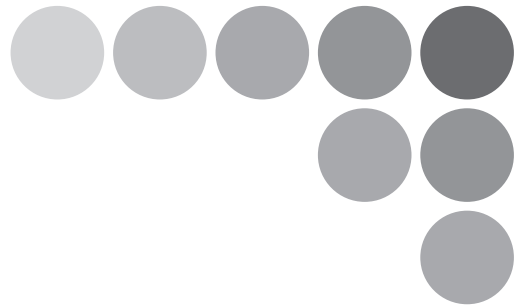


OMRON

Smart Sensors

ZS-HL-N Series



CompoWay/F Communication Command Reference

Introduction

Thank you for purchasing the ZS-HL-N Series. This manual provides information regarding operations and input/output formats for the communication between ZS-HL-N Series controllers and external devices using the Omron proprietary protocol, CompoWay/F.

When using the ZS-HL-N Series, be sure to observe the following:

- The ZS-HL-N Series must be operated by personnel knowledgeable in electrical engineering.
- To ensure correct use, please read this manual thoroughly to deepen your understanding of the product.
- Please keep this manual in a safe place so that it can be referred to whenever necessary.






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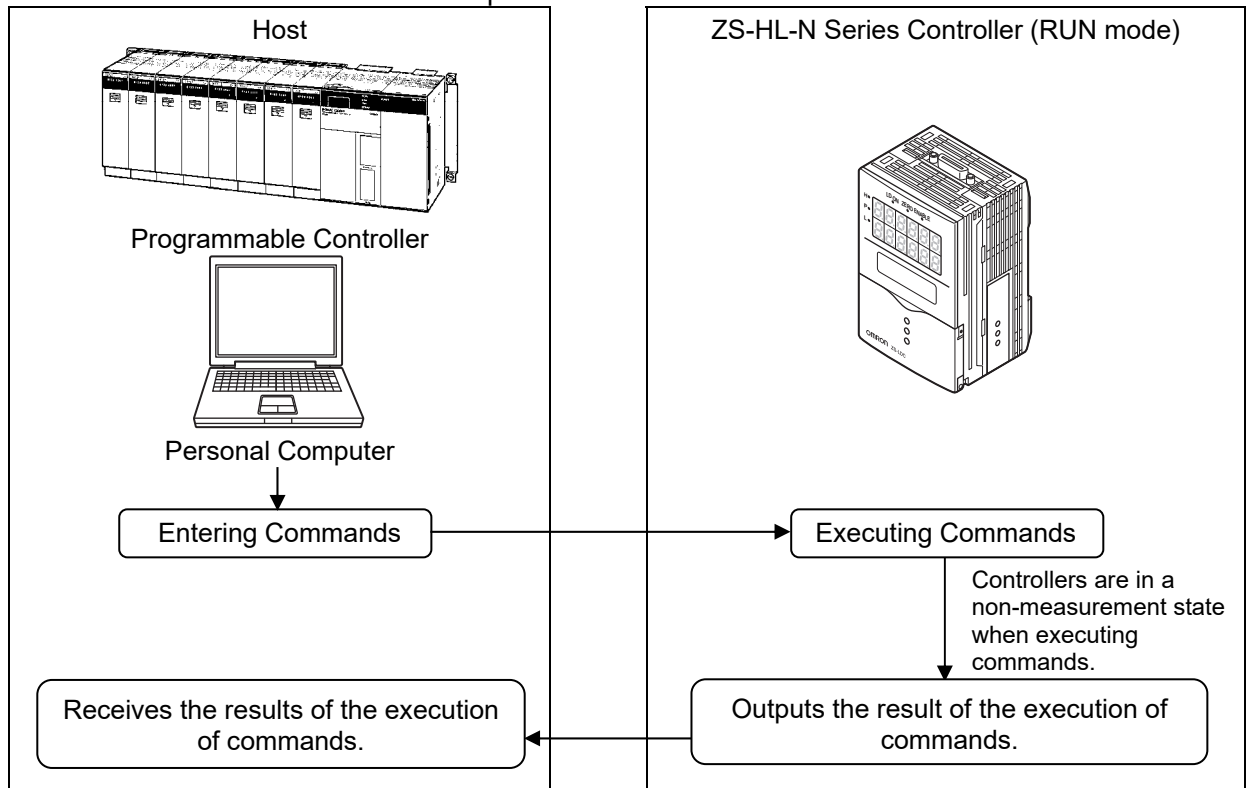
Section 1

About Communication Commands

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How Communication Works

ZS-HL-N Series controllers have communication functions with external devices. Use this function to read the data in ZS-HL-N Series controllers from the host and to write the setting data. Communication is achieved via the Command and Response Method based on the CompoWay/F, which is Omron's proprietary communication protocol. Controllers perform processing according to the command sent from the host, and then return the result to the host which sent the command as a response.



Setting the Communication Specifications

Change the settings of the controller communication specifications for communicating with the external device by CompoWay/F protocol.



CHECK!

Use USB cable or RS-232C cable to connect ZS-HL-N Series controllers to external devices.

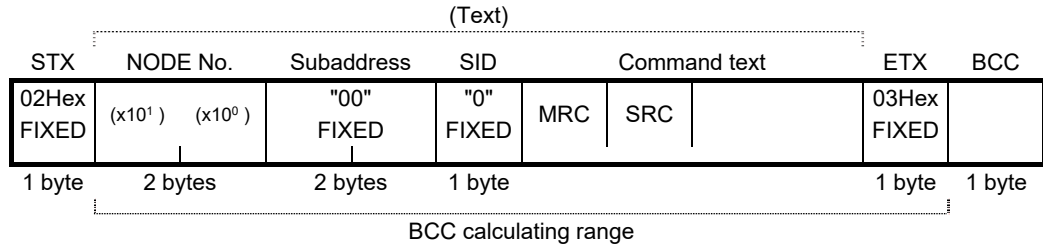
For USB cable connection, install Smart Monitor ZS and USB driver beforehand. After installing Smart Monitor ZS, USB ports are recognized as standard COM ports, and communication is achieved as with the RS-232C. (Setting the communication specifications including baud rate is not necessary.)

For details on how to connect cable, refer to the User's Manual for each controller.

- 1. Set the mode switch to "FUN"**
- 2. Select [System] - [Communication] - [Mode] menu.**
- 3. Select [CompoWay/F].**
- 4. For RS-232C cable connection, select [System] - [Communication] - [RS-232C] menu to set the appropriate communication specifications for the external device.**
- 5. Save the settings.**

Command Formats

The command format of the communication commands is shown below. In the following section, items described with "Hex" after numerical values (ex. 02Hex) indicate hexadecimal numbers. Those described with " " or only with numeral values indicate ASCII characters.



* In the example format, 1 byte = 1 ASCII character.

