FnIO S–Series: NA-9161

CANopen Specification

CREVIS

DOCUMENT CHANGE SUMMARY				
REV.	**PAGES**	**REMARKS**	**DATE**	**Editor**
0.01	New Document	Draft	2003/06/21	SW Kim
0.02	Adjust	Insert FnBus Monitoring Object	2003/07/22	SW Kim
0.03	Adjust	Change FnBus LED status	2003/08/11	SW Kim
0.10	Adjust	Change OD	2003/10/09	SW Kim
0.11	Adjust	Change FnBus data mode – assemble mode	2003/10/20	SW Kim
0.90			2003/10/20	SW Kim
0.91		Object Index doc Adjust		
0.92		Auto baud rate		
0.93		Insert Bus cable spec	2004/10/18	SW Kim
1.00		HSC parameter change	2005/01/22	SW Kim
1.01		Parameter table change and object information change	2005/8/18	SW Kim

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1. DEVICE PROFILE

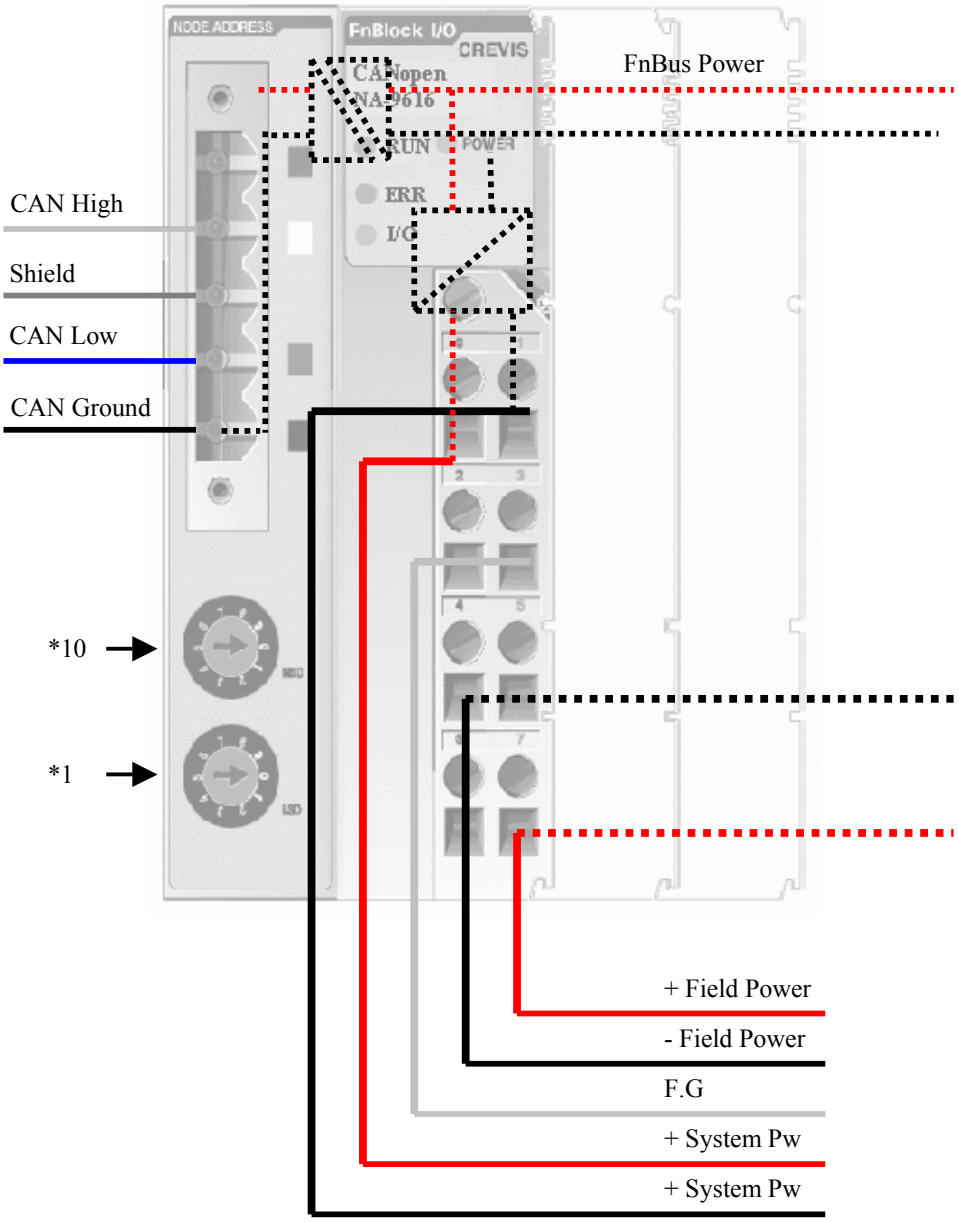
- Communications Adapter
- Device Type : 401D

2. DEVICENET COMMUNICATION

Communication Interface Specifications	
Number of Network modules	Max. 99 slot
Expansion I/O module	Max. 32 slot
Peripheral signals	Input 64byte / Output 64 byte
Indicators	1 green : CAN-RUN status indicator 1 red : CAN-ERR status indicator 1 red/green : FnBus status indicator 1 green : Field Power supply status indicator
Communication Rate	10 kByte ...1 MByte
Max. bus length	Depending on Baud rate
Number of PDOs available	8 Transmit PDOs / 8 Receive PDOs
Number of SDOs available	1 Standard SDOs

General Specification	
System Power	Supply voltage : 24Vdc nominal Voltage range : 11~28.8Vdc,
Power dissipation	Nominal 24Vdc@ 100mA
Current for I/O module	Max 5Vdc@ 1.5A
Isolation	Network to Logic : Isolation Logic to Field power : Isolation Logic to System power : Non-isolation
Field Power	Supply voltage : 24Vdc nominal Voltage range : 11~28.8Vdc
Current in jumper contacts	DC 10A maximum capacity
Weight	
Module Size	42*67*95(W*H*L)
Environment Condition	Refer to ‘2. Environment Specification’

3. WIRE MAPPING



- Field Power is 10~28.8Vdc
- System power is 24Vdc(± 20%)

4. CONFIGURATION OF THE FIELD BUS NODE

4.1. Network Address and Baud rate

Before starting Adapter operation the node number (node ID) and the Network adapter's baud rate must be set. These settings are made by means of 2 rotary switches on the Adapter.

4.1.1. Node ID

The coupler's node ID is set with Rotary switches.

The node ID can be set in the range from 1 to 99(the ID 0 is not allowed).

4.1.2. Baud rate

Before starting Rotary switches must be '0' '0'.
The switch in the table above can be stored when '1' 'x'.(x is don't care)

The select S/W can be set in the range from 0 to 8
The Acceptance S/W can be set in the range from 0 to 1

	0	1	2	3	4	5	6	7	8	9
Select S/W	0	1	2	3	4	5	6	7	8	9
Acceptance S/W	'0'->'1'	'0'->'1'	'0'->'1'	'0'->'1'	'0'->'1'	'0'->'1'	'0'->'1'	'0'->'1'	'0'->'1'	0->'1'
Baud rate	1MB	800KB	500KB	250KB	125KB	100KB	50KB	20KB	10KB	Auto baud rate

5. STATUS INDICATOR LED

5.1. CAN-RUN LED Status

State	LED is:	To indicate:
Not Powered Not On-line	Off	The Device is not on-line or may not be powered - Not completed the Dup-MAC_ID test yet
On-line, STOPED	Single flash Green	The Device is in STOPED state
On-line, PRE-OPERATIONAL	Blinking Green	The Device is in the PRE-OPERATIONAL state
On-line, OPERATIONAL	Green	The Device is in the OPERATIONAL state

5.2. CAN-ERR LED Status

State	LED is :	To indicate :
Not Powered Not On-line	Off	The Device is in working condition
Warning limit reached On-line	Single flash Red	At least one of the error counters of the CAN controller has reached or exceeded the warning level(too many error frames).
Error Control Event On-line	Double flash Red	The guarding monitor has asserted, guarding telegrams are no longer being received. The adapter is pre-operational state.
Sync Error On-line	Triple flash Red	A sync error has occurred. - The adapter is pre-operational(PDOs switch off).
Bus Off	Red	The CAN controller is bus off.

5.3. FnBus LED Status

State	LED is :	To indicate :
Not Powered No Expansion Module	Off	Device has no expansion module or may not be powered
Fn-Bus On-line, Do not Exchanging I/O	Flash Green	Fn-Bus is on-line but does not exchanging I/O data - Passed the expansion module configuration.
Fn-Bus Connection, Run Exchanging IO	Green	Expansion Slot is connected and run exchanging I/O data
FnBus connection fault during exchanging IO	Flash Red	One or more expansion module occurred in fault state. - FnBus communication failure.
Expansion Configuration Failed	Red	Failed to initialize expansion module - detected invalid expansion module ID. - overflowed Input/Output Size - initial protocol failure

5.4. Field Power LED Status

State	LED is :	To indicate :
Not Supplied Field Power	Off	Not supplied 24V dc field power

Supplied Field Power	Green	Supplied 24V dc field power

6. COMMUNICATION

6.1. Device model

6.1.1. Structure of the device model

Communication. This functional unit makes the communication data objects and the associated functionality for data exchange over the CANopen network available. The network status machine is part of this.

Object directory. This contains all the data objects (application data + parameters) that are accessible from outside and that affect the behaviour of communication, application and status machines. The object directory is organised as a two-imensional table in which the data are addressed by their index and sub-index.

The data exchange with CANopen devices takes place by means of data objects. In the CANopen communication profile, two types of standard object (PDO and SDO) and special objects (for network management etc.) are defined. The NA-9161 supports the following objects:

. 8 transmit PDOs

. 8 receive PDOs

. 1 standard SDO (server)

. 1 emergency object

. 1 synchronisation object (SYNC, without time stamp)

. node guarding

. NMT objects

Every CANopen device possesses a CANopen object directory in which
the parameters for all the CANopen objects are entered.

6.2. PDO(Process Data)

6.2.1. Introduction

In many fieldbus systems the entire process image is continuously transferred - usually in a more or less cyclic manner. CANopen is not limited to this communication principle, since the multi-master bus access protocol allows CAN to offer other methods.

The process data in CANopen is divided into segments with a maximum of 8 bytes. These segments are known as process data objects (PDOs). The PDOs each correspond to a CAN telegram, whose specific CAN identifier is used to allocate them and to determine their priority.

The PDOs are named from the point of view of the bus coupler: receive PDOs (RxPDOs) are received by the coupler and contain output data, while transmit PDOs (TxPDOs) are sent by the coupler and contain input data.

6.2.2. PDO Mapping

CANopen specifies the data assignment for the first two PDOs in the device profile for input/output groups (DS401) ("default mapping"). The first PDO is provided for digital inputs (TxPDO1) or outputs (RxPDO1). The first 4 analogue inputs or outputs are located in the second PDO. These PDOs are accordingly occupied by the bus couplers - if, for instance, no digital output terminals are plugged in, RxPDO1 remains empty.

