DVPCOPM-SL

CANopen Communication Module

Operation Manual

http://www.delta.com.tw/industrialautomation

DVP-0204420-03

⚠ Warning

- ✓ *This manual provides functional specifications, installation, basic operations and settings, and introduction of relevant network protocols.*
- ✓ *DVPCOPM-SL is an OPEN TYPE device and therefore should be installed in an enclosure free of airborne dust, humidity, electric shock and vibration. The enclosure should prevent non-maintenance staff from operating the device (e.g. key or specific tools are required for operating the enclosure) in case danger and damage on the device may occur. DO NOT touch any terminals when power ON.*
- ✓ *Please read this manual carefully before use and follow this manual to operate the device in order to prevent damages on the device or injuries to staff.*

🕮 Table of Contents

1 Introduction

1. To ensure correct installation and operation of DVPCOPM-SL, please read this chapter carefully before using your DVPCOPM-SL.
2. This chapter only provides introductory information on DVPCOPM-SL. For more detailed information on CANopen protocol, please refer to relevant references or literatures.
3. DVPCOPM-SL is a CANopen module operating on the left side of the PLC. The PLC can have a maximum of 8 DVPCOPM-SL modules connected to its left side. DVPCOPM-SL master module is responsible for the data exchange between the PLC and other slaves on the bus when the PLC is connected to the CANopen network via DVPCOPM-SL. To achieve data exchange, DVPCOPM-SL master module is used for transmitting the data in PLC to slaves on the bus and meanwhile returns the data in slaves to the PLC.
4. The PLC connected to the right side of DVPCOPM-SL includes DVP-28SV, DVP-SX2, DVP-EH2-L, DVP-SV3 and DVP-SX3.

1.1 Features

DVPCOPM-SL can be used as the master in CANopen network, as well as the slave for other masters.

As a master, DVPCOPM-SL features:

- Complying with CANopen standard protocol DS301v4.02.
- Supporting NMT Master Service.
- Error control: Supporting Heartbeat/Node Guarding Protocol.
- Supporting PDO Service.

  Max. 200 RxPDOs and 390 bytes of data

  Max. 200 TxPDOs and 390 bytes of data

  Each slave can be allocated maximum 8 TxPDOs and 8 RxPDOs.

  PDO transmission type: Supporting event trigger, time trigger, synchronous cycle, and synchronous non-cycle.

  PDO mapping: Every PDO is able to map maximum 32 parameters.

  Type of mapping data supported:

Storage space	Data type
1 bit	BOOL
8 bits	SINT USINT BYTE
16 bits	INT UINT WORD
32 bits	DINT UDINT REAL DWORD
64 bits	LINT ULINT LREAL LWORD

- Supporting SDO Service.

  Number of server: 0

  Number of user: 3

  Supporting standard expedited SDO transmission mode.

  Supporting Auto SDO function. Able to execute maximum 20 Auto SDOs to each slave.

  Supporting reading/writing of data in slave by using SDO Service in the ladder diagram in PLC.
- Supporting Emergency Protocol:

  Able to store 5 latest Emergency messages for each slave.

Able to indicate Emergency messages in slave from digital display.

Able to read Emergency message through the ladder diagram in PLC.

- SYNC producer; Range: 0 ~ 65,535ms.
- As the interface between Delta CANopen Builder software and CANopen network. The software can configure the network directly through DVPCOPM-SL.
- Automatically in data exchange with the PLC. Users only need to edit a program for D registers mapped in the PLC without using From and To instructions when programming. When DVPCOPM-SL is connected to the PLC which is DVP-28SV, DVP-SX2 or DVP-EH2-L, the registers D6000~D9999 are occupied. When DVPCOPM-SL is connected to the PLC which is DVP-SV3 or DVP-SX3, the registers D16000~D19999 are occupied.

As a slave, DVPCOPM-SL features:

- Complying with CANopen standard protocol DS301v4.02
- Supporting NMT Slave Service
- Error control: Supporting Heartbeat Protocol
- Supporting PDO Service: Each slave can be allocated maximum 8 TxPDOs and 8 RxPDOs.
- PDO transmission type: Supporting event trigger, time trigger, synchronous cycle, synchronous non-cycle.
- Supporting SDO Service.

  Number of server: 1

  Number of user: 0

  Supporting standard expedited SDO transmission mode.
- Supporting Emergency Protocol.

  Able to indicate Emergency event in the slave through digital display.

1.2 Functions

■ CANopen connection

Item	Specificatioin
Transmission method	CAN
Electrical isolation	500VDC
Interface	Removable connector (5.08mm)
Transmission cable	2-wire twister shielded cable with 2-wire bus power and drain

■ Communication

Item	Specificatioin
Message type	PDO, SDO, SYNC (synchronous object), Emergency (Emergency object), NMT
Baud rate	10k, 20k, 50k, 125k, 250k, 500k, 800k, 1M bps (bit/sec)

■ Electrical specification

Item	Specificatioin
Power voltage	24VDC, supplied by internal bus from PLC CPU (-15% ~ 20%)
Power consumption	1.7W
Isolation voltage	500V

- Environment

Item	Specificatioin
Noise immunity	ESD (IEC 61131-2, IEC 61000-4-2): 8KV Air Discharge, 4KV Contact Discharge EFT (IEC 61131-2, IEC 61000-4-4): Power Line: 2KV, Digital I/O: 1KV Analog & Communication I/O: 1KV Damped-Oscillatory Wave: Power Line: 1KV, Digital I/O: 1KV RS (IEC 61131-2, IEC 61000-4-3): 80MHz ~ 1,000MHz, 1.4GHz ~ 2.0GHz, 10V/m
Operation	0ºC ~ 55ºC (temperature); 50 ~ 95% (humidity); pollution degree 2
Storage	-25ºC ~ 70ºC (temperature); 5 ~ 95% (humidity)
Shock/vibration immunity	International standard: IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Certificates	IEC 61131-2, UL508

1.3 Input and Output Mapping Areas for DVPCOPM-SL

- When DVPCOPM-SL serves as CANopen master, the input and output mapping areas are described as below.
  - When the PLC is DVP-28SV, DVP-SX2 and DVP-EH2-L, the input and output mapping areas for different positions of the left side of the PLC are shown in the table below. The position of the first one on the left of the PLC is 1, the second one is 2, and so on.

Mapping Area / Position	Output Mapping Area	Input Mapping Area
1	D6250~D6476	D6000~D6226
2	D6750~D6976	D6500~D6726
3	D7250~D7476	D7000~D7226
4	D7750~D7976	D7500~D7726
5	D8250~D8476	D8000~D8226
6	D8750~D8976	D8500~D8726
7	D9250~D9476	D9000~D9226
8	D9750~D9976	D9500~D9726

  - When the PLC is DVP-SV3 and DVP-SX3, the input and output mapping areas for different positions of the left side of the PLC are shown in the table below. The position of the first one on the left of the PLC is 1, the second one is 2, and so on.

Mapping Area / Position	Output Mapping Area	Input Mapping Area
1	D16250~D16476	D16000~D16226
2	D16750~D16976	D16500~D16726
3	D17250~D17476	D17000~D17226
4	D17750~D17976	D17500~D17726
5	D18250~D18476	D18000~D18226
6	D18750~D18976	D18500~D18726

Mapping Area / Position	Output Mapping Area	Input Mapping Area
7	D19250~D19476	D19000~D19226
8	D19750~D19976	D19500~D19726

- When DVPCOPM-SL serves as CANopen master, the request message areas and response message areas of SDO, NMT and Emergency, and PDO mapping areas are described as below.
  - When the PLC is DVP-28SV, DVP-SX2 and DVP-EH2-L, the request message areas and response message areas of SDO, NMT and Emergency, and PDO mapping areas for different positions of the left side of the PLC are shown in the table below. The position of the first one on the left of the PLC is 1, the second one is 2, and so on.

Mapping area / Position	Request Message Area of SDO, NMT, Emergency	Response Message Area of SDO, NMT, Emergency	RxPDO Mapping Area	TxPDO Mapping Area
1	D6250~D6281	D6000~D6031	D6282~D6476	D6032~D6226
2	D6750~D6781	D6500~D6531	D6782~D6976	D6532~D6726
3	D7250~D7281	D7000~D7031	D7282~D7476	D7032~D7226
4	D7750~D7781	D7500~D7531	D7782~D7976	D7532~D7726
5	D8250~D8281	D8000~D8031	D8282~D8476	D8032~D8226
6	D8750~D8781	D8500~D8531	D8782~D8976	D8532~D8726
7	D9250~D9281	D9000~D9031	D9282~D9476	D9032~D9226
8	D9750~D9781	D9500~D9531	D9782~D9976	D9532~D9726

  - When the PLC is DVP-SV3 and DVP-SX3, the request message areas and response message areas of SDO, NMT and Emergency, and PDO mapping areas for different positions of the left side of the PLC are shown in the table below. The position of the first one on the left of the PLC is 1, the second one is 2, and so on.

Mapping area / Position	Request Message Area of SDO, NMT, Emergency	Response Message Area of SDO, NMT, Emergency	RxPDO Mapping Area	TxPDO Mapping Area
1	D16250~D16281	D16000~D16031	D16282~D16476	D16032~D16226
2	D16750~D16781	D16500~D16531	D16782~D16976	D16532~D16726
3	D17250~D17281	D17000~D17031	D17282~D17476	D17032~D17226
4	D17750~D17781	D17500~D17531	D17782~D17976	D17532~D17726
5	D18250~D18281	D18000~D18031	D18282~D18476	D18032~D18226
6	D18750~D18781	D18500~D18531	D18782~D18976	D18532~D18726
7	D19250~D19281	D19000~D19031	D19282~D19476	D19032~D19226
8	D19750~D19781	D19500~D19531	D19782~D19976	D19532~D19726

- When DVPCOPM-SL serves as CANopen slave, the input and output mapping areas for different positions of the left side of the PLC are as below.
  - When the PLC is DVP-28SV, DVP-SX2 and DVP-EH2-L, the input and output mapping areas for different positions of the left side of the PLC are shown in the table below. The position of the first one on

the left of the PLC is 1, the second one is 2, and so on.

Mapping area / Position	Output Mapping Area	Input Mapping Area
1	D6282~D6476	D6032~D6226
2	D6782~D6976	D6532~D6726
3	D7282~D7476	D7032~D7226
4	D7782~D7976	D7532~D7726
5	D8282~D8476	D8032~D8226
6	D8782~D8976	D8532~D8726
7	D9282~D9476	D9032~D9226
8	D9782~D9976	D9532~D9726

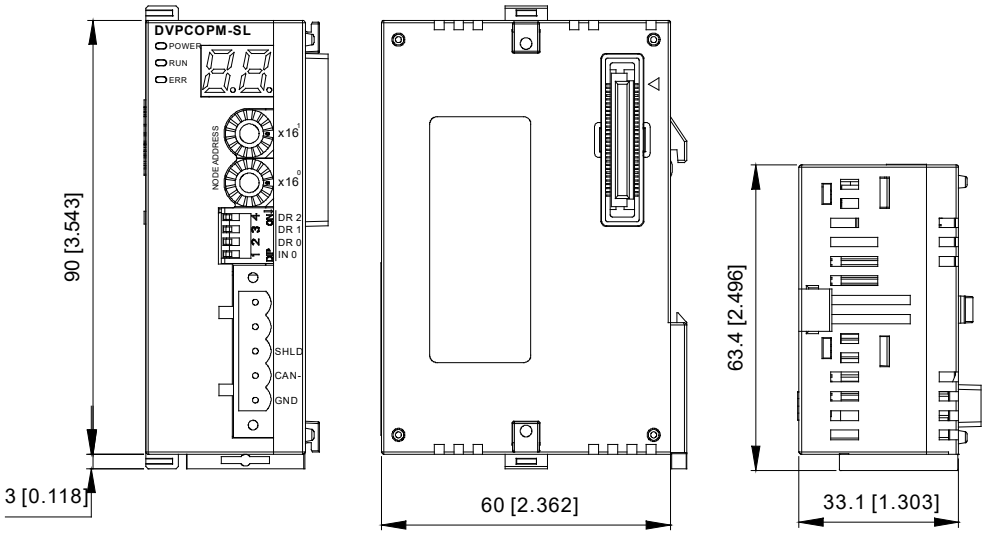
- When the PLC is DVP-SV3 and DVP-SX3, the input and output mapping areas for different positions of the left side of the PLC are shown in the table below. The position of the first one on the left of the PLC is 1, the second one is 2, and so on.

Mapping area / Position	Output Mapping Area	Input Mapping Area
1	D16282~D16476	D16032~D16226
2	D16782~D16976	D16532~D16726
3	D17282~D17476	D17032~D17226
4	D17782~ D17976	D17532~D17726
5	D18282~ D18476	D18032~D18226
6	D18782~D18976	D18532~D18726
7	D19282~D19476	D19032~D19226
8	D19782~D19976	D19532~D19726

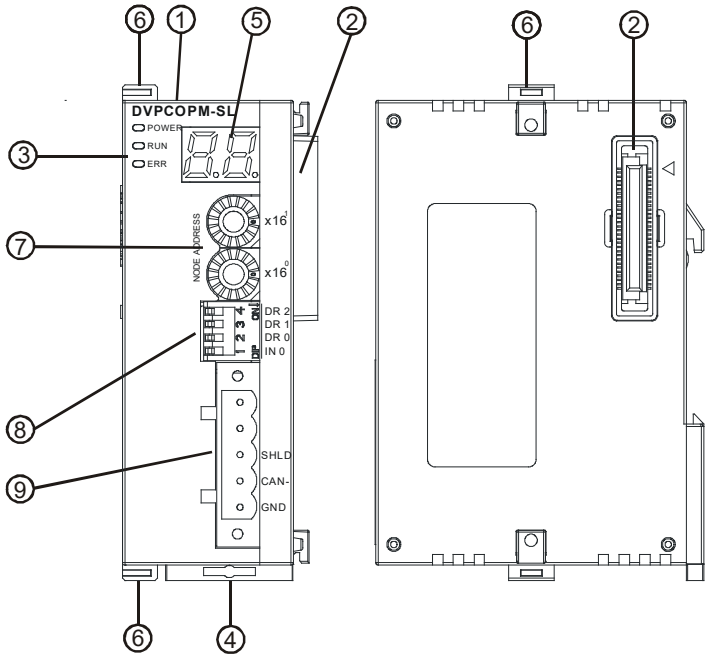
2 Product Profile & Outline

DVPCOPM-SL is composed of CANopen connection port, address switch, function switch, and digital display.

2.1 Dimension



2.2 Product Profiles

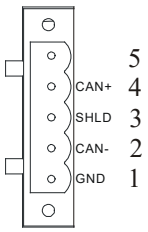


1. Model name	6. Fixing clip for I/O module
2. I/O module Interface	7. Address switch
3. POWER, RUN, ERR indicators	8. Function switch
4. DIN rail clip	9. CANopen connection port
5. Digital display	

2.3 CANopen Connection Port

The connector is used on the connection to CANopen network. Wire by using the connector enclosed with DVPCOPM-SL.

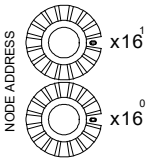
PIN	Signal	Content
1	GND	0 VDC
2	CAN_L	Signal-
3	SHLD	Shielded
4	CAN_H	Signal+
5	-	Reserved



2.4 Address Switch

The switch is used on setting up the node address of DVPCOPM-SL on CANopen network. Range: 1 ~ 7F (0, 88 ~ FF are forbidden).

