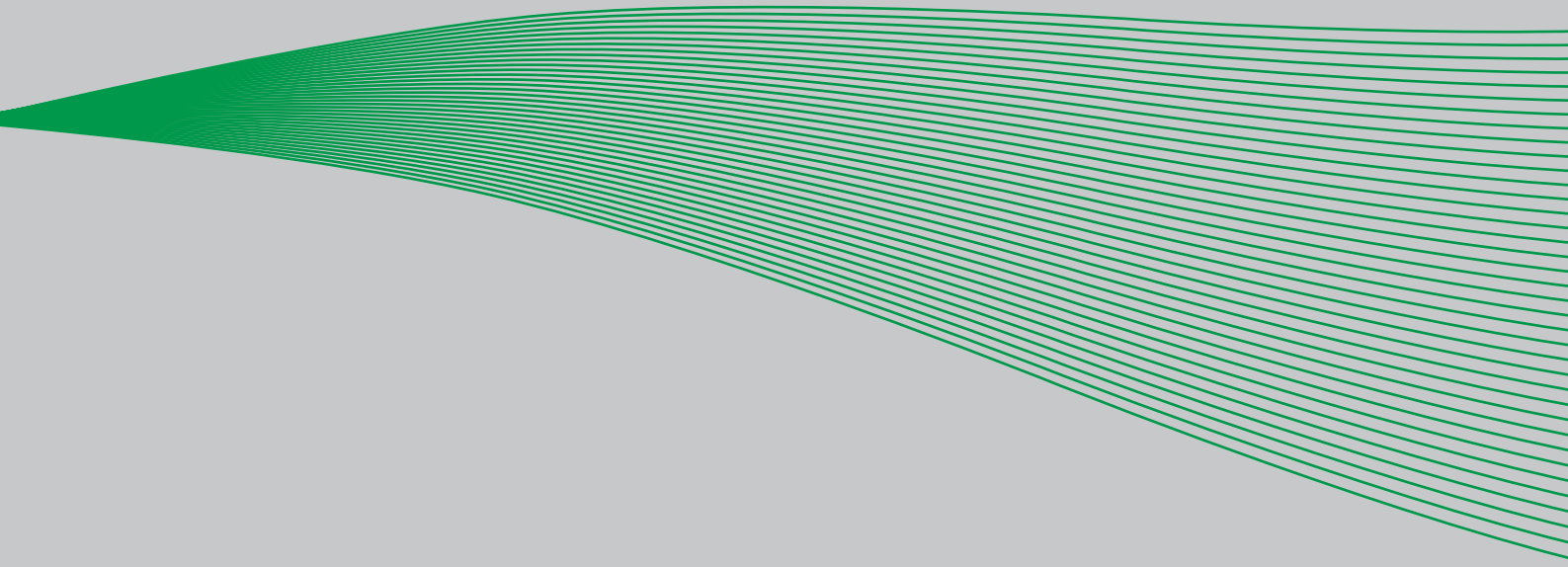
VACON
AC DRIVES

OPTE2/E8

RS485 MULTIPROTOCOL OPTION BOARD

INSTALLATION MANUAL



VACON®
DRIVEN BY DRIVES

1. SAFETY

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

Please read the information included in cautions and warnings carefully.

The cautions and warnings are marked as follows:

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

Table 1.1: Warning signs

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 Warning

The AC drive is meant for **fixed installations only**.

Do not perform any measurements when the AC drive is connected to the mains.

The **earth leakage current** of the AC drives exceeds 3.5mA AC. According to standard EN61800-5-1, **a reinforced protective ground connection must be** ensured. See Chapter 1.3.

If the AC drive is used as a part of a machine, the **machine manufacturer is responsible** for providing the machine with a **supply disconnecting device** (EN 60204-1).

Only **spare parts** delivered by Vacon can be used.

At power-up, power brake or fault reset **the motor will start immediately** if the start signal is active, unless the pulse control for Start/Stop logic has been selected.Furthermore, 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.

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 must be satisfied:

1. The protective conductor must have a cross-sectional area of at least 10 mm2 Cu or 16 mm2 Al, through its total run.
2. 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 must 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.
3. 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 must, 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 must be performed. Ignoring this procedure can cause damage to the product.

NOTE!	**You can download the English and French product manuals with applicable safety, warning and caution information from www.vacon.com/downloads.**
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 www.vacon.com/downloads.**

2. GENERAL

OPTE2/E8 RS-485 multiple protocols field option board supports both Modbus RTU and Metasys N2 protocols. It can be connected to Vacon AC drives like Vacon 20, Vacon 100, Vacon 100 Flow and Vacon 100 X. The drives can then be controlled by and monitored from the master.

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3. OPTION BOARD TECHNICAL DATA

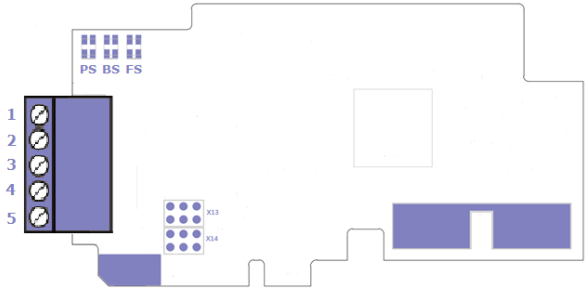
3.1 General

Protocols	Modbus RTU / Metasys N2	
Communications	Interface	OPTE2: 5-pin pluggable connector OPTE8: 9-pin DSUB connector (female)
	Data transfer method	RS-485, half-duplex
	Transfer cable	Shielded Twisted Pair
	Electrical isolation	500 VDC
Environment	Ambient operating temperature	-10°C...50°C
	Storing temperature	-40°C...70°C
	Humidity	<95%, no condensation allowed
	Altitude	Max. 1000 m
	Vibration	0.5 G at 9...200 Hz
Safety	Fulfills EN50178 standard	

4. LAYOUT AND CONNECTIONS

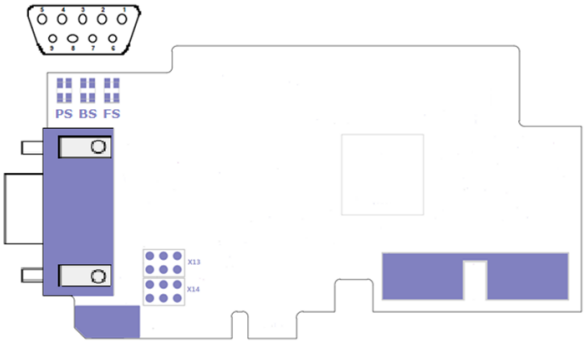
The difference between OPTE2 option board and OPTE8 option board is bus connector. OPTE2 option board has a 5-pin pluggable bus connector, and OPTE8 option board has a 9-pin female DSUB connector. Except that, they have the same LED indications, jumpers and interface board connector.

4.1 OPTE2 (Screw plug) option board layout



Signal	Pin	Description
Shield	1	Cable Shield
VP	2	Supply voltage - plus (5V)
RxD / TxD-P	3	Receive/Transmit data - plus(B)
RxD / TxD-N	4	Receive/Transmit data - minus(A)
DGND	5	Data ground (reference potential for VP)

4.2 OPTE8 (Sub-D9) option board layout



Signal	Pin	Description
Shield	1	Cable Shield
VP	6	Supply voltage - plus (5V)
RxD / TxD-P	3	Receive/Transmit data - plus(B)
RxD / TxD-N	8	Receive/Transmit data - minus(A)
DGND	5	Data ground (reference potential for VP)

4.3 LED indications

There are three LEDs on OPTE2/E8 option board to indicate board and communication status. This table describes their indications.

LEDs	Indication
PS	• Yellow blinking (2.5s ON / 2.5s OFF) when protocol is ready for external communication. • Green ON when protocol is communicating. • OFF when protocol is not ready for communications.
BS	• Green ON when board is operational. • Red when board is not operational.

LEDs	Indication
FS	• Green ON when protocol is communicating. • Red is blinking (0.25s ON / 0.25s OFF) when board firmware is corrupted or board does not have software. • OFF when protocol is not communicating.

Figure below lists possible LED indication combinations.

