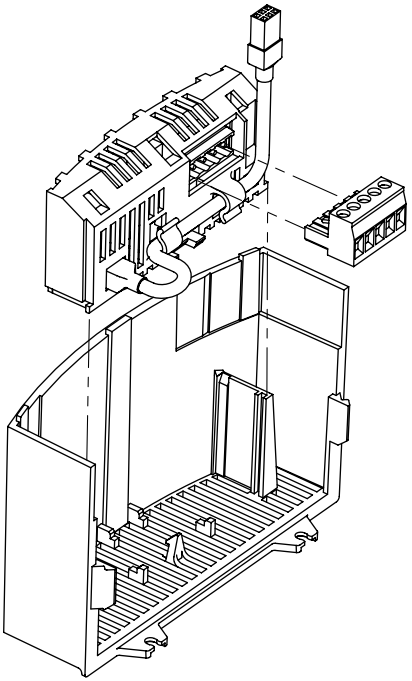
CMVCAN01A

Lenze
AC Tech



SMVector - CANopen Communication Module

Communications Interface Reference Guide

About these instructions

This documentation applies to the CANopen communications option for the SMVector inverter and should be used in conjunction with the SMVector Operating Instructions (Document SV01) that shipped with the drive. These documents should be read carefully as they contain important technical data and describe the installation and operation of the drive and this option.

Contents

1 Safety information

General

Some parts of Lenze controllers (frequency inverters, servo inverters, DC controllers) can be live, moving and rotating. Some surfaces can be hot.

Non-authorized removal of the required cover, inappropriate use, and incorrect installation or operation creates the risk of severe injury to personnel or damage to equipment.

All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE0110 and national regulations for the prevention of accidents must be observed).

According to this basic safety information, qualified skilled personnel are persons who are familiar with the installation, assembly, commissioning, and operation of the product and who have the qualifications necessary for their occupation.

Application as directed

Drive controllers are components which are designed for installation in electrical systems or machinery. They are not to be used as appliances. They are intended exclusively for professional and commercial purposes according to EN 61000-3-2. The documentation includes information on compliance with the EN 61000-3-2.

When installing the drive controllers in machines, commissioning (i.e. the starting of operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 98/37/EC (Machinery Directive); EN 60204 must be observed.

Commissioning (i.e. starting of operation as directed) is only allowed when there is compliance with the EMC Directive (89/336/EEC).

The drive controllers meet the requirements of the Low Voltage Directive 73/23/EEC. The harmonised standards of the series EN 50178/DIN VDE 0160 apply to the controllers.

The availability of controllers is restricted according to EN 61800-3. These products can cause radio interference in residential areas. In this case, special measures can be necessary.

Installation

Ensure proper handling and avoid excessive mechanical stress. Do not bend any components and do not change any insulation distances during transport or handling. Do not touch any electronic components and contacts.

Controllers contain electrostatically sensitive components, which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical components since this might endanger your health!

Electrical connection

When working on live drive controllers, applicable national regulations for the prevention of accidents (e.g. VBG 4) must be observed.

The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross-sections, fuses, PE connection). Additional information can be obtained from the documentation.

The documentation contains information about installation in compliance with EMC (shielding, grounding, filters and cables). These notes must also be observed for CE-marked controllers.

The manufacturer of the system or machine is responsible for compliance with the required limit values demanded by EMC legislation.

Operation

Systems including controllers must be equipped with additional monitoring and protection devices according to the corresponding standards (e.g. technical equipment, regulations for prevention of accidents, etc.). You are allowed to adapt the controller to your application as described in the documentation.

Safety information

DANGER!

- After the controller has been disconnected from the supply voltage, live components and power connection must not be touched immediately, since capacitors could be charged. Please observe the corresponding notes on the controller.
- Do not continuously cycle input power to the controller more than once every three minutes.
- Please close all protective covers and doors during operation.

WARNING!

Network control permits automatic starting and stopping of the inverter drive. The system design must incorporate adequate protection to prevent personnel from accessing moving equipment while power is applied to the drive system.

Pictographs used in these instructions

Pictograph	Signal word	Meaning	Consequences if ignored
	**DANGER!**	Warning of Hazardous Electrical Voltage.	Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
	**WARNING!**	Impending or possible danger for persons	Death or injury
	**STOP!**	Possible damage to equipment	Damage to drive system or its surroundings
	**Note**	Useful tip: If observed, it will make using the drive easier	

2 Introduction

This reference guide assumes that the reader has a working knowledge of CANopen Fieldbus Protocol and familiarity with the programming and operation of motion control equipment. This guide is intended as a reference only.

2.1 Overview

CANopen Fieldbus is an internationally accepted communications protocol designed for commercial and industrial installations of motion control applications. High data transfer rates combined with it's efficient data formatting permit the coordination of motion control devices in multi-axis applications. AC Tech's implementation of the CANopen protocol allows for baud rates ranging from 10 kbps to 1Mbps.

DSP402 compatible control and status words are available to the user for configuring modes of operation and altering the drive operating parameters. Additionally, to offer greater interoperability with the SMVector inverter, a drive specific set of objects are available that offer further drive profile configuration and allow access to specific modes of operation.

