

PST20 User Manuel

PST20 CANOPEN interface inclinometer

Terms & abbreviation

Baud rate	Speed of data transfer(1 Baud=1Bit/s)
BOOL	Data type BOOLEAN(8Bit,0=FALSE,1=TRUE)
CAN	Controller Area Network
CANOPEN	Standardized application layer for CAN devices
CiA	CAN in Automation e.V
CiA DS	CiA Draft Standard(specification published by CiA)
CiA DS-301	Specification of the CANOPEN application layer and the communication parameters in the OD
CiA DP	CiA Device Profile(device profile published by CiA)
CiA DR	CiA Draft Recommendation (implementation published by CiA)
CiA DR-303-3	Recommended implementation for display of CANOPEN-device states and errors by LED(s)
CiA DSP	Draft Standard Proposal(specification draft published by CiA)
CiA DSP-410	Specification draft of the device profile 410 for inclination sensors
Client	CANOPEN station which claims the service of a server
COB	CANOPEN Communication Object
COB-ID	CAN-Identifier of a COB
DOMAIN	Data type DOMAIN(arbitrary large block of data,e.g.program code)
EDS	Electronic Data Sheet(of a CANopen device)
EMCY	Emergency Object(Object that informs of errors)
xxxxh/xxh	Index/Subindex,position of an OD parameter
Heartbeat	Surveillance mechanism for CANopen stations
ID	Identifier of a CAN message
INT8	Data type INTEGER8(8Bit,complement on two,-128...127)
INT16	Data type INTEGER16(8Bit,complement on two,-32768...32767)
Longitudinal/lateral	Axis assignment(X/Y-axis)
LSS	Layer Setting Service
NMT	Network Management Object(Object to set and check CANopen device states)
Node-ID	Node number of a CANopen device(1...127)
Node-/Lifeguarding	Surveillance mechanism for CANopen stations
Operational	CANopen device state(SDO,PDO,EMCY,NMT possible)
OD	Object dictionary(virtual directory with device parameter,addressed by index and subindex)
PDO	Process Data Object(Object for transfer of process data without protocol offset)
PDO Mapping	Sequence in which process data is arranged in a PDO
Pre-Operational	CANopen device state(SDO,EMCY,NMT possible)
Pre-defined Connec-tion Set	In CiA DS-301 defined concept how COB IDs of the communication object have to be calculated in dependence of the Node ID
Ro	Read only,access right,"read only" of an object in the object dictionary
RTR	Remote Transmit Request,Bit which causes the receiver to send data
Rw	Write and read,access right,"write and read" of an object in the object

	dictionary
SDO	Service Data Object(object for access to the object dictionary)
Server	CANopen station which offers a service for one/several client(s)
Stopped	CANopen device state(only NMT possible)
UNS8	Data type UNSIGNED8(8Bit,without,0...255)
UNS16	Data type UNSIGNED16(16Bit,without,0...65535)
UNS32	Data type UNSIGNED32(32Bit,without,0...4294967296)
VSTR	Data type VISIBLE STRING(ASCII-string inclusive end identifier 0h)
Wo	Write only,access right,"write only"of an object in the object dictionary

CAN in Automation e. V.



CANopen Vendor-ID Registration

The following CANopen vendor-ID has been registered for:

Company:
(mandatory)

Shanghai Vigor Technology Development Co., Ltd.

Department:
(optional)

Should your company be re-named, you may still use the assigned vendor-ID, however, the vendor-ID will be still registered to the 'old' company's name. Please make sure to inform CiA Headquarters in writing of the 'new' company name.

If you vest the vendor-ID to a legal successor you have to inform CiA Headquarters, however, the vendor-ID will be still registered to the predecessor, and the current legal successor will be listed as well.

The Vendor-ID:

31	24	23	0
department	company		
00	00	03	C2
MSB	LSB		

1. Terminal resistance

There is no terminal resistance inside PST20 which can match to CAN output.

