Chapter 15 CANopen Overview

The built-in CANopen function is a kind of remote control. Master can control the AC motor drive by using CANopen protocol. CANopen is a CAN-based higher layer protocol. It provides standardized communication objects, including real-time data (Process Data Objects, PDO), configuration data (Service Data Objects, SDO), and special functions (Time Stamp, Sync message, and Emergency message). And it also has network management data, including Boot-up message, NMT message, and Error Control message. Refer to CiA website http://www.can-cia.org/ for details. The content of this instruction sheet may be revised without prior notice. Please consult our distributors or download the most updated version at http://www.delta.com.tw/industrialautomation

Delta CANopen supporting functions:

- Support CAN2.0A Protocol
- Support CANopen DS301 V4.02
- Support DSP-402 V2.0

Delta CANopen supporting services:

- PDO (Process Data Objects): PDO1~ PDO4
- SDO (Service Data Object):
  Initiate SDO Download;
  Initiate SDO Upload;
  Abort SDO;
  SDO message can be used to configure the slave node and access the Object Dictionary in every node.
- SOP (Special Object Protocol):
  Support default COB-ID in Predefined Master/Slave Connection Set in DS301 V4.02;
  Support SYNC service;
  Support Emergency service.
- NMT (Network Management):
  Support NMT module control;
 Support NMT Error control;
  Support Boot-up.

## Delta CANopen not supporting service:

- Time Stamp service

15-1 CANopen Overview

● **CANopen Protocol**

CANopen is a CAN-based higher layer protocol, and was designed for motion-oriented machine control networks, such as handling systems. Version 4.02 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA 302), recommendations for cables and connectors (CiA 303-1) and SI units and prefix representations (CiA 303-2).
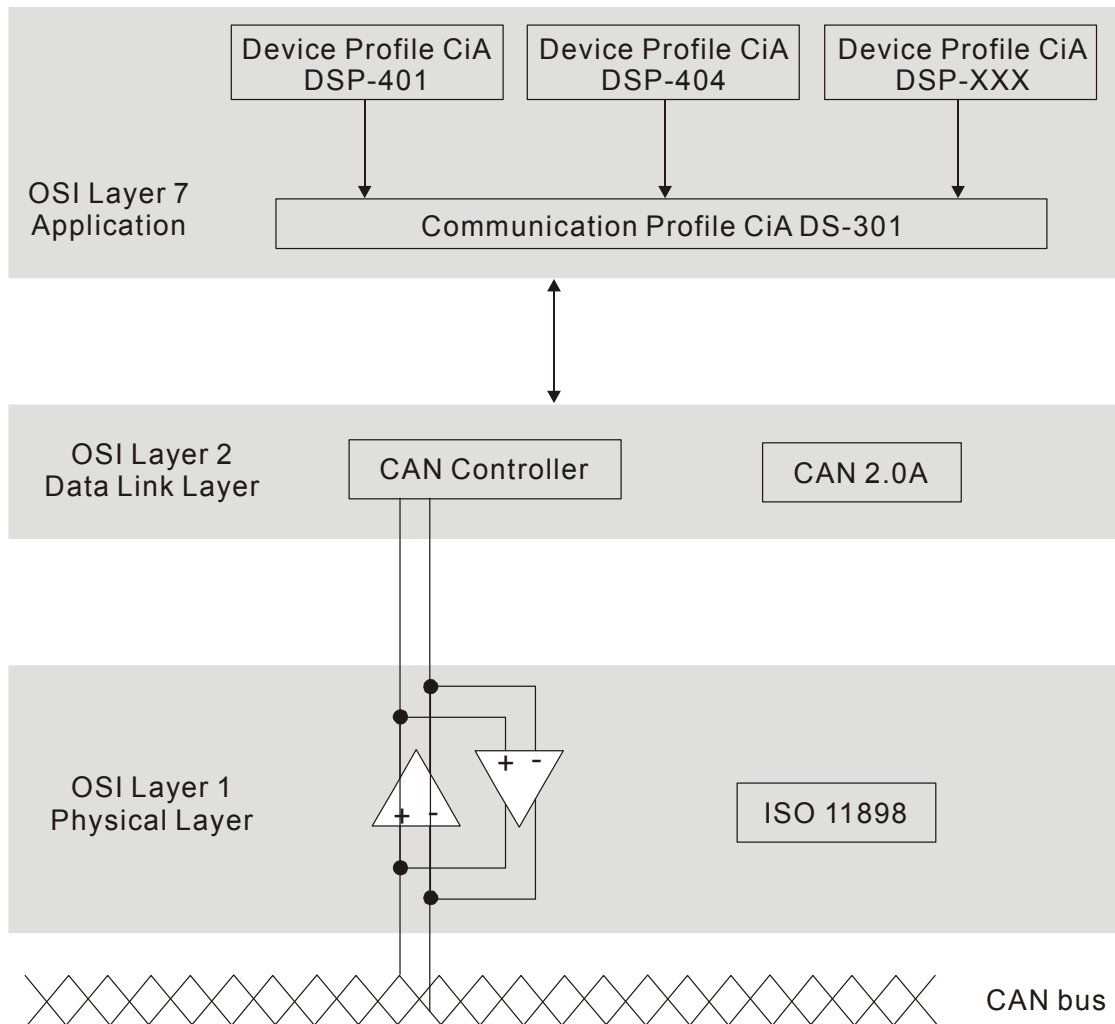
RJ-45 Pin Definition
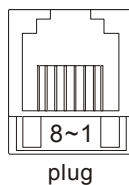
| PIN	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground / 0V /V-
6	CAN_GND	Ground / 0V /V-

- ● **CANopen Communication Protocol**

It has services as follows:

- ■ NMT (Network Management Object)
- ■ SDO (Service Data Objects)
- ■ PDO (Process Data Object)
- ■ EMCY (Emergency Object)

NMT (Network Management Object)

The Network Management (NMT) follows a Master/Slave structure for executing NMT service. Only one NMT master is in a network, and other nodes are regarded as slaves. All CANopen nodes have a present NMT state, and NMT master can control the state of the slave nodes. The state diagram of a node is shown as follows:
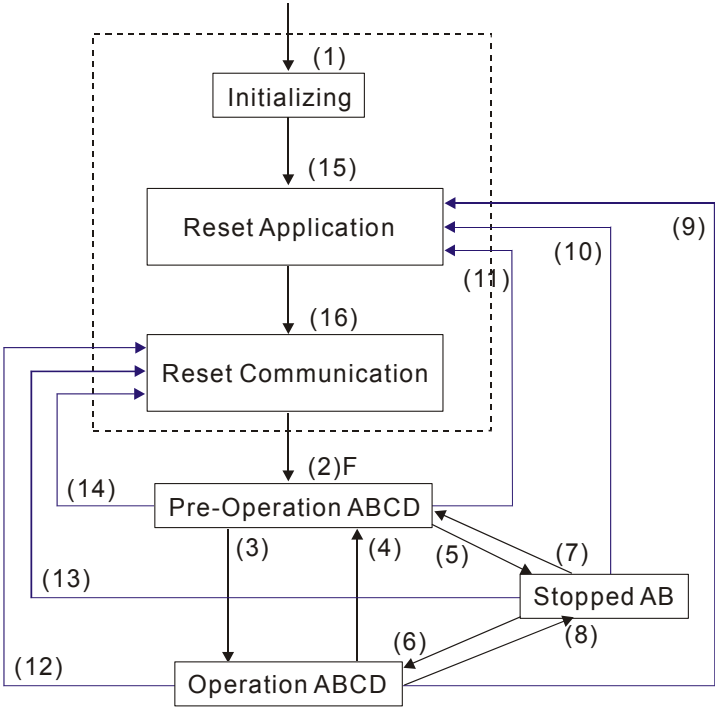
(1) After power is applied, it is auto in initialization state
(2) Enter pre-operational state automatically
(3) (6) Start remote node
(4) (7) Enter pre-operational state
(5) (8) Stop remote node
(9) (10) (11) Reset node
(12) (13) (14) Reset communication
(15) Enter reset application state automatically
(16) Enter reset communication state automatically

A: NMT
B: Node Guard
C: SDO
D: Emergency
E: PDO
F: Boot-up

	Initializing	Pre-Operational	Operational	Stopped
PDO			○	
SDO		○	○	
SYNC		○	○	
Time Stamp		○	○	
EMCY		○	○	
Boot-up	○			
NMT		○	○	○

SDO (Service Data Objects)

SDO is used to access the Object Dictionary in every CANopen node by Client/Server model. One SDO has two COB-ID (request SDO and response SDO) to upload or download data between two nodes. No data limit for SDOs to transfer data. But it needs to transfer by segment when data exceeds 4 bytes with an end signal in the last segment.

