AVTRON
CANopen OPTION BOARD

(For Use with ACCel500 Frequency Converters)

Cleveland, Ohio

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AVTRON
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TABLE OF CONTENTS

SECTION PAGE

TABLE OF CONTENTS (continued)

AVTRON
CANopen OPTION BOARD

SECTION I

GENERAL INFORMATION

ACCel500 frequency converters can be connected to the CANopen system using a fieldbus board. The converter can then be controlled, monitored and programmed from the host system.

The CANopen fieldbus board shall be installed in slot E on the control board of the frequency converter.

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WARNING

Internal components and circuit boards are at high potential when the frequency converter is connected to the power source. This voltage is extremely dangerous and may cause death or severe injury if you come into contact with it.

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SECTION II

CANopen OPTION BOARD TECHNICAL DATA

2-1 GENERAL

TABLE 2-1. CANopen TECHNICAL DATA

CANopen Connections	Interface	Open Style Connector (Pluggable connector, 5.08 mm)
	Data transfer method	CAN (ISO 11898)
	Transfer cable	2 wire twisted shielded cable
	Electrical isolation	500 VDC
Communications	CANopen	CiA DS-301 CiA DSP-402
	Baud rate	10 kBaud, 20 kBaud, 50 kBaud , 100 kBaud, 125 kBaud, 250 kBaud, 500 kBaud, 1000 kBaud
	Addresses	1 – 127
Environment	Ambient operating temperature	–10°C to 55°C
	Storage temperature	–40°C to 60°C
	Humidity	<95%, no condensation allowed
	Altitude	Max. 1000 m
	Vibration	0.5 G at 9 to 200 Hz
Safety		Fulfills EN50178 standard

2-2 CANopen CABLE

According to the ISO 11898 standard, cables to be chosen for CAN bus lines should have a nominal impedance of 120Ω, and a specific line delay of nominal 5 ns/m. Line termination has to be provided through termination resistors of 120Ω located at both ends of the line. The length related resistance should have 70 mΩ/m. All these mentioned AC and DC parameters are suitable for a 1 Mbit/s transmission rate.

The table below shows practical bus length for CANopen networks with less than 64 nodes:

TABLE 2-2. MAXIMUM BUS LENGTH

Baudrate [Kbit/s]	**Max. Bus Length [m]**
1000	30
800	50
500	100
250	250
125	500
50	1000
20	2500

SECTION III

CANopen

CANopen is a networking system based on the serial bus Controller Area Network (CAN). The CANopen Communication Profile (CiA DS-301) supports both direct access to device parameters and time-critical process data communication. CANopen device profiles (CiA DS40x) define standards for basic device functionality while providing ample scope for additional vendor-specific device features. CANopen leashes the full power of CAN by allowing direct peer to peer data exchange between nodes in an organized and, if necessary, deterministic manner. The network management functions specified in CANopen simplify project design, implementation and diagnosis by providing standard mechanisms for network start-up and error management.

CANopen supports both cyclic and event-driven communication. This makes it possible to reduce the bus load to a minimum but still maintaining extremely short reaction times. High communication performance can be achieved at relatively low baud rates, thus reducing EMC problems and minimizing cable costs.

CANopen is the ideal networking system for all types of automated machinery. One of the distinguishing features of CANopen is its support for data exchange at the supervisory control level as well as accommodating the integration of very small sensors and actuators on the same physical network. This avoids the unnecessary expense of gateways linking sensor/actuator bus systems with higher communication networks and makes CANopen particularly attractive to original equipment manufacturers.

Device Profile Drives and Motion Control (CiA DSP-402) document represents the standardized CANopen Device Profile for digital controlled motion products like servo controllers, frequency converters or stepper motors. All the above-mentioned devices use communication techniques which conform to those described in the CANopen Application Layer and Communication Profile. The starting and stopping of the drive and several mode specific commands are executed by the state machine. The operation mode defines the behavior of the drive. The following modes are defined in this profile:

- Homing Mode
- Profile Position Mode
- Interpolated Position Mode
- Profile Velocity Mode
- Profile Torque Mode
- Velocity Mode

The Avtron CANopen Option Board supports the Velocity Mode.

SECTION IV

CANopen OPTION BOARD LAYOUT AND CONNECTIONS

The CANopen Board is connected to the fieldbus through a 5-pin pluggable bus connector (board OPTC6). The communication with the control board of the frequency converter takes place through the standard Avtron Interface Board Connector.

4-1 CANopen OPTION BOARD

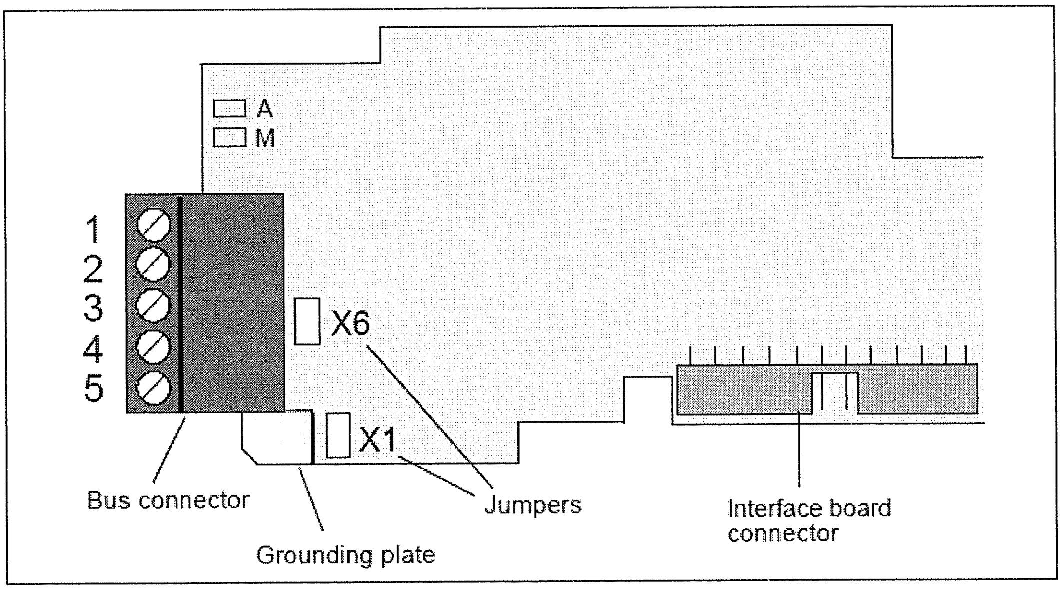


Figure 4-1. CANopen Option Board OPTC6

TABLE 4-1. OPTC6 BUS CONNECTOR SIGNALS

Signal	Connector	Description
CAN_GND	1	Ground / 0V / V-
CAN_L	2	CAN_L bus line (dominant low)
(CAN_SHLD)	3	Optional CAN shield
CAN_H	4	CAN_H bus line (dominant high)
(CAN_V+)	5	–

4-2 BUS TERMINAL RESISTORS

If the Avtron drive is the last device of the CANopen line, the bus termination must be set. Use jumper X6 (ON position, see Figure 4-2), or an external resistor (120Ω) connected to terminals 2 and 4.

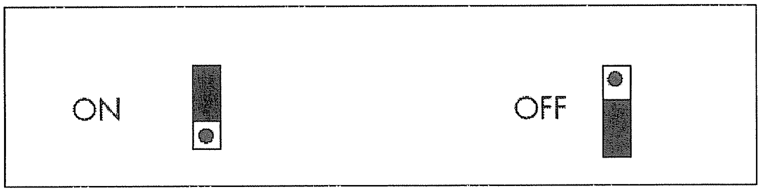


Figure 4-2. Setting Bus Termination

4-3 LED INDICATORS

The CANopen Option Board includes two LED status indicators next to the connector: Fieldbus Status (M) and CANopen (A). LED N is unused.

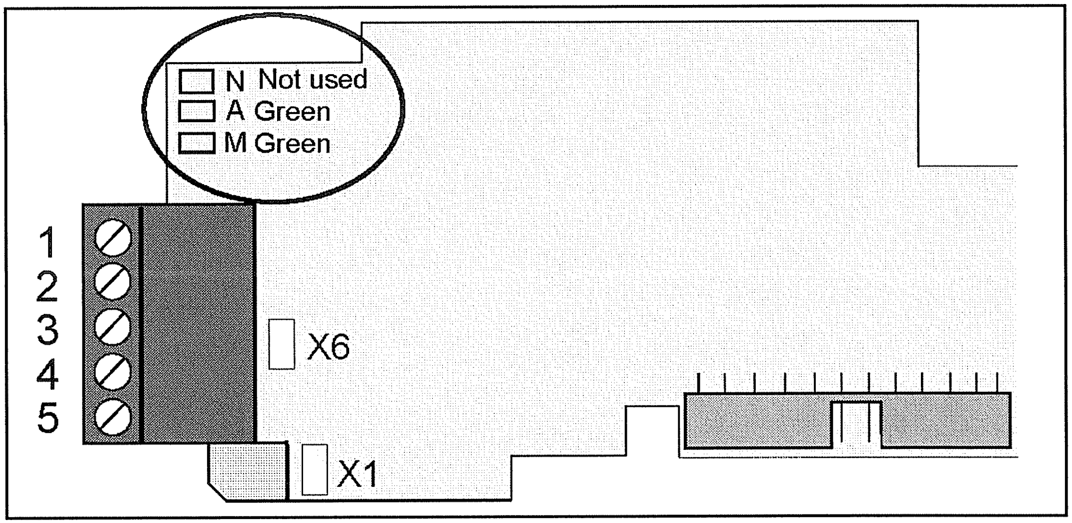


Figure 4-3. LED Indicators on the CANopen Board

CANopen Board Status LED (A) GREEN

LED is:	Meaning:
OFF	Option board not activated.
ON	Option board in initialization state waiting for activation. command from the frequency converter.
Blinking fast (1 blink / s)	Option board is activated and in RUN state. Option board is ready for external communication,
Blinking slow (1 blink/ 5s)	Option board is activated and in FAULT state. Internal fault of option board .

Fieldbus Status LED (M) GREEN

LED is:	Meaning:
OFF	Fieldbus module is waiting for parameters from the frequency converter. No external communication.
ON	Fieldbus module is activated. Parameters received and module activated. Module is waiting for messages from the bus.
Blinking fast (1 blink / s)	Module is activated and receiving messages from the bus.
Blinking slow (1 blink / 5s)	Module is in FAULT state. No messages from Master within the watchdog time. Bus broken, cable loose or Master off line.

4-4 CONNECTION OF CANopen BUS CABLE

The bus cable shield can be grounded in three different ways:

- directly to the frequency converter frame
- to the frame of the frequency converter through an RC filter
- clamping the cable to the converter frame

Normally, the option board has already been installed in slot E of the control board. It is not necessary to detach the whole board for the grounding of the bus cable shield. Just detach the terminal block.

