



Technical Specifications

Product name : SI unit

Model : EX250-SCA1A

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1. Safety

This manual contains essential information for the protection of users and others from possible injury and damage to property and to ensure correct handling.

Please check that you fully understand the definition of the following messages (signs) before going on to read the text, and always follow the instructions.

Also read carefully the instruction manual of relevant equipment or apparatus before use.

◆ Indications

IMPORTANT MESSAGES	
Read this manual and follow its instructions. Signal words such as WARNING, CAUTION and NOTE, will be followed by important safety information that must be carefully reviewed.	
▲WARNING	Indicates a potentially hazardous situation which could result in death or serious injury if you do not follow instructions.
▲CAUTION	Indicates a potentially hazardous situation which if not avoided, may result in minor injury or moderate injury.
NOTE	Gives you helpful information.

◆ Operator

- ◆ This operation manual has been written for those who have knowledge of machinery and apparatus that use pneumatic equipment and have full knowledge of assembly, operation and maintenance of such equipment.
- ◆ Please read this operation manual carefully and understand it before assembling, operating or providing maintenance to the SI Unit.

◆ Usage Restrictions

- ◆ This product is designed for use in general equipment for factory automation. Never use this product with equipment or apparatus that directly concerns human lives*¹, or which malfunction or failure can cause a huge loss.
 - *1: Equipment or apparatus that directly matters human lives means the following:
 - Medical equipment such as life support systems or equipment used in operating rooms
 - Compulsory equipment required by law such as the Fire Prevention Law, Construction Law and etc.
 - Equipment or apparatus that conforms with those mentioned above.
- ◆ Contact our sales department when plans are made for the product to be used for the system*² including equipment that concerns itself with the safety of persons or that seriously affects the public. This usage needs special consideration*³.
 - *2: The system including equipment that concerns itself with the safety of persons or that seriously affects the public means the following:
 - Nuclear reactor control systems in nuclear power plants, safety protection systems or other systems important for safety in nuclear power facilities
 - Driving control systems of mass transportation systems, and flight control systems
 - Equipment or apparatus that comes into contact with foods or beverages
 - *3: Special consideration means discussing usage with our engineers to establish a safe system designed as fool-proof, fail-safe, redundant and etc.
- ◆ Special consideration of safety or maintainability should be taken to prevent hazard or loss caused by a failure or malfunction that is likely to occur in certain probability due to environmental stress (deterioration). The special consideration means to fully review the equipment or apparatus in design stage and to establish a backup system in advance such as a redundant system or fail-safe system.

⚠ WARNING

- ◆ Do not disassemble, modify (including change of printed circuit board) or repair.
An injury or failure can result.
- ◆ Do not operate the product beyond specification range.
Operation at a range that exceeds the specifications can cause a fire, malfunction, or damage to SI Unit.
Verify the specifications before use.
- ◆ Do not use the product in an atmosphere containing combustible, explosive or corrosive gas.
It can cause a fire, explosion or corrosion.
This SI Unit is not designed to be explosion-proof.
- ◆ These instructions must be followed when using the product in an interlocking circuit:
 - Provide double interlocking by another system such as mechanical protection
 - Check the product regularly to ensure proper operationOtherwise malfunction can cause an accident.
- ◆ These instructions must be followed while in maintenance:
 - Turn off the power supply
 - Stop the supplied air, exhaust the residual pressure and verify the release of air before performing maintenance
 - Release all energy stored in equipment or devices (hydraulic pressure, mechanical springs, electric capacitors or gravity force), verify the energy is reset to zero, and then perform maintenance work.Otherwise it can cause injury.

⚠ CAUTION

- ◆ Perform proper functional checks after maintenance.
Stop operation when an abnormality is observed such that the SI unit does not work properly.
Safety is not be assured due to unexpected malfunction.

NOTE

- ◆ Follow the instructions given below when selecting and handling your SI Unit:
- ◆ The instructions on selection (installation, wiring, environment of use, adjustment, operation and maintenance) described below must also be followed.

*Product specifications

- Operate SI Unit with the specified voltage.
Operation with a voltage beyond specifications can cause malfunction or damage of the unit.
- Reserve a space for maintenance
Remember to leave space for maintenance when designing layout of the unit.
- Do not remove labels.
Otherwise error while in maintenance or misreading of an operation manual can cause damage or malfunction. It may also result in nonconformity to safety standards.

- ◆ Instructions on handling

*Installation

- Do not drop, hit or apply excessive shock to the unit.
Otherwise it can result in damage to the unit causing failure or malfunction.
- Follow the specified tightening torque.
Excessive tightening torque can break screws.
Refer to "5-6 Installation and Maintenance" for installation.

*Wiring (including plugging in/out of connector)

- Do not bend or apply tensile force to cables, or apply force by placing heavy load on them.
Wiring with bending stress or tensile stress can cause breakage of the cables.
- Connect wires and cables correctly.
Miswiring can break the SI Unit depending on the miswired circuit .
- Do not connect wires while the power is on.
Otherwise it can break the SI Unit or I/O devices causing damage or malfunction.
- Do not lay wires or cables with power cable or high-voltage cable in the same wiring route.
Otherwise the wires to the SI Unit can be contaminated with noise or induced surge voltage from power lines or high-voltage lines causing malfunction.
Lay the wires to the SI Unit and each I/O device to a wire duct or in a protective tube other than those for power lines or high- voltage lines.
- Verify the insulation of wiring.
Poor insulation (interference with other circuit, poor insulation between terminals and etc.) can introduce excess voltage or current to the SI Unit or each I/O device causing damage.
- Separate power lines for solenoid valves from power line for Input and control unit.
Otherwise wires can be contaminated with noise or induced surge voltage causing malfunction.
- Take proper measurements against noise such as noise filter when the SI Unit is incorporated in equipment or devices.
Otherwise contamination with noise can cause malfunction.

*Environment

- Select the proper type of protection according to the environment of operation.
IP67 protection is achieved when the following conditions are met.
(1) Wire between units properly with power cables, communication connectors and the cable with M12 connector.
(2) To install Input unit and input block, and SI Unit and manifold valves properly.
Use cover or etc. when install in an environment where water always splashes on these units.

NOTE

- Take sufficient shielding measures when install at a following place.
Insufficient measures can cause malfunction or failure.
Verify the effect of the measures after installation of the unit in equipment or devices:
(1)A place where noise due to static electricity is generated.
(2)A place where electric field strength is high.
(3)A place where there is radioactive irradiation.
(4)A place near power line.
(5)A place where water splashes on the product.
- Do not use the product near by a place where electric surges are generated.
Internal circuit elements of the SI Unit can deteriorate or break when equipment generating a large surge (electromagnetic lifter, high frequency induction furnace, motor, etc.) is located near the SI Unit. Provide surge preventives, and avoid interference.
- Use a SI Unit equipped with surge absorber when a surge-generating load such as a relay or solenoid valve is driven directly.
Direct drive of a load generating surge voltage can damage SI Unit.
- Prevent foreign matter such as remnant of wires from entering this product.
Take proper measures for the remnant not to enter the SI Unit in order to prevent failure or malfunction.
- Do not expose the SI Unit to vibration and impact.
Otherwise it can cause failure or malfunction.
- Keep the specified ambient temperature range.
Otherwise it can cause malfunction.
- Do not use SI Unit in a place where temperature suddenly changes even if it stays within the specified range.
- Do not expose the SI Unit to heat radiation from a heat source located nearby.
It can cause malfunction.

***Adjustment and Operation**

- Use precision screwdriver with small flat blade when setting DIP and rotary switches.

***Maintenance**

- Before performing maintenance, make sure to turn of the power supply, stop supplied air, release the residual air in the piping into the atmosphere, and verify that the pneumatic system is open to the air.
Otherwise an unexpected operation of a system component can occur.
- Perform maintenance and check regularly.
Otherwise an unexpected malfunction of the system can occur due to a malfunction of the unit.
Refer to “3-6 Installation and Maintenance” the maintenance and checking methods.
- Perform a proper functional check.
Stop operation when an abnormality is observed such that the device does not work properly.
Otherwise an unexpected malfunction of the system component can occur.
- Do not use solvents such as benzene, thinner or other to clean the SI Unit.
It can damage the surface of the body and erase the indication on the body.
Use a soft cloth to remove stains. For heavy stains, use a cloth soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

2. Specifications

2-1. General specification

Item	Specification
Operating ambient temp.	-10 to +50°C
Operating ambient humidity	35 to 85% RH (No dew condensation)
Storage ambient temp.	-20 to +60°C
Vibration proof	10 to 57Hz 0.35mm (constant amplitude) 57 to 150Hz 50m/s ² (constant acceleration)
Impact proof	100m/s ² (peak), 11ms × 3 times in each direction ±X,Y,Z
Noise immunity	Normal mode: ±1500V Pulse duration 1μs Common mode: ±1500V Pulse duration 1μs Radiation mode: ±1000V Pulse duration 1μs
Withstand voltage	500VAC for 1min.
Insulation resistance	500VDC min10Mohm
Operating environment	No corrosive gas
Weight	About 250g
Enclosure	IP67

2-2. Electrical and network

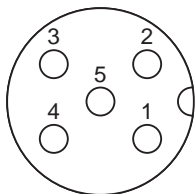
Item	Specification	
Applicable system	CAN open CiA DS-301 V4.02 and CiA DS-401	
Power voltage range	Power for SI unit	18 to 30VDC (24VDC typical.)
	Current consumption	100mA or less
Current consumption	Power for Input Block	19.2 to 28.8VDC
	Current consumption	Depending on the number of Input Block stations and sensor specifications. Max 1A or less
	Power for solenoid valve	22.8 to 26.4VDC
	Current consumption	Depending on the number of solenoid valve stations and specifications. Max 2A or less
Solenoid valve connection spec.	Output type	P-ch MOS-FET Open drain type
	Connection load	Solenoid valve with protection circuit for 24VDC and 1.5W or less surge voltage. (made by SMC)
	Insulation type	Opto-coupler type
Residual voltage	0.3VDC or less	
Node-ID setting range	1 to 63 (1 to 127 at the SW mode)	
Baudrate setting range (Transmission speed)	1000k, 800k, 500k, 250k, 125k, 50k, 20k, 10kbps	
COB-Identifier	11bit ID (CAN2.0A)	
Input /Output	32 points/32 points	

2-3. Applicable solenoid valve series

Valve type	Valve Series
VQC series	VQC1000, VQC2000, VQC4000
SV series	SV1000, SV2000, SV3000

3.Connector

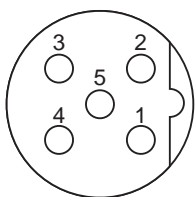
3-1.Communication connector M12 male 5pins



Pin No.	Description	Function
1	CAN_SHLD	Shield
2	CAN_V+	Power supply + for CANopen
3	CAN_GND	Power supply – for CANopen
4	CAN_H	CAN_H bus line (dominant high)
5	CAN_L	CAN_L bus line (dominant low)

(Female connector cable: M12 female 5pins cable with shield (according to ISO11898))

3-2.Power supply connector M12 male 5pins reverse key type



Pin No.	Description	Function
1	SV 24V	+24V for solenoid valve.
2	SV 0V	0V for solenoid valve
3	SW 24V	+24V for input block
4	SW 0V	0V for input block
5	E	Earth

(Female connector cable: WAKW4.5T-2 TURCK Co. ,etc.)

3-3.Baudrate and Bus cable length

Relation Baudrate and Bus length are as follows.

Baudrate	Max. bus cable length
1Mbit/s	25m
800kbit/s	50m
500kbit/s	100m
250kbit/s	250m
125kbit/s	500m
50kbit/s	1000m
20kbit/s	2000m
10kbit/s	5000m

3-4.Bus cable and termination resistors

The cables, connectors, and termination resistors used in CANopen networks shall meet the requirements defined in ISO 11898. In addition, here are given some guidelines for selecting cables and connectors.