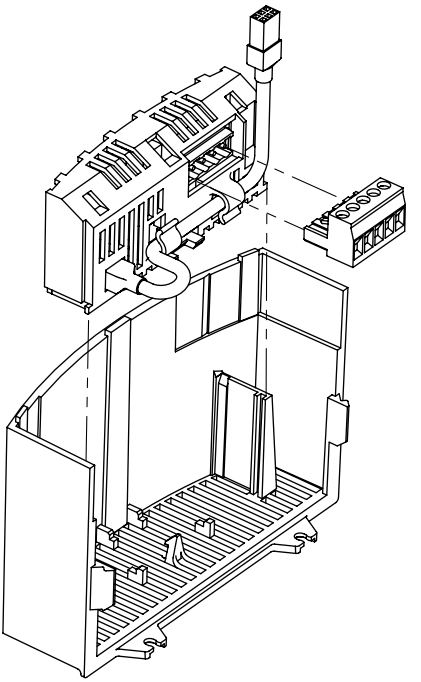
2.2 SMVector CANopen Implementation Specifications

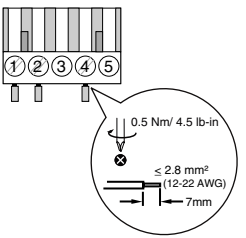
- Supported data rates (bit/s): 1.0M, 800K, 500K, 250K, 125K, 50K, 20K, 10K.
- 2 transmit and 2 receive process data objects (PDOs) supported.
- Synchronous, Asynchronous and Change of State PDO communications modes supported.
- Two Service Data Objects (SDO) provide access to all SMV parameters
- Heartbeat and Node guarding with selectable timeout action
- DSP402 compatible Control and Status Words accessible via PDO and SDO.

To simplify the setup of the CANopen Master, AC Tech will provide the applicable EDS (Electronic Data Sheet).

3 Installation

3.1 Installing the Module into the Terminal Cover





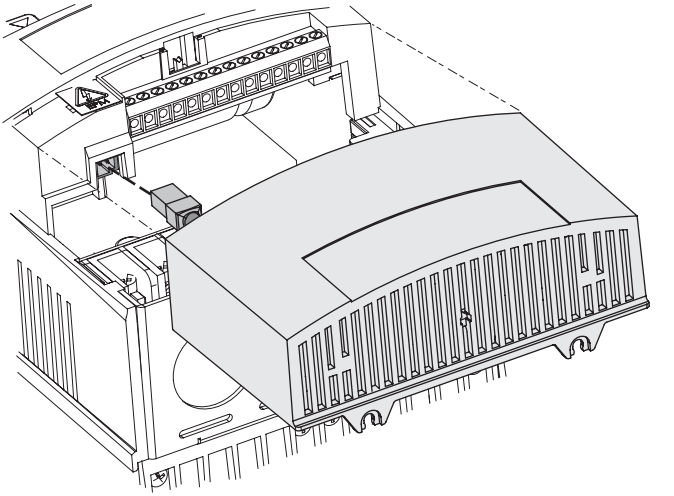
3.2 CANopen terminal block

Terminal	Description	Important
1	CAN_GND: CAN earth ground	For reliable communication make sure terminal CAN_GND is connected to CAN network GND/common. If only two wires are used (CAN_H and CAN_L) in the network, connect CAN_GND to chassis/earth ground.
2	CAN_L: CAN low	If controller is located at either end of the network, a terminating resistor (120ohm typical) should be connected across CAN_L and CAN_H
3		
4	CAN_H: CAN high	
5		

Protection against contact

- All terminals have basic isolation (single insulating distance)
- Protection against contact can only be ensured by additional measures (i.e. double insulation)

3.3 Installing the Terminal Cover



4 Commissioning CANopen communications

Following installation of the CANopen communications module,

4.1 Quick Set-up

With drive power disconnected connect the CANopen communication module and network cable to the drive as shown in the preceding section.

NOTE:
If CANopen network is already operational do NOT connect the network connector until the Node ID and Baud rate parameters on installed drive are setup correctly.

Apply Power to the drive. In drive parameter menu, select parameter P400 Network Protocol and set it to 3 -- CANopen. After this action, the module will be initialized with CANopen protocol and will enter Online mode - P402 = 3.

To monitor and control the drive via network, the following parameters should be set as a minimum:

P410 Node Id (default 1)

P411 Baud Rate (default 5 = 500 kbps)

P100 Start Control Source - Network control can be taken in any mode of operation except when P100 = 2 Remote Keypad Only.

NOTE:
If P100 is not equal 0, TB1 must be connected to TB4 in order to start the drive.

P112 Rotation - Set this parameter to Forward and Reverse (1) if operation in both directions is required.

P121
P122 or P123 One of these parameters must be set to 9 - Network Enable and corresponding terminal must be closed in order to take network control and start via network.

P304 Motor Rated frequency, P305 Motor Rated Speed - if Network speed needs to be scaled in RPMs units; those parameters must be set accordingly to motor nameplate.

To activate changes made to P400 and P401 use P418 Reset CAN node parameter or recycle the power.

If no other CANopen parameter has been modified the drive will enter CANopen Pre-operational state (see P412, P419) and every 2 seconds (P416) will transmit a heartbeat message.

As a default, RPDO#1 (P44x) and TPDO#1 (P46x) are active when the CANopen state is switched to the operational state.

5 Extended Parameters for CANopen

In addition to the drive parameters (detailed in the Installation and Operation manual that accompanied the drive), the installation of the CANopen module will give access to the 400 series parameters that are exclusively for the CANopen communications module.