4-4.1 GROUNDING THE BUS CABLE SHIELD DIRECTLY TO THE FREQUENCY CONVERTER FRAME

1 Set jumper X1 to ON position:

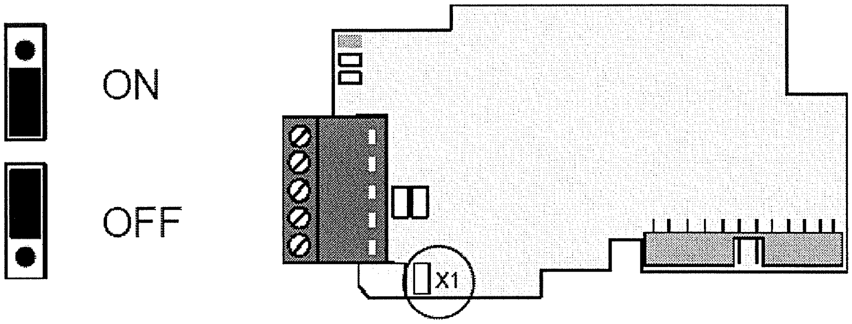


Figure 4-4. Jumper X1 Positions

2 Strip about 5 cm of the CANopen cable as shown in Figure 4-5. NOTE: Do the same for both bus cables (except for the last device). However, since the grounding shall be done on one cable only, cut off the exposed part of the other grounding cable.

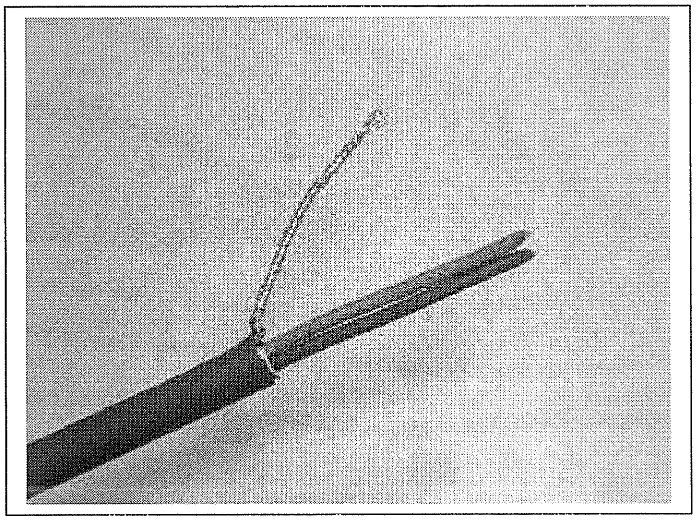


Figure 4-5. Stripping the CANopen Cable

3 Leave no more than 1 cm of the red and green data cable outside the terminal block and strip the data cables at about 0.5 cm to fit in the terminals. See Figures 4-6 and 4-7. Do this for both bus cables.

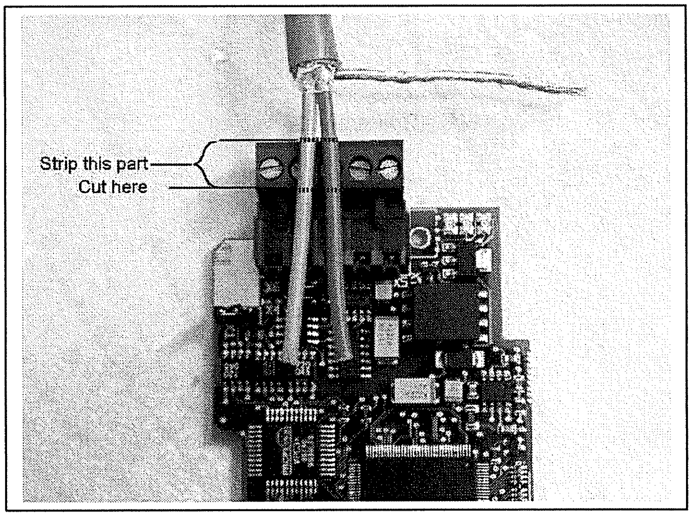


Figure 4-6. Stripping the Data Cables

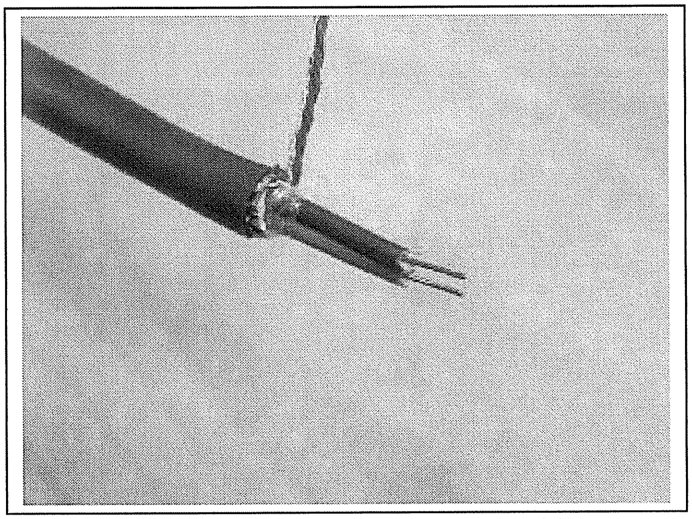


Figure 4-7. Stripping the Data Cables

4 We recommend you to use an Abico connector to fit the grounding cable into the grounding terminal (#3). Insert the white and brown data cables of both CANopen cables into terminals #2 (white) and #4 (brown). See Figure 4-8.

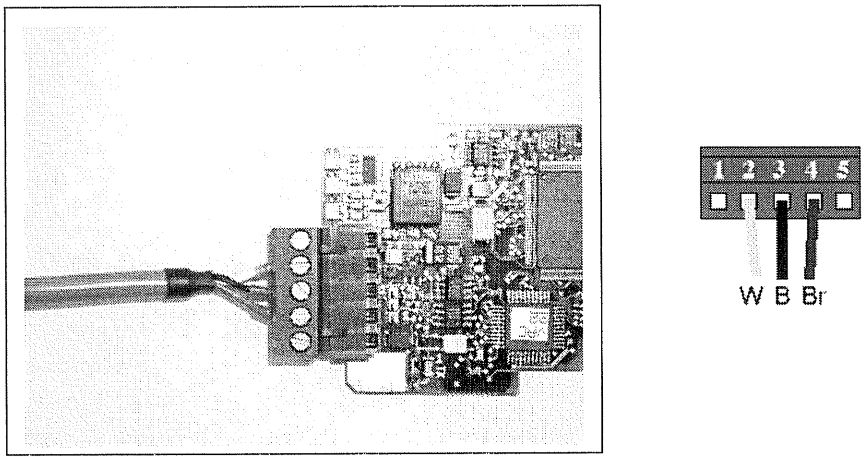


Figure 4-8. Connecting the Grounding Cable

5 Place the CANopen board into slot E of the control board (see board installation in section 5) and fix both the CANopen cables on the frame with the clamp. See Figure 4-9.

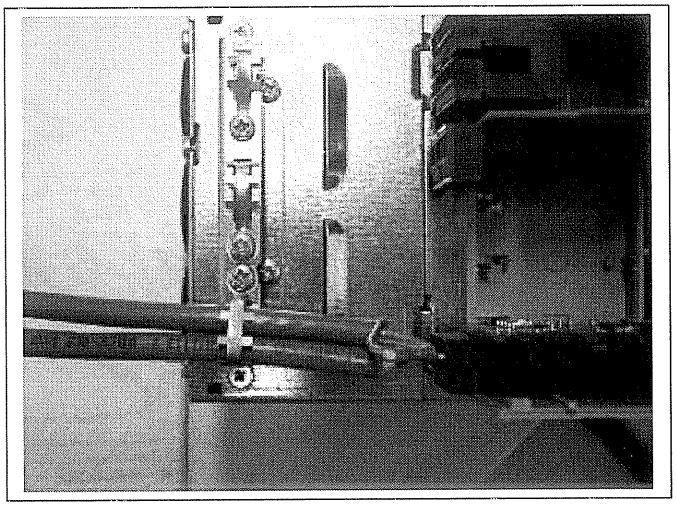


Figure 4-9. Grounding the CANopen Cables

4-4.2 GROUNDING WITH AN RC FILTER

We recommend you do the grounding in this manner when the distance between the devices exceeds 50 meters (165 ft). When the distance between the devices is long disturbances (e.g., voltage spikes) are more likely to appear. In this grounding method, the disturbances are filtered out. Even if the ground planes of A, B and C are different (which is very typical in construction), there is no current between them because the points do not have a ground connection. See Figure 4-10.

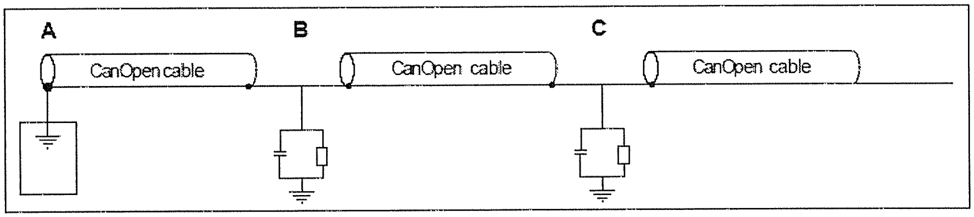


Figure 4-10. Grounding with an RC Filter

1 Set jumper X1 in OFF position. See Figure 4-11.

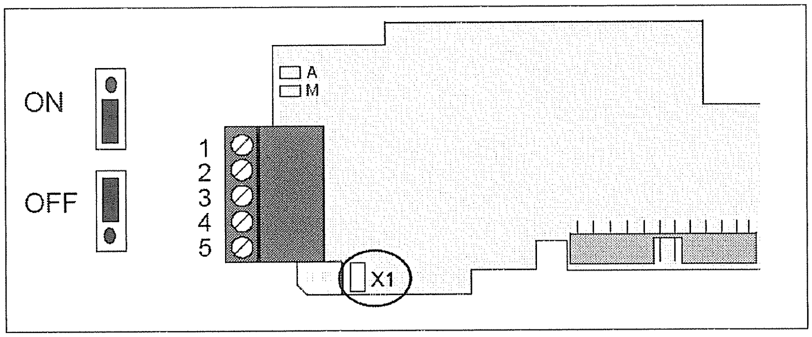


Figure 4-11. Jumper X1 Positions

2 Carry out the grounding in the same way as advised in section 4-4.1.

4-4.3 GROUNDING BY CLAMPING THE CABLE TO THE CONVERTER FRAME

This manner of grounding is the most effective and especially recommended when the distances between the devices are relatively short.

In this manner of grounding, the position of jumper X1 is of no importance.

