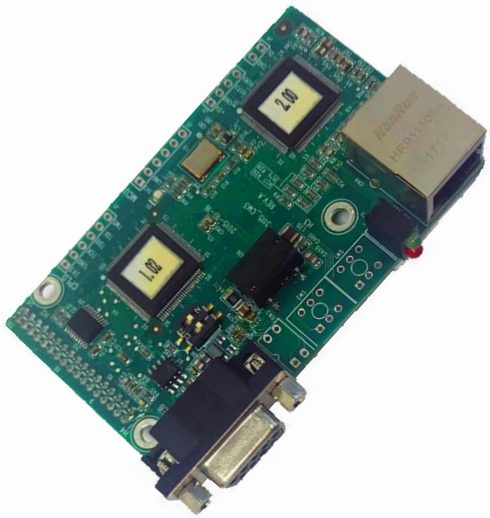
IMO

Instruction Manual

Profibus-DP option card

HD1-E-PDP



⚠CAUTION

Thank you for purchasing your HD1-E-PDP option card.

- This product is designed for setting and programming Profibus-DP communication protocol with HD1 series of inverters
- Improper handling might result in incorrect operation, a short life, or even a failure of this product.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
- For how to use an optional device, refer to the instruction and installation manuals for that optional device.

Option card

A.1 What this manual contains

This chapter describes the Profibus communication card used in HD1 series inverters.

A.2 PROFIBUS communication card

(1) PROFIBUS is an open international fieldbus standard that allows data exchange among various types of automation components. It is widely used in manufacturing automation, process automation and in other automation areas such as buildings, transportation, power, providing an effective solution for the realization of comprehensive automation and site-equipment intellectualization.
(2) PROFIBUS is composed of three compatible components, PROFIBUS -DP (Decentralized Periphery, distributed peripherals), PROFIBUS-PA (Process Automation), PROFIBUS-FMS (Fieldbus Message Specification). It is periodically exchange data with the inverter when using master-slave way. PRNV PROFIBUS-DP Adapter module only supports PROFIBUS-DP protocol.
(3) The physical transmission medium of bus is twisted-pair (in line with RS-485 standard), two-wire cable or fiber optic cable. Baud rate is from 9.6Kbit/s to 12Mbit/s. The maximum bus cable length is between 100 m and 1200 m, specific length depending on the selected transmission rate (see chapter ***Technical Data***). Up to 31 nodes can be connected to the same PROFIBUS network when repeaters aren't used. But, if use repeaters, up to 127 nodes can be connected to the same PROFIBUS network segment (including repeaters and master stations).
(4) In the process of PROFIBUS communication, tokens are assigned among main stations and master-slave transmission among master-slave stations. Supporting single-master or multi-master system, stations-programmable logic controller (PLC)-choose nodes to respond to the host instruction. Cycle master-from user data transmission and non-cyclic master-master station can also send commands to multiple nodes in the form of broadcast. In this case, the nodes do not need to send feedback signals to the host. In the PROFIBUS network, communication between nodes cannot be allowed.
(5) PROFIBUS protocol is described in detail in EN 50170 standard. To obtain more information about PROFIBUS, please refer to the above-mentioned EN 50170 standards.

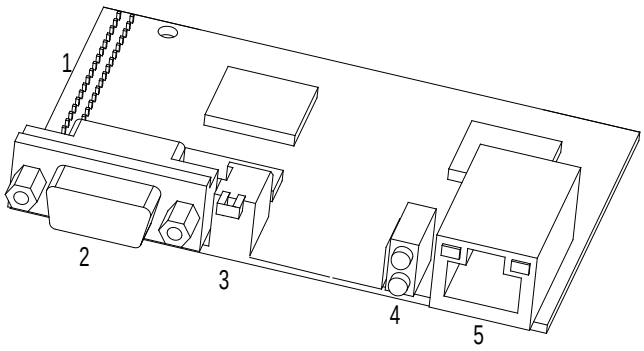
A.2.2 HD-E-PDP communication card

HD1-E-PDP communication card is an optional device to inverter which makes inverter connected to PROFIBUS network. In PROFIBUS network, inverter is a subsidiary device. The following functions can be completed using HD1-E-PDP communication card:

- Send control commands to inverter (start, stop, fault reset, etc.).
- Send speed or given torque signal to inverter.
- Read state and actual values from inverter.
- Modify inverter parameter.

