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**Sumitomo Drive Technologies**



# Smart Squirrel CANOpen Communication



Attention.

■ This product should only be handled by persons skilled in the work. Please read the instruction manual carefully before use.

■ This instruction manual should be delivered to the customer who will actually use the product.

■ Please be sure to keep this instruction manual.



住友重機械工業株式会社

Handling instructions

No.DM1803-1



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This instruction manual is for the smartris servo driver CANOpen.  
Refer to the smartris servo driver instruction manual (No.DM1802) for handling the driver, and the smartris gearmotor instruction manual (No.DM1801) for handling the motor/gear sections.

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Introduction】 How to read the instruction

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# [1] Overview

## 1-1 Purpose of this document

This manual contains information on the safe installation and operation of this product (Smart Squirrel). Please read this manual carefully before use.

To use this product safely, follow the safe handling and warnings described. Keep this manual in a safe place and available at all times.

### Attention

- This manual is intended for use by designated operators of the product.
- This is the instruction manual for CANOpen.

This document is written subject to the following conditions and limitations

This document contains information that belongs to our company.

Information for servo drive users to implement CANOpen networking is provided.

The documents and diagrams included in this document are for illustrative and reference purposes only.

The companies and individual names and data used in the examples are fictitious unless otherwise noted.

The contents of this document are subject to change without notice.

## 1-2 Safety Precautions

To ensure safe operation of this product, the safe procedures described in this manual should be followed. When this product and peripheral equipment are in operation, the operator and surrounding areas are to be protected.

### Attention

- The entire system should be checked to ensure that the various switches are operating properly and that there are no warning indications.
- Before startup, check wiring and make sure drivers are not damaged.
- Applying an out-of-specification voltage or reverse-connecting the cable may cause the driver to malfunction.
- Do not connect or disconnect cables with the power on or during operation.
- The operator is responsible for safe installation that complies with codes and standards.

Note: Read this chapter carefully before installation.

This product contains parts sensitive to static electricity and will malfunction if handled improperly.

To prevent static electricity failure, avoid touching highly insulated plastic films or synthetic fibers.

Install on top of a conductive product and ground it to discharge static electricity.

Close the cover and control panel door to avoid hazards that may cause injury to operators or product failure.

## hazard

- Do not disconnect or connect the wires of the driver while the power is on. This is to avoid malfunctions or electric shock accidents caused by arcing.
- High voltage is applied to the cable even when the motor is stopped. Do not disconnect the cable.
- When disconnecting the power connection after turning off the power, wait at least one minute before touching the device. This is because the capacitors and contacts are charged.

It is recommended to measure the voltage with a measuring instrument before touching the equipment.

## attention

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This is a precaution to avoid harm to personnel or damage to the product or equipment.

- DC power should be applied within the voltage specifications listed in this manual.
- When connecting this product to a power cable, separate it from hazardous high-voltage lines and insulate it in accordance with safety standards.
- Before operating the product, check for safety that it has been installed according to the procedures in this manual.
- Before using the Safe Torque Off function, please confirm its operation.
- If a fire breaks out in the equipment, do not spray water directly on the equipment to extinguish it.

## attention

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- This information confirms that the product can be operated normally and that it is understood.

Safety measures must be taken for the operator and the machine in accordance with the standards.

## 1.3 Certification

### (1) CE Conformity

This product has been certified by a certification body as conforming to the following EC directives

- EMC Directive (2014/30/EU)
- RoHS Directive (2011/65/EU)
- WEEE Directive (2012/19/UE)

### (2) safety

Conforms to the following EN standards for safety

- EN 61800-5-1: Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and Electrical, thermal and energy.



# [1] Outline

## (3) EMC Requirements

This product meets the requirements of the "second environment" (industrial environment) category terms of emissions and immunity.

- EN 61800-3: Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods.

## (4) Functional Safety Compliance (STO)

This product is equipped with a two-channel STO (Safe Torque-Off) input that conforms to functional safety. Its function is to stop the PWM output and safely torque-off the driver.

The designed circuit has been tested and certified by TÜV Süd.

The functional safety of "Safe Torque Off" in the design circuit of this product complies with the following EN standards

- EN 61508: Functional safety of electrical/electronic/programmable electronic safety-related systems
- EN 61800-5-2 and category : Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
- EN ISO 13849-1: 2015: Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design.

The subsystems contain safety conditions based on the following characteristics

EN 13849-1	EN 61508	PFHD [1/h]
PL <sub>e</sub>	SIL3	-

**Important:** This product must start up as an EMC directive until the product has been verified that it is installed to the standards of the EC Directive.

## (1) Correct usage

This product can be applied to drive synchronous type servo motors using permanent magnets. (Servo motors for feedback systems in machines and systems)

This product is certified for use in industrial applications. Additional EMC measures are required for use in residential areas.

The customer must prepare a hazard analysis of the final product.

Attention	
●	Customers intending to use the product for non-industrial applications must first obtain our approval.

## (2) Inappropriate use

This product is not compatible with motors other than synchronous servo motors. It is also not compatible with motors to which the feedback system is not compatible.

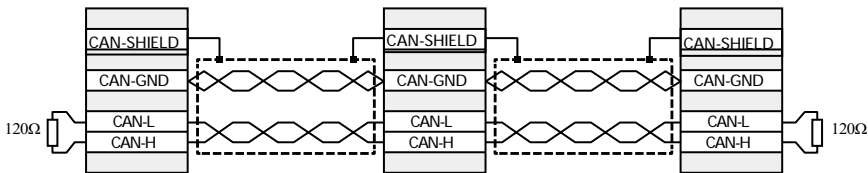
Installation in hazardous areas with flammable materials, combustible gases, dust, etc. may cause fire or explosion. Do not install or use the driver or motor of this product in such an environment.

CANOpen is a communication protocol, used for automation, and is a device profile for integration into systems.

The CANOpen standard utilizes an application layer defined by an addressing scheme, communication protocol, and device profile.

Table 2-1 CANOpen network topology

Signal	Contents
GND_CAN	GND of CANOpen
CAN_T	120 Ω CANOpen termination resistor (connection to CAN_H)
CAN_L	CAN_L connection
CAN_H	CAN_H connection



## (1) CANOpen baud rate and node ID

Complies with CiA DS301 Ver. 4.02 and DSP402 Ver. 2.0 directives.

- CANOpen object baud rates 250K, 500K, 800K, 1000K (default setting: 1000Kb)
- Node ID (initial value: ID = 1)

## (2) EDS File

The EDS file is a standard format describing the device. It contains the following items

- File properties (name, version, release date, etc.)
- General device information (manufacturer, code)
- Device name, type, version

Supported baud rates and boot-up options

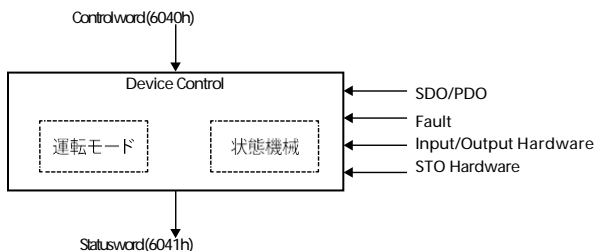
- Description of supported objects and attributes

## 2] CANOpen operation

### 2-2 CAN Overview

The CAN Overview via CANOpen, a state machine defined in the DSP402. Device control functions can monitor controller functions.

This function is an operating mode function and is divided into device control of the state machine.



The status machine is controlled by the control word (6040h). The state of the controller can be read by the status word (6041h).

The master controller can be controlled by PDO and SDO protocols.

The state machine is affected by internal events. → Hardware inputs like errors (if they work)

#### (1) System Details

Complies with CiA DS301 Ver. 4.02 and DSP402 Ver. 2.0 directives.

#### (2) forte

- Identity Objects: proof of vendor ID, product code, revision number, and serial number. Baud rate set by CANOpen. (Default value: 1000 kb)  
Node Id is set by the CANOpen object (initial value: node Id = 1).
- Service Data Object (SDO): SDO messages are used for read-write access on all inputs of the object dictionary; SDOs are used to configure the device in the first step.
- Process Data Object: real-time data transmission of target position and target velocity, input and output definitions are performed in the PDO message. Data is transmitted in no more than four TPDOs (PDO transmissions) in data blocks of up to 8 bytes; there are maps fixed to four TPDOs and four RPDOs.
- Network Management (NMT): The NMT state machine defines the communication of CANOpen devices.
- Emergency Object: Emergency messages are triggered by a fatal error inside the device and are sent from the associated application device to other devices with higher priority.  
This is suitable for error warnings to interrupt.
- Sync Message: the SYNC protocol enables synchronized network operation. (Not implemented)
- Node-Guard Protocol: periodic query of node state by the NMT master.  
The NMT master sends a message to the CANOpen slave, which responds within a defined time.

## 2] CANOpen operation

→Heartbeat Function Protocol: Automatic forwarding of heartbeat messages by network nodes.

Heartbeat messages are sent to the bus at ms intervals.

Heartbeats help locate the presence or absence of nodes in the network.

-Event Timer: (Not implemented)

-Store and Restore Parameters: Parameters are saved in non-volatile memory.

(communication, manufacturer specific, device profile related parameters)

-Input/output: Digital input/output is defined by the enable input object.

(Low level in standby mode and Switch ON Disabled)

-State Machine: Device control is performed by the DSP402 state machine.

-Mode of Operation: Different operating modes of the CiA402 profile can be used.

It also supports manufacturer-specific modes of operation where the drive is controlled by hardware inputs and outputs.

2-3 DS301s Profile, see CiA DS301 Standard.

### (1) SDO Service Data Object

The SDO protocol is used to set/read parameters.

SDOs are used to perform access to the object dictionary. Communication is initiated by the SDO client at all times.

At the request of the client (master, PC, PLC) the drive makes the data available. The following communication protocols are supported

-SDO download protocol, SDO upload protocol, SDO abort protocol

### ■ SDO Download Protocol

The SDO download service is used to initialize communication, device, and manufacturer-specific parameters.

Table 2-2 SDO Download Message Structure

COB-ID	Request Respond	DLC	data							
			D0	D1	D2	D3	D4	D5	D6	D7
0x600 +Node ID	Rx	8	0x2x	Index		Sub Index	Data LSB	Data	Data	Data MSB
0x580 +Node ID	Tx	8	0x60	Index		Sub Index	0x00	0x00	0x00	0x00

Table 2-3 SDO Download Messages - Data Fields

D0	Contents	Number of data bytes
0x22	Right Request (domain download started)	-
0x23	Request (domain download started)	4 bytes
0x27	Right Request (domain download started)	3 bytes
0x28	Light Response (domain download started)	2 bytes
0x2F		1 byte
0X60		-

## 2] CANOpen operation

### ■ SDO Upload Protocol

The SDO Upload Service is used for communication and reading device and manufacturer-specific parameters.

Table 2-4 SDO Upload Message Structure

COB-ID	Request Respond	DLC	data							
			D0	D1	D2	D3	D4	D5	D6	D7
0x600 +Node ID	Rx	8	0x40	Index		Sub Index	0x00	0x00	0x00	0x00
0x580 +Node ID	Tx	8	0x4x	Index		Sub Index	Data LSB	Data	Data	Data MSB

Table 2-5 SDO Upload Messages - Data Fields

D0	Cont ents	Number of data bytes
0x40	Lead request (domain upload initiated)	-
0x43	Lead response (domain upload initiated)	4 bytes
0x47	response (domain upload initiated)	3 bytes
0x48	Lead response (domain upload initiated)	2 bytes
0x4F		1 byte

### Abort Code

The SDO abort service is used to communicate anomaly information by either download or upload service.

If SDO communication fails, CANOpen returns an SDO abort message instead of the normal SDO message. The abort message contains an abort code that identifies the nature of the error.

Table 2-6 SDO Abort Message Structure

COB-ID	Request Respond	DLC	data							
			D0	D1	D2	D3	D4	D5	D6	D7
0x580 +Node ID	Tx	8	0x80	Index		Sub Index	Abort Code			

Abort codes are defined in the following table. They are encoded in unsigned 32-bit.

Table 2-7 Abort Codes

abort code	Cont ents
0504 0000h	SDO Protocol Timeout
0504h	Invalid or unknown client/server directive
0504 0002h	Prohibited block size (block mode only)
0504 0003h	Prohibited sequence number (block mode only)
0504 0004h	CRC error (block mode only)
0504 0005h	out of memory
0601 0000h	Unsupported access to objects
0601 0001h	Read to write-only object
0601 0002h	Write to read-only object

## 2] CANOpen operation

abort code	Contents
0602 0000h	Object does not exist in the object dictionary.
0604 0041h	Object cannot be mapped to PDO.
0604 0042h	The number and length of the object being mapped exceeds the length of the PDO.
0604 0043h	Reason for parameter mismatch
0604 0047h	Internal device mismatch
0606 0000h	Access failure due to hardware error
0607 0010h	Data type incompatibility (inconsistent data length of service parameters)
0607 0012h	Data type incompatibility (long data length of service parameter)
0607 0013h	Data type incompatibility (short data length of service parameter)
0609 0011h	No sub-indexes exist.
0609 0030h	Invalid parameter value (download only)
0609 0031h	High parameter values. (Download only)
0609 0032h	Low parameter values. (Download only)
0609 0036h	The maximum value is less than the minimum value.
060A 0000h	Operation is not allowed in this state
060A 0023h	Resource is not available. SDO Connection
0800 0000h	general error
0800 0020h	Data cannot be sent or stored in the application.
0800 0021h	Data is not sent or cannot be sent or stored in the application(Local system for the sake of ...)
0800 0022h	Data is not sent or cannot be sent or stored in the application(Current dev. (sstate))
0800 0023h	Dynamic generation of object dictionary failed or object dictionary does not exist. (e.g., when generating an object dictionary from a file, the file error (Generation fails due to))
0800 0024h	Data unavailable
0800 0025h	Data cannot be written. (STORE command and reset or power supply reset are not available. (Because it is necessary))

### (2) PDO Process Data Objects (Process Data Objects)

The PDO protocol is used to process real-time data between various nodes. PDO is defined via an object dictionary and is currently defined in the default fixed map.

PDO services and protocols are defined in DS301. Basically, two types of PDO are distinguished according to the direction of transmission.

-Receive PDO (RPDO): Driver from master controller (e.g., speed set point)

→Transmit PDO (TPDO): Driver to master controller (e.g., drive status, actual speed, etc.)

The driver supports four independent PDOs in each transmission direction.

## 2] CANOpen operation

### Receive PDO (RPDO: Receive Process Data Object )

The RPDO is configured to obtain operational data from the controller. RPDO is a CAN frame identified by an 11-bit header.

4 bits	7 bits
object type	Node ID

-RPDO1: 0x200 + node ID, RPDO2: 0x300 + node ID

-RPDO3: 0x400 + node ID, RPDO4: 0x500 + node ID

CANOpen in smartris supports RPDO.

Unless otherwise specified in the product datasheet, data received using the RPDO is stored in eight user variables that can be processed by the script. The following table shows the mapping of the RPDO default settings.

Table 2-8 Contents of RPDO

RPDO	Index	Sub Index	Contents	data type	access	initial value	Contents
1	1400h	0	Receive PDO1 (RPDO1)	U8	ro	3	Number of entries
		1	COB ID (RPDO1)	U32	RW	0x200 +Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFE	Asynchronous Man.Spec.
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1600h	0	RPDO1 Mapping	U8	ro	3	Number of entries
		1	Application object 1	U16	RW	0x6040 0010	control word
		2	Application object 2	INT8	RW	0x6060 0008	Operation mode
		3	Application Object 3	U32	RW	0x60FE 0020	Digital output
2	1401h	0	Receive PDO2 (RPDO2)	U8	ro	3	Number of entries
		1	COB ID (RPDO2)	U32	RW	0x300 +Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFE	Asynchronous Man.Spec.
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1601h	0	RPDO2 Mapping	U8	ro	2	Number of entries
		1	Application object 1	U16	RW	0x6040 0010	control word
		2	Application object 2	INT32	RW	0x607A 0020	target position
		3	Application Object 3	U32	RW	0x60FE 0020	Digital output
3	1402h	0	Receive PDO3 (RPDO3)	U8	ro	3	Number of entries
		1	COB ID (RPDO3)	U32	RW	0x400 +Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFE	Asynchronous Man.Spec.
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1602h	0	RPDO3 Mapping	U8	ro	2	Number of entries
		1	Application object 1	U16	RW	0x6040 0010	control word
		2	Application object 2	INT32	RW	0x60FF 0020	Target Speed
		3	Application Object 3	U32	RW	0x60FE 0020	Digital output
4	1403h	0	Receive PDO4 (RPDO4)	U8	ro	3	Number of entries
		1	COB ID (RPDO4)	U32	RW	0x500 +Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFE	Asynchronous Man.Spec.
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1603h	0	RPDO4 Mapping	U8	ro	2	Number of entries
		1	Application object 1	U16	RW	0x6040 0010	control word
		2	Application object 2	INT16	RW	0x6071 0010	Target torque
		3	Application Object 3	U32	RW	0x60FE 0020	Digital output

### ■ Transmit PDO (TPDO)

TPDOs are identified on the CANOpen network by the bit pattern in the 11-bit header of the CAN frame.

4 bits	7 bits
object type	Node ID

-TPDO1: 0x180 + node ID, TPDO2: 0x280 + node ID

-TPDO3: 0x380 + node ID, TPDO4: 0x480 + node ID

CANOpen in smartis allows 4 TPDOs for all node IDs.

Unless otherwise specified in the product datasheet, TPDO 1 through 4 are used to send 8 user variables that can be loaded with operating parameters using scripts.

The following table shows the mapping of TPDO's default settings.

Table 2-9 Contents of TPDO

TPDO	Index	Sub Index	Contents	data type	access	initial value	Contents
1	1800h	0	Transmit PDO1 (TPDO1)	U8	ro	3	Number of entries
		1	COB ID (TPDO1)	U32	RW	0x180 + Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFD	Asynchronous RTR
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1A00h	0	TPDO1 Mapping	U8	ro	3	Number of entries
		1	Application object 1	U16	RW	0x6041 0010	status word
		2	Application object 2	INT8	RW	0x6061 0008	Operation display mode
2	1801h	0	Transmit PDO2 (TPDO2)	U8	ro	3	Number of entries
		1	COB ID (TPDO2)	U32	RW	0x280 + Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFD	Asynchronous RTR
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1A01h	0	TPDO2 Mapping	U8	ro	2	Number of entries
		1	Application object 1	U16	RW	0x6041 0010	status word
		2	Application object 2	INT32	RW	0x6064 0020	position actual value
3	1802h	0	Transmit PDO3 (TPDO3)	U8	ro	3	Number of entries
		1	COB ID (TPDO3)	U32	RW	0x380 + Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFD	Asynchronous RTR
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1A02h	0	TPDO3 Mapping	U8	ro	2	Number of entries
		1	Application object 1	U16	RW	0x6041 0010	status word
		2	Application object 2	INT32	RW	0x606C 0020	Velocity Actual
4	1803h	0	Transmit PDO4 (TPDO4)	U8	ro	3	Number of entries
		1	COB ID (TPDO4)	U32	RW	0x480 + Node ID	PDO Enabled
		2	Transmission type	U8	RW	0xFD	Asynchronous RTR
		3	Inhibit time	U16	RW	0x5	Unit 10ms
	1A03h	0	TPDO4 Mapping	U8	ro	2	Number of entries
		1	Application object 1	U16	RW	0x6041 0010	status word
		2	Application object 2	INT16	RW	0x6077 0020	Actual torque



## 2] CANOpen operation

RPDO mapping  
initialization  
n RPDO1: PDS FSA control -  
Forced

Table 2-10 RPDO1 Mapping

Index	Sub-Index	Name	initial value
1600h	-	Receive RPDO1	COB-ID
	0	Number of mapped objects	3
	1	control word	6040 0010h
	2	Operation mode	6060 0008h
	3	Digital output	60FE 0120h

Mapping initialization RPDO2: RPDO2: RPDO2: RPDO2  
PDS FSA control and target position (pp) - optional

Table 2-11 RPDO2 Mapping

Index	Sub-Index	Name	initial value
1601h	-	Receive RPDO2	COB-ID
	0	Number of mapped objects	2
	1	control word	6040 0010h
	2	target position	607A 0020h

Mapping initialization RPDO3: RPDO3: RPDO3: RPDO3  
PDS FSA control and target speed (pv) - optional

Table 2-12 RPDO3 Mapping

Index	Sub-Index	Name	initial value
1602h	-	Receive RPDO3	COB-ID
	0	Number of mapped objects	2
	1	control word	6040 0010h
	2	Target Speed	60FF 0020h

Mapping initialization RPDO3: RPDO3: RPDO3: RPDO3  
PDS FSA control and target torque (tq) - optional

Table 2-13 RPDO4 Mapping

Index	Sub-Index	Name	initial value
1603h	-	Receive RPDO4	COB-ID
	0	Number of mapped objects	2
	1	control word	6040 0010h
	2	Target torque	6071 0010h

### TPDO mapping initialization

TPDO1: PDS FSA status specified

- Forced

Table 2-14 TPDO1 Mapping

Index	Sub-Index	Name	initial value
1A00h	-	Transmission TPDO1	COB-ID
	0	Number of mapped objects	3
	1	status word	6041 0010h
	2	Operation mode display	6061 0008h
	3	Digital input	60FD 0020h

Mapping initialization TPDO2: TPDO2: TPDO2: TPDO2

PDS FSA status specification and current position (pp) - Optional

Table 2-15 TPDO2 Mapping

Index	Sub-Index	Name	initial value
1A01h	-	Send TPDO2	COB-ID
	0	Number of mapped objects	2
	1	status word	6041 0010h
	2	position actual value	6064 0020h

Mapping initialization TPDO3: TPDO3: TPDO3: TPDO3

PDS FSA status specification and current speed (pv)-optional

Table 2-16 TPDO3 Mapping

Index	Sub-Index	Name	initial value
1A02h	-	Send TPDO3	COB-ID
	0	Number of mapped objects	2
	1	status word	6041 0010h
	2	Velocity Actual	606C 0020h

Mapping initialization TPDO4: TPDO4: TPDO4: TPDO4

PDS FSA status specification and current torque (tq) - Optional

Table 2-17 TPDO4 Mapping

Index	Sub-Index	Name	initial value
1A03h	-	Send TPDO4	COB-ID
	0	Number of mapped objects	2
	1	status word	6041 0010h
	2	Actual torque	6077 0010h

## 2] CANOpen operation

### (3) Emergent Messages (EMCY)

An emergence object is triggered by the occurrence of an error in the CANOpen device and is sent to the network. The emergence object is suitable for error alerts.

An emergence object is sent for each event.

