ZLAC8030D Servo Driver (Special For HUB Servo Motor)

CANopen Communication Instruction

Version	Description	Date
V1.00	First version	

CATALOGUE

1. Outline

This manual only gives a brief introduction to the most commonly used related concepts and precautions in the use of ZLAC8030D, so that users can understand the normal use of ZLAC8030D series products in the shortest time.

Communication Standard followed by ZLAC8030D

- CAN 2.0A Standard
- CANopen Standard protocol DS 301 V4.02
- CANopen Standard protocol DS 402 V2.01

Services Supported by ZLAC8030D

- Supports SDO services
- Supports PDO services: Each slave station can be configured with up to 4 TxPDOs and 4 RxPDOs
- Supports NMT Slave services
- Device monitoring: supports heartbeat messages

The following instructions take the drive address as 1 and the baud rate as 500K.

The drive address can be set from 1 to 127; Baud rates of 100kHz, 125kHz, 250kHz, 500kHz, 1000kHz, can be set through software, with a default of 500kHz.

2. CiA301 Description

2.1 Communication object identifier(COB-ID)

Communication Object Identifier (COB-ID) is used to specify the priority and identification of communication objects. In CANopen protocol, it is stipulated that 11 arbitration bits are divided into the high 4 bits of the Function Code and the low 7 bits of the node address (Node-ID), which is called COB-ID (Communication Object Identifier).

CANopen predefined master/slave connection set										
Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function Code				Node-ID						

Node-ID range is 1-127 (0 is not allowed to be used).

Object	Function Code	Node Address	COB-ID	Object Dictionary Index
NMT Network Management Terminal	0000	0	0x000	-
Synchronization Object	0001	0	0x080	0x1005
EMCY	0001	1-127	0x081-0x0FF	0x1014
TPDO0	0011	1-127	0x181-0x1FF	0x1800

RPDO0	0100	1-127	0x201-0x27F	0x1400
TPDO1	0101	1-127	0x281-0x2FF	0x1801
RPDO1	0110	1-127	0x301-0x47F	0x1401
TPDO2	0111	1-127	0x381-0x3FF	0x1802
RPDO2	1000	1-127	0x401-0x47F	0x1402
TPDO3	1001	1-127	0x481-0x4FF	0x1803
RPDO3	1010	1-127	0x501-0x57F	0x1403
RSDO server sending	1100	1-127	0x581-0x5FF	0x1200
TSDO Client Response	1011	1-127	0x601-0x67F	0x1200
NMT Error Control	1110	1-127	0x701-0x77F	0x1016-0x1017

2.2 Object Dictionary (OD)

Object Dictionary is the core concept of CANopen. Every CANopen device in the network has an object dictionary. Object Dictionary is an ordered collection of data objects. These objects describe all the communication and device parameters of the device, and their positions are determined in Object Dictionary by a 16-bit index and an 8-bit subindex.

Object Dictionary supported by ZLAC8030D

Index Range	Description
0x1000-0x1A03	CiA301 Communication Object Sub-Protocol Area
0x2000-0x2035	Factory Custom Area
0x603F-0x60FF	CiA402 Motion Control Sub-Protocol Area

2.3 Service Data Object (SDO)

SDO is used to access the object dictionary of a device. The visitor is referred to as the client, and the CANopen device that accesses the object dictionary and provides the requested service is referred to as the server. The customer's CAN message and the server's response CAN message always contain 8 bytes of data (although not all data bytes are necessarily meaningful). A customer's request must have a response from the server.

The basic structure is as follows:

Byte0	Byte1:2	Byte3	Byte4:7
SDO Command Word	Object Index	Object Sub-Index	Data

Command word:

Command	Function	Type	Data length
2F	Setting	M->S Request	1 byte
2B	Setting	M->S Request	2 byte
27	Setting	M->S Request	3 byte
23	Setting	M->S Request	4 byte

60	Setting feedback	S->M confirm	
40	Read	M->S Request	0 byte
4F	Read feedback	S->M feedback	1 byte
4B	Read feedback	S->M feedback	2 byte
47	Read feedback	S->M feedback	3 byte
43	Read feedback	S->M feedback	4 byte
80	Read feedback	S->M feedback	4 byte

For example, writing data 0x03 to an object dictionary with index 0x6060 and sub index 0 through an SDO message.

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Client → Server								
0x601	2F	60	60	00	03	00	00	00
Server → Client								
0x581	60	60	60	00	00	00	00	00

2.4 Network Management Terminal NMT

NMT provides network management services. This service is implemented using a master-slave communication mode (so there is only one NMT master node). Only the NMT master node can transmit NMT module control messages, and all slave nodes must support NMT module control services. NMT module control does not require a response. The message format is as follows:

NMT master node → NMT slave node		
COB-ID	Byte 0	Byte 1
0x000	Command word	Node-ID

When Node ID=0, all NMT slave nodes are addressed. The corresponding relationship between the values of command words and services is shown in the table below:

Command word	NMT Service
0x01	Start Command (Put the node into an operational state)
0x02	Stop command (to put the node into a stop state)
0x80	Pre operation command (to put the node into a pre operation state)
0x81	Reset the node application layer (to put the node into the application layer reset state)
0x82	Reset node communication (put the node into communication reset state)

The node status description is shown in the table below:

State	Instruction
Initialization	CAN controller initialization after node power on
Application layer reset	Node application reset
Communication reset	Node CANopen communication reset
Pre operation status	Node CANopen communication is in operation state; Can communicate with SDO and NMT
Operational state	After receiving the start command from the NMT master station, the node's PDO communication is activated
Stop Status	After receiving a stop command from the NMT master station, the node's PDO communication is disabled

2.5 Heartbeat (NMT Error Control)

NMT error control is mainly used to detect whether devices in the network are online and the status of the devices, including node/lifetime protection and heartbeat. ZLAC8030D currently only supports heartbeat mode.

A node can be configured to generate periodic packets called heartbeat. The heartbeat mode adopts a producer (slave) - consumer (host) model. CANopen devices can send heartbeat messages based on the cycle set by the producer heartbeat interval object 0x1017, in milliseconds. A node in the network that always has consumer heartbeat function monitors the producer based on the consumer time set by object 0x1016. Once the heartbeat of the corresponding node's producer is not received within the consumer heartbeat time range, it is considered that the node is disconnected (or faulty).

The CANopen slave station sends heartbeat messages based on the heartbeat production time (ms) filled in 0x1017 of its object dictionary, while the CANopen master station (NMT master station) checks based on the heartbeat consumption time filled in 0x1016. Assuming that no heartbeat messages are received from the slave station after several heartbeat consumption times, it is considered that the slave station has been offline or damaged.

If the slave sends a heartbeat message every 0x1017 to monitor the slave's host (or other slave) and fails to receive the heartbeat message within the consumer's time, it is considered that the slave has dropped. 0x1017 × 2 ≤ Monitor the consumer time of the host (or other slave) of the slave, otherwise it is easy to misreport the slave dropping.

The heartbeat format is as follows:

Heartbeat Producer → Consumer	
COB-ID	Byte 0

0x700+Node-ID	Status

Status Description:

Status	Desciption
0x00	Boot-up
0x04	Stop Status
0x05	Operational state
0x7F	Pre operation status

※Note：ZLAC8030D is the heartbeat producer.

2.6 Process Data Object (PDO)

PDO belongs to the process data category and is used to transmit real-time data, i.e. one-way transmission, without the need for receiving nodes to respond to CAN messages for confirmation. In communication terminology, it belongs to the "production consumption" model. The PDO length can be less than 8 bytes, and the transmission speed is relatively fast. Each PDO information includes both sending PDO (TxPDO) and receiving PDO (RxPDO) information, and its transmission method is defined in the PDO communication parameter index. All PDO transmission data must be mapped to the corresponding index area through the object dictionary.

ZLAC8030D supports 4 sets of sending and receiving PDOs, with the following related objects:

Object	COB-ID	Communication Sbject	Mapping parameter
TPDO0	0x181-0x1FF （0x180+ node address）	0x1800	0x1A00
RPDO0	0x201-0x27F （0x200+ node address）	0x1400	0x1600
TPDO1	0x281-0x2FF （0x280+ node address）	0x1801	0x1A01
RPDO1	0x301-0x37F （0x300+ node address）	0x1401	0x1601
TPDO2	0x381-0x3FF （0x380+ node address）	0x1802	0x1A02
RPDO2	0x401-0x47F （0x400+ node address）	0x1402	0x1602
TPDO3	0x481-0x4FF （0x480+ node address）	0x1803	0x1A03
RPDO3	0x501-0x57F （0x500+ node address）	0x1403	0x1603

2.6.1 PDO Communication Parameter

1. PDO CAN identifier

The CAN identifier of PDO, also known as the COB-ID of PDO, contains control bits and identification data to determine the bus priority of the PDO. The COB-ID is located on the sub index 01 of the communication parameters (RPDO: 1400h~1403h, TPDO: 1800h~1803h), and the highest bit determines whether the PDO is valid.