Once the first PDOs have been occupied, the next PDOs are filled with process data in the following sequence:

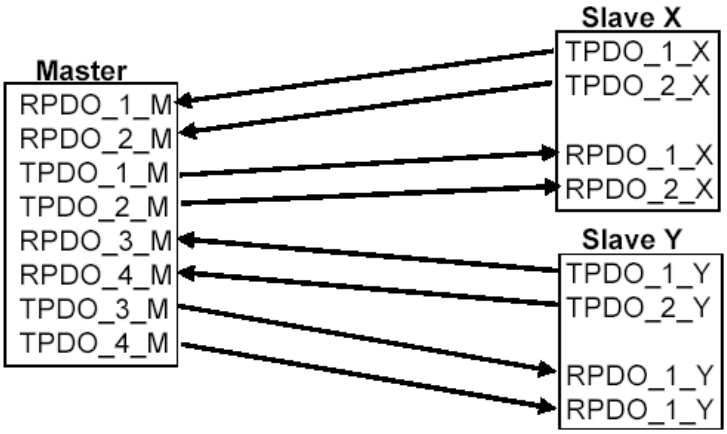
1. Digital I/Os (1-byte)
2. Digital I/Os (2-byte)
3. Analogue I/Os

6.2.3. PDO Identifier

For the first two PDOs (PDO1 + PDO2) CANopen provides default identifiers depending on the node address, but all other PDOs must have identifiers assigned to them. The principle of the default identifiers is explained in the section on "Network Management", and there is a list of all the CANopen default identifiers in the appendix.

Pre-Define Connection Set

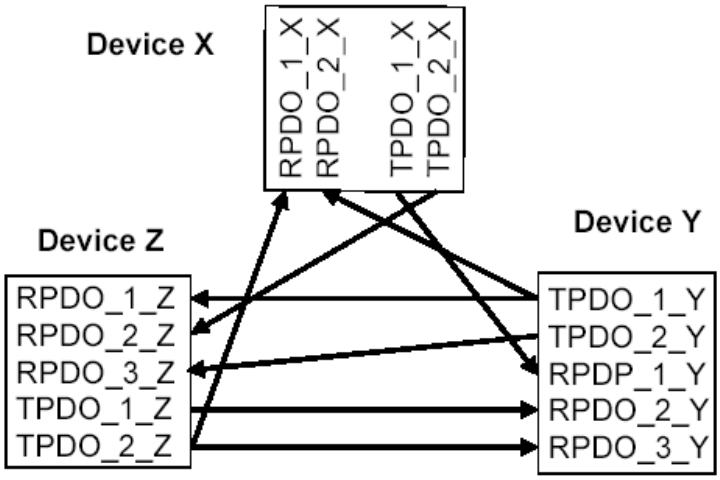
In the system of default identifiers, all the nodes (here: slaves) communicate with one central station (the master), since slave nodes do not listen by default to the send identifier of other slave nodes:



PDO Linking

If the consumer-producer model of CANopen PDOs is to be used for direct data exchange between nodes (without a master), the distribution of identifiers must be appropriately adapted, so that the TxPDO identifier of the producer agrees with the

RxPDO identifier of the consumer:



This procedure is known as PDO linking. It permits, for example, easy construction of electronic drives in which several slave axes simultaneously listen to the actual value in the master axis TxPDO.

6.2.4. PDO Communication Type

Event driven

The “event” is the alteration of an input value, the data being transmitted immediately after this change. The event-driven flow can make optimal use of the bus bandwidth, since instead of the whole process image it is only the changes in it that are transmitted. A short reaction time is achieved at the same time, since when an input value changes it is not necessary to wait for the next interrogation from a master.

Polling

The PDOs can also be polled by data request telegrams (remote frames). In this way it is possible to get the input process image of event-driven inputs onto the bus, even when the inputs have not changed, for instance by a monitoring or diagnostic device brought into the network while it is running.

The Crevis CANopen bus Adapter support the interrogation of PDOs by means of remote frames.

Synchronized

It is not only for drive applications that it is worthwhile to synchronize the determination of the input information and the setting the outputs. For this purpose CANopen provides the SYNC object, a CAN telegram of high priority but containing no user data, whose reception is used by the synchronized nodes as a trigger for reading the inputs or for setting the outputs:

PDO transmission type

The “PDO transmission type” parameter specifies how the transmission of the PDO is triggered, or how received PDOs are handled:

Transmission type	PDO transmission				
	cyclic	acyclic	synchronous	asynchronous	RTR only
0		X	X		
1-240	X		X		
241-251	reserved				
252			X		X
253				X	X
254				X	
255				X	

Synchronous

Transmission type 0 is only useful for RxPDOs: the PDO is only used when the next SYNC telegram is received. In transmission types 1-240 the PDO is cyclically transmitted or expected: after every "nth" SYNC (n = 1...240).

Since transmission types can be combined on a coupler as well as in the network, it is possible, for example, for a fast cycle to be agreed for digital inputs (n = 1), whereas the data for analogue inputs is transmitted in a slower cycle (e.g. n = 10). The cycle time (SYNC rate) can be monitored (object 0x1006), so that if the SYNC fails the Adapter switches its outputs into the fault state.

Asynchronous

The transmission types 254 + 255 are asynchronous, but may also be event-driven. In transmission type 254, the event is specific to the manufacturer, whereas for type 255 it is defined in the device profile. Since the Beckhoff CANopen bus couplers support device profile DS401 no distinction is made here between the two transmission types.

Inhibit Time

The "inhibit time" parameter can be used to implement a "transmit filter" that does not increase the reaction time for relatively new input alterations, but is active for changes that follow immediately afterwards. The inhibit time (transmit delay time) specifies the minimum length of time that must be allowed to elapse between the transmission of two of the same telegrams. If the inhibit time is used, the maximum bus loading can be determined, so that the worst case latency can then be found.

6.3. SDO(Service Data)

6.3.1. Introduction

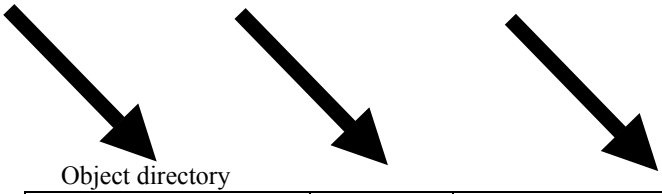
The parameters listed in the object directory are read and written by means of service data objects. These SDOs are multiplexed domains, i.e. structures of any size that have a multiplexer (address). The multiplexer consists of a 16-bit index

and an 8-bit sub-index that address the corresponding entries in the object directory.

Byte 0 Byte 1-3 : data addressing Byte 4-7 : 1-4 byte of data

Command Specifier	Index Low Byte	Index High Byte	Subindex	Data 0	Data 1	Data 2	Data 3

-Upload
-Download
-Number of data byte
-Request
-Response



Object directory

Index	Sub-index	Data

The CANopen bus couplers are servers for the SDO, which means that at the request of a client they make data available (upload), or they receive data from the client (download).

This involves a handshake between the client and the server. When the size of the parameter to be transferred is not more than 4 bytes, a single handshake is sufficient (one telegram pair).

For a download, the client sends the data together with its index and subindex, and the server confirms reception. For an upload, the client requests the data by transmitting the index and sub-index of the desired parameter, and the server sends the parameter (including index and sub-index) in its answer telegram. The same pair of identifiers is used for both upload and download. The telegrams, which are always 8 bytes long, encode the various services in the first data byte.

All parameters with the exception of objects 1008h, 1009h and 100Ah (device name, hardware and software versions) are only at most 4 bytes long, so this description is restricted to transmission in expedited transfer.

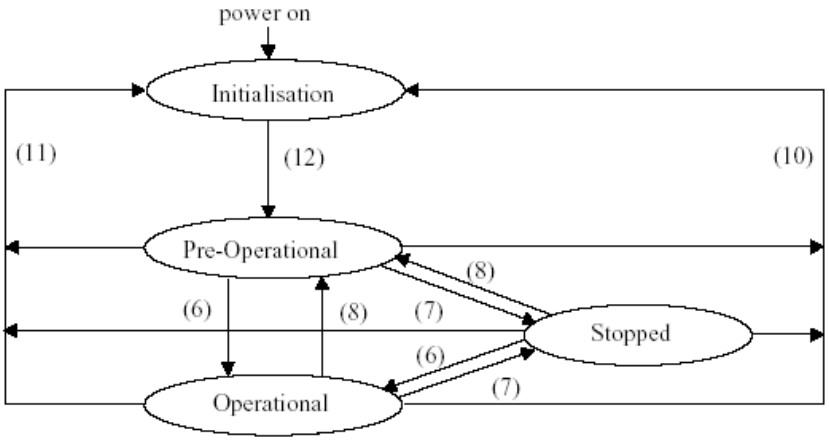
6.4. Emergency Object(Error Msg)

6.5. NMT (Network Managemet)

6.5.1. Network Start-up

CANopen defines a state machine that controls the functionality of a device. Transition between the individual states is

initiated by internal events or services from the NMT master. These devices states can be connected to application processes.



In ***Initialization*** state, the CANopen data structures of a node are initialized by the application. The CiA DS-301 standard defines various mandatory OD entries for this task as well as specific communication objects required for that. In the minimum device configuration, the identifier for these communication ojects must correspond to the so-called **Pre-Defined Connection-Set.** The device profiles define further settings for the applicable device class. The pre-defined settings for identifier for emergency, PDOs and SDOs are calculated based on the node address (Node ID), that can be in the range from 1 to 99, added to a base identifier that determines the function of the individual object..

After ***Initialization*** is completed the node automatically switches into **PRE-OPERATIONAL** (12) state. The NMT master will be informed about this state change with the BOOT-UP message sent by the corresponding node. In this state it is not possible to communicate with the node using PDOs. However, the node can be configured over the CAN bus using SDOs in **PRE-OPERATIONAL** state. NMT services and Life Guarding are also available in this state.

The application as well as the available ressources of the CANopen device determine to what extend configuration over the CAN bus with the help of SDOs must take place. For example, if the CANopen device does not provide a non-volatile memory to store mapping and communication parameters for PDOs and these parameters differ from the default values, then these parameters must be transmitted to the node over the network after initialization is completed.

After the configuration of these parameters by the application or the NMT master is completed, the NMT service *Start_Remote_Node* (6) can be used to render the node from **PRE-OPERATIONAL** state into **OPERATIONAL** state. This state change also causes the initial transmission of all TPDOs independently of whether an event for it is present. Each susequent transmission of PDOs then always takes place as a function of an event.

All CANopen devices also support the *Stop_Remote_Node* (7), *Enter_PRE-OPERATIONAL_State* (8), *Reset_Node* (10), *Reset_Communication* (11) services. *Reset_Node* is used to reset the application-specific data and the communication parameter of the node. The CANopen data structures are loaded with their initial values. Data stored in a non-volatile

memory are rejected. This state change is comparable with an initial operation of the node.

If the NMT service *Reset_Communication* is used to change the state of a node, then loading initial values exclusive for the communication parameters in the CANopen stack takes palce.

No communication via PDO and SDO is possible if the device is in **STOPPED** state. Only NMT services, Node Guarding, Life Guarding as well as Heartbeat are possible in this state.

6.5.2. Boot-up Message

After the initialisation phase and the self test, the bus coupler sends the boot-up message, a CAN message with no data bytes and with the identifier of the emergency message: CAN-ID = 0x80 + node ID.