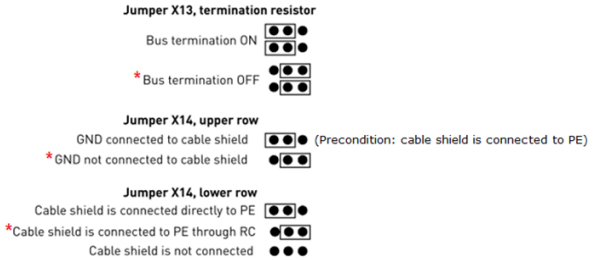
(Please add LED different color pictures in below table)

LED combinations			Description
PS	BS	FS	
Dim	Dim	Dim	No power. All LEDs are OFF.
Dim	Red	Dim	Option board firmware is corrupted or its software is missing. BS is blinking (0.25s ON / 0.25s OFF)
Dim	Red	Red	Option board failure. Option board is not operational. BS and possibly FS are blinking (0.25s ON / 0.25s OFF)
Dim	Green	Dim	Option board is operational.
Yellow	Green	Dim	Protocol is ready for communications. PS is blinking (0.25s ON / 0.25s OFF)
Green	Green	Green	Protocol is communicating.
Yellow	Red	Dim	Protocol communication fault. BS is blinking to indicate a fault. PS is blinking to indicate that protocol is again ready for communications.
Green	Red	Green	Protocol is communicating with an active fault. BS is blinking.

4.4 Jumpers

Setting of termination resistance and cable shield grounding options is described in 5. Cabling instruction chapter.

Position definition of jumpers are described in following:



* Factory Default Setting

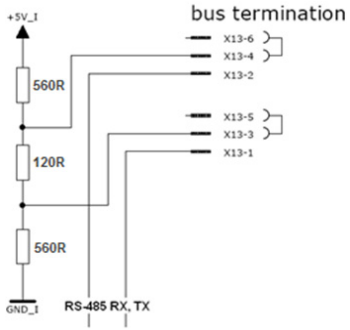
Recommended setting of Jumper X14 is described in 5. Cabling instruction chapter, which is depending on different equipotential bonding situation.

4.5 Bus terminal and bias resistors

If Vacon is the last device of RS-485 line, the bus termination must be set. Use jumper X13 (ON position) or external termination resistors.

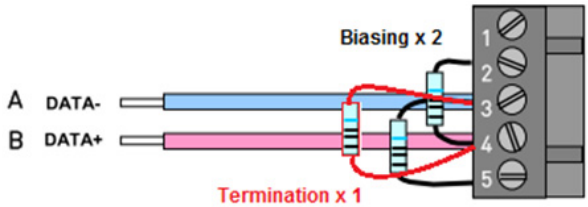
Bus biasing is required to ensure faultless communication between devices at RS-485 bus. Bus biasing makes sure that the bus state is at proper potential when no device is transmitting. Without biasing, faulty messages can be detected when the bus is in idle state. RS-485 bus state should be neither +0,200..+7V or -0,200..-7V. Illegal bus state is <200mV..-200mV. *

The resistance of internal termination and biasing are 120Ohm and 560Ohm.



If necessary, external termination and biasing can be added depending on number of nodes and total length of cable.

Number of nodes	Bias resistance	Termination resistance
2-5	1.8kOhm	120Ohm
5-10	2.7kOhm	
11-20	12kOhm	
21-30	18kOhm	
31-40	27kOhm	



5. CABLING INSTRUCTIONS

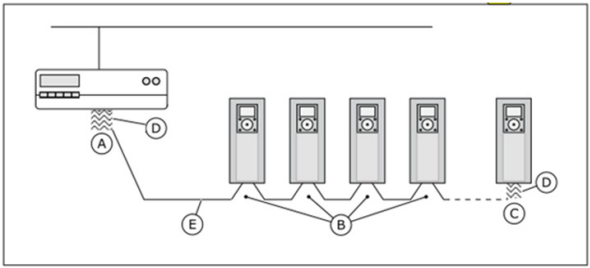
5.1 Selecting cable

In EIA-485 systems, use only shielded cables with twisted-pair signal wires. With EIA-485 protocols, use for example:

- Lapp Kabel UNITRONICR BUS LD FD P A, part number 2170813 or 2170814

5.2 Setting the termination resistance

Install termination resistors at or near both ends of the EIA-485 segment. The typically termination resistor for EIA-485 is 120 Ohms.



A. The termination is activated
B. The termination is deactivated
C. The termination is activated with a jumper
D. The bus termination
E. The fieldbus cable

5.3 Shield grounding options

The equipotential bonding system in an installation refers to metalwork that is used to bring earth potential everywhere in the installation to a common level, the system earth. The purpose is that the earth potential for all devices and equipment would be same, avoiding undesirable current flow through paths not normally designed to carry current, and to allow efficient shielding of cables.

5.3.1 Shield grounding when equipotential bonding is good

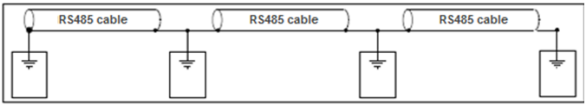
When the equipotential bonding is good, the fieldbus cable shield can be grounded at each frequency converter. The grounding can be done by connecting the shield to the drive frame directly, or it can be done through the fieldbus connector and the grounding tab in the option board.

Jumper X14 setting (all points in system):

Jumper X14, lower row

Cable shield is connected directly to PE

If the fieldbus cable is subjected to tensile load, it is recommended to do this grounding via the fieldbus board connector and grounding tab. The strain relief of the cable is then done without exposing the cable shield, which reduces the risk of mechanical wear on the cable.



Grounding by clamping the cable to the converter frame

5.3.2 Shield grounding when equipotential bonding is poor

In a situation where the equipotential bonding is poor, the fieldbus cable should be grounded directly only at one point in the system. This can be a Vacon drive but can also be some other point in the system. The fieldbus cable should not be directly grounded elsewhere in the system, because difference in electrical potential can cause equalization currents to appear in the shield, causing unnecessary disturbances.

Jumper X14 setting (cable grounding to drive):

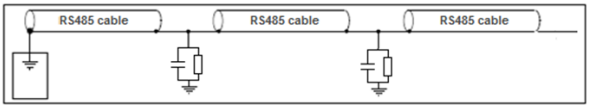
Jumper X14, lower row

Cable shield is connected directly to PE

Jumper X14 setting (cable shield to RC filter):

Cable shield is connected to PE through RC

In Vacon drives, the fieldbus cable can in these cases be connected to ground through an RC filter, which helps filter out disturbances in the shield without directly connecting it to the earth. In this case, the shield is connected to the option board connector and through an RC filter to the grounding tab in the option board. The strain relief is done without exposing the cable shield.



Grounding with RC filter

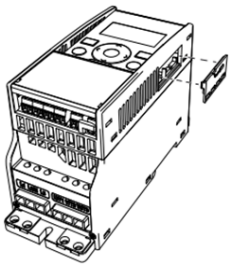
5. INSTALLATION

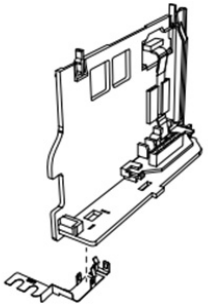
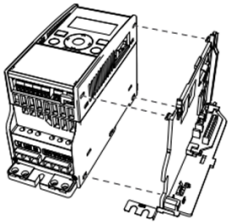
Following table shows which drives support OPTE2/E8 option board.

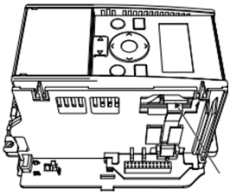
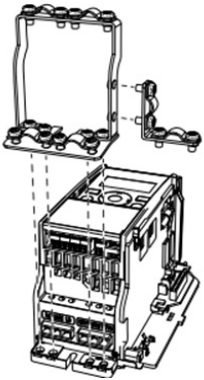
Drive	Slot	Since drive software version	Since OPTE2/E8 software version
Vacon 20	E	FW0107V012	FW0204V001
Vacon 100/100X	D, E	FW0072V016	FW0204V001
Vacon 100 Flow	D, E	FW0159V010	FW0204V001

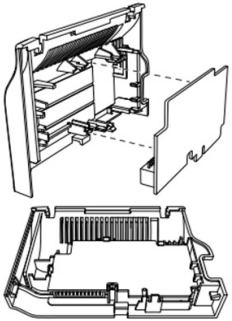
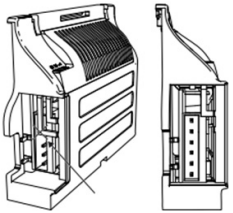
5.1 Installing option board in Vacon 20

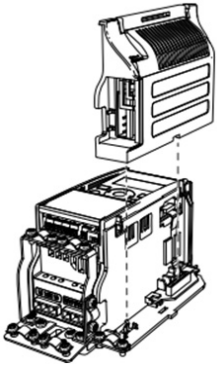
5.1.1 Frames MI1, MI2, MI3

1	Remove the cable connector lid from the AC drive. 

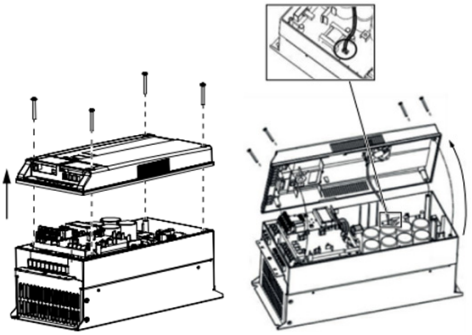
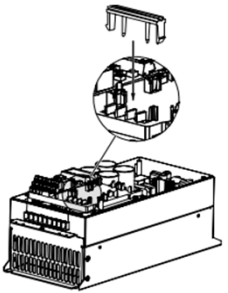
2	Select a correct grounding plate and attach it to the option board mounting frame. The grounding plate is marked with the supported frame size. 
3	Attach the option board mounting frame to the drive. 