#### EMERGENCY MESSAGE STRUCTURE

CANOpenDSP402: Table 2-18 Emergency Message

COB-ID	Rx/Tx	DLC	0	1	2	3	byte	4	5	6	7
			error code		resistor	manufacturer specific error field					
0x80 +Node ID	Tx	8	E0	E1	R0	M0	M1	Mega 2	M3	M4	

Field Standard for Error Codes DS301: Table 2-19

#### Emergency Error Codes

error code	Name	Contents
0x0000	NO ERROR	Error reset or no error
0x1000	GENERIC ERROR	General Error
0x2000	CURRENT	electric current
0x2000	CURRENT INPUT	Device input current
0x2100	CURRENT INSIDE	Device internal current
0x2000	CURRENT OUTPUT	Device output current
0x3000	VOLTAGE	Voltage
0x3100	VOLTAGE MAINS	Main power supply voltage
0x3200	VOLTAGE INSIDE	Internal voltage of device
0x3300	VOLTAGE OUTPUT	Output voltage
0x4000	TEMPERATURE	Temperature
0x4100	TEMP AMBIENT	Ambient temperature
0x4200	TEMP DEVICE	Device temperature
0x5000	HARDWARE	Device Hardware
0x6000	SOFTWARE DEVICE	Device Software
0x6100	SOFTWARE INTERNAL	internal software
0x6200	SOFTWARE USER	user software
0x6300	DATA SET	data setup
0x7000	ADDITIONAL MODULE	Additional Modules
0x8000	MONITORING	monitoring
0x8100	communication	communication
0x8200	PROTOCOL ERROR	protocol error
0x9000	EXTERNAL ERROR	external error
0xF000	ADDITIONAL FUNC	Additional Functions
0xFF00	DEVICE SPECIFIC	Device Specifications

## 2] CANOpen operation

Register Field Standard DS301: CANOpen devices map internal errors to this object. Bit 0 is a general error. It is forced to be set when an error occurs. Other bits indicate specific different types of errors.

Table 2-20 Emergency Register Fields

resistor	bit	Name	Contents
0x00	-	NO ERROR	Error reset or no error
0x01	1	REGISTER GENERIC ERROR	General Error
0x02	2	REGISTER CURRENT	electric current
0x04	3	REGISTER VOLTAGE	Voltage
0x08	4	REGISTER TEMPERATURE	Temperature
0x10	5	REGISTER COMMUNICATION ERROR	Communication errors (overrun, error state)
0x20	6	REGISTER DEVICE PROFILE	Device Profile Specifications
0x40	7	REGISTER RESERVED	Reserved area (always 0)
0x80	8	REGISTER MANUFACTURER	Manufacturer-specific specifications

Below are the alarm groups (Fault /Fault, Warning / Alarm) implemented in smartris in the CANOpen code.

Table 2-21 Emergencies

error	error code	Contents	Explanation	F/W	LED code
NO ERROR	0x0000	No Error	Execute reset instruction or reset power supply	-	-
GENERIC ERROR	0x1000	General Error	General Error	-	-
Current alarm					
SHORT CIRCUIT MOTOR	0x2340	Short circuit (motor side)	Overcurrent alarm occurs	f	3, 1
LOAD LEVEL FAULT	0x2350	Overload alarm (I <sup>2</sup> t, thermal)	I <sup>2</sup> Overcurrent with t integration	f	5, 2
LOAD LEVEL WARNING	0x2351	Overload Warning (I <sup>2</sup> t, thermal)	Warning Limit I <sup>2</sup> t	w	-
Voltage Alarm					
OVER VOLTAGE	0x3210	DC link overvoltage	Overvoltage alarm occurs	f	4, 2
DC LINK UNDER VOLTAGE	0x3220	DC link undervoltage	Undervoltage alarm occurs	f	4, 1
Temperature Alarm					
TEMPERATURE DRIVE	0x4300	Driver temperature	Heatsink temperature overheat alarm occurs	f	1, 1
	0x4310	Driver temperature is abnormally high	Heat sink temperature out of measurement range (high)	f	1, 3
	0x4320	Driver temperature is abnormally low	Heat sink temperature out of measurement range (low)	f	1, 3
TEMPERATURE INTERNAL1- BOARD	0x4500	Internal board temperature	Overheating of substrate temperature occurs	f	1, 4
	0x4510	Abnormally high internal board temperature	Substrate temperature outside the measurement range (high)	f	1, 5
	0x4520	Abnormally low internal board temperature	Substrate temperature outside the measurement range (low)	f	1, 5
TEMPERATURE EXTERNAL1-MOTOR	0x4A00	Motor temperature	Overheat alarm occurs at motor temperature	f	1, 10
	0x4A10	Motor temperature is abnormally high	Motor temperature outside the measurement range (high)	f	1, 6
	0x4A20	Motor temperature is abnormally low	Motor temperature out of measurement range (low)	f	1, 6
hardware alarm					
	0x5430	Input stage	General input stage	-	-

## 2] CANOpen operation

error	error code	Cont ents	Expla natio n	F/W	LED code				
HARDWARE MEMORY EEPROM - USER	0x5530	EEPROM	General EEPROM errors	-	-				
	0x5531	EEPROM General Error	General EEPROM write error	f	6, 1				
	0x5532 ~ (after a number N) 0x5539	EEPROM error parameters 1-8	EEPROM parameter write error						
	0x553A ~ (after a number N) 0x553F	EEPROM error Parameters 9 to 14							
	0x5540 ~ (after a number N) 0x5549	EEPROM error Parameters 15 to 24							
	0x554A ~ (after a number N) 0x554F	EEPROM error Parameters 25 to 30							
	0x5550 ~ (after a number N) 0x5559	EEPROM error Parameters 31-40							
	0x555A ~ (after a number N) 0x555F	EEPROM error Parameters 41 to 46							
	0x5560 ~ (after a number N) 0x5563	EEPROM error Parameters 47-50							
	HARDWARE MEMORYEEPROM FACTORY PARAMETERS	0x5A00				The Golden Image EEPROM Data Area	General EEPROM errors Golden Image Data Area	-	-
		0x5A01				The Golden Image Warning data	Golden Image is a free Warning Data	w	-
0x5A02		The Golden Image error data	Golden Image's un-writable data	f	8, 1				
software alarm									
SOFTWARE	0x6000	software device	General software device errors	-	-				

DEVICE	0x6001	Parameter update	The update request by CANOpen is Not permitted. (RS232 only)	W	-
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## 2] CANOpen operation

error	error code	Contents	Explanation	F/W	LED code
parameter alarm					
DATA SET	0x6300	Parameters for data setting table	Programming error in data setup	-	-
	0x6301	Data Record No.1	Programming error Data setting	f	7, 1
	0x6302	Data Record No.2			7, 2
	0x6303	Data Record No.3			7, 3
	0x6304	Data Record No.4			7, 4
	0x6305	Data Record No.5			7, 5
	0x6306	Data Record No.6			7, 6
	0x6307	Data Record No.7			7, 7
	0x6308	Data Record No.8			7, 8
	0x6309	Data Record No. 9			7, 9
	0x630A	Data Record No.10			7, 10
	0x630B	Data Record No.11			7, 11
	0x630C	Data Record No.12			7, 12
	0x630D	Data Record No.13			7, 13
PARAMETER ERROR	0x6320	parameter error	General parameter error	-	-
	0x6321	mismatch data Configuration 1	configuration error	f	6, 4
ENCODER SINCOS	0x7350	absolute encoder	General absolute encoder error	f	2, 6
	0x7351	Rx Error	Error message received		
	0x7352	Tx Error	error message transmission		
	0x7353	Position error read command	positional lead error		
	0x7354	status error indication	Absolute Encoder Status error		
	0x7355	type error instruction	Absolute encoder type error		
	0x7356	Initialization timeout instruction	Absolute encoder initialization timeout error		
RESOLVER	0x7310	resolver	general error	-	-
	0x7373	Resolver phase is not adjustable	Adjustment error during initial resolver read	-	-
	0x7374	Resolver initialization	Resolver initialization error occurs	-	2, 4
	0x7375	Resolver hardware error (OS: no signal)	Describes the causes of failure detection. 0x01 (Bit 0): Parity error setting	f	2, 10
	0x7376	Resolver hardware error (OS: Signal attenuation)	0x02 (Bit 1): Phase error (out of range)		
	0x7377	Resolver hardware error (OT: no tracking)	0x04 (Bit 2): Overspeed Maximum tracking rate 0x08 (Bit 3): Tracking error (LOT exceeded)		
	0x7378	Resolver hardware error LOS, DOS, LOT: Initializing	0x10 (Bit 4): SIN/COS signal exceeded (DOS non-conformance) 0x20 (Bit 5): SIN/COS signal exceeded (DOS range) 0x40 (Bit 6): SIN/COS signal below (LOS or lower) 0x80 (Bit 7): SIN/COS signal missing		
communication	0x7500	communication	-	-	-
	0x7530	CANOpen protocol	CANOpen General Error	f	6, 2
	0x7531	initialization error	CANOpen protocol initialization error		

	0x7532	hardware error	CANOpen protocol hardware error	
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## 2] CANOpen operation

error	error code	Cont ents	Expl anati on	F/W	LED code
Alarm Monitoring					
COMMUNICATION CANOPEN	0x8100	CANOpen communication	communication error	f	6, 2
	0x8110	CAN Overrun	CAN Controller Rx buffer overrun (overflow)		
	0x8111	Tx buffer overflow	Tx Software buffer overflow		
	0x8112	Rx buffer overflow	Rx software buffer overflow		
	0x8120	CAN passive state	Passive state due to CAN error		
	0x8130	Heartbeat/Nord Guarding	Heartbeat or Life Node Garding		
	0x8131	node guarding error Slave message not received	Slave has not received guarding message		
	0x8132	node guarding error unconnected	Unconnected, node lifetime elapsed	w	-
	0x8133	Node guarding error at least 1 message Not received	Slave has not received at least one guarding message		
	0x8140	RETURN-BACK-TO-BUSH OFF	Return from CAN bus off		
	0x8150	CAN ID collision	CAN ID collision		
	0x8160	CAN initialization state	Communication state message: INT state		
	0x8170	CAN Operating State	Communication state message: ACTIVE state		
	0x8180	CAN bus off-state	Communication state message: BUSOFF state		
	0x8190	CAN Error Passives Tate.	Communication state message: Passive state		
alarm protocol					
TORQUE PROFILE control	0x8300	Torque Control	of the torque controller profile. general error	f	6, 2
VELOCITY SPEED CONTROLLER	0x8400	Speed controller	of the speed controller profile. general error		
	0x8411	following error	Speed command and speed discrepancy is greater than the maximum speed error		
	0x8412	overspeed	Speed exceeds overspeed value		
POSITION controller	0x8500	Position controller	of the position controller profile. general error		
POSITIONING CONTROLLER	0x8600	Positioning Controller	of the positioning controller profile. general error		
	0x8611	Tracking error	Difference between position command and position is greater than the maximum position error (BJECT 6065h)		

## 2] CANOpen operation

error	error code	Contents	Explanation	F/W	LED code
CANOPEN EEPROM	0x8B00	Store and restore process	Store and Restore Process General Error	w	-
	0x8B01	Store / Restore / Load Parameter Warning	Store / Restore / Load instruction invalid warning with "Ready to Switch ON" or "Disabled" status because there is no ...	f	6, 2
	0x8B02	store parameter error	Store parameter object 1010h Management Errors in		
	0x8B03	EEPROM Memory Storeful	CAN object parameters Memory Restore Full Error		
	0x8B04	EEPROM Restore	Restore parameter object 1011h of management error		
	0x8B05	EEPROM Memory List Af rule	CAN object parameters Memory Restore Full Error		
	0x8B06	Golden Image Area Warning of	Golden Image Write Request Warning		
DSP402 FSM	0x8C00	Profile 402 State Machine	Profile 402 State Machine General Error	f	6, 5
	0x8C01	Operation mode error	Operation mode (6060h) is set to "Operation Enabled" written at state time		
	0x8C02	profile type	No profile type defined		
	0x8C03	profile error	The selected profile is not handled (after noun, adjective-stem or plain verb) just keeps		
	0x8C04	Profile Not Selected	Profile not selected in RUN state		

# 2] CANOpen operation

## (4) Node Guarding Protocol

This service is based on the master sending RTR messages with the identifier (700h + node ID) to each slave.

The slave must send a message in response. The message has the following structure Bit 7 alternates with each transfer to determine if the message has been lost.

Bits 6 through 0 represent the current NMT status of the slave.

Table 2-22 Message Structure of Node Guarding

COB-ID	Rx/Tx	DLC	0	1	2 byte	3	4	5	6	7
			7-bit toggle + NMT State	-						
0x700 + Node ID	Tx	1								

Node guarding settings use three time intervals.

■ Guard Time: Time between two RTR messages.

Different settings are possible for each CAN node and are stored in the slave at (object 100Ch:00) guard time(ms).

Live Time Factor: Multiplication of guard time

Different settings are possible for each CAN node and are stored in the slave with a live time factor of (object 100Dh:00).

■ Possible Live Time (Possible Live Time): The time is determined by multiplying the guard time by the live time.

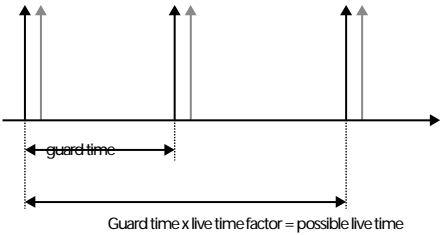


Figure 2-2 Node Guarding Time Messages

During node guarding, the following conditions are checked

- The NMT master must send RTR requests within a possible live time.
- The slave must reply to the RTR request within a possible live time. Slave must reply with NMT state and toggle bit.



Figure 2-4 Heartbeat Time Frame

## 2] CANOpen operation

This service is enabled if the heartbeat time (1017h) object of the producer is non-zero.

The relationship between the producer (driver) and consumer (master controller) is set by an object.

If the consumer cannot receive the signal within the time set by the consumer's heartbeat time (1016h), an error message (heartbeat event) is generated.

If the consumer's heartbeat time (1016h) object is 0, it can be monitored by the consumer.

### Important

- If both monitoring protocols are enabled, the heartbeat protocol takes precedence.

#### (6) Communication State - Bus Off

CAN communication enters the BusOff state when

-Disappearance of Heartbeat

-Disappearance of -node guarding

-NMT stop, i.e., remote node stop instruction is active

-Communication reset, i.e., communication reset instruction is active

-Reset application, i.e., node reset instructions are active

#### (7) Network Management (NMT)

Network Management is a service element in the application hierarchy of the CAN reference model. The NMT performs configuration, initialization, and error handling on the CAN network.

The following figure shows the NMT state machine.

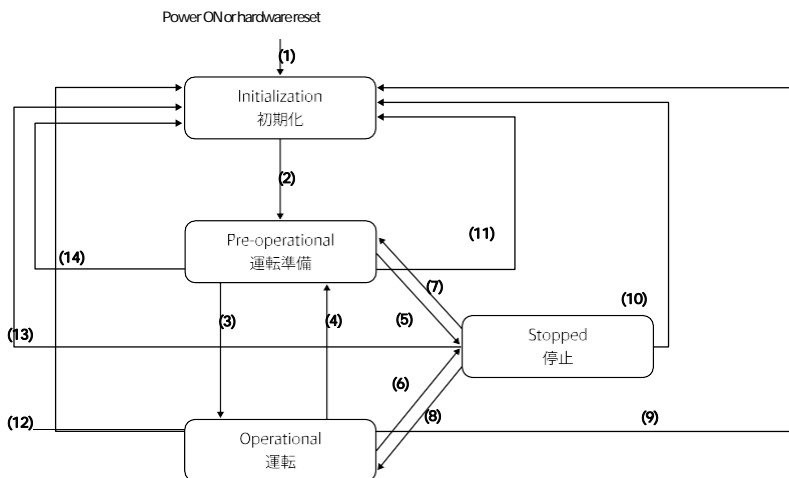


Figure 2-5 NMT state machine

## 2] CANOpen operation

Table 2-24 Changes in NMT Content

No.	Contents
(1)	NMT state initialization starts automatically when power is turned on
(2)	NMT state initialization completed - automatically transitions to NMT state pre-operational
(3)	NMT Service Remote node start instruction or local control
(4) (7)	Transition to NMT service pre-operational instructions
(5) (8)	NMT Service Remote node stop instruction
(6)	NMT Service Remote node start instruction
(9) (10) (11)	NMT Service Node reset instruction
(12) (13) (14)	NMT service Communication reset instruction

Network Management (NMT) is node-oriented and follows a master - slave structure. NMT objects are used to perform NMT services.

Through the NMT service, nodes can initialize, start, monitor, reset, and stop. All nodes are considered NMT slaves.

NMT slaves are identified in the network by a node ID in the range [1-127].

NMT requires that one device in the network serve as the NMT master.

Table 2-25 NMT message structure

COB-ID	Rx/Tx	DLC	0	1	2 byte	3	4	5	6	7
0x00	Rx	2	order	address						

The NMT state can be changed with the following

instructions Table 2-26 NMT Contents

order	Contents
0x01	Remote node start (3) (6):. The NMT master can set the state of the selected NMT slave via this service to Set to "Operational."
0x02	Remote node stop (5) (8) The NMT master can set the state of the selected NMT slave via this service to Set to "Stopped."
0x80	Transition to Pre-operational state (4) (7) The NMT master can set the state of the selected NMT slave via this service to Set to "pre-operational."
0x81	Node reset (9) (10) (11) The NMT master can set the state of the selected NMT slave via this service to Set to sub-substate "Reset application" from all states.
0x82	Communication reset (12) (13) (14):. The NMT master sets the state of the selected NMT slave via this service from all states to the sub-state "Reset communication." After the service is terminated, the state of the selected remote node is communication reset.
address	Contents
Node ID	To select all devices, set to 0x00 (global mode) Set node Id (0x01 to 0x7F) for a specific device

# 2] CANOpen operation

## ■Network initialization

When power is turned on, it enters the Network Management (NMT) state machine.  
The first state after an internal reset or power reset is the NMT initialization state.  
In this state, the driver loads all parameters from nonvolatile memory into RAM. After completion of the NMT initialization state, the drive enters the Pre-operational state.  
During the transition to this state, the driver sends a boot-up message.

## ■Network Pre-operational State:

In the Pre-operational state, communication via SDO is possible, but PDO communication is not available. Emergency objects and error control services, such as the "Heartbeat message" of the CANOpen sensor, occur in this state. The node switches directly to the Operational state by sending the NMT "Start remote mode".

## ■Network Operational State: ■Network Operational State: ■Network Operational State: ■Network Operational State

Operational state enables all communicating objects to (including PDO handling) can access the object dictionary via SDOs.

## ■Network Stopped State: (1)

Switching the device to the Stopped state forces communication to stop except for node guarding and heartbeats (if enabled)

### (8) Bootup message

After power-on or reset, the smartris driver controller sends a boot-up message indicating that initialization is complete. Following this message, the smartris driver moves to the NMT Pre-operational state.

Table 2-27 Message structure for boot-up

COB-ID	Rx/Tx	DLC	0	1	2	3 byte	4	5	6	7
0x700 + Node ID	Tx	1	0x00	-						

### (9) Store and Restore

The CiA CANOpen protocol specification defines two objects for storing and restoring parameters.  
-object 1010h: Parameter store  
-object 1011h: Restore parameters

To save all parameters, the master writes "save" to one of the corresponding sub-indices in SDO1010h. This process writes the corresponding parameter settings to non-volatile memory.  
After an NMT node reset or after a communication parameter reset, the parameters are automatically loaded into the object dictionary.

## 2] CANOpen operation

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The following objects are modified by writing to object 1010h: Sub-Index 2h (communication parameters) and stored in EEPROM.

- 1000h: Device Type
- 1001h: Error Register (Error Register)
- 1002h: Manufacturer-specific status (Manufacture Status Register)
- 1003h: Predefined Error Field (History List)
- 1005h: COB-ID Sync
- 100Ch: Guard Time (Guard Time)
- 100Dh: Life Time Factor
- 1014h: COB-ID EMCY
- 1017h: Producer Heartbeat Time
- 1018h: Identity object
- 1029h: Error Behavior
- 1400h: RxPDO1 Parameter
- 1401h: RxPDO2 Parameter
- 1402h: RxPDO3 Parameter
- 1403h: RxPDO4 Parameter
- 1600h: RxPDO1 mapping
- 1601h: RxPDO2 mapping
- 1602h: RxPDO3 mapping
- 1603h: RxPDO4 mapping
- 1800h: TxPDO1 Parameter
- 1801h: TxPDO2 Parameter
- 1802h: TxPDO3 Parameter
- 1803h: TxPDO4 Parameter
- 1A00h: TxPDO1 mapping
- 1A01h: TxPDO2 mapping
- 1A02h: TxPDO3 mapping
- 1A03h: TxPDO4 mapping

The following objects are modified by writing to object 1010h: Sub-Index 3h (application parameters) and stored in EEPROM.

- 6073h: Max Current
- 607Eh: Polarity Note
- 607Fh: Max Profile Velocity
- 6080h: Max Motor Speed
- 6083h: Profile Acceleration Note
- 6084h: Profile Deceleration Note
- 6096h: Velocity Factor
- 6097h: Acceleration Factor
- 60C5h: Max Acceleration
- 60C6h: Max Deceleration

Note: Objects can be changed even during operation. If the power to the driver is interrupted, the changes will be lost.



## 2] CANOpen operation

The following objects are modified by writing to object 1010h: Sub-Index 4h (manufacturer-specific parameters) and stored in EEPROM.

- 2000h: Node ID
- 2001h: Baud rate
- 3002h: Brake parameter Note)
- 3007h: Dynamic braking parameters Note)
- 3200h: PID current Note)
- 3201h: PID speed Note)
- 3202h: PID position Note)
- 3203h: PID decoupling Note)

Note: Objects can be changed even during operation. If the power to the driver is interrupted, the changes will be lost.

All parameters can be stored in EEPROM. No changes are accepted until a power reset or a CANOpen RESET COMM (NMT) message is sent to the driver.

To avoid accidentally restoring the default parameters, the master must send SDO1011h and write the sign "load" to the appropriate subindex.