5.1 Parameter menu

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
CANopen Module Specific parameters				
P400	Network Protocol		0 Not Active	
			3 CANopen	
P401	Module Revision	02.0.0	Display reads 02.x.x where: 02 = CANopen Module x.x = Module Revision	Read only
P402	Module Status	0	0 Not Initialized	Read only
			1 Initialization: Module to EPM	
			2 Initialization: EPM to Module	
			3 Online	
			4 Failed Initialization Error	
			5 Time-out Error	
			6 Initialization Failed	Module type mismatch (P401)
			7 Initialization Error	Protocol Selection mismatch (P400)
P403	Module Reset	0	0 No Action	
			1 Reset Module parameter values to default.	Returns module parameters 401…499 to the default values shown in this manual.
P404	Module Time-out Action	3	0 Ignore	• Action to be taken in the event of a Module/Drive Time-out. • Time-out is fixed at 200ms. • Selection 1 (STOP) is by the method selected in P111.
			1 STOP (see P111)	
			2 Quick Stop	
			3 Fault (F.nEF)	
P405	Network Fault	0	0 No Fault	Read only
			1 Guard Time Fault F.nF1	
			2 Message Monitor Fault F.nF2	
			3 RPD1 Time-out Fault F.nF3	
			4 RPD2 Time-out Fault F.nF4	
P406	Proprietary		Manufacturer specific	Read only

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
CANopen / System bus parameters				
P4 10(1)	CAN address (Node ID)	1	1 127	If P413 = 0, 1: maximum setting = 63
P4 11(1)	CAN baud rate	5	0 10 kbps (max distance = 5000m) 1 20 kbps (max distance = 2500m) 2 50 kbps (max distance = 1000m) 3 125 kbps (max distance = 500m) 4 250 kbps (max distance = 250m) 5 500 kbps (max distance = 100m) 6 800 kbps (max distance = 50m) 7 1000 kbps (max distance = 25m)	
P4 12(1)	System bus participant	0	0 Slave 1 Slave with autostart enabled 0x1F80 NMT bootup - bit 2 2 System bus master (not NMT master)	• P417 = 1: Controller enters operational state automatically • P417 = 2: Controller sends “NMT start all nodes” after boot-up time (P415) and enters operational state
P4 13(1)	Parameter channel 2 (SDO#2)	2	0 Enable: Node ID range (1...63) with default COB ID for RPDO and TPDO 1 Enable: Node ID range (1...63) with programmable COB ID using P440, P450, P460, P470 2 Disable: Node ID range (1...127) with default COB ID for RPDO and TPDO 3 Disable: Node ID range (1...127) with programmable COB ID using P440, P450, P460, P470	• P413 = 0, 1: CAN address 1...63; 64...127 used for SDO2 • SDO#1 COB ID = 1536 + Node ID • SDO#2 COB ID = 1600 + Node ID (if enabled) Default settings: RPDO#1: COB ID = 0x200 + Node ID RPDO#2: COB ID = 0x300 + Node ID TPDO#1: COB ID = 0x180 + Node ID TPDO#2: COB ID = 0x280 + Node ID
P4 14	SYNC COB ID	128	0 2047	Controller does not generate SYNC object
P4 15(1)	Boot up time	3000	0 {ms} 65535	Controller sends “NMT start all nodes” message after this delay (active only when P412 = 2)
P4 16	Heartbeat time	2000	0 {ms} 65535	• Producer heartbeat time • P416 = 0 disables heartbeat transmission
P4 18	Reset CAN node	0	0 No action 1 Reset CAN communication	On transition from 0 to 1, re-initializes CAN controller and activates changes made to parameters marked with (1)
			WARNING! CAN re-initialization may activate new RPDO configurations, which can result in changes to present controller state, including starting.	

(1) These parameters take effect only after power-up, P418 reset, “NMT reset node”, or “NMT reset communication services”

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P419	CANopen status		0 Not initialized 1 Initializing 2 Stopped 3 Pre-operational 4 reserved 5 Operational	• Read-only • **Note:** RPDOs and TPDOs are only active in operational state (P419 = 5)
P420	Guard time	0	0 {ms} 65535	• P420 x P421 = node life time • If RTR frame with ID = 0x700 + Node ID (P410) is not received during the node life time, the controller will react according to P422 • If heart beat message is enabled, the guard function is disabled • P422 is only active when drive is in Network Control mode (n.xxx) and at least one RTR frame with ID=0x700+NODE ID has been received.
P421	Life time factor	0	0 255	
P422	Guard time event reaction	0	0 Not active 1 STOP (see P111) 2 Quick stop 3 Inhibit 4 Trip fault F.nF1	
P423	Error behavior	1	0 transition to pre-operational (only if current state is operational) 1 No state change 2 transition to stopped	Specifies action taken by the drive when it encounters a communication error (ex. Node guarding event or Bus Off)
P425	Message monitoring time	0	0 {ms} 65535	• P425 and P426 can be used to monitor all valid messages (e.g. SDO, SYNC, PDO...) • P425 = 0 or P426 = 0 disables message monitoring function • P426 is only active when drive is in Network Control Mode (n.xxx)
P426	Message monitoring time out reaction	0	0 Not active 1 STOP (see P111) 2 Quick stop 3 Inhibit 4 Trip fault F.nF2	
P427	Monitoring time-out status		Bits: 0 Guard time time-out 1 No valid message received 2 RPD01 time-out 3 RPD02 time-out 4 reserved 5 reserved 6 reserved 7 reserved	• Read-only • Indicates cause of F.nt (trip fault, inhibit, quick stop, or Stop) depending on the settings of P422, P426, P445, P455

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P429	CAN Peripheral Status		Bits:	• Read-only • CAN warnings and errors
			0 Error passive mode	
			1 Bus off mode	
			2 CAN Enabled	
			3 Receiver busy	
			4 Transmitter busy	
			5 Transmit error count > 128	
			6 Overload frame	
			7 Receive error count > 128	

