

PROTOCOL MANUAL OF MH SERIES-CANOPEN

TEC-MH series CANopen displacement sensors conform to DS301 (CANopen Application Layer and Communication Profile), DS305 (LSS Layer Setting Services and Protocol) and DS406 (Device Profile for Encoders). This manual mainly introduces the CANopen standard protocol content of displacement sensors.

一. Network Management Tool

Network Management(NMT) is responsible for starting the network and monitoring device. According to DS301 (CANopen Application Layer and Communication Profile), the NMT state transition process is as follows:

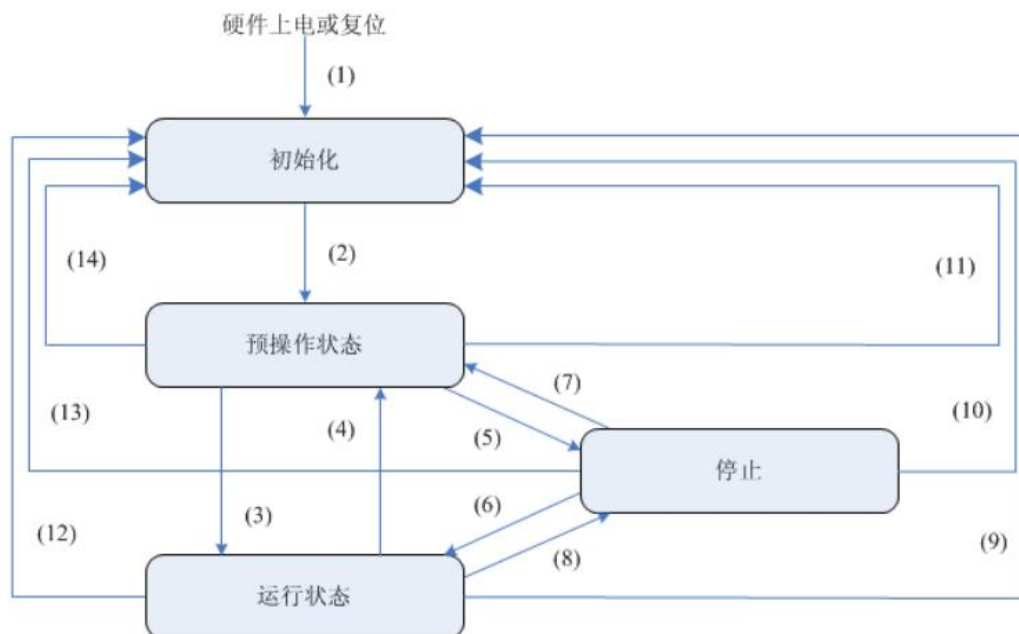


Figure 1.1 NMT State Diagram

Table 1.1 Trigger for State Transition

Transition of state	Required triggering action
(1)	At Power on the initialisation state is entered autonomously
(2)	Initialisation finished - enter Pre-Operational automatically
(3), (6)	Start Remote Node indication
(4), (7)	Enter Pre-Operational State indication
(5), (8)	Stop Remote Node indication
(8), (10), (11)	Reset Node indication
(12), (13), (14)	Reset Communication indication

1. NMT control instruction

In CAN network, TEC-CANopen displacement sensor has the function of NMT slave. An NMT Master can start, monitor and restart all NMT slaves in the network by NMT control instructions.

The NMT control instruction contains two data bytes, the first byte determines the instruction content

and the second byte determines the instruction object (NodeID=1 ~ 127). If the second byte is 0, it means that the Master sends instructions to all Slaves in the network by broadcasting.