The Object Dictionary (OD) is a group of objects in CANopen node. Every node has an OD in the system, and OD contains all parameters describing the device and its network behavior. The access path of OD is the index and sub-index, each object has a unique index in OD, and has sub-index if necessary. The request and response frame structure of SDO communication is shown as follows:

PDO (Process Data Object)

PDO communication can be described by the producer/consumer model. Each node of the network will listen to the messages of the transmission node and distinguish if the message has to be processed or not after receiving the message. PDO can be transmitted from one device to one another device or to many other devices. Every PDO has two PDO services: a TxPDO and a RxPDO. PDOs are transmitted in a non-confirmed mode. All transmission types are listed in the following table:

Type Number	PDO				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
0		○	○		
1-240	○		○		
241-251	Reserved				
252			○		○
253				○	○
254				○	
255				○	

➢ Type number 1-240 indicates the number of SYNC message between two PDO transmissions.
➢ Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.
➢ Type number 253 indicates the data is updated immediately after receiving RTR.
➢ Type number 254: Delta CANopen doesn't support this transmission format.
➢ Type number 255 indicates the data is asynchronous transmission.

All PDO transmission data must be mapped to index via Object Dictionary.

EMCY (Emergency Object)

When errors occurred inside the hardware, an emergency object will be triggered an emergency object will only be sent when an error is occurred.   As long as there is nothing wrong with the hardware, there will be no emergency object to be served as a warning of an error message.

15-2 Wiring for CANopen

An external adapter card: MMC-COP01 is used for CANopen wiring to connect CANopen to MS300. The link is enabled by using RJ45 cable. The two farthest ends must be terminated with 120 Ω terminating resistors.
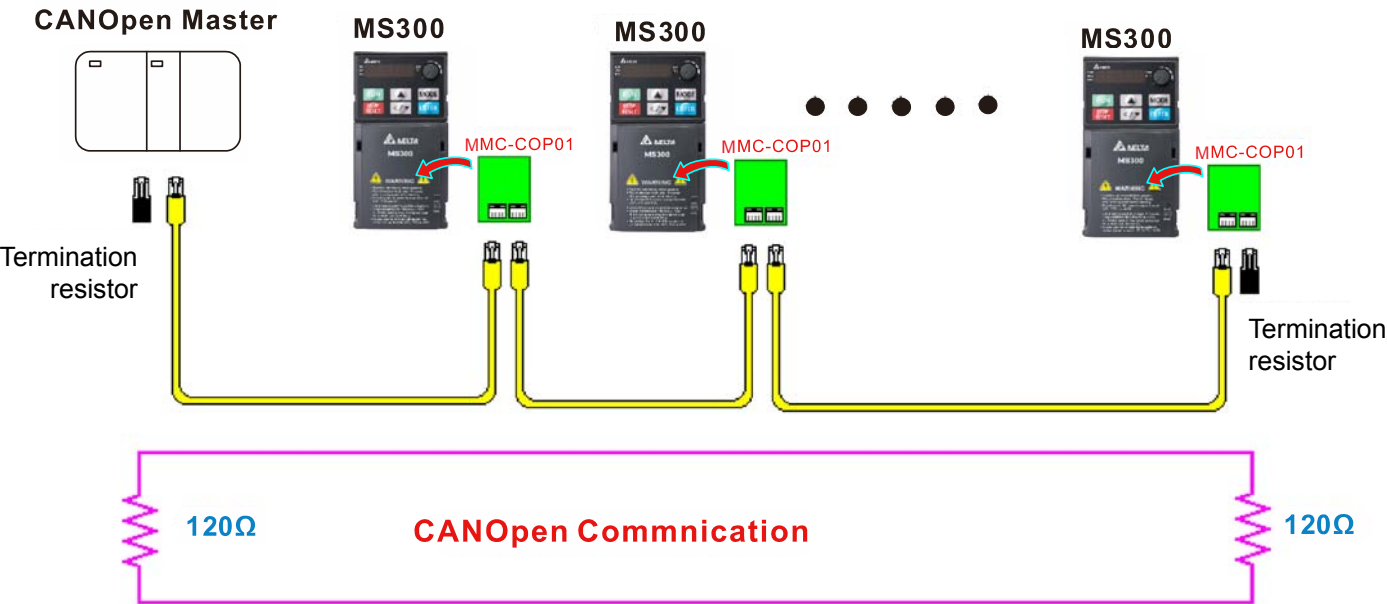
15-3 CANopen Communication Interface Descriptions

15-3-1 CANopen Control Mode Selection

There are two control modes for CANopen; Pr. 09-40 set to 1 is the factory setting mode DS402 standard and Pr. 09-40 set to 0 is Delta's standard setting mode. Actually, there are two control modes according to Delta's standard, one is the old control mode (Pr. 09-30=0). This control mode can only control the motor drive under frequency control. Another mode is a new standard (Pr. 09-30=1) This new control mode allows the motor drive to be controlled under all sorts of mode. MS300 support speed mode only currently, please use MH300 series for torque, position and homing mode. The definition of relating control mode is as follows:

CANopen control mode	Control mode	
	Speed	
	Index	Description
DS402 Pr. 09-40=1	6042-00	Target rotating speed (RPM)
	-----	-----
Delta Standard (Old definition) Pr. 09-40=0, Pr. 09-30=0	2020-02	Target rotating speed (Hz)
Delta Standard (New definition) Pr. 09-40=0, Pr. 09-30=1	2060-03	Target rotating speed (Hz)
	2060-04	Torque limit (%)

CANopen control mode	Operation control	
	Index	Description
DS402 Pr. 09-40=1	6040-00	Operation Command
	-----	-----
Delta Standard (Old definition) Pr. 09-40=0, Pr. 09-30=0	2020-01	Operation Command
Delta Standard (New definition for MS300 series) Pr. 09-40=0, Pr. 09-30=1	2060-01	Operation Command
	-----	-----

CANopen control mode	Other	
	Index	Description
DS402 Pr. 09-40=1	605A-00	Quick stop processing mode
	605C-00	Disable operation processing mode
Delta Standard (Old definition) Pr. 09-40=0, Pr. 09-30=0	-----	-----
Delta Standard (New definition for MS300 series) Pr. 09-40=0, Pr. 09-30=1	-----	-----
	-----	-----

However, you can use some index regardless DS402 or Delta's standard.