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
RPDO#1 configuration parameters				
P440[2]	RPDO#1 COB ID	513	0 2047	If P413 = 0, 2: Setting will change to 512 + Node ID during power-up or P418 reset.
P441	RPDO#1 enable/disable	1	0 Disable 1 Enable	
			WARNING! CAN re-initialization may activate new RPDO configurations, which can result in changes to present controller state, including starting.	
P442	RPDO#1 transmission type	255	0 255	• P442 = 0...240: transfer on every SYNC received. • P442 = 254, 255: immediate transfer
P444	RPDO#1 event monitoring timer	0	0 {ms} 65535	P444 = 0: monitoring disabled
P445	RPDO#1 time out reaction	0	0 Not active 1 STOP (see P111) 2 Quick stop 3 Inhibit 4 Trip fault F.nF3	Only active when in Network Control (n.xxx)
P446[2]	RPDO#1 mapping (see RPDO mapping details)	2	0 DSP402 (Drives & Motion Control): PDO Control Word 0x6040	
			1 DSP402 (Drives & Motion Control): PDO Control Word 0x6040 + vl target velocity 0x6042	• vl target velocity units = signed RPM. • RPM calculation based on P304 and P305
			2 Drive Control Word + Network Speed	Network Control Frequency Scaling: 10 = 1.0 Hz
			3 Drive Control Word + PID Setpoint	Signed PID Setpoint: -999 … 31,000
			4 Drive Control Word + Torque Setpoint	Torque Setpoint: 0…400%
P449	RPDO#1 counter		0 255	• Read-only • Number of received RPDO#1 messages • Above 255, starts over at 0

[2] These parameters take effect only after power-up, P418 reset, P441 transition from disable to enable, "NMT reset node", or "NMT reset communication services"

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
RPDO#2 configuration parameters				
P450[3]	RPDO#2 COB ID	769	0 2047	If P413 = 0, 2: Setting will change to 768 + Node ID during power-up or P418 reset.
P451	RPDO#2 enable/disable	0	0 Disable	
			1 Enable	
			WARNING! CAN re-initialization may activate new RPDO configurations, which can result in changes to present controller state, including starting.	
P452	RPDO#2 transmission type	255	0 255	• P452 = 0...240: transfer on every SYNC received • P452 = 254, 255: immediate transfer
P454	RPDO#2 event monitoring timer	0	0 {ms} 65535	P454 = 0: monitoring disabled
P455	RPDO#2 time out reaction	0	0 Not active	Only active when in Network Control (n.xxx)
			1 STOP (see P111)	
			2 Quick stop	
			3 Inhibit	
			4 Trip fault F.nF4	
P456[3]	RPDO#2 mapping (see RPDO mapping details)	2	0 DSP402 (Drives & Motion Control): PDO Control Word 0x6040	
			1 DSP402 (Drives & Motion Control): PDO Control Word 0x6040 + vl target velocity 0x6042	• vl target velocity units = signed RPM. • RPM calculation based on P304 and P305
			2 Drive Control Word + Network Speed	Network Control Frequency Scaling: 10 = 1.0 Hz
			3 Drive Control Word + PID Setpoint	Signed PID Setpoint: -999 … 31,000
			4 Drive Control Word + Torque Setpoint	Torque Setpoint: 0…400%
P459	RPDO#2 counter		0 255	• Read-only • Number of received RPDO#2 messages • Above 255, starts over at 0

[3] These parameters take effect only after power-up, P418 reset, P451 transition from disable to enable, “NMT reset node”, or “NMT reset communication services”

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
TPDO#1 configuration parameters				
P460(4)	TPDO#1 COB ID	385	0 2047	If P413 = 0, 2: Setting will change to 384 + Node ID during power-up or P418 reset.
P461	TPDO#1 enable/disable	2	0 Disable	
			1 Enable (no RTR)	
			2 Enable (with RTR)	Enable individual polling of TPDO#1
P462	TPDO#1 transmission type	255	0 255	• P462 = 0...240: Transmit TPDO#1 after every nth SYNC received + Event + RTR (if enabled) • P462 = 253: Event + RTR (if enabled) • P462 = 254: COS triggered (WORD0 of TPDO#1) + Event + RTR (if enabled) • P462 = 255: Event + RTR (if enabled)
P463(4)	TPDO#1 inhibit time	0.0	0.0 {0.1 ms} 65535	Sets minimum time between TPDO#1 transmissions.
P464	TPDO#1 event timer	0	0 {ms} 65535	• Sets the fixed interval for TPDO#1 transmission • P464 = 0: disables event timer
P466(4)	TPDO#1 mapping (see TPDO mapping details)	2	0 DSP402 (Drives & Motion Control): Status Word 0x6041	
			1 DSP402 (Drives & Motion Control): Status Word 0x6041 + vl target velocity 0x6044	• vl control effort units = signed RPM. • RPM calculation based on P304 and P305
			2 Drive Status Word + Actual Frequency + I/O	Actual Frequency Scaling: 10 = 1.0 Hz
			3 Drive Status Word + Actual Frequency + PID Setpoint	Signed PID Setpoint: -999 … 31,000
			4 Drive Status Word + Actual Frequency + Torque Setpoint	Torque Setpoint: 0…400%
			5 Status Word matches the drives Control Word	Setting used to control another SMVector Drive. See Appendix A1.1.
P467	TPDO#1 WORD0 bit mask	65535	0 65535	• COS (change of state) bit mask applied to WORD0 of TPDO selected by P466. • P467 = 65535: activates all bits of WORD0 for COS triggering • P467 = 0: disables COS triggering • P462 = 254
P469	TPDO#1 counter		0 255	• Read-only • Number of transmitted TPDO#1 messages • Above 255, starts over at 0

(4) These parameters take effect only after power-up, P418 reset, P461 transition from disable to enable, "NMT reset node", or "NMT reset communication services"