Switch setting	Content
1 ~ 7F	Valid CANopen node address
0, 80 ~ FF	Invalid CANopen node address



Example: If you need to set the node address of DVPCOPM-SL to 26 (1AH), simply switch the corresponding switch of $x16^1$ to 1 and the corresponding switch of $x16^0$ to A.

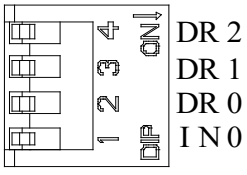
Note:

- Use slotted screwdriver to rotate the switch carefully in case you scratch the switch.
- Please set up the node address when the power is switched off. After the setup is completed, re-poser DVPCOPM-SL.

2.5 Function Switch

The switch is used on setting up the baud rate for the communication between DVPCOPM-SL and CANopen network (DR0 ~ DR2). See the table below for the baud rates and maximum communication distances.

DR2	DR1	DR0	Baud rate (bps)	Max. communication distance (m)
OFF	OFF	OFF	10k	5,000
OFF	OFF	ON	20k	2,500
OFF	ON	OFF	50k	1,000
OFF	ON	ON	125k	500
ON	OFF	OFF	250k	250
ON	OFF	ON	500k	100
ON	ON	OFF	800k	50
ON	ON	ON	1M	25
IN0				Reserved



Note:

- Please use a slotted screwdriver to turn the DIP switch carefully.
- Please set up the function switch when the module is powered off. After setting is over, power on the module again.

2.6 Digital Indicator

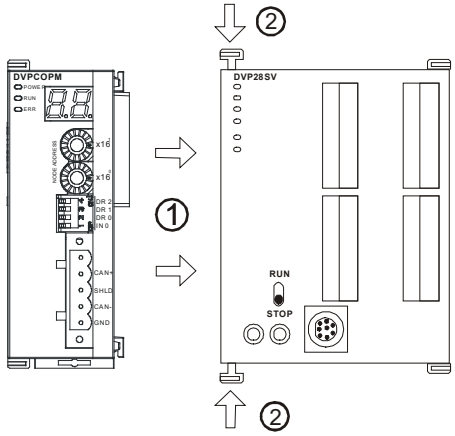
The digital indicator provides the following two functions:

- Displaying the node address of DVPCOPM-SL.
- Displaying the slave error.

3 Basic Operations

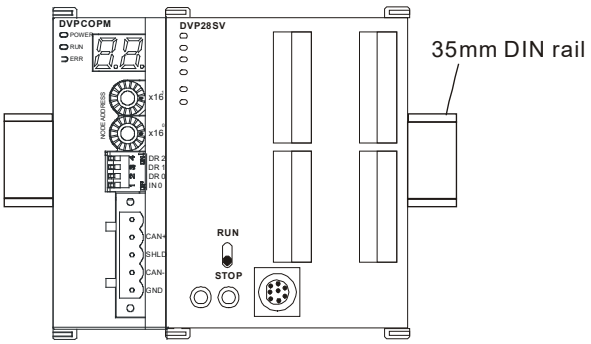
3.1 Connecting DVPCOPM-SL to DVP-SV CPU

- Open the fixing clip on top and bottom of DVP-SV. Meet the extension port of DVPCOPM-SL with DVP-SV, as ①.
- Press the fixing clips on top and bottom of DVP-SV and check is the connection is fine, as ②.



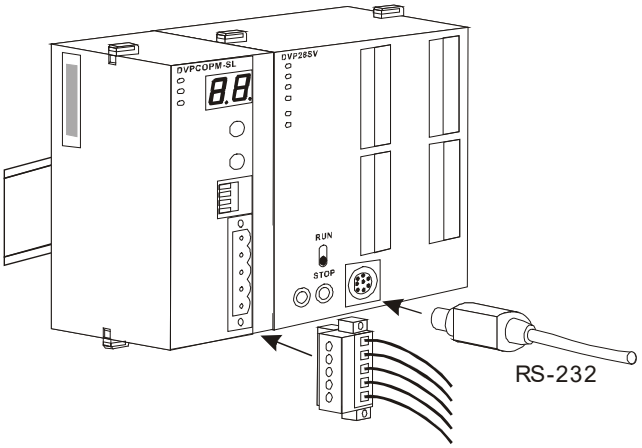
3.2 Installing DVPCOPM-SL and DVP-SV CPU on DIN Rail

- Use 35mm DIN rail.
- Open the DIN rail clip on DVP-SV and DVPCOPM-SL. Insert DVP-SV and DVPCOPM-SL onto the DIN rail.
- Clip up the DIN rail clips on DVP-SV and DVPCOPM-SL to fix DVP-SV and DVPCOPM-SL on the DIN rail, as shown below.



3.3 Connecting to CANopen Connection Port

- Please wire according to the PIN definition of the connection port.
- Plug the communication connector to the CANopen port of DVPCOPM-SL as follows.



4 Constructing a CANopen Network

In this section, we will introduce how to construct a complete CANopen network by using DVPCOPM-SL and other slaves.

Before constructing a network, you have to first know clearly what the network is for and start a preliminary planning for the data to be exchanged. The plan shall include the slaves to be used, type of transmission and the data to be exchanged, total length of data to be exchanged, requirement on the response time for data exchange, and so on. The information will decide whether the network you construct is a reasonable one, or if it satisfies your needs, and even affect the later-on network sustainability and flexibility of network capacity upgrade.

In the example below, we will illustrate how to control RUN/STOP and speed of a Delta ASD-B servo drive by a Delta digital I/O module DVP-08ST.

4.1 How to Construct a CANopen Network

Equipment and software required:

Equipment & software	Function
DVP-PS02	24V power supply module, supplying CANopen network.
DVP-PS01	24V power supply module, supplying DVP-12SA and remote I/O DVP-08ST.
DVP-28SV	DVP-SV PLC CPU
DVPCOPM-SL	CANopen master
DVP-12SA	DVP-SA PLC CPU
DVP-08ST	Digital I/O module
IFD9503	CANopen bus adapter
ASD-B	Delta B series servo drive
WPLSoft	DVP series PLC programming software
Delta CANopen Builder	CANopen configuration software for DVPCOM-SL master

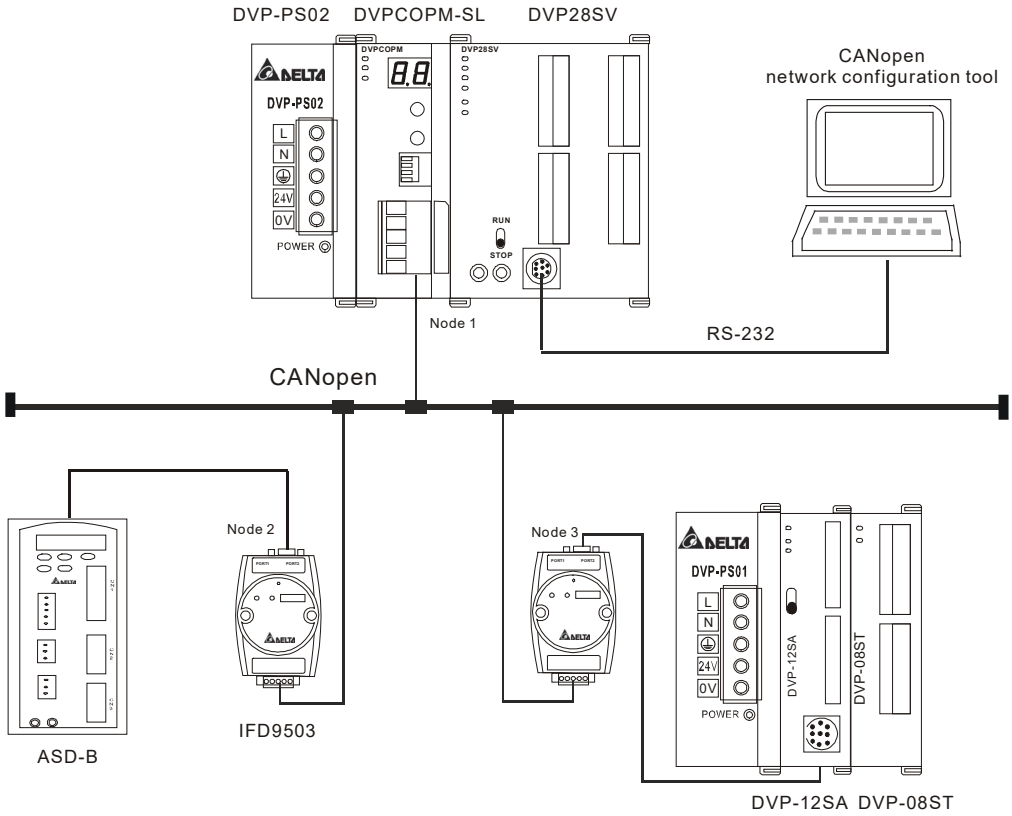
- Set up DVPCOPM-SL and IFD9503 according to the table below. For how to operate IFD9503, please refer to Chapter 13.

Module	Node address	Baud rate (bps)
DVPCOPM-SL	01	1M
IFD9503	02 (connected to ASD-B)	1M
IFD9503	03 (connected to DVP-12SA)	1M

Set up ASD-B as follows:

Parameter	Set value	Explanation
P1-01	02	Control mode: speed mode
P1-09	100 (rpm)	Internal speed command 1 (SP1)
P1-10	300 (rpm)	Internal speed command 2 (SP2)
P1-11	500 (rpm)	Internal speed command 3 (SP3)
P2-10	101	Function of DI1: Servo on
P2-11	114	Function of DI2: SPD0
P2-12	115	Function of DI3: SPD1
P2-18	102	Function of DO1: Output when servo on
P3-00	1	Modbus communication address
P3-01	5 (115,200 bps)	Modbus baud rate
P3-02	1 (7,E,1)	Modbus data format
P3-06	3F	DI1 ~ DI6 controlled by communication

- Constructing the CANopen network following the figure below.



About the connection between IFD9503 and PLC, IFD9503 and ASD-B, or IFD9503 and other equipment, please refer to Chapter 13. For the electrical specifications of ASD-B, please refer to ASD-B user manual.

4.2 Data Mapping in CANopen Network

- Data mapping in DVP-12SA

  DVP-08ST, connected on the right hand side of DVP-12SA, offers 8 channels of digital input and 1 byte of input data. In this example, we will use X0 and X1 on DVP-08ST to RUN/STOP ASD-B and select speed. Y0 is for the output signal of ASD-B operational status. See the table below for more information.

Channel	Function
X0	Controlling RUN/STOP of ASD-B
X1, X2	Selecting the speed of ASD-B: X2 = 0, X1 = 1, selecting SP1 X1 = 1, X2 = 0, selecting SP2 X1 = 1, X2 = 1, selecting SP3
Y0	Operational status of ASD-B: On: RUN Off: STOP

Supposed IFD9503 is connected to DVP-12SA and exchanging data with DVPCOPM-SL master, the default length of input data is 8 bytes and output data is 8 bytes. D256 in DVP-12SA is the start device for input data, and D0 is the start device for output data. To realize the control function of X0, X1 and X2, we place the statuses of X0 ~ X2 to bit 0 ~ 2 of D256. That is, when X0 = On, bit 0 of D256 will become 1. When X1 = On, bit 1 of D256 will become 1. In this way, we can realize the control of RUN, STOP and speed of ASD-B by the changes in D256 through WPLSoft. The status word in ASD-B will then be sent to D0. That is, when bit 0 of D0 becomes 1, there will be signals at Y0.

Mapping between DVPCOPM-SL master and DVP-12SA:

Mapping register in Master	Transmission direction	Mapping register in Slave
D6032	⇐	D256
D6033		D257
D6034		D258
D6035		D259
D6282	⇒	D0
D6283		D1
D6284		D2
D6285		D3

- Data mapping in ASD-B

  In this example, IFD9503 is the interface for the connection between ASD-B and CANopen network. In default setting, IFD9503 offers 1 word of input data and 1 word of output data to exchange data with DVPCOPM-SL master..

Mapping between DVPCOPM-SL master and ASD-B.

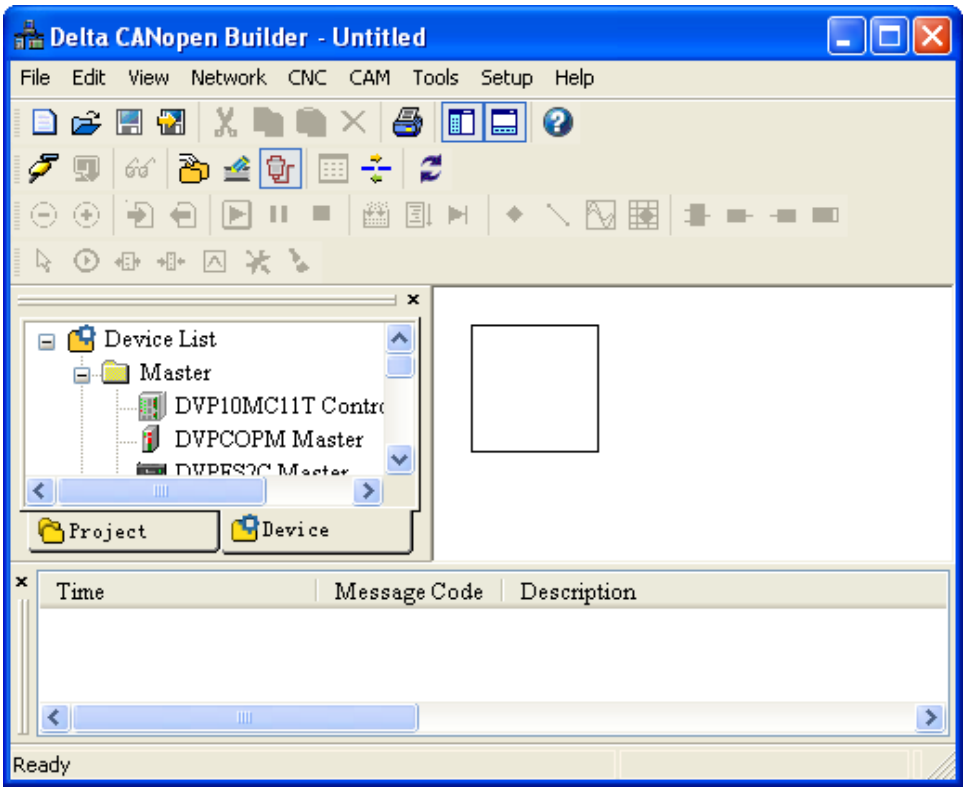
Mapping register in Master	Transmission direction	Mapping parameter in Slave
D6036	⇦	P4-09 (Digital output status)
D6286	⇨	P4-07 (Multi-function digital input)

4.3

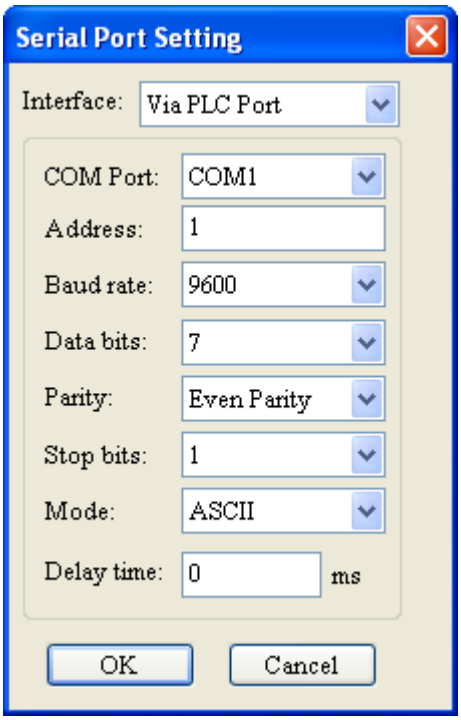
4.3 How to Configure Network by Delta CANopen Builder Software

- Using CANopen Builder to scan the network

  (1) Open CANopen Builder software, as below:



(2) Select ”Setup” => ”Communication Setting” => ”System Channel”, and the "Serial Port Setting” dialog box will appear.

