PowerXL DM1 series VFD Effective May 2021

Communication manual

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Cover Photo: Eaton PowerXL® Series Drives

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Safety

WARNING!
DANGEROUS ELECTRICAL VOLTAGE!

Read this manual thoroughly and make sure you understand the procedures before you attempt to install, set up, operate or carry out any maintenance work on this PowerXL Adjustable Frequency Drive.

Definitions and symbols

WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous high voltage

WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

- **Stand on an insulating pad and make it a habit to use only one hand when checking components.**
- **Always work with another person in case an emergency occurs.**
- **Disconnect power before checking controllers or performing maintenance.**
- **Be sure equipment is properly earthed.**
- **Wear safety glasses whenever working on electronic controllers or rotating machinery.**

WARNING

The components in the drive's power section remain energized after the supply voltage has been switched off. After disconnecting the supply, wait at least five minutes before removing the cover to allow the intermediate circuit capacitors to discharge.

Pay attention to hazard warnings!

DANGER
5 MIN

WARNING

Electric shock hazard—risk of injuries! Carry out wiring work only if the unit is de-energized.

WARNING

Do not perform any modifications on the AC drive when it is connected to mains.

Warnings and cautions

WARNING

Be sure to ground the unit following the instructions in this manual. Ungrounded units may cause electric shock and/or fire.

WARNING

This equipment should only be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of this type of equipment and the hazards involved. Failure to observe this precaution could result in death or severe injury.

WARNING

Components within the drive are live when it is connected to power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

WARNING

Line terminals (L1, L2, L3), motor terminals (U, V, W) and the brake resistor terminals (R+, R–) are live when the drive is connected to power, even if the motor is not running. Contact with this voltage is extremely dangerous and may cause death or severe injury.

EMC warnings and cautions

⚠ WARNING

In a residential environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

⚠ WARNING

- **This type of PDS is not intended to be used on a low-voltage public network which supplies residential premises.**
- **Radio frequency interference is expected if used on such a network.**

⚠ CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

⚠ WARNING

Even though the control I/O-terminals are isolated from line voltage, the relay outputs and other I/O-terminals may have dangerous voltage present even when the drive is disconnected from power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚠ WARNING

This equipment has a large capacitive leakage current during operation, which can cause enclosure parts to be above ground potential. Proper grounding, as described in this manual, is required. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

Before applying power to this drive, make sure that the front and cable covers are closed and fastened to prevent exposure to potential electrical fault conditions. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

An upstream disconnect/protective device must be provided as required by the National Electric Code® (NEC®). Failure to follow this precaution may result in death or severe injury.

⚠ WARNING

This drive can cause a DC current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

⚠ WARNING

Carry out wiring work only after the drive has been correctly mounted and secured.

⚠ WARNING

Before opening the drive covers:

- **Disconnect all power to the drive, including external control power that may be present**
- **Wait a minimum of five minutes after all the lights on the keypad are off. This allows time for the DC bus capacitors to discharge**
- **A hazard voltage may still remain in the DC bus capacitors even if the power has been turned off. Confirm that the capacitors have fully discharged by measuring their voltage using a multimeter set to measure the DC voltage**

Failure to follow these precautions may cause death or severe injury.

⚠ WARNING

The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

⚠ WARNING

Operation of this equipment requires detailed installation and operation instructions provided in the Installation/Operation manual intended for use with this product. It should be retained with this device at all times. A hard copy of this information may be ordered from literature fulfillment.

⚠ WARNING

Before servicing the drive:

- **Disconnect all power to the drive, including external control power that may be present.**
- **Place a "DO NOT TURN ON" label on the disconnect device Lock the disconnect device in the open position.**

Failure to follow these precautions may cause death or severe injury.

⚠ WARNING

The drive outputs (U, V, W) must not be connected to the input voltage or the utility line power as severe damage to the device may occur and there may be a risk of fire.

⚠ WARNING

The heat sink and/or outer enclosure may reach a high temperature.

Pay attention to hazard warnings!

Hot Surface—Risk of Burn. DO NOT TOUCH!

⚠ WARNING

In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

PowerXL series overview

This series overview describes the purpose and contents of this manual, the receiving inspection recommendations, and the PowerXL Series Open Drive catalog numbering system.

How to use this manual

The purpose of this manual is to provide you with information necessary to install, set and customize parameters, start up, troubleshoot and maintain the PowerXL Series Variable Frequency Drive (VFD). To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the PowerXL Series VFD. Keep this operating manual handy and distribute to all users, technicians, and maintenance personnel for reference.

Table 1. Common abbreviations.

Abbreviation	Definition
CT	Constant torque with high overload rating (150%)
VT	Variable torque with low overload rating (110%)
I_H	High Overload (150%)
I_L	Low Overload (110%)
RTC	Real Time Clock
VFD	Variable Frequency Drive

Option card installation steps

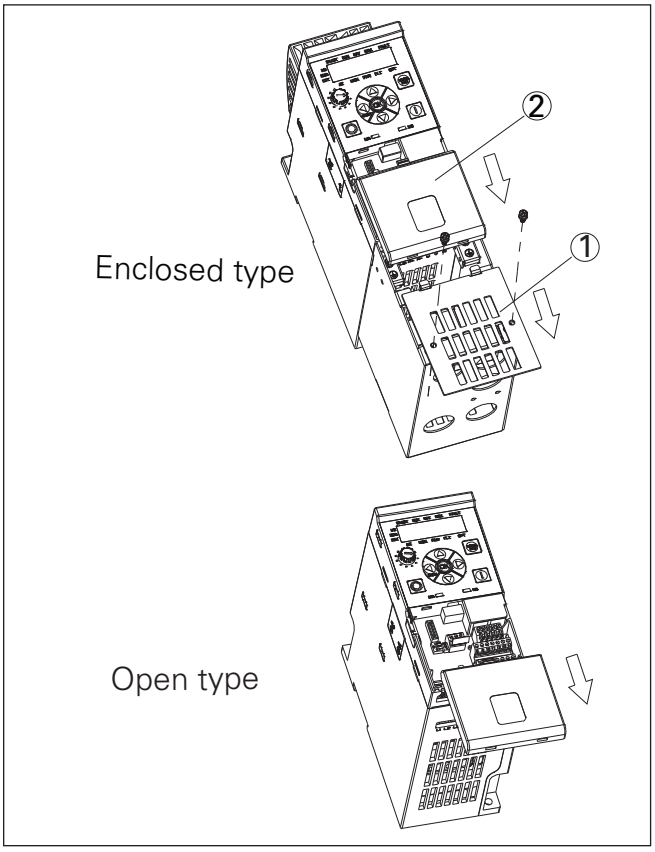
Step 1.

For enclosed type:

1. Remove the front cover ① from the NEMA 1 kit.
2. Remove the terminal cover ② from the drive.

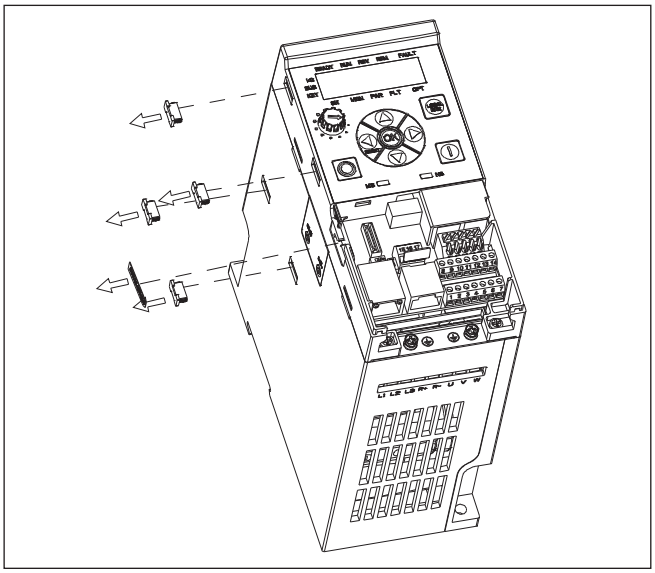
For open type:

1. Only remove the terminal cover ② from the drive.



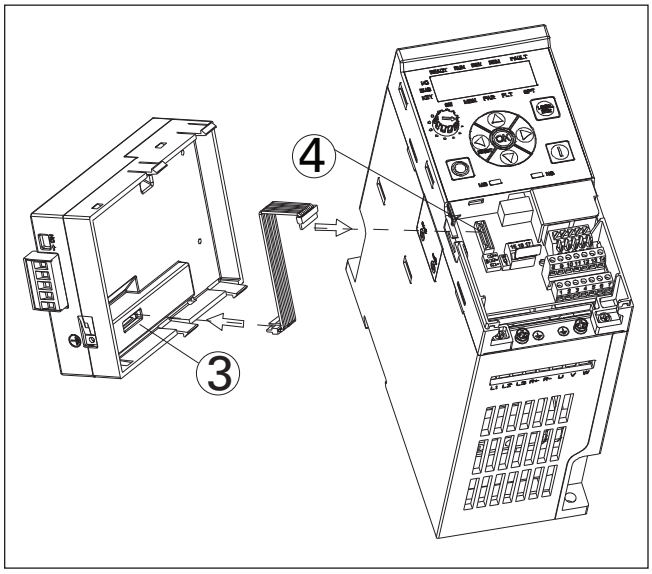
Step 2.

1. Remove the option card port label and four snap covers from the drive.



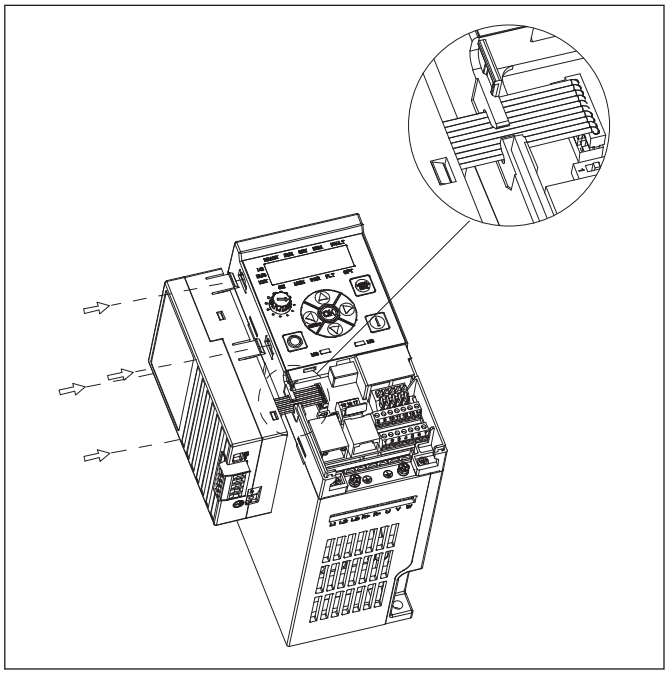
Step 3.

1. Connect the cable to option card connector ③ and MCU board connector ④.



Step 4.

1. Clamp the cable with optional card port.
2. Mount the option card to the drive by inserting the four snaps into the slots on drive.



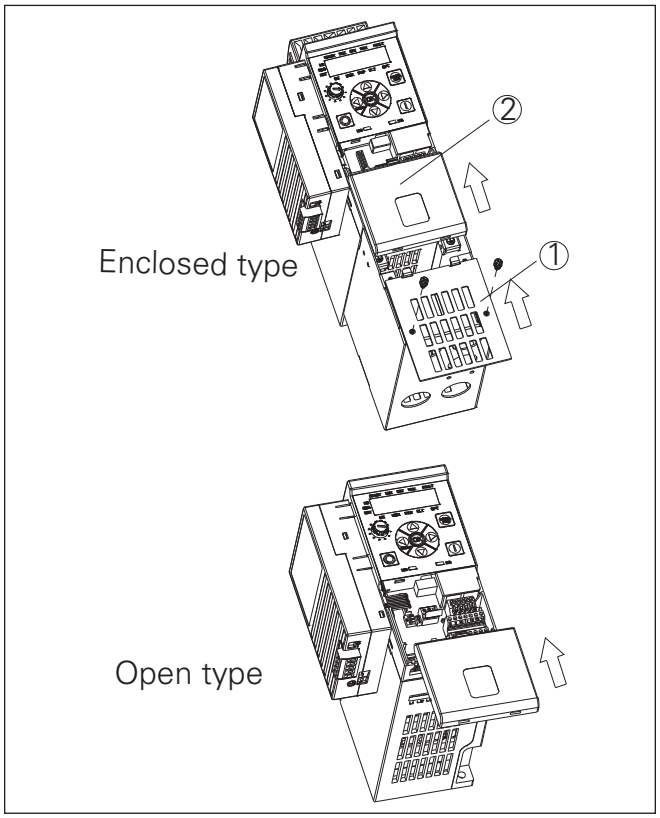
Step 5.

For enclosed type:

1. Install the terminal cover ② to the drive.
2. Install the front cover ① to the NEMA 1 kit.

For open type:

1. Only install the terminal cover ② to the drive.



Control wiring

Digital I/O and 24 Vdc can use Stranded Cu or Solid Cu wire as specified below. Analog signal PT100 must use shielded cables. **Table 2** shows the wire sizes available. I/O terminals allow for 5.00 mm connectors.

Wiring instruction

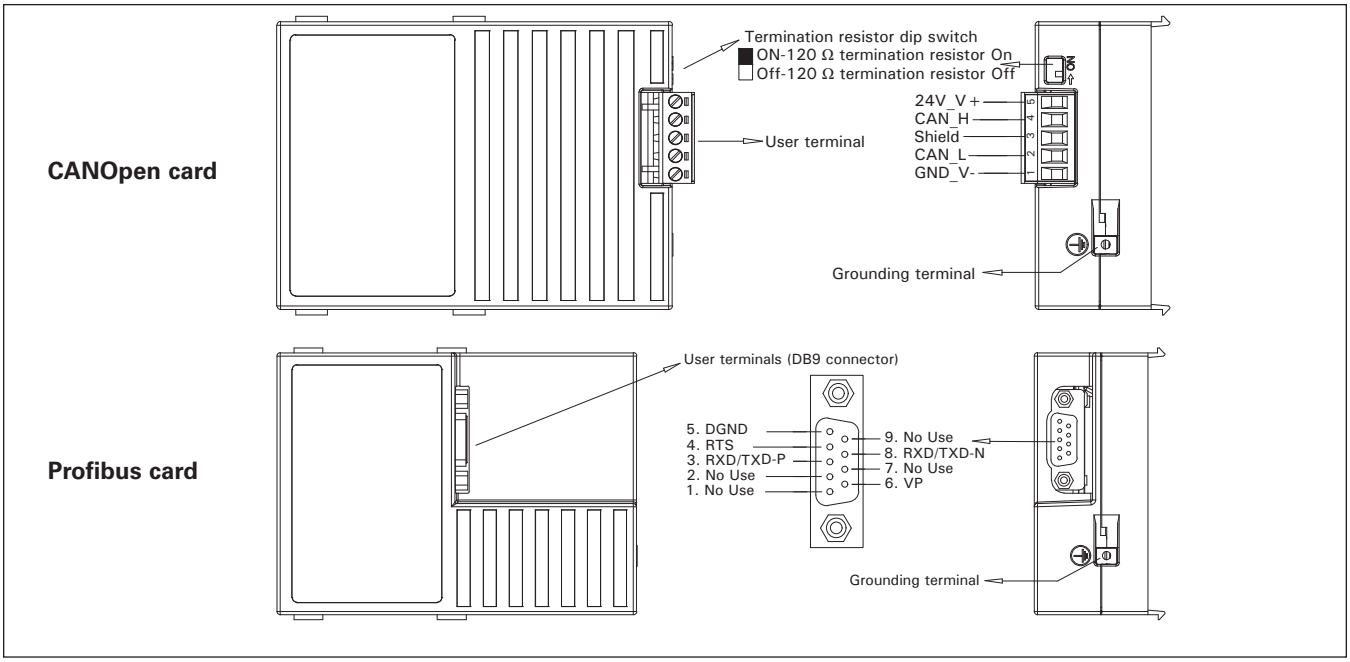


Table 2. Wire sizes.

Wire type	Wire size	Terminal torque
Solid Cu –90 °C	12–28 AWG (0.2~2.5 mm^2)	4.5 in-lb (0.5 Nm)
Stranded Cu –90 °C	12–30 AWG (0.2~2.5 mm^2)	4.5 in-lb (0.5 Nm)

EMC directive

For the electrical equipment installed in the EMC, directive states that the equipment must not disturb the environment and must be immune to other electromagnetic disturbances in the environment. **Table 3** indicates the requirements for the control wiring to meet this directive.

Table 3. Control wiring requirements.

Item	.Directive
Product	IEC 61800-2
Safety	UL 508C, IEC / EN 61800-5-1
EMC (at default settings)	Immunity: EN / IEC 61800-3, 2nd environment
	Radiated emissions: EN / IEC 61800-3 (Transient Testing included), 1st environment
	Conducted emissions: EN / IEC 61800-3
	Category C1: is possible with external filter connected to drive. Please consult factory.
	Category C2: with internal filter maximum of 10 m motor cable length. (FR0: This is obtained with 2 turns on a ferrite core and using metal ground plate.)
	Category C3: with internal filter maximum of 50 m motor cable length. (FR0: This is obtained with no ferrite core and metal plate)

Control cable grounding

It is recommended that the shielded cables be grounded. Use a ring terminal and ground the shield to one of the VFD's ground points.

Table 4. PowerXL series DM1 accessory catalog.

PowerXL Series - DM1 NEMA 1 conversion kits.

Description	Catalog number
DM1 FR1 NEMA 1 kit	**DXM-ACC-FR1N1KIT**
DM1 FR2 NEMA 1 kit	**DXM-ACC-FR2N1KIT**
DM1 FR3 NEMA 1 kit	**DXM-ACC-FR3N1KIT**
DM1 FR4 NEMA 1 kit	**DXM-ACC-FR4N1KIT**
DM1 FR1 Plenum Rated NEMA 1 Kit	**DXM-ACC-FR1N1PKIT**
DM1 FR2 Plenum Rated NEMA 1 Kit	**DXM-ACC-FR2N1PKIT**
DM1 FR3 Plenum Rated NEMA 1 Kit	**DXM-ACC-FR3N1PKIT**
DM1 FR4 Plenum Rated NEMA 1 Kit	**DXM-ACC-FR4N1PKIT**

PowerXL series - DM1 communication card kits.

Description	Catalog number
DG1/DM1 smartwire communication card and module IP20	**DXG-NET-SWD-IP20**
DG1/DM1 smartwire communication card and module IP54	**DXG-NET-SWD-IP54**
DM1 profibus communications card	**DXM-NET-PROFIBUS**
DM1 canopen communications card	**DXM-NET-CANOPEN**

Table 4. PowerXL series DM1 accessory catalog (cont.).

PowerXL series - DM1 remote keypad kits.

Description	Catalog number
Remote keypad	**DXG-KEY-LCD**
Remote keypad mounting holder	**DXG-KEY-HOLDER**
DG1/DM1 remote keypad kit (3.0 m cable)	**DXG-KEY-RMTKIT**
DG1/DM1 remote keypad mounting holder only bulk pack (99)	**DXG-KEY-HOLDER-BP**

PowerXL Series - DM1 demo units.

Description	Catalog number
Demo case DM1 PRO	**DM1-DEMO**

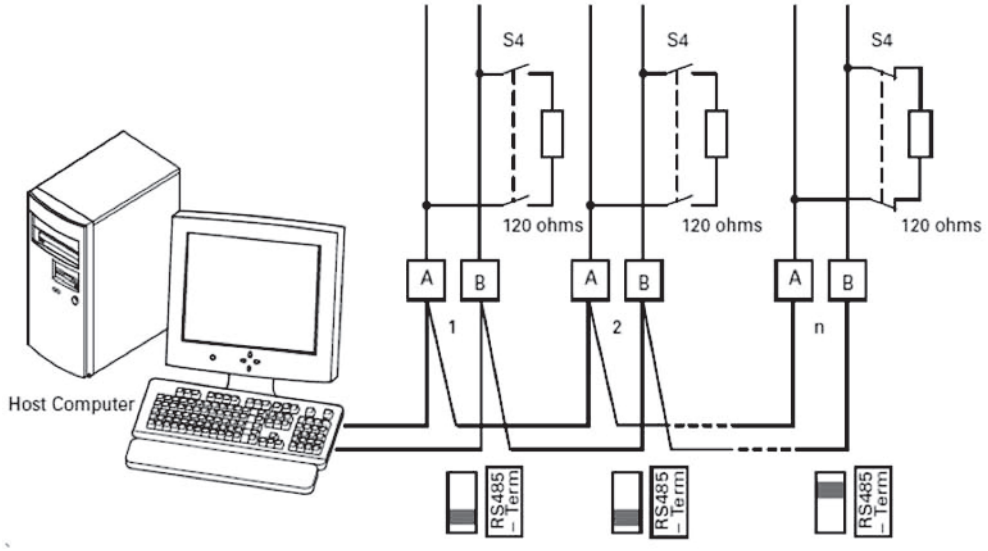
PowerXpert in control software.

Description	Catalog number
PC cable	**DXG-CBL-PCCABLE**

Modbus RTU on-board communications

The drive product can be controlled via Modbus® RTU through the on-board RS-485 terminals.

Figure 1. DM1 connection diagram.



The figure shows a typical arrangement with a host computer (master) and any number maximum 31 slaves of frequency inverters. Each frequency inverter has a unique address in the network. This addressing is executed individually for each VFD via the communication parameters.

The electrical connection between master and the slaves connected in parallel are implemented via the serial interface A-B (A = positive, B = negative) with a shielded RS-485 twisted pair cable.

Modbus RTU specifications

Communication board connections

Table 5. Connections.

Item	Description
Interface	
Data transfer method	RS-485, half-duplex
Transfer cable	Twisted pair (1 pair and shield)
Electrical isolation	

Communications

Table 6. Communications.

Item	Description
Modbus RTU	As described in "Modicon Modbus Protocol Reference Guide" found at. http.//public.modicon.com/
Baud rate	9600,19200,38400,57600,115200
Addresses	1 to 247

Connections

The RS-485 communication port is connected via the A and B terminals on the drives control board.

Connection options

Table 7. Connection options - main keypad.

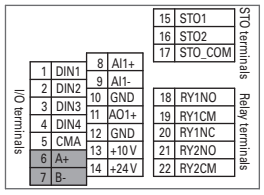
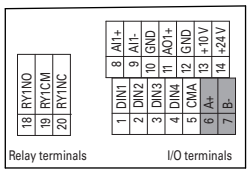
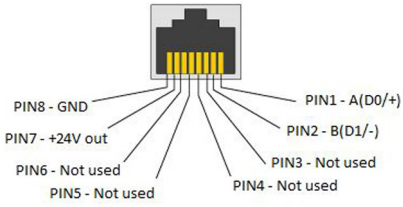
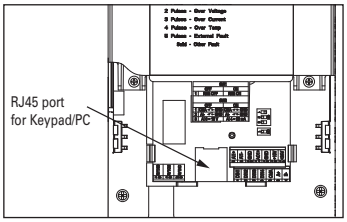
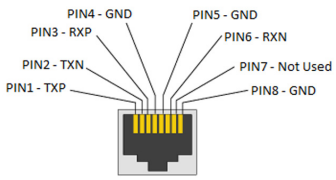
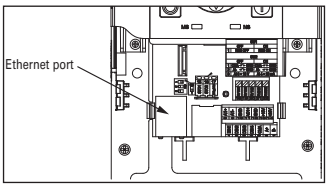
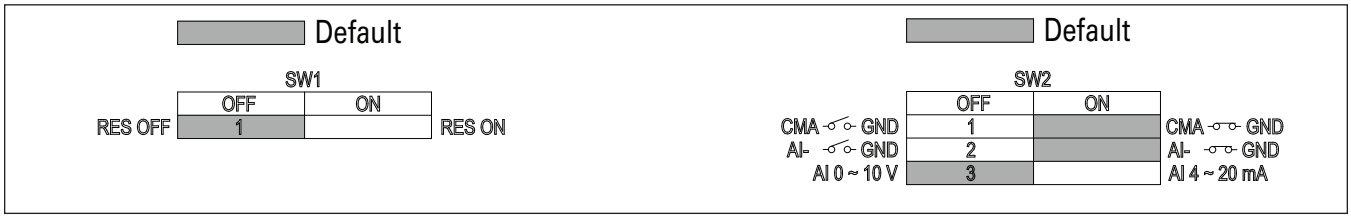
Connection method	Port	Upgrade firmware	Connects to PC tool	Communication settings
RS-485	Modbus serial terminals	✓	✓	DM1 PRO  DM1 
				RS-485 Comm Set: Settable in RS-485 communication parameter group. (Default modbus RTU). **Note:** If set to BACnet MSTP, PC Tool will not communicate.
				Slave address: Settable in RS-485 communication parameter group (Default 1).
				Baud rate: Settable in RS-485 communication parameter group (Default 19,200).
				Parity: Settable in RS-485 communication parameter group (Default even).
				Data bits: Not settable, 8 data bit.
				Stop bits: When parity set to None, 2 stop bits.
	Keypad port	✓	✓	 
				Slave address: Not settable, set to modbus ID 18.
				Baud rate: Not settable, set to 38,400 Kbaud.
				Parity: Not settable, set to even.
				Data bits: Not settable, 8 data bit.
				Stop bits: Not settable, 1 stop bit.
Ethernet	Ethernet port	---	✓	 **DM1 PRO Only** 
				IP address mode: Settable in ethernet communication parameter group. (Default is Static IP). **Note:** Most facilities require a static IP. Change the static IP address before changing. After changing this parameter, the device resets itself.
				Active IP address: Set depending on IP address assigned static or DHCP.
				Active subnet mask: Set depending on IP address assigned static or DHCP.
				Active default gateway: Set depending on IP address assigned static or DHCP.
				Static IP address: Settable in ethernet communication parameters group. (Default 192.168.1.254).
				Static subnet mask: Settable in ethernet communication parameters group. (Default 255.255.255.0).
				Static default gateway: Settable in ethernet communication parameters group. (Default 192.168.1.1).

Figure 2. Termination resistor and shielding.



Commissioning

RS-485 communication parameters

To commission the RS-485 on-board protocol, enter the Keypad menu as described below.

Change the Modbus RTU commissioning parameter values.

In this menu you will be able to scroll through the below settings to setup the communication protocol.

Table 8. Modbus RTU.

P11.1 - Basic settings.

P11.1.1①	***Serial communication***				**ID 586**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Modbus RTU 1 = BACnet MSTP (*DM1 PRO) 2 = SWD (*DM1 PRO)				
Description:	This parameter defines the communication protocol for RS-485.				

P11.2 - Modbus RTU.

P11.2.1①	***Slave address***				**ID 587**
Minimum value:	1	**Maximum value:**	247	**Default value:**	1
Description:	This parameter defines the slave address for RS-485 communication.				
P11.2.2①	***Baud rate***				**ID 584**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	1
Options:	0 = 9,600; 1 = 19,200; 2 = 38,400; 3 = 57,600; or 4 = 115,200				
Description:	This parameter defines communication speed for RS-485 communication.				
P11.2.3①	***Parity type***				**ID 585**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	2
Options:	0 = None; 1 = Odd; or 2 = Even.				
Description:	This parameter defines parity type for RS-485 communication.				
P11.2.4	***Modbus RTU protocol status***				**ID 588**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Options:	0 = Initial; 2 = Operational; or 3 = Faulted.				

Table 8. Modbus RTU (cont).

Description:	This parameter shows the protocol status for RS-485 communication.				
P11.2.5	***Communication timeout modbus RTU***				**ID 593**
Minimum value:	0.00 ms	**Maximum value:**	60,000.00 ms	**Default value:**	10,000.00 ms
Description:	Selects the time to wait before a communication fault occurs over modbus RTU if a message is not received.				
P11.2.6	***Modbus RTU fault response***				**ID 2516**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 - Only in fieldbus control mode. When fieldbus is the control place and fieldbus fault is active, the drive will fault on loss of communications; if not in fieldbus control, drive will not fault. 1 - In all control modes. No matter the control place setting, if communication is lost, fieldbus fault response will occur.				
Description:	Defines the fieldbus fault condition for modbus RTU communication.				

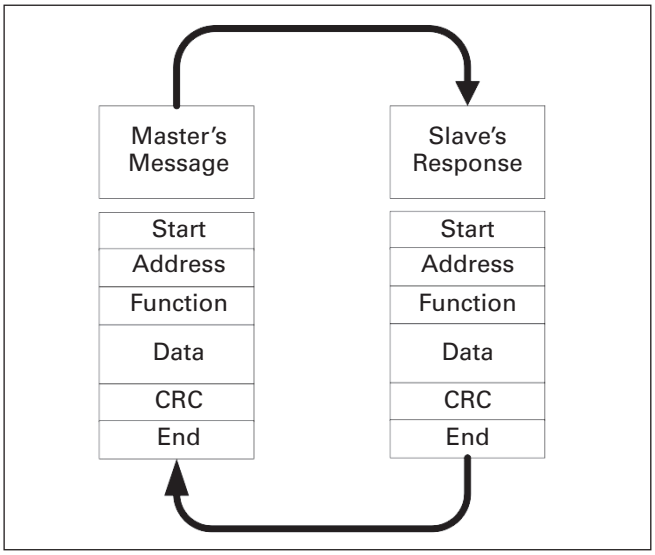
Modbus communication standards

The Modbus protocol is an industrial communications and distributed control system to integrate PLCs, computers, terminals, and other monitoring, sensing and control devices. Modbus is a master-slave communications protocol. The master controls all serial activity by selectively polling one or more slave devices. The protocol provides for one master device and up to 247 slave devices on a common line. Each device is assigned an address to distinguish it from all other connected devices.

The Modbus protocol uses the master-slave technique, in which only one device (the master) can initiate a transaction. The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. The master can address individual slaves or initiate a broadcast message to all slaves. Slaves return a message ("response") to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

A transaction comprises a single query and single response frame or a single broadcast frame. The transaction frames are defined below.

Figure 3. The basic structure of a Modbus frame.



Valid slave device addresses are in the range of 0-247 decimal. The individual slave devices are assigned addresses in the range of 1-247. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

The function code field of a message frame contains two characters (ASCII) or eight bits (RTU). Valid codes are in the range of 1-255 decimal. When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform.

Examples are to read the ON/OFF states of a group of discrete coils or inputs; to read the data contents of a group of registers; to read the diagnostic status of the slave; to write to designated coils or registers; or to allow loading, recording or verifying the program within the slave.

When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to a logic state of 1.

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF hexadecimal. These can be made from a pair of ASCII characters, or from one RTU character, according to the network's serial transmission mode.

The data field of messages sent from a master to slave devices contains additional information that the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

Two kinds of checksum are used for standard Modbus networks. The error checking field contents depend upon the transmission method that is being used.

Supported functions

Table 9. Functions.

Function code	Description
0x01	Read coils
0x02	Read discrete inputs
0x03	Read holding registers
0x04	Read input registers
0x05	Write single coil
0x06	Write single register
0x07	Read exception status
0x08	Read diagnostics (Only support 0x00 return query data)
0x0F	Write multiple coils
0x10	Write multiple registers
0x17	Read/write multiple registers
0x2B/0x0E	Read device identity

Note: Note: Broadcasting can be used with codes 0x05, 0x06, 0x0F, and 0x10.

Example of the request to read coils 2000-2003 from slave device 18.

Table 10. Request to read coils.

Item	Code	Description
Slave address	0x12	
Function code	0x01	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of coils high	0x00	Number of coils 0x0003 hex (= 3)
Number of coils low	0x03	
CRC high	0x7E	
CRC low	0x25	

Example of the request to read discrete inputs 2000-2003 from slave device 18.

Table 11. Request to read discrete inputs.

Item	Code	Description
Slave address	0x12	
Function code	0x02	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of discrete inputs high	0x00	Number of discrete inputs 0x0003 hex (= 3)
Number of discrete inputs low	0x03	
CRC high	0x3A	
CRC low	0x25	

Example of the request to read holding registers 2000-2003 from slave device 18.

Table 12. Request to read holding registers.

Item	Code	Description
Slave address	0x12	
Function code	0x03	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of holding registers high	0x00	Number of holding registers 0x0003 hex (= 3)
Number of holding registers low	0x03	
CRC high	0x07	
CRC low	0xE5	

Example of the request to read input registers 2000-2003 from slave device 18.

Table 13. Request to read input registers.

Item	Code	Description
Slave address	0x12	
Function code	0x04	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of input registers high	0x00	Number of input registers 0x0003 hex (= 3)
Number of input registers low	0x03	
CRC high	0xB2	
CRC low	0x25	

Example of the request to read exception status from slave device 18.

Table 14. Request to read exception status.

Item	Code	Description
Slave address	0x12	
Function code	0x07	
CRC high	4C	
CRC low	D2	

Example of read diagnostics from slave address 18.

Table 15. Read diagnostics.

Item	Code	Description
Slave address	0x12	
Function code	0x08	
Sub function high	0x00	Sub function code 0x0000 (= 0)
Sub function low	0x00	**Note:** Only support sub function code 0x0000
Data high	0xA5	Data 0xA5A5 (= 42405)
Data low	0xA5	
CRC high	0x59	
CRC low	0x83	

Example of the request to write single coil 2000 from slave device 18, the output value is 65280.

Table 16. Request to write single coil.

Item	Code	Description
Slave address	0x12	
Function code	0x05	
Output address high	0x07	Starting address 0x07D0 hex (= 2000)
Output address low	0xD0	
Output value high	0xFF	Output value 0xFF00 hex (= 65280)
Output value low	0x00	**Note:** Output value is 0x0000 or 0xFF00
CRC high	0x8E	
CRC low	0x14	

Example of the request to write single register 2000 from slave device 18, the output value is 5.

Table 17. Request to write single register.

Item	Code	Description
Slave address	0x12	
Function code	0x06	
Output address high	0x07	Starting address 0x07D0 hex (= 2000)
Output address low	0xD0	
Output value high	0x00	Output value 0x0005 hex (= 5)
Output value low	0x05	
CRC high	0x4B	
CRC low	0xE7	

Example of write coils 19–28 from slave device 18.

Table 18. Write coils 19-28.

Item	Code	Description
Slave address	0x12	
Function code	0x0F	
Starting address high	0x00	Starting address 0x0013 (= 19)
Starting address low	0x13	
Quantity of outputs high	0x00	Quantity of outputs 0x000A (= 10)
Quantity of outputs low	0x0A	
Bye count	0x02	
Outputs value high	0xCD	
Outputs value low	0x01	
CRC high	0xAB	
CRC low	0xFB	

Note: The binary outputs in the previous example correspond to the outputs in the following way.

Binary bits and corresponding outputs

Bit	1	1	0	0	1	1	0	1	0	0	0	0	0	0	1
Output	26	25	24	23	22	21	20	19	—	—	—	—	—	28	27

Example of write holding registers 2000-2001 from slave device 18.

Table 19. Request to write holding registers.

Item	Code	Description
Slave address	0x12	
Function code	0x10	
Starting address high	0x07	Starting address 0x07D0 (= 2000)
Starting address low	0xD0	
Quantity of outputs high	0x00	Quantity of outputs 0x0002 (= 2)
Quantity of outputs low	0x02	
Bye count	0x04	
Outputs value high	0x00	
Outputs value low	0x01	
Outputs value high	0x00	
Outputs value low	0x02	
CRC high	0x53	
CRC low	0x46	

Modbus registers

The variables and fault codes as well as the parameters can be read and written from Modbus. The parameter addresses are determined in the application. Every parameter and actual value have been given an ID number in the application. The ID numbering of the parameter, as well as the parameter ranges and steps, can be found in the application manual in question. The parameter value shall be given without decimals.

All values can be read with function codes 3 and 4 (all registers are 3X and 4X reference). Modbus registers are mapped to drive IDs as follows.

Table 20. Index table.

ID	Modbus register	Group	R/W
1-98	40001-40098 (30001-30098)	Actual values	1/1
100	40099 (30099)	Fault code	1/1
101-1999	40101-41999 (30101-31999)	Parameters	1/1
2004-2011	42004-42011 (32004-32011)	Process data in	1/1
2104-2111	42104-42111 (32104-32111)	Process data out	1/1

Process data

The process data fields are used to control the drive (e.g., run, stop, reference, fault reset) and to quickly read actual values (e.g., output frequency, output current, fault code). The fields are structured as follows.

Table 21. Process data slave ⟶ master (max. 22 bytes).

ID	Modbus register	Group	Range/type
2101	32101, 42101	FB status word	Binary coded
2102	32102, 42102	FB general status word	Binary coded
2103	32103, 42103	FB actual speed	0-100.00%
2104	32104, 42104	FB process data out 1	
2105	32105, 42105	FB process data out 2	
2106	32106, 42106	FB process data out 3	
2107	32107, 42107	FB process data out 4	
2108	32108, 42108	FB process data out 5	
2109	32109, 42109	FB process data out 6	
2110	32110, 42110	FB process data out 7	
2111	32111, 42111	FB process data out 8	

Table 22. Process data master ⟶ slave (max. 22 bytes).

ID	Modbus register	Group	Range/type
2001	32001, 42001	FB control word	Binary coded
2002	32002, 42002	FB general control word	Binary coded
2003	32003, 42003	FB speed reference	0-100.00% Hz
2004	32004, 42004	FB process data in 1	Integer 16
2005	32005, 42005	FB process data in 2	Integer 16
2006	32006, 42006	FB process data in 3	Integer 16
2007	32007, 42007	FB process data in 4	Integer 16
2008	32008, 42008	FB process data in 5	Integer 16
2009	32009, 42009	FB process data in 6	Integer 16
2010	32010, 42010	FB process data in 7	Integer 16
2011	32011, 42011	FB process data in 8	Integer 16

The use of process data depends on the application. In a typical situation, the device is started and stopped with the control word (CW) written by the master and the rotating speed is set with reference (REF). With PD1-PD8, the device can be given other reference values (e.g., torque reference). With the status word (SW) read by the master, the status of the device can be seen. Actual value (ACT) and PD1–PD8 show the other actual values.

Process data in

This register range is reserved for the control of the VFD. Process data in is located in range ID 2001-2099. The registers are updated every 10 ms. See table below.

Table 23. Fieldbus (FB) basic input table

ID	Modbus register	Group	Range/type
2001	32001, 42001	FB control word	Binary coded
2002	32002, 42002	FB general control word	Binary coded
2003	32003, 42003	FB speed reference	0-100.00%
2004	32004, 42004	FB process data in 1	Integer 16
2005	32005, 42005	FB process data in 2	Integer 16
2006	32006, 42006	FB process data in 3	Integer 16

ID	Modbus register	Group	Range/type
2007	32007, 42007	FB process data in 4	Integer 16
2008	32008, 42008	FB process data in 5	Integer 16
2009	32009, 42009	FB process data in 6	Integer 16
2010	32010, 42010	FB process data in 7	Integer 16
2011	32011, 42011	FB process data in 8	Integer 16

Note: For FB process data In, see section below on "Process data in".

Control word

The drive uses 16 bits as shown below. These bits are application specific.

Binary bits and corresponding outputs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
①	①	①	①	①	①	FB Ref	FB Ctrl	Bypass	FB DI 4	FB DI 3	FB DI 2	FB DI 1	Fault Reset	Reverse	RUN

Note:
① The bit is not used.

Table 24. FB control word.

Bit	Description Value = 0	Value = 1
0	Drive output off	Drive output on
1	Clockwise rotation	Counter clockwise
2	No reset	Fault reset
3	FB INDATA1 off	FB INDATA1 on
4	FB INDATA2 off	FB INDATA2 on
5	FB INDATA3 off	FB INDATA3 on
6	FB INDATA4 off	FB INDATA4 on
7	Bypass relay disable	Bypass relay enable
8	FB control off	FB control on
9	FB reference off	FB reference on
10–15	Not in use	Not in use

FB general control word

The PowerXL series drive does not use the FB general control word. The main control word is used to provide commands to the drive.

Speed reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is the reference 1 to the VFD. It is used normally as speed reference.

The scaling on this value is 0-100.00% of the maximum frequency. The 0 to 100.00% is represented by 0 to 10,000 value indicating 0 or 0% as minimum frequency and 10,000 or %100.00 as maximum frequency. This value has two decimal places in it.

Process data in 1 to 8

Process data in values 1 to 8 can be used in applications for various purposes. See "Process data in" section for setup.

Process data out

This register range is normally used for fast monitoring of the VFD. Process data out is located in range ID 2101-2199. See the table below.

Table 25. FB basic output table.

ID	Modbus register	Group	Range/type
2101	32101, 42101	FB status word	Binary coded
2102	32102, 42102	FB general status word	Binary coded
2103	32103, 42103	FB actual speed	%
2104	32104, 42104	FB process data out 1	
2105	32105, 42105	FB process data out 2	
2106	32106, 42106	FB process data out 3	
2107	32107, 42107	FB process data out 4	
2108	32108, 42108	FB process data out 5	
2109	32109, 42109	FB process data out 6	
2110	32110, 42110	FB process data out 7	
2111	32111, 42111	FB process data out 8	

FB status word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
—	—	—	—	—	—	—	—	—	—	—	Direction	Fault	Direction	Running	Ready

Information about the status of the device and messages is indicated in the FB status word. The FB status word is composed of 16 bits that have the following meanings.

Table 26. FB status word bit descriptions.

Bit	Description Value = 0	Value = 1
0	Not ready	Ready
1	Stop	Run
2	Clockwise	Counter clockwise
3	—	Faulted
4	—	Warning
5	Ref. frequency not reached	Ref. frequency reached
6	Bypass not activated	Bypass activated
7	Run disable	Run enable
8	Not in use	Not in use
9–15	Not in use	Not In use

Table 27. FB general status word.

Bit	Description Value = 0	Value = 1
0	Not Ready	Ready
1	Stop	Run
2	Clockwise	Counter clockwise
3	No fault	Fault
4	No warning	Warning
5	Ref. frequency not reached	Ref. frequency reached
6	Ref. > 0 speed	Ref. = 0 speed
7	Motor flux off	Motor flux on ①
8	Motor speed limit on	Motor speed limit off ①
9	Encoder direction off	Encoder direction on ①
10	Under voltage fast stop off	Under voltage fast stop on ①
11	DC brake off	DC brake on
12	FB ref. not enable	FB ref. enabled
13	Motor start delay off	Motor start delay on
14	Remote not enable	Remote enable
15	FB WD pulse not enabled	FB WD pulse enable ①

Note:
① The bit is not used.

Speed reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is the actual speed of the motor. This value comes back in the form of %.

Process data out 1 to 8

Process data out values 1 to 8 can be used in application for various purposes. See below tables for additional information.

Process data OUT (slave → master)

The fieldbus master can read the VFD actual values using process data variables. The applications use process data as follows.

These values are selectable via the fieldbus process data parameter group. These values would correspond to the Modbus ID value. See **Appendix A** for the Parameter ID table showing values can be set.

Table 28. Process data OUT.

Id	Data	Value	Default value	Default para	Unit	Scale
2104	Process data OUT 1	-32768-32767	1	Output frequency	Hz	
2105	Process data OUT 2	-32768-32767	2	Motor speed	RPM	
2106	Process data OUT 3	-32768-32767	3	Motor current	A	
2107	Process data OUT 4	-32768-32767	4	Motor torque	%	
2108	Process data OUT 5	-32768-32767	5	Motor power	%	
2109	Process data OUT 6	-32768-32767	6	Motor voltage	V	
2110	Process data OUT 7	-32768-32767	7	DC link voltage	V	
2111	Process data OUT 8	-32768-32767	28	Latest fault code	—	

Process data IN (master → slave)

Control word, reference, and process data are used with "All-in-One" applications as follows.

Table 29. Process data IN.

ID	Data	Value	Unit	Scale
2003	Reference	Speed Reference	Hz	0.01
2001	Control word	—	—	—
2004	Process data IN 1	①	%	0.01%
2005	Process data IN 2	①	%	0.01%
2006	Process data IN 3	①	%	0.01%
2007	Process data IN 4	①	%	0.01%
2008	Process data IN 5	①	%	0.01%
2009	Process data IN 6	①	%	0.01%
2010	Process data IN 7	①	%	0.01%
2011	Process data IN 8	①	%	0.01%

Note:
① Process data IN 1 through process data IN 8 change based off the selected application. See **Appendix B** for layout.

Startup test

Select Fieldbus (Bus/Comm) as the active control and reference place.

1. Set FB control word (Modbus Address 42001) value to 301hex.
2. The drive status is RUN.
3. Set FB speed reference (Modbus Address 42003) value to 5,000 (= 50.00%).
4. The actual value is 5,000 and the output frequency is 50.00%.
5. Set FB control word (Modbus Address 42001) value to 300 hex.
6. The drive status is STOP.

Modbus TCP on-board communications

Modbus/TCP specifications

Table 30. Modbus/TCP technical data.

General	Description	Specification
Ethernet connections	Interface	RJ-45 connector
Communications	Transfer cable	Shielded twisted pair
	Speed	10/100 Mb
	Duplex	Half/full
	Default IP–address mode	Static IP
Default static IP configurations	Default static IP address	192.168.1.254
	Default network mask	255.255.255.0
	Default gateway address	192.168.1.1

Modbus/TCP protocol

Modbus/TCP is a variant of the Modbus family. It is a manufacturer-independent protocol for monitoring and controlling automatic devices. Modbus/TCP is a client-server protocol. The client makes queries to the server by sending "request" messages to the server's TCP port 502. The server answers client queries with "response" messages. The term "client" can refer to a master device that runs queries. Correspondingly, the term "server" refers to a slave device that serves the master device by answering its queries. Both the request and the response messages are composed as follows.

Byte 0. Transaction ID high

Byte 1. Transaction ID low

Byte 2. Protocol ID high

Byte 3. Protocol ID low

Byte 4. Length field high

Byte 5. Length field low

Byte 6. Unit identifier

Byte 7. Modbus function code

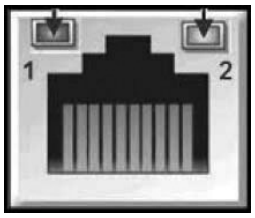
Byte 8. Data (of variable length)

Modbus/TCP vs. Modbus RTU

Compared to the Modbus RTU protocol, the Modbus/TCP differs mostly in error checking and slave addresses. As the TCP already includes an efficient error checking function, the Modbus/TCP protocol does not include a separate CRC field. In addition to the error checking functionality, the TCP is responsible for resending packets and for splitting long messages so that they fit the TCP frames. The slave address field of the Modbus/RTU is named as the unit identifier field in Modbus/TCP, and it is only used when one IP address stands for several endpoints.

Hardware specifications

Ethernet port LED indications



Ethernet LED

1. Ethernet link status
2. Ethernet link speed

Table 31. Ethernet LED description.

LED	Meaning
Ethernet link status	Flashes with Ethernet message activity.
Ethernet link speed	Displays the link speed.
	Yellow LED on the Ethernet jack is ON when link speed is 100 mbps.
	Yellow LED on the Ethernet jack is OFF when link speed is 10 mbps.

Ethernet LED indications at power up

When the drive is powered up, an indicator test will be performed. To allow a visual inspection, the following sequence will be performed.

1. Turn first indicator Green, all other indicators off.
2. Leave first indicator on Green for approximately 0.25 second.
3. Turn first indicator on Red for approximately 0.25 second.
4. Turn first indicator on Green.
5. Turn second indicator (if present) on Green for approximately 0.25 second.
6. Turn second indicator (if present) on Red for approximately 0.25 second.
7. Turn second indicator (if present) off.

If other indicators are present, test each indicator in sequence as prescribed by the second indicator above. If a Module status indicator is present, it will be the first indicator in the sequence, followed by any network status indicators present. After completion of this power up test, the indicator(s) will turn to a normal operational state.

Commissioning

Connections and wiring

The Ethernet port supports 10/100 Mb speeds in both full and half-duplex modes. The boards must be connected to the Ethernet network with a shielded CAT-5e cable.

A crossover cable (at least CAT-5e cable with STP, shielded twisted pair) may be needed if you want to connect the EtherNet/IP board directly to the master appliance.

Use only industrial standard components in the network and avoid complex structures to minimize the length of response time and the amount of incorrect dispatches.

It is often a good practice to use a subnet that is different from other devices not related to the drive control.

Figure 4. CAT-5e cable

Table 32. Ethernet communication.

P12.1 - Basic settings.					
P12.1.1①	***IP address mode***				**ID 1500**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Static IP; or 1 = DHCP with AutoIP.				
Description:	This parameter defined the IP address configuration mode for EIP/modbus TCP. Changing this parameter causes the drive to reset.				
P12.1.2	***Active IP address***				**ID 1507**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active IP address.				
P12.1.3	***Active subnet mask***				**ID 1509**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active subnet mask.				
P12.1.4	***Active default gateway***				**ID 1511**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active default gateway.				
P12.1.5	***MAC address***				**ID 1513**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current MAC address.				
P12.1.6①	***Static IP address***				**ID 1501**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.254
Description:	Defines the static IP address. Changing this parameter causes the drive to reset.				
P12.1.7①	***Static subnet mask***				**ID 1503**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	255.255.255.0
Description:	Defines the static subnet mask.				
P12.1.8①	***Static default gateway***				**ID 1505**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.1
Description:	Defines the static default gateway.				
P12.1.9	***Ethernet communication timeout***				**ID 611**
Minimum value:	0.00 ms	**Maximum value:**	60,000 ms	**Default value:**	10,000 ms
Description:	Selects the time it waits before a communication fault occurs over ethernet. **Note:** setting this value to 0 will mask the ethernet fault.				

Table 32. Ethernet communication (Cont.).