2. Description of Function

PST20 is a very convenience and easy operation inclinometer during your application. PST20 support CANopen output interface which comply with CiA DS-301 and CiA DSP-410 requirements. The reading of angle value and configuration parameter amendment is realizable through visiting dictionary table (OD). The amended parameter is stored at nonvolatile storage inside of the inclinometer. Supportive functions description under CANopen is like below:

- a TPDO message transmission
- transmit remote message requests method, obtain TPDO message
- set time interval as period, recycling continuous transmitting TPDO message.
- event trigger TPDO message transmission
- synchronous frame message guides TPDO message transmission
- a SDO message service
- support urgent message
- general error temporary storage
- manufacture define state temporary storage
- predefined error table
- heartbeat packet and the note guard error management mechanism
- store and load all parameter
- Support function comply with CiA DS-301 and more like below:
- configuration inclinometer bandwidth
- configuration minimum angle change value, trigger TPDO message transmission incident
- configuration inclinometer angle direction changing measurement
- configuration inclinometer zero bias
- configuration Node-ID and Baud rate.

3. COB-IDs

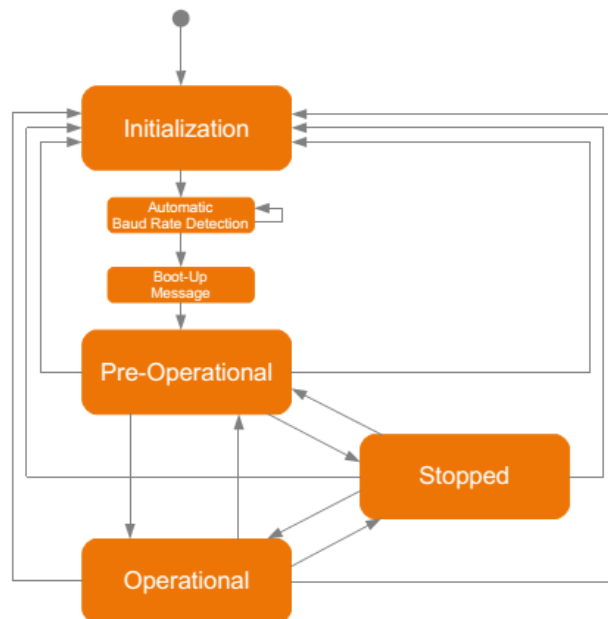
Communication object's CAN-OD has obviously rules. Bellowing CANopen devices restoration (communication, application and hardware restoration), reserve define connection setting are necessary. According to stated Node-ID, the default predefined connections as below: (the default Node-ID=10)

Communication Object(COB)	Calculation COB-ID	Default (Node-ID=10h)
NMT	0h	0h
SYNC	80h	80h
EMCY	80h+Node-ID	90h
TPDO1	180h+Node-ID	190h
Default SDO(Client>Server)	600h+Node-ID	610h
Default SDO(Server>Client)	580h+Node-ID	590h
Heartbeat	700h+Node-ID	710h

4. Network administration NMT

CANopen device NMT state machine: initialization、per-operation 、operation、stop.

When power on, CANopen device enters into Initialization, then device automatically comes to per-operational state. Meanwhile, device will transmit a Boot-Up Message. During the pre-operational mode, allows to visit device object dictionary table, SDO is usable, PDO is unable to use. Through transmit "Start Remote Node" CAN message, CANopen device enters into operational state, now PDO is usable. When in stopped state, all communication message is unable to use except heartbeat packet and the node guard.



CANOPEN device NMT FSM

NMT control order

COB-ID(CAN-ID)	DLC	BYTE0	BYTE1
0x000	2	CS(CW)	Node ID(node number)

NMT command words and reference function service

CS(command words)	NMT service(control action)
0x01	Start slave station device
0x02	Stop slave node device
0x80	From slave station to pre-operational
0x81	Restoration slave node
0x82	Restoration node communication

5. Process data objects TPDO

Every inclinometer supports a TPDO1 message, TPDO contains current measurement angle value, the mapping value as below:

CAN message part of TPDO1							
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Angle value (OV:6010h)		unused					

Notes: single axis inclinometer ,DLC=2,message ID=180h+NodeID,angle resolution is 0.01°.

If measurement range was 0~360°, data type of angle value is unsigned 16 bits integer.

If measurement range was within ±180°, data type of angle value is signed 16 bits integer.

For example: received TPDO message is: frame ID:00000190, data frame , standard frame, DLC:02h , Data: AD h,8Bh .

PDO Object	Node ID	PDO Data
PDO(delivery)	0x10	ADh 8Bh

PDO Data analysis: low 8-bit is in before, high 8-bit is in behind, 1 no symbol 32-bit integer value is 10000, angle value is 10000/1000=10.000°

CAN message part of TPDO1							
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Angle value ((OV:6010h,X-Axis)		Angle value (OV:6020h,Y-Axis)		Unused			

Remarks: dual axis inclinometers ,DLC=4,message ID=180h+NodeID, angle resolution is 0.01°.

