POWER ELECTRONICS

SD300 – ETHERCAT MODULE

ACCESORIES MANUAL

LOW VOLTAGE VARIABLE SPEED DRIVE

SD300

A C C E S O R I E S

EtherCAT Module
Accessories Manual

Edition: October 2018

SD30MA04BI Rev. B

REVISIONS CONTROL		
DATE	**REVISION**	**DESCRIPTION**
15 / 10 / 2018	A	First edition
22 / 10 / 2018	B	Misprints correction.

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SAFETY SYMBOLS

Always follow safety instructions to prevent accidents and potential hazards from occurring.
In this manual, safety messages are classified as follows:

WARNING	Identifies potentially hazardous situations where dangerous voltage may be present, which if not avoided, could result in minor personal injury, serious injury or death.
	Be extremely careful and follow the instructions to avoid the risk of electrical shocks.

CAUTION	Identifies potentially hazardous situations, which if not avoided, could result in product damage, or minor or moderate personal injury.
	Read the message and follow the instructions carefully.

NOTICE	Identifies important measures to take in order to prevent damage equipment and warranty lost, as well as encouraging good use and environmental practices

The following CAUTION symbols can be used in this manual and they symbolize:

	Hot surface. Be careful and follow the instructions to avoid burns and personal injuries.
	Risk of fire. Be careful and follow the instructions to prevent causing an unintentional fire.

SAFETY INSTRUCTIONS

IMPORTANT!

Read carefully this manual to maximize the performance of the product and to ensure its safe use.

In order to appropriately use the drive, please, follow all instructions described in the installation manual which refer to transportation, installation, electrical connection and commissioning of the equipment.

Power Electronics accepts no responsibility or liability for partial or total damages resulting from incorrect use of equipment.

Please, pay careful attention to the following recommendations:

⚠ WARNING

Be cautious when handling the CMOS components of the communication module.
Static may lead to product malfunctioning.

Turn the drive power off before changing the communication cable. Otherwise, you may damage the module or a communication error may occur.

Make sure to insert precisely the communication module connector to the drive.
Otherwise, you may damage the module or a communication error may occur.

Check the parameter unit before setting up the parameters.
Otherwise, a communication error may occur.

Do not remove the cover while power supply is connected or the drive is operating.
Otherwise, you may get an electric shock.

Do not run the drive with the front cover removed.
Otherwise, you may get an electric shock.

The drive does not remove the voltage from the input terminals. Before working on the drive, isolate the whole drive from the supply.
If you do not remove the power supply, you may get an electric shock.

Do not remove the cover except for periodic inspections or wiring, even if the input power is not applied.
Otherwise, you get an electric shock.

Operate the drive with dry hands.
Otherwise, you may get an electric shock.

Do not use cables with damaged insulation.
Otherwise, you may get an electric shock.

Do not subject the cables to abrasions, excessive stress, heavy loads or pinching.
Otherwise, you may get an electric shock.

 CAUTION

Install the drive on a non-flammable surface. Do not place flammable material nearby. Otherwise, a fire could occur.

Disconnect the input power if the drive is damaged.
Otherwise, it could result in a secondary accident or fire.

Do not allow lint, paper, wood chips, dust, metallic chips or other foreign matter into the drive. Otherwise, a fire or accident could occur.

The drive becomes hot during operation. Wait until it cools down before performing any actions.
Touching hot parts may result in skin burns.

Do not apply power to a damaged drive or to a drive with parts missing, even if the installation is complete.
Otherwise, you may get an electric shock.

ⓘ **NOTICE**

RECEPTION

- The SD300 are carefully tested and perfectly packed before delivery.

- In the event of transport damage, please ensure to notify the transport agency and POWER ELECTRONICS: 902 40 20 70 (International +34 96 136 65 57), or your nearest agent, within 24hrs from receiving the goods.

UNPACKING

- Make sure model and serial number of the variable speed drive are the same on the box, delivery note and unit.

- Each variable speed drive is delivered with Hardware and Software technical manuals.

RECYCLING

Equipment packaging must be recycled. Separate all different materials (plastic, paper, cardboard, wood…) and place them in the corresponding containers. Ensure waste collection is properly managed with a Non-Hazardous Waste Agent.

To guarantee health and natural environmental sources protection, the European Union has adopted the WEEE directive concerning discarded electric and electronic equipment (SEEA).

Waste of electrical and electronic equipment (WEEE) must be collected selectively for proper environmental management.

Our products contain electronic cards, capacitors and other electronic devices that should be separated when they are no longer functional. These WEEEs should be managed accordingly with a Hazardous Waste Agent.

Power Electronics promotes good environmental practices and recommends that all its products sold outside of the European Union, once they reach the end of their life, are separated and the WEEE managed according to the particular country applicable legislation (especially: electronic cards, capacitors and other electronic devices)

If you have any questions about the electric and electronic equipment waste, please contact Power Electronics.

CYBER SECURITY DISCLAIMER

This product is designed to be connected to and to communicate information and data via a network interface. The customer is the sole responsible for providing and continuously ensuring a secure connection between the product and customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.

Power Electronics and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

SAFETY

- Before operating the drive, read this manual thoroughly to gain an understanding of the unit. If any doubt exists, please contact POWER ELECTRONICS, (902 40 20 70 / +34 96 136 65 57) or your nearest agent.

- Wear safety glasses when operating the drive with power applied or for when the front cover is removed.

- Handle and transport the drive following the recommendations within this manual.

- Install the drive according to the instructions within this manual and local regulations.

- Do not place heavy objects on the drive.

- Ensure that the drive is mounted vertically and keeping the minimum clearance distances.

- Do not drop the drive or subject it to impact.

- The SD300 drives contain static sensitive printed circuits boards. Use static safety procedures when handling these boards.

- Avoid installing the drive under conditions that differ from those described in the Environmental Ratings section.