P12.2 - Trusted IP filter (DM1 PRO only).					
P12.2.1	***Trusted IP white list***				**ID 68**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.255 0.0.0. 0 0.0.0.0
Description:	Defines the IP addresses in the white list. A setting of 192.168.1.255 enables all connections on the local subnet.				
P12.2.2	***Trusted IP filter enable***				**ID 76**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	1
Options:	0 = Disabled; or 1 = Enabled.				
Description:	Enables IP white listing. Devices not in the white list will not be able to establish communications with the drive.				
P12.3 - Modbus TCP (DM1 PRO only).					
P12.3.1①	***Modbus TCP enable***				**ID 1942**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Disable; or 1 = Enable.				
Description:	Enables modbus TCP communications, must be enabled to connect to Power Xpert inControl.				
P12.3.2	***Modbus TCP connection limit***				**ID 609**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	5
Description:	Maximum number of connections allowed to the drive.				
P12.3.3	***Modbus TCP unit identifier number***				**ID 610**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	1
Description:	Unit identifier unit value for modbus TCP.				
P12.3.4	***Modbus TCP protocol status***				**ID 612**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Options:	0 = Stopped; 1 = Operational; or 2 = Faulted.				
Description:	This parameter shows the protocol status for modbus TCP communication.				
P12.3.5	***Modbus TCP fault response***				**ID 2517**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Only in fieldbus control mode - when fieldbus is the control place and fieldbus fault is active, the drive will fault on loss of communications. If not in fieldbus control, drive will not fault. 1 = In all control modes - no matter the control place setting, if communication is lost, fieldbus fault response will occur.				
Description:	Defines the fieldbus fault condition for modbus TCP communication.				

DHCP

The EtherNet/IP communication supports DHCP for easier network configuration. Dynamic host configuration protocol (DHCP) is a network protocol that is used to configure network devices so that they can communicate on an IP network. As a DHCP client, the EtherNet/IP negotiates with the DHCP server to determine its IP address and obtain any other initial configuration details it needs for network operation.

IP address

IP is divided into four parts. (Part = Octet) Default Static IP Address is 192.168.1.254

Communication time-out

Defines how much time can pass from the last received message from the client device before fieldbus fault is generated. Default communication time-out is ten seconds.

Note: Setting this value to 0 will mask the ethernet fault even after it is detected.

Static IP address

In most cases, the user may want to establish a static IP address for the EtherNet/IP based on their network configuration.

Static IP address default configurations are as defined in "EtherNet/IP network settings" table, provided in "Connections and Wiring" section.

The user can manually define the network address for the EtherNet/IP as long as all units connected to the network are given the same network portion of the address. In these situations, the user will need to manually set the IP address in the device by using the drive keypad. Be aware that overlapping IP addresses can cause conflicts between devices on the network. For more information about selecting IP addresses, contact your network administrator.

Unit identifier

The unit identifier used in Modbus TCP is used for the Modbus protocol in place of the slave address used in Modbus RTU. This unit identifier is used to communicate via devices such as bridges, routers, and gateways that use a single IP address to support multiple independent Modbus end units.

Modbus communication standards

Example of the request to read coils 2000–2003 from slave device 18.

Table 33. Request to read coils.

Item	Code	Description
Slave address	0x12	
Function code	0x01	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of coils high	0x00	Number of coils 0x0003 hex (= 3)
Number of coils low	0x03	
CRC high	0x7E	
CRC low	0x25	

Example of the request to read discrete inputs 2000-2003 from slave device 18.

Table 34. Request to read discrete inputs.

Item	Code	Description
Slave address	0x12	
Function code	0x02	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of discrete inputs high	0x00	Number of discrete inputs 0x0003 hex (= 3)
Number of discrete inputs low	0x03	
CRC high	0x3A	
CRC low	0x25	

Example of the request to read holding registers 2000-2003 from slave device 18.

Table 35. Request to read holding registers.

Item	Code	Description
Slave address	0x12	
Function code	0x03	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of holding registers high	0x00	Number of holding registers 0x0003 hex (= 3)
Number of holding registers low	0x03	
CRC high	0x07	
CRC low	0xE5	

Example of the request to read input registers 2000-2003 from slave device 18.

Table 36. Request to read input registers.

Item	Code	Description
Slave address	0x12	
Function code	0x04	
Start address high	0x07	Starting address 0x07D0 hex (= 2000)
Start address low	0xD0	
Number of input registers high	0x00	Number of input registers 0x0003 hex (= 3)
Number of input registers low	0x03	
CRC high	0xB2	
CRC low	0x25	

Example of the request to read exception status from slave device 18.

Table 37. Request to read exception status.

Item	Code	Description
Slave address	0x12	
Function code	0x07	
CRC high	4C	
CRC low	D2	

Example of read diagnostics from slave address 18.

Table 38. Read diagnostics.

Item	Code	Description
Slave address	0x12	
Function code	0x08	
Sub function high	0x00	Sub function code 0x0000 (= 0)
Sub function low	0x00	**Note:** Only support sub function code 0x0000
Data high	0xA5	Data 0xA5A5 (= 42405)
Data low	0xA5	
CRC high	0x59	
CRC low	0x83	

Example of the request to write single coil 2000 from slave device 18, the output value is 1.

Table 39. Request to write single coil.

Item	Code	Description
Slave address	0x12	
Function code	0x05	
Output address high	0x07	Starting address 0x07D0 hex (= 2000)
Output address low	0xD0	
Output value high	0xFF	Output value 0xFF00 hex (= 65280)
Output value low	0x00	**Note:** Output value is 0x0000 or 0xFF00
CRC high	0x8E	
CRC low	0x14	

Example of the request to write single register 2000 from slave device 18, the output value is 5.

Table 40. Request to write single register.

Item	Code	Description
Slave address	0x12	
Function code	0x06	
Output address high	0x07	Starting address 0x07D0 hex (= 2000)
Output address low	0xD0	
Output value high	0x00	Output value 0x0005 hex (= 5)
Output value low	0x05	
CRC high	0x4B	
CRC low	0xE7	

Example of write coils 19-28 from slave device 18.

Table 41. Write coils 19-28.

Item	Code	Description
Slave Address	0x12	
Function code	0x0F	
Starting Address high	0x00	Starting address 0x0013 (= 19)
Starting Address low	0x13	
Quantity of Outputs high	0x00	Quantity of outputs 0x000A (= 10)
Quantity of Outputs low	0x0A	
Bye count	0x02	
Outputs value high	0xCD	
Outputs value low	0x01	
CRC high	0xAB	
CRC low	0xFB	

Note: The binary outputs in the previous example correspond to the outputs in the following way.

Binary bits and corresponding outputs

Bit	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	1
Output	26	25	24	23	22	21	20	19	—	—	—	—	—	—	28	27

Example of write holding registers 2000-2001 from slave device 18.

Table 42. Write holding registers.

Item	Code	Description
Slave address	0x12	
Function code	0x10	
Starting address high	0x07	Starting address 0x07D0 (= 2000)
Starting address low	0xD0	
Quantity of outputs high	0x00	Quantity of outputs 0x0002 (= 2)
Quantity of outputs low	0x02	
Bye count	0x04	
Outputs value high	0x00	
Outputs value low	0x01	
Outputs value high	0x00	
Outputs value low	0x02	
CRC high	0x53	
CRC low	0x46	

Modbus registers

The variables and fault codes as well as the parameters can be read and written from Modbus. The parameter addresses are determined in the application. Every parameter and actual value have been given an ID number in the application. The ID numbering of the parameter, as well as the parameter ranges and steps, can be found in the application manual in question. The parameter value shall be given without decimals.

All values can be read with function codes 3 and 4 (all registers are 3X and 4X reference). Modbus registers are mapped to drive IDs as follows.

Table 43. Index table.

ID	Modbus register	Group	R/W
1–98	40001–40098 (30001–30098)	Actual values	1/1
100	40099 (30099)	Fault code	1/1
101–1999	40101–41999 (30101–31999)	Parameters	1/1
2004–2011	42004–42011 (32004–32011)	Process data in	1/1
2104–2111	42104–42111 (32104–32111)	Process data out	1/1

Process data

The process data fields are used to control the drive (e.g., run, stop, reference, fault reset) and to quickly read actual values (e.g., output frequency, output current, fault code). The fields are structured as follows.

Table 44. Process data slave ⟶ master (max. 22 bytes).

ID	Modbus register	Group	Range/type
2101	32101, 42101	FB status word	Binary coded
2102	32102, 42102	FB general status word	Binary coded
2103	32103, 42103	FB actual speed	0-100.00%
2104	32104, 42104	FB process data out 1	
2105	32105, 42105	FB process data out 2	
2106	32106, 42106	FB process data out 3	
2107	32107, 42107	FB process data out 4	
2108	32108, 42108	FB process data out 5	
2109	32109, 42109	FB process data out 6	
2110	32110, 42110	FB process data out 7	
2111	32111, 42111	FB process data out 8	

Table 45. Process data master ⟶ slave (max. 22 bytes).

ID	Modbus register	Group	Range/type
2001	32001, 42001	FB control word	Binary coded
2002	32002, 42002	FB general control word	Binary coded
2003	32003, 42003	FB speed reference	0–100.00%
2004	32004, 42004	FB process data in 1	Integer 16
2005	32005, 42005	FB process data in 2	Integer 16
2006	32006, 42006	FB process data in 3	Integer 16
2007	32007, 42007	FB process data in 4	Integer 16
2008	32008, 42008	FB process data in 5	Integer 16
2009	32009, 42009	FB process data in 6	Integer 16
2010	32010, 42010	FB process data in 7	Integer 16
2011	32011, 42011	FB process data in 8	Integer 16

The use of process data depends on the application. In a typical situation, the device is started and stopped with the control word (CW) written by the master and the rotating speed is set with reference (REF). With PD1-PD8, the device can be given other reference values (e.g., torque reference). With the status word (SW) read by the master, the status of the device can be seen. Actual value (ACT) and PD1–PD8 show the other actual values.

Process data in

This register range is reserved for the control of the VFD. Process data in is located in range ID 2001-2099. The registers are updated every 10 ms. See table below.

Table 46. Fieldbus basic input table

ID	Modbus register	Group	Range/type
2001	32001, 42001	FB control word	Binary coded
2002	32002, 42002	FB general control word	Binary coded
2003	32003, 42003	FB speed reference	0-100.00%
2004	32004, 42004	FB process data in 1	Integer 16
2005	32005, 42005	FB process data in 2	Integer 16
2006	32006, 42006	FB process data in 3	Integer 16
2007	32007, 42007	FB process data in 4	Integer 16
2008	32008, 42008	FB process data in 5	Integer 16
2009	32009, 42009	FB process data in 6	Integer 16
2010	32010, 42010	FB process data in 7	Integer 16
2011	32011, 42011	FB process data in 8	Integer 16

FB control word

The drive uses 16 bits as shown below. These bits are application specific.

Binary bits and corresponding outputs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
①	①	①	①	①	①	FB Ref	FB Ctrl	BYS	FB DIN 4	FB DIN 3	FB DIN 2	FB DIN 1	F_RST	DIR	RUN

Note:
① The bit is not used.

FB general control word

The drive does not use the FB general control word. The main control word is used to provide commands to the drive.

Table 47. FB control word.

Bit	Description value = 0	Value = 1
0	Drive output off	Drive output on
1	Clockwise rotation	Counter clockwise
2	No reset	Fault reset
3	FB INDATA1 off	FB INDATA1 on
4	FB INDATA2 off	FB INDATA2 on
5	FB INDATA3 off	FB INDATA3 on
6	FB INDATA4 off	FB INDATA4 on
7	Bypass relay disable	Bypass relay enable
8	FB control off	FB control on
9	FB reference off	FB reference on
10-15	Not in use	Not in use

Speed reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is the reference 1 to the VFD. Used normally as speed reference.

The scaling on this value is 0-100.00% of the maximum frequency (P1.2). The 0 to 100.00% is represented by 0 to 10,000 value indicating 0 or 0% as minimum frequency (P1.1) and 10,000 or %100.00 as maximum frequency (P1.2). This value has two decimal places in it.

Process data in 1 to 8

Process data in values 1 to 8 can be used in applications for various purposes. See below process data iN section for setup.

Process data out

This register range is normally used to fast monitoring of the VFD. Process data out is located in range ID 2101-2199. See table below.

Table 48. Fieldbus basic output table.

ID	Modbus register	Group	Range/type
2101	32101, 42101	FB status word	Binary coded
2102	32102, 42102	FB general status wWord	Binary coded
2103	32103, 42103	FB actual speed	%
2104	32104, 42104	FB process data out 1	
2105	32105, 42105	FB process data out 2	
2106	32106, 42106	FB process data out 3	
2107	32107, 42107	FB process data out 4	
2108	32108, 42108	FB process data out 5	
2109	32109, 42109	FB process data out 6	
2110	32110, 42110	FB process data out 7	
2111	32111, 42111	FB process data out 8	

FB status word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
—	—	—	—	—	—	—	—	RUNEN	BYS	AREF	WARN	FLT	DIR	RUN	RDY

Information about the status of the device and messages is indicated in the status word. The status word is composed of 16 bits that have the following meanings.

Table 49. FB status word bit descriptions.

Bit	Description value = 0	Value = 1
0	Not ready	Ready
1	Stop	Run
2	Clockwise	Counter clockwise
3	—	Faulted
4	—	Warning
5	Ref. frequency not reached	Ref. frequency reached
6	Bypass not activated	Bypass activated
7	Run disable	Run enable
8	Not in use	Not in use
9–15	Not in use	Not In use

Table 50. FB general status word.

Bit	Description value = 0	Value = 1
0	Not ready	Ready
1	Stop	Run
2	Clockwise	Counter clockwise
3	No fault	Fault
4	No warning	Warning
5	Ref. frequency not reached	Ref. frequency reached
6	Ref > 0 speed	Ref = 0 speed
7	Motor flux off	Motor flux on ①
8	Motor speed limit on	Motor speed limit off ①
9	Encoder direction off	Encoder direction on ①
10	Under voltage fast stop off	Under voltage fast stop on ①
11	DC brake off	DC brake on
12	FB ref. not enable	FB ref. enabled
13	Motor start delay off	Motor start delay on
14	Remote not enable	Remote enable
15	FB WD pulse not enabled	FB WD pulse enable ①

Note:

① Indicates the bit is not used.

Actual speed

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is the actual speed of the motor. This value comes back in the form of %.

Process data out 1 to 8

Process data out values 1 to 8 can be used in application for various purposes. See below tables for additional information.

Process data OUT (slave → master)

The fieldbus master can read the VFD's actual values using process data variables. PowerXL series applications use process data as follows. These values are selectable via the fieldbus process data parameter group. These values would correspond to the Modbus ID value. See **Appendix A** for parameter ID table showing values can be set.

Table 51. Process data OUT.

ID	Data	Value	Default value	Default para	Unit	Scale
2104	Process data out 1	-32768–32767	1	Output frequency	Hz	
2105	Process data out 2	-32768–32767	2	Motor speed	RPM	
2106	Process data out 3	-32768–32767	3	Motor current	A	
2107	Process data out 4	-32768–32767	4	Motor torque	%	
2108	Process data out 5	-32768–32767	5	Motor power	%	
2109	Process data out 6	-32768–32767	6	Motor voltage	V	
2110	Process data out 7	-32768–32767	7	DC link voltage	V	
2111	Process data out 8	-32768–32767	28	Latest fault code	—	

Process data IN (master → slave)

Control word, reference, and process data are used with "All-in-One" applications as follows.

Table 52. Process data IN.

ID	Data	Value	Unit	Scale
2003	Reference	Speed Reference	%	0.01
2001	Control word	—	—	—
2004	Process data in 1	①	%	0.01%
2005	Process data in 2	①	%	0.01%
2006	Process data in 3	①	%	0.01%
2007	Process data in 4	①	%	0.01%
2008	Process data in 5	①	%	0.01%
2009	Process data in 6	①	%	0.01%
2010	Process data in 7	①	%	0.01%
2011	Process data in 8	①	%	0.01%

Note:

① Process data in 1 through process data in 8 change based off the selected application. See **Appendix B** for layout

EtherNet/IP on-board communications

The EtherNet/IP communication interface features standard EtherNet/IP communication, allowing you to easily manage drive control and data over EtherNet/IP networks.

EtherNet/IP communication interface features:

- Provides a means to control, configure, and collect data over an Ethernet network;
- 10/100 Mbps, full duplex operation;
- Explicit messaging (for example, parameter read/write);
- Diagnostics, device items, and events.

Every device connected to an Ethernet network has two identifiers. a MAC address and an IP address. The MAC address (address format. 00.D0.AF.xx.yy.zz) is unique to the appliance and cannot be changed. The EtherNet/IP board's MAC address can be found on the sticker attached to the board.

In a local network, IP addresses are determined by the network server using DHCP protocol. The user can also manually define the network address for the drive as long as all units connected to the network are given the same network portion of the address. For more information about IP addresses, contact your network administrator.

Overlapping IP addresses can cause conflicts between appliances. For more information about setting IP addresses, see Table 57 - Ethernet communication.

Note: EtherNet/IP is a trademark of the Open DeviceNet Vendor Association (ODVA).

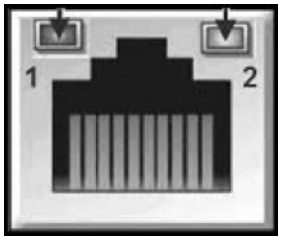
EtherNet/IP specifications

Table 53. EtherNet/IP technical data.

General	Description	Specification
Ethernet connections	Interface	RJ-45 connector
Communications	Transfer cable	Shielded twisted pair
	Speed	10/100 Mb
	Duplex	Half/full
	Default IP-address mode	Static
Default static IP configurations.	Default static IP address	192.168.1.254
	Default network mask	255.255.255.0
	Default gateway address	192.168.1.1

Hardware specifications

Ethernet port LED indications



Ethernet LED

1. Ethernet link status.
2. Ethernet link speed.

Table 54. Ethernet LED description.

LED	Meaning
Ethernet link status	Flashes with ethernet message activity.
Ethernet link speed	Displays the link speed.
	Yellow LED on the ethernet jack is ON when link speed is 100 mbps.
	Yellow LED on the ethernet jack is OFF when link speed is 10 mbps.

Ethernet LED indications at power up

When the drive is powered up, an indicator test will be performed. To allow a visual inspection, the following sequence will be performed.

1. Turn first indicator Green, all other indicators off.
2. Leave first indicator on Green for approximately 0.25 second.
3. Turn first indicator on Red for approximately 0.25 second.
4. Turn first indicator on Green.
5. Turn second indicator (if present) on Green for approximately 0.25 second.
6. Turn second indicator (if present) on Red for approximately 0.25 second.
7. Turn second indicator (if present) Off.

If other indicators are present, test each indicator in sequence as prescribed by the second indicator above. If a module status indicator is present, it will be the first indicator in the sequence, followed by any network status indicators present. After completion of this power up test, the indicator (s) will turn to a normal operational state.

Figure 5. Module and network status

Module status indications

Represents the state of the drive.

Table 55. Module status LED description

Indicator state	Summary	Meaning
Steady off	No power	No power is supplied to the PowerXL.
Steady green	Device operational	Drive is operating correctly.
Flashing green ①	Standby	Drive has not been configured.
Flashing red ①	Minor fault	Drive has detected a recoverable minor fault. Note. An incorrect or inconsistent configuration would be considered a minor fault. Also check that on clearing the fault, it turns off.
Steady red	Major fault	Drive has detected a non-recoverable major fault.
Flashing green/red	Self-test	Drive is performing its power on self test.

Network status indications

Represents the state of the Ethernet port network interface.

Table 56. Network status LED description

Indicator State	Summary	Meaning
Steady off	Not powered, no IP address	Drive is powered off, or is powered on but with no IP address configured (Interface Configuration attribute of the TCP/IP Interface Object).
Flashing green ①	No connections	An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out.
Steady green	Connected	At least one CIP connection (any transport class) is established, and an Exclusive Owner connection has not timed out.
Flashing red ①	Connection timeout	Drive is powered on and an exclusive Owner connection has timed out. It returns to steady green only when all timed out Exclusive Owner connections are established.
Steady red	Duplicate IP address	Drive has detected a Duplicate IP.
Flashing green/red	Self-test	Drive is performing its power on self test.

① Flash rate is 1 flash per second.

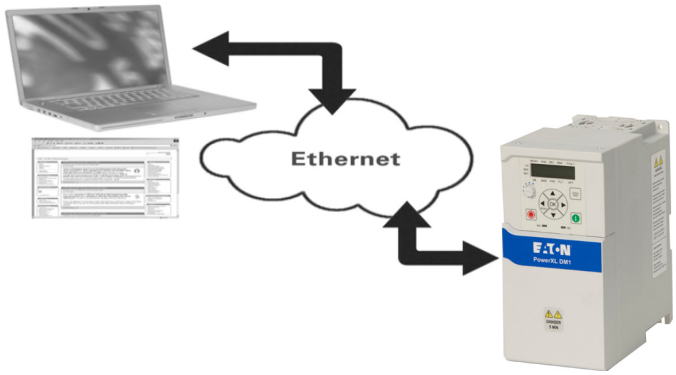
EtherNet/IP overview

EtherNet/IP was introduced in 2001 and today is the most developed, proven, and complete industrial Ethernet network solution available for manufacturing automation. EtherNet/IP is a member of a family of networks that implements the common industrial protocol (CIP) at its upper layers. CIP encompasses a comprehensive suite of messages and services for a variety of manufacturing automation applications, including control, safety, synchronization, motion, configuration, and information. As a truly media-independent protocol that is supported by hundreds of vendors around the world, CIP provides users with unified communication architecture throughout the manufacturing enterprise.

There are two common use cases of Ethernet - devices are "human to machine" and "machine to machine." Basic features are presented in the figures below.

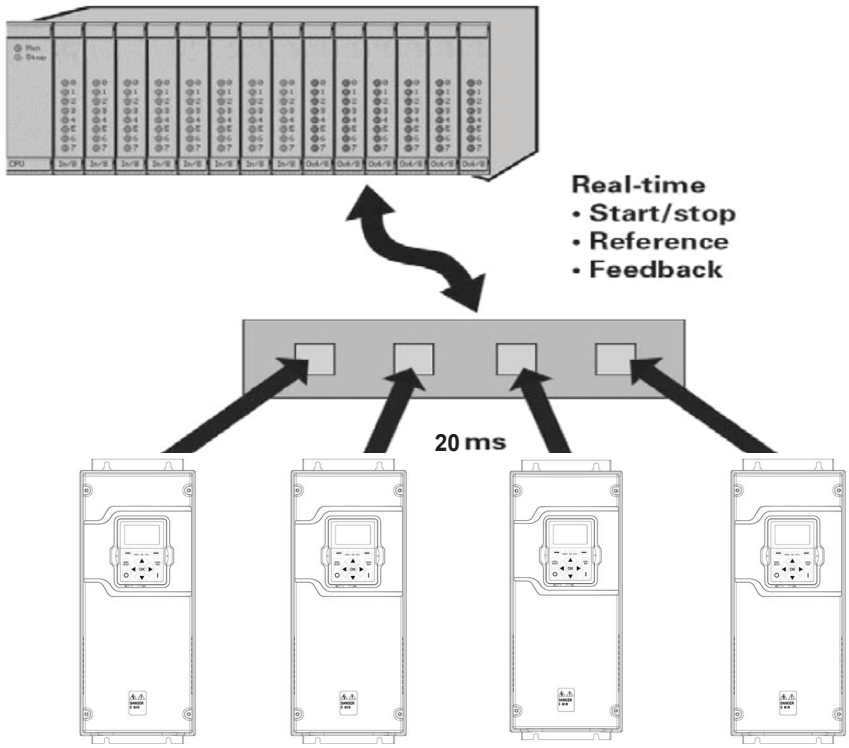
1. Human to machine (graphical user interface, relatively slow communication).
   User Interface

Figure 6. Human to machine user interface.



2. Machine to machine (industrial environment, fast communication).
   Industrial Environment

Figure 7. Machine to machine interface (industrial environment, fast communication).



Note: PowerXL DM1 Pro should receive commands from PLC with minimum 20ms RP.

Connections and wiring

The EtherNet/IP board supports 10/100 Mb speeds in both full and half-duplex modes. The boards must be connected to the Ethernet network with a shielded CAT-5e cable. A crossover cable (at least CAT-5e cable with STP, shielded twisted pair) may be needed if you want to connect the EtherNet/IP board directly to the master appliance.

Use only industrial standard components in the network and avoid complex structures to minimize the length of response time and the amount of incorrect dispatches. It is often a good practice to use a sub-net that is different from other devices not related to the drive control.

Figure 8. CAT-5e cable.

Table 57. Ethernet communication .

P12.1 - Basic settings.					
P12.1.1ⓘ	***IP address mode***				**ID 1500**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Static IP; or 1 = DHCP with AutoIP.				
Description:	This parameter defined the IP address configuration mode for EIP/modbus TCP. Changing this parameter causes the drive to reset.				
P12.1.2	***Active IP address***				**ID 1507**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active IP address.				
P12.1.3	***Active subnet mask***				**ID 1509**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active subnet mask.				
P12.1.4	***Active default gateway***				**ID 1511**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active default gateway.				
P12.1.5	***MAC address***				**ID 1513**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current MAC address.				
P12.1.6ⓘ	***Static IP address***				**ID 1501**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.254
Description:	Defines the static IP address. Changing this parameter causes the drive to reset.				
P12.1.7ⓘ	***Static subnet mask***				**ID 1503**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	255.255.255.0
Description:	Defines the static subnet mask.				
P12.1.8ⓘ	***Static default gateway***				**ID 1505**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.1
Description:	Defines the static default gateway.				
P12.1.9	***Ethernet communication timeout***				**ID 611**
Minimum value:	0.00 ms	**Maximum value:**	60,000 ms	**Default value:**	10,000 ms
Description:	Selects the time it waits before a communication fault occurs over ethernet. **Note:** setting this parameter to 0 will mask the ethernet fault.				

Table 57. Ethernet communication (Cont.).

P12.2 - Trusted IP filter (DM1 Pro only).

P12.2.1	***Trusted IP white list***				**ID 68**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.255 0.0.0. 0 0.0.0.0
Description:	Defines the IP addresses in the white list. A setting of 192.168.1.255 enables all connections on the local subnet.				
P12.2.2	***Trusted IP filter enable***				**ID 76**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	1
Options:	0 = Disabled; or 1 = Enabled.				
Description:	Enables IP white listing. Devices not in the white list will not be able to establish communications with the drive.				

P12.4 - Ethernet IP (DM1 Pro only).

P12.4.1①	***Ethernet based protocol select***				**ID 1997**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Disabled; or 1 = Ethernet IP; or 2 = BACnet IP.				
Description:	Selects the active communication protocol on the ethernet I/P port. Changing this parameter causes the drive to reset.				
P12.4.2	***Ethernet IP protocol status***				**ID 608**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Options:	0 = Off; 1 = Operational; or 2 = Faulted.				
Description:	Indicates if ethernet protocol is active or not.				
P12.4.3	***Ethernet IP fault response***				**ID 2518**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Only in fieldbus control mode - when fieldbus is the control place and Fieldbus fault is active, the drive will fault on loss of communications. If not in fieldbus control, drive will not fault. 1 = In all control modes - no matter the control place setting. If communication is lost, fieldbus fault response will occur.				
Description:	Defines the fieldbus fault condition for ethernet IP communication.				

Commissioning

Keypad EtherNet/IP communication menu

DHCP

The drives EtherNet/IP communication supports DHCP for easier network configuration. Dynamic host configuration protocol (DHCP) is a network protocol that is used to configure network devices so that they can communicate on an IP network. As a DHCP client, EtherNet/IP negotiates with the DHCP server to determine its IP address and obtain any other initial configuration details it needs for network operation.

IP address

IP is divided into four parts. (Part = Octet) Default Static IP Address is 192.168.1.254

Communication timeout

Defines how much time can pass from the last received message from the client device before fieldbus fault is generated. Default communication time-out is 10 seconds.

Note: If the network cable is broken from the EtherNet/IP slot, a fieldbus error is generated immediately.

Note: Setting this parameter to 0 will mask the ethernet fault.

Static IP address

In most cases, the user may want to establish a static IP address for the drives EtherNet/IP based on their network configuration. Static IP address default configurations are as defined in "EtherNet/IP network settings" table, provided in "Connections and Wiring" section. The user can manually define the network address for the EtherNet/IP as long as all units connected to the network are given the same network portion of the address. In these situations, the user will need to manually set the IP address in the drive by using the drive keypad. Be aware that overlapping IP addresses can cause conflicts between devices on the network. For more information about selecting IP addresses, contact your network administrator.

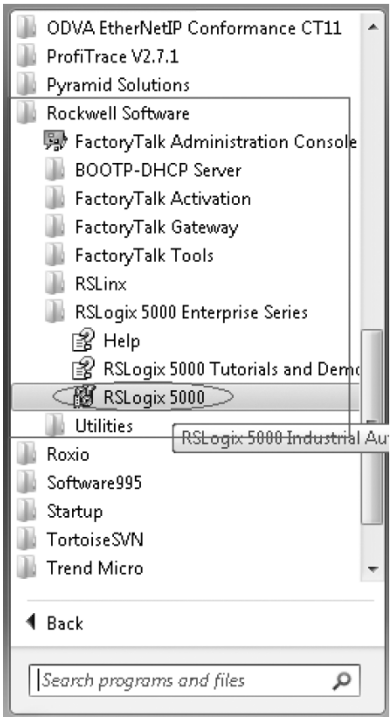
PLC programming

ControlLogix 5000

When using a ControlLogix PLC as an EIP master, you must first configure a compatible EtherNet/IP scanner, and then map ladder logic variables to the scanner. The following example is for an RSLogix5000 with a CompactLogix-L23E-QB1 PLC controller.

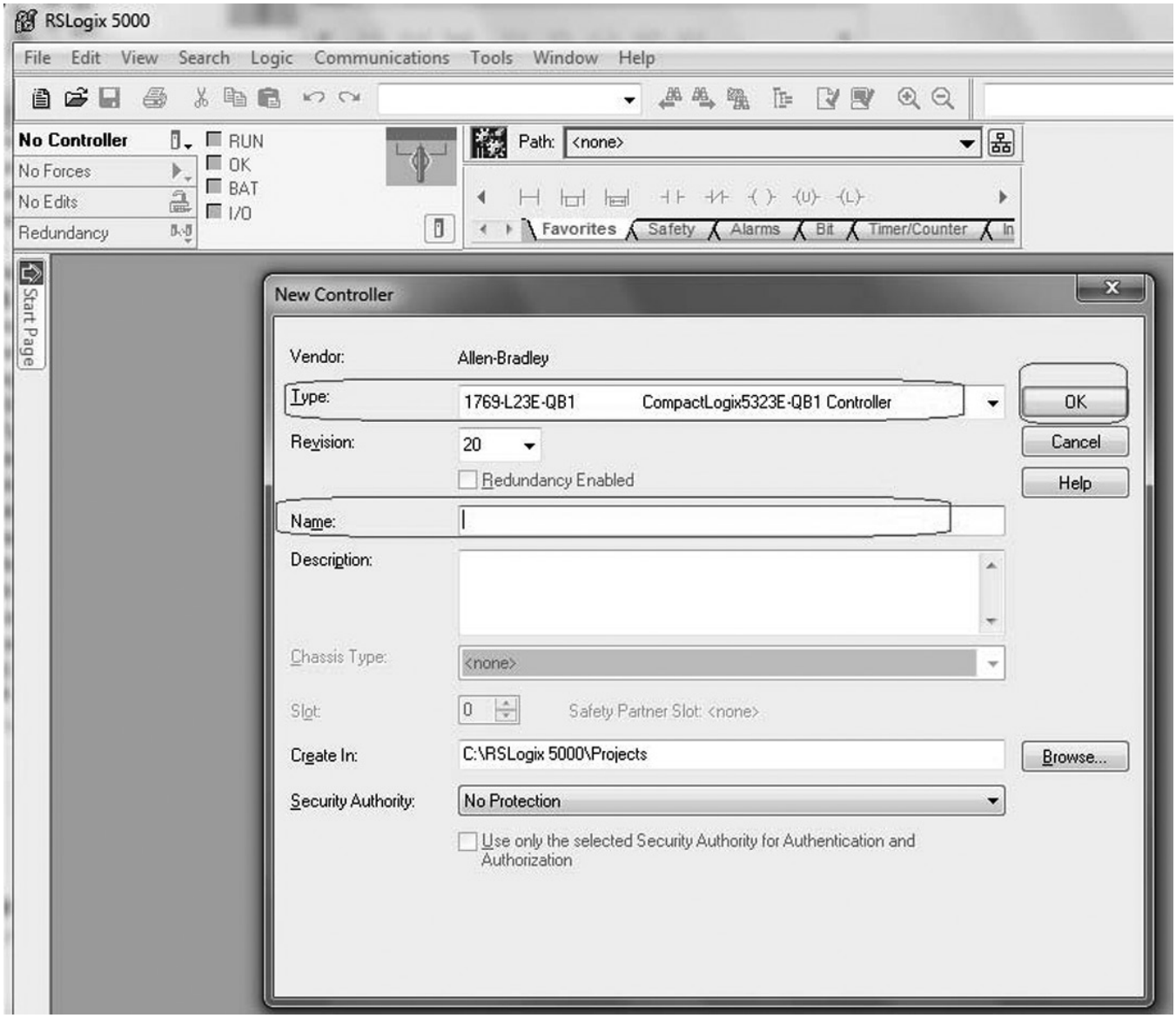
Note: Some PLCs do not support polled messaging for EtherNet/IP. For example, the SLC500 only supports explicit messaging.

Select windows Start ⟶ All Programs. Open RSLogix 5000.



From the Tools drop-down menu, select EDS Hardware Installation Tool to install the PowerXL DM1 Pro drive EtherNet/IP EDS file. This file can be downloaded from the Eaton website.

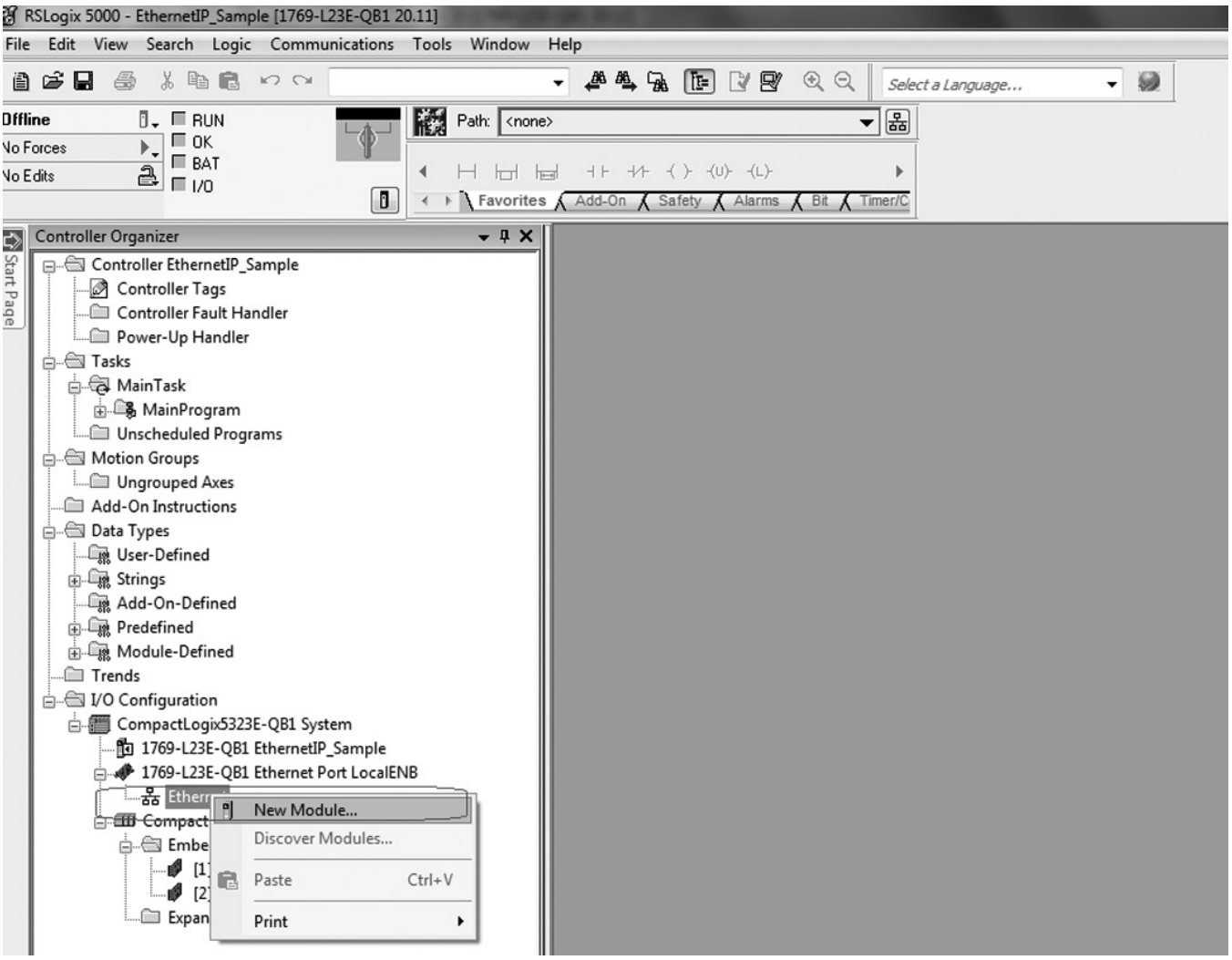
Select "New" from "File" menu. A new controller window will pop-up. Select the controller and assign an unique name.



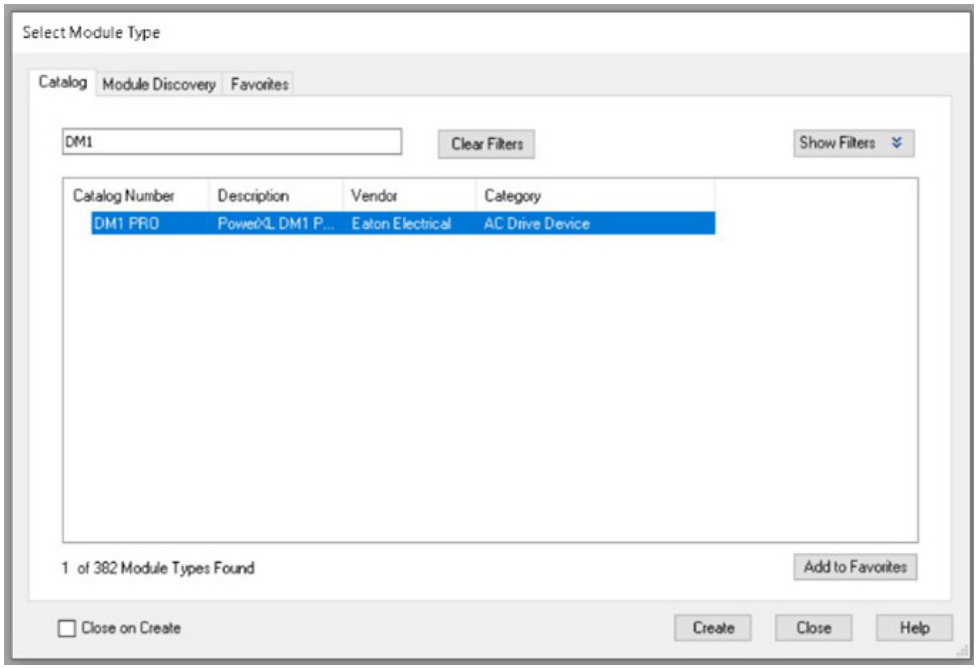
Press OK.

Right-click on Ethernet. Select "New Module".

Note: PC on which RSLogix (master) is running and PowerXL DM1 Pro device (slave) should be connected in same network.

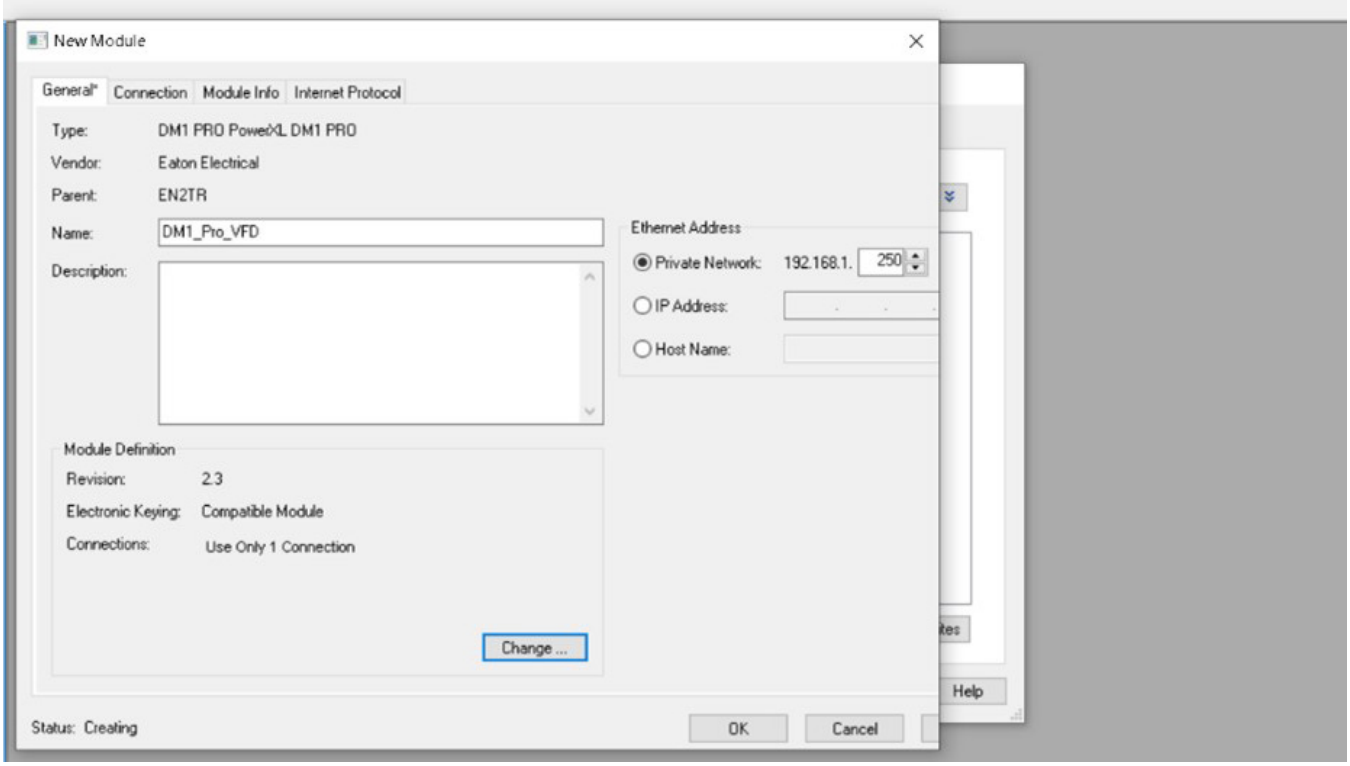


"Select Module Type" window will pop-up. Select "PowerXL DM1 Pro" (use filter to search PowerXL from catalog).

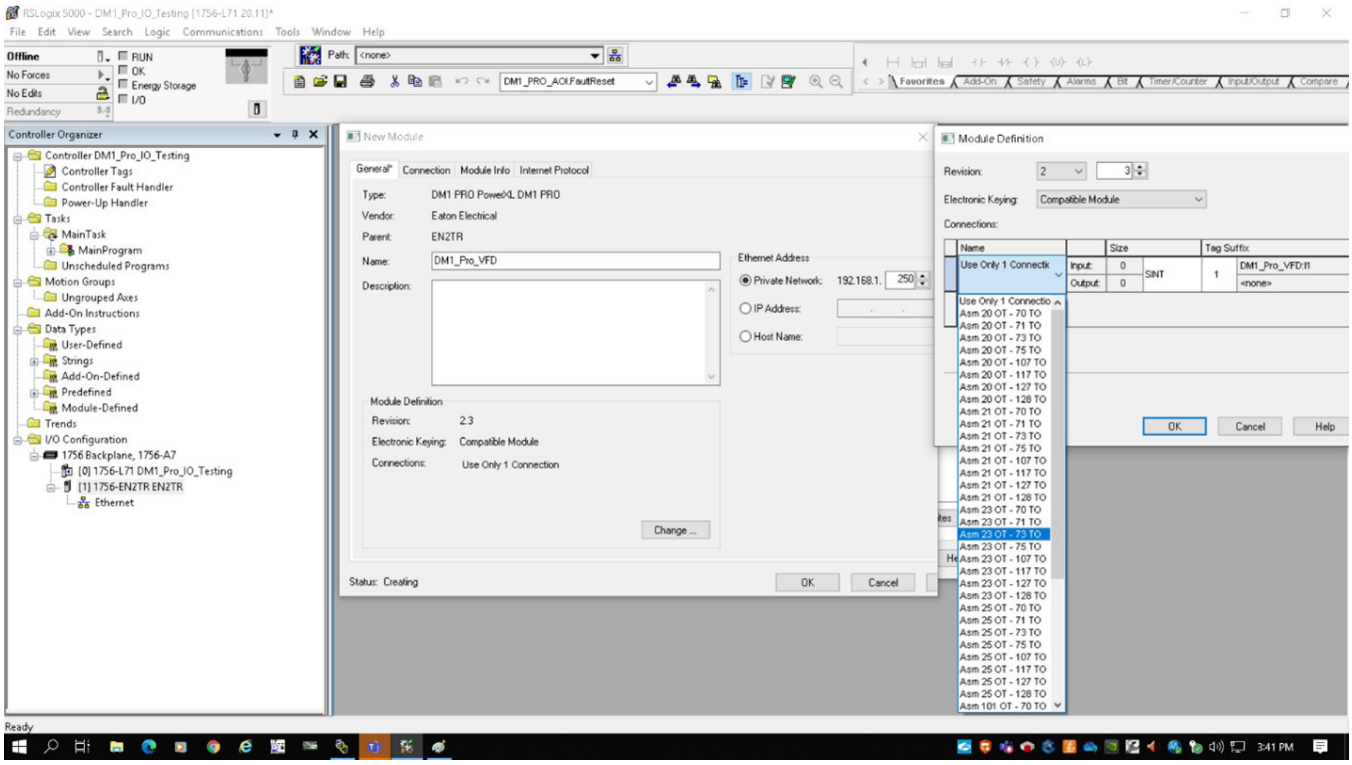


After selecting "PowerXL DM1 Pro," "New Module" window will pop-up (as shown below). Fill in a unique name and appropriate IP address for device. Press OK. The device will get added under "Ethernet" module.

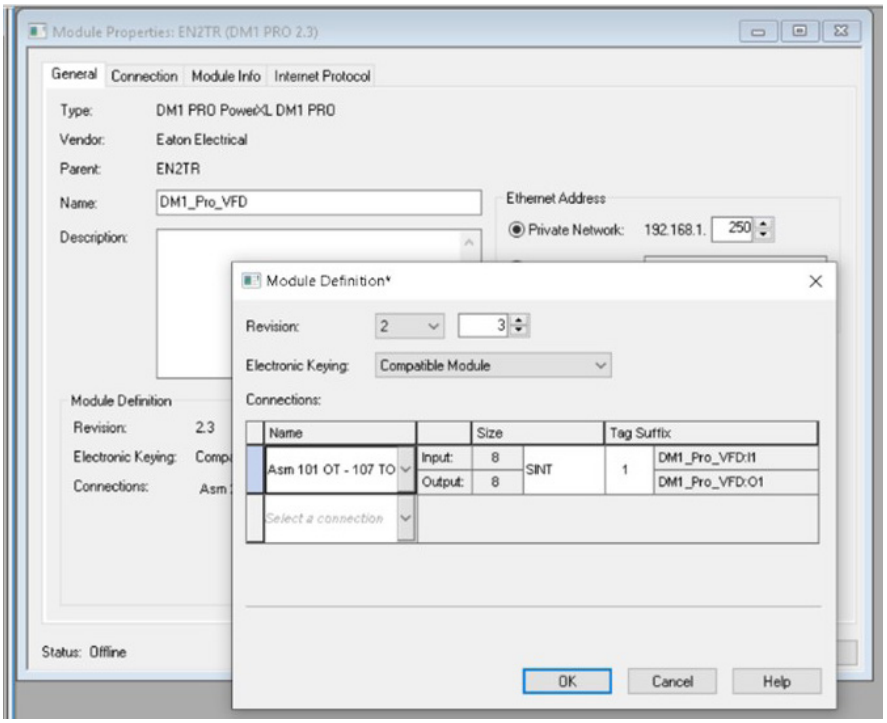
Note: You must change the class1 connection from provided default option by using "Change" button available on "New Module" window. This can also be done after adding the device under Ethernet by double-clicking on it.



