

CANopen



AC20 Series CANopen– Communication Option *Technical Manual*

DOC-0017-06-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:	
	<ul style="list-style-type: none">- 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:	
	<ul style="list-style-type: none">- 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

Parker Hannifin Manufacturing Germany GmbH & Co. KG

Electric Motion & Pneumatic Division (EMPD)

Robert-Bosch-Strasse 22

77656 Offenburg (Germany)

Tel.: + 49 (0781) 509-0

Website: www.parker.com/eme

Certified according to ISO 9001:2015

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
Geschäftsführung der Parker Hannifin GmbH: Ulrich Jochem, Achim Kohler, Andreas Paulsen, Kirsten Stenvers
Vorsitzender des Aufsichtsrates: Dr.-Ing. Gerd Scheffel

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

- CiA 301 version 4.0.2 compliant
- Automatic baud rate detection
- Supports all standard baud rates
- Supports LSS
- Customizable Identity Information
- Galvanically isolated bus via DB9M male connector
- Up to 64 TPDO's and 64 RPDO's (Corresponds to a total of 512 bytes of Process Data in each direction)
- PDO mapping can be customized via network configuration tool or via application
- Diagnostic support
- Heartbeat functionality supported
- Supports Expedited and segmented SDO Transfer (Block Transfer not supported)
- EDS files provided
- Run and Error LEDs




Note:

- **CiA 301** specification released by CAN in Automation specifies the CANopen application layer and communication profile.
- **LSS (Layer Setting Services)** can be used to set data rate and node address via the network and may address the module by its Vendor-ID, Product Code, Revision number and serial number.

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.

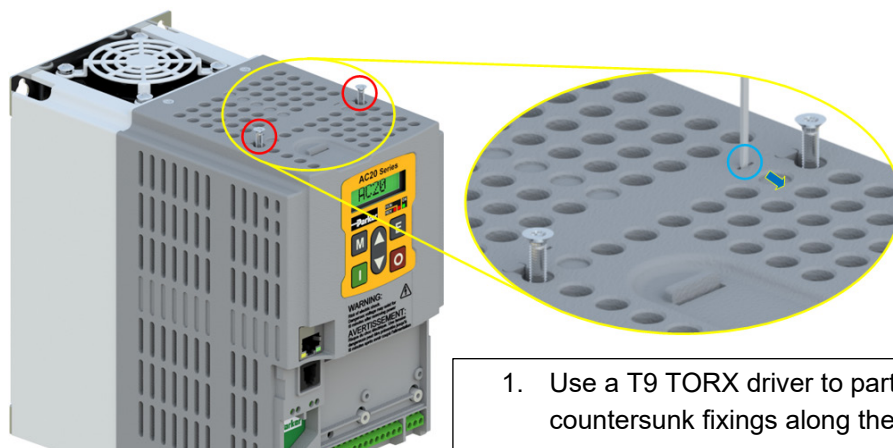
6.1 Order Codes

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

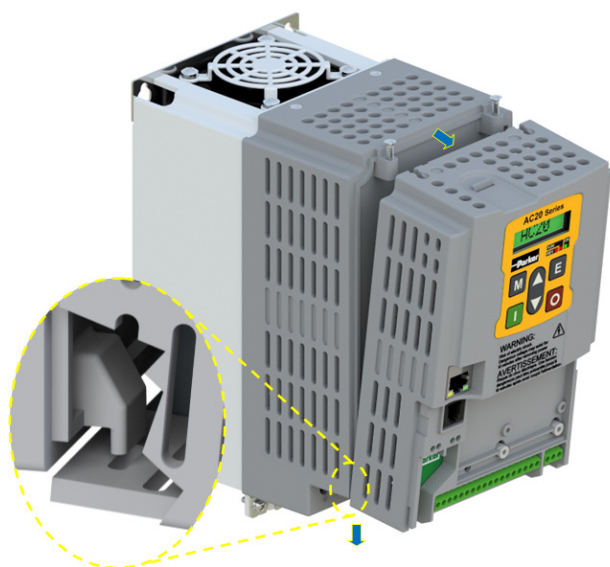
6.2 Fitting the Option

Frames 2 – 5

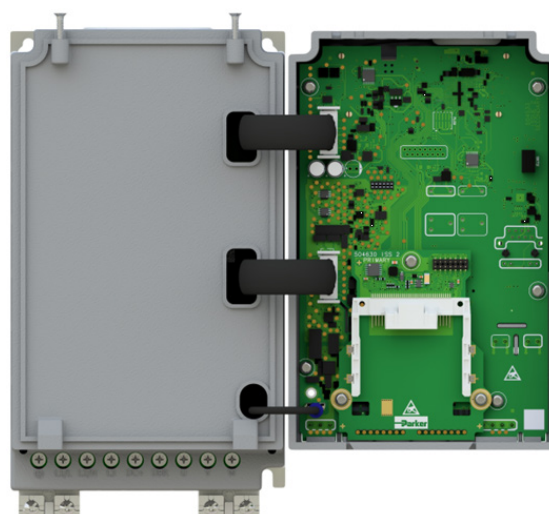
The Communication Interface Option Cards are intended to be customer installed. The control module housing cover will need to be removed prior to option card installation.



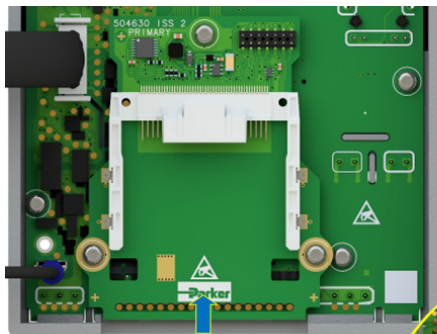
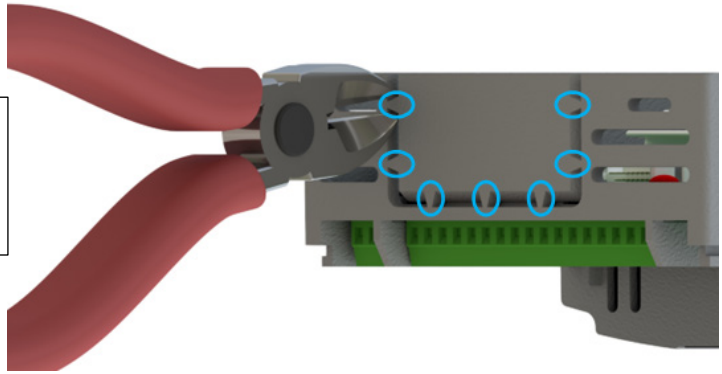
1. Use a T9 TORX driver to partially unscrew the two 3x12 countersunk fixings along the top of the product.
2. Insert a flat head screwdriver into the moulding features and lever the control module housing away from the power



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.

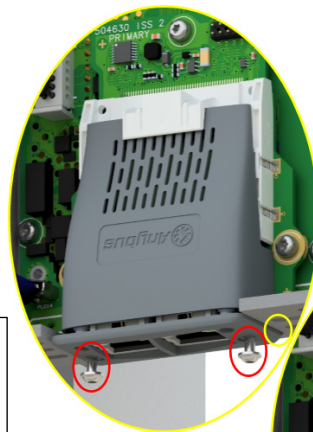


5. Remove and discard the Comms Option break-out feature in the control module housing by cutting the 7x bridges using suitable small side cutters.



6. Remove the Comms Interface Option card from its packaging.
7. 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.



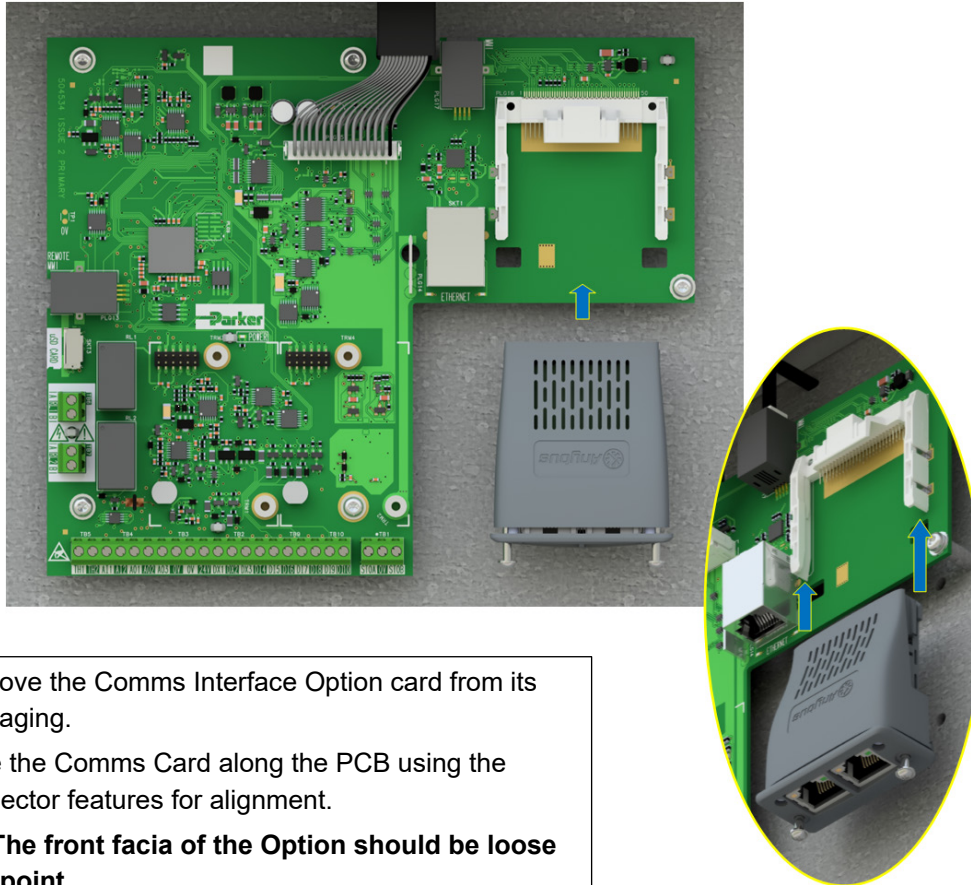
9. Now fully tighten the two T8 screws on the front facia of the Communication Interface Option Card.
10. Check that the Option Card is secure and that it cannot slide out.
11. Reassemble the product by performing the reverse process of steps 1 – 4.



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 facia 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 hocked onto the edge of the PCB, fully tighten the two T8 screws on the front facia.
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.

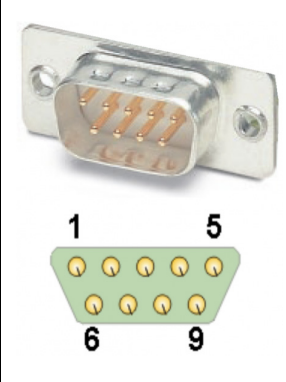
7 Network

7.1 Network Connector and Cable Specification

CANopen Connector

1xD-Sub socket male, 9 pole.

Pin	Signal
1	-
2	CAN_L
3	CAN_GND
4	-
5	CAN_SHLD
6	-
7	CAN_H
8	-
9	-
Housing	CAN_SHIELD Connected to protective earth via filter



Note: It is possible to make serial communications operate without adhering to the following recommendations; however, the recommendations will promote greater reliability.

