VACON® 100 INDUSTRIAL
VACON® 100 FLOW
VACON® 100 X

AC DRIVES

ETHERNET/IP
USER MANUAL

VACON®

TABLE OF CONTENTS

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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.

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 break 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.

NOTE! You can download the English and French product manuals with applicable safety, warning and caution information from http://drives.danfoss.com/knowledge-center/technical-documentation/.

REMARQUE Vous pouvez télécharger les versions anglaise et française des manuels produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site http://drives.danfoss.com/knowledge-center/technical-documentation/ .

2. EtherNet/IP - General info

EtherNet/IP is industrial Ethernet network solution available for manufacturing automation. EtherNet/IP™ is a trademark of ODVA, Inc.

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.

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

Table 2. List of abbreviations used in this document

Abbreviation	Explanation
CIP	Common Industrial Protocol
STP	Shielded Twisted Pair
DHCP	Dynamic Host Configuration Protocol is used for dynamical resolving of network configuration parameters like an IP address.
FB	Fieldbus
GW	Gateway
PLC	Programmable Logic Controller
PDI	Process Data In
PDO	Process Data Out
RPM	Revolutions per minute
ACD	Address Conflict Detection
ARP	Address Resolution Protocol
LED	Light-Emitting Diode
TCP/IP	Transmission Control Protocol / Internet Protocol
UDP	User Datagram Protocol
EDS	Electronic Data Sheet
RPI	Requested Packet Interval
MAC	Media Access Control
DNS	Domain Name System
TTL	Time To Live

2.1 Connections and Wiring

The VACON® 100 Family AC drives support 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.

2.1.1 ACD (Address Conflict Detection)

The VACON® 100 Family AC drives implement ACD algorithm (IETF RFC 5227). The implementation includes requirements from the EtherNet/IP protocol.

The ACD algorithm tries to actively detect if the IP address configured to this device is been used by another device in the same network. To accomplish this, ACD sends four ARP request packets when the device's Ethernet interface goes up or when its IP address changes. ACD prevents the use of the Ethernet interface until the ARP probing finishes. This delays the startup of fieldbus protocols about one second. During the delay or after it, the ACD passively checks incoming ARP messages for use of the device's IP address. If another device with the same IP address is detected, the ACD will try to defend its IP address with a single ARP message. If the other device with the same IP address also supports ACD, it should stop using the address. If not, the ACD will close the Ethernet connection and indicate the situation with an alarm. This is done according the "DefendWithPolicyB". You cannot acknowledg the alarm if the problem is active. The ACD opens Ethernet connection if the other device with the same IP address disappears from the network. You can acknowledge the alarm after this.

Other policies are not supported. If the fieldbus protocol has been active, a fieldbus fault may be activated (depends on the fieldbus and drive application configuration).

2.1.2 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

3.1 INSTALLATION IN VACON® 100 INDUSTRIAL AND FLOW

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 the AC drive is disconnected from mains.

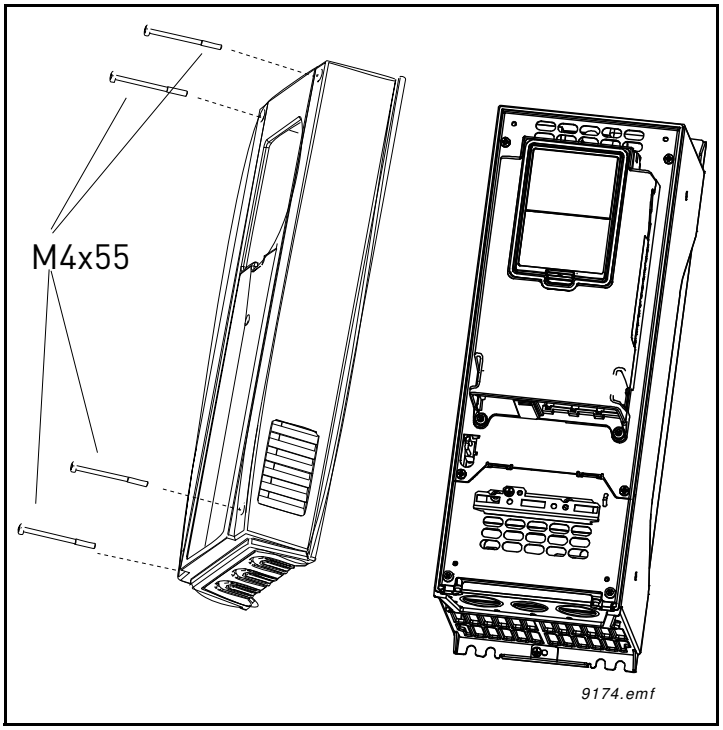

Figure 1.

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.

3.2 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.

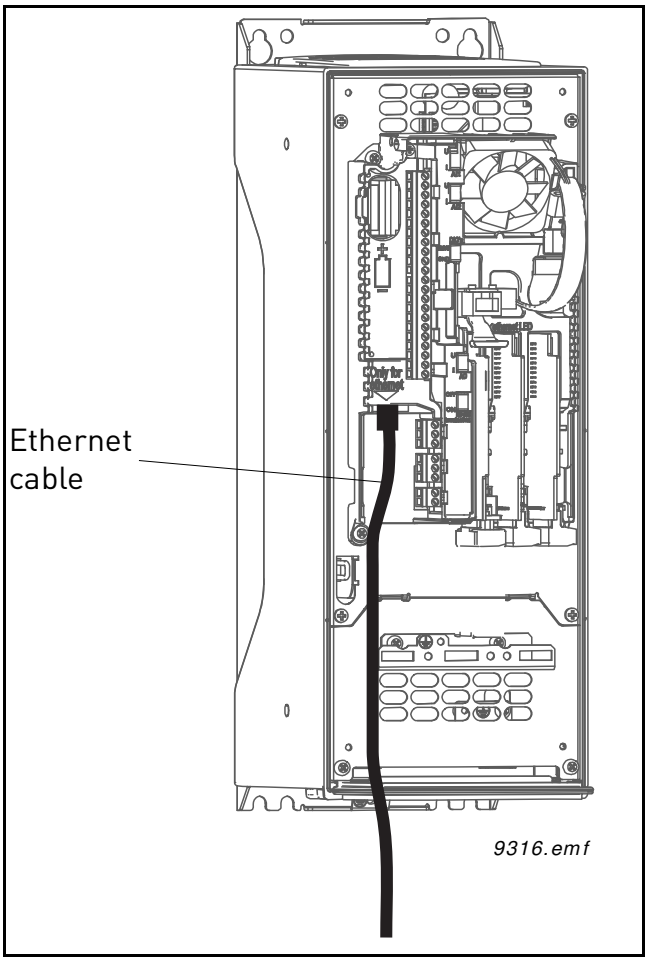

Figure 2.

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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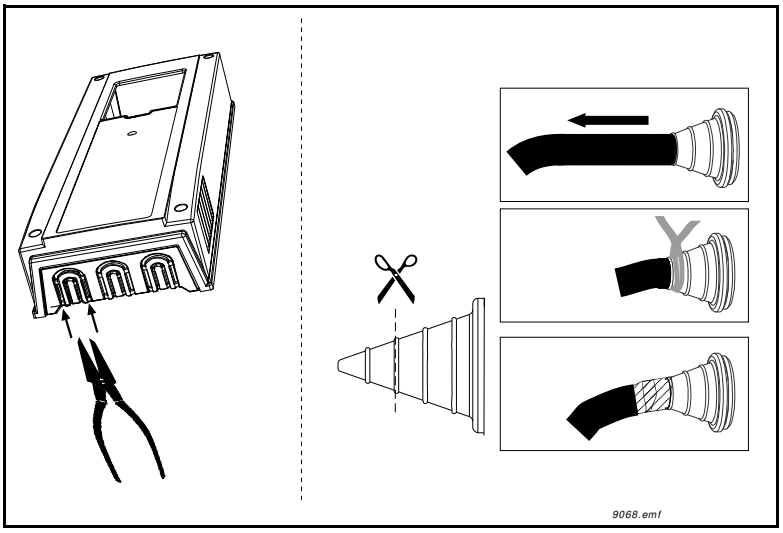


Figure 3. Leading the cables, left: IP21, right: IP54

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**.

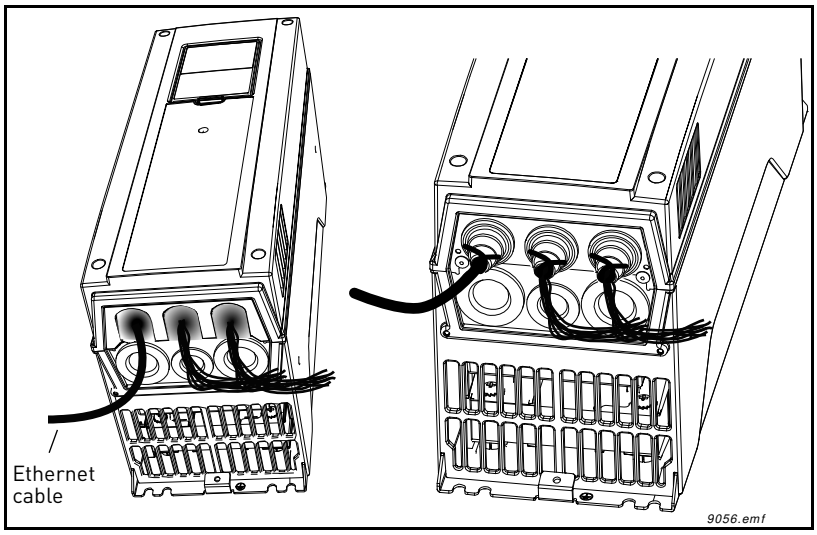
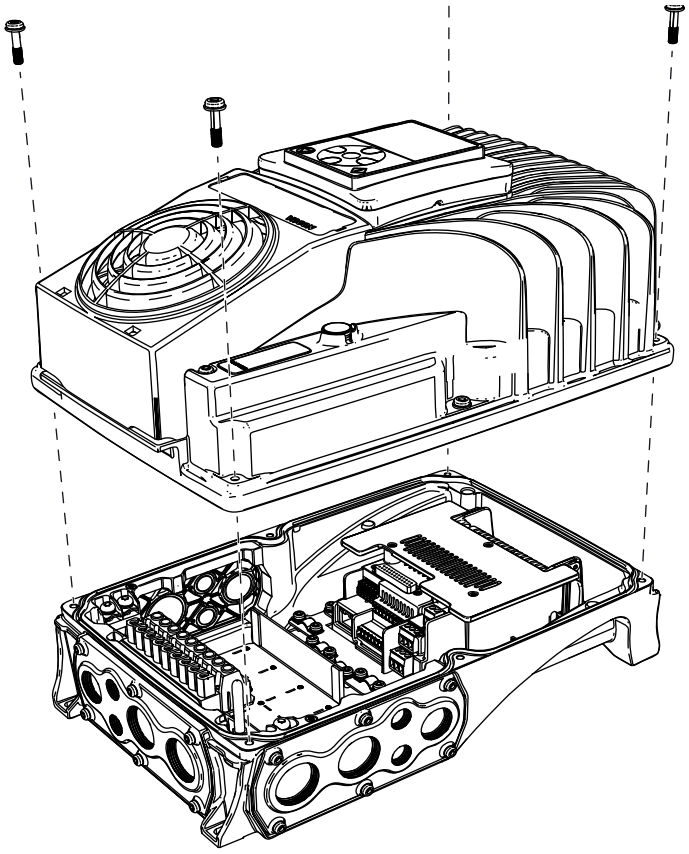
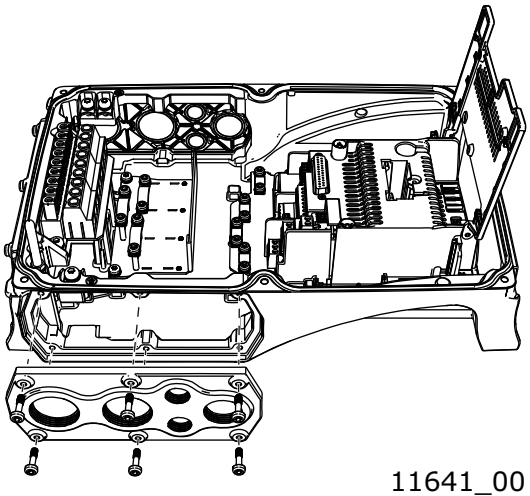


Figure 4.

