

PROTOCOL MANUAL OF R SERIES-CANOPEN

TEC-R series CANopen displacement sensors conform to DS301 (CANopen communication protocol), DS305 (LSS layer setting service protocol) and DS406 (encoder protocol). This manual mainly introduces the CANopen standard protocol content of displacement sensors.

一. Network Management Tool

Network Management Tool (NMT) is responsible for starting the network and monitoring device. According to DS301 (CANopen communication protocol), the NMT state transition process is as follows:

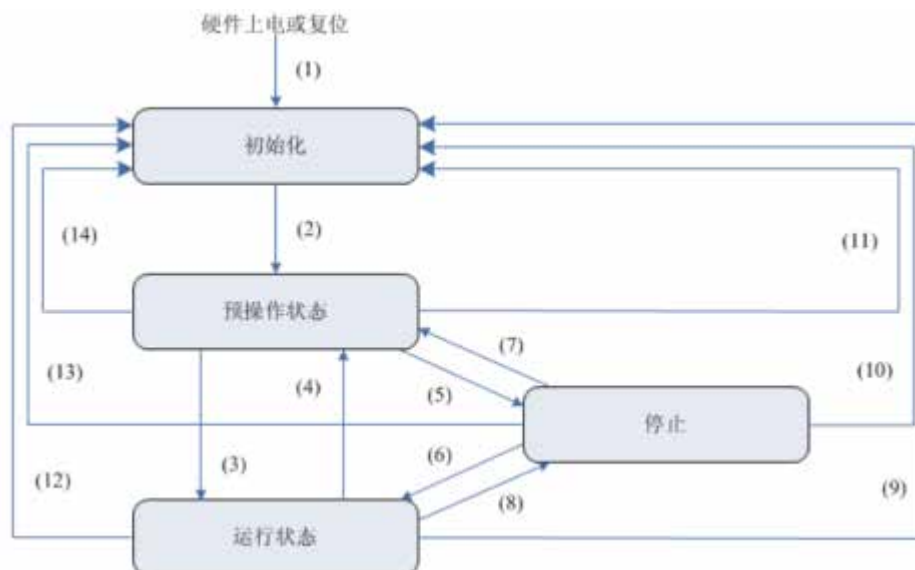


Figure 1.1 NMT State Diagram

Table 1.1 Transition of NMT State

Transition of state	Required triggering action
(1)	Automatic initialization of device after power-on
(2)	Automatically change after initialization is completed
(3), (6)	NMT Host Start Remote Node Instruction
(4), (7)	Instruction for NMT Host to Enter Pre-Operation State
(5), (8)	NMT Host Enters Stop State Command
(9), (10), (11)	NMT Host Reset Remote Node Command
(12), (13), (14)	NMT Host Reset Remote Node Communication Parameter Command

1.NMT control instruction

In CAN network, TEC-CANopen displacement sensor has the function of NMT slave. An NMT host can start, monitor and restart all NMT slaves in the network through 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 host sends instructions to all slaves in the network by broadcasting.

(1) Start the remote node instruction: the NMT host controls the selected slave to enter the working operation state;

Table 1.2 Start Remote Node Instructions

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x01	00	-	-	-	-	-	-
RX	0x000	2	0x01	NId	-	-	-	-	-	-

(2) Instruction of entering the pre-operation state: NMT host controls the selected slave to enter the pre-operation state;

Table 1.3 Instructions for entering pre-operation state

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x80	00	-	-	-	-	-	-
RX	0x000	2	0x80	NId	-	-	-	-	-	-

(3) Stop remote node instruction: NMT host controls the selected slave to enter a stop state;

Table 1.4 Stop remote node instruction

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x20	00	-	-	-	-	-	-
RX	0x000	2	0x20	NId	-	-	-	-	-	-

(4) Reset Remote Node Command: The NMT host controls the selected slave to enter the reset application sub-state from any 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 enter the reset communication sub-state.

Table 1.5 Reset Remote Node Instruction

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x81	00	-	-	-	-	-	-
RX	0x000	2	0x81	NId	-	-	-	-	-	-

(5) Reset remote node communication parameter instruction: NMT host controls selected slave to enter reset communication sub-state from any state, in which the parameters related to communication sub-protocol in object dictionary will be restored to default values.

Table 1.6 Reset Remote Node Communication Parameter Instruction

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x000	2	0x82	00	-	-	-	-	-	-
RX	0x000	2	0x82	NId	-	-	-	-	-	-

2. NMT status

2.1 Initialization

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

Table 1.7 Initiation Message

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x80+NId	0	-	-	-	-	-	-	-	-

2.2 Pre-operation status

In the pre-operation state, we can communicate with sensors through SDO server, 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 host sends an instruction to start the remote node, the selected slave switches to the running state.