Elements	Details
STX	This is a code to indicate the first part of communication frames (02Hex). Make sure to set the first byte to 02Hex. When a controller receives STX while receiving a command, it receives the command again starting from where it received STX.
NODE No.	This is the Node No. for the identification of the destination. * About Node No. It refers to the connection group No. as seen from the host device (PLC). Not only the ZS-HL-N Series but other multiple devices are connected to the PLC. The number assigned to devices connected to a PLC such as this is referred to as a Node No.
Subaddress	This should be fixed to "00."
SID (Service ID)	This should be fixed to "0."
Command text	This is the text part of the command. "Section 2 – Details of Commands" describes these parts by command.
ETX	This is a code to indicate the end of the text (03Hex).
BCC	This is a block check character. The exclusive OR (XOR) of values from Node No. to ETX per byte is BCC.

■ Example of BCC calculation

STX	NODE No.		Subaddress	SID	Command text	ETX	BCC
02Hex	"0" (30Hex)	"0" (30Hex)	"00" (3030Hex)	"0" (30Hex)	"30053001" (3330303533303031Hex)	03Hex	37Hex

Set the result of calculation, which is "37Hex," to BCC.

<Calculation>



$$\text{BCC} = 30\text{Hex} + 30\text{Hex} + 30\text{Hex} + 30\text{Hex} + 30\text{Hex} + 33\text{Hex} + 30\text{Hex} + 30\text{Hex} + 35\text{Hex} + 33\text{Hex} + 30\text{Hex} + 30\text{Hex} + 31\text{Hex} + 03\text{Hex} = 37\text{Hex}$$

"+" indicates the exclusive OR (XOR) operation.

Response Formats

The response format of the communication commands is shown below. In the following section, items described with "Hex" after numerical values (ex. 02Hex) indicate hexadecimal numbers. Those described with " " or only with numeral values indicate ASCII characters.

STX	NODE No.	Subaddress	End code	Response text		ETX	BCC
02Hex Fixed	($\times 10^1$) ($\times 10^0$)	"00" Fixed		MRC	SRC	03Hex Fixed	
1 byte	2 bytes	2 bytes	2 bytes			1 byte	1 byte

Elements	Details
STX	 Command Formats - page 1 - 4
NODE No.	
Subaddress	
End code	Refer to the next page.
Response text	This is the response text part of the command. "Section 2 – Details of Commands" describes these parts by command.
ETX	 Command Formats - page 1 - 4
BCC	

End codes of responses are shown below.

End code	Name	Details
"00"	Normal end	Command ends successfully.
"0F"	Command error	Specified command is not executed. Refer to the response code for details of the non-execution.
"10"	Parity error	Parity error occurred with any character while receiving a command.
"11"	Framing error	Framing error occurred with any character while receiving a command.
"12"	Overrun error	Overrun error occurred with any character while receiving a command.
"13"	BCC error	Received an invalid BCC.
"14"	Format error	<ul style="list-style-type: none"> Occurs when characters other than 0 to 9 or A to F are used for command text parts. (Except during echo back tests) No SID and command texts exist. Or no command text exists. Either MRC or SRC is missing in the command text.
"16"	Subaddress error	<ul style="list-style-type: none"> Subaddress of the receiving frame is invalid (not supported). No subaddress, SID, and command texts exist. Subaddress is shorter than two characters, and no SID and command texts exist.
"18"	Frame length error	Receiving frame exceeds the supported number of bytes.

One end code is returned after receiving one complete command frame to the node.

No response is made when ETX or BCC characters are missing.



CHECK!

Noises may cause response errors or no response.

Make sure to retry from the host.

It may take three seconds at longest from sending a command to receiving a response. If no response is returned, make sure to send another command after waiting for more than three seconds.

Examples of Abnormal End

This section shows the examples of end codes for abnormal ends while receiving commands.

- **Invalid subaddress, and no SID and command text exist**

Command

STX	NODE No.	Subaddress	ETX	BCC
02Hex		"0" "A"	03Hex	

Response

STX	NODE No.	Subaddress	End code	ETX	BCC
02Hex		"0" "A"	"1" "6"	03Hex	

End code is "16" (Subaddress error).

- This response occurred because subaddress errors are prioritized over format errors.

- **No command text exists in the command**

Command

STX	NODE No.	Subaddress	SID	ETX	BCC
02Hex		"0" "0"	"0"	03Hex	

Response

STX	NODE No.	Subaddress	End code	ETX	BCC
02Hex		"0" "0"	"1" "4"	03Hex	

End code is "14" (Format error).

- **Node No. is missing**

Command

STX	ETX	BCC
02Hex	03Hex	

One character is missing for the Node No.

Response

No response is returned.

- **No subaddress exists, and an invalid BCC is used**

Command

STX	NODE No.	ETX	BCC
02Hex		03Hex	Err







Response

STX	NODE No.	Subaddress	End code	ETX	BCC
02Hex		"0" "0"	"1" "3"	03Hex	

Subaddress is "00" and end code is "13" (BCC error).

Section 2

Details of Commands

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About General Information of Communication Commands

Communication commands are categorized into the groups and meanings as in the following table:

Groups		Meanings	Pages for Reference
Reading parameter areas	System- related	Read setting values related to the system.	Page 2-3
	Measurement- related	Read measurement-related setting values and results of measurements. Obtain data by specifying Unit No. and Data No.	(Refer to Section 3 for Unit No. and Data No.)
Writing parameter areas	System- related	Write setting values related to the system.	-
	Measurement- related	Write measurement-related setting values and results of measurements. Write data by specifying Unit No. and Data No.	(Refer to Section 3 for Unit No. and Data No.)
Reading variable areas		Read particular kinds of data.	Page 2-9
Reading controller information		Read information on the models connected with a cable.	Page 2-11
Operation instructions		Operate data of each bank or all banks.	Page 2-12

[Notes on the exchange of communication data]

- Number of elements indicates the size of data to be exchanged. ASCII character length per element is determined depending on parameter type codes. Specifically,
8000h to BFFFh : 4 characters per element
From C000h: 8 characters per element
Number of elements = 1 for all commands in this manual. Please enter "8001h" to specify number of elements.
- All data is exchanged in hexadecimal numbers. Therefore, "15" of the decimal number should be expressed as "0000000Eh." (*1)
- Distance values should be expressed in the unit of [nm]. Therefore, note that "100 (=00000064h)" indicates "100nm 0.1um" and not 100mm. (*1)
- Negative values are expressed as the complements of 2. For example, "-100" should be expressed as "FFFFFF9Ch." (*1)
- In the case that the measured values such as distance are abnormal values, data parts are expressed as "7FFFFFFXh" ("X" varies depending on the case.) (*1)

*1: This is an example for 8 characters per element.

Reading Parameter Areas

Read parameter areas.