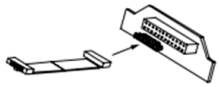
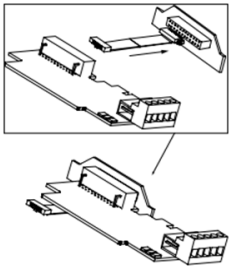
4	Connect the flat cable from the option board mounting frame to the drive. 
5	If a strain relief is necessary for the cable, attach it. 

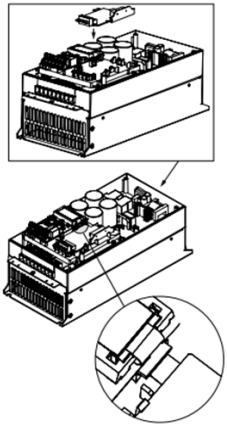
6	Install the option board to the option board holder. Make sure that the option board is securely fastened. 
7	Cut free a sufficiently wide opening for the option board connector. 

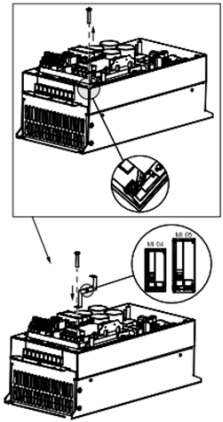
8	Attach the option board cover to the drive. If strain relief is necessary, attach the strain relief cable clamp with screws. 

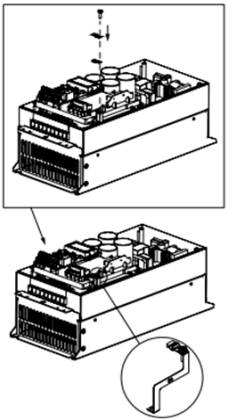
5.1.2 Frames MI4, MI5

1	In MI4, open the cover of the AC drive. In MI5, open the cover of the AC drive and release the fan connector.  **MI4** **MI5**
2	Attach the option board support. 

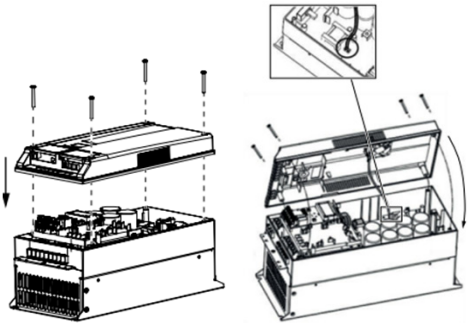
3	Connect the flex cable to the connector PCB. 
4	Attach the option board to the connector PCB. 

5	Attach the option board assembly to the drive and connect the flex cable. 

6	Attach a correct grounding plate to the drive. The grounding plate is marked with the supported frame size. 

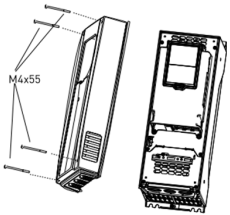
7	Put a clamp on top of the grounding plate on both sides of the option board. 

8	In MI4, close the cover of the drive. In MI5, attach the fan connector and close the cover of the drive.

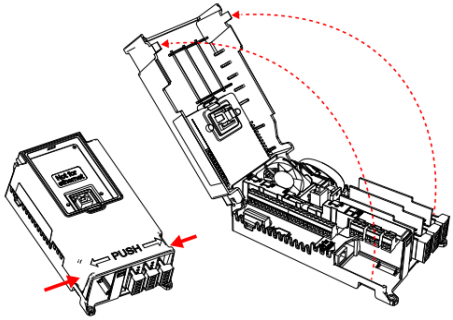
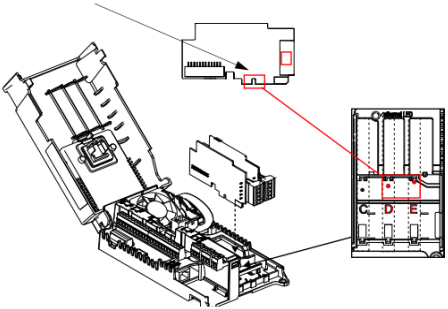


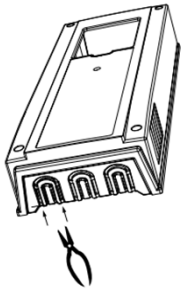
5.2 Installing option board in Vacon100 and Vacon 100 Flow

1	Open the cover of the AC drive.

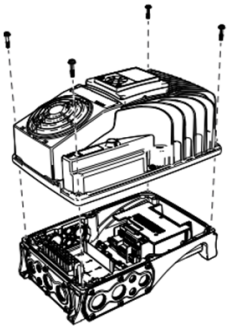


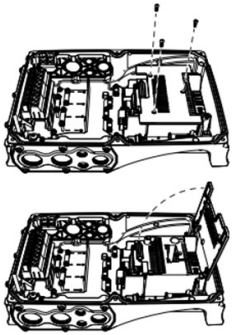
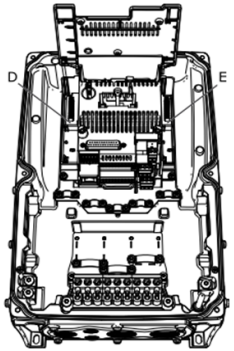
The relay outputs and other I/O-terminals may have a dangerous control voltage present even when Vacon 100 is disconnected from mains.

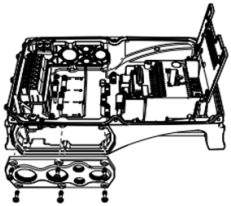
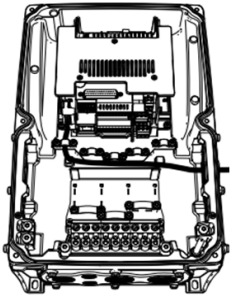
2	Open the inner cover to reveal the option board slots (C,D,E). See Figure below. 
3	Install the fieldbus board into slot D or E. See figure below. **NOTE! Incompatible boards cannot be installed on Vacon 100. Compatible boards have a slot coding that enable the placing of the board.** 
4	Close the cover of the control unit.

5	In IP21, cut free the opening on the cover of the AC drive for the fieldbus cable.In IP54, cut a hole in a grommet and move the cable through it. Make the connection tight.  **IP21** **IP54**
6	Install the fieldbus cables and other cables.
7	Close the cover of the AC drive.

5.3 Installing option board in Vacon100 X

1	Open the cover of the AC drive. 

2	To get access to the option board slots, remove the screws and open the cover of the control unit. 
3	Install the option board into the correct slot, D or E. 
4	Close the option board cover.

5	Remove the cable entry plate. If you installed the option board in the slot D, use the cable entry plate on the right side. If you installed the option board in the slot E, use the cable entry plate on the left side. 
	NOTE! The cable entry plate at the bottom of the drive is used only for mains and motor cables.
6	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.
7	Attach a cable gland on the hole in the cable entry plate. Pull the fieldbus cable through the hole. 
	NOTE! The fieldbus cable must go through the correct cable entry plate to avoid going near the motor cable.
8	Put the cable entry plate back.
9	Close the cover of the AC drive.