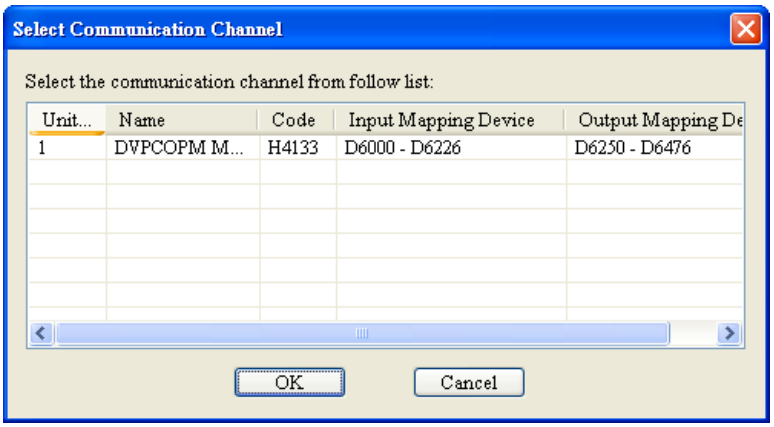


(3) Set up the parameters for communication between the PC and DVP-SV, e.g. the communication port, address, baud rate and communication format.

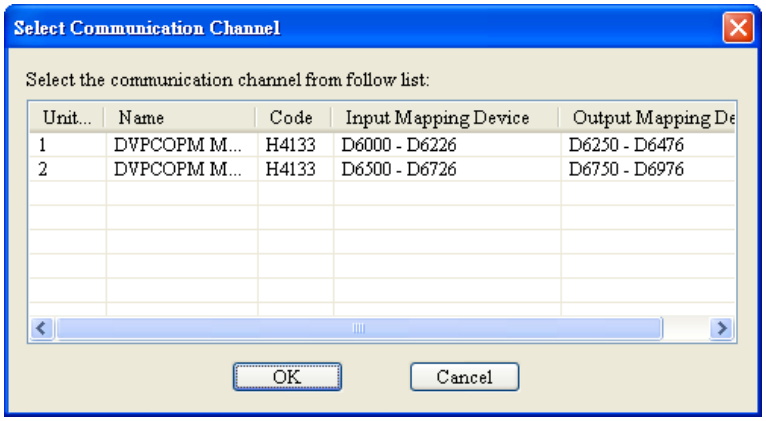
Item	Function	Default
COM Port	COM port on the PC to be used to communicate with DVP-SV	COM1
Address	Communication address of DVP-SV	1
Baud rate	Communication speed between the PC and DVP-SV	9,600 (bps)
Data Bits	Communication protocol between the PC and DVP-SV	7
Parity		Even Parity
Stop Bit		1
Mode	Communication mode between the PC and DVP-SV	ASCII

Click on “OK” to return to the main page.

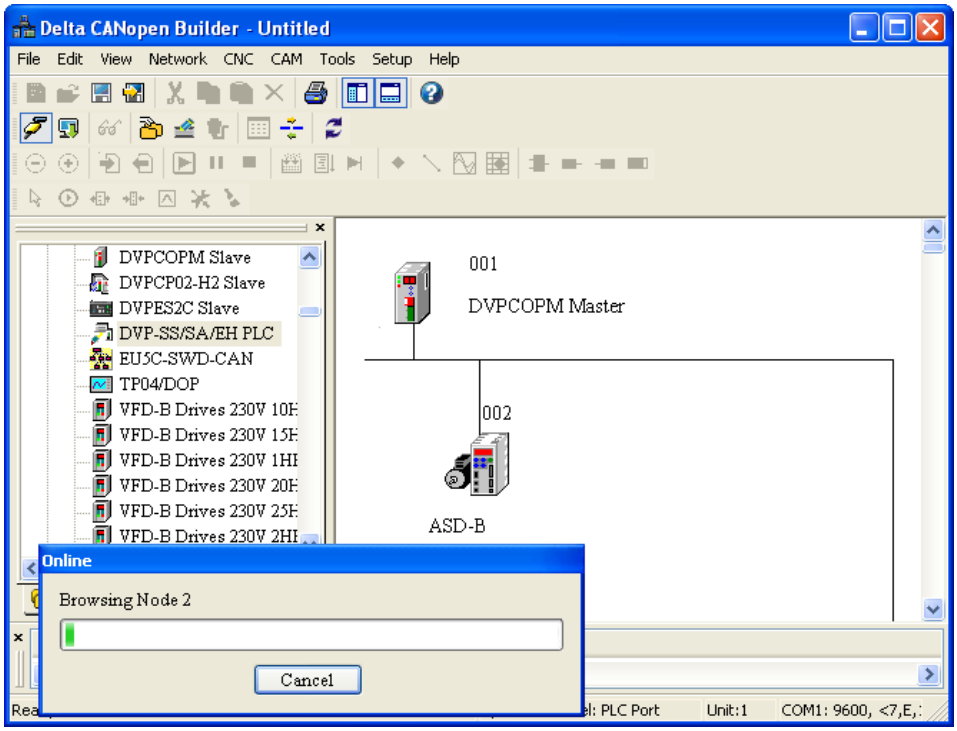
(4) Select “Network” => ”Online”, and the “Select Communication Channel” dialog box will appear. In this example, if the connection with DVP-SV is in normal status, you will see the screen as below.



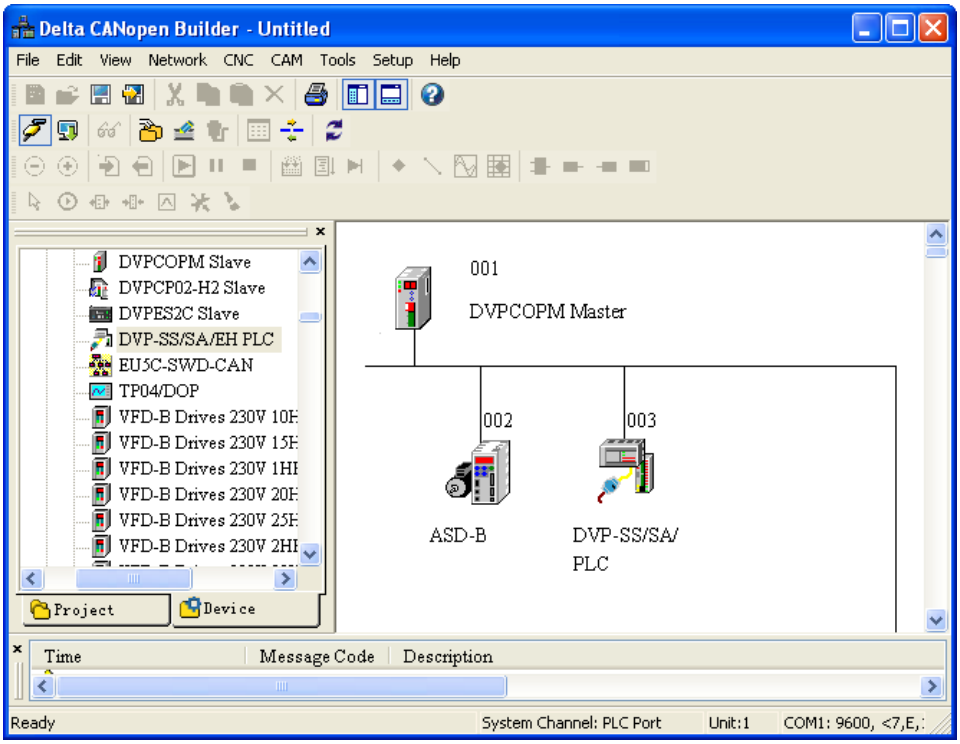
If there are more than one DVPCOPM-SL module (less than 8) connected to the left side of DVP-SV and supposed there are two connected in this example, after clicking on “Online”, you will see the screen as below. The DVPCOPM-SL which is closest to DVP-SV is regarded as the first module, and so on.



(5) Select the DVPCOPM-SL which needs to establish the communication. Click on “OK” and start to scan all the slaves in the network. If the network installation and power supply are normal, you will see the screen as below.

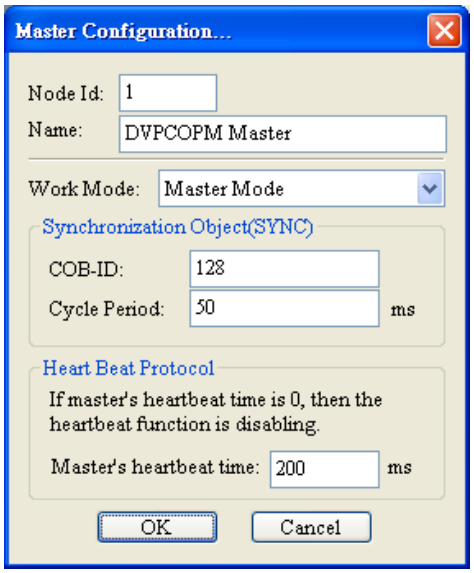


(6) In normal condition, after the scan is over, you will find the master and all the slaves displayed in CANopen network, as below.



- Setting up parameters in CANopen master

  Select “Network” => ”Master Parameter”, and you will see the dialog box as below.



  Work Mode: The work mode of DVPCOPM-SL. You can select either “Master Mode” or “Slave Mode”.

  Cycle Period: The period of sending synchronous information.

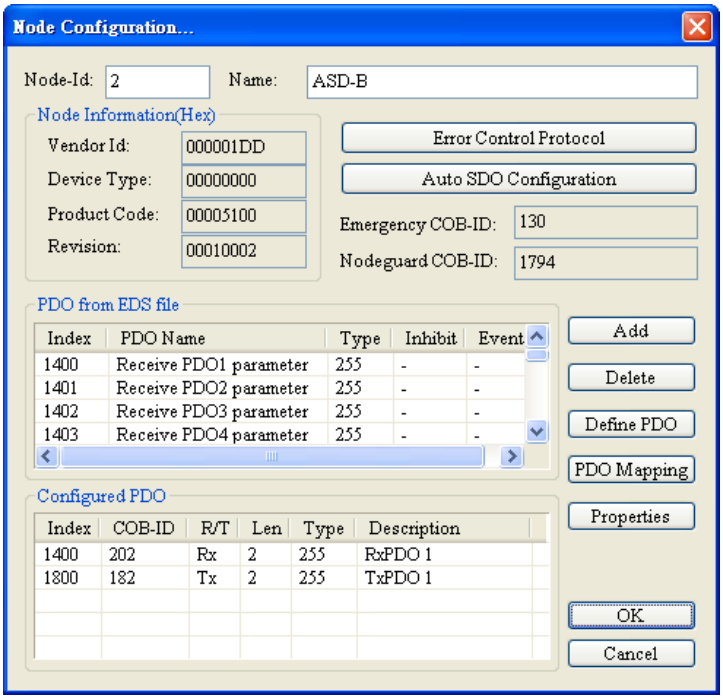
  Master’s heartbeat time: Time for DVPCOPM-SL to send out the heartbeat message.

  After all the parameters are set up, click on “OK".

- Setting up parameters in CANopen slave

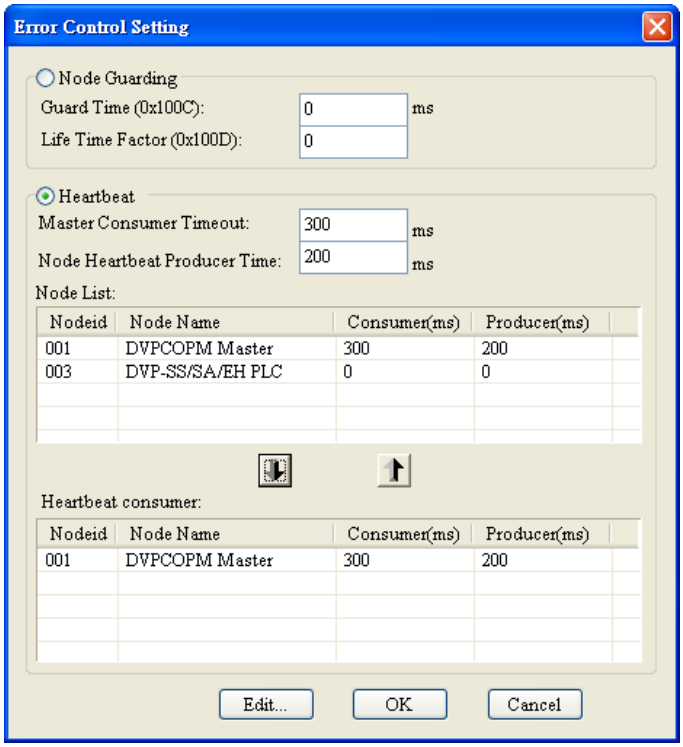
  Take the parameter settings in ASD-B for example:

  (1) Double click on ASD-B, and you will see the dialog box as below.



(2) Relevant parameter settings

Error Control Protocol: In the “Node Configuration…” page, click on “Error Control Protocol”, and you will see the dialog box appearing as below.



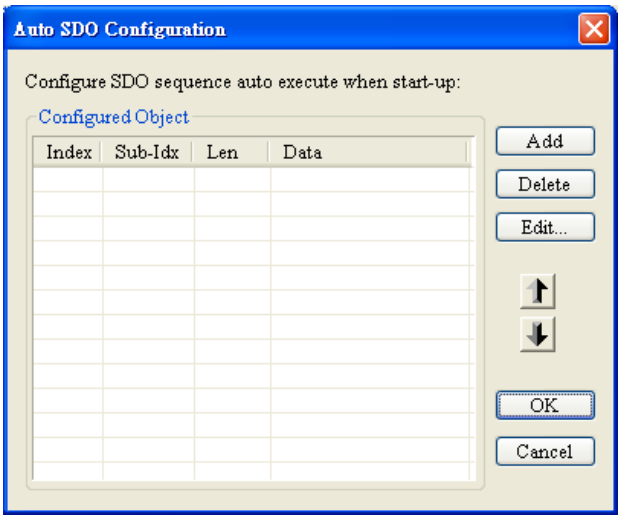
In this page, you can set up parameters for error control, e.g. “Master Consumer Timeout” and “Node Heartbeat Producer Time”. Please note that the value of “Master Consumer Timeout" shall be bigger than the value of “Node Heartbeat Producer Time”. After you have set up the heartbeat function, and the slave turns off-line and does not turn on-line within “Master Consumer Timeout”, the master will consider the slave off-line. If “Heartbeat" is selected, you cannot select “Node Guarding”. In “Heartbeat consumer”, you can add devices into the node list. Add a device A, and the slave will be able to monitor whether device A is on-line. Select a device and click on “Edit…” to modify the “Consumer" and “Producer” value.

Explanation of Parameters for above table is as below.

Parameter Name		Explanation	Remark
Node Guarding	Guard time	Master sends the guard message to slave in cycle of “Guard Time”.	When “Heartbeat” is selected, “Node Guarding” can not be selected.
	Life Time Factor	Life time=Guard Time x Life Time Factor. Slave does not respond to the polling from master within the period of Life Time and then master assumes the slave is offline.	

