Advanced User Guide

SE77-CANopen

Commander SE

Part Number: 0452-0052-02
Issue Number: 2

www.controltechniques.com

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive (Drive) with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of this guide, without notice.

Drive software version

The SE77-CANopen can only be used with Commander SE firmware version V1.08.00 and later.

Issue Code: 2
Hardware: 01.00
Firmware: V1.01.00

Contents

1 Safety Information

1.1 Warnings, Cautions and Notes

A **Warning** contains information, which is essential for avoiding a safety hazard.

A **Caution** contains information, which is necessary for avoiding a risk of damage to the product or other equipment.

NOTE A **Note** contains information, which helps to ensure correct operation of the product.

1.2 Electrical safety - general warning

The voltages used in the Commander SE can cause severe electrical shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to the Commander SE. Specific warnings are given at the relevant places in this User Guide.

1.3 System design and safety of personnel

The Commander SE is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, it may present a safety hazard.

The Commander SE uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and this User Guide carefully.

The STOP function of the Commander SE does not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

None of the drive functions must be used to ensure safety of personnel, i.e. they must not be used for safety-related functions.

Careful consideration must be given to the functions of the Commander SE which might result in a hazard, either through their intended behaviour or through incorrect operation due to a fault. In any application where a malfunction of the Commander SE or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking.

The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.

1.4 Environmental limits

Instructions in the *Commander SE User Guide* regarding transport, storage, installation and use of the Commander SE must be complied with, including the specified environmental limits. Drives must not be subjected to excessive physical force.

1.5 Compliance with regulations

The installer is responsible for complying with all relevant regulations, such as national wiring regulations, accident prevention regulations and electromagnetic compatibility (EMC) regulations. Particular attention must be given to the cross-sectional areas of conductors, the selection of fuses or other protection, and protective earth (ground) connections.

The *Commander SE User Guide* contains instruction for achieving compliance with specific EMC standards.

Within the European Union, all machinery in which this product is used must comply with the following directives:

98/37/EC: Safety of machinery.

89/336/EEC: Electromagnetic Compatibility.

1.6 Motor

Ensure the motor is installed in accordance with the manufacturer's recommendations. Ensure the motor shaft is not exposed.

Standard squirrel cage induction motors are designed for single speed operation. If it is intended to use the capability of the Commander SE to run a motor at speeds above its designed maximum, it is strongly recommended that the manufacturer is consulted first.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective. The motor should be fitted with a protection thermistor. If necessary, an electric forced vent fan should be used.

The values of the motor parameters set in the drive affect the protection of the motor. The default values in the Commander SE should not be relied upon.

It is essential that the correct value is entered in Pr **0.46** motor rated current. This affects the thermal protection of the motor.

1.7 Adjusting parameters

Some parameters have a profound effect on the operation of the Commander SE. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering.

2 Introduction

NOTE Commander SE parameters are denoted in this manual by "Pr **MM.PP**", where MM refers to the menu number, and PP refers to the parameter number within that menu. Please refer to the Commander SE manual for full parameter definitions.

2.1 SE77-CANopen for Commander SE

The SE77-CANopen provides a CANopen communications interface for the Commander SE. It uses a 16-bit processor and is capable of communicating at 1.0 Mbit/s, currently the fastest data rate available for CANopen. SESoft V1.04.00 and later provides full support for the SE77-CANopen.

Parameter data is transferred to and from the Commander SE using a 2-wire RS485 link into the RJ-45 serial communications connector on the Commander SE.

Although power is taken from the Commander SE under normal operating conditions, an optional back-up power supply can also be connected to the SE77-CANopen. This ensures that the SE77-CANopen is kept powered up, and continues to communicate with the CANopen network, even when the Commander SE is powered down.

2.2 Product conformance certificate

The SE77-CANopen has been awarded full conformance certification by CAN In Automation. (CiA). (CANopen Certificate No. CiA200104-301V30/11-023) Further details about CANopen are available on the CiA web site at www.can-cia.de.

2.3 Overview specification

- Auto-configuration of the Commander SE serial communications port when the SE77-CANopen is connected.
- Supported data rates (bits/s): 1.0M, 800K, 500K, 250K, 125K, 50K, 20K, 10K
- 1 TxPDO and 1 RxPDO with three 16 bit words each
- Service Data Object provides allows access to all Commander SE parameters and all supported CANopen object dictionary entries
- CANopen Velocity Mode profile supported
- CT Single Word (Mode 1) non-cyclic data channel (optional)

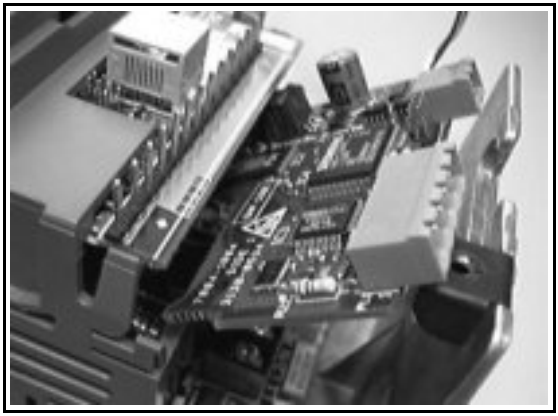
3 Mechanical Installation

The Commander SE must be disconnected from the mains supply before installing or removing the SE77-CANopen.

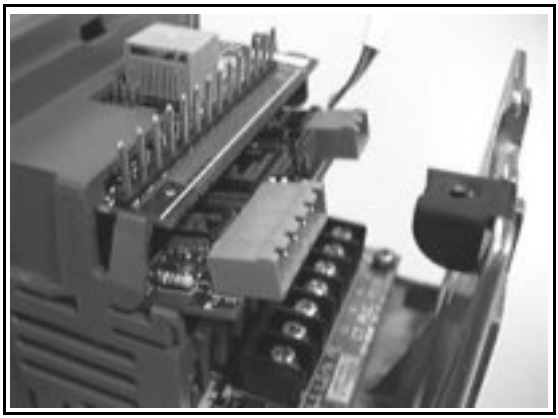
NOTE Care should be taken when handling the SE77-CANopen, as it may be damaged by electrostatic discharge. To prevent inadvertent damage, touch an earthed bare metal surface to discharge yourself before removing the SE77-CANopen from the anti-static bag.

3.1 Commander SE Size 1

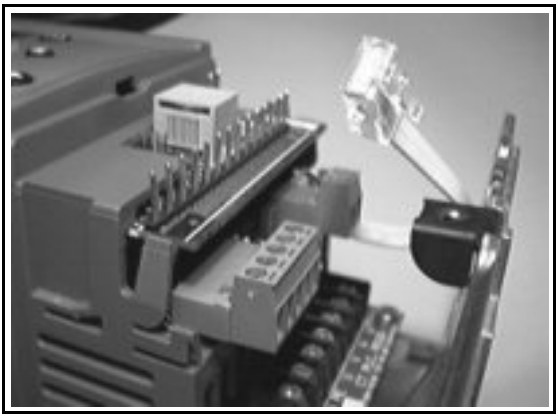
1. Remove any terminal blocks from the SE77-CANopen. Slide the SE77-CANopen diagonally into the Commander SE.



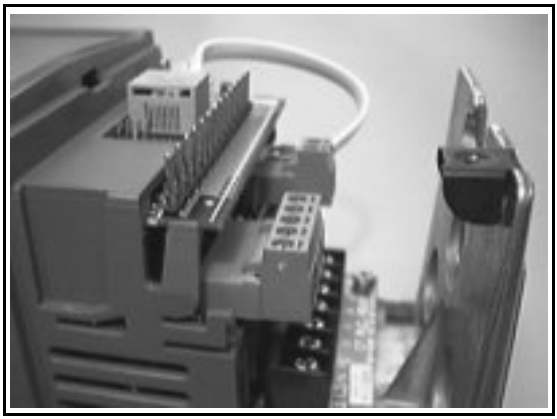
2. Ensure that the SE77-CANopen is aligned between the runners moulded into the plastic casing, and slide into the Commander SE.



3. Push the SE77-CANopen firmly into the Commander SE until the plastic spring clips latch it securely in place.

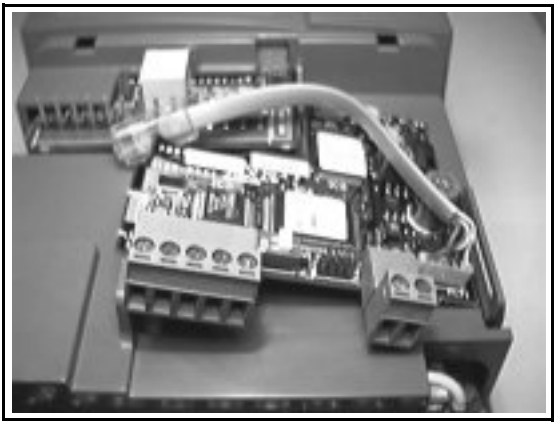


4. Plug the flylead into the RJ45 socket on the Commander SE.

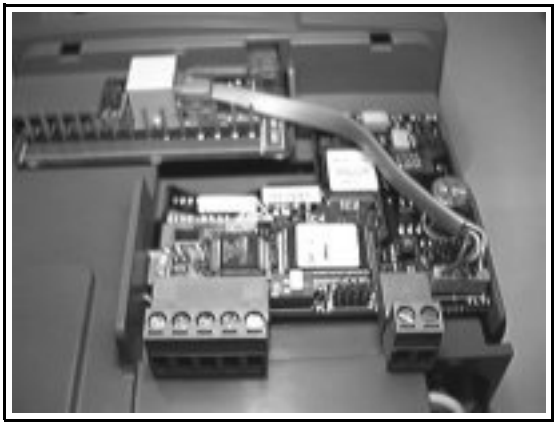


3.2 Commander SE Sizes 2, 3, 4 and 5

1. Locate the right hand side of the SE77-CANopen under the flange.



2. Push the left hand side of the SE77-CANopen down to clip into place. Connect the fly-lead to the RJ-45 connector on the Commander SE.

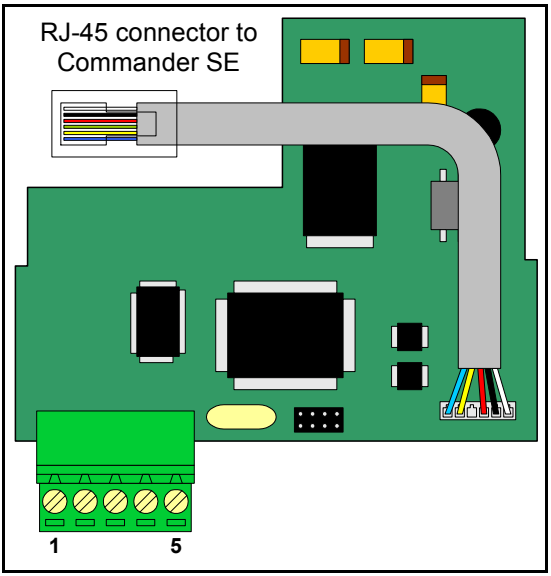


4 Electrical Installation

4.1 SE77-CANopen terminal descriptions

The SE77-CANopen has a single 5-way screw terminal block connector for the CANopen network connections.

Figure 4-1



The connections for the CANopen connector are given in the table below.

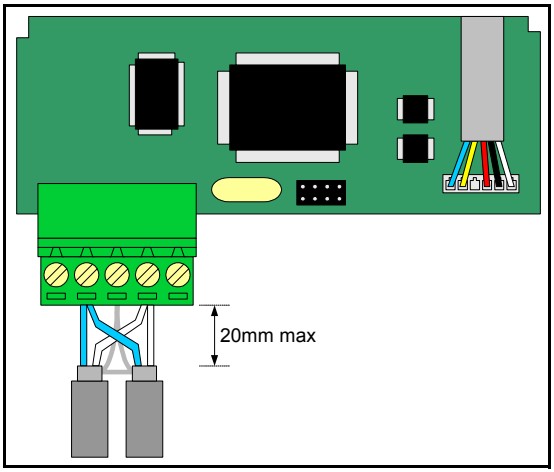
Table 4.1 SE77-CANopen terminal descriptions

Terminal	Function	Description
1	0V BACKUP	0V CANopen external supply (optional)
2	CAN-L	Negative data line
3	Shield	Cable braided shield connection
4	CAN-H	Positive data line
5	+24V BACKUP	+24V CANopen external supply (optional)

4.2 SE77-CANopen connections

To connect the SE77-CANopen to the CANopen network, make the connections as shown in the diagram below. The length of the "pigtail" shield connection should be kept as short as possible.

Figure 4-2



4.3 CANopen cable

CANopen cable requires a single twisted pair with overall shielding for the data wires. A second twisted pair may be used for a network power supply if required. The data wires are usually white and blue in cable designed for use in CAN networks.

Table 4.2 CAN colour codes

Cable	Data Signal	Terminal	Description
Blue	CAN-L	2	Negative data line
Braided Shield	Shield	3	Cable shield
White	CAN-H	4	Positive data line

CANopen networks run at high data rates, and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes on the network. Further details are available on the CAN In Automation (CiA) web site at www.can-cia.de.

NOTE Control Techniques can only guarantee correct and reliable operation of the SE77-CANopen if all other equipment installed (including the network cable) has been approved by the CiA.

4.4 SE77-CANopen cable shield connections

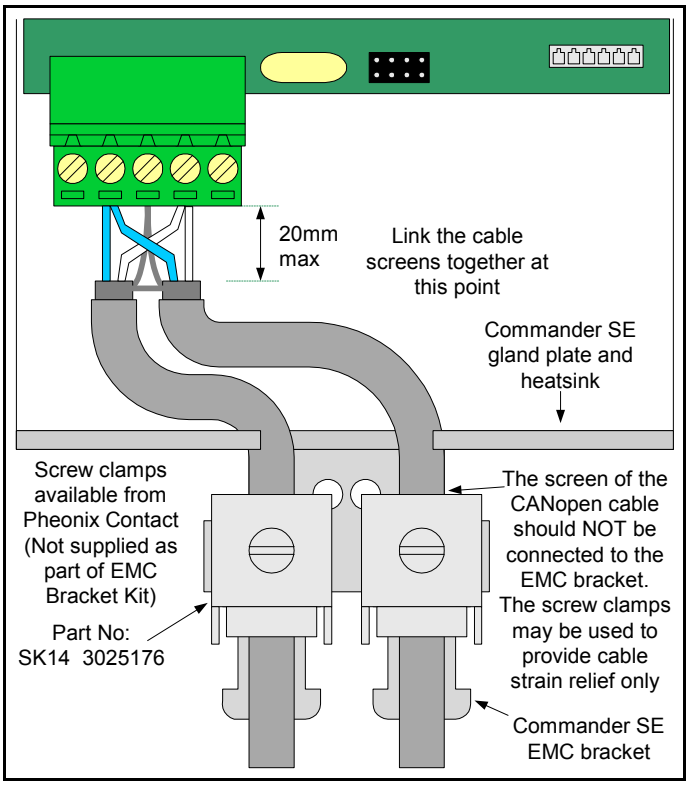
An EMC bracket kit is available for each size of Commander SE. This plate must be fastened to the Commander SE gland plate, and provides a path to earth via the Commander SE heatsink.

Table 4.3 EMC bracket kits

Commander SE	Part no.	Name	Commander SE	Part no.	Name
Size 1	9500-0014	SE11	Size 4	9500-0018	SE14
Size 2	9500-0016	SE12	Size 5	9500-0041	SE15
Size 3	9500-0017	SE13			

The SE77-CANopen should be wired with the cable shields isolated from earth at each Commander SE. The cable shields should be linked together at the point where they emerge from the cable, and formed into a short pigtail to be connected to pin 3 on the CANopen connector.

