VACON®
AC DRIVES

CANOPEN OPTION BOARD OPTE6
USER MANUAL

VACON®

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1. SAFETY

This manual contains clearly marked cautions and warnings that 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**

1.1 DANGER

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

1.2 WARNINGS

	The AC drive is meant for **fixed installations only**.
	**Do not perform any measurements** when the AC drive is connected to the mains.
	The **earth leakage current** of the AC drives exceeds 3.5mA AC. According to standard EN61800-5-1, **a reinforced protective ground connection** must be ensured. See Chapter 1.3.
	If the AC drive is used as a part of a machine, the **machine manufacturer is responsible** for providing the machine with a **supply disconnecting device** (EN 60204-1).
	Only **spare parts** delivered by Vacon can be used.
	At power-up, power brake or fault reset **the motor will start immediately** if the start signal is active, unless the pulse control for Start/Stop logic has been selected. 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.
	Wear protective gloves when you do mounting, cabling or maintenance operations. There can be sharp edges in the AC drive that can cause cuts.

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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 must be satisfied:

0) The protective conductor must have a cross-sectional area of at least 10 mm^2 Cu or 16 mm^2 Al, through its total run.

a) Where the protective conductor has a cross-sectional area of less than 10 mm^2 Cu or 16 mm^2 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 mm^2 Cu or 16 mm^2 Al.

b) 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:

- 2.5mm^2 if mechanical protection is provided or
- 4mm^2 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 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. CANopen option board OPTE6 - General

2.1 Overview

OPTE6 is a CANopen adapter board for Vacon-manufactured AC drives. The board allows the AC drive to be controlled by using the CANopen protocol. The board implements the AC drive profile with the velocity mode.

The option board firmware implements the following protocol specifications:

- **CiA-301** CANopen communication specification version 4.2
- **CiA-402** CANopen Profile for Drives and Motion Controller version 3.2

  Device: AC drive

  Operation mode: velocity mode
- **CiA-303-3** CANopen indicator specification, implemented by using 2 CANopen status led indicators

2.2 Software

2.2.1 CAN

The CAN data link layer protocol is standardised in ISO 11898. The standard describes mainly the data link layer composed of the logical link control (LLC) sub layer and the media access control (MAC) sub layer, and some aspects of the physical layer of the OSI reference model.

2.2.2 CANopen

CANopen is an application layer protocol on top of the CAN bus.

The protocol specification describes:

- Set of bit rates to support
- Network Management (NMT)
- Service data transmission (SDO)
- Process data transmission (PDO)
- Error message transmission (EMCY)
- Node status monitoring (heartbeat and node guarding)
- Identity information
- Parameter saving and restoring

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3. CANopen protocol description

3.1 NMT

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

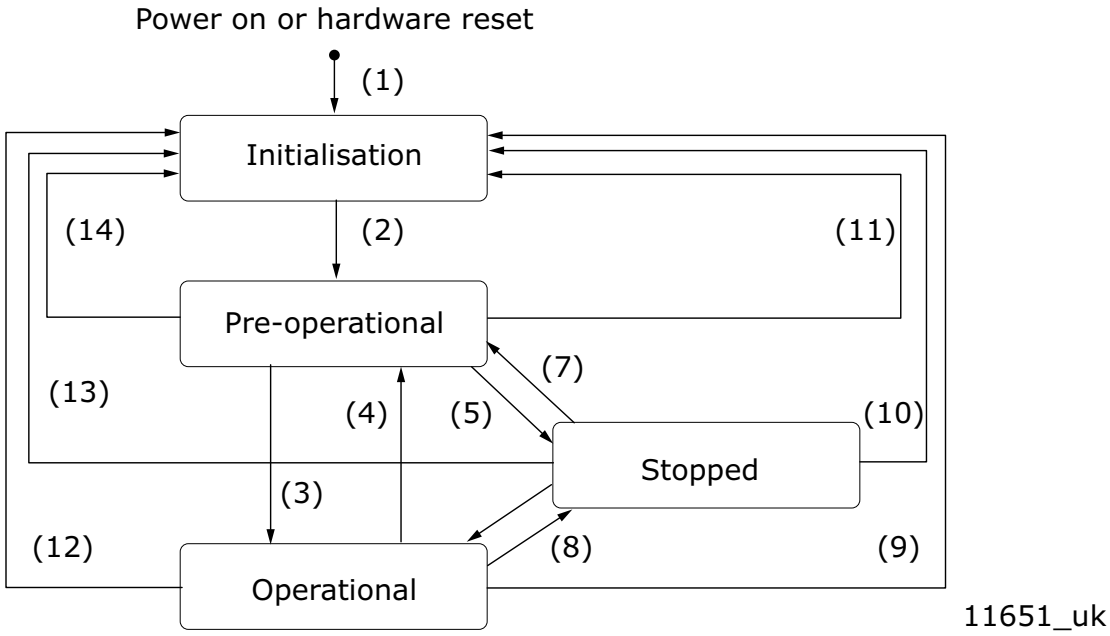

Figure 1. NMT state machine

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

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

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

4 and 7 = NMT service enters pre-operational indication

5 and 8 = NMT service stops remote node indication

6 = NMT service starts remote node indication

9, 10 and 11 = NMT resets node indication

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

Boot-up protocol

After a node starts, it will enter automatically into the pre-operational state. Always when this transition occurs, a boot-up message is sent into the bus.

Table 1: Boot-up message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x700 + Node ID	1	0							

3.2 NODE CONTROL PROTOCOLS

Protocol start remote node

The start remote node message sets the node(s) into operational state. See Figure 1. NMT state machine. If the node ID in the message is set to '0', the message affects all nodes (broadcast).

Table 2: Start remote node message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x0	0x2	0x1	NODE ID						

Protocol stop remote node

The stop remote node message sets the node(s) into stopped state. See Figure 1 NMT state machine. If the node ID in the message is set to '0', the message affects all nodes (broadcast). When the node is in stopped state, it will not answer to SDO or PDO messages.

Table 3: Stop remote node message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x0	0x2	0x2	NODE ID						

Protocol enter pre-operational

The enter pre-operational message sets the node(s) into pre-operational state. See Figure 1. NMT state machine. If the node ID in the message is set to '0', the message affects all nodes (broadcast). When the node is in pre-operational state, it will not answer to PDO messages.

Table 4: Enter pre-operational message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x0	0x2	0x80	NODE ID						

Protocol reset node

The reset node message makes the node(s) apply application reset. See Figure 1. NMT state machine. Application reset sets the whole object dictionary back to the default or previously saved values. If the node ID in the message is set to '0', the message affects all nodes (broadcast). After the node has made the application reset, it will enter the pre-operational state automatically from the initialising state. This also creates a boot-up event and the boot-up message is sent after the reset.

Table 5: Reset node message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x0	0x2	0x81	NODE ID						

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Protocol reset communication

The reset communication message makes the node(s) apply communication reset. See Figure 1. NMT state machine. Communication reset does not affect the object dictionary values. If the node ID in the message is set to '0', the message affects all nodes (broadcast). After the node has made the communication reset, it will enter the pre-operational state automatically from the initialising state. This also creates a boot-up event and the boot-up message is sent after the reset.

Table 6: Reset communication message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x0	0x2	0x82	NODE ID						

3.3 ERROR CONTROL PROTOCOLS

3.3.1 HEARTBEAT PROTOCOL

Heartbeat protocol defines the producer and consumer. The producer node sends its NMT status that is then available for any consumer node. The consumer node is the receiver of heartbeat messages. The producer node has a timing parameter that indicates how often the heartbeat message should be sent. The consumer node has a relative parameter that indicates how often the heartbeat message should be received. If the consumer does not receive the heartbeat message within the time defined in the heartbeat object entry, an error event occurs.

Table 7: Node status description

Value	Description
0x0	Boot-up
0x4	Stopped
0x5	Operational
0x7F	Pre-operational

Table 8: Heartbeat message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x700 + Node ID	0x1	Status							

Table 9: Heartbeat-related objects in OD

Index	Description
0x1016	Consumer heartbeat time
0x1017	Producer heartbeat time
0x1029	Error behaviour

3.3.2 NODE GUARDING PROTOCOL

Node guarding protocol is a NMT master driver protocol, where the master sends a remote transmission request, which is answered by the slave. The slave response includes one data byte that consists of a NMT slave state, and a toggle bit that toggles every response.

NOTE! The CiA application note 802 recommends that the node guarding protocol should not be used, because of different handling of RTR frames in CAN controllers.

OPTE6 option board does not have a hardware-triggered automatic response to the RTR frame. RTR information is handled by software, and the response data always consists of updated information.

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Table 10: Node guarding RTR frame (remote request)

CAN ID	LENGTH	RTR	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x700 + Node ID	0x0	1								

Table 11: Node guarding response

CAN ID	LENGTH	DATA0		DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x700 + Node ID	0x1	t	Status							

Table 12: Node guarding slave status

Status	
Value	**Description**
0x4	Stopped
0x5	Operational
0x7F	Pre-operational

Table 13: Node guarding related objects in OD

Index	**Description**
0x100C	Guard time
0x100D	Life time factor

3.3.3 EMCY object

Option board works as an EMCY producer. The EMCY object is transmitted when a fault occurs in the drive or option board. To switch off the EMCY producer, disable the EMCY COB-id by writing MSB bit to 1 (object 0x1014).

When an error occurs, the EMCY message is transmitted with the current value of the error register and the error code is inserted into the pre-defined error field list. The newest error code is always the first sub-index on the error field list. When all active errors are cleared, an empty EMCY object is transmitted.

If a drive-internal fault occurs, the MSEF field contains the drive fault code. See the application and user manual for possible fault codes. The ER field holds a bit coded value of the error type. See object 0x1001 for more details.

Table 14: EMCY message

CAN ID	LENGTH	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x80 + Node ID	0x8	EEC		ER	MSEF				

Table 15: EMCY message data fields

EEC	Emergency error code
ER	Error register value
MSEF	Manufacturer-specific error code

Table 16: Used EMCY error codes and description MSEF fields

DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x0000		ER	3: Number of remaining error sources				
0x1000			Drive fault codes				
0x8110			-				
0x8120			-				
0x8130			3: Heartbeat consumer subindex 4: Heartbeat consumer node-ID				
0x8140			-				
0x8210			-				
0x8220			-				
0x8240			-				
0x8250			-				

Table 17: Description and behavior of different error situations

EEC	Description	Error behaviour	Err LED
0x0000	Error Reset or No Error	If MSEF field is empty all error sources are cleared and drive fault is cleared.	-
0x1000	Generic Error	Drive fault codes have changed.	-
0x8120	CAN in Error Passive Mode	EMCY is sent after CAN driver goes back to active state. This also clears the fault.	Single flash
0x8130	Life Guard Error	Error is reset when a RTR is received or either of the life guard objects (0x100C, 0x100D) is written to zero.	Double flash
	Heartbeat Error	Error is reset when a HB message is received by the HB consumer, or the consumer entry is changed (either Node-ID or Heartbeat Time).	
0x8140	Recovered from Bus-Off	EMCY is sent after CAN driver goes back to active state. This also clears the fault.	On
0x8250	PDO timer expired	Error is cleared when a PDO is received (in expired PDO).	Quadruple flash

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All communication errors are reset if a reset command is given. This does not however reset drive faults if there are active error sources.

EMCYs are also created in some cases, even though a fault is not created. These are for notification only.

Table 18: Notification EMCY objects

EEC	Description
0x8110	CAN overrun (objects lost)
0x8210	PDO not processed due to length error
0x8220	PDO length exceeded
0x8240	Unexpected SYNC data length

Table 19: EMCY-relate objects in OD

Index	Description
0x1001	Error register
0x1003	Pre-defined error field list
0x1014	EMCY object COB-ID

3.4 SDO protocol

The Option board contains one SDO server. The SDO protocol provides a direct access to the object entries of the object dictionary of the CANopen device. Each message is acknowledged by the server. The protocol is mostly used to set and read parameters from the object dictionary at the pre-operational state. Some objects have limitations for SDO usage at the operational state.

Up to four bytes can be transferred by using the expedited transfer, where the data fits into one CAN message. For bigger than 4-byte object sizes, segmented transfer must be used. Optionally, block transfer is also possible with bigger data types. Block transfer is most efficient with big data sizes.

Table 20: SDO-related objects in OD

Index	Description
0x1200	SDO server parameter object

3.5 PDO PROTOCOL

Process data objects PDOs are used to transmit real-time data with no protocol overhead. Each PDO has its mapping and communication parameter record.

There are two different types of PDOs. Transmit PDOs for producing data into network and Receive PDOs for consuming data from network. OPTE6 board consist totally 3 receive and 3 transmit PDOs.

Table 21: PDO-related objects in OD

Index	Description
0x1400	1st rxPDO communication parameter record
0x1401	2nd rxPDO communication parameter record
0x1402	3rd rxPDO communication parameter record
0x1600	1st rxPDO mapping parameter record
0x1601	2nd rxPDO mapping parameter record
0x1602	3rd rxPDO mapping parameter record
0x1800	1st txPDO communication parameter record
0x1801	2nd txPDO communication parameter record
0x1802	3rd txPDO communication parameter record
0x1A00	1st txPDO mapping parameter record
0x1A01	2nd txPDO mapping parameter record
0x1A02	3rd txPDO mapping parameter record

3.5.1 PDO COMMUNICATION PARAMETER RECORD

PDO communication parameter record defines the COB-id, transmission type and how often the PDO is transmitted. The fields can be modified during the pre-operational state.

Table 22: PDO communication parameter record

Indexes	Sub-index	Name	Data type	RX PDO	TX PDO
0x1400 0x1401 0x1402 0x1800 0x1801 0x1802	0	Highest sub-index supported	UNSIGNED8	ro	ro
	1	COB ID	UNSIGNED32	r/w	r/w
	2	Transmission type	UNSIGNED8	r/w	r/w
	3	Inhibit time	UNSIGNED16	ro	r/w
	4	Reserved	UNSIGNED8	ro	ro
	5	Event timer	UNSIGNED16	r/w	r/w
	6	SYNC start value	UNSIGNED8	Not available	r/w

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3.5.2 COB ID

COB ID determines whether the PDO is valid (active) and using 11-bit or 29-bit frames.

troller application and user manual for possible fault codes.

Table 23: COB ID

31	30	29	28 11	10 0
Valid	Reserved	Frame	0x00000	11-bit CAN-ID
			29-bit CAN-ID	

Table 24: COB ID data fields

Bit(s)	Value	Description
Valid	0	PDO exists / enabled
	1	PDO does not exist / disabled
Reserved	x	Not applicable
Frame	0	11-bit CAN-ID valid
	1	20-bit CAN-ID valid
29-bit CAN-ID	x	29-bit CAN-ID of the CAN extended frame
11-bit CAN-ID	x	11-bit CAN-ID of the CAN base frame

3.5.3 TRANSMISSION TYPE

Table 25: PDO transmission types

Value	Description	Receive PDO	Transmit PDO
0x00	Synchronous (acyclic)	X	X
0x01	Synchronous (cyclic every sync)	X[1]	X
0x02	Synchronous (cyclic every 2nd sync)	X[1]	X
0x03	Synchronous (cyclic every 3rd sync)	X[1]	X
0x04	Synchronous (cyclic every 4th sync)	X[1]	X
...	...	X[1]	X
0xF0	Synchronous (cyclic every 240th sync)	X[1]	X
0xF1	Reserved	-	-
...	...	-	-
0xFB	Reserved	-	-
0xFC	RTR-only (synchronous)	-	X
0xFD	RTR-only (Event-driven)	-	X
0xFE	Event-driven (manufacturer-specific)	X	X
0xFF	Event-driven (device and application profile)	X	X

[1] For receive PDO, each sync transmission mode equals the same. Each sync always activates the latest received PDO value.

Synchronous means that the PDO is transmitted after the SYNC. The CANopen device starts sampling the data with the reception of the SYNC. If the transmission mode of the PDO is acyclic, the CANopen device gives an internal event, the sampling starts with the next SYNC and the PDO is transmitted afterwards. If the transmission mode is cyclic, the sampling starts with the reception of every SYNC, every second SYNC, every third SYNC etc. depending on the given value, and the PDO is transmitted afterwards.

RTR-only means that the PDO is requested via RTR. If the transmission mode of the PDO is synchronous, the CANopen device starts sampling with the reception of every SYNC and will buffer the PDO. If the mode is event-driven, the CANopen device starts the sampling with the reception of the RTR and transmits the PDO immediately.

Event-driven means that the PDO can be transmitted at any time based on the occurrence of the internal event of the CANopen device. An event that triggers the OPTE6 transmission occurs when the data mapped into the PDO is changed. Also, an event timer can be used to create transmit events.

Inhibit time

For transmit PDOs, the inhibit time defines the minimum transmission interval, when 0xFE or 0xFF transmission types are selected. For receive PDOs, the inhibit time is disabled. The inhibit time is 16bit unsigned value that is given as multiple of 100µs. Zero value means that the inhibit time is disabled.

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Event timer

For a transmit PDO event, the timer defines the maximum interval between the transmissions, if the transmission type is set to 0xFE or 0xFF.

For a receive PDO event, the timer activates the deadline monitoring. The deadline monitoring is activated at the first received PDO. If the time between the after the last PDO received is longer than defined in the event timer, a fault will occur.