List of Parameter Area Reading Commands

Data Name	MRC	SRC	Parameter Type	Reading start address	Specification of element numbers	Data to be read	Data Length *2
Bank switching	02h	01h	8000h	<0000h>	8001h	0 to 3	4
Keylock	02h	01h	A002h	<0000h>	8001h	0 : OFF, 1 : ON	4
Version Information	02h	01h	A021h	<0000h>	8001h	Software Version	4
Controller type Information	02h	01h	A022h	<0000h>	8001h	3 : ZS-HLDC-N	4
RS-232C Data Length Setting	02h	01h	A030h	<0000h>	8001h	0 : 7 bits, 1 : 8 bits	4
RS-232C Parity Setting	02h	01h	A031h	<0000h>	8001h	0 : None, 1 : Odd Number, 2 : Even Number	4
Stop bits setting	02h	01h	A032h	<0000h>	8001h	0 : 1 bit, 1 : 2 bits	4
Communication node setting	02h	01h	A033h	<0000h>	8001h	0 to 64	4
Digits after decimal point	02h	01h	A040	<0000h>	8001h	0 : 1 digit, 1 : 2 digits, 2 : 3 digits, 3 : 4 digits, 4 : 5 digits	4
Digital "Eco" mode	02h	01h	A041h	<0000h>	8001h	0 : NORMAL, 1 : ECO1, 2 : OFF	4
LCD ON/OFF	02h	01h	A042h	<0000h>	8001h	0 : OFF, 1 : AUTOOFF, 2 : ON	4
LCD Backlight	02h	01h	A043h	<0000h>	8001h	0 : OFF, 1 : AUTOOFF, 2 : ON	4
Sensor Load	02h	01h	A050h	<0000h>	8001h	0 : LOAD every time, 1 : SAVE	4
Language	02h	01h	A051h	<0000h>	8001h	0 : Japanese, 1 : English	4
Reading processing unit data *1	02h	01h	C000h+ <Data No.>	XX00h XX : Unit No.	8000h + <No. of Elements>	Data to be read	8

* 1 - All reading/writing operations on processing units are assigned by using this command.

* 2 - Indicates ASCII character length. Refer to page 2-2 for details.






Refer to "Section 3 - Unit No. and Parameter No." for Unit No. and Parameter No. for each processing unit.

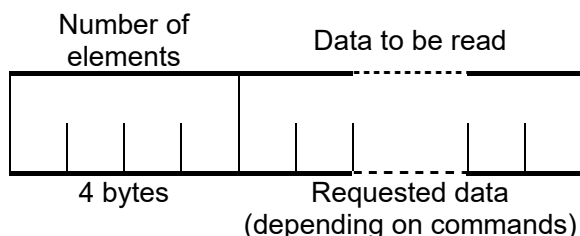
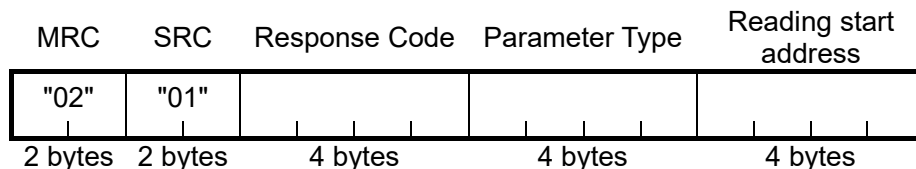
Commands and Responses


Command

MRC	SRC	Parameter Type	Reading start address	Number of elements
"02"	"01"			
2 bytes	2 bytes	4 bytes	4 bytes	4 bytes

Elements	Details
Parameter Type	Specify parameters depending on the data to be obtained.  List of Parameter Area Reading Commands page 2-3
Reading start address	Specify 0000h. Please note that the format of "processing unit data reading" commands is XX00h (XX : <Unit No.>)  Unit No. and Parameter No. page 3-4
Number of elements	Specify number of elements depending on the Parameter Type.  List of Parameter Area Reading Commands page 2-3

Response



Elements	Details
Response Code	Indicates controller status for the command. Data to be read is not returned when an error occurs.
Data to be read	Data to be read is expressed by using an ASCII code in hexadecimal numbers. Data length varies depending on commands.  List of Parameter Area Reading Commands page 2-3

Response code for normal end

Response Code	Name	Details
"0000"	Normal end	No errors.

Response code when an error occurs

Response Code	Error name	Cause
"1001"	Long command length	Command length is too long.
"1002"	Short command length	Command length is too short.
"1003"	Inconsistent number of elements/data	Number of elements and data do not match.
"1101"	Area type error	Parameter type is wrong.
"1103"	Start address outside of range error	Reading start address is out of range. Bit position is other than "00."
"1104"	End address outside of range error	Specified number of elements is out of range.
"2203"	Operating error	Reading error.
"2204"	Operating error	Operating mode of sensor is other than RUN.
"2205"	Operating error	Invalid command.

Writing Parameter Areas

Write parameter areas.

List of Parameter Area Writing Commands

Data Name	MRC	SRC	Parameter Type	Writing start address	Specification of element numbers	Data to be written	Data Length *2
Bank switching	02h	02h	8000h	<0000h>	8001h	0 to 3	4
KEYLOCK	02h	02h	A002h	<0000h>	8001h	0 : OFF, 1 : ON	4
RS-232C Data Length Setting	02h	02h	A030h	<0000h>	8001h	0 : 7 bits, 1 : 8 bits	4
RS-232C Parity Setting	02h	02h	A031h	<0000h>	8001h	0 : None, 1 : Odd Number, 2 : Even Number	4
Stop bits setting	02h	02h	A032h	<0000h>	8001h	0 : 1 bit, 1 : 2 bits	4
Communication node setting	02h	02h	A033h	<0000h>	8001h	0 to 64	4
Digits after decimal point	02h	02h	A040	<0000h>	8001h	0 : 1 digit, 1 : 2 digits, 2 : 3 digits, 3 : 4 digits, 4 : 5 digits	4
Digital "Eco" mode	02h	02h	A041h	<0000h>	8001h	0 : NORMAL, 1 : ECO1, 2 : OFF	4
LCD ON/OFF	02h	02h	A042h	<0000h>	8001h	0 : OFF, 1 : AUTOOFF, 2 : ON	4
LCD Backlight	02h	02h	A043h	<0000h>	8001h	0 : OFF, 1 : AUTOOFF, 2 : ON	4
Sensor Load	02h	02h	A050h	<0000h>	8001h	0 : LOAD, 1 : SAVE	4
Language	02h	02h	A051h	<0000h>	8001h	0 : Japanese, 1 : English	4
Writing processing unit data *1	02h	02h	C000h+ <Data No.>	XX00h XX : Unit No.	8000h + <No. of Elements>	Data to be written	8

* 1 - All reading/writing operations on processing units are assigned by using this command.