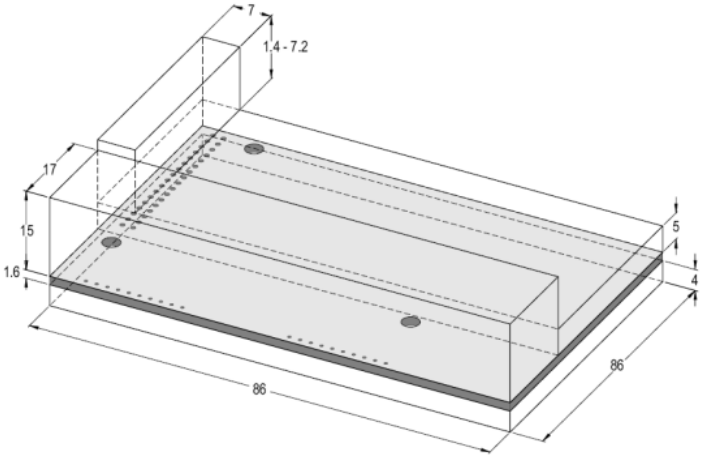
Please refer to the description of function codes in Group P15 for the commands supported by the inverter. Below is the structure diagram of the connection between the inverter and PROFIBUS:

A.2.3 The appearance of HD1-E-PDP communication card



Outline diagram of HD1-I-PDP communication card

1. Interface to the panel 2. Bus connector 3. Rotation node address selection switches 4. State display LEDs



External dimensions of HD1-E-PDP communication card (Unit : mm)

A.2.4 Compatible motor of HD1-E-PDP communication card

HD1-E-PDP communication card is compatible with the following products:

- HD1 series inverters and all blasters supporting PROFIBUS-DP extension
- Host station supporting PROFIBUS-DP protocol

A.2.5 Delivery list

The package of HD1-E-PDP communication card contains:

- HD1-E-PDP communication card
- Three copper columns (M3x10)
- User's manual

Please contact supplier if any items are missing from packaging.

A.2.6 Installation of HD1-E-PDP communication card

A.2.6.1 Mechanical installation of HD1-E-PDP communication card

1. Installation ambient

- Ambient temperature:0℃ ~ +40℃
- Relative humidity:5%~95%
- Other climate conditions: no dew, ice, rain, snow, hail air condition and the solar radiation is below 700W/m^2,air pressure 70~106kPa
- Content of salt spray and corrosive gases :Pollution level 2
- Dust and solid particles content: Pollution level 2
- Vibration and shock: 5.9m/s^2 (0.6g) on 9~200Hz sinusoidal vibration

2. Installation steps:

- Fix the three copper columns on the location holes with screws.
- Insert the module into the defined location carefully and fix it on the copper column with screw.
- Set the bus terminal switch of the module to the needed location.

3. Notes:

Disconnect the device from the power line before installation. Wait at least three minutes to allow the capacitors to discharge. Disconnect dangerous voltage from external control circuit to the unit output and input terminals.

Some electric components are sensitive to static charge. Do not touch the circuit board. If you must operate on it, wear a grounding wrist belt.

A.2.6.2 Electrical installation of HD1-E-PDP communication card

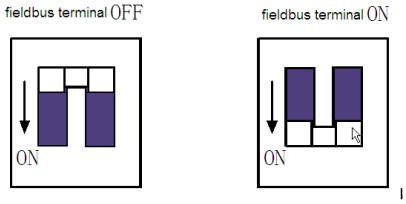
1. Node selection

Node address is the only address of PROFIBUS on the bus. The address which is among 00~99 is shown with two figures and is selected by the spinning switch on the module. The left switch shows the first number and the right one show the second number.

Node address = 10 x the first digital value + the second digital value x 1

2. Bus terminals

There is a bus terminal in each heading and ending to avoid error during operation. The DIP switch on RPBA-01PCB is used to connect the bus terminals which can avoid the signal feedback from the bus cables. If the module is the first or last one in the internet, the bus terminal should be set as ON. Please disconnect HD1-E-PDP communication card terminals when the PROFIBUS D-sub connector with internal terminals is in use.



