

CT-5331 CANopen Master module

1 Module Description

The CANopen master module supports 1 x CAN interface, supports the CANopen master working mode.

The CT-5331 could be applied with the I/O adapter modules, so it could convert CANopen into other protocols, such as Modbus-TCP, Profinet, EtherCAT, Ethernet/IP, etc. When the module is used, input and output commands need to be configured in the IO Config software through the Type-C interface of the module.

All slave devices that support the CANopen protocol can use this module to interconnect with the upper PLC or the upper computer. Such as: CANopen remote IO station, CANopen various sensors, CANopen drivers and so on.

2 Technical Parameters

General Parameters	
Power	Max.50mA@5.0Vdc
Isolation	I/O to internal bus: opto-couple isolation (3KVrms)
Field Power	Nominal voltage: 24Vdc Input range: 19.2~28.8Vdc
Wiring	I/O wiring: Max.: AWG 18
Mounting Type	35mm Din-Rail
Size	115*14*75mm
Weight	65g
Environment Specification	
Operating Temperature of Vertical Installation	-35°C~60°C
Operating Temperature of Horizontal Installation	-35°C~70°C
Relative Humidity	5~ 95%RH (No Condensation)
Storage Temperature	-40°C~85°C
Storage Humidity	5~ 95%RH (No Condensation)
Manufacturing Test Temperature	-40°C~75°C
Ingress Protection Rating	IP20
Vibration Resistance	Comply with IEC 61131-2 and EC 60068-2-6
Impact resistance	Comply with IEC 61131-2 and IEC 60068-2-27
EMC Performance	Comply with IEC 61131-2 and IEC 61000-4
CAN Parameters	
Channel Number	1channel
Interface	CAN
Protocol	CANopen Conform DS301 V4.02
Working Mode	CANopen Master
Station Number	16 Slave station
Baud Rate	10K~1Mbps
Support	PDO, SDO, Heartbeat, NMT, EMCY and Network Scan
Support	Automatically assign PDO serial number, Default: disabled
Support	Automatically assign PDO COB-ID, Default: disabled
Support	Reset function to restore factory Setting

 WARNING

UNEXPECTED EQUIPMENT OPERATION

Do not exceed any of the ratings specified in the environmental and electrical characteristics table.

Failure to follow instructions specified by the manufacturer may result in serious consequences such as death, personal injury, or damage to equipment since the protection provided by the equipment may be impaired.

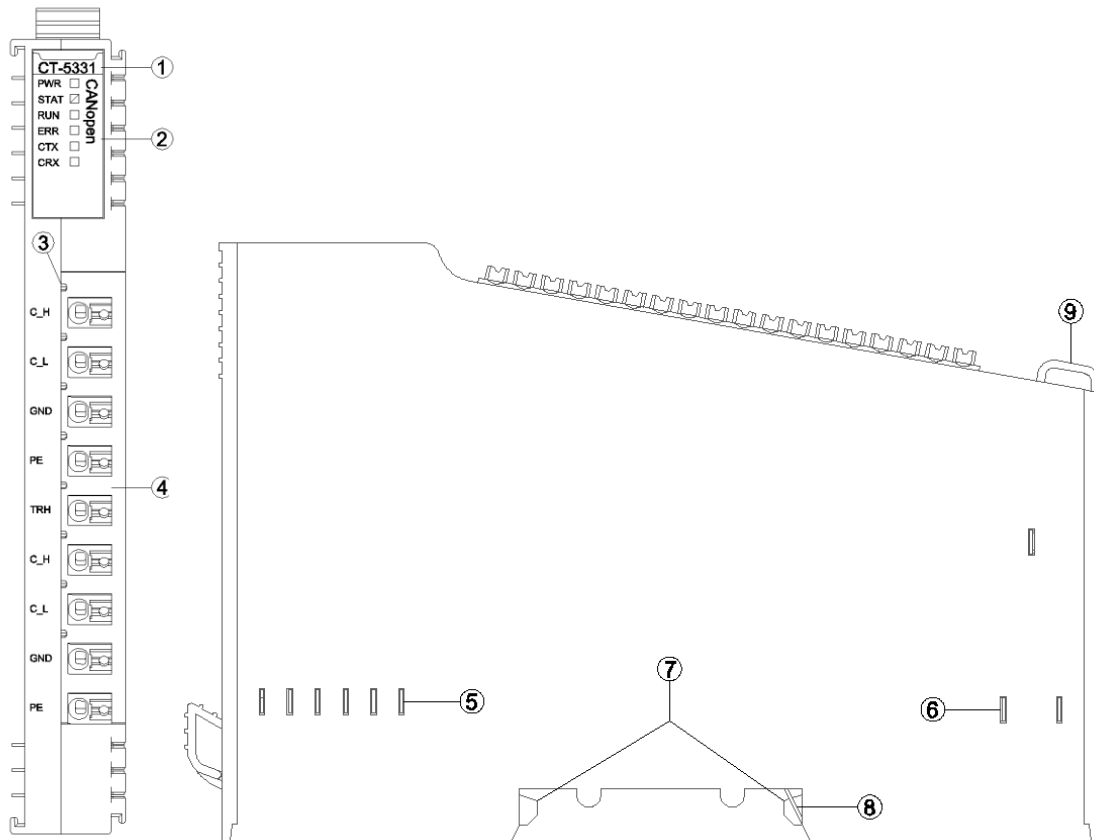
 AVERTISSEMENT

FONCTIONNEMENT INATTENDU DE L'EQUIPEMENT

Ne dépassez aucune évaluation spécifiée dans le tableau de caractéristiques environnementales et électriques..

Le fait de ne pas suivre les instructions peut entraîner une défaillance de la protection fournie par l'équipement, ce qui peut entraîner des conséquences graves, comme des blessures ou des dommages à l'équipement.

3 Hardware Interface



- ① Module Type
- ② State indicator
- ③ N/A
- ④ Wiring Terminal and identification
- ⑤ Internal Bus
- ⑥ Field Power
- ⑦ Buckle
- ⑧ Grounding Spring Sheet Fixed Wiring Harness
- ⑨ Fixed Wiring Harness

3.1 Wiring Terminal

Terminal	Location at Head, tail of the CAN bus	Location at middle of the CAN bus
C_H	CAN_H signal wire	CAN_H signal wire
C_L	CAN_L signal wire	CAN_L signal wire
GND	CAN signal earth	CAN signal earth
PE	Ground terminal	Ground terminal
TRH	Built-in terminal resistance	
C_H		CAN_H signal wire
C_L	N/A	CAN_L signal wire
GND		CAN signal earth
PE		Ground terminal

WARNING

UNEXPECTED EQUIPMENT OPERATION

Calculate the maximum field power current consumption of a single module based on the actual field load. If the total field power current consumption of all I/O modules exceeds the power supply capacity of the field power supply, you must add an extra power expansion module. Otherwise, an output channel exception may occur.