If it's dual axis inclinometers , the data type of angle value is signed 16 bits integers.

For example: received TPDO message is : frame ID:00000190, data frame , standard

frame , DLC:04h , Data:E7h, 00h,75h,F5h 。

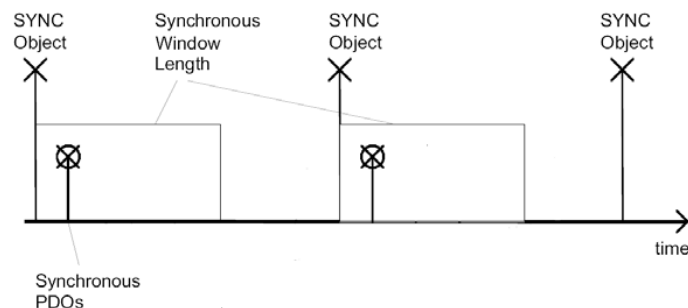
PDO Object	Node ID	PDO Data
PDO(delivery)	0x10	E7h 00h 75h F5h

PDO Data analysis: low 8 bytes ahead, high 8 bytes behind , X-Axis angle value is 0x00E7(231/100=2.31°), Y-Axis angle value is 0xF575(-2698/100=-26.98°)。

6. Around synchronization

Through around synchronization acquire message, after inclinometer receive the synchronous message, it will deliver the TPDO1 to response the message in synchronous time window. When in default condition, TPDO1 transmit type is cycle synchronous. If under CANopen network with multi-sensor exist, multi-sensors angle value can be acquired from cycle synchronous at the same time.

Synchronous frame message information (SYNC): frame ID: 00000080, data frame, standard frame DLC: 00, Data: blank.



For example: TPDO1 around synchronization working step as below

list	Time stamp	Frame ID	format	type	DLC	data
synchronous request	14:51:42.192	0x00000080	Data frame	Standard frame	0x00	---
TPDO1 response message	14:51:42.192	0x00000190	Data frame	Standard frame	0x04	E7 00 82 F5
synchronous	14:51:42.691	0x00000080	Data	Standard	0x00	----

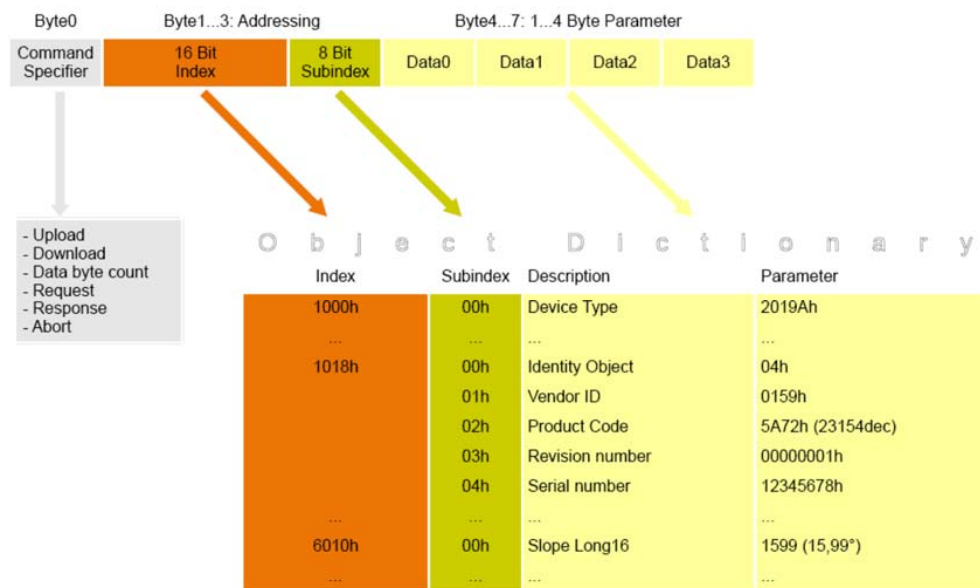
request			frame	frame		
TPDO1 response message	14:51:42.693	0x00000190	Data frame	Standard frame	0x04	E6 00 83 F5
synchronous request	14:51:43.191	0x00000080	Data frame	Standard frame	0x00	---
TPDO1 response message	14:51:43.193	0x00000190	Data frame	Standard frame	0x04	E6 00 84 F5
...	...	...	...	...	...	...