2. PDO transmission type

PDO transmission type is located on sub index 02 of the communication parameters (RPDO: 1400h~1403h, TPDO: 1800h~1803h).

Asynchronous transmission: triggered by events, including data change triggering and periodic event timer triggering.

Synchronous transmission: related to synchronous frames in a network.

The communication parameters (RPDO: 1400h~1403h, TPDO: 1800h~1803h) sub index 02 represent different transmission types and define the methods for triggering TPDO transmission or processing received RPDO. The specific correspondence is as follows:

transport type	Synchronous		Asynchronous
	cyclic	Acyclic	
0		√	
1-240	√		
241-254	√		
254、255			√

Explanation:

①When the TPDO transmission type is 0, if the data of the mapping object changes and a synchronization frame is received, the TPDO is sent;

②When the transmission type of TPDO is 1-240, when the corresponding number of synchronization frames are received, the TPDO is sent.

③When the transmission type of TPDO is 254 or 255, if the mapping data changes or the event timer arrives, the TPDO is sent.

④When the transmission type of RPDO is 0-240, as long as a synchronization frame is received, the latest data of that RPDO will be updated to the application; When the transmission type of RPDO is 254 or 255, the received data is directly updated to the application.

※Note: ZLAC8030D currently only supports 254/255 transmission methods

3. Prohibition time

A prohibition time has been set for TPDO, which is stored on sub index 03 of communication parameters (1800h~1803h) to prevent the CAN network from being

continuously occupied by higher priority PDO. The unit of this parameter is 100us. After setting the value, the transmission interval of the same TPDO should not decrease by less than the time corresponding to this parameter.
For example, if the prohibition time of TPDO2 is 300, the transmission interval of TPDO will not be less than 30ms.
Suggestion: When objects with frequent changes (such as feedback position, feedback speed, etc.) are configured to TPDO and the transmission type of the TPDO is asynchronous, it is recommended to set a certain prohibition time.

4) Event Timer

For TPDO with asynchronous transmission (transmission type 254 or 255), define an event timer located on sub index 05 of communication parameters (1800h~1803h), with a unit of 500us. The event timer can also be seen as a triggering event, which also triggers the corresponding TPDO transmission. If other events such as data changes occur during the running cycle of the timer, TPDO will also be triggered and the event counter will be immediately reset.

2.6.2 PDO mapping parameter

The PDO mapping parameters contain process data pointers corresponding to the PDO that PDO needs to send or receive, including indexes, sub indexes, and the length of the mapping object. Each PDO data can have a maximum length of 8 bytes and can map one or more objects simultaneously. Among them, sub index 0 records the specific number of objects mapped by the PDO, and sub indexes 1-8 represent the mapping content. The mapping parameter content is defined as follows:

For example, mapping 0x6040 to 0x1A00 01

	Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
	2B	00	1A	01	10	00	40	60
Define	2B	Map section		Subindex number	Mapping Object Length	Mapped subindex	Mapped object	

2.6.3 PDO Mapping Example

1. Configure 0x606C 03 as TPDO0 and use event triggered (254) or timer triggered (255) transmission methods respectively

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function Description
2F 00 1A 00 00 00 00 00	60 00 1A 00 00 00 00 00	Clear TPDO0 mapping
23 00 1A 01 20 03 6C 60	60 00 1A 01 00 00 00 00	Mapping 0x606C 03 to 0x1A00 01
2F 00 18 02 FE 00 00 00	60 00 18 02 00 00 00 00	Set the transmission method of TPDO0 to event triggered
2B 00 18 03 E8 03 00 00	60 00 18 03 00 00 00 00	Set Prohibition time 500ms

2F 00 1A 00 01 00 00 00	60 00 1A 00 00 00 00 00	Enable 1 TPD00 mapping
2B 10 20 00 01 00 00 00	60 10 20 00 00 00 00 00	Save parameters to EEPROM

Master station(COB-ID:0x601)	Slave station (COB-ID:0x581)	Function Description
2F 00 1A 00 00 00 00 00	60 00 1A 00 00 00 00 00	Clear TPD00 mapping
23 00 1A 01 20 03 6C 60	60 00 1A 01 00 00 00 00	Mapping 0x606C 03 to 0x1A00 01
2F 00 18 02 FF 00 00 00	60 00 18 02 00 00 00 00	Set the transmission method of TPD00 to timer triggered
2B 00 18 05 E8 03 00 00	60 00 18 05 00 00 00 00	Set timer time 500ms
2F 00 1A 00 01 00 00 00	60 00 1A 00 00 00 00 00	Enable 1 TPD00 mapping
2B 10 20 00 01 00 00 00	60 10 20 00 00 00 00 00	Save parameter to EEPROM

After the mapping is completed, switch the communication status to operation mode to enable PDO transmission and send the NMT start command
The format of the NMT startup command is as follows:
COB-ID: 000 Data: 01+ID (00 represents opening all address PDO)

The TPDO upload format is shown in the table below:

Slave station (COB-ID:0x181)	Function Description
01 02 03 04	Upload data from 606C 03 as 01 02 03 04

2. Configure 0x60FF 01 and 60FF 02 as RPD01, transmission mode event triggered (254)

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function Description
2F 01 16 00 00 00 00 00	2F 01 16 00 00 00 00 00	Clear RPD01 mapping
23 01 16 01 20 01 FF 60	23 01 16 01 00 00 00 00	Mapping 0x60FF 01 to 0x1601 01
23 01 16 02 20 02 FF 60	23 01 16 02 00 00 00 00	Mapping 0x60FF 02 to 0x1601 02
2F 01 16 00 02 00 00 00	2F 01 16 00 00 00 00 00	Start RPD01 mapping
2B 10 20 00 01 00 00 00	2B 10 20 00 00 00 00 00	Save parameter to ERRPOM

After mapping, switch the communication status to operation mode to enable PDO transmission and send the NMT start command
The format of the NMT startup command is as follows:
COB-ID: 000 Data: 01+ID (00 represents opening all address PDO)

The RPDO sending format is shown in the table below:

Master (COB-ID:0x301)	Function description

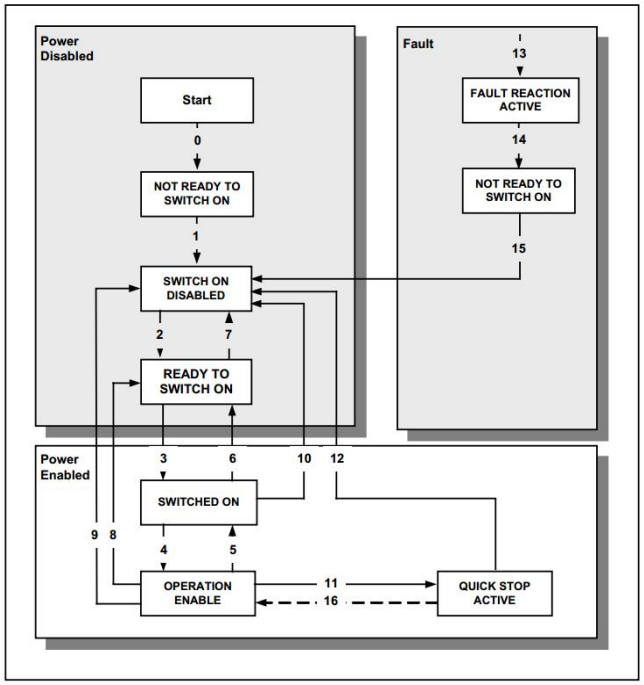
01 02 03 04 05 06 07 08	01 02 03 04 write in 60FF 01 05 06 07 08 write in 60FF 02

3. CiA402 Description

3.1 CiA402 State Machine

The CiA402 protocol defines the standard state machine for motion control devices, as well as various operating modes and their definitions in the object dictionary.

The standard state machine describes the state of the device and the possible control sequence of the driver. Each step represents a specific internal or external behavior,



and the state of the device also determines which commands can be received.

Driver state machine

※ The corresponding descriptions of each state of the state machine are shown in the table below:

State name	Illustrate
NOT READY TO SWITCH ON	Only power is supplied to the driver chip, the driver is initializing and self checking, and the driver function is not enabled. This state is internal.
SWITCH ON DISABLED	The initialization of the driver is completed, the driver parameters are established and can be modified. This state does not provide power to the motor, and it is the lowest state that the user can operate. After the drive is powered on, the user is in contact with the state.
READY TO SWITCH ON	The driver parameters can be modified, the drive

	function is not enabled, waiting to enter the SWITCH ON state.
SWITCH ON	Provide high voltage to the driver, the power amplifier is ready, the driving parameters can be modified, and the driving function is not enabled.
OPERATION ENABLE	No faults were detected, the driver function was enabled, and the motor power on driver parameters can be modified. Based on the BP [N] parameter, it is determined whether the brake will automatically release in this state.
QUICK STOP ACTIVE	The driver parameters can be modified, the emergency stop function is enabled, the driver function is enabled, and the motor is in a powered on state.
FAULT REACTION ACTIVE	The driver parameters can be modified. If a fault occurs in the driver, the fault response function is enabled, and the driver function is disabled. This state cannot be manually entered, but will automatically enter when a fault occurs in the driver.