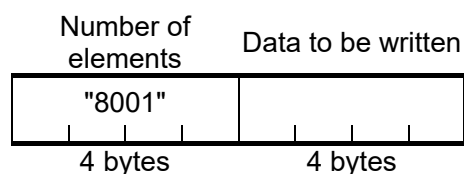
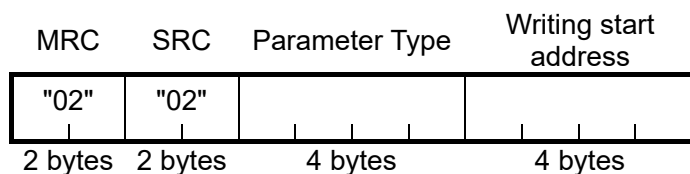
* 2 - Indicates ASCII character length. Refer to page 2-2 for details.







Refer to "Section 3 - Unit No. and Parameter No." for Unit No. and Parameter No. for each processing unit.

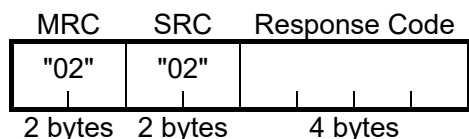
Commands and Responses

Command



Elements	Details
Parameter Type	Specify parameters depending on the data to be written.  List of Parameter Area Writing Commands page 2-6
Writing start address	Specify 0000h. Please note that the format of "processing unit data writing" commands is XX00h (XX : <Unit No.>)  Unit No. and Parameter No. page 3-4
Number of elements	Specify number of elements depending on the Parameter Type.  List of Parameter Area Writing Commands page 2-6
Data to be written	Data to be written is specified by using an ASCII code in hexadecimal numbers. Data length varies depending on commands. <ul style="list-style-type: none"> List of Parameter Area Writing Commands page 2-6 Do not issue commands other than specified parameter types. Issuing wrong commands may rewrite internal parameters. In the case that internal parameters of connected sensors are rewritten, execute "EEPROM initialization" of operation instruction commands. 

Response



Elements	Details
Response Code	Indicates controller status for the command.

Response code for normal end

Response Code	Name	Details
"0000"	Normal end	No errors.

Response code when an error occurs

Response Code	Error name	Cause
"1001"	Long command length	Command length is too long.
"1002"	Short command length	Command length is too short.
"1003"	Inconsistent number of elements/data	Number of elements and data do not match.
"1100"	Parameter error	Data to be written is out of specified range.
"1101"	Area type error	Parameter type is wrong.
"1103"	Start address outside of range error	Writing start address is out of range.
"1104"	End address outside of range error	Specified number of elements is other than "8001."
"2203"	Operating error	Setting is abnormal. Refer to the User's Manual of the ZS-HL-N Series for setting error conditions of thresholds and the hysteresis width.
"2204"	Operating error	Operating mode of sensor is other than RUN.
"2205"	Operating error	Invalid command.

Reading Variable Areas

Read variable areas.




List of Variable Area Reading Commands

Data Name	MRC	SRC	Variable Type	Reading start address	Bit position	Number of elements
Flow data	01h	01h	E1h	0000h	00h	0001h
Measurement Cycle	01h	01h	81h	0000h	00h	0002h

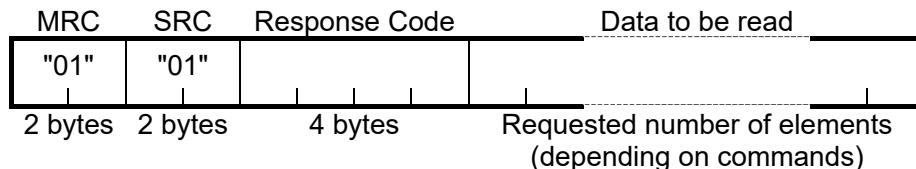
Commands and Responses


Command

MRC	SRC	Variable Type	Reading start address	Bit position	Number of elements
"01"	"01"			"00"	
2 bytes	2 bytes	2 bytes	4 bytes	2 bytes	4 bytes

Elements	Details
Variable type	Specify variables depending on the data to be obtained.  List of Variable Area Reading Commands page 2-9
Reading start address	Specify 0000h.  Unit No. and Parameter No. page 3-4
Bit position	ZS-HL-N Series does not support bit access. It is fixed to "00."
Number of elements	Specify number of elements depending on the Variable Type.  List of Variable Area Reading Commands page 2-6

Response



Elements	Details
Response Code	Indicates controller status for the command. Data to be read is not returned when an error occurs.
Data to be read	Data length is number of elements x 4 ASCII characters. Since the data reading part of the flow data obtaining commands use special formats, refer to "Section 4: How to Obtain Flow Data."  Composition of Flow Data Responses page 4-10

Response code for normal end

Response Code	Name	Details
"0000"	Normal end	No errors.

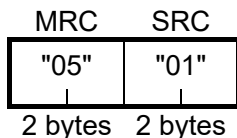
Response code when an error occurs

Response Code	Error name	Cause
"1001"	Long command length	Command length is too long.
"1002"	Short command length	Command length is too short.
"1003"	Inconsistent number of elements/data	Number of elements and data do not match.
"1101"	Area type error	Variable type is wrong.
"1103"	Start address outside of range error	Reading start address is out of range. Bit position is other than "00."
"1104"	End address outside of range error	Specified number of elements is out of range.
"2203"	Operating error	Reading error.
"2204"	Operating error	Operating mode of sensor is other than RUN.
"2205"	Operating error	Invalid command.

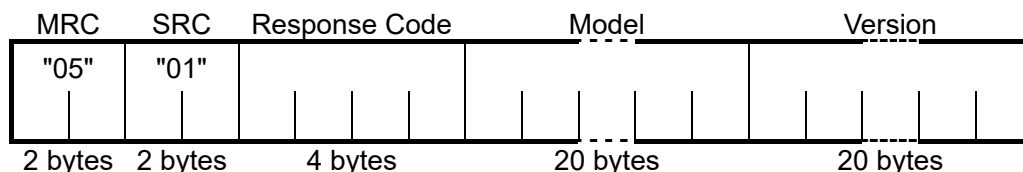
Reading Controller Information

Read data about ZS-HL-N Series types and so on.

Command



Response



Elements	Details
Response Code	Indicates controller status for the command. Data to be read is not returned when an error occurs.
Model	Model is expressed with 20 ASCII characters.
Version	Version is expressed with 20 ASCII characters.

Response code for normal end

Response Code	Name	Details
"0000"	Normal end	No errors.

Response code when an error occurs

Response Code	Error Name	Cause
"1001"	Long command length	Command length is too long.
"1002"	Short command length	Command length is too short.

Operation Instructions

Provides operation instructions to controllers.