Parameter Name		Explanation	Remark
Heartbeat	Node heartbeat producer time	Slave sends the heartbeat message to master in cycle of “Node heartbeat producer time”	The time for “Master consumer timeout” should be longer than that for “slave heartbeat producer time”.
	Master consumer time-out	If master does not receive the heartbeat message from slave within the period of “master consumer timeout”, master assumes the slave is offline.	
Node list		All nodes configurated in CANopen network are all displayed in node list.	--
Heartbeat consumer		The node configurating “error control setting” can monitor whether the nodes in the window of “Heartbeat consumer” are offline.	In”Heartbeat monitoring” is configurated only one node.
Icon		Select some node in “Node list” and add it to the window of “heartbeat monitoring” by clicking the icon .	--
Icon		Select one node in “Heartbeat” and then delete the selected node by clicking the icon .	--
“Edit” Button		Select one node in “Heartbeat monitoring” and revise the monitoring time clicking “Edit…”	--
“OK” Button		By clicking “OK” return to the dialogue box of “Node configuration” and the parameters set in “Error control setting” are saved	--
“Cancel” Button		By clicking “Cancel” return to the dialogue box of “Node configuration” and the parameters set in “Error control setting” are invalid.	--

Auto SDO Configuration: In the “Node Configuration” page, click on “Auto SDO Configuration”, and you will see the page as below.



Click on “Add” to edit Auto SDO. Click on “Edit” to modify the Auto SDO selected. Please note that the Auto SDO cannot be longer than 8 bytes, and every slave is able to posses maximum 20 auto SDOs.

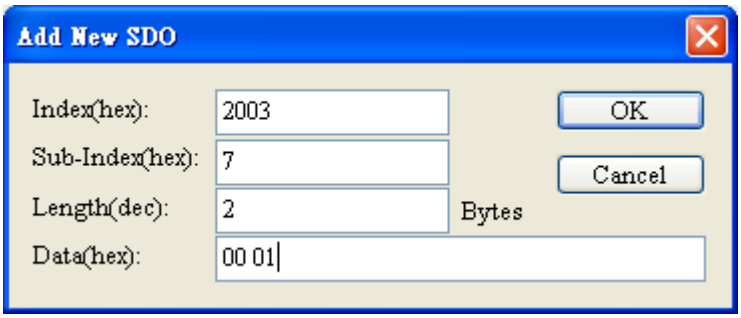
Below window pops up by clicking on “Add” button in above window. “Index (hex)”, “Sub-Index (hex)” are the index and sub-index of the parameters to be visited; “Length (dec)” is determined by the data type of the parameter to be visited with the unit: byte.

The data length of word type is 2. “Data (hex)” is the data of the parameter to be written with the data type of hex, low byte in the left, high byte in the right and space between every two bytes. For data type: double words, low word is in the left and high word is in the right.

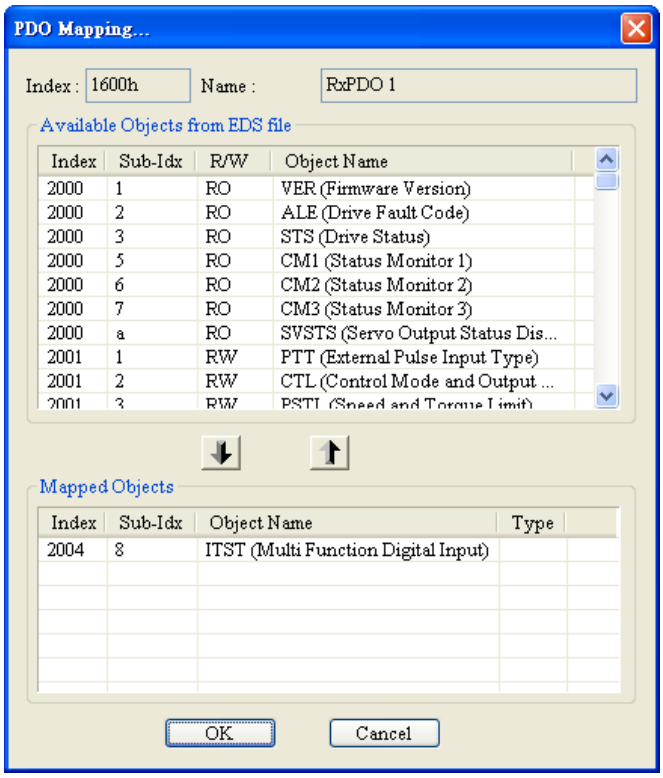
“Index (hex)”, “Sub-Index (hex)” are the index and sub-index of the parameters to be visited;

“Length (dec)” is determined by the data type of the parameter to be visited with the unit: byte.

The data length of word type is 2. “Data (hex)” is the data of the parameter to be written with the data type of hex, low byte in the left, high byte in the right and space between every two bytes. For data type: double words, low word is in the left and high word is in the right.

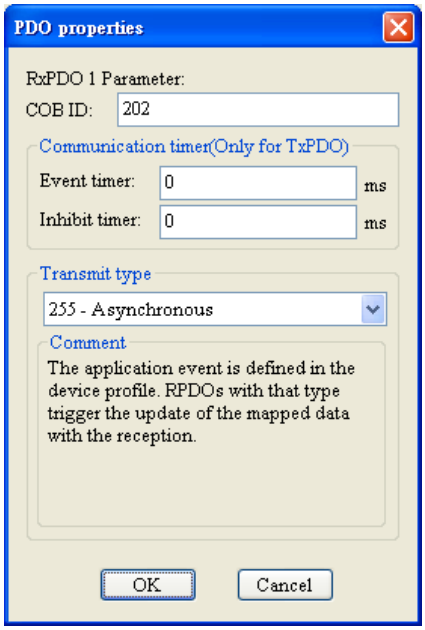


PDO mapping: In the “Node Configuration…” page, select a TxPDO or RxPDO in “Configured PDO” and click on “PDO Mapping”, and you will enter the “PDO Mapping…” page as below. You can add the parameters in “Available Objects from EDS file” into “Mapped Objects”. The total length of the parameters added in each PDO cannot exceed 8 bytes. After the configuration is completed, click on “OK”.



In the “Node Configuration…” page, click on “Properties” to enter the "PDO Properties” page and modify COB-ID and Transmit type. After the configuration is completed, click on “OK”. In the “Node Configuration…” page, click on “Define PDO” to self define RxPDO or TxPDO.

In this example, we adopt the default configuration. Finally, click “OK” in the “Node Configuration…” page.



PDO COB-ID setting rule is as follows.

RxPDO Number	COB-ID(HEX)	TxPDO Number	COB-ID (HEX)
RxPDO1	200+slave node address	TxPDO1	180+slave node address
RxPDO2	300+slave node address	TxPDO2	280+slave node address
RxPDO3	400+slave node address	TxPDO3	380+slave node address
RxPDO4	500+slave node address	TxPDO4	480+slave node address

Note:

COB-ID of RxPDO5~ RxPDO8, TxPDO5~ TxPDO8 can be the COB-ID of other slaves: RxPDO1~ RxPDO4, TxPDO1~ TxPDO4 which has not been used in the network yet. COB-ID of every PDO must not be identical.

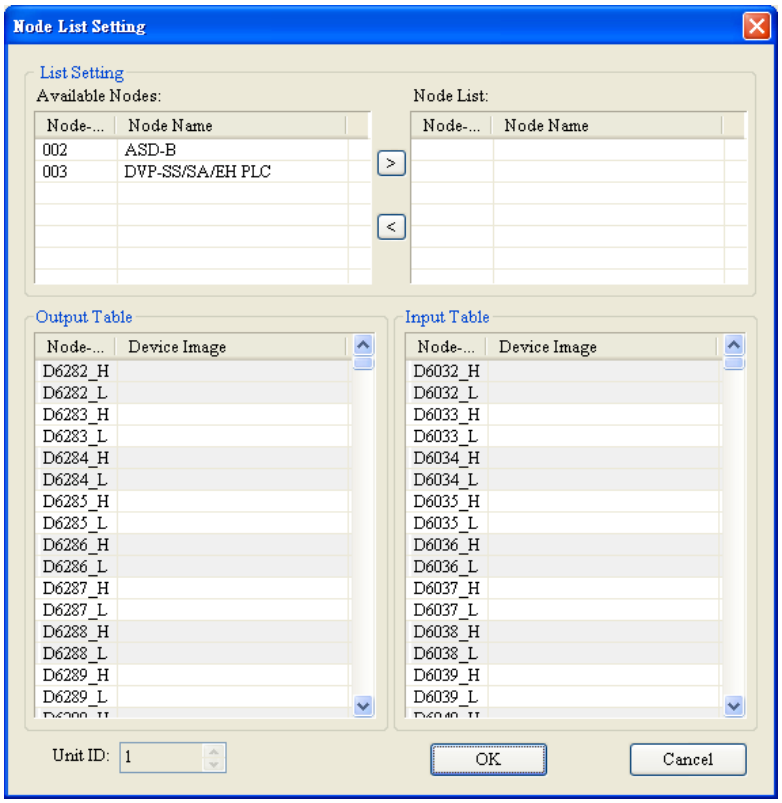
PDO transmission type is as below;

Transmission Type		Description	Remark
0	RxPDO	Master transmits a SYNCH message to slave every SYNCH cycle. When there is change for RxPDO data, RxPDO data is transmitted to slave and the data that slave receives is valid after receiving the next SYNCH message. When there is no change in RxPDO data, master does not transmit RxPDO data to slave.	SYNCH non-cycle
	TxPDO	Master transmits a SYNCH message to slave every SYNCH cycle. When TxPDO data changes, slave sends the TxPDO data to master after receiving SYNCH message, TxPDO data that master receives is valid immediately. When there is no change in TxPDO data, slave does not transmit TxPDO data to master.	
1	RxPDO	Master transmits a SYNCH message to slave every SYNCH cycle. Master sends out RxPDO data to slave once every SYNCH cycle. RxPDO data that slave receives from master is valid after slave receives the next SYNCH message.	SYNCH Cycle
	TxPDO	Master transmits a SYNCH message to slave every SYNCH cycle. Slave sends out TXPDO data to master once after receiving one SYNCH message. And then the TxPDO data master receives is valid immediately.	
2	RxPDO	Master transmits a SYNCH message to slave every SYNCH cycle. Master transmits RxPDO data to slave every two SYNCH cycles. The RxPDO data slave receives will be valid after slave receives the next SYNCH message.	SYNCH Cycle
	TxPDO	Master transmits a SYNCH message to slave every SYNCH cycle. Slave sends out TxPDO data to master once after receiving 2 SYNCH messages. And the TxPDO data master receives is valid immediately.	

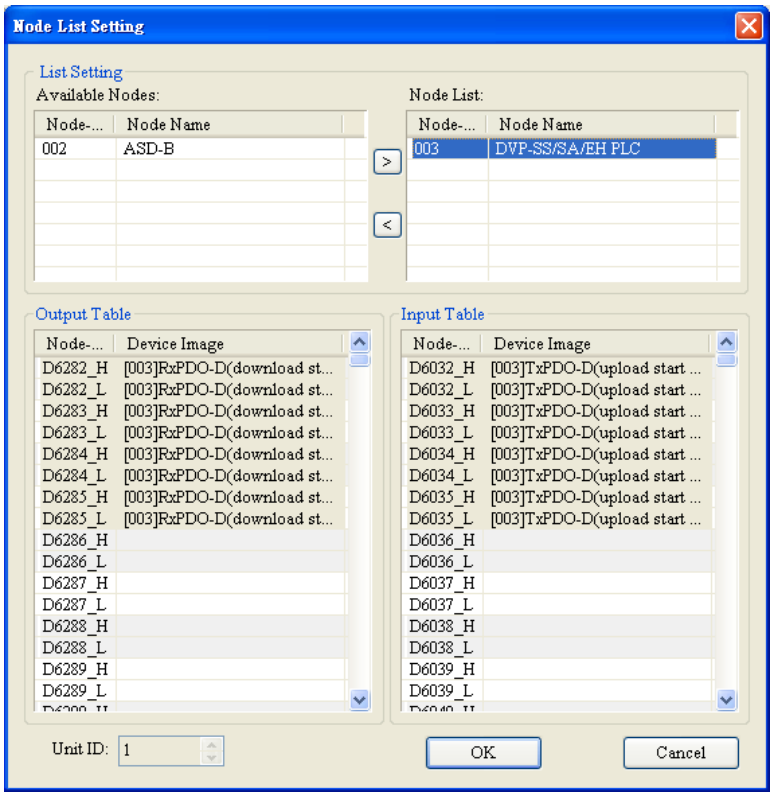
Transmission Type		Description	Remark
3～240	RxPDO	To analogize on basis of transmission type 1 and 2	SYNCH Cycle
	TxPDO	To analogize on basis of transmission type 1 and 2	
254	RxPDO	When there is any change in RxPDO, RxPDO data is transmitted to slave and the PxPDO that slave receives is valid immediately. When there is no change in RxPDO, master does not send RxPDO data to slave.	ASYNCH
	TxPDO	When Event timer and inhibit timer are both 0, TxPDO data is transmitted to master after TXPDO data changes and the data that master receives will be valid immediately; when TxPDO data does not change, slave does not send out TxPDO data to master. When neither of Event timer and inhibit timer are 0, slave sends out TxPDO data to master once every a period of Event timer. After TxPDO data is sent out once, no TxPDO data is allowed to be sent out again within the period of inhibit timer and when TxPDO data changes, TxPDO data is transmitted to master at once and the data that master receives will be valid immediately.	
255	RxPDO	Same as transmission type: 254	ASYNCH
	TxPDO	Same as transmission type: 254	

- Node List Setting

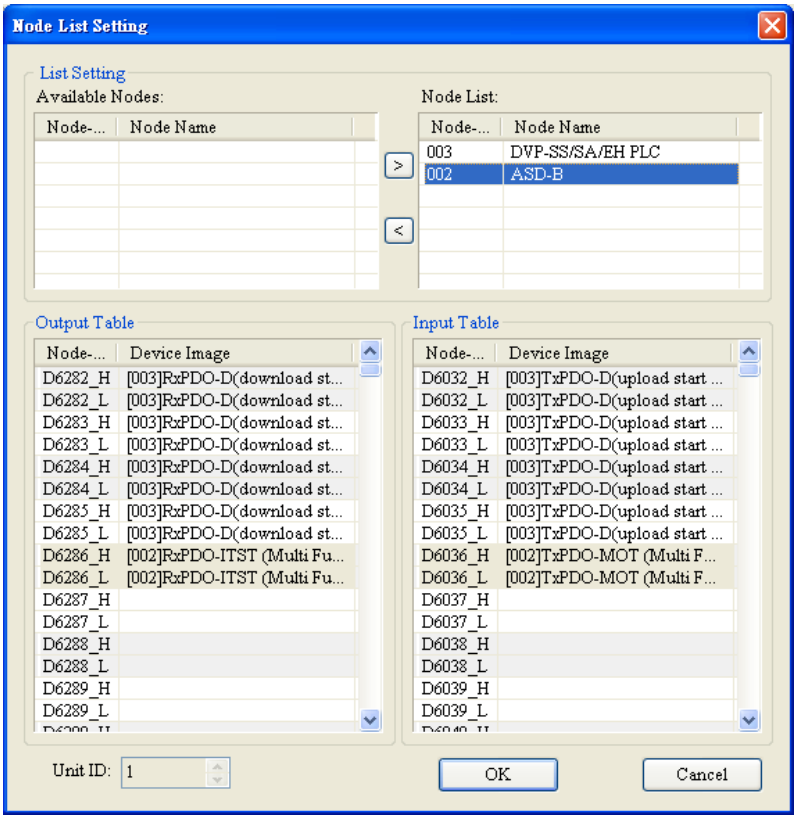
  (1) Double click on “DVPCOPM Master” icon, and you will see the “Node List Setting” dialog box as below.