Function mode to restore factory set parameters

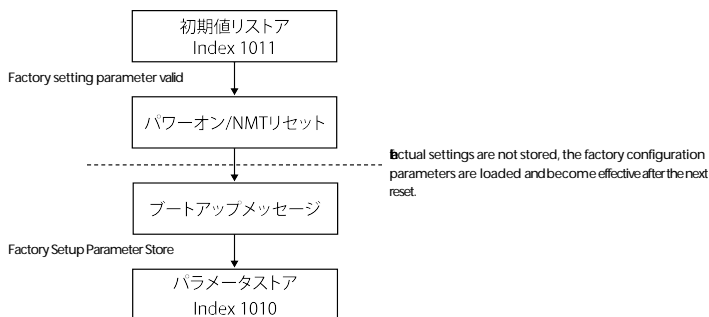


Figure 2-6 Restore

Flowchart Communication parameters are the following

"DEFAULT COMMUNICATION"

Table 2-28 Communication parameters

Name	Index	Sub-Index	value field (Value Field)	Default Parameters (Default Parameters)
P301 DEV TYPE	0x1000	0	Device Type	0xFF7A0192
P301 ERR REG	0x1001	0	Error Register	0
P301 MANUF STATUS REG	0x1002	0	Manufacture Status Register	0
P301 PREDEF ERR FIELD	0x1003	0	Number of Errors	15
		1~15	History[1]~[15].	0
P301 COBID SYNC	0x1005	0	COB-ID SYNC	COB-ID = 80000080h+Id
P301 GUARD TIME	0x100C	0	Life Time Factor	0 = Disabled

## 2] CANOpen operation

Name	Index	Sub-Index	value field (Value Field)	Default Parameters (Default Parameters)
P301 LIFETIME FACTOR	0x100D	0	COB-ID	0 = Disabled
P301 COBID EMERGENCY	0x1014	0	COB-ID EMCY	COB-ID = 80h+Id
p301 producer hb time	0x1017	0	Producer Heartbeat Time	0
P301 IDENTITY OBJECT	0x1018	0	Number of Entries	4
		1	Vendor Id	0
		2	Product Code	0
		3	Revision Number	0
		4	Serial Number	0
P301 ERR BEHAVIOR	0x1029	0	Number of Entries	1
		0	Communication Error	0
P301 RXPDO1 PARAM	0x1400	0	Number of Entries	3
		1	COB-ID	COB-ID = 200h+ID, PDO enabled
		2	Transmission Type	0xFE = Asynchronous
		3	Inhibit Time	<del>05=100μs</del>
P301 RXPDO2 PARAM	0x1401	0	Number of Entries	3
		1	COB-ID	COB-ID = 300h+ID, PDO enabled
		2	Transmission Type	0xFE = Asynchronous
		3	Inhibit Time	<del>05=100μs</del>
P301 RXPDO3 PARAM	0x1402	0	Number of Entries	3
		1	COB-ID	COB-ID = 400h+ID, PDO enabled
		2	Transmission Type	0xFE = Asynchronous
		3	Inhibit Time	<del>05=100μs</del>
P301 RXPDO4 PARAM	0x1403	0	Number of Entries	3
		1	COB-ID	COB-ID = 500h+ID, PDO enabled
		2	Transmission Type	0xFE = Asynchronous
		3	Inhibit Time	<del>05=100μs</del>
P301 RXPDO1 MAPPING	0x1600	0	Number of Entries	3
		1	Mapping Entry1	0x60400010 = Controlword
		2	Mapping Entry2	0x60600008 = Mode of Operation Display
		3	Mapping Entry3	0x60FE0120 = Digital Output
P301 RXPDO2 MAPPING	0x1601	0	Number of Entries	2
		1	Mapping Entry1	0x60400010 = Controlword
		2	Mapping Entry2	0x607A0020 = Target Position
P301 RXPDO3 MAPPING	0x1602	0	Number of Entries	2
		1	Mapping Entry1	0x60400010 = Controlword
		2	Mapping Entry2	0x60FF0020 = Target Velocity
P301 RXPDO4 MAPPING	0x1603	0	Number of Entries	2
		1	Mapping Entry1	0x60400010 = Controlword
		2	Mapping Entry2	0x60710010 = Target Torque
P301 TXPDO1 PARAM	0x1800	0	Number of Entries	3
		1	COB-ID	COB-ID = 180h+ID, PDO enabled
		2	Transmission Type	0xFD = Asynchronous - RTR only
		3	Inhibit Time	<del>05=100μs</del>

## 2] CANOpen operation

Name	Index	Sub-Index	value field (Value Field)	Default Parameters (Default Parameters)
P301 TXPDO2 PARAM	0x1801	0	Number of Entries	3
		1	COB-ID	COB-ID = 280h+ID, PDO enabled
		2	Transmission Type	0xFD = Asynchronous - RTR only
		3	Inhibit Time	<del>05=10µs</del>
P301 TXPDO3 PARAM	0x1802	0	Number of Entries	3
		1	COB-ID	COB-ID = 380h+ID, PDO enabled
		2	Transmission Type	0xFD = Asynchronous - RTR only
		3	Inhibit Time	<del>05=10µs</del>
P301 TXPDO4 PARAM	0x1803	0	Number of Entries	3
		1	COB-ID	COB-ID = 480h+ID, PDO enabled
		2	Transmission Type	0xFD = Asynchronous - RTR only
		3	Inhibit Time	<del>05=10µs</del>
P301 TXPDO1 MAPPING	0x1A00	0	Number of Entries	3
		1	Mapping Entry1	0x60410010 = Statusword
		2	Mapping Entry2	0x60600008 = Mode of Operation Display
		3	Mapping Entry3	0x60FD0020 = Digital Input
P301 TXPDO2 MAPPING	0x1A01	0	Number of Entries	3
		1	Mapping Entry1	0x60410010 = Statusword
		2	Mapping Entry2	0x60640020 = Position Actual Value
P301 TXPDO3 MAPPING	0x1A02	0	Number of Entries	3
		1	Mapping Entry1	0x60410010 = Statusword
		2	Mapping Entry2	0x606C0020 = Velocity Actual Value
P301 TXPDO4 MAPPING	0x1A03	0	Number of Entries	3
		1	Mapping Entry1	0x60410010 = Statusword
		2	Mapping Entry2	0x60770010 = Torque Actual Value

2-4 the identifier table outlines the identifiers used.

Table 2-29 Table of identifiers

object type	identifier (Hex decimal)	object type	identifier (Hex decimal)
SDO (master to driver)	0x600 +Node Id	SYNC	0x80
SDO (Driver to Master)	0x580 +Node Id	EMCY	0x80 +Node Id
TPD01	0x180 +Node Id	HEATBEAT	0x700 +Node Id
TPD02	0x280 +Node Id	BOOTUP.	0x700 +Node Id
TPD03	0x380 +Node Id	NMT	0x00
TPD04	0x480 +Node Id		
RPD01	0x200 +Node Id		
RPD02	0x300 +Node Id		
RPD03	0x400 +Node Id		
RPD04	0x500 +Node Id		

### 2-5 DSP402 Profile

For more information, see CiA DS402 Standard.

#### (1) DSP402 profile state machine

The drive is checked and controlled by the DSP402 state machine.

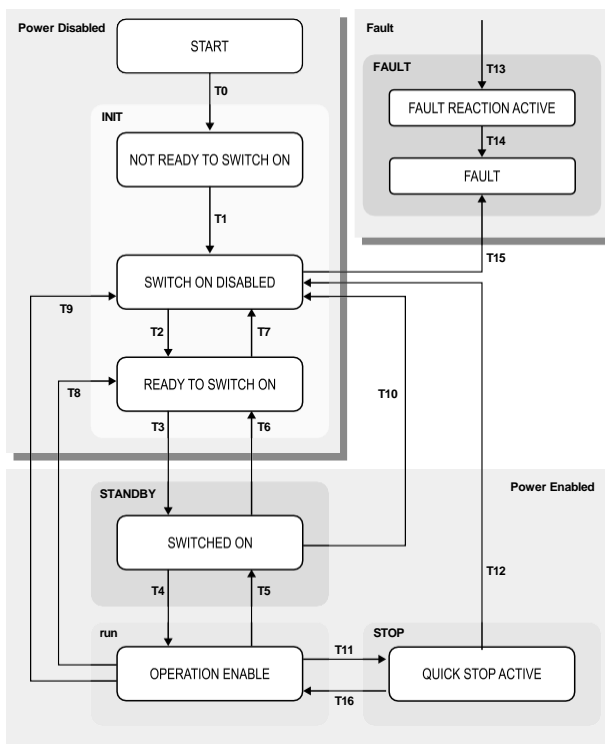


Figure 2-7 DSP402 state machine

State changes are triggered by internal events, such as the occurrence of an error, or by external requests through the control word (6040h). The status word (6041h) provides feedback on the actual state.

After power-up and initialization, the drive automatically switches to the "Switch ON Disabled" state. The device waits for a control word command in this state.

"Operation Enabled" state allows the driver to perform all operations.

"SAFETY" state is not implemented in the DSP402. The "SAFETY state" has been added to protect the driver and limit its behavior when emergencies are applied. (See chapter "SAFETY")

## 2] CANOpen operation

The actual state can be read by a status word in standard code (defined in CiA DSP402)

Table 2-30 Status words












status	Contents
NOT READY TO SWITCH ON	INIT State: -Driver is initializing and self-testing -Driver function disabled -Internal state where communication is valid only at the end of this state -The user cannot retrieve or monitor this state.
SWITCH ON DISABLED	INIT State: -Power off -Drive initialization complete -Complete setting of driver parameters -Driver parameters can be changed -Driver function disabled -Parameters can be saved in EEPROM SWITCH ON DISABLED is the minimum state that can be switched by the user. It is.
READY TO SWITCH ON	INIT State: -Power off -Complete setting of driver parameters -Driver parameters can be changed -Driver function disabled -Parameters can be saved in EEPROM
SWITCHED ON	STANDBY State: -Power off -RUN state ("Operation enable") ready -Driver parameters can be changed -Driver function disabled -Parameters can be saved in EEPROM
OPERATION ENABLE	RUN state: (normal operation of the drive) -No failure detection -Power is supplied to the motor -Driver function is enabled -Driver parameters can be changed → If automatic braking is enabled, the brake is released according to the timing of the brake parameters Driver parameters cannot be saved or restored to EEPROM.
QUICK STOP ACTIVE	STOP STATE: STOP -No failure detection -Power is supplied to the motor -Driver function is enabled -Driver parameters can be changed -Drive stops operating and comes to an abrupt stop, generating holding torque Driver parameters cannot be saved or restored to EEPROM.
FAULT REACTION ACTIVE	FAULT State -Driver parameters can be changed -Drive has failed. -Perform fault handling -Driver function disabled -This parameter cannot be retrieved by the user. -Parameters can be saved in EEPROM

## 2] CANOpen operation

status	Contents
FAULT	<u>FAULT State</u> -Driver parameters can be changed -Drive has failed. -Driver function disabled -Parameters can be saved in EEPROM

The following table shows the LED codes related to the driver. (Corresponds to the

DSP402 status machine.) Table 2-31 Drive Status

driver state	CANOpen status	Status 1 LED (green)	Status 2 LED (yellow)	LED Indication
initial state (INIT)	Switching on Preparing (Not Ready to Switch ON Disabled Switch ON Disabled) Switch ON Ready Ready to Switch ON)	Alternating "flashing"	Alternating "flashing"	 1 Alternating flashing  2 Alternating flashing
Operational Preparation (STANDBY)	switch on SWITCHED ON)	Flashing	OFF	 1 Blinking 50%  2 OFF
damage caused by a disaster (FAULT)	Fault Fault processing in progress Fault Reaction Fault)	Flashing Code [x].	Flashing Code [y].	 1 See Chapter 9.  2    
Driving (RUN)	Operational availability Operation Enabled)	ON	OFF	 1 ON 2 OFF
suspension	abort operation Quick Stop Active)	ON	ON	1 ON 2 ON
2-6 Operation Modes are available in the CiA 402 profile.				
Operation Modes				
-Position profile mode: Calculates the required motion profile individually for the target position determined by the controller. (See chapter 6)			flashing	1 OFF 2 flashing
-Speed profile mode: Calculates the speed command required motion profiles individually as determined by the controller. (see chapter 6)				
-Torque profile mode: Calculates the required motion profile for each torque/force command determined by the controller. (see chapter 6)				
-Homing mode: (see chapter 6)				

### (1) Operation sequence in CANOpen speed mode

The operation sequence is shown on the next page.

## 2] CANOpen operation

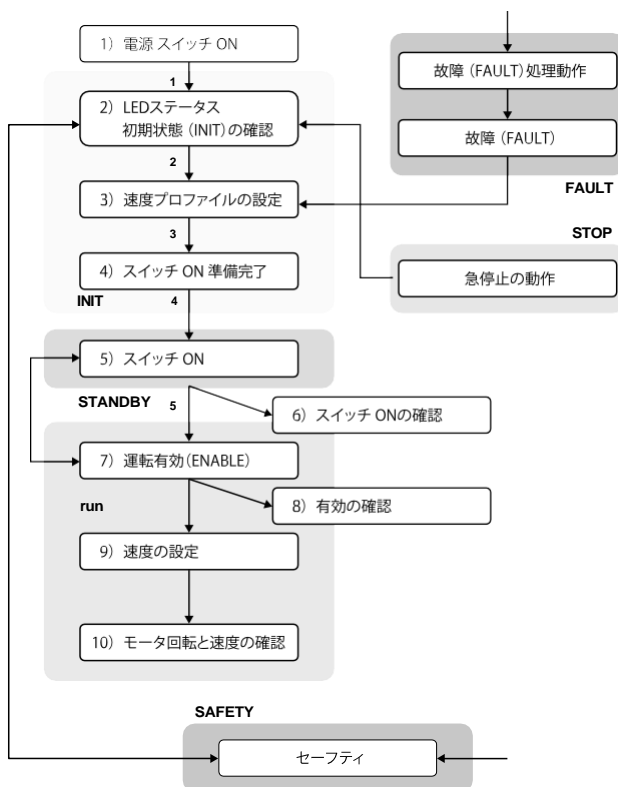


Figure 2-8 Operation sequence in CANOpen speed mode

(Note) STO: With a **safety (SAFETY)** command, the operation command stops immediately. With a **STOP** command, the operation command stops immediately.

If a **fault (FAULT)** (see Chapter 9 Diagnostics) occurs, the operation command stops immediately.

- (1) Power switch on
- (2) Confirm initial status (INT mode) with LED status 3)  
Set speed profile 0x6060 → 0x03
- (4) Write ready to switch on (READY TO SWITCH ON state) to the setting control word 0x6040 → 0x06
- (5) Set SWITCHED ON state: Write to control word 0x6040 → 0x07
- (6) Confirm SWITCHED ON: Read status word 0x6041 → 0x23
- (7) Write to control word 0x6040 to set operation enable (OPERATION ENABLED state) → 0x0F

## 2] CANOpen operation

---

(8) Check LED status(ENABLED)

Read status word 0x6041 → 0x27 9) Confirm

brake release and set speed

Write speed set point: 0x60FF → 0x03e8 (ex. 1000 r/min) 10) Check  
motor rotation and speed

Read motorspeed(after acceleration) 0x606C → 0x03e8 (e.g., 1000 r/min)



# [3 ] Conversion of measurement units

Parameters are used in a variety of applications. In order to easily set parameters in different applications, user parameters can be converted to the driver's internal units using the Units of Measurement Conversion Module.

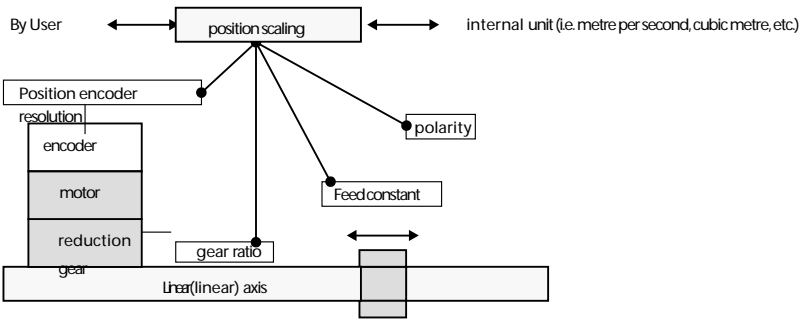


Figure 3-1 Factor Groups

Factor group objects are used to convert internal position values, velocity values, and acceleration values into user-defined units.

The internal position values are entered in increments (incremental values) and depend on the resolution of the encoder used.

User-defined units depend on the resolution of the encoder and the reduction ratio of the linearly moving device (linear axis) to which it is attached, etc.

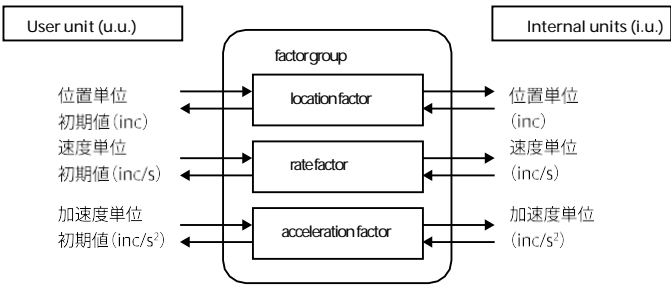


Figure 3-2 Factor Group Unit

All parameters are stored in internal units.

Parameters can be converted to user units using factor group values.

# [3] Conversion of

## measurement units

The default values are shown below.

object	Name	user unit
distance	positional unit	Inc.
Speed	speed unit	Inc/s
acceleration	acceleration unit	Inc/s <sup>2</sup>

Factors defined in the Factor Group set the relationship between internal units (increments) and physical units. It defines [u.u.] as the user unit and [i.u.] as the internal unit.

### 3-1 Measurement Unit Conversion Parameters and denominator parameters.

Index	Name	object code	data type	Access	Remarks
608Fh	Encoder resolution (position)	ARRAY	Unsigned U32	RW	disuse
6090h	Encoder resolution (speed)				
6091h	gear ratio				
6092h	Feed constant				
6096h	rate factor				
6097h	acceleration factor				use

#### ■ Object 6096h: Speed factor

This object can be used to match a speed unit to a user-defined speed unit.

Object content:

Index	EDS Name	object code	data type	category
6096h	rate factor	ARRAY	U32	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data type	initial value
0	Maximum Sub-Index	ro	nash  		

# [3] Conversion of measurement units

Example: Speed setting in revolutions per minute (rpm)

$$\text{Velocity [inc/s]} = \text{velocity [rpm]} \times (60/\text{resolution}) \times (\text{numerator} / \text{denominator})$$

If the encoder resolution is 213h = 16384, the numerator is 16384 and the denominator is 60.

Factor groups are used in the following objects

- 60FFh: Target speed
- 606Dh: Speed window
- 606Fh: Speed threshold
- 6081h: Speed profile (for positioner profile mode)
- 6082h: Speed end (for positioner profile mode)

■ Object 6097h: Acceleration factor

This object can be used to match acceleration units to user-defined acceleration units.

Object content:

Index	EDS Name	object code	data type	category
6097h	acceleration factor	Array	U32	indispensable

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data type	initial value
0	Maximum Sub-Index	ro	nash	U32	2
1	The numerator and denominator of the acceleration factor are entered separately. Acceleration Factor = (numerator / denominator)	PW	i		1
2	Default user units are [inc/s2]: numerator, denominator = 1 Acceleration [i.u.] = Acceleration [u.u.] x (60/resolution) (numerator / denominator) Resolution is the number of measurement segments, 0 units, of 1 encoder revolution or 1 in/mm of linear scale. Example: To specify acceleration setting in revolutions/minutes/seconds (rpm/s) $\text{Acceleration [inc/s2]} = \text{Acceleration [rpm/s]} \times (60/\text{resolution}) \times (\text{numerator} / \text{denominator})$ If the encoder resolution is 213h = 16384, the numerator is 16384 and the denominator is 60.	PW	(Pyru Pyrif olia esp. var. cultu )		1

Factor groups are used for the following objects

- 6083h: Acceleration profile
- 6084h: Deceleration profile
- 60C5h: Maximum acceleration
- 60C6h: Maximum deceleration

All states are transitioned to the safety state. To exit the safety state, a "Disable Voltage" value must be sent to the control word.

The object 4000h "Safety State" informs whether the driver is in the safety state and what safety function is occurring. Currently, the STO function is the only safety function implemented.

## ■ Object 4000h: Safety State

This object informs the safety state of the drive. It is read-only.

Object content:

Index	EDS Name	object code	data type	category
4000h	Safety State	ARRAY	U16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data type	initial value
0	Number of entries	ro	nash i	-	2
1	safety state			[0, 1].	-
2	STO Function				
Sub-Index	field	configuration		Defin ition	
1	safety state	0b 1b	s pyrif	Drive is not a safety state Drive is Safety State	
2	STO Function	0b 1b	olia, esp. var. cult )	STO Without safety state STO Safety state generation	

#### 4-1 The Safety State State Machine DSP402

The figure shows the safety state machine that is added to the state machine DSP402.  
To exit the safety state, a "Disable Voltage" value must be sent to the control word.

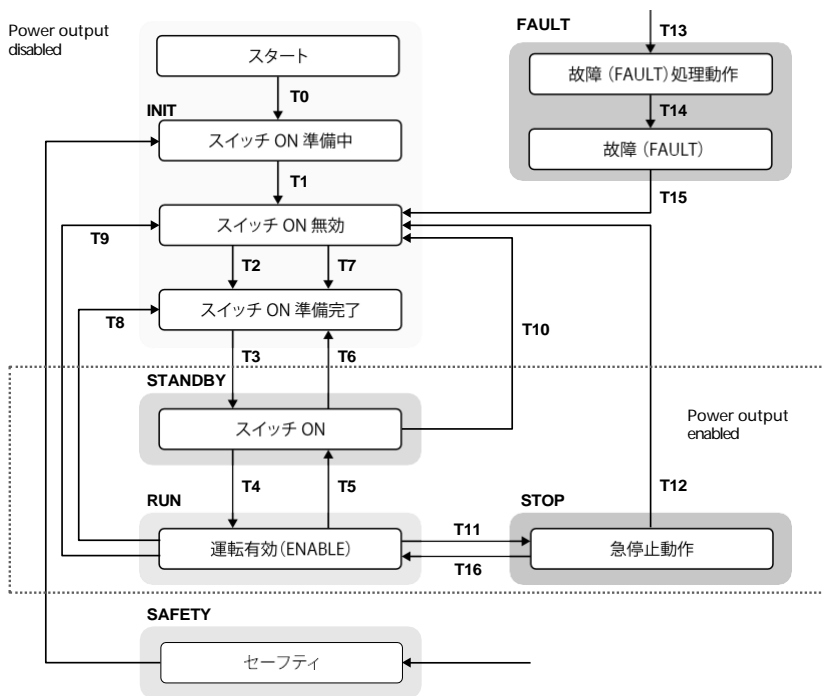


Figure 4-1 Safety State State Machine DSP402

#### (1) STO Features

The STO circuit is a 2-channel structure. This structure is shown in the block diagram below.

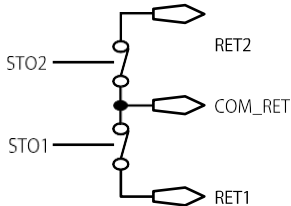


Figure 4-2 STO circuit

The two isolated STO inputs must be connected to a 24V supply to run the motor. The state of the STO digital inputs is written to object-digital input 60FDh.