3.3 INSTALLATION IN VACON® 100 X

1	Open the cover of the AC drive.  11638_00
2	Remove the cable entry plate. **NOTE!** The cable entry plate at the bottom of the drive is used only for mains and motor cables.  11641_00
3	Open the necessary holes in the cable entry plate. Do not open the other holes. See the VACON ® 100X Installation Manual for the dimensions of the holes.

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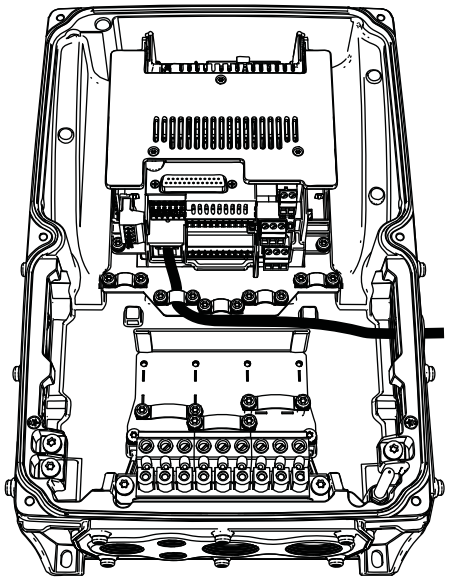
4	Attach a cable gland on the hole in the cable entry plate. Pull the EtherNet cable through the hole.  11739_00
5	Put the cable entry plate back.
6	Close the cover of the AC drive.

4. COMMISSIONING

The integrated EtherNet/IP protocol in the VACON® 100 Family AC 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.).

Basic information on how to use the control keypad you can find in the VACON 100 INDUSTRIAL Application Manual. See chapter 10 for information on how to configure the VACON ® 100 drive to be controlled from fieldbus.

4.1 ETHERNET COMMON SETTINGS

Table 3. EtherNet common settings

Panel Tree	Parameter	Range	Default	ID	Description
P5.9.1.1	IP address mode	Fixed (1), DHCP(2)	DHCP(2)	2482	IP Mode
P5.9.1.2	Duplicate IP Detection	Disabled (0), Enabled (1)	enabled	2569	This is setting for enabling ACD (See Chapter 2.1.1). When disabled drive does not check for or react to address conflict situation.
P5.9.1.3.1	IP address	1.0.0.0 - 223.255.255.255	192.168.0.10	2529	Fixed IP address
P5.9.1.3.2	Subnet mask	0.0.0.0- 255.255.255.255	255.255.0.0	2530	Fixed Subnet mask
P5.9.1.3.3	Default gateway	0.0.0.0- 255.255.255.255	192.168.0.1	2531	Fixed default gateway
P5.9.1.4	Active IP address	-	-	2483	Shows current active IP address. It is same as fixed value if IP mode is "Fixed".
P5.9.1.5	Active subnet mask	-	-	2484	Shows current active subnet mask. It is same as fixed value if IP mode is "Fixed".
P5.9.1.6	Active default gateway	-	-	2485	Shows current active default gateway. It is same as fixed value if IP mode is "Fixed".
P5.9.1.7	MAC address	-	-	2486	Drive MAC address

4.1.1 IP ADDRESS MODE

The selectable alternatives are DHCP (Dynamic Host Configuration Protocol) and Fixed. DHCP protocol gives IP addresses to new devices connecting to the local network. If the AC drive is unable to retrieve its IP settings, it will set a link-local address as the current IP address after about one minute (for example 169.x.x.x).

A fixed IP address is specified manually and it does not change. When the mode is changed from DHCP to Fixed the fixed addresses are taken into use:

IP: 192.168.0.10

Subnet mask: 255.255.0.0

Default gateway: 192.168.0.1

4.1.2 FIXED IP ADDRESS, SUBNET MASK AND DEFAULT GATEWAY

IP is divided into 4 parts. (Part = Octet). Changing these values does not have any effect if the current IP mode is "DHCP". The values will become active when the mode is changed to "fixed IP". When these values are changed and the mode is "fixed IP", the changes are taken into use immediately.

Subnet Mask marks all the bits of an IP address for the identification of the network and the sub-network.

Gateway address is the IP address of a network point that acts as an entrance to another network.

4.1.3 ACTIVE IP ADDRESS, SUBNET MASK AND DEFAULT GATEWAY

These values cannot be changed. If IP mode is "fixed" then it will display same value as in Fixed IP address (5.3.3). If mode is "DHCP", the value is 0.0.0.0 when DHCP is retrieving IP settings or 169.x.x.x if it could not retrieve an address. Otherwise it shows currently active IP address.

4.1.4 MAC ADDRESS

The MAC address of the control board. MAC address (Media Access Control) is a unique address given to each network host. It is not editable.

4.2 ETHERNET/IP PARAMETERS

Table 4. 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" (1), "21" (2), "23" (3), "25" (4), "101" (5), "111" (6), "128" (7), "131" (8)	2418_d	Ethernet/IP input assembly instance. See Chapter 8.

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Table 4. Parameters Menu

#	Name	Default	Range / Accepted Values	ID	Definition
3	Input Instance	71	"70" (1), "71" (2), "73" (3), "75" (4), "107" (5), "117" (6), "127" (7), "137" (8)	2419_d	Ethernet/IP input assembly instance. See Chapter 8.
4	Communication Timeout	10	0...65535	2420_d	Communication timeout in seconds

4.2.1 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 minutes. 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).

4.2.2 OUTPUT INSTANCE

Defines which output instance is used (for incoming data to the drive). For details see Chapter 8..

4.2.3 INPUT INSTANCE

Defines which input instance is used (for outgoing data from the drive). For details see Chapter 8.

4.2.4 COMMUNICATION TIMEOUT

It defines how much time can pass from the last received message from the Master Device before a fieldbus fault is generated. For EtherNet/IP this value is considered as an additional timeout. The protocol itself has timeout mechanism (Requested Packet Interval (RPI) multiplied by Connection Timeout Multiplier (CTM)). When it notices that the connection has been lost, a fault activation is started. If communication timeout value is zero, the fault is activated immediately, otherwise the fault activates after a specified time. If the connection is reopened before the specified time has elapsed, no fault is activated.

4.3 ETHERNET/IP MONITORING MENU

Table 5. Monitoring Menu

#	Name	Type / Values	ID	Definition
1	Reset Counters	"Button"	2421_d	Resets monitoring counters.

Table 5. Monitoring Menu

#	Name	Type / Values	ID	Definition
2	Open Requests	16 bit	2422_d	For details, see Instance Attribute "Open Requests" in Table 14.
3	Open Format Rejects	16 bit	2423_d	For details, see Instance Attribute "Open Format Rejects" in Table 14.
4	Open Resource Rejects	16 bit	2424_d	For details, see Instance Attribute "Open Resource Rejects" in Table 14.
5	Open Other Rejects	16 bit	2425_d	For details, see Instance Attribute "Open Other Rejects" in Table 14.
6	Close Requests	16 bit	2426_d	For details, see Instance Attribute "Close Rejects" in Table 14.
7	Close Format Rejects	16 bit	2427_d	For details, see Instance Attribute "Close Format Rejects" in Table 14.
8	Close Other Rejects	16 bit	2428_d	For details, see Instance Attribute "Close Other Rejects" in Table 14.
9	Connection Timeouts	16 bit	2429_d	For details, see Instance Attribute "Connection Timeouts" in Table 14.
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.
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.

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5. EtherNet/IP connection example

Preparing the connection

1. Set the EtherNet/IP as the active protocol from the panel parameters.
2. Set proper IP addresses.
3. Open a connection with the settings described in the table below.
4. Before trying to run motor, see Chapter 10 "APPENDIX 2 - FIELDBUS PARAMETRISATION" for information how to configure the drive.

Table 6.

Description	Instance	Size
Configuration instance	103_d / 67_h	0
Output instance	21_d / 15_h	4
Input instance	71_d / 47_h	4

1. Set control word to 0x0 (00000000)
2. Set control word to 0x61 (01100001) (NetRef, NetCtrl and Run Fwd enabled)
3. Drive status is: RUN
4. Set speed reference to 0x05EE (=25%)
5. Actual speed is 0x05EE (= 25% if MinFreq is 0Hz and MaxFreq is 50Hz)
6. Set control word 0x60 (01100000)
7. Drive status is: STOP

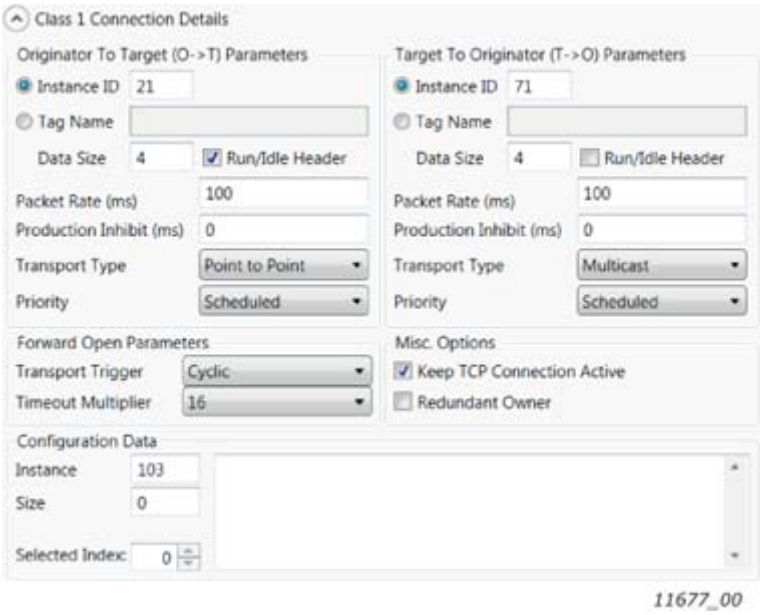

Figure 5. Configuration example from EIPScan Tool

6. EtherNet/IP

6.1 Overview

The EtherNet/IP (Ethernet/Industrial Protocol) is a communication system suitable for use in industrial environments. The 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 c ontrollers, welders, and process controllers.

The EtherNet/IP uses CIP (Control and Information Protocol), the common network, transport and application layers also shared by ControlNet and EtherNet/IP. The 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.

The 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 the TCP protocol.
- Implicit (I/O Data) Connections are established to move application specific I/O Data at regular intervals. They are often set up as one-to-many relationships in order to take full advantage of the producer-consumer multicast model. Implicit messages are sent through the UDP protocol.

6.2 AC/DC Drive Profile

VACON® 100 Family AC drives implement the CIP AC/DC drive profile.

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

- exhibit the same behaviour
- 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.

6.3 EDS file

You can provide configuration support for your device by using a specially formatted ASCII file, referred to as the EDS (Electronic Data Sheet). An EDS provides information about the device configuration.

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.

You can download the EDS for VACON® 100 Family AC drives from Danfoss website (http://drives.danfoss.com).

6.4 EXPLICIT MESSAGING

Explicit Messaging is used in commissioning and parameterizing of the EtherNet/IP.