2.3 Running status

The running 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 Stop state

The NMT host can force the device into a stop state where all CANopen communication services except network management and heartbeat services are disabled. CANopen agreement does not specify the reaction when entering the stop state, and the specific reaction is specified in detail in the relevant device sub-agreement.

二. Emergency Message

When an error occurs in the operation of a device, an emergency message is triggered to inform other devices in the network of their error status. 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. 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, which indicates 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

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x80+NId	8	An 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 identifier 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

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x700+NId	1	Status	-	-	-	-	-	-	-

Note:

1. Status: 0x00-start state, 0x04-stop state, 0x05-run state, 0x7f-pre-operation state;
2. Heartbeat message identifier can be set to other formats, which need to be changed through object dictionary 0x100E.

四. LSS Layer Setting Service

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 before configuration, and there are two ways to realize it.

Method 1: Switch the selected mode. The host input LSS address to switch the selected sensor to LSS configuration state. The LSS address consists of four transmission parameters, namely manufacturer ID, product code, version number and serial number. When all parameters are consistent, the sensor will respond positively. The specific operation process is as follows:

Table 4.1 Protocol Operation Procedure for Switching Selected Mode

Direction	Identifier	Length	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: Manufacturer ID-0x0FFE, Product Code-0x00433031, Version No.-0x00010001, Serial No.-0x50484551.

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

Table 4.2 Switching Global Mode Operation Procedures

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x7E5	8	0x40	0x01	0x00	0x00	0x00	0x00	0x00	0x00

When the sensor switches to the LSS configuration state, the baud rate and node address can be configured. The specific steps are as follows:

Table 4.3 Configure Node Address Instructions

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

Table 4.4 Baud Rate-Configuration Bit Timing Parameter Instruction

Direction	Identifier	Length	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	0x00

Note:

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

Direction	Identifier	Length	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 between sensors.

Table 4.5 LSS Configuration Data Store Instructions

Direction	Identifier	Length	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 address 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 Service Setting 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

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x600+NId	8	0x40	Object dictionary index		Sub-index	0x00	0x00	0x00	0x00
TX	0x580+NId	8	0x4x	Object dictionary index		Sub-index	Data LSB	Data	Data	Data MSB

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

Table 5.2 SDO Download Operation Instructions

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x600+NId	8	0x2x	Object dictionary index		Sub-index	Data LSB	Data	Data	Data MSB
TX	0x580+NId	8	0x60	Object dictionary index		Sub-index	0x00	0x00	0x00	0x00

Note: The value of x of 0x2x in a message depends on the number of bytes of object data, 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

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x580+NId	8	0x80	Object dictionary index		Sub-index	Fault code			

Note: Fault code: 0x06090011-sub-index object does not exist
0x06090030-Value overrun
0x06020000-Index object does not exist
0x06010001-Index object is write-only
0x06010002-index object is read-only
0x08000020-Data transmission error
0x08000000-General 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 identifier. 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 their needs.

6.1 Synchronization mode

Sync mode is enabled when the CANopen sensor is in the NMT running state and the object 0x1800 sub-index 0x02 transport type value is in the range of 1 to 240. After receiving n ($n=1\sim240$) synchronization messages, the sensor sends PDO data once. The synchronization message format is as follows:

Table 6.1 Synchronization Messages

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	0x80	0	-	-	-	-	-	-	-	-

Note: Synchronization message identifiers 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 running 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 Subindex 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

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
RX	00x180 + 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 displacement resolution and velocity resolution in PDO message content can be obtained by visiting object 0x6005. PDO message formats are as follows:

Table 6.3 PDO message

Direction	Identifier	Length	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
TX	0x180 + NId	6	Displacement LSB	Displacement	Displacement	Displacement MSB	Speed LSB	Speed MSB	-	-

Note: PDO message identifiers 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	Type of device	U32	Read-only	0x00080196	Device Subprotocol: DS406 Encoder Device Protocol
1001	0	Error register	U8	Read-only	0	0x00: No Error 0x81: Sensor No Magnetic Ring
1005	0	Synchronization message identifier	U32	Read and write	0x80	Synchronization message Identifier
1008	0	Device name	String	Constant	C100	Device name
1009	0	Hardware version	String	Constant	1.00	Hardware version
100A	0	Software version	String	Constant	1.00	Software version
100B	0	Node address	U32	Read-only	0x7F	Node address can be changed through LSS
100E	0	Error control identifier	U32	Read and write	0x700 + NId	Error control identifier (Cannot be changed)
1010	0	Storage parameter	U8	Read-only	1	Number of sub-indexes
	1		U32	Read and write	0x73617665	Store the parameter "SAVE" and store the whole object dictionary parameters
1011	0	Recover default parameter	U8	Read-only	1	Number of sub-indexes
	1		U32	Read and write	0x6C6F6164	Store the parameter "LOAD" and restore the whole object dictionary parameter
1014	0	Emergency message identifier	U32	Read and write	0x80 + NId	Emergency message identifier
1017	0	Heartbeat message time interval	U16	Read and write	0	Time unit ms