ELECTROMAGNETIC COMPATIBILITY (EMC)

- **The drive is intended to be used in industrial environments (Second Environment). It achieves compliance with C3 category defined in IEC/EN 61800-3 standard when the installation recommendation within this manual are followed.**

- **Select communication and control system according to the drive EMC environment. Otherwise, systems could suffer from interferences due to a low EMS level.**

CONNECTION PRECAUTIONS

- To ensure a correct operation of the drive, it is recommended to use a SCREENED CABLE for the control wiring.

- The motor cable should comply with the requirements within this manual. Due to increased leakage capacitance between conductors, the external ground fault protection threshold value should be adjusted ad hoc.

- Do not disconnect motor cables if the input power supply remains connected.

- The internal circuits of the SD300 Series will be damaged if the incoming power is connected and applied to the output terminals (U, V, W).

- Do not use power factor correction capacitor banks, surge suppressors, or RFI filters on the output side of the drive. Doing so may damage these components.

- Before wiring the terminals, make sure that the drive keypad display is turned off and the front cover is off as well. The drive may hold a high voltage electric charge long after the power supply has been turned off.

EARTH CONNECTION

- Ground the drive and adjoining cabinets to ensure a safe operation and to reduce electromagnetic emission.

- Connect the input PE terminal only to the dedicated PE terminal of the drive. Do not use the case, nor chassis screws for grounding.

- Ground the drive chassis through the labelled terminals. Use appropriate conductors to comply with local regulations. The ground conductor should be connected first and removed last.

- Motor ground cable must be connected to the PE output terminal of the drive and not to the installation's ground. We recommend that the section of the ground conductor (PE) is equal or greater than the active conductor (U, V, W).

TRIAL RUN

- Verify all parameters before operating the drive. Alteration of parameters may be required depending on application and load.
- Always apply voltage and current signals to each terminal that are within the levels indicated in this manual. Otherwise, damage to the drive may occur.

CAPACITORS DEPLETION

If the drive has not been operated for a long time, capacitors lose their charging characteristics and are depleted. To prevent depletion, once a year run the device under no-load conditions during 30-60 minutes. For further information, contact Power Electronics.

REFERENCE DOCUMENTS

The following documents are available for SD300 variable speed drives:

- Getting Started Manual.

INTRODUCTION

1

What is EtherCAT?

EtherCAT[1] (Ethernet for control automation technology) is a real-time Ethernet technology developed by Beckhoff with outstanding performance, flexible topology and simple configuration.

It represents a huge benefit for all applications in which the target system is controlled or measured via the bus system. The rapid reaction times work to reduce the wait times during the transitions between process steps, which significantly improves application efficiency.

EtherCAT system architecture typically reduces the load on the CPU by 25 – 30 % in comparison to other bus systems (given the same cycle time). When optimally applied, EtherCAT's performance leads to improved accuracy, greater throughput, and thus to lowered costs.

Technical Features

Communication protocol	EtherCAT
Communication speed	100Mbps
Communication type	Full duplex
Distance	100m (twisted pair)
Service	EtherCAT / Full slave / CoE / CiA402 / EMCY
Topology	Line / Ring topology network (Tree / Star topology is available when an additional device, such as an EtherCAT hub, is installed.)
Cable	STP

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[1] Source: https://www.beckhoff.com, https://www.ethercat.org

Components of the EtherCAT kit

The EtherCAT communication module provides EtherCAT network communication to the SD300 drives.

The EtherCAT module kit contains the following parts:

- 1 EtherCAT Communication Module board
- 1 EtherCAT module manual
- 1 Brass bar (M3xL23)
- 1 Brass bar (M3xL17.3)
- 2 Fixing screws (M3xL8)

INSTALLATION AND CONNECTION

2

![warning symbol] WARNING

Turn the power supply off before connecting a communication network.
If the EtherCAT communication module is removed or installed, the power supply should be switched off. Otherwise, the SD300 drive may get damaged and warranty will be voided.
Before removing the EtherCAT communication module from the product, ensure power supply is totally discharged.

Installation

To install the EtherCAT communication module, please follow these steps:

① Unfasten the front cover fixing bolt to remove the front cover and ② remove the I/O cover.

SD30ITM0011A
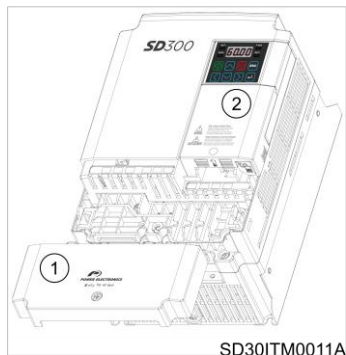
③ Remove the keypad

SD30ITM0012A
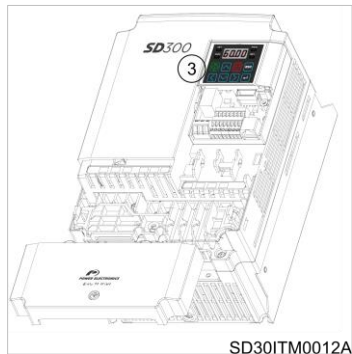
④ Unfasten the screw from I/O the board and fasten the prepared brass bars.

SD30ITM0013A
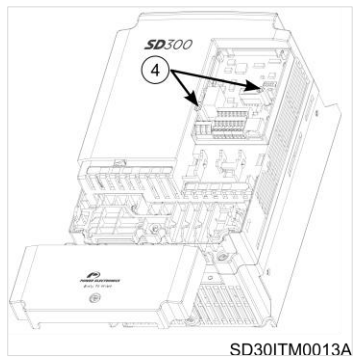
⑤ Mount EtherCAT communication module and ⑥ fasten the two screws (one was removed in step 4; the second is included in the kit).

SD30ITM0014A
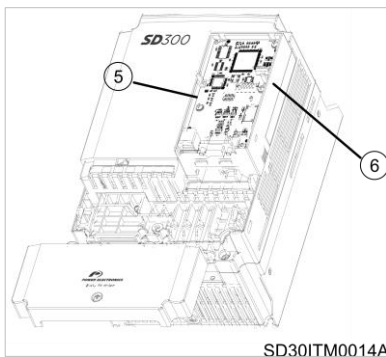
⑦ Install the keypad and ⑧ the communication module cover.