7. Loop asynchronous

Inclinometer periodic continuously cycle transmit TPDO1 message according to its inner set time interval. Through amending dictionary object 1800h/5h into nonzero value, and then amend dictionary object 1800h/2h (TPDO1 transmit data type) is 254 (asynchronous, manufacturer defined), finally TPDO cycle asynchronous working message is valid. Inclinometer firmware edition 2.4 and hardware edition 1.9 support this function.

8. SDO service data objects

Object dictionary should serve as main data exchange medium between apply layer and communication layer. A CANopen device all data should be managed in object dictionary. Each object dictionary can be located through index and sub-index. CANopen defines SDO to visit these item.



Inclinometer support 1 SDO server, which means, it supports SDO service, and SDO uses pre-defines connection's transmit and receive COB-ID, 0x580 + NodeID (delivery) and 0x600 + NodeID (receive). SDO contains accelerate transmit, section of the transmission and block transmission. Hence the SDO accelerate transmit is mostly often used, this content will importantly show the accelerate transmission. Other transmission type can be checked according to reference protocol documents.

SDO data transmission

One frame acceleration transmit ult-mostly can transmit 4-bit data, message basic structure as SDO message format (client side → server).

COB-ID(CAN-ID)	DLC	Byte 0	Byte 1-2	Byte 3
0x600 + Node ID	8	CMD(SDO CW)	Object index	Object sub-index

Through the SDO command word to distinguish the type of data frames.

COB-ID(CAN-ID)	DLC	Byte 0	Byte 1-2	Byte 3
0x580 + Node ID	8	CMD(SDO CW)	Object index	Object sub-index

Download means client side operate writing on server object dictionary. Upload means client side is reading from server object dictionary.

Initiate Domain Download

Bit							
-----	--	--	--	--	--	--	--

	7	6	5	4	3	2	1
Client→Server	0	0	1	-	n	e	s
Client←Server	0	1	1	-	-	-	-

Initiate Domain Download

Bit	7	6	5	4	3	2	1	0
Client→Server	0	1	-	-	-	-	-	-
Client←Server	0	1	1	-	n	e		s

Explanation: “-” is no related items, normally set as 0.

n: if e=1, and s=1, effective, otherwise it is 0; Which means for meaningless byte number. (bytes [8 – n] to 7 is meaningless) ;

e: 0 = normal delivery, 1 = expedited transfer;

s: specify the data length or not, 0 = unspecified data length, 1 = specified data length;

e = 0, s = 0: reserved by CiA;

e = 0, s = 1: data byte (byte counter), byte 4 is low byte part (LSB), byte 7 is high byte part (MSB);

e = 1: data byte (the data which is going to download)

Eg: suppose current inclinometer address is 0x20, operate writing and reading 0x1800 03 on object dictionary.

Write 0x3E8 into 0x1800 03, please check below instructions:

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5	Byte 6
0x620	8	0x2B	0x00	0x18	0x03	0xE8	0x03	0x00

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5	Byte 6
0x5A0	8	0x60	0x00	0x18	0x03	0x00	0x00	0x00

Reading data from object dictionary 0x1800 03, the command and response like below:

COB-ID	DL C	Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5	Byte 6
0x620	8	0x40	0x00	0x18	0x03	0x00	0x00	0x00

The response frame for reading object dictionary 0x1800 03

COB-ID	DL C	Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5	Byte 6
0x5A0	8	0x4B	0x00	0x18	0x03	0xE8	0x03	0x00

SDO service suspended

Error occurs during SDO transmission, SDO client side and server can notify to suspend current operation via message transmission. Suspension message format like below:

COB-ID(CAN-ID)	DLC	Byte 0	Byte 1-2	Byte 3
0x600 + NodeID/0x580+NodeID	8	CMD(SDO CW)	INDEX	SUB-IN DEX

Suspend message command words define

Bit	7	6	5	4	3	2	1
Client to Server/ Client to Server	1	0	0	-	-	-	-

Eg: Suppose current node's NodeID is 0x20, when error suspension occurs during reading data, the error code will be reversed back like below:

COB-ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5	Byte 6
0x620	8	0x40	0x00	0x60	0x00	0x00	0x00	0x00

Note: the reverse back data is a suspended transmission error code, SDO error code is 32 bit length data, this frame data 's response error code is 0x0602000, it means "object dictionary not exists", the suspension code meaning as below:

Suspension code	Code function description
0503 0000	Toggle bit without alternating
0504 0000	SDO agreement timeout
0504 0001	Illegal or unknown Client/Server command word
0504 0002	Invalid block size (only Block Transfer mode)
0504 0003	Invalid serial number (only Block Transfer mode)
0503 0004	CRC error (only Block Transfer mode)
0503 0005	Memory overflow
0601 0000	Object not access
0601 0001	attempt read write only object
0601 0002	Attempt write read only object
0602 0000	Object not exist in object dictionary
0604 0041	Object can not map to PDO
0604 0042	The numbers and length of map object is over PDO length
0604 0043	Generalized parameter incompatible
0604 0047	Generalized inner device incompatible
0606 0000	Hardware error leading to object fail access
0606 0010	Data type mismatching, service parameter length mismatching
0606 0012	Data type mismatching, service parameter length is too long
0606 0013	Data type mismatching, service parameter length is too short
0609 0011	Sub-index not exist
0609 0030	Out of parameter value range (when writing access)
0609 0031	Writing parameter value is too large
0609 0032	Writing parameter value is too small
0609 0036	Maximum value less than Minimum value
0800 0000	General fault
0800 0020	Unable transmit data or storage to application
0800 0021	Local control leading to data unable transmit or storage to application
0800 0022	Current device state leading to data unable transmit or storage to application
0800 0023	Object dictionary dynamic condition occurs fault or object dictionary not exist. (eg: object dictionary is created by files, but fault occurs due to files damage)

9. LSS Service Application

Firmware edition 2.4 and hardware edition 1.9 not support LSS service application and 10K/bits baud rate, but NodeID and Baud rate can be set by SDO service message. NodeID range is 1~126, supportable baud rate contains: 10K/bits、20K/bits、50K/bits、100K/bits、125K/bits、250K/bits、500K/bits、800K/bits、1000K/bits etc.

10. NodeID set

Master station NMT Module Control starts long distance sensor node of slave station, transmit message: frame ID 00000000h, data frame, standard frame, DLC:02h, Data:01h 10h. Suppose current NodeID is 0x10, then amend address into 11h.

NMT Command	Node ID
Start Remote Node	0x10

Master station NMT Module Control set slave station sensor as "Enter Pre-operational State", transmit message: frame ID 00000000h, data frame, standard frame, DLC:02h, Data:80h ,10h

NMT Command	Node ID
Enter Pre-operational State	0x10

Master station Initiate SDO Download Request amend slave station sensor's dictionary object 2101h value into 11h, transmit message: frame ID 00000610h, data frame, standard frame, DLC:08h , Data:2Fh 01h 21h 00h 11h 00h 00h 00h.

Node ID	Object Index	Object Sub-Index	Transfer Type	Size Indicator	Bytes Not Data	SDO Data
0x10h	0x2101	0x0	Expedited	Indicated	0x03	0x10 0x00 0x00 0x00

Slave station sensor Initiate SDO Download Response, message: ID 00000590h, data frame, standard frame, DLC:08h, Data:60h 01h 21h 00h 00h 00h 00h 00h.

Node ID	Object Index	Object Sub-Index
0x10	0x2101	0x0

Node ID finished setting, need to re-start sensor, then new set Node Id is effective.

11. Baud rate setting

Master station NMT Module Control starts long distance slave station sensor node, transmit message: frame ID 00000000h, data frame, standard frame, DLC:02h, Data:01h 10h. Suppose current Node Id is 0x10, baud rate 250k, please amend the baud rate into 500K/bits.

NMT Command	Node ID
Start Remote Node	0x10

Master station NMT Module Control set slave station sensor as "Enter Pre-operational State", transmit message: frame ID 00000000h, data frame, standard frame, DLC:02h, Data:80h ,10h.

NMT Command	Node ID
Enter Pre-operational State	0x10

Master station Initiate SDO Download Request amend slave station sensor's dictionary object 2102h value into FAh 01h, transmit message: frame ID 00000610h, data frame, standard frame, DLC:08h, Data:2Bh 02h 21h 00h FAh 01h 00h 00h.