Cable

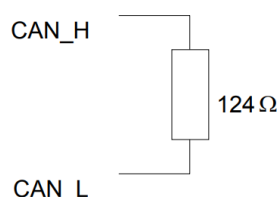
The cable for CANopen is shielded copper cable consisting of one twisted pair and two optional cables for an extra power supply. The CANopen option does not use the external power supply. The use of CAN_GND is recommended throughout the network. The user organization (CiA) has specified ISO/DIS 11898 as the standard bus cable.

The maximum allowable cable length depends on the baud rate selected:

Data Rate	Maximum Distance
125 kBit/s	500 metres
250 kBit/s	250 metres
500 kBit/s	100 metres
1 MBit/s	25 metres

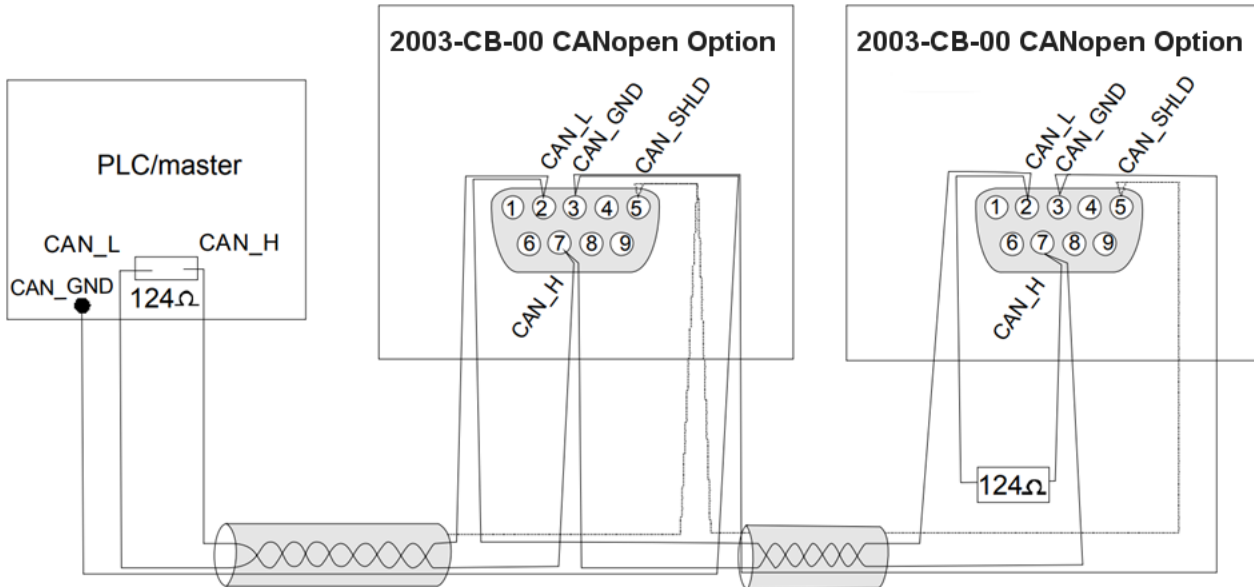
Terminators

- If the drive is at the end of the chain, it must have a terminating resistor.
- All other drives in the system should not have a terminator.
- Required resistor is + 1%, minimum ¼ Watt)
- The CANopen specification recommends 124Ω, but it should be chosen to equal as closely as possible the characteristic impedance of the cable.



Important: *Failing to fit terminating resistors correctly may result in unreliable operation.*

Wiring Diagram Example



7.2 LED Indications

RUN LED

This LED reflects the status of the CANopen device.

LED State	Description	Comments
Off	-	No Power.
Green	OPERATIONAL	-
Green, Blinking	PRE-OPERATIONAL	-
Green, 1 Flash	STOPPED	-
Green, Flickering	AUTOBAUD	Baud rate detection in progress or LSS in progress (alternately flickering with ERROR LED)
Red	EXCEPTION	Fatal Event

If both LEDs turn red, this indicates a fatal event; the bus interface is shifted into a physically passive state

ERR LED

This LED indicates CANopen communication errors.

LED State	Description	Comments
Off	-	No power or the device is in working condition.
Red, 1 flash	Warning limit reached	A bus error counter reached or exceeded its warning level
Red, Flickering	LSS	LSS services in progress (alternately flickering with RUN LED)
Red, 2 flash	Error Control Event	A heartbeat event (Heartbeat consumer) has occurred
Red	Bus off (Fatal Event)	Bus off

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 CANopen option requires configuration of both communication parameters and process data mapping.

8.1 Communication parameters

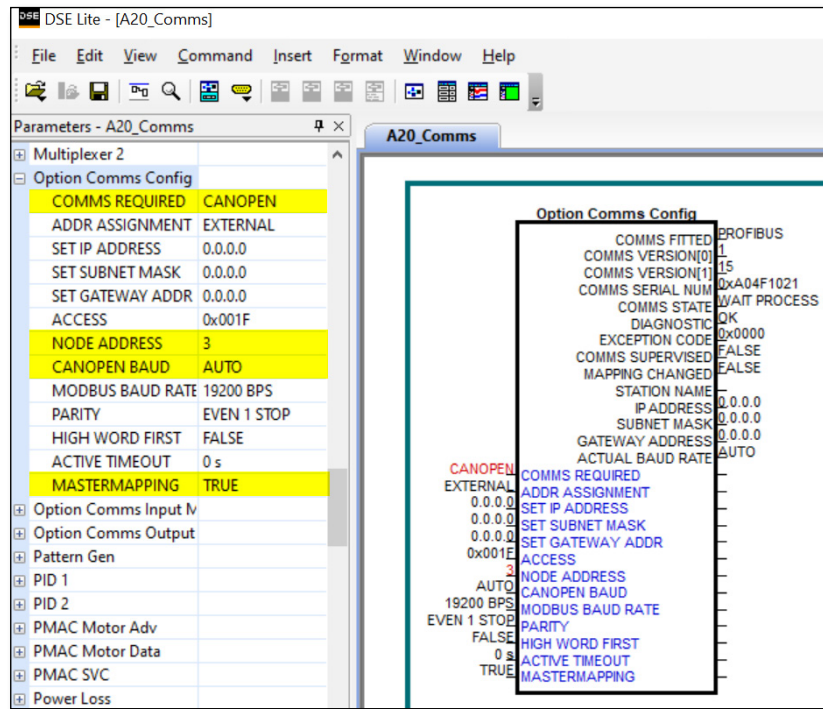
Keypad Menu Path	DSE-Lite Function Block	Webserver
<pre> graph TD Setup[Setup] --> Communication[Communication] Communication --> Option[Option] </pre>	<pre> Option Comms Config COMMS FITTED NONE COMMS VERSION(0) 0 COMMS VERSION(1) 0 COMMS SERIAL NUM 0x00000000 COMMS STATE NONE DIAGNOSTIC OK EXCEPTION 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 s 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 MASTERMAPPING </pre>	<pre> Home ► Engineer ► Communications ► Option Comms 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 master.

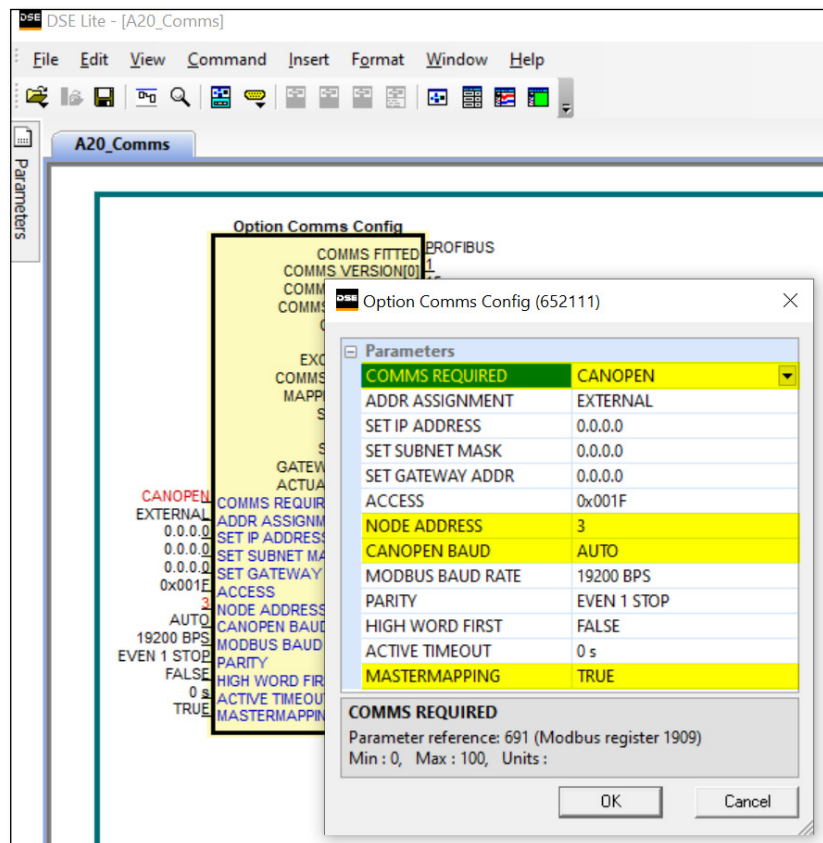
- The parameter **0691 COMMS REQUIRED** must be set to **CANOPEN**.
- The parameter **0763 NODE ADDRESS** must be set to the required address of the AC20 CANopen slave. The module address must be unique to be able to communicate on the CANopen network. The valid setting range is from **1 to 127**.
- The parameter **0764 CANOPEN BAUD** must be set to the required baud rate for the network. A baud rate of up to 1000 Kbits/s may be chosen. Alternatively, **AUTO** may be selected so that the option automatically detects the baud rate.
- The parameter **2566 MASTERMAPPING** must be set to choose how process data mapping is defined. (See 8.2 *Process Data for detail*)

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 CAN Option comms parameters as shown below.

AC20 Webserver view when Master mapping is TRUE

The screenshot shows the Parker webserver interface. At the top, there is a navigation bar with 'Summary', 'Parameters', and 'Passwords'. Below this, a dropdown menu is set to 'ENGINEER'. The breadcrumb path is 'Home > Engineer > Communications > Option Comms'. On the left, there are control buttons: a refresh button, a play button, a stop button, and a 'Monitor' button. The 'State' is 'Configuration' and the 'Drive' is 'OK'. The main configuration area shows the following parameters:

0691: Comms Required	CANOPEN
2566: MasterMapping	<input checked="" type="checkbox"/>
2586: InMappingStatus +	
2619: OutMappingStatus +	
0763: Node Address	3
0764: CANopen Baud	AUTO
0769: Comms Fitted	UNKNOWN

AC20 Webserver view when Master mapping is FALSE

The screenshot shows the Parker webserver interface. At the top, there is a navigation bar with 'Summary', 'Parameters', and 'Passwords'. Below this, a dropdown menu is set to 'ENGINEER'. The breadcrumb path is 'Home > Engineer > Communications > Option Comms'. On the left, there are control buttons: a refresh button, a play button, a stop button, and a 'Monitor' button. The 'State' is 'Configuration' and the 'Drive' is 'OK'. The main configuration area shows the following parameters:

0691: Comms Required	CANOPEN
2566: MasterMapping	<input type="checkbox"/>
0692: Input Mapping +	
0725: Out Mapping +	
0763: Node Address	3
0764: CANopen Baud	AUTO
0769: Comms Fitted	UNKNOWN

8.2 Process Data

AC20 parameters implementation

The AC20 CANopen data can be accessed from the network via dedicated object entries in the object dictionary. The object dictionary contains Standard, Manufacturer and Profile Specific Objects.

