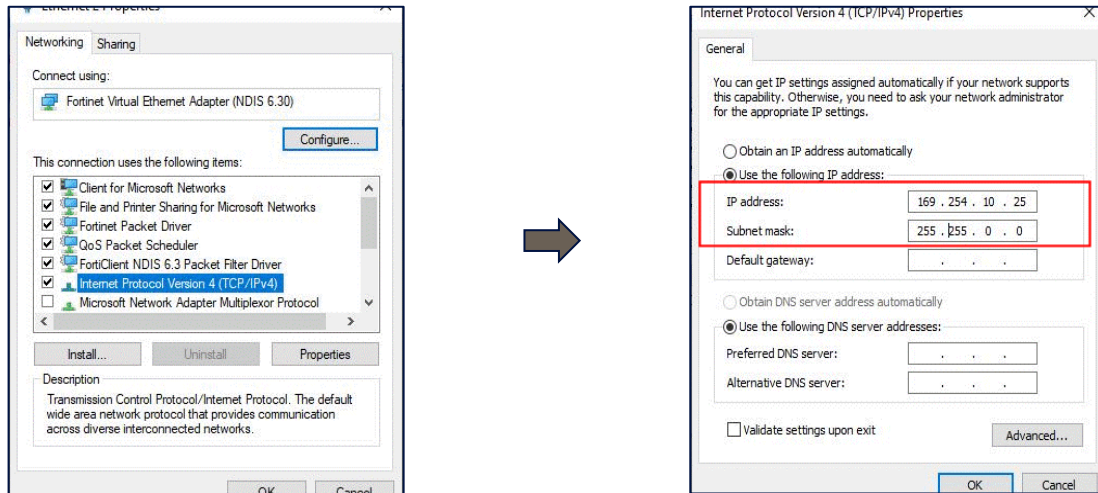
APPENDIX D: DSE Lite Quick Start Guide

Follow the steps below to configure the AC20 via DSE Lite PC-Tool.

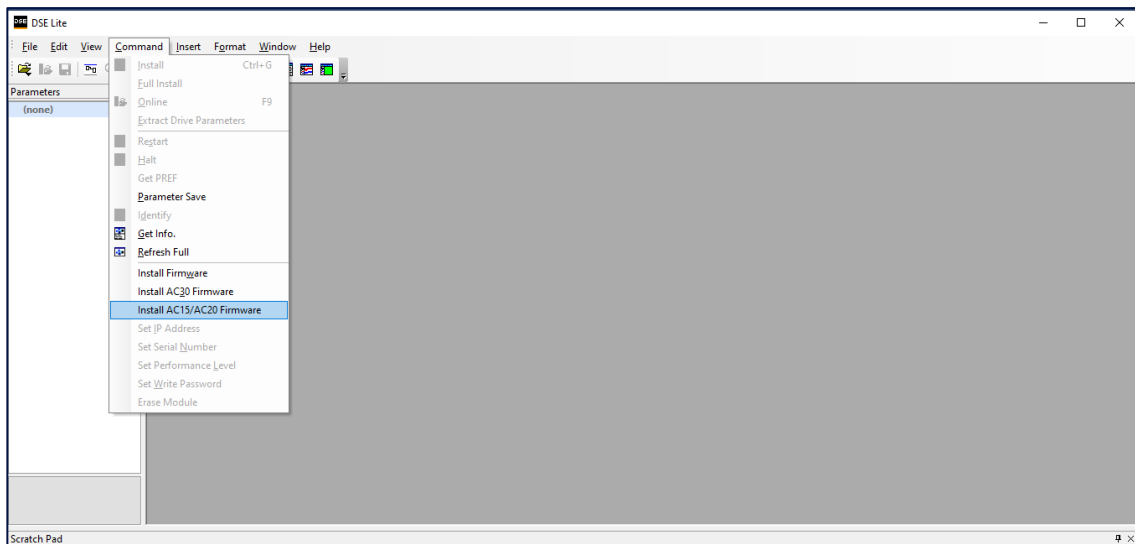
The block diagram of the AC20 may be accessed through the onboard webserver or DSE Lite.