5.4 PC tools

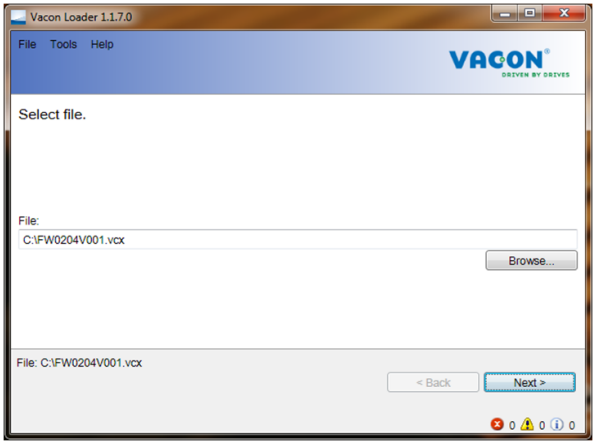
Vacon Drives provides powerful PC tools to facilitate firmware installation and operation of option board. Vacon Loader is used to update option board firmware. Vacon Live is used to set parameters and monitor values. All PC tools are available on Vacon official website: www.vacon.com/downloads.

For Vacon 100, use Vacon special cable to directly connect Vacon 100 and PC. For Vacon 20, connect PC by cable to MCA adaptor, then plug MCA to Vacon 20.

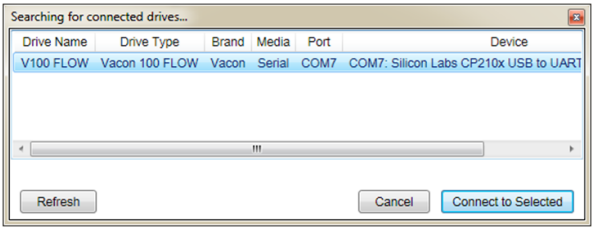
5.4.1 Vacon Loader

To update option board firmware, user needs to connect PC to drive and then load the new program with Vacon Loader software. It has been bundled with Vacon Live software package.

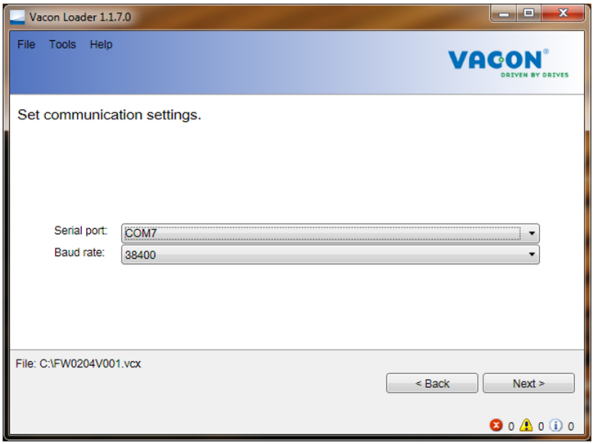
Step 1. Connect PC to drive. Open Vacon Loader, click Browse to select firmware file; or directly double click the firmware file, then it loads firmware with Vacon Loader. Then, press Next.



Step 2. The Vacon Loader will search for and list the connected drives and serial port information. Select the drive mounted option board from the drive list and press Connect to Select.

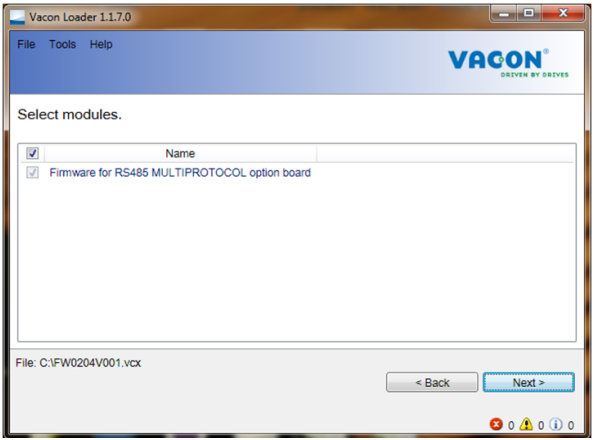


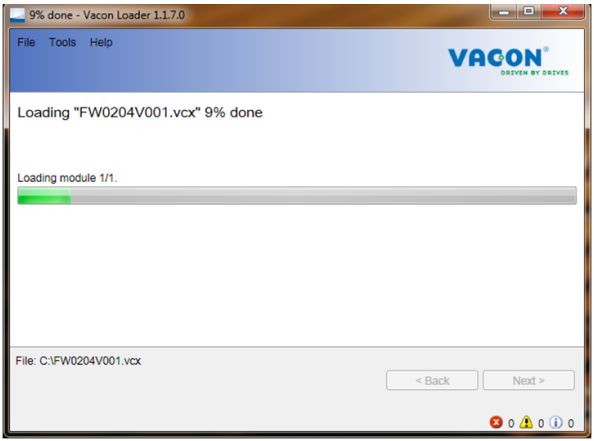
Or press Cancel to end searching and manually select serial port and baud rate.

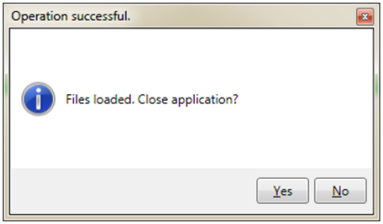


Then press Next to enter next step.

Step 3. Vacon Loader automatically detects the object slot. In this step, just press Next and wait until firmware updating finished.


Vacon Loader 1.1.7.0
File Tools Help
VACON
DRIVEN BY DRIVES
Select modules.
Name
Firmware for RS485 MULTIPROTOCOL option board
File: C:\FW0204V001.vcx
< Back
Next >
0 0 0


9% done - Vacon Loader 1.1.7.0
File Tools Help
VACON
DRIVEN BY DRIVES
Loading "FW0204V001.vcx" 9% done
Loading module 1/1.
File: C:\FW0204V001.vcx
< Back
Next >
0 0 0

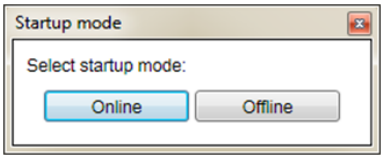


Then press Yes to exit, or press No to stay in Vacon Loader to continue the **Step 1**.

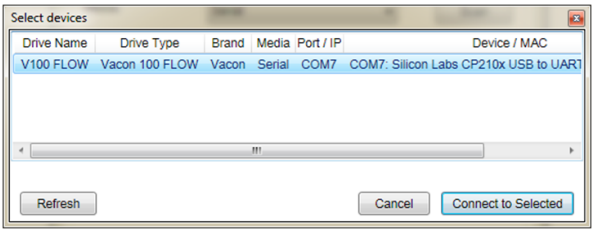
5.4.2 Vacon Live

Vacon Live is a powerful PC tool to enable you to read/write parameters and monitor values of option board.

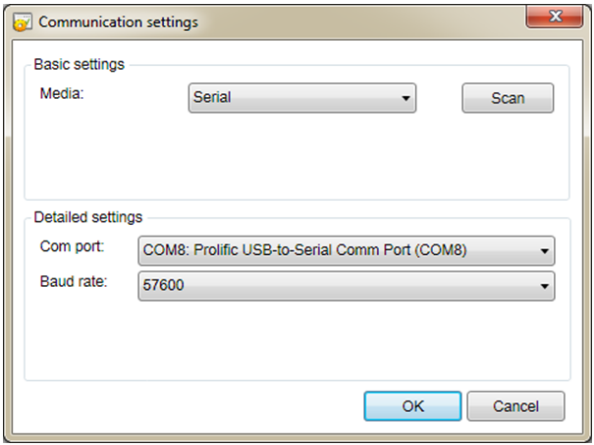
Step 1. Connect PC to drive by adapter cable or Ethernet connection. Open Vacon Live and select startup mode as Online.



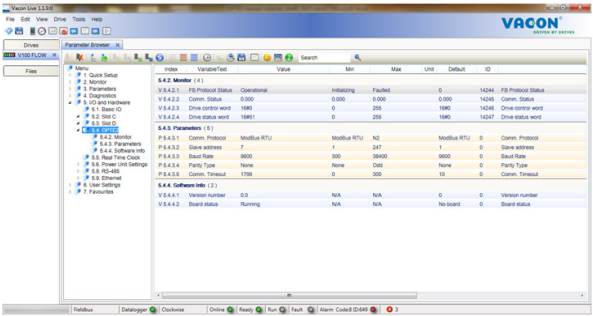
Step 2. Vacon Live will automatically search for connected drives and list them. Select the object drive with serial port and press Connect to Select.



Or press Cancel to manually select serial port and baud rate, and press OK.



Step 3. Then Vacon Live communicates with drive and loads parameters and values. When loading parameters done, you can find all OPTE2/E8 parameters and monitor values.



6. COMMISSION

OPTE2/E8 option board is commissioned with Vacon 20 keypad/Vacon 100 panel by setting values to appropriate parameters in option board menu (or via PC tools, see Chapter 5.3).

Keypad/Panel commissioning and location of parameters are different between these two types of drives.