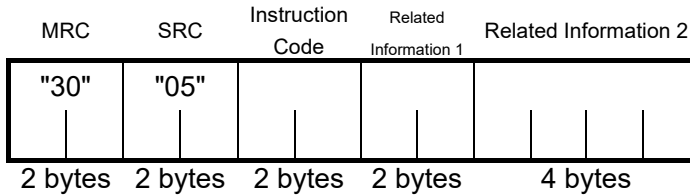
List of Operation Instruction Commands

Instruction Name	MRC	SRC	Instruction Code	Related Information 1	Related Information 2
Complete INIT	30h	05h	55h	0000h	0000h
DATA SAVE	30h	05h	57h	0000h	0000h
CLEAR	30h	05h	58h	0000h	0000h

CLEAR (which clears banks) initializes current banks' sensing settings and measurement settings. Settings of other banks and system settings are not initialized.
Complete INIT initializes all settings (settings of all banks and system settings).

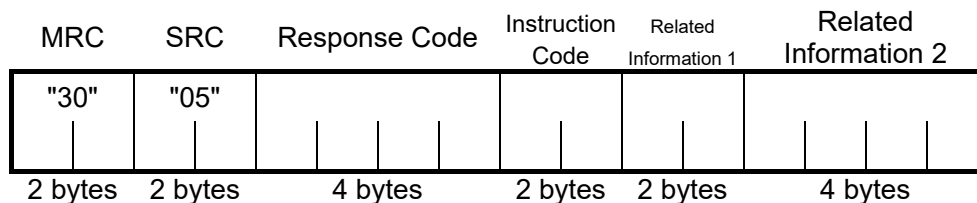
Commands and Responses

Command



Elements	Details
Instruction Code	Specify commands depending on the instruction to be executed.
Related Information 1	Specify 0000h.
Related Information 2	Usually, setting other than "0000" is not accepted.

Response



Elements	Details
Response Code	Indicates controller status for the command.
Instruction Code	The code which is the same as the transmitted will be returned.
Related Information 1	
Related Information 2	

Response code for normal end

Response Code	Name	Details
"0000"	Normal end	No errors.



Response code when an error occurs

Response Code	Error Name	Cause
"1001"	Long command length	Command length is too long.
"1002"	Short command length	Command length is too short.
"1101"	Area type error	Instruction code is invalid.
"1103"	Start address outside of range error	Related Information 1 specifies an address other than 0000h.
"2203"	Operating error	Setting is abnormal. Refer to the User's Manual of the ZS-HL-N Series for error conditions.
"2204"	Operating error	Operating mode of sensor is other than RUN.
"2205"	Operating error	Invalid command.

MEMO

Section 3

Unit No. and Parameter No.

 Measurement Result Obtaining Command	3-2
 Setting Value Obtaining and Changing Command	3-3
Parameter List	3-3

Measurement Result Obtaining Command

■ Parameter List

For single task mode

When selecting a mode other than "GLASS/MODE 2" or "GLASS THICKNESS/MODE 2" mode

(when no 2-area measurement is performed):

Unit No.	Data No.	Parameter Description
30h	20h	Measurement result (=Main digital display value)

When selecting "GLASS/MODE 2" or "GLASS THICKNESS/MODE 2" mode

(when a 2-area measurement is performed):

Unit No.	Data No.	Parameter
30h	20h	Area 1 displacement value (TASK1)
44h		Area 2 displacement value (TASK2)
58h		Glass surface and/or Glass thickness results (=Main digital display value = TASK3 = Area1 – Area2)

For multi-task mode

Unit No.	Data No.	Parameter
30h	20h	TASK1 measurement result
44h		TASK2 measurement result
58h		TASK3 measurement result
6Ch		TASK4 measurement result

Setting Value Obtaining and Changing Command Parameter List

■ Sensing Setting (common for all TASKs)

Unit No.	Data No.	Parameter	Setting range/output range	Remarks
0h	0h	Measurement mode	0: STANDARD 1: HI-RESO 2: HI-SPEED 3: HI-SENS 4: CUSTOM	When multi-task mode is OFF
		Measurement mode	1: STANDARD 2: HI-RESO 3: HI-SENS 4: CUSTOM	When multi-task mode is ON
	Ch	Start position of area 1	0 to 639 (pix)	
	Eh	End position of area 1	0 to 639 (pix)	
	Dh	Start line of area 1	0 to (Number of additional lines - 1)	
	Fh	End line of area 1	0 to (Number of additional lines - 1)	
	18h	Start position of area 2	0 to 639 (pix)	
	1Ah	End position of area 2	0 to 639 (pix)	
	19h	Start line of area 2	0 to (Number of additional lines - 1)	
	1Ah	End line of area 2	0 to (Number of additional lines - 1)	
	12h	Exposure time	2 to 200 (1div:0.1ms) When multi-task mode is OFF	Parameters for CUSTOM mode
			5 to 200 (1div:0.1ms) When multi-task mode is ON	
	13h	Number of additional lines	1 to 200 When multi-task mode is OFF	
			8 to 200 When multi-task mode is ON	
	14h	Line skipping	0: OFF	
			1: ON	
	16h	2-area mode	0: OFF	
			1: ON	
	17h	Compensation mode	0: OFF 1: Start position compensation 2: End position compensation 3: Start/end position compensation	
20h	Measurement cycle	112 to 20000 (us)		
C0h	Reference point teach for compensation mode	1: Execute teach		
C1h	2-area teach	1: Execute teach		
1h	0h	Head installation	0: Diffuse 1: Regular	
2h	0h	LD power mode	0: Auto 1: Auto-scale 2: Fixed	

Section 3
Setting Value Obtaining and Changing Command

Unit No.	Data No.	Parameter	Setting range/output range	Remarks	
	2h	Surface to be controlled for light amount	0: Peak 1: First surface 2: Second surface 3: Third surface		
	6h	LD power when fixed	0 to 800 (1div:0.1%)		
2h	Dh	Lower limit of LD power	0 to 800 (1div:0.1%)		
	Eh	Upper limit of LD power	0 to 800 (1div:0.1%)		
	20h	Incident level	0 to 4095 (1div:0.1%)		
	24h	LD power	0 to 800 (1div:0.1%)		
	25h	Incident level (First surface)	0 to 4095 (1div:0.1%)		
	26h	Incident level (Second surface)	0 to 4095 (1div:0.1%)		
	27h	Incident level (Third surface)	0 to 4095 (1div:0.1%)		
3h	0h	Measuring object	0: Normal 1: PCB 2: Mirror 3: Glass 4: Glass thickness		
	2h	GLASS/GLASS THICKNESS mode	0: Mode 1 1: Mode 2		
	3h	Image smoothing level	0: No filter 1: Filter size 2 2: Filter size 4 3: Filter size 8 4: Filter size 16	When the measurement object is changed, the settings are initialized according to the selected object.	
	4h	Background removing level before addition	0 to 255 (tone)		
	6h	Edge threshold	0: 0% 1: 12.5% 2: 25% 3: 37.5% 4: 50% 5: 62.5% 6: 75% 7: 87.5%		
4h	0h	Mutual interference prevention mode	0: OFF 1: ON		
	1h	Mutual interference prevention timing	0: Timing A 1: Timing B		
5h	0h	Gain setting	1 to 5		
28h	0h	Measurement mode	0: OFF 1: Average 2: Peak 3: Bottom 4: Thickness 5: Gap 6: K+mX;+nY	TASK1 settings. The settings in Unit Number 28h are valid only for multi-task mode.	