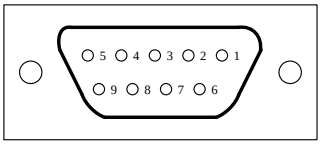
A.2.6.3 Bus net connection of HD1-E-PDP communication card

Bus communication interface

Transformation by double-shielded twisted pair copper cable is the most common way in PROFIBUS (conform to RS-485standard).

The basic characteristics of transformation technology:

- Net topology: Linear bus, there are bus resistors at both ends.
- Transforming speed: 9.6k bit/s~12M bit/s
- Medium: double-shielded twisted pair cables, the shield can be removed according to the environment (EMC).
- Station number: There are 32 stations in each segment (without relays) as to 127 stations (with relays)
- Contact pin: 9 frames D pin, the connector contact pins are as below:,



Contact pin of the connector		Instruction
1	-	Unused
2	-	Unused
3	B-Line	Positive data(twisted pair cables 1)
4	RTS	Sending requirement
5	GND_BUS	Isolation ground
6	+5V BUS	Isolated 5V DC power supply
7	-	Unused
8	A-Line	Negative data(twisted pair cables 2)
9	-	Unused
Housing	SHLD	PROFIBUS shielded cable

+5V and GND_BUS is used in the fieldbus terminals. Some devices, such as light transceiver (RS485) may get external power supply from these pins.

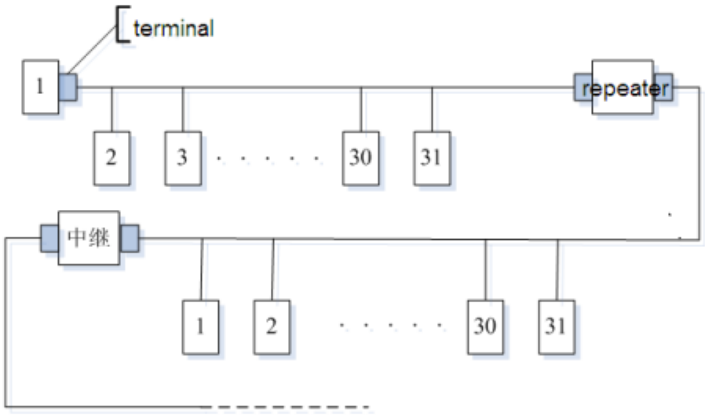
RTS is used in some devices to determine the sending direction. Only A-Line wires, B-Line wires and shield are used in the normal application.

It is recommended to use a standard DB9 connector. If the communication baud rate is above 187.5kbps, please follow the connection rules of SIEMENS accurately.

Repeater

Up to 32 stations can be connected to each segment (master station or subsidiary stations), the repeater have to be used when stations is more than 32. The repeaters in series are generally no more than 3.

Note: There is no repeater station address.



A.2.6.4 Transmission rate and maximum distance

Maximum length of cable depends on the transmission rate. The Table below shows the relationship between transmission rate and distance.

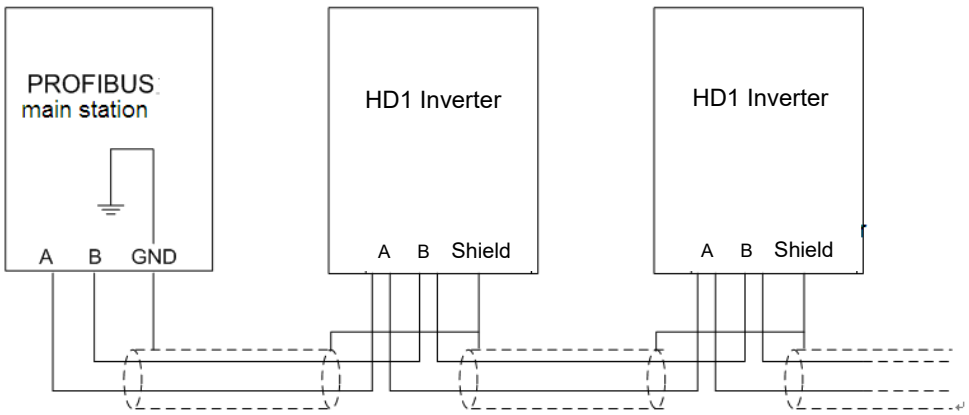
Transmission rate (kbps)	A-wire (m)	B-wire (m)
9.6	1200	1200
19.2	1200	1200
93.75	1200	1200
187.5	1000	600
500	400	200
1500	200	-----
12000	100	-----

