



# CP301 User Manual

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CANopen communication card

V2.00

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Applicable versions: Rev. SF3 0.140 and above, Rev. SA3 0.200 and above, Rev. SE3 0.150 and above

# 1. Introduction of CP301 Communication Card

This chapter briefly introduces CANopen protocol and information about the CP301 communication card. The CP301 communication card supports the full series of SA3, SE3, and SF3 models.

## 1.1 Overview

The master can control the inverter by the CANopen communication protocol. CANopen is a CAN-based upper layer protocol which provides a set of standard communication objects, including: timely Process Data Objects, Service Data Objects and some specific functions, such as Time Stamps, Sync Messages and Emergency Messages. Moreover, Network Management Data such as Boot-up message, NMT message, and Error Control message are also defined.

## 1.2 CP301 Function Introduction

- Support functions:
  1. CAN2.0A protocol
  2. CANopen DS301 V4.02
  3. DS402 V2.0
  
- Support services:
  1. Support 4 groups of PDO (Process Data Objects) PDO1~PDO4.
  2. Support SDO (Service Data Objects), SDO configuration and set-up messages are mainly used to access the node of object dictionary.
  3. NMT service (Network Management).
  4. Boot-up message (Boot-up)
  5. Heartbeat (pulsing) object
  6. Emergency service (Emergency Message)
  
- Unsupported services:

Time Stamp service (Time Stamp)

For more information, please visit the CAN In Automation website: <http://www.can-cia.org>

## 2. Precautions Before Operation

### 2.1 Inspection After Received

Before shipment, each CP301 machine is passed strict quality control process, and packed with reinforced anti-collision packaging, and the packaging contains the following objects:

- ✓ *CP301 machine* ;
- ✓ *1 quick start guide* ;
- ✓ *2 fixing screws*

Note: If the received CP301 is different from the above description, please contact your agent or distributor.

### 2.2 Specification

Item	Description
Connector	RJ45
Number of ports	2 Port
Transmission method	CAN
Transmission cable	Use CAN standard cable
Transmission speed	1 Mbps / 500 Kbps / 250 Kbps / 125 Kbps / 100 Kbps / 50 Kbps
Network Protocol	CANopen protocol

## 3. Installation

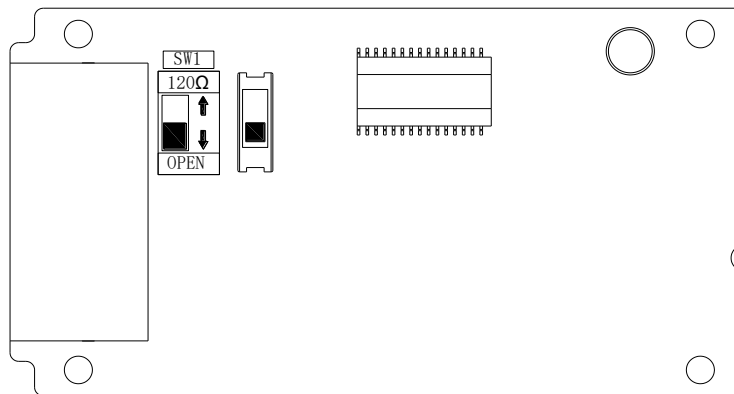
### 3.1 Precautions Before Installation

Make sure the input power of the inverter is off.

Note: Do not install or remove the built-in optional parts when the power is on. Otherwise, the inverter and built-in optional parts may be damaged

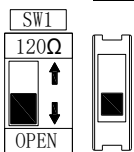
### 3.2 Communication Interface Description

- Appearance description(use CAN standard communication cable)



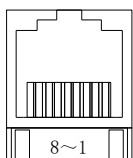
- Terminal resistance switch

No	Status	Description
1	120Ω	short the circuit of terminal resistor
2	OPEN	open the circuit of the terminal resistor



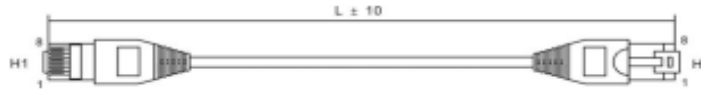
- Definition of position RJ-45

Position	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	grounding terminal /0V/V-
7	CAN_GND	grounding terminal /0V/V-



CANopen communication cable

Model : SNKCBLxxGTN2 (xx indicates 1R5,3,5,10)



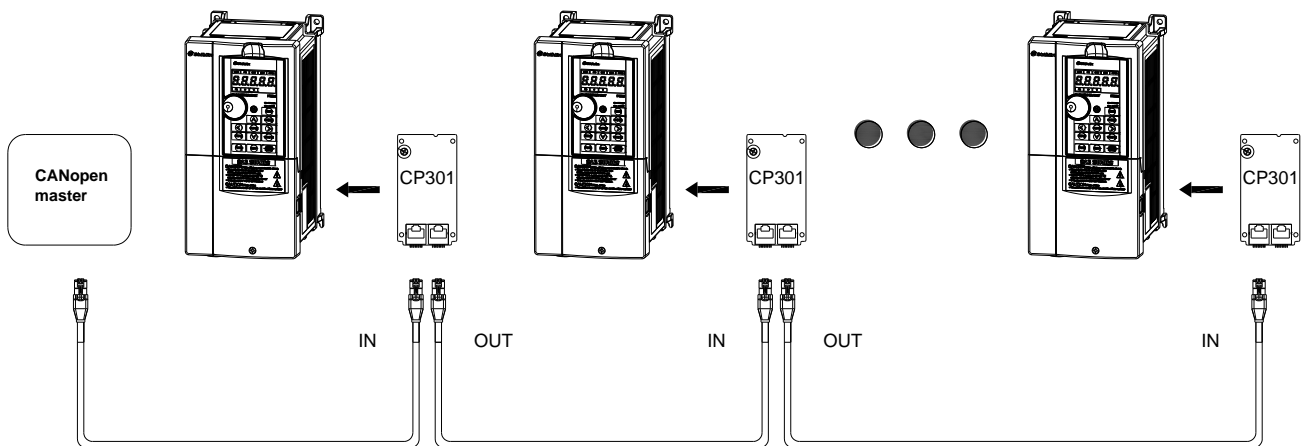
Item No.	Part No.	L(mm)
1	SNKCBL1R5GTN2	1500
2	SNKCBL3GTN2	3000
3	SNKCBL5GTN2	5000
4	SNKCBL10GTN2	10000

➤ Part number for ordering

NO.	Model	Name	Part number for ordering
1	CP301	CP301 Communication card	SNKCP301

### 3.3 CP301 Wiring Instruction

The CANopen wiring of the inverter requires the Communication card CP301, and uses one-in-one-out RJ45 connector as shown in the figure below



