

## CANopen **Option board**

SV-iS7



- Be sure to read “Safety Instructions” before using for the proper use.
- Keep this manual within easy reach for quick reference.

Before using the product, thank you for purchasing SV-iS7 CANopen option board.

## SAFETY PRECAUTIONS

- Always follow safety instructions to prevent accidents and potential hazards from occurring.
- Safety precautions are classified into “WARNING” and “CAUTION” and their meanings are as follows:



### WARNING

Improper operation may result in serious personal injury or death.



### CAUTION

Improper operation may result in slight to medium personal injury or property damage.

- The indicated illustrations on the product and in the manual have the following meanings.



Danger may be present. Read the message and follow the instructions carefully.



Particular attention should be paid because danger of an electric shock may be present.

- Keep operating instructions handy for quick reference.
- Read the operating instructions carefully to fully understand the functions of the SV-iP5A series and to use it properly.



## CAUTION

- **Be cautious, when handling the CMOS components of the Option Board.**  
Static may lead to malfunctioning of the product.
- **Turn off the inverter power, when changing the communication cable.**  
Otherwise, you may damage the board or a communication error may occur.
- **Make sure to insert the Option Board connector to the inverter precisely.**  
Otherwise, you may damage the board or a communication error may occur.
- **Check the parameter unit before setting up the parameter.**  
Otherwise, a communication error may occur.

## **1. Introduction**

### **1.1 What is CANopen?**

The CANopen is a Fieldbus using the CAN (Controller Area Network) specified by the CiA (CAN in Automation) Association. Currently, the CANopen is used in machine control, medical equipments, autos, and building automation.

### **1.2 What are the Benefits of Using the CANopen Option Board?**

Inverters can be monitored and controlled by PLC sequence program or any master module.

Multiple inverters can be connected with a single communication line, saving the installation cost. Simple and clean wiring makes installation and maintenance works much easier and faster.

Various peripheral devices of PLC can be used to control inverters. Various systems including PCs can be linked for plant automation.

### **1.3 Components**

The option board is comprised with following components;

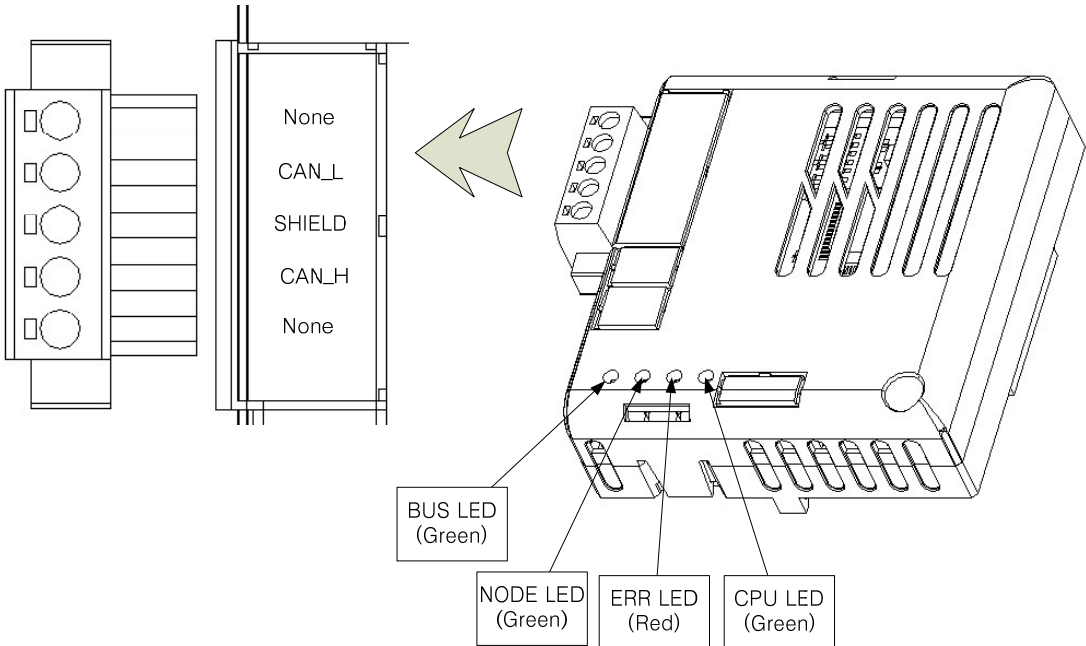
- . CANopen Communication Card: 1 ea
- . CANopen User Manual: 1 ea
- . Fixing Screw (M3): 1 ea
- . Terminal resistance (120Ω, 1/2W): 1 ea

## 2. SV-iS7 CANopen Communication Option

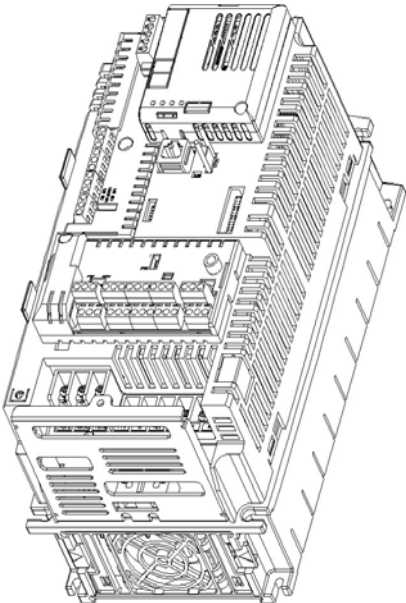
### 2.1 General Specification of CANopen Communication Card

Items		Description
Power Supply	Power supply of CANopen communication card	Supplied from inverter.
Network Topology		Bus Topology
Communication BaudRate		20kbps, 50kbps, 100kbps, 125kbps, 250kbps, 500kbps, 800kbps, 1Mbps
Max. number of Node		64 ea (Including Master) With 1 Master connected to network, the maximum number of inverter nodes is 63 (64-1).
Device Type		AC Drive
Supported Communication Type		PDO, SDO, Sync, NMT
Terminal Resistance		120 ohm 1/2W Lead Type
Available PDO		PDO1 (CiA 402 Drive and Motion Control device profile) PDO3 (LS Profile)
Vender Name		0x7D (LSIS)
PDO Mapping		N/A
Group Messaging		N/A
LSS Supported		N/A

### 2.2 External Appearance of Communication Card



### Installation



#### Precautions for Installation)

Do not install or remove the CANopen communication card while the power supply of the equipment is ON. Otherwise, both the CANopen communication card and the inverter may be damaged. Install or remove the CANopen communication card when the condenser of the inverter has been fully discharged.

Do not change the connection of communication signal wire while the inverter power is on.

Make sure that the inverter terminal and the connector of the option board are in agreement.

When building a network, make sure to connect the terminal resistance to the CANopen communication card at the end position. The terminating resistor, a 120 ohm 1/2W resistor, should connect the CAN\_L and CAN\_H.

### 2.3 Maximum Communication Range according to Baud Rate

In a network system, the total length of the network line is determined by the baud rate. The performance of the communication farther than this distance is not guaranteed.

Baud Rate	Bus Length	Remark
1 Mbit/s	25 m	-
800 Kbit/s	50 m	-
500 Kbit/s	100 m	-
250 Kbit/s	250 m	-
125 Kbit/s	500 m	-
100 Kbit/s	700 m	-
50 Kbit/s	1000 m	-
20 Kbit/s	2500 m	-

### 3. Diagnosis of the Option Statuses and LED Definition

#### 3.1 Definition of the LED Signal

The CANopen communication option has 4 LEDs.

LED	Description
CPU	When the Option card is energized and the CPU is in normal operation state, this LED is turned on and off at 1 second cycle – on for 500 ms and off for 500 ms.
ERR	This LED turns on if the Option parameters have been set up inappropriately, or the Internal CAN communication between the inverter and the CANopen is lost.
NODE	This LED turns on according to the status of the current NMT (Network Management).
BUS	This LED turns on or off according to the baud rate or profile set up, or communication status.

