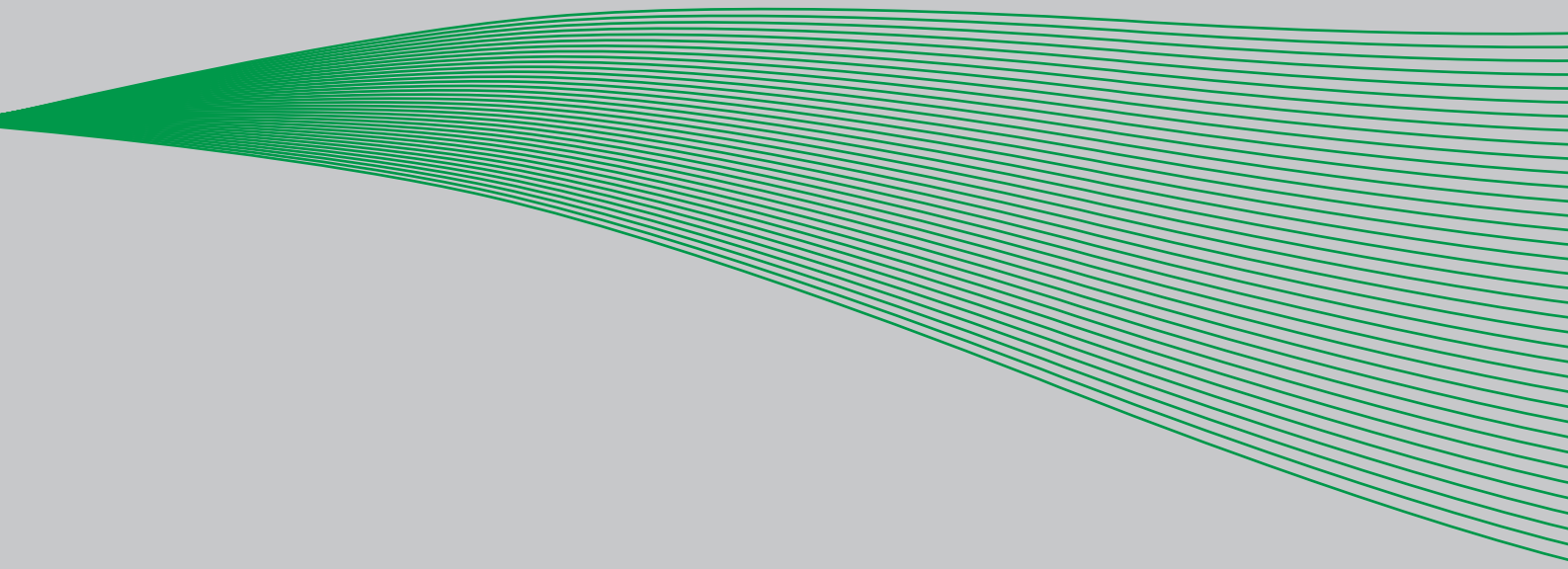
VACON® 100
AC DRIVES

ETHERNET/IP USER MANUAL



VACON®
DRIVEN BY DRIVES

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1. SAFETY

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Please read the information included in cautions and warnings carefully.

The cautions and warnings are marked as follows:

Table 1. Warning signs

	**= DANGER! Dangerous voltage**
	**= WARNING or CAUTION**
	**= Caution! Hot surface**

1.1 DANGER

	The **components of the power unit are live** when the drive is connected to mains potential. Coming into contact with this voltage is **extremely dangerous** and may cause death or severe injury.
	The **motor terminals U, V, W and the brake resistor terminals are live** when the AC drive is connected to mains, even if the motor is not running.
	**After disconnecting** the AC drive from the mains, **wait** until the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait 5 more minutes before doing any work on the connections of the drive. Do not open the cover before this time has expired. After expiration of this time, use a measuring equipment to absolutely ensure that no voltage is present. **Always ensure absence of voltage before starting any electrical work!**
	The control I/O-terminals are isolated from the mains potential. However, the **relay outputs and other I/O-terminals may have a dangerous control voltage** present even when the AC drive is disconnected from mains.
	**Before connecting** the AC drive to mains make sure that the front and cable covers of the drive are closed.
	During a ramp stop (see the Application Manual), the motor is still generating voltage to the drive. Therefore, do not touch the components of the AC drive before the motor has completely stopped. Wait until the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait additional 5 minutes before starting any work on the drive.

1.2 WARNINGS

	The AC drive is meant for **fixed installations only**.
	**Do not perform any measurements** when the AC drive is connected to the mains.
	The **earth leakage current** of the AC drives exceeds 3.5mA AC. According to standard EN61800-5-1, **a reinforced protective ground connection** must be ensured. See chapter 1.3.
	If the AC drive is used as a part of a machine, the **machine manufacturer is responsible** for providing the machine with a **supply disconnecting device** (EN 60204-1).
	Only **spare parts** delivered by Vacon can be used.
	At power-up, power brake or fault reset **the motor will start immediately** if the start signal is active, unless the pulse control for Start/Stop logic has been selected. Futhermore, the I/O functionalities (including start inputs) may change if parameters, applications or software are changed. Disconnect, therefore, the motor if an unexpected start can cause danger.
	The **motor starts automatically** after automatic fault reset if the auto restart function is activated. See the Application Manual for more detailed information.
	**Prior to measurements on the motor or the motor cable**, disconnect the motor cable from the AC drive.
	**Do not touch the components on the circuit boards**. Static voltage discharge may damage the components.
	Check that the **EMC level** of the AC drive corresponds to the requirements of your supply network.

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1.3 EARTHING AND EARTH FAULT PROTECTION

CAUTION!

The AC drive must always be earthed with an earthing conductor connected to the earthing terminal marked with ⏚.

The earth leakage current of the drive exceeds 3.5mA AC. According to EN61800-5-1, one or more of the following conditions for the associated protective circuit shall be satisfied:

b) The protective conductor shall have a cross-sectional area of at least 10 mm2 Cu or 16 mm2 Al, through its total run.

c) Where the protective conductor has a cross-sectional area of less than 10 mm2 Cu or 16 mm2 Al, a second protective conductor of at least the same cross-sectional area shall be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm2 Cu or 16 mm2 Al.

d) Automatic disconnection of the supply in case of loss of continuity of the protective conductor.

The cross-sectional area of every protective earthing conductor which does not form part of the supply cable or cable enclosure shall, in any case, be not less than:

- 2.5mm² if mechanical protection is provided or
- 4mm² if mechanical protection is not provided.

The earth fault protection inside the AC drive protects only the drive itself against earth faults in the motor or the motor cable. It is not intended for personal safety.

Due to the high capacitive currents present in the AC drive, fault current protective switches may not function properly.

Do not perform any voltage withstand tests on any part of the AC drive. There is a certain procedure according to which the tests shall be performed. Ignoring this procedure may result in damaged product.

2. ETHERNET/IP - GENERAL INFO

EtherNet/IP™ is industrial Ethernet network solution available for manufacturing automation.

CIP™ (Common Industrial Protocol) encompasses a comprehensive suite of messages and services for a variety of manufacturing automation applications, including control, safety, synchronization, motion, configuration and information. CIP provides users with unified communication architecture throughout the manufacturing enterprise.

2.1 CONNECTIONS AND WIRING

The Vacon® 100 drive supports 10/100Mb speeds in both Full and Half-duplex modes. The drive must be connected to the Ethernet network with a shielded CAT-5e cable. Use a so called crossover cable (at least CAT-5e cable with STP, Shielded Twisted Pair) 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.

More information on EtherNet/IP can be found at www.odva.org.

2.1.1 TECHNICAL DETAILS

EtherNet/IP is a connection-oriented communication protocol designed for use in industrial environments. The protocol allows simple and complex industrial devices to communicate with each other.

Standard Ethernet and TCP/IP technology is used by the EtherNet/IP protocol. There are different messaging forms in EtherNet/IP:

- Connections are established using so-called "Unconnected Messaging",
- Real-time I/O data transfer happens through "Connected Messaging"

There are two kinds of connections in EtherNet/IP:

- General-purpose, point-to-point connections are known as "Explicit Messaging Connections". These messages are sent using the TCP protocol.
- Connections for moving application-specific I/O data at regular intervals are known as "Implicit Connections" or "I/O Data Connections". These messages are sent using the UDP protocol

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3. ETHERNET INSTALLATION

1	Open the cover of the AC drive.

The relay outputs and other I/O-terminals may have a dangerous control voltage present even when Vacon® 100 is disconnected from mains.

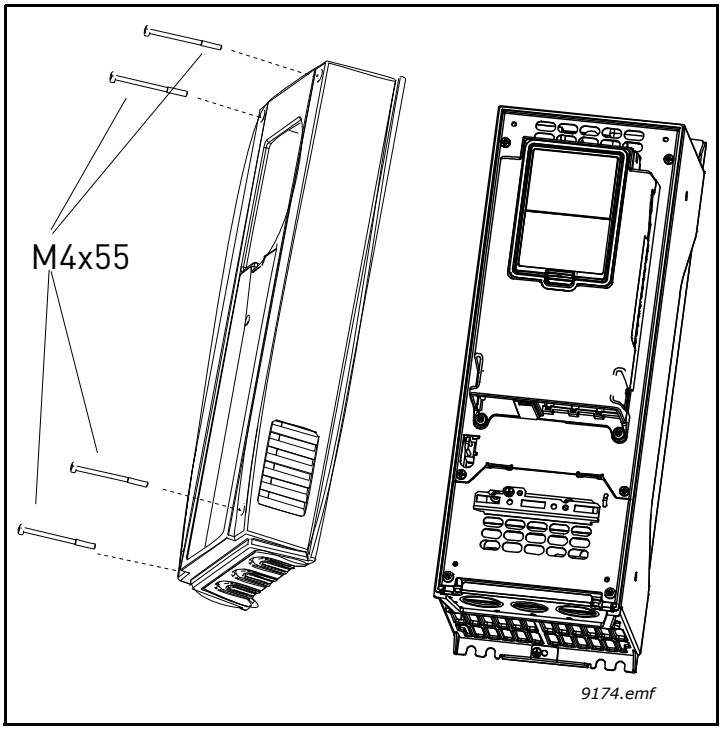

Figure 1.

2	Locate the components that you will need on the AC drive to connect and run the Ethernet cables.

Be sure not to plug the Ethernet cable to the terminal under the keypad! This might harm your personal computer.

3.1 PREPARE FOR USE THROUGH ETHERNET

3	Connect the Ethernet cable to its terminal and run the cable through the conduit as shown in Figure 2.

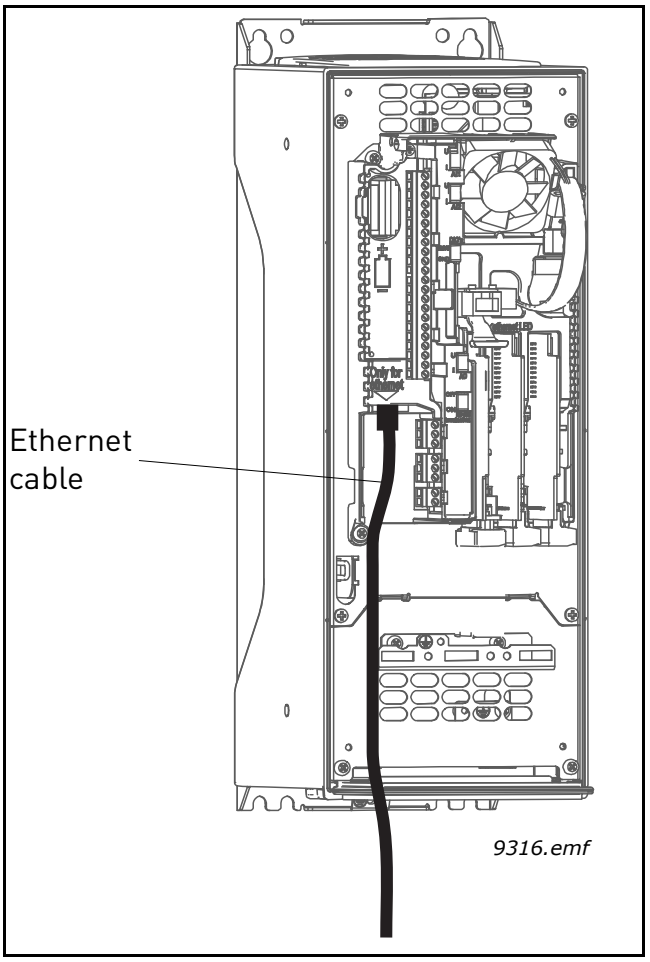

Figure 2.

4	**Protection class IP21:** Cut free the opening on the AC drive cover for the Ethernet cable. **Protection class IP54:** Cut the rubber grommets open to slide the cables through. Should the grommets fold in while inserting the cable, just draw the cable back a bit to straighten the grommets up. Do not cut the grommet openings wider than what is necessary for the cables you are using. **IMPORTANT:** To meet the requirements of the enclosure class IP54, the connection between the grommet and the cable must be tight. Therefore, lead the first bit of the cable out of the grommet **straight** before letting it bend. If this is not possible, the tightness of the connection must be ensured with insulation tape or a cable tie.

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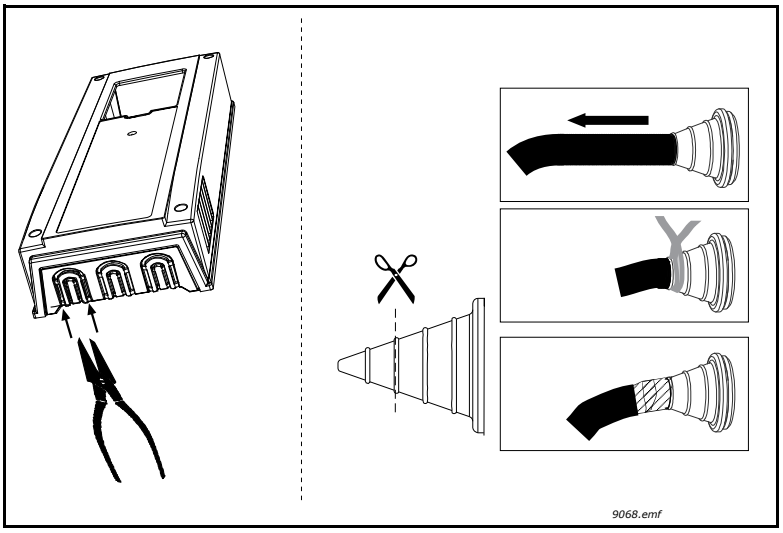

Figure 3. Leading the cables, left: IP21, right: IP54

5	Remount the AC drive cover. **NOTE:** When planning the cable runs, remember to keep the distance between the Ethernet cable and the motor cable at a **minimum of 30 cm**.