Event timer is 16bit unsigned value that is given as multiple of 1ms. Zero value means that the event timer is disabled.

Sync start value

Sync start value gives the possibility to compensate network peak traffic in case of sync transmission mode. If the sync start value is zero, the normal sync behaviour for the PDO is used. If the sync start value is greater than zero, the PDO waits for the SYNC message that contains the counter value. When the counter value of a SYNC message equals the SYNC start value, the first SYNC message is regarded as received. The sync start value must not be changed while the PDO exists. See the SYNC message format in Table 28.

3.5.4 PDO parameter mapping record

Each PDO consists of a maximum of 8 bytes of mapped data. To data map the PDO, use a corresponding mapping record that consists of index, sub-index and the length of the mapped object.

Table 26: PDO mapping structure

31 16	15 8	7 0
Index	Sub-index	Length

To data map the PDOs, first disable the related PDO COB ID in the pre-operational state. In the mapping structure, write the sub-index 0 to zero (number of mapped objects). Then write the mapping structures on the mapping parameter record, starting from the sub-index 1. When you have written all the necessary structures, write the sub-index 0 to correspond to the mapped objects.

Table 27: PDO mapping parameter record

Indexes	Sub-index	Name	Data type	Access
0x1600 0x1601 0x1602 0x1A00 0x1A01 0x1A02	0	Number of mapped objects in PDO	UNSIGNED8	r/w
	1	1st object to be mapped	UNSIGNED32	r/w
	2	2nd object to be mapped	UNSIGNED32	r/w
	3	3rd object to be mapped	UNSIGNED32	r/w
	4	4th object to be mapped	UNSIGNED32	r/w

3.6 SYNC PROTOCOL

Sync protocol is used by PDOs when the transmission is synchronous. The sync object that is defined by COB ID in the object 0x1005 triggers the transmission of the txPDOs, or activates the previously received data of the rxPDO. At the default sync message the CAN-ID is 0x80. The sync message is a zero-length message but optionally it can consist of an 8bit counter.

Table 28: SYNC message

CAN ID	LENGTH
0x80	0x0

Table 29: SYNC message with counter

CAN ID	LENGTH	DATA0
0x80	0x1	Counter

3.6.1 SYNC WITH COUNTER

When a counter is used in a sync message, the PDOs that have a defined sync start value compare the value against the sync message counter. The sync producer counter will overflow after it reaches the value defined in its 'synchronous counter overflow value' at the object 0x1019. Also, the sync consumer has the object 0x1019 even when the value itself is ignored. When the value of the sync consumer is greater than zero, the sync counter handling and expecting of the sync messages with counter are activated.

When the sync start value and the sync counter value match, the first sync message is regarded as received.

The following figure shows an example of SYNC messaging, when the slave is configured with:

- 0x1019 - Synchronous counter > 0
- 0x1800,2 - Transmission type = 2 (Cyclic, No. of SYNCs = 2)
- 0x1800,6 - Sync start value = 4

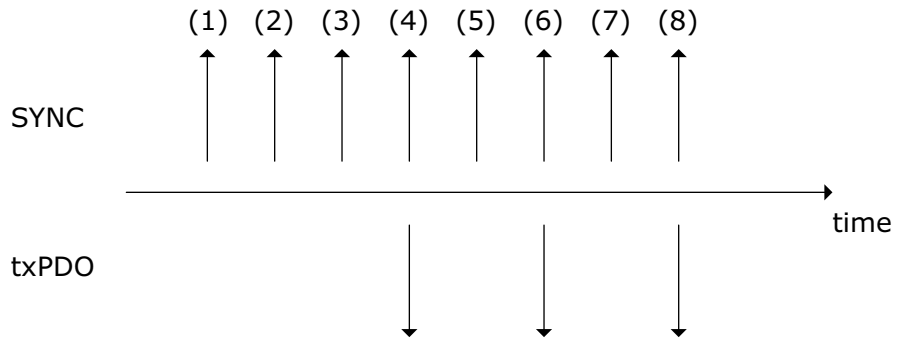

Figure 2. txPDO responses to SYNC messages

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Table 30: Sync-related object in OD

Index	Description
0x1005	COB ID SYNC
0x1019	Synchronous counter
0x1014	EMCY object COB ID
0x1400	1st rxPDO communication parameter record
0x1401	2nd rxPDO communication parameter record
0x1402	3rd rxPDO communication parameter record
0x1800	1st txPDO mapping parameter record
0x1801	2nd txPDO mapping parameter record
0x1802	3rd txPDO mapping parameter record

3.7 COMMUNICATION OBJECTS

3.7.1 0X1000 - DEVICE TYPE

The device type object indicates basic information about the device, including the supported device profile and the profile settings.

Table 31: 0x1000 Device type

Index	Sub-index	Value	Name	Data type	Access
0x1000	-	0x00010192	Device type	UNSIGNED32	const

Value description:

0x0192 = 402 (Drive profile)

0x0001 = AC drive with PDO set for a generic drive device

3.7.2 0X1001 - ERROR REGISTER

Error register indicates the active error code.

Table 32: 0x1001 Error register

Index	Sub-index	Value	Name	Data type	Access
0x1001	-	0x0	Error register	UNSIGNED8	const

Table 33: Error register bit descriptions

Bit	Meaning
0	Generic error
1	Current
2	Voltage
3	Temperature
4	Communication error (overrun, error state)
5	Device profile-specific*
6	Reserved*
7	Manufacturer-specific*

* Not used/supported

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3.7.3 0x1003 - Pre-defined Error Field

Pre-defined error field is a list of errors signaled with an EMCY object, listing the error history of up to 9 error entries. Sub-index 1 contains the latest error.

Table 34: 0x1003 Pre-defined error field

Index	Sub-index	Value	Name	Data type	Access
0x1003	0	0x0	Number of errors	UNSIGNED32	ro
	1	0x0	Standard error field	UNSIGNED32	ro
	..	..	..	..	..
	9	0x0	Standard error field	UNSIGNED32	ro

3.7.4 0x1005 - COB ID SYNC

Defines the synchronisation message COB ID. Receiving the sync message causes actions in the PDOs that have a synchronous transmission mode.

Table 35: 0x1005 COB ID sync

Index	Sub-index	Value	Name	Data type	Access
0x1005	-	0x00000080	COB ID sync	UNSIGNED32	r/w

3.7.5 0x100C - Guard Time

The object contains the guard time in milliseconds. As a default, guarding is disabled.

Table 36: 0x100C Guard time

Index	Sub-index	Value	Name	Data type	Access
0x100C	-	0x0000	Guard time	UNSIGNED16	r/w

3.7.6 0x100D - Life Time Factor

Life time factor is used together with guard time, which is multiplied with the life time factor.

Table 37: 0x100D Guard time

Index	Sub-index	Value	Name	Data type	Access
0x100D	-	0x00	Guard time	UNSIGNED8	r/w

Node life time = life time factor x guard time. If node life time is zero, guarding is disabled.

3.7.7 0X1014 - COB ID EMCY

The object defines the emergency message COB ID.

Table 38: 0x1014 COB ID EMCY

Index	Sub-index	Value	Name	Data type	Access
0x1014	-	0x00000080+ node id	COB ID EMCY	UNSIGNED32	r/w

3.7.8 0X1016 - HEARTBEAT CONSUMER ENTRIES

The device can act as the heartbeat consumer. Up to 8 devices can be monitored, as defined in the table below. If the heartbeat transmission delay of a defined node ID exceeds the heartbeat time, the error behaviour is activated according to the error behaviour object.

Table 39: 0x1016 Heartbeat consumer entries

Index	Sub-index	Value	Name	Data type	Access
0x1016	0	0x0000 0008	COB ID EMCY	UNSIGNED32	ro
	1	0x0000 0000	Consumer heart beat time 1	UNSIGNED32	r/w
	2	0x0000 0000	Consumer heart beat time 2	UNSIGNED32	r/w
	3	0x0000 0000	Consumer heart beat time 3	UNSIGNED32	r/w
	4	0x0000 0000	Consumer heart beat time 4	UNSIGNED32	r/w
	5	0x0000 0000	Consumer heart beat time 5	UNSIGNED32	r/w
	6	0x0000 0000	Consumer heart beat time 6	UNSIGNED32	r/w
	7	0x0000 0000	Consumer heart beat time 7	UNSIGNED32	r/w
	8	0x0000 0000	Consumer heart beat time 8	UNSIGNED32	r/w

Table 40: Consumer heartbeat time entry

31 24	23 16	15 0
Not used, must be zeroes.	Node ID	Heartbeat time

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3.7.9 0x1017 - Producer Heartbeat Time

Heartbeat producer object consists of the time in milliseconds (ms) that it takes to transmit the heartbeat message into the network. If the value is zero, the heartbeat is not used.

Table 41: 0x1017 Producer heartbeat time

Index	Sub-index	Value	Name	Data type	Access
0x1017	-	0x0000	Producer heartbeat time	UNSIGNED16	r/w

Table 42: Heartbeat message

CAN ID	LENGTH	DATA0
0x700 + node	0x1	Node state

3.7.10 0x1018 - Identify Object

The object gives information about the option board

Table 43: 0x1018 Identify object

Index	Sub-index	Value	Name	Data type	Access
0x1018	0	0x04	Number of entries	UNSIGNED8	ro
	1	0x90	Vendor ID	UNSIGNED32	ro
	2	-	Product code	UNSIGNED32	ro
	3	-	Revision number	UNSIGNED32	ro
	4	-	Serial number	UNSIGNED32	ro

3.7.11 0x1019 - Synchronous counter

The synchronous counter defines whether a counter is mapped into the SYNC message, as well as the highest value the counter can reach. 0 disables the sync counter.

Table 44: 0x1019 Synchronous counter

Index	Sub-index	Value	Name	Data type	Access
0x1019	-	0x00	Synchronous counter	UNSIGNED8	r/w

3.7.12 0x1029 - Error behaviour

Error behaviour allows a change in the default error behaviour if there is a communication error.

Table 45: 0x1029 Error behaviour

Index	Sub-index	Value	Name	Data type	Access
0x1019	0	0x01	Number of entries	UNSIGNED8	ro
	1	0x00	Communication error	UNSIGNED8	r/w

Table 46: Error behaviour

Value	Description
0	Pre-operational
1	No change in state
2	Stopped
3..127	Reserved

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3.8 Saving and restoring the object dictionary

CANopen defines a way of restoring the values in an object dictionary to the defaults and saving the values if the modified values must be valid after the power cycle. The manufacturer-specific bypass configuration can be restored to the object dictionary.

When the object dictionary is saved, the ID of the PDO, EMCY or SYNC COB ID does not change with the node ID. When the default parameters are used, the COB IDs are always calculated according to the node ID.

3.8.1 0x1010 Store parameter field

To save the object dictionary, use the object 0x1010 'Store Parameter Field'.

The option board only saves the parameters in the object dictionary with a command. Autonomous saving is not supported. To save the parameters in the object dictionary, write the value 0x65766173 (ASCII "save") into the sub-index by using the SDO protocol.

Table 47: 0x1010 Store parameter field

Index	Sub-index	Name	Data type	Access
0x1010	0	Highest sub-index supported	UNSIGNED8	ro
	1	Save all parameters	UNSIGNED32	r/w

3.8.2 0x1011 Restore default parameters

The object values of the object dictionary are restored to defaults by using the object 0x1011. Option board supports restoring only for All parameters (sub index 1) and for manufacturer-specific Bypass mode defaults (sub index 4).

To restore parameters, write 0x64616F6C (ASCII "load") into the sub-index by using the SDO protocol. Default object values are selected after reset.

Table 48: 0x1011 Restore default parameters

Index	Sub-index	Name	Data type	Access
0x1011	0	Highest sub-index supported	UNSIGNED8	ro
	1	Restore all default parameters	UNSIGNED32	r/w
	4	Restore bypass parameter set*	UNSIGNED32	r/w

* Bypass parameter set is used with a drive that has special applications. The bypassed set disables the CIA-402 drive profile and resets the PDO mapping to the vendor specific configuration. See chapter "Bypass parameter set" for more information.

3.8.3 Bypass parameter set

Bypass parameter set can be restored to activate direct communication with the application. The CIA-402 state machine and the related objects are bypassed. The bypass set is used with special drive applications.

NOTE! When the bypass parameter set is restored, the COB IDs are calculated according to the table below. After the bypass parameter set is used, the node ID change does not affect the COB IDs.

Table 49: Overview of bypass RX PDO configuration

Object	COB ID	Size	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
RPDO1	0x200 +node ID	6	FB PD in offset 0		FB PD in offset 1		FB PD in offset 2			
RPDO2	0x300 +node ID	8	FB PD in offset 3		FB PD in offset 4		FB PD in offset 5		FB PD in offset 6	
RPDO3	0x400 +node ID	8	FB PD in offset 7		FB PD in offset 8		FB PD in offset 9		FB PD in offset 10	

Table 50: Overview of bypass TX PDO configuration

Object	COB ID	Size	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
TPDO1	0x180 +node ID	6	FB PD in offset 0		FB PD in offset 1		FB PD in offset 2			
TPDO2	0x280 +node ID	8	FB PD in offset 3		FB PD in offset 4		FB PD in offset 5		FB PD in offset 6	
TPDO3	0x380 +node ID	8	FB PD in offset 7		FB PD in offset 8		FB PD in offset 9		FB PD in offset 10	

Configuration of the receive PDO mapping, when the bypass parameter set is restored, is the following:

Table 51: Receive PDO 1

Index	Sub-index	Value	Name	Data type	Access
0x1600	0	3	Number of entries	UNSIGNED8	r/w
	1	0x20000110	FB PD In Offset 0*	UNSIGNED32	r/w
	2	0x20000210	FB PD In Offset 1*	UNSIGNED32	r/w
	3	0x20000310	FB PD In Offset 2*	UNSIGNED32	r/w

Table 52: Receive PDO 2

Index	Sub-index	Value	Name	Data type	Access
0x1601	0	4	Number of entries	UNSIGNED8	r/w
	1	0x20000410	FB PD In Offset 3*	UNSIGNED32	r/w
	2	0x20000510	FB PD In Offset 4*	UNSIGNED32	r/w
	3	0x20000610	FB PD In Offset 5*	UNSIGNED32	r/w
	4	0x20000710	FB PD In Offset 6*	UNSIGNED32	r/w

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Table 53: Receive PDO 3

Index	Sub-index	Value	Name	Data type	Access
0x1602	0	4	Number of entries	UNSIGNED8	r/w
	1	0x20000810	FB PD In Offset 7*	UNSIGNED32	r/w
	2	0x20000910	FB PD In Offset 8*	UNSIGNED32	r/w
	3	0x20000A10	FB PD In Offset 9*	UNSIGNED32	r/w
	4	0x20000B10	FB PD In Offset 10*	UNSIGNED32	r/w

* Data inside 'FB PD In' vary according to the drive application. For further information, see Application Manual.

Configuration of the receive PDO parameter, when the bypass parameter set is restored, is the following:

Table 54: Receive PDO 1 communication parameter record

Index	Sub-index	Value	Name	Data type	Access
0x1400	0	5	Highest sub-index	UNSIGNED8	ro
	1	0x00000200+id	COB-ID	UNSIGNED32	r/w
	2	0xFE	Transmission type	UNSIGNED8	r/w
	3	0x03E8	Inhibit time	UNSIGNED16	r/w
	4	-	Reserved	UNSIGNED8	ro
	5	0x0	Event timer	UNSIGNED16	r/w

Table 55: Receive PDO 2 communication parameter record

Index	Sub-index	Value	Name	Data type	Access
0x1401	0	5	Highest sub-index	UNSIGNED8	ro
	1	0x00000300+id	COB-ID	UNSIGNED32	r/w
	2	0xFE	Transmission type	UNSIGNED8	r/w
	3	0x03E8	Inhibit time	UNSIGNED16	r/w
	4	-	Reserved	UNSIGNED8	ro
	5	0x0	Event timer	UNSIGNED16	r/w

Table 56: Receive PDO 3 communication parameter record

Index	Sub-index	Value	Name	Data type	Access
0x1402	0	5	Highest sub-index	UNSIGNED8	ro
	1	0x00000400+id	COB-ID	UNSIGNED32	r/w
	2	0xFE	Transmission type	UNSIGNED8	r/w
	3	0x03E8	Inhibit time	UNSIGNED16	r/w
	4	-	Reserved	UNSIGNED8	ro
	5	0x0	Event timer	UNSIGNED16	r/w

Configuration of the transmit PDO mapping, when the bypass parameter set is restored, is the following:

Table 57: Transmit PDO 1 mapping entry

Index	Sub-index	Value	Name	Data type	Access
0x1A00	0	3	Number of entries	UNSIGNED8	r/w
	1	0x20010110	FB PD Out Offset 0*	UNSIGNED32	r/w
	2	0x20010210	FB PD Out Offset 1*	UNSIGNED32	r/w
	3	0x20010310	FB PD Out Offset 2*	UNSIGNED32	r/w

Table 58: Transmit PDO 2 mapping entry

Index	Sub-index	Value	Name	Data type	Access
0x1A01	0	4	Number of entries	UNSIGNED8	r/w
	1	0x20010410	FB PD Out Offset 3*	UNSIGNED32	r/w
	2	0x20010510	FB PD Out Offset 4*	UNSIGNED32	r/w
	3	0x20010610	FB PD Out Offset 5*	UNSIGNED32	r/w
	4	0x20010710	FB PD Out Offset 6*	UNSIGNED32	r/w

Table 59: Transmit PDO 3 mapping entry

Index	Sub-index	Value	Name	Data type	Access
0x1A02	0	4	Number of entries	UNSIGNED8	r/w
	1	0x20010810	FB PD Out Offset 7*	UNSIGNED32	r/w
	2	0x20010910	FB PD Out Offset 8*	UNSIGNED32	r/w
	3	0x20010A10	FB PD Out Offset 9*	UNSIGNED32	r/w
	4	0x20010B10	FB PD Out Offset 10*	UNSIGNED32	r/w

* Data inside 'FB PD Out' vary according to the drive application. For further information, see Application Manual.