Failure to follow instructions specified by the manufacturer may result in serious consequences such as death, personal injury, or damage to equipment since the protection provided by the equipment may be impaired.

AVERTISSEMENT

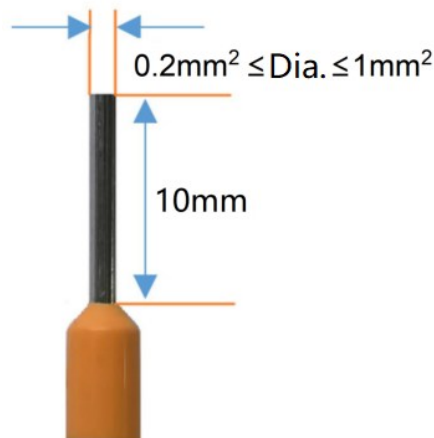
FONCTIONNEMENT INATTENDU DE L'EQUIPEMENT

Calculez la consommation maximale de courant de champ d'un seul module en fonction de la charge de champ réelle. Si la consommation totale de courant de champ de tous les modules d'E/S dépasse la capacité d'alimentation de l'alimentation de champ, vous devez ajouter un module d'extension de puissance supplémentaire. Dans le cas contraire, une exception de canal de sortie peut se produire.

Le fait de ne pas suivre les instructions peut entraîner une défaillance de la protection fournie par l'équipement, ce qui peut entraîner des conséquences graves, comme des blessures ou des dommages à l'équipement.

When connecting a cold-pressed terminal, the terminal must be terminated and checked in strict accordance with the corresponding termination specifications or

requirements, and connect the cold-pressed terminal according to the corresponding node serial number. The conductor should use copper conductor and the conductor core should be larger than 0.2mm^2 and smaller than 1mm^2 (AWG18~AWG24). Cold-pressed terminal parameters are as follows:



! WARNING

UNEXPECTED EQUIPMENT OPERATION

Strip the length of the conductor insulation layer is greater than 10mm to ensure reliable signal connection.

The wire needs to use copper wire and the wire core is greater than or equal to 0.2mm^2 and less than or equal to 1mm^2 to ensure reliable signal connection.

When connecting a cold-press terminal, connect the cold-press terminal strictly in accordance with the corresponding termination specifications or requirements, and connect the cold-press terminal according to the corresponding node serial number.

Do not power on cold-press terminals until they are properly connected or fully locked.

Failure to follow instructions specified by the manufacturer may result in serious consequences such as death, personal injury, or damage to equipment since the protection provided by the equipment may be impaired.

! AVERTISSEMENT

FONCTIONNEMENT INATTENDU DE L'EQUIPEMENT

Dépouillez la longueur de la couche isolante du fil plus de 10mm pour assurer la connexion fiable du signal.

Le conducteur doit utiliser le fil de cuivre et le noyau de fil est supérieur ou égal à $0,2\text{ mm}^2$, inférieur ou égal à 1mm^2 , afin d'assurer la connexion fiable du signal.

Lorsque les terminaux de presse à froid sont terminés, ils doivent être terminés et visualisés en

stricte conformité avec les spécifications ou les exigences correspondantes et terminés selon le numéro de série de noeud correspondant.

Il est interdit d'activer les bornes à froid avant qu'elles ne soient correctement articulées ou complètement verrouillées.

Le fait de ne pas suivre les instructions peut entraîner une défaillance de la protection fournie par l'équipement, ce qui peut entraîner des conséquences graves, comme des blessures ou des dommages à l'équipement.

DANGER

FIRE DANGER

Use the correct wiring rules only for the maximum current capacity of the I/O channel and power supply.

Failure to follow instructions specified by the manufacturer may result in serious consequences such as death, personal injury, or damage to equipment since the protection provided by the equipment may be impaired.

WARNING

UNEXPECTED EQUIPMENT OPERATION

Do not exceed any of the ratings specified in the environmental and electrical characteristics table.

Failure to follow instructions specified by the manufacturer may result in serious consequences such as death, personal injury, or damage to equipment since the protection provided by the equipment may be impaired.

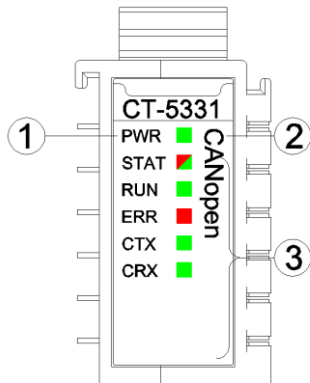
AVERTISSEMENT

FONCTIONNEMENT INATTENDU DE L'EQUIPEMENT

Ne dépassez aucune évaluation spécifiée dans le tableau de caractéristiques environnementales et électriques..

Le fait de ne pas suivre les instructions peut entraîner une défaillance de la protection fournie par l'équipement, ce qui peut entraîner des conséquences graves, comme des blessures ou des dommages à l'équipement.

3.2 LED indicator definition



PWR power indicator (Green)	Definition
ON	The system power supply is normal.
OFF	The system power supply is failure.
STAT- Module State Indicator (Red/Green)	Definition
Double Flash (RED)	Module Exception has been soft-restarted
ON (GREEN)	Operational Mode
Green Single Flash	Stop mode
Flash(2.5Hz) (RED/GREEN)	Upgrading mode
Flash(10Hz) (RED/GREEN)	Firmware Update
RUN -Running status indicator (Green)	Definition
Flash(2Hz)	Pre-Operational status
Single flash	Stopped status
Steady on	operation status
ERR Error status indicator (red)	Definition
Single flash	CAN error frame reaches warning value
Double flash	Error control event
Steady on	Bus Off
OFF	Bus in normal
CTX CAN Sending indicator (Green)	Definition
Flash	CAN is sending data
OFF	CAN not sending data
CRX CAN Receiving indicator (Green)	Definition
Flash	CAN is receiving data
OFF	CAN not receiving data

! WARNING

UNEXPECTED EQUIPMENT OPERATION

By viewing the PW indicator, could determine the power supply status of a module. If the PW is steady green, the power supply is normal. Otherwise, the module cannot work properly.

When the module is initially powered on, there will be 3S for the backplane bus connection. After the backplane bus is initialized, STA is in the green steady state. If STA is in the green blinking state, it indicates that the backplane bus has not been initialized, and it needs to be powered off and restarted for re-initialization.

STA abnormal working state occurs during the normal operation of the module, please check the firmware version information of all modules, and consult ODOT technical support for details.

If a module is upgraded, check that all modules are in the normal state after the upgrade. Otherwise, an exception may occur.

Failure to follow instructions specified by the manufacturer may result in serious consequences such as death, personal injury, or damage to equipment since the protection provided by the equipment may be impaired.