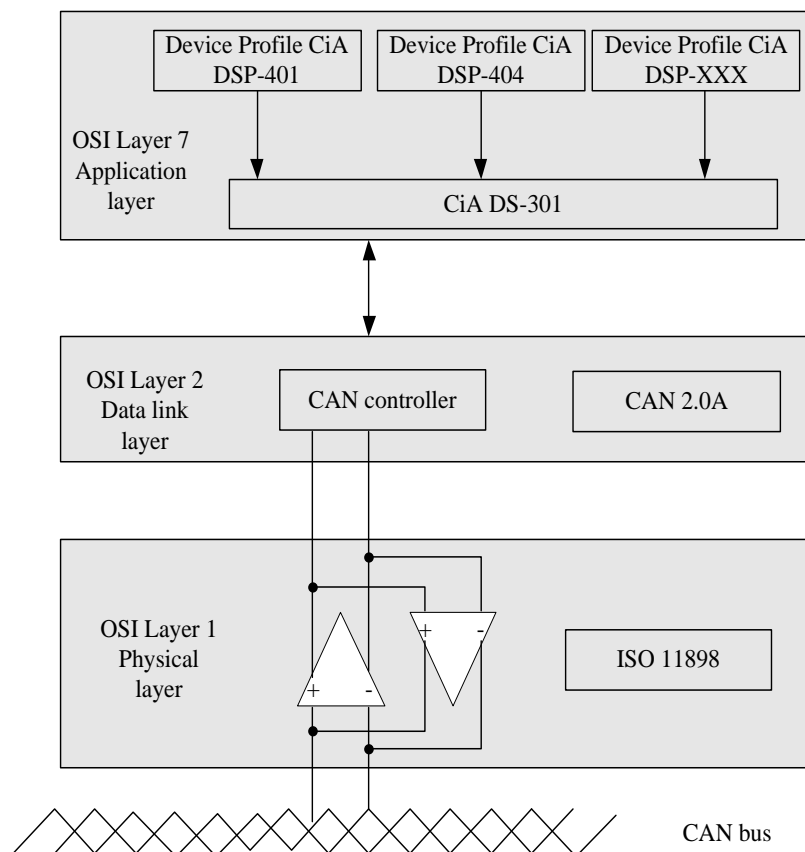
- Note:**
1. Please make sure the whole series circuit only add the termination resistor at the start and end before turn on the power. Otherwise, the inverter and the built-in optional parts may be damaged.
  2. Do not install or remove the built-in optional parts when the power is on. Otherwise, the inverter and the built-in optional parts may be damaged.
  3. SA3 must be inserted into SLOT 1 of control board, do not insert into SLOT 2 and SLOT 3 of control board.

## 4. CANopen Communication Description

### 4.1 CANopen Overview

The built-in CANopen function is an external control method. The master can control the inverter via CANopen communication protocol.

CANopen is a CAN-based application layer protocol, it is a control network function which enables the device to perform motion control.





## 4.2 CANopen Communication Protocol

### 4.2.1. Predefined Connection Settings

Simplified format of the message:

Identifier (11 digits)	User data( max length 8 bytes)							
COB-ID	0 byte	1 byte	2 bytes	3 bytes	4 bytes	5 bytes	6 bytes	7 bytes

- Identifier: The identifier of a CANopen message consists 11 bits, which also called COB-ID (Communication Object Identifier). 1 group of 11-bit COB-ID is defined as follows:

COB Identifier (CAN Identifier)										
10	9	8	7	6	5	4	3	2	1	0
Function Code				Node-ID						

- To simplify the network configuration, below is some predefined basic ID configurations for CANopen.

Object	Function code	Node number	COB-ID	Object Dictionary Index
message				
NMT	0000	-	0	-
SYNC	0001	-	80h	1005h,1006h,1007h
TIME STAMP	0010	-	100h	1012h,1013h
point to point message				
Emergency	0001	1-127	81h-FFh	1014h,1015h
TPDO1	0011	1-127	181h-1FFh	1800h
RPDO1	0100	1-127	201h-27Fh	1400h
TPDO2	0101	1-127	281h-2FFh	1801h
RPDO2	0110	1-127	301h-37Fh	1401h
TPDO3	0111	1-127	381h-3FFh	1802h
RPDO3	1000	1-127	401h-47Fh	1402h
TPDO4	1001	1-127	481h-4FFh	1803h
RPDO4	1010	1-127	501h-57Fh	1403h
Transmit SDO	1011	1-127	581h-5FFh	1200h
Receive SDO	1100	1-127	601h-67Fh	1200h
heartbeat	1110	1-127	701h-77Fh	1016h,1017h

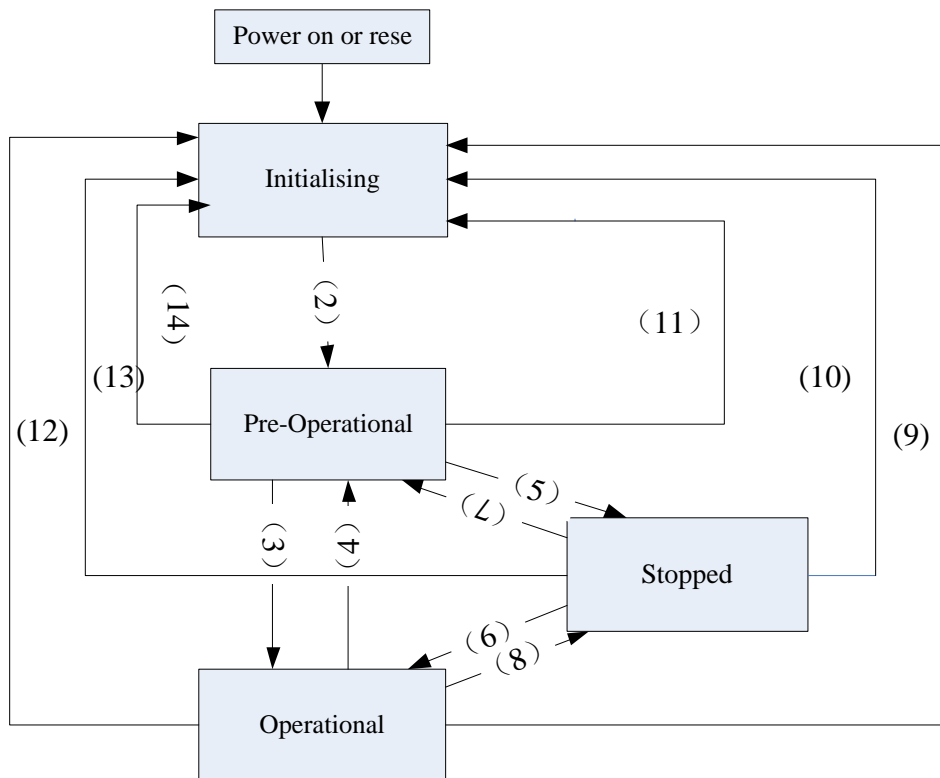
## 4.2.2. Services Supported by CANopen Communication Protocol

1. NMT(Network Management Object)
2. SDO(Service Data Objects)
3. PDO(Process Data Object)
4. EMCY(Emergency Object)

### ➤ NMT (Network Management Object)

Network Management Message NMT follows a master/slave structure for NMT services. Under this structure, there is only one master, which can be paired with multiple slaves. All CANopen nodes have their own NMT status, and the master can control the status of the slaves by NMT messages.