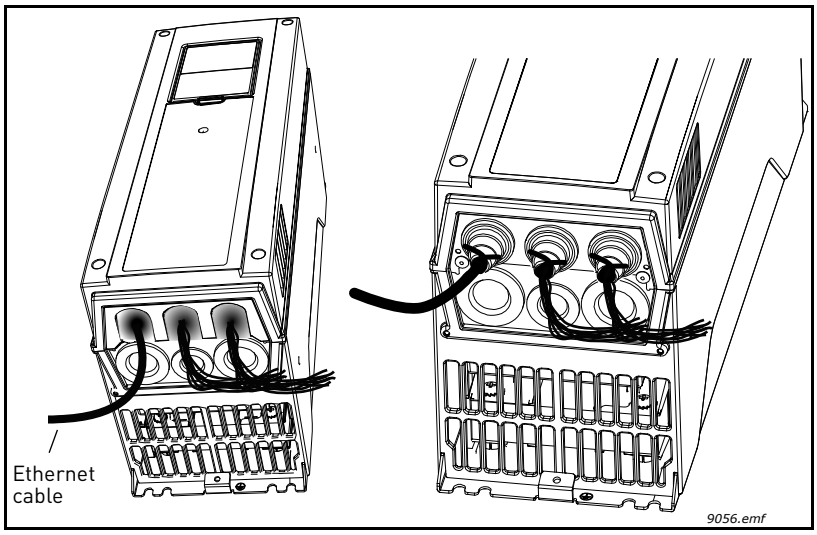

Figure 4.

4. COMMISSIONING

The integrated EtherNet/IP protocol in the Vacon® 100 drive must be selected when ordering the drive. If the drive is not equipped with the integrated EtherNet/IP protocol, the EtherNet/IP menus do not appear and the protocol cannot be used.

EtherNet/IP is configured from panel or with Vacon Live. Settings for EtherNet/IP can be found under *"I/O and Hardware / Ethernet / EtherNet/IP".* EtherNet/IP has two menus, one for parameters and one for monitoring. If the protocol has been disabled, the monitoring menu is not shown on panel.

In addition to settings below, EtherNet/IP uses common network settings (i.e. IP address, network mask, etc.).

In the EtherNet/IP master, the configuration assembly for the Vacon 100 drive must be configured as instance number 103 with a byte size of 0.

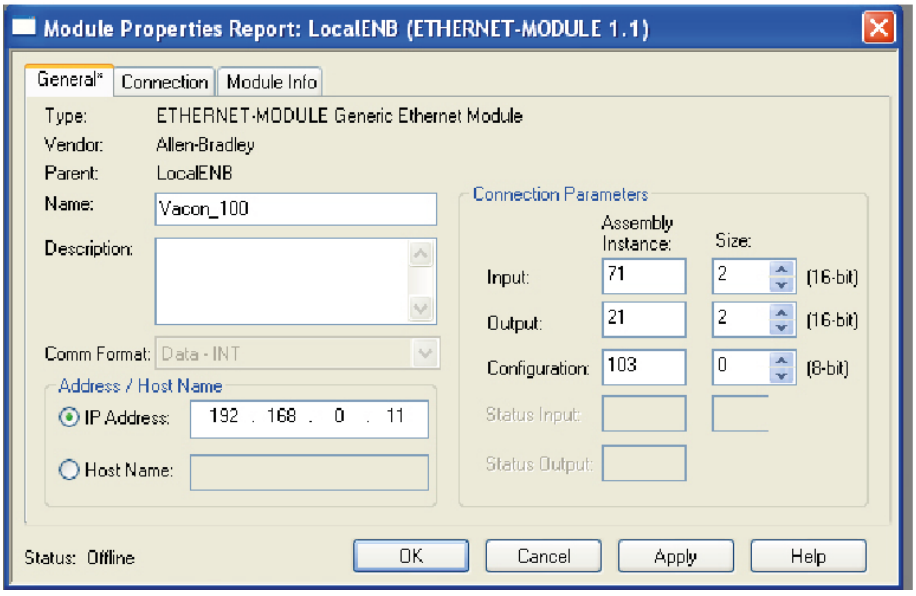

Figure 5.Configuration example from Rockwell PLC.

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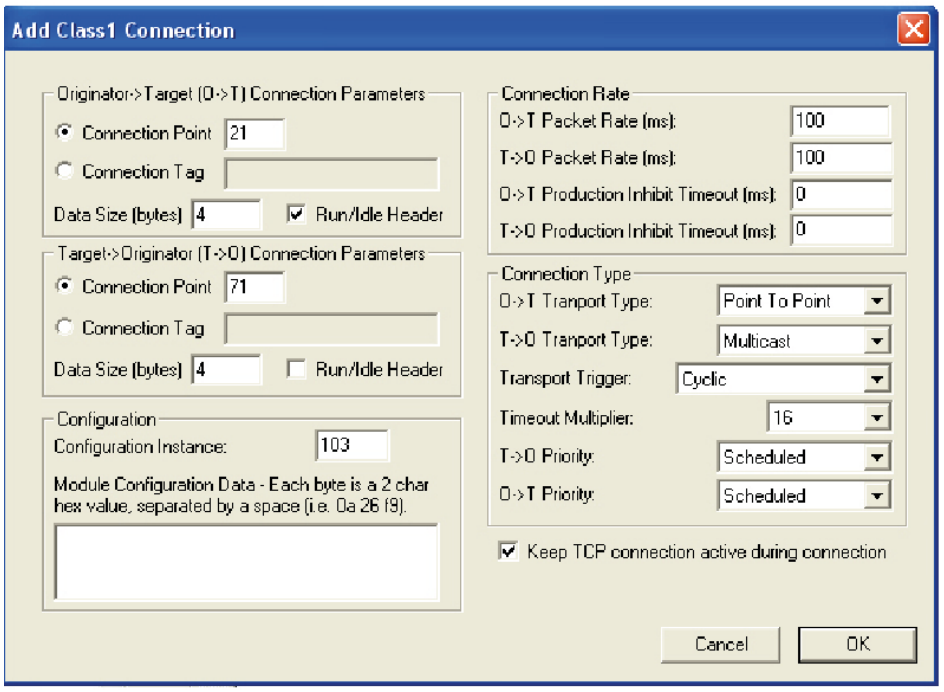

Figure 6.Configuration example from EIPScan tool.

4.1 PARAMETERS

Table 2. Parameters Menu

#	Name	Default	Range / Accepted Values	ID	Definition
1	Protocol In Use	0	0...1	2417_d	0 = protocol not in use.
2	Output Instance	21	20, 21, 23, 101, 111, 128, 131	2418_d	See chapter Assembly Instances Implemented By Vacon® 100
3	Input Instance	71	70, 71, 73, 107, 117, 127, 137	2419_d	See chapter Assembly Instances Implemented By Vacon® 100
4	Communication Timeout	10	0...65535	2420_d	0 = timeout is defined by the master through Requested Packet Interval (RPI) multiplied by Connection Timeout Multiplier (CTM). Other value than 0 means the total time (in seconds) including the RPI x CTM timeout

4.1.1 PROTOCOL IN USE

When value is changed to one, protocol stack is activated.

Please notice that if protocol is stopped (for example protocol is set to zero from panel) and communications have been open, it might be that stack cannot be reinitialized during the next few min-

utes. This is because TCP/IP stack waits for certain time before releasing previously reserved socket. This happens because TCP/IP stack needs to make sure that all packets sent previously arrive at their destination(s).

4.1.2 Output Instance

Defines which output instance is used (for incoming data to the drive). For details see Chapter 6.3.

4.1.3 Input Instance

Defines which input instance is used (for outgoing data from the drive). For details see Chapter 6.3.1.4, 6.3.1.5,6.3.1.6, 6.3.2.5, 6.3.2.6, 6.3.2.7 and 6.3.2.8.

4.1.4 Communication timeout

Defines how much time can pass from the last received message before fieldbus fault is generated. When communication timeout is set to zero, only "Requested Packet Interval" (RPI) and a "Connection Timeout Multiplier" (CTM) are used for timeout. If the Ethernet LINK is lost then the Vacon 100 drive generates a fieldbus fault immediately.

4.2 Monitoring Menu

Table 3. Monitoring Menu

#	Name	Type / Values	ID	Definition
1	Reset Counters	"Button"	2421_d	Resets monitoring counters.
2	Open Requests	16 bit	2422_d	For details, see "Instance Attribute "Open Requests""
3	Open Format Rejects	16 bit	2423_d	For details, see "Instance Attribute "Open Format Rejects""
4	Open Resource Rejects	16 bit	2424_d	For details, see "Instance Attribute "Open Resource Rejects""
5	Open Other Rejects	16 bit	2425_d	For details, see "Instance Attribute "Open Other Rejects""
6	Close Requests	16 bit	2426_d	For details, see "Instance Attribute "Close Requests""
7	Close Format Rejects	16 bit	2427_d	For details, see "Instance Attribute "Close Format Rejects""
8	Close Other Rejects	16 bit	2428_d	For details, see "Instance Attribute "Close Other Rejects""
9	Connection Timeouts	16 bit	2429_d	For details, see "Instance Attribute "Connection Timeouts""
10	Communication Status	Max value is 999	2430_d	This monitoring value reveals the number of good I/O messages received by the connection. The counter automatically wraps around to 0.
11	Control Word	32 bit	2431_d	This monitoring value reveals the latest control word received from the network.

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Table 3. Monitoring Menu

#	Name	Type / Values	ID	Definition
12	Status Word	32 bit	2432_d	This monitoring value reveals the latest status word sent to the network.
13	Fieldbus Protocol Status	Initializing, Stopped, Operational, Faulted	2433_d	This monitoring value reveals the status of the protocol.

5. PROGRAMMING

Basic information on how to use the control keypad you will find in the Vacon®100 Drive Application Manual (publication DPD00927).

The navigation path to the fieldbus parameters may differ from application to application. The exemplary paths below apply to the Vacon100 drive.

First ensure that the right fieldbus protocol is selected.

Navigate: Main Menu > I/O and Hardware (M5)

Select *'Fieldbus control'* as the *Remote Control Place*.

Choose source of reference.

Navigate: Main Menu > Quick Setup (M1) > Rem. Ctrl. Place (P1.21)

OR

Navigate: Main Menu > Parameters (M3) > Start/Stop Setup (M3.2) > Rem. Ctrl. Place (P3.2.1)

Navigate: Main Menu > Parameters (M3) > References (M3.3)

Set fieldbus parameters (M5.9).

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6. COMMUNICATIONS

6.1 ETHERNET/IP

6.1.1 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 utilizes resources which 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 setup as one-to-many relationships in order to take full advantage of the producer-consumer multicast model. Implicit messages are sent through UDP protocol.

6.1.2 AC/DC DRIVE PROFILE

In order to provide interoperability between devices from different manufacturers, there must be defined "standard" in which those devices:

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

6.1.3 EDS FILE

EDS - 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 Electronic Data Sheet (EDS). An EDS provides information about the device configuration data's:

- context
- content
- format

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.

EDS can be downloaded from Vacon web site www.vacon.com

6.1.4 EXPLICIT MESSAGING

Explicit Messaging is used in commissioning and parameterizing of the EtherNet/IP device. Explicit messages provide multipurpose, point-to-point communication paths between two devices. They provide the typical request/response-oriented network communication used to perform nodeconfiguration 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 doesn't apply for IO Data reading.

6.1.4.1 List of Object Classes

The Communication Interface supports the following object classes.

CIP Objects

Table 4.

Class	Object	Details
0x01	Identity Object	See 6.2.1.1
0x04	Assembly Object	See 6.2.2.1
0x06	Connection Manager Object	See 6.2.1.3
0x02	Message router class	See 6.2.1.2
0x28	Motor Data Object	See 6.2.2.2
0x29	Control Supervisor Object	See 6.2.2.3
0x2A	AC/DC Drive Object	See 6.2.2.4
0xF5	TCP/IP Interface Object	See 6.2.1.4
0xF6	Ethernet Link Object	See 6.2.1.5

Vendor Specific Objects

Table 5.

Class	Object	Details
0xA0	Vendor Parameters Object	See 6.2.3.1
0xBE	Assembly Instance Selector Object	See 6.2.3.2
0xA1	Motor Control Mode Object	See 6.2.3.3
0xA2	Fault History Object	See 6.2.3.4

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6.1.4.2 List of data types

The elementary data types in CIP are (among others):

Table 6.

Name	Description	Bit size	Range	
			Minimum	Maximum
BOOL	Boolean	8	0=FALSE	1=TRUE
SINT	Short Integer	8	-128	127
INT	Integer	16	-32768	32767
DINT	Double Integer	32	-2^{31}	$2^{31} - 1$
LINT	Long Integer	64	-2^{63}	$2^{63} - 1$
USINT	Unsigned Short Integer	8	0	255
UINT	Unsigned Integer	16	0	65535
UDINT	Unsigned Double Integer	32	0	$2^{32} - 1$
ULINT	Unsigned Long Integer	64	0	264 - 1
REAL	Floating Point	32	See IEEE 754	
LREAL	Long Floating Point	64	See IEEE 754	
$STRING_1$	Character String (1 octet per char.)	N		
$SHORT\_STRING_1$	Character String (1 octet per char., 1 octet lenght indicator	N+1		
BYTE	Bit string (8 bits)	8		
WORD	Bit string (16 bits)	16		
DWORD	Bit string (32 bits)	32		
LWORD	Bit string (64 bits)	64		

Note 1: ISO/IEC-8859-1 encoding.

6.2 COMMON INDUSTRIAL OBJECTS IMPLEMENTED BY THE VACON® 100

6.2.1 CIP COMMON REQUIRED OBJECTS

6.2.1.1 Identity Object, Class 0x01

The Identity Object provides identification of and general information about the device.