The explicit messages provide multipurpose, point-to-point communication paths between two devices. They provide the typical request/response-oriented network communication used to perform node configuration and problem diagnosis. The 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, the Explicit Messages should not be used to control the Output Data. However this restriction does not apply for the IO Data reading.

6.4.1 LIST OF DATA TYPES

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

Table 7. EtherNet/IP datatypes

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	$2^{64} - 1$
REAL	Floating Point	32	See IEEE 754	
LREAL	Long Floating Point	64	See IEEE 754	
STRING *	Character string (1 octet per char.)	N		
SHORT_STRING *	Character string (1 octet per char., 1 octet length 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		

* ISO/IEC-8859-1 encoding.

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6.4.2 General CIP error codes

The table below contains the error codes used by EtherNet/IP.

Table 8. General CIP error codes

Code	Status name	Description
0	Success	Service was successfully performed by the object specified.
1	Connection failure	A connection related service failed along the connection path.
2	Resource unavailable	Resources needed for the object to perform the requested service were unavailable.
3	Invalid parameter value	See Status Code 0x20, which is the preferred value to use for this condition.
4	Path segment error	The path segment identifier or the segment syntax was not understood by the processing node.
5	Path destination unknown	The path is referencing an object class, instance or structure element that is not known or is not contained in the processing node.
6	Partial transfer	Only part of the expected data was transferred.
8	Service not supported	The requested service was not implemented or was not defined for this Object Class/Instance.
9	Invalid attribute value	Invalid attribute data detected.
12_d / $0C_h$	Object state conflict	The object cannot perform the requested service in its current mode/state.
14_d / $0E_h$	Attribute not settable	A request to modify a non-modifiable attribute was received.
15_d / $0F_h$	Privilege violation	A permission/privilege check failed.
16_d / 10_h	Device state conflict	The device's current mode/state prohibits the execution of the requested service.
17_d / 11_h	Reply data too large	The data to be transmitted in the response buffer is larger than the allocated response buffer.
19_d / 13_h	Not enough data	The service did not supply enough data to perform the specified operation.
20_d / 14_h	Attribute not supported	The attribute specified in the request is not supported.
21_d / 15_h	Too much data	The service supplied more data than was expected.
30_d / $1E_h$	Embedded service error	An embedded service resulted in an error.
31_d / $1F_h$	Vendor specific error	A vendor specific error has been encountered. The Additional Code Field of the Error Response defines the particular error encountered.
32_d / 20_h	Invalid parameter	A parameter associated with the request was invalid.
38_d / 26_h	Path Size Invalid	The size of the path which was sent with the Service Request is either not large enough to allow the Request to be routed to an object or too much routing data was included.

Table 8. General CIP error codes

Code	Status name	Description
29_h	Member not settable	A request to modify a non-modifiable member was received.
46_d / $2E_h$	Service Not Supported for Specified Path	The object supports the service, but not for the designated application path (e.g. attribute).

6.4.3 CONNECTION MANAGER OBJECT ERROR CODES

These are the extended status codes used when the general status code is 1.

Table 9. Connection Manager Object Error codes

Extended Status	Descriptions
256_d / 100_h	Connection in use or duplicate forward open
259_d / 103_h	Transport class and trigger combination not supported
262_d / 106_h	Ownership conflict
263_d / 107_h	Target connection not found
264_d / 108_h	Invalid network connection parameter
265_d / 109_h	Invalid connection size
272_d / 110_h	Target for connection not configured
273_d / 111_h	RPI not supported
274_d / 112_h	RPI value(s) not acceptable
275_d / 113_h	Out of connections
276_d / 114_h	Vendor id or product code mismatch
277_d / 115_h	Product type mismatch
278_d / 116_h	Revision mismatch
279_d / 117_h	Invalid produced or consumed application path
280_d / 118_h	Invalid or inconsistent configuration application path
281_d / 119_h	Non-listen only connection not opened
283_d / $11B_h$	RPI is smaller than the production inhibit time
294_d / 126_h	Invalid configuration size
295_d / 127_h	Invalid originator to target size
296_d / 128_h	Invalid target to originator size
297_d / 129_h	Invalid configuration application path
298_d / $12A_h$	Invalid consuming application path
299_d / $12B_h$	Invalid producing application path
306_d / 132_h	Null forward open function not supported
517_d / 205_h	Parameter error in unconnected request service

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Table 9. Connection Manager Object Error codes

Extended Status	Descriptions
789_d / 315_h	Invalid segment in connection path
Range 320h – 7FFh are vendor specific	
800_d / 320_h	Internal: Connection disabled
64258_d / $FB02_h$	Internal: Bad socket
64259_d / $FB03_h$	Internal: Bad originator to target net parameter
64260_d / $FB04_h$	Internal: Bad target to originator net parameter
64261_d / $FB05_h$	Internal: Bad UDP port
64262_d / $FB06_h$	Internal: Join multicast
64263_d / $FB07_h$	Internal: Prepare IO packet
64267_d / $FB0B_h$	Internal: Consumption
64268_d / $FB0C_h$	Internal: FW close
64270_d / $FB0E_h$	Internal: Adapter stopped

6.4.4 Supported CIP and Vendor Objects

The Communication Interface supports the following object classes.

Table 10. CIP Objects

Type	Class	Object	Details
Required by Ether-Net/IP	1	Identity Object	See chapter 7.1.1
	2	Message Router Object	See chapter 7.1.2
	4	Assembly Object	See chapter 7.2.1
	6	Connection Manager Object	See chapter 7.1.3
	245_d / $F5_h$	TCP/IP Interface Object	See chapter 7.1.4
	246_d / $F6_h$	Ethernet Link Object	See chapter 7.1.5
Required by Drive Profile	40_d / 28_h	Motor Data Object	See chapter 7.2.2
	41_d / 29_h	Control Supervisor Object	See chapter 7.2.3
	42_d / $2A_h$	AC/DC Drive Object	See chapter 7.2.4
Vendor-Specific	160_d / $A0_h$	Vendor Parameters Object	See chapter 7.3.1
	161_d / $A1_h$	Motor Control Mode Object	See chapter 7.3.3
	162_d / $A2_h$	Fault History Object	See chapter 7.3.4
	190_d / BE_h	Assembly Instance Selector Object	See chapter 7.3.2

6.4.5 ETHERNET/IP COMMUNICATION AND CONNECTION TIMEOUT

The EtherNet/IP declares a watchdog the time within which both master and slave must send IO back to each other. This watchdog time is a factor of the communication cycle time (cycle time x timeout multiplier) and is set by the master. Minimum cycle time for VACON 100 EtherNet/IP is 4 milliseconds.

When an IO message is not received within the watchdog time, the timeout setting value is activated and a fault is created after it elapses. This means that the panel parameter "Communication timeout" (refer to chapter 4.2.4) is used as an additional timeout value. The same logic applies if a connection is closed or the cable disconnects (link loss).

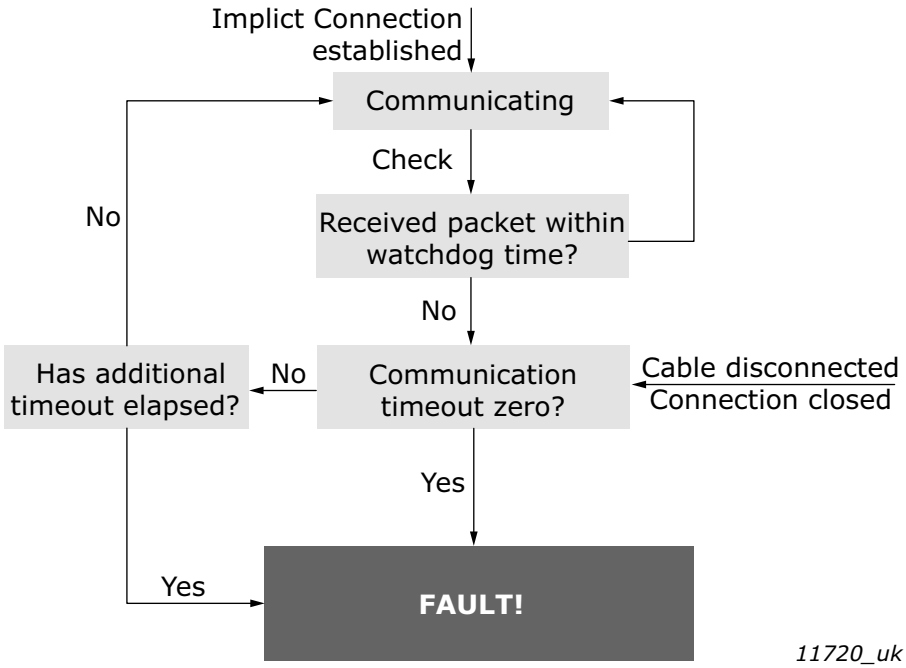

Figure 6. EtherNet/IP timeout logic with implicit connection (IO connection)

The explicit connections (TCP connection where PLC/user reads and writes data via CIP objects) will generate fieldbus fault only if that connection has been used to write process data over Assembly, Control Supervisor or AC/DC object. The explicit connection timeout is defined with TCP/IP Object's attribute 13d "Encapsulation Inactivity Timeout".

We recommend that implicit connection is used for motor control and explicit connections for "service data".

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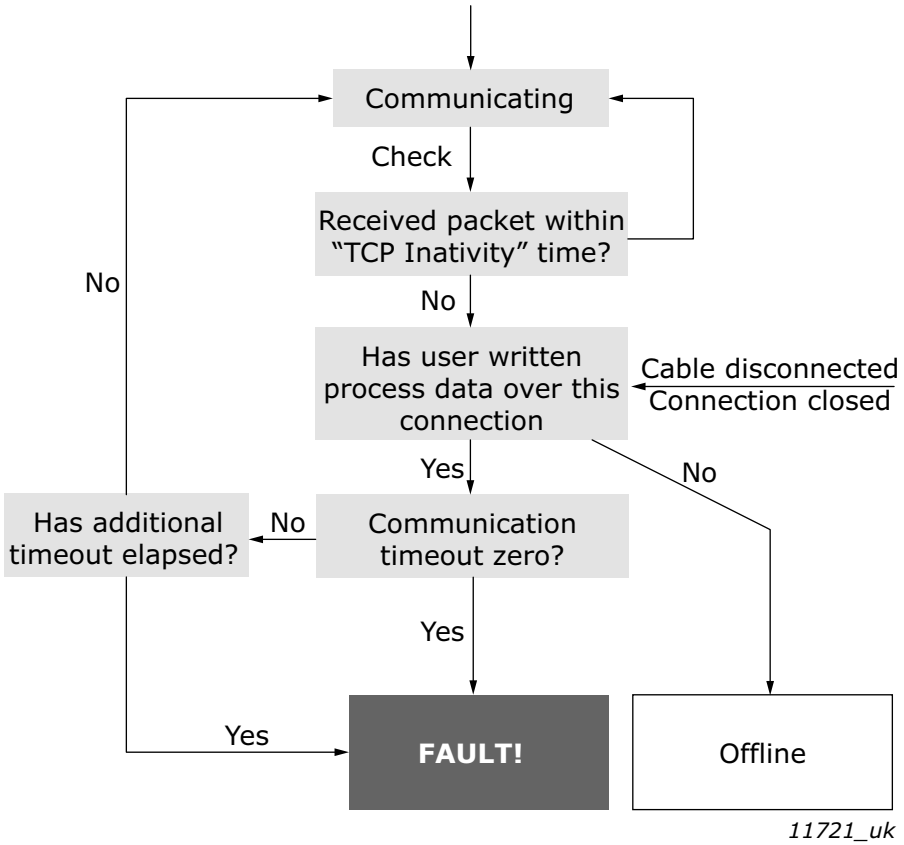

Figure 7. EtherNet/IP timeout logic with explicit connection

7. COMMON INDUSTRIAL OBJECTS IMPLEMENTED BY VACON® 100 FAMILY

7.1 CIP COMMON REQUIRED OBJECTS

7.1.1 IDENTITY OBJECT, CLASS 0X01

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

Table 11. Identity Object

Class name		Identity Object			
Class identifier		1			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	Revision	UINT	Class revision (1)
	2	Get	Max Instance	UINT	Maximum instance number (1)
	3	Get	Number of Instances	UINT	Number of object instances(1)
Class Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Get all attributes	
	14_d $0E_h$	Get_Attribute_Single		Get single attribute	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	Vendor ID	UINT	Vendor identification
	2	Get	Device Type	UINT	General type of product
	3	Get	Product Code	UINT	Product identification
	4	Get	Revision	STRUCT of	Revision of the item the Identity Object represents
			Major Revision	USINT	
			Minor Revision	USINT	
	5		Status	WORD	Summary status of device
	6		Serial number	UDINT	Serial number of the device
	7		Product Name	SHORT STRING	Human readable identification
Instance Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Get all attributes	
	5	Reset		Only reset type 0	
	14_d $0E_h$	Get_Attribute_Single		Get single attribute	

7.1.1.1 Instance Attributes

Instance Attribute "Vendor ID"

This number is assigned to vendors of CIP devices by the ODVA user organization. The vendor ID for VACON® is $01BB_h(443_d)$.