The CANopen manufacturer specific range (index 2001h to FFFFh) of object entries corresponds directly to the AC20 parameters numbers.

Each object entry corresponds to an AC20 parameter number, with parameter number 1 corresponding to object index 2001h, parameter number 2 to object index 2002h, etc.

For standard parameters (of a single element), sub-index 00h of the object represents the value of the parameter, its data type and access depend on the AC20 parameter.

For multiple element parameters (parameter arrays), sub-index 00h represents the number of parameter elements and sub-indexes 01h-FEh represents the value of each of the parameter elements.

In the example below parameter number 1 is a single element parameter and parameter number 2 is a 4-element parameter array:

AC20 Parameter number	Index	Subindex	Description	Type / Access
1	2001h	00h	Parameter Value	Parameter dependent
2	2002h	00h	Number of Elements	Unsigned8 / Read only
		01h	value of element 0	Parameter dependent
		02h	value of element 1	
		03h	value of element 2	
		04h	value of element 3	

Config Mapping

The AC20 CANopen option requires configuration of process data mapping. Parameters mapped as Process Data can be exchanged cyclically as Process Data Objects (PDOs) on the bus.

The slave supports up to 4 TPDOs and up to 4 RPDOs, each capable of carrying up to 8 bytes of data. (See Appendix – CANopen Object Dictionary)

There are two methods to define process data mapping: The process data can be mapped using the AC20 input and output mapping tables or from the PLC.

The parameter **2566 MASTERMAPPING** defines the method: If FALSE the AC20 input and output mapping tables will be used to configure process data mapping. If TRUE, the bus master set/configures the Process data mapping and AC20 input and output mapping tables will be cleared.

*Note: For parameter **2566 MASTERMAPPING** = 'FALSE': If the AC20 mapping tables are both set to zeros or AC20 mapping tables differs from PLC mapping then the option will be mapped from the PLC.*

Set process data using AC20 input and output mapping tables

These tables are two parameter arrays in which AC20 parameter numbers may be added. The parameter **2566 MASTERMAPPING** must be set to **FALSE**.

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> Option Comms Input Mapping 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] </pre>	

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
	<pre> Option Comms Output Mapping 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] </pre>	

Note: String-type parameters cannot be mapped.

Set process data from CANopen master

The eds file defines the list of manufacturer specific objects. Each object corresponds to an AC20 parameter.

When configuring the PLC, the objects may be mapped to the process data objects (PDO) as required. These objects map to the process data in the order in which they are added.

The parameter **2566 MASTERMAPPING** must be set to **TRUE** and this will auto reset any AC20 input and output mapping inside the drive.

Cyclic Data Exchange

Cyclic data exchange will occur when the option is in the OPERATIONAL (PROCESS ACTIVE) or STOP (IDLE) state.

However, the read process data will only update the mapped parameters when in the PROCESS ACTIVE state.

On 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 if Parameter **2566 MasterMapping** = **TRUE** and are valid if **Parameter 0774 Comms State** = **PROCESS ACTIVE**.

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 breadcrumb trail reads: Home ► Engineer ► Communications ► Option Comms. On the left, there is a user dropdown menu set to 'ENGINEER', a 'Monitor' button, and status indicators: 'State: Operational' and 'Drive: OK'. The main area displays a list of parameters:

- 0691: Comms Required
- 2566: MasterMapping
- 2586: InMappingStatus +
- 2619: OutMappingStatus +
- 0763: Node Address
- 0764: CANopen Baud
- 0769: Comms Fitted

On the right side, there are configuration controls:

- A dropdown menu set to 'CANOPEN'.
- A checked checkbox.
- A text input field containing the value '3'.
- A dropdown menu set to 'AUTO'.
- The text 'CANOPEN' below the dropdown.

The parameters 2586 and 2619 are highlighted with a yellow box in the original image.

8.3 Acyclic Data Exchange

AC20 parameters may be accessed using the SDO (Service Data Object) protocol. The parameter numbers are mapped to the manufacturer specific range as described in the Manufacturer Specific Objects section.

Accessing Parameters

The value of a single-element AC20 parameter is accessed by via its corresponding object:

$$\begin{aligned} \text{index} &= 2000h + \text{parameter number} \\ \text{sub-index} &= 00h \end{aligned}$$

The values of a multi-element AC20 parameter are accessed via its corresponding object:

$$\begin{aligned} \text{index} &= 2000h + \text{parameter number} \\ \text{sub-index} &= \text{element number} + 1 \end{aligned}$$

Alternatively, each element has its own parameter number and may be accessed via its corresponding object index.

A string parameter array must be accessed via each element of the array. Each element has its own parameter number.

Status Codes

The following CANopen report codes may be reported

CANopen Abort Code	Description
0602 0000h	Object does not exist in the object dictionary (Parameter does not exist)
0609 0011h	Sub-index does not exist
0601 0002h	Attempt to write to read-only object
0601 0001h	Attempt to read a write-only object
0607 0012h	Data type does not match. Too much data.
0607 0013h	Data type does not match. Not enough data.
0609 0030h	Out of range.

8.4 CANopen EDS File

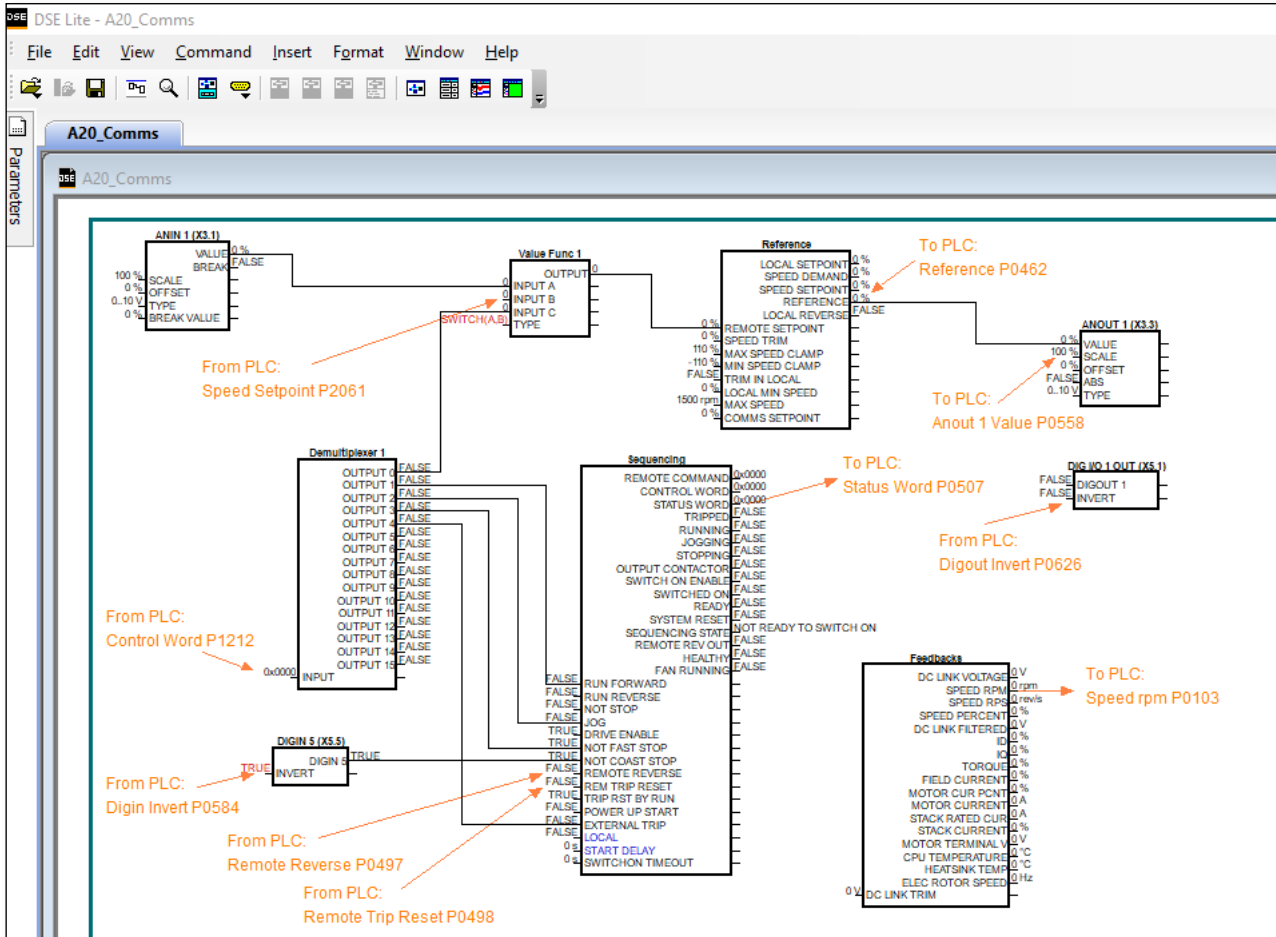
AC20 CANopen option is associated with an Electronic Data Sheet (EDS file), which holds a description of the device and its functions. Most importantly, the file describes the object dictionary implementation in the module. All the AC20 parameters will be mapped as Manufacturer Specific Objects. EDS files for the AC20 CANopen option may be downloaded from www.parker.com

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	

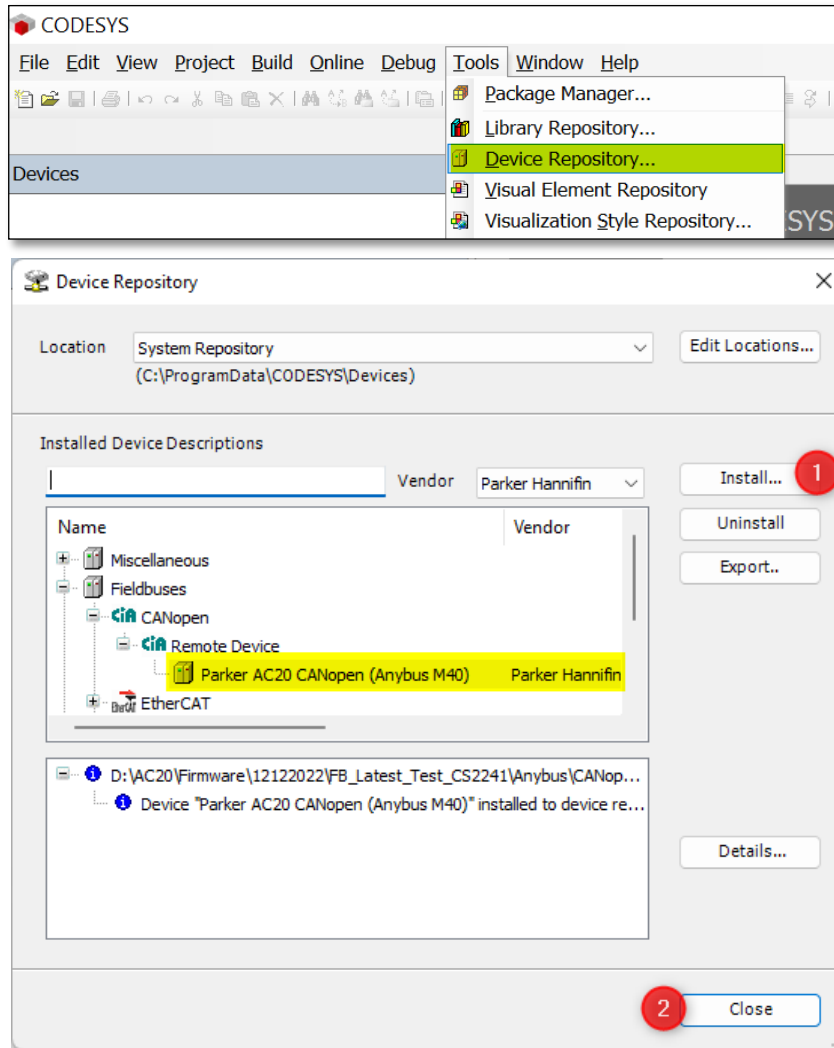
AC20 Output Mapping	Data Type	Comments	PLC Module
0507 Status Word	WORD	Status Word	Input
0462 Reference	REAL	Speed Reference	
0103 Speed rpm	REAL	Speed Feedback	
0534 Anin1 Value	REAL	Analog In1 Value	
0540 Anin2 Value	REAL	Analog In2 Value	
0558 Anout1 Value	REAL	Analog Out1 Value	
0563 Anout2 Value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

9.3 Programming using Codesys platform

This example uses a Parker PAC120 as the controller PLC and Codesys as the programming environment. Prior knowledge of Codesys software is assumed.