Table 7. The Identity Object

Class name	Identity object			
Class Identifier	01_h			
Class Attributes	Id	Name	Data Type	Access Rule
	1_h	Revision	Unsigned16	Read-only
	2_h	Max Instance	Unsigned 6	Read-only
	3_h	Number of Instances	Unsigned16	Read-only
Class Services	Id	Name		
	1_h	Get_Attributes_All		
	$0E_h$	Get_Attributes_Single		
Instance Attributes	Id	Name	Data Type	Access Rule
	1_h	Vendor ID	Unsigned16	Read-only
	2_h	Device Type	Unsigned16	Read-only
	3_h	Product Code	Unsigned16	Read-only
	4_h	Revision	Unsigned 8[2]	Read-only
	5_h	Status	Unsigned 16	Read-only
	6_h	Serial Number	Unsigned32	Read-only
	7_h	Product Name	Short string	Read-only
Instance Services	Id	Name		
	1_h	Get_Attributes_All		
	5_h	Reset*		
	$0E_h$	Get_Attribute_Single		

*Only reset type 0

Instance Attribute "Vendor ID"
The Identity Object has an instance attribute named "Vendor ID" which has the Attribute Identifier 01_h. This attribute reveals the vendor ID number which is assigned to the device.

This number is assigned to vendors of CIP devices by the ODVA user organisation. The data type of the attribute is UINT (16-bit). The vendor ID for Vacon Plc is $01BB_h$ (443_d).

Instance Attribute "Device Type"
The Identity Object has an instance attribute named "Device Type" which has the Attribute Identifier 02_h. This attribute indicates which device profile is implemented by the device. The data type of the attribute is UINT (16-bit). For Vacon drives this device number is 02_h ("AC Drive" profile).

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Instance Attribute "Product Code"
The Identity Object has an instance attribute named "Product Code" which has the Attribute Identifier 03_h. This attribute reveals the vendor-assigned product code for a particular product within a device type. Two products shall have different product codes if their configuration and/or runtime options re different.

The data type of the attribute is UINT (16-bit). In Vacon 100, the Product Code is 100_d (64_h).

Instance Attribute "Revision"
The Identity Object has an instance attribute named "Revision" which has the Attribute Identifier 04_h.

This attribute, which consists of Major and Minor Revision fields, identifies the revision of the item/device that the Identity Object is representing. Both the Major and Minor fields are of data type USINT (8-bit). The Major Revision is limited to values between 1 and 127, as the eighth bit is reserved by CIP and is zero.

Instance Attribute "Status"
The Identity Object has an instance attribute named "Status" which has the Attribute Identifier 05_h.

The value of the attribute presents the current status of the entire device.

The data type of the attribute is WORD (16-bit bitmask). The coding of the field is defined in the table below.

Table 8.

Bit(s)	Name	Definition	
0	Owned	TRUE, if device has owner.	
1		Reserved, is zero.	
2	Configured	TRUE, if device has been configured (always true in Vacon 100).	
3		Reserved, is zero.	
4-7	Extended Device Status	Value	Description
		0	Self -testing or unknown
		1	Firmware upgrade in progress
		2	At least one faulted I/O connection
		3	No I/O connections established
		4	Non-Volatile configuration bad
		5	Major fault - either bit 10 or bit 11 is true
		6	At least one I/O connection in run mode
		7	At least one I/O connection established, all in idle mode
		8 and 9	Reserved
		10 thru 15	Vendor specific, not used by Vacon
8	Minor Recoverable fault	TRUE, if recoverable problem detected.	
9	Minor Unrecoverable Fault	TRUE, in unrecoverable problem detected.	
10	Major Recoverable Fault	TRUE, if recoverable problem detected.	
11	Major Unrecoverable Fault	TRUE, if unrecoverable problem detected.	
12-15	Extended Device Status 2	Reserved, is zero.	

Vacon 100 drive implements bits 0, 2, and 4-11 according to the specification. The bits 8-11 shall be set according to the faults occurring in the drive.

Instance Attribute "Serial Number"

The Identity Object has an instance attribute named "Serial Number" which has the Attribute Identifier 06_h. This attribute can be used in conjunction with the Vendor ID to form a unique identifier for each device on any CIP network.

The serial number is formed such that the first octet is 00 and the last 3 octets are taken from the end of the MAC address of the drive. Example MAC address = 00:21:99:AA:BB:CC, then the serial number would be $00AABBCC_h$.

The data type of the attribute is UDINT (32-bit).

Instance Attribute "Product Name"

The Identity Object has an instance attribute named "Product Name" which has the Attribute Identifier 07_h.

The data type of the attribute is SHORT_STRING. Vacon 100 drive returns value "Vacon 100".

Instance Service "Reset"

Vacon 100 supports only reset type 0.

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Reset type 0 means that the device represented by the Identity Object will as closely as possible emulate cycling of power.
If an error is detected, an error response is returned. Otherwise a successful Reset response is returned.

6.2.1.2 Message Router Object, Class 0x02

The Message Router Object is mandatory in all CIP devices. It provides a messaging connection point through which a Client may address a service to any object class or instance in a target device.
Although the object is mandatory, there are no mandatory attributes or services.
Vacon 100 drive does not currently implement any of the objects services or attributes.

Table 9.

Class Name	Message Router Object			
Class Identifier	02_h			
Class Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Class Services	Id	Name		
	-	-		
Instance Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Instance services	Id	Name		
	-	-		

6.2.1.3 Connection Manager Object, Class 0x06

The communication characteristics between applications in different devices are modeled using Connection Objects. The entities (devices) involved in a connection are referred to as *end-points .* A Connection Manager is required in some CIP networks to control aspects of Connection object instances.
The Connection Manager class allocates and manages the internal resources associated with both I/O and Explicit Messaging connections.

Table 10.

Class Name	Connection Manager Object			
Class Identifier	06_h			
Class Attributes	Id	Name	Data Type	Access Rule
	1_h	Revision	Unsigned16	Read-Only
	2_h	Max Instance	Unsigned16	Read-Only
	3_h	Number Of Instances	Unsigned16	Read-Only
Class Services	Id	Name		
	1_h	Get_Attributes_All		
	$0E_h$	Get_Attributes_Single		
Instance Attributes	Id	Name	Data Type	Access Rule
	1_h	Open Requests	Unsigned16	Read-Only
	2_h	Open Format Rejects	Unsigned16	Read-Only
	3_h	Open Resource Rejects	Unsigned16	Read-Only
	4_h	Open Other Rejects	Unsigned16	Read-Only
	5_h	Close Request	Unsigned16	Read-Only
	6_h	Close Format Rejects	Unsigned16	Read-Only
	7_h	Close Other Rejects	Unsigned16	Read-Only
	8_h	Connection Timeouts	Unsigned16	Read-Only
Instance Services	Id	Name		
	1_h	Get_Attributes_All		
	$0E_h$	Get_Attribute_Single		
	$4E_h$	Forward_Open		
	54_h	Forward_Close		

Instance Attribute "Open Requests"
The Connection Manager Object has an instance attribute named "Open Requests" which has the Attribute Identifier 01_h. This attribute presents the number of Forward Open service requests that have been received by the Connection Manager instance.

The Data type of this attribute is UINT (16-bit).

Instance Attribute "Open Format Rejects"
The Connection Manager Object has an instance attribute named "Open Format Rejects" which has the Attribute Identifier 02_h. This attribute presents the number of Forward Open service requests that have been rejected by the Connection Manager instance due to bad format.

The Data type of this attribute is UINT (16-bit).

Instance Attribute "Open Resource Rejects"
The Connection Manager Object has an instance attribute named "Open Resource Rejects" which has the Attribute Identifier 03_h. This attribute presents the number of Forward Open service requests that have been rejected by the Connection Manager instance due to lack of resources.

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The Data type of this attribute is UINT (16-bit).

Instance Attribute "Open Other Rejects"
The Connection Manager Object has an instance attribute named "Open Other Rejects" which has the Attribute Identifier 04_h. This attribute presents the number of Forward Open service requests that have been rejected by the Connection Manager instance for reasons other than bad format or lack of resources.

The Data type of this attribute is UINT (16-bit).

Instance Attribute "Close Requests"
The Connection Manager Object has an instance attribute named "Close Requests" which has the Attribute Identifier 05_h. This attribute presents the number of Forward Close service requests that have been received by the Connection Manager instance.

The Data type of this attribute is UINT (16-bit).

Instance Attribute "Close Format Rejects"
The Connection Manager Object has an instance attribute named "Close Format Rejects" which has the Attribute Identifier 06_h. This attribute presents the number of Forward Close service requests that have been rejected by the Connection Manager instance due to bad format.

The Data type of this attribute is UINT (16-bit).

Instance Attribute "Close Other Rejects"
The Connection Manager Object has an instance attribute named "Close Other Rejects" which has the Attribute Identifier 07_h. This attribute presents the number of Forward Close service requests that have been rejected by the Connection Manager instance due to other reasons than bad format.

The Data type of this attribute is UINT (16-bit).

Instance Attribute "Connection Timeouts"
The Connection Manager Object has an instance attribute named "Connection Timeouts" which has the Attribute Identifier 08_h. This attribute presents the number of connection timeouts that have occurred in connections controlled by this Connection Manager instance.

The Data type of this attribute is UINT (16-bit).

Instance Service "Forward Open"
The Forward Open service is used to open a connection to a target device. If the path between devices consists of multiple links, then local connections between these are also established. The service code for the Forward Open service is $4E_h$.

Minimum time for RPI (Request Packet Interval) is 8ms. Connection object instance number is 103_d (67_h).

Instance Service "Forward Close"

The Forward Close service is used to close a connection between two devices (and all nodes in the connection path). The service code for the Forward Close service is 54_h.

6.2.1.4 TCP/IP Interface Object, Class 0xF5

TCP/IP Interface Object provides interface to configure device's TCP/IP settings. With this object, user is able to configure, for example, device's IP address, network mask etc.

Table 11.

Class Name	TCP/IP Interface Object			
Class Identifier	$F5_h$			
Class Attributes	Id	Name	Data Type	Access Rule
	1_h	Revision	Unsigned16	Read-only
	2_h	Max Instance	Unsigned16	Read-only
	3_h	Number of Instances	Unsigned16	Read-only
Class Services	Id	Name		
	1_h	Get_Attributes_All		
	$0E_h$	Get_Attribute_Single		
Instance Attributes	Id	Name	Data Type	Access Rule
	1_h	Status	Unsigned32	Read-only
	2_h	Configuration Capability	Unsigned32	Read-only
	3_h	Configuration Control	Unsigned32	Read-write
	4_h	Physical Link Object	Struct of: Unsigned 16 EPATH	Read-only
	5_h	Instance Configuration	Struct of: Unsigned32[25] String	Read-write
	6_h	Host Name	String	Read-write
Instance Services	Id	Name		
	1_h	Get_Attributes_All		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

Instance Attribute "Status"

The TCP/IP Interface Object has an instance attribute named "Status" which has the Attribute Identifier 01_h. This attribute presents the status of the TCP/IP network interface.
The attribute has data type DWORD (32-bit).

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Table 12.

Bit(s)	Name	Definition		
0-3	Interface Configuration Status	Indicates the status of the interface configuration attribute	**Value**	**Definition**
			0	The Interface Configuration Attribute has not been configured.
			1	The Interface Configuration Attribute contains valid configuration obtained from BOOTP, DHCP or non-volatile storage.
			2	The IP address member of the Interface Configuration Attribute contains valid configuration, obtained from hardware settings
			3-15	Reserved for future use
4	Mcast Pending	Indicates a pending configuration change in the TTL Value and/or Mcast Config attributes.		
5	Interface Configuration Pending	Indicates a pending configuration change in the Interface Configuration attribute.		
6	AcdStatus	Set(1) Address Conflict Detected, Clear(0) No Address Conflict Detected		
7-31	Reserved	Always zero		

Instance Attribute "Configuration Capability"

The TCP/IP Interface Object has an instance attribute named "Configuration Capability" which has the Attribute Identifier 02h. This attribute presents the capability flags (i.e. support for optional network configuration capability) of the TCP/IP network interface. The attribute has data type DWORD (32-bit). Vacon 100 drive supports DHCP and configuration is settable.

Table 13.

Bit(s)	Name	Definition
0	BOOTP Client	TRUE, if supports BOOTP
1	DNS Client	TRUE, if supports capable of resolving DNS names
2	DHCP Client	TRUE, if supports DHCP
3	DHCP-DNS Update	Always zero
4	Configuration Settable	TRUE, if configuration settable
5	Hardware Configurable	TRUE, configurable can be obtained from hardware settings
6	Interface Configuration Change Requires Reset	TRUE, if configuration change results in reset
7	AcdCapable	TRUE, if supports ACD
8-31	Reserved	Reserved, always zero

Instance Attribute "Configuration Control"

The TCP/IP Interface Object has an instance attribute named "Configuration Control" which has the

Attribute Identifier 03_h. This attribute allows control of the TCP/IP network interface configuration. The attribute has data type DWORD (32-bit).

Using Configuration Control-attribute, device can be configured to use statically assigned IP values or DHCP. If value is changed from DHCP to statically assigned, device will continue using current IP address. When changing from statically assigned to DHCP, drive will try to get IP address from DHCP server. If this fails, then communication with drive cannot be re-opened and user must set IP address manually from panel or enable DHCP server in network.
Changing Configuration Control is not allowed if I/O connection is open.

Table 14.

Bit(s)	Name	Definition		
0-3	Configuration Method	Determines how the device shall obtain its IP related configuration	Value	Definition
			0	The device shall use statically-assigned IP configuration values.
			1	The device shall obtain its interface configuration values via BOOTP
			2	The device shall obtain its interface configuration values via DHCP
			3-15	Reserved for future use.
4	DNS Enable	If TRUE, the device shall resolve host names by querying a DNS server		
5-31	Reserved	Reserved, always zero		

In the Vacon 100 product, if the "IP Address Mode" panel parameter is "Fixed IP" then the value of Configuration Control is 0. If the "IP Address Mode" is "DHCP" then the value of the Configuration Control is 2.
Vacon 100 does not support BOOTP or DNS.

Instance Attribute "Physical Link Object"
The TCP/IP Interface Object has an instance attribute named "Physical Link Object" which has the Attribute Identifier 04_h. This attribute identifies the object which is associated with the underlying physical communications interface (in the case of Ethernet e.g. an IEEE 802.3 interface). The attribute consists of two components; a Path Size, which reveals the number of UINT values in the path, and the Path itself.