Transmission line parameters:

Transmission rate (kbps)	A-wire (m)	B-wire (m)
Impedance (Ω)	135~165	100~130
Capacitance per unit length(pF/m)	< 30	< 60
Loop Resistance (Ω/km)	110	--------
Core wire diameter (mm)	0.64	> 0.53
Line-core cross-section (mm^2)	> 0.34	> 0.22

Besides shielding twisted-pair copper wires, PROFIBUS can also use optical fiber for transmission in an electromagnetic interference environment to increase the high-speed transmission distance there are two kinds of fiber optical conductors, one is low-cost plastic fiber conductor, used distance is less than 50 meters, the other is glass fiber conductor, and used distance is less than 1 kM.

A.2.6.5 PROFIBUS bus connection diagram



Above is "terminal" wiring diagram. Cable is a standard PROFIBUS cable consisting of a twisted pair and shielding layer. The shielded layer of PROFIBUS cable on all nodes is directly grounded. Users can choose the best grounding method according to the situation.

Note:

Make sure that signal lines do not twist when connecting all stations. Shielded cable should be used when system runs under high electromagnetic interface environment, which can improve electromagnetic compatibility (EMC).

If using shielded braided wire and shielding foil, both ends should be connected to ground. Using shielding area should be large enough to maintain a good conductivity. And data lines must be separated from high-voltage.

Stub line segment should not be used when transmission rate more than 500K bit/s, The plug is available on the market which connects directly to data input and output cable. Bus plug connection can be on or off at any time without interruption of data communications of other station.

A.2.7 System configuration

1. Master station and inverter should be configured so that the master station can communicate with the module after correctly installing HD1-E-PDP communication card.

Each PROFIBUS subsidiary station on the PROFIBUS bus need to have "device description document" named GSD file which used to describe the characteristics of PROFIBUS -DP devices. The software we provided for the user includes inverter related GSD files (device data files) information.

Configuration parameters of HD1-E-PDP communication card:

Parameter number	Parameter name	Optional setting		Factory setting
0	Module type	Read only		PROFIBUS-DP
1	Node address	0~99		2
2	Baud rate setting	kbit/s	0:9.6	6
			1:19.2	
			2:45.45	
			3:93.75	
			4:187.5	
			5:500	
		Mbit/s	6:1.5	
			7:3	
			8:6	
			9:9	
			10:12	
3	PZD3	0~65535		0
4	PZD4	The same as the above		0
…	……	The same as the above		0
10	PZD12	The same as the above		0

2. Module type

This parameter shows communication module type detected by inverter; users can not adjust this parameter. If this parameter is not defined, communication between the modules and inverter cannot be established.

3. Node address

In PROFIBUS network, each device corresponds to a unique node address, you can use the node address selection switch to define node address (switch isn't at 0) and the parameter is only used to display the node address.

If node address selection switch is 0, this parameter can define node address. The user can not adjust the parameter by themselves and the parameter is only used to display the node address.

4. GSD file

In PROFIBUS network, each PROFIBUS subsidiary station needs GSD file "device description document" which used to describe the characteristics of PROFIBUS-DP devices. GSD file contains all defined parameters, including baud rate, information length, amount of input/output data, meaning of diagnostic data.

A CD-ROM will be offered in which contains GSD file (extension name is .gsd) for fieldbus adapter. Users can copy GSD file to relevant subdirectory of configuration tools, please refer to relevant system configuration software instructions to know specific operations and PROFIBUS system configuration.

A.2.8 PROFIBUS-DP communication

1. PROFIBUS-DP

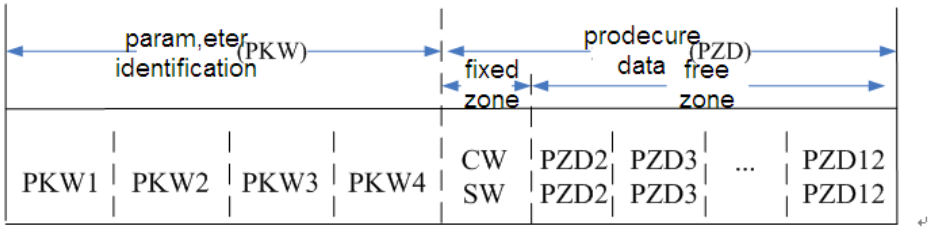
PROFIBUS-DP is a distributed I/O system, which enables master machine to use a large number of peripheral modules and field devices. Data transmission shows cycle: master machine read input information from subsidiary machine then give feedback signal. HD1-E-PDP communication card supports PROFIBUS-DP protocol.