Unit No.	Data No.	Parameter	Setting range/output range	Remarks
	3h	Parameter X	0: None 1: TASK1 2: TASK2 3: TASK3 4: TASK4	
28h	4h	Parameter Y	0: None 1: TASK1 2: TASK2 3: TASK3 4: TASK4	
	5h	Parameter K	-999999999 to 999999999	
	8h	Parameter M	-100 to 100 (1div:0.1%)	
	9h	Parameter N	-100 to 100 (1div:0.1%)	
	1h	Surface for measurement (Area 1)	0: First surface 1: Second surface 2: Third surface	
	Ah	Surface for measurement (Area 2)	0: First surface 1: Second surface 2: Third surface	
	Bh	Measurement position 1 (for thickness measurement)	0: None 1: Average 2: Peak 3: Bottom	
	Ch	Measurement position 2 (for thickness measurement)	0: None 1: Average 2: Peak 3: Bottom	
	Dh	Measurement area	0: Area 1 1: Area 2	
	Eh	Width of peak bottom	0 to 255	
	20h	Measurement value (First surface)	- (nm)	
	21h	Measurement value (Second surface)	- (nm)	
	22h	Measurement value (Third surface)	- (nm)	
29h	0h	Scaling mode	0: OFF 1: ON	
	1h	Span value	-20000 to 20000 (1div:0.0001)	
	2h	Offset value	-999999999 to 999999999 (nm)	
2Ah	2h	Smooth	0: OFF 1: ON	TASK1 settings.

Section 3
Setting Value Obtaining and Changing Command

Unit No.	Data No.	Parameter	Setting range/output range	Remarks
2Bh	2h	Average	0: 1 time 1: 2 times 2: 4 times 3: 8 times 4: 16 times 5: 32 times 6: 64 times 7: 128 times 8: 256 times 9: 512 times 10: 1024 times 11: 2048 times 12: 4096 times	
2Ch	2h	Differential	0: OFF 1: ON	
	3h	Differentiation cycles	1 to 5000 (ms)	
2Dh	2h	Hold type	0: Through 1: Peak 2: Bottom 3: Peak to peak 4: Average 5: Sampling	
	3h	Trigger method	0: External input 1: Self up 2: Self down	
	4h	Trigger level	-999999999 to 999999999 (nm)	
	5h	Trigger hysteresis	0 to 999999999 (nm)	
	6h	Trigger delay (ms)	0 to 5000 (ms)	
	7h	Sampling time (ms)	1 to 5000 (ms)	
	8h	Trigger delay mode	0: OFF 1: ON	
2Eh	5h	Offset at zero reset	-999999999 to 999999999 (nm)	
	7h	Zero reset mode	0: Real 1: Hold	
	40h	Status	0: OFF 1: ON	

(*)

If GLASS/MODE 2 or GLASS THICKNESS/MODE 2 is selected, a process using multiple tasks will be performed, as in multi-task mode.

The following processes are assigned to the respective tasks:

TASK1	Calculates Area 1 displacement value
TASK2	Calculates Area 2 displacement value
TASK3	GLASS: Calculates the result of the NEAR side of TASK 1 and TASK 2.
	GLASS THICKNESS: Calculates the difference value between TASK1 and TASK2.
TASK4	Unused

The measurement conditions can be set for each task in this mode.

Unit No.	Data No.	Parameter	Setting range/output range	Remarks
78h	0h	Hysteresis width	0 to 999999999 (nm)	Setting judgment process
	1h	Timer mode	0: OFF 1: OFF-Delay 2: ON-Delay 3: One shot	
	2h	Delay time	1 to 5000 (ms)	
	3h	Judgment output TASK	0: TASK1 1: TASK2 2: TASK3 3: TASK4	
79h	0h	Non-measurement settings	0: Keep 1: Clamp	
7Ah	2h	Monitor focus mode	0: OFF, 1: ON	
	3h	Monitor focus distance value 1	-999999999 to 999999999 (nm)	
	4h	Monitor focus distance value 2	-999999999 to 999999999 (nm)	
	5h	Monitor focus current value 1	4 to 20 (mA)	
	6h	Monitor focus current value 2	4 to 20 (mA)	
	7h	Monitor focus voltage value 1	-10 to 10 (V)	
	8h	Monitor focus voltage value 2	-10 to 10 (V)	
	15h	Output mode TASK	When multi-task mode is OFF 0: OFF 1: ON	
	When multi-task mode is ON 0: OFF 1: TASK1 2: TASK2 3: TASK3			

Section 3
Setting Value Obtaining and Changing Command





Unit No.	Data No.	Parameter	Setting range/output range	Remarks
7Ah	17h	Output at CLAMP	Voltage output 0: MAX 1: 10V 2: 9V 3: 8V 4: 7V 5: 6V 6: 5V 7: 4V 8: 3V 9: 2V 10: 1V 11: 0V 12: -1V 13: -2V 14: -3V 15: -4V 16: -5V 17: -6V 18: -7V 19: -8V 20: -9V 21: -10V 22: MIN	
			Current output 0: MAX 1: 20mA 2: 19mA 3: 18mA 4: 17mA 5: 16mA 6: 15mA 7: 14mA 8: 13mA 9: 12mA 10: 11mA 11: 10mA 12: 9mA 13: 8mA 14: 7mA 15: 6mA 16: 5mA 17: 4mA	
7Bh Digital Output	2h	Monitor focus mode	0: OFF, 1: ON	
	3h	Monitor focus distance value 1	-999999999 to 999999999 (nm)	
	4h	Monitor focus distance value 2	-999999999 to 999999999 (nm)	
	5h	Monitor focus current value 1	0 to 65535	
	6h	Monitor focus current value 2	0 to 65535	
	7h	Clear Monitor Focus	1: Clear	
	8h	Output at CLAMP	0 to 65535	