Figure 4-3

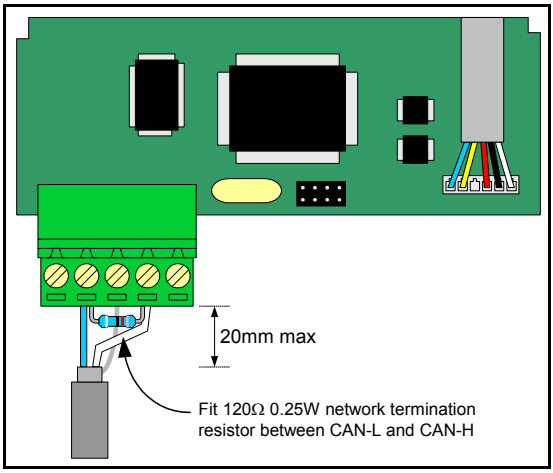


NOTE The CANopen cable shield should be grounded at one place ONLY in the network, to prevent it from becoming live in the unlikely event of a major fault in one of the CANopen devices. The shield can be earthed by exposing the braid shield and clamping it to the EMC clamp on a Commander SE.

4.5 CANopen network termination

The CANopen network must be terminated at each end by fitting a 120R termination resistor between the CAN-H and CAN-L lines. This prevents signals from being reflected back down the cable and interfering with each other.

Figure 4-4



NOTE Failure to terminate a network correctly can seriously affect the operation of the network. If termination is not fitted, the noise immunity of the network is greatly reduced, while if too many nodes have their internal termination resistor networks enabled, the network will be over-loaded and may not operate at all.

4.6 External back-up power supply

Usually, the SE77-CANopen will draw power via the RJ-45 communications lead from the unregulated +28V rail of the Commander SE. If the SE77-CANopen is disconnected to check and update the configuration of the Commander SE using SESoft, the SE77-CANopen will power down, and this will cause the master controller to indicate a network error.

By connecting a +24V back-up power supply to the SE77-CANopen, it will continue to communicate with the master controller, and no network errors will be detected. The SE77-CANopen will indicate (using the status word) to the master controller that it is not currently communicating with the Commander SE. When the SE77-CANopen is re-connected to the Commander SE, communications will be re-established automatically.

The back-up power supply should be +24V ±20%, and should have sufficient current capability to supply the maximum current for all devices connected to it. This condition will occur if the power supply is switched on while the main power supply to the Commander SE is off. The consumption of the SE77-CANopen is dependent on the supply voltage, with typical and maximum currents listed in Table 4.4.

Table 4.4 SE77-CANopen current requirements

Back-up power supply voltage	Nominal current (mA)	Typical current (mA)	Maximum current (mA)
19.2V (24V -20%)		45	90
21.6V (24V -10%)		40	80
24V nominal		38	76
26.4V (24V +10%)		35	70
28.8V (24V+20%)		35	70

Under normal operating conditions, the Commander SE and the back-up power supply share the power supply requirements of the SE77-CANopen. The inrush current of 2.0 times the nominal current should be allowed for at power-up, although this factor will typically be nearer 1.7.

4.7 Maximum network length

The maximum number of nodes that can be connected to a single CANopen network segment is 32 nodes. Repeaters may be used to increase the number of nodes on a network to a maximum of 127. The maximum network length depends on the specified data rate.

Table 4.5 Maximum network lengths

Data rate (bits/s)	Maximum bus LIngth (m)
10K	5000
20K	2500
50K	1000
125K	500
250K	250
500K	100
800K	50
1.0M	30

5 Getting Started

Full explanations of the cyclic data functions and supported data formats are given in Chapter 6 *Cyclic Data* on page 15. Non-cyclic data and node configuration using non-cyclic data are described in Chapter 8 *Non-Cyclic Data* on page 23.

NOTE The Commander SE must be fitted with firmware V1.08.00 or later for use with the SE77-CANopen. SESoft V1.04.00 or later provides support for all fieldbus options.

5.1 SESoft wizard

The SESoft wizard guides the user through the basic configuration of the Commander SE. Specify the power supply and motor details in pages 1 and 2 of the Wizard. For the "Speed Input References" screen (page 3), follow the instructions below:

- Set the speed input to "**Fieldbus**".
- Set the fieldbus type to "CANopen".
- Specify the node address for the Commander SE. (Not required for the SE74-INTERBUS .)
- Specify the data rate to be used. (Not required for SE73-Profibus-DP or SE74-INTERBUS s.)

Complete the remainder of the wizard, and click **DOWNLOAD** to download the configuration to the Commander SE. When complete, click **FINISH** to exit the wizard.

The wizard will download all appropriate information to the Commander SE, configure it to use the digital speed reference Pr **1.21**, change the communications mode to "FbuS", and save all parameters in the Commander SE.

- Power down the Commander SE.
- Plug the SE77-CANopen into the Commander SE.
- Power up the Commander SE.

The SE77-CANopen is now ready to communicate with the CANopen master controller.

5.2 Commander SE communications mode

Name	Commander SE communications mode		
Param	Pr **0.41**	**Default**	ANSI (0)
Access	RW	**Range**	ANSI (0), RTU (1), FBUS (2)

The Commander SE has several communications mode that can be selected by Pr **0.41**. When a SE77-CANopen is connected to the Commander SE, it will automatically change the communications mode to "FbuS". This change will take effect immediately without any need to store the parameters or reset the Commander SE.

5.3 SE77-CANopen node address

Name	SE77-CANopen node address		
Param	Pr **0.45**	Default	1
Access	RW	Range	1 to 127

Every node on a CANopen network must be given a unique network address. If 2 or more nodes are assigned the same address, they may cause CAN framing errors, and prevent the network from operating correctly. The valid range of addresses is from 1 to 127, with a default address of 0.

If an invalid node address is set in Pr **0.45**, the SE77-CANopen will reject the configured address, reset to 127, and update Pr **0.45** with the address that is actually being used.

NOTE Changes to Pr **0.45** will be stored automatically when the MODE button is pressed after the value has been set.

5.4 SE77-CANopen data rate

Name	SE77-CANopen data rate		
Param	Pr **0.46**	Default	0
Access	RW	Range	0 to 7

Every node on a CANopen network must be configured to run at the network data rate. If a node is configured with the wrong data rate, it may cause errors on the CAN network, and eventually trip on “t60”, Bus Off error. This parameter should be set to the same value on all nodes on the network. The SE77-CANopen has a default data rate setting of 1.0 Mbits/sec.

Table 5.1 SE77-CANopen data rates

Pr 0.46	bits/s		Pr 0.46	bits/s
0	1.0M		4	125K
1	800K		5	50K
2	500K		6	20k
3	250k		7	10k

5.5 SE77-CANopen data format

The default data format is 1 TxPDO and 1 RxPDO, each with 3 words. Each PDO data word is mapped to a Commander SE parameter with default mappings as shown in Table 5.2.

Table 5.2 SE77-CANopen data format

PDO word	Default mapping status
RxPDO1 word 0	Control word
RxPDO1 word 1	Digital speed reference 1
RxPDO1 word 2	Not mapped
TxPDO1 word 0	Status word
TxPDO1 word 1	Post-ramp speed reference
TxPDO1 word 2	Motor load current as % of rated load current

Other data formats with are also supported. For further details, see section 6.3 *SE77-CANopen data formats* on page 16.

5.6 SE77-CANopen operating status

Name	SE77-CANopen operating status		
Param	Pr **0.47**	**Default**	N/A
Access	RO	**Range**	-2 to 999

The SE77-CANopen operating status is displayed in Pr **0.47**, and can be viewed on the display on the Commander SE. Normally, this parameter will display the number of messages being handled per second, while a negative number indicates some sort of error status. See for a full list of operating staus codes.

6 Cyclic Data

NOTE "Transmit PDO" and "Receive PDO" describe the direction of data transfer as seen by the SE77-CANopen.

6.1 What is cyclic data?

Cyclic data is a method of data transfer that must be set-up during network configuration, but is transmitted automatically once configuration is complete. The high-speed data transfer is achieved by transmitting only a 16-bit data value for each cyclic channel over the CANopen network, and relying on local mapping information within the Commander SE to ensure the correct data is sent to the correct locations. This method relies on the master controller program writing and reading data values to and from the registers allocated to the node during network configuration, and the source and destination of IN and OUT data being set-up correctly in the Commander SE itself.

The flexibility of the SE77-CANopen means that each cyclic data OUT channel can be directed to any read-write Commander SE parameter. Similarly, each cyclic data IN channel can use any Commander SE parameter as a source of data.

6.2 Process Data Objects (PDO)

CANopen uses Process Data Objects (PDOs) to implement automatic data transfer. PDO details are stored in the CANopen "Object Dictionary", which stores data values about all aspects of the SE77-CANopen. (See section 12 *CANopen Object Dictionary* on page 39 for a complete listing of all supported objects.)

The default settings for TxPDO1 and RxPDO1 are generated from the parameter values read from the Commander SE during initialisation. This allows the PDOs to be configured using only Commander SE parameters.

However, the mapping for PDO data is dynamic, and can be changed “on-the-fly” by writing directly to the PDO mapping objects in the CANopen Object Dictionary.

6.2.1 Receive Process Data Object 1 (RxPDO1)

RxPDO 1 consists of three 16-bit parameter values, and can be referred to as the IN cyclic data channels. The data transferred over the 3 cyclic data channels can be mapped to any read/write destination parameter in the Commander SE.

The COB-ID is automatically assigned for RxPDO1 using the node address, and may need to be entered manually when configuring the CANopen master controller.

COB-ID = 512 + Pr **15.03** (0x200 + Pr **15.03**)

6.2.2 Transmit Process Data Object 1 (TxPDO1)

TxPDO 1 also consists of three 16-bit parameter values, and can be referred to as the OUT cyclic data channels. Any read/write or read only parameter in the Unidrive can be selected as the data source parameter for any cyclic data channel.

The COB-ID is automatically assigned for TxPDO1 using the node address, and may need to be entered manually when configuring the CANopen master controller.

COB-ID = 384 + Pr **15.03** (0x180 + Pr **15.03**)

6.3 SE77-CANopen data formats

Name	SE77-CANopen data format		
Param	Pr **15.05**	Default	0.03
Access	RW	Range	0.02, 0.03 or 1.03

The SE77-CANopen must be configured with the required data format. Supported data formats are listed in Table 6.1.

Table 6.1 SE77-CANopen data formats

Pr 15.05	Cyclic data channel	Non-cyclic mode	Description
0.03	3	0	Same format as used on the Unidrive CANopen
1.03	3	1	Word 0 reserved for CT Single Word non-cyclic data
0.02	2	0	Selects the Velocity Mode Profile

The mapping for the cyclic data channels on Commander SE can be changed using either the SESoft configuration software, or a Universal Keypad. The mapping method is similar to the method used in Commander SE for mapping analogue inputs and outputs. The value entered in the mapping parameter takes the form MMPP, where MM = menu number of the target parameter and PP = parameter number of the target parameter. If a mapping parameter is set to an invalid value, e.g. destination parameter is read only, or does not exist, the Commander SE will reset the mapping parameter (Pr **15.PP**) to 0.

NOTE The cyclic data channels do not use decimal points. For example, the digital speed reference 1 (Pr **1.21**) has units of Hertz, accurate to 1 decimal place. To write a value of 24.6Hz to Pr **1.21**, the value must be transmitted as 246.

6.3.1 3 cyclic words

This data format provides three 16-bit cyclic data words, with no non-cyclic data channel. To select this data format, set Pr **15.05** = 0.03.

Table 6.2 3 cyclic words

Data word	Mapping parameter	Default mapping status
IN word 0	----	Status word
IN word 1	Pr **15.11**	Pr **2.01**, post-ramp speed reference
IN word 2	Pr **15.12**	Pr **4.20**, motor load as % of rated motor load
OUT word 0	----	Control word
OUT word 1	Pr **15.21**	Pr **1.21**, digital speed reference 1
OUT word 2	Pr **15.22**	Not mapped

6.3.2 3 cyclic words with CT Single Word

This data format provides three 16-bit cyclic data words, plus CT Single Word (Mode 1) non-cyclic data. To select this data format, set Pr **15.05** = 1.03.

Table 6.3 3 cyclic words with CT Single Word

Data word	Mapping parameter	Default mapping status
IN word 0	----	Reserved for CT Single Word non-cyclic data channel
IN word 1	----	Status word
IN word 2	Pr **15.11**	Pr **2.01**, post-ramp speed reference
IN word 3	Pr **15.12**	Pr **4.20**, motor load as % of rated motor load
OUT word 0	----	Reserved for CT Single Word non-cyclic data channel
OUT word 1	----	Control word
OUT word 2	Pr **15.21**	Pr **1.21**, digital speed reference 1
OUT word 3	Pr **15.22**	Not mapped

6.3.3 CANopen Velocity Mode profile

The pre-defined CANopen Velocity Mode profile is supported. To select this format, set Pr **15.05** = 0.02.

Table 6.4 Velocity Mode profile

Data word	Default mapping status
IN word 0	***controlword***
IN word 1	***vl_velocity_reference***
OUT word 0	***statusword***
OUT word 1	***vl_velocity_demand***

See Chapter 14 *CANopen Velocity Mode Profile* on page 51 for full details.

6.4 Commander SE mapping conflicts

When the mapping parameters for the SE77-CANopen cyclic channels are set, care must be taken to ensure that there are no clashes with the mapping of the analogue and digital inputs within the Commander SE. The SE77-CANopen will not indicate if there is a conflict of mapping parameters. This only applies to analogue and digital inputs, and OUT data on the CANopen network.

If a numerical parameter is written to from two different sources, the value of this parameter will depend entirely upon the scan times for the analogue or digital input and the CANopen network. Further confusion may be caused due to the update rate of the display. A parameter may appear to be steady at a particular value, but an occasional glitch in the displayed value may be seen. In reality, this value may be changing continuously, leading to unusual behaviour from the Commander SE.

Table 6.5 Commander SE destination parameters

Function	Mapping parameter	Function	Mapping parameter
Analogue input 1	Pr **7.10**	Logic output 1	Pr **9.10**
Analogue input 2	Pr **7.14**	Motorised pot output	Pr **9.25**
Digital input 1	Pr **8.21**	Comparator 1 output	Pr **12.07**
Digital input 2	Pr **8.22**	Source select output	Pr **12.11**
Digital input 3	Pr **8.23**	PID output	Pr **14.16**

Table 6.5 Commander SE destination parameters

Function	Mapping parameter		Function	Mapping parameter
Digital input 4	Pr **8.24**		Cyclic OUT word 2	Pr **15.21**
Digital input 5	Pr **8.25**		Cyclic OUT word 3	Pr **15.22**
Digital input 6	Pr **8.26**			

The Linking Screen in SESoft displays all mapping parameters within the Commander SE, allowing the user to easily check that there are no mapping conflicts.

6.5 Storing SE77-CANopen parameters

Menu 15 parameters are stored in the Commander SE and the SE77-CANopen. If the Commander SE has previously stored SE77-CANopen settings, these will always be used by the SE77-CANopen . All Pr **15.PP** parameters will be read and stored automatically in FLASH memory on the SE77-CANopen .

NOTE If the stored values in the Commander SE are for a different type of option module, the SE77-CANopen will download its stored values to the Commander SE, and configure itself using those values.

6.5.1 Commander SE

Menu 0 parameters are automatically stored when they are edited using the keypad on the Commander SE. All other parameters can be stored using SESoft by selecting **TOOLS** and **SAVE PARAMETERS IN DRIVE**.

If a Universal Keypad is being used, set Pr **MM.00** to 1000 and press the red **RESET** button to store all Commander SE parameters.

6.5.2 SE77-CANopen Module

When the SE77-CANopen establishes the "FbuS" communications link, it checks the value in Pr **15.01**.

1. If this is set to 1, it uploads all menu 15 parameters from the Commander SE and stores them in the FLASH memory.
2. If Pr **15.01** is not set to 1 and Pr **15.30** is set to 0, the previous set of values stored in the FLASH memory are downloaded to theCommander SE.
3. If Pr **15.01** is not set to 1, and Pr **15.30** is set to 1, default values are downloaded to the Commander SE, and these values are stored in the FLASH memory.

6.6 Disabling data channels

If any data words are not being used in an application, the mapping parameter should be set to 0. Although the data word will still be transmitted over the CANopen network, no corresponding message will be generated to read or write a parameter over the "FbuS" RS485 link to the Commander SE. This reduces the number of "FbuS" messages required to complete a single data cycle, and improves the efficiency of data transfer over the RS485 link, allowing each parameter to be updated more frequently.