Drive	Parameters location
Vacon 20	'System Menu' → P 2.x
Vacon 100	'I/O and Hardware (M7)' → Slot D' or 'Slot E'

6.1 Option board menu

The keypad/panel makes it possible for users to see which option board is connected to drive, and to reach and edit the parameters associated with option board.

6.1.1 Option board monitor menu

Monitor	Range	Description
Fieldbus protocol status	0 - Initializing, 1 - Stopped, 2 - Operational, 3 - Faulted	
Communication Status	X.Y 0.0 ... 64.999	X = Number of messages with errors Y = Number of messages without communication errors
Drive control word	-	Control word in drive format
Drive status word	-	Status word in drive format

6.1.2 Option board parameter menu

Parameter	Range	Description
Communication protocol	1 - Modbus RTU 2 - N2	Current active fieldbus protocol. Default communication protocol is Modbus RTU
Slave address	1 ... 247	Slave address
Baud rate	1 - 300 bps 2 - 600 3 - 1200 4 - 2400 5 - 4800 6 - 9600 7 - 19200 8 - 38400	Baud rate. Default baud rate is 9600 bps. When N2 protocol is used baud rate must be set to 9600.

Parameter	Range	Description
Parity	0 - None 1 - Even 2 - Odd	Parity. Default parity is None with 2 stop bits. Even and Odd parity use 1 stop bit. When N2-protocol is used Parity type must be set to 0 = None
Communication timeout	0 - Disable 1 ... 65535 s	Protocol communication timeout.

OPTE2/8 RS485 option board reports communication timeout to the drive if the option board cannot receive Modbus RTU or Metasys N2 request during a communication timeout time. Only Modbus RTU or Metasys N2 requests that are pointed to the option board are taken into account in communication timeout calculation. Requests that are pointed to other devices are not handled.

How the drive shall react in communication timeout situation can be defined in drive application:

Fieldbus Fault Reaction in Vacon 100 General Purpose and Vacon 20 Standard Application.

Code		Parameter	Min	Max	Default	ID	Note
V100	V20						
P3.9.1.6	P13.19	Response to fieldbus fault	0	4	3	733	0 = No response 1 = Alarm 2 = Fault, stop by stop function 3 = Fault, stop by coasting

Fieldbus Fault Reaction in Vacon 20X Multi-Purpose Application

Code	Parameter	Min	Max	Default	ID	Note
P9.15	Response to fieldbus fault	0	2	2	733	0 = No action 1 = Warning 2 = Fault

7. MODBUS RTU

7.1 Overview

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

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

7.2 Modbus RTU communications

Features of the Modbus-Vacon interface:

- Acts as a Modbus slave
- Direct control of Vacon drive (e.g. Run, Stop, Direction, Speed reference, Fault reset)
- Full access to all Vacon parameters
- Monitor Vacon status (e.g. Output frequency, Output current, Fault code)

7.2.1 Data addresses in Modbus message

All data addresses in Modbus messages are referenced to zero. The first occurrence of a data item is addressed as item number zero. For example:

- Holding register 40001 is addressed as register 0000 in the data address field of the message. The function code field already specifies a 'holding register' operation. Therefore the '4XXXX' reference is implicit.
- Holding register 40108 is addressed as register 006B hex (107 decimal).

7.2.2 Modbus memory map

The Vacon variables and fault codes as well as the parameters can be read and written from Modbus. The parameter addresses are determined in the application. Every parameter and actual value has been given an ID number in the application. The ID numbering of the parameters as well as the parameter ranges and steps can be found in the application manual in question. The parameter value shall be given without decimals. If several parameters/actual values are read with one message, the addresses of the parameters/actual values must be consecutive.

Function code	Current terminology	Access type	Address range (hex)
3 (0x03)	Read holding registers	16bit	40000-4FFFF
4 (0x04)	Read input registers	16bit	30000-3FFFF
6 (0x06)	Write single register	16bit	40000-4FFFF
16 (0x10)	Write multiple registers	16bit	40000-4FFFF
23 (0x17)	Read/Write multiple registers	16bit	40000-4FFFF

7.2.3 Modbus exception responses

Code	Function	Description
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the slave
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the slave
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the slave
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while slave was attempting to perform the requested action.
06	SLAVE DEVICE BUSY	The slave is engaged in processing a long-duration program command.
08	MEMORY PARITY ERROR	The slave attempted to read record file, but detected a parity error in memory.

7.3 Modbus data mapping

7.3.1 Holding and input registers

Values can be read with function code 3 and code 4 (all registers are 3X and 4X reference). Modbus registers are mapped to drive ID's as follows:

Address range	Purpose	Access type	See
0001 - 2000	Vacon Application ID´s	16bit	
2001 - 2050	FBProcessDataIN	16bit	
2051 - 2099	FBProcessDataIN	32bit	
2101 - 2150	FBProcessDataOUT	16bit	
2151 - 2199	FBProcessDataOUT	32bit	
2200 - 10000	Vacon Application ID´s	16bit	
10501 - 10530	IDMap	16bit	
10601 - 10630	IDMap Read/Write	16bit	
10701 - 10760	IDMap Read/Write	32bit	
20001 - 40000	Vacon Application ID's	32bit	

Address range	Purpose	Access type	See
40001 - 40005	Operation day counter	16bit	
40011 - 40012	Operation day counter	32bit	
40101 - 40105	Resettable operation day counter	16bit	
40111 - 40112	Resettable operation day counter	32bit	
40201 - 40203	Energy counter	16bit	
40211 - 40212	Energy counter	32bit	
40301 - 40303	Resettable energy counter	16bit	
40311 - 40312	Resettable energy counter	32bit	
40401 - 40430	Fault history	16bit	
40501	Communication timeout	16bit	

7.3.1.1 Vacon application ID's

Application ID's are parameters that depend on the drive's application. These parameters can be read and written by pointing the corresponding memory range directly or by using the so-called ID map (more information below). It is easiest to use a straight address if you want to read a single parameter value or parameters with consecutive ID numbers. It is possible to read 12 consecutive ID addresses.

Address range	Purpose	ID
0001-2000	Application parameters	1-2000
2200-10000	Application parameters	2200-10000

7.3.1.2 FB Process data IN

The process data fields are used to control the drive (e.g. Run, Stop, Reference, Fault Reset) and to quickly read actual values (e.g. Output frequency, Output current, Fault code). The fields are structured as follows:

Process Data Master -> Slave (max 22 bytes)

Address		Name	Range/Type
16-bit*	32-bit		
2001	2051 = High data 2052 = Low data	FB Control Word	Binary coded
2002	-	FB General Control Word	Binary coded
2003	2053 = High data 2054 = Low data	FB Speed Reference	0...10000 %

Address		Name	Range/Type
16-bit*	32-bit		
2004	2055 = High data 2056 = Low data	FB Process Data In 1	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2005	2057 = High data 2058 = Low data	FB Process Data In 2	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2006	2059 = High data 2060 = Low data	FB Process Data In 3	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2007	2061 = High data 2062 = Low data	FB Process Data In 4	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2008	2063 = High data 2064 = Low data	FB Process Data In 5	See Chapter 10 "APPENDIX 1 - PROCESS DATA
2009	2065 = High data 2066 = Low data	FB Process Data In 6	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2010	2067 = High data 2068 = Low data	FB Process Data In 7	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2011	2069 = High data 2070 = Low data	FB Process Data In 8	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
*. In Vacon 100, the Control Word and the Status Word are formed of 32 bits. Only the initial 16bits can be read in the 16-bit area.			

Control word bits

The Control word is composed of 32 bits. Meanings of bits are described below. Unused bits have to be set to zero.

NOTE! This table is valid only for Vacon standard applications.
Always check application specific status from the application manual.

Bit	V100	V20	Function		Description
B0	x	x	Start/Stop	0	Stop request from fieldbus.
				1	Run request from fieldbus.
B1	x	x	Direction	0	Requested direction is "FORWARD".
				1	Requested direction is "REVERSE".
B2	x	x	Fault reset	0	No action.
				1	No action. Rising edge (0->1) = Active faults, alarms and infos are reset.
B3	x		Stop mode 1	0	Stop mode is unmodified.
				1	Stop mode is overridden to "Coasting".
B4	x		Stop mode 2	0	Stop mode is unmodified.
				1	Stop mode is overridden to "Ramping".