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
TPDO#2 configuration parameters				
P470[5]	TPDO#2 COB ID	641	0 2047	If P413 = 0, 2: Setting will change to 640 + Node ID during power-up or P418 reset.
P471	TPDO#2 enable/disable	0	0 Disable	
			1 Enable (no RTR)	
			2 Enable (with RTR)	Enable individual polling of TPDO#2
P472	TPDO#2 transmission type	255	0 255	• P472 = 0...240: Transmit TPDO#2 after every nth SYNC received + Event + RTR (if enabled) • P472 = 253: Event + RTR (if enabled) • P472 = 254: COS triggered (WORD0 of TPDO#2) + Event + RTR (if enabled) • P472 = 255: Event + RTR (if enabled)
P473[5]	TPDO#2 inhibit time	0.0	0.0 {0.1 ms} 65535	Sets minimum time between TPDO#2 transmissions.
P474	TPDO#2 event timer	0	0 {ms} 65535	• Sets the fixed interval for TPDO#2 transmission • P474 = 0: disables event timer
P476[5]	TPDO#2 mapping (see TPDO mapping details)	2	0 DSP402 (Drives & Motion Control): Status Word 0x6041	
			1 DSP402 (Drives & Motion Control): Status Word 0x6041 + vl target velocity 0x6044	• vl control effort units = signed RPM. • RPM calculation based on P304 and P305
			2 Drive Status Word + Actual Frequency + I/O	Actual Frequency Scaling: 10 = 1.0 Hz
			3 Drive Status Word + Actual Frequency + PID Setpoint	Signed PID Setpoint: -999 … 31,000
			4 Drive Status Word + Actual Frequency + Torque Setpoint	Torque Setpoint: 0…400%
			5 Status Word matches the drives Control Word	Setting used to control another SMVector Drive. See Appendix A1 - Example 1.
P477	TPDO#2 WORD0 bit mask	65535	0 65535	• COS (change of state) bit mask applied to WORD0 of TPDO selected by P476. • P477 = 65535: activates all bits of WORD0 for COS triggering • P477 = 0: disables COS triggering • P472 = 254
P479	TPDO#2 counter		0 255	• Read-only • Number of transmitted TPDO#2 messages • Above 255, starts over at 0

[5] These parameters take effect only after power-up, P418 reset, P471 transition from disable to enable, “NMT reset node”, or “NMT reset communication services”

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
CANopen Module Specific parameters				
P495	Communication Module software version			• Read only • Alternating Display: xxx-; -yy
P498	Missed Messages Drive to Module			• Read only
P499	Missed Messages Module to Drive			• Read only

5.2 CANopen mapping details

The tables in the following sections may use descriptions from the CANopen DSP 402 standard. This terminology should not be interpreted as referring to drive hardware.

5.2.1 RPDO mapping details (P446/P456)

	Bit	P446 / P456 setting = 0
WORD0 - DSP402 control word 0x6040	0	Output Switch[6] 0 = switch OFF *(i)* 1 = switch ON *(e)*
	1	Voltage Enable[6] 0 = Disable Voltage *(i)* 1 = Enable Voltage *(e)*
	2	Quick stop 0 = Quick stop active 1 = Quick stop not active
	3	Controller inhibit[6] 0 = Controller inhibit *(i)* 1 = No controller inhibit *(e)*
	4	Reserved
	5	Reserved
	6	Reserved
	7	Fault Reset: on transition from 0 to 1
	8	Motion Inhibit[6] 0 = execute motion *(e)* 1 = halt *(i)*
	9	Reserved
	10	Reserved
	11	Direction of rotation 0 = CW (forward) 1 = CCW (reverse)
	12	Control 0 = Local Control 1 = Network Control
	13	Speed Reference 0 = Local Reference 1 = Network Reference
	14	DC brake 0 = DC brake not active 1 = DC brake active
	15	Reserved

	Bit	P446 / P456 setting = 1
WORD0 - DSP402 control word 0x6040	0	Output Switch[6] 0 = switch OFF *(i)* 1 = switch ON *(e)*
	1	Voltage Enable[6] 0 = Disable Voltage *(i)* 1 = Enable Voltage *(e)*
	2	Quick stop 0 = Quick stop active 1 = Quick stop not active
	3	Controller inhibit[6] 0 = Controller inhibit *(i)* 1 = No controller inhibit *(e)*
	4	Reserved
	5	Reserved
	6	Reserved
	7	Fault Reset: on transition from 0 to 1
	8	Motion Inhibit[6] 0 = execute motion *(e)* 1 = halt *(i)*
	9	Reserved
	10	Reserved
	11	Direction of rotation 0 = CW (forward) 1 = CCW (reverse)
	12	Control 0 = Local Control 1 = Network Control
	13	Speed Reference 0 = Local Reference 1 = Network Reference
	14	DC brake 0 = DC brake not active 1 = DC brake active
	15	Reserved
WORD1		Signed vl target velocity 0x6042 (RPM) • RPM calculation based on P304 and P305 • Example 1: P304 = 60Hz; P305 = 1750 RPM request setpoint forward (CW) at 25.0 HZ = 25.0 x 1750/60 = 729 = 0x02D9 • Example 2: P304 = 50Hz; P305 = 1390 RPM request setpoint reverse (CCW) at 44.5 HZ = -(44.5 x 1390/50) = -1237 = 0xFB2B **Note**: sign of the target velocity takes priority over bit 11 in word 0!

[6] Action of indicated bit is implemented as inhibit. These bits inhibit the drive when in the state indicated with *(i)* and enable the drive in the state indicated with *(e)*.