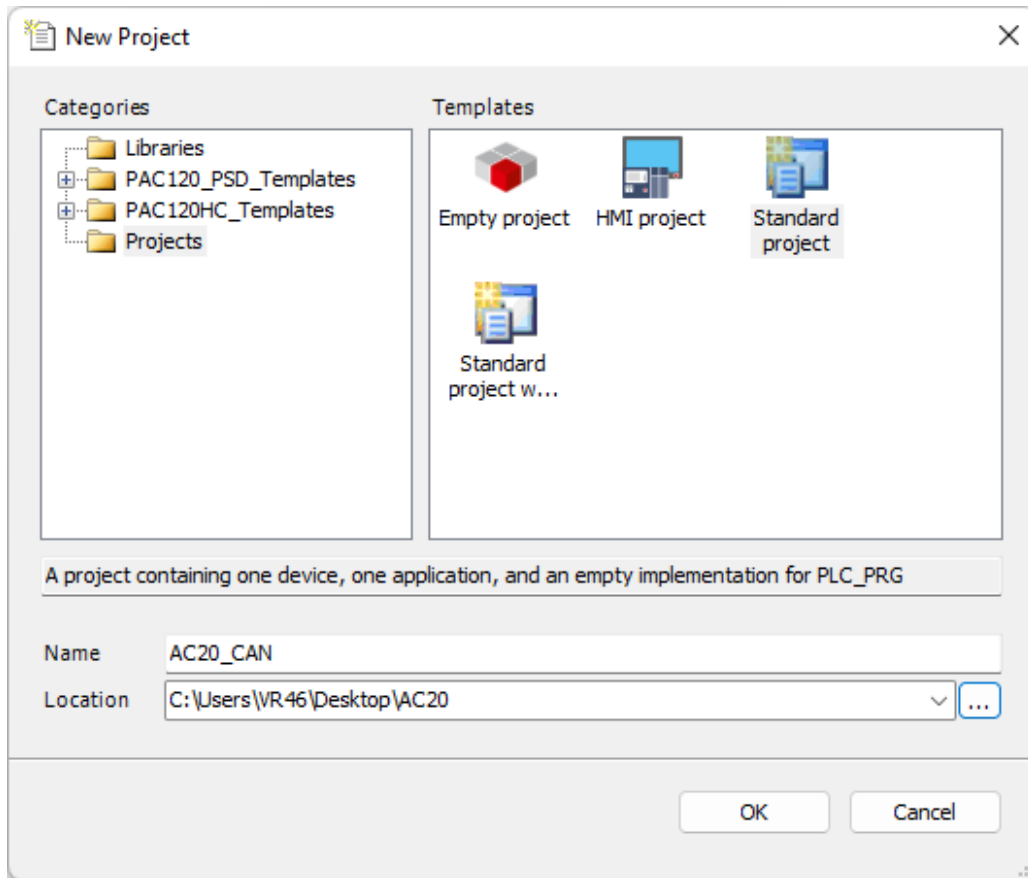
CANopen EDS File Installation

- Download the AC20 CANopen option comms from the Parker website.
- Start Codesys and from menu select **Tools > Device Repository**
- From Device Repository tab, click on Install, Select AC20 eds device description file then click **Add** to install device into the Codesys catalog.

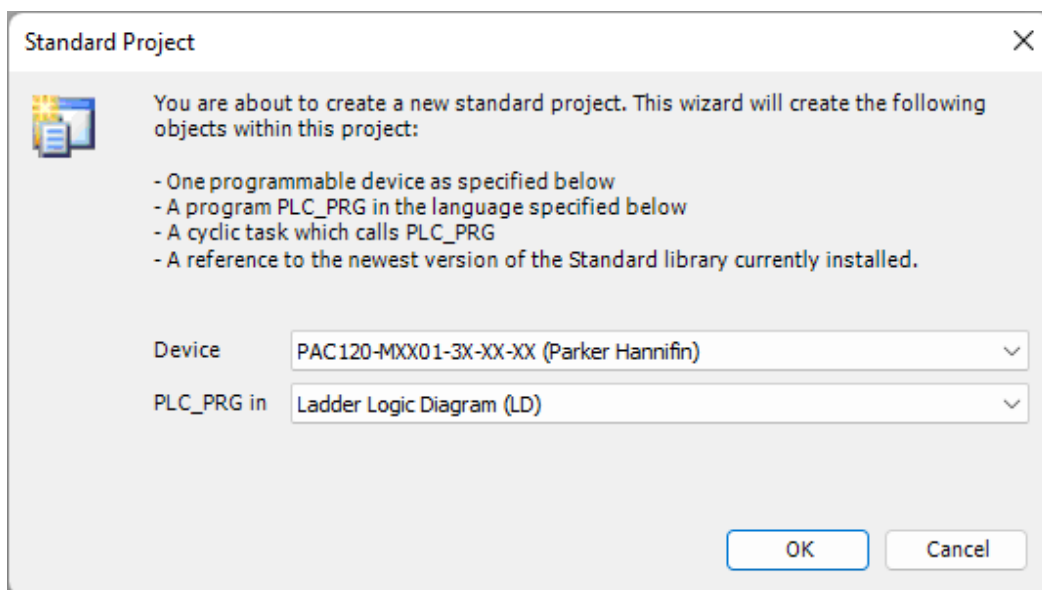


Create a project

- Launch Codesys and select **New Project** from the start page. In the **New Project** Tab select project type and define properties, then click on **OK**.

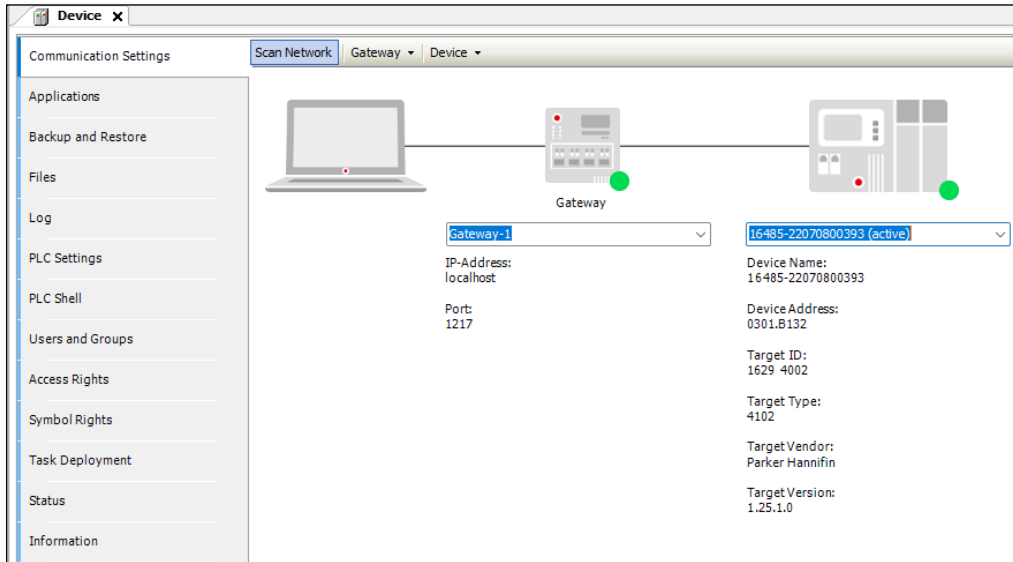


- Select PAC120 as PLC controller and select programming language, then press **OK**.



Set the gateway

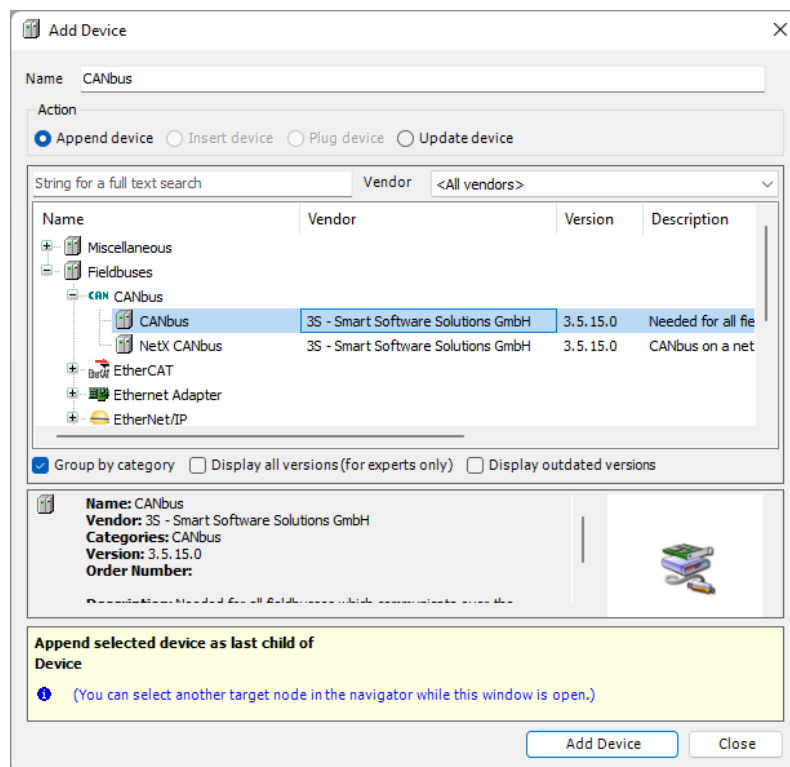
- Double-click Device (**PAC 120-MXX01-3X-XX-XX**). In the device tab select Communication settings and click on **Scan network** to find the required node. From the **Scan network** pane click the required node to make it the active path.