7 Control and Status Words

7.1 SE77-CANopen control word

Name	SE77-CANopen control word		
Param	Pr **90.12**	**Default**	0
Access	WO	**Range**	0 to 255

The SE77-CANopen control word allows digital control of the Commander SE to be implemented using a single data word. Each bit in the SE77-CANopen control word has a particular function, and provides a method of controlling the output functions of the Commander SE (RUN FWD, JOG, TRIP, etc.) with a single data word.

b15	b14	b13	b12b	b11	b10	b9	b8
Reserved							

b7	b6	b5	b4	b3	b2	b1	b0
TRIP	RESET	DIG REF	FBUS CTRL	RUN REV	JOG	RUN FWD	ENABLE

To enable fieldbus control of the Commander SE, set the FBUS CTRL bit to 1. The 0-1 transition of the FBUS CTRL bit will cause the SE77-CANopen to set Pr **6.43** to 1 in the Commander SE, and enable fieldbus control of the Commander SE. When the FBUS CTRL bit is reset to 0, the SE77-CANopen will reset Pr **6.43** to 0, thus putting the Commander SE back into terminal control mode.

NOTE For safety reasons, the HARDWARE ENABLE signal (terminal 9) must be present (connected to +24V, terminal 7) before the SE77-CANopen control word can be used to start the Commander SE. This signal is usually linked to the external Emergency Stop circuit to ensure that the Commander SE is disabled in an emergency situation.

The DIG REF bit allows the source of the speed reference to be changed via the fieldbus. The 0-1 transition of the DIG REF will cause the SE77-CANopen to set Pr **1.14** to 3, selecting digital speed reference as the source of the speed reference. (By default, this will digital speed reference 1, Pr **1.21**.) When the DIG REF bit is reset to 0, the SE77-CANopen will set Pr **1.14** to 1, selecting the analogue input as the source of the speed reference. (The actual digital speed reference selected will depend on the setting of the digital speed reference selector, Pr **1.15**)

A full description of each bit in the control word is given in the table below.

Table 7.1 SE77-CANopen control word

Bit	Function	Description
0	ENABLE	Must be set to 1 to put the Commander SE in READY mode. Resetting to 0 will immediately disable the Commander SE, and the motor will coast to stop. The external HARDWARE ENABLE signal (terminal 9) must also be present before the Commander SE can be enabled and run.
1	RUN FWD	Set to 1 (with ENABLE set to 1) to run the motor in the forward direction. When reset to 0, the Commander SE will decelerate the motor to a controlled stop before the outputs disabled
2	JOG	Set to 1 with RUN FWD or RUN REV bit also set to one to jog the motor in the appropriate direction. The Commander SE will ramp the motor to the normal speed reference if the bit is reset to 0

Table 7.1 SE77-CANopen control word

Bit	Function	Description
3	RUN REV	Set to 1 (with ENABLE set to 1) to run the motor in the reverse direction. When reset to 0, the Commander SE will decelerate the motor to a controlled stop before the outputs disabled
4	FBUS CTRL	A 0-1 transition of this bit will set Pr **6.43** to 1 to enable fieldbus control of the Commander SE. Pr **6.43** can subsequently be over-written by a digital input if a terminal or fieldbus control selector switch is required. A 1-0 transition will reset Pr **6.43** to 0, setting the Commander SE back into terminal control.)
5	DIG REF	A 0-1 transition of this bit will set Pr **1.14** to 3 to select digital speed reference control. Pr **1.14** can subsequently be over-written by a digital input controlling Pr **1.42** if an analogue/digital reference select switch is required. A 1-0 transition will reset Pr **1.14** to 1 to select analogue reference control.
6	RESET	A 0-1 transition will reset the Commander SE from a trip condition. If the cause of the trip has not been cleared, the Commander SE will trip again immediately
7	TRIP	A 0-1 transition will force a “t52” trip on the Commander SE. If the RESET and TRIP bits change from 0 to 1 on the same cycle, the TRIP bit will take priority
8-15	Reserved	

When a trip occurs, the Commander SE will automatically reset the control word (Pr **6.42**) to 0. This ensures that, for safety reasons, the Commander SE is in a safe, disabled state and cannot re-start immediately when it is reset.

However, the control word in the SE77-CANopen is not affected by a Commander SE trip. As the SE77-CANopen will only update the Commander SE control word (Pr **6.42**) when it sees a change in the SE77-CANopen control word, if the Commander SE control word is not updated. Hence. the Commander SE will not automatically restart when full communications is re-established. A change to the SE77-CANopen control word is required before the Commander SE will restart.

For this reason, it is necessary (and good safety practice!!) for the master controller program to monitor the status word, and reset the SE77-CANopen control word to a safe state if any Commander SE trip, SE77-CANopen fault or RS485 "FbuS" link loss error is detected. When both CANopen and “FbuS” communications links are healthy again, and it is safe to re-start the Commander SE, the appropriate SE77-CANopen control word can be set, a change of SE77-CANopen control word is detected, the SE77-CANopen will update the Commander SE control word (Pr **6.42**) and the Commander SE will restart.

Some example SE77-CANopen control words are shown in the table below..

Table 7.2 Example SE77-CANopen control words

Control Word (Hex)	Control Word (Dec)	Action
0x0000	0	Control word disabled, Commander SE will run under terminal control
0x0010	16	Disabled
0x0011	17	Enabled, stopped
0x0033	51	Enabled, run fwd, digital speed ref
0x0039	57	Enabled, run rev, digital speed ref
0x0013	19	Enabled, run fwd, analogue speed ref
0x0019	25	Enabled, run rev, analogue speed ref
0x0017	23	Enabled, jog fwd
0x001D	29	Enabled, jog rev

Table 7.2 Example SE77-CANopen control words

Control Word (Hex)	Control Word (Dec)	Action
0x0080	128	Trip Commander SE
0x0070	112	Reset Commander SE into fieldbus control
0x0040	64	Reset Commander SE into terminal control

7.2 SE77-CANopen status word

Name	SE77-CANopen status word		
Param	Pr **90.12**	**Default**	0
Access	RO	**Range**	0x0 to 0xFFFF

The status word returns the status of multiple functions within the Commander SE, e.g. at speed, zero speed, drive healthy, etc., and provides a quick method of checking the current operating status of the Commander SE. The status word is mapped to cyclic data as Pr **90.12**.

b15	b14	b13	b12b	b11	b10	b9	b8
FBUS LOSS	Pr **10.15**	Pr **10.14**	Pr **10.13**	Pr **10.12**	Pr **10.11**	Pr **10.10**	Pr **10.09**

b7	b6	b5	b4	b3	b2	b1	b0
Pr **10.08**	Pr **10.07**	Pr **10.06**	Pr **10.05**	Pr **10.04**	Pr **10.03**	Pr **10.02**	Pr **10.01**

Bit 15 will be set to 1 (with all other bits reset to 0) if the "FbuS" communications link between the SE77-CANopen and the Commander SE is lost.

NOTE Bit 15 of the status word effectively indicates that the master controller does not have control of the Commander SE. Under this condition, it is the User's responsibility to ensure that the master controller takes appropriate action to ensure system safety is maintained, in all respects.

Table 7.3 shows the function indicated by each bit in the status word when set to 1. A bit set to 0 indicates that the condition is false.

Table 7.3 SE77-CANopen status word

Bit	Parameter	Description
0	Pr **10.01**	Drive healthy
1	Pr **10.02**	Drive running
2	Pr **10.03**	Zero speed
3	Pr **10.04**	Running at or below minimum speed
4	Pr **10.05**	Below set speed
5	Pr **10.06**	At speed
6	Pr **10.07**	Above set speed
7	Pr **10.08**	Load reached
8	Pr **10.09**	In current limit
9	Pr **10.10**	Regenerating
10	Pr **10.11**	Dynamic brake active
11	Pr **10.12**	Dynamic brake alarm
12	Pr **10.13**	Direction commanded

Table 7.3 SE77-CANopen status word

Bit	Parameter	Description
13	Pr **10.14**	Direction running
14	Pr **10.15**	Mains loss
15	FBUS LOSS	"FbuS" communications link lost

7.3 Selecting control source externally

A selector switch can be used to select whether the RUN FWD, JOG, RUN REV functions are controlled externally by the digital inputs, or remotely by the CANopen master. This allows a machine to be run in a "manual" mode temporarily, e.g. while feeding new material though a machine, and switched to "automatic" mode, running under PLC control once material loading has been completed.

Another switch can also be used to select the source of the speed reference for the Commander SE. This may allow the speed of the machine to be controlled manually while new material fed through at a slow speed, and switched to automatic PLC control once material is flowing freely.

7.3.1 FBUS CTRL

When a 0-1 transition of the FBUS CTRL bit in the SE77-CANopen control word occurs, the SE77-CANopen will set Pr **6.43** to 1. This will disable terminal control of the Commander SE, and allow the fieldbus to control the ENABLE, RUN FWD, JOG and RUN REV functions of the Commander SE. Similarly, when FBUS CTRL is reset to 0, the SE77-CANopen will set Pr **6.43** to 0 to enable terminal control again.

If a digital input is configured to directly control Pr **6.43** in the Commander SE, the value written to Pr **6.43** by the SE77-CANopen will be immediately overwritten by the digital input. This allows the source of the ENABLE, RUN FWD, JOG and RUN REV functions of the Commander SE to be selected externally.

NOTE Use SESoft or the Universal Keypad to configure a spare digital input to control Pr **6.43**.

7.3.2 DIG REF

When a 0-1 transition of the DIG REF bit in the SE77-CANopen control word occurs, the SE77-CANopen will set Pr **1.14** to 3. This will select the digital speed references as the source of the Commander SE speed reference. When DIG REF is reset to 0, the SE77-CANopen will set Pr **1.14** to 1 to re-select the analogue reference as the source of the speed reference.

If a digital input is configured to directly control Pr **6.43** in the Commander SE, the value written to Pr **6.43** by the SE77-CANopen will be immediately overwritten by the digital input. This allows the source of the ENABLE, RUN FWD, JOG and RUN REV functions of the Commander SE to be selected externally.

NOTE Pr **1.14** cannot be controlled directly by a digital input, but Pr **1.42** can be used to select digital speed reference externally. Use SESoft or the Universal Keypad to configure a spare digital input to control Pr **1.42**.

Refer to the *Commander SE Advanced User Guide* for details on how to configure digital inputs.

8 Non-Cyclic Data

The Service Data Object provides a method for the master controller to read from or write to any object in the CANopen object dictionary within the SE77-CANopen. This service can be used for single infrequent data transfers, or uploading and downloading parameter sets to or from a particular node. The service data object (SDO) is always enabled and available for accessing parameters.

An additional method of non-cyclic data access to Commander SE parameters is also provided. CT Single Word is also implemented by using an additional word in RxPDO 1 and TxPDO 1. This form of non-cyclic data is controlled entirely by the master controller program, and is not configured in any way when the CANopen network map is defined. All Commander SE parameters can be accessed using this method, but it is not possible access objects in the CANopen object dictionary.

Table 8.1 Non-cyclic data modes

Non-cyclic mode	Data format (Pr 15.05)	Description
Disabled	0.xx	Non-cyclic data disabled
CT Single Word	1.xx	CT Single Word. Word 0 is reserved and used for non-cyclic data transfers

Pr **15.05** must be set as required in the Commander SE before the SE77-CANopen is powered up and initialised.

NOTE The non-cyclic data channel does not use decimal points. For example, the digital speed reference 1 (Pr 1.21) has units of Hertz, accurate to 1 decimal place. To write a value of 24.6Hz to Pr 1.21, the value must be transmitted as 246.

8.1 Service Data Object

The SE77-CANopen provides one SDO server. The following services are supported:

- Initiate SDO Download
- Download SDO Segment
- Initiate SDO Upload
- Upload SDO Segment
- Abort SDO Transfer

All Commander SE parameters have been mapped to the CANopen Object Dictionary, allowing full access using SDO communications.

The parameter mapping is calculated as.

Object Index: = 0x2000 + menu number (in hex)

Sub Index: = 0x01 + parameter number (in hex)

For example, to access Pr **14.12**, the CANopen Object Dictionary location would be:

Object Index: = 0x200E

Sub Index: = 0x0D

8.2 Mode 1 - CT Single Word mode

The CT Single Word mode of non-cyclic data uses one word cyclic data word to implement the CT Single Word protocol. The non-cyclic sub-protocol requires a specific sequence of 4 words or "telegrams" to implement the parameter access. Each non-cyclic word or telegram is split into 2 bytes to implement the sub-protocol, with the high byte containing the control codes for each telegram, and the low byte containing the data for each telegram.

b15	b14	b13	b12	b11	b10	b9	b8
READ	ERROR	Reserved		Stamp number			

b7	b6	b5	b4	b3	b2	b1	b0
Data nyte							

Table 8.2 CT Single Word control

Bit	Function	Values	Description
0 to 7	Data	0 to 255	Depending on the stamp number of the telegram, this byte contains the menu or parameter number, or high data or low data byte
8 to 11	Stamp number	0 to 4	Indicates the stamp number of the word. This shows which part of the message is currently in progress. Setting the stamp number to 0 resets the internal non-cyclic state machine
12, 13	Not used	0	These should be set to 0
14	ERROR	0 = Data OK 1 = Error	Indicates the success or failure of the message. Failure could occur if the parameter does not exist, or is a read-only or write-only parameter
15	READ	0 = Write 1 = Read	SPecifies a READ message when set to 1, and a WRITE message when set to 0

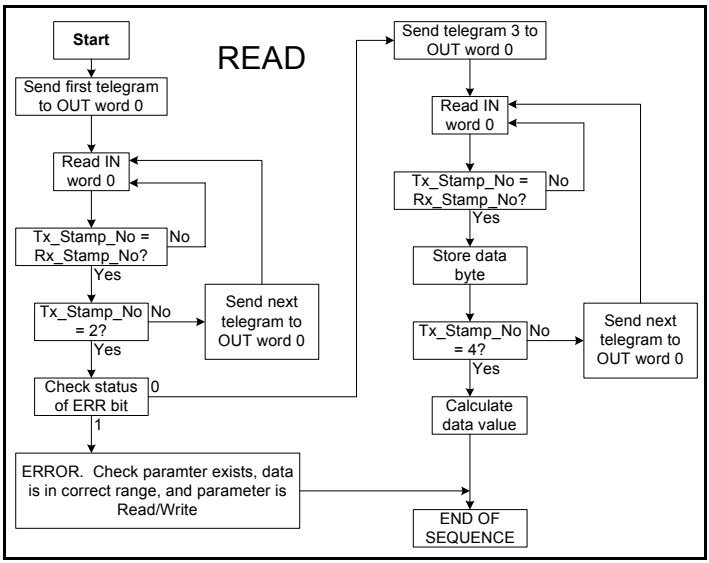
NOTE X = don't care. Generally, these bits should be set to 0. If a message is aborted part way through, the non-cyclic OUT word should be reset to 0. This will reset the non-cyclic state machine, and allow the message sequence to be restarted.

8.2.1 Reading parameters using Mode 1

To read parameters using the non-cyclic channel, the following “telegrams” must be transmitted to construct the final message.

- Telegram 1 Define menu number.
- Telegram 2 Define parameter number.
- Telegram 3 Request high data byte.
- Telegram 4 Request low data byte.

Figure 8-1 CT Single Word read sequence



The following example telegrams show how to read the post-ramp frequency reference (in Hz) from Pr **2.01** in the Commander SE.

TELEGRAM 1

The first telegram from the CANopen master indicates a READ cycle, and the stamp number is 1. The data byte would contain the menu number for the parameter that is to be read.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0001	0000	0010

Data word = 0x8102

Stamp number = 1

Menu = 2

When the first telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word back to the PLC. This is the signal to the master controller program that the first telegram of the message has been received and understood, and the second telegram can be transmitted.

TELEGRAM 2

The second telegram from the CANopen master also indicates a READ cycle, but the stamp number is now 2. The data byte would contain the parameter number for the parameter that is to read.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0010	0000	0001

Data word = 0x8201

Stamp number = 2

Parameter = 1

When the second telegram has been received and processed in the slave, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the second telegram of the message has been received and understood, and the third telegram can be transmitted.