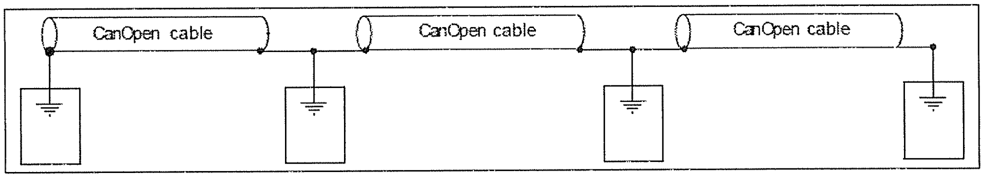


Figure 4-12. Grounding the CANopen Cable

1 Strip about 5 cm of the CANopen cable in the same way as shown in Figure 4-5, but cut off the grey cable shield. Remember to do this for both bus cables (except for the last device).

2 Leave no more than 1 cm of the data cable outside the terminal block and strip the data cables at about 0.5 cm to fit in the terminals. See Figure 4-7. Note: Do this for both bus cables.

3 Insert the data cables of both CANopen cables into terminals #2 and #4. See Figure 4-8.

4 Strip the CANopen cable at such a distance from the terminal that you can fix it to the frame with the grounding clamp. See Figure 4-13.

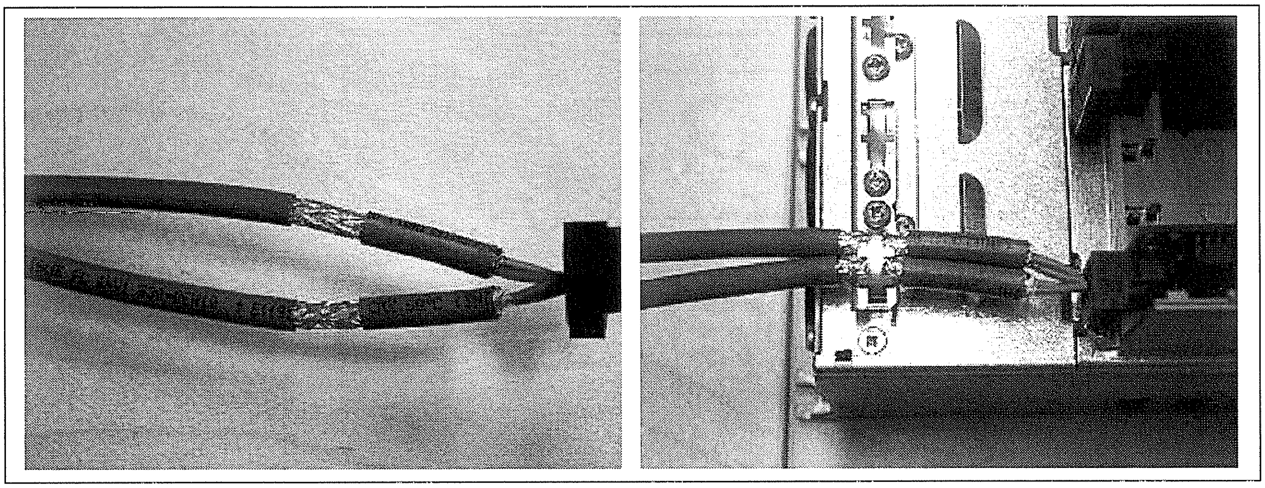
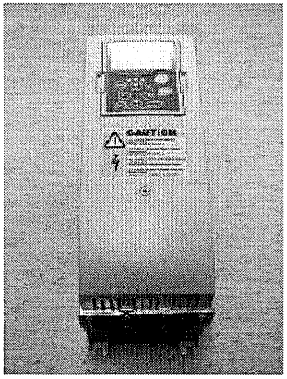
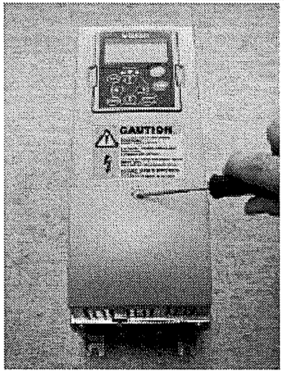


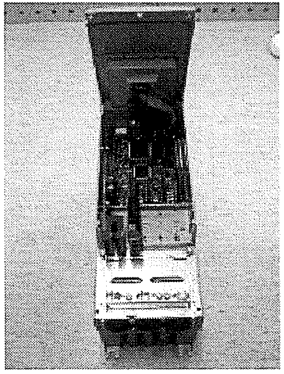
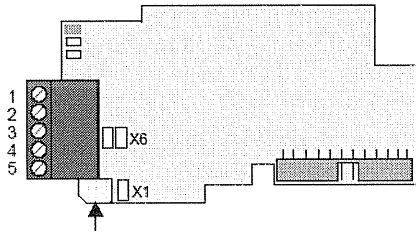
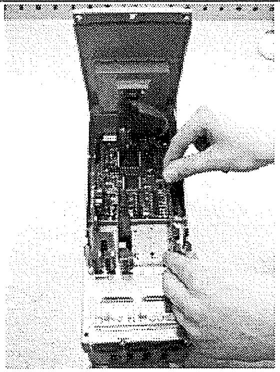
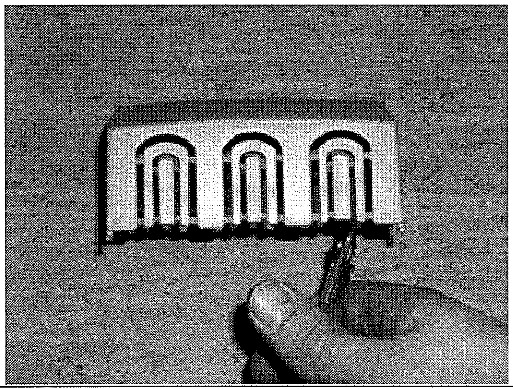
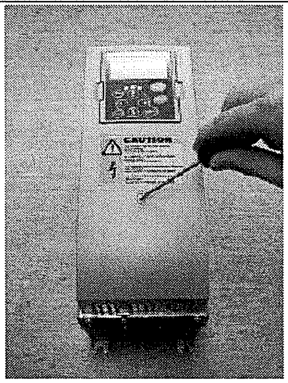
Figure 4-13. Grounding the CANopen Cable

SECTION V

INSTALLATION OF THE CANopen OPTION BOARD

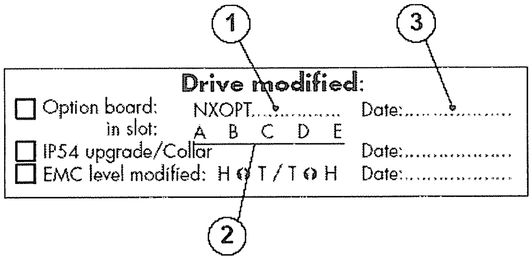
Make sure that the frequency converter is switched OFF before an option or fieldbus board is changed or added.

A	ACCel500 frequency converter.	
B	Remove the cable cover.	

C	Open the cover of the control unit. 
D	Install CANopen option board in slot E on the control board of the frequency converter. Make sure that the grounding plate (see below) fits tightly in the clamp.  
E	Make a sufficiently wide opening for your cable by cutting the grid as wide as necessary. 
F	Close the cover of the control unit and the cable cover. 

5-1 BOARD INFORMATION STICKER

The CANopen option board package delivered by the factory includes a sticker (shown below). Please mark the board type (1), the slot into which the board is mounted (2) and the mounting date (3) on the sticker. Finally, attach the sticker on your drive.



Drive modified:

□ Option board: NXOPT........... Date:...................

in slot: A B C D E

□ IP54 upgrade/Collar Date:...................

□ EMC level modified: H → T / T → H Date:...................

SECTION VI

COMMISSIONING

Before beginning, read Section VII, Commissioning, in the ACCel500 Frequency Converter's Manual. You must select Fieldbus as the active control place if you wish to control the frequency converter through fieldbus. The CANopen board is commissioned with the control keypad by giving values to appropriate parameters in menu M7 (for locating the expander board menu, see the ACCel500 Software Manual, Section II).

Expander Board Menu (M7)

The Expander board menu makes it possible for the user 1) to see what expander boards are connected to the control board and 2) to reach and edit the parameters associated with the expander board. Enter the following menu level (G#) with the Menu button right. At this level, you can browse through slots A to E with the Browser buttons to see what expander boards are connected. On the lowermost line of the display, you also see the number of parameter groups associated with the board. If you press the Menu button right once, you will reach the parameter group level where there are two groups: Editable parameters and Monitored values. Pressing on the Menu button right again takes you to either of these groups.

CANopen Parameters

To commission the CANopen board, enter the level P7.5.1.# from the Parameters group (G7.5.1). Give desired values to all CANopen parameters (see xx and xx).

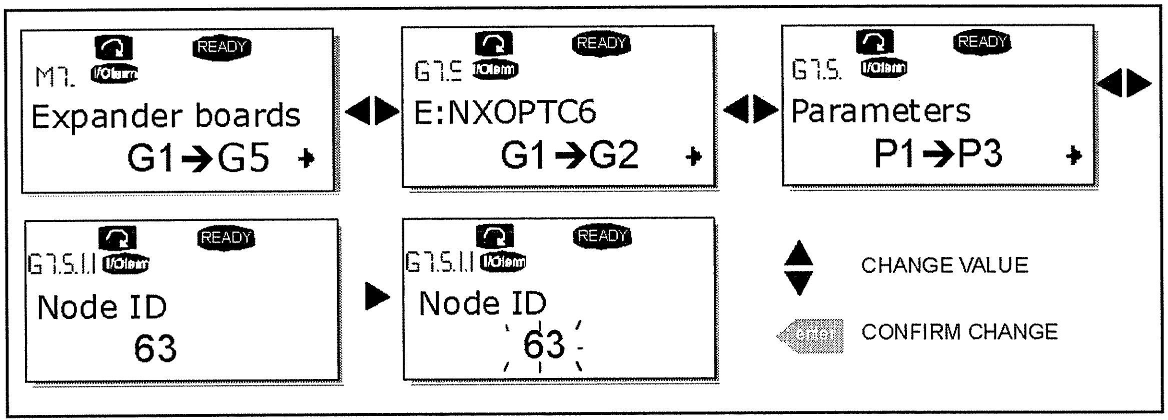


Figure 6-1. Changing the CANopen Option Board Parameters

TABLE 6-1. CANopen PARAMETERS

#	Name	Default	Range	Description
1	Node ID	1	1 – 127	
2	BAUD RATE	6	1 – 10 kBaud 2 – 20 kBaud 3 – 50 kBaud 4 – 100 baud 5 – 125 baud 6 – 250 baud 7 – 500 baud 8 – 1000 baud	Communication speed
3	Operate mode	1	1 – Drive Profile 2 – Bypass	Communication set selection 1 = xPDO1, xPDO6 2 = xPDO1, xPDO21, xPDO22

The parameters of every device must be set before connecting to the bus. Especially the parameters “NODE ID” and “BAUD RATE” must be the same as in the master configuration.

CANopen Status

To see the present status of the CANopen Fieldbus, enter the CANopen Status page from Monitor menu (G7.5.2). See Figure 6-2 and Table 6-2.