The status flowchart is as follows:



Status transition	description
(1)	The protocol stack is automatically initialized after power-on
(2)	Enters Pre-Operational status automatically after initialization
(3)(6)	Start_Remote_Node command
(4)(7)	Enter_Pre-Operational_State command
(5)(8)	Stop_Remote_Node command
(9)(10)(11)	Reset_Node command
(12)(13)(14)	Reset_Communication command

The following services are available base on the inverter communication status:

	Initialization	Pre-Operational	Operational	Stopped
PDO			√	
SDO		√	√	
SYNC		√	√	
EMCY		√	√	
Boot-up	√			
NMT		√	√	√

Frame description: Client → Inverter

COB-ID	0 byte	1 byte
0 (16#000)	Command specifier (CS)	Node ID (1)

(1) If the Node ID is 0, the "Command Specifier" is transferred to all CANopen slaves, each slave must execute this NMT command and convert accordingly (see below).

Command Specifier (CS)	Content
1(16#01)	Start_Remote_Node
2(16#02)	Stop_Remote_Node
128(16#80)	Enter_PRE-OPERATIONAL_State
129(16#81)	Reset_Node
130(16#82)	Reset_Communication

➤ SDO (Service Data Objects)

SDO applies a client/server mode which both ends have access to each other for object dictionary. An SDO message contains a set of COB-IDs (request SDO and response SDO) and it can be accessed between two nodes. SDO can transmit data of any size, but it must be transmitted by segment once it exceeds 4 bytes, and the last segment must contain an end indication.

The object dictionary is a group object of CANopen nodes, each node has its own object dictionary, and the object dictionary contains several parameters which describe the properties and values of its supported parameters. The SDO access path is performed by indexes and sub-indexes. Each object has one single index value and might have multiple sub-index values if needed. The structure of SDO request and response messages is as follows.

Request: Client → Inverter

COB-ID	0 byte	1 byte	2 bytes	3 bytes	4 bytes	5 bytes	6 bytes	7 bytes
1536 (16#600) +Node-ID	Request code	Object index		Object sub-index	Request data			
		LSB	MSB		bit 7-0	bit 15-8	bit 23-16	bit 31-24

Response: Client ← Inverter

COB-ID	0 byte	1 byte	2 bytes	3 bytes	4 bytes	5 bytes	6 bytes	7 bytes
1408 (16#580) +Node-ID	Response code	Object index		Object sub-index	Response data			
		LSB	MSB		bit 7-0	bit 15-8	bit 23-16	bit 31-24

The "request data" and "response data" may change depending on the "request code" and "response code", as shown in the following table:

Request code	Description
16#23	Write a 4-byte data
16#2B	Write a 2-byte data
16#2F	Write a 1-byte data
16#40	Read data
16#80	Terminate current SDO command

Response code	Description
16#43	Read data: 4 bytes of data
16#4B	Read data: 2 bytes of data
16#4F	Read data: 1 bytes of data
16#60	Write a 1/2/4 byte data: response
16#80	Error response: abandon the returned code

➤ PDO (Process Data Object)

PDO applies a production/consumption mode, each network node can receive messages from the transmitting node and can also judge whether to process them after receiving. PDO data transmission can be done on a one-to-one or one-to-many methods. Each PDO message contains a transmit PDO (TxPDO) and a receive PDO (RxPDO) message, and the transmission method is defined in the PDO communication parameter index (The first group receives PDO messages at index 1400h, the first group transmits PDO messages at index 1800h). The transmission methods are listed in the following table:

Type number	PDO transmit type				
	cycle	non-cycle	Synchronized	Asynchronized	RTR
0		√	√		
1-240	√		√		
241-251	Reserved				
252			√		√
253				√	√
254				√	
255				√	

Type No (Type No) 1-240 represents the number of synchronized messages (SYNC) between two PDO transmissions.

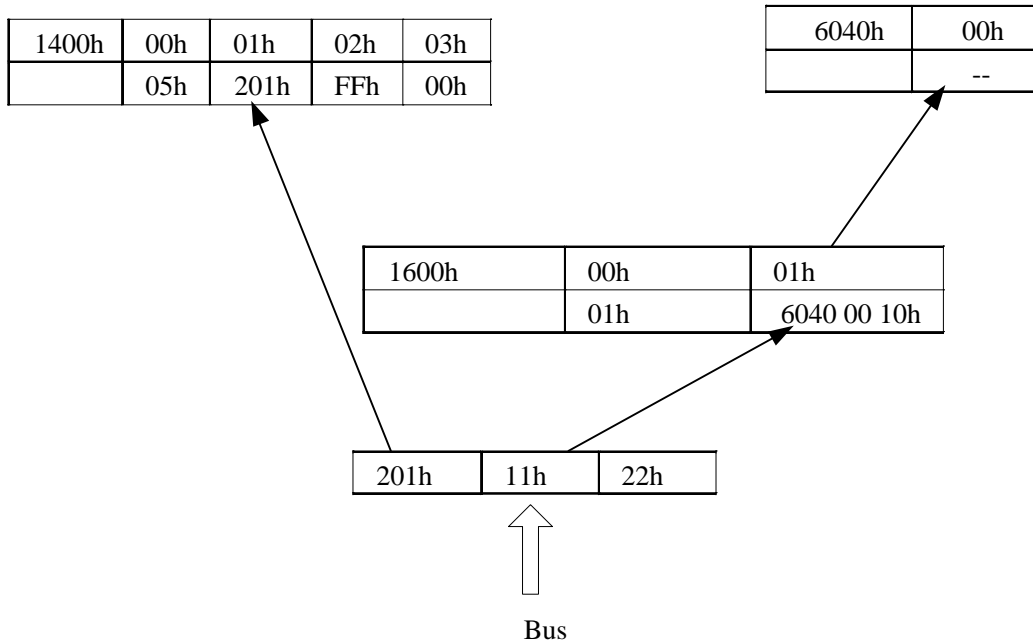
Type No. 252 represents date is updated immediately after receiving a SYNC message.

Type No. 253 represents the data is updated immediately after receiving RTR message.