#### 3.2 Diagnosis of Option by LED Signal

LED	LED Signal	Option Status	Possible Cause	Action
CPU	Kept OFF	No Power	Failure in power supply (5V) to the CANopen communication card	Check inverter power supply. Check power supply to the CANopen communication card
	Blink at 1 sec intervals	On Power	5V power supplied	Normal status
ERR	Kept OFF	No Error	Normal Option setting	Normal status
	Blinks synchronously with the CPU LED	Internal CAN communication Error	Data communication between the inverter and Option is lost.	Turn the inverter power off, reinstall the Option card and turn the power on again.
	Blinks asynchronously with the CPU LED	FBus ID Setting Error	'0' is entered as the ID of the COM-7 FBus	Enter a figure between 1~127, not zero, into the FBus ID, and execute COM-94 Comm Update

ERR	Blinks at an interval twice as long as that of the CPU LED.	Opt Parameter Setting	The parameters for the CANopen entered using keypad differ from those set up in the CANopen option card.	Run COMM Update to apply the CANopen parameter set up with keyboard. To maintain the CANopen parameters, set up with the previous values, or turn off and on the inverter power supply. Though the ERR LED may blink, the CANopen is driven with the previous set up values.
NODE	Kept OFF	CANopen Not Initial	If the NODE LED has not been turned on yet after the CANopen Option has been energized, the CANopen has not been initialized yet and is not ready for CANopen communication.	Wait until lit. If not, set the COMM Update of the COM-94 to Yes.
	Kept OFF	CANopen Stopped	If the NODE LED has been lit at least by once, the CANopen Master has issued a Stopped command.	Normal status.
	Blinks synchronously with the CPU LED	CANopen Pre-Operational	CANopen communication available with the Master, but the connection with the Master has not been made yet.	Normal status.
	Kept ON	CANopen Operational	Master has been connected and communicating with the CANopen normally.	Normal status.



BUS	Kept ON	CANopen Network Bus No Error	No problem in the CANopen Network.	Normal status.
	Blinks synchronously with the CPU LED	CANopen Profile Setting Error	The profile set up on the CANopen Master differs from that set up in the Option.	Check that the PDOs set up in the Master and Option are identical.
	Blinks at an interval twice as long as that of the CPU LED	PDO Communication Not Connected	CANopen's communication speed is different.	Check that the baud rate of the CANopen set up in the Master and that in the Option are identical.
	Blinks at an interval twice as long as that of the CPU LED Kept OFF	PDO Communication Not Connected Bus Off	Master has not been connected for communication yet.	Check that the Master has started communication.
			Network line has not been connected yet.	Check that Network Line has been connected.
			CANopen Option is isolated from the network due to problem in the network.	Check the connection with the Network Line. Check tightness of bolts and nuts. Turn the power on and off.

## 4. Data Communication Protocol of the CANopen

### 4.1 Communication Protocol of the CANopen

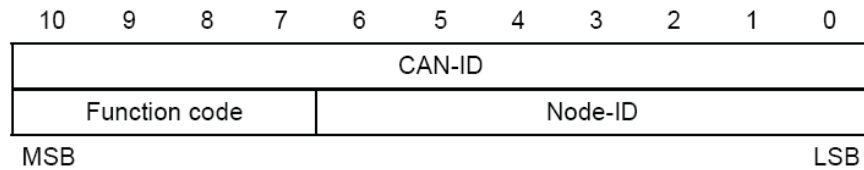
#### 4.1.1 CAN-ID

Following is the description on the ID part of the CAN frame.

In the IS7 CANopen, only CAN2.0A (Standard) is supported.

As the CAN2.0A is implemented, the ID comprises 11Bits.

The figure below shows the configuration of the ID.



The table below presents the Broadcast Function code.

COB	Function code	resulting CAN-ID
NMT	0000 <sub>b</sub>	0 (000 <sub>h</sub> )
SYNC	0001 <sub>b</sub>	128 (080 <sub>h</sub> )
TIME	0010 <sub>b</sub>	256 (100 <sub>h</sub> )

The table below presents the function code for peer to peer.

COB	Function code	Resulting CAN-IDs
EMCY	0001 <sub>b</sub>	129 (081 <sub>h</sub> ) – 255 (0FF <sub>h</sub> )
PDO1 (tx)	0011 <sub>b</sub>	385 (181 <sub>h</sub> ) – 511 (1FF <sub>h</sub> )
PDO1 (rx)	0100 <sub>b</sub>	513 (201 <sub>h</sub> ) – 639 (27F <sub>h</sub> )
PDO2 (tx)	0101 <sub>b</sub>	641 (281 <sub>h</sub> ) – 767 (2FF <sub>h</sub> )
PDO2 (rx)	0110 <sub>b</sub>	769 (301 <sub>h</sub> ) – 895 (37F <sub>h</sub> )
PDO3 (tx)	0111 <sub>b</sub>	897 (381 <sub>h</sub> ) – 1023 (3FF <sub>h</sub> )
PDO3 (rx)	1000 <sub>b</sub>	1025 (401 <sub>h</sub> ) – 1151 (47F <sub>h</sub> )
PDO4 (tx)	1001 <sub>b</sub>	1153 (481 <sub>h</sub> ) – 1279 (4FF <sub>h</sub> )
PDO4 (rx)	1010 <sub>b</sub>	1281 (501 <sub>h</sub> ) – 1407 (57F <sub>h</sub> )
SDO (tx)	1011 <sub>b</sub>	1409 (581 <sub>h</sub> ) – 1535 (5FF <sub>h</sub> )
SDO (rx)	1100 <sub>b</sub>	1537 (601 <sub>h</sub> ) – 1663 (67F <sub>h</sub> )
NMT error control	1110 <sub>b</sub>	1793 (701 <sub>h</sub> ) – 1919 (77F <sub>h</sub> )

Since only CAN2.0A is used, the PDO also is available between 1~4.

Presently, the PDOs used in the CANopen Option are PDO1 (CiA402 Profile) and PDO3 (LS Profile).

### 4.1.2 SDO communication

Regardless of the connection of the CANopen with the master, this is the protocol for the client to read or write data on the server.

SDO Download means the client writing data on the server, and the SDO Upload is the client reading data from the server.

### 4.1.3 PDO communication

According to the protocol, the only the Index and SubIndex Data which are specified to the PDO are transmitted. Though the data type of the PDO can be set up by mapping, the IS7 prohibits setting by mapping.

PDO has two types which are Transmit-PDO (TPDO) and Receive-PDO (RPDO).

PDO is classified into the Producer and Consumer, which are different from the server and client in the SDO communication. The Producer can be a client or a server. The Producer of the TPDO is a server and the Producer of the RPDO is a client. This is because the PDO is classified in the perspective of the server. The Consumer is the recipient of the PDO created by Producer.

#### 4.1.3.1 Transmission modes

Synchronous transmission: PDO is transmitted according to SYNC frame

Event-driven transmission: PDO is transmitted by an event.

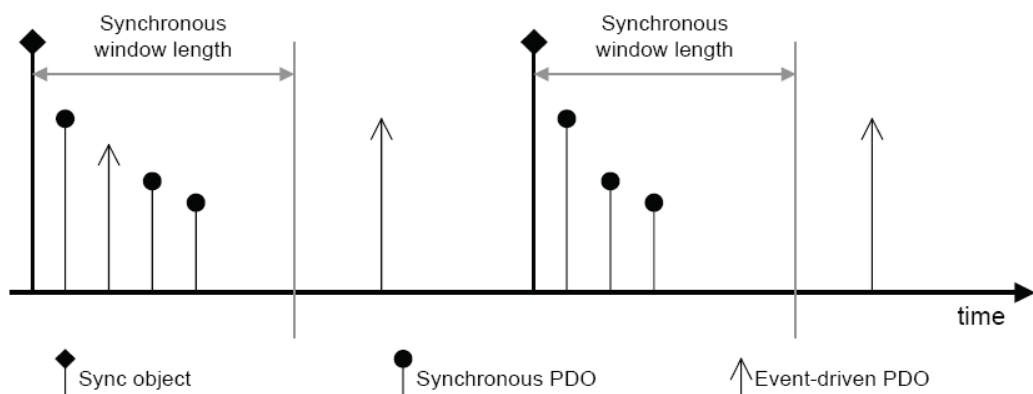


Figure 16: Synchronous and event-driven transmission

#### 4.1.3.2 Triggering modes

There are 3 trigger modes available for the generation of the event for PDO transmission.