Table 4-1 STO input/output operations

Input 1	Input 2	Output 1	Output 2	output state
STO1	STO2	RET1	RET2	status
0	0	closing	closing	safety
24V		opening		
0	24V	closing	opening	normal mode
24V		opening		

In the safety state, no torque is applied to the motor; the STO function operates to keep the motor in a safe state without applying torque to it.

Stops the motor even if it is already in accelerated operation and also prevents it from starting operation. It is expected that the motor will generate no torque, thereby reducing the hazardous operation to the system.

⚠Attention

(heed)

The driver cannot hold a load because no torque is generated when the STO function is activated.

●

If the STO function is activated during operation, the driver will stop uncontrolled.

●

If the driver has a safety torque-off (STO) function, it must be verified that this circuit operates properly before all functions are activated.

# [5] CANOpen Object Dictionary

## Object 1000h: Device type (DS301)

Object content:.

Index	Name	object code	data type	category
1000h	Device Type	VAR	U8	option

Bit MSB 31	Bit LSB 0
Additional Information	Device Profile Number

Default value: 0xFF7A0192 (The meaning of 0192h is that the device uses profile 402.)

### 1001h: Error register (Error Register)

The error registers are 8-bit fields, each corresponding to a specific error type.

When an error occurs, the bits shown below are set.

bit	Contents
0	Generic Error
1	electric current
2	Voltage
3	Temperature
4	Communication errors (overruns, error states)
5	Device Profile Specifications
6	reserved area
7	Manufacturer Specifications

### 1002h: Manufacturer Status Register

This object provides a common status register for manufacturer specifications. Only the size and position of the object are defined.

Object content:

Index	EDS Name	object code	data type	category
1002h	Manufacturer Status Register	VAR	U32	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	initial value
0	Manufacturer Status Register	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-

# 5] CANOpen Object Dictionary

## 1003h: Pre-defined Error Field (Pre-defined Error Field)

This object contains an error stack with up to eight entries.  
Errors that occur on the device and are notified via the emergence object are retained and become error history.  
Writing 0 to Sub-Index deletes the entire error history.

Object content:

Index	EDS Name	object code	data type	category
1003h	Pre-defined Error Field	VAR	U32	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	initial value
0	Number of Errors	RW	nashi (Pyrus pyrifolia, esp. var. culta)	-
1	Error code of last alarm occurred	R	nashi (Pyrus pyrifolia, esp. var. culta)	-
2	Error code before last alarm	R	nashi (Pyrus pyrifolia, esp. var. culta)	-
3 to 15	Error code of error history	R	nashi (Pyrus pyrifolia, esp. var. culta)	-

If a new error occurs, it is entered in Sub-Index 1. If through 15 already entered in Sub-Indexes are advanced by one position. Therefore, error 15 in Sub-Index 15 will be deleted. The number of errors that have already occurred can be read by the object at Sub-Index 0.  
If no error is entered in the error stack, Sub-Indexes 1 through 15 cannot be read and the error content is returned.  
The device returns an SDO clear message (abort code: 0800 0024h) (Pyrus pyrifolia, esp. var. culta).  
The predefined error field has the following structure

Bit MSB	31	24	23	16	15	Bit LSB
	Manufacturer-specific Error code		Error register		Error code	

Writing 00h to Sub-Index 00h will erase the entire error history. (The array will be empty.) Values other than 00h are not allowed and will result in an abort message (error code: 0609 0030h).

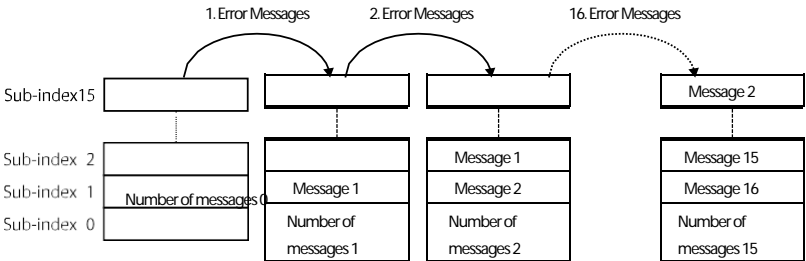


Figure 5-1 Message history list

To read the history of error messages, see Appendix.



## 5] CANOpen Object Dictionary

### 1008h: Manufacturer Device Name

This object indicates the device name.

Object content:.

Index	EDS Name	object code	data type	category
1008h	Manufacture Device Name	VAR	character string	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	initial value
0	Manufacture Device Name	C	nashi (Pyrus pyrifolia, esp. var. culta)	-

See Appendix to read "Manufacture Device Name."

### ■ Object 1009h: Manufacturer hardware version (Manufacturer Hardware Version)

This object indicates the hardware version.

Object content:.

Index	EDS Name	object code	data type	category
1009h	Manufacture Hardware Version	VAR	character string	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	initial value
0	Manufacture Hardware Version	C	nashi (Pyrus pyrifolia, esp. var. culta)	-

See Appendix to read "Manufacture Hardware Version."

### ■ Object 100Ah: Manufacturer-specific software version (Manufacturer Software Version)

This object indicates the software version.

Object content:.

Index	EDS Name	object code	data type	category
100Ah	Manufacture Software Version	VAR	character string	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	initial value
0	Manufacture Software Version	C	nashi (Pyrus pyrifolia, esp. var. culta)	-

See Appendix to lead "Manufacture Software Version."

# 5] CANOpen Object Dictionary

## ■ Object 100Ch: Guard Time (Guard Time)

Guard time is entered in ms. 0 toggles node guarding off.  
Multiply the guard time by the lifetime factor of the object 100Dh to obtain the lifetime of the life guarding protocol.

Object content:

Index	EDS Name	object code	data type	category
100Ch	Guard Time	VAR	U16	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range
0	Guard Time	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[ms].

### Important

- Heartbeat protocols have a higher priority than node guarding.
- If both protocols operate simultaneously, the node guarding timer stops and no EMCY message is sent.

## ■ Object 100Dh: Life Time Factor

Multiply the guard time object 100Ch by the lifetime factor to get the lifetime of node guarding.  
0 toggles node guarding off.

Object content:

Index	EDS Name	object code	data type	category
100Dh	Life Time Factor	VAR	U8	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range
0	Life Time Factor	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0-255].

## ■ Object 1010h: Store Parameters Field

This object supports the storage of parameters in non-volatile memory. Read access provides the device with information about its storage capabilities.

Parameter groups are categorized as follows

- Sub-Index 0: Contains the maximum Sub-Index supported.
- Sub-Index 1: Reference to all parameters that can be stored in the device
- Sub-Index 2: Communication-related parameters (Index 1000h to 1FFFh) (manufacturer-specific communication parameters)
- Sub-Index 3: Reference to application-related parameters (Index 6000h to 9FFFh) (manufacturer-specific application parameters)
- Sub-Index 4 to 127: Allows individual storage of manufacturer-selected parameters
- Sub-Index 128 to 254: Reserved area

# 5] CANOpen Object Dictionary

This directive can only be executed if the module is not "Operation Enabled" or "Quick Stop". If the directive cannot be processed, a warning message is sent. The third bit of the warning code (2003h) then set to 1.

Object content:

Index	EDS Name	object code	data type	category
1010h	Store Parameter Field	ARRAY	U32	option

Entry content:.

Sub-Index	Contents				Access	PDO Mapping	initial value
0	Number of Errors				c	nashi (Pyrus pyrifolia, esp. var. culta)	5
1	Save all Parameters				RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
To avoid storing the wrong parameters, the save is performed only when a specific signal is written to the appropriate Sub-Index. The specific signature is "save": 0x857666173.							
2	Save Communication Parameters				RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
Write Save access structure:							
3	Save Application Parameters				RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
Signature	ISO 8859 (ASCII)	e	V	a	s	pyr	folia, esp. var. culta)
	hex	65h	76h	61h	73h		
4	Save Manufacture Parameters				RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
The CANOpen device stores the parameter when the correct signature is accepted. If the signature is not correct, the CANOpen device returns an SDO abort transmission service (abort code 0000h). If an incorrect signature is made, the CANOpen device also rejects the store and an SDO abort transmission service (abort code: 0800 002xh).							
5	Reserved				RDV	nashi (Pyrus pyrifolia, esp. var. culta)	0

To avoid storing the wrong parameters, the save is performed only when a specific signature is written to the appropriate Sub-Index. The specific signature is "save": 0x65766173. The CANOpen device stores the parameter when the correct signature is accepted at the appropriate Sub-Index. The SDO transmission (return of SDO download) is then acknowledged. If the store fails, the CANOpen device returns an SDO abort transmission service (abort code: 0606 0000h). If an incorrect signature is made, the CANOpen device also rejects the store and returns an SDO abort transmission service (abort code: 0800 002xh).

The CANOpen device provides information about its storage capabilities during read access to the appropriate Sub-Index in the following format.

Bit MSB		Bit LSB	
32	2	1	0
Reserved	Auto	Cmd	

Lead access structure:.

bit	field	config. ration	Defin ition
0	Cmd	0b 1b	CANOpen devices do not save parameters in commands. The CANOpen device saves parameters on command.
1	Auto	0b 1b	CANOpen devices do not automatically save parameters. The CANOpen device automatically saves parameters.

# 5] CANOpen Object Dictionary

## ■ object 1011h: Restore Default Parameters

- This entry supports restoring default parameters.
- Read access provides the device with information about its ability to restore numbers. It is classified into parameter groups as follows
- Sub-Index 0: Contains the maximum Sub-Index supported.
  - Sub-Index 1: Restore all factory settings
  - Sub-Index 2: Restore all communication-related factory-set parameters (0x0000 to 0x1FFF)
  - Sub-Index 3: Restore all application-related factory configuration parameters (from 0x2000)
  - Sub-Index 4 to 127: Manufacturer-defined parameters

Object content:

Index	EDS Name	object code	data type	category
1010h	Store Parameter Field	ARRAY	U32	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	initial value
0	Number of Errors	c	nashi (Pyrus pyrifolia, esp. var. culta)	5
1	Restore all Default Parameters	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
2	Restore Communication Default Parameters	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
3	Restore Application Default Parameters	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
4	Restore Manufacturer Parameters	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0
5	Reserved	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0

The object "Restore Default Parameters" loads standard configuration parameters. The standard configuration parameters are either the initial or the last saved ones.

Read access supplies information about restore options.

To restore, the "Load" (0x641646) sign must be written.

"Load" Signed.

Signature (0x651646) is used.

The CANOpen device restores the default parameters once the correct signature is accepted at the appropriate Sub-Index. Then the SDO transmission (SDO Download: CANOpen application hierarchy and communication profile for reply initiation) is confirmed.

If the restore fails, the CANOpen device will return an SDO abort transmission service (abort code: 06060000h).

If incorrectly signed, the CANOpen device will reject the default restore and return an SDO abort transmission service (abort code: 0800 002xh).

The default value is set as valid after the CANOpen device is reset (NMT service node reset: Sub-Index 01h to 7Fh, NMT service communication reset: Sub-Index 02h) or power reset.

# 5] CANOpen Object Dictionary

The CANOpen device will provide information on the default parameter restore function during read access to the appropriate Sub-Index in the following format.

Bit MSB	Bit LSB
31	1
Reserved	CMD

Lead access structure:

bit	field	config. ration	Defin ition
0	Cmd	0b 1b	CANOpen devices do not restore default parameters. The CANOpen device restores the parameters.

■ Object 1014h: COB-ID Emergency Message (COB-ID Emergency Message)

Object content:

Index	Name	object code	data type	category
1010h	COB-ID EMCY	VAR	U32	option

Entry content:

Sub-Index	Access	PDO Mapping	initial value
0	ro	nashi (Pyrus pyrifolia, esp. var. culta)	0x80+ Node Id

■ Object 1017h: Producer Heartbeat Time (Producer Heartbeat Time)

Object content:

Index	Name	object code	data type	category
1017h	Producer Heartbeat Time	VAR	U16	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	initial value
0	Producer Heartbeat Time	RW	nashi (Pyrus pyrifolia, esp. var. culta)	-

Data bytes of NMT state evaluation of heartbeat producer:

-0 (00h): "Boot-up"

-4 (04h): "Stopped"

-5 (05h): "Operational"

-127 (7Fh): "Pre-operational"

# 5] CANOpen Object Dictionary

## 5-2. Manufacturer-specific objects (configuration parameters)

### Object 2000h: Node ID (IdNode)

This object sets the CAN node ID. Changes will take effect at the next power reset.

Object content:

Index	EDS Name	object code	data type	category
2000h	IdNode	VAR	U8	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data type	data range
0	CAN IdNode	RW	nashi (Pyrus pyrifolia, esp. var. culta)	1 to 127	1

To change the node ID and save, follow these steps

-Write "Command Disable Operation" in the control word (6040h).

→Read the status of the state machine P402(Must be "Switch on Disabled" with control word: 6040h)

-Set new node ID

→Write "save" to Sub-Index 4 of object 1010h (store parameter)(note the processing time)

-NMT Reset node

### Object 2001h: CAN Baud Rate

This object sets the CAN baud rate for the node. Changes will take effect at the next power reset.

Object content:

Index	EDS Name	object code	data type	category
2001h	CAN Baud rate	VAR	U16	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	CAN Baud rate	RW	nashi (Pyrus pyrifolia, esp. var. culta)	(see the following table or tables)	01F4h
	baud rate	input	Remarks		
	10 kb/s	000Ah			
	20 kb/s	0014h			
	50 kb/s	0032h			
	125 kb/s	007Dh			
	250 kb/s	00FAh			
	500 kb/s	01F4h			
	800 kb/s	0320h			
	1000 kb/s	03E8h			

Baud rate setting: 1.5

disabled

available

# 5] CANOpen Object Dictionary

To change the baud rate and save, follow these steps

- Write "Command Disable Operation" in the control word(6040h).
- Read the status of the state machine P402(Must be "Switch on Disabled" with control word: 6040h)
- Set a new baud rate
- Write "save" to Sub-Index 4 of object 1010h (store parameter). (note processing time)
- NMT Reset node

## ■ Object 3001h: Absolute Limits Parameters

This object describes the absolute limit. This parameter is read-only because it is set by the manufacturer.

Object content:

Index	EDS Name	object code	data type	category
3001h	Absolute Limits Parameters	ARRAY	U32	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of Errors	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-	5
1	Velocity ABS	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[rpm].	Depends on the application
2	Acceleration ABS	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[rpm/s].	
3	Limit Profile Velocity	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[rpm].	
1	Velocity ABS	[rpm].	The maximum absolute value of the speed profile. 607Fh (maximum speed file) limit.		
4	Acceleration ABS	[rpm/s].	The maximum absolute value of the acceleration profile. 60C5h (maximum acceleration) and 60C6h (maximum deceleration) limits.		
5	Limit Profile Velocity (Min Value)	[rpm].	This is the speed limit in profile mode. It is the smaller of 607Fh (maximum speed profile) and 3300h (speed full scale).		

## Object 3002h: Motor brake parameters (Mode Brake Parameters)

This object describes the brake parameter settings.

Object content:

Index	EDS Name	object code	data type	category
3002h	Brake Parameters	ARRAY	INT16	Required IF

## 5] CANOpen Object Dictionary

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of Entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-	7
1	Motor Brake Option	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	Defined by application
2	Motor Brake Delay	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[1 to 32767].	
3	Unlock Motor Brake Time	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[1 to 32767].	
4	Brake Timeout	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	
5	Automatic/Manual Mode Configuration	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	
6	Motor Brake Status	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	-
7	Brake Type	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[1,2]	Defined by application

Set value definitions:

Sub-Index	field	configuration	Contents
1	Motor Brake Option	0b 1b	Motor brake disabled or motor brake enabled without motor brake
2	Motor Brake Delay	[ms × 10].	Release command delay time [ms]. Delay time between STBY status and brake release
3	Unlock Brake Time	[ms × 10].	Delay time delay between STOP and RUN modes before brake release The delay time depends on the motor brake model.
4	Brake Timeout	[ms × 10].	Valid only without dynamic braking (object 0x3007) Maximum time with free-run deceleration At the end of this set time, the brakes will lock and the driver will be in STBY status.
5	Automatic/Manual Mode Configuration	0b 1b	Automatic mode enabled Manual mode enabled
6	Motor Brake Status	0b 1b	Brake status: 0b - Motor is not locked. 1b - Motor is locked.
7	Brake Type	1 2	PM Brake spring brake



The following figure shows brake timing as the drive transitions from the STANDBY state to the RUN state.

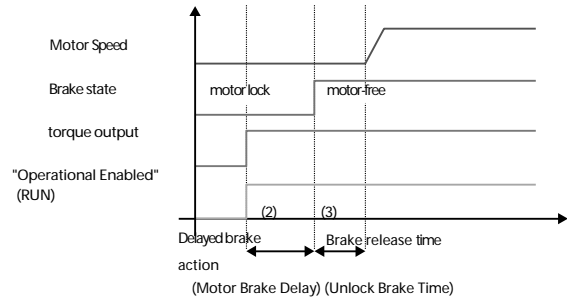


Figure 5-2 Brake time chart

## 5] CANOpen Object Dictionary

Brake parameters can be changed in real time. To save changes, follow these steps

- Write "Command Disable Operation" in the control word (6040h).
- Read the status of the state machine P402(Must be "Switch on Disabled" with control word: 6040h)
- Write "save" to Sub-Index 4 of object 1010h (store parameter)(note the processing time)
- NMT Reset node

### Object 3007h: Dynamic Brake Parameters

This object describes the parameters of the dynamic brake.

Object content:

Index	EDS Name	object code	data type	category
3007h	Dynamic Brake Parameters	ARRAY	INT16	Required IF

Entry content:..

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of Entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-	7
1	Dynamic Brake Option	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	1
2	Holding Torque Time	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[1 to 32767].	

Set value definitions:..

Sub-Index	field	config. ration	Contents
1	Dynamic Brake Option	0b 1b	Dynamic brake mode enabled Dynamic brake mode disabled
2	Decrement Step Ramp Time	[ms × 10 <sup>4</sup> ]	At the end of ramp deceleration, between STOP state and brake release Delay time (time to remain in STBY state) of
3	Dynamic Brake Status	0b 1b	Dynamic brake is operating. Dynamic brake is not working.
4	Max Timeout Before Brake Step Ramp	[ms × 100/s].	Dynamic braking is enabled and the RUN to STANDBY
5	Max Timeout Dynamic Brake	[ms × 10].	When the maximum dynamic braking time is exceeded, the system exits the dynamic braking state. Sub-Index greater than 4 (Decrement Step Ramp) and Please do so.

## 5] CANOpen Object Dictionary

The following figure describes the timing when the dynamic brake is activated.

This state is when the drive is transitioned from the RUN state (Operation Enabled: DSP402) to the STANDBY state (Operation Enabled: DSP403).

(Switched ON: DSP402).

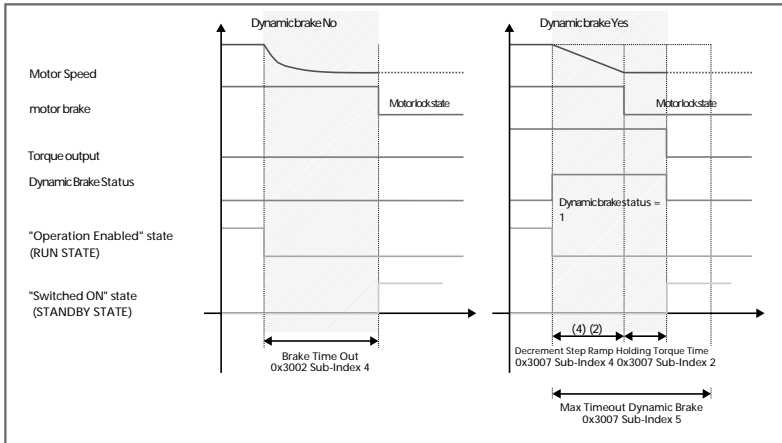


Figure 5-3 Timing Chart for Dynamic Braking

The following is a list of items that can be transferred from the RUN state to dynamic braking (when enabled).

Set "Disable operation" instruction in -object 6040h (control word)

→ Set "Input 3 Emergency Enable" if optional digital input 3 is applied

(Object 3008h)

-Alarm occurs

Dynamic braking parameters can be changed in real time. To make changes, follow these steps

-Write "Command Disable Operation" in the control word (6040h).

→ Read the status of the state machine P402. (Must be "Switch on Disabled" with control word: 6040h)

→ Write "save" to Sub-Index 4 of object 1010h (store parameter). (note the processing time)

-NMT Node reset

### ■ Object 3008h: Emergency enable parameter

(Emergency Enable Parameters)

This object describes the parameters that enable the functions of Digital Input 3.

Digital input 3 is set as the hardware signal to transition from the "Operation Enable" state [RUN] to the "Switched ON" state [STANDBY]. The "Operation Enable" state [RUN] is set to "STANDBY".

It can be set as an emergency signal, but it is not safety certified.

(Refer to the servo driver instruction manual: STO chapter.)

For safety-certified output shutdown, digital input 3 is used to transition the DSP402 state machine if the "Emergency Enable" function is performed.

## 5] CANOpen Object Dictionary

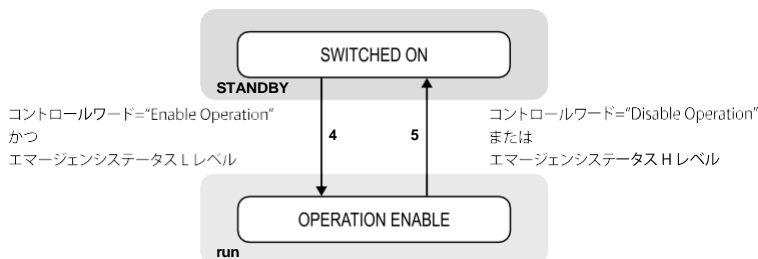


Figure 5-4 Emergency Enable Settings

### ■ CANOpen State Transition:

Transition 4: SWITCHED ON → OPERATION ENABLE

The control word (6040h) defines "Enable Operation" and digital input 3 at "L" level.

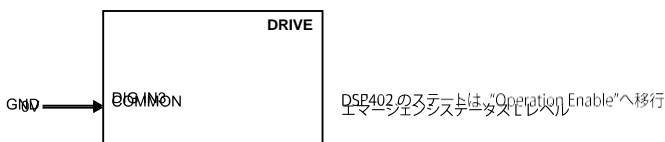


Figure 5-5 Emergency enable L level

Transition 5: OPERATION ENABLE → SWITCHED ON

Either "Disable Operation" is defined by the control word (6040h) or digital input 3 is defined at H level.