Commissioning

	Bit	P446 / P456 setting = 2
WORD0 - SMV control word	0	Run Forward 0 = NOT Run Forward 1 = Run Forward
	1	Run Reverse 0 = NOT Run Reverse 1 = Run Reverse
	2	Fault Reset: on transition from 0 to 1
	3	Reserved
	4	Reserved
	5	Control 0 = Local Control 1 = Network Control
	6	Speed Reference 0 = Local Reference 1 = Network Reference
	7	Reserved
	8	Network setpoint / reference (when Bit 6 = 1) 0 - Network 6 - Preset #3 1 - Keypad 7 - Preset #4 (7) 2 - 0-10VDC 8 - Preset #5 (7) 3 - 4-20mA 9 - Preset #6 (7) 4 - Preset #1 10 - Preset #7 (7) 5 - Preset #2 11 - MOP
	9	
	10	
	11	
	12	Controller inhibit 0 = No controller inhibit 1 = Controller inhibit
	13	Quick stop 0 = Quick stop not active 1 = Quick stop active
	14	Force Mode (Network / PID modes only) 0 = No Action 1 = Force Manual / Open Loop Mode
	15	DC brake 0 = DC brake not active 1 = DC brake active
WORD1		Unsigned speed 0.1 Hz resolution • Received value = 0x01F0 = 49.6 Hz
WORD2		Digital Output and Relay; Active when: • Bit 9 = Open Collector (and P142 = 25) • Bit 10 = Relay (and P140 = 25) Others reserved for future use
WORD3		Analog Output [0.01 VDC]; Active when P150 = 9 • Received value = 0x024B = 5.87 VDC

	Bit	P446 / P456 setting = 3
WORD0 - SMV control word	0	Run Forward 0 = NOT Run Forward 1 = Run Forward
	1	Run Reverse 0 = NOT Run Reverse 1 = Run Reverse
	2	Fault Reset: on transition from 0 to 1
	3	Reserved
	4	Reserved
	5	Control 0 = Local Control 1 = Network Control
	6	Speed Reference 0 = Local Reference 1 = Network Reference
	7	Reserved
	8	Network setpoint / reference (when Bit 6 = 1) 0 - Network 6 - Preset #3 1 - Keypad 7 - Preset #4 (7) 2 - 0-10VDC 8 - Preset #5 (7) 3 - 4-20mA 9 - Preset #6 (7) 4 - Preset #1 10 - Preset #7 (7) 5 - Preset #2 11 - MOP
	9	
	10	
	11	
	12	Controller inhibit 0 = No controller inhibit 1 = Controller inhibit
	13	Quick stop 0 = Quick stop not active 1 = Quick stop active
	14	Force Mode (Network / PID modes only) 0 = No Action 1 = Force Manual / Open Loop Mode
	15	DC brake 0 = DC brake not active 1 = DC brake active
WORD1		Network PID setpoint Signed value -999…3100
WORD2		Digital Output and Relay; Active when: • Bit 9 = Open Collector (and P142 = 25) • Bit 10 = Relay (and P140 = 25) Others reserved for future use
WORD3		Analog Output [0.01 VDC]; Active when P150 = 9 • Received value = 0x024B = 5.87 VDC

(7) Preset #4, #5, #6 and #7 are ignored when the drive is operating in either PID Mode or Torque Mode.

	Bit	P446 / P456 setting = 4
WORD0 - SMV control word	0	Run Forward 0 = NOT Run Forward 1 = Run Forward
	1	Run Reverse 0 = NOT Run Reverse 1 = Run Reverse
	2	Fault Reset: on transition from 0 to 1
	3	Reserved
	4	Reserved
	5	Control 0 = Local Control 1 = Network Control
	6	Speed Reference 0 = Local Reference 1 = Network Reference
	7	Reserved
	8	Network setpoint / reference (when Bit 6 = 1) 0 - Network 6 - Preset #3 1 - Keypad 7 - Preset #4 (7) 2 - 0-10VDC 8 - Preset #5 (7) 3 - 4-20mA 9 - Preset #6 (7) 4 - Preset #1 10 - Preset #7 (7) 5 - Preset #2 11 - MOP
	9	
	10	
	11	
	12	Controller inhibit 0 = No controller inhibit 1 = Controller inhibit
	13	Quick stop 0 = Quick stop not active 1 = Quick stop active
	14	Force Mode (Network / PID modes only) 0 = No Action 1 = Force Manual / Open Loop Mode
	15	DC brake 0 = DC brake not active 1 = DC brake active
WORD1		Unsigned Torque Setpoint 0 - 400% limited by P330 (Torque Limit)
WORD2		Digital Output and Relay; Active when: • Bit 9 = Open Collector (and P142 = 25) • Bit 10 = Relay (and P140 = 25) Others reserved for future use
WORD3		Analog Output [0.01 VDCC]; Active when P150 = 9 • Received value = 0x024B = 5.87 VDC

(7) Preset #4, #5, #6 and #7 are ignored when the drive is operating in either PID Mode or Torque Mode.

5.2.2 TPDO mapping details (P466/P476)

	Bit	**P466 / P476 setting = 0**
WORD0 - DSP402 control word 0x6041	0	Ready 0 = Not ready to switch on 1 = Ready to switch on
	1	Output Switch 0 = switch OFF 1 = switch ON
	2	Operation 0 = operation disabled 1 = operation enabled
	3	Fault 0 = No fault 1 = Fault
	4	Voltage Enable [= 1 (enabled) on drive]
	5	Quick stop 0 = Quick stop active 1 = Quick stop not active
	6	Switch ON enabled [= 0 (disabled) on drive]
	7	Warning 0 = No Warning 1 = Warning
	8	Manufacturer specific
	9	Network 0 = Not Remote (Manual) 1 = Remote (Network)
	10	Operation at Setpoint 0 = Setpoint not reached 1 = Setpoint reached
	11	Internal Limit 0 = Limit NOT active 1 = Internal limit active
	12	Reserved
	13	Reserved
	14	Reserved
	15	Reserved