Instance Attribute "Device Type"

This attribute indicates which device profile is implemented by the device. For VACON® drives this device number is 02_h("AC Drive" profile).

Instance Attribute "Product Code"

This attribute reveals the vendor-assigned product code for a particular product within a device type.

Separate products must have different product codes if their configuration and/or runtime options are different.

The AC drive will return the product code value $64_h(100_d)$.

Instance Attribute "Revision"

This attribute, which consists of the Major and Minor Revision fields, identifies the revision of the item/ device that the Identity Object is representing. 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 value of the attribute presents the current status of the entire device. The coding of the field is defined in the table below.

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Table 12. Status bit descriptions

Bit(s)	Called	Definition	
0	Owned	TRUE, if device has owner	
1		Reserved, is zero	
2	Configured	TRUE, if device has been configured (always true)	
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	The Status attribute is not applicable to this instance. Valid only for instances greater than one (1).
		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, if 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	

The VACON® 100 Family AC drives drive implement bits 0, 2, and 4-11 according to the specification (Extended Device Status values 1, 4 and 8 to 15 are not used by VACON®). The bits 8-11 must be set according to the faults occurring in the drive.

Instance Attribute "Serial Number"

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 so that the first octet is 00 and the last 3 octets are taken from the end of the MAC address of the drive. For example, when the MAC address is 00:21:99:AA:BB:CC, then the serial number would be 00AABBCCh.

Instance Attribute "Product Name"

This attribute contains human readable name identification for this instance. The value returned is "VACON® 100".

7.1.1.2 Services

Instance Service "Reset"

The VACON® 100 Family AC drives support only reset type 0.

The reset type 0 means that the device represented by the Identity Object will as closely as possible emulate the cycling of power.

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

7.1.2 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.

The VACON® 100 Family AC drives do not currently implement any of the object's services or attributes

Table 13. Message router object

Class name		Message Router Object			
Class identifier		2			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	-	-	-	-	-
Class Services	**Id**	**Name**		**Description**	
	-	-		-	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	-	-	-	-	-
Instance Services	**Id**	**Name**		**Description**	
	-	-		-	

7.1.3 CONNECTION MANAGER OBJECT, CLASS 0X06

The communication characteristics between the applications in different devices are modelled 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 the aspects of Connection object instances.

The Connection Manager class allocates and manages the internal resources associated with both I/O and Explicit Messaging connections.

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Table 14. Connection manager object

Class name		Connection Manager Object			
Class identifier		6			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	Revision	UINT	Class revision (1)
	2	Get	Max Instance	UINT	Maximum instance number (1)
	3	Get	Number of Instances	UINT	Number of object instances(1)
Class Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the class.	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	Open Requests	UINT	Number of Forward Open service requests received.
	2	Get	Open Format Rejects	UINT	Number of Forward Open service requests which were rejected due to bad format.
	3	Get	Open Resource Rejects	UINT	Number of Forward Open service requests which were rejected due to lack of resources.
	4	Get	Open Other Rejects	UINT	Number of Forward Open service requests which were rejected for other reasons.
	5	Get	Close Requests	UINT	Number of Forward Close service requests received.
	6	Get	Close Format Rejects	UINT	Number of Forward Close service requests which were rejected due to bad format.
	7	Get	Close Other Rejects	UINT	Number of Forward Close service requests which were rejected for other reasons
	8	Get	Connection Timeouts	UINT	Total number of connection timeouts that have occurred in connections controlled by this Connection Manager.

Table 14. Connection manager object

	Id	Name	Description
Instance Services	1	Get_Attributes_All	Returns content of all (implemented) attributes in the instance
	14_d $0E_h$	Get_Attribute_Single	Used to read the single attribute value
	78_d $4E_h$	Forward_Open	Opens a connection (maximum data size is 511 bytes)
	84_d 54_h	Forward_Close	Closes a connection

7.1.3.1 Services

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 minimum time for the RPI (Request Packet Interval) is 4 ms. The 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).

7.1.4 TCP/IP Interface Object, Class oxF5

The TCP/IP Interface Object provides an interface to configure the device's TCP/IP settings. With this object, you can configure, for example, the device's IP address, network mask and so on.

Table 15. TCP/IP interface object

Class name		TCP / IP object			
Class identifier		245_d / $F5_h$			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	Revision	UINT	Class revision (4)
	2	Get	Max Instance	UINT	Maximum instance number (1)
	3	Get	Number of Instances	UINT	Number of object instances(1)
Class Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the class.	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	

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Table 15. TCP/IP interface object

	Id	Access rule	Name	Datatype	Description
Instance Attributes	1	Get	Status	DWORD	Interface status
	2	Get	Configuration Capability	DWORD	Interface capability flags
	3	Get/set	Configuration Control	DWORD	Interface control flags
	4	Get	Physical Link Object	STRUCT of	Path to physical link object
			Path size	UINT	Size of the path
			Path	Padded EPATH	Logical segments identifying the physical link object
	5	Get/set	Instance Configuration	STRUCT of	TCP/IP network interface configuration
			IP Address	UDINT	The device's IP address
			Network Mask	UDINT	The device's network mask
			Gateway Address	UDINT	Default gateway address
			Name Server	UDINT	Primary name server
			Name Server 2	UDINT	Secondary name server
			Domain Name	STRING	Default domain name
	6	Get/set	Host Name	STRING	Host name
	10_d / $0A_h$	Get/set	Select ACD	BOOL	Activates the use of ACD (enabled by default)
	11_d / $0B_h$	Get	Last Conflict Detected	STRUCT of:	Structure containing information related to the last conflict detected.
			ACD activity	USINT	State of ACD activity
			Remote MAC	Array of 6 USINT	MAC address of last conflict source.
			ARP PDU	Array of 28 USINT	Copy of the last ARP PDU in which a conflict was detected.
Instance Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the instance	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
	16_d 10_h	Set_Attribute_Single		Used to write a single attribute value.	

7.1.4.1 Instance Attributes

Instance Attribute "Status"

This attribute presents the status of the TCP/IP network interface.

Table 16. Status Bit Descriptions

Bit(s)	Called	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"

This attribute presents the capability flags (that is, the support for the optional network configuration capability) of the TCP/IP network interface.

Table 17. Configuration capability bit descriptions

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

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Instance Attribute "Configuration Control"

This attribute allows control of the TCP/IP network interface configuration.

When using the Configuration Control attribute, the device can be configured to use statically assigned IP values or DHCP. If the value is changed from DHCP to statically assigned, the device will continue using the current IP address. When changing from statically assigned to DHCP, the drive will try to get an IP address from the DHCP server. If this fails, the communication with the drive cannot be re-opened and you must set the IP address manually from the panel or enable the DHCP server in the network.

Changing the Configuration Control is not allowed if the I/O connection is open.

Table 18. Configuration control bit descriptions

<table>
<tr><th>Bit(s)</th><th>Called</th><th colspan="2">Definition</th></tr>
<tr><td rowspan="5">0-3</td><td rowspan="5">Configuration Method</td><td rowspan="5">Determines how the device obtains its IP related configuration</td><td>Value</td><td>Definition</td></tr>
<tr><td>0</td><td>The device uses statically-assigned IP configuration values.</td></tr>
<tr><td>1</td><td>The device obtains its interface configuration values via BOOTP</td></tr>
<tr><td>2</td><td>The device obtains its interface configuration values via DHCP</td></tr>
<tr><td>3-15</td><td>Reserved for future use.</td></tr>
<tr><td>4</td><td>DNS Enable</td><td colspan="2">If TRUE, the device resolves host names by querying a DNS server</td></tr>
<tr><td>5-31</td><td>Reserved</td><td colspan="2">Reserved, always zero</td></tr>
</table>

In the VACON® 100 Family AC drives, the value of the Configuration Control is 0, when the "IP Address Mode" panel parameter is "Fixed IP". If the "IP Address Mode" is "DHCP", the value of the Configuration Control is 2.

The VACON® 100 Family AC drives do not support BOOTP or DNS.

Instance Attribute "Physical Link Object"

This attribute identifies the object which is associated with the underlying physical communications interface (in the case of Ethernet, for example, the 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 the VACON® 100 Family AC drives, the path points to an instance of the EtherNet Link Object. The value of the 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"

This attribute 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), the values in the Interface Configuration are those statically assigned and stored in the non-volatile memory. If the device uses DHCP (or BOOTP) (Configuration Method value is 1 or 2), the Interface Configuration values will contain the

configuration obtained through this channel. Until the BOOTP/DHCP reply is received, the values are 0.

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

The IP address, Network Mask and Gateway address consists of four bytes. For example, the IP address 192.168.0.10 would be in format: $C0_h$, $A8_h$, 00_h, $0A_h$.

Table 19. Instance configuration

Interface Configuration	STRUCT of:	Description	Semantics 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 must be set to a valid Class A, B, or C address and must 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 must be set to a valid Class A, B, or C address and must 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 must be set to a valid Class A, B, or C address.
Name Server 2	UDINT	Secondary name server	Value of 0 indicates no secondary name server address has been configured. Otherwise, the name server address must be set to a valid Class A, B, or C address.
Domain Name	STRING	Default domain name	ASCII characters. Maximum length is 48 characters. Must be padded to an even number of characters (pad not included in length). A length of 0 indicates that no Domain Name is configured.

Instance Attribute "Host Name"

This attribute contains the device's host name. The maximum length is 64 ASCII characters. The name is padded to an even number of characters. The Attribute Host Name is used only for information purpose.

Instance Attribute "Select ACD"

This attribute is used to enable or disable ACD (Address Conflict Detection) functionality.

For more information see chapter 2.1.1.

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Instance Attribute "Last Conflict Detected"

This attribute contains information of the last IP address conflict. The content of this attribute can be resetted by writing zero to this attribute.

The struct member "ACD Activity" tells the state of ACD algorithm when the last conflict was detected. Possible values are defined in the table below.

Table 20. ACD Activity values

Value	ACD Mode	Description
0	No conflict detected (default)	No conflict has been detected since this attribute was last cleared.
1	Probe IPV4 address	Last conflict detected during IPV4 address probe state
2	Ongoing detection	Last conflict detected during OngoingDetection-state or subsequent DefendWithPolicyB state
3	Semi active probe	Last conflict detected furint SemiActiveProbe-state or subsequent DefendWithPolicyB-state

The struct member "Remote MAC" tells the MAC address the source of the last IP address conflict.