The driver state machine is controlled by the bit0~bit3, and bit7 bits of the control word (object 6040h), as described in the following table:

※ Control word switching status

Command	Control word					State switching
	Bit7	Bit3	Bit2	Bit1	Bit0	
Shutdown	0	X	1	1	0	2,6,8
Switchon	0	0	1	1	1	3
Switchon +Enable operation	0	1	1	1	1	3+4
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable Operation	0	0	1	1	1	5
Enable Operation	0	1	1	1	1	4,16
Fault reset	↑	X	X	X	X	15
Bits marked as X is invalid						

Each state in the state machine can be displayed through the bit 0~bit 3, bit 5, and bit 6 of the state word (object 6041h), as described in the following table:

※ Status word switching status

State	State word					
	Bit6	Bit5	Bit3	Bit2	Bit1	Bit0
Not ready to switch on	0	X	0	0	0	0
Switch on disabled	1	X	0	0	0	0
Ready to switch on	0	1	0	0	0	1
Switched on	0	1	0	0	1	1

Operation enabled	0	1	0	1	1	1
Quick stop active	0	0	0	1	1	1
Fault reaction active	0	X	1	1	1	1
Fault	0	X	1	0	0	0
Bits marked as X is invalid						

3.2 Control Word And Status Word

The start stop control command and status description of the driver are mainly achieved through the control word 6040h and status word 6041h. Therefore, it is necessary to proficiently use the control word and status word. The following table briefly describes the definitions of each control word and status word.

Control word	Common command	Function Description
6040h	00	Initialization step 0: At this time, the status of 6041 low 4 bits is: 0000, and the motor is released
	06	Initialization step 1: At this time, the status of 6041's low 4 bits is 0001, and the motor is released
	07	Initialization step 2: At this time, the status of 6041 low 4 bits is: 0011, and the motor is enabled
	0F	Initialization step 3: At this time, the status of 6041 low 4 bits is: 0111, and the motor is enabled
	0F	Start command in speed mode (6061=3)
	0F->1F	Start command in torque mode (6061=4) Absolute motion start command in position mode (6061=1)
	4F->5F	Relative motion start command in position mode (6061=1)

Status word	Bit definition	Function Description
6041h	Bit0~Bit3	6040=0: xxxx xxxx xxxx 0000 6040=6: xxxx xxxx xxxx 0001 6040=7: xxxx xxxx xxxx 0011 6040=F: xxxx xxxx xxxx 0111
	Bit7	0: The drive is normal 1: Driver alarm
	Bit8	0: The torque is not completed 1: The torque has been completed
	Bit11	0: indicates that the Bit4 status of 6040h is 0 at this time;

		1: Indicates that the Bit4 status of 6040h is 1 at this time
	Bit13	0: Motor release 1: Motor enable
	Bit14	0: The motor is stopping 1: The motor is running
	Bit15	0: Movement not in place in position mode 1: The movement is in place in position mode

Example: After powering on, the driver is initialized and enters a normal working state. This operation is usually performed after powering on.

Master station	Slave station	Slave status word
00: 01 00	NMT initialization	NMT initialization
601: 2B 40 60 00 00 00 00 00	581: 60 40 60 00 00 00 00 00	6041: xxxx xxxx xxxx 0000
601: 2B 40 60 00 06 00 00 00	581: 60 40 60 00 00 00 00 00	6041: xxxx xxxx xxxx 0001
601: 2B 40 60 00 07 00 00 00	581: 60 40 60 00 00 00 00 00	6041: xxxx xxxx xxxx 0011
601: 2B 40 60 00 0F 00 00 00	581: 60 40 60 00 00 00 00 00	6041: xxxx xxxx xxxx 0111

CANopen sets the operating mode of the driver through object 6060h (Mode of Operation) and reflects the current operating mode status of the drive through object 6061h (Mode of Operation display). The ZLAC8030D series drive currently supports three operating modes: Profile Position Mode, Profile Velocity Mode, and Profile Torque Mode.

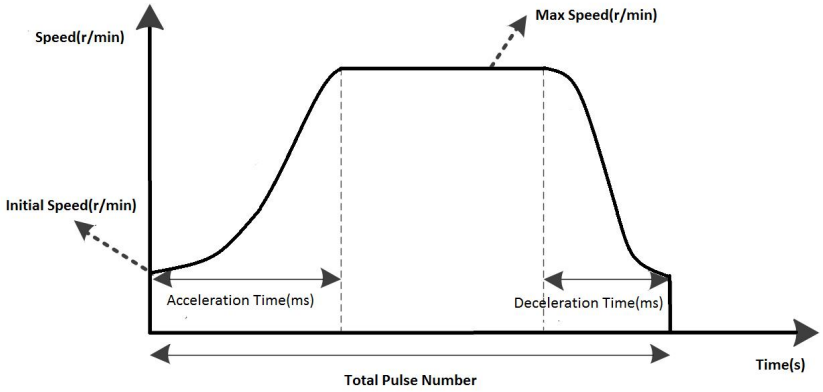
※ Driver operating mode

index	Sub-Index	Name	Type	Attribute	PDO mapping	Parameter range	Default value
6060h	00	Working mode	I8	RW	NO	0: Undefined 1: Position mode 3: Speed mode 4: Torque mode	0

3.3 Profile Position Mode

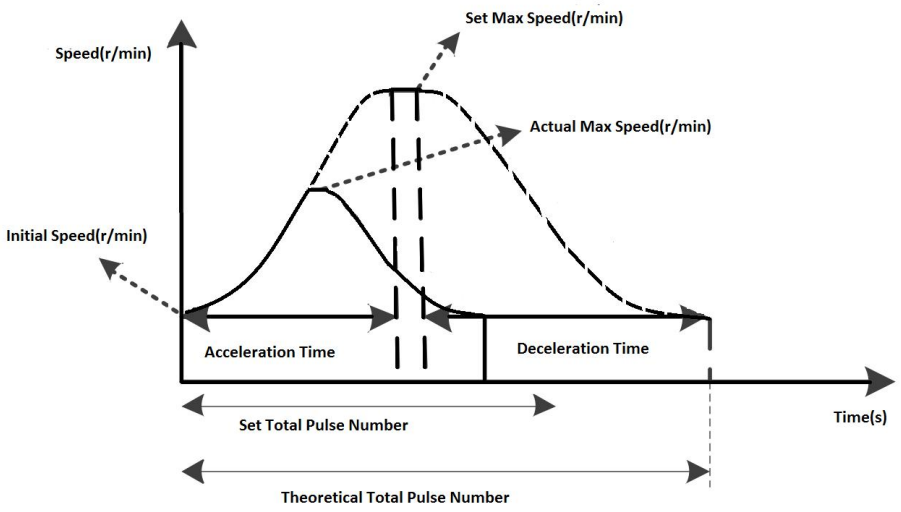
3.3.1 Profile Position Mode Description

The position mode is achieved using an S-shaped acceleration/deceleration curve, and users can set the starting speed, maximum speed, acceleration time, deceleration time, and total number of pulses through the bus to achieve precise position control. The S-shaped acceleration and deceleration curve is shown in the following figure.



Profile position mode acceleration/deceleration curve

When the total pulse number set by user is small, the motor may need to decelerate before it accelerates to the maximum speed (that is, the motor does not accelerate to the maximum speed set by the user during actual operation). The speed curve is shown in the figure below. The solid line in the figure shows the actual running curve of the motor, and the dotted line is the curve that motor needs to run, to accelerate to the set maximum speed. The theoretical total pulse number is the minimum total pulse number calculated according to the user-set parameters (initial speed, maximum speed, acceleration time, deceleration time). When the total pulse number set by the user is less than the theoretical total pulse number, the motor will run as shown by the solid line in the figure.