SD30ITM0015A

⑨ Finally, install the front cover again.

SD30ITM0016A
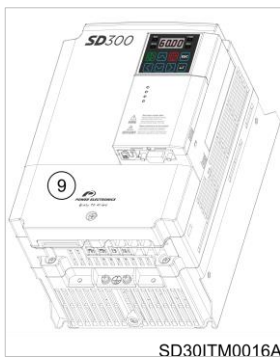
Network connections

The following image shows the communication cable connector. Its pins and description can be found in the table below.

SD30ITR0002A
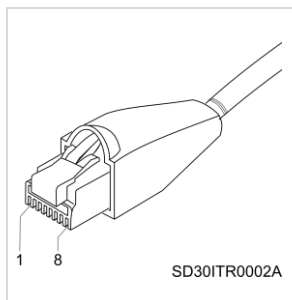
Pin No.	Signal	Description	Cable color
1	TX+	Data transmission (+)	White / Yellow
2	TX-	Data transmission (-)	Yellow
3	RX+	Data reception (+)	White / Green
4	None	Not used	Blue
5	None	Not used	White / Blue
6	RX-	Data reception (-)	Green
7	None	Not used	White / Brown
8	None	Not used	Brown

Notes:

- Make sure that cables connected to Pin 1 and 2 are twisted together.
- Make sure that cables connected to Pin 3 and 6 are twisted together.

Network cable specification

There are five different STP cable categories depending on the frequency range, from category 1 to category 5.

The EtherCAT network communication requires using CAT5 STP cables.

Classification	Detail	Used
STP (S.STP)	Shielded twisted pair cable	Maximum 500MHz, Voice + Information(Data) + Video signal, Replacement for 750 coaxial cable

Transmission speed of category 5 is 100MHz and available up to 100Mbps.

LEDs description

The EtherCAT module has four LEDs in its front panel that show its status at all times.

RUN ○
ERROR ○
IN LINK ○
OUT LINK ○
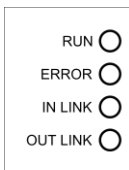
SD30ITG0006AI

Led	Description	Color	Operation	Status	Function
RUN	Operating status	Green	Normal	Flashing	Preoperational
				OFF	Ready for operation
				ON	Operation in progress.
				Single flash	Safe operation in progress.
ERROR	Error status	Red (*)	Normal	OFF	ESC is operating normally.
			ESC communication error	Flashing 0.2 s ON / 0.2 s OFF	ESC configuration error
				Single Flash 0.2 s ON / 1 s OFF	ESC local error detected (enters a safe state).
				Double Flash 0.2s ON / 0.2 s OFF / 0.2 s ON / 1s OFF	ESC Watchdog timeout
				ON	Severe ESC Error detected.
				Flashing	ESC failed to boot.

Led	Description	Color	Opera-tion	Status	Function
		Green (*)	Normal	OFF	Communication between the communication module and the drive is normal.
			Communication error	Flashing 0.2 s ON / 0.2 s OFF	Abnormal communication (failures) conditions exist between the communication module and the drive.
				ON	Communication error occurred (no communication is established) between the communication module and the drive.
		(*) The green and red indications are mutually exclusive–they do not light up at the same time. The red indication holds priority over the green indication. Eg. If an ESC error and a drive communication error occur simultaneously, a red indication is turned on. A green indication is turned on after the ESC error condition is resolved.			
IN LINK	IN Link status	Green	Normal	ON	Link is established, but no operation is in progress.
				OFF	Network Link 1 is not connected.
				Flashing 0.05 s ON / 0.05 OFF	Link is established, and an operation is in progress.
OUT LINK	OUT Link status	Green	Normal	ON	Link is established, but no operation is in progress.
				OFF	Network Link 2 is not connected.
				Flashing 0.05 s ON / 0.05 OFF	Link is established, and an operation is in progress.

ETHERCAT

3

EtherCAT is a fieldbus protocol for I/O transmission and servo actuation, created by the German corporation "Beckhoff". The EtherCAT Technology Group, promoted its standardization and the EtherCat protocol is now part of the IEC 61131 and IEC 61158 international standards. As a high-performance industrial protocol based on real-time Ethernet communication, it provides high-speed Ethernet frame transmission between nodes (master and slave devices) in short cycles.

An EtherCAT network features linear data transmission, which enables high-speed data transmission. The master device does not transmit multiple data frames to multiple slave devices. Instead, the master device transmits a single data frame to one slave device, and then the data frame received by the slave device is transmitted to the next slave device. Each slave device performs reading and writing while the data frame is being transmitted, and then the data frame is returned to the master device after the last slave device on the network has received it.

Since the EtherCAT network is based on the same standard frame structure and physical hierarchy defined in the IEEE 802.3 standard, it is compatible with existing Ethernet devices.
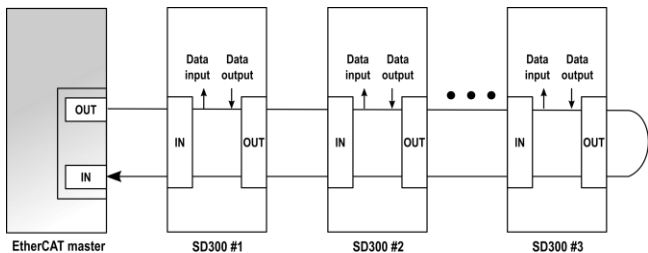
SD30ITG0007AI

CANopen over EtherCAT (CoE)

The SD300 EtherCAT communication module enables network communication between EtherCAT master and EtherCAT slave devices, using the CANopen over EtherCAT (COE) protocol for data transmission. In the CoE protocol, the parameter settings and data information is stored in an object dictionary. The object dictionary is a group of objects (parameters) accessible on a network, which includes device configurations and information for network communication.