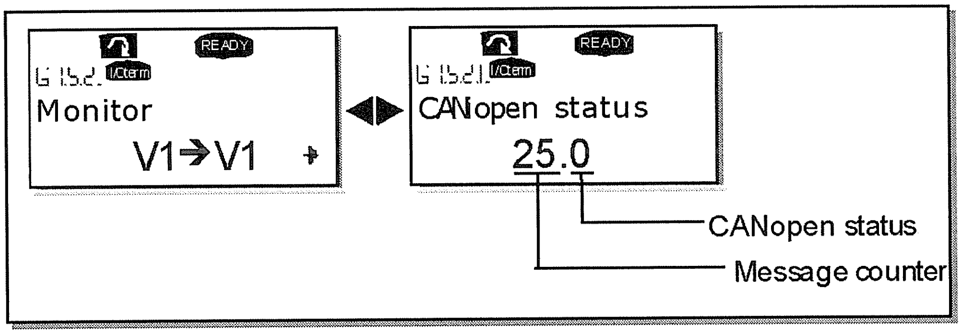


Figure 6-2. DeviceNet Status

TABLE 6-2. CANopen STATUS INDICATIONS

CANopen Status	
0	INITIALIZING
4	STOPPED
5	OPERATIONAL
6	PRE_OPERATIONAL
7	RESET_APPLICATION
8	RESET_COMM
9	UNKNOWN

SECTION VII

CANopen-ACCel500 INTERFACE

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

- The real-time data transfer is performed by the Process Data Objects (PDOs) protocol
  →REAL-TIME CONTROL OF THE DRIVE

- Service Data Objects (SDO) protocols provide the read and write access to entries of a device object dictionary
  →CONFIGURATION OF THE DRIVE, READ/WRITE DRIVE PARAMETERS

- The Network Management (NMT) protocols provide services for network initialization, error control and device status control
  →START/STOP CANOPEN COMMUNICATION

7-1 CANopen MESSAGE FRAME

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

SOF	Start of Frame	CRC	Cyclic Redundancy Check
RTR	Remote Transmission Request	ACK	Acknowledge
CTRL	Control Field (i.e. Data Length)	EOF	End of Frame

COB-ID

The identification field of the CANopen message is 11 bits.

ID-Bit	10	9	8	7	6	5	4	3	2	1	0
COB-ID	Function Code				Module-ID						

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

Predefined Connection Sets

The CANopen option board has two different communication parameter sets. These sets can be selected via Operate Mode – parameter from the panel. Both communication sets fulfill the 'Drives and Motor Control' profile described in CiA DSP-402.

TABLE 7-1. DRIVE PROFILE – MODE

Drive Profile - Mode			
Object	**Function Code (binary)**	**COB-ID**	**Comm. Parameter at Index**
NMT message	0000	0x0000	–
Sync Message	0001	0x0080	0x1005
Time-Stamp-Message	0001	0x0100	–
PDO1, Process Data Objects (tx)	0011	0x0180 +Node	0x1800
PDO1, Process Data Objects (rx)	0100	0x0200 +Node	0x1400
PDO6, Process Data Objects (tx)	0101	0x0280 +Node	0x1801
PDO6, Process Data Objects (rx)	0110	0x0300 +Node	0x1401
SDO, Service Data Objects (tx)	1011	0x0580 +Node	
SDO, Service Data Objects (rx)	1100	0x0600 +Node	
Node Guarding	1110	0x0700 +Node	(0x100E)

TABLE 7-2. BYPASS – MODE

Bypass - Mode			
Object	**Function Code (binary)**	**COB-ID**	**Comm. Parameter at Index**
NMT message	0000	0x0000	–
Sync Message	0001	0x0080	0x1005
Time-Stamp-Message	0010	0x0100	–
PDO1, Process Data Objects (tx)	0011	0x0180 +Node	0x1800
PDO1, Process Data Objects (rx)	0100	0x0200 +Node	0x1400
PDO21, Process Data Objects (tx)	0111	0x0380 +Node	0x1814
PDO21, Process Data Objects (rx)	1000	0x0400 +Node	0x1414
PDO22, Process Data Objects (tx)	1001	0x0480 +Node	0x1815
PDO22, Process Data Objects (rx)	1010	0x0500 +Node	0x1415
SDO, Service Data Objects (tx)	1011	0x0580 +Node	
SDO, Service Data Objects (rx)	1100	0x0600 +Node	
Node Guarding	1110	0x0700 +Node	(0x100E)

7-2 NETWORK MANAGEMENT (NMT)

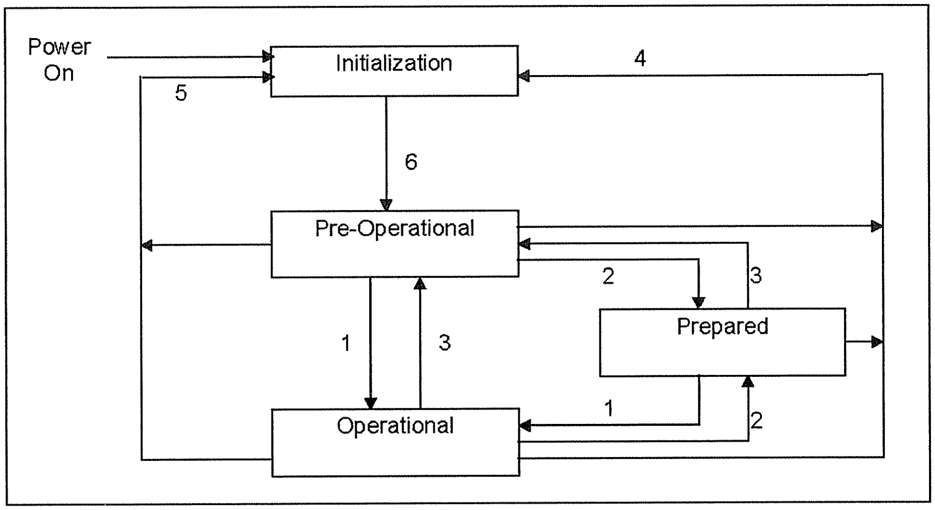
The CANopen network management is node-oriented and follows a master/slave structure. It requires one device in the network, which fulfills the function of the NMT master. The other nodes are NMT slaves. The CANopen NMT slave devices implement a state machine. After power on a node initializes and transits to the "Pre-operational State". In this state, communication across SDO channels is possible for node configuration, but not yet across PDOs. With the NMT message "Start Remote Node", a selected or any nodes on the network can be set into the "Operational State". In this state, also the exchange of data by means of PDOs is possible. With enabling the operation of all nodes of a network at the same time, a coordinated operation of the communicating system is secured (DS301). To set the CANopen Option board to the operational state, the following message must be sent:

Message: Start_Remote_Node

Master to Slave (1)

Header			Data							
ID	RTR	Len	1 = **CS**	2 = Node ID	3	4	5	6	7	8
0000	0	2	01	01						

Function of the internal state machine:



Change	**Message / Event**	**Command Specifier (CS)**
1	Start Remote Node	CS = 1
2	Stop Remote Node	CS = 2
3	Enter Pre-operational State	CS = 128
4	Reset Node	CS = 129
5	Reset Communication	CS = 130
6	Initialization finished	Automatic

7-3 PROCESS DATA (PDO)

The real-time data transfer is performed by means of “Process Data Objects” (PDO). The transfer of PDOs is performed with no protocol overhead. Process Data is time-critical data used for control of the drive and monitor status of the drive. Transmit PDOs support several transmission modes which are cyclic, acyclic, synchronous, asynchronous, and RTR only mode. Most PDOs also support Event Timer for transmitting PDOs. TPDO1 is exception which is defined for asynchronous only operation. Receive PDOs support only asynchronous transmission mode (event driven). The CANopen option board uses eight types of PDOs as follows:

PDO Type	**Mapped Data**	**Mapped Data**	**Mapped Data**	**Mapped Data**	**Cyclic**	**Acyclic**	**Synchronous**	**Asynchronous (default)**	**RTR Only mode**	**Event Timer**
TPDO1	statusword	–	–	–				x		
TPDO6	statusword	vl_control_effort	–	–	x	x	x	x	x	x
TPDO21	nx_status_word	nx_actual_speed	process_data_out1	process_data_out2	x	x	x	x	x	x
TPDO22	process_data_out3	process_data_out4	process_data_out5	process_data_out6	x	x	x	x	x	x
RPDO1	controlword	–	–	–				x		
RPDO6	controlword	vl_target_velocity	–	–				x		
RPDO21	nx_control_word	nx_speed_reference	process_data_in1	process_data_in2				x		
RPDO22	process_data_in3	process_data_in4	process_data_in5	process_data_in6				x		

Manufacturer-specific PDOs (TPDO21/RPDO21/ TPDO22/RPDO22) consist of application-specific process data. See Appendix C for contents of process data in different applications. See section 7-6 (Using Manufacturer-Specific PDOs).

All Tx objects are event-driven by default. (Message is sent out if one or several values within the message change.)

7-4 TRANSMISSION TYPES

TABLE 7-3. DESCRIPTION OF TRANSMISSION TYPE

Transmission Type	**PDO Transmission**				
	Cyclic	**Acyclic**	**Synchronous**	**Asynchronous**	**RTR Only**
0		X	X		
1-240	X		X		
241-251	- Reserved -				
252			X		X
253				X	X
254				X	
255				X	

Synchronous (transmission types 0-240 and 252) means that the transmission of the PDO shall be related to the SYNC object. Preferably, the devices use the SYNC as a trigger to output or actuate based on the previous synchronous Receive PDO respectively to update the data transmitted at the following synchronous Transmit PDO. Asynchronous means that the transmission of the PDO is not related to the SYNC object. A transmission type of zero means that the message shall be transmitted synchronously with the SYNC object but not periodically. A value between 1 and 240 means that the PDO is transferred synchronously and cyclically. The transmission type indicates the number of SYNC which are necessary to trigger PDO transmissions. Receive PDOs are always triggered by the following SYNC upon reception of data independent of the transmission types 0 - 240.

The transmission types 252 and 253 mean that the PDO is only transmitted on remote transmission request. At transmission type 252, the data is updated (but not sent) immediately after reception of the SYNC object. At transmission type 253, the data is updated at the reception of the remote transmission request (hardware and software restrictions may apply). These values are only possible for TPDOs. For TPDOs, transmission type 254 means the application event is manufacturer-specific (manufacturer-specific part of the Object Dictionary). Transmission type 255 means that the application event is defined in the device profile. RPDOs with that type trigger the update of the mapped data with the reception. PDOs Sub-index 3h contains the inhibit time. This time is a minimum interval for PDO transmission. The value is defined as multiple of 100 ms. It is not allowed to change the value while the PDO exists (Bit 31 of sub-index 1 is 0).