Profile position mode acceleration/deceleration curve (not accelerated to the set maximum speed)

Status word

Status word	Bit	Function Description
6041h	Bit0~Bit3	6040=0: xxxx xxxx xxxx 0000 6040=6: xxxx xxxx xxxx 0001 6040=7: xxxx xxxx xxxx 0011 6040=F: xxxx xxxx xxxx 0111
	Bit5	0: Emergency stop 1: Non-emergency stop (command emergency stop)

	Bit10	0: Target position is not in place 1: Target position in place
	Bit12	0：The target location has not taken effect 1：Target location effective
	Bit13	0: Motor operation is not in place 1: Motor running in place (Based on the drive overshoot threshold)
	Bit14	0: Motor stop 1: Motor is running;
	Bit15	0：In the non-external scram state. 1：In external scram state

※ Related Object Dictionary Content

Index	Sub-Index	Name	description	Type	Attribute	PDO Mapping	Default value
6040h	00	Control word	Control word	U16	RW	YES	0
6060h	00	Working mode	0: Undefined 1: Position mode 3: Speed mode 4: Torque mode	I8	RW	YES	0
607Ah	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	Target position (left)	Range of total pulses in position mode operation: Relative: -0x7FFFFFFF~0x7FFFFFFF Absolute: -0x3FFFFFFF~0x3FFFFFFF	I32	RW	YES	0
	02	Target position (right)	Range of total pulses in position mode operation: Relative: -0x7FFFFFFF~0x7FFFFFFF Absolute: -0x3FFFFFFF~0x3FFFFFFF	I32	RW	YES	0
6081h	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	Max speed	Max speed in position	U32	RW	YES	120r/m

		(left)	mode Range: 1-1000r/min				in
	02	Max speed (right)	Max speed in position mode Range: 1-1000r/min	U32	RW	YES	120r/min
6083h	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	S-shaped acceleration time (left)	Acceleration time Range: 0-32767ms	U32	RW	YES	500ms
	02	S-shaped acceleration time (right)	Acceleration time Range: 0-32767ms	U32	RW	YES	500ms
6084h	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	S-shaped deceleration time (left)	Deceleration time Range: 0-32767ms	U32	RW	YES	500ms
	02	S-shaped deceleration time (right)	Deceleration time Range: 0-32767ms	U32	RW	YES	500ms

3.3.2 Location Mode Configuration Routine

For example, make the motor move relative to the parameters (acceleration time 100ms, deceleration time 100ms, maximum speed 60r/min, total pulse count 3200).

Position mode initialization:

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2F 60 60 00 01 00 00 00	60 60 60 00 00 00 00 00	Set position mode
23 83 60 01 64 00 00 00	60 83 60 01 00 00 00 00	Set left motor S-shaped acceleration time 100ms
23 83 60 02 64 00 00 00	60 83 60 01 00 00 00 00	Set right motor S-shaped acceleration time 100ms
23 84 60 01 64 00 00 00	60 84 60 01 00 00 00 00	Set left motor S-shaped deceleration time 100ms
23 84 60 02 64 00 00 00	60 84 60 01 00 00 00 00	Set right motor

		S-shaped deceleration time 100ms
23 81 60 01 3C 00 00 00	60 81 60 01 00 00 00 00	Set left motor Max speed 60r/min
23 81 60 02 3C 00 00 00	60 81 60 01 00 00 00 00	Set right motor Max speed 60r/min
2B 40 60 00 06 00 00 00	60 40 60 00 00 00 00 00	Enable
2B 40 60 00 07 00 00 00	60 40 60 00 00 00 00 00	
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	

Relative position synchronization control

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
23 7A 60 01 00 7D 00 00	60 7A 60 01 00 00 00 00	Set left motor Target position 32000
23 7A 60 02 00 83 FF FF	60 7A 60 02 00 00 00 00	Set right motor Target position -32000
2B 40 60 00 4F 00 00 00	60 40 60 00 00 00 00 00	Start relative motion
2B 40 60 00 5F 00 00 00	60 40 60 00 00 00 00 00	
23 7A 60 01 00 83 FF FF	60 7A 60 01 00 00 00 00	Set left motor Target Location -32000
23 7A 60 02 00 7D 00 00	60 7A 60 02 00 00 00 00	Set right motor Target position 32000
2B 40 60 00 4F 00 00 00	60 40 60 00 00 00 00 00	Start relative motion
2B 40 60 00 5F 00 00 00	60 40 60 00 00 00 00 00	
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Power off

Absolute position synchronization control

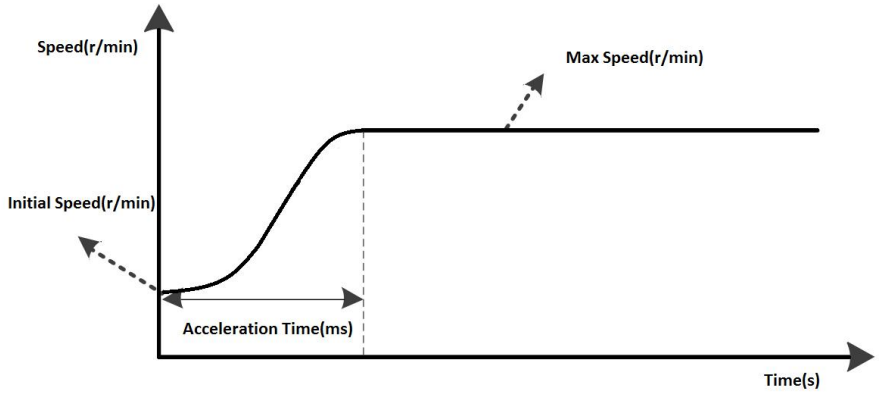
Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
23 7A 60 01 00 7D 00 00	60 7A 60 01 00 00 00 00	S et left motor Target position 32000
23 7A 60 02 00 83 FF FF	60 7A 60 02 00 00 00 00	Set right motor Target Location -32000
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	Start absolute motion
2B 40 60 00 1F 00 00 00	60 40 60 00 00 00 00 00	
23 7A 60 01 00 83 FF FF	60 7A 60 01 00 00 00 00	Set left motor Target Location -32000
23 7A 60 02 00 7D 00 00	60 7A 60 02 00 00 00 00	Set right motor Target position 32000
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	Start absolute motion
2B 40 60 00 1F 00 00 00	60 40 60 00 00 00 00 00	
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Power off

※Note: When controlling the position, the switching of the control word will simultaneously control two motors. Therefore, when controlling a single motor, the target position of the other motor should be given 0

3.4 Profile Velocity Mode

3.4.1 Profile Velocity Mode Description

The acceleration curve of the speed mode is shown in the following figure. Unlike the position mode, the speed mode only needs to set three parameters: starting speed, target speed, and acceleration time. After the motor accelerates to the max speed according to these three parameter settings, it runs at a constant speed at the max speed.



Profile Velocity Mode acceleration curve

Status word

Status word	Bit	Function Description
6041h	Bit0~Bit3	6040=0: xxxx xxxx xxxx 0000 6040=6: xxxx xxxx xxxx 0001 6040=7: xxxx xxxx xxxx 0011 6040=F: xxxx xxxx xxxx 0111
	Bit5	0: Emergency stop 1: Non-emergency stop (command emergency stop)
	Bit10	0: Speed not in place 1: Speed in place
	Bit12	0: Speed is not 0 speed 1: Speed is 0 speed
	Bit14	0: Motor stop 1: Motor is running
	Bit15	0: In the non-external scram state 1: In external scram state

※ Related Object Dictionary Content

Index	Sub-Index	Name	Description	Type	Attribute	PDO mapping	Default value
200Fh	00	Synchronous/asynchronous control flag bit	0: Asynchronous control 1: Synchronous control	U16	RW	YES	0
6040h	00	Control word	Control word	U16	RW	YES	0
6060h	00	Working mode	0: Undefined 1: Position mode 3: velocity mode 4: Torque mode	I8	RW	YES	0
6083h	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	S-shaped acceleration time (left)	Acceleration time Range: 0-32767ms	U32	RW	YES	500ms
	02	S-shaped acceleration time (right)	Acceleration time Range: 0-32767ms	U32	RW	YES	500ms
6084h	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	S-shaped deceleration time (left)	Deceleration time Range: 0-32767ms	U32	RW	YES	500ms
	02	S-shaped deceleration time (right)	Deceleration time Range: 0-32767ms	U32	RW	YES	500ms
60FFh	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	Target Speed (Left)	Target speed in speed mode, Range: -1000-1000r/min	I32	RW	YES	0
	02	Target Speed (Right)	Target speed in speed mode, Range: -1000-1000r/min	I32	RW	YES	0
	03	Left and right target speed combination Low 16 represents the left motor High 16 represents the right motor	The current movement speed of the motor, in units of 0.1r/min	U32(I16+I16)	RO	YES	0

3.4.2 Velocity Mode Configuration Routine

For example, rotate the motor according to the parameters (acceleration time 100ms, deceleration time 100ms, target speed 60r/min).