Data transmission between the master and slave units utilizing the CoE protocol includes synchronous transmissions utilizing the process data object (PDO) and asynchronous transmissions utilizing the service data object (SDO). The EtherCAT communication module performs periodic data transmissions to communicate the frequency reference and status data, and other data transmissions for error state reports and parameter reading and writing are performed when the requests are received.

Communication Type	Intervals	Description
Process data communication (PDO communication)	Synchronous (main task cycle)	Frequency reference, operating frequency, control commands, status commands, etc.
Service data communication (SDO communication)	Asynchronous (upon request)	Read/write drive parameter, read drive error information, etc.

EtherCAT Status Machine

EtherCAT network communication between the master and slave units begins with a transition from an initial state (Init) to an operational state (Operational). Normal data transmission processes for controlling the motors connected to the drives are available in the operational state.

If a communication error occurs during EtherCAT data communication while in an operational state, a transition to an initial state takes place, and communication stops. If this happens, the cause of the communication error must be eliminated before communication can resume.

The following diagram explains the EtherCAT communication statuses and transitions between different statuses.
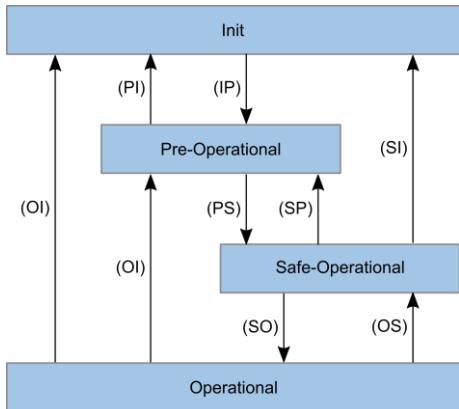
SD30ITG0008AI

EtherCAT Process Data Object (PDO)

A synchronous EtherCAT communication utilizes the process data object (PDO). Process data includes TxPDO, which is transmitted from an drive to the EtherCAT master, and RxPDO, which is transmitted from the EtherCAT master to an drive.

* When the PE Profile is in use, users can customize the data defined in the object dictionary by remapping the object dictionary using the configuration data COM31- COM38 and COM51-COM58. When the CiA402 Profile is in use, the object dictionary data "Control word," "vl target velocity," "Status word," and "vl velocity actual value" are fixed and cannot be customized.

The SD300 EtherCAT communication module provides such data in XML files. These files should first be recognized by the EtherCAT master unit during the installation and test drive phases. By analyzing these information files on the slave units, optimal control over the network can be achieved.

PROFILE

CiA 402 Drive and Motion Control Device Profile

Only Velocity Mode is supported.

Finite State Automation (FSA)

The following diagram explains the EtherCAT communication statuses and transitions between different statuses when the CiA 402 profile is used.
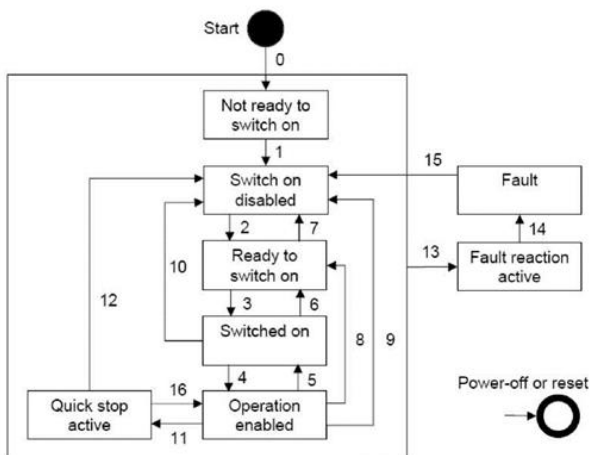
- **Not ready to switch on**: The EtherCAT hardware and memory stack are being initialized.
- **Switch on disabled**: The device cannot be switched on.

- **Ready to switch on**: The device is ready to be switched on.
- **Switched on**: The device is switched on and ready for operation. It is waiting for a run command.
- **Operation enabled**: The motor is operating.
- **Quick stop active**: The motor is being stopped, or it has been stopped.

The following table explains drive operations for different statuses.

Transition	Event	Action
0	Automatic transition	Self-diagnosis and initialization of variables.
1	Automatic transition	EtherCAT communication is ready.
2	Transition to operation mode	None.
3	Switch on command is received.	None.
4	Enable operation command is received.	Motor operation.
5	Disable operation command is received.	Performs a free run stop.
6	Shut down command is received.	None.
7	Disable voltage command is received.	None.
8	Shut down command is received.	Performs a free run stop.
9	Disable voltage command is received.	Performs a free run stop.
10	Disable voltage command, or Quick Stop command is received.	Performs a free run stop.
11	Quick Stop command is received.	Decelerates according to the deceleration time set at Quick Stop.
12	Disable voltage command is received.	Performs a free run stop.
13	Drive trip occurred.	Performs a trip sequence.
14	Automatic transition	Performs a trip sequence.
15	Reset command is received, or the trip condition is resolved.	Transitions to "Switch on disabled" status.
16	Enable operation command is received.	Operates the motor again.

NOTE: Command inputs on the keypad are not available during a free run stop.

* Please use the Quick Stop with setting the 604A:001 'vl velocity Quick Stop:Delta' in CiA402 object dictionary.

CiA 402 Object Dictionary

Error codes (Object: 0x603F)

Index:0x603F

A service data object (SDO) is used to identify the fault trip types when an drive fault trip occurs.

The following table lists the error codes that are used to respond to drive fault trips (refer to drive addresses 0h0330, 0h0331, 0h0332, 0h0333, and 0h0334 for details).

* When a fault trip occurs, the SD300 drive transmits the following error codes and an emergency code which includes the error code and the error register.