Bit	V100	V20	Function		Description
B5	x	x	Quick ramp time	0	Normal deceleration ramp time.
				1	Deceleration ramp time is switched to shorter than normal.
B6	x		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	x		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	x		Request Fieldbus Control	0	Control Place is as parameterized in the drive (unchanged).
				1	Control Place is overridden to Fieldbus Control.
B9	x		Request Fieldbus Reference	0	Source of setpoint value is as parameterized in the drive (unchanged).
				1	Source of setpoint value is overridden to Fieldbus.
B10	x		Jogging 1	0	No action.
				1	Jogging request with ref1.
B11	x		Jogging 2	0	No action.
				1	Jogging request with ref2.
B12	x		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	-

7.3.1.3 FB Process data OUT

Address		Name	Range/Type
16-bit*	32-bit		
2101	2151 = High data 2152 = Low data	FB Status Word	Binary coded
2102	-	FB General Status Word	Binary coded
2103	2153 = High data 2154 = Low data	FB Actual Speed	0...10000 %

Address		Name	Range/Type
16-bit*	32-bit		
2104	2155 = High data 2156 = Low data	FB Process Data Out 1	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2105	2157 = High data 2158 = Low data	FB Process Data Out 2	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2106	2159 = High data 2160 = Low data	FB Process Data Out 3	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2107	2161 = High data 2162 = Low data	FB Process Data Out 4	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2108	2163 = High data 2164 = Low data	FB Process Data Out 5	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2109	2165 = High data 2166 = Low data	FB Process Data Out 6	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2110	2167 = High data 2168 = Low data	FB Process Data Out 7	See Chapter 10 "APPENDIX 1 - PROCESS DATA"
2111	2169 = High data 2170 = Low data	FB Process Data Out 8	See Chapter 10 "APPENDIX 1 - PROCESS DATA"

* In Vacon 100, the Status Word is formed of 32 bits. Only the lower 16bits can be read in the 16-bit area

Status word bits

The Status word is composed of 32 bits. The meanings of bits are described below.

Bit	V100	V20	Function		Description
B0	x	x	Ready	0	Drive is not ready.
				1	Drive is ready to run.
B1	x	x	Run	0	Motor is not running.
				1	Motor is running.
B2	x	x	Direction	0	Motor is running clockwise
				1	Motor is running counterclockwise.
B3	x	x	Fault	0	No fault active.
				1	Drive has active fault
B4	x		Alarm	0	No alarm active.
				1	Drive has active alarm.
B5	x	x	At reference	0	Motor is not running at reference speed.
				1	Motor is running at referesnce speed.
B6	x	x	Zero speed	0	Motor is not at zero speed.
				1	Motor is running at zero speed.
B7	x	x	Flux ready	0	Motor is not magnetized.
				1	Motor is magnetized.

Bit	V100	V20	Function		Description
B8-B12			Reserved		

The use of process data depends on the application. In a typical situation, the device is started and stopped with the Control Word (CW) written by the Master and the Rotating speed is set with Reference (REF). With PD1...PD8 the device can be given other reference values (e.g. Torque reference).

With the Status Word (SW) read by the Master, the status of the device can be seen. Actual Value (ACT) and PD1...PD8 show the other actual values.

7.3.1.4 ID map

Using the ID map, you can read consecutive memory blocks that contain parameters whose ID's are not in a consecutive order. The address range 10501 - 10530 is called 'IDMap', and it includes an address map in which you can write your parameter ID's in any order. The address range 10601 to 10630 is called 'IDMap Read/Write,' and it includes values for parameters written in the IDMap. As soon as one ID number has been written in the map cell 10501, the corresponding parameter value can be read and written in the address 10601, and so on. The address range 10701 - 10730 contains the ID Map for 32bit values.

Parameters	
ID	Value
699	123
700	321
701	456
702	654
703	1789
704	987
705	2741
706	1147
707	258
708	3852

ID Map			
Address	Data: ID	Address	Data: Value
410501	700	410601	321
410502	702	410602	654
410503	707	410603	258
410504	704	410604	987

Once the IDMap address range has been initialized with parameter IDs, the parameter values can be read and written in the IDMap Read/Write address range address (IDMap address + 100).

Address	Data
410601	Data included in parameter ID700
410602	Data included in parameter ID702

Address	Data
410603	Data included in parameter ID707
410604	Data included in parameter ID704

If the IDMap table has not been initialized, all fields show index as '0'. If it has been initialized, the parameter ID's included in it are stored in the flash memory of the option board.

Example of 32bit IDMap

Address	Data
410701	Data High, parameter ID700
410702	Data Low, parameter ID700
410703	Data High, parameter ID702
410704	Data Low, parameter ID702

7.3.1.5 Operation day counter

Control unit operating time counter (total value). This counter cannot be reset.

Operation day counter as seconds

This counter in registers 40011d to 40012d holds the value of operation days as seconds in a 32-bit unsigned integer.

Address	Register	Description
40011 High data 40012 Low data	440011, 440012	Holds the counter value as seconds.

Operation day counter

This counter in registers 40001d to 40005d holds the value of operation days counter.

For compatibility with V100 internal and OPT-CI option board, this counter is found from two different register areas: holding registers 40001d to 40005d and input registers 1d to 5d.

Holding register address	Input register address	Purpose
40001	1	Years
40002	2	Days
40003	3	Hours
40004	4	Minutes
40005	5	Seconds

7.3.1.6 Resettable operation day counter

This register holds the value for resettable control unit operating time counter (trip value).

NOTE! Vacon20 does not support resettable operation day counter

Resettable operation day counter as seconds

This counter in registers 40111d to 40112d holds the value of resettable operation days as seconds in a 32-bit unsigned integer.

Address	Register	Description
40111 High data 40112 Low data	440111, 440112	Holds the counter value as seconds.

Resettable operation day counter

This counter in registers 40101d to 40105d holds the value of operation days counter.

For compatibility, this counter is found from two different register areas: holding registers 40101d to 40105d and input registers 30101d to 30105d.

Holding register address	Input register address	Purpose
40101	101	Years
40102	102	Days
40103	103	Hours
40104	104	Minutes
40105	105	Seconds

7.3.1.7 Energy counter

This counter holds the value of total amount of energy taken from supply network. This counter cannot be reset.

Energy counter as kWh

This counter is in registers 40211d to 40212d and is a 32-bit floating point (IEEE 754) value containing the number of kilowatt-hours (kWh) that is in the drive's energy counter. This value is read-only.

Address	Register	Description
40211 High data 40212 Low data	440201, 440202	Holds the value of energy counter in kWh. Datatype is 32 bit float IEEE 754

Energy counter

These registers hold three values for the energy counter, amount of energy used, format of the energy value and unit of the energy value.

For compatibility, this counter is found from two different register areas: holding registers 40201d to 40203d and input registers 201d to 203d.

Example: If energy = 1200, format = 52, unit = 1, then actual energy is 12.00 kWh.

Holding register address	Input register address	Purpose	Description
40201	201	Energy	Amount of energy taken from supply network.
40202	202	Format	The last number of the Format field indicates the decimal point place in the Energy field. **Example:** 40 = 4 number of digits, 0 fractional digits 41 = 4 number of digits, 1 fractional digit 42 = 4 number of digits, 2 fractional digits
40203	203	Unit 1 = kWh 2 = MWh 3 = GWh 4 = TWh	Unit of the value.

7.3.1.8 Resettable energy counter

This counter holds the value of total amount of energy taken from supply network since the counter was last reset.

Resettable energy counter as kWh

This counter is in registers 40311d to 40312d and is a 32-bit floating point (IEEE 754) value containing the number of kilowatt-hours (kWh) that is in the drive's resettable energy counter.

Address	Register	Description
40311 High data 40312 Low data	440311, 440312	Holds the value of energy counter in kWh since last counter reset. Datatype is 32 bit float IEEE 754

Resettable energy counter

These registers hold three values for the energy counter, amount of energy used, format of the energy value and unit of the energy value.

For compatibility, this counter is found from two different register areas: 40301d to 40303d and 301d to 303d.

Example: If energy = 1200, format = 52, unit = 1, then actual energy is 12.00 kWh.

Holding register address	Input register address	Purpose	Description
40301	301	Energy	Amount of energy taken from supply network.
40302	302	Format	The last number of the Format field indicates the decimal point place in the Energy field. **Example:** 40 = 4 number of digits, 0 fractional digits 41 = 4 number of digits, 1 fractional digit 42 = 4 number of digits, 2 fractional digits
40303	303	Unit 1 = kWh 2 = MWh 3 = GWh 4 = TWh	Unit of the value.

7.3.1.9 Fault history

The fault history can be viewed by reading from address 40401 onward. The faults are listed in chronological order so that the latest fault is mentioned first and the oldest last. The fault history can contain maximum 29 faults at the same time (Note: Vacon20 fault history contains only maximum 9 faults). For compatibility, this counter is also found from input register area: 401d to 403d.