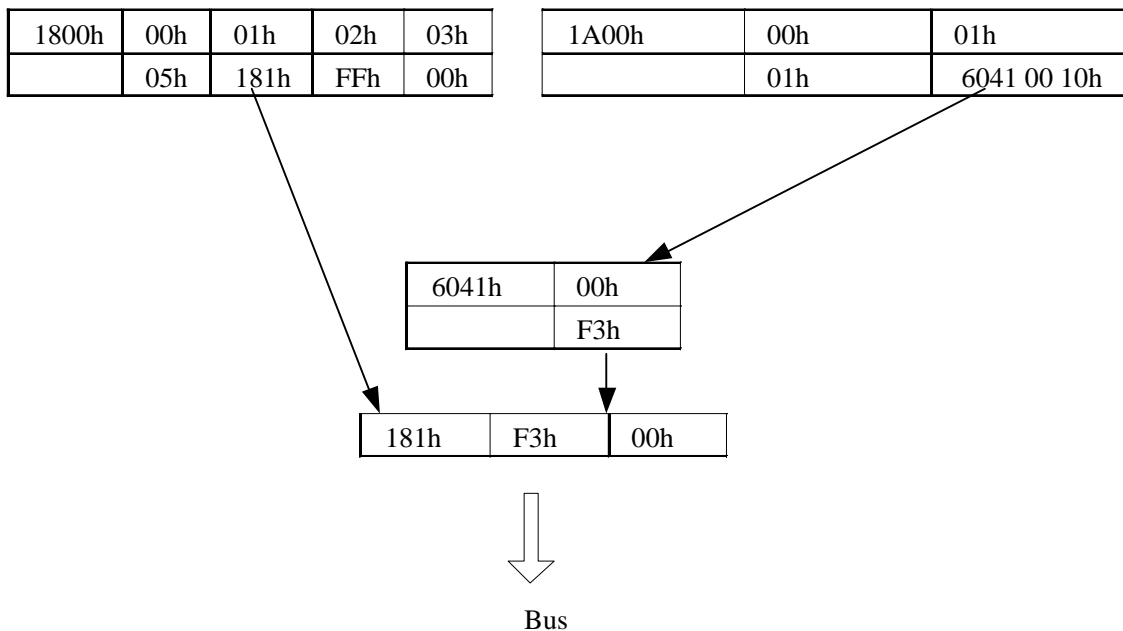
Type No. 254, 255 means asynchronized transmission.

All PDO transfer data must be mapped to the corresponding index area through the object dictionary. The following are examples:

Master transmits PDO messages to the slave



Slave replies to the master



➤ EMCY (Emergency Object)

The emergency objects are triggered when an internal error occurs in the device hardware. The emergency object is only transmitted when an error event occurs. As long as no error occurs in the hardware, it is considered as an error warning interrupt message and no emergency object is generated. The emergency object is an 8-byte data format with the following frame format:

COB-ID	0	1	2	3	4	5	6	7
128 (16#080) +Node-ID	Emergency Error Code		Error register (Object 1001h)	Manufacturer specific Error Field				

Please refer to the CANopen error code for the definition of the CP301 emergency object message

## 5. CP301 Operation Instructions

### 5.1 Inverter Settings

1. Wiring (refer to 3.3 CP301 Wiring instruction)
2. Set CANopen slave address: CANopen slave address can be set by inverter parameter 07-15 (P.800) (range 1-127, 0 to turn off CANopen slave function).
3. Set CANopen rate: The CANopen rate can be set via inverter parameter 07-16 (P.801) (options are 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and 50K(5)).
4. Set 00-16 (P .79) = 99999, and select the second operation mode.
5. Set the source of start command: Inverter parameter 00-18 (P.109) = 3, the external communication card is selected to give the operation signal.
6. Set the frequency command source: Inverter parameter 00-17 (P.97) = 3, the external communication card is selected to give the frequency.

**Note:** After the CANopen slave address and rate are modified, the inverter needs to be re-powered.

### 5.2 CiA402 Device Regulations

CANopen status machine:

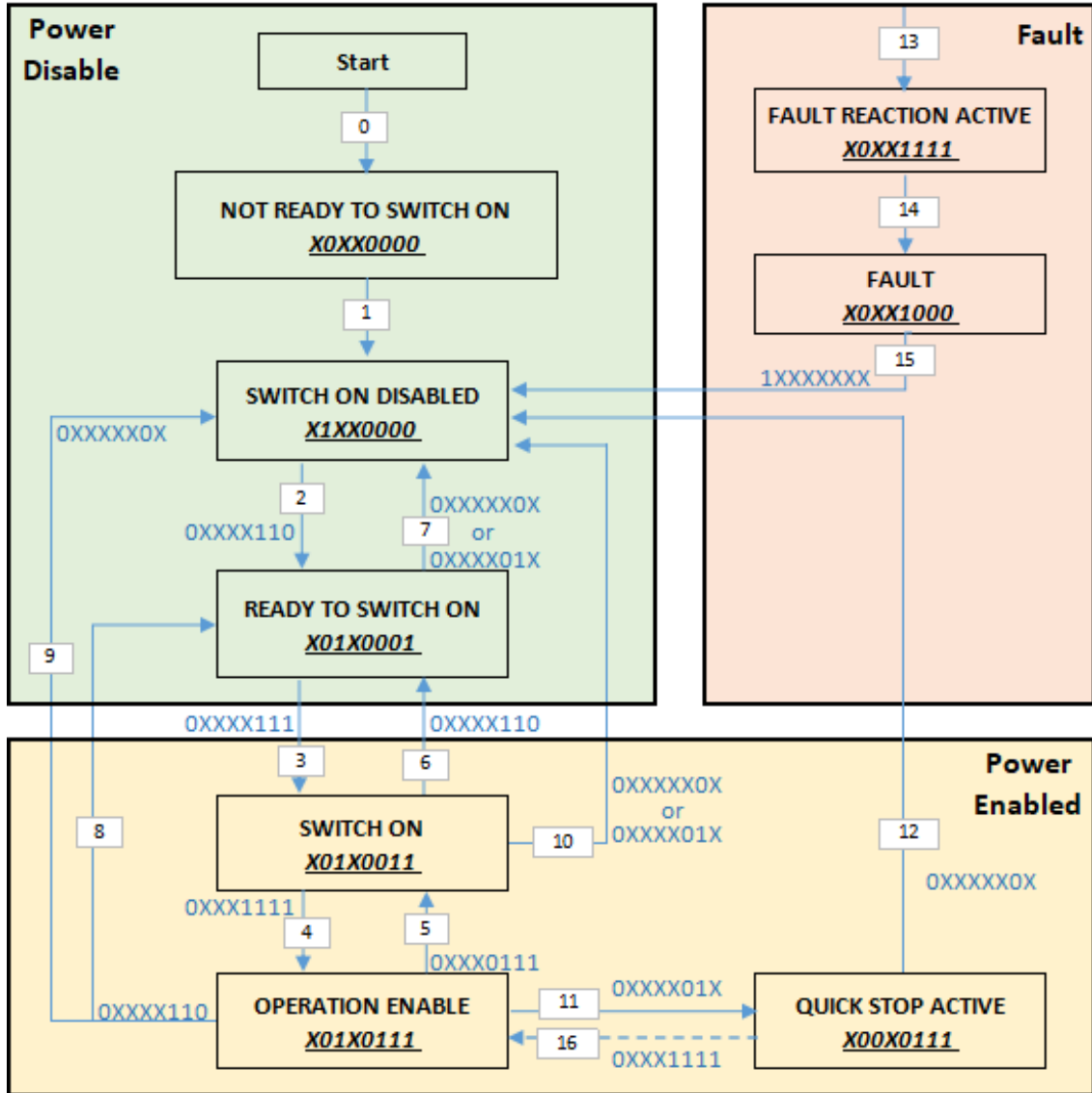
The state machine can be divided into three blocks:

Block	Description
Power Disable	No PWM output
Power Enable	With PWM output
Fault	Error occurs

A total of nine status are contained in three blocks:

Status	Description
Start	Power on
Not Ready to Switch On	In the process of initialization
Switch On Disable	Initialization completed
Ready to Switch On	Waiting to enter Switch On, motor is not on.
Switch On	Enable PWM output , but the reference command is invalid
Operation Enable	The operation is enabled according to the control command.
Quick Stop Active	Stop according to the setting.
Fault Reaction Active	An alarm is detected and the motor is stopped according to the setting, while the motor is still on.
Fault	Motor is disabled.

Control flow chart:



**Note:** The string next to the arrow is the Control word and the string in the status box is the Status word

Once the inverter is turned on and initialized, the inverter stays in the Switch On Disable state. To control the operation of the inverter, It must be switched to the Operate Enable state.

The upper computer switches the status by bit0~bit3 and bit7 of control word Index 6040h( Controlword), and reads the current inverter status by Index 6041h(StatusWord).

each bit description for Index 6040h (Control word):

Bit 15~9	Bit 8	Bit 7	Bit 6~4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Halt	Fault reset	Operation mode specific	Enable operation	Quick stop	Enable voltage	Switch on

each bit description for Index 6041h(Status Word):

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Switch On Disabled	Quick Stop	Voltage enabled	Fault	Operation Enabled	Switched On	Ready to Switch On
Bit 15~14	Bit 13~12	Bit 11	Bit 10	Bit 9~8	Bit 8	Bit 7
Reserved	Operation Mode Specific	Reserved	Target Reached	Remote	Reserved	Warning

The dotted line remarked process is determined by the setting value of Index 605Ah. (When the setting value is 5 or 6, this dotted line is valid, On the contrary, when 605Ah is set to other values, it is not possible to return to Operation Enable mode directly if the inverter is switched to Quick Stop Active status.)

Index	Sub	Definition	Initial value	R/W	Size	PDO Map	Remark
605Ah	0	Quick stop option code	2	RW	S16	No	0:Disable drive function
							1:Slow down on slow down ramp
							2:Slow down on quick stop ramp
							5:Slow down on slow down ramp and stay in Quick Stop
							6:Slow down on quick stop ramp and stay in Quick Stop

When switching from Operation Enable to Switch On, you can define the stop method via 605C.

Index	Sub	Definition	Initial value	R/W	Size	PDO Map	Remark
605Ch	0	Disable operation option code	1	RW	S16	No	0: Disable drive function
							1: Slow down with slow down ramp; disable of the drive function

In addition, when switching from Operation Enable to Ready To Switch On, the stop method can be defined via 605B.

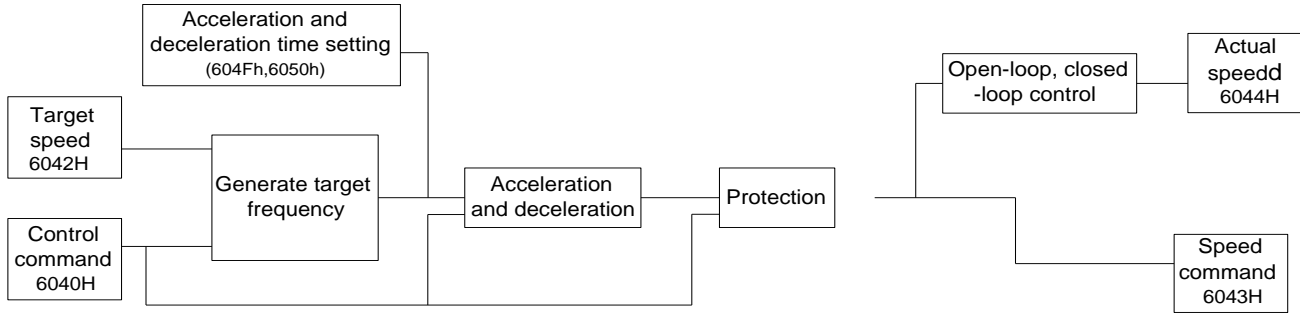
Index	Sub	Definition	Initial value	R/W	Size	PDO Map	Remark
605Bh	0	Shut down option code	1	RW	S16	No	0: Disable drive function
							1: Slow down with slow down ramp; disable of the drive function



### 5.3 Velocity Mode

The CP301 currently supports speed control.

The speed of inverter can be controlled when the status machine is switched to Operation enable. (refer to chapter 5.1 for related inverter parameters).



Speed-related Index:

Index	Sub-index	Object Name	Description
6042h	0	Target Velocity	Set the target speed (RPM) of the inverter --- Note 1
6043h	0	Velocity Demand	Current speed command (RPM)
6044h	0	Control Effort	Current output speed (RPM)
604Fh	0	Ramp function time	Acceleration time, unit in ms
6050h	0	Slow down time	Deceleration time, unit in ms

Note 1: The Index 6042h is set to the value of RPM with the following formula:

$$n = f \times \frac{120}{p} \text{ (n: Speed rpm P: Number of motor poles f : Rotation frequency)}$$

P: The number of motor poles is related to inverter parameter 05-02(P.303)/05-23(P.333).

Velocity Mode : Operation mode specific (bit 4~bit 6) corresponds to the following table:

bit6	bit5	bit4	Result
1	1	1	Rotate to target frequency
1	0	1	Keep in current frequency
other			Decelerate to 0hz

For example: set the target frequency of inverter to 50.00hz, acceleration time to 5.00 s, deceleration time to 10.00 s, start running direction to forward, and it switches to reverse rotation when the inverter accelerates to the target speed

1. set the rotation speed by Index 6042h = 1500 rpm via the master, which is calculated by the formula above(50\*120/4);
2. set the acceleration and deceleration setting time by Index 604Fh = 5000 ms, Index 6050h = 10000 ms via the master;
3. set the Index 6040h = 06h, 6040h = 07h, 6040h = 0Fh via the master, the motor switches to Operation Enable state;
4. set the Index 6040h = 7Fh via the master, the inverter starts forwardly rotation and runs the motor;
5. read Index 6043h or Index 6044h via the master to obtain the current actual motor output speed;

Set Index 6042h = -1500 rpm via the master and switch the direction of operation to reverse by negative speed.