6.5.3. Node Guarding

Node Guarding represents a means of node supervision that is initiated by the NMT master. This service is used to request the node's operational state and to determine whether the node is functioning correctly. The NMT master transmits a single Node Guard message to the slave in the form of a remote frame with the CAN identifier 0x700 plus the node address of the NMT slave. As a response to this remote frame, the NMT slave sends a CAN message back containing its current NMT state and a one bit that toggles between two subsequent messages.

Response from the NMT Slave to a Node Guard Remote Frame:

Identifier	DLC	Data
		0
0x700 + Node Address	1	Status Byte

Node State of a CANopen Device

Status Byte	Node State
0x00	BOOT-UP
0x04	STOPED
0x05	OPERATIONAL
0x7F	PRE-OPERATIONAL

Bit 7 of the status byte always starts with a 0 and changes its value after each transmission. The application is responsible for actively toggeling this bit. This ensures that the Node Guard response message from a slave is not just stored in one of the Full-CAN channels. Thus the NMT master will get the confirmation from the NMT slave node that the application is still running.

6.5.4. Life Guarding

As an alternative to Node Guarding node supervision can also be performed by Life Guarding services. In contrast to the Node Guarding the NMT master cyclically sends a Life Guard message to the slave in the form of a remote frame with the CAN identifier 0x700 plus the node address of the NMT slave. As a response to this remote frame, the NMT slave sends a

CAN message back containing its current NMT state and a one bit that toggles between two subsequent messages. With being missing the answer or unexpected status of the slave the NMT masters application is informed. Further the slave can detect the loss of the masters. The Life Guarding is started with the transmission of the first Life Guard message of the masters.

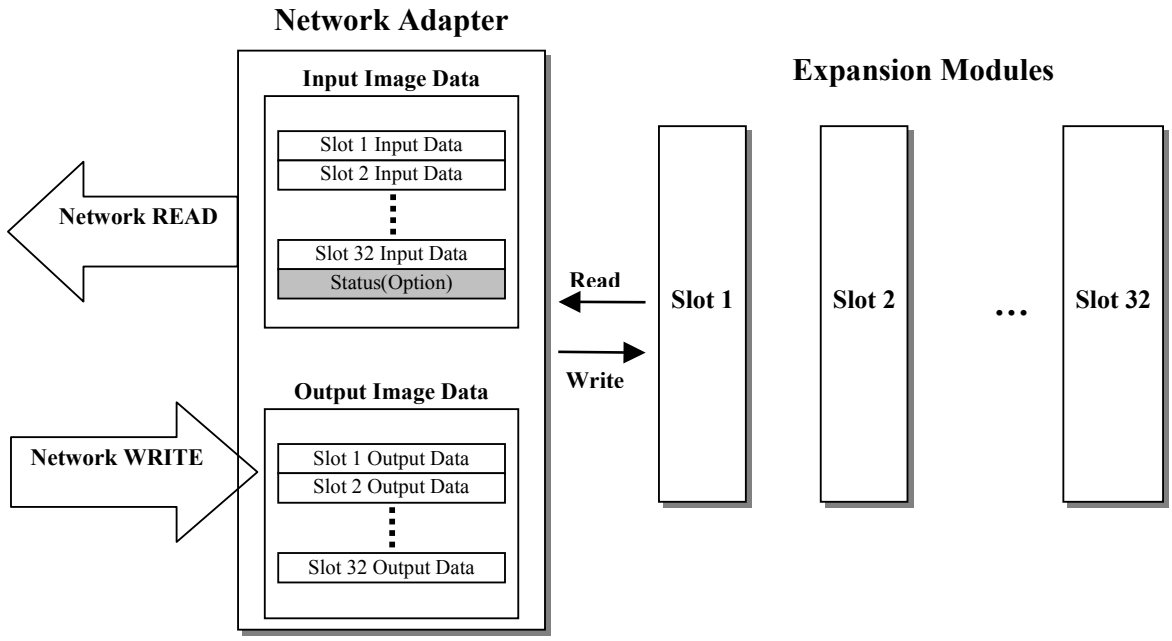
Response from the NMT Slave to a Life Guard Remote Frame

Identifier	DLC	Data
		0
0x700 + Node Address	1	Status Byte

Meaning of the status byte corresponds to that of the Node Guarding messageThe Life Guarding supervision on the NMT slave node is deactivated, if the Life Guard time (object entry 0x100C in the object dictionary) or the Life time factor (object entry 0x100D in the object dictionary) are equal to zero.

6.6. I/O Process Image Map

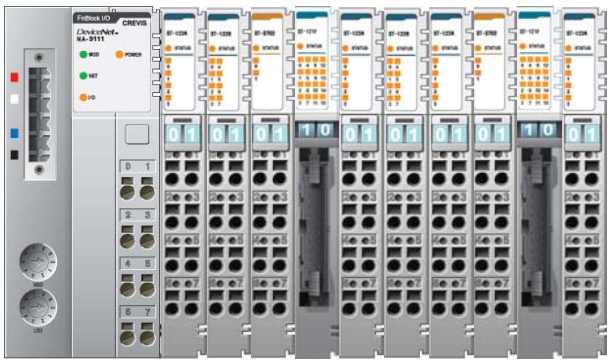
An expansion module may have 3 types of data as I/O data, configuration parameter and memory register.
The data exchange between network adapter and expansion modules is done via an I/O process image data by FnBus protocol.
The following figure shows the data flow of process image between network adapter and expansion modules.



6.6.1. Example of Input Process Image Map

Input image data depends on slot position and expansion slot data type. Input process image data is only ordered by expansion slot position when input image mode is uncompressed (mode 0). But, when input image mode is compressed (mode 1), input process image data is ordered by expansion slot position and slot data type.
Input process image mode can be set by Object Index 0x4500

- **For example slot configuration**



Slot Address	Module Description
0	CANopen Adapter
1	4-discrete input
2	8-discrete input
3	2-analog input
4	16-discrete input
5	4-discrete input
6	8-discrete input
7	4-discrete input
8	2-analog input
9	16-discrete input
10	1ch, high speed counter

- Compress mode data format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Index	Sub-Index
0	Analog Input Ch0 low byte (Slot#3)								0x6401	0x01
1	Analog Input Ch0 high byte (Slot#3)								0x6401	0x01
2	Analog Input Ch1 low byte (Slot#3)								0x6401	0x02
3	Analog Input Ch1 high byte (Slot#3)								0x6401	0x02
4	Analog Input Ch0 low byte (Slot#8)								0x6401	0x03
5	Analog Input Ch0 high byte (Slot#8)								0x6401	0x03
6	Analog Input Ch1 low byte (Slot#8)								0x6401	0x04
7	Analog Input Ch1 high byte (Slot#8)								0x6401	0x04
8	Discrete Input 4 pts (Slot#2)				Discrete Input 4 pts (Slot#1)				0x6000	0x01
9	Discrete Input 4 pts (Slot#4)				Discrete Input 4 pts (Slot#2)				0x6000	0x02
10	Discrete Input 8 pts (Slot#4)								0x6000	0x03
11	Discrete Input 4 pts (Slot#5)				Discrete Input 4 pts (Slot#4)				0x6000	0x04
12	Discrete Input 8 pts (Slot#6)								0x6000	0x05
13	Discrete Input 4 pts (Slot#9)				Discrete Input 4 pts (Slot#7)				0x6000	0x06
14	Discrete Input 8 pts (Slot#9)								0x6000	0x07
15					Discrete Input 4 pts (Slot#9)				0x6000	0x08
16	HSC Input 0byte(Slot#10)								0x3000	0x01
17	HSC Input 1byte(Slot#10)								0x3000	0x02
18	HSC Input 2byte(Slot#10)								0x3000	0x03
19	HSC Input 3byte(Slot#10)								0x3000	0x04
20	HSC Input 4byte(Slot#10)								0x3000	0x05

21	HSC Input 5byte(Slot#10)								0x3000	0x06

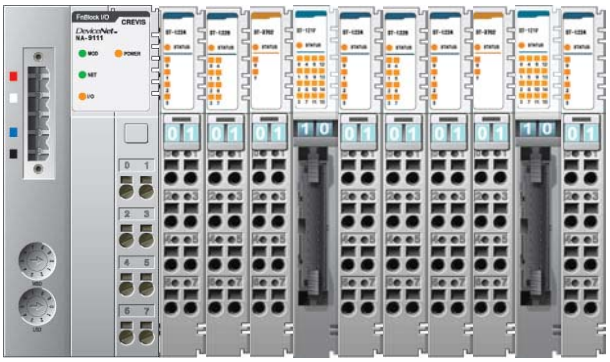
■ Non-compress mode data format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Index	Sub-Index
0	Analog Input Ch0 low byte (Slot#3)								0x6401	0x01
1	Analog Input Ch0 high byte (Slot#3)								0x6401	0x01
2	Analog Input Ch1 low byte (Slot#3)								0x6401	0x02
3	Analog Input Ch1 high byte (Slot#3)								0x6401	0x02
4	Analog Input Ch0 low byte (Slot#8)								0x6401	0x03
5	Analog Input Ch0 high byte (Slot#8)								0x6401	0x03
6	Analog Input Ch1 low byte (Slot#8)								0x6401	0x04
7	Analog Input Ch1 high byte (Slot#8)								0x6401	0x04
8	Reserved				Discrete Input 4 pts (Slot#1)				0x6000	0x01
9	Discrete Input 8 pts (Slot#2)								0x6000	0x02
10	Discrete Input low 8 pts (Slot#4)								0x6000	0x03
11	Discrete Input high 8 pts (Slot#4)								0x6000	0x04
12	Reserved				Discrete Input 4 pts (Slot#5)				0x6000	0x05
13	Discrete Input 8 pts (Slot#6)								0x6000	0x06
14	Reserved				Discrete Input 4 pts (Slot#7)				0x6000	0x07
15	Discrete Input low 8 pts (Slot#9)								0x6000	0x08
16	Discrete Input high 8 pts (Slot#9)								0x6000	0x09
17	Reserved				Discrete Input 4 pts (Slot#10)				0x6000	0x0A
18	HSC Input 0byte(Slot#10)								0x3000	0x01
19	HSC Input 1byte(Slot#10)								0x3000	0x02
20	HSC Input 2byte(Slot#10)								0x3000	0x03
21	HSC Input 3byte(Slot#10)								0x3000	0x04
22	HSC Input 4byte(Slot#10)								0x3000	0x05
23	HSC Input 5byte(Slot#10)								0x3000	0x06

6.6.2. Example of Output Process Image Map

Output image data depends on slot position and expansion slot data type. Output process image data is only ordered by expansion slot position when output image mode is uncompressed (mode 0). But, when output image mode is compressed (mode 1), output process image data is ordered by expansion slot position and slot data type.
Output process image mode can be set by Object Index 0x4500.