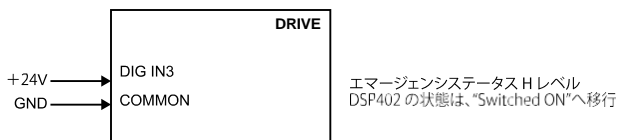


Figure 5-6 Emergency enable H level

If the "Emergency Enable" function is not used, digital input 3 is set as a general purpose input. You can change the configuration level.

Object content:

Index	EDS Name	object code	data type	category
3008h	Emergency Enabling Input Parameters	ARRAY	INT16	Required IF

# 5] CANOpen Object Dictionary

Entry content..

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of Entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-	7
1	Emergency Enable Option	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0, 1].	1
2	Emergency Input Neg	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0, 1].	0
3	Emergency Input Status	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0, 1].	0
4, 5, 6, 7	Free	RW	nashi (Pyrus pyrifolia, esp. var. culta)	-	-

Numerical Definition

Sub-Index	field	setting	Definition
1	Emergency Enable Option	0b 1b	Digital input 3 is set to general-purpose input. Digital input 3 is set to Emergency Enable
2	Emergency Input Neg	0b 1b	Emergent level input without inversion Emergent level input with inversion
3	Emergency Status	0b 1b	Status L: Emergence disabled Status H: Emergence enabled

Object 3030h: Drive Digital Output (Drive Digital Output)... Not available

Object 3050h: Analog Output 1 (Analog Output1)... Not available

## ■ Object 3200h: Current PID (Current Pid)

This object controls the current PID parameters.

Object content:

Index	EDS Name	object code	data type	category
3200h	Current Pid	ARRAY	INT16	indispensable

Entry content..

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of Entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	6	6
1	PidCur Kp	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	Defined by application
2	PidCur Ki	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
3	PidCur Kv	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	

The value of the Current PID can be changed in real time. To change it, follow these steps:  
- Write "Command Disable Operation" in the control word (06040h).

- Read the status of the state machine P402. (Must be "Switch on Disabled" with control word: 6040h)
- Write "save" to Sub-Index 4 of object 1010h (store parameter). (note the processing time)
- NMT Node reset

# 5] CANOpen Object Dictionary

## ■ Object 3201h: Speed PID (Speed Pid)

This object controls the speed PID parameter.

Object content:

Index	EDS Name	object code	data type	category
3201h	Speed Pid	ARRAY	INT16	indispensable

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of Entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	6	6
1	PidVel Kp	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	Defined by application
2	PidVel Ki (reserved area)	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
3	PidVel Kd (reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	reserved area
4	PidVel N (reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
5	PidVel FF (reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	

The value of the Speed PID can be changed in real time. To change it, follow these steps:  
— Write "Command Disable Operation" in the control word (6040h).  
— Read the status of the state machine P402. (Must be "Switch on Disabled" with control word: 6040h).  
— Write "save" to Sub-Index 4 of object 1010h (store parameter). (note the processing time)

## ■ Object 3202h: Position PID (Position Pid)

This object controls the position PID parameter.

Object content:

Index	EDS Name	object code	data type	category
3202h	Position Pid	ARRAY	INT16	indispensable

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of Entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	9	9
1	Pidpos Kp	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	Defined by application
2	Pidpos Ki	RW	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
3	Pidpos Kd (reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	reserved area
4	Pidpos FF (reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
5	Pidpos FF Ra A (reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
6	Pidpos FF Vr V (Reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	reserved area
7	Pidpos FF Rd A (Reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
8	Pidpos FF Rd V (Reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	
9	Pidpos Tc (reserved area)	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	

The position PID value can be changed in real time. To change it, follow these steps:  
— Write "Command Disable Operation" in the control word (6040h).  
— Read the status of the state machine P402. (Must be "Switch on Disabled" with control word: 6040h).  
— Write "save" to Sub-Index 4 of object 1010h (store parameter). (note the processing time)

# 5] CANOpen Object Dictionary

## ■ Object 3300h: Velocity Full Scale

This object shows the full scale of speed.

Object content:

Index	EDS Name	object code	data type	category
3300h	Velocity Full Scale	VAR	U16	indispensable

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Velocity Full Scale	RW	nashi (Pyrus pyrifolia, esp. var.	[0 to 32767].	Application defined by

## ■ 5-3. Manufacturer-specific objects (operation data)

### ■ Object 2002h: Drive Control State (Drive Control State)

This object communicates the drive state and accurately defines the PWM controlled motor.

Object content:

Index	EDS Name	object code	data type	category
2002h	Drive Control State	VAR	INT16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range
0	Drive Control State	ro	nashi (Pyrus pyrifolia, esp. var. culta)	see table

Data content: (1)

Number Value	bit	Name	Contents
0x0001	1	Run Velocity	Motor running in speed control mode
0x0002	2	Standby	Driver is in standby and PWM is off
0x0004	3	Stop.	Drive stops and generates holding torque
0x0008	4	Off	disuse
0x0010	5	Alarm	Alarm detection
0x0020	6	Run Current	Motor running in current control mode
0x0040	7	Init.	Driver is initializing and PWM is off
0x0080	8	Safe	STO l s active, driver is in safe state, PWM is off
0x0100	9	Run Positioner	Motor running in position control mode



## 5] CANOpen Object Dictionary

### ■ Object 2003h: Warning

This object logs drive warnings. To clear the warnings, set the Abnormality Reset bit (# 7) in [ Control Word: 6040h]. The meanings of the bits are shown below.

- Node guarding warning
- I2t limit warning
- Store/restore/load (EEPROM) directive warning
- Writing to Golden Image Warning
- CANOpen disabled warning during initialization
- CANOpen object configuration initialization warning

Object content:

Index	EDS Name	object code	data type	category
2003h	Warning	VAR	U32	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range
0	Drive Warning	ro	nashi (Pyrus pyrifolia, esp. var. culta)	see table
Bits Contents: 1.				
bit	Name	Contents		
0	Node Guarding	Master loses node guarding message.		
1	I2t Limit	Driver is in I2t-limited state		
2	Command Store/Restore/Load EEPROM	Store/restore/load commands are disabled because the drive is not "Ready to Switch on" or "Disabled"		
3	Update Parameters Manufacture	Update request by CANOpen is not allowed (RS232 only)		
4	Golden Image Writing	Golden image area "free": write		
5	Alarm CANOpen Disabled	CANOpen disabled alarm during initialization		
6	Init Object CANOpen	Configuration initialization of CANOpen object		
7 to 31	-	freedom		

### ■ Object 2004h: Servo drive state (State smartris Drive Machine)

This object accurately describes the drive state.

It follows the smartris drive's own finite state machine in accordance with the DSP402 profile.

Drive State Definitions:

- 0 = smartris Drive State INIT: p402 state not ready to switch on
- 1 = smartris Drive State SAFETY
- 2 = smartris Drive State STOP: p402 state quick stop active
- 3 = smartris Drive State RUN: p402 state operation enabled
- 4 = smartris Drive State STANDBY: p402 state switched on
- 5 = smartris Drive State DYNAMIC BRAKE
- 6 = Reserved area
- 7 = Reserved area
- 10 = smartris Drive State INIT: p402 state switch on disabled

## 5] CANOpen Object Dictionary

- 11 = smartris Drive State INIT: p402 state ready to switch on
- 16 = smartris Drive State FAULT: p402 state fault reaction active
- 17 = smartris Drive State FAULT: p402 state fault
- 18 = smartris Drive State FAULT: p402 state error

Object content:

Index	EDS Name	object code	data type	category
2004h	Drive Status smartris Drive	VAR	INT16	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range
0	Drive State smartris Drive	ro	nashi (Pyrus pyrifolia, esp. var. culta)	see table

Valid entries:

Number Value	Servo drive state	DSP402 State
0	INIT	Not ready to switch on
1	SAFETY	-
2	STOP	Quick stop active
3	run	Operation enabled
4	STANDBY	-
5	DYNAMIC BRAKE	-
6	Reserved	-
7		
8	Free	-
9		
10	INIT	State switch on disabled
11	INIT	Ready to switch on
12	Free	-
13		
14		
15		
16	FAULT	Fault reaction active
17		Fault
18		error

### ■ Object 2030h: Driver temperature(Temperature Drive)

This object communicates the driver temperature.

Object content:

Index	EDS Name	object code	data type	category
2030h	Temperature Drive	VAR	INT16	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range	Unit
0	Drive Temperature	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-150 to 1250	[° C /10]

## 5] CANOpen Object Dictionary

### Object 2031h: Temperature Motor

This object communicates the motor temperature.

Object content:

Index	EDS Name	object code	data type	category
2031h	Temperature Motor	VAR	INT16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	Unit
0	Motor Temperature	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-400 to 1300	[° C /10]

### ■ Object 2032h: Temperature Heat Sink

This object communicates the heat sink temperature.

Object content:

Index	EDS Name	object code	data type	category
2032h	Temperature Heat Sink	VAR	INT16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	Unit
0	Heat Sink Temperature	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-400 to 1300	[° C /10]

### ■ Object 2041h: Bus voltage (Voltage Bus)

This object communicates bus voltage values.

Object content:

Index	EDS Name	object code	data type	category
2041h	Voltage Bus	VAR	INT16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	Unit
0	Voltage Bus	ro	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 11000	[V/100].

### ■ Object 2050h: Torque Current

This object communicates torque current values.

Object content:.

Index	EDS Name	object code	data type	category
2050h	Torque Current	VAR	INT16	option

# 5] CANOpen Object Dictionary

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	Unit
0	Torque Current	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-32767 to 32767	[A/100].

■ Object 2051h: Power Drive

■ Object 2052h: Motorpower (Power Motor)

■ object 2053h: Velocity Filtered

This object communicates speed filter values.

Object content:

Index	EDS Name	object code	data type	category
2053h	Velocity Filtered	VAR	INT16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	Unit
0	Velocity Filtered	ro	nashi (Pyrus pyrifolia, esp. var. culta)	-32767 to 32767	[rpm/4].

Object 3004h: Feedback Parameters

This object defines the specification of feedback characteristics. It is for lead only.

Object content:

Index	EDS Name	object code	data type	category
3004h	Feedback Parameters	ARRAY	INT16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	Unit
0	Number of Entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	2	2
1	Feedback Type	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	Application
2	Resolution	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	Feedback resolution
3	Feedback Type (Feedback Type)	[0, 2].	Resolver	2	Feedback resolution
4	Resolution	[0 to 32767].	Feedback resolution		

## 5] CANOpen Object Dictionary

## ■ Object 3006h: Motor Specific Setting

This object defines the motor characteristic specification. It is for lead only.

Object content:

Index	EDS Name	object code	data type	category
3006h	Motor Specific Setting	ARRAY	INT16	option

Entry content:

■ **Object 3020h: Digital input (Drive Digital Input)**

0	Maximum Speed	0	0
This object describes the contents of the digital input.		pyrasi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767]
Object content:			

Object content:

Index	EDS Name	object code	data type	category
3020h	Drive Digital Input	ARRAY	INT16	option

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Number of entries	ro	nashi (Pyrus pyrifolia, esp. var. culta)	6	6
1	Digital input 1- RUN	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	0
2	Digital input 2 - STOP	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	0
3	Digital input 3 - Emergency stop	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	0
4	Digital input 4 - Hardware reset	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	0
5	Digital input STO1	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	0
6	Digital input 1 STO2	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	0
7	Digital input 2 STOP	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0,1]	0

# 5] CANOpen Object Dictionary

Sub-Index	field	setting	Defin ition
3	Digital input 3 emergency stop	0b 1b	Emergency Input Enable" is defined for digital input 3. If the command is "STANDBY," it is a directive to move to the STANDBY state.
4	Digital input 4 hardware reset	0b 1b	This digital input is a reset. There is a 100ms filter.
5	Digital input STO1	0b 1b	Defines the state of STO1; if 1, STO1 is enabled. To check the safety state, use the object See 4000h (Safety)
6	Digital input STO2	0b 1b	Defines the state of STO2; if 1, STO2 is enabled. To check the safety state, use the object See 4000h (Safety)

## ■ Object 3022h: Analog Input

### 6402h: Motor type (Motor Type)

This object describes the motor type driven by the driver.

Object content:

Index	EDS Name	object code	data type	category
6402h	Motor Type	VAR	INT16	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
6402h	Motor Type	RW	nashi (Pyrus)	0 to 0xFFFF	-
Sub-Index	field	Defin ition			
0000h	Non-standard motor	-			
0001h	DC motor (phase modulation)	-			
0002h	DC motor (frequency control)	-			
0003h	Synchronous motor (permanent magnet)	-			
0004h	Synchronous motor (field winding)	-			
0005h	Switched Reluctance Motor	AC Synchronous switched reluctance motor			
0006h	Wire-wound induction motors	AC Winding Motor			
0007h	Cage type induction motor	AC Induction motor			
0008h	stepping motor	AC Synchronous stepping motor			
0009h	microstepping motor	-			
000Ah	Brushless motor (sinusoidal drive)	AC Synchronous brushless motor			
000Bh	Brushless motor (square wave drive)	AC Synchronous brushless motor			
000Ch	AC Synchronous Reluctance Motor	-			
000Dh	DC motor (permanent magnet)	-			
000Eh	DC motor (direct-wound)	-			
000Fh	DC motor (field winding) <sup>67</sup>	-			
0010h	DC motor (double winding)	-			

# 5] CANOpen Object Dictionary

Sub-Index	field	Defin ition
0011h to 7FEh	reserved area	-
7FFFh	No motor allocation	-
8000h to FFFFh	manufacturer-specific	-

## 6403h: Motor Catalogue Number

This object indicates the motor catalog number (nameplate No.) provided by the motor manufacturer.  
If there is no number, this object will show 0 (a string of color)

Object content:

Index	EDS Name	object code	data type	category
6403h	Motor Catalogue Number	VAR	character string	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0 Valid entries:	Motor Catalogue Number	RW	nashi (Pyrus pyrifolia, esp. var. cultu)	4	"000"
Number	Motor Production Code	Name			
Value					
"0000"	undefined	nashi (Pyrus pyrifolia , esp. var. cultu)			
"0001".	B40E4J - C1078	B40			
"0002".	B6304K - H32 mm - 48Vdc	B63			
"0003".	B7108Q - H40mm - 48Vdc	B71			

## Object 6404: Motor Manufacture

This object indicates the name of the motor manufacturer.  
If there is no name, this object will show 0 (a string of color)

Object content:

Index	EDS Name	object code	data type	category
6404h	Motor Manufacture	VAR	character string	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0 Valid entries:	Motor Manufacture	RW	nashi (Pyrus pyrifolia, esp. var. cultu)	4	"000"
Numeric - String	Motor Production Code	Name			
"NaN."	undefined	nashi (Pyrus pyrifolia , esp. var. cultu)			
"B40."	B40E4J - C1078	B40			
"B63."	B6304K - H32 mm - 48Vdc	B63			

# 5] CANOpen Object Dictionary

## Object 6502: Supported Drive Modes

This object shows information on supported drive modes.

Object content:

Index	EDS Name	object code	data type	category
6502h	Supported Drive Modes	VAR	U32	indispensable

Entry content::

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Supported Drive Modes	ro	nashi (Pyrus pyrifolia, esp. var. culta)	[0 to 32767].	4
Bit Definition:					
bit	Contents	this product			
0	positional profile mode	-			
1	Velocity mode	-			
2	Speed profile mode	Support			
3	Torque profile mode	-			
4	reserved area	-			
5	homing mode	-			
6	Interpolated position mode	-			
7	cyclic synchronous position mode	-			
8	cyclic synchronous speed mode	-			
9	Cyclic Synchronous Torque Mode	-			
10 to 15	reserved area	-			
16 to 31	manufacturer-specific	-			

## 5.4. DSP402 Profile Object

6040h - Controlword (Controlword)

This object is used to control CiA-402 FSA, CiA-402 mode, and manufacturer-specific entities.

Object content:

Index	EDS Name	object code	data type	category
6040h	Controlword	VAR	U16	indispensable

Entry content::

Sub-Index	Contents	Access	PDO Mapping	data type	data range
0	Control word	RW	Yes (Initial value)	See below	-

This object is bitwise and has the following meanings

15	11	10	9	8	7	6	5	4	3	2	1	0
ms	ra	OMS	indecent	fr	OMS	eo	QS	ev	so			
	diu											
	s											

MSB



## 5] CANOpen Object Dictionary

Bit Definition:

bit	Definition	Name
0	so	Switch ON (Switch ON)
1	ev	Enable Voltage
2	QS	Quick Stop
3	eo	Enable Operation
4, 5, 6, 9	OMS	Operation mode specific
7	fr	Fault Reset
8	indecent	Halt
9	OMS	Operation mode specific
10	radius	reserved area
11 - 15	ms	manufacturer-specific

com mand	Bits of control word					transition (Transition )
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
	Fault Reset	Enable Operation	Quick Stop.	Enable Voltage	Switch ON	
Shutdown	0	an unknown	1	1	0	2, 6, 8
Switch ON (Switch ON)	0	0	1	1	1	3
Switch ON+ Operation enabled	0	1	1	1	1	3 Note)
Disable Voltage	0	an unknown	an unknown	0	an unknown	7, 9, 10, 12
Quick Stop	0	an unknown	0	1	an unknown	7, 10, 11
Disable Operation	0	0	1	1	1	5
Enable Operation	0	1	1	1	1	4, 16
Fault Reset	1	an unknown	an unknown	an unknown	an unknown	15

Note: After execution of the switch ON, the operation is automatically transitioned to operation enabled. An interval of 20 ms or more is required for the transition.

bit	Maker-specific bits		Contents
	Name	Number Value	
4, 5, 6, 9	Operation mode peculiar	0b 1b	These bits are used to select the profile selected in the mode The meaning is more different.
8	Halt	0b 1b	The commanded operation is continued. The commanded operation is interrupted.
11	warning recognition	0b 1b	When set to 1, the status word warning bit is It will be cleared.
12, 13, 14, 15	manufacturer-specific	-	-

### 6041h: Statusword (Statusword)

This object is used to indicate the FSA's current state, operating mode, and manufacturer-specific entities.

Object content:..

Index	EDS Name	object code	data type	category
6041h	Statusword	VAR	U16	indispensable

# 5] CANOpen Object Dictionary

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data type	data range
0	Status Word	ro	Yes (default)	see table	-

15 MSB	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0 LSB
ms		OMS	ILA	tr	rm	ms	LOL	sod	QS	ve	f	Oe.	so	rtso	

Bit Definition:

bit	Definition	Name
0	rtso	Ready to Switch ON
1	so	Switch ON (Switch ON)
2	Oe.	Operation Enable
3	f	Fault
4	ve	Voltage Enabled
5	QS	Quick Stop
6	sod	Switch ON Disabled
7	LOL	Warning
8	ms	manufacturer-specific
9	rm	Remote
10	tr	Target Reached
11	ita	Internal Limit Active
12, 13	OMS	Operation Mode Specific
14, 15	ms	manufacturer-specific

Bits Contents: 1.

bit	Name	Number Value	Contents
0, 1, 2 3, 5, 6	status word	x0xx 0000b	Not Ready to Switch ON
		x1xx 0000b	Switch ON Disabled
		x01x 0001b	Ready to Switch ON
		x01x 0011b	Switched ON
		x01x 0111b	Operation Enabled
		x00x 0111b	Quick Stop Active
		x0xx 1111b	Fault Reaction Active
		x0xx 1000b	Fault
4	Voltage Effective	0b 1b	Bus voltage is less than the undervoltage value. Bus voltage is greater than the undervoltage value.
5	(coming to a) sudden stop	0b 1b	Sudden stop operation of the drive Drive does not stop abruptly.
7	Warning	0b 1b	No warnings generated (no errors or malfunctions) Warning occurred (see warning list, object 2003h)
8	emergence enable input	0b 1b	Emergence input is invalid. EMERGENCY input enabled
10	goal achievement	0b 1b	Target not reached Target value reached
11	Internal limit operation	0b 1b	Indicates that the I2t limit is not operating. Indicates that the I2t limit is operating.

## 5] CANOpen Object Dictionary

bit	Name	Number Value	Contents
14	Drive Safety	0b	If the drive is in NORMAL mode (or SAFETY mode or the drive is in (I am not) at fault
		1b	Drive is in SAFETY mode
15	drive failure	0b	If the drive is in NORMAL mode (or SAFETY mode or the drive is in (I am not) at fault
		1b	Drive has failed (alarm detected)

Contents of bit operation mode

bit	Operation Mode					
	Velocity mode	positional profile mode	Velocity Profile mode	torque profile mode	homing mode	Corrected. position mode
12	reserved area	Recognition of setpoint values	attainment of velocity	reserved area	Homing Arrival	Ip mode enabled
13	reserved area	following error	Velocity slip error	reserved area	homing error	reserved area

### Object 6060h: Mode of Operation

This object allows you to select the operation mode.

Only the requested operation mode value is shown; the actual operation mode of PDS is reflected in the object (Mode of Operation Display: 6061h).

Object content:

Index	EDS Name	object code	data type	category
6060h	Mode of Operation	VAR	INT8	indispensable

Entry content::

Sub-Index	Contents	Access	PDO Mapping	data type	data range
0	Mode of Operation	RW	Yes (default)	see table	-128 to 10

Bit Definition::

bit	Contents	bit	Contents
0	No mode change / No mode assignment	6	homing mode
1	positional profile mode	7	Interpolated position mode
2	Velocity mode	8	cyclic synchronous position mode
3	Speed profile mode (available)	9	cyclic synchronous speed mode
4	Torque profile mode	10	Cyclic Synchronous Torque Mode
5	reserved area	-1	Manufacturer specific (analog or hardware controlled)

Manufacturer specific is (-1). Analog or hardware-controlled operation mode is defined.

# 5] CANOpen Object Dictionary

## Object 6061h: Mode of Operation Display

This object shows the actual mode of operation.

Object content:

Index	EDS Name	object code	data type	category
6061h	Mode of Operation Display	VAR	INT8	indispensable

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data type	data range
0	Mode of Operation Display	ro	Yes (default)	see table	-128 to 10

Bit Definition:

bit	Contents	bit	Contents
0	No mode change / No mode assignment	6	homing mode
1	positional profile mode	7	Interpolated position mode
2	Velocity mode	8	cyclic synchronous position mode
3	Speed profile mode	9	cyclic synchronous speed mode
4	Torque profile mode	10	Cyclic Synchronous Torque Mode
5	reserved area	-1	Manufacturer's specifications (analog or hardware)

## ■ object 607Eh: Polarity

This object affects the sign of (Position Demand Value: 6062h) and (Velocity Demand Value: 606Bh).