In mode 254/255, additionally, an event time can be used for TPDO. If an event timer exists for a TPDO (value not equal to 0), the elapsed timer is considered to be an event. The event timer elapses as multiple of 1 ms of the entry in sub-index 5h of the TPDO. This event will cause the transmission of this TPDO in addition to otherwise defined events. The occurrence of the events set the timer. Independent of the transmission type, the RPDO event timer is used recognize the expiration of the RPDO.

7-5 CONTROLLING THE DRIVE VIA PDO MESSAGES

PDO1 Rx
Master to Slave (1)

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x201	0	2	**controlword**		–	–	–	–	–	–

PDO1 Tx
Slave (1) to Master

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x181	0	2	**statusword**		–	–	–	–	–	–

PDO6 Rx
Master to Slave (1)

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x301	0	4	**controlword**		**vl_target_velocity**		-	-	-	-

PDO6 Tx
Slave (1) to Master

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x281	0	4	**statusword**		**vl_control_effort**		-	-	-	-

The state of the drive can be controlled by the controlword.
The state of the drive is shown in the statusword.

The Statemachine describes the device status and the possible control sequence of the drive.

controlword

bit	**Name**
0	Switch ON
1	Disable Voltage
2	Quick Stop
3	Enable Operation
4	Operation Mode Specific
5	Operation Mode Specific
6	Operation Mode Specific
7	Reset Fault
8	Halt
9	Reserved
10	Reserved
11	Manufacturer Specific
12	Manufacturer Specific
13	Manufacturer Specific
14	Manufacturer Specific
15	Manufacturer Specific

statusword

bit	**Name**
0	Ready to Switch ON
1	Switched ON
2	Operation Enable
3	Fault
4	Voltage Disable
5	Quick Stop
6	Switch ON Disable
7	Warning
8	Manufacturer Specific
9	Remote
10	Target Reached
11	Internal Limit Active
12	Operation Mode Specific
13	Operation Mode Specific
14	Manufacturer Specific
15	Manufacturer Specific

By using a controlword, the drive can be controlled as follows:

Command	ControlWord	Description
Prepare RUN	0006hex	Set Statemachine to "Ready To Switch ON" state
RUN	000Fhex	Start motor if "Fieldbus" is the active control place
STOP	0007hex	Stop motor
FAULT RESET (step 1) FAULT RESET (step 2)	bit 7 = 0 bit 7 = 1	Falling edge to bit 7

vl_target_velocity

The vl_target_velocity is the required speed reference to the frequency converter. The unit is RPM.

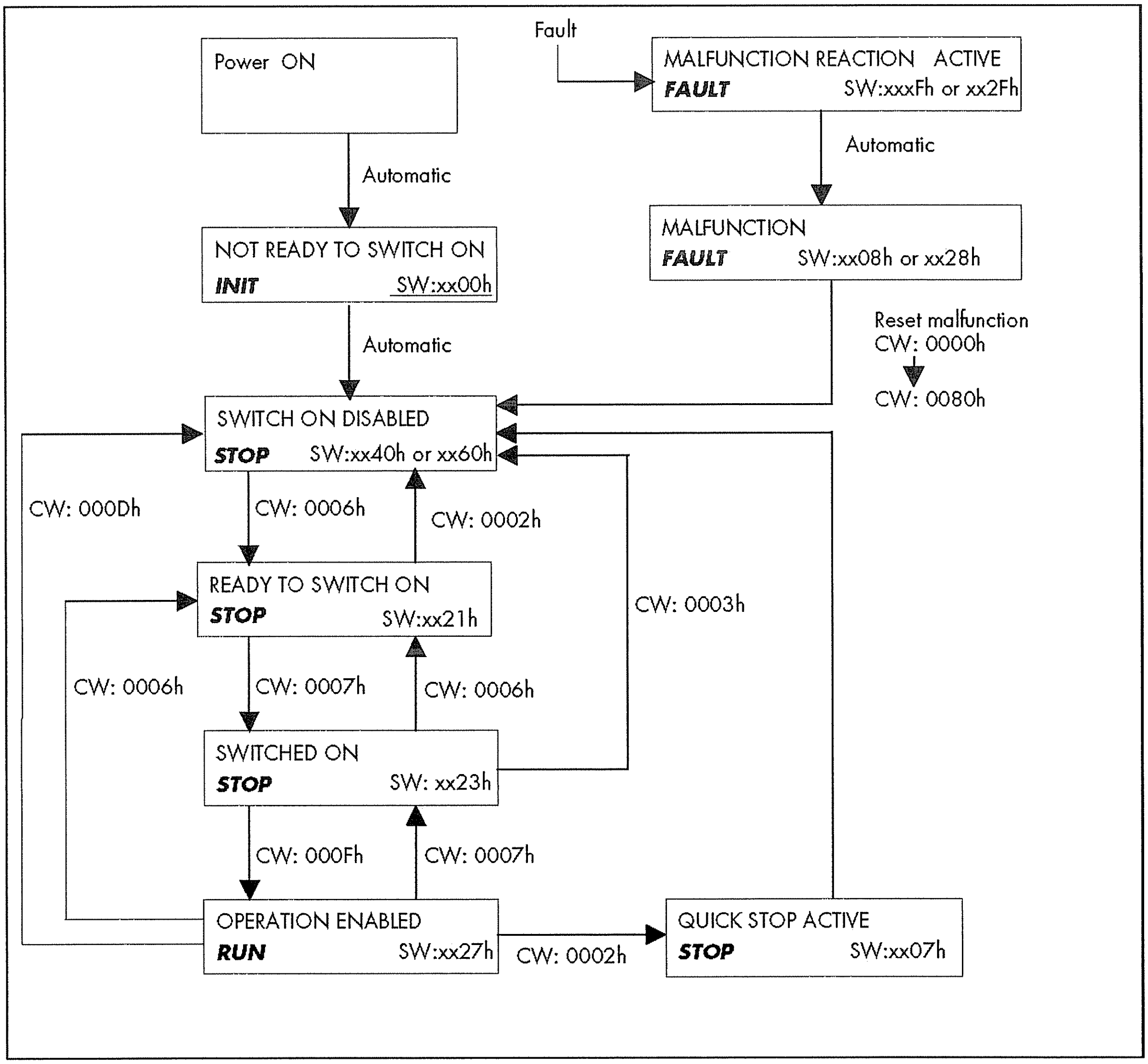
vl_control_effort

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

State Machine

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

SW = StatusWord
CW = ControlWord word



7-6 USING MANUFACTURER-SPECIFIC PDOS

Manufacturer-specific PDOs are in use when 'Operate Mode' parameter in panel is set to Bypass. Manufacturer specific PDOs are TPDO21, TPDO22, RPDO21 and RPDO22.

PDO21 Rx
Master to Slave (1)

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x401	0	8	**nx_control_word**		**nx_speed_reference**		**process_data_in1**		**process_data_in2**	

PDO21 Tx
Slave (1) to Master

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x381	0	8	**nx_status_word**		**nx_actual_speed**		**process_data_out1**		**process_data_out2**	

PDO22 Rx
Master to Slave (1)

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x501	0	8	**process_data_in3**		**process_data_in4**		**process_data_in5**		**process_data_in6**	

PDO22 Tx
Slave (1) to Master

Header			Data							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x481	0	8	**process_data_out3**		**process_data_out4**		**process_data_out5**		**process_data_out6**	

Controlling the Drive

The Reference to the drive can be set also via manufacturer-specific Process Data Object 21 (rx) when option board is set to Bypass mode. In the application, the value is scaled in percentage of frequency area between the set minimum and maximum frequencies.

nx_control_word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	-	-	-	-	-	-	RST	DIR	RUN

In Avtron applications, the three first bits of the control word are used to control the frequency converter. However, you can customize the content of the control word for your own applications because the control word is sent to the frequency converter as such.

Bit	Description	
	Value = 0	Value = 1
0	Run	Stop
1	Clockwise	Counterclockwise
2	Rising edge of this bit will reset active fault	
3 to 15	Not in use	Not in use

nx_speed_reference

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

This is the Reference 1 to the frequency converter. Used normally as Speed reference. The allowed scaling is –10000 to 10000. In the application, the value is scaled in percentage of the frequency area between the set minimum and maximum frequencies.

Processdata_in1 to Processdata_in6

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

These are application-specific process data. See Appendix C for content of these process data in different applications.

7-7 DRIVE MONITORING

Several drive actual values/parameters can be monitored by using manufacturer-specific PDOs.

nx_speed_reference

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

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

nx_status_word

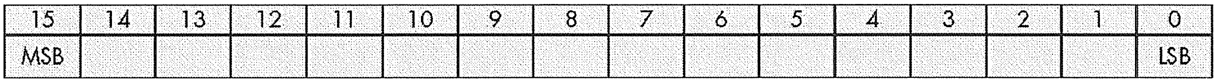
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	-	-	-	UVFS	DDIR	TCSPDL	FR	Z	AREF	W	FLT	DIR	RUN	RDY

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

TABLE 7-4. STATUS WORD BIT DESCRIPTIONS

Bit	**Description**	
	Value = 0	Value = 1
0	Not Ready	Ready
1	STOP	RUN
2	Clockwise	Counterclockwise
3	–	Faulted
4	-	Warning
5	Ref. frequency not reached	Ref. Frequency reached
6	-	Motor is running at zero speed
7	Flux Ready	Flux Not Ready
8	TC Speed Limit Active	TC Speed Limit Not Active
9	Detected Encoder Direction Clockwise	Encoder Direction Counterclockwise
10	UV Fast Stop Active	UV Fast Stop Not Active
11 to 15	Not In use	Not In use

Processdata_out1 to Processdata_out6



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

These are application-specific process data. See Appendix C for content of these process data in different applications.