For example:

1. Index which are defined as RO attributes.

2. Index correspond to parameters such as (2000-00~200B-XX)

3. Accelerating / Decelerating Index: 604F 6050

15-3-2 DS402 Standard Control Mode

15-3-2-1 Related set up of ac motor drive (by following DS402 standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

1. Wiring for hardware (refer to chapter 15-2 Wiring for CANopen)
2. Operation source setting: set Pr. 00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr. 00-20 to 6. (Choose source of frequency commend from CANopen setting.)
4. Set DS402 as control mode: Pr. 09-40=0
5. CANopen station setting: The CANopen station (range 1-127, 0 is the Disable CANopen slave function) can be set via Pr. 09-36. (Note: Set Pr. 00-02 = 7 to reset if the station number error CAdE or CANopen memory error CFrE appears).
6. CANopen baud rate setting: set Pr. 09.37 (CANBUS Baud Rate: 1 M, 500 K, 250 K, 125 K, 100 K and 50 K)
7. Set multiple input functions to Quick Stop (it can also be enabled or disable, default setting is disabled). If it is necessary to enable the function, set MI terminal to 53 in one of the following parameter: Pr. 02-01 ~Pr. 02-08 or Pr. 02-26 ~ Pr. 02-31. (Note: This function is available in DS402 only.)

15-3-2-2 The status of the motor drive (by following DS402 standard)

According to the DS402 definition, the motor drive is divided into 3 blocks and 9 statuses as described below.

3 blocks:

1. Power Disable: That means without PWM output
2. Power Enable: That means with PWM output
3. Fault: One or more than one error has occurred.

9 statuses:

1. Start: Power On
2. Not ready to switch on: The motor drive is initiating.
3. Switch On Disable: When the motor drive finishes the initiation, it will be at this mode.
4. Ready to switch on: Warming up before running.
5. Switch On: The motor derive has the PWM output now, but the reference commend is not effective.
6. Operate Enable: Able to control normally.
7. Quick Stop Active: When there is a Quick Stop request, you have to stop running the motor drive.
8. Fault Reaction Active: The motor drive detects conditions which might trigger error(s).
9. Fault: One or more than errors has occurred to the motor drive.

Therefore, when the motor drive is turned on and finishes the initiation, it will remain at Ready to Switch on status. To control the operation of the motor drive, you need to change this status to Operate Enable status. The way to change it is to commend the control word's bit 0 ~ bit 3 and bit 7 of the Index 6040H and to pair with Index Status Word (Status Word 0X6041). The control steps and index definition are described as below:

Index 6040

15~9	8	7	6~4	3	2	1	0
Reserved	Halt	Fault Reset	Operation	Enable operation	Quick Stop	Enable Voltage	Switch On

Index 6041

15~14	13~12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	Operation	Internal limit active	Target reached	Remote	Reserved	Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on
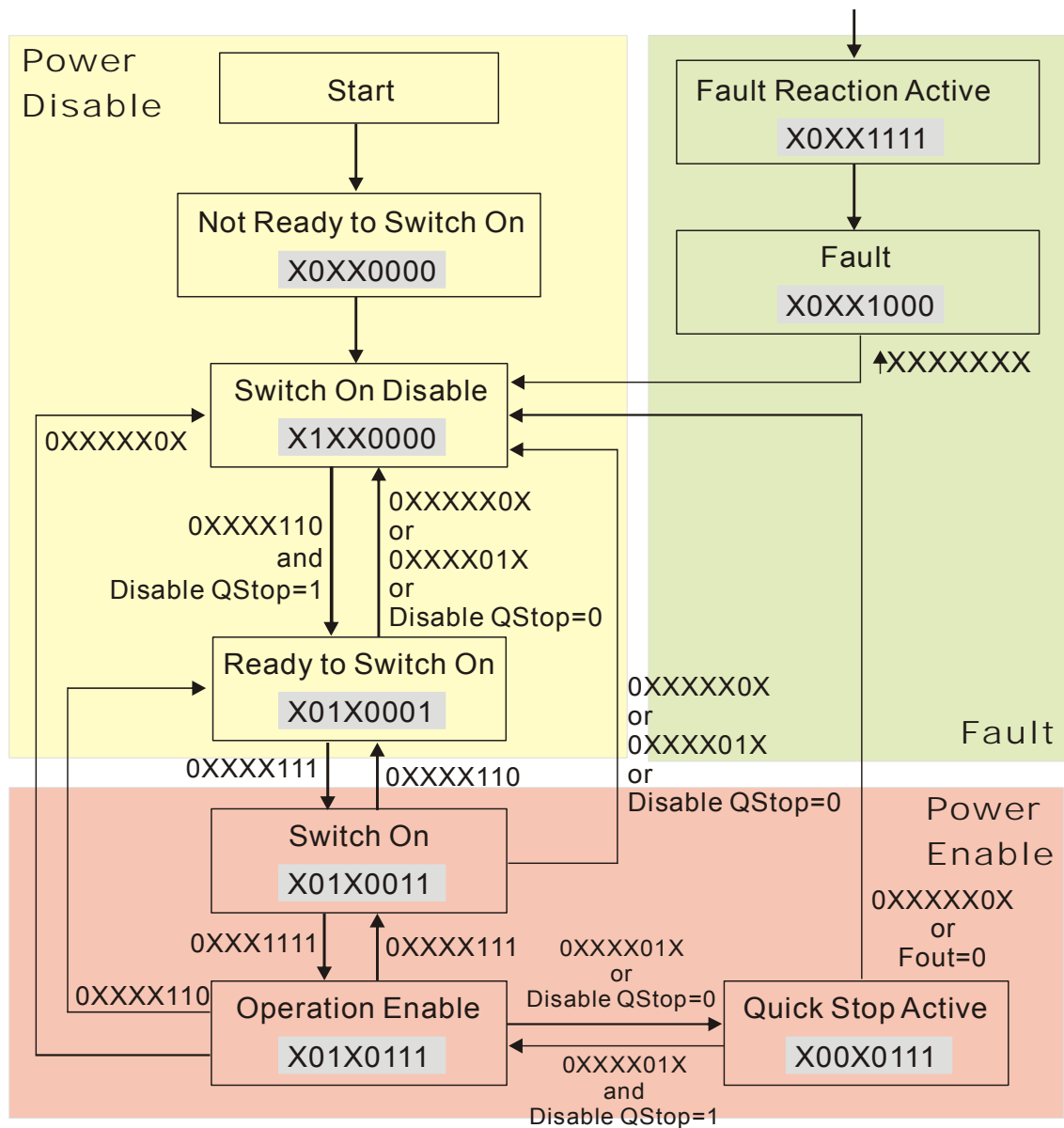
Set command 6040 =0xE, then set another command 6040 =0xF. Then the motor drive can be switched to Operation Enable. The Index 605A decides the dashed line of Operation Enable when the control mode changes from Quick Stop Active. (When the setting value is 1~3, this dashed line is active. But when the setting value of 605A is not 1~3, once he motor derive is switched to Quick Stop Active, it will not be able to switch back to Operation Enable.)

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	note
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
									7: slow down on the current limit and stay in Quick stop

Besides, use 605C to define parking method when the control section is switched from Power Enable to Power Disable.