Error codes:

Fault Code Number	Description
0x0000	None
0x1000	Undefined
0x2220	Drive OLT
0x2310	OverCurrent1
0x2330	Ground Trip
0x2340	OverCurrent2
0x3130	In Phase Open
0x3210	Over Voltage
0x3220	Low Voltage
0x4000	NTC Open
0x4310	Over Heat
0x5000	HWDiag
0x5001	No Drive
0x5450	Fuse Open
0x6300	Para Write Trip

Fault Code Number	Description
0x7001	Fan Trip
0x7011	OptionTrip1
0x7021	IO Board Trip
0x7022	XIO Trip
0x7120	No Motor Trip
0x7310	EncorderTrip
0x9001	External Trip
0x9002	BX
0xFF01	Thermal
0xFF03	Out Phase Open
0xFF04	Over Load
0xFF05	Under Load
0xFF06	Thermal Trip
0xFF07	Pre PID Fail
0xFF0A	Lost Command
0xFF0B	Lost Keypad
0xFF0E	ANY WARNING

Error Register (Object: 0x1001)

Fault Code Number	Description
0x01	Generic error
0x02	Current error
0x04	Voltage error
0x08	Temperature error
0x10	Communication error
0x20	Device profile specific error
0x40	Reserved
0x80	Manufacture specific error

Control word

The following table lists the bit control words.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
nu	nu	nu	nu	nu	r	nu	H	fr	rr	ur	Er	eo	Qs	ev	so

so: Switch on

ev: Enable voltage

Qs: Quick stop

eo: Enable operation

Er: Enable ramp

ur: Unlock ramp

rr: Reference ramp

fr: Fault reset

H: Halt

r: Reserved

nu: Not used

Bits 4 through 7 are used for the operation mode commands

The following table lists the command bits in the Finite State Automation status (refer to section "Finite State Automation (FSA)" for detailed information).

Command	Control word bits					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (NOTE)
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset		X	X	X	X	15

NOTE: Automatic transition to Enable operation state after executing SWITCHED ON state functionality.

Numbers listed in the Transitions column indicate the drive operation numbers that are in the drive operation table at "Finite State Automation (FSA)".

The following table explains the command bits in the Enable Operation status.

Bit	Value	Description
4 (Enable Ramp)	0	Maintains the current operation.
	1	Operates the drive according to the command bits.
5 (Unlock Ramp)	0	Holds the output frequency.
	1	Accelerates to the frequency reference.
6 (Reference Ramp)	0	Inputs "0" as the frequency reference.
	1	Inputs the set value as the frequency reference.
8 (Halt)	X	Not used.
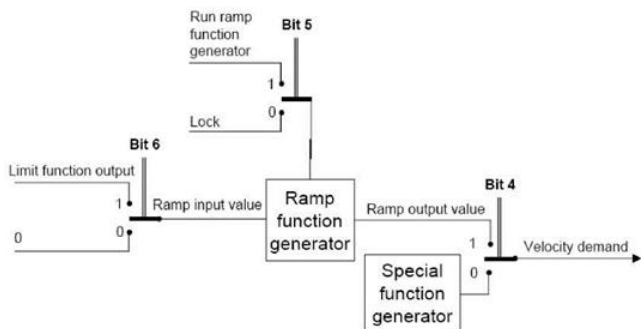
Status word (Object: 0x6041)

Index: 0x6041.

The following table lists the bit control words.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
nu	nu	nu	Nu	lla	tr	rm	nu	w	sod	qs	Ve	f	oe	so	rtso

rtso: Ready to switch on

so: Switched on

oe: Operation enabled

f: Fault (Trip)

ve: Voltage enabled

qs: Quick stop

sod: Switch on disabled

w: Warning

rm: Remote

tr: Target reached

ila: Internal limit active

nu: Not used

The following table lists the bit settings for the FAS statuses.

Status word	PDS FSA state
xxxx xxxx x0xx 0000b	Not ready to switch on
xxxx xxxx x1xx 0000b	Switch on disabled
xxxx xxxx x01x 0001b	Ready to switch on
xxxx xxxx x01x 0011 b	Switched on
xxxx xxxx x01x 0111b	Operation enabled
xxxx xxxx x00x 0111b	Quick stop active
xxxx xxxx x0xx 1111b	Fault reaction active
xxxx xxxx x0xx 1000b	Fault

vl target velocity (Object: 0x6042)

Index:0x6042

Function: Target speed Unit: rpm Basic format: 0

Setting range: -30,000 to 30,000

(Negative values are for reverse operations and positive values are for forward operations. The setting range may vary depending on the drive parameter settings).

Object description

Attribute	Value
Index	6042h
Name	vl target velocity
Object Code	Variable
Data Type	Integer16
Category	Conditional: mandatory if vl is supported

Entry description

Attribute	Value
Subindex	00h
Access	RW
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	0000h

vl velocity demand (Object: 0x6043)

Index:0x6042

Function: The current target speed Unit: rpm Basic format: 0

Setting range: -30,000 to 30,000

(Negative values are for reverse operations and positive values are for forward operations. The setting range may vary depending on the drive parameter settings.)

Object description

Attribute	Value
Index	6043h
Name	vl velocity demand
Object Code	Variable
Data Type	Integer16
Category	Conditional: mandatory if vl is supported

Entry description

Attribute	Value
Subindex	00h
Access	RO
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	No

vl velocity actual value (Object: 0x6044)

Index: 0x6044

Function: Sets the current operation speed Unit: rpm Basic format: 0

Setting range: -30,000 to 30,000

(Negative values are for reverse operation and positive values are for forward operation. The setting range may vary based on the drive parameter settings.)

Object description

Attribute	Value
Index	6044h
Name	vl velocity actual value
Object Code	Variable
Data Type	Integer16
Category	Conditional: Mandatory if vl is supported

Entry description

Attribute	Value
Subindex	00h
Access	RO
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	No

vl velocity min max amount (Object :0x6046)

This object is not supported by SD300 drives to prevent confusion, although it is included in the CiA402 profile. Drive parameters ADV 24, ADV 25, and ADV26 perform the same function as this object.

vl velocity Acceleration (Object :0x6048)

Index:0x6048

Function: Sets the acceleration time Unit: Sec.