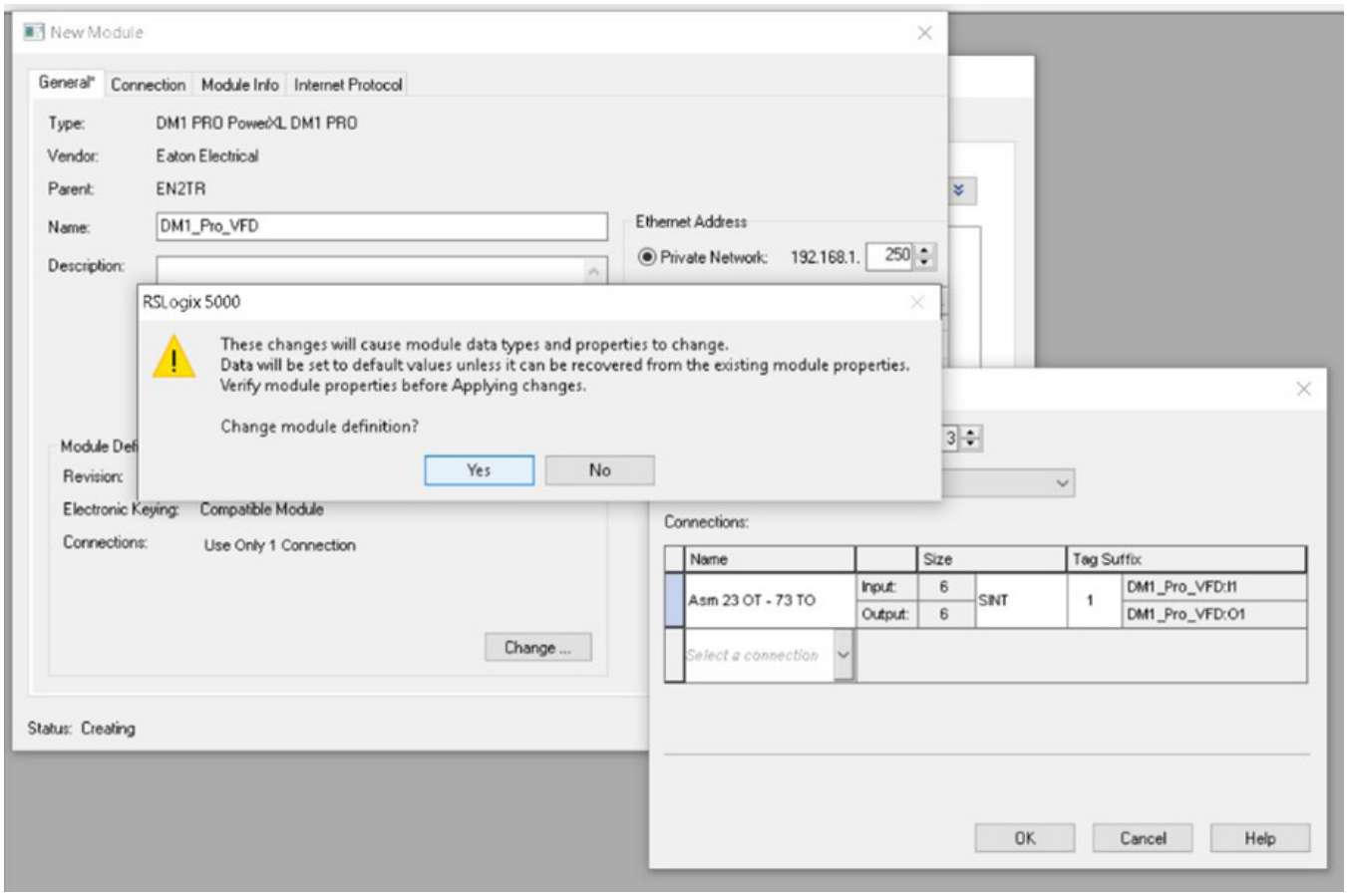
Choose the INT data type then select /IO connection from the provided list. After selecting desired I/O assembly instance connection, information related to it will appear.



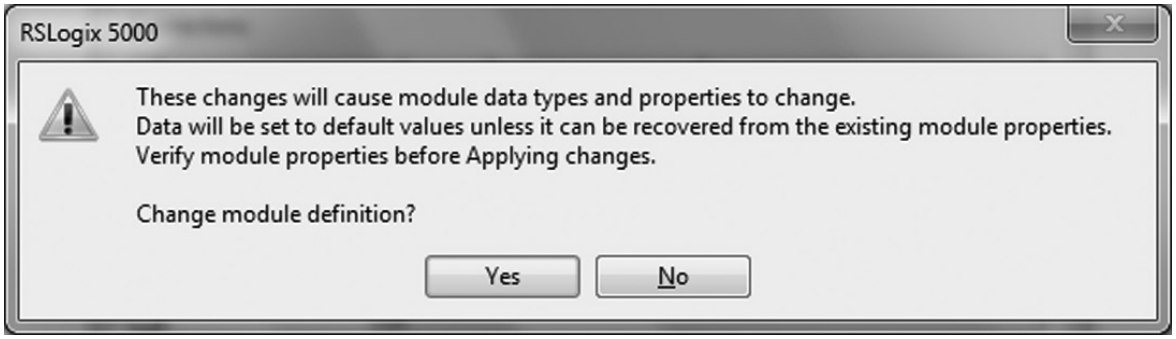
After selecting the I/O connection, click "OK." For this example, I/O connection ASM101OT-107TO will be used. The module definition window will then look as follows.



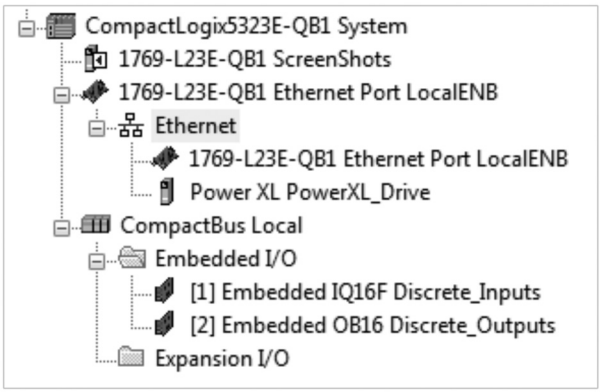
After pressing "OK," the following warning will pop-up.
Press "Yes."



Warning snapshot.



Then select “OK” on the New Module Window and the PowerXL DM1 Pro Series drive will be added to the EtherNet/IP Network on the left, in this case under the CompactLogix EtherNet/IP master port as shown.



Close the Select Module Type window or add more devices to the network.

Select the controller tags to view the three INT input and output tags for the drive. The layout for the three input and output INTs for input assembly 73 and output assembly 23 are shown later in this section.

Name	Value	Force Mask	Style	Data Type
Local:1:C	{...}	{...}		AB:Embedded_IQ16F:C:0
Local:1:I	{...}	{...}		AB:Embedded_IQ16F:I:0
Local:2:C	{...}	{...}		AB:Embedded_OB16:C:0
Local:2:I	{...}	{...}		AB:Embedded_OB16:I:0
Local:2:O	{...}	{...}		AB:Embedded_OB16:O:0
PowerXL_Drive:I1	{...}	{...}		_0044:PowerXL_BD7BDD2...
PowerXL_Drive:I1.ConnectionFaulted	0		Decimal	BOOL
PowerXL_Drive:I1.Data	{...}	{...}	Decimal	INT[3]
PowerXL_Drive:I1.Data[0]	0		Decimal	INT
PowerXL_Drive:I1.Data[1]	0		Decimal	INT
PowerXL_Drive:I1.Data[2]	0		Decimal	INT
PowerXL_Drive:O1	{...}	{...}		_0044:PowerXL_B82B6E11:...
PowerXL_Drive:O1.Data	{...}	{...}	Decimal	INT[3]
PowerXL_Drive:O1.Data[0]	0		Decimal	INT
PowerXL_Drive:O1.Data[1]	0		Decimal	INT
PowerXL_Drive:O1.Data[2]	0		Decimal	INT

Eaton also provides a tag generation tool that generates I/O tags for your Eaton EtherNet/IP slave devices. This software tool generates a CSV file containing all the I/O tags that can then be imported into RSLogix5000. These tags are automatically aliased to the generic I/O tags created by RSLogix5000. The generic tags shown above for the PowerXL DM1 Pro drive are an example.

This means you will not have to type any data into the Controller tags area for your Eaton EtherNet/IP products. The imported tags will match the layouts for the I/O assemblies chosen and displayed later in this section and can be used directly in your programs. This tool and a user manual can be downloaded from the Eaton website at the following link:

www.eaton.com/software

Note: The drive auto senses when a master polls it for valid I/O assemblies. There is no configuration necessary in the drive with regard to I/O assemblies or data lengths.

EtherNet/IP

Overview

EtherNet/IP (Ethernet/Industrial Protocol) is a communication system suitable for use in industrial environments. EtherNet/IP allows industrial devices to exchange time-critical application information. These devices include simple I/O devices such as sensors/actuators, as well as complex control devices such as robots, programmable logic controllers, welders, and process controllers. EtherNet/IP uses CIP (Control and Information Protocol), the common network, transport, and application layers also shared by ControlNet and EtherNet/IP. EtherNet/IP then makes use of standard Ethernet and TCP/IP technology to transport CIP communications packets. The result is a common, open application layer on top of open and highly popular Ethernet and TCP/IP protocols.

EtherNet/IP messaging forms.

- Unconnected messaging is used for connection establishment and for infrequent, low-priority messages.
- Connected messaging uses resources that are dedicated in advance to a particular purpose such as real-time I/O data transfer.

EtherNet/IP messaging connections.

- Explicit messaging connections are general purpose point-to-point connections. Messages are sent through TCP protocol.
- Implicit (I/O data) connections are established to move application-specific I/O data at regular intervals. They are often set up as one-to-many relationships in order to take full advantage of the producer-consumer multicast model. Implicit messages are sent through UDP protocol.

AC/DC drive profile

In order to provide compatibility between similar devices from different manufacturers, there a defined "standard" in which those devices:

- Exhibit the same behavior;
- Produce and/or consume the same basic set of I/O data; and
- Contain the same basic set of configurable attributes. The formal definition of this information is known as a device profile.

EDS file

EDS - Is the abbreviation for electronic data sheet, a file on disk that contains configuration data for specific device types. You can provide configuration support for your device by using a specially formatted ASCII file, referred to as the EDS.

The information in an EDS allows configuration tools to provide informative screens that guide a user through the steps necessary to configure a device. An EDS provides all of the information necessary to access and alter the configurable parameters of a device. This information matches the information provided by instances of the parameter object class. The CIP object library describes the parameter object class in detail.

Explicit messaging

Explicit messaging is used in commissioning and parameterizing of the EtherNet/IP board. Explicit messages provide multipurpose, point-to-point communication paths between two devices. They provide the typical request/response-oriented network communication used to perform node configuration and problem diagnosis. Explicit messages typically use low priority identifiers and contain the specific meaning of the message right in the data field. This includes the service to be performed and the specific object attribute address.

Note: If Class 1 connection (cyclic data) has been established, then explicit messages cannot be used to control output data. However, this restriction does not apply for IO Data reading.

List of object classes

The communication interface supports the following object classes.

Table 58. List of object classes.

Class	Object	Remark
0x01	Identity objects	CIP required object
0x04	Assembly object	CIP object for drive device
0x06	Connection manager object	Communication object
0x28	Motor data object	CIP object for drive device
0x29	Control supervisor object	CIP object for drive device
0x2A	Ac/dc drive object	CIP object for drive device
0xA0	Vendor parameters object	CIP object for drive device—vendor specific
0xA1	Vendor parameter object	Please refer to **Appendix A**
0xA2	Vendor parameter object	Please refer to **Appendix A**
0xA3	Vendor parameter object	Please refer to **Appendix A**
0xA4	Vendor parameter object	Please refer to **Appendix A**
0xA5	MPFC parameter object	Please refer to **Appendix A**
0xA6	Vendor parameter object	Please refer to **Appendix A**
0xF5	TCP/IP interface object	CIP required object
0x02	Message router object	Communication object
0xF4	Port object	Communication object
0xF6	Ethernet link object	CIP required object

List of services

The services supported by these object classes are shown below.

Table 59. Services supported by object classes.

		Identity		Port		Message router		Connection manager		TCP/IP		Ethernet link		Assembly		Motor Data		Control Supervisor		AC/DC drive		Vendor Parameter	
Service name	**Service code in (hex)**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**	**Class**	**Inst**
Get_attributes_all	01h	X	X	X	X	X	X	X	X	X	X	X	X										
Reset (type 0 & 1)	05h		X																X ①				
Get_attribute_single	0Eh	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Set_attribute_single	0x10								X		X		X		X		X		X		X		X
Set_attribute_all	0x02								X		X												
Forward close	0x4E								X														
Unconnected_send	0x52								X														
Forward_open	0x54								X														
Get connection owner	0x5A								X														
Large forward open	0x5B								X														

① Control supervisor supports only reset-type 0 instance service.

List of data types

The attribute list that follows includes information on the data type of each attribute. The following tables explain the data, structure, and array type codes used in the data type column.

Following data types are supported.

Table 60. Elementary data types.

Data type name	Data type code (in hex)	Data type description
BOOL	C1	Logical Boolean with values TRUE and FALSE
SINT	C2	Signed 8-bit integer value
INT	C3	Signed 16-bit integer value
USINT	C6	Unsigned 8-bit integer value
UINT	C7	Unsigned 16-bit integer value
UDINT	C8	Unsigned 32-bit integer value
BYTE	D1	Bit string–8-bit
WORD	D2	Bit string–16-bit
SHORT_STRING	DA	Character string (1 byte per character, 1 byte length indicator)
REAL	CA	32-bit floating point value
SHORT_STRING	DA	Character string (1 byte per character, 1 byte length indicator)

Table 61. Constructed data types.

Type code	Description
A1	Abbreviated array type encoding
A2	Formal structure type encoding

Reset service

The following table lists the different types of resets supported by the identity object.

Resetting the drive interface to its out-of-box configuration will change the response of the drive to a loss of communications with the master. The device will have to be re-configured for your application before resuming normal operation. Reset time is 1 sec.

Table 62. Different types of resets supported by the identity object.

Value	Type of reset
0	Initializes drive to the power-up state.
1	Writes default values to all instance attributes AND then saves all non-volatile attributes to FLASH memory AND then performs the equivalent of a reset (0).

Common industrial objects implemented by the PowerXL DM1 EIP

CIP common required objects

Identity object, class 0x01

This object provides identification of and general information about the PowerXL DM1 Pro.

Table 63. Identity object.

ID	Description	Data type	Access rule	Remarks/Default values
Class attributes				
01h	Revision	UINT	Get	1
02h	MaxiInstances	UINT	Get	1
03h	Number of instances	UINT	Get	1
06h	Maximum ID class attribute	UINT	Get	7
07h	Maximum ID instance attribute	UINT	Get	7
Class services				
0Eh	Get_attribute_single			
01h	Get_attribute_all			
Instance attributes				
01h	Vendor ID	UINT	Get	68 (Eaton vendor ID)
02h	Device type	UINT	Get	CIP specified - lined to motor (AC drive)–2
03h	Product code	UINT	Get	0x3029
04h	Revision	STRUCT of	Get	
	Major revision	USINT		
	Minor revision	USINT		
05h	Status	WORD	Get	0x34 - default
06h	Serial number	UDINT	Get	
07h	Product name	SHORT_STRING	Get	PowerXL DM1 Pro
Instance services				
01h	Get_attributes_all			
05h	Reset			Reset type 0 & 1
0Eh	Get_attribute_single			

Connection manager object, class 0x06

The connection manager class allocates and manages the internal resources associated with both I/O and explicit messaging connections. The specific instance generated by the connection manager class is referred to as a "Connection Instance" or a "Connection Object".

Table 64. Connection manager object.

ID	Description	Data type	Access rule	Remarks/default values
Class attributes				
01h	Revision	UINT	Get	
02h	Max instances	UINT	Get	
03h	Number of instances	UINT		
04h	Optional attribute list	STRUCT of	Get	
	Number of optional attributes	UINT		
06h	Maximum ID	UINT	Get	
	Number class			
	Attributes			
07h	Maximum ID number	UINT	Get	
	Instance attribute			
Class services				
0Eh	Get_attribute_single			
01h	Get_attribute_all			
Instance attributes				
01h	Open requests	UINT	Get/Set	
02h	Open format rejects	UINT	Get/Set	
03h	Open resource rejects	UINT	Get/Set	
04h	Open other rejects	UINT	Get/Set	
05h	Close requests	UINT	Get/Set	
06h	Close format requests	UINT	Get/Set	
07h	Close other requests	UINT	Get/Set	
08h	Connection timeouts	UINT	Get/Set	
Instance services				
01h	Get_attributes_all			
0Eh	Get_attribute_single			
4Eh	Forward_close			
52h	Unconnected_send			
54h	Forward_open			
0x2	Set attribute all			
0x10	Set attribute single			
0x5a	Get connection owner			
0x5b	Large forward open			

TCP/IP interface object, class 0XF5

The TCP/IP interface object provides the mechanism to configure a device's TCP/IP network interface. Examples of configurable items include the device's IP address, network mask, and gateway address.

Table 65. TCP/IP interface object.

ID	Description	Data type	Access rule	Remarks/default values
Class attributes				
01h	Revision	UINT	Get	4
02h	Max instance	UINT	Get	1
03h	Number of instances	UINT	Get	1
04h	Optional attribute list	Array of UINT	Get	0x05 0x00 0x08 0x00 0x09 0x00 0x0A 0x00 0x0B 0x00 0x10 0x00
06h	Maximum ID class attribute	UINT	Get	7
07h	Maximum ID instance attribute	UINT	Get	0x0010
Class services				
01h	Get_attributes_all			
0Eh	Get_attribute_single			
Instance attributes				
01h	Status	DWORD	Get	01
02h	Configuration capability	DWORD	Get	0x00000094
03h	Configuration control	DWORD	Get/Set ①	02-dhcp, 0- static
04h	Physical link	STRUCT of	Get	
	Path size	UINT		00
	Path	Padded EPATH		00
05h	Interface configuration	Struct of:-NV	Get/Set ①	
	Ip address	UDINT		192.168.1.254
	Network mask	UDINT		255.255.255.0
	Gateway address	UDINT		192.168.1.1
	Name server	UDINT		00
	Name server 2	UDINT		00
	Domain name	STRING		00
06h	Host name	STRING	Get/Set ①	00
08h	TTL value	USINT	Get	01
09h	Multicast configuration	Struct of	Get	
	Alloc control	USINT		00
	Reserved	USINT		00
	Number of mcast	UINT		0x20
	Starting multicast address	DWORD		0xA0 0x20 0xC0 0xEF
0Ah	Select ACD	BOOL	Get/Set ①	1
0Bh	Last conflict detected	Struct of	Get/Set ①	
	ACD activity	USINT		0
	Remote MAC	Array of 6 USINT		00
	ARP PDU	Array of28 USINT		00
Instance services				
01h	Get_attributes_all			
0Eh	Get_attribute_single			
10h	Set_attribute_single			
0x2	Set attribute all			

① Set service is applicable only in static IP addressing mode.

Note: Attribute configuration control supports only value 0 (device is using configuration values that are stored in non-volatile memory). Attribute host name is used just for information purposes.

Ethernet link object class 0XF6

The Ethernet link object maintains link-specific counters and status information for an IEEE® 802.3 communications interface.

Table 66. Ethernet link object.

ID	Description	Data type	Access rule	Remarks/default values
Class attributes				
01h	Revision	UINT	Get	4
02h	Max instance	UINT	Get	1
03h	Number of instances	UINT	Get	1
04h	Optional attribute list	Struct of:	Get	
	Number of attributes	UINT		0x04 0x00
	Array of attributes	Array of UINT		0x07 0x00 0x08 0x00 0x09 0x00 0x0A 0x00
06h	Maximum ID class attribute	UINT	Get	0x07
07h	Maximum ID instance attribute	UINT	Get	0x0B
Class services				
01h	Get_attributes_all			
0Eh	Get_attribute_single			
Instance attributes				
01h	Interface speed	UDINT	Get	0x64 0x00 0x00 0x00
02h	Interface flags	DWORD	Get	0x0D
03h	Physical	ARRAY of	Get	
	Address	6 USINTs		
07h	Interface type	USINT	Get	02
08h	Interface state	USINT	Get	01
09h	Admin state	USINT	Get/Set	01 (Other value write is invalid)
0Ah	Interface label	Short String	Get	ASCII code of “PowerXL DM1 Pro”
Instance services				
01h	Get_attribute_all			
10h	Set_attribute_single			
0Eh	Get_attribute_single			

Objects present in an AC/DC drive.

Assembly object class 0X04

Table 67. Assembly object.

ID	Description	Data type	Access rule	Remarks/default values
Class attributes				
01h	Revision	UINT	Get	2
02h	Max instance	UINT	Get	0x80
03h	Number of instances	UINT	Get	0x0E
04h	Optional attribute list	Struct of:	Get	
	Number of attributes	UINT		01
	Array of attributes	Array of UINT		04 00
06h	Maximum ID class attribute	USINT	Get	07 00
07h	Maximum ID instance attribute	USINT	Get	04 00
Class services				
0Eh	Get_attribute_single			
Instance attributes				
03	Data	ARRAY of BYTES	Get/Set	
Instance services				
10h	Set_attribute_single			
0Eh	Get_attribute_single			

Motor data object, class 0x28

Table 68. Motor data object.

ID	Description	Data type	Access rule	Remarks/default values/min./max.
Class attributes				
01	Revision	UINT	Get	1
02	Max instance	UINT	Get	1
03	Number of instances	UINT	Get	1
Class services				
0Eh	Get_attribute_single			
Instance 1 attributes				
03h	Motor type	USINT-V	Get/Set	Squirrel cage induction motor (7)
06h	Rated current	UINT	Get/Set	126,1,5000
07h	Rated voltage	UINT	Get/Set	380,180,690
09h	Rated frequency	UINT	Get/Set	50,30,400
0Ch	Pole count	UINT	Get	4,1,8
0Fh	Base speed	UINT	Get/Set	1440,300,20000
Instance services				
0Eh	Get_attribute_single			
10h	Set_attribute_single			

Control supervisor object, class 0x29

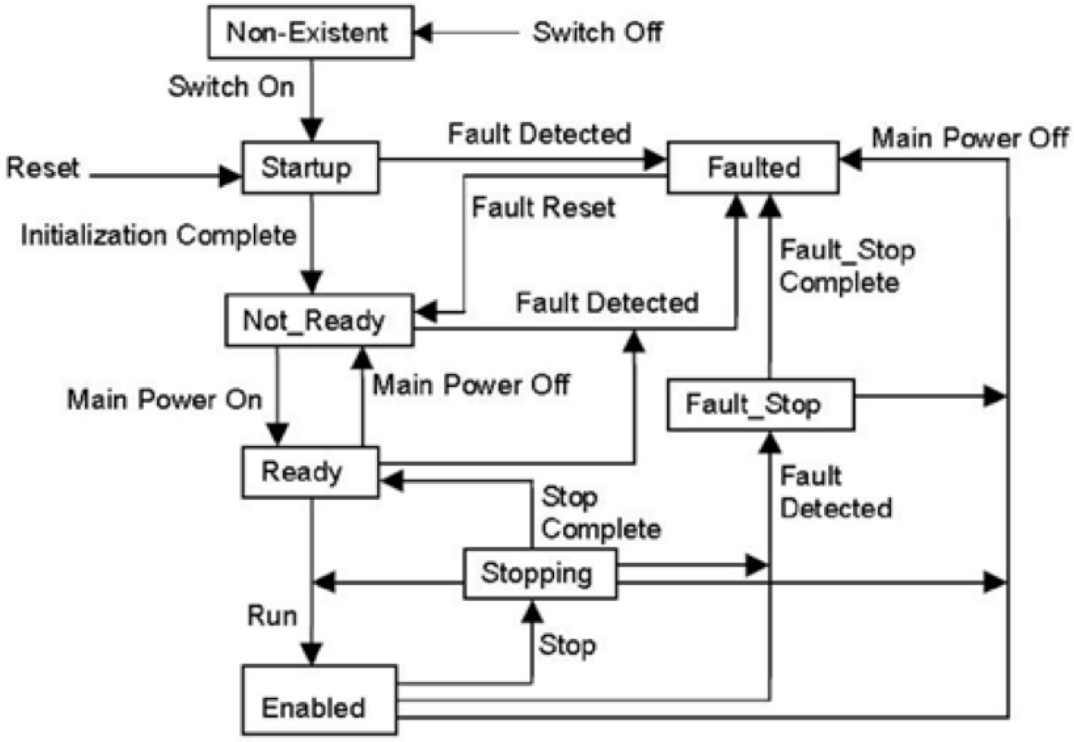
Table 69. Control supervisor object.

ID	Description	Data type	Access rule	Default	Range
Class attributes					
01h	Revision	UINT	Get	1	—
02h	Max instance	UINT	Get	1	—
03h	Number of instances	UINT	Get	1	—
Class services					
0Eh	Get_attribute_single				
Instance attributes					
03h	Run1 (RunForward)	BOOL	Get/Set	0	0–1
04h	Run2 (RunReverse)	BOOL	Get/Set	0	0–1
05h	NetCtrl	BOOL	Get/Set	0	0–1
06h	State	USINT	Get	0	0–7
07h	Running1	BOOL	Get	0	0–1
08h	Running2	BOOL	Get	0	0–1
09h	Ready	BOOL	Get	0	0–1
0Ah	Faulted	BOOL	Get	0	0–1
0Bh	Warning	BOOL	Get	0	0–1
0Ch	FaultRst	BOOL	Get/Set	0	0–1
0Fh	CtrlFromNet	BOOL	Get	0	0–1
0Dh	Active fault code ①	UINT	Get	0	0–65535
6Ch	Comm idle action value	BOOL	Get/Set	2	0–2
6Dh	Comm timeout	UINT	Get/Set	10 sec	0-60sec
Instance services					
0Eh	Get_attribute_single				
10h	Set_attribute_single				
05h	Reset (Type 0)			Type 0	

① See **Appendix C** for list of fault codes.

Note: When both Run (Run1 & Run2) attributes set, then no action.

Figure 9. State transition diagram.



AC/DC drive object, class 0x2a

This object models the functions specific to an AC or DC Drive, e.g., speed ramp, torque control, and so on.

Table 70. AC/DC drive object.

ID	Description	Data type	Access rule	Default
Class attributes				
01h	Revision	UINT	Get	1
02h	Max instance	UINT	Get	1
03h	Number of instances	UINT	Get	1
Class services				
0Eh	Get_attribute_single			
Instance attributes				**Default, min./max.**
03h	AtReference	BOOL	Get	0
04h	NetRef	BOOL	Get/Set	0
06h	DriveMode	USINT	Get	0
07h	Speed Actual	INT	Get	0
08h	SpeedRef	INT	Get/Set	0
0Bh	Torque Actual	INT	Get	0
0Ch	TorqueRef	INT	Get/Set	0
1Dh	RefFromNet	BOOL	Get	0
12h	Accel time	UINT	Get	468,1,46875
13h	Decel time	UINT	Get	468,1,46875
0Ah	Currentlimit	INT-NV	Get/Set	345
64h	Accel time 1	UINT-NV	Get/Set	468,1,46875
65h	Accel time 2	UINT-NV	Get/Set	468,1,46875
66h	Decel time 1	UINT-NV	Get/Set	468,1,46875
67h	Decel time 2	UINT-NV	Get/Set	468,1,46875
1Ch	Time scale	SINT-NV	Get/Set	6,0,127
Instance services				
0Eh	Get_attribute_single			
10h	Set_attribute_single			

Note: Final Accel Time = Accel Time 1 x (2 to power Time Scale).

Vendor parameters object, class 0xA0, 0xA1, 0xA2, 0xA3, 0xA4, 0xA5, and 0xA6

PowerXL DM1 Pro series shall support vendor parameters object, class 0xA0, 0xA1, 0xA2, 0xA3, 0xA4, 0xA5 and 0xA6 as given in table below.

Vendor parameter object is used in order to get access to drive parameters.

Please refer to **Appendix A** for Class, Instance, and Attribute values for each parameter.

Table 71. Vendor specific objects.

ID	Description	Data type	Access rule	Remarks/default
Class attributes				
01h	Revision	UINT	Get	1
02h	Max instance	UINT	Get	1
03h	Number of instances	UINT	Get	Varies for different objects
Class services				
0Eh	Get_attribute_single			
Instance attributes				
	Varies for different objects			
Instance services				
0Eh	Get_attribute_single			
10h	Set_attribute_single			

Note: All the drive parameters given in the application manual are accessible using the vendor parameter object. See **Appendix A** for instance values.

Assembly instances implemented by PowerXL DM1 Pro EtherNet/IP

Assemblies 20, 21, 23, & 25 ODVA AC/DC profile; assemblies 70, 71, 73, & 75 ODVA AC/DC profile; assemblies >100, Eaton profile.

Output instances

Assembly instance 20

Table 72. Instance 20 (Output) length = 4 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0						FaultReset		RunFwd
1								
2	Speed reference (low byte), rpm							
3	Speed reference (high byte), rpm							

Assembly instance 21

Table 73. Instance 21 (Output) length = 4 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		NetRef	NetCtrl			FaultReset	RunRev	RunFwd
1								
2	Speed reference (low byte), rpm							
3	Speed reference (high byte), rpm							

Assembly instance 23

Table 74. Instance 23 (Output) length = 6 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		NetRef	NetCtrl			FaultReset	RunRev	RunFwd
1								
2	Speed reference (low byte), rpm							
3	Speed reference (high byte), rpm							
4	Torque reference (low byte), Nm ①							
5	Torque reference (High Byte), Nm ①							

① Torque reference is sent to the drive only if motor control mode is set to "Torque Control".

Note: Torque reference is sent to the drive as a process data 1.

Assembly instance 25

Table 75. Instance 25 (Output) length = 6 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		NetRef	NetCtrl			FaultReset	RunRev	RunFwd
1								
2	Speed reference (low byte), rpm							
3	Speed reference (high byte), rpm							
4	Process reference (low byte) ①							
5	Process reference (high byte)							

① In speed control mode - process ref. is process data IN8 (analog input 1).
In freq. control - process ref. is process data IN8 (analog output 1, reading the actual output current).
In torque control - process ref. is process data IN1 (torque reference).
Based on selection of AO, process reference value will be sent on AO out.

Assembly instance 101

Table 76. Instance 101 (output) length = 8 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		NetRef	NetCtrl	FB DATAIN 2	FB DATAIN 1	FaultReset	RunRev	RunFwd
1	PDSELB3	PDSELB2	PDSELB1	PDSELB0	PDSELA3	PDSELA2	PDSELA1	PDSELA0
2	FBSpeed reference (low byte), rpm							
3	FBSpeed reference (high byte), rpm							
4	FBProcessDataIn1 (low byte)							
5	FBProcessDataIn1 (high byte)							
6	FBProcessDataIn2 (low byte)							
7	FBProcessDataIn2 (high byte)							

Note: Process data is sent to the drive independently from the NetRef and NetCtrl bits settings.

Byte 1 of the 101 output assembly selects which process data out selection is read back to the EIP scanner. Bytes 4 through 7 of the 101 output assembly are application specific.

Select the multi-purpose application to read data other than what is set as default process data.

Default fieldbus process data out selections 1 through 8 are:

1 = Output frequency (hertz);
2 = Motor speed (rpm);
3 = Motor current (amps);
4 = Motor torque (% of nominal motor torque);
5 = Motor power (% of nominal motor power);
6 = Motor voltage (calculated motor voltage);
7 = DC Bus voltage;
8 = Active fault code.

Multipurpose has a "Fieldbus" group where you reference the FBProcessDataOUT1 through FBProcessDataOUT8 selections. Referring to the 101/107 I/O assembly sheet, bits PDSELx0–PDSELx3 in each "nibble" of byte 1 of output assembly 101 are used to select which FBProcessDataOUT (1–8) you "read" back to your PLC. That is integer 1 through 8 converted to binary Bit 0 through Bit 3. Any parameter or monitored value can be read using the multi-purpose application, as long as it references a specific ID number. Whichever ProcessDataOutput selector used from 1 through 8 dictates what bits are used in byte 1 of the output assembly 101. Values are then sent via input asssembly 107 in bytes 4 and 5 and bytes 6 and 7 respectively. If all PDSELxx values are zero, the "Drive state" will be selected at byte 1 location of 107 assembly.

Speed reference commands for instances 20, 21, 23, 25, and 101 are set up to send the RPM value. This value is sent based off the motor nameplate setting provided in the drive. This would be the direct RPM value written.

Assembly instance 111

Table 77. Instance 111 (output) length = 20 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		NetRef	NetCtrl	FB DATAIN 2	FB DATAIN 1	FaultReset	Direction	Run
1	NA							
2	FBSpeedReference (low byte) ①							
3	FBSpeedReference (high byte) ①							
4	ProcessDataIn1 (LowByte)							
5	ProcessDataIn1 (HighByte)							
6	ProcessDataIn2 (LowByte)							
7	ProcessDataIn2 (HighByte)							
8	ProcessDataIn3 (LowByte)							
9	ProcessDataIn3 (HighByte)							
10	ProcessDataIn4 (LowByte)							
11	ProcessDataIn4 (HighByte)							
12	ProcessDataIn5 (LowByte)							
13	ProcessDataIn5 (HighByte)							
14	ProcessDataIn6 (LowByte)							
15	ProcessDataIn6 (HighByte)							
16	ProcessDataIn7 (LowByte)							
17	ProcessDataIn7 (HighByte)							
18	ProcessDataIn8 (LowByte)							
19	ProcessDataIn8 (HighByte)							

① This is the reference 1 to the frequency converter. Used normally as speed reference. The allowed scaling is 0 to 10000. In the application, the value is scaled in percentage of the frequency area between set minimum and maximum frequency. (0 = 0.00%–10000 = 100.00%).

Input instances

Assembly instance 70

Table 78. Instance 70 (input) length = 4 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0						Running1		Faulted
1								
2	Speed actual (low byte), rpm							
3	Speed actual (high byte), rpm							

Assembly instance 71

Table 79. Instance 71 (input) length = 4 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	AtReference	RefFromNet	CtrlFromNet	Ready	Running2	Running1	Warning	Faulted
1	Drive state ①							
2	Speed actual (low byte), rpm							
3	Speed actual (high byte), rpm							

① Refer "State transition diagram," provided under "Control Supervisor Object" and "Drive State" table specified at end of "Input Instances" section.

Drive State	
0x00	DN_NON_EXISTANT
0x01	DN_STARTUP
0x02	DN_NOT_READY
0x03	DN_READY
0x04	DN_ENABLED
0x05	DN_STOPPING
0x06	DN_FAULT_STOP
0x07	DN_FAULTED

Assembly instance 73

Table 80. Instance 73 (input) length = 6 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	AtReference	RefFromNet	CtrlFromNet	Ready	Running2	Running1	Warning	Faulted
1	Drive state ①							
2	Speed actual (low byte), rpm							
3	Speed actual (high byte), rpm							
4	Torque actual (low byte), Nm							
5	Torque actual (high byte), Nm							

① See note 1 from **Table 79**.

Assembly instance 75

Table 81. Instance 75 (input) length = 6 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	AtReference	RefFromNet	CtrlFromNet	Ready	Running2	Running1	Warning	Faulted
1	Drive state ①							
2	Speed actual (low byte), rpm							
3	Speed actual (high byte), rpm							
4	Process actual (low byte), Nm ②							
5	Process actual (high byte), Nm							

① See note 1 from **Table 79**.
② Process actual value is same as process reference. This value will be a 0 to 10,000 (100.00%) for use with analog outputs writing, 0 = 0 or 4 mA and 10,000 being 20 mAs.

Assembly instance 107

Table 82. Instance 107 (input) length = 8 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	AtReference	RefFromNet	CtrlFromNet	Ready	Running2	Running1	Warning	Faulted
1	Drive state/Processdata selector value (if pd selector is used) ①							
2	% Speed actual (low byte) ②							
3	% Speed actual (high byte) ②							
4	Process DataOut1 (low byte)							
5	Process DataOut1 (high byte)							
6	Process DataOut2 (low byte)							
7	Process DataOut2 (high byte)							

① See note 1 from **Table 79**.
② Speed actual. This is the actual value from the frequency converter. The value is between 0 and 10,000. In the application, the value is scaled in percentage of frequency area between set minimum and maximum frequency. (0 = 0.00%–10,000 = 100.00%).

Note: See info on assembly 101 for varying values in the process data out 1 and process data out 2 bytes. See **Appendix B** on default process data info.

Assembly instance 117

Table 83. Instance 117 (input). EIP drive status length = 34 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	CtrlFromNet	At zero speed	AtReference	Alarm/warning	faulted	Direction	Running	Ready
1	NA							
2	% Speed actual (low byte) ①							
3	% Speed actual (high byte) ①							
4	RPM speed actual (low byte) ②							
5	RPM speed actual (high byte) ②							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							
16	Reserved							
17	Reserved							
18	ProcessDataOut1 (LowByte)							
19	ProcessDataOut1 (HighByte)							
20	ProcessDataOut2 (LowByte)							
21	ProcessDataOut2 (HighByte)							
22	ProcessDataOut3 (LowByte)							
23	ProcessDataOut3 (HighByte)							
24	ProcessDataOut4 (LowByte)							
25	ProcessDataOut4 (HighByte)							
26	ProcessDataOut5 (LowByte)							
27	ProcessDataOut5 (HighByte)							
28	ProcessDataOut6 (LowByte)							
29	ProcessDataOut6 (HighByte)							
30	ProcessDataOut7 (LowByte)							
31	ProcessDataOut7 (HighByte)							
32	ProcessDataOut8 (LowByte)							
33	ProcessDataOut8 (HighByte)							

① This is the actual value from the frequency converter. The value is between 0 and 10,000. In the application, the value is scaled in percentage of frequency area between set minimum and maximum frequency. (0 = 0.00%–10,000 = 100.00%).

② The RPM speed actual is the actual speed of the motor. The unit is RPM.

Note: See **Appendix B** for process data value defaults.

Assembly instance 127

Table 84. Instance 127 (input). EIP drive status length = 20 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	CtrlFromNet	At zero speed	AtReference	Alarm/warning	faulted	Direction	Running	Ready
1	NA							
2	% Speed actual (low byte) ①							
3	% Speed actual (high byte) ①							
4	ProcessDataOut1 (LowByte)							
5	ProcessDataOut1 (HighByte)							
6	ProcessDataOut2 (LowByte)							
7	ProcessDataOut2 (HighByte)							
8	ProcessDataOut3 (LowByte)							
9	ProcessDataOut3 (HighByte)							
10	ProcessDataOut4 (LowByte)							
11	ProcessDataOut4 (HighByte)							
12	ProcessDataOut5 (LowByte)							
13	ProcessDataOut5 (HighByte)							
14	ProcessDataOut6 (LowByte)							
15	ProcessDataOut6 (HighByte)							
16	ProcessDataOut7 (LowByte)							
17	ProcessDataOut7 (HighByte)							
18	ProcessDataOut8 (LowByte)							
19	ProcessDataOut8 (HighByte)							

① This is the actual value from the frequency converter. The value is between 0 and 10,000. In the application, the value is scaled in percentage of frequency area between set minimum and maximum frequency. (0 = 0.00%–10,000 = 100.00%).

Note: See **Appendix B** for process data value defaults.

Table 85. Instance 128 (input). EIP drive status length = 20 bytes.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	AtReference	RefFromNet	CtrlFromNet	Ready	Running2	Running1	Warning	Faulted
1	Drive state							
2	% Speed actual (low byte) ①							
3	% Speed actual (high byte) ①							
4	ProcessDataOut1 (LowByte)							
5	ProcessDataOut1 (HighByte)							
6	ProcessDataOut2 (LowByte)							
7	ProcessDataOut2 (HighByte)							
8	ProcessDataOut3 (LowByte)							
9	ProcessDataOut3 (HighByte)							
10	ProcessDataOut4 (LowByte)							
11	ProcessDataOut4 (HighByte)							
12	ProcessDataOut5 (LowByte)							
13	ProcessDataOut5 (HighByte)							
14	ProcessDataOut6 (LowByte)							
15	ProcessDataOut6 (HighByte)							
16	ProcessDataOut7 (LowByte)							
17	ProcessDataOut7 (HighByte)							
18	ProcessDataOut8 (LowByte)							
19	ProcessDataOut8 (HighByte)							

① This is the actual value from the frequency converter. The value is between 0 and 10,000. In the application, the value is scaled in percentage of frequency area between set minimum and maximum frequency. (0 = 0.00%–10,000 = 100.00%).

BACnet MS/TP - on-board communication

BACnet stands for Building Automation and Control Networks. It is the common name for the communication standard ISO 16484-5 which defines the methods and the protocol for cooperating building automation devices to communicate. Devices can be designed to operate using BACnet communication protocol as well as utilizing BACnet protocol to communicate between systems. BACnet is an internationally accepted protocol for building automation (such as lightning control, air conditioning and heating automation) and control over a communications network. BACnet provides a method by which computer-based control equipment, from different manufacturers can work together, or "interoperate." For this to be achieved, components must be able to exchange and understand BACnet data messages. Your drive is equipped with BACnet support as standard.

BACnet MS/TP specifications

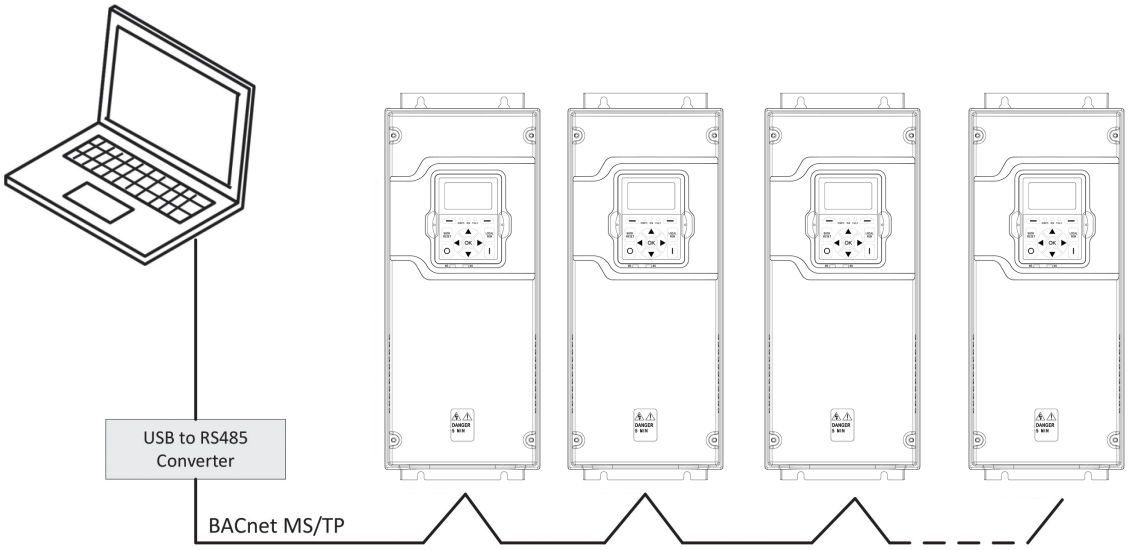
Table 86. BACnet MS/TP technical data.

Item	Description
Interface	RS-485
Data transfer method	RS-485, half-duplex
Transfer cable	STP (shielded twisted pair), type Belden or similar
Connection: Electrical isolation	Communication: functional
Connection: BACnet MS/TP	Communication: As described in ANSI/ ASHRAE Standards 135-2012
Connection: Baud rate	Communication: 9,600, 19,200, 38,400, 76,800, 115,200

BACnet MS/TP connections

The control board is located inside the control unit of the drive.

Figure 10. Principal example diagram.



Prepare for use through MS/TP

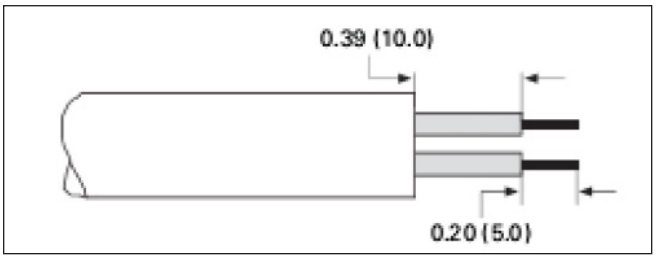
1. Open the cover of the AC drive.

⚠ WARNING

The relay outputs and other I/O-terminals may have a dangerous control voltage present even when drive is disconnected from mains.

2. Locate the components that you will need on the drive to connect and run the BACnet cables.
3. Strip about 0.59 in. (15 mm) of the RS-485 cable and cut off the grey cable shield. Remember to do this for both bus cables (except for the last device). Leave no more than 0.39 in. (10 mm) of the cable outside the terminal block and strip the cables at about 0.20 in. (5 mm) to fit in the terminals. See Figure below.

Figure 11. Stripping the cable.

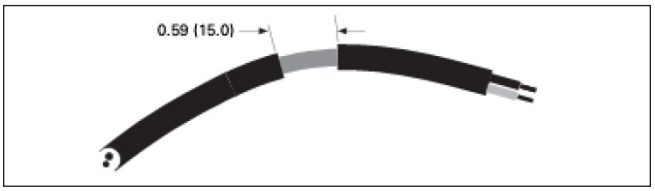


Also strip the cable now at such a distance from the terminal that you can fix it to the frame with the grounding clamp. Strip the cable at a maximum length of 0.59 in. (15 mm).

⚠ IMPORTANT

Do not strip the aluminum cable shield!

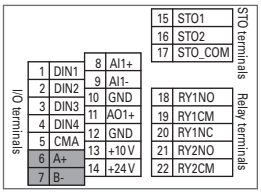
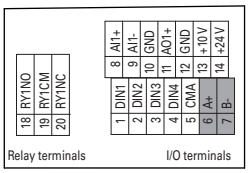
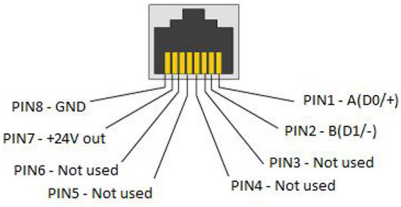
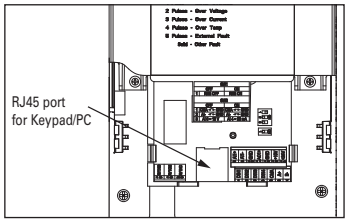
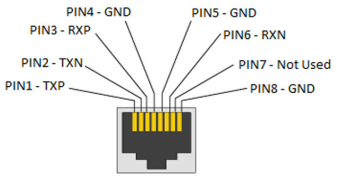
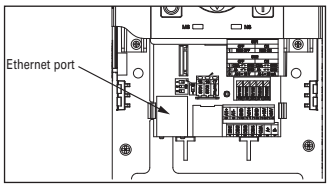
Figure 12. RS-485 cable strip (aluminum shield).



4. Then connect the cable to its appropriate terminals on the drive standard terminal block, terminals A and B (A = positive, B = negative). See table that follows

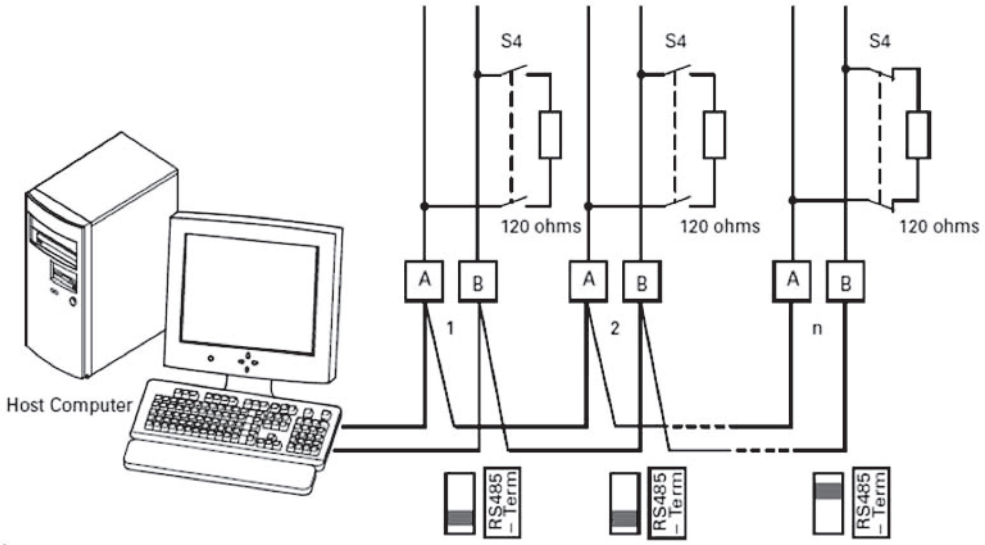
Connection options

Table 87. Connection options - main keypad.

Connection method	Port	Upgrade firmware	Connects to PC tool	Communication settings
RS-485	Modbus serial terminals	✓	✓	DM1 PRO  DM1 
				RS-485 Comm Set: Settable in RS-485 communication parameter group. (Default modbus RTU). **Note:** If set to BACnet MSTP, PC Tool will not communicate.
				Slave address: Settable in RS-485 communication parameter group (Default 1).
				Baud rate: Settable in RS-485 communication parameter group (Default 19,200).
				Parity: Settable in RS-485 communication parameter group (Default even).
				Data bits: Not settable, 8 data bit.
				Stop bits: Not settable, 1 stop bit.
	Keypad port	✓	✓	 
				Slave address: Not settable, set to modbus ID 18.
				Baud rate: Not settable, set to 38,400 Kbaud.
				Parity: Not settable, set to even.
				Data bits: Not settable, 8 data bit.
				Stop bits: Not settable, 1 stop bit.
Ethernet	Ethernet port	---	✓	 **DM1 PRO Only** 
				IP address mode: Settable in ethernet communication parameter group. (Default Static IP). **Note:** Most facilities require a static IP. Change the static IP address before changing. After changing this parameter, a reset or power cycle is required.
				Active IP address: Set depending on IP address assigned static or DHCP.
				Active subnet mask: Set depending on IP address assigned static or DHCP.
				Active default gateway: Set depending on IP address assigned static or DHCP.
				Static IP address: Settable in ethernet communication parameters group. (Default 192.168.1.254).
				Static subnet mask: Settable in ethernet communication parameters group. (Default 255.255.255.0).
				Static default gateway: Settable in ethernet communication parameters group. (Default 192.168.1.1).