In Vacon 100 the path points to an instance of the EtherNet Link Object. The value of Path Size is 2 (total of four octets) and the value of the Path is $20_h F6_h 24_h XX_h$, where XX is the instance number of the EtherNet Link object.

Instance Attribute "Instance Configuration"
The TCP/IP Interface Object has an instance attribute named "Interface Configuration", having the Attribute Identifier 5_h, which contains the configuration parameters required for a device to operate as a TCP/IP node. The contents of the attribute depend on how the device has been configured to obtain its IP parameters (the "Configuration Method" field in the Configuration Control attribute). If the device uses a static IP address (Configuration Method value is 0) then the values in the Interface Configuration are those statically assigned and stored in non-volatile memory. If the device uses DHCP (or BOOTP) (Configuration Method value is 1 or 2) then the Interface Configuration values will contain the configuration obtained through this channel. Until the BOOTP/DHCP reply is received, the values are 0.

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Changing Instance Configuration is not allowed when I/O connection is open or Configuration Control-attribute is not set to "statically-assigned".

Table 15.

Interface	Struct.of:	Description	Sementics of the value
IP Address	UDINT	The device's IP address	Value of 0 indicates no IP address has been configured. Otherwise, the IP address shall be set to a valid Class A, B, or C address and shall not be set to the loopback address (127.0.0.1).
Network Mask	UDINT	The Device's network mask	Value of 0 indicates no network mask address has been configured.
Gateway Address	UDINT	Default gateway address	Value of 0 indicates no IP address has been configured. Otherwise, the IP address shall be set to a valid Class A, B, or C address and shall not be set to the loopback address (127.0.0.1).
Name Server	UDINT	Primary name server	Value of 0 indicates no name server address has been configured. Otherwise, the name server address shall be set to a valid Class A, B, or C address. In Vacon 100 this value is not supported and is always 0.
Name Server2	UDINT	Secondary name server	Value of 0 indicates no secondary name server address has been configured. Otherwise, the name server address shall be set to a valid Class A, B, or C address. In Vacon 100 this value is not supported and is always 0.
Domain Name	STRING	Default domain name	ASCII characters. Maximum length is 48 characters. Shall be padded to an even number of characters (pad not included in length). A length of 0 shall indicate no Domain Name is configured.

Instance Attribute "Host Name"
The TCP/IP Interface Object has an instance attribute named "Host Name", having the Attribute Identifier 6_h, which contains the device's host name. The maximum length is 64 ASCII characters. The name is padded to an even number of characters. Attribute Host Name is used just for information purpose.

6.2.1.5 Ethernet Link Object, Class 0xF6

Ethernet Link Object provides interface to Ethernet link counters and attributes. With this object, user can retrieve for example link speed.

Table 16.

Class Name	Ethernet Link Object			
Class Identifier	$F6_h$			
Class Attributes	Id	Name	Data Type	Access Rule
	1_h	Revision	Unsigned16	Read-Only
	2_h	Max Instance	Unsigned16	Read-Only
	3_h	Number of Instances	Unsigned16	Read-Only
Class Services	Id	Name		
	1_h	Get_Attributes_All		
	$0E_h$	Get_Attribute_Single		
Instance Attributes	Id	Name	Data Type	Access Rule
	1_h	Interface Speed	Unsigned32	Read-Only
	2_h	Interface Flags	Unsigned32	Read-Only
	3_h	Physical Address	Unsigned8[6]	Read-Only
	4_h	Interface Counters	Struct	Read-Only
	5_h	Media Counters	Struct	Read-Only
	7_h	Interface Type	Unsigned8	Read-Only
	8_h	Interface State	Unsigned8	Read-Only
	9_h	Admin State	Unsigned8	Read-Write
	$0A_h$	Interface Label	Short string	Read-Only
Instance Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

Instance Attribute "Interface Speed"
The Ethernet Link Object has an instance attribute named "Interface Speed" which has the Attribute Identifier 01_h. The attribute reveals the currently used speed in the interface. The speed is announced as an integer number, with the unit Mbps, e.g. 0, 10, 100 etc. The attribute is of type UDINT (32-bit). The attribute is read-only.
The value 0 indicates that the interface speed in indeterminate.

Instance Attribute "Interface Flags"
The Ethernet Link Object has an instance attribute named "Interface Flags" which has the Attribute Identifier 02_h. The attribute contains status and configuration information about the physical interface in the form of a 32-bit bitmask (DWORD). The attribute is read-only.

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Table 17.

Bit(s)	Name	Definition	
0	Link Status	One, if link is active	
1	Half/Full Duplex	One, if full duplex	
2-4	Negotiation Status	**Value**	**Definition**
		0	Auto-negotiation in progress
		1	Auto-negotiation and speed detection failed. Using default values for speed and duplex.
		2	Auto-negotiation failed but detected speed. Duplex was defaulted.
		3	Successfully negotiated speed and duplex.
		4	Auto-negotiation not attempted. Forced speed and duplex.
5	Manual Setting Requires Reset	0 indicates the interface can activate changes to link parameters (auto-negotiate, duplex mode, interface speed) automatically. 1 indicates the device requires a Reset service be issued to its Identity Object in order for the changes to take effect.	
6	Local Hardware Fault	0 indicates the interface detects no local hardware fault; 1 indicates a local hardware fault is detected.	
7-31	Reserved	Always zero	

Instance Attribute "Physical Address"
The Ethernet Link Object has an instance attribute named "Physical Address" which has the Attribute Identifier 03_h. The attribute reveals the MAC layer address of the physical interface. The attribute is an array of 6 USINT values (total of 6 octets). The attribute is read-only.

Instance Attribute "Interface Counters"
The Ethernet Link Object has an instance attribute named "Interface Counters" which has the Attribute Identifier 04_h. The attribute is a collection of counters related to the Ethernet physical interface.

Table 18.

Field name	Field data type	Description
In Octets	Unsigned32	The number of octets received on the interface (including framing characters).
In Unicast Packets	Unsigned32	The number of unicast packets received on the interface.
In NonUnicast Packets	Unsigned32	The number of non-unicast packets received on the interface.
In Discards	Unsigned32	Inbound packets received on the interface but which were discarded.
In Errors	Unsigned32	Inbound packets received on the interface but which contained errors (excluding Discards).
In Unknown Protocols	Unsigned32	Inbound packets received on the interface which belonged to unknown protocols.
Out Octets	Unsigned32	The number of octets sent on the interface (including framing characters).
Out Unicast Packets	Unsigned32	The number of unicast packets requested to be transmitted on the interface, including those that were discarded or not sent.
Out NonUnicast Packets	Unsigned32	The number of non-unicast packets requested to be transmitted on the interface, including those that were discarded or not sent.
Out Discards	Unsigned32	Outbound packets which were discarded.
Out Errors	Unsigned32	Outbound packets which contained errors (excluding Discards).

Instance Attribute "Media Counters"
The Ethernet Link Object has an instance attribute named "Media Counters" which has the Attribute Identifier 05_h. The attribute is a collection of counters related to the Ethernet physical interface.

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Table 19.

Field	Field data type	Description
Alignment Errors	Unsigned32	Frames received that are not an integral number of octets in length.
FCS Errors	Unsigned32	Frames received that do not pass the FCS check.
Single Collisions	Unsigned32	Successfully transmitted frames which experienced exactly one collision.
Multiple Collisions	Unsigned32	Successfully transmitted frames which experienced more than one collision.
SQE Test Errors	Unsigned32	The number of times SQE test error message is generated.
Deferred Transmissions	Unsigned32	Frames for which the first transmission attempt is delayed because the medium is busy.
Late Collisions	Unsigned32	Number of times a collision is detected later than 512 bit-times into the transmission of a packet.
Excessive Collisions	Unsigned32	Frames for which transmission fails due to excessive collisions.
MAC Transmit Errors	Unsigned32	Frames for which transmission fails due to an internal MAC sub layer transmit error.
Carrier Sense Errors	Unsigned32	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Frame Too Long	Unsigned32	Frames received that exceed the maximum permitted frame size.
MAC Receive Errors	Unsigned32	Frames for which reception on an interface fails due to an internal MAC sub layer receive error.

Instance Attribute "Interface Type"
The Ethernet Link Object has an instance attribute named "Interface Type" which has the Attribute Identifier 07_h. The attribute indicates the type of the Ethernet interface, i.e. twisted-pair cable, optical fiber, device-internal etc.

Instance Attribute "Interface State"
The Ethernet Link Object has an instance attribute named "Interface State" which has the Attribute Identifier 08_h. The attribute indicates the current state of the Ethernet interface, i.e. operational, disabled etc.

Instance Attribute "Admin State"
The Ethernet Link Object has an instance attribute named "Admin State" which has the Attribute Identifier 09_h. The attribute indicates the ability to use the Ethernet interface for administration e.g. changing settings.

Vacon 100 drives support this attribute with the value 01_h (administration enabled). An attempt to disable the administration (by writing value 02_h) will result in an error.

Instance Attribute "Interface Label"
The Ethernet Link Object has an instance attribute named "Interface Label" which has the attribute identifier 0Ah. The attribute contains a vendor-specific, human-readable text string with a maximum length of 64 characters which describes the interface. The attribute is read-only

6.2.2 OBJECTS PRESENT IN AN AC/DC DRIVE

6.2.2.1 Assembly Object, Class 0x04

Assembly object groups (or assembles) attribute values into single block of data.

Table 20.

Class Name	Assembly Object			
Class Identifier	04_h			
Class Attributes	Id	Name	Data Type	Access Rule
	1_h	Revision	Unsigned16	Read-only
	2_h	Max Instance	Unsigned16	Read-only
	3_h	Number of Instances	Unsigned16	Read-only
Class Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
Instance Attributes	Id	Name	Data Type	Access Rule
	3_h	Data	Unsigned8[]	Read-Write
Instance Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

Instance Attribute "Data"
The Assembly Object has a mandatory instance attribute named "Data" which has the Attribute Identifier 03_h. The attribute has read and write access and its data type is an array of BYTE values. Depending on the selected Assembly Instance in both cases, the "Data" field must be accordingly configured.

6.2.2.2 Motor Data Object, Class 0x28

Motor Data Object provides interface to motor data attributes, for example "motor type".

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Table 21.

Class Name	Motor Data Object			
Class Identifier	28_h			
Class Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Class Services	Id	Name		
	-	-		
Instsance Attributes	Id	Name	Data Type	Access Rule
	3_h	MotorType	Unsigned8	Read-write
	6_h	RatedCurrent	Unsigned16	Read-write
	7_h	RatedVoltage	Unsigned16	Read-write
	9_h	RatedFreq	Unsigned16	Read-write
	$0C_h$	PoleCount	Unsigned16	Read-only
	$0F_h$	Base Speed	Unsigned16	Read-write
Instance Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

Instance Attribute "MotorType"

Vacon 100 drives support values 3 (Permanent Magnet Synchronous Motor) and 7 (Squirrel Cage Induction Motor)

Instance Attribute "RatedCurrent"

This attribute allows reading and writing of the motor rated current. The unit of the attribute is 100 milliamperes.

Instance Attribute "RatedVoltage"

This attribute allows reading and writing of the motor rated voltage. The unit of the attribute is 1 volt.

Instance Attribute "RatedFreq"

This attribute allows reading and writing of the motor rated electrical frequency. The unit of the attribute is 1 hertz.

Instance Attribute "PoleCount"

This attribute allows read only of the number of poles in the motor. The unit of the attribute is 1.
Instance Attribute "Base Speed"
This attribute allows reading and writing of the nominal speed at rated frequency. The unit of the attribute is 1 RPM.

6.2.2.3 Control Supervisor Object, Class 0x29

Control Supervisor Object provides interface for drive management. For example, user can start/ stop motor with this object.

Table 22.

Class Name	Control Supervisor Object			
Class Identifier	29_h			
Class Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Class Services	Id	Name		
	-	-		
Instance Attributes	Id	Name	Data Type	Access Rule
	3_h	Run1	Boolean	Read-write
	4_h	Run2	Boolean	Read-write
	5_h	NetCtrl	Boolean	Read-write
	6_h	State	Unsigned8	Read-only
	7_h	Running1	Boolean	Read-only
	8_h	Running2	Boolean	Read-only
	9_h	Ready	Boolean	Read-only
	$0A_h$	Faulted	Boolean	Read-only
	$0B_h$	Warning	Boolean	Read-only
	$0C_h$	FaultRst	Boolean	Read-write
	$0D_h$	FaultCode	Unsigned16	Read-only
	$0F_h$	CtrlFromNet	Boolean	Read-only
Instance Services	Id	Name		
	5_h	Reset		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

Instance Attribute "Run1"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 3_d. This attribute affects the run/stop behavior of the drive.

Instance Attribute "Run2"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 4_d. This attribute affects the run/stop behavior of the drive.

Instance Attribute "NetCtrl"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 5_d. This attribute allows the network to request run/stop control to be assigned to the network. If the bit is 0, this means that run/stop control is local. If the bit is 1, this means that run/stop control is requested to this network interface.

It should be noted that the actual assignment of run/stop control to this network interface is reflected in attribute 15_d.

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Instance Attribute "State"
The data type of this attribute is USINT (8-bit). The Attribute Identifier of this attribute is 6_d. This attribute reveals the state of the device according to the below definitions:

Table 23.

Value (hex)	Definition
0	Vendor Specific
1	Startup
2	Not_Ready
3	Ready
4	Enabled
5	Stopping
6	Fault_Stop
7	Faulted

Instance Attribute "Running1"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 7_d. This attribute is used to describe the run state of the drive. The value of the attribute shall be 1 if one of the below conditions are fulfilled:

- The "State" attribute has the value 4 ("Enabled") and the bit "Run1" has the value 1, **or**
- The "State" attribute has the value 5 ("Stopping") and the bit "Running1" has the value 1, **or**
- The "State" attribute has the value 6 ("Fault_Stop") and the bit "Running1" has the value 1

Otherwise, the value of this attribute is 0.

Instance Attribute "Running2"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 8_d. This attribute is used to describe the run state of the drive. The value of the attribute shall be 1 if one of the below conditions are fulfilled:

- The "State" attribute has the value 4 ("Enabled") and the bit "Run2" has the value 1, or
- The "State" attribute has the value 5 ("Stopping") and the bit "Running2" has the value 1, or
- The "State" attribute has the value 6 ("Fault_Stop") and the bit "Running2" has the value 1

Otherwise, the value of this attribute is 0.