Basic format: 0.0

Setting range: 0.0 to 600.0 (The setting range may vary based on the drive parameter settings.)

$$vl\ velocity\ acceleration = \frac{delta\ speed}{delta\ time}$$
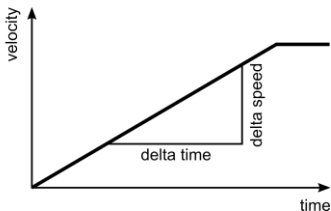
Transfer characteristic of the velocity acceleration

As explained in the figure above, this object is used to set the acceleration time using the speed and time differences (delta [A] speed and delta [A] time).

This setting is not configurable for the SD300 drive. To ensure reliable drive operation, the "delta_speed" is fixed as the "Max Speed."

Object description

Attribute	Value
Index	6048h
Name	vl velocity acceleration
Object Code	Record
Data Type	vl velocity acceleration deceleration
Category	Conditional: Mandatory if vl is supported

Entry description

| Attribute	Value
Subindex	02h
Description	Delta time
Entry Category	Mandatory
Access	RW
PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer specific

vl velocity Quick Stop (Object :0x604A)

Index:0x604A

Function: Sets the Quick Stop time

Unit: sec

Basic format: 0.0

Setting range: 0.0 to 600.0 (The setting range may vary based on the drive's parameter settings.)

Default setting: 100 (10 sec.)

$$vl \ velocity \ acceleration = \frac{delta \ speed}{delta \ time}$$
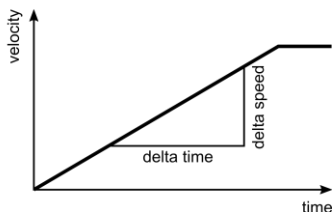
Transfer characteristic of the velocity acceleration

As explained in the figure above, this object is used to set the Quick Stop deceleration time using the speed and time differences (delta [A] speed and delta [A] time).

This setting is not configurable for the SD300 drive. To ensure reliable drive operation, the "delta_speed" is fixed as the "Max Speed."

Object description

Attribute	Value
Index	604Ah
Name	vl velocity quick stop
Object Code	Record
Data Type	vl velocity acceleration deceleration
Category	Conditional: Mandatory if vl is supported

Entry description

Attribute	Value
Subindex	02h
Description	Delta time
Entry Category	Mandatory
Access	RW
PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer specific

Modes of operation (Object: 0x6060)

Index:0x6060

This object indicates the drive's operation modes. The setting value is fixed as "0x02 (frequency converter)."

Modes of operation display (Object: 0x6061)

Index: 0x6061

This object indicates the drive's operation modes. The setting value is fixed as "0x02 (frequency converter).

Supported drive modes (Object: 0x6502)

Index: 0x6502

This object indicates the drive's operation modes. The setting value is fixed as "0x02 (frequency converter).

Service Data Objects for the SD300 Drive

When the PE Profile is used, these objects can be mapped as process data objects (PDO3) using the settings at parameters COM31 through COM38 and COM51 through COM58. If the CiA402 profile is used, these objects can only be used for accessing service data objects.

Common Area Service Data Object (SDO) Address Drive Monitoring Area

The drive monitoring area refers to the common read-only parameters located at 0h300 through 0h37F.

In the CiA402 profile, the index base address is 0x3300 and the subindex address is [(communication address - 0h300) + 1].

Example: Data at 0h0310 can be read from index 0x3300 (subindex: 0x11).

* Using the EDS file provided by Power Electronics, you can conveniently access the data by name.

Drive Control Area

The drive control area refers to the common parameters located at 0h380 through 0h3DF, which are used exclusively for drive control.

In the CiA402 profile, the index base address is 0x3380 and the subindex address is [(communication address - 0h380) + 1].

Example: Data at 0h0389 can be read from index 0x3380 (subindex: 0x0A).

Drive Memory Control Area

The drive memory control area refers to the common parameters located at 0h3E0 through 0h3FF, which are used exclusively for drive memory control.

In the CiA402 profile, the index base address is 0x33E0 and the subindex address is [(communication address - 0h3E0) + 1].

Example: Data at 0h03E1 can be read from index 0x33E0 (subindex: 0x02).

NOTE:

Before configuring a memory control area parameter, ensure that the previous parameter setting value is "0." If the setting value is not "0," you must set it to "0" first, then reset it to the desired value. If you try to change the setting value of a memory control parameter whose previous setting value is not "0," the change will not take effect.

Example: 0h03E0 (index:0x33E0, subindex: 0x01), if the parameter setting is "1:Yes," you must change it to "0:No," and then set it to "1:Yes" again to save the drive parameters.

Service Data Object Address for Keypad Parameter Area

For the keypad parameters, the parameter group decides the index address and the subindex is the code number.

The following table lists the index addresses by parameter groups.

Index	Area
0x3000	Common Area Parameter
0x3300	Extended Common Monitor
0x3380	Extended Common Control
0x33E0	Extended Common Memory Control
0x4100	DRV Group
0x4200	BAS Group
0x4300	ADV Group
0x4400	CON Group
0x4500	IN Group
0x4600	OUT Group
0x4700	COM Group
0x4800	APP Group
0x4B00	PRT Group
0x4C00	M2 Group
0x4D00	USS Group
0x4E00	USF Group

Example: You can access ind ex 0x4500 and subindex 0x05 to read the parameter setting at In (input) group code number 5 (In05, V1 Monitor[V]).

Process Data Objects for the SD300 Drive

The SD300 EtherCAT uses the PDOs defined for a frequency converter in the Drive and Motion Control features of the CiA 402 profile.

Receive Process Data Object (RPDO)

The RPDOs in the CiA 402 profile are as follows.

RPDO number	Type	Description
1	Mandatory	Control PDS FSA* and Target velocity (vl)
3	Optional	Manufacturer specifications

*PDS FAS: Power Drive System Finite State Automaton

The SD300 EtherCAT supports only RPDO1 and RPDO3.