(1) Start Remote Node indication: the NMT Master controls the selected Slaves to Operational state;

Table 1.2 Start Remote Node indication

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x01	00	-	-	-	-	-	-
RX	0x000	2	0x01	NId	-	-	-	-	-	-

(2) Enter Pre-Operational State indication: the NMT Master controls the selected Slaves to Pre-Operational state;

Table 1.3 Enter Pre-Operational State indication

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x80	00	-	-	-	-	-	-
RX	0x000	2	0x80	NId	-	-	-	-	-	-

(3) Stop Remote Node indication: the NMT Master controls the selected Slaves to Stopped state;

Table 1.4 Stop Remote Node indication

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x02	00	-	-	-	-	-	-
RX	0x000	2	0x02	NId	-	-	-	-	-	-

(4) Reset Node indication: The NMT Master controls the selected Slaves from any state to the reset application sub-state. The parameters related to the manufacturer in the object dictionary and the parameters of the device sub-protocol are restored to the default values. After the above operation is completed, it automatically triggers to the reset communication sub-state.

Table 1.5 Reset Node indication

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x81	00	-	-	-	-	-	-
RX	0x000	2	0x81	NId	-	-	-	-	-	-

(5) Reset Communication indication: The NMT Master controls the selected Slaves from any state to the reset communication sub-state, in which the parameters related to communication sub-protocol in the object dictionary will be restored to the default values.

Table 1.6 Reset Communication indication

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x82	00	-	-	-	-	-	-
RX	0x000	2	0x82	NId	-	-	-	-	-	-

2. NMT state

2.1 Initialisation

When the sensor is powered on and started, or the sensor receives the NMT reset command, or the sensor is reset internally, it will automatically enter the NMT initialisation state. The sensor loads all the parameters of the nonvolatile memory cell into the internal microcontroller and performs module initialisation configuration, at which time the sensor cannot communicate. After the sensor completes NMT initialisation, it will automatically enter NMT Pre-Operational state. In the process of switching between the two states, the sensor will automatically send Boot-up message, and the Boot-up message format is as follows:

Table 1.7 Boot-up Message

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x700+NId	1	00	-	-	-	-	-	-	-

Note: The Boot-up Message COB-ID is the same as the Heartbeat Message COB-ID. The Boot-up message COB-ID can be set to other formats and needs to be changed through the Object Dictionary 0x100E.

2.2 Pre-Operational state

In the Pre-Operational state, we can communicate with sensors through Service Data Objects(SDO), configure PDO and device related parameters, such as emergency message, heartbeat message and so on. PDO communication is not allowed in the state. After the NMT Master sends Start_Remote_Node indication, the selected Slaves switches to the Operational state.

2.3 Operational state

The Operational state is the normal working state of the sensor, and all CANopen communication services are supported in this state. All PDO can be used to send and receive communication after being created. The object dictionary can be accessed through SDO.

2.4 Stopped state

The NMT Master can force the device into Stopped state where all CANopen communication services except network management and heartbeat services are disabled.

二. Emergency Message

When an error occurs in the operation of a device, an emergency message will be triggered to inform other devices in the network of their error state. An error event triggers the sending of an emergency message. After the error is eliminated, the device sends an emergency message with an error code of 0x0000. At this time, it can be further judged whether there are still other errors unresolved

through the error register (0x1001).

A hardware error occurs during the operation of the CANopen sensor with error code 0x5000 and error register 0x81, indicating that the sensor cannot detect the magnetic ring within the measurement range. The format of emergency message when error occurs and recovers is as follows:

Table 2.1 Emergency Object Message

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x80+NId	8	Emergency error code		Error register (0x1001)	Manufacturer-defined error code				
TX	0x80+NId	8	0x00	0x50	0x81	0x00	0x00	0x00	0x00	0x00
TX	0x80+NId	8	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Note: The emergency message COB-ID can be set to other formats and needs to be changed through the object dictionary 0x1014.

三. Error Control

In the CANopen specification, error control is used to detect whether a device in the network is online and the state of the device. When error control is enabled, the sensor sends heartbeat message periodically, the first byte of which indicates the current NMT state of the sensor, and other devices in the network can receive heartbeat message to monitor each other. The configuration of heartbeat message can be changed by SDO access object dictionary, and the default heartbeat interval of sensor is 0ms, that is, heartbeat is turned off.