※ Assuming the driver slave station number is 1, the CANopen instruction control is described in the following table:

Velocity mode asynchronous control initialization:

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 0F 20 00 00 00 00 00	60 0F 20 00 00 00 00 00	Set asynchronous control
2F 60 60 00 03 00 00 00	60 60 60 00 00 00 00 00	Set Velocity mode
23 83 60 01 64 00 00 00	60 83 60 01 00 00 00 00	Set left motor S-shaped acceleration time 100ms
23 83 60 02 64 00 00 00	60 83 60 02 00 00 00 00	Set right motor S-shaped acceleration time 100ms
23 84 60 01 64 00 00 00	60 84 60 01 00 00 00 00	Set left motor S-shaped deceleration time 100ms
23 84 60 02 64 00 00 00	60 84 60 02 00 00 00 00	Set right motor S-shaped deceleration time 100ms
2B 40 60 00 06 00 00 00	60 40 60 00 00 00 00 00	Enable
2B 40 60 00 07 00 00 00	60 40 60 00 00 00 00 00	
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	

Left motor velocity control

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
23 FF 60 01 64 00 00 00	60 FF 60 01 00 00 00 00	Set left motor Target speed 100rpm
23 FF 60 01 9C FF FF FF	60 FF 60 01 00 00 00 00	Set left motor Target speed -100rpm
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Power off

Right motor speed mode

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
23 FF 60 02 64 00 00 00	60 FF 60 02 00 00 00 00	Set right motor Target speed 100rpm
23 FF 60 02 9C FF FF FF	60 FF 60 02 00 00 00 00	Set right motor Target speed -100rpm
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Power off

Speed mode synchronization control initialization:

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 0F 20 00 01 00 00 00	60 0F 20 00 00 00 00 00	Set synchronization control
2F 60 60 00 03 00 00 00	60 60 60 00 00 00 00 00	Set velocity mode
23 83 60 01 64 00 00 00	60 83 60 01 00 00 00 00	Set left motor S-shaped acceleration time 100ms
23 83 60 02 64 00 00 00	60 83 60 02 00 00 00 00	Set right motor S-shaped acceleration time 100ms
23 84 60 01 64 00 00 00	60 84 60 01 00 00 00 00	Set left motor S-shaped deceleration time 100ms
23 84 60 02 64 00 00 00	60 84 60 02 00 00 00 00	Set right motor S-shaped deceleration time 100ms
2B 40 60 00 06 00 00 00	60 40 60 00 00 00 00 00	Enable
2B 40 60 00 07 00 00 00	60 40 60 00 00 00 00 00	
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	

Synchronous velocity control

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
23 FF 60 03 64 00 64 00	60 FF 60 03 00 00 00 00	Set synchronization Target speed 100rpm
23 FF 60 03 9C FF 9C FF	60 FF 60 03 00 00 00 00	Set synchronization Target speed -100rpm
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Power off

※Note: Synchronous target speed: Low 16 represents the left motor, high 16 represents the right motor

3.5 Profile Torque Mode

3.5.1 Profile Torque Mode Description

In Profile torque mode, the value of operation mode object 6060h needs to be set to 4. When the operation mode status reads the register of object 6061h as 4, the relevant operations of HM operation mode can be performed. The objects involved in this mode are as follows:

Status word

Status word	Bit	Function Description
	Bit0~Bit3	6040=0: xxxx xxxx xxxx 0000 6040=6: xxxx xxxx xxxx 0001 6040=7: xxxx xxxx xxxx 0011

		6040=F： xxxx xxxx xxxx 0111
	Bit5	0: Emergency stop 1: Non-emergency stop (command emergency stop)
	Bit10	0: Torque is not in place 1: Torque in place
	Bit14	0: Motor stop 1: Motor is running
	Bit15	0：In the non-external scram state 1：In external scram state

※ Related Object Dictionary Content

Index	Sub-Index	Name	Description	Type	Attribute	PDO mapping	Default value
200Fh	00	Synchronous/asynchronous control flag bit	0: Asynchronous control 1: Synchronous control	U16	RW	YES	0
6040h	00	control word	control word	U16	RW	YES	0
6060h	00	Working mode	0: Undefined 1: Position mode 3: Speed mode 4: Torque mode	I8	RW	YES	0
6071h	00	Number of sub indexes	Number of sub indexes	U16	RW	NO	2
	01	Target torque (left)	Unit：mA Range：-30000~30000；	I16	RW	YES	0
	02	Target torque (right)	Unit：mA Range：-30000~30000；	I16	RW	YES	0
	03	Left and right target torque combination Low 16 represents the left motor High 16 represents the right motor	Unit：mA Range：-30000~30000；	U32(I16+I16)	RW	YES	0
6087h	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	Torque slope (left)	Current/1000/second Unit: mA/s;	U32	RW	YES	300ms
	02	Torque slope (right)	Current/1000/second Unit: mA/s;	U32	RW	YES	300ms

3.5.2 Torque Mode Configuration Routine

Complete torque work, target torque 100mA.

※ Assuming the driver slave station number is 1, the CANopen instruction control is described in the following table:

Torque mode asynchronous control initialization

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 0F 20 00 00 00 00 00	60 0F 20 00 00 00 00 00	Set asynchronous control
2F 60 60 00 04 00 00 00	60 60 60 00 00 00 00 00	Set torque mode
23 87 60 01 64 00 00 00	60 87 60 01 00 00 00 00	Set left motor Torque slope 100mA/s
23 87 60 02 64 00 00 00	60 87 60 02 00 00 00 00	Set right motor Torque slope 100mA/s
2B 40 60 00 06 00 00 00	60 40 60 00 00 00 00 00	Enable
2B 40 60 00 07 00 00 00	60 40 60 00 00 00 00 00	
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	

Left motor torque control

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 71 60 01 E8 03 00 00	60 71 60 01 00 00 00 00	Set left motor Target torque 1000mA/s
2B 71 60 01 18 FC FF FF	60 71 60 01 00 00 00 00	Set left motor Target torque -1000mA/s
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Enable

Right motor torque control

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 71 60 02 E8 03 00 00	60 71 60 02 00 00 00 00	Set right motor Target torque 1000mA/s
2B 71 60 02 18 FC FF FF	60 71 60 02 00 00 00 00	Set right motor Target torque -1000mA/s
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Power off

※Note: The left/right target torque is 16 bit data, the SDO write command word is 0x2B, the synchronous target torque is 32 bit data, and the SDO write command word is 0x23

Torque mode synchronization control initialization

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 0F 20 00 01 00 00 00	60 0F 20 00 00 00 00 00	Set synchronization control
2F 60 60 00 04 00 00 00	60 60 60 00 00 00 00 00	Set torque mode
23 87 60 01 64 00 00 00	60 87 60 01 00 00 00 00	Set left motor

		Torque slope 100mA/s
23 87 60 02 64 00 00 00	60 87 60 02 00 00 00 00	Set right motor Torque slope 100mA/s
2B 40 60 00 06 00 00 00	60 40 60 00 00 00 00 00	Enable
2B 40 60 00 07 00 00 00	60 40 60 00 00 00 00 00	
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	

Synchronous torque control

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
23 71 60 03 E8 03 E8 03	60 71 60 03 00 00 00 00	Set up synchronization Target torque 1000mA/s
23 71 60 03 18 FC 18 FC	60 71 60 03 00 00 00 00	Set up synchronization Target torque -1000mA/s
2B 40 60 00 00 00 00 00	60 40 60 00 00 00 00 00	Power off

※Note: Synchronous target torque: low 16 represents the left motor, high 16 represents the right motor

3.6 Emergency Stop Instruction

Emergency stop can be controlled through external input signals or achieved by switching control word states through communication.※ Related Object Dictionary Content

Index	Sub-Index	Name	Description	Type	Attribute	PDO mapping	Default value
2003h	00	Input signal status	2-way input signal level status Bit0~Bit1: X0~X1 input level status	U16	RO	YES	0
2030h	01	Effective level of input terminal	Bit0: Input terminal X0 control position; Bit1: Input terminal X1 control position; Bit2~Bit15: reserved; 0: Default; 1: Level reversal; The default input terminal level rising edge or high level of the driver is valid	U16	RW	YES	0
	02	Input terminal X0 terminal	0: Undefined 1-6: NC;	U16	RW	YES	9

		function selection	9: Emergency stop signal				
	03	Input terminal X1 terminal function selection		U16	RW	YES	0
605Ah	00	Quick Stop Code	Drive processing method after fast stop command 0x00 05: Normal stop, maintain quick stop status; 0x00 06: Emergency deceleration stop, maintain quick stop status; 0x00 07: Emergency stop, maintain quick stop status	I16	RW	NO	5
6085h	00	Number of sub indexes	Number of sub indexes	U16	RO	NO	2
	01	Emergency stop deceleration time (left)	Deceleration time Range: 0-32767ms	U32	RW	YES	10ms
	02	Emergency stop deceleration time (right)	Deceleration time Range: 0-32767ms	U32	RW	YES	10ms

Emergency stop command:

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 40 60 00 02 00 00 00	60 40 60 00 00 00 00 00	The motor stops and remains enabled
2B 40 60 00 0F 00 00 00	60 40 60 00 00 00 00 00	Motor Enable (Release Emergency Stop)

3.7 Error And Clear

ZLAC8030D Supports overvoltage, overcurrent and other protections, and all fault information can be obtained by reading object 0x603F.