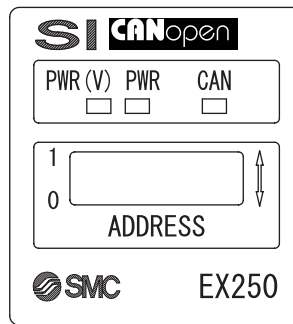
The table below shows some standard values for DC parameters for CANopen networks with less than 64 nodes:

Bus length [m]	Bus Cable (1)		Termination resistance [Ω]
	Length-related resistance [$m\Omega/m$]	Cross-section [mm^2]	
0...40	<70	0.25...0.34	124
40...300	<60	0.34...0.6	150...300
300...600	<40	0.5...0.6	150...300
600...1000	<26	0.75...0.8	150...300

For drop cables a wire cross-section of 0.25 to 0.34 mm^2 would be an appropriate choice in many cases.

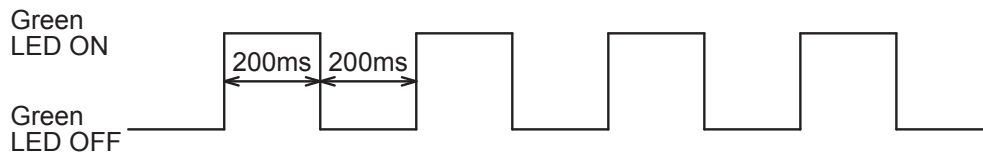
Besides the cable resistance, there should also be considered the real resistance of the connectors, if calculating the voltage drop. The read resistance of one connector should be in the range of 2.5 to 10 $m\Omega$.

4. LED indication

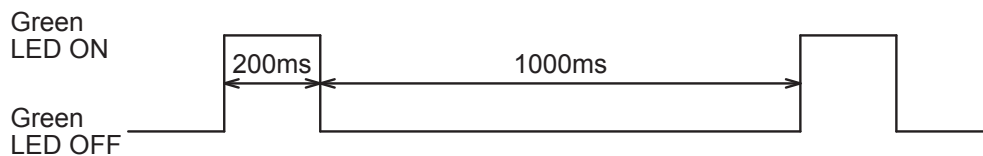


Indication	Contents	
PWR(V)	Green Light	Illuminates when power for solenoid valves is supplied
PWR	Green Light	Illuminates when power for CANopen line is supplied
CAN	Green Light	Illuminates when SI unit is in the Operational state
	Green Light (blinking)	SI unit is in the Pre-Operational state
	Green Light (single flash)	Single flash when SI unit is in Stopped state
	Red Light (single flash)	Single flash when CAN controller error occurs
	Red Light (double flash)	Double flash when Error Control Event occurs
	Green / Red Light (flickering)	Flickering when SI unit is in Configuration mode (LSS services)
	Red Light	SI unit is in "Bus OFF" state

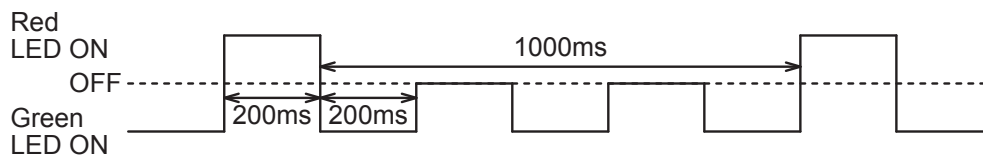
4-1. Green (Blinking) : Pre-Operational State



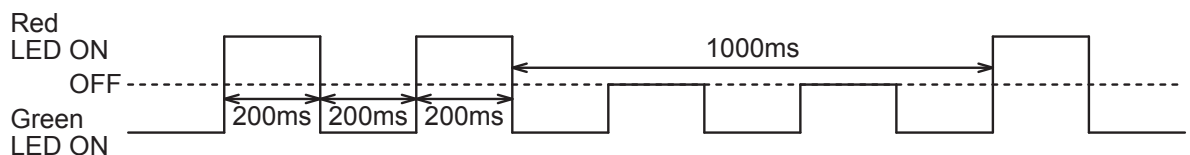
4-2. Green (Single Flash) : Stopped State



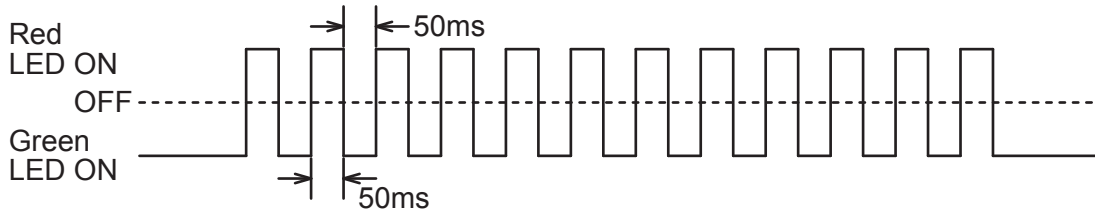
4-3. Red (Single Flash) : CAN Controller Error



4-4. Red (Double Flash) : Error Control Event



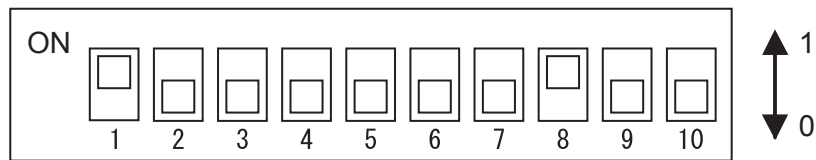
4-5. Green / Red (Flickering) : LSS Configuration Mode



Note: LED Indication of SI unit is based on CANopen Specification (CANopen Spec.DR-303-3). Refer to DR-303-3 Indicator Specification for details.

5. Switch setting

Before setting of Node-ID by DIP switch, turn "OFF" power supply to the SI unit.



5-1. Setting of Node-ID

Node-ID	SW1	SW2	SW3	SW4	SW5	SW6
0	0	0	0	0	0	0
1	1	0	0	0	0	0
2	0	1	0	0	0	0
⋮						
62	0	1	1	1	1	1
63	1	1	1	1	1	1

5-2. Set SW7 to 0. (SW7 is not used.)

5-3. Set SW8 to 1.(fixed)

5-4. Setting of output when communication stops

SW9	Output condition of solenoid valve when an error occurs (Error Control ,Emergency Object) or Fault message is received.
0	Output Value shall take the pre-defined condition specified in Error Value Output Object (6207h,6307h,6327h) Default: all outputs are cleared.
1	Output Value shall be kept.

5-5. Setting of mode

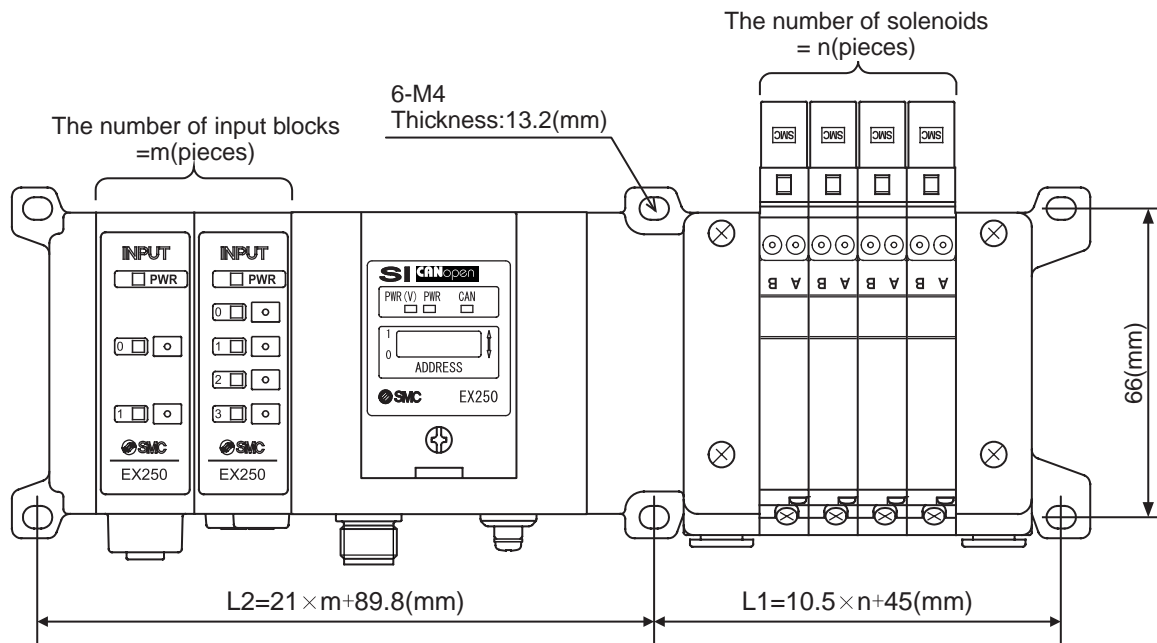
SW10	Mode
0	HW mode. Setting of Node-ID is achieved by DIP switches SW1-6.
1	SW mode. Setting of Node-ID is achieved via network. SW1-8 become unavailable. Node-ID can be set up to 127. Default is 127 (7Fh).

5-6.Installation and maintenance

Installation size

- SI unit does not have mounting holes.
- The unit can not be installed by itself.
- Solenoid valve manifold must be attached with SI unit.
- If no input Block is required, then them End plate must be attached with SI unit.

Example of installation



n,m	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
L1	45	55.5	66	76.5	87	97.5	108	118.5	129	139.5	150	160.5	171	181.5	192	202.5	213
L2	89.8	110.8	131.8	152.8	173.8	194.8	215.8	236.8	257.8	278.8	299.8	320.8	341.8	362.8	383.8	404.8	425.8

(mm)

Note: Dimensions of L1 are shown for VQC1000 solenoid valve series.

Refer to SMC catalogue for valve series.

Wiring (for power supply, communication and input) and piping are done on only one side. On the side, make a space for wiring and piping.

Maintenance

Addition of Input Block

1. Remove screws from End Plate.
2. Mount attached tie rod.
3. Connect additional Input Block.
4. Connect End Plate and tighten removed screws by specified tightening torque. (0.6N·m)

Exchange of SI unit

1. Remove screws from End Plate and release connection of each unit.
2. Replace old SI unit with new one. (Tie rod does not need to be removed.)
3. Connect End Plate and tighten removed screws by specified tightening torque. (0.6N·m)

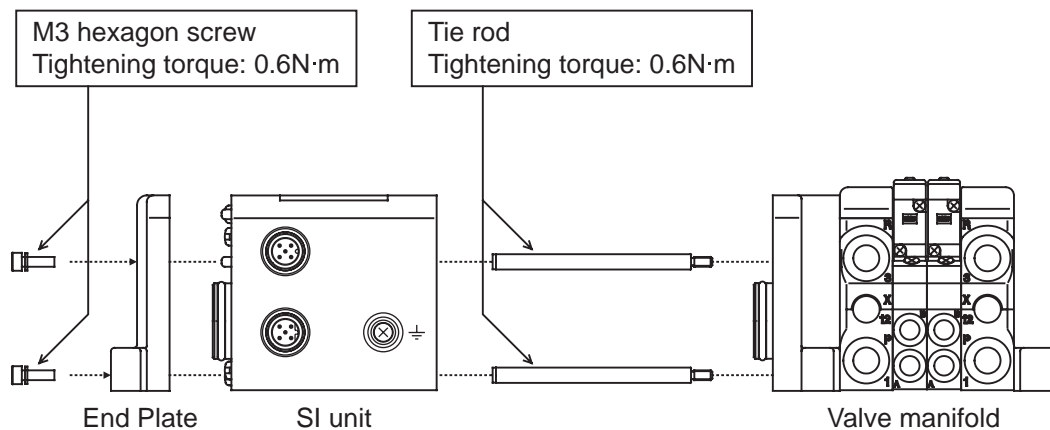


Caution for maintenance

- (1) Be sure to turn-off all power supplies.
- (2) Be sure that there is no foreign object in any of units.
- (3) Be sure that gasket is lined properly.
- (4) Be sure that tightening torque is according to specification.