- **Event- and timer-driven**

When the preset event time is elapsed the PDO frame is transmitted automatically.

- **Remotely requested**

PDO frame is transmitted when the RTR frame requesting for PDO is received.

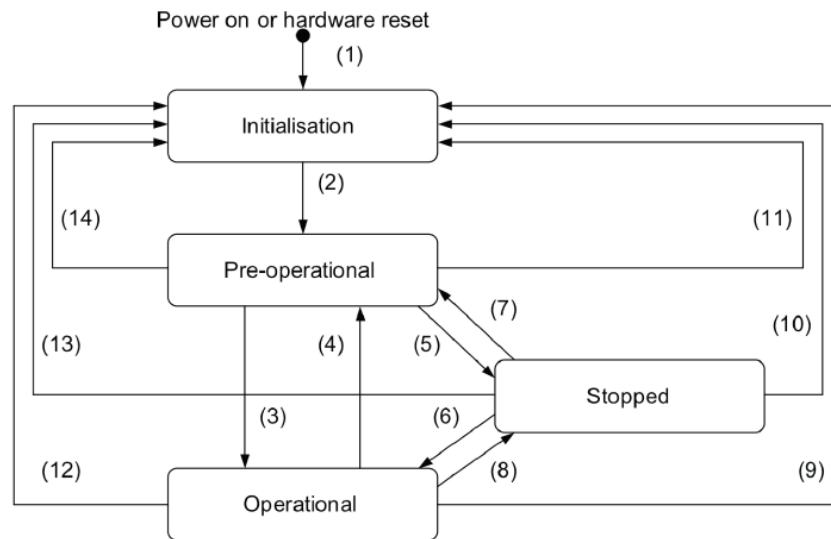
- **Synchronously triggered**

PDO frame is transmitted by the preset number of the SYNC frames.

## 4.2 NMT (Network Management) state machine

This command is used by the master to control the slave devices in the network.

The figure below shows the NMT State Diagram of a CANopen device.

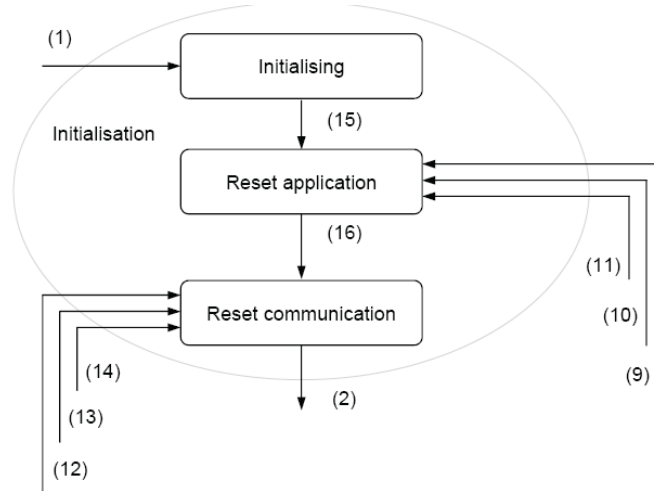


(1)	At Power on the NMT state initialisation is entered autonomously
(2)	NMT state Initialisation finished - enter NMT state Pre-operational automatically
(3)	NMT service start remote node indication or by local control
(4),(7)	NMT service enter pre-operational indication
(5),(8)	NMT service stop remote node indication
(6)	NMT service start remote node indication
(9),(10),(11)	NMT service reset node indication
(12),(13),(14)	NMT service reset communication indication

The above table presents the conditions for status transfer. The NMT Service means those converted by the NMT command frame.

### 4.2.1 NMT state initialization

The Initialization also is divided into 3 modes.



(1)	At power on the NMT state initialisation is entered autonomously
(2)	NMT state Initialisation finished - enter NMT state Pre-operational automatically
(12), (13), (14)	NMT service reset communication indication
(9), (10), (11)	NMT service reset node indication
(15)	NMT sub-state Initialization finished – NMT sub-state reset application is entered autonomously
(16)	NMT sub-state reset application is finished – NMT sub-state reset communication is entered autonomously

**Initializing:** the beginning status of the Option, which is the initialization stage after Power-On or H/W Reset.

**Reset Application:** NMT requested Node Reset. The initialization is conducted according to the profile.

**Reset Communication:** NMT requested Communication Reset, and notice the Master of boot-up via NMT frame. This state is transferred to Pre Operational automatically.

### 4.2.2 NMT state pre-operational

Before PDO communication, the PDO information is sent by the Master to the Slave via SDO, or necessary data is read. In this state, the PDO communication is being prepared via SDO.

### 4.2.3 NMT state operational

PDO communication is started by changing all the devices to Operation via the NMT frame. Of course, SDO communication is enabled too.

### 4.2.4 NMT state stopped

SDO and PDO communications are stopped due to a problem in the network. However the Node Guarding and Heartbeat communication are enabled.

### 4.2.5 The frames enabling communication by NMT status

	Pre-operational	Operational	Stopped
PDO	-	O	-
SDO	O	O	-
SYNC	O	O	-
TIME	O	O	-
EMCY	O	O	-
Node control and error control	O	O	O

\* "O" mark indicates communication enabled.

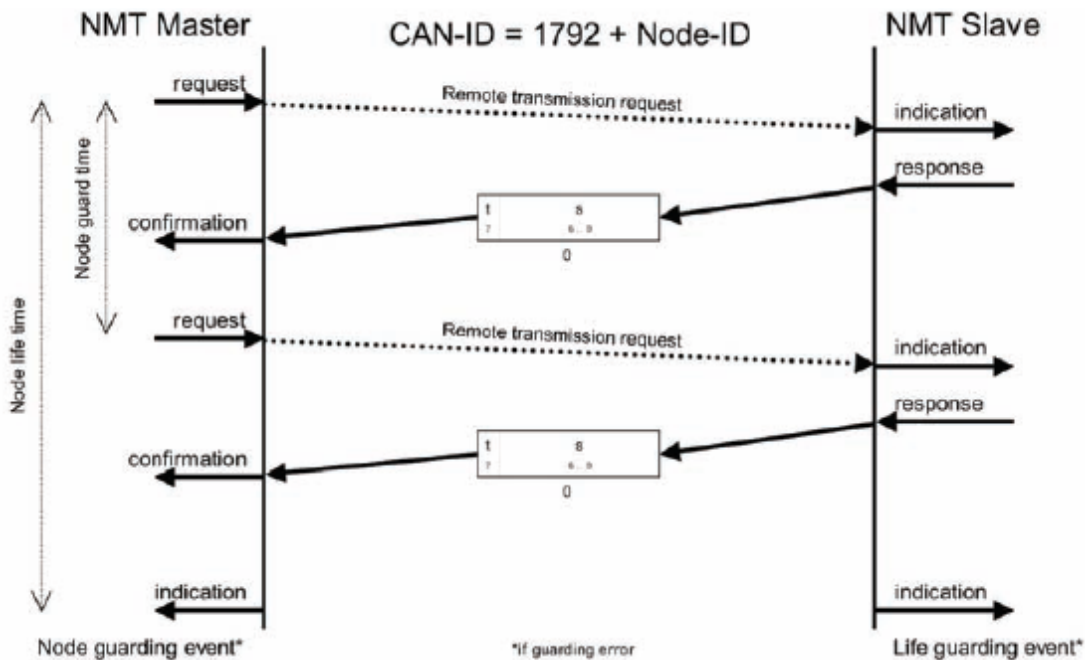
### 4.3 Error Control Protocols

These protocols are used to check normal operation of the device.

Two methods are available in the CANopen; Protocol node guarding and Protocol heartbeat.