Node ID	Object Index	Object Sub-Index	Transfer Type	Size Indicator	Bytes Not Data	SDO Data
0x10h	0x2102	0x0	Expedited	Indicated	0x02	0xFA 0x01 0x00 0x00

Slave station sensor Initiate SDO Download Response, message: frame ID 00000590h, data frame, standard frame,

DLC:08h, Data:60h 02h 21h 00h 00h 00h 00h 00h.

Node ID	Object Index	Object Sub-Index
0x10	0x2102	0x0

Baud rate finished set, need to re-start sensor, then new setting baud rate will be effective.

12. Fault management

CANopen network provides device fault management function, heartbeat packet or node guard as main management method, once device can only support one function, either heartbeat packet or node guard. Firmware edition 2.4 and hardware under edition 1.9 support heartbeat packet mode.

13. The node guard

The node guard is benefit for NMT Master manage slave node, NMT Master periodic transmit RTR long distance frame message to slave node, slave node response NMT Slave message, which contains a slave station and an unit flip marking. The flip marking is changing between neighboring RTR long distance frame messages' response. NMT host node can check each noted current condition through node guard protection service. The corresponding slave node's protection is triggered by host node through transmitting long distance frame. The command format as below:

The host node->slave node(command):

Table 21 NMT host node protection command frame (long distance frame)

COB-ID(CAN-ID)	DL
	C
0x700 + NodeID	1

The slave node->host node(response):

Table 22 NMT slave node response frame

COB-ID(CAN-ID)	DL	BYTE0
	C	
0x700 + NodeID	1	Bit7:toggle bit, Bit0~Bit6state

The highest bit 7 of Byte0 is toggle bit, it means, slave station will be alternative changed (0, 1) when each frame has been sent. This is for distinguish the difference between each frames. Bit0~Bit6 is slave node state, this value means for slave station sate as below:

Node protection state value

Value	State
0x00	Initialising
0x04	Stopped
0x05	Operational
0x7F	Pre-operational

Eg: Suppose host node need to protect slave node 0x20, its command words like below:

Host node->slave node:

Protection node (long distance frame)

COB-ID(CAN-ID)	DL
	C
0x720	1

slave node->Host node:

Slave node (0x20) response frame

COB-ID(CAN-ID)	DL	BYTE
	C	0
0x720	1	0x85

BYTE0Bit7 = 1, state=0x05, which means the slave station of node number 20 is under operation.

14. Heartbeat packet

Heartbeat packet message contains producer and consumer, this parameter is defined in object dictionary 0x1017 (data length 16 bit, unit: millisecond), and its heartbeat message is like the table below, the response is the same as node protection and life protection.

Eg: Suppose node address is 0x20, in operation status, the parameter of 0x1017 should set as 100, then this node will transmit a frame message every 100 millisecond like below:

Slave node (0x20) heartbeat message

COB-ID(CAN-ID)	DLC	BYTE0
0x720	1	0x05

15. Device information search

Master station served message via Initiate SDO Upload Request (Server<-->Client), the address gradually accumulate 1, and continue polling. When it is matching with slave station NodeID address, the slave station will automatically report the device information, the master station will continuously confirm device information for realizing master station effectively identify slave station, and the information establishment between master and slave station.

Master station Initiate SDO Upload Request, message information frame ID:00000600h + XXh , data frame, standard frame, DLC:08h Data:40h 00h 10h 00h 00h 00h 00h 00h. XX is slave station's Node ID, Node ID is accumulated from 1 to 126 in single step. Master station continuously Initiate SDO Upload Request slave station.

Node ID	Object Index	Object Sub-Index
0xXX	0x1000	0x0

If timeout (timeout value is set and judged by master station) not response from the slave station, the master station Abort SDO Transfer, message: frame ID 00000600 + XXh, data frame, standard frame, DLC:08h , Data:80h 00h 10h 00h 00h 00h 04h 05h.

SDO Object	Node ID	Object Index	Object Sub-Index	Abort Code
Client	0xXX	0x1000	0x0	SDO Protocol timed out

If matching with slave station Node Id, and response to master station in rule time. The existence of current polling slave station with same Node ID will be identified by master station at once in network. Then master station will stay at current Node ID for requesting slave station uploading device information.