5. Using the cable clamp included in the delivery of the drive, ground the shield of the RS-485 cable to the frame of the AC drive.

Figure 13. Serial ground..



6. If the drive is the last device on the bus, the bus termination must be set. Locate the DIP switches to the right of the control keypad of the drive and turn the switch for the RS-485 bus termination resistor to position ON. Biasing is built in the termination resistor. See also Step 8 that follows.

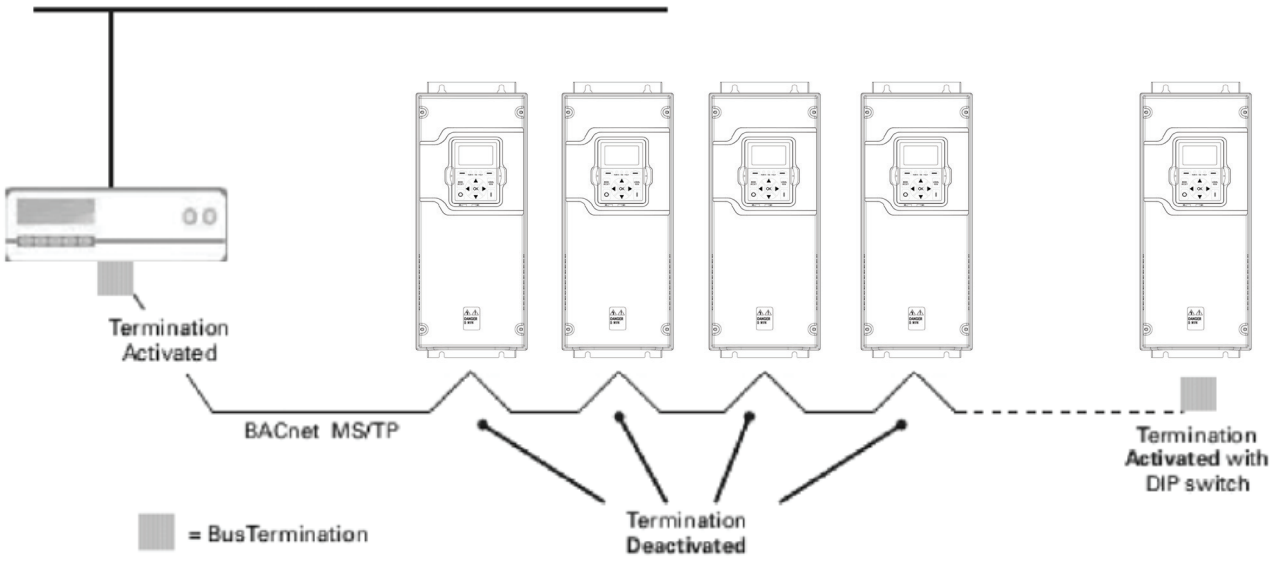
7. Remount the AC drive cover.

Note: When planning the cable runs, remember to keep the distance between the fieldbus cable and the motor cable at a minimum of 11.81 in. (30 cm).

8. The bus termination must be set for the first and last device of the fieldbus line. See illustration below. See also previous Step 6. We recommend that the first device on the bus terminated is the master device.

BACnet MS/TP bus termination

Figure 14. BACnet bus termination.



Commissioning

1. First ensure that the right fieldbus protocol is selected.

Navigate:
Main Menu ⟶ Parameter ⟶ Communication ⟶ RS485 Bus ⟶ RS-485 Comm Set ⟶ Edit ⟶
(Choose Protocol as BACnet MS/TP)

BACnet MS/TP parameters and monitoring values

Table 88. BACnet MS/TP parameter table.

P11.1 - Basic settings.					
P11.1.1①	***Serial communication***				**ID 586**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Modbus RTU 1 = BACnet MSTP (*DM1 Pro) 2 = SWD (*DM1 Pro).				
Description:	This parameter defines the communication protocol for RS-485. When this parameter is set, it will cause drive to reset.				

P11.3 - BACnet MSTP.					
P11.3.1①	***MSTP baud rate***				**ID 594**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	2
Options:	0 = 9,600; 1 = 19,200; 2 = 38,400; 3 = 76,800; or 4 = 115,200.				
Description:	This parameter defines the communication speed for BACnet MSTP network.				
P11.3.2①	***MSTP device address***				**ID 595**
Minimum value:	0	**Maximum value:**	127	**Default value:**	1
Description:	Defines the device address of the drive on the BACnet MSTP network.				
P11.3.3①	***MSTP instance number***				**ID 596**
Minimum value:	0	**Maximum value:**	4,194,302	**Default value:**	0
Description:	Defines the instance number of the drive on the BACnet MSTP network.				
P11.3.4	***MSTP communication timeout***				**ID 598**
Minimum value:	0.00 ms	**Maximum value:**	60,000.00 ms	**Default value:**	10,000.00 ms
Description:	Selects the time to wait before a communication fault occurs over BACnet MSTP if a message is not received. Setting this to 0 will mask the fault.				
P11.3.5	***MSTP protocol status***				**ID 599**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Options:	0 = Stopped; 1 = Operational; or 2 = Faulted.				
Description:	This parameter shows the protocol status for BACnet MSTP communication.				
P11.3.6	***MSTP fault code***				**ID 600**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Options:	0 = None; or 1 = Sole master.				
Description:	This parameter shows the protocol status for BACnet MSTP communication.				

Table 88. BACnet MS/TP parameter table (Cont.).

P11.3.7	***MSTP fault response***				**ID 2526**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Only in fieldbus control mode - when fieldbus is the control place and fieldbus fault is active, the drive will fault on loss of communications. If not in fieldbus control, the drive will not fault. 1 = In all control modes - no matter the control place setting. If communication is lost, fieldbus fault response will occur.				
Description:	Defines the fieldbus fault condition for BACnet MSTP communication.				
P11.3.8	***MSTP maximum master***				**ID 1537**
Minimum value:	1	**Maximum value:**	127	**Default value:**	127
Description:	Defines the maximum number of masters that can establish connections with the drive.				

BACnet MS/TP parameters

Baud rate

Select the communication speed for the network. The default value is 38,400 baud.

MAC address

The parameters of every device must be set before connecting to the bus. Especially the parameters MAC (Medium Access Control) address and baud rate must be the same as in the master's configuration. The first parameter, MAC address, must be unique on the network to which it is connected. The same MAC address may be used on a device on another network within the internetwork. Addresses 128 - 254 are reserved for slaves. Addresses 1 - 127 are valid for both masters and slaves. The portion of the address space that is actually used for masters in a particular installation is determined by the value of the Max_Master property of the device object. It is recommended that MAC address 0 be reserved for the MS/TP router and MAC address 255 is used for broadcasts.

Instance number

The device object's instance number is used in conjunction with the MAC address to assign the devices on the network. The instance number can have up to 127 nodes on it before a different instance number is required.

Communication time-out

BACnet board initiates a communication error if the board is a "sole master" in the network for a time defined with this parameter. When set to 0 it will mask this fault.

BACnet overview

BACnet technical data

Protocol implementation conformance statement (PICS)

Controller profile

- B—ASC

Segmentation capability

- Not supported

Data link layer and routing options

- MS/TP master baud rates (9,600, 19,200, 38,400, 76,800, 115,200)

Character sets supported

- UTF8

BIBBS supported

- Data sharing
  - ReadProperty—B
  - ReadPropertyMultiple—B
  - WriteProperty—B
  - WritePropertyMultiple—B
  - COV—B
- Device management
  - Dynamic device binding—B
  - Dynamic object binding—B
  - DeviceCommunicationControl—B
  - ReinitializeDevice—B
- Alarms and events: Not supported
- Schedules: Not supported
- Trends: Not supported
- Network management: Not supported

Table 89. Supported object types and properties summary.

Property	Device object type	Analog input object type	Analog value object type	Binary value object type	Multiple state value object type
Acked_Transitions					
Active_Cov_Subscriptions	X				
Active_Text				X	
Active_Vt_Sessions					
Alarm_Value					
Alarm_Values					
Align_Intervals					
Apdu_Segment_Timeout					
Apdu_Timeout	X				
Application_Software_Version	X				
Auto_Slave_Discovery					
Backup_And_Restore_State					
Backup_Failure_Timeout					
Backup_Preparation_Time					
Change_Of_State_Count					
Change_Of_State_Time					
Configuration_Files					
Cov_Increment		X	X		
Database_Revision	X				
Daylight_Savings_Status					
Deadband					
Description	X	X	X	X	X
Device_Address_Binding	X				
Device_Type					
Elapsed_Active_Time					
Event_Algorithm_Inhibit					
Event_Algorithm_Inhibit_Ref					
Event_Detection_Enable					
Event_Enable					
Event_Message_Texts					
Event_Message_Texts_Config					
Event_State		X	X	X	X
Event_Time_Stamps					
Fault_Values					
Firmware_Revision	X				
High_Limit					
Inactive_Text				X	
Interval_Offset					
Last_Restart_Reason					
Last_Restore_Time					
Limit_Enable					
Local_Date					

Table 89. Supported object types and properties summary (Cont.).

Property	Device object type	Analog input object type	Analog value object type	Binary value object type	Multiple state value object type
Local_Time					
Location					
Low_Limit					
Manual_Slave_Address_Binding					
Max_Apdu_Length_Accepted	X				
Max_Info_Frames	X				
Max_Master	X				
Max_Pres_Value					
Max_Segments_Accepted					
Min_Pres_Value					
Minimum_Off_Time					
Minimum_On_Time					
Model_Name	X				
Notification_Class					
Notify_Type					
Number_Of_Apdu_Retries	X				
Number_Of_States					X
Object_Identifier	X	X	X	X	X
Object_List	X				
Object_Name	X	X	X	X	X
Object_Type	X	X	X	X	X
Out_Of_Service		X	X	X	X
Password ①	X				
Present_Value		X	X	X	X
Priority_array			X	X	
Profile_Name	X				
Property_List	X	X	X	X	X
Protocol_Object_Types_supported	X				
Protocol_Revision	X				
Protocol_Services_Supported	X				
Protocol_Version	X				
Reliability					
Reliability_Evaluation_Inhibit					
Relinquish_Default			X	X	
Resolution					
Restart_Notification_Recipients					
Restore_Completion_Time					
Restore_Preparation_Time					
Segmentation_Supported	X				
Serial_Number	X				
Slave_Address_Binding					
Slave_Proxy_Enable					

Table 89. Supported object types and properties summary (Cont.).

Property	Device object type	Analog input object type	Analog value object type	Binary value object type	Multiple state value object type
State_Text					X
Status_Flags		X	X	X	X
Structured_Object_list					
System_Status	X				
Time_Delay					
Time_Delay_Normal					
Time_Of_Active_Time-reset					
Time_Of_Device_Restart					
Time_Of_State_Count_Reset					
Time_Synchronization_Interval					
Time_Synchronization_Recipients					
Units		X	X		
Update_Interval					
Utc_Offset					
Utc_Time_Synchronization_Recipients					
Vendor_Identifier	X				
Vendor_Name	X				
Vt_Classes_Supported					

① Password is a vendor specific property added to device object with property identifier as 600. Default value of password is empty string; this is a writable property with maximum length of 20, it always returns ***** on read. Same password will be used for Reinitialize Device Service and Device communication control service.

Object instance summary

Binary value object instance summary

The following table summarizes the binary value objects supported.

Table 90. Binary value object instance summary.

Instance ID	Object name (related to drive parameter)	Description	Inactive/active text	Preset value access
BV0	Ready state (Ready state)	Indicates whether the drive is ready or not.	Not ready/ready	R
BV1	Run/stop state (Drive running)	Indicates whether the drive is running or stopped.	Stop/run	R
BV2	Fwd./rev. state	Indicates the rotation direction of motor.	Fwd./rev.	R
BV3	Fault state	Indicates if a fault is active.	OK/fault	R
BV4	Warning state	Indicates if a warning is active.	OK/warning	R
BV5	At setpoint (At setpoint)	Ref. frequency reached.	False/true	R
BV6	At zero speed	Motor running at zero speed.	False/true	R
BV7	Motor ctrl source	Command to change active source for controlling motor .	LocalMotorCtrl / FBMotorCtrl	C
BV8	Speed reference source	Command to change source of motor speed reference.	LocalSpeedRef / FBSpeedRef	C
BV9	Run/stop CMD (Run/stop CMD)	Command to start drive.	Stop/run	C
BV10	Fwd./rev. CMD (Fwd/rev CMD)	Command to change rotational direction.	Fwd./rev.	C
BV11	Reset fault (Reset drive fault)	Command to reset active fault from drive.	0/reset	C
BV12	Digital input 1	Digital input 1.	OFF/ON	R
BV13	Digital input 2	Digital input 2.	OFF/ON	R
BV14	Digital input 3	Digital input 3.	OFF/ON	R
BV15	Digital input 4	Digital input 4.	OFF/ON	R
BV16	Digital input 5	Digital input 5.	OFF/ON	R
BV17	Digital input 6	Digital input 6.	OFF/ON	R
BV18	Digital input 7	Digital input 7.	OFF/ON	R
BV19	Digital input 8	Digital input 8.	OFF/ON	R
BV20	Digital output 1	Digital output 1.	OFF/ON	R
BV21	Digital output 2	Relay 1 output.	OFF/ON	R
BV22	Digital output 3	Relay 2 output.	OFF/ON	R
BV23	Digital output 4	Relay 3 output.	OFF/ON	R
BV24	Stop by coast	Indicates if drive stop by coast.	ON/OFF	C
BV25	Stop by ramp	Indicates if drive stop by ramp	OFF/ON	C
BV26	Belt broken	Indicates if belt is broken.	OFF/ON	R
BV27	Drive fan failure	Indicates if drive fan failed.	OFF/ON	R
BV28	Force bypass	Command to take drive in bypass mode.	OFF/ON	C
BV29	Fire mode	Enable fire mode.	OFF/ON	C
BV30	DIN 1	Fieldbus digital input.	OFF/ON	C
BV31	DIN 2	Fieldbus digital input.	OFF/ON	C
BV32	DIN 3	Fieldbus digital input.	OFF/ON	C
BV33	DIN 4	Fieldbus digital input.	OFF/ON	C

Note: For present value access types: R = Read-only; W = Writeable; and C = Commandable.

Commandable values support priority arrays and relinquish defaults.

Analog value object instance summary

The following table summarizes the analog value objects supported.

Table 91. Analog value object instance summary.

Instance ID	Object name	Description	Units	Preset value access
AV0	Speed reference (Reference command)	Motor speed reference from network	Percent	C
AV1	Current limit	Current limit	Amps	W
AV2	Minimum frequency	Minimum frequency	Hz	W
AV3	Maximum frequency	Maximum frequency	Hz	W
AV4	Accel. time 1 (Accel time)	Acceleration time	Seconds	W
AV5	Decel. time 1 (Decel time)	Deceleration time	Seconds	W
AV6	AnyParam ID	Parameter ID number to be accessed	No units	W
AV7	AnyParam value	Value of parameter defined by AV6	No units	W
AV8	Process data In 1	Fieldbus process data In 1	NA	C
AV9	Process data In 2	Fieldbus process data In 2	NA	C
AV10	Process data In 3	Fieldbus process data In 3	NA	C
AV11	Process data In 4	Fieldbus process data In 4	NA	C
AV12	Process data In 5	Fieldbus process data In 5	NA	C
AV13	Process data In 6	Fieldbus process data In 6	NA	C
AV14	Process data In 7	Fieldbus process data In 7	NA	C
AV15	Process data In 8	Fieldbus process data In 8	NA	C

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays and relinquish defaults.

Table 92. Analog Input object instance summary.

Instance ID	Object name	Description	Units	Preset value access
AI0	Frequency setpoint (Speed setpoint)	Frequency setpoint	Hz	R
AI1	Output frequency (Output frequency)	Output frequency	Hz	R
AI2	Motor speed (Motor speed)	Motor speed	rpm	R
AI3	Motor load	Motor load	Percent	R
AI4	Kilowatt hours total (Kilowatt hours total)	Kilowatt hour counter (total) scaled by 1000	KWh	R
AI5	Motor current	Motor current	Amps	R
AI6	DC link voltage (DC link voltage)	DC link voltage	Volts	R
AI7	Motor voltage (Motor voltage)	Motor voltage	Volts	R
AI8	Unit temperature (Unit temperature)	Heat sink temperature	°C	R
AI9	Motor torque (Motor torque)	In % of motor nominal torque	Percent	R

Table 92. Analog Input object instance summary (Cont.).

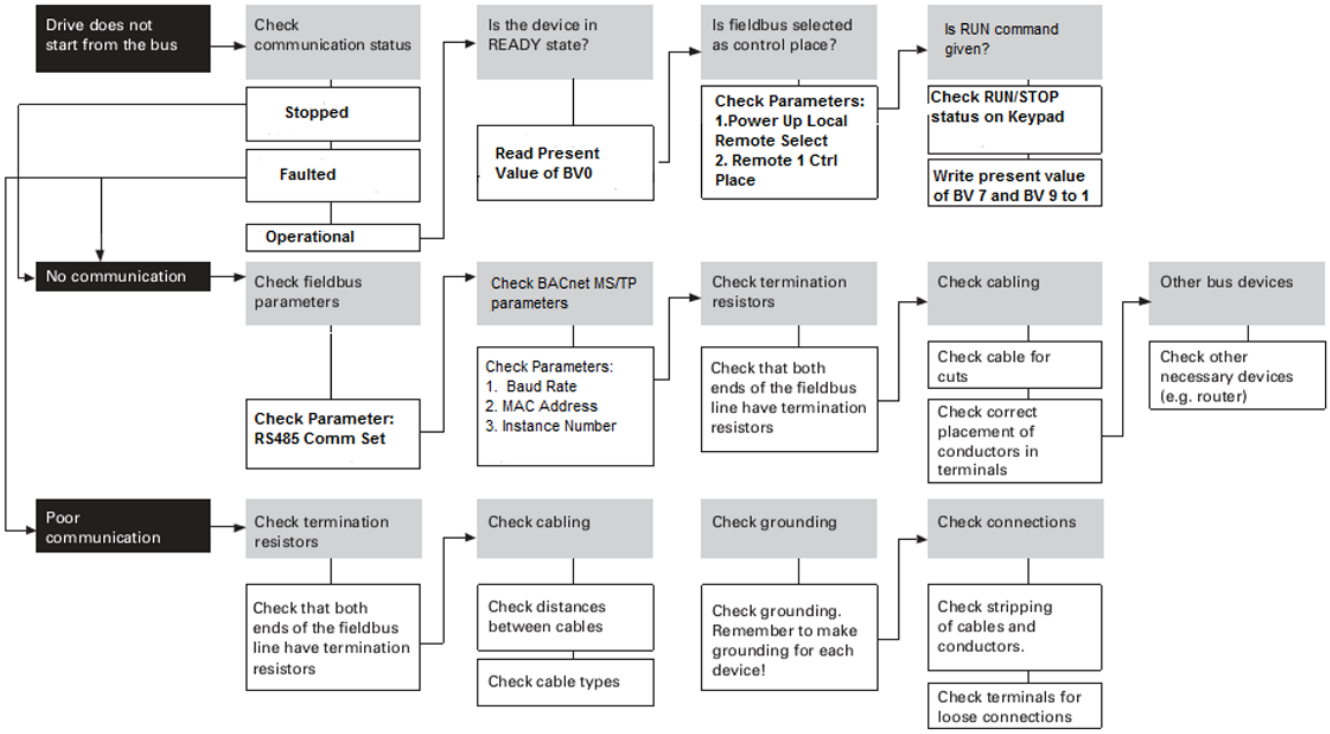
Instance ID	Object name	Description	Units	Preset value access
AI10	Operating days (Operating days)	Operating days (resettable)	Day	R
AI11	Operating hours (Operating hours)	Operating hours (resettable)	Hour	R
AI12	Motor temperature	Motor temperature	Percent	R
AI13	Analog input 1	Analog input 1	Volts	R
AI14	Analog input 2	Analog input 2	Volts	R
AI15	Analog output 1	Analog output 1	Volts	R
AI16	Analog output 2	Analog output 2	Volts	R
AI17	Kilowatt instantaneous	Kilowatt instantaneous	KW	R
AI18	Process data out 1	Fieldbus process data out 1	NA	R
AI19	Process data out 2	Fieldbus process data out 2	NA	R
AI20	Process data out 3	Fieldbus process data out 3	NA	R
AI21	Process data out 4	Fieldbus process data out 4	NA	R
AI22	Process data out 5	Fieldbus process data out 5	NA	R
AI23	Process data out 6	Fieldbus process data out 6	NA	R
AI24	Process data out 7	Fieldbus process data Out 7	NA	R
AI25	Process data out 8	Fieldbus process data out 8	NA	R
AI26	Frequency setpoint %	Frequency reference percent	Percent	R

Note: Line length depends on different transmission speeds.

Table 93. Multi state object instance summary.

Instance ID	Object name	Description	State text	Preset value access
MV0	Control mode	Indicates the drive control mode - local, remote or off	0 = Local (hand); 1 = Remote 2 = Off	R
MV1	Active fault code (Fault code)	Indicates the latest active fault code of the drive	Description of all fault codes 255 - no faults	R

Figure 15. Fault tracing



PROFIBUS-DP external communication cards

PowerXL series can be connected to the PROFIBUS® DP using an optional PROFIBUS communication card. PowerXL series drive can be controlled, monitored, and programmed from the host system. The devices are connected in a bus structure. There is a maximum of 32 stations (master or slave) can be connected to one segment bus. The bus is terminated at beginning and end of each segment. To ensure error-free operation, both bus terminations must always be powered, if more than 32 stations are used, repeaters are required.

PROFIBUS specifications

Table 96. PROFIBUS technical data.

Items	Value
Terminal	DB9 connector (female) or 5.00 mm connector (male)
Data transfer method	RS-485 half-duplex
Cable	Twisted pair (1 pair and shield)
Isolation	500 Vdc
Protocol	PROFIBUS-DP-V1
DOIO type	ST1 telegram
Baud rate	9.6K~12M
Addresses	2~125
Environment	
Ambient operating temperature	–10°C to +55°C
Storing temperature	–40°C to +60°C
Humidity	<95%, no condensation allowed
Altitude	Maximum 1000 m
Vibration	0.5 G at 9 - 200 Hz
Safety	Fulfills EN 50178 standard

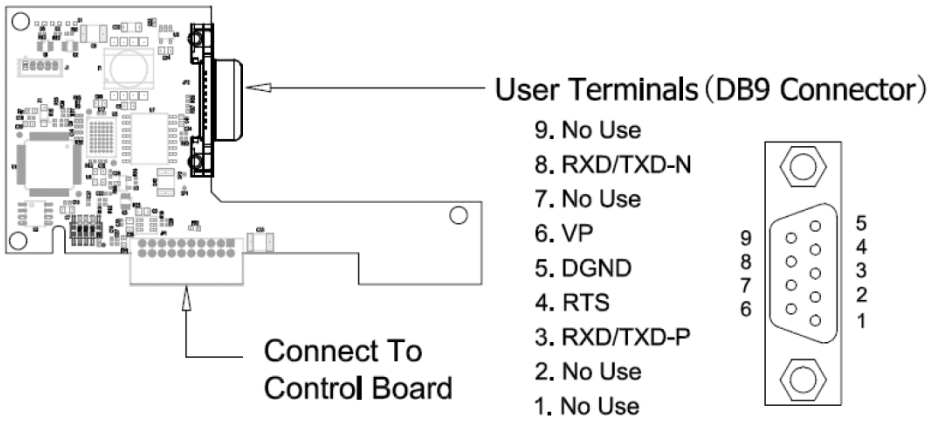
Table 97. Line length.

Baud rate (kbit/s)	9.6	19.2	93.75	187.5	500	1,500	3,000–12,000
Length line A [m]	1,200	1,200	1,200	1,000	400	200	100
Length line B [m]	1,200	1,200	1,200	600	200	—	—

Note: Line length depends on different transmission speeds.

Hardware specifications

Figure 16. Com1 PROFIBUS card layout.



LEDs

PROFIBUS LEDs are as stated below.

Table 98. PROFIBUS LEDs.

ON (GREEN, the left one)	BF (RED, the middle one)	SF (RED, the right one)	Fault condition
Blinking	Blinking	Blinking	Board Initialization
ON	OFF	OFF	Everything OK
ON	ON	OFF	No communication
ON	Blinking	OFF	Communication, but not in data exchange
ON	ON	ON	No communication and system fault
ON	OFF	ON	Communication and system fault

Connector On-Board

Use DB-9 connector, pin assignment as below.

Figure 17. DB-9 pin assignment.

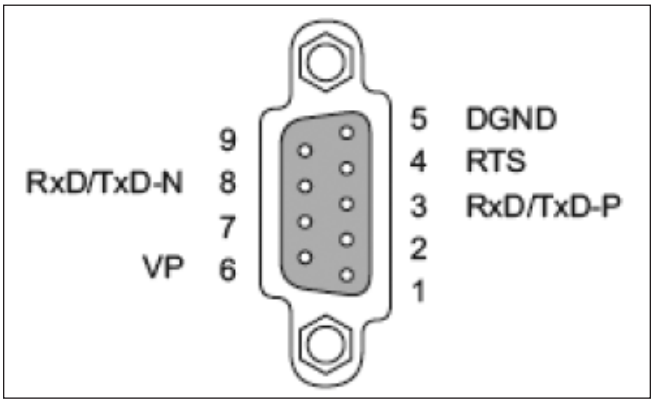


Table 99. Connector and pin assignment.

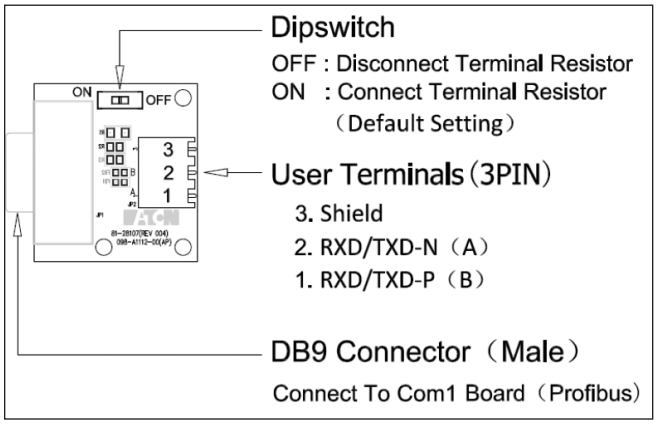
Pin number	Purpose
Housing	Shield, connected to PE
1	No use (or shield, shield or protect GND)
2	No use (or M24, minus 24 V output Voltage)
3	RXD/TXD-P, positive of receive or Transmit signal
4	RTS, request to send
5	DGND, GND of signal (isolated GND from RS-485 side
6	VP, +5 V, (voltage- plus, isolated 5 V from RS-485 side)
7	No use (or P24, plus 24 V output voltage)
8	RXD/TXD-N, negative of receive or transmit signal
9	No use (or CNTR_N, control-N)

Use 5.0 mm connector and pin assignment.

Connector on customer side

Customer side connector for DB9.

Figure 18. Com1 PROFIBUS DB9 adapter.



PROFIBUS cable

Two types of cables can be used for PROFIBUS connection.

Table 100. PROFIBUS cable connections.

Parameter	Line A	Line B
Impedance	135–165 Ω (3–20 MHz)	100–130 Ω (f >100 kHz)
Capacity	<30 pF/m	<60 pf/m
Resistance	<100 Ω/km	—
Wire gauge	>0.64 mm	>0.53 mm
Conductor area	>0.34 mm^2	>0.22 mm^2

Table 101. Recommended cable.

Cable	Description	Part Number
Belden	PROFIBUS data cable	**3079A**
Olflex	PROFIBUS cable	**21702xx**
Siemens	SINEC L2 LAN cable for PROFIBUS	**6XV1830 = 0AH0**

Commissioning

The PROFIBUS board is commissioned by inserting it into the Slot A or Slot B on the drive control board. Once the card is inserted to the slot, the device will recognize it and will show a warning for "Device Added." This warning will be shown for 5 seconds and will be cleared. Once the card is detected, the keypad will show the menu for this card in Optional Card Menu.

Optional comm cards parameters

Once the card is detected, following parameters can be set on keypad for the PROFIBUS.

Table 102. PROFIBUS parameters.

DM1 code	Parameter	Min.	Max.	Unit	Default	ID	Note
2.1	Monitor						
2.1.1	Device parameters						
2.1.1.1	Board status				0	883	B0 = Optional comm. card fault B1 = Board HW fault B2 = Reserved B3 = Fieldbus fault B4 = Reserved
2.1.1.2	Firmware version					1064	V2.00.0007
2.1.1.3	Protocol status				0	2131	B0 = Waiting for parameterization B1 = Parameterization fault B2 = Waiting for configuration B3 = Configuration fault B4 = Data exchange
2.1.1.4	PDP-Telegram selection	1	1		1	1244	1 = Standard telegram 1
2.1.1.5	Fault counter PDP	0	65535				
2.1.1.6	Fault situations max.				8x8		
2.1.1.7	PDP-Profile number				341		
2.1.1.8	PDP-Control word	0x0000	0xFFFF				
2.1.1.9	PDP-Status word	0x0000	0xFFFF				
2.1.2	Parameter access						
2.1.2.1	PDP-MaxBlockLength				30		
2.1.2.2	PDP-NoOfMultiparameter				1		
2.1.2.3	PDP-MaxLatency				2		
2.1.3	DO identification						
2.1.3.1	PDP-DO manufacturer				0x019D		
2.1.3.2	PDP-DO device type				0x3029		
2.1.3.3	PDP-DO FW-Interface						
2.1.3.4	PDP-DO FW-Year						
2.1.3.5	PDP-DO FW-DayMonth						
2.1.3.6	PDP-DO NoOfDOs				1		
2.1.3.7	PDP-DO subclass				1		
2.2	Parameters						
2.2.1	Slave address	2	125		118	1242	Address of the PROFIBUS slave
2.2.2	Operation mode	1	2		1	1245	Operation Mode 0 = PROFIdrive 1 = Echo 2 = Bypass
2.2.3	Parameter access	0	1		1		0=Local control; 1=Fieldbus
2.2.4	Process data access	0	5		1		0=Local control; 1=Fieldbus; 2=NET control, local ref.; 4=NET, local on fault; 5=NET & local CMD;
2.2.5	Fault situation counter						
2.2.6	Parameter sets					619	

The parameters of every device must be set before connecting to the bus. Especially the parameters "slave address" must be same as set in master.

PROFIBUS—PowerXL series

General

Data transfer between PROFIBUS-DP master and slave takes place via the input/output data field. The master writes to slave's output data and the slave answers by sending the contents of its inputs data to master. The content of the input/output data is defined in the device profile. The device profile for drives is PROFIdrive.

The drive can be controlled by PROFIBUS-DP master using ST1 telegram of the PROFIdrive profile using the ST1 standard telegram in Drive profile mode, or using other modules in bypass mode. The modules where process data values are returned can be used via the bypass operation mode. When fieldbus has been selected as the active control place, the drive operation is controlled from PROFIBUS-DP master as long as PNU927 = 1 and PNU928 = 1 by default. When these bits are disabled, it only allows monitoring values via cyclic and acyclic commands.

Operation mode

The parameter operation mode BX.2.4 above defines how the input/output data is handled on the option board.

PROFIdrive

Data transfer follows the document PROFIBUS profile for variable speed drives, PROFIdrive following the standard telegram 1.

Echo

The OUTPUT data written by the master is echoed back to the master in the INPUT field.

The data is not shown in the drive, but echoing is carried out on the option board.

This mode can be used when the function of the bus connection is tested.

Bypass

The information of the process data field is transferred to the application interface without handling.

The desired modules define the amount of data that is transferred. Once drive is set in bypass mode, it will give the ability to set the desired module.

PowerXL PROFIdrive interface

PowerXL has PROFIdrive profile 4.1, which allows:

- Direct control of the drive using PROFIBUS master; and
- Full access to all drive parameters.

Control word and status word

The control word and status word used when in bypass mode using one of the four modules will follow the layout used in Modbus for the CW, SW, Ref. Speed, ACT. Speed, and FB data points.

Control word

PowerXL series drive uses 16 bits as shown in the following table. These bits are application specific.

Table 103. Binary bits and corresponding outputs.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
①	①	①	①	①	①	FB Ref	FB Ctrl	BYS	FB DIN 4	FB DIN 3	FB DIN 2	FB DIN 1	F_RST	DIR	RUN

① The bit is not used.

FB general control word

The drive does not use the FB general control word. The main control word is used to provide commands to the drive.

Table 104. FB control word.

Bit	Description value = 0	Value = 1
0	Drive output off	Drive output on
1	Clockwise rotation	Counter-clockwise
2	No reset	Fault reset
3	FB INDATA1 Off	FB INDATA1 On
4	FB INDATA2 Off	FB INDATA2 On
5	FB INDATA3 Off	FB INDATA3 On
6	FB INDATA4 Off	FB INDATA4 On
7	Bypass relay disable	Bypass relay enable
8	FB control off	FB control on
9	FB reference off	FB reference on
10–15	Not in use	Not in use

Table 105. Speed reference.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is the reference 1 to the VFD. Used normally as speed reference.

The scaling on this value is 0 - 100.00% of the maximum frequency (P1.2). The 0 to 100.00% is represented by 0 to 10,000 value indicating 0 or 0% as minimum frequency (P1.1) and 10,000 or %100.00 as maximum frequency (P1.2). This value has two decimal places in it.

Process data in 1 to 8

Process data in values 1 to 8 can be used in applications for various purposes.

Table 106. Bypass mode process data modules.

Module	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
Module 1 ①	CW	REF	FBData_In_1	FBData_In_2						
	SW	ACT	FBData_Out_1	FBData_Out_2						
Module 2 ①	CW	REF	FBData_In_1	FBData_In_2	FBData_In_3	FBData_In_4				
	SW	ACT	FBData_Out_1	FBData_Out_2	FBData_Out_3	FBData_Out_4				
Module 3 ①	CW	REF	FBData_In_1	FBData_In_2	FBData_In_3	FBData_In_4	FBData_In_5	FBData_In_6		
	SW	ACT	FBData_Out_1	FBData_Out_2	FBData_Out_3	FBData_Out_4	FBData_Out_5	FBData_Out_6		
Module 4 ①	CW	REF	FBData_In_1	FBData_In_2	FBData_In_3	FBData_In_4	FBData_In_5	FBData_In_6	FBData_In_7	FBData_In_8
	SW	ACT	FBData_Out_1	FBData_Out_2	FBData_Out_3	FBData_Out_4	FBData_Out_5	FBData_Out_6	FBData_Out_7	FBData_Out_8

① Only available in bypass mode.

Process data out

This register range is normally used to fast monitoring of the VFD. Process data out is located in range ID 2104–2111. See table below.

Table 107. Fieldbus basic output table.

ID	Modbus register	Group	Range/type
2101	32101, 42101	FB status word	Binary coded
2102	32102, 42102	FB general status word	Binary coded
2103	32103, 42103	FB actual speed	%
2104	32104, 42104	FB process data out 1	
2105	32105, 42105	FB process data out 2	
2106	32106, 42106	FB process data out 3	
2107	32107, 42107	FB process data out 4	
2108	32108, 42108	FB process data out 5	
2109	32109, 42109	FB process data out 6	
2110	32110, 42110	FB process data out 7	
2111	32111, 42111	FB process data out 8	

Note: FB process data is defined in **Appendix B.**

Table 108. Status word.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
—	—	—	—	—	—	—	—	RUNEN	BYS	AREF	WARN	FLT	DIR	RUN	RDY

Information about the status of the device and messages is indicated in the status word. The status word is composed of 16 bits that have the following meanings.

Table 109. Status word bit descriptions

Bit	Description value = 0	Value = 1
0	Not ready	Ready
1	STOP	RUN
2	Clockwise	Counter-clockwise
3	—	Faulted
4	—	Warning
5	Ref. frequency not reached	Ref. frequency reached
6	Bypass not activated	Bypass activated
7	Run disable	Run enable
8	Not in use	Not in use
9–15	Not in use	Not In use

Table 110. Actual speed.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is the actual speed of the motor. This value comes back in the form of Hz.

PROFIBUS overview

PROFIBUS is a vendor independent, open fieldbus standard for a wide range of applications in manufacturing, process and building automation. Vendor independence and openness are guaranteed by the PROFIBUS standard EN 50 170. With PROFIBUS, devices of different manufactures can communicate without special interfaces adjustment. PROFIBUS can be used for both high-speed time critical data transmission and extensive complex communication tasks.

PROFIBUS-DP—Optimized for high speed and inexpensive hookup, this PROFIBUS version is designed especially for communication between automation and control systems and distributed I/O at the device level. PROFIBUS-DP can be used to replace parallel signal transmission with 24V or 0 to 20 mA.

The PROFIBUS Family—PROFIBUS specifies the technical and functional characteristics of a serial fieldbus system with decentralized digital controllers can be networked together from the field level to the cell level. PROFIBUS distinguishes between master and slave devices.

Master Devices—Determines the data communication on the bus. A master can send messages without an external request when it holds access rights (the token). Master are also called "active stations" in the PROFIBUS protocol.

Slave Devices are peripheral devices. Typical devices include input/output devices, valves, drives and measuring transmitters. They do not have bus access rights and they can only acknowledge received messages or send messages to the master when requested to do so. Slaves are also called 'passive stations".

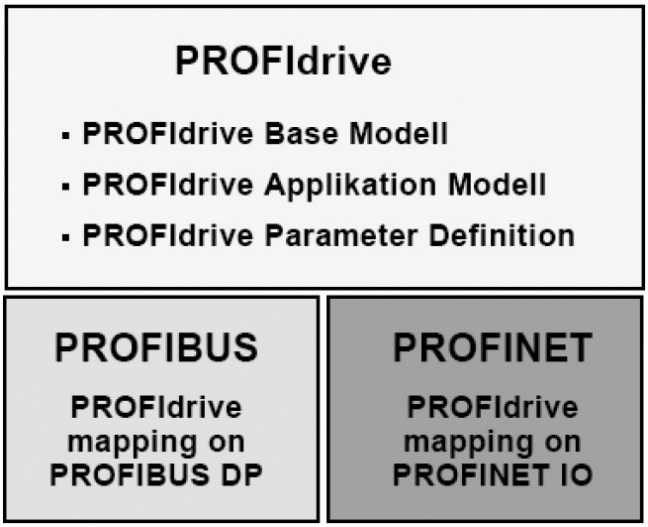
Profiles—The PROFIBUS-DP protocol defines how user data to be transmitted between stations over the bus. User data are not evaluated by the PROFIBUS transmission protocol. The meaning is specified in the profiles. In addition, the profiles specify how PROFIBUS-DP is to be used in the drives PROFIBUS Fieldbus board.

Leading manufacturers of drive technology have jointly defined the PROFIdrive profile. The profile specifies how the drives are to be parameterized and how the set points and actual values are to be transmitted. This enables drives from different vendors to be exchanged. The profile contains necessary specifications for speed control and positioning. It specifies the basic drive functions while leaving sufficient freedom for application-specific expansions and further developments. The profile describes the mapping of the application functions for DP.

PROFIdrive consists of a general part and a bus specific part. The following properties are defined in the general part.

- Base Model
- Parameter model
- Application Model

Figure 19. PROFIdrive



The PROFIdrive base model describes an automation system in terms of a number of devices and their interrelationships (application interfaces, parameter access). The base model distinguishes between following device classes.

Communication Services—Two communication services are defined in the PROFIdrive profile; namely, cyclic data exchange and acyclic data exchange.

Cyclic data exchange via a cyclic data channel

Motion control system need cyclically updated data during operation for open and closed loop control purposes. This data must be sent to the drive units in the form of set points or transmitted from the drive units in the form of actual values, via the communication systems.

Acyclic data exchange via an acyclic data channel

In addition to cyclic data exchange, there is an acyclic parameter channel for exchanging parameters between control/supervisor and drive units. Access to this data is not time critical.

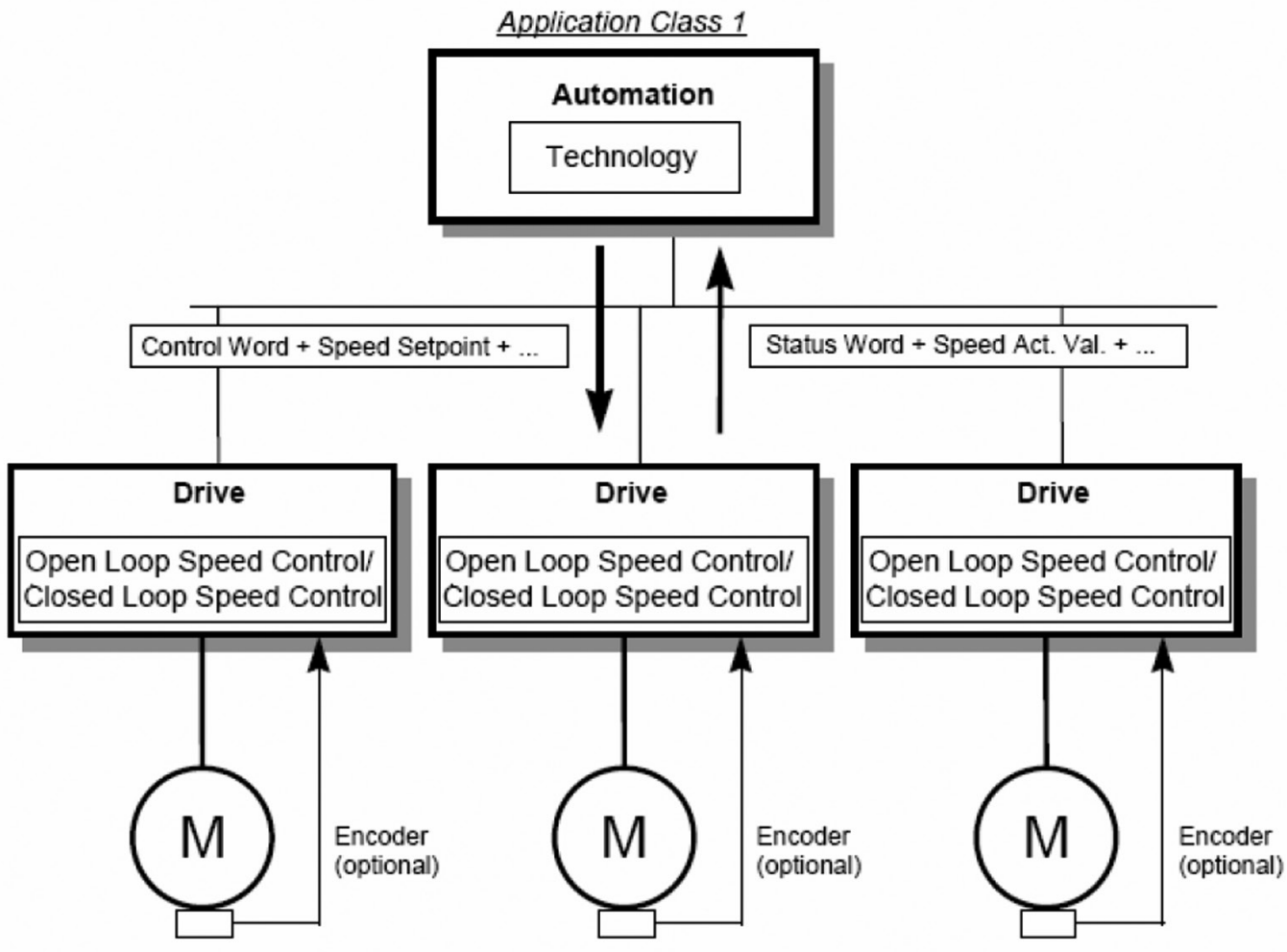
Application classes

The integration of drives into automation solutions depend strongly upon the drive task. To cover the extensive range of drive application from the most simple frequency convertor up to highly dynamic synchronized multi axis systems with a single profile. PROFIdrive defines six application categories but the drives PROFIBUS optional card support below application class 1.

Table 111. Application class

SN	Application class	Interface	Function
1	Standard Drive (e.g., pumps, fans, agitators)	n-set point	Cyclic I/O data interface

Figure 20. Application class



Startup test

Set up the communication with Master and follow below steps.

1. Complete Parameterization of the device. Below parameters are important to control device on PROFIBUS.
   a. Parameterization Enable/Disable = 1 (Enabled)
   b. Local / remote selection = 1 (Remote control)
   c. Remote 1 control place = 1 (Fieldbus)
   d. Remote 1 reference = 7 (Fieldbus Ref)
   e. PNU927-Opern priority of param = 1
   f. PNU928 Ctrl priority DOIO Data = 1
   g. ProfiBus Operation Mode = 0 (ProfiDrive)
2. Select the "Standard Telegram 1" in the Configuration step in the PLC
3. Set control word value to 0x0406 to enter ProfiDrive State S2
4. Set control word value to 0x0407 to enter ProfiDrive State S3
5. Set control word value to 0x047F and Set Frequency reference t0 0x4000 to enter ProfiDrive State S4
6. Check drive is running on output frequency 100%.
7. Set control word value to 0x047E to drive stop and ProfiDrive State S2
8. Check drive is in stop mode and output frequency 0%

Control and status words

The Control Word (PROFIBUS Parameter number (PNU) = 967) is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive, the adapter module acting as a gateway.

The drive switches between its states according to the bit-coded instructions on the Control Word, and returns status information to the master in the Status Word (PROFIBUS Parameter number (PNO) = 968).

Control word 1 (STW1)

To improve the exchange of devices of different manufacturers in a control application, we strongly recommend using the device-specific bits only for the control of manufacturer specific functions. The device-specific bits shall not be necessary for the operation of a device in the speed control mode and in the positioning mode (default of the device-specific bits = 0).

Table 112. PROFIdrive control word 1—STW1 message examples.

Bit	Value	Significance	Comments
0	1	ON	"Switched on" condition; voltage at the power converter, i.e. the main contact is closed (if present).
	0	OFF (OFF 1)	Power-down (the drive returns to the "ready for switching on "condition); the drive is ramped-down along the ramp (RFG) or along the current limit or along the voltage limit of the d.c. link; if standstill is detected, the voltage is isolated; the main contact is opened (if present). During deceleration bit 1 of ZSW1 is still set. An OFF command is interruptible.
1	1	No Coast Stop (no OFF 2)	All "Coast Stop (OFF2)" commands are withdrawn.
	0	Coast Stop (OFF 2)	Voltage is isolated. The main contact is then opened (if present) and the drive goes into the "Switching On Inhibited" condition; the motor coasts down to a standstill.
2	1	No Quick Stop (no OFF 3)	All "Quick Stop (OFF3)" commands are withdrawn.
	0	Quick Stop (OFF 3)	Quick stop; if required, withdraw the operating enable, the drive is decelerated as fast as possible, e.g., along the current limit or at the voltage limit of the d.c. link, at n / f = 0; if the rectifier pulses are disabled, the voltage is isolated (the contact is opened) and the drive goes into the "Switching On Inhibited" condition. A Quick Stop command is not interruptible.
3	1	Enable Operation (Start)	Enable electronics and pulses. The drive then runs-up to the set point.
	0	Disable Operation (Stop)	The drive coasts down to a standstill (ramp-function generator to 0 or tracking) and goes into the "Switched on" condition (refer to control word 1, bit 0).
4	1	Enable Ramp Generator	

Table 112. PROFIdrive control word 1—STW1 message examples (Cont.).

Bit	Value	Significance	Comments
	0	Reset Ramp Generator	Output of the RFG is set to 0. The main contact remains closed, the converter is not isolated from the line, the drive decelerates along the current limit or along the voltage limit of the d.c. link.
5	1	Unfreeze Ramp Generator	
	0	Freeze Ramp Generator	Freeze the actual set point entered by the ramp-function generator. If Application Class 4 is used Bit 5 is not relevant.
6	1	Enable Set point	The value selected at the input of the RFG is switched-in.
	0	Disable Set point	The value selected at the input of the RFG is set to 0.
7	1	Fault Acknowledge (0⟶1)	The group signal is acknowledged with a positive edge; the drive reaction to a fault depends on the type of fault. If the fault reaction has isolated the voltage, the drive then goes into the "Switching On Inhibited" condition.
	0	No significance	
8	1	Jog 1 Ona	Prerequisite. Operation is enabled, drive is in standstill and STW1 bit 4, 5, 6 = 0. The drive runs up along the ramp of RFG to jogging set point 1.
	0	Jog 1 OFFa	Drive brakes along the ramp of RFG, if "Jog 1" was previously ON, and goes into "Operation Enabled" when drive comes to a standstill.
9	1	Jog 2 Ona	N/A
	0	Jog 2 OFFa	N/A
10	1	Control By PLC	Control via interface, DO I/O Data valid (refer to 6.3.11).
	0	No Control By PLC	DO I/O Data not valid; expect Sign-Of-Life. If loosing the control priority bit the reaction is device-specific. Possible reactions. 1) speed control. "old" process data is kept, 2) positioning. DO I/O Data are set to 0.
11	1	Device Specific	N/A
	0	Device Specific	N/A
12	1	Device Specific	N/A
	0	Device Specific	N/A
13	1	Device Specific	N/A
	0	Device Specific	N/A
14	1	Device Specific	N/A
	0	Device Specific	N/A
15	1	Device Specific	N/A
	0	Device Specific	N/A

Below is various defined control word (STW1) command.