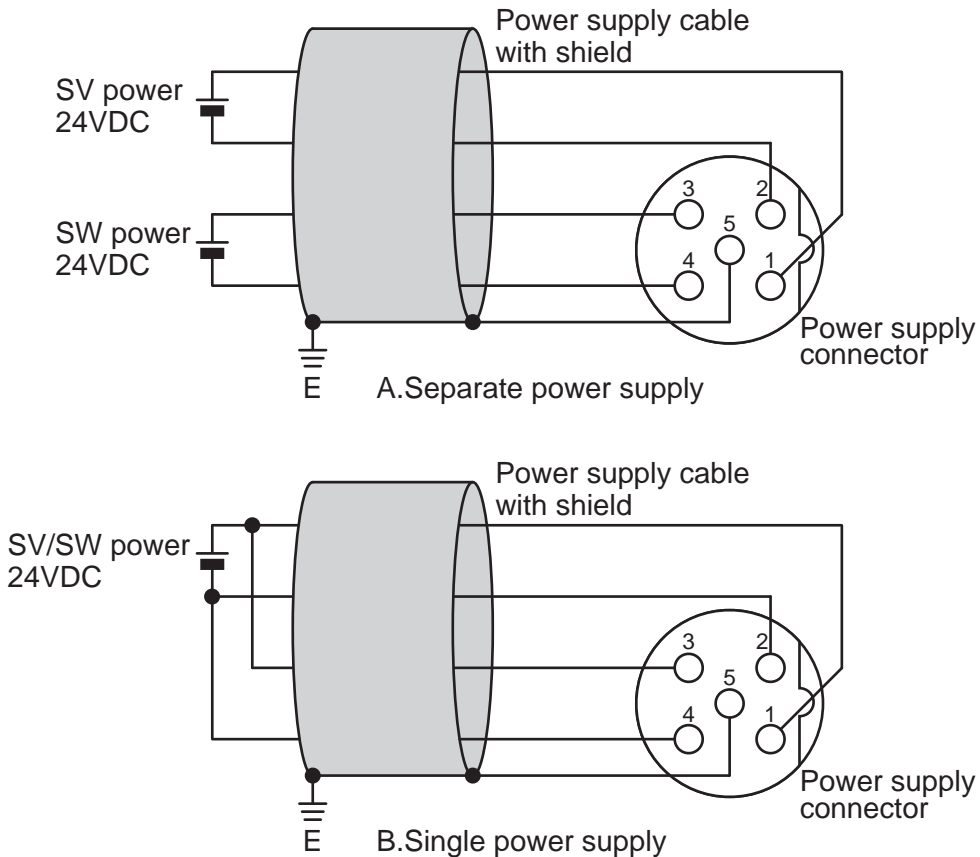
If these items are not kept, it may lead to the breakage of substrate or intrusion of liquid or dust into the units.

Assembly and disconnection of unit



5-7. Wiring of power supply

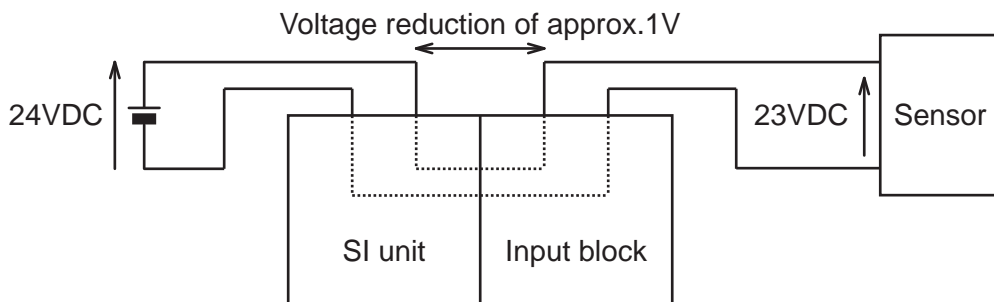
Power supply line inside the unit has individual power supplies for solenoid valve actuation (SV power supply) and for Control parts and Sensor (SW power supply). Supply 24V DC for each of them. Either single or dual power supply is available. Wiring is not necessary for SW power supply when Input Block is not used.



*In case of single power supply, pay attention to the range of each supply voltage.

Power for sensor is supplied to sensor connected with Input Block. Select sensor concerning voltage drop up to approx. 1V inside the unit at this moment.

If sensor requires 24V, it is necessary to lower power supply voltage for sensor slightly or secure power supply for sensor separately without going through SI unit so that sensor input voltage can be 24V with actual loading (allowable voltage of sensor power supply: 19.2V to 28.8V).



6. Baudrate

The baudrate can be set in the HW mode by the following methods: -

6-1.Method of re-setting to default baudrate (125kbps)

- 1) Turn off the power supply (for CANopen line) and set Node-ID to 0 with DIP switches SW1-6.
- 2) CAN LED will blink RED for five seconds at the frequency of 2Hz when the power supply to the SI unit is restored.
- 3) The baudrate is set to 125kbps and CAN LED illuminates green and red alternately (2Hz).
- 4) Turn off the power supply, set Node-ID, and turn on the power supply again.
- 5) CAN LED illuminates (GREEN). The SI units state of communication is. (When SI unit is stand by mode (pre-operational).)

6-2.Method of setting baudrate to value within CiA specification

- 1) Turn OFF the power supply (for CANopen line) and set Node-ID to 0 with DIP switches SW1-6.
- 2) CAN LED will blinks RED for five seconds at the frequency of 2Hz when the power supply is returned to SI unit.
- 3) Set DIP switch SW6 to 1 while CAN LED is blinking (within five seconds).
- 4) Blinking CAN LED stops (CAN LED is off). Set the baudrate with DIP switches SW1-4 within ten seconds as shown in the table below.

Baudrate Table

DIP switches SW1-4 setting	0	1	2	3	4	5	6	7	8
Baudrate (kbps)	1000	800	500	250	125	-	50	20	10

Note: CAN LED illuminates RED when an invalid combination is set with DIP switches SW1-4.

<Example: When you set the baudrate of SI unit to 500kbps.>

Because the baudrate is 500kbps, DIP switches SW1-4 setting is 2.

i.e. SW1 = 0 , SW2 = 1 , SW3 = 0 and SW4 = 0

- 5) CAN LED blinks RED for two seconds at the frequency of 1Hz when setting is successful.
- 6) After that, CAN LED blinks RED for five seconds at a frequency of 5Hz to acknowledge the end of the setting procedure.
- 7) CAN LED lights GREEN and RED alternately (at the frequency of 2Hz).
- 8) Turn OFF the power supply, set Node-ID, then turn ON the power supply again.
- 9) CAN LED will illuminate GREEN. The SI units state of communication is standby. (When SI unit is stand by mode (pre-operational).)

7. Overview object dictionary entries for communication profile

Index	Sub-Index	Object	Name	Type	Acc	Default
1000		VAR	device type	Unsigned32	ro	
1001		VAR	error register	Unsigned8	ro	
1002		VAR	manufacturer status register	Unsigned32	ro	
1003		ARRAY	pre-defined error register	Unsigned32	ro	
	0	VAR	number of errors	Unsigned8	rw	00H
	1	VAR	standard error field	Unsigned32	ro	
	2-8	VAR	standard error field	Unsigned32	ro	
1005		VAR	COB-ID SYNC	Unsigned32	rw	00000080H
1006		VAR	communication cycle period	Unsigned32	rw	00000000H
1008		VAR	manufacturer device name	Vis-String	const	
1009		VAR	manufacturer hardware version	Vis-String	const	
100A		VAR	manufacturer software version	Vis-String	const	
100C		VAR	guard time	Unsigned16	rw	0000H
100D		VAR	life time factor	Unsigned8	rw	00H
1010		ARRAY	store parameters	Unsigned32	rw	
	0	VAR	largest subindex supported	Unsigned8	ro	
	1	VAR	save all parameters	Unsigned32	rw	
1011		ARRAY	restore default parameters	Unsigned32	rw	
	0	VAR	largest subindex supported	Unsigned8	ro	
	1	VAR	restore all default parameters	Unsigned32	rw	
1014		VAR	COB-ID EMCY	Unsigned32	ro	
1016		ARRAY	Consumer heartbeat time	Unsigned32	rw	
	0	VAR	number of entries	Unsigned8	ro	
	1	VAR	Consumer heartbeat time	Unsigned32	rw	00000000H
	2-9	VAR	Consumer heartbeat time	Unsigned32	rw	00000000H
1017		VAR	Producer heartbeat time	Unsigned16	rw	0000H
1018		RECORD	identity object	Identity(0023h)	ro	
	0	VAR	number of entries	Unsigned8	ro	
	1	VAR	vender ID	Unsigned32	ro	
	2	VAR	product code	Unsigned32	ro	
	3	VAR	revision number	Unsigned32	ro	
	4	VAR	serial number	Unsigned32	ro	
Server SDO Parameter						
1200		RECORD	1st server SDO parameter	SDO Parameter(22h)	ro	
	0	VAR	number of entries	Unsigned8	ro	
	1	VAR	COB-ID client->server	Unsigned32	ro	\$NODEID+600H
	2	VAR	COB-ID server->client	Unsigned32	ro	\$NODEID+580H
Receive PDO Communication Parameter						
1400		RECORD	1st receive PDO parameter	PDO CommPar(20h)	ro	
	0	VAR	largest subindex supported	Unsigned8	ro	
	1	VAR	COB-ID used by PDO	Unsigned32	rw	\$NODEID+200H
	2	VAR	transmission type	Unsigned8	rw	FFH
Receive PDO Mapping Parameter						
1600		RECORD	1st receive PDO mapping	PDO Mapping(21h)	rw	
	0	VAR	number of mapped application objects in PDO	Unsigned8	rw	04H
	1	VAR	PDO mapping for the 1th application object to be mapped	Unsigned32	rw	62000108H
	2	VAR	PDO mapping for the 2th application object to be mapped	Unsigned32	rw	62000208H
	3	VAR	PDO mapping for the 3th application object to be mapped	Unsigned32	rw	62000308H
	4	VAR	PDO mapping for the 4th application object to be mapped	Unsigned32	rw	62000408H
	5	VAR	PDO mapping for the 5th application object to be mapped	Unsigned32	rw	
	6	VAR	PDO mapping for the 6th application object to be mapped	Unsigned32	rw	
	7	VAR	PDO mapping for the 7th application object to be mapped	Unsigned32	rw	
	8	VAR	PDO mapping for the 8th application object to be mapped	Unsigned32	rw	
Transmit PDO Communication Parameter						
1800		RECORD	1st transmit PDO parameter	PDO CommPar(20h)	ro	
	0	VAR	largest subindex supported	Unsigned8	ro	05H
	1	VAR	COB-ID used by PDO	Unsigned32	rw	\$NODEID+180H
	2	VAR	transmission type	Unsigned8	rw	FFH
	3	VAR	Inhibit time	Unsigned16	rw	0000H
	5	VAR	Event timer	Unsigned16	rw	0000H

Transmit PDO Mapping Parameter						
1A00		RECORD	1st transmit PDO mapping	PDO Mapping(21h)	rw	
	0	VAR	number of mapped application objects in PDO	Unsigned8	rw	04H
	1	VAR	PDO mapping for the 1th application object to be mapped	Unsigned32	rw	60000108H
	2	VAR	PDO mapping for the 2th application object to be mapped	Unsigned32	rw	60000208H
	3	VAR	PDO mapping for the 3th application object to be mapped	Unsigned32	rw	60000308H
	4	VAR	PDO mapping for the 4th application object to be mapped	Unsigned32	rw	60000408H
	5	VAR	PDO mapping for the 5th application object to be mapped	Unsigned32	rw	
	6	VAR	PDO mapping for the 6th application object to be mapped	Unsigned32	rw	
	7	VAR	PDO mapping for the 7th application object to be mapped	Unsigned32	rw	
	8	VAR	PDO mapping for the 8th application object to be mapped	Unsigned32	rw	

ro=read only access rw=read and write access const=read only access, value is constant

7-1.Index 1000h Device Type

This object describes the type of device and its functionality.
The type of SI unit is as follows.