Instance Attribute "Ready"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 9_d. This attribute is used to signal the state of the drive, that it is ready for operation. The value of the attribute is 1 if the value of the "State" attribute is either 3 ("Ready"), 4 ("Enabled") or 5 ("Stopping"). Otherwise the value of this attribute is 0.

Instance Attribute "Faulted"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 10_d. This attribute is used to signal that one or several faults have occurred in the drive. The value of the attribute is 1 if a fault has occurred and has not been acknowledged. Otherwise, the attribute has the value 0 indicating that no faults are present.

Instance Attribute "Warning"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 11_d. This attribute is used to signal that one or several warnings have appeared in the drive. The value of the attribute is 1 if a warning has appeared and has not been acknowledged. Otherwise, the attribute has the value 0 indicating that no warnings are present.

Instance Attribute "FaultRst"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 12_d. This attribute is used to reset faults and warnings in the drive. The attribute is read-write. When the value of the attribute is changed from 0 to 1 (rising-edge) then this will reset faults in the drive. If the value is static 0 then no action is started.

Instance Attribute "FaultCode"
The data type of this attribute is UINT (16-bit). The Attribute Identifier of this attribute is 13_d. This attribute is used to read the kind of fault which has caused the device to transition into the "Faulted" state. In the case of multiple faults occurring simultaneously, only one code is reported. If the device is not in the Faulted state, the FaultCode attribute indicates the fault which caused the last transition to the Faulted state.

Instance Attribute "CtrlFromNet"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 15_d. The attribute is read-only. It indicates whether run/stop control is assigned to the local interface or to this network interface. When the value of the attribute is 0, control is local. When the value of the attribute is 1, run/stop control is assigned to the network interface.

Instance Service "Reset"
The Control Supervisor Object has a instance service named "Reset" which has the Service Code 05_h. The service resets the drive to the start-up state by setting the Control Supervisor state machine to the Startup state. Parameters are not changed.

If an error is detected, an error response is returned. Otherwise a successful Reset response is returned.

Control Supervisor State Machine

The Control Supervisor Object defines a state machine for governing the behavior of devices. The figure below describes the states and transitions of the state machine.

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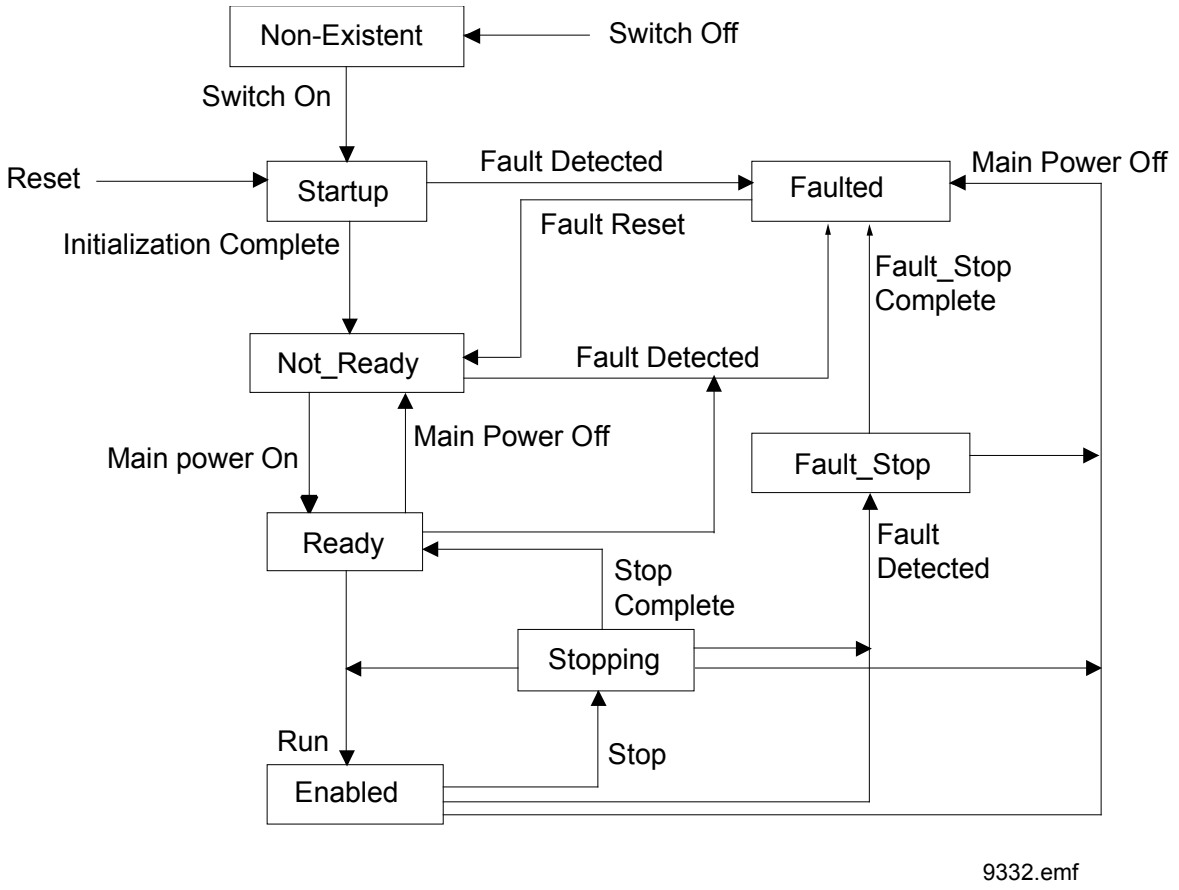
Non-Existent
Switch Off
Switch On
Reset
Startup
Fault Detected
Faulted
Main Power Off
Initialization Complete
Fault Reset
Fault_Stop
Complete
Not_Ready
Fault Detected
Main power On
Main Power Off
Fault_Stop
Ready
Fault
Detected
Stop
Complete
Stopping
Run
Stop
Enabled
9332.emf

Figure 7.

6.2.2.4 AC/DC Drive Object, Class 0x2A

AC/DC Drive Object models functions specific to an AC or DC drive.

Table 24.

Class Name	AC/DC Drive Object			
Class Identifier	$2A_h$			
Class Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Class Services	Id	Name		
	-	-		
Instance Attributes	Id	Name	Data Type	Access Rule
	3_h	AtReferance	Boolean	Read-only
	4_h	NetRef	Boolean	Read-write
	6_h	DriveMode	Unsigned8	Read-write
	7_h	SpeedActual	Signed16	Read-only
	8_h	SpeedRef	Signed16	Read-write
	$0B_h$	TorqueActual	Signed16	Read-only
	$0C_h$	TorqueRef	Signed16	Read-write
	16_h	SpeedScale	Signed16	Read-write
	18_h	TorqueScale	Signed8	Read-write
	$1D_h$	RefFromNet	Boolean	Read-only
Instance Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

Instance Attribute "AtReference"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 3_d. This attribute indicates whether the actual value is at the reference value (e.g. drive actual speed is that which is requested in the speed reference). If the bit is 1 then this means that the drive actual value is at the reference value.

Instance Attribute "NetRef"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 4_d. Both read and write accesses are allowed for this attribute. When the bit is 1, the torque or speed reference is requested to be allocated to this network interface. If the bit is 0, then no such request is made. It should be noted that the actual assignment of the reference to this network interface is reflected in the attribute 29_d.

Instance Attribute "DriveMode"
The data type of this attribute is USINT (8-bit). The Attribute Identifier of this attribute is 6_d. This attribute allows reading and writing of the motor control mode of the drive. The defined values for this attribute are:

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- 0 = Vendor-specific mode
- 1 = Open loop speed (Frequency)
- 2 = Closed loop speed control
- 3 = Torque control
- 4 = Process control (e.g. PI control)
- 5 = Position control

The Vacon 100 drive supports the drive mode options 1 and 3. If mode 1 is written through the EtherNet/IP interface, the motor control mode of the drive is to "Speed OL". If mode 3 is written the motor control mode of the drive is set to "Torque OL". These changes shall be reflected in the "Motor Control Mode Object".
The drive will respond with "Invalid attribute value" status code 0x09, if other values are written.

Instance Attribute "SpeedActual"
The data type of this attribute is INT (16-bit). The Attribute Identifier of this attribute is 7_d. This attribute allows reading of the speed actual value. The unit of the attribute shall be (RPM / $2^{SpeedScale}$), where SpeedScale is attribute 22.

If the SpeedScale attribute is not used by the master, then the default unit [1 RPM] is assumed. This is equivalent to the value 0 being used for SpeedScale.

Instance Attribute "SpeedRef"
The data type of this attribute is INT (16-bit). The Attribute Identifier of this attribute is 8_d. This attribute allows reading and writing of the speed reference set point. The unit of the attribute shall be (RPM / $2^{SpeedScale}$), where SpeedScale is attribute 22.

If the SpeedScale attribute is not used by the master, then the default unit [1 RPM] is assumed. This is equivalent to the value 0 being used for SpeedScale.

Instance Attribute "TorqueActual"
The data type of this attribute is INT (16-bit). The Attribute Identifier of this attribute is 11_d. This attribute allows reading of the torque actual value. The unit of the attribute shall be (Nm / $2^{TorqueScale}$), where TorqueScale is attribute 24.

If the TorqueScale attribute is not used by the master, then the default unit [1 Nm] is assumed. This is equivalent to the value 0 being used for TorqueScale.

Instance Attribute "TorqueRef"
The data type of this attribute is INT (16-bit). The Attribute Identifier of this attribute is 12_d. This attribute allows reading and writing of the torque reference set point. The unit of the attribute shall be (Nm / $2^{TorqueScale}$), where TorqueScale is attribute 24.

If the TorqueScale attribute is not used by the master, then the default unit [1 Nm] shall be assumed. This is equivalent to the value 0 being used for TorqueScale.

Instance Attribute "SpeedScale"
The data type of this attribute is SINT (8-bit). The Attribute Identifier of this attribute is 22_d. This attribute allows reading and writing of the speed scaling factor. The SpeedActual and SpeedRef values are scaled according to the value of this attribute. The default value is 0_d.

The largest allowed value for this attribute in the Vacon 100 drive is 7 (allowing resolution of 0.0078 RPM) and the minimum allowed value is -4 (allowing resolution of 16 RPM). The maximum speed value that can be input/output to the Vacon 100 drive is thus ca 524000 RPM.

Instance Attribute "TorqueScale"
The data type of this attribute is SINT (8-bit). The Attribute Identifier of this attribute is 24_d. This attribute allows reading and writing of the torque scaling factor. The TorqueActual and TorqueRef values are scaled according to the value of this attribute. The default value is 0_d.

The largest allowed value for this attribute in the Vacon 100 drive is 7 (allowing resolution of 0.0078 Nm) and the minimum allowed value is -8 (allowing resolution of 256 Nm). The maximum torque value that can be input/output to the Vacon 100 drive is thus ca 8.4 MNm.

Instance Attribute "RefFromNet"
The data type of this attribute is BOOL. The Attribute Identifier of this attribute is 29_d. This attribute reveals whether the torque or speed reference is local or from the network. If the reference is local, then the value of the attribute shall be 0. If the reference is from the network, then the value of the attribute is 1.

6.2.3 VENDOR SPECIFIC OBJECTS

6.2.3.1 Vendor Parameters Object, Class 0xA0

The Vendor Parameters Object is a vendor-specific object which allows the user to access any application parameter from the drive.

Table 25.

Class Name	Vendor Parameters Object			
Class Identifier	$A0_h$			
Class Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Class Services	Id	Name		
	-	-		
Instance Attributes	Id	Name	Data Type	Access Rule
	XX_h	Parameter Value		Read-write
Instance Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

Instance Attribute "Parameter Value"
This class has an instance attribute which is named "Parameter Value" and has the Attribute Identifier 01_h.
In Vacon 100 Drive option board the attribute ID is 8 bits in length. When accessing a drive parameter, the drive parameter ID high octet is the instance ID of this class, while the low octet is the attribute ID which is specified. The data type of the parameter value can be 8, 16 or 32 bits.

Table 26.

Drive prm ID high octet	Drive prm ID low octet
Instance #	Attribute #

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As an example, if the drive parameter with ID=2291_d ($08F3_h$) is read from the drive, then the Get_Attribute_Single service request is targeted at the Vendor Parameters class, instance 08_h and attribute $F3_h$.

The Vacon 100 integrated EtherNet/IP implementation supports the above mechanism from OPTCQ for backwards compatibility reasons. It shall also support the use of a 16-bit attribute identifier, in which case the request shall always be targeted to instance #1 of the class.

Table 27.

Drive prm ID high octet	Drive prm ID low octet
Attribute # high octet	Attribute # low octet

With the same example above, the request would be targeted at the same class, instance 01_h and attribute $08F3_h$.

Instance Service "Get_Attribute_Single"
This class has an instance service named "Get_Attribute_Single" which has the Service Code $0E_h$. When invoked in an instance, the parameter ID to be fetched from the drive is calculated, then the read operation is started and once available, a response is provided to the master.

The format of the message is as follows (Vacon 100):

Table 28.

Field	Data
Service Code	$0E_h$
Class Code	$A0_h$
Instance Number	01_h
Attribute ID	$XXXX_h$

The old format of the message is as follows (OPTCQ option board):

Table 29.

Field	Data
Service Code	$0E_h$
Class code	$A0_h$
Instance Number	YY_h
Attribute ID	XX_h

Instance Service "Set_Attribute_Single"

This class has an instance service named "Set_Attribute_Single" which has the Service Code 10_h. When invoked in an instance, the parameter ID to be modified in the drive is calculated. The data type, write permission etc. is verified before the write operation is started. When the operation finishes, or if an error occurs, an appropriate response is provided to the master.
The format of the message is as follows (Vacon 100):

Table 30.

Field	Data
Service Code	10_h
Class code	$A0_h$
Instance Number	01_h
Atttribute ID	$XXXX_h$
Attribute Data	Parameter-spesific

The old format of the message is as follows (OPTCQ option board):

Table 31.

Field	Data
Service Code	10_h
Class code	$A0_h$
Instance Number	YY_h
Attribute ID	XX_h
Attribute Data	Parameter-Specific

6.2.3.2 Assembly Instance Selector Object, Class 0xBE

The Assembly Instance Selector Object is a vendor-specific object available in the OPTCQ option board and the Vacon 100 drive which allows the user to get and set the input and output instances used.