(2) In this example, first select DVP-SS/SA/EH PLC at Node 003 and click on > to add this node into the node list. After this, select Node 003 in the node list, and you will be able to see how the I/O data correspond to D registers in DVP-SV from the Output Table and Input Table below.

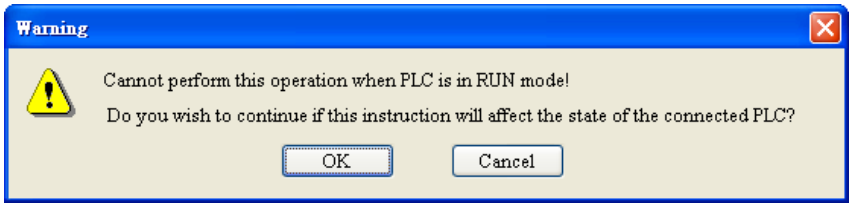


(3) Add also Node 002 into the node list, and you will be able to see how the I/O data correspond to D registers in DVP-SV from the Output Table and Input Table below. Click on “OK” to complete setting up the node list.

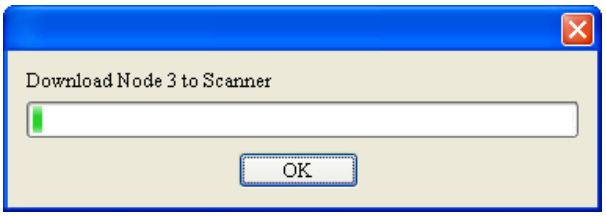


- Downloading the data to the master

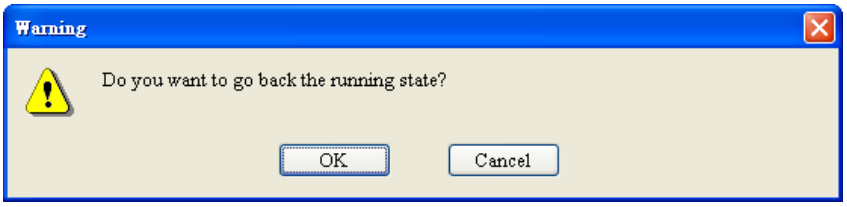
  Select “Network“ => “Download” to download the configuration data to DVPCOPM-SL master. If the PLC is in RUN status at this moment, you will be given a warning saying that you have to stop the operation before the download.



  Click on “OK” to stop the PLC and start to download the data to the master.



  After the download is completed, you will be given another warning, asking you if you would like to run the PLC again. Click on “OK” to restart the PLC program, or click on “Cancel” to stop the PLC.



4.4 Saving Configuration Data

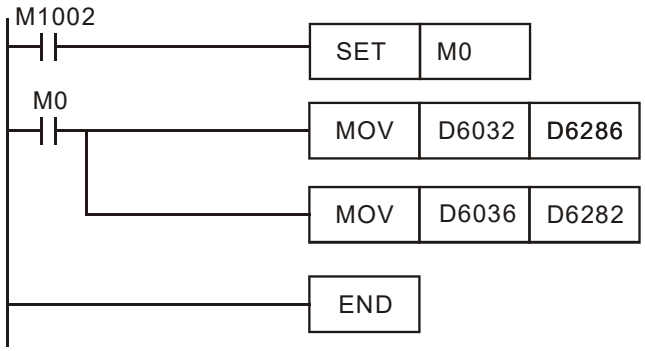
Select “File” => "Save” to save the current configuration data.

4.5 CANopen Network Control

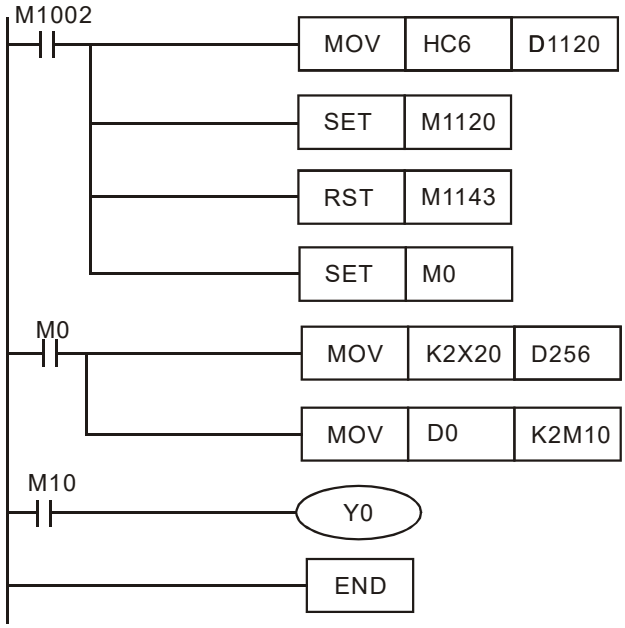
In this section, we will introduce how to compile WPL program and control CANopen network.

- Target:
  1. When SW0 on Slave 3 is closed, the servo drive on Slave 2 will start to run.
  2. When SW0 on Slave 3 is open, the servo drive on Slave 2 will stop.
  3. When the status of SW1 and SW2 on Slave 3 is switched, the running speed of servo drive on Slave 2 can be modified.
  4. When the servo drive is running, the signal LED on Slave 2 will be On.
  5. When the servo drive stops, the signal LED on Slave 2 will be Off.

- The program in DVP-SV CPU (master):



- Program explanations:
  1. The 2nd row of the program indicates sending the content of D256 in DVP-SA (mapped on D6032 of DVP-SV) to the control word (Multi-Function Digital Input, mapped on D6286 of DVP-SV) of the servo drive.
  2. The 3rd row of the program indicates sending the output status of the servo drive (Multi-Function Digital Output, mapped on D6036 of DVP-SV) to D0 in DVP-SA (mapped on D6282 of DVP-SV).
- The program in DVP-SA CPU (slave):

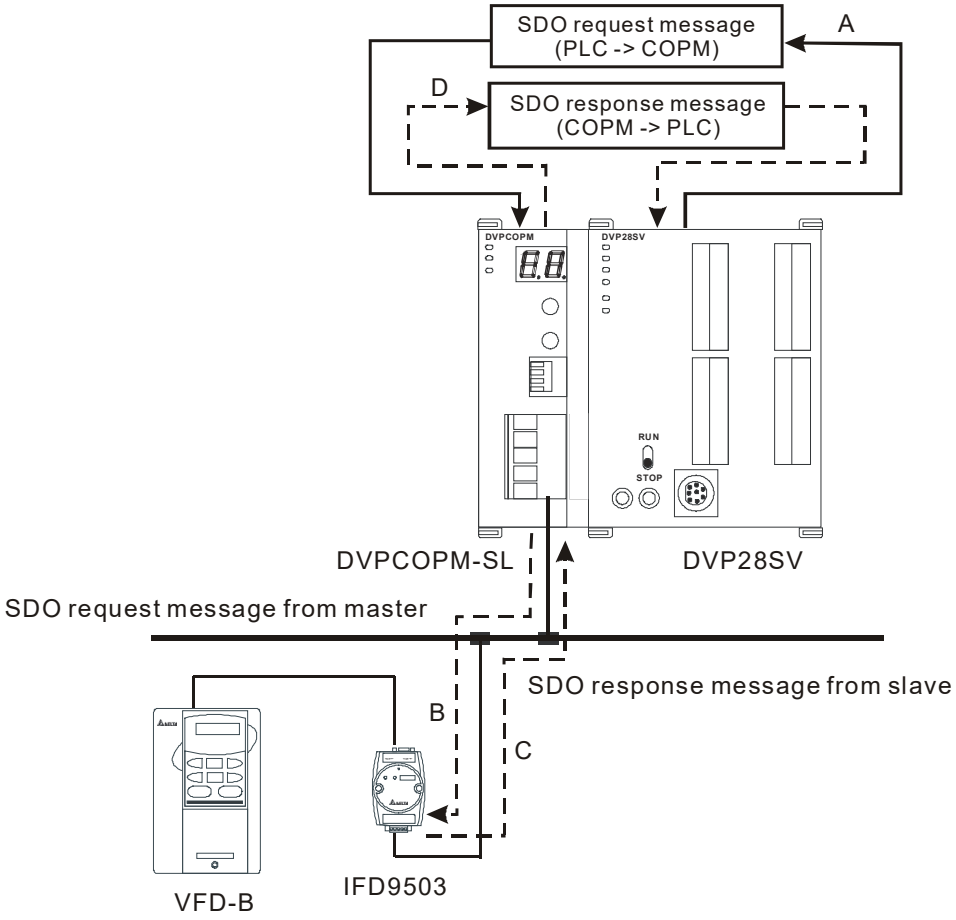


- Program explanations:
  1. The first 3 rows of the program set up the communication format between DVP-SA and IFD9503, which is 115,200bps, 7E1-ASCII; communication port is COM2.
  2. When M0 = On, send the input status of X20 ~ X28 on DVP-08ST to D256, and send the data in b0 ~ b15 of D0 to M10 ~ M25.
  3. When D0 = 1, M10 will be On, and Y0 on DVP-SA CPU will output.

5 Sending SDO, NMT and Reading Emergency by Ladder Diagram

5.1 Principle

See the chart below for sending SDO by WPL program:



A: DVP-SV sends out the request message to DVPCOPM-SL (master).

B: DVPCOPM-SL (master) sends out the request message to the target equipment.

C: The target equipment processes the request message and sends the response message to DVPCOPM-SL.

D: DVP-SV receives SDO, NMT and Emergency data.

Note: The corresponding device addresses are different for DVPCOPM-SL with different PLC. Please refer to Input and Output Mapping Areas for DVPCOPM-SL in Section 1.3 for details. Here the PLC is DVP-28SV.

5.2 Structures of SDO Request and Response Messages

You can edit SDO, NMT and Emergency in “request message editing area”. Take the first DVPCOPM-SL master placed on the left hand side of DVP-SV for example. See the table below for the corresponding relation between “request message editing area” and “response message editing area” and the devices in PLC.

PLC device	Mapping area	Data length
D6000 ~ D6031	SDO response message and Emergency response message	64 bytes
D6250 ~ D6281	SDO request message, NMT service message and Emergency request message	64 bytes

Structure of SDO request message:

PLC device	Request Message															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D6250	Message Header	ReqID								Command							
D6251		Reserved								Size							
D6252		Type								MAC ID							
D6253	Message Data	Index high byte								Index low byte							
D6254		Reserved								Sub-index							
D6255		Datum 1								Datum 0							
D6256		Datum 3								Datum 2							
D6257 ~ D6281		Reserved															

- Command: Fixed to “01Hex”.
- ReqID: The request ID. Whenever an SDO request message is sent out, the message will be given a ReqID for CANopen master to identify. For the next request message to be sent out, you have to change the ID number. Range of ReqID: 00Hex ~ FFHex.
- Size: The length of the message. Max. 8 bytes. Unit: byte.
- MAC ID: The node address of the target equipment on the CANopen network.
- Type: In SDO request message, 01Hex refers to SDO read message service; 02Hex refers to SDO write message service; 4FHex refers to read 1 byte of data; 60Hex refer to write 1/2/4 byte(s) of data; 80Hex refers to end SDO command. For example, if the type is 02Hex in SDO request message, the type is 60Hex in the SDO response message when the writing of data is successful.

  Structure of SDO response message:

PLC device	Response message															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D6000	Message header	ReqID								Status							
D6001		Reserved								Size							
D6002		Type								MAC ID							
D6003	Message data	Index high byte								Index low byte							
D6004		Reserved								Sub-index							
D6005		Datum 1								Datum 0							
D6006		Datum 3								Datum 2							
D6007 ~ D6031		Reserved															

- Status code:

Status code	Explanation
0	No data transmission request
1	SDO data transmission is successful.
2	SDO data is being transmitted.
3	Error: SDO transmission time-out
4	Error: Illegal command
5	Error: Size of request message is illegal.
6	Error: Size of response message is illegal.

Status code	Explanation
7	Error: Equipment to be sent messages is busy.
8	Error: Illegal type
9	Error: Incorrect node address
0A	Error message (See the error code for SDO response message)
0B ~ FF	Reserved

- ReqID: Normally, it is the same as the ReqID in the request message.
- Size: the data length of the message, the maximum length is 20. Unit: Bytes
- MAC ID: the node address of the target equipment on the CANopen network.
- Type: In the SDO response message, 43Hex means that 4-byte data are read; 4BHex means that 2-byte data are read; 4FHex means that 1-byte data are read; 60Hex means that 1/2/4 byte (s) of data are written, 80Hex means ending the SDO command. E.g., if the type is 02Hex in the SDO request message, the type in the SDO response message is 60Hex when writing data is successful.

5.3 Structure of NMT Service Message

You can send the NMT request message to D6250 ~ D6281, and the slave will not respond with a message.
Note: The corresponding device addresses are different for DVPCOPM-SL with different PLC. Please refer to Input and Output Mapping Areas for DVPCOPM-SL in Section 1.3 for details. Here the PLC is DVP-28SV.

PLC device	Request Message															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D6250	Message Header	ReqID							Command							
D6251		Reserved							Size (fixed to 04Hex)							
D6252		Type (fixed to 03Hex)							MAC ID							
D6253	Message Data	Reserved							NMT service code							
D6254		Reserved							MAC ID							

- Command: Fixed to “01Hex”.
- ReqID: The request ID. Whenever an NMT request message is sent out, the message will be given a ReqID for the CANopen master to identify. For the next NMT request message to be sent out, you have to change the ID number. Range of ReqID: 00Hex ~ FFHex.
- MAC ID: The node address of the target equipment on the CANopen network.
- NMT service code
- 01Hex: Enable remote node; 02Hex: Disable remote node; 80Hex: Enter pre-operational status; 81Hex: Reset application; 82Hex: Reset communication

  Example: If you would like to stop node 03 equipment on the CANopen network, you have to set NMT service code to “02Hex” and MAC ID to “03".

5.4 Structures of Emergency Request and Response Messages

The corresponding device addresses are different for DVPCOPM-SL with different PLC. Please refer to Input and Output Mapping Areas for DVPCOPM-SL in Section 1.3 for details. Here the PLC is DVP-28SV.

See the table below for the format of Emergency request message:

PLC device	Request Message															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D6250	Message Header	ReqID								Command							
D6251		Reserved								Size (fixed to 0)							
D6252		Type (fixed to 04Hex)								MAC ID							
D6253 ~ D6281	Message Data	Reserved															

See the table below for the format of Emergency response message:

PLC device	Response Message															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D6000	Message Header	ReqID								Status							
D6001		Reserved								Size (2A Hex)							
D6002		Type (04Hex)								MAC ID							
D6003	Message Data	Total number of data								Number of data stored							
D6004		Datum 1								Datum 0							
D6005		Datum 3								Datum 2							
D6006		Datum 5								Datum 4							
D6007		Datum 7								Datum 6							
D6008 ~ D6011		Emergency2															
D6012 ~ D6015	Message Data	Emergency3															
D6016 ~ D6019		Emergency4															
D6020~ D6023		Emergency5															
D6024~ D6031		Reserved															

- Command: Fixed to “01Hex”.
- ReqID: The request ID. Whenever an Emergency message is sent out, the message will be given a ReqID for the CANopen master to identify. For the next Emergency message to be sent out, you have to change the ID number. Range of ReqID: 00Hex ~ FFHex.
- MAC ID: The node address of the target equipment on CANopen network.
- Total number of data: The total number of Emergency messages CANopen master receives.
- Number of data stored: The latest number of Emergency messages CANopen master receives. (Every slave gives less than 5 messages.)