General Information

Device profile number: 0191h

Additional Information

I/O Functionality: 00000011 (Digital Input /Output)

Specific Functionality: 00h (No Specific Function)

7-2.Index 1001h Error Register

This object is an error register for the SI unit .It is a part of an Emergency object.
If Error has occurred, a bit is set to 1.

Bit	Meaning	Content
0	Generic Error	
1	Current	Non-correspondence (always 0)
2	Voltage	Non-correspondence (always 0)
3	Temperature	Non-correspondence (always 0)
4	Communication Error	CAN Over-run , CAN Error , Bus Off
5	Device Profile Specific	Non-correspondence (always 0)
6	Reserved	always 0
7	Manufacturer Specific	Heartbeat, Node Guarding, Self-diagnosis

Structure of the Error Register

7-3.Index 1002h Manufacturer Status Register

This object is used when Self-diagnosis Error for SI unit occurs.
If Error has occurred, a bit is set to 1.

X and Reserved = 0

Reserved	X	X	X	X	DI	SOLV	X	X
31	8	7						0
MSB								LSB

SOLV: When the power supply for the valve is supplied, SOLV Status is 0.
When the power supply for the valve is not supplied, SOLV Status is 1.

DI: When the error of the Input Block occurs (e.g. blow a fuse), DI Status is 1.
When the Input Block is normal, DI Status is 0.

7-4.Index 1003h Pre-defined Error Field

This object holds the errors that have occurred on the SI unit and have been signaled via the Emergency Object.

The entry at Sub-Index 0 describes the number of errors that have been stored. Every new error is stored at Sub-Index 1, the older ones move down the list. If 0 is written at the Sub-Index 0, error history is deleted. Values higher than 0 are prevented from being written.

7-5.Index 1005h COB-ID SYNC message

This object defines the COB-ID of the Synchronisation Object (SYNC).

Bit number	Value	meaning	
31 (MSB)	X	do not care	
30	0	Device does not generate SYNC message	*
	1	Device generate SYNC message	
29	0	11 bit ID (CAN 2.0A)	*
	1	29 bit ID (CAN 2.0B)	
28-11	0	if bit 29 = 0	*
	X	If bit 29 = 1, bits 28-11 of 29-bit-SYNC-COB-ID	
10-0 (LSB)	X	bits 10-0 of SYNC-COB-ID	

☐ * : The default values when the SI unit is supplied.

Bits 29 -11 are fixed (not changeable).

As an example, if an attempt is made to set bit 29 to 1, the SI unit will respond with an abort message.

7-6.Index 1006h Communication Cycle period

When bit 30 of Index 1005h (COB-ID SYNC) is set to 1 (SYNC, Producer), the SYNC message is transmitted at intervals set to this object.

The time can be set in multiples of 1us.

7-7.Index 100Ch Guard Time

Refer to 7-8. Index 100Dh Life Time Factor.

7-8.Index 100Dh Life Time Factor

The Life Time for the Life Guarding Protocol is given by multiplying Guard Time and Life Time Factor.

SI unit supports Node/Life Guarding Protocol by setting Index 100C and Index 100D.

If these objects are set to 0, SI unit does not support Node/Life Guarding Protocol.

These objects are set the time in multiples of 1ms.

7-9.Index 1010h Store parameters

The various parameters can be saved in internal EEPROM of the SI unit by using this object. The parameters that can be saved in internal EEPROM of the SI unit are as follows:-

Index	Sub-Index	Name
1005		COB-ID, SYNC
1006		Communication cycle period
100C		guard time
100D		life time factor
1016	1-9	Consumer heartbeat time
1017		Producer heartbeat time
1400	1-2	1st receive PDO parameter
1600	0-8	1st receive PDO mapping
1800	1-3,5	COB-ID used by PDO
1A00	0-8	1st transmit PDO mapping
6206	1-4	Error Mode Output 8-bit
6207	1-4	Error Value Output 8-bit
6306	1-2	Error Mode Output 16-bit
6307	1-2	Error Value Output 16-bit
6326	1	Error Mode Output 32-bit
6327	1	Error Value Output 32-bit

Object that can be written by "Store parameters".

7-10.Index 1011h Restore Default parameters

The values in the internal EEPROM of the SI unit can be restored to their default values by using this object.

A list of objects that can be restored to default values is mentioned. (Refer to table: object that can be written by "store parameters").

Note: The default values become valid after the SI unit is reset (reset node, reset communication) or the power cycled.

ROM = Read Only Memory, data can not be modified (R)

EEPROM = Memorize data although power is off (R/W)

RAM = Actual memory the SI-unit is working with (R/W).

1.Reset node, Reset com or Power cycle: -

EEPROM is copied into RAM

2.STORE: -

Copy RAM (with modified/non-modified values) into EEPROM

3.RESTORE: -

Copy ROM (manufactures origin values) to EEPROM then copy EEPROM to RAM

Note: Index 1010h, 1011h

Never turn off the power supply of the unit when you save the parameters to internal EEPROM.

When the parameters are saved internal EEPROM, the unit will be damaged by turning off the power supply.

To save the parameter to internal EEPROM, necessary time is about 1sec.

7-11.Index 1014h COB-ID Emergency Object

This object defines the COB-ID of the Emergency Object (EMCY).

Bit number	Value	Meaning	
31 (MSB)	0	EMCY exists (is valid)	*
	1	EMCY does not exist (is not valid)	
30	0	Reserved	
29	0	11 bit ID (CAN 2.0A)	*
	1	29 bit ID (CAN 2.0B)	
28-11	0	if bit 29 = 0	*
	X	if bit 29 = 1;bits 28-11 of 29-bit-COB-ID	
10-0 (LSB)	X	bits 10-0 of COB-ID	

☐ : The default values when the SI unit is supplied.

7-12.Index 1016h Consumer Heartbeat Time

The Consumer Heartbeat Time is defined in this object.

The time can be set in multiples of 1ms.

If the Consumer Heartbeat Time is 0, SI unit does not support Consumer Heartbeat.

7-13.Index 1017h Producer Heartbeat Time

The Producer Heartbeat Time is defined in this object.

The time can be set in multiples of 1ms.

It should be noted that if a time of 100ms or less is set in this object, the SI unit responds with an abort message. *This object is not setting a time of 100ms or less.

7-14.Index 1200h Server SDO Parameter

Bit number	Value	Meaning	
31 (MSB)	0	SDO exists (is valid)	*
	1	SDO does not exists (is not valid)	
30	0	Reserved (always 0)	
29	0	11 bit ID (CAN 2.0A)	*
	1	29 bit ID (CAN 2.0B)	
28-11	0	if bit 29 = 0	*
	X	if bit 29 = 1 ; bits 28-11 of 29-bit-COB-ID	
10-0 (LSB)	X	bits 10-0 of COB-ID	

☐ : The default values when the SI unit is supplied.

7-15.Index 1400h Receive PDO Communication Parameter

Index1400h_Sub-Index1 means COB-ID of PDO.

Bit number	Value	Meaning	
31 (MSB)	0	PDO exists (is valid)	*
	1	PDO does not exist (is not valid)	
30	0	RTR allowed on this PDO	*
	1	no RTR allowed on this PDO	
29	0	11 bit ID (CAN 2.0A)	*
	1	29 bit ID (CAN 2.0B)	
28-11	0	if bit 29 = 0	*
	X	if bit 29 = 1: bits 28-11 of 29-bit-COB-ID	
10-0 (LSB)	X	bits 10-0 of COB-ID	

* : The default values when the SI unit is supplied.
Bits 29-11 are fixed (not changeable).

Index1400h_Sub-Index2 means transmission type of PDO.

Transmission type	Meaning
0-240	When the next SYNC message is received, the PDO data is processed. The value of the transmission type is irrelevant.
241-253	No used
254	It is the same as 255. (It differs according to the manufacturer).
255 (default)	When the PDO data is received, the data is processed at once.

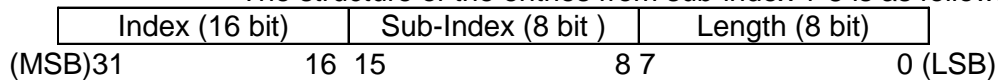
7-16.Index 1600h Receive PDO Mapping Parameter

Sub-Index0: Number of mapped application objects in PDO.

Sub-Index1-8: The sub-index (from 1h to number of entries) contain the information about the mapped application variables.

*When SI unit is shipped, the mapping is done from Sub-Index1 to Sub-Index4.

The structure of the entries from sub-index 1-8 is as follows:-



Structure of PDO Mapping Entry

7-17.Index 1800h Transmit PDO Communication Parameter

Index1800h_Sub-Index1 means COB-ID of PDO.

Bit number	Value	Meaning	
31 (MSB)	0	PDO exists (is valid)	*
	1	PDO does not exist (is not valid)	
30	0	RTR allowed on this PDO	*
	1	no RTR allowed on this PDO	
29	0	11 bit ID (CAN 2.0A)	*
	1	29 bit ID (CAN 2.0B)	
28-11	0	if bit 29 = 0	*
	X	if bit 29 = 1: bits 28-11 of 29-bit-COB-ID	
10-0 (LSB)	X	bits 10-0 of COB-ID	

* : The default values when the SI unit is supplied.

Bits 29-11 are fixed (not changeable).

Index1800h_Sub-Index2 means transmission type of PDO.

Transmission type	Meaning
0	When the next SYNC message is received, the PDO data is transmitted.
1-240 (N)	When the SYNC message of time N is received, the PDO data is transmitted.
241-251	Not used
252	When the next SYNC message is received, the PDO is not transmitted though the PDO data is updated. When RTR is received, the PDO is transmitted.
253	When RTR is received, the PDO data is transmitted.
254	It is the same as 255 (It differs according to the manufacturer).
255 (default)	When the PDO data is updated, the data is transmitted at once.

Index1800h_Sub-Index3 means inhibit time.

The time can be set in multiples of 100us.

Index1800h_Sub-Index5 means event timer.

The time can be set in multiples of 1ms.

7-18.Index 1A00h Transmit PDO Mapping Parameter

Sub-Index0: Number of mapped application objects in PDO.

Sub-Index1-8: The sub-index (from 1h to number of entries) contain the information about the mapped application variables.

* When SI unit is shipped, the mapping is done from Sub-Index1 to Sub-Index4.

The structure of the entries from sub-index 1-8 is as follows:

Index (16 bit)	Sub-Index (8 bit)	Length (8 bit)
(MSB)31	16 15	8 7
		0 (LSB)

Structure of PDO Mapping Entry

8. Overview object dictionary entries for manufacturer specific profile

Index	Sub-Index	Object	Name	Type	Acc	Default
2000		VAR	Reserve	Unsigned32	ro	
2001		VAR	Password	Unsigned16	wo	

ro=read only access wo=write only access

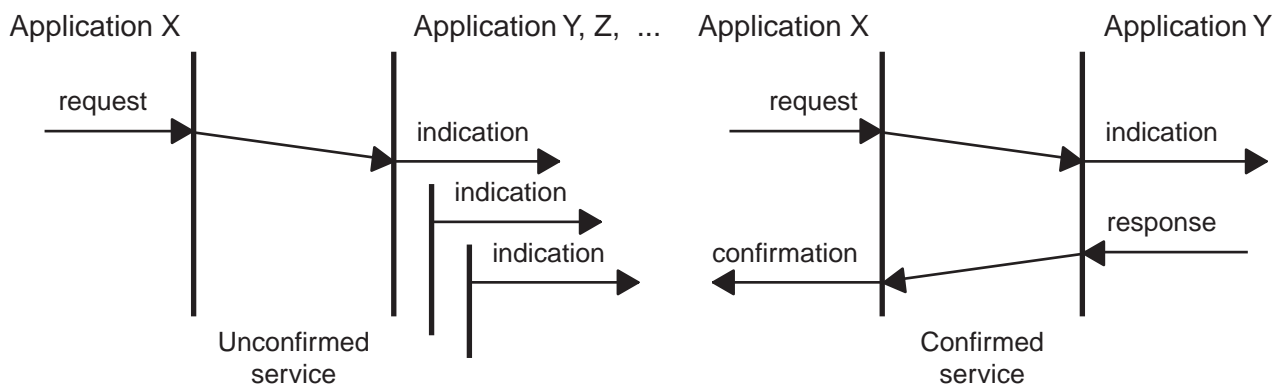
8-1.Index 2000h Reserve

This object is not used.