Table 32.

Class Name	Assembly Instance Selector Object			
Class Identifier	BE_h			
Class Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Class Services	Id	Name		
	-	-		
Instance Attributes	Id	Name	Data Type	Access Rule
	03_h	InputInstance	Unsigned8	Read-write
	04_h	OutputInstance	Unsigned8	Read-Write
Instance Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute_Single		

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Instance Attribute "InputInstance"
The object has an instance attributed named "InputInstance" which has the Attribute Identifier 03_h. The data type is USINT (8-bit). The value can be read and written, and is used to detect or change the used input assembly instance.

Instance Attribute "OutputInstance"

The object has an instance attributed named "OutputInstance" which has the Attribute Identifier 04_h. The data type is USINT (8-bit). The value can be read and written, and is used to detect or change the used output assembly instance.

Instance Service "Get_Attribute_Single"
This class has an instance service named "Get_Attribute_Single" which has the Service Code $0E_h$. The service is used to get the value of an instance attribute.

The format of the message is as follows

Table 33.

Field	Data
Service Code	$0E_h$
Class Code	BE_h
InstanceNumber	01_h
Attribute ID	03_h or 04_h

Instance Service "Set_Attribute_Single"
This class has an instance service named "Set_Attribute_Single" which has the Service Code 10_h. The service is used to set the value of an instance attribute.

The format of the message is as follows:

Table 34.

Field	Data
Service Code	10_h
Class code	BE_h
Instance Number	01_h
Attribute ID	03_h or 04_h

Rejection of Set_Attribute_Single request
If an I/O connection has been established with a master through the Forward_Open request and a successful response, any request to set the selected assembly through the Assembly Instance Selector object shall be rejected. These attributes may only be changed when no I/O connection is established, i.e. before the Forward_Open request.

6.2.3.3 Motor Control Mode Object, Class 0xA1

The Motor Control Mode Object is a vendor-specific object available in the Vacon 100 drive which more clearly indicates to the user which motor control mode is used, and allows the user to configure this mode.

Table 35.

Class Name	Motor Control Mode Object			
Class Identiefier	$A1_h$			
Class Attributes	Id	Name	Data Type	Access Rule
	-	-	-	-
Class Services	Id	Name		
	-	-		
Instance Attributes	Id	Name	Data Type	Access Rule
	01_h	Control Mode	Unsigned8	Read-write
	02_h	FeedbackMode	Unsigned8	Read-write
Instance Services	Id	Name		
	$0E_h$	Get_Attribute_Single		
	10_h	Set_Attribute-Single		

Instance Attribute "ControlMode"
The object has an instance attribute named "ControlMode" which has the Attribute Identifier 01_h. The data type is USINT (8-bit). The value can be read and written, and is used to detect or change the used motor control mode.

The values allowed for this attribute are:

Table 36.

ControlMode Value	Description
0_d	Frequency control
1_d	Speed control
2_d	Torque control

Instance Attribute "FeedbackMode"
The object has an instance attribute named "FeedbackMode" which has the Attribute Identifier 02_h. The data type is USINT (8-bit). The value can be read and written, and is used to detect or change the used feedback mode.

The values allowed for this attribute are:

Table 37.

FeedbackMode value	Description
0_d	Open Loop

ControlMode and FeedbackMode combinations
The following combinations of ControlMode and FeedbackMode are supported by the Vacon 100 drive:

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Table 38.

ControlMode Value	Allowed FeedbackMode	Description
0	0	Frequency Open Loop
1	0	Speed Open Loop
2	0	Torque Open Loop

Instance Service "Get_Attribute_Single"
This class has an instance service named "Get_Attribute_Single" which has the Service Code $0E_h$.

The service is used to get the value of an instance attribute.

The format of the message is as follows

Table 39.

Field	Data
Service Code	$0E_h$
Class code	BE_h
Instance umber	01_h
Attribute ID	01_h or 02_h

Instance Service "Set_Attribute_Single"
This class has an instance service named "Set_Attribute_Single" which has the Service Code 10_h.
The service is used to set the value of an instance attribute.

The format of the message is as follows:

Table 40.

Field	Data
Service Code	10_h
Class Code	BE_h
Instance Numeber	01_h
Attribute ID	01_hor 02_h
Attribute Data	(Mode number)

Link to AC/DC Drive Object "DriveMode" attribute

The Motor Control Mode Object is linked to the "DriveMode" attribute of the AC/DC Drive Object so, that changes in one affects the values in the other.
In the Vacon 100 drive, when the following values are set to the AC/DC Drive Object "DriveMode" attribute, the Motor Control Mode Object attributes shall be set to the following values:

Table 41.

Set DriveMode	ControlMode Value	FeedbackMode Value
1_d (Open Loop speed/frequency)	1_d (Speed control)	0_d (Open Loop)
3_d (Torque control)	2_d (Torque control)	0_d (Open Loop)

In the Vacon 100 drive, when the following values are set to the Motor Control Mode Object "ControlMode" and "FeedbackMode" attributes, the AC/DC Drive Object "DriveMode" attribute is set as follows:

Table 42.

Set Motor control Mode Object values		DriveMode value
ControlMode	**Feedback Mode**	
0_d (Frequency)	0_d (Open loop)	1_d (Open loop speed/frequency)
1_d (Speed)	0_d (Open loop)	1_d (Open loop speed/frequency)
2_d (Torque)	0_d (Open loop)	3_d (Torque control)

6.2.3.4 Fault History Object, class 0xA2

The Fault History Object is a vendor-specific object available in the Vacon 100 drive which allows access to the contents of the fault history over the EtherNet/IP network.
Each entry in a fault history is represented by an instance of the Fault History Object. Low instance numbers correspond to the most recent fault entries.

Table 43.

Class Name	Fault History Object			
Class Identifier	$A2_h$			
Class Attributess	Id	Name	Data Type	Access Rule
	01_h	Revision	Unsigned8	Read-only
	02_h	Max instance	Unsigned8	Read-only
	03_h	Number of Instances	Unsigned8	Read-only
Class Services	Id	Name		
	01_h	Get_Attributes_All		
	05_h	Reset		
	$0E_h$	Get_Attribute_Single		
Instance Attributess	Id	Name		
	01_h	FaultCode	Unsigned8	Read-only
	02_h	FaultID	Unsigned16	Read-only
	03_h	FaultYear	Unsigned16	Read-only
	04_h	FaultMonth	Unsigned8	Read-only
	05_h	FaultDay	Unsigned8	Read-only
	06_h	FaultMillisAfterMidnight	Unsigned32	Read-only
Instance Services	Id	Name		
	01_h	Get_Attributes_All		
	$0E_h$	Get_Attribute_Single		

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Class Attribute "Revision"
The Fault History Object has a class attribute named "Revision" which has the Attribute Identifier 01_h. This attribute presents the revision of the Fault History Object which is implemented by the device.

The Data type of this attribute is UINT (16-bit).

Class Attribute "Max Instance"
The Fault History Object has a class attribute named "Max Instance" which has the Attribute Identifier 02_h. This attribute presents the maximum number of instances that can exist of the Fault History Object in the device (i.e. the maximum length of the fault history).

The Data type of this attribute is UINT (16-bit).

Class Attribute "Number of Instances"
The Fault History Object has a class attribute named "Number of Instances" which has the Attribute Identifier 03_h. This attribute presents the number of instances that currently exist of the Fault History Object in the device.

The Data type of this attribute is UINT (16-bit).

Instance Attribute "FaultCode"
The object has an instance attribute named "FaultCode" which has the Attribute Identifier 01_h. The data type is USINT (8-bit). The value returns the fault code of a fault entry which is represented by the Fault History Object instance.

Instance Attribute "FaultID"
The object has an instance attribute named "FaultID" which has the Attribute Identifier 02_h. The data type is UINT (16-bit). The value returns the fault ID of a fault entry which is represented by the Fault History Object instance. This value more exactly specifies which kind of fault is in question.

Instance Attribute "FaultYear"
The object has an instance attribute named "FaultYear" which has the Attribute Identifier 03_h. The data type is UINT (16-bit). The value returns the year in which the fault occurred (according to the fault history).

Instance Attribute "FaultMonth"
The object has an instance attribute named "FaultMonth" which has the Attribute Identifier 04_h. The data type is USINT (8-bit). The value returns the month in which the fault occurred (according to the fault history).

Instance Attribute "FaultDay"
The object has an instance attribute named "FaultDay" which has the Attribute Identifier 05_h. The data type is USINT (8-bit). The value returns the day-of-month in which the fault occurred (according to the fault history).

Instance Attribute "FaultMillisAfterMidnight"
The object has an instance attribute named "FaultMillisAfterMidnight" which has the Attribute Identifier 06_h. The data type is UDINT (32-bit). The value returns the number of milliseconds after midnight when the fault is time stamped.

Class Service "Reset"
The Fault History Object has a class service named "Reset" which has the Service Code 05_h. Using the service causes the fault history to be cleared. The service does not take any parameters for its invocation.

6.3 ASSEMBLY INSTANCES IMPLEMENTED BY VACON® 100

6.3.1 ODVA I/O ASSEMBLY INSTANCES FOR AC/DC DRIVE

The Vacon 100 drive supports the Output Assembly Instances 20, 21 and 23, and the Input Assembly Instances 70, 71 and 73.

6.3.1.1 Output Assembly Instance 20

Table 44.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit0
20 (length 4)	0						Fault Reset		Run Fwd
	1								
	2	Speed Reference (Low Octet)							
	3	Speed Reference (High Octet)							

The contents of the assembly are defined as follows:

- Bits 7-3 and bit 1 in the first octet of the assembly are reserved, and always have the value 0.
- Bit 2 in the first octet of the assembly is "Fault Reset", which is mapped to the "FaultRst" attribute (Attribute ID = 12_d) in the Control Supervisor Object (Class number 29_h). See Instance Attribute "FaultRst".
- Bit 0 in the first octet of the assembly is "Run Fwd", which is mapped to the "Run1" attribute (Attribute ID = 3_d) in the Control Supervisor Object (Class number 29_h). See Instance Attribute "Run1".
- The second octet of the assembly is reserved and always has the value 0.
- The third octet of the assembly is the low-octet of "Speed Reference", while the fourth octet is the high-octet of "Speed Reference". The combined 16-bit reference of these fields is mapped to the "SpeedRef" attribute (Attribute ID = 8_d) in the AC/DC Drive Object (Class number $2A_h$). See Instance Attribute "SpeedRef".

6.3.1.2 Output Assembly Instance 21

Table 45.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
21 (length 4)	0		NetRef	NetC-TRL			Fault Reset	Run Rev	Run Fwd
	1								
	2	Speed Reference (Low Octet)							
	3	Speed Reference (High Octet)							

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The contents of the assembly are defined as follows

- Bit 7 and bits 4-3 in the first octet of the assembly are reserved, and always have the value 0.
- Bit 6 in the first octet of the assembly is "NetRef", which is mapped to the "NetRef" attribute (Attribute ID = 4d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.2.
- Bit 5 in the first octet of the assembly is "NetCtrl", which is mapped to the "NetCtrl" attribute (Attribute ID = 5d) in the Control Supervisor Object (Class number 29h). See 7.2.3.3.
- Bit 2 in the first octet of the assembly is "Fault Reset", which is mapped to the "FaultRst" attribute (Attribute ID = 12d) in the Control Supervisor Object (Class number 29h). See 7.2.3.10.
- Bit 1 in the first octet of the assembly is "Run Rev", which is mapped to the "Run2" attribute (Attribute ID = 4d) in the Control Supervisor Object (Class number 29h). See 7.2.3.2.
- Bit 0 in the first octet of the assembly is "Run Fwd", which is mapped to the "Run1" attribute (Attribute ID = 3d) in the Control Supervisor Object (Class number 29h). See 7.2.3.1.
- The second octet of the assembly is reserved and always has the value 0.
- The third octet of the assembly is the low-octet of "Speed Reference", while the fourth octet is the high-octet of "Speed Reference". The combined 16-bit reference of these fields is mapped to the "SpeedRef" attribute (Attribute ID = 8d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.5.

6.3.1.3 Output Assembly Instance 23

Table 46.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
23 (length 6)	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1								
	2	Speed Reference (Low Octet)							
	3	Speed Reference (High Octet)							
	4	Torque Reference (Low Octet)							
	5	Torque Reference (High Octet)							

The contents of the assembly are defined as follows:

- Bit 7 and bits 4-3 in the first octet of the assembly are reserved, and always have the value 0.
- Bit 6 in the first octet of the assembly is "NetRef", which is mapped to the "NetRef" attribute (Attribute ID = 4d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.2.
- Bit 5 in the first octet of the assembly is "NetCtrl", which is mapped to the "NetCtrl" attribute (Attribute ID = 5d) in the Control Supervisor Object (Class number 29h). See 7.2.3.3.
- Bit 2 in the first octet of the assembly is "Fault Reset", which is mapped to the "FaultRst" attribute (Attribute ID = 12d) in the Control Supervisor Object (Class number 29h). See
- 7.2.3.10.
- Bit 1 in the first octet of the assembly is "Run Rev", which is mapped to the "Run2" attribute (Attribute ID = 4d) in the Control Supervisor Object (Class number 29h). See 7.2.3.2.
- Bit 0 in the first octet of the assembly is "Run Fwd", which is mapped to the "Run1" attribute (Attribute ID = 3d) in the Control Supervisor Object (Class number 29h). See 7.2.3.1.
- The second octet of the assembly is reserved and always has the value 0.
- The third octet of the assembly is the low-octet of "Speed Reference", while the fourth octet is the high-octet of "Speed Reference". The combined 16-bit reference of these fields is mapped to the "SpeedRef" attribute (Attribute ID = 8d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.5.
- The fifth octet of the assembly is the low-octet of "Torque Reference", while the sixth octet is the high-octet of "Torque Reference". The combined 16-bit reference of these fields is

mapped to the "TorqueRef" attribute (Attribute ID = 12d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.7.

Torque Reference is not send to the Drive if Motor Control Mode is set to values others than:

- 2 – Torque Control
- 4 – Closed Loop Torque Control

Torque Reference is send to the Drive as a Process Data 1.

6.3.1.4 Input Assembly Instance 70

Table 47.