The fault codes are shown in the table below:

0x603F	Function Description
0x0000 0000h	No errors

0x0000 0001h	Overvoltage
0x0000 0002h	Undervoltage
0x0000 0100h	EEPROM Read and writ errors
0x0004 0004h	Overcurrent
0x0008 0008h	Overload
0x0020 0020h	Encoder out of tolerance
0x0080 0080h	Reference voltage error
0x0200 0200h	Hall error
0x0400 0400h	Motor temperature is too high
0x0800 0800h	Encoder error
0x1000 1000h	Driver temperature is too high
0x2000 2000h	Given speed error

※Note: No errors/overvoltage/undervoltage/EEPROM read and write errors are common faults, and other faults are divided into left and right drive. The high 16 bits of the fault code are left drive, and the low 16 bits are right drive

Clear error:

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 40 60 00 80 00 00 00	60 40 60 00 00 00 00 00	Clear error

3.8 External brake

※ Related Object Dictionary Content

Index	Sub-Index	Name	Description	Type	Attribute	PDO mapping	Default value
2030h	04	Effective level of output terminal	Bit0: Output terminal Y0 control position; Bit1: Output terminal Y1 control position; Bit2: Output terminal B0 control position; Bit3: Output terminal B1 control position; 0: Default; 1: Level reversal; The default input	U16	RW	YES	0

			terminal level rising edge or high level of the driver is valid				
	07	Output terminal B0 terminal function selection	Holding brake on/off 0: Close 1: Open	U16	RW	YES	0
	08	Output terminal B1 terminal function selection	Holding brake on/off 0: Close 1: Open	U16	RW	YES	0

※Note: The wiring diagram of the brake is detailed in the "ZLAC8030D Servo Hub Driver User Manual", and the brake is enabled by default

Close brake (left motor B0):

Master station (COB-ID:0x601)	Slave station (COB-ID:0x581)	Function description
2B 30 20 07 00 00 00 00	60 30 20 00 00 00 00 00	Close the left motor brake

4. Object Dictionary

The parameter register of the ZLAC8030D series bus type hub motor driver includes three parts: the 1000h~1FFFh register defined by CIA301, the 2000h~2FFFh register customized by the manufacturer, and the 6000h~6FFFh register defined by CIA402.

The 1000h~1FFFh register is the basic communication parameter related to CANopen defined by CIA301, including SDO, PDO, and mapping registers;

The 2000h~2FFFh register is a user-defined register content by the manufacturer, including subdivision and modification of current within this set of parameters;

The 6000h~6FFFh registers are motion parameters related to motion control defined by CIA402, including operating mode registers such as position mode, speed mode, torque mode, and related motion parameter registers

Index	Sub-Index	Name	Description	Type	Attribute	PDO mapping	Default value
CiA301 Basic Communication Parameter Group							
1000h	00	Device Type	This device supports the CiA301 and CiA402 protocols	U32	RO	NO	0X00040192
1001h	00	Rrror register	Current error status	U8	RO	NO	0

			of the drive				
1005h	00	Synchronous message COB identifier	Synchronous message COB identifier	U32	RW	NO	0x80
1009h	00	Hardware version	Hardware version	U16	RO	NO	-
100Ah	00	Software version	Software version	U16	RO	NO	-
1014h	00	EMNC emergency message COB	EMNC emergency message COB	U32	RW	NO	0x80
1017h	00	Producer heartbeat interval	Producer heartbeat time interval,unit ms	U16	RW	NO	0
1018h	00	Manufacturer information	Sub-Index	U8	RO	NO	2
	01	Vendor ID	Vendor ID	U32	RO	NO	0x0100
	02	Product Code	Supplier Product Number	U32	RO	NO	0x0001
1200h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	2
	01	COB-ID (slave station receives)	COB-ID (slave station receives)	U32	RO	NO	600h+Node-ID
	02	COB-ID (slave station sends)	COB-ID（slave station sends）	U32	RO	NO	580h+Node-ID
1400h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	RPDO0-COB-ID	Identifier COB-ID	U32	RW/S	NO	200+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh
	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0
	05	Event Timer	Event Timer	U16	RW/S	NO	0
1401h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	RPDO1-COB-ID	Identifier COB-ID	U32	RW/S	NO	300+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh
	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0
	05	Event Timer	Event Timer	U16	RW/S	NO	0
1402h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	RPDO2-COB-ID	标识符 COB-ID	U32	RW/S	NO	400+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh

	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0
	05	Event Timer	Event Timer	U16	RW/S	NO	0
1403h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	RPDO3-COB-ID	COB-ID	U32	RW/S	NO	500+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh
	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0
	05	Event Timer	Event Timer	U16	RW/S	NO	0
1600h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	1
	01	RPDO0-Mapping 1	Map to 6040h register	U32	RW/S	NO	60400010h
	02	RPDO0- Mapping 2	No Mapping	U32	RW/S	NO	-
	03	RPDO0- Mapping 3	No Mapping	U32	RW/S	NO	-
	04	RPDO0- Mapping 4	No Mapping	U32	RW/S	NO	-
1601h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	0
	01	RPDO1- Mapping 1	No Mapping	U32	RW/S	NO	-
	02	RPDO1- Mapping 2	No Mapping	U32	RW/S	NO	-
	03	RPDO1- Mapping 3	No Mapping	U32	RW/S	NO	-
	04	RPDO1- Mapping 4	No Mapping	U32	RW/S	NO	-
1602h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	0
	01	RPDO2- Mapping 1	No Mapping	U32	RW/S	NO	-
	02	RPDO2- Mapping 2	No Mapping	U32	RW/S	NO	-
	03	RPDO2- Mapping 3	No Mapping	U32	RW/S	NO	-
	04	RPDO2- Mapping 4	No Mapping	U32	RW/S	NO	-
1603h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	0
	01	RPDO3- Mapping 1	No Mapping	U32	RW/S	NO	-
	02	RPDO3- Mapping 2	No Mapping	U32	RW/S	NO	-
	03	RPDO3- Mapping 3	No Mapping	U32	RW/S	NO	-
	04	RPDO3- Mapping 4	No Mapping	U32	RW/S	NO	-
1800h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	TPDO0-COB-ID	标识符 COB-ID	U32	RW/S	NO	180+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh
	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0

	05	Event Timer	Event Timer	U16	RW/S	NO	0
1801h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	TPDO1-COB-ID	标识符 COB-ID	U32	RW/S	NO	280+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh
	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0
	05	Event Timer	Event Timer	U16	RW/S	NO	0
1802h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	TPDO2-COB-ID	标识符 COB-ID	U32	RW/S	NO	380+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh
	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0
	05	Event Timer	Event Timer	U16	RW/S	NO	0
1803h	00	Number of sub indexes	Number of sub indexes	U8	RO	NO	5
	01	TPDO3-COB-ID	标识符 COB-ID	U32	RW/S	NO	480+Node-ID
	02	Transport type	Transport type	U8	RW/S	NO	FFh
	03	Prohibited time	Prohibited time	U16	RW/S	NO	0
	04	Save	Save	U8	RW	NO	0
	05	Event Timer	Event Timer	U16	RW/S	NO	0
1A00h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	0
	01	TPDO0-Mapping 1	No Mapping	U32	RW/S	NO	-
	02	TPDO0-Mapping 2	No Mapping	U32	RW/S	NO	-
	03	TPDO0-Mapping 3	No Mapping	U32	RW/S	NO	-
	04	TPDO0-Mapping 4	No Mapping	U32	RW/S	NO	-
1A01h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	0
	01	TPDO1-Mapping 1	No Mapping	U32	RW/S	NO	-
	02	TPDO1-Mapping 2	No Mapping	U32	RW/S	NO	-
	03	TPDO1-Mapping 3	No Mapping	U32	RW/S	NO	-
	04	TPDO1-Mapping 4	No Mapping	U32	RW/S	NO	-
1A02h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	0
	01	TPDO2-Mapping 1	No Mapping	U32	RW/S	NO	-
	02	TPDO2-Mapping 2	No Mapping	U32	RW/S	NO	-
	03	TPDO2-Mapping 3	No Mapping	U32	RW/S	NO	-
	04	TPDO2-Mapping 4	No Mapping	U32	RW/S	NO	-