2. Service access point

PROFIBUS-DP has access to PROFIBUS data link layer (Layer 2) services through service access point SAP. Every independent SAP has clearly defined function. Please refer to relevant PROFIBUS user manual to know more about service access point information. PROFIDRIVE-Variable speed drive adopts PROFIBUS model or EN50170 standards (PROFIBUS protocol).

3. PROFIBUS-DP information frame data structures

PROFIBUS-DP bus mode allows rapid data exchange between master station and inverter. Adopting master-slave mode dealing with inverter access, inverter is always subsidiary station, and each has definite address. PROFIBUS periodic transmission messages use 16 words (16 bit) transmission, the structure shown in figure1.



Parameters area:

PKW1-Parameter identification

PKW2-array index number

PKW3-parameter value 1

PKW4-parameter value 2

Process data:

CW-Control word (from master to slave)

SW-state word (from slave to master)

PZD-process data (decided by users) (From master to slave output 【given value】, from slave to master input【actual value】)

PZD area (process data area)

PZD area of communication message is designed for control and monitor inverter. PZD from master and slave station is addressed in high priority; the priority of dealing with PZD is superior to that of PKW, and always sends current valid date from interface.

Control word (CW) and state word (SW)

Control word (CW) is a basic method of fieldbus system controlling inverter. It is sent by the fieldbus master station to inverter and the HD1-E-PDP communication cards act as gateway. Inverter responds according to the control word and gives feedbacks to master machine through state word (SW).

Given value

Inverter can receive control information by several ways, these channels include analog and digital input terminals, inverter control board and module communication (such as RS485, HD1-E-PDP communication cards). In order to use PROFIBUS/CANOPEN control inverter, the communication module must be set to be inverter controller.

Actual value

Actual value is a 16-bit word, which contains converter operation information. Monitoring capabilities are defined by inverter parameter. The integer scaling of actual value is sent to master machine depending on selected function, please refer to inverter manual.

Note: inverter always check the control word (CW) and bytes of given value.

Mission message (From master station to inverter)

Control word (CW)

The first word of PZD is control word (CW) of inverter; due to different control word (CW) of PWM rectifier regenerative part and inverter part Illustration is depart in next two tables.

Control word (CW) of HD1

Bit	Name	Value	State/Description
0~7	COMMAND BYTE	1	Forward running
		2	Reverse running
		3	Forward jogging
		4	Reverse jogging
		5	Decelerate to stop
		6	Coast to stop (Emergency stop)
		7	Fault reset
		8	Jogging stop
8	WRITE ENABLE	1	Write enable (mainly is PKW1-PKW4)
9~10	MOTOR GROUP SELECTION	00	Motor group 1 selection
		01	Motor group 2 selection
		02	Motor group 3 selection
		03	Motor group 4 selection
11	TORQUE CONTROL SELECTION	1	Torque control enable
		0	Torque control disable
12	ELECTRIC CONSUMPTION CLEAR	1	Electric consumption clear enable
		0	Electric consumption clear disable
13	PRE-EXCITATION	1	Pre-excitation enable
		0	Pre-excitation disable
14	DC BRAKE	1	DC braking enable
		0	DC braking disable
15	HEARTBEAT REF	1	Heartbeat enable
		0	Heartbeat disable

Reference value (REF):

From 2nd word to 12th of PZD task message is the main set value REF, main frequency set value is offered by main setting signal source. As PWM rectifier feedback part doesn't have main frequency setting part, corresponding settings belong to reserved part, the following table shows inverter part settings for HD1