	Bit	**P466 / P476** setting = 1
WORD0 - DSP402 control word 0x6041	0	Ready 0 = Not ready to switch on 1 = Ready to switch on
	1	Output Switch 0 = switch OFF 1 = switch ON
	2	Operation 0 = operation disabled 1 = operation enabled
	3	Fault 0 = No fault 1 = Fault
	4	Voltage Enable [= 1 (enabled) on drive]
	5	Quick stop 0 = Quick stop active 1 = Quick stop not active
	6	Switch ON enabled [= 0 (disabled) on drive]
	7	Warning 0 = No Warning 1 = Warning
	8	Manufacturer specific
	9	Network 0 = Not Remote (Manual) 1 = Remote (Network)
	10	Operation at Setpoint 0 = Setpoint not reached 1 = Setpoint reached
	11	Internal Limit 0 = Limit NOT active 1 = Internal limit active
	12	Reserved
	13	Reserved
	14	Reserved
	15	Reserved
WORD1		Signed actual output frequency • RPM calculation based on P304 and P305 • Example 1: P304 = 60Hz; P305 = 1750 RPM request setpoint forward (CW) at 25.0 HZ = 25.0 x 1750/60 = 729 = 0x02D9 • Example 2: P304 = 50Hz; P305 = 1390 RPM request setpoint reverse (CCW) at 44.5 HZ = -(44.5 x 1390/50) = -1237 = 0xFB2B

	Bit	P466 / P476 setting = 2
WORD0 - SMV control word	0	Drive Fault 0 = No Fault 1 = Faulted
	1	Reserved
	2	Run Forward 0 = NOT Run Forward 1 = Run Forward
	3	Run Reverse 0 = NOT Run Reverse 1 = Run Reverse
	4	Drive Status 0 = NOT Ready 1 = Ready
	5	Control 0 = Local Control 1 = Network Control
	6	Speed Reference 0 = Local Reference 1 = Network Reference
	7	Operation at Setpoint 0 = Setpoint not reached 1 = Setpoint reached
	8 9 10 11	Actual setpoint / reference source 0 - Keypad 6 - Preset #4 1 - 0-10VDC 7 - Preset #5 2 - 4-20mA 8 - Preset #6 3 - Preset #1 9 - Preset #7 4 - Preset #2 10 - MOP 5 - Preset #3 11 - Network
	12	PID Mode Status 0 = PID NOT Active 1 = PID Active
	13	Torque Mode Status 0 = NOT in Torque Mode 1 = Torque Mode Active
	14	Current Limit Status 0 = NOT in Current Limit 1 = in Current Limit
	15	DC brake 0 = DC brake not active 1 = DC brake active
WORD1		Unsigned speed 0.1 Hz resolution
WORD2		Digital input/Output States Bit 2 - Output Fault Bit 3 - Fast Current Limit State Bit 4 - TB1 ON Bit 6 - TB13A Bit 7 - TB13B Bit 8 - TB13C Bit 9 - TB14 Out State Bit 10 - Relay State Bit 11 - Charge Relay Bit 12 - Assertion Level
WORD3		Analog Input [0.01 VDC]; Active when P150 = 9 • Received value = 0x024B = 5.87 VDC

	Bit	P466 / P476 setting = 3
WORD0 - SMV control word	0	Drive Fault 0 = No Fault 1 = Faulted
	1	Reserved
	2	Run Forward 0 = NOT Run Forward 1 = Run Forward
	3	Run Reverse 0 = NOT Run Reverse 1 = Run Reverse
	4	Drive Status 0 = NOT Ready 1 = Ready
	5	Control 0 = Local Control 1 = Network Control
	6	Speed Reference 0 = Local Reference 1 = Network Reference
	7	Operation at Setpoint 0 = Setpoint not reached 1 = Setpoint reached
	8 9 10 11	Actual setpoint / reference source 0 - Keypad 6 - Preset #4 1 - 0-10VDC 7 - Preset #5 2 - 4-20mA 8 - Preset #6 3 - Preset #1 9 - Preset #7 4 - Preset #2 10 - MOP 5 - Preset #3 11 - Network
	12	PID Mode Status 0 = PID NOT Active 1 = PID Active
	13	Torque Mode Status 0 = NOT in Torque Mode 1 = Torque Mode Active
	14	Current Limit Status 0 = NOT in Current Limit 1 = in Current Limit
	15	DC brake 0 = DC brake not active 1 = DC brake active
WORD1		Unsigned actual frequency 0.1 Hz resolution
WORD2		Actual PID setpoint Signed value -999…3100
WORD3		Actual PID feedback Signed value -999…3100

	Bit	P466 / P476 setting = 4
WORD0 - SMV control word	0	Drive Fault 0 = No Fault 1 = Faulted
	1	Reserved
	2	Run Forward 0 = NOT Run Forward 1 = Run Forward
	3	Run Reverse 0 = NOT Run Reverse 1 = Run Reverse
	4	Drive Status 0 = NOT Ready 1 = Ready
	5	Control 0 = Local Control 1 = Network Control
	6	Speed Reference 0 = Local Reference 1 = Network Reference
	7	Operation at Setpoint 0 = Setpoint not reached 1 = Setpoint reached
	8 9 10 11	Actual setpoint / reference source 0 - Keypad 6 - Preset #4 1 - 0-10VDC 7 - Preset #5 2 - 4-20mA 8 - Preset #6 3 - Preset #1 9 - Preset #7 4 - Preset #2 10 - MOP 5 - Preset #3 11 - Network
	12	PID Mode Status 0 = PID NOT Active 1 = PID Active
	13	Torque Mode Status 0 = NOT in Torque Mode 1 = Torque Mode Active
	14	Current Limit Status 0 = NOT in Current Limit 1 = in Current Limit
	15	DC brake 0 = DC brake not active 1 = DC brake active
WORD1		Unsigned actual frequency 0.1 Hz resolution
WORD2		Actual Torque [%]
WORD3		Analog Input 0-10 VDC TB [0.01 VDC] • Received value = 0x024B = 5.87 VDC