If telegrams 1 and 2 were not received correctly, or an invalid parameter was specified, e.g. parameter is write only, or does not exist, the CANopen interface will set the ERROR bit to 1 (b14 = 1). The data bits will have no significance.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1100	0010	XXXX	XXXX

Data word = 0xC2XX

Stamp number = 2

If an error is reported, it is recommended that the non-cyclic data word is set to 0 to ensure that the non-cyclic state machine is completely reset, and ready for the next non-cyclic READ or WRITE sequence.

TELEGRAM 3

The third telegram from the CANopen master acts as the indication to the slave to send the high data byte from the requested parameter. The data byte is not used in this telegram, and should be set to 0.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0010	0000	0000

Data word = 0x8300

Stamp number = 3

When the third telegram has been received and processed in the slave node, the node will mirror the stamp number in the non-cyclic IN word, and load the high byte of the parameter value into the data byte.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0011	0000	0101

Data word = 0x8305

Stamp number = 3

Data high byte = 5

TELEGRAM 4

The fourth telegram from the CANopen master acts as the indication to the slave to send the high data byte from the requested parameter. The data byte is not used in this telegram and should be set to 0.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0100	0000	0000

Data word = 0x8400

Stamp number = 4

When the fourth telegram has been received and processed in the slave node, the node will mirror the stamp number in the non-cyclic IN word, and load the low byte of the parameter value into the data byte.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0100	1101	1100

Data word = 0x84DC

Stamp number = 4

Data low byte = 220

Speed feedback= (Data high byte * 256) + Data low byte

= (5 * 256) + 220

= 1500

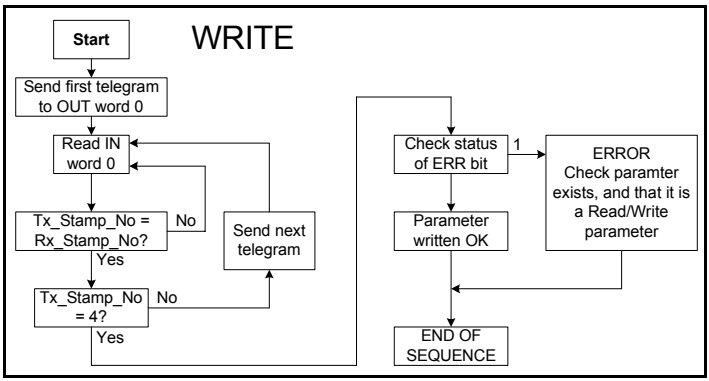
= 150.0 Hz

8.2.2 Writing parameters using Mode 1

To write to parameters using the non-cyclic channel, the following telegrams must be sent on each network cycle to construct the final message.

- Telegram 1 Define menu number.
- Telegram 2 Define parameter number.
- Telegram 3 Send high data byte.
- Telegram 4 Send low data byte.

Figure 8-2 CT Single Word write sequence



The following example telegrams show how to set the digital speed reference 1 (Pr **1.21**) to 40.0Hz (400) in the Commander SE.

TELEGRAM 1

The first telegram from the CANopen master indicates a WRITE cycle by setting the R/W bit to 0. The stamp number is set to 1. The data byte contains the menu number for the parameter that is to be written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0001	0000	0001

Data word = 0x0101

Stamp number = 1

Menu = 1

When the first telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the first telegram of the message has been received and understood, and the second telegram can be transmitted.

TELEGRAM 2

The second telegram from the CANopen master also indicates a Write cycle, but the stamp number is now set to 2. The data byte would contain the parameter number for the parameter that is to be written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0010	0001	0101

Data word = 0x0215

Stamp number = 2

Parameter = 21

When the second telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the second telegram of the message has been received and understood, and the third telegram can be transmitted.

TELEGRAM 3

The third telegram from the CANopen master has the stamp number set to 3. The data bits contain the high data byte for the parameter being written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0011	0000	0001

Data word = 0x0301

Stamp number = 3

Data high byte = 1

When the third telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the third telegram of the message has been received and understood, and the fourth telegram can be transmitted.

TELEGRAM 4

The fourth telegram from the CANopen master has the stamp number set to 4. The data bits contain the low data byte for the parameter that is being written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0100	1001	0000

Data word = 0x0490

Stamp number = 4

Data low byte = 144

When the fourth telegram has been received and processed in the slave node, it will write the data (Pr **1.21** = 40.0) as transmitted. (The decimal point is automatically inserted iwhen the data is transferred to the Commander SE.) If the operation is successful, the ERR bit is reset to 0 and the telegram is reflected in the non-cyclic IN word.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0100	1001	0000

Data word = 0x0490

Stamp number = 4

Data low byte = 144

If there was a problem with writing the data to the defined parameter, e.g. parameter is read only, does not exist, or data is out of range, the ERR bit is set to 1.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0100	0100	XXXX	XXXX

Data word = 0x44XX

Stamp number = 4

8.2.3 Abort CT Single Word message

The internal state machine that controls the non-cyclic data transfer will only accept a new telegram if it contains the next expected telegram, i.e. after accepting telegram 2, the state machine will only respond to telegram 3. If telegram 4 is received, it will be ignored.

If an error occurs in the master controller that causes the telegrams to get out of step, the master controller program should time-out, abort the message and reset the non-cyclic state machine.

A CT Single Word message can be be abandoned by resetting the state machine. This is done be setting the non-cyclic word to 0.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0000	0000	0000

Data word = 0x0000

Stamp number = 0

8.3 SE77-CANopen reset-up using non-cyclic data

Name	SE77-CANopen reset		
Param	Pr **15.31**	**Default**	0
Access	RW	**Range**	0 to 1

Pr **15.31** is only available in the SE77-CANopen, can only be accessed using non-cyclic communications.

Set Pr **15.31** to store the current configuration parameters in the SE77-CANopen FLASH memory, and reset the SE77-CANopen. This stores any changes made that have been made via the non-cyclic communications, and resets the SE77-CANopen to make the changes take effect.

9 EDS Files

9.1 What are EDS files?

EDS files are text files that are used with some CANopen network configuration packages. They contain information about the device capabilities, such as supported data rates, supported objects, etc.

Control Techniques cannot offer specific technical support on any of the software packages available for configuring CANopen networks or on the use and configuration of any specific PLC with CANopen.

9.2 SE77-CANopen EDS files

EDS files are available for the SE77-CANopen, and can be obtained from your local Control Techniques Drive Centre. Each file contains a full description of the performance capabilities of the SE77-CANopen.

Table 9.1 CANopen EDS files

Drive	Filename	Description
Commander SE	RD77CO_STD.EDS	EDS file for use with SE77-CANopen in default configuration. (See section 6.3.1 *3 cyclic words* on page 16.)
Commander SE	RD77CO_M1.EDS	For use with SE77-CANopen when CT Mode non-cyclic communications is enabled. (See section 6.3.2 *3 cyclic words with CT Single Word* on page 17 and section 8.2 *Mode 1 - CT Single Word mode* on page 24.)
Commander SE	RD77CO_VM.EDS	For use with SE77-CANopen when Velocity Mode profile is enabled. (See section 6.3.3 *CANopen Velocity Mode profile* on page 17 and Chapter 14 *CANopen Velocity Mode Profile* on page 51.)
Unidrive	UD77FULL.EDS	

10 Diagnostics

The information from the parameters described below should always be noted before contacting Control Techniques for technical support.

10.1 Module ID code

Name	Module ID code		
Param	Pr **15.01**	**Default**	N/A
Access	RO	**Range**	0 to 6

The module ID code identifies the type of option module last fitted to the Commander SE. 0 indicates that the Commander SE does not have any valid configuration parameters in Pr **15.PP**,

Table 10.1 Module ID codes

Pr 15.01	Module Type
0	None fitted
1	SE73-PROFIBUS-DP
2	SE74-INTERBUS
3	Reserved
4	Reserved
5	SE77-DeviceNet
6	SE77-CANopen

If the configuration parameters in Pr **15.PP** are not for the SE77-CANopen, it will over-write the values in Pr **15.PP** with the last set of values that were stored in it's internal FLASH memory.

10.2 SE77-CANopen firmware version

Name	SE77-CANopen major firmware version		
Param	Pr **15.02**	**Default**	N/A
Access	RO	**Range**	0 to 999

Name	SE77-CANopen minor firmware version		
Param	Pr **15.50**	**Default**	N/A
Access	RO	**Range**	0 to 99

The SE77-CANopen firmware version can be read from Pr **15.02** and Pr **15.50** in the Commander SE. These parameters should always be checked before contacting Control Techniques for technical support.

Table 10.2 SE77-CANopen firmware version

Major code (Pr 15.02)	Minor code (Pr 15.50)	Firmware version
1.01	2	V1.01.02

10.3 SE77-CANopen node address

Name	SE77-CANopen node address		
Param	Pr **15.03**	**Default**	0
Access	RW	**Range**	0 to 127

Every node on a CANopen network must be assigned a unique node address. If two or more nodes have the same address, this will cause a conflict when the master attempts to initialise the network. Nodes with the same address may attempt to communicate over the CAN network at the same time, and this network error may lead to a Bus Off error. (See section 10.6 *SE77-CANopen error codes* on page 34.) The node address can also be set or viewed in Pr **0.45**.

10.4 SE77-CANopen data rate

Name	SE77-CANopen node address		
Param	Pr **15.04**	**Default**	0
Access	RW	**Range**	0 to 7

The SE77-CANopen must be configured to run at the network data rate. This parameter should be set to the same value on all nodes on the network. The data rate can also be set or viewed in Pr **0.46**.

Table 10.3 SE77-CANopen data rates

Data rate	bits/s		Data rate	bits/s
0	1.0M		4	125K
1	800K		5	50K
2	500K		6	20K
3	250K		7	10K

10.5 SE77-CANopen operating status

Name	SE77-CANopen operating status		
Param	Pr **0.47**	**Default**	N/A
Access	RO	**Range**	-2 to 999

The SE77-CANopen operating status is displayed in Pr **0.47**, and can be viewed on the display on the Commander SE. Normally, this parameter will display the number of messages being handled per second, while a negative number indicates some sort of error status. See for a full list of operating staus codes.

Table 10.4 SE77-CANopen operating status

Pr 0.47	Status	Description
>0	Network healthy	Indicates the number of messages being processed every second. Pr **0.47** counts 1 for each SYNC message received, 1 for each RxPDO received, and 1 for each TxPDO transmitted.
0	Network healthy, no data transfer	Indicates that the master controller has established communications with the node, but that no messages are currently being received.

Table 10.4 SE77-CANopen operating status

Pr 0.47	Status	Description
-1	No network master	Indicates that the SE77-CANopen module has initialised correctly, detetced an active CAN network. and is now waiting for the master controller to initialise communications.
-2	Initialisation Failure	Indicates that the SE77-CANopen module is not connected to an active CAN network. If a CAN network is present and active, -2 may also indicate that the hardware initialisation sequence failed, and the SE77-CANopen module should be replaced.

10.6 SE77-CANopen error codes

The SE77-CANopen will trip the Commander SE if an error condition is seen. The error codes shown in Table 10.5 can be viewed on the display of the Commander SE.

Table 10.5 SE77-CANopen error codes

Trip code	Error
t52	This code indicates that the trip was caused by bit 7 in the control word being set to 1. The trip is initiated by a 0-1 transition of bit 7 in the control word. (See section 7.1 *SE77-CANopen control word* on page 19)
t60	CAN “Bus Off” Trip. The “Bus Off” trip occurs when a node detects an excessive number of CAN frame errors on the network. Framing errors can be caused by a wiring fault, e.g. broken wire, disconnected node, missing termination resistors, etc, by noise getting onto the network due to incorrect earth and screen arrangements, or by 2 or more nodes having the same node address. If the SE77-CANopen is in the “Bus Off” condition, it will reset and re-initialise the CAN controller when it detects that the Commander SE has been reset.
t62	SE77-CANopen Network Loss. The node has not received a polled data message for a time period specified in #15.07. This trip can be caused by a network fault, e.g. broken wire, disconnected node, missing termination resistors, etc. "t62" may also occur if the master controller stops the network while it is being re-programmed or reset. (See section 11.1 *CANopen network loss trip* on page 36)
t63	SE77-CANopen Node Guarding Trip. See section 11.2 *Node guarding protocol* on page 37 for further details about node guarding.
SCL	RS485 "FbuS" link failure. Communications between the SE77-CANopen and the Commander SE (RJ45) port have been interrupted.

10.7 Loss of RS485 "FbuS" link

The Commander SE has a serial communications watchdog that must be updated at least once every second. The SE77-CANopen ensures that the watchdog is updated regularly while the RS485 link is healthy. If the RS485 link is broken, the watchdog in the Commander SE will not get updated, and the Commander SE will trip "SCL".

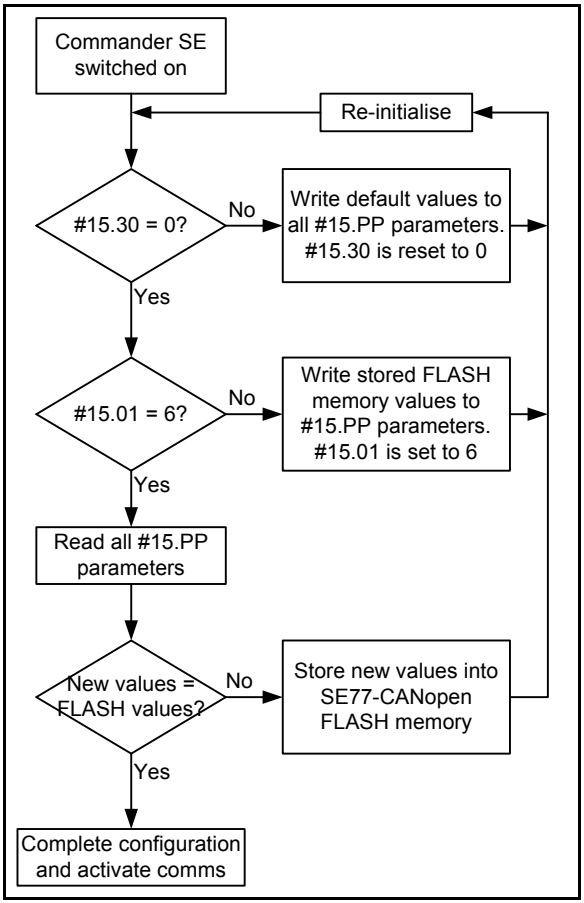
If the SE77-CANopen remains powered up, it will continue to communicate with the CANopen master controller. The loss of the RS485 link to the Commander SE is indicated by bit 15 of the status word being set to 1. (All other bits in the status word are reset to 0 in this state.) Bit 15 is reset to 0 when the RS485 link is re-established.

NOTE If bit 15 of the status word is set to 1, the remaining IN polled data words will continue to hold the last values read from the Commander SE. Bit 15 is an important check for the validity of the IN data.

10.8 SE77-CANopen power-up sequence

The SE77-CANopen is powered by the Commander SE, but a +24V back-up power supply can also be used to keep the SE77-CANopen communicating in the event of loss of the main supply to the Commander SE. The power-up initiialisation sequence is shown in Figure 10-1.

Figure 10-1 Commander SE initialisation sequence



If SE77-CANopen is powered up from the +24V back-up power supply, it will configure itself using the node address and data rate settings stored in its FLASH memory. The boot-up object will be transmitted, followed approximately 5 seconds later by an emergency message as the communications link to the Commander SE is not operating. SE77-CANopen will respond with an error message to any SDO communcations while in this state. When the Commander SE is subsequently powered up, it will go through the procedure shown in Figure 10-1.

11 Advanced Features

11.1 CANopen network loss trip

Name	SE77-CANopen network loss trip		
Param	Pr **15.07**	**Default**	200
Access	RW	**Range**	0 to 2000

The SE77-CANopen can be configured to monitor the CANopen network, and trip the Commander SE on error code 62 if a loss of network is detected. The network loss trip delay time is specified (in ms) in Pr **15.07**.

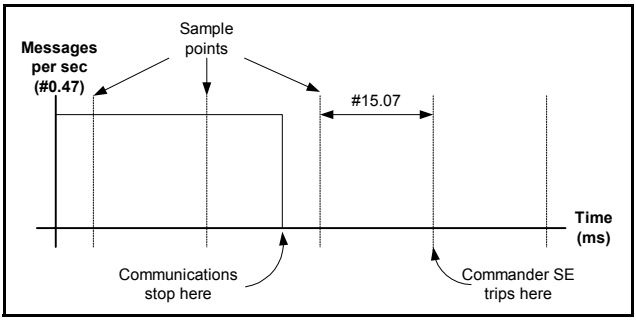
NOTE The network loss trip can be disabled by setting Pr **15.07** to 0.