#### 4.3.1 Protocol node guarding

Master inquires the Slave for normal operation via the RTR Frame, and the Slave returns the current NMT State to the Master.



The NMT status of the Slave is indicated by the value of S;

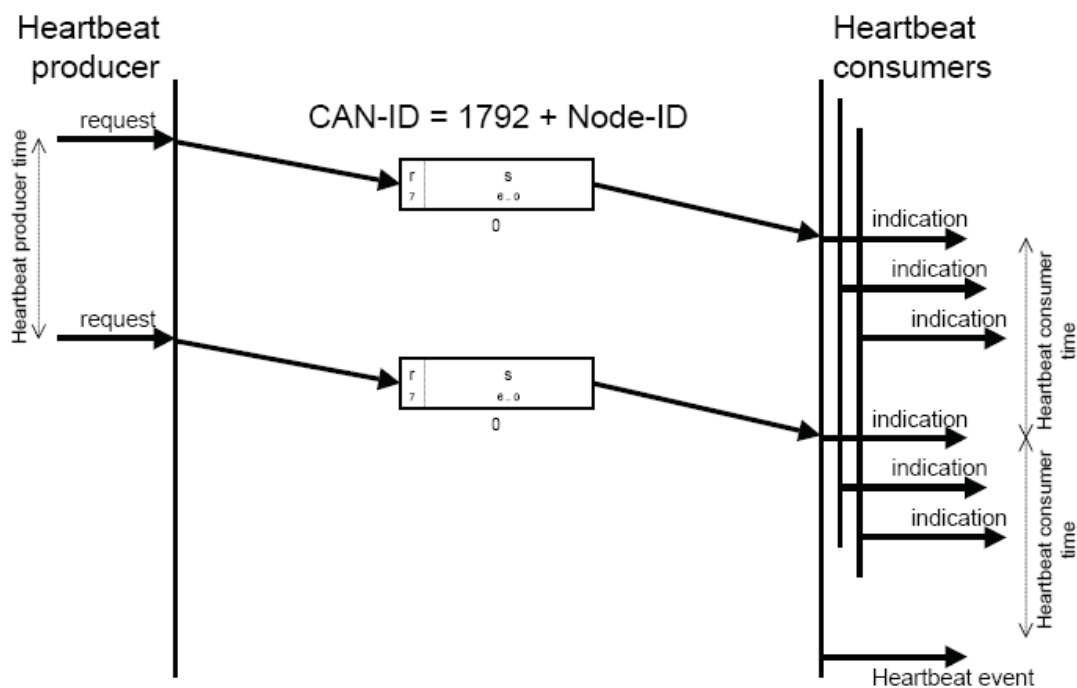
- 4: Stopped
- 5: Operational
- 127: Pre-operational

The 't' of the top bit is the Toggle Bit which toggles at every response of the Slave.

The Master sends the RTR Frame at every preset Node guard time. If the Master fails to send RTR Frame until the expiration of the Node life time, or the Slave fails to response to the Mater until the expiration of the Node life time, a Guard Error is generated. Then, the Guard Error Event set up in each Master and Slave is executed. In the case of iS7, the CANopen NMT State is changed to Pre-operational.

### 4.3.2 Protocol heartbeat

If the Error Control Protocol is set to Heartbeat, the MNT State information of itself is sent at the time intervals set up in the Heartbeat Producer. If the Heartbeat Producer fails to send the Heartbeat within the preset time, the Heartbeat consumer generates a Heartbeat event.



The value of S represents the MNT state of the Slave;

- 4: Stopped
- 5: Operational
- 127:Pre-operational

The upper 'r' is the reservation bit which is always zero.

The IS7 CANopen informs the Consumer of the current MNT State at the time intervals set up with the Producer. Therefore, in general, the Master is the Consumer.

#### 4.4 CANopen EDS File

This file contains the parameter data of the inverter, which is used to control the parameters of the SV-iS7 via the CANopen Manager software program. To do this, you need to install the EDS file for the iS7 provided by the LS Industrial System in your PC.

- The EDS file can be downloaded from the Webpage of LS Industrial System ([www.lsis.biz](http://www.lsis.biz)).
- EDS file name: `LSIS_IS7_CANOPENxx.EDS`

`LSIS_IS7_CANOPENxx.EDS` should be copied into the folder where the EDS file is stored in the Master Configuration program.



## 5. Detailed Specification of Communication Profile Specific Objects

### 5.1 Device Type

The SDO indicates the device type of the Option.

Index	0x1000
Data type	UNSIGNED32
Sub-index	0x00
Access	RO (Read Only)
Data	0x00010192

### 5.2 Error Register

The information on the error of the Option.

Index	0x1001	
Data type	UNSIGNED8	
Sub-index	0x00	
Access	RO	
Data	Bit	Information
	0	Generic error
	1	Current
	2	Voltage
	3	Temperature
	4	Communication error (overrun, error state)
	5	Device profile specific
	6	reserved (always 0)
7	manufacturer-specific	

### 5.3 Pre-defined Error Field

The information on the current Emergency.

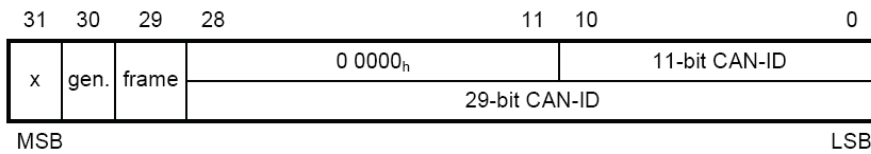
Index	0x1003	
Data type	UNSIGNED32	
Object code	Object code	
Sub-index	0x00	
Description	Number of the occurred errors	
Access	RW (Read/ Write)	
Data	Read	Number of the current emergency errors
	Write	Enter "0" to rest all the emergencies

Sub-index	0x01
Description	Information on the last emergency
Access	RO
Data	The value of Error code (Refer to Error code table of 6.1.2.1)
Sub-index	0x02~0x08
Description	Information on the last emergency
Access	RO
Data	The value of Error code (Refer to Error code table of 6.1.2.1)

### 5.4 COB-ID SYNC Message

The SDO for reading and writing the information on the CAN ID of the device that sends the SYNC Message.

The Bit format is as follows;



The iS7 CANopen Option only receives and does not generate SYNC, and supports Standard ID only. Therefore, both the gen and frame must be 0.

Index	0x1005	
Data type	UNSIGNED32	
Sub-index	0x00	
Access	RW	
Data	Read	COB-ID of the current SYNC setting
	Write	Set up the COB-ID of SYNC

### 5.5 Manufacturer Device Name

Name information of the CANopen Option.

Index	0x1008	
Data type	VISIBLE_STRING (String)	
Sub-index	0x00	
Access	CONST (Read only data. Unchangeable)	
Data	IS7 CANopen	

## 5.6 Manufacturer Hardware Version

Version data of the hardware of the Option.

Index	0x1009
Data type	VISIBLE_STRING (String)
Sub-index	0x00
Access	CONST (Read only data. Unchangeable)
Data	CANopen 1.00 (May differ by the hardware version of the Option)

## 5.7 Manufacturer Software Version

Version data of the software of the Option.

Index	0x100A
Data type	VISIBLE_STRING (String)
Sub-index	0x00
Access	CONST (Read only data. Unchangeable)
Data	Version 1.00 (May differ by the software version of the Option)

## 5.8 Guard Time

This SDO sets the guard time when using the Node Guarding Protocol of the Error Control Protocol.

Index	0x100C
Data type	UNSIGNED16
Sub-index	0x00
Access	RW
Data	Guard Time, unit: msec

## 5.9 Life Time Factor

This SDO sets the life time factor when using the Node Guarding Protocol of the Error Control Protocol.

Index	0x100D
Data type	UNSIGNED8
Sub-index	0x00
Access	RW
Data	This factor is for the calculation of the Node Life Time, and is zero when not using the Node Guarding Protocol.

### 5.10 Store Parameters

This SDO saves keypad data changed by communication when power turns to off.

Sub-Index 0x01, 0x02, and 0x03 are not supported. 0x04 only is supported.