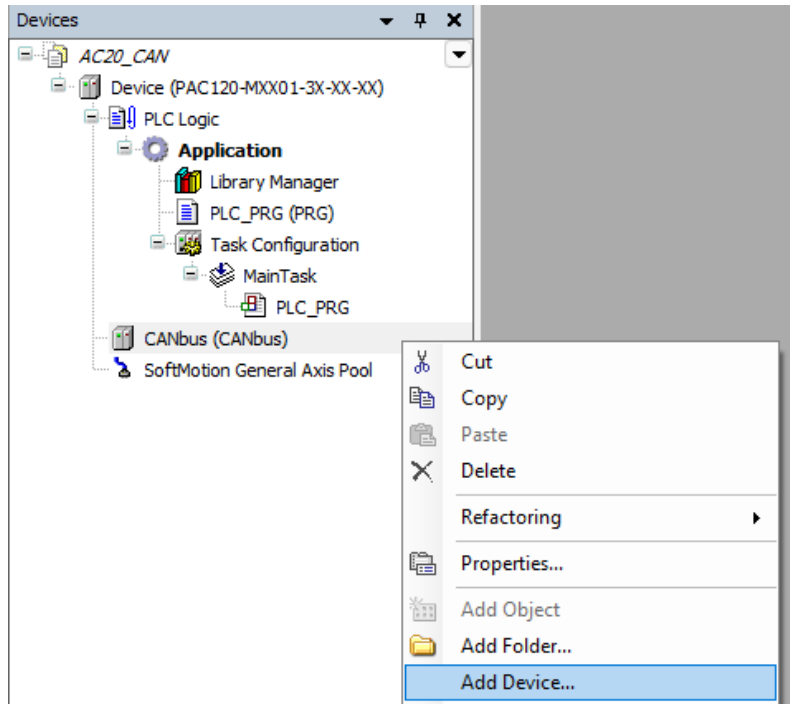
Note: if the node is not found, make sure the PAC 120 controller is powered on!

Add CANbus master

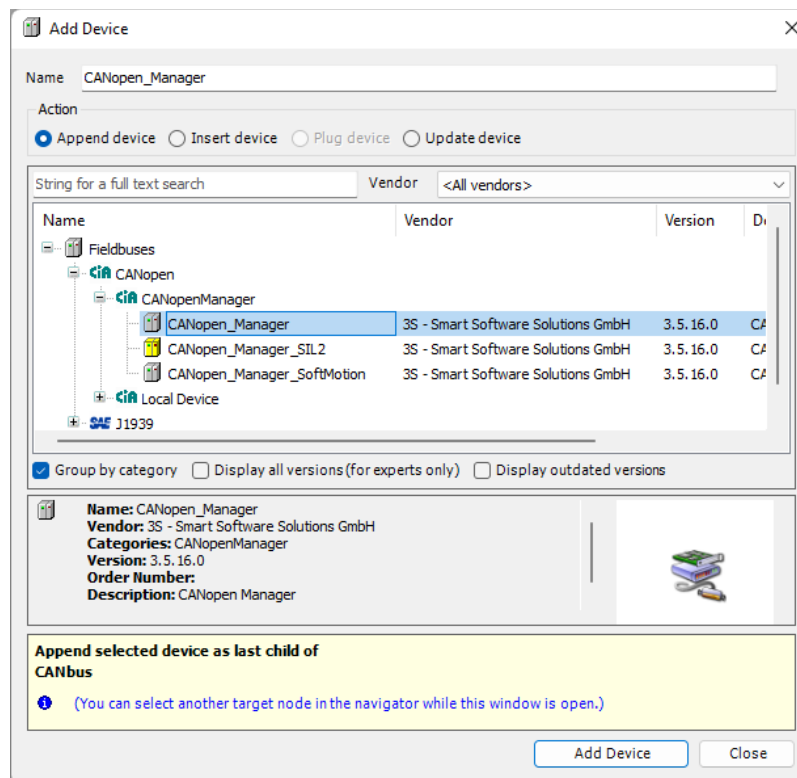
- Right click on Device (**PAC 120-MXX01-3X-XX-XX**) open **Add device** Tab, select the CANbus and click on **Add Device** followed by **Close**.



- Right click on **CANbus** from project tree, select **Add device**



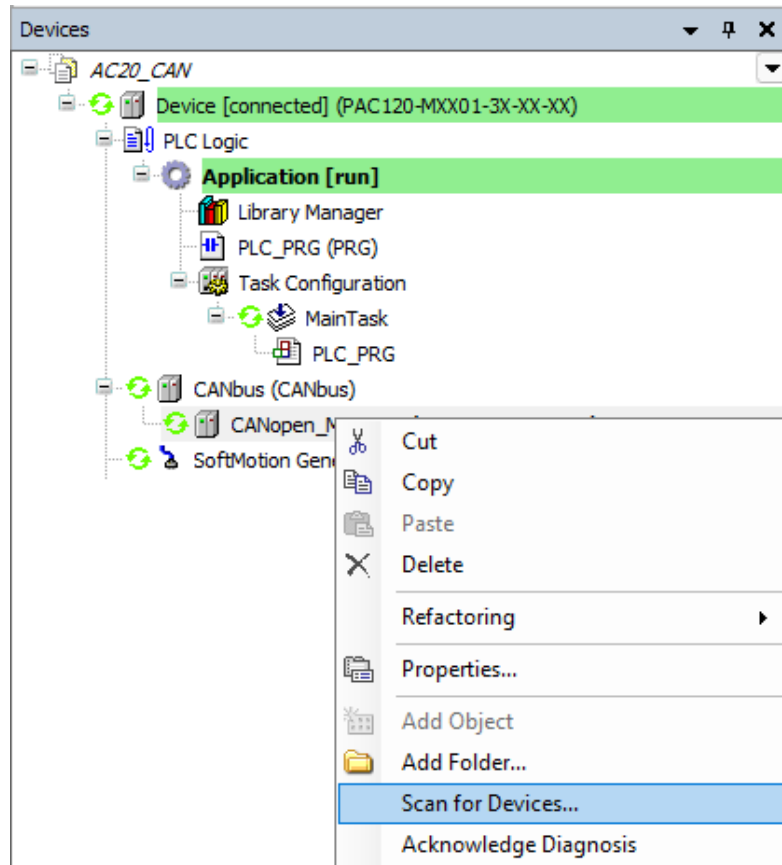
- Select the **CANopen Manager** and click on **Add Device** and then **Close**.



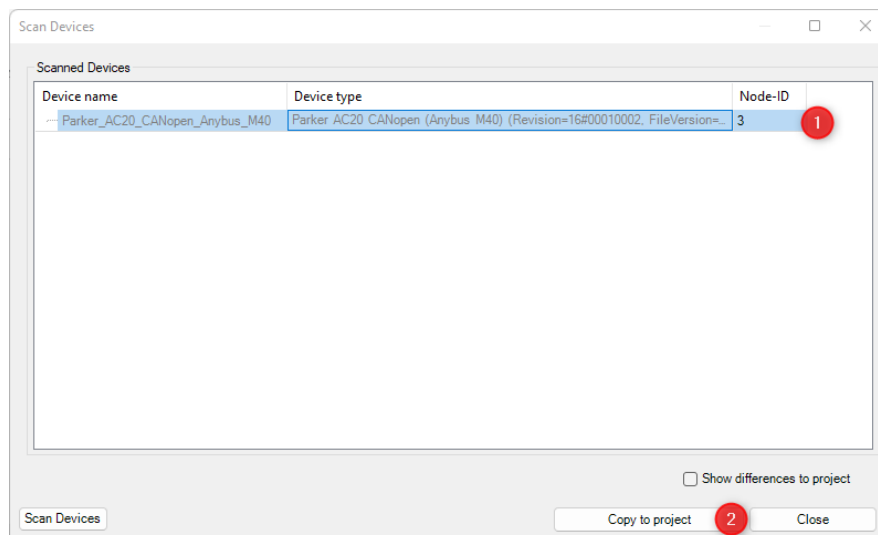
Add AC20 CANopen Slave

Scan for Device

- First compile and download the project into the PLC then Right-click **CANopen Manager** and select **Scan for Devices**.

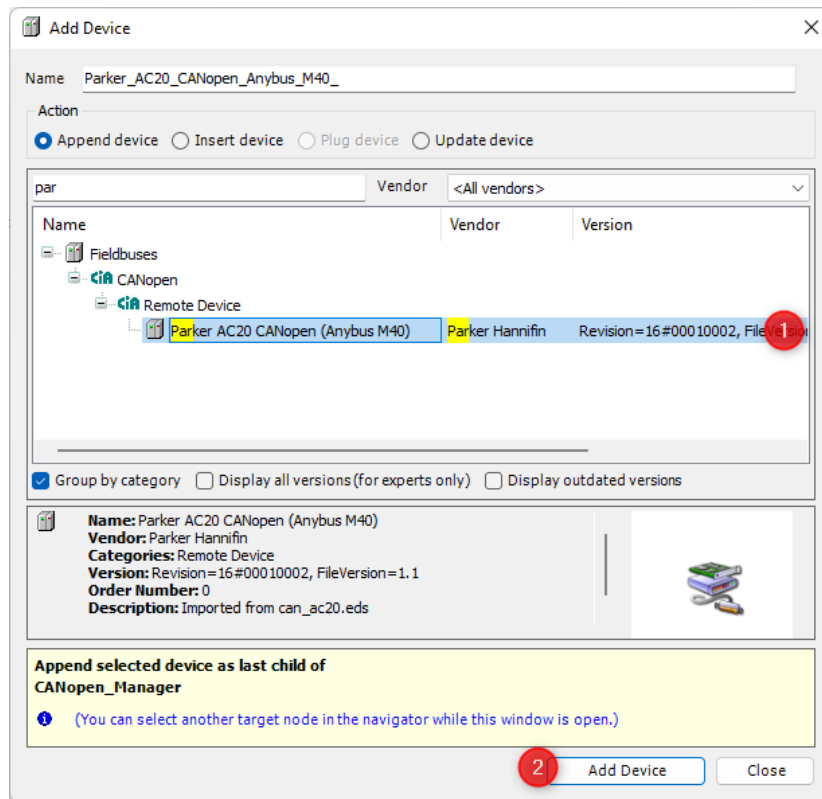


- Select device found and click on Copy All Devices to Project.



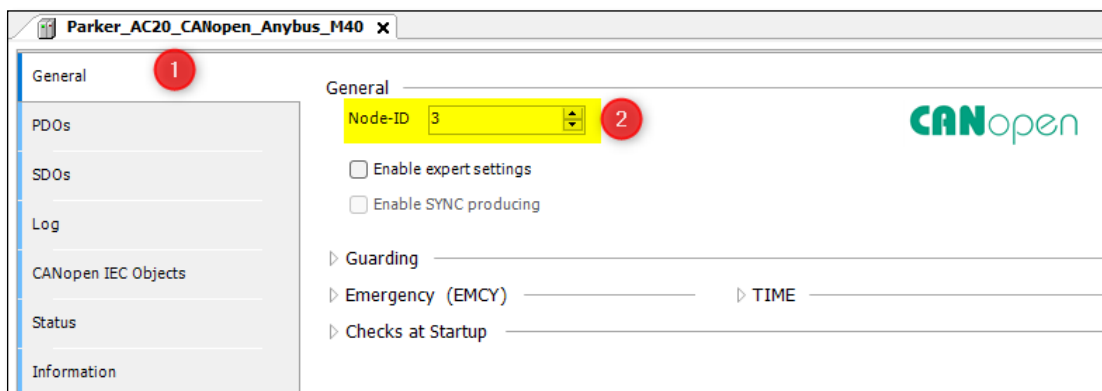
Add Device Manually

- Right-click on **CANopen Manager** and select **Add Device...** Select the device **Anybus_CompactCom_40_CANopen** and click on **Add Device** and then **Close**.



Set device address

- In the project double click the device, the General pane set **Node-ID**.