- For example slot configuration



Slot Address	Module Description
0	CANopen Adapter
1	4-discrete output
2	8-discrete output
3	2-analog output
4	16-discrete output
5	4-discrete output
6	8-discrete output
7	2-realy output
8	2-realy output
9	2-analog output
10	16-discrete output
11	1ch, high speed counter

- Compress mode data format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Index	Sub-Index
0	Analog Output Ch0 low byte (Slot#3)								0x6411	0x01
1	Analog Output Ch0 high byte (Slot#3)								0x6411	0x01
2	Analog Output Ch1 low byte (Slot#3)								0x6411	0x02
3	Analog Output Ch1 high byte (Slot#3)								0x6411	0x02
4	Analog Output Ch0 low byte (Slot#9)								0x6411	0x03
5	Analog Output Ch0 high byte (Slot#9)								0x6411	0x03
6	Analog Output Ch1 low byte (Slot#9)								0x6411	0x04
7	Analog Output Ch1 high byte (Slot#9)								0x6411	0x04
8	Discrete Output 4 pts (Slot#2)				Discrete Output 4 pts (Slot#1)				0x6200	0x01
9	Discrete Output 4 pts (Slot#4)				Discrete Output 4 pts (Slot#2)				0x6200	0x02
10	Discrete Output low 8 pts (Slot#4)								0x6200	0x03
11	Discrete Output 4 pts (Slot#5)				Discrete Output 4 pts (Slot#4)				0x6200	0x04
12	Discrete Output 8 pts (Slot#6)								0x6200	0x05
13	Discrete Output 4 pts (Slot#10)				Discrete Output 2 pts (Slot#8)		Discrete Output 2 pts (Slot#7)		0x6200	0x06
14	Discrete Output high 8 pts (Slot#10)								0x6200	0x07
15	Reserved				Discrete Output 4 pts (Slot#10)				0x6200	0x08
16	HSC Output low byte(Slot#11)								0x3200	0x01
17	HSC Output high byte(Slot#11)								0x3200	0x02

■ Non-compress mode data format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Index	Sub-Index
0	Analog Output Ch0 low byte (Slot#3)								0x6411	0x01
1	Analog Output Ch0 high byte (Slot#3)								0x6411	0x01
2	Analog Output Ch1 low byte (Slot#3)								0x6411	0x02
3	Analog Output Ch1 high byte (Slot#3)								0x6411	0x02
4	Analog Output Ch0 low byte (Slot#9)								0x6411	0x03
5	Analog Output Ch0 high byte (Slot#9)								0x6411	0x03
6	Analog Output Ch1 low byte (Slot#9)								0x6411	0x04
7	Analog Output Ch1 high byte (Slot#9)								0x6411	0x04
8	Reserved				Discrete Output 4 pts (Slot#1)				0x6200	0x01
9	Discrete Output 8 pts (Slot#2)								0x6200	0x02
10	Discrete Output low 8 pts (Slot#4)								0x6200	0x03
11	Discrete Output high 8 pts (Slot#4)								0x6200	0x04
12	Reserved				Discrete Output 4 pts (Slot#5)				0x6200	0x05
13	Discrete Input 8 pts (Slot#6)								0x6200	0x06
14	Reserved						Discrete Output 2 pts (Slot#7)		0x6200	0x07
15	Reserved						Discrete Output 2 pts (Slot#8)		0x6200	0x08
16	Discrete Output low 8 pts (Slot#10)								0x6200	0x09
17	Discrete Output high 8 pts (Slot#10)								0x6200	0x0A
18	Reserved				Discrete Output 4 pts (Slot#11)				0x6200	0x0B
19	HSC Output low byte(Slot#11)								0x3200	0x01
20	HSC Output high byte(Slot#11)								0x3200	0x02

6.6.3. Default Identifier

CANopen provides default identifiers for the most important communication objects, and these are derived from the 7-bit node address (the node ID) and a 4-bit function code in accordance with the following scheme:

11 Bit Identifier

10	9	8	7	6	5	4	3	2	1	0
Function				Code Node ID						

The COB ID are given according to DS301. This gives rise to the following default identifiers:

Object	**Function**	**Function Code**	**COB ID (hex/dec)**	**Object for Communication parameter/mapping**
NMT	Boot-up	0000	0x00 / 0	-
SYNC	Synch.	0001	0x80 / 128	0x1500+0x1006
EMERGENCY	Status/Error	0001	0x81-0xFF / 129-255	-
PDO 1(Tx)	Digital Input	0011	0x181-0x1FF / 385-511	0x1800/0x1A00
PDO 1(Rx)	Digital Output	0100	0x201-0x27F / 513-639	0x1400/0x1600
PDO 2(Tx)	Analog Input	0101	0x281-0x2FF / 641-767	0x1801/0x1A01
PDO 2(Rx)	Analog Output	0110	0x301-0x37F / 769-895	0x1401/0x1601
SDO (Tx)	Parameter	1011	0x581-0x5FF / 1409-1535	-
SDO (Rx)	Parameter	1100	0x601-0x67F / 1537-1663	-
Nodeguard	Life/Nodeguard	1110	0x701-0x77F / 1793-1919	0x100C,0x100D,0x100E

The COB ID can be changed vis SDO.

The PDOs 3-8 do not have default values in DeviceProfile 402. The COB ID of these PDOs have to be set by the user with regard to the COB ID which are already use by the network.

6.7. Object Directory

All the CANopen objects relevant for the bus coupler are entered into the CANopen object directory. The object directory is divided into three different regions:

1) communication-specific profile region (index 0x1000 – 0x1FFF)
2) manufacturer-specific profile region (index 0x2000 – 0x5FFF)
3) standardised device profile region (0x6000 – 0x9FFF)

Region 1 thus contains the description of all the parameters particular to communication, the manufacturer-specific entries are described in region 2, and region 3 stores the objects for the device profile according to DS-401. Every entry in the object directory is identified by a 16 bit index.

Index	Sub-Index	Name	Type	Attribute	Default	Meaning
0x1000	0	device Type	unsigned32	ro	Value	Statement of device type
0x1001	0	error register	unsgined8	ro		Error register
0x1003	0	predefine error field	unsgined8	ro	0x00	Number of error states stored
	1	standard error filed	unsigned32	ro	0x00	Error state are stored
0x1004	0	number of PDOs support	unsigned32	rw	None	number of PDOs support
0x1005	0	COB-ID sync message	unsigned32	rw	0x80000080	Identifier of the Sync message
0x1006	0	communication cycle preiod	unsigned32	rw	0x00000000	Communication cycle period in s.'0' if not used
0x1007	0	sync window length	unsigned32	rw	0x00000000	Contain the length of the time window for sync message in s.'0' if not used
0x1008	0	manufacturer device name	visible string	ro	NA-9616	Device name of the Adapter
0x1009	0	manufacturer hardware version	visible string	ro	-	H/W version description
0x100A	0	manufacturer softdware version	visible string	ro	-	Software version number
0x100B	0	Node ID	unsigned32	ro	None	Set node number
0x100C	0	guard time	unsigned16	rw	0	Interval between two guard telegrams. Is set by the NMTmaster.(mS)
0x100D	0	life time factor	unsgined8	rw	0	Life time factor * guard time = life time(watchdog for life guarding)
0x100E	0	COB-ID guarding protocol	unsigned32	rw	0x700+node ID	Identifier of the guarding protocol
0x1010	0	store parameters	unsgined8	ro	3	Number of store options
	1	save all parameters	unsigned32	rw	0	Store all parameters
0x1011	0	restore default parameters	unsgined8	ro	3	Number of restore options
	1	restore all default	unsigned32	rw	0	Restore all default parameters
0x1014	0	COB-ID emergency message	unsigned32	rw	0x80000000	COB-ID of the emergency object
0x1015	0	inhibit time EMCY	unsigned16	rw		
0x1016	0	Consumer Heartbeat time	unsgined8	ro	1	Number of entries
	1	Consumer Heartbeat time	unsigned32	rw	0	Heartbeat time value
0x1017	0	producer Hertbit time	unsigned16	rw		
0x1400	0	receive PDO parameter	unsgined8	rw	5	number of following parameters
	1	COB-ID used by PDO	unsigned32	rw	0x200+nodeID	COB-ID RxPDO1
	2	transfer type	unsgined8	rw	254	Transmission type of the PDO
	3	inhibit time	unsigned16	rw	0	Inhibit Ime of the PDO
	5	event timer	unsigned16	rw	0	Event time of the PDO
…	…	…				
0x1407	0	receive PDO parameter	unsgined8	rw	5	number of following parameters
	1	COB-ID used by PDO	unsigned32	rw	0x80000000	COB-ID RxPDO8
	2	transfer type	unsgined8	rw	254	Transmission type of the PDO
	3	inhibit time	unsigned16	rw	0	Inhibit Ime of the PDO
	5	event timer	unsigned16	rw	0	Event time of the PDO
0x1600	0	receive PDO mapping	unsgined8	rw	0	number of mapped objects.
	1	1. Object	unsigned32	rw	0x62000108	
	…	…				
	8	8. Object	unsigned32	rw	0x62000808	

…	…	…				
0x1607	0	receive PDO mapping	unsgined8	rw	0	number of mapped objects.
	1	1. Object	unsigned32		0	
	…	…				
	8	8. Object	unsigned32	rw	0	
0x1800	0	transfer PDO parameter	unsgined8	rw	5	number of following parameters
	1	COB-ID used by PDO	unsigned32	rw	0x180+nodeID	COB-ID TxPDO1
	2	transfer type	unsgined8	rw	254	Transmission type of the PDO
	3	inhibit time	unsigned16	rw	0	Inhibit Ime of the PDO
	5	event timer	unsigned16	rw	0	Event time of the PDO
…	…	…				
0x1807	0	transfer PDO parameter	unsgined8	rw	5	number of following parameters
	1	COB-ID used by PDO	unsigned32	rw	0x80000000	COB-ID TxPDO1
	2	transfer type	unsgined8	rw	254	Transmission type of the PDO
	3	inhibit time	unsigned16	rw	0	Inhibit Ime of the PDO
	5	event timer	unsigned16	rw	0	Event time of the PDO
0x1A00		transfer PDO mapping	unsgined8	rw	0	number of mapped objects.
	1	1. Object	unsigned32	rw	0x60000108	
	…	…				
	8	8. Object	unsigned32	rw	0x60000808	
…	…	…				
0x1A07	0	transfer PDO mapping	unsgined8	rw	0	number of mapped objects.
	1	1. Object	unsigned32	rw	0	
	…	…				
	8	8. Object	unsigned32	rw	0	
0x2000	0	read memorry data	unsigned8	ro	None	number of entries(slot number)
	1	read memory slot #01	visible data	ro	None	expansion slot#1 memory block read
	…	…				
	32	read memory slot #32	visible data	ro	None	expansion slot#32 memory block read
0x2020	0	input information	Unsigned8	ro	1	
	1	digital input bit size	Unsigned16	ro		expansion digital input all bit size
0x2200	0	write memorry data	unsigned8	ro	None	number of entries(slot number)
	1	write memory slot #01	visible data	wo	None	expansion slot#1 memory block write
	…	…				
	32	write memory slot #32	visible data	wo	None	expansion slot#32 memory block write
0x2220	0	input information	Unsigned8	ro	1	
	1	digital output bit size	Unsigned16	ro		Expansion digital output all bit size
0x3000	0	read special input data	unsigned8	ro	None	number of entries
	1	special Input8 0H~7H	unsigned8	ro	None	1st special input block
	…	…				
	64	special Input8 1F8H~1FFH	unsigned8	ro	None	64st special input block
0x3200	0	write special output data	unsigned8	ro	None	number of entries
	1	special output8 0H~7H	unsigned8	ro	None	1st special output block
	…	…				
	64	special output8 1F8H~1FFH	unsigned8	ro	None	64st special output block
0x4500	0	FnBus communication register	unsgined8	ro	0x03	number of communication register block