DSE Lite is recommended.

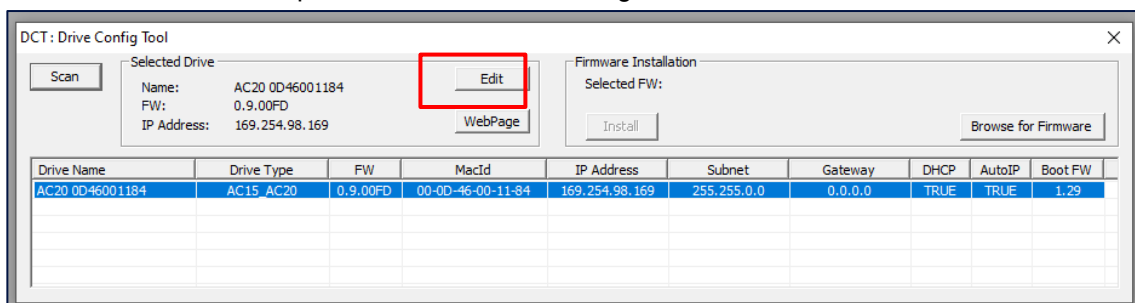
The IP address of the AC20 is in the range 169.254.xx.xx by default. Therefore, the user's PC network adapter must be configured to this range as shown below (IPv4 is used for communication).

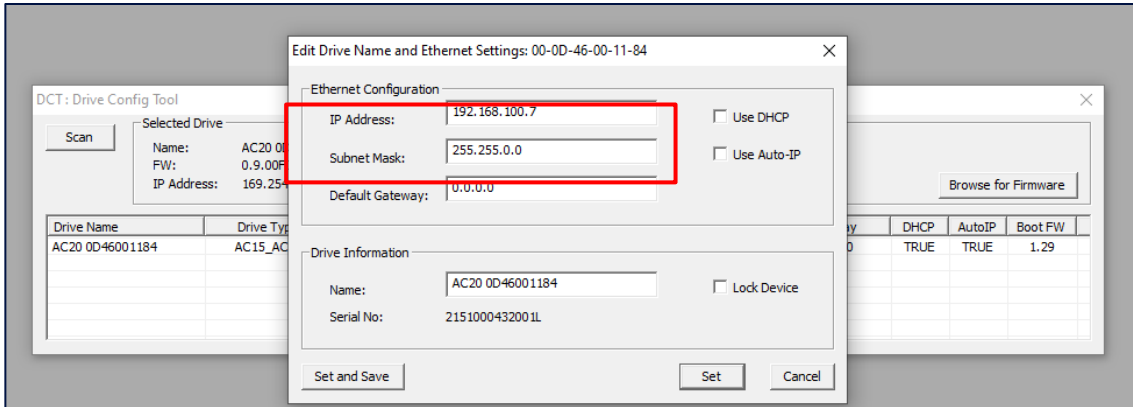


Alternatively, the IP address of the drive may be changed to suit the settings of the PC network adapter. The IP address of the drive can be configured using the DCT function, accessible from within DSE Lite by selecting Command -> Install AC15/AC20 Firmware.