Bit	Name	Function selection
PZD2 receiving	0:Invalid 1:Set frequency(0~Fmax(unit:0.01Hz)) 2: Given PID, range (0~1000,1000 corresponds to 100.0%) 3: PID feedback, range (0~1000,1000 corresponds to 100.0%) 4:Torque set value(-3000~3000,1000 corresponds to 100.0% the rated current of the motor) 5:Set value of the forward rotation upper-limit frequency(0~Fmax unit:0.01Hz)) 6:Set value of the reversed rotation upper-limit frequency(0~Fmax(unit:0.01Hz)) 7:Electromotion torque upper limit (0~3000,1000 corresponds to 100.0%of the rated current of the motor) 8:Braking torque upper limit (0~2000,1000 corresponds to 100.0% of the rated current of the motor) 9:Virtual input terminals command Range:0x000~0x1FF 10:Virtual output terminals command Range:0x00~0x0F 11:Voltage setting value(special for V/F separation) (0~1000,1000 corresponds to 100.0% the rated voltage of the motor) 12:AO output set value 1 (-1000~1000, 1000 corresponds to 100.0%) 13:AO output set value 2 (-1000~1000, 1000 corresponds to 100.0%)	0
PZD3 receiving		0
PZD4 receiving		0
PZD5 receiving		0
PZD6 receiving		0
PZD7 receiving		0
PZD8 receiving		0
PZD9 receiving		0
PZD10 receiving		0
PZD11 receiving		0
PZD12 receiving		**0**

State word (SW):

The first word of PZD response message is state word (SW) of inverter, the definition of state word is as follows:

State Word (SW) of HD1 (SW)

Bit	Name	Value	State/Description
0~7	RUN STATE BYTE	1	Forward running
		2	Reverse running
		3	The inverter stops
		4	The inverter is in fault
		5	The inverter is in POFF state
		6	Pre-exciting state
8	DC VOLTAGE ESTABLISH	1	Running ready
		0	The running preparation is not ready
9~10	MOTOR GROUP FEEDBACK	0	Motor 1 feedback
		1	Motor 2 feedback
		2	Motor 3 feedback
		3	Motor 4 no feedback
11	MOTOR TYPE FEEDBACK	1	Synchronous motor
		0	Asynchronous motor
12	OVERLOAD ALARM	1	Overload pre-alarm
		0	Non-overload pre-alarm
13	RUN/STOP MODE	0	Keypad control
		1	Terminal control
14		2	Communication control
		3	Reserved
15	HEARTBEAT FEEDBACK	1	Heartbeat feedback
		0	No heartbeat feedback

Actual value (ACT):

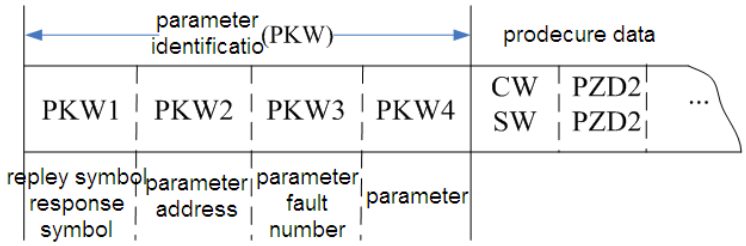
From 2nd word to 12th of PZD task message is main set value ACT, main frequency set value is offered by main setting signal source.

Actual value of HD1

Bit	Name	Function selection
PZD2 sending	0: Invalid	0
PZD3 sending	1:Running frequency(*100, Hz)	0
PZD4 sending	2: Set frequency(*100, Hz)	0
PZD5 sending	3: Bus voltage(*10, V)	0
PZD6 sending	4: Output voltage(*1, V)	0
PZD7 sending	5:Output current (*10, A)	0
PZD8 sending	6: Output torque actual value (*10, %)	0
PZD9 sending	7: Output power actual value (*10, %)	0
PZD10 sending	8:Running rotating speed(*1, RPM)	0
PZD11 sending	9:Running linear speed (*1, m/s)	0
PZD12 sending	10:Ramp given frequency 11:Fault code 12:AI1 value (*100, V) 13:AI2 value (*100, V) 14:AI3 value (*100, V) 15:PULSE frequency value (*100, kHz) 16:Terminals input state 17:Terminals output state 18: PID given (*100, %) 19: PID feedback (*100, %) 20:Motor rated torque	0

PKW area (parameter identification marks PKW1-value area). PKW area describes treatment of parameter identification interface, PKW interface is a mechanism which determine parameters transmission between two communication partners, such as reading and writing parameter values.