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Configuration of the transmit PDO parameter, when the bypass parameter set is restored, is the following:

Table 60: Transmit PDO 1 communication parameter record

Index	Sub-index	Value	Name	Data type	Access
0x1800	0	6	Highest sub-index	UNSIGNED8	ro
	1	0x00000180+id	COB-ID	UNSIGNED32	r/w
	2	0xFE	Transmission type	UNSIGNED8	r/w
	3	0x03E8	Inhibit time	UNSIGNED16	r/w
	4	-	Reserved	UNSIGNED8	ro
	5	0x0	Event timer	UNSIGNED16	r/w
	6	0x0	Sync start value	UNSIGNED8	w

Table 61: Transmit PDO 2 communication parameter record

Index	Sub-index	Value	Name	Data type	Access
0x1801	0	6	Highest sub-index	UNSIGNED8	ro
	1	0x00000280+id	COB-ID	UNSIGNED32	r/w
	2	0xFE	Transmission type	UNSIGNED8	r/w
	3	0x03E8	Inhibit time	UNSIGNED16	r/w
	4	-	Reserved	UNSIGNED8	ro
	5	0x0	Event timer	UNSIGNED16	r/w
	6	0x0	Sync start value	UNSIGNED8	w

Table 62: Transmit PDO 3 communication parameter record

Index	Sub-index	Value	Name	Data type	Access
0x1802	0	5	Highest sub-index	UNSIGNED8	ro
	1	0x00000400+id	COB-ID	UNSIGNED32	r/w
	2	0xFE	Transmission type	UNSIGNED8	r/w
	3	0x03E8	Inhibit time	UNSIGNED16	r/w
	4	-	Reserved	UNSIGNED8	ro
	5	0x0	Event timer	UNSIGNED16	r/w
	6		Sync start value	UNSIGNED8	w

4. CANopen option board OPTE6 - technical data

4.1 General

Table 63. Technical data of CANopen option board

CAN bus electrical isolation	500 VDC	
Ambient temperature	As specified in drive specification (-10°C ... 40°C)	
Storing temperature	As specified in drive specification (-40°C ... 70°C)	
Humidity	0-95%, non-condensing, corrosive	
Vibration and electrical safety	EN 61800-5-1 (2007) 5... 15.8 Hz 1mm (peak) 15.8 ...150 Hz 1 G	
Emission	C2 level, EN 61800-3 (2004)	
Immunity	C2 level, EN 61800-3 (2004)	
CAN Interface	Isolation	2500 V rms isolation with a less than 10-ns propagation delay
	Protection	±8kV ESD IEC 61000-4-2 Contact Discharge ±80V Fault Protection greater than ±12V common Mode Range

4.2 CAN cable

The recommended cables for installations are 4 wires twisted and a shielded cable with an impedance of 120 Ohm. The network topology is a 2-wire bus line that is terminated at both ends by resistors representing the characteristic impedance of the bus line. The typical CAN cable impedance is 120 Ohm, and so for the termination resistors of ~120 Ohm must be used. For long networks a higher resistor value must be used (150-300 Ohm).

Table 64. Bus parameter relation to cable length

Cable length	Max bit rate [kbit/s]	Max cable resistance [mΩ/m]
0-40 m	1000	Max 70
100 m	500	<60
500 m	100	<40
1 km	50	<26

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4.2.1 Isolated ground connection

The OPTE6 option board is galvanically isolated. In CANopen networks that are completely galvanically isolated the CAN ground signal is carried in the cable line. It is connected at only one point into common ground potential. If one CAN device with not galvanically isolated interface is connected to the network, the potential for isolated CAN ground is given. Therefore only one device with not galvanically isolated interface may be connected to the network.

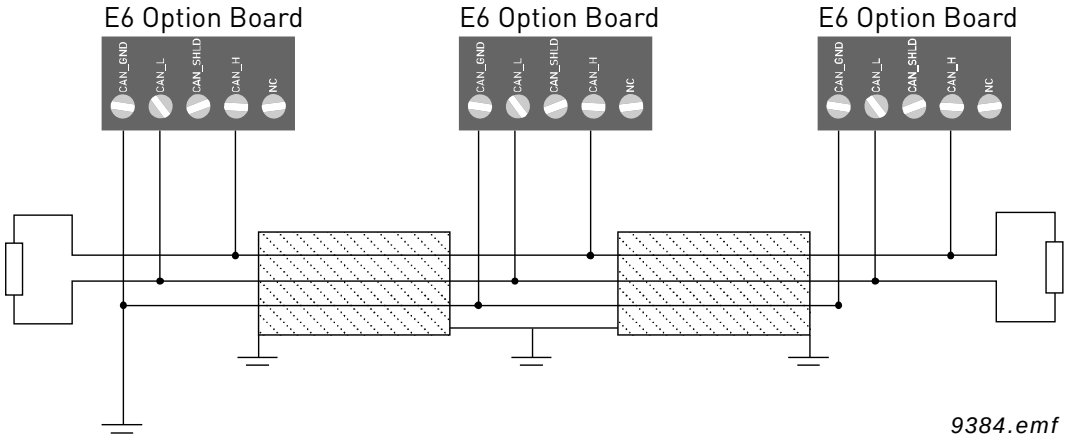

Figure 3. Completely isolated nodes

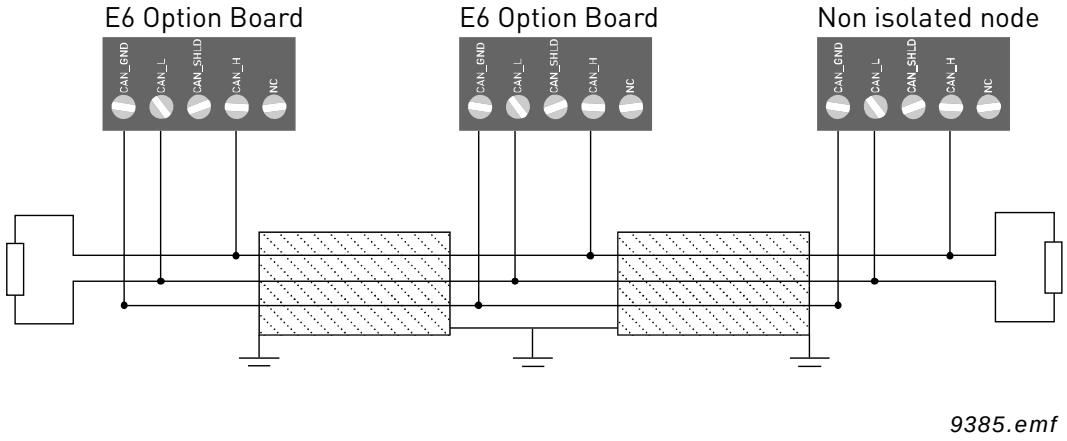

Figure 4. CAN network with one non-isolated node

4.2.2 RECOMMENDED CABLE

For all OPTE6 installations the use of 4-wire cable is recommended. 4 wires enable the connection of isolated digital grounds with nodes.

Vacon recommends the following cable:

UNITRONIC® BUS CAN FD P

Colour-coded in accordance with DIN 47100

Figure 5. Recommended cable

Table 65. Cable thickness, length and baud rate relation

Bit rate	Min cable thickness			
1 Mbit/s	0.25			
500 kbit/s	0.25	0.34		
250 kbit/s	0.25	0.34	0.6	
125 kbit/s	0.25	0.34	0.6	
100 kbit/s	0.25	0.34	0.6	0.6
50 kbit/s	0.25	0.34	0.6	0.6
Cable length	25	100	250	500

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5. OPTE6 LAYOUT AND CONNECTIONS

5.1 LAYOUT AND CONNECTIONS

OPTE6 has two different hardware revisions with slightly different layout. Layout is different in LED arrangement and termination resistor orientation.

The two hardware revisions are marked with different product codes, and this product code can be located from the sticker on the top side (location marked in Figure 6).

The two hardware revisions are named 70CVB01605 and 70CVB01124.

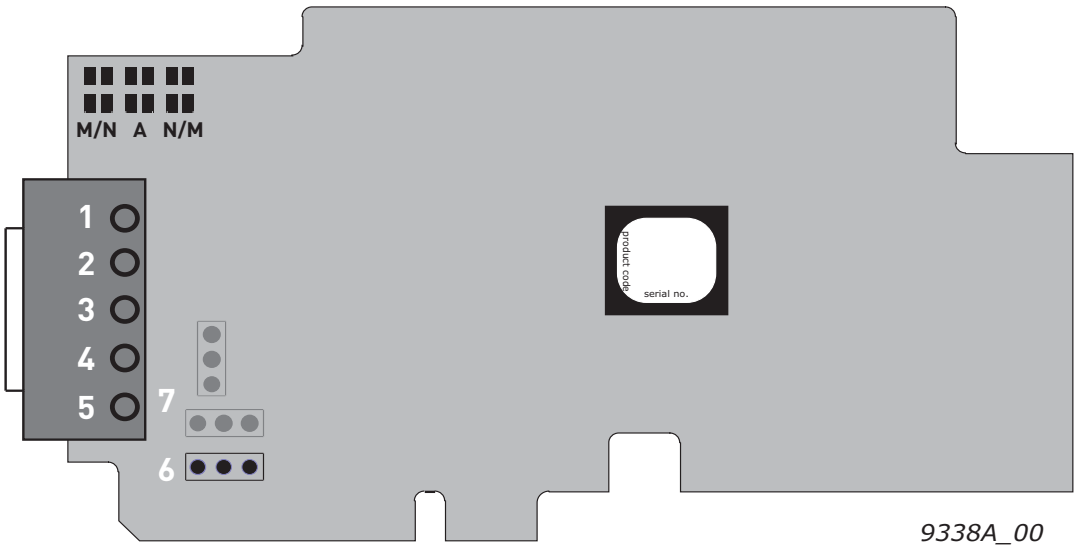

Figure 6. OPTE6 board layout

1 = CAN GND (isolated digital ground reference)
2 = CAN L
3 = SHIELD (shield connector)
4 = CAN H
5 = NC (No connection)
6 = Grounding option jumper
7= Bus termination resistor

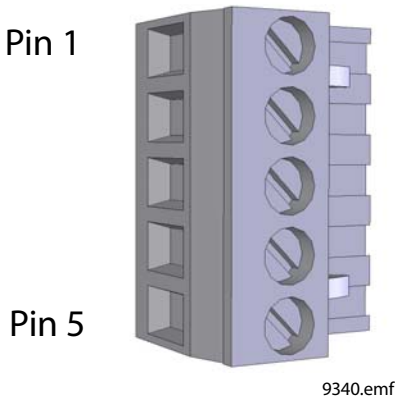

Figure 7. CAN connector

CAN connector pinout

1	CAN GND, isolated digital ground reference
2	CAN LO
3	Shield connector
4	CAN HI
5	No connection

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5.2 LED INDICATIONS

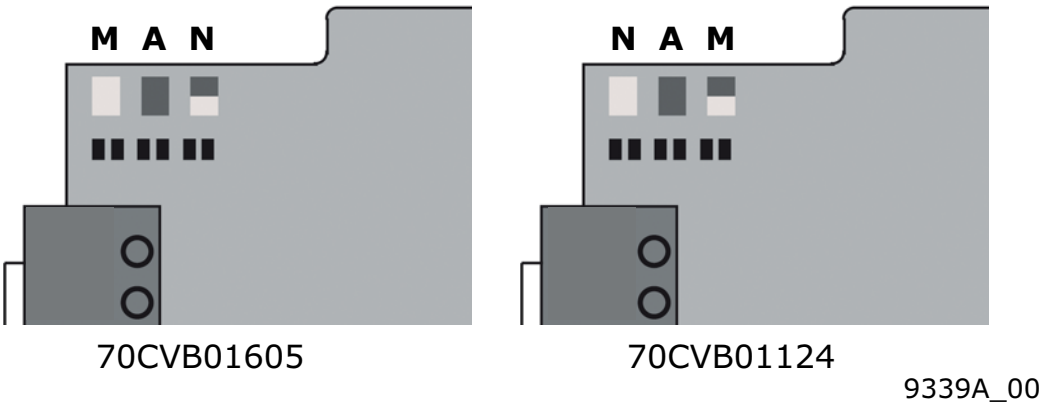

Figure 8. LED indicators

M = CANopen run led

A = CANopen err led

N = Board status

CANopen run led (green)

Blinking	The CANopen device is in the pre-operational state.
Single flash	The CANopen device is in the stopped state.
ON	The CANopen device is in the operational state.

CANopen err led (red)

OFF	No error
Blinking	Invalid configuration
Single flash	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames).
Double flash	A guard event (NMT slave or NMT master) or a heartbeat event (heartbeat consumer) has occurred.
Quadruple flash	An expected PDO was not received before the event timer elapsed.
ON	The CAN controller is bus-off.

Board status led (green)

OFF	Option board is not activated.
ON	Option board is in initialization state, waiting activation command from the AC drive.
Blinking (once/ 1s)	Option board is activated and in RUN state. Option board is ready for external communication.

5.3 JUMPERS

The termination resistor jumper location differs on used hardware version. The jumper locations can be seen from figure below.

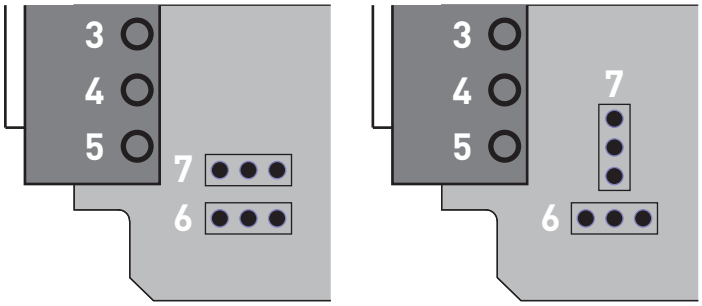

Figure 9. LED indicators

The jumper settings for the CAN bus termination resistor are shown in the figure below.

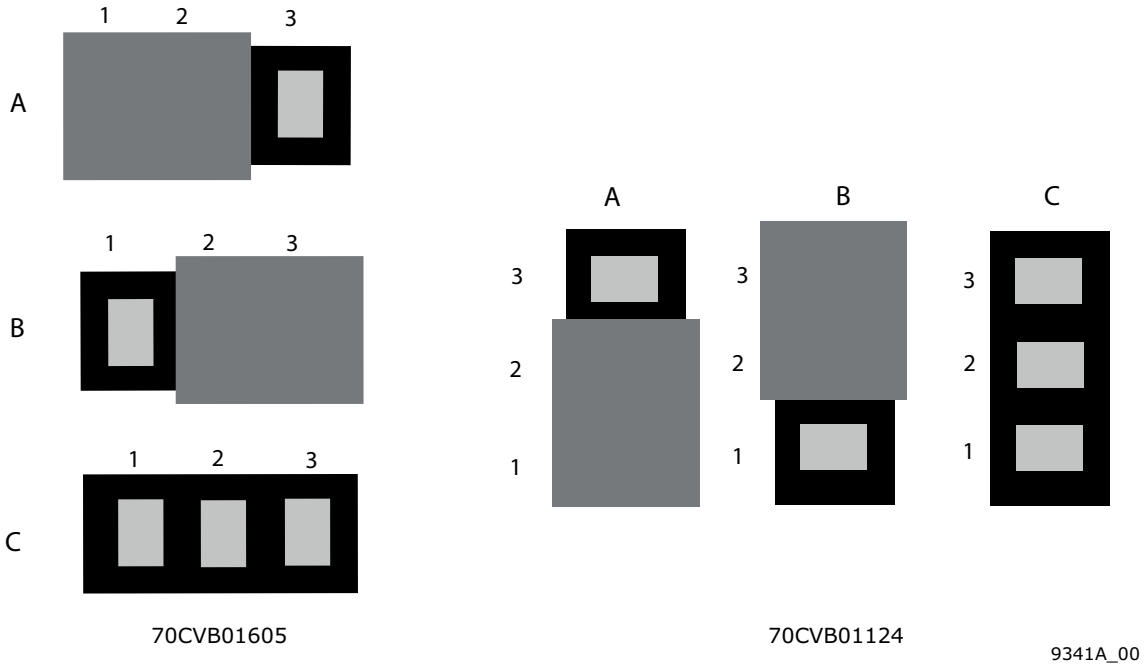

Figure 10. CAN bus termination jumper

A = Termination resistor 120 Ohm connected

B = Termination resistor is not connected to the CAN bus. (Factory default setting)

C = Termination resistor is not connected to the CAN bus

The jumper settings for the CAN cable shield grounding are shown in the figure below.