	1	FnBus status	unsigend32	ro	0x00000000	FnBus Error monitoring ,field power check
	2	FnBus Data mode	unsigend8	rw	0x00	0: non compress mode 1: compress mode
	3	expansion IO active flag	unsgined32	rw	0x00000000	expansion module active flag(bit active)
0x4501	0	Range of Read Memorry map	unsigend8	ro	None	number of expansion slot
	1	vision config of slot #01	unsigned32	ro	None	number of read memory window slot #1
	…					
	20	vision config of slot #01	unsigned32	ro	None	number of read memory window slot #32
0x4502	0	Expansion slot configuration	unsigend8	ro	None	number of expansion slot
	1	configuration of slot #01	visible data	ro	None	configuration parameter of slot #01
	…					
	20	configuration of slot #32	visible data	ro	None	configuration parameter of slot #32
0x4503	0	expansion module product code	unsigend8	ro	None	number of expansion module product code
	1	slot product code #01	unsigned32	ro	None	expansion module product code slot #1
	…					
	20	slot product code #32	unsigned32	ro	None	expansion module product code slot #32
0x4504	0	expansion module catalog code	unsigend8	ro	None	number of expansion module catalog code
	1	slot catalog code #01	unsigned32	ro	None	expansion module catalog code slot #1
	…					
	20	slot catalog code #32	unsigned32	ro	None	expansion module catalog code slot #32
0x6000	0	digital 1byte inputs	unsgined8	rw	None	Number of available 8bit digital input blocks
	1	input8 0~8h	unsgined8	rw	None	1st input block
	…	…				
	64	input8 1F8~1FFh	unsgined8	rw	None	64 input block
0x6200	0	digital 1byte outputs	unsgined8	rw	None	Number of available 8bit digital output blocks
	1	output8 0~8h	unsgined8	rw	None	1st output block
	…	…				
	64	output8 1F8~1FFh	unsgined8	rw	None	64 output block
0x6401	0	analog inputs	unsgined8	rw	None	Number of available analog input blocks
	1	analog input16 0~Fh	unsigned16	rw	None	1st input block
	…	…				
	32	analog input16 1F0~1FFh	unsigned16	rw	None	32 input block
0x6411	0	analog outputs	unsgined8	rw	None	Number of available analog output blocks
	1	analog output16 0~Fh	unsigned16	rw	None	1st output block
	…	…				
	32	analog output8 1F0~1FFh	unsigned16	rw	None	32 output block

APENDIX A

A.1. Product List

No.	ST-Number	Description	Module Id (hex)	Catalog Number	Product Code
1	ST-1214	4-sinking input, 24Vdc	03	00 03 00 41	83 C0 40 01
2	ST-1224	4-sourcing input, 24Vdc	04	00 04 00 41	83 C0 40 01
3	ST-1218	8-sinking input, 24Vdc	07	00 07 00 41	00 C0 40 01
4	ST-1228	8-sourcing input, 24Vdc	08	00 08 00 41	00 C0 40 01
5	ST-121F	16-sinking input, 24Vdc	13	00 13 01 41	01 C0 40 01
6	ST-122F	16-sourcing input, 24Vdc	14	00 14 01 41	01 C0 40 01
7	ST-1314	4-sinking input, 48Vdc	05	00 05 00 41	83 C0 40 01
8	ST-1324	4-sourcing input, 48Vdc	06	00 06 00 41	83 C0 40 01
9	ST-1804	4-ac input, 110Vac	09	00 09 00 41	83 C0 40 01
10	ST-1904	4-ac input, 220Vac	0A	00 0A 00 41	83 C0 40 01
11	ST-2314	4-sinking output, 24Vdc 0.5A	0E	00 0E 00 81	C0 83 80 01
12	ST-2324	4-sourcing output, 24Vdc 0.5A	10	00 10 00 81	C0 83 80 01
13	ST-2318	8-sinking output, 24Vdc 0.5A	11	00 11 00 81	C0 00 80 01
14	ST-2328	8-sourcing output, 24Vdc 0.5A	12	00 12 00 81	C0 00 80 01
15	ST-221F	16-sinking output, 24Vdc 0.3A	15	00 15 01 81	C0 01 80 01
16	ST-222F	16-sourcing output, 24Vdc 0.3A	16	00 16 01 81	C0 01 80 01
17	ST-2414	4-sinking output, diag, 24Vdc 0.5A	37	37 00 00 C1	83 83 C0 01
18	ST-2424	4-sourcing output, diag, 24Vdc 0.5A	38	38 00 00 C1	83 83 C0 01
19	ST-2514	4-sinking output, diag, 24Vdc 2A	35	35 00 00 C1	83 83 C0 01
20	ST-2524	4-sourcing output, diag, 24Vdc 2A	36	36 00 00 C1	83 83 C0 01
21	ST-2742	2-relay output, 230Vac 2A	0B	00 0B 00 81	C0 81 80 01
22	ST-2852	2-triac output, 120Vac 0.5A	0C	00 0C 00 81	C0 81 80 01
23	ST-3114	4-current analog input, 0~20mA, 12bit	1C	00 1C 43 41	43 C0 60 03
24	ST-3134	4-current analog input, 0~20mA, 14bit	1E	00 1E 43 41	43 C0 60 03
25	ST-3214	4-current analog input, 4~20mA, 12bit	1D	00 1D 43 41	43 C0 68 03
26	ST-3234	4-current analog input, 4~20mA, 14bit	1F	00 1F 43 41	43 C0 68 03
27	ST-3424	4-voltage analog input, 0~10V, 12bit	20	00 20 43 41	43 C0 60 03
28	ST-3444	4-voltage analog input, 0~10V, 14bit	22	00 22 43 41	43 C0 60 03
29	ST-3524	4-voltage analog input, -10~10V, 12bit	21	00 21 43 41	43 C0 60 03
30	ST-3544	4-voltage analog input, -10~10V, 14bit	23	00 23 43 41	43 C0 60 03
31	ST-3624	4-voltage analog input, 0~5V, 12bit	24	00 24 43 41	43 C0 60 03
32	ST-3644	4-voltage analog input, 0~5V, 14bit	25	00 25 43 41	43 C0 60 03
33	ST-3702	2-RTD/Resistance input	28	00 28 41 41	41 C0 68 03
34	ST-3802	2-Thermocouple/mV input	2A	00 2A 41 41	41 C0 68 03
35	ST-4112	2-current analog output, 0~20mA, 12bit	2C	00 2C 41 81	C0 41 A0 03
36	ST-4212	2-current analog output, 4~20mA, 12bit	2D	00 2D 41 81	C0 41 A0 03
37	ST-4422	2-voltage analog output, 0~10Vdc, 12bit	2E	00 2E 41 81	C0 41 A0 03
38	ST-4522	2-voltage analog output, -10~10Vdc, 12bit	2F	00 2F 41 81	C0 41 A0 03
39	ST-4622	2-voltage analog output, 0~5Vdc, 12bit	30	00 30 41 81	C0 41 A0 03
40	ST-5101	1 Channel, High Speed Counter, 5Vdc	34	34 05 01 C1	05 01 D0 03
41	ST-5111	1 Channel, High Speed Counter, 24Vdc	39	39 05 01 C1	05 01 D0 03

A.2. Digital Data Bit size Information.

: The index is can be access via SDO.

A.2.1. Input bit size information.

: All digital input data are counted.

Index	Sub-Index	Decimal Byte	Data Type	Description
0x2020	0x01	Byte 00	unsigned8	All Digital input bit size

Ex) Data Read : Id=RxSDO DLC=8; Data=40 20 20 00 xx xx xx xx

A.2.2. Output bit size information.

: All digital ouput data are counted.

Index	Sub-Index	Decimal Byte	Data Type	Description
0x2220	0x01	Byte 00	unsigned8	All Digital output bit size

Ex) Data Read : Id=RxSDO DLC=8; Data=40 20 22 00 xx xx xx xx

A.3. Special IO Data Block.

A.3.1. Special Input Block

Index	Sub-Index	Decimal Byte	Data Type	Description
0x3000	0x01	Byte 00	unsigned8	0h~7h Special input data
	0x02	Byte 01	unsigned8	8h~15h Special input data
	. . .	. . .	. . .	. . .
	0x64	Byte64	unsigned8	1F8h~1FFh Special input data

*user set PDO mapping.

A.3.2. Special Ouput Block.

Index	Sub-Index	Decimal Byte	Data Type	Description
0x3200	0x01	Byte 00	unsigned8	0h~7h Special output data
	0x02	Byte 01	unsigned8	8h~15h Special output data
	. . .	. . .	. . .	. . .
	0x64	Byte64	unsigned8	1F8h~1FFh Special output data

*user set PDO mapping.

A.4. FnBus communication register Format

: The Index 0x4500 are can be access via SDO.

A.4.1. FnBus Error monitor data format

: This object are FnBus state.

Index	Sub-Index	Decimal Byte	Data Type	Description
0x4500	0x01	Byte 00	unsgined8	FnBUS Error Code
		Byte 01	unsigend32	Error Slot number
		Byte 02	unsigend8	Reserve
		Byte 03	unsgined32	Field Power state 0x80 : not supply, 0x00 : supply

Ex) Data Read : Id=RxSDO DLC=8; Data=40 00 45 01 xx xx xx xx

A.4.2. FnBus Data Mode

: The Process Image are can be changed via this object.

Index	Sub-Index	Decimal Byte	Data Type	Description
0x4500	0x02	Byte 00	unsigned8	0 : non-compress mode
				1 : compress mode

Ex) Data Read : Id=RxSDO DLC=8; Data=40 00 45 02 xx xx xx xx
Data write : Id=RxSDO DLC=8;Data=2F 00 45 02 01 xx xx xx(compress mode set)

A.4.3. Expansion module active flag data format

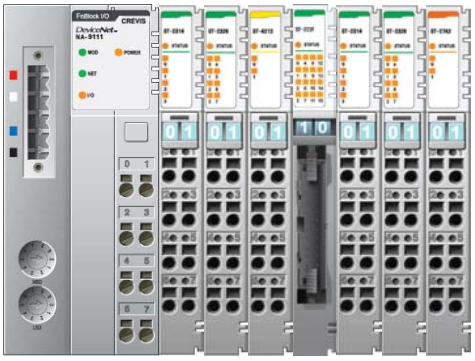
: The IO Slot are deactivated via the bit flag.