1A03h	00	Number of sub indexes	Number of sub indexes	U8	RW/S	NO	0
	01	TPDO3-Mapping 1	No Mapping	U32	RW/S	NO	-
	02	TPDO3-Mapping 2	No Mapping	U32	RW/S	NO	-
	03	TPDO3-Mapping 3	No Mapping	U32	RW/S	NO	-
	04	TPDO3-Mapping 4	No Mapping	U32	RW/S	NO	-
Factory custom parameters							
2000h	00	Communication power-down protection time	Driver and host communication power-down time setting Unit: ms Range: 0-32767;	U16	RW	YES	0
2001h	00	RS485 custom driver node number	Rage:0 - 127.	U16	RW	YES	1
2002h	00	RS485 custom communication baudrate	1：128000bps 2：115200bps 3：57600bps 4：38400bps 5：19200bps 6：9600bps	U16	RW	YES	2
2003h	00	Input signal status	2 input signal level status; Bit0 - Bit1: X0 ~ X1 input level status;	U16	RO	YES	0
2004h	00	Output signal status	2 output signal level status; Bit0: Y1 output status; Bit1 ~ Bit2: B0 ~ B1 output status;	U16	RO	YES	0
2005h	00	Clear postion feedback	Used to clear feedback position 0: Invalid; 1: Clear the feedback position of the left motor 2: Clear the feedback position of the right motor 3: Clear the synchronization feedback position	U16	RW	YES	0

2006h	00	Set original position(absolute position move)	Set current position as original position for absolute position move. 0: Invalid; 1: Set original position (left) 2: Set original position (right) 3: Set original position synchronously	U16	RW	YES	0
2007h	00	Shaft lock method	0: Not enable, not lock the shaft; 1: Not enable, lock the shaft;	U16	RW	YES	0
2008h	00	Motor max speed	Motor max working speed Unit: r/min; Range: 1-1000r/min;	U16	RW	YES	300
2009h	00	Register parameter setting	0: Invalid; 1: Restore factory settings;	U16	RW	YES	0
200Ah	00	CAN custom driver node number	Range: 1-127;	U16	RW	YES	1
200Bh	00	CAN custom communication baudrate	0: 1000 Kbit/s 1: 500 Kbit/s 2: 250 Kbit/s 3: 125 Kbit/s 4: 100 Kbit/s	U16	RW	YES	1
200Ch	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Motor pole pair (Left)	4-64	U16	RW	YES	20
	02	Motor pole pair (Right)	4-64	U16	RW	YES	20
200Dh	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Starting speed (left)	The initial speed at which the movement started; Unit The initial speed at which the movement started;	U16	RW	YES	1r/min

			Unit: r/min; Range: 1-256r/ min;				
	02	Starting speed (right)	The initial speed at which the movement started; Unit The initial speed at which the movement started; Unit: r/min; Range: 1-256r/ min;	U16	RW	YES	1r/min
200Eh	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Encoder wire number setting (left)	0-4096	U16	RW	YES	4096
	02	Encoder wire number setting (right)	0-4096	U16	RW	YES	4096
200Fh	00	Synchronous/asynchronous control flag	0: Asynchronous control 1: Synchronous control	U16	RO	YES	1
2010h	00	Whether the parameter are updated to EEPROM	Whether the communication write function code value is updated to EEPROM 0: Invalid; 1: Parameters with attribute RW / S are updated to EEPROM synchronously;	U16	RW	YES	0
2011h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Offset angle of motor and Hall (left)	Unit: 1° ; Range: -360-+360	I16	RW	YES	0
	02	Offset angle of motor and Hall (right)	Unit: 1° ; Range: -360-+360	I16	RW	YES	0
2012h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Overload factor (left)	Range: 0-300, Unit: %	U16	RW	YES	200
	02	Overload factor	Range: 0-300,	U16	RW	YES	200

		(right)	Unit: %				
2013h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Motor temperature protection threshold (left)	Unit: 0.1° C; Range: 0-1200	U16	RW	YES	800
	02	Motor temperature protection threshold (right)	Unit: 0.1° C; Range: 0-1200	U16	RW	YES	800
	03	Driver temperature protection threshold	Unit: 0.1° C; Range: 0-1200	U16	RW	YES	800
2014h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	Rated current (left)	Driver rated output current Unit: 0.1A; Range: 0-300	U16	RO	NO	200
	02	Rated current (right)	Driver rated output current Unit: 0.1A; Range: 0-300	U16	RW	YES	200
2015h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	Maximum current (left)	Maximum driver output current Unit: 0.1A; Range: 0-600	U16	RO	NO	600
	02	Maximum current (right)	Maximum driver output current Unit: 0.1A; Range: 0-600	U16	RW	YES	600
2016h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	Overload protection time (left)	Driver overload protection time Unit: 10ms; Range: 0-6553	U16	RO	NO	300
	02	Overload protection time (right)	Driver overload protection time Unit: 10ms; Range: 0-6553	U16	RW	YES	300
2017h	00	Number of	Number of sub-indexes	U16	RW	YES	2

		sub-indexes					
	01	Out of tolerance alarm threshold (left)	Encoder tolerance threshold Unit: *10counts; Range: 1-6553	U16	RO	NO	1638
	02	Out of tolerance alarm threshold (right)	Encoder tolerance threshold Unit: *10counts; Range: 1-6553	U16	RW	YES	1638
2018h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed smoothing coefficient	0-30000	U16	RO	NO	50
	02	R speed smoothing coefficient	0-30000	U16	RW	YES	50
2019h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L current loop proportional coefficient	0-30000	U16	RO	NO	3000
	02	R current loop proportional coefficient	0-30000	U16	RW	YES	3000
201Ah	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L current loop integral gain	0-30000	U16	RO	NO	300
	02	R current loop integral gain	0-30000	U16	RW	YES	300
201Bh	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L feedforward output smoothing coefficient	0-30000	U16	RO	NO	100
	02	R feedforward output smoothing coefficient	0-30000	U16	RW	YES	100
201Ch	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L torque output smooth coefficient	0-30000	U16	RO	NO	100
	02	R torque output smooth	0-30000	U16	RW	YES	100

		coefficient					
201Dh	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed proportional gain Kp	0-30000	U16	RO	NO	80
	02	R speed proportional gain Kp	0-30000	U16	RW	YES	80
201Eh	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed integral gain Ki	0-30000	U16	RO	NO	3000
	02	R speed integral gain Ki	0-30000	U16	RW	YES	3000
201Fh	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed feedforward gain Kf	0-30000	U16	RO	NO	1000
	02	R speed feedforward gain Kf	0-30000	U16	RW	YES	1000
2020h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L position proportional gain Kp	0-30000	U16	RO	NO	200
	02	R position proportional gain Kp	0-30000	U16	RW	YES	200
2021h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L position feedforward gain Kf	0-30000	U16	RO	NO	200
	02	R position feedforward gain Kf	0-30000	U16	RW	YES	200
2022h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed observer coefficient 1	0-30000	U16	RO	NO	1000
	02	R speed observer	0-30000	U16	RW	YES	1000

		coefficient 2					
2023h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed observer coefficient 2	0-30000	U16	RO	NO	750
	02	R speed observer coefficient 2	0-30000	U16	RW	YES	750
2024h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed observer coefficient 3	0-30000	U16	RO	NO	350
	02	R speed observer coefficient 3	0-30000	U16	RW	YES	350
2025h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	YES	2
	01	L speed observer coefficient 4	0-30000	U16	RO	NO	1000
	02	R speed observer coefficient 4	0-30000	U16	RW	YES	1000
2026h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Alarm PWM processing method	0: close; 1: open	U16	RW	YES	0
	02	Overload processing method	0: close; 1: open	U16	RW	YES	0
	03	I/O emergency stop processing mode	0: Lock shaft 1: Release shaft	U16	RW	YES	0
	04	Parking mode	0: Lock shaft 1: Release shaft	U16	RW	YES	0
	05	Send speed resolution	Set value range: 1-A 1: Speed resolution 1RPM 2: Speed resolution 0.5RPM 3: Speed resolution 1/3 RPM 4: Speed resolution 0.25RPM 5: Speed resolution 0.2RPM 6: Speed resolution 1/6RPM 7: Speed resolution 1/7RPM	U16	RW	YES	1