AVERTISSEMENT

FONCTIONNEMENT INATTENDU DE L'EQUIPEMENT

En regardant l'état de l'indicateur de PW, jugez l'état d'alimentation du module. Le feu vert PW reste allumé et l'alimentation est normale. Autrement, le module ne fonctionnera pas correctement.

Lorsque le module est alimenté initialement, il y aura 3S pour la connexion de bus de backboard. STA est un état vert permanent après l'initialisation du bus de backboard. Si STA est en état de clignotement vert, cela signifie que l'initialisation du bus de backboard n'est pas passée et doit être redémarrée hors tension et réinitialisée.

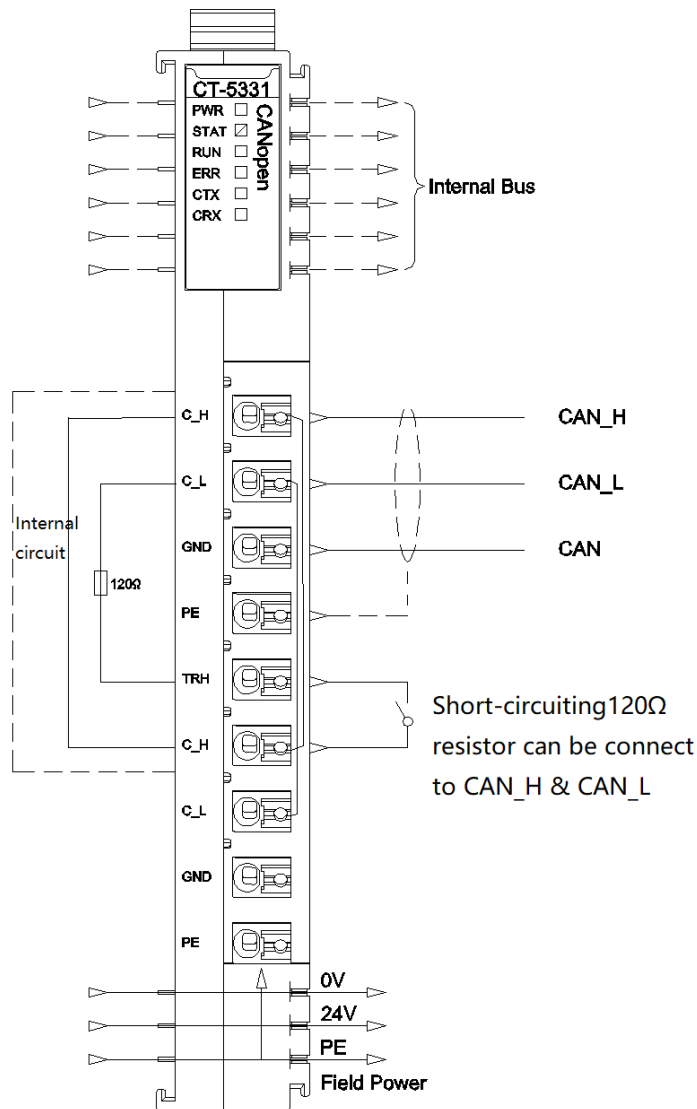
L'état de fonctionnement anormal de STA se produit pendant le fonctionnement normal du module, veuillez vérifier les informations de version du firmware de tous les modules, et consulter le support technique ODOT pour plus de détails.

Si le module a une opération de mise à niveau, après l'achèvement de la mise à niveau, le besoin de vérifier que tous les modules sont dans l'état normal avant de courir, sinon il conduira à une exception.

Le fait de ne pas suivre les instructions peut entraîner une défaillance de la protection fournie par l'équipement, ce qui peut entraîner des conséquences graves, comme des blessures ou des dommages à l'équipement.

4 Wiring

CT-5331 set location at Head, tail of the CAN bus



NOTICE

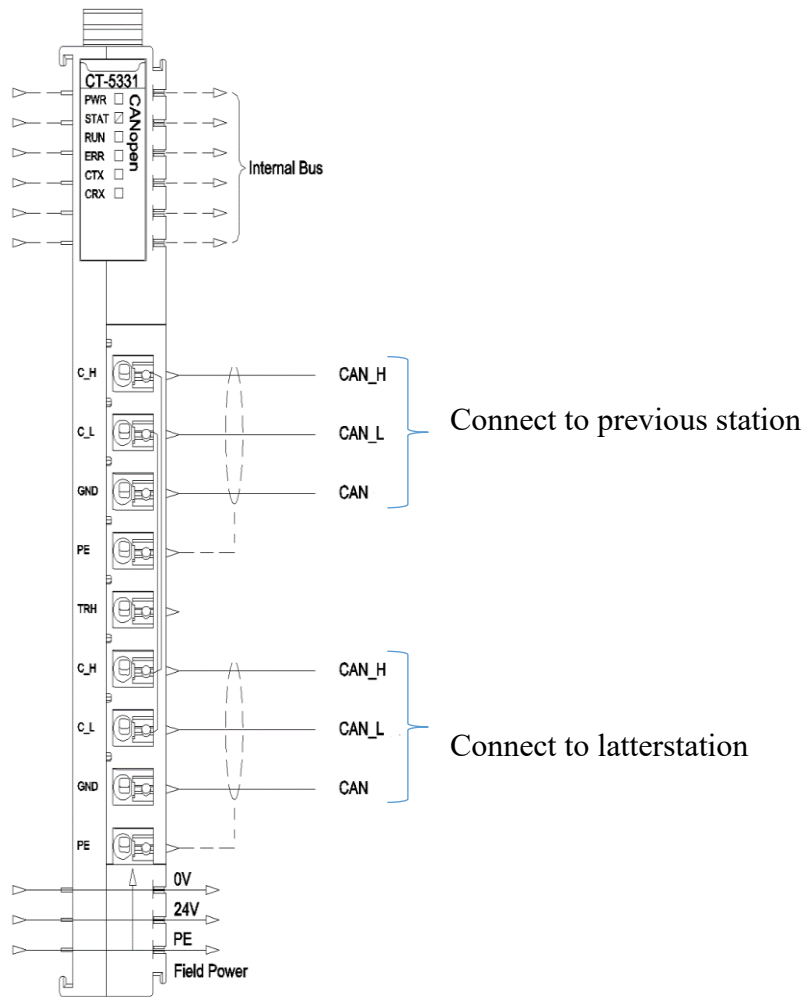
EQUIPMENT INOPERABLE

Do not crimp the spring terminal with more than the maximum pressure specified for the terminal. Otherwise, the resilience of the spring terminal may be damaged and the terminal rebound may be affected.

Do not press the spring terminal with a sharp tool when removing cable from the channel. Otherwise, the spring terminal will be damaged.

Failure to follow these instructions may result in equipment damage.