## 6. CP301 Support Index List

### 6.1 Basic Index

Index	Sub	Definition	Initial value	R/W	Size	Remark
1000h	0	Device type	0	R	U32	
1001h	0	Error register	0	R	U8	
1005h	0	COB-ID SYNC message	80h	R	U32	
1008h	0	Manufacturer device name	0	R	U32	
1009h	0	Manufacturer hardware version	0	R	U32	
100Ah	0	Manufacturer software version	0	R	U32	
1010h	0	Store Parameter	3	R	U8	
	1	Save all parameters	0	RW	U32	
	2	Save communication parameter	0	RW	U32	
	3	Save application parameters	0	RW	U32	
1011h	0	Restore Parameter	3	R	U8	
	1	Restore all parameters	0	RW	U32	
	2	Restore communication parameter	0	RW	U32	
	3	Restore application default parameters	0	RW	U32	
1014h	0	COB-ID emergency	0000080h+Node-ID	R	U32	
1016h	0	Consumer heartbeat time	1	R	U8	
	1	Consumer 1	0	RW	U32	Unit : 1ms
1017h	0	Producer heartbeat time	0	RW	U16	unit : 1ms
1018h	0	Number	3	R	U8	
	1	Vender ID	0	R	U32	
	2	Product code	0	R	U32	
	3	Revision	0	R	U32	
1200h	0	Server SDO Parameter	2	R	U8	
	1	COB-ID Client -> Server	0000600h+Node-ID	R	U32	
	2	COB-ID Client <- Server	0000580h+Node-ID	R	U32	

Index	Sub	Definition	Initial value	R/W	Size	Remark
1400h	0	Number	2	R	U8	
	1	COB-ID used by PDO	00000200h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240: Cyclic& Synchronous
						254:Asynchronous
					255:Asynchronous	
1401h	0	Number	2	R	U8	
	1	COB-ID used by PDO	80000300h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240: Cyclic& ynchronous
						254:Asynchronous
					255:Asynchronous	
1402h	0	Number	2	R	U8	
	1	COB-ID used by PDO	80000400h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240: Cyclic& ynchronous
						254:Asynchronous
					255:Asynchronous	
1403h	0	Number	2	R	U8	
	1	COB-ID used by PDO	80000500h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240: Cyclic& ynchronous
						254:Asynchronous
					255:Asynchronous	
1600h	0	Number	2	RW	U8	
	1	1.Mapped Object	60400010h	RW	U32	
	2	2.Mapped Object	60420010h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	
1601h	0	Number	0	RW	U8	
	1	1.Mapped Object	0h	RW	U32	
	2	2.Mapped Object	0h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	

Index	Sub	Definition	Initial value	R/W	Size	Remark
1602h	0	Number	0	RW	U8	
	1	1.Mapped Object	0h	RW	U32	
	2	2.Mapped Object	0h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	
1603h	0	Number	0	RW	U8	
	1	1.Mapped Object	0h	RW	U32	
	2	2.Mapped Object	0h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	
1800h	0	Number	5	R	U8	
	1	COB-ID used by PDO	00000180h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240:Cyclic& Synchronous
						254:Asynchronous
						255:Asynchronous
	3	Inhibit time	0	RW	U16	Unit : 100us Set an integer multiple of 10
	4	CMS-Priority Group	0	RW	U8	
5	Event timer	0	RW	U16	Unit : 1ms	
1801h	0	Number	5	R	U8	
	1	COB-ID used by PDO	80000280h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240:Cyclic& Synchronous
						254:Asynchronous
						255:Asynchronous
	3	Inhibit time	0	RW	U16	Unit : 100us Set an integer multiple of 10
	4	CMS-Priority Group	0	RW	U8	
5	Event timer	0	RW	U16	Unit : 1ms	
1802h	0	Number	5	R	U8	
	1	COB-ID used by PDO	80000380h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240: Cyclic& ynchronous
						254:Asynchronous
					255:Asynchronous	

Index	Sub	Definition	Initial value	R/W	Size	Remark
1802h	3	Inhibit time	0	RW	U16	Unit : 100us Set an integer multiple of 10
	4	CMS-Priority Group	0	RW	U8	
	5	Event timer	0	RW	U16	Unit : 1ms
1803h	0	Number	5	R	U8	
	1	COB-ID used by PDO	80000480h+NodeID	RW	U32	
	2	Transmission Type	5	RW	U8	01-240: Cyclic& ynchronous
						254:Asynchronous
						255:Asynchronous
	3	Inhibit time	0	RW	U16	Unit : 100us Set an integer multiple of 10
	4	CMS-Priority Group	0	RW	U8	
5	Event timer	0	RW	U16	Unit : 1ms	
1A00h	0	Number	2	RW	U8	
	1	1.Mapped Object	60410010h	RW	U32	
	2	2.Mapped Object	60430010h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	
1A01h	0	Number	0	RW	U8	
	1	1.Mapped Object	0h	RW	U32	
	2	2.Mapped Object	0h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	
1A02h	0	Number	0	RW	U8	
	1	1.Mapped Object	0h	RW	U32	
	2	2.Mapped Object	0h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	
1A03h	0	Number	0	RW	U8	
	1	1.Mapped Object	0h	RW	U32	
	2	2.Mapped Object	0h	RW	U32	
	3	3.Mapped Object	0h	RW	U32	
	4	4.Mapped Object	0h	RW	U32	

## 6.2 Parameter Index of Inverter

It is for the inverter parameter-related setting, and the setting method is as follows:

The parameter index is regular.

1 ) Parameter group mode:

Index = 2000h + Group (parameter group number)

Sub-index = Num (parameter membership number) + 1

For example: for parameters 10-40 (VF separated voltage source)

Group	Num
10 ( Ah )	40 ( 28h )

So:

Index = 2000h + Ah = 200Ah;

Sub-index = 28h + 1 = 29h

2 ) P-parameter mode:

P-parameter number /100 = X(quotient) .....Y(remainder)

Index = 2100h + X

Sub-index = Y + 1

Example: for parameter P.308 (motor power on current)

308 / 100 = 3 ..... 8

So.