Table 7.1 CANopen Sensor Object Dictionary List (Hexadecimal)

6005	0	Linear encoder measurement resolution setting	U8	Read-only	2	Number of sub-indexes
	1		U32	Constant	1000	Unit of displacement measurement 0.001 um
	2		U32	Constant	10	Speed measurement unit 0.01 mm/s
6010	0	Reset value	U8	Read and write	1	Number of sub-indexes
	1		I32	Read and write	xxxx	PD01 Reset Value
6020	0	Displacement value	U8	Read-only	1	Number of sub-indexes
	1		I32	Read-only	No	PD01 displacement value
6030	0	Velocity value	U8	Read-only	1	Number of sub-indexes
	1		I16	Read-only	No	PD01 Velocity Value
6200	0	Events Timing time	U16	Read and write	10	Event timing time unit ms
6501	2	Displacement resolution	U32	Read-only	1000	Unit of displacement 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-Sync message identifier

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

Note: Sync message identifier 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	"1.00"	"1.00"

0x100A-Software version

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x100A	0	Software version	String	Constant	"1.00"	"1.00"

0x100A-Software version

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

0x100E-Error control identifier

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

Note: The identifier defined by this object is also applied to heartbeat and startup messages.

0x1010-Store parameters

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

Table 7.2 Store all parameter instructions

Direction	Identifier	Length	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
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

Direction	Identifier	Length	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 are restored to the values stored in the nonvolatile unit of the sensor, and the restored values are valid after the sensor is reset.

0x1014-Emergency message identifier

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1014	0	Emergency message identifier	Unsigned 32-bit	Read and write	0~0x7FFF	0x80 + NId

0x1017-Heartbeat message interval

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

Note: This object defines the time interval for incorrectly controlling 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	Manufacturer ID	Unsigned 32-bit	Read-only	0x0FFE	0x0FFE
	2	Product code	Unsigned 32-bit	Read-only	0x00433031	0x00433031
	3	Version number	Unsigned 32-bit	Read-only	0x00010001	0x00010001
	4	Serial number	Unsigned 32-bit	Read-only	xxxx	xxxx

Note: The identification 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 selecting the mode.

0x1200-First Service SDO Parameter

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

0x1800-First send PDO parameter

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x1800	0	Number of sub-indexes	Unsigned 8-bit	Read-only	5	5
	1	PD01 Identifier	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 bits	Read and write	0~0xFFFF	10

Note:

1. Subindex 0x01 contains valid bits, remote frame bits, and standard/extended identifier distinguishing bits in addition to the CAN identifier branch used, as shown in the following table:

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

2. Subindex 0x02 defines the transport type of PDO, as shown in the following table:

Numerical 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

3. Subindex 0x05 defines an event timer (in ms) for event timing in asynchronous transfer mode. 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-First send PDO map

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
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-Measurement resolution

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	Displacement resolution	Unsigned 32-bit	Read-only	1000	1000
	2	Velocity resolution	Unsigned 32-bit	Read-only	10	10

Note: The DS406 protocol stipulates that the displacement measurement unit is 0.001 μm and the velocity measurement unit is 0.01 mm/s. Therefore, the displacement resolution of CANopen sensor is 1 μm and the velocity resolution is 0.1 mm/s.

0x6010-Reset 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	PD01 Reset Value	Unsigned 32-bit	Read and write	xxxx	xxxx

Note: CANopen sensor has reset function. Users can change the current magnetic ring output value to any reset value according to actual needs, and the reset value takes effect at the next reset. The user-set reset 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-Displacement 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	PD01 displacement value	Unsigned 32-bit	Read-only	xxxx	xxxx

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

0x6030-Velocity value

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x6030	0	Number of sub-indexes	Unsigned 8-bit	Read-only	1	1
	1	PD01 Velocity Value	Unsigned 16-bit	Read-only	xxxx	xxxx

Note: This object contains the speed value of the CANopen sensor and maps to the PDO. Velocity 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-Event Timer

Index	Sub-index	Name	Data type	Access properties	Range/value	Default value
0x6200	0	Event timer	Unsigned 16 bits	Read and write	1	1

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-Displacement Resolution

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

Note: This object functionally equates to the object 0x6005 sub-index 0x01. DS406 protocol stipulates that the displacement measurement unit is 0.001 μm , so the displacement resolution of CANopen sensor is 1 μm .