Unit No.	Data No.	Parameter	Setting range/output range	Remarks
7Bh Digital Output	Ah	Output TASK(When the measurement value is output)	0: TASK1 1: TASK2 2: TASK3 3: TASK4 4: Consecutively	
	Bh	Output mode	0: OFF 1: Measurement value 2: Judgment	
	Ch	Update cycle	1 to 100	
7Ch Logging	5h	Mode	0: OFF 1: ON	
	3h	Buffering period	1 to 65535	
	4h	Buffer size per item of data	1 to 1000	
	Eh	TASK1	0: OFF 1: ON	When multi-task mode is ON
	Fh	TASK2	0: OFF 1: ON	
	10h	TASK3	0: OFF 1: ON	
	11h	TASK4	0: OFF 1: ON	
F0h Parallel Input	4h	Input 0	0: Low Active 1: High Active	
	5h	Input 1		
	6h	Input 2		
	7h	Input 3		
	8h	External input mode	0: Normal mode 1: Bank switching mode 2: Parallel IN off mode	
	9h	Control TASK setting	0: TASK1 1: TASK2 2: TASK3 3: TASK4	

MEMO

Section 4

How to Obtain Flow Data

	About Obtaining Flow Data	4-2
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	Setting Parameters	4-7
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	Logging Data Type	4-7
	Flow Data Response	4-9
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About Obtaining Flow Data

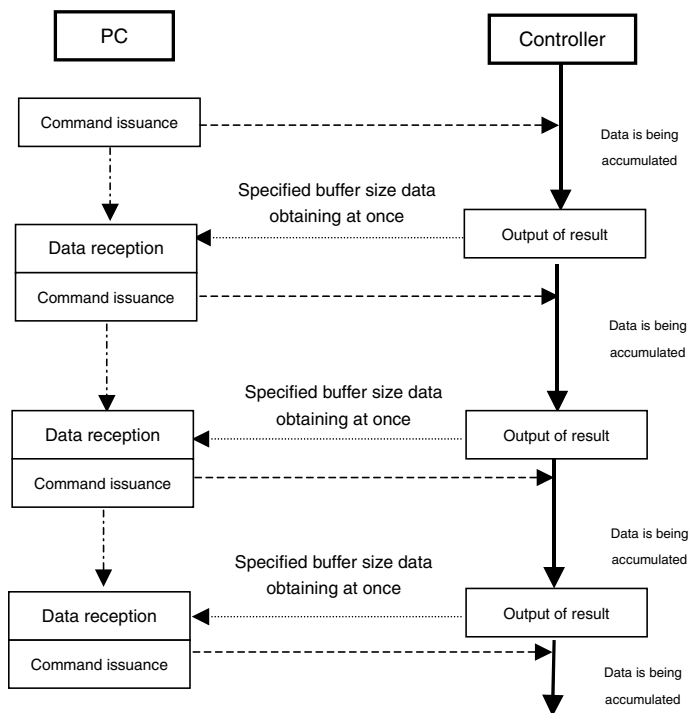
■ What is flow data?

In the ZS-HL-N series, a high-speed sampling measurement at a maximum of 110 microseconds is implemented. To handle the measurement data with external devices, it is necessary to obtain a large volume of data. The ZS-HL-N series provides a system to handle measurement data as a bunch of any number of data items and to obtain data in units of bunches. A bunch of data is called flow data.

■ Process to obtain flow data

A data items bunch is transmitted as flow data output upon full data accumulation specified by buffer size (a maximum of 1000 data items) if a flow data obtaining command has been received. A data recipient (such as a personal computer) must issue a command in advance of full measurement data accumulation specified by buffer size to the ZS-HLDC-N controller.

Commands and data items are exchanged between a data recipient and the ZS-HLDC-N controller as shown in the flow chart below:



- The previous data is overwritten upon full measurement data accumulation specified by buffer size in the ZS-HLDC-N controller if no command has been received. In this case, an error flag appears as buffer overflow occurs. A data recipient (such as a personal computer) must confirm whether or not a command is properly issued in time by observing this flag.
- Even if an error occurs, as much data as that for the specified number of accumulated data will be returned. However, since the previous data will have been overwritten, the returned data is not continuous.

Setting Procedures for Data Obtaining Conditions

Follow the procedures below to set the data obtaining conditions:

Note that setting conditions described in this section are cleared upon turning OFF the power of the controller. (Set the threshold values again.)

The all data obtaining conditions set here are written using the parameter area write command. When setting, refer to the corresponding tables in "Unit No." and "Data No.", command examples described in Section 3, and the description of the parameter area write in Section 2.

1. Set the accumulation mode to ON.

Set the flow data accumulation mode to ON (=1). Make sure to set this value to ON (or write 1 to this value) in advance of obtaining data because flow data is not accumulated unless this setting is made. Specifically, write ON (=1) to Data No. 2 of Unit No.124 (=7Ch).

Example: When writing the above command to ZS-HLDC-N, a command to be sent is shown as below:

```
02h 02h C002h 7C00h 8001h 00000001
```

2. Set the target data to be obtained.

The ZS-HLDC-N can be used to select the data to be accumulated depending on the multi-task mode setting and measurement object type. The specified area for accumulation data is provided respectively.

First, perform the setting of accumulation execution for each area. Specifically, write the command for Parameter No. 5, 14 (Eh) to 17 (=11h) of Unit No. 124 (=7Ch).

Example: Example: When accumulating the measurement value for the ZS-HLDC-N (multi-task mode: ON), the command to be sent is as follows:

```
02h 02h C00Eh 7C00h 8001h 00000001h } (TASK1)
02h 02h C00Fh 7C00h 8001h 00000001h } (TASK2)
02h 02h C010h 7C00h 8001h 00000001h } (TASK3)
02h 02h C011h 7C00h 8001h 00000001h } (TASK4)
```

3. Read a measurement cycle.

Read the current measurement cycle.

Measurement cycle information is necessary to execute step 4, "Specify the buffer interval."

The measurement cycle information must be obtained again in this step because it may vary depending on the settings specified in the steps 1 and 2 above.

Example: When reading the measurement cycle to the ZS-HLDC-N, a command to be sent is shown as below:

```
01h 01h 81h 0000h 00h 0002h
```

You will find that the measurement cycle is 269 microseconds (=010Dh) when the response is returned as below:

```
01h 01h 0000h 0000010Dh
```

4. Specify the buffer interval.

A number of skips, which is referred to as a “buffer interval”, can be set to the controller upon data accumulation. Calculate and set an optimal value according to the sampling interval to be obtained.

For example, to set the sampling interval to 100ms when the current measurement cycle is 269 μ s, set the buffer interval to 371 (=372-1), which is calculated by the following formula:

$$100\text{ms}/269\mu\text{s}=371.747\dots$$

Set the most approximate value to the sampling interval to be obtained because the sampling interval can be set only to the multiple number of measurement cycles as shown above.

The buffer interval value can be calculated by subtracting 1 from the value calculated using the formula above because the buffer interval must be the number of skips to be executed.

Example: When writing the buffer interval (=371) to ZS-HLDC-N, a command to be sent is shown below:

02h 02h C003h 7C00h 8001h 00000173h (371(dec) = 1F4(hex))

5. Set the number of data items to be accumulated.

Set the number of data items to be batch-obtained.