After power-up or reset, the network loss trip is not actually armed until one of the following events occur:

- SYNC message is received.
- RxPDO1 is received.
- TxPDO1 is transmitted.

Once the trip has been armed, a minimum of one of the above messages must be received or transmitted in each time period. If this does not happen, the SE77-CANopen will trip the Commander SE on “t62”.

Figure 11-1 Network Loss Trip



As can be seen from the diagram, the actual time from the network loss to the Network Loss trip actually occurring will range from Pr **15.07** ms to 2 * Pr **15.07** ms. By decreasing Pr **15.07**, the maximum trip time will be reduced, but if the trip time is set too low, spurious network loss trips will be seen.

The actual network loss trip time that should be set depends entirely on the number of messages per second being received under normal operation. As a rough guide, the Network Loss Trip time (Pr **15.07**) should be set such that a minimum of 5 messages will be received in any given sample period under normal operating conditions.

CAUTION

The Network Loss trip can be disabled by setting Pr **15.07** to 0, but the Commander SE may continue to operate using the last received values in the case of a network loss. It is the User’s responsibility to ensure that adequate safety precautions are taken to prevent damage or injury by disabling the Commander SE in the event of any loss of the CANopen network.

11.2 Node guarding protocol

"Node guarding" is the specified CANopen mechanism where a master polls a remote slave node periodically, and the slave responds with the current operating state.

The “guard time” and “life time factor” define how often the slave is polled, and how many missed messages are permitted before a node guarding event occurs in the master controller, and a life guarding event occurs in the SE77-CANopen. The SE77-CANopen will trip the Commander SE on "t63" when a life guarding event occurs.

11.3 Restore SE77-CANopen default values

Name	Restore SE77-CANopen default configuration		
Param	Pr **15.30**	**Default**	0
Access	RW	**Range**	0 or 1

Default SE77-CANopen values can be restored using either SESoft or the Universal Keypad. This resets ALL SE77-CANopen configuration parameters (including node address) back to the factory default values.

Table 11.1 Restore defaults

Pr 15.30	Status
0	No action
1	Restore default settings

NOTE To restore communications to the node, the node address (Pr 0.45) must be set to the required value, and the Commander SE powered down. Communications will be re-established (with default settings) when power is re-applied to the Commander SE. (This does not apply to the INTERBUS .)

The +24V back-up power supply should be switched off or switched while default parameters are restored.

11.3.1 SESoft

- Power down the Commander SE and disconnect the SE77-CANopen .
- Connect the SESoft communications lead, and power up the Commander SE.
- In SESoft, go to **MENU 15**, and click **LOAD DEFAULTS**.
- Power down the Commander SE and re-connect the SE77-CANopen .
- Re-apply power to the Commander SE.
- The SE77-CANopen will overwrite all Pr **15.PP** parameters with their default values. The default values will take effect immediately.

11.3.2 Universal Keypad

- Set Pr **15.30** to 1.
- Store the Commander SE parameters from the Universal Keypad by setting Pr **MM.00** to 1000, and pressing the red **RESET** button.
- Power down the Commander SE, and re-connect the SE77-CANopen .
- The SE77-CANopen will overwrite all Pr **15.PP** parameters with their default values. The default values will take effect immediately.

11.4 Restore previous SE77-CANopen configuration

The SE77-CANopen stores the last set of configuration parameters in its own FLASH memory. These values can be restored to the Commander SE using SESoft or the Universal Keypad.

NOTE A brand new Commander SE will have Pr **15.01** set to 0 by default. When a previously confiured SE77-CANopen is connected, it will detect that Pr **15.01** is set to 0, and will automatically revert to the configuration values stored in its internal FLASH memory.

11.4.1 SESoft

- Go to the Menu 15 Screen
- Set the Fieldbus Type to "**None**" and click on the **PROGRAM** button. SESoft will set Pr **15.01** to 0 and store all parameters.
- Power down the Commander SE, and re-connect the SE77-CANopen .
- Re-apply power to the Commander SE.
- The SE77-CANopen will detect that Pr **15.01** is 0, and download the previously stored values (including the node address) to all Pr **15.PP** parameters. The stored values will take effect immediately.

11.4.2 Universal Keypad

- Set Pr **15.01** to 0.
- Store the Commander SE parameters from the Universal Keypad by setting Pr **MM.00** to 1000, and pressing **RESET**.
- Power down the Commander SE, and re-connect the SE77-CANopen .
- Re-apply power to the Commander SE.
- The SE77-CANopen will detect that Pr **15.01** is 0, and download the previously stored values (including the node address) to all Pr **15.PP** parameters. The stored values will take effect immediately.

NOTE Universal Keypads must have V1.04.00 or later fitted to allow access to Pr **15.01**.

12 CANopen Object Dictionary

12.1 Communication profile objects

Table 12.1 contains a list of all communication profile objects supported by the SE77-CANopen.

Table 12.1 Communication profile objects

Object	Object Description	Object code	Data type	Access
1000	***Device type***	VAR	USIGN32	RO
1001	***Error register***	VAR	USIGN8	RO
1002	***Manufacturer status register***	VAR	USIGN32	RO
1003	***Pre-defined error field***	ARRAY	USIGN32	RO
1004	***Number of PDOs supported***	ARRAY	USIGN32	RO
1005	***COB-ID of the SYNC message***	VAR	USIGN32	RO
1008	***Manufacturer device name***	VAR	STRING	CONST
1009	***Manufacturer hardware version***	VAR	STRING	CONST
100A	***Manufacturer software version***	VAR	STRING	CONST
100B	***Node ID***	VAR	USIGN32	RO
100C	***Guard time***	VAR	USIGN16	RW
100D	***Life time factor***	VAR	USIGN8	RW
100E	***COB-ID guarding protocol***	VAR	USIGN32	RW
100F	***Number of SDOs supported***	VAR	USIGN32	RO
1014	***COB-ID EMCY***	VAR	USIGN32	RW

12.1.1 *Device type*

Index	0x1000	**Sub-Index**	0	**Attribute**	RO
Default	0x00010192	**Data Type**	USIGN32	**Object Code**	VAR

Index 0x1000 describes the type of device and the functionality. The SE77-CANopen supports device profile number 402 (0x0192) and is type 1 “frequency converter”. Mode is manufacturer-specific and is not used.

Table 12.2 Device type

Additional Information		Device Profile Number
Mode	**Type**	
0x00	0x01	0x0192

12.1.2 *Error register*

Index	0x1001	**Sub-Index**	0	**Attribute**	RO
Default	N/A	**Data Type**	USIGN8	**Object Code**	VAR

This object is an error register for the SE77-CANopen, and is transmitted as part of the emergency object. See section 13.4 *Error register* on page 49 for full details.

12.1.3 *Manufacturer status register*

Index	0x1002	**Sub-Index**	0	**Attribute**	RO
Default	N/A	**Data Type**	USIGN8	**Object Code**	VAR

Returns the SE77-CANopen status word, Pr **90.12**.

12.1.4 *Pre-defined error field*

Index	0x1003	**Sub Index**		**Attribute**	RW
Elements	2	**Data Type**	USIGN32	**Object Code**	ARRAY

Number of errors

Index	0x1003	**Sub-Index**	0	**Attribute**	RO
Default	1	**Data Type**	USIGN8	**Object Code**	VAR

Error field

Index	0x1003	**Sub-Index**	1	**Attribute**	RO
Default	N/A	**Data Type**	USIGN32	**Object Code**	VAR

See section 13.3 *Emergency error code* on page 48

12.1.5 *Number of PDOs supported*

Number of PDOs supported

Index	0x1004	**Sub-Index**	0	**Attribute**	RO
Default	0x00010001	**Data Type**	USIGN32	**Object Code**	VAR

The SE77-CANopen supports 1 transmit and 1 receive PDO only.

Number of synchronous PDOs

Index	0x1004	**Sub-Index**	1	**Attribute**	RO
Default	0x00010001	**Data Type**	USIGN32		

Both PDOs on the SE77-CANopen are synchronous PDOs.

Number of asynchronous PDOs

Index	0x1004	**Sub-Index**	2	**Attribute**	RO
Default	0x00000000	**Data Type**	USIGN32		

There SE77-CANopen does not support asynchronous PDOs.

12.1.6 *COB-ID SYNC*

Index	0x1005	**Sub-Index**	0	**Attribute**	RW
Default	0x80000080	**Data Type**	USIGN32	**Object Code**	VAR

Index 0x1005 defines the COB-ID of the synchronisation object (SYNC). The SE77-CANopen will consume the SYNC message, but it cannot be used to generate the SYNC message.

12.1.7 *Manufacturer device name*

Index	0x1008	**Sub-Index**	0	**Attribute**	RO
Default	SE77_CO	**Data Type**	STRING	**Object Code**	VAR

Returns a string to indicate the product name.

12.1.8 *Manufacturer hardware name*

Index	0x1009	**Sub-Index**	0	**Attribute**	RO
Default	HV01.00	**Data Type**	STRING	**Object Code**	VAR

Returns a string to indicate the product hardware version.

12.1.9 *Manufacturer software version*

Index	0x100A	**Sub-Index**	0	**Attribute**	RO
Default	V010000	**Data Type**	STRING	**Object Code**	VAR

Returns a string to indicate the firmware version installed.

12.1.10 *Node-ID*

Index	0x100B	**Sub-Index**	0	**Attribute**	RO
Default	Pr **15.03**	**Data Type**	USIGN32	**Object Code**	VAR

Object 0x100B will return the node address currently in use. This object cannot be edited using SDO services, as the node address is only read from Pr **15.03** during the initialisation sequence. The SE77-CANopen must be reset before any changes to the Pr **15.03** will take effect.

12.1.11 *Guard time*

Index	0x100C	**Sub-Index**	0	**Attribute**	RW
Default	0	**Data Type**	USIGN16	**Object Code**	VAR

Used in conjunction with the ***life time factor*** (0x100D) to specify the lifetime for the life guarding protocol. The lifetime is calculated as ***guard time*** (in ms) * ***life time factor***. The ***guard time*** is usually downloaded to the slave by the master controller during initialisation.

The master controller will check for the presence of the slave node every ***guard time*** period. If the slave has not responded after the ***life time factor*** number of checks, the master controller will indicate that an error occurred with the slave node.

12.1.12 *Life time factor*

Index	0x100D	**Sub-Index**	0	**Attribute**	RW
Default	0	**Data Type**	USIGN8	**Object Code**	VAR

Used in conjunction with the ***guard time*** (0x100D) to specify the lifetime for the node guarding protocol. The ***life time factor*** is usually downloaded to the slave by the master controller during initialisation.

The master controller will check for the presence of the slave node every ***guard time*** period. If the slave has not responded after the ***life time factor*** number of checks, the master controller will indicate that an error occurred with the slave node.

12.1.13 *COB-ID guarding protocol*

Index	0x100E	**Sub-Index**	0	**Attribute**	RW
Default	0x700 + Node ID	**Data Type**	USIGN32	**Object Code**	VAR

Index 0x100E specifies the identifier used for the node guarding protocol, with the default value calculated using the node address.

12.1.14 *Number of SDOs supported*

Index	0x100F	**Sub-Index**	0	**Attribute**	RO
Default	0x00000001	**Data Type**	USIGN32	**Object Code**	VAR

Specifies the number of service data objects (SDOs) supported. The SE77-CANopen supports 1 server SDO only.

12.1.15 *COB-ID emergency object*

Index	0x1014	**Sub-Index**	0	**Attribute**	RW
Default	0x80 + Node ID	**Data Type**	USIGN32	**Object Code**	VAR

Index 0x1014 defines the COB-ID of the emergency object. Refer to section 13.2 *Emergency object format* on page 48 for full details.

12.2 Parameter data objects

The default mapping values for RxPDO1 and TxPDO1 are derived from the menu 15 parameters within the Commander SE during inititalisation. The mapping for each data word of each PDO can be dynamically re-mapped by the master, but the values in Pr **15.PP** will not be automatically over-written. If the Pr **15.PP** parameters are not updated, the SE77-CANopen will revert to default mappings after each reset, so the master controller must over-write the default mapping values after each SE77-CANopen reset sequence.

The mapping values for each data word in RxPDO1 and TxPDO1 are represented as shown in section 12.4 *RxPDO1 mapping parameters* on page 43 and section 12.6 *TxPDO1 mapping parameters* on page 45

Table 12.3 PDO mapping value

b31 – b16	b15 – b8	b7 – b0
Index	Sub-index	Object length (in bits)

For example, the mapping for word 1 of TxPDO1 is specified in Pr **15.21**. The default value is preset speed reference 1, Pr **1.21**. The corresponding value for index 0x1600 sub 1 will be 0x20011610. (Refer to section 8.1 *Service Data Object* on page 23 for more details on how to access Commander SE parameters.)

Index = 0x2001 (Index = 0x2000 + Menu)

Sub-Index = 0x16 (Sub-Index = Parameter + 1)

Object Length = 0x10 (Object Length = 16 bits)

NOTE If a data word in a PDO is not used, the mapping value will have the following format:
Index = 0x4000
Sub-index = PDO word number (0x01 – 0x04)
Object length = 0x10

12.3 RxPDO1 Communication Parameters

Index	0x1400	**Sub Index**		**Attribute**	RO
Elements	4	**Data Type**	USIGN32	**Object Code**	PDOCommPar

This object contains the communication parameters for RxPDO1.

12.3.1 *Number of entries*

Index	0x1400	Sub-Index	0	Attribute	RO
Default	4	Data Type	USIGN8		

Returns the number of sub-indexes available for the RxPDO1 communication parameter object.

12.3.2 *COB-ID used by RxPDO1*

Index	0x1400	Sub-Index	1	Attribute	RW
Default	0x200 + Node ID	Data Type	USIGN32		

The COB-ID is calculated from the Node ID (Pr **15.03**) during initialisation, but the COB-ID for RxPDO1 is dynamic, and any subsequent change to this object will immediately.

12.3.3 *Transmission type*

Index	0x1400	Sub-Index	2	Attribute	RW
Default	1	Data Type	USIGN8		

When RxPDO1 is received, it is processed immediately, and parameters updated in the Commander SE. This means that the transmission type actually has no effect on RxPDO1.

12.3.4 *Inhibit time*

Index	0x1400	Sub-Index	3	Attribute	RO
Default	0	Data Type	USIGN16		

If an unsuccessful attempt is made to transmit a message, the inhibit time specifies the minimum time to wait before attempting to re-send the PDO. For this reason, the inhibit time has no function for RxPDO1.

12.3.5 *Compatibility entry*

Index	0x1400	Sub-Index	4	Attribute	RO
Default	0	Data Type	USIGN16		

Not used on the SE77-CANopen.

12.4 RxPDO1 mapping parameters

This object contains the mappings for each word in RxPDO1. The SE77-CANopen reads the values from Pr **15.21** and Pr **15.22** from the Commander SE during initialisation, and derives the default mappings for each data word from parameters Pr **15.20** to Pr **15.22**. (Pr **15.20** is stored in the SE77-CANopen only, it is not stored in the Commander SE itself.)

However, the mapping for RxPDO1 is dynamic, so the mapping destination of a data word from RxPDO1 can be changed “on-the-fly” by writing a new value (using SDO communications) to the appropriate sub-index, and the change in mapping will take effect immediately.

NOTE Parameter Pr **15.20** to Pr **15.22** are NOT updated if the mapping is changed by writing to index 0x1600, so the SE77-CANopen will revert to the parameter-defined mappings during the next initialisation.

The default mapping applied to each data word of RxPDO1 depends on the data format selected. (See section 6.3 *SE77-CANopen data formats* on page 16.) Table 12.4 shows the RxPDO1 mapping if Pr **15.05** = 0.03.