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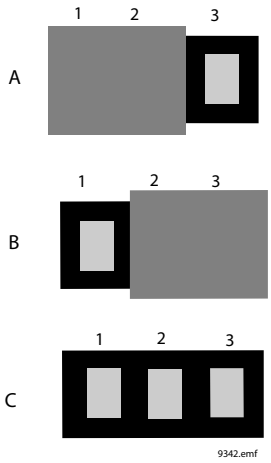


Figure 11. CAN shield grounding option

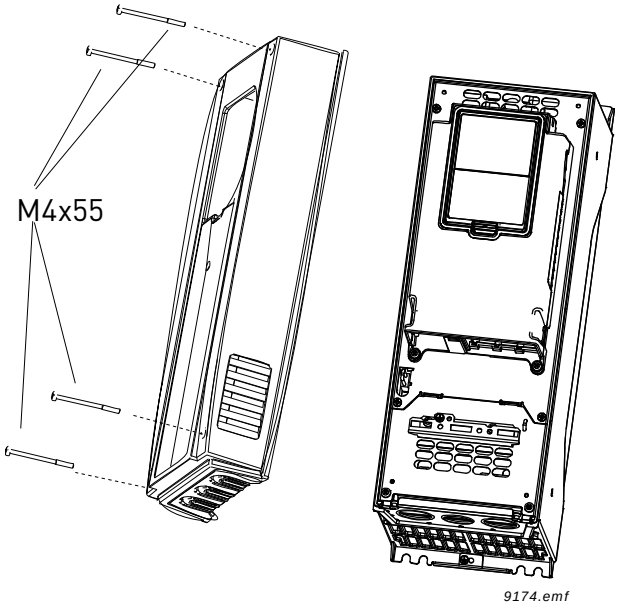
A = CAN connector pin 3 (shield) connected to the drive chassis with a high-impedance RC circuit. Recommended option when equipotential bonding is poor.

B = CAN connector pin 3 (shield) connected directly into the drive chassis. Recommended option when equipotential bonding is good. (Factory default setting)

C = CAN connector pin 3 is not connected.

6. INSTALLATION

6.1 INSTALLATION IN VACON® 100

1	Open the cover of the AC drive.  9174.emf
DANGER	The relay outputs and other I/O-terminals may have a dangerous control voltage present even when AC drive is disconnected from mains.

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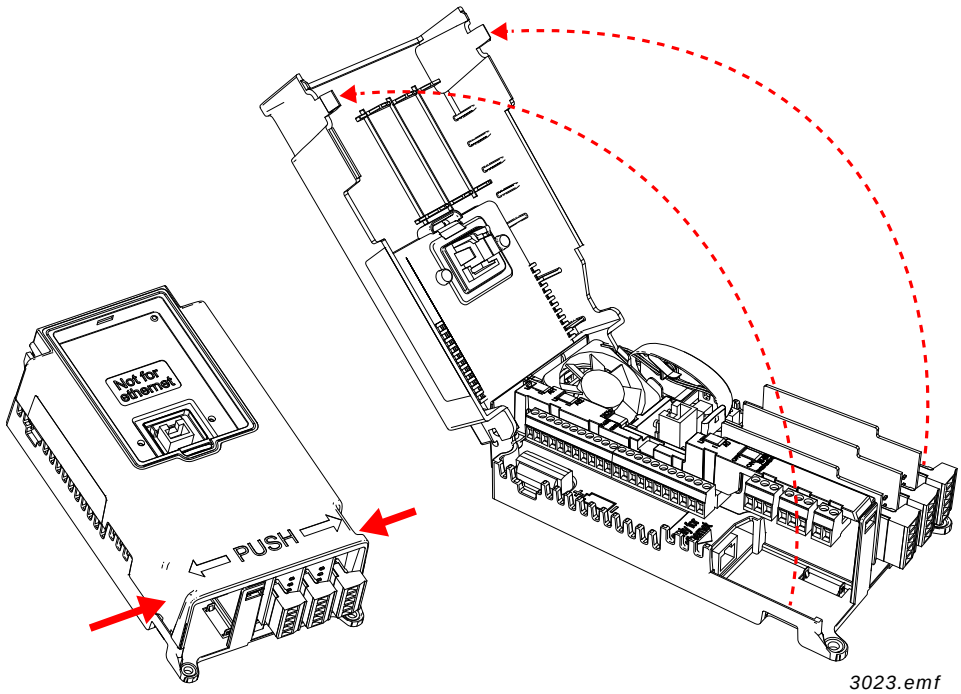
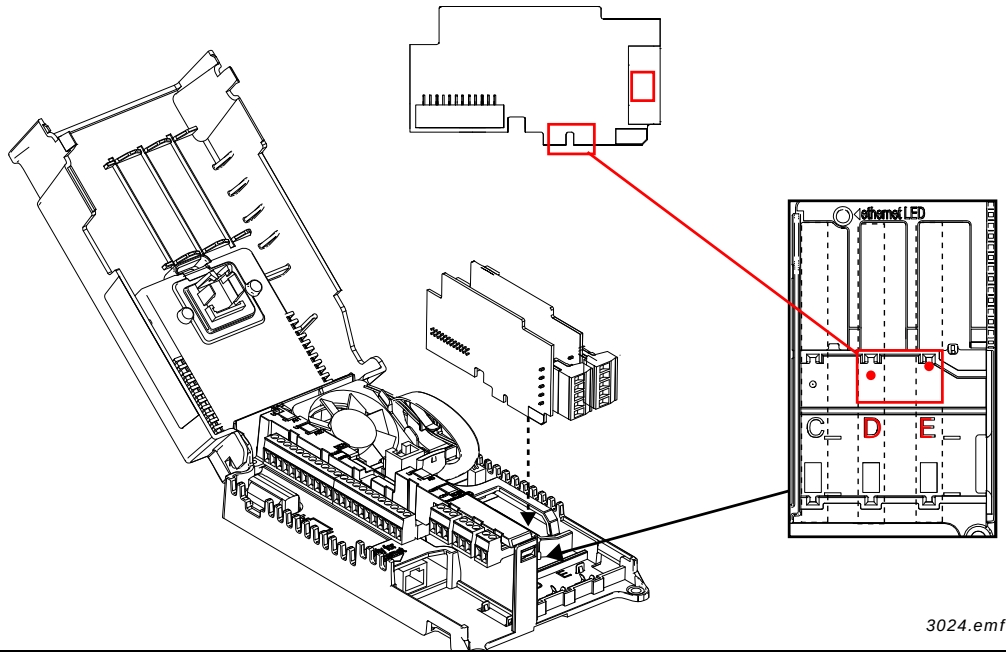
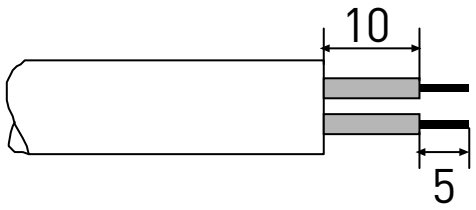
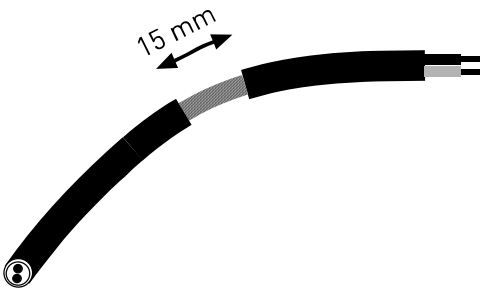
2	Open the inner cover to reveal the option board slots **(C,D,E)**. See Figure below.  3023.emf
3	Install the fieldbus board into slot **D** or **E**. See figure below. **NOTE:** Incompatible boards cannot be installed on the AC drive. Compatible boards have a slot coding that enable the placing of the board.  3024.emf

6.2 PREPARE FOR USE THROUGH FIELDBUS

4	Strip about 15 mm of the fieldbus cable (see specification in ch. 3.2) and cut off the grey cable shield. Remember to do this for both bus cables (except for the last device). Leave no more than 10 mm of the cable outside the terminal block and strip the cables at about 5 mm to fit in the terminals. See picture below.  Also strip the cable now at such a distance from the terminal that you can fix it to the frame with the grounding clamp. Strip the cable at a maximum length of 15 mm. **Do not strip the aluminum cable shield!** 
5	Then connect the cable to its appropriate terminals on the OPTE6 CANopen option board terminal block.

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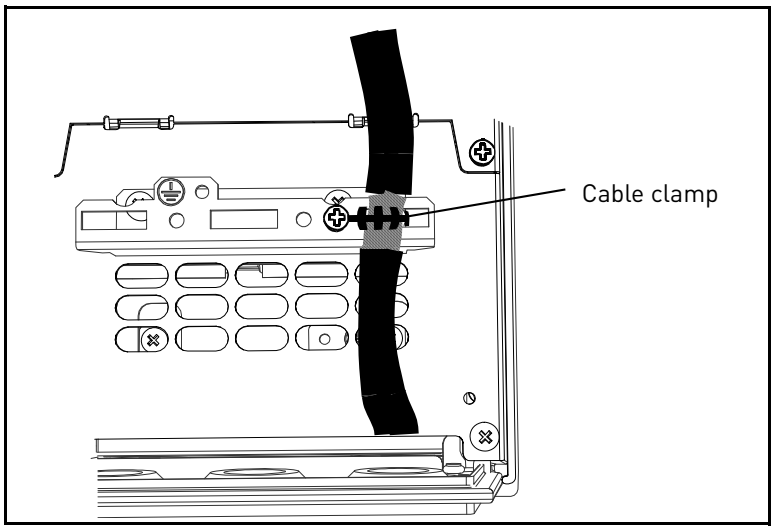
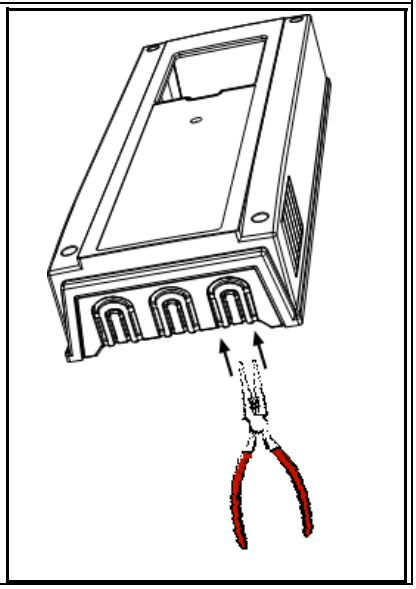
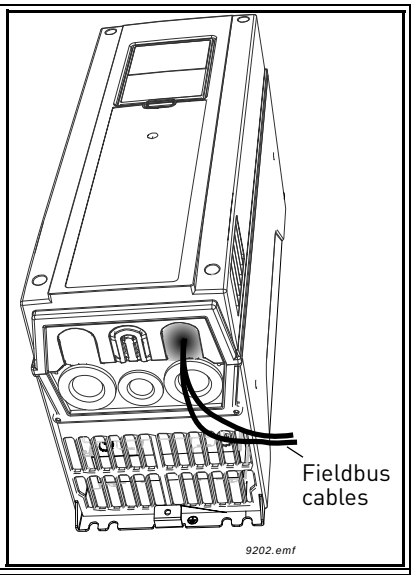
6	Using the cable clamp included in the delivery of the drive, ground the shield of the CAN cable to the frame of the AC drive. **NOTE:** This can be done in all drives if there is no difference in PE potential between the drives. However, if there is PE potential difference then the shield should be connected to PE only at one point in the system. The shields of the cables shall be joint but not connected to several PE points with different potential. 
7	**If the AC drive is the last device on the bus**, the bus termination must be set with jumper X13 (see ch. 4.3.)
8	Unless already done for the other control cables, cut free the opening on the AC drive cover for the fieldbus cable (protection class IP21). **NOTE:** Cut the opening on the same side you have installed the board in! 

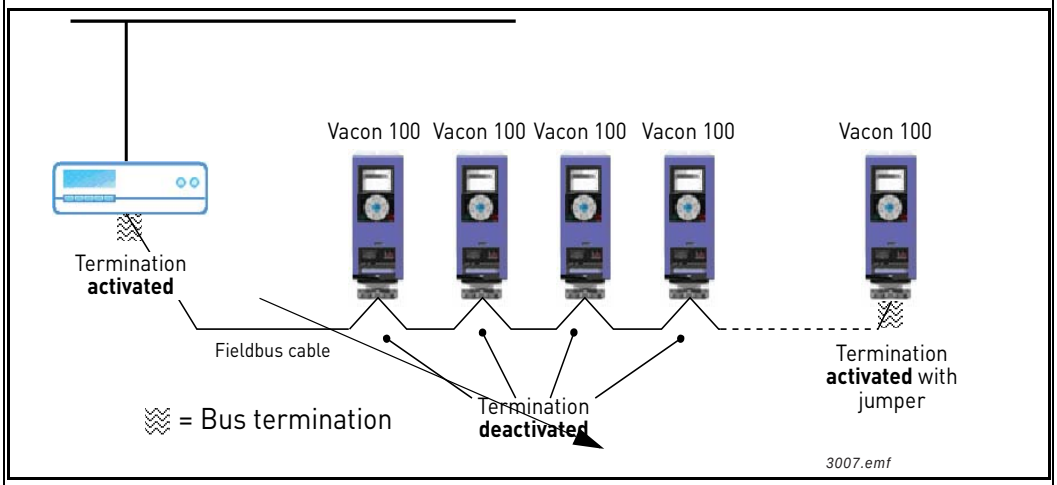
9

Remount the AC drive cover and run the cable as shown in picture.
NOTE: When planning the cable runs, remember to keep the distance between the fieldbus cable and the motor cable at a **minimum of 30 cm**. It is recommended to route the option board cables away from the power cables as shown in the picture.



10

The bus termination must be set for the first and the last device of the fieldbus line. See picture below. See also step 7 on page 41. We recommend that the first device on the bus and, thus, terminated was the Master device.



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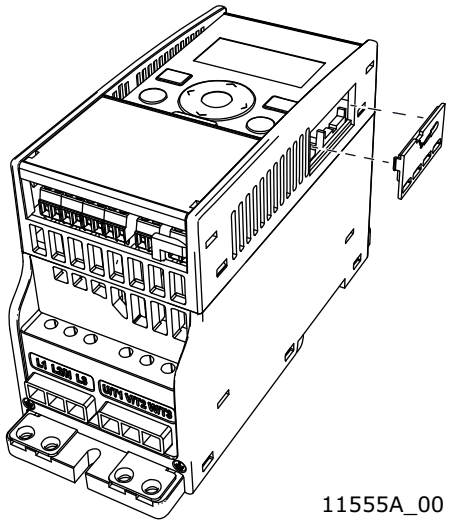
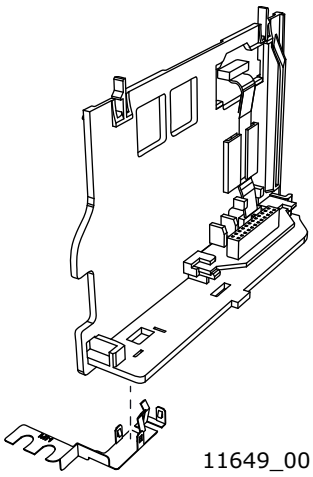
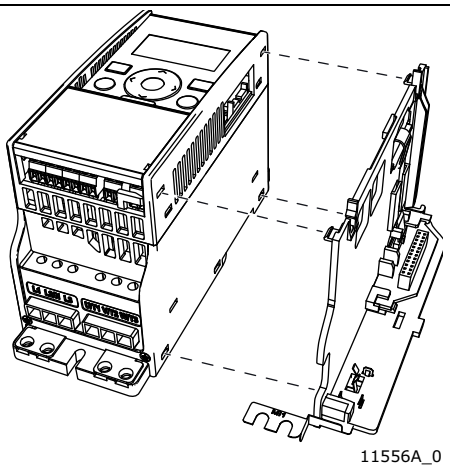
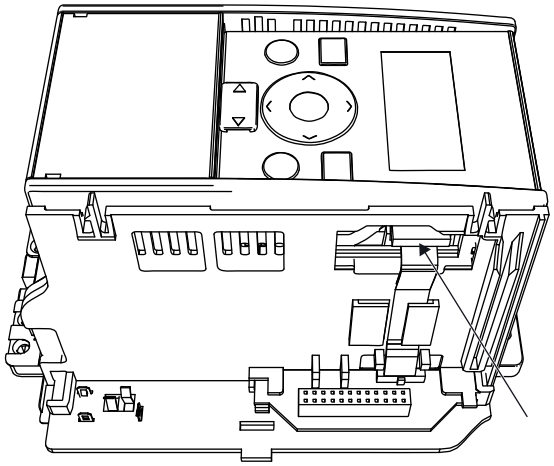
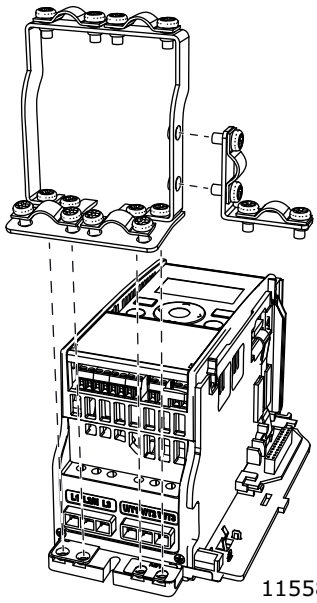
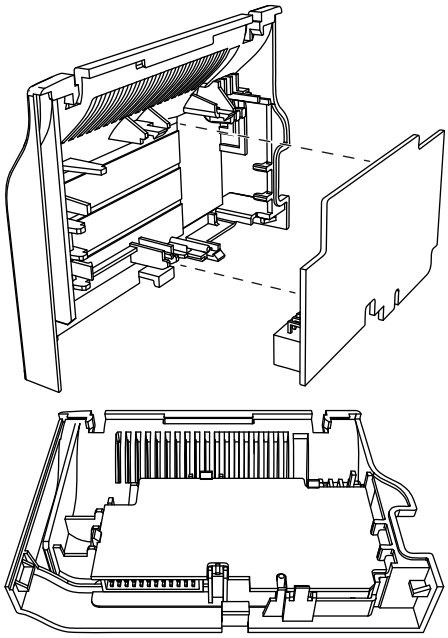
6.3 INSTALLATION IN VACON® 20

6.3.1 FRAMES MI1, MI2, MI3

1	Remove the cable connector lid from the AC drive.  11555A_00
2	 11649_00 Select a correct grounding plate and attach it to the option board mounting frame. The grounding plate is marked with the supported enclosure size.
3	 11556A_0 Attach an option board mounting frame to the AC drive.