Table 3.1 Heartbeat message

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x700+NId	1	State	-	-	-	-	-	-	-

Note:

1. State: 0x00-Bootup, 0x04-Stopped, 0x05- Operational, 0x7f-Pre-Operational;
2. Heartbeat message COB-ID can be set to other formats, which need to be changed through object dictionary 0x100E.

四. LSS Layer Setting Services

In the same CANopen network, each device has the same transmission rate and is assigned a unique node ID. The Layer Setting Service LSS, described in the DS305 specification, can be used to set the transmission Baud Rate and Node ID of a device. The sensor needs to enter the LSS configuration state, and there are two ways to realize it.

Method 1: Switch the selected mode. The Master input LSS address to switch the selected sensor to LSS configuration state. The LSS address consists of four transmission parameters, namely Vendor ID, Product Code, Revision Number and Serial Number. When all parameters are consistent, the sensor

will respond positively. The specific operation process is as follows:

Table 4.1 Switching Selected Mode Operation Procedures

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x7E5	8	0x40	0xFE	0x0F	0x00	0x00	0x00	0x00	0x00
RX	0x7E5	8	0x41	0x31	0x30	0x43	0x00	0x00	0x00	0x00
RX	0x7E5	8	0x42	0x01	0x00	0x01	0x00	0x00	0x00	0x00
RX	0x7E5	8	0x43	0x51	0x45	0x48	0x50	0x00	0x00	0x00
TX	0x7E4	8	0x44	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Note: Vendor ID-0x0FFE, Product Code-0x00433031, Revision Number-0x00010001, Serial Number-0x50484551.

Method 2: Switch global mode. The Master sends only one command to switch all Slaves in the network to the LSS configuration state.

Table 4.2 Switching Global Mode Operation Procedures

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x7E5	8	0x04	0x01	0x00	0x00	0x00	0x00	0x00	0x00

When the sensor switches to the LSS configuration state, the Baud Rate and Node ID can be configured. The specific steps are as follows:

Table 4.3 Configure Node ID Instructions

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x7E5	8	0x11	Nid	0x00	0x00	0x00	0x00	0x00	0x00
TX	0x7E4	8	0x11	Error code	0x00	0x00	0x00	0x00	0x00	0x00

Note:

- 1.Nid: New Node ID, ranging from 1 to 127;
2. Error code: 0x00-Configure Node ID instruction modified successfully, 0x01-New Node ID out of range.
3. The new Node ID is activated immediately after the sensor issues the configuration success response command. In addition, the COB-IDs associated with the Node ID are also updated, such as emergency message, heartbeat message, PDO (Tx) and so on.

Table 4.4 Baud Rate-Configuration Bit Timing Parameter Instruction

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x7E5	8	0x13	0x00	Bit timing index	0x00	0x00	0x00	0x00	0x00
TX	0x7E4	8	0x13	Error code	0x00	0x00	0x00	0x00	0x00	0x00
RX	0x7E5	8	0x15	Bit timing delay execution time			0x00	0x00	0x00	0x00

Note:

1.

Table 4.5 Bit Timing Index and Baud Rate Correspondence Table

Index	0	1	2	3	4	5	6	7
Baud Rate (Kbit/s)	1000	800	500	250	125	100	50	20

2. Error code: 0x00-Configure Baud Rate instruction modified successfully, 0x01-This bit timing index is not supported;

3. There are two methods to activate the new Baud Rate. One is to send the activation bit timing parameter instruction, and the new Baud Rate can be executed after a short delay. The other is to send LSS configuration data storage instructions, which transmit data at the new Baud Rate when the sensor is powered up again.

Table 4.6 Activate Bit Timing Parameter Instruction

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x7E5	8	0x15	Bit timing delay execution time		0x00	0x00	0x00	0x00	0x00

Note:

1. Send an instruction to activate the bit timing parameter, and activate the new Baud Rate after the bit timing delay execution time;

2. The actual delay time is (bit timing delay time parameter * 2) in ms, during which there is no communication.

Table 4.7 LSS Configuration Data Store Instructions

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x7E5	8	0x17	0x00	0x00	0x00	0x00	0x00	0x00	0x00
TX	0x7E4	8	0x17	Error code	0x00	0x00	0x00	0x00	0x00	0x00

Note:

1. After sending the LSS configuration data storage instruction, the new Node ID and Baud Rate will be stored in the sensor nonvolatile storage unit;

2. Error code: 0x00-LSS configuration data store succeeded.

In addition to changing Baud Rate and node ID, the sensor also supports LSS query service and identification service functions, please refer to DS305 Layer Setting Services and Protocol for details.