Table 113. Control word (STW1) message examples

SN	Control word (STW1)	Control word description (STW1)	Comment
1	0x0400	Set PLC Control	PLC Control should be set in MCU
2	0x0000	Clear PLC Control	PLC Control should be reset in MCU
3	0x040F	Run Command without RFG	Motor Off as no RAMP Generator
4	0x0407	Clear Run Command	Motor Off as earlier
5	0x041F	Run Command with RFG and without Set point	Motor Off as no Set point Generator
6	0x0407	Clear Run Command	Motor Off as earlier
7	0x047F	Run Command with RFG and with Set point	Motor ON with RFG
8	0x0407	Clear Run Command	Motor Off as earlier
9	0x047F	Run Command with RFG and with Set point	Motor ON with RFG
10	0x045F	Set Freeze of Ramp	Motor ON with Ramp Freeze
11	0x047F	Clear Freeze of Ramp	Motor ON with Following Ramp Timing
12	0x047E	OFF 1 Command	Motor Off with RFG
13	0x047F	Run Command with RFG and with Set point	Motor ON with RFG
14	0x047D	OFF 2 Command (Coast Stop)	Motor Off with Coast
15	0x047F	Run Command with RFG and with Set point	Motor ON with RFG
16	0x047B	OFF 3 Command (Quick Stop)	Motor Off with 0 DECEL Time
17	0x047F	Run Command with RFG and with Set point	Motor ON with RFG
18	0x0477	Disable Operation	Motor Off with Coast
19	0x057F	Run Command with RFG and with Set point At Jog Speed	Motor ON at Jog Speed
20	0x0477	Disable Operation	Motor Off with Coast
21	0x0480	Fault Reset bit	Fault should get reset

Status word 1 (ZSW1)

Table 114. Application status word PROFIdrive

Bit	Value	Significance	Comments
0	1	Ready To Switch On	Power supply is switched on, electronics initialized, main contact, if available, has dropped out, pulses are inhibited.
	0	Not Ready To Switch On	
1	1	Ready To Operate	Refer to control word 1, bit 0.
	0	Not Ready To Operate	
2	1	Operation Enabled	Drive follows set point. This means, that the electronic and pulses are enabled (Refer to control word 1, bit 3), the closed loop control is active and controls the motor and the output of the set point channel is the input for the closed loop control.
	0	Operation Disabled	Either the pulses are disabled or the drive doesn't follow the output value of the set point channel.
3	1	Fault Present	Unacknowledged faults or currently not acknowledgeable faults (fault messages) are present (in the fault buffer). The fault reaction is fault-specific and device-specific. The acknowledging of a fault may only be successful, if the fault cause has disappeared or has been removed before. If the fault has isolated the voltage, the drive goes into the "Switching On Inhibited" condition, otherwise the drive returns to operation. The related fault numbers are in the fault buffer.
	0	No Fault	
4	1	Coast Stop Not Activated (No OFF 2)	
	0	Coast Stop Activated (OFF 2)	"Coast Stop (OFF 2)" command is present.
5	1	Quick Stop Not Activated (No OFF 3)	
	0	Quick Stop Activated (OFF 3)	"Quick Stop (OFF 3)" command is present.

Table 114. Application status word PROFIdrive (Cont.).

Bit	Value	Significance	Comments
6	1	Switching On Inhibited	The drive goes only again in the "Switched On" condition with "No Coast Stop AND No Quick Stop" followed by "ON." This means that the "Switching On Inhibited" bit is only set back to zero if the OFF command is set after "No Coast Stop AND No Quick Stop."
	0	Switching On Not Inhibit	
7	1	Warning Present	Warning information present in the service/maintenance parameter; no acknowledgement.
	0	No Warning	There is no warning or the warning has disappeared again.
8	1	Speed Error Within Tolerance Range	Actual value is within a tolerance band; dynamic violations are permissible for t < tmax, e.g., n = nset±, f = fset±, etc., tmax may be parameterised
	0	Speed Error Out Of Tolerance Range	
9	1	Control Requested	The automation system is requested to assume control (refer to 6.3.11.
	0	No Control Requested	Control by the automation system is not possible, only possible at the device or by another interface.
10	1	f Or n Reached Or Exceeded	Actual value ≥ comparison value (set point) which may be set via the parameter number.
	0	f Or n Not Reached	
11	1	Device Specific	N/A
	0	Device Specific	N/A
12	1	Device Specific	N/A
	0	Device Specific	N/A
13	1	Device Specific	N/A
	0	Device Specific	N/A
14	1	Device Specific	N/A
	0	Device Specific	N/A
15	1	Device Specific	N/A
	0	Device Specific	N/A

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the 2's complement from the corresponding positive reference.

Table 115. References

SN	N2 data type hex	N2 data type decimal	N2 data type percentage	Frequency in decimal
1	4000	16384	100	50
2	3000	12288	74	37
3	2000	8192	50	25
4	1000	4096	24	12
5	0	0	0	0
6	F000	61440	–25	12
7	E000	57344	–50	25
8	D000	53248	–75	37
9	C000	49152	–100	50

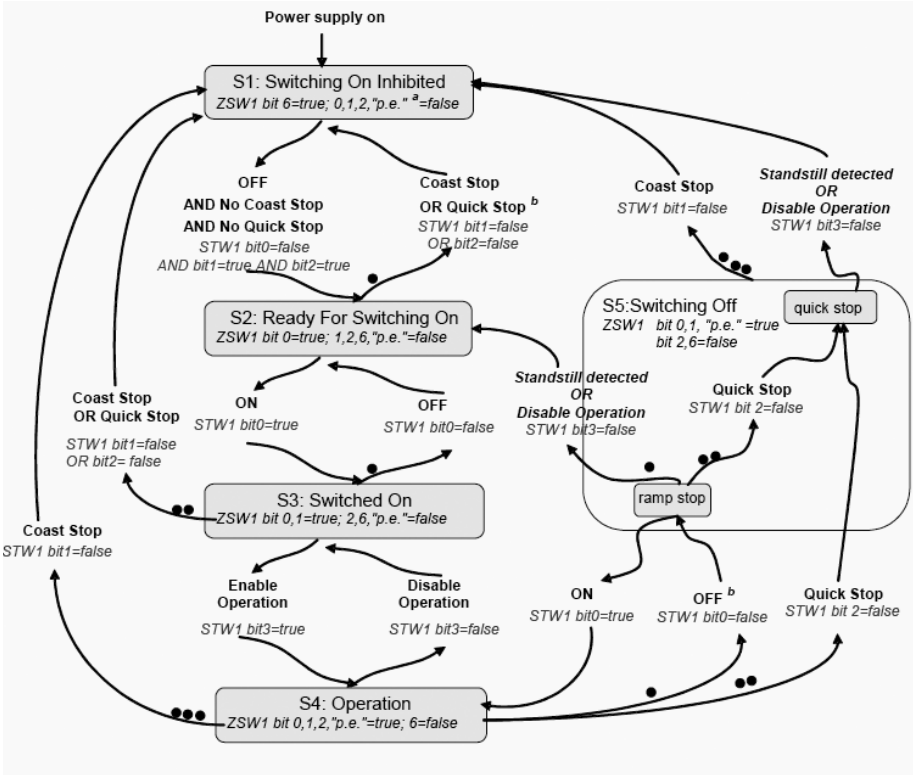
Actual values

Actual values are 16-bit words containing information on the operation of the drive. The function to be monitored are selected by a drive parameter. The scaling of the integers sent to the master as Actual Values depends on the selected function.

General state machine

State diagrams are defined for the operating modes. In the PROFIdrive control profile, the controls bits 0 to 3 perform the basic start-up / power down functions whereas the control bits 4 to 15 perform application-oriented control.

Figure 21. General state diagram



Notes: STW1 bit x, y = These control word bits shall be set by the control.

ZSW1 bit x, y = These status word bits indicate the actual state.

Standstill detected is an internal result of a stop operation.

a Abbr.: "p.e." = "Pulses enabled" optional.

b The internal condition "fault with ramp stop" also activates this transition.

Information on the general state diagram

- The green blocks represent states, the arrows represent transitions
- From several states, several transitions are possible
- The more points that a transition has, the higher is its priority. A transition without points has the lowest priority
- The PROFIBUS interfaces between this controller and the DO has the control priority (PNO 928)
- ZSW1 Bit 9 is set by the DO
- STW1 Bit 10 is set by the controller
- The bits defined for positioning mode are only relevant, if the drive is in the state "S4" operation
- All stop-reactions caused by faults (Fault with Ramp stop, Fault with Quick stop, Fault with Coast stop) for the general state machine to switch to state S1 (Switching on Inhibited) or S2 (Ready For switching)

DO I/O data

The set points to the Axis and also the actual from the Axis are transferred as DO I/O data. The DO I/O data is transferred using the cyclic data exchange. The representation of data shall be in big endian format.

The following advantages are obtained due to the telegram configuring and normalization.

- Interoperability and interchangeability of PROFIdrive Controllers and Drive Objects
- Standard components may be simply commissioned
- Automation mechanisms in the controller application

Signals

A series of signals with appropriate signal numbers is defined to configure the DO I/O Data (set points, actual values).

The following values are permissible for the signal numbers.

- 0 = not assigned
- 1-99 = standard signal numbers (profile-specific signal numbers)
- 100-65535 = signal numbers (device-specific)

The PowerXL PROFIBUS optional card, the defined signal numbers are listed in the following.

Table 116. PROFIBUS option Card

Signal no.	Significance	Abbreviation	Length
1	Control word 1	STW1	16
2	Status word 1	ZSW1	16
5	Speed set point A	NSOLL_A	16
6	Speed actual value A	NIST_A	16

Standard telegram 1

Standard telegrams 1 is defined for speed set point interface operations application class (AC1). The standard telegrams are selected when configuring the DO I/O Data.

The standard telegram 1 has the following structure.

- n set interface, 16 bit

Table 117. Standard telegram 1

I/O Data Number	Set point	Actual value
1	STW1	ZSW1
2	NSOLL_A	NIST_A

PROFIdrive Profile

The PROFIdrive profile PNU numbers are listed in **Appendix A** of this manual.

DPV1 acyclic communication

Base model parameter access, whose structure is defined in the PROFIdrive profile 4.2, is always used for communicating the writing/reading parameters for PROFIdrive drives.

Under this arrangement, parameters access always consists of two elements. Under this arrangement, parameter access always consists of two elements.

Write request ("Write data set ")
Read request ("Read data set")

Write request or Request can be send via DPV1 master class 1 or master class 2.

The DP V1 command/response part is used for the standard DP V1 read/Write on the Slot 0, Index47 data block.

Parameter requests and parameter responses

A parameter consists of three segments.

Request header

ID for the request and number of parameters which are accessed. Multi-Axis and Modular drives, Addressing of one DO.

Parameter address

Addressing of a parameter. If parameters are accessed, there are correspondingly many parameter addresses but can only be accessed on a single case. The parameter address appears only in the request, not in the response.

Parameter value. Per addressed parameter, there is a segment for the parameter values. Depending on the request ID, parameter values appear only either in the request or in the reply.

Words and double words

The following telegram contents are displayed in words (a word or 2 bytes per line). Words or double words will have the most significant byte being transmitted first (big endian).

Table 118. Words and Double Words

Word	Byte 1	Byte 2
Double Word	Byte 1	Byte 2
	Byte 3	Byte 4

According to the Base Model Parameter access the structure of the parameter request and parameter response as shown in **Table 119** and **Table 120**.

Table 119. Base mode parameter request

Block definition	Byte n	Byte n +1	n
Request Header	Request reference	Request ID 0	0
	Axis-No. / DO-ID	No. of parameters = i	2
1st Parameter address	Attribute	No. of elements	4
	Parameter number (PNU)		
	Subindex		
with Parameter address	...		4 + 6 × (i-1)
1st Parameter value(s) (only for requst "change parameter")	Format	No. of values	4 + 6 × i
	Value		
	...		
with Parameter value	...		
			4 + 6 × i + ... + (Format_n x Qty_n)

Table 120. Base model response

Block definition	Byte n	Byte n +1	n
Response header	Request Ref. mirrored	Response ID	0
	Axis-No. / DO-ID mirrored	No. of parameters = i	2
1st Parameter Value (s) (only after request "Request")	Format	No.of values	4
	Values or error values		
	...		
with Parameter values	...		4 +... + (Format_n × Qty_n)

Coding

Coding of the fields in parameter request/parameter response of base model parameter access.

PROFIBUS board support only single parameter and single element.

Max No. of Parameters = 1

Max No. of Elements = 1

Max No. of Values = 1

Table 121. Field coding (Cont.).

Field	Data Type	Value		Comment
Request Reference	Unsigned 8	0x00	Reserved	
		0x01…0xFF		
Response ID	Unsigned 8	0x00	Reserved	
		0x01	Request parameter (+)	
		0x02	Change parameter(+)	
		0x03…0x3F	Reserved	
		0x40	INCORRECT Request Ref	
		0x41	INCORRECT Request ID	
		0x42	INVALID NOS PARAM	
		0x43	INVALID_Axis_DO_DI	
		0x44…0x7F	Manufacturer-specific	
		0x80	Reserved	
		0x81	Request parameter (–)	
		0x82	Change parameter (–)	
		0x83…0xBF	Reserved	
		0xC0…0xFF	Manufacturer-specific	
Axis/DO-ID	Unsigned 8	0x00	Device-Representative	Zero is not a DO but representative of the access to the drive unit.
		0x01…0xFE	DO-ID-Number 1–254	
		0xFF	Reserved	
No. of Parameters	Unsigned 8	0x00	Reserved	There may be an additional limitation through the communication system (telegram length) or optional scalability.
		0x01…0x27	Quantity 1–39	
		0x28…0xFF	Reserved	
Attribute	Unsigned 8	0x00	Reserved	The four less significant bits are reserved for (future) expansion of “No. of Elements” to 12 bits.
		0x10	Value	
		0x20	Description	
		0x30	Text	
		0x40…0x70	Reserved	
		0x80…0xF0	Manufacturer-specific	
No. of Elements	Unsigned 8	0x00	Special Function	Limitation through compatibility with PROFIBUS process data ASE telegram length.
		0x01…0xEA	Quality 1–234	
		0xEB…0xFF	Reserved	
Parameter Number	Unsigned 16	0x0000	Reserved	
		0x0001	Number 1–65535	
		0xFFFF		
Subindex	Unsigned 16	0x0000…	Number 0–65534	
		0xFFFF		

Table 121. Field coding (Cont.).

Field	Data Type	Value		Comment
Format	Unsigned 8	0x00	Reserved	Every slave shall at least support the data types Byte, Word and Double Word (mandatory). Write requests by the master preferable use the "correct" data types. As substitute, Byte, Word, or Double Word are also possible. The master shall be able to interpret all values/data types.
		0x01…0x36	Data types	
		0x37…0x3F	Reserved	
		0x40	Zero	
		0x41	Byte	
		0x42	Word	
		0x43	Double word	
		0x44	Error	
		0x45…0xFF	Reserved	
No. of Values	Unsigned 8	0x00…0xEA	Quantity 0–234	Limitation because of 240 Bytes Data block size (compatible with former PROFIdrive version 3.1.2).
		0xEB…0xFF	Reserved	
Error Number	Unsigned 16	0x0000…	Error numbers	The more significant byte is reserved.
		0x00FF		

Generic station description (GSD) file

Please refer GSD file "EATN0EF5.gsd"

CANopen external communication cards

The Eaton PowerXL DM1 series drive can be connected to the CANopen system using a fieldbus board. Through this board the drive can be controlled, monitored and programmed from the Host system. The CANopen fieldbus board can be installed in either slot A or slot B on the control board of the drive. The devices are connected in a bus structure. There is a maximum of 127 devices that can be connected to a single master. The bus termination should be made on the end of the bus segment.

CANopen technical data

Table 122. CANopen connections.

Item	Value
Interface	Open style connector (pluggable connector)
Data transfer method	CAN (ISO 11898)
Transfer cable	2-wire twisted shielded cable
Electrical isolation	500 Vdc

Table 123. Communications.

Item	Value
CANopen	CiA DS-301, CiA DSP-402
Baud rate	1000 kBaud
	800 kBaud
	500 kBaud
	250 kBaud
	125 kBaud
	50 kBaud
	20 kBaud
Addresses	1–127

Table 124. Environment.

Description	Specification
Ambient operation temperature	–10 °C to +55 °C
Storing temperature	–40 °C to +60 °C
Humidity	<95%, no condensation allowed
Altitude	Max. 1000 M
Vibration	0.5G at 9–200 Hz
Safety	Fulfills EN 50178 standard

CANopen cable

To meet the ISO 11898 standard, cables to be used with CANbus lines should have a nominal impedance of 120 ohms, a line delay of 5 ns/m. Line termination has to be provided through termination resistors of 120 ohms on both ends of the transmission lines. The length should be related to resistance at 70 mohm/m. There is a terminating resistor bank on all boards and can be set via the DIP switch setting.

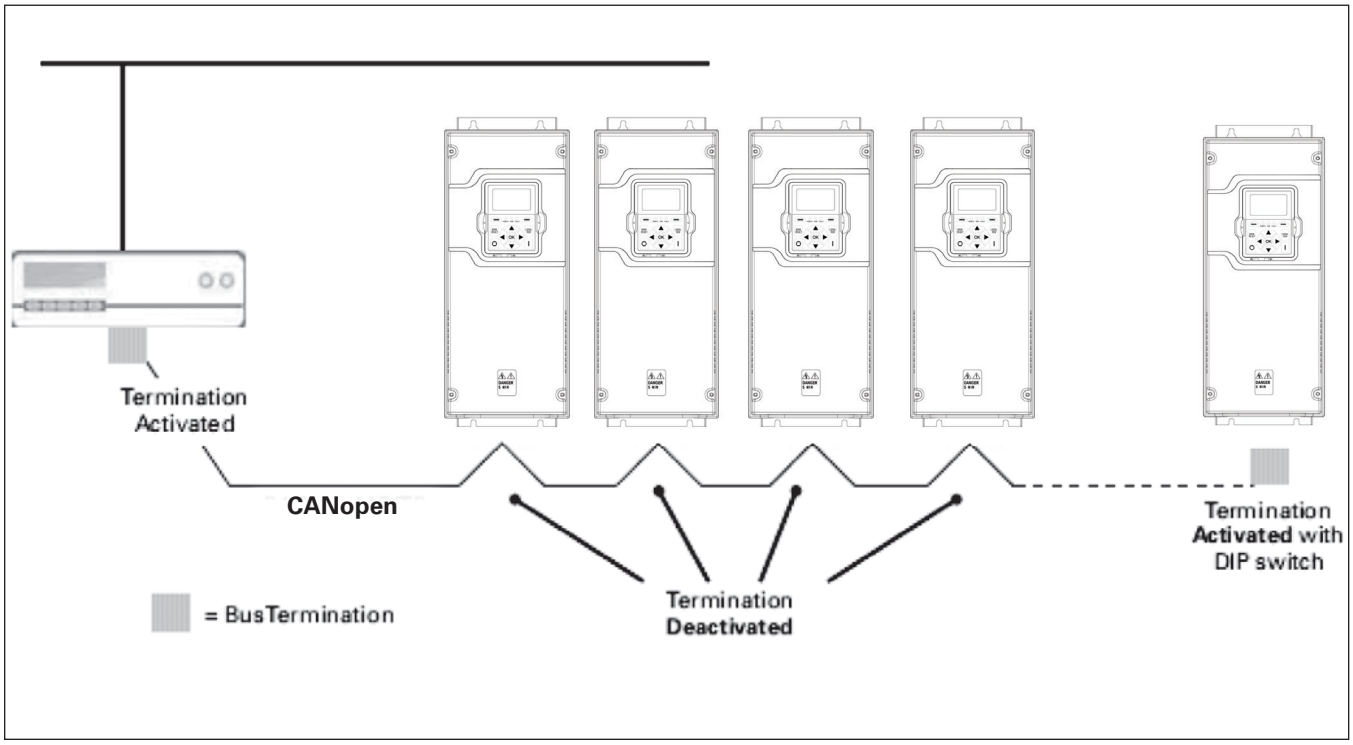
Below are the practical bus length for CANopen networks with less than 64 nodes.

Table 125. Practical bus length.r

Item	Value						
Baud rate (kbits/s)	1,000	800	500	250	125	50	20
Max. bus length in m	30	50	100	250	500	1,000	2,500

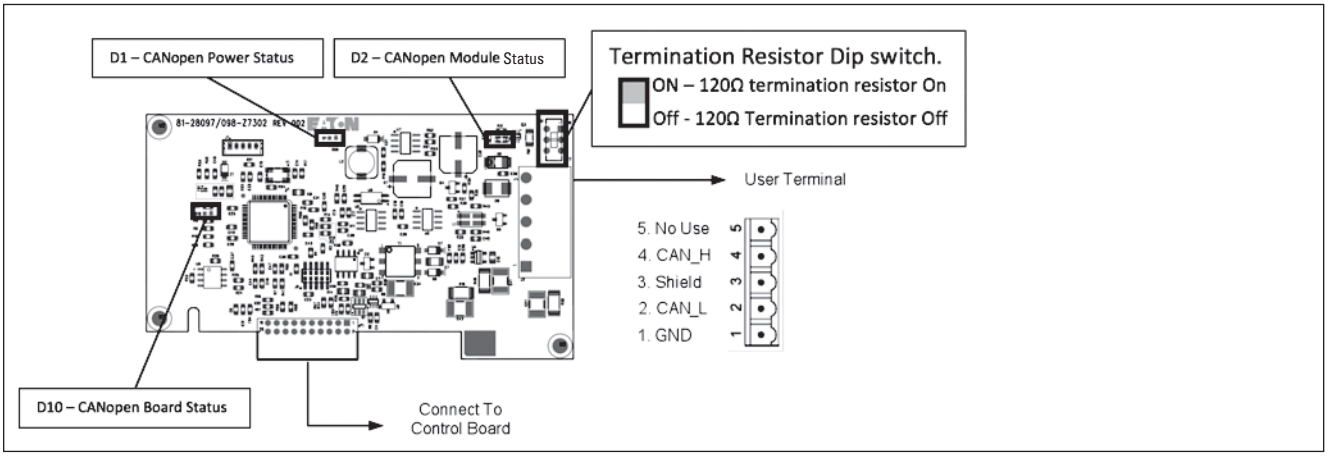
CANopen bus termination

Figure 22. CANopen bus termination.



Hardware specification

Figure 23. CANopen hardware.



LED status

CANopen LEDs are as stated below.

Table 126. Power LED (D1) red LED.

Illumination Pattern	Meaning
OFF	Power to option board is not activated
ON	Power to option board is activated

Table 127. CANopen board status LED (D10) (red LED).

Illumination pattern	Meaning
OFF	Option board not activated
ON	Option board in normal condition, i.e., no fault is occurred
Blinking at 40 Hz	Optional card communication fault
Blinking at 20 Hz	Option card hardware fault occurs
Blinking at 10 Hz	CAN communication fault occurs

Table 128. CANopen module status—error LED (D2-red LED).

Illumination pattern	Meaning	Description
OFF	No error	The device is in working condition.
Single flash	Warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames).
Double flash	Error control event	A guard event (NMT-slave or NMT-master) or a heartbeat event (heartbeat consumer) has occurred.
ON	Bus off	The CAN controller is bus off.

Note: An LSS master shall flicker its ERROR and RUN LED whilst executing LSS services.

Table 129. CANopen module status—run LED (D2-green LED).

Illumination Pattern	Meaning	Description
Blinking	PREOPERATIONAL	The device is in state PREOPERATIONAL.
Single flash	STOPPED	The device is in state STOPPED.
On	OPERATIONAL	The device is in state OPERATIONAL.

Table 130. CANopen parameters.

Code	Parameter	Min.	Max.	Unit	Default	ID (slot A/slot B)	Note
BX.1.1	Board status				0	883/910	B0 = DCOM Comm. fault B1 = Board HW fault B2 = Reserved B3 = Fieldbus fault B4 = Reserved
BX.1.2	Firmware version					1064/1066	
BX.1.3	Protocol status				0	2132/2143	0 = Initialization 4 = Stopped 5 = Operational 6 = Pre-operational
BX.2.1	Node ID	1	127		1	2133/2144	Address of device
BX.2.2	Baud rate	0	6		0	2134/2145	0 = 1,000 kBaud 1 = 800 kBaud 2 = 500 kBaud 3 = 250 kBaud 4 = 125 kBaud 5 = 50 kBaud 6 = 20 kBaud
BX.2.3	Operate mode	0	1		0	2135/2146	0 = Drive profile 1 = Bypass profile
BX.2.4	Comm. Card FB Fault response	0	1		0	2519/2520	0 = In fieldbus control 1 = In all control

Note: PDO1 and PDO2 should be used when in "Drive mode" and PDO3 and PDO4 used in "Bypass mode".

By default, the CANopen option board is configured to be used in the Drive Profile mode but can be changed to a Bypass mode, which is a manufacturer specified mode.

Drive profile

The CIA 402 Drive Profile mode where the control of the drive is done using a control word and speed reference value as specified in the drive profile specification.

Bypass profile

In this mode, the drive control can be done using the process data that is defined by the Drive application. The Drive Profile state machine and other objects are not valid in this mode.

Electronic data source file

The usage of devices in a communication network requires configuration of the device parameters and communication facilities. CANopen defines the required standard way to access these parameters via the object directory.

Please refer to the EDS file "PowerXL_CANopen_vx.x.eds."

CANopen overview

CANopen is a network system based on the serial bus network controller area network (CAN). The CANopen communication profile (CiA-301) supports both direct access to device parameters and critical process data communications. CANopen device profiles (CiA DS-40X) define standards for device functionality while providing ample ability for additional vendor-specific device features. CANopen is used in direct peer-to-peer data exchange between nodes and the host machine. CANopen supports cyclic and event driven communications, allowing for reduced bus load and better performance with minimal cable loss.

Device Profile drives and Motion Control (CiA-402) document represents the standardized CANopen Device Profile for digital controlled motion products like servo, drives or stepper motors. All these types of devices use the same communication techniques that conform to those described in the CANopen Application Layer and Communication Profile. The starting and stopping of the drive and several mode specific commands are executed by the state machine.

CANopen communication objects transmitted via the CAN network are described by services and protocols. They are set up as follows:

- The real-time data transfer is performed by the Process Data Objects (PDOs) protocol
- Service Data Object (SD) protocols provide the read and write access to entries of a device dictionary
- The Network Management (NMT) protocols provide services for network initialization, error control and device status control

CANopen message frame

Table 131. Message frame.

SOF	COB-ID	RTR	CTRL	Data segment	CRC	ACK	EOF
1 bit	11 bits	1 bit	5 bit	0–8 bytes	16 bits	2 bits	7 bits

SOF	Start of frame	CRC	Cyclic redundancy check
RTR	Remote transmission request	ACK	Acknowledge
CTRL	Control field (i.e., data length)	EOF	End of frame

COB-ID

The identification field of the CANopen-message is 11 bits.

D-bit	10	9	8	7	6	5	4	3	2	1	0
COB-ID	Function Code				Node ID						

The default identification field consists of a functional part and a module-ID part.
The functional part determines the object priority. This kind of identification field allows communication between a master and 127 slaves. Broadcasting is indicated by a module-ID of zero. Function codes are determined with object dictionaries in device profiles.

Predefined connection set

CANopen pre-defines some communication objects and their connection set (DS301).

Table 132. Predefined connection set.

Object	Function code	COB-ID	Comm. parameter index
NMT	0000	0x0000	
Emergency	0010	0x0080+Node ID (Hex)	
TxPDO1	0011	0x0180+Node ID (Hex)	0x1800
RxPDO1	0100	0x0200+Node ID (Hex)	0x1400
TxPDO2	0101	0x0280+Node ID (Hex)	0x1801
RxPDO2	0110	0x0300+Node ID (Hex)	0x1401
TxPDO3	0111	0x0380+Node ID (Hex)	0x1802
RxPDO3	1000	0x0400+Node ID (Hex)	0x1402
TxPDO4	1001	0x0480+Node ID (Hex)	0x1803
RxPDO 4	1010	0x0500+Node ID (Hex)	0x1403
SDO-TX	1011	0x0580+Node ID (Hex)	0x1200-01
SDO-RX	1100	0x0600+Node ID (Hex)	0x1200-02
Node guarding	1110	0x0700+Node ID (Hex)	0x100E

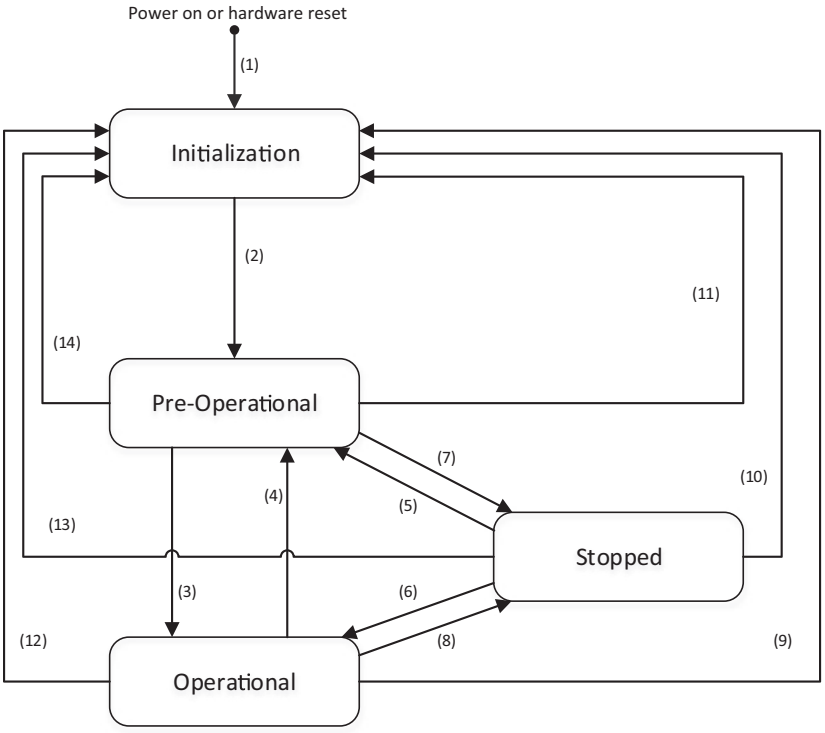
Network management (NMT)

The CANopen network management is node-oriented and follows a master/slave structure. It requires one device to function as the NMT master, the others are slaves.

The CANopen NMT slave devices implement state machine tasks shown below. After power-up of a node, it will initialize and transmit to the "Pre-Operational State". In this state, communication across SDO channels is possible for node configuration, but not yet across PDOs. With the NMT message "Start Remote Node," a selected node or all nodes on the network can be set into the "Operational State". When the device is in this state, data exchange can be done via PDOs.

NMT network management manages CANopen, and is a mandatory, common feature for all devices. The protocol describes several node control services and the state machine.

Figure 24. NMT state machine.



1 = When the power is on, the NMT state is entered autonomously.

2 = The NMT state initialization is finished, the NMT pre-operational state is entered automatically.

3 = NMT service starts with remote node indication or by local control.

4 and 5 = NMT service enters pre-operational indication.

6 = NMT service starts remote node indication.

7 and 8 = NMT service stops remote node indication.

9, 10 and 11 = NMT resets node indication.

12, 13 and 14 = Indication of NMT service reset communication.

To set the connected node into the "Operational State," the following message is required.

Table 133. Start remote node message.

CAN ID	LENGTH	DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7
0x0	0x2	0x1	NODE ID						

The stop remote message sets the node into a "Stopped State" indicated in the NMT state machine. When the node ID in the message is set to "0," the message broadcasts to all nodes on the network.

Table 134. Stop remote node message.

CAN ID	LENGTH	DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7
0x0	0x2	0x2	NODE ID						

The pre-operation message sets the node into the "Pre-Operational state" indicated in the NMT state machine. If the node ID in the message is set to "0," it will broadcast to all nodes.

Table 135. Enter pre-operational message.

CAN ID	LENGTH	DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7
0x0	0x2	0x80	NODE ID						

The reset node message makes the nodes apply application reset. The application reset sets the whole object dictionary back to the default or previously stored values. If the node ID in the message is set to "0," it will broadcast to all nodes. Upon a reset, the node will enter into the "Pre-Operational state."

Table 136. Reset node message.

CAN ID	LENGTH	DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7
0x0	0x2	0x81	NODE ID						

The reset communication message when sent to the node causes the communication reset. This does not affect the object dictionary values. If the node ID in the message is set to "0," it will broadcast to all nodes. After the node has received the communication reset, it will enter into the "Pre-Operational" state.

Table 137. Reset communication message.

CAN ID	LENGTH	DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7
0x0	0x2	0x82	NODE ID						

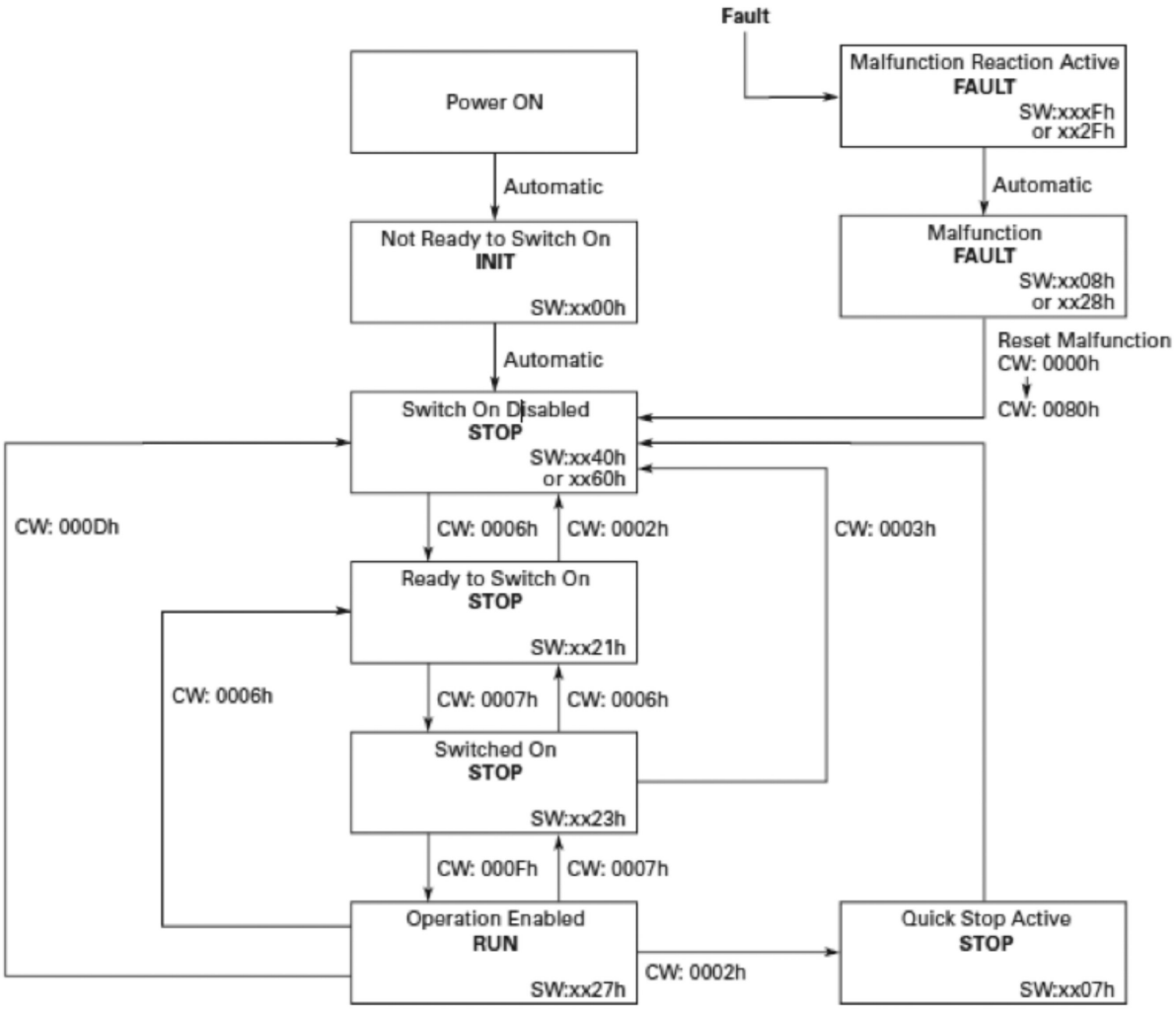
Drive profile state machine

State machine

The state machine describes the device status and the possible control sequence of the drive. The state transitions can be generated by using "controlword". The "statusword" parameter indicates the current status of the state machine. The modes ***INIT, STOP, RUN*** and ***FAULT*** correspond to the actual mode of the drive.

SW = StatusWord
CW = ControlWord

Figure 25. Internal state machine.



Device profile parameters

Table 138. Device profile parameters index.

Hex	Dec	Sub-index	Name	Type	Attr.
6040	24640		Control word	Unsigned16	RW
6041	24641		Status word	Unsigned16	RO
6042	24642		vl target velocity	Integer16	RW
6043	24643		vl velocity demand	Integer16	RO
6044	24644		vl control effort	Integer16	RO
6046	24646		vl velocity min max amount		
		0	Number of entries	Unsigned8	RO
		1	Minimum speed	Unsigned16	RW
		2	Maximum speed	Unsigned16	RW
6048	24648		vl velocity acceleration		
		0	Number of entries	Unsigned8	RO
		1	Delta speed	Unsigned32	RW
		2	Delta time	Integer16	RW
6049	24649		vl velocity deceleration		
		0	Number of entries	Unsigned8	RO
		1	delta speed	Unsigned32	RW
		2	Delta time	Integer16	RW
604A	24650		vl velocity quick stop		
		0	Number of entries	Unsigned8	RO
		1	Delta speed	Unsigned32	RW
		2	Delta time	Integer16	RW
604E	24654		vl velocity reference	Unsigned32	RW
6052	24658		vl nominal percentage	Integer16	RW
6053	24659		vl percentage demand	Integer16	RO
6054	24660		vl actual percentage	Integer16	RO
6060	24672		Modes of operation	Unsigned8	RW
6061	24673		Modes of operation display	Unsigned8	RO

Control word

The control word is used to control the drive operation according to the Internal State Machine.
This is mapped into the first 2 bytes of rxPDO1.

Table 139. 0x6040 control word.

Bit	Name	Description
0	Switch ON	Enables drive start command
1	Disable voltage	Enable/disable DM1 motor output voltage
2	Quick stop	Stops drive with a 0.1 sec. ramp when value is changed to 0.
3	Enable operation	Enable drive start
4	Operation mode specific	Not used
5	Operation mode specific	Not used
6	Operation mode specific	Not used
7	Reset fault	Rising edge resets active faults.
8	Reserved	Not used
9	Reserved	Not used
10	Reserved	Not used
11	Manufacturer specific	Not used
12	Manufacturer specific	Not used
13	Manufacturer specific	Not used
14	Manufacturer specific	Not used
15	Manufacturer specific	Not used

Status word

The Status Word provides drive status for the current control. By default this is mapped into the first two bytes of txPDO1

Table 140. 0x6041 status word.

Bit	Name	Description
0	Ready to switch on	Device is in the ready state, ready to switch on
1	Switched on	Device switch is enabled
2	Operation enabled	Device drive is enabled and running
3	Fault present	Device fault is present
4	Voltage disable	Drive output voltage is enabled
5	Quick stop	Device quick stop is enabled
6	Switching on disable	Device switch is disabled
7	Warning present	Indicates if drive is in warning state
8	Manufacturer specific	Not used
9	Remote	Indicates if the drive is in the remote control state
10	Target reached or exceeded	Target velocity is reached
11	Manufacturer specific	Not used
12	Manufacturer specific	Not used
13	Manufacturer specific	Not used
14	Manufacturer specific	Not used
15	Manufacturer specific	Not used

VL target velocity

The signed value of the requested motor rpm speed. When the value is reading negative, it indicates the motor spinning in the counterclockwise direction. By default, this is mapped into the bytes of RxPDO1.

Range: –32,768 to 32,767

VL velocity demand

The signed value is of the ramp generator output scaled into rpm and is a read only value. A negative value will indicate the motor is running in the clockwise direction.

Range: –32,768 to 32,767

VL velocity control effort

This signed value is the motor actual rpm speed. A negative value will indicate that the motor is running in the clockwise rotation. By default, this is mapped into the TxPDO1.

Range: –32,678 to 32,767

Process data (PDO)

The real time data transfer is performed by means of using the "Process Data Objects." The transfer of PDOs is performed with no protocol overhead. The process data is time-critical data used for control of the drive and monitor status.

Table 141. Process data (PDO).

RxPDO1										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x201	0	4	Control word		Target velocity					
TxPDO1										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x181	0	4	Status word		Control effort					
RxPDO2										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x301	0	8	Motor nominal percentage		Velocity deceleration delta speed				Velocity deceleration delta time	
TxPDO2										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x281	0	8	Motor actual percentage		Torque %		Current %		Fault code	
RxPDO3										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x401	0	8	Fixed control word		Speed reference percentage		FB_Process_data_in1		FB_Process_data_in2	
TxPDO3										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x381	0	8	Fixed status word		Actual speed percentage		FB_Process_data_out1		FB_Process_data_out2	
RxPDO4										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x501	0	8	FB_Process_data_in3		FB_Process_data_in4		FB_Process_data_in5		FB_Process_data_in6	
TxPDO4										
Header			**Data**							
ID	**RTR**	**LEN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x481	0	8	FB_Process_data_out3		FB_Process_data_out4		FB_Process_data_out5		FB_Process_data_out6	

Some drive actual values can be monitored by using a Process Data Object 2 (rx).
Addressing of the data in these addresses is based off the following scheme this is in a hex:

RxPDO1 = 0x200 + node ID(hex) RxPDO2 = 0x300 + node ID(hex) RxPDO3 = 0x400 + node ID(hex) RxPDO4 = 0x500 + node ID(hex)

TxPDO1 = 0x180 + node ID(hex) TxPDO2 = 0x280 + node ID(hex) TxPDO3 = 0x380 + node ID(hex) TxPDO4 = 0x480 + node ID(hex)

Note: PDO1 and PDO2 should be used when in "Drive mode" and PDO3 and PDO4 used in "Bypass mode".

vl_actual percentage Motor speed. Scaled with percentage function.
_torque_percentage Calculated torque. Scaled in 0.0%–100% (0–1000).
_current_percentage Measured motor current. (1 = 0.01 A).
fault_code Shows the drive fault code (= 0, if no fault active).

Fixed control word

Table 142. Fixed control word.

Bit	Name
0	Run
1	Counterclockwise
2	Rising edge of this bit will reset active fault
3	FB input data 1
4	FB input data 2
5	FB input data 3
6	FB input data 4
7	Bypass
8	FB_Ctrl
9	FB_Ref
10	Not in use
11	Not in use
12	Not in use
13	Not in use
14	Not in use
15	Not in use

Bit	Description value = 0	Value = 1
0	Stop	RUN
1	Clockwise	Counterclockwise
2	Rising edge of this bit will reset active fault	Rising edge of this bit will reset active fault
3	FB input data 1 off	FB input data 1 On
4	FB input data 2 off	FB input data 2 On
5	FB input data 3 off	FB input data 3 On
6	FB input data 4 off	FB input data 4 On
7	Switch to drive	Switch to bypass
8	Control of drive is not selected from fieldbus	Control of drive is selected from fieldbus
9	Reference is not selected from fieldbus	Reference is selected from fieldbus
10–15	Not in use	Not in use

Speed reference percentage

The speed reference percentage is based off a 0 to 100.00 %(10,000) scale with 0 being 0 rpm and 10,000 indicating 100.00% speed value. A negative value will indicate the inverted direction.

Process data in

The Process Data In values are based off the application selected. See **Appendix B** to reference the current Process Data In values assigned.

Fixed status word

Table 143. Fixed status word.

Bit	Name
0	Ready
1	RUN
2	Counter-clockwise
3	Faulted
4	Warning
5	Ref. frequency reached
6	Bypass
7	Run enable
8	Not in use
9	Not in use
10	Not in use
11	Not in use
12	Not in use
13	Not in use
14	Not in use
15	Not in use

Bit	Description value = 0	Value = 1
0	Not ready	Ready
1	STOP	RUN
2	Clockwise	Counter-clockwise
3	—	Faulted
4	—	Warning
5	Ref. frequency not reached	Ref. frequency reached
6	—	Motor is running in bypass
7	Disable motor run	Enable motor run
8–15	Not in use	Not in use

Actual speed percentage

The actual speed percentage indicates the actual speed value of the motor. This value will be read as a 0 to 10,000 value, which indicates 0 to 100.00% speed actual.

FB process data out

The Process Data Out value is assigned by the Fieldbus Parameter group in the application parameters. These eight values can be set to any available Modbus ID value listed. See **Appendix B** to reference the default Process Data Out values assigned.

Object directory

Table 144. Object directory index.

Hex	Dec	Sub-index	Name	Type	Attr.
1000	4096		Device type	Unsigned32	RO
1001	4097		Error register	Unsigned8	RO
1003	4099		Predefined error field		
		0	Highest index	Unsigned8	RW
		1	Standard error field 1	Unsigned32	RO
100C	4108		Guard time	Unsigned16	RW
100D	4109		Life time factor	Unsigned8	RW
1014	4116		COB ID EMCY	Unsigned 32	RO
1018	4120		Identity object		
		0	Highest index	Unsigned8	RW
		1	Vendor ID	Unsigned32	RO
		2	Product code	Unsigned32	RO
		3	Revision number	Unsigned32	RO
		4	Serial number	Unsigned32	RO
1200	4608		Server SDO parameter		
		0	Highest index	Unsigned8	RW
		1	COB-ID Client⟶Server (RX)	Unsigned32	RO
		2	COB-ID Server⟶ Client (TX)	Unsigned32	RO
1400	5120		Receive PDO communication parameter 1		RO
		0	Number of entries	Unsigned8	RW
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
1401	5121		Receive PDO communication parameter 2		
		0	Number of entries	Unsigned8	RW
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
1402	5122		Receive PDO communication parameter 3		RO
		0	Number of entries	Unsigned8	RW
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
1403	5123		Receive PDO communication parameter 4		
		0	Number of entries	Unsigned8	RW
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
1600	5632		Receive PDO 1 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	60400020-controlword	Unsigned32	RO
		2	60420010-vl target velocity	Integer16	RO
1601	5633		Receive PDO 2 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	60520010-vl nominal percentage	Integer16	RO
		2	60490120-vl velocity deceleration-delta speed	Unsigned32	RO
		3	60490210-vl velocity deceleration-delta time	Integer16	RO

Table 144. Object directory index (cont).

Hex	Dec	Sub-index	Name	Type	Attr.
1602	5634		Receive PDO 3 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	20100010-fixed control word	Unsigned16	RW
		2	20110010-speed reference in percentage	Unsigned16	RW
		3	20120010-FB process data In 1	Integer16	RW
		4	20130010-FB process data In 2	Integer16	RW
1603	5635		Receive PDO 4 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	20140010-FB process data In 3	Integer16	RW
		2	20150010-FB process data In 4	Integer16	RW
		3	20160010-FB process data In 5	Integer16	RW
		4	20170010-FB process data In 6	Integer16	RW
1800	6144		Transmit PDO 1 communication parameters		
		0	Highest sub index	Unsigned8	RO
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
		3	Inhibit time	Unsigned16	RW
		4	Event timer	Unsigned16	RW
1801	6145		Transmit PDO 2 communication parameters		
		0	Highest sub index	Unsigned8	RO
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
		3	Inhibit time	Unsigned16	RW
		4	Event timer	Unsigned16	RW
1802	6146		Transmit PDO 3 communication parameters		
		0	Highest sub index	Unsigned8	RO
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
		3	Inhibit time	Unsigned16	RW
		4	Event timer	Unsigned16	RW
1803	6147		Transmit PDO 4 communication parameters		
		0	Highest sub index	Unsigned8	RO
		1	COB ID	Unsigned32	RW
		2	Transmission type	Unsigned8	RO
		3	Inhibit time	Unsigned16	RW
		4	Event timer	Unsigned16	RW
1A00	6656		Transmit PDO 1 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	60410010-statusword	Unsigned16	RO
		2	60440010-vl control effort	Unsigned16	RO

Table 144. Object directory index (cont).

Hex	Dec	Sub-index	Name	Type	Attr.
1A01	6657		Transmit PDO 2 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	60540020-vl velocity reference	Unsigned32	RO
		2	20040010- torque percentage	Unsigned16	RO
		3	20030010- current percentage	Unsigned16	RO
		4	20630010-fault code	Unsigned16	RO
1A02	6658		Transmit PDO 3 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	20180010-fixed status word	Unsigned16	RO
		2	20190010-actual speed in percentage	Unsigned16	RO
		3	20200010-FB process data Out 1	Integer16	RO
		4	20210010-FB process data Out 2	Integer16	RO
1A03	6659		Transmit PDO 4 mappings		
		0	Number of mapped objects	Unsigned8	RW
		1	20220010-FB process data Out 3	Integer16	RO
		2	20230010-FB process data Out 4	Integer16	RO
		3	20240010-FB process data Out 5	Integer16	RO
		4	20250010-FB process data Out 6	Integer16	RO

Service data (SDO)

With service data objects (SDOs), the access to entries of a device object dictionary is provided. Via SDO, all items from object dictionary can be read/write. These are mainly used for device configuration such as setting device parameters. They are also used to define the types and formats of the information in the process data objects. CANopen Configuration tools with EDS files can be used for this purpose.

SDO protocol can be used to read any parameter or actual value and write any parameter from the drive. These parameters are read from the drive with its ID number specified in the user manual. There are three indexes in the object dictionary as follows for any parameter service.

Table 145. Service data (SDO).

Index	Description	Size	Access type	Hi 16 b	Low 16 b
2000	AnyparameterReadID	UINT16	RW	-	Read ID
2001	AnyparameterReadValue	UINT32	RO	Status	Value
2002	AnyparameterWrite	UINT32	RW	ID	Write Value

Reading any parameter

Writing new value to index 2000 will trigger read event, while read in process index 2001 is zero. Read event will return value to index 2001. If read is success, status will get value of ID and Value is value of ID. If read fails, the status will get value 0xFFFF (Dec 65535).