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	note
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

15-3-2-3 Various mode control method (by following DS402 standard)

Currently MS300 support speed control mode, as follows:

Speed mode:

1. Let MS300 be at the speed control mode: Set Index6060 to 2.

2. Switch to Operation Enable mode: Set 6040=0xE, then set 6040 = 0xF.

3. To set target frequency: Set target frequency of 6042, since the operation unit of 6042 is rpm, there is a transformation:

$$n = f \times \frac{120}{p}$$ n: rotation speed (rpm) (rounds/minute)   P: motor's pole number (Pole)

f: rotation frequency (Hz)

For example:

Set 6042H = 1500 (rpm), if the motor drive's pole number is 4 (Pr. 05-04 or Pr. 05-16), then the motor drive's operation frequency is 1500 (120 / 4) = 50 Hz. Besides, the 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter clockwise

4. To set acceleration and deceleration: Use 604F (Acceleration) and 6050 (Deceleration).

5. Trigger an ACK signal: In the speed control mode, the bit 6~4 of Index 6040 needs to be controlled. It is defined as below:

	Index 6040			SUM
Speed mode (Index 6060=2)	bit 6	bit 5	bit 4	
	1	0	1	Locked at the current signal.
	1	1	1	Run to reach targeting signal.
	Other			Decelerate to 0 Hz.
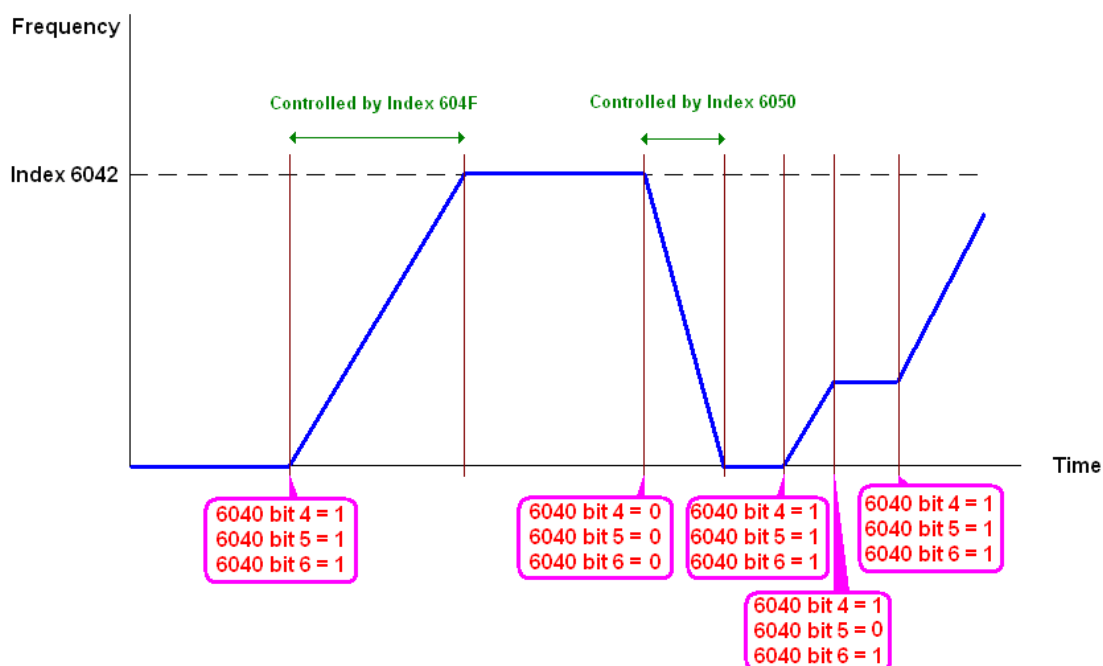
NOTE 1: To know the current rotation speed, read 6043. (Unit: rpm)

NOTE 2: To know if the rotation speed can reach the targeting value; read bit 10 of 6041.

(0: Not reached; 1: Reached)

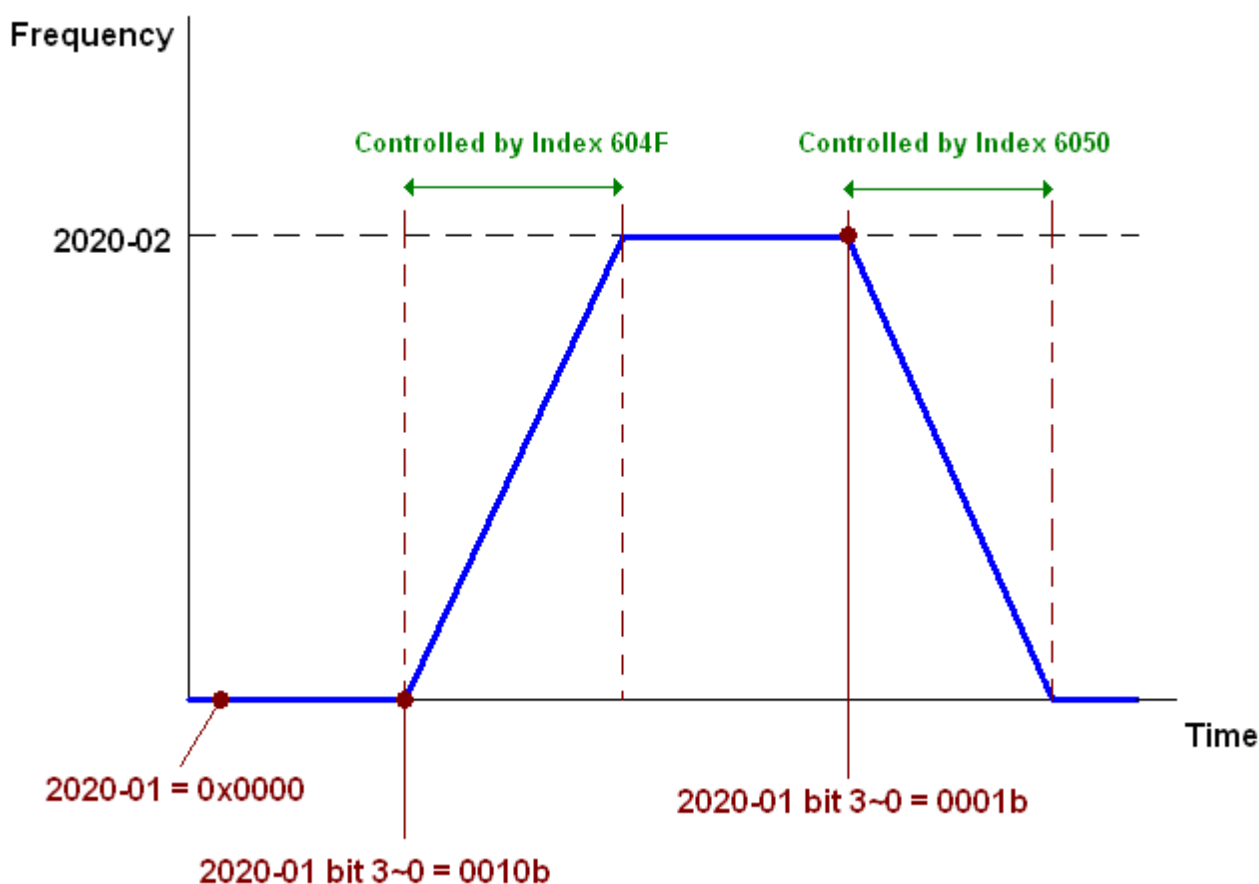## 15-3-3 By using Delta Standard (Old definition, only support speed mode)