Initiate SDO Upload Request:

Node ID	Object Index	Object Sub-Index
0x10	0x1000	0x0
Frame ID:00000610h, data frame , standard frame ,DLC:08h, Data:40h 00h 10h 00h 00h 00h 00h 00h		

Initiate SDO Upload Response

Node ID	Object Index	Object Sub-Index	Transfer Type	Size Indicator	Bytes Not Data	SDO Data
0x10h	0x1000	0x0	Expedited	Indicated	0x00	0x9A 0x01 0x02 0x00
Frame ID:00000590h, data frame ,standard frame ,DLC:08h, Data:43h 00h 10h 00h 9Ah 01h 02h 00h						

Initiate SDO Upload Request:

Node ID	Object Index	Object Sub-Index
0x10	0x1018	0x1
Frame ID:00000610h, data frame ,standard frame ,DLC:08h, Data:40h 18h 10h 01h 00h 00h 00h 00h		

Initiate SDO Upload Response

Node ID	Object Index	Object Sub-Index	Transfer Type	Size Indicator	Bytes Not Data	SDO Data
0x10h	0x1018	0x1	Expedited	Indicated	0x00	0xC2 0x03 0x00 0x00
Frame ID:00000590h, data frame ,standard frame ,DLC:08h, Data:43h 18h 10h 01h C2h 03h 00h 00h						

Initiate SDO Upload Request:

Node ID	Object Index	Object Sub-Index
0x10	0x1018	0x2
Frame ID:00000610h, data frame ,standard frame ,DLC:08h, Data:40h, 18h 10h 02h 00h 00h 00h 00h		

Initiate SDO Upload Response

Node ID	Object Index	Object Sub-Index	Transfer Type	Size Indicator	Bytes Not Data	SDO Data
0x10h	0x1018	0x2	Expedited	Indicated	0x00	0x14 0x00 0x00 0x00
Frame ID:00000590h, data frame ,standard frame ,DLC:08h, Data:43h 18h 10h 02h 14h 00h 00h 00h						

16. Emergency message object (EMCY)

Sensor supports emergency message, which means, message will be reported when error occurs. The format is like below. Emergency code is for current error type. The error register is stored at current error type. The error type could be judged from current emergency message via its value, the value defines like below:

Emergency message frame format

COB-ID(CAN-ID)	DLC	BYTE0	BYTE1	BYTE2	BYTE3～BYTE7	
					BYTE3	BYTE4～BYTE7
0x80 + NodeID	8	Emergency error code		Error register	Sensor sets error code	00 00 00 00
		Index 0x1003		Index 0x1001		

Emergency error code meaning as below:

Emergency error code	Description of code meaning
0x0000	Error reduction/ no error
0x 5010	Sensor X axis exceed range
0x 5020	Sensor Y axis exceed range
8110	CAN overrun
8120	Error Passive
8130	Life Guard Error Or Heartbeat Error
8140	Recovered from Bus-Off
8210	PDO no processed Due to length error
8220	Length exceedd
0xFF03	Sensor parameter setting error

Error register

Error register (1001h)							
BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Manufacturer defines error	Reserved(=0)	Device description error	Communication error	Reserved(=0)			General error (Generic)

error code set for sensor

Value	Error type
0x01	Refresh rate fault set
0x02	Filter coefficient fault set

Eg: suppose node ID is 0x20, CAN BUS error exceed warning value, occur "Error Passive" warning, then sensor will transmit message as below:

Emergency message (BUS error)

COB-ID(CAN-ID)	DL C	BYTE 0	BYTE 1	BYTE 2	BYTE3 — BYTE7
0xA0	8	0x20	0x81	0x11	0x00000000

Note: these error initiative transmit when sensor module occurs emergency situation.