CT-5331 set location at middle of the CAN bus



5 Process data definition

5.1 Module process data definition

CT-5331, the module itself has no input or output process data.

5.2 Submodule process data mapping

The network adapter reads and writes the input and output process data of the submodule of CT-5331 in real time through the internal bus.

6 Configuration parameters definition

6.1 CT-5331 Configuration parameter definition

Configuration parameter								
Bit No	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BYTE0					Auto COB-ID	Auto PDO Number	Auto Start	CAN Mode
BYTE1	Manager Node ID							
BYTE2					CAN Baud Rate			
BYTE3								SYNC ENABLE
BYTE4	SYNC COBID							
BYTE5								
BYTE6	SYNC Cycle							
BYTE7								
BYTE8								
BYTE9								
BYTE10	SYNC Window Length							
BYTE11								
BYTE12								
BYTE13								
BYTE14	Heartbeat time							
BYTE15								
BYTE16	Consumer/Producer Heartbeat Ratio							
BYTE17								
BYTE18								
BYTE19								
BYTE20	SDO timeout							
BYTE21								

Working Mode: Module working mode (Default: CANopen Host/Master)

Auto Start: (Default : enable)

Auto Generate PDO Nunber: Automatically assign PDO serial number,

Enable or Disable are optional. (Default: enable)

Auto Generate PDO COB-ID: Automatically assign PDO COB-ID, Enable or

Disable are optional .(Default: enable)

Manager Node-ID: Manager node address (Default: 127)

CAN BaudRate: CAN Baud Rate (Default: 125KBit/sec)

0: 1MBit/sec

- 1: 800 KBit/sec
- 2: 500 KBit/sec
- 3: 250 KBit/sec
- 4: 125 KBit/sec
- 5: 100 KBit/sec
- 6: 50 KBit/sec
- 7: 20 KBit/sec
- 8: 10 KBit/sec

SYNC Enable: (Default: disable)

- 0: Disable
- 1: Enable

SYNC COB-ID: sync identifier (Default: 0x0800)

Communication Cycle Period (us) : 32-bit unsigned value can be set up.

(Default : 0)

Synchronnous Windows Length(us): 32-bit unsigned value can be set up

(Default: 0)

Manager Producer Heartbeat time(ms): 0~65535 can be set up. (Default: 1000)

Consumer/Producer Heartbeat Ratio: 1.5~10 can be set up (Default : 1.5)

SDO Response Timeout (ms): the master waits for the slave station to respond after sending commands : 100~2000 can be set up (Default : 500)

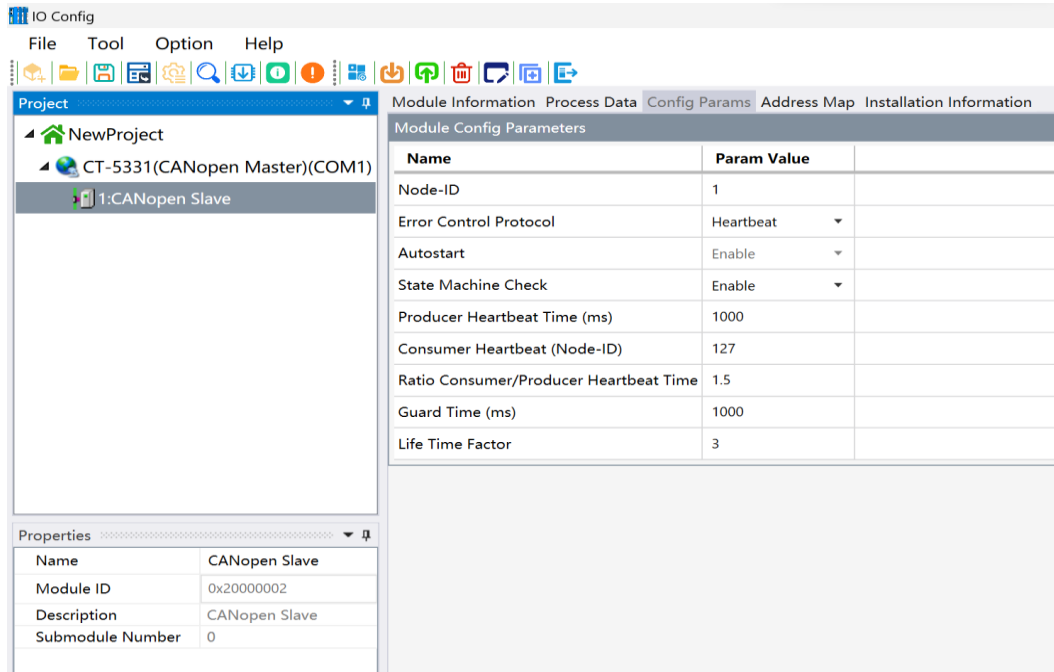
6.2 CT-5331 Parameter definitions for submodules

6.2.1 CANopen Slave station

The CT-5331 module supports mounting of 16 CANOPEN slave devices, each with 4 RPos and 4 TPos by default.

6.2.1.1 CANopen Slave station configure parameters

Configure Parameters								
Bit No	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BYTE0	CAN Node ID							
BYTE1						State Machine Check	Auto Star	Error Control Protocol
BYTE2	Producer Heartbeat Time(ms)							
BYTE3								
BYTE4	Consumer Heartbeat Time Node ID							
BYTE5	Consumer/Producer Heartbeat Ratio							
BYTE6								
BYTE7								
BYTE8								
BYTE9	Guard Time(ms)							
BYTE10								
BYTE11	Life Time Factor							



CAN Node ID: Can be set 1-127, Default :1

Error Control Protocol : Error control protocol, Heartbeat packet and node protection are optional, Default : Heartbeat

Auto Star : Automatically, Default: enable

State Machine Check: State machine check: Enable or disable (optional), Default: enable

Producer Heartbeat Time: Producer Heartbeat Time (ms),16 bits unsigned type, Default:1000