4	Connect the flat cable from the option board mounting frame to V20.  11557A_00
5	If a cable strain relief is required, attach the parts as shown in the figure.  11558A_00
6	Install the option board to the option board holder. Make sure that the option board is securely fastened.  11559A_00

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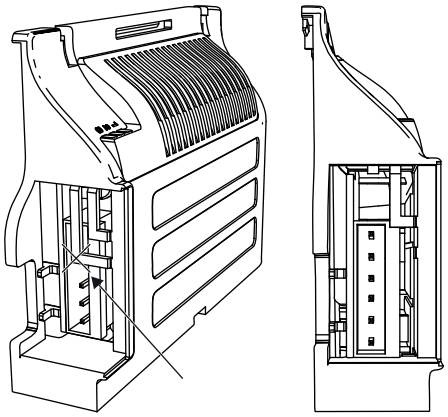
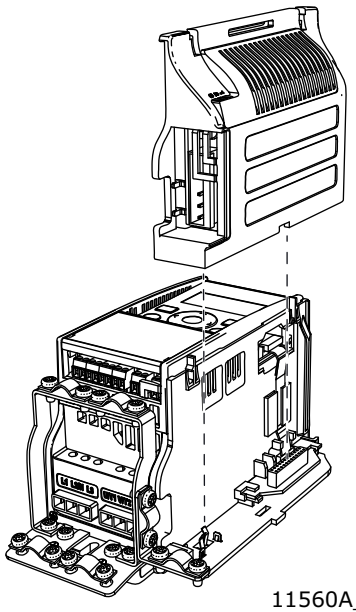
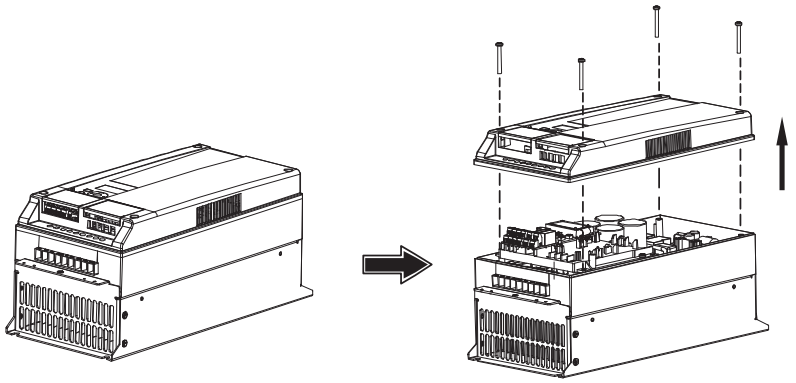
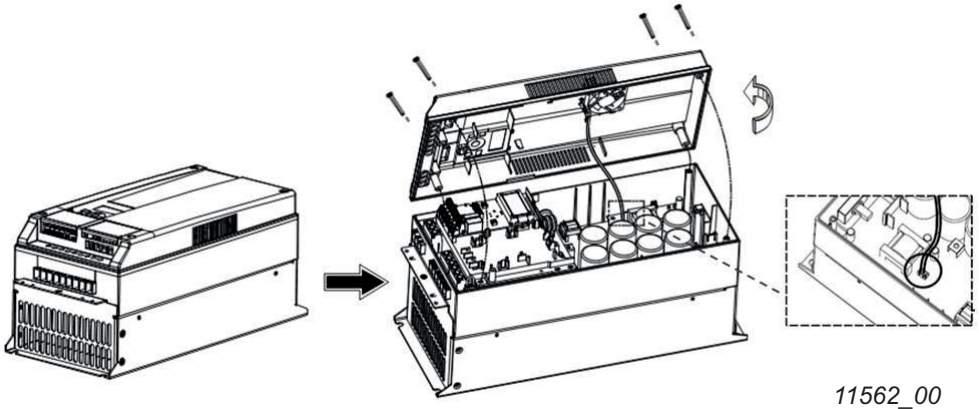
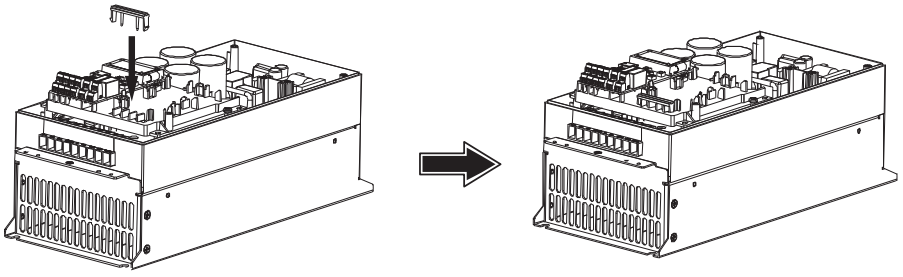
7	Cut free a sufficiently wide opening for the option board connector.	 11650_00
8	Attach the option board cover to V20. Attach the strain relief cable clamp with screws if needed.	 11560A_00

6.3.2 FRAMES MI4, MI5

⚠	Make sure power is disconnected before opening the V20 cover.

1	1a: For MI4: Open the cover.  *11561_00* 1b: For MI5: Open the cover and release the fan connector.  *11562_00*
2	Attach the option board support.  *11563_00*

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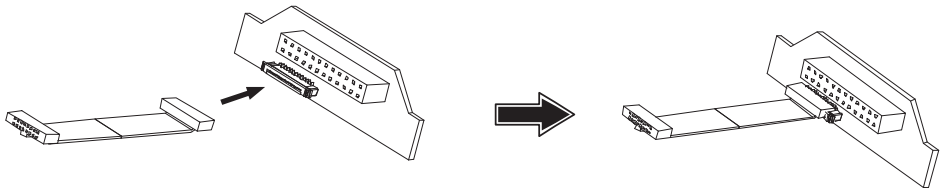
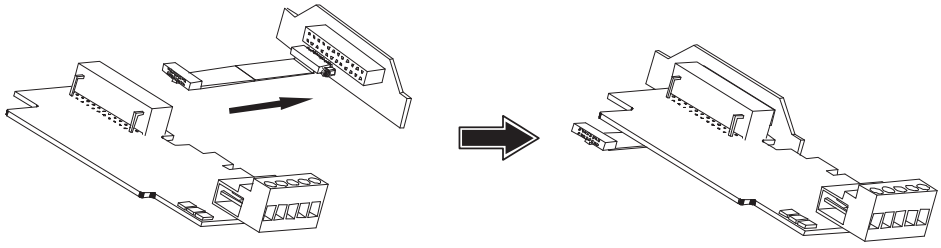
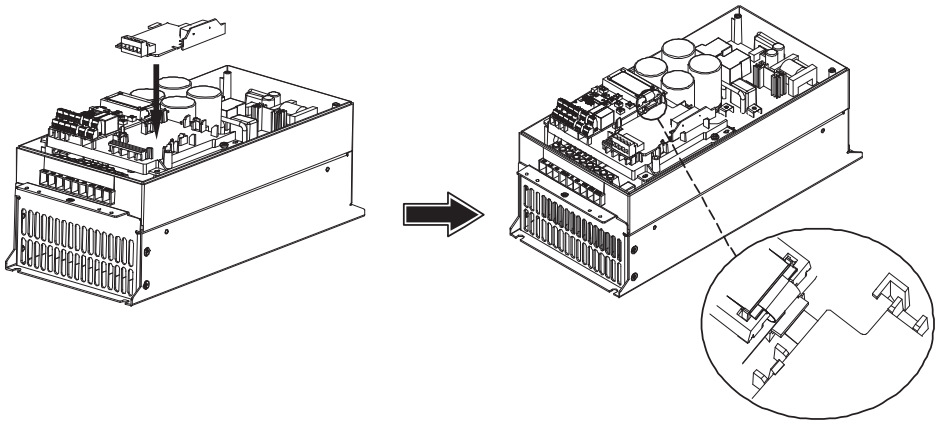
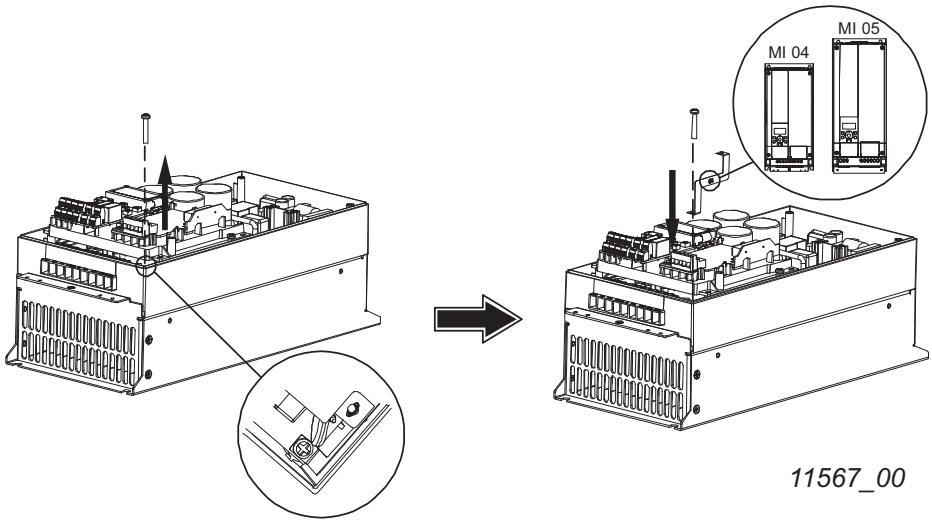
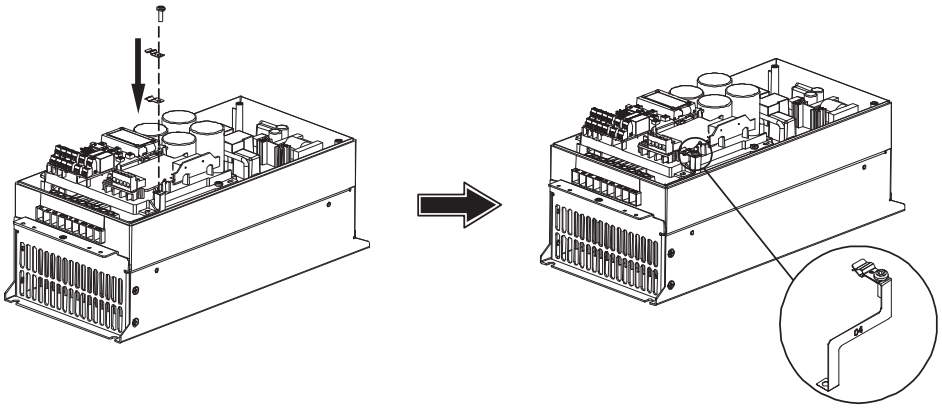
3	Connect the flex cable to option board connector PCB.  *11564_00*
4	Connect the option board to connector PCB.  *11565_00*
5	Attach the option board with connector PCB to V20 and connect the flex cable.  *11566_00*
6	Attach a suitable grounding plate to V20. The grounding plate is marked with supported enclosure size.  *11567_00*

7

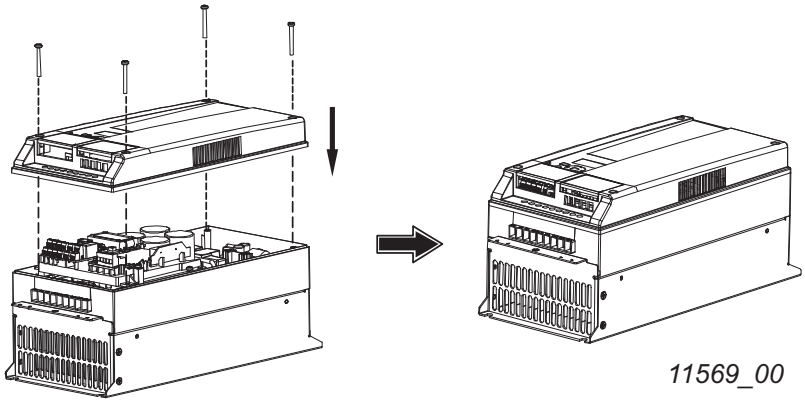
Assemble a clamp on top of the grounding plate on both sides of the option board.



11568_00

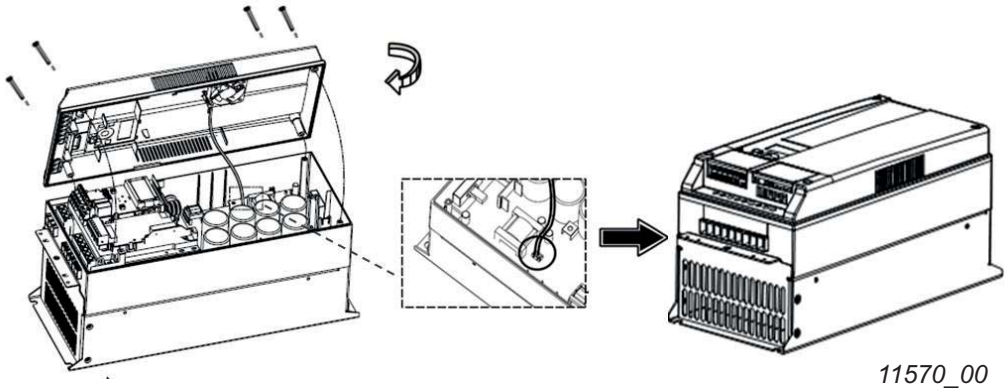
8

8a: For MI4: Close the cover.



11569_00

8b: For MI5: Remount the fan connector and close the cover.



11570_00

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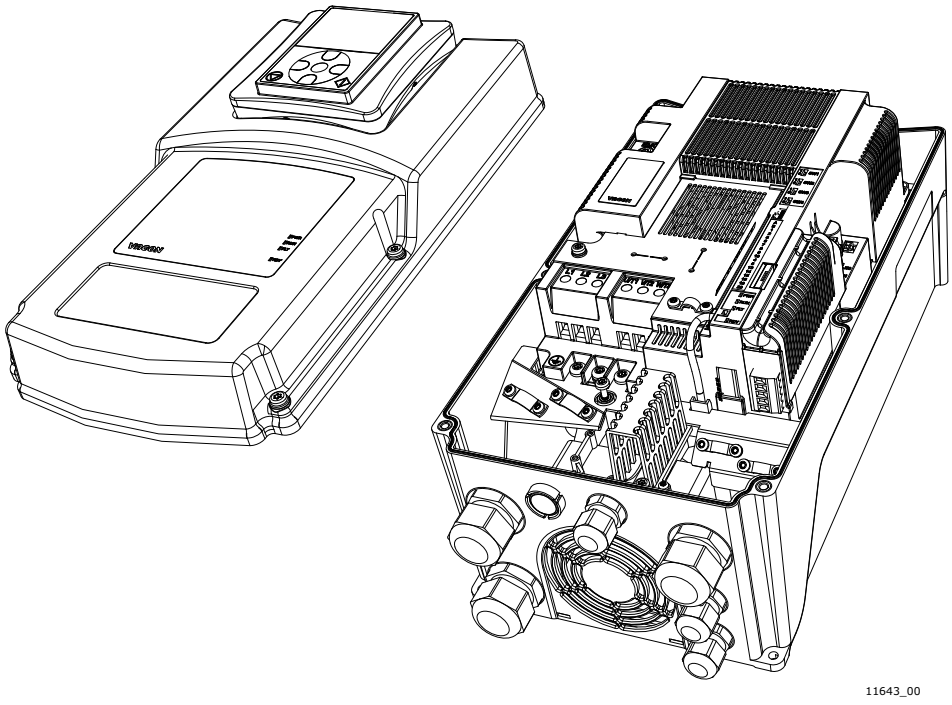
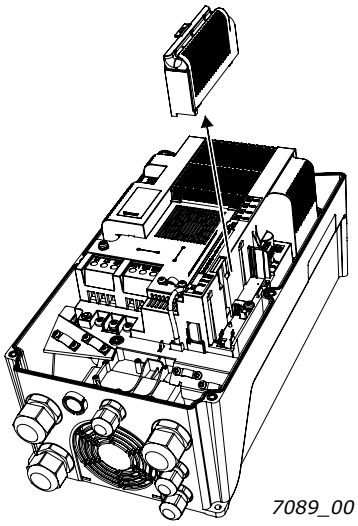
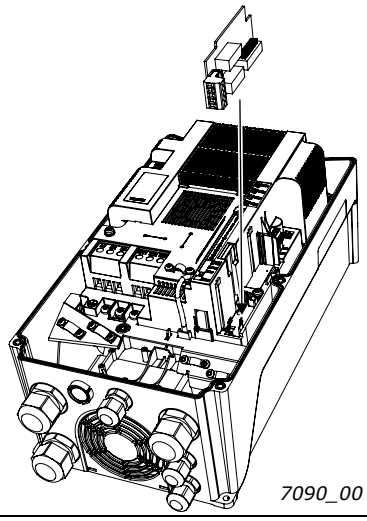
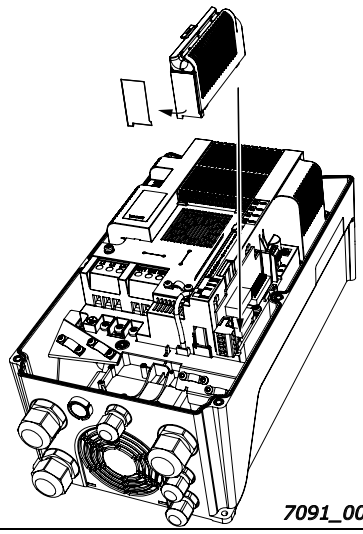
6.4 INSTALLATION IN VACON® 20 X AND 20 CP

Do not add or replace option boards or fieldbus boards on an AC drive with the power switched on. This may damage the boards.