五. SDO Service Data Objects

CANopen sensor data is all managed by object dictionaries, such as communication parameters, device parameters, manufacturer-specific defined parameters, and so on. Entries in the object dictionary need to be accessed through SDO. Usually, reading the object dictionary is called uploading, and writing the object dictionary is called downloading. The specific operation instructions are as follows:

Table 5.1 SDO Upload Operation Instructions

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x600+NId	8	0x40	Index		Sub-index	0x00	0x00	0x00	0x00
TX	0x580+NId	8	0x4x	Index		Sub-index	Data LSB	Data	Data	Data MSB

Note: X value of 0x4x in a message depends on the object data size, 0x4F-one byte, 0x4B-two bytes, and 0x43-four bytes.

Table 5.2 SDO Download Operation Instructions

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x600+NId	8	0x2x	Index		Sub-index	Data LSB	Data	Data	Data MSB
TX	0x580+NId	8	0x60	Index		Sub-index	0x00	0x00	0x00	0x00

Note: X value of 0x2x in a message depends on the object data size, 0x2F-one byte, 0x2B-two bytes, and 0x23-four bytes.

In the process of uploading or downloading SDO, the sensor may not send the correct response instruction for some reason, but send the SDO failure response message.

Table 5.3 SDO Failure Response Message

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x580 + NId	8	0x80	Object dictionary index			Sub-index	Abort code		

Note: Abort code:

0x06010001-Index object is write-only

0x06010002-Index object is read-only

0x06020000-Index object does not exist

0x06090011-Sub-index object does not exist

0x06090030-Value overrun

0x08000000-General error

0x08000020-Data transmission error

0x08000022-In error state

六. PDO Process Data Objects

The process data object is composed of a CAN message, and the priority of the process data object is determined by the CAN COB-ID. There are three communication types of process data objects: synchronous mode, asynchronous mode and remote request mode. Users can switch different modes by accessing 0x1800 sub-index 0x02 of the object according to needs.

6.1 Synchronous mode

Synchronous mode is enabled when the CANopen sensor is in the NMT Operational state and the object 0x1800 sub-index 0x02 transport type value is in the range of 1 to 240. After receiving n ($n=1 \sim 240$) synchronous messages, the sensor sends PDO data once. The synchronous message format is as follows:

Table 6.1 Synchronous Messages

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x80	0	-	-	-	-	-	-	-	-

Note: Synchronous message COB-IDs can be set to other formats and need to be changed through the Object Dictionary 0x1005.

6.2 Asynchronous mode

Asynchronous mode is enabled when the CANopen sensor is in the NMT Operational state and the object 0x1800 sub-index 0x02 transport type value is 254 or 255. When the event timer overflows, the sensor triggers a PDO to be sent. Object 0x1800 Sub-index 0x05 and Object 0x6200 are both overflow values of the event timer (in ms) and have the same function.

6.3 Remote request mode

PDO can also be queried through remote request mode, which is independent of the object 0x1800 sub-index 0x02 transport type value. The CANopen sensor sends a PDO after receiving the remote request message. The format of remote request message is as follows:

Table 6.2 Remote Request Message

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x180+NId+ Remote frame flag bit	0	-	-	-	-	-	-	-	-

6.4 PDO message format

The message mapping of CANopen sensor PDO can be obtained by accessing object 0x1A00. The position resolution and speed resolution in PDO message content can be obtained by visiting object 0x6005. PDO message formats are as follows:

Table 6.3 PDO Message

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x180+NId	6	Position LSB	Position	Position	Position MSB	Speed LSB	Speed MSB	-	-

Note: PDO message COB-IDs can be set to other formats and need to be changed through object dictionary 0x1800 sub-index 0x01.