Instance	Octet	Bit 7	Bit 6	Bit 5	bit 4	Bit 3	Bit 2	Bit 1	Bit 0
70 (length 4)	0						Running 1		Faulted
	1								
	2	Speed Actual (Low Octet)							
	3	Speed Actual (High Octet)							

The contents of the assembly are defined as follows:

- Bits 7-3 and bit 1 in the first octet of the assembly are reserved, and always have the value 0.
- Bit 2 in the first octet of the assembly is "Running1", which is mapped to the "Running1" attribute (Attribute ID = 7d) in the Control Supervisor Object (Class number 29h). See 7.2.3.5.
- Bit 0 in the first octet of the assembly is "Faulted", which is mapped to the "Faulted" attribute
- (Attribute ID = 10d) in the Control Supervisor Object (Class number 29h). See 7.2.3.8.
- The second octet of the assembly is reserved and always has the value 0.
- The third octet of the assembly is the low-octet of "Speed Actual", while the fourth octet is
- the high-octet of "Speed Actual". The combined 16-bit reference of these fields is mapped to the "SpeedActual" attribute (Attribute ID = 7d) in the AC/DC Drive Object (Class number
- 2Ah). See 7.2.4.4.

6.3.1.5 Input Assembly Instance 71

Table 48.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
71 (length 4)	0	AtReference	RefFromNet	CtrlFromNe	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Octet)							
	3	Speed Actual (High Octet)							

The contents of the assembly are defined as follows:

- Bit 7 in the first octet of the assembly is "AtReference", which is mapped to the "AtReference" attribute (Attribute ID = 3d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.1.
- Bit 6 in the first octet of the assembly is "RefFromNet" , which is mapped to the

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- "RefFromNet" attribute (Attribute ID = 29d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.10.
- Bit 5 in the first octet of the assembly is "CtrlFromNet" , which is mapped to the "CtrlFromNet" attribute (Attribute ID = 15d) in the Control Supervisor Object (Class number 29h). See 7.2.3.12.
- Bit 4 in the first octet of the assembly is "Ready" , which is mapped to the "Ready" attribute
- (Attribute ID = 9d) in the Control Supervisor Object (Class number 29h). See 7.2.3.7.
- Bit 3 in the first octet of the assembly is "Running2 (Rev)" , which is mapped to the
- "Running2" attribute (Attribute ID = 8d) in the Control Supervisor Object (Class number 29h).
- See 7.2.3.6.
- Bit 2 in the first octet of the assembly is "Running1 (Fwd)", which is mapped to the "Running1" attribute (Attribute ID = 7d) in the Control Supervisor Object (Class number 29h). See 7.2.3.5.
- Bit 1 in the first octet of the assembly is "Warning", which is mapped to the "Warning" attribute (Attribute ID = 11d) in the Control Supervisor Object (Class number 29h). See 7.2.3.9.
- Bit 0 in the first octet of the assembly is "Faulted", which is mapped to the "Faulted" attribute (Attribute ID = 10d) in the Control Supervisor Object (Class number 29h). See 7.2.3.8.
- The second octet of the assembly is "Drive State", which is mapped to the "State" attribute (Attribute ID = 6d) in the Control Supervisor Object (Class number 29h). See 7.2.3.4.
- The third octet of the assembly is the low-octet of "Speed Actual", while the fourth octet is the high-octet of "Speed Actual". The combined 16-bit reference of these fields is mapped to the "SpeedActual" attribute (Attribute ID = 7d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.4.

6.3.1.6 Input Assembly Instance 73

Table 49.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
73 (length 6)	0	AtReference	RefFromNe	CtrlFromNet	Ready	Running 2 (Rev)	Running 1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Octet)							
	3	Speed Actual (High Octet)							
	4	Torque Actual (Low Octet)							
	5	Torque Actual (High Octet)							

The contents of the assembly are defined as follows:

- Bit 7 in the first octet of the assembly is "AtReference", which is mapped to the "AtReference" attribute (Attribute ID = 3d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.1.
- Bit 6 in the first octet of the assembly is "RefFromNet" , which is mapped to the "RefFromNet" attribute (Attribute ID = 29d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.10.
- Bit 5 in the first octet of the assembly is "CtrlFromNet" , which is mapped to the "CtrlFromNet" attribute (Attribute ID = 15d) in the Control Supervisor Object (Class number 29h). See 7.2.3.12.
- Bit 4 in the first octet of the assembly is "Ready" , which is mapped to the "Ready" attribute (Attribute ID = 9d) in the Control Supervisor Object (Class number 29h). See 7.2.3.7.

- Bit 3 in the first octet of the assembly is "Running2 (Rev)" , which is mapped to the "Running2" attribute (Attribute ID = 8d) in the Control Supervisor Object (Class number 29h). See 7.2.3.6.
- Bit 2 in the first octet of the assembly is "Running1 (Fwd)", which is mapped to the"Running1" attribute (Attribute ID = 7d) in the Control Supervisor Object (Class number 29h). See 7.2.3.5.
- Bit 1 in the first octet of the assembly is "Warning", which is mapped to the "Warning" attribute (Attribute ID = 11d) in the Control Supervisor Object (Class number 29h). See 7.2.3.9.
- Bit 0 in the first octet of the assembly is "Faulted", which is mapped to the "Faulted" attribute (Attribute ID = 10d) in the Control Supervisor Object (Class number 29h). See 7.2.3.8.
- The second octet of the assembly is "Drive State", which is mapped to the "State" attribute (Attribute ID = 6d) in the Control Supervisor Object (Class number 29h). See 7.2.3.4.
- The third octet of the assembly is the low-octet of "Speed Actual", while the fourth octet is the high-octet of "Speed Actual". The combined 16-bit reference of these fields is mapped to the "SpeedActual" attribute (Attribute ID = 7d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.4.
- The fifth octet of the assembly is the low-octet of "Torque Actual", while the sixth octet is the high-octet of "Torque Actual". The combined 16-bit reference of these fields is mapped to the "TorqueActual" attribute (Attribute ID = 11d) in the AC/DC Drive Object (Class number 2Ah). See 7.2.4.6.

6.3.2 Vendor-specific I/O Assembly Instances

The Vacon 100 drive supports the assemblies 101, 111, 128, 131, 107, 117, 127 and 137.

6.3.2.1 Output Assembly Instance 101

Table 50.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
101 (length 8)	0		NetRef	NetCtrl			Fault Reset	RunRev	RunFwd
	1								
	2	FBSpeedReference (Low Octet) in %							
	3	FBSpeedReference (High Octet) in %							
	4	FBProcessDataIn1 (Low Octet)							
	5	FBProcessDataIn1 (High Octet)							
	6	FBProcessDataIn2 (Low Octet)							
	7	FBProcessDataIn2 (High Octet)							

The contents of the assembly are defined as follows

- Bits 7 and bits 4-3 in the first octet of the assembly are reserved, and always have the value 0.
- Bits 6-5 and 2-0 in the first octet of the assembly operate the same manner as in e.g. Output Instance 21 (see 8.1.2).
- The second octet of the assembly is reserved and always has the value 0.

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- The third octet of the assembly is the low-octet of "FBSpeedReference", while the fourth octet is the high-octet of "FBSpeedReference". The combined 16-bit value of these fields is the vendor-specific Vacon FBSpeedReference value.
- The fifth octet of the assembly is the low-octet of "FBProcessDataIn1", while the sixth octet is the high-octet of "FBProcessDataIn1". The combined 16-bit value of these fields is the vendor-specific Vacon FBProcessDataIn1 value.
- The seventh octet of the assembly is the low-octet of "FBProcessDataIn2", while the eighth octet is the high-octet of "FBProcessDataIn2". The combined 16-bit value of these fields is the vendor-specific Vacon FBProcessDataIn2 value.

6.3.2.2 Output Assembly Instance 111

Table 51.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
111 (length 20)	0	FBFixedControlWord (Low Octet)							
	1	FBFixedControlWord (High Octet)							
	2	FBSpeedReference (Low Octet) in %							
	3	FBSpeedReference (High Octet) in %							
	4	FBProcessDataIn1 (Low Octet)							
	5	FBProcessDataIn1 (High Octet)							
	6	FBProcessDataIn2 (Low Octet)							
	7	FBProcessDataIn2 (High Octet)							
	8	FBProcessDataIn3 (Low Octet)							
	9	FBProcessDataIn3 (High Octet)							
	10	FBProcessDataIn4 (Low Octet)							
	11	FBProcessDataIn4 (High Octet)							
	12	FBProcessDataIn5 (Low Octet)							
	13	FBProcessDataIn5 (High Octet)							
	14	FBProcessDataIn6 (Low Octet)							
	15	FBProcessDataIn6 (High Octet)							
	16	FBProcessDataIn7 (Low Octet)							
	17	FBProcessDataIn7 (High Octet)							
	18	FBProcessDataIn8 (Low Octet)							
	19	FBProcessDataIn8 (High Octet)							

The contents of the assembly are defined as follows

- The first octet of the assembly is the low-octet of "FBFixedControlWord", while the second octet is the high-octet of "FBFixedControlWord". The combined 16-bit value of these fields is the vendor-specific Vacon FBFixedControlWord value.
- The third octet of the assembly is the low-octet of "FBSpeedReference", while the fourth octet is the high-octet of "FBSpeedReference". The combined 16-bit value of these fields is the vendor-specific Vacon FBSpeedReference value.
- The rest of the telegram is organized as eight pieces of 16-bit words (low octet first) which compose the FBProcessDataIn fields 1-8. These fields are the vendor-specific Vacon FBProcessDataIn1...8 values.

6.3.2.3 Output Assembly Instance 128

Table 52.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit2	Bit1	Bit 0
128 (length 20)	0	FBFixedControlWord (Low Octet)							
	1	FBGeneralControlWord (High Octet)							
	2	FBSpeedReference (Low Octet) in %							
	3	FBSpeedReference (High Octet) in %							
	4	FBProcessDataIn1 (Low Octet)							
	5	FBProcessDataIn1 (High Octet)							
	6	FBProcessDataIn2 (Low Octet)							
	7	FBProcessDataIn2 (High Octet)							
	8	FBProcessDataIn3 (Low Octet)							
	9	FBProcessDataIn3 (High Octet)							
	10	FBProcessDataIn4 (Low Octet)							
	11	FBProcessDataIn4 (High Octet)							
	12	FBProcessDataIn5 (Low Octet)							
	13	FBProcessDataIn5 (High Octet)							
	14	FBProcessDataIn6 (Low Octet)							
	15	FBProcessDataIn6 (High Octet)							
	16	FBProcessDataIn7 (Low Octet)							
	17	FBProcessDataIn7 (High Octet)							
	18	FBProcessDataIn8 (Low Octet)							
	19	FBProcessDataIn8 (High Octet)							

The contents of the assembly are otherwise identical to the output assembly 111, except that the second octet of the assembly is the high octet of FBGeneralControlWord instead of FBFixedControlWord.

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6.3.2.4 Output Assembly Instance 131

Table 53.

Instance	Offset	Octet 0	Octet +1	Octet +2	Octet +3
131 (length 40)	0	FBFixedControl-Word (Low Octet)	FBFixedControl-Word (High Octet)	FBGeneralCon-trol-Word (Low Octet)	FBGeneralCon-trol-Word (High Octet)
	4	Reserved	Reserved	FBSpeedRef (Low Octet)	FBSpeedRef (High Octet)
	8	ProcessDataIn1 Bits 7:0	ProcessDataIn1 Bits 15:8	ProcessDataIn1 Bits 23:16	ProcessDataIn1 Bits 31:24
	12	ProcessDataIn2 Bits 7:0	ProcessDataIn2 Bits 15:8	ProcessDataIn2 Bits 23:16	ProcessDataIn2 Bits 31:24
	16	ProcessDataIn3 Bits 7:0	ProcessDataIn3 Bits 15:8	ProcessDataIn3 Bits 23:16	ProcessDataIn3 Bits 31:24
	20	ProcessDataIn4 Bits 7:0	ProcessDataIn4 Bits 15:8	ProcessDataIn4 Bits 23:16	ProcessDataIn4 Bits 31:24
	24	ProcessDataIn5 Bits 7:0	ProcessDataIn5 Bits 15:8	ProcessDataIn5 Bits 23:16	ProcessDataIn5 Bits 31:24
	28	ProcessDataIn6 Bits 7:0	ProcessDataIn6 Bits 15:8	ProcessDataIn6 Bits 23:16	ProcessDataIn6 Bits 31:24
	32	ProcessDataIn7 Bits 7:0	ProcessDataIn7 Bits 15:8	ProcessDataIn7 Bits 23:16	ProcessDataIn7 Bits 31:24
	36	ProcessDataIn8 Bits 7:0	ProcessDataIn8 Bits 15:8	ProcessDataIn8 Bits 23:16	ProcessDataIn8 Bits 31:24

The contents of the assembly are defined as follows

- The first word of the assembly is "FBFixedControlWord", while the second word is the "FBGeneralControlWord". The values are communicated low octet first.
- The third word is reserved and shall always be zero.
- The fourth word is the "FBSpeedReference" value, which is communicated low octet first.
- Starting from octet 8 of the assembly are eight ProcessDataIn values (numbered 1 to 8) which are 32 bits each in length. These fields are the vendor-specific Vacon FBProcessDataIn1...8 values. They are transmitted LSB first.

6.3.2.5 Input Assembly Instance 107

Table 54.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
107 (length 8)	0	AtReference	RefFromNet	CtrlFromNet	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	FBSpeedActual (Low Octet) in %							
	3	FBSpeedActual (High Octet) in %							
	4	FBProcessDataOut1 (Low Octet)							
	5	FBProcessDataOut1 (High Octet)							
	6	FBProcessDataOut2 (Low Octet)							
	7	FBProcessDataOut2 (High Octet)							

The contents of the assembly are defined as follows

- The first and second octets of the assembly operate the same manner as in Input Instance 71 (see 8.1.5).
- The third octet of the assembly is the low-octet of "FBSpeedActual", while the fourth octet is the high-octet of "FBSpeedActual". The combined 16-bit value of these fields is the vendor-specific Vacon FBSpeedActual value.
- The fifth octet of the assembly is the low-octet of "FBProcessDataOut1", while the sixth octet is the high-octet of "FBProcessDataOut1". The combined 16-bit value of these fields is the vendor-specific Vacon FBProcessDataOut1value.
- The seventh octet of the assembly is the low-octet of "FBProcessDataOut2", while the eighth octet is the high-octet of "FBProcessDataOut2". The combined 16-bit value of these fields is the vendor-specific Vacon FBProcessDataOut2value.