1	Open the cover of the drive.  MU3 example

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

2	Remove the option slot cover.  7089_00
3	Install the option board into the slot as shown in the figure.  7090_00
4	Mount the option slot cover. Remove the plastic opening for the option board terminals.  **7091_00**

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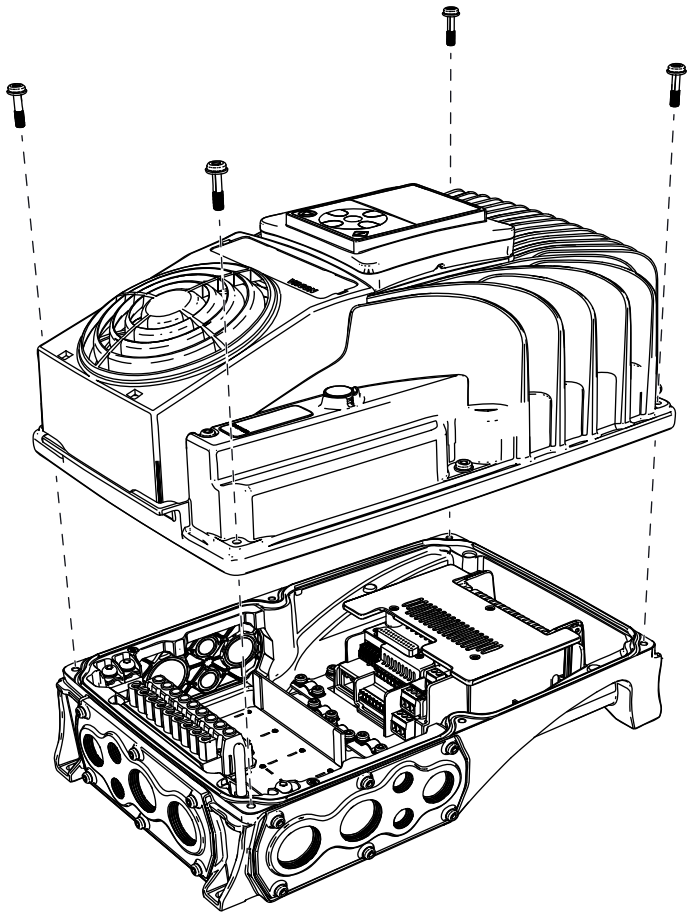
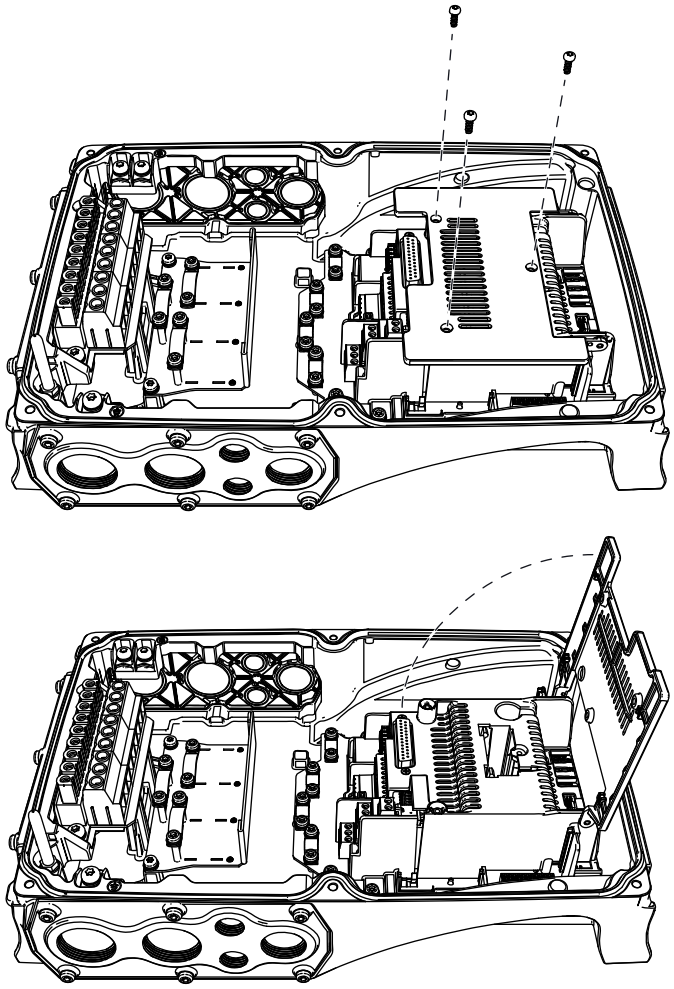
6.5 INSTALLATION IN VACON® 100 X (FRAMES MM4-MM6)

1	Open the cover of the AC drive.  11638_00

2	To get access to the option board slots, remove the screws and open the cover of the control unit.  11639_00

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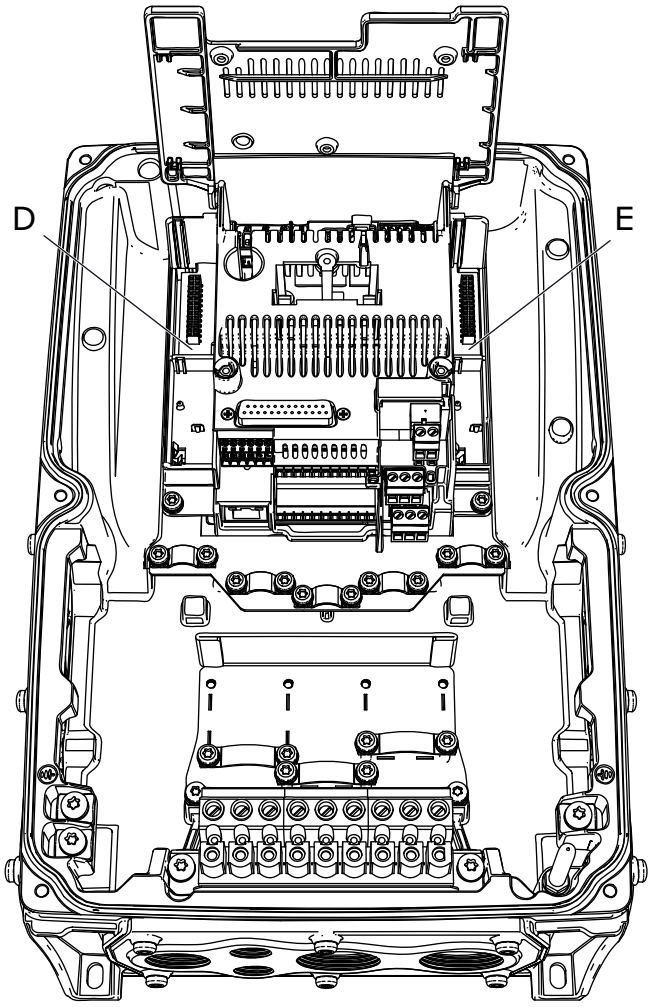
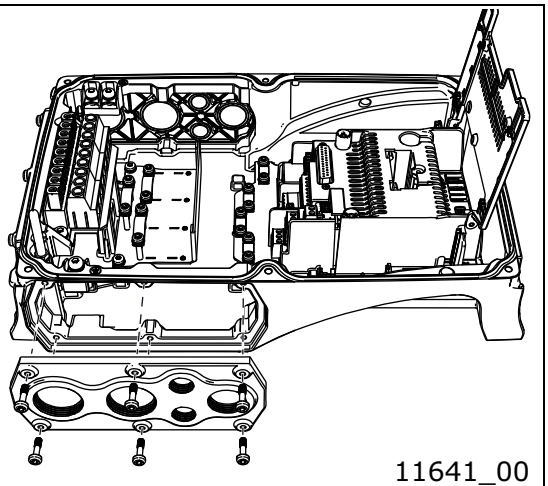
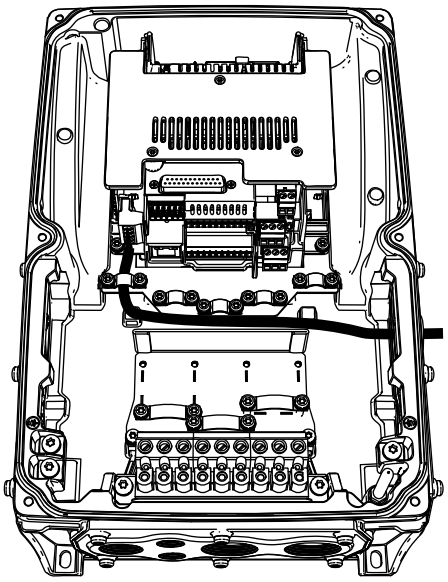
3	Install the option board into the correct slot, D or E.  11640_00
4	Close the option board cover.
5	Remove the cable entry plate. If you installed the option board in the slot D, use the cable entry plate on the right side. If you installed the option board in the slot E, use the cable entry plate on the left side. **NOTE!** The cable entry plate at the bottom of the drive is used only for mains and motor cables.  11641_00

6	Open the necessary holes in the cable entry plate. Do not open the other holes. See the Vacon 100 X 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.  11642_00
8	Put the cable entry plate back.
9	Close the cover of the AC drive.

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7. COMMISSIONING

7.1 OPTE6 PANEL PARAMETERS

When OPTE6 board is attached to a drive, 3 basic communication parameters will appear on the panel menu. The parameters are saved automatically when changed.

NOTE! Parameters 1-2 are saved into the memory of the AC drive. Remember this if the board is moved into another drive. Parameter 3 - "Operate Mode" is read at startup from option board memory.

Table 66. OPTE6 board parameters

Index	Parameter	Min	Max	Default	Description
1	Node ID	1	127	1	Network-wide unique identifier for each CANopen device
2	Baud rate	3	8	5	Data signalling rate. Should be the same on each node in the same bus.
3	Operate Mode	1	2	1	Selection between a CIA-402 drive profile and a manufacturer-specific bypass mode.

Table 67. OPTE6 board monitoring values

Index	Monitoring value	Description
1	CANopen Status	A running counter for incoming messages combined with node CANopen status (see the description below)

7.1.1 PARAMETER DESCRIPTIONS

CANopen Status: indicates the NMT state of CANopen.

CANopen Status is in the following format:

NNNNN.S

where NNNNN is the counter for received messages and S is the CANopen status.

Table 68: CANopen status

Value	Description
0	Initialising
4	Stopped
5	Operational
6	Pre-operational
7	Reset application
8	Reset communication

Operate Mode: is used to change the modes of operation between the velocity mode of the CIA-402 drive profile and the manufacturer-specific bypass mode.

Table 69: Operate mode

Value	Name	Description
1	Drive Profile	CIA-402 drive profile, velocity mode active
2	Bypass	Manufacturer-specific bypass mode active

Figure 12 and Figure 13 describe the outputs when you change the parameter.

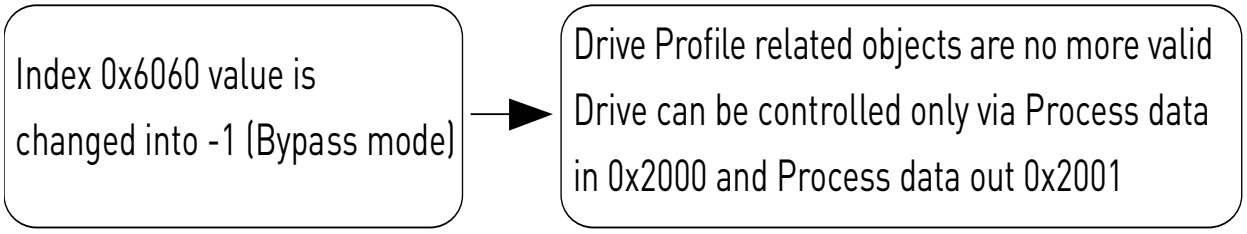

Figure 12. Value changed from Drive Profile to Bypass mode

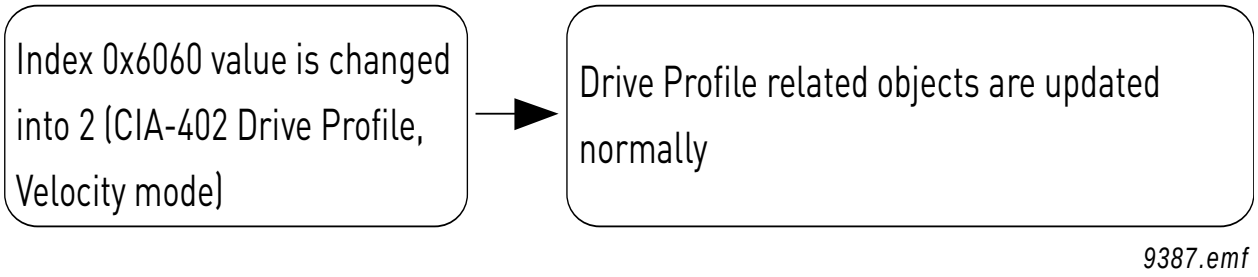

Figure 13. Value changed from Bypass mode into Drive profile

NOTE! Changing operate mode either via panel or object 0x6060 will cause receive and transmit PDO mapping objects to revert back to mode specific default values! If custom mapping is used this has to be taken into account!

Node ID: can be set to values 1-127.

Baud Rate: is used in CANopen communication. Regardless of the selected bitrate, the bit sample timing is set as close as possible to 87.5 % according to the CANopen specification.

Table 70: The available bit rates

Value	Bit rate
3	50 kbit/s
4	100 kbit/s
5	125 kbit/s
6	250 kbit/s
7	500 kbit/s
8	1000 kbit/s

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8. CANopen option board interface

By default, the CANopen option board is configured to operate in Drive Profile mode. The drive profile implementation is 'Velocity Mode' which is defined in CiA 402 specification with PDO set for the AC drive. The board can also be configured into Manufacturer specific mode.

8.1 Supported drive modes

Drive modes can be selected by writing the desired mode in Modes of Operation (0x6060) object or by selecting the mode from panel. The active mode of operation can be read from object Modes of Operation Display (0x6061).

The supported drive modes object will return value 0x80000002, which is described in table below.

Table 71. Supported drive modes

Bit(s)	Description
31	Manufacturer specific Bypass mode
30-2	Not supported
1	Velocity mode
0	Not supported

Table 72. Drive modes

Value	Mode name	Description
2	Velocity Mode	The CiA 402 Drive Profile mode where the control of the drive is done using a control word and speed reference value as specified in the drive profile specification.
-1	Bypass mode	In this mode, the Drive control can be done using raw process data which is exchanged with drive application. The drive profile state machine and the related objects become invalid.

Table 73. Operating mode related objects

Index	Description
0x6060	Modes of Operation
0x6061	Modes of Operation Display
0x6502	Supported Drive Modes

8.2 Velocity mode

The velocity mode is one of the specific modes that CIA-402 Drive Profile defines. Common behaviour in all modes are PDS state machine, some control and status bits and certain objects.

8.2.1 PDS State machine

The PDS state machine describes the generic start and stop sequence of the drive and the error behavior. The state machine is controlled by the Controlword object and internal events.The following objects are usable in velocity mode:

Table 74. Velocity mode related objects in OD

Index	Description
0x6040	Controlword
0x6041	Statusword
0x6042	Vl Target Velocity
0x6043	Vl Velocity Demand
0x6044	Vl Velocity Actual Value
0x6046	Vl Velocity Min Max Amount
0x6048	Vl Velocity Acceleration
0x6049	Vl Velocity Deceleration

The possible state machine transitions can be seen from Figure 15. The state of the AC drive can be changed by writing the corresponding bits to Controlword data object. The needed bit values for each command can be seen from Figure 14.