Config Process Data Mapping

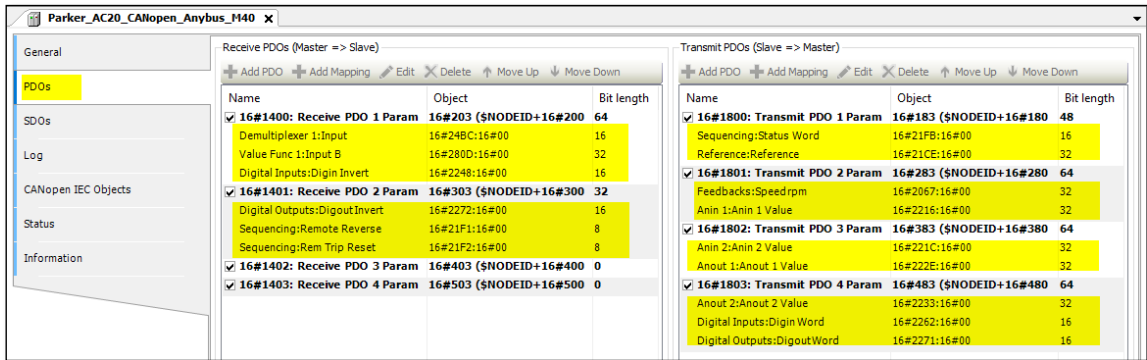
Option 1: Using AC20 Input and output mapping tables

- The parameter **2566 MASTERMAPPING** must be set to **FALSE** to prevent the PLC from overwriting the mapping.
- Through the mapping tables from the keypad, DSE Lite or Webserver, add parameter numbers into the appropriate table.

Option Comms Input Mapping		Option Comms Output Mapping	
1212	MAPPING[0]	507	MAPPING[0]
2061	MAPPING[1]	462	MAPPING[1]
584	MAPPING[2]	103	MAPPING[2]
626	MAPPING[3]	534	MAPPING[3]
497	MAPPING[4]	546	MAPPING[4]
498	MAPPING[5]	558	MAPPING[5]
0	MAPPING[6]	563	MAPPING[6]
0	MAPPING[7]	610	MAPPING[7]
0	MAPPING[8]	625	MAPPING[8]
0	MAPPING[9]	0	MAPPING[9]
0	MAPPING[10]	0	MAPPING[10]
0	MAPPING[11]	0	MAPPING[11]
0	MAPPING[12]	0	MAPPING[12]
0	MAPPING[13]	0	MAPPING[13]
0	MAPPING[14]	0	MAPPING[14]
0	MAPPING[15]	0	MAPPING[15]
0	MAPPING[16]	0	MAPPING[16]
0	MAPPING[17]	0	MAPPING[17]
0	MAPPING[18]	0	MAPPING[18]
0	MAPPING[19]	0	MAPPING[19]
0	MAPPING[20]	0	MAPPING[20]
0	MAPPING[21]	0	MAPPING[21]
0	MAPPING[22]	0	MAPPING[22]
0	MAPPING[23]	0	MAPPING[23]
0	MAPPING[24]	0	MAPPING[24]
0	MAPPING[25]	0	MAPPING[25]
0	MAPPING[26]	0	MAPPING[26]
0	MAPPING[27]	0	MAPPING[27]
0	MAPPING[28]	0	MAPPING[28]
0	MAPPING[29]	0	MAPPING[29]
0	MAPPING[30]	0	MAPPING[30]
0	MAPPING[31]	0	MAPPING[31]

Note: If the first row of a table (input mapping or Output mapping) is empty or equal to 0, the table will not be accessible and configurable from PLC.

- From the Codesys project tree double-Click **Anybus_CompactCom_40_CANopen** to open device tab, select **PDOs**, and add process data objects.
- In **Transmit PDOs** Pane, select **Transmit PDO Parameter**, click **Add Mapping** then select item from object directory in the opened Tab and click OK. Repeat this task to add all parameters listed in the above table.
- In **Receive PDOs** Pane, select **Receive PDO Parameter**, click **Add Mapping** then select item from object directory in the opened Tab and click OK. Repeat this task to add all parameters listed in the above table.

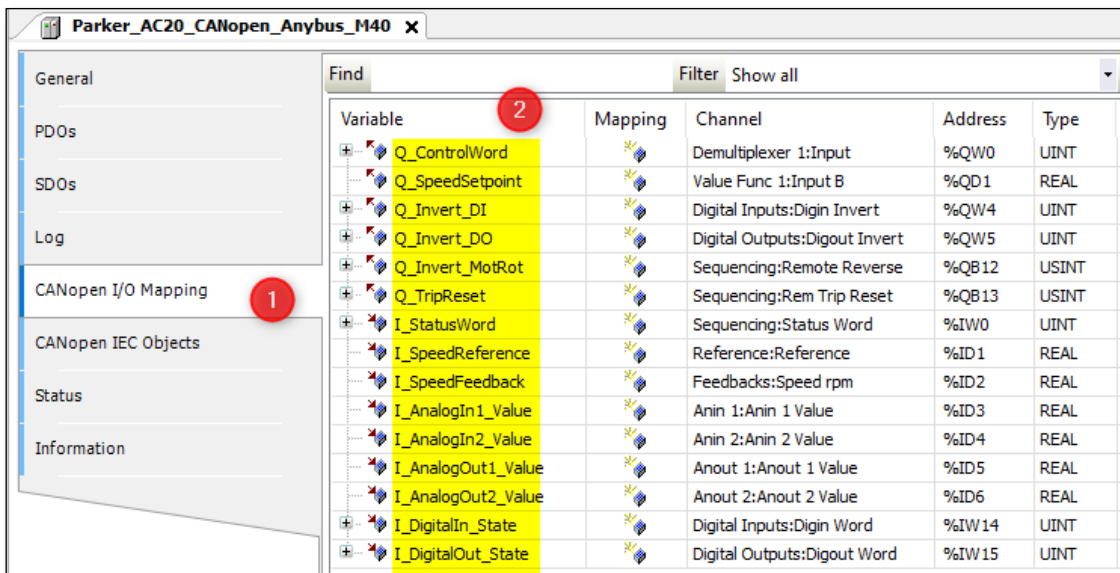


Option 2 : From PLC

- The parameter **2566 MASTERMAPPING** must be set to TRUE to allow the PLC to transfer the mapping to the AC20.
- In **Transmit PDOs** Pane, select **Transmit PDO Parameter**, click **Add Mapping** then select item from object directory in the opened Tab and click **OK**. Repeat this task to add all parameters listed in the above table.
- In **Receive PDOs** Pane, select **Receive PDO Parameter**, click **Add Mapping** then select item from object directory in the opened Tab and click **OK**. Repeat this task to add all parameters listed in the above table.

Note: The AC20 Input/Output mapping table will be set to zero and will not have effect in this configuration.

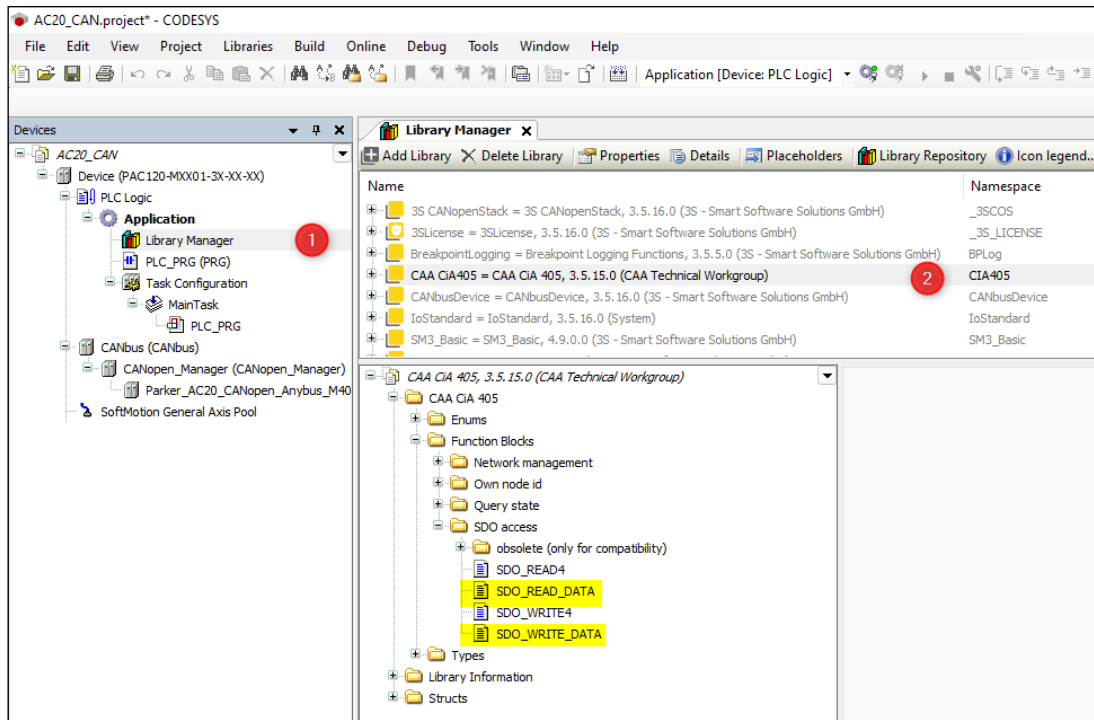
- After process data mapping configuration, compile the project then select **CANopen I/O Mapping** and assign a name to the variables.



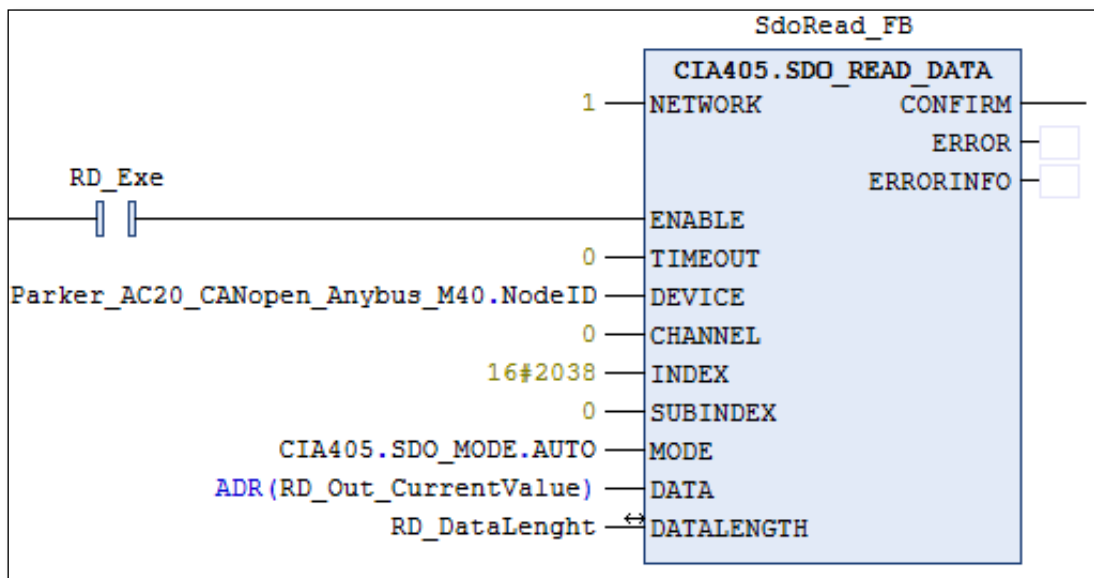
Read / Write parameters Acyclically

Acyclic read / Write services can be achieved using the functions blocks **SDO_READ_DATA** and **SDO_WRITE_DATA**:

- Add function block Library: From project tree, double-click on **Library Manager**, then Click on **add Library** select **CAA CiA405** Library and press **OK** to Add.