17.17. Communication sub-protocol region (refer to CIA DS-301)

Index	Sub-index	Parameter name	Default	Data type	Memory attribute	changeable
1000		Device Type	0x2019A	UN32	RO	no
1001		Error Register	0x0	UN8	RO	no
1002		Manufacturer Status Register	0x0	UN32	RW	yes
1003	Pre-defined Error Field					
	0	number of errors	0x0	UN8	RW	yes
	1~5	Error Code (oldest error on highest index)	0x0	UN32	RO	yes
1005		COB-ID SYNC	0x80	UN32	RW	yes
1006		Communication cycle period	0x0	UN32	RW	yes
1007		Sync Windows Length	0x0	UN32	RW	yes
1008		PST Name	SST_Canopen	VISIBLE	CONST	no
1009		PST Hardware Version	V1.01	VISIBLE	CONST	no
100A		PST Software Version	V1.05	VISIBLE	CONST	no
100C		Guard time	0x0	UN16	RW	yes
100D		Life Time Factor	0x0	UN8	RW	yes
1010	store Parameters					
	0	largest supported Sub-Index	0x1	UN8	RO	no
	1	save all parameters	0x0	UN32	RW	yes
1011	restore default parameters					
	0	largest supported Sub-Index	0x1	UN8	RO	yes
	1	restore default parameters	0x0	UN32	RW	yes
1014		COB-ID Emergency message	0x1	UN32	RW	yes
1016	consumer heartbeat time					
	0	Number of Entries	0x1	UN8	RO	yes
	1	Consumer Heartbeat Time #1	0x0	UN32	RW	yes
1017		Producer HeartBeat Time	0x0	UN16		yes
1018	Identity Object					
	0	number of Entries	0x4	UN8	RO	yes
	1	Vendor ID	0x2B6	UN32	RO	yes
	2	Product code	0x0A	UN32	RO	yes
	3	Revision number	0x0A	UN32	RO	yes
	4	Serial number	0x0A	UN32	RO	yes
1200	Server SDO Parameter					
	0	Highest Subindex	0x2	UN8	RO	no
	1	COB-ID Client->Server	0x600+\$Node-ID	UN32	RW	yes
	2	COB-ID Server->Client	0x580+\$Node-ID	UN32	RW	yes

1800	Transmit PDO1 parameter					
	0	largest subindex supported	0x5	UN8	RO	no
	1	COB-ID used	0x1	UN32	RW	no
	2	transmissin type	0x1	UN8	RW	no
	3	inhibit time	0x0	UN16	RW	no
	5	event timer	0x0	UN16	RW	no
1801	Transmit PDO2 parameter					
	0	largest subindex supported	0x5	UN8	RO	no
	1	COB-ID used	0x1	UN32	RW	no
	2	transmissin type	0x1	UN8	RW	no
	3	inhibit time	0x0	UN16	RW	no
	5	event timer	0x0	UN16	RW	no
1A00	Transmit PDO1 mapping parameter					
	0	number of mapped objects	0x0	UN8	RW	no
	1	PDO mapping1 app.object	0x60100010	UN32	RW	no
	2	PDO mapping2 app.object	0x60200010	UN32	RW	no
1A01	Transmit PDO2 mapping parameter					
	0	number of mapped objects	0x0	UN8	RW	no
	1	PDO mapping1 app.object	0x61100020	UN32	RW	no
	2	PDO mapping2 app.object	0x61200020	UN32	RW	no

18. Sensor device sub-protocol region (refer to CIA DS-410)

Index	Parameter name	Default	Data type	Memory attribute	changeable
6000	Resolution	0x0	UN8	RO	no
6010	Slope Long16 (X axis 16 bytes)	0x0	INT16	RO	no
6011	Slope Long16 Operating Parameter	0x0	UN8	RW	yes
6012	Slope Long16 Preset Value	0x0	INT16	RW	yes
6013	Slope Long16 Offset	0x0	INT16	RW	yes
6014	Differential Slope Long16 Offset	0x0	INT16	RW	yes
6020	Slope Lateral16	0x0	INT16	RO	no
6021	Slope Lateral16 Operating Parameter	0x0	UN8	RW	yes
6022	Slope Lateral16 Preset Value	0x0	INT16	RW	yes
6023	Slope Lateral16 Offset	0x0	INT16	RW	yes
6024	Differential Slope Lateral16 Offset	0x0	INT16	RW	yes
6110	Slope Long32	0x0	INT32	RO	no
6111	Slope Long32 Operating Parameter	0x0	UN8	RW	yes
6112	Slope Long32 Preset Value	0x0	INT32	RW	yes
6113	Slope Long32 Offset	0x0	INT32	RW	yes
6114	Differential Slope Long32 Offset	0x0	INT32	RW	yes

6120	Slope Lateral32	0x0	INT32	RO	no
6121	Slope Lateral32 Operating Parameter	0x0	UN8	RW	yes
6222	Slope Lateral32 Preset Value	0x0	INT32	RW	yes
6123	Slope Lateral32 Offset	0x0	INT32	RW	yes
6124	Differential Slope Lateral32 Offset	0x0	INT32	RW	yes

19.Object dictionary 6000h: Resolution

Define Slope_Long16 (6110h) and Slope_Lateral16 (6120h) object dictionary value's resolution, forbid amendment, read only.

6000h value	Resolution
1	0.001°
10	0.01°
100	0.1°
1000	1.0°

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