Index	Sub-Index	Data type	Decimal Bit	Description
0x4500	0x03	Unsigned32	Bit 00	Activate/Deactivate flag for slot position #1 (0:Active, 1:Deactivate)
			Bit 01	Activate/Deactivate flag for slot position #2 (0:Active, 1:Deactivate)
			Bit 03	Activate/Deactivate flag for slot position #3 (0:Active, 1:Deactivate)
			. . .	. . .
			Bit 30	Activate/Deactivate flag for slot position #31 (0:Active, 1:Deactivate)
			Bit 31	Activate/Deactivate flag for slot position #32 (0:Active, 1:Deactivate)

* bit position – IO slot poison.
Ex) Data Read : Id=RxSDO DLC=8; Data=40 00 45 03 xx xx xx xx
Data write : Id=RxSDO DLC=8;Data=2B 00 45 03 01 00 xx xx(Slot 1 Deactivated)

A.4.4. Module product code Read example

□ **For Example**



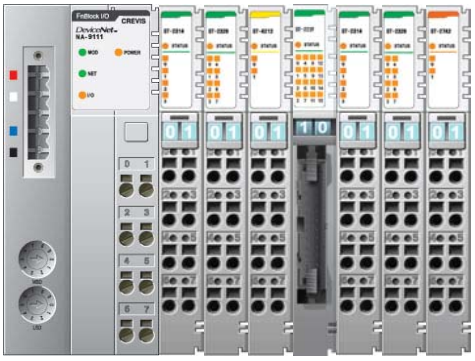
Slot Address	Module Description
0	CANopen Adapter
1	4-discrete output(ST-2424)
2	8-discrete output(ST-2318)
3	2-analog output(ST-4112)
4	16-discrete output(ST-222F)
5	4-discrete output(ST-2314)
6	8-discrete output(ST-2328)
7	2-realy output(ST-2742)

■ **Object**

Index	Sub-Index	Data	Description	SDO protocol
0x4503	0x00	07	Total expansion slot number	Id=RxSDO DLC=8; Data=40 03 45 00 xx xx xx xx
0x4503	0x01	83 83 C0 01	Slot#1 Product code	Id=RxSDO DLC=8; Data=40 03 45 01 xx xx xx xx
0x4503	0x02	C0 00 80 01	Slot#2 Product code	Id=RxSDO DLC=8; Data=40 03 45 02 xx xx xx xx
0x4503	0x03	C0 41 A0 03	Slot#3 Product code	Id=RxSDO DLC=8; Data=40 03 45 03 xx xx xx xx
0x4503	0x04	C0 01 80 01	Slot#4 Product code	Id=RxSDO DLC=8; Data=40 03 45 04 xx xx xx xx
0x4503	0x05	C0 83 80 01	Slot#5 Product code	Id=RxSDO DLC=8; Data=40 03 45 05 xx xx xx xx
0x4503	0x06	C0 00 80 01	Slot#6 Product code	Id=RxSDO DLC=8; Data=40 03 45 06 xx xx xx xx
0x4503	0x07	C0 81 80 01	Slot#7 Product code	Id=RxSDO DLC=8; Data=40 03 45 07 xx xx xx xx

A.4.5. Module Catalog code Read example

□ **For Example**



Slot Address	Module Description
0	CANopen Adapter
1	4-discrete output(ST-2424)
2	8-discrete output(ST-2318)
3	2-analog output(ST-4112)
4	16-discrete output(ST-222F)
5	4-discrete output(ST-2314)
6	8-discrete output(ST-2328)
7	2-realy output(ST-2742)

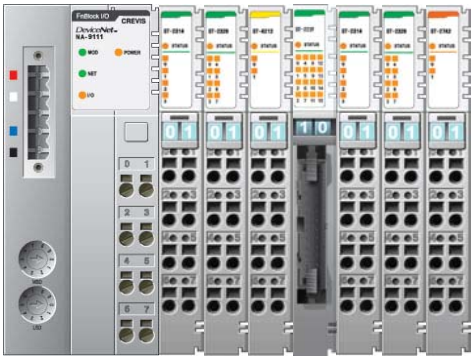
■ **object**

Index	Sub-Index	Data	Description	SDO protocol
0x4504	0x00	07	Total expansion slot number	Id=RxSDO DLC=8; Data=40 04 45 00 xx xx xx xx
0x4504	0x01	38 00 00 C1	Slot#1 Product code	Id=RxSDO DLC=8; Data=40 04 45 01 xx xx xx xx
0x4504	0x02	00 11 00 81	Slot#2 Product code	Id=RxSDO DLC=8; Data=40 04 45 02 xx xx xx xx
0x4504	0x03	00 2C 41 81	Slot#3 Product code	Id=RxSDO DLC=8; Data=40 04 45 03 xx xx xx xx
0x4504	0x04	00 16 01 81	Slot#4 Product code	Id=RxSDO DLC=8; Data=40 04 45 04 xx xx xx xx
0x4504	0x05	00 0E 00 81	Slot#5 Product code	Id=RxSDO DLC=8; Data=40 04 45 05 xx xx xx xx
0x4504	0x06	00 12 00 81	Slot#6 Product code	Id=RxSDO DLC=8; Data=40 04 45 06 xx xx xx xx
0x4504	0x07	00 0B 00 81	Slot#7 Product code	Id=RxSDO DLC=8; Data=40 04 45 07 xx xx xx xx

A.5. Configuration Parameter

A.5.1. Configuration parameter format

□ **For Example**



Slot Address	Module Description
0	CANopen Adapter
1	4-discrete output(ST-2424)
2	8-discrete output(ST-2318)
3	2-analog output(ST-4112)
4	16-discrete output(ST-222F)
5	4-discrete output(ST-2314)
6	8-discrete output(ST-2328)
7	2-realy output(ST-2742)

■ **Object**

Index	Sub-Index	Data	Description
0x4502	0x00	7	Number of entries
0x4502	0x01	Unsigned 16	Slot#1 Parameter 2 byte
0x4502	0x02	Unsigned 16	Slot#2 Parameter 2 byte
0x4502	0x03	Unsigned 48	Slot#3 Parameter 6 byte
0x4502	0x04	Unsigned 32	Slot#4 Parameter 4 byte
0x4502	0x05	Unsigned 16	Slot#5 Parameter 2 byte
0x4502	0x06	Unsigned 16	Slot#6 Parameter 2 byte
0x4502	0x07	Unsigned 16	Slot#7 Parameter 2 byte

- ex) output slot #2(ST2318) all channel setting of the hold last state.
- SDO protocol : Id=RxSDO DLC=8; Data= 2b 02 45 02 FF 00 00 00

A.5.2. ST-1214 (4-sinking input, 24Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.3. ST-1224 (4-sourcing input, 24Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.4. ST-1218 (8-sinking input, 24Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.5. ST-1228 (8-sourcing input, 24Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.6. ST-121F (16-sinking input, 24Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.7. ST-122F (16-sourcing input, 24Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.8. ST-1314 (4-sinking input, 48Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.9. ST-1324 (4-sourcing input, 48Vdc)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.10. ST-1804 (4-ac input, 110Vac)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.11. ST-1904 (4-ac input, 220Vac)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.12. ST-2314 (4-sinking output, 24Vdc 0.5A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-03	Fault Action (ch0~ch3) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		04-07	Reserved	0
1	R/W	00-03	Fault Value (ch0~ch3) 0: off, 1: on	0 (off)
		04-07	Reserved	0

A.5.13. ST-2324 (4-sourcing output, 24Vdc 0.5A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-03	Fault Action (ch0~ch3) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		04-07	Reserved	0
1	R/W	00-03	Fault Value (ch0~ch3) 0: off, 1: on	0 (off)
		04-07	Reserved	0

A.5.14. ST-2318 (8-sinking output, 24Vdc 0.5A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-07	Fault Action (ch0~ch7) 0: Fault Value, 1: Hold last state	0 (Fault Value)
1	R/W	00-07	Fault Value (ch0~ch7) 0: off, 1: on	0 (off)

A.5.15. ST-2328 (8-sourcing output, 24Vdc 0.5A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-07	Fault Action (ch0~ch7) 0: Fault Value, 1: Hold last state	0 (Fault Value)
1	R/W	00-07	Fault Value (ch0~ch7) 0: off, 1: on	0 (off)

A.5.16. ST-221F (16-sinking output, 24Vdc 0.1A)

- Parameter length: 4 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-07	Fault Action (ch0~ch7) 0: Fault Value, 1: Hold last state	0 (Fault Value)
1	R/W	00-07	Fault Action (ch8~ch15) 0: Fault Value, 1: Hold last state	0 (Fault Value)
2	R/W	00-07	Fault Value (ch0~ch7) 0: off, 1: on	0 (off)
3	R/W	00-07	Fault Value (ch8~ch15) 0: off, 1: on	0 (off)

A.5.17. ST-222F (16-sourcing output, 24Vdc 0.1A)

- Parameter length: 4 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-07	Fault Action (ch0~ch7) 0: Fault Value, 1: Hold last state	0 (Fault Value)
1	R/W	00-07	Fault Action (ch8~ch15) 0: Fault Value, 1: Hold last state	0 (Fault Value)
2	R/W	00-07	Fault Value (ch0~ch7) 0: off, 1: on	0 (off)
3	R/W	00-07	Fault Value (ch8~ch15) 0: off, 1: on	0 (off)

A.5.18. ST-2414 (4-sinking output, Diag, 24Vdc 0.5A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-03	Fault Action (ch0~ch3) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		04-07	Reserved	0
1	R/W	00-03	Fault Value (ch0~ch3) 0: off, 1: on	0 (off)
		04-07	Reserved	0

A.5.19. ST-2424 (4-sourcing output, Diag, 24Vdc 0.5A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-03	Fault Action (ch0~ch3) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		04-07	Reserved	0
1	R/W	00-03	Fault Value (ch0~ch3) 0: off, 1: on	0 (off)
		04-07	Reserved	0

A.5.20. ST-2514 (4-sinking output, Diag, 24Vdc 2A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-03	Fault Action (ch0~ch3) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		04-07	Reserved	0
1	R/W	00-03	Fault Value (ch0~ch3) 0: off, 1: on	0 (off)
		04-07	Reserved	0

A.5.21. ST-2524 (4-sourcing output, Diag, 24Vdc 2A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00-03	Fault Action (ch0~ch3) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		04-07	Reserved	0
1	R/W	00-03	Fault Value (ch0~ch3) 0: off, 1: on	0 (off)
		04-07	Reserved	0

A.5.22. ST-2742 (2-relay output, 230Vac 2A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00, 01	Fault Action (ch0, ch1) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		02-07	Reserved	0
1	R/W	00, 01	Fault Value (ch0, ch1) 0: off, 1: on	0 (off)
		02-07	Reserved	0

A.5.23. ST-2852 (2-triac output, 120Vac 0.5A)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Access	Decimal Bit	Description	Default Value
0	R/W	00, 01	Fault Action (ch0, ch1) 0: Fault Value, 1: Hold last state	0 (Fault Value)
		02-07	Reserved	0
1	R/W	00, 01	Fault Value (ch0, ch1) 0: off, 1: on	0 (off)
		02-07	Reserved	0

A.5.24. ST-3114 (4-current analog input, 0~20mA, 12bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.25. ST-3134 (4-current analog input, 0~20mA, 14bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.26. ST-3214 (4-current analog input, 4~20mA, 12bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.27. ST-3234 (4-current analog input, 4~20mA, 14bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.28. ST-3424 (4-voltage analog input, 0~10V, 12bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.29. ST-3444 (4-voltage analog input, 0~10V, 14bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.30. ST-3524 (4-voltage analog input, -10~10V, 12bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.31. ST-3544 (4-voltage analog input, -10~10V, 14bit)

- Parameter length: 0 bytes
- Parameter Data: none

A.5.32. ST-3624 (4-voltage analog input, 0~5V, 12bit)

- Valid Parameter length: 0 bytes
- Parameter Data: none.

A.5.33. ST-3644 (4-voltage analog input, 0~5V, 14bit)

- Valid Parameter length: 0 bytes
- Parameter Data: none.