Table 12.4 RxPDO1 mapping (Pr 15.05 = 0.03)

Index	Sub-index	Description	Data type	Attr.	Default
0x1600	0	No of entries	USIGN8	RO	4
0x1600	1	Word 0 mapping	USIGN32	RW	Derived from Pr **15.20**
0x1600	2	Word 1 mapping	USIGN32	RW	Derived from Pr **15.21**
0x1600	3	Word 2 mapping	USIGN32	RW	Derived from Pr **15.22**
0x1600	4	Not used	USIGN32	RO	0x40000410

Table 12.5 shows the RxPDO1 mapping if Pr **15.05** = 1.03, i.e. CT Single Word non-cyclic data is enabled.

Table 12.5 RxPDO1 mapping (Pr 15.05 = 1.03)

Index	Sub-index	Description	Data type	Attr.	Default
0x1600	0	No of entries	USIGN8	RO	4
0x1600	1	Word 0 mapping	USIGN32	RO	Fixed mapping to CT Single Word non-cyclic data
0x1600	2	Word 1 mapping	USIGN32	RW	Derived from Pr **15.20**
0x1600	3	Word 2 mapping	USIGN32	RW	Derived from Pr **15.21**
0x1600	4	Word 3 mapping	USIGN32	RW	Derived from Pr **15.22**

12.5 TxPDO1 communication parameters

Index	0x1800	**Sub Index**		**Attribute**	RO
Elements	3	**Data Type**	USIGN32	**Object Code**	PDOMapping

This object contains the communication parameters for TxPDO1

12.5.1 *Number of entries*

Index	0x1800	**Sub-Index**	0	**Attribute**	RO
Default	3	**Data Type**	USIGN8		

Returns the number of sub-indexes available for the TxPDO1 communication parameter object.

12.5.2 *COB-ID used by TxPDO1*

Index	0x1800	**Sub-Index**	1	**Attribute**	RO
Default	0x180 + Node ID	**Data Type**	USIGN32		

The COB-ID is calculated from the ***node ID***, specified in Pr **15.03** (Pr **0.45**). It is not possible to directly edit the COB-ID for TxPDO1 by writing to this object.

12.5.3 *Transmission type*

Index	0x1800	Sub-Index	2	Attribute	RO
Default	1	Data Type	USIGN8		

The transmission type specifies when TxPDO1 will be transmitted by the SE77-CANopen. Supported transmission types are listed in Table 12.6.

Table 12.6 SE77-CANopen supported transmission modes

Transmission type	Timing	Comments
0	Acyclic, synchronous	Not supported
1 - 240	Cyclic, synchronous	TxPDO1 is transmitted after every nth SYNC message
252	RTR, synchronous	Not supported
253	RTR, asynchronous	Not supported
254, 255	Asynchronous	Not supported

12.5.4 *Inhibit Time*

Index	0x1800	Sub-Index	3	Attribute	RW
Default	0	Data Type	USIGN16		

If an unsuccessful attempt is made to transmit a message, the ***inhibit time*** specifies the minimum time to wait before attempting to re-send TxPDO1.

12.6 TxPDO1 mapping parameters

This object contains the mappings for each word in TxPDO1. The SE77-CANopen reads the values from Pr **15.11** and Pr **15.12** from the Commander SE during initialisation, and derives the default mappings for each data word from parameters Pr **15.10** to Pr **15.12**. (Pr **15.10** is stored in the SE77-CANopen only, it is not stored in the Commander SE itself.)

However, the mapping for TxPDO1 is dynamic, so the source of a data word from RxPDO1 can be changed “on-the-fly” by writing a new value (using SDO communications) to the appropriate sub-index, and the change in mapping will take effect immediately.

NOTE Parameter Pr **15.10** to Pr **15.12** are NOT updated if the mapping is changed by writing to index 0x1600, so the SE77-CANopen will revert to the parameter-defined mappings during the next initialisation.

The default mapping applied to each data word of TxPDO1 depends on the data format selected. (See section 6.3 *SE77-CANopen data formats* on page 16.) Table 12.7 shows the TxPDO1 mapping if Pr **15.05** = 0.03.

Table 12.7 TxPDO1 mapping (Pr 15.05 = 0.03)

Index	Sub-index	Description	Data type	Attr.	Default
0x1A00	0	No of entries	USIGN8	RO	4
0x1A00	1	Word 0 mapping	USIGN32	RW	Derived from Pr **15.10**
0x1A00	2	Word 1 mapping	USIGN32	RW	Derived from Pr **15.11**
0x1A00	3	Word 2 mapping	USIGN32	RW	Derived from Pr **15.12**
0x1A00	4	Not used	USIGN32	RO	0x40000410

Table 12.8 shows the TxPDO1 mapping if Pr **15.05** = 1.03, i.e. CT Single Word non-cyclic data is enabled.

Table 12.8 TxPDO1 mapping (Pr 15.05 = 1.03)

Index	Sub-index	Description	Data type	Attr.	Default
0x1A00	0	No of entries	USIGN8	RO	4
0x1A00	1	Word 0 mapping	USIGN32	RO	Fixed mapping to CT Single Word non-cyclic data
0x1A00	2	Word 1 mapping	USIGN32	RW	Derived from Pr **15.10**
0x1A00	3	Word 2 mapping	USIGN32	RW	Derived from Pr **15.11**
0x1A00	4	Word 3 mapping	USIGN32	RW	Derived from Pr **15.12**

12.7 Blank mapping objects

This object contains the blank mapping objects. When a word in RxPDO1 and/or TxPDO1 is mapped to one of these objects, this is the equivalent of setting a Commander SE mapping parameter to 0. Data received in RxPDO1 will be discarded, and data transmitted in TxPDO1 will be set to 0.

This object allows the data being received in RxPDO1 to be accessed using SDO communications.

Table 12.9 Blank mapping objects

Index	Sub-index	Description	Data type	Attribute
0x4000	0	No of entries	USIGN8	RO
0x4000	1	Blank mapping 1	USIGN32	RO
0x4000	2	Blank mapping 2	USIGN32	RO
0x4000	3	Blank mapping 3	USIGN32	RO
0x4000	4	Blank mapping 4	USIGN32	RO

12.8 RxPDO1 direct data access

This object allows the data being received in RxPDO1 to be accessed using SDO communications.

Table 12.10 RxPDO1 direct data access

Index	Sub-index	Description	Data type	Attribute
0x6000	0	No of entries	USIGN8	RO
0x6000	1	RxPDO1 byte 0	USIGN8	RO
0x6000	2	RxPDO1 byte 1	USIGN8	RO
0x6000	3	RxPDO1 byte 2	USIGN8	RO
0x6000	4	RxPDO1 byte 3	USIGN8	RO
0x6000	5	RxPDO1 byte 4	USIGN8	RO
0x6000	6	RxPDO1 byte 5	USIGN8	RO
0x6000	7	RxPDO1 byte 6	USIGN8	RO
0x6000	8	RxPDO1 byte 7	USIGN8	RO

Data bytes 6 and 7 will only contain data if CT Mode non-cyclic data is enabled, i.e. Pr **15.05** = 1.03.

12.9 TxPDO1 direct data access

This object allows the data being received in TxPDO1 to be accessed using SDO communications.

Table 12.11 TxPDO1 direct data access

Index	Sub-Index	Description	Data Type	Attribute
0x6200	0	No of entries	USIGN8	RO
0x6200	1	TxPDO1 byte 0	USIGN8	RO
0x6200	2	TxPDO1 byte 1	USIGN8	RO
0x6200	3	TxPDO1 byte 2	USIGN8	RO
0x6200	4	TxPDO1 byte 3	USIGN8	RO
0x6200	5	TxPDO1 byte 4	USIGN8	RO
0x6200	6	TxPDO1 byte 5	USIGN8	RO
0x6200	7	TxPDO1 byte 6	USIGN8	RO
0x6200	8	TxPDO1 byte 7	USIGN8	RO

Data bytes 6 and 7 will only contain data if CT Mode non-cyclic data is enabled, i.e. Pr **15.05** = 1.03.

13 Emergency Object

13.1 What is the emergency object?

Emergency objects are transmitted by the SE77-CANopen when it detects that the Commander SE has tripped. They are high priority messages that inform the CANopen master controller that some sort of error has occurred. It is up to the CANopen master controller to take appropriate action.

Emergency objects are suitable for interrupt-type error alerts. An emergency object is transmitted only once per error event, and provided that no new errors occur, no further emergency objects will be transmitted.

13.2 Emergency object format

The emergency object consists of a total of 8 data bytes. The first 3 bytes are defined by the CANopen specification, and the remaining 5 bytes are manufacturer-specific. SE77-CANopen will return the Commander SE trip code in the byte 3, with bytes 4 to 7 alwyas set to 0.

Table 13.1 Emergency object format

COB-ID	Byte			
	0	1	2	3
COB-ID EMCY (Index 0x1014)	Emergency error code (0x1003) (See Table 13.2)		Error register (Index 0x1001)	Commander SE trip code (Pr **10.20**)

13.3 Emergency error code

The emergency error code (0x1003) returns a CANopen error code, and supported error codes are listed in Table 13.2. Any other Commander SE error will produce a generic error, and the actual reson for the trip can be determined from the Commander SE trip code.

Table 13.2 Emergency error codes

Emergency error code	Description
0x0000	Error reset or no error
0x1000	Generic error
0x2300	Current error
0x3100	Voltage error
0x8100	Communications error

13.4 Error register

The error register (0x1001) is indicates that certain type of error has occurred, and can be mapped to TxPDOs if required. If a bit is set to 1, the error has occurred. Non-defined types of error will simply indicate that a generic error has occurred, and the reason for the error can be determined from the Commander SE trip code. (See section 13 *Emergency Object* on page 48.)

Table 13.3 Error register

Bit	Error	Description
0	Generic error	Set if any other bits in the error register are set.
1	Current	Set if Pr **10.09** is set.
2	Voltage	Set if Pr **10.15** is set.
3	Temperature	Always set to 0
4	Communication error	Set if CAN ASIC indicates a network error
5	Device profile specific	Always set to 0
6	Reserved	
7	Manufacturer specific	Set if the communications link to the Commander SE is lost. (Bit 15 of Pr **90.12**)

13.5 Emergency object state

The SE77-CANopen may be in one of two emergency states, as shown in Figure 13-1.

Figure 13-1 Emergency object states

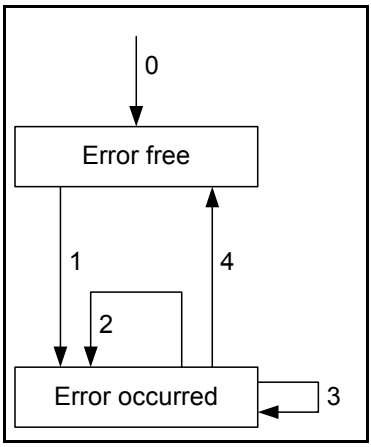


Table 13.4 Emergency object state transitions

Transition	Reference	Description
0	Initialisation	After initialisation, SE77-CANopen enters the error free state if no error is detected. The emergency object is not transmitted.
1	Error occurred	SE77-CANopen detects an error, transmits the emergency object once, and enters the error state.

Table 13.4 Emergency object state transitions

Transition	Reference	Description
2	Reset, new error occurred	One error (but not all errors) have been cleared. SE77-CANopen will transmit another emergency object with information about the remaining error.
3	New error occurred	SE77-CANopen has detected a new error condition, while in the error state. SE77-CANopen remains in error state and transmits another emergency object with the appropriate error codes.
4	Reset, error cleared	All errors have been cleared. SE77-CANopen will return to the error free state, and transmit an emergency object with the emergency error code set to 0x0000.

14 CANopen Velocity Mode Profile

The Velocity Mode profile has been implemented in the SE77-CANopen, and can be selected by setting Pr **15.05** = 0.02. The PDO mappings for this profile are fixed and cannot be modified, but all other supported objects can be accessed using SDO services.

NOTE The 0x6XXX series of objects (apart from 0x6000 and 0x6200) can only be access if the Velocity Mode profile is enabled.

14.1 Initialisation

When the SE77-CANopen is initialised, it will read and cache the number of motor poles (Pr **5.11**) configured in the Commander SE. This value is required to allow RPM to be converted to Hz, and vice versa.

If Pr **5.11** is set to AUTO, the SE77-CANopen will read the motor rated frequency (Pr 5.06) and motor rated full load rpm (Pr 5.08) and use these values to calculate the number of motor poles.

If the number of motor poles is changed, the SE77-CANopen must be reset to ensure that it uses the new configuration when converting between RPM and Hz.

NOTE It is recommended that the motor map in the Commander SE should be fully configured before the SE77-CANopen is connected.

14.2 Conversion Factors

The Velocity Mode profile specifies velocity parameters in RPM or Percent, time parameters in seconds, and ramps in RPM/second. The Commander SE uses different units for the different types of parameter, so conversion factors must be used.

14.2.1 Percentage Function

The Percentage Function is used to convert a velocity reference from Percent to RPM. The equation used is:

$$\mathbf{RPM} = \frac{\mathbf{Percentage} \times \mathbf{vl\_velocity\_reference}}{\mathbf{0x3FFF}}$$

14.2.2 Reverse Percentage Function

The Reverse Percentage Function is used to convert a velocity reference from RPM to Percent. The equation used is:

$$\mathbf{Percentage} = \frac{\mathbf{RPM} \times \mathbf{0x3FFF}}{\mathbf{vl\_velocity\_reference}}$$

14.2.3 RPM to Hz

The RPM to Hz function is required for Commander SE as all speed reference parameters within the Commander SE have units of Hz. The number of motor poles is read from the Commander SE during initialisation and cached for use in this conversion:

$$\mathbf{Hertz} = \frac{\mathbf{RPM} \times \mathbf{PolePairs}}{\mathbf{60}}$$

14.2.4 Hz to RPM

The Hz to RPM function is required for Commander SE as all speed reference parameters within the Commander SE have units of Hz. The number of motor poles is read from the Commander SE during initialisation and cached for use in this conversion:

$$\mathbf{RPM} = \frac{\mathbf{Hertz} \times \mathbf{60}}{\mathbf{PolePairs}}$$

14.2.5 Ramp Conversion

Ramps (RPM/Sec) are calculated using the change of speed required (DeltaSpeed) in a specified time period (DeltaTime). The ramps are converted to the Commander SE ramp units (Secs/100Hz) using the equation below:

$$\mathbf{Secs/100Hz} = \frac{\mathbf{DeltaTime} \times \mathbf{100} \times \mathbf{60}}{\mathbf{DeltaSpeed} \times \mathbf{PolePairs}}$$

14.2.6 Reverse Ramp Conversion

The ramps within the Commander SE (Secs/100Hz) must be converted to RPM/Sec when a ramp object is read. They are converted using the equation below:

$$\mathbf{DeltaTime} = \frac{(\mathbf{Secs/100Hz}) \times \mathbf{DeltaSpeed} \times \mathbf{PolePairs}}{\mathbf{60} \times \mathbf{100}}$$

14.3 Parameter Data Object Mapping

The ***controlword*** and ***statusword*** used by the Velocity Mode profile are not the standard Commander SE control and status word. They are defined in CiA DSP-402 V1.1, “Device Profile for Drive and Motion Control”.

14.3.1 Receive PDO 1

When the Velocity Mode profile is selected, RxPDO1 consists of two 16-bit words. These words are mapped as shown in the table below, as specified for the Velocity Mode profile, and cannot be changed.

Table 14.1 RxPDO1 Data Format

Data Word	Mapping Status
Rx Word 0	***controlword***
Rx Word 1	***vl_target_velocity***

14.3.2 Transmit PDO 1

When the Velocity Mode profile is selected, TxPDO1 consists of two 16-bit words. These words are mapped as shown in the table below, as specified for the Velocity Mode profile, and cannot be changed.