The fault history contents are represented as follows.

Holding register address	Input register address	Purpose
40401	401	Upper byte is fault code, lower byte is sub code
40402	402	
40403	403	
...	...	
40429	429	

7.3.1.10 Fault history with 16-bit error codes

The fault history can be viewed by reading from address 40511 onward. The faults are listed in chronological order so that the latest fault is mentioned first and the oldest last. These addresses contain fault code and the subcode for the fault. Reading can be started from any address.

Holding register address	Input register address	Purpose
40511	Fault code 1	16-bit fault code in index 1.
40512	Sub code 1	16-bit sub code for fault in index 1.
40513	Fault code 2	16-bit fault code in index 2.
40514	Sub code 2	16-bit sub code for fault in index 2.
...		
40567	Fault code 29	
40568	Sub code 29	

7.4 Quick setup

Following these instructions, you can easily and fast set up your Modbus for use:

In the AC drive application: Choose Fieldbus as the active control place (see drives User's Manual).

In the Master software:

1. Make these settings in the master software
2. Set Control Word to **'0'** (2001)
3. Set Control Word to **'1'** (2001)
4. Drive's status is RUN
5. Set Reference value to **'5000'** (50.00%) (2003).
6. Actual speed is 5000 (25.00 Hz if MinFreq is 0.00 Hz and MaxFreq is 50.00 Hz)
7. Set Control Word to **'0'** (2001)
8. Drive's status is STOP.

7.5 Example messages

7.5.1 Example 1: Write process data

Write the process data 42001...42003 with command 16 (Preset Multiple Registers).

Command Master - Slave:

ADDRESS	01 hex	Slave address 1 hex (= 1)
FUNCTION	10 hex	Function 10 hex (= 16)

DATA	Starting address HI	07 hex	Starting address 07D0 hex (= 2000)
	Starting address LO	D0 hex	
	No. of registers HI	00 hex	Number of registers 0003 hex (= 3)
	No. of registers LO	03 hex	
	Byte count	06 hex	Byte count 06 hex (= 6)
	Data HI	00 hex	Data 1 = 0001 hex (= 1). Setting control word run bit to 1.
	Data LO	01 hex	
	Data HI	00 hex	Data 2 = 0000 hex (= 0).
	Data LO	00 hex	
	Data HI	13 hex	Data 3 = 1388 hex (= 5000), Speed Reference to 50.00%
	Data LO	88 hex	
ERROR CHECK	Data HI	C8 hex	CRC field C8CB hex (= 51403)
	Data LO	CB hex	

Message frame:

01	10	07	D0	00	03	06	00	01	00	00	13	88	C8	CB

The reply to Preset Multiple Registers message is the echo of 6 first bytes.

Answer Slave - Master:

ADDRESS		01 hex	Slave address 1 hex (= 1)
FUNCTION		10 hex	Function 10 hex (= 16)
DATA	Starting address HI	07 hex	Starting address 07D0 hex (= 2000)
	Starting address LO	D0 hex	
	No. of registers HI	00 hex	Number of registers 0003 hex (= 3)
	No. of registers LO	03 hex	
ERROR CHECK	CRC HI	80 hex	CRC 8085 hex (= 32901)
	CRC LO	85 hex	

Reply frame:

01	10	07	D0	00	03	80	85

7.5.2 Example 2: Read process data

Read the Process Data 42103...42104 with command 4 (Read Input Registers).

Command Master - Slave:

ADDRESS	01 hex	Slave address 1 hex (= 1)

FUNCTION		04 hex	Function 4 hex (= 4)
DATA	Starting address HI	08 hex	Starting address 0836 hex (= 2102)
	Starting address LO	36 hex	
	No. of registers HI	00 hex	Number of registers 0002 hex (= 2)
	No. of registers LO	02 hex	
ERROR CHECK	CRC HI	93 hex	CRC 93A5 hex (= 37797)
	CRC LO	A5 hex	

Message frame:

01	04	08	36	00	02	93	A5

The reply to the Read Input Registers message contains the values of the read registers.

Answer Slave - Master:

ADDRESS		01 hex	Slave address 1 hex (= 1)
FUNCTION		04 hex	Function 4 hex (= 4)
DATA	Byte count	04 hex	Byte count 4 hex (= 4)
	Data HI	13 hex	Speed reference = 1388 hex (=5000 => 50.00%)
	Data LO	88 hex	
	Data HI	09 hex	Output Frequency = 09C4 hex (=2500 =>25.00Hz)
	Data LO	C4 hex	
ERROR CHECK	CRC HI	78 hex	CRC 78E9 hex (= 30953)
	CRC LO	E9 hex	

Reply frame:

01	04	04	13	88	09	C4	78	E9

7.5.3 Example 3: Exception response

In an exception response, the Slave sets the most-significant bit (MSB) of the function code to 1. The Slave returns an exception code in the data field.

Command Master - Slave:

ADDRESS	01 hex	Slave address 1 hex (= 1)
FUNCTION	04 hex	Function 4 hex (= 4)

DATA	Starting address HI	17 hex	Starting address 1770 hex (= 6000)
	Starting address LO	70 hex	
	No. of registers HI	00 hex	Invalid number of registers 0005 hex (= 5)
	No. of registers LO	05 hex	
ERROR CHECK	CRC HI	34 hex	CRC 3466 hex (= 13414)
	CRC LO	66 hex	

Message frame:

01	04	17	70	00	05	34	55

Exception response.

Answer Slave - Master:

ADDRESS		01 hex	Slave address 1 hex (= 1)
FUNCTION		84 hex	Most significant bit set to 1
DATA	Starting address HI	04 hex	Error code 04 => Slave device failure
ERROR CHECK	CRC HI	42 hex	CRC 3466 hex (= 13414)
	CRC LO	C3 hex	

Reply frame:

01	84	04	42	C3

8. METASYS N2

8.1 Overview

The N2 communications protocol is used by Johnson Controls and others to connect terminal unit controllers to supervisory controllers. It is open to any manufacturer and based upon simple ASCII protocol widely used in the process control industry.

The physical characteristics of the N2 bus are two wires RS-485 with a maximum of 100 devices over a 4000 foot distance running at 9600 bps by default. Logically, the N2 is a master-slave protocol, the supervisory controller normally being the master.

8.2 Metasys N2 communication

Features of the N2 interface:

- Direct control of drive (e.g. Run, Stop, Direction, Speed reference, Fault reset)
- Full access to necessary parameters
- Monitor drive status (e.g. Output frequency, Output current, Fault code)
- In standalone operation, or should the polling stop, the overridden values are released after a specified period.

8.2.1 Analogue Input (AI)

All Analogue Input (AI) points have the following features:

- Support Change of State (COS) reporting based on high and low warning limits.
- Support Change of State (COS) reporting based on high and low alarm limits.
- Support Change of State (COS) reporting based on override status.
- Always considered reliable and never out of range.
- Writing of alarm and warning limit values beyond the range that can be held by the drive's internal variable will result in having that limit replaced by the "Invalid Float" value even though the message is acknowledged. The net result will be the inactivation of the alarm or warning (the same as if the original out of range value was used).
- Overriding is supported from the standpoint that the "Override Active" bit will be set and the value reported to the N2 network will be the overridden value. However, the value in the drive remains unchanged. Therefore, the N2 system should be set up to disallow overriding AI points or have an alarm condition activated when an AI point is overridden.
- Overriding an AI point with a value beyond the limit allowed by the drive's internal variable will result in an "Invalid Data" error response and the override status and value will remain unchanged.

8.2.2 Binary Input (BI)

All Binary Input (BI) points have the following features:

- Support Change of State (COS) reporting based on current state.

- Support Change of State (COS) reporting based on alarm condition.
- Support Change of State (COS) reporting based on override status.
- Always considered reliable.

Overriding is supported from the standpoint that the "Override Active" bit will be set and the value reported to the N2 network will be the overridden value. However, the value in the drive remains unchanged. Therefore, the N2 system should be set up to disallow overriding BI points or have an alarm condition activated when a BI point is overridden.

8.2.3 Analogue Output (AO)

All Analogue Output (AO) points have the following features:

- Support Change of State (COS) reporting based on override status.
- Always considered reliable.
- Overriding of the AO points is the method used to change a value. Overriding an AO point with a value beyond the limit allowed by the drive's internal variable will result in an "Invalid Data" error response and the override status and value will remain unchanged. If the overridden value is beyond the drive's parameter limit but within the range that will fit in the variable, an acknowledge response is given and the value will be internally clamped to its limit.
- An AO point override copies the override value to the corresponding drive parameter. This is the same as changing the value on the keypad. The value is non-volatile and will remain in effect when the drive is turned off and back on. It also remains at this value when the N2 network "releases" the point. The N2 system always reads the current parameter value.