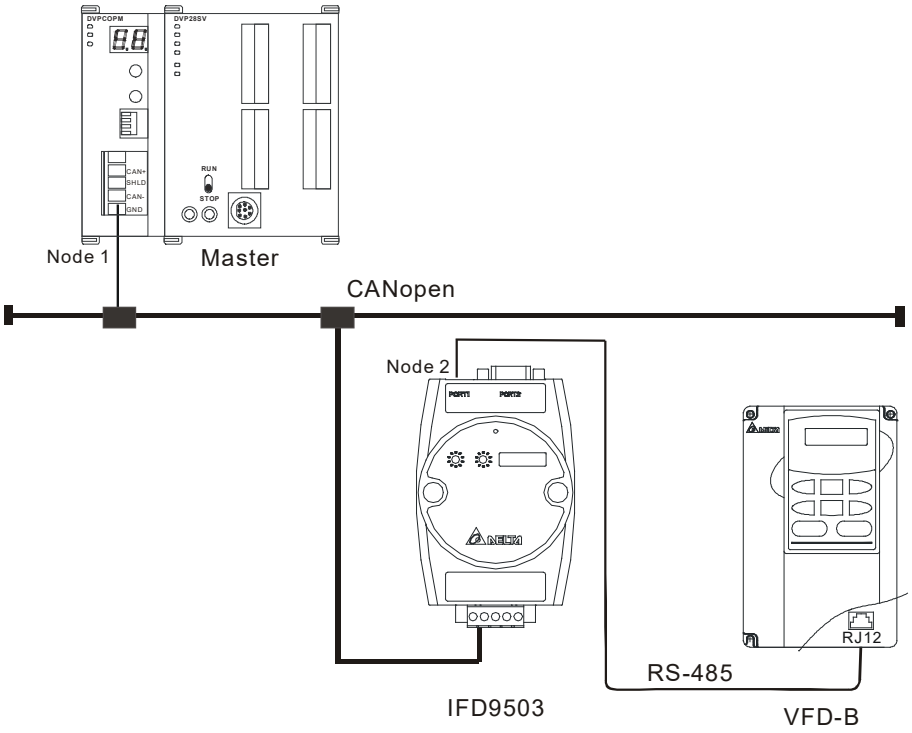
Note:

- CANopen master can only send out 1 SDO, NMT or Emergency request message to one piece of equipment at a time.
- When you use WPL program to send out SDO, NMT or Emergency request messages, we recommend you clear the “request message editing area” and “response message editing area” to 0.

5.5 Application Examples

In this section, we will illustrate how to compile a WPL program to send out SDO and NMT messages or read Emergency request messages. (Note: here the PLC is DVP-28SV.)

- Example I
  - Control requirement:
    When M0 turns ON, the actual output value of AC motor drive is read via SDO. The corresponding index/ sub-index of the actual output value of AC motor drive is 2021/4.
  - Hardware connection:



Required settings in DVPCOPM-SL:

Parameter	Setting	Explanation
Node address	01	Set the node address of DVPCOPM-SL to “01”.
Baud rate	1 Mbps	Set the communication speed between DVPCOPM-SL and bus to “1 Mbps”.

Required settings in IFD9503:

Parameter	Setting	Explanation
Node address	02	Set the node address of IFD9503 to “02”.
Baud rate	1 Mbps	Set the communication speed between IFD9503 and bus to “1 Mbps”.

Required settings in VFD-B AC motor drive:

Parameter	Setting	Explanation
02-00	04	The main frequency is operated by RS-485 interface.
02-01	03	The running command is operated by communication interface. Operation by keys is valid.

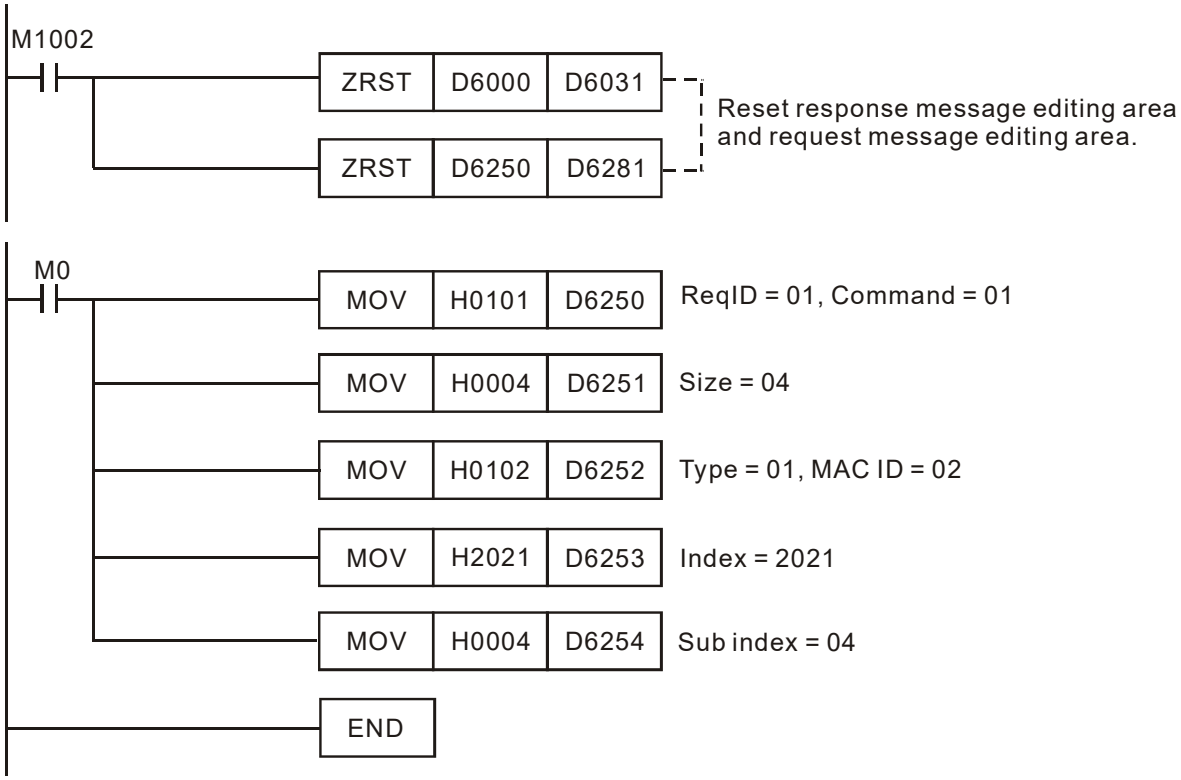
Parameter	Setting	Explanation
09-00	01	Communication address of VFD-B: 01
09-01	03	Baud rate: 38,400 bps
09-04	03	Modbus RTU mode, format <8, N, 2>

Devices in PLC:

PLC device		Content	Explanation													
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SDO request message editing area	D6250	0101Hex	ReqID = 01Hex								Command = 01Hex							
	D6251	0004Hex	Reserved								Size = 04Hex							
	D6252	0102Hex	Type = 01Hex								MAC ID = 02Hex							
	D6253	2021Hex	High byte of index = 20Hex								Low byte of index = 21Hex							
	D6254	0004Hex	Reserved								Sub index = 04Hex							
SDO response message editing area	D6000	0101Hex	ReqID = 01Hex								Status = 01Hex							
	D6001	0006Hex	Reserved								Size = 06Hex							
	D6002	4B02Hex	Type = 4BHex								MAC ID = 02Hex							
	D6003	2021Hex	High byte of index = 20Hex								Low byte of index = 21Hex							
	D6004	0004Hex	Reserved								Sub index = 04Hex							
	D6005	0100Hex	Datum 1= 01Hex								Datum 0 = 00Hex							

The value 0100Hex in D6005 indicates that the actual output frequency of the AC motor drive is 2.56Hz.

- PLC program



- Program explanation

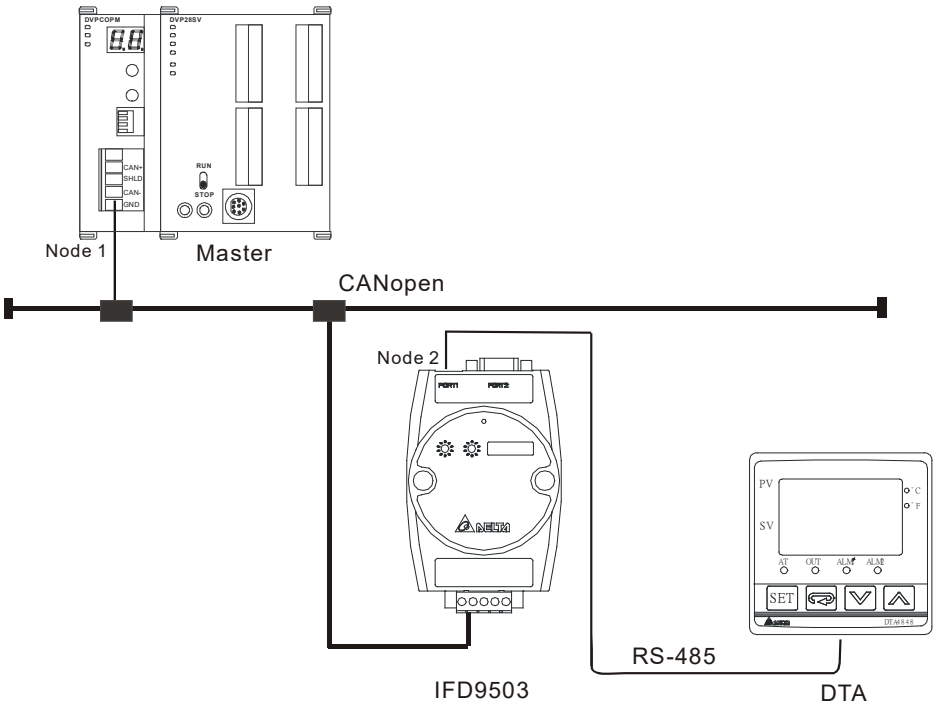
1. The program first reset the SDO request message editing area and SDO response message editing area to 0.
2. When M0 = On, CANopen master will send out SDO request message and read the contents in index

2021, sub index 4 of the target equipment (at node address 02). If the communication is successful, the slave will return with the response message.

3. When M0 = On, CANopen master will send out request message only once. If you would like it to send out messages again, you will have to change the ReqID.
4. Reading data is successful and the data returned from the target equipment are stored in D6000 ~ D6005.

- Example II
  - Control requirement:

    When M0 turns ON, the target temperature of the DTA temperature controller is set to 26.0℃ via SDO. The corresponding index/ sub-index of the target temperature of the DTA is 2047/2.
  - Hardware connection:



  - Master and slave parameters setting:

    Required settings in DVPCOPM-SL:

Parameter	Setting	Explanation
Node address	01	Set the node address of DVPCOPM-SL to “01”.
Baud rate	1 Mbps	Set the communication speed between DVPCOPM-SL and the bus to “1 Mbps”.

    Required settings in IFD9503:

Parameter	Setting	Explanation
Node address	02	Set the node address of IFD9503 to “02”.
Baud rate	1 Mbps	Set the communication speed between IFD9503 and the bus to “1 Mbps”.

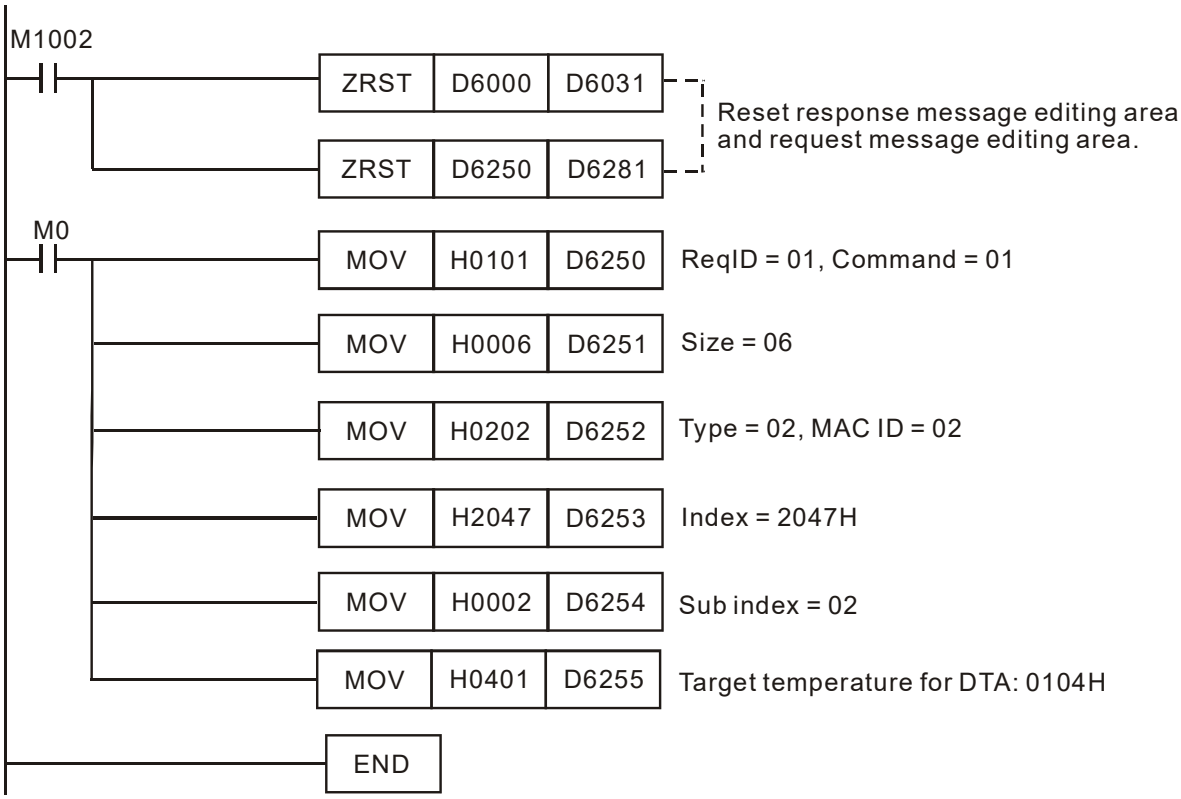
Required settings in DTA temperature controller:

Parameter	Setting	Explanation
CoSH	On	C WE: Enable/disable communication write-in
C-SL	ASCII	C-SL: Select ASCII or RTU format
C-no	1	C NO: Set up communication address
bPS	38400	BPS: Set up communication speed
LEn	7	LENGTH: Set up data length
PrtY	E	PARITY: Set up parity bit
StoP	1	STOP BIT: Set up stop bit
tPUn	°C	UNIT: Select temperature unit, °C or °F

Devices in PLC

PLC Device		Content	Explanation															
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SDO request message editing area	D6250	0101Hex	ReqID = 01Hex								Command = 01Hex							
	D6251	0006Hex	Reserved								Size = 06Hex							
	D6252	0202Hex	Type = 02Hex								MAC ID = 02Hex							
	D6253	2047Hex	High byte of index = 20Hex								Low byte of index = 47Hex							
	D6254	0002Hex	Reserved								Sub index = 02Hex							
	D6255	0401 Hex	Datum 1= 04Hex								Datum 0= 01Hex							
SDO response message editing area	D6000	0101Hex	ReqID = 01Hex								Status = 01Hex							
	D6001	0004Hex	Reserved								Size = 04Hex							
	D6002	6002Hex	Type = 60Hex								MAC ID = 02Hex							
	D6003	2047Hex	High byte of index = 20Hex								Low byte of index = 47Hex							
	D6004	0002Hex	Reserved								Sub index = 02Hex							

- PLC program



- Program explanation
  1. The program first reset the SDO request message editing area and SDO response message editing area to 0.
  2. When M0= On, CANopen master will send out SDO request message and write 0104Hex into index 2047, sub index 2 of the target equipment (at node address 02). If the communication is successful, the slave will return with the response message.
  3. When M0 = On, CANopen master will send out request message only once. If you would like it to send out messages again, you will have to change the ReqID.
  4. The messages returned from the target equipment are stored in D6000 ~ D6004.