Index	0x1010														
Data type	UNSIGNED32														
Sub-index	0x04														
Name	Save Inverter Parameters														
Access	RW														
Data	Read	0x0001 indicates that the data can be saved. 0x0000 indicates saving is not available due to inverter drive, etc.													
	Write	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Signature</td> <td style="text-align: center;">MSB</td> <td style="text-align: center;">LSB</td> </tr> <tr> <td style="text-align: center;">/ISO8859/ character</td> <td style="text-align: center;">e</td> <td style="text-align: center;">v</td> <td style="text-align: center;">a</td> <td style="text-align: center;">s</td> </tr> <tr> <td style="text-align: center;">hex</td> <td style="text-align: center;">65<sub>h</sub></td> <td style="text-align: center;">76<sub>h</sub></td> <td style="text-align: center;">61<sub>h</sub></td> <td style="text-align: center;">73<sub>h</sub></td> </tr> </table> <p>The data in above table must be transmitted to save the keypad parameters in the ROM.</p>		Signature	MSB	LSB	/ISO8859/ character	e	v	a	s	hex	65 <sub>h</sub>	76 <sub>h</sub>	61 <sub>h</sub>
Signature	MSB	LSB													
/ISO8859/ character	e	v	a	s											
hex	65 <sub>h</sub>	76 <sub>h</sub>	61 <sub>h</sub>	73 <sub>h</sub>											

### 5.11 COB-ID EMCY

This SDO sets the CAN-ID of the Emergency Frame. In the IS7 CANopen, setting is prohibited, only reading is allowed.

Index	0x1014
Data type	UNSIGNED32
Sub-index	0x00
Access	RW
Data	\$NODEID+0x80 (Node ID is the FBus ID currently set up in the Option.)

### 5.12 Producer Heartbeat Time

This SDO indicates the time at which the Heartbeat is transmitted.

Index	0x1017
Data type	UNSIGNED16
Sub-index	0x00
Access	RW
Data	Set up time in msec units.

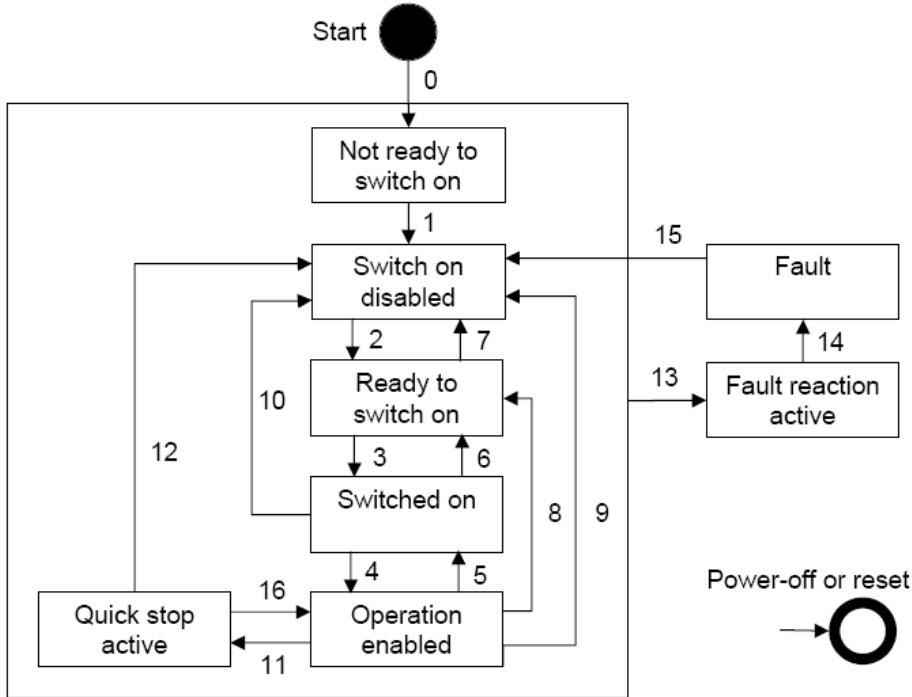
## 6. Profile

### 6.1 CiA 402 Drive and Motion Control Device Profile

Velocity Mode only is supported.

#### 6.1.1 Finite state automation

This is the state of the Option used at CiA 402.



**Not ready to Switch On:** The hardware and Stack of CANopen are initialized in this state.

**Switch on disable:** Current Option state is not available for Switch On.

**Ready to switch on:** Ready to change to switch-on state anytime

**Switch on:** Ready for Operation enable. RN command can be issued at anytime.

**Operation enabled:** Motor is running

**Quick stop active:** Motor is to be or has been stopped.

The table below presents the action of the inverter according to status change.

Transition	Event	Action
0	Automatic change	Conduct self diagnosis and initialize parameters
1	Automatic change	CANopen communication enabled
2	Change to Operation Mode	None
3	On receiving Switch on command	None
4	On receiving Enable Operation command	Motor drive

Transition	Event	Action
5	On receiving Disable Operation command	The command to maintain current inverter status is not accepted. I.e., stop command is not accepted.
6	On receiving Shut Down command	If motor has been running, conduct Free run stop
7	On receiving Disable voltage command	None
8	On receiving Shut Down command	Conduct Free run stop
9	On receiving Disable voltage command	Conduct Free run stop
10	On receiving Disable voltage command or Quick Stop command	Conduct Free run stop
11	On receiving Quick Stop command	Reduce speed at the reducing time setup in the Quick Stop
12	On receiving Disable voltage command	Conduct Free run stop
13	When the inverter tripped	Conduct Trip sequence
14	Automatic change	Conduct Trip sequence
15	On receiving Reset command or Trip is released	Change to Switch on disable state
16	On receiving Enable operation command	Motor runs again

## 6.1.2 CiA 402 SDO

### 6.1.2.1 Error codes (Object: 0x603F)

Index: 0x603F

When the inverter is tripped, this SDO is used to identify the type of the trip.

The table below presents the Error code No. for response to the inverter trip.

Fault Code Number	Description
0x0000	None
0x1000	UNDEFINED
0x2220	Inverter OLT
0x2310	OverCurrent1
0x2330	Ground Trip
0x2340	OverCurrent2
0x3130	In Phase Open
0x3210	Over Voltage
0x3220	Low Voltage
0x4000	NTC Open

Fault Code Number	Description
0x4310	Over Heat
0x5000	HWDiag
0x5450	Fuse Open
0x6300	Para Write Trip
0x7001	Fan Trip
0x7011	OptionTrip1
0x7012	OptionTrip2
0x7013	OptionTrip3
0x7021	IO Board Trip
0x7022	XIO Trip
0x7120	No Motor Trip
0x7310	EncoderTrip
0x8401	Speed Dev Trip
0x8402	OverSpeed
0x9001	External Trip
0x9002	BX
0xFF01	Ethermal
0xFF03	Out Phase Open
0xFF04	Over Load
0xFF05	Under Load
0xFF06	Thermal Trip
0xFF07	Pre PID Fail
0xFF0A	Lost Command
0xFF0B	Lost Keypad

### 6.1.2.2 Control word (Object: 0x6040)

Index: 0x6040

The Bit composition below presents the bit command of the Control Word.


15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
nu	nu	nu	nu	nu	r	nu	h	fr	rr	ur	er	eo	qs	ev	so

- so: Switch on
- ev: Enable Voltage
- qs: Quick stop
- eo: Enable operation
- er: Enable ramp

- ur: Unlock ramp
- rr: Reference ramp
- fr: Fault reset
- h: halt
- r: reserved
- nu: Not used

The bits between 4bit and 7bit are command bits which run in Operation Mode.

The table below presents the commanding method in the FSA state described in 5.1.1.