Object content:

Index	EDS Name	object code	data type	category
607Eh.	Polarity	VAR	U8	indispensable

Entry content:

Sub-Index	Contents	Access	PDO Mapping	data range	initial value
0	Polarity	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 192	00h
1	Bits Contents:				
bit	Contents				
0 to 5	reserved area				
6	Speed polarity				
7	Position polarity				

Bit value definitions:

-bit value = 0: requested value x 1

-bit value = 1: requested value x -1

## 5] CANOpen Object Dictionary

### 60FDh: Digital input (Digital Input)

This object describes the digital input.

The low word shows the status of the digital inputs as defined in the CANOpen 402 profile.

The high word shows the status of all digital inputs. The state of the digital inputs is output in object 60FDh.

-Homing profile limit switch or reference ~~is~~ not yet implemented)

Digital inputs 1-4: programmable and defined by application

-Safe Torque Off (STO)

Object content:

Index	EDS Name	object code	data type	category
60FDh	Digital Inputs	VAR	U32	option

Entry content:.

Sub-Index	Contents	Access	PDO Mapping	data range			
0	Digital Inputs	ro	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 0xFFFFFFFF			
Bit Structure							
	Bit MSB		Bit LSB				
	31	16	15	4	3	2	1
Digital Input Status Manufacturer Specifications		reserved area		interlock	home switch	+ Limit switch	- limit switch

Data Details:.

bit	configuration	Number Value	Definition	Remarks
0	- limit switch	0b 1b	- Limit switch not reached - Limit switch reached	Not used.
1	+ Limit switch	0b 1b	+ Limit switch not reached + Limit switch reached	
2	home switch	0b 1b	Home switch not reached Reaching the home switch	
3	interlock	0b 1b	No interlock interlocking operation	
4 to 15	reserved area	-	-	-
16	Digital Input - DigIn1	0b 1b	Status Lead: L level Status Lead: H level	RUN command in analog mode
17	Digital Input - DigIn2			STOP command in analog mode
18	Digital Input - DigIn3			"Emergency Input Enable". configurable
19	Digital Input - DigIn4			hardware reset
20	Digital Input - STO1			Connect the digital inputs to the STO circuit If the STO input is not used, the
21	Digital Input - STO2			Always set to High level.
20 to 31	Digital input	-	-	disabled

# 5] CANOpen Object Dictionary

## 60FEh: Digital Output (Digital Output)

This object is a digital output command. It represents the output level of the logic.

Object content:

Index	EDS Name	object code	data type	category
60FEh	Digital Outputs	VAR	U32	option

Entry content:.

Sub-Index	Name	Access	PDO Mapping	data range	initial value
00h	Highest sub-index supported	C	nashi (Pyrus pyrifolia, esp. var. culta)	[1, 2].	2
01h	Physical outputs	RW	possible	0	00000000h
02h	Bit Mask	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0	00000000h
31	Digital output command manufacturer specifications	15	reserved area	Motor brake command	

Sub-Index 01h Numeric Definition: Numeric

bit	configuration	Number Value	Definition	Remarks
0	Motor brake command	0b 1b	<del>Brake - Motor lock</del> <del>Brake - Motor free</del>	Brake can be used in manual mode
1 to 15	reserved area	-	-	-
16	Digital output 1 Drive Status	0b 1b	Switch off: Drive failure Switch on: Drive normal	Connect to Drive Status
17	Digital output 2	0b 1b	switch off switch on	available
18	Digital output 3	0b 1b	switch off switch on	available
19	Digital output 4	0b 1b	Switch off - Brake operation Switch on - Brake release	Connected to brake status

Bit Structure of Sub-Index 02h: 1.

Bit MSB			Bit LSB
31	16	15	1
			0
Digital output Enable / Disable Manufacturer Specifications		reserved area	Motor brake operation

## 5] CANOpen Object Dictionary

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Sub-Index 02h Numeric Definitions:

bit	configuration	Number Value	Definition	Remarks
0	Motor brake operation	0b 1b	output disabled output enabled	always on
1 to 15	reserved area	-	reserved area	-
16	Digital output 1	0b 1b	Output Disable Output Enable	always on
17	Digital output 2			
18	Digital output 3			
19	Digital output 4			



## 6-1. Operation mode

This product has the following operation modes

-Position profile mode: 1 (to be supported soon)

This mode allows the user to move to a defined target position.

Mode of Operation "Mode of Operation" object (6060h) set to 1

-Speed profile mode: 3

This mode can follow the speed set point without defining a target position. Set the operation mode object (6060h) to 3

-Torque profile (torque profile mode: 4) (to be supported soon)

This mode can follow the current set point without defining a target position. Set the operation mode object (6060h) to 4

-Homing (homing profile mode: 6) (not implemented) Used to define the home position.

Set to operation mode object (6060h)6

-Analog motion request)

In this mode, drive state is determined by command transitions similar to those in speed profile mode, but the speed ID is determined by analog inputs.

Set operation mode object (6060h) to -1

The operating mode is selected by object 0x6060. Changes to this object are performed only at velocity 0 in "velocity profile mode" and "homing mode" and only when the target position is reached in "position mode".

## 6-2. Speed profile mode

In the speed profile mode (PV), the speed of the drive is controlled by the PID controller. It is guaranteed that the drive will operate without deviating from the specified value as long as it does not become overloaded.

Requirements for the drive to operate in PV mode

-Speed profile mode is set to 3 for operation mode (6060h).

-NMT Must be in the "Operation Enabled" state via the state machine.

(Check the status word: 6041h.)

-The speed and position controllers must be set correctly.

The target speed is set via a target speed object (60FFh) in the object dictionary. In speed profile mode, the drive follows the newly transmitted set value.

At the same time, the maximum values for acceleration, deceleration ramps, and speed settings are taken into account.

## 6] CANOpen operation mode

### ■ Speed profile mode control configuration

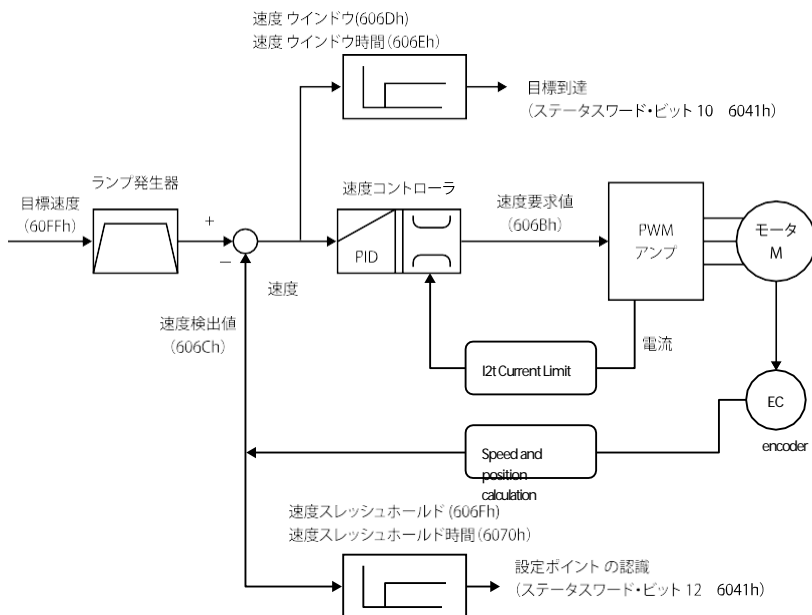


Figure 6-1 Control configuration of speed profile

In the speed operation mode profile, the operating profile is defined by speed and acceleration/deceleration commands.

### ■Initialization of speed control profile: ■Initialization of speed control profile: ■Initialization of speed control profile

- Writing 3 to the operation mode object (6060h) switches the operation mode to the speed profile mode.
- Use control word (6040h) to shift the state machine DSP402 to the "Operation Enable" state
- Acceleration and deceleration speeds are set with the objects "Acceleration profile: 6083h" and "Deceleration profile: 6084h"
- Start operation by setting the target speed with the "Target speed: 60FFh" object.

If necessary, clear bit 8 of the Control word: 6040h object to start driving. In this mode, the driver can follow the speed set point of "Target Speed: 60FFh". The target speed can be changed during operation.

The set point is reached with the accelerations defined in 6083h and 6084h.

## 6] CANOpen operation mode

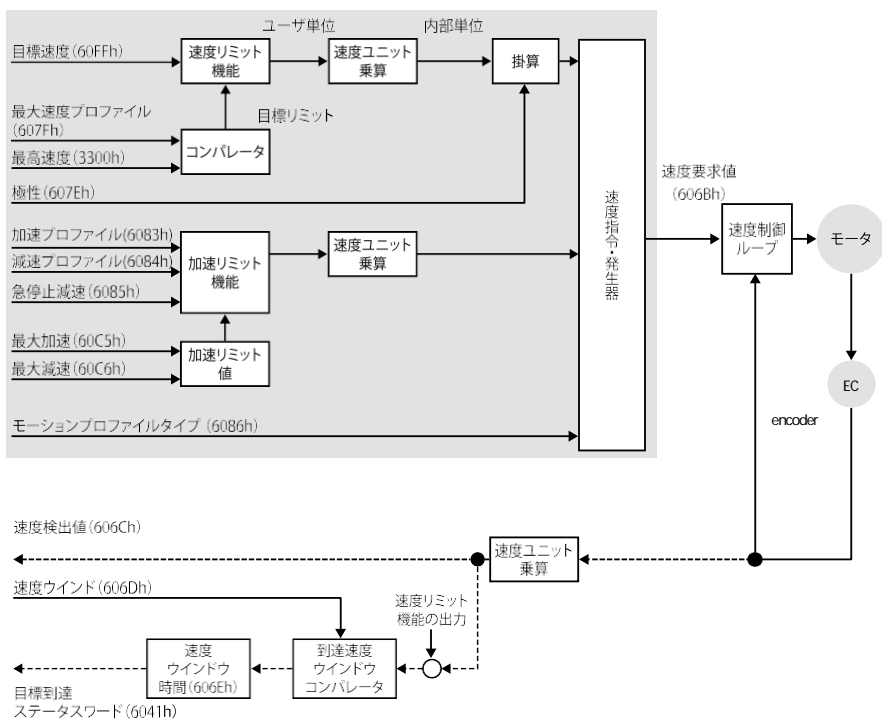


Figure 6-2 Block diagram of speed control

Operation is terminated when any of the following conditions occur

- Set "Target speed: 60FFh" to 0 (In this case, the motor torque is retained.)
- Stop by Halt bit(8) of Control word: 6040h
- Due to error occurrence (driver transitions to failure state)
- Disable Operation", "Disable Voltage", and "Quick Stop" commands in "Control Word: 6040h" are used to stop the DSP402. Use of the "Quick Stop" command to stop the DSP402 out of the "Operation Enabled" state.
- Stopped by safety (STO input)

The speed profile results are the following bits

- Object "Speed Window: 606Dh" -> "Status Word: 6041h" bit 10: Target reached
- Object "Speed threshold: 606Fh" to "Status word: 6041h" bit 12: Speed attained
- Object "Speed slip error: 60F8h" -> Bit 13 of "Status word: 6041h": Maximum speed slip reached

## 6] CANOpen operation mode

The next bit of the object "Control word: 6040h" is a manufacturer-specific function.

bit	Number Value	Contents
Bit 8 = Halt	0b 1b	Operation continues axis stop running

The next bit of the object "Status word: 6041h" is a manufacturer-specific function.

bit	Number Value	Contents
Bit 10 = Target reached	0b	When Halt (bit 8 of control word) = 0: Target not reached
	1b	When Halt (bit 8 of control word) = 1: Deceleration of axis in progress
Bit 12 = Speed attained	0b	When Halt (bit 8 of control word) = 0: Target reached
	1b	When Halt (bit 8 of control word) = 1: Axis speed 0
Bit 10 = Maximum slip error	0b 1b	Speed is less than the speed threshold. Speed is greater than the speed threshold.
	0b 1b	Maximum slip not reached Maximum slip reached

### ■Details of operation mode

Speed profile operation mode allows operation according to target speed.

Procedure: 1.

"Operation mode: 6060h" is set to speed profile mode(3)

-Set ramp acceleration/deceleration speeds to "Acceleration profile: 6083h" and "Deceleration profile: 6084h"

-Set target speed to "Target speed: 60FFh"

If the power stage is enabled, the new target speed becomes effective immediately and either starts operation or is set to the Halt = 0 bit operation mode.

-Set "Control word: 6040h" to start operation mode.

Option: Option

-Inquire "Status word: 6041h" to obtain the device status.

The value is reset to 0 when the operation mode is changed, the power stage is disabled, or an abrupt stop is triggered.

-Query "Speed request value: 606Bh" to obtain speed command

-Query "Measured Speed: 606Ch" to obtain actual speed

-Query "speed window: 606Dh" to obtain speed window value

These are the additional steps for the target speed.

## 6] CANOpen operation mode

In order to compare the measured speed "606Ch" with the target speed "TargetSpeed:60FFh", an allowable window for the measured speed is defined using the object "Speed Window: 606Dh".  
If the speed deviation is less than the "Speed window:606Dh" for a longer time than specified in the object "Speed window time: 606Fh", bit 10 (target reached) of object "Status word:6041h" is set.

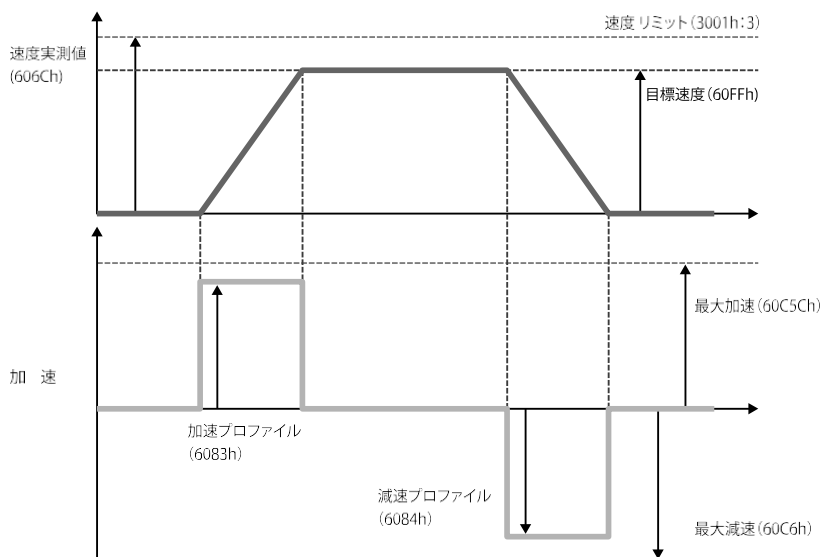


Figure 6-3 Speed pattern

## 6] CANOpen operation mode

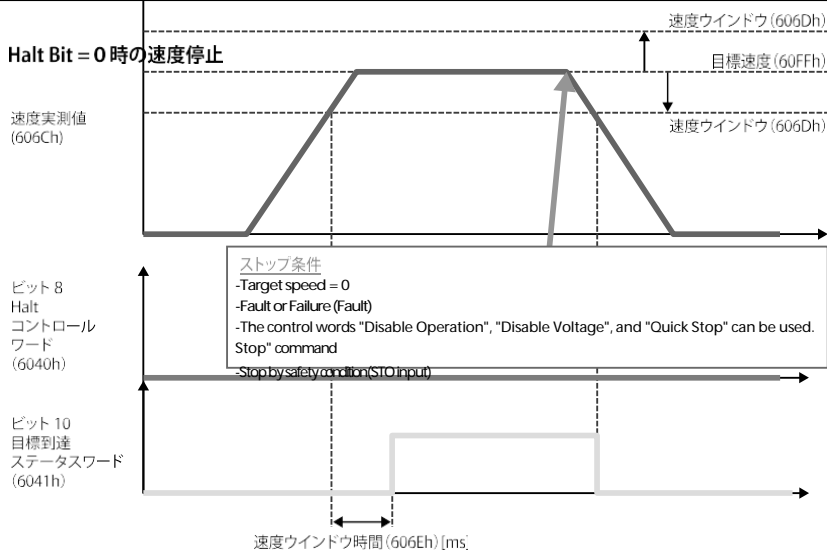


Figure 6-4 Speed window 1

### Halt Bit = 1 時の速度停止

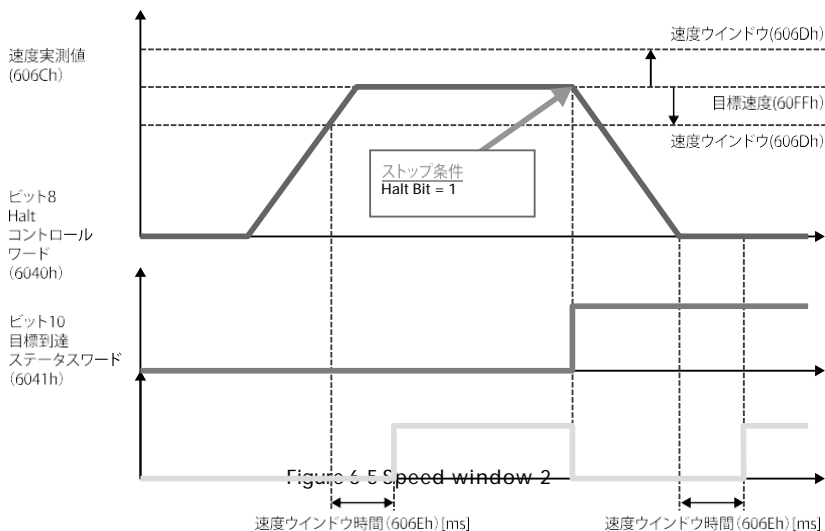


Figure 6-5 Speed window 2

## 6] CANOpen operation mode

Inquire "Speed Threshold: (606Fh)" and set a still window.

The object "Speed Threshold: (606Fh)" determines the speed at which it is considered stationary.

As soon as the object "Actual Speed: 606Ch" exceeds "Speed Threshold 606Fh" for longer than "Speed Threshold Time: 6070h", bit 12 (Speed Attained) of Status Word: 6041h is cleared.

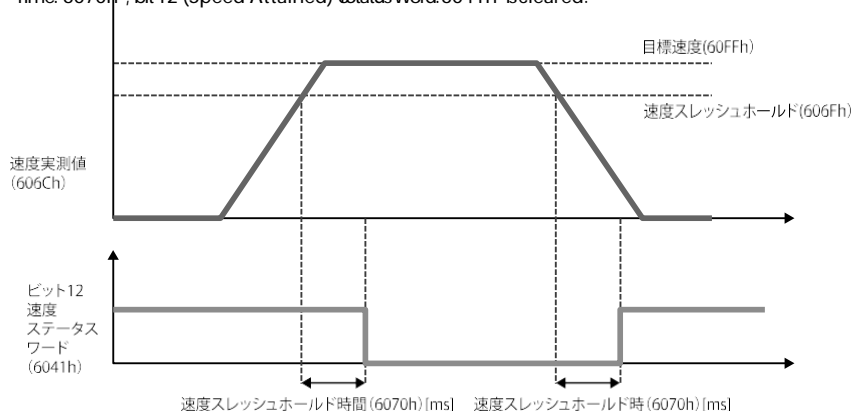


Figure 6-6 Speed Threshold

### ■ Object 60FFh: Target Velocity

This object indicates the set target speed and is used as an input for the speed pattern. Object 60FFh sets the target speed when using the speed profile mode. The acceleration/deceleration commands set by objects 6083h and 6084h are used to accelerate/decelerate the drive.

Object content:

Index	object code	data type	category
60FFh	VAR	INT32	indispensable

Entry content:

Sub-Index	Access	PDO Mapping	data type	initial value	unit
00h	RW	ant	-2147483648 to 2147483648	Manufacturer Specifications	[u.u.]

## 6] CANOpen operation mode

### ■ object 607Fh: Max Profile Velocity

This object indicates the maximum allowable speed in either direction of rotation during profile operation.

Object content:.

Index	object code	data type	category
607Fh	VAR	U32	option

Entry content:.

Sub-Index	Access	PDO Mapping	data type	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 4294967196	Manufacturer Specifications	[u.u.].

(This object is also used for position profiles.)

If the maximum speed profile is greater than the absolute value of the maximum speed (Index 3001h: 1), the driver sends an abort code message (0x060900031: parameter value excessive).

### Object 6083h: Profile Acceleration

This object indicates acceleration.

Object content:.

Index	object code	data type	category
6083h	VAR	U32	option

Entry content:.

Sub-Index	Access	PDO Mapping	data type	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 4294967196	Manufacturer Specifications	[u.u.].

(This object is also used for position profiles.)

### Object 6084h: Profile Deceleration

This object indicates deceleration.

Object content:.

Index	object code	data type	category
6084h	VAR	U32	option

Entry content:.

Sub-Index	Access	PDO Mapping	data type	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 4294967196	Manufacturer Specifications	[u.u.].

(This object is also used for position profiles.)



## 6] CANOpen operation mode

### ■ object 60C5h: Max Acceleration

This object indicates the maximum acceleration. It is used to limit the allowable acceleration in order to prevent destruction of the motor or machine.

Object content:

Index	object code	data type	category
60C5h	VAR	U32	option

Entry content:

Sub-Index	Access	PDO Mapping	data type	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 4294967196	Manufacturer Specifications	[u.u.]

If the maximum acceleration is greater than the absolute maximum acceleration (Index 3012) the driver sends an abort code message (0x060900031: parameter value excessive).

### ■ Object 60C6h: Max Deceleration

This object indicates the maximum deceleration. It is used to limit the permissible deceleration to prevent destruction of the motor or machine.

Object content:

Index	object code	data type	category
60C6h	VAR	U32	option

Entry content:

Sub-Index	Access	PDO Mapping	data range	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 4294967196	Manufacturer Specifications	[u.u.]

If the maximum deceleration is greater than the absolute maximum deceleration (Index 3012) the driver sends an abort code message (0x060900031: parameter value excessive).

If the maximum deceleration overflows, the driver sends an abort code message (0x060900031: parameter value excessive).

### Object 6068h: Velocity Demand Value

This object provides the output value of the velocity pattern.

Object content:

Index	object code	data type	category
6068h	VAR	INT32	option

Entry content:

Sub-Index	Access	PDO Mapping	data range	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	-2147483648 to 2147483648	Manufacturer Specifications	[u.u.]

## 6] CANOpen operation mode

### Object 606Ch: Velocity Actual Value

This object supplies the measured speed value detected by the speed or position sensor.

Object content:

Index	object code	data type	category
606Ch	VAR	INT32	Conditional (required if pv or csv is supported)

Entry content:

Sub-Index	Access	PDO Mapping	data range	initial value	unit
00h	RW	Yes (default)	-2147483648 to 2147483648	Manufacturer Specifications	[u.u.].

### ■ object 606Dh: Velocity Window

This object indicates the velocity window.