Table 14.2 TxPDO1 Data Format

Data Word	Mapping Status
Tx Word 0	***statusword***
Rx Word 1	***vl_velocity_demand***

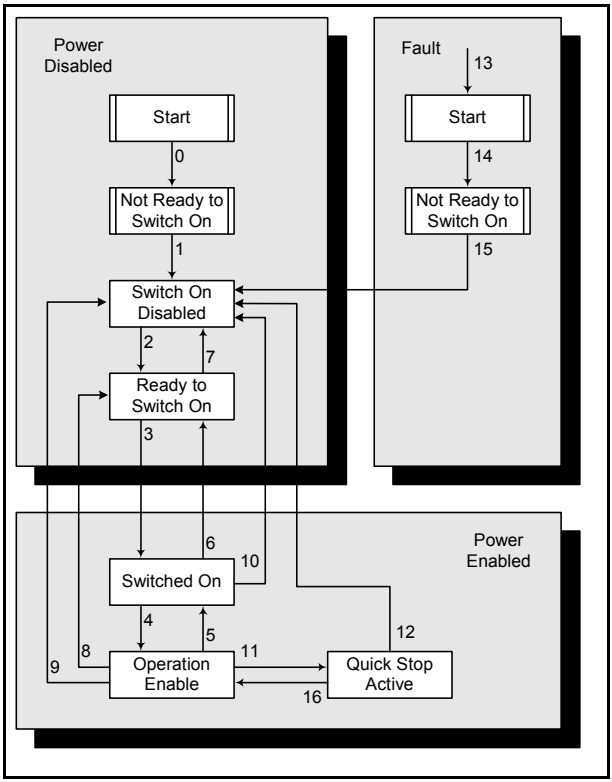
14.4 Device Control

The state machine describes the device status and the possible control sequence of the Commander SE. A single state represents a special internal or external behaviour. The state of the Commander SE also determines which commands are accepted, e.g. it is only possible to start a point-to-point move when the Commander SE is in state OPERATION ENABLED.

Table 14.3 Device Control

Index	Object	Name	Type	Attr
0x6040	VAR	***controlword***	USIGN16	rw
0x6041	VAR	***statusword***	INT16	rw
0x6042	VAR	***vl_target_velocity***	INT16	rw
0x605B	VAR	***shut_down_option_code***	INT16	rw
0x605C	VAR	***disable_operation_option_code***	INT16	rw
0x605A	VAR	***quick_stop_option_code***	INT16	rw
0x6061	VAR	***modes_of_operation_display***	INT8	rw

States may be changed using the ***controlword*** and/or according to internal events. The current state can be read using the ***statusword***.



14.4.1 Drive States

When the Velocity Mode profile is enabled, the Commander SE is controlled using the Control Word parameter, Pr 6.42. As the Commander SE can only be enabled and run in certain states, the Control Word Mask (Pr 6.41) is modified in each different state. The following states of the device are possible:

Table 14.4 Device States

State	Pr 6.41	Comment
Not Ready to Switch On	0x00	Low level power has been applied to the Commander SE The Commander SE is initialising or running a self test A brake (if present) must be applied in this state The Commander SE function is disabled
Switch On Disabled	0x00	Commander SE Initialisation is complete The Commander SE parameters have been set up Commander SE parameters may be changed High voltage may not be applied to the Commander SE, e.g. for safety reasons The Commander SE function is disabled
Ready to Switch On	0x00	High Voltage may be applied to the Commander SE The Commander SE parameters may be changed The Commander SE function is disabled
Switched On	0x00	High Voltage has been applied to the Commander SE The Power Amplifier is ready The Commander SE parameters may be changed The Commander SE function is disabled
Operation Enable	0x01	No faults have been detected The Commander SE function is enabled and power is applied to the motor The Commander SE parameters may be changed This corresponds to normal operation of the Commander SE
Quick Stop Active	0x03	The Commander SE parameters may be changed The Quick Stop function is being executed The Commander SE function is enabled and power is applied to the motor If the 'Quick-Stop-Option-Code' is switched to 5 (Stay in Quick-Stop), you can't leave the Quick-Stop-State, but you can transmit to 'Operation Enable' with the command 'Enable Operation'
Fault Reaction Active	0x01	The Commander SE parameters may be changed A non-fatal fault has occurred in the Commander SE The Quick Stop function is being executed The Commander SE function is enabled and power is applied to the motor
Fault	0x00	The Commander SE parameters may be changed A fault has occurred in the Commander SE The Commander SE function is disabled

14.4.2 State Transitions of the Drive Supervisor

State transitions are caused by internal events in the Commander SE or by commands received from the host via the ***controlword.***

Table 14.5 State Transitions

State Transition	Event	Action
0	Pr **10.01** = 1	Ensure Commander SE is healthy
1	Pr **10.02**	Ensure outputs are not active
2	"Shutdown" command received	Internal state change only
3	"Switch On" command received	Select decel ramp 1, Pr 2.20 = 1 Set decel ramp rate, Pr 2.21 Set control mask bit 0
4	"Enable Operation" command received	Set control mask bit 1
5	"Disable operation" command received	Select decel ramp 1, Pr 2.20 = 1 Set decel ramp rate, Pr 2.21 Reset control mask bit 1
6	"Shutdown" command from ***controlword***	Reset control mask bit 0
7	"Quick Stop" command received	Internal state change only
8	"Shutdown" command received	Reset control mask bit 0 and bit 1
9	"Disable voltage" command received	Reset control mask bit 0 and bit 1
10	"Disable voltage" or "Quick Stop" command received	Reset control mask bit 0
11	"Quick Stop" command received	Select ramp stop mode, Pr 6.01 = 1 Select standard ramps, Pr 2.04 = 1 Select decel ramp 3, Pr 2.20 = 3 Reset control mask bit 0
12	"Quick Stop" complete or "Disable Voltage" command received	Reset control mask bit 0
13	A fatal fault has occurred in the Commander SE	Reset control mask bit 0 and bit 1
14	The fault reaction is completed	Wait for "Drive Running" to clear, fault reaction has finished
15	"Fault Reset" command received	Reset Commander SE, Pr 10.38 = 100
16	"Enable Operation" command received	Set control mask bit 1

If a command is received which causes a change of state, this command must be processed completely and the new state attained before the next command can be processed.

NOTE State Transition 16 is only available if the quick_stop_option_code is set to 5, 6, 7 or 8.

14.4.3 controlword

Index	0x6040	Sub-Index	0	Attribute	RW
Default	N/A	Target	N/A	Data Type	USIGN32
Units	N/A	Object Type	VAR		

The logical addition of several bits in the ***controlword*** and the external signals (transitions) results in the device control command. The bits of ***controlword*** are defined as follows:

Table 14.6 Bit Functions

Bit	Name
0	Switch On
1	Disable Voltage
2	Quick Stop
3	Enable Operation
4	Reserved
5	Reserved
6	Reserved
7	Fault Reset
8	Halt
9-15	Reserved

Device control commands are triggered by the following bit patterns in ***controlword***:

Table 14.7 Example Control Words

Command	Fault Reset	Enable Operation	Quick Stop	Disable Voltage	Switch On	Transitions Affected
Shutdown	0	X	1	1	0	2, 6, 8
Switch On	0	X	1	1	1	3
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	0-1	X	X	X	X	15

14.4.4 statusword

Index	0x6041	Sub-Index	0	Attribute	RO
Default	N/A	Target	N/A	Data Type	USIGN16
Units	N/A	Object Type	VAR		

The ***statusword*** indicates the current status of the Commander SE. The following bits are defined in the ***statusword***.

Table 14.8 Bit Status

Bit	Name	Source
0	Ready to Switch On	State Machine
1	Switched On	State Machine
2	Operation Enabled	State Machine

Table 14.8 Bit Status

Bit	Name	Source
3	Fault	State Machine
4	Voltage Disabled	State Machine
5	Quick Stop	State Machine
6	Switch On Disabled	State Machine
7-8	Reserved	
9	Remote	Control Word Enable (Pr 6.43)
10	Target	At Speed (Pr 10.06) Drive Running (Pr 10.02) if in Quick Stop
11	Internal Limit Active	Set if ***vl_velocity_demand*** goes outside the minimum or maximum velocity limits
12-15	Reserved	

The following bits indicate the status of the Commander SE. Bits marked X are irrelevant for that state, and other combinations are not allowed.

Table 14.9 Example Status Words

State	Switch on disabled	Quick Stop	Fault	Operation enabled	Switched on	Ready to switch on
Not rdy to switch on	0	X	0	0	0	0
Switch on disabled	1	X	0	0	0	0
Rdy to switch on	0	1	0	0	0	1
Switched on	0	1	0	0	1	1
Operation enabled	0	1	0	1	1	1
Fault	0	X	1	1	1	1
Fault reaction active	0	X	1	1	1	1
Quick stop active	0	0	0	1	1	1

Descriptions of the remaining bits in the ***statusword*** are given in the table below.

Table 14.10 Additional Status Bits

Bit	Function	Comment
4	Voltage Disabled	The Disable Voltage request is active when the Voltage Disabled bit is cleared to 0
5	Quick Stop	When reset, this bit indicates that the Commander SE is reacting on a quick stop request. Bits 0, 1 and 2 of the ***statusword*** must be set to 1 to indicate that the Commander SE is capable to regenerate. The setting of the other bits indicates the status of the Commander SE (e.g. the Commander SE is performing a quick stop as result of a reaction to a non-fatal fault. The fault bit is set as well as bits 0, 1 and 2)
7-8	Reserved	
9	Remote	If bit 9 is set, then parameters may be modified via the CAN-network, and the Commander SE executes the content of a command message. If the bit remote is reset, then the Commander SE is in local mode and will not execute the command message. The Commander SE may transmit messages containing valid actual values like a ***position_actual_value***, depending on the actual Commander SE configuration. The Commander SE will accept accesses via service data objects (SDOs) in local mode

Table 14.10 Additional Status Bits

Bit	Function	Comment
10	Target Reached	If bit 10 is set by the Commander SE, then a setpoint has been reached (torque, speed or position depending on the modes_of_operation). The change of a target value by software alters this bit if ***quick_stop_option_code*** is 5, 6, 7 or 8, this bit must be set, when the quick stop operation is finished and the Commander SE is halted. If Halt occured and the Commander SE has halted then this bit is set too
11	Internal Limit Active	This bit set by the Commander SE indicates, that an internal limitation is active
12-15	Reserved	

14.4.5 error_code

Index	0x603F	**Sub-Index**	0	**Attribute**	RO
Default	N/A	**Target**	N/A	**Data Type**	USIGN16
Units	N/A	**Object Type**	VAR		

The ***error_code*** captures the code of the last error that occurred in the Commander SE. It corresponds to the value of the low 16 bits of object 0x1003, pre_defined_error_field.

14.4.6 shutdown_option_code

Index	0x605B	**Sub-Index**	0	**Attribute**	RW
Default	0	**Target**	N/A	**Data Type**	INT16
Units	N/A	**Object Type**	VAR		

The ***shutdown_option_code*** parameter determines what action should be taken if there is a transition from OPERATION ENABLE to READY TO SWITCH ON.

Table 14.11 Shutdown Option Codes

Value	Action
-32768 to -1	Reserved
0	Disable drive function
1	Slow down with slow down ramp, then disable of the drive function
2 to 32767	Reserved

14.4.7 disable_operation_option_code

Index	0x605C	**Sub-Index**	0	**Attribute**	RW
Default	1	**Target**	N/A	**Data Type**	INT16
Units	N/A	**Object Type**	VAR		

The ***disable_operation_option_code*** parameter determines what action should be taken if there is a transition from OPERATION ENABLE to SWITCHED ON.

Table 14.12 Disable Operation Option Codes

Value	Action
-32768 to -1	Reserved

Table 14.12 Disable Operation Option Codes

Value	Action
0	Disable drive function
1	Slow down with slow down ramp, then disable of the drive function
2 to 32767	Reserved

14.4.8 quick_stop_option_code

Index	0x605A	**Sub-Index**	0	**Attribute**	RW
Default	2	**Target**	N/A	**Data Type**	INT16
Units	N/A	**Object Type**	VAR		

The ***quick_stop_option_code*** parameter determines what action should be taken if the Quick Stop Function is executed.

Table 14.13 Quick Stop Option Codes

Value	Action	Parameter Settings	Description
0	Disable drive function	Pr 6.01=0	Select coast stop
1	Slow down on slow down ramp	Pr 6.01 = 1 Pr 2.20 = 2 Pr 2.04 = 1	Select ramp stopSelect ramp Pr 2.22Select standard ramp with normal motor voltage
2	Slow down on quick stop ramp	Pr 6.01 = 1 Pr 2.20 = 3 Pr 2.04 = 0	Select ramp stopSelect ramp Pr 2.23Select fast ramp
3	Slow down on the current limit		
4	Slow down on the voltage limit		
5	Slow down on slow down ramp and stay in Quick-Stop	Pr 6.01 = 1 Pr 2.20 = 2 Pr 2.04 = 1	As 1 with stay in Quick-Stop
6	Slow down on quick stop ramp and stay in Quick-Stop	Pr 6.01 = 1 Pr 2.20 = 3 Pr 2.04 = 0	As 2 with stay in Quick-Stop
7	Slow down on the current limit and stay in Quick-Stop		
8	Slow down on the voltage limit and stay in Quick-Stop		
9 to 32767	Reserved		

Some manufacturer specific options are also available. These allow the various ramp modes implemented in the Commander SE to be used.

Table 14.14 Manufacturer Specific Quick Stop Option Codes

Value	Action	Parameter Settings	Description
-1	Slow down on slow down ramp with timed DC injection	Pr 6.01 = 2 Pr 2.20 = 2 Pr 2.04 = 1	Select ramp stop with timed DC injection Select ramp Pr 2.22 Select standard ramp with normal motor voltage
-2	Slow down on quick stop ramp with timed DC injection	Pr 6.01 = 2 Pr 2.20 = 3 Pr 2.04 = 0	Select ramp stop with + timed DC injection Select ramp Pr 2.23 Select fast ramp
-3	Slow down on slow down ramp with high motor voltage	Pr 6.01 = 1 Pr 2.20 = 2 Pr 2.04 = 2	Select ramp stop Select ramp Pr 2.22 Select standard ramp with high motor voltage
-4	Slow down on slow down ramp with high motor voltage and timed dc injection	Pr 6.01 = 2 Pr 2.20 = 2 Pr 2.04 = 2	Select ramp stop with timed DC injection Select ramp Pr 2.22 Select standard ramp with high motor voltage
-5	Injection braking stop with detection of zero speed	Pr 6.01 = 3	Select injection braking stop
-6	Timed injection braking stop	Pr 6.01 = 4	Select timed injection braking stop

Options -11 to -16 are also available. These are identical to options -1 to –6, except that the profile will stay in Quick Stop.

Options –7 to –10, and –17 to –32768 are all reserved for possible future use.

14.4.9 stop_option_code

Index	0x605D	**Sub-Index**	0	**Attribute**	RW
Default	1	**Target**	N/A	**Data Type**	INT16
Units	N/A	**Object Type**	VAR		

The ***stop_option_code*** parameter determines what action should be taken if the Stop Function is active.