The struct member "ARP PDU" contains the ARP message (raw copy) received from the source of the IP address conflict. Content of the ARP message is described in the table below.

Table 21. The ARP PDU in binary format

Field size (bytes)	Field Description
2	Hardware type (1 for Ethernet HW)
2	Protocol type (0x800 for IP)
1	Hardware size (6 for Ethernet HW)
1	Protocol size (4 for IP)
2	Operation code (1 for request or 2 for response)
6	Sender MAC address
4	Sender IP address
6	Target MAC address
4	Target IP address

Instance Attribute "Encapsulation Inactivity Timeout"

The Encapsulation Inactivity Timeout attribute is used to enable the TCP socket cleanup (closing) when the defined number of seconds have elapsed with no Encapsulation activity. The default value is 120 seconds. The TCP keep-alive traffic does not count as Encapsulation activity.

Table 22.

Value	Description
0	Disable
1-3600	Timeout in seconds

7.1.5 ETHERNET LINK OBJECT, CLASS OXF6

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

Table 23. Ethernet Link Object

Class name		Ethernet Link Object			
Class identifier		246_d / $F6_h$			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	Revision	UINT	Class revision (4)
	2	Get	Max Instance	UINT	Maximum instance number (1)
	3	Get	Number of Instances	UINT	Number of object instances(1)
Class Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the class.	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	

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Table 23. Ethernet Link Object

	Id	Access rule	Name	Datatype	Description
Instance Attributes	1	Get	Interface Speed	UDINT	Interface speed currently in use
	2	Get	Interface Flags	DWORD	Interface status flags
	3	Get	Physical Address	ARRAY of 6 USINTs	MAC layer address
	4	Get	Interface Counters	STRUCT of 11 UDINTs	Interface counters. See Table 25
	5	Get	Media Counters	STRUCT of 12 UDINTs	Media specific counters. See Table 26
	7	Get	Interface Type	USINT	Type of interface: twisted pair, fiber, internal, etc
	8	Get	Interface State	USINT	Current state of the interface: operational, disabled, etc
	9	Get/Set	Admin State	USINT	Administrative state: enable, disable
	10_d $0A_h$	Get	Interface Label	SHORT STRING	Human readable identification
Instance Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the instance	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value	
	16_d 10_h	Set_Attribute_Single		Used to write a single attribute value.	
	76_d $4C_h$	Get_and_Clear		Gets then clears the specified attribute (Interface Counters, Media Counters). Not instance/class dependent service.	

7.1.5.1 Instance Attributes

Instance Attribute "Interface Speed"

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 value 0 indicates that the interface speed is indeterminate.

Instance Attribute "Interface Flags"

The attribute contains status and configuration information about the physical interface.

Table 24. Interface flag bit descriptions

Bit(s)	Called	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 automatically activate changes to link parameters (auto-negotiate, duplex mode, interface speed). 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 attribute reveals the MAC layer address of the physical interface.

Instance Attribute "Interface Counters"

The attribute is a collection of counters related to the Ethernet physical interface. Only packets sent or received by the device itself are counted.

Table 25. Interface counters

Field name	Data type	Description
In Octets	UDINT	The number of octets received on the interface (including framing characters).
In Unicast Packets	UDINT	The number of unicast packets received on the interface.
In NonUnicast Packets	UDINT	The number of non-unicast packets received on the interface.
In Discards	UDINT	Inbound packets received on the interface but which were discarded.

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Table 25. Interface counters

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

Instance Attribute "Media Counters"

The attribute is a collection of counters related to the Ethernet physical interface.

Table 26. Media counters

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

Table 26. Media counters

Field name	Data type	Description
MAC Receive Errors	UDINT	Frames for which reception on an interface fails due to an internal MAC sub layer receive error.

Instance Attribute "Interface Type"

The attribute indicates the type of the Ethernet interface, i.e. twisted-pair cable, optical fiber, device-internal etc. The AC drive will always return the value 2, twisted-pair cable.

Instance Attribute "Interface State"

The attribute indicates the current state of the Ethernet interface, i.e. operational, disabled etc.

Table 27. Interface state

Value	Interface state
0	Unknown interface state
1	The interface is enabled and is ready to send and receive data
2	The interface is disabled
3	The interface is testing
4-255	Reserved

Instance Attribute "Admin State"

The attribute indicates the ability to use the Ethernet interface for administration, for example, for changing the settings.

The VACON® 100 Family AC 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.

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7.2 OBJECTS PRESENT IN AN AC/DC DRIVE

7.2.1 ASSEMBLY OBJECT, CLASS 0X04

The assembly object groups (or assembles) the attribute values into a single block of data.

Table 28. Assembly object

Class name		Assembly object			
Class identifier		4			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	Revision	UINT	Class revision (2)
	2	Get	Max Instance	UINT	Maximum instance number (137_h)
	3	Get	Number of Instances	UINT	Number of object instances(17)
Class Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the class.	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	3	Set	Data	ARRAY of BYTE	Assembly data
Instance Services	**Id**	**Name**		**Description**	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value	
	16_d 10_h	Set_Attribute_Single		Used to write a single attribute value	

7.2.1.1 Instance Attributes

Instance Attribute "Data"

This attribute can be used to get assembly data. The content and length of the data depends on the configuration of the assembly instance.

7.2.2 MOTOR DATA OBJECT, CLASS 0X28

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

Table 29. Motor data object

Class name	Motor data object
Class identifier	40_d / 28_h

Table 29. Motor data object

Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	-	-	-	-	-
Class Services	**Id**	**Name**		**Description**	
	-	-		-	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	3	Get/Set	MotorType	USINT	Motor type
	6	Get/Set	RatedCurrent	UINT	Rated Stator Current Units: [100mA]
	7	Get/Set	RatedVoltage	UINT	Rated Base Voltage Units: [V]
	9	Get/Set	RatedFreq	UINT	Rated Electrical Frequency Units: [Hz]
	12_d $0C_h$	Get	PoleCount	UINT	Number of poles in the motor.
	15_d $0F_h$	Get/Set	Base Speed	UINT	Nominal speed at rated frequency from nameplate Units: [RPM]
Instance Services	**Id**	**Name**		**Description**	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
	16_d 10_h	Set_Attribute_Single		Used to write a single attribute value.	

7.2.2.1 Instance Attributes

Instance Attribute "MotorType"

The VACON® 100 Family AC 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.

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Instance Attribute "PoleCount"

This attribute allows reading and writing 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

7.2.3 CONTROL SUPERVISOR OBJECT, CLASS 0X29

Control Supervisor Object provides an interface for drive management. You can, for example, start and stop the motor with this object.

Table 30. Control supervisor object

Class name		Control supervisor object			
Class identifier		41_d / 29_h			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	-	-	-	-	-
Class Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the class.	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	

Table 30. Control supervisor object

	Id	Access rule	Name	Datatype	Description
Instance Attributes	3	Get/Set	Run1	BOOL	Run forward
	4	Get/Set	Run2	BOOL	Run reverse
	5	Get/Set	NetCtrl	BOOL	Request Run/Stop control to be local or from network
	6	Get	State	USINT	State. See Table 32.
	7	Get	Running1	BOOL	True, when running forward
	8	Get	Running2	BOOL	True, when running in reverse
	9	Get	Ready	BOOL	True, when Ready or Enabled or Stopping
	10_d $0A_h$	Get	Faulted	BOOL	True, when fault is active
	11_d $0B_h$	Get	Warning	BOOL	True, when warning/alarm is active
	12_d $0C_h$	Get/Set	FaultRst	BOOL	Resets fault when transits from zero to one
	13_d $0D_h$	Get	FaultCode	UINT	If in Faulted-state, FaultCode indicates the active fault. Otherwise last error or zero after startup.
	15_d $0F_h$	Get	CtrlFromNet	BOOL	True, control is from network False, control is local.
	21_d 15_h	Get/Set	NetIdleMode	USINT	Mode on reception of CIP communication IDLE event.
Instance Services	**Id**	**Name**			**Description**
	5	Reset			Resets drive to startup state.
	14_d $0E_h$	Get_Attribute_Single			Used to read single attribute value.
	16_d 10_h	Set_Attribute_Single			Used to write a single attribute value.

7.2.3.1 Instance Attributes

Instance Attribute "Run1"

This attribute affects the run/stop behavior of the drive. See Table 31.

Instance Attribute "Run2"

This attribute affects the run/stop behavior of the drive. See Table 31.

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Table 31. Run/Stop Event Matrix

Run1	Run2	Trigger event	Run type
0	0	Stop	N/A
0 -> 1	0	Run	Run1
0	0 -> 1	Run	Run2
0 -> 1	0 -> 1	No Action	N/A
1	1	No Action	N/A
1 -> 0	1	Run	Run2
1	1 -> 0	Run	Run1

Instance Attribute "NetCtrl"

This attribute allows the network to request the run/stop control to be assigned to the network. If the bit is 0, given control word is not updated to the drive. If the bit is 1, this means that the run/stop control is requested to this network interface.

NOTE! The actual assignment of the run/stop control to this network interface is reflected in attribute 15_d.

The AC drive will not force control to the network. You must change the control location (fieldbus/IO/keypad) from the drive parameters.

Instance Attribute "State"

This attribute reveals the state of the device according to the table below. See also chapter 7.2.3.3.

Table 32. State Value Descriptions

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

Instance Attribute "Running1"

This attribute is used to describe the run state of the drive. The value of the attribute is 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"

This attribute is used to describe the run state of the drive. The value of the attribute is 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"

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"

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"

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"

This attribute is used to reset faults and warnings in the drive. The attribute is write-only. Changing the value of the attribute from 0 to 1 (rising-edge) resets the faults in the drive. If the value is static 0, no reset action is started.

Instance Attribute "FaultCode"

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"

It indicates whether the run/stop control is assigned to the local interface or to this network interface. When the value of the attribute is 0, the control is local. When the value of the attribute is 1, the run/stop control is assigned to the network interface.

Instance Attribute "NetIdleMode"

This attribute establishes the mode of operation on reception of network idle communication. Default value for this attribute is zero. Possible values are listed in the table below.

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Table 33. NetIdleMode values

Mode	Action	Error/Warning
0	Stops motor	Fault
1	Ignored. IO data is not used, drive stays in state which was active before reception of IDLE	-
2	Vendor specific, fieldbus fault is activated (actual behavior depends on drive application and parametrization).	Fault
Other values are not supported		

7.2.3.2 Services

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.