8-2.Index 2001h Password

This object is a manufacturing password so is not supplied to the user.

⚠ CAUTION : For making sure that the machine works fine, the machine builder is responsible. As for CANopen unit made of each maker, the ability (Minimum message interval) is different respectively. The machine builder should consider the difference of the ability. Method (confirmed service) of sending the following request after the response to the request is received to communicate surely is recommended. When you use method (unconfirmed service) of sending the following request without receiving the response to the request, If the request which exceeds the processing performance of each unit is sent, it is not treatable. Please confirm the normal operation beforehand when our unit is used for your machine. Please consult our company when there is a problem.



9. Overview object dictionary entries for standardised device profile

Index	Sub-Index	Object	Name	Type	Acc	Default
Digital Input Module						
6000		ARRAY	Read Inputs 8-bit			
	0	VAR	Number of inputs 8-bit	Unsigned8	ro	
	1	VAR	Read Inputs 1h-8h	Unsigned8	ro	
	2	VAR	Read Inputs 9h-16h	Unsigned8	ro	
	3	VAR	Read Inputs 17h-24h	Unsigned8	ro	
	4	VAR	Read Inputs 25h-32h	Unsigned8	ro	
6100		ARRAY	Read Inputs 16-bit			
	0	VAR	Number of inputs 16-bit	Unsigned8	ro	
	1	VAR	Read Inputs 1h-16h	Unsigned16	ro	
	2	VAR	Read Inputs 17h-32h	Unsigned16	ro	
6120		ARRAY	Read Inputs 32-bit			
	0	VAR	Number of inputs 32-bit	Unsigned8	ro	
	1	VAR	Read Inputs 1h-32h	Unsigned32	ro	
Digital Output Module						
6200		ARRAY	Write Outputs 8-bit			
	0	VAR	Number of outputs 8-bit	Unsigned8	ro	
	1	VAR	Write Outputs 1h-8h	Unsigned8	rw	00H
	2	VAR	Write Outputs 9h-16h	Unsigned8	rw	00H
	3	VAR	Write Outputs 17h-24h	Unsigned8	rw	00H
	4	VAR	Write Outputs 25h-32h	Unsigned8	rw	00H
6206		ARRAY	Error Mode Outputs 8-bit			
	0	VAR	Number of outputs 8-bit	Unsigned8	ro	
	1	VAR	Error Mode Outputs 1h to 8h	Unsigned8	rw	FFH
	2	VAR	Error Mode Outputs 9h to 16h	Unsigned8	rw	FFH
	3	VAR	Error Mode Outputs 17h to 24h	Unsigned8	rw	FFH
	4	VAR	Error Mode Outputs 25h to 32h	Unsigned8	rw	FFH
6207		ARRAY	Error Value Outputs 8-bit			
	0	VAR	Number of outputs 8-bit	Unsigned8	ro	
	1	VAR	Error Value Outputs 1h to 8h	Unsigned8	rw	00H
	2	VAR	Error Value Outputs 9h to 16h	Unsigned8	rw	00H
	3	VAR	Error Value Outputs 17h to 24h	Unsigned8	rw	00H
	4	VAR	Error Value Outputs 25h to 32h	Unsigned8	rw	00H
6300		ARRAY	Write Outputs 16-bit			
	0	VAR	Number of outputs 16-bit	Unsigned8	ro	
	1	VAR	Write Outputs 1h-16h	Unsigned16	rw	0000H
	2	VAR	Write Outputs 17h-32h	Unsigned16	rw	0000H
6306		ARRAY	Error Mode Outputs 16-bit			
	0	VAR	Number of outputs 16-bit	Unsigned8	ro	
	1	VAR	Error Mode Outputs 1h to 16h	Unsigned16	rw	FFFFH
	2	VAR	Error Mode Outputs 17h to 32h	Unsigned16	rw	FFFFH
6307		ARRAY	Error Value Outputs 16-bit			
	0	VAR	Number of outputs 16-bit	Unsigned8	ro	
	1	VAR	Error Value Outputs 1h to 16h	Unsigned16	rw	0000H
	2	VAR	Error Value Outputs 17h to 32h	Unsigned16	rw	0000H
6320		ARRAY	Write Outputs 32-bit			
	0	VAR	Number of outputs 32-bit	Unsigned8	ro	
	1	VAR	Write Outputs 1h-32h	Unsigned32	rw	00000000H
6326		ARRAY	Error Mode Outputs 32-bit			
	0	VAR	Number of outputs 32-bit	Unsigned8	ro	
	1	VAR	Error Mode Outputs 1h to 32h	Unsigned32	rw	FFFFFFFFH
6327		ARRAY	Error Value Outputs 32-bit			
	0	VAR	Number of outputs 32-bit	Unsigned8	ro	
	1	VAR	Error Value Outputs 1h to 32h	Unsigned32	rw	00000000H

ro=read only access rw=read and write access

9-1.Index 6000h Read Inputs 8-Bit

This object shall read groups of 8 input lines as 8-bit information.

Sub-Index 0 : Number of Inputs 8-Bit (Number of Sub-Index)

Sub-Index 1 : Input Data 0 – 7th Bit

Sub-Index 2 : Input Data 8 – 15th Bit

Sub-Index 3 : Input Data 16 – 23rd Bit

Sub-Index 4 : Input Data 24 – 31st Bit

9-2.Index 6100h Read Inputs 16-Bit

This object shall read a group of 16 input lines as 16-bit information.

Sub-Index 0 : Number of Inputs 16-Bit (Number of Sub-Index)

Sub-Index 1 : Input Data 0 – 15th Bit

Sub-Index 2 : Input Data 16 – 31st Bit

9-3.Index 6120h Read Inputs 32-Bit

This object shall read a group of 32 input lines as 32-bit information.

Sub-Index 0 : Number of Inputs 32-Bit (Number of Sub-Index)

Sub-Index 1 : Input Data 0 – 31st Bit

9-4.Index 6200h Write Outputs 8-Bit

This object shall set a group of 8 output lines as 8-bit information.

Sub-Index 0 : Number of Outputs 8-Bit (Number of Sub-Index)

Sub-Index 1 : Output Data 0 – 7th Bit

Sub-Index 2 : Output Data 8 – 15th Bit

Sub-Index 3 : Output Data 16 – 23rd Bit

Sub-Index 4 : Output Data 24 – 31st Bit

9-5.Index 6206h Error Mode Outputs 8-Bit

This object indicates whether an output is set to a pre-defined error value when an error of the SI unit occurs.

1 = the output value shall be set to the pre-defined condition specified in the 6207h object

0 = the output value shall be retained

The value in the EEPROM (Index 6206h) depends on the status of DIP Switch SW9

If DIP switch SW9 is 0 (OFF), the value of Index 6206h is FFh. (This is default value)

If DIP switch SW9 is 1 (ON), the value of Index 6206h is 00h.

However, if the value of Index 6206h is changed and “Store Parameters” is executed, the set value is saved in internal EEPROM of the SI unit. After that the SI unit will use this value until the default value of FFh is set or a “Restore default parameters” is executed.

Note: If “Store Parameters” is not executed when the value of Index 6206h is changed, the value is not saved in internal EEPROM of SI unit.

Sub-Index 0 : Number of Outputs 8-Bit (Number of Sub-Index)

Sub-Index 1 : Error Mode Output Data 0 – 7th Bit

Sub-Index 2 : Error Mode Output Data 8 – 15th Bit

Sub-Index 3 : Error Mode Output Data 16 – 23rd Bit

Sub-Index 4 : Error Mode Output Data 24 – 31st Bit

9-6.Index 6207h Error Value Outputs 8-Bit

When DIP switch SW9 is set to 0 or the value of Index 6206h is 1, the SI unit will reflect the value of Index 6207h.

0 = Output will be set to 0 in case of fault. (Output clear)

1 = Output will be set to 1 in case of fault. (Output on)

9-7.Index 6300h Write Outputs 16-Bit

This object shall set a group of 16 output lines as 16-Bit information.

Sub-Index 0 : Number of Outputs 16-Bit (Number of Sub-Index)

Sub-Index 1 : Output Data 0 – 15th Bit

Sub-Index 2 : Output Data 16 – 31st Bit

9-8.Index 6306h Error Mode Outputs 16-Bit

This object indicates whether an output is set to a pre-defined error value when an error of the SI unit occurs.

1 = the output value shall be set to the pre-defined condition specified in the 6307h object

0 = the output value shall be retained

The SI unit reflects the status of the DIP switch SW9 when the value of the index 6306h in the internal EEPROM of the SI unit is FFFFh (default).

If DIP switch SW9 is 0 (OFF), the value of Index 6306h is FFFFh. (This is default value)

If DIP switch SW9 is 1 (ON), the value of Index 6306h is 0000h.

If the value of Index 6306h is changed and “Store Parameters” is executed, the set value is saved in the internal EEPROM of the SI unit. After this, the SI unit operates by setting a value until the value of Index 6306h is set to the default value (FFFFh) or “Restore default parameters” is executed.

Note: If “Store Parameters” is not executed when the value of Index 6306h is changed, the value is not saved in internal EEPROM of SI unit.

Sub-Index 0 : Number of Outputs 16-Bit (Number of Sub-Index)

Sub-Index 1 : Error Mode Output Data 0 – 15th Bit

Sub-Index 2 : Error Mode Output Data 16 – 31st Bit

9-9.Index 6307h Error Value Outputs 16-Bit

When DIP switch SW9 is set to 0 or the value of Index 6306h is 1, the SI unit reflects the value of Index 6307h.

0 = In case of a fault, the output shall be set to 0. (Output clear)

1 = In case of a fault, the output shall be set to 1. (Output on)

9-10.Index 6320h Write Outputs 32-Bit

This object shall set a group of 8 outputs lines as 32-Bit of information.

Sub-Index 0 : Number of Outputs 32-Bit (Number of Sub-Index)

Sub-Index 1 : Output Data 0 – 31st Bit

9-11.Index 6326h Error Mode Outputs 32-Bit

This object indicates whether an output is set to a pre-defined error value when an error of the SI unit occurs.

1 = the output value shall be set to the pre-defined condition specified in the 6327h object

0 = the output value shall be retained.

The SI unit reflects the status of the DIP switch SW9 when the value of Index 6326h in internal EEPROM of SI unit is default (FFFFFFFFh).

If DIP switch SW9 is 0 (OFF), the value of Index 6326h is FFFFFFFFh. (This is default value)

If DIP switch SW9 is 1 (ON), the value of Index 6326h is 00000000h.

If the value of Index 6326h is changed and “Store Parameters” is executed, the set value is saved in the internal EEPROM of the SI unit.

After that, the SI unit operates by setting the value until the value of Index 6326h is set to the default value (FFFFFFFFh) or “Restore default parameters” is executed.

Note: If “Store Parameters” is not executed when the value of Index 6326h is changed, the value is not saved in internal EEPROM of SI unit.

Sub-Index 0: Number of Outputs 32-Bit (Number of Sub-Index)

Sub-Index 1: Error Mode Output Data 0 – 31st Bit

9-12.Index 6327h Error Value Outputs 32-Bit

When DIP switch SW9 is set to 0 or the value of Index 6326h is 1, SI unit reflects the value of Index 6327h.