Writing any parameter

When new ID and value is written to index 2002, a write event will be triggered. Index 2002 value will remain as long as writing is processed (normal SDO/PDO operation during this time). If write is success, index 2002 ID and value will be cleared and new write is possible. If write fails, ID will clamp to 0xFFFF and value zero.

Process data application mapping

Table 146. Process data application mapping index.

Hex	Dec	Sub-index	Name	Type	Attr.
2000	8192		Any parameter read ID	Unsigned16	RW
2001	8193		Any parameter read value	Unsigned32	RO
2002	8194		Any parameter write	Unsigned32	RW
2003	8196		Current percentage	Unsigned16	RO
2004	8195		Torque percentage	Unsigned16	RO
2005	8197		Motor nom. current	Unsigned16	RW
2006	8198		Motor nom. speed	Unsigned16	RW
2007	8199		Motor PF	Unsigned16	RW
2008	8200		Motor nom. voltage	Unsigned16	RW
2009	8201		Motor nom. frequency	Unsigned16	RW
200A	8202		Power up local remote select	Unsigned8	RW
200B	8203		Remote 1 control place	Unsigned8	RW
200C	8204		Local control place	Unsigned8	RW
200D	8205		Local reference	Unsigned8	RW
200E	8206		Remote 1 ref	Unsigned8	RW
200F	8207		Reverse enable	Unsigned8	RW
2010	8208		Fixed control word	Unsigned16	RW
2011	8209		Speed reference in percentage	Unsigned16	RW
2012	8210		FB process data in 1	Integer16	RW
2013	8211		FB process data in 2	Integer16	RW
2014	8212		FB process data in 3	Integer16	RW
2015	8213		FB process data in 4	Integer16	RW
2016	8214		FB process data in 5	Integer16	RW
2017	8215		FB process data in 6	Integer16	RW
2018	8216		Fixed status word	Unsigned16	RO
2019	8217		Actual speed in percentage	Unsigned16	RO
201A	8218		FB process data out 1	Integer16	RO
201B	8219		FB process data out 2	Integer16	RO
201C	8220		FB process data out 3	Integer16	RO
201D	8221		FB process data out 4	Integer16	RO
201E	8222		FB process data out 5	Integer16	RO
201F	8223		FB process data out 6	Integer16	RO
2063	8291		Fault code	Integer16	RO

Fixed control word

Refer to **Table 142** on **page 105**.

Speed reference percentage

The speed reference percentage is based off a 0 to 100.00 % (10,000) scale with 0 being 0 rpm and 10,000 indicating 100.00% speed value.

Process data in

The Process Data In values are based off the application selected. See **Appendix B** to reference the current Process Data In values assigned.

Fixed status word

Refer to **Table 143** on **page 106**.

Actual speed percentage

The actual speed percentage indicates the actual speed value of the motor. This value will be read as a 0 to 10,000 value, which indicates 0 to 100.00% speed actual.

FB process data out

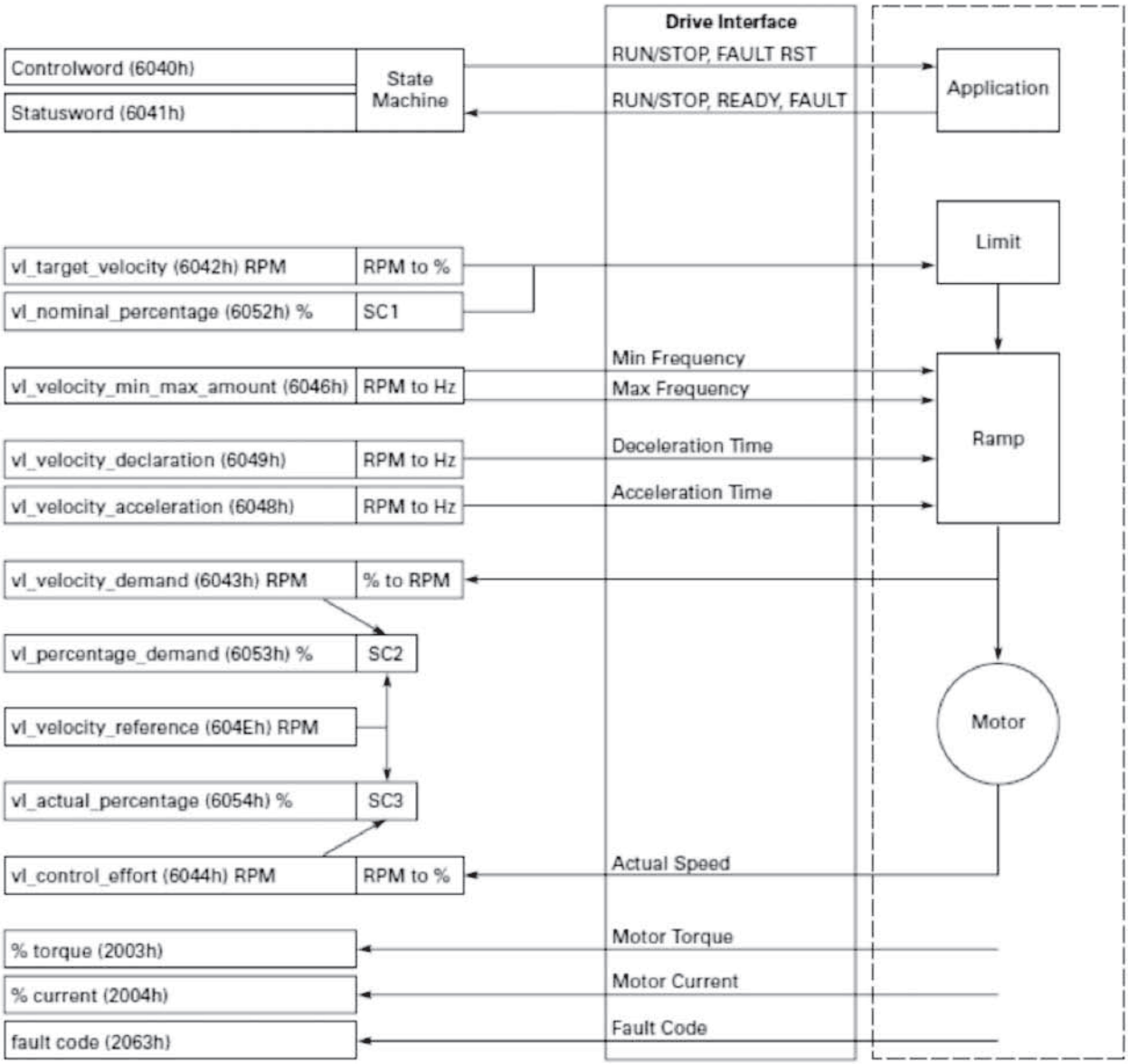
The Process Data Out value is assigned by the fieldbus parameter group in the application parameters. These eight values can be set to any available Modbus ID value listed. See **Appendix B** to reference the default Process Data Out values assigned.

Fault code

The fault code is an indication of the current fault code; the default value will be 0.

Bypass profile

Figure 26. Device profile.



SC2: Percentage Function 2

$$vl\_percentage\_demand = \frac{vl\_velocity\_demand * 0x3FFF}{vl\_velocity\_reference}$$

SC3: Percentage Function 3

$$vl\_actual\_percent = \frac{vl\_control\_effort * 0x3FFF}{vl\_velocity\_reference}$$

SmartWire-DT external communication cards

SmartWire-DT is an intelligent wiring system and makes for a reliable and easy connection of switching devices, pilot devices and I/O components with overriding bus systems possible. The components that are connected with SmartWire-DT are linked, e.g.: to SMARTWIRE-DT -DP or CANopen communication networks via gateways using SmartWire-DT masters.

With the SmartWire-DT system, up to 99 modules can be connected to form a network. Modules can include SmartWire-DT I/O modules or SmartWire-DT modules for contactors, soft starters, drives, or pilot devices. The electrical connection is effected via a special 8-pole connecting cable and the relevant plugs.

When equipped with a DXG-NET-SWD; SmartWire-DT interface module, the variable frequency drives can be connected to a SmartWire-DT system and, as a result, to a higher-level PLC. SmartWire-DT can then be used to configure, control, and monitor these devices.

SmartWire-DT specifications

Table 147. SmartWire-DT technical data.

Items	Value
Electrical and thermal safety standards	UL 508C, CSA C22.2 IEC/EN 61800-5-1
Ambient operating temperature	-10°C to +50°C IH, with de-rating up to 60 °C
Storage temperature	-40°F (-40°C) to 158°F (70°C)
Vibration	1G at 15.8—150 Hz
Interface connector	8-pin Flat Connector/5-pin M12 Connector
Transfer cable	IP20: SmartWire-DT 8-pin ribbon cable IP54: 5 pin round cable
Max. current consumption	IP20: 75 mA@15 Vdc IP54: 75 mA@24 Vdc

Line length depends on different transmission speeds.

A SmartWire-DT network can have a length of up to 600 m. The actual maximum length will depend on the baud rate and cable type (ribbon cable or round cable) being used.

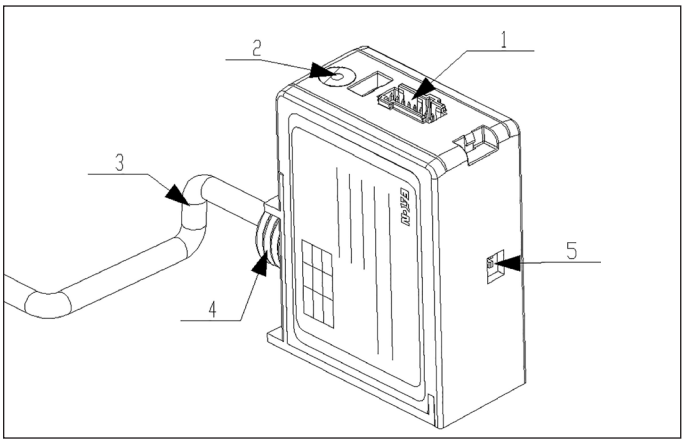
Table 148. Line length.

Baud rate	Ribbon cable	Round cable (5-pole)
125KB	600m	600m
250KB	600m	600m

Hardware specifications

PowerXL DM1 series has two SmartWire-DT communication modules, "DXG-NET-SWD-IP20" for IP20 and "DXG-NET-SWD-IP54" for IP54.

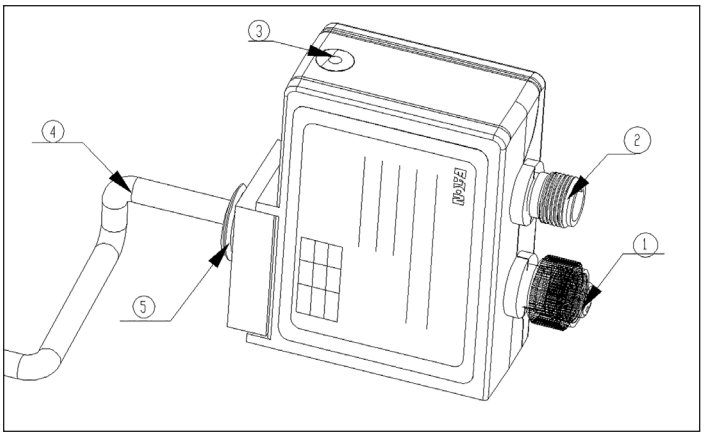
Figure 27. SmartWire-DT "DXG-NET-SWD-IP20" module details.



1. Connection of SmartWire-DT external device plug
2. SmartWire-DT dignostics LED
3. Modbus cable
4. Mounting screw
5. Selection DIP switch

The following drawing shows the DXG-NET-SWD-IP54 SmartWire-DT communication module.

Figure 28. SmartWire-DT "DXG-NET-SWD-IP54" module details.



1. Connection of SmartWire-DT external device plug out
2. Connection of SmartWire-DT external device plug in
3. SmartWire-DT dignostics LED
4. Modbus cable
5. Mounting screw

LEDs

SmartWire-DT LEDs are as stated below.

Table 149. SmartWire-DT diagnostic LED.

Color	Status	Meaning
Green	LED flashes slowly (1Hz).	Device is active, but it is not coupled to the SWD bus.
Green	LED flashes quickly (3Hz).	An error condition was discovered. Device may or may not be in normal operation.
Green	LED is turned on continuously.	Device is in normal operation

Connector details

SmartWire-DT "DXG-NET-SWD-IP20" module uses eight core flat cable whereas SmartWire-DT "DXG-NET-SWD-IP54" module uses five core round cable.

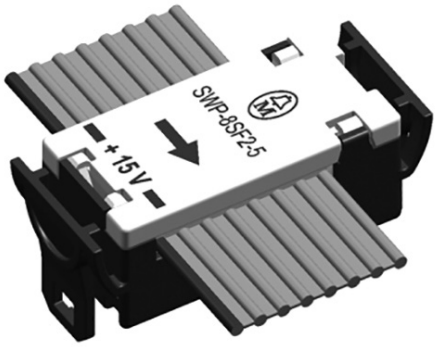


Figure 29. Eight core flat cable and pin assignment.

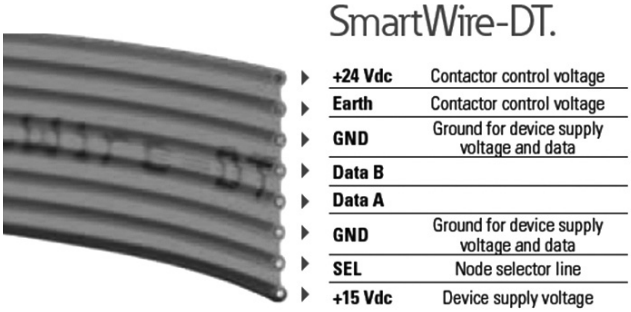
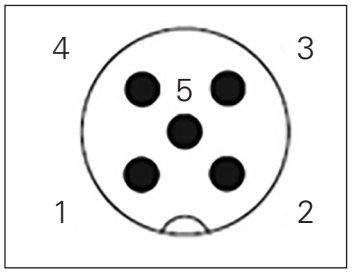


Figure 30. Five core round cable and pin assignment.

SACC-E-MS-5CON-M16/0,5 SCO - 1520055

Schematic diagram



Pin assignment M12 male connector, 5-pos., A-coded, male side

Male connector (pins) = Smartwire IN

Pin 1: -24 Vdc

Pin 2: Smartwire A

Pin 3: 0 Vdc

Pin 4: Smartwire B

Pin 5: SEL In

SmartWire-DT cable

Table 150. Recommendation for eight core flat cable.

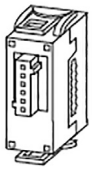
8-pin SWD4-8MF2 ribbon connectors need to be connected at the beginning and at the end of the ribbon cable.

Ribbon cables are available in various lengths and configurations. See table below:

Flat band conductor	Description
SWD4-100LF8-24	100-m long roll for making custom SmartWire-DT cables
SWD4-3LF8-24-2S SWD4-5LF8-24-2S SWD4-10LF8-24-2S	Prefabricated cable (with lenght of 3, 5, or 10 m) with two 8-pin SWD4-8MF2 ribbon connectors

All SmartWire-DT modules inside a control panel need to be connected to the ribbon cable using an 8-pin SWD4-8SF2-5 external device plug.

Figure 31. External device plug SWD4-8SF2-5.



The SmartWire-DT round cable is used as a connecting cable for connecting to the SmartWire-DT communication system. The SmartWire-DT round cable is the only way to guarantee error-free transmissions up to the maximum possible SmartWire-DT network length of 600 m.

Prefabricated cables with two M12 plug connectors (socket, plug).

Table 151. Recommendation for five core round cable.

Cable	Description
SWD4-M1LR5-2S	SWD cable, 5-pole, 0.1 m, M12-M/M12-F
SWD4-M3LR5-2S	SWD cable, 5-pole, 0.3 m, M12-M/M12-F
SWD4-M6LR5-2S	SWD cable, 5-pole, 0.6 m, M12-M/M12-F
SWD4-1LR5-2S	SWD cable, 5-pole, 1.0 m, M12-M/M12-F
SWD4-1M5LR5-2S	SWD cable, 5-pole, 1.5 m, M12-M/M12-F
SWD4-2LR5-2S	SWD cable, 5-pole, 2.0 m, M12-M/M12-F
SWD4-3LR5-2S	SWD cable, 5-pole, 3.0 m, M12-M/M12-F
SWD4-5LR5-2S	SWD cable, 5-pole, 5.0 m, M12-M/M12-F
SWD4-10LR5-2S	SWD cable, 5-pole, 10.0 m, M12-M/M12-F

Gateways for using SmartWire-DT module

The DXG-NET-SWD SmartWire-DT interface module's interoperability is guaranteed with the following SmartWire-DT gateway versions (and higher).

Table 152. Firmware versions of SmartWire-DT gateways.

SmartWire-DT gateway	Firmware version
EU5C-SWD-CAN	V 1.30
EU5C-SWD-DP	V 1.30

Fieldbus description files

The DXG-NET-SWD SmartWire-DT interface module's interoperability is guaranteed with the following versions (and higher) of the fieldbus description file for the gateways listed below.

Table 153. Compatible field bus description files.

SmartWire-DT gateway	Description file
EU5C-SWD-CAN	from EU5C-SWD-CAN_V130.eds Rev.42
EU5C-SWD-DP (Intel-based CPU)	from Moel14.gsd (V. 1.19)
EU5C-SWD-DP (Motorola-based CPU)	from Moel14.gsd (V. 1.18)
SWD master (i. e. XV100)	from ASIC FW Version 2.01 Build: 0081

SWD-assist

The SWD-Assist program provides valuable support in the engineering of your SmartWire-DT topology. SWD-Assist is software that runs under operating systems Windows 2000 (SP 4), Windows XP, Windows Vista (32-bit) or Windows 7/10 and relieves you of the planning work required for an SWD topology.

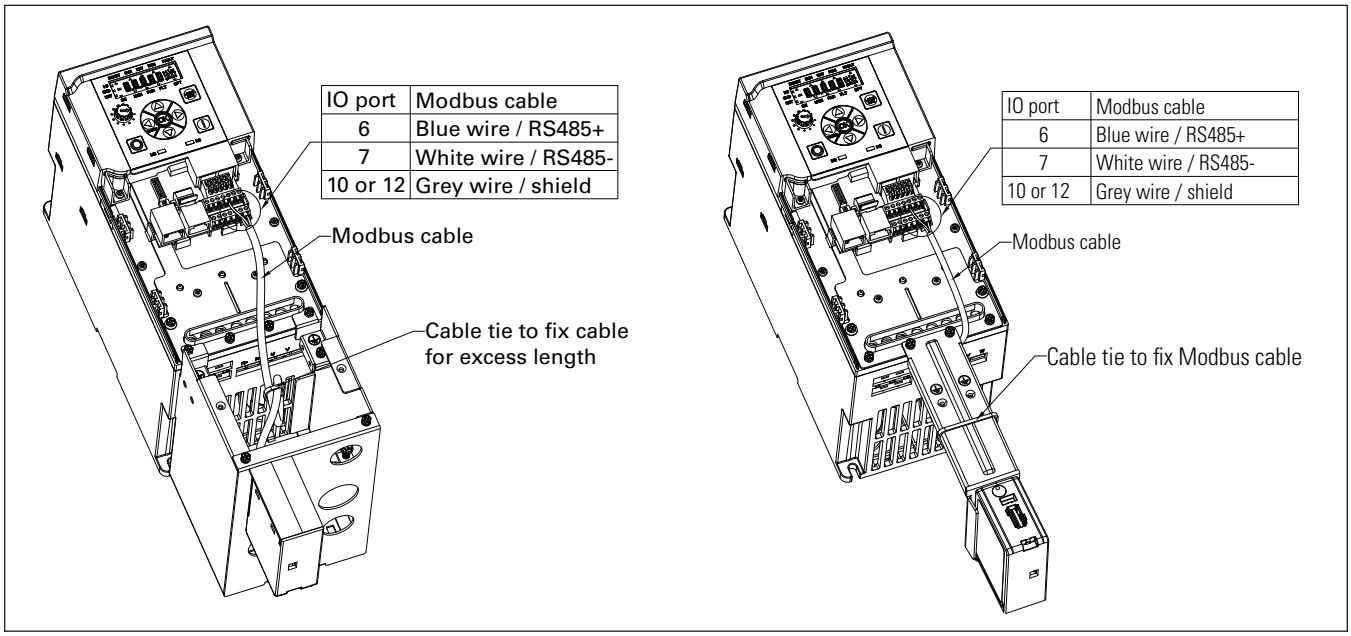
The DX-NET-SWD… SmartWire-DT interface module can be used in SWD-Assist version V 2.50 and higher.

The SWD-Assist program can be downloaded for free on the Internet at: http://downloadcenter.moeller.net

Connection of SmartWire-DT module to drive

SmartWire-DT "DXG-NET-SWD-IP20" &
"DXG-NET-SWD-IP54" modules are attached to PowerXL DM1 drive at the bottom cable insert area as shown below.

Figure 32. Connection of SmartWire-DT module to PowerXL DM1 drive.



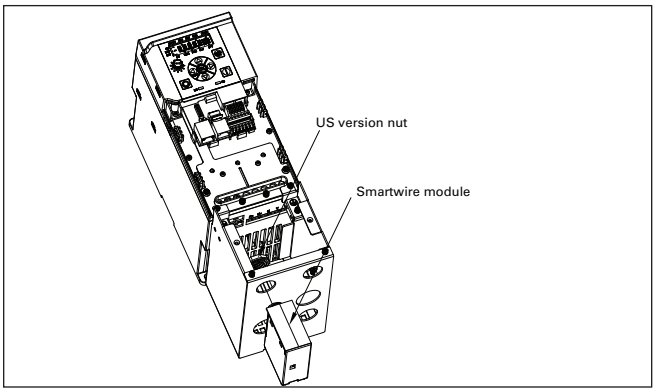
Installation

Mounting

Mounting of SmartWire-DT "DXG-NET-SWD-IP20" module

DXG-NET-SWD-IP20 modules can be installed in PowerXL DM1 VFD with an IP20 degree of protection.

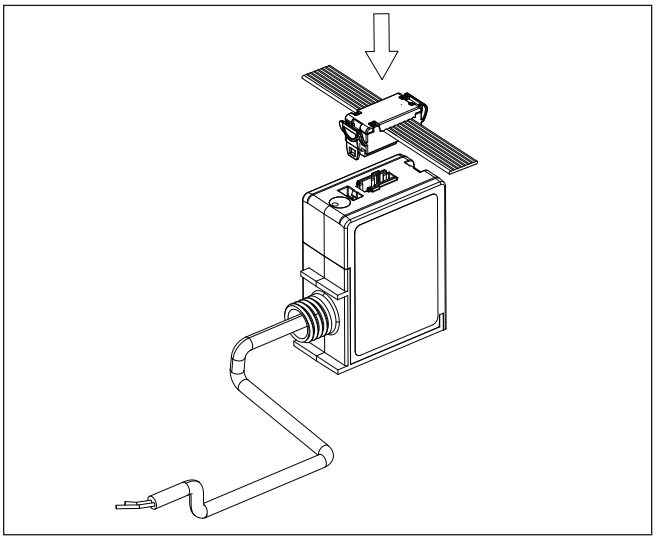
Figure 33. Mounting of SmartWire-DT "DXG-NET-SWD-IP20" module on PowerXL DM1 drive.



Connection of SmartWire-DT flat cable

Connect the SWD external device plug SWD4-8SF2-5 with the adapted SmartWire-DT ribbon cable.

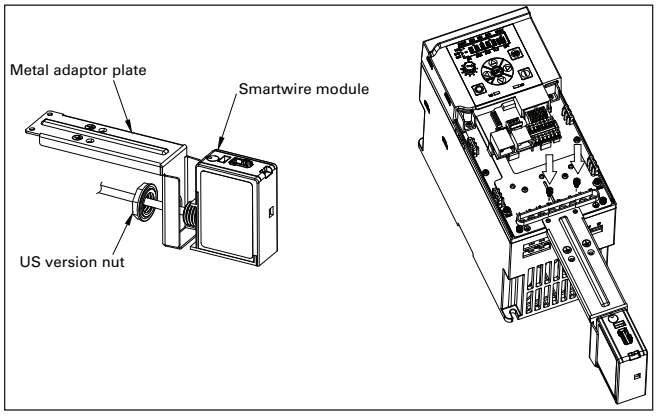
Figure 34. Connection of flat cable with SmartWire-DT "DXG-NET-SWD-IP20" module.



Mounting of SmartWire-DT "DXG-NET-SWD-IP54" module

DXG-NET-SWD-IP54 modules can be installed in PowerXL DM1 variable frequency drive with an IP54 degree of protection.

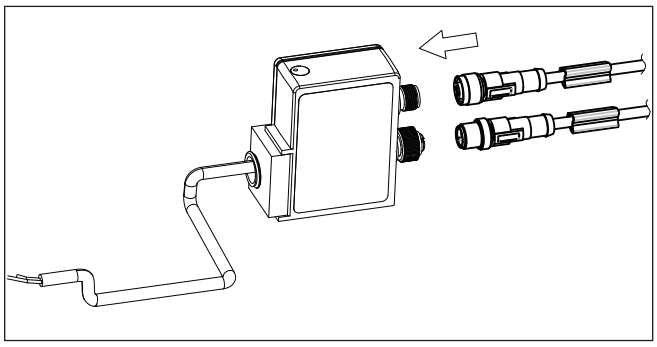
Figure 35. Mounting of SmartWire-DT "DXG-NET-SWD-IP54" module on PowerXL DM1 drive .



Connection of SmartWire-DT round cable

Connect the SWD external device plug SWD4-8SF2-5 with the adapted SmartWire-DT ribbon cable.

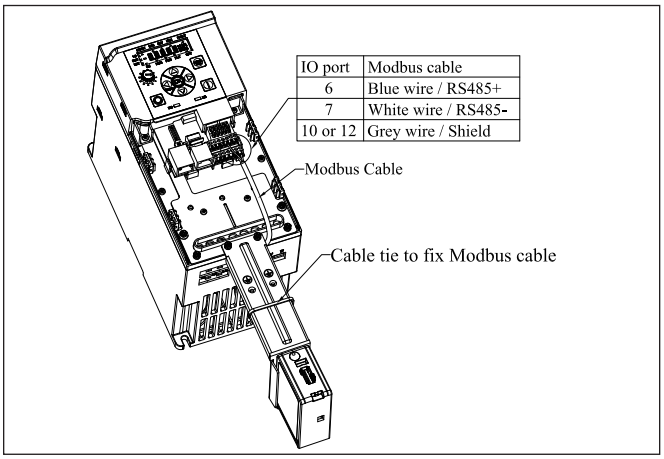
Figure 36. Connection of round cable with SmartWire-DT "DXG-NET-SWD-IP54" module.



Commissioning

The SmartWire-DT module is commissioned by connecting it to the RS-485 communication port via the A and B terminals on the drives control board. Once the module is connected to the terminal, select "SWD" from keypad menu "RS485 Comm Set". The keypad will now start showing SWD menu. The device will recognize it and will show a warning for "Device Added". This warning will be shown for five seconds and will be cleared.

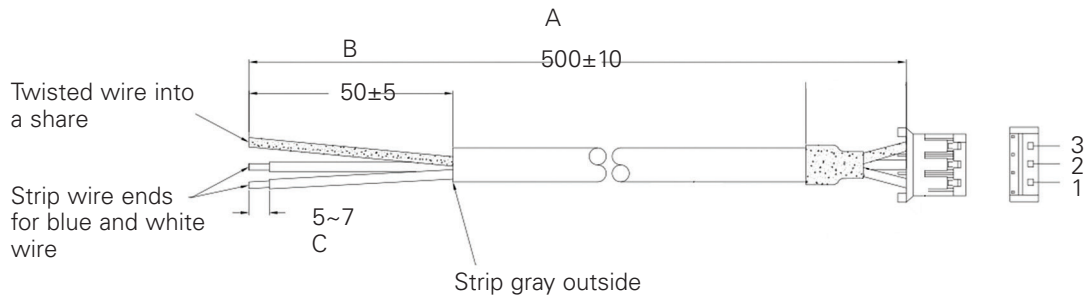
Figure 37. Connection of SmartWire-DT module with PowerXL DM1 drive.



SWD board	Black	Blue	White
PowerXL DM1 control board	Ground	A	B

The following diagram and table are the recommended wire lengths by frame size. Actual cable length is dependent on customer cable route.

Figure 38. Recommended wire lengths.



A connection	
Shielded braid wire to ground	1
Blue	2
White	1

Table 154. Recommended cable lengths.

	A (Length of recommended gray wire)	B (Length of recommended strip length for gray insulation cable)	C (Length of recommended strip length for blue and white wire)
Frame 1	200 mm	50 mm	5-7 mm
Frame 2	250 mm	50 mm	5-7 mm
Frame 3	350 mm	50 mm	5-7 mm
Frame 4	450 mm	50 mm	5-7 mm
Frame 5	500 mm (no change)	50 mm	5-7 mm
Frame 6	500 mm (no change)	50 mm	5-7 mm

Table 155. SmartWire-DT parameters.

DM1 code	Parameter	Min.	Max.	Unit	Default	ID	Note
11.5.1	Parameter access	0	1		1		0=Local control; 1=Fieldbus
11.5.2	Process data access	0	5		1		0=Local control; 1=Fieldbus; 2=NET control, local ref.; 4=NET, local on fault; 5=NET & local CMD;
11.5.3	Fault situation counter						
11.5.4	Board status				0		B0 = Optional comm. card fault B1 = Board HW fault B2 = Reserved B3 = Fieldbus fault B4 = Reserved
11.5.5	Firmware version						V2.00.0007
11.5.6	Protocol status				0		B0 = Waiting for parameterization B1 = Parameterization fault B2 = Waiting for configuration B3 = Configuration fault B4 = Data exchange

SmartWire-DT – PowerXL DM1 series

General

Cyclic and acyclic data as well as diagnostic data can be transferred via the SmartWire-DT system. The number of cyclic data is variable and is defined with the aid of profiles. The cyclical and acyclical data used by PowerXL DM1 variable frequency drives has been designed in such a way as to match the following profiles and meet the following standards:

- The standard specified by SmartWire-DT;
- The PROFIdrive profile.

The appropriate profile can be selected by the user.

Operation mode

The parameter Operation Mode B19.1.1.4 above shows the mode in which SmartWire-DT module is working.

PD2x16 bit profile

This group supplements the variable frequency drive profile with the PROFIdrive profile as the PNO has defined for the cyclic data-exchange with a drive. Control and status data will be processed according to the PROFIdrive profile.

8 bit profile

Control and status data will be processed as per the I/O link profile.

1-0-A switch

The drive is controlled by dip switch to test the functionality. The 1-0-A switch's positions are as follows:

- 1: Variable frequency drive is activated;
- 0: Variable frequency drive deactivated;
- A: switching command via SmartWire-DT.

Note: Intermediate 1-0-A switch positions are not permitted, and will have no defined function.

PowerXL DG1 SmartWire-DT interface

PowerXL DG1 has SmartWire-DT profile 4.1, which allows –

- Direct control of the drive using PROFIBUS Master
- Full access to all drive parameters

Cyclic data

The amount of cyclical input/output data (process data) for the variable frequency drive can be adjusted as necessary for the application at hand by using the various profiles. These profiles can be selected in the hardware/PLC configuration program (in the SWD-Assist program).

Table 156. Cyclic profile data

Profile	Input bytes (status)						Output bytes (control)						Bytes
	0	1	2	3	4	∑	0	1	2	3	4	∑	∑
DXG-NET-SWD 8 bit	SMARTWIRE-DT	FU				1+1	SMARTWIRE-DT	FU				1+1	4
DXG-NET-SWD PD 2 x 16-Bit	SMARTWIRE-DT	FU	FU	FU	FU	1+4	SMARTWIRE-DT	FU	FU	FU	FU	1+4	10

Control word and status word

Profile 1 (8 bit): inputs (status)

Table 157. Profile 1: input bytes 0 and 1.

Byte	Bit	Designation	Meaning
0	0	--	NA
	1	--	NA
	2.3	A1, A2	1-0-A switch on DXG-NET-SWD
			00 = Pos. A(utomatic)
			01 = Pos. 0 (off)
			10 = Pos. 0 (off)
			11 = Pos. 1 (on)
	4	DIAG	Diagnostics present
	5	--	NA
	6	PRSNT	Device present
	7		NA

1	0	ERR	**Error present** 0: No error 1: Error Indicates whether there is a variable frequency drive fault. If there is one, the device will respond as configured in PNU **840.29953**
	1	WARN	**Warning present** 0: No warning 1: Warning Indicates whether there is a variable frequency drive warning.
	2	RDY	**Ready, switched on** 0: Not switched on 1: Switched on Indicates Power supply is switched on, electronics initialized, main contact, if available, has dropped out, pulses are inhibited.
	3	RUN	**Run** 0: Not running 1: Running Indicates drive follows set point. This means, that the electronic and pulses are enabled.
	4	f-Level	Actual speed is greater than the signaling threshold. 0: Actual speed is less than or equal to the signaling threshold. 1: Actual speed is greater than the signaling threshold If the actual speed is greater than the value set on relay. Output 1, the value will be 1. Otherwise, it will be 0.
	5	Q5 (Output 1)	Q5 (Output 1)
	6	Q6 (Output 2)	Q6 (Output 2)
	7	Q7 (Output 3)	Q7 (Output 3)

Profile 1 (8 bit): outputs (control)

Table 158. Profile 1: output bytes 0 and 1.

Byte	Bit	Designation	Meaning
0	0	FWD	**Start reverse** A value of 1 will start the variable frequency drive in the clockwise operating direction.
	1	REV	**Start anti-clockwise operation** A value of 1 will start the variable frequency drive in the anti-clockwise operating direction.
	2	EN_Op	**Enable operation** 0: Stop (immediate disconnection of the output); 1: Operation. If this bit has a value of 0, the variable frequency drive's output will be switched off directly. To start the device, this bit must be set to a value of 1 and the FWD or REV bit must be set to 1 as well.
	3	FaultAck	**Fault acknowledge** 0: Do not acknowledge current fault. 1: Acknowledge current fault (rising edge: 0 ⟶ 1). This bit can be used to reset a fault in the variable frequency drive. The fault acknowledge function will only respond to a rising edge, i.e., to the value changing from 0 to 1.
	4	I4 (Input 1)	**Programmable input 1** Reserved – not used as of this writing.
	5	I5 (Input 2)	**Programmable input 2** Reserved – not used as of this writing.
	6	I6 (Input 3)	**Programmable input 3** Reserved – not used as of this writing.
	7	I7 (Input 4)	**Programmable input 4** Reserved – not used as of this writing.
1	0-7	--	Reserved – not used as of this writing.

Profile 2 (2 x 16 bit): inputs (status)

Table 159. Profile 2: input bytes 0 to 4.

Byte	Bit	Designation	Meaning
0	0	--	Not used.
	1	--	Not used.
	2.3	A1, A2	**1-0-A-switch on DXG-NET-SWD**
			00 = Pos. A(utomatic)
			01 = Pos. 0 (off)
			10 = Pos. 0 (off)
			11 = Pos. 1 (on)
	4	DIAG	0: No diagnostic alarm. 1: Diagnostic alarm present.
	5	--	Not used.
	6	PRSNT	0: Device not present. 1: Device present.
	7	--	Not used.

Table 159. Profile 2: input bytes 0 to 4 (cont).

Byte	Bit	Designation	Meaning
1	0	RSO	**Ready for switching on: S2** 0: Not ready for switching on. 1: Ready for switching on. If this bit has a value of 1, the variable frequency drive is ready to be switched on and has status 2.
	1	RDY	**Ready to operate; switched on: S3** 0: Not ready for operation. 1: Ready for operation, If this bit has a value of 1, the variable frequency drive is ready for operation and has status 3. This means that the device can be switched on immediately.
	2	EN	**Enabled; operation: S4** 0: Stop. 1: Operation. If this bit has a value of 1, the variable frequency drive's power section (IGBTs) is active.
	3	ERR	**Error present** 0: No error. 1: Error. Indicates whether there is a variable frequency drive fault. If there is a fault, the variable frequency drive/variable speed starter will respond as configured in PNU **840.29953.**
	4	C_Stop	**Free run-down, output de-energized (coast stop)** 0: No free run-down. 1: Free run-down. If this bit has a value of 1, the variable frequency drive is coasting and the output is de-energized.
	5	Q_Stop	**Quick stop, shortest ramp** 0: No quick stop. 1: Quick stop. If this bit has a value of 1, the variable frequency drive is stopping with the shortest ramp and the output is not de-energized.
	6	SOI	**Reclosing lockout (switching on inhibited: S1)** 0: No switch-on inhibit. 1: Switch-on inhibit. If this bit has a value of 1, the variable frequency drive is in reclosing lockout mode and cannot be started.
	7	WARN	**Warning present** 0: No warning. 1: Warning. Indicates whether there is a variable frequency drive warning.
2	8	f =f-Ref	**Operation at setpoint** 0: Ref. frequency not reached. 1. Ref. frequency reached. As long as the slip compensation is lower than 5%, this parameter will have a value of 1. The bit's value will change to 0 for values higher than 5%.
	9	Ctl_Req	**Control requested to PLC** Is set if PNU 928.0 = 1 - 5. 0: Not ready for remote control. 1, 2, 4, 5: Ready for remote control. If the bit has a value of 1, the variable frequency drive can be controlled with the help of a PLC. If the bit has a value of 0, the variable frequency drive is not ready to be controlled by a PLC. The variable frequency drive may be in local or terminal control mode.
	10	f-Level	**Size comparison actual value - signaling threshold** 0: Actual speed is less than or equal to the signaling threshold. 1: Actual speed is greater than the signaling threshold. As soon as the actual speed is greater than the value set on relay output 1, the value will be set to 1. Otherwise, this bit will have a value of 0.
	11	Q11 (Output 1)	**Output Q1** Reserved – not used as of this writing.
	12	Q12 (Output 2)	**Output Q2** Reserved – not used as of this writing.
	13	Q13 (Output 3)	**Output Q3** Reserved – not used as of this writing.
	14	Q14 (Output 4)	**Output Q4** Reserved – not used as of this writing.
	15	--	Reserved – not used as of this writing.
3, 4	0..15	ActSpeed	**Actual speed** Provides the current speed as an integer value between -200% and 200%. 100 % ≙ 4,000 hex

Profile 2 (2 x 16 bit): outputs (control)

Table 160. Profile 2: output bytes 0 and 4 .

Byte	Bit	Designation	Meaning
0	0	OnOff	**On/off** 0: Normal stop (with configured ramp time). 1: Operation. This bit needs to be toggled once in order to start operation. This bit will not start or stop the device during normal operation.
	1	Off2	**Run-down (coast stop: Off 2)** 0: Coast stop (switch off output voltage). 1: No free run-down. If this bit has a value of 0, the variable frequency drive is coasting and the output is de-energized. If it has a value of 1, the variable frequency drive is running normally. This bit will not start or stop the device during normal operation.
	2	Off3	**Quick stop: Off3** 0: Quick stop (shortest ramp). 1: Nno quick stop. If this bit has a value of 0, the device will be stopped with a quick stop with the shortest ramp time. If it has a value of 1, the variable frequency drive is running normally. This bit will not start or stop the device during normal operation.
	3	EN_Op	**Operation released** 0: Stop. 1: Operation. If this bit has a value of 0, the variable frequency drive will stop. If it has a value of 1, the variable frequency drive's output will be enabled. This bit will start and stop the device during normal operation.
	4	EN_Ramp	**Release ramp (enable ramp generator)** 0: Reset ramp (set point value = 0). 1: Release ramp. If this bit has a value of 0, the variable frequency drive will remain stopped; the output will not be switched off. If it has a value of 1, the ramp enable signal will be activated and the device will start with the set ramp.
	5	Unfreeze	**Unfreeze ramp** 0: Freeze ramp (the ramp generator's current output value will be frozen). 1: Do not freeze ramp. If this bit has a value of 0, the variable frequency drive will continue running with the most recently set frequency; the output will not be switched off. If this occurs after the ramp time elapses, this will have no effect until the next set point change. If the bit has a value of 1, the device will continue running along the set ramp all the way to the frequency set point.
	6	EN_Set	**Enable setpoint** EN_Set enables the set point value and starts or stops the motor with the ramp function. 0: Do not activate set point value. 1: Activate set point value. If this bit has a value of 0, the variable frequency drive will not receive a set point and will remain at the minimum frequency; the output will not be switched off. If it has a value of 1, the set point will be activated.
	7	FaultAck	**Fault acknowledge** 0: Do not acknowledge current fault. 1: Acknowledge current fault (rising edge: 0 –> 1). This bit can be used to reset a fault in the variable frequency drive. The fault acknowledge function will only respond to a rising edge, i.e., to the value changing from 0 to 1.

Table 160. Profile 2: output bytes 0 and 4 (cont).

Byte	Bit	Designation	Meaning
1	8	Jog 1	Jog with set point value 1. If this bit and byte 1, bit 0 (OnOff) are set to 1 after byte 0, bit 2 (Ctl_PLC); byte 1, bit 1 (Off2); byte 1, bit 2 (Off3); and byte 1, bit 3 (EN_OP) have been set to 1,the variable frequency drive will start with fixed frequency 1 in the forward operating direction.
	9	Jog 2	Reserved – not used as of this writing.
	10	Ctl_PLC	PLC assumes control (Control by PLC). 0: No control via PLC. 1: Control via PLC. If this bit has a value of 1, the PLC will be able to control the variable frequency drive. Before this, the variable frequency drive will not carry out any commands it receives from the PLC. If the bit has a value of 0, the PLC will not be able to control the variable frequency drive.
	11	I11 (Input 1)	**Programmable input 1** Reserved – not used as of this writing.
	12	I12 (Input 2)	**Programmable input 2** Reserved – not used as of this writing.
	13	I13 (Input 3)	**Programmable input 3** Reserved – not used as of this writing.
	14	I14 (Input 4)	**Programmable input 4** Reserved – not used as of this writing.
	15	ExtFault	**External fault** If this bit is set, the variable frequency drive will stop with a selected PNU 840.29953 function. The behavior is the same as if there were a change from 1 –> 0 in the enable signal, with the exception that the variable frequency drive will switch to the error status. The external fault can be reset just like any other fault (with fault acknowledge (bit 7) or by switching the supply voltage off and back on). 0: No external fault. 1: External fault.
2,3	0..15	Setpoint	**Setpoint as a percentage** The setpoint is specified as an integer value between -100 % and 100 %: 100% = 4,000 hex = 16,384 dec -100% = -4,000 hex = -16,384 dec.

Table 161. References table for setpoint/actual speed.

SN	N2 data type hex	N2 data type decimal	N2 data type percentage	Frequency in decimal
1	0x4000	16384	100	50
2	0x 3000	12288	74	37
3	0x 2000	8192	50	25
4	0x 1000	4096	24	12
5	0x 0000	0	0	0
6	0x F000	61440	–25	12
7	0x E000	57344	–50	25
8	0x D000	53248	–75	37
9	0x C000	49152	–100	50

SmartWire-DT diagnostics

The variable frequency drive supplies diagnostic messages for itself and for the DXG-NET-SWD… SmartWire-DT connection.

Basically, a distinction must be drawn between:

- Basic diagnostics (basic SmartWire-DT diagnostics);
- Advanced diagnostics (advanced SmartWire-DT diagnostics);
- PROFIdrive parameter channel diagnostics.

PROFIdrive parameter channel diagnostics are shown with fault messages or warnings in the cyclic profile with PROFIdrive (profile 2).

Basic SWD diagnostics

A pending diagnostic alarm from the variable frequency drive will be signaled as a collective diagnostic in the cyclic profile with input byte 0, bit 4 (DIAG). A device response, if any, will be described in the advanced diagnostics.

In addition, in all profiles, the following bits:

- ERR (the variable frequency drive stops); or
- WARN (no reaction of the variable frequency drive).

In the corresponding input bytes are used to show whether there are any diagnostic alarms (i.e. errors or warnings).

Advanced SmartWire-DT diagnostics

When there is a collective diagnostic (input byte 0, bit 4 (DIAG)), the variable frequency drive will provide advanced diagnostic messages.

The following messages are generated by the variable frequency drive

After the cause of the fault is fixed, you can acknowledge a fault (ERR) as follows:

- Profile: FaultAck = 1;
- 1-0-A switch in position 0.

Warnings (WARN) cannot be acknowledged, since they are simply messages without an ensuing response (the variable frequency drives).

The diagnostic data that corresponds to the PROFIdrive profile can be sent at any time regardless of the profile chosen. It is provided via the acyclic services of the relevant bus system.

Note: For available diagnostic alarms FaultBuffer: PNU 947 sub-index 0 to 7.

Table 162. Diagnostic alarms of the PowerXL DM1 variable frequency drive.

Value [hex]	Meaning	Remedy	Notes
0x14	No communications between the PowerXL DM1 communication module and the PowerXL DM1 inverter or internal error in the communication module (board fault).	If the error continues, switch the supply voltage off/on: • Check EMC; • Replace the variable frequency drive.	
0x19	There is a warning from the PowerXL DM1 inverter	Read warning PNU 882.0 and fix the cause.	Corresponds to the WARN bit in the corresponding input byte.
0x1A	There is a PowerXL DM1 inverter error	Read fault PNU 944 to PNU 952 • Fix the fault and acknowledge the fault message.	Corresponds to the ERR bit in the corresponding input byte

BACnet/IP on-board communication — PowerXL DM1

BACnet stands for building automation and control networks. It is the common name for the communication standard ISO 16484-5 that defines the methods and the protocol for cooperating building automation devices to communicate. Devices can be designed to operate using BACnet communication protocol as well as utilizing BACnet protocol to communicate between systems. BACnet is an internationally accepted protocol for building automation (such as lightning control, air conditioning, and heating automation) and control over a communications network. BACnet provides a method by which computer-based control equipment, from different manufacturers can work together, or "interoperate". For this to be achieved, components must be able to exchange and understand BACnet data messages. Your drive is equipped with BACnet support as standard.

BACnet/IP specifications

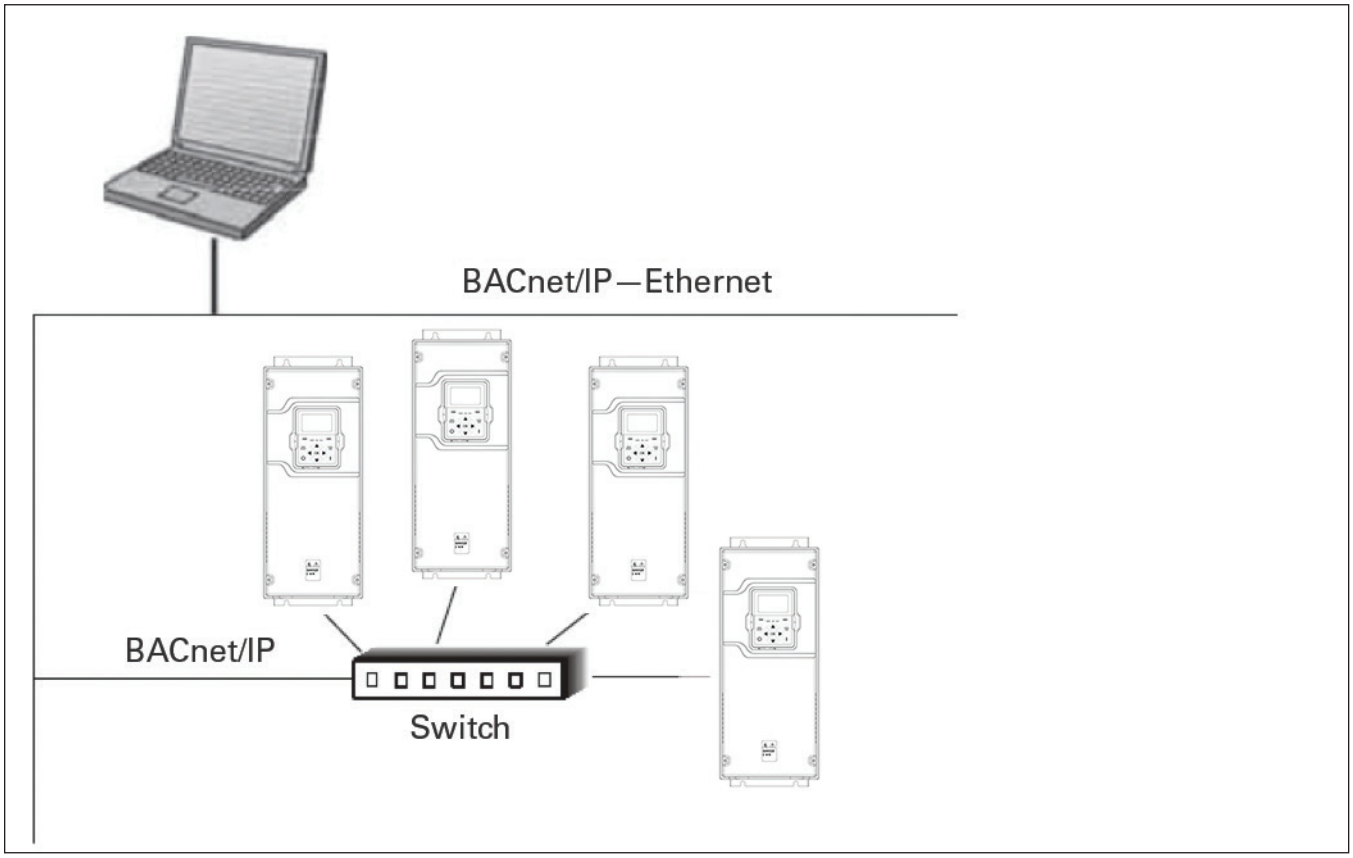
Table 163. BACnet/IP protocol.