15-3-3-1 Various mode control method (Delta Old Standard)
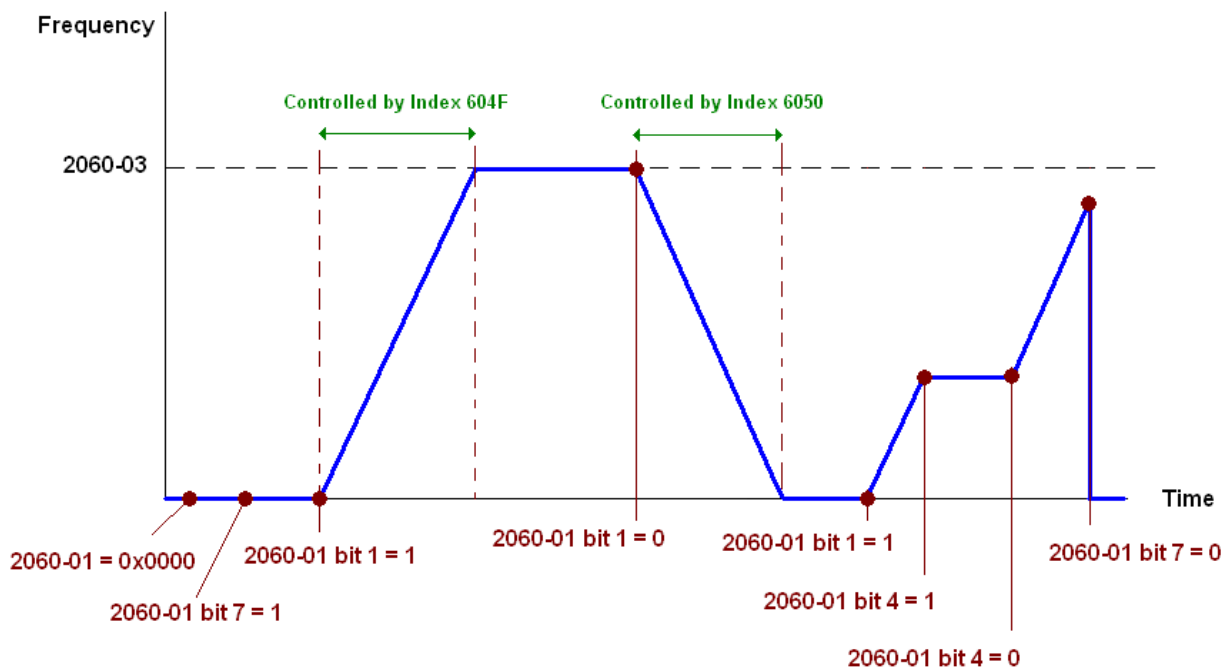
Please follow the steps below:

1. Wiring for hardware (Refer to chapter 15-2 Wiring for CANopen)
2. Operation source setting: set Pr. 00-21 to 3 to choose source of operation commend from CANopen setting. (Run / Stop, Forward / Reverse etc.)
3. Frequency source setting: set Pr. 00.20 to 6. (Choose source of frequency commend from CANopen setting.)
4. Set Delta Standard (Old definition) as control mode: Pr. 09-40 = 0 and Pr. 09-30 = 0.
5. CANopen station setting: set Pr. 09-36 (Range of setting is 1~127. When Pr. 09-36=0, CANopen slave function is disabled.) (Note: If error appears (CAdE or CANopen memory error CFrE or index error CIdE) as station setting is completed, press Pr. 00-02=7 for reset.)
6. CANopen baud rate setting: set Pr. 09.37 (CANopen Baud Rate: 1 M (0), 500 K (1), 250 K (2), 125 K (3), 100 K (4) and 50 K (5))

15-3-3-2 By speed mode

1. Set the target frequency: Set 2020-02, the unit is Hz, with a number of 1 decimal place. For example 1000 is 100.0.
2. Operation control: Set 2020-01 = 0002H for Running, and set 2020-01 = 0001H for Stopping.

15-3-4 By using Delta Standard (New definition)

15-3-4-1 Related set up of ac motor drive (Delta New Standard)

Please follow the steps below:

1. Wiring for hardware (Refer to chapter 15-2 Wiring for CANopen)
2. Operation source setting: set Pr. 00-21 to 3 to choose source of operation commend from CANopen setting. (Run / Stop, Forward / Reverse etc.)
3. Frequency source setting: set Pr. 00-20 to 6. (Choose source of frequency commend from CANopen setting.)
4. Set Delta Standard (New definition) as control mode: Pr. 09-40 = 0 and 09-30 = 1.
5. CANopen station setting: set Pr. 09-36 (Range of setting is 1~127. When Pr.09-36=0, CANopen slave function is disabled.) (Note: If error appears (CAdE or CANopen memory error) as station setting is completed, press Pr. 00-02=7 for reset.)
6. CANopen baud rate setting: set Pr. 09-37 (CANopen Baud Rate: 1 M (0), 500 K (1), 250 K (2), 125 K (3), 100 K (4) and 50 K (5))

15-3-4-2 Various mode control method (Delta New Standard)

Speed Mode

1. Let MS300 be at the speed control mode: Set Index 6060 = 2.
2. Set the target frequency: set 2060-03, unit is Hz, with a number of 1 decimal place. For example 1000 is 100.0 Hz.
3. Operation control: set 2060-01 = 008H for Server on, and set 2060-01 = 0081H for Running.

15-3-5 DI / DO / AI / AO are controlled via CANopen

To control the DO AO of the motor drive through CANopen, follow the steps below:

1. To set the DO to be controlled, define this DO to be controlled by CANopen. For example, set Pr. 02-13=50 to control RY1.

2. To set the AO to be controlled, define this AO to be controlled by CANopen. For example, set Pr. 03-20=20 to control AFM.

3. To control the mapping index of CANopen. If you want to control DO, then you will need to control Index2026-41. If you want to control AO, then you will need to control 2026-AX. If you want to set RY1 as ON, set the bit 1 of Index 2026-41 =1, then RY1 will output 1. If you want to control AFM output = 50.00 %, then you will need to set Index 2026-A2 =5000, then AFM will output 50 %.

Mapping table of CANopen DI DO AI AO:

DI:

Terminal	Related Parameters	R/W	Mapping Index
MI 1	==	RO	2026-01 bit 0
MI 2	==	RO	2026-01 bit 1
MI 3	==	RO	2026-01 bit 2
MI 4	==	RO	2026-01 bit 3
MI 5	==	RO	2026-01 bit 4
MI 6	==	RO	2026-01 bit 5
MI 7	==	RO	2026-01 bit 6

DO：

Terminal	Related Parameters	R/W	Mapping Index
RY	Pr. 02-13 = 50	RW	2026-41 bit 0 of the initial value 0x01
MO1	Pr. 02-16 = 50	RW	2026-41 bit 3 of the initial value 0x01
MO2	Pr. 02-17 = 50	RW	2026-41 bit 4 of the initial value 0x01

AI：

Terminal	Related Parameters	R/W	Mapping Index
AVI	==	RO	Value of 2026-61
ACI	==	RO	Value of 2026-62

AO：

Terminal	Related Parameters	R/W	Mapping Index
AFM	Pr. 03-20 = 20	RW	Value of 2026-A1

15-4 CANopen Supporting Index

MS300 Index:

Parameter index corresponds to each other as following:

Index	**sub-Index**
2000H + Group	member+1

For example: Pr. 10-15 (Encoder Slip Error Treatment)

Group		**member**
10 (0AH)	-	15 (0FH)

Index = 2000H + 0AH = 200A

Sub Index = 0FH + 1H = 10H

MS300 Control Index:
Delta Standard Mode (Old definition)

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
2020H	0	Number	3	R	U8		
	1	Control word	0	RW	U16	Bit 1~0	00B: Disable
							01B: Stop
							10B: Disable
							11B: JOG Enable
						Bit 3~2	Reserved
						Bit 5~4	00B: Disable
							01B: Direction forward
							10B: Reverse
							11B: Switch Direction
						Bit 7~6	00B: 1st step Accel. / Decel.
							01B: 2nd step Accel. / Decel.
							10B: 3rd step Accel. / Decel.
							11B: 4th step Accel. / Decel.
						Bit 11~8	0000B: Master speed
							0001B: 1st step speed
							0010B: 2nd step speed
							0011B: 3rd step speed
							0100B: 4th step speed
							0101B: 5th step speed
							0110B: 6th step speed
							0111B: 7th step speed
							1000B: 8th step speed
							1001B: 9th step speed
							1010B: 10th step speed
							1011B: 11th step speed
							1100B: 12th step speed
							1101B: 13th step speed
							1110B: 14th step speed
							1111B: 15th step speed
						Bit 12	1: Enable the function of Bit 6-11
						Bit 14~13	00B: No function
							01B: Operation command by the digital keypad
							10B: Operation command by Pr. 00-21 setting
							11B: Switch the source of operation command
						Bit 15	Reserved