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Command	Bits of the *controlword*					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2.6.8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (NOTE)
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset	↑	X	X	X	X	15
NOTE Automatic transition to Enable operation state after executing SWITCHED ON state funtionality. 9422A_uk						

Figure 14. Controlword commands

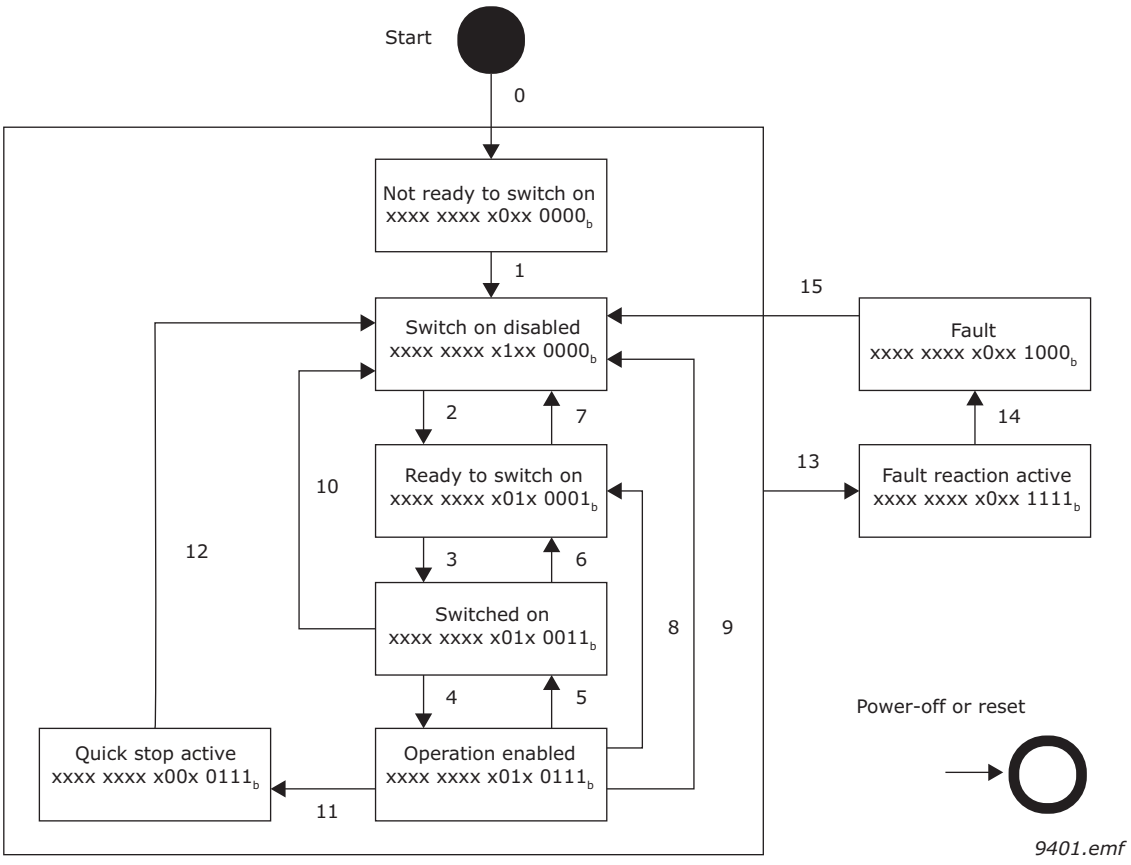

Figure 15. Power Drive System state machine

The table below explains the actions taken in different state transitions and which event triggers which state transition. If the used drive/application does not support different stop bits in Fixed Control Word, the stop method will always be according to set stop function.

Table 75. State transition events and actions

Transition	Event(s)	Action(s)
0	Automatic transition after power-on or reset	Self-initialization is performed
1	Automatic transition after drive status is 'ready'	None
2, 6	Shutdown command	None
3	Switch on command	None
4	Enable operation command	Drive function is enabled
5	Disable operation command	Drive function is disabled
7	Disable voltage or quick stop command	None
8	Shutdown command	Stop by ramp /stop function
9	Disable voltage command	Stop by coast / stop function
10, 12	Disable voltage command	None
11	Quick stop command	Quick stop / stop function
13	Fault signal	Go to fault state and stop by stop function
14	Automatic transition	None
15	Fault reset command	Reset fault if no fault currently exists on drive

Current state can be determined by reading the value of Statusword data object and comparing the value of bits to the table below.

Table 76. Statusword bits

Bits of the statusword									PDS state
15-8	7	6	5	4	3	2	1	0	
x	x	0	x	x	0	0	0	0	Not ready to switch on
x	x	1	x	x	0	0	0	0	Switch on disabled
x	x	0	1	x	0	0	0	1	Ready to switch on
x	x	0	1	x	0	0	1	1	Switched on
x	x	0	1	x	0	1	1	1	Operation enabled
x	x	0	0	x	0	1	1	1	Quick stop active
x	x	0	x	x	1	1	1	1	Fault reaction active
x	x	0	x	x	1	0	0	0	Fault
x = Do not care									

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8.2.2 0x6040 - Controlword

Controlword is used to control the drive operation according to the PDS state machine. By default, Controlword is mapped into the first two bytes of rxPD01.

Table 77. 0x6040:Controlword

Bit		Name	Description
12-15	na	Not used	Bits 12 through 15 are not in use.
11	ar	Alarm reset	Rising edge resets alarm
10	r	Reserved	Bit 10 is not in use
9	oms	Operation mode specific	Bit 9 is not in use
8	h	Halt	Bit 8 is not in use
7	fr	Fault reset	Rising edge resets fault
4-6	na	Not Used	Bits 4 through 6 are not in use.
3	eo	Enable operation	Start drive
2	$\overline{qs}$	Quick stop	Stops the drive using the drive/application specific stop function used as quick stop
1	ev	Enable voltage	Enables/disables output voltage
0	so	Switch on	Enables possibility to start drive together with ev

8.2.3 0x6041 - Statusword

Statusword indicates whether the drive is in remote control and if the target velocity is reached. By default, Statusword is mapped into the first two bytes of txPD01.

Table 78. 0x6041:Statusword

Bit		Name	Description
15	na	Not in use	Bit 15 is not in use
14	idm	Incorrect drive mode	Indicates that the drive is in incorrect “Control mode” for the used CiA-402 profile
12-13	oms	Operation mode specific	Bits 12 through 13 are not in use
10	tr	Target reached	Target velocity reached
9	rm	Remote	Indicates if the drive is controllable by Fieldbus
8	na	Not in use	Bit 8 not in use.
7	w	Warning	The AC drive has an active Alarm.
6	sod	Switch on disabled	PDS switch on disable
5	qs	Quick stop	PDS quick stop active
4	ve	Voltage enabled	Voltage is enabled
3	f	Fault	PDS Fault (indicates fault condition)
2	oe	Operation enabled	PDS operation enabled (drive is running)
1	so	Switched on	PDS switched on
0	rtso	Ready to switch on	PDS ready to switch on

8.2.4 0X6042 - VL Target Velocity

The signed value of motor rpm speed request to drive. A negative value means that the motor is running clockwise. By default, the object is mapped into the last two bytes of rxPD01.

Range: -32768...32767

0x6042:vl Target Velocity	
15	**0**
Rpm request to drive	

8.2.5 0X6043 - VL Velocity Demand

The signed read-only value of the ramp generator output scaled into rpm. A negative value means that the motor is running clockwise. By default, the object is not mapped into any PD0.

Range: -32768...32767

0x6043:vl Velocity Demand	
15	**0**
Drive ramp generator output scaled into rpm	

8.2.6 0X6044 - VL Velocity Actual Value

The signed value of the motor actual rpm speed. A negative value means that the motor is running clockwise. By default, the object is mapped into the last two bytes of txPD01.

Range: -32678...32767

0x6044:vl Velocity Actual Value	
15	**0**
Motor actual rpm speed	

8.2.7 0X6046 - VL Velocity Min Max Amount

The minimum and maximum rpm speed of the AC drive's motor. The motor runs on minimum speed defined here when the vl Target Velocity is set to 0.

0x6046.01: vl Velocity Min Amount	
31	**0**
Motor minimum rpm speed	

0x6046.02: vl Velocity Max Amount	
31	**0**
Motor maximum rpm speed	

Range: 0... 4294967296

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8.2.8 0x6048 - vl Velocity Acceleration

This object indicates the configured delta speed and delta time of the slope of the acceleration ramp.

0x6048.01: Delta speed	
31	**0**
Maximum change of rpm the motor will accelerate during the time specified in Delta Time.	

Range: 0... 4294967296

0x6048.02: Delta time	
16	**0**
Time (in seconds) in which the rpm of the motor will accelerate the amount specified in Delta Speed.	

Range: 0... 65536

8.2.9 0x6049 - vl Velocity Deceleration

This object indicates the configured delta speed and delta time of the slope of the deceleration ramp.

0x6049.01: Delta speed	
31	**0**
Maximum change of rpm the motor will accelerate during the time specified in Delta Time.	

Range: 0... 4294967296

0x6049.02: Delta time	
16	**0**
Time (in seconds) in which the rpm of the motor will accelerate the amount specified in Delta Speed.	

Range: 0... 65536

8.3 Bypass mode

In bypass mode, some data defined in the profile is invalid, and the drive control is done using raw process data. The raw process data arrays are located in the manufacturer specific objects 0x2000 and 0x2001. There are two arrays: one for incoming data and one for outgoing data. The drive application defines which one is mapped into the process data.

Table 79. Process data in

Index	Sub index	Name	Data type	Access
0x2000	0	Number of entries	UNSIGNED16	ro
	1	PB PD In Offset 0	UNSIGNED16	r/w
	2	PB PD In Offset 1	UNSIGNED16	r/w
	3	PB PD In Offset 2	UNSIGNED16	r/w
	4	PB PD In Offset 3	UNSIGNED16	r/w
	5	PB PD In Offset 4	UNSIGNED16	r/w
	6	PB PD In Offset 5	UNSIGNED16	r/w
	7	PB PD In Offset 6	UNSIGNED16	r/w
	8	PB PD In Offset 7	UNSIGNED16	r/w
	9	PB PD In Offset 8	UNSIGNED16	r/w
	10	PB PD In Offset 9	UNSIGNED16	r/w
	11	PB PD In Offset 10	UNSIGNED16	r/w

Table 80. Process data out

Index	Sub index	Name	Data type	Access
0x2001	0	Number of entris	UNSIGNED16	ro
	1	FB PD Out Offset 0	UNSIGNED16	ro
	2	FB PD Out Offset 1	UNSIGNED16	ro
	3	FB PD Out Offset 2	UNSIGNED16	ro
	4	FB PD Out Offset 3	UNSIGNED16	ro
	5	FB PD Out Offset 4	UNSIGNED16	ro
	6	FB PD Out Offset 5	UNSIGNED16	ro
	7	FB PD Out Offset 6	UNSIGNED16	ro
	8	FB PD Out Offset 7	UNSIGNED16	ro
	9	FB PD Out Offset 8	UNSIGNED16	ro
	10	FB PD Out Offset 9	UNSIGNED16	ro
	11	FB PD Out Offset 10	UNSIGNED16	ro

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8.3.1 Exception when using bypass mode

When using bypass mode, the profile objects listed in table Objects disabled at bypass mode are invalid and do not contain valid data.

Table 81. Objects disabled at bypass mode

Index	Description
0x6040	Controlword
0x6041	Statusword
0x6042	VI Target Velocity
0x6043	VI Velocity Demand
0x6044	VI Velocity Actual Value

8.4 Default process data application mapping

This chapter describes the default mapping of the OPTE6 process data variables to the application data in the drive. It also provides a description of the application data in the drive. Supported control/status word bits might differ depending on used application. Please read also the corresponding section of the drive's application manual for additional information.

Table 82. Process data in

Sub-index	Mapped Application data
In Offset0	FB Control word
In Offset 1	FB Control word Extension
In Offset 2	FB Speed reference
In Offset 3	FB Process data in 01
In Offset 4	FB Process data in 02
In Offset 5	FB Process data in 03
In Offset 6	FB Process data in 04
In Offset 7	FB Process data in 05
In Offset 8	FB Process data in 06
In Offset 9	FB Process data in 07
In Offset 10	FB Process data in 08

Table 83. Process data out

Sub-index	Mapped Application data
Out Offset 0	FB Status Word
Out Offset 1	FB Status Word Extension
Out Offset 2	FB Actual Speed
Out Offset 3	FB Process data out 01
Out Offset 4	FB Process data out 02
Out Offset 5	FB Process data out 03
Out Offset 6	FB Process data out 04
Out Offset 7	FB Process data out 05
Out Offset 8	FB Process data out 06
Out Offset 9	FB Process data out 07
Out Offset 10	FB Process data out 08

8.4.1 FB Control Word

Mapped into FB PD in offset 0.

Table 84. FB Control Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	-	ESTP	JOG2	JOG1	BREF	BCTRL	ZREF	FRMP	ZRMP	STPM2	STPM1	FRST	DIR	STRT

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Table 85. FB Control Word description

Bit		Name	Description	0	1
12	ESTP	Emergency Stop	Request as fast stop as possible	-	Emergency stop
11	JOG2	Jogging request	Select jogging with reference 2	-	Select ref2 jogging
10	JOG1	Jogging request	Select jogging with reference 1	-	Select ref1 jogging
9	BREF	Bus Reference	Force Reference to fieldbus	Selected reference place	Force Fieldbus reference
8	BCTRL	Bus Control	Force fieldbus control active	Selected control place	Force Fieldbus Control
7	ZREF	Zero Ref	Force reference to zero	-	Force reference to zero
6	FRMP	Ramp Freeze	Freeze ramp generator	-	Freeze ramp generator
5	QRMP	Quick Ramp Time	Use quick ramp time	Normal ramp time	Quick ramp time
4	STPM2	Stop Mode2	Stop mode ramping	-	Stop By Ramp mode
3	STPM1	Stop Mode1	Stop mode coasting	-	Coasting Stop Mode
2	FRST	Fault Reset	Request fault reset from drive	-	Request reset from drive
1	DIR	Direction	Rotation direction	Clockwise	Counter clockwise
0	STRT	Start / Stop	Start / Stop request	Stop	Run

8.4.2 FB Control Word Extension (general control word)

Mapped into FB PD in offset 1.

Table 86. FB Control Word Extension

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BSTAT2	BSTAT1	BFLT	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 87. FB Control Word extension description

Bit		Name	Description	0	1
15	BSTAT2	Bus status	Informs bus status into application	Status of option board	
14	BSTAT1	Bus status	Informs bus status into application		
13	BFLT	Bus fault	Request fieldbus fault	-	Generate field bus fault

8.4.3 FB Speed Reference

Mapped into FB PD in offset 2.

Table 88. FB Speed Reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FB Speed Reference															

Table 89. FB Speed reference description

Name	Description	Min	Max
FB Speed Reference	Frequency reference at percentage between minimum and maximum frequency. Control word DIR bit is used to select rotation direction.	0 (0%)	10000 (100.00%)

8.4.4 FB Process data Input 1...8

Mapped into FB PD in offset 3...11.

Table 90. FB Process Data Input 1...8

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FB Process data in															

8.4.5 FB Processdata Input mapping in application

In addition to sending control commands and speed reference values to the application, 8 process data items can be sent directly to the application to control other features via fieldbus. These can be, for example, activating preset frequencies, activating or deactivating faults, selecting different ramp times, controlling I/O's, and so on. Different applications support different features. For more information, see the application manual. Also, always check the value of the sent data in the application manual to see in which format they are given (for example, % values, bit coded values, and so on).

Table 91. FB Processdata application mapping

PD	Mapped Application Data	Unit
PD in 1	-	-
PD in 2	-	-
PD in 3	-	-
PD in 4	-	-
PD in 5	-	-
PD in 6	-	-
PD in 7	-	-
PD in 8	-	-

8.4.6 FB Status Word

Mapped into FB PD out offset 0.

Table 92. FB Status Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	-	FRDY	ZSPD	ATREF	ALARM	FLT	DIR	RUN	RDY

Table 93. FB Status word description

Bit		Name	Description	0	1
7	FRDY	Flux ready	Motor magnetization is ready	-	Flux ready
6	ZSPD	Zero speed	Motor is running on zero speed	-	Zero speed condition
5	ATREF	At reference	Reference frequency is reached	-	Reference reached
4	ALARM	Alarm	Alarm indication	-	Drive is in Alarm
3	FLT	Faulted	Drive fault indicatioin	-	Drive is Faulted
2	DIR	Direction	Motor running direction	Clockwise	Counter clockwise
1	RUN	Run	Motor running information	Stopped	Running
0	RDY	Ready	Drive readiness information	-	Ready

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8.4.7 FB Status Word Extension (general status word)

Mapped into FB PD out offset 1.

Table 94. FB Status word extension

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CP3	CP2	CP1	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 95. FB Status word extension description

Bit		Name	Description	0	1
15	CP3	Control Place	Drive Control place information	0,0,1-(1) Fieldbus 0,1,0- (2) Panel 0,1,1 - (3) Tool 1,0,0 - (4) I/O	
14	CP2				
13	CP1				

8.4.8 FB Actual Speed

Mapped into FB PD out offset 2.