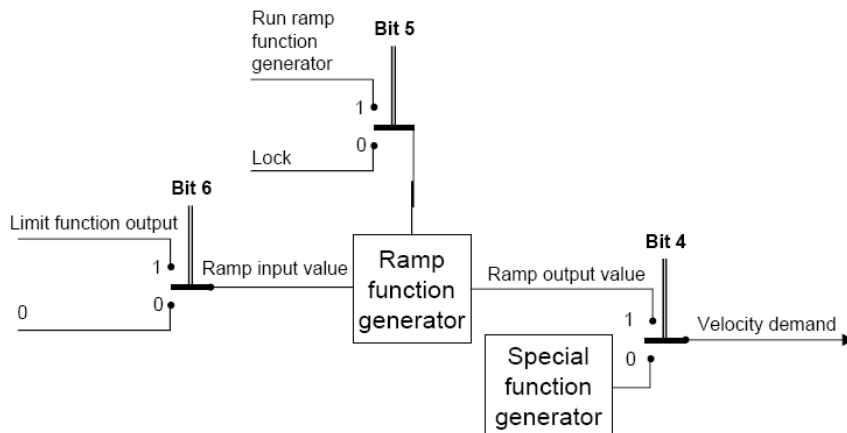
Command	Bits of the <i>controlword</i>					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (NOTE)
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset		X	X	X	X	15
NOTE Automatic transition to Enable operation state after executing SWITCHED ON state functionality.						

The figure in the Transitions is the numbers of the inverter action table described in 5.1.1.

Followings are the command bits used in Enable Operation.

Bit	Value	Description
4 (Enable Ramp)	0	Maintain previous operational state
	1	Operate inverter by command bit
5 (Unlock Ramp)	0	Holds output frequency
	1	Drive up to the target frequency
6 (Reference Ramp)	0	Enter zero in the target frequency
	1	Enter setting value in the target frequency
8 (Halt)	X	Not used





### 6.1.2.3 Statusword (Object: 0x6041)

Index: 0x6041

The bit composition below presents the command by bits of Control Word.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
nu	nu	nu	Nu	ila	tr	rm	nu	w	sod	qs	ve	f	oe	so	rtso

- rtso: ready to switch on
- so: switched on
- oe: operation enabled
- f: fault(Trip)
- ve: voltage enabled
- qs: quick stop
- sod: switch on disabled
- w: warning
- rm: remote
- tr: target reached
- ila: internal limit active
- nu: not used

The bit values according to the state of FAS.

Statusword	PDS FSA state
xxxx xxxx x0xx 0000 <sub>b</sub>	Not ready to switch on
xxxx xxxx x1xx 0000 <sub>b</sub>	Switch on disabled
xxxx xxxx x01x 0001 <sub>b</sub>	Ready to switch on
xxxx xxxx x01x 0011 <sub>b</sub>	Switched on
xxxx xxxx x01x 0111 <sub>b</sub>	Operation enabled
xxxx xxxx x00x 0111 <sub>b</sub>	Quick stop active
xxxx xxxx x0xx 1111 <sub>b</sub>	Fault reaction active
xxxx xxxx x0xx 1000 <sub>b</sub>	Fault

#### 6.1.2.4 vl target velocity (Object: 0x6042)

**Index:** 0x6042

**Function:** Target velocity

**Unit:** rpm

**Basic format:** 0

**Setting range:** -30000 ~ 30000

(- value represents inverse run, + represents normal run, the range varies by the parameter setting.)

##### Object description

Attribute	Value
Index	6042 <sub>h</sub>
Name	vl target velocity
Object Code	Variable
Data Type	Integer16
Category	Conditional: mandatory if vl is supported

##### Entry description

Attribute	Value
Sub-Index	00 <sub>h</sub>
Access	rw
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	0000 <sub>h</sub>

#### 6.1.2.5 vl velocity demand (Object: 0x6043)

**Index:** 0x6042

**Function:** Current target velocity

**Unit:** rpm

**Basic format:** 0

**Setting range:** -30000 ~ 30000

(- value represents inverse run, + represents normal run, the range varies by the parameter setting.)

#### Object description

Attribute	Value
Index	6043 <sub>h</sub>
Name	v/ velocity demand
Object Code	Variable
Data Type	Integer16
Category	Conditional: mandatory if v/ is supported

#### Entry description

Attribute	Value
Sub-Index	00 <sub>h</sub>
Access	ro
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	No

### 6.1.2.6 v/ velocity actual value (Object: 0x6044)

**Index:** 0x6044

**Function:** Current run velocity

**Unit:** rpm

**Basic format:** 0

**Setting range:** -30000 ~ 30000

(- value represents inverse run, + represents normal run, the range varies by the parameter setting.)

#### Object description

Attribute	Value
Index	6044 <sub>h</sub>
Name	v/ velocity actual value
Object Code	Variable
Data Type	Integer16
Category	Conditional: mandatory, if v/ is supported

#### Entry description

Attribute	Value
Sub-Index	00 <sub>h</sub>
Access	ro
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	No

**6.1.2.7 vI velocity min max amount (Object: 0x6046)**

This object is supported in the CiA402 Profile, but not implemented in the IS7 because it may make users confused according to the function of the iS7. The parameters of the same functionalities are ADV 24, ADV 25, and ADV26.

**6.1.2.8 vI velocity acceleration (Object: 0x6048)**

**Index:** 0x6050

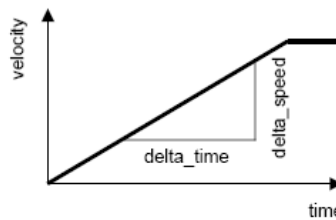
**Function:** Object which determines an acceleration time

**Unit:** sec

**Basic format:** 0.0

**Setting range:** 0.0 ~ 600.0 (Setting range differs from parameter setting of inverter.)

$$vI \text{ velocity acceleration} = \frac{\text{delta speed}}{\text{delta time}}$$



**Transfer characteristic of the velocity acceleration**

As shown in the figure, the acceleration time is determined using the Delta speed and Delta time. For the safety of the inverter, the delta\_speed was fixed to Max Speed, and the setting parameter was removed.

**Object description**

Attribute	Value
Index	6048 <sub>h</sub>
Name	vI velocity acceleration
Object Code	Record
Data Type	vI velocity acceleration deceleration
Category	Conditional: Mandatory of vI is supported

**Entry description**

Sub-Index	02 <sub>h</sub>
Description	Delta time
Entry Category	Mandatory
Access	rw
PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer-specific

### 6.1.2.9 vI velocity deceleration (Object: 0x6049)

**Index:** 0x6049

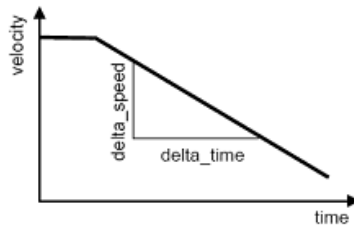
**Function:** Object which determines a deceleration time

**Unit:** sec

**Basic format:** 0.0

**Setting range:** 0.0 ~ 600.0 (Setting range differs from parameter setting of inverter)

$$vI \text{ velocity deceleration} = \frac{\text{delta speed}}{\text{delta time}}$$



**Transfer characteristic of the velocity deceleration**

As shown in the figure, the deceleration time is determined using the Delta speed and Delta time.

For the safety of the inverter, the delta\_speed was fixed to Max speed, and the setting parameter was removed.

#### Object description

Attribute	Value
Index	6049 <sub>h</sub>
Name	vI velocity deceleration
Object Code	Record
Data Type	vI velocity acceleration deceleration
Category	Conditional: Mandatory of vI is supported

#### Entry description

Sub-Index	02 <sub>h</sub>
Description	Delta time
Entry Category	Mandatory
Access	rw
PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer-specific

**6.1.2.10 vI velocity Quick Stop (Object: 0x604A)**

**Index:** 0x604A

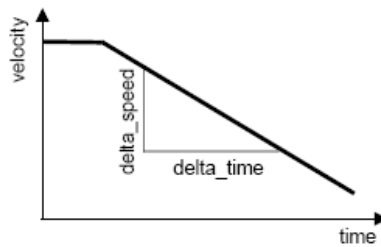
**Function:** Object which determines Quick Stop time

**Unit:** sec

**Basic format:** 0.0

**Setting range:** 0.0 ~ 600.0 (Setting range differs from parameter setting of inverter.)

$$velocity\ quick\ stop = \frac{\delta\ speed}{\delta\ time}$$



**Transfer characteristic of the quick stop deceleration**

As shown in the figure, the deceleration time is determined using the Delta speed and Delta time. For the safety of the inverter, the delta\_speed was fixed to Max speed, and the setting parameter was removed.