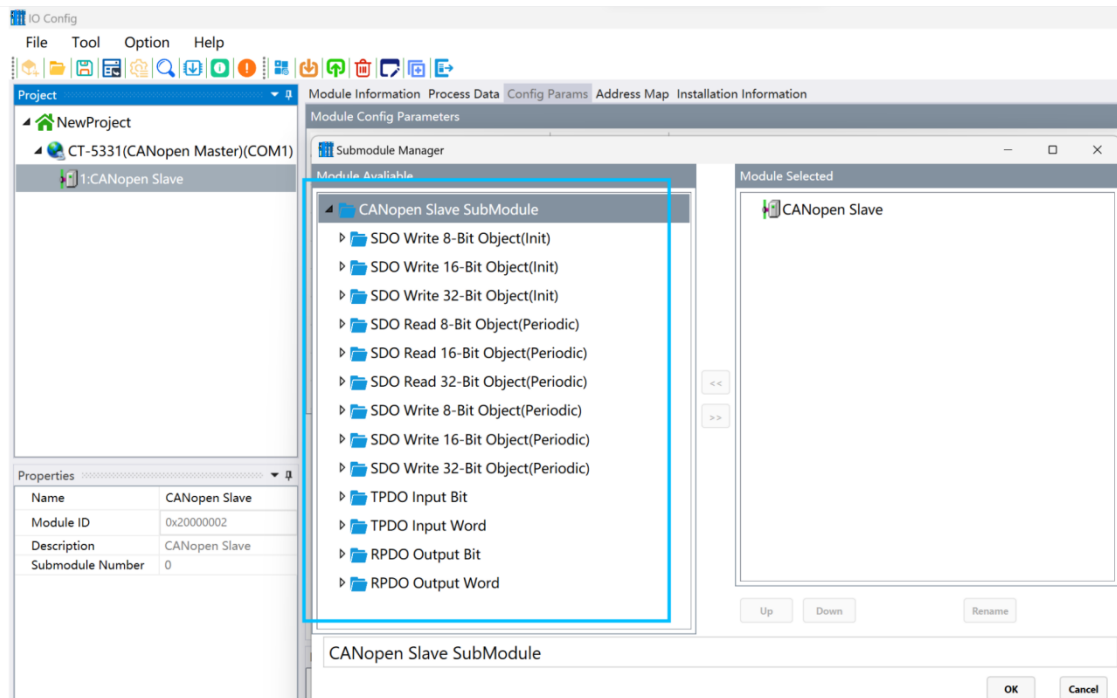
Consumer Heartbeat Time Node ID: can be set 0-127, Default :127

Consumer/Producer Heartbeat Ratio: Consumer/Producer Heartbeat Ratio,can be set 1.5-10 , Default :1.5

Guard Time: guard Time (ms), 6 bits unsigned type, Default :1000

Life Time Factor: Life Time ,8 bits unsigned type, Default : 3

6.2.1.2 CANopen Sub-module



Contains:

SDO Write 8bit Object (Init) : include Write 1~8 8bit Objects

SDO Write16bit Object (Init) : include Write 1~8 16bit Objects

SDO Write 32bit Object (Init) : include Write 1~8 32bit Objects

SDO Read 8bit Object (Read Periodic) : include Read 1~8 8bit Objects

SDO Read 16bit Object (Read Periodic) : include Read 1~8 16bit Objects

SDO Read 32bit Object (Read Periodic) : include Read 1~8 32bit Objects

SDO Write 8bit Object (Write Periodic) : include Write 1~8 8bit Objects

SDO Write 16bit Object (Write Periodic) : include Write 1~8 16bit Objects

SDO Write 32bit Object (Write Periodic) : include Write 1~8 32bit Objects

TPDO data input (Bit variable) : include TPDO input 1~8 byte (bit)

TPDO data input (Word variable) : include TPDO input 1~8 byte (word)

TPDO data output (Bit variable) : include RPDO data input 1~8 byte (bit)

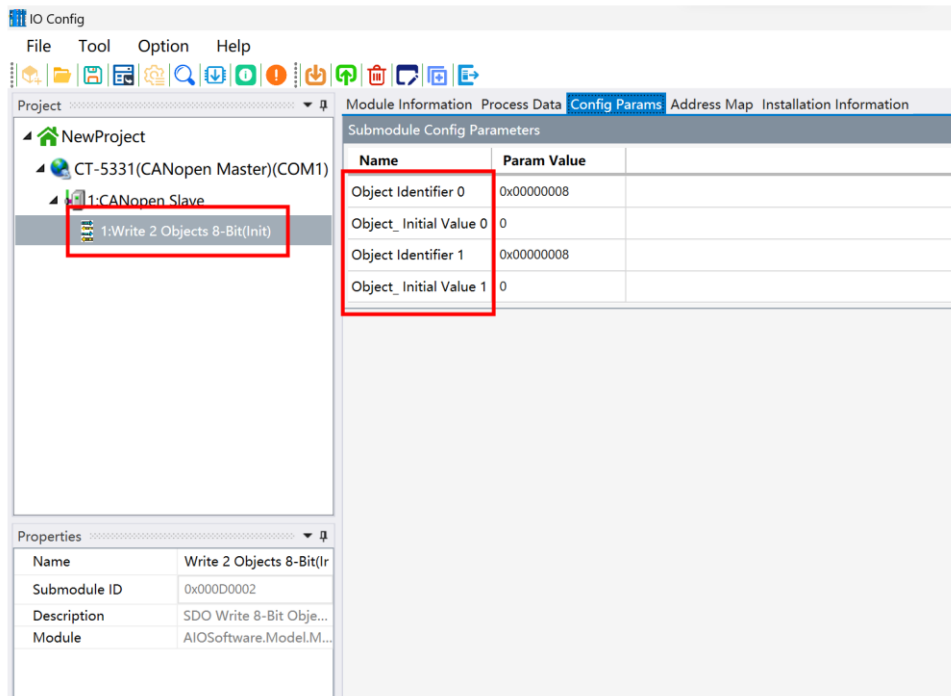
TPDO data output (Word variable) : include RPDO data input 1~8 byte (word)

1. SDO Init Write

The instruction configuration parameters include the object identifier (index + subindex + data length) and the initial value of the object.

Object Identifier: object identifier (index + subindex + data length)

Object Initial Value: Initial Value



2. SDO Read Periodic, Write Periodic The instruction configuration parameters includes: Scan speed, object identifier (index + subindex + data length).

Scan Rate(ms) : Scan speed, Default :1000ms

Object Identifier: object identifier, (index + subindex + data length).

IO Config

File Tool Option Help

Project

- NewProject
 - CT-5331(CANopen Master)(COM1)
 - 1:CANopen Slave
 - 1:Read 1 Object 8-Bit (Periodic)
 - 2:Read 2 Objects 8-Bit(Periodic)
 - 3:Read 3 Objects 8-Bit(Periodic)

Module Information Process Data Config Params Address Map Installation Information

Submodule Config Parameters

Name	Param Value
Scan Rate (ms)	1000
Object Identifier 0	0x00000008
Object Identifier 1	0x00000008

Properties

Name	Read 2 Objects 8-Bit(Pe
Submodule ID	0x00010002
Description	SDO Read 8-Bit Objec...
Module	AIOSoftware.Model.M...