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

7.2.3.3 Control Supervisor State Machine

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

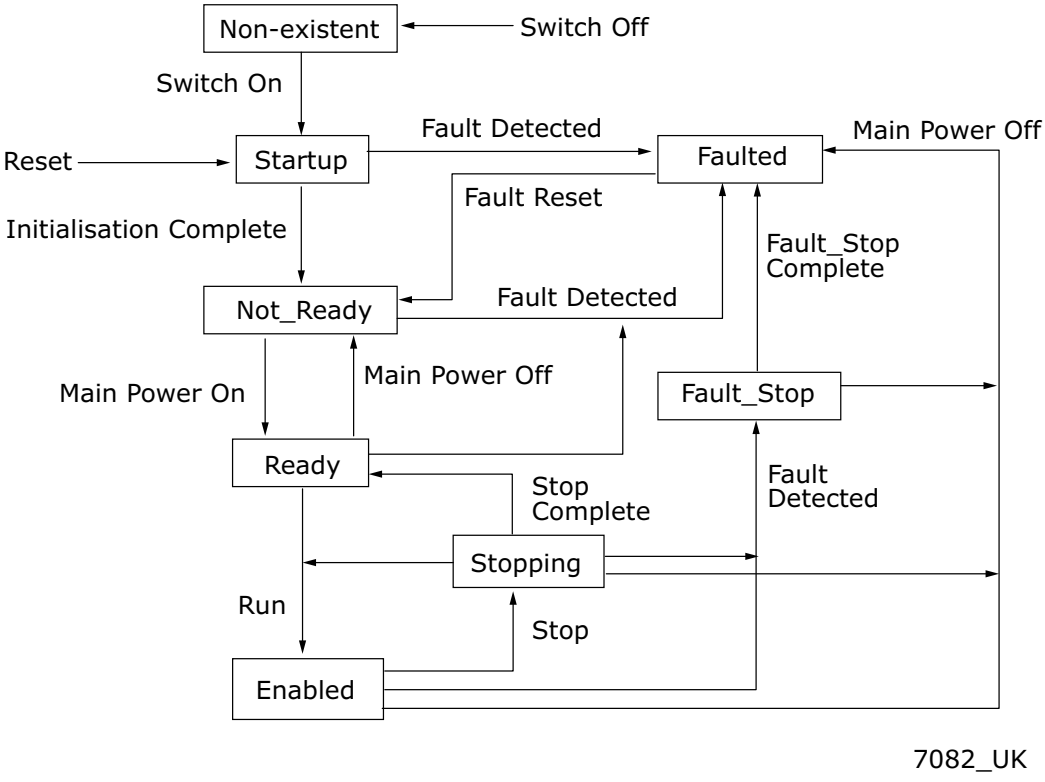

Figure 8. Control Supervisor State Machine

7.2.4 AC/DC Drive Object, Class 0x2A

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

Table 34. AC/DC drive object

Class name		AC/DC drive object			
Class identifier		42_d / $2A_h$			
Class Attributes	**Id**	**Access rule**	**Name**	**Data-type**	**Description**
	-	-	-	-	-
Class Services	**Id**	**Name**		**Description**	
	-	-		-	

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Table 34. AC/DC drive object

	Id	Access rule	Name	Data-type	Description
Instance Attributes	3	Get/Set	AtReference	BOOL	True, when drive actual at reference (speed or torque reference) based on mode
	4	Get/Set	NetRef	BOOL	Requests torque or speed reference to be from the network. False, when Set Reference not DN Control True, when Set Reference at DN Control
	5	Get/Set	NetProc	BOOL	Requests process control reference to be from the network. False, when Set Process not DN Control True, when Set Process at DN Control
	6	Get	DriveMode	USINT	Drive mode. See Table 35.
	7	Get	SpeedActual	INT	Actual drive speed Units: RPM / $2^{SpeedScale}$ where SpeedScale is attribute 22_d
	8	Get	SpeedRef	INT	Speed reference Units: RPM / $2^{SpeedScale}$ where SpeedScale is attribute 22_d
	11_d $0B_h$	Get	TorqueActual	INT	Actual torque Units: Nm / $2^{TorqueScale}$ where TorqueScale is attribute 24_d
	12_d $0C_h$	Get/Set	TorqueRef	INT	Torque reference Units: Nm / $2^{TorqueScale}$ where TorqueScale is attribute 24_d
	13_d $0D_h$	Get	ProcessActual	INT	Actual process control value Units: % ProcessScale is not supported.
	14_d $0E_h$	Get/Set	ProcessRef	INT	Process control reference set point. Units: % ProcessScale is not supported
	22_d 16_h	Get/Set	SpeedScale	SINT	Speed scaling factor. Scaling is accomplished as follows: ScaledSpeed = RPM / $2_{SpeedScale}$ Range: -4 .. 7
	24_d 18_h	Get/Set	TorqueScale		Torque scaling factor. Scaling is accomplished as follows: ScaledTorque = Nm / $2^{TorqueScale}$ Range: -8 .. 7
	29_d $1D_h$	Get	RefFromNet	BOOL	Status of torque/speed reference False, when local torque/speed reference. True, when network torque/speed reference

Table 34. AC/DC drive object

	Id	Name	Description
Instance Services	14_d $0E_h$	Get_Attribute_Single	Used to read single attribute value.
	16_d 10_h	Set_Attribute_Single	Used to write a single attribute value.

7.2.4.1 Instance Attributes

Instance Attribute "AtReference"

This attribute indicates whether the actual value is at the reference value (e.g. the drive actual speed is the same as what is requested in the speed reference). If the bit is 1, the drive actual value is at the reference value.

Instance Attribute "NetRef"

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.

NOTE! The actual assignment of the reference to this network interface is reflected in the attribute 29_d.

Instance Attribute "NetProc"

This attribute is used to request torque or speed reference to be local or from network. Values are:

- 0 = Set reference not DN control
- 1 = Set reference at DN control

Instance Attribute "DriveMode"

Allowed values for Drive Mode defined in the table below.

NOTE! The actual drive mode support depends on the used drive and application. Check the actual drive mode support from the drive application manual.

Table 35. Supported Drive Modes

Value	Name	Supported
0	Vendor-specific mode	Yes (Open loop frequency)
1	Open loop speed	Yes (Open loop speed)
2	Closed loop speed control	Yes (Closed loop speed)
3	Torque control	Yes (Open loop torque)
4	Process control (e.g. PI control)	No
5	Position control	No

Changes to DriveMode attribute must be reflected in the "Motor Control Mode Object". The drive will respond with "Invalid attribute value" status code 0x09, if other values are written.

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Instance Attribute "SpeedActual"

This attribute allows reading of the speed actual value. The unit of the attribute must be (RPM / $2^{SpeedScale}$), where the SpeedScale is attribute 22_d.

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

Instance Attribute "SpeedRef"

This attribute allows reading and writing of the speed reference set point. The unit of the attribute must be (RPM / $2^{SpeedScale}$), where SpeedScale is attribute 22_d.

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

Instance Attribute "TorqueActual"

This attribute allows reading of the torque actual value. The unit of the attribute must be (Nm / $2^{TorqueScale}$), where the TorqueScale is attribute 24_d.

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

Instance Attribute "TorqueRef"

This attribute allows reading and writing of the torque reference set point. The unit of the attribute must be (Nm / $2^{TorqueScale}$), where the TorqueScale is attribute 24_d.

If the TorqueScale attribute is not used by the master, the default unit [1 Nm] must be assumed. This is equivalent to the value 0 being used for TorqueScale. To set the drive to the torque control, see Chapter 10 "APPENDIX 2 - FIELDBUS PARAMETRISATION".

Instance Attribute "ProcessActual"

This attribute allows reading of the process actual value. The unit of the attribute must be (% / $2^{ProcessScale}$), where the ProcessScale is attribute 25_d. The VACON® 100 Family EtherNet/IP does not support ProcessScale.

Instance Attribute "ProcessRef"

This attribute allows reading and writing of the process reference set point. The unit of the attribute must be (% / $2^{ProcessScale}$), where ProcessScale is attribute 25_d. The VACON® 100 Family EtherNet/IP does not support ProcessScale.

Instance Attribute "SpeedScale"

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 Family AC drives is 7 (allowing resolution of 0.0078 RPM) and the minimum allowed value is -4 (allowing resolution of 16 RPM). The maximum speed value for input/output is thus ca 524000 RPM.

Instance Attribute "TorqueScale"

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 Family AC drives is 7 (allowing resolution of 0.0078 Nm) and the minimum allowed value is -8 (allowing resolution of 256 Nm). The maximum torque value for input/output is thus ca 8.4 MNm.

Instance Attribute "RefFromNet"

This attribute reveals whether the torque or speed reference is local or from the network. If the reference is local, the value of the attribute is 0. If the reference is from the network, then the value of the attribute is 1.

7.3 VENDOR SPECIFIC OBJECTS

7.3.1 VENDOR PARAMETERS OBJECT, CLASS OXA0

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

Table 36. Vendor parameter object

Class name		Vendor parameter object			
Class identifier		160_d / $A0_h$			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	-	-	-	-	-
Class Services	**Id**	**Name**		**Description**	
	-	-		-	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	XX	Get/Set	Parameter Value	UINT	Parameter Value
Instance Services	**Id**	**Name**		**Description**	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
	16_d 10_h	Set_Attribute_Single		Used to write a single attribute value.	

7.3.1.1 Instance Attributes

Instance Attribute "Parameter Value"

If you want to read the value of a drive parameter, for example ,"Motor control mode" ID600_d, set the instance attribute to value 600_d and the instance number to 1 to the request. The data type of the parameter value can be 8, 16 or 32 bits.

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The VACON® 100 Family AC drives also support an old method from the OPTCQ option board of reading/writing ID values when the PLC supports only 8 bit instance attributes. This method is bit more complex.

In this mode, set the instance number to high octet of the ID, and the instance attribute as low octet of the ID. For example, if you want to read the value of ID 2291_d ($08F3_h$), the Get_Attribute_Single service request is targeted at the Vendor Parameters class, instance 08_h and attribute $F3_h$.

7.3.1.2 Services

Instance Service "Get_Attribute_Single"

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:

Table 37.

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 38.

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

Instance Service "Set_Attribute_Single"

When invoked in an instance, the parameter ID to be modified in the drive is calculated. The data type, write permission etc. are 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:

Table 39.

Field	Data
Service Code	10_h
Class Code	$A0_h$
Instance Number	01_h

Table 39.

Field	Data
Attribute ID	$XXXX_h$
Attribute Data	Parameter-specific

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

Table 40.

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

7.3.2 ASSEMBLY INSTANCE SELECTOR OBJECT, CLASS OXBE

The Assembly Instance Selector Object is a vendor-specific object which allows the user to get and set the input and output instances used.

The VACON® 100 Family AC drives will automatically change the current assembly instances by what is requested in the connection opening. This means that it is not mandatory to pre-set assembly instances.

Table 41. Assembly instance selector object

Class name		Assembly instance selector object			
Class identifier		190_d / BE_h			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	-	-	-	-	-
Class Services	**Id**	**Name**		**Description**	
	-	-		-	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	3	Get/Set	InputInstance	USINT	Input assembly instance
	4	Get/Set	OutputInstance	USINT	Output assembly instance
Instance Services	**Id**	**Name**		**Description**	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
	16_d 10_h	Set_Attribute_Single		Used to write a single attribute value.	

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7.3.2.1 Instance Attributes

Instance Attribute "InputInstance"

This attribute shows the currently active (or what was last used) input assembly instance id.

Instance Attribute "OutputInstance"

This attribute shows the currently active (or what was last used) output assembly instance id.

7.3.2.2 Services

Instance Service "Get_Attribute_Single"

The format of the message is as follows.

Table 42.

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

Instance Service "Set_Attribute_Single"

The format of the message is as follows:

Table 43.

Field	Data
Service Code	10_h
Class Code	BE_h
Instance Number	01_h
Attribute ID	03_h or 04_h
Attribute Data	(Assembly number)

7.3.2.3 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 is rejected. These attributes may only be changed when no I/O connection is established, i.e. before the Forward_Open request.

7.3.3 MOTOR CONTROL MODE OBJECT, CLASS OXA1

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

Table 44. Motor Control Mode Object

Class name		Motor Control Mode Object			
Class identifier		161_d / $A1_h$			
Class Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	-	-	-	-	-
Class Services	**Id**	**Name**		**Description**	
	-	-		-	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get/Set	ControlMode	USINT	Motor control mode
	2	Get/Set	FeedbackMode	USINT	Motor feedback mode
Instance Services	**Id**	**Name**		**Description**	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
	16_d 10_h	Set_Attribute_Single		Used to write a single attribute value.	

7.3.3.1 Instance Attributes

Instance Attribute "ControlMode"

This attribute is used to detect or change the used motor control mode. The values allowed for this attribute are listed in the table below.

Table 45. Motor Control Mode Values

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

Instance Attribute "FeedbackMode"

This attribute is used to detect or change the used feedback mode. The values allowed for this attribute are listed in the table below.