6 Network Node Status Display

All slave state of the CANopen network can be read through reading 5002/1 (index/subindex) value by sending SDO via ladder diagram; master state of the CANopen network can be read through reading 5003/1 (index/subindex) value by sending SDO via ladder diagram; the CANopen network state can be read through reading 5004/1 (index/subindex) value by sending SDO via ladder diagram.

6.1 Slave State of CANopen Network

Users can read the content value for H'5002>>H'01 to acquire the slave status of the CANopen network by sending SDO.

Index	Subindex	Object Name	Data Type	Attribute	Default
H'5002	H'00	Entry	Unsigned 16 bits	Read-only	---
	H'01	Status word for node 1 ~ node 127	Unsigned 128 bits	Read-only	---

The corresponding relations between index H"5002>> subindex H'01 and network nodes are as follows.

H'5002>>H'01	Corresponding Network Node					
	b15	b14	b13	… …	b1	b0
Word 0	Node 15	Node 14	Node 13	… …	Node 1	Reserved
Word 1	Node 31	Node 30	Node 29	… …	Node 17	Node 16
Word 2	Node 47	Node 46	Node 45	… …	Node 33	Node 32
Word 3	Node 63	Node 62	Node 61	… …	Node 49	Node 48
Word 4	Node 79	Node 78	Node 77	… …	Node 65	Node 64
Word 5	Node 95	Node 94	Node 93	… …	Node 81	Node 80
Word 6	Node 111	Node 110	Node 109	… …	Node 97	Node 96
Word 7	Node 127	Node 126	Node 125	… …	Node 113	Node 112

The corresponding bit is in off status when the nodes in the node list of master module are normal; the corresponding bit is in on status when the nodes in the node list of master module are abnormal, e.g. Initializing fails or other abnormality causes slave offline.

6.2 Master Status of CANopen Network

Users can read the content value for H'5003>>H'01 to acquire the master module status message of CANopen network by sending SDO. When master module is at normal work, the content value for H'5003>>H'01 is 0; when there is any error in master module, the content value for H'5003>>H'01 is the corresponding error code.

Index	Subindex	Object Name	Data Type	Attribute	Default
H'5003	H'00	Entry	Unsigned 16 bits	Read-only	---
	H'01	Status of master module	Unsigned 16 bits	Read-only	---

Explanation of the Content value for H'5003>>H'01

Content Value	Explanation	Actions
F1	Slave has not been added to the node list of CANopen Builder.	Add slave to node list and redownload configuration to DVPCOPM-SL

Content Value	Explanation	Actions
F2	In process of downloading configuration to DVPCOPM-SL.	Wait till the configuration is finished downloading.
F3	DVPCOPM-SL in error status	Redownload configuration and change into a new DVPCOPM-SL if the error still exists.
F4	Bus-off is detected	Check the wiring for all cables of CANopen network is proper; ensure all nodes in network are at same baud rate and finally repower DVPCOPM-SL.
F5	The setting for DVPCOPM-SL node address is incorrect	The DVPCOPM-SL node address should be set in the range of 1~127.
F9	Low-voltage detection error	Check and ensure the work power of DVPCOPM-SL is normal.
FA	The inner part of DVPCOPM-SL firmware is in error state.	Repower DVPCOPM-SL.
FB	The storage space sending data in DVPCOPM-SL is full.	Check and ensure bus cable connection is normal and then repower DVPCOPM-SL.
FC	The storage space receiving data in DVPCOPM-SL is full.	Check and ensure bus cable connection is normal and then repower DVPCOPM-SL.
0	Master is in normal status	--

6.3 CANopen Network Status

Users can read the content value for H'5004>>H'01 to acquire CANopen network status by editing ladder diagram to send SDO. When all nodes of CANopen network are all at normal work, the content value for H'5004>>H'01 is 0; when any node of CANopen network is abnormal or initializing fails, the content value for H'5004>>H'01 is 1.

Index	Subindex	Object Name	Data Type	Attribute	Default
H'5004	H'00	Entry	Unsigned 16 bits	Read-only	---
	H'01	CANopen network status	Unsigned 16 bits	Read-only	---

6.4 Data Structures of SDO Request and Response Messages

Here, the SDO request message structure is for 5002/1 (index/ subindex), 5003/1 (index/ subindex), 5004/1 (index/ subindex) only and can be realized by editing request message mapping area. Take DVPCOPM-SL, the first master module on the left of PLC as an example, the table below shows the corresponding relations between request and response message mapping areas, and PLC devices.

Note: The corresponding device addresses are different for DVPCOPM-SL with different PLC. Please refer to Input and Output Mapping Areas for DVPCOPM-SL in Section 1.3 for details. Here the PLC is DVP-28SV.

PLC Device	Mapping Area	Mapping Length
D6000~D6031	SDO response message area	64 bytes
D6250~D6281	SDO request message area	64 bytes

Data Format of SDO Request Message

PLC Device	Request Message															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D6250	Message header								Request ID							Command code
D6251									Reserved							Data length
D6252									Type							MAC ID
D6253	Message data								Main index high byte							Main index low byte
D6254									Reserved							Subindex
D6255									Data1							Data 0
D6256									Data 3							Data 2
D6257 ~ D6281									Reserved							

- Command code: fixed to 01 (Hex)
- Request ID: Every SDO request message sent out should be given a request ID. CANopen master recognizes every request message via “Request ID number” which must be changed for the next communication after the communication is finished. The value range for Request ID is 00 (Hex) ~ FF (Hex).
- Data length: the data length of message is fixed to 4 bits.
- MAC ID: node address of CANopen network master
- Type: it is fixed to 1 in SDO request message which indicates SDO data reading service.

Data Format for SDO Response Message

PLC Device	Response Message															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D6000	Message Header								Response ID							Status code
D6001									Reserved							Data Length
D6002									Type							MAC ID
D6003	Message Data								Main index high byte							Main index low byte
D6004									Reserved							Subindex
D6005									Data 1							Data 0
D6006									Data 3							Data 2
D6007									Data 5							Data 4
D6008									Data 7							Data 6
D6009									Data 9							Data 8
D6010									Data 11							Data 10
D6011									Data 13							Data 12
D6012									Data 15							Data 14
D6013 ~ D6031									Reserved							

- Status Code

Status Code	Explanation
0	No data transmission request
1	SDO message transmission succeeds.
2	SDO message is being transmitted.
3	Error – SDO message transmitting is time-out.
4	Error – Command code is invalid.

Status Code	Explanation
5	Error – The transmitted data length is invalid.
6	Error – Response data length is invalid.
7	Error – The device which is to be used for transmission is busy.
8	Error – Type code is invalid.
9	Error – Node address is wrong.
0A	Error information (refer to the error code in SDO response message)
0B~FF	Reserved

- Response ID: Normally, the Response ID is same as the Request ID in request message; in abnormal status, the Response ID is 0.
- Data length: data length of message data; maximum value: 32; Unit: byte.
- MAC ID: node address of CANopen network master.
- Type: In SDO response message, 43 (Hex) represents that data of 4 bytes are read; 4B (Hex) represents that data of 2 bytes are read; 4F (Hex) represents that data of 1 byte are read and 42(Hex) represents data longer than 4 bytes are read.

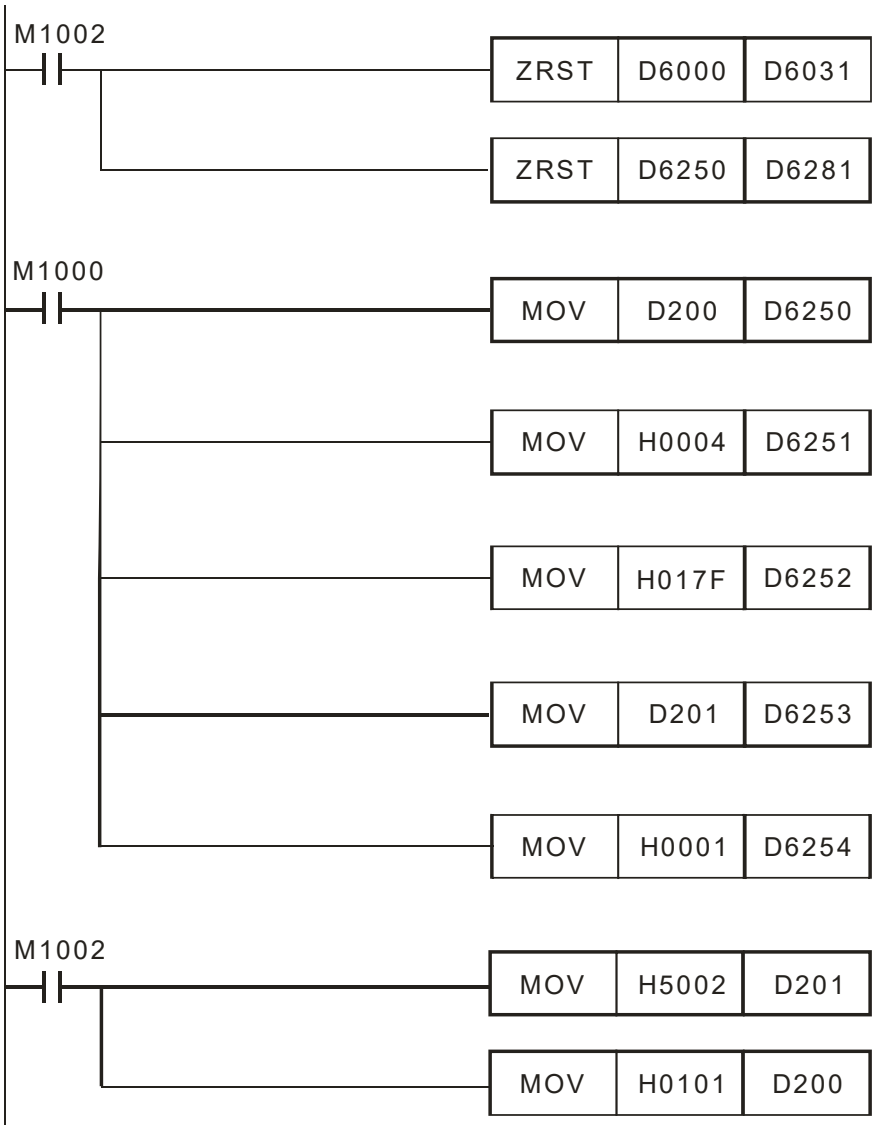
6.5 Application Examples

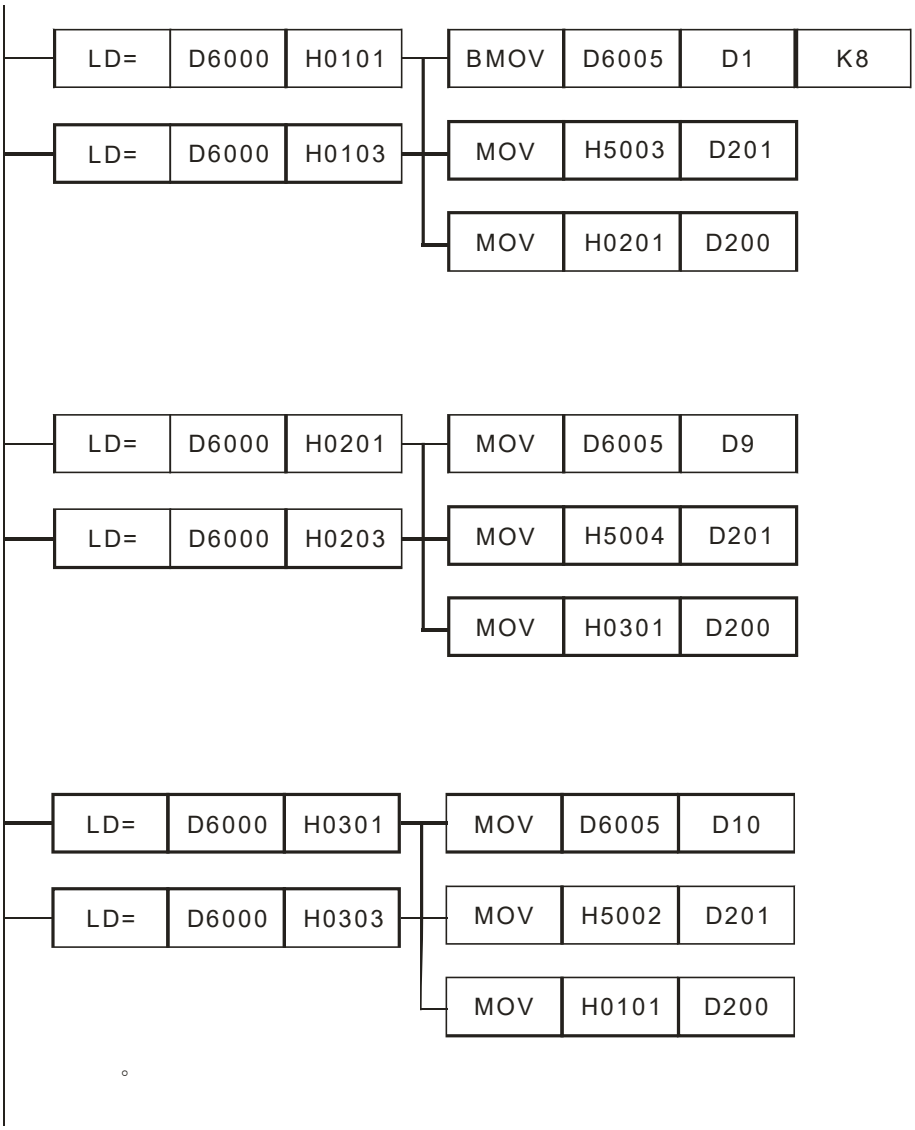
【Control Requirement】

Edit ladder diagram to achieve monitor function of CANopen network as follows.

- Real-time monitoring of the slave state in the node list of master module;
- Real-time monitoring of the state of master module;
- Real-time monitoring of the state of CANopen network.

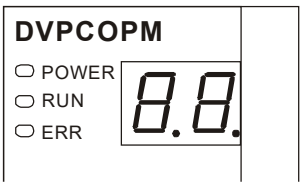
Note: The corresponding device addresses are different for DVPCOPM-SL with different PLC. Please refer to Input and Output Mapping Areas for DVPCOPM-SL in Section 1.3 for details. Here the PLC is DVP-28SV.


M1002
ZRST D6000 D6031
ZRST D6250 D6281
M1000
MOV D200 D6250
MOV H0004 D6251
MOV H017F D6252
MOV D201 D6253
MOV H0001 D6254
M1002
MOV H5002 D201
MOV H0101 D200


LD= D6000 H0101
BMOV D6005 D1 K8
LD= D6000 H0103
MOV H5003 D201
MOV H0201 D200
LD= D6000 H0201
MOV D6005 D9
LD= D6000 H0203
MOV H5004 D201
MOV H0301 D200
LD= D6000 H0301
MOV D6005 D10
LD= D6000 H0303
MOV H5002 D201
MOV H0101 D200

7 LED Indicator & Trouble-shooting

DVPCOPM-SL has three LED indicators and a digital display on it. POWER LED displays whether the power supply of DVPCOPM-SL is normal. RUN LED and ERR LED display the current operational status. The digital display shows the node address of DVPCOPM-SL and error messages from the slave.