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
	2	Freq. command (XXXX.X Hz)	0	RW	U16		
	3	Other trigger	0	RW	U16	Bit 0	1: E.F. ON
						Bit 1	1: Reset
						Bit 2	1: External interrupt (b.b.) ON
						Bit 15~3	Reserved
2021H	0	Number	10	R	U8		
	1	Error code	0	R	U16	High byte: Warn Code Low byte: Error Code	
	2	AC motor drive status	0	R	U16	Bit 1~0	00B: Stop
							01B: Decelerate to stop
							10B: Waiting for operation command
							11B: In operation
						Bit 2	1: JOG command
						Bit 4~3	00B: Forward running
							01B: Switch from reverse running to forward running
							10B: Switch from forward running to reverse running
							11B: Reverse running
						Bit 7~5	Reserved
						Bit 8	1: Master frequency command controlled by communication interface
						Bit 9	1: Master frequency command controlled by analog signal input
						Bit 10	1: Operation command controlled by communication interface
						Bit 11	1: parameter lock
						Bit 12	1: the digital keypad copy parameter function is enabled
						Bit 15~13	Reserved
	3	Freq. command (XXXX.X Hz)	0	R	U16		
	4	Output freq. (XXXX.X Hz)	0	R	U16		
	5	Output current (XX.X A)	0	R	U16		
	6	DC bus voltage (XXX.X V)	0	R	U16		
	7	Output voltage (XXX.X V)	0	R	U16		
	8	the current segment run by the multi-segment speed commend	0	R	U16		
	9		0	R	U16		
	A	Display counter value (c)	0	R	U16		
	B						
	C	Display output torque (XXX.X %)	0	R	U16		
	D	Display actual motor speed (rpm)	0	R	U16		
	E	Number of PG feedback pulses (0~65535)	0	R	U16		
	F	Number of PG2 pulse commands (0~65535)	0	R	U16		
	10	power output (X.XXX KWH)	0	R	U16		

Index	Sub	Definition	Factory Setting	R/W	Size	Note
	17	Multi-function display (Pr. 00-04)	0	R	U16	
2022H	0	Reserved	0	R	U16	
	1	Display output current	0	R	U16	
	2	Display counter value	0	R	U16	
	3	Display actual output frequency (XXX.XX Hz)	0	R	U16	
	4	Display DC-BUS voltage (XXX.X V)	0	R	U16	
	5	Display output voltage (XXX.X V)	0	R	U16	
	6	Display output power angle (XX.X °)	0	R	U16	
	7	Display output power in kW	0	R	U16	
	8	Display actual motor speed (rpm)	0	R	U16	
	9	Display estimate output torque (XXX.X %)	0	R	U16	
	A	Display PG feedback	0	R	U16	
	B	Display PID feedback value after enabling PID function in % (To 2 decimal places)	0	R	U16	
	C	Display signal of AVI analog input terminal, 0-10V corresponds to 0-100 % (To 2 decimal places)	0	R	U16	
	D	Display signal of ACI analog input terminal, 4-V 20 mA / 0-10 V corresponds to 0-100 % (To 2 decimal places)	0	R	U16	
	F	Display the IGBT temperature of drive power module in °C	0	R	U16	
	10	Display the temperature of capacitance in °C	0	R	U16	
	11	The status of digital input (ON / OFF), refer to Pr. 02-12	0	R	U16	
	12	The status of digital output (ON / OFF), refer to Pr. 02-18	0	R	U16	
	13	Display the multi-step speed that is executing	0	R	U16	
	14	The corresponding CPU pin status of digital input	0	R	U16	
	15	The corresponding CPU pin status of digital output	0	R	U16	
	16	Number of actual motor revolution (PG1 of PG card). It will start from 9 when the actual operation direction is changed or keypad display at stop is 0. Max. is 65535	0	R	U16	
	17	Pulse input frequency (PG2 of PG card)	0	R	U16	
	18	Pulse input position (PG card PG2), maximum setting is 65535.	0	R	U16	
	1A	Display times of counter overload (0.00~100.00 %)	0	R	U16	
	1B	Display GFF in %	0	R	U16	
	1C	Display DC-BUS voltage ripples (Unit: VDC)	0	R	U16	

Index	Sub	Definition	Factory Setting	R/W	Size	Note
	1D	Display PLC register D1043 data	0	R	U16	
	1E					
	1F	User page displays the value in physical measure	0	R	U16	
	20	Output Value of Pr. 00-05	0	R	U16	
	21					
	22					
	23	Fan speed of the drive	0	R	U16	
	24	Control mode of the drive 0: speed mode 1: torque mode	0	R	U16	
	25	Carrier frequency of the drive	0	R	U16	
	26	Reserved				
	27	Status of the drive				
	28					
	29	Reserved				
	2A	KWH display				
	2B	PG2 pulse input in low word				
	2C	PG2 pulse input in high word				
	2D					
	2E					
	2F					
	30					
	31					

CANopen Remote IO mapping

Index	Sub	R/W	Definition
2026H	01h	R	Each bit corresponds to the different input terminals
	02h	R	Each bit corresponds to the different input terminals
	03h~40h	R	Reserved
	41h	RW	Each bit corresponds to the different output terminals
	42h~60h	R	Reserved
	61h	R	AVI (%)
	62h	R	ACI (%)
	63h	R	Reserved
	64h~A0h	R	Reserved
	A1h	RW	AFM1 (%)
	A2h	RW	AFM2 (%)

Index 2026-01	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Bit 9	Bit 10	Bit 11	Bit 12	Bit 13	Bit 14	Bit 15
1	FWD	REV	MI1	MI2	MI3	MI4	MI5	MI6	MI7	MI8						

1: Control broad I/O (Standard)

2: Add external card, EMM-D33A

Index 2026-41	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Bit 9	Bit 10	Bit 11	Bit 12	Bit 13	Bit 14	Bit 15
1	RY	Reserved	Reserved	MO1	MO2											

1: Control broad I/O (Standard)

Delta Standard Mode (New definition)

Index	sub	R/W	Size	Descriptions			Speed Mode
				bit	Definition	Priority	
2060h	00h	R	U8				
	01h	RW	U16	0	Ack	4	0: fcmd =0 1: fcmd = Fset (Fpid)
				1	Dir	4	0: FWD run command 1: REV run command
				2			
				3	Halt	3	0: Drive run till target speed is attained 1: Drive stop by declaration setting
				4	Hold	4	0: Drive run till target speed is attained 1: Frequency stop at current frequency
				5	JOG	4	0: JOG OFF Pulse 1: JOG RUN
				6	QStop	2	Quick Stop
				7	Power	1	0: Power OFF 1: Power ON
				8	Ext_Cmd2	4	0-> 1: Clear absolute position
				14~8			
				15	RST	4	Pulse 1: Fault code cleared
	02h	RW	U16		Mode Cmd		0: Speed mode
	03h	RW	U16				Speed command (unsigned decimal)
	04h	RW	U16				
	05h	RW	S32				
	06h	RW					
	07h	RW	S16				
	08h	RW	U16				
2061h	01h	R	U16	0	Arrive		Frequency attained
				1	Dir		0: Motor FWD run 1: Motor REV run
				2	Warn		Warning
				3	Error		Error detected
				4			
				5	JOG		JOG
				6	QStop		Quick stop
				7	Power On		Switch ON
				15~8			
	02h	R					
	03h	R	U16				Actual output frequency
	04h	R					
	05h	R	S32				
	06h	R					
	07h	R	S16				