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Table 46. Motor Feedback Mode Values

Value	Description
0_d	Open Loop
1_d	Closed Loop

ControlMode and FeedbackMode combinations

ControlMode and FeedbackMode combinations depends on used drive and application. Check the actual mode support from the AC drive's application manual.

7.3.3.2 Services

Instance Service "Get_Attribute_Single"

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

The format of the message is as follows.

Table 47.

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

Instance Service "Set_Attribute_Single"

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

The format of the message is as follows.

Table 48.

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

7.3.3.3 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.

When the following values are set to the AC/DC Drive Object "DriveMode" attribute, the Motor Control Mode Object attributes are set to the following values:

Table 49.

Set DriveMode value	ControlMode value	FeedbackMode value
0_d (Vendor specific)	0_d (Frequency control)	0_d (Open Loop)
1_d (Open loop speed)	1_d (Speed control)	0_d (Open Loop)
2_d (Closed loop speed)	1_d (Speed control)	1_d (Closed Loop)
3_d (Torque control)	2_d (Torque control)	*

*Feedback mode does not change. CIP does not define is torque control open or closed loop.

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 50.

Set Motor Control Mode Object values		DriveMode value
ControlMode	FeedbackMode	
0_d (Frequency)	0_d (Open loop)	1_d (Vendor/frequency)
1_d (Speed)	0_d (Open loop)	1_d (Open loop speed)
1_d (Speed)	1_d (Closed loop)	2_d (Closed loop speed)
2_d (Torque)	0_d (Open loop) or 1_d (Closed loop)	3_d (Torque control)

7.3.4 FAULT HISTORY OBJECT, CLASS OXA2

The Fault History Object is a vendor-specific object 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 51. Fault history object

Class name		Fault history object			
Class identifier		162_d / $A2_h$			
Class Attributes	Id	Access rule	Name	Datatype	Description
	1	Get	Revision	UINT	Class revision (2)
	2	Get	Max Instance	UINT	Maximum instance number (40)
	3	Get	Number of Instances	UINT	Number of object instances. Depends on drive type.

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Table 51. Fault history object

Class Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the class.	
	5	Reset		Reset fault history	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value.	
Instance Attributes	**Id**	**Access rule**	**Name**	**Datatype**	**Description**
	1	Get	FaultCode	UINT	Fault code
	2	Get	FaultID	UINT	Fault ID
	3	Get	FaultYear	UINT	Fault date: Year
	4	Get	FaultMonth	USINT	Fault date: Month
	5	Get	FaultDay	UINT	Fault date: Day
	6	Get	FaultMillisAfterMidnight	UDINT	Fault date: Time, milliseconds after midnight
Instance Services	**Id**	**Name**		**Description**	
	1	Get_Attributes_All		Returns content of all (implemented) attributes in the instance	
	14_d $0E_h$	Get_Attribute_Single		Used to read single attribute value	

7.3.4.1 Changes from revision 1 to revision 2

The attributes FaultCode and FaultDay were changed from 8 bit to 16 bit.

7.3.4.2 Class Attributes

Class Attribute "Revision"

This attribute presents the revision of the Fault History Object which is implemented by the device. The current revision is 2.

Class Attribute "Max Instance"

This attribute presents the maximum number of instances that can exist of the Fault History Object in the device. The maximum value is 40.

Class Attribute "Number of Instances"

This attribute presents the number of instances that currently exist of the Fault History Object in the device.

7.3.4.3 Instance Attributes

Instance Attribute "FaultCode"

The value returns the fault code of a fault entry which is represented by the Fault History Object instance.

Instance Attribute "FaultID"

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 attribute contains the year in which the fault occurred (according to the fault history).

Instance Attribute "FaultMonth"

The attribute contains the month in which the fault occurred (according to the fault history).

Instance Attribute "FaultDay"

The attribute contains the day-of-month in which the fault occurred (according to the fault history).

Instance Attribute "FaultMillisAfterMidnight"

The attribute contains the number of milliseconds after midnight when the fault is time-stamped. The purpose of this format is to provide high accuracy and give you the possibility of representation according to 24-hour or 12-hour clock.

7.3.4.4 Class Services

Class Service "Reset"

This service is used to reset the fault history of the drive.

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8. ASSEMBLY INSTANCES IMPLEMENTED BY VACON® 100 FAMILY

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

The VACON® 100 Family AC drives support the Output Assembly Instances 20, 21, 23 and 25, and the Input Assembly Instances 70, 71, 73 and 75.

The control word bits are mapped to the object data according to the table below.

Table 52. CIP Control Word Mapping To Object Data

Bit	Bit name	Object	Attribute name	Attribute ID
0	RunFwd	Control Supervisor Object	Run1	3_d
1	RunRev	Control Supervisor Object	Run2	4_d
2	FaultRst	Control Supervisor Object	FaultRst	12_d
3	-	-	-	-
4	-	-	-	-
5	NetCtrl	Control Supervisor Object	NetCtrl	5_d
6	NetRef	AC/DC Drive Object	NetRef	4_d
7	NetProc	AC/DC Drive Object	NetProc	5_d

The status word bits are mapped to the object data according the table below.

Table 53. CIP Status Word Mapping to Object Data

Bit	Bit name	Object	Attribute name	Attribute ID
0	Faulted	Control Supervisor Object	Faulted	10_d
1	Warning	Control Supervisor Object	Warning	11_d
2	Running1	Control Supervisor Object	Running1	7_d
3	Running2	Control Supervisor Object	Running2	8_d
4	Ready	Control Supervisor Object	Ready	9_d
5	CtrlFromNet	Control Supervisor Object	CtrlFromNet	15_d
6	RefFromNet	AC/DC Drive Object	RefFromNet	29_d
7	AtReference	AC/DC Drive Object	AtReference	3_d

The process data IN is mapped according to the table below.

Table 54. Process Data IN Mapping To Object Data

Parameter name	Object	Attribute name	Attribute ID
Speed Reference	AC/DC Drive Object	SpeedRef	8_d
Torque Reference	AC/DC Drive Object	TorqueRef (ProcessDataIn1)	12_d
Process Reference	AC/DC Drive Object	ProcessRef If Drive Mode is: 0 = ProcessDataIn1 4 = ProcessDataIn2	14_d
Drive Mode	AC/DC Drive Object	DriveMode	6_d

The process data OUT is mapped according to the table below.

Table 55. Process Data OUT Mapping To Object Data

Parameter name	Object	Attribute name	Attribute ID
Speed Actual	AC/DC Drive Object	SpeedActual	7_d
Torque Actual	AC/DC Drive Object	TorqueActual	11_d
Process Actual	AC/DC Drive Object	ProcessActual (ProcessDataOut1)	13_d
Drive State	Control Supervisor Object	State	6_d

The Speed Reference is updated to the drive only when the NetRef bit is set to 1. The torque reference is updated to the drive only when the motor control mode is "Torque Control".

Table 56. ODVA I/O Assembly Reference Data Descriptions

Attribute	Unit	Range	Note
Speed Reference	rpm	0...32767	Negative values are converted to positive
Torque Reference	Nm / $2^{TorqueScale}$	-32768...32767	
Process Reference	-	-	

Table 57. ODVA I/O Assembly Actual Data Descriptions

Attribute	Unit	Range	Note
Speed Actual	rpm	0...32767	
Drive State	-	0...7	See Table 32
Torque Actual	Nm / $2^{TorqueScale}$	-32768...32767	
Process Actual	-	-	
Drive Mode	-	-	See Table 35

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8.1.1 ODVA OUTPUT INSTANCES

8.1.1.1 Assembly Instance 20 – Basic Speed Control Output

Table 58.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
20 (length 4)	0						Fault Reset		Run Fwd
	1								
	2	Speed Reference (Low Octet)							
	3	Speed Reference (High Octet)							

8.1.1.2 Assembly Instance 21 – Extended Speed Control Output

Table 59.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
21 (length 4)	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1								
	2	Speed Reference (Low Octet)							
	3	Speed Reference (High Octet)							

8.1.1.3 Assembly Instance 23 – Extended Speed and Torque Control Output

Table 60.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
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)							

8.1.1.4 Assembly Instance 25 – Extended Process Control Output

The extended process control assembly can be used to send process reference value directly to the application. The Process Reference value destination can be selected with the Drive Mode byte according to the table below. This should be configured in the application as the receiving input. The ProcessDataOut1 is always mapped to the ProcessDataOut1. Note that the process reference value is sent to the drive only when NetProc bit is set.

Table 61. Drive Mode Selection in Process Control

Drive Mode	Process reference mapping
0	ProcessDataIn1
4	ProcessDataIn2
Other	Not valid

Table 62.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
23 (length 6)	0	Net-proc	NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1	Drive Mode							
	2	Speed Reference (Low Octet)							
	3	Speed Reference (High Octet)							
	4	Process Reference (Low Octet)							
	5	Process Reference (High Octet)							

8.1.2 ODVA INPUT INSTANCES

8.1.2.1 Assembly Instance 70 – Basic Speed Control Input

Table 63.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
70 (length 4)	0						Running1		Faulted
	1								
	2	Speed Actual (Low Octet)							
	3	Speed Actual (High Octet)							

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8.1.2.2 Assembly Instance 71 – Extended Speed Control Input

Table 64.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
71 (length 4)	0	AtReference	Ref-From-Net	Ctrl-From-Net	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Octet)							
	3	Speed Actual (High Octet)							

8.1.2.3 Assembly Instance 73 – Extended Speed and Torque Control Input

Table 65.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
73 (length 6)	0	AtReference	Ref-From-Net	Ctrl-From-Net	Ready	Running2 (Rev)	Running1 (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)							

8.1.2.4 Assembly Instance 75 – Extended Process Control Input

Table 66.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
75 (length 6)	0	AtReference	Ref-From-Net	Ctrl-From-Net	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Octet)							
	3	Speed Actual (High Octet)							
	4	Process Actual (Low Octet)							
	5	Process Actual (High Octet)							

8.2 VENDOR-SPECIFIC I/O ASSEMBLY INSTANCES

The VACON® 100 Family AC drives support the assemblies 101, 111, 128, 131, 141, 107, 117, 127, 137 and 147.

The instances 101 and 107 use the CIP control and status words. Others use the vendor specific control and status words. All items started with "FB" are sent directly to the drive without any modifications.

Table 67. Vendor-specific I/O Reference Data Descriptions

Attribute	Unit	Range	Note
FB Speed Reference	%	0...10000 (100.00%)	
ProcessDataIn1..8	-	-	

Table 68. Vendor-specific I/O Actual Data Descriptions

Attribute	Unit	Range	Note
FB Speed Actual	%	0...10000 (100.00%)	
RPM Speed Actual	rpm	-32768...32767	Ramp output frequency converted to rpm.
Speed Actual With Slip	rpm	0...32767	Slip compensated RPM value.
ProcessDataOut1..8	-	-	
Drive State	-	0...7	See Table 32

8.2.1 VENDOR OUTPUT INSTANCES

8.2.1.1 Assembly Instance 101

Table 69.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
101 (length 8)	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	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)							

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8.2.1.2 Assembly Instance 111

Table 70.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
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)							

8.2.1.3 Assembly Instance 128

Table 71.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
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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8.2.1.4 Assembly Instance 131

Table 72.