0 = In case of a fault, the output shall be set to 0. (Output clear)

1 = In case of a fault, the output shall be set to 1. (Output on)

10. Error control services

SI unit supports both Node Guarding Protocol and Heartbeat Protocol.

Node Guarding Protocol can be used by setting Index 100Ch and Index 100Dh Objects.

Heartbeat Protocol can be used by setting Index 1016h and Index 1017h Objects.

Error Control Services are not set on shipment. (100C, 100D, 1016, 1017h = 0)

Node Guarding Protocol and Heartbeat Protocol are not able to be used at the same time.

If both Node Guarding Protocol and Heartbeat Protocol are set at the same time, the Heartbeat Protocol is used.

There are the following possibilities:-

	Heartbeat Protocol	Node Guarding	Life Guarding
Heartbeat is configured; Node and Life guarding are also configured	ON	OFF	OFF
Heartbeat is configured; Node and Life guarding are not configured	ON	OFF	OFF
Heartbeat is not configured; Node and Life guarding are configured	OFF	ON	ON
Node guarding is configured; Heartbeat and Life guarding are not configured	OFF	ON	OFF

The possibilities of Error Control Services

10-1.Node Guarding Protocol

This protocol is used to detect remote errors in the network. Each NMT Slave uses one remote COB for the Node Guarding Protocol. This protocol implements the provider initiated Error Control Services.

Life Guarding is set by the Guard Time (Index 100C) multiplied by the Life Time Factor (Index 100D). Life Guarding starts when SI unit receives the first Remote-Transmit-Request (RTR).

If the SI unit does not receive RTR for the Node Life Time, the SI unit will be informed about that event. (The SI unit sends the Emergency Object).

Note: If the Guard Time (Index 100C) and Life Time Factor (Index 100D) are set to 0, the Node Guarding Protocol (Error Control Services) is not set, however, even when neither the Heartbeat Protocol nor Node Guarding Protocol are set, the SI unit returns the response if the SI unit receives RTR.

10-2.Heartbeat Producer Protocol

The Heartbeat Producer transmits a Heartbeat Message cyclically at the Producer Heartbeat Time (Index 1017h: Producer Heartbeat Time).

10-3.Heartbeat Consumer Protocol

The Heartbeat Consumer guards the reception of the Heartbeat within the Heartbeat Consumer Time (Index 1016h_Sub-Index1: Consumer Heartbeat Time)

If SI unit does not receive a message by a Heartbeat Producer for the Heartbeat Consumer Time, the SI unit will be informed about that event. (The SI unit sends the Emergency Object).

Note: If the Heartbeat Consumer Time (Index 1016h_Sub-Index1) is set to 0, the Heartbeat Protocol (Error Control Services) is not set.

11. Emergency object

SI unit sends Emergency Objects when error occurs in SI unit .

Byte	0	1	2	3	4	5	6	7
	Emergency Error Code		Error register Object	Manufacturer specific Error Field				

Structure of the Emergency Object Data

Error code (Hex)	Meaning
0000h	Error Reset (or No Error)
1000h	Generic Error
8110h	CAN Over-run
8120h	CAN in Error Passive Mode
8130h	Life Guard Error or Heartbeat Error
8210h	PDO not processed due to length error

Emergency Error Code

11-1. Error register Object (1001H)

Bit	Meaning	Content
0	Generic Error	
1	Current	Non-correspondence (always 0)
2	Voltage	Non-correspondence (always 0)
3	Temperature	Non-correspondence (always 0)
4	Communication Error	CAN Over-run , CAN Error , Bus Off
5	Device Profile Specific	Non-correspondence (always 0)
6	Reserved	always 0
7	Manufacturer Specific	Heartbeat , Node Guarding , Self-diagnosis

Structure of the Error Register

11-2. Error register Manufacturer specific Error Field

When Self-diagnosis Error occurs, the SI unit puts the error result in bytes 2 and bytes 3 of the Emergency Object and sends to master. Bytes 4 to 7 are always 0.

Bit	Meaning	Content
0	Reserved	always 0
1	Reserved	always 0
2	SOLV	Reflect the status of the power supply for the valve
3	DI	Reflect the status of the Input Block
4	Reserved	always 0
5	Reserved	always 0
6	Reserved	always 0
7	Reserved	always 0

Structure of the Manufacturer specific Error Field

SOLV: When the valve power supply is supplied, SOLV Status becomes 0.

When the valve power supply is not supplied, SOLV Status becomes 1.

DI: When an error occurs in the Input Block (EX250-IE1,2,3), DI status becomes 1.

When the Input Block is normal, DI status is 0.

12. Service Data Object (SDO)

12-1.SDO Upload

12-1-1.Initiate SDO Upload

This protocol is used when the size of the data to be uploaded is 4 bytes or less.

When the data size exceeds 4 bytes, the number of uploaded data bytes is transmitted.

12-1-2.Upload SDO Segment

This protocol is used when the size of the data to upload exceeds 4 bytes.

In this case, the upload data is transmitted by using the "Upload SDO Segment" after executing the "Initiate SDO Upload".

The maximum data size in 1 data frame is 7 Bytes.

When the data size exceeds 7 Bytes, "Upload SDO Segment" has to be executed until all data is sent from the server of the SDO to the client.

12-2.SDO Download

12-2-1.Initiate SDO Download

This protocol is used when the size of the data to be downloaded is 4 bytes or less.

When the data size exceeds 4 bytes, the number of downloaded data bytes is transmitted.

12-2-2.Download SDO Segment

This protocol is used when the size of the data to download exceeds 4 Bytes.

In this case, the download data is transmitted by using the "Download SDO Segment" after executing the "Initiate SDO Download".

The maximum data size in 1 data frame is 7 Bytes.

When the data size exceeds 7 Bytes, "Download SDO Segment" has to be executed until all data is sent from the client of the SDO to the server.

13. Abort SDO transfer

The SI unit sends an abort code, which is encoded as an UNSIGNED32 (4 byte data) value.

When something wrong is found in the message from the SDO server, the SI unit sends the message which is referred to in the table below: -

Abort code	Description
0504 0001h	Client/server command specifier not valid or unknown
0601 0001h	Attempt to read a write only object.
0601 0002h	Attempt to write a read only object.
0602 0000h	Object does not exist in the object dictionary.
0604 0041h	Object cannot be mapped to the PDO.
0604 0043h	General parameter incompatibility reason.
0607 0010h	Data type does not match , length of service parameter does not match
0609 0011h	Sub-index does not exist.
0609 0030h	Value range of parameter exceeded (only for write access).
0609 0032h	Value of parameter written too low.
0800 0000h	general error
0800 0020h	Data cannot be transferred or stored to the application.
0800 0021h	Data cannot be transferred or stored to the application because of local control.
0800 0022h	Data cannot be transferred or stored to the application because of the present device state.

SDO abort codes

14. Process Data Object (PDO)

The SI unit receives and outputs the N data bytes that are defined by Object 1600h and 1A00h. The SI unit returns an Emergency Object (Error Code: 8210h) when the data that the SI unit receives is smaller than N bytes.

SI unit outputs the first N bytes of data as “pertinent data” when the data that the SI unit receives is larger than N bytes.

The SI unit supports Dynamic Mapping and Dummy Entry and variable COB-ID.

When more than two slaves are used with the same COB-ID, Dummy Data may be needed. Dummy entries are only used within the received PDO. The dummy data that can be used with SI unit is shown below: -

Index 0005h: Unsigned8
 Index 0006h: Unsigned16
 Index 0007h: Unsigned32

<For Example >

Slave1 => Node-ID = 1 , COB-ID for RPDO = 420h(Index 1400_Sub1)*default 201h

Slave2 => Node-ID = 5 , COB-ID for RPDO = 420h(Index 1400_Sub1)*default 205h

*SI unit supports variable COB-ID.

Slave1 Mapping (1600h RPDO Mapping Parameter)

1600h_sub0 = 2

1600h_sub1 = 6320 01 20(Object 6320h sub-index 1, length 32-bit)

1600h_sub2 = 6320 02 20(Object 6320h sub-index 2, length 32-bit)

Slave2 Mapping (1600h RPDO Mapping Parameter)

1600h_sub0 = 2

1600h_sub1 = 0007 00 20(Object 0007h(Unsigned 32) sub-index 0, length 32-bit)

1600h_sub2 = 6320 01 20(Object 6320h sub-index 1, length 32-bit)

PDO Data from Master to each Slaves.

COB-ID	1th_data	2th_data	3th_data	4th_data	5th_data	6th_data	7th_data	8th_data
420h	12	34	56	78	9A	BC	DE	FF

Output status of Slave1 and Slave2

COB-ID	1th_data	2th_data	3th_data	4th_data	5th_data	6th_data	7th_data	8th_data
420h (Slave1)	6320h/01h 32bit (Output 0-31bit)				6320h/02h 32bit (Output 32-63bit)			
	12	34	56	78	9A	BC	DE	FF
420h (Slave2)	0007h/00h 32bit				6320h/01h 32bit (Output 0-31bit)			
	Dummy Entry				12	34	56	78

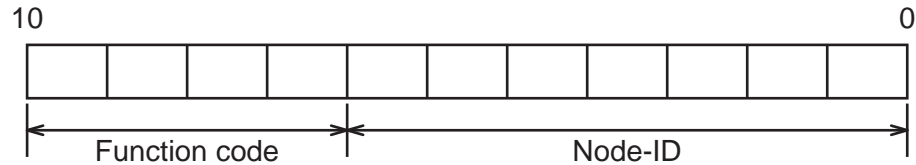
: SI unit ignores the first 4-bytes of data (PDO Data from Master).

Note: SI unit supports valuable COB-ID, therefore, SI unit can set an arbitrary value, however, if you set COB-ID to SI unit, we recommend to set Unused COB-ID (281h-57F) for safety reasons.

Dynamic mapping is only possible in "pre-operational" mode.

15. Pre-defined connection set

COB-Identifier



COB-Identifier allocation scheme for the pre-defined Connection set

COB-ID is composed of 11 bits.

The Function Code is allocated in bits 7-10 and the Node-ID is allocated in bits 0-6.

Object	Function Code	Resulting COB-ID	Communication Parameters at Index
NMT	0000	0	–
SYNC	0001	128 (80h)	1005h
Emergency	0001	129 (81h) – 255 (FFh)	1014h
PDO(tx)	0011	385 (181h) – 511 (1FFh)	1800h
PDO(rx)	0100	513 (201h) – 639 (27Fh)	1400h
SDO(tx)	1011	1409 (581h) – 1535 (5FFh)	1200h
SDO(rx)	1100	1537 (601h) – 1663 (67Fh)	1200h
NMT Error Control	1110	1793 (701h) – 1919 (77Fh)	100Ch,100Dh,1016h,1017h

Objects of the Pre-defined Connection Set

All devices (clients) have to receive and correspond when NMT and SYNC Object are transmitted.

The SI unit can change COB-ID of PDO (tx) and PDO (rx). (Index 1400h_01, Index 1800h_01)

If COB-ID is changed and “Store Parameters” are not executed, SI unit operates according to above-mentioned COB-ID (refer to Objects within Pre-defined Connection Set) at the next Power Supply ON.

Note: The value is not saved in internal EEPROM of SI unit.

16. Layer Setting Services (LSS)

SI unit supports LSS function, therefore SI unit supports the following function:-

- 16-1.Switch Mode Services
- 16-2.Configuration Services
- 16-3.Inquiry Services
- 16-4.Identification Services

Request COB-ID is 2021 (7E5h) in the services.