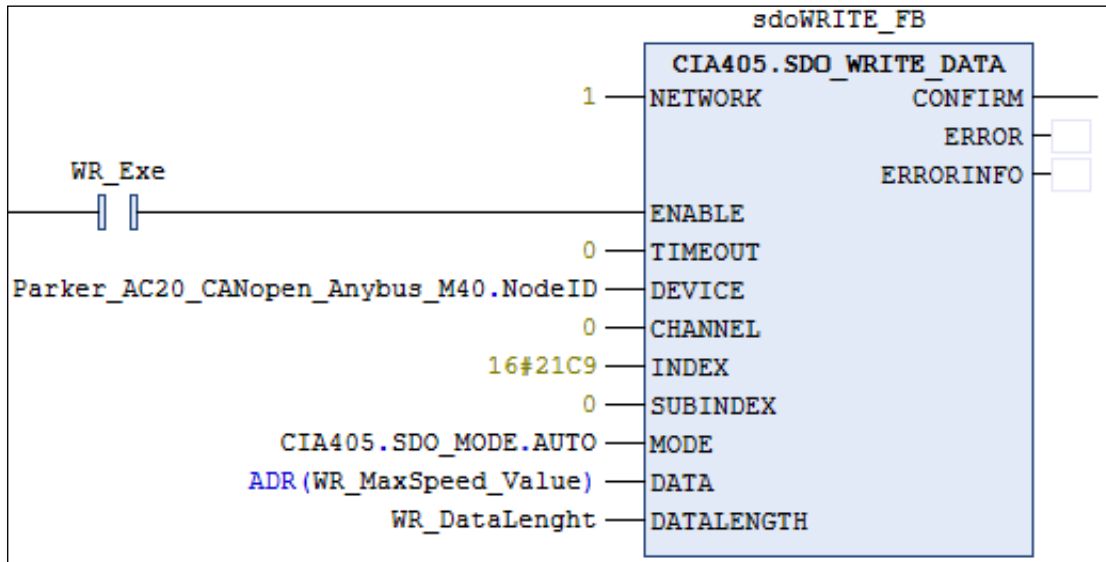


- Example: Read parameter **0056 Current Limit Out** (2038h).



Function Block Input	Type	Notes
NETWORK	USINT	CAN network number, The CiA405 NETWORK is calculated by NetID + 1 . <i>Double click "CANbus" select "General" and read the network value (NetID)</i>
DEVICE	DEVICE	NodeID of destination device. <i>Double click AC20 device and read the value of NodeID</i>
CHANNEL	USINT	SDO channel which should be used. 0 means auto channeling
INDEX	WORD	AC20 Parameter Index
SUBINDEX	BYTE	AC20 Parameter Subindex
MODE	SDO_MODE	Use AUTO, Mode will be selected automatically
DATA	POINTER TO BYTE	Pointer to data buffer where result should be written to
DATALENGTH	UDINT	Length of data buffer in Bytes

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



Function Block Input	Type	Notes
NETWORK	USINT	CAN network number, The CiA405 NETWORK is calculated by NetID + 1 . <i>Double click "CANbus" select "General" and read the network value (NetID)</i>
DEVICE	DEVICE	NodeID of destination device. <i>Double click AC20 device and read the value of NodeID</i>
CHANNEL	USINT	SDO channel which should be used. 0 means auto channeling
INDEX	WORD	AC20 Parameter Index
SUBINDEX	BYTE	AC20 Parameter Subindex
MODE	SDO_MODE	Use AUTO, Mode will be selected automatically
DATA	POINTER TO BYTE	pointer to data which should be written
DATALENGTH	UDINT	Length of data buffer in Bytes

10 Lost Communication Trip

Supervised Parameter:

The **0777 Comms Supervised** parameter indicates that the CANopen network participation is supervised by another CANopen device.

The Supervised parameter value is set to TRUE when either:

- The heartbeat consumer and Heartbeat producer is enabled and error free.
- Node guarding is enabled and error free.

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 parameter **0774 Comms State** indicates 'PROCESS_ACTIVE' when the CANopen communication is active. The table below describes how the comms state relates to the CANopen network:

Comms State	Comments
NW_INIT	Network initialization
WAIT_PROCESS	PRE-Operational
IDLE	STOPPED, the network device is in idle
PROCESS_ACTIVE	Operational: the network process data channel is active and error free
ERROR	controller has entered the BUS-off state
EXCEPTION	<ul style="list-style-type: none"> - An illegal configuration or a NMT (Network management) service RESET NODE request have been received. - Application error (invalid network configuration parameter, timeout etc.)

11 Diagnostic Event

Configuration problems can often be identified by looking at the Run and Error LEDs and from the CANopen State and Comms Diagnostic **0775 parameters**. Under normal operating conditions the Comms diagnostic parameter should indicate **OK**. Other values are summarized in the Diagnostic Parameters section.

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

When a diagnostic event is entered a new entry is created in object entry 1003h (pre-defined error field) The Error Register (object 1001h) is set with the corresponding bit information.

High Byte		Low Byte	
Not used	Not used	Event Code	00h

The EMCY Object is sent to the network with the following information:

Byte 0	Byte 1	Byte 2	Byte 3 Byte7
00h	Event Code	Event Register (1001h)	Not used

EMCY Error Code	Description
8110h	CAN controller signaled a lost message
8120h	CAN controller reached the warning limit due to error frames.
8210h	A received PDO was smaller than specified by the valid mapping table
8220h	The DLC of a received PDO exceeded the length specified by the mapping table.
8130h	An error control event has occurred (either a life guarding or heartbeat event).
8140h	CAN controller has recovered from a BUS OFF state.
8150h	COB-ID collision detected.
FF01h	Process data remap was NAKed by the host application. No valid process data map available.

APPENDIX A: Data types

The relationship between AC20 parameter and CANopen data type is given in the table below.

AC20 Parameter		CIP	
Data Type	Description	Data Type	Bytes
BOOL	Boolean	BOOL	1
SINT	Short integer	SINT	1
INT	Integer	INT	2
DINT	Double integer	DINT	4
USINT	Unsigned short integer	USINT	1
UINT	Unsigned integer	UINT	2
UDINT	Unsigned double integer	UDINT	4
REAL	Floating point	FLOAT	4
TIME	Duration	UDINT	4
DATE	Date	UDINT	4
TIME_OF_DAY	Time of day	UDINT	4
DATE_AND_TIME	Date and time of day	UDINT	4
STRING	String	SHORT_STRING**	<i>n</i>
BYTE	Bit string length 8	USINT	1
WORD	Bit string length 16	UINT	2
DWORD	Bit string length 32	UDINT	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 0134, 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.						

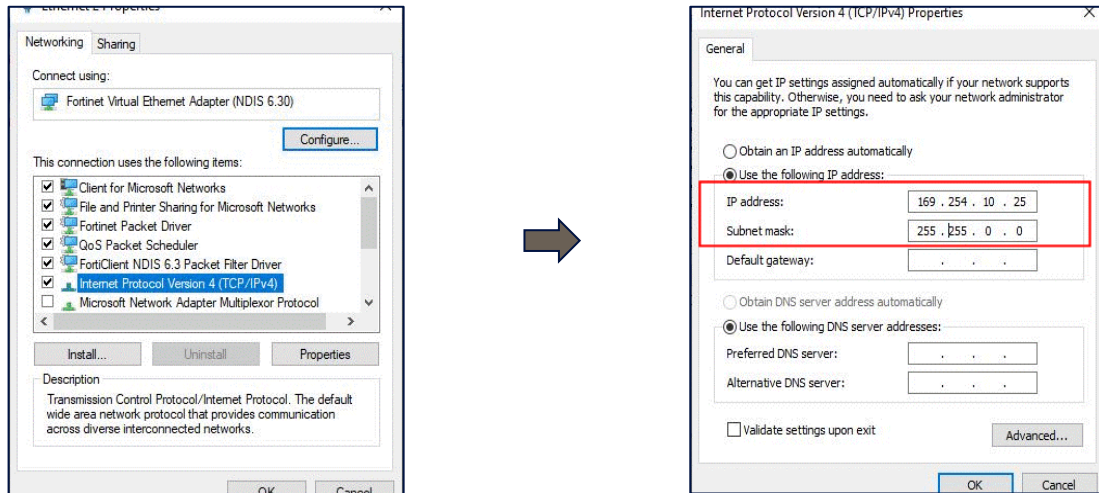
APPENDIX C: DSE Lite Quick Start Guide

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

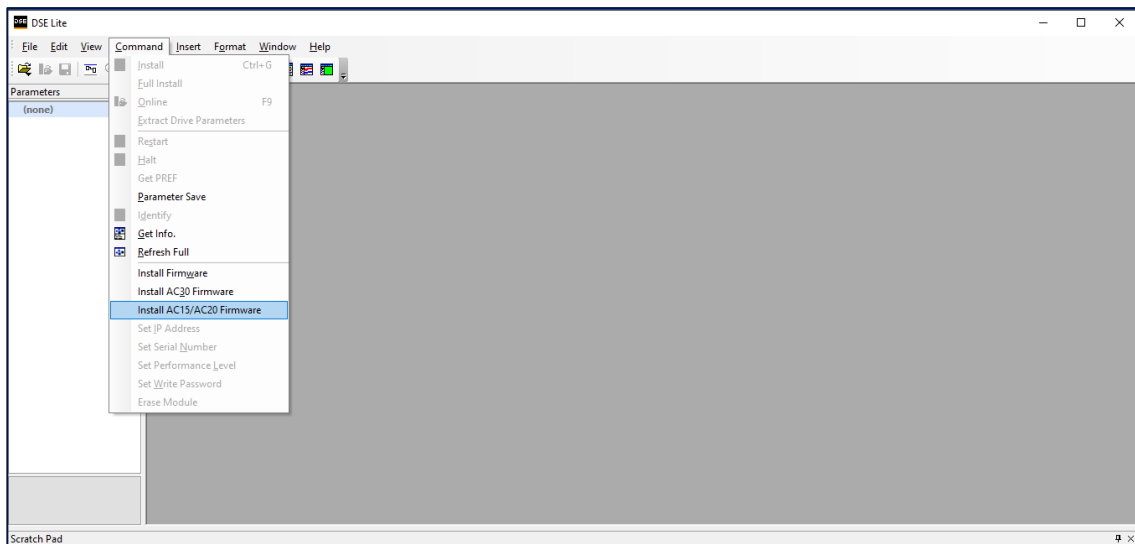
The block diagram of the AC20 may be accessed through the onboard webserver or DSE Lite.

DSE Lite is recommended.