DS402 Standard

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	Note
6007h	0	Abort connection option code	2	RW	S16		Yes		0: No action 2: Disable Voltage, 3: quick stop
603Fh	0	Error code	0	R0	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	R0	U16		Yes		
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	vl	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	vl	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	vl	
604Fh	0	vl ramp function time	10000	RW	U32	1ms	Yes	vl	Unit must be: 100ms, and check if the setting is set to 0.
6050h	0	vl slow down time	10000	RW	U32	1ms	Yes	vl	
6051h	0	vl quick stop time	1000	RW	U32	1ms	Yes	vl	
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
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
6060h	0	Mode of operation	2	RW	S8		Yes		2: Velocity Mode
6061h	0	Mode of operation display	2	RO	S8		Yes		Same as above

15-5 CANopen Fault Codes
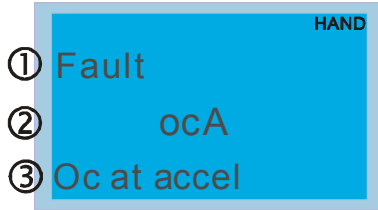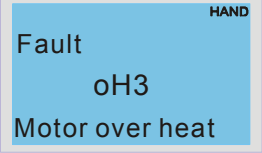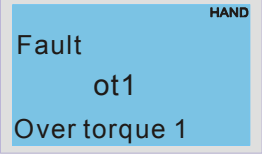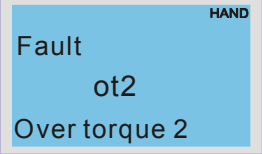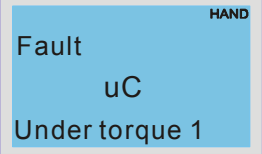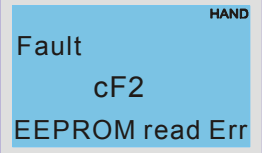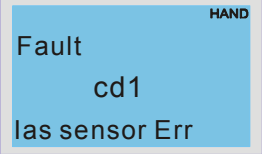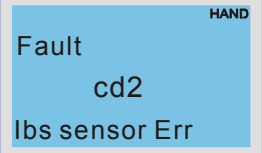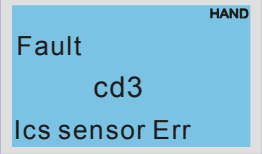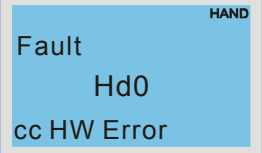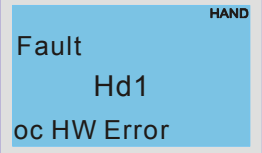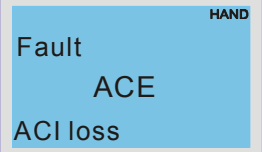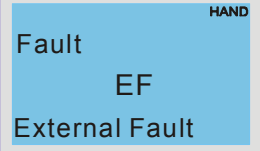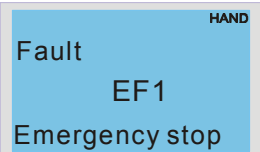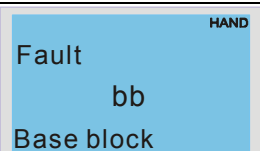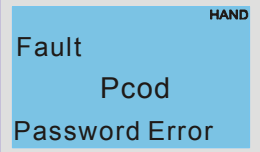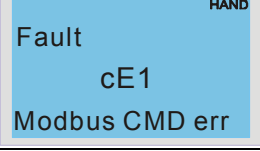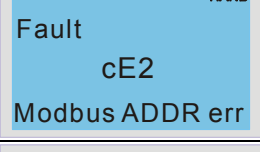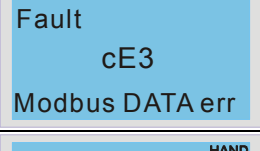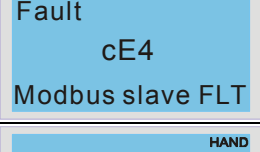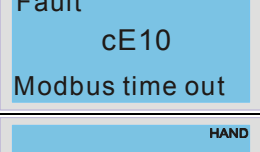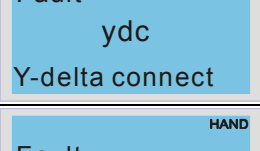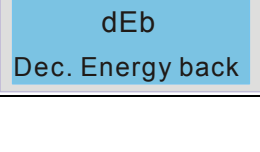
① Display error signal

② Abbreviate error code

　　The code is displayed as shown on KPMS-LE01

③ Display error description

* Refer to setting of Pr. 06-17~Pr. 06~22 and Pr. 14-70~Pr. 14-73

Setting *	Display	Fault code	Description	CANopen fault register (bit 0~7)	CANopen fault code
1	Fault　ocA　Oc at accel	0001H	Over-current during acceleration	1	2213H
2	Fault　ocd　Oc at decel	0002H	Over-current during deceleration	1	2213H
3	Fault　ocn　Oc at normal SPD	0003H	Over-current during steady status operation	1	2214H
4	Fault　GFF　Ground fault	0004H	Ground fault. When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AC motor drive rated current. NOTE: The short circuit protection is provided for AC motor drive protection, not for protection of the user.	1	2240H
6	Fault　ocS　Oc at stop	0006H	Over-current at stop. Hardware failure in current detection	1	2214H
7	ovA　Ov at accel	0007H	Over-current during acceleration. Hardware failure in current detection	2	3210H
8	Fault　ovd　Ov at decel	0008H	Over-current during deceleration. Hardware failure in current detection.	2	3210H
9	Fault　ovn　Ov at normal SPD	009H	Over-current during steady speed. Hardware failure in current detection.	2	3210H

| Setting *	Display	Fault code	Description	CANopen fault register (bit 0~7)	CANopen fault code
10	**Fault** HAND ovS Ov at stop	000AH	Over-voltage at stop. Hardware failure in current detection	2	3210H
11	**Fault** HAND LvA Lv at accel	000BH	DC BUS voltage is less than Pr.06.00 during acceleration.	2	3220H
12	**Fault** HAND Lvd Lv at decel	000CH	DC BUS voltage is less than Pr.06.00 during deceleration.	2	3220H
13	**Fault** HAND Lvn Lv at normal SPD	000DH	DC BUS voltage is less than Pr.06.00 in constant speed.	2	3220H
14	**Fault** HAND LvS Lv at stop	000EH	DC BUS voltage is less than Pr.06-00 at stop	2	3220H
15	**Fault** HAND OrP Phase Lacked	000FH	Phase Loss Protection	2	3130H
16	**Fault** HAND oH1 IGBT over heat	0010H	IGBT overheat IGBT temperature exceeds protection level.	3	4310H
18	**Fault** HAND tH1o Thermo 1 open	0012H	IGBT over-heat protection error	3	FF00H
21	**Fault** HAND oL Inverter oL	0015H	Overload. The AC motor drive detects excessive drive output current.	1	2310H
22	**Fault** HAND EoL1 Thermal relay 1	0016H	Electronics thermal relay 1 protection	1	2310H
23	**Fault** HAND EoL2 Thermal relay 2	0017H	Electronics thermal relay 2 protection	1	2310H

Setting *	Display	Fault code	Description	CANopen fault register (bit 0~7)	CANopen fault code
24	Fault HAND oH3 Motor over heat	0018H	Motor PTC overheat	3	FF20H
26	Fault HAND ot1 Over torque 1	001AH	When the output current exceeds the over-torque detection level (Pr. 06-07 or Pr. 06-10) and also exceeds Pr. 06-08 or Pr. 06-11, when Pr. 06-06 or Pr. 06-09 is set as 1 or 3, it will display warning without abnormal record; when Pr. 06-06 or 06-09 is set as 2 or 4, it will display error, stop running and there will be an abnormal record.	3	8311H
27	Fault HAND ot2 Over torque 2	001BH		3	8311H
28	Fault HAND uC Under torque 1	001CH	Low current	1	8321H
31	Fault HAND cF2 EEPROM read Err	001FH	Internal EEPROM cannot be programmed.	5	5530H
33	Fault HAND cd1 Ias sensor Err	0021H	U-phase error	1	FF04H
34	Fault HAND cd2 Ibs sensor Err	0022H	V-phase error	1	FF05H
35	Fault HAND cd3 Ics sensor Err	0023H	W-phase error	1	FF06H
36	Fault HAND Hd0 cc HW Error	0024H	cc (current clamp) hardware error	5	FF07H
37	Fault HAND Hd1 oc HW Error	0025H	oc hardware error	5	FF08H
48	Fault HAND ACE ACI loss	0030H	ACI loss	1	FF25H