	Bit	P466 / P476 setting = 5 (Special for Daisy Chaining)
WORD0 - SMV control word	0	Run Forward 0 = NOT Run Forward 1 = Run Forward
	1	Run Reverse 0 = NOT Run Reverse 1 = Run Reverse
	2	Fault Reset: on transition from 0 to 1
	3	Reserved
	4	Reserved
	5	Control 1 = Network Control (set to 1 to match Network Control on RPDO)
	6	Speed Reference 1 = Network Reference (set to 1 to match speed reference on RPDO)
	7	Reserved
	8 9 10 11	Actual setpoint / reference source 0 - Network 6 - Preset #3 1 - Reserved 7 - Preset #4 2 - Reserved 8 - Preset #5 3 - Reserved 9 - Preset #6 4 - Preset #1 10 - Preset #7 5 - Preset #2 11 - Reserved
	12	Controller inhibit 0 = No controller inhibit 1 = Controller inhibit
	13	Quick stop 0 = Quick stop not active 1 = Quick stop active
	14	Force Mode (Network / PID modes only) 0 = No Action 1 = Force Manual / Open Loop Mode (must be set to 0)
	15	DC brake 0 = DC brake not active 1 = DC brake active
WORD1		Unsigned Command speed 0.1 Hz resolution • Received value = 0x01F0 = 49.6 Hz
WORD2		Digital Output and Relay; Active when: • Bit 9 = Open Collector (and P142 = 25) • Bit 10 = Relay (and P140 = 25) Others reserved for future use
WORD3		Analog Output [0.01 VDCC]; Active when P150 = 9 • Received value = 0x024B = 5.87 VDC

6 Troubleshooting and fault elimination

6.1 Faults

Status		Cause	Remedy
F.nEF	Module to Drive communication time out	Connection between drive and module is not made.	Check cable and connection between module and drive
F.nF1	Guard Time Fault		See parameters P420, P421, P423
F.nF2	Message Monitoring time-out		See parameters P425, P426
F.nF3	RPDO#1 Monitoring time-out		See parameters P444, P445
F.nF4	RPDO#2 Monitoring time-out		See parameters P454, P455

6.2 Troubleshooting

Symptom	Possible Cause	Remedy
No communication from the drive	Module is not initialized properly	• Verify the module connection • Check P400 and P402
	Incorrect CANopen settings	• Use P403 to reset CANopen parameters. • Verify P410 and P411
	Improper wiring	• Check wiring between the CANopen Network and communication module. • Ensure that terminal block is properly seated. • Check connection between module and drive.
CANopen write commands are ignored or return exceptions.	“Network Enabled terminal is either open or not configured.	Configure one of the input terminals (P121, P122, or P123) to “Network Enabled” function (selection 9) and close the corresponding contact.
Drive stops without obvious reason	One of the CANopen monitoring messages timed out and it’s time-out reaction is set to STOP.	Identify the time-out message (P427) and modify appropriate time-out time or reaction to the time-out settings.

A1 Appendix A - Configuration Example

A1.1 Master / Follower drive system

The following example shows how to set up for a typical “Master - Follower” drive system using CANopen as the link between the two drives. The “Master” drive can be controlled by CANopen or by traditional control elements (relays, switches, potentiometers, etc.), the “Follower” will receive it’s commands (run, speed, etc.) from the “Master” when a contact closure (or jumper) is made between terminals 4 and 13-A to enable Network Control on the follower drive.

WARNING!
Network control permits automatic starting and stopping of the inverter drive. The system design must incorporate adequate protection to prevent personnel from accessing moving equipment while power is applied to the drive system.

This example is shown for illustrative purposes only. In an actual implementation, additional safety precautions must be made. Included in these should be the prevention of access to the “Follower” drive keypad for operational purposes since the “Master” drive may restart the “Follower” drive even after a local keypad STOP command. As always, system safety is the responsibility of the machine designer.

Parameters

Master Drive configuration		
No.	**Name**	**Setting**
P410	CAN address (Node ID)	1
P411	CAN baud rate	5 500 kbps
P412	System bus participant	1 Slave with autostart enabled
P413	Parameter channel 2 (SDO#2)	2 Disable with default COB ID
P464	TPDO#1 event timer	10 ms
P466	TPDO#1 mapping	5 Status Word matches the SMV Control word.

Follower Drive configuration		
No.	**Name**	**Setting**
P100	Setpoint source	3 Network Only
P121	TB-13A input function	9 Network Enable
	Any of the TB13 inputs can be used, this example uses TB-13A	
P410	CAN address (Node ID)	2
P411	CAN baud rate	5 500 kbps
P412	System bus participant	1 Slave with autostart enabled
P413	Parameter channel 2 (SDO#2)	3 Disable with programmable COB ID
P440	RPDO#1 COB ID	385 (P460 from controller #1)
P441	RPDO#1 enable/disable	1 Enable
P444	RPDO#1 event monitoring timer	50 ms
P445	RPDO#1 time out reaction	1 STOP
P446	RPDO#1 mapping	2 SMV Control Word + Network Speed.

After setting the parameters, perform Node reset using parameter P418 or cycle the power.

NOTE:
ANY time the PDO modes or addresses are changed, they must be either disabled/enabled (using P441 or P451) or the drive must be reset by cycling power.

After these controllers are configured as above, the “Follower” drive will follow the operation of the “Master” drive, including functions of Inhibit state, Quick Stop, DC brake, preset setpoint selections, direction, and speed. For additional safety, the “Follower” drive will transition to inhibit state if a valid PDO is not received from the “Master” within 50ms.

NOTE:
- If the Follower drive does not see a valid PDO within the time-out period, it will transition to the inhibit state. This action is always immediate STOP by coast, even if the follower specifies other action in P111. For example, a fault on the Master should cause an inhibit state on the follower (displayed as STOP) by switching off of all power devices.
- On power up, the drives will not start running unless the master is configured to do so (P110 = 1, 3, 4,5, or 6). Follower drive will respond with a normal start even if the Master is configured for flying start.
- While running, the master will continuously send a “run” command to the follower.

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