Connection	Communication
Interface	100BaseTX, IEEE 802.3 compatible
Data transfer method	Ethernet half-/full-duplex
Data transfer speed	10/100 MBit/s, autosensing
Protocol	BACnet over UDP/IP
Connector	Shielded RJ45 connector
Cable type	CAT5e STP
BACnet/IP	As described in ANSI/ASHRAE Standards 135-2012
Default/IP	Selectable: Fixed or DHCP

BACnet/IP connections

The control board is located inside the control unit of the drive.

Figure 39. Principle example diagram of BACnet.



Prepare to use BACnet/IP through RJ45 port

1. Open the cover of the AC drive.

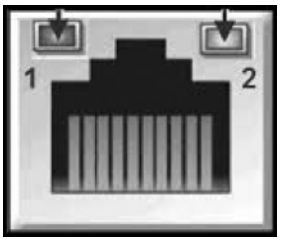
⚠ WARNING

The relay outputs and other I/O-terminals may have a dangerous control voltage present even when drive is disconnected from mains.

2. Connect ethernet cable.
3. Remount the AC drive cover.

Note: When planning the cable runs, remember to keep the distance between the fieldbus cable and the motor cable at a minimum of 11.81 in. (30 cm).

RJ45 port LED indications



RJ45 LED

1. Ethernet link status.
2. Ethernet link speed.

Commissioning

Connections and wiring

The RJ45 port supports 10/100 Mb speeds in both full and half-duplex modes. The boards must be connected to the RJ45 network with a shielded CAT-5e cable. A crossover cable (at least CAT-5e cable with STP, shielded twisted pair) may be needed if you want to connect the drive directly to the master appliance.

Use only industrial standard components in the network and avoid complex structures to minimize the length of response time and the amount of incorrect dispatches. It is often a good practice to use a subnet that is different from other devices not related to the drive control.

Figure 40. CAT-5e cable.

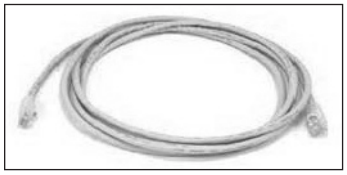


Table 164. Ethernet communication.

P12.1 - Basic settings.					
P12.1.1ⓘ	***IP address mode***				**ID 1500**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Static IP; or 1 = DHCP with AutoIP.				
Description:	This parameter defined the IP address configuration mode for EIP/modbus TCP. **Note:** When this is changed, the drive resets..				
P12.1.2	***Active IP address***				**ID 1507**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active IP address.				
P12.1.3	***Active subnet mask***				**ID 1509**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active subnet mask.				
P12.1.4	***Active default gateway***				**ID 1511**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current active default gateway.				
P12.1.5	***MAC address***				**ID 1513**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Description:	Reads the current MAC address.				
P12.1.6ⓘ	***Static IP address***				**ID 1501**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.254
Description:	Defines the static IP address.				
P12.1.7ⓘ	***Static subnet mask***				**ID 1503**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	255.255.255.0
Description:	Defines the static subnet mask.				

Table 164. Ethernet communication (cont).

P12.1.8 ⓘ	***Static default gateway***				**ID 1505**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.1
Description:	Defines the static default gateway.				
P12.1.9	***Ethernet communication timeout***				**ID 611**
Minimum value:	0.00 ms	**Maximum value:**	60,000 ms	**Default value:**	10,000 ms
Description:	Selects the time it waits before a communication fault occurs over ethernet. **Note:** When this is set to 0, it will mask the fault.				

P12.2 - Trusted IP filter (DM1 PRO only).

P12.2.1	***Trusted IP white list***				**ID 68**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	192.168.1.255 0.0.0. 0 0.0.0.0
Description:	Defines the IP addresses in the white list. A setting of 192.168.1.255 enables all connections on the local subnet.				
P12.2.2	***Trusted IP filter enable***				**ID 76**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	1
Options:	0 = Disabled; or 1 = Enabled.				
Description:	Enables IP white listing. Devices not in the white list will not be able to establish communications with the drive.				

P12.3 - Modbus TCP (DM1 PRO only).

P12.3.1 ⓘ	***Modbus TCP enable***				**ID 1942**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Disable; or 1 = Enable.				
Description:	Enables modbus TCP communications, must be enabled to connect to Power Xpert inControl. **Note:** When this is changed, the drive will reset itself.				
P12.3.2	***Modbus TCP connection limit***				**ID 609**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	5
Description:	Maximum number of connections allowed to the drive.				
P12.3.3	***Modbus TCP unit identifier number***				**ID 610**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	1
Description:	Unit identifier unit value for modbus TCP.				
P12.3.4	***Modbus TCP protocol status***				**ID 612**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Options:	0 = Stopped; 1 = Operational; or 2 = Faulted.				
Description:	This parameter shows the protocol status for modbus TCP communication.				
P12.3.5	***Modbus TCP fault response***				**ID 2517**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Only in fieldbus control mode - when fieldbus is the control place and fieldbus fault is active, the drive will fault on loss of communications. If not in fieldbus control, drive will not fault. 1 = In all control modes - no matter the control place setting, if communication is lost, fieldbus fault response will occur.				
Description:	Defines the fieldbus fault condition for modbus TCP communication.				

Table 164. Ethernet communication (cont).

P12.4 - Ethernet IP (DM1 PRO only).					
P12.4.1①	***Ethernet based protocol select***				**ID 1997**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0,DISABLED,Disabled; 1,ETHERNET_IP,Ethernet IP; 2,BACNET_IP,BACnet IP				
Description:	Selects the active communication protocol on the ethernet I/P port.				
P12.4.2	***Ethernet IP protocol status***				**ID 608**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	N.A.
Options:	0 = Off; 1 = Operational; or 2 = Faulted.				
Description:	Indicates if ethernet protocol is active or not.				
P12.4.3	***Ethernet IP fault response***				**ID 2518**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Only in fieldbus control mode - when fieldbus is the control place and Fieldbus fault is active, the drive will fault on loss of communications. If not in fieldbus control, drive will not fault. 1 = In all control modes - no matter the control place setting. If communication is lost, fieldbus fault response will occur.				
Description:	Defines the fieldbus fault condition for ethernet IP communication.				

DHCP

The BACnet/IP network communication supports DHCP for easier network configuration. Dynamic Host Configuration Protocol (DHCP) is a network protocol that is used to configure network devices so that they can communicate on an IP network. As a DHCP client, the device negotiates with the DHCP server to determine its IP address and obtain any other initial configuration details it needs for network operation.

IP address

IP is divided into four parts. (Part = Octet) Default Static IP Address is 192.168.1.254

Communication timeout

Defines how much time can pass from the last received message from the client device before fieldbus fault is generated. Default communication timeout is 10 seconds.

Note: If the network cable is broken from the RJ45 port, a fieldbus error is generated immediately.

Static IP address

In most cases the user may want to establish a static IP address for the BACnet/IP based on their network configuration.

Static IP address default configurations are as defined in "EtherNet/IP network settings" table, provided in "Connections and Wiring" section.

The user can manually define the network address for the BACnet/IP as long as all units connected to the network are given the same network portion of the address. In these situations, the user will need to manually set the IP address in the device by using the drive keypad. Be aware that overlapping IP addresses can cause conflicts between devices on the network. For more information about selecting IP addresses, contact your network administrator.

Enable BACnet/IP

The enable BACnet/IP will enable the BACnet/IP ability and disable the BACnet MSTP protocol function.

Table 165. BACnet/IP.

P12.5 - BACnet IP (DM1 PRO only).					
P12.5.1①	***BACnet IP UDP port number***				**ID 1733**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	47,808
Options:	47808 = BAC0; 47809 = BAC1; 47810 = BAC2; 47811 = BAC3; 47812 = BAC4; 47813 = BAC5; 47814 = BAC6; 47815 = BAC7; 47816 = BAC8; 47817 = BAC9; 47818 = BACA; 47819 = BACB; 47820 = BACC; 47821 = BACD; 47822 = BACE; or 47823 = BACF.				
Description:	Defines the BACnet UDP port number.				
P12.5.2①	***BACnet IP foreign devise***				**ID 1734**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Disabled; or 1 = Enabled.				
Description:	Enables BACNET IP foreign device configuration.				
P12.5.3①	***BACnet IP BBMD IP***				**ID 1735**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0.0.0.0
Description:	Displays the BACnet BBMD IP address.				
P12.5.4①	***BACnet IP UDP port***				**ID 1737**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	47,808
Options:	47808 = BAC0; 47809 = BAC1; 47810 = BAC2; 47811 = BAC3; 47812 = BAC4; 47813 = BAC5; 47814 = BAC6; 47815 = BAC7; 47816 = BAC8; 47817 = BAC9; 47818 = BACA; 47819 = BACB; 47820 = BACC; 47821 = BACD; 47822 = BACE; or 47823 = BACF.				
Description:	Displays the BACnet BBMD UDP port number.				
P12.5.5①	***BACnet IP registration interval***				**ID 1738**
Minimum value:	0.00	**Maximum value:**	65,535.00	**Default value:**	10.00
Description:	Defines the registration interval.				
P12.5.6	***BACnet IP communication timeout***				**ID 1739**
Minimum value:	0.00 mS	**Maximum value:**	60,000.00 mS	**Default value:**	0.00 mS
Description:	Selects the time it waits before a communication fault occurs over BACnet IP. **Note:** Setting this parameter to 0 will mask this fault.				
P12.5.7	***BACnet IP protocol status***				**ID 1740**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Stopped; 1 = Operational; or 2 = Faulted.				
Description:	This parameter shows the protocol status for BACnet IP communication.				

Table 165. BACnet/IP (cont).

P12.5.8	***BACnet IP fault behavior***				**ID 1741**
Minimum value:	N.A.	**Maximum value:**	N.A.	**Default value:**	0
Options:	0 = Only in fieldbus control mode - when fieldbus is the control place and Fieldbus fault is active, the drive will fault on loss of communications. If not in fieldbus control, drive will not fault. 1 = In all control modes - no matter the control place setting. If communication is lost, fieldbus fault response will occur.				
Description:	Defines the fieldbus fault condition for BACnet IP communication.				
P12.5.9①	***BACnet IP instance number***				**ID 1742**
Minimum value:	0.00	**Maximum value:**	4,194,302.00	**Default value:**	0.00
Description:	Displays the BACnet instance number.				

BACnet/IP parameters

Table 166. BACnet/IP parameter descriptions.

ID	Name	Description
12.5.1	BACnet IP UDP port number	The UDP port for the BACnet IP communication.
12.5.2	BACnet IP foreign device	The foreign device feature is used when the device is located in a different network than the BBMD. A normal router does not send broadcast messages between different networks. The 'Foreign device' feature solves this problem by establishing a connection to the BBMD with unicast messages. All broadcast messages are forwarded to a BBMD device that takes care of receiving and transmitting broadcast messages in both directions for all foreign devices.
12.5.3	BACnet IP BBMD IP	The IP address of the BACnet IP broadcast management device.
12.5.4	BACnet IP BBMD port	The BBMD port number.
12.5.5	BACnet IP registration interval	The registration interval to keep a live connection to the BBMD. Unit is seconds.
12.5.6	BACnet IP comm timeout	Defines the number of seconds after a time-out is indicated after a communication break or disconnected EtherNet link. Value 0 disables communication link supervision.
12.5.7	BACnet IP protocol status	Fieldbus protocol status tells the status of the protocol.
12.5.8	BACnet IP fault behavior	Defines when fieldbus fault to be raise if fault condition is detected.
12.5.9	BACnetIP instance number	The device object's instance number is used in conjunction with the MAC address to assign the devices on the network. The instance number can have up to 127 nodes on it before a different instance number is required.

BACnet overview

BACnet technical data

Protocol Implementation Conformance Statement (PICS)

Controller profile

- B—ASC

Segmentation capability

- Not supported

Data link layer and routing options

- 10/100 MBit/s, autosensing

Character sets supported

- UTF8

BIBBS supported

- Data sharing
  - ReadProperty—B
  - ReadPropertyMultiple—B
  - WriteProperty—B
  - WritePropertyMultiple—B
  - COV—B
- Device management
  - Dynamic device binding—B
  - Dynamic object binding—B
  - DeviceCommunicationControl—B
  - ReinitializeDevice—B
- Alarms and events: Not supported.
- Schedules: Not supported.
- Trends: Not supported.
- Network management: Not supported.

Table 167. Supported object types and properties summary (cont).

Property	Device object type	Analog input object type	Analog value object type	Binary value object type	Multiple state value object type
Acked_Transitions					
Active_Cov_Subscriptions	X				
Active_Text				X	
Active_Vt_Sessions					
Alarm_Value					
Alarm_Values					
Align_Intervals					
Apdu_Segment_Timeout					
Apdu_Timeout	X				
Application_Software_Version	X				
Auto_Slave_Discovery					
Backup_And_Restore_State					
Backup_Failure_Timeout					
Backup_Preparation_Time					
Change_Of_State_Count					
Change_Of_State_Time					
Configuration_Files					
Cov_Increment		X	X		
Database_Revision	X				
Daylight_Savings_Status					
Deadband					
Description	X	X	X	X	X
Device_Address_Binding	X				
Device_Type					
Elapsed_Active_Time					
Event_Algorithm_Inhibit					
Event_Algorithm_Inhibit_Ref					
Event_Detection_Enable					
Event_Enable					
Event_Message_Texts					
Event_Message_Texts_Config					
Event_State		X	X	X	X
Event_Time_Stamps					
Fault_Values					
Firmware_Revision	X				
High_Limit					
Inactive_Text				X	
Interval_Offset					
Last_Restart_Reason					
Last_Restore_Time					
Limit_Enable					
Local_Date					

Table 167. Supported object types and properties summary (cont).

Property	Device object type	Analog input object type	Analog value object type	Binary value object type	Multiple state value object type
Local_Time					
Location					
Low_Limit					
Manual_Slave_Address_Binding					
Max_Apdu_Length_Accepted	X				
Max_Info_Frames	X				
Max_Master	X				
Max_Pres_Value					
Max_Segments_Accepted					
Min_Pres_Value					
Minimum_Off_Time					
Minimum_On_Time					
Model_Name	X				
Notification_Class					
Notify_Type					
Number_Of_Apdu_Retries	X				
Number_Of_States					X
Object_Identifier	X	X	X	X	X
Object_List	X				
Object_Name	X	X	X	X	X
Object_Type	X	X	X	X	X
Out_Of_Service		X	X	X	X
Password ①	X				
Present_Value		X	X	X	X
Priority_array			X	X	
Profile_Name	X				
Property_List	X	X	X	X	X
Protocol_Object_Types_supported	X				
Protocol_Revision	X				
Protocol_Services_Supported	X				
Protocol_Version	X				
Reliability					
Reliability_Evaluation_Inhibit					
Relinquish_Default			X	X	
Resolution					
Restart_Notification_Recipients					
Restore_Completion_Time					
Restore_Preparation_Time					
Segmentation_Supported	X				
Serial_Number	X				
Slave_Address_Binding					
Slave_Proxy_Enable					

Table 167. Supported object types and properties summary (cont).

Property	Device object type	Analog input object type	Analog value object type	Binary value object type	Multiple state value object type
State_Text					X
Status_Flags		X	X	X	X
Structured_Object_list					
System_Status	X				
Time_Delay					
Time_Delay_Normal					
Time_Of_Active_Time-reset					
Time_Of_Device_Restart					
Time_Of_State_Count_Reset					
Time_Synchronization_Interval					
Time_Synchronization_Recipients					
Units		X	X		
Update_Interval					
Utc_Offset					
Utc_Time_Synchronization_Recipients					
Vendor_Identifier	X				
Vendor_Name	X				
Vt_Classes_Supported					

① Password is a vendor specific property added to device object with property identifier as 600. Default value of password is empty string; this is a writable property with maximum length of 20, it always returns ***** on read. Same password will be used for Reinitialize Device Service and Device communication control service.

Object instance summary

Binary value object instance summary

The following table summarizes the binary value objects supported.

Table 168. Binary value object instance summary.

Instance ID	Object name (related to drive parameter)	Description	Inactive/ active text	Preset value access
BV0	Ready state (Ready state)	Indicates whether the drive is ready or not.	Not ready/ready	R
BV1	Run/stop state (Drive running)	Indicates whether the drive is running or stopped.	Stop/run	R
BV2	Fwd./rev. state	Indicates the rotation direction of motor.	Fwd./rev.	R
BV3	Fault state	Indicates if a fault is active.	OK/fault	R
BV4	Warning state	Indicates if a warning is active.	OK/warning	R
BV5	At setpoint (At setpoint)	Ref. frequency reached.	False/true	R
BV6	At zero speed	Motor running at zero speed.	False/true	R
BV7	Motor ctrl source	Command to change active source for controlling motor .	LocalMotorCtrl / FBMotorCtrl	C
BV8	Speed reference source	Command to change source of motor speed reference.	LocalSpeedRef / FBSpeedRef	C
BV9	Run/stop CMD (Run/stop CMD)	Command to start drive.	Stop/run	C
BV10	Fwd./rev. CMD (Fwd/rev CMD)	Command to change rotational direction.	Fwd./rev.	C
BV11	Reset fault (Reset drive fault)	Command to reset active fault from drive.	0/reset	C
BV12	Digital input 1	Digital input 1.	OFF/ON	R
BV13	Digital input 2	Digital input 2.	OFF/ON	R
BV14	Digital input 3	Digital input 3.	OFF/ON	R
BV15	Digital input 4	Digital input 4.	OFF/ON	R
BV16	Digital input 5	Digital input 5.	OFF/ON	R
BV17	Digital input 6	Digital input 6.	OFF/ON	R
BV18	Digital input 7	Digital input 7.	OFF/ON	R
BV19	Digital input 8	Digital input 8.	OFF/ON	R
BV20	Digital output 1	Digital output 1.	OFF/ON	R
BV21	Digital output 2	Relay 1 output.	OFF/ON	R
BV22	Digital output 3	Relay 2 output.	OFF/ON	R
BV23	Digital output 4	Relay 3 output.	OFF/ON	R
BV24	Stop by coast	Indicates if drive stop by coast.	ON/OFF	C
BV25	Stop by ramp	Indicates if drive stop by ramp	OFF/ON	C
BV26	Belt broken	Indicates if belt is broken.	OFF/ON	R
BV27	Drive fan failure	Indicates if drive fan failed.	OFF/ON	R
BV28	Force bypass	Command to take drive in bypass mode.	OFF/ON	C
BV29	Fire mode	Enable fire mode.	OFF/ON	C
BV30	DIN 1	Fieldbus digital input.	OFF/ON	C
BV31	DIN 2	Fieldbus digital input.	OFF/ON	C
BV32	DIN 3	Fieldbus digital input.	OFF/ON	C
BV33	DIN 4	Fieldbus digital input.	OFF/ON	C

Note: For present value access types: R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays and relinquish defaults.

Analog value object instance summary

The following table summarizes the analog value objects supported.

Table 169. Analog value object instance summary.

Instance ID	Object name	Description	Units	Preset value access
AV0	Speed reference (Reference command)	Motor speed reference from network	Percent	C
AV1	Current limit	Current limit	Amps	W
AV2	Minimum frequency	Minimum frequency	Hz	W
AV3	Maximum frequency	Maximum frequency	Hz	W
AV4	Accel. time 1 (Accel time)	Acceleration time	Seconds	W
AV5	Decel. time 1 (Decel time)	Deceleration time	Seconds	W
AV6	AnyParam ID	Parameter ID number to be accessed	No units	W
AV7	AnyParam value	Value of parameter defined by AV6	No units	W
AV8	Process data In 1	Fieldbus process data In 1	NA	C
AV9	Process data In 2	Fieldbus process data In 2	NA	C
AV10	Process data In 3	Fieldbus process data In 3	NA	C
AV11	Process data In 4	Fieldbus process data In 4	NA	C
AV12	Process data In 5	Fieldbus process data In 5	NA	C
AV13	Process data In 6	Fieldbus process data In 6	NA	C
AV14	Process data In 7	Fieldbus process data In 7	NA	C
AV15	Process data In 8	Fieldbus process data In 8	NA	C

Note: For present value access types: W = Writeable, C = Commandable.

Commandable values support priority arrays and relinquish defaults.

Analog input object instance summary

The following table summarizes the analog input objects supported.

Table 170. Analog input object instance summar

Instance ID	Object name	Description	Units	Preset value access
AI0	Frequency setpoint (Speed setpoint)	Frequency setpoint	Hz	R
AI1	Output frequency (Output frequency)	Output frequency	Hz	R
AI2	Motor speed (Motor speed)	Motor speed	rpm	R
AI3	Motor load	Motor load	Percent	R
AI4	Kilowatt hours total (Kilowatt hours total)	Kilowatt hour counter (total) scaled by 1000	KWh	R
AI5	Motor current	Motor current	Amps	R
AI6	DC link voltage (DC link voltage)	DC link voltage	Volts	R
AI7	Motor voltage (Motor voltage)	Motor voltage	Volts	R
AI8	Unit temperature (Unit temperature)	Heat sink temperature	°C	R
AI9	Motor torque (Motor torque)	In % of motor nominal torque	Percent	R
AI10	Operating days (Operating days)	Operating days (resettable)	Day	R
AI11	Operating hours (Operating hours)	Operating hours (resettable)	Hour	R
AI12	Motor temperature	Motor temperature	Percent	R
AI13	Analog input 1	Analog input 1	Volts	R
AI14	Analog input 2	Analog input 2	Volts	R
AI15	Analog output 1	Analog output 1	Volts	R
AI16	Analog output 2	Analog output 2	Volts	R
AI17	Kilowatt instantaneous	Kilowatt instantaneous	KW	R
AI18	Process data out 1	Fieldbus process data out 1	NA	R
AI19	Process data out 2	Fieldbus process data out 2	NA	R
AI20	Process data out 3	Fieldbus process data out 3	NA	R
AI21	Process data out 4	Fieldbus process data out 4	NA	R
AI22	Process data out 5	Fieldbus process data out 5	NA	R
AI23	Process data out 6	Fieldbus process data out 6	NA	R
AI24	Process data out 7	Fieldbus process data Out 7	NA	R
AI25	Process data out 8	Fieldbus process data out 8	NA	R
AI26	Frequency setpoint %	Frequency reference percent	Percent	R

Note: For present value access types, R = read-only.

Commandable values support priority arrays and relinquish defaults.

Multi state object instance summary

The following table summarizes the multi state objects supported.

Table 171. Multi state object instance summary.

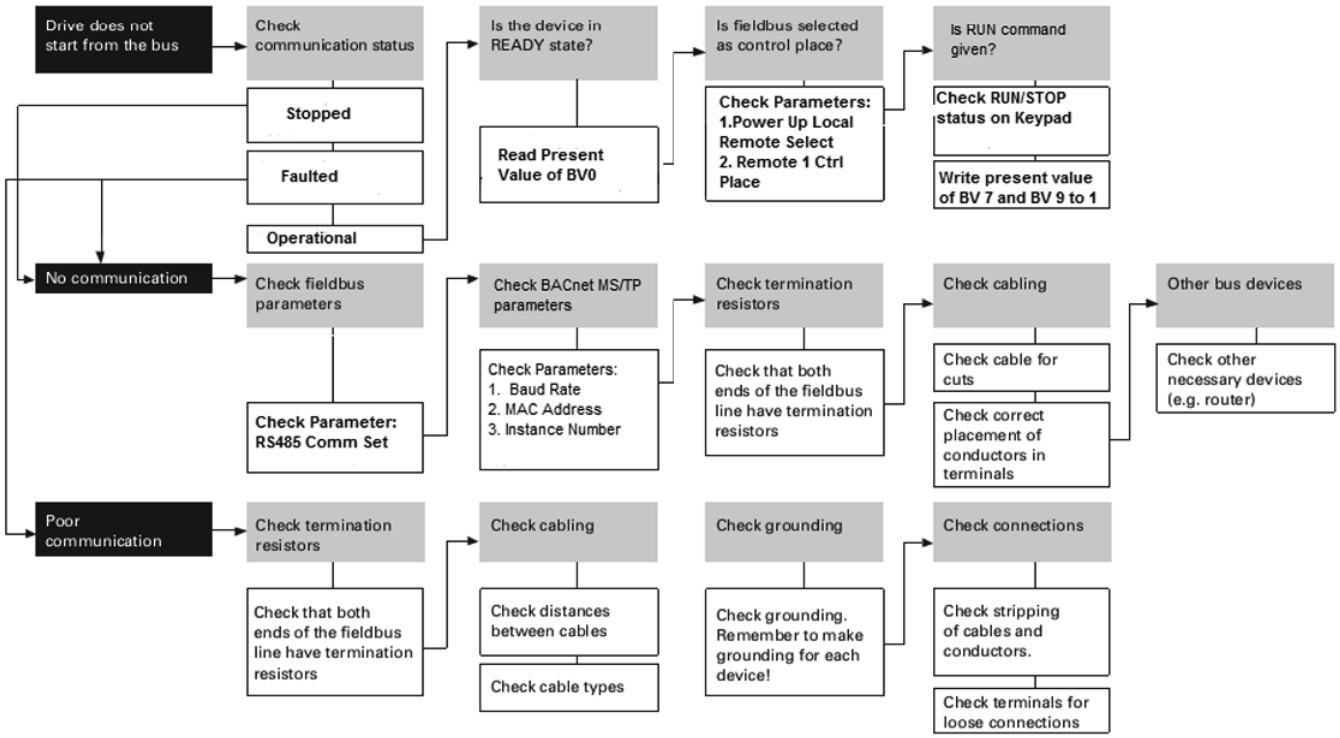
Instance ID	Object name	Description	State text	Preset value access
MV0	Control mode	Indicates the drive control mode - local, remote, or off	0 = Local (hand); 1 = Remote; 2 = OFF.	R
MV1	Active fault code (Fault code)	Indicates the latest active fault code of the drive	Description of all fault codes 255 – No faults	R

Note: For present value access types, R = read-only.

Commandable values support priority arrays and relinquish defaults.

Fault tracing

Figure 41. Fault tracing.



Appendix A—Parameter ID list

Parameter descriptions

Table 172. DM1 parameter ID list.

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
M1.1	1	502	0	160	1	1	Output frequency	INTEGER	2
M1.2	24	1	0	160	1	2	Freq reference	INTEGER	2
M1.3	2	503	0	4	70	3	Motor speed	INTEGER	2
M1.4	3	504	0	160	1	4	Motor current	INTEGER	2
M1.5	4	507	0	160	1	5	Motor torque	INTEGER	2
M1.6	5	513	1	160	1	6	Motor power	INTEGER	2
M1.7	6	501	0	160	1	7	Motor voltage	INTEGER	2
M1.8	7	501	1	160	1	8	DC-link voltage	INTEGER	2
M1.9	8	822	6	160	1	9	Unit temperature	INTEGER	2
M1.10	9	822	4	160	1	10	Motor temperature	INTEGER	2
M1.11	28	NA	NA	160	1	24	Latest fault code	BYTE	1
M1.12	1686	NA	NA	164	1	12	Instant motor power	DOUBLE	4
M2.1	10	560	0	160	1	11	Analog input 1	INTEGER	2
M2.2	1858	NA	NA	166	1	1	Keypad pot voltage	INTEGER	2
M2.3	25	570	0	4	75	3	Analog output	INTEGER	2
M2.4	12	760	0	160	1	13	DI1, DI2, DI3	BYTE	1
M2.5	13	760	1	160	1	14	DI4	BYTE	1
M2.6	1998	NA	NA	166	1	2	Virtual DI1,virtual DI2	BYTE	1
M2.7	1817	NA	NA	166	1	3	Virtual RO1,virtual RO2	BYTE	1
M2.8	557	762	0	160	1	15	RO1, RO2	BYTE	1
M3.1	2120	NA	NA	164	1	24	Energy savings	DOUBLE	4
M3.2	1818	NA	NA	166	1	4	CO2 savings	DOUBLE	4
M4.1	2209	NA	NA	166	1	5	Control board DIDO status	INTEGER	2
M4.2	29	NA	NA	160	1	23	Application status word	INTEGER	2
M4.3	2414	NA	NA	166	1	6	Standard status word	INTEGER	2
M4.4	2542	NA	NA	166	1	7	FB PI setpoint 1	DOUBLE	4
M4.5	2544	NA	NA	166	1	8	FB PI setpoint 2	DOUBLE	4
M4.6	2550	NA	NA	166	1	9	FB PI feedback	INTEGER	2
M5.1	16	2150	0	160	1	17	PI set point	DOUBLE	4
M5.2	18	2864	0	160	1	18	PI feedback	DOUBLE	4
M5.3	20	2167	0	160	1	19	PI error value	DOUBLE	4
M5.4	22	2124	0	160	1	20	PI output	INTEGER	2
M5.5	23	2133	0	160	1	21	PI status	BYTE	1
M6.1	2445	NA	NA	166	1	10	Output	DOUBLE	4
M6.2	2447	NA	NA	166	1	11	Reference	DOUBLE	4
M7.1.1	2218	NA	NA	165	1	1	Drive 1	BYTE	1
M7.1.2	2230	NA	NA	165	1	12	Drive 2	BYTE	1
M7.1.3	2242	NA	NA	165	1	23	Drive 3	BYTE	1
M7.1.4	2254	NA	NA	165	1	34	Drive 4	BYTE	1
M7.1.5	2266	NA	NA	165	1	45	Drive 5	BYTE	1
M7.2.1	2219	NA	NA	165	1	2	Drive 1	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
M7.2.2	2231	NA	NA	165	1	13	Drive 2	BYTE	1
M7.2.3	2243	NA	NA	165	1	24	Drive 3	BYTE	1
M7.2.4	2255	NA	NA	165	1	35	Drive 4	BYTE	1
M7.2.5	2267	NA	NA	165	1	46	Drive 5	BYTE	1
M7.3.1	2220	NA	NA	165	1	3	Drive 1	BYTE	1
M7.3.2	2232	NA	NA	165	1	14	Drive 2	BYTE	1
M7.3.3	2244	NA	NA	165	1	25	Drive 3	BYTE	1
M7.3.4	2256	NA	NA	165	1	36	Drive 4	BYTE	1
M7.3.5	2268	NA	NA	165	1	47	Drive 5	BYTE	1
M8.1.1	2221	NA	NA	165	1	4	Drive 1	BYTE	1
M8.1.2	2233	NA	NA	165	1	15	Drive 2	BYTE	1
M8.1.3	2245	NA	NA	165	1	26	Drive 3	BYTE	1
M8.1.4	2257	NA	NA	165	1	37	Drive 4	BYTE	1
M8.1.5	2269	NA	NA	165	1	48	Drive 5	BYTE	1
M8.2.1	2222	NA	NA	165	1	5	Drive 1	INTEGER	2
M8.2.2	2234	NA	NA	165	1	16	Drive 2	INTEGER	2
M8.2.3	2246	NA	NA	165	1	27	Drive 3	INTEGER	2
M8.2.4	2258	NA	NA	165	1	38	Drive 4	INTEGER	2
M8.2.5	2270	NA	NA	165	1	49	Drive 5	INTEGER	2
M8.3.1	2223	NA	NA	165	1	6	Drive 1	INTEGER	2
M8.3.2	2235	NA	NA	165	1	17	Drive 2	INTEGER	2
M8.3.3	2247	NA	NA	165	1	28	Drive 3	INTEGER	2
M8.3.4	2259	NA	NA	165	1	39	Drive 4	INTEGER	2
M8.3.5	2271	NA	NA	165	1	50	Drive 5	INTEGER	2
M8.4.1	2224	NA	NA	165	1	7	Drive 1	INTEGER	2
M8.4.2	2236	NA	NA	165	1	18	Drive 2	INTEGER	2
M8.4.3	2248	NA	NA	165	1	29	Drive 3	INTEGER	2
M8.4.4	2260	NA	NA	165	1	40	Drive 4	INTEGER	2
M8.4.5	2272	NA	NA	165	1	51	Drive 5	INTEGER	2
M8.5.1	2225	NA	NA	165	1	8	Drive 1	INTEGER	2
M8.5.2	2237	NA	NA	165	1	19	Drive 2	INTEGER	2
M8.5.3	2249	NA	NA	165	1	30	Drive 3	INTEGER	2
M8.5.4	2261	NA	NA	165	1	41	Drive 4	INTEGER	2
M8.5.5	2273	NA	NA	165	1	52	Drive 5	INTEGER	2
M8.6.1	2226	NA	NA	165	1	9	Drive 1	INTEGER	2
M8.6.2	2238	NA	NA	165	1	20	Drive 2	INTEGER	2
M8.6.3	2250	NA	NA	165	1	31	Drive 3	INTEGER	2
M8.6.4	2262	NA	NA	165	1	42	Drive 4	INTEGER	2
M8.6.5	2274	NA	NA	165	1	53	Drive 5	INTEGER	2
M8.7.1	2227	NA	NA	165	1	10	Drive 1	INTEGER	2
M8.7.2	2239	NA	NA	165	1	21	Drive 2	INTEGER	2
M8.7.3	2251	NA	NA	165	1	32	Drive 3	INTEGER	2
M8.7.4	2263	NA	NA	165	1	43	Drive 4	INTEGER	2
M8.7.5	2275	NA	NA	165	1	54	Drive 5	INTEGER	2
M8.8.1	2228	NA	NA	165	1	11	Drive 1	DOUBLE	4
M8.8.2	2240	NA	NA	165	1	22	Drive 2	DOUBLE	4
M8.8.3	2252	NA	NA	165	1	33	Drive 3	DOUBLE	4
M8.8.4	2264	NA	NA	165	1	44	Drive 4	DOUBLE	4
M8.8.5	2276	NA	NA	165	1	55	Drive 5	DOUBLE	4
M9.1	30	329	0	160	1	25	Multi-monitoring	BYTE	3

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P1.1	101	20	0	160	1	73	Min frequency	INTEGER	2
P1.2	102	20	1	160	1	74	Max frequency	INTEGER	2
P1.3	103	130	0	160	1	75	Accel time 1	INTEGER	2
P1.4	104	134	0	160	1	76	Decel time 1	INTEGER	2
P1.5	1820	NA	NA	40	1	3	Motor type selection	BYTE	1
P1.6	486	210	0	40	1	6	Motor nom current	INTEGER	2
P1.7	489	217	0	40	1	15	Motor nom speed	INTEGER	2
P1.8	490	215	0	161	1	38	Motor PD	INTEGER	2
P1.9	487	211	0	40	1	7	Motor nom voltage	INTEGER	2
P1.10	488	216	0	161	1	40	Motor nom frequency	INTEGER	2
P1.11	1695	NA	NA	164	1	14	Local control place	BYTE	1
P1.12	136	436	0	160	1	64	Local reference	BYTE	1
P1.13	135	408	0	160	1	63	Remote control place	BYTE	1
P1.14	137	437	0	160	1	65	Remote reference	BYTE	1
P2.1.1	144	35	1	160	1	30	Ai ref scale min value	INTEGER	2
P2.1.2	145	34	1	160	1	31	Ai ref scale max value	INTEGER	2
P2.1.3	143	425	0	160	1	80	IO terminal start stop logic	BYTE	1
P2.1.4	2297	NA	NA	166	1	12	Ext. Fault 1 text	BYTE	1
P2.1.5	2298	NA	NA	166	1	13	Ext. Fault 2 text	BYTE	1
P2.1.6	2299	NA	NA	166	1	14	Ext. Fault 3 text	BYTE	1
P2.1.7	156	111	4	160	1	71	Motor pot ramp time	INTEGER	2
P2.1.8	169	426	0	160	1	72	Motor pot ref reset	BYTE	1
P2.2.1	1801	NA	NA	166	1	15	DI1 Function	BYTE	1
P2.2.2	1802	NA	NA	166	1	16	DI1 invert	BYTE	1
P2.2.3	1803	NA	NA	166	1	17	DI2 function	BYTE	1
P2.2.4	1804	NA	NA	166	1	18	DI2 invert	BYTE	1
P2.2.5	1805	NA	NA	166	1	19	DI3 function	BYTE	1
P2.2.6	1806	NA	NA	166	1	20	DI3 invert	BYTE	1
P2.2.7	1807	NA	NA	166	1	21	DI4 function	BYTE	1
P2.2.8	1808	NA	NA	166	1	22	DI4 invert	BYTE	1
P2.2.9	1809	NA	NA	166	1	23	Virtual RO1 input	BYTE	1
P2.2.10	1810	NA	NA	166	1	24	Virtual RO1 invert	BYTE	1
P2.2.11	1811	NA	NA	166	1	25	Virtual RO2 input	BYTE	1
P2.2.12	1812	NA	NA	166	1	26	virtual RO2 invert	BYTE	1
P2.3.1	105	5	1	161	1	5	Preset speed 1	INTEGER	2
P2.3.2	106	5	2	161	1	6	Preset speed 2	INTEGER	2
P2.3.3	118	5	3	161	1	7	Preset speed 3	INTEGER	2
P2.3.4	119	5	4	161	1	8	Preset speed 4	INTEGER	2
P2.3.5	120	5	5	161	1	9	Preset speed 5	INTEGER	2
P2.3.6	121	5	6	161	1	10	Preset speed 6	INTEGER	2
P2.3.7	122	5	7	161	1	11	Preset speed 7	INTEGER	2
P2.3.8	117	1	9	160	1	70	Jog reference	INTEGER	2
P2.4.1	222	263	0	160	1	32	AI mode	BYTE	1
P2.4.2	175	260	0	160	1	33	AI sgnal range	BYTE	1
P2.4.3	176	264	0	160	1	34	AI custom min	INTEGER	2
P2.4.4	177	265	0	160	1	35	AI custom max	INTEGER	2
P2.4.5	174	266	0	160	1	36	AI filter time	INTEGER	2
P2.4.6	181	267	0	160	1	37	AI signal invert	BOOLEAN	1
P2.4.7	178	1711	0	160	1	38	AI joystick hyst	INTEGER	2
P2.4.8	179	1720	0	160	1	39	AI sleep limit	INTEGER	2

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P2.4.9	180	1721	0	160	1	40	AI sleep delay	INTEGER	2
P2.4.10	133	1712	0	160	1	41	AI joystick offset	INTEGER	2
P2.5.1	1814	NA	NA	166	1	27	Pot custom min	INTEGER	2
P2.5.2	1815	NA	NA	166	1	28	Pot custom max	INTEGER	2
P2.5.3	1816	NA	NA	166	1	29	Pot filter time	INTEGER	2
P3.1.1	152	451	0	160	1	47	RO1 function	BYTE	1
P3.1.2	2112	NA	NA	164	1	20	RO1 on delay	INTEGER	2
P3.1.3	2113	NA	NA	164	1	21	RO1 off delay	INTEGER	2
P3.1.4	153	451	1	160	1	48	RO2 function	BYTE	1
P3.1.5	2114	NA	NA	164	1	22	RO2 on delay	INTEGER	2
P3.1.6	2115	NA	NA	164	1	23	RO2 off delay	INTEGER	2
P3.1.7	2118	NA	NA	166	1	30	RO2 reverse	BYTE	1
P3.1.8	2463	NA	NA	166	1	31	Virtual RO1 function	BYTE	1
P3.1.9	2464	NA	NA	166	1	32	Virtual RO2 function	BYTE	1
P3.2.1	154	1201	0	160	1	49	Freq limit supv	BYTE	1
P3.2.2	1821	NA	NA	166	1	33	Freq limit display	BYTE	1
P3.2.3	155	1101	0	160	1	50	Freq limit supv val	INTEGER	2
P3.2.4	2200	NA	NA	166	1	34	Freq limit supv hyst	INTEGER	2
P3.2.5	159	1202	0	160	1	51	Torque limit supv	BYTE	1
P3.2.6	1822	NA	NA	166	1	35	Torque limit display	BYTE	1
P3.2.7	160	1102	0	160	1	52	Torque limit supv val	INTEGER	2
P3.2.8	2202	NA	NA	166	1	36	Torque limit supv hyst	INTEGER	2
P3.2.9	161	1200	0	160	1	53	Ref limit supv	BYTE	1
P3.2.10	1823	NA	NA	166	1	37	Ref limit display	BYTE	1
P3.2.11	162	1100	0	160	1	54	Ref limit supv val	INTEGER	2
P3.2.12	2203	NA	NA	166	1	38	Ref limit supv hyst	INTEGER	2
P3.2.13	165	1222	1	160	1	55	Temp limit supv	BYTE	1
P3.2.14	1824	NA	NA	166	1	39	Temp limit display	BYTE	1
P3.2.15	166	822	0	160	1	56	Temp limit supv val	INTEGER	2
P3.2.16	2204	NA	NA	166	1	40	Temp limit supv hyst	INTEGER	2
P3.2.17	167	1203	0	160	1	57	Power limit supv	BYTE	1
P3.2.18	1825	NA	NA	166	1	41	Power limit display	BYTE	1
P3.2.19	168	1103	0	160	1	58	Power limit supv val	INTEGER	2
P3.2.20	2205	NA	NA	166	1	42	Power limit supv hyst	INTEGER	2
P3.2.21	170	1504	0	160	1	59	AI supv select	BYTE	1
P3.2.22	171	1204	0	160	1	60	AI limit supv	BYTE	1
P3.2.23	1826	NA	NA	166	1	43	AI limit display	BYTE	1
P3.2.24	172	1404	0	160	1	61	AI limit supv val	INTEGER	2
P3.2.25	2198	NA	NA	166	1	44	AI supv hyst	INTEGER	2
P3.2.26	2189	NA	NA	166	1	45	Motor current supv	BYTE	1
P3.2.27	1827	NA	NA	166	1	46	Motor current limit display	BYTE	1
P3.2.28	2190	NA	NA	166	1	47	Motor current supv value	INTEGER	2
P3.2.29	2196	NA	NA	166	1	48	Motor current supv hyst	BYTE	1
P3.2.30	1346	2860	0	161	1	1	PI superv enable	BOOLEAN	1
P3.2.31	1828	NA	NA	166	1	49	PI superv display	BYTE	1
P3.2.32	1347	2861	0	161	1	2	PI superv upper limit	DOUBLE	4
P3.2.33	1349	2862	0	161	1	3	PI superv lower limit	DOUBLE	4
P3.2.34	1351	2863	0	161	1	4	PI superv delay	INTEGER	2
P3.3.1	227	276	0	160	1	42	AO mode	BYTE	1
P3.3.2	146	460	0	160	1	43	AO function	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P3.3.3	147	277	0	160	1	45	AO filter time	INTEGER	2
P3.3.4	1863	NA	NA	166	1	50	AO custom min	DOUBLE	4
P3.3.5	1865	NA	NA	166	1	51	AO custom max	DOUBLE	4
P3.3.6	1867	NA	NA	166	1	52	AO value min	INTEGER	2
P3.3.7	1868	NA	NA	166	1	53	AO value max	INTEGER	2
P4.1.1	141	1	8	160	1	66	Keypad reference	INTEGER	2
P4.1.2	116	621	1	160	1	67	Keypad/drive ref pot direction	BOOLEAN	1
P4.1.3	114	622	1	160	1	68	Keypad stop	BOOLEAN	1
P4.1.4	1679	622	3	164	1	9	Reverse enable	BYTE	1
P4.1.5	2515	NA	NA	166	1	54	Change phase sequence motor	BYTE	1
P4.1.6	1685	NA	NA	164	1	11	Power up local remote select	BYTE	1
P4.1.7	2462	NA	NA	166	1	55	Bumpless enable	BYTE	1
P4.1.8	252	620	0	160	1	78	Start mode	BYTE	1
P4.1.9	253	620	1	160	1	79	Stop mode	BYTE	1
P4.1.10	247	117	0	160	1	77	Ramp 1 shape	INTEGER	2
P4.1.11	248	117	1	160	1	83	Ramp 2 shape	INTEGER	2
P4.1.12	249	130	1	160	1	81	Accel time 2	INTEGER	2
P4.1.13	250	134	1	160	1	82	Decel time 2	INTEGER	2
P4.1.14	2444	NA	NA	166	1	56	2th stage ramp frequency	INTEGER	2
P4.1.15	2483	NA	NA	166	1	57	Fault reset start	BYTE	1
P4.2.1	1829	NA	NA	166	1	58	Brake chopper enable	BYTE	1
P4.2.2	254	2227	0	161	1	24	DC-brake current	INTEGER	2
P4.2.3	263	2222	0	161	1	25	Start DC-brake time	INTEGER	2
P4.2.4	262	2223	0	161	1	26	Stop DC-brake frequency	INTEGER	2
P4.2.5	255	2222	1	161	1	27	Stop DC-brake time	INTEGER	2
P4.2.6	266	2214	0	161	1	28	Flux brake	BOOLEAN	1
P4.2.7	265	2217	0	161	1	29	Flux brake current	INTEGER	2
P4.3.1	264	43	0	160	1	90	Skip range ramp factor	INTEGER	2
P4.3.2	256	41	0	160	1	84	Skip F1 low limit	INTEGER	2
P4.3.3	257	42	0	160	1	85	Skip F1 high limit	INTEGER	2
P4.3.4	258	41	1	160	1	86	Skip F2 low limit	INTEGER	2
P4.3.5	259	42	1	160	1	87	Skip F2 high limit	INTEGER	2
P4.3.6	260	41	2	160	1	88	Skip F3 low limit	INTEGER	2
P4.3.7	261	42	2	160	1	89	Skip F3 high limit	INTEGER	2
P4.4.1	2122	NA	NA	164	1	25	Currency	BYTE	1
P4.4.2	2123	NA	NA	164	1	26	Energy cost	INTEGER	2
P4.4.3	2124	NA	NA	164	1	27	Data type	BYTE	1
P4.4.4	2125	NA	NA	164	1	28	Energy savings reset	BYTE	1
P5.1.1	287	255	0	161	1	19	Motor control mode	BYTE	1
P5.1.2	107	281	0	42	1	10	Current limit	INTEGER	2
P5.1.3	109	60	0	161	1	20	V/Hz optimization	BOOLEAN	1
P5.1.4	108	61	0	161	1	12	V/Hz ratio	BYTE	1
P5.1.5	289	23	0	161	1	13	Field weakening point	INTEGER	2
P5.1.6	290	24	0	161	1	14	Voltage at FWP	INTEGER	2
P5.1.7	291	23	1	161	1	15	V/Hz mid frequency	INTEGER	2
P5.1.8	292	24	1	161	1	16	V/Hz mid voltage	INTEGER	2
P5.1.9	293	27	0	161	1	17	Zero frequency voltage	INTEGER	2
P5.1.10	288	390	0	161	1	18	Switching frequency	INTEGER	2
P5.1.11	1665	341	0	164	1	2	Sine filter enabled	BYTE	1
P5.1.12	294	626	3	161	1	21	Overvoltage controller	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P5.1.13	1874	NA	NA	166	1	59	Over voltage controller reference	INTEGER	2
P5.1.14	298	2901	0	161	1	22	Load drooping	INTEGER	2
P5.1.15	1630	2902	0	163	1	95	Droop control filter time constant	INTEGER	2
P5.1.16	299	340	0	161	1	23	Identification	BYTE	1
P5.1.17	771	218	0	162	1	82	Stator resistor	INTEGER	2
P5.1.18	772	221	0	162	1	83	Rotor resistor	INTEGER	2
P5.1.19	773	224	0	162	1	84	Leak inductance	INTEGER	2
P5.1.20	774	225	0	162	1	85	Mutual inductance	INTEGER	2
P5.1.21	775	223	0	162	1	86	Excitation current	INTEGER	2
P5.1.22	1881	NA	NA	166	1	60	Motor inertia	INTEGER	2
P5.1.23	1882	NA	NA	166	1	61	PM BEMF voltage	INTEGER	2
P5.1.24	1884	NA	NA	166	1	62	PM d-axis stator inductance	INTEGER	2
P5.1.25	1883	NA	NA	166	1	63	PM q-axis stator inductance	INTEGER	2
P5.1.26	1664	NA	NA	164	1	1	Slip compensation coefficient	INTEGER	2
P5.1.27	1888	NA	NA	166	1	64	VF stable Kd	INTEGER	2
P5.1.28	1889	NA	NA	166	1	65	VF stable Kq	INTEGER	2
P5.1.29	2835	NA	NA	166	1	66	Overmodulation enable	BYTE	1
P5.2.1	1591	2406	1	163	1	91	Speed error filter time constant	INTEGER	2
P5.2.2	1830	NA	NA	166	1	67	Speed control Kp1	INTEGER	2
P5.2.3	1831	NA	NA	166	1	68	Speed control Ti1	INTEGER	2
P5.2.4	1832	NA	NA	166	1	69	Speed control FS1	INTEGER	2
P5.2.5	1833	NA	NA	166	1	70	Speed control FS2	INTEGER	2
P5.2.6	1834	NA	NA	166	1	71	Speed control Kp2	INTEGER	2
P5.2.7	1835	NA	NA	166	1	72	Speed control Ti2	INTEGER	2
P5.2.8	1836	NA	NA	166	1	73	Motoring torque limit FWD	INTEGER	2
P5.2.9	1837	NA	NA	166	1	74	Generator torque limit FWD	INTEGER	2
P5.2.10	1838	NA	NA	166	1	75	Motoring torque limit REV	INTEGER	2
P5.2.11	1839	NA	NA	166	1	76	Generator torque limit REV	INTEGER	2
P5.2.12	1607	282	0	163	1	92	Motoring power limit	INTEGER	2
P5.2.13	1608	282	1	163	1	93	Generator power limit	INTEGER	2
P5.2.14	1620	254	0	163	1	94	Flux reference	INTEGER	2
P5.2.15	1890	NA	NA	166	1	77	PM initialselection	BYTE	1
P5.2.16	1891	NA	NA	166	1	78	PM initial time	INTEGER	2
P5.2.17	1892	NA	NA	166	1	79	PM excited current	INTEGER	2
P5.2.18	1893	NA	NA	166	1	80	PM excited current off frequency	INTEGER	2
P5.2.19	2901	NA	NA	166	1	81	Observer Kp	INTEGER	2
P6.1.1	308	840	9040	160	1	108	Output phase fault	BYTE	1
P6.1.2	309	840	9008	160	1	110	Ground fault	BYTE	1
P6.1.3	2158	NA	NA	164	1	42	Ground fault limit	BYTE	1
P6.1.4	310	840	17168	160	1	101	Motor thermal protection	BYTE	1
P6.1.5	311	1012	0	160	1	102	Motor thermal F0 current	INTEGER	2
P6.1.6	313	840	28963	160	1	93	Stall protection	BYTE	1
P6.1.7	314	1010	0	160	1	94	Stall current limit	INTEGER	2
P6.1.8	315	1010	1	160	1	95	Stall time limit	INTEGER	2
P6.1.9	316	1010	2	160	1	96	Stall frequency limit	INTEGER	2
P6.1.10	317	840	28979	160	1	97	Underload protection	BYTE	1
P6.1.11	318	1013	0	160	1	98	Underload from torque	INTEGER	2
P6.1.12	319	1013	1	160	1	99	Underload F0 torque	INTEGER	2
P6.1.13	320	1011	1	160	1	100	Underload time limit	INTEGER	2
P6.1.14	2159	NA	NA	164	1	43	Preheat mode	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P6.1.15	2160	NA	NA	164	1	44	Preheat control source	BYTE	1
P6.1.16	2161	NA	NA	164	1	45	Preheat enter temp	INTEGER	2
P6.1.17	2162	NA	NA	164	1	46	Preheat quit temp	INTEGER	2
P6.2.1	750	861	0	162	1	59	Line start lockout	BYTE	1
P6.2.2	332	840	12592	160	1	107	Input phase fault	BYTE	1
P6.2.3	306	840	29520	160	1	91	4mA input fault	BYTE	1
P6.2.4	331	1	7	160	1	92	4mA fault frequency	INTEGER	2
P6.2.5	307	840	36864	160	1	106	External fault	BYTE	1
P6.2.6	330	840	12576	160	1	109	Uvolt fault response	BYTE	1
P6.2.7	1564	840	16912	163	1	89	Unit under temp prot	BYTE	1
P6.2.8	2126	NA	NA	164	1	29	Cold weather mode	BYTE	1
P6.2.9	2127	NA	NA	164	1	30	Cold weather volt. Level	BYTE	1
P6.2.10	2128	NA	NA	164	1	31	Cold weather time out	BYTE	1
P6.2.11	2427	NA	NA	166	1	82	STO fault response	BYTE	1
P6.2.12	2401	NA	NA	166	1	83	PI feedback AI loss response	BYTE	1
P6.2.13	2402	NA	NA	166	1	84	PI feedback AI loss prefreq	INTEGER	2
P6.2.14	2403	NA	NA	166	1	85	PI feedback AI loss fipe fill loss level	INTEGER	2
P6.2.15	2404	NA	NA	166	1	86	PI feedback AI loss prefreq timeout	INTEGER	2
P6.2.16	1840	NA	NA	166	1	87	Overvoltage controller response	BYTE	1
P6.2.17	1841	NA	NA	166	1	88	Overcurrent controller response	BYTE	1
P6.2.18	2129	NA	NA	164	1	32	Cold weather password	INTEGER	2
P6.2.19	2130	NA	NA	164	1	33	Under temp fault override	BYTE	1
P6.3.1	334	840	29953	160	1	104	Fieldbus fault response	BYTE	1
P6.3.2	335	840	35088	160	1	105	OPTcard fault response	BYTE	1
P6.3.3	1678	840	30070	163	1	88	IP address confliction resp	BYTE	1
P6.3.4	2157	NA	NA	164	1	41	Keypad comm fault response	BYTE	1
P6.4.1	321	846	0	160	1	111	AR wait time	INTEGER	2
P6.4.2	322	846	1	160	1	112	AR trail time	INTEGER	2
P6.4.3	323	847	0	160	1	113	AR start function	BYTE	1
P6.4.4	324	845	12832	160	1	114	Undervoltage attempts	BYTE	1
P6.4.5	325	845	12816	160	1	115	Overvoltage attempts	BYTE	1
P6.4.6	326	845	8736	160	1	116	Overcurrent attempts	BYTE	1
P6.4.7	327	845	29520	160	1	117	4mA fault attempts	BYTE	1
P6.4.8	329	845	28978	160	1	118	Motor temp fault attempts	BYTE	1
P6.4.9	328	845	36864	160	1	119	External fault attempts	BYTE	1
P6.4.10	336	845	28979	160	1	120	Underload attempts	BYTE	1
P6.4.11	2405	NA	NA	166	1	89	PI feedback AI loss attempts	BYTE	1
P7.1.1	1294	2100	0	160	1	121	PI control gain	INTEGER	2
P7.1.2	1295	2101	0	160	1	122	PI control itime	INTEGER	2
P7.1.3	1297	2870	0	160	1	123	PI process unit	BYTE	1
P7.1.4	1298	2871	0	160	1	124	PI process unit min	DOUBLE	4
P7.1.5	1300	2872	0	160	1	125	PI process unit max	DOUBLE	4
P7.1.6	1303	2850	0	160	1	126	PI error inversion	BOOLEAN	1
P7.1.7	1304	2851	0	160	1	127	PI dead band	DOUBLE	4
P7.1.8	1306	2852	0	160	1	128	PI dead band delay	INTEGER	2
P7.1.9	1311	2151	0	160	1	131	PI ramp time	INTEGER	2
P7.2.1.1	1307	2170	0	160	1	129	PI keypad setpoint 1	DOUBLE	4
P7.2.1.2	1309	2179	0	160	1	130	PI keypad setpoint 2	DOUBLE	4
P7.2.1.3	2466	NA	NA	166	1	90	PI wake up action	BYTE	1
P7.2.2.1	1312	2110	0	160	1	132	PI set point 1 source	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P7.2.2.2	1315	2136	0	160	1	133	PI set point 1 sleep enable	BOOLEAN	1
P7.2.2.3	1317	2138	0	160	1	134	PI set point 1 sleep delay	INTEGER	2
P7.2.2.4	1318	2139	0	160	1	135	PI set point 1 wake up level	DOUBLE	4
P7.2.2.5	1320	2154	0	160	1	136	PI set point 1 boost	BYTE	1
P7.2.2.6	2450	2137	0	166	1	91	PI set point 1 sleep level	DOUBLE	4
P7.2.2.7	1842	NA	NA	166	1	92	SP1 sleep mode over cycle time	BYTE	1
P7.2.2.8	1843	NA	NA	166	1	93	SP1 sleep mode max cycle time	INTEGER	2
P7.2.3.1	1321	2116	0	160	1	137	PI set point 2 source	BYTE	1
P7.2.3.2	1324	2140	0	160	1	138	PI set point 2 sleep enable	BOOLEAN	1
P7.2.3.3	1326	2142	0	160	1	139	PI set point 2 sleep delay	INTEGER	2
P7.2.3.4	1327	2143	0	160	1	140	PI set point 2 wake up level	DOUBLE	4
P7.2.3.5	1329	2157	0	160	1	141	PI set point 2 boost	BYTE	1
P7.2.3.6	2452	2141	0	166	1	94	PI set point 2 sleep level	DOUBLE	4
P7.2.3.7	1844	NA	NA	166	1	95	SP2 sleep mode over cycle time	BYTE	1
P7.2.3.8	1845	NA	NA	166	1	96	SP2 sleep mode max cycle time	INTEGER	2
P7.3.1.1	1331	2153	0	160	1	142	PI feedback gain	INTEGER	2
P7.3.2.1	1332	2112	0	160	1	143	PI feedback 1 source	BYTE	1
P7.3.2.2	1333	2172	0	160	1	144	PI feedback 1 min	INTEGER	2
P7.3.2.3	1334	2173	0	160	1	145	PI feedback 1 max	INTEGER	2
P8.1.1	483	636	0	160	1	27	Damper start	BYTE	1
P8.1.2	484	118	0	160	1	28	Damper time out	INTEGER	2
P8.1.3	485	118	1	160	1	29	Damper delay	INTEGER	2
P8.2.1	535	640	0	161	1	30	Fire mode function	BOOLEAN	1
P8.2.2	536	438	0	161	1	31	Fire mode ref select function	BYTE	1
P8.2.3	537	28	2	161	1	32	Fire mode min frequency	INTEGER	2
P8.2.4	565	1	5	161	1	33	Fire mode freq ref 1	INTEGER	2
P8.2.5	564	1	6	161	1	34	Fire mode freq ref 2	INTEGER	2
P8.2.6	2443	NA	NA	166	1	97	Fire mode test enable	BOOLEAN	1
P8.2.7	554	1	11	161	1	35	Smoke purge frequency	INTEGER	2
P8.3.1	317	840	28979	160	1	97	Broken belt protection	BYTE	1
P8.3.2	318	1013	0	160	1	98	Broken belt from torque	INTEGER	2
P8.3.3	319	1013	1	160	1	99	Broken belt F0 torque	INTEGER	2
P8.3.4	320	1011	1	160	1	100	Broken belt time limit	INTEGER	2
P9.1.1	2468	NA	NA	166	1	98	Derag cycles	BYTE	1
P9.1.2	2469	NA	NA	166	1	99	Derag at start/stop	BYTE	1
P9.1.3	2470	NA	NA	166	1	100	Deragging run time	INTEGER	2
P9.1.4	2471	NA	NA	166	1	101	Derag speed	INTEGER	2
P9.1.5	2472	NA	NA	166	1	102	Derag off delay	INTEGER	2
P9.1.6	1879	NA	NA	166	1	103	Derag current	INTEGER	2
P9.2.1	1847	NA	NA	166	1	104	Valve start	BYTE	1
P9.2.2	1848	NA	NA	166	1	105	Valve time out	INTEGER	2
P9.2.3	1849	NA	NA	166	1	106	Valve delay	INTEGER	2
P9.2.4	2423	NA	NA	166	1	107	Back spin delay	INTEGER	2
P9.2.5	1813	NA	NA	166	1	108	Minimum run time	INTEGER	2
P9.2.6	1850	NA	NA	166	1	109	Min frequency ramp time	INTEGER	2
P9.3.1	2279	NA	NA	165	1	57	Multi-pump mode	BYTE	1
P9.3.2	2449	NA	NA	166	1	110	Number of drives	BYTE	1
P9.3.3	2278	NA	NA	165	1	56	Drive ID	BYTE	1
P9.3.4	2284	NA	NA	165	1	61	Regulation source	BYTE	1
P9.3.5	2458	NA	NA	166	1	111	PI bandwidth	DOUBLE	4