七. Object Dictionary

Table 7.1 CANopen Sensor Object Dictionary List (Hexadecimal)

Index	Sub-index	Name	Data type	Access properties	Default value	Content
Communication protocol part						
1000	0	Device type	U32	ro	0x00080196	Device Subprotocol: DS406 Device Profile for Encoders
1001	0	Error register	U8	ro	0	0x00: No Error 0x81: Sensor No Magnetic Ring
1005	0	COB-ID SYNC message	U32	rw	0x80	Synchronous message COB-ID
1008	0	Device name	String	const	C100	Device name
1009	0	Hardware version	String	const	xxxx	Hardware version
100A	0	Software version	String	const	xxxx	Software version
100B	0	Node ID	U32	ro	0x7F	Node ID can be changed by LSS
100E	0	COB-ID Error control	U32	rw	0x700 + NId	Error control COB-ID (Cannot be changed)
1010	0	Store parameters	U8	ro	1	Number of sub-indexes
	1		U32	rw	0x73617665	Store the parameter "SAVE" and store the whole object dictionary parameters
1011	0	Restore default parameters	U8	ro	1	Number of sub-indexes
	1		U32	rw	0x6C6F6164	Store the parameter "LOAD" and restore the whole object dictionary parameter
1014	0	COB-ID	U32	rw	0x80+NId	Emergency

		Emergency				message COB-ID
1017	0	Producer Heartbeat time	U16	rw	0	Time unit ms
1018	0	Identity Object	U8	ro	4	Number of sub-indexes
	1		U32	ro	0x0FFE	Vendor ID
	2		U32	ro	0x00433031	Product code
	3		U32	ro	xxxx	Revision number
	4		U32	ro	xxxx	Serial number
1200	0	The first Service SDO parameter	U8	ro	2	Number of sub-indexes
	1		U32	ro	0x600 + NId	Master » Slave COB-ID
	2		U32	ro	0x580 + NId	Slave » Master COB-ID
1800	0	The first transmit PDO parameter	U8	ro	5	Number of sub-indexes
	1		U32	rw	0x180 + NId	PDO1 COB-ID
	2		U8	rw	254	1: Send synchronously 254: Send Asynchronously
	5		U16	rw	10	Event timing time unit ms
1A00	0	The first transmit PDO mapping	U8	ro	2	Number of sub-indexes
	1		U32	const	0x60200120	Mapping parameter 1
	2		U32	const	0x60300110	Mapping parameter 2
DS406 Device Profile for Encoders Protocol Part						
6005	0	Linear encoder measuring step setting	U8	ro	2	Number of sub-indexes
	1		U32	ro	100000	Unit of position measurement 0.001 um
	2		U32	ro	100	0.01mm/s Speed measurement unit 0.01 mm/s
6010	0	Preset value	U8	rw	1	Number of sub-indexes

	1		I32	rw	xxxx	PDO1 Preset value
6020	0	Position value	U8	ro	1	Number of sub-indexes
	1		I32	ro	No	PDO1 Position value
6030	0	Speed value	U8	ro	1	Number of sub-indexes
	1		I16	ro	No	PDO1 Speed value
6200	0	Cyclic timer	U16	rw	10	Event timing time unit ms
6501	0	Measuring step	U32	ro	100000	Unit of position measurement 0.001 um

0x1000-Device type

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1000	0	Type of device	Unsigned 32-bit	Read-only	0x00080196	0x00080196

0x1001-Error register

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1001	0	Error register	Unsigned 8-bit	Read-only	0	0

0x1005-COB-ID SYNC message

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1005	0	COB-ID SYNC message	Unsigned 32-bit	Read and write	0 ~ 0x7FF	0x80

Note: Sync message COB-ID is used to transmit PDO in synchronous mode. CANopen sensor defines it as 0x80. Please do not modify it.