Structure of PKW area:



Parameter identification zone

In the process of periodic PROFIBUS-DP communication, PKW area is composed of four words (16 bit), each word is defined as follows:

The first word PKW1 (16 bit)		
Bit 15~00	Task or response identification marks	0~7
The second word PKW2 (16 bit)		
Bit 15~00	Basic parameters address	0~247
The third word PKW3 (16 bit)		
Bit 15~00	Parameter value (high word) or return error code value	00
The fourth word PKW4 (16 bit)		
Bit 15~00	Parameter value (low word)	0~65535

Note: If the master requests one parameter value, the value of PKW3 and PKW4 will not be valid.

Task requests and responses

When passing data to slave machine, master machine use request label while slave machine use response label to positive or negative confirmation. Table 5.5 and Table 5.6 list the request/response functional.

The definition of task logo PKW1 is as follows:

Definition of task logo PKW1

Request label (From master to slave)		Response label	
Request	Function	Positive confirmation	Negative confirmation
0	No task	0	—
1	Request parameter value	1,2	3
2	Modification parameter value (one word) [only change RAM]	1	3 or 4
3	Modification parameter value (double word) [only change RAM]	2	3 or 4
4	Modification parameter value (one word) [RAM and EEPROM are modified]	1	3 or 4
5	Modification parameter value (double word) [RAM and EEPROM are modified]	2	3 or 4

Request label

"2"-modification parameter value (one word) [only change RAM],

"3"-modification parameter value (double word) [only change RAM]

"5"-modification parameter value (double word) [RAM and EPROM are modified] not support currently.

Reponses logo PKW1 defines as below:

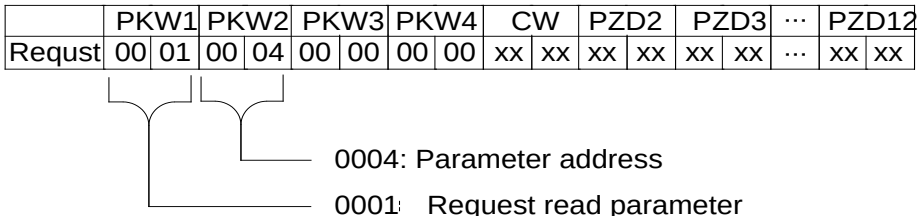
Response label (From slave to master)	
Confirmation	**Function**
0	No response
1	Transmission parameter value (one word)
2	Transmission parameter value (two word)
3	Task cannot be executed and returns the following error number: 0: Illegal parameter number 1: Parameter values cannot be changed (read-only parameter) 2: Out of set value range 3: The sub-index number is not correct 4: Setting is not allowed (only reset)

Response label (From slave to master)	
Confirmation	**Function**
	5: Data type is invalid 6: The task could not be implemented due to operational state 7: Request isn't supported. 8: Request can't be completed due to communication error 9: Fault occurs when write operation to stationary store 10: Request fails due to timeout 11: Parameter cannot be assigned to PZD 12: Control word bit can't be allocated 13: Other errors
4	No parameter change rights

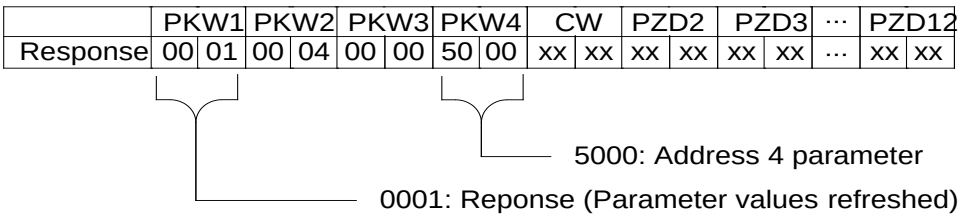
Example 1: Read parameter value

Read keypad set frequency value (the address of keypad set frequency is 4) which can be achieved by setting PKW1 as 1, PKW2 as 4, return value is in PKW4.