A.5.34. ST-3702 (2-RTD input)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Decimal Bit	Description	Default Value
0	00-07	The selection **Sensor Type** =00h:PT100, 0.00385, -200~850°C, 0.1°C /count =01h:PT200, 0.00385, -200~850°C, 0.1°C/count =02h:PT500, 0.00385, -200~850°C, 0.1°C/count =03h:PT1000, 0.00385, -200~350°C, 0.1°C/count =04h:PT50, 0.00385, -200~850°C, 0.1°C/count =10h:JPT100, 0.003916, -200~640°C, 0.1°C/count =11h:JPT200, 0.003916, -200~640°C, 0.1°C/count =12h:JPT500, 0.003916, -200~640°C, 0.1°C/count =13h:JPT1000, 0.003916, -200~350°C, 0.1°C/count =20h:NI100, 0.00618, -60~250°C, 0.1°C/count =21h:NI200, 0.00618, -60~250°C, 0.1°C/count =22h:NI500, 0.00618, -60~250°C, 0.1°C/count =23h:NI1000, 0.00618, -60~180°C, 0.1°C/count =30h:NI120, 0.00672, -80~250°C, 0.1°C/count =40h:CU10, 0.00427, -200~260°C, 0.1°C/count =80h:Resistance Input, 1~2000Ω, 100mΩ /1count =81h: Resistance Input, 1~327Ω, 10mΩ/1count =82h: Resistance Input, 1~620Ω, 20mΩ/1count =Others: Reserved	0: PT100
1	00	Temperature Type 0: Celsius(°C), 1: Fahrenheit(°F)	0: Celsius(°C)
	01-03	Reserved	0
	04	Filter Type 0: Normal Filter, 1: Enhanced Filter	0: Normal Filter
	05-07	Reserved	0
2	00-07	Not used	0
3	00-07	Not used	0
4	00-07	Not used	0
5	00-07	Not used	0
6	00-07	Not used	0
7	00-07	Not used	0

A.5.35. ST-3802 (2-thermocouple input)

- Parameter length: 2 bytes
- Parameter Data:

Offset	Decimal Bit	Description	Default Value
0	00-07	The selection **Sensor Type** =00h: Type K, 0.1°C/count =01h: Type J, 0.1°C/count =02h: Type T, 0.1°C/count =03h: Type B, 0.1°C/count =04h: Type R, 0.1°C/count =05h: Type S, 0.1°C/count =06h: Type E, 0.1°C/count =07h: Type N, 0.1°C/count =08h: Type L, 0.1°C/count =09h: Type U, 0.1°C/count =0Ah: Type C, 0.1°C/count =0Bh: Type D, 0.1°C/count =80h: 10uV Input, -78.0~78.0mV, 10uV/count =81h: 1uV Input, -32.7~32.7mV, 1uV/count =82h: 2uV Input, -65.5~65.5mV, 2uV/count =Others: Reserved	0: Type K
1	00	Temperature Type 0: Celsius(°C), 1: Fahrenheit(°F)	0: Celsius(°C)
	01	0: Cold Junction Compensation 1: Disable Compensation	0
	02, 03	Reserved	0
	04	Filter Type 0: Normal Filter, 1: Enhanced Filter	0: Normal Filter
	05-07	Reserved	0
2	00-07	Not used	0
3	00-07	Not used	0
4	00-07	Not used	0
5	00-07	Not used	0
6	00-07	Not used	0
7	00-07	Not used	0

A.5.36. ST-4112 (2-current analog output, 0~20mA, 12bit)

A.5.37. ST-4212 (2-current analog output, 4~20mA, 12bit)

A.5.38. ST-4422 (2-voltage analog output, 0~10Vdc, 12bit)

A.5.39. ST-4522 (2-voltage analog output, -10~10Vdc, 12bit)

A.5.40. ST-4622 (2-voltage analog output, 0~5Vdc, 12bit)

- Valid Parameter length: 6 bytes
- Parameter Data:

Offset	Decimal Bit	Description	Default Value
0	00-01	Fault Action for channel 0 00: Fault Value, 01: Hold last state, 10: Low Limit, 11:High Limit	0 (Fault Value)
	02-03	Fault Action for channel 0 00: Fault Value, 01: Hold last state, 10: Low Limit, 11:High Limit	0 (Fault Value)
	04-07	Reserved	0
1	00-07	Reserved	0
2	00-07	Channel 0 Fault Value Low Byte	0
3	00-03	Channel 0 Fault Value High Byte	0
	04-07	Reserved	0
4	00-07	Channel 1 Fault Value Low Byte	0
5	00-03	Channel 1 Fault Value High Byte	0
	04-07	Reserved	0
6	00-07	Not used	0
7	00-07	Not used	0

A.5.41. ST-5101 (1 Channel High Speed Counter 5Vdc)

A.5.42. ST-5111(1 Channel High Speed Counter 24Vdc)

- Valid Parameter length: 6 bytes
- Parameter Data:

Offset	Decimal Bit	Description	Default Value
0	00-03	Counter Mode	0
	04-07	Gate Function	0
1	00-03	Input Filter	0
	04-07	Gate Sampling Time	0
2	00-07	Not used	0
3	00-07	Not used	0
4	00-07	Not used	0
5	00-07	Not used	0
6	00-07	Not used	0
7	00-07	Not used	0

A.6. Memory Register

A.6.1. Memory Register data format

□ **Write Data Format**

Byte 00	Byte 01	Byte 02	Byte 03	Byte 04	Byte n
Offset low	Offset high	Length	Data	…	Data

- □ Index Write Data memory Register object(0x2200)
- □ Sub-Index Number of Expansion slot(0~0x20)
- □ Offset Write Start address(low + high)
- □ Length Size of write memory data(byte)
- □ Data 0 to length-1

□ **Read Data Request #1**

Byte	Byte	Byte	Byte	Byte	Byte	Byte	Byte
Access	Index		Sub-inex	Offset low	Offset high	Length	Reserve

- □ Access SDO read request(0x40)
- □ Index Read Data memory Register object(0x2000)
- □ Sub-Index Number of Expansion slot(0~0x20)
- □ Offset Read Start address(low + high)
- □ Length Size of read memory data(byte)

□ **Read Data Request #2**

□ **Write read memory size**

Byte	Byte	Byte	Byte	Byte	Byte	Byte	Byte
Access	Index		Sub-inex	Offset low	Offset high	Length	00

- □ Access SDO write request(0x23)
- □ Index Read Data memory Register object(0x4501)
- □ Sub-Index Number of Expansion slot(0~0x20)
- □ Offset Start address(low + high)
- □ Length Size of Read data(byte)

□ **Read memory**

Byte	Byte	Byte	Byte	Byte	Byte	Byte	Byte
Access	Index		Sub-inex	Reserve	Reserve	Reserve	Reserve

- □ Index Read Data memory Register object(0x2000)
- □ Sub-Index Number of Expansion slot(0~0x20)
- □ If Index 0x4501 parameters are all '0', can see All Data.

A.6.2. ST-1214 (4-sinking input, 24Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.3. ST-1224 (4-sourcing input, 24Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.4. ST-1218 (8-sinking input, 24Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.5. ST-1228 (8-sourcing input, 24Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.6. ST-121F (16-sinking input, 24Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.7. ST-122F (16-sourcing input, 24Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.8. ST-1314 (4-sinking input, 48Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.9. ST-1324 (4-sourcing input, 48Vdc)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.10. ST-1804 (4-ac input, 110Vac)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.11. ST-1904 (4-ac input, 220Vac)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.12. ST-2314 (4-sinking output, 24Vdc 0.5A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.13. ST-2324 (4-sourcing output, 24Vdc 0.5A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.14. ST-2318 (8-sinking output, 24Vdc 0.5A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.15. ST-2328 (8-sourcing output, 24Vdc 0.5A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.16. ST-221F (16-sinking output, 24Vdc 0.1A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.17. ST-222F (16-sourcing output, 24Vdc 0.1A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.18. ST-2414 (4-sinking output, Diag, 24Vdc 0.5A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.19. ST-2424 (4-sourcing output, Diag, 24Vdc 0.5A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.20. ST-2514 (4-sinking output, Diag, 24Vdc 2A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.21. ST-2524 (4-sourcing output, Diag, 24Vdc 2A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.22. ST-2742 (2-relay output, 230Vac 2A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.23. ST-2852 (2-triac output, 120Vac 0.5A)

- ☐ Memory Register length: 0 bytes
- ☐ Memory Register: none

A.6.24. ST-3114 (4-current analog input, 0~20mA, 12bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-03	Channel 0 Input Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-03	Channel 1 Input Data High 4 bits	
		04-07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-03	Channel 2 Input Data High 4 bits	
		04-07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-03	Channel 3 Input Data High 4 bits	
		04-07	not used	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.25. ST-3134 (4-current analog input, 0~20mA, 14bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-05	Channel 0 Input Data High 6 bits	
		06, 07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-05	Channel 1 Input Data High 6 bits	
		06, 07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-05	Channel 2 Input Data High 6 bits	
		06, 07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-05	Channel 3 Input Data High 6 bits	
		06, 07	not used	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.26. ST-3214 (4-current analog input, 4~20mA, 12bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-03	Channel 0 Input Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-03	Channel 1 Input Data High 4 bits	
		04-07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-03	Channel 2 Input Data High 4 bits	
		04-07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-03	Channel 3 Input Data High 4 bits	
		04-07	not used	0
8	R	00-03	Alarm Status Bit for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on. When set(1), the input signal is below the input channel's minimum range(3mA). And Input Data will be 0x8000(-32678)	
		04-07	Reserved	0
9	R	00-07	Reserved	0

A.6.27. ST-3234 (4-current analog input, 4~20mA, 14bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-05	Channel 0 Input Data High 6 bits	
		06, 07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-05	Channel 1 Input Data High 6 bits	
		06, 07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-05	Channel 2 Input Data High 6 bits	
		06, 07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-05	Channel 3 Input Data High 6 bits	
		06, 07	not used	0
8	R	00-03	Alarm Status Bit for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on. When set(1), the input signal is below the input channel's minimum range(3mA). And Input Data will be 0x8000(-32678)	
		04-07	Reserved	0
9	R	00-07	Reserved	0

A.6.28. ST-3424 (4-voltage analog input, 0~10V, 12bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-03	Channel 0 Input Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-03	Channel 1 Input Data High 4 bits	
		04-07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-03	Channel 2 Input Data High 4 bits	
		04-07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-03	Channel 3 Input Data High 4 bits	
		04-07	not used	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.29. ST-3444 (4-voltage analog input, 0~10V, 14bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-05	Channel 0 Input Data High 6 bits	
		06, 07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-05	Channel 1 Input Data High 6 bits	
		06, 07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-05	Channel 2 Input Data High 6 bits	
		06, 07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-05	Channel 3 Input Data High 6 bits	
		06, 07	not used	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.30. ST-3524 (4-voltage analog input, -10~10V, 12bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-06	Channel 0 Input Data High 7 bits	
		07	Sign Bit	
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-06	Channel 1 Input Data High 7 bits	
		07	Sign Bit	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-06	Channel 2 Input Data High 7 bits	
		07	Sign Bit	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-06	Channel 3 Input Data High 7 bits	
		07	Sign Bit	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.31. ST-3544 (4-voltage analog input, -10~10V, 14bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-06	Channel 0 Input Data High 7 bits	
		07	Sign Bit	
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-06	Channel 1 Input Data High 7 bits	
		07	Sign Bit	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-06	Channel 2 Input Data High 7 bits	
		07	Sign Bit	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-06	Channel 3 Input Data High 7 bits	
		07	Sign Bit	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.32. ST-3624 (4-voltage analog input, 0~5V, 12bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-03	Channel 0 Input Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-03	Channel 1 Input Data High 4 bits	
		04-07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-03	Channel 2 Input Data High 4 bits	
		04-07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-03	Channel 3 Input Data High 4 bits	
		04-07	not used	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.33. ST-3644 (4-voltage analog input, 0~5V, 14bit)

- Memory Register length: 10 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-05	Channel 0 Input Data High 6 bits	
		06, 07	not used	0
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-05	Channel 1 Input Data High 6 bits	
		06, 07	not used	0
4	R	00-07	Channel 2 Input Data Low 8 bits	
5	R	00-05	Channel 2 Input Data High 6 bits	
		06, 07	not used	0
6	R	00-07	Channel 3 Input Data Low 8 bits	
7	R	00-05	Channel 3 Input Data High 6 bits	
		06, 07	not used	0
8	R	00-07	Reserved	0
9	R	00-07	Reserved	0

A.6.34. ST-3702 (2-RTD input)

- Memory Register length: 8 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-06	Channel 0 Input Data High 7 bits	
		07	Sign Bit	
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-06	Channel 1 Input Data High 7 bits	
		07	Sign Bit	
4	R/W	00-07	Sensor Type (same as A.3.31)	0
5	R/W	00-07	Temperature Type (same as A.3.31)	0
6	R	00, 01	Alarm Status Bit for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1. When set(1), the input signal is below the input channel's minimum range or above the input channel's maximum range. And Input Data will be 0x8000(-32678)	
		02-07	Reserved	0
7	R	00-07	Reserved	

* Offset 4,5: All values are not stored in DeviceNet Adapter's EEPROM.