0x1008-Device name

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1008	0	Device name	String	Constant	"C100"	"C100"

0x1009-Hardware version

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1009	0	Hardware version	String	Constant	“xxxx”	“xxxx”

0x100A-Software version

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x100A	0	Software version	String	Constant	“xxxx”	“xxxx”

0x100B- Node ID

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x100B	0	Node ID	Unsigned 32-bit	Read-only	0x01 ~ 0x7F	0x7F

0x100E- COB-ID Error control

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x100E	0	COB-ID Error control	Unsigned 32-bit	Read and write	0~0x7FF	0x700+NId

Note: The COB-ID defined by this object is also applied to heartbeat and Boot-up messages.

0x1010-Store parameters

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1010	0	Store parameters	Unsigned 8-bit	Read-only	1	1
	1		Unsigned 32-bit	Read and write	0x73617665	0x73617665

Table 7.2 Store all parameter instructions

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x600+NId	8	0x23	0x10	0x10	0x01	0x73	0x61	0x76	0x65
TX	0x580+NId	8	0x60	0x10	0x10	0x01	0x00	0x00	0x00	0x00

Note: Send the store all parameters instruction through SDO download, and all changed communication parameters and protocol parameters will be stored in the nonvolatile unit of the sensor.

0x1011-Restore default parameters

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
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0x1011	0	Restore default parameters	Unsigned 8-bit	Read-only	1	1
	1		Unsigned 32-bit	Read and write	0x6C6F6164	0x6C6F6164

Table 7.3 Restore Default Parameter Directive

Rx/Tx	COB-ID	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x600+NId	8	0x23	0x11	0x10	0x01	0x6C	0x6F	0x61	0x64
TX	0x580+NId	8	0x60	0x11	0x10	0x01	0x00	0x00	0x00	0x00

Note: Send the command of restoring default parameters through SDO download, and all changed communication parameters and protocol parameters will be restored to the values stored in the nonvolatile unit of the sensor, and the restored values will be valid after the sensor is reset.

0x1014- COB-ID Emergency

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1014	0	COB-ID Emergency	Unsigned 32-bit	Read and write	0 ~ 0x7FF	0x80 + NId

0x1017- Producer Heartbeat time

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1017	0	Producer Heartbeat time	Unsigned 16-bit	Read and write	0~0xFFFF	0

Note: This object defines the time interval of producer heartbeat messages, in ms, and the default value of 0 means that the heartbeat function is turned off.

0x1018-Identity Object

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1018	0	Number of sub-indexes	Unsigned 8-bit	Read-only	4	4
	1	Vendor ID	Unsigned 32-bit	Read-only	0x0FFE	0x0FFE
	2	Product code	Unsigned 32-bit	Read-only	0x00433031	0x00433031
	3	Revision number	Unsigned 32-bit	Read-only	xxxx	xxxx
	4	Serial number	Unsigned 32-bit	Read-only	xxxx	xxxx

Note: The identity object content includes the basic information of the CANopen sensor, which is also used as the LSS address where the LSS switches to the LSS configuration state by the selected mode.

0x1200- The first Service SDO parameter

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
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0x1200	0	Number of sub-indexes	Unsigned 8-bit	Read-only	2	2
	1	Master » Slave COB-ID	Unsigned 32-bit	Read-only	0x600 + NId	0x600+NId
	2	Slave » Master COB-ID	Unsigned 32-bit	Read-only	0x580 + NId	0x580 + NId

0x1800-The first transmit PDO parameter

Index	Sub-index	Name	Data type	Access properties	Range/vale	Default value
0x1800	0	Number of sub-indexes	Unsigned 8-bit	Read-only	5	5
	1	PDO1 COB-ID	Unsigned 32-bit	Read and write	0x180 + NId	0x180 + NId
	2	Transmission type	Unsigned 8-bit	Read and write	0 ~ 0xFF	254
	5	Event timer	Unsigned 16-bit	Read and write	0 ~ 0xFFFF	10

Note:

- Sub-index 0x01 contains valid bits, remote frame bits, and standard/extended COB-ID distinguishing bits in addition to the CAN COB-ID, as shown in the following table:

Table 7.4 0x1800 Sub-index 0x01 Parameter Structure

31(MSB)	30	29	28~11	10~0(LSB)
PDO effective bit	Remote frame bit	Standard/extended discrimination	Extended 18-bit COB-ID	Standard 11-bit COB-ID

- Sub-index 0x02 defines the transport type of PDO, as shown in the following table:

Table 7.5 PDO Transport Types

Value	Transmission type
0	Remote request mode
1~240	Synchronous mode, remote request mode
241~251	Illegal
252, 253	Remote request mode
254, 255	Asynchronous mode, remote request mode

- Sub-index 0x05 defines an event timer (in ms)) for asynchronous transfer mode event timing. When the timer overflows, it triggers a PDO send, and then the timer restarts, so that PDO can be sent periodically. When the event timer value is 0, PDO asynchronous transmission is turned off.

0x1A00- The first transmit PDO mapping

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
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0x1A00	0	Number of sub-indexes	Unsigned 8-bit	Read-only	2	2
	1	Mapping parameter 1	Unsigned 32-bit	Constant	0x60200120	0x60200120
	2	Mapping parameter 2	Unsigned 32-bit	Constant	0x60300110	0x60300110

0x6005- Linear encoder measuring step setting

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x6005	0	Number of sub-indexes	Unsigned 8-bit	Read-only	2	2
	1	Position resolution	Unsigned 32-bit	Read-only	100000	100000
	2	Speed resolution	Unsigned 32-bit	Read-only	100	100

Note: The DS406 protocol stipulates that the position measurement unit is 0.001 μ m and the speed measurement unit is 0.01 mm/s. Therefore, the position resolution of CANopen sensor is 100 μ m and the speed resolution is 1 mm/s.

0x6010-Preset value

Index	Sub-index	Name	Data type	Access properties	Range/ value	Default value
0x6010	0	Number of sub-indexes	Unsigned 8-bit	Read and write	1	1
	1	PDO1 Preset Value	Signed 32-bit	Read and write	xxxx	xxxx

Note: CANopen sensor has preset function. Users can change the current magnetic ring output value to any preset value according to actual needs, and the preset value will take effect at the next reset. The user-set preset value is not stored in the nonvolatile cell, but instead stores the calculated deviation value, which can be obtained by accessing the object 0x2900.

0x6020-Position value

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x6020	0	Number of sub-indexes	Unsigned 8-bit	Read-only	1	1
	1	PDO1 position value	Signed 32-bit	Read-only	xxxx	xxxx

Note: This object contains the magnetic ring position value of the CANopen sensor and maps to the PDO.

0x6030- Speed value

Index	Sub-index	Name	Data type	Access	Range/value	Default
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				properties		value
0x6030	0	Number of sub-indexes	Unsigned 8-bit	Read-only	1	1
	1	PDO1 Speed Value	Signed 16-bit	Read-only	xxxx	xxxx

Note: This object contains the speed value of the CANopen sensor and maps to the PDO. Speed values are positive and negative, positive in the direction away from the electron bin and negative in the direction close to the electron bin.

0x6200-Cyclic timer

Index	Sub-index	Name	Data type	Access properties	Range/ value	Default value
0x6200	0	Cyclic timer	Unsigned 16-bit	Read and write	0~0xFFFF	10

Note: This object functionally equates to the object 0x1800 sub-index 0x05. This object defines an event timer (in ms) for asynchronous transfer mode event timing. When the timer overflows, it triggers a PDO send, and then the timer restarts, so that PDO can be sent periodically. When the event timer value is 0, PDO asynchronous transmission is turned off.

0x6501-Measuring step

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x6501	0	Measuring step	Unsigned 32-bit	Read-only	100000	100000

Note: This object functionally equates to the object 0x6005 sub-index 0x01. DS406 protocol stipulates that the position measurement unit is 0.001 um, so the position resolution of CANopen sensor is 100um.