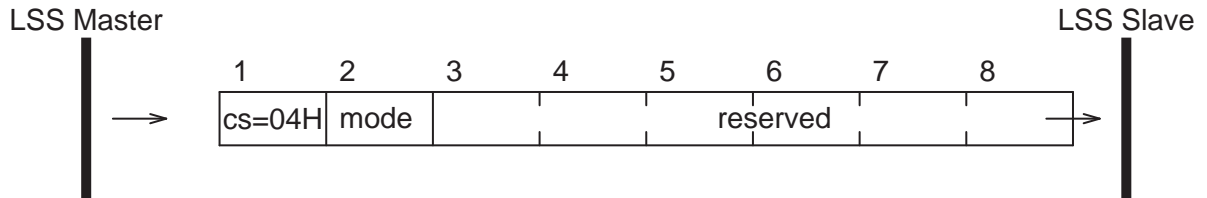
Response COB-ID is 2020 (7E4h) in the services.

Request and Response COB-ID are all common in this LSS.

16-1.Switch Mode Services

16-1-1.Switch Mode Global

This service is used to switch all LSS Slaves in the network between operation mode and configuration mode.



cs: LSS command specifier (04h for Switch Mode Global)

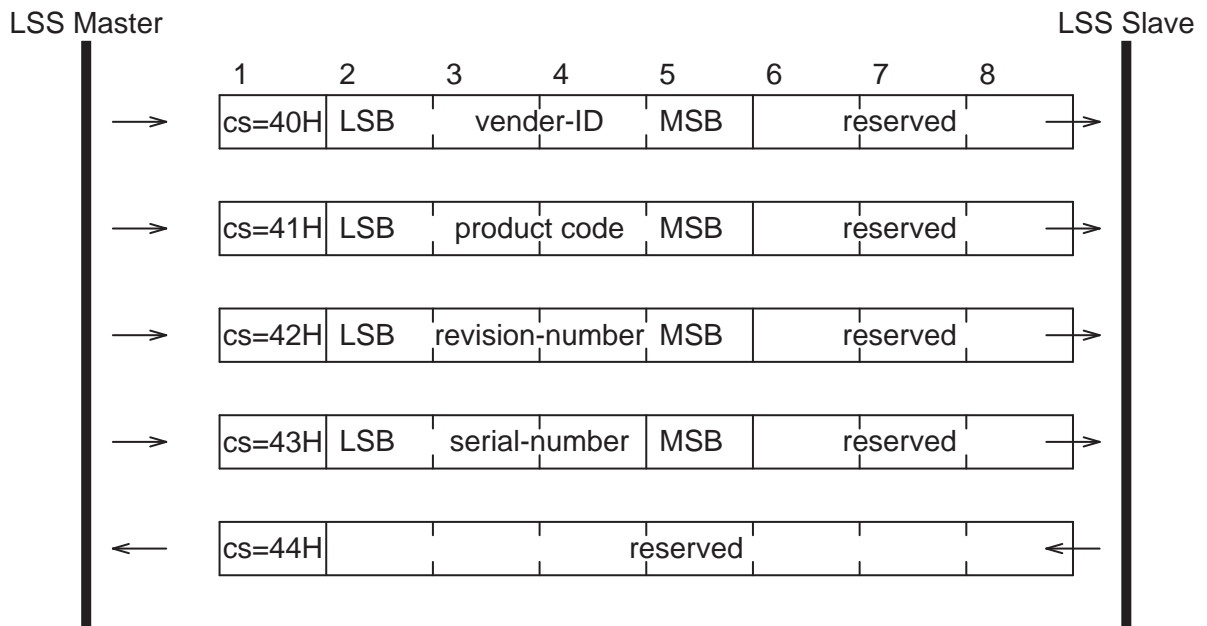
mode: 0 = Switches to Operation Mode

1 = Switches to Configuration Mode

reserved: reserved for further use by CiA

16-1-2.Switch Mode Selective

This service is used to switch the LSS Slave whose LSS address attribute equals LSS_address, into configuration mode.



cs: LSS command specifier (40h to 44h for Switch Mode Selective)

vendor-ID: Vendor name. Part of the LSS address(Index 1018h sub-index 1)

product-code: Product name. Part of LSS address(Index 1018h sub-index 2)

revision-number: Revision. Part of the LSS address(Index 1018h sub-index 3)

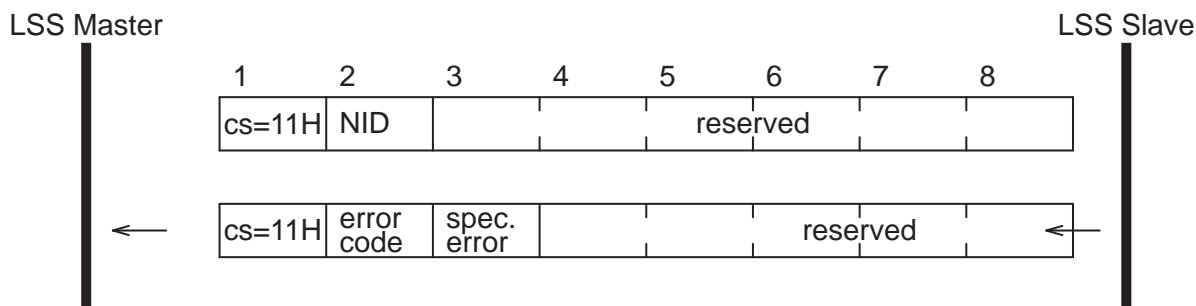
serial-number: Serial number. Part of the LSS address(Index 1018h sub-index 4)

16-2. Configuration Services

This services are supported only at the SW mode (DipSW10 = 1).

16-2-1. Configure Node-ID

This protocol is used to implement the “Configure Node-ID” service for the Node-ID part of NMT address. After switching back to LSS “Operation Mode” to “Configuration Mode” a change of the Node-ID will occur.



cs: LSS command specifier (11h for Configure Node-ID)

NID: The new Node-ID to configure

error code: 0: protocol successfully completed

1: Node-ID out of range

2-254: reserved for further use by CiA

255: implementation specific error occurred (not used)

spec error: not used

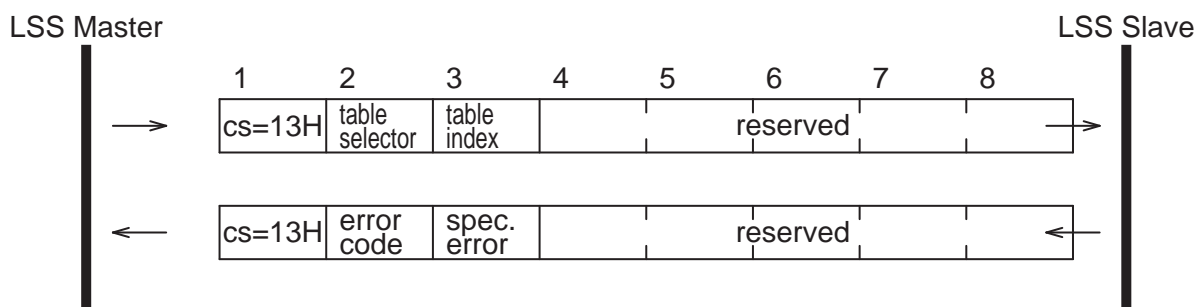
16-2-2. Configure Bit Timing Parameters

The bit Timing of LSS Slave can be changed by this service.

This service allows only one LSS Slave in configuration mode.

The service has to be followed by an “Activate Bit Timing Parameters” service to activate the configured parameters.

After execution of the “Configure Bit Timing Parameters” service the node may not execute any remote LSS services except the services “Configure Bit Timing Parameters services”, “Activate Bit Timing Parameters” and Switch Mode.



cs: LSS command specifier (13h for Configure Bit Timing Parameters)

table selector: selects which bit timing parameters table has to be used

0: standard CiA bit timing table

1-127: reserved for further use by CiA

128-255: may be used for manufacturer specific bit timings (not used)

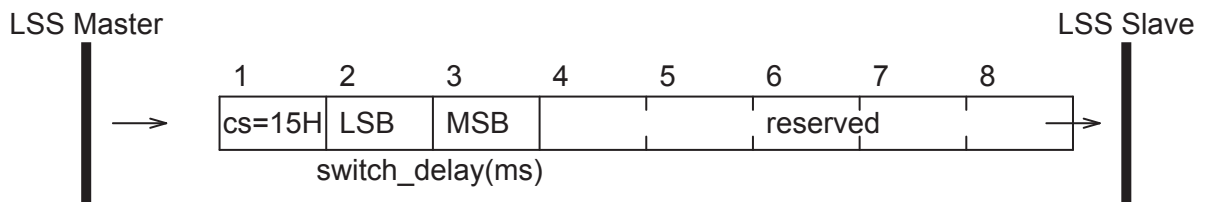
table index: selects the entry (bit timing parameters) in the selected table.

error code: 0: protocol successfully completed
 1: bit timing not supported
 2-254: reserved for further use by CiA
 255: implementation specific error occurred
 (not used)
 spec error: not used

Baudrate	Table Index
1000kbps	0
800kbps	1
500kbps	2
250kbps	3
125kbps	4
reserved	5
50kbps	6
20kbps	7
10kbps	8

16-2-3. Activate Bit Timing Parameters Protocol

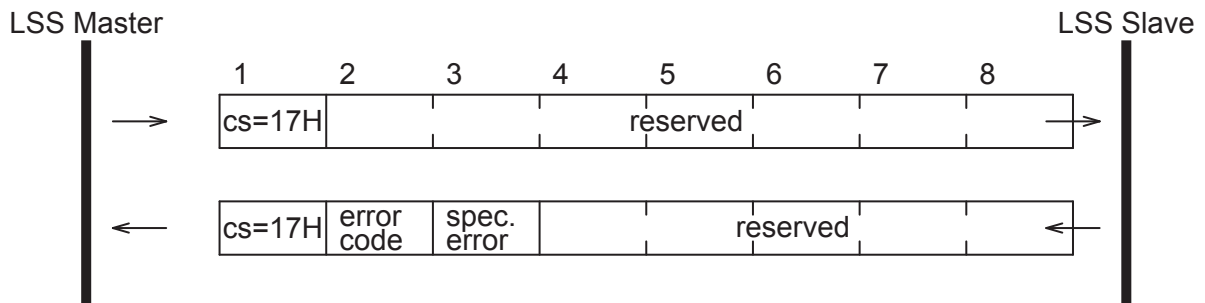
The `switch_delay` parameter specifies the length of two delay periods of equal length, which are necessary to avoid operating the bus with differing bit timing parameters. Each node performs the actual switch of the bit timing parameters after reception of the command (the delay “`switch_delay`” is in milliseconds). After performing the switch, SI unit does not transmit any message before the second time “`switch_delay`” has passed. This service allows all LSS Slaves in “Configuration Mode”.



cs: LSS command specifier (15h for Activate Bit Timing Parameters)
 switch delay: The duration of the two periods of time to wait until the bit timing parameters switch is done (first period) and before transmitting any CAN message with the new bit timing parameters after performing the switch (second period). The `switch_delay` is set in multiples of 1ms.
 reserved: reserved for further use by CiA

16-2-4. Store Configured Parameters

The configured parameters can be stored in internal EEPROM of SI unit. This service allows only one LSS Slave in “Configuration Mode”.