Setting *	Display	Fault code	Description	CANopen fault register (bit 0~7)	CANopen fault code
49	HAND Fault EF External Fault	0031H	External Fault. When the multi-function input terminal (EF) is active, the AC motor drive will stop output.	5	9000H
50	HAND Fault EF1 Emergency stop	0032H	Emergency stop. When the multi-function input terminal (EF1) is active, the AC motor drive will stop output.	5	9000H
51	HAND Fault bb Base block	0033H	External Base Block. When the multi-function input terminal (B.B) is active, the AC motor drive will stop output.	5	9000H
52	HAND Fault Pcod Password Error	0034H	Keypad is locked after enter wrong password three times.	5	FF26H
54	HAND Fault cE1 Modbus CMD err	0036H	Modbus function code error (Illegal function code)	4	7500H
55	HAND Fault cE2 Modbus ADDR err	0037H	Modbus data address is error [Illegal data address (00 H to 254 H)]	4	7500H
56	HAND Fault cE3 Modbus DATA err	0038H	Modbus data error (Illegal data value)	4	7500H
57	HAND Fault cE4 Modbus slave FLT	0039H	Modbus communication error (Data is written to read-only address)	4	7500H
58	HAND Fault cE10 Modbus time out	003AH	Modbus transmission time-out	4	7500H
61	HAND Fault ydc Y-delta connect	003DH	Y-connection / Δ-connection switch error	2	3330H
62	HAND Fault dEb Dec. Energy back	003EH	Energy regeneration when decelerating	2	FF27H

Setting *	Display	Fault code	Description	CANopen fault register (bit 0~7)	CANopen fault code
72	**Fault** STL1 STO Loss 1 HAND	0048H	S1~DCM internal hardware detect error	5	FF30H
76	**Fault** STo STO HAND	004CH	Safety torque off function active	5	FF31H
77	**Fault** STL2 STO Loss 2 HAND	004DH	S2~DCM internal hardware detect error.	5	FF32H
78	**Fault** STL3 STO Loss 3 HAND	004EH	S1~DCM & S2~DCM internal hardware detect error.	5	FF33H
79	**Fault** Aoc U phase oc HAND	0050H	U-phase short circuit	1	FF2BH
80	**Fault** boc V phase oc HAND	0051H	V-phase short circuit	1	FF2CH
81	**Fault** coc W phase oc HAND	0050H	W-phase short circuit	1	FF2DH
82	**Fault** oPL1 U phase lacked HAND	0052H	Output phase loss 1 (Phase U)	2	2331H
83	**Fault** oPL2 V phase lacked HAND	0053H	Output phase loss 2 (Phase V)	2	2332H
84	**Fault** oPL3 W phase lacked HAND	0054H	Output phase loss 3 (Phase W)	2	2333H
87	**Fault** oL3 Derating Error HAND	0057H	Over load protection at low frequency	0	8A00H
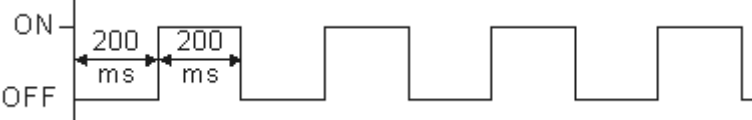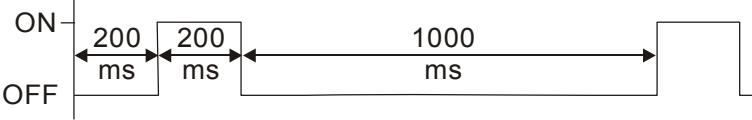
Setting *	Display	Fault code	Description	CANopen fault register (bit 0~7)	CANopen fault code
101	**HAND** Fault CGdE Guarding T-out	0065H	CANopen guarding error	4	8130H
102	**HAND** Fault CHbE Heartbeat T-out	0066H	CANopen heartbeat error	4	8130H
104	**HAND** Fault CbFE CAN/S bus off	0068H	CANopen bus off error	4	8140H
105	**HAND** Fault CIdE CAN/S Idx exceed	0069H	CANopen index error	4	8100H
106	**HAND** Fault CAdE CAN/S add. set	006AH	CANopen station address error	4	8100H
107	**HAND** Fault **CFrE** CAN/S FRAM fail	006BH	CANopen memory error	4	8100H
121	**HAND** Fault **CP20** CP 20	007AH	Internal communication error	7	FF36H
123	**HAND** Fault **CP22** CP 22	007CH	Internal communication error	7	FF38H
124	**HAND** Fault **CP30** CP 30	007DH	Internal communication error	7	FF39H
126	**HAND** Fault **CP32** CP 32	0080H	Internal communication error	7	FF3BH
127	**HAND** Fault **CP33** CP 33	0081H	Software version error	7	FF3CH

Setting *	Display	Fault code	Description	CANopen fault register (bit 0~7)	CANopen fault code
128	HAND Fault **ot3** Over torque 3	0082H	Over torque fault 3	1	2310H
129	HAND Fault **ot4** Over torque 4	0083H	Over torque fault 4	1	2310H
134	HAND Fault **EoL3** Thermal relay 3	0088H	Electronics thermal relay 3 protection	1	2310H
135	HAND Fault **EoL4** Thermal relay 4	0089H	Electronics thermal relay 4 protection	1	2310H
140	HAND Fault **Hd6** GFF HW error	008EH	GFF detected when power on	1	2240H
141	HAND Fault **BGFF** BeforeRUN GFF	0090H	GFF occurs before run	1	2240H
145	HAND Fault **MErr** Model Error	0094H	Model identification error	1	FF40H

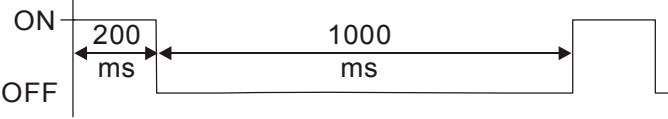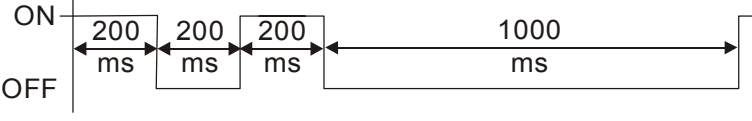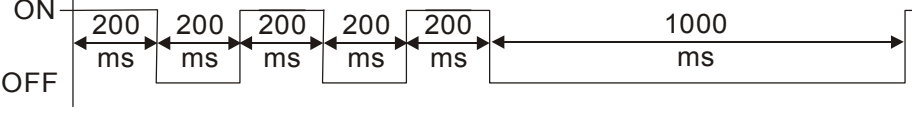## 15-6 CANopen LED Function

There are two CANopen flash signs: RUN and ERR.

Green light RUN:

LED status	Condition	CANopen State
OFF	Keep lighting off	Initial
Blinking		Pre-Operation
Single flash		Stopped
ON	Keep lighting on	Operation

Red light ERR:

LED status	Condition / State
OFF	No Error
Single flash	One Message fail
Double flash	Guarding fail or heartbeat fail
Triple flash	SYNC fail
ON	Bus off