Table 96. FB Actual Speed

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FB Actual Speed															

Table 97. FB Actual Speed description

Name	Description	Min	Max
FB Actual Speed	Actual output frequency at percentage between minimum and maximum frequency. Status word bit DIR is used to indicate actual direction.	0 (0%)	10000 (100.00%)

8.4.9 FB Processdata Output 1...8

Mapped into FB PD out offset 3...11

Table 98. FB Process data output 1...8

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FB Process data Out 1...8															

8.4.10 FB Processdata Output mapping in application

Process data output mappings are selectable and also the default settings vary between drives. Refer to application manual for details. The following tables show the default values for Vacon 100 INDUSTRIAL application, Vacon 20 X Multipurpose Application and Vacon 20 Standard Application.

Table 99. Process data output mapping defaults for V100 GP and V20X MP

PD Out	Application	Mapped Application Data	Unit	Scale
1	V100 GP	Output Frequency	Hz	0.01Hz
	V20X MP	Output Current	A	0.1 A
2	V100 GP & V20X MP	Motor Speed	Rpm	1rpm
3	V100 GP & V20X MP	Motor Current	A	0.1A
4	V100 GP & V20X MP	Motor Torque	%	0.1%
5	V100 GP & V20X MP	Motor Power	%	0.1%
6	V100 GP & V20X MP	Motor Voltage	V	0.1V
7	V100 GP & V20X MP	DC Link Voltage	V	1V
8	V100 GP & V20X MP	Last Active Fault Code	-	-

Table 100. Process data output mapping defaults for V20 Standard Application

PD Out	Mapped Application Data	Unit	Scale
1	Frequency Reference	Hz	0.01Hz
2	Output Reference	Hz	0.01Hz
3	Motor Speed	Rpm	1rpm
4	Motor Voltage	V	0.1V
5	Motor Torque	%	0.1%
6	Motor Current	A	0.01A
7	Motor Power	%	0.1%
8	DC Link Voltage	V	1 V

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9. APPENDIX A: OBJECT DICTIONARY

9.1 COMMUNICATION SEGMENT

Index	Sub-index	Description	Object Code	Data Type	Access	PDO Mapping	Default value	Unit
Object 1000h: Device Type								
1000	0	Device type	Variable	UNSIGNED32	CONST	No	0x00010192	
Object 1001h: Error Register								
1001	0	Error Register	Variable	UNSIGNED8	RO	No	0x00	
Object 1003h: Pre-defined Error Field								
1003		Pre-defined Error Field	Array	UNSIGNED32				
	000	Number of Errors			RW	No	0x00000000	
	001	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	002	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	003	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	004	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	005	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	006	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	007	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	008	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
	009	Standard Error Field		UNSIGNED32	RO	No	0x0000000	
Object 1005h: COB-ID SYNC								
1005	0	COB-ID SYNC	Variable	UNSIGNED32	RW	No	0x00000080	
Object 100Ch: Guard Time								
100C	0	Guard Time	Variable	UNSIGNED16	RW	No	0x00000000	ms
Object 100Dh: Life Time Factor								
100D	0	Life Time Factor	Variable	UNSIGNED8	RW	No	0x00000000	
Object 1010h: Store Parameter Field								
1010		Store Parameter Field	Array	UNSIGNED32				
	000	Number of Entries			RO	No	0x2	
	001	Save all Parameters		UNSIGNED32	RW	No	-	
Object 1011h: Restore Default Parameters								
1011		Restore Default Parameters	Array	UNSIGNED32				
	000	Number of Entries			RO	No	0x4	
	001	Restore all Default Parameters		UNSIGNED32	RW	No	-	
	004	Restore Bypass parameter set		UNSIGNED32	RW	No	-	
Object 1014h: COB-ID EMCY								
1014	0	COB-ID EMCY	Variable	UNSIGNED32	RW	No	0x80	
Object 1016h: Heartbeat Consumer Entries								

Index	Sub-index	Description	Object Code	Data Type	Access	PDO Mapping	Default value	Unit
1016		Heartbeat Consumer Entries	Array	UNSIGNED32				
	000	Number of Entries			RO	No	0x08	
	001	Consumer Heartbeat Time 1		UNSIGNED32	RW	No	0x0000000	
	002	Consumer Heartbeat Time 2		UNSIGNED32	RW	No	0x0000000	
	003	Consumer Heartbeat Time 3		UNSIGNED32	RW	No	0x0000000	
	004	Consumer Heartbeat Time 4		UNSIGNED32	RW	No	0x0000000	
	005	Consumer Heartbeat Time 5		UNSIGNED32	RW	No	0x0000000	
	006	Consumer Heartbeat Time 6		UNSIGNED32	RW	No	0x0000000	
	007	Consumer Heartbeat Time 7		UNSIGNED32	RW	No	0x0000000	
	008	Consumer Heartbeat Time 8		UNSIGNED32	RW	No	0x0000000	
Object 1017h: Producer Heartbeat Time								
1017	0	Producer Heartbeat Time	Variable	UNSIGNED16	RW	No	0x00000000	
Object 1018h: Identity Object								
1018		Identity Object	Record	IDENTITY				
	000	number of entries			RO	No	0x4	
	001	Vendor Id		UNSIGNED32	RO	No	0x90	
	002	Product Code		UNSIGNED32	RO	No	-	
	003	Revision number		UNSIGNED32	RO	No	0x01	
	004	Serial number		UNSIGNED32	RO	No	-	
Object 1019h: Synchronous counter								
1019	0	Synchronous counter	Variable	UNSIGNED8	RW	No	0x00000000	
Object 1029h: Error Behaviour								
1029		Error Behaviour	Array	UNSIGNED8				
	000	Number of Entries			RO	No	0x1	
	001	Communication Error		UNSIGNED8	RW	No	0x0	
Object 1400h: Receive PDO Communication Parameter 1								
1400		Receive PDO Communiction Parameter 1	Record	PDO_COMM_PAR				
	000	Number of Entries			RO	No	0x05	
	001	COB-ID		UNSIGNED32	RW	No	0x200	
	002	Transmission Type		UNSIGNED8	RW	No	0xFE	
	003	Inhibit Time		UNSIGNED16	RW	No	0x0	100 µs
	005	Event Timer		UNSIGNED16	RW	No	0x0	ms
Object 1401h: Receive PDO Communication Parameter 2								
1401		Receive PDO Communiction Parameter 2	Record	PDO_COMM_PAR				
	000	Number of Entries			RO	No	0x05	
	001	COB-ID		UNSIGNED32	RW	No	0x80000300	
	002	Transmission Type		UNSIGNED8	RW	No	0xFE	
	003	Inhibit Time		UNSIGNED16	RW	No	0x0	100 µs
	005	Event Timer		UNSIGNED16	RW	No	0x0	ms

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Index	Sub-index	Description	Object Code	Data Type	Access	PDO Mapping	Default value	Unit
Object 1402h: Receive PDO Communication Parameter 3								
1402		Receive PDO Communiction Parameter 3	Record	PDO_COMM_PAR				
	000	Number of Entries			RO	No	0x05	
	001	COB-ID		UNSIGNED32	RW	No	0x80000400	
	002	Transmission Type		UNSIGNED8	RW	No	0xFE	
	003	Inhibit Time		UNSIGNED16	RW	No	0x0	100 µs
	005	Event Timer		UNSIGNED16	RW	No	0x0	ms
Object 1600h: Receive PDO Mapping Parameter 1								
1600		Receive PDO Mapping Parameter 1	Record	PDO_MAPPING				
	000	Number of Entries			RW	No	0x02	
	001	Mapping Entry 1		UNSIGNED32	RW	No	0x60400010	
	002	Mapping Entry 2		UNSIGNED32	RW	No	0x60420010	
	003	Mapping Entry 3		UNSIGNED32	RW	No	0x00000000	
	004	Mapping Entry 4		UNSIGNED32	RW	No	0x00000000	
Object 1601h: Receive PDO Mapping Parameter 2								
1601		Receive PDO Mapping Parameter 2	Record	PDO_MAPPING				
	000	Number of Entries			RW	No	0x04	
	001	Mapping Entry 1		UNSIGNED32	RW	No	0x20000410	
	002	Mapping Entry 2		UNSIGNED32	RW	No	0x20000510	
	003	Mapping Entry 3		UNSIGNED32	RW	No	0x20000610	
	004	Mapping Entry 4		UNSIGNED32	RW	No	0x20000710	
Object 1602h: Receive PDO Mapping Parameter 3								
1602		Receive PDO Mapping Parameter 3	Record	PDO_MAPPING				
	000	Number of Entries			RW	No	0x04	
	001	Mapping Entry 1		UNSIGNED32	RW	No	0x20000810	
	002	Mapping Entry 2		UNSIGNED32	RW	No	0x20000910	
	003	Mapping Entry 3		UNSIGNED32	RW	No	0x20000A10	
	004	Mapping Entry 4		UNSIGNED32	RW	No	0x20000B10	
Object 1800h: Transmit PDO Communication Parameter 1								
1800		Transmit PDO Communiction Parameter 1	Record	PDO_COMM_PAR				
	000	Number of Entries			RO	No	0x06	
	001	COB-ID		UNSIGNED32	RW	No	0x180	
	002	Transmission Type		UNSIGNED8	RW	No	0xFE	
	003	Inhibit Time		UNSIGNED16	RW	No	0x64	100 µs
	005	Event Timer		UNSIGNED16	RW	No	0x0	ms
	006	Sync start value		UNSIGNED8	RW	No	0x0	
Object 1801h: Transmit PDO Communication Parameter 2								

Index	Sub-index	Description	Object Code	Data Type	Access	PDO Mapping	Default value	Unit
1801		Transmit PDO Communiction Parameter 2	Record	PDO_COMM_PAR				
	000	Number of Entries			RO	No	0x06	
	001	COB-ID		UNSIGNED32	RW	No	0x80000280	
	002	Transmission Type		UNSIGNED8	RW	No	0xFE	
	003	Inhibit Time		UNSIGNED16	RW	No	0x3E8	100 µs
	005	Event Timer		UNSIGNED16	RW	No	0x0	ms
	006	Sync start value		UNSIGNED8	RW	No	0x0	
Object 1802h: Transmit PDO Communication Parameter 3								
1802		Transmit PDO Communiction Parameter 3	Record	PDO_COMM_PAR				
	000	Number of Entries			RO	No	0x06	
	001	COB-ID		UNSIGNED32	RW	No	0x80000380	
	002	Transmission Type		UNSIGNED8	RW	No	0xFE	
	003	Inhibit Time		UNSIGNED16	RW	No	0x3E8	100 µs
	005	Event Timer		UNSIGNED16	RW	No	0x0	ms
	006	Sync start value		UNSIGNED8	RW	No	0x0	
Object 1A00h: Transmit PDO Mapping Parameter 1								
1A00		Transmit PDO Mapping Parameter 1	Record	PDO_MAPPING				
	000	Number of Entries			RW	No	0x02	
	001	Mapping Entry 1		UNSIGNED32	RW	No	0x60410010	
	002	Mapping Entry 2		UNSIGNED32	RW	No	0x60440010	
	003	Mapping Entry 3		UNSIGNED32	RW	No	0x00000000	
	004	Mapping Entry 4		UNSIGNED32	RW	No	0x00000000	
Object 1A01h: Transmit PDO Mapping Parameter 2								
1A01		Transmit PDO Mapping Parameter 2	Record	PDO_MAPPING				
	000	Number of Entries			RW	No	0x04	
	001	Mapping Entry 1		UNSIGNED32	RW	No	0x20010410	
	002	Mapping Entry 2		UNSIGNED32	RW	No	0x20010510	
	003	Mapping Entry 3		UNSIGNED32	RW	No	0x20010610	
	004	Mapping Entry 4		UNSIGNED32	RW	No	0x20010710	
Object 1A02h: Transmit PDO Mapping Parameter 3								
1A02		Transmit PDO Mapping Parameter 3	Record	PDO_MAPPING				
	000	Number of Entries			RW	No	0x04	
	001	Mapping Entry 1		UNSIGNED32	RW	No	0x20010810	
	002	Mapping Entry 2		UNSIGNED32	RW	No	0x20010910	
	003	Mapping Entry 3		UNSIGNED32	RW	No	0x20010A10	
	004	Mapping Entry 4		UNSIGNED32	RW	No	0x20010B10	

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9.2 MANUFACTURER SEGMENT

Index	Sub-index	Description	Object Code	Data Type	Access	PDO Mapping	Default value	Unit
Object 2000h: FB Processdata In								
2000		FB Processdata In	Array	UNSIGNED16				
	000	Number of Entries			CONST	No	0xB	
	001	FB PD In Offset 0		UNSIGNED16	RWW	Yes	0x0	
	002	FB PD In Offset 1		UNSIGNED16	RWW	Yes	0x0	
	003	FB PD In Offset 2		UNSIGNED16	RWW	Yes	0x0	
	004	FB PD In Offset 3		UNSIGNED16	RWW	Yes	0x0	
	005	FB PD In Offset 4		UNSIGNED16	RWW	Yes	0x0	
	006	FB PD In Offset 5		UNSIGNED16	RWW	Yes	0x0	
	007	FB PD In Offset 6		UNSIGNED16	RWW	Yes	0x0	
	008	FB PD In Offset 7		UNSIGNED16	RWW	Yes	0x0	
	009	FB PD In Offset 8		UNSIGNED16	RWW	Yes	0x0	
	010	FB PD In Offset 9		UNSIGNED16	RWW	Yes	0x0	
	011	FB PD In Offset 10		UNSIGNED16	RWW	Yes	0x0	
Object 2001h: FB Processdata Out								
2001		FB Processdata Out	Array	UNSIGNED16				
	000	Number of Entries			CONST	No	0xB	
	001	FB PD Out Offset 0		UNSIGNED16	RO	Yes	0x0	
	002	FB PD Out Offset 1		UNSIGNED16	RO	Yes	0x0	
	003	FB PD Out Offset 2		UNSIGNED16	RO	Yes	0x0	
	004	FB PD Out Offset 3		UNSIGNED16	RO	Yes	0x0	
	005	FB PD Out Offset 4		UNSIGNED16	RO	Yes	0x0	
	006	FB PD Out Offset 5		UNSIGNED16	RO	Yes	0x0	
	007	FB PD Out Offset 6		UNSIGNED16	RO	Yes	0x0	
	008	FB PD Out Offset 7		UNSIGNED16	RO	Yes	0x0	
	009	FB PD Out Offset 8		UNSIGNED16	RO	Yes	0x0	
	010	FB PD Out Offset 9		UNSIGNED16	RO	Yes	0x0	
	011	FB PD Out Offset 10		UNSIGNED16	RO	Yes	0x0	

The objects from 0x2100 to 0x5FFF contain the device-specific parameters and monitor valuesdefined in separate .EDS files. These files can be downloaded from http://drives.danfoss.com.

To access the application IDs in the drive, make the following calculation:

Index = ID number + 2100h

For example: Reading parameter acceleration time (ID 103d), has the index 2100h + 103d = 2167h.

Any application ID between 1 and 3EFFh (16127d) can be read/written using this method.

9.3 DEVICE PROFILE SEGMENT

Index	Sub-index	Description	Object Code	Data Type	Access	PDO Mapping	Default Value
Object 6040h: Controword							
6040	0	Controlword	Variable	UNSIGNED16	RWW	Yes	-
Object 6041h: Statusword							
6041	0	Statusword	Variable	UNSIGNED16	RO	Yes	-
Object 6042h: vl Target Velocity							
6042	0	vl Target Velocity	Variable	INTEGER16	RWW	Yes	0x0000
Object 6043h: vl Velocity Demand							
6043	0	vl Velocity Demand	Variable	INTEGER16	RO	Yes	-
Object 6044h: vl Velocity Actual Value							
6044	0	vl Velocity Actual Value	Variable	INTEGER16	RO	Yes	-
Object 6046h: vl Velocity Min Max Amount							
6046		vl Velocity Min Max Amount	Array	UNSIGNED32			
	000	Number of Entries		CONST		No	0x00000002
	001	vl_Velocity_Min_Amount		UNSIGNED32	RW	No	0x2
	002	vl_Velocity_Max_Amount		UNSIGNED32	RW	No	-
Object 6048h: vl Velocity Acceleration							
6048		vl Velocity Acceleration	Record	P402_VL_VEL_ACC_T			
	000	NumOfEntries		CONST		No	0x2
	001	DeltaSpeed		UNSIGNED32	RW	No	0x0
	002	DeltaTime		UNSIGNED16	RW	No	0x0
Object 6049h:vl Velocity Decelaration							
6049		vl Velocity Deceleration	Record	P402_VL_VEL_ACC_T			
	000	NumOfEntries		CONST		No	0x2
	001	DeltaSpeed		UNSIGNED32	RW	No	0x0
	002	DeltaTime		UNSIGNED16	RW	No	0x0
Object 6060h: Modes of Operation							
6060	0	Modes of Operation	Variable	INTEGER8	RW	No	-
Object 6061h: Modes of Operation Display							
6061	0	Modes of Operation Display	Variable	INTEGER8	RO	No	-
Object 6502h: Supported Drive Modes							
6502	0	Supported Drive Modes	Variable	UNSIGNED32	RO	No	-

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