A.6.35. ST-3802 (2-thermocouple input)

- Memory Register length: 12 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Input Data Low 8 bits	
1	R	00-06	Channel 0 Input Data High 7 bits	
		07	Sign Bit	
2	R	00-07	Channel 1 Input Data Low 8 bits	
3	R	00-06	Channel 1 Input Data High 7 bits	
		07	Sign Bit	
4	R/W	00-07	Sensor Type (same as A.3.32)	0
5	R/W	00-07	Temperature Type (same as A.3.32)	0
6	R	00, 01	Alarm Status Bit for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1. When set(1), the input signal is below the input channel's minimum range or above the input channel's maximum range. And Input Data will be 0x8000(-32678)	
		02-07	Reserved	0
7	R	00, 01	Burn-Out Bit for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1. When set(1), the input channel is burn-out. And Input Data will be 0x8000(-32678)	
		02-07	Reserved	0
8	R	00-07	Cold Junction Low 8 bits	
9	R	00-07	Cold Junction High 8 bits	
10	R/W	00-07	Cold Junction Offset Low 8 bits	
11	R/W	00-07	Cold Junction Offset High 8 bits	

* Offset 4,5,10,11: All values are not stored in DeviceNet Adapter's EEPROM.

A.6.36. ST-4112 (2-current analog output, 0~20mA, 12bit)

- Memory Register length: 12 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Output Data Low 8 bits	
1	R	00-03	Channel 0 Output Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Output Data Low 8 bits	
3	R	00-03	Channel 1 Output Data High 4 bits	
		04-07	not used	0
4	R	00-07	Reserved	0
5	R	00-07	Reserved	0
6	R/W	00-07	Fault Action (Same as A.3.22)	0
7	R/W	00-07	Reserved	0
8	R/W	00-07	Channel 0 Fault Value Low Byte (Same as A.3.33)	0
9	R/W	00-07	Channel 0 Fault Value High Byte (Same as A.3.33)	0
10	R/W	00-07	Channel 1 Fault Value Low Byte (Same as A.3.33)	0
11	R/W	00-07	Channel 1 Fault Value High Byte (Same as A.3.33)	0

* Offset 6-11: All values are not stored in DeviceNet Adapter's EEPROM.

A.6.37. ST-4212 (2-current analog output, 4~20mA, 12bit)

- Memory Register length: 12 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Output Data Low 8 bits	
1	R	00-03	Channel 0 Output Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Output Data Low 8 bits	
3	R	00-03	Channel 1 Output Data High 4 bits	
		04-07	not used	0
4	R	00-07	Reserved	0
5	R	00-07	Reserved	0
6	R/W	00-07	Fault Action (Same as A.3.22)	0
7	R/W	00-07	Reserved	0
8	R/W	00-07	Channel 0 Fault Value Low Byte (Same as A.3.34)	0
9	R/W	00-07	Channel 0 Fault Value High Byte (Same as A.3.34)	0
10	R/W	00-07	Channel 1 Fault Value Low Byte (Same as A.3.34)	0
11	R/W	00-07	Channel 1 Fault Value High Byte (Same as A.3.34)	0

* Offset 6-11: All values are not stored in DeviceNet Adapter's EEPROM.

A.6.38. ST-4422 (2-voltage analog output, 0~10Vdc, 12bit)

- Memory Register length: 12 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Output Data Low 8 bits	
1	R	00-03	Channel 0 Output Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Output Data Low 8 bits	
3	R	00-03	Channel 1 Output Data High 4 bits	
		04-07	not used	0
4	R	00-07	Reserved	0
5	R	00-07	Reserved	0
6	R/W	00-07	Fault Action (Same as A.3.22)	0
7	R/W	00-07	Reserved	0
8	R/W	00-07	Channel 0 Fault Value Low Byte (Same as A.3.35)	0
9	R/W	00-07	Channel 0 Fault Value High Byte (Same as A.3.35)	0
10	R/W	00-07	Channel 1 Fault Value Low Byte (Same as A.3.35)	0
11	R/W	00-07	Channel 1 Fault Value High Byte (Same as A.3.35)	0

* Offset 6-11: All values are not stored in DeviceNet Adapter's EEPROM.

A.6.39. ST-4522 (2-voltage analog output, -10~10Vdc, 12bit)

- Memory Register length: 12 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Output Data Low 8 bits	
1	R	00-03	Channel 0 Output Data High 4 bits	
		04-07	not used	0
2	R	00-07	Channel 1 Output Data Low 8 bits	
3	R	00-03	Channel 1 Output Data High 4 bits	
		04-07	not used	0
4	R	00-07	Reserved	0
5	R	00-07	Reserved	0
6	R/W	00-07	Fault Action (Same as A.3.22)	0
7	R/W	00-07	Reserved	0
8	R/W	00-07	Channel 0 Fault Value Low Byte (Same as A.3.36)	0
9	R/W	00-07	Channel 0 Fault Value High Byte (Same as A.3.36)	0
10	R/W	00-07	Channel 1 Fault Value Low Byte (Same as A.3.36)	0
11	R/W	00-07	Channel 1 Fault Value High Byte (Same as A.3.36)	0

* Offset 6-11: All values are not stored in DeviceNet Adapter's EEPROM.

A.6.40. ST-4622 (2-voltage analog output, 0~5Vdc, 12bit)

- Memory Register length: 12 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Channel 0 Output Data Low 8 bits	0
1	R	00-03	Channel 0 Output Data High 4 bits	0
		04-07	not used	0
2	R	00-07	Channel 1 Output Data Low 8 bits	0
3	R	00-03	Channel 1 Output Data High 4 bits	0
		04-07	not used	0
4	R	00-07	Reserved	0
5	R	00-07	Reserved	0
6	R/W	00-07	Fault Action (Same as A.3.35)	0
7	R/W	00-07	Reserved	0
8	R/W	00-07	Channel 0 Fault Value Low Byte (Same as A.3.35)	0
9	R/W	00-07	Channel 0 Fault Value High Byte (Same as A.3.35)	0
10	R/W	00-07	Channel 1 Fault Value Low Byte (Same as A.3.35)	0
11	R/W	00-07	Channel 1 Fault Value High Byte (Same as A.3.35)	0

* Offset 6-11: All values are not stored in Adapter's EEPROM.

A.6.41. ST-5101 (1 Channel High Speed Counter 5Vdc)

A.6.42. ST-5111 (1 Channel High Speed Counter 24Vdc)

- Memory Register length: 24 bytes
- Memory Register:

Offset	Access	Decimal Bit	Description	Default Value
0	R	00-07	Current count value Low byte	0
1	R	00-07	Current count value Middle byte	0
2	R	00-07	Current count value High byte	0
3	R	00-07	Always 0	0
4	R	00-07	Status Low (compared flags)	0
5	R	00-07	Status High (same as LED display)	0
6	R	00-07	Output Terminal (OT) Control	0
7	R	00-07	SSR(Special Selection Register)	0
8	R/W	00-07	Gate Function/Counter Mode (Same as A.3.36)	0
9	R/W	00-07	Gate Sampling Time/Input Filter (Same as A.3.36)	0
10	R/W	00-07	Don't care	0
11	R/W	00-07	Don't care	0
12	R	00-07	Stored count value Low byte	0
13	R	00-07	Stored count value Middle byte	0
14	R	00-07	Stored count value High byte	0
15	R	00-07	Always 0	0
16	R/W	00-07	Initial Counter Value Low byte (Initial counter or PWM Frequency value)	0
17	R/W	00-07	Initial Counter Value Middle byte (Initial counter or PWM Frequency value)	0
18	R/W	00-07	Initial count value High byte (Initial counter or PWM Frequency value)	0
19	R/W	00-07	Always 0	0
20	R/W	00-07	Compare count value Low byte	0
21	R/W	00-07	Compare count value Middle byte	0
22	R/W	00-07	Compare count value High byte	0
23	R/W	00-07	Always 0	0

* Offset 8-9: All values are not stored in Adapter's EEPROM.

APENDIX B

B. 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 [ ]**	**Baudrate [Kbit/s]**
	Length-related Resistance [m /m]	**Cross-section [mm2]**		
0 ... 40	70	0.25 … 0.34	124	1000 at 40m
40 … 300	< 60	0.34 … 0.6	150 … 300	> 500 at 100m
300 ... 600	< 40	0.5 ... 0.6	150 ... 300	> 100 at 500 m
600 ... 1000	< 26	0.75 ... 0.8	150 ... 300	> 50 at 1 km

(1) Recommended cable AC parameters: 120- impedance and 5-ns/m specific line delay

For drop cables a wire cross-section of 0.25 to 0.34 mm2 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 transmission resistance of one connector should be in the range of 2.5 to 10 m .

With the assumed values for

minimum dominant value $V_{diff.out.min} = 1.5$ V

minimum differential input resistance $R_{diff.min} = 20$ k

requested differential input voltage $V_{th.max} = 1.0$ V

minimum termination resistance $R_{T.min} = 118$

The maximum wiring length is given for different bus cables and different number of connected bus nodes in the following table.

Wire cross-Section [mm2]	**Maximum length [m] (1)**			**Maximum length [m] (2)**		
	n = 32	**n = 64**	**n = 100**	**n = 32**	**n = 64**	**n = 100**
0.25	200	170	150	230	200	170
0.5	360	310	270	420	360	320
0.75	550	470	410	640	550	480

(1) safety margin of 0.2 (2) safety margin of 0.1

Note: If driving more than 64 nodes and/or more than 250 m bus length the accuracy of the V_{CC} supply voltage for the ISO 11898 transceiver is recommended to be 5% or better. You also have to consider the minimum supply voltage of at least 4.75V when driving 50 load, i.e. 64 bus nodes, and at least 4.9V when driving 45 load, i.e. 100 bus nodes.