**Object description**

Attribute	Value
Index	6049 <sub>h</sub>
Name	vI velocity deceleration
Object Code	Record
Data Type	vI velocity acceleration deceleration
Category	Conditional: Mandatory of vI is supported

**Entry description**

Sub-Index	02 <sub>h</sub>
Description	Delta time
Entry Category	Mandatory
Access	rw
PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer-specific

## Object description

Attribute	Value
Index	604A <sub>n</sub>
Name	v/ velocity quick stop
Object Code	Record
Data Type	v/ velocity acceleration deceleration
Category	Conditional: Mandatory of v/ is supported

## Entry description

Sub-Index	02 <sub>n</sub>
Description	Delta time
Entry Category	Mandatory
Access	rw
PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer-specific

### 6.1.3 SDO for IS7

#### 6.1.3.1 SDO address in common area

##### - Inverter monitoring area

These are the parameters in the read-only common area between the communication address; 0h300 ~ 0h37F. In the CANopen, the Index is 0x4000, and the Sub Index is the value of the communication address deducted with 0h300 and added with 1.

E.g.) To read the value in the communication address 0h0310, the data is in Index: 0x4000 and Sub Index: 0x11.

##### - Inverter control area

These are the parameters in the control-only common area between the communication address: 0h380 ~ 0h3DF.

In the CANopen, Index is 0x4001 and Sub Index is the last 2 digits of the communication address added with 1.

E.g.) To read the value in the communication address 0h0389, the data is in Index: 0x4001 and Sub Index: 0x0A.

##### - Inverter memory control area

These are the parameters in the memory control common area between the communication address: 0h3E0 ~ 0h3FF.

In the CANopen, Index is 0x4002 and Sub Index is the communication address deducted with 0h3E0 and added with 1.

E.g.) To read the value in the communication address 0h03E1, the data is in Index: 0x4002 and Sub Index: 0x02.

Note) Before setting the memory control area value, check that the preset value is zero. If the previous value is not zero, then set the value to zero and then reset it to the desired value for appropriate operation of the parameter function. If the preset value was not zero, and the new setting value also is not zero, the parameter does not function.

E.g.) In the 0h03E0 (Index:0x4002 SubIndex 0x01) parameter setting, if the previous value is 1:Yes, first, change it to 0:No, then set it to 1:Yes to save the inverter parameter settings.

### 6.1.3.2 SDO address in the keypad parameter area

The Keypad parameters are indexed by group. The SubIndex is the code number.

The table below presents the index values by Group.

Index	Area
0x4010	DRV Group
0x4011	BAS Group
0x4012	ADV Group
0x4013	CON Group
0x4014	IN Group
0x4015	OUT Group
0x4016	COM Group
0x4017	APP Group
0x4018	APO Group
0x4019	PRT Group
0x401A	M2 Group

E.g.) To obtain the value of the I1 Monitor[mA] which is the Code 20 parameter in Group, read the values in the Index 0x4014 and SubIndex 0x14.

## 6.2 PDO

Of the CiA 402 Drive and Motion Control, implemented for the PDO for the frequency converter.

### 6.2.1 RPDO

The RPDO of the CiA 402 Profile are as follows;

Number of RPDO	Support	Description
1	Mandatory	Controls PDS FSA and Target velocity(vl)
2	Optional	Controls PDS FSA and Target velocity(vl), and target torque(tq)
3	Optional	Manufacture Specification

iS7 CANopen supports RPDO1 and RPDO3 only.



The settings are for the receiving methods of the RPDOs.

The index of the communication parameter object of the RPDO1 is 0x1400.

The index of the communication parameter object of the RPDO3 is 0x1402.

The Sub Index parameters in the object are the same.

Sub Index	Property	Description
0x01	Function	COB-ID (The unique CAN ID value of PDO)
	Access	RW
	Initial value	0x0200 + Node ID (RPDO1), 0x0400 + Node ID (RPDO3)
0x02	Function	Transmission Type
	Access	RW
	Initial value	255

**Trans Mode according to the Transmission Type value:**

0: at the occurrence of SYNC, the master creates RPDO, which is transmitted only when the data has been changed from the previous value.

1~240: receiving SYNC for preset frequency, the RPDO is transmitted once.

252: not supported.

253: Not supported.

254: Manufacturer defined (varies by Master Type.)

255: transmits RPDO by Event Trigger.

**6.2.2 RPDO mapping**

Since IS7 CANopen Map is fixed, user cannot edit the map.

**6.2.2.1 RPDO1 mapping**

The RPDO set up in the CiA 402 Profile.

Index: 0x1600

The table below presents the RPDO1 Map.

Sub index	Setting value	Parameter Index	Parameter Sub Index	The name of parameter
0x01	0x60400010	0x6040	-	Control word
0x02	0x60420010	0x6042	-	vl target velocity

**6.2.2.2 RPDO3 mapping**

The RPDO set up in the LS Drive Profile.

Index: 0x1602

The table below presents the RPDO3 Map.

Sub index	Setting value	Parameter Index	Parameter Sub Index	The name of parameter
0x01	0x30100010	0x3010	-	Para Control - 1 Data Value
0x02	0x30110010	0x3011	-	Para Control - 2 Data Value
0x03	0x30120010	0x3012	-	Para Control - 3 Data Value
0x04	0x30130010	0x3013	-	Para Control - 4 Data Value

Para Control –x Data Value is the value to be written in the parameter of the communication address set up in COM-51~54.

### 6.2.3 TPDO

The TPDO of the CiA 402 Profile are as follows.

Number of RPDO	Support	Description
1	Mandatory	Controls PDS FSA and Target velocity(vl)
2	Optional	Controls PDS FSA and Target velocity(vl), and target torque(tq)
3	Optional	Manufacture specification

IS7 CANopen supports only TPDO1 and TPDO3.

The settings are for the receiving methods of the TPDOs.

The index of the communication parameter object of the TPDO1 is 0x1400.

The index of the communication parameter object of the TPDO3 is 0x1402.

The Sub Index parameters in the object are the same.

Sub Index	Property	Description
0x01	Function	COB-ID (Unique CAN ID value of PDO)
	Access	RW
	Initial value	0x0180 + Node ID (TPDO1), 0x0380 + Node ID (TPDO3)
0x02	Function	Transmission Type
	Access	RW
	Initial value	255
0x03	Function	Inhibit Time
	Access	RW
	Initial value	0
0x05	Function	Event Timer
	Access	RW
	Initial value	0

**Trans Mode according to the Transmission Type value:**

- 0: at the occurrence of SYNC, the CANopen Option creates TPDO, which is transmitted only when the data has been changed from the previous value.
- 1~240: receiving SYNC for preset frequency, the TPDO is transmitted once.
- 252: at every occurrence of SYNC, data is updated to PDO, and TPDO is transmitted when the master transmits a remote frame requesting TPDO.
- 253: receiving the remote frame from the master requesting the TPDO, data is updated and TPDO is transmitted.
- 254: Manufacturer defined (in the IS7 CANopen, TPDO is transmitted at every Event Time.)
- 255: transmits TPDO by Event Trigger. If the data is not changes within the Event Time, TPDO is transmitted. If the data changes within the Event Time, the TPDO is transmitted after Inhibit Time. TPDO is not transmitted until the Inhibit Time has been passed.

**6.2.4 TPDO mapping**

The map of the IS7 CANopen is fixed; therefore, user cannot edit the map.

**6.2.4.1 TPDO1 mapping**

The PDO set up in the CiA 402 Profile.

Index: 0x1A00

The table below presents the PDO1 Map.