The RPDO addresses are as follows:

The communication parameter object index address of RPDO1 is 0x1600.
The communication parameter object index address of RPDO3 is 0x1602.
The subindex parameters in the object are identical.

The following table lists the **RPDO1** parameters.

Subindex	Description	
0x00	Function	Number of Entries
	Access	Ready only
	Default setting	2
0x01	Function	Mapping Entry 1
	Access	Read only
	Default setting	0x60400010; RPDO data1 address
0x02	Function	Mapping Entry 2
	Access	Read only
	Default setting	0x60420010; RPDO data2 address

RPDO MAPPING

In the SD300 CiA402 profile, the map is fixed and cannot be modified by users.

• RPDO1 Mapping

The RPDO is set in the CiA 402 profile. The index address is 0x1600 The following table shows the map settings for RPDO1.

Subindex	Setting value	Parameter index	Parameter subindex	Parameter name
0x01	0x60400010	0x6040	0	Control word
0x02	0x60420010	0x6042	0	vl target velocity

• RPDO3 Mapping

The PDO is set in the PE Drive profile. The index address is 0x1602. The following table shows the map settings for RPDO3.

Subindex	Setting value	Parameter index	Parameter subindex	Parameter name
0x01	0x50000110	0x5000	1	Para Control - 1 Data Value
0x02	0x50000210	0x5000	2	Para Control - 2 Data Value
0x03	0x50000310	0x5000	3	Para Control - 3 Data Value
0x04	0x50000410	0x5000	4	Para Control - 4 Data Value
0x05	0x50000510	0x5000	5	Para Control - 5 Data Value
0x06	0x50000610	0x5000	6	Para Control - 6 Data Value
0x07	0x50000710	0x5000	7	Para Control - 7 Data Value
0x08	0x50000810	0x5000	8	Para Control - 8 Data Value

Para Control -x Data Values are the values to be written to the parameter addresses for COM-51 through COM-58.

After the SD300 SDO addresses are set to parameters COM-51 through COM-58 by accessing the SDO, a PDO communication becomes available with the setting values set in the PDO3 objects.

Transmit Process Data Object (TPDO)

The TPDOs in the CiA 402 profile are as follows.

TPDO number	Type	Description
1	Mandatory	Controls PDS FSA and Target velocity (vl)
2	Optional	Manufacturer specifications

The SD300 EtherCAT communication supports only TPDO1 and TPDO3.

The RPDO addresses are as follows:

The communication parameter object index address of TPDO1 is 1x1A00.
The communication parameter object index address of TPDO2 is 0x1A02.
The subindex parameters in the object are identical.

The following table lists the **TPDO1** parameters.

Subindex	Description	
0x00	Function	Number of Entries
	Access	Ready only
	Default setting	2
0x01	Function	Mapping Entry 1
	Access	Read only
	Default setting	0x60410010; TPDO data1 address
0x02	Function	Mapping Entry 2
	Access	Read only
	Default setting	0x60440010; TPDO data2 address

TPDO MAPPING

In the SD300 CiA402 profile, the map is fixed and cannot be modified by users.

• TPDO1 Mapping

The TPDO set in the CiA 402 profile. The index address is 1x1A00. The following table shows the map settings for PDO1:

Subindex	Setting value	Parameter index	Parameter subindex	Parameter name
0x01	0x60410010	0x6041	0	Statusword
0x02	0x60440010	0x6044	0	vl velocity actual value

• TPDO3 Mapping

The PDO is set in the PE Drive Profile. The index address is 0x1A02. The following table shows the map settings for PDO3.

Subindex	Setting value	Parameter index	Parameter subindex	Parameter name
0x01	0x50100110	0x5010	1	Para Status - 1 Data Value
0x02	0x50100210	0x5010	2	Para Status - 2 Data Value
0x03	0x50100310	0x5010	3	Para Status - 3 Data Value
0x04	0x50100410	0x5010	4	Para Status - 4 Data Value
0x05	0x50100510	0x5010	5	Para Status - 5 Data Value
0x06	0x50100610	0x5010	6	Para Status - 6 Data Value
0x07	0x50100710	0x5010	7	Para Status - 7 Data Value
0x08	0x50100810	0x5010	8	Para Status - 8 Data Value

Para Control -x Data Values are the values to be read from the parameter addresses for COM-31 through COM-38. After the SD300 SDO addresses are set to parameters COM-31 through COM-38 by accessing the SDO, a PDO communication becomes available with the setting values set in the PDO3 objects.

* While using CiA402 or PE profile communication, Keypad control is not recommended to prevent command collision. (It operates in predefined motion when controlling the drive with communication system. Controlling the drive randomly with key pad may cause errors in systematic operation.)

* It may prevent false operation if KeyPad is set to 1000 FWD when target velocity is set to -1000FWD.

* Please change the control word to 0x0F when using CiA402.

* It is not requested the additional setting when using the PE profile.

OPERATION

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To run the SD300 drive using the EtherCAT communication module, set drv (Cmd Source) to [4 Comms] using the keypad. To provide a frequency reference via the EtherCAT communication module, set frq (Freq Ref Src) to [8 Comms].

Screen	Description	Keypad display	Range	Default value	Set on run
drv	Set this parameter to "4 COMMS" to select the EtherCAT ommunication module as the command source.	Cmd Source	LOCAL REMOTE REMOTE 2 MODBUS COMMS PLC	REMOTE	N
frq	Set to "8 COMMS" to select the EtherCAT communication module as the source of the frequency reference.	Freq Source	LOCAL V1 V2 I2 MODBUS COMMS PLC PULSE	LOCAL	N
dr.08	Set the torque reference source.	Trq Source	LOCAL V1 V2 I2 MODBUS COMMS PLC PULSE	LOCAL	N
CM.06	Display the software version of the EtherCAT module.	S/W Ver	X.XX	-	Read only