			8: Speed resolution 0.125RPM 9: Speed resolution 1/9RPM A:Speed resolution 0.1RPM				
	06	Speed out of tolerance	0: close; 1: open	U16	RW/S	YES	1
	07	Default rotate direction	0: CW 1: CCW	U16	RW/S	YES	0
2027h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	4
	01	Regen resistance value	Unit 0.1Ω; Range 0-1000 (*0.1)	U16	RW/S	YES	50
	02	Regen resistance power	Unit W; Range 0-1000	U16	RW/S	YES	100
	03	Regen opening voltage	Unit 0.1V; Range 360-750 (*0.1)	U16	RW/S	YES	700
	04	Regen close voltage	Unit 0.1V; Range 310-700 (*0.1)	U16	RW/S	YES	620
	05	Regen function control	Holding brake on/off 0: Close 1: Open	U16	RW/S	YES	1
2030h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	8
	01	Effective level of input terminal	Bit0: Input terminal X0 control position; Bit1: Input terminal X1 control position; Bit2: AD input control bit Bit3~Bit15: reserved; 0: Default; 1: Level reversal; The default input; terminal level rising edge or high level of the driver is valid	U16	RW	YES	0
	02	Input terminal X0 terminal function selection	0: Undefined; 1-6: NC; 9: Emergency stop signal	U16	RW	YES	9
	03	Input terminal X1 terminal function selection		U16	RW	YES	0
	04	Effective level	Bit0: output terminal	U16	RW	YES	0

		of output terminal	Y0 control position; Bit1: Output terminal B0 control position; Bit2: Output terminal B1 control position; 0: Default; 1: Level reversal; The default input terminal level rising edge or high level of the driver is valid				
	05	Output terminal Y0 terminal function selection	0: Undefined 1: Alarm signal; 2: Driver status signal; 3: In place signal (reserved)	U16	RW	YES	0
	06	NC	NC	U16	RW	YES	0
	07	Output port B0 function selection	Brake state 0: Open 1: Close	U16	RW	YES	0
	08	Output port B1 function selection	Brake state 0: Open 1: Close	U16	RW	YES	0
2031h	00	Software version	Factory default	U16	RO	NO	-
2032h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	3
	01	Motor temperature (left)	Unit: 0.1° C; Range: -500~1200° C	U16	RO	YES	-
	02	Motor temperature (right)	Unit: 0.1° C; Range: -500~1200° C	U16	RO	YES	-
	03	Driver temperature	Unit: 0.1° C; Range: -500~1200° C				-
2033h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Motor status register (left)	The driver controls the motor motion state 0: The motor is stationary; 1: Motor is running;	U16	RO	YES	0
	02	Motor status register (right)	The driver controls the motor motion state 0: The motor is stationary;	U16	RO	YES	0

			1: Motor is running;				
2034h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Hall input state (left)	0-7; If 0 or 7 appears, it is a Hall error	U16	RO	YES	0
	02	Hall input state (right)	0-7; If 0 or 7 appears, it is a Hall error	U16	RO	YES	0
2035h	00	Bus voltage	Unit: 0.01V	U16	RO	YES	0
CiA 402 参数组							
603Fh	00	Error_code	Factory-defined drive error conditions. High 16 bit: right motor, Low 16 bit:left motor. 0x0000 0000h: no error; 0x0000 0001h: over-voltage; 0x0000 0002h: under-voltage; 0x0000 0100h：EEPROM read and write error; Left motor: 0x0000 0004h: over-current; 0x0000 0008h: overload; 0x0000 0010h: current out of tolerance;(Reserved) 0x0000 0020h: encoder out of tolerance; 0x0000 0040h: velocity out of tolerance;(Reserved) 0x0000 0080h: reference voltage error; 0x0000 0200h: hall error; 0x0000 0400h: high motor temperature.	U16	RO	YES	0

			0x0000 0800h: Encoder error 0x0000 1000h: high driver temperature. 0x0000 2000h: Speed setting error (the given speed cannot exceed the rated speed). Right Motor: 0x0004 0000h: over-current 0x0008 0000h: overload 0x0010 0000h: current out of tolerance;(Reserved) 0x0020 0000h: encoder out of tolerance; 0x0040 0000h: velocity out of tolerance;(Reserved) 0x0080 0000h: reference voltage error; 0x0200 0000h: hall error; 0x0400 0000h: high motor temperature. 0x0800 0000h: Encoder error 0x1000 0000h: high driver temperature. 0x2000 0000h: Speed setting error (the given speed cannot exceed the rated speed).				
6040h	00	Controlword	Control word	U16	RW	YES	0
6041h	00	Statusword	Status word; High 16 bit: left motor; Low 16 bit: right motor.	U32	RO	YES	0

605Ah	00	Quick_stop_option_code	Driver processing method after quick stop command. 0x00 05: Stop normally , maintain quick stop status; 0x00 06: Decelerate to stop emergencely and maintain quick stop state; 0x00 07: Emergency stop, maintain quick stop state;	I16	RW	NO	5
605Bh	00	Shutdown_option_code	Driver processing method after the close command 0x00 00: invalid; 0x00 01: Stop normally, go to ready to switch on state;	I16	RW	NO	1
605Ch	00	Disable_operation_option_code	Driver processing mode after the disable operation command 0x00 00: Invalid; 0x00 01: Stop normally , switch to switched on state;	I16	RW	NO	1
605Dh	00	Disable_operation_option_code	Driver processing mode after the disable operation command 0x00 01: Stop normally , switch to Operation Enabled state; 0x00 02: Decelerate to stop emergencely and maintain Operation Enabled state; 0x00 03: Emergency stop, maintain Operation Enabled state;	I16	RW	NO	1
6060h	00	Modes_of_operation	0: undefined; 1: position mode;	I8	RW	YES	0

			3: velocity mode; 4: torque mode;				
6061h	00	Modes_of_operation_display	0: undefined; 1: position mode; 3: velocity mode; 4: torque mode;	I8	RO	YES	0
6064h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Position_actual_value (left)	Actual position feedback, unit: count;	I32	RO	YES	0
	02	Position_actual_value (right)	Actual position feedback, unit: count;	I32	RO	YES	0
606Ch	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	3
	01	Velocity_actual_value (left)	Current motor speed, Unit: 0.1 r / min	I32	RO	YES	0
	02	Velocity_actual_value (right)	Current motor speed, Unit: 0.1 r / min	I32	RO	YES	0
	03	Left motor and right motor speed actual value combination High 16 is left motor, Low 16 is right motor.	Current motor speed, Unit: 0.1 r / min	U32(I16+I16)	RO	YES	0
6071h	00	Number of sub-indexes	Number of sub-indexes	U16	RW	NO	3
	01	Target torque (left)	Unit: mA Range: -30000~30000;	I16	RW	YES	0
	02	Target torque (right)	Unit: mA Range: -30000~30000;;	I16	RW	YES	0
	03	Left moroe and right motor target torque combination Low 16 is the left motor, High 16 is the right motor	Unit: mA Range: -30000~30000;	U32(I16+I16)	RW	YES	0
6077h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	3

	01	Torque actual value (left)	Unit: 0.1A Range: -600~600;	I16	RO	YES	0
	02	Torque actual value (right)	Unit: 0.1A Range: -600~600;	I16	RO	YES	0
	03	Left motor and right motor torque actual value combination Low 16 is the left motor, High 16 is the right motor	Unit: 0.1A Range: -600~600;	U32(I16+I16)	RW	YES	0
607Ah	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Target_position (left)	Total number of pulses in profile position mode; Range: Relative: -0x7FFFFFFF~0x7FFFFFFF Absolute: -0x3FFFFFFF~0x3FFFFFFF	I32	RW	YES	0
	02	Target_position (right)	Total number of pulses in profile position mode; Range: Relative: -0x7FFFFFFF~0x7FFFFFFF Absolute: -0x3FFFFFFF~0x3FFFFFFF	I32	RW	YES	0
6081h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Profile_velocity (left)	Max speed in profile position mode; Range: 1-1000r/min;	U32	RW	YES	120r/min
	02	Profile_velocity (right)	Max speed in profile position mode; Range: 1-1000r/min;	U32	RW	YES	120r/min
6082h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2

	01	End_velocity (left)	Start / stop speed in profile position mode; Range: 1-250r/min;	U32	RW	YES	1r/min
	02	End_velocity (right)	Start / stop speed in profile position mode; Range: 1-250r/min;	U32	RW	YES	1r/min
6083h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	S-shape acceleration (left)	Acceleration time; Range: 0-32767ms;	U32	RW	YES	10ms
	02	S-shape acceleration (right)	Acceleration time; Range: 0-32767ms;	U32	RW	YES	10ms
6084h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	S-shape deceleration (left)	Deceleration time; Range: 32767ms;	U32	RW	YES	10ms
	02	S-shape deceleration (right)	Deceleration time; Range: 32767ms;	U32	RW	YES	10ms
6085h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Quick_stop_deceleration (left)	Deceleration time; Range: 0-32767ms;	U32	RW	YES	10ms
	02	Quick_stop_deceleration (right)	Deceleration time; Range: 0-32767ms;	U32	RW	YES	10ms
6087h	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Torque Slope (left)	Current/1000/second; Unit: mA/s;	U32	RW	YES	300ms
	02	Torque Slope (right)	Current/1000/second; Unit: mA/s;	U32	RW	YES	300ms
60FFh	00	Number of sub-indexes	Number of sub-indexes	U16	RO	NO	2
	01	Target_velocity (left)	Target speed in profile velocity mode; Range: -1000-1000r/min;	I32	RW	YES	0
	02	Target_velocity	Target speed in	I32	RW	YES	0

		(right)	profile velocity mode; Range: -1000-1000r/min;				
	03	Left and right target speed combination Low 16 is the left motor High 16 is the right moto	Target speed in profile velocity mode; Range: -1000~1000r/min;	U32(I16+I16)	RO	YES	0

Note:

- U16 means unsigned 16 bits; I16 means signed 16 bits; U32 means unsigned 32 bits; I32 means signed 32 bits.