Object content:

Index	object code	data type	category
606Dh	VAR	UINT16	option

Entry content:

Sub-Index	Access	PDO Mapping	data range	initial value	unit
00h	RW	Yes (default)	0 to 65535	Manufacturer Specifications	[u.u.].

### ■ object 606Eh: Velocity Window Time

This object indicates the velocity window time.

Object content:

Index	object code	data type	category
606Eh.	VAR	UINT16	option

Entry content:

Sub-Index	Access	PDO Mapping	data range	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 65535	Manufacturer Specifications	[ms].

## 6] CANOpen operation mode

### ■ Object 606Fh: Velocity Threshold

This object indicates the speed threshold. Object content:.

Index	object code	data type	category
606Fh	VAR	UINT16	option

Entry content:.

Sub-Index	Access	PDO Mapping	data range	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 65535	Manufacturer Specifications	[u.u.].

### ■ object 6070h: Velocity Threshold Time

This object indicates the velocity threshold time.

Object content:

Index	object code	data type	category
6070h	VAR	UINT16	option

Entry content:.

Sub-Index	Access	PDO Mapping	data range	initial value	unit
00h	RW	nashi (Pyrus pyrifolia, esp. var. culta)	0 to 65535	Manufacturer Specifications	[ms].

### 6-3. Analog mode (Note)

In the analog mode, the driver can be operated with a  $\pm 10$  V command.

+VREF and -VREF will be the speed setting value of the driver if the voltage is applied to them.

The motor rotates up to its maximum speed in proportion to the reference voltage applied to +VREF and -VREF.

+VREF will rotate the motor clockwise (CW) and -VREF will rotate the motor counterclockwise (CCW) up to its maximum speed.

■ Voltage input = +10V → Rotation speed (CW) = + Max. speed

r/min

= -10V → Rotation speed (CCW) = - Max. speed r/min

= +5V → Rotation speed (CW) = 1/2 Maximum speed r/min

= -5V → Rotation speed (CCW) = -1/2 Maximum speed r/min

To rotate the motor, the IN1 and IN2 inputs must be turned ON. (See chapter 8-4 Digital I/O.)

Note: For analog mode, please contact us.

## 6] CANOpen operation mode

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### (1) Monitoring

In analog mode, a CAN interface can be connected and CANOpen can monitor the variables on the drive (listed below)

- object 2002h: Drive Status Mode (Drive Status Mode)
- object 2003h: Warning
- object 2004h: State of servo drive (State smartris Drive Machine)
- Object 2030h: Driver temperature (Temperature Drive)
- Object 2031h: Temperature Motor
- Object 2032h: Temperature Heat Sink
- Object 2041h: Bus voltage (Voltage Bus)
- Object 2050h: Torque Current
- object 2051h: Power Drive
- Object 2052h: Motor power (Power Motor)
- Object 2053h: Velocity Filtered
- object 3020h: Digital input (Drive Digital Input)
- Object 3022h: Analog Input
- Object 4000h: Safety State

# [7] CANOpen Object List

Index	Sub.	Name	code	type	O/M	Access	OP Mode
Object DS301 Standard							
1000h	0	Device Type	COST	UINT32	Mega	RO	communication
1001h	0	Error Register	VAR	UINT32	O	RO	
1002h	0	Manufacturer Status Register	VAR	UINT32	O	RO	
1003h	0	Pre-Defined Error Field	ARRAY	UINT32	Mega	RO	
	1	History Error Field	-	UINT32	Mega		
	2				O		
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
15							
1005h	0	Cob-ID Sync	VAR	UINT32	-	R/W	
1008h	0	Manufacturer Device Name	VAR	STRING	Mega	RO	
1009h	0	Manufacturer Hardware Version	VAR	STRING	Mega	RO	
100Ah	0	Manufacturer Software Version	VAR	STRING	Mega	RO	
100Ch	0	Guard Time	VAR	UINT16	O	R/W	
100Dh	0	Life Time Factor	VAR	UINT8	O	R/W	
1010h	0	Store Parameter Fields	ARRAY	UINT32	O	R/W	
	1	Save all Parameters	-	-	Mega		
	2	Save Communication Parameters			O		
	3	Save Application Parameters					
	4	Save Manufacturer Parameters					
	5	Data Golden Image (reserved)					
1011h	0	Restore Default Parameter	ARRAY	UINT32	O	R/W	
	1	Restore all Default Parameters	-	-			
	2	Restore Communication Default Parameters					
	3	Restore Application Default Parameters					
	4	Restore Manufacturer Default Parameters					
	5	Data Golden Image(reserved)					
1014h	0	Cob-ID Emergency Message	VAR	UNIT32	O	RO	
1017h	0	Producer HeartBeat Time	VAR	UNIT 16	O	R/W	
1018h	0	Identity Object	RECORD	UINT32	Mega	RO	disabled
	1	ID Vendor Id	-	-	Mega		
	2	Product Code			O		
	3	Revision number					

	4	Serial number				
1029h	0	Error Behaviour	ARRAY	UINT8	O	RO
	1	Communication Error	-	-		R/W

# **[7] CANOpen object list**

Index	Sub.	Name	code	type	O/M	Access	OP Mode	
1200h	0	Server SDO Parameter 1	-	-	O	R/W	communication	
1280h	0	Client SDO Parameter 1	-	-	O	R/W		
1400h	0	Receive PDO Communication Parameter 1	RECORD	UINT8	Me ga O	R/W		
	1	COB-ID	-	UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				
1401h	0	Receive PDO Communication Parameter 2	RECORD	UINT8	Me ga O			
	1	COB-ID	-	UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				
1402h	0	Receive PDO Communication Parameter 3	RECORD	UINT8	Me ga O			
	1	COB-ID		UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				
1403h	0	Receive PDO Communication Parameter 4	RECORD	UINT8	Me ga O			
	1	COB-ID	-	UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				
1600h	0	Receive PDO Mapping Parameter 1	RECORD	UINT8	Me ga			
	1	Mapping Entry 1	-	UINT32				
	2	Mapping Entry 2						
	3	Mapping Entry 3						
1601h	0	Receive PDO Mapping Parameter 2	RECORD	UINT8	Me ga			
	1	Mapping Entry 1	-	UINT32				
	2	Mapping Entry 2						
1602h	0	Receive PDO Mapping Parameter 3	RECORD	UINT8	Me ga			
	1	Mapping Entry 1	-	UINT32				
	2	Mapping Entry 2						
1603h	0	Receive PDO Mapping Parameter 4	RECORD	UINT8	Me ga			
	1	Mapping Entry 1	-	UINT32				
	2	Mapping Entry 2						
1800h	0	Transmit PDO Communication Parameter 1	RECORD	UINT8	Me ga O			
	1	COB-ID	-	UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				
1801h	0	Transmit PDO Communication Parameter 2	RECORD	UINT8	Me ga O			
	1	COB-ID	-	UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				
1802h	0	Transmit PDO Communication Parameter 3	RECORD	UINT8	Me ga O			
	1	COB-ID	-	UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				
1803h	0	Transmit PDO Communication Parameter 4	RECORD	UINT8	Me ga O			
	1	COB-ID	-	UINT32				
	2	Transmission Type		UINT8				
	3	Inhibit Time		UINT16				

# **[7] CANOpen object list**

Index	Sub.	Name	code	type	O/M	Access	OP Mode
1A00h	0	Transmit PDO Mapping Parameter 1	RECORD	UINT8	Me ga	R/W	communi cation
	1	Mapping Entry 1	-	UINT32			
	2	Mapping Entry 2					
	3	Mapping Entry 3					
1A01h	0	Transmit PDO Mapping Parameter 2	RECORD	UINT8	Me ga		
	1	Mapping Entry 1	-	UINT32			
	2	Mapping Entry 2					
1A02h	0	Transmit PDO Mapping Parameter 3	RECORD	UINT8	Me ga		
	1	Mapping Entry 1	-	UINT32			
	2	Mapping Entry 2					
1A03h	0	Transmit PDO Mapping Parameter 4	RECORD	UINT8	Me ga		
	1	Mapping Entry 1	-	UINT32			
	2	Mapping Entry 2					
manufacturer specific object							
2000h	0	ID Node	VAR	UINT8	Meg a	R/W	setting (of a computer or file, etc.)
2001h	0	CAN Baud Rate	VAR	UINT16	Meg a	R/W	setting (of a computer or file, etc.)
2002h	0	Drive Status	VAR	INT16	O	RO	TELL
2003h	0	Warning	VAR	UINT32	O	RO	TELL
2004h	0	State smartris Drive Machine	VAR	INT16	O	RO	TELL
2030h	0	Drive Temperature	VAR	INT16	O	RO	TELL
2031h	0	Motor Temperature	VAR	INT16	O	RO	TELL
2032h	0	Heat Sink Temperature	VAR	INT16	O	RO	TELL
2040h	0	Voltage Brake	VAR	INT16	O	RO	disabled
2041h	0	Voltage Bus	VAR	INT16	O	RO	TELL
2042h	0	Voltage Logic Board	VAR	INT16	O	RO	disabled
2043h	0	Voltage Reference	VAR	INT16	O	RO	disabled
2050h	0	Torque Current	VAR	INT16	O	RO	TELL
2051h	0	Drive Power	VAR	INT16	O	RO	disabled
2052h	0	Motor Power	VAR	INT16	O	RO	disabled
2053h	0	Velocity Filtered	VAR	INT16	O	RO	TELL
3001h	0	Limits Parameter	ARRAY	UINT32	O	RO	-
	1	Velocity ABS	-				setti ng (of a com pute r or file, etc.)
	2	Acceleration ABS					
	3	Limit Velocity Profile					
3002h	0	Brake Parameters	ARRAY	INT16	M IF	RO	-
	1	Motor Brake Option	-			R/W	setti
	2	Motor Brake Delay					
	3	Brake Unlock time					
	4	Brake Timeout					



	5	Automatic/Manual Mode Configuration						ng
	6	Motor Brake Status						(of a
	7	Brake Type				RO		com
								pute
								r or
								file,
								etc.)

## 【7】 CANOpen object list

Index	Sub.	Name	code	type	O/M	Access	OP Mode
3003h	0	Drive Size Parameters	ARRAY	INT16	O	RO	-
	1	Maximum Current	-				TELL
	2	Peak Current					
	3	Rated Current					
	4	I <sup>2</sup> T					
	5	Maximum Peak Current					
	6	Maximum Rated Current					
	7	Maximum I <sup>2</sup> T					
3004h	0	FeedBack Parameters	ARRAY	INT16	O	RO	-
	1	Feedback Type	-				setting (of a computer or file, etc.)
	2	Resolution					
3005h	0	Filter Parameters	ARRAY	INT16	O	RO	disabled
3006h	0	Motor Specific Settings	ARRAY	INT16	O	RO	-
	1	Motor Part Number	-				setting (of a computer or file, etc.)
	2	Max Motor Speed					
	3	N Poli					
3007h	0	Dynamic Brake Parameter	ARRAY	INT16	M IF	RO	-
	1	Dynamic Brake Option	-			R/W	setting (of a computer or file, etc.)
	2	Holding Torque Time					
3	Dynamic Brake Status	-	RO	TELL			
4	Decrement step ramp		R/W	setting (of a computer or file, etc.)			
3008h	0	Emergency Enable Parameter	ARRAY	INT16	M IF	RO	-
	1	Emergency Enable Option	-			R/W	setting ng
	2	Emergency Input Neg					

							(of a com pute r or file, etc.)
	3	Emergency Status				RO	TELL
3010h	0	Alarm Option	ARRAY	INT16	O	RO	disabled
3020h	0	Drive Digital Input	ARRAY	INT16	O	RO	TELL
	1	Dig In 1 - Phisic Value	-				
	2	Dig In 2 - Phisic Value					
	3	Dig In 3 - Phisic Value					
	4	Dig In 4 - Phisic Value					
	5	Dig In STO1 - Phisic Value					
6	Dig In STO2 - Phisic Value						
3030h	0	Drive Digital Output	-	INT16	O	RO	TELL
3040h	0	Analog Input	-	INT16	O	RO	TELL
3050h	0	Analog Output 1	-	INT16	O	RO	TELL
3051h	0	Analog Output 2	-	INT16	O	RO	TELL
3200h	0	Current PID	ARRAY	INT16	Me ga	R/W	-
	1	PidCur Kp	-				setti ng (of a com pute r or file, etc.)
	2	PidCur Ki					
	3	PidCur Kv					
	4	PidCur Kd					
	5	PidCur N					
	6	PidCur FF					

# **[7] CANOpen object list**

Index	Sub.	Name	code	type	O/M	Access	OP Mode
3201h	0	Speed PID	ARRAY	INT16	Me ga	R/W	-
	1	PidVel Kp	-				setti ng (of a com pute r or file, etc.)
	2	PidVel Ki					
	3	PidVel Kv					
	4	PidVel Kd					
	5	PidVel N					
	6	PidVel FF					
3202h	0	Position PID	ARRAY	INT16	Me ga	R/W	-
	1	PidPos Kp	-				setti ng (of a com pute r or file, etc.)
	2	PidPos Ki					
	3	PidPos Kv					
	4	PidPos FF Ra V					
	5	PidPos FF Ra A					
	6	PidPos FF Vr V					
	7	PidPos FF Rd A					
	8	PidPos FF Rd V					
	9	PidPos Tc					
3203h	1	Decoupling PID	ARRAY	INT16	Me ga	R/W	-
	2	PidPos Fli	-				setti ng (of a com pute r or file, etc.)
	3	PidPos Ffem					
3300h	0	Velocity Full Scale	-	UINT16	O	R/W	setting (of a computer or file, etc.)
4500h	0	Safety Feature	-	UINT16	O	RO	-
	1	Safety State					TELL
	2	STO Function					
4501h	0	Dummy.	ARRAY	INT16	O	RO	disabled
4502h	0	Dummy Tell					
4503h	0	Dummy TellLong					
4504h	0	Dummy CANOpen					
Object DSP402 Standard							
6007h	0	Abort Connection Option Code	VAR	UINT16	O	R/W	disabled
603Fh	0	Error Code	VAR	UINT16	O	RO	All profiles

6040h	0	Control Word	VAR	UINT16	Mega	R/W	All profiles
6041h	0	Status Word	VAR	UINT16	Mega	RO	All profiles
605Ah	0	Quick Stop Option Code	VAR	INT16	O	R/W	disabled
605Bh	0	Shutdown Option Code	VAR	INT16	O	R/W	disabled
605Ch	0	Disable Option Code	VAR	INT16	O	R/W	disabled
605Dh	0	Halt Option Code	VAR	INT16	O	R/W	disabled
605Eh	0	Fault Reaction Code	VAR	INT16	O	R/W	disabled
6060h	0	Modes of Operation	VAR	INT8	Mega	R/W	All profiles
6061h	0	Modes of Operation Display	VAR	INT8	Mega	RO	
6062h	0	Position Demand Value	VAR	INT32	O	RO	position profile
6063h	0	Position Actual internal Value	VAR	INT32	O	RO	
6064h	0	Position Actual Value	VAR	INT32	Mega	RO	
6065h	0	Following Error Windows	VAR	UINT32	O	R/W	
6066h	0	Following Error TimeOut	VAR	UINT16	O	R/W	
6067h	0	Position Windows	VAR	UINT32	O	R/W	
6068h	0	Position Window Time	VAR	UINT16	O	R/W	
6069h	0	Velocity Sensor Actual Value	VAR	INT32	O	RO	disabled
606Ah	0	Sensor Selection Code	VAR	INT16	O	R/W	disabled

# **【7】 CANOpen object list**

Index	Sub.	Name	code	type	O/M	Access	OP Mode
606Bh	0	Velocity Demand Value	VAR	INT32	O	RO	Velocity Profile
606Ch	0	Velocity Actual Value	VAR	INT32	Mega	RO	
606Dh	0	Velocity Window	VAR	UINT16	O	R/W	
606Eh	0	Velocity Window Time	VAR	UINT16	O	R/W	
606Fh	0	Velocity Threshold	VAR	UINT16	O	R/W	
6070h	0	Velocity Threshold Time	VAR	UINT16	O	R/W	Torque Profile
6071h	0	Target Torque	VAR	INT16	Mega	R/W	
6072h	0	Max Torque	VAR	UINT16	O	R/W	
6073h	0	Max Current	VAR	UINT16	O	R/W	
6074h	0	Torque Demand	VAR	INT16	O	RO	
6075h	0	Motor Rated Current	VAR	UINT32	O	R/W	
6076h	0	Motor Rated Torque	VAR	UINT32	O	R/W	
6077h	0	Torque Actual Value	VAR	INT16	O	RO	
6078h	0	Current Actual Value	VAR	INT16	O	RO	All profiles
6079h	0	DC Link Circuit Voltage	VAR	UINT32	O	RO	
607Ah	0	Target Position	VAR	INT32	Mega	R/W	position profile
607Bh	0	Position Range Limit	VAR	INT32	O	R/W	position profile
607Ch	0	Home Offset	VAR	INT32	O	R/W	homing
607Dh	0	Software Position Limit	VAR	INT32	O	R/W	position profile
607Eh	0	Polarity	VAR	UINT 8	O	R/W	Speed, position profile
607Fh	0	Max Profile Velocity	VAR	UINT32	O	R/W	
6080h	0	Max Motor Speed	VAR	UINT32	O	R/W	disabled
6081h	0	Profile Velocity	VAR	UINT32	Mega	R/W	position profile
6082h	0	End Velocity	VAR	UINT32	O	R/W	position profile
6083h	0	Profile Acceleration	VAR	UINT32	Mega	R/W	Speed, position profile
6084h	0	Profile Deceleration	VAR	UINT32	O	R/W	
6085h	0	Quick Stop Deceleration	VAR	UINT32	O	R/W	disabled
6086h	0	Motion Profile Type	VAR	INT16	O	R/W	disabled
6087h	0	Torque Slope	VAR	UINT32	Mega	R/W	Torque Profile
6088h	0	Torque Profile Type	VAR	INT16	O	R/W	
608Fh	0	Position Encoder Resolution	VAR	UINT32	O	R/W	disabled
6090h	0	Velocity Encoder Resolution	VAR	UINT32	O	R/W	disabled
6091h	0	Gear Ratio	VAR	UINT32	O	R/W	disabled
6092h	0	Feed Constant	VAR	UINT32	O	R/W	disabled
6096h	0	Velocity Factor Group	VAR	-	O	R/W	All profiles
	1	Num Velocity Factor					
	2	Div Velocity Factor					
6097h	0	Acceleration Factor Group	VAR	-	O	R/W	All profiles
	1	Num Acceleration Factor					
	2	Div Acceleration Factor					
6098h	0	Homing Method	VAR	INT8	Mega	R/W	homing
6099h	0	Homing Speeds	VAR	UINT32	Mega	R/W	
609Ah	0	Homing Acceleration	VAR	UINT32	O	R/W	

60A2h	0	Jerk factor	VAR	UINT32	O	R/W	disabled
60A3h	0	Profile Jerk Use	VAR	UINT8	O	R/W	
60A4h	0	Profile Jerk	VAR	UINT32	O	R/W	
60A8h	0	SI Unit Position	VAR	UINT32	O	R/W	disabled
60A9h	0	SI unit velocity	VAR	UINT32	O	R/W	disabled
60B0h	0	Position Offset	VAR	INT32	O	R/W	disabled

# **【7】 CANOpen object list**

Index	Sub.	Name	code	type	O/M	Access	OP Mode
60B1h	0	Velocity Offset	VAR	INT32	O	R/W	disabled
60B2h	0	Torque Offset	VAR	INT16	O	R/W	disabled
60C5h	0	Max Acceleration	VAR	UINT32	O	R/W	position profile
60C6h	0	Max Deceleration	VAR	UINT32	O	R/W	
60E0h	0	Positive Torque Limit Value	VAR	UINT16	O	R/W	disabled
60E1h	0	Negative Torque Limit Value	VAR	UINT16	O	R/W	
60F2h	0	Position Option Code	VAR	UINT16	O	R/W	disabled
60F4h	0	Following Error Actual Value	VAR	INT32	O	RO	disabled
60F8h	0	Max Slippage	VAR	INT32	O	R/W	disabled
60 FAh	0	Control Effort	VAR	INT32	O	RO	disabled
60FCh	0	Position Demand Internal Value	VAR	INT32	O	RO	disabled
60FDh	0	Digital Inputs	VAR	UINT32	O	RO	All profiles
60FEh	0	Digital Outputs	VAR	UINT32	O	RO	All profiles
60FFh	0	Target Velocity	VAR	INT32	Mega	R/W	Velocity Profile
6402h	0	Motor Type	VAR	UINT16	O	R/W	All profiles
6403h	0	Motor Catalogue Number	VAR	character string	O	R/W	All profiles
6404h	0	Motor Manufacturer	VAR	character string	O	R/W	All profiles
6407h	0	Motor Service Period	VAR	UINT32	O	R/W	disabled
6502h	0	Supported Drive Modes	VAR	UINT32	Mega	RO	All profiles
6503h	0	Drive Catalogue Number	VAR	character string	O	R/W	disabled
6504h	0	Drive Manufacturer	VAR	character string	O	R/W	disabled



## [8 ] Function

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### 8-1 Ramp speed setting

The ramp speed setting mode. In this operation mode, the speed changes in a user-defined ramp shape. This ramp operation mode is disabled when a stop (STOP) command is issued.

### 8-2 Ramp stop

The ramp stop operation can be used to stop the motor. In this operating mode, the speed changes in a ramped fashion defined by the user.

When the ramp stop is activated, the velocity change decelerates in a ramped fashion with a set parameter (ms) time.

Ramp stop (deceleration) and ramp acceleration can be set separately.

### 8-3 motor brake

The motor brake output is an output that can power and directly drive the motor brake. The brake can be set to automatic or manual mode.

-Automatic mode: The brake is automatically released when an operation **on** (RUN/Enable) is input. Brake power supply (+24V)

-Manual mode: The brake release is commanded via CANOpen communication or parameters. The command in analog mode is a digital input (hardware). In CANopen mode, set bit 1 of 60FEh Sub-Index1SetBrake.

(Index 60FEh: Sub-Index 1, bit 1 = 1 brake released)

The brake delay time is the time between the brake release command and the release of the motor lock.

### 8-4 Digital I/O

The following digital I/Os are available

- Digital input 4: DIG-INx
- Digital output 4: DIG-OUTx
- Digital safety input 2: DIG-STO

### (1) Digital input

In analog mode, two digital inputs are used to drive the motor.

#### ■ DIG-IN1 = RUN (analog mode)

#### ■ DIG-IN2 = STOP (analog mode)

For drivers with STO functionality, when STO is active, the driver moves to safety status independently of other selections.

■ FAULT, the driver transitions to FAULT status.

In CANOpen operation mode, the state machine follows the control word (6060h) and digital inputs are ignored.