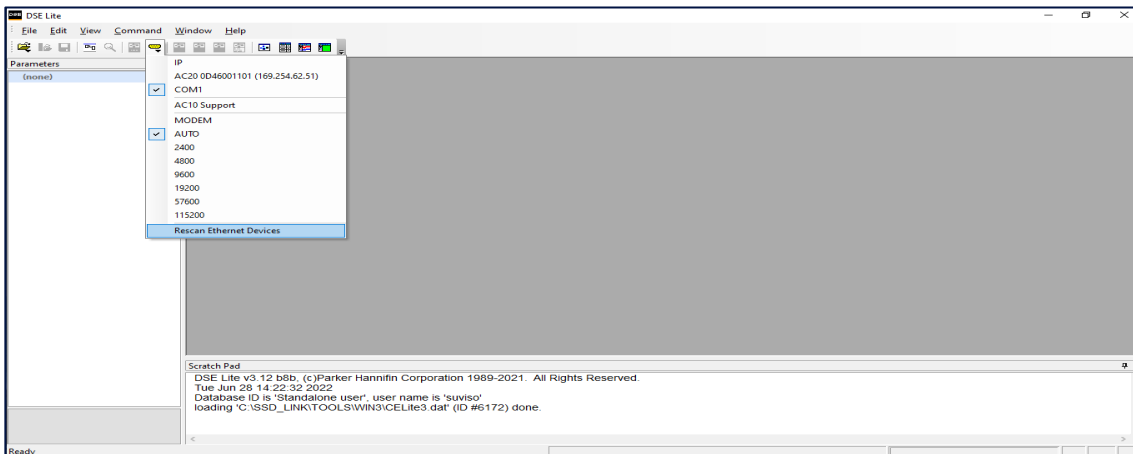


Once the network scan is completed, then the drive settings can be edited.

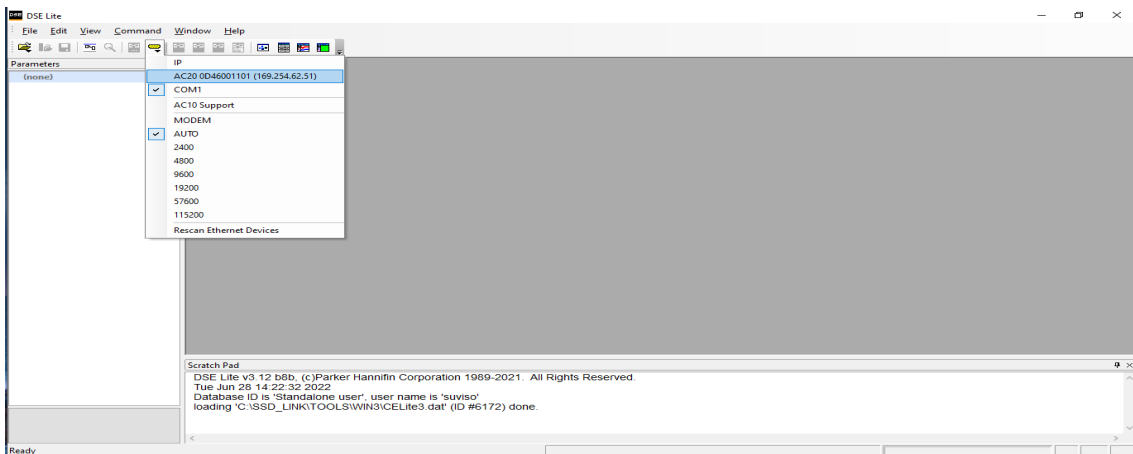




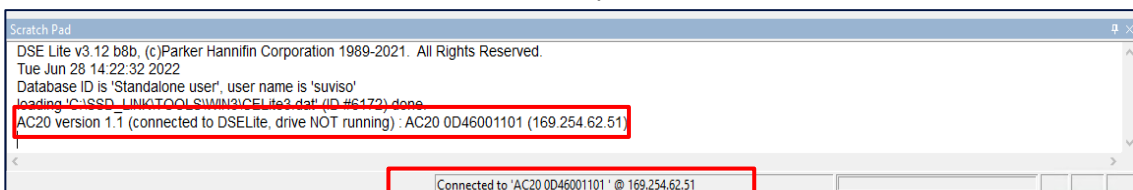
If the drive is not found by DSE lite, or a new drive is connected to the Ethernet port, a network scan must be performed again, as blow.



Once the network scan has been performed, any AC20 connected to the network will appear and DSE lite can connect to the drive.



When connected to a drive, this is shown in the scratch pad.



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