Instance	Offset	Octet 0	Octet +1	Octet +2	Octet +3
131 (length 40)	0	FBFixedControl-Word (Low Octet)	FBFixedControl-Word (High Octet)	FBGeneralCon-trolWord (Low Octet)	FBGeneralCon-trolWord (High Octet)
	4	Reserved	Reserved	FBSpeedRef (Low Octet)	FBSpeedRef (High Octet)
	8	FBProcessDataIn 1 Bits 7:0	FBProcessDataIn 1 Bits 15:8	FBProcessDataIn 1 Bits 23:16	FBProcessDataIn 1 Bits 31:24
	12	FBProcessDataIn 2 Bits 7:0	FBProcessDataIn 2 Bits 15:8	FBProcessDataIn 2 Bits 23:16	FBProcessDataIn 2 Bits 31:24
	16	FBProcessDataIn 3 Bits 7:0	FBProcessDataIn 3 Bits 15:8	FBProcessDataIn 3 Bits 23:16	FBProcessDataIn 3 Bits 31:24
	20	FBProcessDataIn 4 Bits 7:0	FBProcessDataIn 4 Bits 15:8	FBProcessDataIn 4 Bits 23:16	FBProcessDataIn 4 Bits 31:24
	24	FBProcessDataIn 5 Bits 7:0	FBProcessDataIn 5 Bits 15:8	FBProcessDataIn 5 Bits 23:16	FBProcessDataIn 5 Bits 31:24
	28	FBProcessDataIn 6 Bits 7:0	FBProcessDataIn 6 Bits 15:8	FBProcessDataIn 6 Bits 23:16	FBProcessDataIn 6 Bits 31:24
	32	FBProcessDataIn 7 Bits 7:0	FBProcessDataIn 7 Bits 15:8	FBProcessDataIn 7 Bits 23:16	FBProcessDataIn 7 Bits 31:24
	36	FBProcessDataIn 8 Bits 7:0	FBProcessDataIn 8 Bits 15:8	FBProcessDataIn 8 Bits 23:16	FBProcessDataIn 8 Bits 31:24

8.2.2 Vendor Input Instances

8.2.2.1 Assembly Instance 107

Table 73.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
107 (length 8)	0	AtRef-erence	Ref-From-Net	Ctrl-From-Net	Ready	Runnin g2 (Rev)	Runnin g1 (Fwd)	Warn-ing	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)							

8.2.2.2 Assembly Instance 117

Table 74.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
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)							

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8.2.2.3 Assembly Instance 127

Table 75.

Instance	Octet	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
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.

8.2.2.4 Input Assembly Instance 137

Table 76.

Instance	Offset	Octet 0	Octet +1	Octet +2	Octet +3
137 (length 40)	0	FBFixedStatus-Word (Low Octet)	FBFixedStatus-Word (High Octet)	FBGeneralSta-tus-Word (Low Octet)	FBGeneralSta-tus-Word (High Octet)
	4	Reserved	Reserved	FBSpeedActual (Low Octet)	FBSpeedActual (High Octet)
	8	FBProcessData Out1 Bits 7:0	FBProcessData Out1 Bits 15:8	FBProcessData Out1 Bits 23:16	FBProcessData Out1 Bits 31:24
	12	FBProcessData Out2 Bits 7:0	FBProcessData Out2 Bits 15:8	FBProcessData Out2 Bits 23:16	FBProcessData Out2 Bits 31:24
	16	FBProcessData Out3 Bits 7:0	FBProcessData Out3 Bits 15:8	FBProcessData Out3 Bits 23:16	FBProcessData Out3 Bits 31:24
	20	FBProcessData Out4 Bits 7:0	FBProcessData Out4 Bits 15:8	FBProcessData Out4 Bits 23:16	FBProcessData Out4 Bits 31:24
	24	FBProcessData Out5 Bits 7:0	FBProcessData Out5 Bits 15:8	FBProcessData Out5 Bits 23:16	FBProcessData Out5 Bits 31:24
	28	FBProcessData Out6 Bits 7:0	FBProcessData Out6 Bits 15:8	FBProcessData Out6 Bits 23:16	FBProcessData Out6 Bits 31:24
	32	FBProcessData Out7 Bits 7:0	FBProcessData Out7 Bits 15:8	FBProcessData Out7 Bits 23:16	FBProcessData Out7 Bits 31:24
	36	FBProcessData Out8 Bits 7:0	FBProcessData Out8 Bits 15:8	FBProcessData Out8 Bits 23:16	FBProcessData Out8 Bits 31:24

8.3 MAPPING OF STANDARD OUTPUT ASSEMBLIES ONTO VACON® DATA

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

8.3.1 FBGENERALCONTROLWORD AND FBGENERALSTATUSWORD

FBGeneralControlWord and FBGeneralStatusWord are purely application specific. Check the used application's manual for description of their content.

8.3.2 FBFIXEDCONTROLWORD

See Chapter 9 "APPENDIX 1 - VENDOR CONTROL AND STATUS WORD DESCRIPTIONS".

8.3.3 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, no changes are done to FBFixedControlWord.

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8.3.4 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.

8.3.5 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® FBFixedControlWord. Both bits are rising-edge sensitive.

8.3.6 Request Fieldbus Control bit in VACON® FBFixedControlWord

The "NetCtrl" bit in an Output Assembly is not mapped to the "Request Fieldbus Control" bit 8 in the VACON® FBFixedControlWord because this way you can place the drive to the IO or keypad control while fieldbus is active.

8.3.7 Request Fieldbus Reference bit in VACON® FBFixedControlWord

The "NetRef" bit in an Output Assembly is not mapped to the "Request Fieldbus Reference" bit 9 in the VACON® FBFixedControlWord.

8.4 Mapping of VACON® data onto Standard Input Assemblies

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

8.4.1 FBFixedStatusWord

See Chapter 9 "APPENDIX 1 - VENDOR CONTROL AND STATUS WORD DESCRIPTIONS".

8.4.2 Ready Indication bit in VACON® FBFixedStatusWord

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

8.4.3 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 77. Run/Stop Bit Indication Map

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

8.4.4 Direction Indication bit in VACON® FBFixedStatusWord

See chapter 8.4.3.

8.4.5 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.

8.4.6 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.

8.4.7 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.

8.4.8 Fieldbus Control indication in Input Assemblies

The selected control place is indicated in the 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.

8.4.9 Fieldbus Reference indication in Input Assemblies

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

8.4.10 FBSpeedReference in percentage

This is the reference 1 to the AC drive. 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.

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9. APPENDIX 1 - VENDOR CONTROL AND STATUS WORD DESCRIPTIONS

9.1 FBFixedControlWord and FBGeneralControlWord

The Control word is composed of 32 bits. FBFixedControlWord consist of the first 16 bits. FBGeneralControlWord consist of the remaining 16 bits. While the functionality of FBFixedControlWord is fixed in the VACON® standard applications, the functionality of FBGeneralControlWord is totally application specific and can vary even in the VACON® standard applications.

The meanings of FBFixedControlWord bits are described below. Unused bits have to be set to zero.

NOTE! This table is valid for VACON® standard applications.

Table 78. FBFixedControlWord bits

Bit	Function		Description
B0	Start/Stop	0	Stop request from fieldbus.
		1	Run request from fieldbus.
B1	Direction	0	Requested direction is "FORWARD".
		1	Requested direction is "REVERSE".
B2	Fault reset	0	No action.
		1	No action. Rising edge (0->1) = Active faults, alarms and infos are reset.
B3	Stop mode 1	0	Stop mode is unmodified.
		1	Stop mode is overridden to "Coasting".
B4	Stop mode 2	0	Stop mode is unmodified.
		1	Stop mode is overridden to "Ramping".
B5	Quick ramp time	0	Normal deceleration ramp time.
		1	Deceleration ramp time is switched to shorter than normal.
B6	Freeze Setpoint	0	Changes in the setpoint value from fieldbus (FB Speed Reference) are taken into use by the application.
		1	Changes in the setpoint value from fieldbus (FB Speed Reference) are **not** taken into use by the application.
B7	Setpoint to Zero	0	The setpoint value from fieldbus is taken from FB Speed Reference.
		1	The setpoint value from fieldbus is changed to 0.
B8	Request Fieldbus Control	0	Control Place is as parameterized in the drive (unchanged).
		1	Control Place is overridden to Fieldbus Control.
B9	Request Fieldbus Reference	0	Source of the setpoint value is as parameterized in the drive (unchanged).
		1	Source of the setpoint value is overridden to Fieldbus.

Table 78. FBFixedControlWord bits

Bit	Function		Description
B10	Jogging 1	0	No action.
		1	Jogging request with ref1.
B11	Jogging 2	0	No action.
		1	Jogging request with ref2.
B12	Quick stop	0	Drive operates as normal.
		1	Drive executes quick stop / emergency stop.
B13	Reserved	0	-
		1	-
B14	Reserved	0	-
		1	-
B15	Reserved	0	-
		1	-

9.2 FBFixedStatusWord and FBGeneralStatusWord

The Status word is composed of 32 bits. FBFixedStatusWord consist of the first 16 bits. FBGeneralStatusWord consist of the remaining 16 bits. While the functionality of FBFixedStatusWord is fixed in the VACON® standard applications, the functionality of FBGeneralStatusWord is totally application specific and can vary even in the VACON® standard applications.

The meanings of FBFixedStatusWord bits are described below. Unused bits have to be set to zero.

Table 79. FBFixedStatusWord bits

Bit	Function		Description
B0	Ready	0	Drive is not ready.
		1	Drive is ready to run.
B1	Run	0	Motor is not running.
		1	Motor is running.
B2	Direction	0	Motor is running clockwise.
		1	Motor is running counterclockwise.
B3	Fault	0	No fault active.
		1	Drive has an active fault.
B4	Alarm	0	No alarm active.
		1	Drive has active alarm.
B5	At reference	0	Motor is not running at reference speed.
		1	Motor is running at reference speed.
B6	Zero speed	0	Motor is not at zero speed.
		1	Motor is running at zero speed.
B7	Flux ready	0	Motor is not magnetized.
		1	Motor is magnetized.
B8-B12	Reserved		

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10. APPENDIX 2 - FIELDBUS PARAMETRISATION

The following chapter describes briefly how to parametrise the AC drive in order for the motor to be controllable via fieldbus. These instructions are written for basic applications. For more information, consult the application-specific manual.

In order for the AC drive to accept commands from the fieldbus network, the control place of the AC drive has to be set to fieldbus. The default value of the parameter "Control Place" is usually I/O. Note that if the control unit firmware is updated, the default settings are restored. In addition, some applications may have the remote speed reference selection set by default to other than fieldbus. In these cases, the speed reference selection must be set to fieldbus, in order for the speed reference to be controlled via fieldbus. In EtherNet/IP, the bits NetCtrl, NetRef and NetProc must be set so that the AC drive will use the sent commands/reference setpoint values. The bits Ctrl From Net and Ref From Net can be read to determine the actual control / reference place. Note that these bits are valid only if NetCtrl / NetRef bits are also set.

NOTE! The motor control mode should be selected to support the used process and profile.

10.1 Fieldbus control and basic reference selection

The following tables list some of the parameters related to fieldbus control in applications for use via fieldbus. See the application specific manuals for more detailed information.

Parameters can be read and written by using the drive panel, PC Tools or fieldbus protocol (see Chapter 7.3.1).

Table 80. Parametrization for VACON® 100 INDUSTRIAL

Parameter name	ID	Value	Default	Panel Tree
Control mode	600	0 = Frequency 1 = Speed 2 = Torque	0	P 3.1.2.1
Remote control place	172	1 = Fieldbus CTRL	0	P 3.2.1
Local / remote	211	0 = Remote	0	P 3.2.2
Fieldbus ref. sel.	122	3 = Fieldbus	3	P 3.3.1.10

10.2 Torque control parametrization

Some extra parametrisation has to be made in order to control the frequency control with torque control. The following instructions are for the VACON® 100 INDUSTRIAL, see the application-specific manual for more detailed information.

- Motor control mode (ID 600) should be configured to "Torque control" (2).

To configure the drive to use correct torque reference, select the parameter "Torque Reference Selection" to ProcessDataIn1 (9). This can be done with:

- PC-tool or panel (VACON® 100 Family AC drives: P 3.3.2.1) / ID 641
- Vendor Parameter Object

11. APPENDIX 3 - LWIP LICENCE

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