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6.3.2.6 Input Assembly Instance 117

Table 55.

Instance	Octet	Bit 7	Bit 6	Bit5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
117 (length 34)	0	FBFixedStatusWord (Low Octet)							
	1	FBFixedStatusWord (High Octet)							
	2	FBSpeedActual (Low Octet) in %							
	3	FBSpeedActual (High Octet) in %							
	4	RPMSpeedActual (Low Octet) in rpm							
	5	RPMSpeedActual (High Octet) in rpm							
	6	RPM With Slip SpeedActual (Low Octet) in rpm							
	7	RPM With Slip SpeedActual (High Octet) in rpm							
	8	Reserved (=0)							
	...	Reserved (=0)							
	17	Reserved (=0)							
	18	FBProcessDataOut1 (Low Octet)							
	19	FBProcessDataOut1 (High Octet)							
	20	FBProcessDataOut2 (Low Octet)							
	21	FBProcessDataOut2 (High Octet)							
	22	FBProcessDataOut3 (Low Octet)							
	23	FBProcessDataOut3 (High Octet)							
	24	FBProcessDataOut4 (Low Octet)							
	25	FBProcessDataOut4 (High Octet)							
	26	FBProcessDataOut5 (Low Octet)							
	27	FBProcessDataOut5 (High Octet)							
	28	FBProcessDataOut6 (Low Octet)							
	29	FBProcessDataOut6 (High Octet)							
	30	FBProcessDataOut7 (Low Octet)							
	31	FBProcessDataOut7 (High Octet)							
	32	FBProcessDataOut8 (Low Octet)							
	33	FBProcessDataOut8 (High Octet)							

The contents of the assembly are defined as follows

- The first octet of the assembly is the low-octet of "FBFixedStatusWord", while the second octet is the high-octet of "FBFixedStatusWord". The combined 16-bit value of these fields is
- the vendor-specific Vacon FBFixedStatusWord value.
- The third octet of the assembly is the low-octet of "FBSpeedActual", while the fourth octet is the high-octet of "FBSpeedActual". The combined 16-bit value of these fields is the vendor-specific Vacon FBSpeedActual value.The fourth octet of the assembly is the low-octet of "RPMSpeedActual", while the fifth octet is the high-octet of "RPMSpeedActual". The combined 16-bit value of these fields is the speed of the controlled motor in RPMs.
- The sixth octet of the assembly is the low-octet of "RPM With Slip SpeedActual", while the seventh octet is the high-octet of "RPM With Slip SpeedActual". The combined 16-bit value of these fields is the speed of the controlled motor in RPMs, taking slip in to account

- The octets 8 to 17 are reserved and shall always be 0.
- The rest of the telegram is organized as eight pieces of 16-bit words (low octet first) which compose the FBProcessDataOut fields 1-8. These fields are the vendor-specific Vacon FBProcessDataOut1...8 values.

6.3.2.7 Input Assembly Instance 127

Table 56.

Instance	Octet	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit2	Bit 2	Bit 0
127 (length 20)	0	FBFixedStatusWord (Low Octet)							
	1	FBGeneralStatusWord (High Octet)							
	2	FBSpeedActual (Low Octet) in %							
	3	FBSpeedActual (High Octet) in %							
	4	FBProcessDataOut1 (Low Octet)							
	5	FBProcessDataOut1 (High Octet)							
	6	FBProcessDataOut2 (Low Octet)							
	7	FBProcessDataOut2 (High Octet)							
	8	FBProcessDataOut3 (Low Octet)							
	9	FBProcessDataOut3 (High Octet)							
	10	FBProcessDataOut4 (Low Octet)							
	11	FBProcessDataOut4 (High Octet)							
	12	FBProcessDataOut5 (Low Octet)							
	13	FBProcessDataOut5 (High Octet)							
	14	FBProcessDataOut6 (Low Octet)							
	15	FBProcessDataOut6 (High Octet)							
	16	FBProcessDataOut7 (Low Octet)							
	17	FBProcessDataOut7 (High Octet)							
	18	FBProcessDataOut8 (Low Octet)							
	19	FBProcessDataOut8 (High Octet)							

The contents of the assembly are otherwise identical to the input assembly 117, except that the second octet of the assembly is the high octet of FBGeneralStatusWord instead of FBFixedStatusWord.

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6.3.2.8 Input Assembly Instance 137

Table 57.

Instance	Offset	Octet 0	Octet +1	Octet +2	Octet +3
137 (length 40)	0	FBFixedStatus-Word (Low Octet)	FBFixedStatus-Word (High Octet)	FBGeneralStatus-Word (Low Octet)	FBGeneralStatus-Word (High Octet)
	4	Reserved	Reserved	FBSpeedActual (Low Octet)	FBSpeedActual (High Octet)
	8	ProcessDataOut1 Bits 7:0	ProcessDataOut1 Bits 15:8	ProcessDataOut1 Bits 23:16	ProcessDataOut1 Bits 31:24
	12	ProcessDataOut2 Bits 7:0	ProcessDataOut2 Bits 15:8	ProcessDataOut2 Bits 23:16	ProcessDataOut2 Bits 31:24
	16	ProcessDataOut3 Bits 7:0	ProcessDataOut3 Bits 15:8	ProcessDataOut3 Bits 23:16	ProcessDataOut3 Bits 31:24
	20	ProcessDataOut4 Bits 7:0	ProcessDataOut4 Bits 15:8	ProcessDataOut4 Bits 23:16	ProcessDataOut4 Bits 31:24
	24	ProcessDataOut5 Bits 7:0	ProcessDataOut5 Bits 15:8	ProcessDataOut5 Bits 23:16	ProcessDataOut5 Bits 31:24
	28	ProcessDataOut6 Bits 7:0	ProcessDataOut6 Bits 15:8	ProcessDataOut6 Bits 23:16	ProcessDataOut6 Bits 31:24
	32	ProcessDataOut7 Bits 7:0	ProcessDataOut7 Bits 15:8	ProcessDataOut7 Bits 23:16	ProcessDataOut7 Bits 31:24
	36	ProcessDataOut8 Bits 7:0	ProcessDataOut8 Bits 15:8	ProcessDataOut8 Bits 23:16	ProcessDataOut8 Bits 31:24

The contents of the assembly are defined as follows

- The first word of the assembly is "FBFixedStatusWord", while the second word is the "FBGeneralStatusWord". The values are communicated low octet first.
- The third word is reserved and shall always be zero.
- The fourth word is the "FBSpeedActual" value, which is communicated low octet first.
- Starting from octet 8 of the assembly are eight ProcessDataOut values (numbered 1 to 8) which are 32 bits in length. These fields are the vendor-specific Vacon FBProcessDataOut1...8 values. They are transmitted LSB first.

6.3.3 MAPPING OF STANDARD OUTPUT ASSEMBLIES ONTO VACON DATA

This section specifies how data in the Standard Output Assemblies are mapped into Vacon data.

6.3.3.1 FBFixedControlWord

Bit	Description		
		0	1
0	Start/Stop	Stop request from fieldbus	Run request from fieldbus
1	Direction	Requested direction is "FORWARD"	Requested direction is "REVERSE"
2	Fault Reset	No action.	No action. Rising edge (0->1) = Active faults, alarms and infos are reset.
3	Coast Stop Mode	Stop mode is unmodified.	Stop mode is overridden to "Coasting".
4	Ramp Stop Mode	Stop mode is unmodified.	Stop mode is overridden to "Ramping".
5	Quick Ramp Time	Normal deceleration ramp time.	Deceleration ramp time is switched to shorter than normal.
6	Freeze Setpoint	Changes in the setpoint value from fieldbus (FBSpeedReference) are taken into use by the application.	Changes in the setpoint value from fieldbus (FBSpeedReference) are not taken into use by the application.
7	Setpoint to Zero	The setpoint value from fieldbus is taken from FBSpeedReference.	The setpoint value from fieldbus is switched to 0. When bit 7 has the value 1, the setpoint value from the fieldbus control place shall be set to 0. This value shall be interpreted as absolute 0 (not as Minimum Frequency setting).
8	Request Fieldbus Control	Control Place is as parameterised in the drive (unchanged).	Control Place shall be overridden to Fieldbus Control.
9	Request Fieldbus Reference	Source of setpoint value shall be as parameterised in the drive (unchanged).	Source of setpoint value shall be overridden to Fieldbus.
10	Inching 1		
11	Inching 2		
12	Quick Stop	Drive operates as normal.	Drive executes quick stop / emergency stop.
13	Reserved		
14	Reserved		
15	Master connection state	Offline.	Active.

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6.3.3.2 Start/Stop bit in Vacon FBFixedControlWord

If one of the "RunFwd" or "RunRev" bits in an Output Assembly has the value 1, the "Start/Stop" bit 0 in the Vacon FBFixedControlWord is set to 1. Otherwise the bit is set to 0.

If both the "RunFwd" and "RunRev" bits have the value 1, the "Start/Stop" bit in the Vacon FBFixed-ControlWord is set to 0.

6.3.3.3 Direction bit in Vacon FBFixedControlWord

If the "RunRev" bit in an Output Assembly has the value 1, and the "RunFwd" bit in the assembly has the value 0, then the "Direction" bit 1 in the Vacon FBFixedControlWord is set to 1. Otherwise the bit is set to 0.

6.3.3.4 Fault Reset bit in Vacon FBFixedControlWord

The "Fault Reset" bit in an Output Assembly is mapped to the "Fault Reset" bit 2 in the Vacon FB-FixedControlWord. Both bits are rising-edge sensitive.

6.3.3.5 Request Fieldbus Control bit in Vacon FBFixedControlWord

The "NetCtrl" bit in an Output Assembly is mapped to the "Request Fieldbus Control" bit 8 in the Vacon FBFixedControlWord. When bit 8 is set in the FBFixedControlWord, the fieldbus control is requested to the fieldbus interface.

6.3.3.6 Request Fieldbus Reference bit in Vacon FBFixedControlWord

The "NetRef" bit in an Output Assembly is mapped to the "Request Fieldbus Reference" bit 9 in the Vacon FBFixedControlWord. When bit 9 is set in the FBFixedControlWord, the setpoint value for the drive is requested to the fieldbus interface.

6.3.3.7 Master Connection State bit in Vacon FBFixedControlWord

If the EtherNet/IP communication with the master device is functional, the bit 15 in the Vacon FB-FixedControlWord is set to 1. If the communication with the master device is not working, the bit 15 in the FBFixedControlWord is set to 0.

6.3.4 Mapping of Vacon data onto Standard Input Assemblies

This section specifies how Vacon data is mapped onto the data in the Standard Input Assemblies.

6.3.4.1 FBFixedStatusWord

Table 58.

Bit	Description	
	0	1
0	Not ready	Ready
1	Stopped	Running

Table 58.

2	Running clockwise	Running counter-clockwise
3	No fault	Fault active
4	No alarm	Alarm active
5	Not reached reference	Reference reached
6	Motor not running zero speed	Motor running at zero speed
7	Motor not magnetized	Motor magnetized
8-12	Reserved	Reserved
13-15	Application-Specific	Application-Specific

6.3.4.2 Ready Indication bit in Vacon FBFixedStatusWord

The "Ready Indication" bit 0 in the Vacon FBFixedStatusWord is mapped to the "Ready" bit in an Input Assembly which supports this bit.

6.3.4.3 Run/Stop Indication bit in Vacon FBFixedStatusWord

The "Run/Stop Indication" bit 1 in the Vacon FBFixedStatusWord is mapped to the "Running1" and "Running2" bits in an Input Assembly which supports these bits.

The state of the Running1 and Running2 bits depends further on the "Direction Indication" bit 2 of the Vacon FBFixedStatusWord as follows:

Table 59.

	Run/Stop = 0	**Run/Stop = 1**	
	Direction = X	**Direction = 0**	**Direction = 1**
Running1	0	1	0
Running2	0	0	1

6.3.4.4 Direction Indication bit in Vacon FBFixedStatusWord

See chapter 6.3.4.3.

6.3.4.5 Fault Indication bit in Vacon FBFixedStatusWord

The "Fault Indication" bit 3 in the Vacon FBFixedStatusWord is mapped to the "Faulted" bit in an Input Assembly which supports this bit.

6.3.4.6 Alarm Indication bit in Vacon FBFixedStatusWord

The "Alarm Indication" bit 4 in the Vacon FBFixedStatusWord is mapped to the "Warning" bit in an Input Assembly which supports this bit.

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6.3.4.7 Setpoint Reached Indication bit in Vacon FBFixedStatusWord

The "Setpoint Reached Indication" bit 5 in the Vacon FBFixedStatusWord is mapped to the "AtReference" bit in an Input Assembly which supports this bit.

6.3.4.8 Fieldbus Control indication in Input Assemblies

The selected control place is indicated in Input Assemblies which contain the "CtrlFromNet" bit. If the control place is assigned to fieldbus then this bit is set to 1, else it is 0.

6.3.4.9 Fieldbus Reference indication in Input Assemblies

The selected reference is indicated in Input Assemblies which contain the "RefFromNet" bit. If thereference is assigned to fieldbus then this bit is set to 1, else it is 0.

6.3.4.10 FBSpeedReference in percentage

This is the reference 1 to the frequency converter. The allowed scaling is from 0 to 10000. In the application, the value is scaled in percentage of the frequency area between set minimum and maximum frequency.

Table 60.

FBSpeedReference	Percentage
0	0,00 %
10000	100,00 %

6.3.4.11 Fieldbus Process Data mapping

The Input Assembly Instances 107, 117, 127 and 137 include a number of ProcessDataOut variables, which are vendor-specific variables which can be sent from the Vacon 100 drive to the EtherNet/IP master. There can be up to eight ProcessDataOut variables communicated from the drive. The contents of these variables can be parameterised in the Vacon 100 drive using a feature known as "Fieldbus Process Data mapping".

The Fieldbus Process Data mapping can be configured in the panel or with Vacon Live under "Parameters / Fieldbus DataMap". Here can be found eight values by which the contents of the eight ProcessDataOut variables can be configured. Please refer to the Vacon 100 Application Manual and the section on Fieldbus Data Mapping for further details.

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