Index = 2100h + 3h = 2103h

Sub-index = 8h + 1 = 9h

## 6.3 Inverter Monitoring Value Index

2D02h : INV monitor						
Index	Sub-index	Modbus_addr	Definition	R/W	Size	PDOMap
2D02h	0	-	Maximum number of supported sub-indexes	RO	U8	NO
	X	1000h+X-1	See the communication parameter group (Group 07) of the corresponding machine operation manual for details	RO	U16	Yes

The monitoring sub-index X and its Modbus address corresponds one by one.

$$\text{Sub index } X = \text{Modbus Address} - 1000h + 1;$$

For example: By monitoring the output voltage, we find that the corresponding Modbus address is 1005h;

$$\text{Sub-index } X = 1005h - 1000h + 1 = 6h;$$

Therefore:

Corresponding object dictionary of output voltage is 2D02h : 6h

## 6.4 Related Devices Index of DSP402

Index	Sub	Definition	Initial value	R/W	Size	Remark	PDO Map	Remark
6007h	0	Abort connection option code	2	RW	S16		Yes	0:No action 1:malfunaction 2:Disable Voltage 3:Quick Stop
603Fh	0	Error code	0	RO	U16		Yes	
6040h	0	Control word	0	RW	U16		Yes	
6041h	0	Status word	0	RO	U16		Yes	
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	
604Fh	0	vl ramp function time	Note1	RW	U32	1ms	Yes	
6050h	0	vl slow down time	Note2	RW	U32	1ms	Yes	
6051h	0	Quick stop time	1000	RW	U32	1ms	Yes	
605Ah	0	Quick stop option code	2	RW	S16		No	0:disable drive function
								1:slow down on slow down ramp
								2: slow down on quick stop ramp
								5:slow down on slow down ramp and stay in Quick Stop
								6:slow down on quick stop ramp and stay in Quick Stop
605Bh	0	Shut down option code	0	RW	S16		No	0: Disable drive function
								1: Slow down with slow down ramp; disable of the drive function
605Ch	0	Disable operation option code	1	RW	S16		No	0: Disable drive function
								1: Slow down with slow down ramp; disable of the drive function
6061h	0	Mode of operation display	2	RO	S8		Yes	

**Note 1:** See the acceleration time 01-06 (P.7) in the user manual of the corresponding series for details.

**Note 2:** See the acceleration time 01-07 (P.8) of the user manual of the corresponding series for details.



## 7. CP301 error code

Error code	Description	CANopen error code
OC1	Overcurrent during acceleration	2213h
OC2	Overcurrent at constant speed	2214h
OC3	Overcurrent at deceleration	2213h
OC0	Overcurrent at shutdown	2310h
OV1	Overvoltage during acceleration	3210h
OV2	Overvoltage at constant speed	3210h
OV3	Overvoltage at deceleration	3210h
OV0	Overvoltage at shutdown	3210h
ThT	IGBT electronic thermo dynamic electric stage action	4300h
ThN	Motor electronic thermal relay action	4000h
FAN	Cooling fan abnormal	FF00h
OhT	External motor thermal relay operation	7120h
OPT	External abnormal	7500h
EEP	Memory abnormal	5530h
PID	PID abnormal	7300h
CPU	CPU abnormal	6000h
OLS	Stall prevention protection	8311h
SCP	Short-circuit overcurrent	2320h
NTC	Module overheat	4310h
NTC2	Module2 overheat	4310h
NTC3	Module3 overheat	4310h
NTC4	Module4 overheat	4310h
NTC5	Module5 overheat	4310h
NTC6	Module6 overheat	4310h
NTC7	Module7 overheat	4310h
NTC8	Module8 overheat	4310h
OL2	Over torque abnormal	8311h
BE	Brake crystal abnormal	7110h
IPF	Current input abnormal	5100h
CPR	CPU abnormal	6010h
AEr	4-5 terminal abnormal	7110h
PG1	Encoder type abnormal	7301h
PG2	PG card feedback signal abnormal	7301h
PG3	Excessive speed deviation during closed-loop control	7301h
PTC	Motor overheat	4000h
BEB	Material disconnection	FF01h

Error code	Description	CANopen error code
DV1	Z-phase pulse loss	7301h
DV2	Z-phase noise detection	7301h
DV3	Reverse rotation detection	7301h
DV4	Reverse rotation prevention detection	7301h
EbE	Communication card abnormal	FF02h
GF	Output shorted to ground	2330h
SAF	Safety circuit abnormal	FF03h
LF	Three-phase output abnormal	2300h
hDC	Hardware detection circuit abnormal	FF04h
ADE	Three-phase current sampling line abnormal	5210h
rAE	Charging circuit Relay abnormal	7110h
CbE	External communication card disconnection	8130h

## 8. Index

### 8.1 Index Specification Description

Object Type

Object type	Description
Variable	A single value, such as an UNSIGNED8, Boolean, float, INTEGER16, etc.
Array	A multiple data object consists of multiple variables with the same data type, such as UNSIGNED16, etc. Sub-index 0 data type is UNSIGNED8, it is not an array data.
Record	An object with multiple data fields consisting of multiple variables of different data types. Sub-index0 is UNSIGNED8, so it is not RECORD data.

### 8.2 DSP402 Device Index Detail Description

#### 8.2.1 Object 6007h : Abort connection option code

Index	6007h
Name	Abort connection option code
Object type	Variable
Data type	INTEGER16
Read/write permissions	RW
PDO mapping setting	Yes
Setting range	0 : No action
	1 : Malfunction
	2 : Disable Voltage
	3 : Quick Stop
Default value	2

1) When object 6007h = 0, it means that a disconnection error is ignored, no warning and no action need to be taken.

2) When object 6007h = 1, it means that the CANopen status switches to Fault and displays CBE and triggers a free stop if a disconnection error occurs, the warning code is not cleared when the connection cable is successfully connected.

3) When object 6007h = 2, it means the CANopen status switches to Switch on Disabled and displays CBE when a disconnection occurs, and triggers the free stop action. The warning code is cleared automatically when the connection cable is successfully connected.

4) When object 6007h = 3, it means the CANopen status switches to Quick Stop and displays CBE when a disconnection occurs, and triggers a stop action according to object 605Ah setting. The warning code is cleared automatically when the connection cable is successfully connected.

### 8.2.2 Object 603Fh : Error code

Index	603Fh
Name	Error code
Object type	Variable
Data type	UNSIGNED16
Read/write permissions	RO
PDO mapping setting	Yes
Setting range	UNSIGNED32
Default value	0

### 8.2.3 Object 6040h : Control word

Index	6040h
Name	Control word
Object type	Variable
Data type	UNSIGNED16
Read/write permissions	RW
PDO mapping setting	Yes
Setting range	UNSIGNED16
Default value	0