Screen	Description	Keypad display	Range	Default value	Set on run
CM.09	EtherCAT communication module's LED status.	Comms LED	0Bit : RUN LED (Green) 1Bit : ERROR LED (Red) 2Bit : LINK in LED (Green) 3Bit : LINK out LED (Green) **NOTE**: Refer to section *"LEDs description"* for further details.		N
CM.11	Select the profile type: **0**: CiA 402 Drive and Motion Control Velocity Mode (Frequency Converter PDO1) **1:** PE Device Profile (PDO3).	Opt Parameter 2	0: CiA402 Profile 1:PE profile	CiA402 Profile	N
CM.30[1]	Number of the TPDO data to be read by the EtherCAT master device	Para Status Num	0 to 8	3	N
CM.31[2]		Para Status - 1		0x000A	N
CM.32[3]		Para Status - 2		0x000E	N
CM.33[3]		Para Status - 3		0x000F	N
CM.34[3]	Address of the TPDO data to be read by the EtherCAT master device	Para Status - 4	0x0000 to 0xFFFF	0x0000	N
CM.35[3]		Para Status - 5		0x0000	N
CM.36[3]		Para Status - 6		0x0000	N
CM.37[3]		Para Status - 7		0x0000	N
CM.38[3]		Para Status - 8		0x0000	N

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[1] This parameter can only be configured if CM.11 is set to 1. Configure this parameter to set the number of parameters to receive from the master unit.
[2] These parameters can only be configured if CM.11 is set to 1.

Screen	Description	Keypad display	Range	Default value	Set on run
CM.50[3]	Number of the RPDO data to be controlled by the EtherCAT master device	Para Control Num	0 to 8	2	N
CM.51[3]		Para Control -1		0x0005	N
CM.52[3]		Para Control -2		0x0006	N
CM.53[3]		Para Control -3		0x0000	N
CM.54[3]	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -4	0x0000 to 0xFFFF	0x0000	N
CM.55[3]		Para Control -5		0x0000	N
CM.56[3]		Para Control -6		0x0000	N
CM.57[3]		Para Control -7		0x0000	N
CM.58[3]		Para Control -8		0x0000	N
CM.94	Apply parameter settings changed by keypad to the EtherCAT module. Select "Yes" to apply changes	Comm Update	No Yes	No	N
Pr.12	Set the operation mode for a Lost Command condition	Lost Cmd Mode	None Free-Run Dec Hold Input Hold Output Lost Preset	None	N
Pr.13	Set the Lost Command time.	Lost Cmd Time	0.1 to 120.0s	1.0s	N
Pr.14	Set the Lost Preset speed.	Lost Preset F	dr.19 to dr.20 Hz/Rpm	0 Hz/Rpm	N

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[3] This parameter can only be configured if CM.11 is set to 1. Configure this parameter to set the number of parameters to be transmitted to the master unit.

Setting the Parameters for Lost Command Conditions

When the NMT status is "Operation" and "Pre-operation," the EtherCAT module assumes normal network communication where the master and slave units are linked. When the NMT status becomes any status other than "Operation" or "Pre-operation," the drive enters the Lost Command condition after the lost command time set at Pr.13 has elapsed. The Lost Command condition is available only when both or either the command reference and/or the source of frequency reference is set to "COMMS."

Pr.12 Lost Cmd Mode

- **None**: The drive does not perform actions when the Lost Command condition is met.
- **Free-Run**: When the Lost Command condition is met, the motor performs a free-run stop and the drive outputs a Lost Command fault trip.
- **Dec**: When the Lost Command condition is met, the motor performs a deceleration stop and the drive outputs a Lost Command fault trip.
- **Hold Input**: When the Lost Command condition is met, the drive operates the motor using the last speed reference received and outputs a Lost Command warning.
- **Hold Output**: When the Lost Command condition is met, the drive maintains the current motor speed and outputs a Lost Command warning.
- **Lost Preset**: When the Lost Command condition is met, the drive runs the motor at the speed set at Pr.14 and outputs a Lost Command Warning.

Pr.13 Lost Cmd Time

During EtherCAT network communication, the drive enters the Lost Command condition if the MNT state enters anything other than the Operation or Pre-operation status and if the condition is maintained after exceeding the time set at Pr.13.

Pr.14 Lost Preset F

If Pr.12 (Lost Cmd Mode) is set to "Lost Preset," the drive operates the motor using the preset speed set at Pr.14 when it enters the Lost Command mode

CONFIGURATION REGISTER

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VARIABLE SPEED DRIVE: SD300.
SERIAL Nº: MODEL:
APPLICATION:
DATE:
CUSTOMER:
NOTES:

PARAMETER / DESCRIPTION	DEFAULT VALUE	SETTING 1	SETTING 2
CM.6 Communication S/W version	0.00		
drv Command source	REMOTE		
frq Frequency reference source	LOCAL		
dr.08 Torque reference source	LOCAL		
CM.06 Software version	X.XX		
CM.09 LEDs status	0000		
CM.11 Profile Type	CiA402 Profile		
CM.30 Number of TPDO data objects to be read	3		
CM.31 TPDO data address 1	0x0000		
CM.32 TPDO data address 2	0x0000		
CM.33 TPDO data address 3	0x0000		
CM.34 TPDO data address 4	0x0000		

PARAMETER / DESCRIPTION	DEFAULT VALUE	SETTING 1	SETTING 2
CM.35 TPDO data address 5	0x0000		
CM.36 TPDO data address 6	0x0000		
CM.37 TPDO data address 7	0x0000		
CM.38 TPDO data address 8	0x0000		
CM.50 Number of RPDO data to be controlled by master	2		
CM.51 RPDO data address 1	0x0000		
CM.52 RPDO data address 2	0x0000		
CM.53 RPDO data address 3	0x0000		
CM.54 RPDO data address 4	0x0000		
CM.55 RPDO data address 5	0x0000		
CM.56 RPDO data address 6	0x0000		
CM.57 RPDO data address 7	0x0000		
CM.58 RPDO data address 8	0x0000		
CM.94 Apply changes	No		
Pr.12 Operation mode for lost command	None		
Pr.13 Lost command time	1.0s		
Pr.14 Lost preset speed	0 Hz/Rpm		

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