#### ■ DIG-IN3: Can be programmed as "Enable Input Emergency".

In this case, DIG-IN3 is used to transition from RUN to STANDBY in an emergency stop condition with dynamic braking.

This feature can be enabled with the following settings

-CANOpen: Set object 0x3008h (Emergency Input Enable) Sub-Index 1

The logic of the input can be inverted.

-CANOpen: set object 0x3008h Sub-Index 2

#### ■ DIG-IN4: This is a hardware reset of the driver.

#### ■ DIG-STO: The STO circuit is shown below.

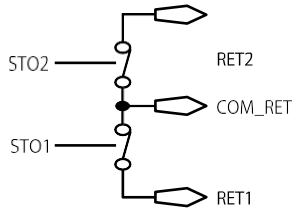


Figure 8-1 STO circuit

# [8] Function

The following figure shows the STO state machine in analog mode.

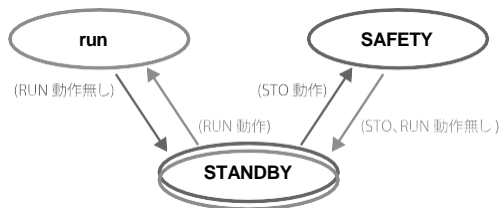


Figure 8-2 STO state machine

Table 8-1 Input/output operation

Input 1	Input 2	Output 1	Output 2	output state
STO1	STO2	RET1	RET2	status
0	0	closing	closing	safety
24V		opening		
0	24V	closing	opening	normal mode
24V		opening		

⚠Attention

(heed)

To re-enable the ready status, STO and RUN must be disabled once. The procedure for returning from safety is shown below.

- Analog mode: SAFETY →STANDBY →RUN
- CANOpen mode: SAFETY → SWITCH ON DISABLED → READY TO SWITCH ON → SWITCH ON →OPERATION ENABLED

If the application requires a deceleration stop operation (controlled deceleration stop) before using the STO function, the deceleration stop operation must first be performed and the STO function must be activated after the stop.

1. Drive deceleration stop operation
2. If the operation is stopped, the driver is invalid.
3. Mechanically locks drive unit in case of gravity load
4. Activate STO function

⚠Attention

(heed)

The driver cannot hold a load because no torque is generated when the STO function is activated.

- When the STO function is activated during operation, the driver stops uncontrolled.
- If the driver has a safety torque-off (STO) function, it must be verified that the circuit is normal in addition to all operational functions.

## ■ Schematic diagram of application examples

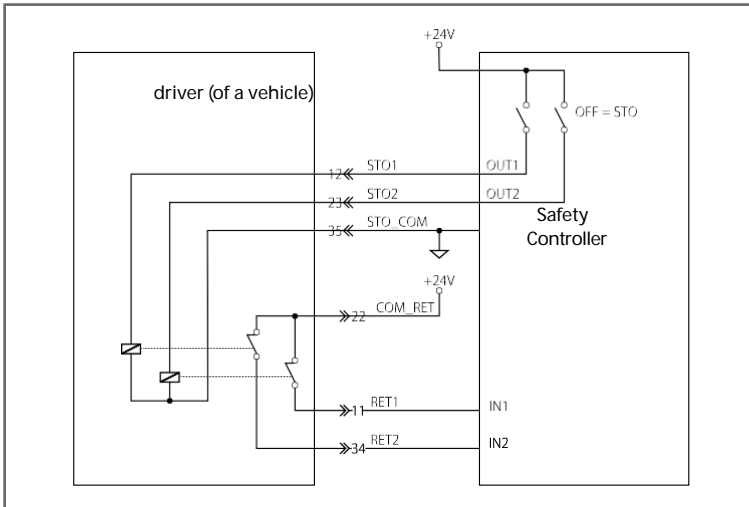


Figure 8-3 Application example of STO

### ■ Feedback on STO 2 input

The feedback signal of each STO input can be monitored by 2-channel relay outputs (RET1 and RET2). With each relay output, the state of the STO command can be monitored (Safety functions can be fully monitored.) The state of the digital inputs can be read by the CANOpen DSP402. (60FDh: Sub-Index 0)

### (2) CANOpen digital input

CANOpen DSP402: (06x60FD: 0) to read the status of the digital input. See object 0x60FD: Digital input.

### (3) Digital output

#### ■ DIG-OUT1: Indicates drive status.

- 1 = Drive OK
- 0 = Drive FAULT

#### ■ DIG-OUT2: Can be used as a general-purpose output.

#### ■ DIG-OUT3: Can be used as a general-purpose output.

#### ■ DIG-OUT4: Indicates brake status.

- 1 = Brake release, motor shaft free
- 0 = Brake action, motor locked

## [8] Function

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### (4) CANOpen digital output

CANOpen DSP402: (0x60FE) allows reading the status of digital outputs. See object 0x60FE: Digital output.

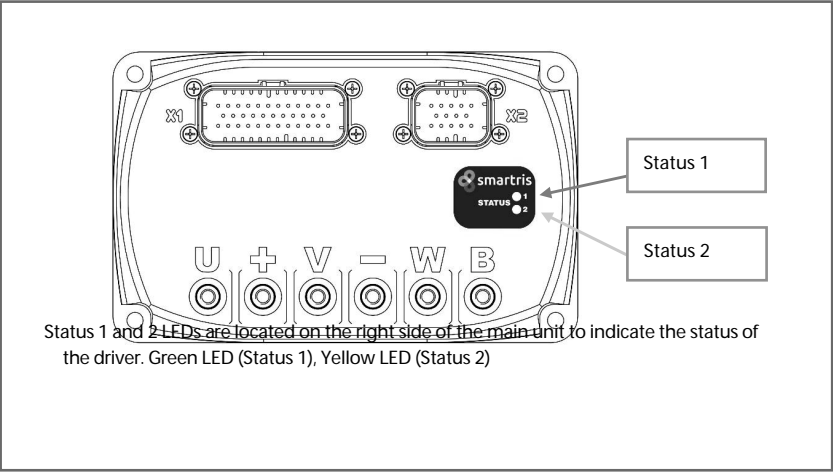


Table 9-1 Status LEDs

driver state	CANOpen status	Status 1 LED (green)	Status 2 LED (yellow)	LED Indication
Initial state (INIT)	Switching on Preparing (Not Ready to Switch ON Disabled) Switch ON Disabled Switch ON Ready (Ready to Switch ON)	Alternating "flashing"	Alternating "flashing"	1 Alternating flashing 2 Alternating flashing
Operational Preparation (STANDBY)	switch on (SWITCHED ON)	Flashing	OFF	1 Blinking 50% 2 OFF
damage caused by a disaster (FAULT)	Fault Fault processing in progress (Fault Reaction Fault)	Flashing Code [x].	Flashing Code [y].	1 See Table 9-2 2
Driving (RUN)	Operational availability (Operation Enabled)	ON	OFF	1 ON 2 OFF
suspension (STOP)	abort operation (Quick Stop Active)	ON	ON	1 ON 2 ON
safety (SAFETY)	-	OFF	Flashing	1 OFF 2 flashing

# 9] Diagnosis

Table 9-2 Alarm list

Classifi cation	alarm	Status 1 LED (green)	Status 2 LED (yellow)	Alarms
		⚙ Code [x].	⚙ Code [y].	
A Temperat ure	Motor overheating	1	10	Motor temperature exceeds setpoint. Operation not possible due to high motor temperature
	Heat sink overheating		1	Heat sink temperature exceeds setpoint Operation not possible due to high heat sink temperature
	Heat sink temperature out of range		3	Heatsink temperature sensor is out of measurement range Temperature sensor malfunction
	Printed circuit board overheating		4	Printed circuit board temperature exceeds setpoint. Operation not possible due to high temperature of printed board
	Printed board temperature out of range		5	Temperature sensor on printed circuit board is out of measurement range Temperature sensor malfunction
	Out of motor temperature range		6	Motor temperature sensor is out of measurement range Temperature sensor malfunction
B feedback	resolver	2	10	Check resolver connectors and wiring
	Resolver initialization		4	Resolver initialization error
	absolute encoder		6	Failure of absolute encoder
	Hall sensor		7	Hall sensor failure
	Hall sensor gap		8	
C Electric current	The current sensor offset	3	10	Current sensor offset out of range
	over current		1	Motor overcurrent Check motor wiring and short circuits
D Voltage	Undervoltage	4	1	DC bus voltage is below the set value + -Check + and - power supply terminal voltages
	over-voltage		2	DC bus voltage is above the set value. + -Check + and - power supply terminal voltages
E functionalit y	speed error	5	10	Large error between speed command and actual speed
	Overload protection (I <sup>2</sup> T) hardware (esp. computer)		2	Motor overload protection (I 2T)
			3	hardware error
f communi cation	EEPROM	6	1	Parameter error stored in EEPROM
	CanOpen		2	CanOpen communication error
	absolute error		3	Internal communication error
	parameter initialization		4	Parameter initialization error
	profile		108 5	Profile setting error
G, H, L	program error	7	× x-mark (used	Program error code
		8		

# 10 ] Sample Programs

The following is a sample program for driving this product with CANOpen.  
In the sample, the node ID of the drive = 1.

10.1. factor group

Change the User RPM from increment to RPM (r/min).

The master should be able to set the SDOs "Speed Factor Group: 6096h" and "Acceleration Factor Group: 0x6097" to Sub-Index 1 and 2" must be sent.

Tx/Rx	ID	Number Value	Contents
Rx	0x601	23 96 60 01 00 40 00 00	Velocity factor (molecules): 16384
Tx	0x581	60 96 60 01 00 00 00 00	
Rx	0x601	23 96 60 02 3c 00 00 00	Velocity factor (denominator):
Tx	0x581	60 96 60 02 00 00 00 00	
Rx	0x601	23 97 60 01 00 40 00 00	60 Acceleration
Tx	0x581	60 97 60 01 00 00 00 00	
Rx	0x601	23 97 60 02 3c 00 00 00	factor
Tx	0x581	60 97 60 02 00 00 00 00	
			( numerator ) :
			16384 Acceleration factor
			(denominator): 60

Note: If the master operates in increments, the above object need not be sent.



# [10] Sample Programs

## 10.2 Manufacturer-specific version name

Lead example of manufacturer-specific device name:..

The master must send SDO Request Index "Manufacturer Device Name: 1008h".

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 08 10 00 00 00 00 00	
Tx	0x581	41 08 10 00 43 00 00 00	
Rx	0x601	60 00 00 00 00 00 00 00	
Tx	0x581	00 4c 61 66 65 72 74 20	
Rx	0x601	70 00 00 00 00 00 00 00	
Tx	0x581	10 53 65 72 76 6f 20 44	
Rx	0x601	60 00 00 00 00 00 00 00	
Tx	0x581	00 72 69 76 65 73 20 2d	
Rx	0x601	70 00 00 00 00 00 00 00	
Tx	0x581	10 20 41 47 56 20 50 72	
Rx	0x601	60 00 00 00 00 00 00 00	
Tx	0x581	00 6f 6a 65 63 74 20 77	
Rx	0x601	70 00 00 00 00 00 00 00	
Tx	0x581	10 69 74 68 20 43 41 4e	
Rx	0x601	60 00 00 00 00 00 00 00	
Tx	0x581	00 6f 70 65 6e 20 70 72	
Rx	0x601	70 00 00 00 00 00 00 00	
Tx	0x581	10 6f 74 6f 63 6f 6c 20	
Rx	0x601	60 00 00 00 00 00 00 00	
Tx	0x581	00 20 20 20 20 20 20 20	
Rx	0x601	70 00 00 00 00 00 00 00	
Tx	0x581	17 20 2a 0d 00 00 00 00	

The string **Lafert Servo Drive -AGV Project (CANOpen protocol)**.

To read the hardware "Manufacturer Hardware Version" and software "Manufacturer Software Version" versions, execute the same sequence message on objects 0x1009 and 0x100A. To read the hardware "Manufacturer Hardware Version" and software "Manufacturer Software Version" versions, execute the same sequence message on objects 0x1009 and 0x100A.

# 【10】 Sample Programs

10. Be Velocity Profile indicates the "Switch on disabled" state (CANOpen profile DS402), "Fast mode" "Macro drive state The LEDs blink alternately in "Fast mode" and "Macro drive state: INT".

1. The drive must be in a state other than "Operation enabled" to set the speed profile mode. The master must have an SDO operation mode object (Index 0x6060, Sub- (Index 0), 3 must be sent.

Tx/Rx	ID	Number Value	Contents
Rx Tx	0x601 0x581	2f 60 60 00 03 00 00 00 60 60 60 60 00 00 00 00	Speed profile "Mode of Operation" request

Note: This message cannot be sent in "Operation enabled" mode.

2. CANOpen profile DS402 state machine changed to "Switched On" state  
The master must send 6 and 7 twice to the SDO control word object (Index 0x6040).

Tx/Rx	ID	Number Value	Contents
Rx Tx	0x601 0x581	2b 40 60 00 06 00 00 00 60 40 60 00 00 00 00 00	Changed to "Ready to Switch ON" state
Rx Tx	0x601 0x581	2b 40 60 00 00 07 00 00 00 60 40 60 00 00 00 00 00	

3. Verify that the status of profile 402 is "Switched On" "Macro Drive State: STANDBY  
"Status word" object (Index 0x6041, subindex 0 = xxxx xxxx x01x 0011b) check

Tx/Rx	ID	Number Value	Contents
Rx Tx	0x601 0x581	40 41 60 00 00 00 00 00 4b 41 60 00 23 00 00 00	Read SDO status word "Switched ON": xxxxx xxxx x01x 0011b

4. Setting the acceleration and deceleration of the speed profile

The master must send to the SDO factor group (Index 0x6083, 0x6084).

Tx/Rx	ID	Number Value	Contents
Rx Tx	0x601 0x581	23 83 60 00 e8 03 00 00 60 83 60 00 00 00 00 00	Acceleration 1000 rpm/s (example setting)
Rx Tx	0x601 0x581	23 84 60 00 e8 03 00 00 60 84 60 00 00 00 00 00	Deceleration 1000 rpm/s (example setting)

5. CANOpen profile DS402 state machine changed to "Operation enabled" state  
The master must send 15 to the SDO control word object (Index 0x6040).

Tx/Rx	ID	Number Value	Contents
Rx Tx	0x601 0x581	2b 40 60 00 0f 00 00 00 60 40 60 00 00 00 00 00	"Operation Enabled" status changed to

# 【10】 Sample Programs

- Verify that the status of profile 402 is "Operation Enabled" "Macro Drive State: RUN

Check status word object (Index 0x6041, sub-index 0 = xxxx xxxx x01x 0111b)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 41 60 00 00 00 00 00	Read SDO status word "Switched On": xxxxx xxxx x01x 0111b
Tx	0x581	4b 41 60 00 27 00 00 00	

- Target speed setting

The master must send to SDO target speed (Index 0x60FF).

Tx/Rx	ID	Number Value	Contents
Rx	0x601	23 ff 60 00 e8 03 00 00	Target speed setting (e.g., 1000 r/min)
Tx	0x581	60 ff 60 00 00 00 00 00	

- Read (confirm) master of the measured speed value object (Index 0x606C, sub-index 0) must send SDO (Index 0x606Ch).

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 6c 60 00 00 00 00 00	Leading actual speed measurement
Tx	0x581	43 6c 60 00 e8 03 00 00	

The master can stop the drive in different ways. The following are examples of stops other than emergence stops.

(See App. 4 for more information on emergence stops.)

- Set target speed to 0

The master must send 0 for the SDO target speed (Index 0x60FF).

Tx/Rx	ID	Number Value	Contents
Rx	0x601	23 ff 60 00 00 00 00 00	Set 0 r/min for target speed
Tx	0x581	60 ff 60 00 00 00 00 00	

The motor ramps down and stops properly and torque is retained.

- Change the state of the state machine of CANOpen profile DS402 to "Switched On" "Macrodrive State: STANDBY".

No torque generation in motor.

The master must send 7 to the SDO control word (Index 0x6040).

Tx/Rx	ID	Number Value	Contents
Rx	0x601	2b 40 60 00 00 07 00 00	Set to "Switched On" state
Tx	0x581	60 40 60 00 00 00 00 00	

The state of profile 402 is "Switched ON".

Read (confirm) status word object (Index 0x6041, subindex 0 = xxxx xxxx x01x 0011b)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 41 60 00 00 00 00 00	SDO Status Word Read
Tx	0x581	4b 41 60 00 23 00 00 00	

## 【10】 Sample Programs

3. Change the state of the state machine of CANOpen profile DS402 to "Switch On Disabled" "Macrodrive State: INT".

No torque generation in motor.

The master must send 0 to the SDO control word object (0x6040).

Tx/Rx	ID	Number Value	Contents
Rx	0x601	2b 40 60 00 00 00 00 00	Set to "Switch On Disabled" state
Tx	0x581	60 40 60 00 00 00 00 00	

The status of profile DS402 is "Switch On Disabled".

Read status word object (Index 0x6041, subindex 0: xxxxx xxxx x1xx 0000b)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 41 60 00 00 00 00 00	Read status word "Switch On disabled": xxxxx xxxx x1xx 0000b
Tx	0x581	4b 41 60 00 40 00 00 00	

4. Change the state of the state machine in CANOpen profile DS402 to "Quick Stop Active" "Macro Drive State STOP".

Motor torque is generated.

The master must send 2 for the SDO control word.

Tx/Rx	ID	Number Value	Contents
Rx	0x601	2b 40 60 00 02 00 00 00	Set to "Quick Stop Active" state
Tx	0x581	60 40 60 00 00 00 00 00	

The status of profile 402 is "Quick Stop Active".

Read(confirm) status word object (Index 0x6041, subindex 0 = xxxx xxxx x00x 0111b)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 41 60 00 00 00 00 00	SDO Status Word Read "Switched On" state xxxx xxxx x00x 0111b
Tx	0x581	4b 41 60 00 00 07 00 00 00	

### 10.4 Emergency stop

The master sets Digital input 3 as the "Emergency Enable" function.  
When Digital Input 3 is set to "Emergency Enable," the master is able to perform an emergency stop. In order for Digital Input 3 to be Emergency Enable, the master must enable Digital Input 3 via hardware.

The status of profile 402 is "Switched ON" "Macro Drive State: STANDBY".

You can check the status in the drive object (Index 0x6041 = xxxx xxxx x01x 0011b).

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 41 60 00 00 00 00 00	SDO Status Word Read "Switched On" state xxxx xxxx x01x 0011b
Tx	0x581	4b 41 60 00 23 00 00 00	

# [10] Sample Programs

## 10.5 Safety State

This procedure is for setting the safety mode and checking the status.

1. The master enables the STO input. "Macro drive state: SAFETY"  
To enable the safety mode, shut off the +24V inputs to STO1 and STO2.
2. The status of the drive will be "SAFE".

Read(confirm) status word object (Index 0x6041: Sub-Index 0: xx1x xxxx xxxxb)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 41 60 00 00 00 00 00	SDO Status Word Read
Tx	0x581	4b 41 60 00 23 40 00 00	Bit 14 = 0 without safety, 1 = safe

Read(confirm) safety state object (Index 0x4000: Sub-Index 1)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 00 40 01 00 00 00 00	"Safety State" state lead 0: no safety, 1: safety present
Tx	0x581	4b 00 40 01 00 00 00 00	

Read(confirm) drive mode object (Index 0x2002, Sub-Index 0)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 02 20 00 00 00 00 00	"Drive Mode" state reads.
Tx	0x581	4b 02 20 00 01 00 00 00	0= Normal mode, 1= Safety 2= FAULT

## 10.6 Emergency (Delete Emergency History)

This procedure is read (check) emergency history read the number of

errors that occurred (Sub-Index 0)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 03 10 00 00 00 00 00	Leading error count (subindex 0)
Tx	0x581	4f 03 10 00 02 00 00 00	Response from CANOpen

Byte 5: 02h Two error messages are recorded. Delete emergency

message (Write 0 to Sub-Index 0)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	22 03 10 00 00 00 00 00	Deleting an emergence message
Tx	0x581	60 03 10 00 00 00 00 00	Response from CANOpen

Read error messages (Sub-Index 1 to 15)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 03 10 01 00 00 00 00	Read error messages
Tx	0x581	43 03 10 01 00 ff 81 00	Response from CANOpen

Details of error message codes are listed in the Error Codes section.

## 【10】 Sample Programs

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Leading error messages (Sub-Index 1 to 15) (for no alarm)

Tx/Rx	ID	Number Value	Contents
Rx	0x601	40 03 10 01 00 00 00 00	Read error messages
Tx	0x581	80 03 10 01 11 00 09 06	Response from CANOpen

A read request to a Sub-Index with no error history will send the above error message.

# [11] Guarantee

The scope of warranty for products delivered by our company is limited to the scope of our production. Warranty (duration and contents)

Warranty Period	The warranty period for new products is 18 months after shipment from the factory or 12 months after operation, whichever is shorter.
Warranty	<p>If this product fails during the warranty period in spite of proper installation, connection, and maintenance in accordance with the instruction manual, and correct operation under the specifications described in the catalog or separately agreed conditions, we will, at our discretion, repair or replace the product free of charge, except in the following exempted cases We will, at our discretion, repair or replace the product free of charge, except in the following cases where the warranty does not apply</p> <p>However, if this product is connected to other equipment of the customer, we will not compensate for the cost of removing the product from the equipment, attaching it to the equipment, or other incidental construction costs, transportation costs, or any other indirect damages such as loss of opportunity or loss of operation incurred by the customer. In the event of any such loss or damage, the Company shall not be liable for such costs.</p>
Warranty coverage excluded not covered by warranty	<p>The following items are excluded from the warranty</p> <ul style="list-style-type: none"> <li>Malfunctions caused by installation of the product or connection of the product with other equipment, etc.</li> <li>(2) Malfunction caused by inadequate maintenance and proper handling of the product, such as storage of the product not being performed in accordance with the procedures specified in the storage manual provided by the Company</li> <li>3. failure caused by operation outside of the specifications or other operating conditions or usage conditions beyond our knowledge, or failure caused by the use of lubricant other than that recommended by us</li> <li>4. failure due to malfunction or special specifications of the customer's connected equipment, etc.</li> <li>5. failure resulting from modification or structural alteration of the product</li> <li>6. secondary failure of our products due to malfunction of sequence circuits, etc., which are within the customer's scope of responsibility</li> <li>7. failure caused by malfunction of parts supplied by the customer or parts specified by the customer</li> <li>8. failure due to earthquake, fire, water, salt, gas, lightning, or other force majeure</li> <li>9. warranty for consumable parts such as electrolytic capacitors in the event of natural wear and tear, abrasion, or deterioration even under normal use.</li> <li>10. failure due to reasons not attributable to the Company in addition to the preceding items</li> </ul>





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