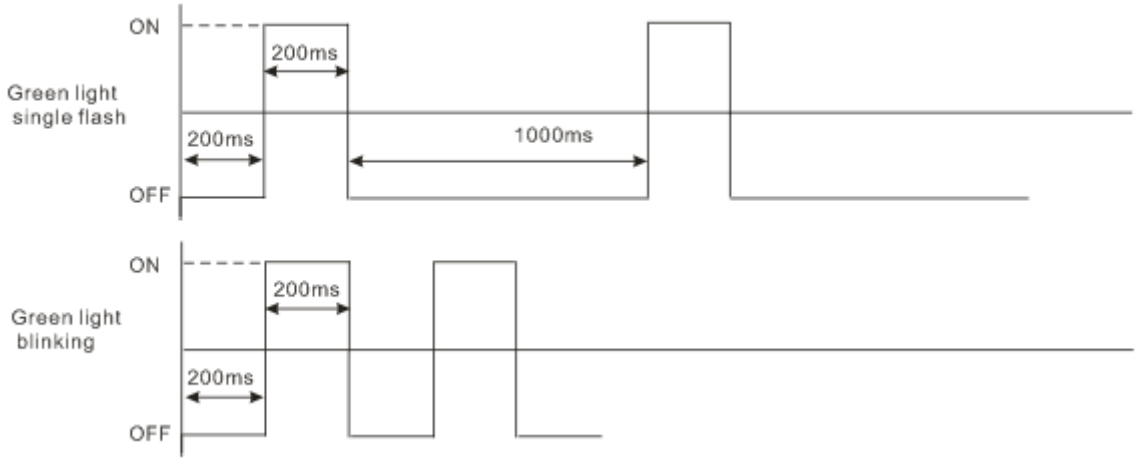
7.1 POWER LED

LED status	Indication	How to correct
Off	Power supply is abnormal.	Check the power supply of DVPCOPM-SL.
Green light On	Power supply is normal.	--

7.2 RUN LED

LED status	Indication	How to correct
Green light single flash	DVPCOPM-SL in STOP status	Upper computer is downloading network configuration and DVPCOPM-SL is waiting till the download is finished.
Green light blinking	DVPCOPM-SL in pre-operational status	1. Ensure that the wiring for bus cables of CANopen network is proper. 2. Ensure that the baud rates of master and other slaves are identical. 3. Check if the configured slave has been connected to network. 4. Check if the slave is offline.
Green light steady on	DVPCOPM-SL is operational status	--

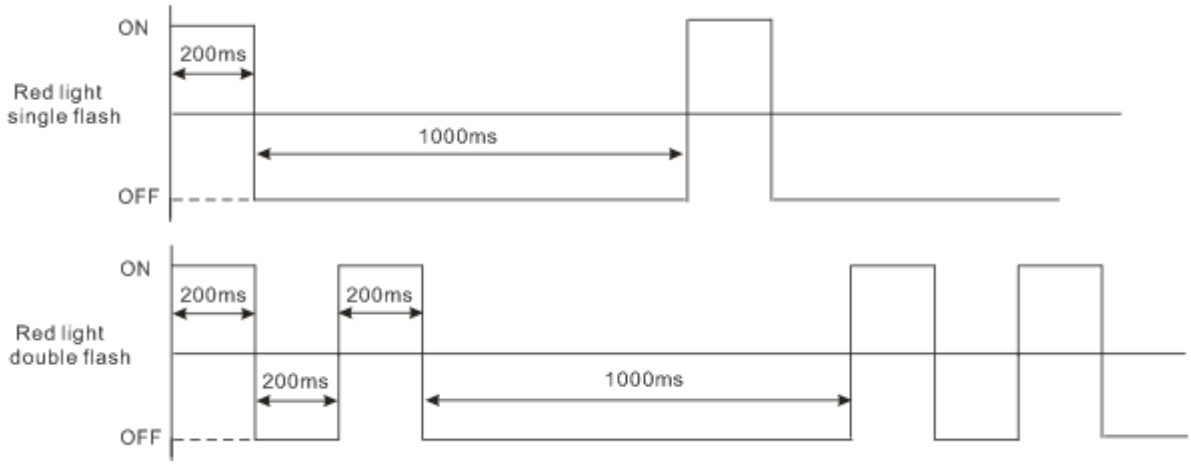
RUN LED green light single flash versus blinking:



7.3 ERR LED

LED status	Indication	How to correct
Off	Normal	--
Red light double flash	Slave is offline.	1. Check if CANopen bus is standard cable. 2. Check if both terminals of CANopen bus are connected with terminal resistance.
Red light single flash	Bus error exceeds the warning limit.	1. Check if CANopen bus is standard cable. 2. Check if both terminals of CANopen bus is connected with terminal resistance. 3. Check if the interference around CANopen bus is too strong.
Red light steady on	Bus-off	1. Check if connection for CANopen network bus cables is proper. 2. Check if DVPCOPM-S and other slaves are identical in baud rate.

Error LED red light single flash versus double flashes:



7.4 Codes in Digital Display

- DVPCOPM-SL as master:

Code	Indication	How to correct
1 ~ 7F	The node address of DVPCOPM-SL when in normal operation.	--
F1	Slave has not been added to node list of CANopen builder software.	Add slave into the node list and then redownload it to DVPCOPM-SL.
F2	The data are being downloaded to DVPCOPM-SL.	Wait till configuration is finished downloading
F3	DVPCOPM-SL in error status	Redownload parameter configuration and change into a new DVPCOPM-SL if the error still exists.
F4	Bus-off is detected.	Check if CANopen network bus cables are properly connected.

Code	Indication	How to correct
F5	Incorrect node address of DVPCOPM-SL settings	The node address for DVPCOPM-SL should be set in the range of 1~127.
F6	Internal error: manufacturing process	Repower DVPCOPM-SL. If the error still exists, change to a new DVPCOPM-SL.
F7	Internal error: GPIO check	
F8	Internal error: memory check	
F9	Low voltage is detected.	Check and make sure the power of DVPCOPM-SL works normally.
FA	The firmware of DVPCOPM-SL is in error status.	Repower DVPCOPM-SL.
FB	The sending buffer in DVPCOPM-SL is full.	Check and ensure CANopen network bus cables are properly connected and then repower DVPCOPM-SL
FC	The receiving buffer in DVPCOPM-SL is full.	Check and ensure CANopen network bus cables are properly connected and then repower DVPCOPM-SL.

E0	DVPCOPM-SL receives Emergency message sent by the slave.	Read relevant information through PLC CPU or Delta CANopen Builder software.
E1	PDO data length returned from the slave is not consistent with the length set in the node list.	Reset the PDO data length in the slave and download the new setting to DVPCOPM-SL.
E2	PDO message from the slave has not been received.	Check and make sure the setting is correct.
E3	Auto SDO download failed.	Check and make sure auto SDO is correct.
E4	PDO parameter setting has failed.	Make sure the PDO parameter setting is legal.
E5	Error in key parameter setting.	Make sure all the slaves connected are consistent with the slaves set.
E6	Slave is offline.	1. Make sure the power of the slave and the network connection work normally. 2. Check if CANopen bus is standard cable. 3. Check if Both terminals of CANopen bus is connected with terminal resistance. 4. Check if the interference around CANopen bus is too strong.
E7	The slave's error control is timed-out.	
E8	Master/slave node address is repeated.	Reset the node address and make sure the new address is not a repeated one.

- DVPCOPM-SL as slave:

Code	Indication	How to correct
1 ~ 7F	The node address of DVPCOPM-SL when in normal operation.	--
A0	The parameters in DVPCOPM-SL are being initialized.	Wait till initializing is finished.

Code	Indication	How to correct
A1	DVPCOPM-SL is in pre-operational status.	Check if the bus cables in CANopen network are connected properly.
A3	The data are being downloaded to DVPCOPM-SL.	Wait till configuration is finished downloading.
B0	Heartbeat timed-out	Check if the bus cables in CANopen network are connected properly.
B1	PDO data length returned from the slave is not consistent with the length set in the node list.	Reset the PDO data length in the slave and download the new setting to DVPCOPM-SL.
F4	Bus-off is detected	Check if the bus cables in CANopen network are connected properly; ensure all the nodes in the network work are at the same baud rate. Repower DVPCOPM-SL.
FB	The sending buffer in DVPCOPM-SL is full.	Make sure the bus works normally and repower DVPCOPM-SL.
FC	The receiving buffer in DVPCOPM-SL is full.	Check if the bus cables in CANopen network are connected properly and repower DVPCOPM-SL.

8 Indexes and Sub-indexes for DVPCOPM-SL Working as CANopen Slave

When DVPCOPM-SL serves as CANopen slave, the indexes/sub-indexes for different positions of the module on the left side of the PLC correspond to the registers in the PLC as shown in the following table. The position of the first one on the left of the PLC is 1, the position of the second one is 2, and so on.

Note: The corresponding device addresses are different for DVPCOPM-SL with different PLC. Please refer to Input and Output Mapping Areas for DVPCOPM-SL in Section 1.3 for details. Here the PLC is DVP-28SV.

Correspond to / Position	Index	Sub-index range	Input/output mapping area	Register in the PLC
1	H'2000	H'01~ H'20	Output mapping	D6282~D6313
	H'2001	H'01~ H'20	Input mapping	D6032~D6063
2	H'2000	H'01~ H'20	Output mapping	D6782~D6813
	H'2001	H'01~ H'20	Input mapping	D6532~D6563
3	H'2000	H'01~ H'20	Output mapping	D7282~D7313
	H'2001	H'01~ H'20	Input mapping	D7032~D7063
4	H'2000	H'01~ H'20	Output mapping	D7782~D7813
	H'2001	H'01~ H'20	Input mapping	D7532~D7563
5	H'2000	H'01~ H'20	Output mapping	D8282~D8313
	H'2001	H'01~ H'20	Input mapping	D8032~D8063
6	H'2000	H'01~ H'20	Output mapping	D8782~D8813
	H'2001	H'01~ H'20	Input mapping	D8532~D8563
7	H'2000	H'01~ H'20	Output mapping	D9282~D9313
	H'2001	H'01~ H'20	Input mapping	D9032~D9063
8	H'2000	H'01~ H'20	Output mapping	D9782~D9813
	H'2001	H'01~ H'20	Input mapping	D9532~D9563

Take the first one on the left side of the PLC for example. When DVPCOPM-SL serves as CANopen slave, its indexes and sub-indexes, and attributes correspond to the registers in the PLC as shown in the following table.

- Output mapping area

Index	Sub-index	Object name	Data type	Attribute	Register in the PLC (Output mapping area)
H'2000	H'01	Data_in[0]	Signed 16-bit	Write-only	D6282
	H'02	Data_in [1]	Signed 16-bit	Write-only	D6283
	H'03	Data_in [2]	Signed 16-bit	Write-only	D6284
	H'04	Data_in [3]	Signed 16-bit	Write-only	D6285
	H'05	Data_in [4]	Signed 16-bit	Write-only	D6286
	H'06	Data_in [5]	Signed 16-bit	Write-only	D6287
	H'07	Data_in [6]	Signed 16-bit	Write-only	D6288
	H'08	Data_in [7]	Signed 16-bit	Write-only	D6289
	H'09	Data_in [8]	Signed 16-bit	Write-only	D6290
	H'0A	Data_in [9]	Signed 16-bit	Write-only	D6291

Index	Sub-index	Object name	Data type	Attribute	Register in the PLC (Output mapping area)
	H'0B	Data_in [10]	Signed 16-bit	Write-only	D6292
	H'0C	Data_in [11]	Signed 16-bit	Write-only	D6293
	H'0D	Data_in [12]	Signed 16-bit	Write-only	D6294
H'2000	H'0E	Data_in [13]	Signed 16-bit	Write-only	D6295
	H'0F	Data_in [14]	Signed 16-bit	Write-only	D6296
	H'10	Data_in [15]	Signed 16-bit	Write-only	D6297
	H'11	Data_in [16]	Signed 16-bit	Write-only	D6298
	H'12	Data_in [17]	Signed 16-bit	Write-only	D6299
	H'13	Data_in [18]	Signed 16-bit	Write-only	D6300
	H'14	Data_in [19]	Signed 16-bit	Write-only	D6301
	H'15	Data_in [20]	Signed 16-bit	Write-only	D6302
	H'16	Data_in [21]	Signed 16-bit	Write-only	D6303
	H'17	Data_in [22]	Signed 16-bit	Write-only	D6304
	H'18	Data_in [23]	Signed 16-bit	Write-only	D6305
	H'19	Data_in [24]	Signed 16-bit	Write-only	D6306
	H'1A	Data_in [25]	Signed 16-bit	Write-only	D6307
	H'1B	Data_in [26]	Signed 16-bit	Write-only	D6308
	H'1C	Data_in [27]	Signed 16-bit	Write-only	D6309
	H'1D	Data_in [28]	Signed 16-bit	Write-only	D6310
	H'1E	Data_in [29]	Signed 16-bit	Write-only	D6311
	H'1F	Data_in [30]	Signed 16-bit	Write-only	D6312
	H'20	Data_in [31]	Signed 16-bit	Write-only	D6313

■ Input mapping area

Index	Sub-index	Object name	Data type	Attribute	Register in the PLC (Input mapping area)
H'2001	H'01	Data_out[0]	Signed 16-bit	Read-only	D6032
	H'02	Data_out[1]	Signed 16-bit	Read-only	D6033
	H'03	Data_out[2]	Signed 16-bit	Read-only	D6034
	H'04	Data_out [3]	Signed 16-bit	Read-only	D6035
	H'05	Data_out [4]	Signed 16-bit	Read-only	D6036
	H'06	Data_out [5]	Signed 16-bit	Read-only	D6037
	H'07	Data_out [6]	Signed 16-bit	Read-only	D6038
	H'08	Data_out [7]	Signed 16-bit	Read-only	D6039
	H'09	Data_out [8]	Signed 16-bit	Read-only	D6040
	H'0A	Data_out [9]	Signed 16-bit	Read-only	D6041
	H'0B	Data_out [10]	Signed 16-bit	Read-only	D6042
	H'0C	Data_out [11]	Signed 16-bit	Read-only	D6043
	H'0D	Data_out [12]	Signed 16-bit	Read-only	D6044
	H'0E	Data[_out 13]	Signed 16-bit	Read-only	D6045

Index	Sub-index	Object name	Data type	Attribute	Register in the PLC (Input mapping area)
	H'0F	Data_out [14]	Signed 16-bit	Read-only	D6046
	H'10	Data_out [15]	Signed 16-bit	Read-only	D6047
	H'11	Data_out [16]	Signed 16-bit	Read-only	D6048
H'2001	H'12	Data_out [17]	Signed 16-bit	Read-only	D6049
	H'13	Data_out [18]	Signed 16-bit	Read-only	D6050
	H'14	Data_out [19]	Signed 16-bit	Read-only	D6051
	H'15	Data_out [20]	Signed 16-bit	Read-only	D6052
	H'16	Data_out [21]	Signed 16-bit	Read-only	D6053
	H'17	Data_out [22]	Signed 16-bit	Read-only	D6054
	H'18	Data_out [23]	Signed 16-bit	Read-only	D6055
	H'19	Data_out [24]	Signed 16-bit	Read-only	D6056
	H'1A	Data_out [25]	Signed 16-bit	Read-only	D6057
	H'1B	Data_out [26]	Signed 16-bit	Read-only	D6058
	H'1C	Data_out [27]	Signed 16-bit	Read-only	D6059
	H'1D	Data_out [28]	Signed 16-bit	Read-only	D6060
	H'1E	Data_out [29]	Signed 16-bit	Read-only	D6061
	H'1F	Data_out [30]	Signed 16-bit	Read-only	D6062
	H'20	Data_out [31]	Signed 16-bit	Read-only	D6063