7-8 ANYPARAMETER SERVICE

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

Index	Description	Size	Type	Hi 16b	Low 16b
2000	AnyparameterReadID	U16	RW	-	Read ID
2001	AnyparameterReadValue	U32	RO	Status	Value
2002	AnyparameterWrite	U32	RW	ID	Write Value

Reading anyparameter

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

Writing anyparameter

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

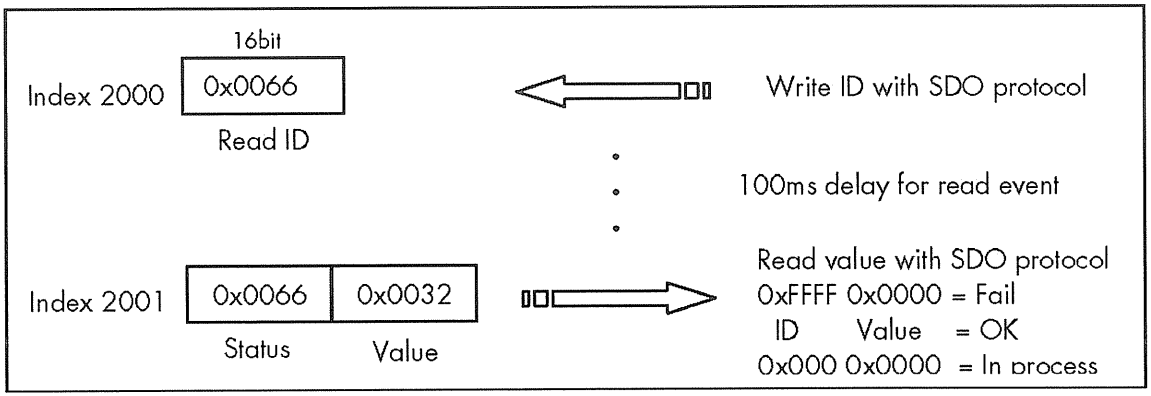

16bit
Index 2000
0x0066
Read ID
Write ID with SDO protocol
100ms delay for read event
Index 2001
0x0066
0x0032
Status
Value
Read value with SDO protocol
0xFFFF 0x0000 = Fail
ID Value = OK
0x000 0x0000 = In process

Figure 7-1. Reading Any Parameter

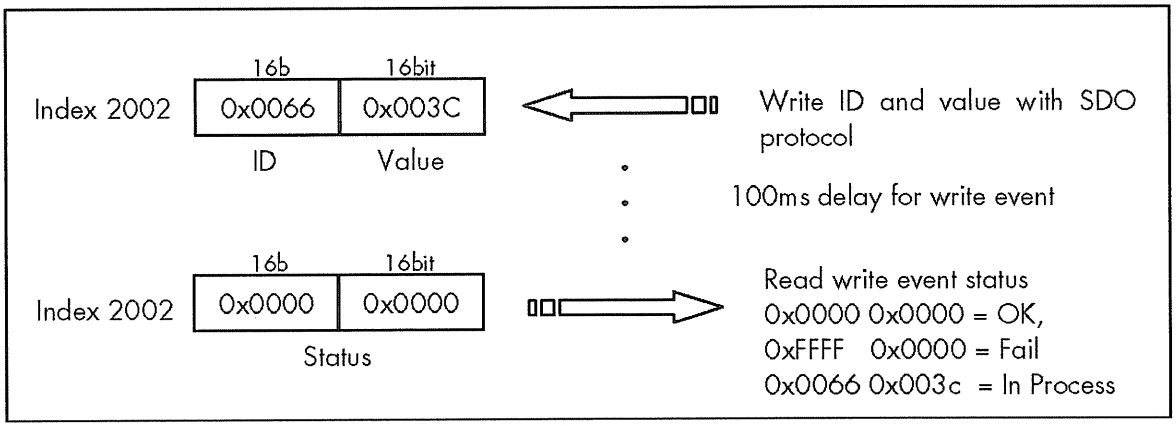


Figure 7-2. Writing Any Parameter

SECTION VIII

SERVICE DATA (SDO)

With Service Data Objects (SDOs), the access to entries of a device Object Dictionary is provided. Via SDO, all items from the object dictionary can be read/written. SDOs are normally used for device configuration such as setting device parameters. They are also used to define the type and format of information communicated using the Process Data Objects. CANopen Configuration tools with EDS files can be used for that purpose. The construction and the method of operation of the SDOs can be found in the CANopen (DS301) Communication Profile document. Appendix B consists of short descriptions of the SDOs used with the CANopen option board.

Object Dictionary

Index		**Name**	**Type**	**Attr.**
hex	dec			
1000	4096	device_type	Unsigned32	RO
1001	4097	error_register	Unsigned8	RO
1003	4099	pre defined error field	Unsigned32	RO
1005	4101	cob-id sync message	Unsigned32	RO
100C	4108	guard_time	Unsigned32	RW
100D	4109	life_time_factor	Unsigned32	RW
1018	4120	Identity Object	Identity	
1200	4608	1st_server_SDO_parameter	SDOParameter	
1400	5120	1st_receive_PDO_parameter	PDOCommPar	
1405	5125	6st_receive_PDO_parameter	PDOCommPar	
1414	5140	21st_receive_PDO_parameter	PDOCommPar	
1415	5141	22st_receive_PDO_parameter	PDOCommPar	
1600	5632	1st_receive_PDO_mapping	PDOMapping	
1605	5637	6st_receive_PDO_mapping	PDOMapping	
1614	5652	21st_receive_PDO_mapping	PDOMapping	
1615	5653	22st_receive_PDO_mapping	PDOMapping	
1800	6144	1st_transmit_PDO_parameter	PDOCommPar	
1805	6149	6nd_transmit_PDO_parameter	PDOCommPar	
1814	6164	21nd_transmit_PDO_parameter	PDOCommPar	
1815	6165	22nd_transmit_PDO_parameter	PDOCommPar	
1A00	6656	1st_transmit_PDO_mapping	PDOMapping	
1A05	6661	6st_transmit_PDO_mapping	PDOMapping	
1A14	6676	21st_transmit_PDO_mapping	PDOMapping	

Index		Name	Type	Attr.
1A15	6677	22st_transmit_PDO_mapping	PDOMapping	
2000	8192	AnyParameterReadID	Integer 16	RW
2001	8193	AnyParameterReadValue	Integer32	RO
2002	8194	AnyParameterWrite	Integer32	RW
2003	8195	nx_current_percentage	Integer16	RO
2004	8196	nx_torque_percentage	Integer16	RO
2063	8291	nx_fault_code	Integer16	RO
27D1	10193	ACCel500 control word	Integer16	RW
27D3	10195	ACCel500 speed reference	Integer16	RW
27D4	10196	Process data in1	Integer16	RW
27D5	10197	Process data in2	Integer16	RW
27D6	10198	Process data in3	Integer16	RW
27D7	10199	Process data in4	Integer16	RW
27D8	10200	Process data in5	Integer16	RW
27D9	10201	Process data in6	Integer16	RW
2836	10294	ACCel500 status word	Integer16	RO
2838	10296	ACCel500actual speed	Integer16	RO
2839	10297	Process data out1	Integer16	RO
283A	10298	Process data out2	Integer16	RO
283B	10299	Process data out3	Integer16	RO
283C	10300	Process data out4	Integer16	RO
283D	10301	Process data out5	Integer16	RO
283E	10302	Process data out6	Integer16	RO
6040	24640	controlword	Unsigned16	RW
6041	24641	statusword	Unsigned16	RO
6042	24642	vl_target_velocity	Integer16	RW
6043	24643	vl_velocity_demand	Integer16	RO
6044	24644	vl_control_effort	Integer16	RO
6046	24646	vl_velocity_min_max_amount	Unsigned32	RW
6048	24648	vl_velocity_acceleration	Ramp	RW
6049	24649	vl_velocity_deceleration	Ramp	RW
604A	24650	vl_velocity_quick_stop	Ramp	RW
604E	24654	vl_velocity_reference	Unsigned32	RW
6060	24672	modes_of_operation	Integer8	RW
6061	24673	modes_of_operation_display	Integer8	RO

Description of the Object Dictionary

Abbreviations

ro	- read only	i16	- Integer8
wo	- write only	i32	- Integer8
rw	- read write	u8	- Unsigned8
co	- constant	u16	- Unsigned16
bool	- Boolean	u32	- Unsigned32
i8	- Integer8	float	- Floating Point

Index (HEX)	**Sub-Index**	**Name**	**Default Min Max**	**Type Attr.**	**Descriptions**
			General Parameters		
1000	00	Device Type	0x00001192 0x00000000 0xFFFFFFFF	u32 co	The device type specifies the kind of device. The lower 16 bits contain the device profile number and the upper16 bits an additional information.
1001	00	Error Register	0x00 0x00 0xFF	u8 ro	The error register is a field of 8 bits, each for a certain error type. If an error occurs the bit has to be set. 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
1003		Pre-defined Error Field			This object holds errors that have occurred on the device and have been signaled via Emergency Object. It is an error history. Writing to sub index 0 deletes the entire error history.
	00	Number of Errors	0x00000000 0x00000000 0x000000FE	u32 rw	
	01	Standard Error Field	0x00000000 0x00000000 0xFFFFFFFF	u32 ro	
1005	00	cob-id sync message	0x00000080 0x00000000 0xFFFFFFFF	u32 ro	cob-id used to synchronize PDO messages
100C	00	Guard Time	1000 0 65535	u16 rw	This entry contains the guard time in milliseconds. It is 0, if not used. Unit: ms
100D	00	Life Time Factor	2 0 255	u8 rw	The life time factor multiplied with the guard time gives the life time for the device. It is 0, if not used.

1018		Identity Object			This object contains general information about the device.
	00	Number of entries	0x4 0x1 0x4	u8 ro	
	01	Vendor Id	0x00000090 0x0 0xFFFFFFFF	u32 ro	Sub-Index 1 contains a unique value allocated each manufacturer.
	02	Product Code	0x00000119 0x0 0xFFFFFFFF	u32 ro	Sub-Index 2 identifies the manufacturer-specific product code (device version).
	03	Revision number	0x00000001 0x0 0xFFFFFFFF	u32 ro	Sub-Index 3 contains the revision number. Bit 31-16 is the major revision number and Bit 15-0 the minor revision number.
	04	Serial number	0x0 0x0 0xFFFFFFFF	u32 ro	Sub-Index 4 identified a manufacturer-specific serial number.
Server SDO Parameters					
1200		Server SDO Parameter			The object contains the parameters for the SDOs for which the device is the server.
	00	Number of Entries	0x02 0x02 0x02	u8 ro	
	01	COB-ID Client -> Server	0x600+NodeID 0x600 0xFFFF	u32 ro	
	02	COB-ID Server -> Client	0x580+NodeID 0x581 0xFFFF	u32 ro	
Receive PDO Communication Parameters					
1400		Receive PDO 1 Communication Parameter			It contains the communication parameters of the first PDO the device is able to receive.
	00	Number of Entries	0x02 0x02 0x05	U8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x200+NodeID 0x00000001 0xFFFFFFFF	U32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00000000 0x000000FF	u8 ro	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)
1405		Receive PDO 6 Communication Parameter			It contains the communication parameters of the second PDO the device is able to receive.
	00	Number of Entries	0x02 0x02 0x05	u8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x300+NodeID 0x00000001 0xFFFFFFFF	u32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00 0xFF	u8 ro	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)

1414		Receive PDO 21 Communication Parameter			It contains the communication parameters of the manufacturer-specific PDO21 the device is able to receive.
	00	Number of Entries	0x02 0x02 0x05	u8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x400+NodeID 0x00000001 0xFFFFFFFF	u32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00 0xFF	u8 ro	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)
1415		Receive PDO 22 Communication Parameter			It contains the communication parameters of the manufacturer-specific PDO22 the device is able to receive.
	00	Number of Entries	0x02 0x02 0x05	u8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x500+NodeID 0x00000001 0xFFFFFFFF	u32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00 0xFF	u8 ro	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)
Receive PDO Mapping Parameters					
1600		Receive PDO 1 Mapping Parameter			It contains the mapping parameters of the first PDO the device is able to receive. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length.
	00	Number of Entries	0x01 0x00 0x40	u8 ro	
	01	PDO Mapping Entry	0x60400010 0x00000000 0xFFFFFFFF	u32 ro	
1605		Receive PDO 6 Mapping Parameter			It contains the mapping parameters of the PDO6 the device is able to receive. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length.
	00	Number of Entries	0x02 0x0 0x40	u8 ro	
	01	PDO Mapping Entry	0x60400010 0x00000000 0xFFFFFFFF	u32 ro	
	02	PDO Mapping Entry	0x60420010 0x00000000 0xFFFFFFFF	u32 ro	