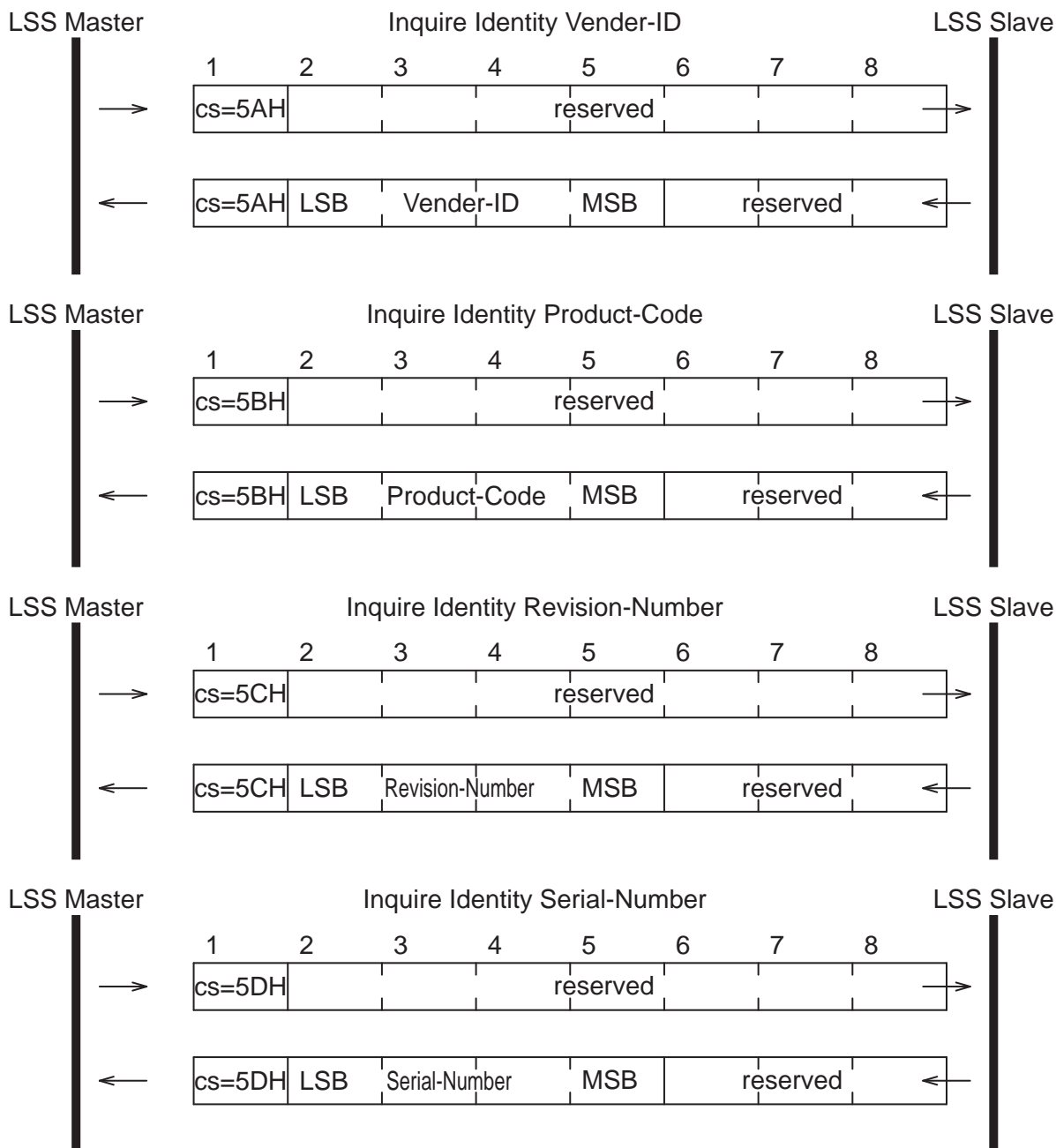
cs: LSS command specifier (17h for Store Configured Parameters)
 error code: 0: protocol successfully completed
 1: store configuration is not supported
 2: storage media access error
 3-254: reserved for further use by CiA
 255: implementation specific error occurred (not used)
 specific error code: If error code equals 255, specific error code gives a specific error code (not used)
 reserved: reserved for further use by CiA

16-3. Inquire Services

These services are supported only in configuration mode.

16-3-1. Inquire LSS Address

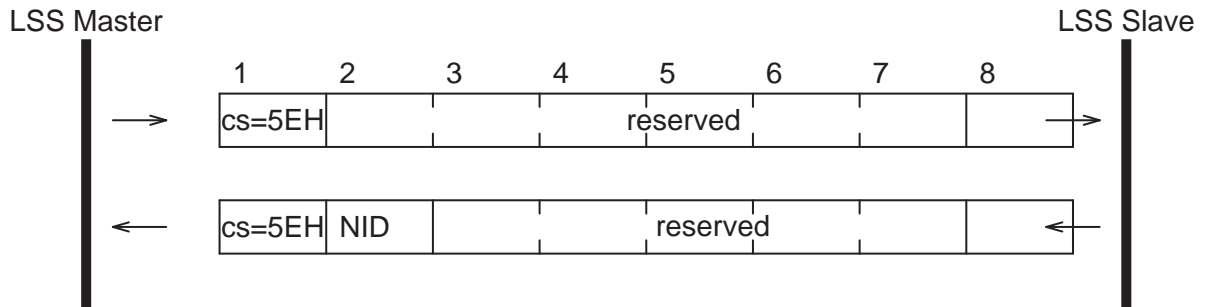
This service allows the determination of the LSS Address parameters of a LSS Slave in configuration mode.



cs: LSS command specifier(5Ah for Inquire Vendor-ID)
 cs: LSS command specifier(5Bh for Inquire Product-Code)
 cs: LSS command specifier(5Ch for Inquire Revision-Number)
 cs: LSS command specifier(5Dh for Inquire Serial-Number)
 reserved: reserved for further use by CiA

16-3-2. Inquire Node-ID

The service allows the determination of the Node-ID of a LSS Slave in configuration mode.



cs: LSS command specifier (5Eh for Inquire Node-ID)

NID: The Node-ID of the selected module. If the Node-ID has been changed by means of previous Configure Node-ID service, the original Node-ID is returned until the next power on reset. A value of FFh is returned if the Node-ID is not configured, which is only possible if the slave is in "LSS In it State".

reserved: reserved for further use by CiA

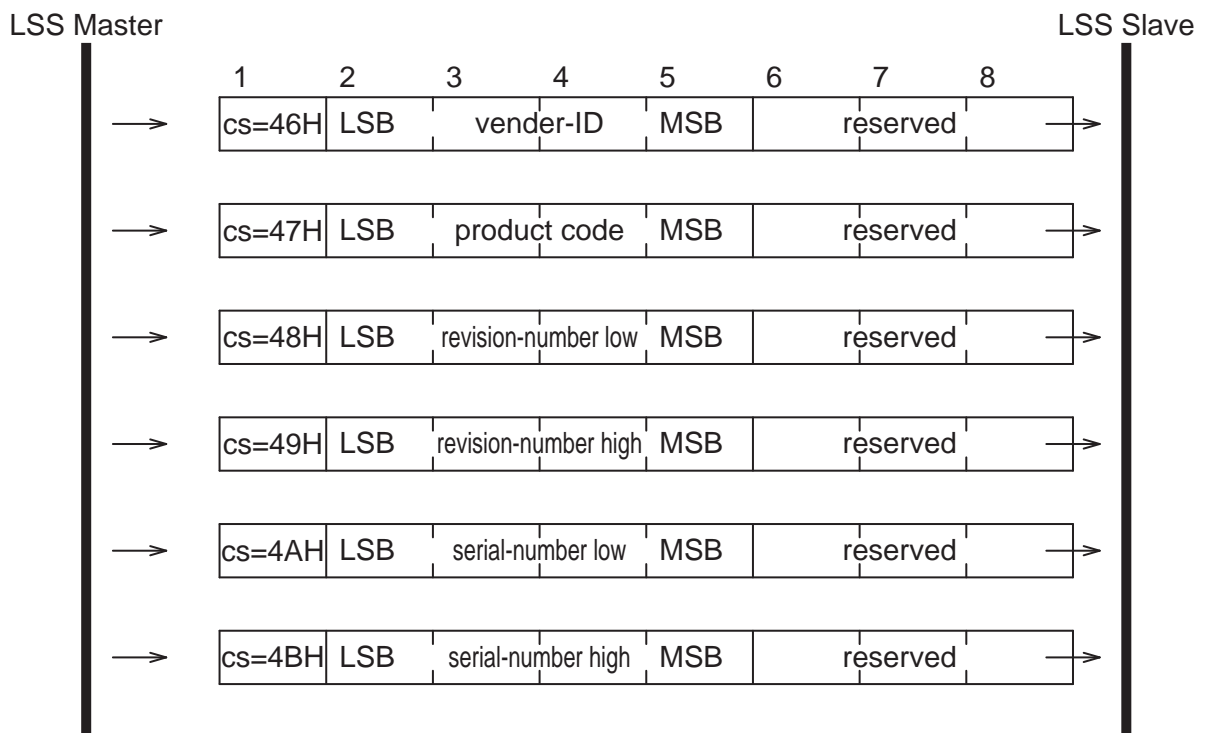
16-4. Identification Services

These services are supported in configuration mode and operation mode.

16-4-1. LSS Identify Remote Slaves

LSS Master can confirm the presence of LSS Slave which is specified by this service. The LSS Slave with a corresponding address, returns "LSS Identify Slave".

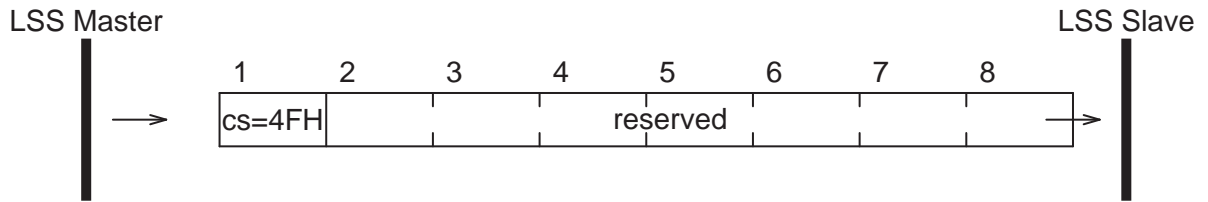
Revision-Number and Serial-Number are specified within the range (Low and High).



cs: LSS command specifier (46h to 4Bh for LSS Identify Remote Slaves)

reserved: reserved for further use by CiA

16-4-2.LSS Identify Slave

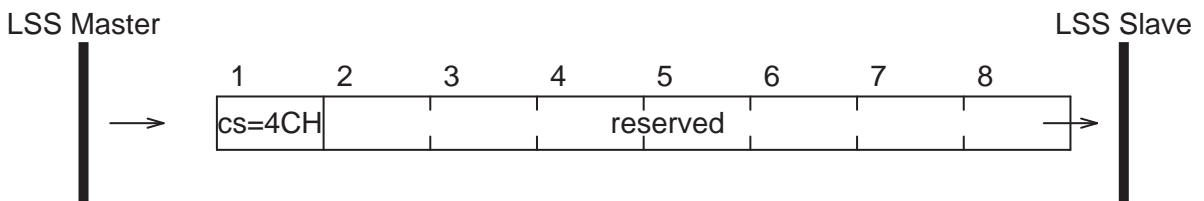


cs: LSS command specifier (4Fh for LSS Identify Slave)
reserved: reserved for further use by CiA

16-4-3.LSS Identify Non-Configured Remote Slaves

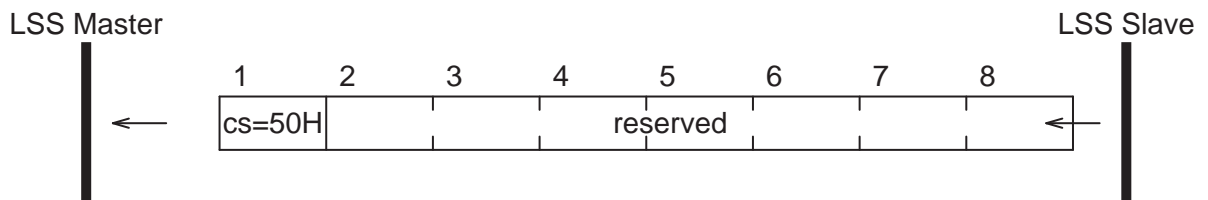
LSS Master can confirm the presence of LSS Slave which has an invalid Node-ID.

The LSS Slave which has a corresponding address returns “LSS Identify Non-Configured Slave”.



cs: LSS command specifier (4Ch for LSS Identify Non-Configured Remote Slave)
reserved: reserved for further use by CiA

16-4-4.LSS Identify Non-Configured Slave



cs: LSS command specifier (50h for LSS Identify Non-Configured Slave)
reserved: all bytes set to “0”.

17. Physical dimension