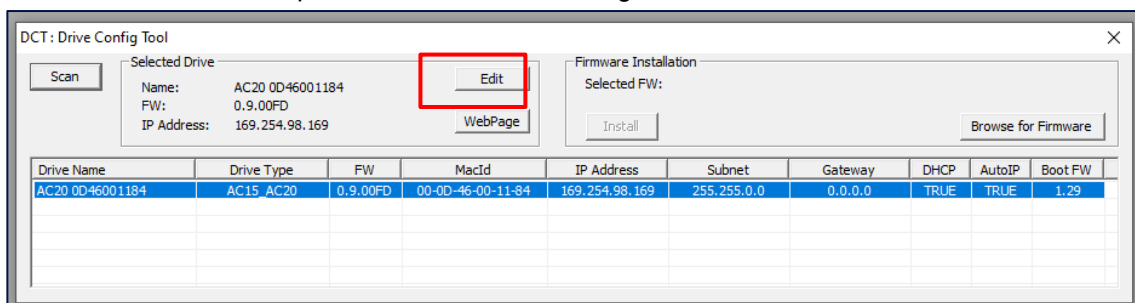
The IP address of the AC20 is in the range 169.254.xx.xx by default. Therefore, the user's PC network adapter must be configured to this range as shown below (IPv4 is used for communication).

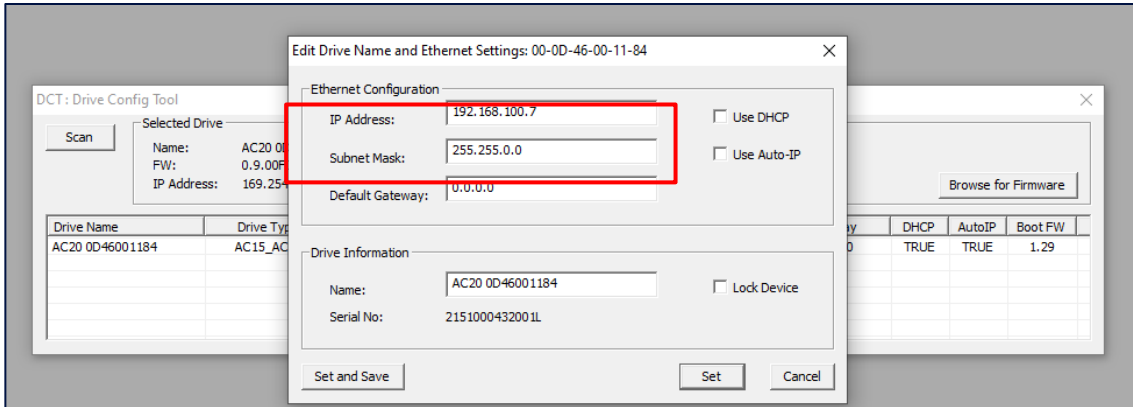


Alternatively, the IP address of the drive may be changed to suit the settings of the PC network adapter. The IP address of the drive can be configured using the DCT function, accessible from within DSE Lite by selecting Command -> Install AC15/AC20 Firmware.



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

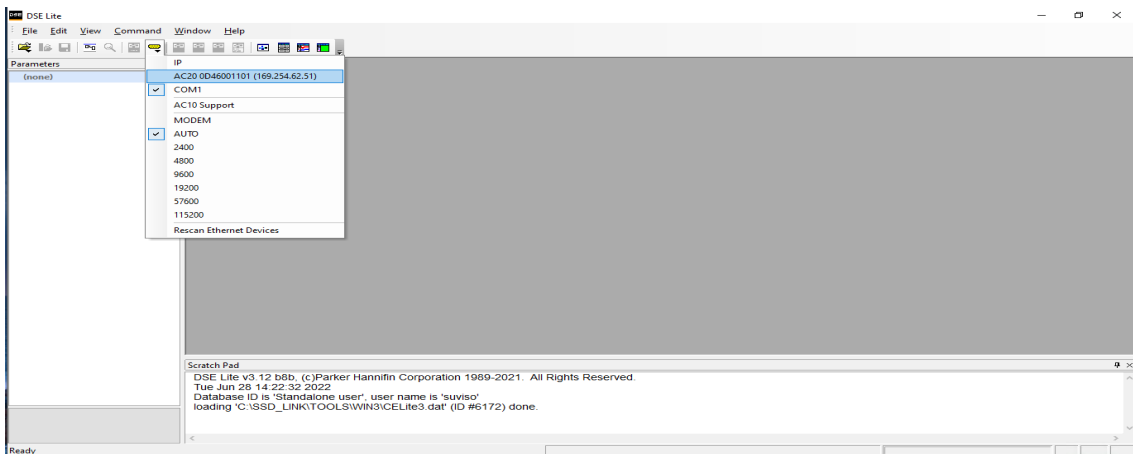




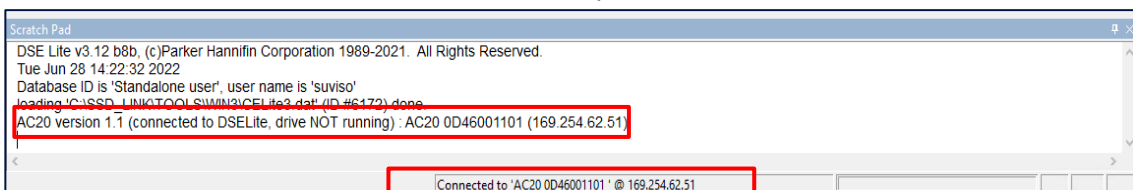
If the drive is not found by DSE lite, or a new drive is connected to the Ethernet port, a network scan must be performed again, as blow.



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.



APPENDIX D: CANopen Object Dictionary

Standard

The standard object dictionary is implemented according to the CiA 302 4.2.0 from CiA (CAN in Automation). Note that certain object entries correspond to settings in the CANopen Object (FBh), and the Diagnostic Object (02h).

Index	Object Name	Sub-Index	Description	Type	Access	Notes
1000h	Device Type	00h	Device Type	U32	RO	CANopen Object,
1001h	Error register	00h	Error register	U8	RO	Diagnostic Object,
1003h	Pre-defined error field	00h	Number of errors	U8	RW	
		01h...05h	Error field	U32	RO	
1005h	COB-ID Sync	00h	COB-ID Sync	U32	RW	Default value is 0000 0080h
1008h	Manufacturer device name	00h	Manufacturer device name	Visible string	RO	CANopen Object,
1009h	Manufacturer hardware version	00h	Manufacturer hardware version	Visible string	RO	
100Ah	Manufacturer software version	00h	Manufacturer software version	Visible string	RO	
1010h	Store Parameters	00h	Largest sub index supported	U8	RO	02h
		01h	Store all parameters	U32	RW	Baud rate and Node ID cannot be stored using this command.
		02h	Store Communication parameters	U32	RW	
1011h	Restore parameters	00h	Largest sub index supported	U8	RO	04h
		01h	Restore all default parameters	U32	RW	-
		02h	Restore communication default parameters	U32	RW	-
		04h	Restore manufacturer parameters to default	U32	RW	-
1014h	COB ID EMCY	00h	COB ID EMCY	U32	RW	Default value is 0000 0080h + NodeID
1015h	Inhibit Time EMCY	00h	Inhibit Time EMCY	U16	RW	Default value is 0000h
1016h	Consumer Heartbeat Time	00h	Numbers of entries	U8	RO	01h
		01h	Consumer Heartbeat Time	U32	RW	Node ID + Heartbeat Time.
1017h	Producer Heartbeat Time	00h	Producer Heartbeat Time	U16	RW	-

Index	Object Name	Sub-Index	Description	Type	Access	Notes
1018h	Identity object	00h	Number of entries	U8	RO	04h
		01h	Vendor ID	U32	RO	CANopen Object,
		02h	Product Code	U32	RO	
		03h	Revision Number	U32	RO	
		04h	Serial Number	U32	RO	
1400h ... 14XXh	RPDO communication parameter	00h	Largest sub-index supported	U8	RO	02h
01h		COB ID used by RPDO	U32	RW	-	
02h		Transmission type.	U8	RW	-	
1600h ... 16XXh	RPDO mapping parameter	00h	No. of mapped application objects in RPDO	U8	RO/RW	0-8
01h		Mapped object #1	U32	RO/RW	-	
02h		Mapped object #2	U32	RO/RW	-	
...		-	
08h		Mapped object #8	U32	RO/RW	-	
1800h ... 18XXh	TPDO communication parameter	00h	Largest sub-index supported	U8	RO	05h
01h		COB ID used by TPDO	U32	RW		
02h		Transmission type	U8	RW		
03h		Inhibit time	U16	RW	-	
05h		Event Timer (ms)	U16	RW	-	
1A00h ... 1AXXh	TPDO mapping parameter	00h	No. of mapped application objects in TPDO	U8	RO/RW	0-8
01h		Mapped object #1	U32	RO/RW	-	
02h		Mapped object #2	U32	RO/RW	-	
...		-	
08h		Mapped object #8	U32	RO/RW	-	

RPDO Default COB IDs

RPDO no.	Default COB ID	Default Transmission Type	Description
1	200h + Node ID	254	Default enabled according to DS301, if the mapping scheme requires this PDO
2	300h + Node ID		
3	400h + Node ID		
4	500h + Node ID		
5...64	000h		Default disabled

TPDO Default COB IDs

TPDO no.	Default COB ID	Default Transmission Type	Description
1	40000180h + Node ID	254	Default enabled according to DS301, if the mapping scheme requires this PDO Please note that the RTR bit is always set
2	40000280h + Node ID		
3	40000380h + Node ID		
4	40000480h + Node ID		
5...64	000h		Default Disabled Must be configured by the configuration tool to be usable

PDO Transmission Types

Transmission Type	Description	RxPDO	TxPDO
254/255	Event driven	Data from RxPDO is copied to correct offset in the read process data buffer. The entire read process data buffer is then sent to the host application immediately.	All event driven TxPDOs are sent immediately when the host application sends new write process data to the module (unless inhibited by inhibit timer).
0	Acyclic Synchronous	Data from RxPDO is copied to correct offset in the read process data buffer. The entire read process data buffer is sent to the host application on the next received SYNC.	TxPDOs with transmission type 0 is sent on every received SYNC.
1...240	Cyclic Synchronous	Data from RxPDO is copied to correct offset in the read process data buffer. The entire read process data buffer is sent to the host application on the next received SYNC.	TxPDOs with transmission type 1-240 are sent on every n:th received SYNC, where n is the configured transmission type.
254/255 with event timer configured for the PDO	Timer driven	Event timer is not supported for RxPDO	All timer driven TxPDOs are sent immediately when the host application sends new write process data to the module or when the event timer expires.

Manufacturer and Profile Specific Objects


The parameters data type is defined according to CiA 302 version 2.4.0

Index	Object Name	Sub-Index	Description	Type	Access	Notes
2001h	Parameters 0001h	00h	Number of entries (NNh)	U8	RO	(Sub-Index FFh excluded)
		01h	Parameter value(s)	-	-	The data type and access rights of the parameter's values are determined by the parameter itself.
		...				
		NNh				
FFh	Parameter data type	U32	RO			
2002h	Parameters 0002h	00h	Parameter value	-	-	Data type and Access rights depends on the parameter itself.
		FFh	Parameter's data type	U32	RO	
...
FFFFh	Parameters DFFFh	00h	Number of entries (NNh)	U8	RO	(Sub-Index FFh excluded)
		01h	Parameter value(s) as multiple subindexes.	-	-	Data type and Access rights depends on the parameter itself.
		...				
		NNh				
FFh	Parameter data type	U32	RO			



EMAC s.r.o.
Kasarenska 2404/26
911 05 Trencin
SLOVAKIA

Parker certified distributor

 +421 32 3810 232

 info@emac.sk

 www.emac.sk