Table 14.15 Stop Option Codes

Value	Action	Parameter Settings	Description
0	Disable drive function	Pr 6.01=0	Select coast stop
1	Slow down on slow down ramp	Pr 6.01 = 1 Pr 2.20 = 2 Pr 2.04 = 1	Select ramp stop Select ramp Pr 2.22 Select standard ramp with normal motor voltage
2	Slow down on quick stop ramp	Pr 6.01 = 1 Pr 2.20 = 3 Pr 2.04 = 0	Select ramp stop Select ramp Pr 2.23 Select fast ramp
3	Slow down on the current limit		
4	Slow down on the voltage limit		

14.4.10modes_of_operation_display

Index	0x6061	**Sub-Index**	0	**Attribute**	RO
Default	2	**Target**	N/A	**Data Type**	INT8
Units	N/A	**Object Type**	VAR		

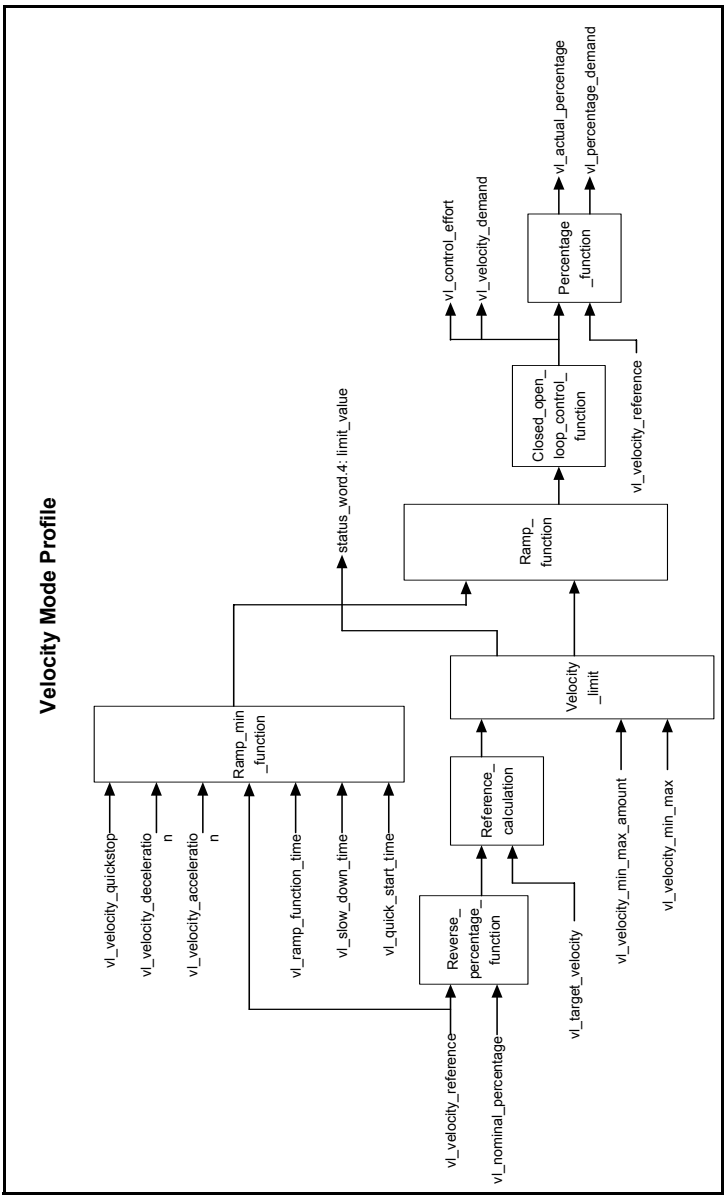
The ***modes_of_operation_display*** parameter shows the current mode of operation. As the only profile implemented in the SE77-CANopen is the Velocity Mode profile, this object will always return a value of 2.

14.5 Velocity Mode Specific Objects

The table below shows a summary of all supported objects of the Velocity Mode profile.

Index	Object	Name	Type	Attribute
0x6042	VAR	***vl_target_velocity***	INT16	rw
0x6043	VAR	***vl_velocity_demand***	INT16	ro
0x6044	VAR	***vl_control_effort***	INT16	ro
0x6046	ARRAY	***vl_velocity_min_max_amount***	USIGN32	rw
0x6047	ARRAY	***vl_velocity_min_max***	USIGN32	rw
0x6048	RECORD	***vl_velocity_acceleration***	RAMP	rw
0x6049	RECORD	***vl_velocity_deceleration***	RAMP	rw
0x604A	RECORD	***vl_velocity_quick_stop***	RAMP	rw
0x604D	VAR	***vl_pole_number***	USIGN8	rw
0x604E	VAR	***vl_velocity_reference***	USIGN32	rw
0x604F	VAR	***vl_ramp_function_time***	USIGN32	rw
0x6050	VAR	***vl_slow_down_time***	USIGN32	rw
0x6051	VAR	***vl_quick_stop_time***	USIGN32	rw
0x6052	VAR	***vl_nominal_percentage***	INT16	rw
0x6053	VAR	***vl_percentage_demand***	INT16	ro
0x6054	VAR	***vl_actual_percentage***	INT16	ro

The diagram below shows the attributes of the Velocity Mode Profile that are supported by the SE77-CANopen.



14.5.1 vl_target_velocity

Index	0x6042	Sub-Index	0	Attribute	RO
Default	0	Target	Pr 1.21	Data Type	INT16
Units	RPM	Object Type	VAR		

The ***vl_target_velocity*** is the required velocity of the system. (***vl_dimension_factor*** and ***vl_setpoint_factor*** are not implemented.) The units of ***vl_target_velocity*** are RPM, and range is from –32768 to +32767.

14.5.2 vl_velocity_demand

Index	0x6043	Sub-Index	0	Attribute	RO
Default	N/A	Target	Pr 2.01	Data Type	INT16
Units	RPM	Object Type	VAR		

The ***vl_velocity_demand*** is the instantaneous velocity provided by the ramp function, scaled to the units of ***vl_target_velocity***. The values range from –32768 to +32767 RPM. This object is read only. The value is converted between Hz and RPM when this object is read from or written to.

14.5.3 vl_control_effort

Index	0x6044	Sub-Index	0	Attribute	RO
Default	N/A	Target	Pr 2.01	Data Type	INT16
Units	RPM	Object Type	VAR		

The ***vl_control_effort*** is the velocity of the motor spindle or load, scaled to the units of ***vl_target_velocity***. For open-loop drives, this value reads the object ***vl_velocity_demand***. The value ranges from –32768 to 32767. The value is converted between Hz and RPM when this object is read from or written to.

14.5.4 vl_velocity_min_max_amount

Index	0x6046	Attribute	RW
Object Type	ARRAY	Data Type	USIGN32

The ***vl_velocity_min_max***_amount parameter is composed of the ***vl_velocity_min_amount*** and ***vl_velocity_max_amount*** sub parameters. These sub parameters don't have units units, and have values with a range of 0 to 4292967295.

vl_velocity_min_amount

Index	0x6046	Sub-Index	1	Attribute	RW
Default	N/A	Target	See below	Data Type	INT32
Units	RPM	Object Type	VAR		

The ***vl_velocity_min_amount*** sub parameter is mapped internally to the ***vl_velocity_min_pos*** and ***vl_velocity_min_neg*** values. Only the positive values are returned when reading from ***vl_velocity_min_max***_amount

The Velocity Mode Profile requires the Commander SE to operate in bi-polar mode. In this mode, the minimum speed parameter is not active, so ***vl_velocity_min_amount*** is not mapped Pr 1.07. The SE77-CANopen will apply the ***vl_velocity_min_amount*** clamp when it updates ***vl_tarvl_target_velocity*** in the Commander SE.

vl_velocity_max_amount

Index	0x6046	**Sub-Index**	2	**Attribute**	RO
Default	N/A	**Target**	Pr 1.06	**Data Type**	INT16
Units	RPM	**Object Type**	VAR		

The ***vl_velocity_max_amount*** sub parameter is mapped internally to the ***vl_velocity_max_pos*** and ***vl_velocity_max_neg*** values. Only the positive values are returned when reading from ***vl_velocity_min_max***_amount

14.5.5 vl_velocity_min_max

Index	0x6047	**Attribute**	RW
Object Type	ARRAY	**Data Type**	USIGN32

The ***vl_velocity_min_max*** parameter is composed of the ***vl_velocity_min_pos***, ***vl_velocity_max_pos***, ***vl_velocity_min_neg*** and ***vl_velocity_max_neg*** sub parameters.

The Velocity Mode Profile requires the Commander SE to operate in bi-polar mode. In this mode, the minimum speed parameter is not active, so ***vl_velocity_min_amount*** is not mapped Pr 1.07. The SE77-CANopen will apply the ***vl_velocity_min_amount*** clamp when it updates ***vl_target_velocity*** in the Commander SE. The largest of any max parameter is converted to Hz and stored in the max speed parameter, Pr 1.06. On initialisation, Pr 1.06 is read from the Commander SE and loaded into both ***vl_velocity_max_pos*** and ***vl_velocity_max_neg***. ***vl_velocity_min_pos*** and ***vl_velocity_min_neg*** are both initialised to 0.

vl_velocity_min_pos

Index	0x6047	**Sub-Index**	1	**Attribute**	RW
Default	N/A	**Target**	See above	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

vl_velocity_max_pos

Index	0x6047	**Sub-Index**	2	**Attribute**	RW
Default	N/A	**Target**	Pr 1.06	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

vl_velocity_min_neg

Index	0x6047	**Sub-Index**	3	**Attribute**	RW
Default	N/A	**Target**	See above	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

vl_velocity_max_neg

Index	0x6047	**Sub-Index**	4	**Attribute**	RW
Default	N/A	**Target**	Pr 1.06	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

14.5.6 vl_velocity_acceleration

Index	0x6048	**Sub-Index**		**Attribute**	RW
Target	Pr 2.11	**Object Type**	RECORD	**Elements**	2

The ***vl_velocity_acceleration*** parameter specifies the slope of the acceleration ramp. It is calculated by dividing the ***delta_speed*** sub parameter by the ***delta_time*** sub parameter.

The defined ramp will have units of RPM/second. This is converted to Seconds/100Hz for the target parameter in the Commander SE.

delta_speed

Index	0x6048	**Sub-Index**	1	**Attribute**	RW
Default	N/A	**Target**	N/A	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

delta_time

Index	0x6048	**Sub-Index**	2	**Attribute**	RW
Default	N/A	**Target**	N/A	**Data Type**	USIGN16
Units	Seconds	**Object Type**	VAR		

14.5.7 vl_velocity_deceleration

Index	0x6048	**Sub-Index**		**Attribute**	RW
Target	Pr 2.21	**Object Type**	RECORD	**Elements**	2

The vl_velocity_deceleration parameter specifies the slope of the deceleration ramp. It is calculated by dividing the ***delta_speed*** sub parameter by the ***delta_time*** sub parameter.

The defined ramp will have units of RPM/second. This is converted to Seconds/100Hz for the target parameter in the Commander SE.

delta_speed

Index	0x6049	**Sub-Index**	1	**Attribute**	RW
Default	N/A	**Target**	N/A	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

delta_time

Index	0x6049	**Sub-Index**	2	**Attribute**	RW
Default	N/A	**Target**	N/A	**Data Type**	USIGN16
Units	Seconds	**Object Type**	VAR		

14.5.8 vl_velocity_quick_stop

Index	0x604A	**Sub-Index**		**Attribute**	RW
Target	Pr 2.23	**Object Type**	RECORD	**Elements**	2

The ***vl_velocity_quick_stop*** parameter specifies the slope of the quick stop ramp. It is calculated by dividing the ***delta_speed*** sub parameter by the ***delta_time*** sub parameter.

The defined ramp will have units of RPM/second. This is converted to Seconds/100Hz for the target parameter in the Commander SE.

delta_speed

Index	0x604A	**Sub-Index**	1	**Attribute**	RW
Default	N/A	**Target**	N/A	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

delta_time

Index	0x604A	**Sub-Index**	2	**Attribute**	RW
Default	N/A	**Target**	N/A	**Data Type**	USIGN16
Units	Seconds	**Object Type**	VAR		

14.5.9 vl_pole_number

Index	0x604D	**Sub-Index**	0	**Attribute**	RW
Default	Auto	**Target**	N/A	**Data Type**	USIGN8
Units	Motor Poles	**Object Type**	VAR		

The ***vl_pole_number*** parameter will return the number of motor poles specified in the Commander SE motor map. This parameter is read only, and returns the actual number of motor poles.

14.5.10vl_velocity_reference

Index	0x604E	**Sub-Index**	0	**Attribute**	RW
Default	N/A	**Target**	Pr 1.22	**Data Type**	USIGN32
Units	RPM	**Object Type**	VAR		

The ***vl_velocity_reference*** parameter serves to represent velocity values (set points, actual values and ramps) as relative values. If ***vl_velocity_reference*** is modified, ***vl_ramp_function_time***, ***vl_slow_down_time*** and ***vl_quick_stop_time*** are updated relative to the change in the vl_velocity reference.

14.5.11vl_ramp_function_time

Index	0x604F	**Sub-Index**	0	**Attribute**	RW
Default		**Target**	Pr 2.11	**Data Type**	USIGN32
Units	Milliseconds	**Object Type**	VAR		

The ***vl_ramp_function_time*** specifies the time that will be taken for the Commander SE to ramp up from zero speed to ***vl_velocity_reference***. ***vl_ramp_function_time*** is specified in milliseconds. If ***vl_ramp_function_time*** is set to 0, the ramp becomes infinite, and the reference variable directly follows the setpoint.

vl_ramp_function_time is used with ***vl_velocity_reference*** to calculate the ramp, and values are converted from RPM/millisecond to Seconds/100Hz.

14.5.12vl_slow_down_time

Index	0x6050	**Sub-Index**	0	**Attribute**	RW
Default		**Target**	Pr 2.22	**Data Type**	USIGN32
Units	Milliseconds	**Object Type**	VAR		

The ***vl_slow_down_time*** specifies the time that will be taken for the Commander SE to ramp down from ***vl_velocity_reference*** to zero speed. ***vl_slow_down_time*** is specified in milliseconds. If ***vl_slow_down_time*** is set to 0, the ramp becomes infinite, and the Commander SE will bring the motor to a crash stop.

vl_slow_down_time is used with ***vl_velocity_reference*** to calculate the ramp, and values are converted from RPM/millisecond to Seconds/100Hz.

14.5.13 vl_quick_stop_time

Index	0x6051	**Sub-Index**	0	**Attribute**	RW
Default		**Target**	Pr 2.23	**Data Type**	USIGN32
Units	Milliseconds	**Object Type**	VAR		

The ***vl_quick_stop_time*** specifies the time that will be taken for the Commander SE to ramp down from ***vl_velocity_reference*** to zero speed. ***vl_quick_stop_time*** is specified in milliseconds. If ***vl_quick_stop_time*** is set to 0, the ramp becomes infinite, and the Commander SE will bring the motor to a crash stop.

vl_quick_stop_time is used with ***vl_velocity_reference*** to calculate the ramp, and values are converted from RPM/millisecond to Seconds/100Hz.

14.5.14 vl_nominal_percentage

Index	0x6052	**Sub-Index**	0	**Attribute**	RW
Default		**Target**	Pr 1.21	**Data Type**	INT16
Units	%	**Object Type**	VAR		

The ***vl_nominal_percentage*** parameter is converted by the percent function to a velocity value. Its value ranges from –32768 to +32767, where 16383 corresponds to 100% of ***vl_velocity_reference***. Accordingly, a total range of the manipulated variable amounting to ±200% is possible.

14.5.15 vl_percentage_demand

Index	0x6053	**Sub-Index**	0	**Attribute**	RO
Default		**Target**	Pr 2.01	**Data Type**	INT16
Units	%	**Object Type**	VAR		

The ***vl_percentage_demand*** is calculated on the basis of the ***vl_velocity_demand*** by using the Percentage Function. ***vl_percentage_demand*** has the same value range as ***vl_nominal_percentage***.

14.5.16 vl_actual_percentage

Index	0x6054	**Sub-Index**	0	**Attribute**	RO
Default		**Target**	Pr 2.01	**Data Type**	INT16
Units	%	**Object Type**	VAR		

The ***vl_actual_percentage*** is calculated on the basis of the ***vl_control_effort*** by using the Percentage Function. ***vl_actual_percentage*** has the same range of values as ***vl_nominal_percentage***.

15 Quick Reference

15.1 SE77-CANopen Parameter Reference

Table 15.1 SE77-CANopen configuration parameters

Parameter	Default	Cross Reference	Description
Pr **15.01**	----	Section 10.1 on page 32	Option ID code
Pr **15.02**	----	Section 10.2 on page 32	Major software version
Pr **15.03**	0	Section 5.3 on page 13	Node address
Pr **15.04**	0	Section 5.4 on page 13	Data rate
Pr **15.05**	0.03	Section 6.3 on page 16	Data format
Pr **15.06**	----	Section 10.5 on page 33	Operating status
Pr **15.07**	200	Section 11.1 on page 36	Trip delay time (ms)
Pr **15.08**	0		Reserved
Pr **15.11**	2.01	Section 6.3 on page 16	TxPDO1 channel 2 Mapping
Pr **15.12**	4.20		TxPDO1 channel 3 Mapping
Pr **15.21**	1.21		RxPDO1 channel 2 Mapping
Pr **15.22**	0.00		RxPDO1 channel 3 Mapping
Pr **15.30**	0	Section 11.3 on page 37	Load SE77-CANopen defaults
Pr **15.50**	----	Section 10.2 on page 32	Minor software version

Table 15.2 SE77-CANopen virtual parameters

Parameter	Default	Cross Reference	Description
Pr **15.10**	90.12	Section 6.3 on page 16	TxPDO1 channel 1 Mapping
Pr **15.20**	90.12		RxPDO1 channel 1 Mapping
Pr **15.31**	0	Section 8.3 on page 30	Reset SE77-CANopen