1614		Receive PDO 21 Mapping Parameter			It contains the mapping parameters of the PDO6 the device is able to receive. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length.
	00	Number of Entries	0x04 0x00 0x40	u8 ro	
	01	PDO Mapping Entry	0x27D10010 0x00000000 0xFFFFFFFF	u32 ro	
	02	PDO Mapping Entry	0x27D30010 0x00000000 0xFFFFFFFF	u32 ro	
	03	PDO Mapping Entry	0x27D40010 0x00000000 0xFFFFFFFF	u32 ro	
	04	PDO Mapping Entry	0x27D50010 0x00000000 0xFFFFFFFF	u32 ro	
1615		Receive PDO 22 Mapping Parameter			It contains the mapping parameters of the PDO6 the device is able to receive. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length.
	00	Number of Entries	0x04 0x00 0x40	u8 ro	
	01	PDO Mapping Entry	0x27D60010 0x00000000 0xFFFFFFFF	u32 ro	
	02	PDO Mapping Entry	0x27D70010 0x00000000 0xFFFFFFFF	u32 ro	
	03	PDO Mapping Entry	0x27D80010 0x00000000 0xFFFFFFFF	u32 ro	
	04	PDO Mapping Entry	0x27D90010 0x00000000 0xFFFFFFFF	u32 ro	

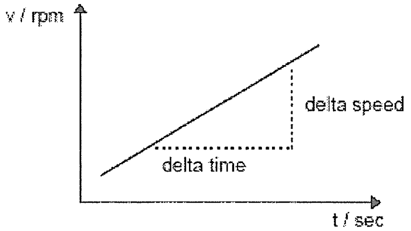
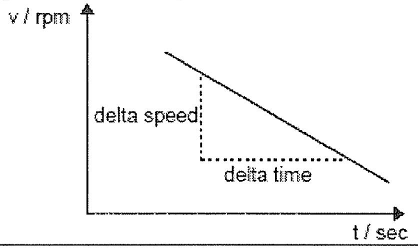
Transmit PDO Communication Parameters					
1800		Transmit PDO 1 Communication Parameter			It contains the communication parameters of the first PDO the device is able to transmit.
	00	Number of Entries	0x04 0x01 0x05	u8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x180+NodeID 0x00000001 0xFFFFFFFF	u32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00 0xFF	u8 ro	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)
	03	Inhibit Time	1000 0x0000 0xFFFF	u16 rw	An inhibit time can be defined on sub-index 3 in 100 µs. This time is minimum interval for PD transmission. Default 100 ms
	04	CMS Priority Group	0x03 0x00 0xFF	u8 ro	
1805		Transmit PDO 6 Communication Parameter			It contains the communication parameters of the PDO 6 the device is able to transmit.
	00	Number of Entries	0x05 0x02 0x05	u8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x280+NodeI D 0x00000001 0xFFFFFFFF	u32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00 0xFF	u8 rw	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)
	03	Inhibit Time	1000 0x0000 0xFFFF	u16 rw	An inhibit time can be defined on sub-index 3 in 100 µs. This time is minimum interval for PD transmission. Default 100 ms
	04	CMS Priority Group	0x03 0x00 0xFF	u8 ro	
	05	Event Timer	0x0000 0x0000 0xFFFF	u16 rw	Event Time can be defined on subindex 5 in 1ms resolution. This is the time interval PDO will be transmitted. Value 0 = Disable Event Timer

1814		Transmit PDO 21 Communication Parameter			It contains the communication parameters of the PDO 21 the device is able to transmit.
	00	Number of Entries	0x05 0x02 0x05	u8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x380+NodeI D 0x00000001 0xFFFFFFFF	u32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00 0xFF	u8 rw	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)
	03	Inhibit Time	1000 0x0000 0xFFFF	u16 rw	An inhibit time can be defined on sub-index 3 in 100 µs. This time is minimum interval for PD transmission. Default 100 ms
	04	CMS Priority Group	0x03 0x00 0xFF	u8 ro	
	05	Event Timer	0x0000 0x0000 0xFFFF	u16 rw	Event Time can be defined on subindex 5 in 1ms resolution. This is the time interval PDO will be transmitted. Value 0 = Disable Event Timer
1815		Transmit PDO 22 Communication Parameter			It contains the communication parameters of the PDO 22 the device is able to transmit.
	00	Number of Entries	0x05 0x02 0x05	u8 ro	Sub-index 0 contains the number of PDO-parameters implemented.
	01	COB-ID	0x380+NodeID 0x00000001 0xFFFFFFFF	u32 ro	Sub index 1 describes the COB-ID. If bit 31 is set the PDO is disabled.
	02	Transmission Type	0xFF 0x00 0xFF	u8 rw	The transmission mode is defined by sub-index 2. Value 0xFF (255) = asynchronous transmission mode (=event driven)
	03	Inhibit Time	1000 0x0000 0xFFFF	u16 rw	An inhibit time can be defined on sub-index 3 in 100 µs. This time is minimum interval for PD transmission. Default 100 ms
	04	CMS Priority Group	0x03 0x00 0xFF	u8 ro	
	05	Event Timer	0x0000 0x0000 0xFFFF	u16 rw	Event Time can be defined on subindex 5 in 1ms resolution. This is the time interval PDO will be transmitted. Value 0 = Disable Event Timer

Transmit PDO Mapping Parameters					
1A00		Transmit PDO 1 Mapping Parameter			It contains the mapping parameter for the PDOs the device is able to transmit. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length. The structure of a mapping entry is: index,subindex,length
	00	Number of Entries	0x01 0x00 0x40	u8 ro	
	01	PDO Mapping Entry	0x60410010 0x00000000 0xFFFFFFFF	u32 ro	
1A05		Transmit PDO 6 Mapping Parameter			It contains the mapping parameter for the PDOs the device is able to transmit. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length. The structure of a mapping entry is: index,subindex,length
	00	Number of Entries	0x02 0x0 0xFF	u8 ro	
	01	PDO Mapping Entry	0x60410010 0x00000000 0xFFFFFFFF	u32 ro	
	02	PDO Mapping Entry	0x60440010 0x00000000 0xFFFFFFFF	u32 ro	
1A14		Transmit PDO 21 Mapping Parameter			It contains the mapping parameter for the PDOs the device is able to transmit. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length. The structure of a mapping entry is: index,subindex,length
	00	Number of Entries	0x04 0x00 0xFF	u8 ro	
	01	PDO Mapping Entry	0x28360010 0x00000000 0xFFFFFFFF	u32 ro	
	02	PDO Mapping Entry	0x28380010 0x00000000 0xFFFFFFFF	u32 ro	
	03	PDO Mapping Entry	0x28390010 0x00000000 0xFFFFFFFF	u32 ro	
	04	PDO Mapping Entry	0x283A0010 0x00000000 0xFFFFFFFF	u32 ro	

1A15		Transmit PDO 22 Mapping Parameter			It contains the mapping parameter for the PDOs the device is able to transmit. Sub-index 0 contains the number of the mapped data objects. All further entries define the data by its index, sub-index and length. The structure of a mapping entry is: index,subindex,length
	00	Number of Entries	0x04 0x00 0xFF	u8 ro	
	01	PDO Mapping Entry	0x283B0010 0x00000000 0xFFFFFFFF	u32 ro	
	02	PDO Mapping Entry	0x283C0010 0x00000000 0xFFFFFFFF	u32 ro	
	03	PDO Mapping Entry	0x283D0010 0x00000000 0xFFFFFFFF	u32 ro	
	04	PDO Mapping Entry	0x283E0010 0x00000000 0xFFFFFFFF	u32 ro	
Manufacturer Specific Parameters					
2000		AnyParameterReadID	0x0000 0x0000 0xFFFF	u16 ro	
2001		AnyParameterReadValue	0x0000 0x0000 0xFFFF	u32 ro	
2002		AnyParameterWrite	0x0000 0x0000 0xFFFF	u32 ro	
2003		ACCel500 current percentage	0x0000 0x0000 0xFFFF	u16 ro	Measured motor current. (1 = 0.01A)
2004		ACCel500 torque percentage	0x0000 0x0000 0xFFFF	u16 ro	Calculated torque. Scaled in 0.0% to 100.0% (0 to 1000)
2063		ACCel500 fault code	0x0000 0x0000 0xFFFF	i16 ro	Shows the drive fault code (=0, if no fault active)
27D1		ACCel500 control word	0x0000 0x0000 0xFFFF	i16 ro	
27D3		ACCel500 speed reference	0x0000 0x0000 0xFFFF	i16 ro	
27D4		Process Data In1	0x0000 0x0000 0xFFFF	i16 ro	
27D5		Process Data In2	0x0000 0x0000 0xFFFF	i16 ro	
27D6		Process Data In3	0x0000 0x0000 0xFFFF	i16 ro	

27D7		Process Data In4	0x0000 0x0000 0xFFFF	i16 ro	
27D8		Process Data In5	0x0000 0x0000 0xFFFF	i16 ro	
27D9		Process Data In6	0x0000 0x0000 0xFFFF	i16 ro	
2836		ACCel500 status word	0x0000 0x0000 0xFFFF	i16 ro	
2837		ACCel500 actual speed	0x0000 0x0000 0xFFFF	i16 ro	
2839		Process data out1	0x0000 0x0000 0xFFFF	i16 ro	
283A		Process data out2	0x0000 0x0000 0xFFFF	i16 ro	
283B		Process data out3	0x0000 0x0000 0xFFFF	i16 ro	
283C		Process data out4	0x0000 0x0000 0xFFFF	i16 ro	
283D		Process data out5	0x0000 0x0000 0xFFFF	i16 ro	
283E		Process data out6	0x0000 0x0000 0xFFFF	i16 ro	
Device Profile Parameters					
6040		controlword	0x0000 0x0000 0xFFFF	u16 rw	The control command for the state machine. The state machine describes the device status and possible control sequence of the drive.
6041		statusword	0x0000 0x0000 0xFFFF	u16 ro	The statusword indicates the current status of the drive.
6042		vl target velocity	0x0000 0x8000 0x7FFF	i16 rw	Speed reference of the drive. Unit: RPM.
6043		vl velocity demand	0x0000 0x8000 0x7FFF	i16 ro	Speed reference after ramp function. Unit: RPM.
6044		vl control effort	0x0000 0x8000 0x7FFF	i16 ro	Actual speed of the motor Unit: RPM.