Because the number of data items specified in this step is the one for the respective accumulation data area, the number of data items to be batch-obtained can be calculated as shown below when three types of data items are obtained as in the example above:

$$\text{Number of data items specified in this step} \times 3$$

Example: When setting the number of data items to be accumulated (=500) to ZS-HLDC-N, a command to be sent is shown below:

02h 02h C004h 7C00h 8001h 000001F4h (500(dec) = 1F4(hex))

6. Request and receive data.

Setting is completed.

All the data items are returned at once when the flow data request command is sent in the status above.

Example: When sending a request command to the ZS-HLDC-N, the command is shown as below:

01h 01h E1h 0000h 00h 0001h

Because the flow data belongs to the “variable area reading” commands, the response follows their format. However, note that only the contents of the “data to be read” follow the format below:

(*)

In addition, whether or not the command ends cannot be judged by ETX specified based on the CompoWay/F because the data to be read is composed by binary data. Confirming the completion of data reception with the number obtained is recommended.

The number of data items to be received can be calculated using the formula specified in the step above: Data type (target data to be obtained) x Number of data items to be accumulated.

[About Continual Data Obtaining]

Note that sending a request command is necessary after starting the data reception until the next data accumulation is completed as described in “How to obtain flow data.”

Calculate the time for the completion of the accumulation using the formula specified in the step above: measurement cycle x number of data items to be accumulated, and send the next request command until the calculated time expires.

Example: When measurement cycle=269 μ s and the number of data items to be accumulated=500:

It will take 134.5 ms (=269 μ s x 500) until the accumulation is completed.

Sending the next request command before the time above expires is necessary.

The “flow data overflow bit,” which is described in Section, “Data Composition of Flow Data” and other sections, is enabled when sending a command is delayed due to the delay of processing at the master side of the communication devices, such as a personal computer.

(In this case, the continuity of data is lost.) Check the processing delay if the bit is enabled or not.

When the processing delay occurred due to the personal computer specification, adjustments below must be performed:

- Increase the buffer interval and decrease the number of data items per unit time.
- Increase the number of data items to be accumulated and lessen the frequency of communication processing.

Flow data is returned from controller upon completion of the data accumulation. Therefore, flow data is immediately returned after sending a command when data accumulation has already been completed upon sending a command. Response is not performed unless the data accumulation is completed upon sending a command.

Setting Parameters

This section describes buffer size, buffer interval, and logging data.

Buffer Size and Buffer Interval

Buffer size of the measurement data to be accumulated in the ZS-HLDC-N controller and its buffer interval can be changed. To change buffer size and buffer interval, change the parameters below:

* Use DATAGET and DATASET commands to change and view the parameter.

Unit No.	Data No.	Parameter	Details
7Ch	2h	Flow data accumulation mode	0: OFF 1: ON
	3h	Buffer interval	0 to 65535
	4h	Buffer size	1 to 1000

Logging Data Type

Data to be accumulated in the ZS-HLDC-N controller can be selected.

- When multi-task mode is OFF
 - When GLASS/MODE 2 or GLASS THICKNESS/MODE 2 is selected for the measurement object

Unit No.	Data No.	Parameter	Details
7Ch	5h	0	No accumulation
		1	Accumulation of result of area 1
		2	Accumulation of result of area 2
		3	Accumulation of result of glass surface or glass thickness

- When a mode other than the above is selected for the measurement object

Unit No.	Data No.	Parameter	Details
7Ch	5h	0	No accumulation
		1	Accumulation

- When multi-task mode is ON

Unit No.	Data No.	Parameter	Details
7Ch	Eh	0	Does not accumulate the result of TASK1.
		1	Accumulates the result of TASK1.
	Fh	0	Does not accumulate the result of TASK2.
		1	Accumulates the result of TASK2.
	10h	0	Does not accumulate the result of TASK3.
		1	Accumulates the result of TASK3.
	11h	0	Does not accumulate the result of TASK4.
		1	Accumulates the result of TASK4.

- When a mode other than the above is selected

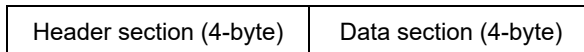
Value	Details
0	No accumulation
1	Distance value (Measurement value)

Flow Data Response

This section describes the format and composition of response of flow data.

Format

Binary data is output in the format below after outputting the flow data obtaining command.



For details, refer to “Composition of Flow Data.”



Response data of the flow data is composed by binary data for the purpose of giving top priority to speed.

Therefore, response data may not be received by generic communication tools, such as hyper terminal.

Composition of Response

FlowDATA 1 packet													
Header section												Data section	
1st byte	2nd byte				3rd byte				4th byte				-
A	B	C	D	E	F	G	H	I	J	K	L	Data	Meaning of data
8	1	1	2	4	5	1	2	1	1	1	5	32	Number of bits

= Total
64 bits

■ Details of Header Section

Data	Name	Details
A	Not used	Reserved bit
B	FlowDATA Overflow bit	NORMAL, 0 : 1 is set when flow data accumulation overflows.
C	Decimal point information	NORMAL, 0 : 0: nm order, 1: μm order
D	TASK No.	TASK1 to TASK4 (*1)
E	Channel No.	Channel No. of the data source
F	Unit status (input)	Indicates ON/OFF status of each input wire. (*2)
G	FlowData stop bit	<ul style="list-style-type: none"> All the data items are 1 when no flow data is sent afterward (or always 1 upon single request). All the data items are 0 when flow data is continuously sent afterward (after the continual flow data request until it is stopped).
H	TASK judgment result bit	Indicates the judgment result for the TASK of the data source. (*3)
I	Use prohibited	Reserved bit
J		
K		
L	Unit status (output)	Indicates output status (measurement result status) (*4)
Data	Measurement data	Signed 32-bit data When the decimal point information section is 0: data in the unit of nm When the decimal point information section is 1: data in the unit of μm

*1 TASK No. = bit data + 1

Example: When bit data=10B=2(dec)

It indicates as TASK3 data.

*2 The input wires are assigned from the lower bit as:

When ZS is used;

- Input terminal 4 (Unused, always 0)
- Input terminal 3
- Input terminal 2
- Input terminal 1
- Input terminal 0

(5 outputs in total)

*3 Data items and statuses to be received are shown below:

00b = unexecuted

01b = LOW

10b = PASS

11b = HIGH

*4 The output statuses are assigned from the lower bit as:

When ZS is used;

- Output terminal 4 (Busy output)
- Output terminal 3 (Enable output)
- Output terminal 2 (Low output)
- Output terminal 1 (Pass output)
- Output terminal 0 (High output)

(5 outputs in total)

Standard status is described in the parentheses.

Revision History

A manual revision code appears as a suffix to the catalog number at the bottom of the front and back covers of this manual.

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