Request (From master to inverter):



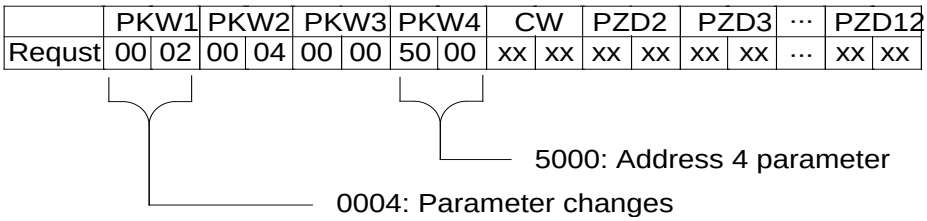
Response (From inverter to master)



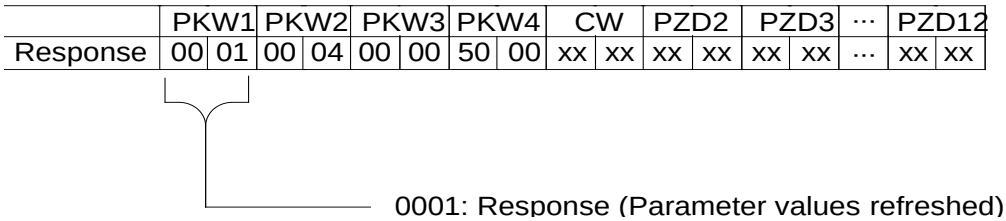
Example 2: Modify the parameter values (RAM and EEPROM are modified)

Modify keypad settings frequency value (the address of keypad set frequency is 4) which can be achieved by setting PKW1 as 2; PKW2 as 4, modification value (50.00) is in PKW4.

Request (From master to inverter):



Response (From inverter to master)



Example for PZD:

Transmission of PZD area is achieved through inverter function code; please refer to relevant HD1 inverter user manual for relevant function code.

Example 1: Read process data of inverter

Inverter parameter selects "8: Running rotation speed" as PZD3 to transmit which can be achieved by setting P15.14 as 8. This operation is mandatory until the parameter is instead of others.

Request (From master to inverter):

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	00	0A	…	xx	xx

Example 2: Write process data into inverter

Inverter parameter selects "2": PID reference" from PZD3 which can be achieved by setting P15.03 as 2. In each request frame, parameters will use PZD3 to update until re-select a parameter.

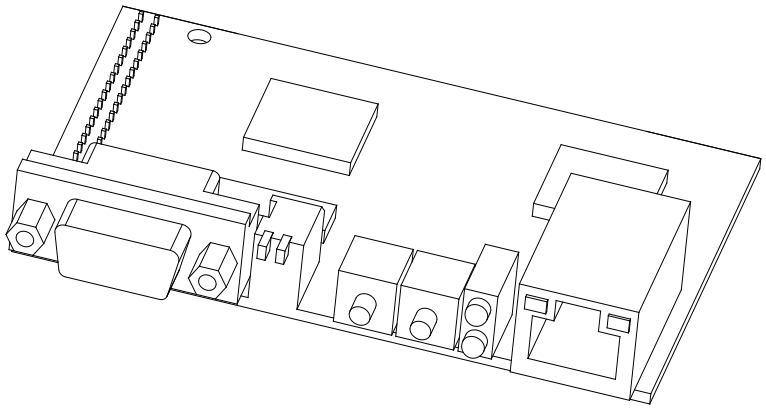
Request (From master to converter):

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	00	00	…	xx	xx

In each request frame contents of PZD3 are given by traction until re-select a parameter.

A.2.9 Fault information

HD1-E-PDP communication card is equipped with 2 fault display LEDs as shown is figure below. The roles of these LEDs are as follows:



Fault display LEDs

LED No.	Name	Color	Function
2	Online	Green	ON-module online and data can be exchanged. OFF-module is not in "online" state.
4	Offline/Fault	Red	ON-module offline and data can't be exchanged. OFF-module is not in "offline" state. 1. Flicker frequency 1Hz-configuration error: The length of user parameter data sets is different from that of network configuration process during module initialization process. 2. Flicker frequency 2Hz-user parameter data error: The length or content of user parameter data sets is different from that of network configuration process during module initialization process. 3. Flicker frequency 4Hz-PROFIBUS communication ASIC initialization error. 4. OFF-Diagnostic closed.

Memo:

Profibus-DP option card.

HD1-E-PDP

Instruction Manual

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The purpose of this instruction manual is to provide accurate information for setting and programming Profibus-DP communication protocol with HD1 series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will IMO Precision Controls Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

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