Note:

On some N2 systems, the system will not poll the AO point when it is being overridden. In this case, the N2 system will not notice a change in value if the change is made with the keypad. To avoid this, set the point up as a "local control" type and release it once it has been overridden. In this way, the N2 system will monitor the value when not being overridden.

8.2.4 Binary Output (BO)

All Binary Output (BO) points have the following features:

- Support Change of State (COS) reporting based on override status.
- Always considered reliable.
- Overriding BO points control the drive. These points are input commands to the drive. When released, the drive's internal value remains at its last overridden value.

8.2.5 Internal Integer (ADI)

All Internal Integer (ADI) points have the following features:

- Do not support Change of State (COS) reporting.

- Can be overridden and the "Override Active" bit will be set. However, the Internal value is unchanged (Read only).

8.3 Metasys N2 point map

8.3.1 Analogue Input (AI)

NPT	NPA	Description	Units	Note
AI	1	Speed setpoint	Hz	2 decimals
AI	2	Output frequency	Hz	2 decimals
AI	3	Motor speed	Rpm	0 decimal
AI	4	Load (power)	%	1 decimal
AI	5	Megawatt hours	MWh	Total counter
AI	6	Motor current	A	2 decimals
AI	7	Bus voltage	V	0 decimal
AI	8	Motor volts	V	1 decimal
AI	9	Heatsink temperature	°C	0 decimal
AI	10	Motor torque	%	1 decimal
AI	11	Operating days (trip)	Day	0 decimal
AI	12	Operating hours (trip)	Hour	0 decimal
AI	13	Kilowatt hours (trip)	kWh	Trip counter
AI	14	Torque reference	%	1 decimal
AI	15	Motor temperature rise*	%	1 decimal
AI	16	FBProcessDataOut1	-32768 to +32767	0 decimal
AI	17	FBProcessDataOut2	-32768 to +32767	0 decimal
AI	18	FBProcessDataOut3	-32768 to +32767	0 decimal
AI	19	FBProcessDataOut4	-32768 to +32767	0 decimal
AI	20	FBProcessDataOut5	-32768 to +32767	0 decimal
AI	21	FBProcessDataOut6	-32768 to +32767	0 decimal
AI	22	FBProcessDataOut7	-32768 to +32767	0 decimal
AI	23	FBProcessDataOut8	-32768 to +32767	0 decimal

*This is not supported by Vacon 20

8.3.2 Binary Input (BI)

NPT	NPA	Description	0 =	1 =
AI	1	Ready	Not ready	Ready
AI	2	Run	Stop	Run
BI	3	Direction	Clockwise	Counterclockwise
BI	4	Faulted	Not faulted	Faulted

NPT	NPA	Description	0 =	1 =
BI	5	Alarm	Not alarm	Alarm
BI	6	Reference frequency reached	False	True
BI	7	Motor running zero speed	False	True
BI	8	Flux ready	Not ready	Ready

8.3.3 Analogue Output (AO)

NPT	NPA	Description	Units	Note
AO	1	Common speed	%	2 decimals
AO	2	Current limit	A	2 decimals
AO	3	Minimum speed	Hz	2 decimals
AO	4	Maximum speed	Hz	2 decimals
AO	5	Acceleration time	s	1 decimal
AO	6	Deceleration time	s	1 decimal
AO	7	FBProcessDataIN1	-32768 to +32767	0 decimal
AO	8	FBProcessDataIN2	-32768 to +32767	0 decimal
AO	9	FBProcessDataIN3	-32768 to +32767	0 decimal
AO	10	FBProcessDataIN4	-32768 to +32767	0 decimal
AO	11	FBProcessDataIN5	-32768 to +32767	0 decimal
AO	12	FBProcessDataIN6	-32768 to +32767	0 decimal
AO	13	FBProcessDataIN7	-32768 to +32767	0 decimal
AO	14	FBProcessDataIN8	-32768 to +32767	0 decimal
AO	15	Any parameter read/write	-	Depends on parameter

8.3.4 Binary Output (BO)

NPT	NPA	Description	0 =	1 =
BO	1	Comms start/stop	Stop	Start
BO	2	Comms forward/reverse	Forward	Reverse
BO	3	Reset fault	N/A	Reset
BO	4	Stop mode information 1	-	-
BO	5	Stop mode information 2	-	-
BO	6	Force ramp to zero	-	-
BO	7	Freeze ramp	-	-
BO	8	Reference to zero	-	-
BO	9	BusCtrl	-	-
BO	10	BusRef	-	-

8.3.5 Internal Integer (ADI)

NPT	NPA	Description	Units
ADI	1	Active fault code	-
ADI	2	Control word	-
ADI	3	Status word	-
ADI	4	Any parameter ID	-

9. FAULT TRACING

When the option board or the AC drive control diagnostics detect an unusual operating condition, the drive opens a notification, for example, on the keypad. The keypad shows the ordinal number of the fault, the fault code and a short fault description.

You can reset the fault with the Reset button on the control keypad, via the I/O terminal or via used fieldbus protocol. The faults are stored in the Fault history menu, which can be browsed. The fault table presents only the fault conditions related to the fieldbus in use.

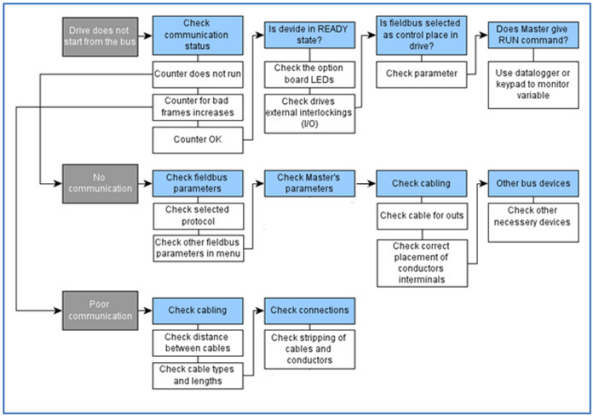
NOTE! When you are contacting a distributor or a factory because of a fault condition, always write down all texts and codes on the keypad display. Then send a description of the problem together with the Drive Info File to **tech.supportVDF@vacon.com**.

9.1 Typical fault conditions

Fault condition	Possible cause	Remedy
Cabling	• Supply or motor cables are located too close to the fieldbus cable • Wrong type of fieldbus cable • Too long cabling	
Grounding	Inadequate grounding.	Ensure grounding in all points on the net
Connections	Faulty connections: • Excessive stripping of cables • Conductors in wrong terminals • Too loose connections of conductors	
Parameter	• Faulty address • Overlapping slave addresses • Wrong control place selected	

9.2 Other fault conditions

The following fault tracing diagram will help you to locate and fix some of the most usual problems. If the problem persists, contact your local distributor.


Drive does not start from the bus
Check communication status
Counter does not run
Counter for bad frames increases
Counter OK
Is devide in READY state?
Check the option board LEDs
Check drives external interlockings (I/O)
Is fieldbus selected as control place in drive?
Check parameter
Does Master give RUN command?
Use datalogger or keypad to monitor variable
No communication
Check fieldbus parameters
Check selected protocol
Check other fieldbus parameters in menu
Check Master's parameters
Check cabling
Check cable for outs
Check correct placement of conductors interminals
Other bus devices
Check other necessery devices
Poor communication
Check cabling
Check distance between cables
Check cable types and lengths
Check connections
Check stripping of cables and conductors

10. APPENDIX 1 - PROCESS DATA

Process Data IN (Master to Slave)

Use of Process Data In variables depends on the used application. The configuration of the data is free.

Process Data OUT (Slave to Master)

Use of Process Data Out variables depends on the used application. The Fieldbus Master can read the frequency converter's actual values using process data variables. Control applications use process data as follows:

ID	Data	Value	Unit	Scale
2104	Process data OUT 1	Output Frequency	Hz	0,01 Hz
2105	Process data OUT 2	Motor Speed	rpm	1 rpm
2106	Process data OUT 3	Motor Current	A	0,1 A
2107	Process data OUT 4	Motor Torque	%	0,10 %
2108	Process data OUT 5	Motor Power	%	0,10 %
2109	Process data OUT 6	Motor Voltage	V	0,1 V
2110	Process data OUT 7	DC link voltage	V	1 V
2111	Process data OUT 8	Active Fault Code	-	-

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