Sub index	Setting value	Parameter Index	Parameter Sub Index	The name of parameter
0x01	0x60410010	0x6041	-	Statusword
0x02	0x60440010	0x6044	-	vl velocity actual value

**6.2.4.2 TPDO3 mapping**

The PDO set up in the LS Drive Profile.

Index: 0x1A02

The table below presents the PDO3 Map.

Sub index	Setting value	Parameter Index	Parameter Sub Index	The name of parameter
0x01	0x30000010	0x3000	-	Para Status - 1 Data Value
0x02	0x30010010	0x3001	-	Para Status - 2 Data Value
0x03	0x30020010	0x3002	-	Para Status - 3 Data Value
0x04	0x30030010	0x3003	-	Para Status - 4 Data Value

Para Status –x Data Value is to read the parameter of the communication address set up by COM-31~34.

## 7. Inverter Parameter

### 7.1 Related Parameter List

Code	Description	Keypad Display	Setting Range	Factory Default	Type/Units
CNF-30	Type of the option board in the inverter	Option-1 Type	-	"CANopen"	
DRV-06	Set up to receive the operating command from the Option	Cmd Source	"FieldBus"	"FX/RX-1"	
DRV-07	Set up to receive the frequency command from the Option	Freq Source	"FieldBus"	"Keypad-1"	
DRV-08	Set up to receive the talk command from the Option	Trq Source	"FieldBus"	"Keypad-1"	
COM-06	Option board version	FBus S/W Ver	-	-	X.XX
COM-07	Station No. setting	FBus ID	1~127	1	X
COM-09	LED status of CANopen	FBus LED	-	-	-
COM-10	CANopen speed	Opt Parameter1	0~7	0	X
COM-11	Select CANopen Profile	Opt Parameter2	0-1	0	X
COM-31	Keypad Addr of the TPDO Data to be read from CANopen Master	Para Status - 1	0x0000-0xFFFF	0x000A	0XXXXX Hex
COM-32	Keypad Addr of the TPDO Data to be read from CANopen Master	Para Status - 2	0x0000-0xFFFF	0x000D	0XXXXX Hex
COM-33	Keypad Addr of the TPDO Data to be read from CANopen Master	Para Status - 3	0x0000-0xFFFF	0x000F	0XXXXX Hex
COM-34	Keypad Addr of the TPDO Data to be read from CANopen Master	Para Status - 4	0x0000-0xFFFF	0x0000	0XXXXX Hex
COM-51	Keypad Addr of the RPDO Data to be read from CANopen Master	Para Control -1	0x0000-0xFFFF	0x0005	0XXXXX Hex
COM-52	Keypad Addr of the RPDO Data to be read from CANopen Master	Para Control -2	0x0000-0xFFFF	0x0006	0XXXXX Hex

Code	Description	Keypad Display	Setting Range	Factory Default	Type/Units
COM-53	Keypad Addr of the RPDO Data to be read from CANopen Master	Para Control -3	0x0000-0xFFFF	0x0000	0XXXXX Hex
COM-54	Keypad Addr of the RPDO Data to be read from CANopen Master	Para Control -4	0x0000-0xFFFF	0x0000	0XXXXX Hex
COM-94	Reflect parameter on Option	Comm Update	"No" "Yes"	"No"	-
PRT-12	Set up inverter operation in the event of Lost Command	Lost Cmd Mode	"None" "Free-Run" "Dec" "Hold Input" "Hold Output" "Lost Preset"	"None"	-
PRT-13	Set up the time for the Lost Command	Lost Cmd Time	0.1~120.0	1.0	0.0 sec
PRT-14	Set up the speed of Lost Preset	Lost Preset F	0.00	0	Hz/Rpm

## 7.2 Description on the Basic Field Bus Parameters

### 7.2.1 COM 07 FBus ID

The allowable setting range in the inverter is 0~127. However, 0 is not used as a station No. in CANopen. If set to 0, the ERR LED will blink in the CANopen Option. (See Section 3.2)

### 7.2.2 COM 09 FBus LED

These parameters control the LEDs on the CANopen board.

0Bit: CPU LED

1Bit: ERR LED

2Bit: NODE LED

3Bit: BUS LED

The example of COM-09 LED status)



BUS LED(Green)	NODE LED(Green)	ERR LED(Red)	CPU LED(Green)
OFF	ON	ON	ON

### 7.2.3 COM 94 Comm Update

Press Yes to reflect the values set up with keypad on the CANopen Option.

## 7.3 Description on the Opt Parameter

### 7.3.1 COM 10 Opt Parameter1

These parameters control the communication speed of the CANopen.

Setting range: 0~7

0: 1Mbps

1: 800Kbps

2: 500Kbps

3: 250Kbps

4: 125Kbps

5: 100Kbps

6: 50Kbps

7: 20Kbps

Default value is 0: 1Mbps.

### 7.3.2 COM 11 Opt Parameter2

These parameters select Profile.

Setting range: 0~1

0: CiA 402 Drive and Motion Control Velocity Mode (Frequency Converter PDO1)

1: LS Device Profile (PDO3)

Default value is 0: CiA 402 Profile.

## 7.4 Parameter Setting for the Periodic Communication

### 7.4.1 COM 31~34 Para Status

This can be set up only when the LS Device Profile is selected in the COM11.

4 parameter addresses are designated and the parameter values are transmitted to the Master through TPDO3.

If CiA 402 Velocity Mode is selected, this status is hidden and setting is prohibited.

#### 7.4.2 COM 51~54 Para Control

This can be set up only when the LS Device Profile is selected in the COM11.

4 parameter addresses are designated and the parameter values transmitted to the Master through RPDO3 is used. If CiA 402 Velocity Mode is selected, this status is hidden and setting is prohibited.

#### 7.5 Parameter setting for the Lost Command

According to the decision criteria of the Lost Command of the IS7 CANopen, it judges that the Master and Slave are connected when the NMT status of the CANopen is Operation, and it does not generate Lost Command. That is, when the NMT State different from Operation is maintained for longer than the time set up in the PR-13, the inverter turns to Lost Command state. However, the Lost Command can be generated only when one or more of the frequency command or operation command is set to Fieldbus.

##### 7.5.1 PRT-12 Lost Cmd Mode

None: no action is taken even when the Inverter turns to Lost Command state.

Free-Run: in Lost Command state, the motor turns to Free Run stop and Lost Command Trip is triggered.

Dec: in Lost Command state, the motor turns to trip deceleration stop, and Lost Command Trip is triggered.

Hold Input: the motor runs at the last speed command, and Lost Command Warning is issued.

Hold Output: the motor runs at the current speed, and Lost Command Warning is issued.

Lost Preset: the motor runs at the speed set up in the PRT-14, and Lost Command Warning is issued.

##### 7.5.2 PRT-13 Lost Cmd Time

While the CANopen is in communication, if the MNT State different from Operation is maintained for the time longer than the time set up in the PRT-13, the Inverter turns to Lost Command state.

##### 7.5.3 PRT-14 Lost Preset F

If Lost Preset is set up in the Lost Cmd Mode of the PRT-12, and if the Inverter turns to Lost command state, the inverter drives the motor at the speed set up in the PRT-14.

## Warranty

Product Name	LSIS Communication Option Card	Installation Date	
Model Name	SV-iS7 CANopen Communication Card	Warranty Period	
Customer	Name		
	Address		
	Tel.		
Sales Offices	Name		
	Address		
	Tel.		

### Note

This product has been manufactured through the strict QC control and inspection of LS Industrial Systems. Warranty period is 12 months after installation or 18 months after manufactured when the installation date unidentified. However, the guarantee term may vary on the sales term.

- In-warranty service information
  - ▶ If the defective part has been identified under normal and proper use within the guarantee term, contact your local authorized LS distributor or LS service center.
- Out-of-warranty service information
  - ▶ The guarantee will not apply in the following cases.
    - ▶ Troubles are attributable to a user's intentional negligence or carelessness.
    - ▶ Damage was caused by abnormal voltage and peripheral devices' malfunction (failure).
    - ▶ Damage was caused by natural disasters (earthquake, fire, flooding, lightning and etc.).
  - ▶ When LS nameplate is not attached.