IO Config

File Tool Option Help

Project

- NewProject
 - CT-5331(CANopen Master)(COM1)
 - 1:CANopen Slave
 - 1:Read 1 Object 8-Bit (Periodic)
 - 2:Read 2 Objects 8-Bit(Periodic)
 - 3:Read 3 Objects 8-Bit(Periodic)
 - 4:Write 1 Object 8-Bit(Periodic)
 - 5:Write 2 Objects 8-Bit(Periodic)
 - 6:Write 3 Objects 8-Bit(Periodic)
 - 7:Write 4 Objects 8-Bit(Periodic)
 - 8:Write 5 Objects 8-Bit(Periodic)
 - 9:Write 2 Objects 16-Bit(Periodic)
 - 10:Write 2 Objects 16-Bit(Periodic)

Module Information Process Data Config Params Address Map Installation Information

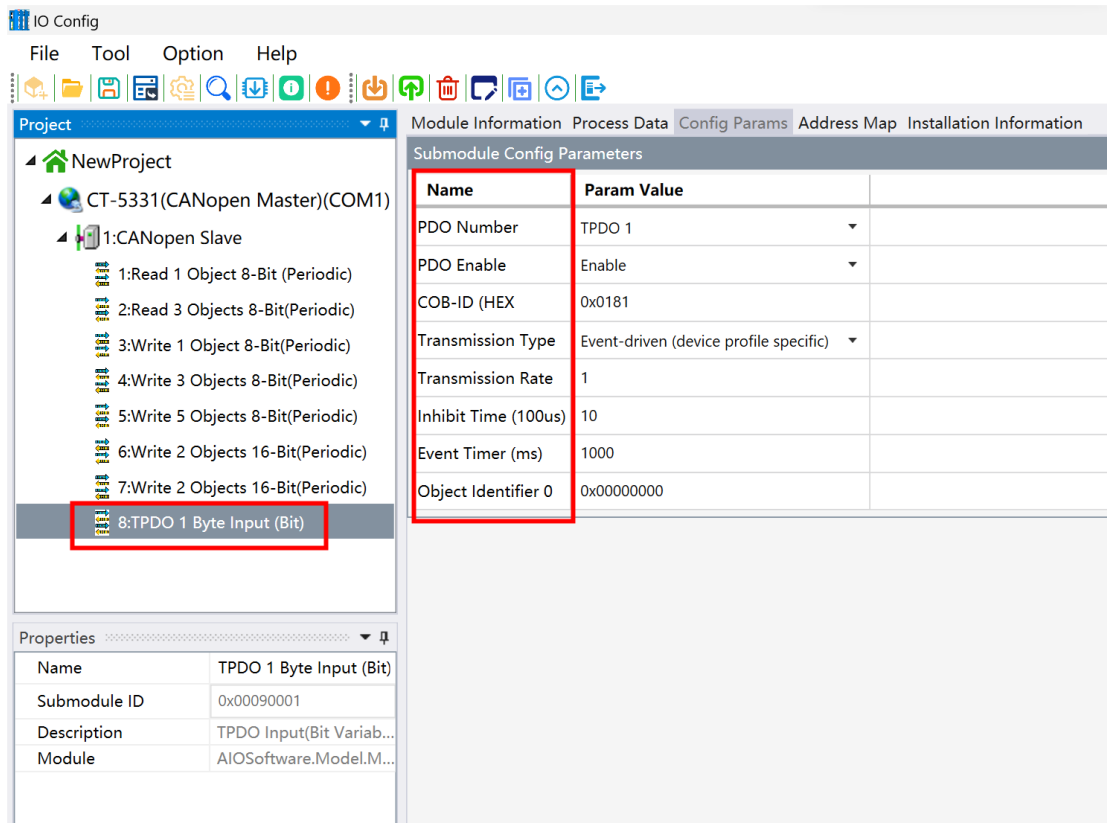
Submodule Config Parameters

Name	Param Value
Scan Rate (ms)	1000
Object Identifier 0	0x00000010
Object Identifier 1	0x00000010

Properties

Name	Write 2 Objects 16-Bit(
Submodule ID	0x00060002
Description	SDO Write 16-Bit Obj...
Module	AIOSoftware.Model.M...

3. TPDO data input Configuration parameters



TPDO Number: TPDO1, TPDO2, TPDO3.....TPDO64

PDO Enable: Enable or disable (optional), Default: enable

COB-ID(HEX): 16#0x180+Node_ID

Transmission Type : Synchronous (acyclic) , Synchronous (cyclic) Event-driven(manufacture specific), Event-driven(device profile specific) can optional , Default: Event-driven (device profile specific)

Transmission Rate: 8bit unsigned type, Default: 1

Inhibit Time(100us): inhibit time (100us) , 16bit unsigned type, Default: 10

Event Timer: event timer (ms), 16 bits unsigned type, Default: 1000

Object Identifier: object identifier, (index + subindex + data length).

4. RPDO data output Configuration parameters

The screenshot shows the IO Config software interface. The Project tree on the left lists the configuration for a CANopen Master (COM1) and its slave. The '8:RPDO 2 Bytes Output (Bit)' module is selected. The Properties panel at the bottom shows the details for this module. The Submodule Config Parameters table on the right lists the configuration parameters for the selected module.

Name	Param Value
PDO Number	RPDO 1
PDO Enable	Enable
COB-ID (HEX)	0x0201
Transmission Type	Event-driven (device profile specific)
Transmission Rate	1
Inhibit Time (100us)	10
Event Timer (ms)	1000
Object Identifier 0	0x00000000
Object Identifier 1	0x00000000

RPDO Number: RPDO1, RPDO2, RPDO3.....RPDO64

PDO Enable: enable, disable can optional, Default: enable

COB-ID(HEX): 16#0x200+Node_ID

Transmission Type: Synchronous (acyclic), Synchronous (cyclic) Event-driven (manufacture specific), Event-driven (device profile specific) can be optional, Default: Event-driven (device profile specific)

Transmission Rate: 8bit unsigned type, Default: 1

Inhibit Time(100us): inhibit time (100us), the minimum interval between two PDO transmissions ,16bit unsigned type, Default: 10

Event Timer (ms) ,16bit unsigned type, Default: 1000

Object Identifier: Object identifier (index + subindex + data length).

6.2.2 EMCY control module

EMCY Control module configuration parameters: EMCY override forbid, enable can

be optional, Default: disable.

An emergency packet is triggered by a fatal error inside the device and sent by the related application device to another device with the highest priority. Error alarm signal for interrupt type.

An emergency message consists of 8 bytes in the following format:

sender → receiver(s)

COB-ID	Byte0-1	Byte2	Byte3-7
0x080+Node_ID	Error Code	Error Register (Object 0x1001)	Manufacture-specific error area

Table 3-5 lists the hexadecimal emergency error code, The 'xx' parts of the emergency error code is defined by the corresponding device subprotocol.