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P9.3.6	2315	NA	NA	165	1	74	Staging frequency	INTEGER	2
P9.3.7	2316	NA	NA	165	1	75	De-staging frequency	INTEGER	2
P9.3.8	344	1923	0	161	1	43	Add/remove delay	INTEGER	2
P9.3.9	350	1909	0	161	1	44	Interlock enable	BYTE	1
P9.3.10	2285	NA	NA	165	1	62	Recovery method	BYTE	1
P9.3.11	2311	NA	NA	165	1	73	Add/remove drive selection	BYTE	1
P9.3.12	2280	NA	NA	165	1	58	Run time enable	BYTE	1
P9.3.13	2281	NA	NA	165	1	59	Run time limit	DOUBLE	4
P9.3.14	2283	NA	NA	165	1	60	Run time reset	BYTE	1
P9.3.15	2473	NA	NA	166	1	112	Master drive mode	BYTE	1
P9.3.16	2474	NA	NA	166	1	113	Master fixed speed	INTEGER	2
P9.3.17	2475	NA	NA	166	1	114	Master fixed speed delay	INTEGER	2
P9.4.1	2410	NA	NA	166	1	115	Pipe fill loss response	BYTE	1
P9.4.2	2406	NA	NA	166	1	116	Pipe fill loss detection method	BYTE	1
P9.4.3	2407	NA	NA	166	1	117	Pipe fill loss low level	INTEGER	2
P9.4.4	2409	NA	NA	166	1	118	Pipe fill loss low frequency	INTEGER	2
P9.4.5	1851	NA	NA	166	1	119	Pipe fill loss high level	INTEGER	2
P9.4.6	1852	NA	NA	166	1	120	Pipe fill loss high frequency	INTEGER	2
P9.4.7	2408	NA	NA	166	1	121	Pipe fill loss time	INTEGER	2
P9.4.8	2411	NA	NA	166	1	122	Pipe fill loss attempts	BYTE	1
P9.5.1	2428	NA	NA	166	1	123	Prime pump enable	BYTE	1
P9.5.2	2429	NA	NA	166	1	124	Prime pump level	DOUBLE	4
P9.5.3	2431	NA	NA	166	1	125	Prime pump frequency	INTEGER	2
P9.5.4	2432	NA	NA	166	1	126	Prime pump delay time	INTEGER	2
P9.5.5	2433	NA	NA	166	1	127	Prime pump loss of prime level	INTEGER	2
P9.5.6	2434	NA	NA	166	1	128	Prime pump level 2	DOUBLE	4
P9.5.7	2436	NA	NA	166	1	129	Prime pump frequency 2	INTEGER	2
P9.5.8	2437	NA	NA	166	1	130	Prime pump delay time 2	INTEGER	2
P9.5.9	2438	NA	NA	166	1	131	Prime pump loss of prime level 2	INTEGER	2
P9.6.1	1853	NA	NA	166	1	132	Broken pipe fault response	BYTE	1
P9.6.2	1854	NA	NA	166	1	133	Broken pipe level	INTEGER	2
P9.6.3	1856	NA	NA	166	1	134	Broken pipe frequency	INTEGER	2
P9.6.4	1855	NA	NA	166	1	135	Broken pipe delay	INTEGER	2
P10.1.1	2533	NA	NA	166	1	136	FB process data input 1 sel	INTEGER	2
P10.1.2	2534	NA	NA	166	1	137	FB process data input 2 sel	INTEGER	2
P10.1.3	2535	NA	NA	166	1	138	FB process data input 3 sel	INTEGER	2
P10.1.4	2536	NA	NA	166	1	139	FB process data input 4 sel	INTEGER	2
P10.1.5	2537	NA	NA	166	1	140	FB process data input 5 sel	INTEGER	2
P10.1.6	2538	NA	NA	166	1	141	FB process data input 6 sel	INTEGER	2
P10.1.7	2539	NA	NA	166	1	142	FB process data input 7 sel	INTEGER	2
P10.1.8	2540	NA	NA	166	1	143	FB process data input 8 sel	INTEGER	2
P10.2.1	1556	442	0	163	1	80	FB process data output 1 sel	INTEGER	2
P10.2.2	1557	442	1	163	1	81	FB process data output 2 sel	INTEGER	2
P10.2.3	1558	442	2	163	1	82	FB process data output 3 sel	INTEGER	2
P10.2.4	1559	442	3	163	1	83	FB process data output 4 sel	INTEGER	2
P10.2.5	1560	442	4	163	1	84	FB process data output 5 sel	INTEGER	2
P10.2.6	1561	442	5	163	1	85	FB process data output 6 sel	INTEGER	2
P10.2.7	1562	442	6	163	1	86	FB process data output 7 sel	INTEGER	2
P10.2.8	1563	442	7	163	1	87	FB process data output 8 sel	INTEGER	2
P10.3.1	2415	NA	NA	166	1	144	Standard status word bit0 function select	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P10.3.2	2416	NA	NA	166	1	145	Standard status word bit1 function select	BYTE	1
P10.3.3	2417	NA	NA	166	1	146	Standard status word bit2 function select	BYTE	1
P10.3.4	2418	NA	NA	166	1	147	Standard status word bit3 function select	BYTE	1
P10.3.5	2419	NA	NA	166	1	148	Standard status word bit4 function select	BYTE	1
P10.3.6	2420	NA	NA	166	1	149	Standard status word bit5 function select	BYTE	1
P10.3.7	2421	NA	NA	166	1	150	Standard status word bit6 function select	BYTE	1
P10.3.8	2422	NA	NA	166	1	151	Standard status word bit7 function select	BYTE	1
P11.1.1	586	3220	0	161	1	45	Serial communication	BYTE	1
P11.2.1	587	3221	0	161	1	46	Slave address	BYTE	1
P11.2.2	584	3222	0	161	1	47	Baud rate	BYTE	1
P11.2.3	585	3224	0	161	1	48	Parity type	BYTE	1
P11.2.4	588	3225	0	161	1	49	Modbus RTU protocol status	BYTE	1
P11.2.5	593	3290	0	161	1	50	Comm timeout Modbus RTU	INTEGER	2
P11.2.6	2516	NA	NA	166	1	152	Modbus RTU fault response	BYTE	1
P11.3.1	594	NA	NA	166	1	153	MSTP baud rate	BYTE	1
P11.3.2	595	NA	NA	166	1	154	MSTP device address	BYTE	1
P11.3.3	596	NA	NA	166	1	155	MSTP instance number	DOUBLE	4
P11.3.4	598	NA	NA	166	1	156	MSTP comm timeout	INTEGER	2
P11.3.5	599	NA	NA	166	1	157	MSTP protocol status	BYTE	1
P11.3.6	600	NA	NA	166	1	158	MSTP fault code	BYTE	1
P11.3.7	2526	NA	NA	166	1	159	MSTP fault response	BYTE	1
P11.3.8	1537	NA	NA	166	1	160	MSTP max master	BYTE	1
P11.4.1	1726	NA	NA	166	1	161	SA bus device address	BYTE	1
P11.4.2	1727	NA	NA	166	1	162	SA bus baud rate	BYTE	1
P11.4.3	1728	NA	NA	166	1	163	SA bus instance number	DOUBLE	4
P11.4.4	1730	NA	NA	166	1	164	SA bus comm timeout	INTEGER	2
P11.4.5	1731	NA	NA	166	1	165	SA bus protocol status	BYTE	1
P11.4.6	1732	NA	NA	166	1	166	SA bus fault response	BYTE	1
P11.5.1	2630	NA	NA	166	1	167	Parameter Access	INTEGER	2
P11.5.2	2631	NA	NA	166	1	168	Process data access	INTEGER	2
P11.5.3	2632	NA	NA	166	1	169	Fault situation counter	INTEGER	2
P11.5.4	2609	NA	NA	166	1	170	Board status	BYTE	1
P11.5.5	2610	NA	NA	166	1	171	Firmware version	INTEGER	4
P11.5.6	2612	NA	NA	166	1	172	Protocol status	BYTE	1
P11.6.1	1895	NA	NA	166	1	173	Blue tooth enable	BYTE	1
P11.6.2	2920	NA	NA	166	1	174	Blue tooth broadcast mode	BYTE	1
P11.6.3	2935	NA	NA	166	1	175	Blue tooth pairing reset	BYTE	1
P12.1.1	1500	3249	0	161	1	51	IP address mode	BOOLEAN	1
P12.1.2	1507	NA	NA	166	1	176	Active IP address	BYTE	4
P12.1.3	1509	NA	NA	166	1	177	Active subnet mask	BYTE	4
P12.1.4	1511	NA	NA	166	1	178	Active default gateway	BYTE	4
P12.1.5	1513	NA	NA	166	1	179	Mac address	BYTE	6
P12.1.6	1501	NA	NA	166	1	180	Static IP address	BYTE	4
P12.1.7	1503	NA	NA	166	1	181	Static subnet mask	BYTE	4
P12.1.8	1505	NA	NA	166	1	182	Static default gateway	BYTE	4

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P12.1.9	611	NA	NA	41	1	109	EtherNet communication timeout	INTEGER	2
P12.2.1	68	NA	NA	166	1	183	Trusted IP white list	BYTE	12
P12.2.2	76	NA	NA	166	1	184	Trusted IP filter enable	BYTE	1
P12.3.1	1942	NA	NA	166	1	185	Modbus TCP enable	BOOLEAN	1
P12.3.2	609	NA	NA	161	1	52	Modbus TCP connection limit	BYTE	1
P12.3.3	610	NA	NA	161	1	53	Modbus TCP unit identifier number	BYTE	1
P12.3.4	612	3235	0	161	1	55	Modbus TCP protocol status	BYTE	1
P12.3.5	2517	NA	NA	166	1	186	Modbus TCP fault response	BYTE	1
P12.4.1	1997	NA	NA	166	1	187	Ethernet based protocol select	BYTE	1
P12.4.2	608	NA	NA	164	1	10	Ethernet IP protocol status	BYTE	1
P12.4.3	2518	NA	NA	166	1	188	Ethernet IP fault response	BYTE	1
P12.5.1	1733	NA	NA	166	1	189	BACnet IP UDP port number	INTEGER	2
P12.5.2	1734	NA	NA	166	1	190	BACnet IP foreign device	BYTE	1
P12.5.3	1735	NA	NA	166	1	191	BACnet IP BBMD IP	BYTE	4
P12.5.4	1737	NA	NA	166	1	192	BACnet IP BBMD port	INTEGER	2
P12.5.5	1738	NA	NA	166	1	193	BACnet IP registration interval	INTEGER	2
P12.5.6	1739	NA	NA	166	1	194	BACnet IP comm timeout	INTEGER	2
P12.5.7	1740	NA	NA	166	1	195	BACnet IP protocol status	BYTE	1
P12.5.8	1741	NA	NA	166	1	196	BACnet IP fault behavior	BYTE	1
P12.5.9	1742	NA	NA	166	1	197	BACnetIP instance number	DOUBLE	4
P12.6.1	2915	NA	NA	166	1	198	WebUI protocol status	BYTE	1
P12.6.2	2916	NA	NA	166	1	199	WebUI fault response	BYTE	1
P12.6.3	2919	NA	NA	166	1	200	Web UI communication timeout	INTEGER	2
P12.6.4	2921	NA	NA	166	1	201	WebUI enable	BYTE	1
P12.7.1	3001	NA	NA	166	1	202	IOT enable	BOOLEAN	1
P12.7.2	3002	NA	NA	166	1	203	IOT connection status	BOOLEAN	1
P12.7.3	3003	NA	NA	166	1	204	Proxy enable	BOOLEAN	1
P12.8.1	3178	NA	NA	166	1	205	SNTP enable	BYTE	1
P12.8.2	3188	NA	NA	166	1	206	SNTP server status	BYTE	1
P12.8.3	3179	NA	NA	166	1	207	SNTP server 1	BYTE	4
P12.8.4	3181	NA	NA	166	1	208	SNTP server 2	BYTE	4
P12.8.5	3183	NA	NA	166	1	209	SNTP server 3	BYTE	4
P13.1.1	340	323	0	162	1	13	Language	BYTE	1
P13.1.2	142	256	0	160	1	26	Application	BYTE	1
P13.1.3	619	970	0	162	1	14	Parameter sets	BYTE	1
P13.1.4	620	302	0	162	1	15	Up to keypad	BOOLEAN	1
P13.1.5	621	302	1	162	1	16	Down from keypad	BYTE	1
P13.1.6	623	305	0	162	1	17	Parameter comparison	BYTE	1
P13.1.7	624	320	0	162	1	18	Parameter lock PIN	INTEGER	2
P13.1.8	625	625	0	162	1	19	Keypad parameter lock	BOOLEAN	1
P13.1.9	626	NA	NA	162	1	20	Startup wizard	BOOLEAN	1
P13.2.1	1875	NA	NA	166	1	210	Local default page	BYTE	1
P13.2.2	1876	NA	NA	166	1	211	Local monitor parameter set	BYTE	3
P13.2.3	628	326	0	162	1	22	Default page	BYTE	1
P13.2.4	629	330	0	162	1	23	Timeout time	INTEGER	2
P13.2.5	630	324	0	162	1	24	Contrast adjust	BYTE	1
P13.2.6	631	330	1	162	1	25	Backlight time	INTEGER	2
P13.2.7	632	627	0	162	1	26	Fan control	BYTE	1
P13.2.8	633	362	0	162	1	27	Keypad ACK timeout	INTEGER	2
P13.2.9	634	3291	0	162	1	28	Keypad retry number	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
P13.3.1	2424	NA	NA	166	1	212	Output display unit	BYTE	1
P13.3.2	2460	NA	NA	166	1	213	Output display unit min	DOUBLE	4
P13.3.3	2425	NA	NA	166	1	214	Output display unit max	DOUBLE	4
P13.4.1	640	207	2	161	1	58	Keypad software version	INTEGER	4
P13.4.2	642	206	0	162	1	1	Motor control software version	INTEGER	4
P13.4.3	644	207	1	1	1	4	Application software version	INTEGER	4
P13.4.4	1714	NA	NA	166	1	215	Software bundle version		20
P13.5.1	648	NA	NA	1	1	6	Serial number	DOUBLE	4
P13.5.2	627	328	0	162	1	21	Multimonitor set	BOOLEAN	1
P13.5.3	75	NA	NA	166	1	216	Keypad lock PIN	INTEGER	2
P13.5.4	2922	NA	NA	166	1	217	Drive application name		20
P13.6.1	601	520	2	162	1	6	Total MWh count	DOUBLE	4
P13.6.2	603	522	0	162	1	7	Total power day count	INTEGER	2
P13.6.3	606	821	1	162	1	8	Total power hr count	DOUBLE	4
P13.6.4	1872	NA	NA	166	1	218	Total motor hr count	DOUBLE	4
P13.6.5	604	806	0	162	1	9	Trip MWh count	DOUBLE	4
P13.6.6	639	322	4	162	1	12	Clear trip MWh count	BYTE	1
P13.6.7	636	870	0	162	1	10	Trip power day count	INTEGER	2
P13.6.8	637	871	0	162	1	11	Trip power hr count	DOUBLE	4
B2.1.1.1	883	710	1	162	1	87	Board status	BYTE	1
B2.1.1.2	1064	NA	NA	162	1	88	Firmware version	INTEGER	4
B2.1.1.3	2131	NA	NA	164	1	36	Protocol status	BYTE	1
B2.1.1.4	2633	NA	NA	166	1	219	PDP-telegram selection	INTEGER	2
B2.1.1.5	2634	NA	NA	166	1	220	Fault counter pdp	INTEGER	2
B2.1.1.6	2635	NA	NA	166	1	221	Fault situations max	INTEGER	4
B2.1.1.7	2637	NA	NA	166	1	222	PDP-profil number	INTEGER	2
B2.1.1.8	2638	NA	NA	166	1	223	PDP-control word	INTEGER	2
B2.1.1.9	2639	NA	NA	166	1	224	PDP-status word	INTEGER	2
B2.1.2.1	2621	NA	NA	166	1	225	PDP-maxblocklength	BYTE	1
B2.1.2.2	2622	NA	NA	166	1	226	PDP-noofmultiparameter	BYTE	1
B2.1.2.3	2623	NA	NA	166	1	227	PDP-maxlatency	BYTE	1
B2.1.3.1	2624	NA	NA	166	1	228	PDP-DO manufacturer	INTEGER	2
B2.1.3.2	1451	NA	NA	1	1	3	PDP-DO device type	INTEGER	2
B2.1.3.3	2625	NA	NA	166	1	229	PDP-DO FW-interface	INTEGER	2
B2.1.3.4	2640	NA	NA	166	1	230	PDP-DO FW-year	INTEGER	2
B2.1.3.5	2641	NA	NA	166	1	231	PDP-DO FW-daymonth	INTEGER	2
B2.1.3.6	2628	NA	NA	166	1	232	PDP-DO NoOfDOs	BYTE	1
B2.1.3.7	2629	NA	NA	166	1	233	PDP-DO subclass	BYTE	1
B2.2.1	1242	3201	100	163	1	41	Slave address	BYTE	1
B2.2.2	1245	3200	100	163	1	42	Operate mode	BYTE	1
B2.2.3	2642	NA	NA	166	1	234	Parameter access	INTEGER	2
B2.2.4	2643	NA	NA	166	1	235	Process data access	INTEGER	2
B2.2.5	2644	NA	NA	166	1	236	Fault situation counter	INTEGER	2
B2.2.6	619	970	0	162	1	14	Parameter sets	BYTE	1
B3.1.1	883	710	1	162	1	87	Board status	BYTE	1
B3.1.2	1064	NA	NA	162	1	88	Firmware version	INTEGER	4
B3.1.3	2132	NA	NA	164	1	37	Protocol status	BYTE	1
B3.2.1	2133	NA	NA	164	1	38	Node ID	BYTE	1
B3.2.2	2134	NA	NA	164	1	39	Baud rate	BYTE	1
B3.2.3	2135	NA	NA	164	1	40	Operate mode	BYTE	1

Table 172. DM1 parameter ID list (cont).

Menu item no	Modbus register	PROFIBUS PNU	PROFIBUS PNU subindex	EtherNet/IP class	EtherNet/IP instance	EtherNet/IP attribute	Parameter description	Data type	Length
B3.2.4	2519	NA	NA	166	1	237	Comm card FB fault response	BYTE	1
O1	1	502	0	160	1	1	Output frequency	INTEGER	2
O2	24	1	0	160	1	2	Freq reference	INTEGER	2
O3	2	503	0	4	70	3	Motor speed	INTEGER	2
O4	3	504	0	160	1	4	Motor current	INTEGER	2
O5	4	507	0	160	1	5	Motor torque	INTEGER	2
O6	5	513	1	160	1	6	Motor power	INTEGER	2
O7	6	501	0	160	1	7	Motor voltage	INTEGER	2
O8	7	501	1	160	1	8	DC-link voltage	INTEGER	2
O9	8	822	6	160	1	9	Unit temperature	INTEGER	2
O10	9	822	4	160	1	10	Motor temperature	INTEGER	2
R11	141	1	8	160	1	66	Keypad reference	INTEGER	2
R12	1307	2170	0	160	1	129	PI keypad setpoint 1	DOUBLE	4
R13	1309	2179	0	160	1	130	PI keypad setpoint 2	DOUBLE	4
P13.1.7	624	320	0	162	1	18	Parameter lock PIN	INTEGER	2
P1.1	101	20	0	160	1	73	Min frequency	INTEGER	2
P1.2	102	20	1	160	1	74	Max frequency	INTEGER	2
P1.6	486	210	0	40	1	6	Motor nom current	INTEGER	2
P1.7	489	217	0	40	1	15	Motor nom speed	INTEGER	2
P1.8	490	215	0	161	1	38	Motor PF	INTEGER	2
P1.9	487	211	0	40	1	7	Motor nom voltage	INTEGER	2
P1.10	488	216	0	161	1	40	Motor nom frequency	INTEGER	2
P1.3	103	130	0	160	1	75	Accel time 1	INTEGER	2
P1.4	104	134	0	160	1	76	Decel time 1	INTEGER	2
P1.13	135	408	0	160	1	63	Remote control place	BYTE	1
P1.14	137	437	0	160	1	65	Remote reference	BYTE	1
P13.5.3	75	NA	NA	166	1	216	Keypad lock pin	INTEGER	2
P11.6.1	1895	NA	NA	166	1	173	Blue tooth enable	BYTE	1
P7.1.3	1297	2870	0	160	1	123	PI process unit	BYTE	1
P7.1.4	1298	2871	0	160	1	124	PI process unit min	DOUBLE	4
P7.1.5	1300	2872	0	160	1	125	PI process unit max	DOUBLE	4
P7.2.2.1	1312	2110	0	160	1	132	PI set point 1 source	BYTE	1
P7.2.1.1	1307	2170	0	160	1	129	PI keypad setpoint 1	DOUBLE	4
P7.3.2.1	1332	2112	0	160	1	143	PI feedback 1 source	BYTE	1
P7.2.2.6	2450	2137	0	166	1	91	PI set point 1 sleep level	DOUBLE	4
P7.2.2.3	1317	2138	0	160	1	134	PI set point 1 sleep delay	INTEGER	2
P7.2.1.3	2466	NA	NA	166	1	90	PI wake up action	BYTE	1
P7.2.2.4	1318	2139	0	160	1	135	PI set point 1 wake up level	DOUBLE	4
P7.1.3	1297	2870	0	160	1	123	PI process unit	BYTE	1
P7.1.4	1298	2871	0	160	1	124	PI process unit min	DOUBLE	4
P7.1.5	1300	2872	0	160	1	125	PI process unit max	DOUBLE	4
P7.2.2.1	1312	2110	0	160	1	132	PI set point 1 source	BYTE	1
P7.2.1.1	1307	2170	0	160	1	129	PI keypad setpoint 1	DOUBLE	4
P7.3.2.1	1332	2112	0	160	1	143	PI feedback 1 source	BYTE	1
P7.2.2.6	2450	2137	0	166	1	91	PI set point 1 sleep level	DOUBLE	4
P7.2.2.3	1317	2138	0	160	1	134	PI set point 1 sleep delay	INTEGER	2
P7.2.1.3	2466	NA	NA	166	1	90	PI wake up action	BYTE	1
P7.2.2.4	1318	2139	0	160	1	135	PI set point 1 wake up level	DOUBLE	4
P8.2.2	536	438	0	161	1	31	Fire mode ref select function	BYTE	1
P8.2.3	537	28	2	161	1	32	Fire mode min frequency	INTEGER	2
							End_Startup_Wizard		

Appendix B—Process data values

Process data OUT (slave → master)

The fieldbus master can read the frequency converter's actual values using process data variables. All software applications use process data as follows:

Table 173. Process data OUT (slave → master).

Data	Value	Unit	Scale	Default, Min., Max.
Process data out 1	Output frequency	Hz	0.01 Hz	
Process data out 2	Motor speed	rpm	1 rpm	
Process data out 3	Motor current	A	0.01 A	
Process data out 4	Motor torque	%	0.10%	
Process data out 5	Motor power	%	0.10%	
Process data out 6	Motor voltage	V	0.1 V	
Process data out 7	DC link voltage	V	1 V	
Process data out 8	Latest fault code			

Note: The communication parameter group in any application has a selector parameter for every process data.
The monitoring values and drive parameters can be selected using the ID number. Default selections are shown in the table above. Reference **Appendix A** for Modbus IDs that can be set via the keypad FB Process Data Out group.

Process data IN (master → slave)

Control word, reference, and process data are used with All-in-One applications as follows:

Table 174. Process data IN (master → slave) for all applications.

Data	Value	Unit	Scale	Default
Process data in 1	FB torque reference	%	0.01	0
Process data in 2	FB setpoint 1	varies	varies	0
Process data in 3	FB feedback 1	varies	varies	0
Process data in 4	Accel time 1	s	0.1	varies
Process data in 5	Decel tiime 1	s	0.1	varies
Process data in 6	Current limit	A	0.1	varies
Process data in 7	Not assigned	—	—	—
Process data in 8	Not assigned	—	—	—

Note: The communication parameter group in any application has a selector parameter for every process data. The monitoring values and drive parameters can be selected using the ID number. Default selections are shown in the table above. Reference **Appendix A** for Modbus IDs that can be set via the keypad B Process Data IN group.

When configuring the process data parameters for the drive, there are many parameters which can monitored over the fieldbus and selected using the communications settings group menu items.

Menu Item	Parameter	Parameter number	Default monitored parameter
P20.1.1	FB data out 1 sel.	1	Output frequency
P20.1.2	FB data out 2 sel.	2	Motor speed
P20.1.3	FB data out 3 sel.	3	Motor current
P20.1.4	FB data out 4 sel.	4	Motor torque
P20.1.5	FB data out 5 sel.	5	Motor power
P20.1.6	FB data out 6 sel.	6	Motor voltage
P20.1.7	FB data out 7 sel.	7	DC-link voltage
P20.1.8	FB data out 8 sel.	8	Unit temperature

However, since these menu Items are read write items, these monitored parameters can be modified to any parameter in the drive by simply changing the value for the menu item. For example, if in **FB Data Out 8** one wanted to monitor the state of the digital inputs D1 to D3 they would change **Process Data Out 8** from an 8 to a 12. For a complete list of parameters please refer to Communication Application Guide which can be found on the drives web site.

Typically the parameters which are monitored over fieldbus are the same types of parameters monitored on the Monitoring menu of the drive, a list of those parameters and IDs are provided below.

Parameter ID	Description	Parameter ID	Description
1	Output frequency	16	PID1 setpoint
2	Motor speed	18	PID1 feedback
3	Motor current	20	PID1 error value
4	Motor torque	22	PID1 output
5	Motor power	23	PID1 status
6	Motor voltage	24	Freq reference
7	DC-link voltage	25	Analog output 1
8	Unit temperature	26	Running motors
9	Motor temperature	27	PT100 temperature
10	Analog input 1	28	Last active fault
11	Analog input 2	30	Multi-monitoring
12	DI1, DI2, DI3	32	PID2 setpoint
13	DI4, DI5, DI6	34	PID2 feedback
14	DO1	36	PID2 error value
15	Torque reference	38	PID2 output
		39	PID2 status

Appendix C—Fault codes

Fault codes

Table 175. Fault code list

Fault code	Fault name	Fault type	Default	Realization	CIP fault code	PROFIdrive fault code
1	Over-current	Fault		DSP	0x2310h	8976
2	Over-voltage	Fault		DSP	0x3210h	12816
3	Earth vault	Configurable	Fault	DSP	0x2330h	9008
9	Under-voltage	Configurable	Fault	DSP/MCU	0x3220h	12576
10	Input phase spv.	Configurable	Fault	DSP	0xA004h	8528
11	Output phase spv.	Configurable	Fault	DSP	0xA005h	9040
13	Drive under temp.	Configurable	Warning	DSP	0x4320h	16928
14	Drive over temp.	Fault		DSP	0x4310h	16912
15	Motor stalled	Configurable	No action	DSP	0x7121h	28963
16	Motor over temp.	Configurable	No action	DSP	0x4210h	17168
17	Motor underload	Configurable	No action	DSP	29d	28979
18	IP address conflict	Configurable	Warning	MCU	0xA006h	30070
19	Power board EEPROM fault	Fault		MCU	0xA007h	21795
20	FRAM fault	Fault		MCU	0xA008h	21777
21	Serial flash fault	Warning		MCU	0xA009h	21796
22	Speed deviation	Fault		DSP		
23	STO fault	Fault		MCU		
25	MCU WatchDog fault	Fault		MCU	0x6010h	24848
26	Start-up prevent	Fault		MCU	0xA00Ah	35585
37	Device change	Warning		MCU	0xA00Ch	35360
38	Device added	Warning		MCU	0xA00Dh	35361
40	Device unknown	Fault		MCU	0xA00Fh	35363
41	IGBT over temperature	Fault		DSP	66d	16913
50	AIN<4mA(4to20mA)	Configurable	No action	MCU	0xA011h	29520
51	External fault	Configurable	Fault	MCU	0x9000h	36864
52	Keypad communication fault	Configurable	Fault	MCU	0xA012h	21264
54	OPT card fault	Configurable	Fault	MCU	0xA013h	35073
57	Motor ID fault	Fault		DSP	0xA017h	29072
58	Current measure fault	Fault		DSP	0x2100h	9217
65	Replace fan	Configurable	Warning	MCU	0xA01Ah	28688
66	Safety torque off	Fault		DSP	0xA01Bh	21665
67	Current limit control	Warning		DSP	0x2200h	8977
68	Over voltage control	Warning		DSP	0x3310h	12817
70	System fault - DSP parameter	Fault		MCU	0xA01Dh	22018
80	FieldBus fault	Configurable	Fault	MCU		
81	FieldBus fault	Configurable	Fault	MCU		
83	FieldBus fault	Configurable	Fault	MCU	0xA026h	30064
84	FieldBus fault	Configurable	Fault	MCU	0xA027h	30065
85	FieldBus fault	Configurable	Fault	MCU	0xA028h	30066
86	FieldBus fault	Configurable	Fault	MCU	0x8100h	30067
87	FieldBus fault	Configurable	Fault	MCU	0xA029h	30068
90	Drive under temp.	Warning/fault		DSP	0x3221h	30071
92	External fault 2	Configurable	Fault	MCU	0xA02Dh	NA
93	External fault 3	Configurable	Fault	MCU	0xA02Eh	NA
97	Pipe fill loss	Configurable	No action	MCU	0xA031	35587

Table 175. Fault code list (cont).

Fault code	Fault name	Fault type	Default	Realization	CIP fault code	PROFIdrive fault code
98	PID1 feedback AI loss	Configurable	No action	MCU	0xA032	33283
100	FieldBus SMDT fault	Configurable	Fault	MCU	0xA034	30002
101	Option card fault	Configurable		MCU	0xA035	35120
102	External fault from SWD	Configurable	Fault	MCU	0xA036	36871
103	Drive over temp. warning	Warning		DSP	0xA037	16912
111	Compatibility fault	Warning		MCU	0xA03F	22792
113	Compatibility fault	Warning		MCU	0xA041	22789
114	Compatibility fault	Warning		MCU	0xA042	22791
115	Fieldbus Fault			MCU		
117	Pump Over Cycle	Warning		MCU		
118	Broken Pipe	Configurable	No action	MCU		
125	Freq Limit Supv	Configurable	No action	MCU		
126	Torque Limit Supv	Configurable	No action	MCU		
127	Ref Limit Supv	Configurable	No action	MCU		
128	Power Limit Supv	Configurable	No action	MCU		
129	Temp Limit Supv	Configurable	No action	MCU		
130	AI Limit Supv	Configurable	No action	MCU		
131	Motor Current Supv	Configurable	No action	MCU		
132	PI Superv	Configurable	No action	MCU		
133	Fieldbus Fault	Configurable	Fault	MCU		

Note: Configurable - Faults that are specified as "Configurable" have "Fault configuration parameter" associated with them. This configuration parameter can be configured as using keypad (menu Protections) or using vendor specific object.

Appendix D—PowerXL recommended secure hardening guidelines

Introduction

This section "secure configuration" or "hardening" guidelines provide information to the users to securely deploy and maintain this product to adequately minimize the cybersecurity risks to their system. Eaton is committed to minimizing the Cybersecurity risk in its products and deploys cybersecurity best practices and latest cybersecurity technologies in its products and solutions; making them more secure, reliable and competitive for our customers. Eaton also offers Cybersecurity Best Practices whitepapers to its customers that can be referenced at www.eaton.com/cybersecurity

Table 176. PowerXL—secure configuration guidelines.

Category	Description
Asset identification and inventory	Keeping track of all the devices in the system is a pre-requisite for effective management of Cybersecurity of a system. Ensure you maintain an inventory of all the components in your system in a manner in which you uniquely identify each component. To facilitate this PowerXL Series VFD supports the following identifying information - manufacturer, type, serial number, f/w version number, and location. Customers/users can read following information from product label: • Model number; • Serial number; • Device name. Information specific to communication protocols is available form parameter menu as below: • IP address mode; • Active IP address; • MAC address (See application manual for these parameter locations).

Restrict physical access	Industrial control protocols do not offer cryptographic protections at protocol level leaving them exposed to Cybersecurity risk. Physical security is an important layer of defense in such cases. PowerXL series VFD is designed with the consideration that it would be deployed and operated in a physically secure location.
	• Eaton suggests that physical access to cabinets and/or enclosures containing PowerXL series VFD and the associated system should be restricted, monitored and logged at all times.
	• Physical access to the communication lines should be restricted to prevent any attempts of wiretapping, sabotage. It is a best practice to use metal conduits for the communication lines running between one cabinet to another cabinet.
	• Attacker with unauthorized physical access to the device could cause serious disruption of the device functionality. A combination of physical access controls to the location should be used, such as locks, card readers, and/or guards etc.
	• PowerXL series VFD supports the following physical access ports:
	  • RJ45 connector for removable keypad as well as Modbus RTU communications;
	  • RJ45 for EtherNet IP/Modbus TCP communications;
	  • Terminal block for Modbus RTU and other Digital IOs.
	Eaton suggests access to above physical ports need to be restricted.

Table 176. PowerXL—secure configuration guidelines (cont).

Category	Description
Restrict logical access to PowerXL series drive	It is extremely important to securely configure the logical access mechanisms provided in PowerXL series VFD to safeguard the device from unauthorized access. PowerXL series VFD provides various types of administrative, operational, configuration privilege levels. Eaton recommends that the available access control mechanisms be used properly to ensure that access to the system is restricted to legitimate users only. And, such users are restricted to only the privilege levels necessary to complete their job roles/functions. Eaton recommends below best practices to be followed to ensure adequate cybersecurity of the setup/system: • Default credentials are changed upon first login. PowerXL series VFD should not be commissioned for production with default credentials, it is a serious Cybersecurity flaw as the default credentials are published in the manuals. Restrict administrative privileges - Threat actors are increasingly focused on gaining control of legitimate credentials, especially those associated with highly privileged accounts. Limit privileges to only those needed for a user's duties. Make sure that the password used in the device is only available to authorized users like configuring engineers and not shared among all operational users. • Perform periodic account maintenance to make sure that password is changed whenever there is personnel change. • Change passwords and other system access credentials as appropriate. • PowerXL series VFD is provided with data/access protection mechanism on keypad, follow below steps to utilize it. PowerXL Series VFD provides four levels of data protection for users to ensure the security: 1. Lock parameters on keypad. User can lock the parameters through DI or disable change, in which way all the parameters cannot be edited. 2. Lock parameters while motor running. Motor control parameters can only be modified when motor is in stop mode. In which way to enhance the motor security. The parameters are listed in the application manual. 3. Through Power Xpert inControl tool, facility to hide parameters on keypad is available. User can hide the parameters he/she thinks are significant for himself/herself. Such as IP address and so on. 4. Password on keypad: • 0000 means no password, which is the default. • Password range is 0001 ~ 9999. • With password, user can monitor parameters value but need enter password if he/she wants to edit parameters. • User needs to re-enter the password if there is no key operation in one minute after enter the password. • User needs to enter the old password if he/she wants to change to a new one.
Restrict network access	PowerXL series VFD provides network access to facilitate communication with other devices in the systems and configuration. But this capability could open up a big security hole if it's not configured securely. Eaton recommends segmentation of networks into logical enclaves and restrict the communication to host-to-host paths. This helps protect sensitive information and critical services and limits damage from network perimeter breaches. At a minimum, a utility industrial control systems network should be segmented into a three-tiered architecture (as recommended by NIST SP800-82[R3]) for better security control. Deploy adequate network protection devices like firewalls, intrusion detection / protection devices. Below are the protocols and their port details available on PowerXL series VFD. Use below information for configuring the firewalls. PowerXL series VFD provides below communication protocols: • EtherNet IP protocols on RJ45 connector – enabled by default on port 44818 and 2222; • Modbus TCP protocol on RJ45 connector – enabled by default on port 502; • Modbus RTU on RS485 physical layer – enabled by default; • BACnet MS/TP on RS485 physical layer – disabled by default, when this is enabled, Modbus RTU is disabled. All the protocols have dedicated menu structure, and details are described in User's Manual for how to activate or configure them. • Eaton has published detailed information about various network level protection strategies in Eaton Cybersecurity Considerations for Electrical Distribution Systems [R1].

Table 176. PowerXL—secure configuration guidelines (cont).

Category	Description
Restrict logical access to PowerXL series drive	It is extremely important to securely configure the logical access mechanisms provided in PowerXL sSeries VFD to safeguard the device from unauthorized access. PowerXL series VFD provides various types of administrative, operational, configuration privilege levels. Eaton recommends that the available access control mechanisms be used properly to ensure that access to the system is restricted to legitimate users only. And, such users are restricted to only the privilege levels necessary to complete their job roles/functions. Eaton recommends below best practices to be followed to ensure adequate cybersecurity of the setup/system: • Default credentials are changed upon first login. PowerXL series VFD should not be commissioned for production with Default credentials, it is a serious Cybersecurity flaw as the default credentials are published in the manuals. Restrict administrative privileges - Threat actors are increasingly focused on gaining control of legitimate credentials, especially those associated with highly privileged accounts. Limit privileges to only those needed for a user's duties. Make sure that the password used in the device is only available to authorized users like configuring engineers and not shared among all operational users. • Perform periodic account maintenance to make sure that password is changed whenever there is personnel change. • Change passwords and other system access credentials as appropriate. • PowerXL series VFD is provided with data/access protection mechanism on keypad, follow below steps to utilize it. PowerXL series VFD provides four levels of data protection for users to ensure the security: 1. Lock parameters on keypad. User can lock the parameters through DI or disable change, in which way all the parameters cannot be edited. 2. Lock parameters while motor running. Motor control parameters can only be modified when motor is in stop mode. In which way to enhance the motor security. The parameters are listed in the application manual. 3. Through Power Xpert inControl tool, facility to hide parameters on keypad is available. User can hide the parameters he/she thinks are significant for himself/herself. Such as IP address and so on. 4. Password on keypad: ◦ 0000 means no password, which is the default; ◦ Password range is 0001 ~ 9999; ◦ With password, user can monitor parameters value but need enter password if he/she wants to edit parameters; ◦ User needs to re-enter the password if there is no key operation in one minute after enter the password; ◦ User needs to enter the old password if he/she wants to change to a new one.
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References

[R1] Cybersecurity Considerations for Electrical Distribution Systems (WP152002EN):

http://www.eaton.com/ecm/groups/public/@pub/@eaton/@corp/documents/content/pct_1603172.pdf

[R2] Cybersecurity Best Practices Checklist Reminder (WP910003EN):

http://www.cooperindustries.com/content/dam/public/powersystems/resources/library/1100_EAS/WP910003EN.pdf

Notes

We make what matters work.*

* At Eaton, we believe that power is a fundamental part of just about everything people do. Technology, transportation, energy and infrastructure—these are things the world relies on every day. That's why Eaton is dedicated to helping our customers find new ways to manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. To improve people's lives, the communities where we live and work, and the planet our future generations depend upon. Because that's what really matters. And we're here to make sure it works.

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