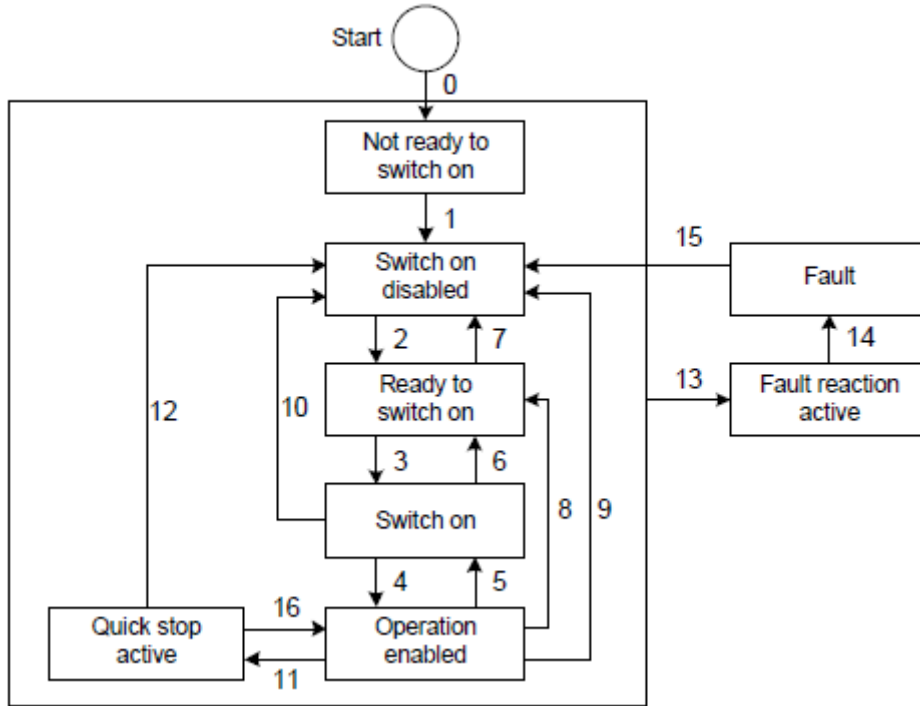
Description of each bit

Bit number	Function
Bit 0	Switch on
Bit 1	Enable voltage
Bit 2	Quick stop
Bit 3	Enable operation
Bit 4~Bit 6	Operation mode specific
Bit 7	Fault reset
Bit 8	Halt
Bit 9~Bit 15	Reserved

Bit description of velocity mode:

Operation mode specific	
Bit 4	Enable ramp
Bit 5	Unlock ramp
Bit 6	Reference ramp


Switching status diagram:



The state switching is defined in the following table:

State switching	Event
0, 1	Automatic execution after power on
2	Shutdown command
3	Switch on command
4	Enable operation command
5	Disable operation command
6	Shutdown command
7	Disable voltage or Quick stop command
8	Shutdown command
9	Disable voltage command
10	Disable voltage or Quick stop command
11	Quick stop command Quick Stop
12	Disable voltage command
13, 14	Warning / Failure occurs
15	Warning / Failure cleared
16	Enable operation ; no alarm command

The status can be changed by the Control word (6040h), commands are listed below:

Command	Bit of the control word					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Switch on	0	1	1	1	1	3+4
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset		X	X	X	X	15

Note:  Rising edge trigger

### 8.2.4 Object 6041h : Status word

Index	6041h
Name	Status word
Object type	Variable
Data type	UNSIGNED16
Read/write permissions	RO
PDO mapping setting	Yes
Setting range	UNSIGNED16
Default value	0

Description of each bit:

Bit	Function
Bit 0	Ready to switch on
Bit 1	Switched on
Bit 2	Operation enabled
Bit 3	Fault
Bit 4	Voltage enabled
Bit 5	Quick stop
Bit 6	Switch on disabled
Bit 7	Warning
Bit 8	Reserved
Bit 9	Remote
Bit 10	Target reached
Bit 11~15	Reserved

Status description:

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

### 8.2.5 Object 6042h : vl target velocity

Index	6042h
Name	vl target velocity
Object type	Variable
Data type	INTEGER16
Read/write permissions	RW
PDO mapping setting	Yes
Setting range	INTEGER16
Default value	0
Unit	RPM

This object is the velocity command value in Velocity Mode.

### 8.2.6 Object 6043h : vl velocity demand

Index	6043h
Name	vl velocity demand
Object type	Variable
Data type	INTEGER16
Read/write permissions	RO
PDO mapping setting	Yes
Setting range	INTEGER16
Unit	RPM

This object is the inverter speed command after calculation in Velocity Mode.

## 8.2.7 Object 6044h : vl velocity actual value

Index	6044h
Name	vl velocity actual value
Object type	Variable
Data type	INTEGER16
Read/write permissions	RO
PDO mapping setting	Yes
Setting range	INTEGER16
Unit	RPM

This object is the actual running speed value in Velocity Mode.

## 8.2.8 Object 604Fh : vl ramp function time

Index	604Fh
Name	vl ramp function time
Object type	Variable
Data type	UNSIGNED32
Read/write permissions	RW
PDO mapping setting	Yes
Setting range	UNSIGNED32
Default value	10000
Unit	ms

This object is the acceleration time from 0Hz to 01-09(P.20) setting value in Velocity Mode.

## 8.2.9 Object 6050h : vl slow down time

Index	Index 6050h
Name	vl slow down time
Object type	Variable
Data type	UNSIGNED32
Read/write permissions	RW
PDO mapping setting	Yes
Setting range	UNSIGNED32
Default value	10000
Unit	ms

This object is the deceleration time from 01-09 (P.20) setting to 0 Hz in Velocity Mode.



### 8.2.10 Object 6051h : vl quick stop time

Index	6051h
Name	vl quick stop time
Object type	Variable
Data type	UNSIGNED32
Read/write permissions	RW
PDO mapping setting	Yes
Setting range	UNSIGNED32
Default value	1000
Unit	ms

This object is deceleration time from the 01-09 (P.20) setting to 0 Hz when Quick Stop is active in Velocity mode.

### 8.2.11 Object 605Ah : Quick stop option code

Index	605Ah
Name	Quick stop option code
Object type	Variable
Data type	INTEGER16
Read/write permissions	RW
PDO mapping setting	No
Setting range	0: Disable inverter function
	1: Decelerate to stop by slow down ramp and transit into Switch on Disabled (not reversible to OP)
	2: Decelerate to stop by quick stop ramp and transit into Switch on Disabled (not reversible to OP)
	5: Decelerate to stop by slow down ramp and stay in Quick Stop status (reversible to OP)
	6: Decelerate to stop by quick stop ramp and stay in Quick Stop status (reversible to OP)
Default value	2

This object is the action selection when Quick Stop is triggered by 6040h (Control word).

### 8.2.12 Object 605Bh : Shut down option code

Index	Index 605Bh
Name	Shut down option code
Object type	Variable
Data type	INTEGER16
Read/write permissions	RW
PDO mapping setting	No
Setting range	0 : Disable inverter function
	1 : Decelerate stop and disable inverter function.
Default value	0

This object is the inverter action selection when transits from Operation Enable to Ready to Switched On.

### 8.2.13 Object 605Ch : Disable operation option code

Index	Index 605Ch
Name	Disable operation option code
Object type	Variable
Data type	INTEGER16
Read/write permissions	RW
PDO mapping setting	No
Setting range	0 : Disable inverter function
	1 : Decelerate stop and disable inverter function.
Default value	1

This object is the inverter action selection when transits from Operation Enable to Switched On.

### 8.2.14 Object 6061h : Modes of operation display

Index	6061h
Name	Modes of operation display
Object type	Variable
Data type	INTEGER8
Read/write permissions	RO
PDO mapping setting	Yes
Setting range	INTEGER8
Default value	2

This object displays the current control mode