Table 3-5 emergency error code (hexadecimal)

Emergency error code	Code function description
00xx	Error Reset or No Error
10xx	Generic Error
20xx	Current
21xx	Current, device input side
22xx	Current, inside the device
23xx	Current, device output side
30xx	Voltage
31xx	Mains voltage
32xx	Voltage inside the device
33xx	Output voltage
40xx	Temperature
41xx	Ambient temperature
42xx	Device temperature
50xx	Device hardware
60xx	Device software
61xx	Internal software
62xx	User software
63xx	Data set

70xx	Additional modules
80xx	Monitoring
81xx	communication
8110	CAN overrun
8120	Error Passive
8130	Life Guard Error or Heartbeat Error Or Heartbeat Error
8140	Recovered from Bus-Off
82xx	Protocol Error
8210	PDO no processed Due to length error Due to length error
8220	Length exceeded
90xx	External error
F0xx	Additional functions
FFxx	Device specific

The error register is in the object dictionary (index 0x1001) of the device. Table 3-6 shows the bit definition of the error register. The device can map internal errors into this status byte and provide a quick view of current errors.

Table 3-6: Bit Definitions for 8-Bit Error Register

Bit	Error Type
0	Generic
1	Current
2	Voltage
3	Temperature
4	Communication
5	Device profile specific
6	Reserved (=0)
7	Manufacturer specific

Manufacture-specific error fields may contain additional device-related error messages. The emergency message is triggered by a fatal error inside the device, and

is sent to other devices by the relevant application device with the highest priority.

This applies to the error alarm signal of the interrupt type.

The emergency alarm function can be realized by adding sub-module for the EMCY control module. The data address of the EMCY control module corresponds to the following:

Data Direction	Word Offset	Description	High Byte								Low Byte								Data Specification
		Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Input	0	Status word	EMCYDATA_Reset	Counter_Reset	Overflow_Reset	NonEmpty_Reset	/		Overflow	NonEmpty	/								NodeID
	1	Overflow counter	Overflow_Couter																
	2	EMCY data1	Error_Code																
	3	EMCY data2	Manufacture_Data_0								Error_Register								
	4	EMCY data3	Manufacture_Data_2								Manufacture_Data_1								
Output	5	EMCY data4	Manufacture_Data_4								Manufacture_Data_3								
	0	Scan control word	EMCYDATA_Reset	Counter_Reset	Overflow_Reset	NonEmpty_Reset	/				/								
		Red: Read-only Blue: Feedback Green: Resettable	Control Flow: 1. Wait until the NonEmpty bit is set to 1, An urgent packet is received. 2. Read emergency message information NodeID, Error_Code, Error_Register, and Manufacture_Data to process alarm information. 3. Control output bit "NonEmpty_Reset" rising edge to clear the "input NonEmpty" flag. 4. If the Overflow bit is set to 1, it indicates that urgent packets are discarded. Overflow_Couter indicates the number of discarded urgent packets. 5. Control the output bit Overflow_Reset, Counter_Reset rising edge to clear the input Overflow, Overflow_Couter. 6. It could control the rising edge of the output bit EMCYDATA_Reset to clear urgent packets NodeID, Error_Code, Error_Register, and Manufacture_Data .																

Notes: Blue: feedback, Green: resettable

Control Flow:

- 1.The input bit “non-Empty” is set to “1” indicates “Received 1 urgent message”.
- 2.Read emergency message information “Node ID, Error Code, Error Register, Manufacture Data,” and handle alarm information
- 3.Control the rising edge of the output bit “Non-Empty Reset” to clear the input mark “non-Empty”.
- 4.If the input bit “Overflow” is set to “1”, it means that there are currently urgent messages being discarded. “Overflow Couter” indicates the number of discarded urgent messages.
- 5.Control the rising edge of the output bits “Overflow Reset, Counter Reset” to clear the input marks “Overflow, Overflow Couter”.
- 6.The emergency message information “Node ID, Error Code, Error Register, Manufacture Data” can be cleared by controlling the rising edge of the output bit “EMCYDATA Reset”.

6.2.3 NMT - Network Management

CANopen NMT network management function can be realized by reading and writing the NMT control field in the “System Control Area”.

The NMT command word is a network management control command, and the valid command word values are as follows:

0x01: start the remote node

0x02: stop the remote node

0x80: enter the pre-operation state

0x81: reset node

0x82: reset communication

Writing other NMT command values will be ignored. When the trigger bit changes from “0” to “1”, an NMT command will be sent. The NMT slave address is the address of the remote node. The value is “1-127”, and “0” represents the broadcast address.

The NMT status contains the current status of all slaves in the current network **(to obtain a valid slave status, the error control function “Node Guarding” or “Heartbeat” of the slave must be activated)**. The status content of the slave station is read-only, and any value written will be ignored. The status corresponding to the status value is shown in **“Table 7”**. The initialization state means that the master has received the “Boot-up” startup message from the slave station. If the slave station is offline, it means that the master has timed out in querying the status of the slave station or receiving the heartbeat packet from the slave station. When receiving the status information from the slave station, there are stop, operation and pre-operation three states. Unknown status means that no slave status information was received.

Table 7. Slave Status List

Status Value	Node Status
0x00	Initialization status
0x01	Offline status
0x04	Stop status
0x05	Operation status
0x7F	Pre-operation status
0x0F	Unknown status

The control function of the slave station status can be realized by adding the sub-module for the NMT network management module.

The data address of the NMT network management module is shown in the figure below:

Data Direction	Word Offset	Description	High Byte								Low Byte									
		Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	Data Specification	
Input	0	NMT (Control Word)	NMT (Command Word)								0->1 Trigger bit	NodeID, 0 (Broadcast Address)								Output NMT control word feedback
Output	0	NMT (Control Word)	NMT(Command Word)								0->1 Trigger bit	NodeID, 0 (Broadcast Address)								NMT Control Word
	Blue: Feedback	Control Flow: 1. NodeID Specifies the node address to be operated. 0 indicates the broadcast address. 2. Assign the NMT command word. 3. Trigger bit 0->1 Rising edge triggers the NMT command to be sent.																		

Notes: (Blue): Data feedback

Control Flow:

1. “Node ID” node address assignment indicates the node ID to be operated, and “0” represents the broadcast address.
2. “NMT” command word assignment.
3. Trigger bit “0->1” indicates that the rising edge triggers the sending of “NMT” command.

6.2.4 SDO Control module

The online read and write function of SDO can be realized by reading and writing to the SDO control domain in the "System Control area". The specific encoding format of the data is shown in Table 9.