6046		vl velocity min max amount			Defines speed limits of the drive in rpm. The parameter consists of a minimum and a maximum speed. 
	00	Number of Entries	0x02 0x00 0x02	u32 ro	
	01	Minimum Speed	0x00000000 0x00000000 0xFFFFFFFF	u32 rw	
	02	Maximum Speed	0x00000000 0x00000000 0xFFFFFFFF	u32 rw	
6048		vl velocity acceleration			This parameter specifies the slope of the acceleration ramp. The parameter consists of two parts: the delta speed and the delta time. 
	00	Number of Entries	0x02 0x00 0x02	u8 ro	
	01	delta_speed	0x0 0x0 0xFFFFFFFF	u32 rw	
	02	delta_time	0x01 0x0 0xFFFF	u16 rw	
6049		vl velocity deceleration			This parameter specifies the slope of the deceleration ramp. The parameter consists of two parts: the delta speed and the delta time.
	00	Number of Entries	0x00 0x00 0x02	u8 ro	
	01	delta_speed	0x00 0x0 0xFFFFFFFF	u32 rw	
	02	delta_time	0x01 0x0 0xFFFF	u16 rw	

604A		vl velocity quick stop			
	00	Number of Entries	0x2 0x0 0x2	u8 ro	
	01	delta_speed	0x00 0x0 0xFFFFFFFF	u32 rw	
	02	delta_time	0x0001 0x0000 0xFFFF	u16 rw	
6060		modes of operation	0x02 0x80 0x7F	i8 ro	This parameter switches the actually chosen operation mode.
6061		modes of operation display	0x02 0x80 0x7F	i8 ro	This parameter shows current mode of operation.

SECTION IX

NODE GUARDING PROTOCOL

This protocol is used to detect remote errors in the network. Master can update status of slaves and slaves can guard if master active. Each NMT slave uses one remote COB for node guarding protocol. The NMT Master polls each NMT slave at a regular time interval. This time interval is called guard time and may be different for each NMT slave. The response of the NMT slave contains the state of that NMT slave. A Slave starts guarding after one Node Guarding message is received from MNT master. After that, if slave (=drive) does not receive any Node Guarding messages during "life time," it will generate a "Fieldbus Fault".

The CANopen option board has the following items for guarding purposes:

Index (HEX)	**Sub-Index**	**Name**	**Default Min Max**	**Type Attr.**	**Descriptions**
100C	00	Guard Time	1000 0 65535	u16 rw	This entry contains the guard time in milliseconds. It is 0, if not used. Unit: ms
100D	00	Life Time Factor	2 0 255	u8 rw	The life time factor multiplied with the guard time gives the life time for the device. It is 0, if not used.

Default "life time" is 1000 ms (Guard Time) * 2 (Life Time Factor) = 2 s

Example node guarding messages:

MASTER -> SLAVE (node id = 1)

Message	ID	Len	RTR
NMT (Node Guarding)	0x701	0	1

SLAVE RESPONSE (node id = 1)

Message	ID	Len	1
NMT (Node Guarding)	0x701	1	X

X =	bit7	0 / 1 (Toggle bit)
	bit6 to 0	Slave state (esim. 5 operational)

SECTION X

ELECTRONIC DATA SHEET, EDS FILE

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

For handling of the complexity of CANopen systems, Software Tools are required. This reduces the complexity of the planning, configuration and analysis process and significantly increases the security of the system.

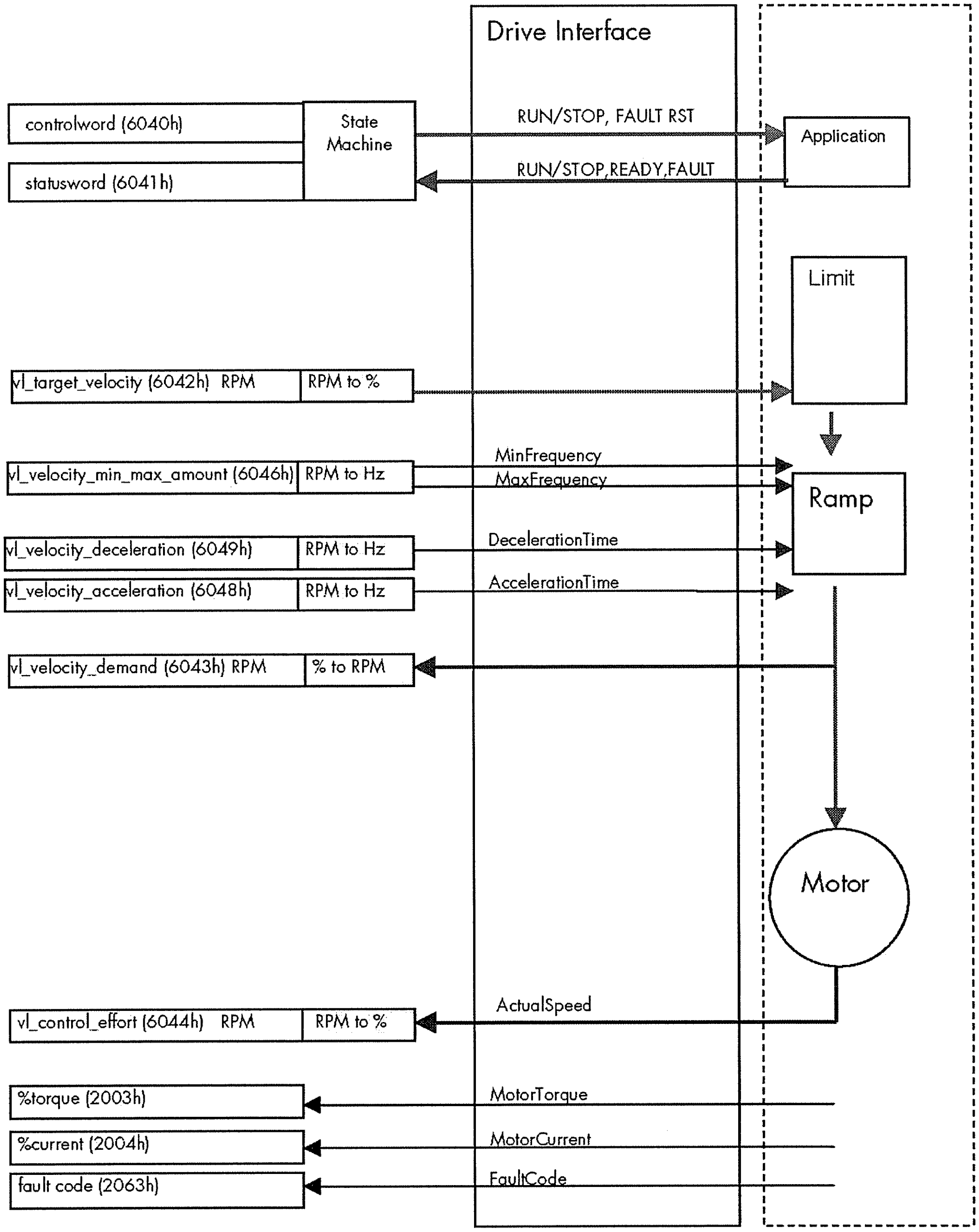
For this purpose, Software Tools need an electronic description of the CANopen devices. To allow the usage of manufacturer independent Tools, this document defines a standardized file format called Electronic Data Sheet EDS.

APPENDIX A

DEVICE PROFILE FOR DRIVES

The Avtron CANopen option board follows Drive device profile DSP-402. The Velocity mode is supported.

Basic Device Control and Device Data Interface



APPENDIX B

SDO MESSAGES

Read Dictionary Object: SDO1 Rx (Master to Slave (1))

Header			**Data**							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x601	0	4	Command	Object Index		Sub- Index	D0	D1	D2	D3

Command = 0x40
Command aaabbbbb (= 0100 0000)
aaa = 010, Initiate upload request

Response: SDO1 Tx (Slave (1) to Master)

Header			**Data**							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x581	0	4	Reply	Object Index		Sub- Index	D0	D1	D2	D3

Reply = e.g. 0x43
Reply aaabcces (= 0100 0011)
aaa = 010 Initiate upload response
b = 0 not used
cc = 00 number of empty bytes (that case answer consist of 4 bytes)
e = 1 expedited transfer
s = 1 data set size is indicated
Data D0 to D4

Write Dictionary Object: SDO1 Rx (Master to Slave (1))

Header			**Data**							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x601	0	4	Command	Object Index		Sub- Index	D0	D1	D2	D3

Command = e.g. 0x2B
Command aaabcces (= 0010 1011)
aaa = 010 Initiate download request
b = 0 not used
cc = 00 number of empty bytes (that case answer consist of 4 bytes)
e = 1 expedited transfer
s = 1 data set size is indicated
Data D0 to D4

Response: SDO1 Tx (Slave (1) to Master)

Header			**Data**							
ID	RTR	Len	1	2	3	4	5	6	7	8
0x581	0	4	Reply	Object Index		Sub- Index	D0	D1	D2	D3

Reply = 0x60
Reply aaabbbbb (= 0110 0000)
Aaa = 010 Initiate download response
bbbbb = 0 0000 not used

APPENDIX C

PROCESS DATA CONTENTS

Process Data OUT (Slave→Master)

The fieldbus master can read the frequency converter's actual values using process data variables.

Basic, Standard, Local/Remote, Multi-Step, PID control and Pump and fan control applications use process data as follows:

Data	Value	Unit	Scale
Process data OUT 1	Output Frequency	Hz	0.01 Hz
Process data OUT 2	Motor Speed	rpm	1 rpm
Process data OUT 3	Motor Current	A	0.1 A
Process data OUT 4	Motor Torque	%	0.1 %
Process data OUT 5	Motor Power	%	0.1 %
Process data OUT 6	Motor Voltage	V	0.1 V

The Multipurpose application has a selector parameter for every Process Data. The monitoring values and drive parameters can be selected using the ID number (see the ACCel500 Adjustable Frequency Drives Application Manual for monitoring values and parameters). Default selections are as in the table above.

Process Data IN (Master→Slave)

ControlWord, Reference and Process Data are used with applications as follows:

Basic, Standard, Local/Remote, Multi-Step Applications

Data	Value	Unit	Scale
Reference	Speed Reference	%	0.01%
ControlWord	Start/Stop Command Fault reset Command	–	–
PD1 – PD6	Not used	–	–

Multipurpose Control Application

Data	Value	Unit	Scale
Reference	Speed Reference	%	0.01%
ControlWord	Start/Stop Command Fault reset Command	–	–
Process Data IN1	Torque Reference	%	0.1%
Process Data IN2	Free Analog INPUT	%	0.01%
PD3 – PD6	Not Used	–	–

PID Control and Pump and Fan Control Applications

Data	Value	Unit	Scale
Reference	Speed Reference	%	0.01%
ControlWord	Start/Stop Command Fault reset Command	–	–
Process Data IN1	Reference for PID controller	%	0.01%
Process Data IN2	Actual Value 1 to PID controller	%	0.01%
Process Data IN3	Actual Value 2 to PID controller	%	0.01%
PD4–PD6	Not Used	–	–