Table 9.SDO Control register encoding format

Data Direction	Word Offset	Description	High Byte								Low Byte								Data Specification			
		Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0				
Input	0	Index	Index								Subindex											
	1	Node ID/ Sub-index	NodeID								Subindex											
	2	Control word	Abort_Code_Reset	Done_Reset	Error_Reset	SDO_Done		SDO_Error	SDO_Busy	/	Trigger	RW_Type	Byte_Len									
	3	Stop Code	Abort_Code_3								Abort_Code_2											
	4	Stop Code	Abort_Code_1								Abort_Code_0											
	5	SDO data1	SDO_Data_1																			
Output	20	SDO data16	SDO_Data_16																			
	0	Index	Index								Subindex											
	1	Node ID/ Sub-index	NodeID								Subindex											
	2	Control word	Abort_Code_Reset	Done_Reset	Error_Reset	SDO_Done		SDO_Error	SDO_Busy	/	Trigger	RW_Type	Byte_Len									
	3	SDO data 1	SDO_Data_1																			
	18	SDO data16	SDO_Data_16																			
			Red: Control Flow; Read-only A: Reading a Flow Blue: 1. Index/SubIndex/NodeID (Set object Index/ sub-index/node address information). Feedback 2. Set RW_Type to 0, it indicates the SDO upload. Orange: 3. Set the Trigger bit to trigger the rising edge, and the SDO transmission starts, and then the SDO_Busy bit is forced to 1. conditional feedback 4. The user waits for SDO_Done to complete to force bit to 1. Green: 5. If SDO_Error and Abort_Code are 0 in SDO transmission, Byte_Len stores the byte length of read object data, and SDO_Data stores the object value. The effective byte length is Byte_Len. Resettable 6. If the SDO transfer fails, the SDO_Error bit is set to 1, and the Abort_Code stores the abort_code, indicating the reason for the failure. Byte_Len and SDO_Data are cleared. 7. Control the rising edge of the Done_Reset/Error_Reset bit to clear the SDO_Done/SDO_Error flag bit to start the next transmission. 8. It could control the Abort_Code_Reset bit rising edge to clear the Abort_Code as error code. B: Writing a Flow 1. Index/SubIndex/NodeID (Set object Index/ sub-index/node address information). 2. Set RW_Type to 1, it indicates SDO download, and set output Byte_Len/SDO_Data (output data length and output data value). The output value will be fed back to the corresponding input value. 3. Set the Trigger bit to trigger the rising edge, and the SDO transmission starts, and then the SDO_Busy bit is forced to 1. 4. The user waits for SDO_Done to complete to force bit to 1. 5. If the SDO transmission is normal, and SDO_Error and Abort_Code will be 0. 6. If the SDO transmission fails and the SDO_Error bit forced to 1, and the Abort_Code will store the abort_code, and it will indicate the reason for the failure. 7. Control the rising edge of the Done_Reset/Error_Reset bit to clear the SDO_Done/SDO_Error flag bit to start the next transmission. 8. It could control the Abort_Code_Reset bit rising edge to clear the Abort_Code as error code.																			

Notes: Red: Read-only, Blue: feedback, Orange: conditional feedback, Green: resettable.

Index of the object. Sub Index indicates the parameter of the object to be accessed. The SDO server slave number has a valid address range of 1-127.

The object dictionary Data Type is defined as shown in Table 10.

Table 10 object dictionary Data Type

Number	Data Type
0x01	BOOLEAN
0x02	INTEGER8
0x03	INTEGER16
0x04	INTEGER32
0x05	UNSIGNED8
0x06	UNSIGNED16
0x07	UNSIGNED32
0x08	REAL32
0x09	VISIBLE STRING
0x0A	OCTET STRING
0x0B	UNICODE STRING
0x0C	TIME_OF_DAY
0x0D	TIM_DIFFERENCE

Control Flow:

A: Read Flow

1. Set object index/ Sub-index/Node address information (Index/Sub Index /Node ID)
2. Set RW type to “0”, SDO representing is “upload”.
3. Set the trigger by rising edge, SDO start of transfer, SDO_Busy showed “1”.
4. The user waits for SDO Done to complete position 1.
- 5.If SDO transfer normal ,SDO_Error and Abort Code are showed “0”, Byte_Len stores the byte length of the read object data, SDO_Data stores the value of the object, and the effective byte length is Byte_Len.
- 6.If SDO transfer fails, SDO_Error showed “1” Abort_Code stores the abort code, indicating the cause of the failure. Byte_Len and SDO_Data are cleared.
7. Control the rising edge of the Done_Reset/Error_Reset to clear the SDO_Done/SDO_Error flag bit so that the next transmission can begin.
8. Control the Abort_Code_Reset bit rising edge to clear the Abort_Code error.

B: Write Flow

1. Set object index/ Sub-index/Node address information (Index/Sub Index /Node ID)
2. Set RW type to “1”, SDO representing is “download” , Set the output data length and output data Byte_Len/SDO_Data, and the output value will be feedback to the corresponds input value.
3. Set the trigger by rising edge, SDO start of transfer, SDO_Busy showed “1”.
4. The user waits for SDO Done to complete position 1.
5. If the SDO transfer normal ,SDO_Error and Abort Code are showed “0”,
If the SDO transfer fails, SDO_Error bit is set to 1, and the Abort_Code stores the abort code, indicating the reason for the failure.
7. Control the rising edge of the Done_Reset/Error_Reset to clear the SDO_Done/SDO_Error flag bit so that the next transmission can begin.
8. Control the Abort_Code_Reset bit rising edge to clear the Abort_Code error.

6.2.5 Network Scanned Module

The scanned module of nodes includes:

Network scanning module has 8 nodes

Network scanning module has 16 nodes

Network scanning module has 32 nodes

Network scanning module has 64 nodes

Network scanning module has 126 nodes

There are a maximum of 127 nodes on the CANopen network, and the gateway itself occupies one node address. The network scan function allows you to scan the basic information of the slave devices on the CANopen network.

The network scanning function is realized by adding the network scanning module.

Network scanning module data address mapping is as follows:

Data Direction	Word Offset	Description	High Byte								Low Byte										
		Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	Data Specification		
Input	0	Scan status word	Module information has scanned number of network nodes								/				Scanning		0->1 Trigger bit		The blue data bit is the output feedback value.		
	1	Module information	Node ID								Node state machine										
	2	Module information	Node ID								Node state machine										
	-	-	-								-										
	-	-	-								-										
	126	Module information	Node ID								Node state machine										
Output	0	Scan Control word	/								/				0->1Trigger bit		Scanning start trigger bit.				
		Red: Read-only Blue: Feedback	Control Flow: 1. The output trigger bit 0->1 rises to start scanning. 2. When the scanning status is set to 1, the number of nodes and module information are cleared. 3. Wait until the scan is completed, and then status is cleared. 4. The number of nodes contains the number of all nodes detected on the current network, and the ID and state machine information of storage nodes in the module information.																		

Notes: Green: read-only; Blue: Feedback

Control Flow:

1. The output trigger bit 0->1 rises to start scanning.
2. When the status is set to 1, the number of nodes and module information are cleared.
3. Wait until the scanning is completed, and the status bit is cleared.
4. The number of nodes contains the number of all nodes detected on the current network, and the ID and state machine information of storage nodes in the module information.

A Dimension drawing

